DESTINATION EARTH

Triggering module for the Extremes DT

Petter Lind[1], Lenka Hájková[2], Toni Jurlina[3], Ilja Maljutenko[4], Marko Rus[5], Boryana Tsenova[6]

1 SMHI (Sweden), 2 CHMI (Czech Republic), 3 GeoSphere (Austria), 4 TalTech (Estonia), 5 ARSO (Slovenia), 6 NIMH (Bulgaria)

correspondence: petter.lind@smhi.se

Funded by the European Union | Destination Earth implemented by ECMWF esa EUMETSAT

Purpose & Goals

- Development of a set of methods designed for **detection of potentially extreme and high-impact weather events**, optimally within a few days lead time.
- The outcome from detection methods will act to **trigger** hyper-resolution Numerical Weather Prediction (NWP) and impact sector model simulations as well as other post-processing procedures.
- This will be part of the DestinE on-demand extreme Digital Twin Engine (DTE) integrated workflow.

Outlook

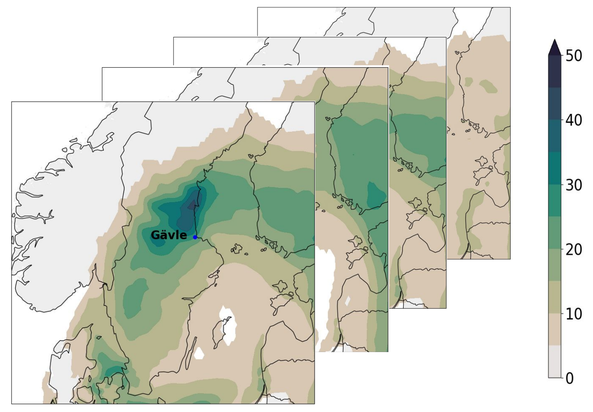
- Continual development and **refinement** of detection methods.
- Development of **more advanced** methods built on statistical or machine learning methods, storm tracking methodologies and large-scale circulation clustering techniques.
- Increase the **robustness** of detection and triggering methods.
- Additional applications on further selected weather events and regions.

Input Data

- Forecast data (e.g. from ECMWF ensemble prediction system (EPS) or optional data from other regional or global NWP models)
- Reanalysis data (e.g. ERA5)
- Observational datasets (e.g. tide gauges)

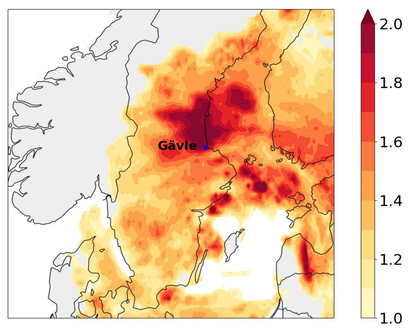
Figure (a): forecasted daily precipitation in mm for different members obtained from the ECMWF EPS data.

a) Daily precipitation (mm/day) from ensemble of forecasts

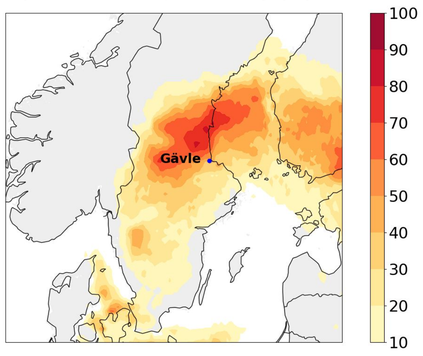


Figures a)-d) shows an example of the OPTI-THRED triggering method applied on the extreme precipitation event over Gävle, Sweden (17 August 2021)

b) Measure of intensity (fraction over threshold)



c) Measure of probability (%)



Detection Method

- Threshold based methods calculated from:
  - Precursors of the event
  - Climatological information
- Machine learning techniques
- Different risk index analysis

Figure (b) & (c): mean intensity and probability derived from OPTI-THRED of an extreme precipitation event.

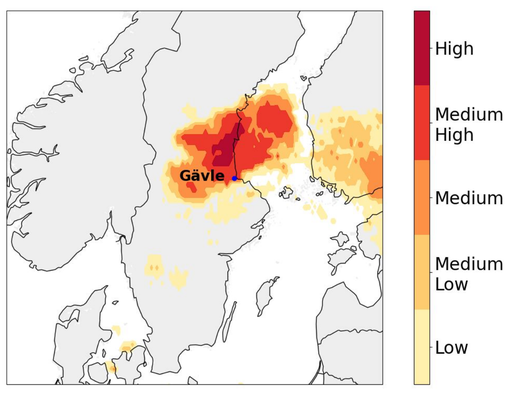
Event	Detection method	Responsible
Storm surge/tide	*Surge-ThreshPB*	TalTech (Estonia)
	StormSurgeDetector (SSD)	ARSO (Slovenia)
Extreme precipitation	*Optimised threshold-based event detection (OPTI-THRED)*	SMHI (Sweden)
Extreme temperatures & winds	*Extreme Forecast Index (EFI)*	GeoSphere (Austria)
Wildfires	*Combined FWI index*	CHMI (Czech Republic) NIMH (Bulgaria)
Drought	*Combined precipitation and temperature index*	CHMI (Czech Republic)
Spring frost	*Combined meteorological and vegetation index*	CHMI (Czech Republic)
Thermal comfort	*Combined meteorological index*	NIMH (Bulgaria)

Triggering Information

- Output information categorised in risk/alert levels:
  - Two level case (*no extreme - extreme*)
  - Multiple risk level case (*no/low risk to high risk*)

Figure (d): Multiple risk levels assigned to the extreme precipitation event

d) Risk levels



Extremes DT Partners

- High-resolution NWP downscaling
- Impact models, e.g. hydrological models
- Further post-processing procedures

Detailed information about the triggering methods