

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)?

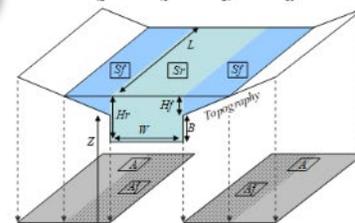
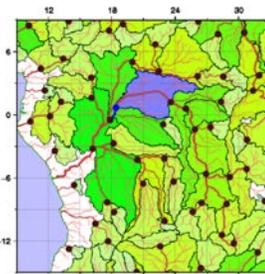
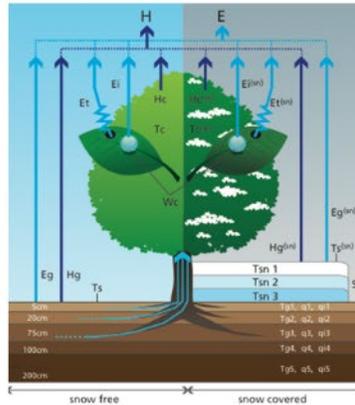
- **Global terrestrial hydrological simulation system**
- Developed and operated under the collaborative research of JAXA and the University of Tokyo
 - <https://www.eorc.jaxa.jp/blue/>
- **Goals:**
 - Estimating/Predicting the water-related physical value and providing them.

Long-term global land surface water dataset

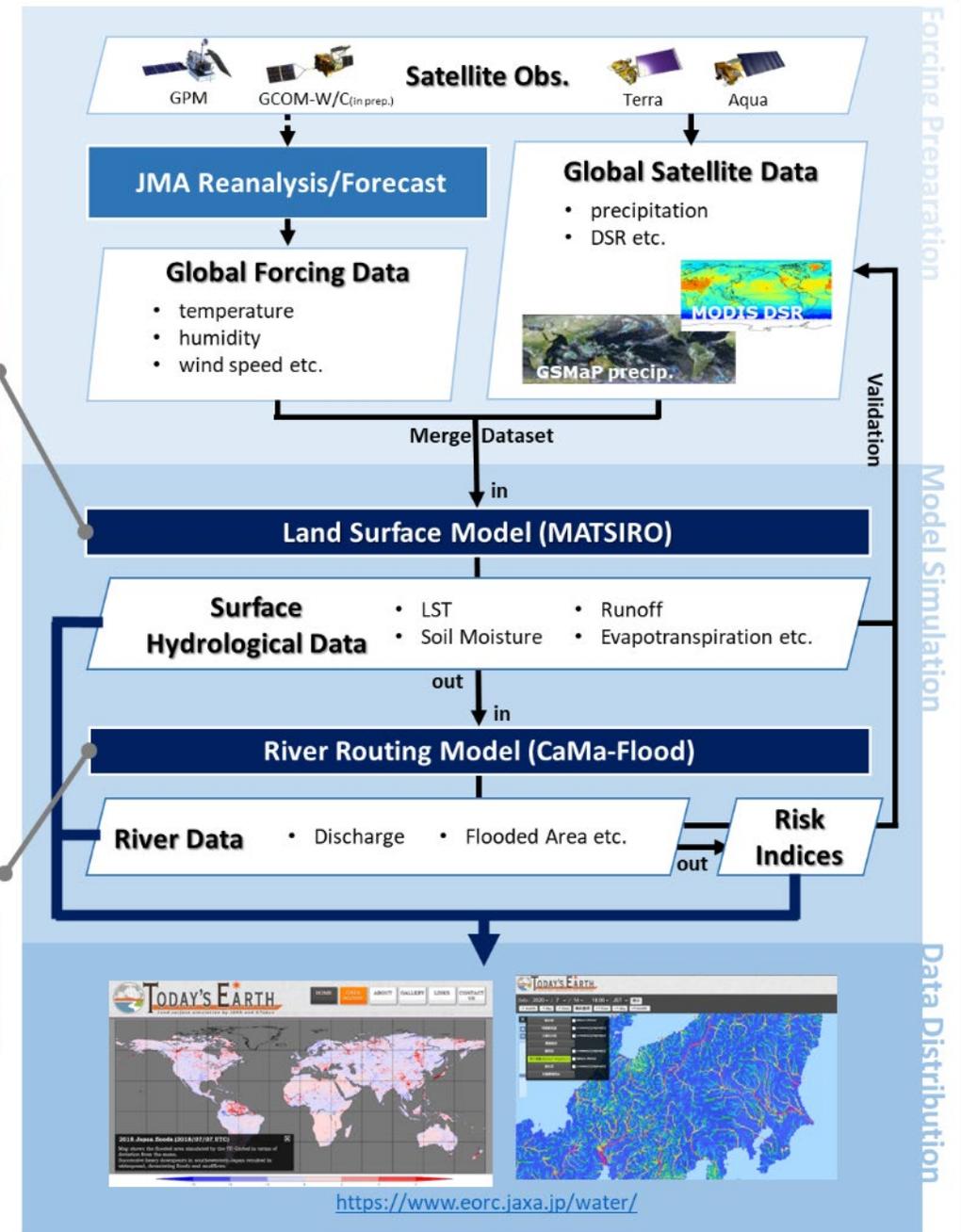
Predicting extreme events such as floods and droughts.

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

Takata et al., 2003



Yamazaki et al., 2011



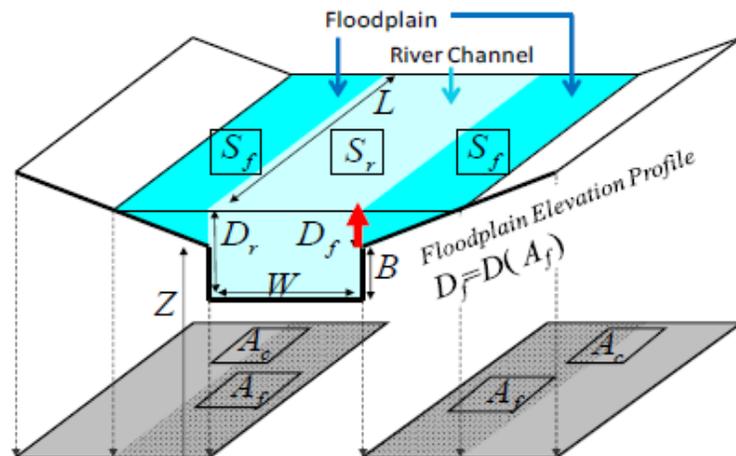
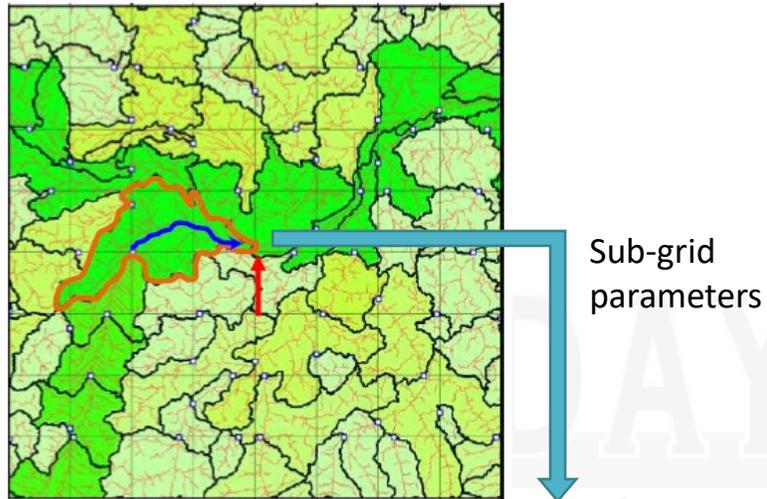
<https://www.eorc.jaxa.jp/water/>

