Integration of impact sector models in the Extremes DT

Roger Randriamampianina
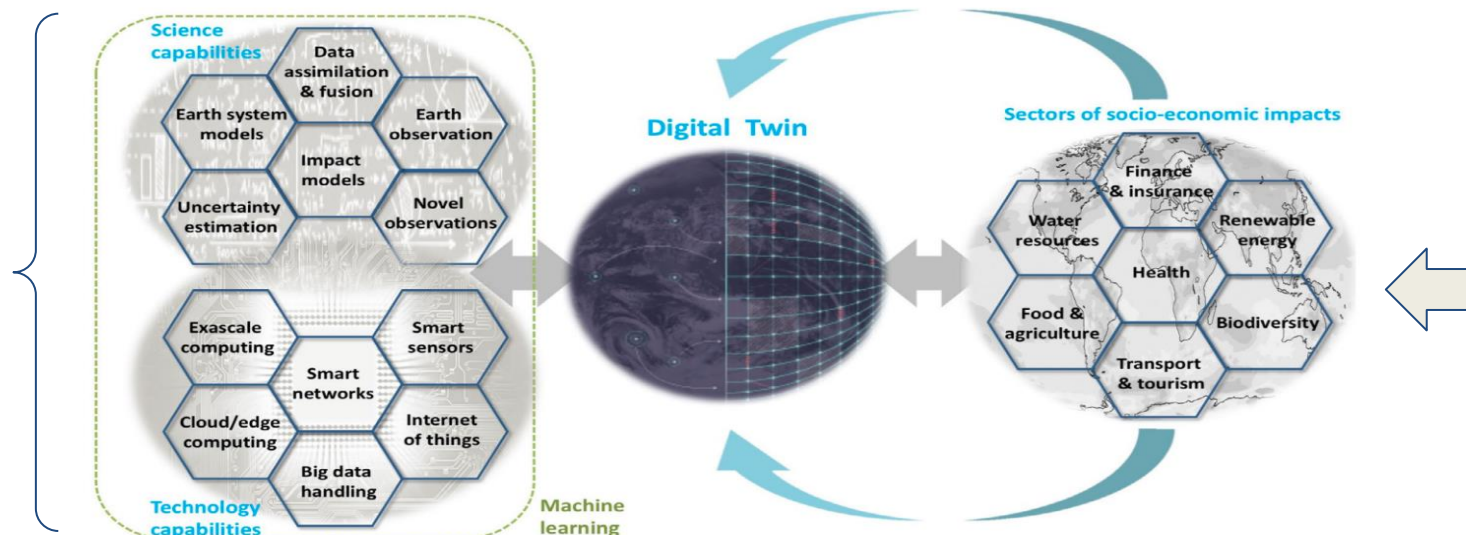
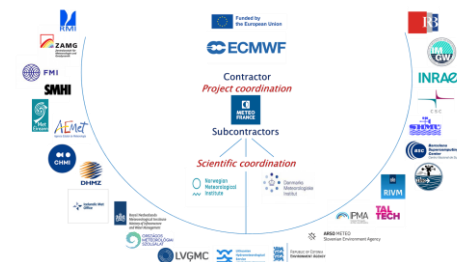**Destination Earth** implemented by ECMWF **esa** EUMETSAT
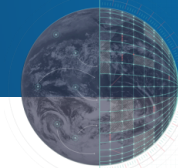
Digital Twin

