

Productos y Aplicaciones de Satélite en Latitudes Medias - Fase Presencial

Acceso y Procesamiento de Datos Satelitales - Prácticas



Diego Souza
diego.souza@inpe.br

DISSM - División de Satélites y Sensores Meteorológicos
CGCT - Coordinación General de Ciencias de la Tierra
INPE - Instituto Nacional de Investigaciones Espaciales

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA
E INovação

GOVERNO FEDERAL
BRASIL
UNIÃO E RECONSTRUÇÃO



	
NOAA/NASA	
137°W	75.2°W
GOES-18	GOES-16



	
EUMETSAT/ESA	
0°	0°
MSG-10	MTG-I1



Estructura de Nuestro Notebook Colab

Los pasos abajo se ejecutan una sola vez

Paso 1: Características de la Máquina Virtual

Paso 2: Instalación de Bibliotecas

Paso 3: Importando las Bibliotecas Necesarias

Paso 4: Credenciales EUMDAC

Paso 5: Cargando las Funciones

Los ejemplos pueden ejecutarse varias veces, con parámetros diferentes

Mosaico Global (EUMETVIEW) : GOES-W + GOES-E + MSG 0° + MSG 45.5° + Himawari

Imágenes GOES-Este (AWS)

Imágenes GOES-Oeste (AWS)

Imágenes MSG 0° (EUMDAC)

Imágenes MSG 45.5° (EUMDAC)

Descarga de Datos + Explicando Como se Procesan con Satpy

Imágenes Modelos Numéricos (varias fuentes)

Imágenes METAR (Unidata)

Animaciones

Acceso y Procesamiento SAF

Fechas disponibles para cada dato

Desde 06 de Junio de 2021 18:00 UTC, cada 3 horas

Desde 10 de Julio de 2017

Desde 28 de agosto de 2018 (G17)
Desde 02 de agosto de 2022 (G18)

Desde 26 de marzo de 2004

Desde 01 de febrero de 2017

Cualquier fecha arriba

Desde 21 de Enero de 2022 (ECMWF)
Desde 26 de Febrero de 2021 (GFS)

Últimos 10 días

Cualquier intervalo entre fechas arriba

Cualquier intervalo de los datos SAF

Paso 1: Verificando la Configuración de la Máquina Virtual

Paso 1: Verificando la Configuración de la Máquina

```
[ ] # verifying the installed OS  
!cat /etc/issue  
!uname -a  
print('\n')  
  
# verifying the available RAM  
!grep MemTotal /proc/meminfo  
print('\n')  
  
# verifying the available HD space  
!df -h  
print('\n')  
  
# verifying the default Python installation directory  
!which python  
print('\n')  
  
# verifying the Python version  
!python --version
```

```
Ubuntu 22.04.2 LTS \n \l  
  
Linux c013493fb1e6 5.15.128+ #1 SMP Wed Aug 30 11:19:59 UTC 2023 x86_64 x86_64 x86_64 GNU/Linux  
  
MemTotal: 13294200 kB  
  
Filesystem Size Used Avail Use% Mounted on  
overlay 108G 28G 81G 26% /  
tmpfs 64M 0 64M 0% /dev  
shm 5.8G 0 5.8G 0% /dev/shm  
/dev/root 2.0G 1.1G 885M 55% /usr/sbin/docker-init  
tmpfs 6.4G 40K 6.4G 1% /var/colab  
/dev/sda1 44G 20G 16G 65% /etc/hosts  
tmpfs 6.4G 0 6.4G 0% /proc/acpi  
tmpfs 6.4G 0 6.4G 0% /proc/scsi  
tmpfs 6.4G 0 6.4G 0% /sys/firmware  
  
/usr/local/bin/python  
  
Python 3.10.12
```

Comandos Linux que “preguntan”:

Sistema Operativo

Memoria RAM disponible

Espacio en Disco Duro

Versión Python instalada



Este paso es totalmente opcional, pero es interesante conocer las características de la máquina Linux de la versión gratuita de Google Colab

Salida con las informaciones:

Sistema Operativo: Ubuntu 22.04.2 LTS

Memoria RAM: 13 GB

Disco Duro: +100 GB

Python 3.10.2 instalado en /usr/local/bin/python

Paso 2: Instalando Bibliotecas y Descargando Archivos

• Paso 2: Instalando Bibliotecas Python y Descargando Archivos Auxiliares

En este paso instalaremos todas las bibliotecas necesarias para esta sesión práctica y bajaremos algunos archivo auxiliares.

Nota: Sólo es necesario ejecutar esta celda una vez (tarda algunos minutos para completar la instalación).

```
[ ] =====#
# INSTALL THE REQUIRED LIBRARIES AND MODULES AND IMPORT ANCILLARY FILES
#=====#
[ ] =====#
# install libraries with conda (system package manager)
!pip install -q condacolab
import condacolab
condacolab.install()
!conda config --add channels conda-forge
!conda config --set channel_priority strict
!conda install -c conda-forge satpy netcdf4 pyproj pyspectral hdf5plugin # install libraries with conda

# install libraries with pip (package installer)
!pip install h5py
!pip install eccodes
!pip install ecmwflibs
!pip install git+https://github.com/blaylockbk/carpenter_workshop.git
!pip install cffi==1.16.0
!pip install eumdac
!pip install boto3
!pip install owslib
!pip install rioxarray
!pip install cartopy
!pip install shapely --no-binary shapely --force

# download a shapefile with states and provinces of the world
!wget -c https://www.naturalearthdata.com/http://www.naturalearthdata.com/download/10m/cultural/ne_10m_admin_1_states_provinces.zip

# unzip the shapefile
!unzip -o ne_10m_admin_1_states_provinces.zip

# download some example "CPT" files
!wget -c https://github.com/diegomsouza/aemet_eumetsat_uruguay_2023/raw/main/
!unzip -o cpt_color_tables.zip

# download the utilities.py script with the load_CPT function
!wget -c https://raw.githubusercontent.com/diegomsouza/aemet_eumetsat_uruguay_2023/main/utilities.py
!cp -f /content/abi_12_nc.py /usr/local/lib/python3.10/site-packages/satpy/readers/abi_12_nc.py

# change some files (necessary for Satpy to work with CMIP6 and goes2go to
!wget -c https://raw.githubusercontent.com/diegomsouza/aemet_eumetsat_uruguay_2023/main/satpy/readers/abi_12_nc.py
!cp -f /content/abi_12_nc.py /usr/local/lib/python3.10/site-packages/satpy/readers/ahi_12_nc.py
```

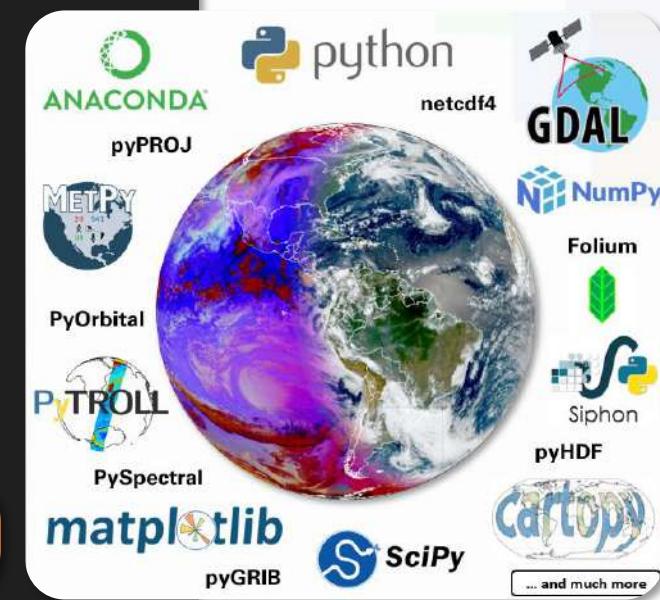
Usando
“conda”

Usando
“pip”



Nota: Este paso es el que más tarda, y siempre debe ejecutarse algunos minutos antes de empezar las prácticas

Vamos a trabajar con datos bien variados (GOES, MSG, Modelos, METAR, etc), entonces un numero considerable de bibliotecas Python son instaladas.



Paso 3: Importando las Bibliotecas Necesarias

• Paso 3: Importando las Bibliotecas Necesarias

En este paso importaremos las bibliotecas instaladas en el paso anterior. Cada biblioteca tiene una aplicación específica, a ser explorada en los scripts Python. Estaremos trabajando con datos Meteosat, GOES-Este, GOES-Oeste, datos de modelo y datos METAR; por lo tanto, usaremos una cantidad considerable de bibliotecas.

Nota: Sólo es necesario ejecutar esta celda una vez.

```
# REQUERID MODULES
#-----#
#-----#
import os
import glob
import zipfile
import shutil
import requests
import numpy as np
import cartopy, cartopy.crs as ccrs
import cartopy.feature as feature
import cartopy.io.shapereader as shapereader
import pyproj
import time
import osrilib
from osrilib.wms import WebMagService
from datetime import timedelta, date, datetime
from pyresample import geometry
import matplotlib.pyplot as plt
import matplotlib.pathEffects as PathEffects
from matplotlib.offsetbox import AnchoredText
from matplotlib.offsetbox import OffsetImage
from matplotlib.offsetbox import AnnotationBbox
from matplotlib import cm
from utilities import loadOPT
from utilities import download_MODIS
import eumodc
import hdmfplugin
from satpy import Scene
from satpy import available_readers
from satpy.writers import get_enhanced_image
from herbie import Herbie
from tools import EasyMap, pc
from metpy.io import wcm
from metpy.io import current_weather, sky_cover, StationPlot
from metpy.io import reduce_point_density
import rioxarray
import imgaug
import warnings
warnings.filterwarnings("ignore")

I'm building Herbie's default config file.
.
.
.
You're ready to go.
You may edit the config file here:
/root/.config/herbie/config.toml
.
.
.

/usr/local/lib/python3.10/site-packages/gribapi/_init_.py:23: UserWarning: ecCodes 2.11.0 or higher is recommended. You are running version 2.10.0
warnings.warn(
```

Después de instalar es necesario importar bibliotecas.
Algunos ejemplos de uso

Cartopy para añadir mapas

Boto3 para descargar datos GOES desde AWS

EUMDAC para descargar datos MSG

Satpy para graficar datos GOES y MSG

Herbie para descargar datos de modelo

Metpy para graficar datos METAR

y mucho más...

Paso 4: Credenciales de Usuario EUMDAC

Para descargar datos de EUMETSAT con EUMDAC, es necesario crear un "Access Token".

1. Crear una cuenta en: [eoportal.eumetsat.int](https://eportal.eumetsat.int) y hacer el login

Paso 4: Credenciales de Usuario EUMDAC (EUMETSAT Data Services Client)

Para descargar datos usando el cliente EUMDAC (EUMETSAT Data Access Client), primero es necesario registrarse en <https://eportal.eumetsat.int/> y después acceder al siguiente enlace: <https://api.eumetsat.int/api-key/>. En esta página, es necesario copiar las llaves "Consumer key" y "Consumer secret" y ingresarlas en las variables de la siguiente celda.

Nota: Sólo es necesario ejecutar esta celda una vez.

```
# 0s
# EUMDAC (EUMETSAT Data Services Client) Access Token
# insert your personal key and secret into the single quotes below.
# first, create an account at this link: https://eportal.eumetsat.int/
# and get the consumer key and secret at this link: https://api.eumetsat.int/api-key/
consumer_key = XXXXXXXXXX
consumer_secret = XXXXXXXXXX

# verifying whether the creation of the Access Token was successful.
credentials = (consumer_key, consumer_secret)
token = eumdac.AccessToken(credentials)
try:
    print(f"This token '{token}' expires {token.expiration}")
except requests.exceptions.HTTPError as error:
    print(f"Error when trying the request to the server: '{error}'")
```

This token '3ca7faf3-4af8-3422-8935-1a3935e58c08' expires 2023-10-31 14:52:37.708641

Al ejecutar la celda de código, esta salida indica que las credenciales están correctas



2. Acceder a la página: <https://api.eumetsat.int/api-key/>, copiar y pegar el "consumer key" y "consumer secret" en tu copia del notebook Colab (paso 4), entre comillas



Paso 5: Cargando las Funciones

El “trabajo sucio” es hecho por funciones! Si no tienes experiencia con programación, sin problemas, podrás cambiar pocas variables en los ejemplos, fácilmente. Si tienes experiencia con Python y programación, puedes expandir esta celda y ver como las cosas se hacen.

• Paso 5: Cargando las Funciones

Para generar imágenes necesitamos hacer algunas operaciones complejas. Para facilitar la manipulación de los datos, se han creado algunas funciones que hacen el trabajo más difícil. Estas funciones son cargadas al ejecutar la siguiente celda.

Nota: Sólo es necesario ejecutar esta celda una vez.

Al hacer click acá, la celda se expande. No es necesario expandir (hay bastante código Python), a no ser que estés interesado en conocer como las imágenes son generadas

‣ Algunas funciones para descargar y graficar datos (no es necesario expandir esta celda, solo ejecutarla)

✓ 0 s Mostrar código

Al ejecutar esta celda de código, todas las funciones necesarias (creadas previamente por el creador del notebook) serán cargadas

Importante: Acciones Necesarias

En cada día, antes de las actividades prácticas Python, es necesario ejecutar las celdas de los pasos 2 a 5 algunos minutos antes, para que los notebooks estén listos cuando empecemos.



Referencia: Latitudes y Longitudes

En todos los scripts es posible seleccionar una región específica, en la variable “extent” (min lon, min lat, max lon, max lat).

En el notebook hay esta imagen de referencia con las coordinadas.

Referencia: Latitudes y Longitudes

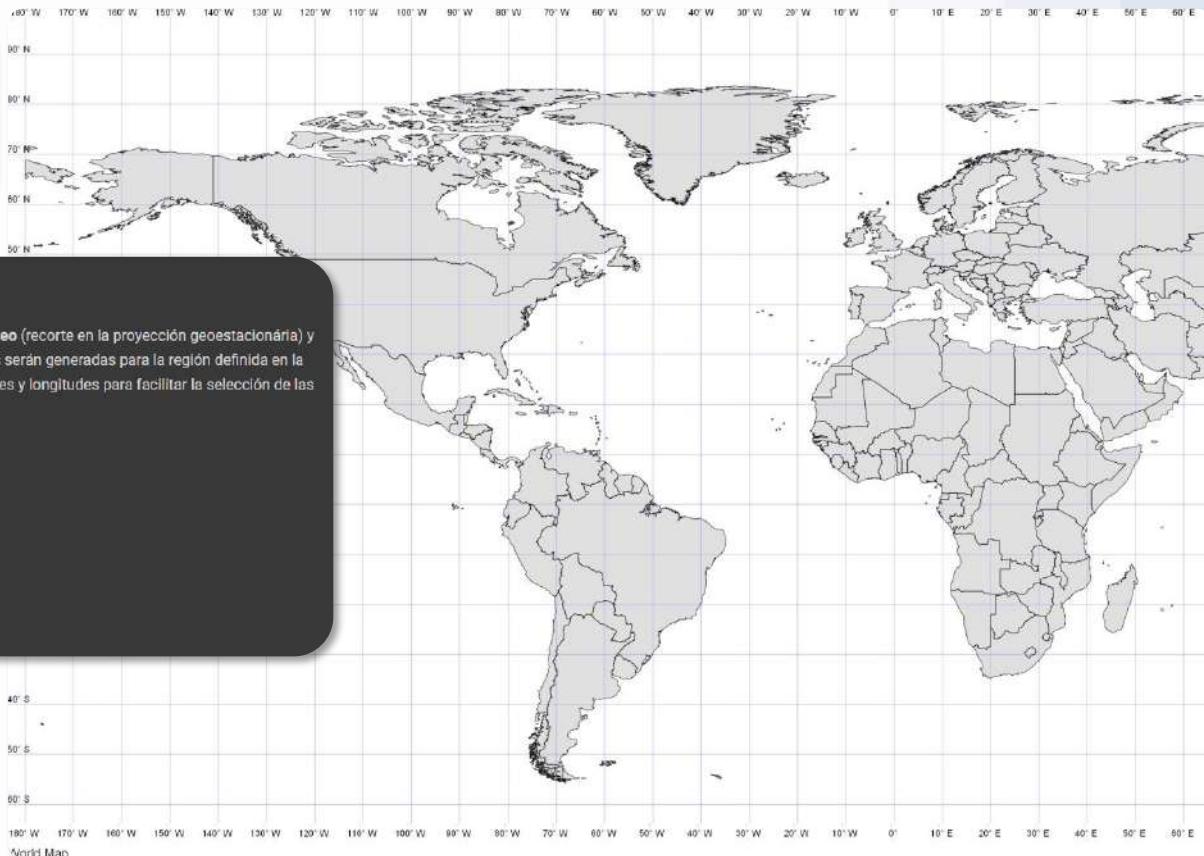
En cada script, en variable “area” puedes elegir la opción “full_disk” (Disco Completo), `custom_geo` (recorte en la proyección geoestacionaria) y “custom” (recorte en la proyección equidistante). Al elegir `custom_geo` o “custom”, las imágenes serán generadas para la región definida en la variable “extent” (min lon, min lat, max lon, max lat). Abajo, una imagen de referencia con latitudes y longitudes para facilitar la selección de las coordenadas del usuario, así como algunos ejemplos de “extent”.

Algunos extent de ejemplo:

- `extent = [-90.0, -60.0, -30.0, 15.00] # South America`
- `extent = [-110.0, 0.00, -60.00, 30.00] # Central America`
- `extent = [-90.0, -60.00, -40.00, -10.00] # Argentina`
- `extent = [-80.0, -40.00, -30.00, 10.00] # Brazil`
- `extent = [-115.0, -60.00, -50.00, -10.00] # Chile`
- `extent = [-120.0, 0.00, -80.00, 40.00] # Mexico`
- `extent = [-80.0, -45.00, -30.00, -20.00] # Uruguay`
- `extent = [-140.0, -70.00, 70.00, 70.00] # GOES-East and MSG 0°`



Además, se ha dejado algunos extent estándar para regiones específicas. Nota: Con el índice lateral de Colab es fácil acceder a esta referencia.



Vamos Usar el Índice Frecuentemente

Entrenamiento_AEMET_EUMETSAT_Nov_2023.ipynb

Archivo Editar Ver Insertar Entorno de ejecución Herramientas Ayuda Se han guardado todos los cambios

Comentario Compartir

RAM Disco

Índice

Paso 2: Instalando Bibliotecas Python y Descargando Archivos Auxiliares

Paso 3: Importando las Bibliotecas Necesarias

Paso 4: Credenciales de Usuario EUMDAC (EUMETSAT Data Services Client)

Paso 5: Cargando las Funciones

Algunas funciones para descargar y graficar datos (no es necesario expandir esta celda, solo ejecutarla)

REFERENCIA: Latitudes y Longitudes

Ejemplo 1: Descargando Datos Multimisión desde EUMETVIEW y Graficando la Imagen

Ejemplo 2: Descargando Datos GOES-Este desde AWS y Graficando la Imagen

Ejemplo 3: Descargando Datos GOES-Oeste desde AWS y Graficando la Imagen

Ejemplo 4: Descargando Datos MSG 0° con EUMDAC y Graficando la Imagen

Ejemplo 5: Descargando Datos MSG 45.5° (IDC) con EUMDAC y Graficando la Imagen

Ejemplo 6: ¿Cómo las Funciones Están Creando Estas Imágenes? Leyendo y Manipulando Datos Satelitales con Pytroll / Satpy (GOES-R)

Ejemplo 7: ¿Cómo las Funciones Están Creando Estas Imágenes? Leyendo y Manipulando Datos Satelitales con Pytroll / Satpy (MSG)

+ Código + Texto

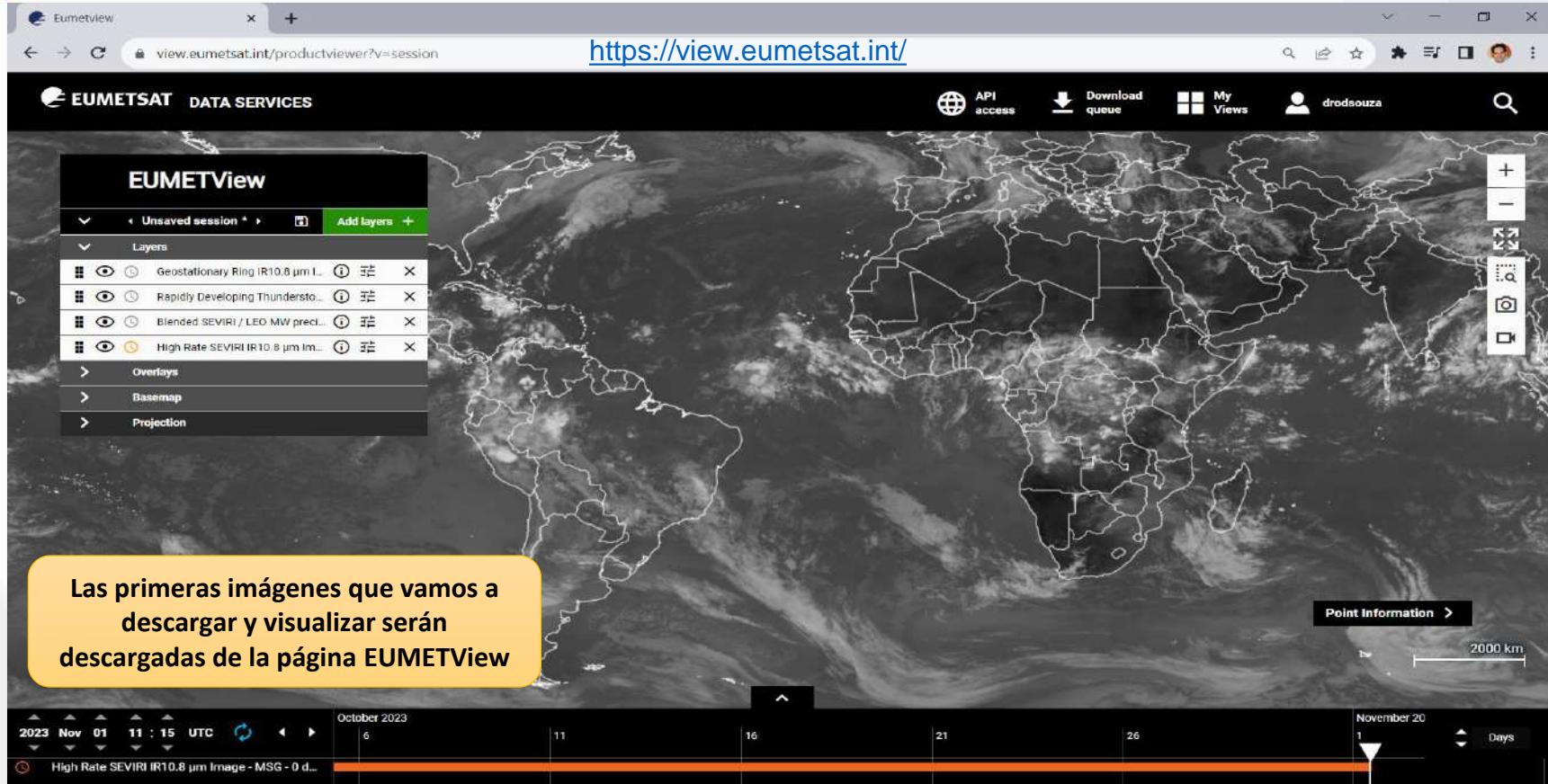
```
extent = [-115.0, -60.00, -50.00, -10.00] # Chile
extent = [-120.0, 0.00, -80.00, 40.00] # Mexico
extent = [-80.0, -45.00, -30.00, -20.00] # Uruguay
extent = [-140.0, -70.00, 70.00, 70.00] # GOES-East and MSG 0°
extent = [-80.0, -70.00, 70.00, 70.00] # MSG 0°
```

World Map

¡Estamos listos para empezar!



Ejemplo 1: Datos Multimisión EUMETView



Las primeras imágenes que vamos a descargar y visualizar serán descargadas de la página EUMETView

Ejemplo 1: Datos Multimisión EUMETView



EUMETView

www.eumetsat.int

*Automated access
to the imagery
and data*

WMS, WFS and WCS
(OGC API)

*Possibility for
further customized
downstream
use*



```
declaration.js x
1 declaration.js ...
2  * decl.type ... /*> 'decl'
3  * decl.toString() .../*> 'colors: black'
4  */
5  *
6  * references
7  * constructor(defaults) {
8  *   super(defaults);
9  *   this.type = 'decl';
10  * }
11  *
12  * reference
13  * get_value() {
14  *   warnOnce('Node#value was deprecated. Use NodeDraws.value');
15  *   return this._value;
16  * }
17  *
18  * reference
19  * set_value(val) {
20  *   warnOnce('Node#value was deprecated. Use NodeDraws.value');
21  * }
```



Web Pages
(Javascript+HTML)

Python Scripts

Desktop GIS
Applications

EUM/USC/VWG/23/1371051, v1 Draft, 19 July 2023

11

Ejemplo 1: Datos Multimisión EUMETView

Ejemplo 1: Descargando Datos Multimisión desde EUMETVIEW y Graficando la Imagen

```
[4] #  
# Training - Satellite Data Access and Processing - Example 1: Downloading and Visualizing Data from EUMETVIEW  
# Author: Diego Souza (INPE/CGCT/DIISM)
```

Nombre de la función

Parámetros

```
# georing available since June 06 2021 18:00 UTC '2021-06-06 18:00' (note: data available  
# available composites: 'ir108', 'airmass', 'natural_color', 'ash', 'dust'  
# max. res: 6  
plot_ring(date_sat='2023-10-28 15:00',  
          composite='airmass',  
          resolution=12,  
          area='custom',  
          extent=[-140.0, -70.00, 70.00, 70.00],  
          coast_color='white',  
          countries_color='white',  
          grid_color='white',  
          overwrite=True,  
          figsize=[20,20])
```

Parámetros

Fecha 'YYYY-MM-DD HH:MM'

Compuesto deseado

Resolución (mínimo 6)

Área deseada

Coordinadas

Color de las líneas de costa

Color de los mapas de países

Color de las líneas de ref.

Sobrescribir archivo

Tamaño de la figura (pulgadas)

Downloading the following file from EUMETView: GLOBAL_mumi_wideareacoverage_rgb_airmass_2023-10-28T1500Z.tif

Plotting the file:

/content/sample_data/GLOBAL_mumi_wideareacoverage_rgb_airmass_2023-10-28T1500Z.tif

Total processing time (satellite): 9.56 seconds.

'output/georing_airmass_2023-10-28_15:00.png'

Salida con informaciones

Desde 06 de junio de 2021, cada tres horas

'ir108', 'airmass',
'natural_color', 'ash',
'dust'

'custom' o 'global'

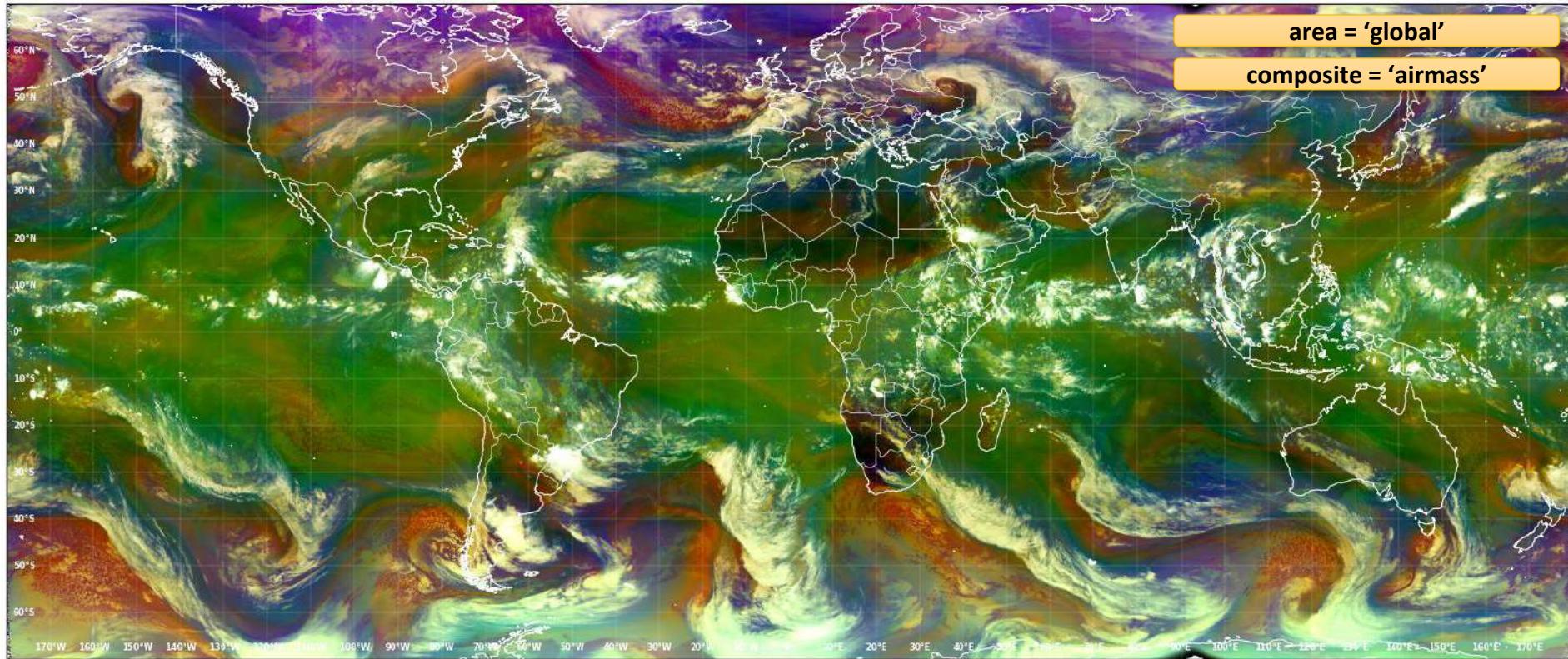
Ejemplo 1: Datos Multimisión EUMETView

Geostationary Ring (EUMETVIEW) - airmass
2023-10-28 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

Datos de GOES-Este, GOES-Oeste, MSG 0°, MSG 45.5° (IODC), Himawari

area = 'global'

composite = 'airmass'



Ejemplo 1: Datos Multimisión EUMETView

• Ejemplo 1: Descargando Datos Multimisión desde EUMETVIEW y Graficando la Imagen

```
#-----  
# Training - Satellite Data Access and Processing - Example 1: Downloading and Visualizing Data from EUMETVIEW  
# Author: Diego Souza (INPE/CGCT/DISSL)  
#-----  
  
# georing available since June 06 2021 18:00 UTC '2021-06-06 18:00' (note: data available every 3 hours)  
# available composites: 'ir100', 'airmass', 'natural_color', 'ash', 'dust'  
# max. res: 6  
plot_ring(date_sat='2023-11-01 15:00',  
         composite='airmass',  
         resolution=6,  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         coast_color='black',  
         countries_color='black',  
         grid_color='white',  
         overwrite=True,  
         figsize=[20,20])
```

```
Downloaded the following file from EUMETVIEW: GLOBAL_mumi_wideareacoverage_rgb_airmass_2023-11-01T15-00Z.tif
```

```
Plotting the file:  
/content/sample_data/GLOBAL_mumi_wideareacoverage_rgb_airmass_2023-11-01T15-00Z.tif
```

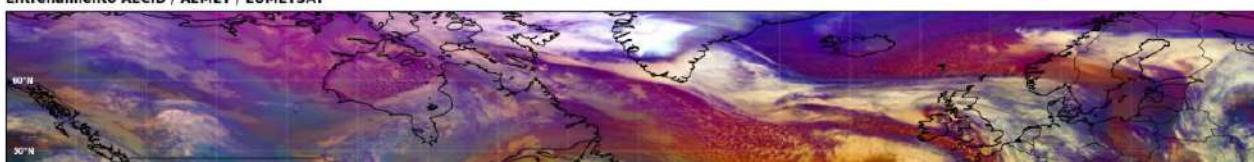
```
Total processing time (satellite): 22.13 seconds.
```

```
'output/georing_airmass_2023-11-01_15:00.png'
```

```
Geostationary Ring (EUMETVIEW) - airmass
```

```
2023-11-01 15:00 UTC
```

```
Entrenamiento AECID / AEMET / EUMETSAT
```



Archivo a ser descargado

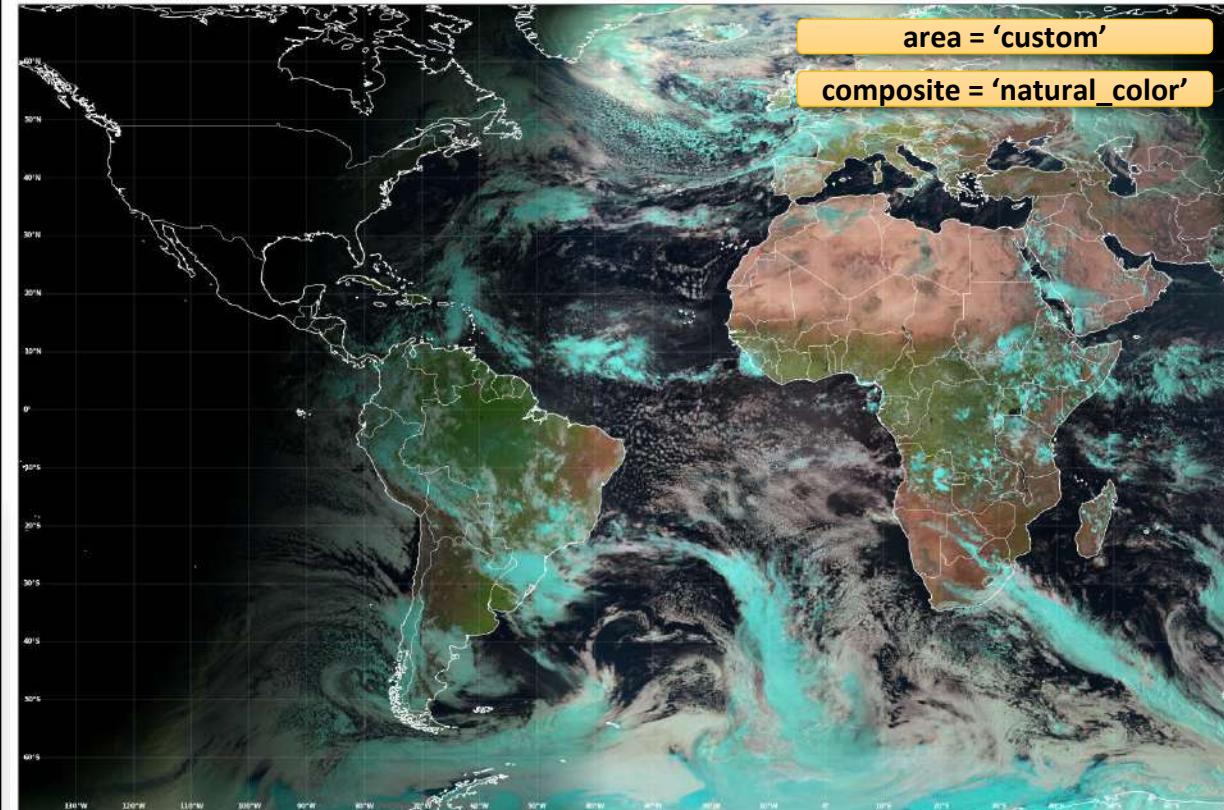
Graficando la información

Tiempo necesario

Nombre de la imagen generada
(carpeta output)

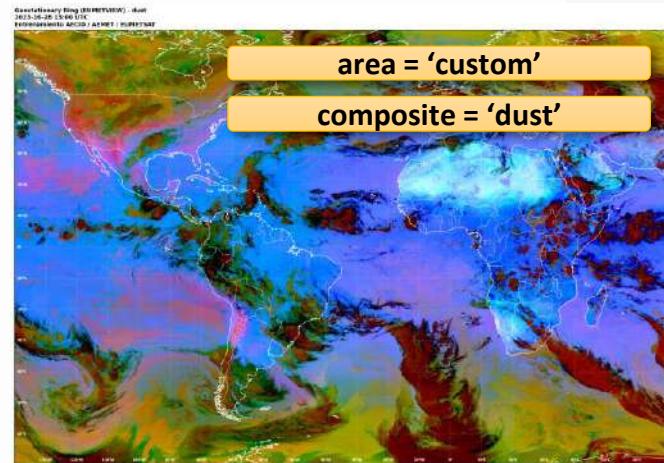
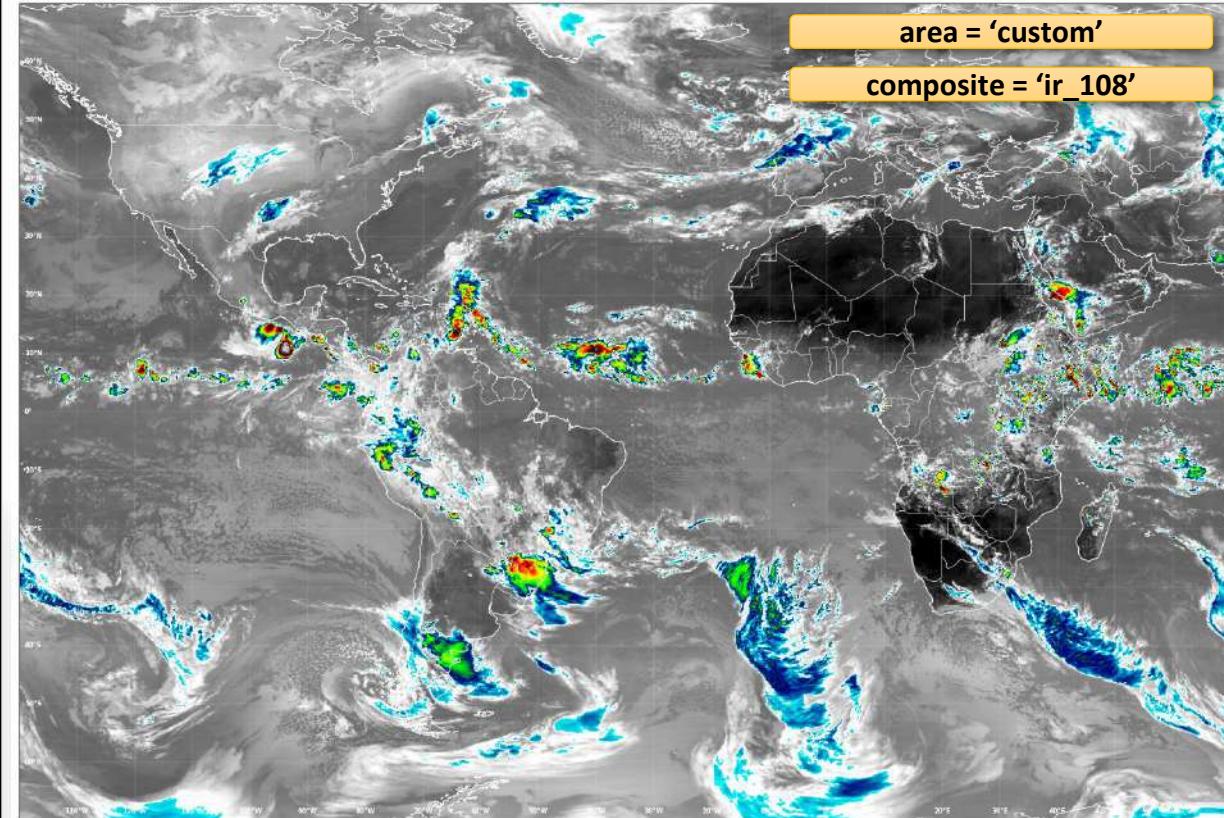
Ejemplo 1: Datos Multimisión EUMETView

Geostationary Ring (EUMETVIEW) - natural_color
2023-10-28 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



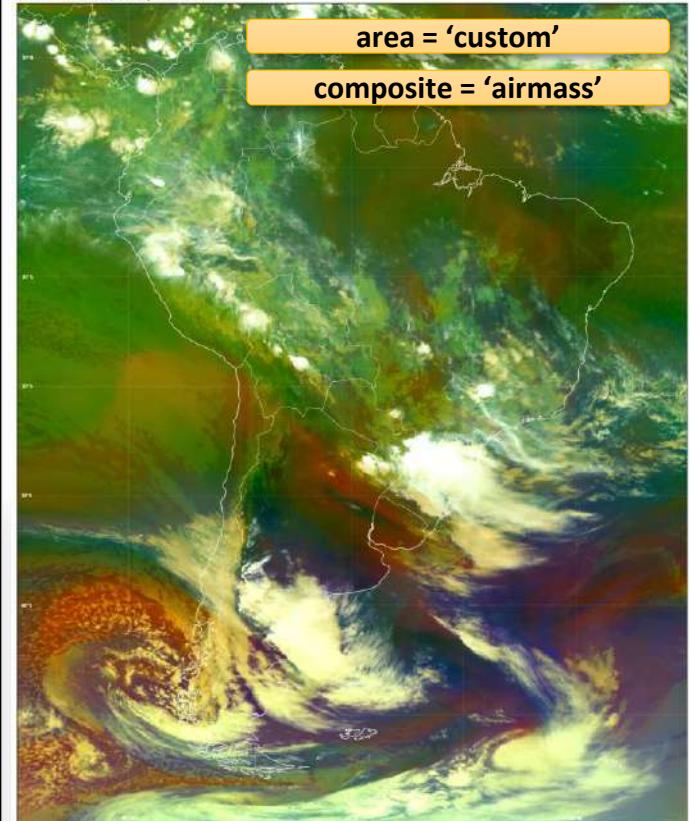
Ejemplo 1: Datos Multimisión EUMETView

Geostationary Ring (EUMETVIEW) - ir108
2023-10-28 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

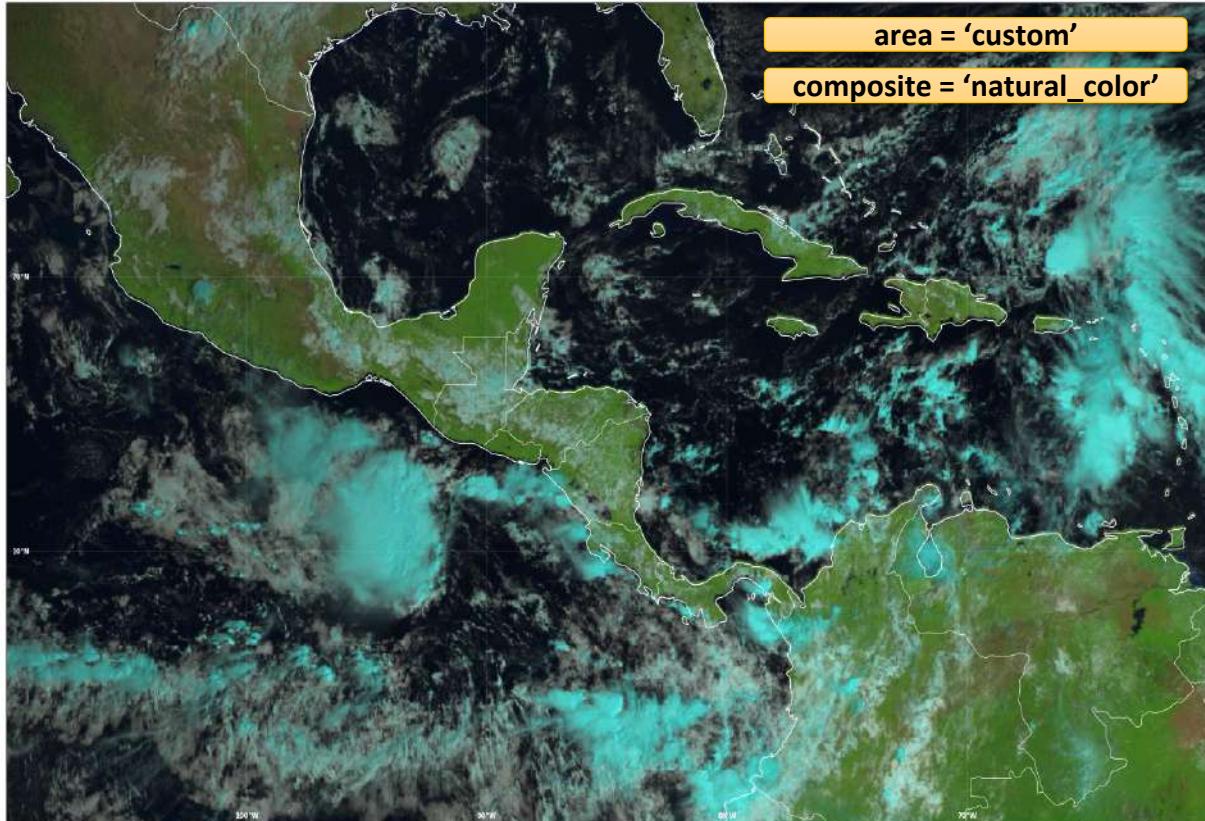


Ejemplo 1: Datos Multimisión EUMETView

Geostationary Ring (EUMETVIEW) - airmass
2023-10-25 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Geostationary Ring (EUMETVIEW) - natural_color
2023-10-28 18:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 1: Nombres de Colores Estándar Matplotlib

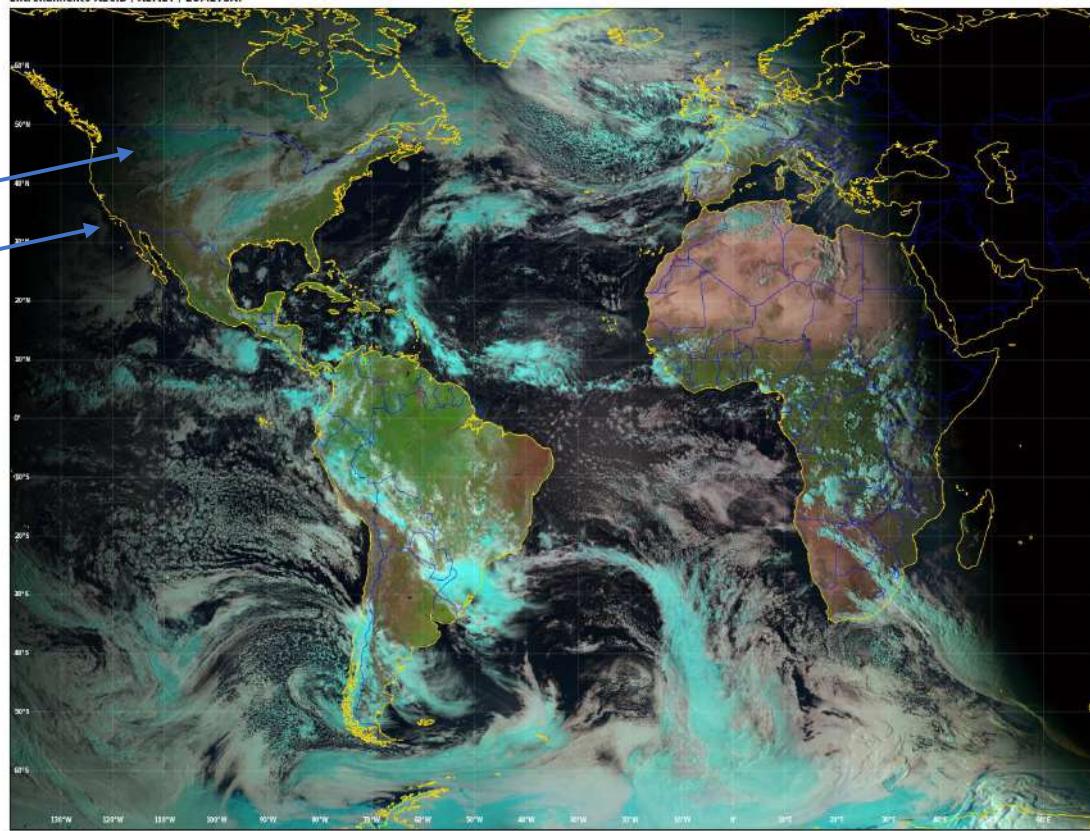
black
k
dimgray
dimgrey
grey
gray
darkgray
darkgrey
silver
lightgrey
lightgray
gainsboro
whitesmoke
white
w
snow
rosybrown
lightcoral
indianred
brown
firebrick
maroon
darkred
red
r
mistyrose
salmon
tomato
darksalmon
coral
orangered
lightsalmon
sienna
seashell
chocolate
saddlebrown
sandybrown
peachpuff
peru

linen
bisque
darkorange
burlywood
antiquewhite
tan
navajowhite
blanchedalmond
papayawhip
moccasin
orange
wheat
oldlace
floralwhite
darkgoldenrod
goldenrod
cornsilk
gold
lemonchiffon
khaki
palegoldenrod
darkkhaki
ivory
beige
lightyellow
lightgoldenrodyellow
olive
y
yellow
olivedrab
yellowgreen
darkolivegreen
greenyellow
chartreuse
lawngreen
honeydew
darkseagreen
palegreen
lightgreen

forestgreen
limegreen
darkgreen
green
lime
seagreen
mediumseagreen
springgreen
mintcream
mediumspringgreen
mediumaquamarine
aquamarine
turquoise
lightseagreen
mediumturquoise
azure
lightcyan
paleturquoise
darkslategray
darkslategrey
teal
darkcyan
c
cyan
aqua
darkturquoise
cadetblue
powderblue
lightblue
deepskyblue
skyblue
lightskyblue
steelblue
aliceblue
dodgerblue
lightslategray
lightslategray
slategray

lightsteelblue
cornflowerblue
royalblue
ghostwhite
lavender
midnightblue
navy
darkblue
mediumblue
blue
b
slateblue
darkslateblue
mediumslateblue
mediumpurple
rebeccapurple
blueviolet
Indigo
darkorchid
darkviolet
mediumorchid
thistle
plum
violet
purple
darkmagenta
m
magenta
fuchsia
orchid
mediumvioletred
deeppink
hotpink
lavenderblush
palevioletred
crimson
pink
lightpink

Geostationary Ring (EUMETVIEW) - natural_color
2023-10-28 18:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejercicio: Erupción de Klyuchevskaya en la Península de Kamchatka

Fecha:

2023-11-01 18:00 UTC

Región:

area = 'custom'
extent = [145.0, 40.00, 178.00, 65.00]

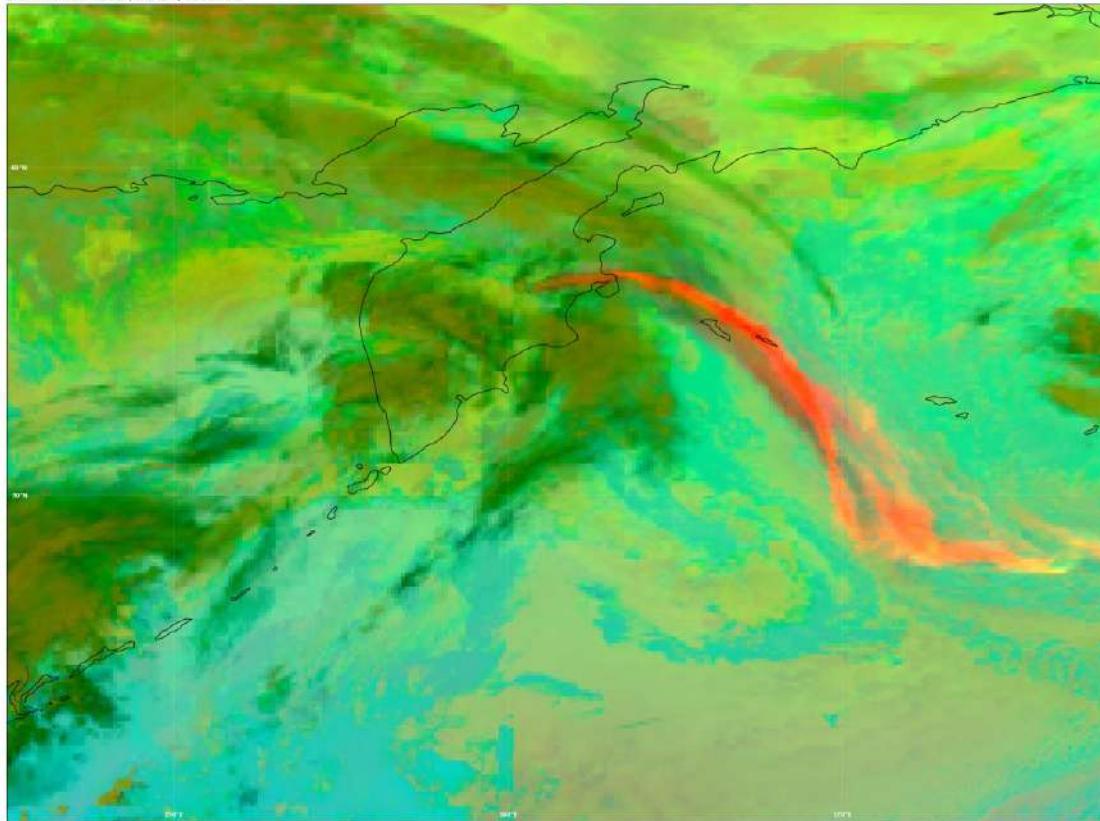
Compuesto:

'ash'

Referencia:

<https://cimss.ssec.wisc.edu/satellite-blog/archives/55417>

Geostationary Ring (EUMETVIEW) - ash
2023-11-01 18:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 1: Datos Multimisión EUMETView



```
# Importar bibliotecas necesarias
import requests
import rasterio
from rasterio import plot
import numpy as np
import matplotlib.pyplot as plt
from datetime import datetime
```

```
# Definir función para descargar y visualizar datos
```

```
def plot_ring(date_sat, composite, resolution, area, extent, coast_color, countries_color, grid_color, overwrite, figsize):
```

```
    print(f'
```

Input del Usuario:
Fecha, Compuesto, Resolución, Área, Extensión, Colores y Tamaño

Descarga de Datos desde EUMETView
Con el Open Geospatial Consortium (OGC) Web Service (OWS)

Procesa y Grafica la Imagen

```
#####
# plot_ring: Function to download and visualize geoestationary ring data from EUMETView
# Author: Diego Souza (INPE/CGCT/DISSM)
#####

def plot_ring(date_sat, composite, resolution, area, extent, coast_color, countries_color, grid_color, overwrite, figsize):
```

```
    print(f'
```

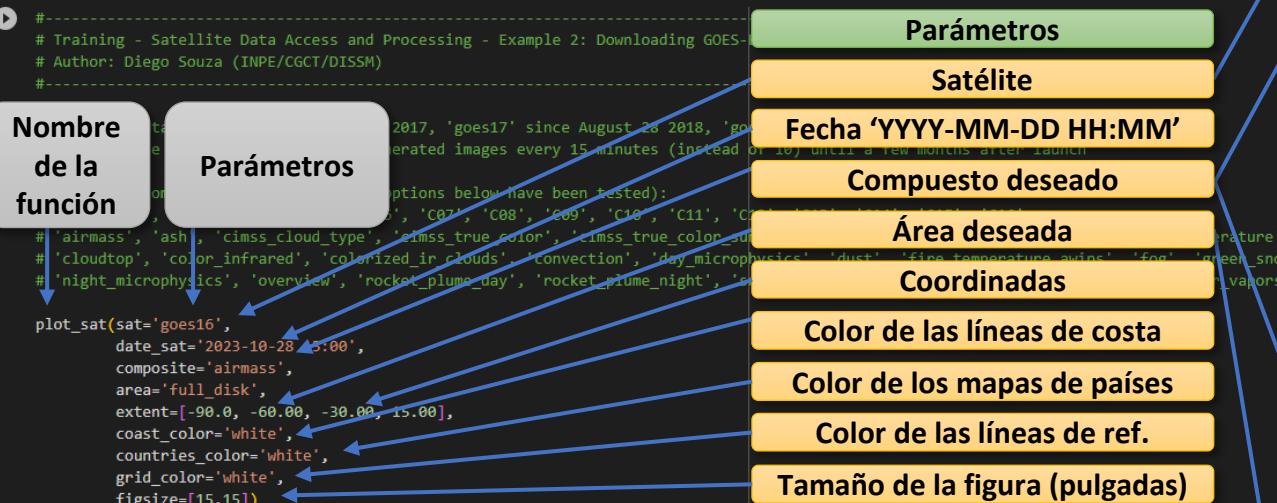
Ejemplo 2: Datos GOES-Este

- Ejemplo 2: Descargando Datos GOES-Este desde AWS y Graficando la Imagen

```
plot_sat(sat='goes16',
          date_sat='2023-10-28 15:00',
          composite='airmass',
          area='full_disk',
          extent=[-90.0, -60.00, -30.00, 15.00],
          coast_color='white',
          countries_color='white',
          grid_color='white',
          figsize=[15,15])
```

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
Total processing time (satellite): 21.81 seconds.

