

Assessing the use of on-demand digital twins in national hydrological models

Peter Berg (SMHI) and
DE_330-WP6-team



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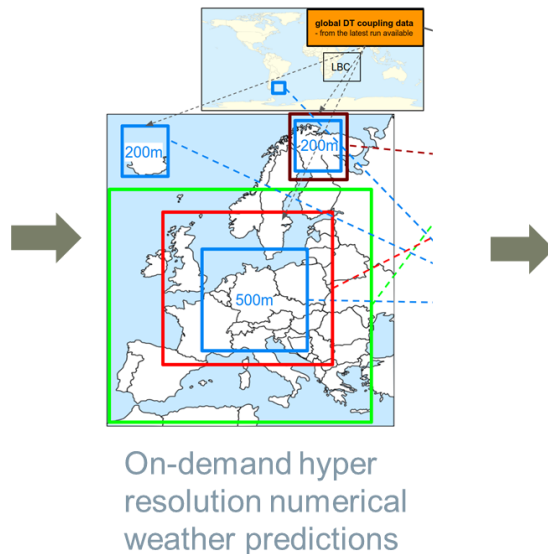
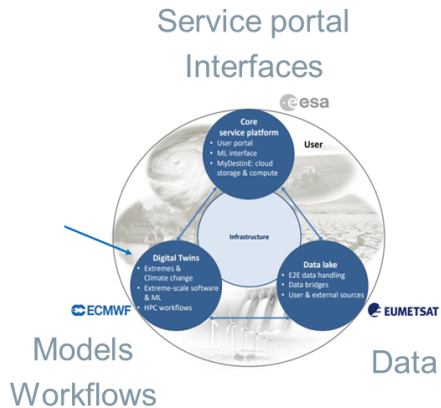
Destination Earth

implemented by

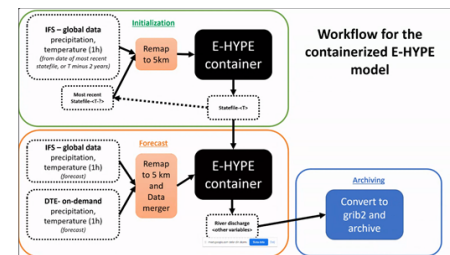


DE_33060: Vision of DestinE for Extreme Flood Events

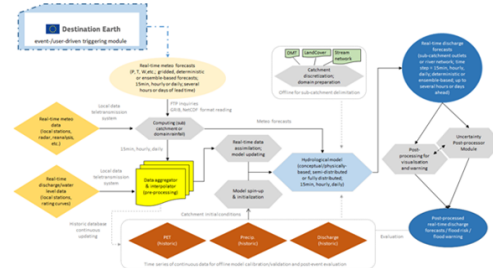
Destination Earth Digital Twin



Path 1: Fully coupled hydro-models



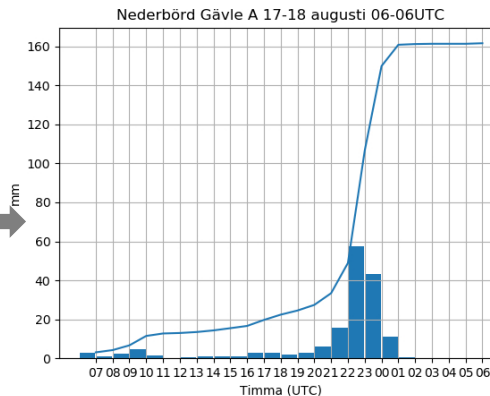
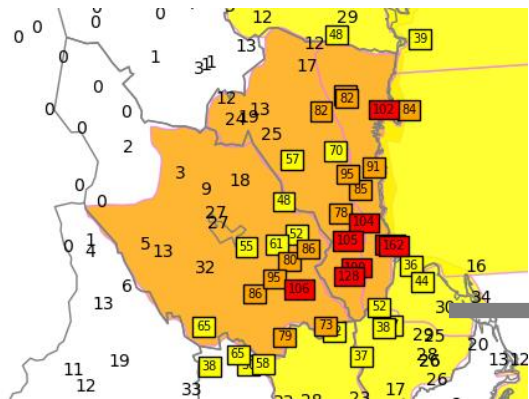
Path 2: Downstream national workflows



