

Detection of extremes and triggering of the On-Demand DT

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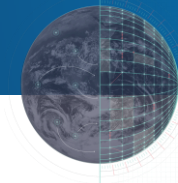


Funded by
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Destination Earth

implemented by





Detection and triggering in the Extreme On-Demand Workflow

Role of the Detection:

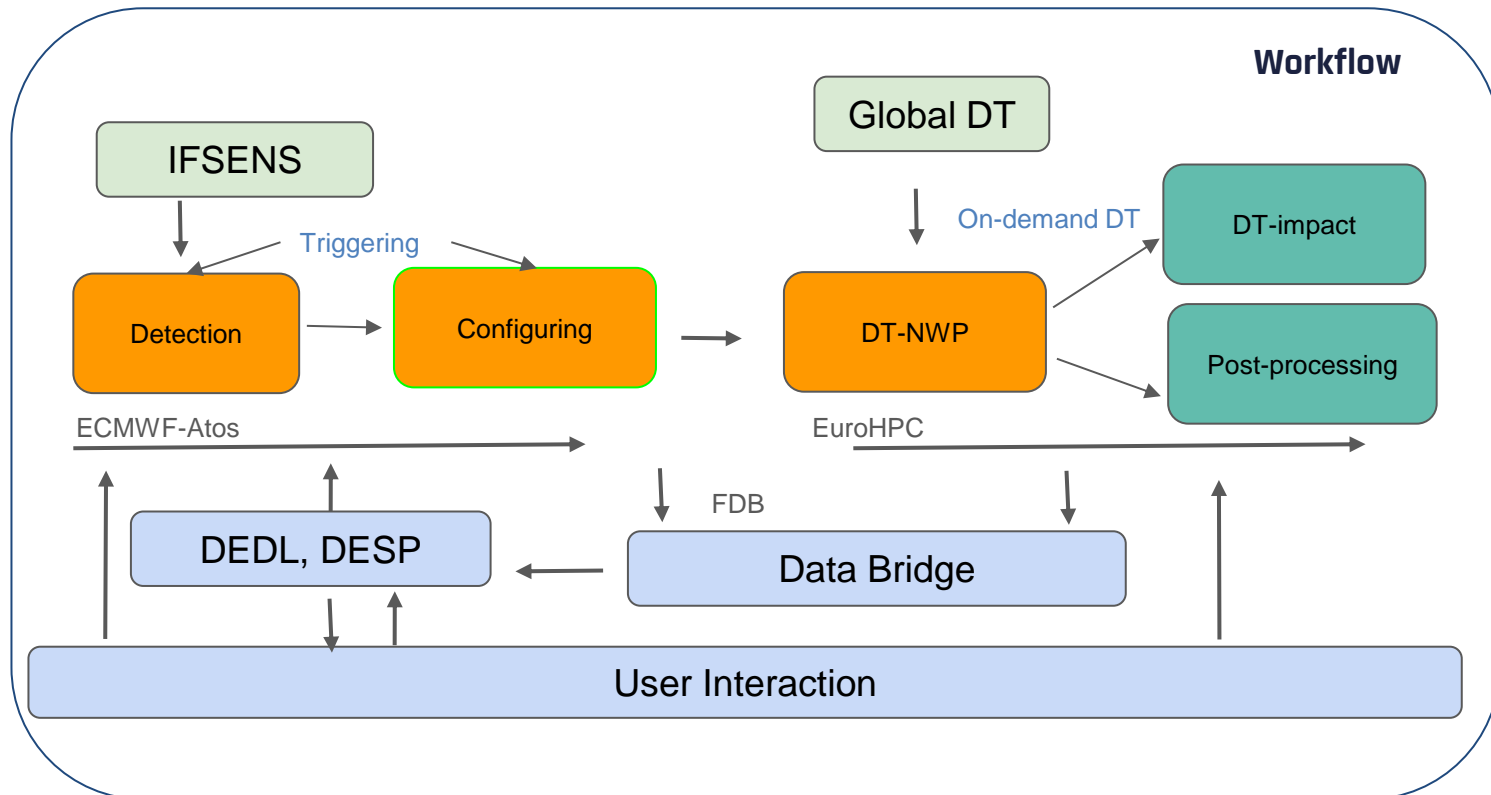
- Provide awareness for the immediate future extreme events happening over Europe:
 - Probability maps
 - Triggering priority maps
- Advanced analytics to substantiate decisions to start forecast runs

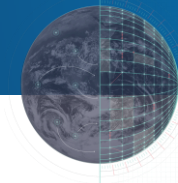
Role of the Configuration:

- Estimate geographical extent of the extremes
- Provide related configuration for the forecast models