Forecast Preparation Model Simulation Data Distribution

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

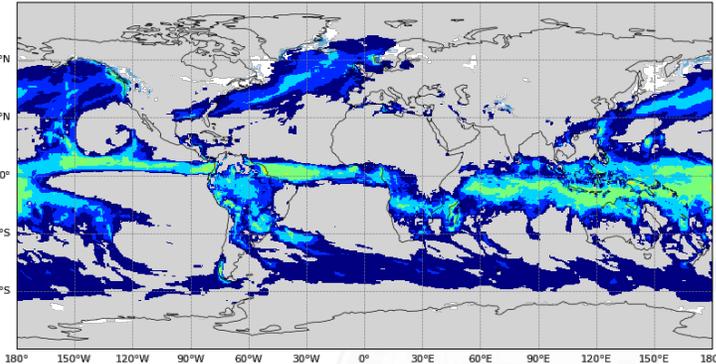
- ① Calculate river discharge
Shallow water
momentum equation
- ② Calculate water storage
in next time step
mass-balance equation

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

Data of Today's Earth(TE)

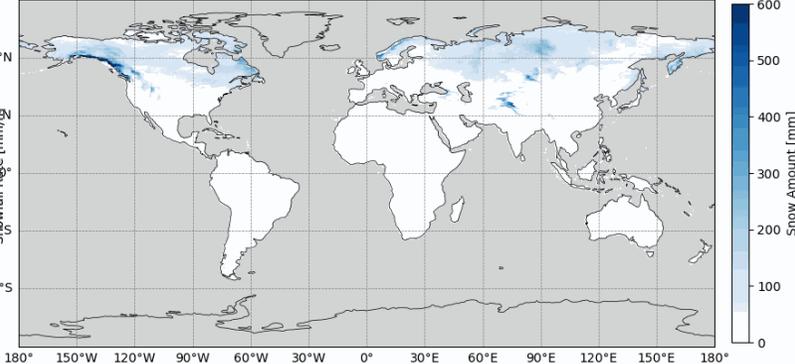
Precipitation (model input)

[Today's Earth-Global] Estimated Monthly Total Precipitation 1990-01



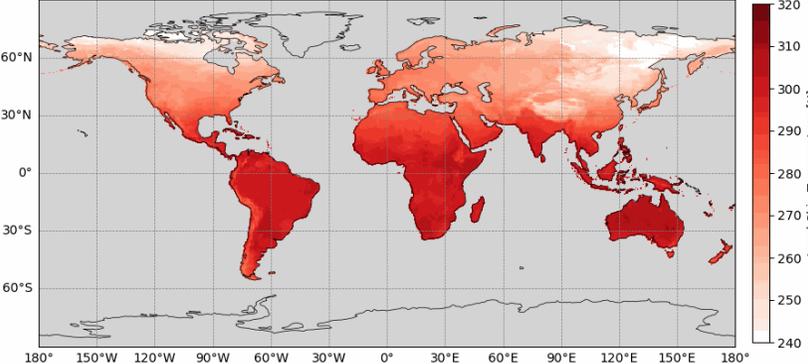
Snow amount

[Today's Earth-Global] Estimated Monthly Snow Amount 1990-01



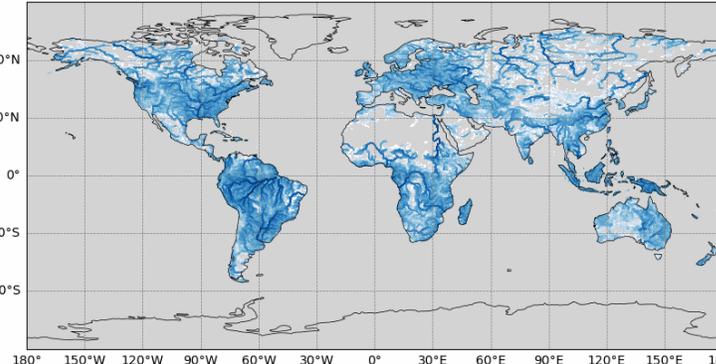
Land surface temperature

[Today's Earth-Global] Estimated Monthly Land Skin Temperature 1990-01



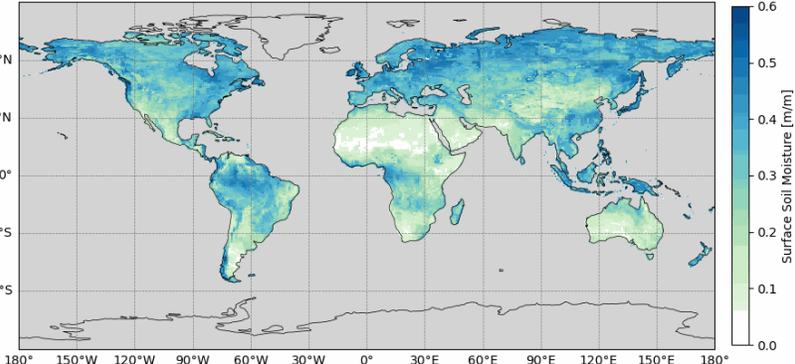
River discharge

[Today's Earth-Global] Estimated Monthly River Discharge 1990-01



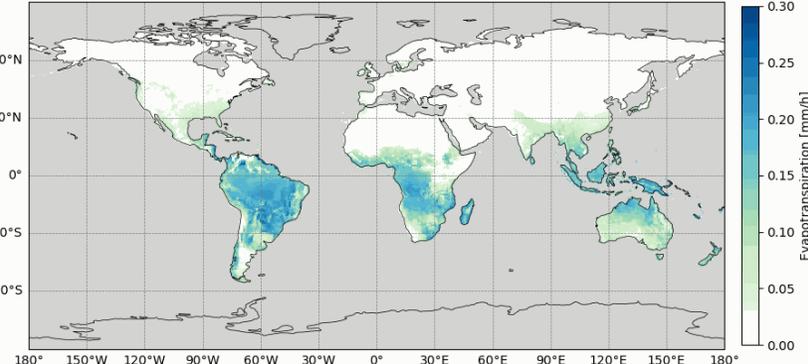
Soil moisture

[Today's Earth-Global] Estimated Monthly Surface Soil Moisture 1990-01



Evapotranspiration

[Today's Earth-Global] Estimated Monthly Evapotranspiration 1990-01



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

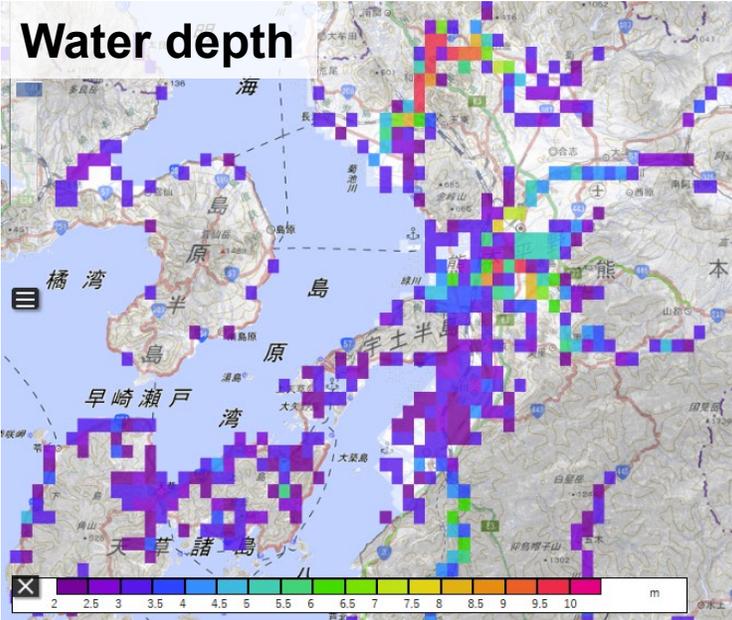
Developing the 10 km (0.1 deg.) system for public release.