'output/goes16_airmass_2023-10-28_15:00.png'



‘goes16’, ‘goes17’, ‘msg0’ o ‘msg45’

Canales: 'C01', 'C02', 'C03', 'C04', 'C05',
'C06', 'C07', 'C08', 'C09', 'C10', 'C11',
'C12', 'C13', 'C14', 'C15', 'C16'

```
Composites: 'airmass', 'ash',
'cimss_cloud_type', 'cimss_true_color',
'cimss_true_color_sunz_rayleigh',
    'cira_day_convection',
'cira_fire_temperature', 'cloud_phase',
    'cloud_phase_distinction',
    'cloudtop', 'color_infrared',
'colorized_ir_clouds', 'convection',
    'day_microphysics', 'dust',
    'fire_temperature_awips', 'fog',
green_snow', 'land_cloud', 'natural_color',
    'night_fog', 'night_microphysics',
    'overview', 'rocket_plume_day',
'rocket_plume_night', 'snow', 'so2',
    'tropical_airmass', 'true_color',
    'water_vapors1', 'water_vapors2'
```

‘full disk’, ‘custom geo’, ‘custom’

Datos GOES-Este: Algunos “Composites” Disponibles

C01



C02



C03



C04



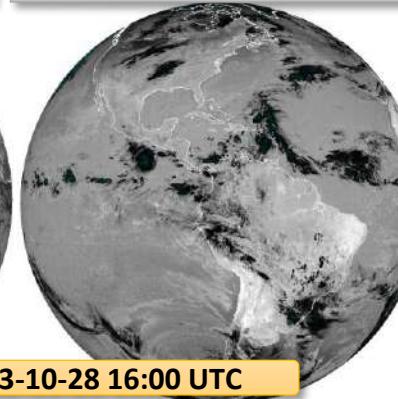
C05



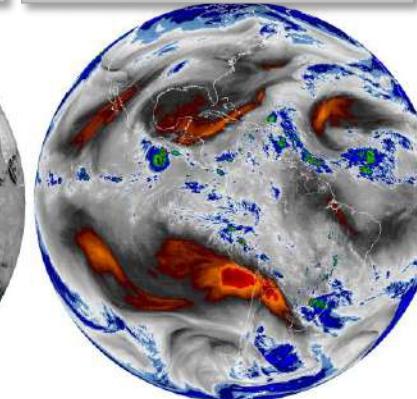
C06



C07



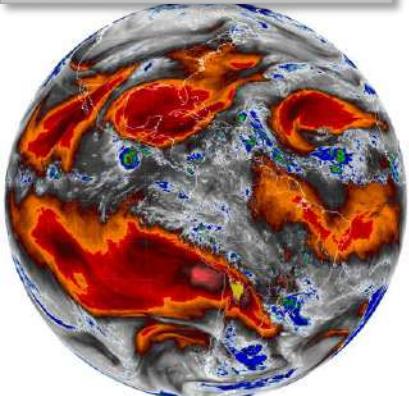
C08



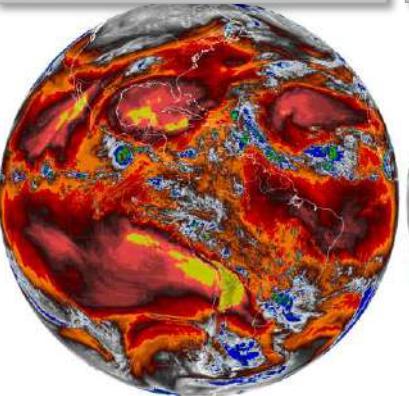
Imágenes de 2023-10-28 16:00 UTC

Datos GOES-Este: Algunos “Composites” Disponibles

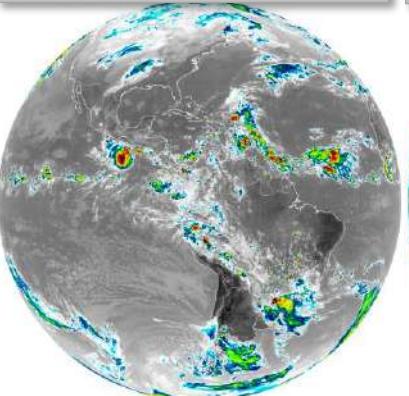
C09



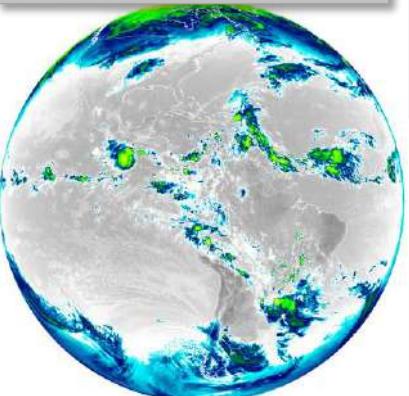
C10



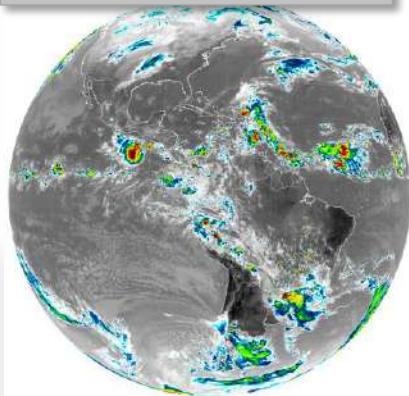
C11



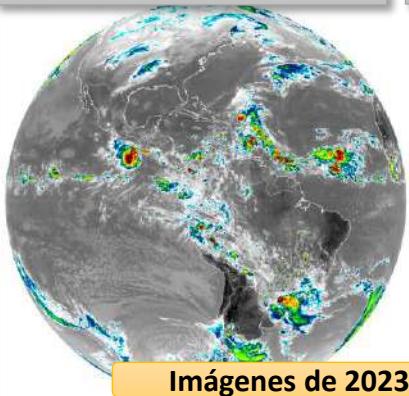
C12



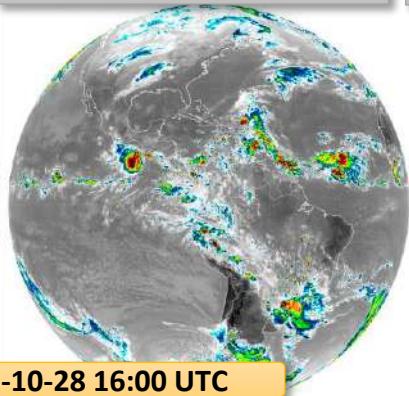
C13



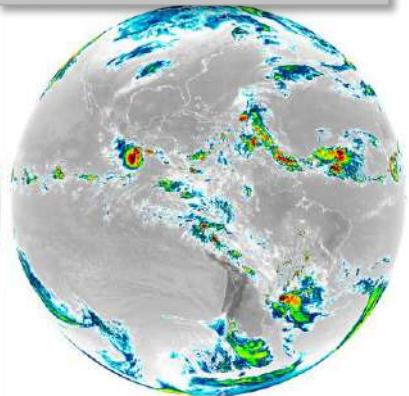
C14



C15



C16

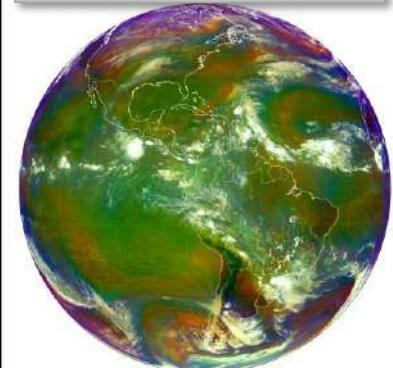


Imágenes de 2023-10-28 16:00 UTC

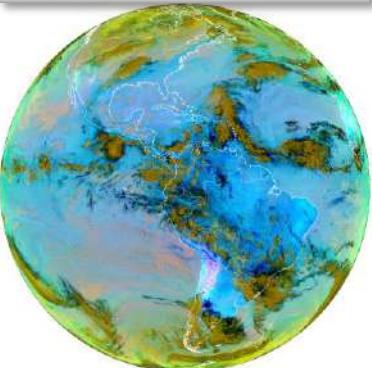
Datos GOES-Este: Algunos “Composites” Disponibles



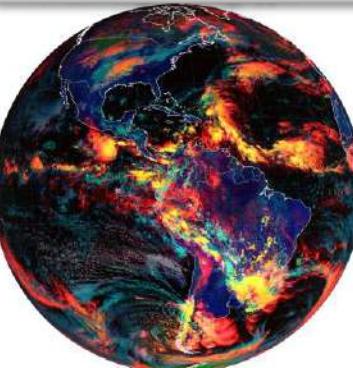
airmass



ash



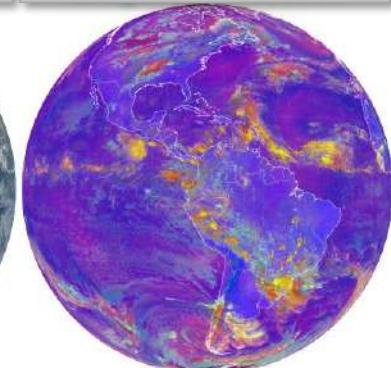
cimss_cloud_type



cimss_true_color



cira_day_convection



cira_fire_temperature



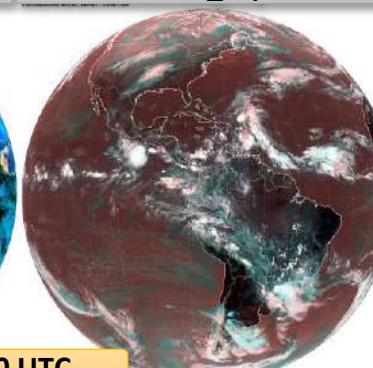
cloud_phase



cloud_phase_distinction



cloud_top



color_infrared

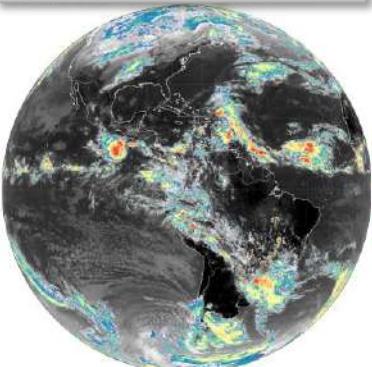


Imágenes de 2023-10-28 16:00 UTC

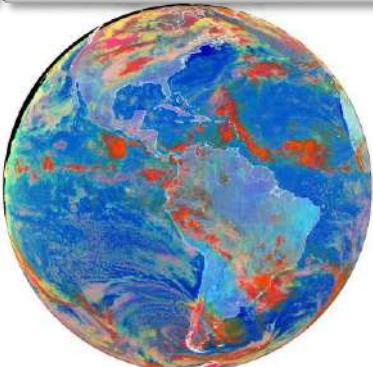
Datos GOES-Este: Algunos “Composites” Disponibles



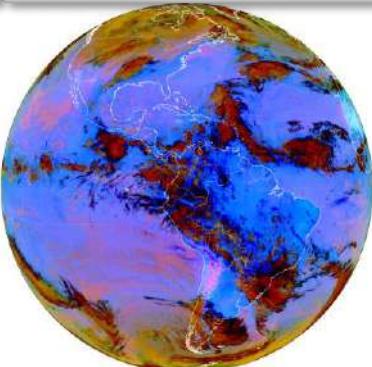
colorized_ir_clouds



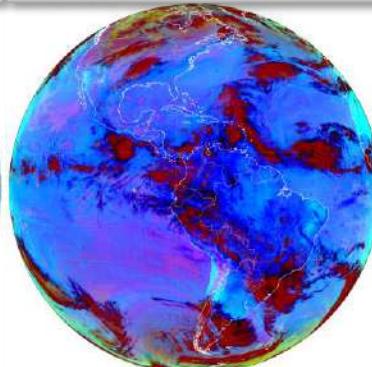
day_microphysics



dust



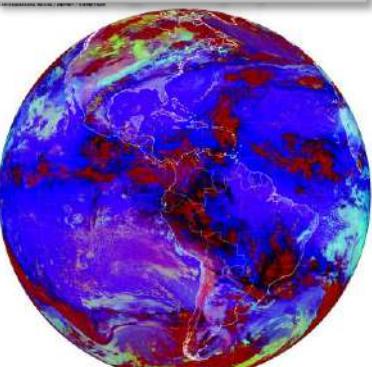
fog



land_cloud



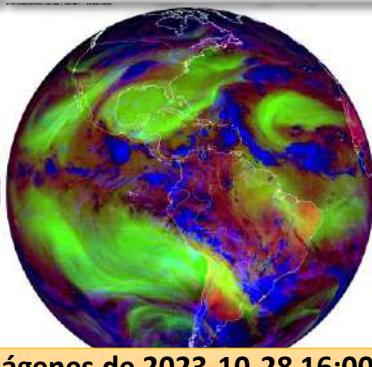
night_microphysics



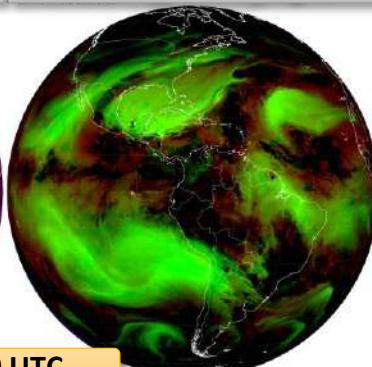
overview



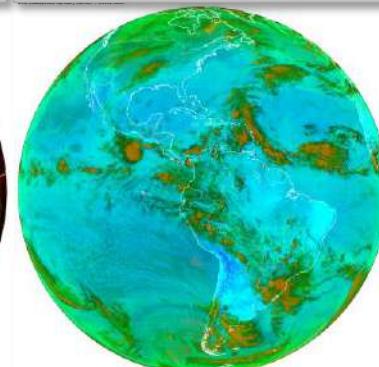
rocket_plume_day



rocket_plume_night



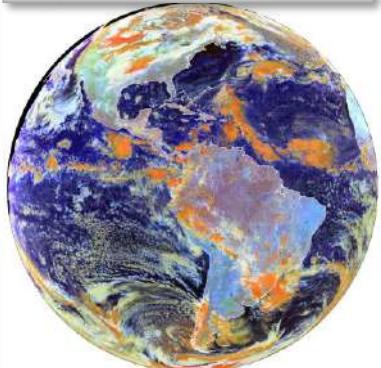
so2



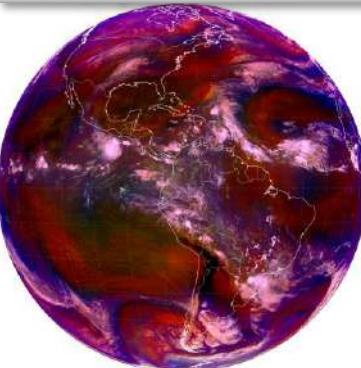
Imágenes de 2023-10-28 16:00 UTC

Datos GOES-Este: Algunos “Composites” Disponibles

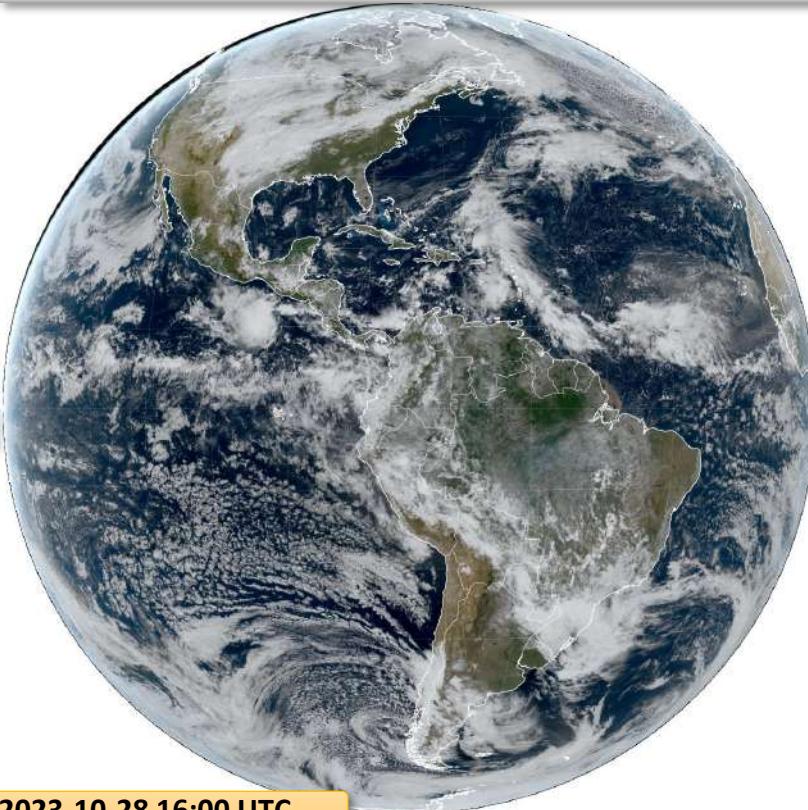
snow



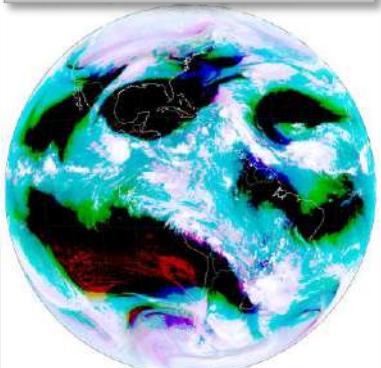
tropical_airmass



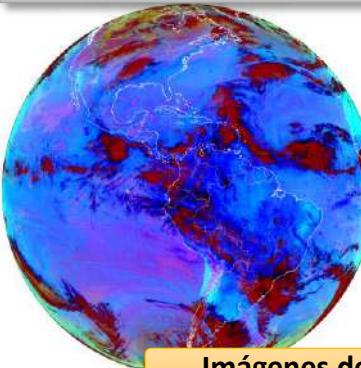
true_color



water_vapors1



water_vapors2

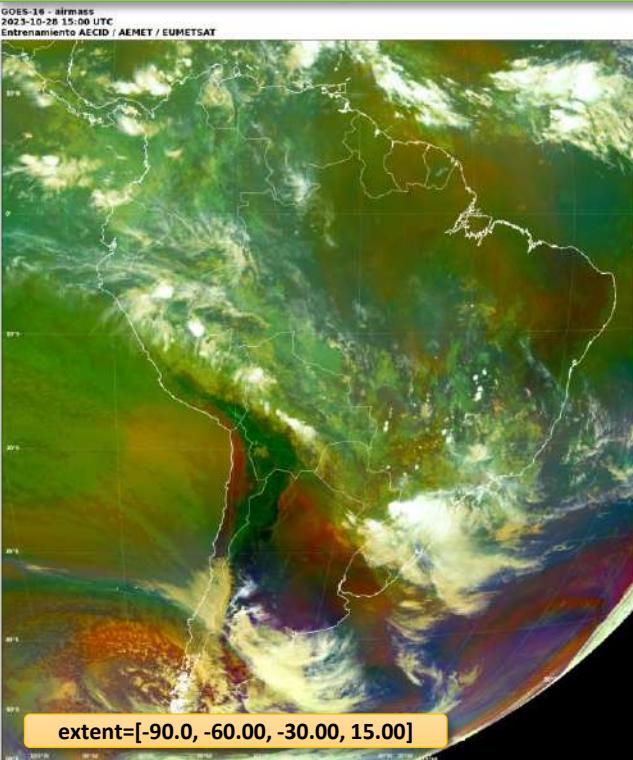


Imágenes de 2023-10-28 16:00 UTC

Ejemplo 2: Datos GOES-Este

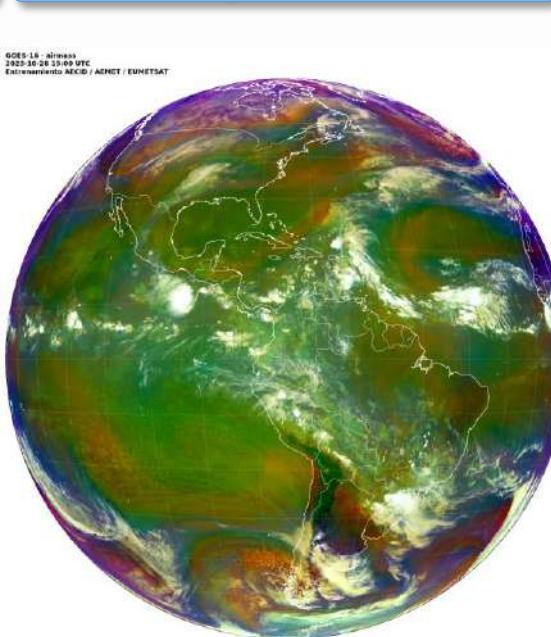
area = 'custom_geo' (recorte en la proyección original)

Más rápido



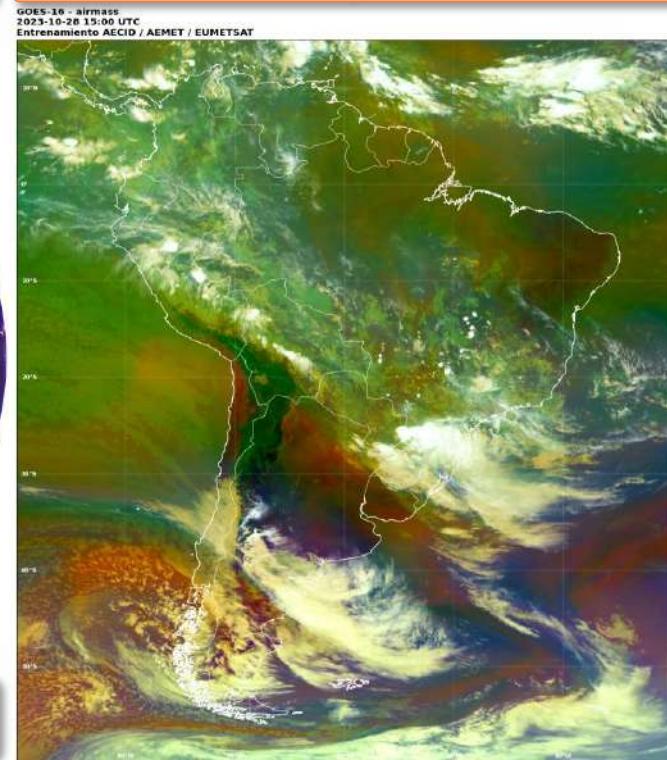
area = 'full_disk'

Tiempo intermedio



area = 'custom' (recorte en la proyección equidistante)

Tarda un poco más



Ejercicio: Huracanes Katia, Irma y José

Satélite:
'goes16'

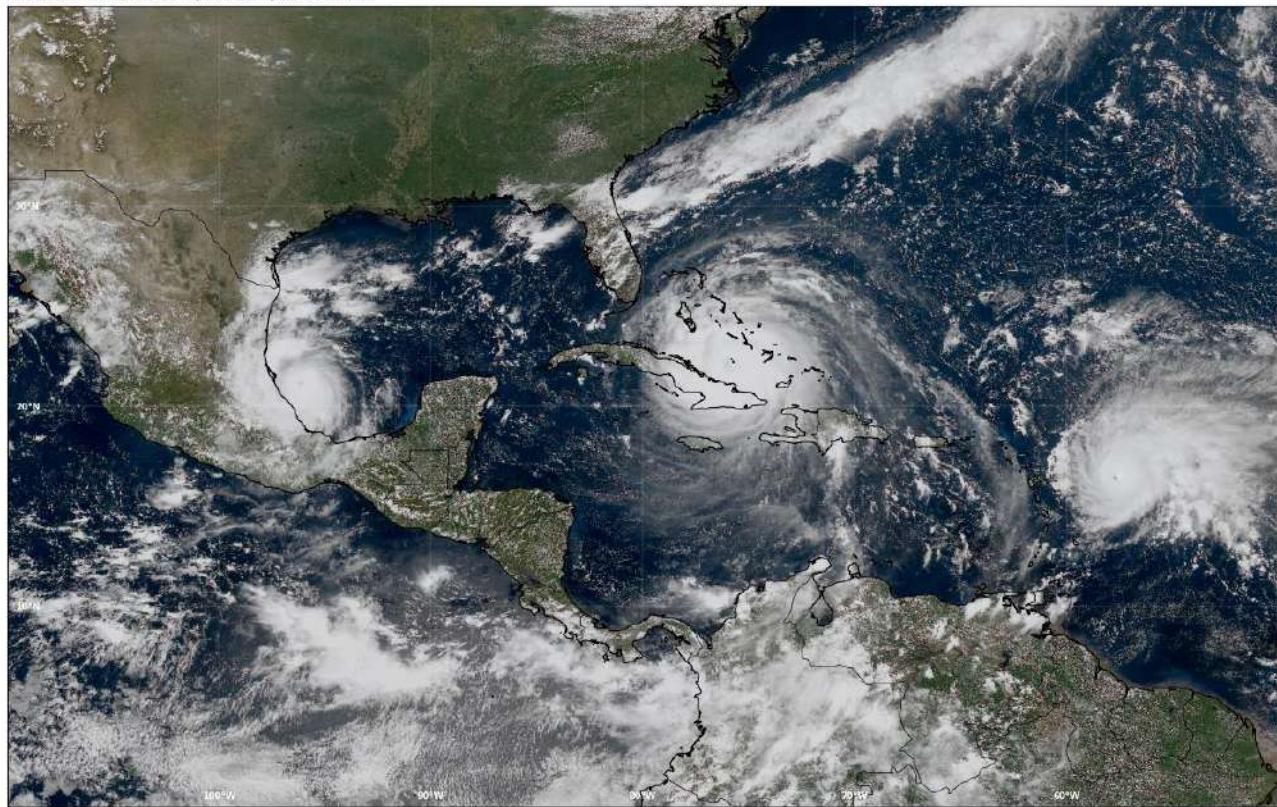
Fecha:
2017-09-08 17:45 UTC

Región (Sudamerica):
area = 'custom'
extent = [-110.0, 0.00, -50.00, 40.00]

Compuestos RGB:
'true_color'
'cloud_phase_distinction'
'convection'

Referencia:
<https://cimss.ssec.wisc.edu/satellite-blog/archives/25537>

GOES-16 - true_color
2017-09-08 17:45 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejercicio: Polvo del Sahara

Satélite:
'goes16'

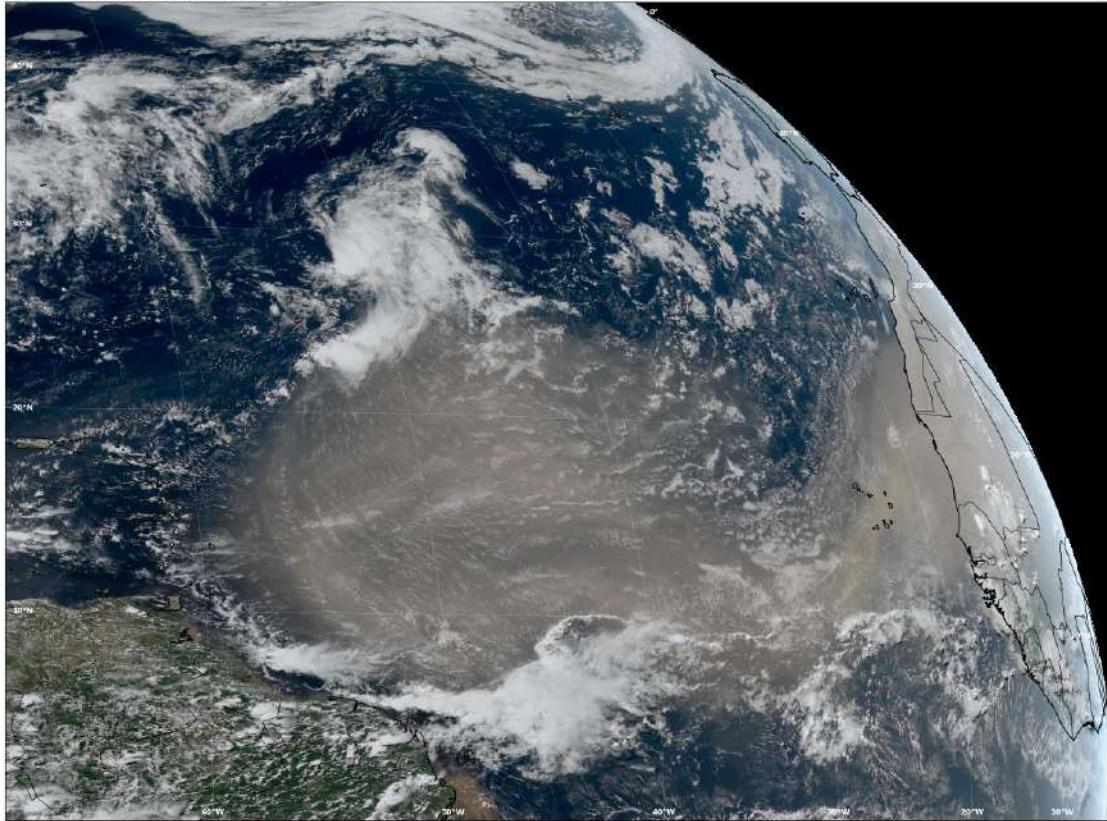
Fecha:
2020-06-20 18:00 UTC

Región:
area = 'custom_geo'
extent = [-65.0, 0.00, 0.00, 45.00]

Compuestos RGB:
'true_color'

Referencia:
<https://www.severe-weather.eu/global-weather/massive-saharan-dust-cloud-atlantic-usa-fa/>

GOES-16 - true_color
2020-06-20 18:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 3: Datos GOES-Oeste

Ejemplo 3: Descargando Datos GOES-Oeste desde AWS y Graficando la Imagen

```

# Training - Satellite Data Access and Processing - Example 3: Downloading GOES-
# Author: Diego Souza (INPE/CGCT/DISSM)
#-

Nombre de la función
Parámetros
    # airmass', 'ash', 'cimss_cloud_type', 'cimss_true_color', 'cimss_true_color_sunz',
    # 'cloudtop', 'color_infrared', 'colorized_ir_clouds', 'convection', 'day_microphysics',
    # 'night_microphysics', 'overview', 'rocket_plume_day', 'rocket_plume_night', 'so2',
    # 'tropical_aimmass', 'true_color', 'water_vapors1', 'water_vapors2'
    plot_sat(sat='goes18',
              date_sat='2023-10-28 15:00',
              composite='airmass',
              area='full_disk',
              extent=[-90.0, -60.00, -30.00, 15.00],
              coast_color='white',
              countries_color='white',
              grid_color='white',
              figsize=[15,15])

```

Downloading file /content/sample_data/OR_ABI-L2-MCMIPF-M6_G18_s2023011500224_e2023011509544_c2023011510011.nc
 Plotting the file:
 /content/sample_data/OR_ABI-L2-MCMIPF-M6_G18_s2023011500224_e2023011509544_c2023011510011.nc

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
 Total processing time (satellite): 28.02 seconds.
 'output/goes18_airmass_2023-10-28_15:00.png'

Salida con informaciones

Productos y Aplicaciones de Satélite em Latitudes Medias - Fase Presencial

'goes16', 'goes17', 'msg0' o 'msg45'

Canales: 'C01', 'C02', 'C03', 'C04', 'C05',
 'C06', 'C07', 'C08', 'C09', 'C10', 'C11',
 'C12', 'C13', 'C14', 'C15', 'C16'

Composites: 'airmass', 'ash',
 'cimss_cloud_type', 'cimss_true_color',
 'cimss_true_color_sunz_rayleigh',
 'cira_day_convection',
 'cira_fire_temperature', 'cloud_phase',
 'cloud_phase_distinction',
 'cloudtop', 'color_infrared',
 'colorized_ir_clouds', 'convection',
 'day_microphysics', 'dust',
 'fire_temperature_awips', 'fog',
 'green_snow', 'land_cloud', 'natural_color',
 'night_fog', 'night_microphysics',
 'overview', 'rocket_plume_day',
 'rocket_plume_night', 'snow', 'so2',
 'tropical_aimmass', 'true_color',
 'water_vapors1', 'water_vapors2'

'full_disk', 'custom_geo', 'custom'

Datos GOES-Oeste: Algunos “Composites” Disponibles

C01



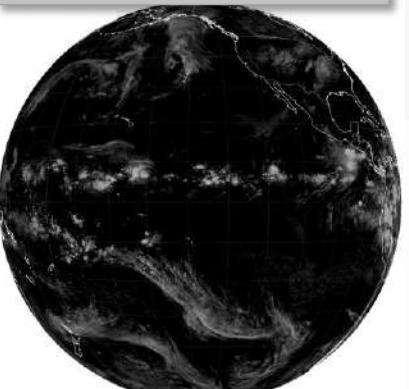
C02



C03



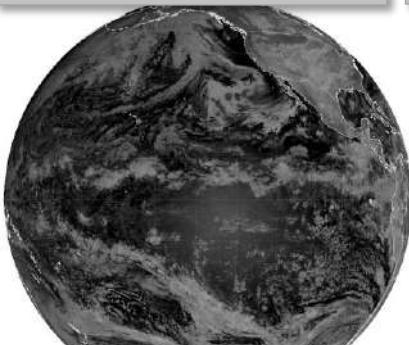
C04



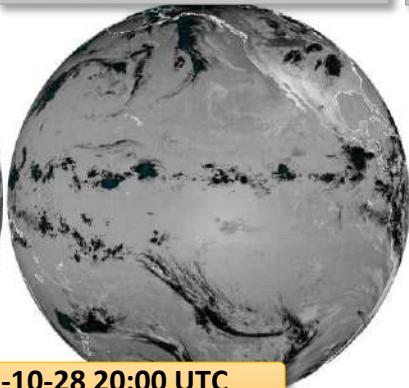
C05



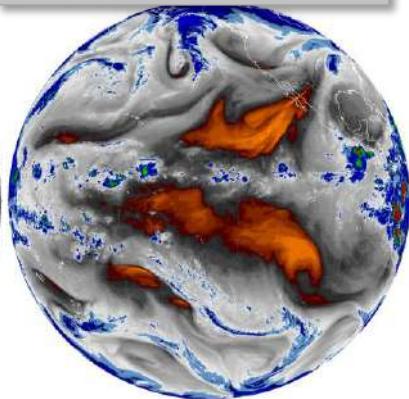
C06



C07



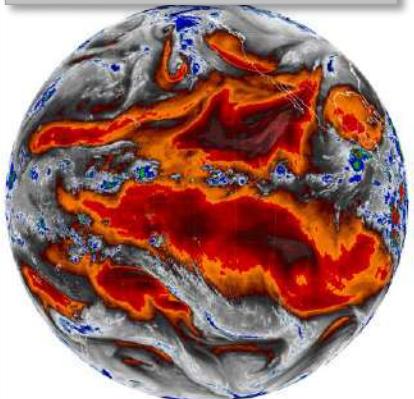
C08



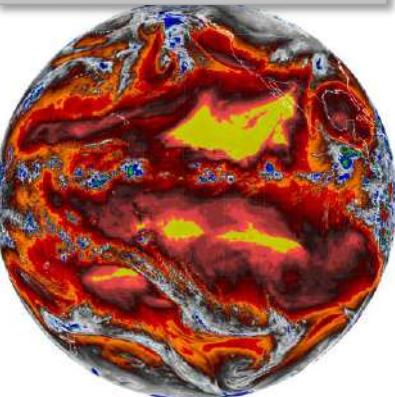
Imágenes de 2023-10-28 20:00 UTC

Datos GOES-Oeste: Algunos “Composites” Disponibles

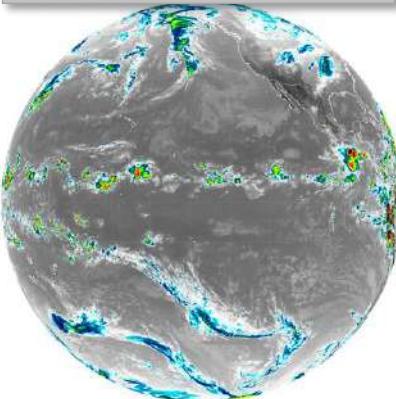
C09



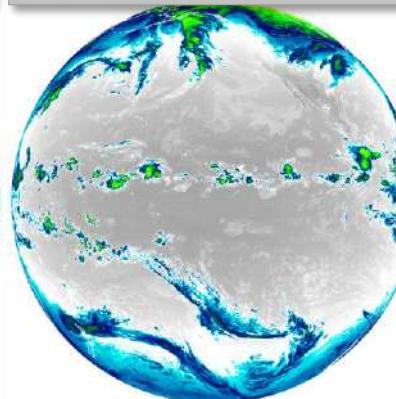
C10



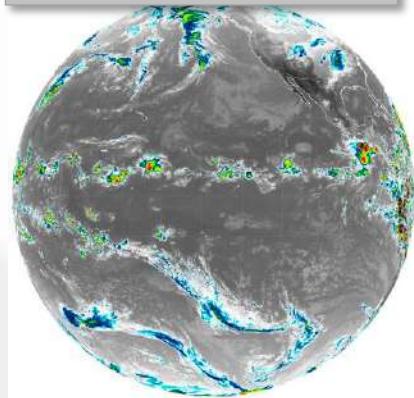
C11



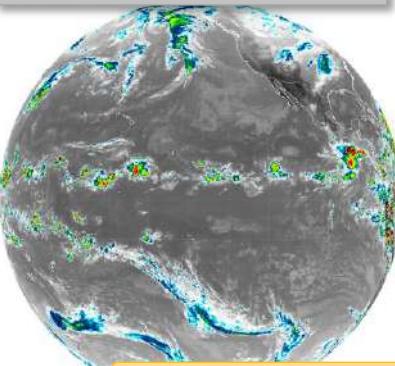
C12



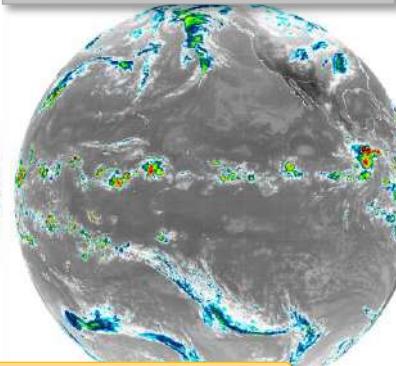
C13



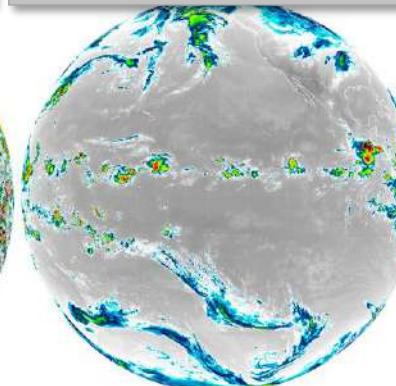
C14



C15



C16



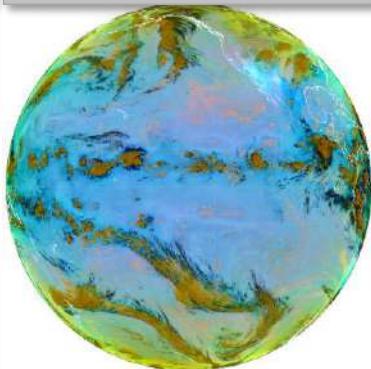
Imágenes de 2023-10-28 20:00 UTC

Datos GOES-Oeste: Algunos “Composites” Disponibles

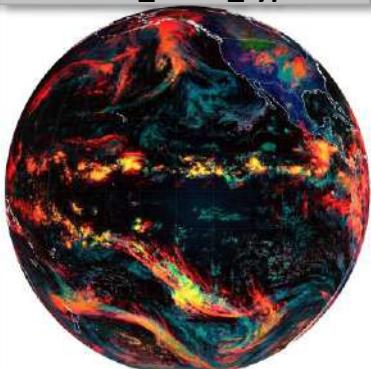
airmass



ash



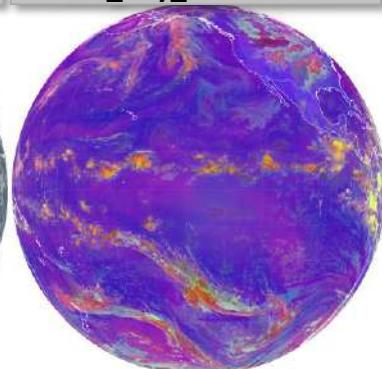
cimss_cloud_type



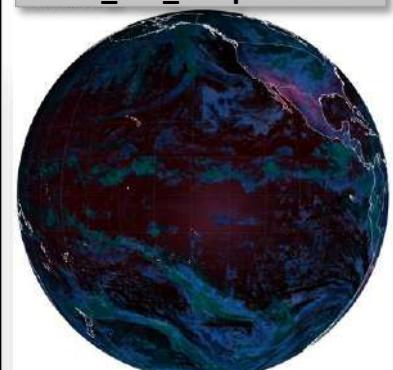
cimss_true_color



cira_day_convection



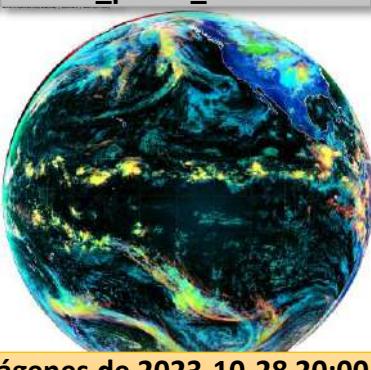
cira_fire_temperature



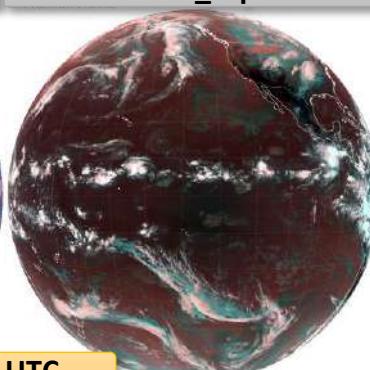
cloud_phase



cloud_phase_distinction



cloud_top



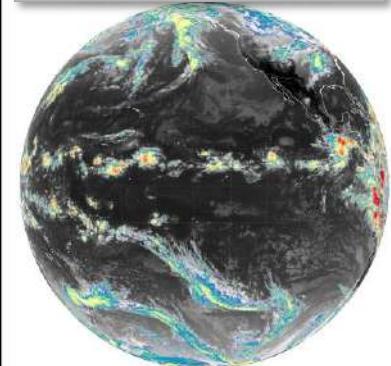
color_infrared



Imágenes de 2023-10-28 20:00 UTC

Datos GOES-Oeste: Algunos “Composites” Disponibles

colorized_ir_clouds



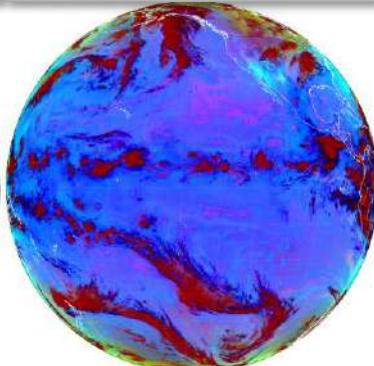
day_microphysics



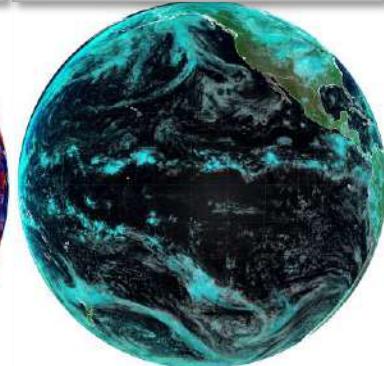
dust



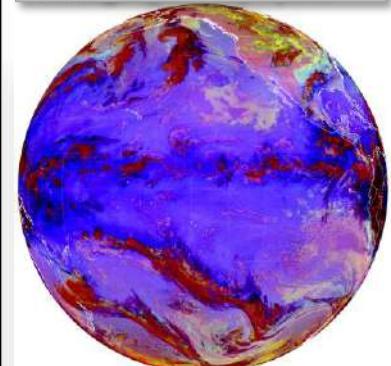
fog



land_cloud



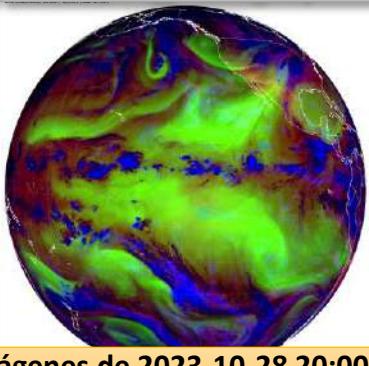
night_microphysics



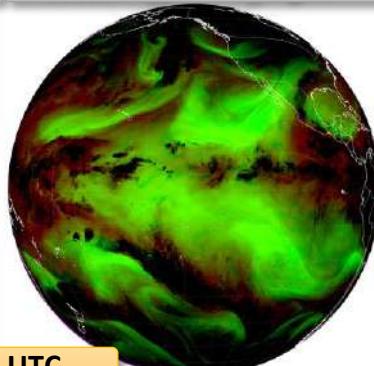
overview



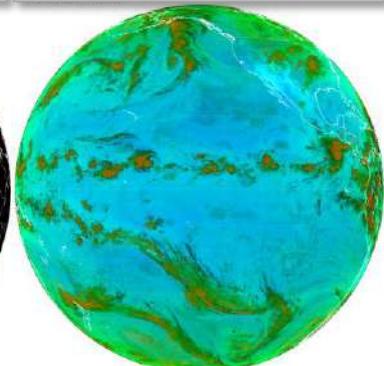
rocket_plume_day



rocket_plume_night



so2



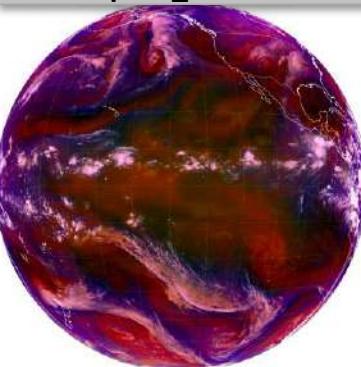
Imágenes de 2023-10-28 20:00 UTC

Datos GOES-Oeste: Algunos “Composites” Disponibles

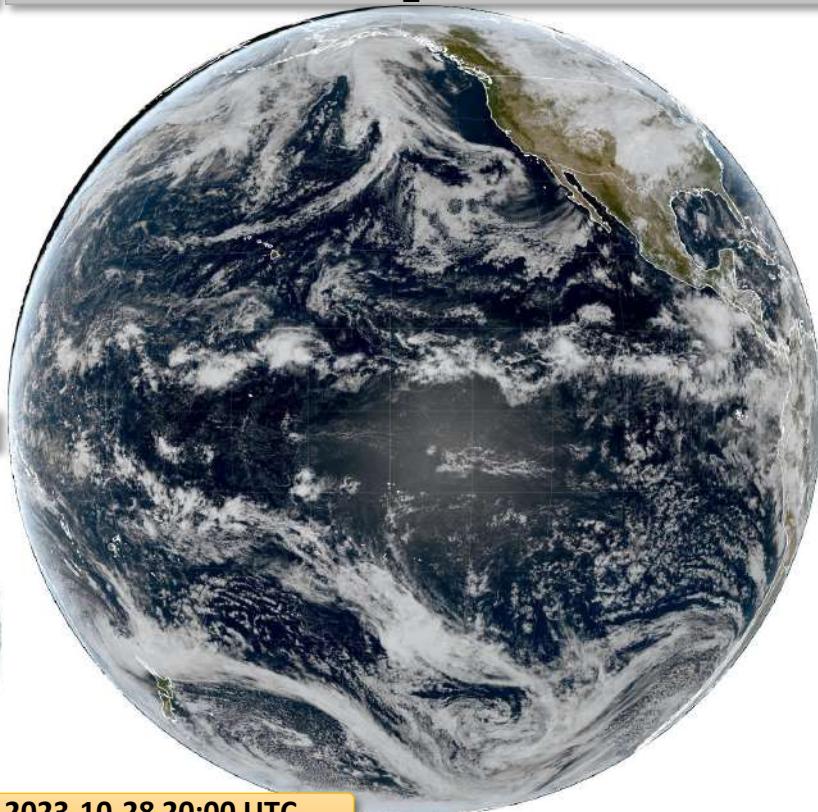
snow



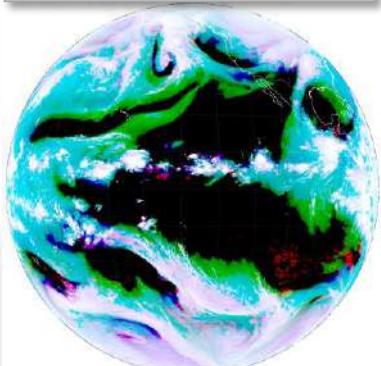
tropical_airmass



true_color



water_vapors1



water_vapors2

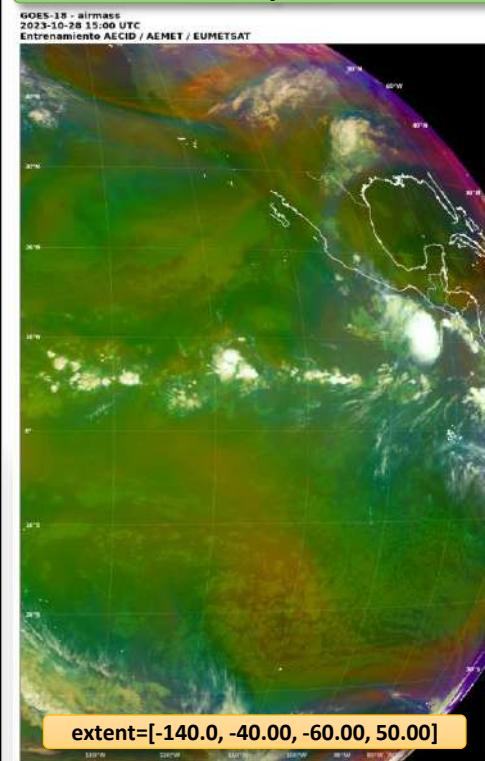


Imágenes de 2023-10-28 20:00 UTC

Ejemplo 3: Datos GOES-Oeste

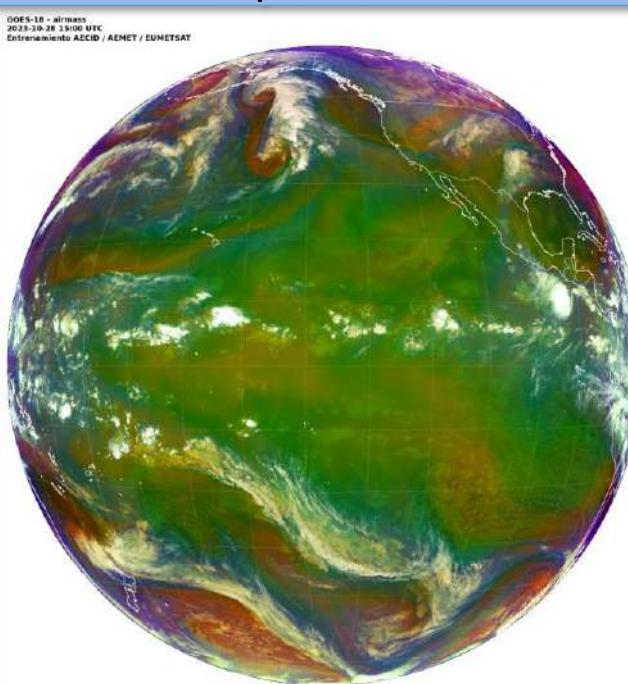
area = 'custom_geo' (recorte en la proyección original)

Más rápido



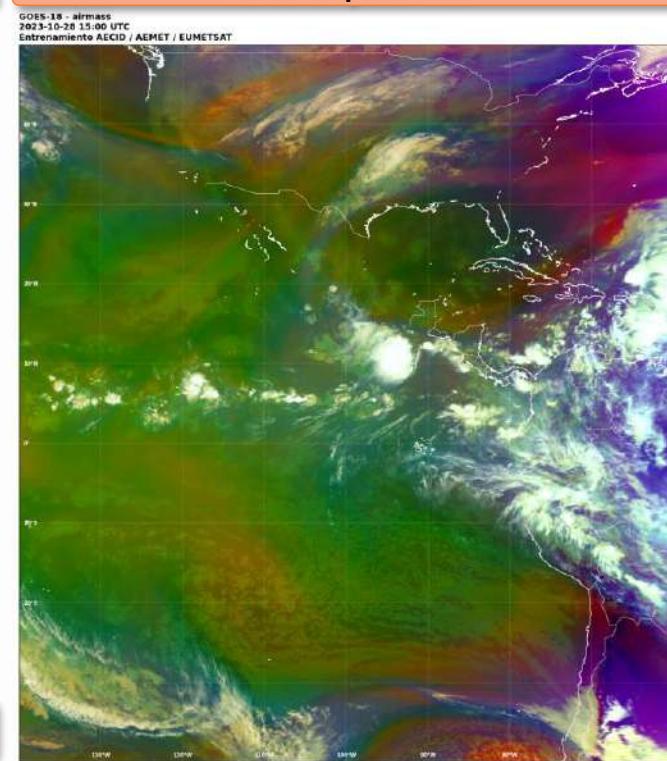
area = 'full_disk'

Tiempo intermedio



area = 'custom' (recorte en la proyección equidistante)

Tarda un poco más



Desde 28 de agosto de 2018 (G17)

Desde 02 de agosto de 2022 (G18)

Ejercicio: Erupción de Klyuchevskaya en la Península de Kamchatka

Satélite:

'goes18'

Fecha:

2023-11-01 18:00 UTC

Región:

area = 'custom_geo'

extent = [145.0, 40.00, 178.00, 65.00]

Compuestos:

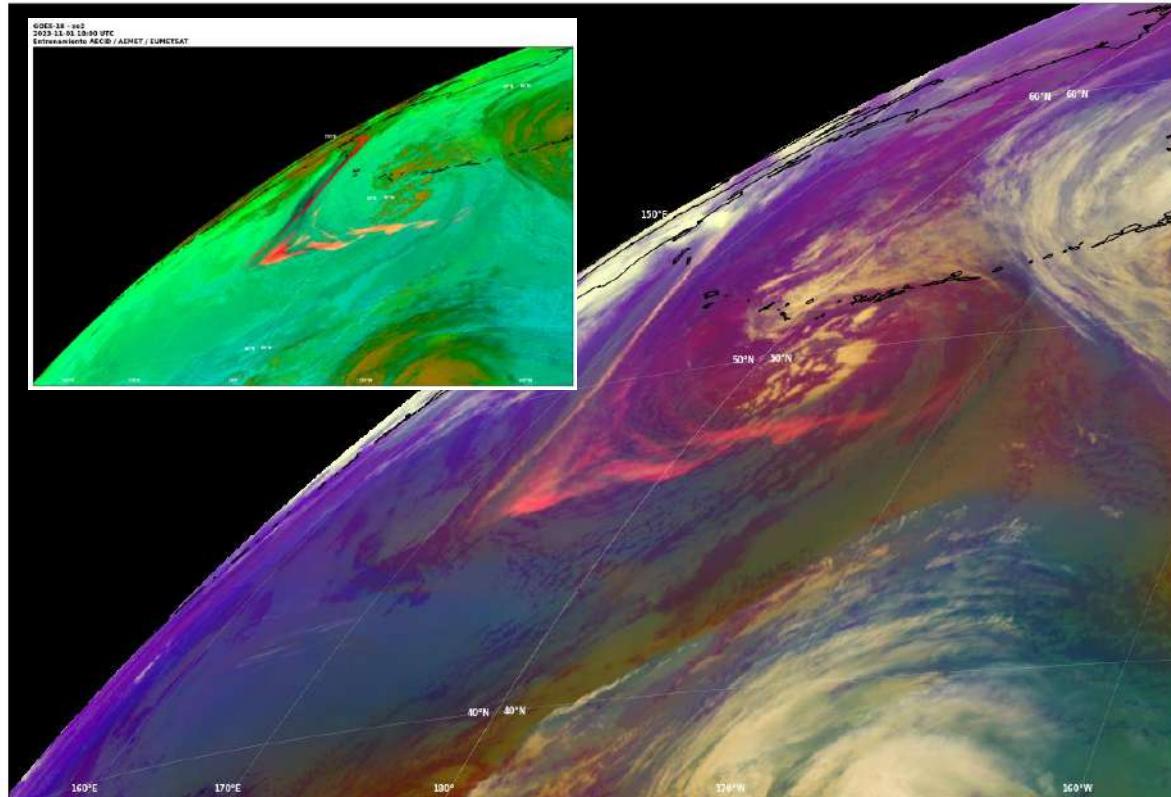
'airmass'

