e-shape solutions: Earth Observation for biodiversity and water management

e-shape

14 - 15 February 2023
9.30 – 17.00 CET
The Hague - NSO Headquarter
Centre Court

Ilias Pechlivanidis (SMHI)

Building EO-tailored water services for the globe - Searching for historical water availability and quality information?

An event co-organised by

eurisy
ACTING COLLECTIVELY TO BRIDGE SPACE AND SOCIETY

Netherlands Space Office

WRM addressing the global challenges

1

Extreme weather conditions
"Extreme weather events have landed on the 1st place in the Top 5 Global Risks in term of likelihood for 2018" (World Economic Forum, 2018)
Sudden intensive rainfall increase the amount of suspended and other solids carried by the river, and result in periodic excessive turbidity of the water.

50%

Water Pollution
"Around half of Europe's rivers and lakes are still polluted" (EEA, 2015)
HAB outbreaks can have serious impacts to human health, threat the sustainability of ecosystems and pose significant economic damage to society (drinking water supply, health care, fisheries, aquaculture and tourism)

100

Water Scarcity
"By 2007 at least 11% of Europe's population and 17% of its territory had been affected by water scarcity, putting the cost of droughts in Europe over the past thirty years at EUR 100 billion"

70%

Population Growth
"70% of the world's projected 10 billion population will live in cities by 2050, increasing the demand for water dramatically in all major use sectors"

Understand the needs – Towards the implementation

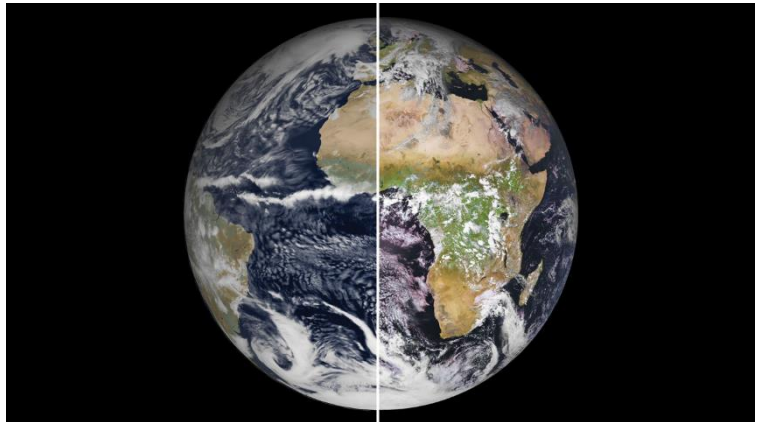
- **Aim:** Setup, evaluate, refine and operationalize water services for different domains (global, Europe, Sweden) and at fine spatial-temporal resolution.

- **Requirements:** Open datasets that describe processes in the water cycle; Expert knowledge; HPC infrastructure; Historical data to evaluate the models for different variables.

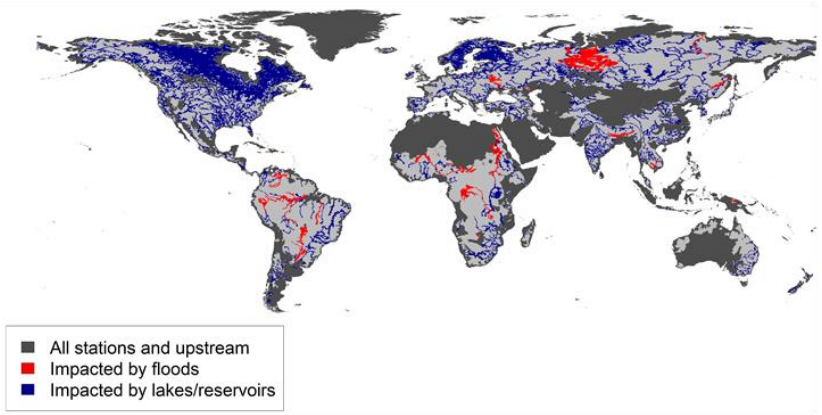
- **Current users:** SMHI operational water resources analysis and forecasting services with their key stakeholders: Swedish Agency for Marine and Water Management (SWAM); Swedish Geological Survey (SGU)