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

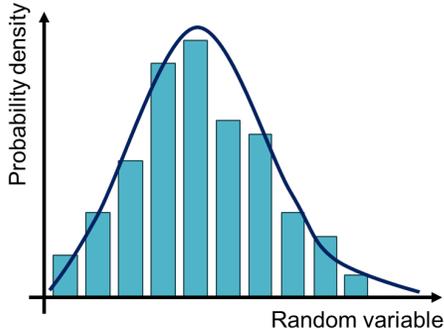
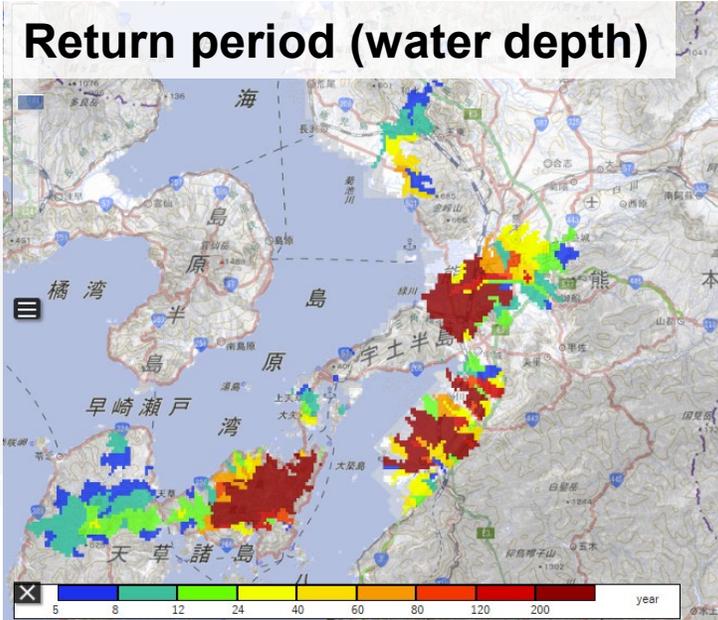
For more detail: <https://www.eorc.jaxa.jp/water/documents.html>

Risk estimation

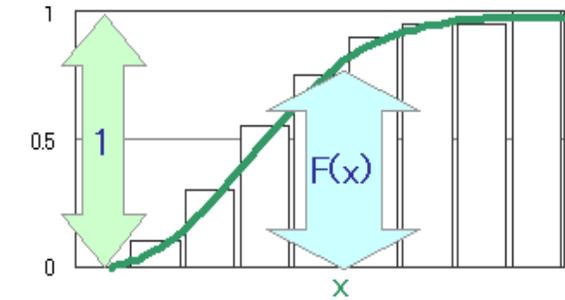
- Today's Earth provides "Return periods" as risk index.
- "Return periods" indicate how often a phenomenon of the same magnitude is expected to occur.



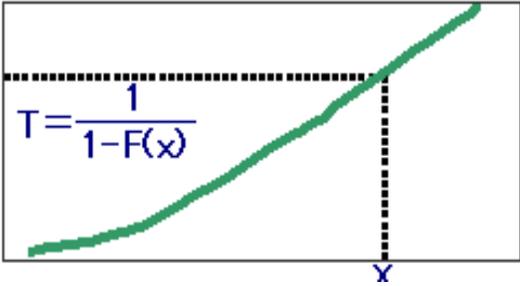
Statistical processing



Gumbel distribution



Calculate cumulative probability



Convert into "return periods" 7

Interface of Today's Earth

The screenshot displays the 'Today's Earth' web interface. At the top, there is a navigation bar with links for 'TOP', 'ABOUT', 'DATA ACCESS', 'TOPICS', 'FAQ', 'LINKS', and 'JP'. Below the navigation bar, the main content area features a global map. The map is overlaid with a color-coded data layer, likely representing soil moisture or a similar variable, with a color scale ranging from 0.1 (lightest) to 0.5 (darkest). The interface includes several control panels:

- Date and Time:** A date selector set to '2023 / 6 / 1' and a time selector set to '21:00 UTC'. A 'Show' button is next to the time selector.
- Update Status:** A red box indicates 'TE-Global Update stopped'.
- Map Style:** A panel on the right allows users to select the map style, currently set to 'GSI Map (eGSI)'. Other options include 'Coast 1:50m', 'Coast 1:10m', 'Lat/Lon (5deg)', and 'River'.
- Geographic Layers:** A panel on the right allows users to select geographic layers, currently set to 'Tilt amount diagram (GSI)'. Other options include 'Coast 1:50m', 'Coast 1:10m', 'Lat/Lon (5deg)', and 'River'.
- Other tilemap:** A panel on the right allows users to select other tilemaps, currently set to 'Tilt amount diagram (GSI)'. Other options include 'Coast 1:50m', 'Coast 1:10m', 'Lat/Lon (5deg)', and 'River'.
- Location change:** A panel on the right allows users to change the map location, with fields for Latitude (12.32), Longitude (95.4), and Zoom (3.0690158087). Buttons for 'Move Center', 'Save Location to Cookie', 'Clear cookie', and 'Share of display (url)' are provided.
- Variable Selection:** A panel on the left allows users to select variables to display on the map. The selected variable is 'Soil moisture (Depth: 0m)'. Other variables include 'Rainfall', 'Surface temp. (2m)', 'Latent heat flux', 'Snow amount', 'Total discharge', 'River depth', 'Flood depth', and 'Flood Fraction'. A 'Risk Index' column is also present.
- Maintenance Notice:** A notice box on the left provides information about system maintenance, stating that the TE-Global NEXRA service has been suspended since 09:00 UTC on June 24, 2024, and is currently preparing for a new version launch.
- Scale and Logos:** A scale bar at the bottom left shows a distance of 2000 km. Logos for JAXA EORC and the University of Tsukuba are also visible.

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 <small>*N = Return period of estimated river water level</small>
Lev.5	$200 \leq N$
Lev.4	$150 \leq N < 200$
Lev.3	$100 \leq N < 150$
Lev.2	$50 \leq N < 100$
Lev.1	$10 \leq N < 50$

