# **Pan-Third Pole Hydro-atmospheric datasets**

Table 1. Pan-Third Pole hydro-atmospheric datasets

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| --- | --- | --- | --- | --- | --- | --- |
| Dataset Name | Subsets | Spatial Resolution | Temporal Resolution | Year of Data | Data Format | Data Citation |
| Pan-Third Pole Rivers and Lakes Datasets | Rivers and lakes data | 500 m | \ | 2008 | shp | ①Lehner, B., Verdin, K., & Jarvis, A. (2008). New global hydrography derived from spaceborne elevation data. Eos, Transactions American Geophysical Union, 89(10), 93-94.  ②Zhang, G. (2019). China lake dataset (1960s-2020). National Tibetan Plateau Data Center, DOI: 10.11888/Hydro.tpdc.270302. |
| Pan-Third Pole Evapotranspiration Datasets | Evapotranspiration data | 500 m | Year | 2019 | nc/tif | ①Running, S., Mu, Q., & Zhao, M. (2017). MOD16A2 MODIS/Terra Net Evapotranspiration 8-day L4 Global 500 m SIN Grid V006 [Data set], NASA EOSDIS Land Processes DAAC, Sioux Falls, South Dakota, USA. |
| Soil evaporation | 0.05° | 8 days | 2002-2019 | nc/tif | ①Zhang, Y. (2020). PML\_V2 global evapotranspiration and gross primary production (2002.07-2019.08). National Tibetan Plateau Data Center, DOI: 10.11888/Geogra.tpdc.270251. |
| ET\_water | 0.05° | 8 days | 2002-2019 | nc/tif |
| Vaporization of intercepted rainfall | 0.05° | 8 days | 2002-2019 | nc/tif |
| Pan-Third Pole Atmosphere Datasets | Surface thermal radiation | 0.1° | Hour | 1981-2020 | nc | Copernicus Climate Change Service (C3S). (2017). ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate. Copernicus Climate Change Service Climate Data Store (CDS). |
| Surface solar radiation | 0.1° | Hour | 1981-2020 | nc |
| Total precipitation | 0.1° | Hour | 1981-2020 | nc |
| Surface pressure | 0.1° | Hour | 1981-2020 | nc |
| 2 m temperature | 0.1° | Hour | 1981-2020 | nc |
| Wind field | 0.1° | Hour | 1981-2020 | nc |

## **(1) Pan-Third Pole Rivers and Lakes Datasets**

The Pan-Third Pole rivers and lakes dataset uses rivers and lakes datasets from the HydroSHEDS website (Lehner et al., 2008). The HydroSHEDS datasets contain global hydrological data and were developed in collaboration with the Worldwide Fund for Nature (WWF)) and the United States Geological Survey (USGS). The Pan-Third Pole rivers and lakes datasets were obtained by cropping from the global datasets according to the basin boundary. The datasets are older. To further improve the accuracy of the rivers and lakes datasets, the China lake dataset (1960s-2020) was used to fuse and update the lakes data mainly for the Tibetan Plateau region. The China lake dataset (1960s-2020) (Zhang et al., 2019) combines Landsat imagery and topographic maps and uses semiautomatic water extraction and manual visual inspection and editing to obtain lake data with high accuracy. Therefore, this paper used the 2015 lake data in this datasets to replace the hydrological data from the HydroSHEDS website to obtain more accurate Pan-Third Pole rivers and lakes datasets, which were more appropriate for the study of related scientific problems in the Tibetan Plateau region. The projection mode of the dataset is Robinson projection with 80 ° central meridian. And the dataset is stored in shapefile format and could be opened by ArcGIS and other software.

## **(2) Pan-Third Pole Evapotranspiration Datasets**

The Pan-Third Pole evapotranspiration datasets use the MOD16A2 product provided by MODIS (Mu Q et al., 2013), which provide 8-day global terrestrial evapotranspiration information. Evapotranspiration (ET) is the sum of evapotranspiration from the Earth's surface to the atmosphere and plant transpiration. Using long-term ET data, the effects of climate, land use, and ecosystem disturbance changes can be quantified. In this paper, we used the Pan-Third Pole basin boundary and used GEE to crop these data to obtain 2019 Pan-Third Pole region evapotranspiration data. The unit of the dataset is mm / yr. The projection mode of the dataset is Robinson projection with 80 ° central meridian. The dataset is stored in TIFF/NETCDF format. TIFF format could be opened by ArcGIS and other software. NETCDF format could be opened by NCL, Matlab and Python.

