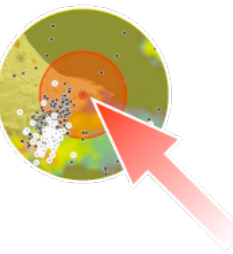




European  
Civil Protection

# HAREN



## **Radar-based rainfall nowcasting at European scale**

### long-term evaluation and performance assessment

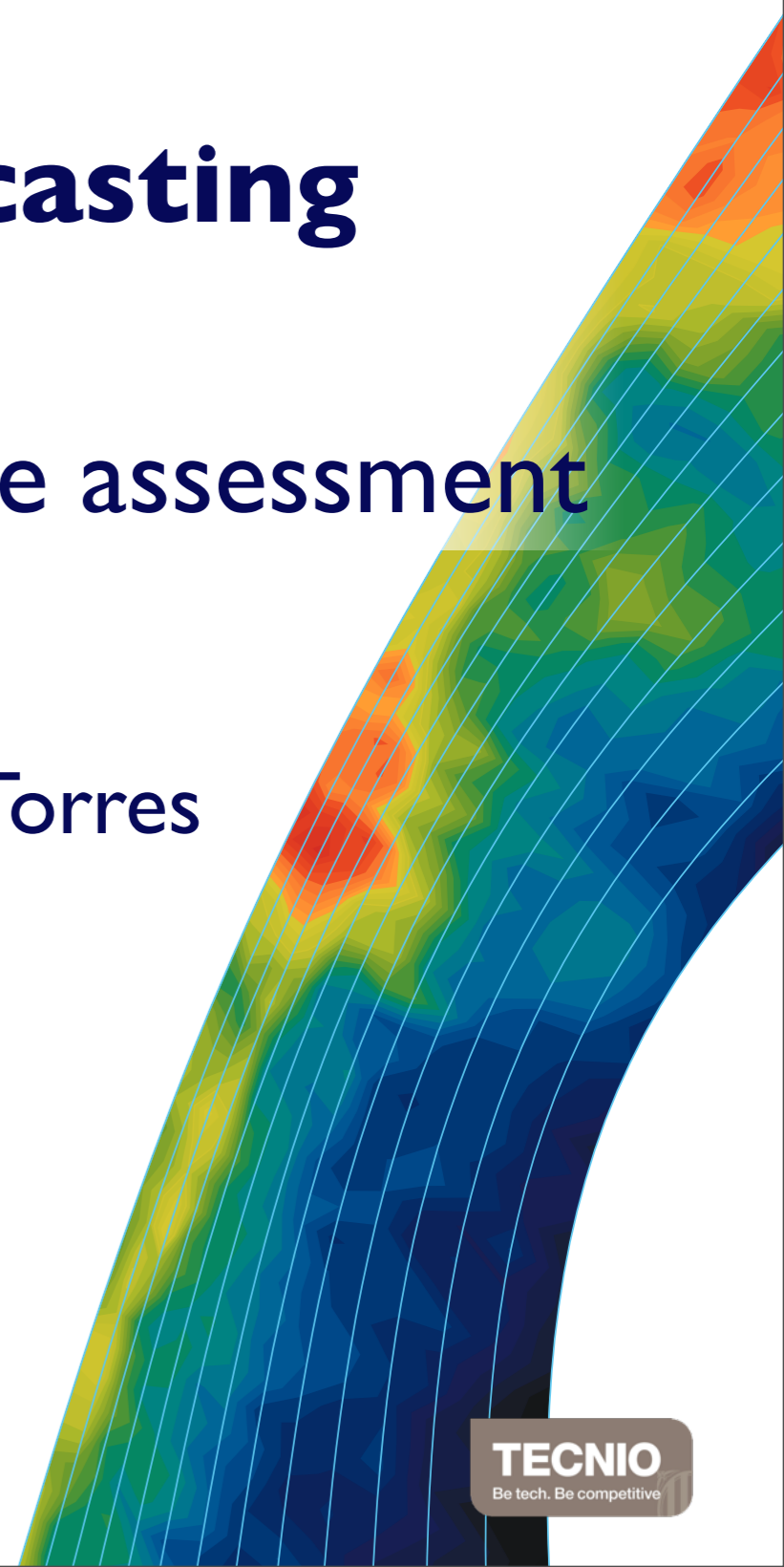
Marc Berenguer, Daniel Sempere-Torres



Centre de Recerca Aplicada  
en Hidrometeorologia

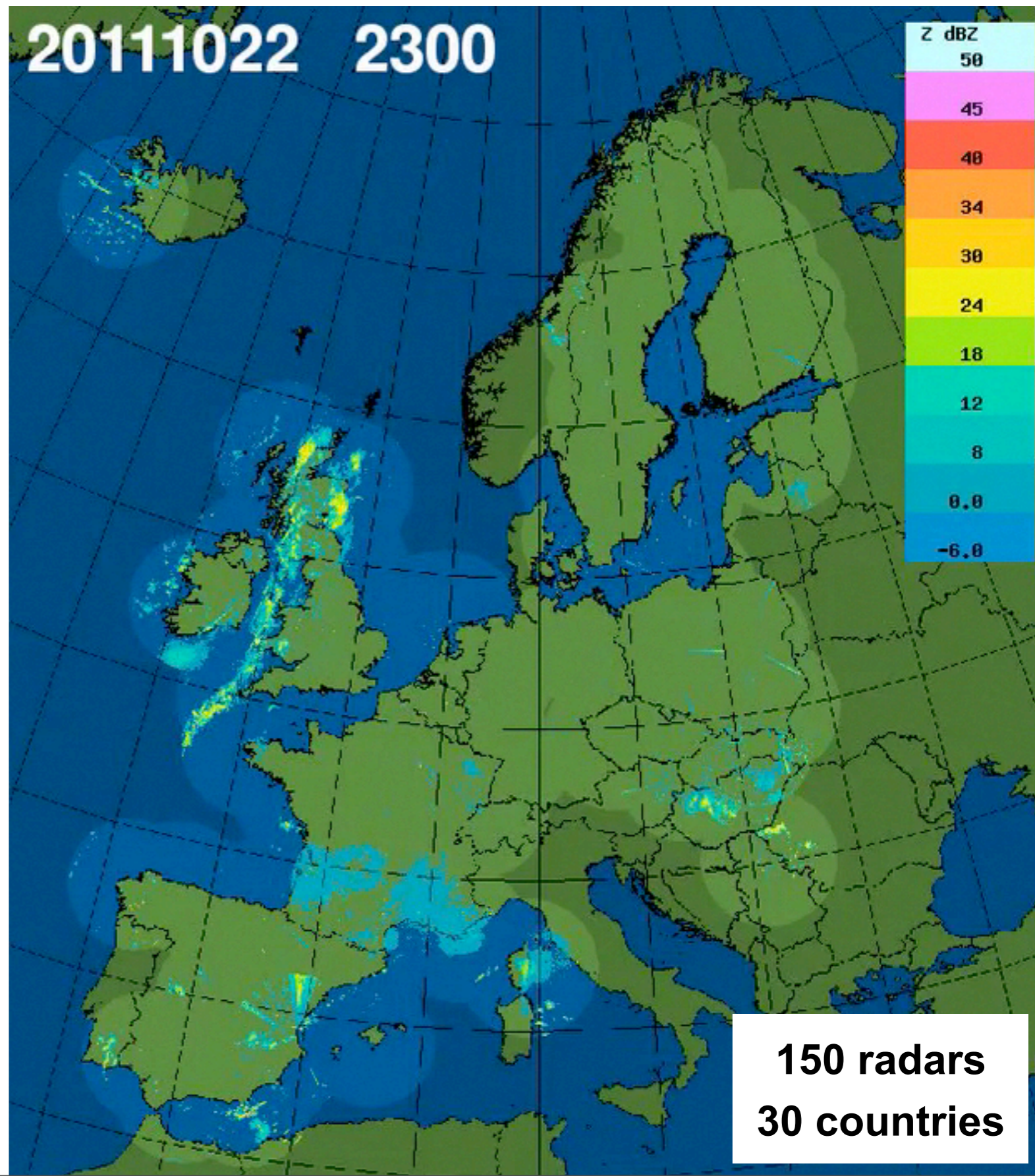
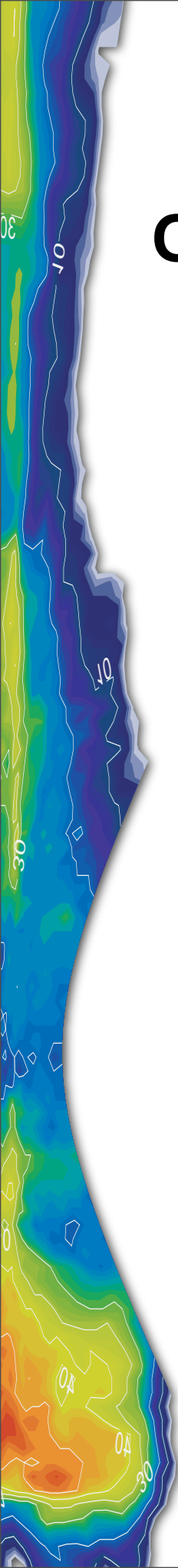
UNIVERSITAT POLITÈCNICA DE CATALUNYA

**TECNIO**  
Be tech. Be competitive



# OPERA radar mosaic

OPERA radar mosaic:

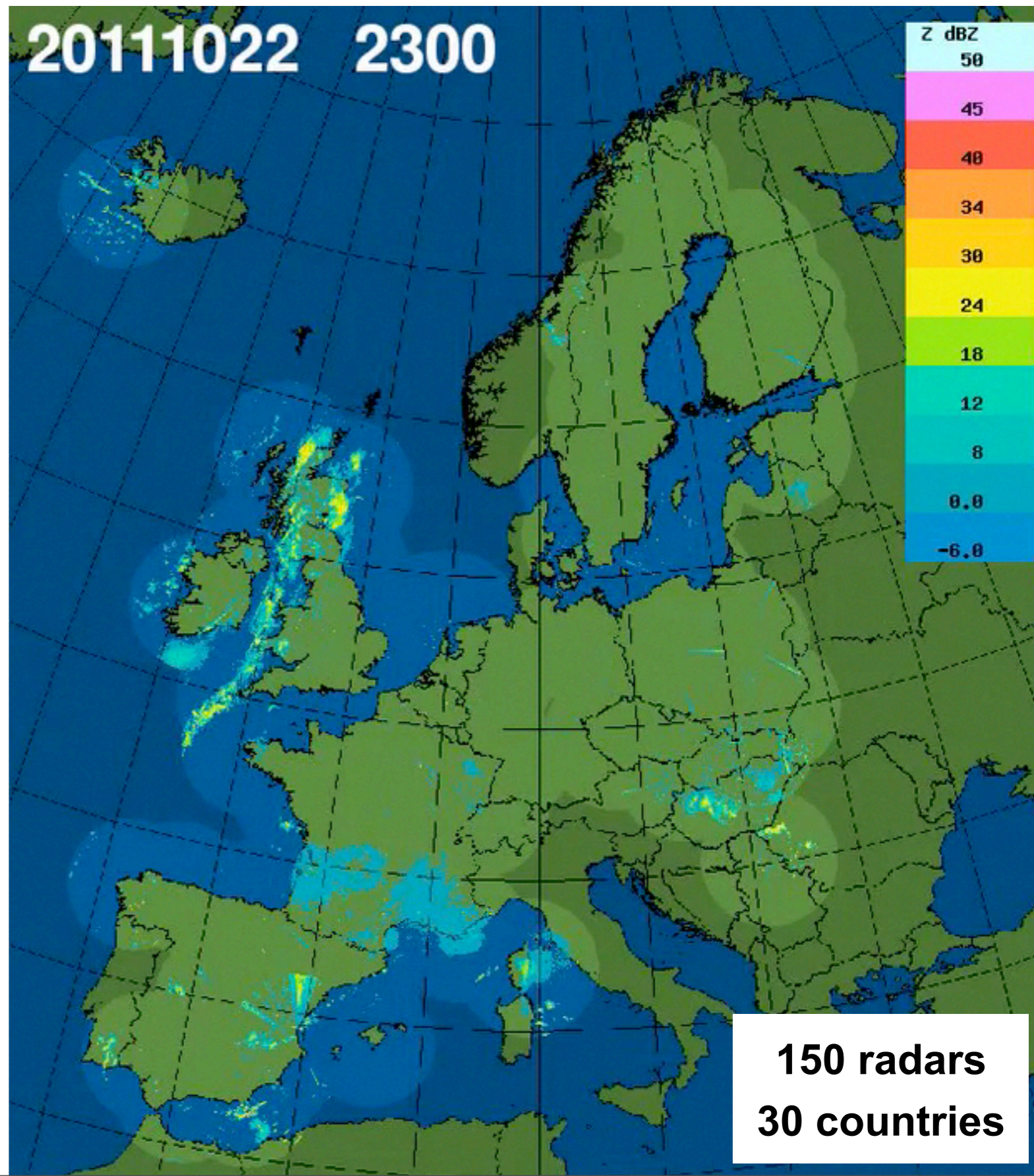




# OPERA radar mosaic

## OPERA radar mosaic:

- Precipitation observations over Europe @2 km and every 15 minutes.

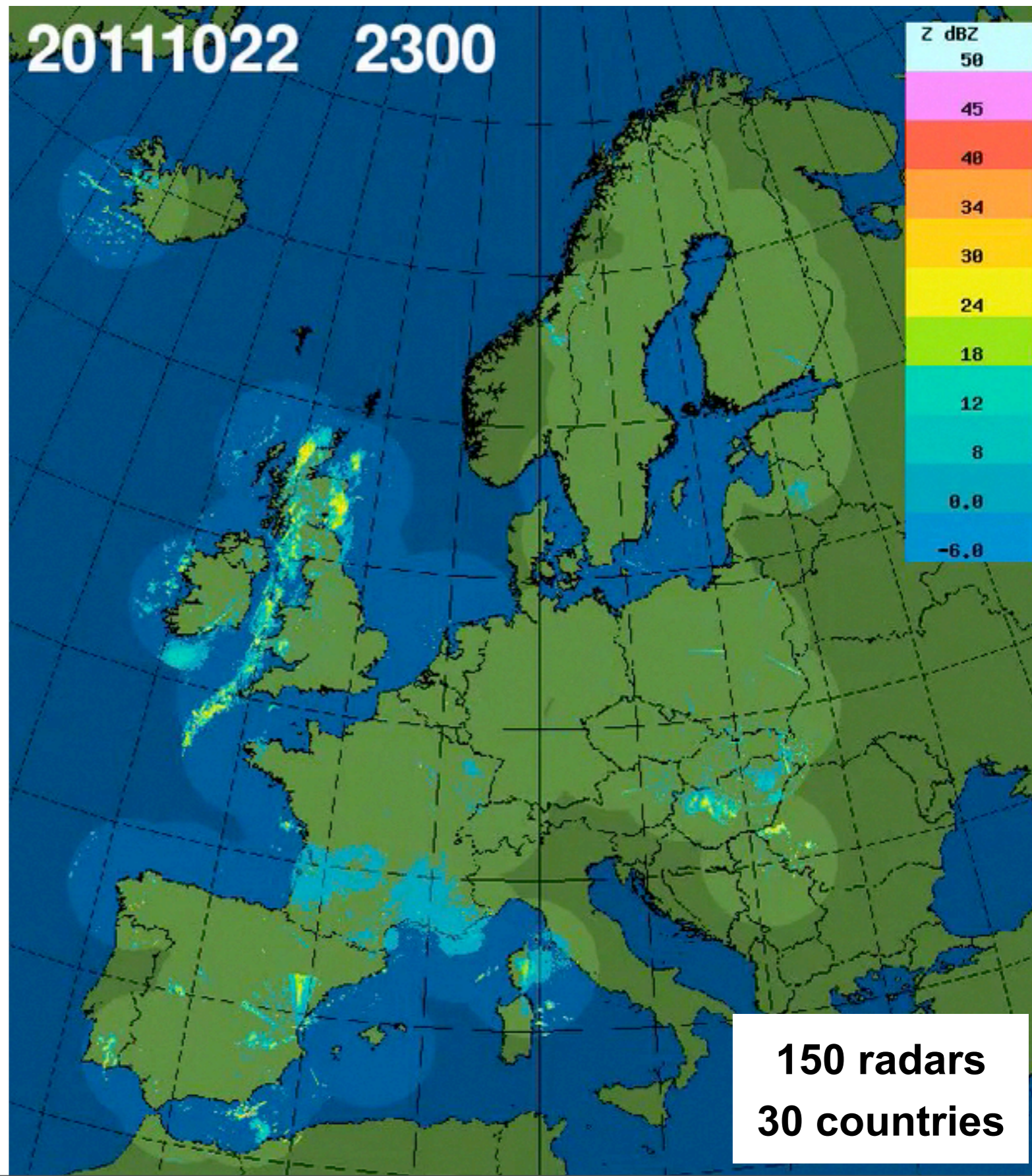




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- Precipitation observations over Europe @2 km and every 15 minutes.
- Operationally produced since mid 2011.

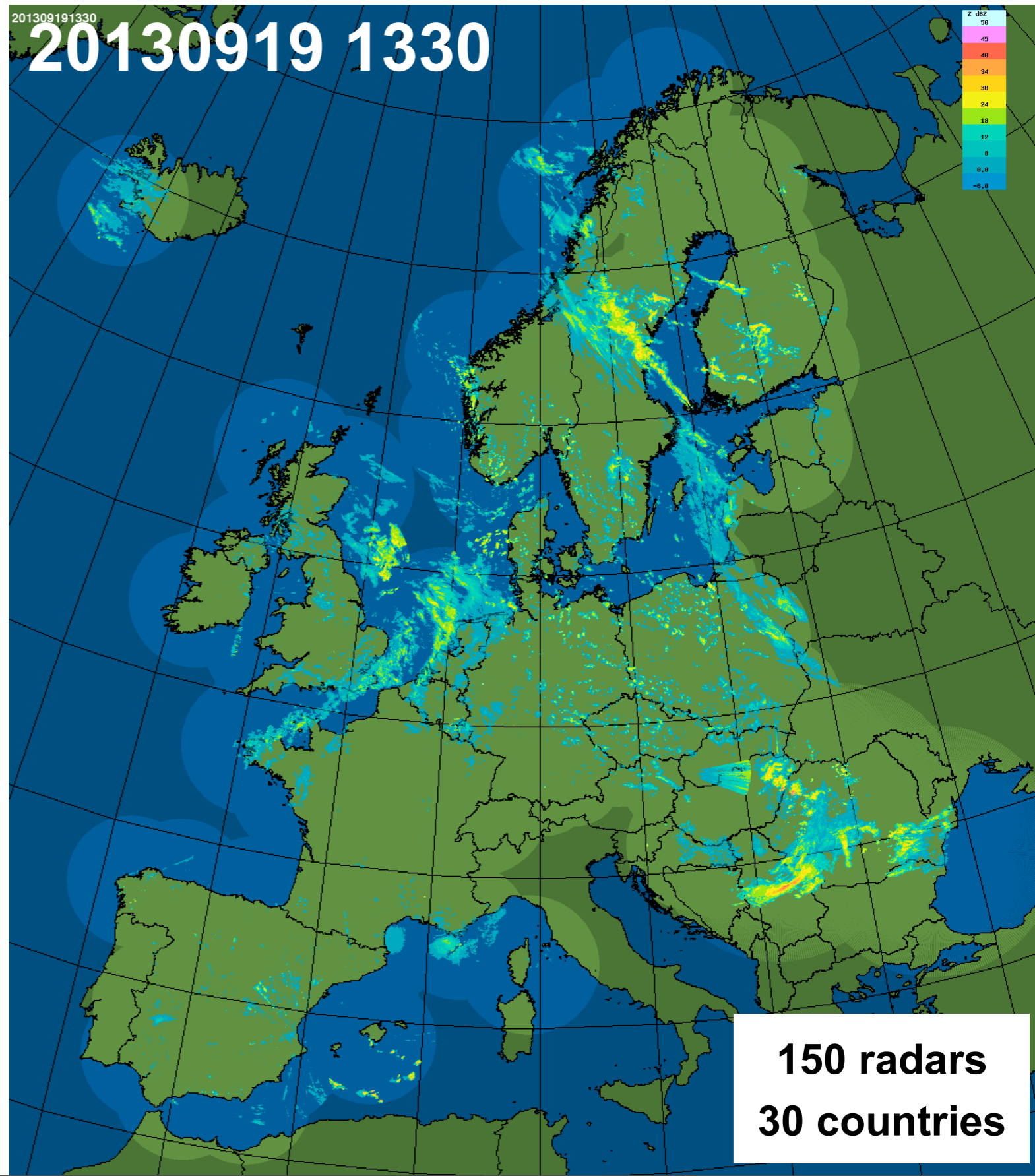




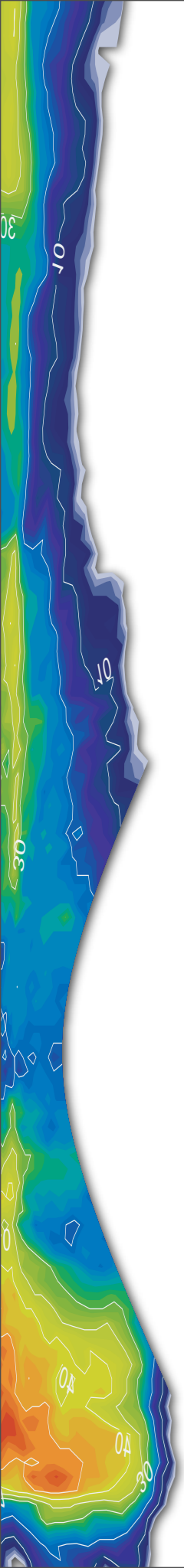
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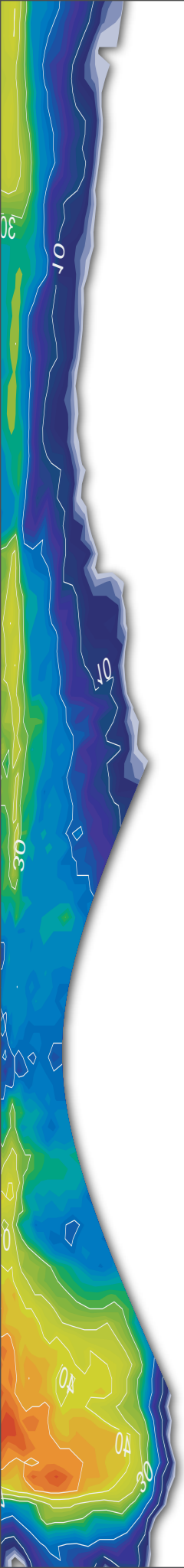
# OPERA radar mosaic





# OPERA radar mosaic

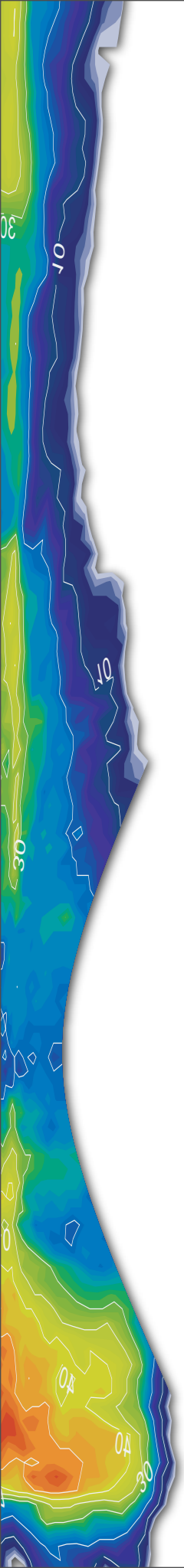
## The European NEXRAD?



# OPERA radar mosaic

## The European NEXRAD?

- Many C-band radars.

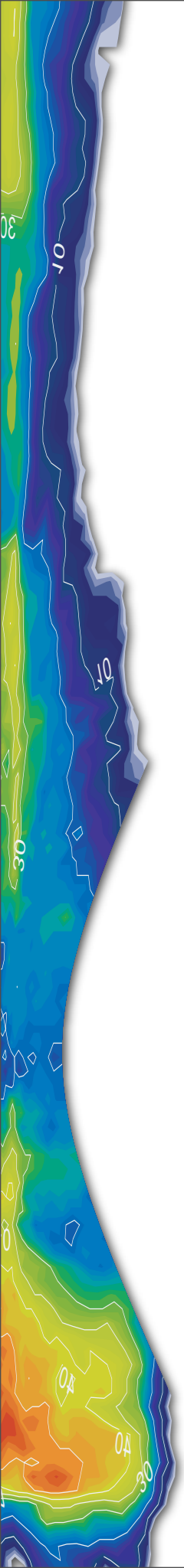




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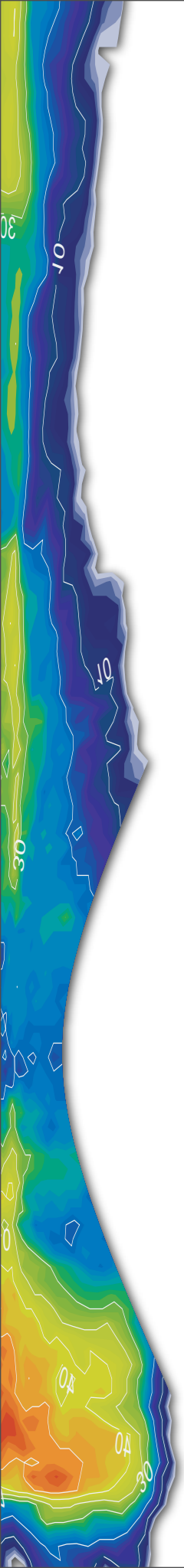
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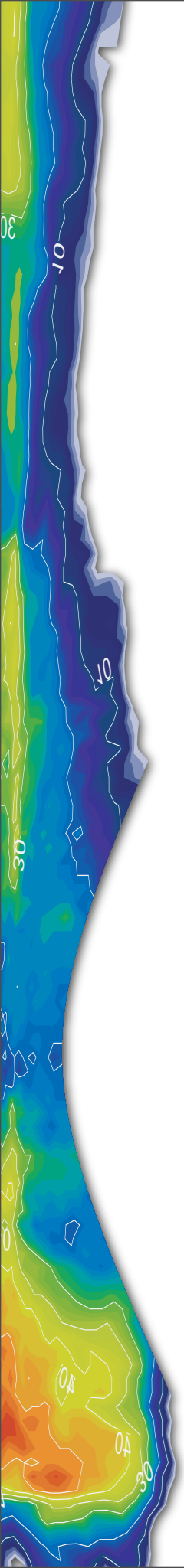
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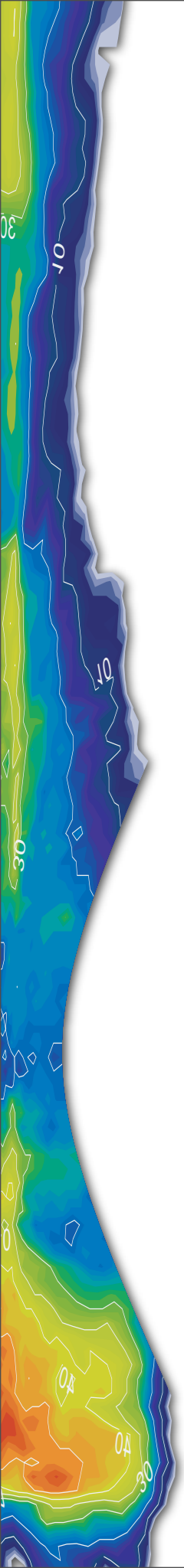




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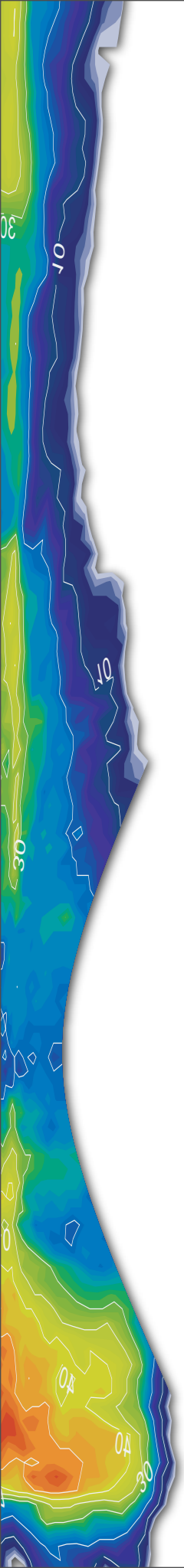
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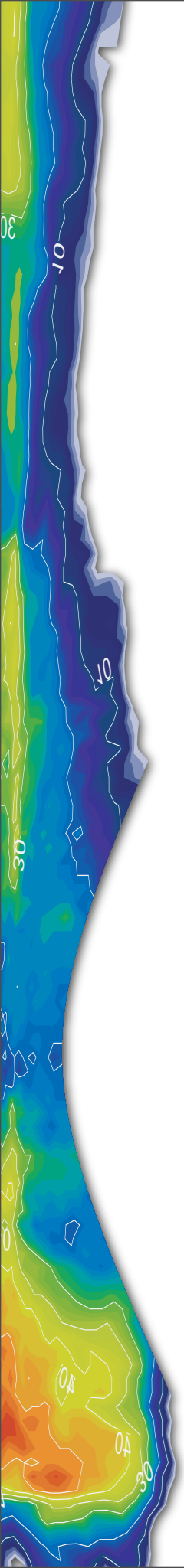
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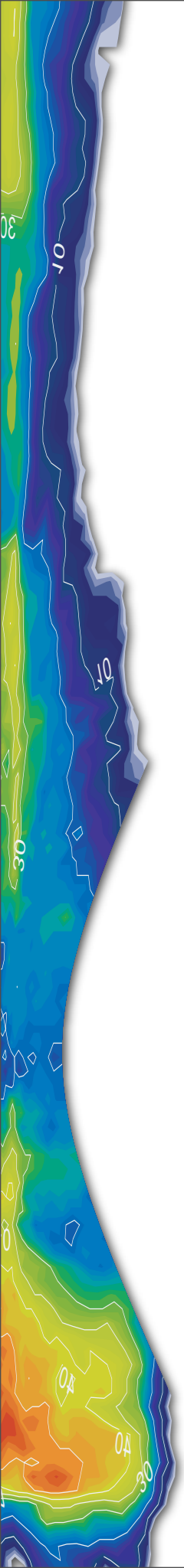




# OPERA radar mosaic

## The European NEXRAD?

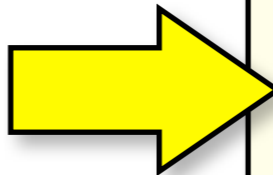
- Many C-band radars.
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- OPERA radar density is about twice that of NEXRAD.