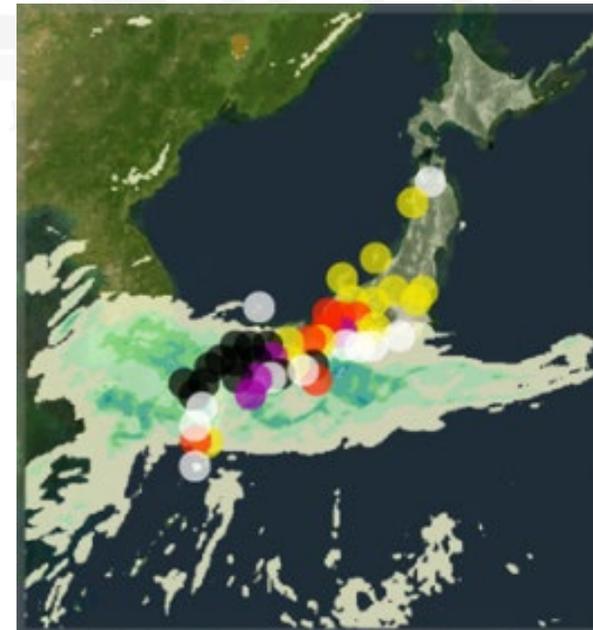
Severe



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



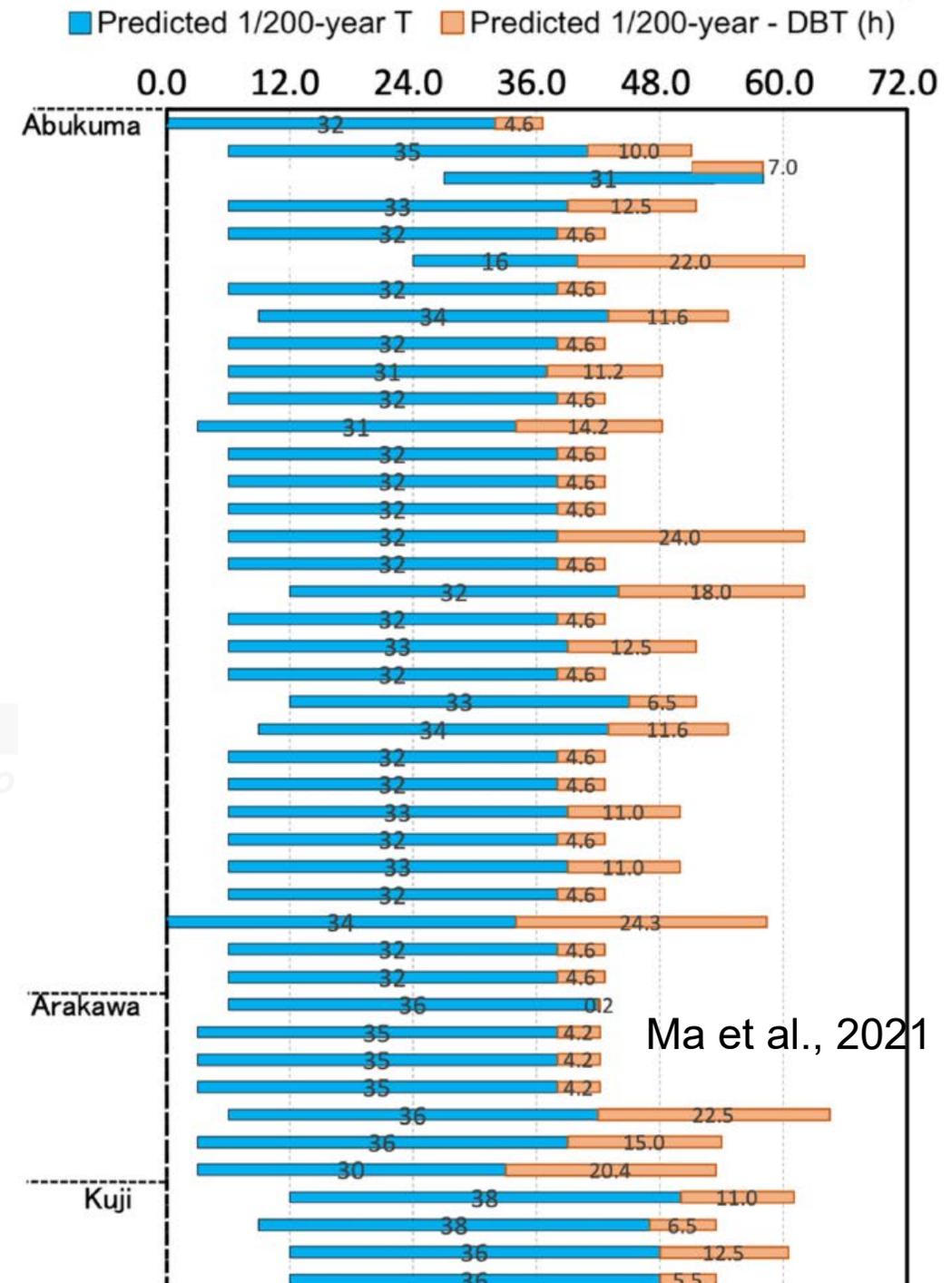
Example of the Issued alert



Case study on typhoon Hagibis, 2019



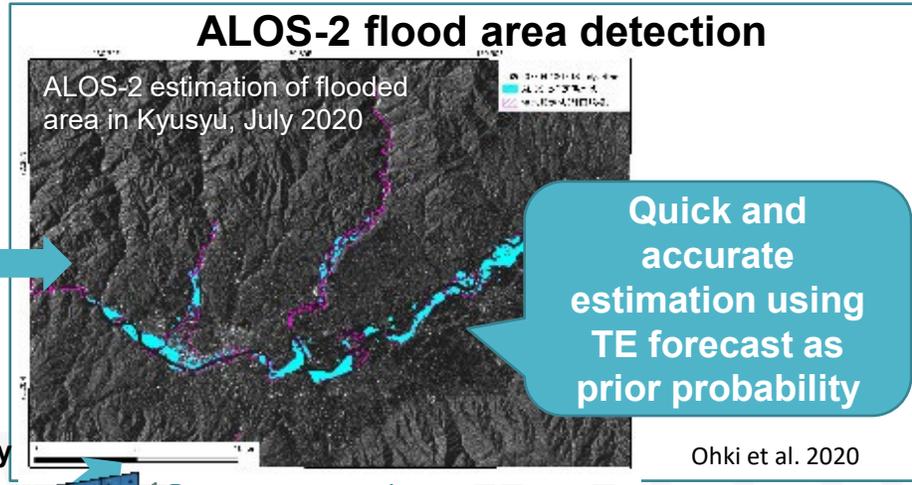
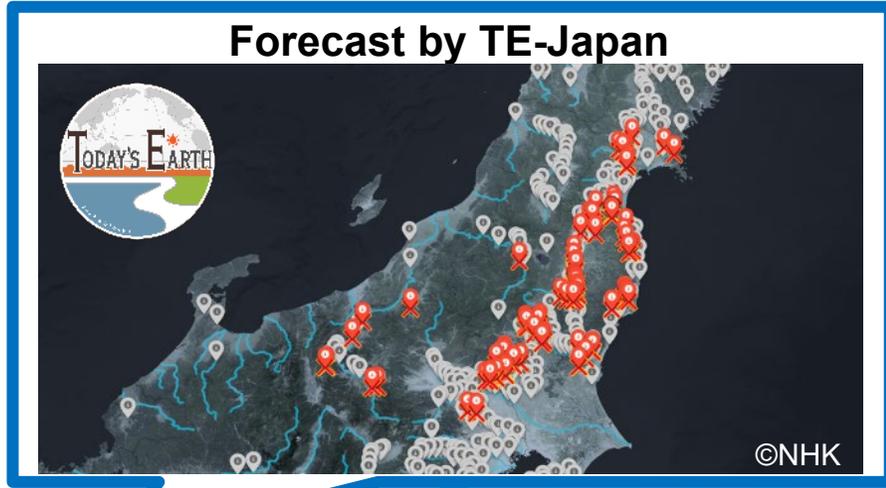
- Among the 142 locations reported to have experienced levee breaches, **TE-Japan successfully alerted at 129 of these sites**
 - **An average lead time was 32.3 hours** and actual breaches occurred 8.5 hours later than the predicted warnings.
- The false alarm rate was approximately 90% at the initial 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



