ClimateSERV Module 1.3

ClimateSERV Dataset Encyclopedia

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Introduction

This document provides information about the various datasets that are available for visualization and download on ClimateSERV. ClimateSERV is a free and open source website created by SERVIR – a joint initiative of USAID and NASA – to provide precipitation and soil moisture datasets for regions of the world where in situ observations of these values are sparse. SERVIR created ClimateSERV because decision-makers around the world need a way to accurately assess precipitation and soil moisture data.

ClimateSERV offers users access to historical data derived from satellite observations as well as model forecasts, which are often influenced by satellite observations.

To jump to a specific dataset in this document, click the “show document outline” icon (square with three horizontal lines) near the top left of this page (below the undo button). This will expand the table of contents. You can then navigate to the dataset you are interested in learning more about by clicking it.

Chapter 1: Historical Data

The datasets in this chapter are historical data. Some datasets are strictly observational, whereas some are combined with a model or downscaled to a higher resolution.

1.1 Historical Precipitation Datasets

NASA-IMERG

The Integrated Multi-satellitE Retrievals for GPM (IMERG) algorithm combines information from the Global Precipitation Measurement Mission (GPM) satellite constellation to estimate precipitation over the majority of the Earth's surface.[1] The algorithm fuses the early precipitation estimates collected during the operation of the Tropical Rainfall Measuring Mission (TRMM) satellite (2000 - 2015) with more recent precipitation estimates collected during operation of the GPM (Global Precipitation Measurement) satellite (2014-present).[2] For more information on the IMERG dataset, consult the NASA IMERG documentation. Click here to visit the NASA IMERG documentation.

Characteristics of the NASA-IMERG Dataset

- Spatial Range: Global
- Spatial Resolution: ≃10 km / 0.1°
- Temporal Range: 2000 - near present
- Temporal Resolution: Daily
- Latency: Depends on subset, see below
- Units: Tenths of a millimeter

Subsets of NASA-IMERG Dataset available in ClimateSERV

- NASA IMERG Early 1 Day
    - Minimum latency: 4 hours[3]
    - Maximum latency in ClimateSERV : <2 days
    - Dataset name in ClimateSERV GUI: "NASA-IMERG-Early 1 Day"
    - Variable name in ClimateSERVpy API:

```python
"IMERG_early"
```

[1] Charles Cosner, "IMERG: Integrated Multi-satellitE Retrievals for GPM", Global Precipitation Measurement, 25 August 2022, https://gpm.nasa.gov/data/imerg
[2] Cosner, "IMERG..."
[3] Huffman, George J., et al, "Integrated Multi-satellitE Retrievals for GPM (IMERG) Technical Documentation", NASA Goddard Space Flight Center, 6 October 2020, https://gpm.nasa.gov/sites/default/files/2020-10/IMERG_doc_201006.pdf

    - Additional notes on Sub-dataset:
        - This dataset only has forward propagation (amounting to extrapolation forward in time).

- NASA IMERG Late 1 Day
    - Minimum latency: 12 hours
    - Maximum latency in ClimateSERV: <2 days
    - Dataset name in ClimateSERV: “NASA-IMERG-Late 1 Day”
    - Variable name in ClimateSERVpy API:

```python
"IMERG"
```

    - Additional notes on Sub-dataset:
        - The Late dataset has both forward and backward propagation – allowing for interpolation.
        - The additional ten hours of latency allows lagging data transmissions in the late run, even if they weren't available for the early run.
        - The late run uses a climatological adjustment that includes gauge data

UCSB CHIRP(S)

CHIRP is an acronym for the Climate Hazards Center for IR (Infrared) Precipitation data. It is a quasi-global rainfall dataset that spans over 35 years. CHIRPS (CHIRP with Stations) is the CHIRP data that is bias-corrected with ground truth data. CHIRPS was created by the University of California in Santa Barbara's Climate Hazards Center (CHC) in collaboration with scientists at the United States Geological Survey Earth Resources Observation and Science (EROS) Center.