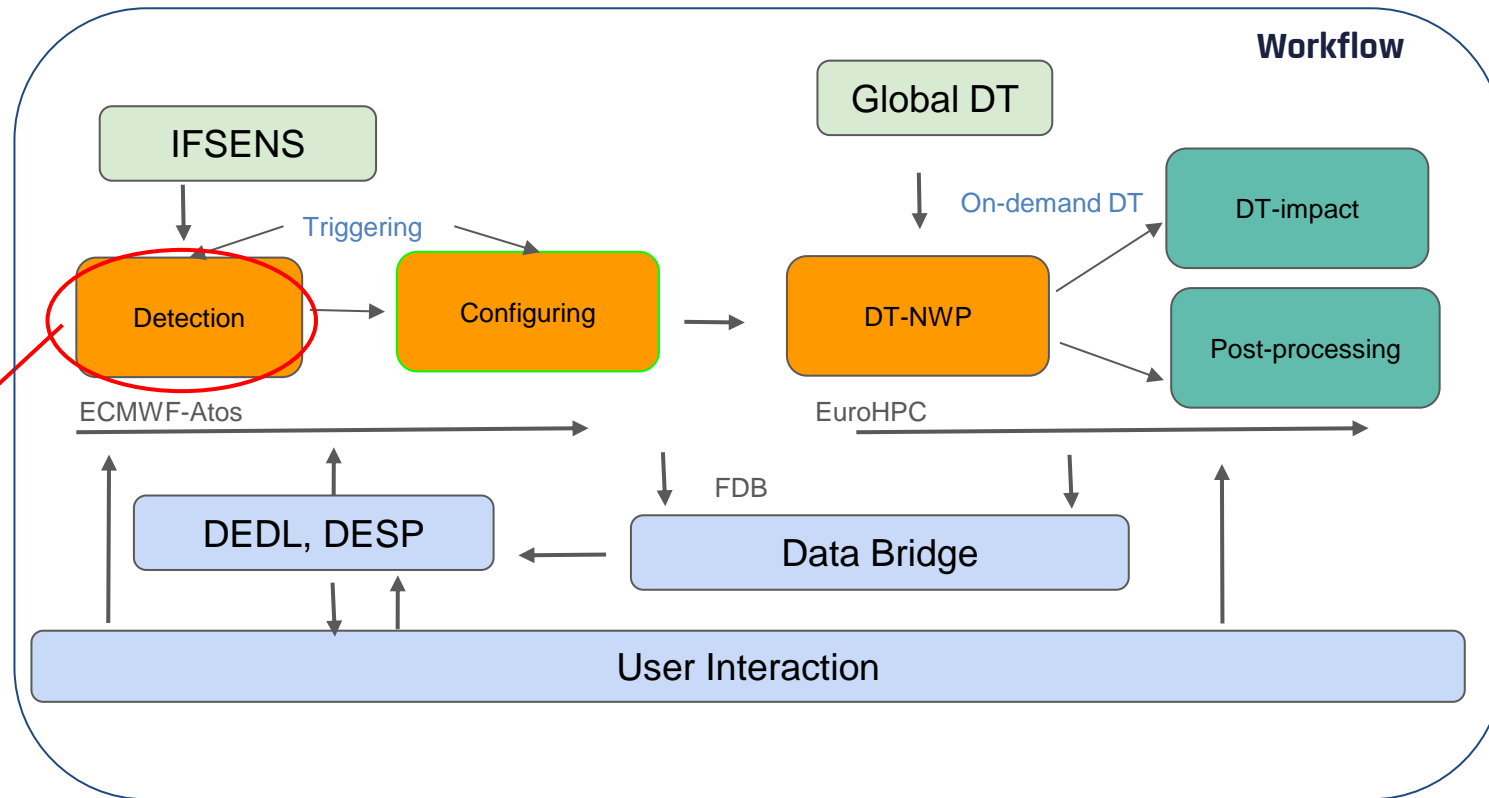
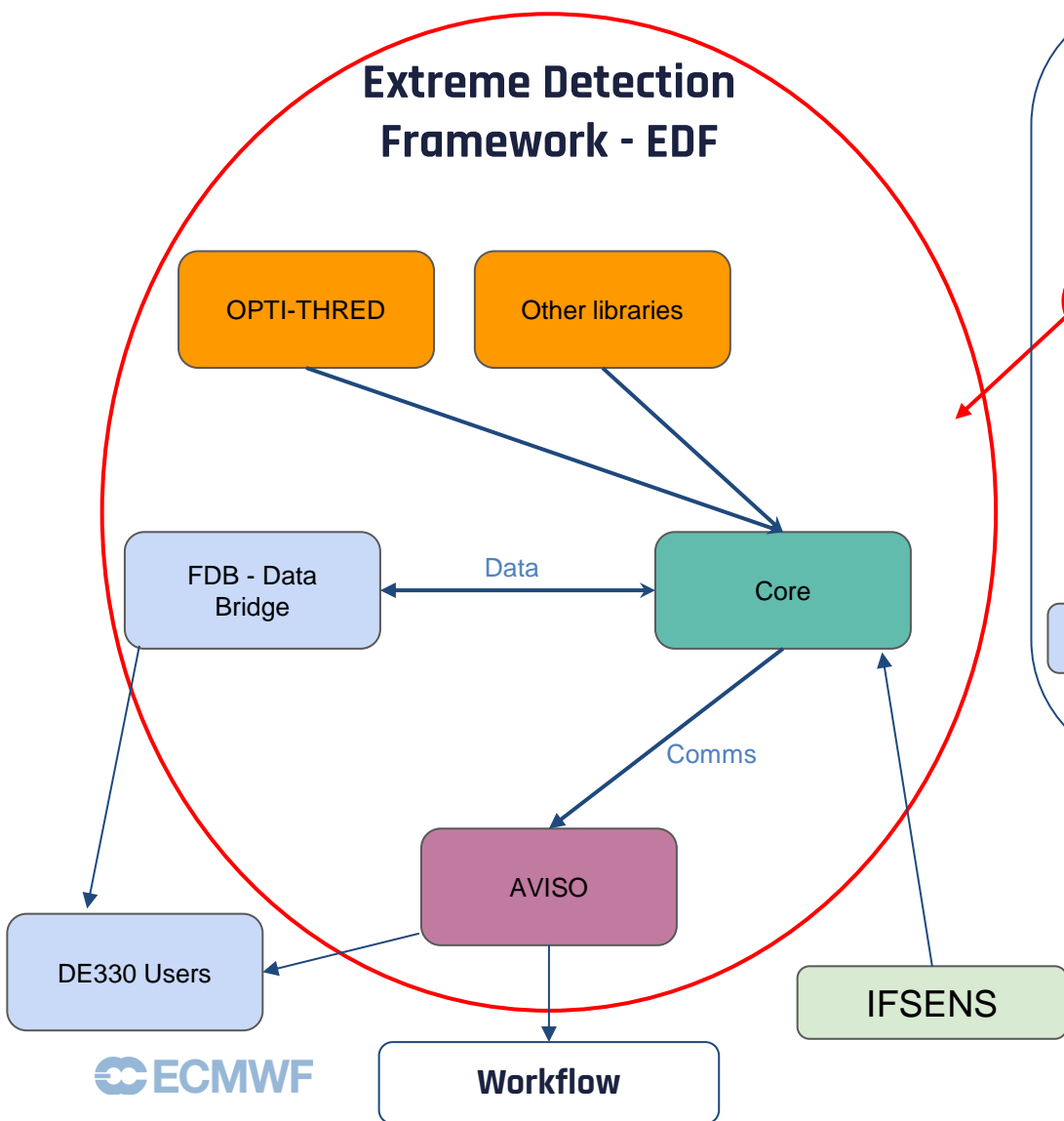
Decision to trigger:

- Human-driven (DE330 forecasters in the loop, see Xiaohua Yang monitoring presentation)
- Automated (not yet implemented in phase 2)



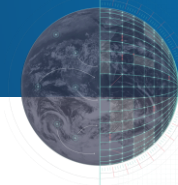


Detection in the Extreme On-Demand Workflow



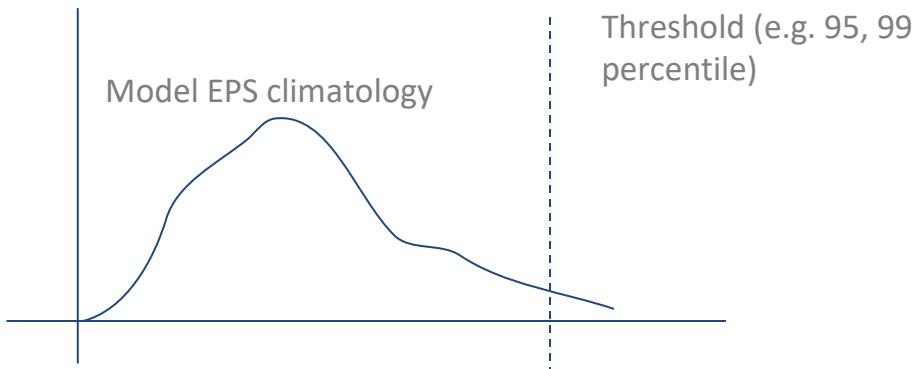
Extreme Detection Framework duties:

- Estimate probability and assess the triggering priority of extremes up to 5 days ahead
- Various use cases (pres. flooding, heatwave, convection, storm, more to come)
- Store analysis data and diagnostics
- Communicate to DE330 users and workflow



OPTI-THRED (OPTImized THReshold-based Event Detection)

- Threshold-based method to detect anomalously high/low values for various meteorological variables.
- So far tested on single variables, daily statistics (avg/max/min):
Precipitation (total and convective), CAPE (cape, capes), 2m temperature, 10m wind (mean wind speed and gust).
- **Input data:**
ECMWF ensemble forecasts (50 members)
Thresholds computed from ECMWF ensemble (EPS) reforecasts climatology (~20 years)
- **Output data:**
Map with detection results - levels of “triggering priorities” (1 -> 5) based on EPS agreement and intensity.