'so2'

Referencia:

<https://cimss.ssec.wisc.edu/satellite-blog/archives/55417>

GOES-18 - airmass
2023-11-01 18:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 4: Datos MSG-0°

Ejemplo 4: Descargando Datos MSG 0° con EUMDAC y Graficando la Imagen

```
# ---  
# Training - Satellite Data Access and Processing - Example 4: Downloading MSG 0° Data with EUMDAC  
# (This example has been tested with Python 3.8.5 and Python 3.9.2)  
  
# Canales: 'VIS006', 'VIS008', 'IR_016',  
#          'IR_039', 'WV_062', 'WV_073', 'IR_087',  
#          'IR_097', 'IR_108', 'IR_120', 'IR_134'  
  
# Composites: 'airmass', 'ash', 'cloudbottom',  
#              'cloudbottom_daytime',  
#              'colorized_ir_clouds', 'convection',  
#              'day_microphysics',  
#              'day_microphysics_winter', 'dust', 'fog',  
#              'green_snow', 'ir108_3d', 'ir_overview',  
#              'natural_color', 'natural_color_nocorr',  
#              'natural_color_raw',  
#              'natural_color_raw_with_night_ir',  
#              'natural_color_with_night_ir',  
#              'natural_enh', 'natural_with_night_fog',  
#              'night_fog', 'night_ir_alpha',  
#              'night_microphysics', 'overview',  
#              'overview_raw', 'rocket_plume_night',  
#              'snow'  
  
# Parámetros  
# Satélite  
# Fecha 'YYYY-MM-DD HH:MM'  
# Compuesto deseado  
# Área deseada  
# Coordinadas  
# Color de las líneas de costa  
# Color de los mapas de países  
# Color de las líneas de ref.  
# Tamaño de la figura (pulgadas)  
  
plot_sat(sat='msg0',  
         date_sat='2023-10-28 15:00',  
         composite='airmass',  
         area='full_disk',  
         extent=[-90.0, -60.0, -30.0, 15.0],  
         coast_color='white',  
         countries_color='white',  
         grid_color='white',  
         figsize=[15,15])
```

Checking the EUMDAC Access Token...
 This Token 082cc401-57e8-3b07-bead-0888544c708d expires 2023-10-31 19:12:41.772760
 Checking if the file already exists: /content/sample_data/MSG3-SEVI-MSG15-0100-NA-20231028151241.81200000Z-NA.zip
 This file doesn't exist.
 Downloading the following file: /content/sample_data/MSG3-SEVI-MSG15-0100-NA-20231028151241.81200000Z-NA.zip
 Download finished.
 The file has been uncompressed.
 Plotting the file: /content/sample_data/MSG3-SEVI-MSG15-0100-NA-20231028151241.81200000Z-NA.nat
 Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
 Total processing time (satellite): 158.14 seconds.
 'output/msg0_airmass_2023-10-28_15:00.png'

Salida con informaciones

'msg0', 'msg45'

Canales: 'VIS006', 'VIS008', 'IR_016',
 'IR_039', 'WV_062', 'WV_073', 'IR_087',
 'IR_097', 'IR_108', 'IR_120', 'IR_134'

Composites: 'airmass', 'ash', 'cloudbottom',
 'cloudbottom_daytime',
 'colorized_ir_clouds', 'convection',
 'day_microphysics'
 'day_microphysics_winter', 'dust', 'fog',
 'green_snow', 'ir108_3d', 'ir_overview',
 'natural_color', 'natural_color_nocorr',
 'natural_color_raw',
 'natural_color_raw_with_night_ir',
 'natural_color_with_night_ir',
 'natural_enh', 'natural_with_night_fog',
 'night_fog', 'night_ir_alpha',
 'night_microphysics', 'overview',
 'overview_raw', 'rocket_plume_night',
 'snow'

'full_disk', 'custom_geo', 'custom'

Datos MSG-0°: Algunos “Composites” Disponibles

VIS006



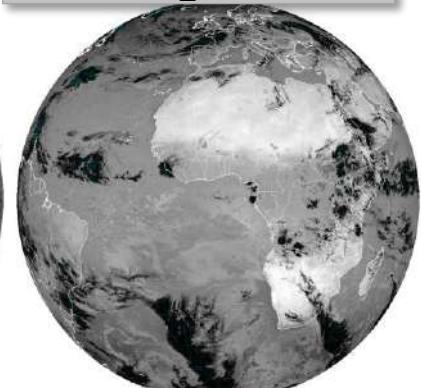
VIS008



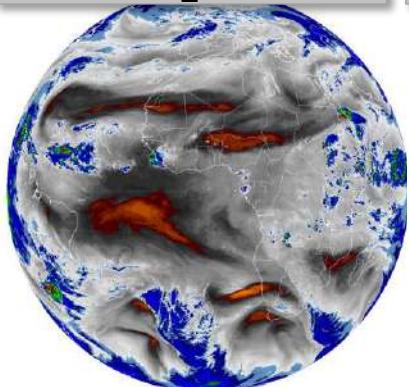
IR_016



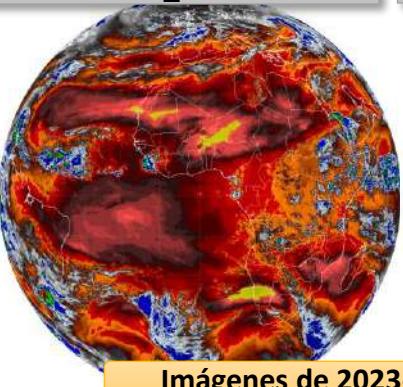
IR_039



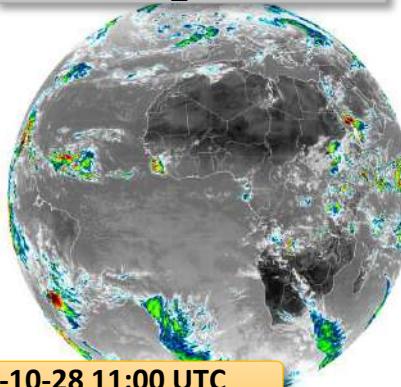
WV_062



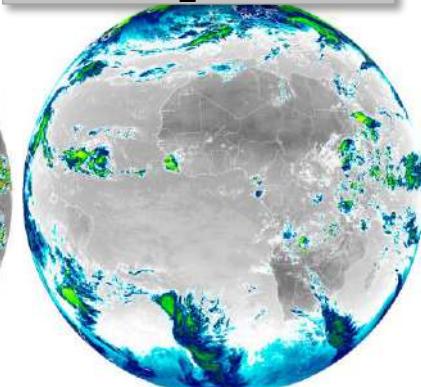
IR_073



IR_087



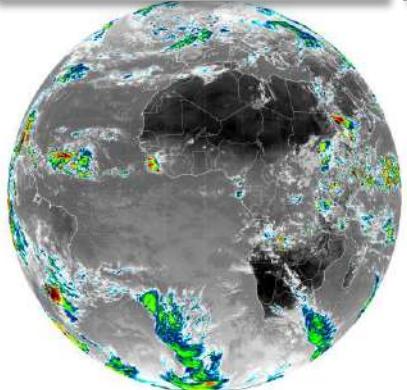
IR_097



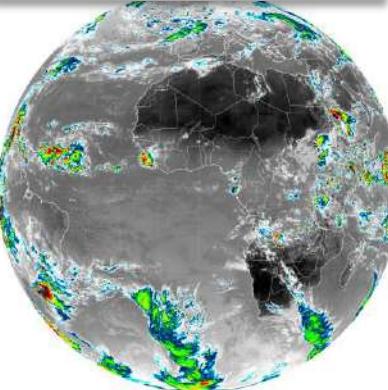
Imágenes de 2023-10-28 11:00 UTC

Datos MSG-0°: Algunos “Composites” Disponibles

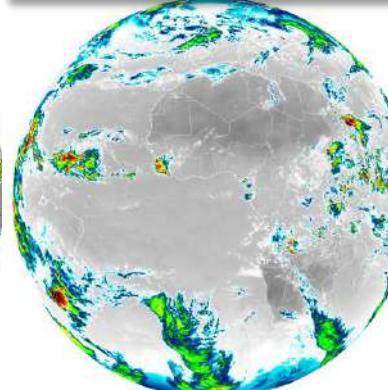
IR_108



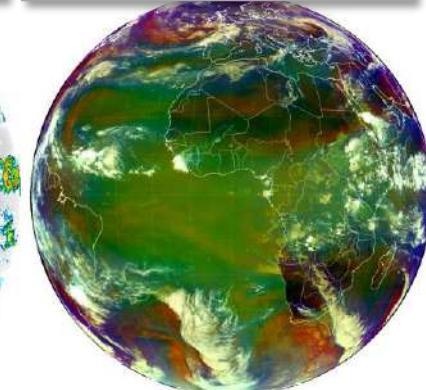
IR_120



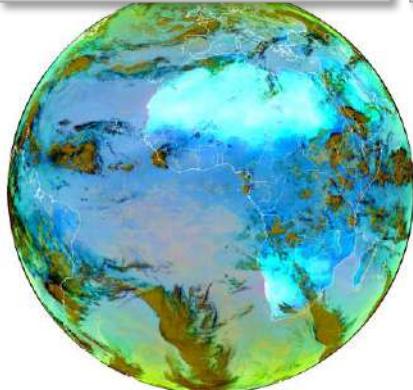
IR_134



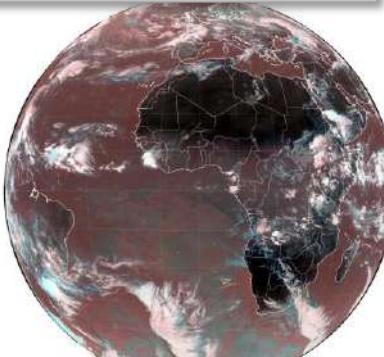
airmass



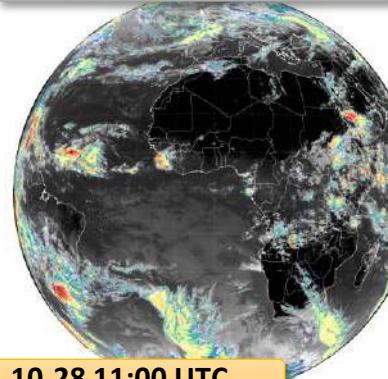
ash



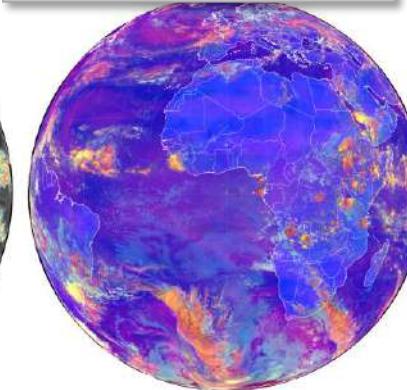
cloudtop



colorized_ir_clouds



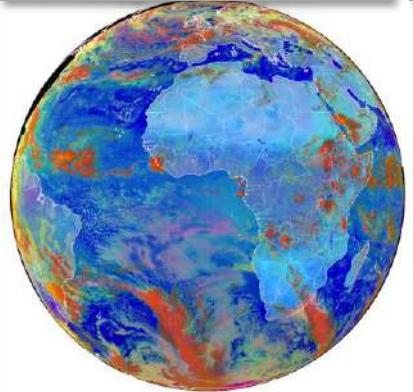
convection



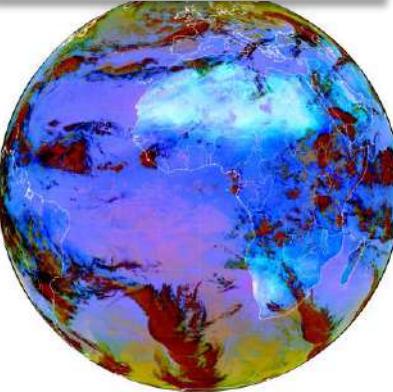
Imágenes de 2023-10-28 11:00 UTC

Datos MSG-0°: Algunos “Composites” Disponibles

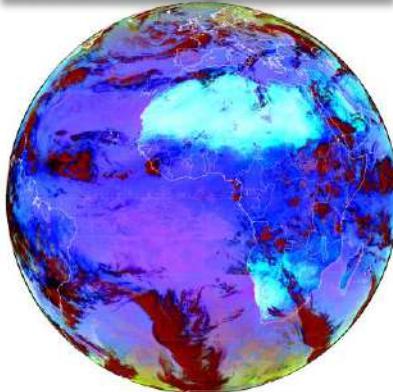
day_microphysics



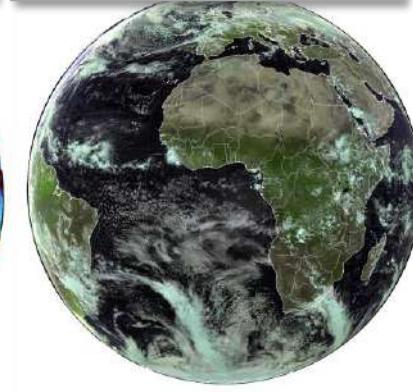
dust



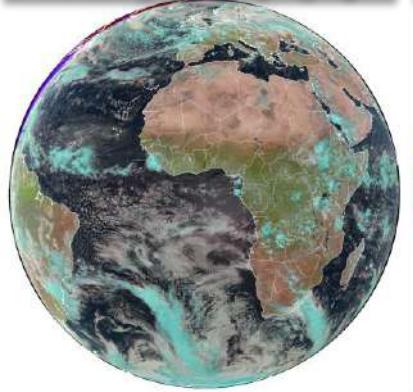
fog



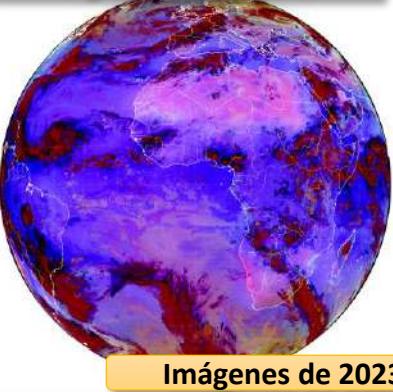
natural_enh



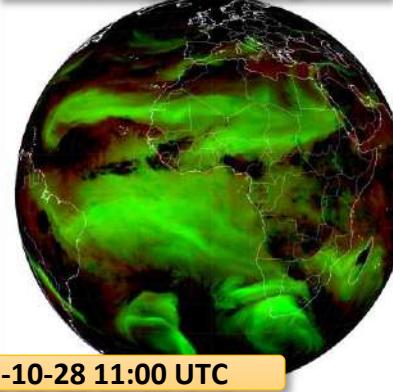
natural_with_night_fog



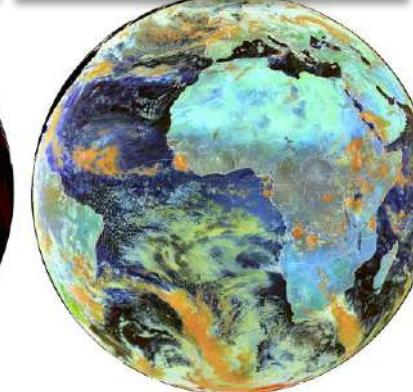
night_microphysics



rocket_plume_night



snow

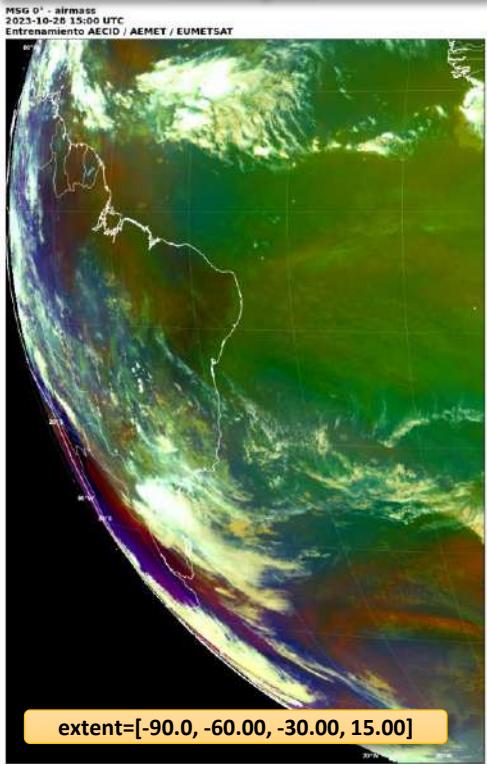


Imágenes de 2023-10-28 11:00 UTC

Ejemplo 4: Datos MSG-0°

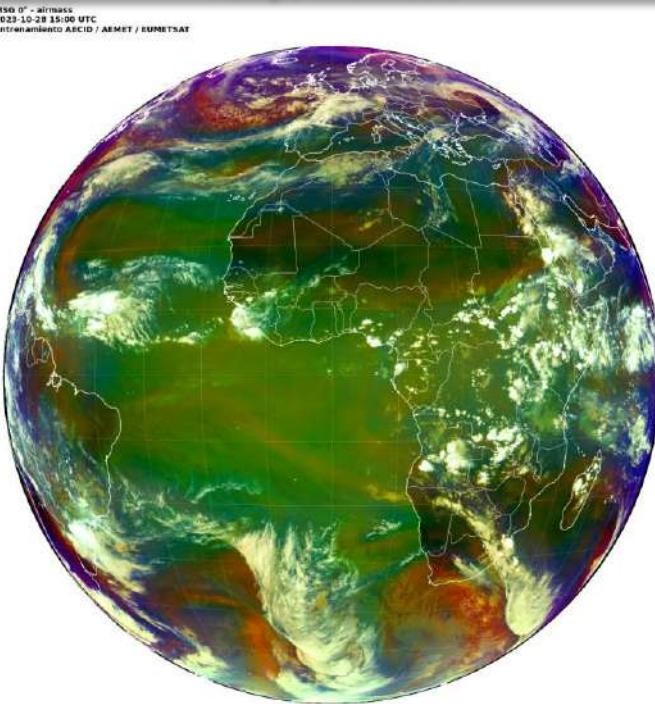
area = 'custom_geo' (recorte en la proyección original)

Más rápido



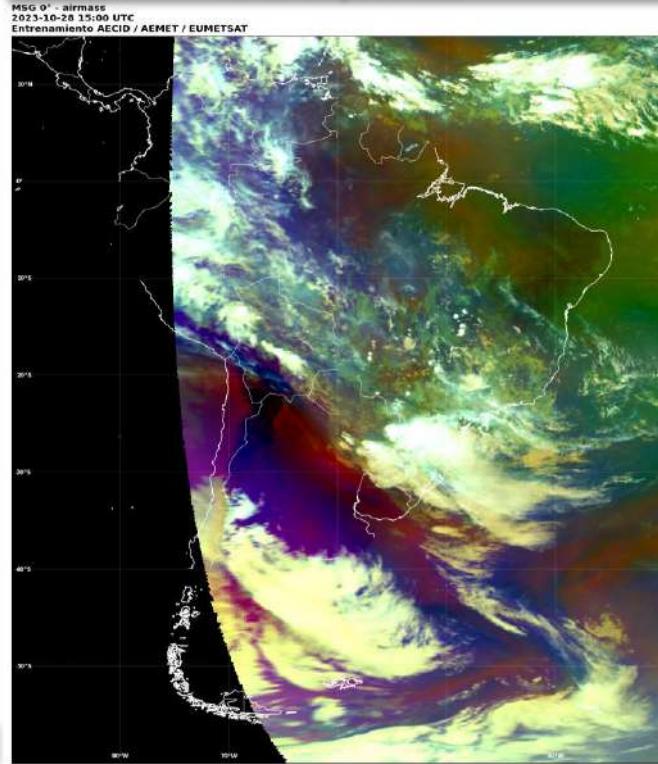
area = 'full_disk'

Tiempo intermedio



area = 'custom' (recorte en la proyección equidistante)

Tarda un poco más



Ejercicio: Huracán Catarina

Satélite:

'msg0'

Fecha:

2004-03-26 15:00 UTC

Región:

area = 'custom'

extent = [145.0, 40.00, 178.00, 65.00]

Compuestos:

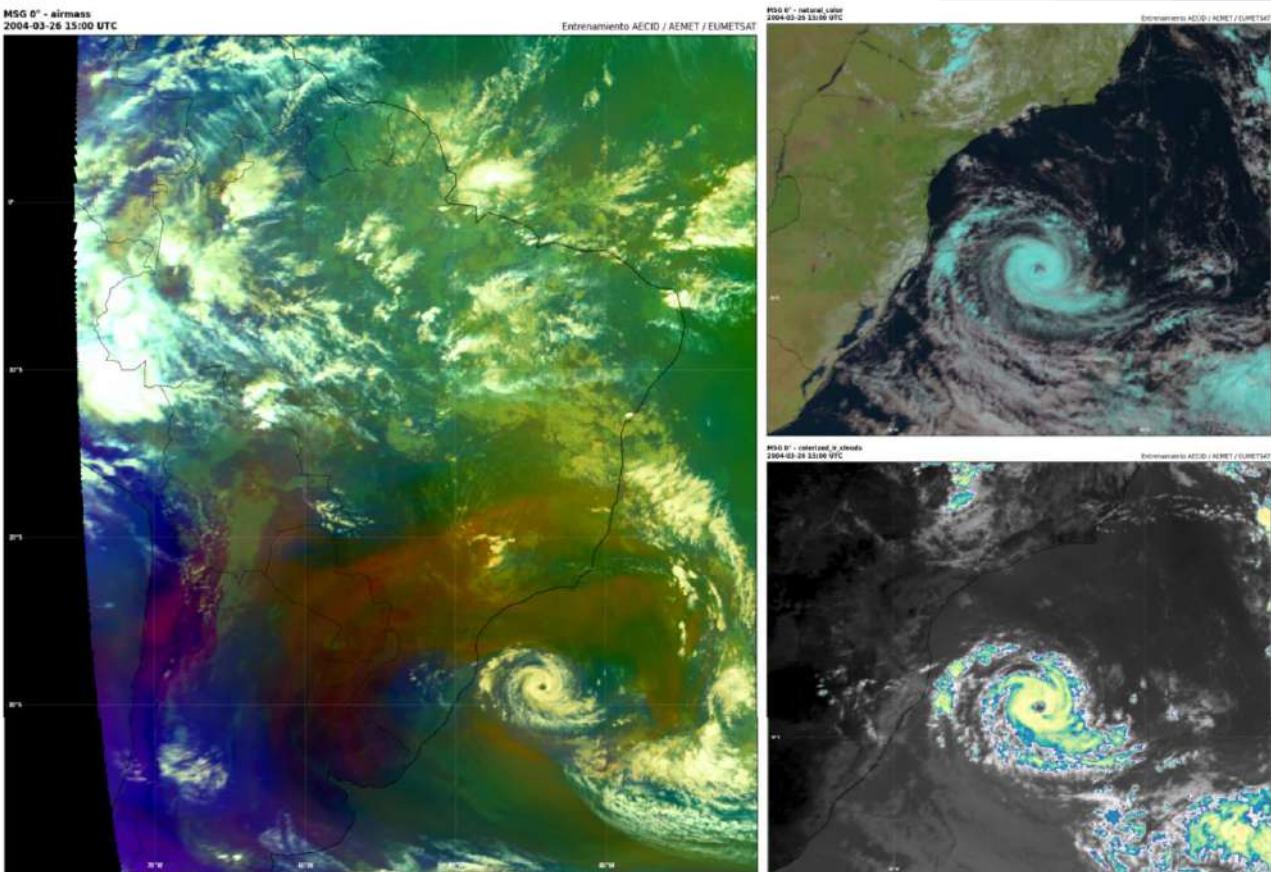
'airmass'

'natural_color'

'colorized_ir_clouds'

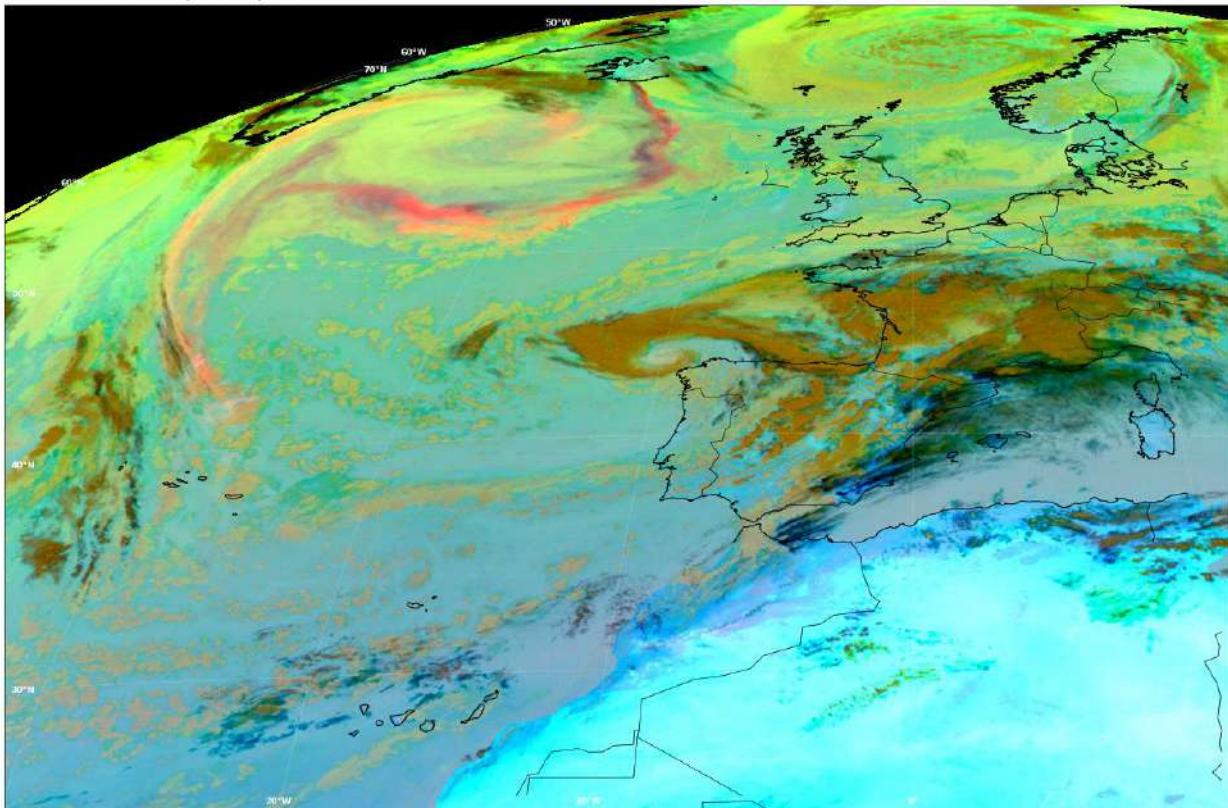
Referencia:

https://en.wikipedia.org/wiki/Hurricane_Catarina



Ejercicio: Erupción Eyjafjallajökull

MSG 0° - ash
2010-05-09 12:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Satélite:

'msg0'

Fecha:

2010-05-09 12:00 UTC

Región:

area = 'custom_geo'

extent = [-30.0, 25.00, 10.00, 75.00]

Compuestos:

'ash'

Referencia:

<https://cimss.ssec.wisc.edu/satellite-blog/archives/5212>

Ejercicio: Niebla en Uruguay

MSG 0° - night_microphysics
2015-07-24 05:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

Satélite:

'msg0'

Fecha:

2015-07-24 05:00 UTC

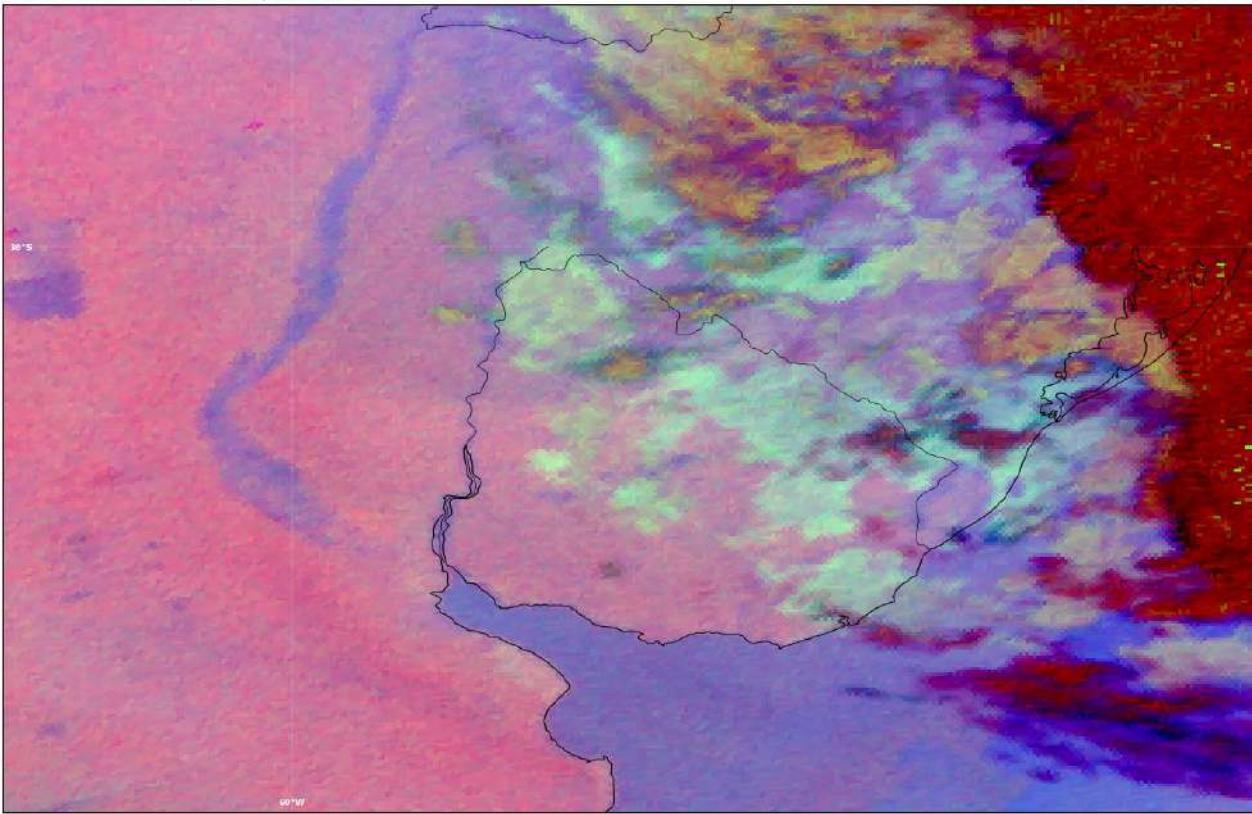
Región:

area = 'custom'

extent = [-63.0, -37.0, -50.00, -27.00]

Compuesto:

'night_microphysics'



Ejercicio: Niebla en España

MSG 0° - night microphysics
2013-01-12 03:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

Satélite:

'msg0'

Fecha:

2013-01-12 03:00 UTC

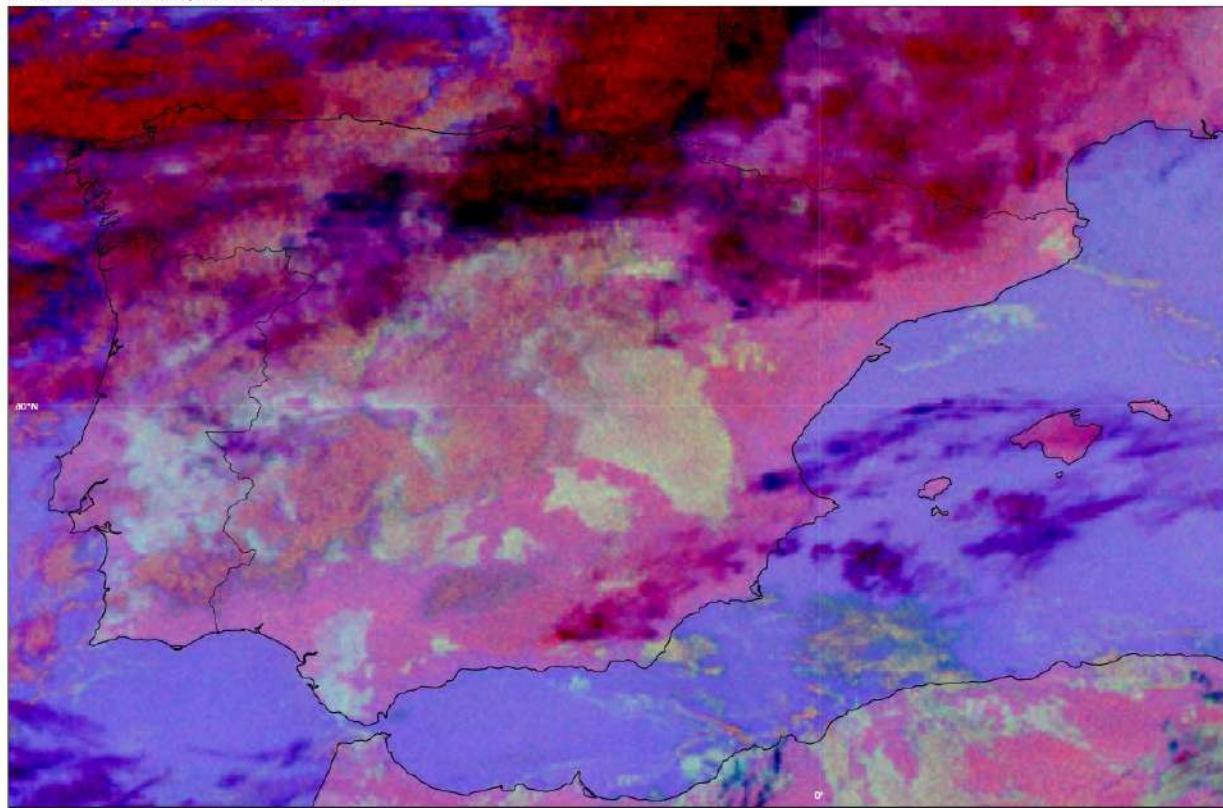
Región:

area = 'custom'

extent = [-10.0, 35.0, 5.00, 45.00]

Compuesto:

'night_microphysics'



Ejemplo 5: Datos MSG-45.5°

Ejemplo 5: Descargando Datos MSG 45.5° (IODC) con EUMDAC y Graficando la Imagen

```

#--  

# Training - Satellite Data Access and Processing - Example 5: Downloading MSG A  

# Author: Diego Souza (INPE/CGCT/DISSM)  

Nombre de la función  

Parámetros  

plot_sat(sat='msg45', date_sat='2023-10-28 15:00', composite='airmass', area='full_disk', extent=[55.0, 0.0, 105.0, 45.0], coast_color='white', countries_color='white', grid_color='white', figsize=[15,15])  

Checking the EUMDAC Access Token...  

This Token 082ccc401-57e8-3b07-bead-0888544c708d expires 2023-10-31 19:12:40.852459  

Checking if the file already exists: /content/sample_data/MSG2-SEVI-MSG15-0100-NA-20231028151240.05900000Z-NA.zip  

This file already exists.  

Plotting the file: /content/sample_data/MSG2-SEVI-MSG15-0100-NA-20231028151240.05900000Z-NA.nat  

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).  

Total processing time (satellite): 18.28 seconds.  

'boutput/msg45_airmass_2023-10-28_15:00.png'

```

Salida con informaciones

Parámetros

Satélite

Fecha 'YYYY-MM-DD HH:MM'

Compuesto deseado

Área deseada

Coordinadas

Color de las líneas de costa

Color de los mapas de países

Color de las líneas de ref.

Tamaño de la figura (pulgadas)

'msg0', 'msg45'

Canales: 'VIS006', 'VIS008', 'IR_016', 'IR_039', 'WV_062', 'WV_073', 'IR_087', 'IR_097', 'IR_108', 'IR_120', 'IR_134'

Composites: 'airmass', 'ash', 'cloudbottom', 'cloudbottom_daytime', 'colorized_ir_clouds', 'convection', 'day_microphysics', 'day_microphysics_winter', 'dust', 'green_snow', 'ir108_3d', 'ir_overview', 'natural_color', 'natural_color_nocorr', 'natural_color_raw', 'natural_color_raw_with_night_ir', 'natural_color_with_night_ir', 'natural_enh', 'natural_with_night_fog', 'night_fog', 'night_ir_alpha', 'night_microphysics', 'overview', 'overview_raw', 'rocket_plume_night', 'snow'

'full_disk', 'custom_geo', 'custom'

Datos MSG-45.5°: Algunos “Composites” Disponibles

VIS006



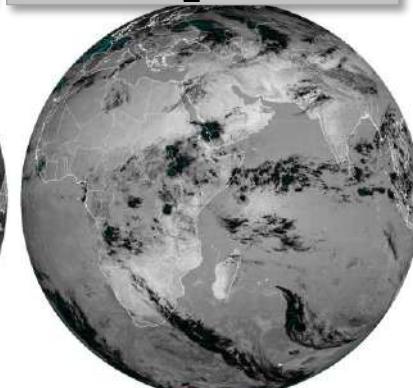
VIS008



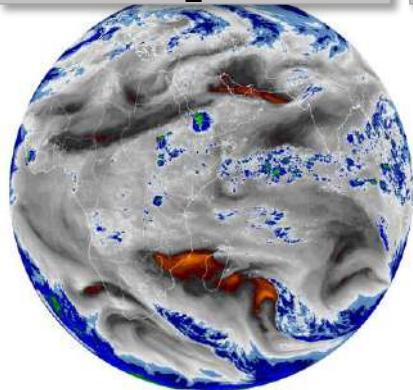
IR_016



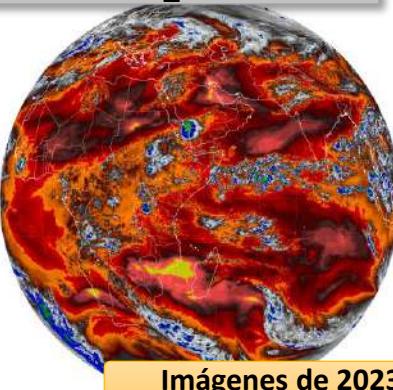
IR_039



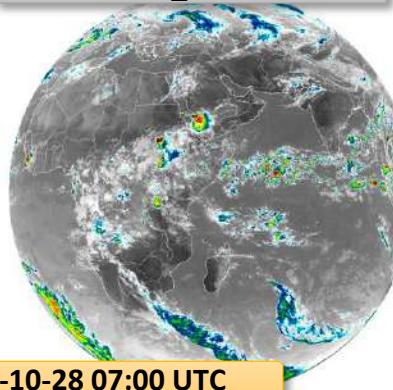
WV_062



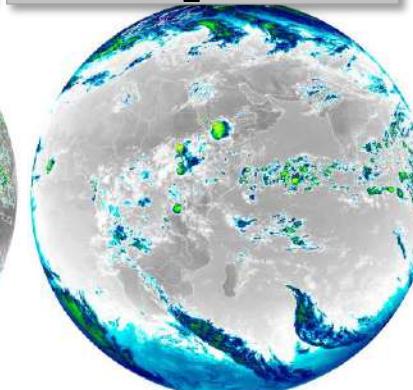
IR_073



IR_087



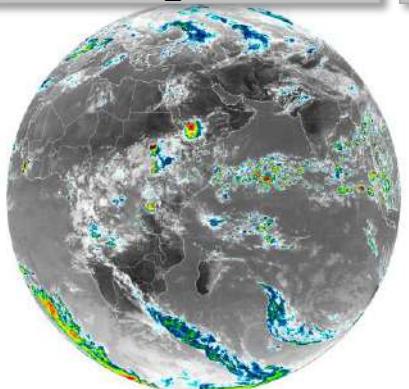
IR_097



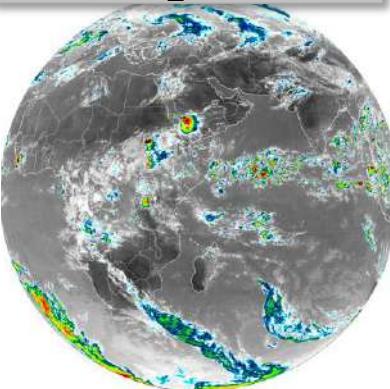
Imágenes de 2023-10-28 07:00 UTC

Datos MSG-45.5°: Algunos “Composites” Disponibles

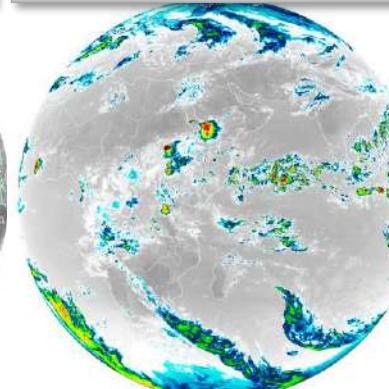
IR_108



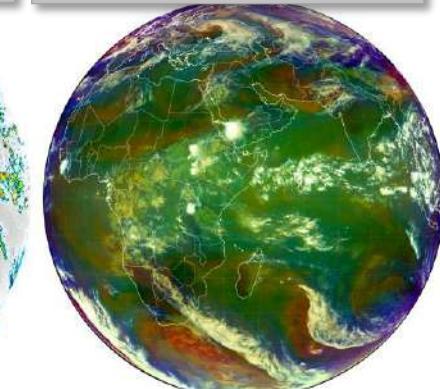
IR_120



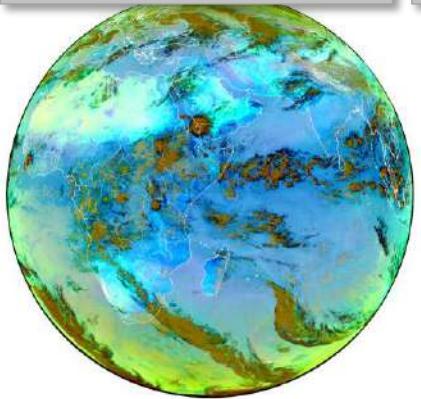
IR_134



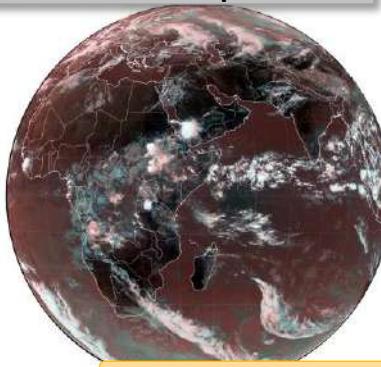
airmass



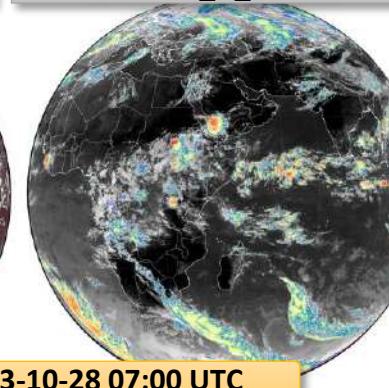
ash



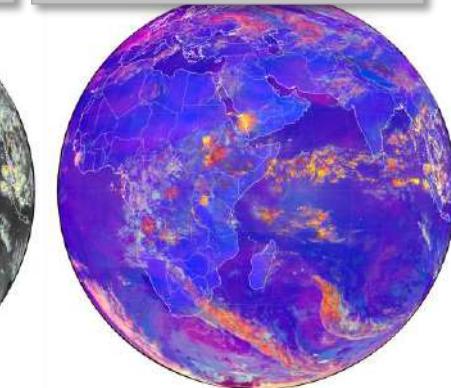
cloudtop



colorized_ir_clouds



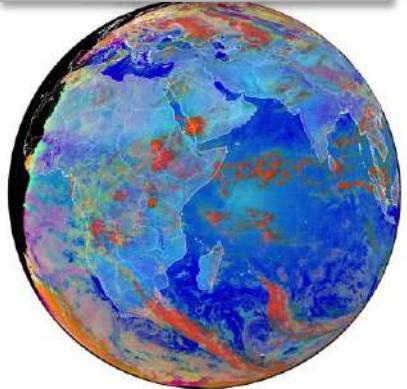
convection



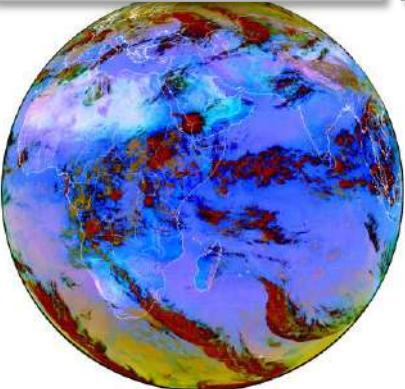
Imágenes de 2023-10-28 07:00 UTC

Datos MSG-45.5°: Algunos “Composites” Disponibles

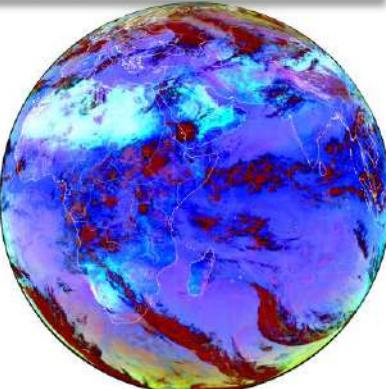
day_microphysics



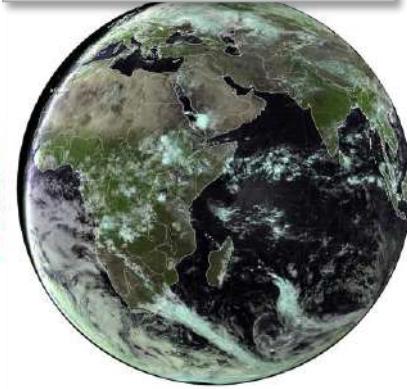
dust



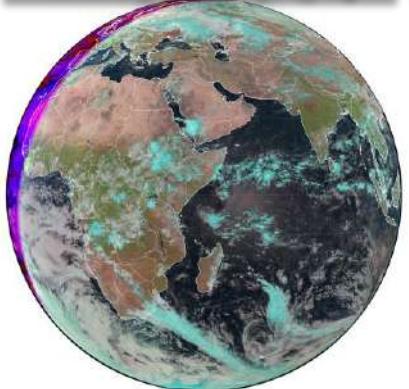
fog



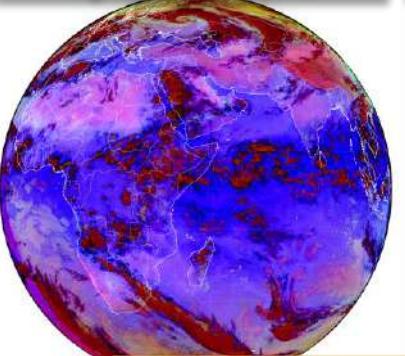
natural_enh



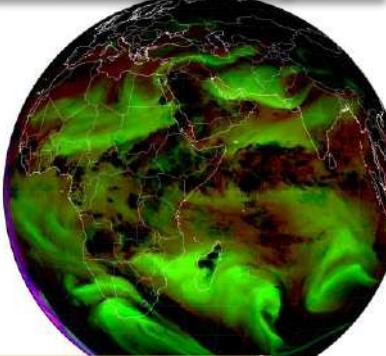
natural_with_night_fog



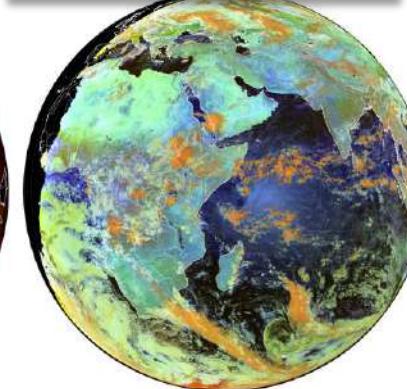
night_microphysics



rocket_plume_night



snow



Imágenes de 2023-10-28 07:00 UTC

Ejemplo 5: Datos MSG-45.5°

area = 'custom_geo' (recorte en la proyección original)

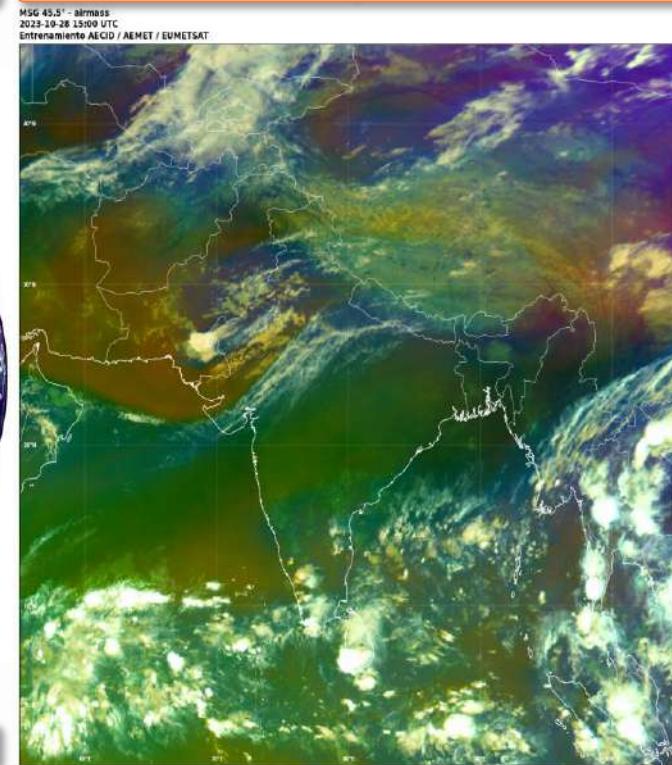
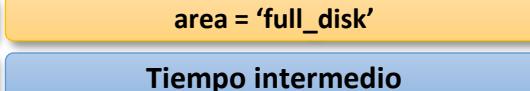
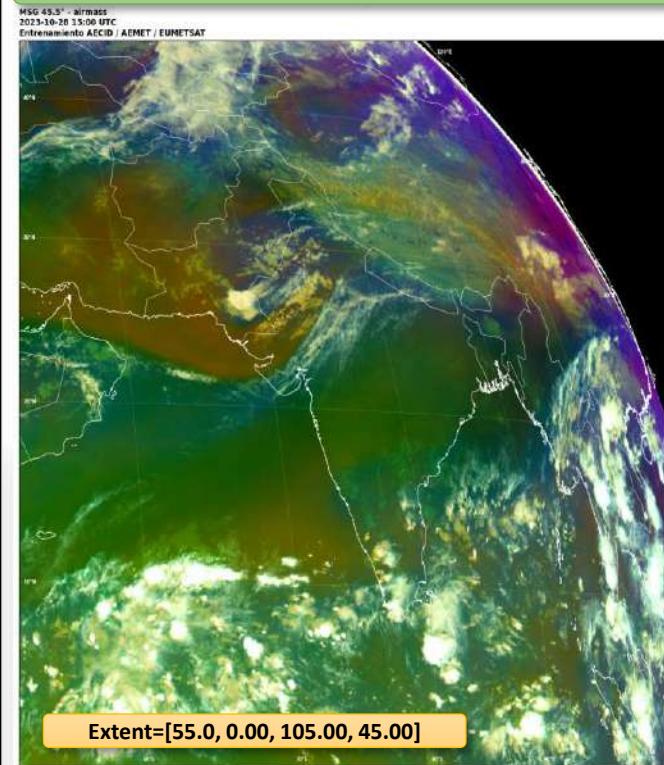
Más rápido

area = 'full_disk'

Tiempo intermedio

area = 'custom' (recorte en la proyección equidistante)

Tarda un poco más



Datos desde 26 de Marzo de 2004

Estudios de Caso de los Alumnos

Elegir cualquier evento significativo en la región y generar imágenes (canales y RGBs)



Ejemplo 6: Manipulando Datos con Satpy

PyTRÖLL

Pytroll: an Open-Source Python Framework for Earth-Observing Satellite Data

...