- Nine hydrological forecasting models
- Recent flood events
- Evaluation of DT data in hydrological forecasting
- Participants: SMHI, INRAE, IMO, SHMU, DMI, FMI, NIMH, CHMI, Met Eireann

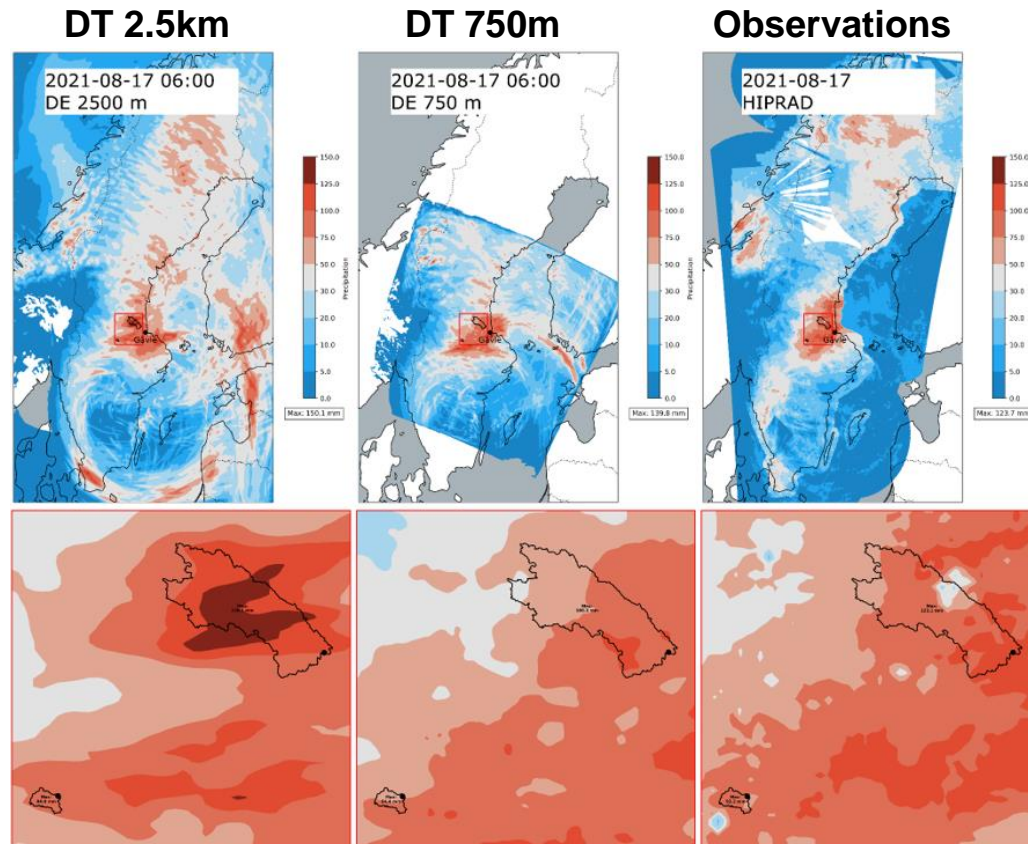


- 17th to 18th August 2021
- 160 mm of precipitation in 24 hours, with a peak of 100 mm in 2 hours
- Flooding in the city of Gävle => high impact event
- High flows recorded in two gauging stations, river Testeboån and river Hyttingsån
- Combined event with pluvial and fluvial flooding

