Today's Earth" for Disaster Warning and Response: Overview and Status

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10th Joint Project Team Meeting for Sentinel Asia STEP-3 (JPTM2025)
11 February, 2026

What is Today's Earth(TE)?

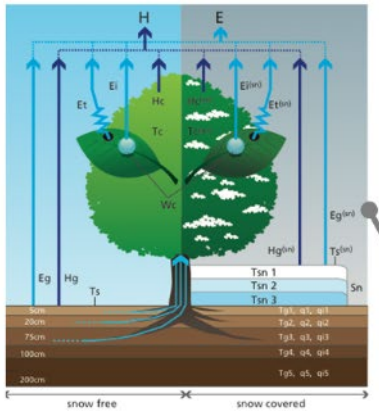
- **Global terrestrial hydrological simulation system**
- Developed and operated under the collaborative research of JAXA and the University of Tokyo
  - https://www.eorc.jaxa.jp/water/
- Goals:
  - Estimating/Predicting the water-related physical value and providing them.

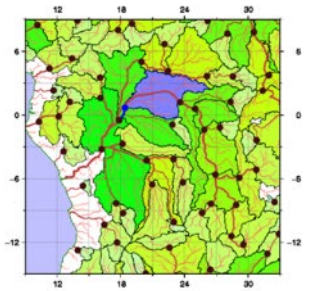
Long-term global land surface water dataset

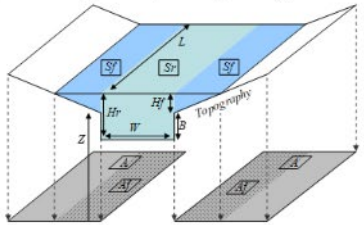
Predicting extreme events such as floods and droughts.

Contribution to water resource management and to monitoring and predicting water-related disasters

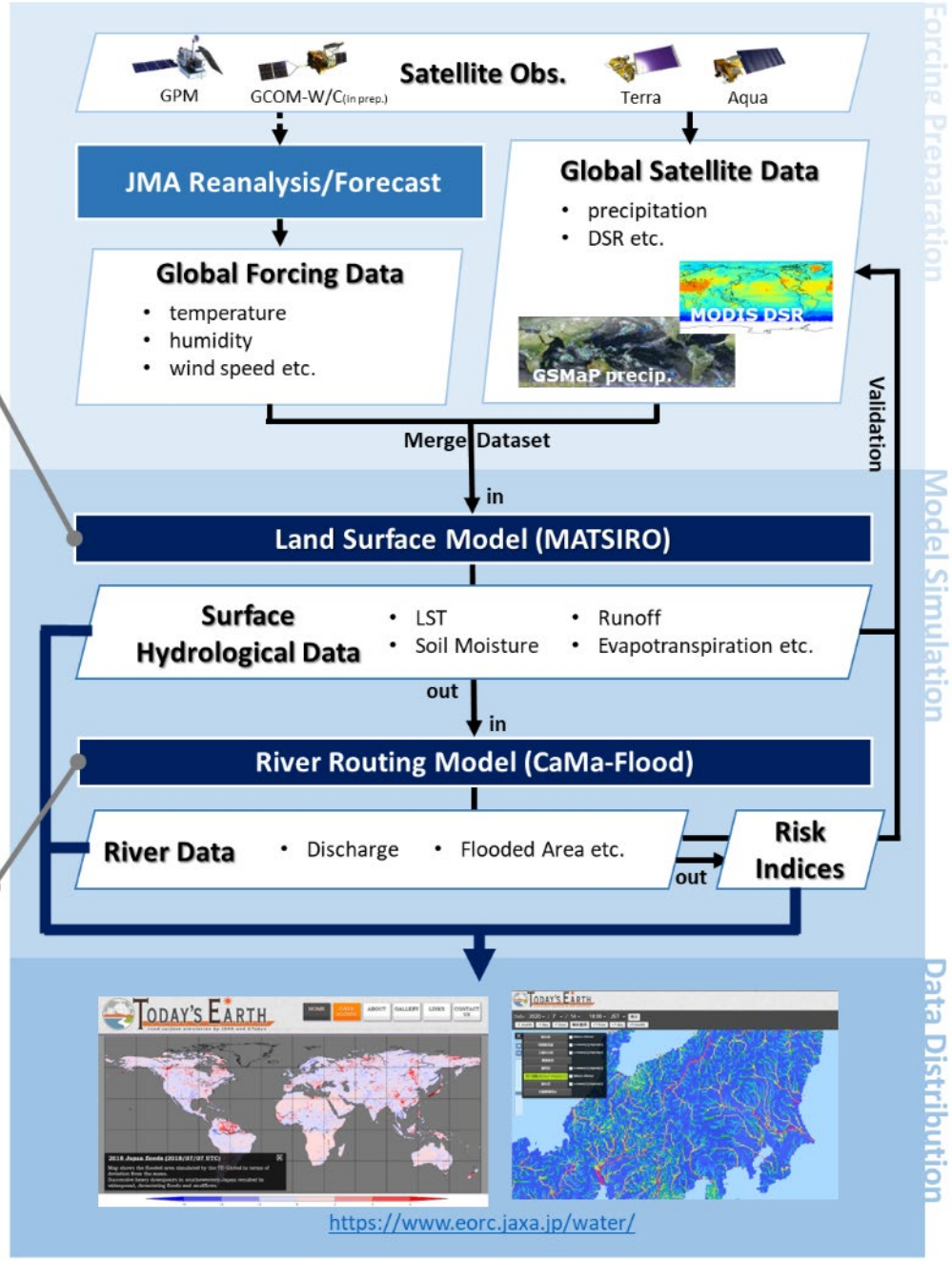
Takata et al., 2003







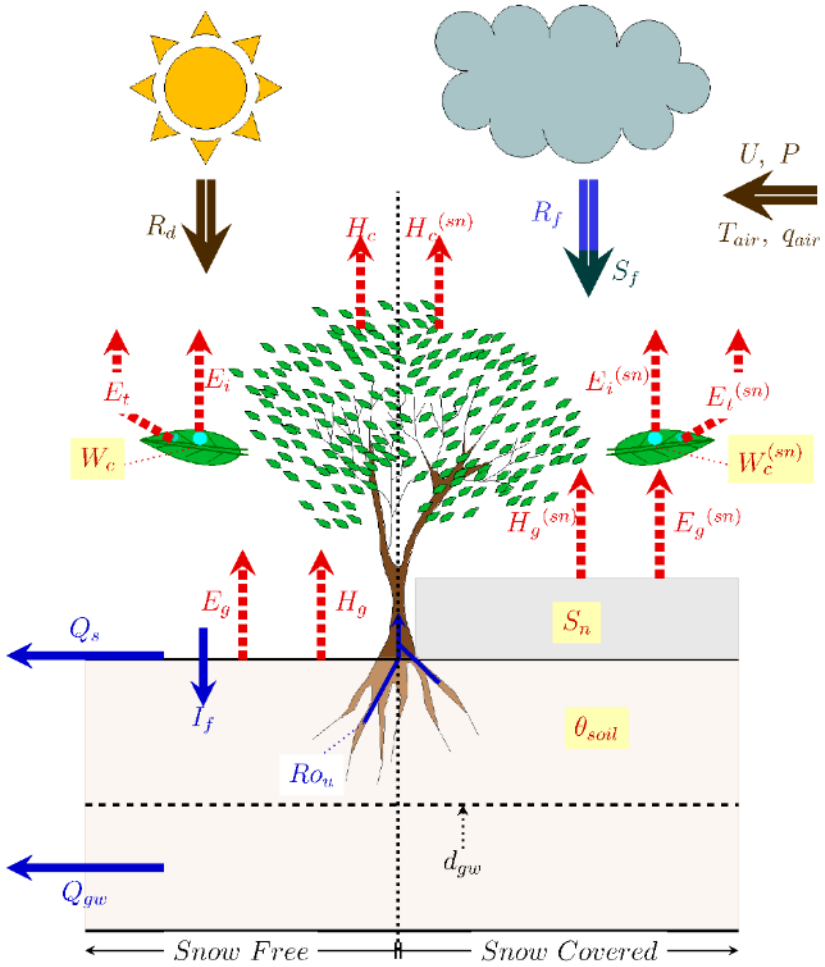
Yamazaki et al., 2011



Land Surface Model: MATSIRO5

Takata et al., 2003

- MATSIRO: Minimal Advanced Treatments of Surface Interaction and RunOff
  - Originally developed for climate studies(GCMs) at the global and regional scales.



- Temperature
- Wind speed
- Solar radiation
- Precipitation etc...