Martin Raspaud, SMHI



martin.raspaud@smhi.se

PyTRÖLL

Pytroll

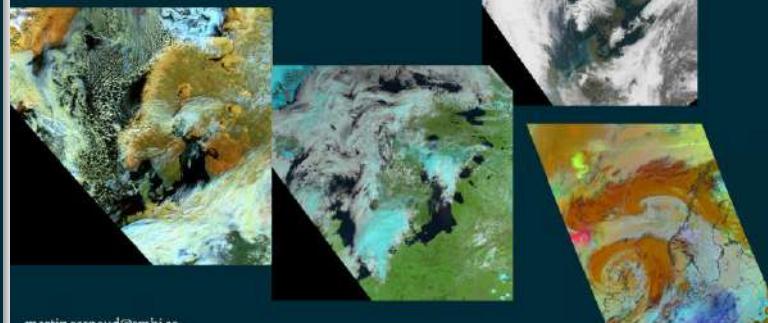


<https://github.com/pytroll/satpy>

SMHI

PyTRÖLL

Satpy built-in composites



martin.raspaud@smhi.se

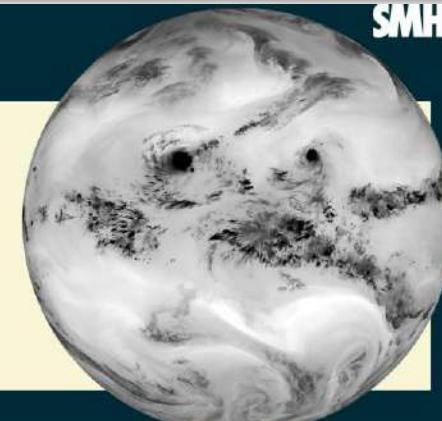
PyTRÖLL

Satpy example

```
# Load single channels  
scn.load(["M15", 0.6])  
  
# Show a channel  
scn.show("M15")  
  
# Channel arithmetics  
array = scn["M15"] + scn[0.6]
```

martin.raspaud@smhi.se

SMHI



Más informaciones en: [Link](#)

Ejemplo 6: Manipulando Datos con Satpy

PyTROLL

Data-size problem

- Too much data to fit in memory of regular computers
- Too long processing times due to single-threading

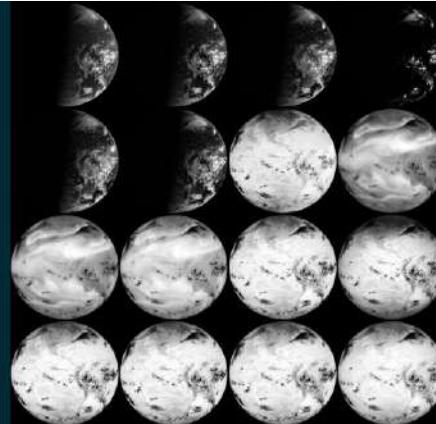


SMHI

PyTROLL

Satellite Data

- Each channel covers a narrow frequency band
- Different frequencies expose different features



PyTROLL

SMHI

RGB Images



PyTROLL

SMHI

Pyspectral: Corrections to channels



<https://github.com/pytroll/satpy>

Más informaciones en: [Link](#)

Ejemplo 6: Manipulando Datos con Satpy (“Readers”)

1. Verificando los “Readers” (lectores disponibles)

Ejemplo 6: ¿Cómo las Funciones Están Creando Estas Imágenes? Leyendo y Manipulando Datos Satelitales con Satpy (GOES-R)

Lectores disponibles en Satpy

available_readers()

Estos dos “readers” son usados en las funciones de
demonstración de este notebook Colab

```
['abi_11b', 'abi_11b_scmi', 'abi_12_nc', 'acspo', 'agri_fy4a_11', 'agri_fy4b_11', 'ahi_hrit', 'ahi_hsd',  
'ahi_11b_gridded_bin', 'ahi_12_nc', 'ami_11b', 'amsr2_11b', 'amsr2_12', 'amsr2_12_gaasp', 'amsub_11c_aapp',  
'ascat_12_soilmoisture_bufr', 'atms_11b_nc', 'atms_sdr_hdf5', 'avhrr_11b_aapp', 'avhrr_11b_eps',  
'avhrr_11b_hrpt', 'avhrr_11c_eum_gac_fdr_nc', 'cmsaf-claas2_12_nc', 'electrol_hrit', 'epic_11b_h5',  
'fci_11c_nc', 'fci_12_nc', 'generic_image', 'geocat', 'gerb_12_hr_h5', 'ghi_11', 'ghrsst_12', 'glm_12', 'gms5-  
vissr_11b', 'goes-imager_hrit', 'goes-imager_nc', 'gpm_imerg', 'grib', 'hsaf_grib', 'hsaf_h5',  
'hy2_scat_12b_h5', 'iasi_12', 'iasi_12_cdr_nc', 'iasi_12_so2_bufr', 'ici_11b_nc', 'jami_hrit', 'li_12_nc',  
'maia', 'meris_nc_sen3', 'mersi2_11b', 'mersi_11_11b', 'mhs_11c_aapp', 'mimicTP12_comp', 'mirs', 'msi_safe',  
'msu_gsa_11b', 'mtsat2-imager_hrit', 'mviri_11b_fiduceo_nc', 'mwi_11b_nc', 'mws_11_nc', 'nucaps', 'nwcsaf-geo',  
'nwcsaf-msg2013-hdf5', 'nwcsaf-pps_nc', 'oceancolorcci_13_nc', 'olci_11b', 'olci_12', 'omps_edr',  
'safe_sar_12_ocn', 'sar-c_safe', 'satpy_cf_nc', 'seviri_11b_hrit', 'seviri_11b_native', 'seviri_11b_nc',  
'seviri_12_bufr', 'seviri_12_grib', 'slstr_11b', 'smos_12_wind', 'tropomi_12', 'vaisala_gla360', 'vii_11b_nc',  
'vii_12_nc', 'viirs_compact', 'viirs_edr', 'viirs_edr_active_fires', 'viirs_11b', 'viirs_sdr',  
'viirs_vgac_11c_nc', 'virr_11b']
```

2. Creando un objeto “Scene”, especificando el dato y el lector

Descargando el dato GOES-R y creando una “Scene”

Función para descargar datos

Nombre del archivo

Reader (lector)

Satélite

Fecha

```
# download the satellite data  
file_name = download_satellite(sat='goes16', date_sat='2023-10-28 15:00')
```

```
# initialise scene  
scn = Scene(filenames=glob.glob(os.path.join('/content/sample_data/'), file_name), reader='abi_l2_nc')
```

“Scene” Satpy

```
File /content/sample_data/OR_ABI-L2-MCMIPF-M6_G16_s2023011500204_e2023011509525_c2023011509594.nc already exists  
Total download time: 0.35 seconds.
```

Ejemplo 6: Manipulando Datos con Satpy (“Datasets”)

3. Visualizando los “Datasets” disponibles

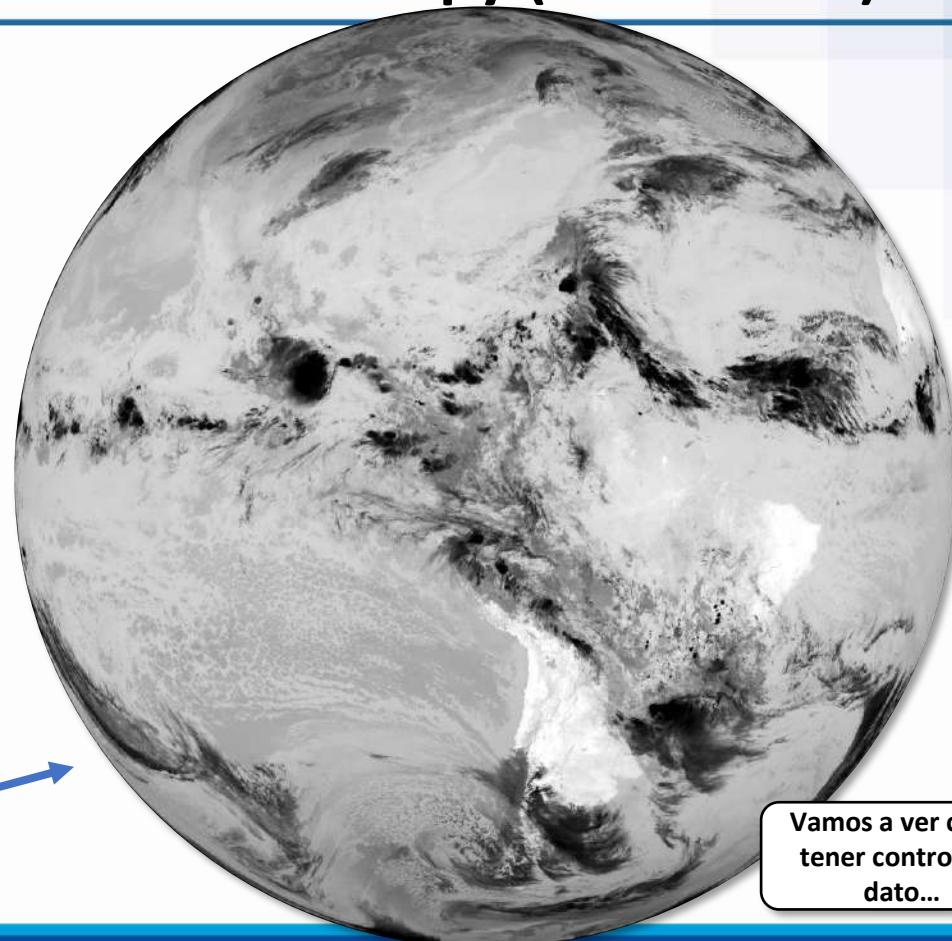
```
# check the available composites  
scn.available_dataset_names()
```

```
[ 'C01',  
  'C02',  
  'C03',  
  'C04',  
  'C05',  
  'C06',  
  'C07',  
  'C08',  
  'C09',  
  'C10',  
  'C11',  
  'C12',  
  'C13',  
  'C14',  
  'C15',  
  'C16' ]
```

16 canales ABI (o de cualquier otro sensor soportado por Satpy)

4. Cargando y visualizando un dataset

```
32 s  # basic plot  
scn.load(['C13'])  
scn.show('C13')
```



Vamos a ver como tener control del dato...

Ejemplo 6: Manipulando Datos con Satpy (Plot)

5. Pasando un dataset a una matriz de datos

8 s

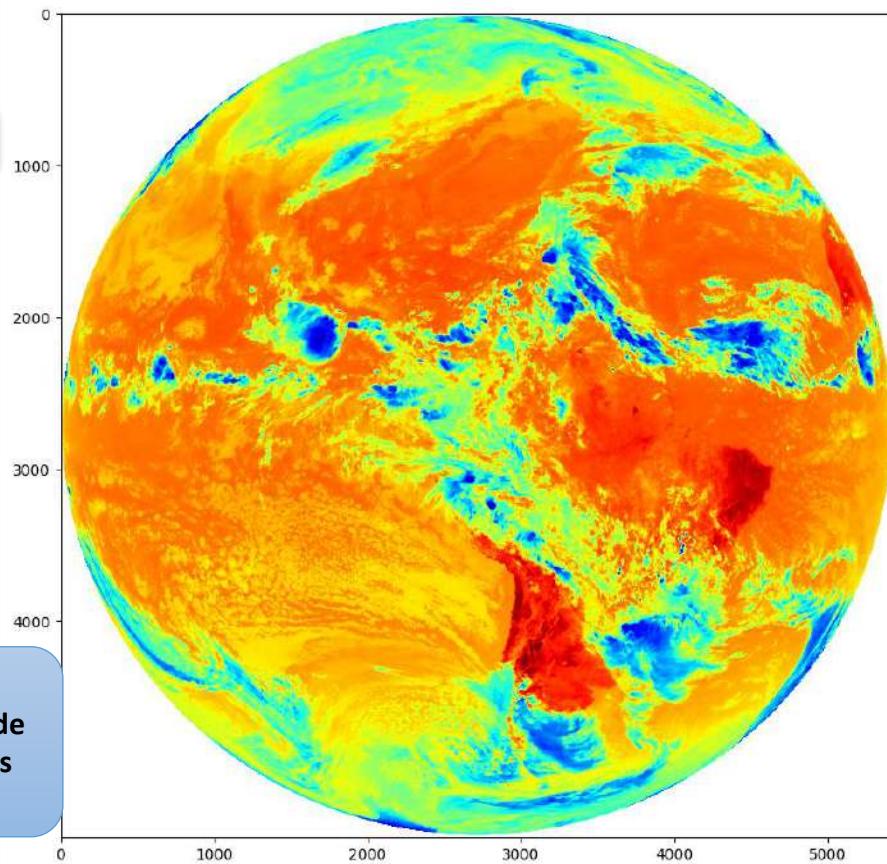
```
# read the pixel values  
data = scn['C13'] ← Pasando los valores de pixel a una variable  
  
# plot size (width x height, in inches)  
plt.figure(figsize=(10,10)) ← Tamaño del plot  
  
# plot the image  
plt.imshow(data, vmin=190, vmax=320, cmap='jet')
```

Variable

Valor mínimo de la escala de colores

Valor máximo de la escala de colores

Escala de colores

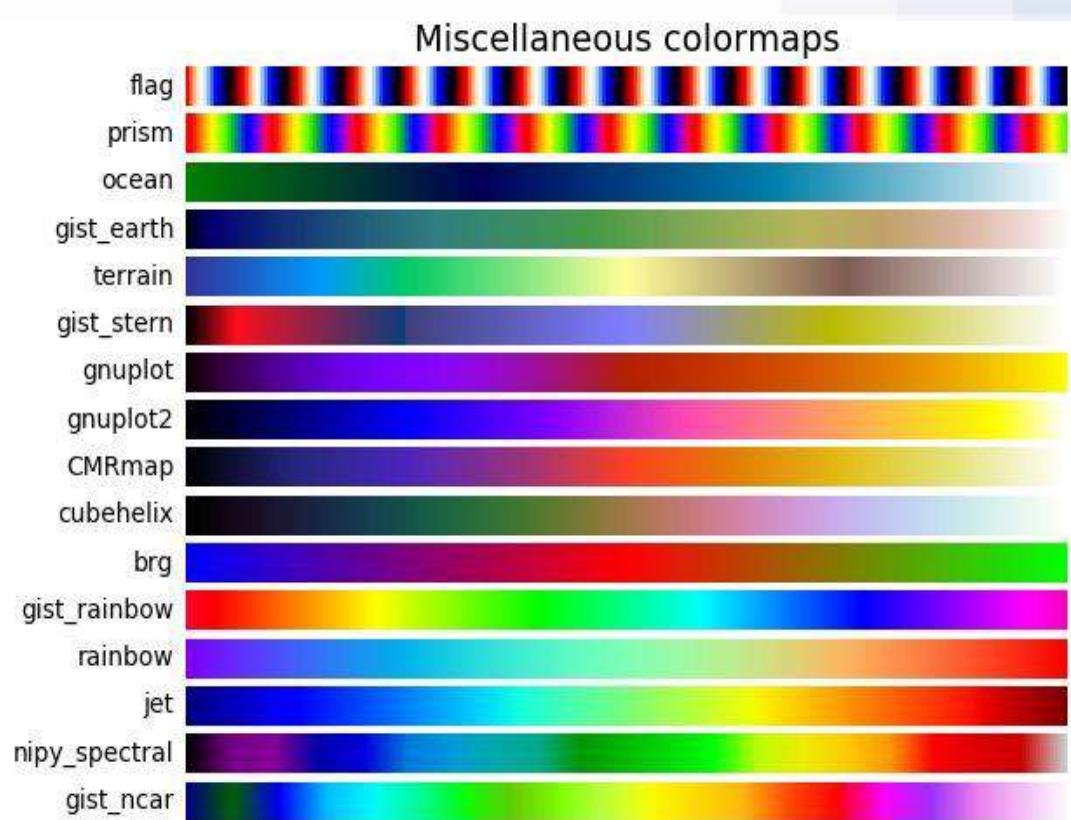
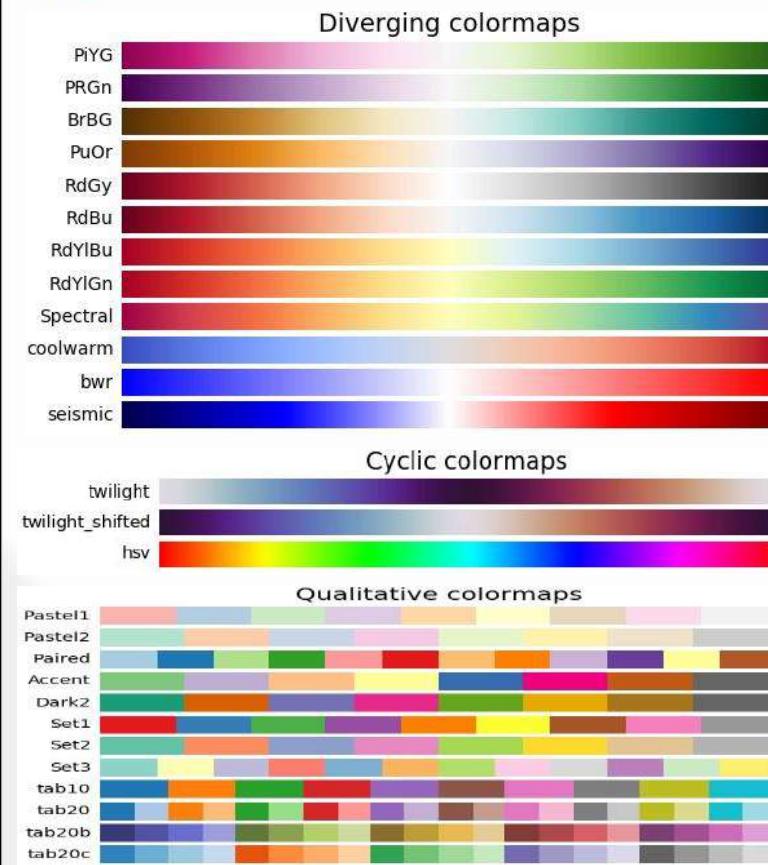


Ejemplo 6: Algunas Escalas de Colores Estándar

<https://matplotlib.org/stable/tutorials/colors/colormaps.html>



Ejemplo 6: Algunas Escalas de Colores Estándar



Ejemplo 6: Manipulando Datos con Satpy (Metadatos)

6. Leyendo los atributos de un dataset (metadatos)

```
# reading the attributes
scn['C13'].attrs
```

→ {
 'orbital_parameters': {'satellite_nominal_latitude': 0.0,
 'satellite_nominal_longitude': -75.19999694824219,
 'satellite_nominal_altitude': 35786023.4375},
 'long_name': 'ABI Cloud and Moisture Imagery brightness temperature at top of atmosphere',
 'standard_name': 'toa_brightness_temperature',
 'sensor_band_bit_depth': 12,
 'units': 'K',
 'resolution': 'y: 0.000056 rad x: 0.000056 rad',
 'grid_mapping': 'goes_imager_projection',
 'cell_methods': 't: point area: point',
 'name': 'C13',
 'wavelength': WavelengthRange(min=10.1, central=10.35, max=10.6, unit='μm'),
 'calibration': 'brightness_temperature',
 'modifiers': (),
 'platform_name': 'GOES-16',
 'sensor': 'abi',
 'scene_abbr': 'F',
 'scan_mode': 'M6',
 'platform_shortname': 'G16',
 'observation_type': 'MCMIP',
 'scene_id': 'Full Disk',
 'orbital_slot': 'GOES-East',
 'instrument_ID': 'FM1',
 'production_site': 'NSOF',
 'timeline_ID': None,
 'start_time': datetime.datetime(2023, 10, 28, 15, 0, 20, 400000),
 'end_time': datetime.datetime(2023, 10, 28, 15, 9, 52, 500000),
 'reader': 'abi_l2_nc',
 'area': Area ID: GOES-East
 Description: 2km at nadir
 Projection ID: abi_fixed_grid
 Projection: {'ellps': 'GRS80', 'h': '35786023', 'lon_0': '-75', 'no_defs': 'None', 'proj': 'geos',
 Number of columns: 5424
 Number of rows: 5424
 Area extent: (-5434894.8851, -5434894.8851, 5434894.8851, 5434894.8851),
 '_satpy_id': DataID(name='C13', wavelength=WavelengthRange(min=10.1, central=10.35, max=10.6, unit='ancillary_variables': []])

7. Leyendo algunos de los atributos del dataset

```
# get some information from the metadata
# what information will we see?
long_name = scn['C13'].attrs['long_name']
print(long_name)

# pixel unit
units = scn['C13'].attrs['units']
print(units)

# data acquisition time and date
date = scn['C13'].attrs['start_time']
date = date.strftime('%Y-%m-%d %H:%M UTC')
print(date)

# satellite name
satellite = scn['C13'].attrs['platform_name']
print(satellite)

# channel name
channel = scn['C13'].attrs['name']
print(channel)

# wavelength
wavelength = scn['C13'].attrs['wavelength']
print(wavelength)
```

→ ABI Cloud and Moisture Imagery brightness temperature at top of atmosphere
 K
 2023-10-28 15:00 UTC
 GOES-16
 C13
 10.35 μm (10.1-10.6 μm)

8. Agregando un título y una barra de colores

```
# read the pixel values  
data = scn['C13']  
  
# plot size (width x height, in inches)  
plt.figure(figsize=(10,10))  
  
# plot the image  
plt.imshow(data, vmin=190, vmax=328, cmap='jet')  
  
# add a colorbar  
cbar = plt.colorbar(label=f'{long_name} {units}', extend='both', orientation='vertical', pad=0.03, fraction=0.05)  
  
# add a title  
plt.title(f'{satellite} - {channel} - [wavelenght]\n{date}', fontweight='bold', fontsize=10, loc='left')  
plt.title('Entrenamiento AECID / AEMET / EUMETSAT', fontsize=10, loc='right')
```

Texto del título

Tamaño del texto

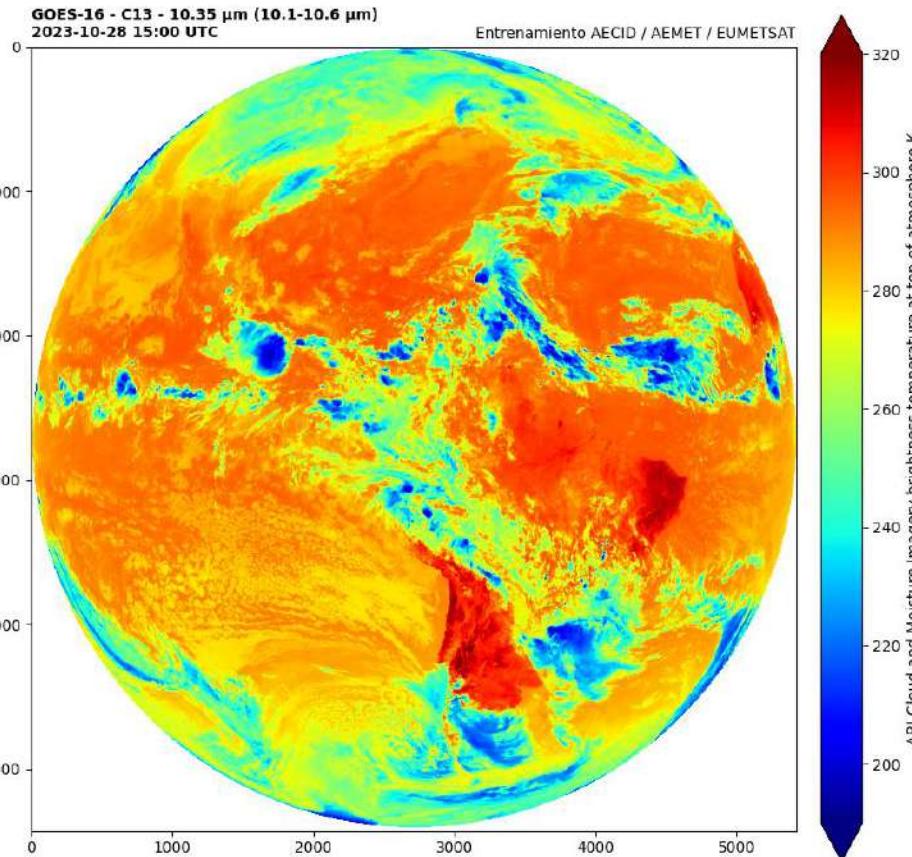
Posición del texto

Extensión de la barra además del plot

Título de la barra de colores
Extender la barra para ambos los lados

Distancia relativa al plot

Orientación de la barra



Ejemplo 6: Manipulando Datos con Satpy (Cartopy)

9. Usando el atributo “área” como parámetro para la biblioteca Cartopy

```
# read the dataset crs (coordinate reference system)  
crs = scn['C13'].attrs['area'].to_cartopy_crs()
```

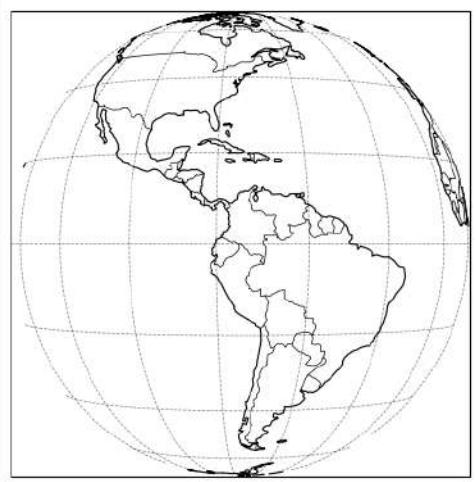
Lee las informaciones de la proyección

```
# define the projection  
ax = plt.axes(projection=crs)  
  
# add coastlines, borders and gridlines  
ax.add_feature(cartopy.feature.BORDERS, edgecolor='black', linewidth=0.5)  
ax.coastlines(resolution='110m', color='black', linewidth=0.8)  
ax.gridlines(color='black', alpha=0.5, linestyle='--', linewidth=0.5)
```

Declara la proyección del dato

<https://scitools.org.uk/cartopy/docs/v0.15/crs/projections.html>

```
<cartopy.mpl.gridliner.Gridliner at 0x7e4c6b444760>
```



Añade los límites de los países con Cartopy

Añade las líneas de costa con Cartopy

Añade las líneas de referencia con Cartopy

Imagen resultante

```
'area': Area ID: GOES-East  
Description: 2km at nadir  
Projection ID: abi_fixed_grid  
Projection: {'ellps': 'GRS80', 'h': '35786023', 'lon_0': '-75', 'no_defs': 'None', 'proj': 'geos', 'sweep': 'x', 'type': 'crs', 'units': 'm', 'x_0': '0', 'y_0': '0'}  
Number of columns: 5424  
Number of rows: 5424  
Area extent: (-5434894.8851, -5434894.8851, 5434894.8851, 5434894.8851),
```

Ejemplo 6: Manipulando Datos con Satpy

10. Todo en un solo script

```
# training - Satellite Data Access and Processing - Example 6: Learning how to Read and Manipulate Data (GOES-R)
# Author: Diego Souza (INPE/GCCT/DISOM)
# ...

# download the satellite data
file_name = download_satellite(sat='goes16', date_sat=2023-10-28 15:00)

# initialise scene
scn = Scene(filenames=glob.glob(os.path.join('/content/sample_data/', file_name)), reader='abi_l2.nc')

# composite = 'C13'
composite = 'C13'

# load the dataset of interest
scn.load([composite])

# read the dataset.crs (coordinate reference system)
crs = scn[composite].attrs['area'].to_cartopy_crs()

# plot size (width x height, in inches)
plt.figure(figsize=(10,10))

# define the projection
ax = plt.axes(projection=crs)

# read the pixel values
data = scn[composite]

# plot the image
plt.imshow(data, extent=crs.bounds, vmin=180, vmax=320, origin='upper', cmap='jet')

# add coastlines and gridlines
ax.coastlines(resolution='10m', color='black', linewidth=0.5)
ax.add_feature(cartopy.feature.BORDERS, edgecolor='black', linewidth=0.5)
gl = ax.gridlines(crs=crs.PlateCarree(), color='white', alpha=1.0, linestyle='--', linewidth=0.25,
                  xlocs=np.arange(-180, 180, 10), ylocs=np.arange(90, 91, 10), draw_labels=True)

# get some information from the metadata
long_name = scn[composite].attrs['long_name']
units = scn[composite].attrs['units']
date = scn[composite].attrs['start_time']
date = date.strftime("%Y-%m-%d %H:%M UTC")
satellite = scn[composite].attrs['platform_name']
channel = scn[composite].attrs['name']
wavelength = scn[composite].attrs['wavelength']

# add a colorbar
cbar = plt.colorbar(label=f'{long_name} ({units})', extend='both', orientation='vertical', pad=0.03, fraction=0.05)

# add a title
plt.title(f'{satellite} - {channel} - {wavelength}\n{date}', fontweight='bold', fontsize=10, loc='left')
plt.title('Entrenamiento AECID / AEMET / EUMETSAT', fontsize=10, loc='right')

# remove frame
ax.axis('off')

# show the image
plt.show()
```

Descarga del Dato

Creación del Scene

Cargando un Dataset

Graficando la Información

Leyendo informaciones de proyección

Tamaño del Plot

Proyección

Matriz de Datos

Grafica la matriz

Mapas

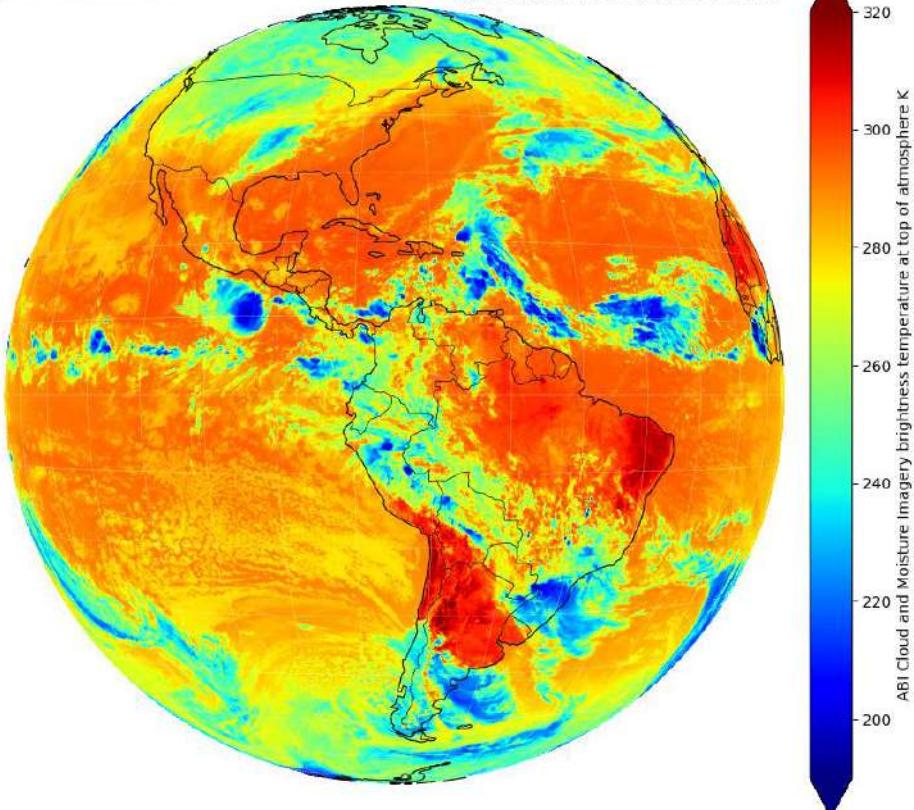
Leyendo los metadatos

Barra de colores

Títulos

GOES-16 - C13 - 10.35 μm (10.1-10.6 μm)
2023-10-28 15:00 UTC

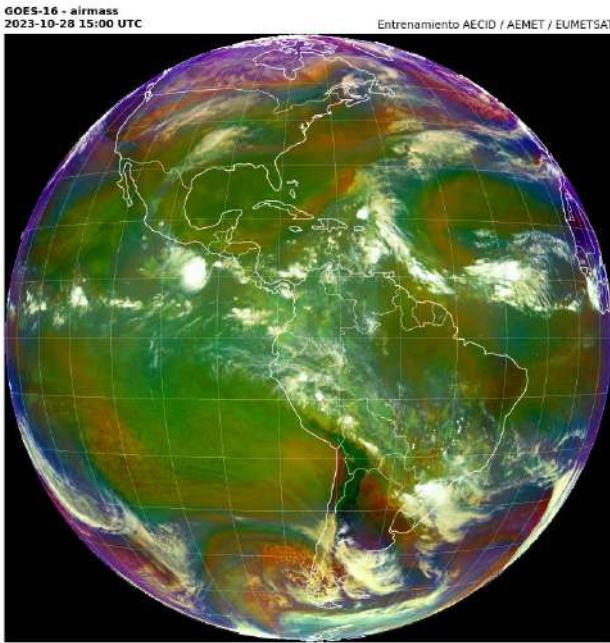
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 6: Manipulando Datos con Satpy (RGBs)

También es posible generar compuestos RGB

```
# check the available composites  
scn.available_composite_names()
```



```
['airmass',
 'ash',
 'cimss_cloud_type',
 'cimss_cloud_type_raw',
 'cimss_green',
 'cimss_green_sunz',
 'cimss_green_sunz_rayleigh',
 'cimss_true_color',
 'cimss_true_color_sunz',
 'cimss_true_color_sunz_rayleigh',
 'cira_day_convection',
 'cira_fire_temperature',
 'cloud_phase',
 'cloud_phase_distinction',
 'cloud_phase_distinction_raw',
 'cloud_phase_raw',
 'cloudtop',
 'color_infrared',
 'colorized_ir_clouds',
 'convection',
 'day_microphysics',
 'day_microphysics_abi',
 'day_microphysics_eum',
 'dust',
 'fire_temperature_awips',
 'fog',
 'green',
 'green_crefl',
 'green_nocorr',
 'green_raw',
 'green_snow',
 'highlight_c14',
 'ir108_3d',
 'ir_cloud_day',
 'land_cloud',
 'land_cloud_fire',
 'natural_color',
 'natural_color_nocorr',
 'natural_color_raw',
 'natural_color_raw_with_night_ir',
 'night_fog',
 'night_ir_alpha',
 'night_ir_with_background',
 'night_ir_with_background_hires',
 'night_microphysics',
 'night_microphysics_eum',
 'overview',
 'overview_raw',
 'rocket_plume_day',
 'rocket_plume_night',
 'snow',
 'snow_fog',
 'so2',
 'tropical_airmass',
 'true_color',
 'true_color_crefl',
 'true_color_nocorr',
 'true_color_raw',
 'true_color_reproduction',
 'true_color_reproduction_corr',
 'true_color_reproduction_uncorr',
 'true_color_with_night_fires',
 'true_color_with_night_fires_nocorr',
 'true_color_with_night_ir',
 'true_color_with_night_ir_hires',
 'water_vapors1',
 'water_vapors2']
```

Ejemplo 7: Manipulando Datos con Satpy (MSG 0°)

```
# Training - Satellite Data Access and Processing - Example 7: Learning how to Read and Manipulate Data (MSG)
# Author: Diego Souza (INPE/CGCT/DISIM)
#--#
# download the satellite data
file_name = download_satellite(sat='msg0', date_sat='2023-10-28 15:00')

# initialise scene
scn = Scene(filenames=glob.glob(os.path.join('/content/sample_data', file_name)), reader='seviri_l1b_native')

# dataset name
composite = 'IR_108'

# load the dataset of interest
scn.load([composite])

# read the dataset crs (coordinate reference system)
crs = scn[composite].attrs['area'].to_cartopy_crs()

# set plot size (width x height, in inches)
plt.figure(figsize=(10,10))

# define the projection
ax = plt.axes(projection=crs)

# read the pixel values
data = scn[composite]

# plot the image
plt.imshow(data, extent=crs.bounds, vmin=190, vmax=320, origin='upper', cmap='jet')

# add coastlines and gridlines
ax.coastlines(resolution='110m', color='black', linewidth=0.8)
ax.add_feature(cartopy.feature.BORDERS, edgecolor='black', linewidth=0.5)
gl = ax.gridlines(crs=crs,PlateCarree(), color='white', alpha=1.0, linestyle='--', linewidth=0.25,
    xlocs=np.arange(-180, 180, 10), ylocs=np.arange(90, 31, 10), draw_labels=False)

# get some information from the metadata
long_name = scn[composite].attrs['standard_name']
units = scn[composite].attrs['units']
date = scn[composite].attrs['start_time']
date = date.strftime('%Y-%m-%d %H:%M UTC')
satellite = scn[composite].attrs['platform_name']
channel = scn[composite].attrs['name']
wavelength = scn[composite].attrs['wavelength']

# add a colorbar
cbar = plt.colorbar(label=f'{long_name} {units}', extend='both', orientation='vertical', pad=0.05, fraction=0.05)

# add a title
plt.title(f'{satellite} - ({channel}) - ({wavelength})\n{date}', fontweight='bold', fontsize=10, loc='left')
plt.title('Entrenamiento AECID / AEMET / EUMETSAT', fontsize=10, loc='right')

# remove frame
ax.axis('off')

# show the image
plt.show()
```

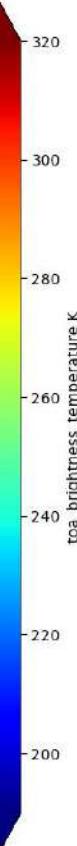
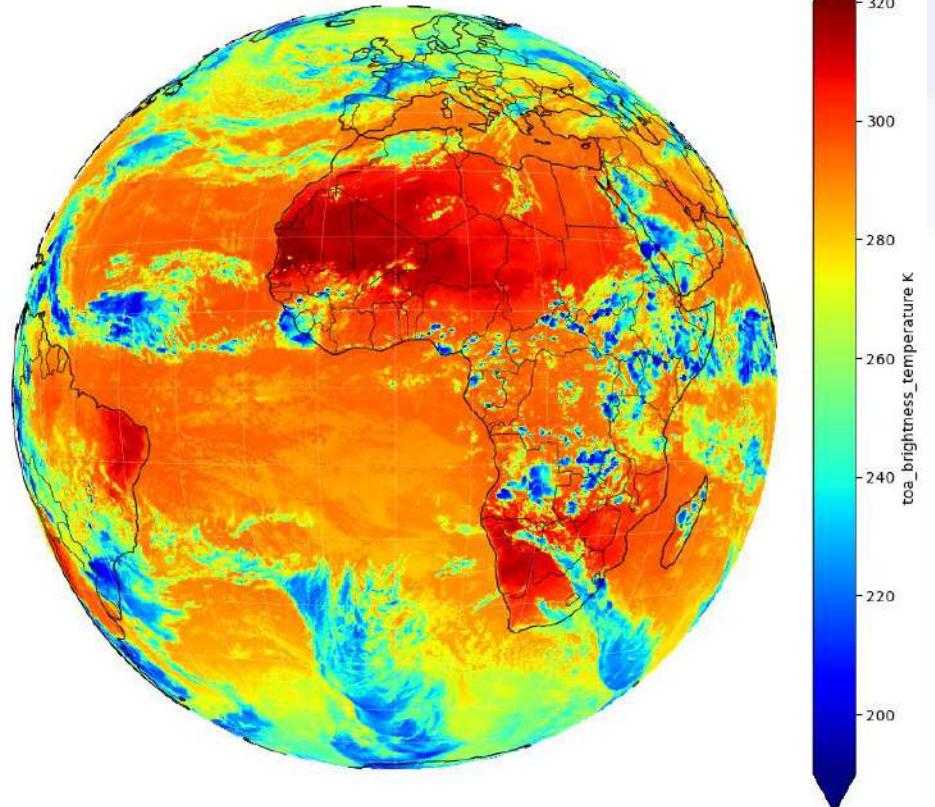
Principales cambios

reader='seviri_l1b_native')

composite = 'IR_108'

Meteosat-10 - IR_108 - 10.8 µm (9.8-11.8 µm)
2023-10-28 15:00 UTC

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 8: Descargando y Graficando Datos de Modelo

Herbie: Retrieve NWP Model Data

Herbie is a python package that liberates recent and archived numerical weather prediction (NWP) model output from different cloud-native sources. Its most popular capability is to download HRER model data. MfN 3000 in the GRIB2 format can be read with xarray.

Some models Herbie can retrieve data from include:

- High-Resolution Rapid Refresh (HRRR)
- Rapid Refresh (RAP)
- Global Forecast System (GFS)
- National Model of Mexico (NM)
- Rapid Refresh Forecast System - Prototype (RRF)
- ECMWF's operational forecast products (ECMWF)

<https://github.com/blaylockbk/Herbie>

<https://herbie.readthedocs.io/en/stable/index.html>

ECMWF Operational High Resolution Forecast, Atmospheric Theta

WRF: 12-00 UTC 24 Jan 2022

2 m temperature

Now the same, but for wind:

```
[1]: u = uinterp(2022-01-24, model="cmip5", product="oper")
      v = v interp(2022-01-24, model="cmip5", product="oper")
      w = w interp(2022-01-24, model="cmip5", product="oper")
```

ECMWF Operational High Resolution Forecast, Specific Humidity

WRF: 00-00 UTC 24 Jan 2022

Specific humidity/Geopotential height

ECMWF Wave Output

Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8: Descargando y Graficando Datos de Modelos de Predicción Numérica del Tiempo (PNT)

Ejemplo 8.1: Geopotential Height

```

Nombre de la función
Parámetros

plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fxx='date',
          var='gh', scale=1, offset=0,
          level_hpa='500',
          level_min=4800, level_max=6000, level_int=60,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='turbo',
          view_clabel=True, fontsize=6,
          linewidth=0.8, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])

```

```

Found | model=ecmwf | product=oper | 2023-10-25 00:00 UTC F12 | GRIB2 @ azure | IDX @ azure
Created directory: [/root/data/ecmwf/20231025]
Total processing time (nwp): 8.44 seconds.

'output/ecmwf_ph_2023-10-25_12:00.png'

```

Salida con informaciones

Ejemplo 8.1

Fecha 'YYYY-MM-DD HH:MM'

Área deseada

Coordinadas

Step de la salida

Variable, escala y offset

Nivel (hPa)

Valores mínimo, máximo y intervalo

Tipo de plot y color de contorno

Aplica una colormap? Cual?

Textos en el contorno? Que tamaño?

Espesor y tipo de línea

Máscara de océano y colores

Transparencia y título

Tamaño de la figura (pulgadas)

'custom' o 'previous'

'date' o algún numero

'c_unfilled', 'c_filled',
'pmesh', 'streamlines',
'barbs'

'solid', 'dashed', 'dotted'



Cambiar las funciones de descarga y visualización de datos de modelo no es simple. Vamos hacer algunos cambios juntos.

Ejemplo 8: Descargando y Graficando Datos de Modelo

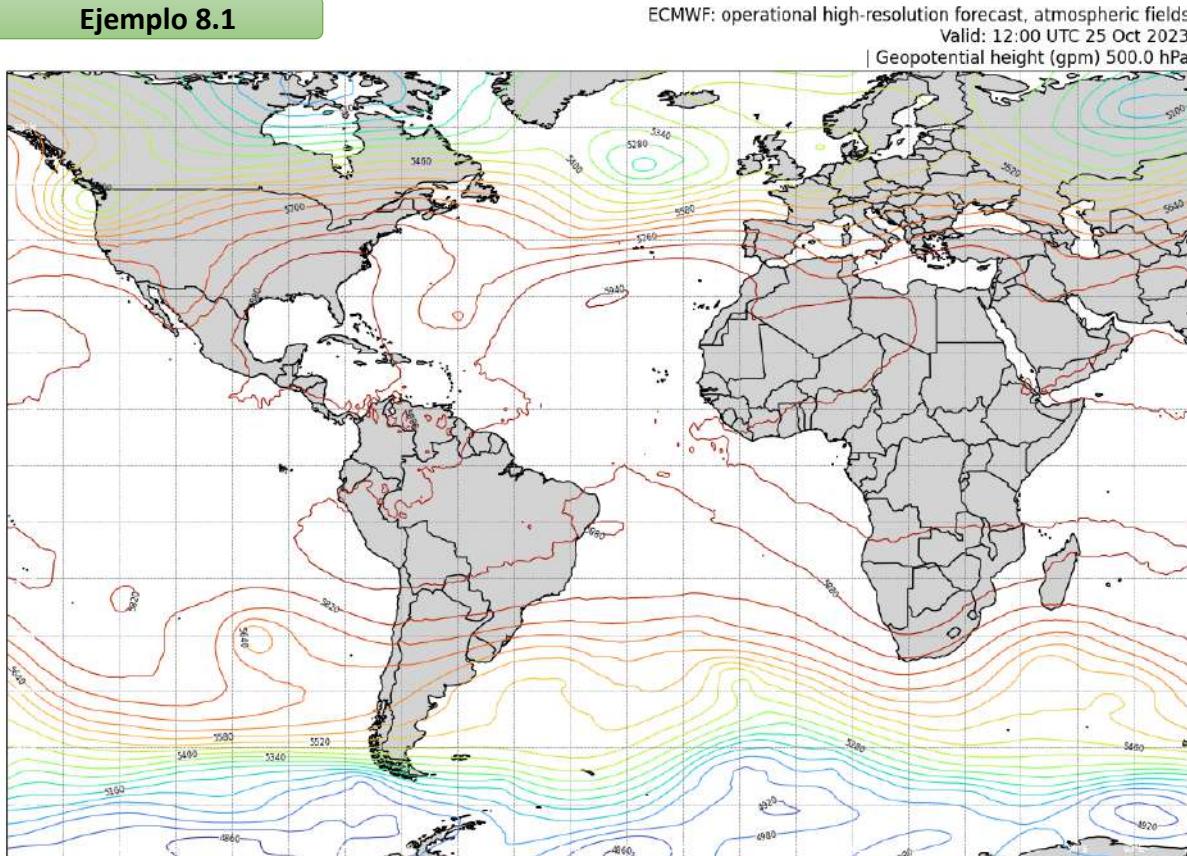
Ejemplo 8.1

Ejemplo 8.1: Geopotential Height

```
##  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DIISM)  
##  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21')  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26')  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
##  
  
# geopotential height (500 hPa [4800~6000] and 300 hPa [8300~9700])  
plot_nwp(model='ecmf',  
         product='open',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='gh', scale=1, offset=0,  
         level_hpa='500',  
         level_min=4000, level_max=6000, level_int=60,  
         plot_type='c_unfilled', contour_color='black',  
         apply_cmap=True, cmap='turbo',  
         view_label=True, fontsize=6,  
         linewidth=0.8, linestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
Found | model=ecmf | product=open | 2023-Oct-25 00:00 UTC F12 | GRIB2  
Created directory: [/root/data/ecmf/20231025]  
Total processing time (nwp): 8.44 seconds.
```

```
output/ecmf_gh_2023-10-25_12:00.png
```



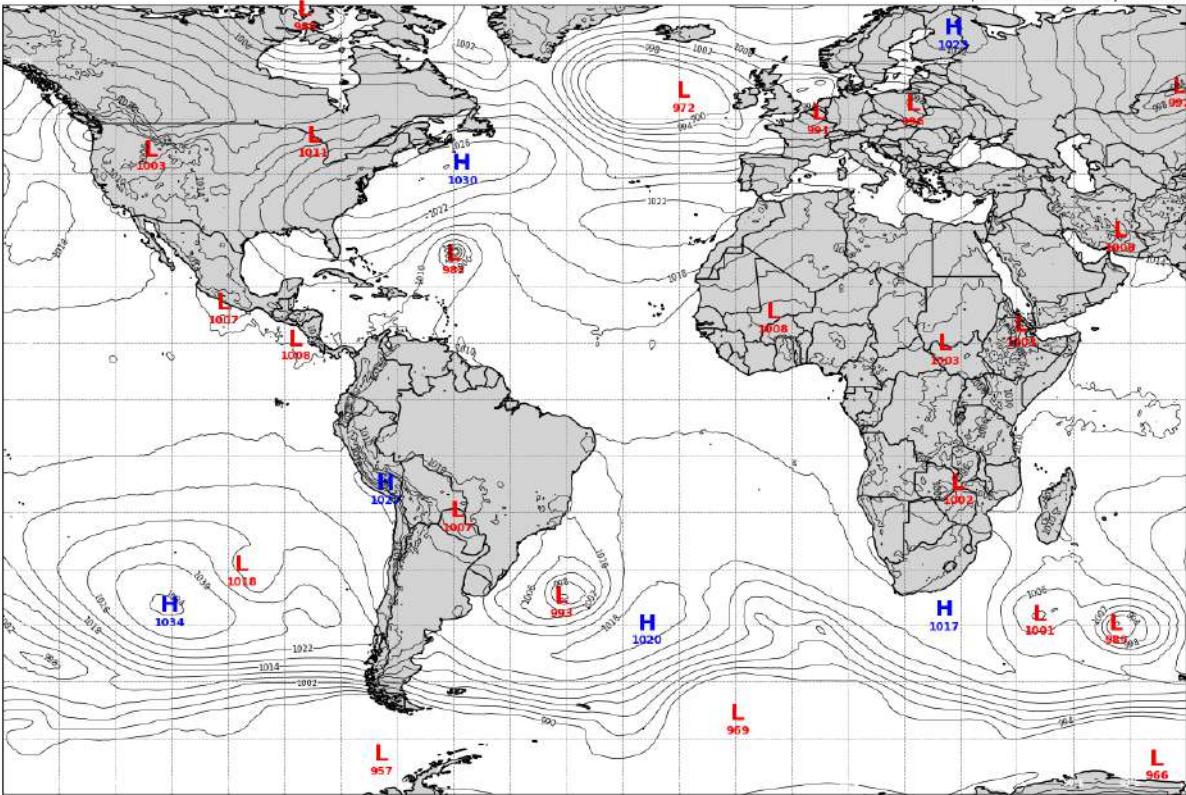
Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.2

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
Mean sea level pressure

Example 8.2: Mean Sea Level Pressure

```
#-----  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DISIM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# mean sea level pressure  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='msl', scale=0.01, offset=0,  
         level_hpa='',  
         level_min=990, level_max=1050, level_int=4,  
         plot_type='c_unfilled', contour_color='black',  
         apply_cmap=False, cmap='jet',  
         view_clabel=True, fontsize=6,  
         linewidth=0.5, linestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])  
  
Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2  
Total processing time (nwp): 9.01 seconds.  
  
'output/ecmwf_msl_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

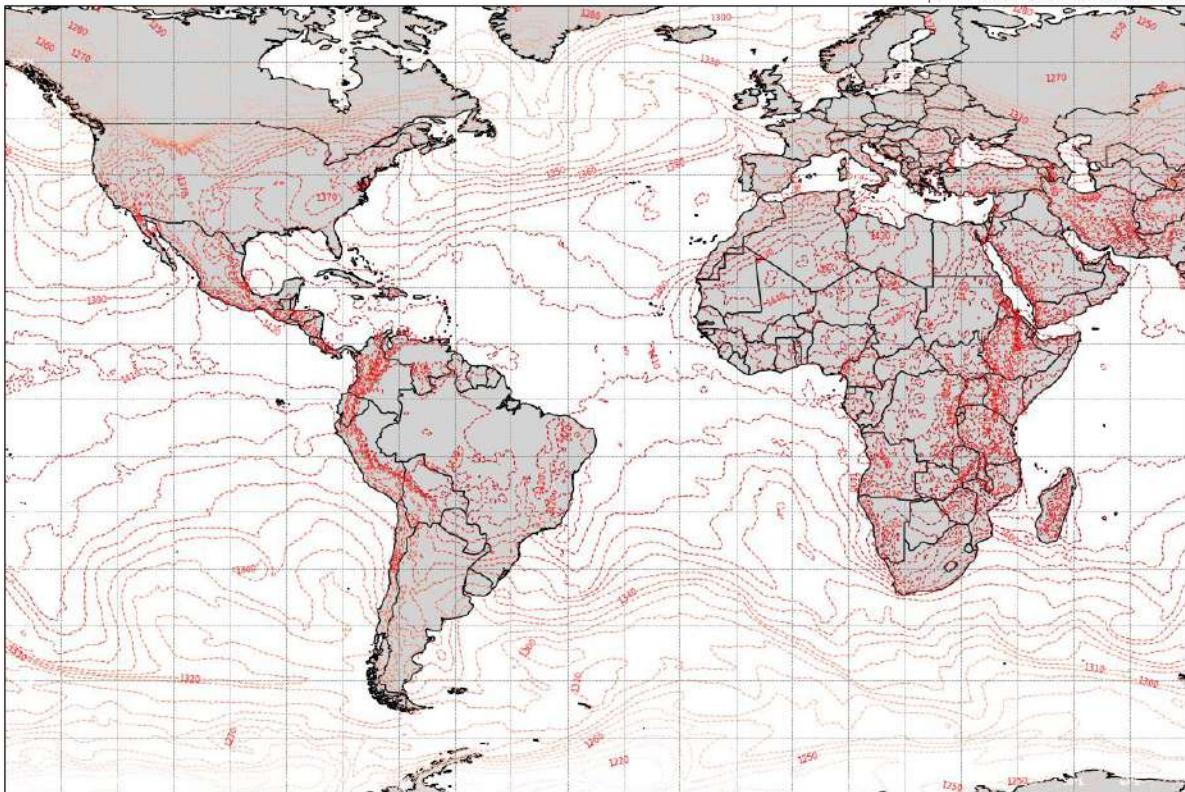
Ejemplo 8.3

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Thickness 1000.0 - 850.0 hPa

Example 8.3: Thickness

```
#-----  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DIISM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# thickness (1000-850 hPa)  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='thickness', scale=1, offset=0,  
         level_hpa= '1000,850',  
         level_min=1200, level_max=1500, level_int=10,  
         plot_type='c_unfilled', contour_color='red',  
         apply_cmap=True, cmap='Reds',  
         view_clabel=True, fontsize=6,  
         linewidth=0.8, linestyle='dashed',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
[ ] Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2  
Total processing time (nwp): 8.4 seconds.  
  
'output/ecmwf_thickness_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

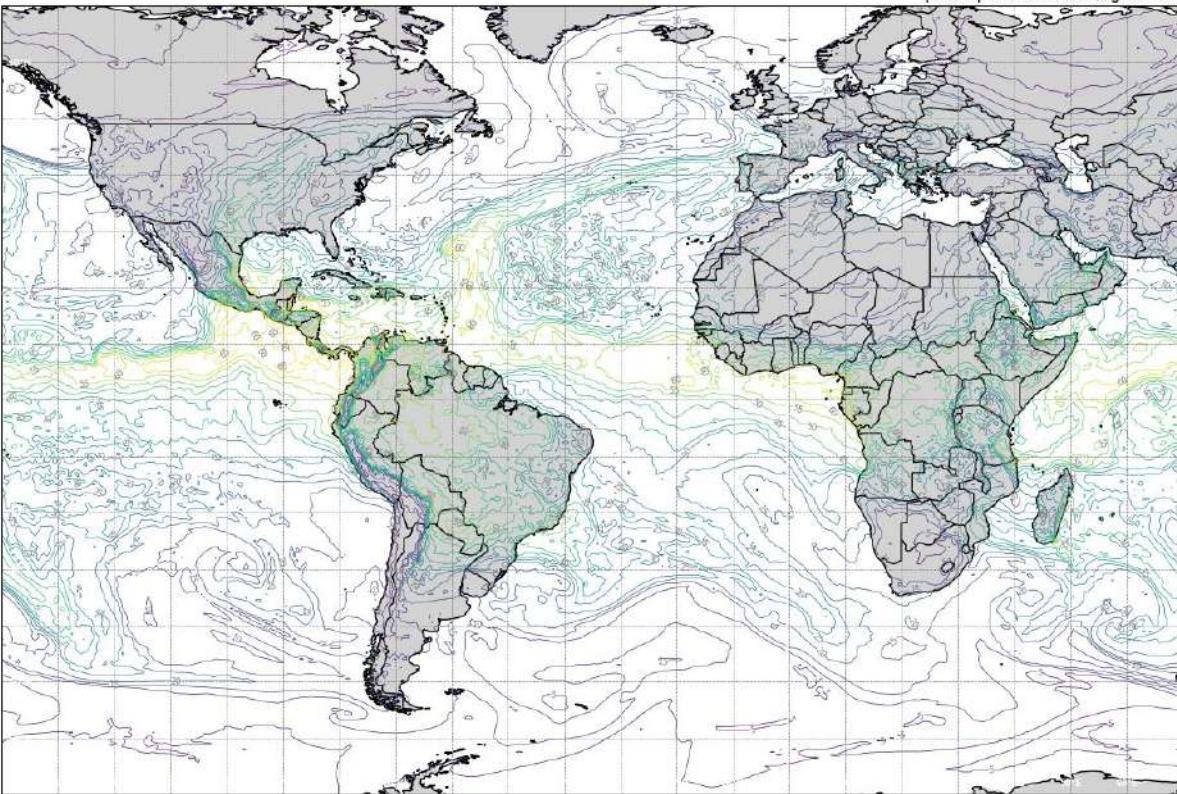
Ejemplo 8.4

GFS: common fields, 0.50 degree resolution
Valid: 12:00 UTC 25 Oct 2023
| Precipitable water (kg m**-2)

Example 8.4: Precipitable Water

```
#  
# Training - Satellite Data Access and Processing - Example 8: Downloading an  
# Author: Diego Souza (INPE/CGCT/DIISM)  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21')  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26')  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# precipitable water  
plot_nwp(model='gfs',  
         product='pgrb2.0p50',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='PWAT', scale=1, offset=0,  
         level_hpa='',  
         level_min=0, level_max=70, level_int=5,  
         plot_type='c_unfilled', contour_color='gray',  
         apply_cmap=True, cmap='viridis',  
         view_clabel=True, fontsize=6,  
         linewidth=0.5, linestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
Found | model-gfs | product-pgrb2.0p50 | 2023-10-25 00:00 UTC F12 | GRIB1  
Created directory: [/root/data/gfs/20231025]  
Total processing time (nwp): 9.1 seconds.  
  
'output/gfs_PWAT_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.5

ECMWF: operational high-resolution forecast, atmospheric fields

Valid: 12:00 UTC 25 Oct 2023

| Vorticity (relative) (s^{-1}) 200.0 hPa

Example 8.5: Vorticity (relative)

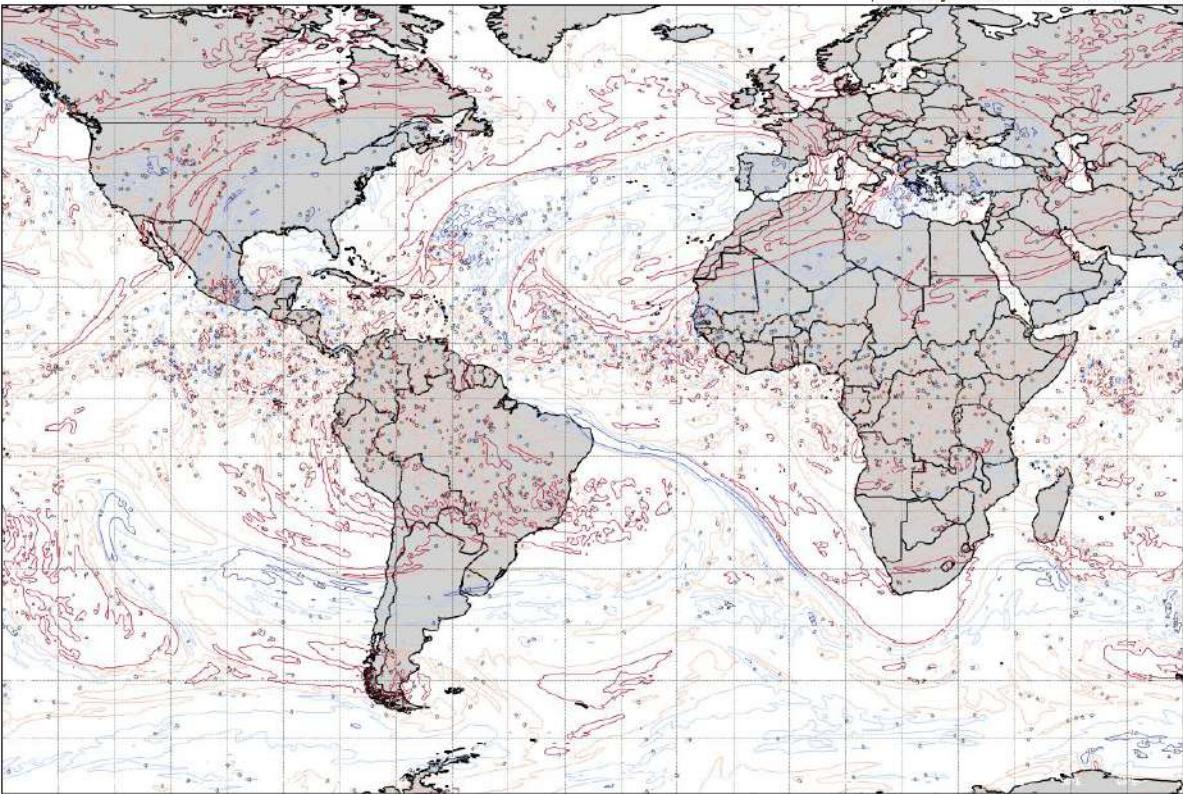
```
#-----
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DIISM)
#-----

# open ecmwf data available for download since January 21 2022 00:00 ('2022
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# vorticity (relative) (1000, 850, 700, 500, 300 and 200 hPa)
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-25 12:00',
          areaa='custom',
          extent=[-140.0, -70.0, 70.0, 70.0],
          fxx='date',
          var='vo', scale=10**5, offset=0,
          level_hpa='200',
          level_min=-10, level_max=10, level_int=5,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='coolwarm',
          view_clabel=True, fontsize=4,
          linewidth=0.5, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2
Total processing time (nwp): 26.81 seconds.