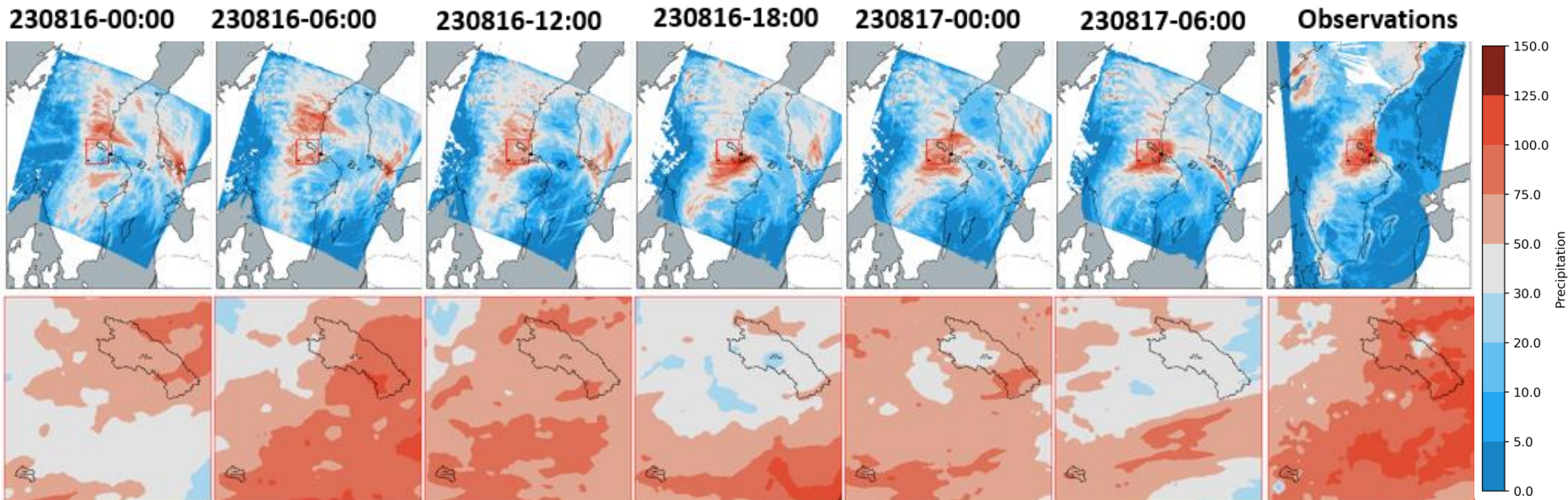


Flooding in Gävle (SvT, 2021)

- A well predicted event by the nordic NWP models
- Also predicted in daily scale hydrological models, and warnings were issued
- This means that it is a good case for the on-demand-extremes-DT to add value by fine scale details

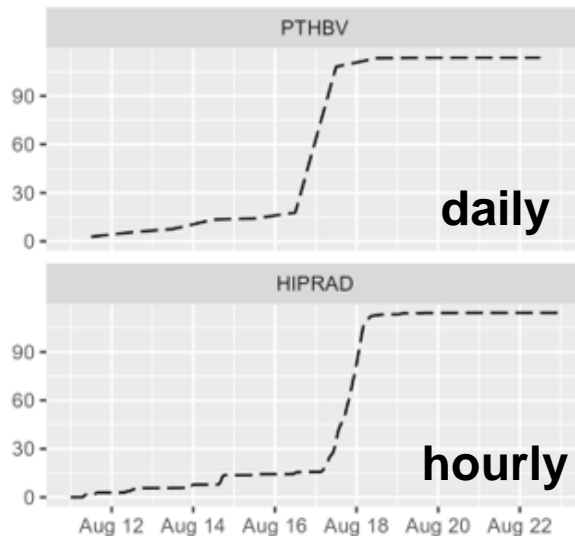
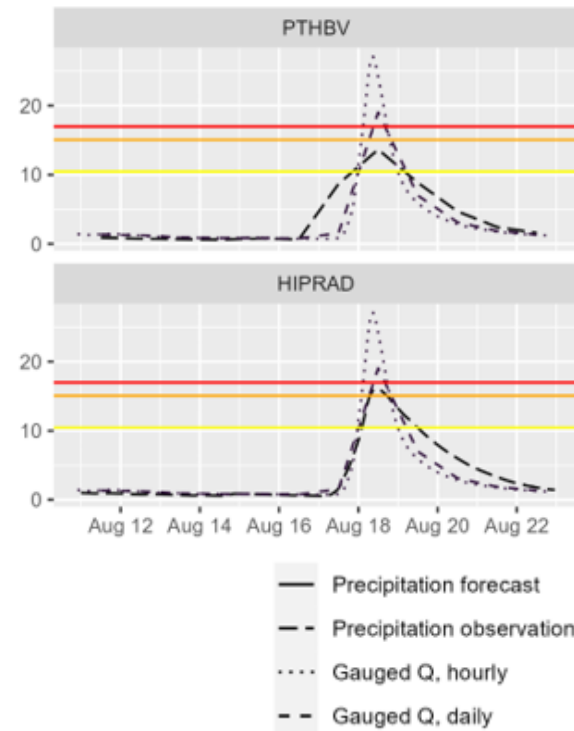


