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METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# **The potential of forecasting the evolution of severe European heatwaves in sub-seasonal time scale**

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# HEATCLIM project



- **Heat and Health in the Changing Climate (HEATCLIM)**
- 2020-2023 funded by the Academy of Finland
- Examines
  - Health effects of high summer temperatures at present and in the future
  - Ways to adapt to the ongoing climate change
  - Predictability of heat waves in subseasonal time-scale
    - ❖ Collaborator from ECMWF: David Richardson

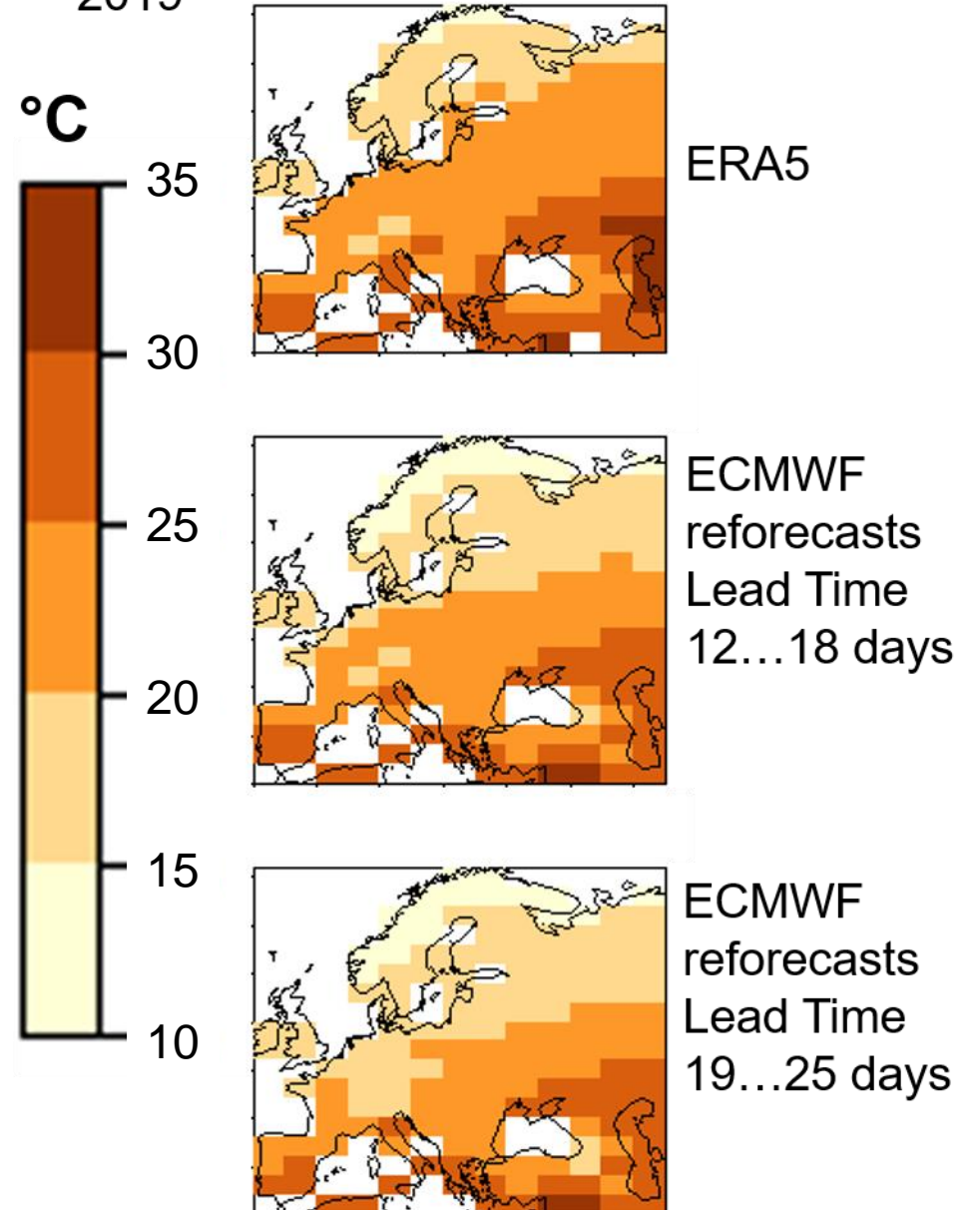
# Severe European heat waves

- *Russo et al.* (2015, [doi:10.1088/1748-9326/10/12/124003](https://doi.org/10.1088/1748-9326/10/12/124003)):
  - spatial extent several 100 km, even 1000 km (Russian heatwave 2010)
  - duration several weeks, even longer than 1 month (Russian heatwave 2010)
- *Wulff and Domeisen* (2019, [doi:10.1029/2019GL084314](https://doi.org/10.1029/2019GL084314)) showed that over Europe the reforecast skill of the Extended Range Forecasts of the ECMWF is:
  - somewhat higher for extreme hot summer temperatures than for long-term mean temperatures, and
  - strongly increased by the most severe heat waves (the European heatwave 2003 and the Russian heatwave 2010).