'output/ecmwf_vo_2023-10-25_12:00.png'



Ejemplo 8: Descargando y Graficando Datos de Modelo

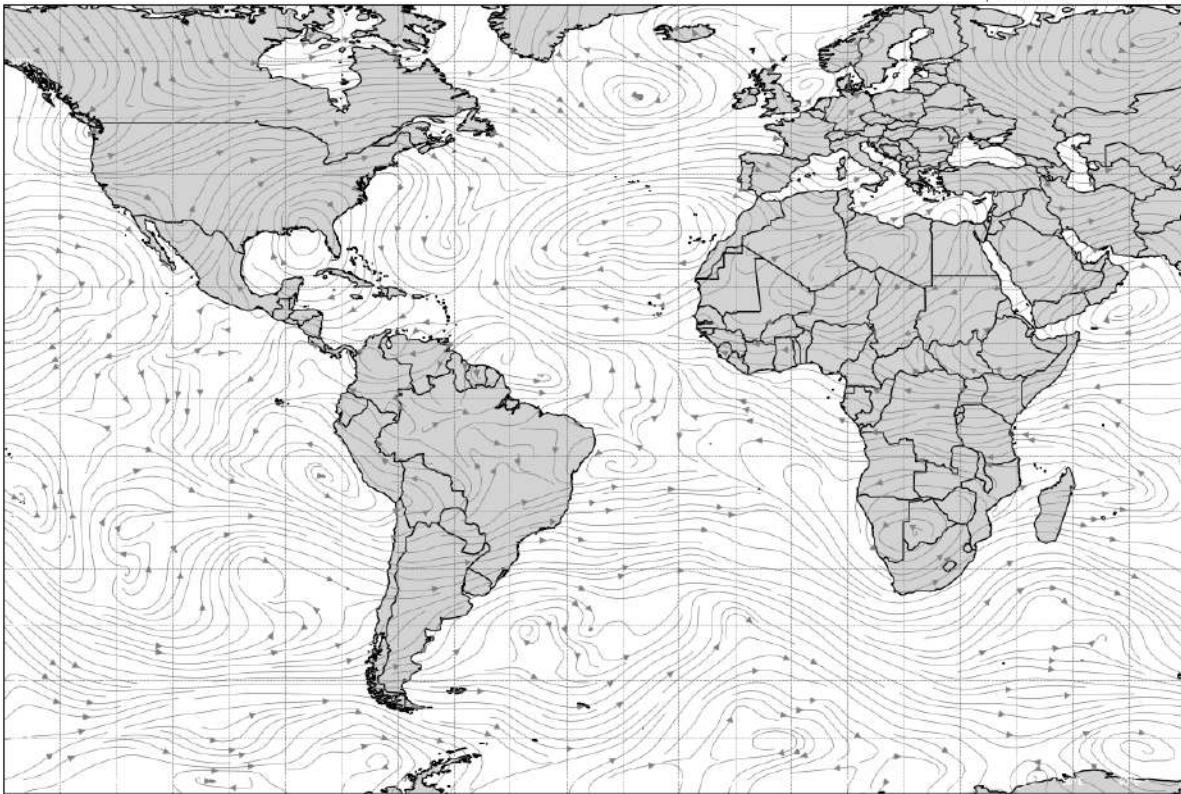
Ejemplo 8.6

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Streamlines 500.0 hPa

Example 8.6: Streamlines

```
#  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DISSM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# streamlines (850, 700, 500 and 200 hPa)  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='winds', scale=1, offset=0,  
         level_hpa='500',  
         level_min=0, level_max=60, level_int=5,  
         plot_type='streamlines', contour_color='gray',  
         apply_cmap=False, cmap='jet',  
         view_clabel=True, fontsize=6,  
         linewidth=0.5, linestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
[ ] Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2  
Total processing time (nwp): 49.26 seconds.  
  
'output/ecmwf winds 2023-10-25 12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

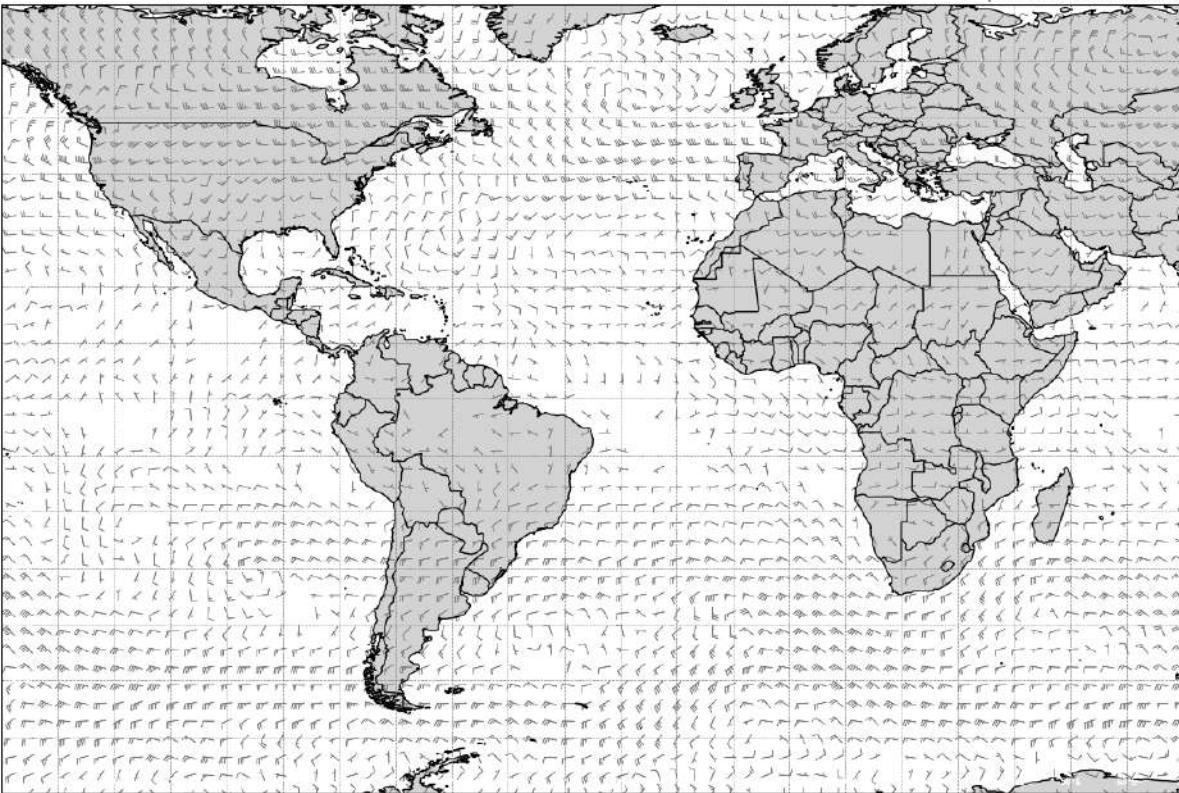
Ejemplo 8.7

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Wind Bars 500.0 hPa

Example 8.6: Streamlines

```
#  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DIISM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# streamlines (850, 700, 500 and 200 hPa)  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='winds', scale=1, offset=0,  
         level_hpa='500',  
         level_min=0, level_max=60, level_int=5,  
         plot_type='streamlines', contour_color='gray',  
         apply_cmap=False, cmap='jet',  
         view_clabel=True, fontsize=6,  
         linewidth=0.5, linestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
[ ] Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2 &  
Total processing time (nwp): 49.26 seconds.  
  
'output/ecmwf winds 2023-10-25 12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

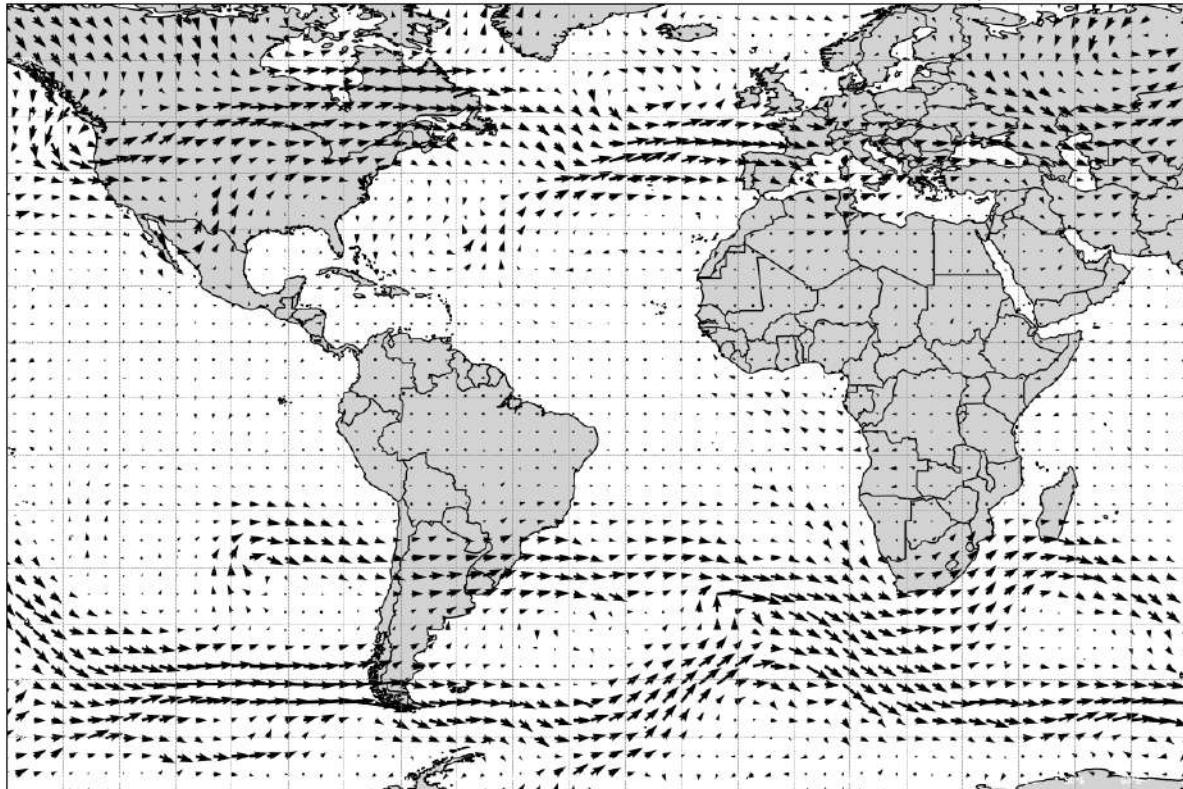
Ejemplo 8.8

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
Wind Vectors 500.0 hPa

Example 8.8: Wind Vectors

```
#-----  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DISSM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21')  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26')  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p08'  
  
# wind barbs (250, 300, 500, 700, 850 hPa)  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.00, 70.00, 70.00],  
         fxx='date',  
         var='winds', scale=1, offset=0,  
         level_hpa=500,  
         level_min=0, level_max=60, level_int=5,  
         plot_type='vectors', contour_color='black',  
         apply_cmap=False, cmap='jet',  
         view_clabel=True, fontsize=6,  
         llineWidth=0.5, llinestyle='solid',  
         land_ocean=True, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
[ ] Found | model=ecmwf | product=oper | 2023-10-25 00:00 UTC F12 | GRIB2.6  
Total processing time (nwp): 7.6 seconds.  
  
'output/ecmwf_winds_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.9

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Windspeed ($m s^{-1}$) 200.0 hPa

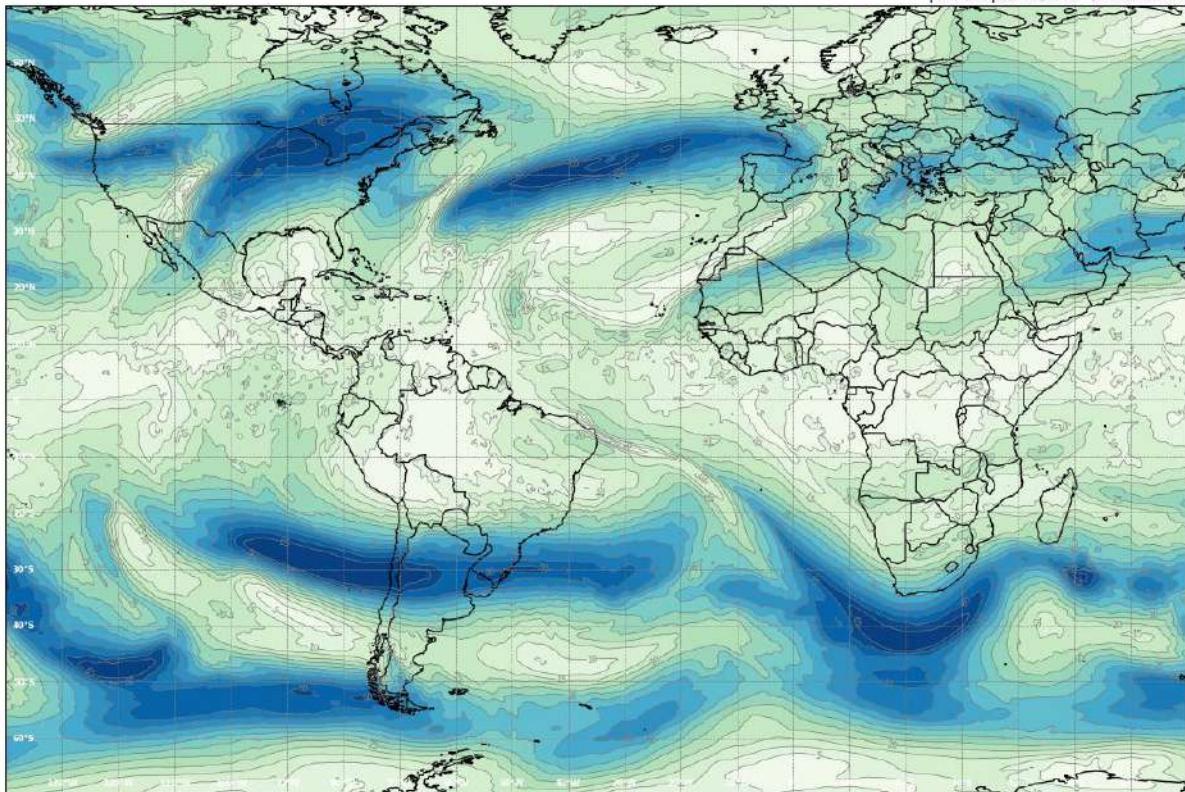
Example 8.9: Wind Speed

```
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DIISM)
#-----#
# open ecmwf data available for download since January 21 2022 00:00 ('2022
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# wind speed (200 hPa)
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fxx='date',
          var='windspeed', scale=1, offset=0,
          level_hpa=200,
          level_min=0, level_max=70, level_int=5,
          plot_type='c_filled', contour_color='gray',
          apply_cmap=True, cmap='GnBu',
          view_label=True, fontsize=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Found | model=ecmwf | product=oper | 2023-10-25 00:00 UTC F12 | GRID2 6 Total processing time (nwp): 7.26 seconds.

'output/ecmwf_windspeed_2023-10-25_12:00.png'



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.10

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Specific humidity (kg kg⁻¹) 850.0 hPa

Example 8.10: Specific Humidity

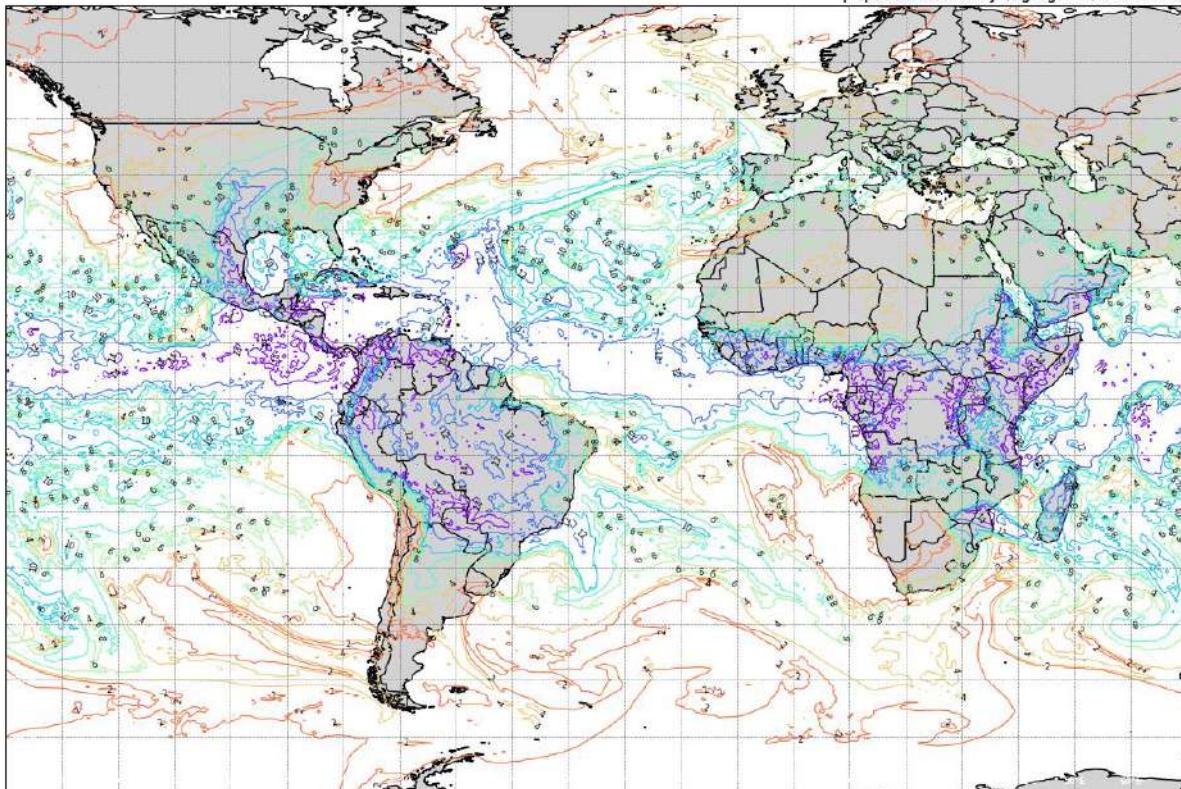
```
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DIISM)
#-----

# open ecmwf data available for download since January 21 2022 00:00 ('2022
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# specific humidity (850 and 700 hPa)
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fxx='date',
          var='q', scale=10**3, offset=0,
          level_hpa='850',
          level_min=0, level_max=15, level_int=2,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='rainbow_r',
          view_clabel=True, fontsize=6,
          linewidth=0.8, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2
Total processing time (nwp): 10.84 seconds.

'output/ecmwf_q_2023-10-25_12:00.png'



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.11

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| Total precipitation (mm)

Example 8.11: Total Precipitation

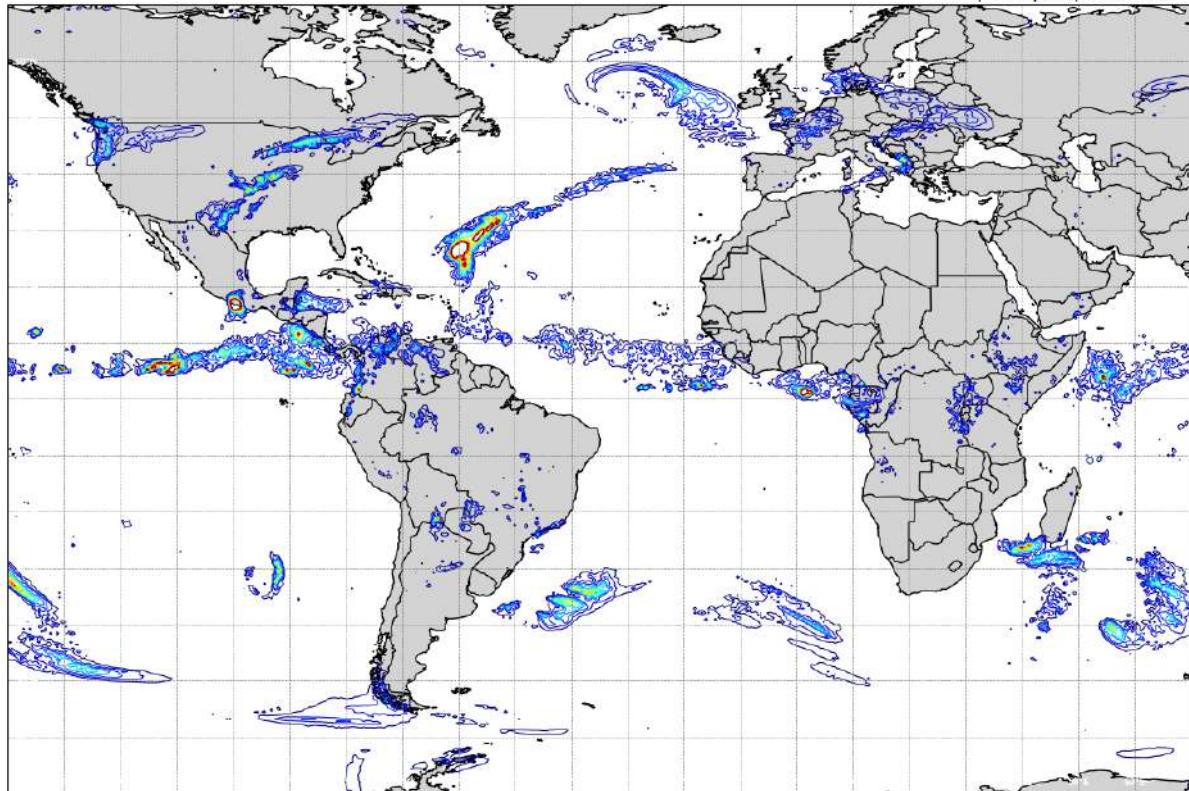
```
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DISSM)
#-----

# open ecmwf data available for download since January 21 2022 00:00 ('2022
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# total precipitation
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fxx='date',
          var='tp', scale=1000, offset=0,
          level_hpa='',
          level_min=5, level_max=70, level_int=5,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='jet',
          view_clabel=False, fontsize=6,
          linewidth=0.8, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Found | model=ecmwf | product=oper | 2023-Oct-25 00:00 UTC F12 | GRIB2 64x64
Total processing time (nwp): 5.59 seconds.

'output/ecmwf_tp_2023-10-25_12:00.png'



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.12

GFS: common fields, 0.50 degree resolution
Valid: 12:00 UTC 25 Oct 2023
| Convective precipitation (water) (kg m⁻²)

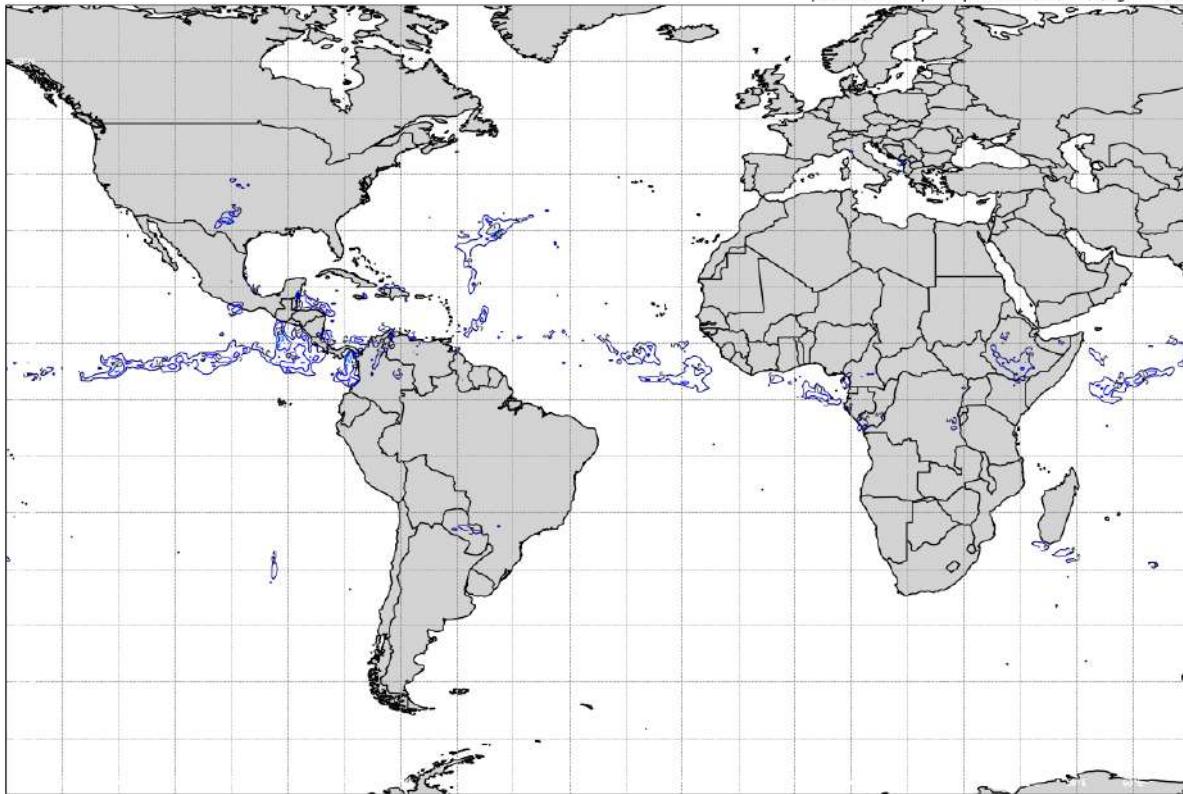
Example 8.12: Convective Precipitation

```
#-----#
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DIISM)
#-----#
# open ecmwf data available for download since January 21 2022 00:00 ('2022
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# convective precipitation (kg/m2)
plot_nwp(model='gfs',
          product='pgrb2.0p50',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fxx='date',
          var='ACCP', scale=1, offset=0,
          level_hpa='',
          level_min=5, level_max=50, level_int=5,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='jet',
          view_clabel=True, fontsize=6,
          linewidth=0.8, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

```
Found | model=gfs | product=pgrb2.0p50 | 2023-Oct-25 00:00 UTC F12 | GRJ
Total processing time (nwp): 3.28 seconds.

'output/gfs_ACCP_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

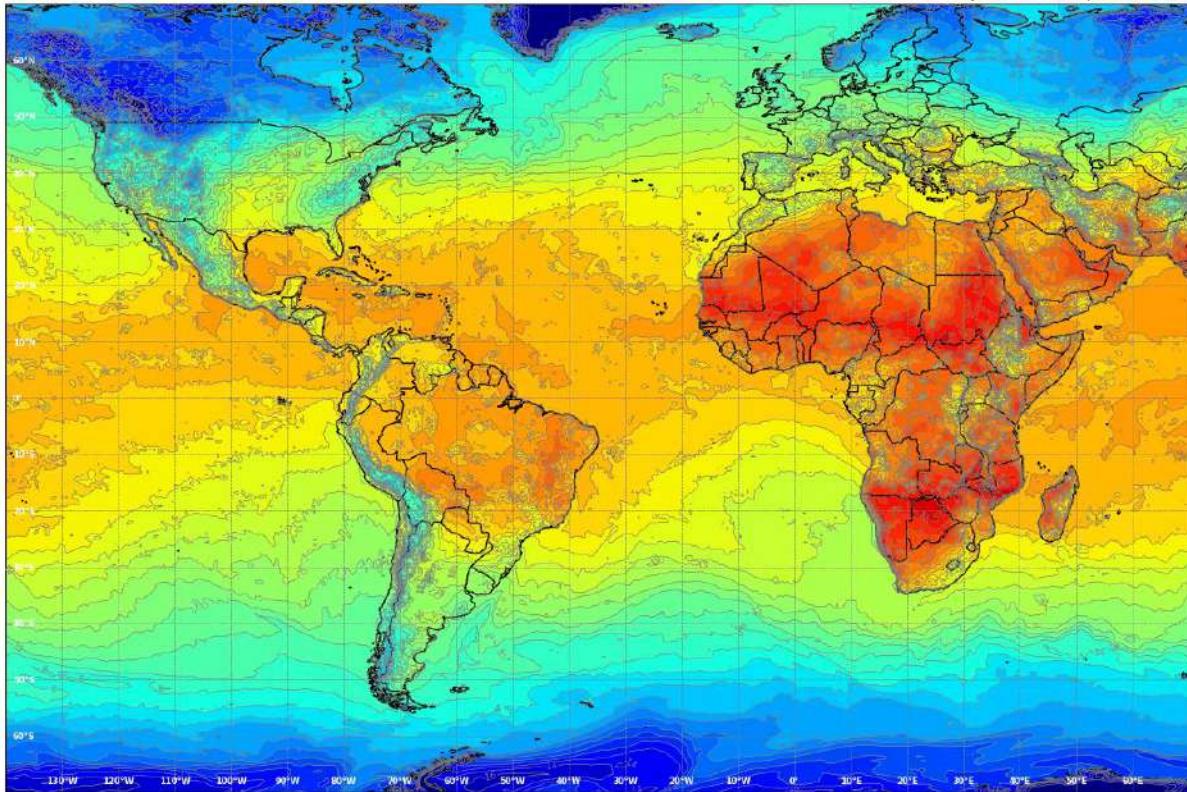
Ejemplo 8.13

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
| 2 metre temperature (K)

Example 8.13: 2m Temperature

```
#  
# Training - Satellite Data Access and Processing - Example 8: Downloading  
# Author: Diego Souza (INPE/CGCT/DIISM)  
#-----  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# 2 m temperature  
plot_nwp(model='ecmwf',  
         product='oper',  
         date_nwp='2023-10-25 12:00',  
         area='custom',  
         extent=[-140.0, -70.0, 70.0, 70.0],  
         fxx='date',  
         var='t2t', scale=1, offset=-273.15,  
         level_hpa='',  
         level_min=-20, level_max=48, level_int=2,  
         plot_type='c_filled', contour_color='gray',  
         apply_cmap=True, cmap='jet',  
         view_clabel=True, fontsize=6,  
         linewidth=0.5, linestyle='solid',  
         land_ocean=False, land_color = 'lightgray', ocean_color = 'white',  
         alpha=1.0, title='new',  
         figsize=[15,15])
```

```
[ ] Found | model=ecmwf | product=oper | 2023-10-25 00:00 UTC F12 | GRIB2 E  
Total processing time (nwp): 14.17 seconds.  
  
'output/ecmwf_t2m_2023-10-25_12:00.png'
```



Ejemplo 8: Descargando y Graficando Datos de Modelo

Ejemplo 8.14

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023
Temperature (°C) 1000.0 hPa

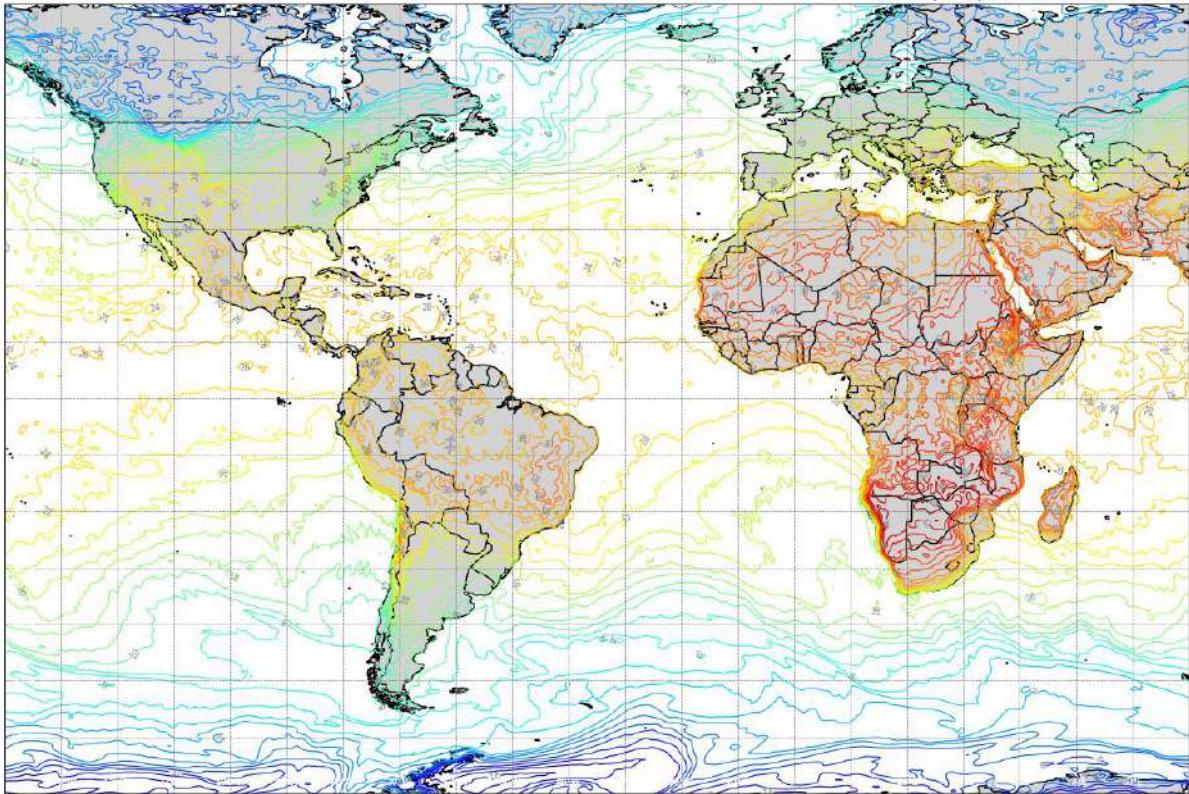
Example 8.14: Temperature

```
# Training - Satellite Data Access and Processing - Example 8: Downloading
# Author: Diego Souza (INPE/CGCT/DISSM)
#-----#
# open ecmwf data available for download since January 21 2022 00:00 ('2022-
# gfs data available for download since February 26 2021 00:00 ('2021-02-26
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# temperature (1000, 925, 950, 700, 600, 500, 300 and 250 hPa)
plot_nwp(model='ecmwf',
          product='open',
          date_nwp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.0, 70.0, 70.0],
          fxx='date',
          var='t', scale=1, offset=-273.15,
          level_hpa='1000',
          level_min=-20, level_max=48, level_int=2,
          plot_type='c_unfilled', contour_color='gray',
          apply_cmap=True, cmap='jet',
          view_clabel=True, fontsize=6,
          linewidth=0.8, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Found | model=ecmwf | product=open | 2023-Oct-25 00:00 UTC F12 | GRIB2
Total processing time (nwp): 7.4 seconds.

'output/ecmwf_t_2023-10-25_12:00.png'



Ejemplo 8: Descargando y Graficando Datos de Modelo

```
Example 8.15: Cloud Cover (low, medium, high levels)

# Finding Satellites Data Access and Processing - Example 8: Downloading and Visualizing NPP Data
# Number Stage (out = 100% / 100%)
# gfs data available for download since February 16 2001 00:00 (~2002-01-01 00:00)
# gfs product: gfs-0.5deg-1991-2023-01-20-00-00.grib2

# Open source data metadata for baseline stereo imagery 00 Jan 2021 00:00 (~2002-01-01 00:00)
# gfs data available for download since February 16 2001 00:00 (~2002-01-20 00:00)
# gfs product: gfs-0.5deg-1991-2023-01-20-00-00.grib2

# Total Cloud cover (0-100%) - need to specify level
# If no options added, there is no need to specify level
# > Total Cloud cover (0-100%) | Low cloud cover (0-100%) | Medium cloud cover (0-100%) | High cloud cover (0-100%)
plot_nppmodel_gfs.py

    products=gfs-0.5deg-1991-2023-01-20-00-00.grib2,
    date_name='2022-01-20-00-00',
    var='LOWCLOUD',
    extenstion='grib2',
    fix_date=True,
    scale=1,
    offset=0,
    level='0000',
    level_min0000_level_max0000_level_lut00,
    plot_type='filler', contour_color='black',
    apply_cmap=True,
    view_cmapvalues=[0,100],
    title='Clouds (0-100%)',
    titlefontdict={'titlesize':10},
    land_ocean=True, land_color = 'lightgrey', ocean_color = 'white',
    sigmaf=0.001,
    figure=(10,8))

# Low Cloud cover (0-100%) | Medium Cloud cover (0-100%) | High Cloud cover (0-100%)
plot_nppmodel_gfs.py

    products=gfs-0.5deg-1991-2023-01-20-00-00.grib2,
    date_name='2022-01-20-00-00',
    area='product',
    extenstion='grib2',
    fix_date=True,
    var='LOWCLOUD',
    scale=1,
    offset=0,
    level='0000',
    level_min0000_level_max0000_level_lut00,
    plot_type='filler', contour_color='black',
    apply_cmap=True,
    view_cmapvalues=[0,100],
    title='Low Clouds (0-100%)',
    titlefontdict={'titlesize':10},
    land_ocean=True, land_color = 'lightgrey', ocean_color = 'white',
    sigmaf=0.001,
    figure=(10,8))

# Low Cloud cover (0-100%) | Medium Cloud cover (0-100%) | High Cloud cover (0-100%)
plot_nppmodel_gfs.py

    products=gfs-0.5deg-1991-2023-01-20-00-00.grib2,
    date_name='2022-01-20-00-00',
    area='product',
    extenstion='grib2',
    fix_date=True,
    var='MEDIUMCLOUD',
    scale=1,
    offset=0,
    level='0000',
    level_min0000_level_max0000_level_lut00,
    plot_type='filler', contour_color='black',
    apply_cmap=True,
    view_cmapvalues=[0,100],
    title='Medium Clouds (0-100%)',
    titlefontdict={'titlesize':10},
    land_ocean=True, land_color = 'lightgrey', ocean_color = 'white',
    sigmaf=0.001,
    figure=(10,8))

# Low Cloud cover (0-100%) | Medium Cloud cover (0-100%) | High Cloud cover (0-100%)
plot_nppmodel_gfs.py

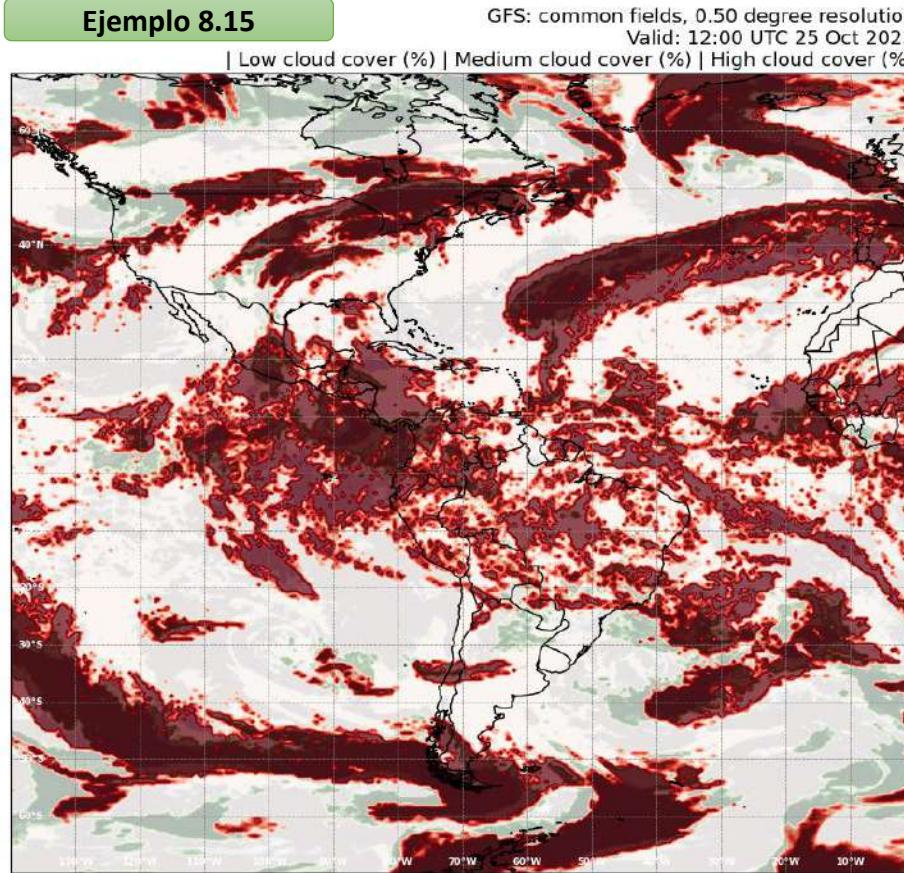
    products=gfs-0.5deg-1991-2023-01-20-00-00.grib2,
    date_name='2022-01-20-00-00',
    area='product',
    extenstion='grib2',
    fix_date=True,
    var='HIGHCLOUD',
    scale=1,
    offset=0,
    level='0000',
    level_min0000_level_max0000_level_lut00,
    plot_type='filler', contour_color='black',
    apply_cmap=True,
    view_cmapvalues=[0,100],
    title='High Clouds (0-100%)',
    titlefontdict={'titlesize':10},
    land_ocean=True, land_color = 'lightgrey', ocean_color = 'white',
    sigmaf=0.001,
    figure=(10,8))

# Using the same area of the previous plots...
Total processing time (npp): 87.72 seconds.

# Found | npp2grib | product=gfs-0.5deg-1991-2023-01-20-00-00.grib2 | 100% | 00:00:00 | 100% | 00:00
# Found | npp2grib | product=gfs-0.5deg-1991-2023-01-20-00-00.grib2 | 100% | 00:00:00 | 100% | 00:00
# Found | npp2grib | product=gfs-0.5deg-1991-2023-01-20-00-00.grib2 | 100% | 00:00:00 | 100% | 00:00
# Using the same area of the previous plots...
Total processing time (npp): 48.45 seconds.

# npp2grib_hrs_0000-01-20-00-00.grib2
```

Ejemplo 8.15



Ejemplo 9: Múltiples Variables

Ejemplo 9: Múltiples Variables de Modelo

```
# Training - Satellite data access and processing - Example 9: Downloading and visualizing RAP data
# Author: Diego Souza (INPE/VGCP/DIFSM)
# RAP ECMWF data available for download since January 21 2022 00:00 ('2022-01-21 00:00')
# gfs data available for download since February 10 2021 00:00 ('2021-02-10 00:00')
# gfs products: 'ngrib2-mpas', 'ngrib2-epoch', 'ngrib2-jpg'

# mean sea level pressure
plot_mslp(model='ecmwf',
          product='oper',
          date_mslp='2023-10-25 12:00',
          area='custom',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fixx_date,
          var='mslp', scale=0.01, offset=0,
          level_rap=800, level_max=5000, level_int=5,
          plot_type='c_unfilled', contour_color='black',
          apply_cmap=True, cmap='jet',
          view_label=True, font_size=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=(15,15))

# thickness (1000-650 hPa)
plot_thick(model='ecmwf',
           product='oper',
           date_mslp='2023-10-25 12:00',
           areas='previous',
           extent=[-140.0, -70.00, 70.00, 70.00],
           fixx_date,
           var='thickness', scale=1, offset=0,
           level_rap=1000, level_max=5000, level_int=20,
           plot_type='c_unfilled', contour_color='red',
           apply_cmap=True, cmap='red',
           view_label=True, font_size=6,
           linewidth=0.5, linestyle='solid',
           land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
           alpha=1.0, title='add',
           figsize=(15,15))

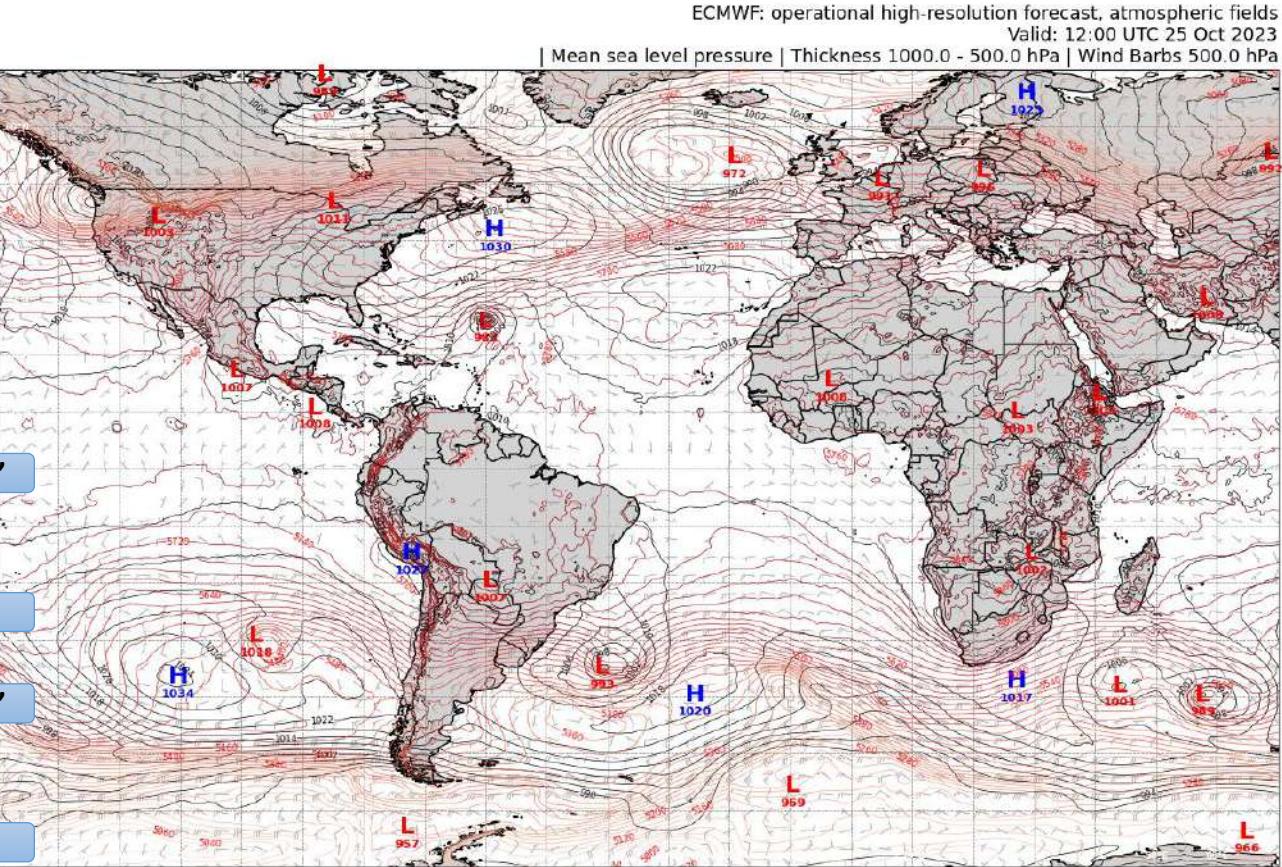
# wind bars (250, 200, 150, 100, 500 hPa)
plot_wind(model='ecmwf',
          product='oper',
          date_mslp='2023-10-25 12:00',
          areas='previous',
          extent=[-140.0, -70.00, 70.00, 70.00],
          fixx_date,
          var='winds', scale=1, offset=0,
          level_rap=500,
          level_min=0, level_max=50, level_int=5,
          plot_type='bars', contour_color='gray',
          apply_cmap=True, cmap='jet',
          view_label=True, font_size=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=0.5, title='add',
          figsize=(15,15))
```

area = 'previous'

title = 'add'

area = 'previous'

title = 'add'



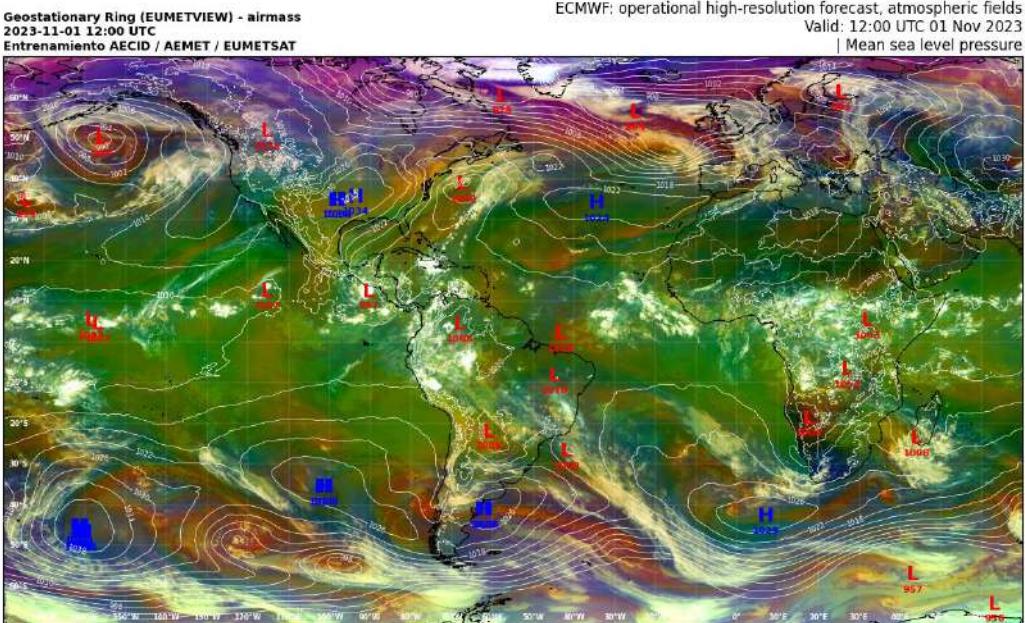
ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 25 Oct 2023

| Mean sea level pressure | Thickness 1000.0 - 500.0 hPa | Wind Barbs 500.0 hPa

Ejemplo 10: Datos de Satélites (Multimisión) y Modelos

Ejemplo 10: Datos de Satélites (Multimisión) con Datos de Modelo

```
#-----  
# Training - Satellite Data Access and Processing - Example 10: Geostationary Ring and NWP Data  
# Author: Diego Souza (INPE/CGCT/DISMM)  
#-----  
  
# georing available since June 06 2021 18:00 UTC ('2021-06-06 18:00' (note: data available every 3 hours)  
# available composites: 'ir108', 'airmass', 'natural_color', 'ash', 'dust'  
# max_res: 6  
plot_ring(date_sat='2023-11-01 12:00',  
          composite='airmass',  
          resolution=12,  
          area='custom',  
          extent=[-180.0, -70.00, 70.00, 70.00],  
          coast_color='black',  
          countries_color='gray',  
          grid_color='white',  
          overwrite=True,  
          figsize=[15,15])  
  
# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21 00:00')  
# gfs data available for download since February 26 2021 00:00 ('2021-02-26 00:00')  
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'  
  
# mean sea level pressure  
plot_nwp(model='ecmwf',  
          product='oper',  
          date_nwp='2023-11-01 12:00',  
          area='previous',  
          extent=[-180.0, -70.00, 70.00, 70.00],  
          fxx='date',  
          var='msl', scale=0.01, offset=0,  
          level_hpa='',  
          level_min=990, level_max=1050, level_int=4,  
          plot_type='c_unfilled', contour_color='white',  
          apply_cmap=False, cmap='jet',  
          view_clabel=True, fontsize=6,  
          linewidth=0.5, linestyle='solid',  
          land_ocean=False, land_color = 'lightgray', ocean_color = 'white',  
          alpha=1.0, title='new',  
          figsize=[15,15])
```



Ejemplo 11: Datos de Satélites (GOES-Este) y Modelos

Ejemplo 11: Datos de Satélites (GOES-Este) con Datos de Modelo

```

# Training - Satellite Data Access and Processing - Example 11: GOES-East and NWP Data
# Author: Diego Souza (INPE/CCT/DISMM)
# ...

# 'goes16' data available since July 10 2017, 'goes17' since August 28 2018, 'goes18' since August 02 2022
# note: please consider that goes-16 generated images every 15 minutes (instead of 10) until a few months after launch

# available composites for GOES-R (the options below have been tested):
# 'C01', 'C02', 'C03', 'C05', 'C06', 'C07', 'C08', 'C09', 'C10', 'C11', 'C12', 'C13', 'C14', 'C15', 'C16',
# 'cimss', 'osh', 'cimss_cloud_type', 'cimss_true_color', 'cimss_true_color_sun_royligh', 'cira_day_convective',
# 'cloudtop', 'color_infrared', 'colorized_in_clouds', 'convective', 'day_micropysics', 'dust', 'fire_temperature_aw',
# 'night_micropysics', 'overview', 'rocket_plume_day', 'rocket_plume_night', 'snow', 'so2', 'tropical_airmass', 'true

plot_sat(sat='goes16',
          date_sat='2023-10-31 15:00',
          composite='cloud_phase_distinction',
          area='full_disk',
          extent=[-90.0, -60.0, -30.0, 15.0],
          coast_color='white',
          countries_color='white',
          grid_color='white',
          figsize=[15,15])

# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21 00:00')
# gfs data available for download since February 26 2021 00:00 ('2021-02-26 00:00')
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

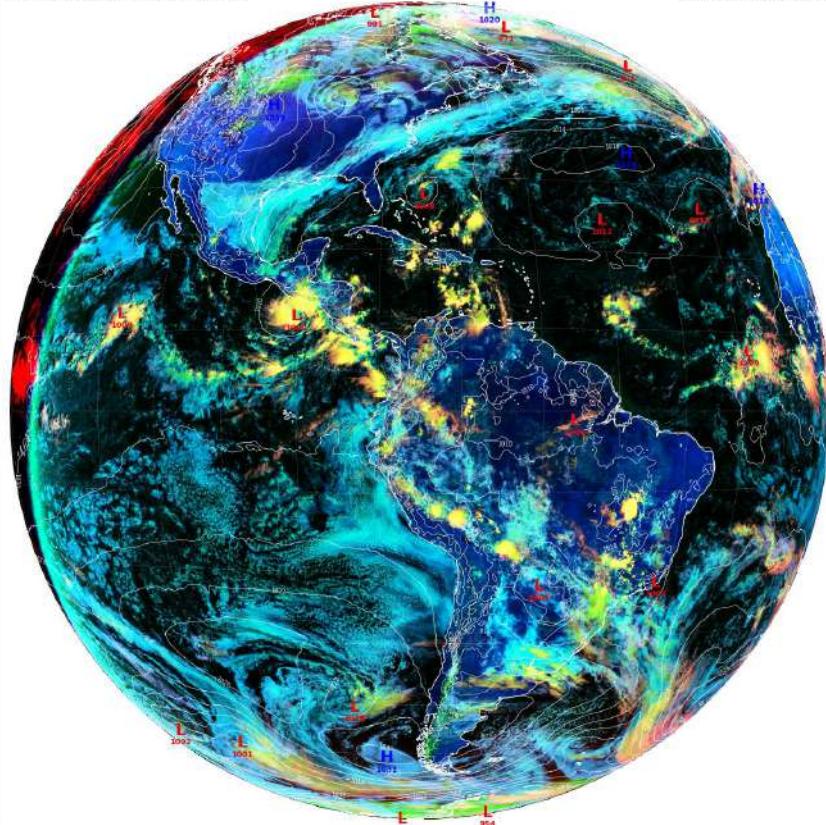
# mean sea level pressure
plot_map(model='ecmwf',
          product='oper',
          date_map='2023-10-31 15:00',
          area='previous', ←
          extent=[-180.0, -70.0, 70.0, 70.0],
          fix_date='',
          var='mslp', scale=0.01, offset=0,
          level_hpa='',
          level_min=990, level_max=1050, level_int=4,
          plot_type='c_unfilled', contour_color='white',
          apply_cmap=False, cmap='jet',
          vmap_label=True, fontsize=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])

```

area = 'previous'

GOES-16 - cloud_phase_distinction
2023-10-31 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 15:00 UTC 31 Oct 2023
| Mean sea level pressure



Ejemplo 12: Datos de Satélites (MSG 0°) y Modelos

Ejemplo 12: Datos de Satélites (MSG 0°) con Datos de Modelo

```

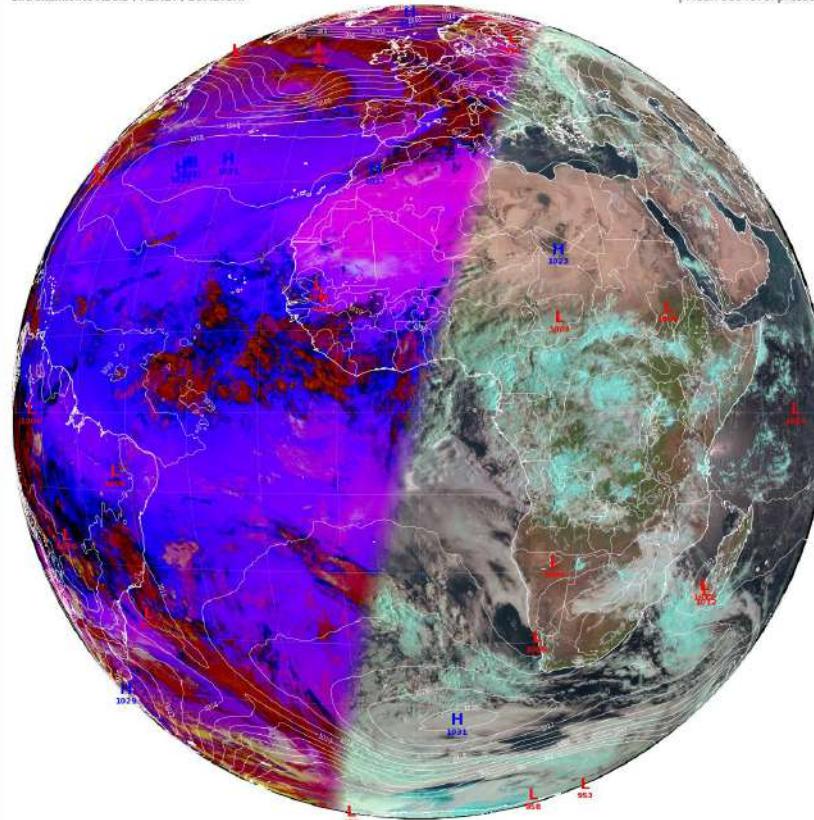
# -----
# Training - Satellite Data Access and Processing - Example 12: MSG 0° and NWP Data
# Author: Diego Souza (INPE/CGCT/DISMM)
# -----
#
# 'msg0' tested with data since March 26 2004 (every 15 minutes)
#
# select the composite (the options below have been tested):
# 'VIS006', 'VIS008', 'IR_016', 'IR_039', 'MW_062', 'MW_073', 'IR_087', 'IR_097', 'IR_108', 'IR_129', 'IR_134'
# 'airmass', 'ash', 'cloudtop', 'cloudtop_daytime', 'colorized_ir_clouds', 'convection', 'day_microphysics', 'day_mic
# 'natural_color', 'natural_color_nocorn', 'natural_color_raw', 'natural_color_raw_with_night_in', 'natural_color_wit
# 'night_ir_alpha', 'night_microphysics', 'overview', 'overview_raw', 'rocket_plume_night', 'snow'
#
plot_sat(sat='msg0',
          date_set='2023-11-01 06:00',
          composite='natural_with_night_fog',
          area='full_disk',
          extent=[-90.0, -60.0, -30.0, 15.0],
          coast_color='white',
          countries_color='white',
          grid_color='white',
          figsize=[15,15])
#
# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21 00:00')
# gfs data available for download since February 26 2021 00:00 ('2021-02-26 00:00')
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'
#
# mean sea level pressure
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-11-01 06:00',
          area='previous', ←
          extent=[-180.0, -70.0, 70.0, 70.0],
          fxx='date',
          var='msl', scale=0.01, offset=0,
          level_hpa='',
          level_min=990, level_max=1050, level_int=4,
          plot_type='c_unfilled', contour_color='white',
          apply_cmap=False, cmap='jet',
          view_clabel=True, fontsize=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])

```

area = 'previous'

MSG 0° - natural_with_night_fog
2023-11-01 06:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 06:00 UTC 01 Nov 2023
| Mean sea level pressure



Ejemplo 13: Descargando y Graficando Datos METAR

Ejemplo 13: Descargando Datos METAR desde Unidata y Graficando la Imagen

```
# Training - Satellite Data Access and Processing - Example 13: METAR Data Access and Visualization  
# Author: Diego Souza (INPE/CGCT/DIISM)  
  
#  
  
# metar data available for the last 10 days, for each hour  
  
# metar plot  
plot_metar(date_metar='2023-10-25 12:00',  
            area='custom',  
            extent= [-90.0, -60.0, -30.00, 15.00],  
            radius=3, land_ocean=True, land_color = 'beige', ocean_color = 'lightblue',  
            figsize=[15,15])
```

```
Downloading the following METAR file from UNIDATA THREDDS Data Server: metar_20231025_1200.txt  
  
Plotting the METAR file: metar_20231025_1200.txt  
  
Total processing time (metar): 20.24 seconds.  
  
