Flooding Project Team - Summary of Datasets Report.

COGS-269 Global Good Studio
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Terminology

CMORPH-KF – The Climate Prediction Center Morphing-Kalman Filter
CORRA – GPM Combined Ku Radar-Radiometer Algorithm adjusted to the monthly Global Precipitation Climatology Project Satellite-Gauge product over high-latitude ocean and tropical land to correct known biases
GPM – Global Precipitation Measurement
IMERG - Integrated Multi-satellitE Retrievals for GPM
SMAP - Soil Moisture Active Passive
USGS - United States Geological Survey
AWIPS - Advanced Weather Interactive Processing System
NWS - National Weather Service
DEM - Digital Elevation Model

Dataset 1. Integrated Multi-satellitE Retrievals for GPM (IMERG) Final Precipitation L3 Half Hourly

Description: IMERG is data created using the U.S. algorithmic approach to calculating multi-satellite precipitation. For the IMERG process, the system is run in near-real time twice shortly after an observation. The "early" run occurs about 4 hours after the observation using only forward CMORPH-KF morphing. The "late" run occurs about 14 hours following the observation using both forward and backward morphing.   An additional run happens after the monthly gauge analysis. A post real-time "final" product happens around 3.5 months after the initial observation that incorporates monthly analyses and used forward and backward morphing.

While the near real-time estimates are not calibrated, in the "final" product, the estimates are adjusted to fit the sum of the monthly satellite-gauge calibration. In the FINAL RUN, the precipitation estimates are intercalibrated to the CORRA project, forward/backward morphed, and combined with microwave precipitation-calibrated geo-IR fields, and adjusted with seasonal GPCP SG surface precipitation data to provide half-hour and monthly precipitation estimates. The precipitation phase uses analysis of surface temperature, humidity, and pressure. The current period of record is June 2000 to the present (delayed by about 3.5 months). The output contains information on input data, intermediate fields, and estimation quality. The field "precipitationCal" is the data field of interest to most users.

Limitations: The data is delayed by 3.5 months. The initial input is estimated and the data is extremely processed (see description).

Source: https://gpm.nasa.gov/data-access/downloads/gpm or
https://disc.gsfc.nasa.gov/datasets/GPM_3IMERGHH_06/summary?keywords=GPM

Citation: Huffman, G.J., E.F. Stocker, D.T. Bolvin, E.J. Nelkin, Jackson Tan (2019), GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V06, Greenbelt, MD, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: 04/07/2020, 10.5067/GPM/IMERG/3B-HH/06

Details:
- Spatial Coverage: -180.0,-90.0,180.0,90.0
- Spatial Resolution: 0.1 ° x 0.1 °
- Temporal Coverage: June 1, 2000 to December 12, 2019
- Temporal Resolution: 30 minutes
- Memory Size: 2.8MB per file (3.19TB as of 04/07/2020)

Variables:
- HQobservationTime = Microwave satellite observation time (units: minutes)
- HQprecipitation = High Quality precipitation from all available passive microwave sources (units: mm/hr)
- HQprecipSource = Microwave satellite source identifier
- IRkalmanFilterWeight = IR-data weights in MW Kalman smoothing
- IRprecipitation = Precipitation (IR-only) from all available geo-satellites, passive-microwave-calibrated (units: mm/hr)

- precipitationCal = Precipitation (combined microwave-IR) estimate with gauge calibration (units: mm/hr)
- precipitationQualityIndex = Quality Index of precipitationCal
- precipitationUncal = Precipitation (combined microwave-IR) estimate without gauge calibration (units: mm/hr)
- probabilityLiquidPrecipitation = Probability of liquid precipitation phase (units: percent)
- randomError = Random error for precipitationCal (units: mm/hr)

Access: This dataset requires users to be registered with the Earthdata Login (https://urs.earthdata.nasa.gov/) system. This data can be accessed using SFTP and can be automated. Access instructions are on this link, https://disc.gsfc.nasa.gov/data-access.

Subset Parameters:
1. Data Range: 2018-07-12 to 2018-07-19
2. Grid: Bicubic Interpolation on geos0.25 grid
3. Format: netCDF