The estimates of precipitation are obtained from thermal-infrared CCD (Cold Cloud Duration) measurements, calibrating the final precipitation estimate using the Tropical Rainfall Measuring Mission Multi-satellite Precipitation Analysis.[4] The dataset leverages historical long-term monthly means from ground stations to create CHPclim, which is CHC's global 0.05 degree monthly precipitation climatology.[5]

If you would like to learn more about the CHIRP(S) dataset, see The University of California – Santa Barbara's Climate Hazards Center's Documentation on CHIRP(S), Click here to view the UCSB CHC CHIRPS documentation. You can also reference Funk et al.. 2015 – a peer-reviewed paper documenting the methodology of the CHIRPS dataset. Click here to view Funk et al 2015.

Characteristics of CHIRPS Dataset

- Spatial Range: 50°S - 50°N, all latitudes
- Spatial Resolution: 0.05 ° (5.56 km)
- Temporal Range: 1981 - near present
- Temporal Resolution: Daily
- Latency: Depends on subset (see below)
- Units: millimeters

Subsets of CHIRPS datasets available in ClimateSERV

- UCSB CHIRP Rainfall
    - Latency: About a week
    - Dataset name in ClimateSERV GUI: "UCSB CHIRP Rainfall"

[4] Climate Hazards Center, "CHIRPS: Rainfall Estimates..."
[5] Climate Hazards Center, "CHIRPS: Rainfall Estimates..."

    - Dataset name in ClimateSERVpy API:

```python
"CHIRP"
```

    - Additional notes on sub-dataset:
        - The CHIRP dataset uses only the satellite estimates of precipitation based on CCD observations using thermal-infrared sensors as described above.
- UCSB CHIRPS Rainfall
    - Latency: About 3 weeks.[6]
    - Dataset name in ClimateSERV GUI: “UCSB CHIRPS Rainfall”
    - Dataset name in ClimateSERVpy API:

```python
"CHIRPS"
```

    - Additional notes on sub-dataset
        - CHIRPS (CHIRP with Stations) blends daily, pentadal, and monthly ground truth data from meteorological organizations around the world with remote sensing measurements to calibrate the CCD observations.[7]
        - For any given pixel, the CHIRPS Blending Procedure is based on a weighted average of the ratios between the five closest stations and the CHIRP estimate

[6] Funk, C., Peterson, P., Landsfeld, M. *et al.* The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes. *Sci Data* 2, 150066 (2015). https://doi.org/10.1038/sdata.2015.66

[7] Climate Hazards Center, “CHIRPS: Rainfall Estimates from Rain Gauge and Satellite Observations”, UC Santa Barbara Department of Geography, 25 August 2022, https://www.chc.ucsb.edu/data/chirps

1.2 Historical Soil Moisture Datasets

USDA SMAP

The NASA-USDA (United States Department of Agriculture) global soil moisture data provides soil moisture information across the globe. These datasets include: surface and subsurface soil moisture, surface and subsurface soil moisture anomalies, and soil moisture profile datasets. These data sets are generated by integrating satellite-derived Soil Moisture Active Passive (SMAP) and Soil Moisture Ocean Salinity (SMOS) soil moisture observations into the modified two-layer Palmer model using the Ensemble Kalman Filter (EnKF) data assimilation approach.[8] The assimilation of the satellite-derived soil moisture observations helped improve the model-based soil moisture predictions, particularly over poorly instrumented areas of the world that lack good quality in situ precipitation data.[9]

The Hydrological Science Laboratory at NASA's Goddard Space Flight Center – in collaboration with USDA Foreign Agricultural Services – developed these datasets. To learn more about this dataset, visit Goddard Space Flight Center's documentation on USDA SMAP data. Click here to visit the NASA Goddard Space Flight Center USDA SMAP Documentation.

Characteristics of USDA SMAP Dataset

- Spatial Range: Global (over landmasses)
- Spatial Resolution: ≃10 km/ 0.1°
- Temporal Range: March 31, 2015 - August 03, 2022
- Temporal Resolution: Every 3 days
- Latency: N/A
- Units: Depends on subset (see below)

Subsets of USDA SMAP Dataset available in ClimateSERV

- USDA SMAP Soil Moisture Profile
    - Dataset name in ClimateSERV GUI: "Soil moisture profile – USDA SMAP"
    - Dataset name in ClimateSERVpy API:

[8] Karen Mohr, "NASA-USDA Global Soil Moisture Data", Goddard Earth Sciences Division Projects, 25 August 2022, https://earth.gsfc.nasa.gov/hydro/data/nasa-usda-global-soil-moisture-data
[9] Karen Mohr, "NASA-USDA Global Soil Moisture Data"

```python
"USDA_SMAP"
```

    - Additional notes on Sub-dataset:
        - Units: Unitless (fraction)
        - Min: 0
        - Max: 1
- USDA Subsurface Soil Moisture
    - Dataset name in ClimateSERV GUI: “Sub surface soil moisture – USDA SMAP”
    - Dataset name in ClimateSERVpy API:

```python
"USDA_SSSM"
```

    - Additional notes on Sub-dataset:
        - Units: millimeters
        - Min: 0
        - Max: 274.6
- USDA SMAP Subsurface Soil Moisture Anomaly
    - Dataset name in ClimateSERV: “Sub surface soil moisture anomaly – USDA SMAP”
    - Dataset name in ClimateSERVpy API:

```python
"USDA_SSSMA"
```

    - Additional notes on Sub-dataset:
        - Units: N/A
        - Min: -4
        - Max: 4
        - USDA SMAP Soil moisture anomaly values are unitless and represent standardized anomalies computed using a 31-day moving window

        - Values around 0 indicate typical moisture conditions, while very positive values and very negative values indicate extreme wetting and drying, respectively.
- USDA SMAP Surface Soil Moisture
    - Dataset name in ClimateSERV GUI: “Surface soil moisture – USDA SMAP”
    - Dataset name in ClimateSERVpy API:

```python
"USDA_SSM"
```

    - Additional notes on Sub-dataset:
        - Units: mm
        - Min: 0
        - Max: 25.39
- USDA SMAP Surface Soil Moisture Anomaly
    - Dataset name in ClimateSERV GUI: “Surface soil moisture anomaly – USDA SMAP”
    - Dataset name in ClimateSERVpy API:

```python
"USDA_SSMA"
```

    - Additional notes on Sub-dataset:
        - Units: N/A
        - Min: -4
        - Max: 4
        - Soil Moisture anomalies are computed from the climatology of the day of interest; this climatology is estimated based on the full data record of the SMAP satellite observation and the 31-day centered moving-window approach.[10] Thus, these USDA SMAP Soil moisture anomaly values are unitless.

[10] Earth Engine Developers, “NASA-USDA Enhanced SMAP Global Soil Moisture Data”, Earth Engine Data Catalog, 25 August 2022, https://developers.google.com/earth-engine/datasets/catalog/NASA_USDA_HSL_SMAP10KM_soil_moisture#terms-of-use

- Values around 0 indicate typical moisture conditions, while very positive values and very negative values indicate extreme wetting and drying, respectively.

NSIDC SMAP 1km

The National Snow and Ice Data Center (NSIDC) product contains global daily 1km resolution surface soil moisture derived from the Soil Moisture Active Passive (SMAP) L-band radiometer.[11] Specifically, MODIS land surface temperature data is used with the SMAP Enhanced L2 Radiometer Half-Orbit 9km EASE-Grid Soil Moisture product in a downscaling algorithm to estimate soil moisture. The dataset is validated by in situ soil moisture measurements from dense soil moisture networks representing different global land cover types. On average the data represents approximately the top 5 cm of the soil column.

Characteristics of the NSIDC SMAP Dataset

- Name of the Dataset in ClimateSERV GUI: See “Subsets of the NSIDC SMAP Dataset”
- Dataset not added to ClimateSERV API yet (as of February 9 2024)
- Spatial Range: Near-Global
    - Longitudes: 180°W - 180° E
    - Latitudes: 86°N - 86°S
- Spatial Resolution: 1 km
- Temporal Range: 1 April 2015 - Near-Present
    - Some empty data files exist where input data were not available[12]. For a comprehensive list of missing or bad data, please see the SMAP Master List of Bad and Missing Data.
- Temporal Resolution: See “Subsets of the NSIDC SMAP Dataset”
- Latency:
- Units: $\frac{m^3}{m^3}$

Subsets of the NSIDC SMAP Dataset

- Daily
    - Dataset name within ClimateSERV GUI: “NSIDC SMAP/Sentinel 1Km”

[11] Lakshmi, V. and B. Fang. 2023. SMAP-Derived 1-km Downscaled Surface Soil Moisture Product, Version 1. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/U8QZ2AXE5V7B. October 11, 2023.