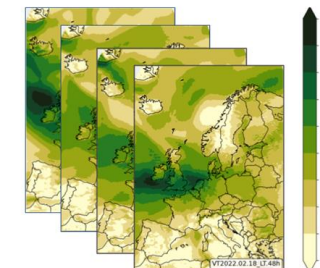


INPUT DATA

- Forecast data (e.g. from ECMWF ensemble prediction system (EPS) or optional data from other regional or global NWP models)

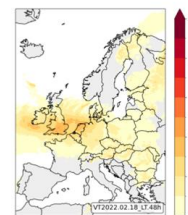
Figure (a): forecasted daily maximum wind gust in m/s for different members obtained from the ECMWF EPS data.

a) Daily maximum wind gust (m/s) from ensemble of forecasts

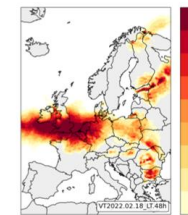


Figures a)-d) shows an example of the OPTI-THRED triggering method applied on the storm Eunice (18 February 2022)

b) Measure of intensity (fraction over threshold)



c) Measure of probability (%)



DETECTION METHOD

- Threshold based methods calculated from climatological information

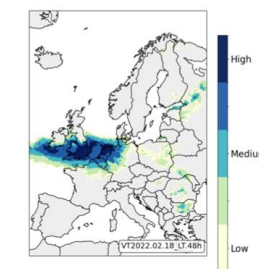
Figure (b) & (c): mean intensity and probability derived from OPTI-THRED.

OUTPUT INFORMATION

- Output information categorised in multiple triggering priorities (no/low risk to high priority)

Figure (d): Multiple triggering priorities assigned to the extreme wind gust event.

d) Triggering information (priority)

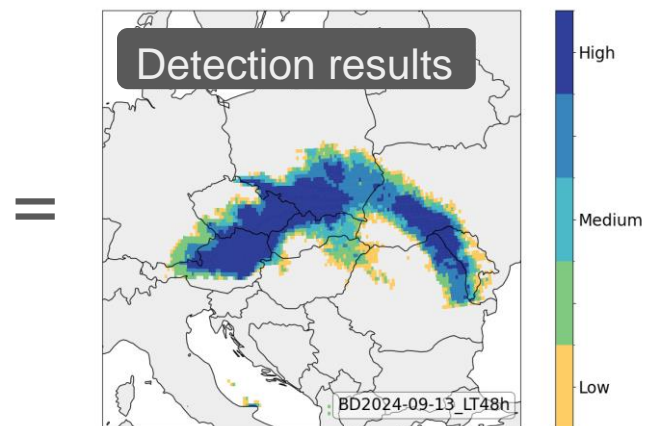
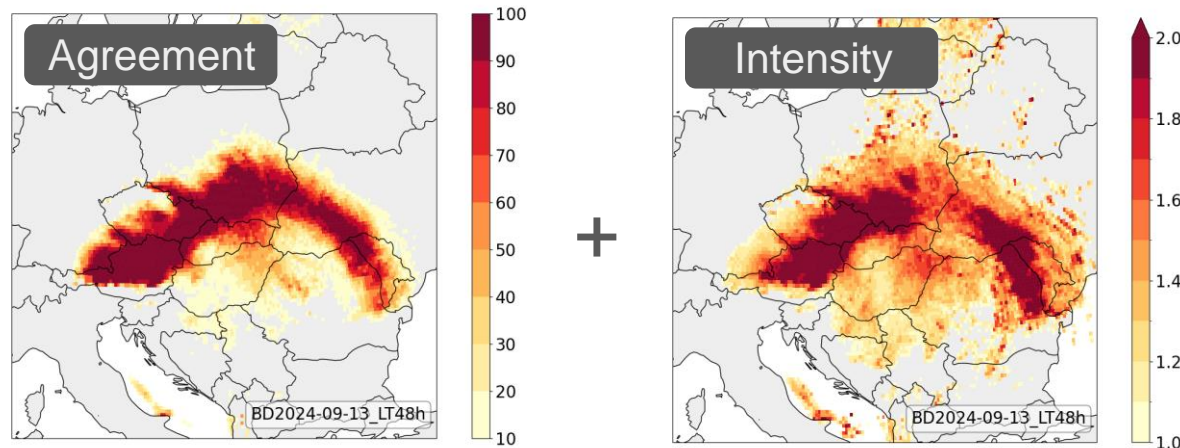
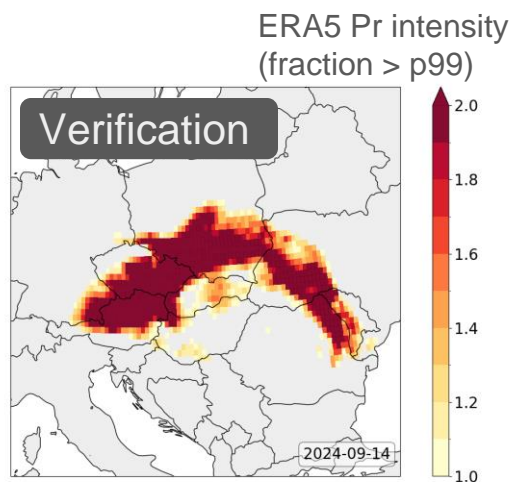