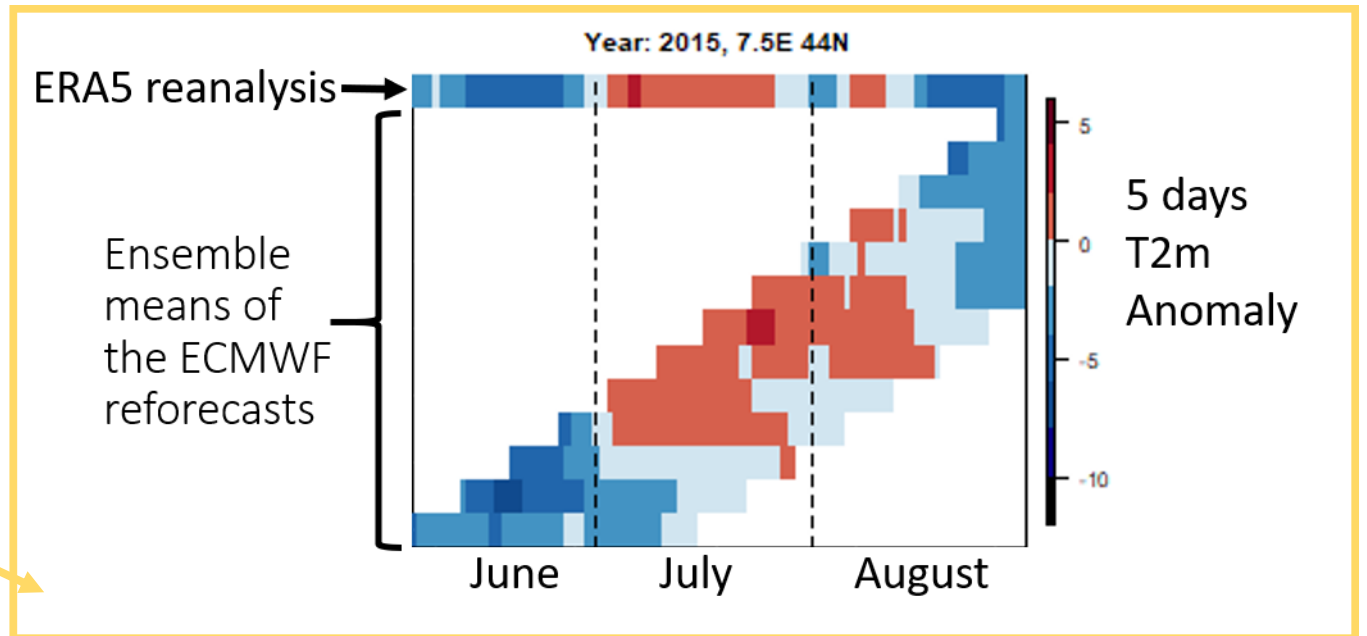
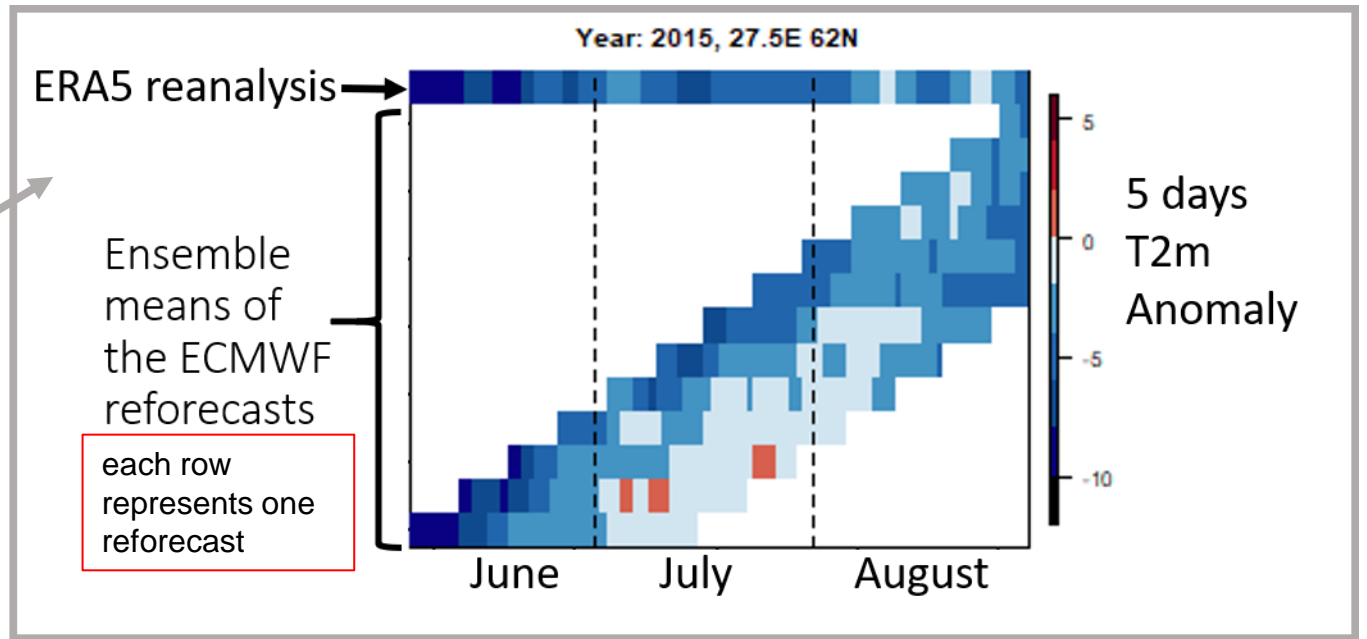