[12] Lakshmi, V. and B. Fang. 2023. SMAP-Derived 1-km Downscaled Surface Soil Moisture Product, Version 1. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/U8QZ2AXE5V7B. October 11, 2023.

    - Temporal Resolution: Daily
    - Notes
        - This dataset shows the daily output from this data. Thus the data is spatially variable
- 15-day
    - Temporal Resolution: Every 15 days
    - Dataset name within ClimateSERV GUI: “NSIDC SMAP/Sentinel 1Km 15 day”

    - Notes
        - This dataset represented the NSIDC SMAP/Sentinel 1Km data when mosaicked over the last fifteen days
            - Thus the dataset has better spatial coverage but worse temporal resolution

1.3 Other Historical Datasets

SPoRT Evaporative Stress Index (ESI)

The Evaporative Stress Index describes temporal anomalies in evapotranspiration (ET), highlighting areas with anomalously high or low rates of water use across the land surface. The evapotranspiration values are retrieved via energy balance using remotely sensed land-surface temperature (LST) time-change signals.[13] LST is a fast-response variable, providing proxy information regarding rapidly evolving surface soil moisture and crop stress conditions at relatively high spatial resolution.[14] The ESI also demonstrates capability for capturing early signals of "flash drought", brought on by extended periods of hot, dry, and windy conditions leading to rapid soil moisture depletion.[15]

ESI values quantify standardized anomalies (sigma values) in the ratio of clear-sky actual-to-potential (fPET), derived using thermal infrared (TIR) satellite imagery. These fPET composites are developed for 4-week and 12-week moving windows.[16]

To learn more about the Evaporative Stress Index datasets, see the National Drought Information System Documentation on ESI. Click here to visit the National Integrated Drought Information System ESI Documentation.

Characteristics of SPoRT Evaporative Stress Index (ESI) Dataset

- Spatial Range: Near-Global (no coverage of the poles)
- Spatial Resolution: 5 km
- Temporal Range: 2000 - Present
- Temporal Resolution: Weekly
- Latency: Depends on subset – see below
- Units: Unitless (sigma values)

---

[13] National Integrated Drought Information System, "Evaporative Stress Index", Drought.gov, 25 August 2022, https://www.drought.gov/data-maps-tools/evaporative-stress-index-esi
[14] National Integrated Drought Information System, "Evaporative Stress Index"
[15] National Integrated Drought Information System, "Evaporative Stress Index"
[16] United States Department of Agriculture, "Evaporative Stress Index", Hydrology & Remote Sensing Lab, 25 August 2022, https://hrsl.ba.ars.usda.gov/drought/index.php

Subsets of SPoRT Evaporative Stress Index (ESI) Dataset available in ClimateSERV

- SPoRT 12-Week Evaporative Stress Index
    - Latency: About 12 weeks
        - fPET composites are developed for a 12-week moving window, advancing at 7-day intervals (interval moves on Sunday).
    - Dataset name in ClimateSERV GUI: “SPoRT Evaporative Stress Index (ESI-12 WEEK)”
    - Dataset name in ClimateSERVpy API:

```python
"ESI_12"
```

    - Additional notes on Sub-dataset:
        - ESI values quantify standardized anomalies (sigma values) in the ratio of clear-sky actual-to-potential (fPET), derived using thermal infrared (TIR) satellite imagery. This dataset develops fPET composites for a 12 week moving window.
- SPoRT 4-Week Evaporative Stress Index
    - Latency: About 4 weeks
        - fPET composites are developed for a 4-week moving window, advancing at 7-day intervals (interval moves on Sunday).
    - Dataset name in ClimateSERV GUI: “SPoRT Evaporative Stress Index” (ESI-4 WEEK)
    - Dataset name in ClimateSERVpy API:

```python
"ESI_4"
```

    - Additional notes on Sub-dataset:
        - ESI values quantify standardized anomalies (sigma values) in the ratio of clear-sky actual-to-potential (fPET), derived using thermal infrared (TIR) satellite imagery. This dataset develops fPET composites for a 4 week moving window