The ET-related datasets also contain soil evaporation, ET\_water, and vaporization of intercepted rainfall. These data were obtained from the PML\_V2 global evapotranspiration and gross primary production (2002.07-2019.08) (Zhang et al., 2016; Zhang et al., 2020). In this paper, the datasets were cropped using the Pan-Third Pole basin boundary to obtain the datasets with temporal resolution of 8 days and spatial resolution of 0.05°, spanning the period 2002.07-2019.08. The dataset contains two data formats : TIFF and NETCDF. The TIFF format is named "xx\_yyyy\_mm\_dd\_clip.tif", where xx denotes the name of the variable, such as Es, Ei and ET \_ water, yyyy denotes the year, mm denotes the month, dd denotes the day, such as "Es\_2002\_07\_04\_clip.tif", which corresponds to Es in the 8 days from 2002-07-04 to 2002-07-11. NETCDF format is named " xx\_yyyy\_mm\_dd\_clip.tif.nc ", where xx denotes variable names, such as Es, Ei and ET \_ water, yyyy denotes year, mm denotes month, dd denotes day, such as "Es\_2002\_07\_04\_clip.tif.nc", which corresponds to Es in the 8 days from 2002-07-04 to 2002-07-11. It should be noted that the true values of Es, Ei and ET \_ water = pixel value \* scale \_ factor ( scale \_ factor = 0.01 ).

## **(3) Pan-Third Pole Atmosphere Datasets**

Based on the surface thermal radiation data, surface solar radiation data, total precipitation data, surface pressure data, 2 m temperature data and wind field data in the downloaded ERA5-Land dataset ( Muñoz Sabater, 2019 ), the Pan-Third Pole atmospheric datasets are cropped according to the boundary of the Pan-Third Pole basin. 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. The temporal and spatial resolutions of ERA5-Land makes this dataset very useful for all kind of land surface applications such as flood or drought forecasting. The temporal resolution of the data set is hour, and the spatial resolution is 0.1°， The time span is 1981-2020. The format of the data set is NETCDF format, and the data of each year are stored in a NETCDF file. The name of the NETCDF file is " xx\_clip\_yyyy.nc ". " xx " represents the element name. " strd " represents the surface thermal radiation. " ssrd " represents the surface solar radiation. " precipitation " represents the total precipitation. " surface\_pressure " represents the surface pressure. " t2m " represents the 2m temperature. " u10 " represents the east component of 10m wind, and " v10 " represents the north component of 10m wind. " yyyy " represents the year. For example, " strd\_clip\_1981.nc " represents the hourly surface thermal radiation data of Pan-Third Pole in 1981.

(a) Surface thermal radiation downwards

Amount of thermal (also known as longwave or terrestrial) radiation emitted by the atmosphere and clouds that reaches the Earth's surface. The surface of the Earth emits thermal radiation, some of which is absorbed by the atmosphere and clouds. The atmosphere and clouds likewise emit thermal radiation in all directions, some of which reaches the surface (represented by this variable). This variable is accumulated from the beginning of the forecast time to the end of the forecast step. The units are joules per square metre (J m-2). To convert to watts per square metre (W m-2), the accumulated values should be divided by the accumulation period expressed in seconds. The ECMWF convention for vertical fluxes is positive downwards.

(b) Surface solar radiation downwards

Amount of solar radiation (also known as shortwave radiation) reaching the surface of the Earth. This variable comprises both direct and diffuse solar radiation. Radiation from the Sun (solar, or shortwave, radiation) is partly reflected back to space by clouds and particles in the atmosphere (aerosols) and some of it is absorbed. The rest is incident on the Earth's surface (represented by this variable). To a reasonably good approximation, this variable is the model equivalent of what would be measured by a pyranometer (an instrument used for measuring solar radiation) at the surface. However, care should be taken when comparing model variables with observations, because observations are often local to a particular point in space and time, rather than representing averages over a model grid box and model time step. This variable is accumulated from the beginning of the forecast time to the end of the forecast step. The units are joules per square metre (J m-2). To convert to watts per square metre (W m-2), the accumulated values should be divided by the accumulation period expressed in seconds. The ECMWF convention for vertical fluxes is positive downwards.