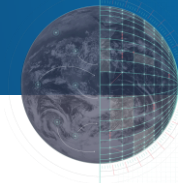


OPTI-THRED Use case example: Boris (September 2024)

- Extreme precipitation over central-east Europe
- Large human, societal and economical damages and costs

OPTI-THRED:

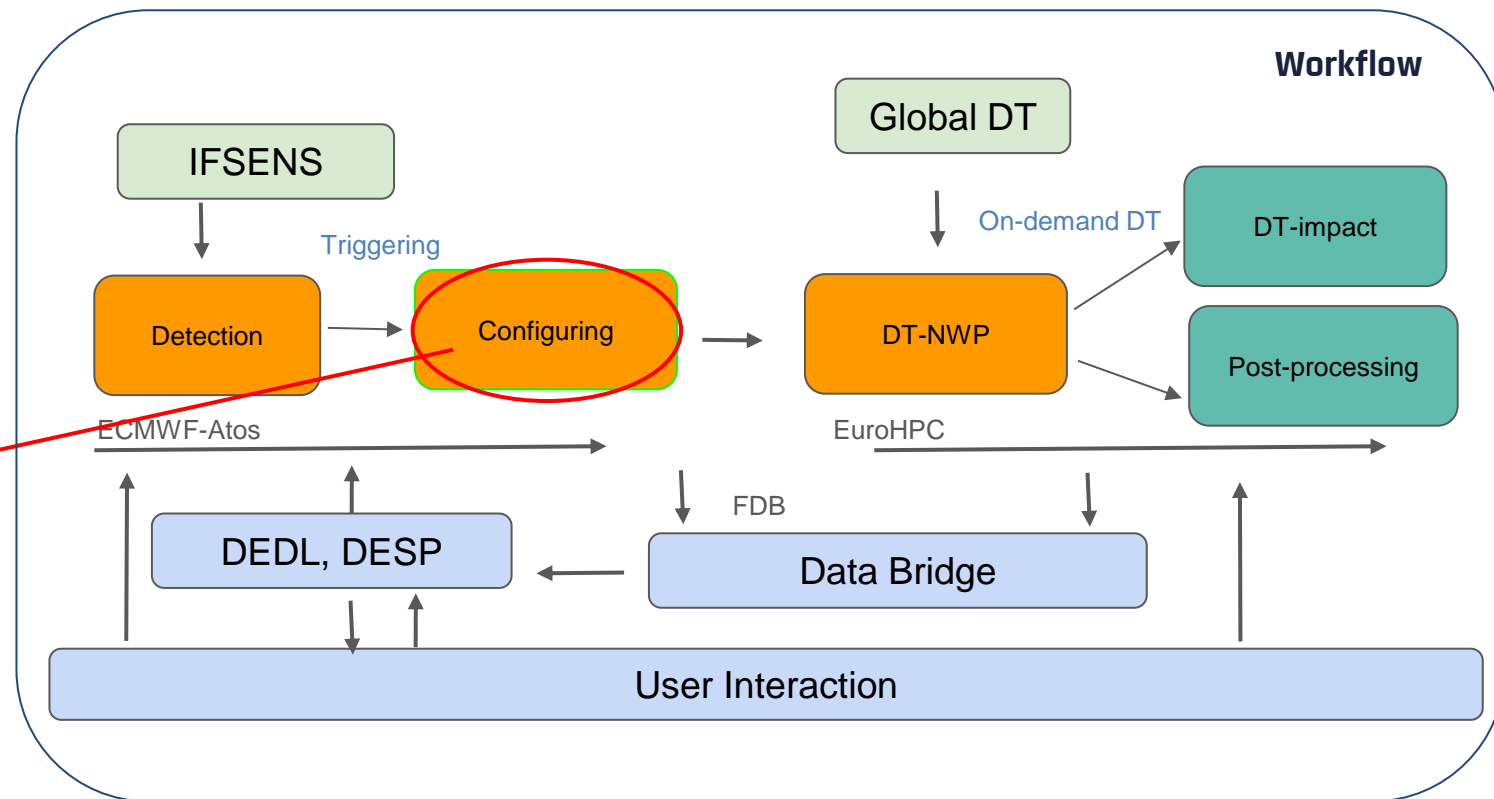
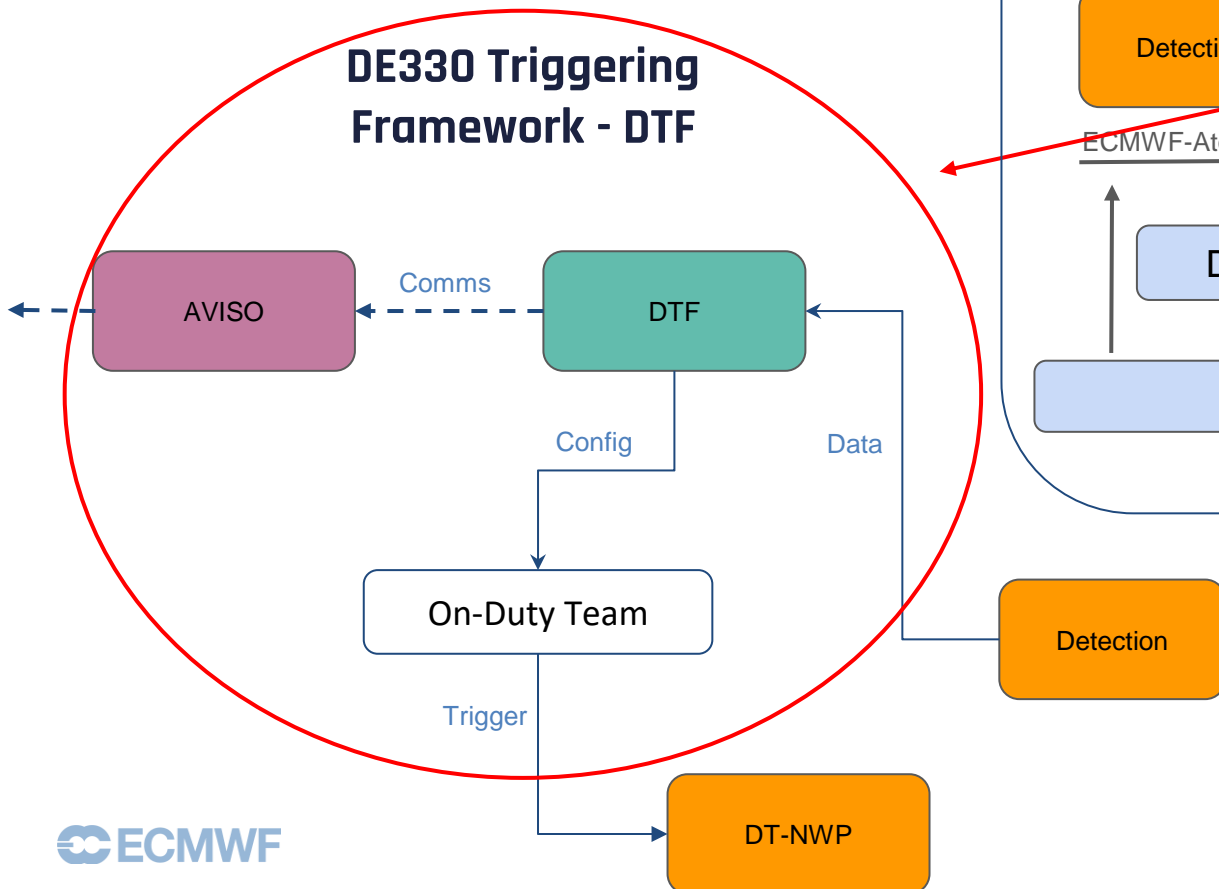




Configuration in the Extreme On-Demand Workflow

- For phase 2, triggering will be done by the DE330 consortium members (On-duty team)