USGS eMODIS NDVI

The Earth Resources Observation and Science Center (EROS) Moderate Resolution Imaging Spectroradiometer (MODIS) database is referred to as eMODIS. The eMODIS collection is based on MODIS data acquired by NASA's Earth Observing System (EOS). The original MODIS data has usability issues encountered with the reprojection, file format, and subsetting.[17] As a result, the eMODIS suite was developed to address these issues, and includes 7-day composited data sets.[18] Each data set delivers acquisition, quality, and Normalized Difference Vegetation Index (NDVI) information at 250-meter spatial resolution.[19] To learn more about the eMODIS NDVI dataset, see the USGS EROS Archive Documentation on EROS Moderate Resolution Imaging Spectroradiometer. Click here to visit the USGS EROS Archive Documentation.

Characteristics of USGS eMODIS NDVI Dataset

- Spatial Range: Depends on the subset (see below)
- Spatial Resolution: 250 meters
- Temporal Range: July 1, 2002 - September 21, 2022
- Temporal Resolution: Dekadal (Every Ten days)
- Latency: N/A
- Units: Unitless (between 0 and 1)

Subsets of USGS eMODIS NDVI Dataset available in ClimateSERV

- Central Asia
    - Dataset name in ClimateSERV GUI: "USGS eMODIS NDVI Central Asia"
    - Dataset name in ClimateSERVpy API:

```python
"CentralAsia_eMODIS"
```

    - Additional notes on sub-dataset:

[17] Earth Resources Observation and Science (EROS) Center, "USGS EROS Archive – Vegetation Monitoring – EROS Moderate Resolution Imaging Spectroradiometer (eMODIS)", 17 July 2018, United States Geological Survey, https://www.usgs.gov/centers/eros/science/usgs-eros-archive-vegetation-monitoring-eros-moderate-resolution-imaging

[18] Earth Resources Observation and Science (EROS) Center, "USGS EROS Archive..."

[19] Earth Resources Observation and Science (EROS) Center, "USGS EROS Archive...

        - Spatial Extent
            - Longitude ranges from roughly 46°E to 88°E
            - Latitude ranges from roughly 23°N to 56°N
- East Africa
    - Dataset name in ClimateSERV GUI: “USGS eMODIS NDVI East Africa”
    - Dataset name in ClimateSERVpy API:

```python
"EastAfrica_eMODIS"
```

    - Additional notes on sub-dataset:
        - Spatial Extent
            - Longitude ranges from roughly 21°E to 52°E
            - Latitude ranges from roughly 12.5°S to 23 °N
- Southern Africa
    - Dataset name in ClimateSERV GUI: “USGS eMODIS NDVI Southern Africa”
    - Dataset name in ClimateSERVpy API:

```python
"SouthAfrica_eMODIS"
```

    - Additional notes on sub-dataset:
        - Spatial Extent
            - Longitude ranges from roughly 5°E to 51°E
            - Latitude ranges from roughly 36°S to 3.5°N
- West Africa
    - Dataset name in ClimateSERV: “USGS eMODIS NDVI West Africa”
    - Dataset name in ClimateSERVpy API:

```python
"WestAfrica_eMODIS"
```

    - Additional notes on sub-dataset:
        - Spatial Extent

- Longitude ranges from roughly 20.5 °W to 20.5 °E
- Latitude ranges from 2 °N to 20.5 °N

Chapter 2: Model Forecasts/Hindcasts

The datasets in this chapter are model forecasts or hindcasts, some of which are bias-corrected or adjusted using remotely sensed data.

UCSB CHIRPS - GEFS

The Global Ensemble Forecast System (GEFS) is a weather forecast model made up of 21 separate forecasts, or ensemble members. GEFS was developed by the National Centers for Environmental Prediction, a group within NOAA (the United States National Oceanic and Atmospheric Administration). GEFS quantifies the amount of uncertainty in a forecast by generating an ensemble of multiple forecasts. GEFS consists of 21 different models that each produce a 16-day forecast every 6 hours. UCSB takes the GEFS data and bias-adjusts each ensemble member using the historical CHIRPS data. For more information on CHIRPS-GEFS, visit the University of California – Santa Barbara Climate Hazards Center Documentation on CHIRPS - GEFS. Click here to visit the UCSB CHC CHIRPS-GEFS Documentation.