Physical and data-driven weather models

Includes the impact sectors

Global and On-Demand components

Hydrology (Flood and Surge)
Air Quality and Health
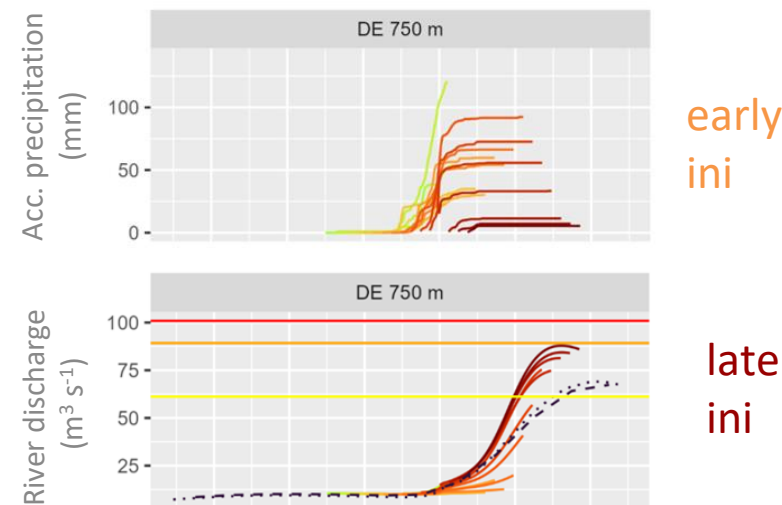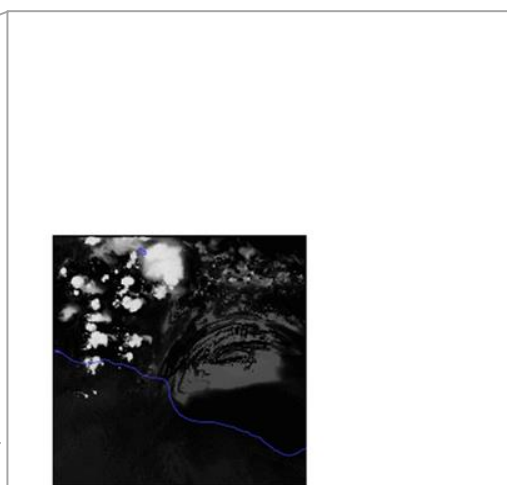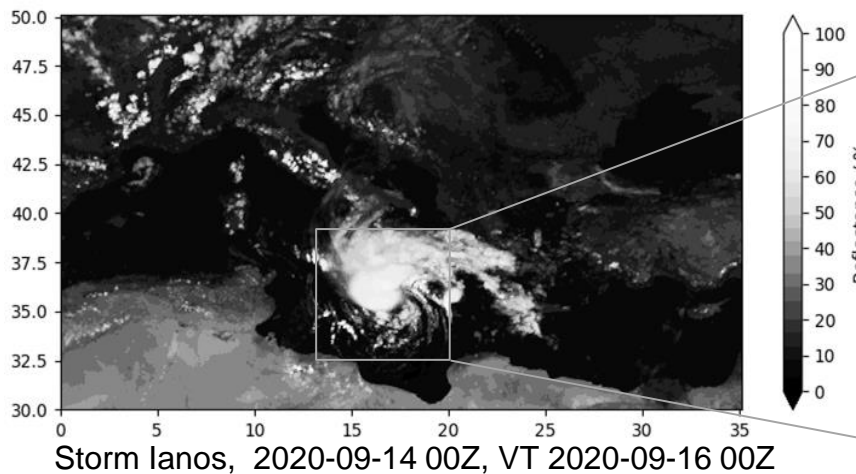Renewable (Wind and Solar) energy
Agriculture (Frost)

Extremes DT : a magnifying glass on extreme events

ECMWF

GLOBAL

DETECTION / TRIGGERING

DE_330

REGIONAL

Medicane Ianos is approaching. What will be the state of rivers in 48 hours?

Impact-sector models:
Forecast evaluation for societal impacts

Daily and global monitoring of extreme events 4 days ahead at 4.4km

On-Demand regional forecasts of extreme events 2 days ahead at 500m

Storm Ianos, 2020-09-14 00Z, VT 2020-09-16 00Z

DE 750 m

Acc. precipitation (mm)

early ini

DE 750 m

River discharge (m³ s⁻¹)

late ini

ECMWF

Impact modelling in the global component

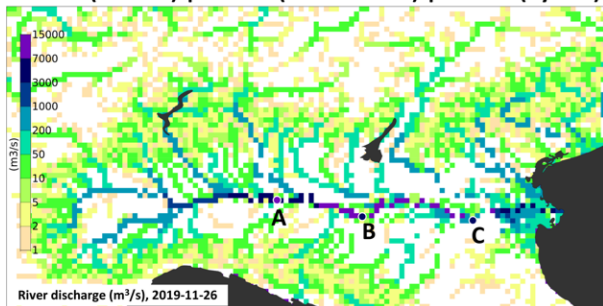## Flood
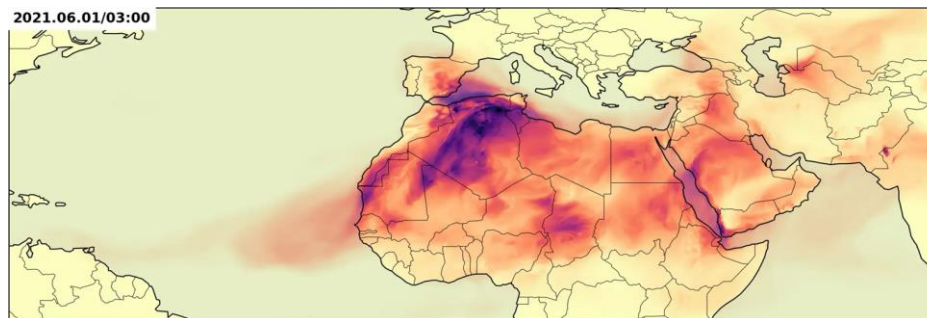