- Currently, no prioritization policy

DE330 Triggering Framework - DTF



DE330 Triggering Framework duties:

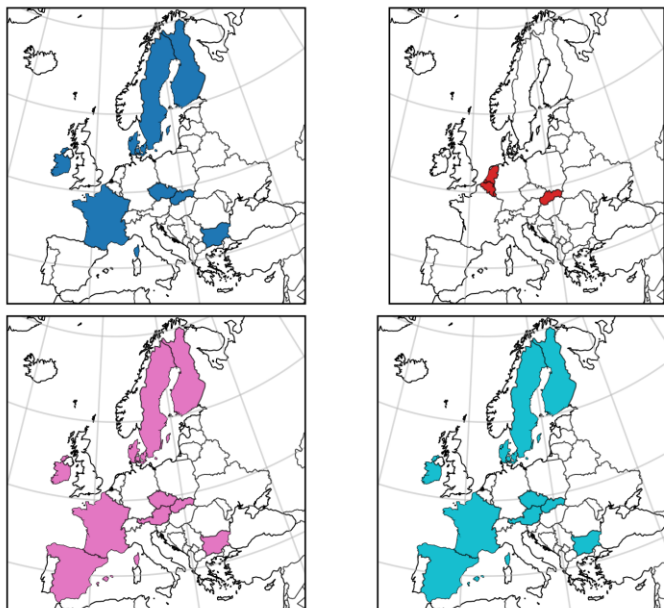
- Compute model domain for each detected extreme
- Provide model configuration files to the workflow
- Currently, used to trigger manually NWP (forecasters from NMHS in the loop)
- In the future, automated triggering (in addition to user triggers)