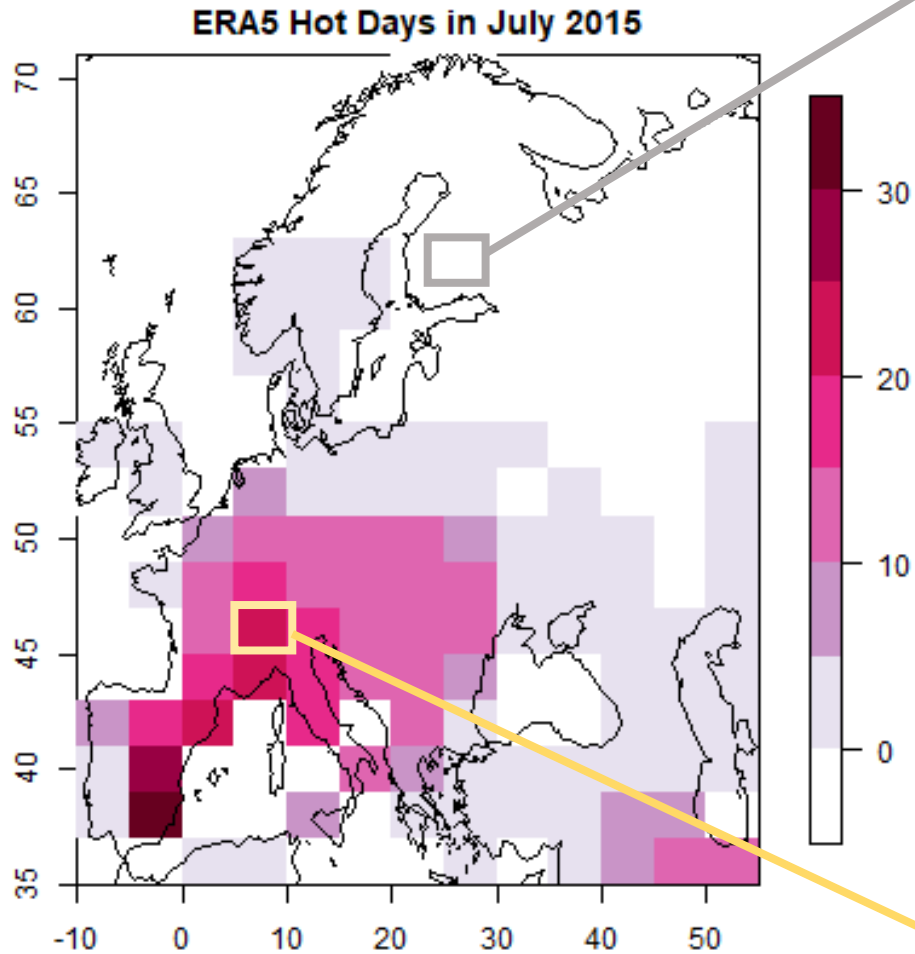
# Verification