9 km (meteo.) | 9 km (land surface) | 11 km (hydro.)
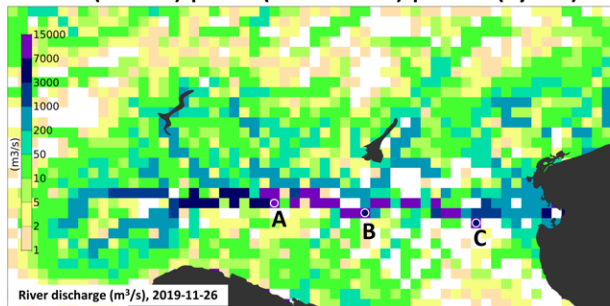
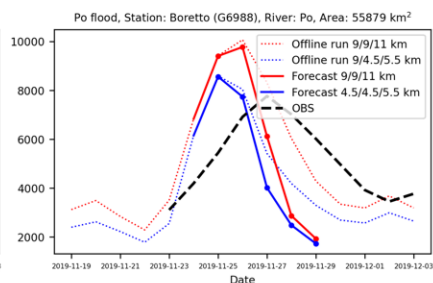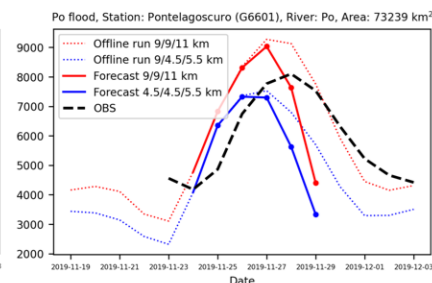4.5 km (meteo.) | 4.5 km (land surface) | 5.5 km (hydro.)

River discharge (m³/s), 2019-11-26

A. Upper Po catchment
B. Middle Po catchment
C. Lower Po catchment
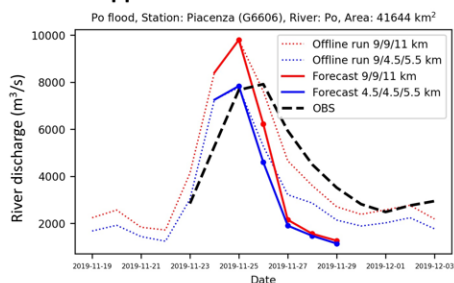
Improved representation of peak intensity of floods at km-scale

Flexible prognostic aerosols scheme

Dust prognostic (all other species CAMS climatology)