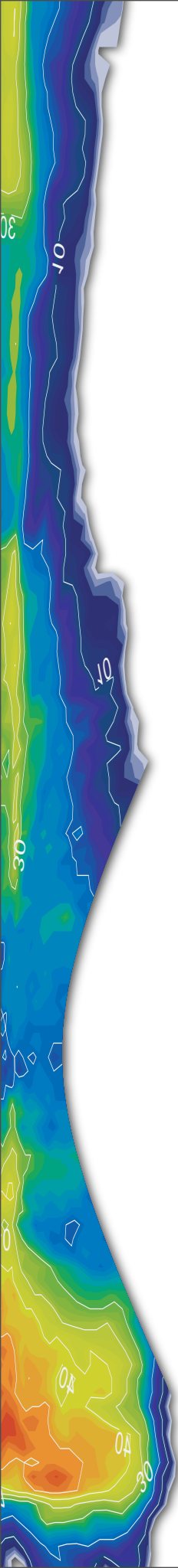
# OPERA radar mosaic

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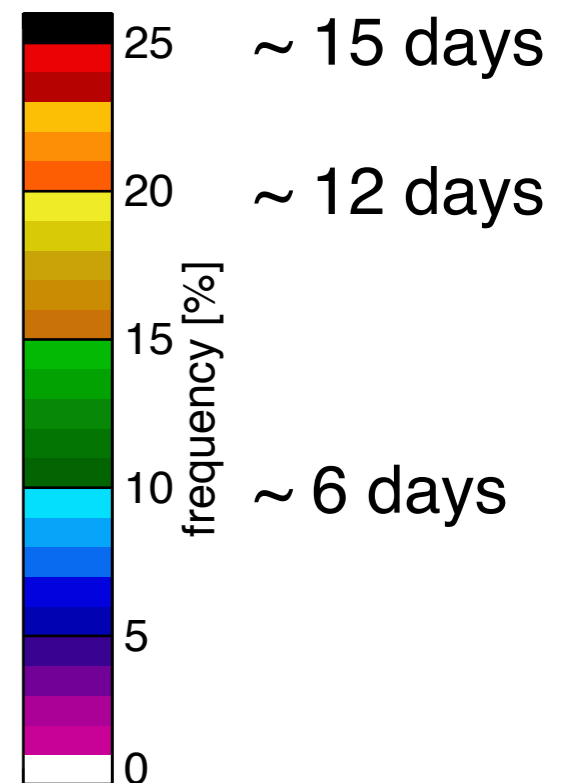
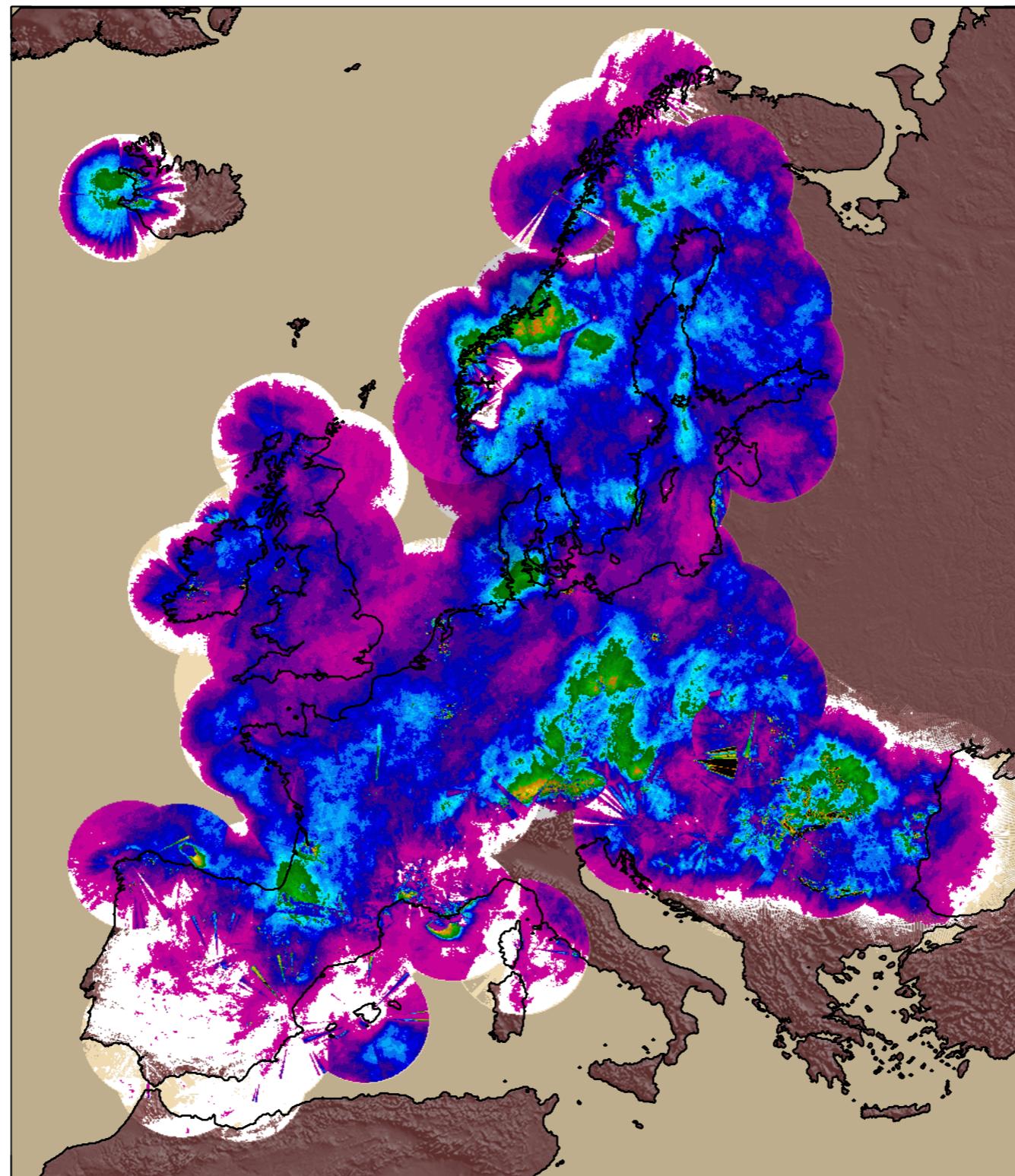
The EU composite is not homogeneous in quality.





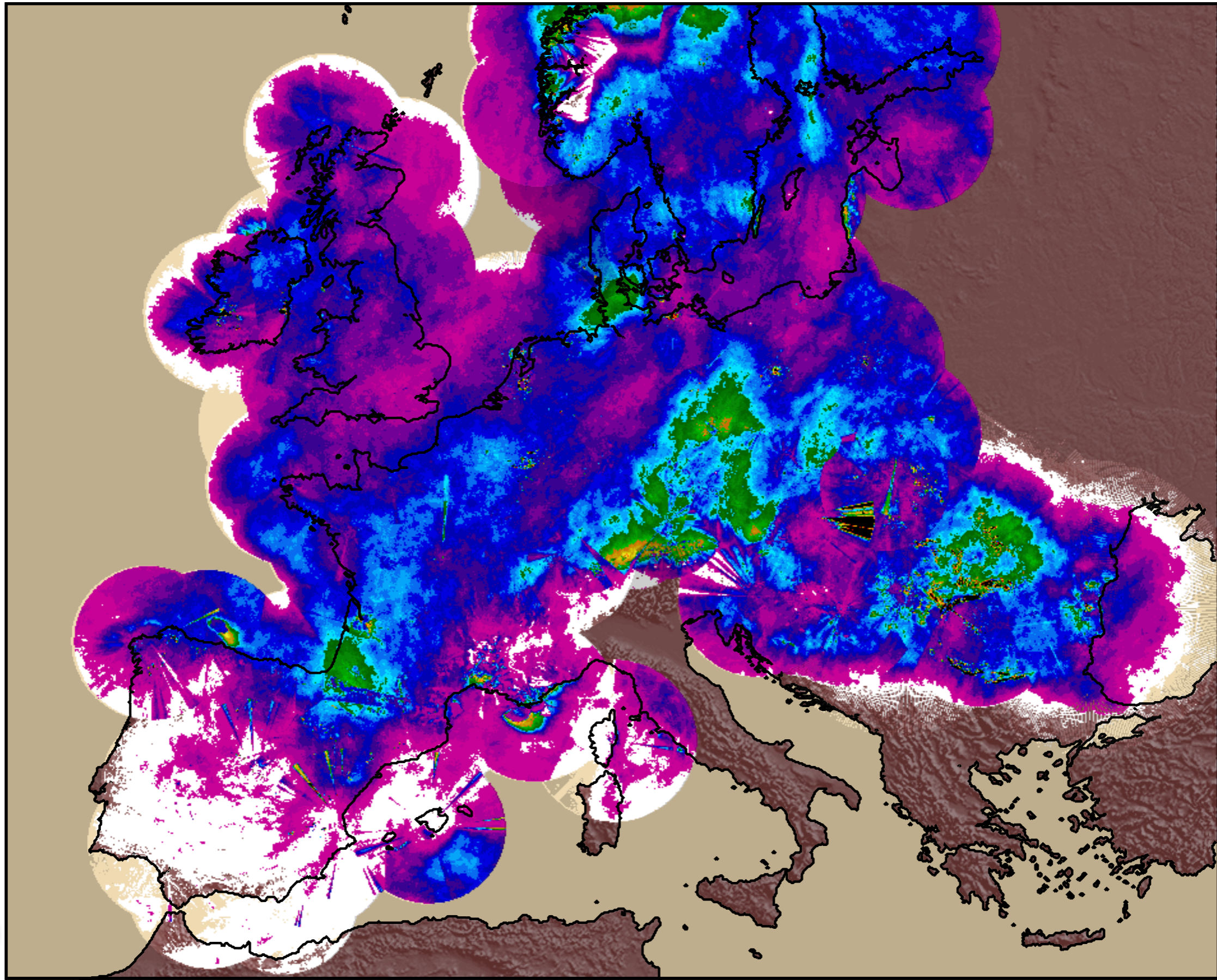
# Frequency of rain (dBZ > 10 dBZ)

in the period **01 June - 30 June 2013**



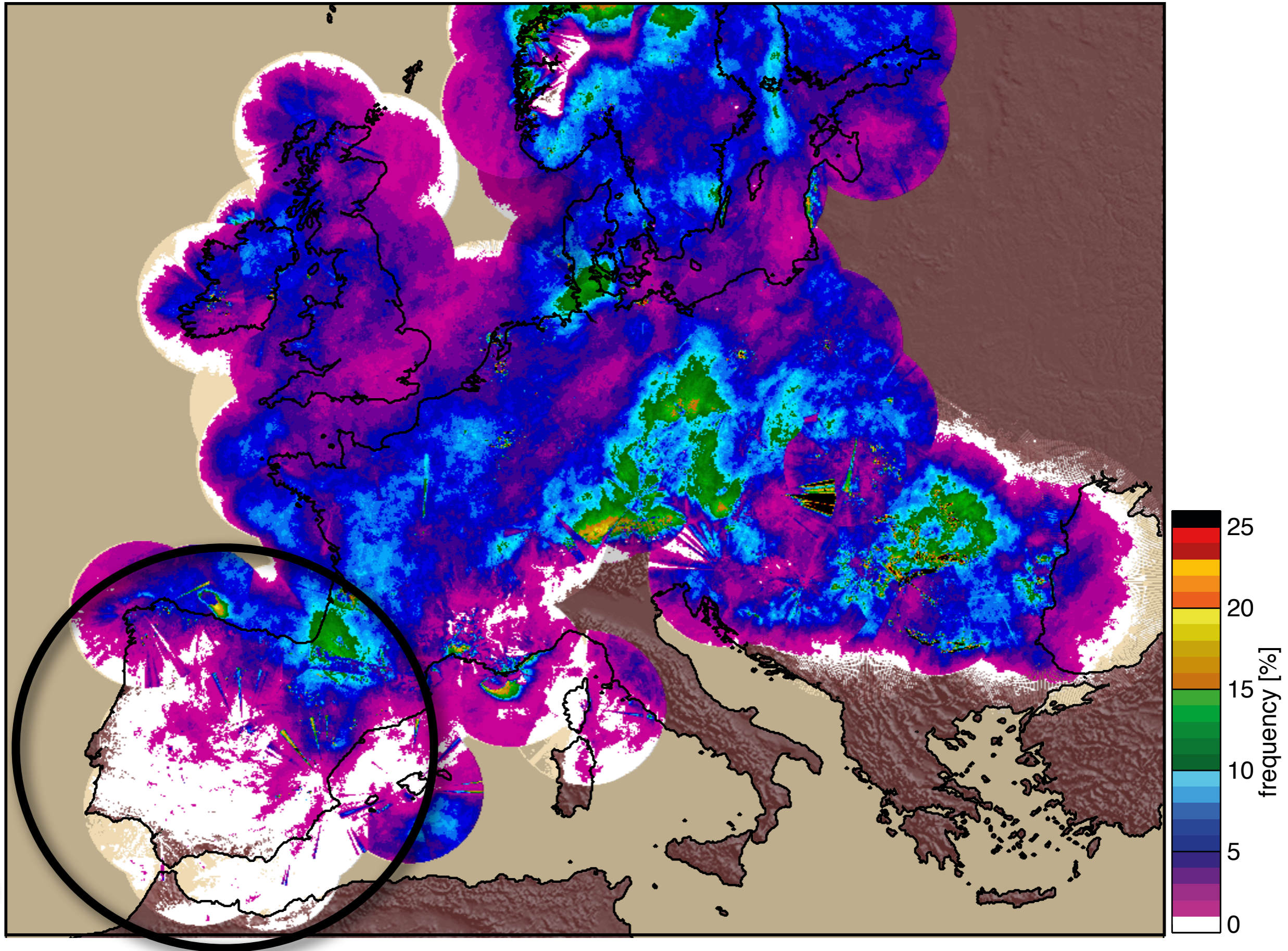


# Frequency dBZ > 10 dBZ



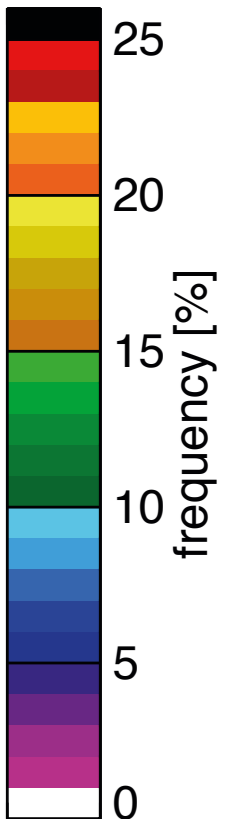
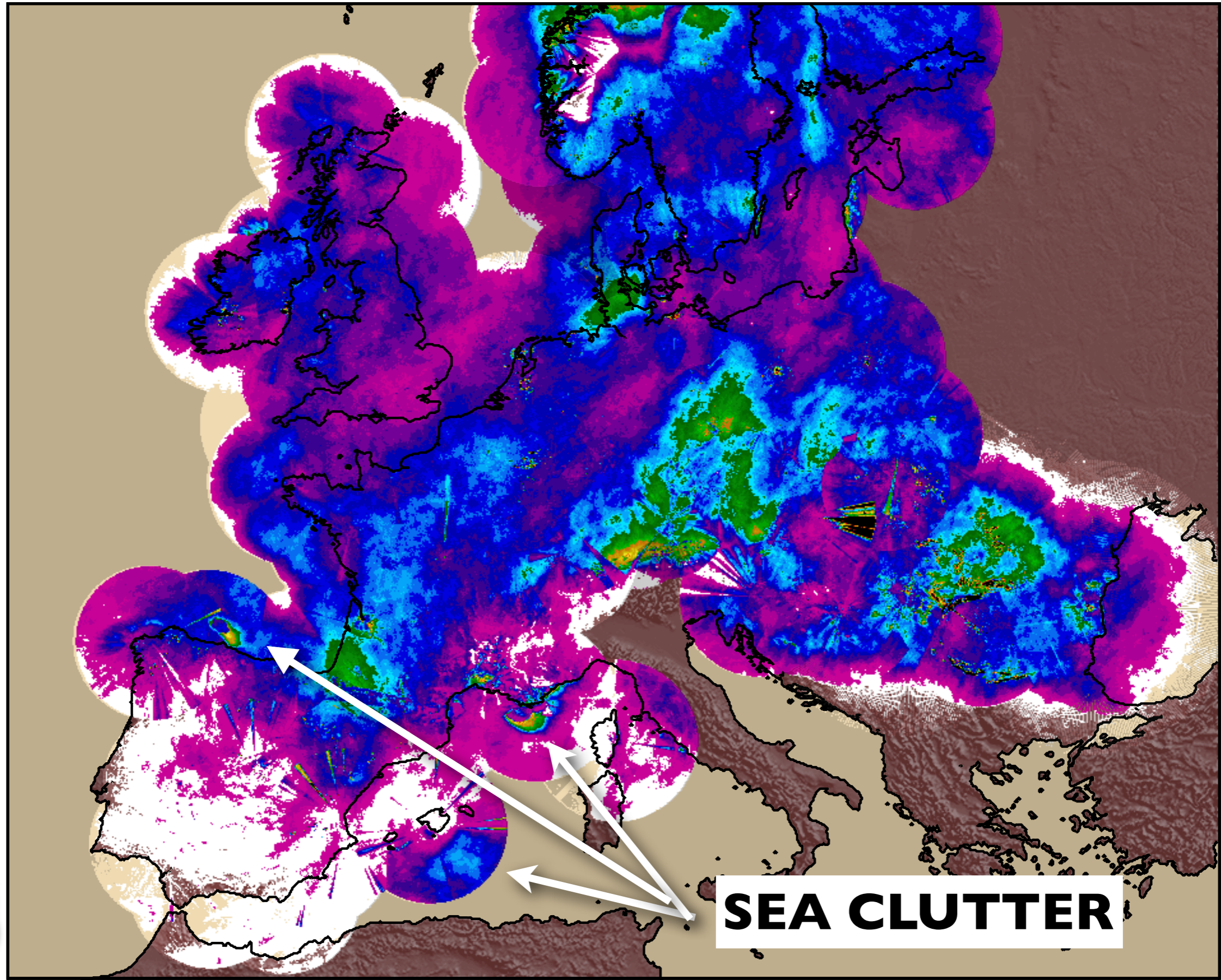


# Frequency dBZ > 10 dBZ



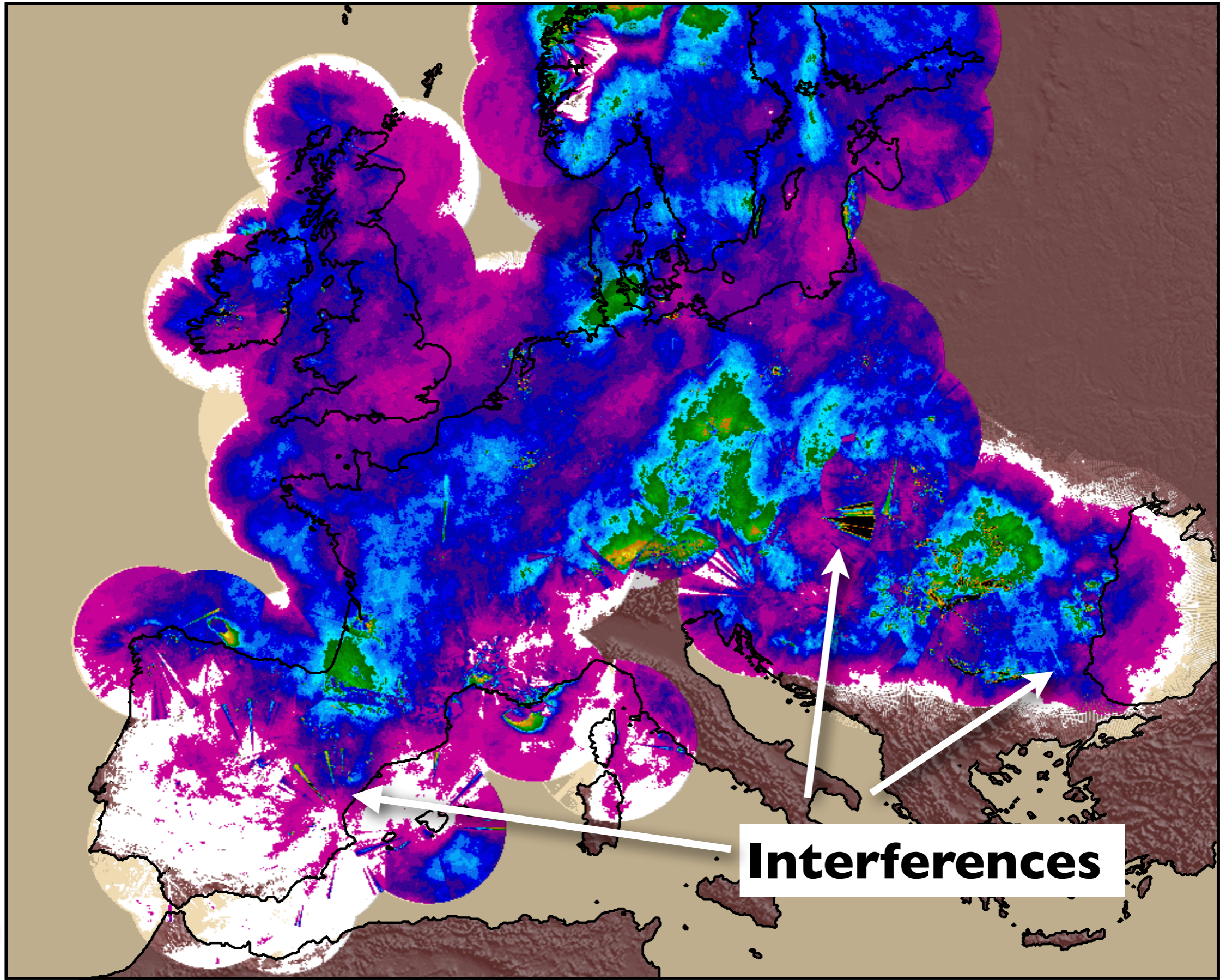


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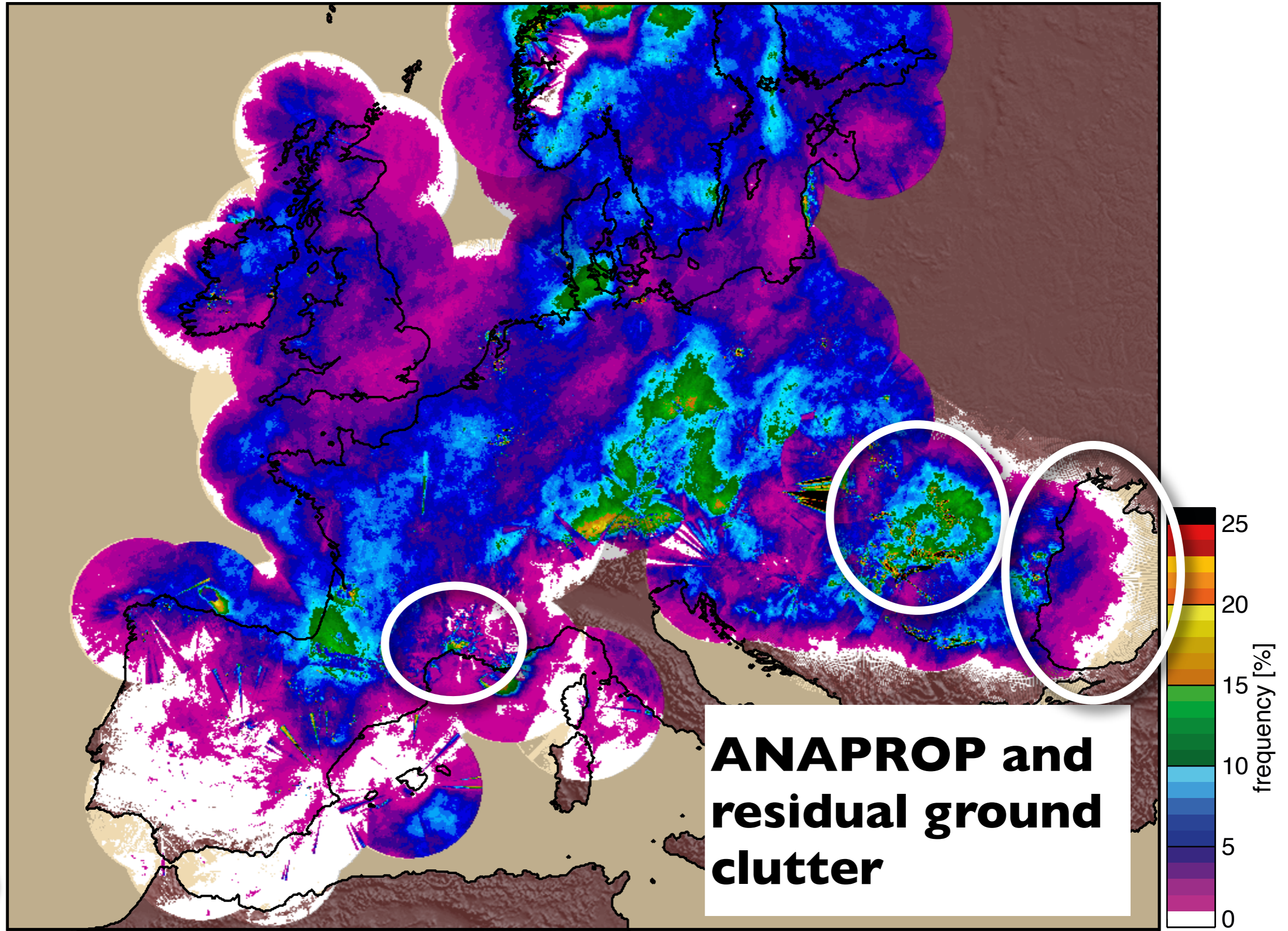