MATSIRO5

①LNTFLX
Flux Calculation

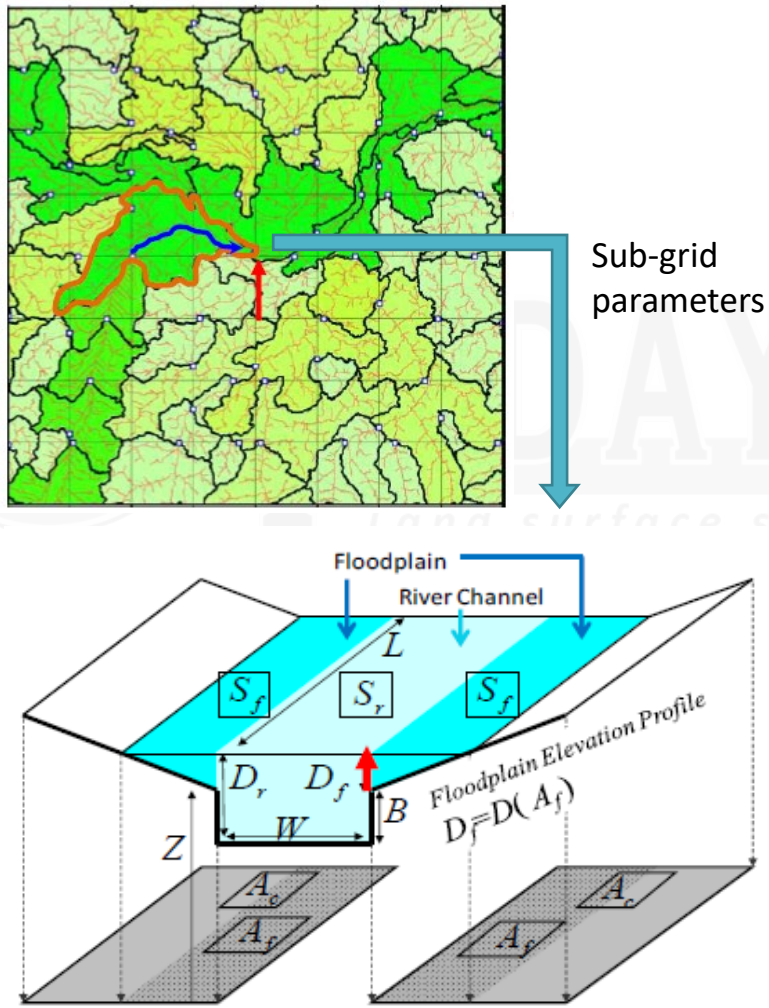
②LNDSTP
Treating Ground Processes

- Soil Moisture
- Evapotranspiration
- **Runoff** etc...

River Routing Model: CaMa-Flood

Yamazaki et al., 2011

- CaMa-Flood: Catchment-based Macro-scale Floodplain model
  - River routing model, which incorporate physically based representation of floodplain inundation dynamics



- Elevation (DEM)
- **Runoff** (from MATSIRO)

CaMa-Flood

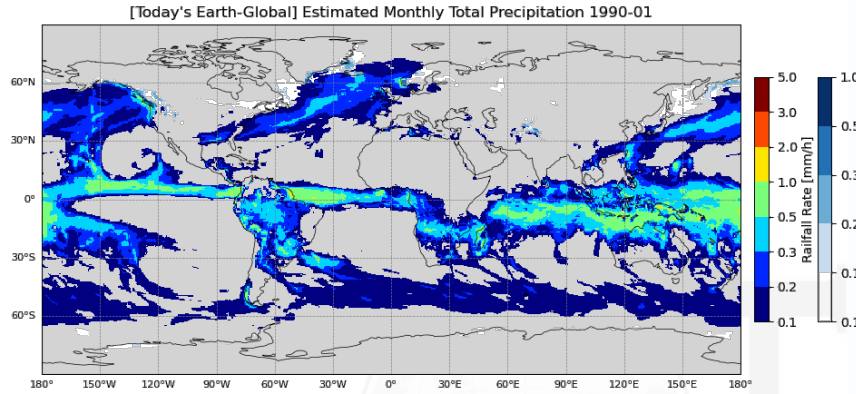
①Calculate river discharge
Shallow water momentum equation

②Calculate water storage in next time step
mass-balance equation

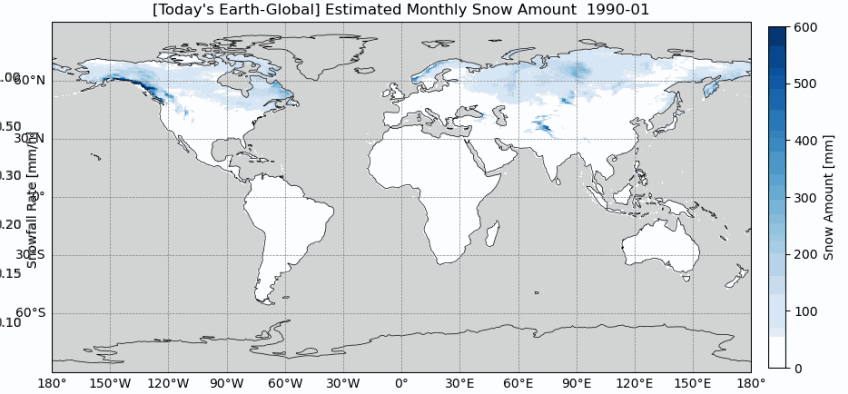
- River discharge
- River water depth
- Flooded fraction (area) etc…

Data of Today's Earth(TE)

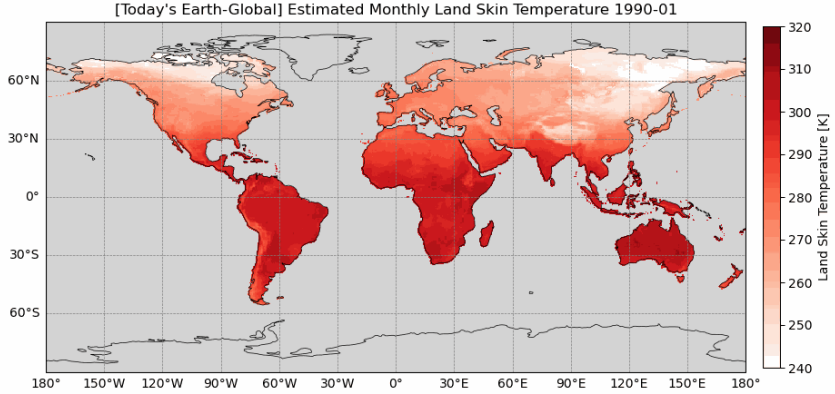
Precipitation（model input）



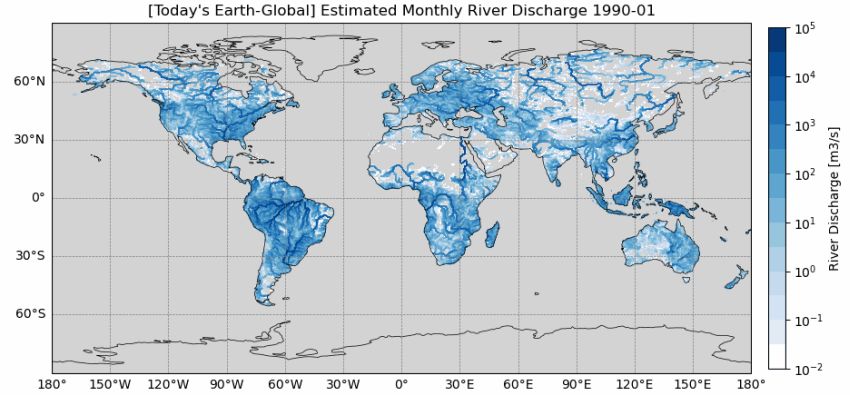
Snow amount



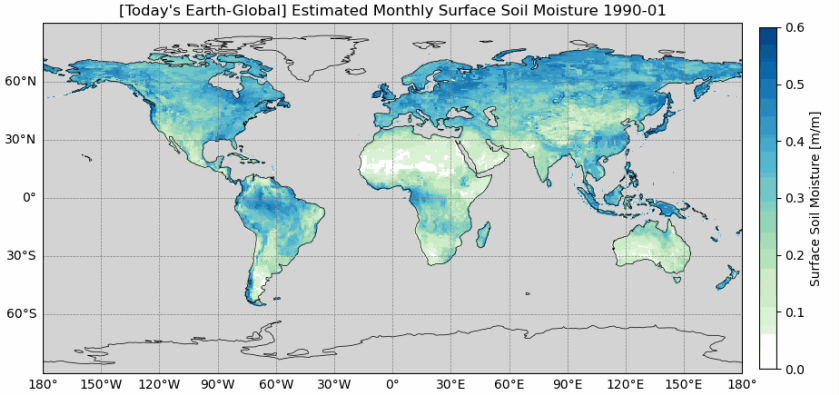
Land surface temperature



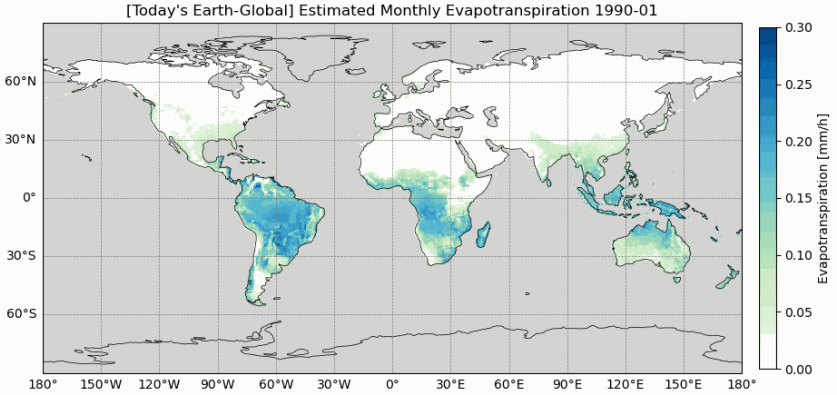
River discharge



Soil moisture



Evapotranspiration



And more…

Various types of Today's Earth

	Global system		system in Japan
	TE-Global (Global System)	**TE-Global NEXRA (Global Ensemble System)**	**TE-Japan (Regional System)**
Horizontal resol. (lat/lon)	Land: 0.5 deg., River: 0.25 deg.		1/60 deg.
Temporal resol.	Every 3 hour		Every hour
Latency	About 3 days~ (Depends on experiment)	About 1~5 days, unstable (Depends on the operation status of JAXA supercomputing system (JSS))	**Real-time** *forecast data distribution is limited within research purpose due to the Japanese law
Satellite data used in the System	GSMaP, Terra/Aqua MODIS, NOAA AVHRR (AW3D, GCOM-C in prep.)	NEXRA (assimilate GSMaP, ATMS, AMSU-A, MHS etc.) with 128 ensemble members	Himawari-8, ALOS HRLULC, NOAA AVHRR (GSMaP in prep.)
Product	River discharge/depth, Flooded area, Soil moisture, Snow amount, Evapotranspiration, etc.		
Reference	Ma et al., 2024	Yamamoto et al., 2024	Yoshimura et al., 2008