  Expected user community: National, European and global authorities for water resources management and planning; SMEs

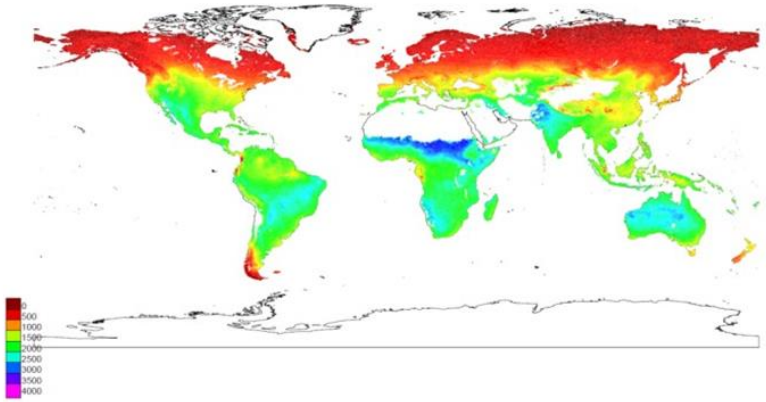
- **Main added value:** (1) Add value to many applications that require long records (i.e. water resources management, return periods of extremes, monitoring and seasonal patterns); (2) contribution to Earth's Digital Twin

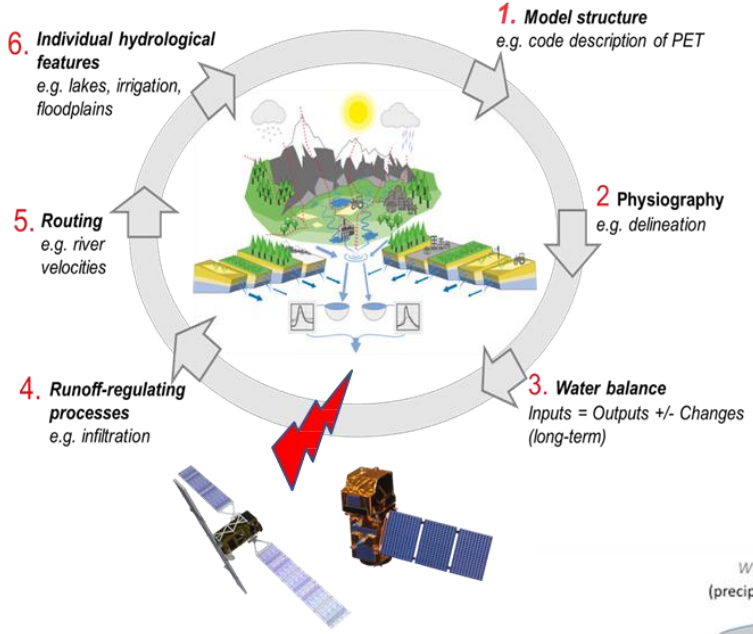


Traditional practices in model setups



MODIS PET (mm/yr)

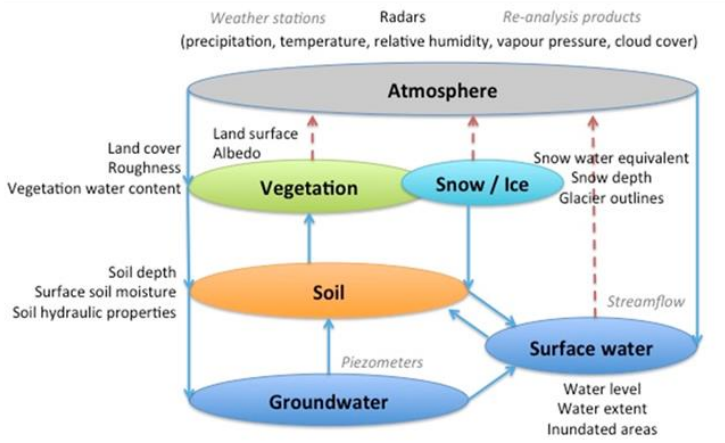




Arheimer et al., 2020, HESS
Hundecha et al., 2016, JoH
Pechlivanidis et al., 2020, WRR

How to better determine the water resources in the absense of in-situ data?