Local government



Quick and accurate estimation using TE forecast as prior probability



Disaster

~30hrs before

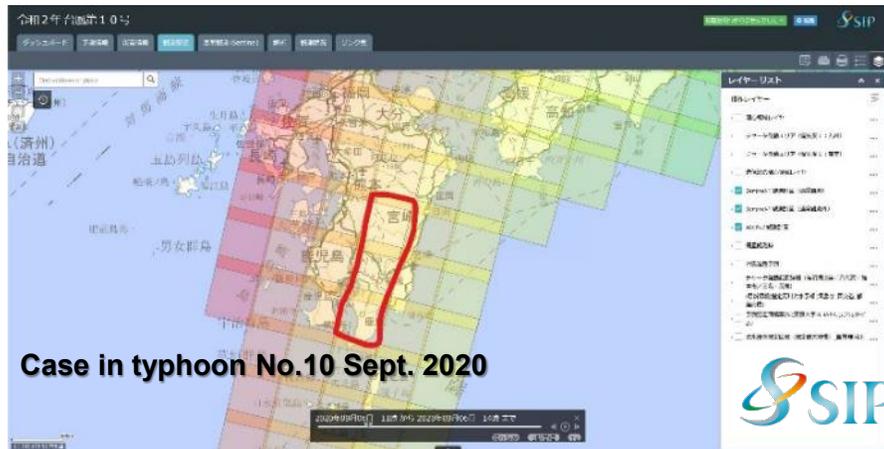
~10 hrs before

10 hrs after~

30hrs after~

Time

Determination of observation area



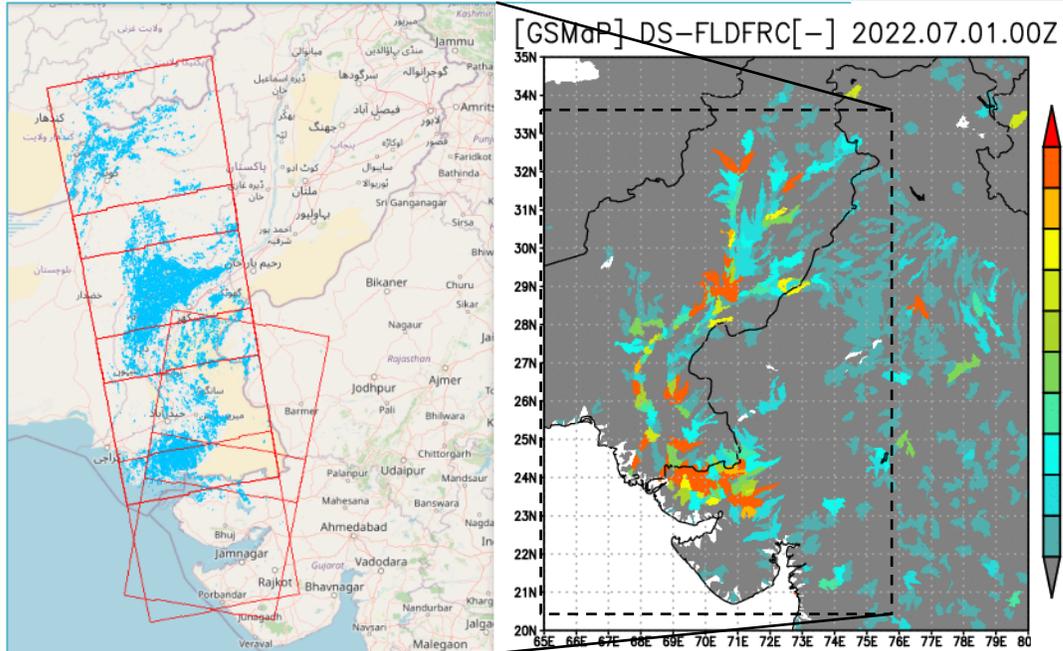
- This framework is effectively used for disaster response
- It is expected that, if TE-Global can provide high-resolution forecasts, collaboration with emergency satellite observations will be possible in a similar manner

Example of TE-Global simulation

◆ Flood in Pakistan 2022

Flooded area detected by ALOS-2

TE-Global estimation (Flooded area fraction)



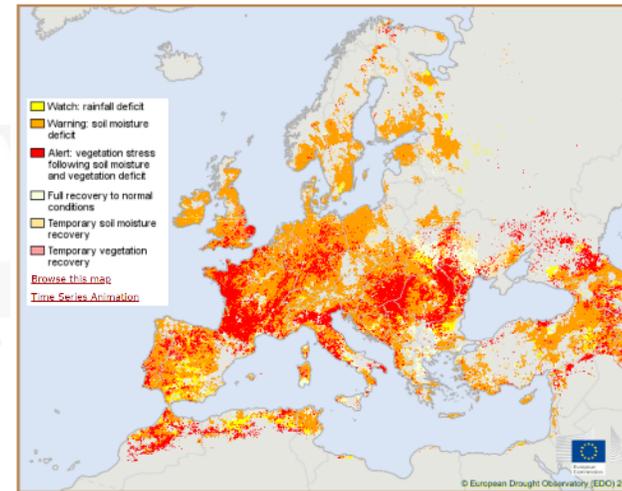
◆ European Heatwave 2022

Drought severity estimated by EU

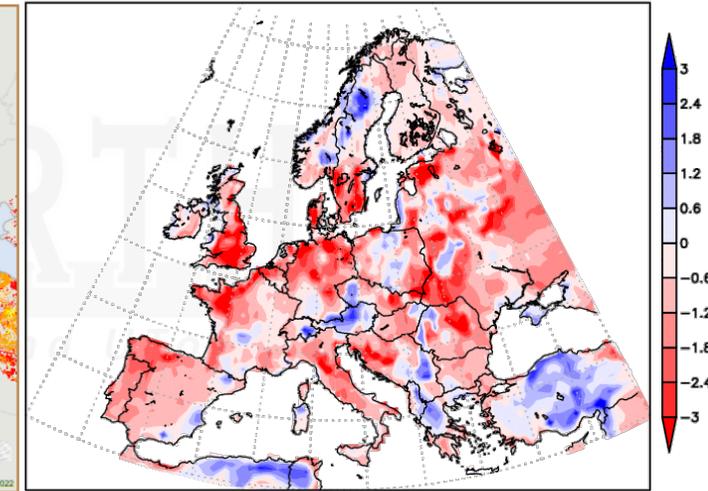
TE-Global estimation (Soil Moisture Anomaly)

Situation of Combined Drought Indicator in Europe - 2nd ten-day period of August 2022

According to the latest map of the Combined Drought Indicator 43% of the EU territory is in Warning conditions and 21% is in Alert conditions