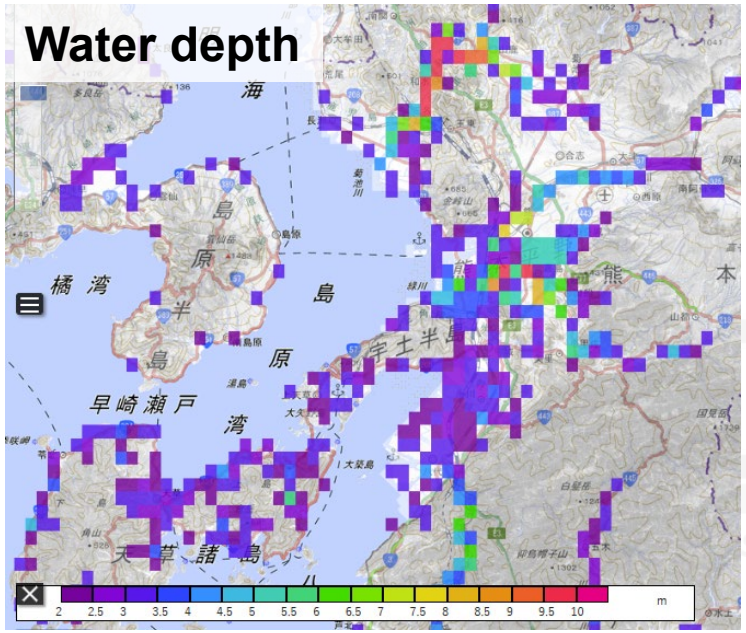
Developing the 10 km (0.1 deg.) system for public release.

- All products are distributed in netCDF format and freely available with simple registration via website.
  - Monitoring page can be used without any registration.

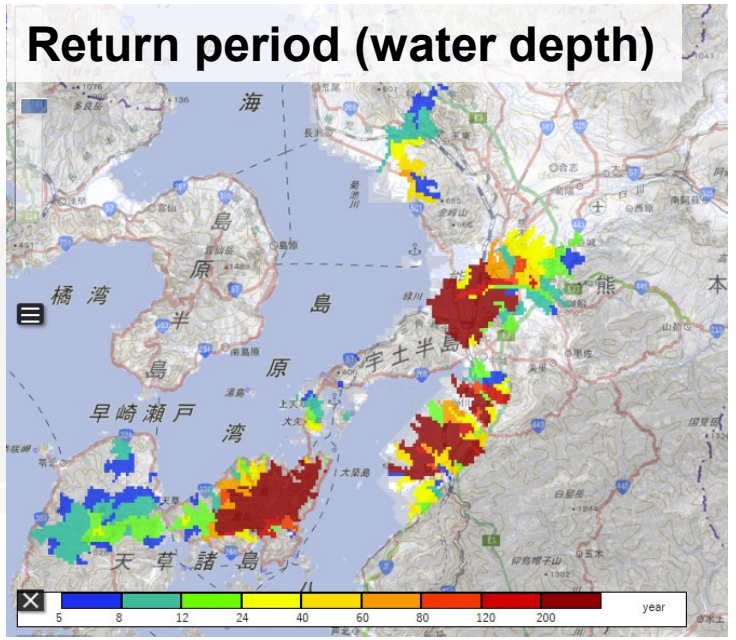
For more detail: https://www.eorc.jaxa.jp/water/documents.html

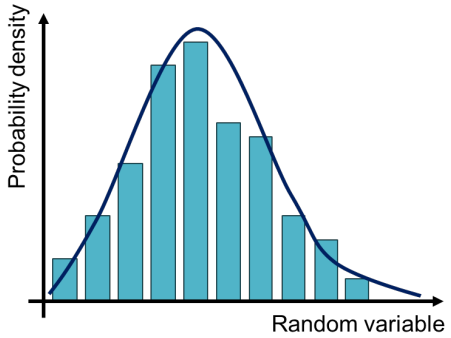
Risk estimation

- Today's Earth provides "Return periods" as risk index.
- "Return periods" indicate how often a phenomenon of the same magnitude is expected to occur.

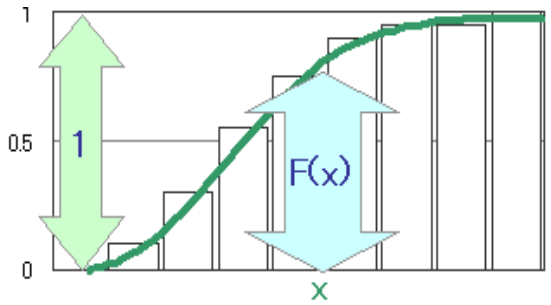


Statistical processing

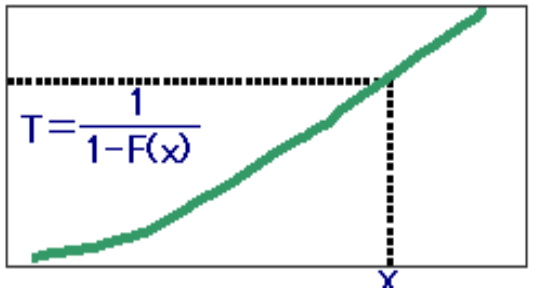




Gumbel distribution

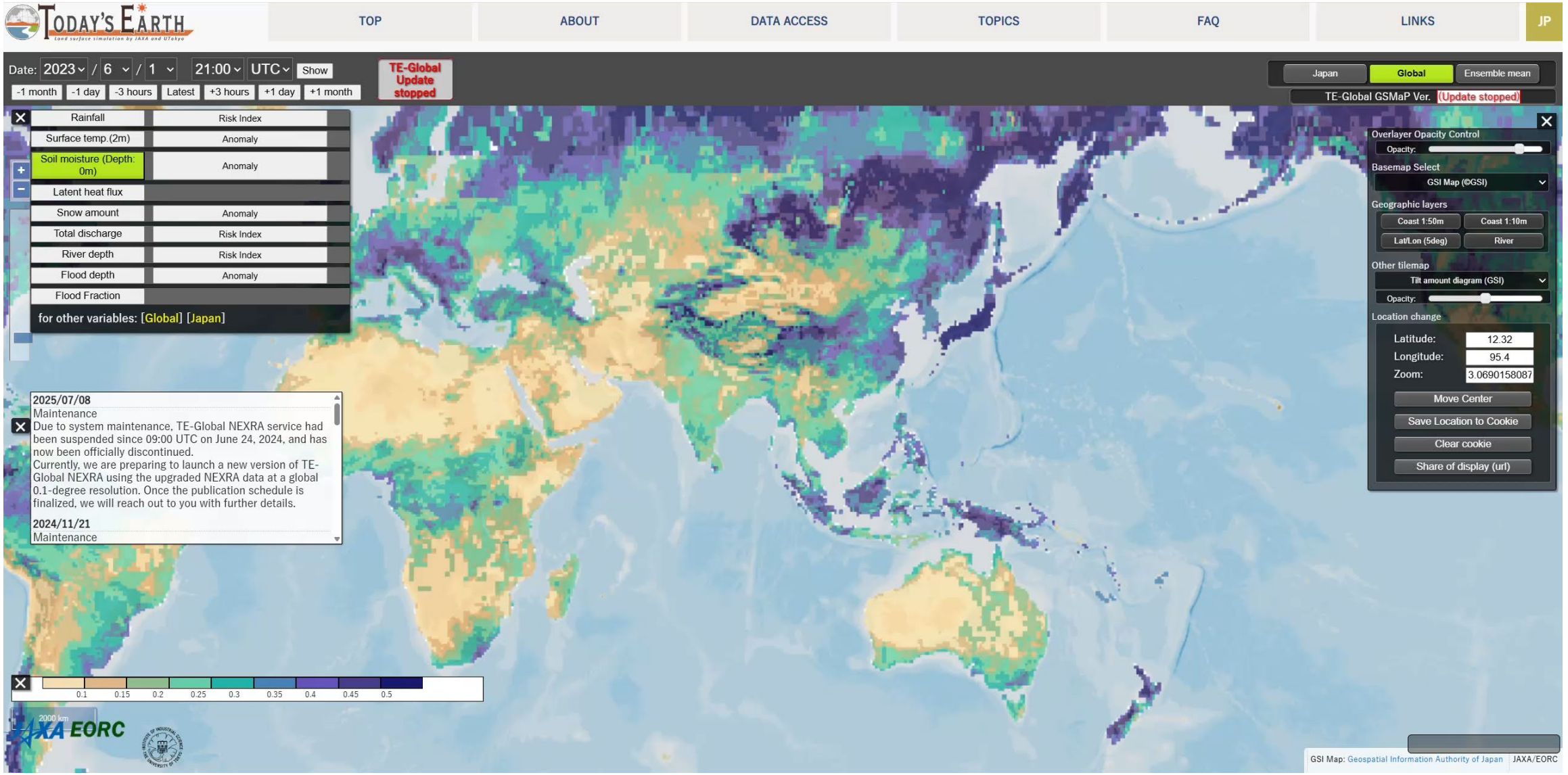


Calculate cumulative probability



Convert into "return periods"

Interface of Today's Earth



You can operate the Today's Earth interface to switch variables, zoom in, and move around the map.

