

ClimateSERV Dataset Encyclopedia

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Introduction

This document will provide 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.

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 click the dataset you are interested in learning more about.

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
- Temporal Range: 2000 - near present
- Spatial Resolution: $\approx 10 \text{ km} / 0.1^\circ$
- Temporal Resolution: Daily
- Units: Tenths of a millimeter

Subsets of NASA-IMERG Dataset available in ClimateSERV

- NASA IMERG Early 1 Day
 - Dataset name within ClimateSERV: "NASA-IMERG-Early 1 Day"
 - Notes on Sub-dataset:
 - This dataset only has forward propagation (amounting to extrapolation forward in time).
- NASA IMERG Late 1 Day
 - Dataset name within ClimateSERV: "NASA-IMERG-Late 1 Day"
 - 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

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..."

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.³ LST is a fast-response variable, providing proxy information regarding rapidly evolving surface soil moisture and crop stress conditions at relatively high spatial resolution.⁴ 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.⁵

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.⁶

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: Global (except for the poles)
- Temporal Range: 2000 - Present
- Spatial Resolution: 5 km
- Temporal Resolution: Weekly
- Units: Unitless (sigma values)

³ National Integrated Drought Information System, “Evaporative Stress Index”, Drought.gov, 25 August 2022, <https://www.drought.gov/data-maps-tools/evaporative-stress-index-esi> ⁴ National Integrated Drought Information System, “Evaporative Stress Index” ⁵ National Integrated Drought Information System, “Evaporative Stress Index” ⁶ 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 NASA-IMERG Dataset available in ClimateSERV

- SPoRT 12-Week Evaporative Stress Index
 - Dataset name within ClimateSERV:
 - “SPoRT Evaporative Stress Index (ESI-12 WEEK)”
 - 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
 - Dataset name within ClimateSERV:
 - “SPoRT Evaporative Stress Index” (ESI-4 WEEK)
 - 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.

USDA SMAP

The NASA-USDA 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.⁷ 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.⁸

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)
- Temporal Range: March 31, 2015 - present
- Spatial Resolution: ≈ 10 km/ 0.1°
- Temporal Resolution: Every 3 days
- Units: Depends on subset (see below)

⁷ 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> ⁸ Karen Mohr, "NASA-USDA Global Soil Moisture Data"

Subsets of USDA SMAP Dataset available in ClimateSERV

- USDA SMAP Soil Moisture Profile
 - Dataset name within ClimateSERV:
 - “Soil moisture profile – USDA SMAP”
 - Notes on Sub-dataset:
 - Units: Unitless (fraction)
 - Min: 0
 - Max: 1
- USDA Subsurface Soil Moisture
 - Dataset name within ClimateSERV:
 - “Sub surface soil moisture – USDA SMAP”
 - Notes on Sub-dataset:
 - Units: millimeters
 - Min: 0
 - Max: 274.6
- USDA SMAP Subsurface Soil Moisture Anomaly
 - Dataset name within ClimateSERV:
 - “Sub surface soil moisture anomaly – USDA SMAP”
 - 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 within ClimateSERV:
 - “Surface soil moisture – USDA SMAP”
 - Notes on Sub-dataset:
 - Units: mm
 - Min: 0
 - Max: 25.39
- USDA SMAP Surface Soil Moisture Anomaly
 - Dataset name within ClimateSERV:

- “Surface soil moisture anomaly – USDA SMAP”
- 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.⁹ Thus, these USDA SMAP Soil moisture anomaly values are unitless.
 - Values around 0 indicate typical moisture conditions, while very positive values and very negative values indicate extreme wetting and drying, respectively.

⁹ 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

UCSB CHIRPS

CHIRPS is an acronym for the Climate Hazards Center for IR (Infrared) Precipitation with Stations data. It is a quasi-global rainfall dataset that spans over 35 years. 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. CHIRPS blends daily, pentadal, and monthly estimates of precipitation from remote sensing measurements with ground station data.¹⁰

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.¹¹ 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.¹²

If you would like to learn more about the CHIRPS dataset, see The University of California – Santa Barbara's Climate Hazards Center's Documentation on CHIRPS, [Click here to view the UCSB CHC CHIRPS documentation](#). You can also reference Funk et al., 2015 – a scientific 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
- Temporal Range: 1981 - near present
- Spatial Resolution: 0.05 ° (5.56 km)
- Temporal Resolution: Daily
- Units: millimeters

¹⁰ 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>

¹¹ Climate Hazards Center, "CHIRPS: Rainfall Estimates..."