# Frequency dBZ > 10 dBZ





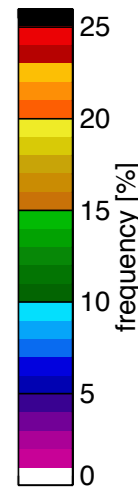
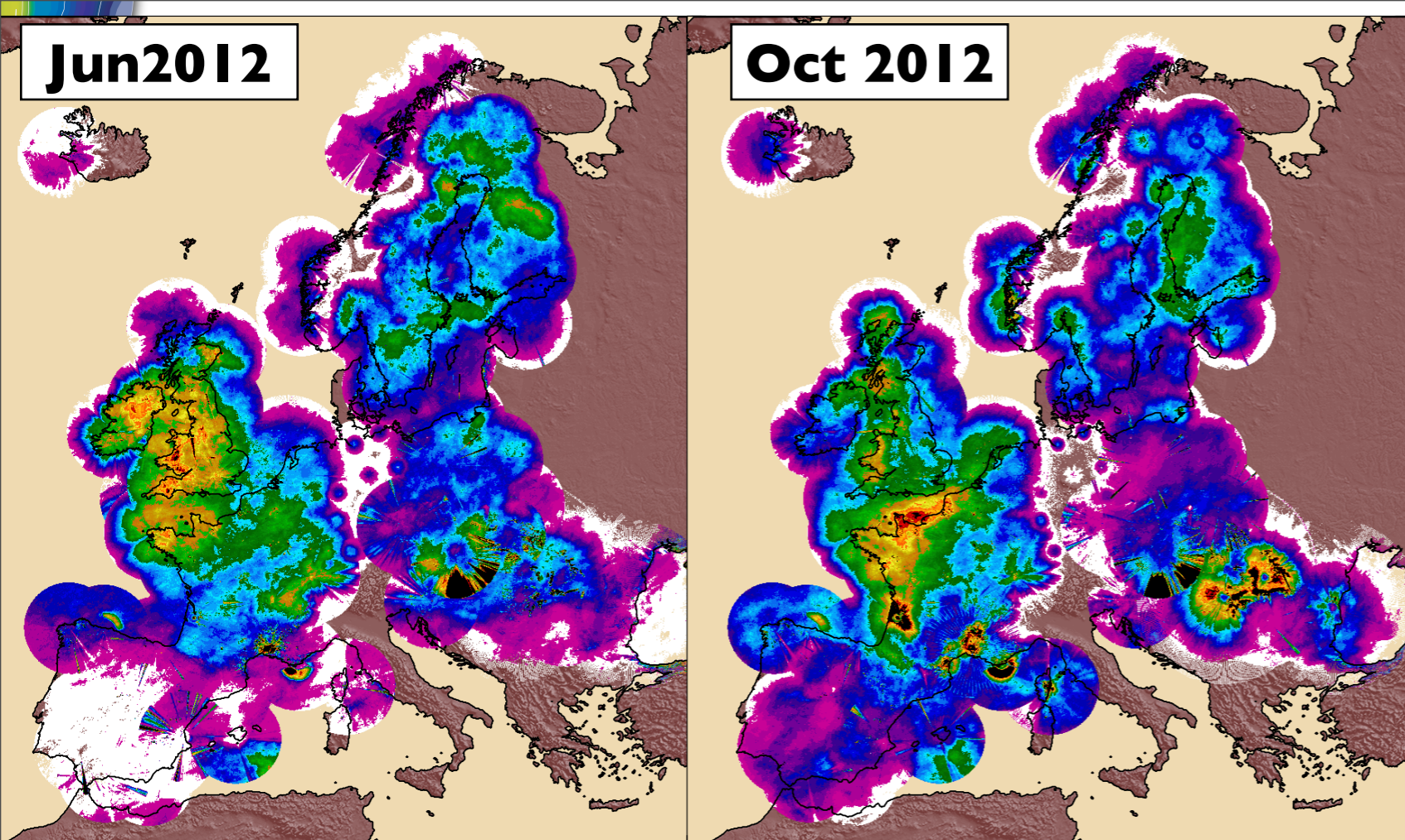
# Frequency dBZ > 10 dBZ





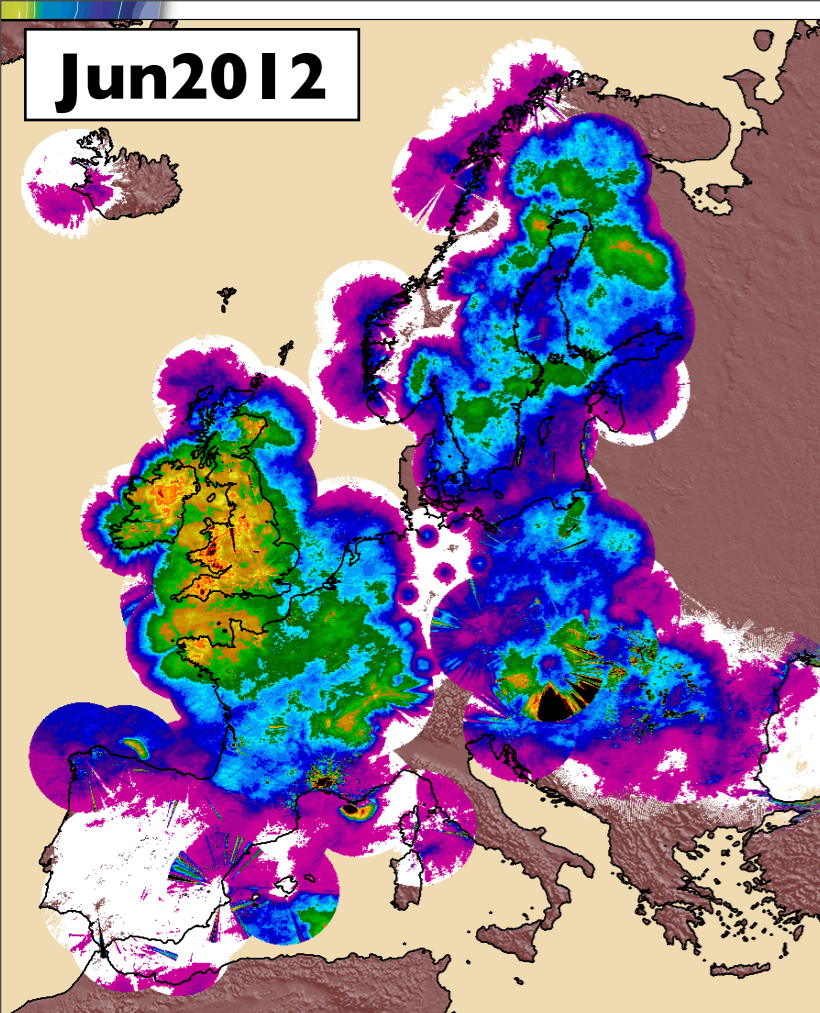
**Jun2012**

**Oct 2012**

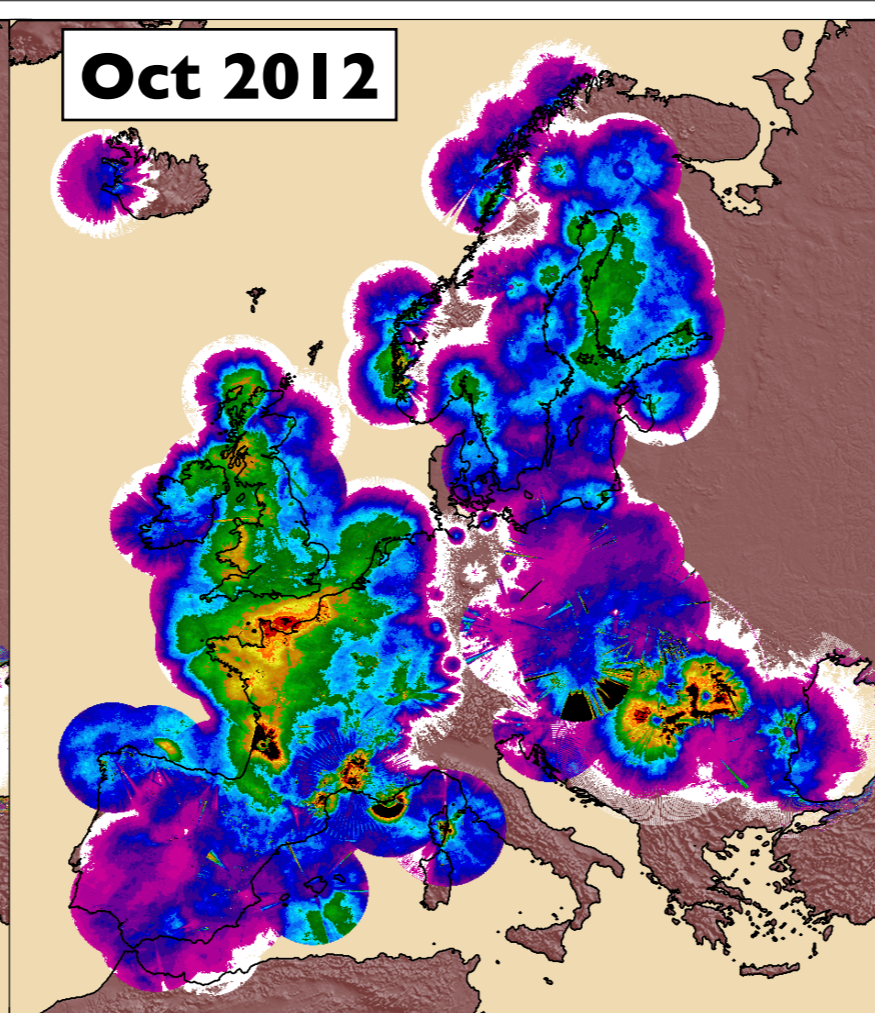




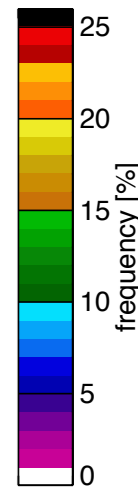
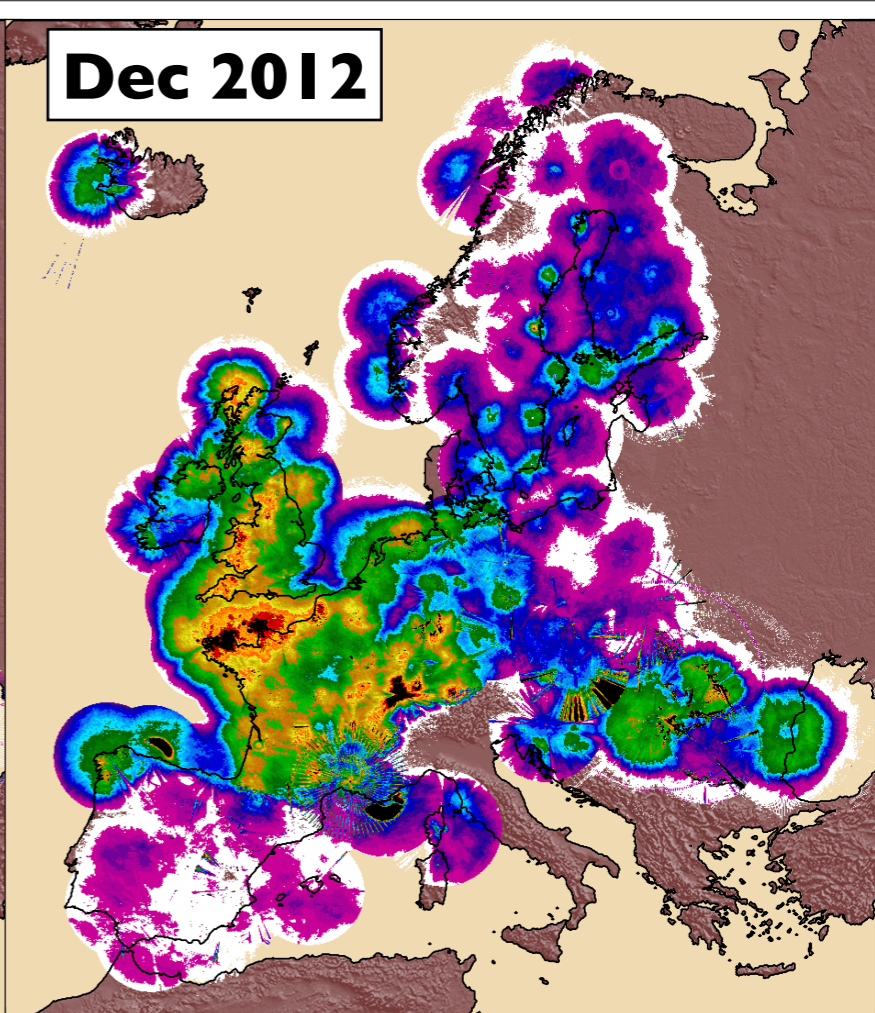
**Jun2012**



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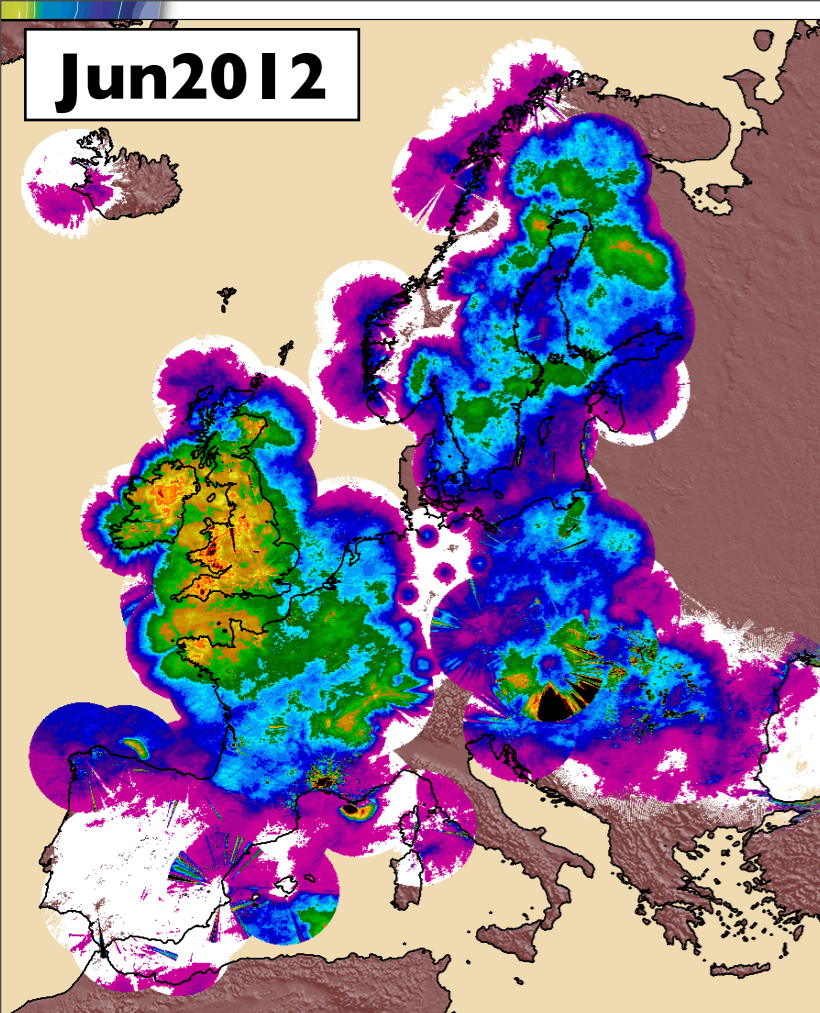


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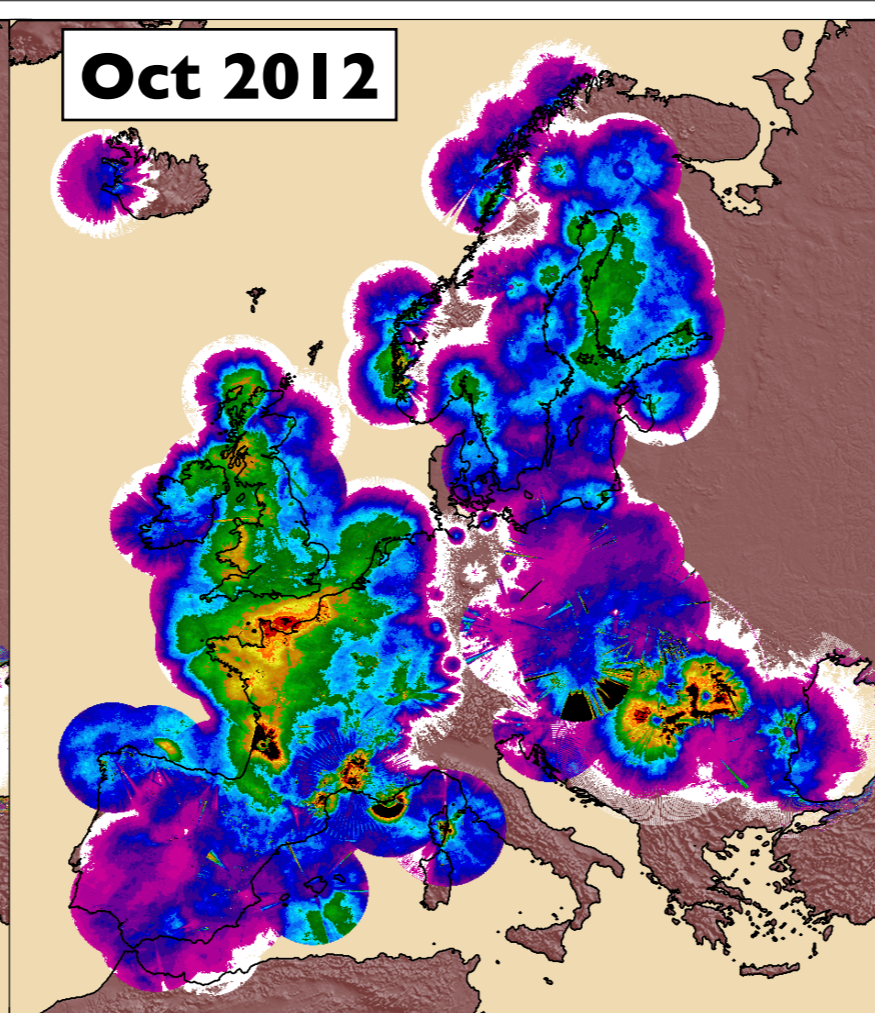




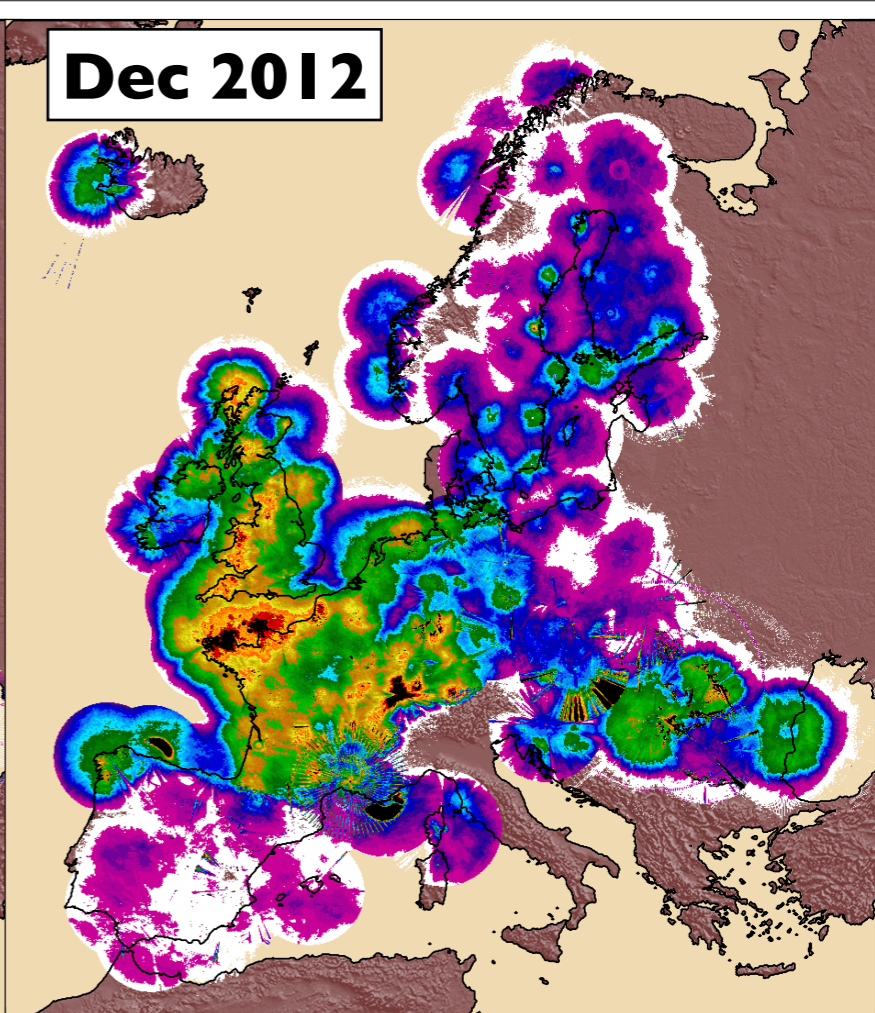
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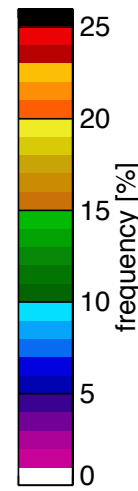
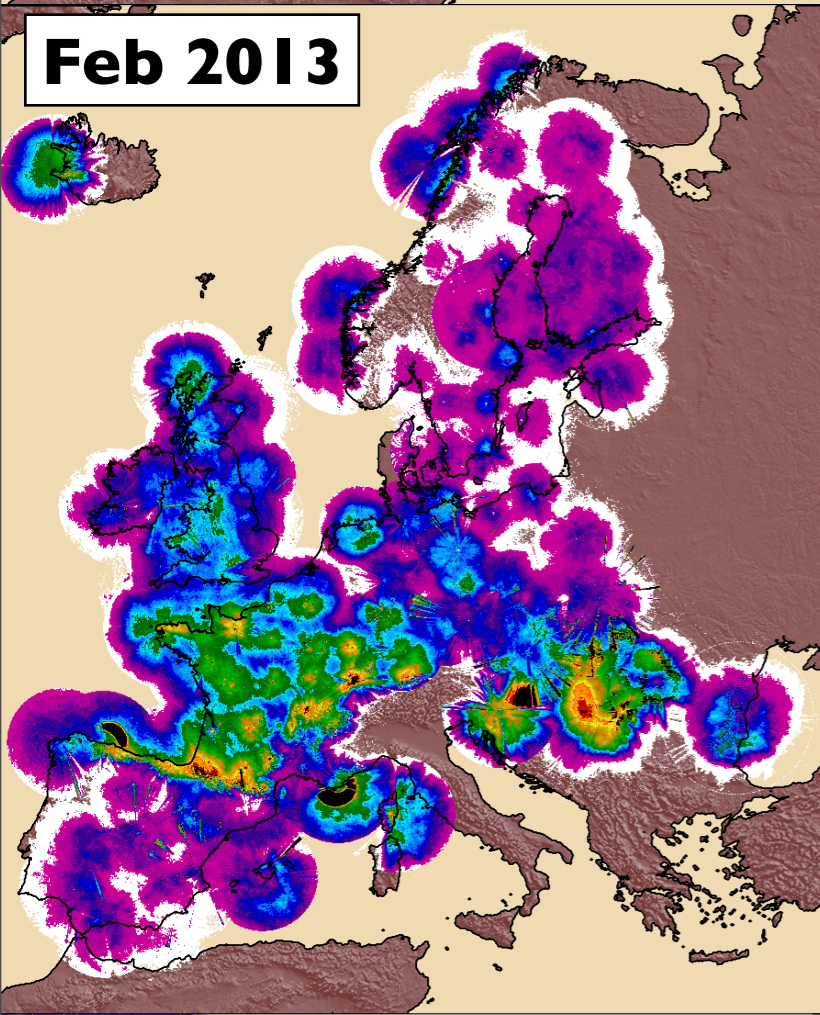
**Oct 2012**



