Using global hydrological models for flood forecasting at the local scale:

A case from Israel

Dr. Amir Givati
Executive Director
Israeli Meteorological Service

Floods

- Flooding is an overflowing of water onto land that is normally dry. Floods can happen during heavy rains, when ocean waves come on shore, when snow melts quickly, or when dams or levees break. Damaging flooding may happen with only a few inches of water, or it may cover a house to the rooftop. Floods can occur within minutes or over a long period, and may last days, weeks, or longer. Floods are the most common and widespread of all weather-related natural disasters.

- Flash floods are the most dangerous kind of floods, because they combine the destructive power of a flood with incredible speed. Flash floods occur when heavy rainfall exceeds the ability of the ground to absorb it. They also occur when water fills normally dry creeks or streams or enough water accumulates for streams to overtop their banks, causing rapid rises of water in a short amount of time. They can happen within minutes of the causative rainfall, limiting the time available to warn and protect the public.

Extreme weather events and flooding

According to the WMO Extreme weather events double themselves during recent years

"Boris": Central Europe, September 2024

Valencia, Spain, October 2024

Northern Israeli coast, NAOVEMBER 2024

Floods

The World's Deadliest Weather Hazard

Killing over 10,000 people a year

Disrupting billions of people lives worldwide

Global economic losses exceeding $20B annually

increase in extreme floods

- Extreme floods are increasing in frequency and intensity in many regions worldwide due to **human-caused climate change**, which causes the atmosphere to hold more moisture, leading to more extreme rainfall events, and also contributes to rising sea levels.

- **Warmer Atmosphere Holds More Moisture:** For every 1° Celsius (1.8° Fahrenheit) rise in air temperature, the atmosphere can hold about 7% more water vapor. This leads to more intense and heavier downpours and storms, a primary driver of flash floods and riverine flooding.

- **Rising Sea Levels:** Global average sea level has risen significantly, a rate that is accelerating due to ice melt and thermal expansion of warmer ocean water. Higher sea levels exacerbate coastal flooding, storm surges, and even contribute to more frequent "nuisance" or high-tide flooding on sunny days.

- **Warmer Oceans:** Higher ocean surface temperatures fuel more intense and frequent hurricanes, cyclones, and typhoons, which in turn produce more rainfall and devastating storm surges.

- **Changes in Land Use:** Urbanization (with impermeable surfaces like asphalt and concrete that prevent water absorption), clear-cutting forests, and certain agricultural practices increase runoff and reduce the ground's natural ability to mitigate flooding.

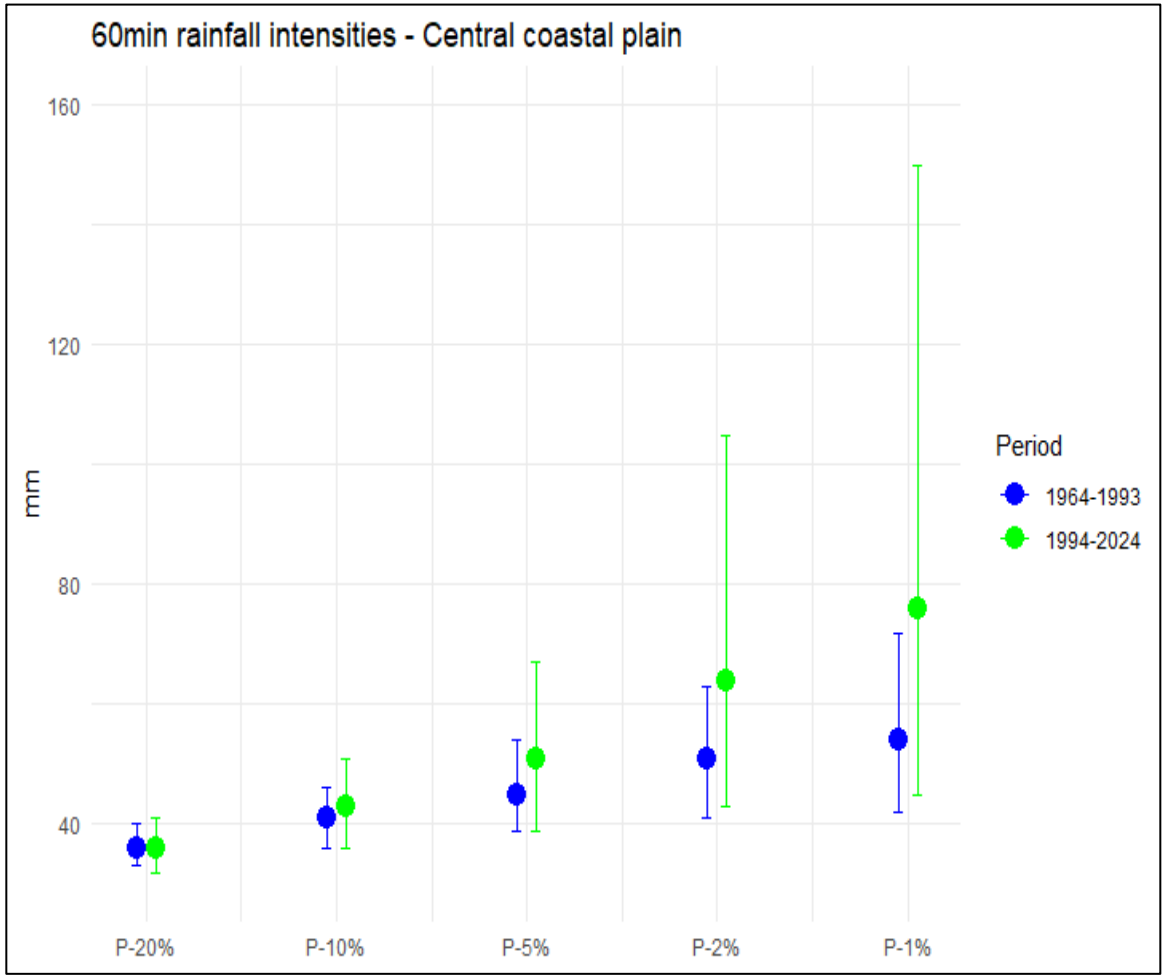
Flood forecasting at IMS

- Flash floods and urban flooding are a major issue in Mediterranean basins, South Europe and other semi-arid regions. Short duration and high intensity precipitation events lead to flooding and major inundation events.
- Studies shows significant increase in precipitation intensities in the Mediterranean basin during the last decades.
- Systems like EFAS, GeoGlows and the SEEMHEWS-CIP provide forecast for river flooding but there is still need for information and alerts for urban flooding, inundation and flash floods caused by local convection and intense precipitation.
- Those floods are the major of damage and lost of life in the urban environment and remi-arid small basins .

- The Israeli Meteorological Service (IMS) is using global and regional (European scale) flood models for flood warning at the national scale

- IMS use output from GLOFAS , EFAS as well GeoGlows hydrological models (with applying bias correction)