'output/metar_2023-10-25_12:00.png'
```



Ejemplo 14: Satélites, Modelos y METAR

- Ejemplo 14: Datos de Satélites, Modelos y METAR

Ejemplo 14.1

```

# Training - Satellite Data Access and Processing - Example 14.1: Satellite, NWP and METAR
# Author: Diego Souza (INPE/CGCT/DISSM)
# ...

# georing available since June 06 2021 18:00 UTC ('2021-06-06 18:00' (note: data available every 3 hours)
# available composites: 'ir108', 'airmass', 'natural_color', 'ash', 'dust'
# Max. res: 6
plot_ring(date_sat='2023-10-26 15:00',
          composite='airmass',
          resolution=6,
          area='custom',
          extent=[-90.0, -60.0, -30.0, 15.0],
          coast_color='black',
          countries_color='gray',
          grid_color='white',
          overwrite=True,
          figsize=[15,15])

# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21 00:00')
# gfs data available for download since February 26 2021 00:00 ('2021-02-26 00:00')
# gfs products: 'prgb2.0p25', 'prgb2.0p50', 'prgb2.1p00'

# mean sea level pressure
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-26 15:00',
          area='previous',
          extent=[-90.0, -60.0, -30.0, 15.0],
          fxx='date',
          var='msl', scale=0.01, offset=0,
          level_hpa='',
          level_min=990, level_max=1050, level_int=1,
          plot_type='c_unfilled', contour_color='white',
          apply_cmap=False, cmap='jet',
          vcm_label=True, fontsize=4,
          linewidth=0.5, linestyle='solid',
          land_ocean=True, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])

# metar data available for the last 10 days, for each hour

# metar plot
plot_metar(date_metar='2023-10-26 15:00',
            area='previous',
            extent=[-90.0, -60.0, -30.0, 15.0],
            radius=3, land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
            figsize=[15,15])

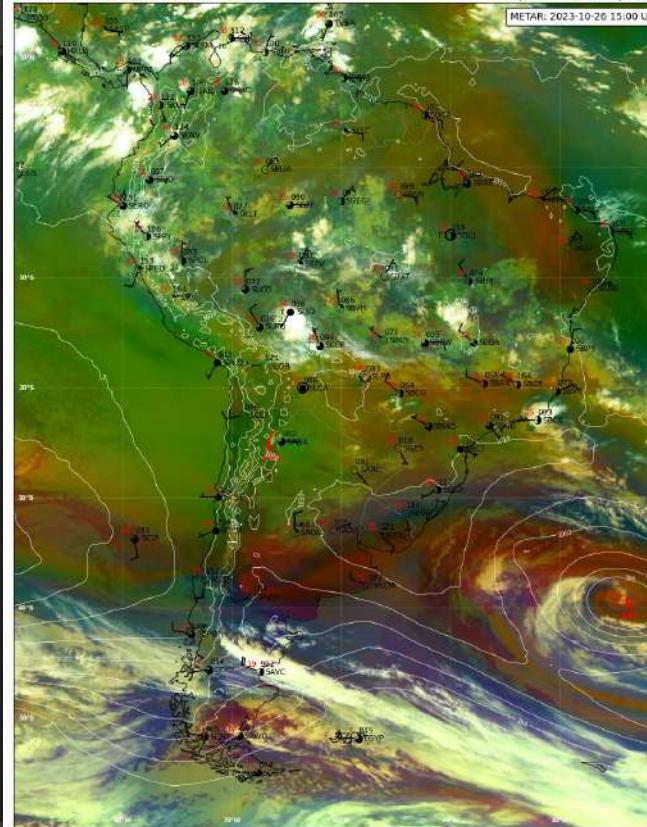
```

area = 'previous'

area = 'previous'

Geostationary Ring (EUMETVIEW) - airmass
2023-10-26 15:00 UTC
Entrenamiento AECLD / AEMET / EUMETSAT

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 15:00 UTC 26 Oct 2023
| Mean sea level pressure



Ejemplo 14: Satélites, Modelos y METAR

Ejemplo 14.2

```

# Training - Satellite Data Access and Processing - Example 13.1: Satellite, MWP and METAR
# Author: Diego Souza (INPE/CGCT/DISSM)
#
# goes-16
plot_sat(sat='goes16',
          date_sat='2023-10-27 13:00',
          composite='colorized_ir_clouds',
          area='full_disk',
          extent=[-90.0, -60.00, -30.00, 15.00],
          coast_color='white',
          countries_color='white',
          grid_color='white',
          figsize=[15,15])

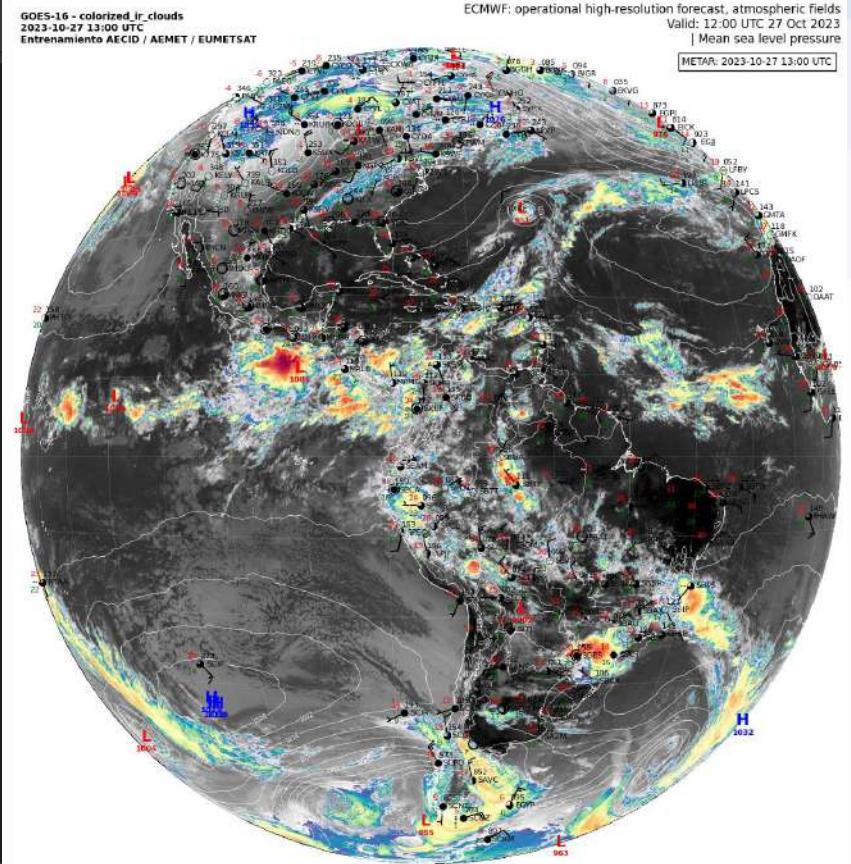
# mean sea level pressure
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-10-27 13:00',
          area='previous',
          extent=[-110.0, 0.00, -60.00, 30.00],
          fxx='date',
          var='msl', scale=0.01, offset=0,
          level_hpa='',
          level_min=990, level_max=1050, level_int=4,
          plot_type='c_unfilled', contour_color='white',
          apply_cmap=False, cmap='jet',
          view_clabel=True, fontsize=6,
          linewidth=0.5, linestyle='solid',
          land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])

# metar plot
plot_metar(date_metar='2023-10-27 13:00',
            area='previous',
            extent= [-110.0, 0.00, -60.00, 30.00],
            radius=300000, land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
            figsize=[15,15])

```

area = 'previous'

area = 'previous'



Ejemplo 15: Animaciones (Satélites)

Ejemplo 15: Creando Animaciones

Ejemplo 15.1 Animaciones con Datos de Satélites

```
# Training - Satellite Data Access and Processing - Example: Creating Animations
# Authors: Diego Souza/CNPEM/COPAC/DESPAP
# ...

# start date
date_init = '2022-11-01 12:00'
# end date
date_end = '2022-11-01 13:00'
# interval (minutes)
interval = 20

# convert to datetime objects
date_init = datetime.strptime(date_init[0:4], '%Y-%m-%d') + timedelta(hours=12)
date_end = datetime.strptime(date_end[0:4], '%Y-%m-%d') + timedelta(hours=12)

# create our references for the loop
date_loop = date_init

# list that will store images
images = []

# ...

# loop between dates
while (date_loop < date_end):

    # convert date time to string
    date = date_loop.strftime('%Y-%m-%d %H:%M')

    # INSERT YOUR FUNCTION HERE WITH "plots"
    # ...

    # call the function
    image = plot_sat(xext='globe',
                      date_satellite=date,
                      composition='GIF',
                      resolution='10km',
                      extent=(-90.0, -10.0, -30.0, 15.0),
                      coast_color='white',
                      countries_color='white',
                      grid_color='white',
                      font_size=(8,8))

    # add the image to the list
    print(f'({image})')
    images.append(image)

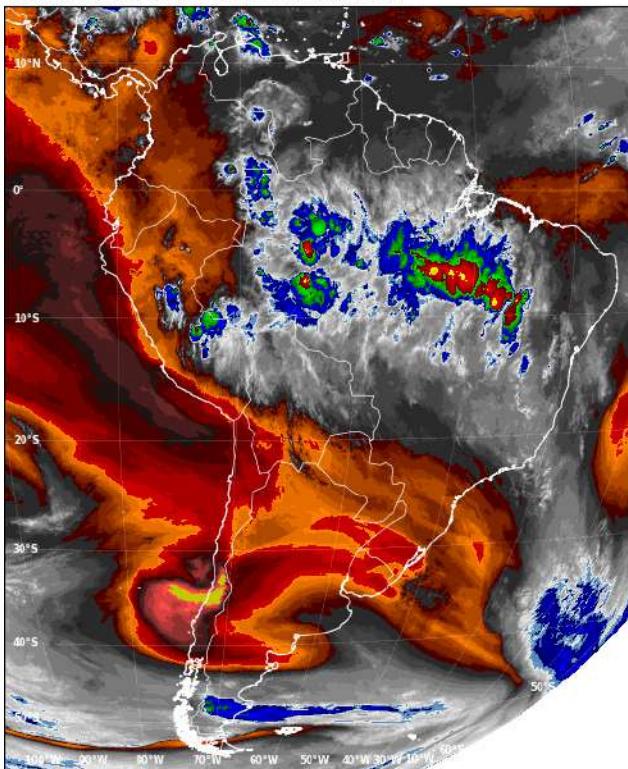
    # increases the date init
    date_loop = date_loop + timedelta(minutes=interval)

# ...

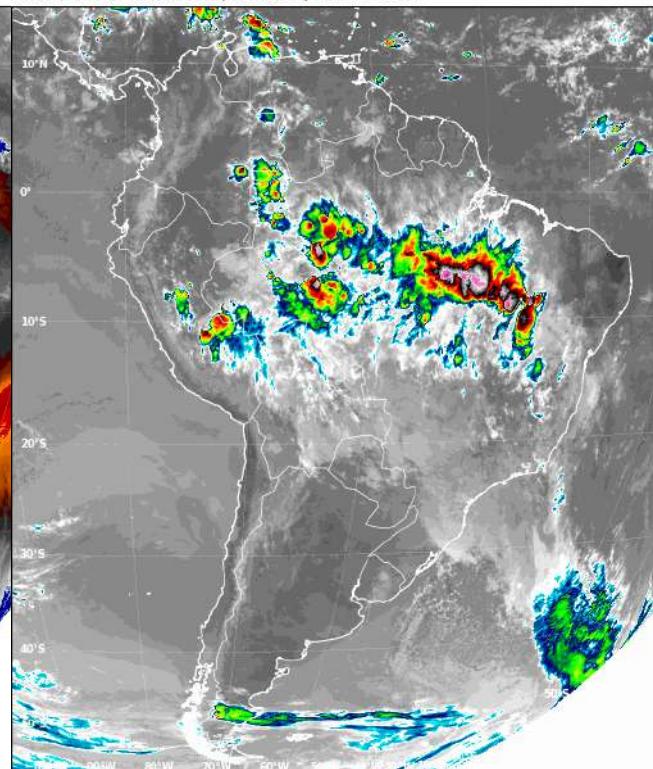
# create the GIF with imageio
filos = []
for image in images:
    filos.append(imageio.imread(image))
imageio.mimwrite('output/animation_gif.gif', filos, loop=0, fps=1)

# open the gif
print('Opening the GIF...\\n')
from IPython.display import Image
Image(filename='output/animation_gif.gif', retina=True)
```

GOES-16 - C09 - 6.95 µm (6.75-7.15 µm)
2022-11-01 12:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



GOES-16 - C13 - 10.35 µm (10.1-10.6 µm)
2022-11-01 12:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 15: Animaciones (Satélites)

1. Elegir fecha inicial, fecha final e intervalo

Ejemplo 15: Creando Animaciones

Ejemplo 15.1 Animaciones con Datos de Satélites

```
#  
# Training - Satellite Data Access and Processing - Example: Creating Animations  
# Author: Diego Souza (INPE/CGCT/DISSM)  
#  
  
# start date  
date_ini = '2022-11-01 12:00'  
  
# end date  
date_end = '2022-11-01 15:00'  
  
# interval (minutes)  
interval = 20
```

2. Pegar la función en esta región

```
while (date_loop <= date_end):  
  
    # convert date time to string  
    date = date_loop.strftime('%Y-%m-%d %H:%M')  
  
    #####  
    # INSERT YOUR FUNCTION HERE WITH "DATE"  
    #####  
  
    # call the function  
    image = plot_sat(sat='goes16',  
                     date_sat=date, ←  
                     composite='C09',  
                     area='custom_geo',  
                     extent=[-90.0, -60.0, -30.0, 15.00],  
                     coast_color='white',  
                     countries_color='white',  
                     grid_color='white',  
                     figsize=[8,8])  
  
    #####  
  
    # add the image to the list  
    print(f'{image}\n')  
    images.append(image)  
  
    # increment the date_ini  
    date_loop = date_loop + timedelta(minutes=interval)
```

Cambiar para
'date'

Ejemplo 15: Animaciones (Modelos)

ECMWF: operational high-resolution forecast, atmospheric fields
 Valid: 15:00 UTC 25 Oct 2023
 | Mean sea level pressure

Ejemplo 15.2 Animaciones con Datos de Modelos

```
# Training - Satellite Data Access and Processing - Example: Creating Animations
# Author: Diogo Souza (COPERNICUS/INPE)

# start date
date_ini = '2023-10-25 23:00'
# end date
date_end = '2023-11-01 23:00'
# interval (minutes)
interval = 1440

# convert to datetime objects
date_ini = datetime.strptime(date_ini,"%Y-%m-%d %H:%M")
date_end = datetime.strptime(date_end,"%Y-%m-%d %H:%M")
date_end += timedelta(minutes=10)
date_ini -= timedelta(minutes=10)

# create our filenames for the loop
date_loop = date_ini

# list that will store images
images = []

# loop between dates
while date_loop < date_end:

    # convert date time to string
    date = date_loop.strftime("%Y-%m-%d %H:%M")

    # import your function here with 'date'
    # import myfunction as mf

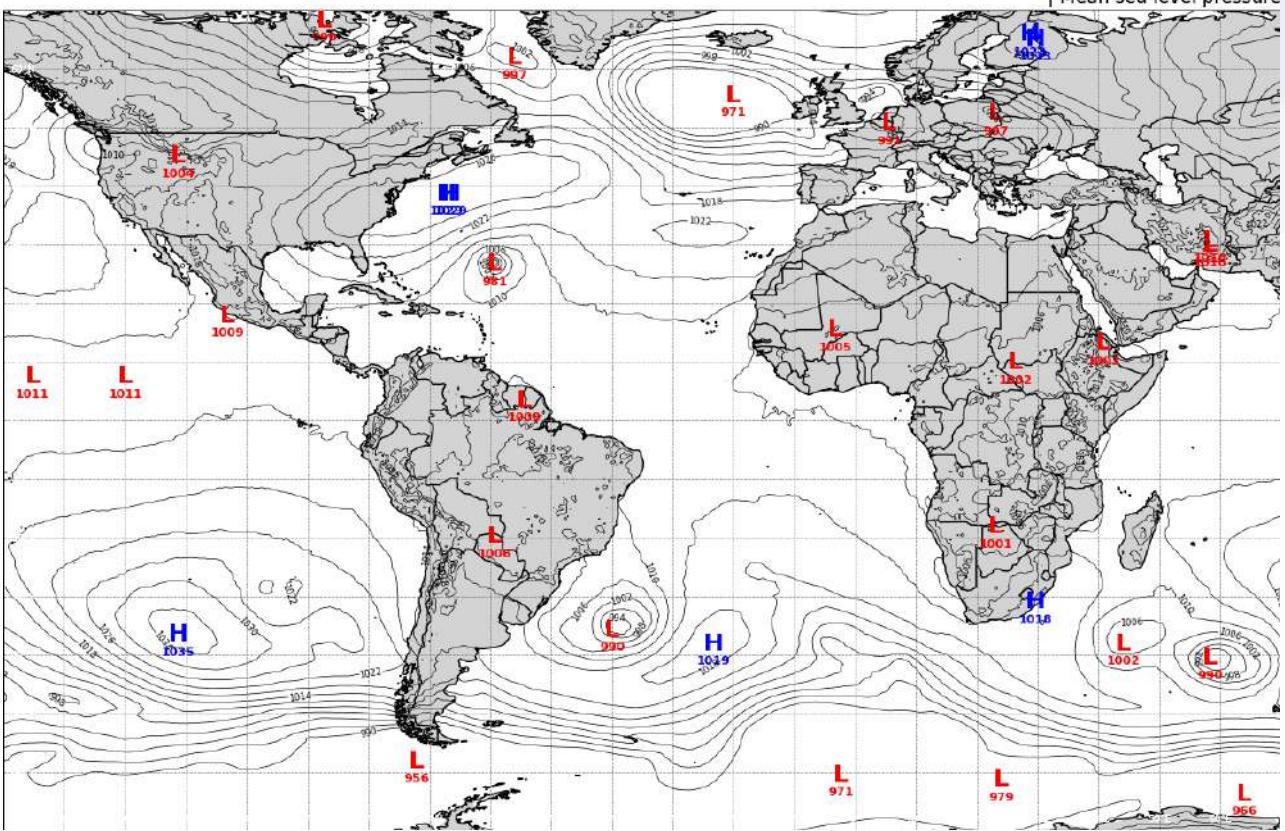
    # call the function
    # a geopotential height (500 hPa) [4000-0000] and 500 hPa [0500-0500]
    # are required
    image = mf.read_model('ecmf',
                          product='oper',
                          date=date,
                          region='global',
                          estimate=144.0,
                          var='dhgt',
                          var_level=1,
                          scale=0.01,
                          offset=0,
                          level_type='isobaric',
                          level_min=900,
                          level_max=900,
                          level_int=4,
                          plot_type='contourfilled',
                          contour_color='black',
                          map_cmap='viridis',
                          cmap_int=100,
                          view_cramer=True,
                          runoutline=True,
                          land_color='white',
                          ocean_color='lightgray',
                          ocean_color_ocean='white',
                          alpha=1.0,
                          title='None',
                          #gridsize=(10,10))

    # add the image to the list
    print(f'Image {date}')
    images.append(image)

    # increment the date
    date_loop = date_loop + timedelta(minutes=interval)

# create the GIF with images
files = []
for image in images:
    files.append(image)
    image.save('output/animation_mg01.gif')
    files.pop(0)
image.animation('output/animation_mg01.gif', files, loop=0, fps=1)

# open the GIF
print('Opening the GIF')
print('Python display import image')
image.open('output/animation_mg01.gif').read()
```



Ejemplo 15: Animaciones (Multimisión + Modelos)

```

Cerro 15.9 Animaciones con Datos de Satélites (Multimisión) y Datos de Modelos

# Training - Satellite data access and Processing - Chapter 15: Creating animations
# Author: Diego Souza (DPS/ECC/DESN)
# Date: 2023-10-25 15:00 UTC
# Entrenamiento AECID / AEMET / EUMETSAT

# Start date
date_start = "2023-10-25 15:00 UTC"
# End date
date_end = "2023-11-01 00:00"
# Interval (minutes)
interval = 1440

# Create a list of images
dates_list = [date_start]
for i in range(1, 10):
    date_end = date_end.replace("00:00", str(i).zfill(2))
    dates_list.append(date_end)

# Create our references for the loop
date_start = date_start.replace("00:00", "00")
date_end = date_end.replace("00:00", "00")

# Loop between dates
while date_start <= date_end:
    # Convert date to string
    date = date_start.strftime("%Y-%m-%d %H:%M")
    
    # Direct visualization here with "plot"
    # Direct visualization here with "plot"
    
    # Geostationary ring
    plot_geostationary(
        satellite=satellite,
        resolution=resolution,
        area=[area],
        extent=[-120, 10, 70, 90],
        levels=[1000, 850, 700, 600, 500],
        contours=True,
        grid=True,
        labels=True,
        alignto=(10, 10))

    # Mean sea level pressure
    image = plot_mean_sea_level(
        pressure_type="mslp",
        area=[area],
        extent=[-120, 10, 70, 90],
        levels=[1000, 980, 960, 940, 920, 900],
        plot_type="contours", center_color="white",
        apply_map=True, map=True,
        land_color="darkgrey", ocean_color="white",
        sigma=0.5, sigma_low=0.5,
        sigma_high=0.5)

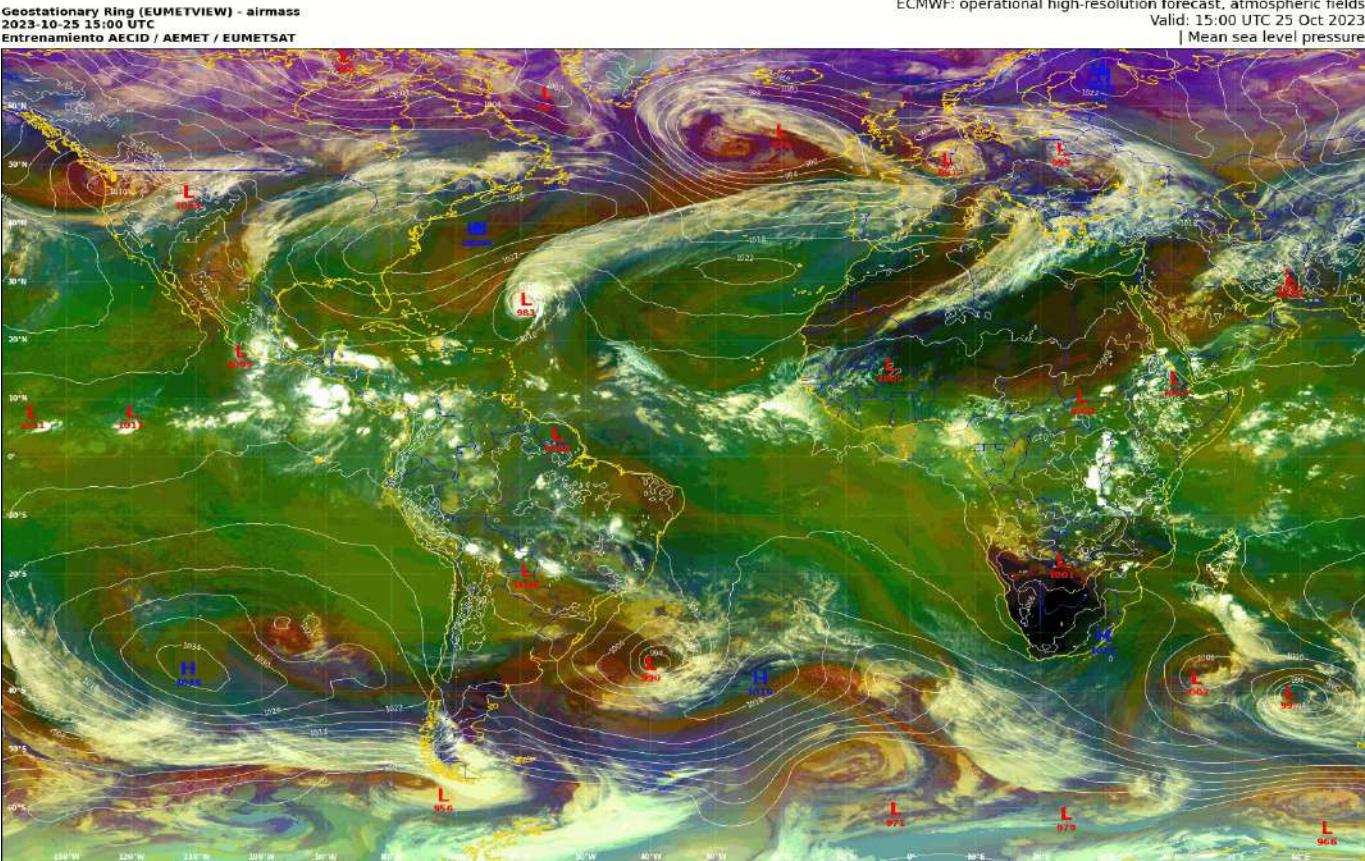
    # Add the image to the list
    print(f"Image {i}")
    images.append(image)

    # Increase the date
    date_start = date_start + timedelta(minutes=interval)

# Create the GIF with images
files = []
for image in images:
    files.append(image)
image.concatenate(images=files, ext="gif", delay=0, loop=0)

# Open the GIF
print("Opening the gif...") 
from IPython.display import Image
Image(filename="multimision_15.9.gif", width=1000, height=1000)

```



Ejemplo 15: Animaciones (Satélites + Modelos)

```
Ejemplo 15.4 Animaciones con Datos de Satélites o Datos de Modelos

# Training - Satelite Data access and Processing - Example creating animations
# Author: Blagoj Simev (CMF/CAET/ISMMI)

# Set start date
date_start = 2023-08-21 23:00
# Set end date
date_end = 2023-08-22 05:00
# Interval (minutes)
interval = 300

# Set our date range
date_start = date_start.replace(tzinfo=None)
date_end = date_end.replace(tzinfo=None)
date_start = date_start + timedelta(minutes=interval)
date_end = date_end - timedelta(minutes=interval)

# Create our filenames for the loop
out_file = date_start.strftime("%Y-%m-%d %H-%M-%S")
# This will add .png to the images
image = [out_file]

# Loop through dates
while date_start <= date_end:
    # Request time slice from sat
    date = date_start.strftime("%Y-%m-%dT%H:%M:%S")
    date_end = date_end.strftime("%Y-%m-%dT%H:%M:%S")
    # Create our filenames for the loop
    out_file = date.strftime("%Y-%m-%d %H-%M-%S")
    # This will add .png to the images
    image.append(out_file)

    # Satellite plot
    plot_satellite_gmtc(
        plot_satellite_gmtc,
        date=date,
        coordinates='lat-lon',
        map_type='full disk',
        extent=(-90.0, -40.0, -30.0, 10.0),
        resolution='0.05deg',
        countries=countries,
        grid_resolution='0.05deg',
        fileplace=[20, 20])

    # Create our level pressure
    image = plot_magnetics_harper(
        image,
        date=date,
        map_type='full disk',
        area='precise',
        area_center=(0.0, -40.0, 0.0, 0.0),
        fileplace=[20, 20],
        map_type='full disk',
        extent=(-90.0, -40.0, -30.0, 10.0),
        resolution='0.05deg',
        levels=levels,
        levels_min=1000,
        levels_max=1010,
        plot_type='contilled',
        contour_color='white',
        apply_magnetics=True,
        plot_magnetics=True,
        magnetics_color='white',
        magnetics_min=-1000,
        magnetics_max=1000,
        land_seas_color='lightgrey',
        land_seas_min=-1000,
        land_seas_max=1000,
        apply_magnetics=True,
        fileplace=[20, 20])

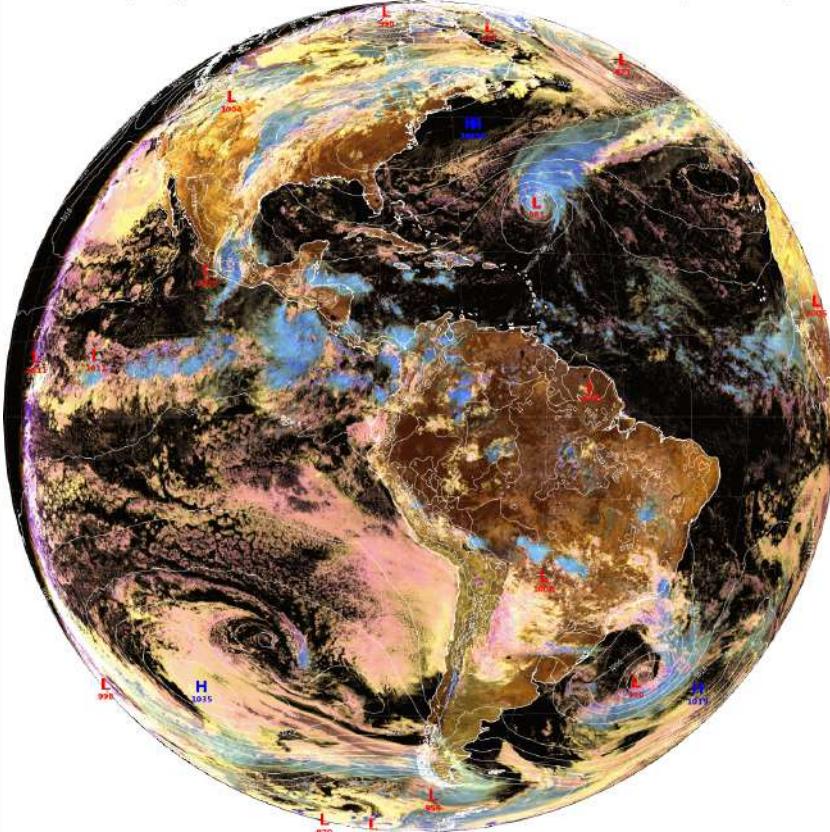
    # Use the image to the list
    print(f"Adding {image[-1]}")
    image.append(image[-1])
    # Increment the date
    date_start += timedelta(minutes=interval)
    image.append(date_start.strftime("%Y-%m-%d %H-%M-%S"))

# Create the gif with images
file = "Ejemplo_15.4.gif"
for image in image:
    plt.imshow(image)
    plt.pause(0.001)
    plt.savefig(file)
    plt.close()

# Open the gif
print("Opening the gif...")
```

GOES-16 - cloud_phase
2023-10-25 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 15:00 UTC 25 Oct 2023
| Mean sea level pressure



Ejemplo 15: Animaciones (Satélites + Modelos + METAR)

```

Ejemplo 15 Animación de sensores de Satélites, Modelos y METAR

# This script generates an animation of satellite imagery, model forecasts, and METAR observations for Brazil. It uses the Geostationary Ring (EUMETVIEW) sensor, ECMWF operational high-resolution forecast for atmospheric fields, and METAR data from AEMET/EUMETSAT.

# Configuration parameters
# Sensor
sensor = "eumetview"
# Forecast
forecast = "ecmwf"
# METAR
metar = "aemetsat"
# Interval
interval = 3000

# Data retrieval
# Sensor data
date_sen = "2023-10-25 15:00 UTC"
# METAR data
date_mete = "2023-10-25 15:00 UTC"
# Interval (seconds)
interval_sen = 3000
# Interval (minutes)
interval_mete = 3000

# Create output directory if it doesn't exist
if not os.path.exists("output"):
    os.makedirs("output")

# Loop over time steps
for i in range(0, 100, interval):
    # Get sensor data
    date_sen = datetime.datetime.now() - timedelta(minutes=30)
    date_sen = date_sen.strftime("%Y-%m-%d %H:00 UTC")
    date_mete = date_sen

    # Convert date to string for saving
    date_sen = date_sen.replace(":", "-").replace(" ", "-")
    date_mete = date_mete.replace(":", "-").replace(" ", "-")

    # Create output file names
    output_sen = f"output/{date_sen}_satellite.png"
    output_mete = f"output/{date_sen}_model.png"

    # Fetch sensor data
    # (Implementation details for fetching sensor data are omitted here)

    # Fetch model forecast
    forecast_data = forecast.get_forecast(date_sen)

    # Fetch METAR observations
    metar_data = metar.get_metar(date_mete)

    # Process sensor data
    # (Implementation details for processing sensor data are omitted here)

    # Process model forecast
    # (Implementation details for processing model forecast are omitted here)

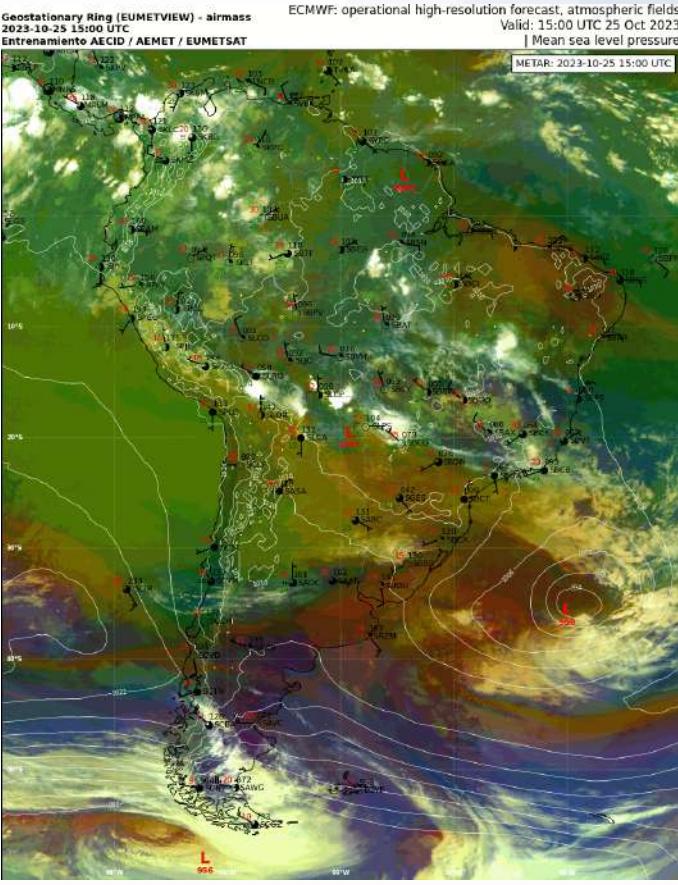
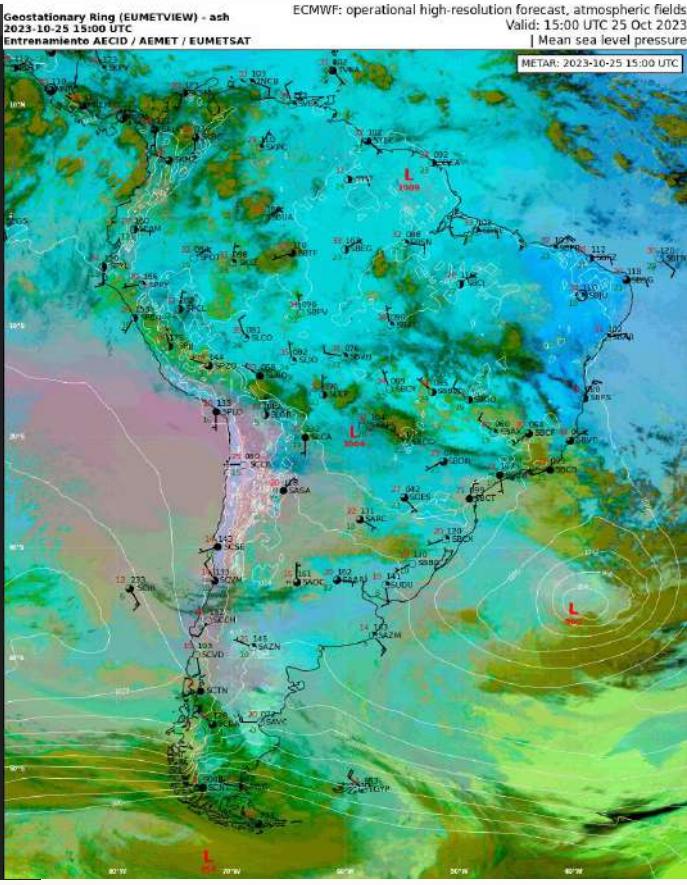
    # Process METAR observations
    # (Implementation details for processing METAR observations are omitted here)

    # Create final image by overlaying sensor, model, and METAR data
    # (Implementation details for creating final image are omitted here)

    # Save final image
    # (Implementation details for saving final image are omitted here)

# Clean up temporary files
# (Implementation details for cleaning up temporary files are omitted here)

```



Productos y Aplicaciones de Satélite en Latitudes Medias - Fase Presencial

Acceso y Procesamiento de Datos
Satelitales - Prácticas

¡GRACIAS! ¿PREGUNTAS?



Diego Souza
diego.souza@inpe.br

DISSM - División de Satélites y Sensores Meteorológicos
CGCT - Coordinación General de Ciencias de la Tierra
INPE - Instituto Nacional de Investigaciones Espaciales

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA
E INOVAÇÃO

GOVERNO FEDERAL
BRASIL
UNIÃO E RECONSTRUÇÃO

Productos y Aplicaciones de Satélite en Latitudes Medias - Fase Presencial

Prácticas LSA SAF y H SAF



Diego Souza
diego.souza@inpe.br

DISSM - División de Satélites y Sensores Meteorológicos
CGCT - Coordinación General de Ciencias de la Tierra
INPE - Instituto Nacional de Investigaciones Espaciales

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA
E INOVAÇÃO

GOVERNO FEDERAL
BRASIL
UNIÃO E RECONSTRUÇÃO

ACCESO A LOS DATOS LSA SAF (LAND SURFACE ANALYSIS)



Informaciones em la Pagina LSA SAF

<https://landsaf.ipma.pt/>

Aplicaciones, descripciones de productos y otras informaciones

Fire Radiative Power
Composite 23 October 2017
Fire Confidence > 80%

Applications

- Forestry & Wildfires
- Renewable Energy
- Agrometeorology
- International Technology
- Climate Studies
- Natural Hazards

Latest News

- 08/03/2023 09:07: New operational data access service and discontinuation of website orders (see details)
- 08/03/2023 09:17: Previous operational data access service discontinued (see details)
- 08/03/2023 09:19: Verification of modeled shortwave radiation using LSA SAF MDSSFTD data
- 08/03/2023 09:20: Verification of nowcasting model output over Slovenia
- 08/03/2023 09:21: New operational data access service and discontinuation of website orders
- 08/03/2023 09:22: New LSA SAF data access service becomes operational
- 08/03/2023 09:23: The Largest Wildfire in Slovenia in Recent Decades
- 08/03/2023 09:24: Analysing Fires with LSA SAF Fire Radiative Power Pixel

MDSS - Latest Generated Products

LSA SAF

landsaf.ipma.pt/en/

LSA SAF
LAND SURFACE ANALYSIS

Fire Radiative Power
Composite 23 October 2017
Fire Confidence > 80%

Applications

- FORESTRY & WILDFIRES
- RENEWABLE ENERGY
- AGROMETEOROLOGY
- INTERNATIONAL TECHNOLOGY
- CLIMATE STUDIES
- NATURAL HAZARDS

Latest News

- Verification of modeled shortwave radiation using LSA SAF MDSSFTD data (June 26, 2023)
- Verification of a nowcasting model output over Slovenia
- New operational data access service and discontinuation of website orders (March 24, 2023)
- New LSA SAF data access service becomes operational
- The Largest Wildfire in Slovenia in Recent Decades (Jan. 18, 2023)
- Analysing Fires with LSA SAF Fire Radiative Power Pixel

Informaciones Sobre Productos

<https://landsaf.ipma.pt/en/data/products/>

LSA SAF
Land Surface Analysis

Home | About | Applications | Data | User Support | News

Land Surface Products

- ALEBRO**: Land Surface Albedo
- LAND SURFACE TEMPERATURE AND EMISSIVITY**: Land Surface Temperature, Land Surface Emissivity
- SURFACE RADIATION**: Downward Shortwave Flux, Downward Longwave Flux, Net Longwave Flux
- VEGETATION**: Leaf Area Index, Fraction of Vegetation Cover, Absorbed Photosynthetic Active Radiation, Gross Primary Production, Normalized Difference Vegetation Index
- EVAPORATION AND TURBULENT FLUXES**: Actual Evapotranspiration, Reference Evapotranspiration, Latent and Sensible Heat Fluxes
- WILDFIRE**: Fire Radiative Power, Fire Risk Mapping

LSA SAF System maintained in cooperation with:

- IPMA
- INTERMAP
- MET
- KING'S LONDON
- UNIVERSITY OF KIT
- VITO
- CPTEC/INPE
- deimos
- SAF

Disclaimer: All intellectual property rights of the LSA SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge. If you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the words "copyright (year) EUMETSAT" in each of the products used.

Land Surface Temperature and Emissivity

Land Surface Temperature (LST)

Land Surface Temperature (LST) provides a daily global product derived from the thermal infrared bands of the ERS-1, ERS-2, and Envisat sensors. The product is generated using a multi-temporal approach, combining information from all three sensors to produce a daily product. The product is generated using a multi-temporal approach, combining information from all three sensors to produce a daily product.

Land Surface Emissivity (LSE)

Land Surface Emissivity (LSE) provides a daily global product derived from the thermal infrared bands of the ERS-1, ERS-2, and Envisat sensors. The product is generated using a multi-temporal approach, combining information from all three sensors to produce a daily product.

Files - LSASAF Nextcloud

nextcloud.lsasaf.ipma.pt/s/NsW275gpDAfekzc

EDLST

Show outline

EDLST Algorithm change record

Version	Date	Description
1.1.1	2021/05/18	Bug fix on QFLAG over inland water
<input type="checkbox"/> Name		
<input type="checkbox"/> ATBD		
<input type="checkbox"/> PUM		
<input type="checkbox"/> VR		
<input type="checkbox"/> README.md		

LSASAF N

Get yo

Páginas de Registro y Acceso al LSA SAF Data Service

<https://mokey.lsasvcs.ipma.pt/auth/signup>

LSA SAF Data Service

Create Account

Username Username

Only lowercase alphanumeric characters

First Name First Name

Last Name Last Name

Email Email Address

Confirm Email

Password Password

Minimum of 8 characters and at least 1 number or special character

Confirm Password

Type the numbers you see in the picture below: Reload



[Sign Up](#)



<https://datalsasaf.lsasvcs.ipma.pt/>

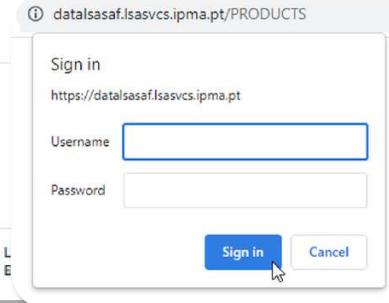
Home

LSA SAF Data Service

Welcome to the LSA SAF data service.



[Click here to Register](#) [Forgot your Password?](#)



ARSO METEO
Slovenian Environment Agency



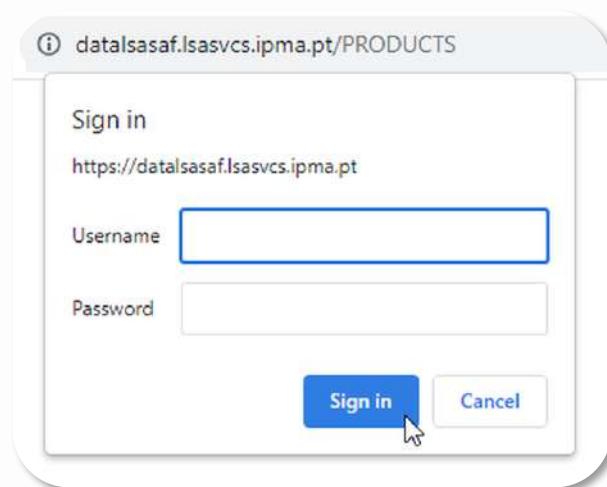
Disclaimer: All intellectual property rights of the L
free of charge. If you wish to use these products, E
each of the products used.

LSA SAF System
maintained in
cooperation with:

These products is granted to every interested user,
by saying the words "copyright (year) EUMETSAT" on

Informaciones: Usuario e Contraseña

Durante el entrenamiento necesitaremos el nombre de usuario y la contraseña para acceder a los datos a través de scripts python



Nota: Despues de registrarse, podrá acceder al servidor manualmente o mediante script transcurridos aproximadamente 30 minutos.

```
[ ] # download a sample of the 10-day composite of MLST (LST retrieval from clear-sky infrared observations performed by SEVIRI/MSG)
# note: after creating the LSA-SAF account it takes about 30 minutes to be able to use it.