**Dec 2012**

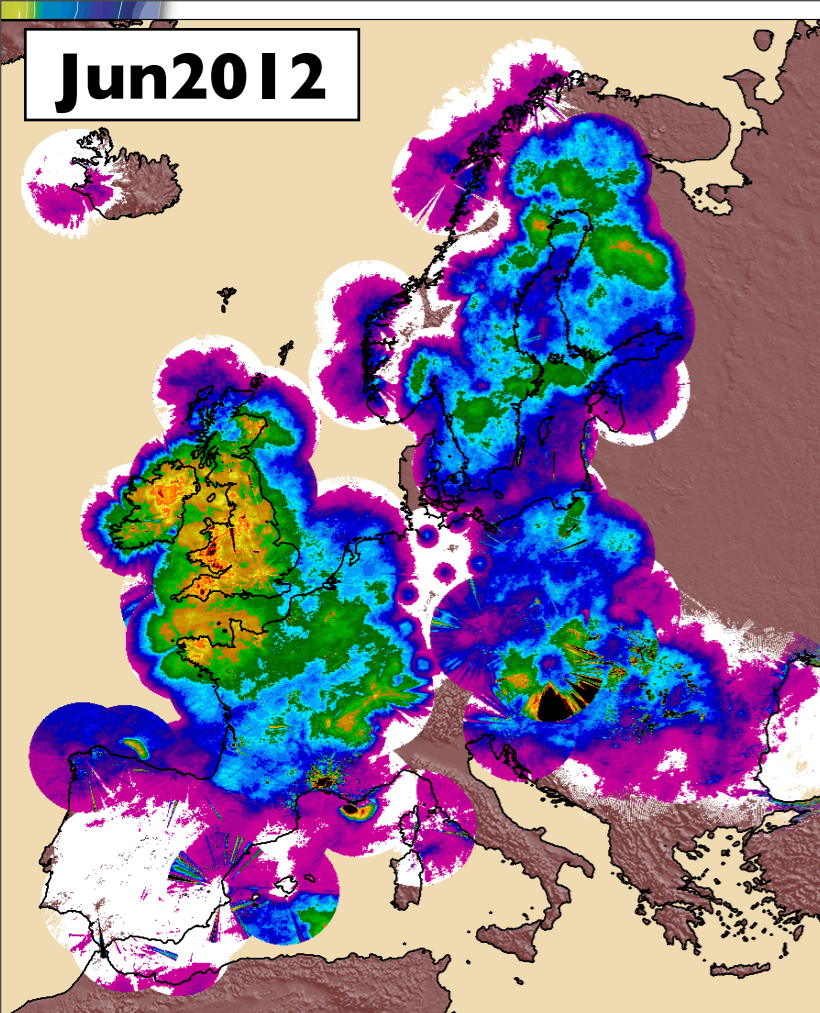


**Feb 2013**

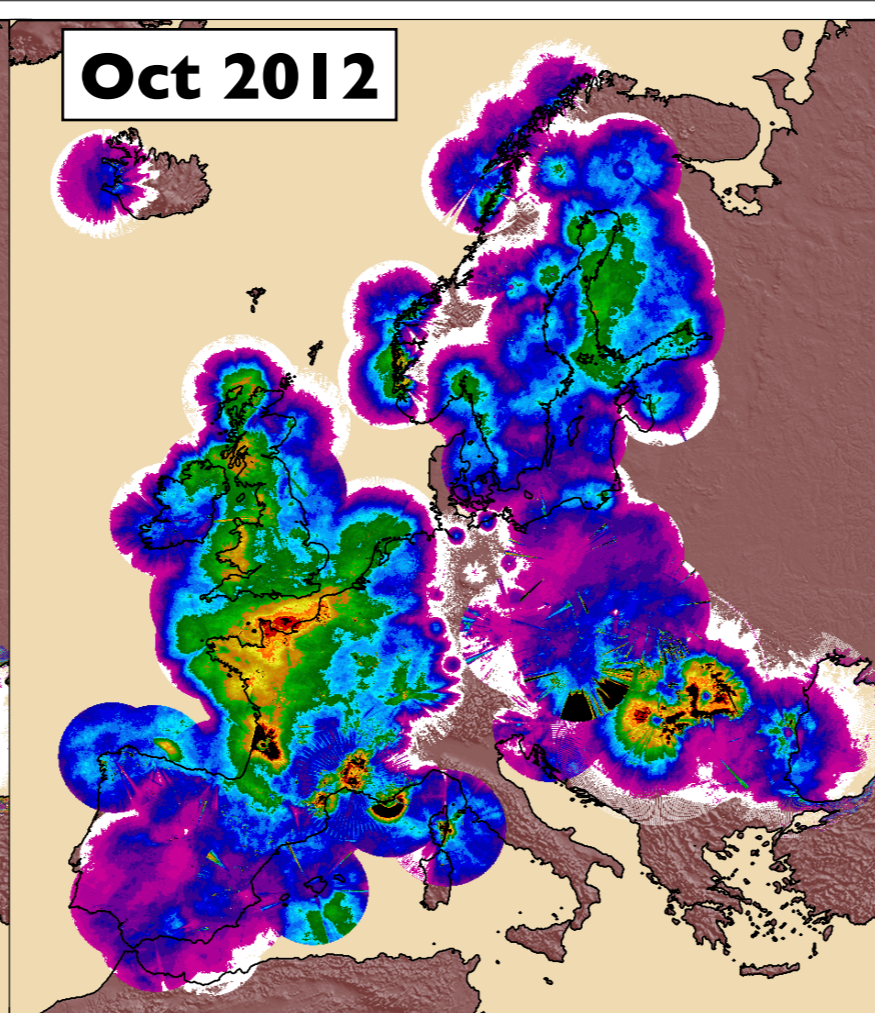




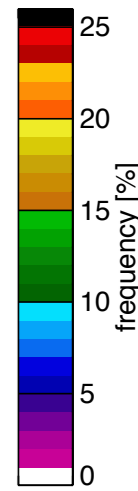
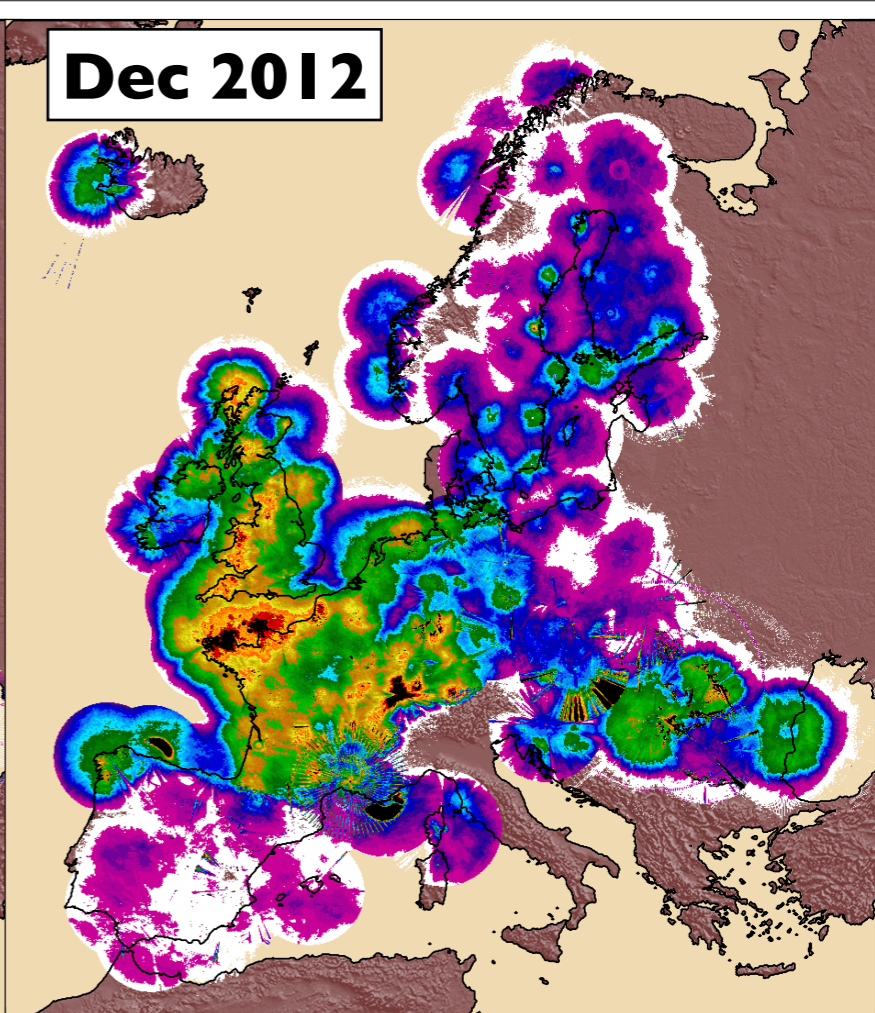
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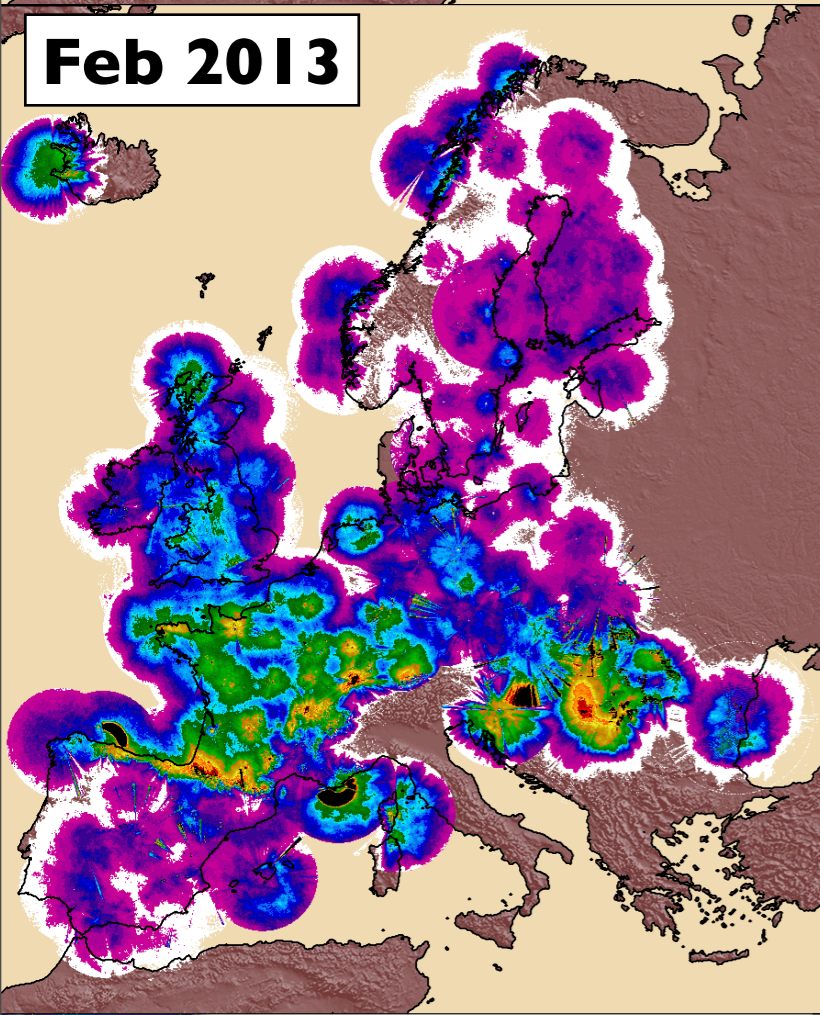
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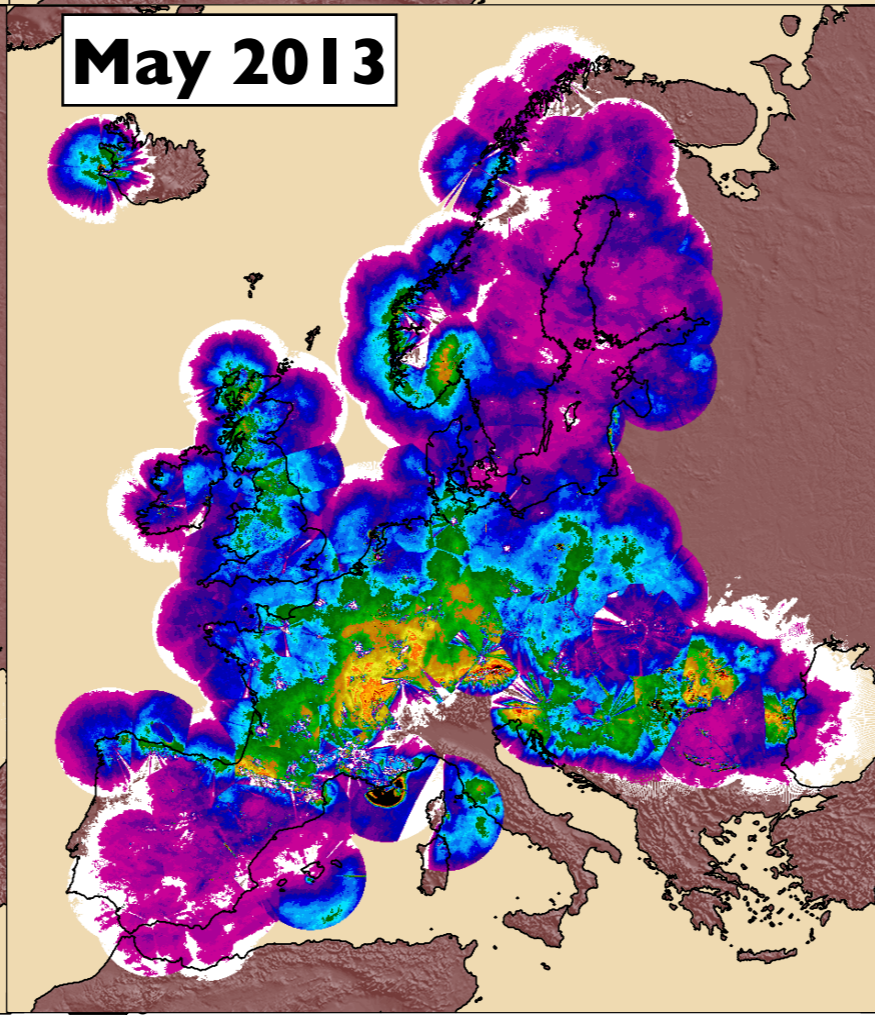
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**Feb 2013**

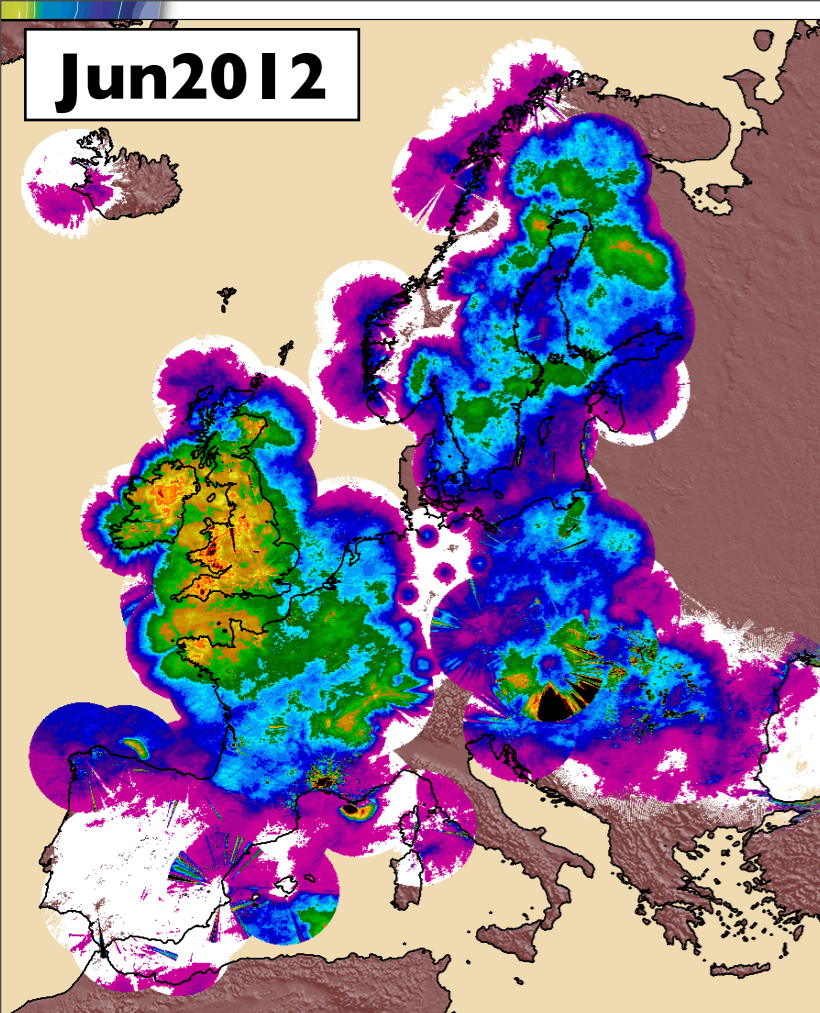


**May 2013**

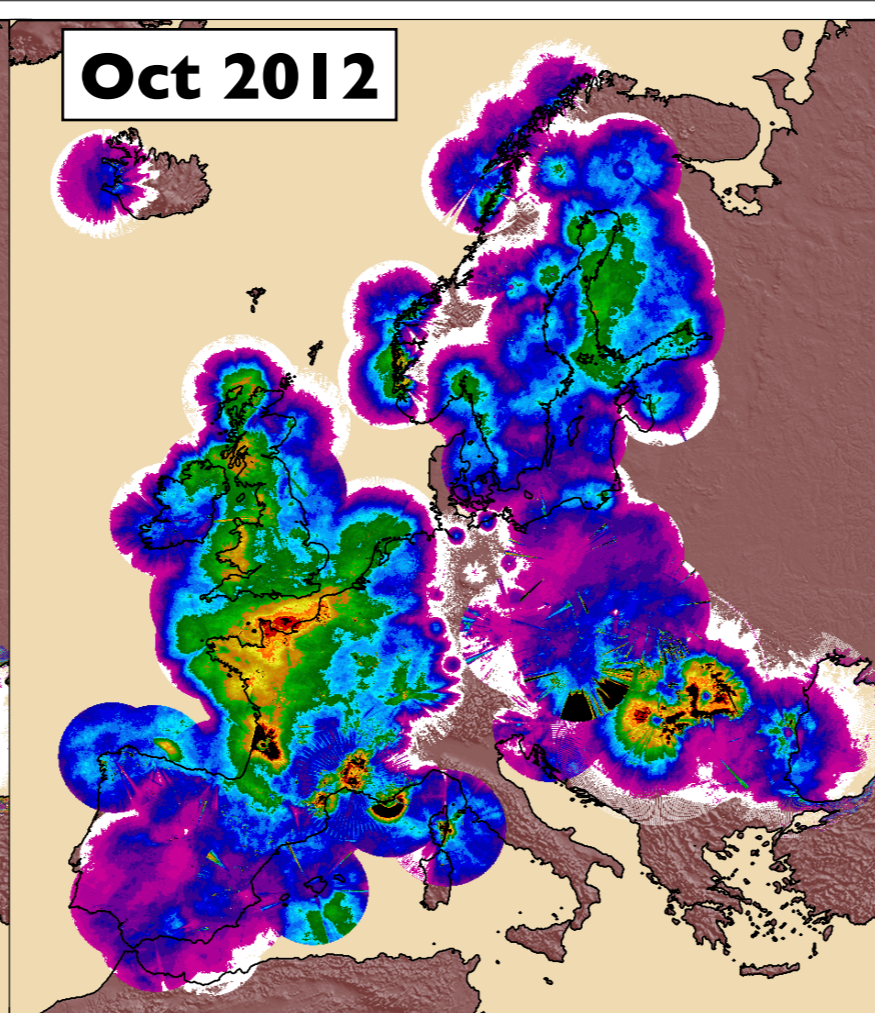




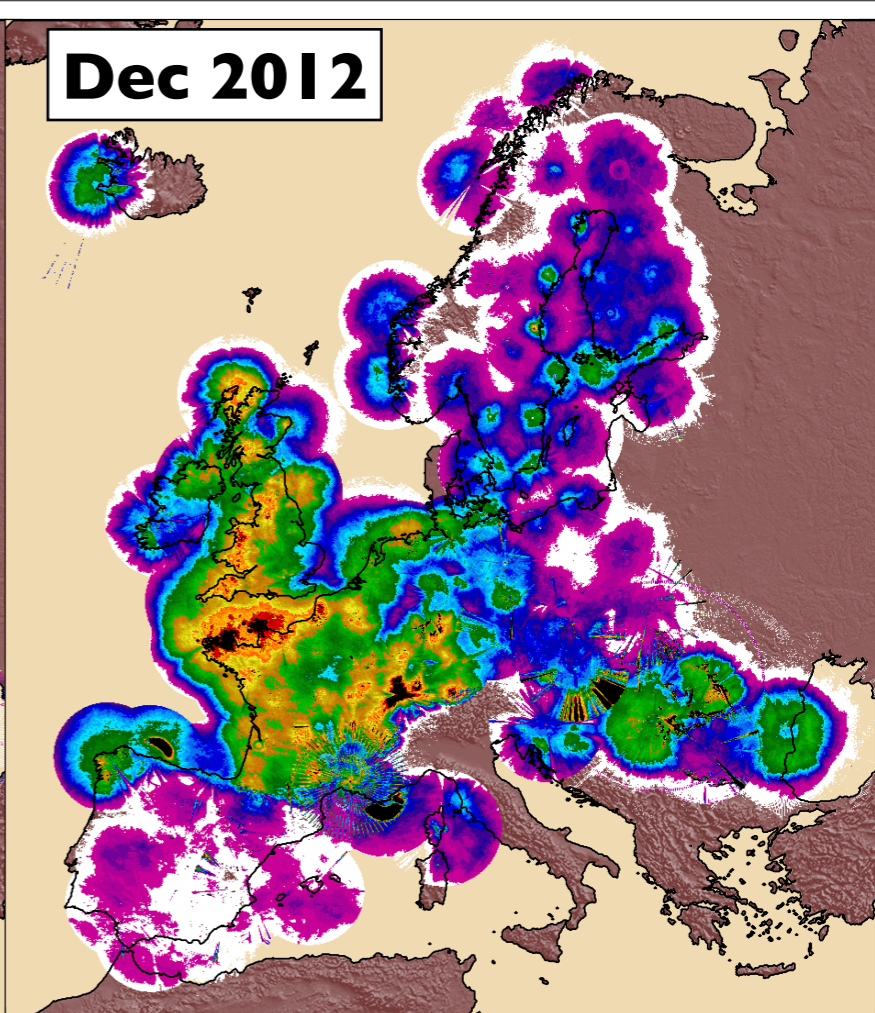
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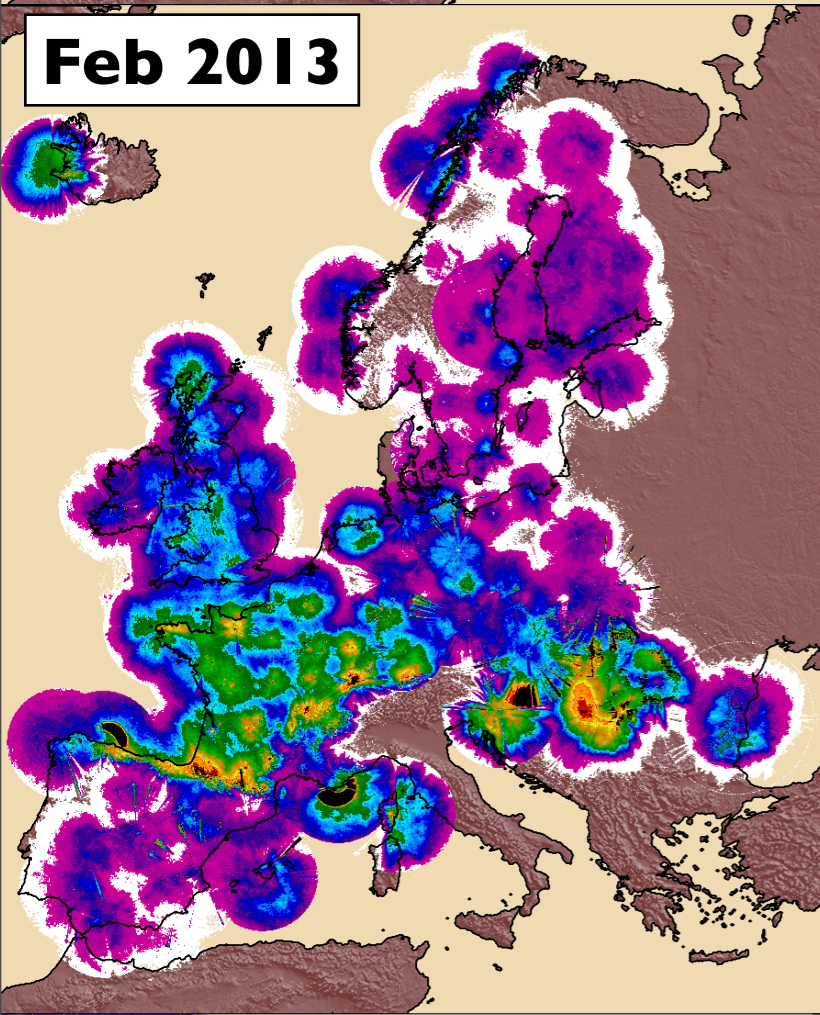
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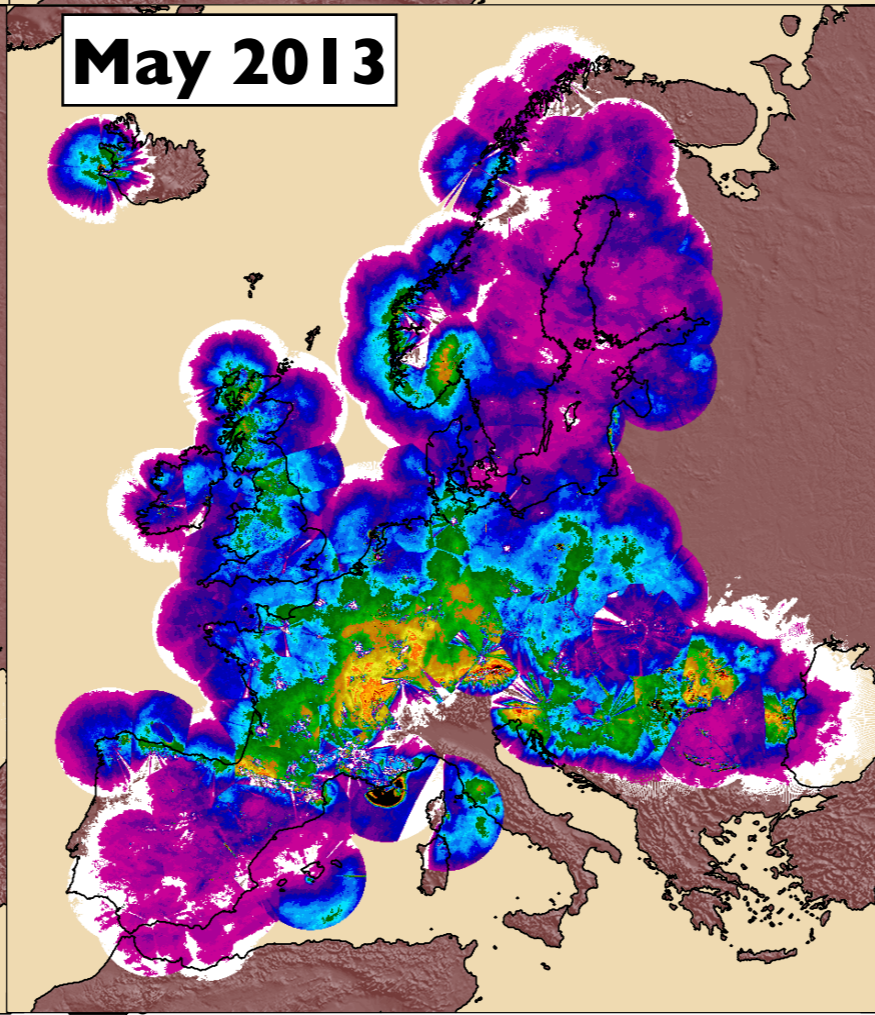
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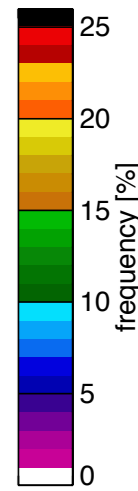
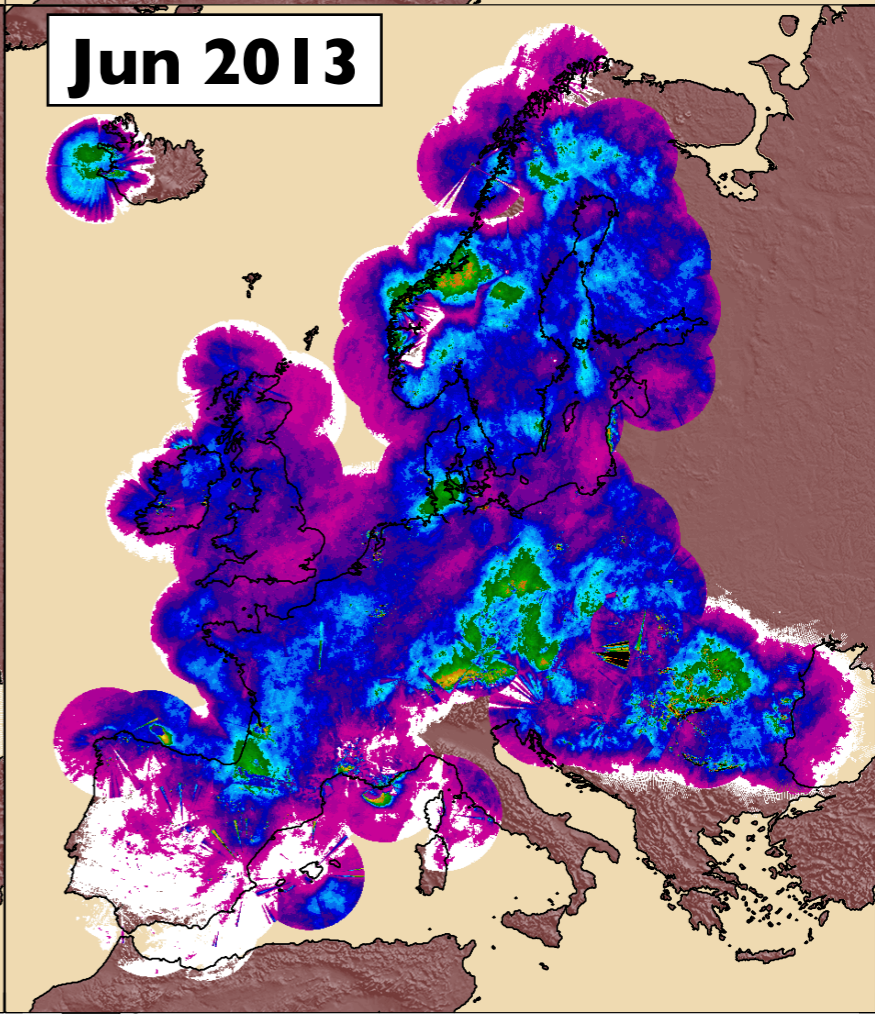
**Feb 2013**