Significant increase in rain intensities and floods

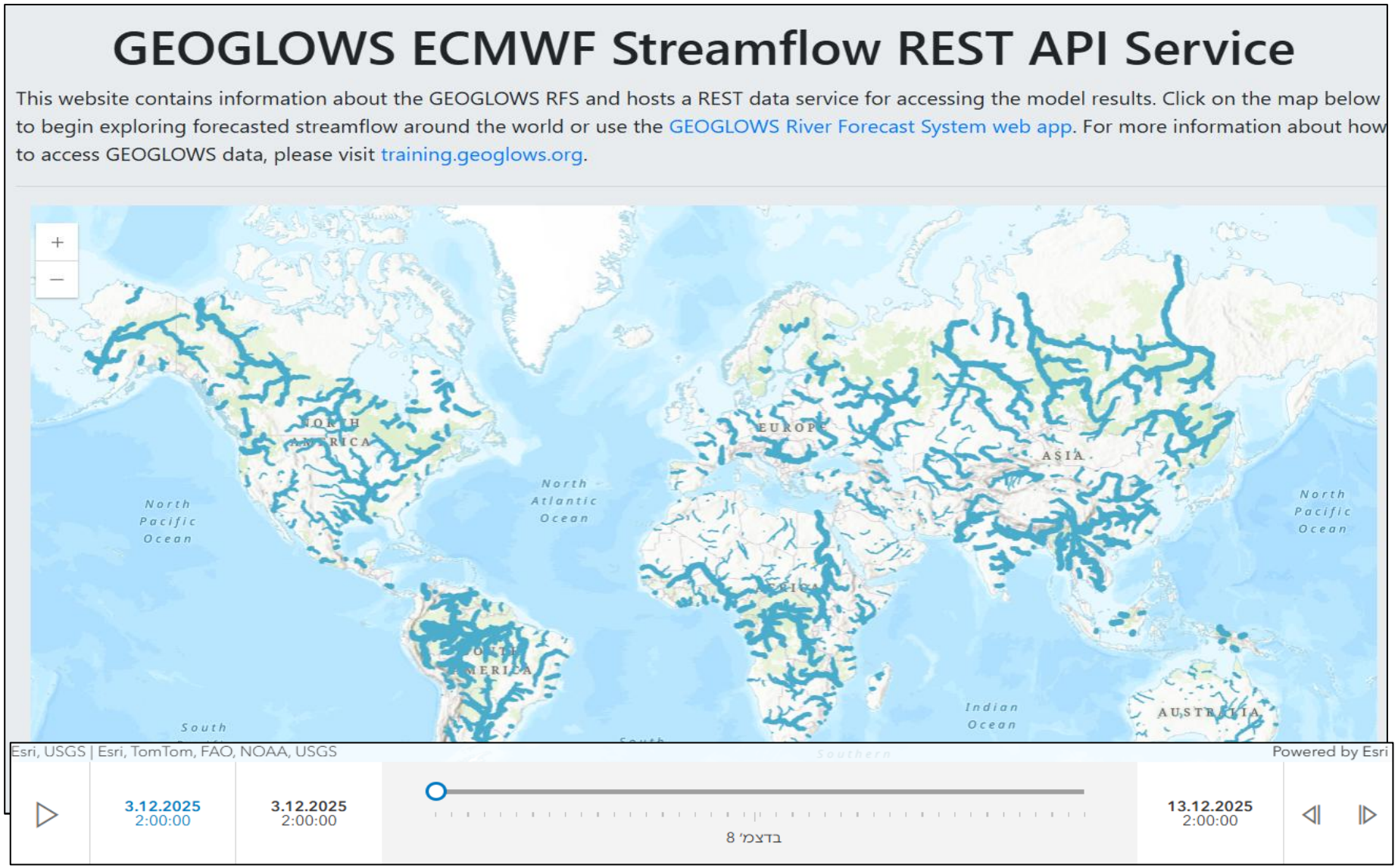


GEOGLOWS Global Streamflow Forecasting

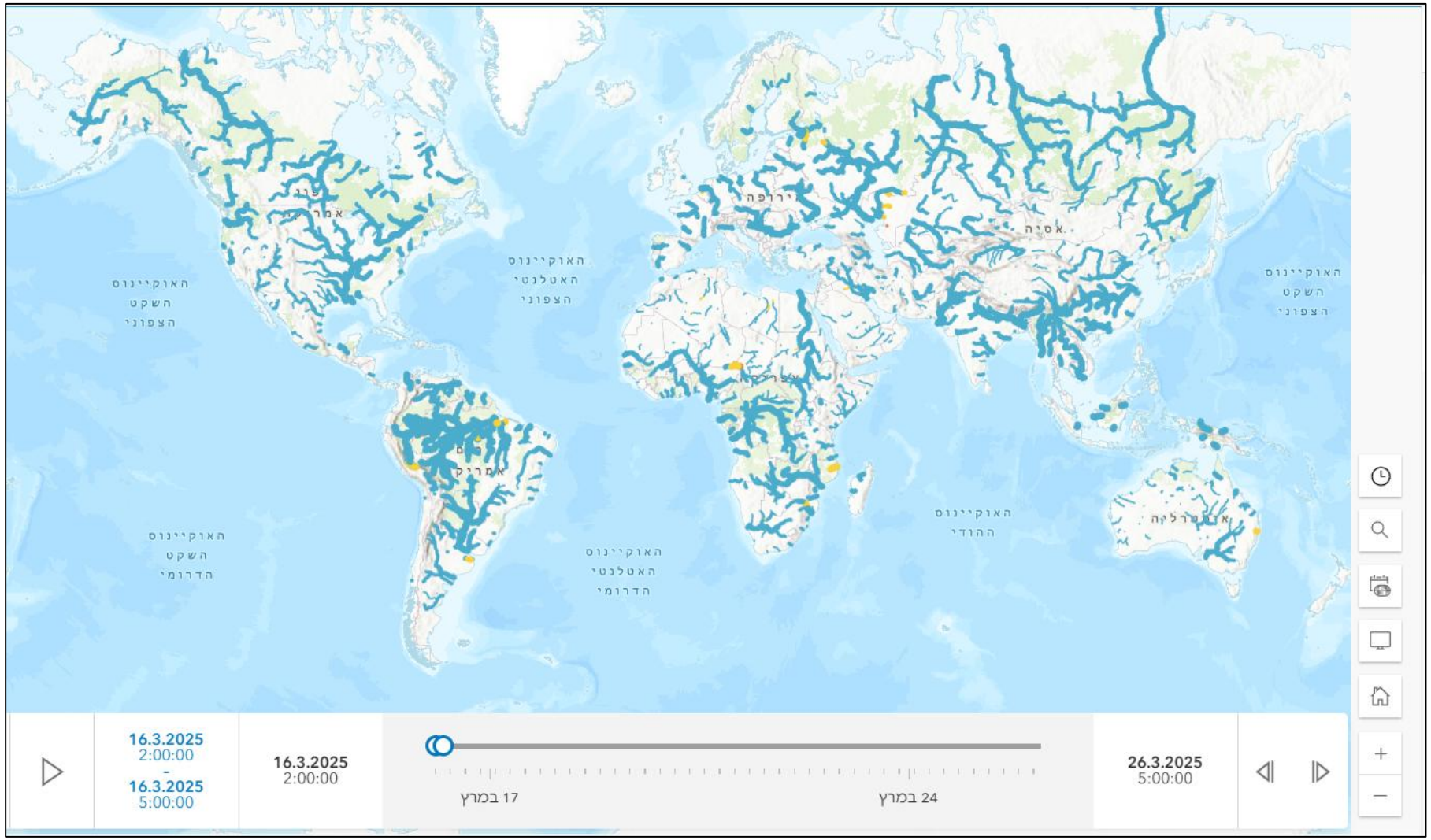
GEOGLOWS provides a forum for government-to-government collaboration, and engagement with the academic and private sectors to achieve the delivery of actionable water information.

GEOGLOWS create a system that forecasts flow on every river of the world while also providing a 40-year simulated historical flow.

