Auswärtiges Amt

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Freie Universität Berlin
Institute of Geographical Sciences

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TRAINING ON GOOGLE EARTH ENGINE

MODULE 8 : GEE Application (DATASET)

Prof. Dr. Eng. Ayman Abdulrahman

Coordinated from

Dr. Wahib Sahwan (Freie Universität Berlin)

Geo-IT

The Technology of Data Acquisition for Sustainable Development and Crisis Management

(Germany, Jordan, Lebanon and Syria)

MODULE 8 : GEE Application (DATASET)

- GEE Precipitation Dataset
- GEE Global Surface Water (GSW)
- GEE Land Use and Land Cover (LULC)
- GEE Evapotranspiration dataset (EVT)
- GEE Global Forest Watch (Hansen)

GEE Precipitation Dataset

ERA5-Land Hourly - ECMWF Climate Reanalysis (1981-present)

ERA5 Daily Aggregates - Latest Climate Reanalysis Produced by ECMWF / Copernicus Climate Change Service

ERA5 Monthly Aggregates - Latest Climate Reanalysis Produced by ECMWF / Copernicus Climate Change Service

GPM: Global Precipitation Measurement (GPM) v6 [30 min] (2000-2014)

GPM: Monthly Global Precipitation Measurement (GPM) v6

GSMaP Operational: Global Satellite Mapping of Precipitation(2014-present)

GSMaP Reanalysis: Global Satellite Mapping of Precipitation (2000-2014)

PERSIANN-CDR: Precipitation Estimation From Remotely Sensed Information Using Artificial Neural Networks-Climate Data Record

TRMM 3B42: 3-Hourly Precipitation Estimates

TRMM 3B43: Monthly Precipitation Estimates

CHIRPS Daily: Climate Hazards Group InfraRed Precipitation With Station Data

ERA5-Land Hourly - ECMWF Climate Reanalysis

The data presented here is a subset of the full ERA5-Land dataset post-processed by ECMWF. Monthly-mean averages have been pre-calculated to facilitate many applications requiring easy and fast access to the data, when sub-monthly fields are not required.

Please note that the convention for accumulations used in ERA5-Land differs with that for ERA5. The accumulations are treated the same as those in ERA-Interim or ERA-Interim/Land, i.e., they are accumulated from the beginning of the forecast to the end of the forecast step. This happens within every day and gets reset on midnight. The Earth Engine Data team added 19 additional bands, one for each of the accumulation bands, with the hourly values computed as the difference between two consecutive forecast steps.

ERA5-Land Monthly Averaged - ECMWF Climate Reanalysis

- ERA5-Land is a reanalysis dataset providing a consistent view of the evolution of land variables over several decades at an enhanced resolution compared to ERA5. ERA5-Land has been produced by replaying the land component of the ECMWF ERA5 climate reanalysis. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset using the laws of physics. Reanalysis produces data that goes several decades back in time, providing an accurate description of the climate of the past. This dataset includes all 50 variables as available on CDS.

- Please note that the convention for accumulations used in ERA5-Land differs with that for ERA5. The accumulations are treated the same as those in ERA-Interim or ERA-Interim/Land, i.e., they are accumulated from the beginning of the forecast to the end of the forecast step. This happens within every day and gets reset on midnight. The Earth Engine Data team added 19 additional bands, one for each of the accumulation bands, with the hourly values computed as the difference between two consecutive forecast steps.

ERA5-Land

- ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset. ERA5 replaces its predecessor, the ERA-Interim reanalysis.
- ERA5 DAILY provides aggregated values for each day for seven ERA5 climate reanalysis parameters: 2m air temperature, 2m dewpoint temperature, total precipitation, mean sea level pressure, surface pressure, 10m u-component of wind and 10m v-component of wind. Additionally, daily minimum and maximum air temperature at 2m has been calculated based on the hourly 2m air temperature data. Daily total precipitation values are given as daily sums. All other parameters are provided as daily averages.

ERA5 MONTHLY

ERA5 MONTHLY provides aggregated values for each month for seven ERA5 climate reanalysis parameters: 2m air temperature, 2m dewpoint temperature, total precipitation, mean sea level pressure, surface pressure, 10m u-component of wind and 10m v-component of wind. Additionally, monthly minimum and maximum air temperature at 2m has been calculated based on the hourly 2m air temperature data. Monthly total precipitation values are given as monthly sums. All other parameters are provided as monthly averages.