Risk estimation

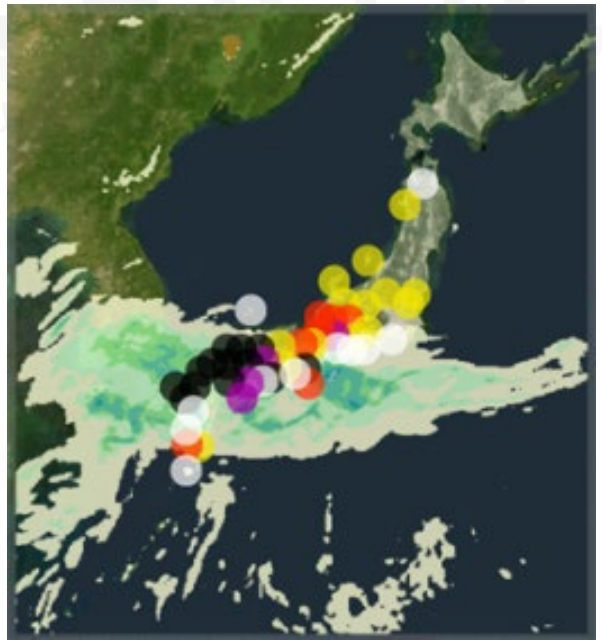
- The **Flood Risk Level is a five-level alert level** based on return period of river water level forecast by TE-Japan
- Currently we define lev.5 as the “Alert” for the flood (Ma et al., 2021).

Flood Risk Level	Definition *N = Return period of estimated river water level
Lev.5	200≦N
Lev.4	150≦N＜200
Lev.3	100≦N＜150
Lev.2	50≦N＜100
Lev.1	10≦N＜50

Severe

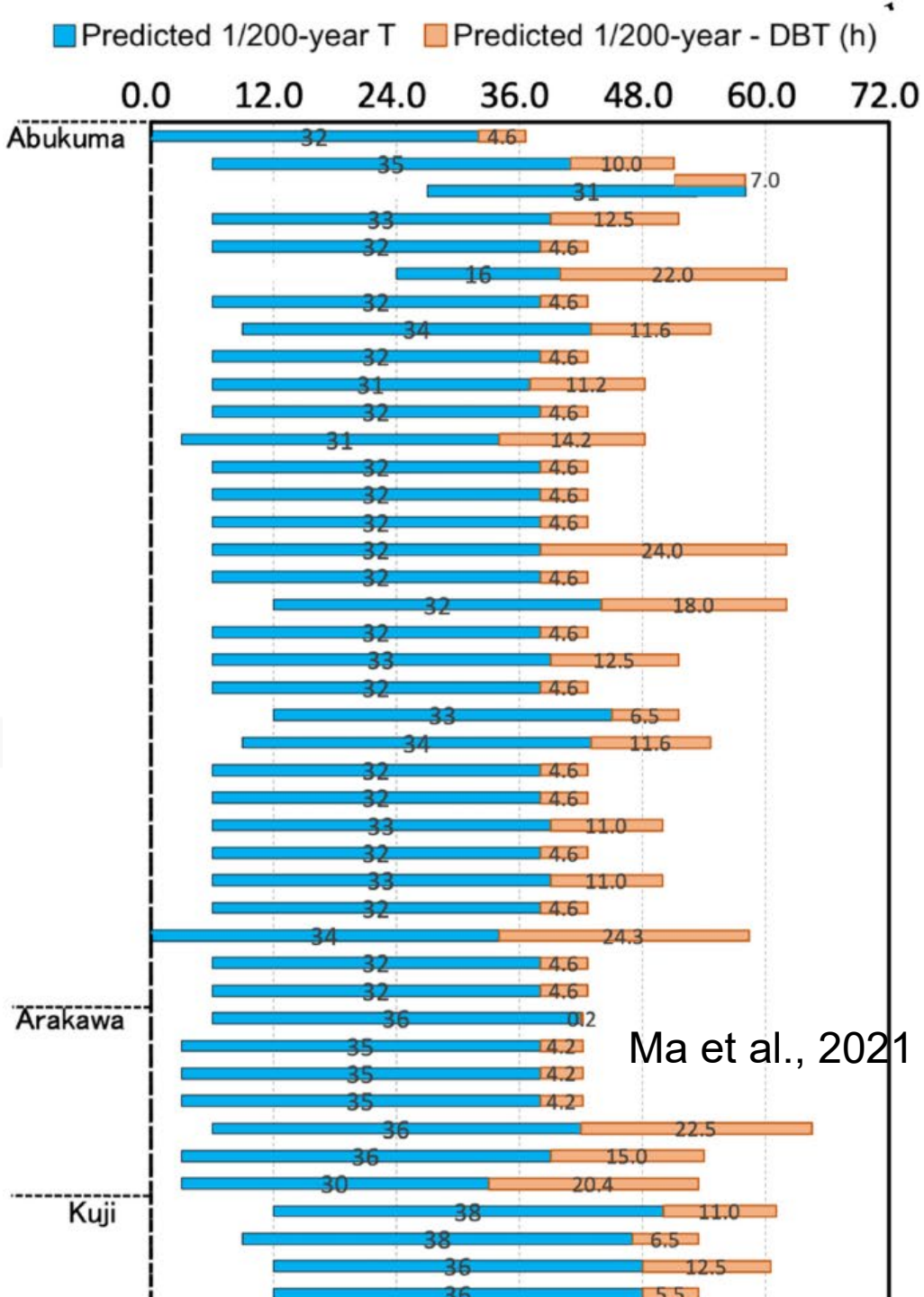
- Similar framework can be applied for the next version of TE-Global

Example of the Issued alert



Case study on typhoon Hagibis, 2019

- Among the 142 locations reported to have experienced levee breaches, **TE-Japan successfully alerted at 129 of these sites**
  - **An average lead time was 32.3 hours** and actual breaches occurred 8.5 hours later than the predicted warnings.
- The false alarm rate was approximately 90% at the initial phase of the forecast, eventually rising to about 60%.
  - The false alarm rate for flood warnings issued by the Japan Meteorological Agency is around 70-90%; Tanaka et al., 2008.



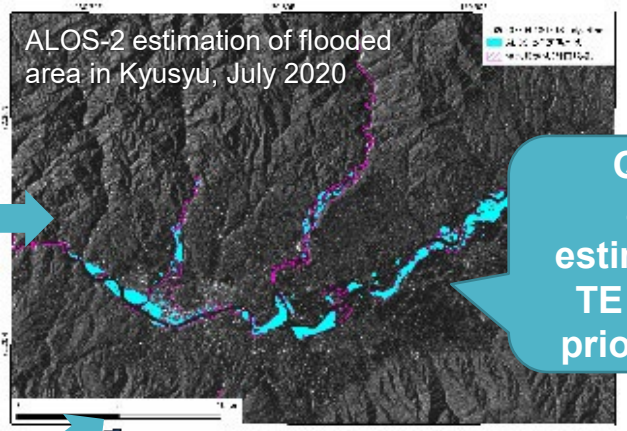
Ma et al., 2021

What can we do with the next TE-Global?

- Example of the use of TE-Japan forecast

Forecast by TE-Japan

ALOS-2 flood area detection



Ohki et al. 2020

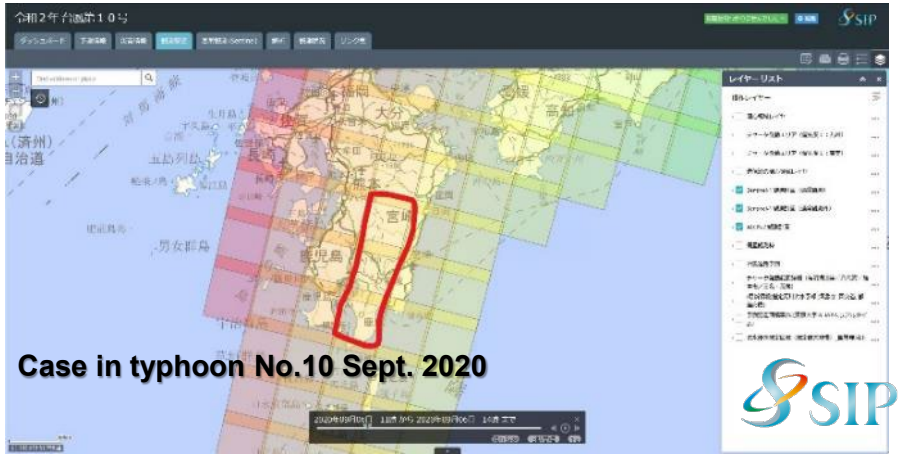
Quick and accurate estimation using TE forecast as prior probability

Local government

Emergency obs.