2021.06.01/03:00

New feature to include custom combination of prognostic and climatological aerosols species in the radiation scheme
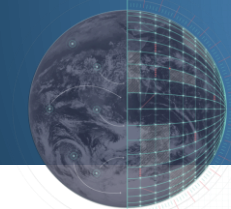
On-Demand components – Air Quality – The workflow
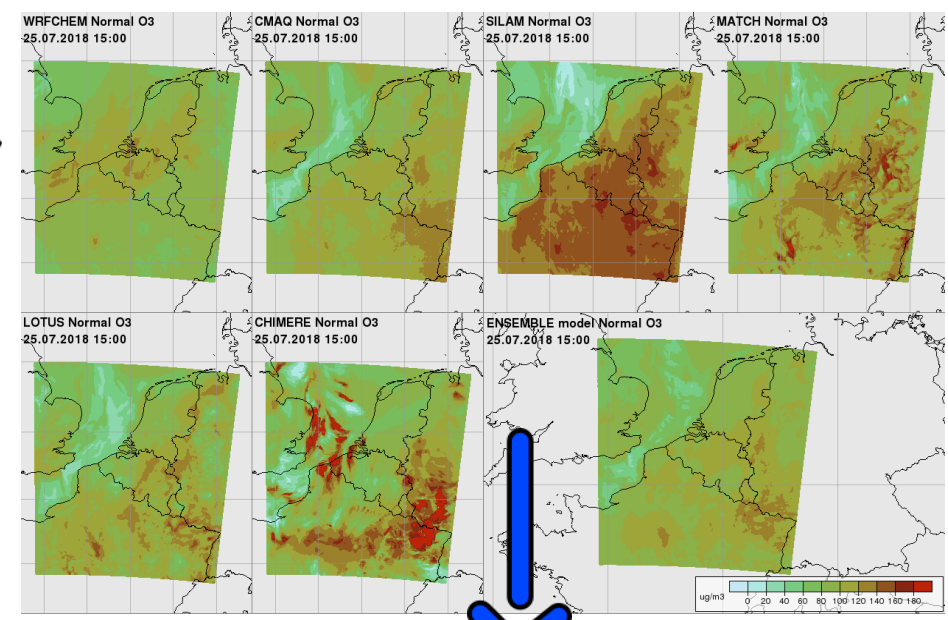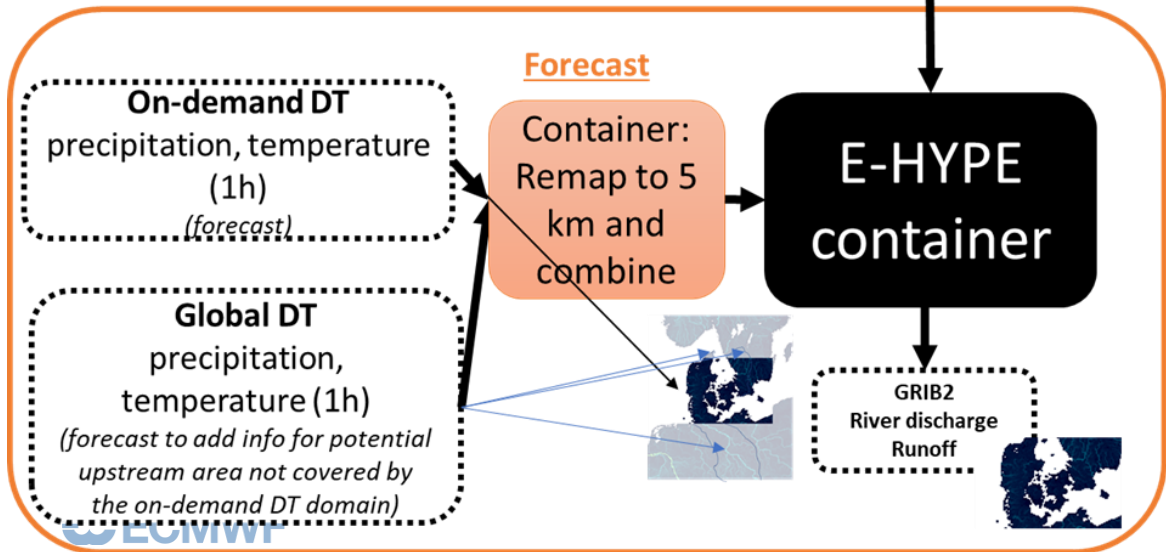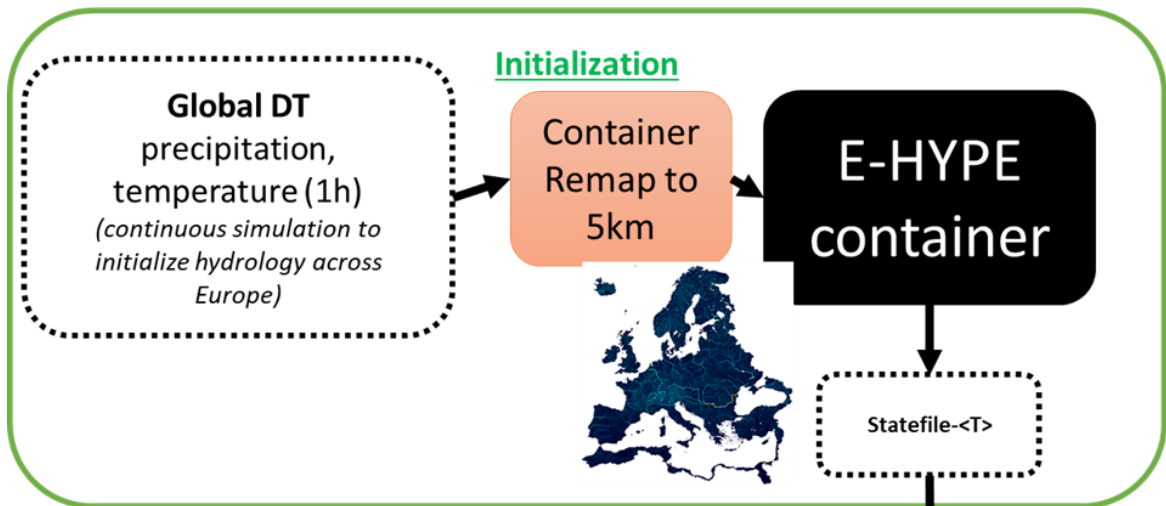