- **ERA5-Land Monthly Averaged - ECMWF Climate Reanalysis**

The data presented here is a subset of the full ERA5-Land dataset post-processed by ECMWF. Monthly-mean averages have been pre-calculated to facilitate many applications requiring easy and fast access to the data, when sub-monthly fields are not required.

GPM: Global Precipitation Measurement

Global Precipitation Measurement (GPM) is an international satellite mission to provide next-generation observations of rain and snow worldwide every three hours. The Integrated Multi-satellitE Retrievals for GPM (IMERG) is the unified algorithm that provides rainfall estimates combining data from all passive-microwave instruments in the GPM Constellation.

This algorithm is intended to intercalibrate, merge, and interpolate all satellite microwave precipitation estimates, together with microwave-calibrated infrared (IR) satellite estimates, precipitation gauge analyses, and potentially other precipitation estimators at fine time and space scales for the TRMM and GPM eras over the entire globe. The system is run several times for each observation time, first giving a quick estimate and successively providing better estimates as more data arrive. The final step uses monthly gauge data to create research-level products.

GPM: Global Precipitation Measurement

Resolution 11132 meters

Bands

Name	Units	Min	Max	Description
HQobservationTime	min.	0*	29*	PMW source time
HQprecipSource				PMW source sensor identifier
Bitmask for HQprecipSource				
HQprecipitation	mm/hr	0*	120*	merged PMW precipitation
IRkalmanFilterWeight	%	0*	100*	Kalman filter weight for IR
IRprecipitation	mm/hr	0*	79.5*	IR precipitation
precipitationCal	mm/hr	0*	174*	snapshot precipitation - calibrated
precipitationUncal	mm/hr	0*	120*	snapshot precipitation - uncalibrated
probLiqPrecipitat	%	0*	100*	probability of liquid precipitation phase
randomError	mm/hr	0.24*	250*	calibrated-precipitation random error

GSMaP Operational: Global Satellite Mapping of Precipitation

Global Satellite Mapping of Precipitation (GSMaP) provides a global hourly rain rate with a 0.1 x 0.1 degree resolution. GSMaP is a product of the Global Precipitation Measurement (GPM) mission, which provides global precipitation observations at three hour intervals. Values are estimated using multi-band passive microwave and infrared radiometers from the GPM Core Observatory satellite and with the assistance of a constellation of other satellites. GPM's precipitation rate retrieval algorithm is based on a radiative transfer model. The gauge-adjusted rate is calculated based on the optimization of the 24h accumulation of GSMaP hourly rain rate to daily precipitation by NOAA/CPC gauge measurement. This dataset is processed by GSMaP algorithm version 6

This dataset contains provisional products GSMaP_NRT that are regularly replaced with updated versions when the GSMaP_MVK data become available. The products are marked with a metadata property called "status". When a product is initially made available, the property value is "provisional". Once a provisional product has been updated with the final version, this value is updated to "permanent".

GSMaP Operational: Global Satellite Mapping of Precipitation

Resolution 11132 meters

Bands

Name	Units	Min	Max	Description
satelliteInfoFlag				Satellite/sensor used
Bitmask for satelliteInfoFlag				
hourlyPrecipRate	mm/hr	0*	200.31*	Snapshot of hourly precipitation rate
hourlyPrecipRateGC	mm/hr	0*	200*	Snapshot of hourly precipitation rate adjusted to rain gauge
observationTimeFlag	Hours	-72.52*	14.97*	Relative time from the starting time of the file to the time of microwave radiometer (imager/sounder) observing. If no observation exists within the hourly window, the time will be the negative number of hours since the last observation.
gaugeQualityInfo	counts/day	0*	82*	Existence of gauge adjustment when the status is 'provisional', 1 indicates adjusted and 0 is non-adjusted. When the status is 'permanent', the pixel value is the daily average of number of gauges used for adjustment in the pixel.

PERSIANN-CDR

PERSIANN-CDR: Precipitation Estimation From Remotely Sensed Information Using Artificial Neural Networks

PERSIANN-CDR is a daily quasi-global precipitation product that spans the period from 1983-01-01 to present. The data is produced quarterly, with a typical lag of three months. The product is developed by the Center for Hydrometeorology and Remote Sensing at the University of California, Irvine (UC-IRVINE/CHRS) using Gridded Satellite (GridSat-B1) IR data that are derived from merging ISCCP B1 IR data, along with GPCP version 2.2.