72-hour accumulated precipitation forecasts at 750m covering the event (230817-08:00 until 230818-07:00)



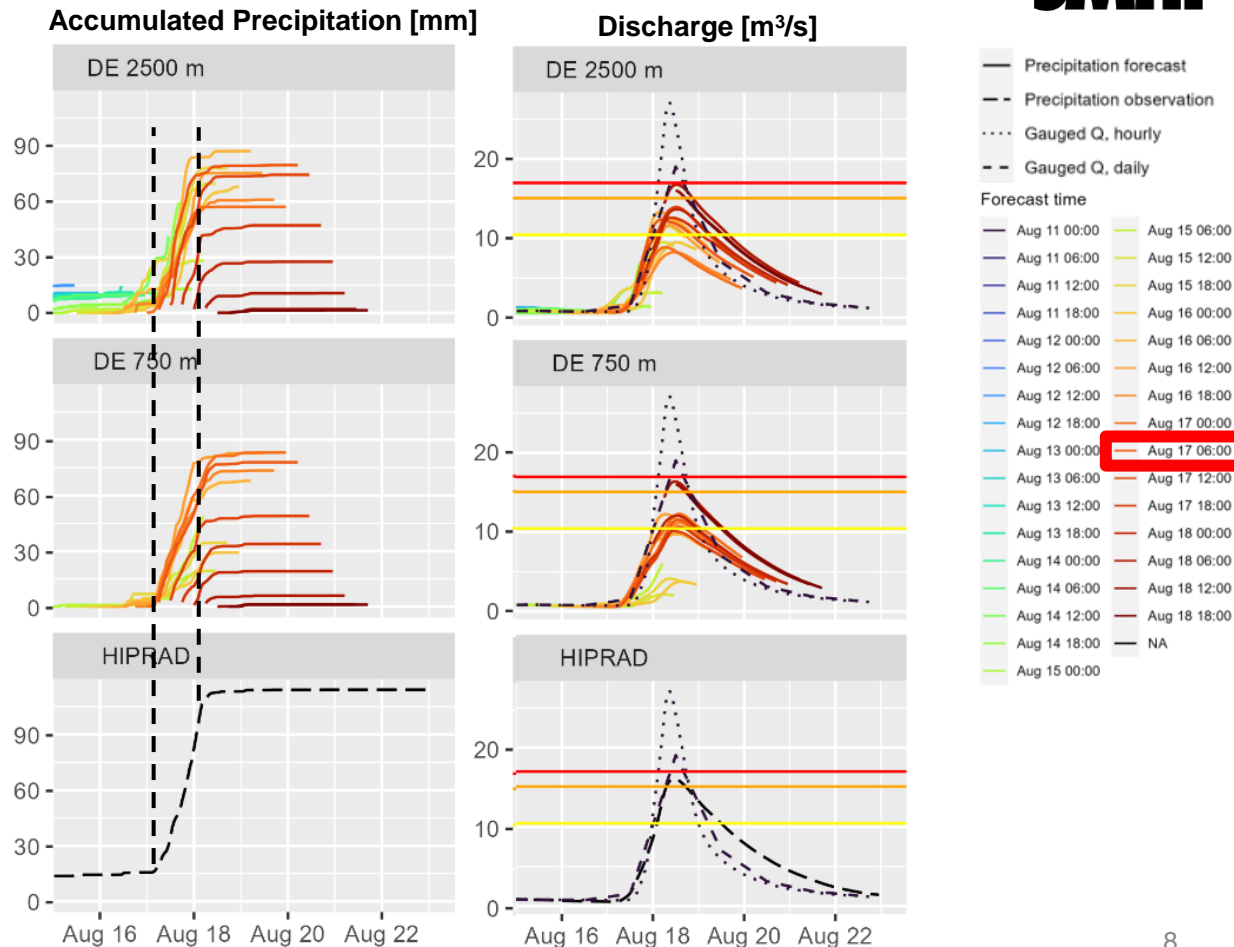
- The S-HYPE national model is operationally run at daily time scale, and in development on hourly
- Daily model underestimates peak and build-up of event
- Hourly model simulates the build-up and peak better, but overestimates the decline
- Total volumes are ok in both cases