~30hrs before | **~10 hrs before** | **Disaster** | **10 hrs after~** | **30hrs after~** | Time

Determination of observation area

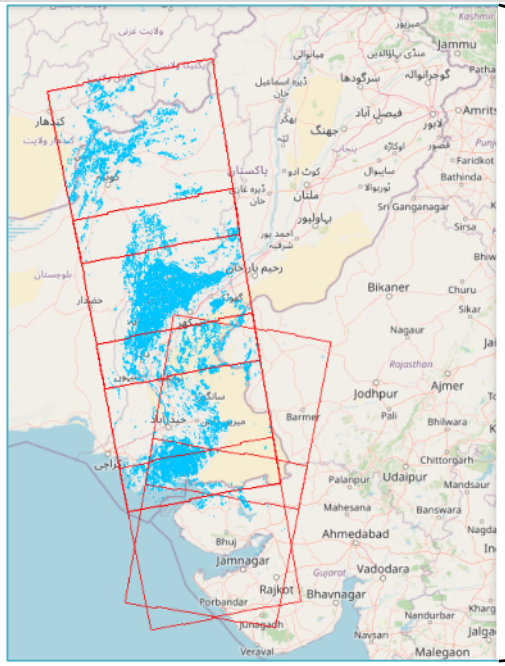


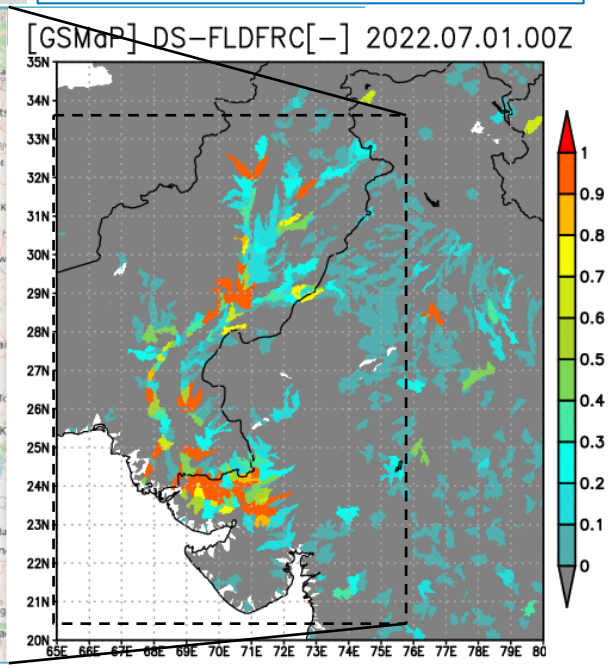
- This framework is effectively used for disaster response
- It is expected that, if TE-Global can provide high-resolution forecasts, collaboration with emergency satellite observations will be possible in a similar manner

Example of TE-Global simulation

◆ Flood in Pakistan 2022

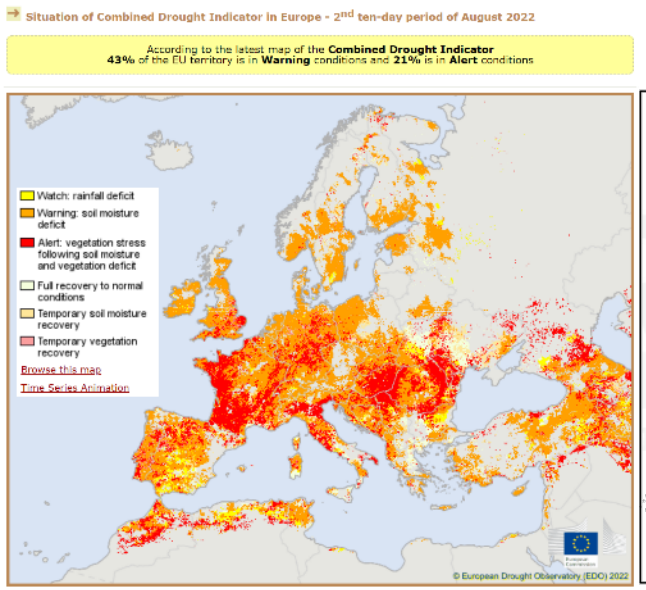
Flooded area detected by ALOS-2	**TE-Global estimation (Flooded area fraction)**

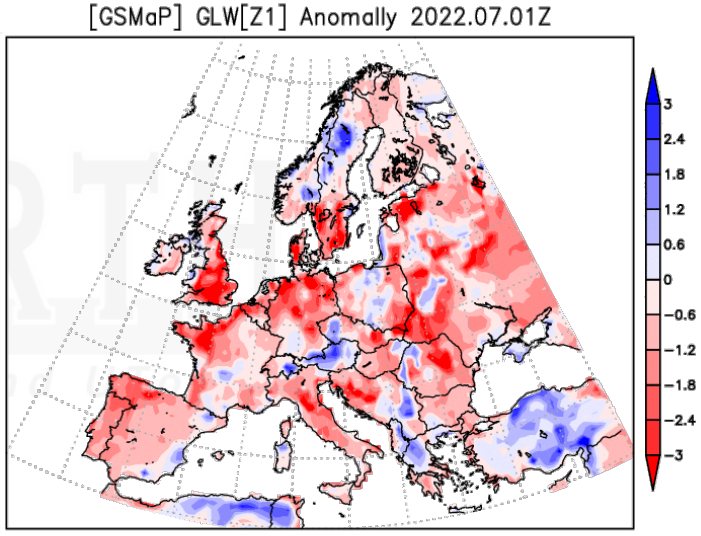




◆ European Heatwave 2022

Drought severity estimated by EU	**TE-Global estimation (Soil Moisture Anomaly)**