Resolution : 27830 meters

Bands

Name	Units	Min	Max	Description
precipitation	mm	0*	718.62*	Estimated daily precipitation

TRMM 3B42: 3-Hourly Precipitation Estimates

The Tropical Rainfall Measuring Mission (TRMM) is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) designed to monitor and study tropical rainfall. The 34B2 product contains a gridded, TRMM-adjusted, merged infrared precipitation (mm/hr) and RMS precipitation-error estimate, with a 3-hour temporal resolution and a 0.25 degree spatial resolution.

TRMM 3B43: Monthly Precipitation Estimates

This dataset algorithmically merges microwave data from multiple satellites, including SSMI, SSMIS, MHS, AMSU-B and AMSR-E, each inter-calibrated to the TRMM Combined Instrument.

Algorithm 3B43 is executed once per calendar month to produce the single, best-estimate precipitation rate and RMS precipitation-error estimate field (3B43) by combining the 3-hourly merged high-quality/IR estimates (3B42) with the monthly accumulated Global Precipitation Climatology Centre (GPCC) rain gauge analysis.

All of the global precipitation datasets have some calibrating data source, which is necessary to control bias differences between contributing satellites. The multi-satellite data are averaged to the monthly scale and combined with the Global Precipitation Climatology Centre's (GPCC) monthly surface precipitation gauge analysis. In each case the multi-satellite data are adjusted to the large-area mean of the gauge analysis, where available (mostly over land), and then combined with the gauge analysis using a simple inverse estimated-random-error variance weighting. Regions with poor gauge coverage, like central Africa and the oceans, have a higher weighting on the satellite input.

CHIRPS Daily: Climate Hazards Group InfraRed Precipitation With Station Data

Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

Resolution 5566 meters

Bands

Name	Units	Min	Max	Description
precipitation	mm/day	0*	1444.34*	Precipitation

GEE Global Surface Water (GSW)

A virtual time machine that maps the location and temporal distribution of water surfaces at the global scale over the past 3.7 decades, and provides statistics on their extent and change to support better informed water-management decision-making.

Measuring the past helps to understand the consequences of our past economic and societal choices, and contributes to more informed management decisions.

1. JRC Global Surface Water Mapping Layers
2. JRC Global Surface Water Metadata
3. JRC Monthly Water History
4. JRC Monthly Water Recurrence
5. JRC Yearly Water Classification History

JRC Global Surface Water Mapping Layers

- This dataset contains maps of the location and temporal distribution of surface water from 1984 to 2020 and provides statistics on the extent and change of those water surfaces.
- These data were generated using 4,453,989 scenes from Landsat 5, 7, and 8 acquired between 16 March 1984 and 31 December 2020. Each pixel was individually classified into water / non-water using an expert system and the results were collated into a monthly history for the entire time period and two epochs (1984-1999, 2000-2020) for change detection.
- This mapping layers product consists of 1 image containing 7 bands. It maps different facets of the spatial and temporal distribution of surface water over the last 35 years. Areas where water has never been detected are masked.

JRC Global Surface Water Mapping Layers

Name	Units	Min	Max
occurrence	%	0	100

The frequency with which water was present.

change_abs	%	-100	100

Absolute change in occurrence between two epochs: 1984-1999 vs 2000-2019.

change_norm	%	-100	100

Normalized change in occurrence. (epoch1-epoch2)/(epoch1+epoch2) * 100

seasonality	0	12

Number of months water is present.

recurrence	%	0	100

The frequency with which water returns from year to year.

transition	Categorical classification of change between first and last year.
max_extent	Binary image containing 1 anywhere water has ever been detected.

JRC Global Surface Water Mapping Layers

Bitmask for max_extent
transition Class Table

Value	Color	Description
0	ffffff	No change
1	0000ff	Permanent
2	22b14c	New permanent
3	d1102d	Lost permanent
4	99d9ea	Seasonal
5	b5e61d	New seasonal
6	e6a1aa	Lost seasonal
7	ff7f27	Seasonal to permanent
8	ffc90e	Permanent to seasonal
9	7f7f7f	Ephemeral permanent
10	c3c3c3	Ephemeral seasonal

JRC Global Surface Water Metadata

Bands

Name	Min	Max
detections	0*	2007*

The number of water detections in the study period.

valid_obs	0*	2076*

The number of valid observations in the study period.

total_obs	0*	2417*

The total number of available observations (i.e. scenes) in the study period.

JRC Monthly Water History

This Monthly History collection holds the entire history of water detection on a month-by-month basis. The collection contains 442 images, one for each month between March 1984 and December 2020.