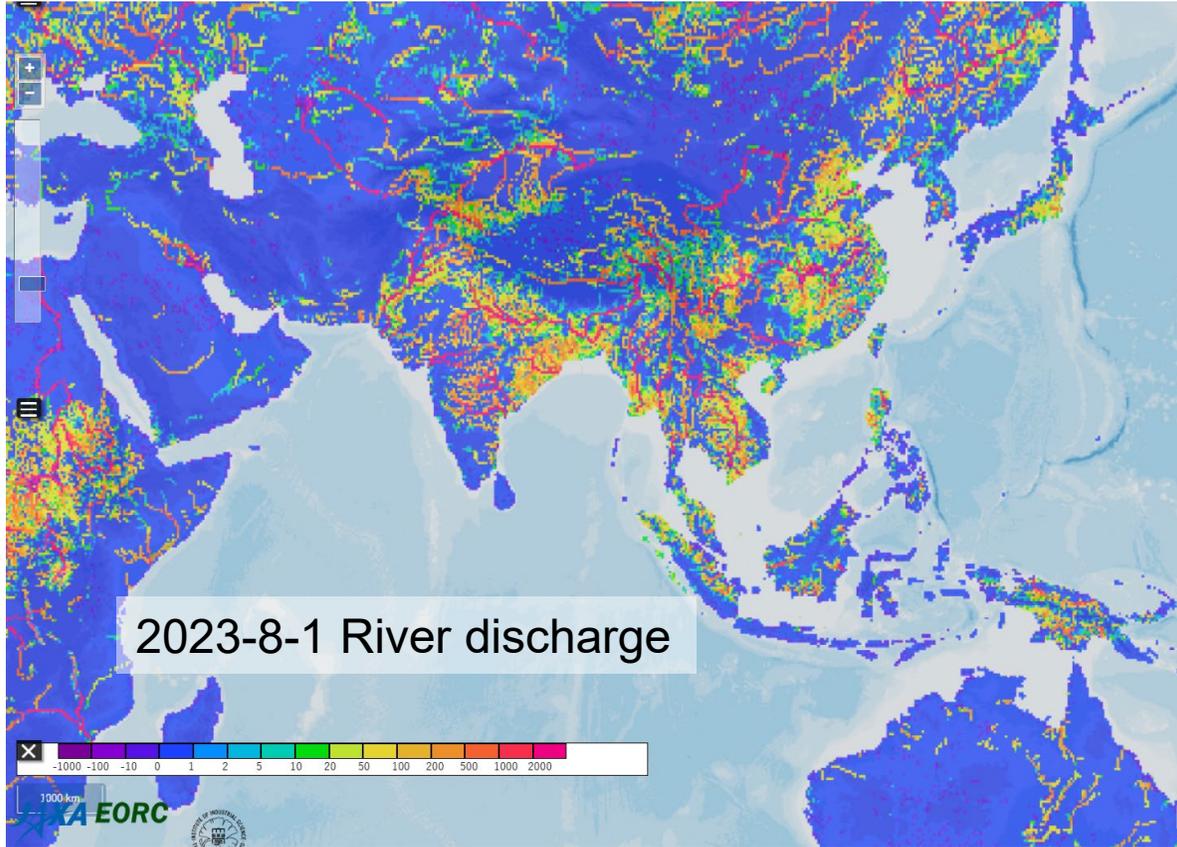
[GSMaP] GLW[Z1] Anomaly 2022.07.01Z



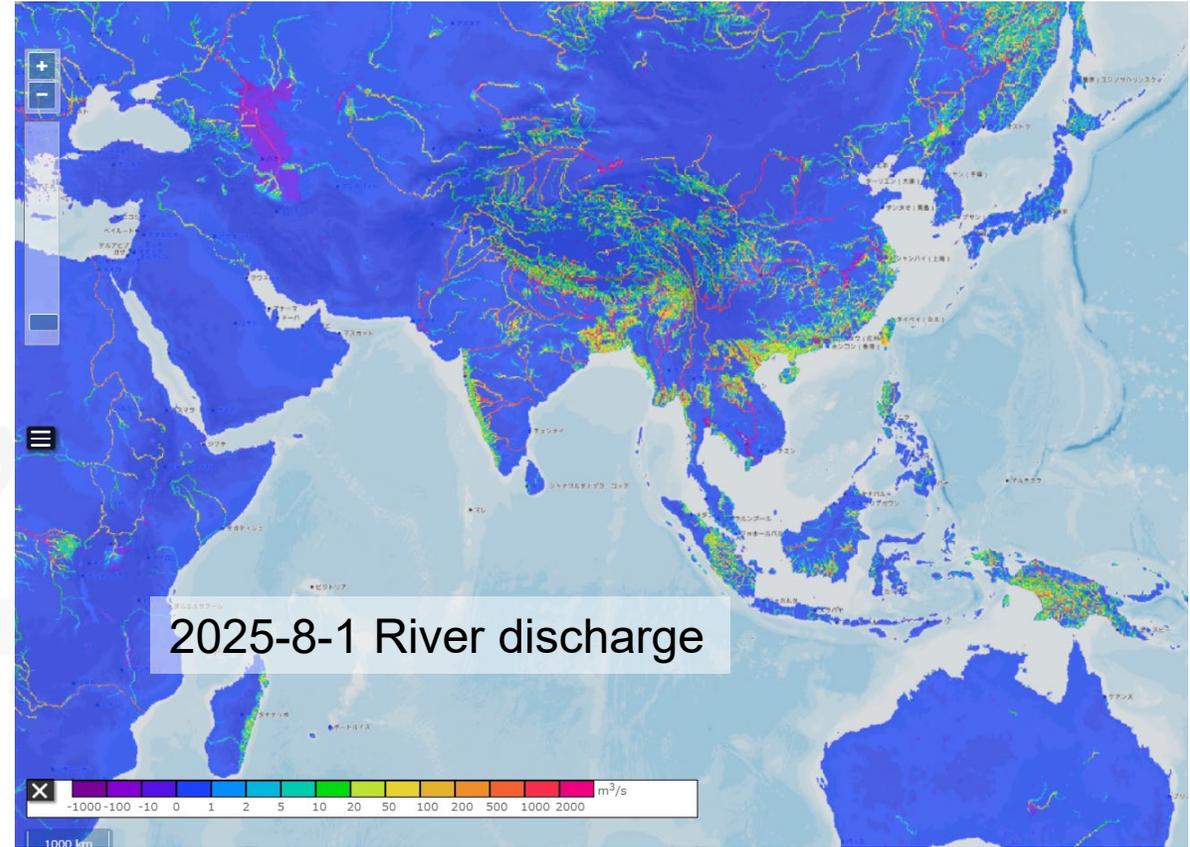
- TE-Global demonstrates its capability to reproduce such hydrological events by physically solving near-surface water and energy budgets globally.

Developing Global 10 km resolution system

Former version (25km(river) resolution)



Developing version (10km resolution)



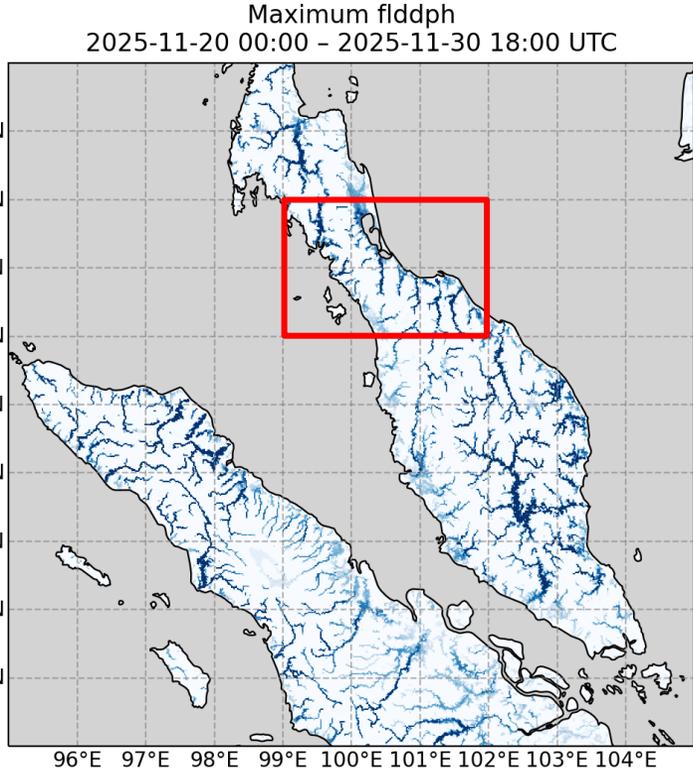
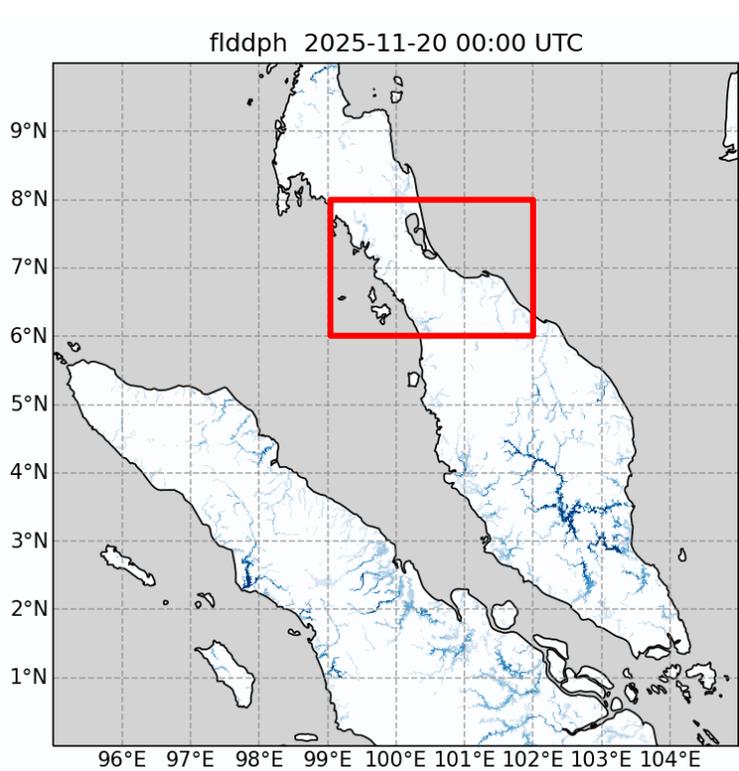
Roadmap

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

← Now developing

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

◆ Flood in Thailand Nov. 2025

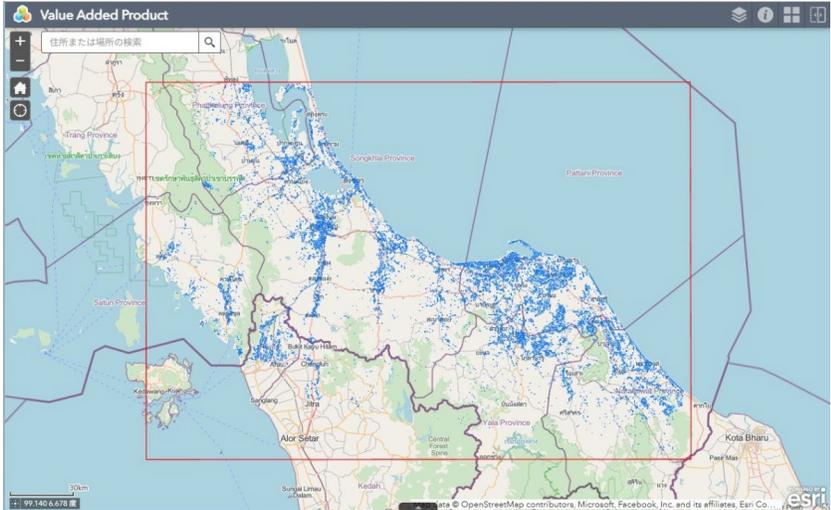


◀ Estimated floodplain water depth by TE-Global (originally 0.1 deg., downscaled to 1/60 deg.)