✓ EOs can drive hydrological model evaluation and hence improve understanding of physical river systems

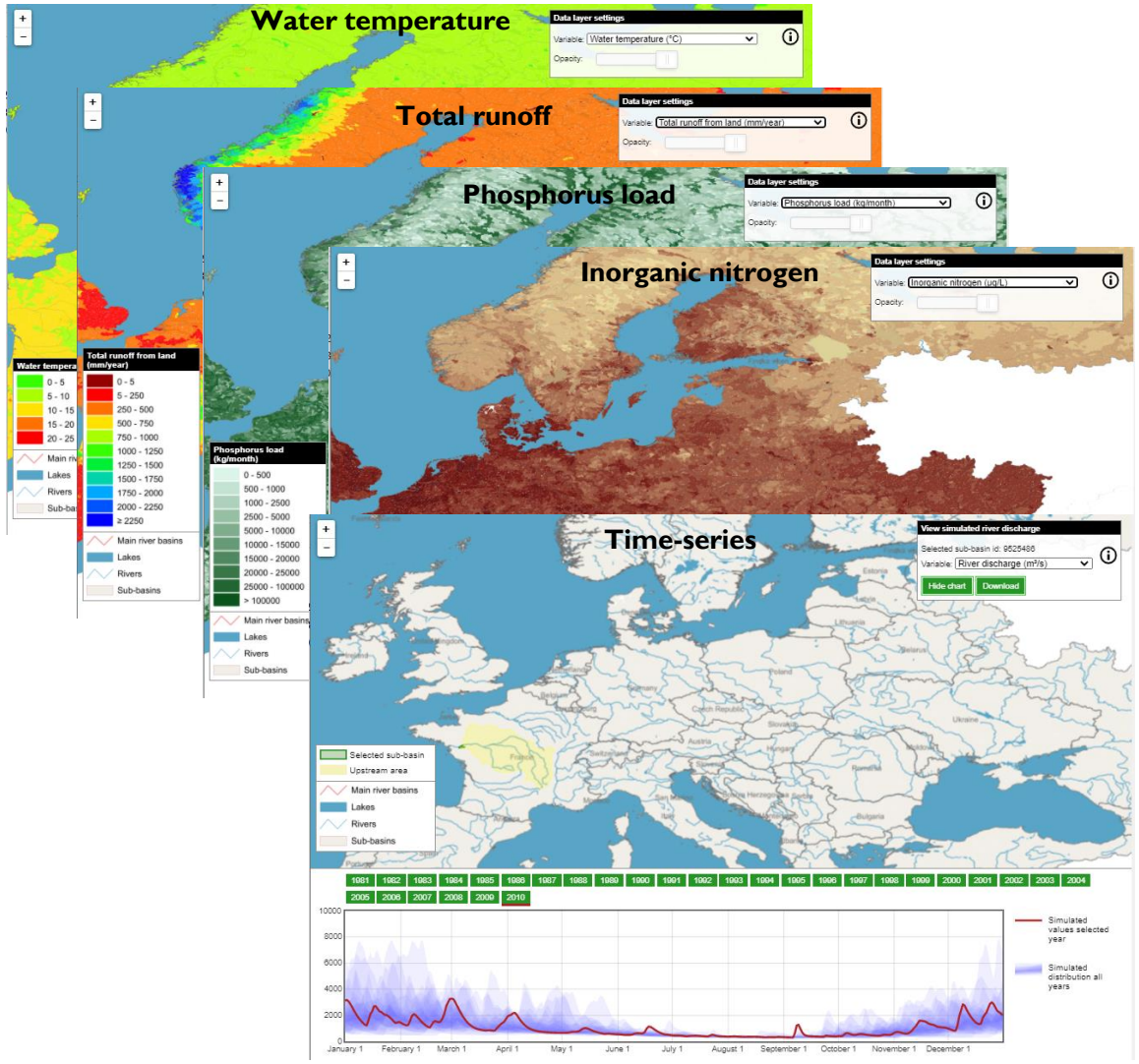


We aim to fill in the spatial and temporal information gap for a number of variables!