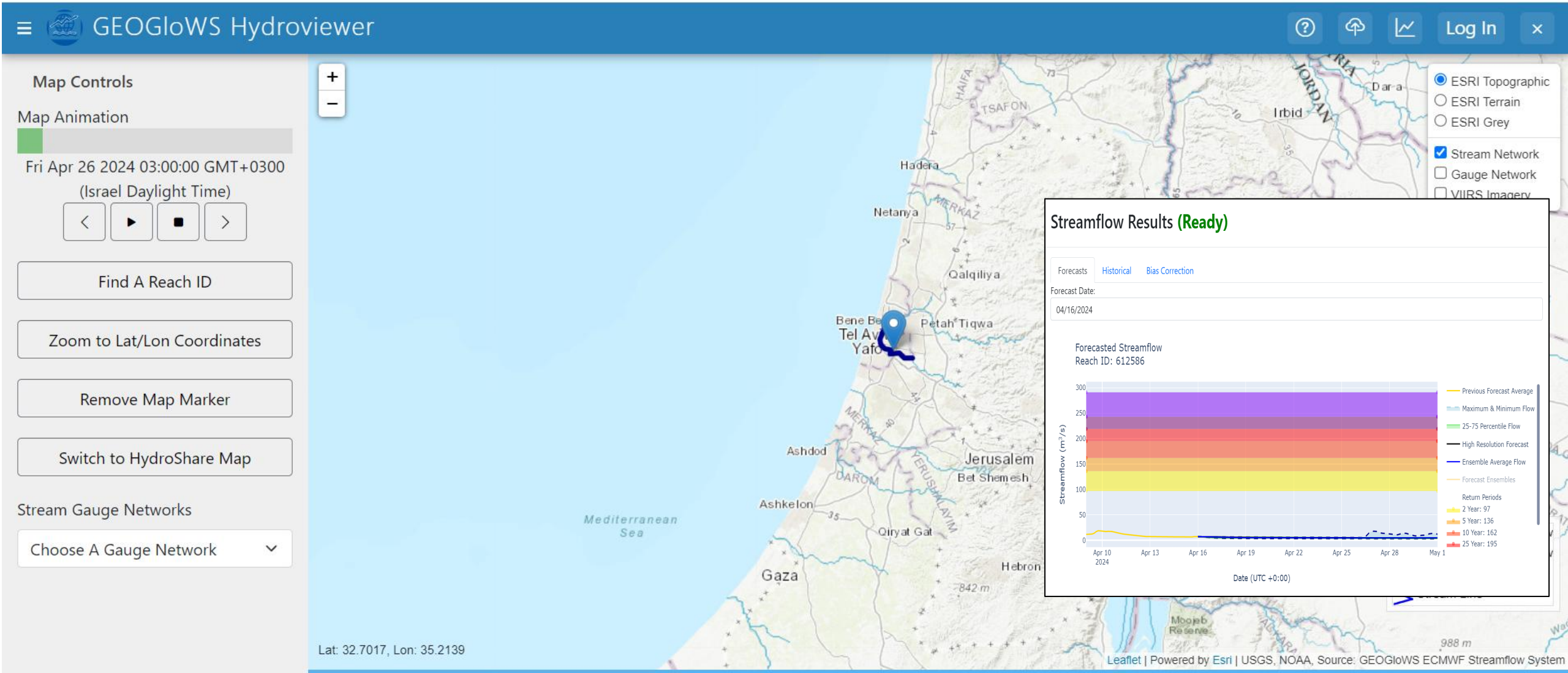
Global flood forecasting: GeoGlows



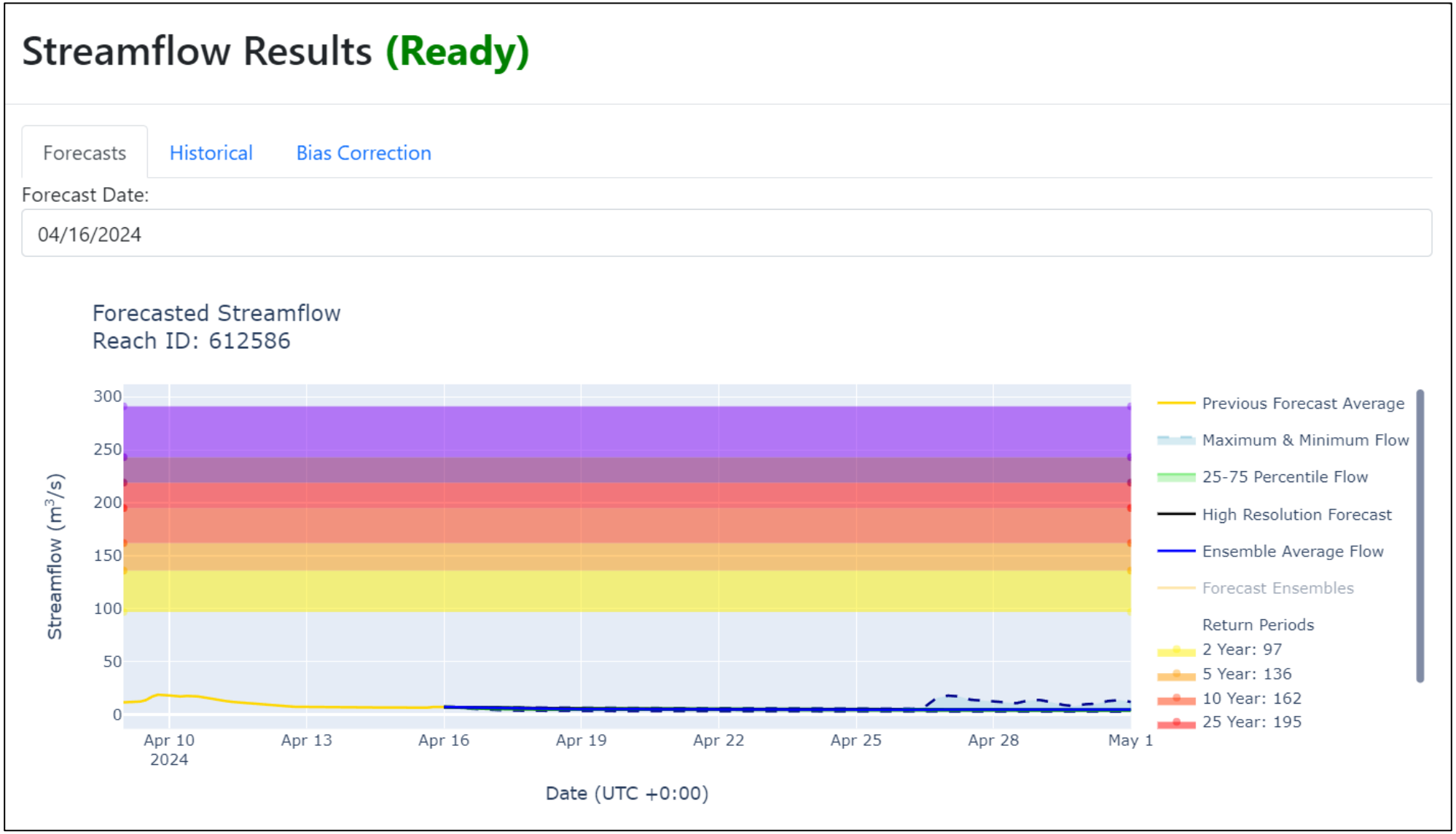
GEOGLOWS Global Streamflow Forecasting



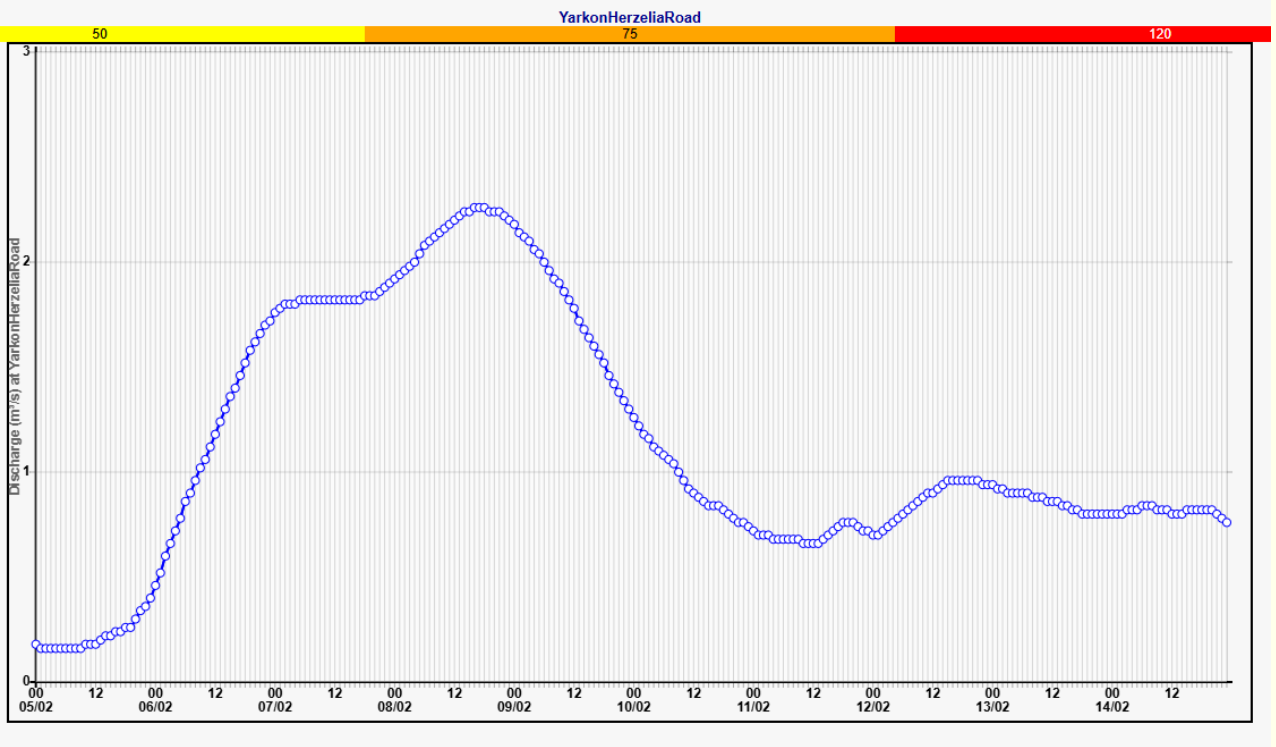
Using the ECMWF GeoGlows flood modeling system for flood forecasting