**May 2013**



**Jun 2013**





**Jun 2012**

**Oct 2012**

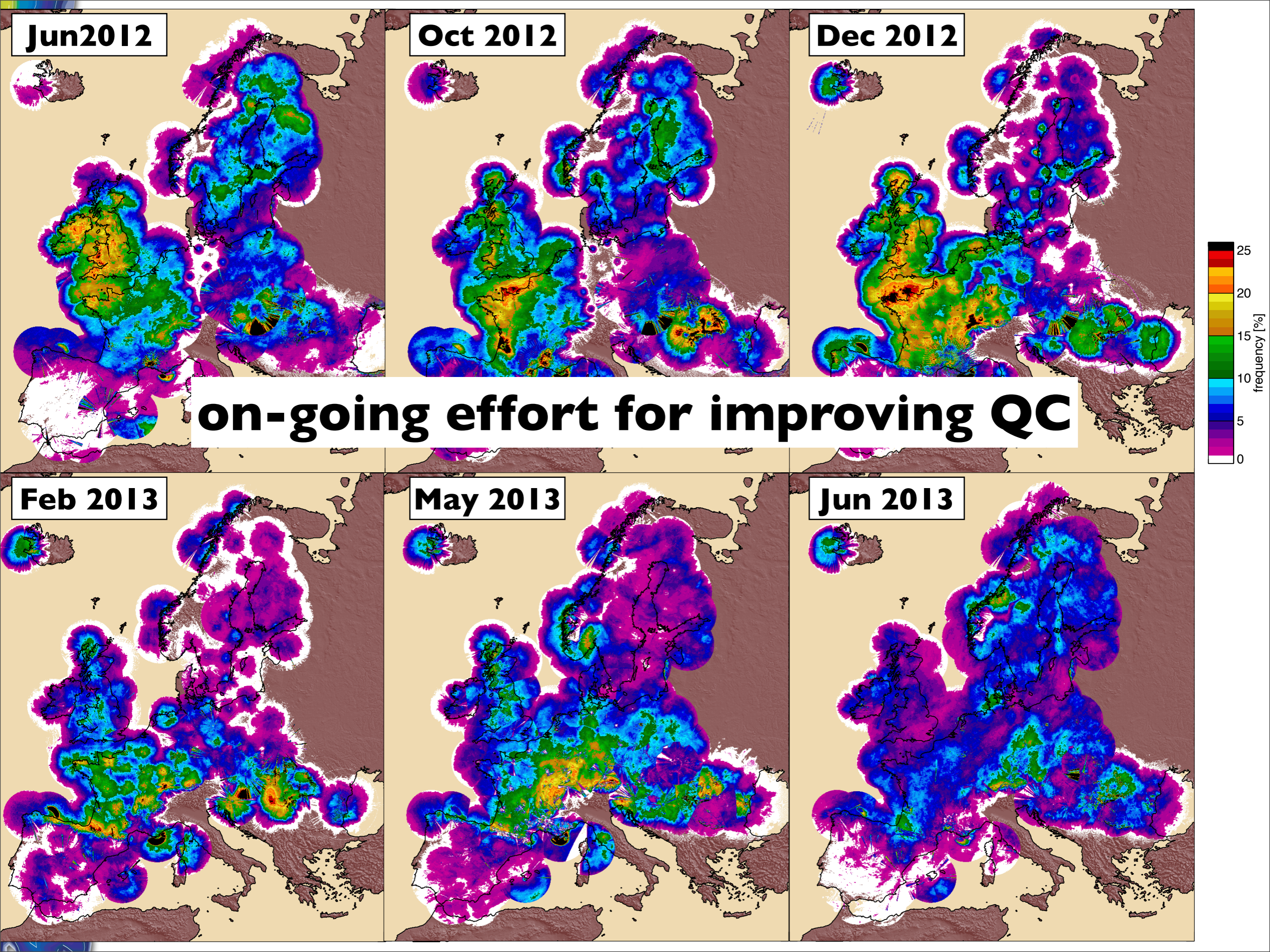
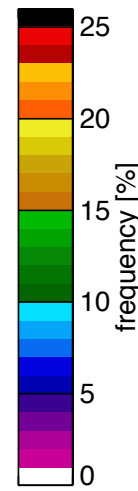
**Dec 2012**

**Feb 2013**

**May 2013**

**Jun 2013**

**on-going effort for improving QC**

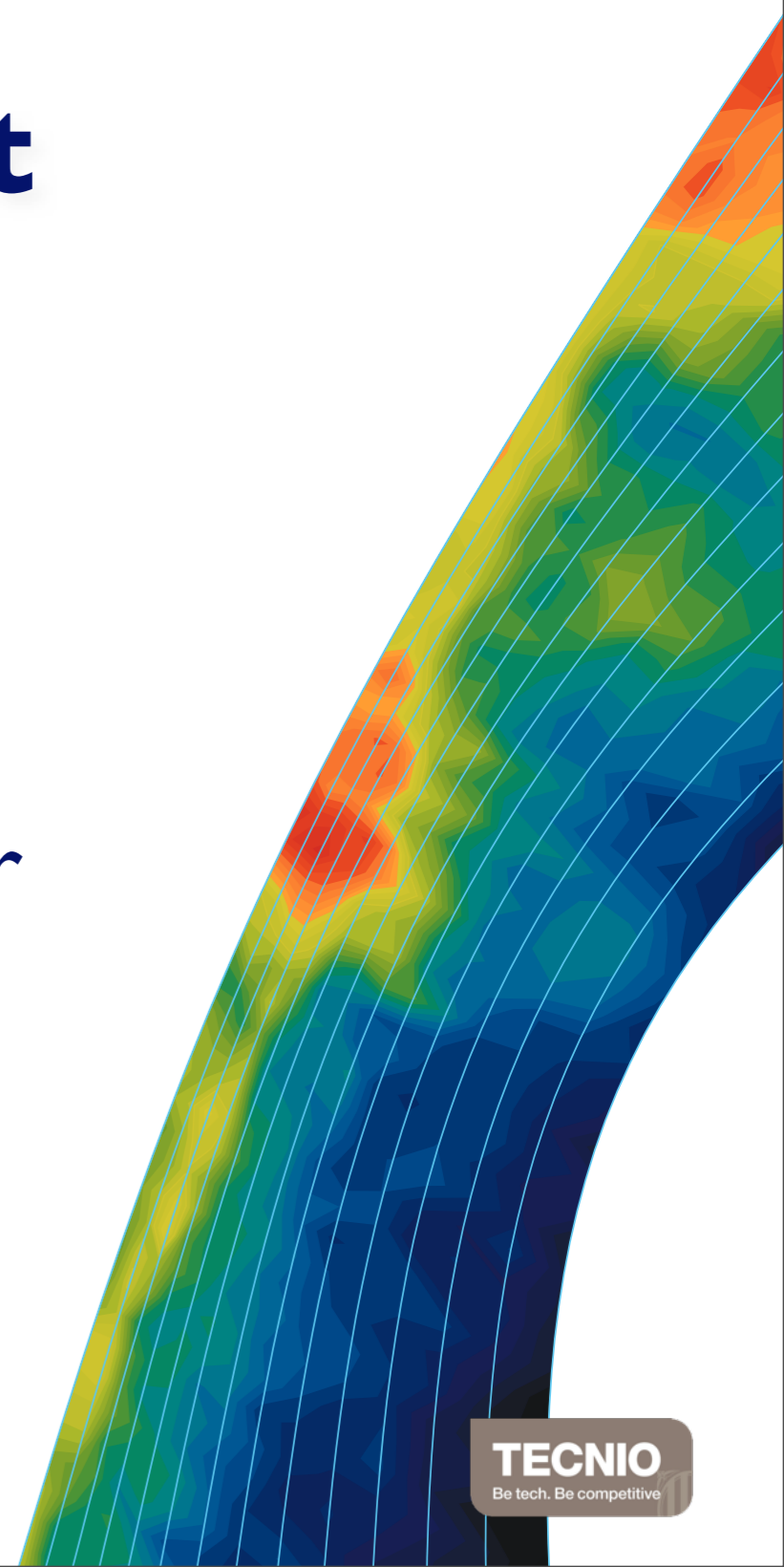




## The HAREN project

The goal:

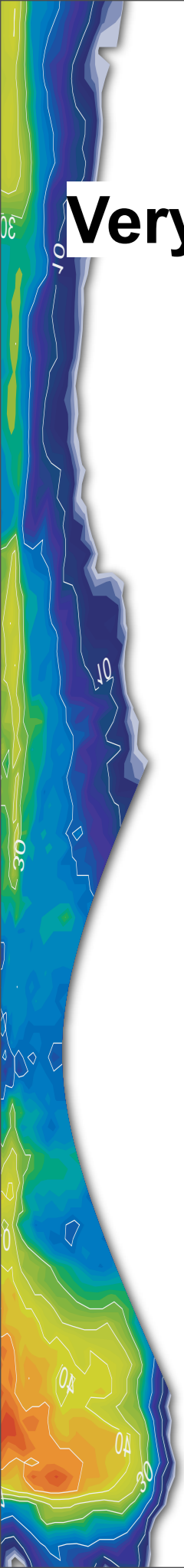
Demonstrate the interest of **rainfall nowcasting** based on OPERA mosaics for **hazard assessment**.





# Radar-based rainfall *nowcasting*

**Very short-term forecasting** by extrapolation of radar observations.

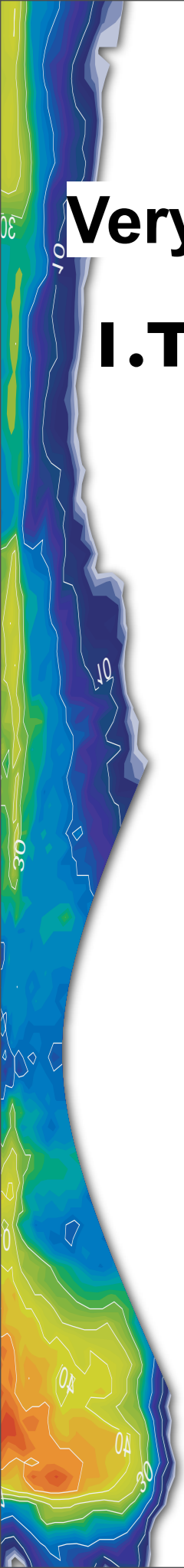




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**Very short-term forecasting** by extrapolation of radar observations.

**I. Tracking:** The motion field of rainfall is estimated from observations.





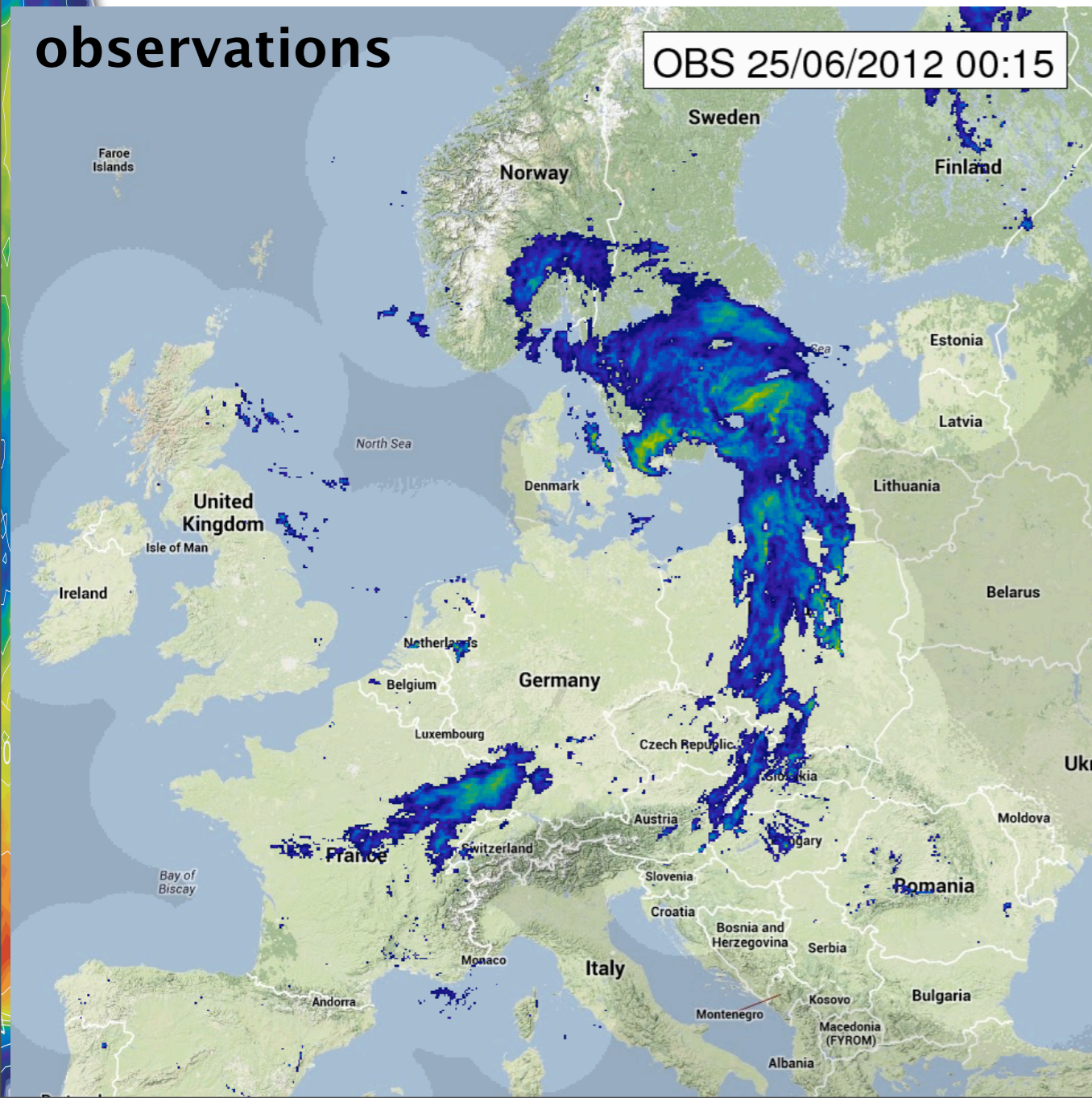
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observations

OBS 25/06/2012 00:15

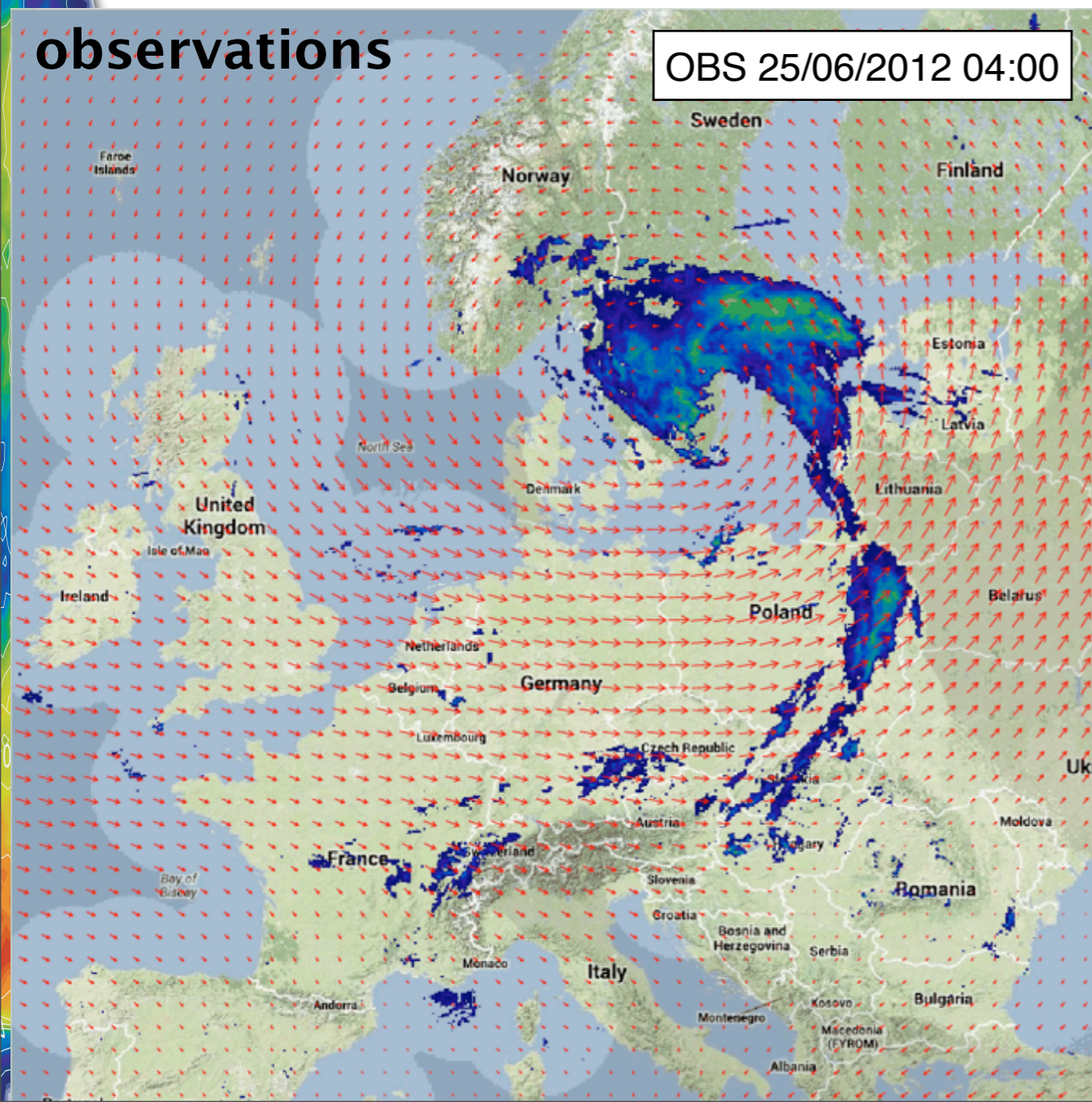




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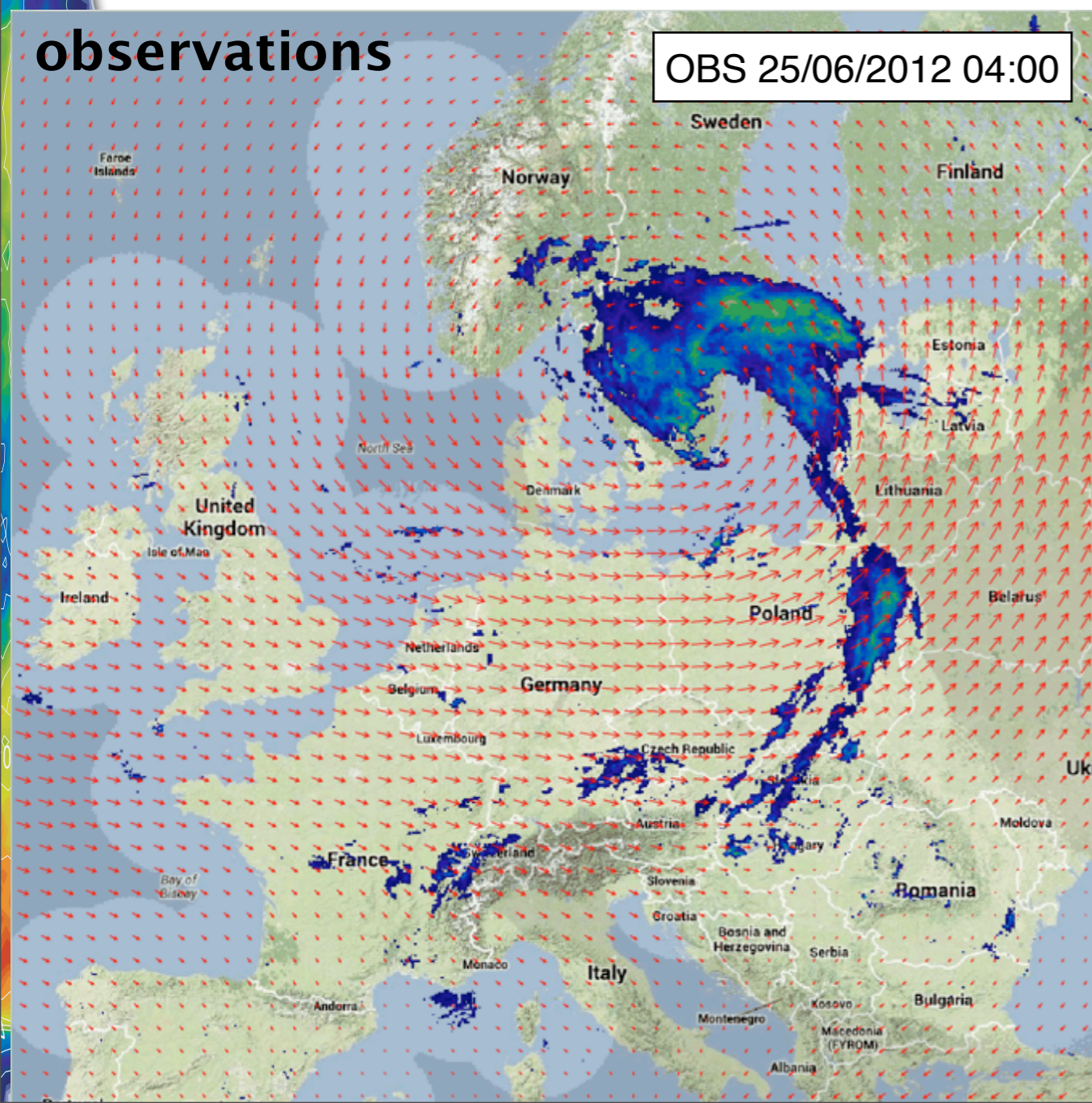


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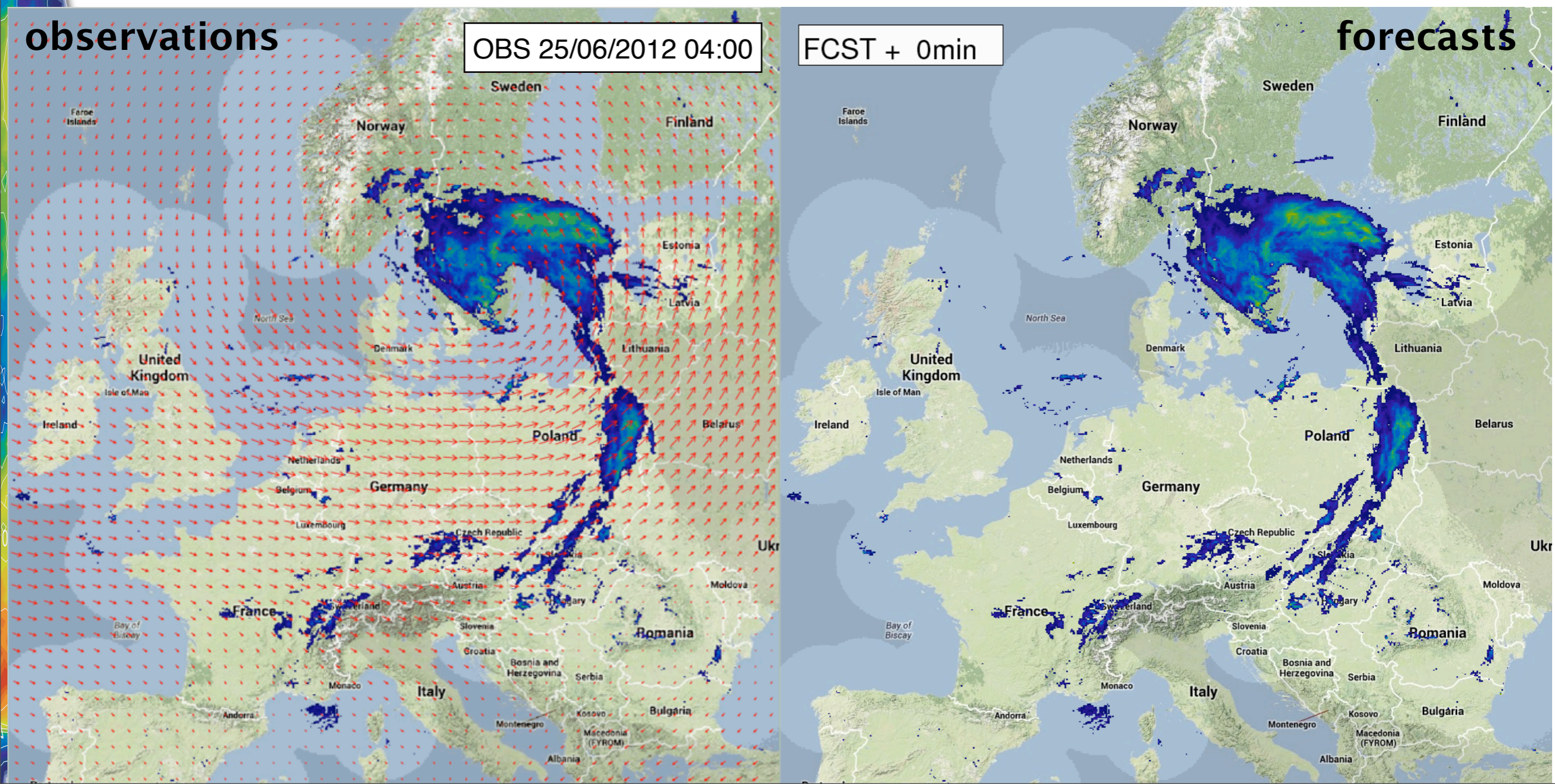


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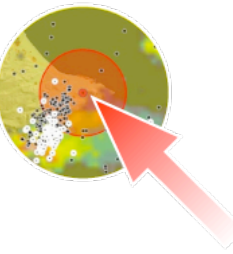