- **Parameter:** Hot days - the 5 days running mean temperature is above its summer 90<sup>th</sup> percentile.
- **Period:** summers 2000-2019
- **Area:** continental Europe
- **Grid size:** 5°lon x 2°lat (only land points)
- **Verified against:** ERA5 reanalysis

90th percentile of the 5 days mean  
Temperature (°C) in summers 2000-  
2019

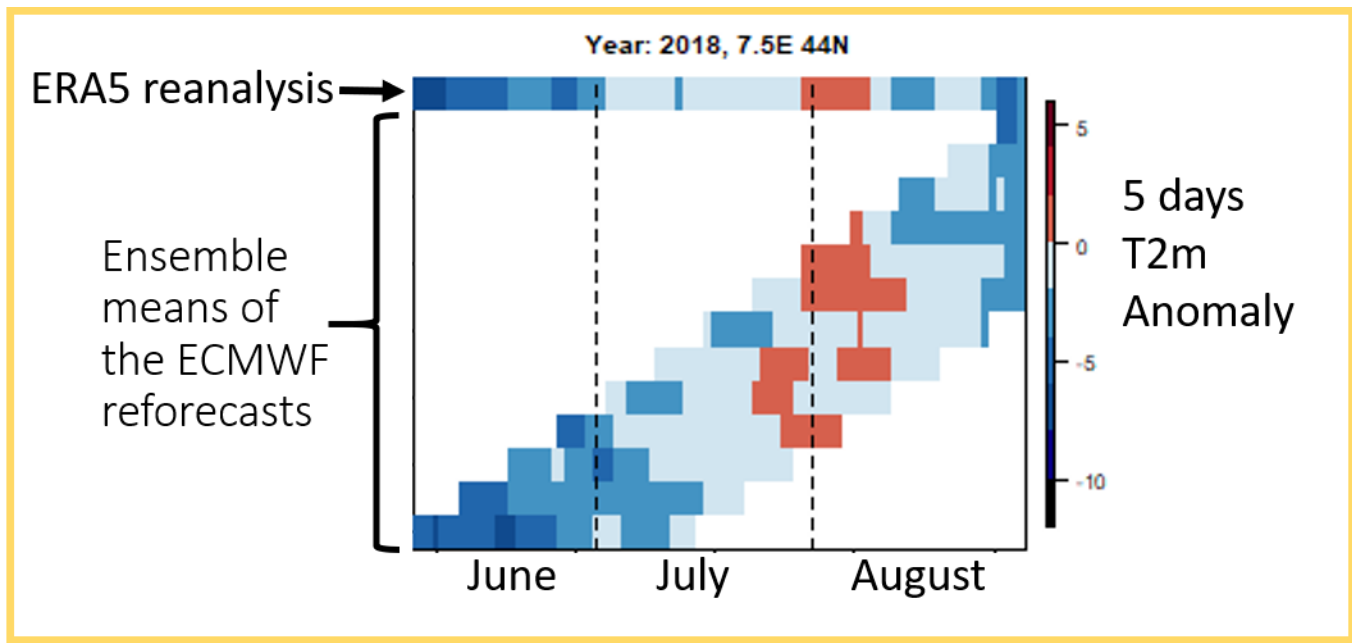
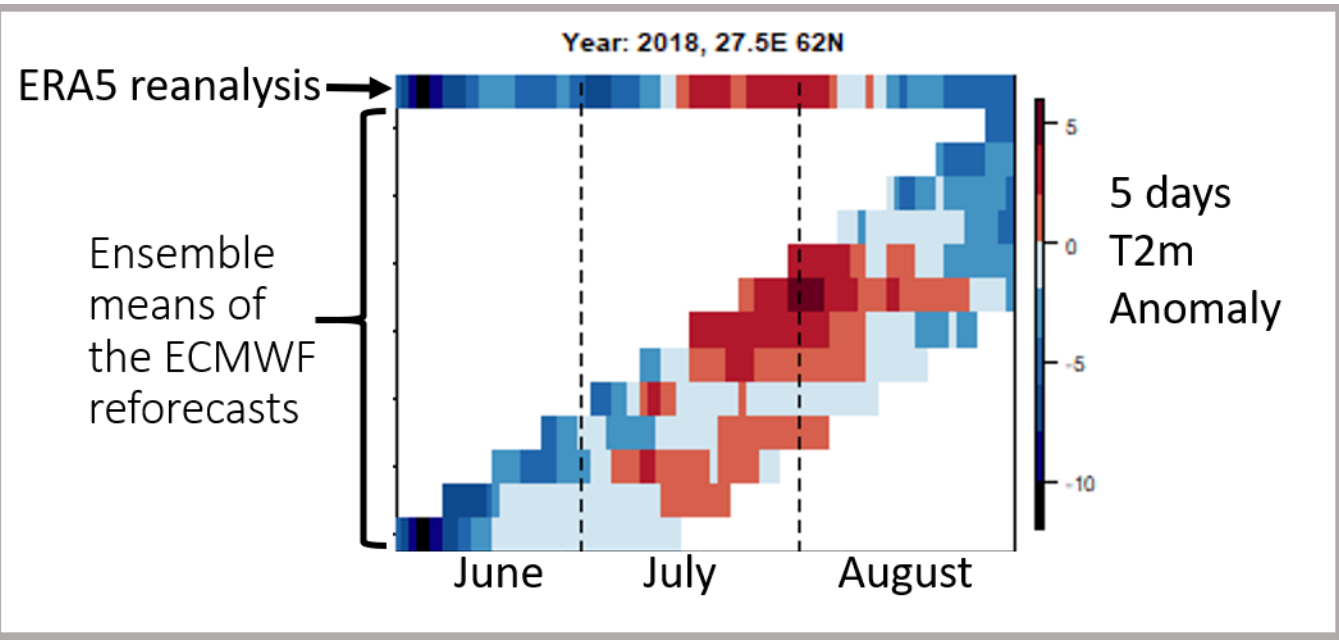
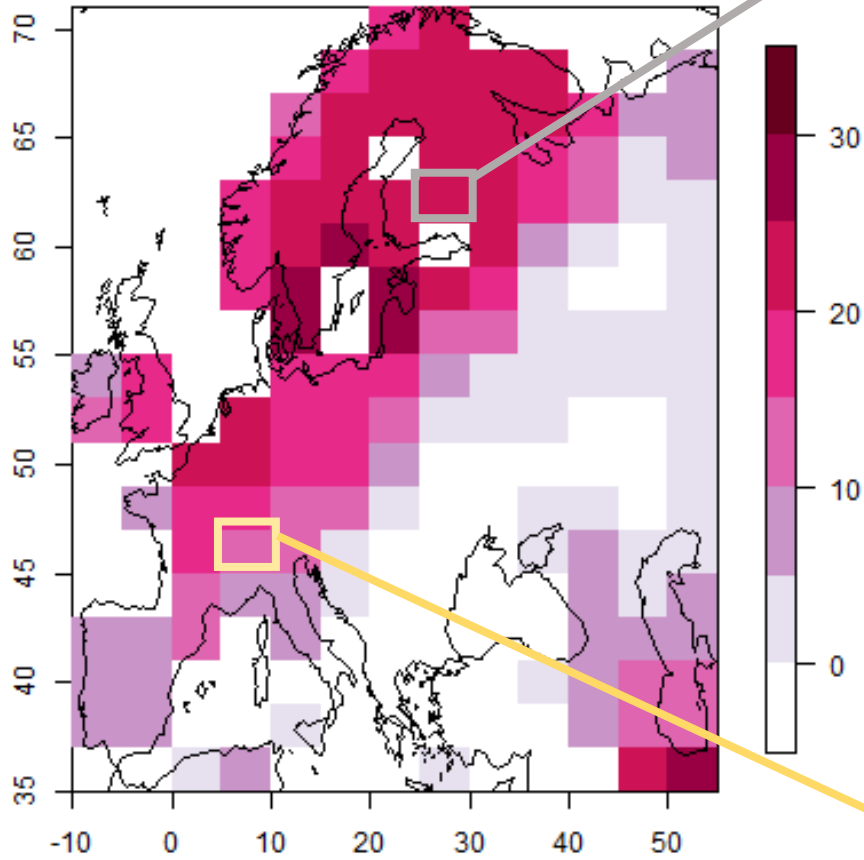