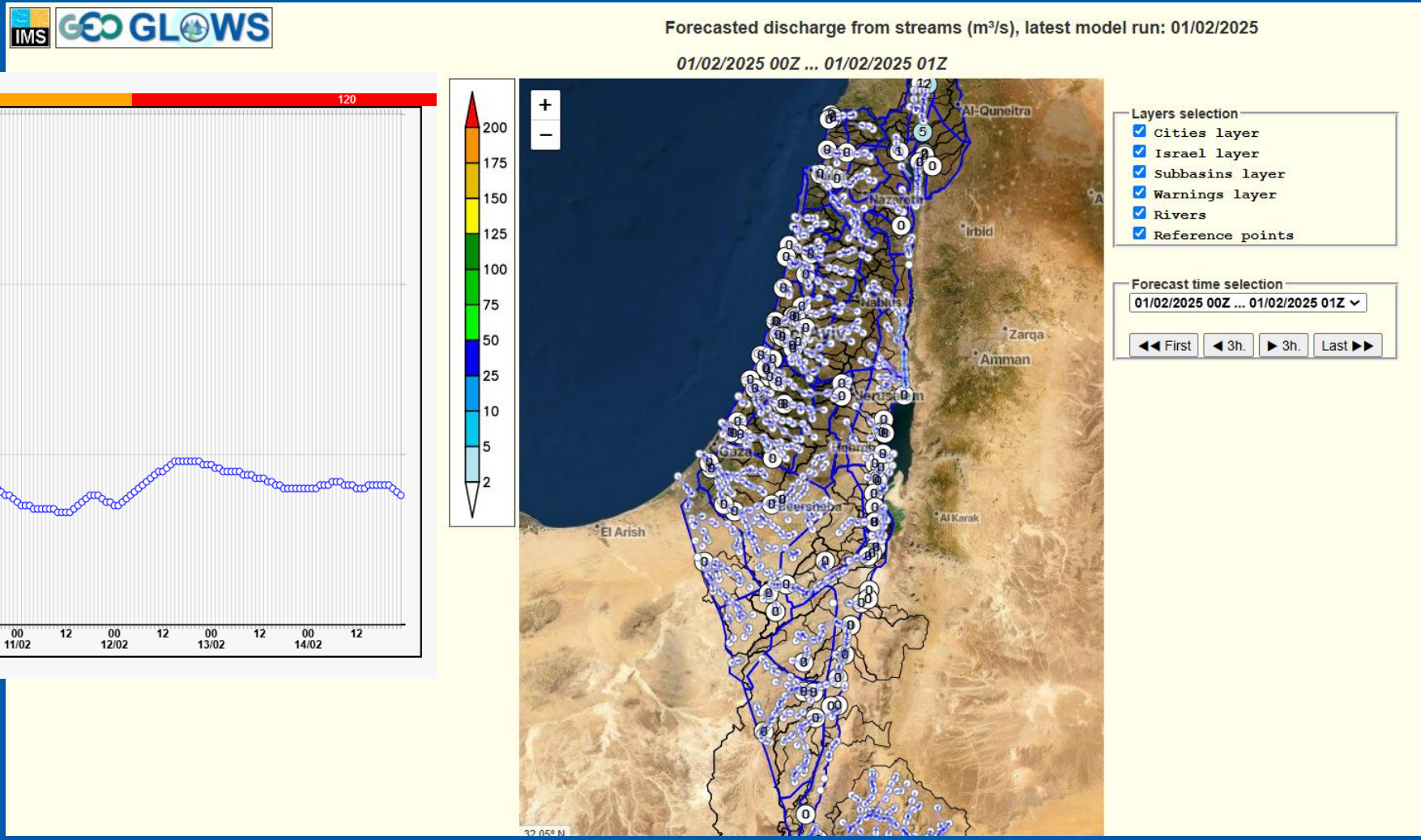


The ECMWF GeoGlows flood modeling



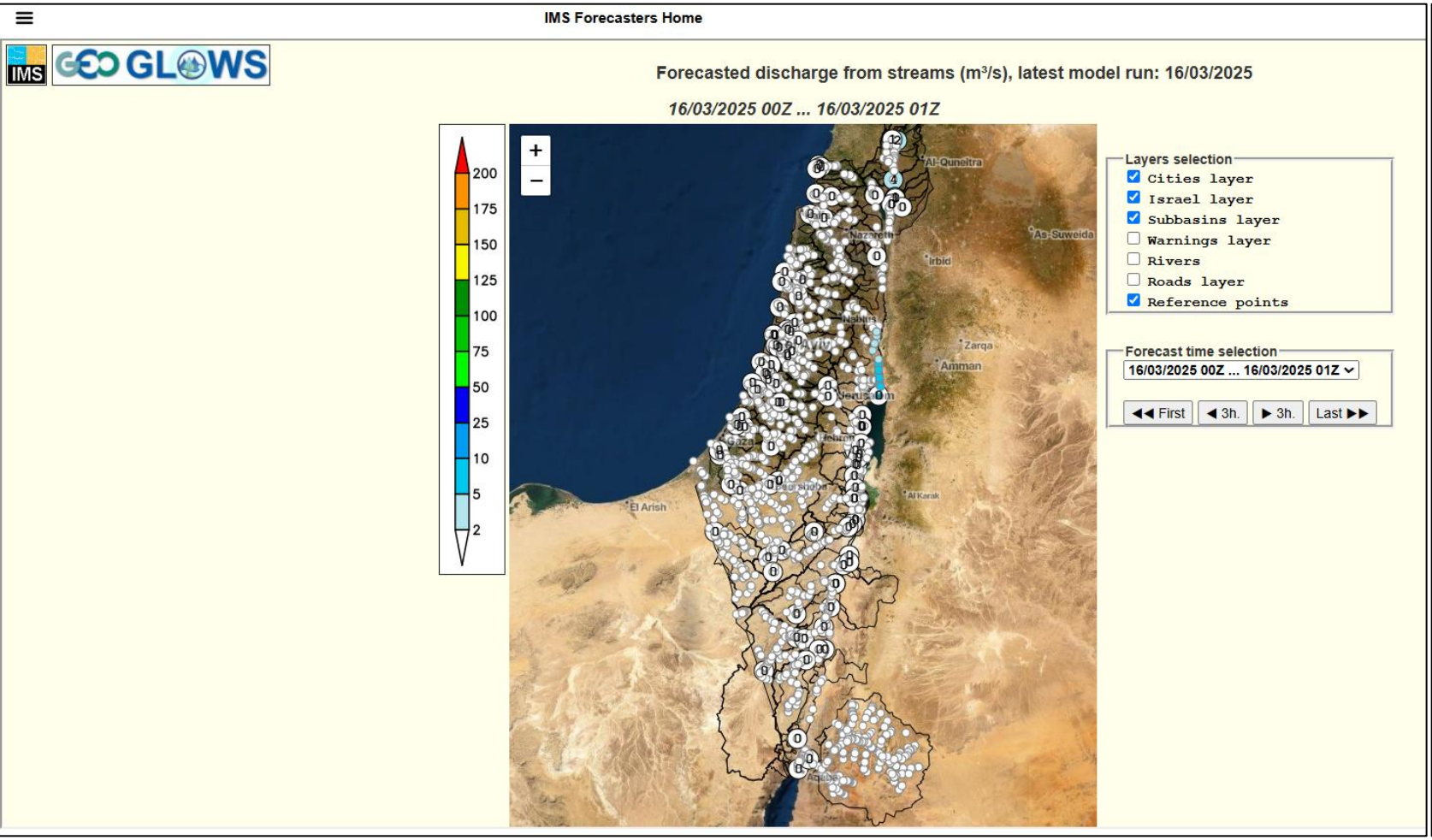
The GeoGlows model display at the forecasters room, IMS