We aim to engage users and ensure their trust by evaluating the model!

Historical data availability for water quantity and quality

A continuous evolution of the service!!



https://hypeweb.smhi.se/explore-water/historical-data/

SMHI Hypeweb

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Historical Data

Home > Explore Water > Historical Data

Historical data is important to understand the character and natural variability of water resources, so that both societal and environmental concerns can be planned accordingly. From long time-series of historical data we can identify normal conditions and detect trends towards new states, identify extreme values and the risk to be exposed to these, and evaluate the model performance against observations.

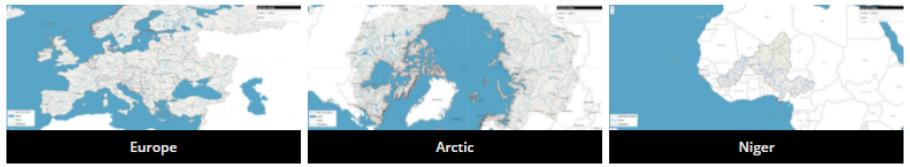
The HYPE model provides at least 30 years of water-related data in each geographical domain, also for areas and periods without measurements. The time-periods may differ but often starts in 1970's or 1980's. The calculations are made on a daily time step and modelled data is given for a number of variables (such as river flow, soil moisture, groundwater fluctuations, water temperature, and nutrient concentrations). The spatial resolution is given by landscape delineation into catchments, for which HYPE data represents average conditions or the outlets.

The historical data differ between the geographical domains, regarding time period, variables and resolution (i.e. catchment size) as these models were set-up with different purposes. Please, read the info button carefully in each of the applications below (top-right corner in the application)!
Here you can see long-term means and download time-series at specific sites:

Historical Long-Term Means

Long-term means for 30-year periods are given to show the normal water balance without annual fluctuations or influence of specific weather events. Hydrological results from HYPE are accompanied with modelled meteorological data, such as precipitation, temperature and evapotranspiration. For each domain we provide maps to give an overview of the spatial pattern for the most important variables or flow signatures in that specific region. For instance, dry regions can be separated from wet regions.

Explore spatial variability of average conditions by selecting variables in the menu of the interactive maps below!