Accumulated Precipitation [mm]

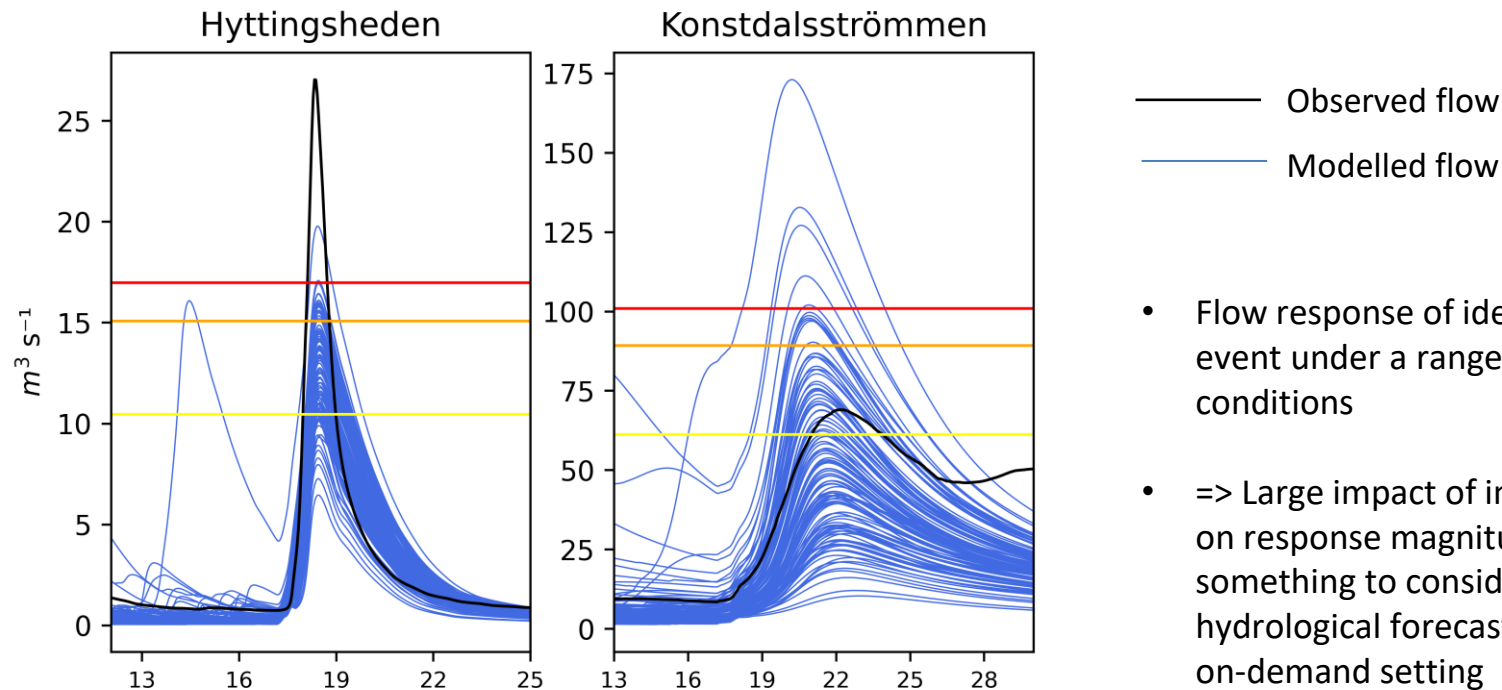
River discharge [m^3/s]