Resolution 30 meters
Bands
Name Description
water Water detection for the month.
Bitmask for water
Bits 0-1: Water detection
0: No data
1: Not water
2: Water

JRC Monthly Water Recurrence

The Monthly Recurrence collection contains 12 images: monthly measures of the seasonality of water based on the occurrence values detected in that month over all years.

Name	Units	Min	Max
monthly_recurrence	%	0	100

The recurrence value expressed as a percentage for this month.

has_observations

A flag to indicate if the month has observations.

Bitmask for has_observations

Bit 0: Observations for the month.

0: No valid observations

1: At least 1 valid observation was available

JRC Yearly Water Classification History

This Yearly Seasonality Classification collection contains a year-by-year classification of the seasonality of water based on the occurrence values detected throughout the year.

Band

waterClass Classification of the seasonality of water throughout the year.

waterClass Class Table

Value	Color	Description
0	cccccc	No data
1	ffffff	Not water
2	99d9ea	Seasonal water
3	0000ff	Permanent water

MCD12Q1.006 MODIS Land Cover Type Yearly Global 500m

The MCD12Q1 V6 product provides global land cover types at yearly intervals (2001-2016) derived from six different classification schemes. It is derived using supervised classifications of MODIS Terra and Aqua reflectance data. The supervised classifications then undergo additional post-processing that incorporate prior knowledge and ancillary information to further refine specific classes.

MCD12Q1.006 MODIS Land Cover Type Yearly Global 500m

Name	Units	Min	Max	Description
LC_Type1 : Land Cover Type 1: Annual International Geosphere-Biosphere Programme (IGBP) classification				
LC_Type2 : Land Cover Type 2: Annual University of Maryland (UMD) classification				
LC_Type3 : Land Cover Type 3: Annual Leaf Area Index (LAI) classification				
LC_Type4 : Land Cover Type 4: Annual BIOME-Biogeochemical Cycles (BGC) classification				
LC_Type5 : Land Cover Type 5: Annual Plant Functional Types classification				
LC_Prop1_Assessment	%	0	100	LCCS1 land cover layer confidence
LC_Prop2_Assessment	%	0	100	LCCS2 land use layer confidence
LC_Prop3_Assessment	%	0	100	LCCS3 surface hydrology layer confidence
LC_Prop1 : FAO-Land Cover Classification System 1 (LCCS1) land cover layer				
LC_Prop2 : FAO-LCCS2 land use layer				
LC_Prop3 : FAO-LCCS3 surface hydrology layer				
QC	Product quality flags			
LW	Binary land (class 2) / water (class 1) mask derived from MOD44W			

Copernicus Global Land Cover Layers: CGLS-LC100 Collection 3

The Copernicus Global Land Service (CGLS) is earmarked as a component of the Land service to operate a multi-purpose service component that provides a series of bio-geophysical products on the status and evolution of land surface at global scale.

The Dynamic Land Cover map at 100 m resolution (CGLS-LC100) is a new product in the portfolio of the CGLS and delivers a global land cover map at 100 m spatial resolution. The CGLS Land Cover product provides a primary land cover scheme. Next to these discrete classes, the product also includes continuous field layers for all basic land cover classes that provide proportional estimates for vegetation/ground cover for the land cover types. This continuous classification scheme may depict areas of heterogeneous land cover better than the standard classification scheme and, as such, can be tailored for application use (e.g. forest monitoring, crop monitoring, biodiversity and conservation, monitoring environment and security in Africa, climate modelling, etc.).

These consistent Land Cover maps (v3.0.1) are provided for the period 2015-2019 over the entire Globe, derived from the PROBA-V 100 m time-series, a database of high quality land cover training sites and several ancillary datasets, reaching an accuracy of 80% at Level1 over al years. It is planned to provide yearly updates from 2020 through the use of a Sentinel time-series.

ESA WorldCover 10m v100

The European Space Agency (ESA) WorldCover 10 m 2020 product provides a global land cover map for 2020 at 10 m resolution based on Sentinel-1 and Sentinel-2 data. The WorldCover product comes with 11 land cover classes and has been generated in the framework of the ESA WorldCover project, part of the 5th Earth Observation Envelope Programme (EOEP-5) of the European Space Agency.