In total 7 Air Quality models providing multi-model-based Uncert. Quantif.
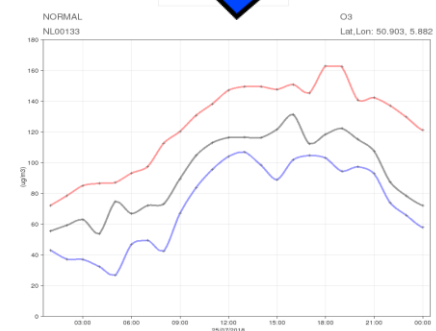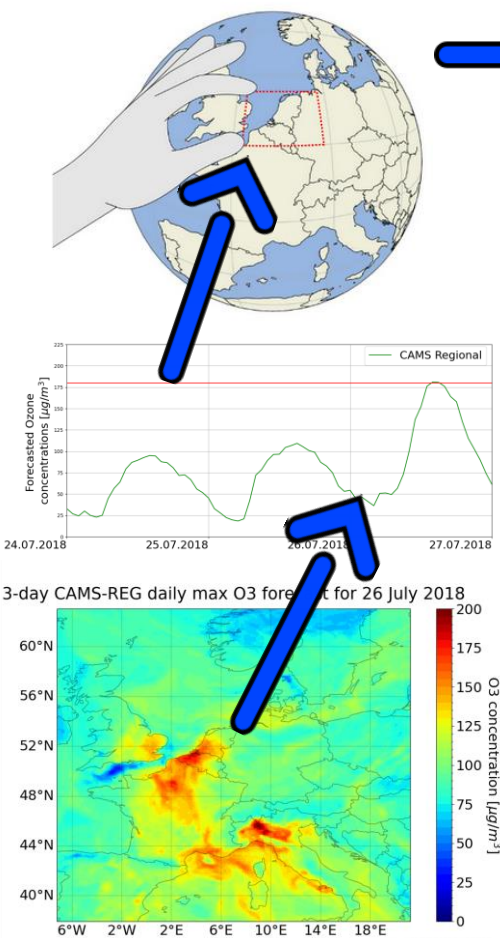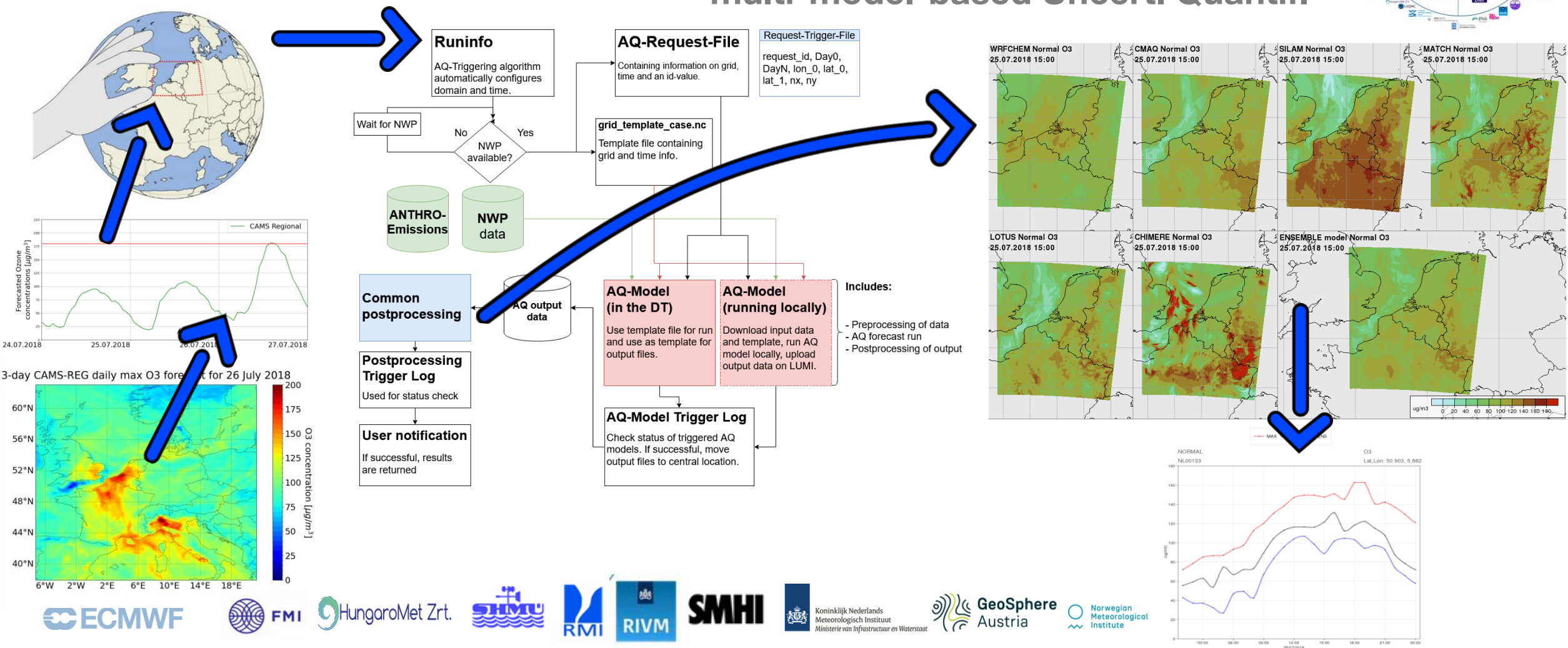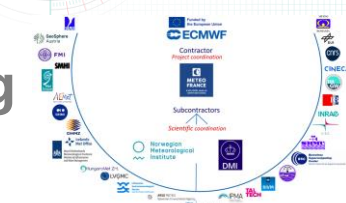
# On-Demand components – Hydrology (see also McKnight; Flood Risk Management)