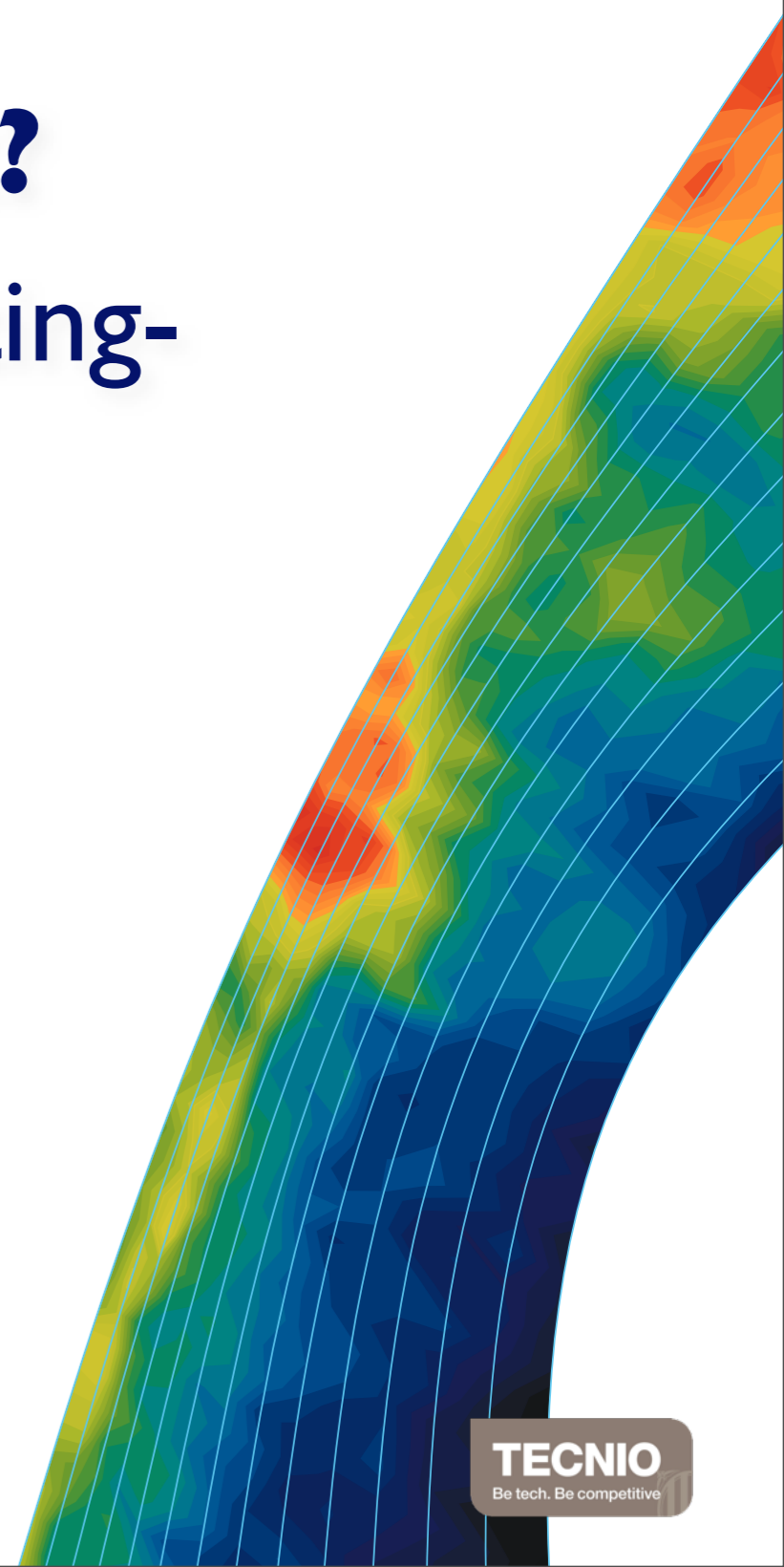


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## How does it work? -performance of nowcasting-



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# Nowcasting evaluation

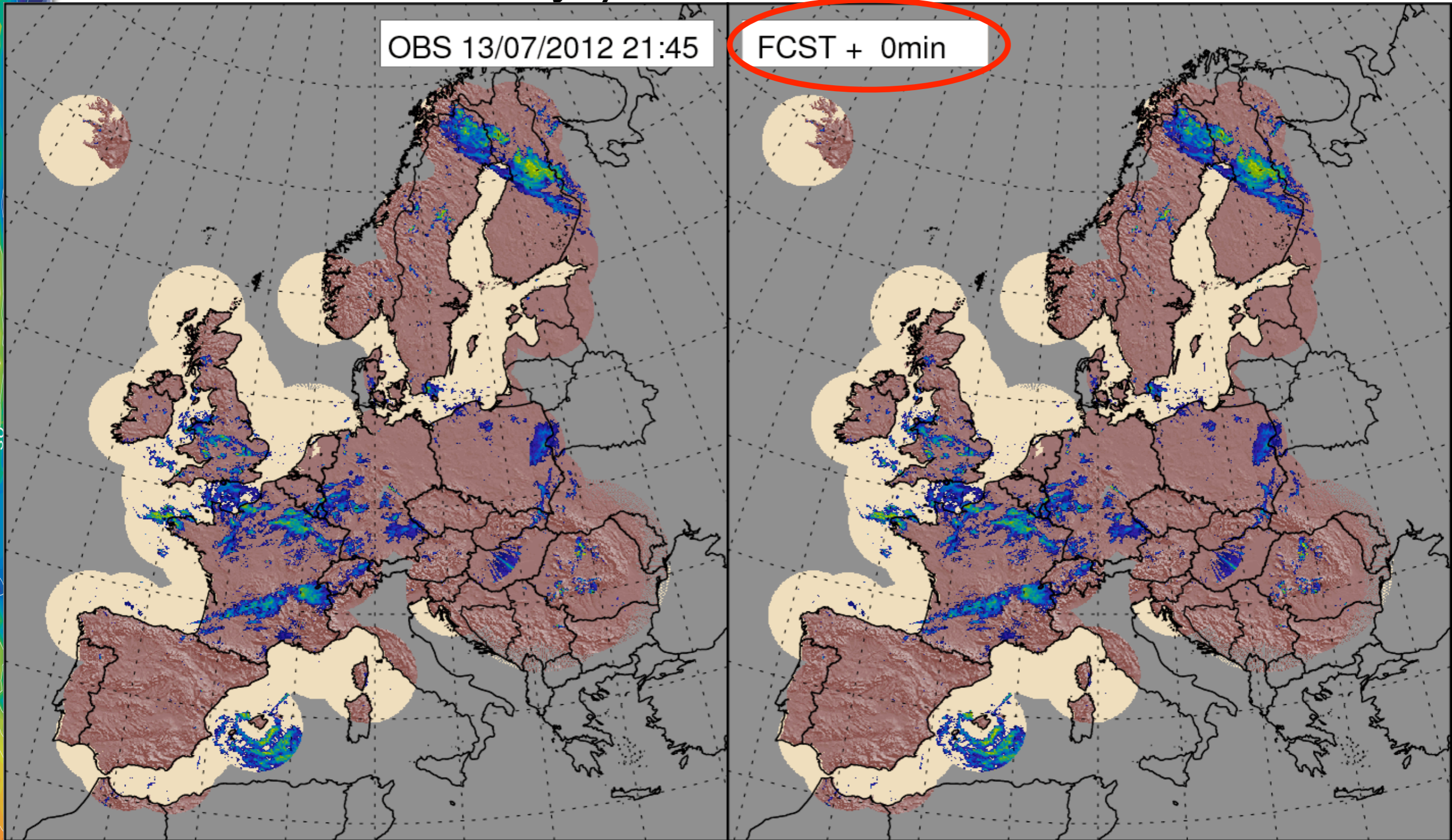
**Observations**

13 July 2012 21:45 UTC

**Forecasts**

OBS 13/07/2012 21:45

FCST + 0min



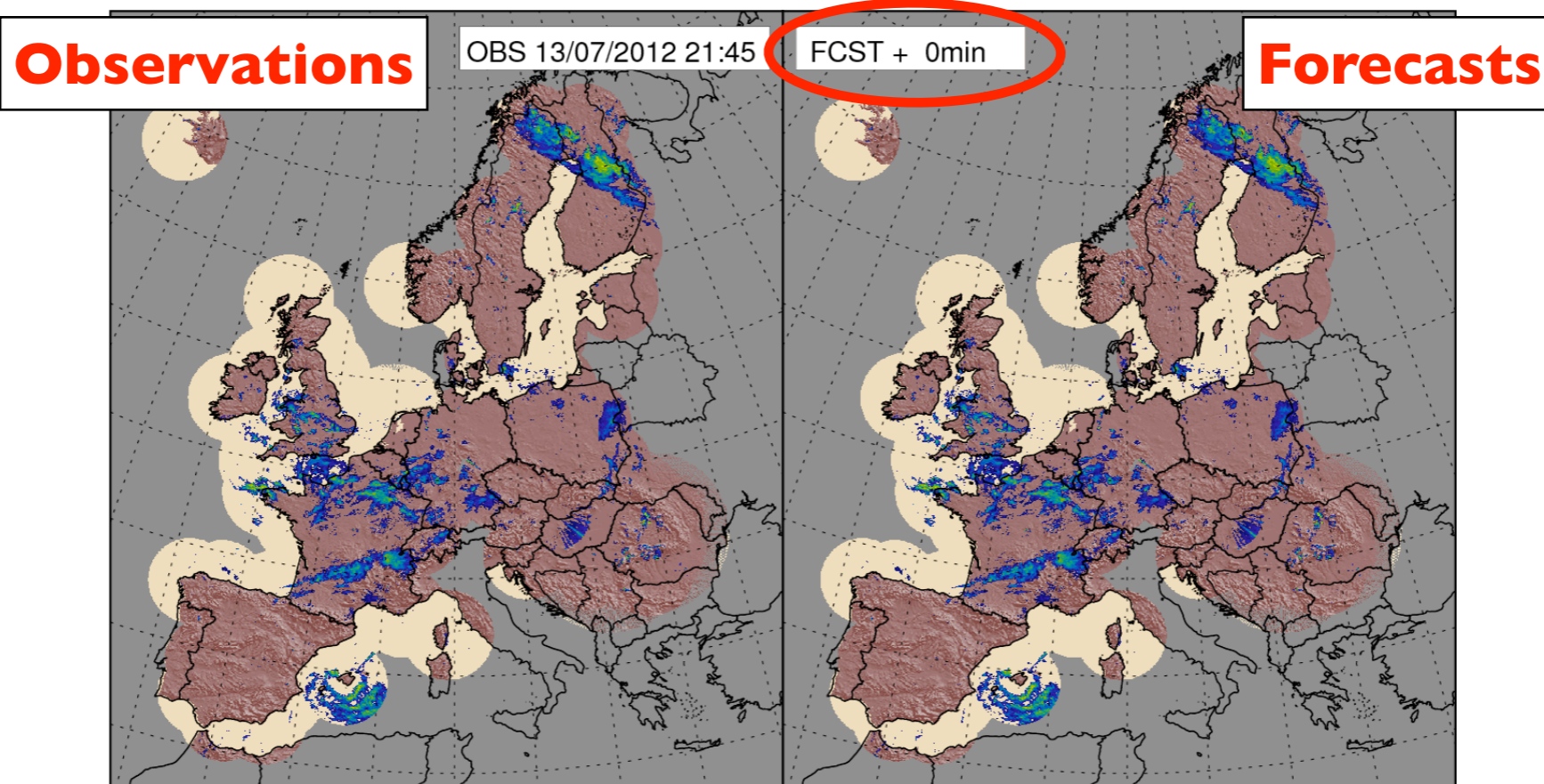
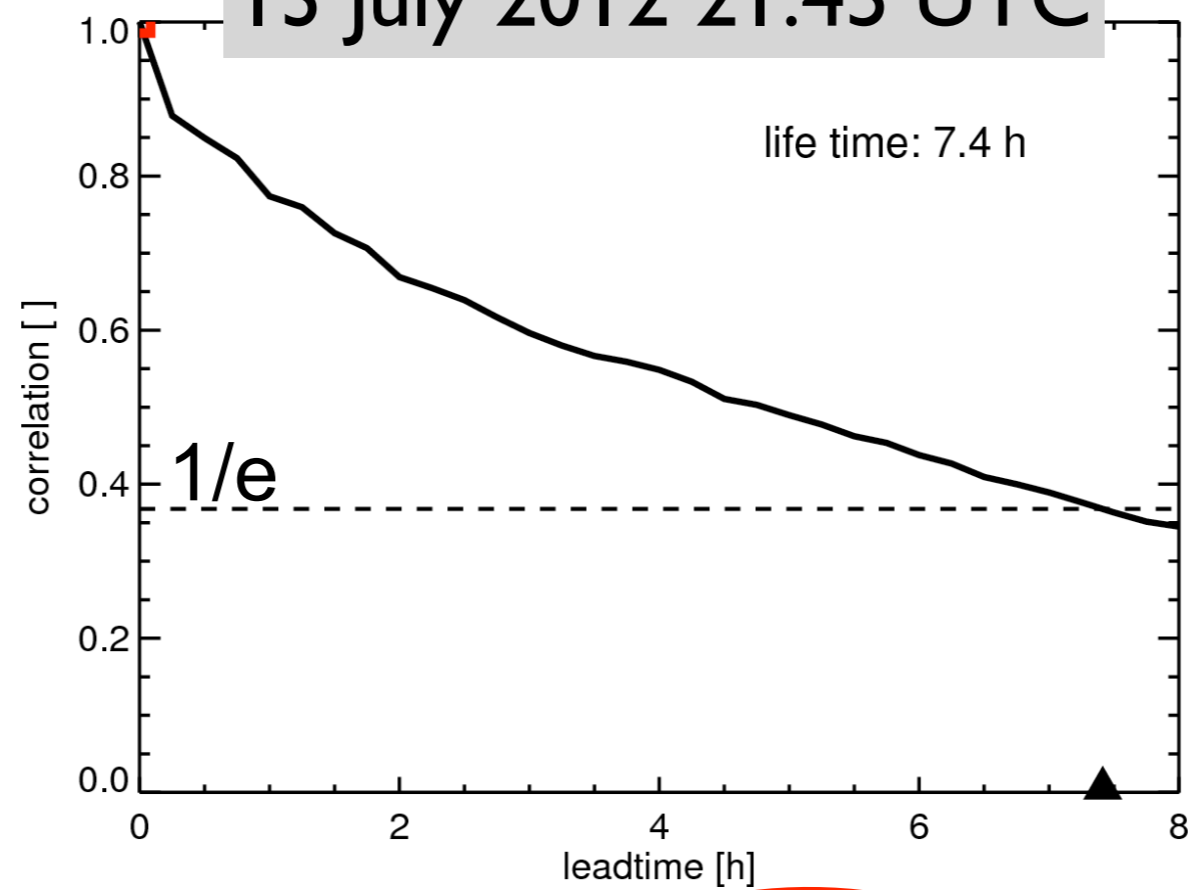
Observed

Forecasted



# Nowcasting evaluation

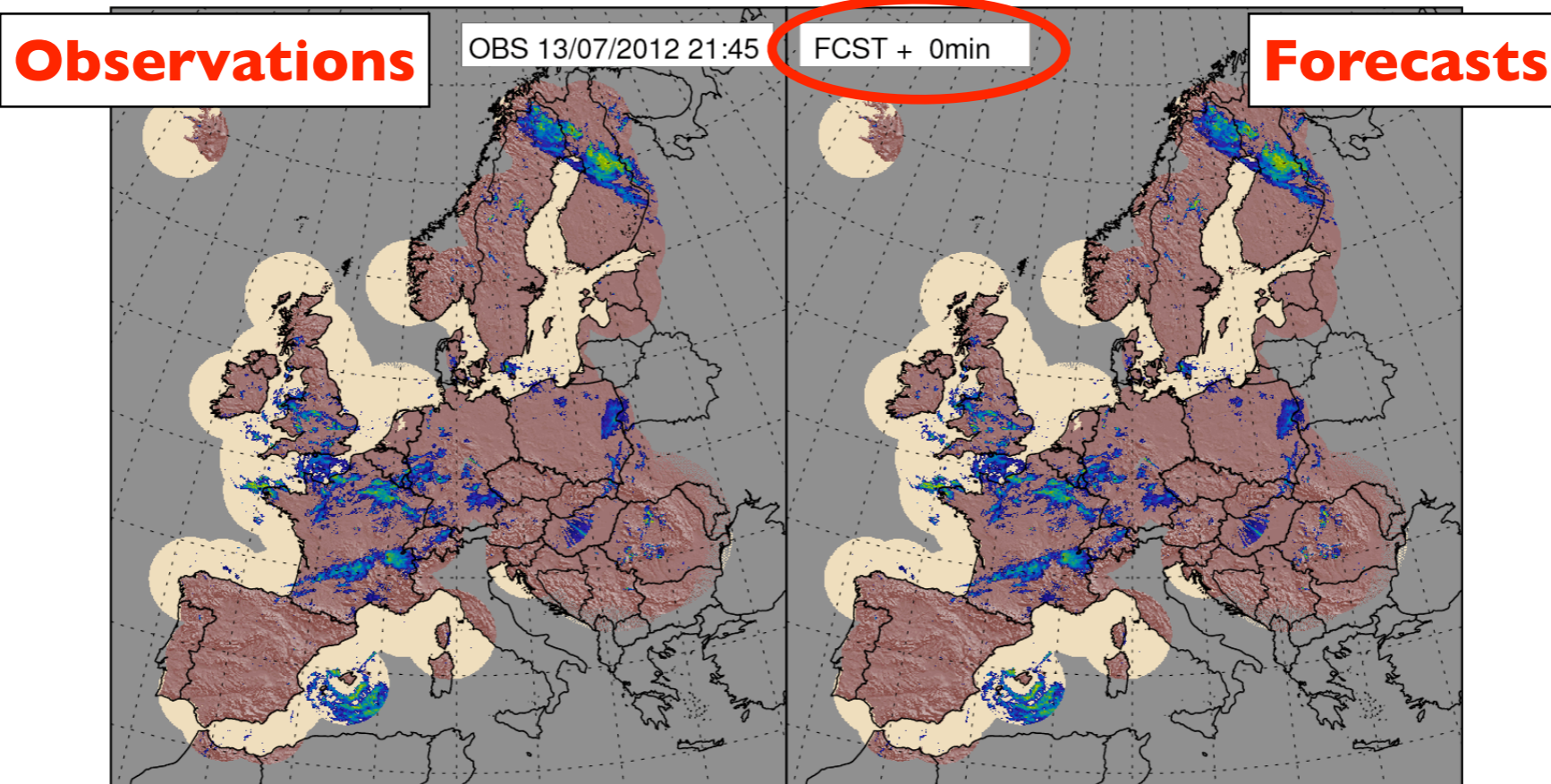
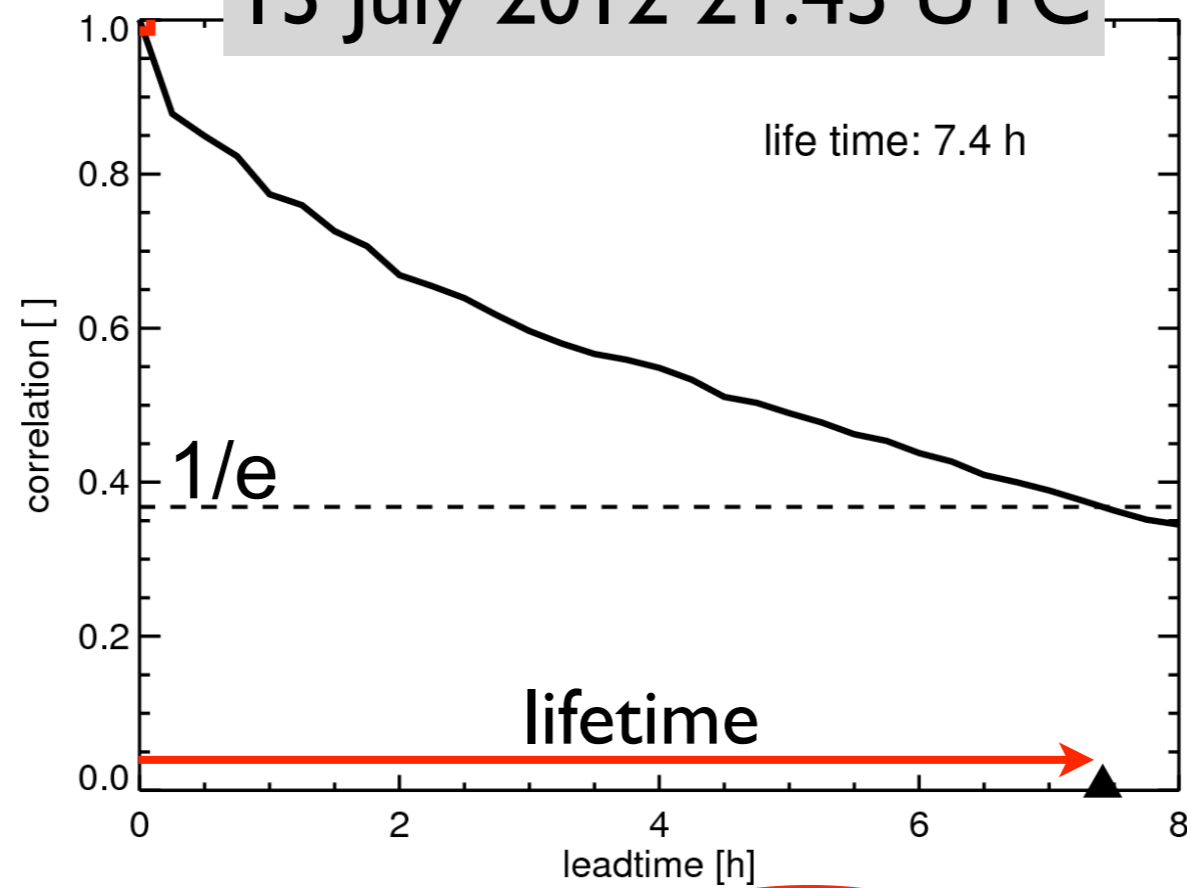
13 July 2012 21:45 UTC





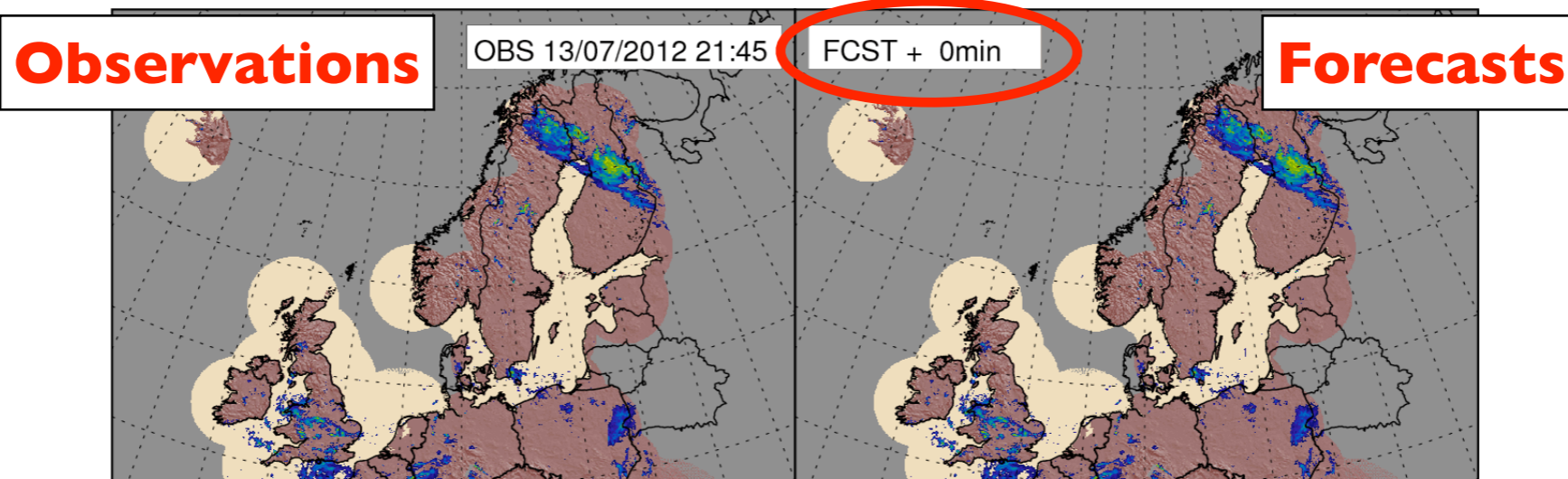
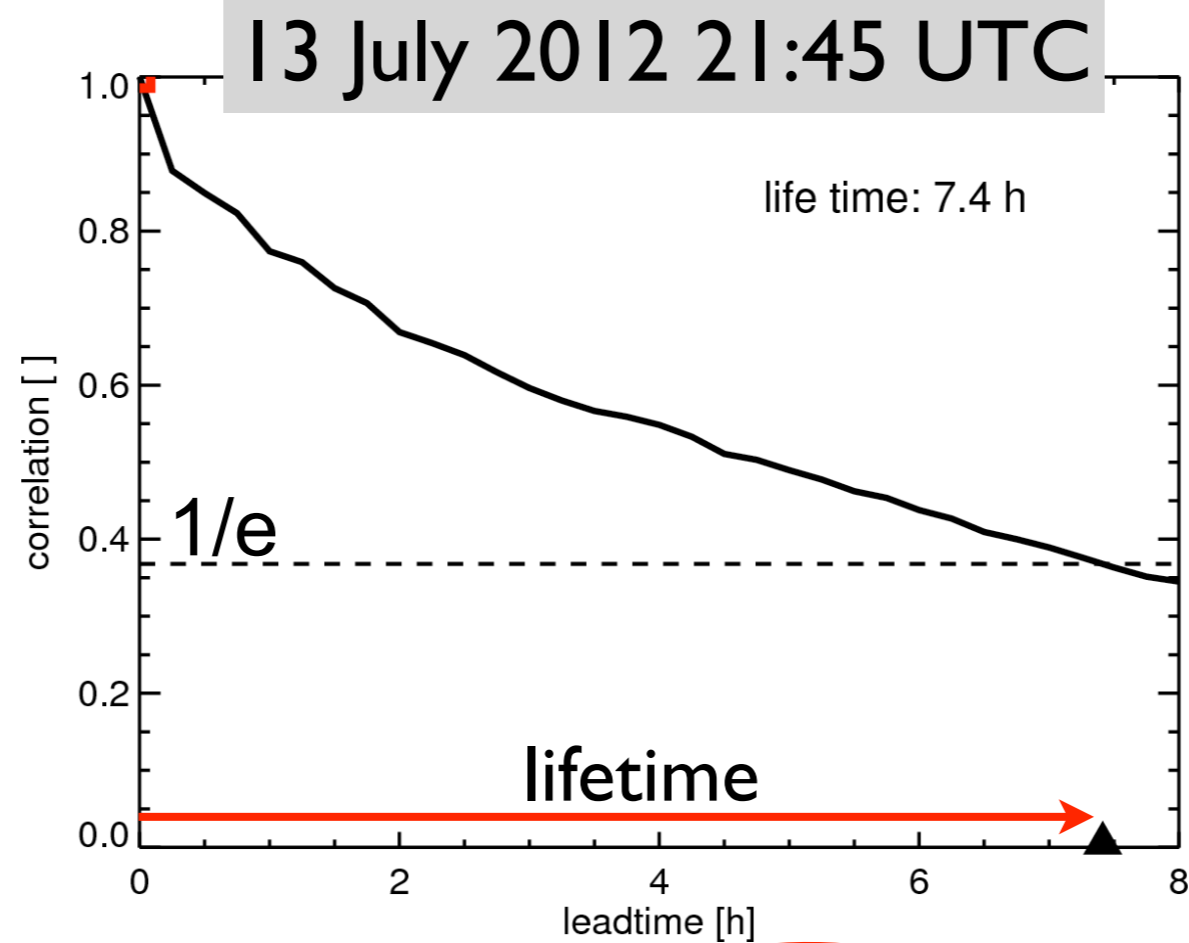
# Nowcasting evaluation

13 July 2012 21:45 UTC





# Nowcasting evaluation



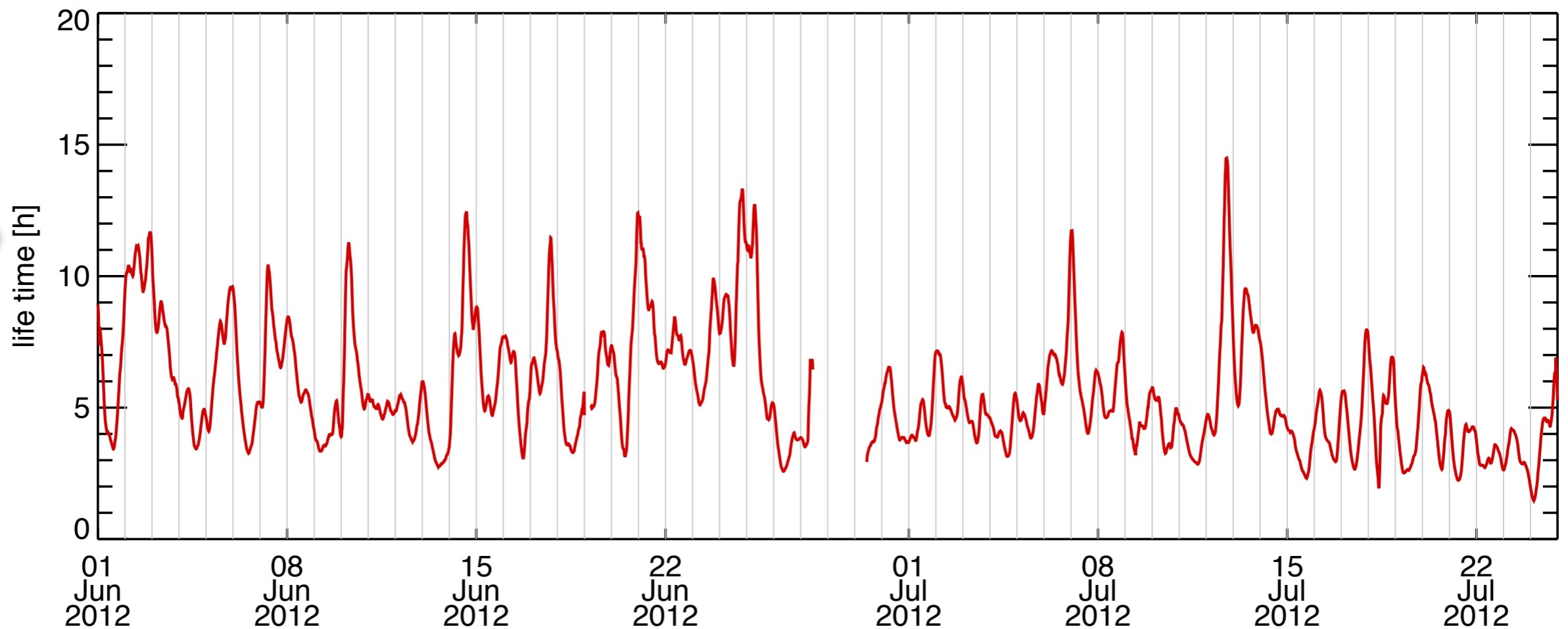
However,  
the quality of the nowcasts depends on the situation.