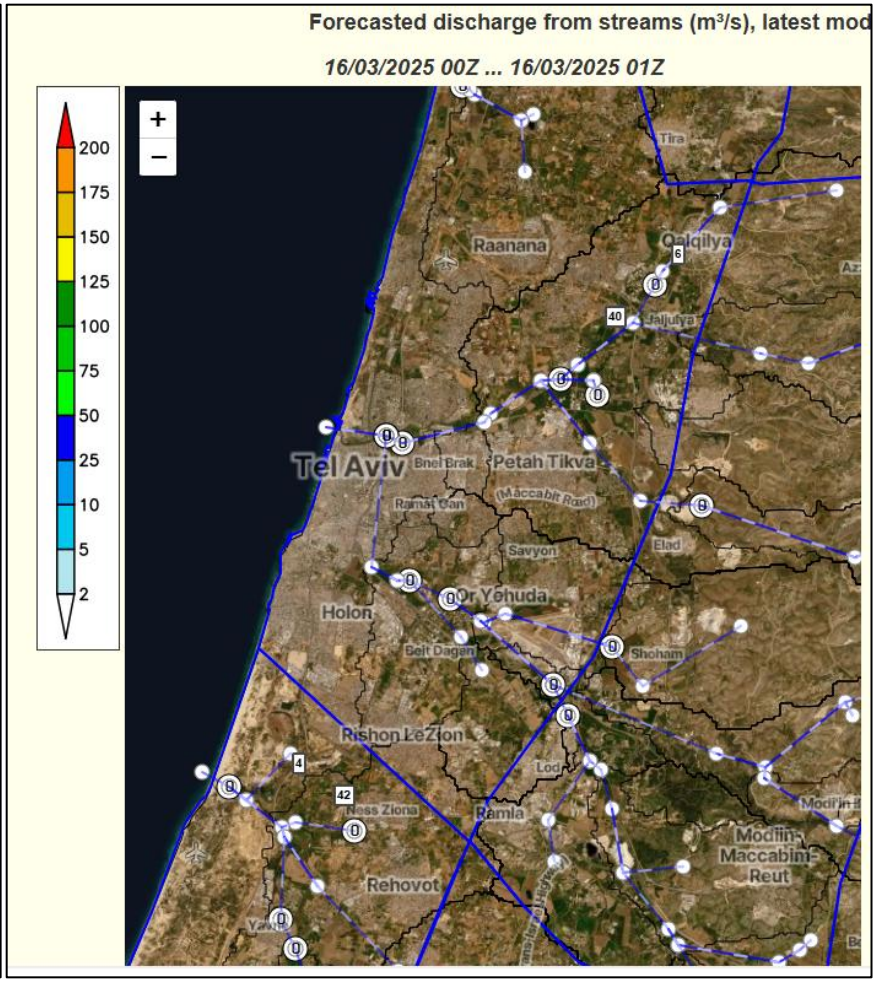




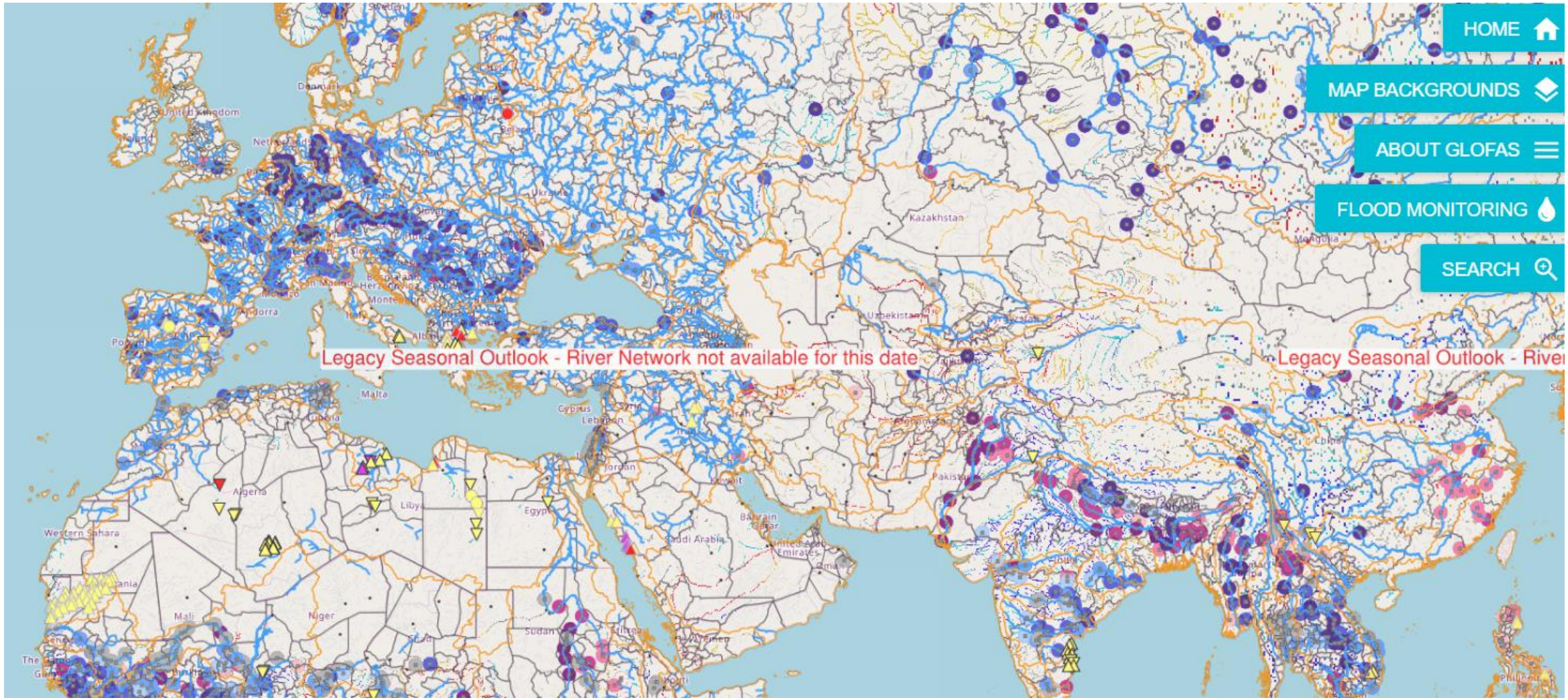
WORLD METEOROLOGICAL ORGANIZATION

Using GEOGLOWS Global Streamflow Forecasting at IMS forecasting center

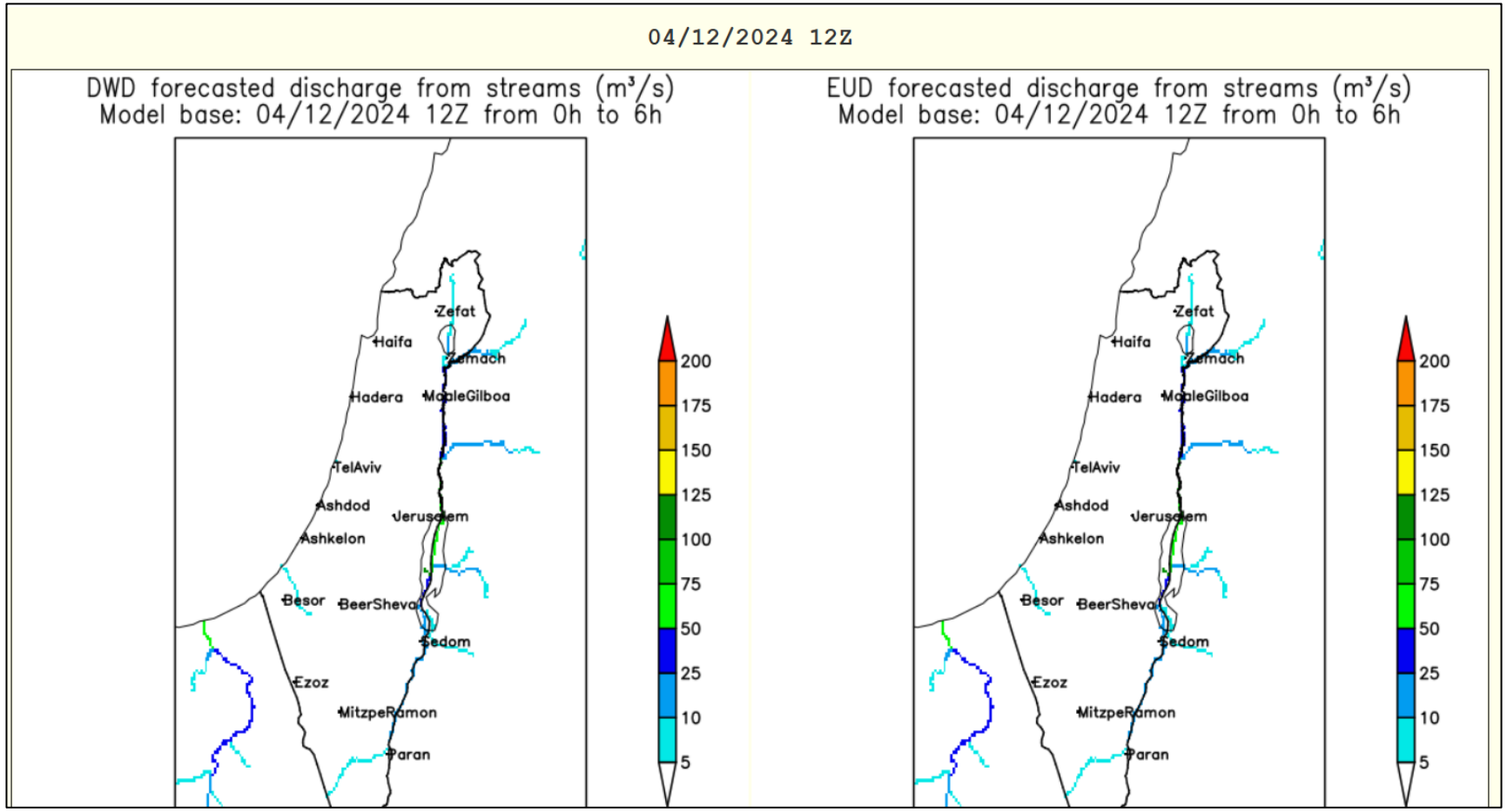




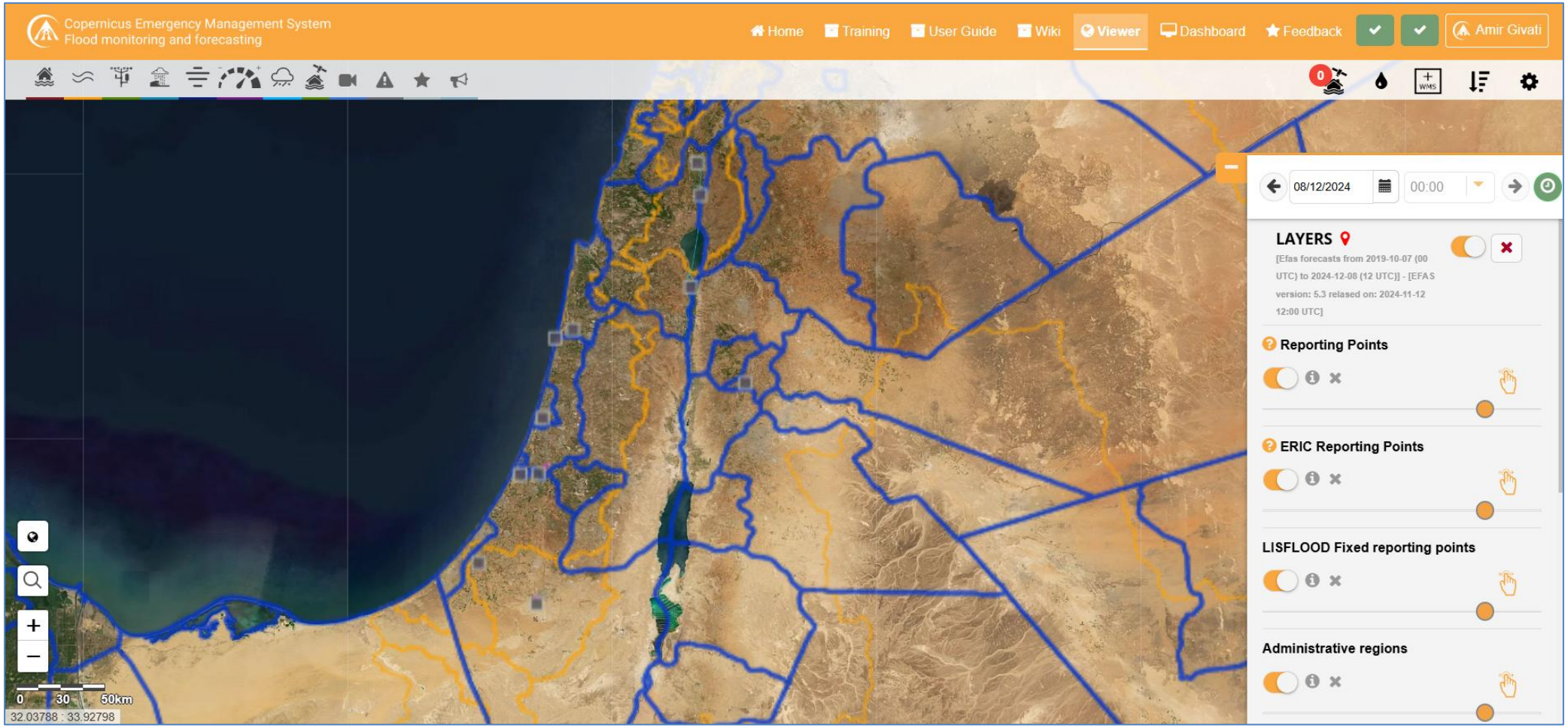
Global flood forecasting: GlowFas



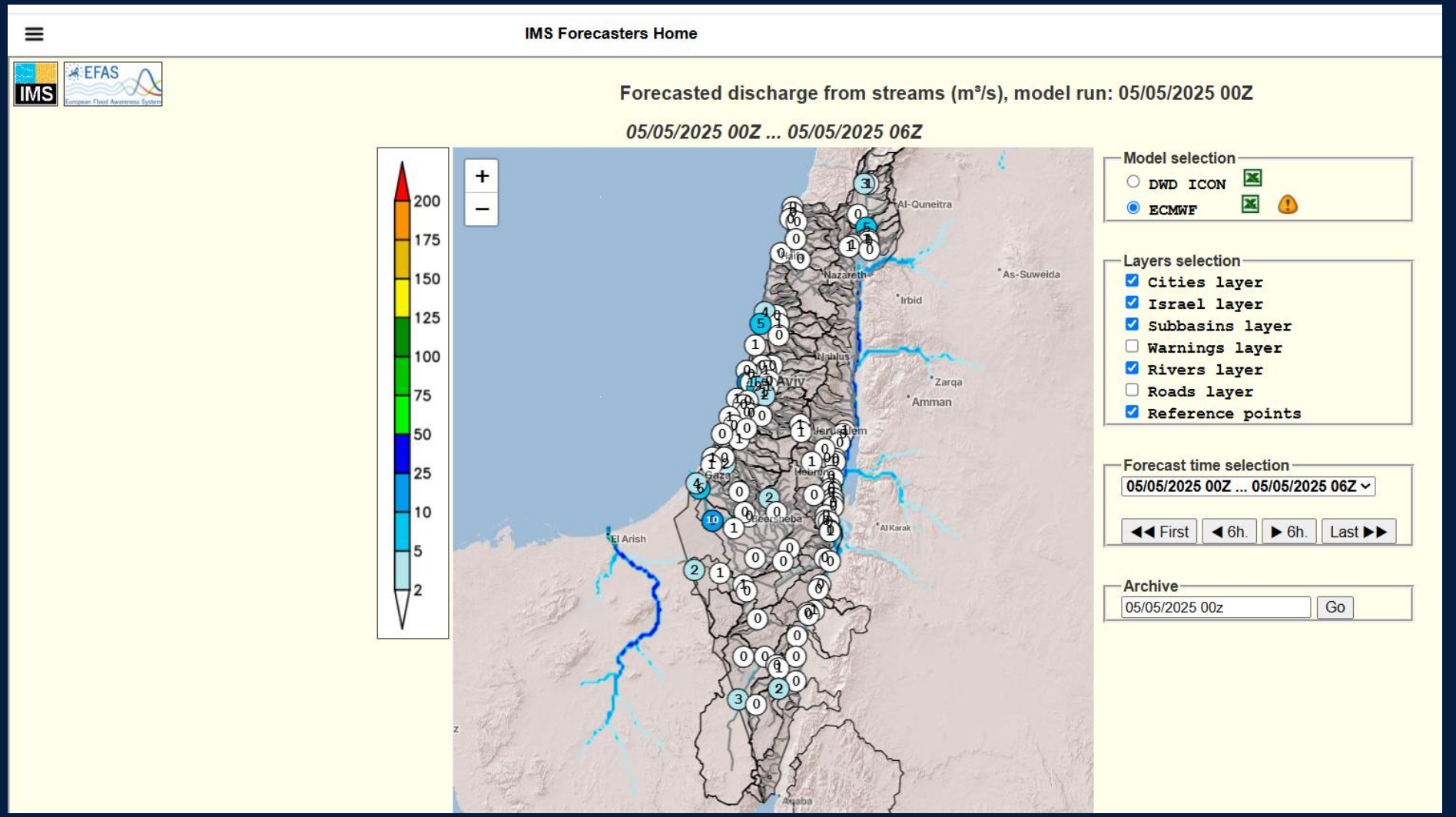
GlowFas/EFAS data for IMS domain