Example Visualization using Python netCDF4 and Matplotlib:
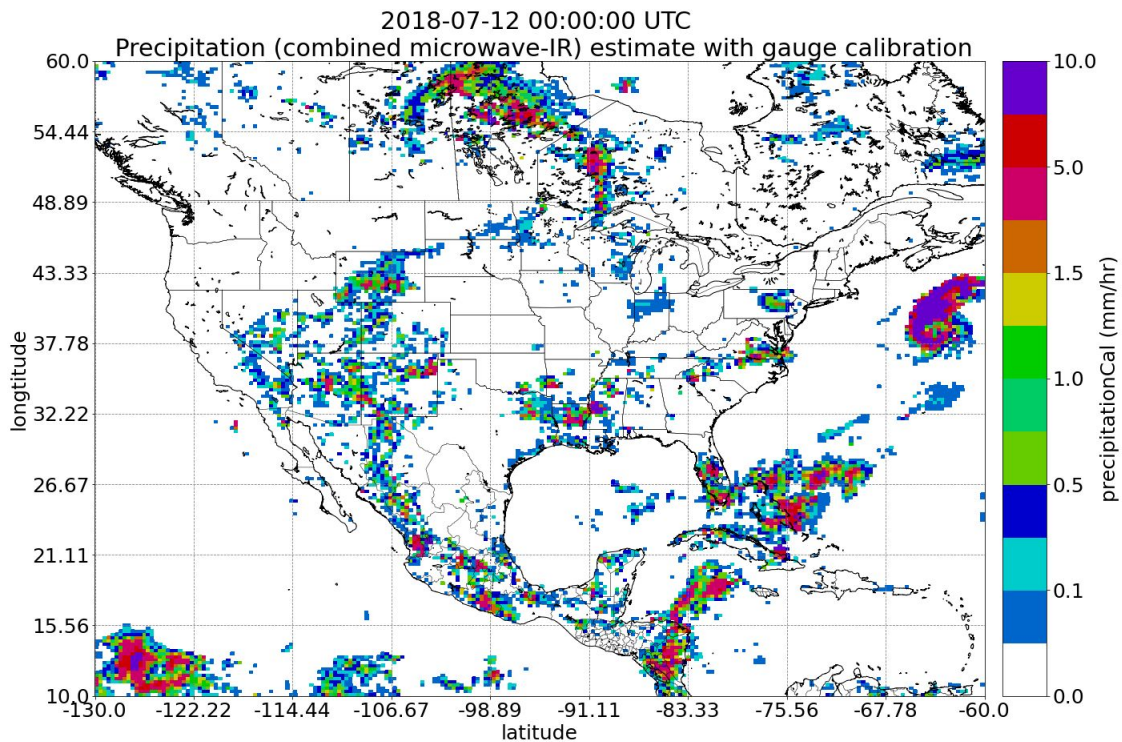
Dataset 2: Soil Moisture Active Passive (SMAP)

Description: SMAP data comes in 7 different levels:

- Level 0 - unprocessed instrument data with communication artifacts removed
- Level 1A - Level 0 data with time reference and metadata computed and appended (but not applied to the data) like radiometric and geometric calibration coefficients.
- Level 1B - Radiometrically corrected and geolocated Level 1A data that have been processed to sensor units.
- Level 1C - Level 1B data that has been spatially resampled.
- Level 2 - Geophysical metadata derived at the same resolution and location as the Level 1 data.
- Level 3 - Geophysical metadata derived from Level 1 or 2 data that is spatially and/or temporally re-sampled to global grid
- Level 4 - Geophysical metadata derived from assimilating Level 1, 2, or 3 data to a land surface model

SMAP data is available through two entities: the Alaska Satellite Facility (ASF) and the National Snow and Ice Data Center (NSIDC). The ASF provides Level 1 radar products only.

Source: https://smap.jpl.nasa.gov/data/

Access: This dataset requires users to be registered with the Earthdata Login (https://urs.earthdata.nasa.gov/) system. Links to specific data subset can be downloaded using the NASA Worldview (https://worldview.earthdata.nasa.gov/).

Subset Parameters: Time-frame: July 12-19, 2020.

Example Visualization using Python netCDF4 and Matplotlib:

2018-07-12 03:00:00 UTC
Soil Moisture
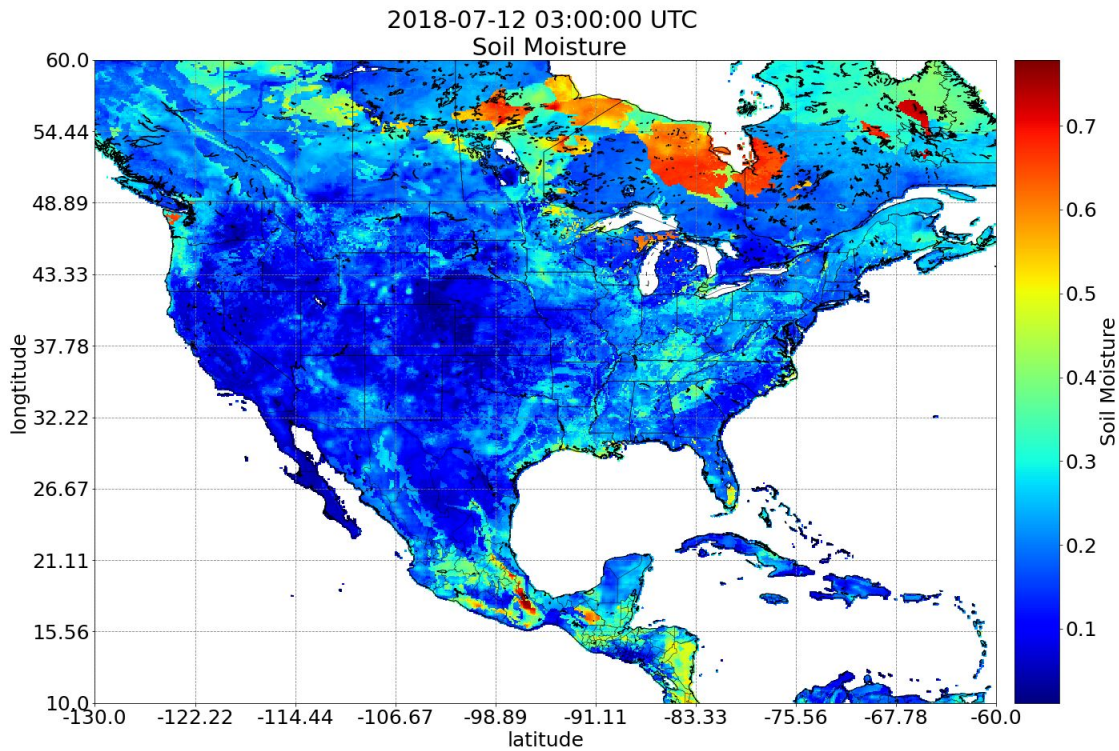
Dataset 3: Digital Elevation Model (DEM) from Shuttle Radar Topography Mission (SRTM)