Hydro workflow

Initialization

Global DT
precipitation, temperature (1h)
(continuous simulation to initialize hydrology across Europe)

→ Container Remap to 5km → **E-HYPE container** → Statefile-<T>

Forecast

On-demand DT
precipitation, temperature (1h)
(forecast)

Global DT
precipitation, temperature (1h)
(forecast to add info for potential upstream area not covered by the on-demand DT domain)

→ Container: Remap to 5 km and combine → **E-HYPE container** → GRIB2 River discharge Runoff

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ecFlow – daily init suite
TRIGGER: date
➢ Download global DT analysis
➢ Remap
➢ Initialization run
=> Hydrological statefile

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ecFlow – on-demand forecast suite
TRIGGER: 'on-demand produced'
➢ Download global DT forecast
➢ Download on-demand DT forecast
➢ Remap & combine
➢ Run forecast starting from statefile
➢ Produce and deliver GRIB2 data

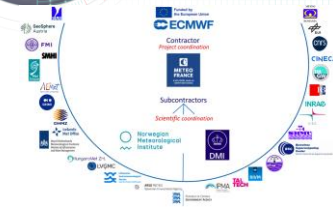In Addition 9 pilot areas, where all contributing models passed sensitivity study through selected cases

Banská Bystrica, Hron river — HBV model
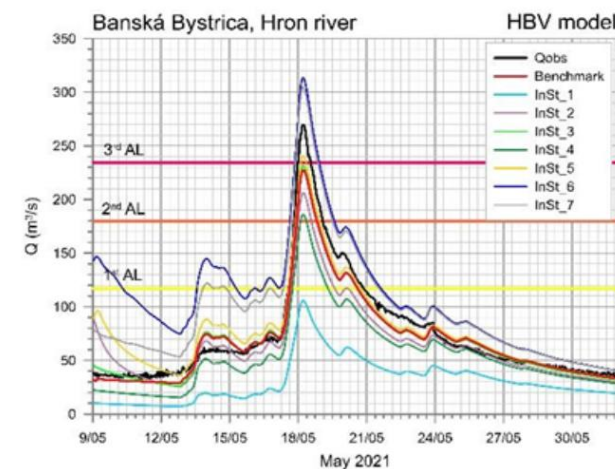
Sensitivity study at SHMU

SMHI INRAE DMI FMI Met Éireann SHMU Icelandic Met Office CHMI
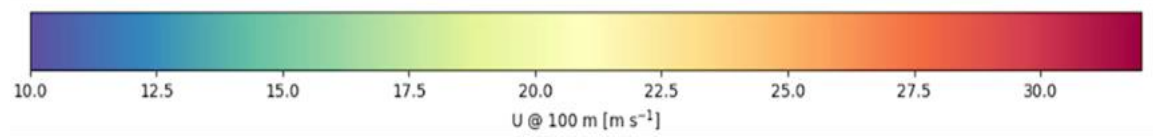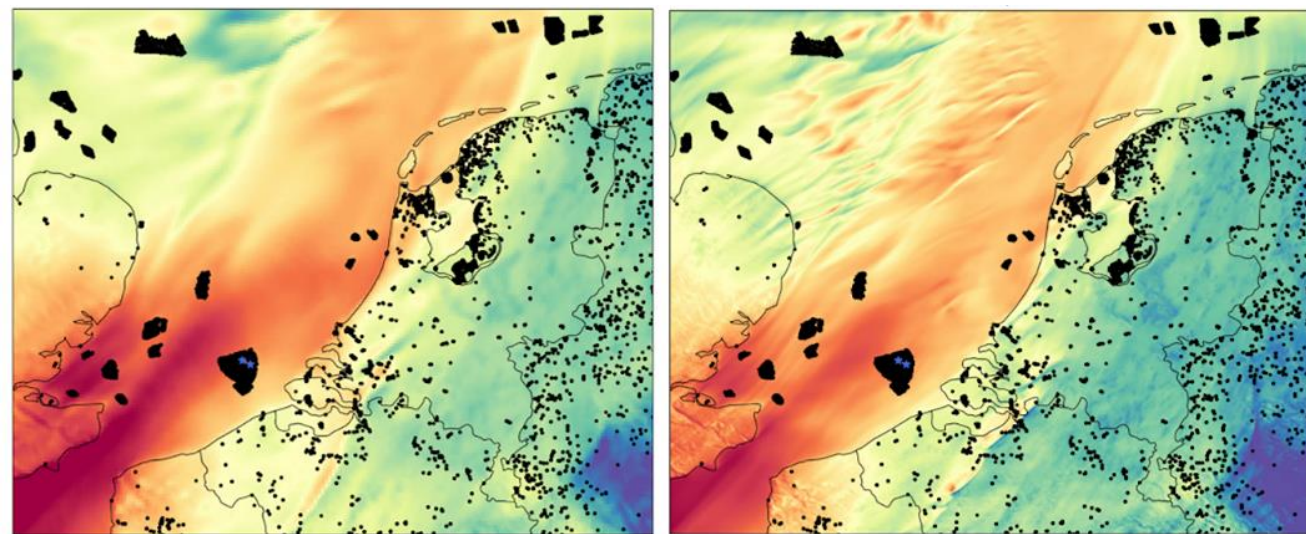
(Peter Berg, SMHI)

On-Demand components – Wind energy (see also Schicker; DestinE in the Energy sector)

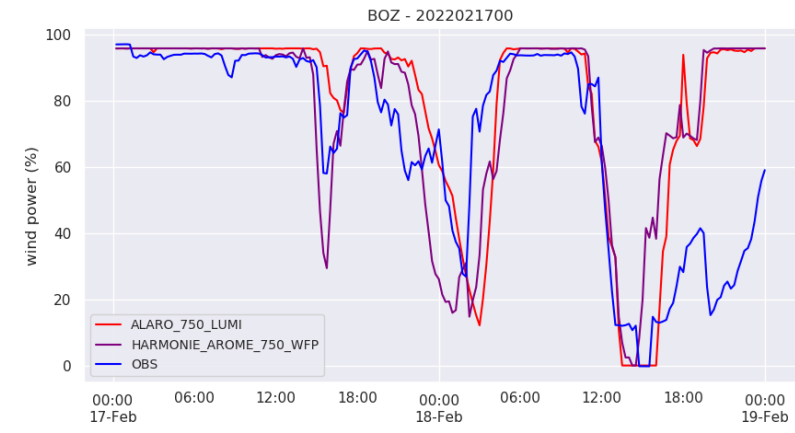## Through model parametrization and post-processing