Historical time series

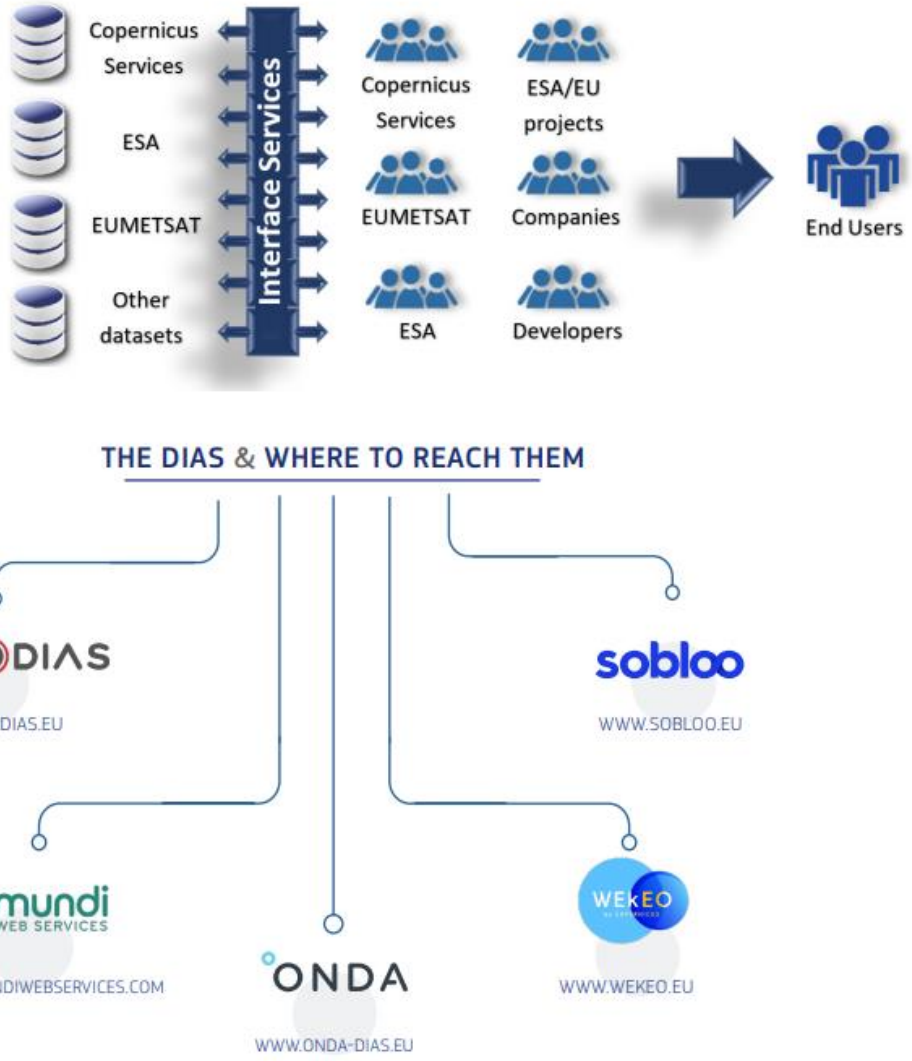
Time-series are given to show the temporal variability of river flow at a specific site. HYPE provides daily or monthly values of river flow for at least 30 years of continuous calculations, which can be downloaded as Excel files for single catchments. Each year can be visualized in a graph to show the seasonal changes in flow and the variability between years. In this way, dry years can be separated from wet years and starting date of seasonal floods or droughts can be identified.

Explore temporal variability of flow in graphs and download time-series by clicking a catchment in the interactive maps below!