# July 2015 Heat wave



# Mid-July-Mid-August Heat wave 2018

ERA5 Hot Days in Mid-July-Mid-August 2018



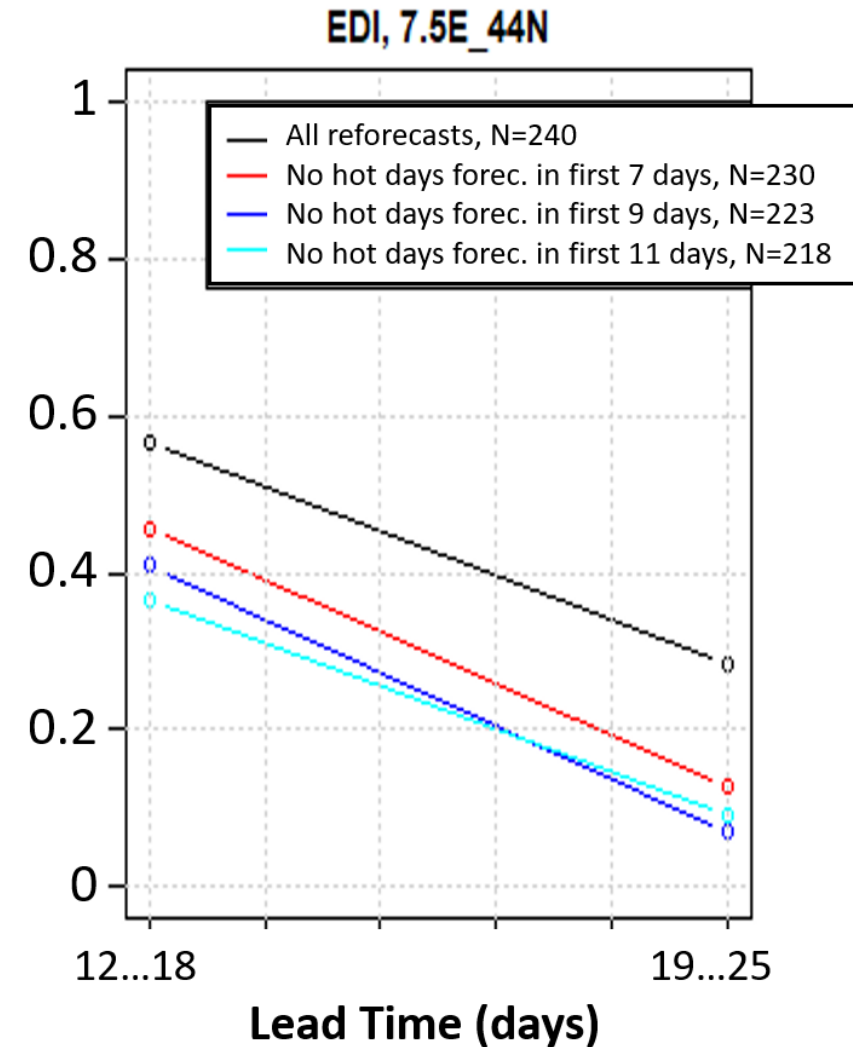
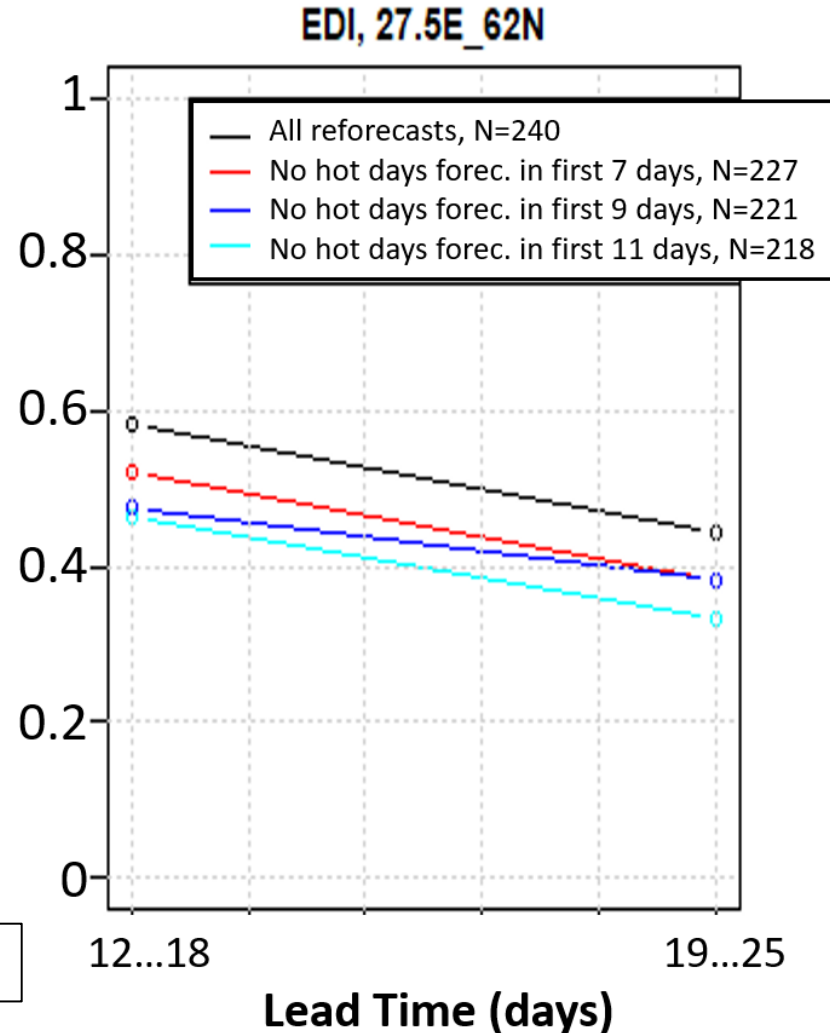
# Deterministic skill at predicting hot days

Extremal Dependence Index:

$$EDI = \frac{\log F - \log H}{\log F + \log H}$$

- **H** is Hit rate: the number of hits divided by the number of observed hot days
- **F** is False Alarm rate: the number of false alarms divided by the observed non-hot days
- The value of **EDI** ranges from -1 to +1, and positive values indicate better than random skill of the forecast system.