ESA WorldCover 10m v100

Resolution 10 meters
Landcover class
Map Class Table

Value	Color	Description
10	006400	Trees
20	ffbb22	Shrubland
30	ffff4c	Grassland
40	f096ff	Cropland
50	fa0000	Built-up
60	b4b4b4	Barren / sparse vegetation
70	f0f0f0	Snow and ice
80	0064c8	Open water
90	0096a0	Herbaceous wetland
95	00cf75	Mangroves
100	fae6a0	Moss and lichen

MOD16A2.006: Terra Net Evapotranspiration 8-Day Global 500m

The MOD16A2 Version 6 Evapotranspiration/Latent Heat Flux product is an 8-day composite product produced at 500 meter pixel resolution. The algorithm used for the MOD16 data product collection is based on the logic of the Penman-Monteith equation, which includes inputs of daily meteorological reanalysis data along with MODIS remotely sensed data products such as vegetation property dynamics, albedo, and land cover.

The pixel values for the two Evapotranspiration layers (ET & PET) are the sum of all eight days within the composite period. The pixel values for the two Latent Heat layers (LE & PLE) are the average of all eight days within the composite period. Note that the last 8-day period of each year is a 5 or 6-day composite period, depending on the year.

MOD16A2.006: Terra Net Evapotranspiration 8-Day Global 500m

Resolution 500 meters

Bands

Name	Units	Min	Max	Scale	Description
ET	kg/m^2/8day	-32767	32700	0.1	Total evapotranspiration
LE	J/m^2/day	-32767	32700	10000	Average latent heat flux
PET	kg/m^2/8day	-32767	32700	0.1	Total potential evapotranspiration
PLE	J/m^2/day	-32767	32700	10000	Average potential latent heat flux
ET_QC					Evapotranspiration quality control flags

Hansen Global Forest Change v1.8 (2000-2020)

Results from time-series analysis of Landsat images in characterizing global forest extent and change.

The 'first' and 'last' bands are reference multispectral imagery from the first and last available years for Landsat spectral bands 3, 4, 5, and 7. Reference composite imagery represents median observations from a set of quality-assessed growing-season observations for each of these bands.

Hansen Global Forest Change v1.8 (2000-2020)

Resolution 30.92 meters

Bands

Name	Units	Min	Max	Wavelength	Description
treecover2000	%	0	100		

Tree canopy cover for year 2000, defined as canopy closure for all vegetation taller than 5m in height.

loss Forest loss during the study period, defined as a stand-replacement disturbance (a change from a forest to non-forest state).

Bitmask for loss Bit 0: Forest loss during the study period.

0: Not loss 1: Loss

gain Forest gain during the period 2000–2012, defined as the inverse of loss (a non-forest to forest change entirely within the study period). Note that this has not been updated in subsequent versions.

Bitmask for gain Bit 0: Forest gain during the period 2000–2012.

0: No gain 1: Gain

Hansen Global Forest Change v1.8 (2000-2020)

Name	Units	Min	Max	Wavelength	Description
first_b30				0.63-0.69µm	Landsat 7 band 3 (red) cloud-free image composite. Reference multispectral imagery from the first available year, typically 2000.
first_b40				0.77-0.90µm	Landsat 7 band 4 (NIR) cloud-free image composite. Reference multispectral imagery from the first available year, typically 2000.
first_b50				1.55-1.75µm	Landsat 7 band 5 (SWIR) cloud-free image composite. Reference multispectral imagery from the first available year, typically 2000.
first_b70				2.09-2.35µm	Landsat 7 band 7 (SWIR) cloud-free image composite. Reference multispectral imagery from the first available year, typically 2000.
last_b30				0.63-0.69µm	Landsat 7 band 3 (red) cloud-free image composite. Reference multispectral imagery from the last available year, typically the last year of the study period.
last_b40				0.77-0.90µm	Landsat 7 band 4 (NIR) cloud-free image composite. Reference multispectral imagery from the last available year, typically the last year of the study period.
last_b50				1.55-1.75µm	Landsat 7 band 5 (SWIR) cloud-free image composite. Reference multispectral imagery from the last available year, typically the last year of the study period.
last_b70				2.09-2.35µm	Landsat 7 band 7 (SWIR) cloud-free image composite. Reference multispectral imagery from the last available year, typically the last year of the study period.
datamask					Three values representing areas of no data, mapped land surface, and permanent water bodies.
Bitmask for datamask					
lossyear		0	20		Year of gross forest cover loss event. Forest loss during the study period, defined as a stand-replacement disturbance, or a change from a forest to non-forest state. Encoded as either 0 (no loss) or else a value in the range 1–20, representing loss detected primarily in the year 2001–2020, respectively.