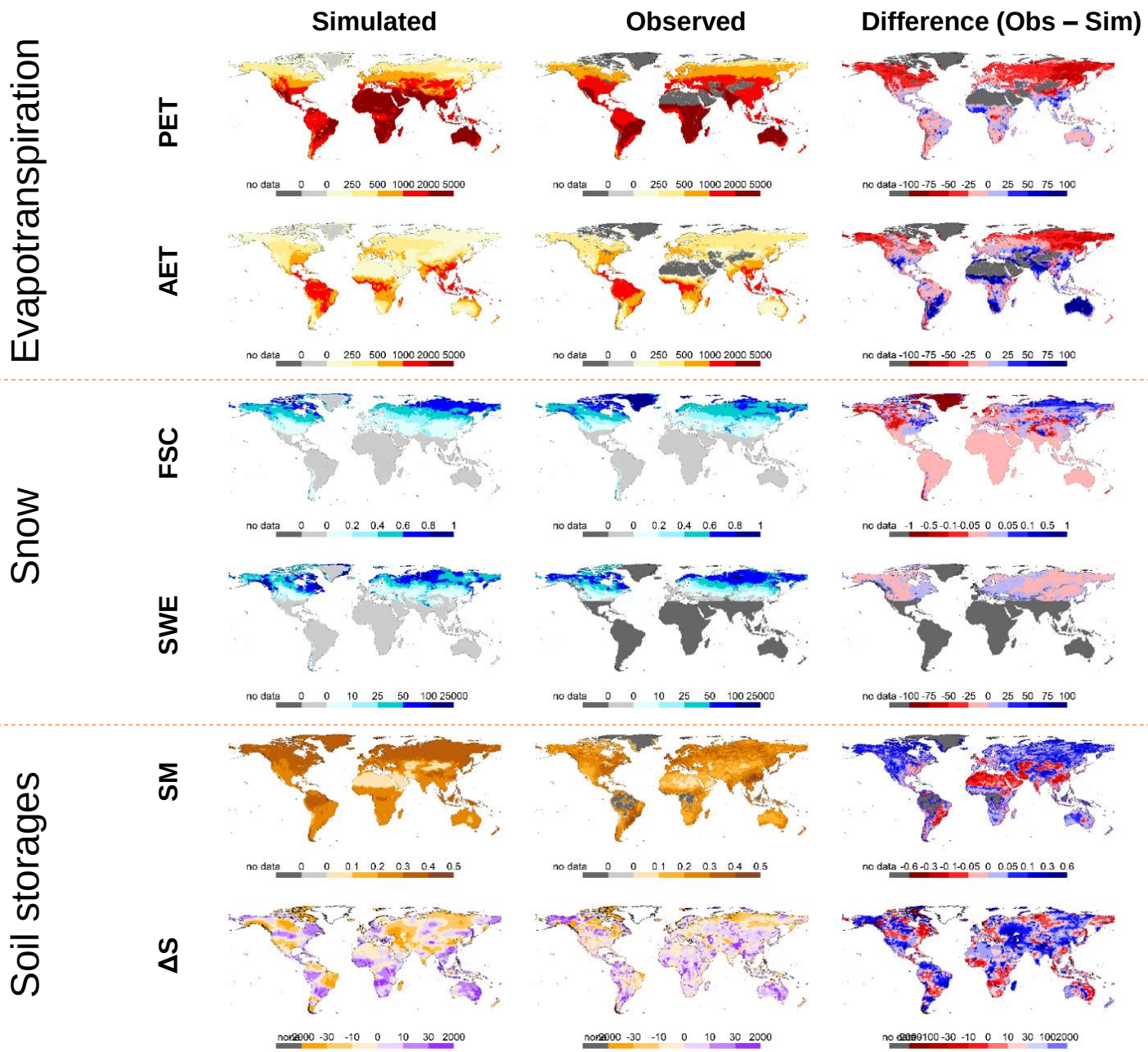
EO data collection

Provider	Product	Coverage	Spatial resolution	Temporal resolution	Status (static / operational)
ESA (CCI) http://cci.esa.int	Snow water equivalent, SWE	Global, 1979-2018	0.25 deg	daily	ST
	Fractional snow cover, FSC	Global, 1982-2018	0.05 deg	daily	ST
	Fractional snow cover, FSC-MODIS	Global, 1982-2018	0.01 deg	daily	ST
	Soil moisture, SM	Global, 1979-2018	0.05 deg	daily	ST
ESA, University of Amsterdam (GLEAM) doi: 10.5194/gmd-10-1903-2017, 2017	Surface soil moisture, SM	Global, 2003-2018	0.25 deg	daily	ST
	Root-zone soil moisture, SM	Global, 2003-2018	0.25 deg	daily	ST
	Actual evapotranspiration, AET	Global, 2003-2018	0.25 deg	daily	ST
	Potential evapotranspiration, PET	Global, 2003-2018	0.25 deg	daily	ST
Finnish Met Inst. FMI (GLOBSNOW) https://doi.org/10.1016/j.rse.2011.08.014	Snow water equivalent, SWE	Northern hemisphere 1979-2013	25 km	daily	ST
	Fractional snow cover, FSC	Northern hemisphere 1979-2013	25 km	daily	ST
NASA (MODIS) doi:10.1016/j.rse.2011.02.019	Actual evapotranspiration, AET	Global, 2000-2018	0.25 deg	8 day aggregates	ST
	Potential evapotranspiration, PET	Global, 2000-2018	0.25 deg	8 day aggregates	ST
HSAF https://doi.org/10.1080/02626667.2012.729132	Snow water equivalent, SWE	Northern hemisphere 2013-2020	0.25 deg	daily	OP
CRYOLAND www.cryoland.eu	Fractional snow cover, FSC	Europe 2000-2020	0.005 deg	daily	OP
	Snow water equivalent, SWE	Europe 2000-2020	0.1 deg	daily	OP
ESA (Hydrology-TEP)	Water level	Global, 2016-present	300 m	once every 27 days	OP
Swedish Meteorological and Hydrological Institute (SMHI)	*River discharge*	*Global*	*Point*	*daily*	*OP*
	Lake and river water level	*Sweden*	*Point*	*daily*	*OP*
Swedish hydropower companies	*Reservoir inflow*	*Sweden*	*Point*	*daily*	*OP*