2.5 km grid spacing   750 m grid spacing

U @ 100 m [m s⁻¹]

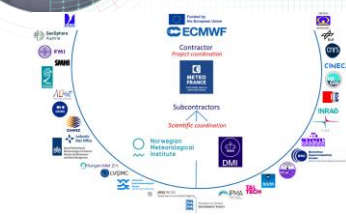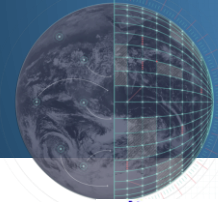Resolving more details in the wind field
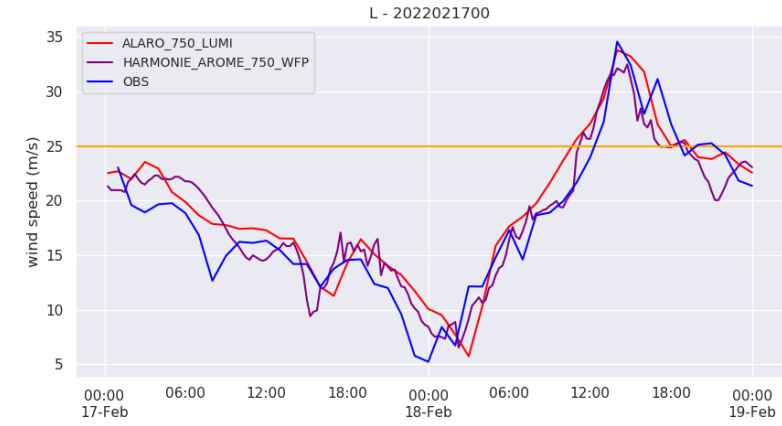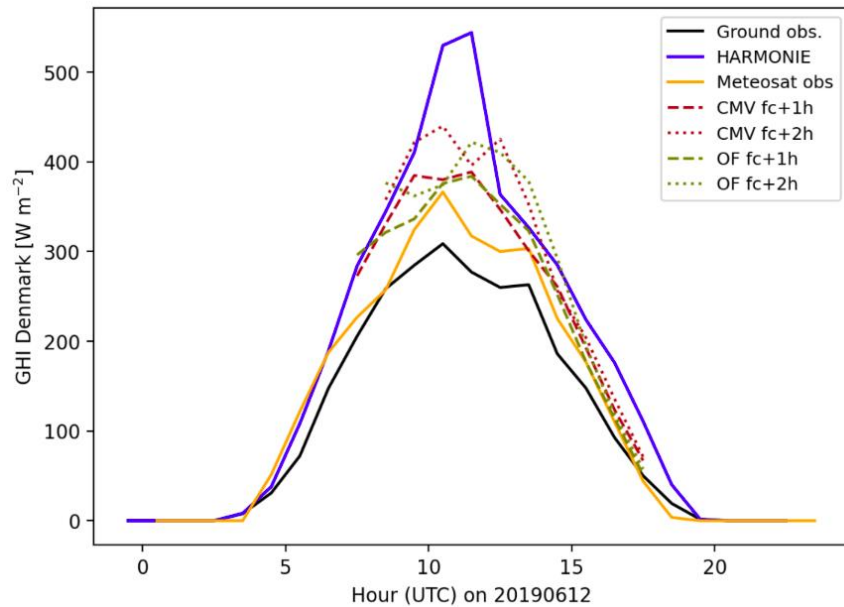
Wind forecast

Wind power prediction

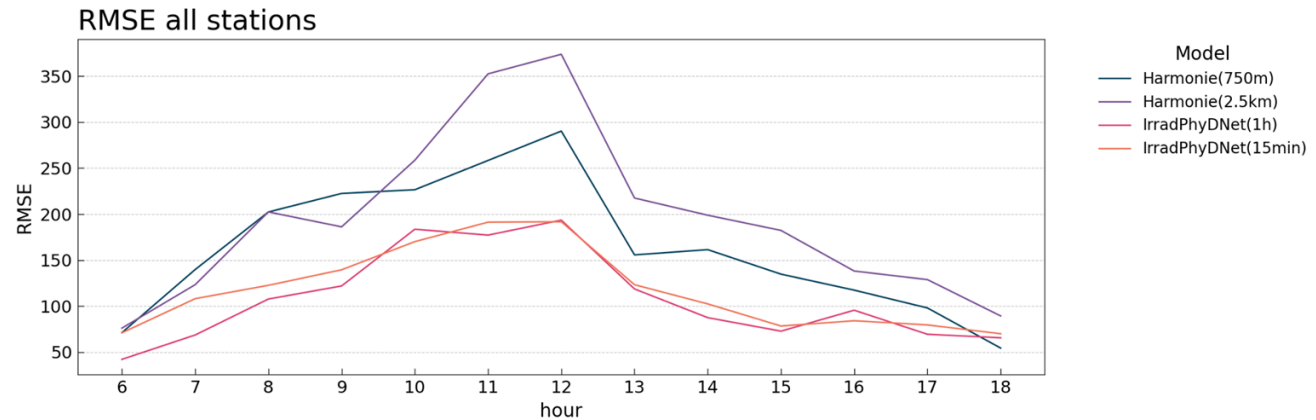Base time 2022-02-17 00Z, lead time T+0 to T+60
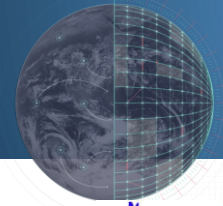
On-Demand components – Solar energy