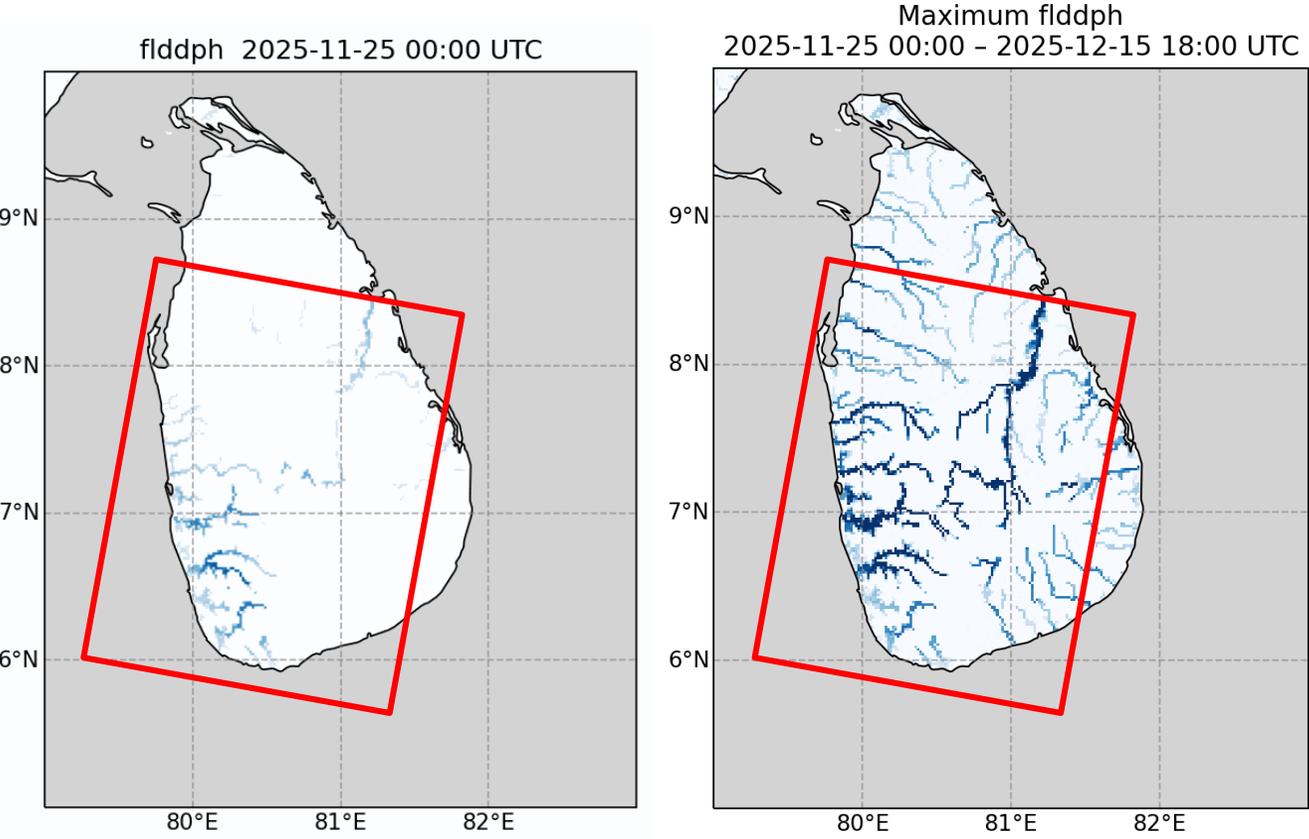
*details to be confirmed

Observed flooded area ▶
By Sentinel Asia



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

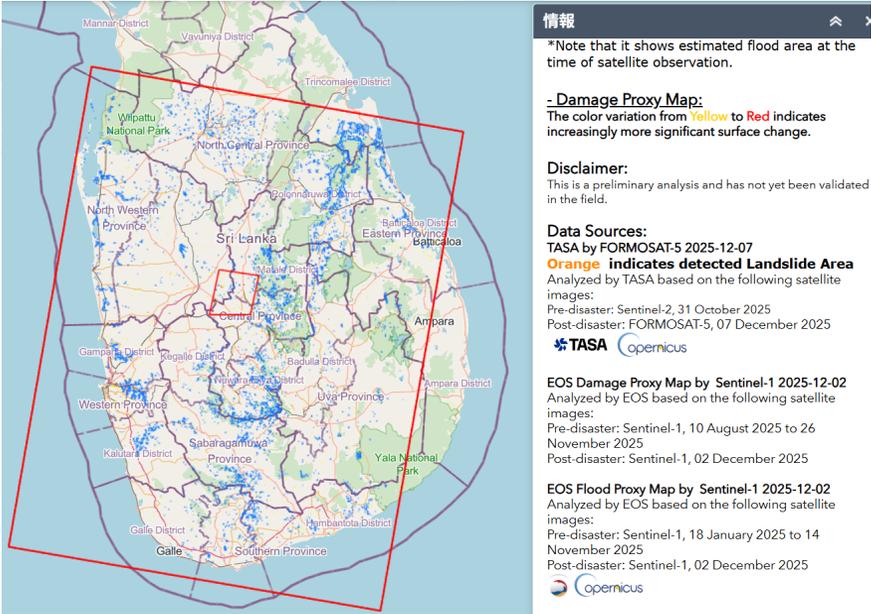
◆ Flood in Sri Lanka Nov. 2025



*details to be confirmed

Observed flooded area ▶
By Sentinel Asia

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



<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.