Tailoring model runs to user needs using the Triggering Framework

“pilot regions for different events and applications”

Event Type Lookup Visualization



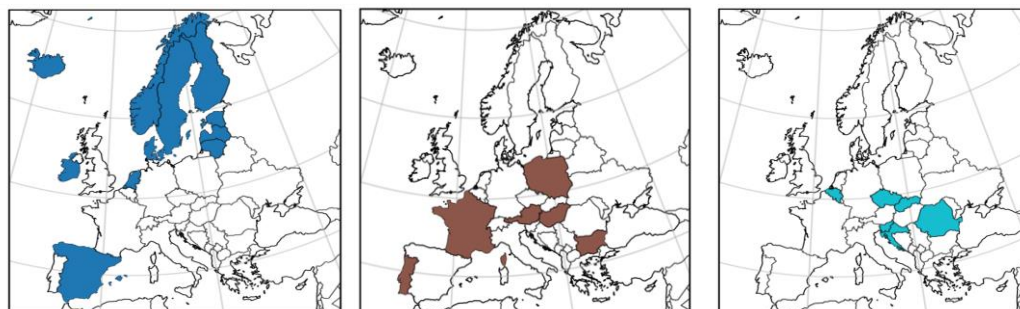
```
[CZE]
csc = ["alaro"]
events = ["flooding", "convection", "storm"]

[DNK]
csc = ["harmonie-arome"]
events = ["flooding", "convection",
          "storm", "storm_surge", "solar_energy"]

[ESP]
csc = ["harmonie-arome"]
events = ["storm", "convection", "fire"]

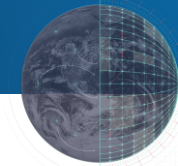
[EST]
csc = ["harmonie-arome"]
events = ["storm_surge"]
```

CSC Lookup Visualization



Model selection

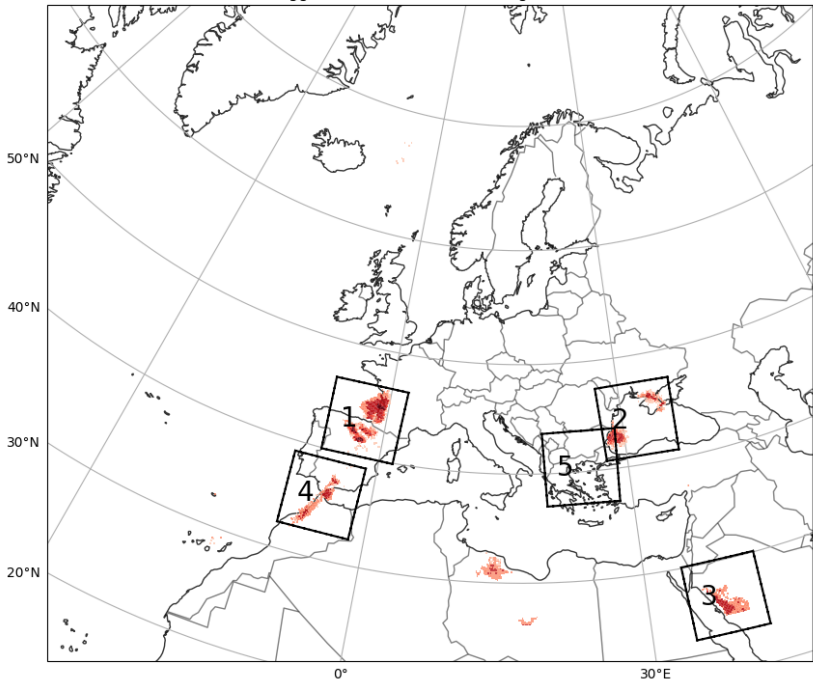
```
[domain]
name = "CUBIC_1500x1500_500m"
nimax = 1489
njmax = 1489
xdx = 500
xdy = 500
xlencn = -3.516191369605984
xlatcn = 42.522448161525034
lmrt = false
tstep = 20
gridtype = "cubic"
order = 1
csc = "harmonie-arome"
```