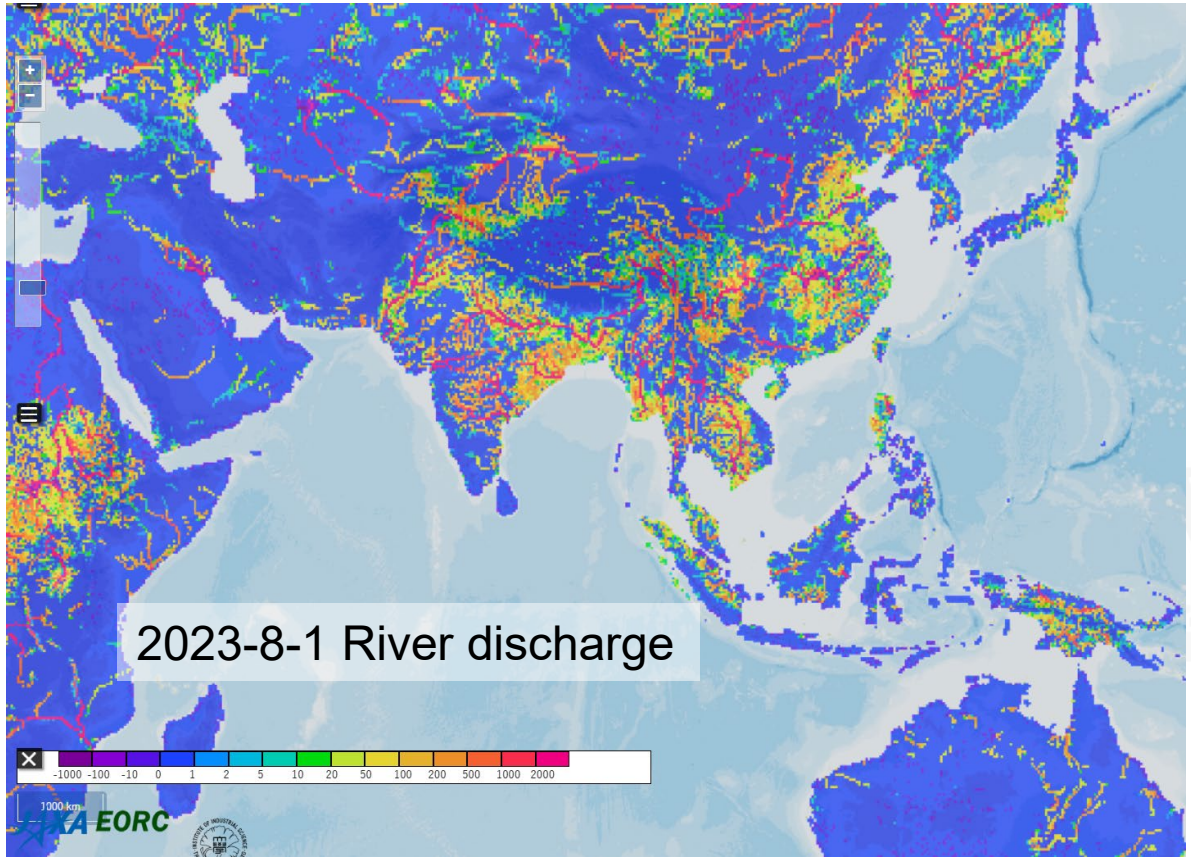




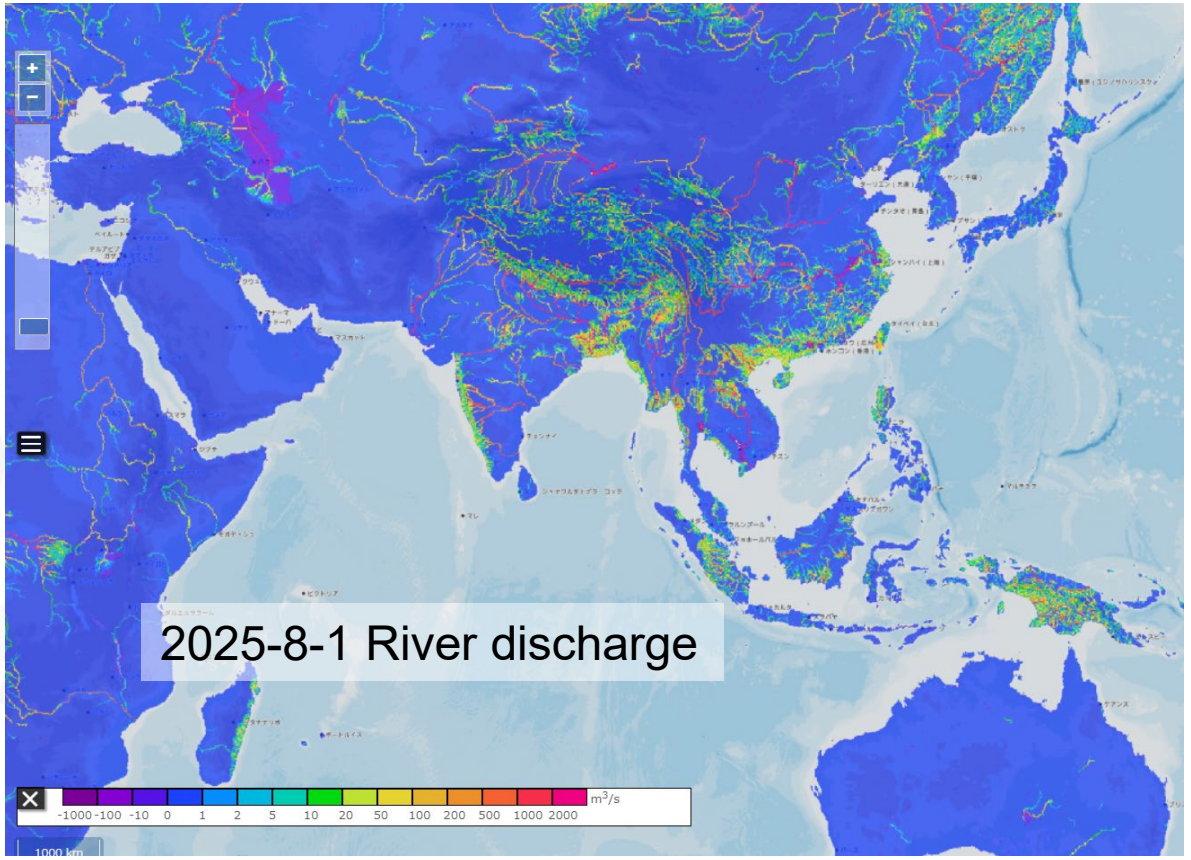
- TE-Global demonstrates its capability to reproduce such hydrological events by physically solving near-surface water and energy budgets globally.

Developing Global 10 km resolution system

Former version (25km(river) resolution)



Developing version (10km resolution)

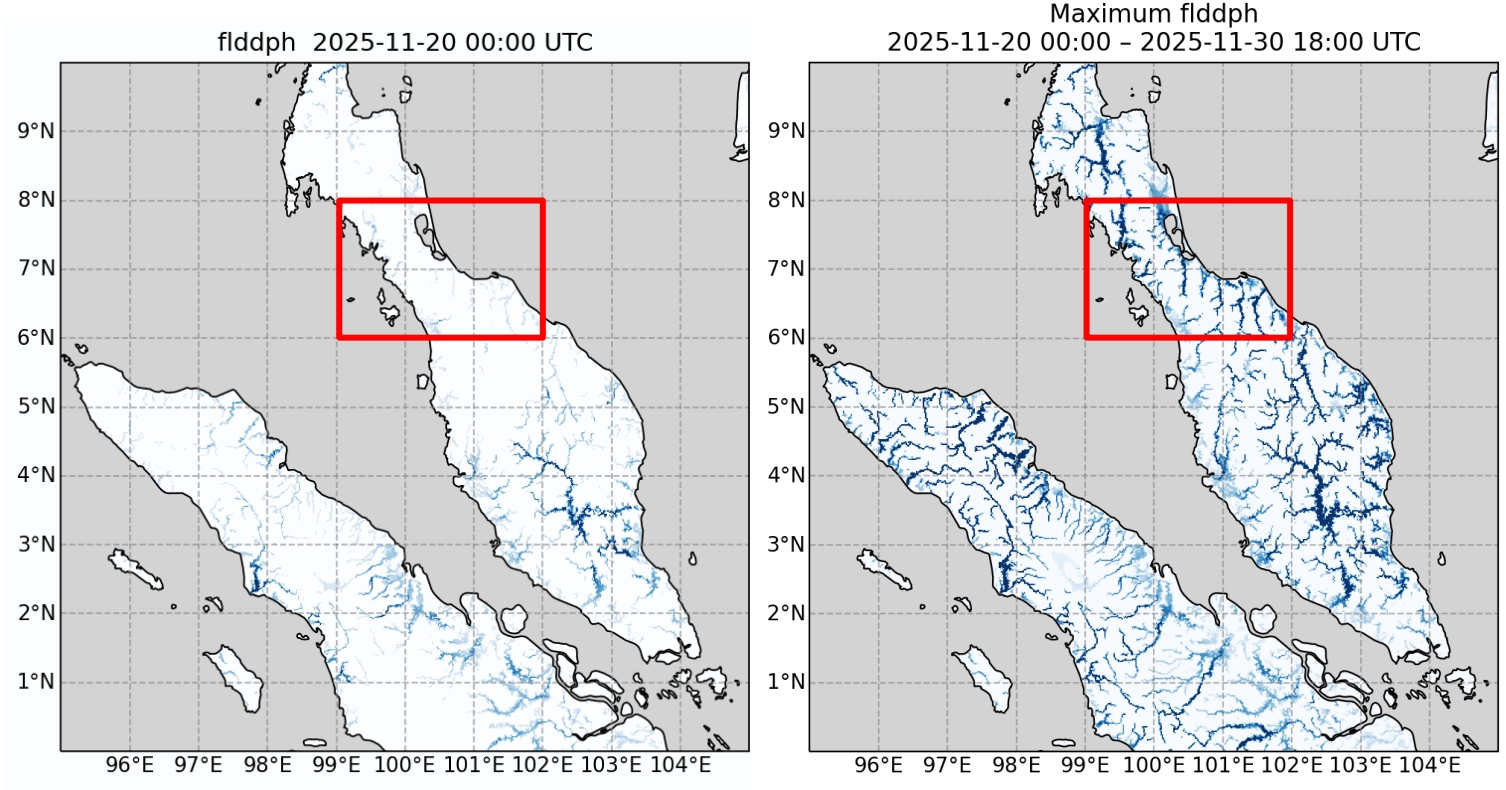


Roadmap

- In FY2025: Release 10km global system ← Now developing
- By FY2027: Release 1km system (ASEAN)
- By FY2029: Release 1km system (Asia)
- By FY2031: Target: public release of 1km global system

Case study for recent flood event by TE-Global (0.1deg)

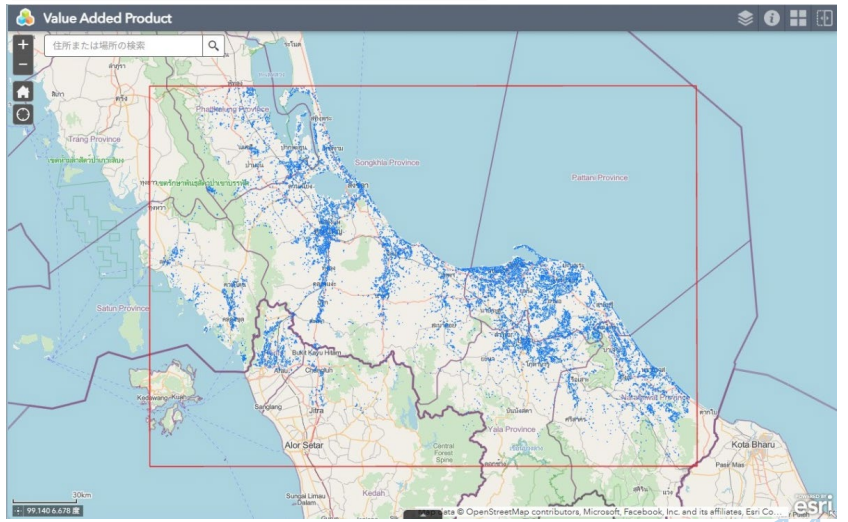
◆ Flood in Thailand Nov. 2025



◄ Estimated floodplain water depth by TE-Global (originally 0.1 deg., downscaled to 1/60 deg.)