➢ Three promising nowcasting methods were explored

    ○ Optical flow (OF), cloud motion vector (CMV) and data-driven and neural network (IrradPhyDNet)

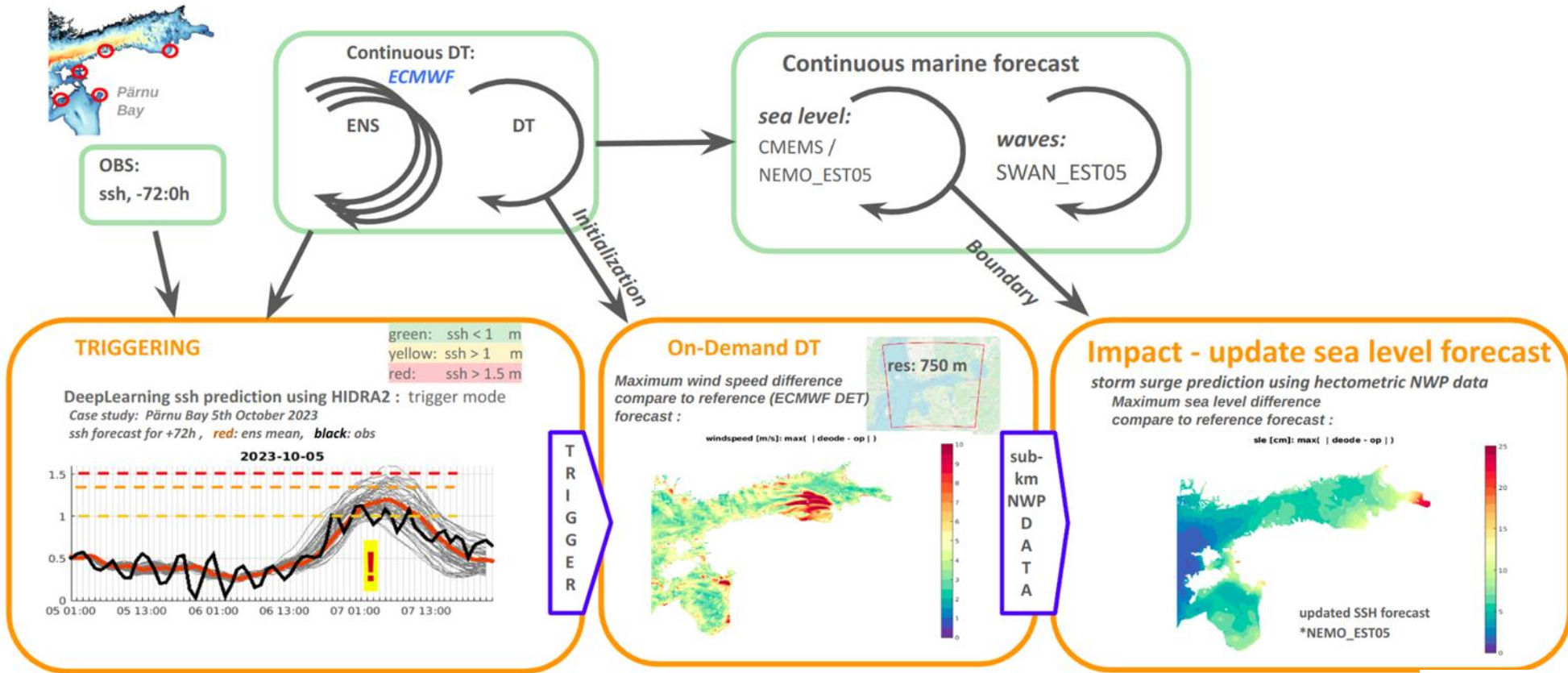Harmonie-Arome and nowcasting using optical flow (OF) and cloud motion vector (CMV) methods

Harmonie-Arome and IrradPhydNet variants based on evaluation with all GLORAD stations in Denmark (invalid/missing results excluded), forecasts from 6:00-18:00 12.6. 2019

On-Demand components – Storm surge

➤ Two applications: Triggering and sea level height forecast

Baltic Sea pilot area

Pilot areas for the implementation of the On-Demand DT