Example: 29th August 2024 Intense Precipitation over Spain

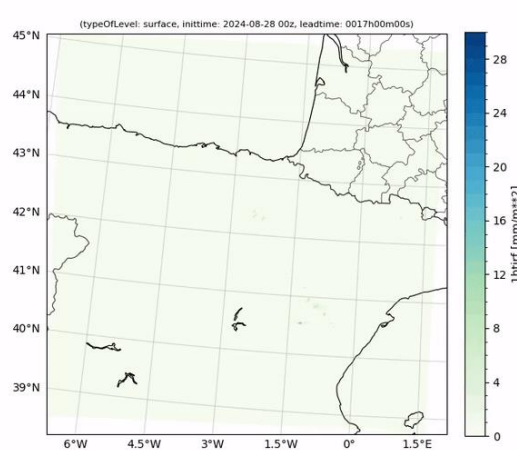
Detection (EDF - OPTITHRED) & Triggering (DTF)

Suggested domains for 'flooding' events



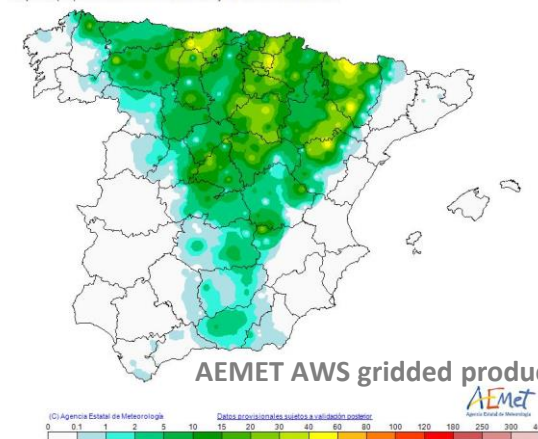
NWP - Precip 1h acc.

1h time integral of rain flux at the surface



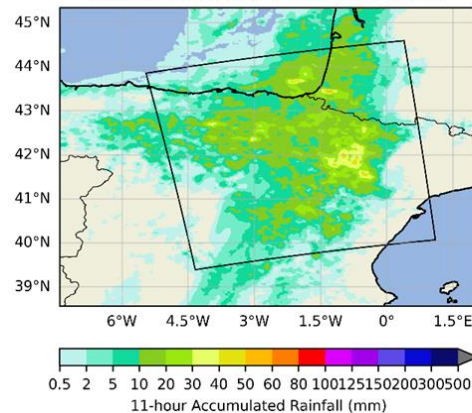
Verification

Precipitación (mm) entre las 00:15UTC del día 29/08/2024 y las 00:00UTC del día 30/08/2024

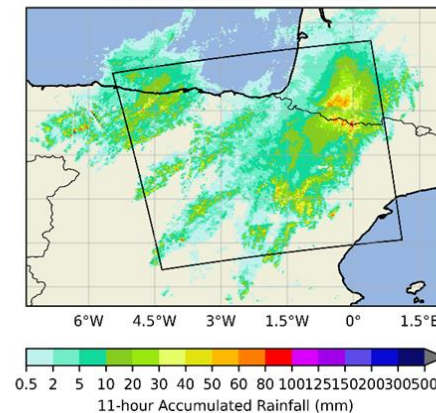


AEMET AWS gridded product

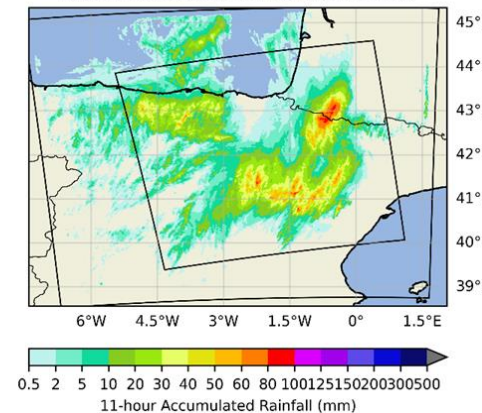
DestinE 4.4 km [exp: rd_i4ql_fc_SP2408]
Run: 2024082800 UTC
Valid from 2024-08 29-13z (+37) to 30-00z (+48)

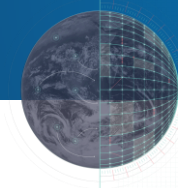


OPERA
Valid from 2024-08 29-13z to 30-00z



HARMONIE_AROME [exp: CY46h1_HARMONIE_AROME_Spain_20240828]
Run: 2024082800 UTC
Valid from 2024-08 29-13z (+37) to 30-00z (+48)





Outlooks/Usage

- More event types detected at the end of phase 2
- Seamless AVISO communications across the workflow and toward users
- Triggering done by consortium members (forecasters) for phase 2:
 - Automation for the end of the phase
 - General open access to triggering not planned
- Detection/triggering data access to be discussed (ECMWF, DE330, EC, Member States / NMHS)