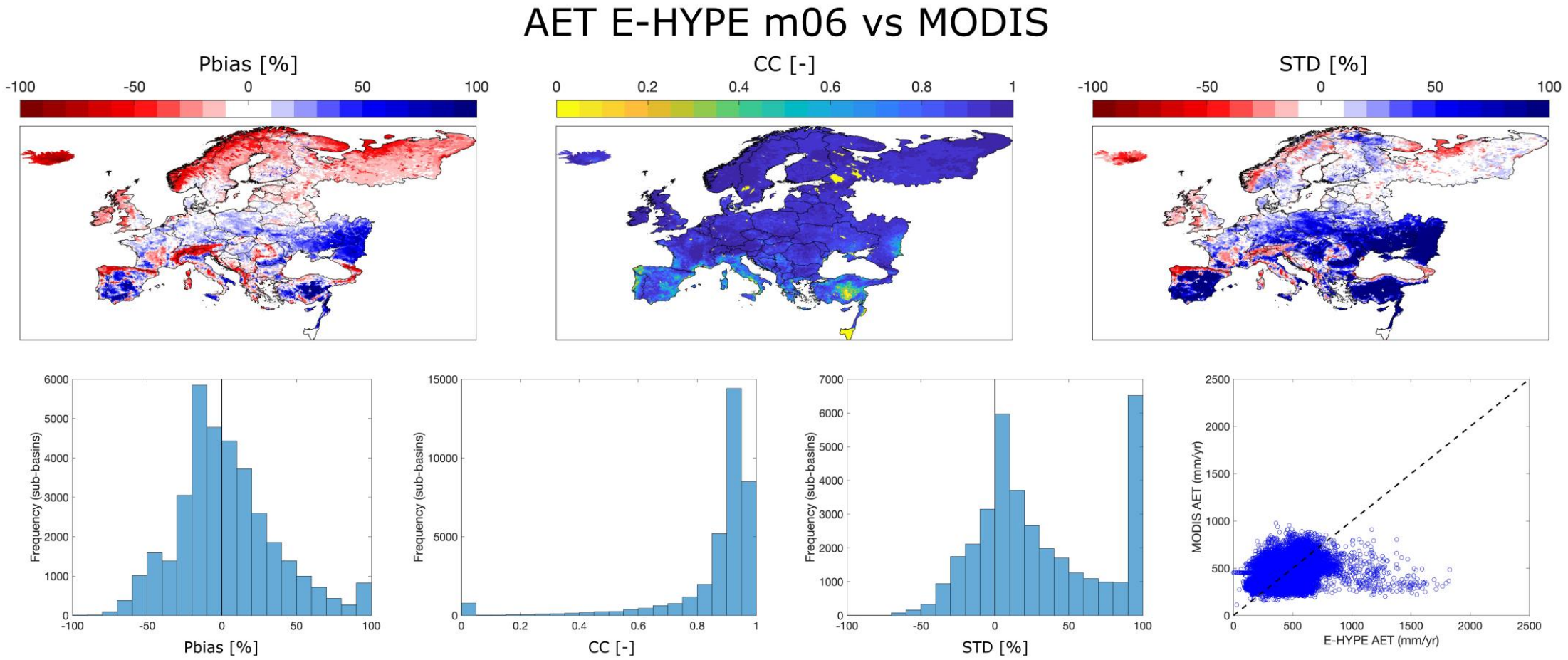
EO data collection



EO-based hydrological evaluation (1- world wide)