!wget -c --no-check-certificate \
--user=██████████ --password=██████████ -P /content/samples \
https://datalsasaf.lsasvcs.ipma.pt/PRODUCTS/MSG/DLST/NETCDF/2023/07/11/NETCDF4_LSASAF_MSG_DLST-MAX10D_MSG-Disk_202307112345.nc
```

Near Real Time Access x +

landsaf.ipma.pt/en/data/nearrealtime/

EUMETSAT
LSA SAF
LAND SURFACE ANALYSIS

Home About Applications Data User Support News

Near Real Time Data Access

Near real time data is available by:

- **EUMETCast** - Some LSA SAF Operational products are disseminated through the EUMETSAT's Broadcast System for Environmental Data. All users owning an EUMETCast Client station may receive LSA SAF Operational Products. For more information please check [here](#).
- **Automatic FTP Dissemination** - All Products (including Internal Products) are available to users through an LSA SAF FTP server. Users can request this service by sending an e-mail to [LSA SAF helpdesk](#) contact, indicating:
 - contact name and e-mail address
 - product(s) of interest

All LSA SAF products are distributed according with EUMETSAT data policy and have been classified as essential and are distributed free of charge.

 LSA SAF System maintained in cooperation with:





Interfaz de Acceso LSA SAF

PRODUCTS - datalsasaf.lsasvcs.ipma.pt X +

datalsasaf.lsasvcs.ipma.pt/PRODUCTS/ https://datalsasaf.lsasvcs.ipma.pt/PRODUCTS/

datalsasaf.lsasvcs.ipma.pt > PRODUCTS

powered by h5ai

	Name	Last modified	Size
◀	datalsasaf.lsasvcs.ipma.pt		
▶	EPS	2022-10-11 13:56	
▶	MSG	2023-07-05 07:27	
▶	MSG-IODC	2022-10-17 13:14	
M▼	Readme.md	2023-04-06 11:45	6 KB

◀ datalsasaf.lsasvcs.ipma.pt

▶ EPS ← Metop 2022-10-11 13:56

▶ MSG ← Meteosat 0° 2023-07-05 07:27

▶ MSG-IODC ← Meteosat 45.5° 2022-10-17 13:14

M▼ Readme.md ← Descripción de acrónimos y otras informaciones 2023-04-06 11:45 6 KB

Acrónimos LSA SAF

Welcome to the LSA SAF Data service.

For queries, contact helpdesk.lsat@inpe.br.

Check the data service user guide for tips to access the data.

The recommended way to download several products is with the `wget` tool which is available in most Linux distributions. Windows Binaries can be found here:

For example to download LST hourly files (lapping minutes 15, 30, 45) for Jan 2006 you can use the following command (don't forget the last "\"):

```
wget -c --no-check-certificate -r -nH -A "LST_HR_15M_*" -P ./output
-w "15_mn_15m_nc_*45_mn_*30m_nc_*15m_nc_*"
https://nltsat.lsaf.eea.ec/Products/Program/NETCDF/2006/01/
```

You can check the details of each option here. If you add the option "-o" all files are saved to the current directory, otherwise they will be downloaded to a folder structure `PROGRAM/NETCDF/2006/01`.

Data organization

The data is organized as:

<http://nltsat.lsaf.eea.ec/Products/Program/NETCDF/> / [product] / [version] / [month] / [day] / [file]

variables satellite missions, EPS, MSG, MSG-IODC

products derived from the list of variables

Format: Data format: NETCDF, HDFS

year/month/day/year with 2 digits, month with 2 digits, day with 2 digits

Satellite missions

EPS: Meteosat polar orbiting meteorological satellites of the EU/EUMETSAT Polar System

MSG: Meteosat Second Generation, geostationary at 0 degrees East

MSG-IODC: Meteosat Second Generation, geostationary at 45.6/45.8 degrees East Indian Ocean Data Coverage

Products acronym

Acronym Description

Land Surface temperature and emissivity

LST Daily LST 10-day composites

LSME Land Surface Emissivity

LSLT Land Surface Temperature

MLST-AS Land Surface Temperature - All Sky

DLST Daily Land Surface Temperature

Fire

FRP-GRID Fire Radiative Power Gridded

FRP-PIXEL Fire Radiative Power Pixel

FRMv2 Fire Risk Map version 2

Albedo and Vegetation

MDAL Daily Surface Albedo

MDFAPAR Daily Fraction of Absorbed Photosynthetic Active Radiation

MDFVC Daily Fraction of Vegetation Cover

MDLAI Daily Leaf Area Index

MGPP 10-days Gross Primary Production

MTAL 10-day Surface Albedo

MTFAPAR 10-day Fraction of Absorbed Photosynthetic Active Radiation

MTVFC 10-day Fraction of Vegetation Cover

MTLAI 10-day Leaf Area Index

ETAL 10-day Surface Albedo

ETFAPAR 10-day Fraction of Absorbed Photosynthetic Active Radiation

ETFVC 10-day Fraction of Vegetation Cover

ETLAI 10-day Leaf Area Index

ENDVI10 10-daily synthesis Normalized Difference Vegetation Index

Radiation Fluxes

MDIDSLF Daily Downward Surface Longwave Flux

MDIDSSF Daily Downward Surface Shortwave Flux

MDSLF Downward Surface Longwave Flux

MDSSFTD Total and Diffuse Downward Surface Shortwave Flux

MNSLF Net Surface Longwave

Evaporation and turbulent fluxes

METREF Reference Evapotranspiration

MDEMET Daily Evapotranspiration

MET Daily Evapotranspiration

MET Latent heat flux

MH Sensible heat flux

MLE Latent heat flux

HSAT products

MSHC Daily snow cover (HSAT H31)

EDSC Daily Snow Cover (HSAT H32)

Disclaimer:
All intellectual property rights of the LSA SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge, if you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the words "Copyright (year) EUMETSAT" on each of the products used.

Acronym Description

Land Surface temperature and emissivity

DLST Derived LST: 10-day composites

MEM Land Surface Emissivity

MLST Land Surface Temperature

MLST-AS Land Surface Temperature - All Sky

EDLST Daily Land Surface Temperature

Fire

FRP-GRID Fire Radiative Power Gridded

FRP-PIXEL Fire Radiative Power Pixel

FRMv2 Fire Risk Map version 2

Albedo and Vegetation

MDAL Daily Surface Albedo

MDFAPAR Daily Fraction of Absorbed Photosynthetic Active Radiation

MDFVC Daily Fraction of Vegetation Cover

MDLAI Daily Leaf Area Index

MGPP 10-days Gross Primary Production

MTAL 10-day Surface Albedo

MTFAPAR 10-day Fraction of Absorbed Photosynthetic Active Radiation

MTVFC 10-day Fraction of Vegetation Cover

MTLAI 10-day Leaf Area Index

ETAL 10-day Surface Albedo

ETFAPAR 10-day Fraction of Absorbed Photosynthetic Active Radiation

ETFVC 10-day Fraction of Vegetation Cover

ETLAI 10-day Leaf Area Index

ENDVI10 10-daily synthesis Normalized Difference Vegetation Index

Radiation Fluxes

MDIDSLF Daily Downward Surface Longwave Flux

MDIDSSF Daily Downward Surface Shortwave Flux

MDSLF Downward Surface Longwave Flux

MDSSFTD Total and Diffuse Downward Surface Shortwave Flux

MNSLF Net Surface Longwave

Evaporation and turbulent fluxes

METREF Reference Evapotranspiration

MDEMET Daily Evapotranspiration

MET Daily Evapotranspiration

MET Latent heat flux

MH Sensible heat flux

MLE Latent heat flux

HSAT products

MSHC Daily snow cover (HSAT H31)

EDSC Daily Snow Cover (HSAT H32)

Satellite missions Format

MSG HDF5, NETCDF

MSG HDF5, NETCDF

MSG, MSG-IODC HDF5, NETCDF

MSG HDF5, NETCDF

EPS HDF5, NETCDF

MSG HDF5

MSG, MSG-IODC HDF5

MSG HDF5

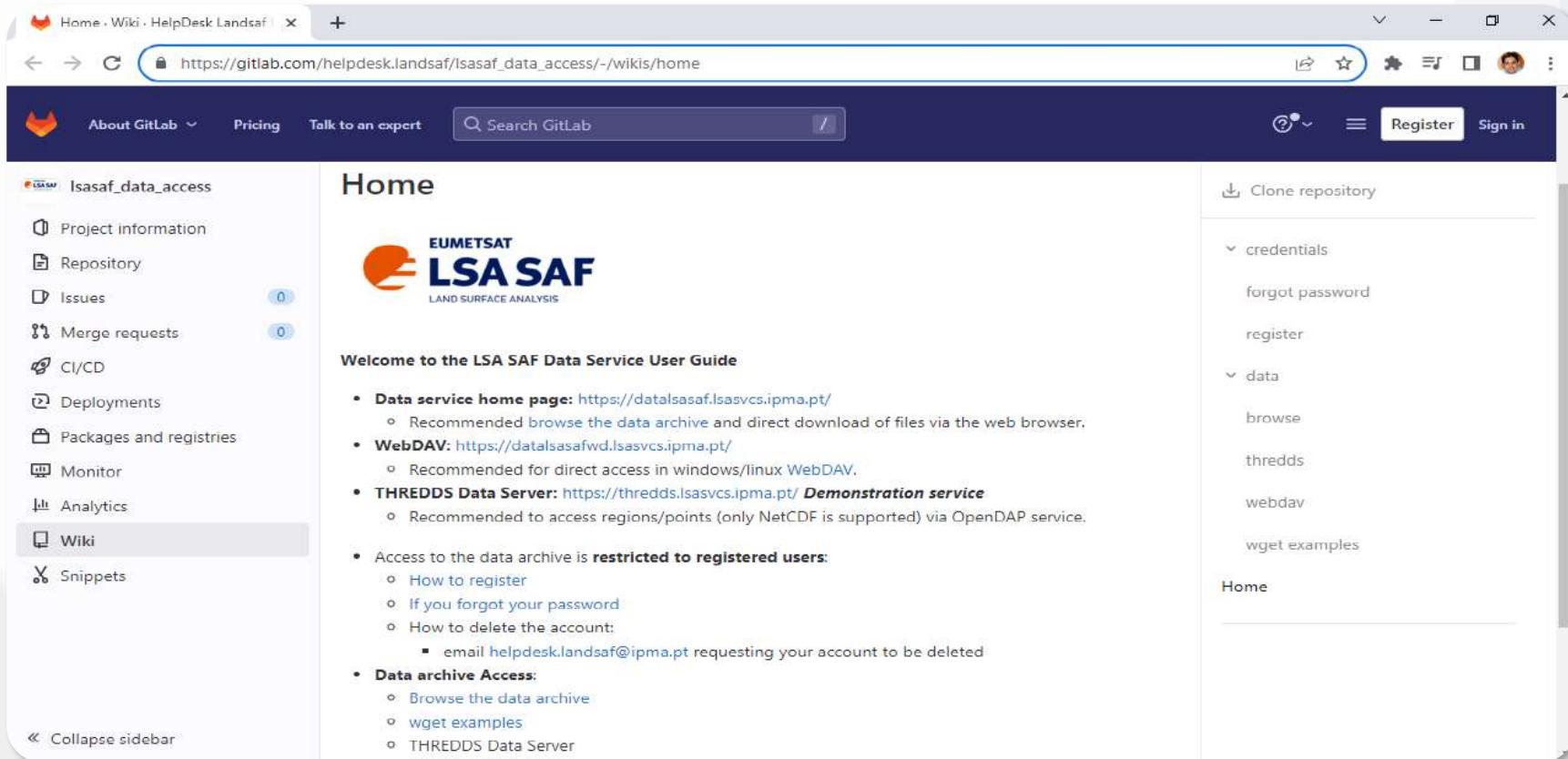
MSG, MSG-IODC HDF5, NETCDF

MSG HDF5

EPS HDF5

Referencia Utilizada Para el Desarrollo LSA SAF

https://gitlab.com/helpdesk.landsaf/lisasaf_data_access/-/wikis/home

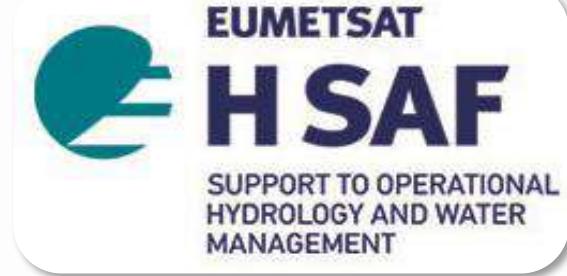


The screenshot shows a GitLab interface for the project "Isasaf_data_access". The left sidebar lists various project sections: Project information, Repository, Issues (0), Merge requests (0), CI/CD, Deployments, Packages and registries, Monitor, Analytics, Wiki (selected), and Snippets. The main content area displays the "Home" page of the LSA SAF Data Service User Guide. It features the EUMETSAT LSA SAF logo and a welcome message. Below the logo, a bulleted list provides instructions for accessing the data service:

- Data service home page:** <https://datalisasaf.lsasaf.ipma.pt/>
 - Recommended browse the data archive and direct download of files via the web browser.
- WebDAV:** <https://datalisasafwfd.lsasaf.ipma.pt/>
 - Recommended for direct access in windows/linux WebDAV.
- THREDDS Data Server:** <https://thredds.lsasaf.ipma.pt/> **Demonstration service**
 - Recommended to access regions/points (only NetCDF is supported) via OpenDAP service.
- Access to the data archive is **restricted to registered users**:
 - [How to register](#)
 - [If you forgot your password](#)
 - [How to delete the account](#):
 - email helpdesk.landsaf@ipma.pt requesting your account to be deleted
- Data archive Access:**
 - [Browse the data archive](#)
 - [wget examples](#)
 - [THREDDS Data Server](#)

The right sidebar contains links for cloning the repository, managing credentials (forgot password, register), and navigating data services (browse, thredds, webdav, wget examples). A "Home" link is also present at the bottom of the sidebar.

ACESSO A DADOS H SAF (HYDROLOGY AND WATER)



Informaciones en la Página H SAF

<https://hsaf.meteoam.it/>

The screenshot shows the main page of the HydroSAF website. At the top, there's a banner with a photo of people in floodwaters and the text "Pakistan's devastating 2022 floods". Below this are three main sections: "Latest news", "Latest products", and "User notifications". The "Latest news" section includes a tweet from @HydroSAF about a rainfall event in Argentina. The "Latest products" section shows a map of precipitation rates. The "User notifications" section has several announcements, one of which is about a visiting scientist at TU Wien.

INPE

KUMITSAT
H SAF
HYDROLOGICAL
SATellite
FOR
MONITORING
AND
ALERTING

HOME ABOUT PRODUCTS NEWS & MEDIA SUPPORT

Click on the slide to read more

Pakistan's devastating 2022 floods

Latest news

Tweets from @HydroSAF Follow

H SAF Retweeted

Lorenzo Arduini @LArduini_ - 9h Anomalia pluviometrica e pluviometria (%) rispetto alla climatologica 1981-2010 in Italia nel periodo Giugno-Luglio. Dimensione x>> Deficit pluviometrico. Colore>> Anomalia Termica. Dati source: Meteonorm

Map showing rainfall anomalies in Italy

Latest products

Product: P-BI-SEVIRI_E [H610] Precipitation rate at ground by GEOPAR moderated by LEOPAR

Map showing precipitation rates

User notifications

announcement 2/4/2023 Dear Users, due to the limited bandwidth on the LAMC Icaro Meirin channel, starting from the 20th of March, the Icaro Meirin channel will be removed. read more...

announcement 4/20/2023 The Data Record Metop-AGCM Surface Soil Moisture Climate Data Record v1 (Version 1.2) (resampling 0.125°) is now available. read more...

announcement 4/11/2023 A Visiting Scientist Activity at TU Wien, Vienna, Austria is available and funded by H SAF. The activity will last from 10 to 14 July 2023. read more...

ECMWF

TELESPAZIO a LEONARDO and THALES company

Disclaimer

Copyright © 2023 EUMETSAT. All rights reserved.

The content has been developed by the Department of Civil Protection – Presidency of the Council of Ministers – Italy.

All intellectual property rights of the H SAF products belong to EUMETSAT. The use of these products is granted to every interested user free of charge. If you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the mark "copyright (2023) EUMETSAT" on each of the products used.

Aplicaciones, descripción de los productos y otras informaciones

The screenshot shows a map of Europe with color-coded drought levels, titled "European drought of summer 2022". To the right of the map is a vertical dropdown menu under the "PRODUCTS" tab, listing "Precipitation", "Soil Moisture", "Snow", "Quality Assessment", "Hydrological Validation", and "Download Products".

HOME

KUMITSAT
H SAF
HYDROLOGICAL
SATellite
FOR
MONITORING
AND
ALERTING

HOME ABOUT PRODUCTS NEWS & MEDIA SUPPORT

hsaf.meteoam.it

Precipitation

Soil Moisture

Snow

Quality Assessment

Hydrological Validation

Download Products

European drought of summer 2022

The screenshot shows a map of Europe with color-coded drought levels, titled "European drought of summer 2022". To the right of the map is a vertical dropdown menu under the "PRODUCTS" tab, listing "Precipitation", "Soil Moisture", "Snow", "Quality Assessment", "Hydrological Validation", and "Download Products".

Latest news

Tweets from @HydroSAF Follow

Product: P-IN-5SMIS [H61] Precipitation rate at around by MW cross track scanners

Latest products

User notifications

announcement 2/4/2023 Dear Users, due to the limited bandwidth on the



Informaciones Sobre Productos

Ejemplo: https://hsaf.meteoam.it/Products/ProductsList?type=soil_moisture

Soil Moisture - Products

SOIL MOISTURE PRODUCT CODE FORMAT

SM-<input data>-<processing type>-<orbit/spatial sampling type>

ASCAT-A = ASCAT on Metop-A, ASCAT-B=ASCAT on Metop-B, ASCAT-C = ASCAT on Metop-C, SOA = SOA on Metop-BG

DIS = Disaggregated, DA = Data Assimilation

Ocean product. 0.25 = Spatial sampling of 0.25 km, 12.5 = Spatial sampling of 12.5 km, 25 = spatial sampling of 25 km

NRT = Near Real Time, DR = Data Record, DR FRT = Offline (Data Record Extension)

RZSM-ASCAT-NRT-10 (H26)

Metop ASCAT NRT Root Zone Soil Moisture Profile Index 10km resolution

Operational

RZSM Layer 0 (0-400 mm) H26 CDOP - Copyright © EUMETSAT 2023

Analyzed liquid soil moisture profile index at 10 km spatial sampling for four different soil layers (covering the root zone from the surface to ~ 3 metres) generated at ECMWF by the dedicated H SAF soil moisture assimilation system at 24 hour time steps. The analysed soil moisture fields are based on the assimilation of ASCAT-derived surface soil moisture. RZSM-ASCAT-NRT-10km is produced daily at 00 UTC with a timeliness of 12 hours.

Units: liquid soil wetness index (0-1)

[Algorithm Theoretical Baseline Document \(ATBD\)](#)
[Product User Manual \(PUM\)](#)
[Product Validation Report \(PVR\)](#)

[DETAIL](#) [DOWNLOAD](#)

RZSM-ASCAT-NRT-10 (H26)

Product image (click on image for animation, frame selection and zoom)

RZSM-ASCAT-NRT Layer 0 (0-400 mm) - Copyright © EUMETSAT 2023

Coverage Global
Cycle 26
Resolution (0.01) degrees x (0.01) degrees = 10km x 10km x 4 layers in the complete dataset: Layer 0 (0-20cm), layer 1 (21-40cm), layer 2 (41-60cm), layer 3 (61-80cm)
Accuracy 1% relative (C/I=5) - Target 0.25 km - DA/DR 0.05 km
Timeliness 12 h
Generations Month (PP) / FRT (DR) / Year (DR)
Remote Senses (L1) / Satellite / MetOp-B / MetOp-BI / MetOp-C / MetOp-CI / MetOp-CII / MetOp-CIII

SHORT DESCRIPTION OF THE BASIC PRINCIPLES FOR PRODUCT GENERATION

The analyzed soil moisture fields are based on a multi-level 1D global, the lower-level temperature and humidity analysis, and the RTOcéane monthly assimilation. They are then re-located and updated every 6 hours by the sub-daily soil moisture assimilation (a hydrology or soil type). The final product is generated starting from the MetOp-CII (MetOp-CIII) generation.

USER DOCUMENTS

Algorithm Theoretical Baseline Document (ATBD) [\[PDF\]](#)

Product User Manual (PUM) [\[PDF\]](#)

Product Validation Report (PVR) [\[PDF\]](#)

Operations Reports

Privacy Policy
The use of this service is subject to the terms and conditions of use of the EUMETSAT website. The use of these products is governed by the license agreement. If you do not accept these terms and conditions, please do not use this service.

Copyright © EUMETSAT 2023. All rights reserved. This document is the intellectual property of EUMETSAT and is subject to its copyright. It may not be reproduced, stored in a retrieval system, or transmitted, in whole or in part, without the prior written permission of EUMETSAT.



Página de Registro H SAF Download Data Centre

<https://hsaf.meteoam.it/User/Register>

The screenshot shows a web browser window with the URL <https://hsaf.meteoam.it/User/Register>. The page has a dark blue header with the EUMETSAT H SAF logo on the left and navigation links for HOME, ABOUT, PRODUCTS, NEWS & MEDIA, and SUPPORT. Below the header, there is a paragraph of text followed by a grid of input fields for user registration.

Registered users are able to receive news and periodic updates on H SAF (news on products characteristics, on program events, on training courses), and will be able to have access to restricted sections of the website as "H SAF Download Data Centre" and product viewer on the Google Map. Furthermore, registration is necessary to perform the products downloading free of charge by mean of a secure FTP server and to receive support on H SAF products.

Email *	Email Confirmation *
<input type="text"/>	<input type="text"/>
Name *	Surname *
<input type="text"/>	<input type="text"/>
Password *	Password Confirmation *
<input type="text"/>	<input type="text"/>
Address	Postal Code
<input type="text"/>	<input type="text"/>
City	Country
<input type="text"/>	<input type="text"/>

Informaciones: Usuario y Contraseña

Durante el entrenamiento necesitaremos el nombre de usuario y la contraseña para acceder a los datos a través de scripts python

Username (email)

Password

LOGIN 

[Forgot your password?](#)

If you are interested in products downloading, a [free registration](#) is necessary; completed the registration process, you will receive via email the accounting credentials, as well as useful information to perform the download.



Nota: Despues de registrarse, podrá acceder al servidor manualmente o mediante script transcurridos aproximadamente 30 minutos.

Baixando o dado com a biblioteca ascat

```
[ ] # download a sample of the Root Zone Soil Moisture Profile Index (Metop/ASCAT)
# note: after creating the H-SAF account it takes about 30 minutes to be able to use it.

import datetime                                     # basic date and time types
from ascat.download.interface import hsaf_download # download data from the hsaf server

credentials = {'user': [REDACTED], 'password': [REDACTED]}
local_path = '/content/samples/'                   # user and password
remote_path = '/h26/h26_cur_mon_nc/'              # where we want to store the data
start_date = datetime.datetime(2023, 7, 25)        # FTP server folder
end_date = datetime.datetime(2023, 7, 26)          # start date
                                                # end date

hsaf_download(credentials, remote_path, local_path, start_date, end_date, limit=1) # download the file(s)
```

Servidor FTP: `ftphsaf.meteoam.it` Nombre de usuario y contraseña de acuerdo con el registro



Access To H SAF On-Line Archive (Last 60 Days)

You can access the H-SAF FTP server with your favourite FTP client.

FTP host: `ftphsaf.meteoam.it`

Credentials are the same as for this website.

NOTE

In case of just created website accounts or in case of just updated passwords a time lapse up to 30 minutes may be required to have access to the FTP server.



Place An Order To Get The H SAF Archived Data (Basic)

This function allows access to the H SAF internal order centre. This service offers all basic functions to carry out orders on H SAF historical archives (starting from the pre-operation/operational status of products). Orders placed will be submitted for approval and will be processed within three working days

The screenshot shows a web browser window with the title 'Orders - H SAF Official web site'. The URL is 'hsaf.meteoam.it/Products/Orders'. The page has a header with 'HOME / ORDERS' and a user profile 'Souza Diego'. On the left, there's a logo for 'EUMETSAT H SAF SUPPORT TO OPERATIONAL HYDROLOGY ACTIVITIES MANAGEMENT'. The main content area features a large image of hands holding a globe. The heading 'DOWNLOAD PRODUCTS ORDER' is displayed prominently. Below the heading, there's a text box containing instructions and notes about ordering products. At the bottom, there are input fields for 'Products', 'Start Date', and 'End Date', with a placeholder 'Please choose a product'.

Using this form you can order H SAF products by selecting the time range you are interested in.

Note: After selecting each product, it is possible to observe the availability time range of the data to correctly place the order.

By this procedure, the selectable end-date is limited to no more than 2 days before today.

Alternatively, you can access to the H SAF FTP server with your favourite FTP client to download the most recent data starting from the last 60 days up to today. Please read the related [Information](#).

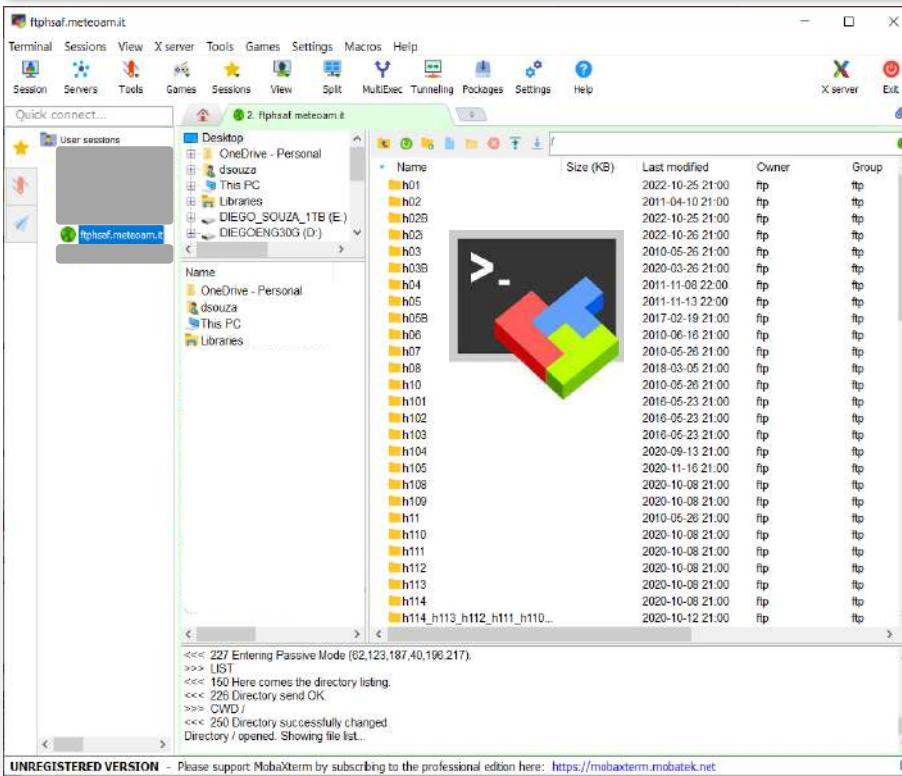
Es posible realizar una solicitud a través de la propia página H SAF (datos de hasta dos días antes de la fecha actual).

Como demostración, no utilizaremos este mecanismo, sino que accederemos a través de scripts. También puede utilizar un cliente FTP.

Existen Clientes FTP Gratuitos

Servidor FTP: [ftphsaf.meteoam.it](ftp://ftphsaf.meteoam.it)

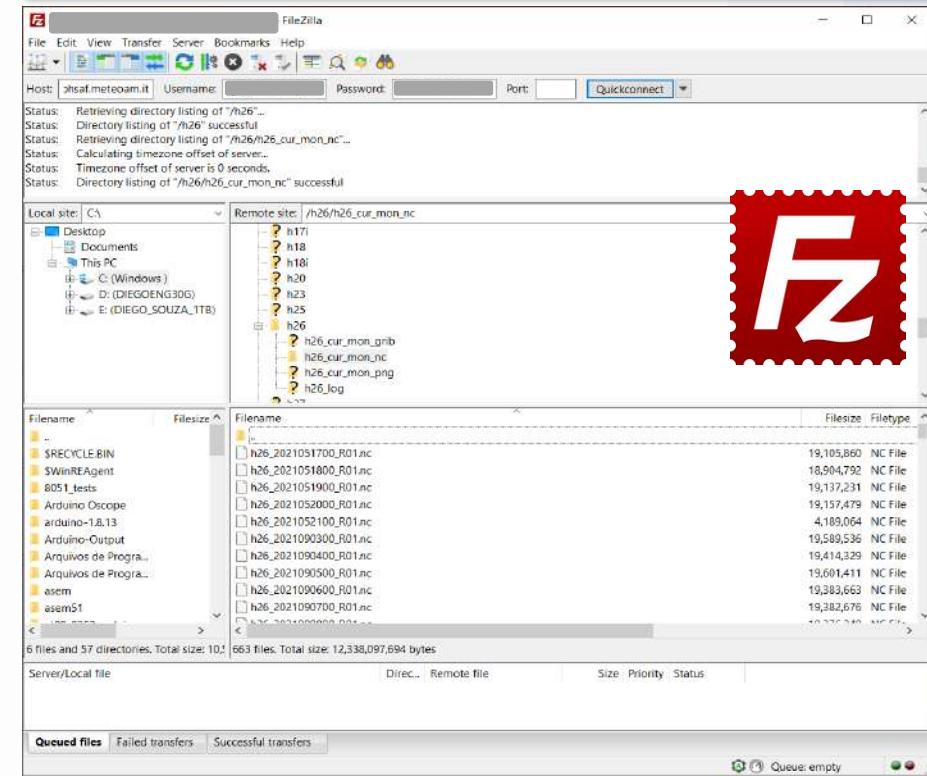
MobaXtern: <https://mobaxterm.mobatek.net/>



The screenshot shows the MobaXterm interface. On the left, there's a sidebar with 'User sessions' and a 'Quick connect...' field. The main area has two panes: one for 'Desktop' showing a file browser with a folder tree and a preview of a 3D puzzle piece icon, and another for 'Sessions' showing a list of files. At the bottom, a terminal window displays a transcript of an FTP session connecting to 'ftphsaf.meteoam.it'. The transcript includes commands like 'LIST', 'CWD /', and directory listing details. A status bar at the bottom says 'UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net/>'.

Nombre de usuario y contraseña de acuerdo con el registro

FileZilla: <https://filezilla-project.org/>



The screenshot shows the FileZilla interface. It has two main panes: 'Local site' (C:\) and 'Remote site' (/h26/h26_cur_mon_nc). The local site pane shows a file browser with a folder tree. The remote site pane shows a detailed directory listing with columns for 'Filename', 'Filesize', and 'Filetype'. A large red stamp with the letter 'F' is overlaid on the right side of the interface. The status bar at the bottom says 'Queue: empty'.

Prácticas LSA-SAF y H-SAF



Credenciales LSA-SAF and H-SAF

Para descargar datos desde LSA SAF y H SAF, primero es necesario registrarse en LSA SAF <https://mokey.lsasvcs.ipma.pt/auth/signup> y H SAF <https://hsaf.meteoam.it/User/Register>, y inserir tus credenciales en las variables abajo.

Nota: Sólo es necesario ejecutar esta celda una vez.

```
#-----#
# LSA SAF AND H SAF CREDENTIALS
#-----#
# LSA-SAF credentials
lsa_saf_user = [REDACTED]
lsa_saf_password = [REDACTED]

# H-SAF credentials
h_saf_user = [REDACTED]
h_saf_password = [REDACTED]
```

DEMONSTRACIONES

Así como estamos haciendo con los datos de canales y RGBs, vamos a usar funciones simples para descargar y visualizar datos SAF



Ejemplo 1: LST - 10 Day Composite (SEVIRI)

Ejemplo 1: Land Surface Temperature - 10 Day Composite (MSG/SEVIRI)

Nombre de la función

```
Land Surface Temperature - 10 Day Composite (MSG/SEVIRI)
possible days (01, 11 and 21), since 20/5 (MS
plot_saf(saf_product='LSASAF_MSG_DLST-MAX10D',
date_saf='2023-10-21 23:45',
extent=[-80.0, -40.0, -30.0, 10.0],
cmap='custom', vmin=-20, vmax=48,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

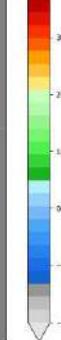
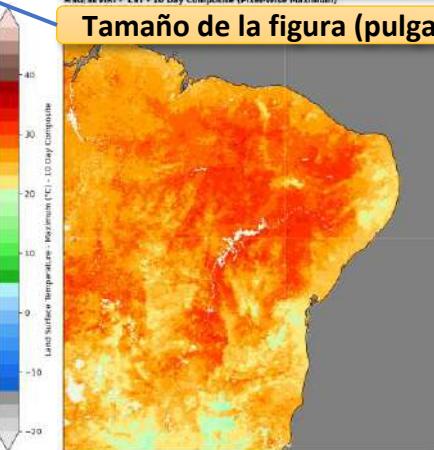
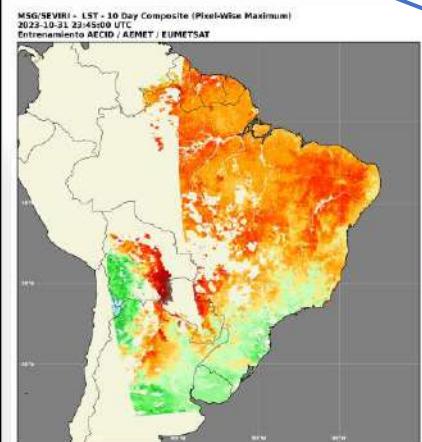
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

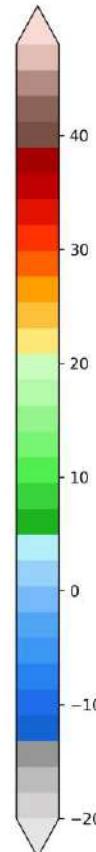
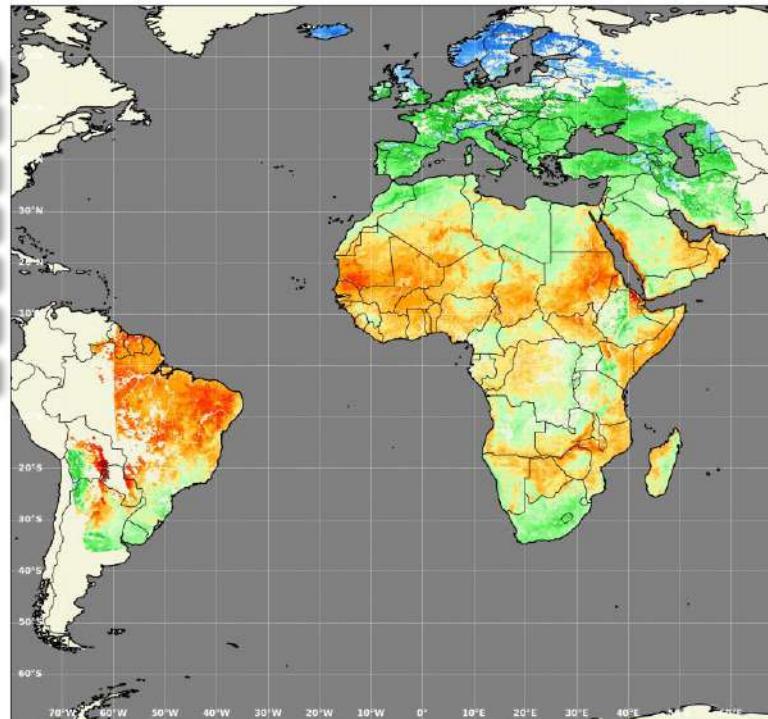
Tamaño de la figura (pulgadas)



MSG/SEVIRI - LST - 10 Day Composite (Pixel-Wise Maximum)

2023-10-31 23:45:00 UTC

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 2: LST (Metop/AVHRR) - Day

Ejemplo 2: Land Surface Temperature (Metop/AVHRR) - Day

Nombre de la función

```
Land surface temperature (Metop/AVHRR)
daily product (00:00), since 2015 (global)
plot_saf(saf_product = 'LSASAF_M01_AVHRR_EDLST-DAY',
         date_saf='2023-11-01 00:00',
         extent=[-80.0, -40.0, -30.0, 10.0],
         cmap='custom', vmin=-20, vmax=48,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

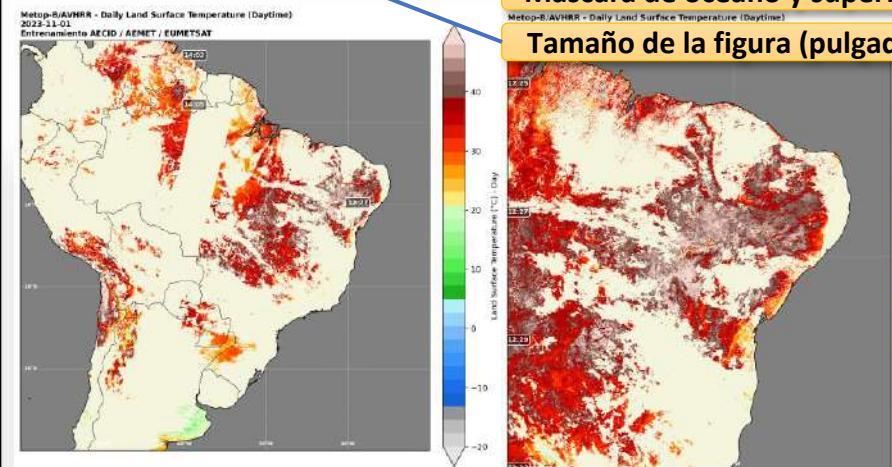
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

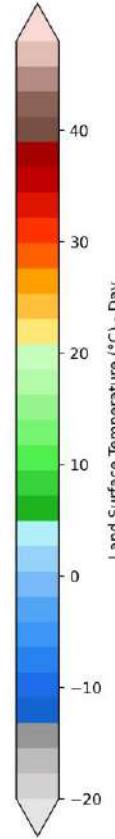
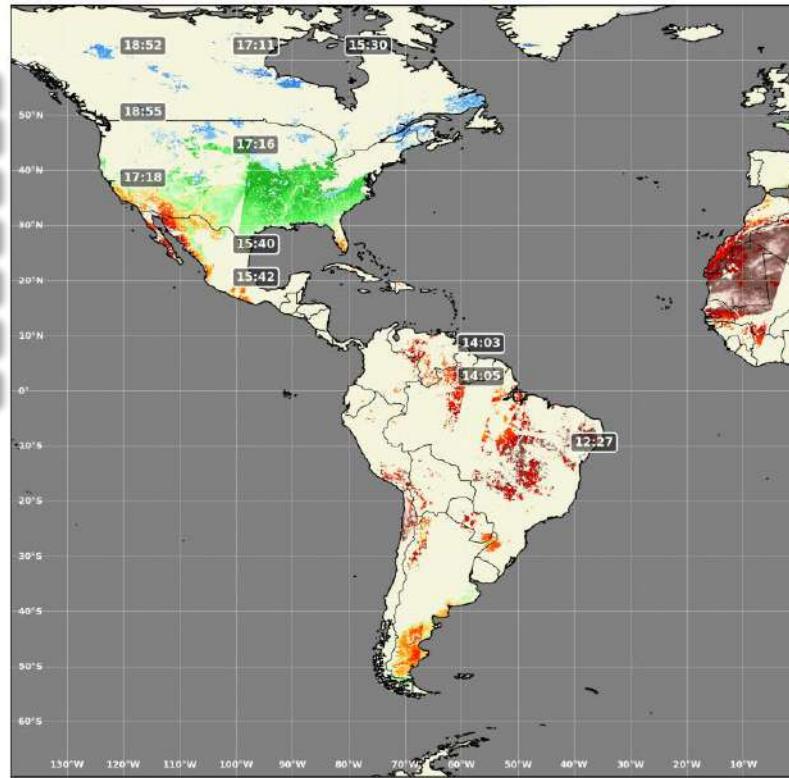
Tamaño de la figura (pulgadas)



Metop-B/AVHRR - Daily Land Surface Temperature (Daytime)

2023-11-01

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 3: LST (Metop/AVHRR) - Night

Ejemplo 3: Land Surface Temperature (Metop/AVHRR) - Night

Nombre de la función

```
Land Surface Temperature (Metop/AVHRR)
daily product (00:00), since 2015 (glob)
plot_saf(saf_product = 'LSASAF_M01-AVHR_EDLST-NIGHT',
         date_saf='2023-11-01 00:00',
         extent=[-80.0, -40.0, -30.0, 10.0],
         cmap='custom', vmin=-20, vmax=48,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

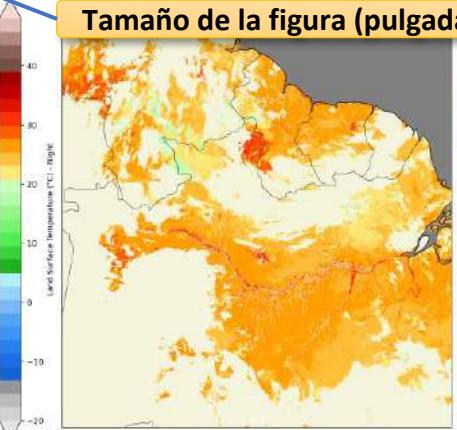
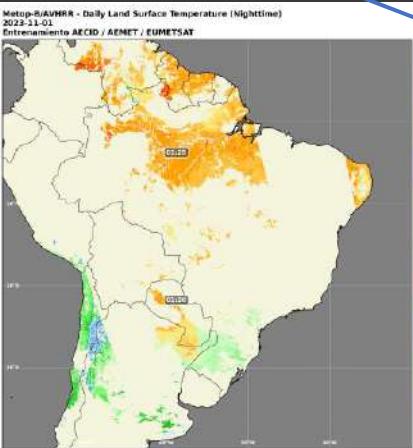
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

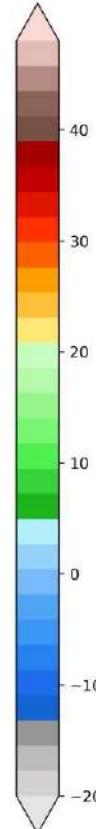
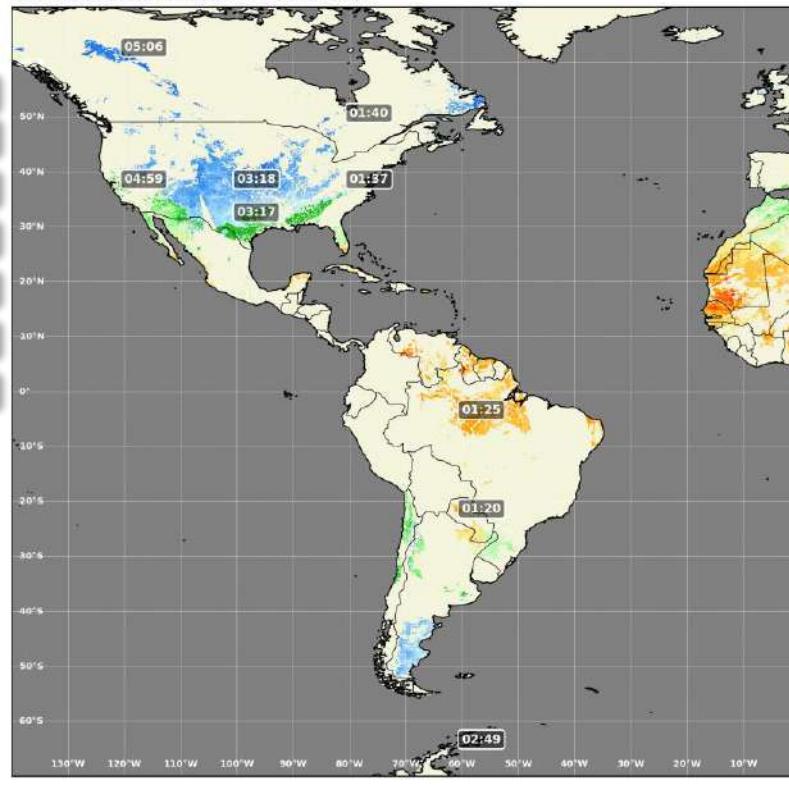
Tamaño de la figura (pulgadas)



Metop-B/AVHRR - Daily Land Surface Temperature (Nighttime)

2023-11-01

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 4: NDVI (Metop/AVHRR) - South America

Ejemplo 4: Normalized Difference Vegetation Index (Metop/AVHRR) - South America

Nombre de la función

Parámetros

```
# Normalized Difference Vegetation Index (Metop/AVHRR) - South America
# possible days (01, 11 and 21, since 20/7. May)
plot_saf(saf_product = 'METOP_AVHRR_S10_AMS_NDVI',
         date_saf='2023-10-21 00:00',
         extent=[-75.0, -37.00, -33.00, 8.00],
         cmap='custom', vmin=0.1, vmax=0.8
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

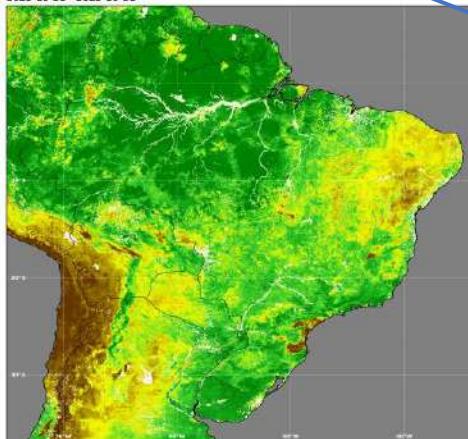
Colormap, mínimo y máximo

Colores

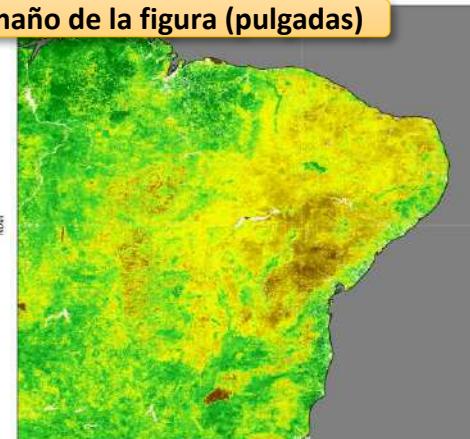
Máscara de océano y superficie

Tamaño de la figura (pulgadas)

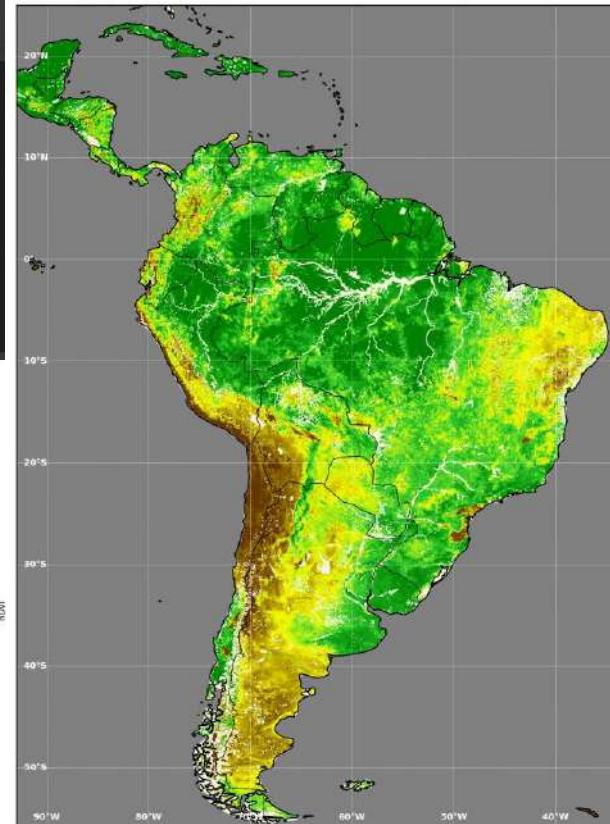
METOP/AVHRR + NDVI + 10-Daily Synthesis
2023-10-21 - 2023-10-31



METOP/AVHRR + NDVI + 10-Daily Synthesis
2023-10-31 - 2023-10-31



METOP/AVHRR - NDVI - 10-Daily Synthesis
2023-10-21 - 2023-10-31



Ejemplo 5: NDVI (Metop/AVHRR) - Central America

Ejemplo 5: Normalized Difference Vegetation Index (Metop/AVHRR) - Central America

Nombre de la función

Parámetros

```
Normalized Difference Vegetation Index (Metop/AVHRR) - Central America
possible days (01, 11 and 21), since 2011. Max
plot_saf(saf_product = "METOP_AVHRR_S10_AMC_NDVI",
date_saf='2023-10-21 00:00',
extent=[-120.0, 0.0, -80.0, 40.0],
cmap='custom', vmin=0.1, vmax=0.8,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

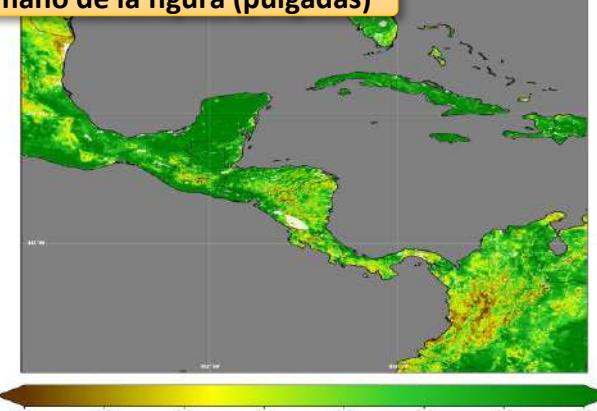
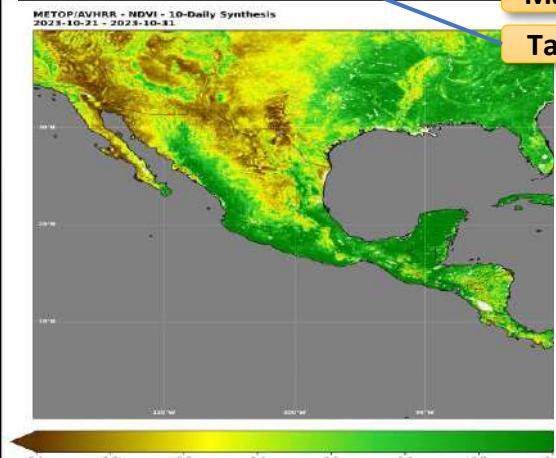
Región deseada

Colormap, mínimo y máximo

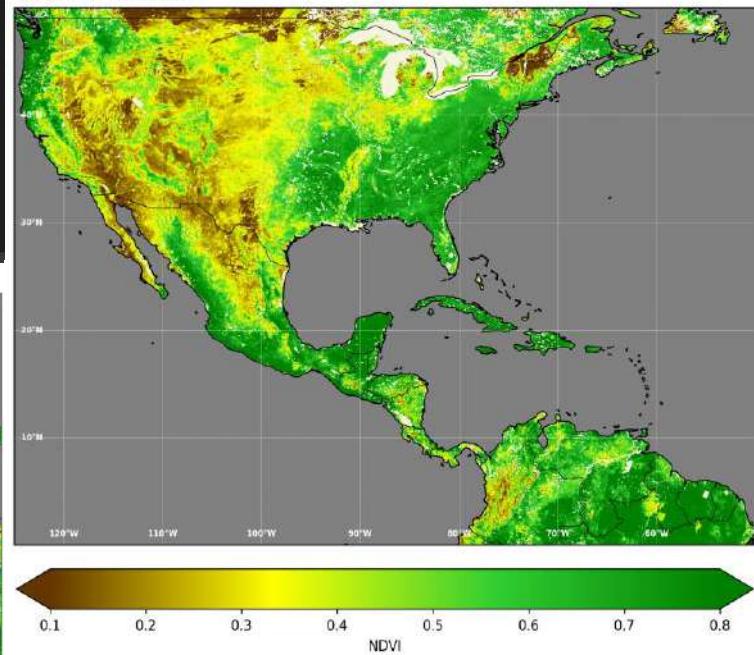
Colores

Máscara de océano y superficie

Tamaño de la figura (pulgadas)



METOP/AVHRR - NDVI - 10-Daily Synthesis
2023-10-21 - 2023-10-31



Ejemplo 6: Fire Radiative Power Pixel (MSG/SEVIRI)

Ejemplo 6: Fire Radiative Power Pixel (MSG/SEVIRI)

Nombre de la función

Parámetros

```

# Fire Radiative Power Pixel (MSG/SEVIRI)
plot_saf(saf_product = 'LSASAF_MSG_FRP-PIXEL',
         date_saf='2023-11-01 23:45',
         extent=[-80.0, -40.0, -30.0, 10.0],
         cmap='custom', vmin=0, vmax=500,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
    
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

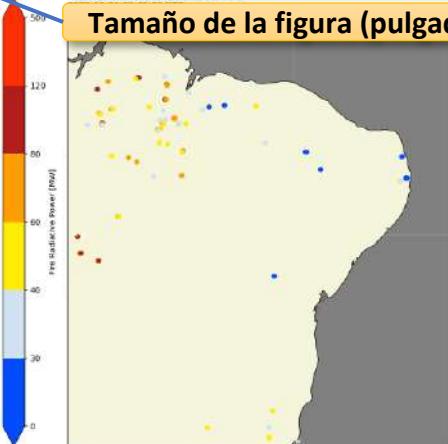
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

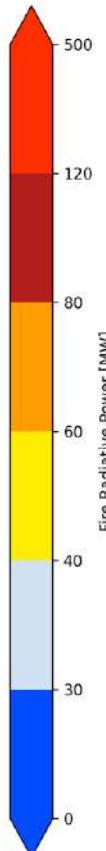
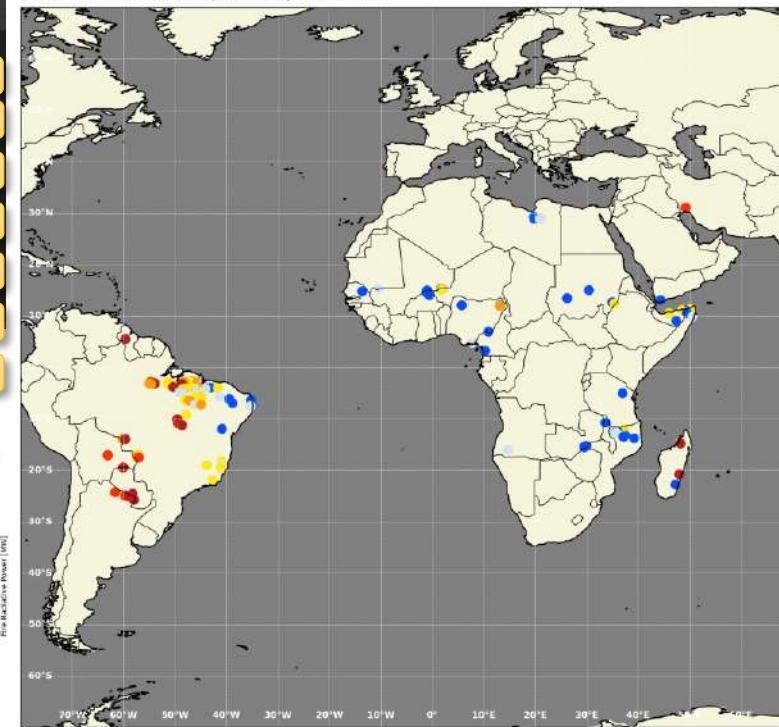
Tamaño de la figura (pulgadas)



MSG/SEVIRI Fire Radiative Power Pixel

2023-11-01 23:45:00 UTC

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 7: 10-day Surface Albedo

Ejemplo 7: 10-day Surface Albedo

Nombre de la función

```
plot_saf(saf_product = 'LSASAF_M01_AVHRR_F1AL_GLOBE',
         date_saf='2023-10-25 00:00',
         extent=[-80.0, -40.0, -30.0, 10.0],
         cmap='custom', vmin=0, vmax=0.9,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

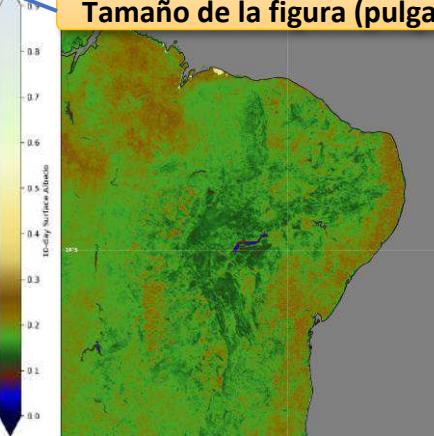
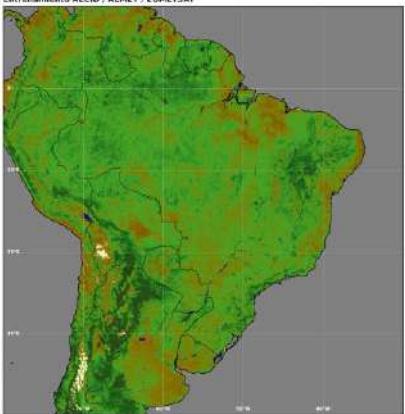
Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

Tamaño de la figura (pulgadas)

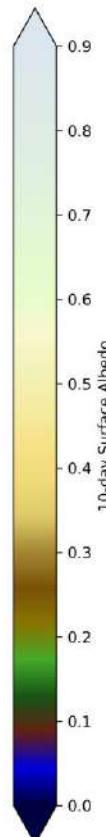
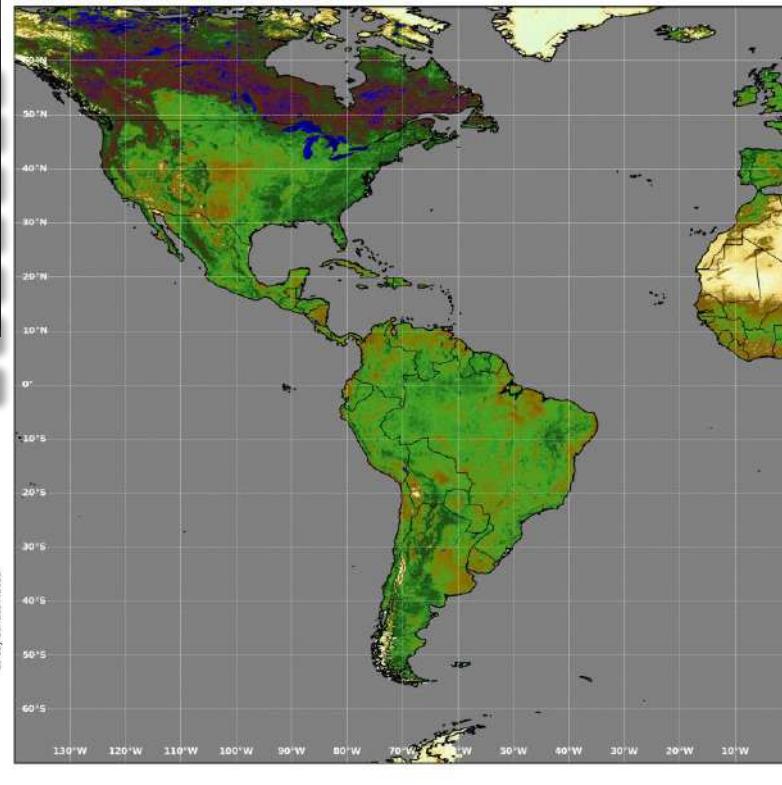
Metop/AVHRR - 10-day Surface Albedo
2023-10-25
Entrenamiento AECID / AEMET / EUMETSAT



Metop/AVHRR - 10-day Surface Albedo

2023-10-25

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 8: 10-day Fract. of Abs. Photosynthetic Active Rad.