(c) Total precipitation

Accumulated liquid and frozen water, including rain and snow, that falls to the Earth's surface. It is the sum of large-scale precipitation (that precipitation which is generated by large-scale weather patterns, such as troughs and cold fronts) and convective precipitation (generated by convection which occurs when air at lower levels in the atmosphere is warmer and less dense than the air above, so it rises). Precipitation variables do not include fog, dew or the precipitation that evaporates in the atmosphere before it lands at the surface of the Earth. This variable is accumulated from the beginning of the forecast time to the end of the forecast step. The units of precipitation are depth in metres. It is the depth the water would have if it were spread evenly over the grid box. Care should be taken when comparing model variables with observations, because observations are often local to a particular point in space and time, rather than representing averages over a model grid box and model time step.

(d) Surface pressure

Pressure (force per unit area) of the atmosphere on the surface of land, sea and in-land water. It is a measure of the weight of all the air in a column vertically above the area of the Earth's surface represented at a fixed point. Surface pressure is often used in combination with temperature to calculate air density. The strong variation of pressure with altitude makes it difficult to see the low and high pressure systems over mountainous areas, so mean sea level pressure, rather than surface pressure, is normally used for this purpose. The units of this variable are Pascals (Pa). Surface pressure is often measured in hPa and sometimes is presented in the old units of millibars, mb (1 hPa = 1 mb = 100 Pa).

(e) 2m temperature

Temperature of air at 2m above the surface of land, sea or in-land waters. 2m temperature is calculated by interpolating between the lowest model level and the Earth's surface, taking account of the atmospheric conditions. Temperature measured in kelvin can be converted to degrees Celsius (°C) by subtracting 273.15.

(f) Wind field

Eastward component of the 10m wind. It is the horizontal speed of air moving towards the east, at a height of ten metres above the surface of the Earth, in metres per second. Care should be taken when comparing this variable with observations, because wind observations vary on small space and time scales and are affected by the local terrain, vegetation and buildings that are represented only on average in the ECMWF Integrated Forecasting System. This variable can be combined with the V component of 10m wind to give the speed and direction of the horizontal 10m wind.

Northward component of the 10m wind. It is the horizontal speed of air moving towards the north, at a height of ten metres above the surface of the Earth, in metres per second. Care should be taken when comparing this variable with observations, because wind observations vary on small space and time scales and are affected by the local terrain, vegetation and buildings that are represented only on average in the ECMWF Integrated Forecasting System. This variable can be combined with the U component of 10m wind to give the speed and direction of the horizontal 10m wind.

## **References**

[1] Lehner, B., Verdin, K. and Jarvis, A.: New global hydrography derived from spaceborne elevation data, Transactions American Geophysical Union, **89**(10), 93-94, 2008.

[2] Mu Q, Zhao M and W, R. S.: MODIS Global Terrestrial Evapotranspiration (ET) Product (MOD16A2/A3)–ATBD Collection 5, 2013.

[3] Muñoz Sabater, J.: ERA5-Land monthly averaged data from 1981 to present, Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2019.

[4] Zhang, X., Liu, L., Wu, C., Chen, X., Gao, Y., Xie, S. and Zhang, B.: Development of a global 30&thinsp;m impervious surface map using multisource and multitemporal remote sensing datasets with the Google Earth Engine platform, Earth Syst. Sci. Data, **12**(3), 1625-1648, <http://dx.doi.org/10.5194/essd-12-1625-2020>, 2020.

[5] Zhang, Y., Peña-Arancibia, J. L., McVicar, T. R., Chiew, F. H. S., Vaze, J., Liu, C., Lu, X., Zheng, H., Wang, Y., Liu, Y. Y., Miralles, D. G. and Pan, M.: Multi-decadal trends in global terrestrial evapotranspiration and its components, Scientific Reports, **6**(1), 19124, <http://dx.doi.org/10.1038/srep19124>, 2016.