EDI: *Ferro and Stephenson (2011)*





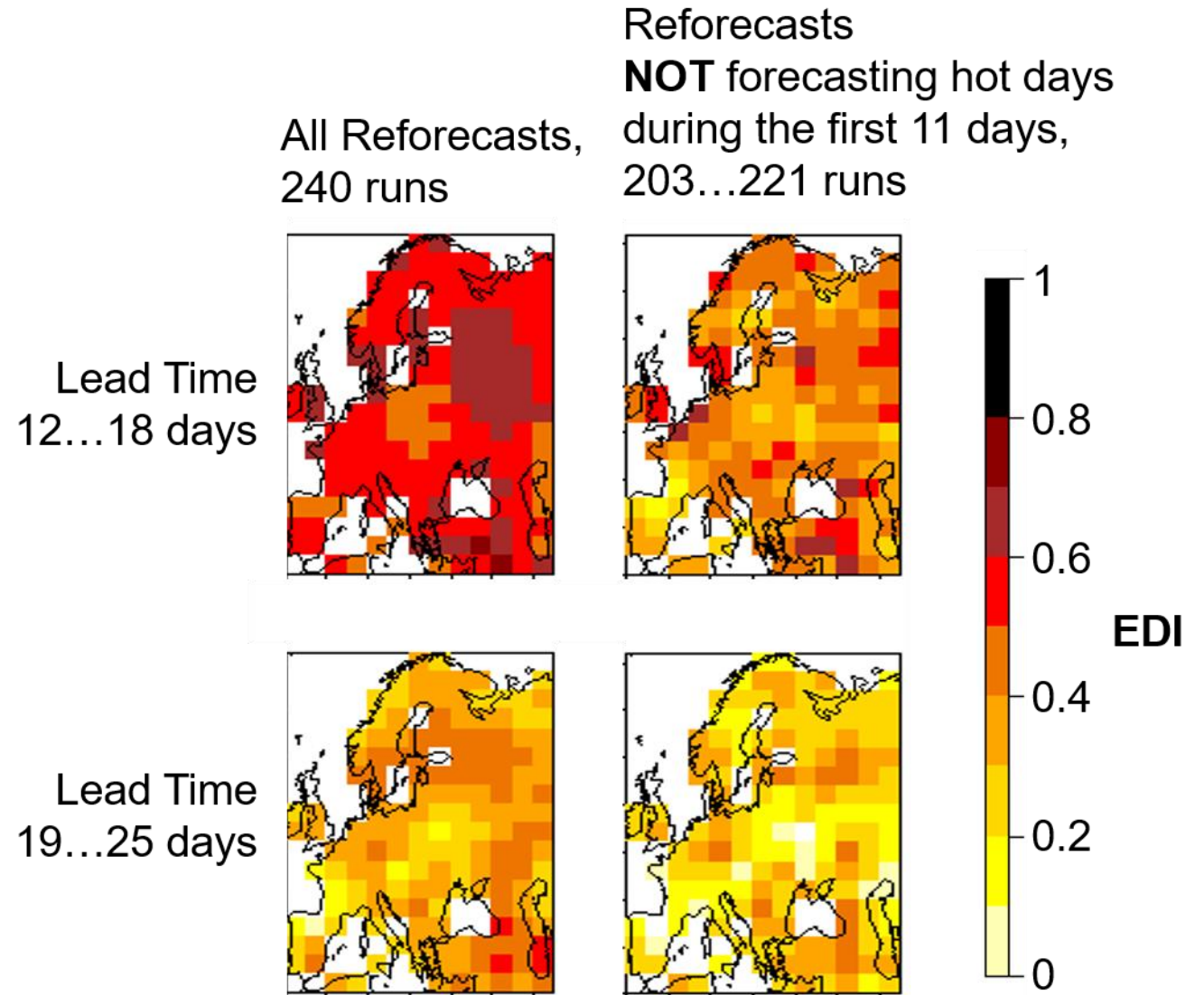
# Deterministic skill at predicting hot days

Extremal Dependence Index:

$$EDI = \frac{\log F - \log H}{\log F + \log H}$$

- $H$  is Hit rate and
- $F$  is False Alarm rate.
- The value of **EDI** ranges from -1 to +1, and positive values indicate better than random skill of the forecast system.
- EDI measures the deterministic skill at predicting hot days

EDI: *Ferro and Stephenson (2011)*



# The potential aid of these forecasts

- Energy production
- Health sector
- Farmers
- Management of water resources

It could be emphasized that on the mesoscale those reforecasts, in which hot day(s) were forecasted to occur during the first 11 days, were more skillful on lead times up to 25 days than the rest of the heat wave forecasts.



# Summary

- Severe European heatwaves:
  - Spatial extent: several 100 km to 1000 km
  - Duration: several weeks, even longer than 1 month
- Temperature reforecast of the ECMWF
  - were most skillful in predicting the life cycle of a heat wave (lasting up to 25 days) about a week before its start and during its course (Korhonen et al., in preparation)



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**Thank you for your attention!**

**Questions or comments?**

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