Hydrological response II

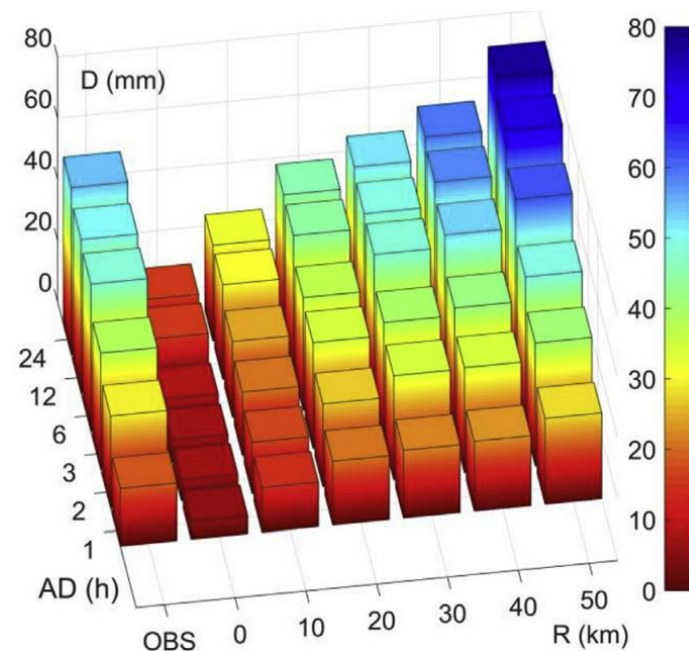
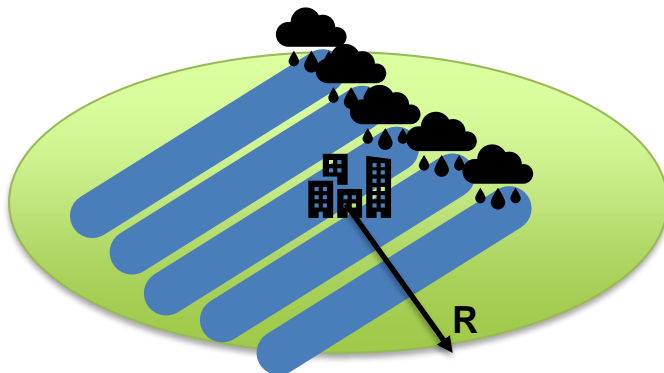
- Two DTs at 2.5km and 750m
- Different forecast times
- All DTs underestimate the peak and volume
- Initialization of the hydrological model with observed precipitation allows the peak to be simulated for the later forecasts.



Sensitivity analysis of initial conditions



- Cloud burst event in Malmö, Sweden
- Predicted, but not at the right location
- Extend meteo ensemble by displacing the events (changing the coordinates)
- Can be applied to DT, and say something about the probability of an event



Distance-dependent depth-duration analysis in high-resolution hydro-meteorological ensemble forecasting: A case study in Malmö City, Sweden

Jonas Olsson ^{a,*}, B. Charlotta Pers ^a, Lisa Bengtsson ^b, Ilias Pechlivanidis ^a, Peter Berg ^a, Heiner Körnich ^b

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- By improving features of convective events (single or embedded), DTs can bring additional local detail which is important for small-scale hydrological and hydraulic forecasting
- Initial conditions strongly affect the hydrological response – probabilistic initial conditions, and/or improved real-time observational data needed to improve pan-European model
- Location is very important and ensembles (dynamical and statistical) are needed to assess added value and to give a plausible range of the impacts