Glofas forecasting points - IMS domain

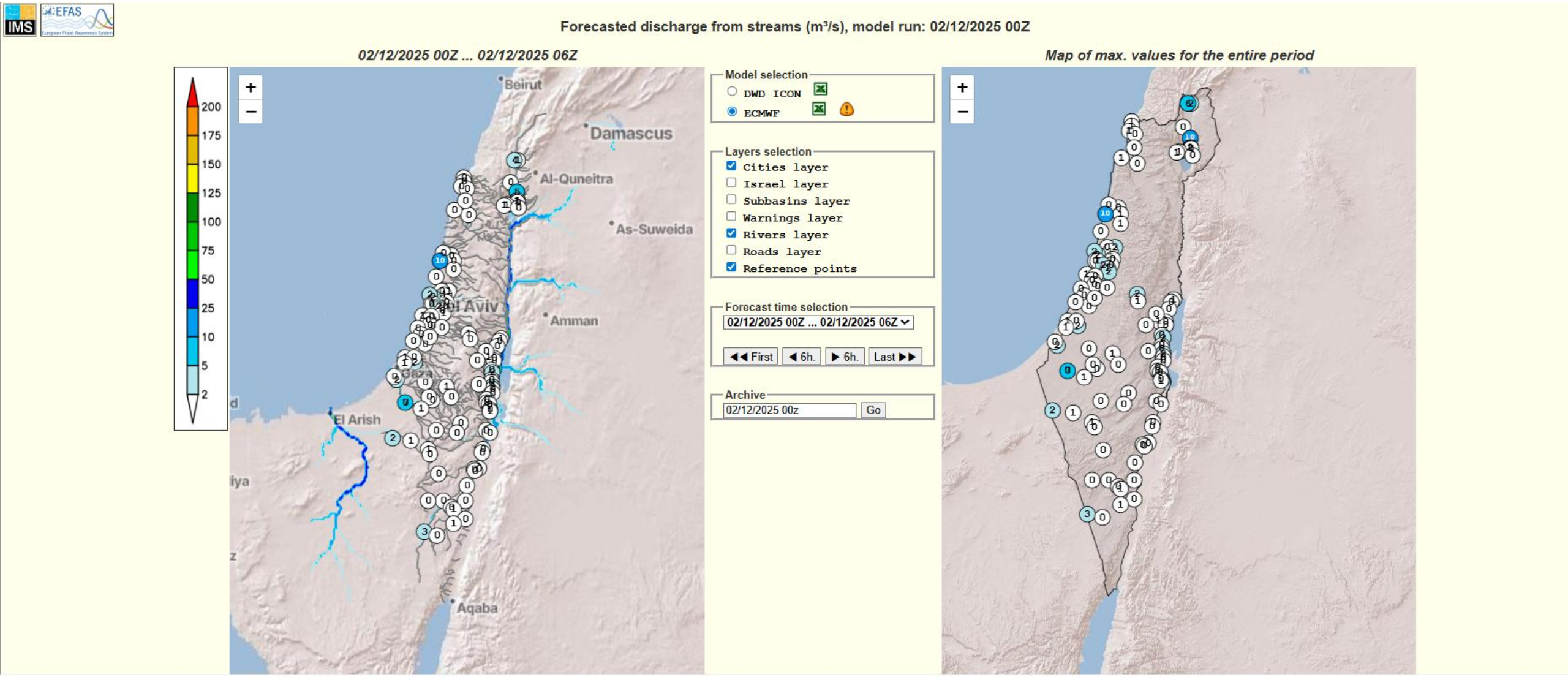


EFAS forecasting points - IMS domain



Using GEOGLOWS Global Streamflow Forecasting at IMS forecasting center

Using EFAS output at IMS forecasting room

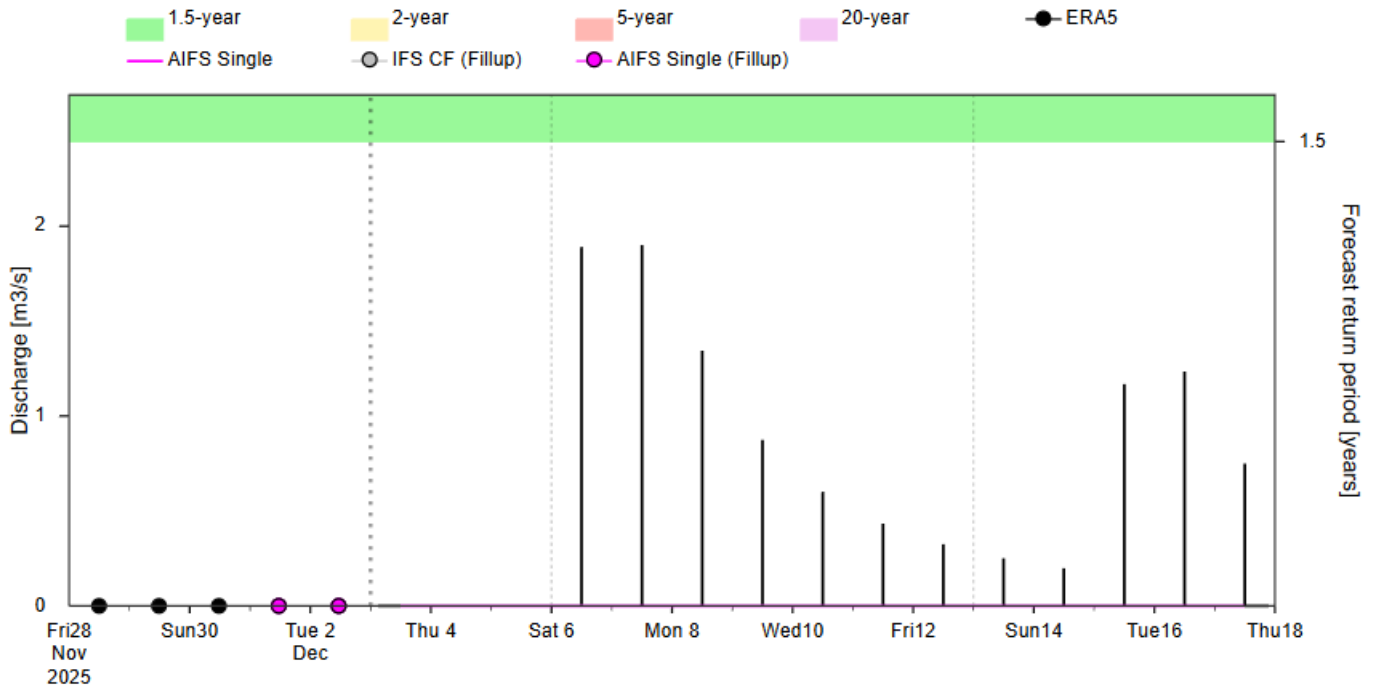


EFAS/GlowFas hydrographs for forecasting points at IMS domain

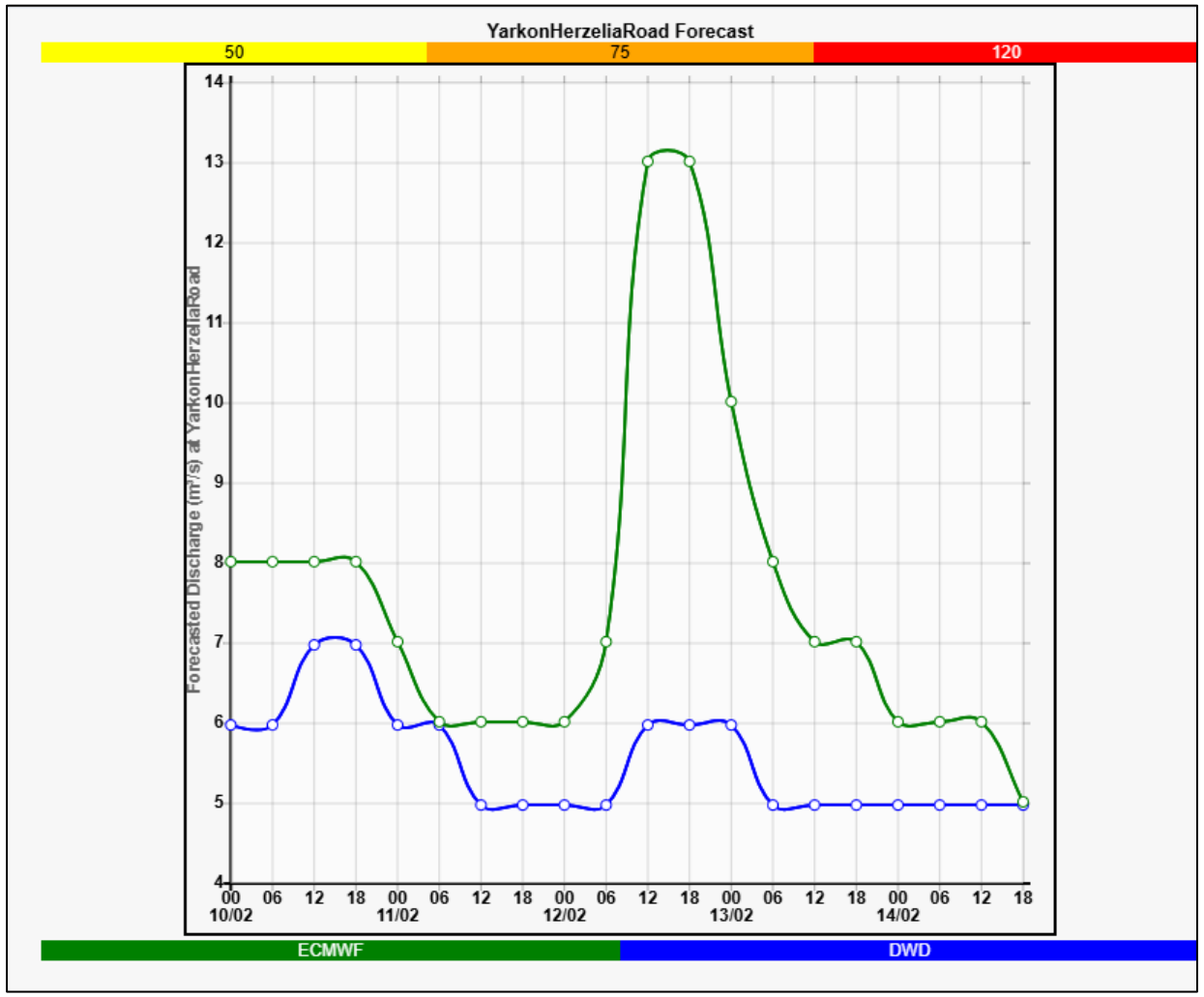