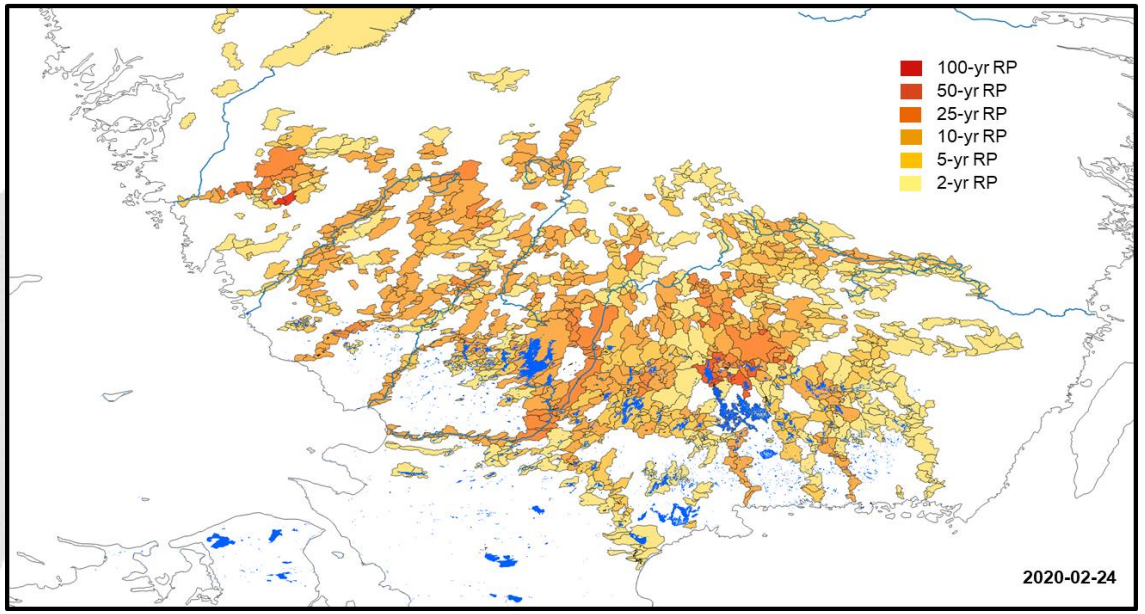
EO-based hydrological evaluation (2- pan-European)



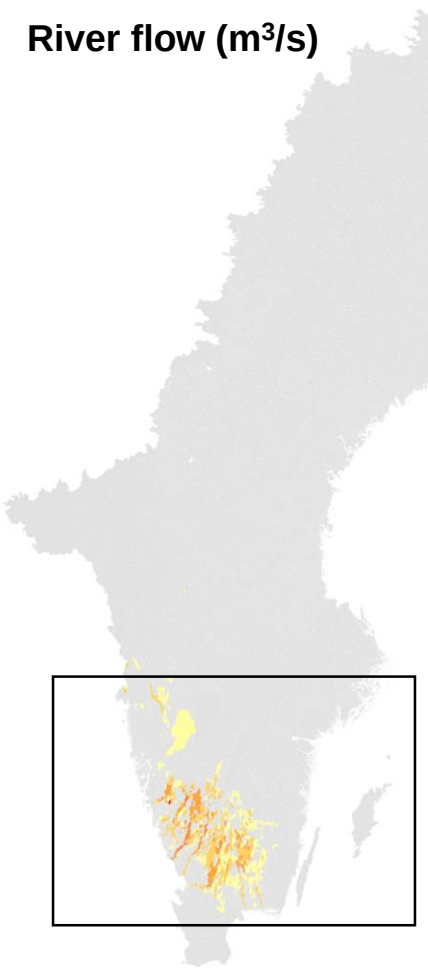
EO-based hydrological evaluation (3- Sweden)

The 2020-02-23 flooding in Lagan, Sweden

Water bodies (satellite-based; source: LIST) Water extents (satellite-based; source: LIST)



River flow (m^3/s)



100-yr RP
50-yr RP
25-yr RP
10-yr RP
5-yr RP
2-yr RP

on the: 2020-02-20

SMHI's class 3 warning for extremely high water flows in Lagan, including at Ljungby. 15,000 sandbags were used in the area.

People are warned not to get too close. The risk of landslides near the water is great and the currents are strong.

The flows in the watercourses are at a level that arises on average every 50 years and causes serious flood problems.

Hands-on (European service)

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Thank you!

www.e-shape.eu