Characteristics of CHIRPS Dataset

- Spatial Range: 50°S - 50°N, all longitudes
- Spatial Resolution: 5.56 km / 0.05°
- Temporal Range: 1985 - near present
- Temporal Resolution: Pentadal
- Units: millimeters

Subsets of CHIRPS-GEFS Dataset Available within ClimateSERV

- UCSB CHIRPS-GEFS 10-day forecast Mean Precipitation
    - Dataset name in ClimateSERV GUI: “UCSB CHIRPS-GEFS 10-day forecast mean precip”
    - Dataset name in ClimateSERVpy API:

```python
"CHIRPS_GEFS_precip_mean"
```

- UCSB CHIRPS-GEFS Anomaly
    - Dataset name in ClimateSERV GUI: “UCSB CHIRPS-GEFS 10-day forecast mean anomaly”
    - Dataset name in ClimateSERVpy API:

```python
"CHIRPS_GEFS_anom"
```

- Additional notes on sub-dataset
  - Produces a sigma value showing whether the precipitation value is above or below the historical precipitation mean

NMME

The North American Multimodel Ensemble (NMME) is a seasonal forecast dataset, meaning it contains forecasted precipitation or temperature values based on past data. Developed by The United States National Oceanic and Atmospheric Administration (NOAA), the ensemble generates global, seasonal forecasts every month for precipitation and temperature, drawing from coupled models from North American modeling centers. All NMME forecasts are bias corrected using hindcasts and cross validated.[20] The models are bias corrected to the Princeton Global Meteorological Forcing Dataset (PGF) climatologies for precipitation and temperature.[21]

NMME consists of multiple coupled models from North American modeling centers. The system has two different models, the Community Climate System Model version 4 (CCSM4), and The Climate Forecast Model version 2 (CFSv2). The individual model with the highest anomaly correlation skill is CFSv2.[22] The NMME dataset is regularly used by the United States Government official drought briefings.

You can learn more about the NMME dataset by reading Kirtman et al 2014 – a scientific paper regarding the NMME dataset. Click here to read Kirtman et al 2014. You can also visit NOAA National Centers of Environmental Information Documentation on the NMME dataset. Click here to visit the NOAA NCEI documentation on NMME.

Characteristics of the NMME Dataset

- Spatial Range: Global
- Spatial Resolution: 0.5° (~55.55 km)
- Temporal Range: From near-present to 180 days in the future
    - Near-present: Starts on the first of the month with a latency of about a month
- Temporal Resolution: Daily
- Units:

[20] Ben P. Kirtman et al, "The North American Multimodel Ensemble: Phase-1 Seasonal-to-Interannual Prediction; Phase-2 toward Developing Intraseasonal Prediction", *Bulletin of the American Meteorological Society* Volume 95, Issue 4 (2014): 585-601, https://doi.org/10.1175/BAMS-D-12-00050.1

[21] Kirtman et al, "The North American Multimodel Ensemble…", 585-601

[22] Kirtman et al, "The North American Multimodel Ensemble…", 585-601

- Temperature: Kelvin
- Precipitation: Millimeters

Subsets of NMME Dataset in ClimateSERV

- NMME CCSM4 (Community Climate System Model version 4)
  - Dataset name in ClimateSERV GUI: “NMME CCSM4”
  - Dataset name in ClimateSERVpy API:

```python
"CCSM4"
```

  - Additional notes on sub-dataset:
    - There are ten individual ensembles, named “NMME CCSM4 ens01”, “NMME CCSM ens02”, “NMME CCSM ens03 … NMME CCSM ens10” in the ClimateSERV GUI
      - Within the ClimateSERVpy API, the ensembles are called:

```python
"ens01", "ens02", "ens03", "ens04".....ens10"
```

- NMME CFSV2 (Climate Forecast Model Version 2)
  - Dataset name in ClimateSERV GUI: “NMME CFSv2”
  - Dataset name in ClimateSERVpy API:

```python
"CFSV2"
```

  - Additional notes on sub-dataset:
    - There are 24 individual ensembles for this dataset, named “NMME cfsv2 ens01”, “NMME cfsv2 ens02”, … “NMME cfsv2 ens24” in the ClimateSERV GUI.
      - Within the ClimateSERVpy API, the ensembles are called:

Python

```
"ens01", "ens02", "ens03".............."ens24"
```

LIS

NASA's Short-term Prediction and Transition Center – Land Information System (SPoRT-LIS) provides soil moisture, runoff, baseflow, and evapotranspiration data at high resolution. The soil moisture product is a long-term run of the Noah Land Surface Model (LSM) that began on June 1, 2010, and is updated every 6 hours in real-time. The SPoRT-LIS product incorporates real-time MODIS-derived vegetation, and by input atmospheric analyses from the NCEP/EMC North American Land Data Assimilation System phase 2 (NLDAS-2) and Stage IV precipitation.[23]

Characteristics of the LIS Dataset

- Spatial Range: Most of Africa, some of the Middle East
    - Approximate Latitudes: 37°S - 31°N
    - Approximate Longitudes: 20°W - 53°E
- Temporal Range: June 1, 2000 - Near-Present
    - LIS can run for 12 days in the future
- Spatial Resolution: 3 kilometers
- Temporal Resolution: Daily
- Units: Depends on subset (see below)

Subsets of the LIS Dataset in ClimateSERV

- Runoff as modeled by LIS
    - Units: $\frac{mm}{day}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Runoff"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

- Soil Moisture at a subsurface depth of 0 - 10 cm as modeled by LIS
    - Units: $\frac{m^3}{m^3}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Soil Moisture 0-10 cm"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

[23] Hain, Christopher, et al., "Real-Time Land Information System", Short-term Prediction Research and Transition Center, National Aeronautics and Space Administration.

- Soil Moisture at a subsurface depth of 10 - 40 cm as modeled by LIS
    - Units: $\frac{m^3}{m^3}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Soil Moisture 10-40 cm"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

- Soil Moisture at a subsurface depth of 40 - 100 cm as modeled by LIS
    - Units: $\frac{m^3}{m^3}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Soil Moisture 40-100 cm"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

- Soil Moisture at a subsurface depth of 100 - 200 cm as modeled by LIS
    - Units: $\frac{m^3}{m^3}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Soil Moisture 100-200 cm"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

- Baseflow as modeled by LIS
    - Units: $\frac{mm}{day}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Baseflow"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

- Evapotranspiration as modeled by LIS
    - Units: $\frac{mm}{day}$
    - Name of dataset in ClimateSERV GUI:"LIS-Modeled Evapotranspiration"
    - Dataset not yet available in ClimateSERV API (as of February 9, 2024)

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Appendix

- External Link 1: NASA documentation on IMERG: Integrated Multi-Satellite Retrievals for GPM. Click here to visit the NASA IMERG documentation.
- External Link 2: National Integrated Drought Information System Documentation on the Evaporative Stress Index dataset. Click here to visit the National Integrated Drought Information System Documentation.
- External Link 3: NASA Goddard Space Flight Center Documentation on USDA Global Soil Moisture Soil Moisture Data. Click here to visit the NASA Goddard Space Flight Center Documentation.
- External Link 4: University of California, Santa Barbara Climate Hazards Center Documentation on CHIRPS. Click here to view the UCSB CHC CHIRPS documentation.
- External Link 5: Funk et al 2015: Scientific paper regarding CHIRPS dataset. Click here to view Funk et al 2015.
- External Link 6: University of California, Santa Barbara Climate Hazards Center Documentation on CHIRPS - GEFS. Click here to visit the UCSB CHC CHIRPS-GEFS Documentation.
- External Link 7: USGS EROS Archive Documentation on EROS Moderate Resolution Imaging Spectroradiometer. Click here to visit the USGS EROS Archive Documentation.
- External Link 8: Kirtman et al 2014: Scientific paper regarding NMME dataset. Click here to visit Kirtman et al 2014.
- External Link 9: NOAA National Centers of Environmental Information documentation on NMME. Click here to visit the NOAA NCEI documentation on NMME.
- External Link 10: NASA Short-term Prediction Research and Transition Center documentation on the LIS (Land Information System). Click here to view the Land Information System.
- External Link 11: National Snow and Ice Data Center documentation regarding the SMAP-derived 1-km Downscaled Surface Soil Moisture Product, Version 1. https://nsidc.org/data/nsidc-0779/versions/1.