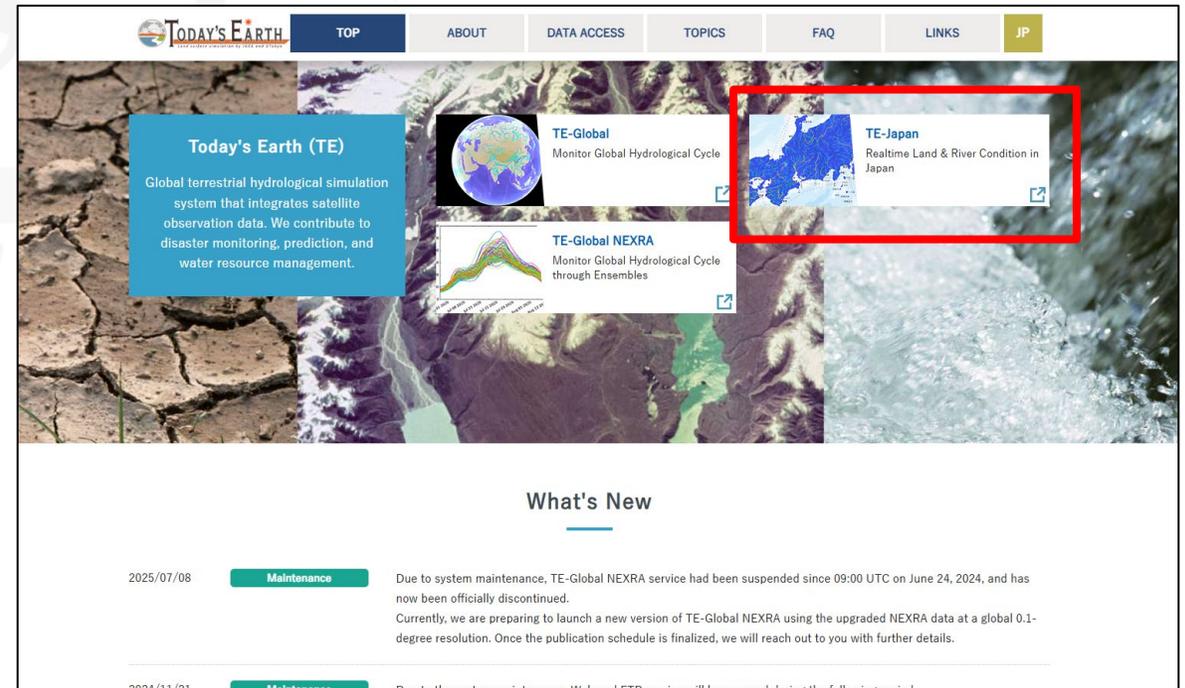
- ① Open a web browser on your PC.
- ② Access the Today's Earth website using the following URL:

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

- ③ Click “TE-Japan”



Smartphones are not supported.



The screenshot shows the homepage of the Today's Earth website. The navigation bar includes links for TOP, ABOUT, DATA ACCESS, TOPICS, FAQ, LINKS, and JP. The main content area features several cards: 'Today's Earth (TE)' with a description of the global terrestrial hydrological simulation system; 'TE-Global' for monitoring the global hydrological cycle; 'TE-Global NEXRA' for monitoring the cycle through ensembles; and 'TE-Japan' for real-time land and river conditions in Japan, which is highlighted with a red rectangular box. Below the main content is a 'What's New' section with a maintenance notice dated 2025/07/08 regarding the suspension of the TE-Global NEXRA service.

How to use “TE-Japan”

The screenshot displays the TE-Japan web application interface. At the top, the URL is `eorc.jaxa.jp/water/map/index.html?area=japan`. The navigation menu includes **TOP**, **ABOUT**, **DATA ACCESS**, **TOPICS**, **FAQ**, **LINKS**, and **JP**. The main content area features a map of Japan with a color-coded overlay representing rainfall. A red box highlights the date and time selection controls, which include a date picker set to 2026/2/2, a time selector set to 02:00 UTC, and a 'Show' button. Below these are buttons for time intervals: -1 month, -1 day, -1 hour, Latest, +1 hour, +1 day, and +1 month. A callout box with a white background and black border points to these controls, containing the text: "You can change the time." The left sidebar contains a list of data layers, with 'Rainfall' selected. Other layers include Risk Index, Surface temp (2m), Anomaly, Soil moisture (Depth: 0m), Anomaly, Latent heat flux, Snow amount, Anomaly, Total discharge, Risk Index, River depth, Risk Index, Flood depth, Anomaly, and Flood Fraction. Below the list are links for 'Global' and 'Japan'. The right sidebar contains an 'Overlay Opacity Control' panel with an opacity slider, a 'Basemap Select' dropdown set to 'GSI Map (@GSI)', and 'Geographic layers' buttons for 'Coast 1:50m', 'Coast 1:10m', 'Lat/Lon (Sdeg)', and 'River'. The 'Other tilemap' section has a 'Tilt amount diagram (GSI)' dropdown and an opacity slider. The 'Location change' section includes input fields for Latitude (35), Longitude (135), and Zoom (5), along with buttons for 'Move Center', 'Save Location to Cookie', 'Clear cookie', and 'Share of display (url)'. A notification box in the bottom left corner contains maintenance information: "2025/07/08 Maintenance Due to system maintenance, TE-Global NEXRA service had been suspended since 09:00 UTC on June 24, 2024, and has now been officially discontinued. Currently, we are preparing to launch a new version of TE-Global NEXRA using the upgraded NEXRA data at a global 0.1-degree resolution. Once the publication schedule is finalized, we will reach out to you with further details." and "2024/11/21 Maintenance". A scale bar at the bottom left shows distances from 0 to 50 km. The bottom right corner features the GSI Map logo and the text "GSI Map: Geospatial Information Authority of Japan | JAXA/EORC".

How to use “TE-Japan”

The screenshot shows the TE-Japan web application interface. At the top, there is a navigation bar with links for TOP, ABOUT, DATA ACCESS, TOPICS, FAQ, LINKS, and JP. Below the navigation bar, the date is set to 2026/2/2 at 02:00 UTC. A callout box with a white background and black border points to the variable selection menu, containing the text: "You can change the displayed variable." The variable selection menu is a table with a red border, listing various variables and their corresponding risk indices. A legend at the bottom left shows a color scale from 0 to 50. On the right side, there is a control panel with options for Overlayer Opacity Control, Basemap Select (GSI Map), Geographic layers (Coast 1:50m, Coast 1:10m, Lat/Lon, River), Other tilemap (Tilt amount diagram), and Location change (Latitude: 35, Longitude: 135, Zoom: 5). The map itself displays rainfall data over Japan and surrounding regions, with a color scale from 0 to 50. The interface also includes a maintenance notice dated 2025/07/08 and 2024/11/21.

Variable	Risk Index
Rainfall	Risk Index
Surface temp. (2m)	Anomaly
Soil moisture (Depth: 0m)	Anomaly
Latent heat flux	
Snow amount	Anomaly
Total discharge	Risk Index
River depth	Risk Index
Flood depth	Anomaly
Flood Fraction	

for other variables: [Global] [Japan]

2025/07/08
Maintenance
Due to system maintenance, TE-Global NEXRA service had been suspended since 09:00 UTC on June 24, 2024, and has now been officially discontinued. Currently, we are preparing to launch a new version of TE-Global NEXRA using the upgraded NEXRA data at a global 0.1-degree resolution. Once the publication schedule is finalized, we will reach out to you with further details.

2024/11/21
Maintenance

500 km
JAXA EORC

GSI Map: Geospatial Information Authority of Japan | JAXA/EORC

How to use “TE-Japan”

The screenshot shows the TE-Japan web application interface. At the top, there is a navigation bar with links for TOP, ABOUT, DATA ACCESS, TOPICS, FAQ, LINKS, and JP. Below the navigation bar, there is a date and time selector set to 2026/2/2 at 02:00 UTC. A central map of Japan is displayed with various data overlays, including a rainfall map. A callout box points to the 'Basemap Select' dropdown menu in the 'Overlayer Opacity Control' panel, which is currently set to 'GSI Map (@GSI)'. Other panels include a list of variables (Rainfall, Surface temp, Soil moisture, etc.), a maintenance notice, and a scale bar.

You can change the basemap.

Variable	Unit/Type
Rainfall	Risk Index
Surface temp (2m)	Anomaly
Soil moisture (Depth: 0m)	Anomaly
Latent heat flux	
Snow amount	Anomaly
Total discharge	Risk Index
River depth	Risk Index
Flood depth	Anomaly
Flood Fraction	

for other variables: [Global] [Japan]

2025/07/08 Maintenance
Due to system maintenance, TE-Global NEXRA service had been suspended since 09:00 UTC on June 24, 2024, and has now been officially discontinued. Currently, we are preparing to launch a new version of TE-Global NEXRA using the upgraded NEXRA data at a global 0.1-degree resolution. Once the publication schedule is finalized, we will reach out to you with further details.

2024/11/21 Maintenance

Scale: 0 to 50 km

Logos: JAXA EORC, National Institute of Advanced Industrial Science and Technology

Footer: GSI Map: Geospatial Information Authority of Japan | JAXA/EORC



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!