Description: Radar gathered from two space shuttle missions in 1994 using single -pass interferometry (two signals taken, with different angles, at the same time from two different locations on the shuttle). The surface elevation is calculated using the differences between the two signals.

SRTM files come in 3 file formats:

- Digital Terrain Elevation Data (DTED) - each file contains a matrix of vertical elevation values spaces at regular horizontal intervals (lat and long units). File size is about 25 MB for 1-arc-second data files and about 3 MB for 3-arc-second data files.
- Band interleaved by lin (BIL) - binary raster format with header file (containing description of raster file). File size is about 7 MB for 1-arc and 1 MB for 3-arc.
- Georeferenced Tagged Image File Format (GeoTIFF) - TIFF file with embedded geographic information which is a standard for GIS applications. Size is about 25 MB for 1-arc and 3 MB for 3-arc.

The data is collected using the EarthExplorer (near the bottom of the page of the above listed website) which allows for selecting and downloading different types of SRTM data: Non-Void Filled, Void Filled, and 1 Arc-Second Global elevation data.

Sources:
1. USGS.
   https://www.usgs.gov/centers/eros/science/usgs-eros-archive-digital-elevation-shuttle-radar-topography-mission-srtm-non?qt-science_center_objects=0#qt-science_center_objects
2. Massachusetts.
   https://docs.digital.mass.gov/dataset/massgis-data-digital-elevation-model-15000

Access: The dataset from the USGS website requires users to be registered in the USGS EROS Registration System (ERS) (https://ers.cr.usgs.gov/login?RET_ADDR=https://ers.cr.usgs.gov). Access to the DEM for Massachusetts state is open source.

Example Visualization using Python gdal, os, and Matplotlib:
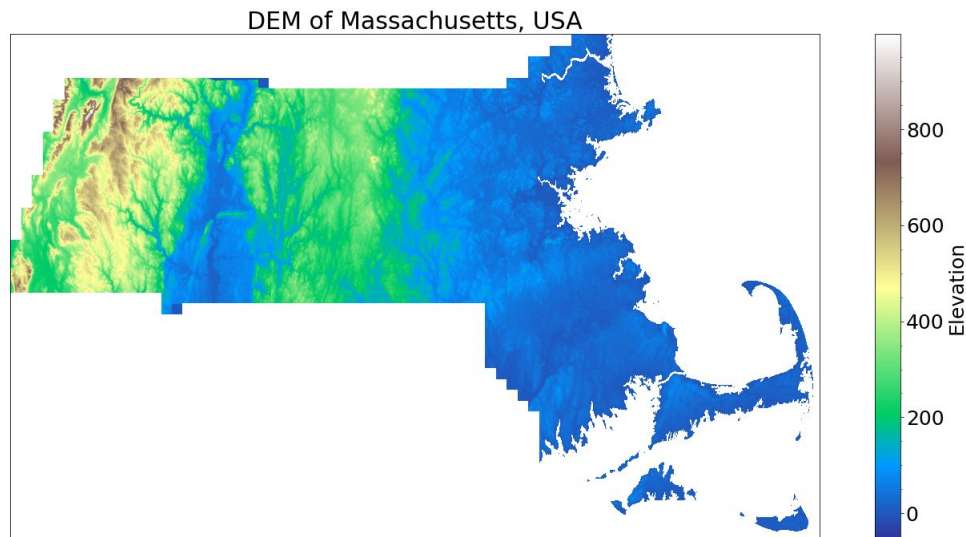
Dataset 4: Geospatial Data for River Basins from NWS
Description: The AWIPS provides shapefiles that contain boundaries of multiple areas for forecasting weather and other natural events. The NWS uses these files for there weather predictions.

Source: https://www.weather.gov/gis/AWIPSShapefiles

Access: The shapefiles for rivers basins can be accessed from the weather.gov (https://www.weather.gov/gis/RiverBasins).

Example Visualization using Python geopandas and Matplotlib:

River Basins of Massachusetts, USA