Ejemplo 8: 10-day Fraction of Absorbed Photosynthetic Active Radiation

Nombre de la función

Parámetros

```
10-day Fraction of Absorbed Photosynthetic Active Radiation
possible days (05, 15 and 25), since 2015 (global)
plot_saf(saf_product = 'LSASAF_M01_AVHRR_ETA_PAK_G',
         date_saf='2023-10-25 00:00',
         extent=[-80.0, -40.0, -30.0, 10.0],
         cmap='custom', vmin=0, vmax=0.9,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

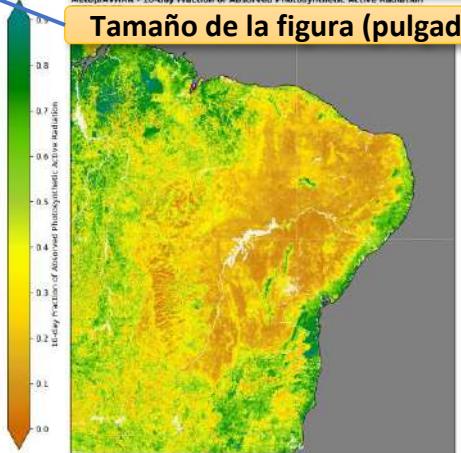
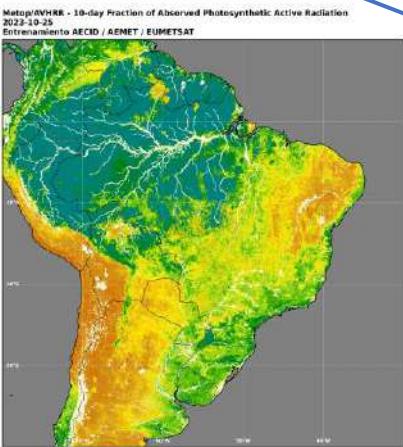
Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

Colores

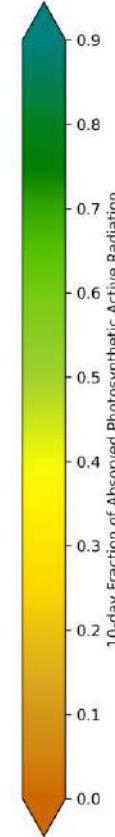
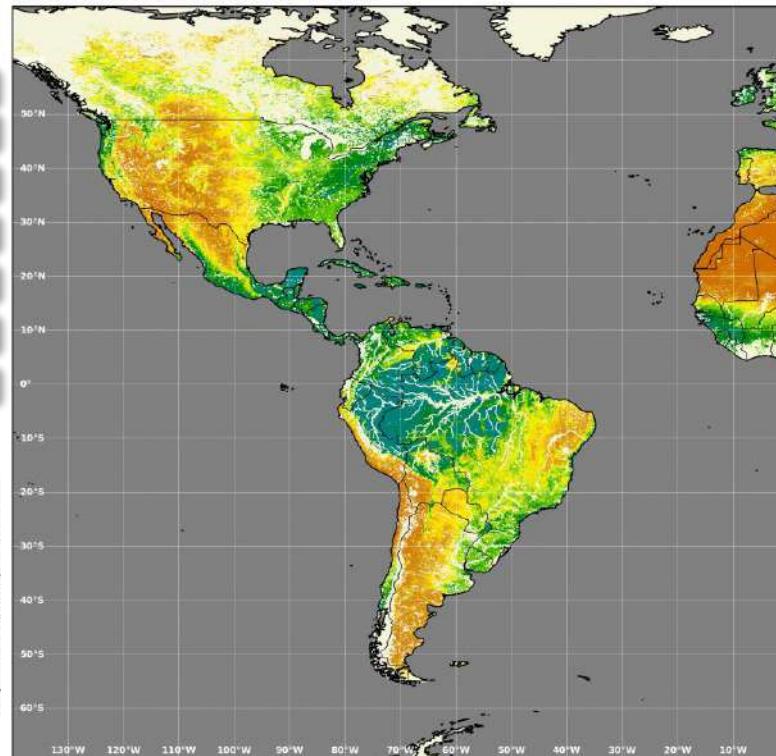
Tamaño de la figura (pulgadas)



Metop/AVHRR - 10-day Fraction of Absorbed Photosynthetic Active Radiation

2023-10-25

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 9: 10-day Fraction of Vegetation Cover

Ejemplo 9: 10-day Fraction of Vegetation Cover

Nombre de la función

Parámetros

```

10-day Fraction of Vegetation Cover
possible days (05, 15 and 25), since 2015 (global)
plot_saf(saf_product = 'LSASAF_M01-AVHRR ETFVC_GLOB',
        date_saf='2023-10-25 00:00',
        extent=[-80.0, -40.0, -30.0, 10.0],
        cmap='custom', vmin=0, vmax=1,
        coast_color='black',
        countries_color='black',
        grid_color='white',
        land_ocean=True,
        land_color='beige',
        ocean_color='gray',
        figsize=[10,10])

```

Producto

Fecha 'YYYY-MM-DD HH:MM'

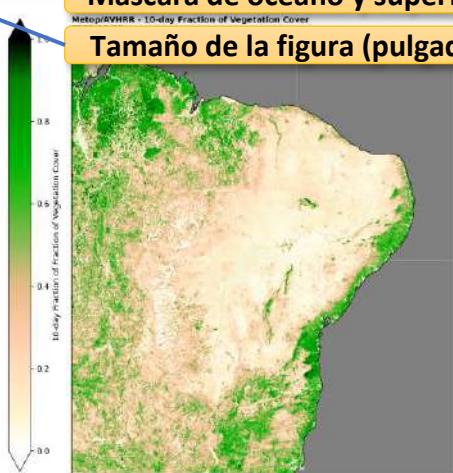
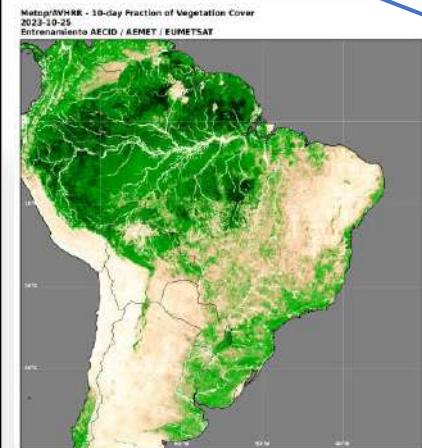
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

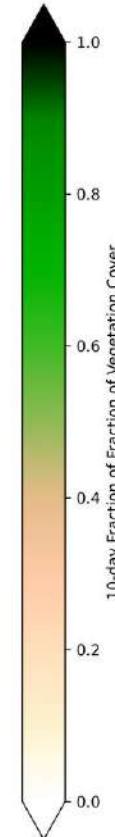
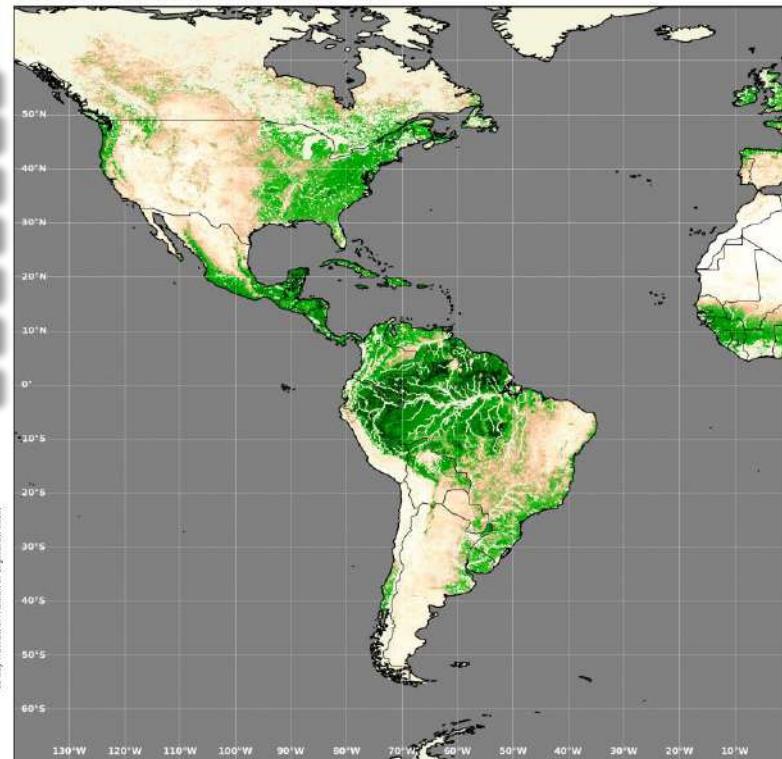
Tamaño de la figura (pulgadas)



Metop/AVHRR - 10-day Fraction of Vegetation Cover

2023-10-25

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 10: 10-day Leaf Area Index

Ejemplo 10: 10-day Leaf Area Index

Nombre de la función

```
10-day Leaf Area Index
possible days (05, 15 and 25), since 2017 (global)
plot_saf(saf_product = 'LSASAF_M01-AVHRR ETAL_GLOB',
        date_saf='2023-10-25 00:00',
        extent=[-80.0, -40.0, -30.0, 10.0],
        cmap='custom', vmin=0, vmax=6,
        coast_color='black',
        countries_color='black',
        grid_color='white',
        land_ocean=True,
        land_color='beige',
        ocean_color='gray',
        figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

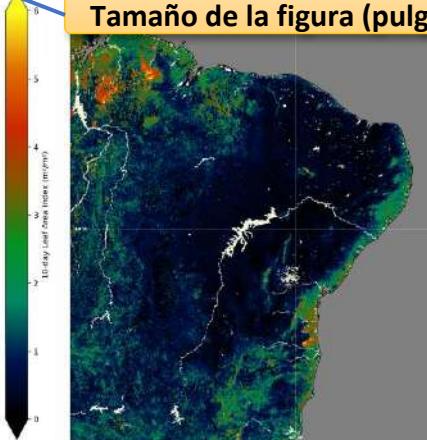
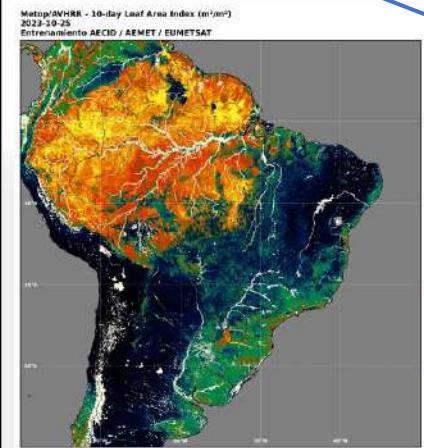
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

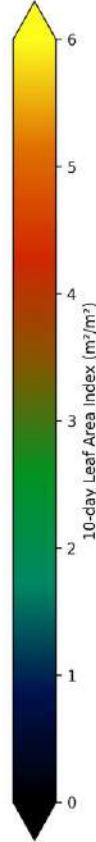
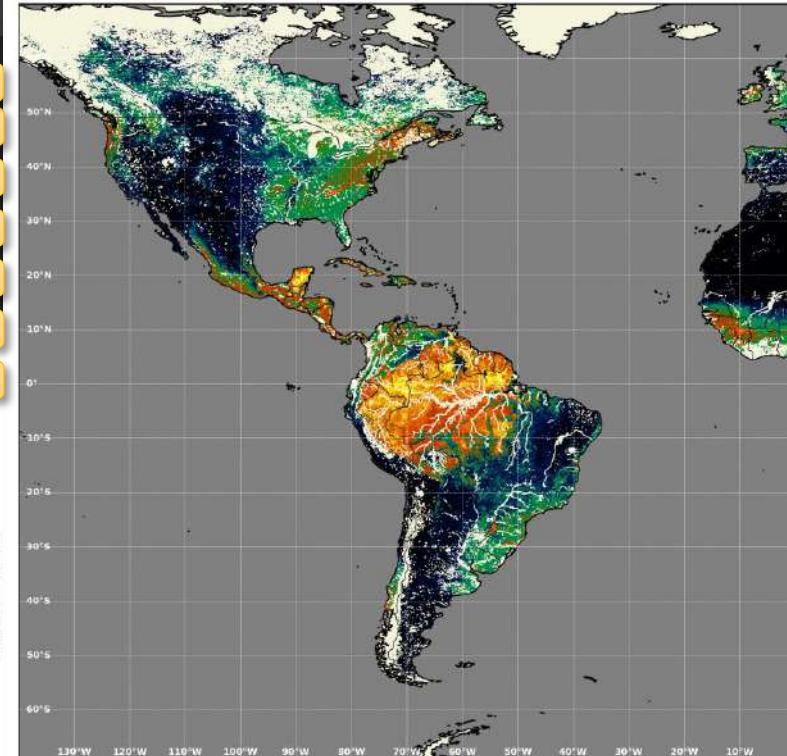
Tamaño de la figura (pulgadas)



Metop/AVHRR - 10-day Leaf Area Index (m²/m²)

2023-10-25

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 11: Evapotranspiration (MSG)

Ejemplo 11: Evapotranspiration (MSG)

Nombre de la función

```
Evapotranspiration (MSG)
daily product (every 30 minutes), since 2004 (MS)
plot_saf(saf_product = 'LSASAF_MSG_ETV3_MSG-Disk',
date_saf='2023-11-01 15:00',
extent=[-80.0, -40.0, -30.0, 10.0],
cmap='jet', vmin=0, vmax=1,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

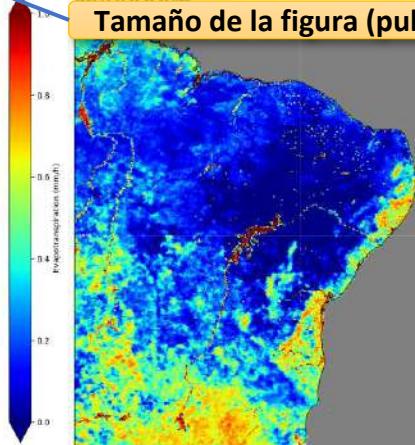
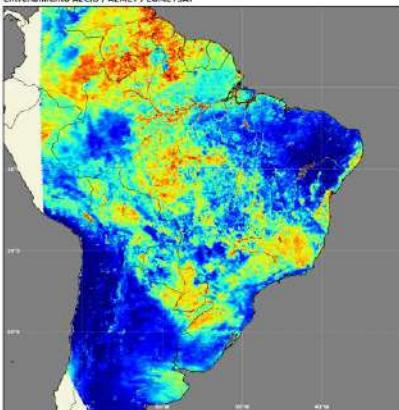
Colormap, mínimo y máximo

Colores

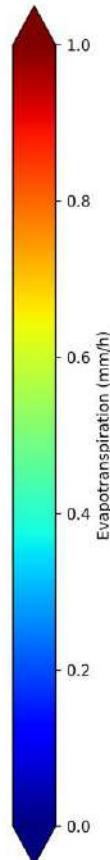
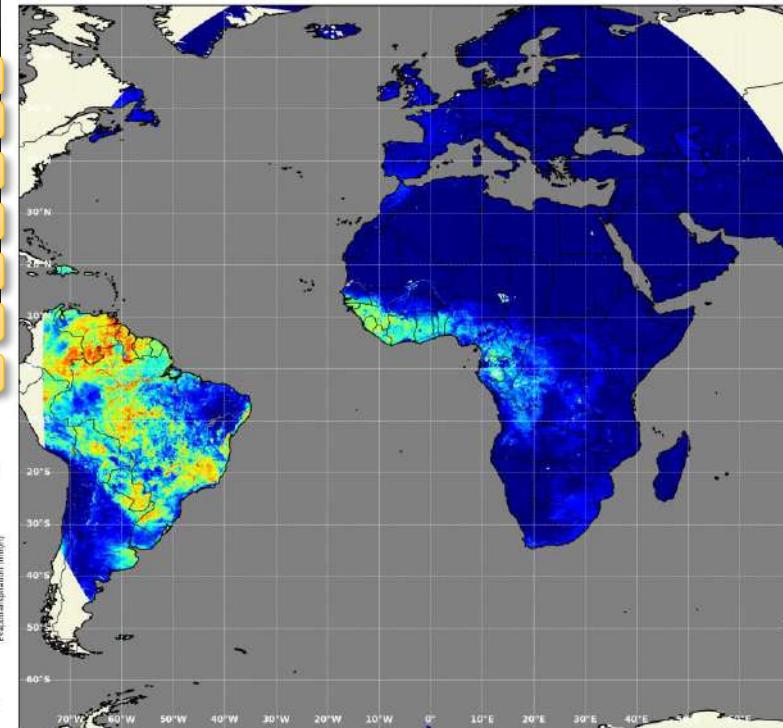
Máscara de océano y superficie

Tamaño de la figura (pulgadas)

MSG/SEVIRI - Evapotranspiration
2023-11-01 15:00:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



MSG/SEVIRI - Evapotranspiration
2023-11-01 15:00:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 12: Total Downward Surface Shortwave Flux (MSG)

Ejemplo 12: Total Downward Surface Shortwave Flux (MSG)

Nombre de la función

Parámetros

```
Total Downward Surface Shortwave Flux (MSG)
daily product (every 15 minutes), since 2004 (MS
plot_saf(saf_product = 'LSASAF_MSG_MDSSTFD_MSG_U15',
date_saf='2023-11-01 15:00',
extent=[-80.0, -40.0, -30.0, 10.0],
cmap='custom', vmin=0, vmax=1050,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

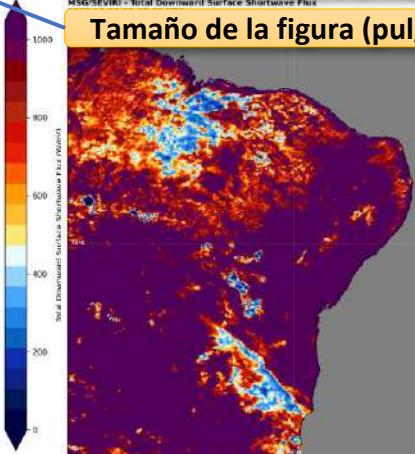
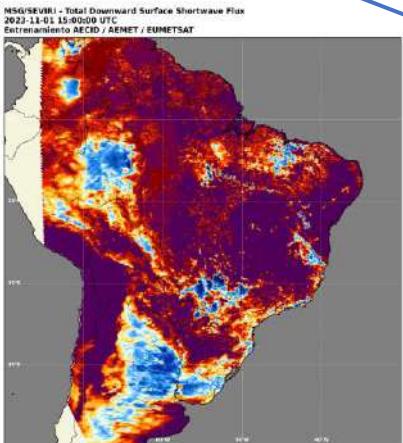
Región deseada

Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

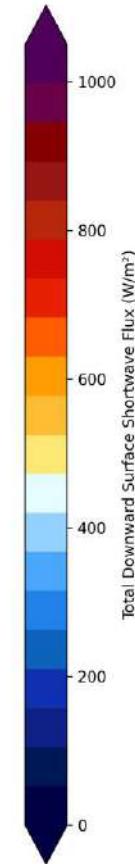
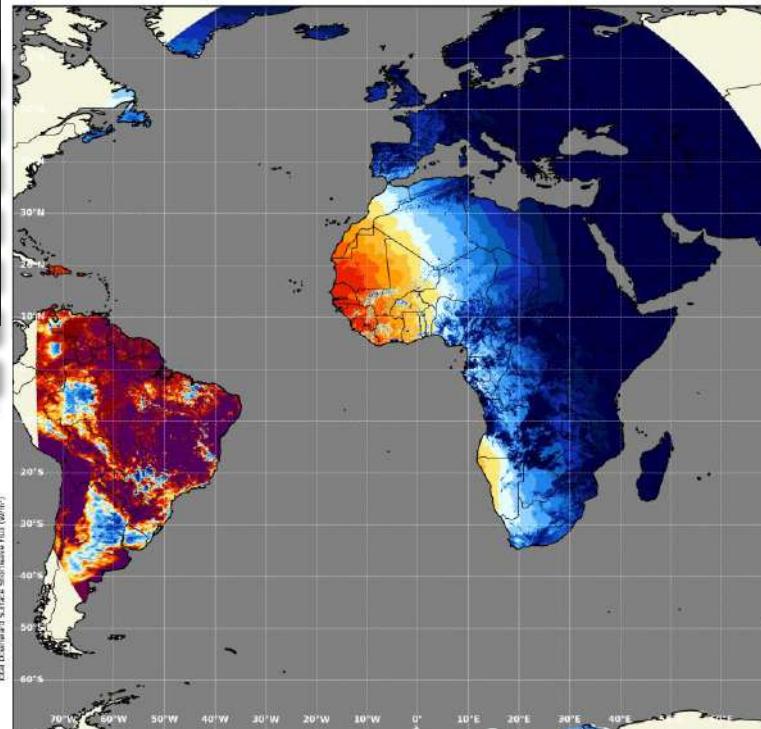
Tamaño de la figura (pulgadas)



MSG/SEVIRI - Total Downward Surface Shortwave Flux

2023-11-01 15:00:00 UTC

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 13: Daily Downward Surface Shortwave Flux (MSG)

Ejemplo 13: Daily Downward Surface Shortwave Flux (MSG)

Nombre de la función

Parámetros

```

Daily Downward Surface Shortwave Flux (MSG)
daily product (00:00), since 2004 (MSG V09r0p0)
plot_saf(saf_product = 'LSASAF_MSG_DIDSSF_MSG-DISK',
date_saf='2023-11-01 00:00',
extent=[-80.0, -40.0, -30.0, 10.0],
cmap='custom', vmin=0, vmax=5.4,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])

```

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

Colormap, mínimo y máximo

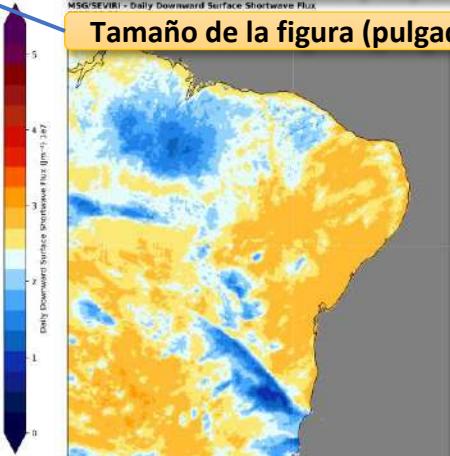
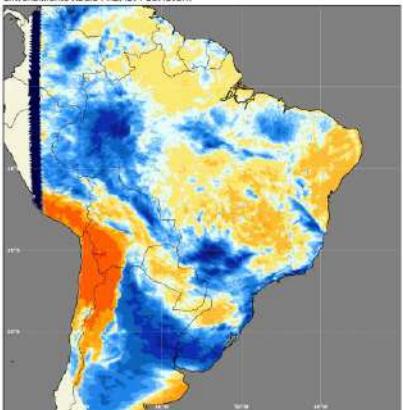
Colores

Máscara de océano y superficie

Colores

Tamaño de la figura (pulgadas)

MSG/SEVIRI - Daily Downward Surface Shortwave Flux
2023-11-01
Entrenamiento AECID / AEMET / EUMETSAT



MSG/SEVIRI - Daily Downward Surface Shortwave Flux

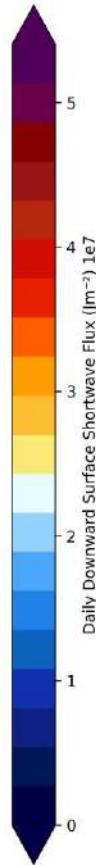
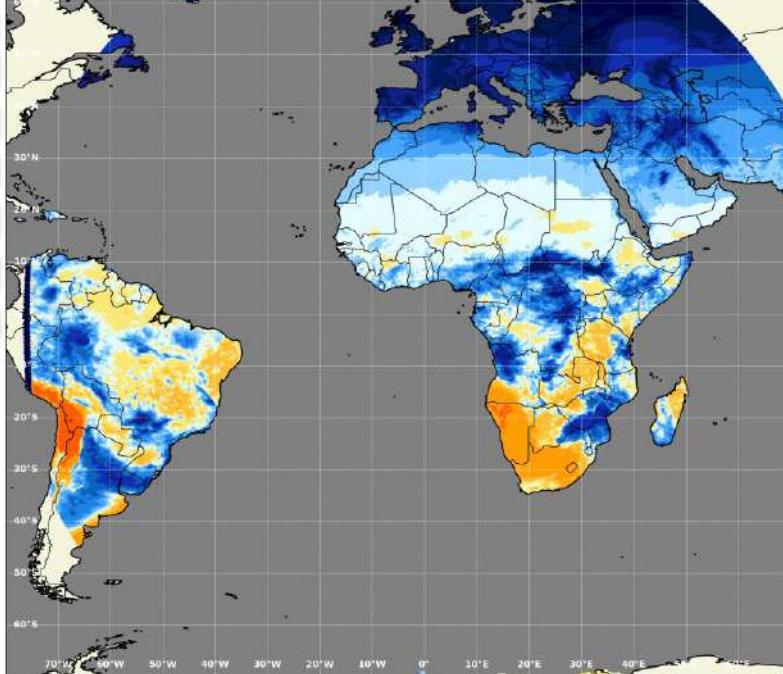
2023-11-01

Entrenamiento AECID / AEMET / EUMETSAT

MSG/SEVIRI - Daily Downward Surface Shortwave Flux

2023-11-01

Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 14: Root Zone Soil Moist. Prof. Index (Metop/ASCAT)

Ejemplo 14: Root Zone Soil Moisture Profile Index (Metop/ASCAT)

Nombre de la función

```
Root_Zone_Soil_Moisture_Prof_Index (Metop/ASCAT)
daily product
plot_saf(saf_product = 'h26_cur_mon_nc',
date_saf='2023-11-01 00:00',
extent=[-140.0, -70.00, 0.00, 70.00],
cmap='Custom', vmin=0, vmax=1,
coast_color='black',
countries_color='black',
grid_color='white',
land_ocean=True,
land_color='beige',
ocean_color='gray',
figsize=[10,10])
```

Parámetros

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

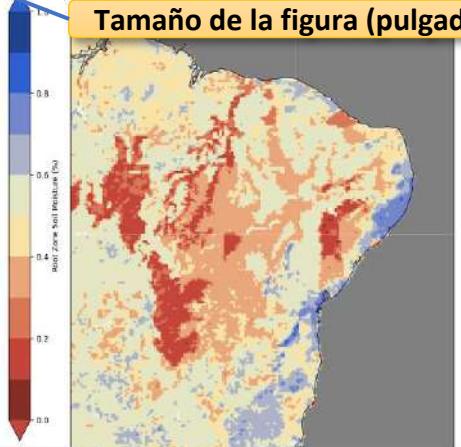
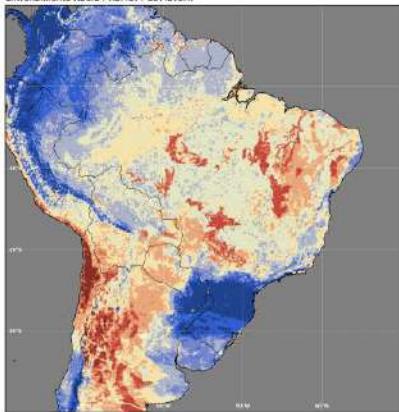
Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

Tamaño de la figura (pulgadas)

Metop/ASCAT NRT Root Zone Soil Moisture Profile Index
2023-11-01
Entrenamiento AECID / AEMET / EUMETSAT

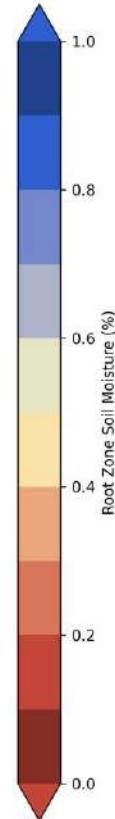
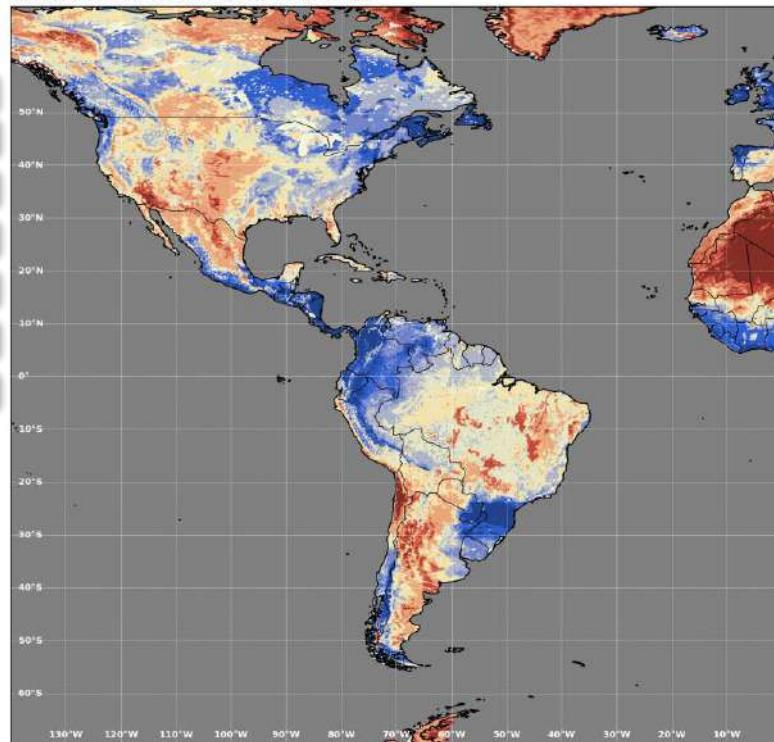


Root Zone Soil Moisture (%)

Metop/ASCAT NRT Root Zone Soil Moisture Profile Index

2023-11-01

Entrenamiento AECID / AEMET / EUMETSAT



Root Zone Soil Moisture (%)

0.8

0.6

0.4

0.2

0.0

Ejemplo 15: Precipitation / Soil Moisture Integrated Product (Multimission)

Nombre de la función

Parámetros

```
daily_product(min_lon: -60)  
plot_saf(saf_product = 'h64_cur_mon_data',  
        date_saf=2023-11-01 00:00,  
        extent=[-60.0, -60.0, 20.00, 20.00],  
        cmap='custom', vmin=0, vmax=100,  
        coast_color='black',  
        countries_color='black',  
        grid_color='white',  
        land_ocean=False,  
        land_color='beige',  
        ocean_color='skyblue',  
        figsize=[10,10])
```

Producto

Fecha 'YYYY-MM-DD HH:MM'

Región deseada

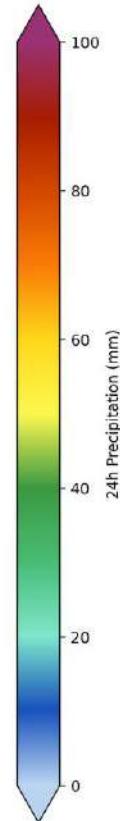
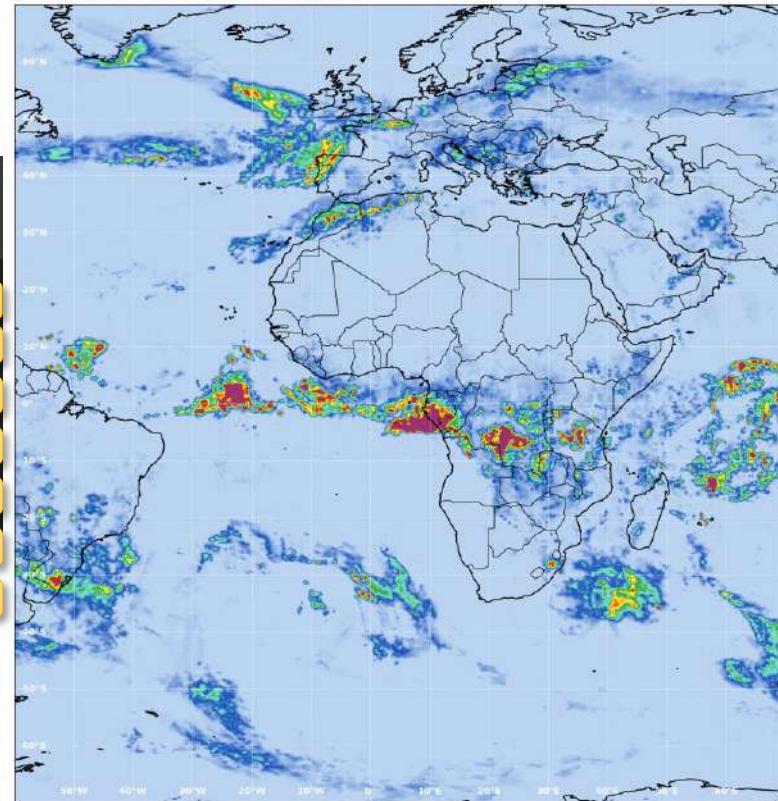
Colormap, mínimo y máximo

Colores

Máscara de océano y superficie

Tamaño de la figura (pulgadas)

Multimission - Gridded 24h Accumulated Precipitation
2023-11-01
Entrenamiento AECID / AEMET / EUMETSAT





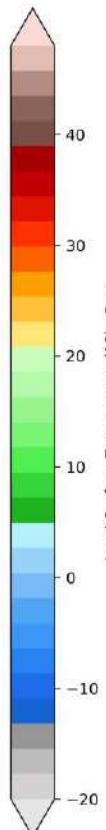
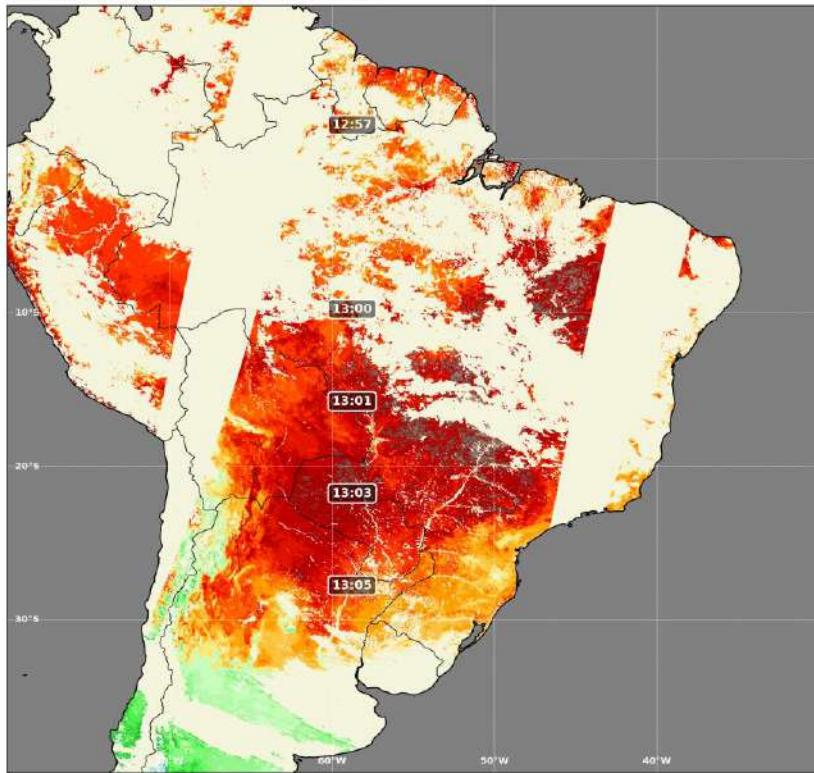
[http://lsa-
saf.eumetsat.int](http://lsa-saf.eumetsat.int)

Ejercicio 1: Ejemplo

Metop-B/AVHRR - Daily Land Surface Temperature (Daytime)

2023-09-17

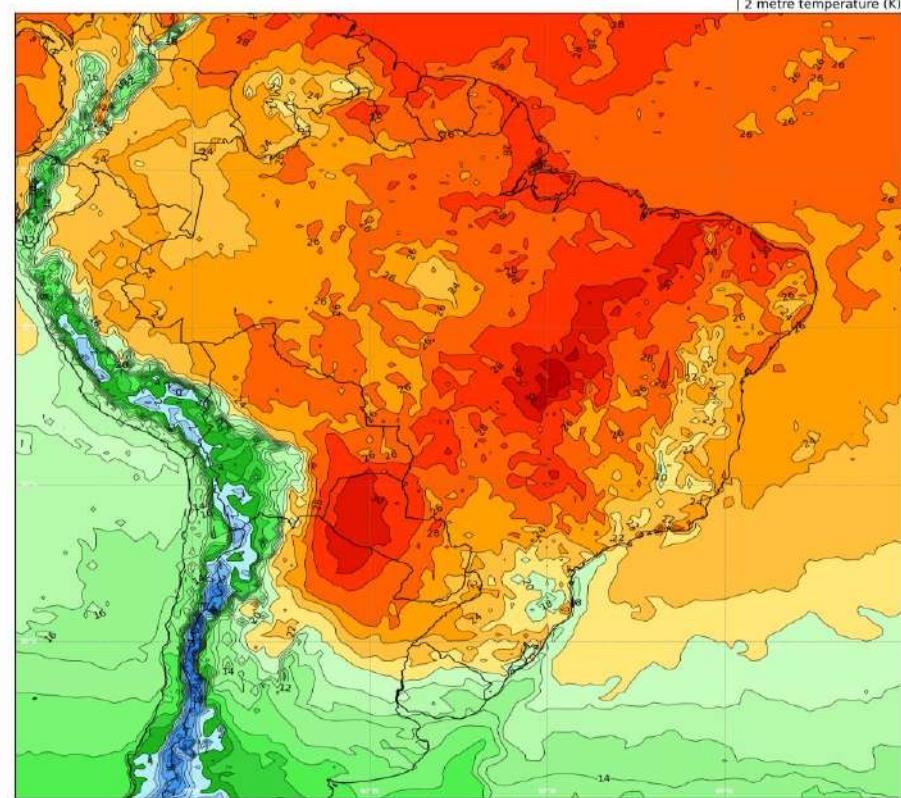
Entrenamiento AECID / AEMET / EUMETSAT



ECMWF: operational high-resolution forecast, atmospheric fields

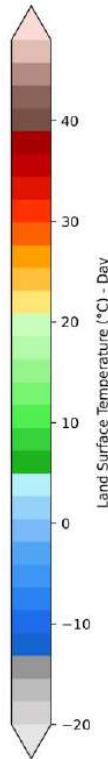
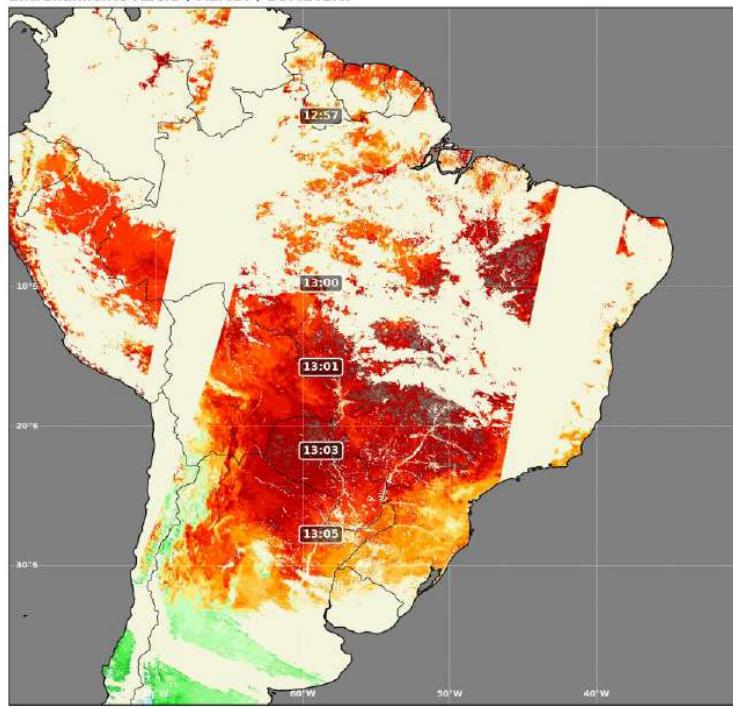
Valid: 12:00 UTC 17 Sep 2023

| 2 metre temperature (K)



Ejercicio 1: Ejemplo

Metop-B/AVHRR - Daily Land Surface Temperature (Daytime)
2023-09-17
Entrenamiento AECID / AEMET / EUMETSAT



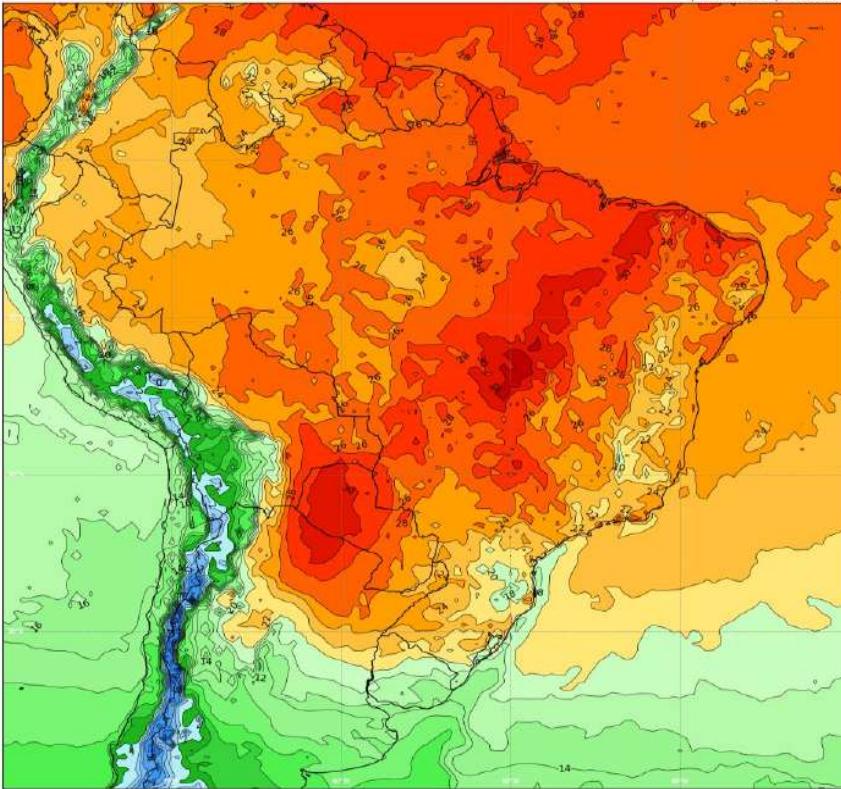
Ejemplo 2 (LSA-SAF)

Ejemplo 2: Land Surface Temperature (Metop/AVHRR) - Day

```
[6] # Land Surface Temperature (Metop/AVHRR)
# daily product (00:00), since 2015 (global)
plot_saf(saf_product = 'LSASAF_M01-AVHRS_EDLST-DAY_GLOBE',
          date_saf='2023-09-17 00:00',
          extent=[-80.0, -40.0, -30.0, 10.0],
          cmap='custom', vmin=-20, vmax=48,
          coast_color='black',
          countries_color='black',
          grid_color='white',
          land_ocean=True,
          land_color='beige',
          ocean_color='gray',
          figsize=[10,10])
```

Ejercicio 1: Ejemplo

ECMWF: operational high-resolution forecast, atmospheric fields
Valid: 12:00 UTC 17 Sep 2023
| 2 metre temperature (K)



Ejemplo 8.13 (ECMWF)

Example 8.13: 2m Temperature

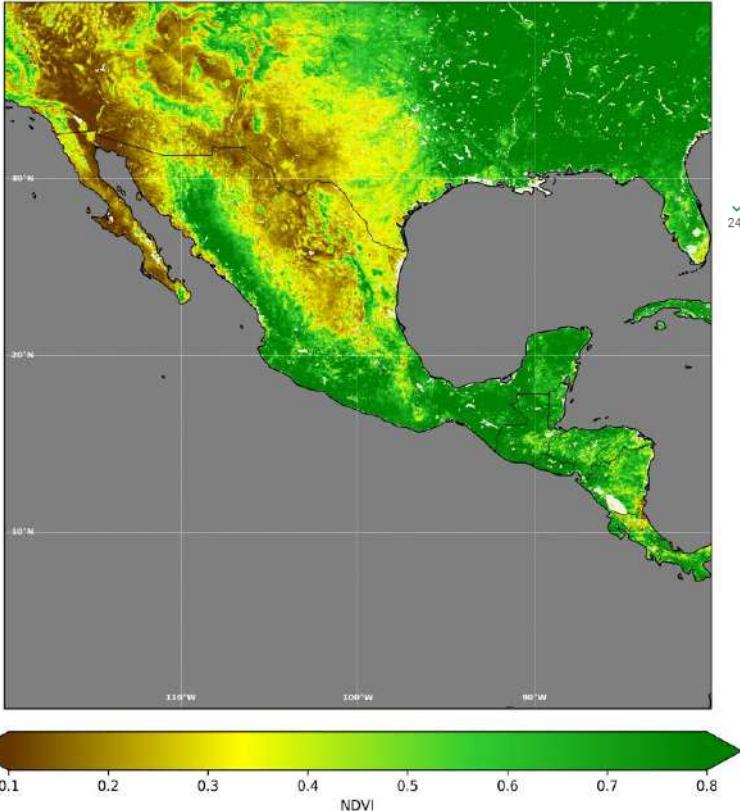
```
[7] #-----
# Training - Satellite Data Access and Processing - Example 8: Downloading and Visualizing NWP Data
# Author: Diego Souza (INPE/CGCT/DISSL)
#-----

# open ecmwf data available for download since January 21 2022 00:00 ('2022-01-21 00:00')
# gfs data available for download since February 26 2021 00:00 ('2021-02-26 00:00')
# gfs products: 'pgrb2.0p25', 'pgrb2.0p50', 'pgrb2.1p00'

# 2 m temperature
plot_nwp(model='ecmwf',
          product='oper',
          date_nwp='2023-09-17 12:00',
          area='custom',
          extent=[-80.0, -40.00, -30.00, 10.00],
          fxx='date',
          var='2t', scale=1, offset=-273.15,
          level_hpa='',
          level_min=-20, level_max=48, level_int=2,
          plot_type='c_filled', contour_color='black',
          apply_cmap=True, cmap='custom',
          view_clabel=True, fontsize=10,
          linewidth=0.5, linestyle='solid',
          land_ocean=False, land_color = 'lightgray', ocean_color = 'white',
          alpha=1.0, title='new',
          figsize=[15,15])
```

Ejercicio 2: Ejemplo

METOP/AVHRR - NDVI - 10-Daily Synthesis
2023-08-11 - 2023-08-21

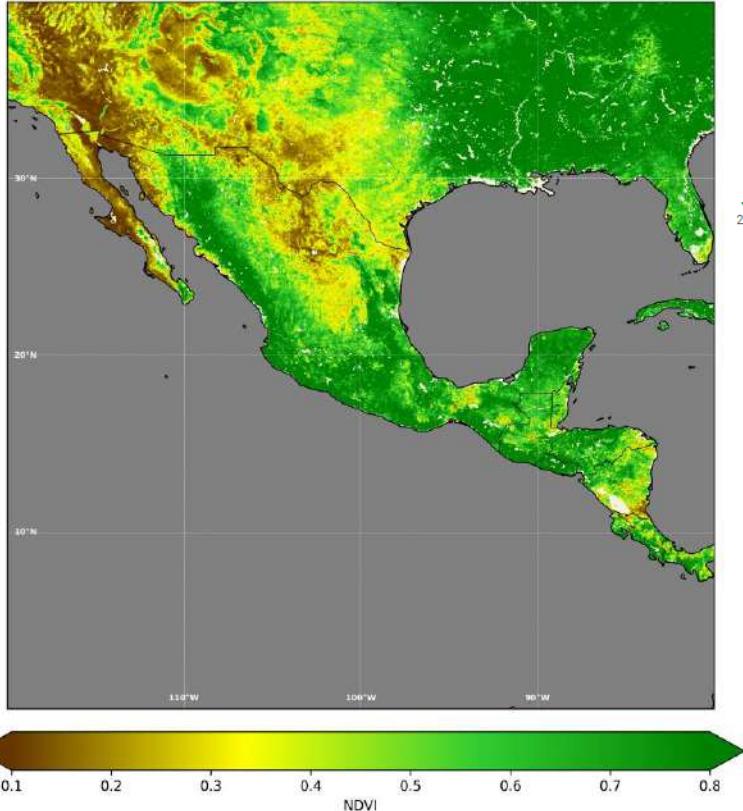


Ejemplo 5 (LSA-SAF)

```
# Normalized Difference Vegetation Index (Metop/AVHRR) - Central America
# possible days (01, 11 and 21), since 2007. Max. coordinates - extent = [-125, 0, -50, 50]
plot_saf(saf_product = 'METOP_AVHRR_S10_AMc_NDV',
         date_saf='2023-08-11 00:00',
         extent=[-120.0, 0.0, -80.0, 40.0],
         cmap='custom', vmin=0.1, vmax=0.8,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Ejercicio 2: Ejemplo

METOP/AVHRR - NDVI - 10-Daily Synthesis
2014-08-11 - 2014-08-21



Ejemplo 5 (LSA-SAF)

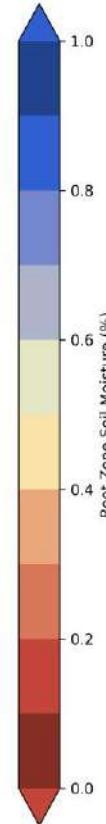
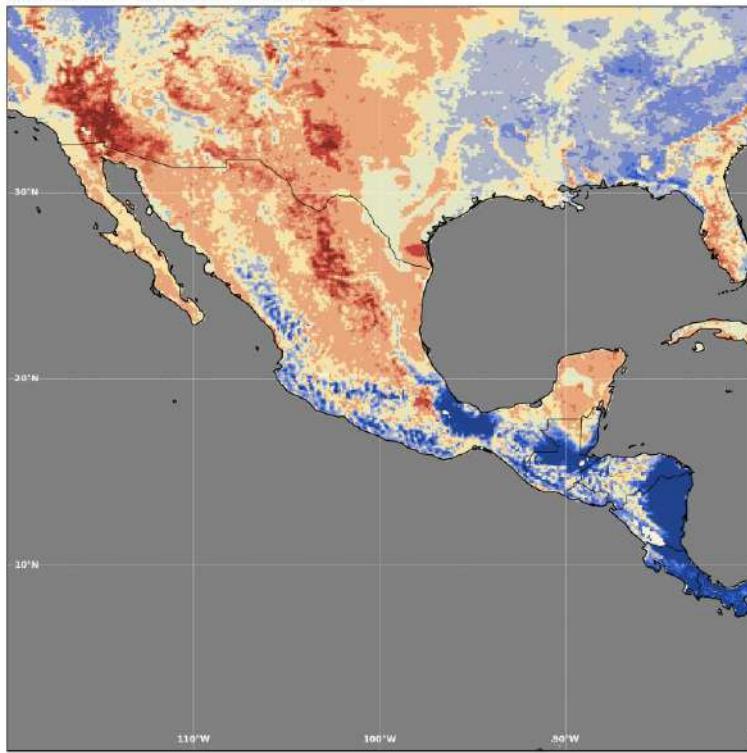
```
# Normalized Difference Vegetation Index (Metop/AVHRR) - Central America
# possible days (01, 11 and 21), since 2007. Max. coordinates - extent = [-125, 0, -50, 50]
plot_saf(saf_product = 'METOP_AVHRR_S10_AMc_NDV',
         date_saf='2014-08-11 00:00',
         extent=[-120.0, 0.00, -80.00, 40.00],
         cmap='custom', vmin=0.1, vmax=0.8,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Ejercicio 2: Ejemplo

Metop/ASCAT NRT Root Zone Soil Moisture Profile Index

2023-08-01

Entrenamiento AECID / AEMET / EUMETSAT

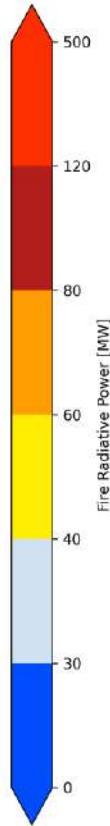


Ejemplo 14 (H-SAF)

```
# Root Zone Soil Moisture Profile Index (Metop/ASCAT)
# daily product
plot_saf(saf_product = 'h26_cur_mon_nc',
         date_saf='2023-08-01 00:00',
         extent=[-120.0, 0.00, -80.00, 40.00],
         cmap='custom', vmin=0, vmax=1,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Ejercicio 3: Ejemplo

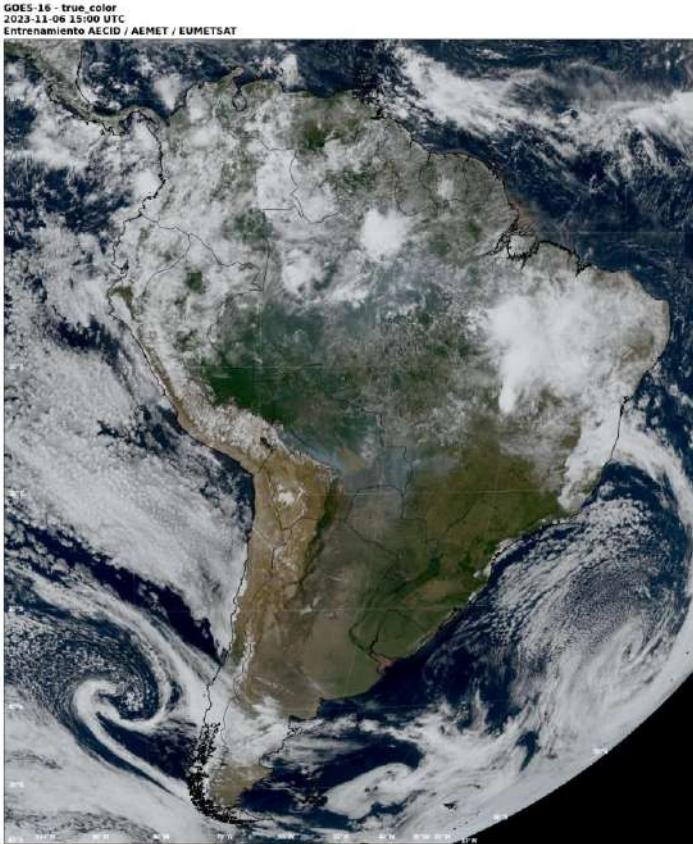
MSG/SEVIRI Fire Radiative Power Pixel
2023-11-06 15:00:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 6 (LSA SAF)

```
# Fire Radiative Power Pixel (MSG/SEVIRI)
# daily product (every 15 minutes), since 2004 (MSG footprint)
plot_saf(saf_product = 'LSASAF_MSG_FRP-PIXEL',
         date_saf='2023-11-06 15:00',
         extent=[-80.0, -40.00, -30.00, 10.00],
         cmap='custom', vmin=0, vmax=500,
         coast_color='black',
         countries_color='black',
         grid_color='white',
         land_ocean=True,
         land_color='beige',
         ocean_color='gray',
         figsize=[10,10])
```

Ejercicio 3: Ejemplo

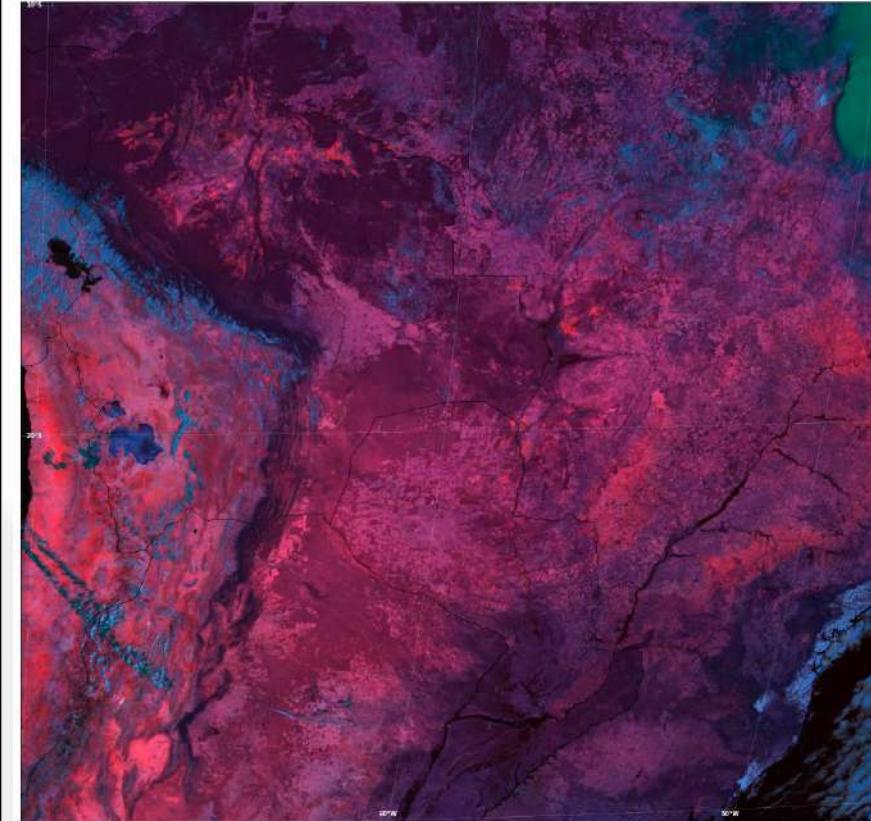


Ejemplo 2 (SATÉLITES)

```
plot_sat(sat='goes16',
          date_sat='2023-11-06 15:00',
          composite='true_color',
          area='custom_geo',
          extent=[-90.0, -60.00, -30.00, 15.00],
          coast_color='black',
          countries_color='black',
          grid_color='white',
          figsize=[15,15])
```

Ejercicio 3: Ejemplo

GOES-16 - cira_fire_temperature
2023-11-06 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT

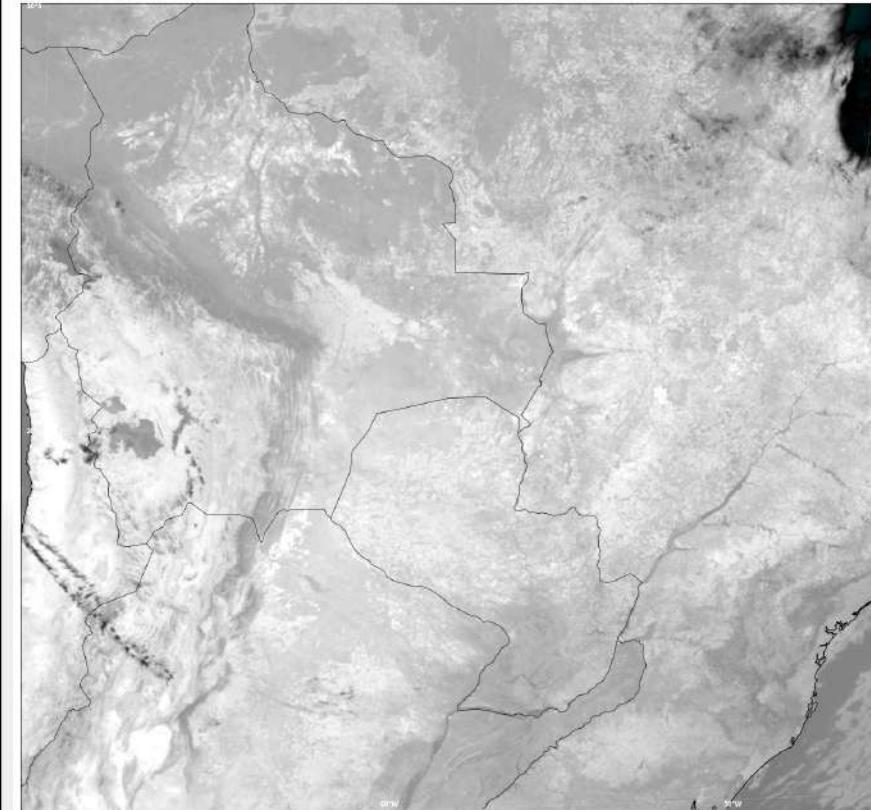


Ejemplo 2 (SATÉLITES)

```
plot_sat(sat='goes16',
          date_sat='2023-11-06 15:00',
          composite='cira_fire_temperature',
          area='custom_geo',
          extent=[-70.0, -30.00, -50.00, -10.00],
          coast_color='black',
          countries_color='black',
          grid_color='white',
          figsize=[15,15])
```

Ejercicio 3: Ejemplo

GOES-16 - C07 - 3.9 μm (3.8-4.0 μm)
2023-11-06 15:00 UTC
Entrenamiento AECID / AEMET / EUMETSAT



Ejemplo 2 (SATÉLITES)

```
plot_sat(sat='goes16',
          date_sat='2023-11-06 15:00',
          composite='C07',
          area='custom_geo',
          extent=[-70.0, -30.00, -50.00, -10.00],
          coast_color='black',
          countries_color='black',
          grid_color='white',
          figsize=[15,15])
```

Productos y Aplicaciones de Satélite en Latitudes Medias - Fase Presencial

Prácticas LSA SAF y H SAF

¡GRACIAS! ¿PREGUNTAS?



Diego Souza
diego.souza@inpe.br

DISSM - División de Satélites y Sensores Meteorológicos
CGCT - Coordinación General de Ciencias de la Tierra
INPE - Instituto Nacional de Investigaciones Espaciales

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA
E INOVAÇÃO

GOVERNO FEDERAL
BRASIL
UNIÃO E RECONSTRUÇÃO