¹² Climate Hazards Center, "CHIRPS: Rainfall Estimates..."

Subsets of CHIRPS datasets available in ClimateSERV

- UCSB CHIRP Rainfall
 - Dataset name within ClimateSERV:
 - "UCSB CHIRP Rainfall"
 - 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
 - Dataset name within ClimateSERV:
 - "UCSB CHIRPS Rainfall"
 - Notes on sub-dataset
 - The CHIRPS dataset involves a station-blending procedure that uses ground truth data from meteorological organizations around the world to calibrate the CCD observations
 - 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

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 latitudes
- Temporal Range: 1985 - near present
- Spatial Resolution: 5.56 km / 0.05°
- Temporal Resolution: Pentadal
- Units: millimeters

Subsets of CHIRPS-GEFS Dataset Available within ClimateSERV

- UCSB CHIRPS-GEFS Precipitation
 - Dataset name within ClimateSERV:
 - “UCSB CHIRPS-GEFS Precip”
- UCSB CHIRPS-GEFS Anomaly
 - Dataset name within ClimateSERV:
 - “UCSB CHIRPS-GEFS Anomaly”
 - Notes on sub-dataset
 - Produces a sigma value showing whether the precipitation value is above or below the historical precipitation mean

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.¹³ As a result, the eMODIS suite was developed to address these issues, and includes 7-day composited data sets.¹⁴ Each data set delivers acquisition, quality, and Normalized Difference Vegetation Index (NDVI) information at 250-meter spatial resolution.¹⁵ 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)
- Temporal Range: 07/01/2002 - near present
- Spatial Resolution: 250 meters
- Temporal Resolution: Dekadal (Every Ten days)
- Units: Unitless (Between 0 and 1)

Subsets of USGS eMODIS NDVI Dataset available in ClimateSERV

- Central Asia
 - Dataset name within ClimateSERV:
 - "USGS eMODIS NDVI Central Asia"
 - Notes on sub-dataset:
 - Spatial Extent
 - Longitude ranges from roughly 46°E to 88°E
 - Latitude ranges from roughly 23°N to 56°N

¹³ 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>

¹⁴ Earth Resources Observation and Science (EROS) Center, "USGS EROS Archive..."

¹⁵ Earth Resources Observation and Science (EROS) Center, "USGS EROS Archive..."

- East Africa

- Dataset name within ClimateSERV:
 - "USGS eMODIS NDVI East Africa"
- 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 within ClimateSERV:
 - "USGS eMODIS NDVI Southern Africa"
 - 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 within ClimateSERV:
 - "USGS eMODIS NDVI West Africa"
 - 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

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.¹⁶ The models are bias corrected to the Princeton Global Meteorological Forcing Dataset (PGF) climatologies for precipitation and temperature.¹⁷

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 CFSv2.¹⁸ 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
- Temporal Range: Up to 180 Days in the future
- Spatial Resolution: 1° (111.11 km)
- Temporal Resolution: Daily
- Units:

¹⁶ 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>

¹⁷ Kirtman et al, "The North American Multimodel Ensemble...", 585-601

¹⁸ Kirtman et al, "The North American Multimodel Ensemble...", 585-601

- Temperature: Kelvin
- Precipitation: Millimeters

Subsets of NMME Dataset in ClimateSERV

- NMME CCSM4
 - Dataset name within ClimateSERV:
 - "NMME CCSM4"
 - Notes on sub-dataset:
 - There are ten individual ensembles, named "NMME CCSM4 ens01", "NMME CCSM ens02", "NMME CCSM ens03 ... NMME CCSM ens10"
- NMME CFSV2
 - Dataset name within ClimateSERV:
 - "NMME CFSv2"
 - Notes on sub-dataset:
 - There are 24 individual ensembles for this dataset, named "NMME cfsv2 ens01", "NMME cfsv2 ens02", ... "NMME cfsv2 ens24"

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.](#)

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