*details to be confirmed

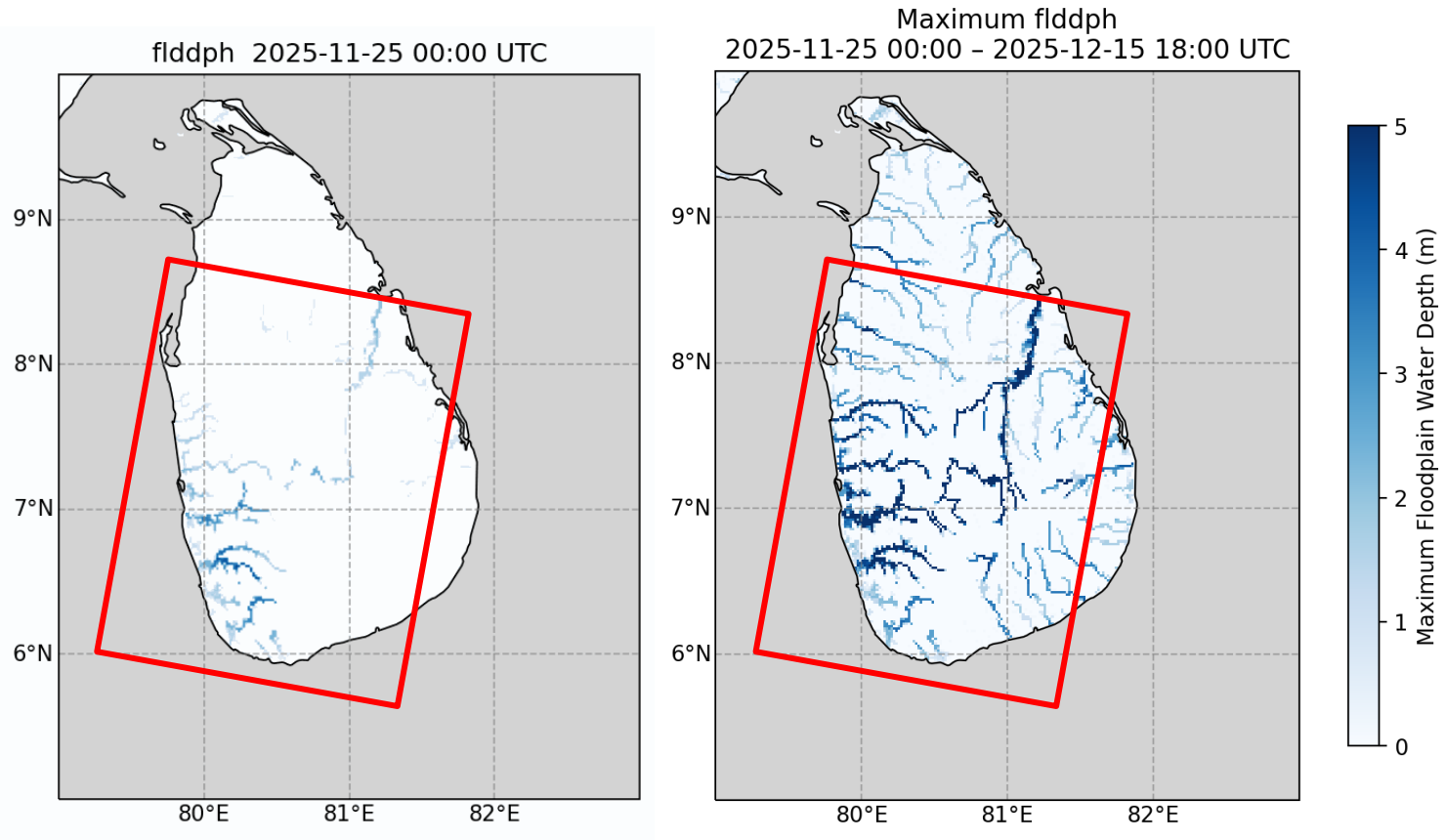
Observed flooded area ► By Sentinel Asia



https://storymaps.arcgis.com/collections/8acb5761eefd4816bbb99f1e7146e6a2?item=2

Case study for recent flood event by TE-Global (0.1deg)

◆ Flood in Sri Lanka Nov. 2025



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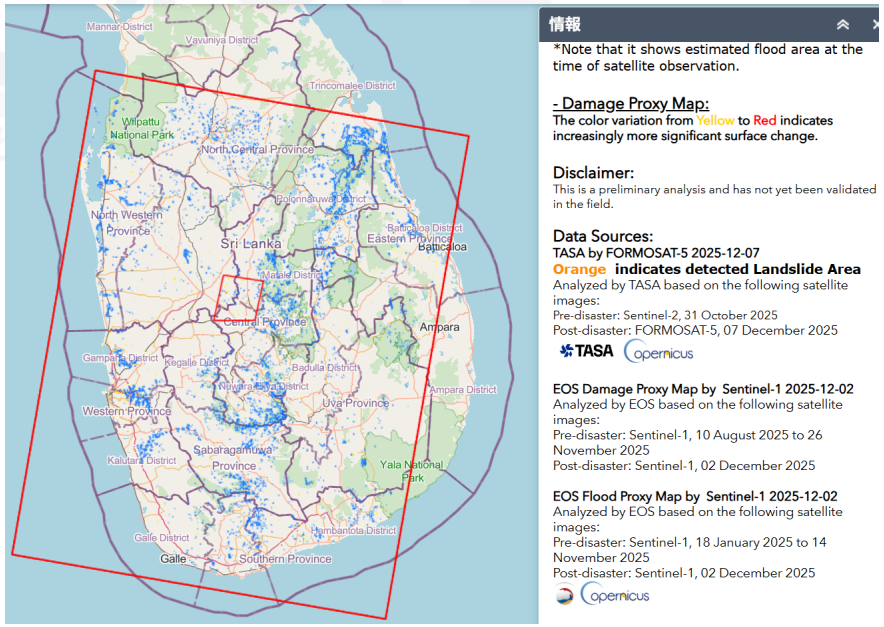


https://storymaps.arcgis.com/collections/8acb5761eefd4816bbb99f1e7146e6a2?item=1

Hands-on Training

Preparing for Hands-on Training

TE-Global is currently not updated. Therefore, this training uses TE-Japan to demonstrate a practical case in Japan.

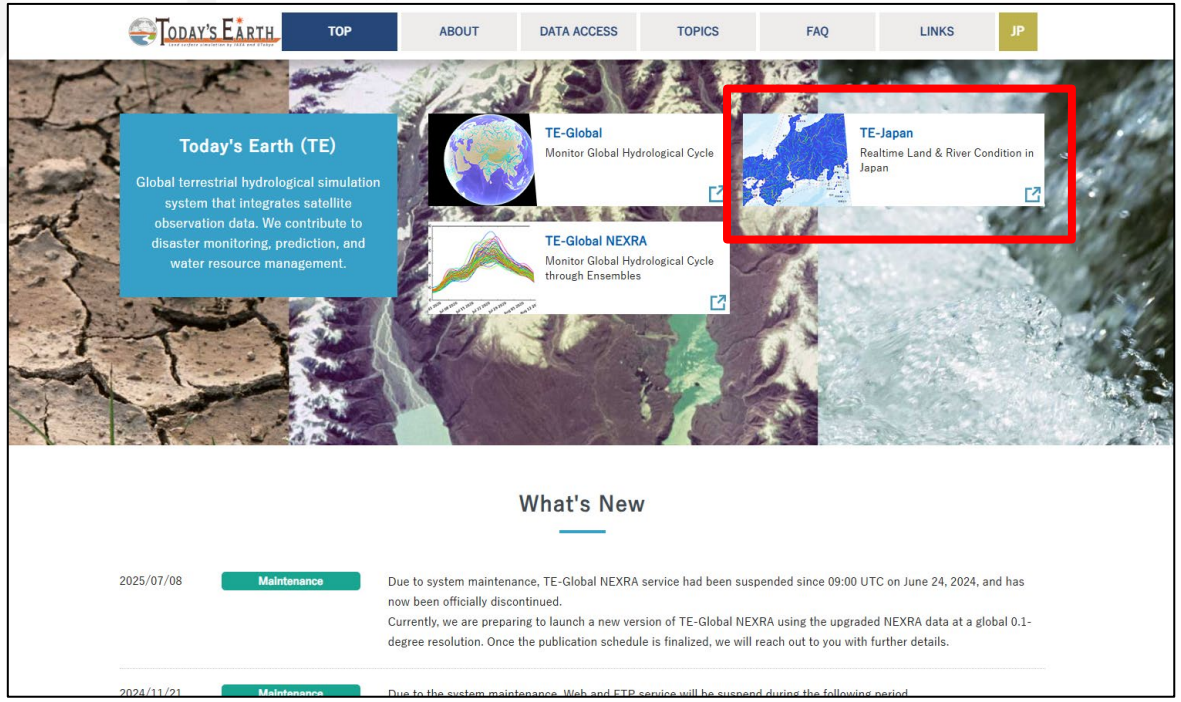
① Open a web browser on your PC.

② Access the Today's Earth website using the following URL:

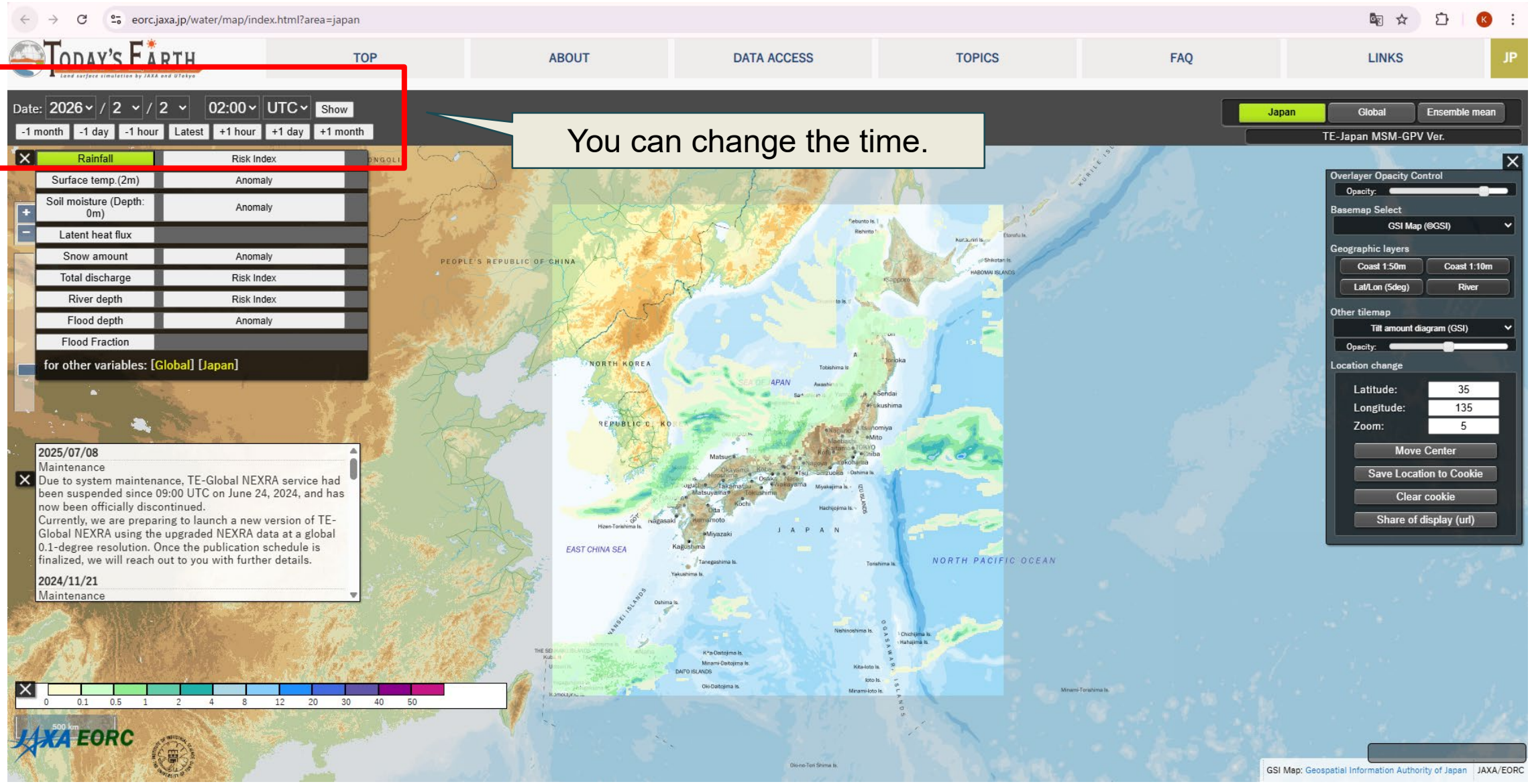
https://www.eorc.jaxa.jp/water/

③Click "TE-Japan"

Smartphones are not supported.



How to use “TE-Japan”



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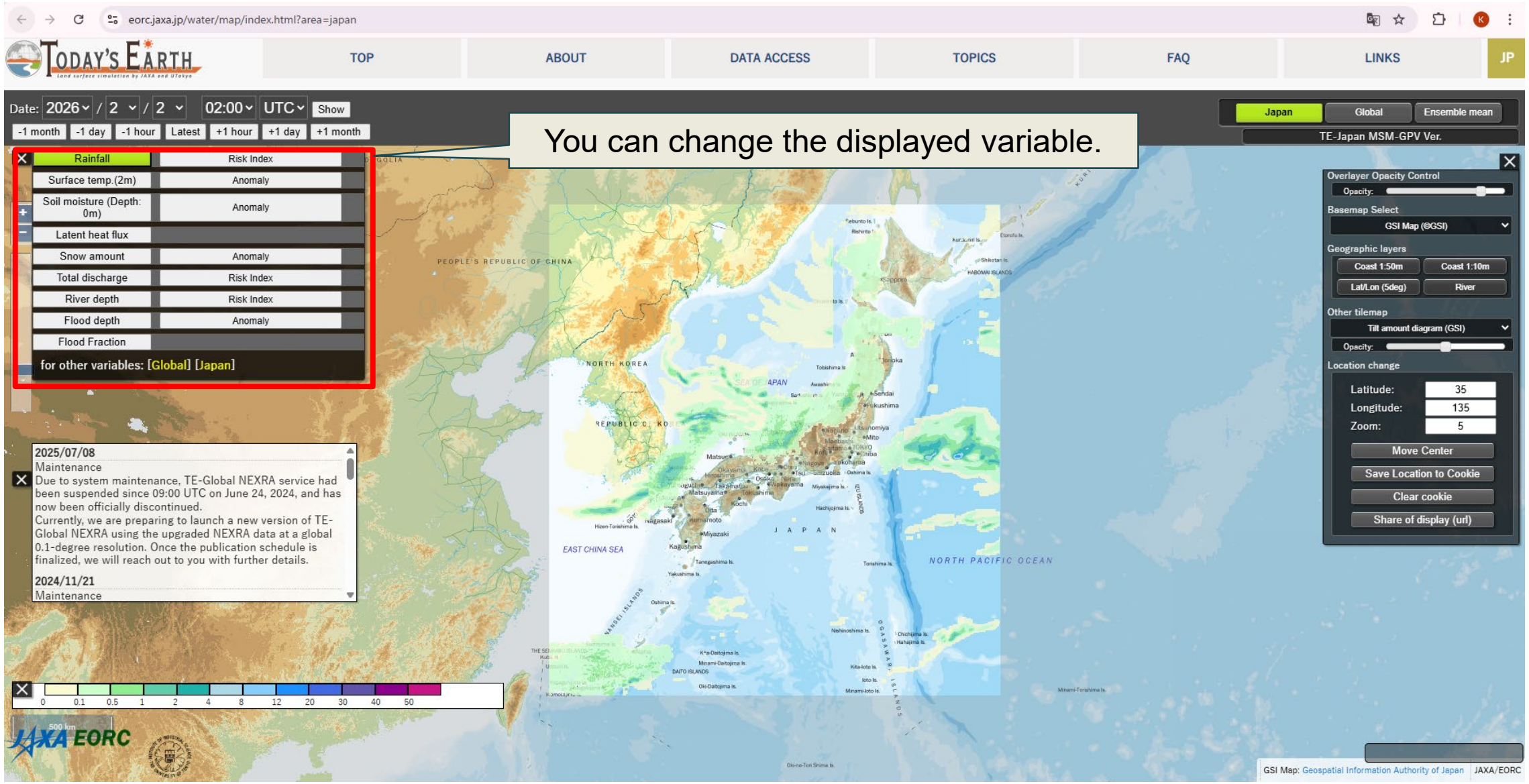

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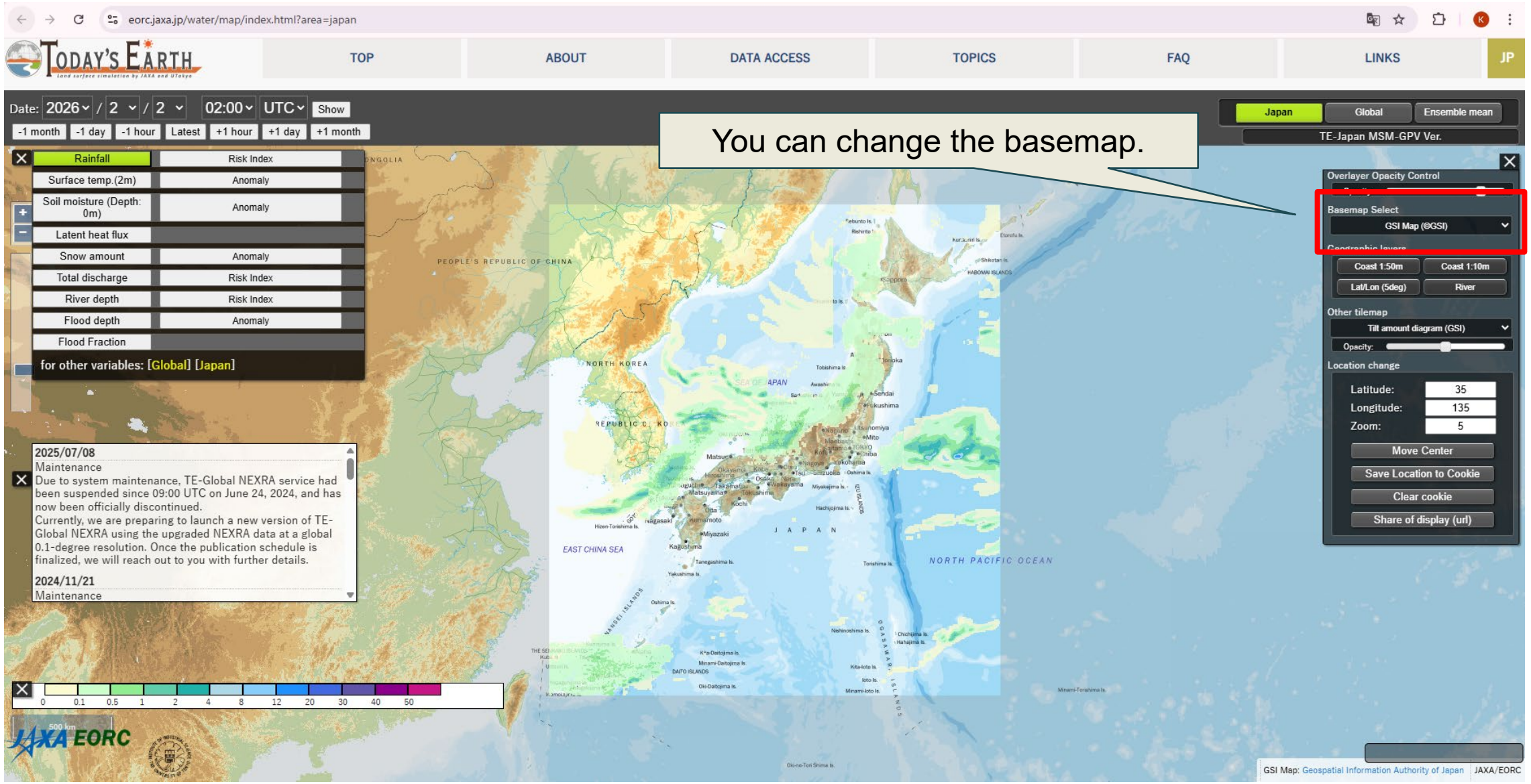

TODAY'S EARTH

Land surface simulation by JAXA and UTokyo

Website

https://www.eorc.jaxa.jp/water/

How to use

https://youtu.be/FaVpeZTq870?si=EjmWydqU0IsBaoVs

*Please turn on the automatic translation on YouTube

Thank you for your attention!