# Evolution of the life time

in the period **01 June - 31 July 2012**

Lifetime mostly between 4 and 10 h

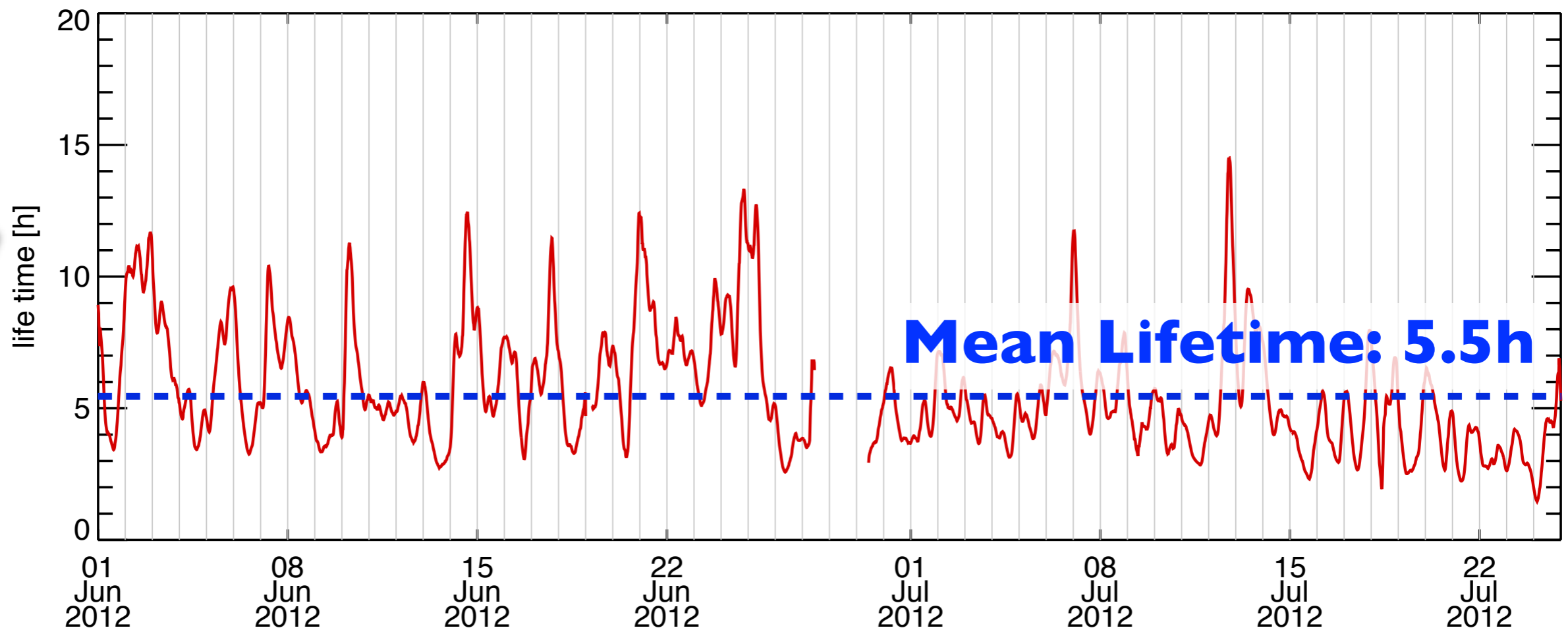


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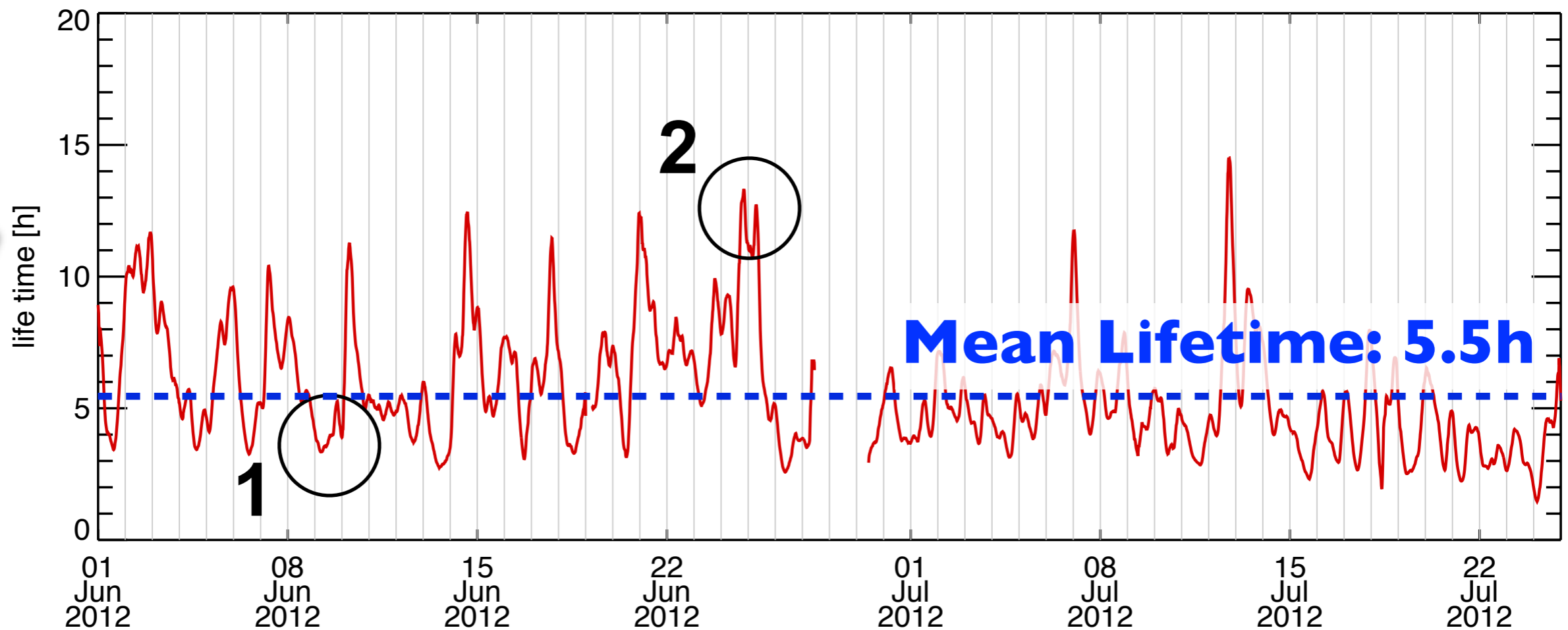
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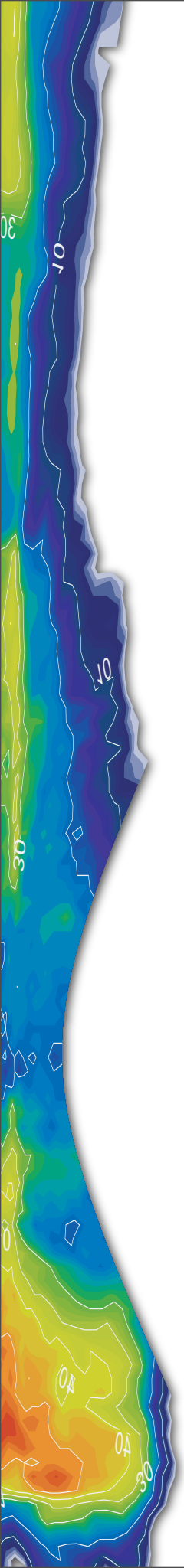
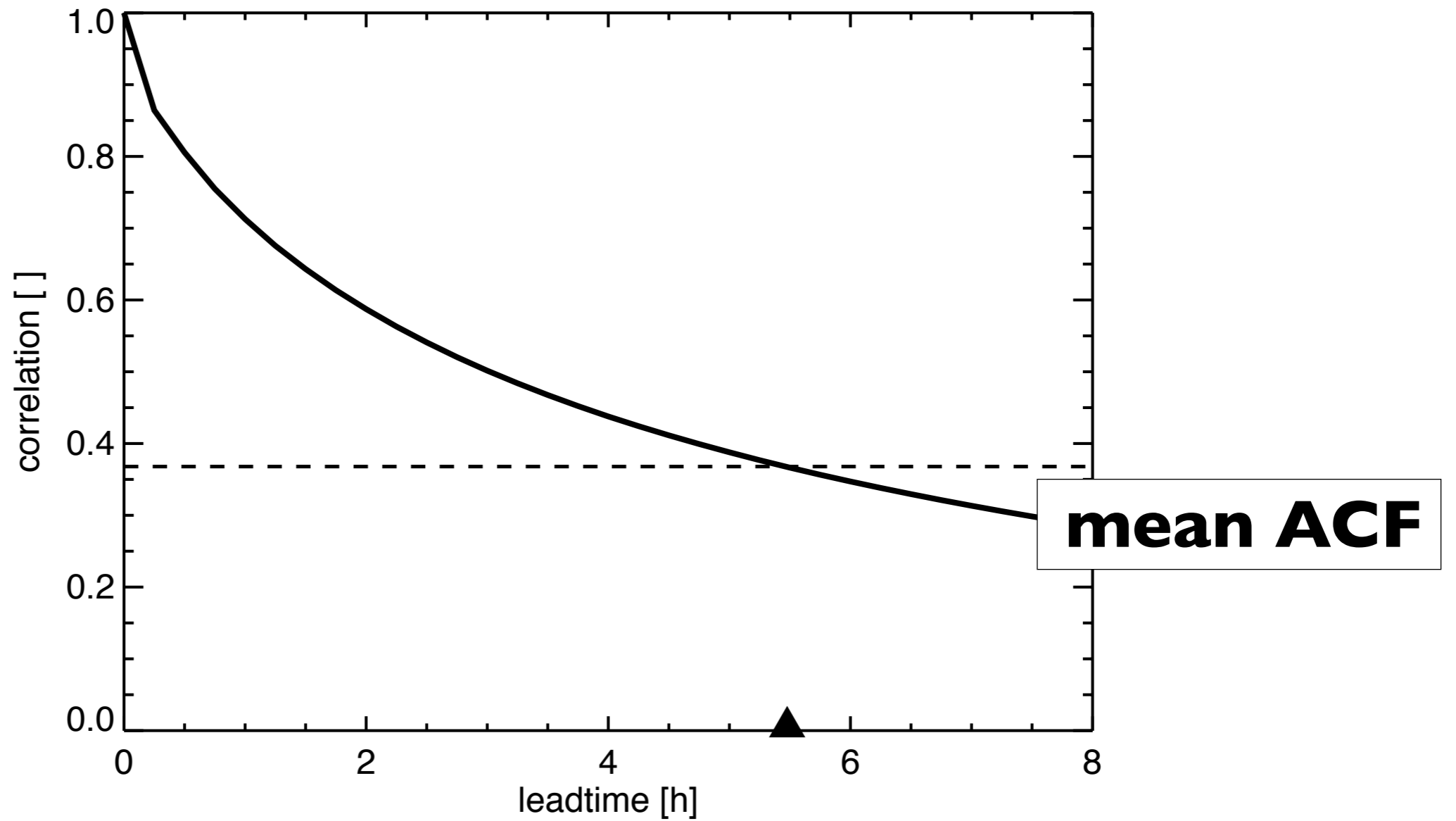


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# Nowcasting evaluation

## Mean Lifetime

in the period **01 June - 31 July 2012**

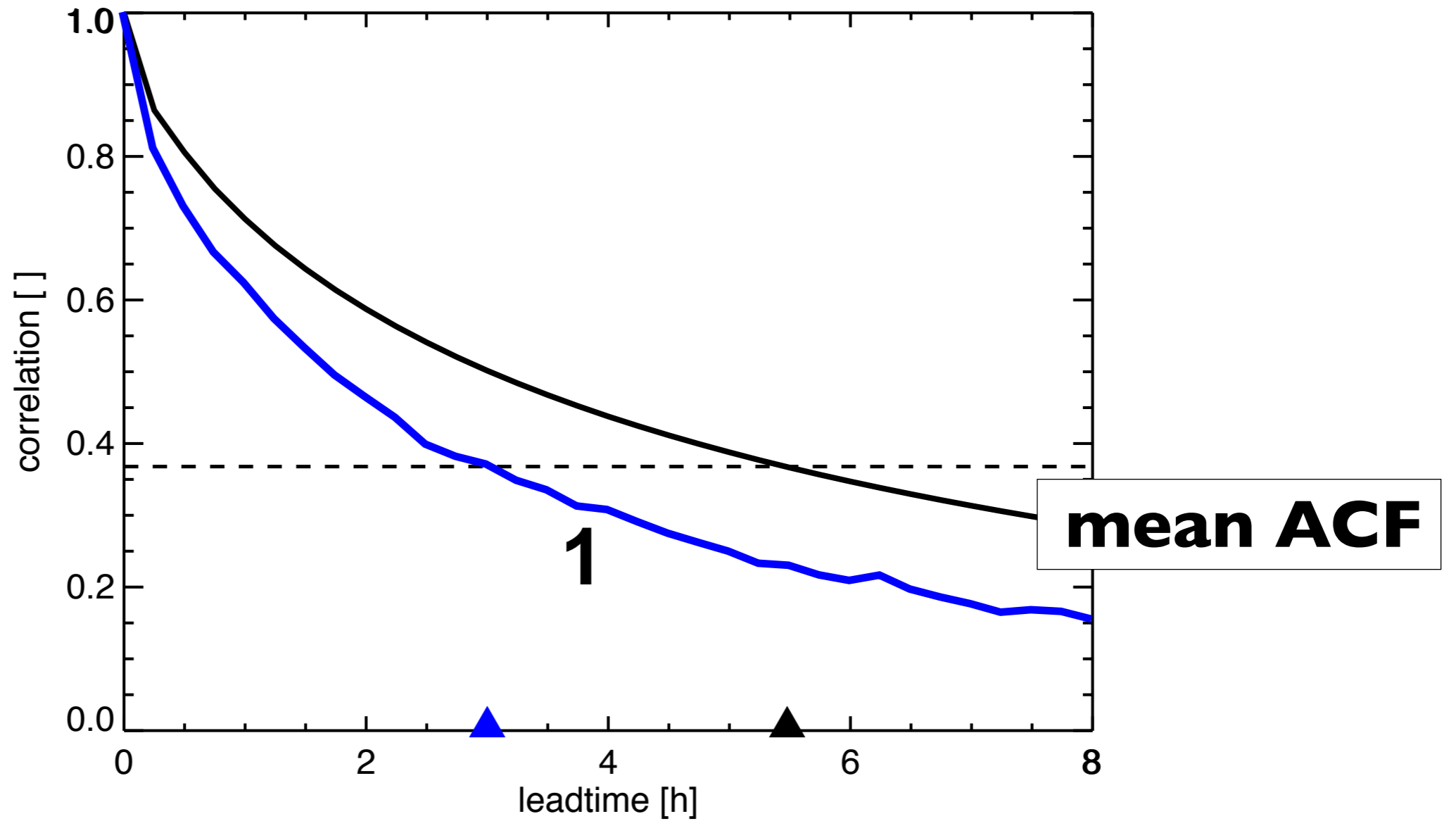




# Nowcasting evaluation

## Mean Lifetime

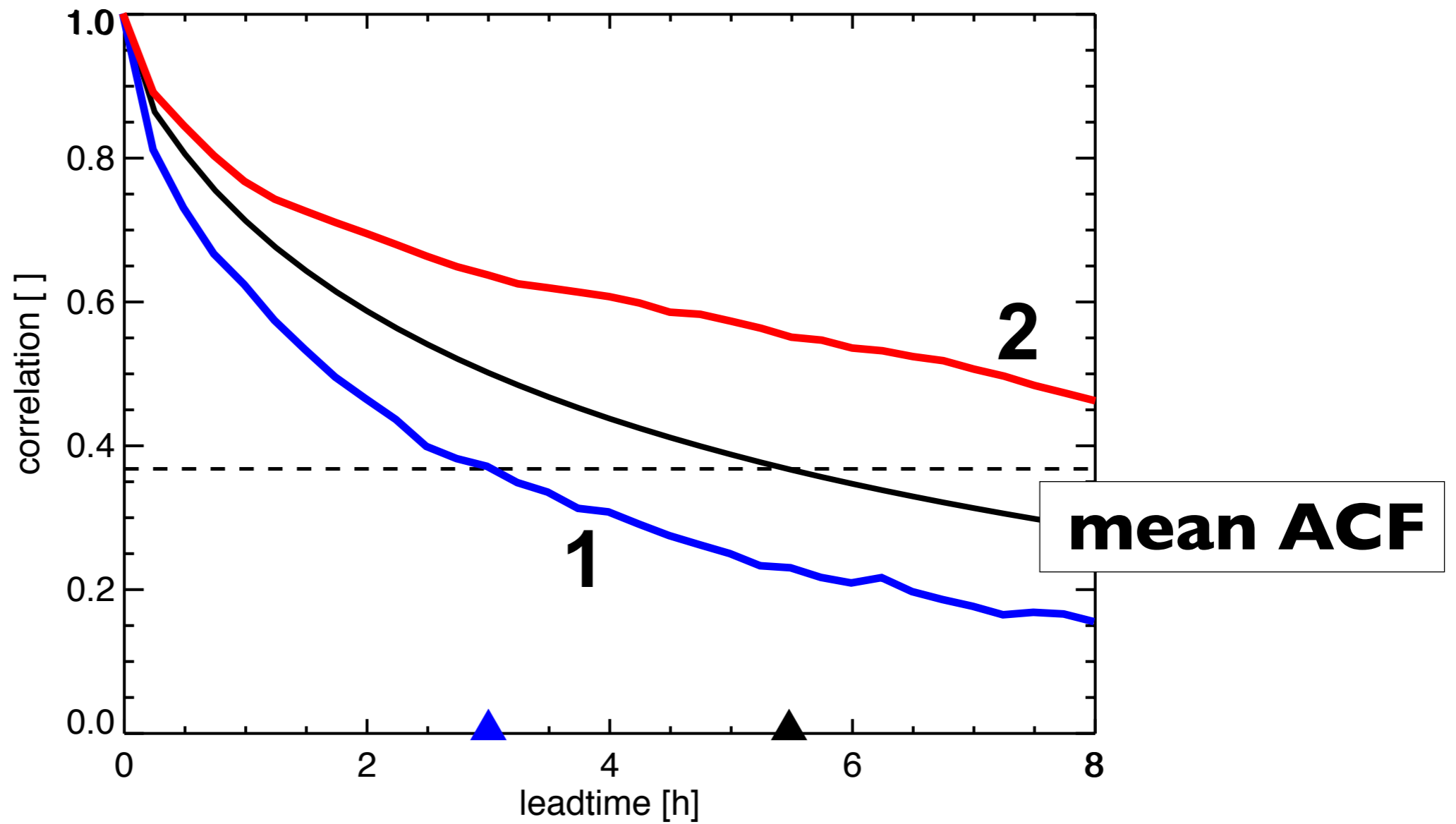
in the period **01 June - 31 July 2012**



# Nowcasting evaluation

## Mean Lifetime

in the period **01 June - 31 July 2012**



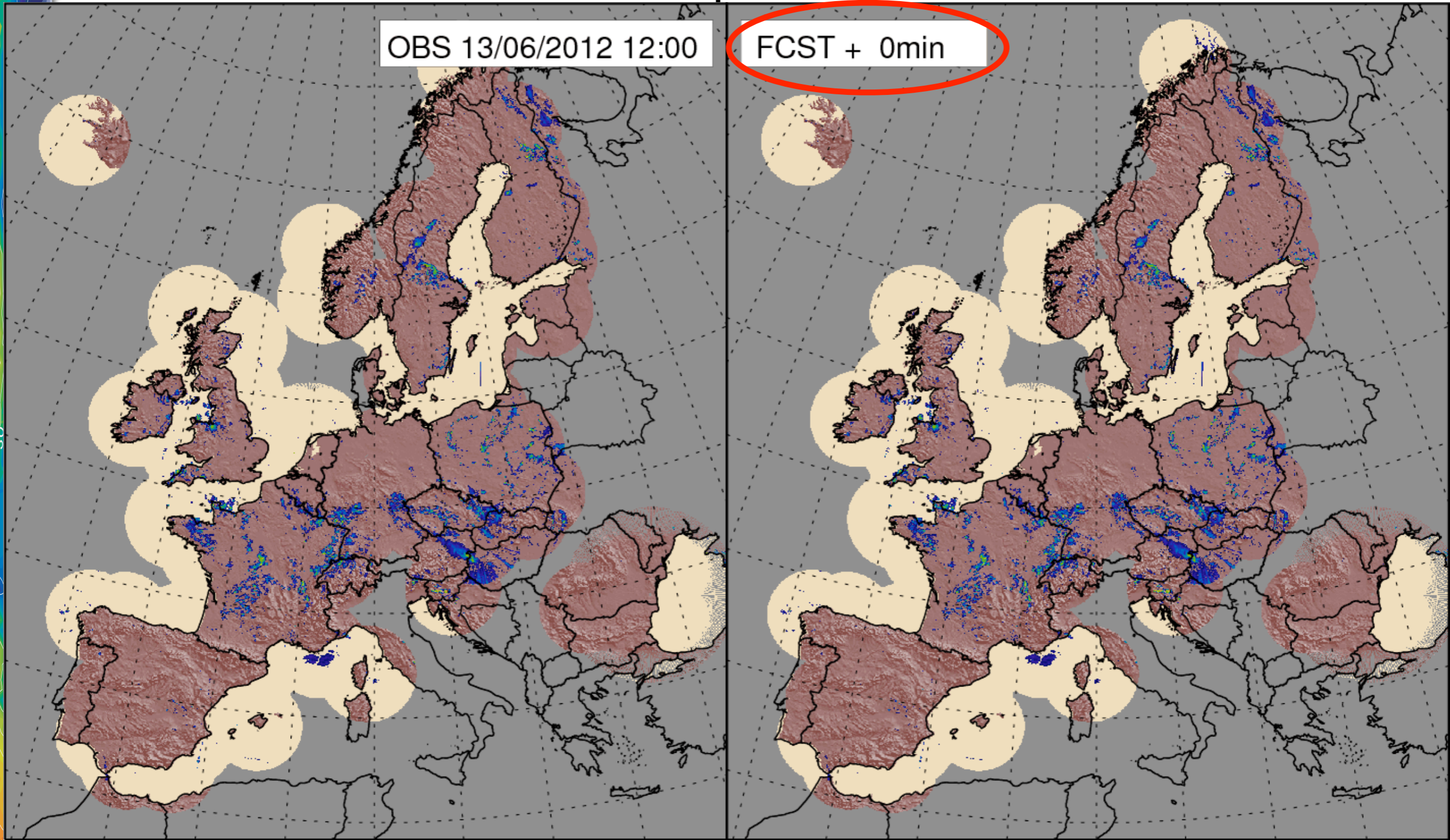


# Case #1: 13 June 2012 1200 UTC

nowcasts up to 8 hours

OBS 13/06/2012 12:00

FCST + 0min



5 10 15 20 25 30 35 40 45 50 55 60 65 70  
Reflectivity (dBZ)