Forecast Skill | **Reporting Points** | Seasonal Outlook | Hydrological Mode... | Major river | Major rivers

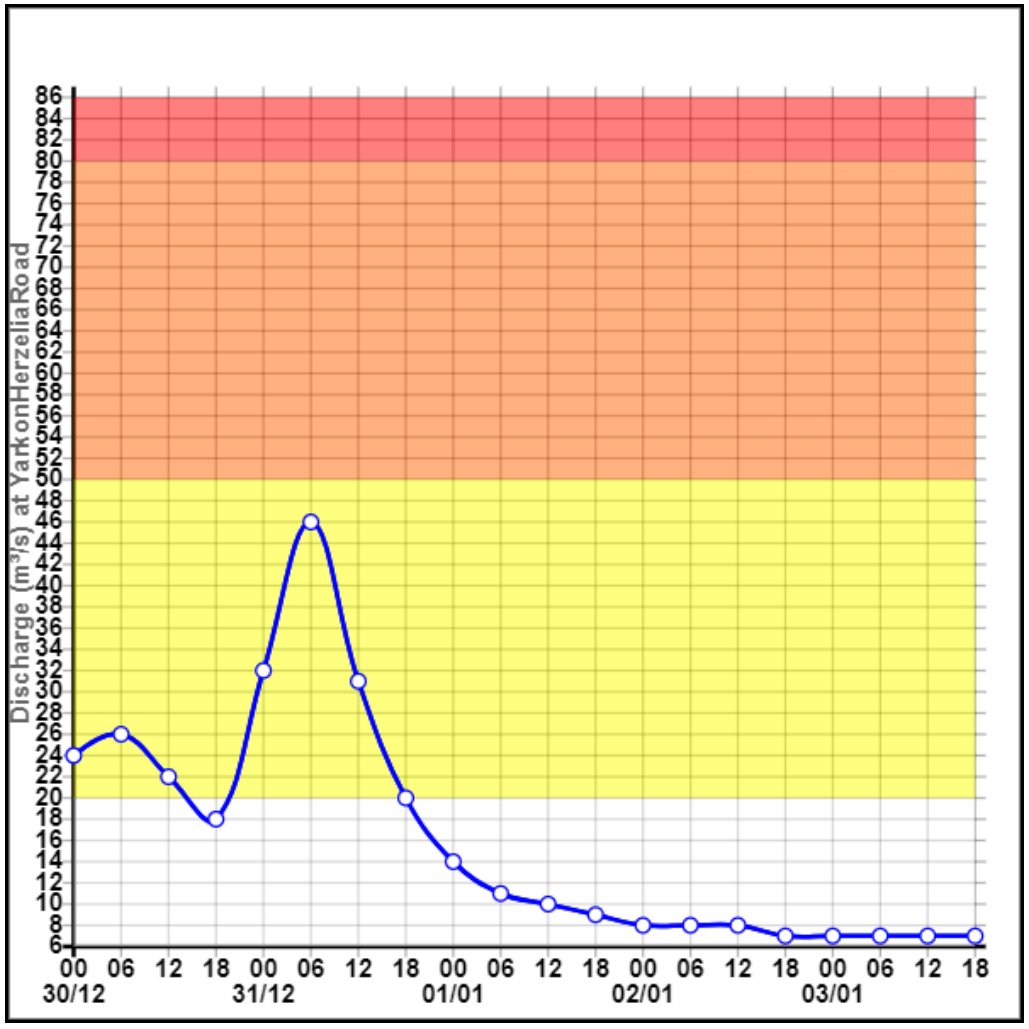
>>Open/Close GloFAS Forecast images

Discharge Hydrograph



Forecasted hydrograph:
Biased corrected EFAS model for the Yarqon River in Israel





Conclusions

- Semi arid basins are relatively small, characterize by flash floods.

- Global precipitation input does not well represent the hydrological response in semi-arid basins. There is a need for “precipitation blending”:

  Using high resolution input precipitation data in global hydrological models

- Allowing users applying local bias correction for the Hydrological output (for example, removing baseflow in semi arid and arid basins).

WORLD METEOROLOGICAL ORGANIZATION