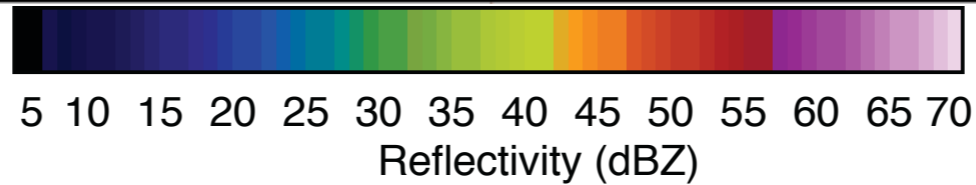
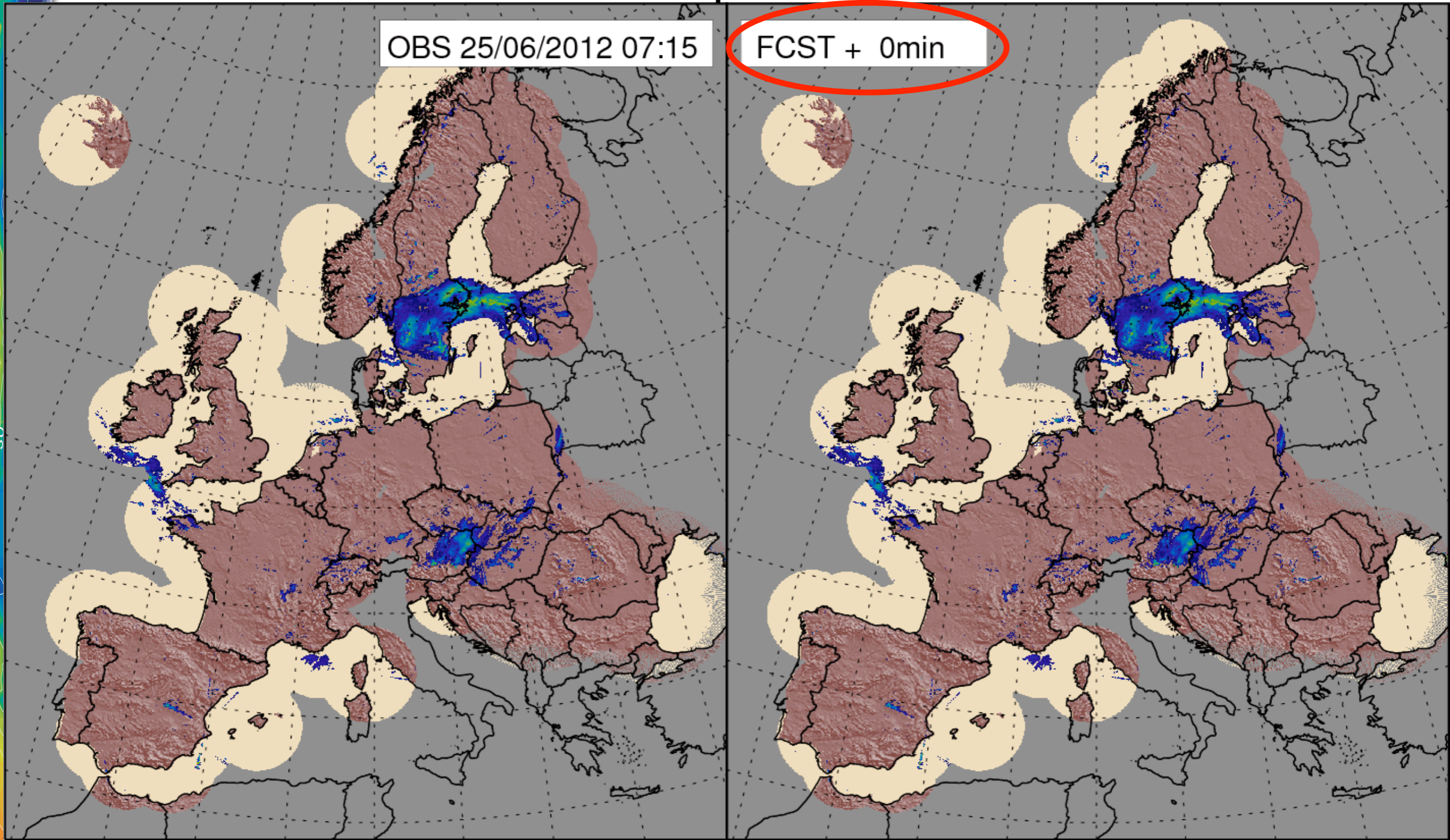


# Case #2: 25 June 2012 0715 UTC

nowcasts up to 8 hours

OBS 25/06/2012 07:15

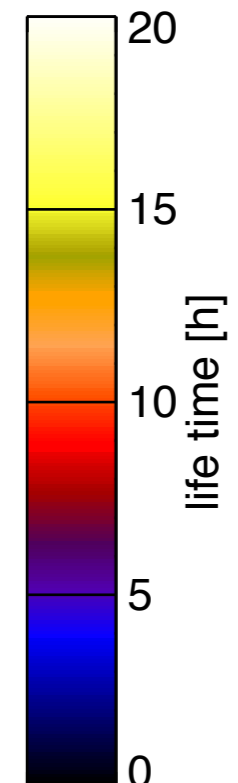
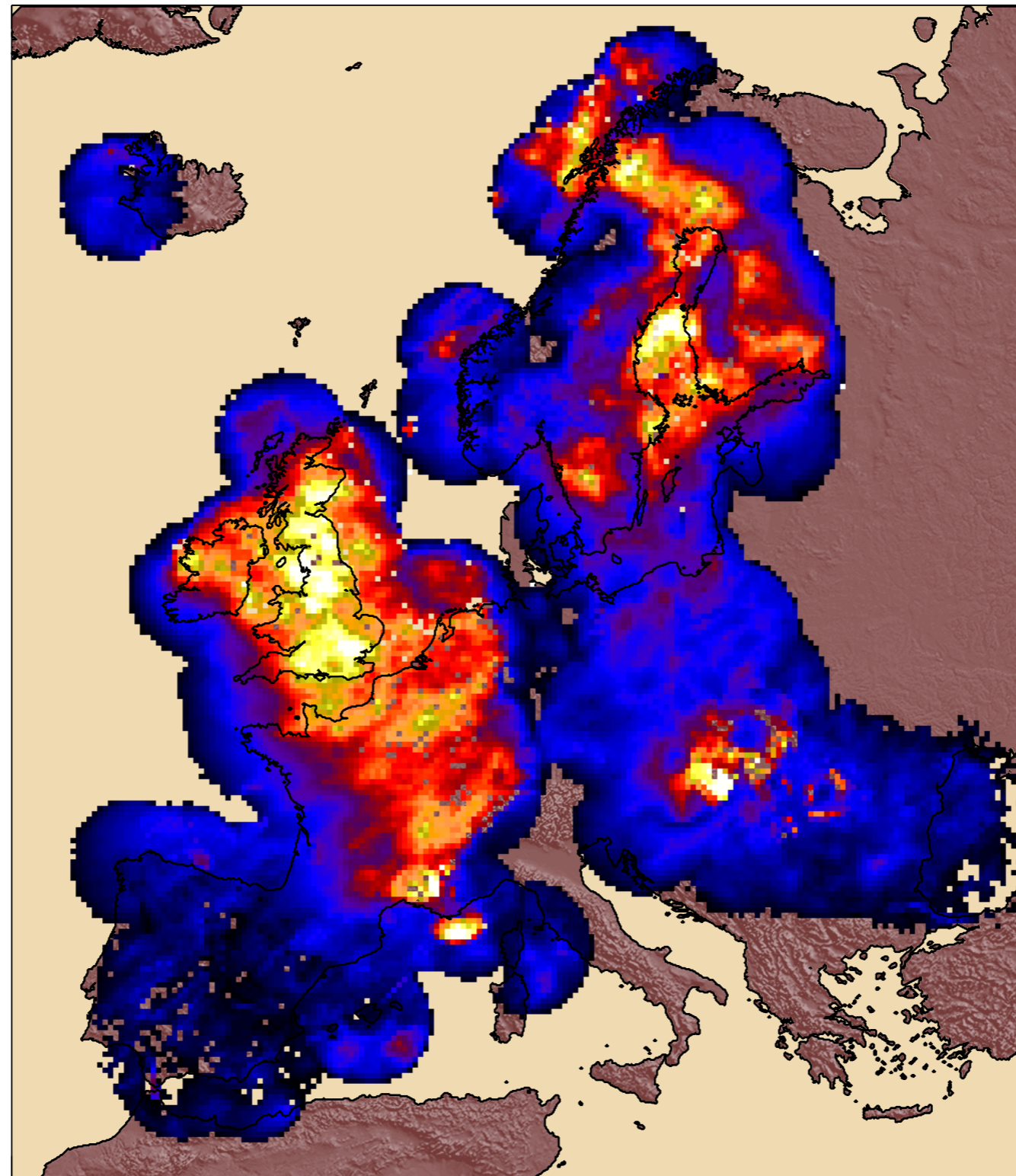
FCST + 0min





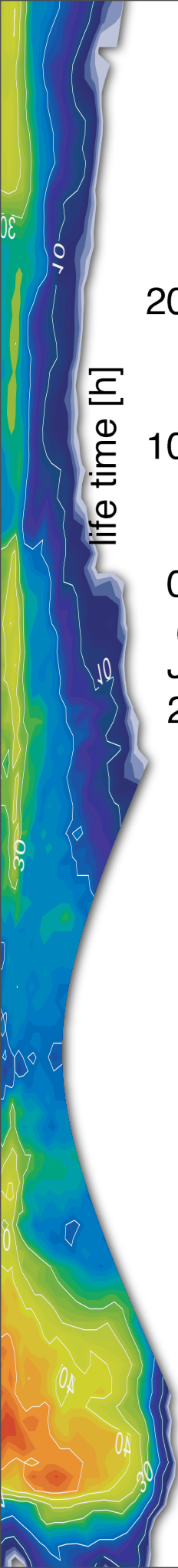
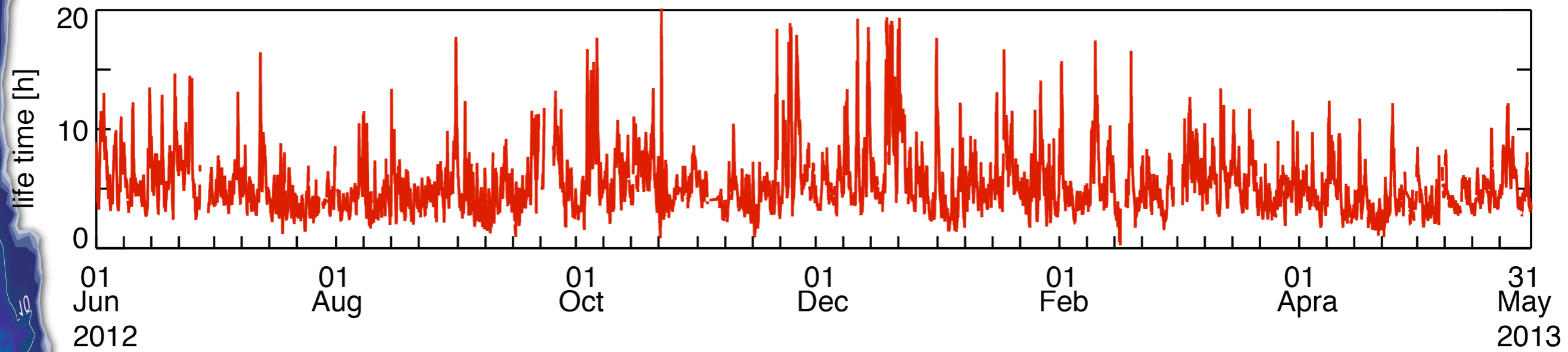
# Geographical variability (Lifetime)

in the period **01 June - 31 July 2012**



# Long-term evaluation

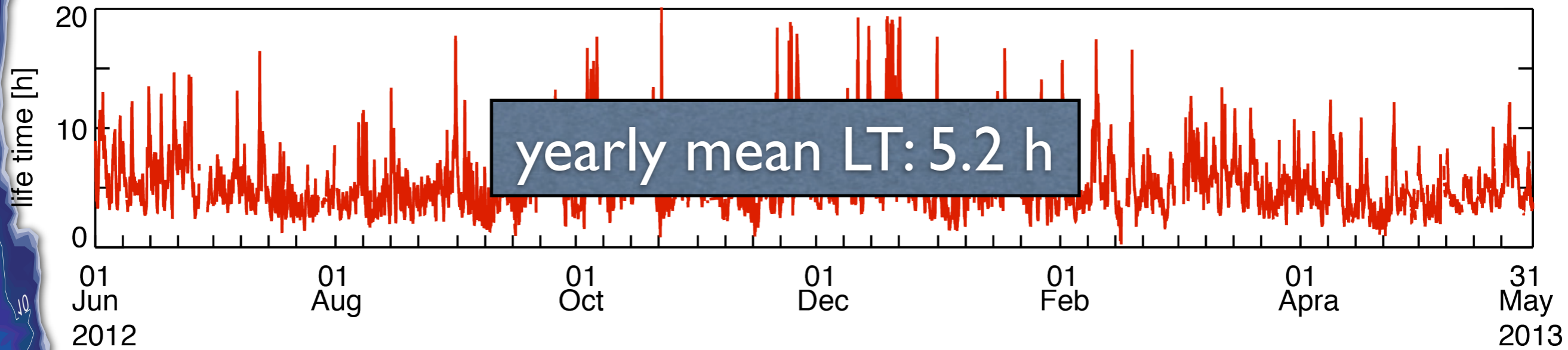
in the period **01 June - 31 May 2013**





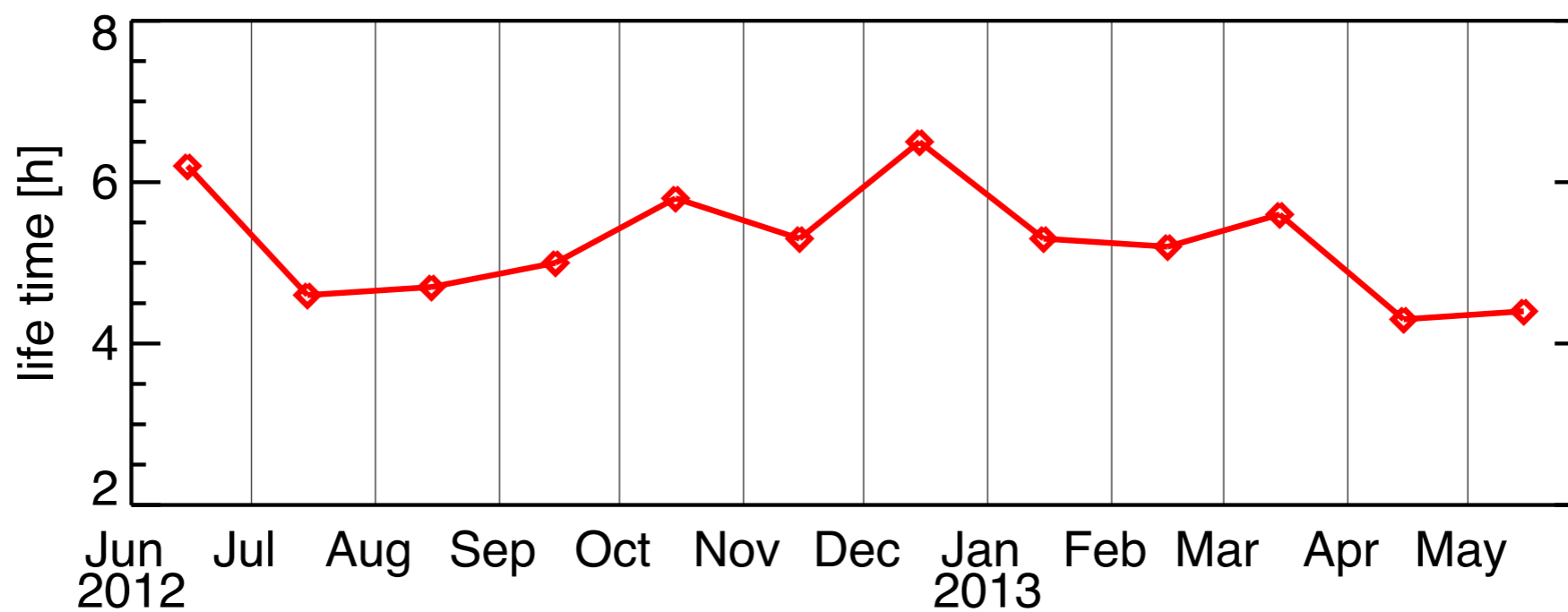
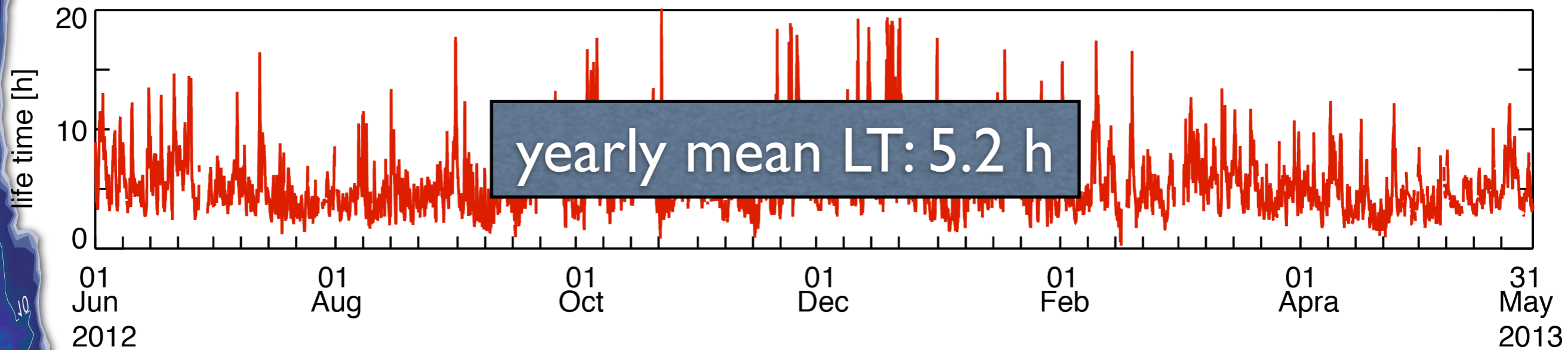
# Long-term evaluation

in the period **01 June - 31 May 2013**



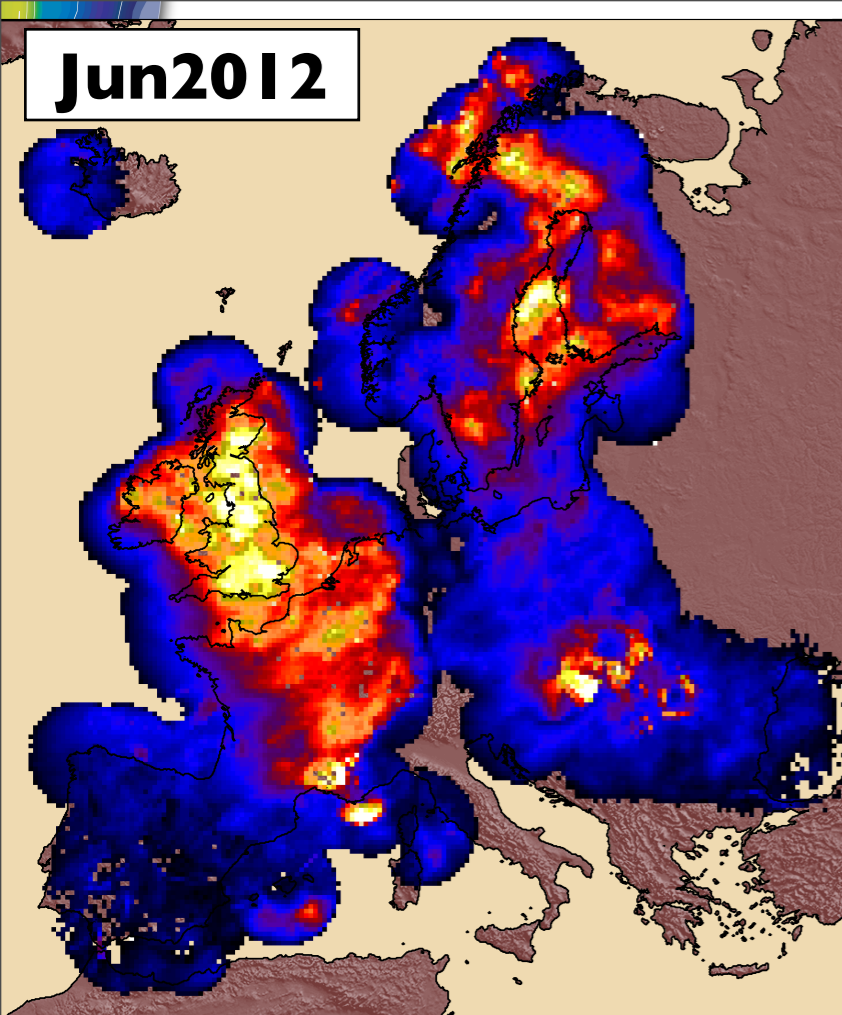
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in the period **01 June - 31 May 2013**

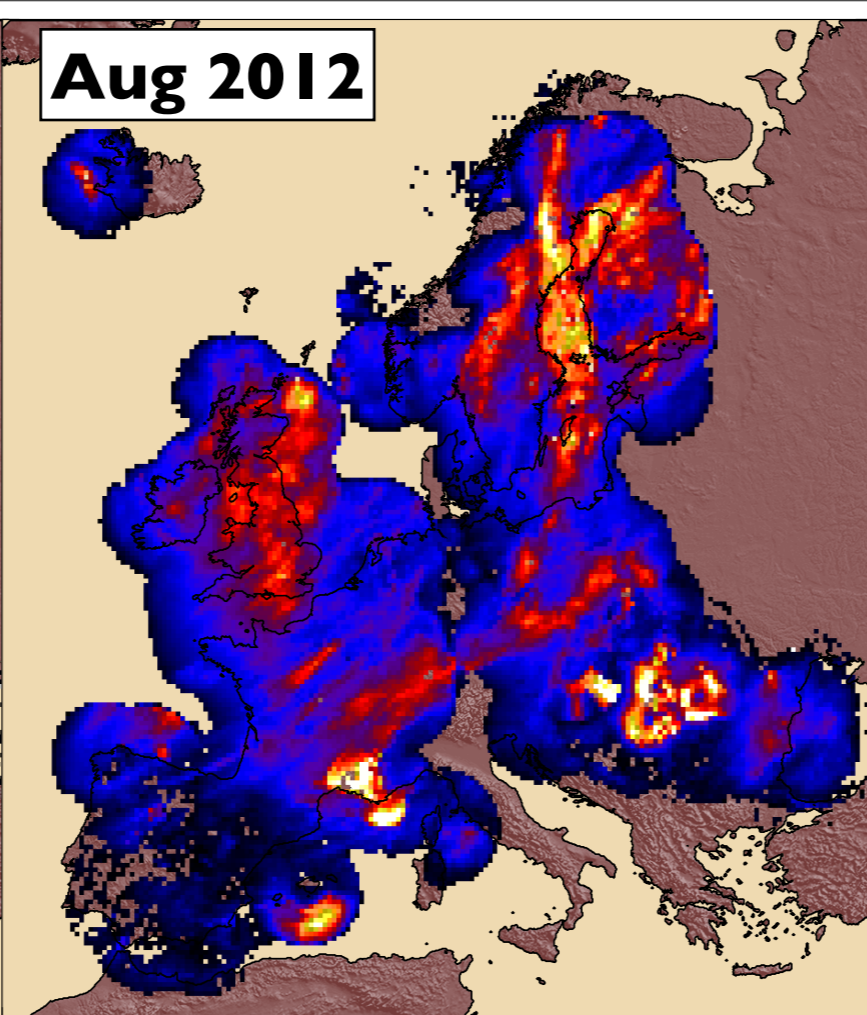




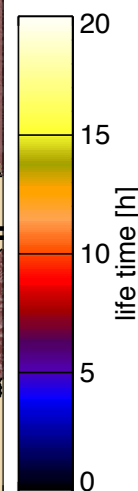
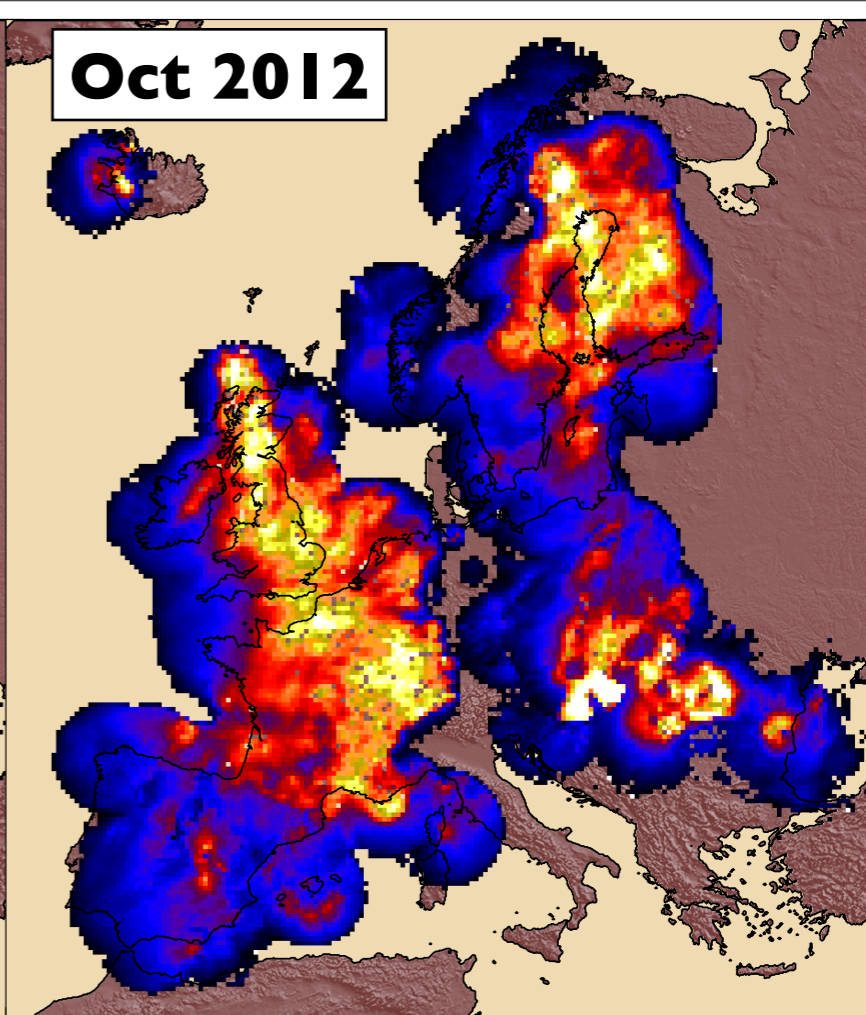
**Jun2012**



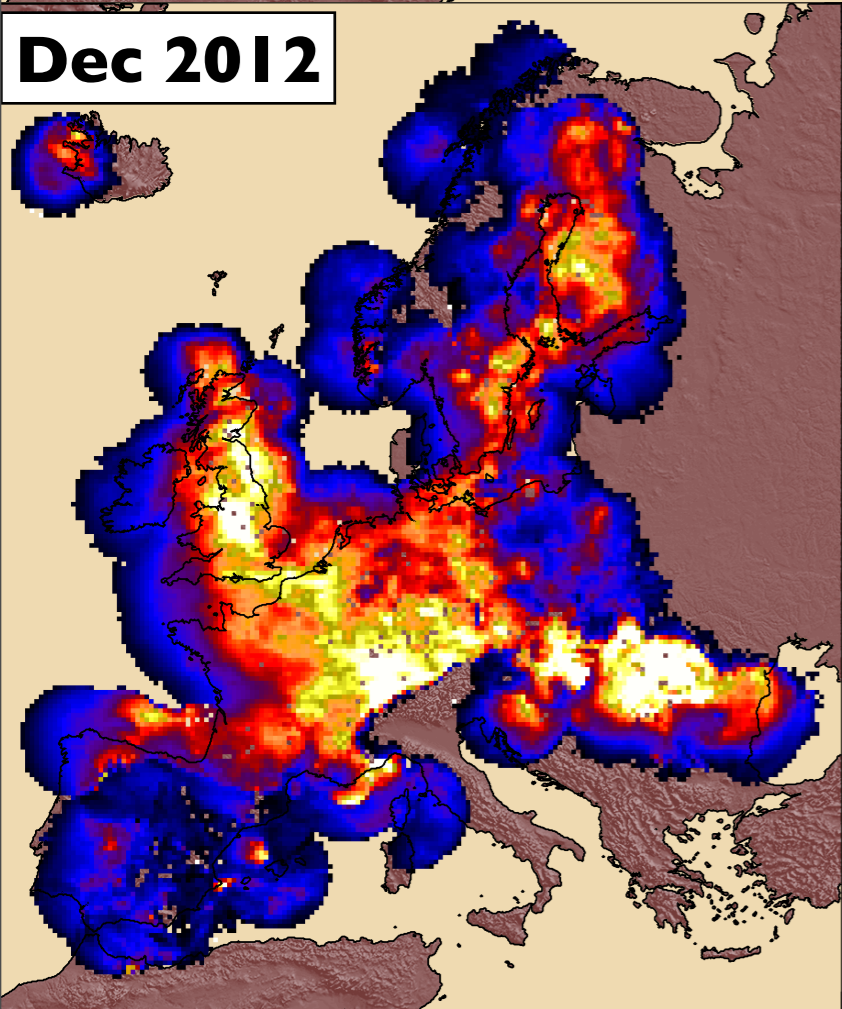
**Aug 2012**



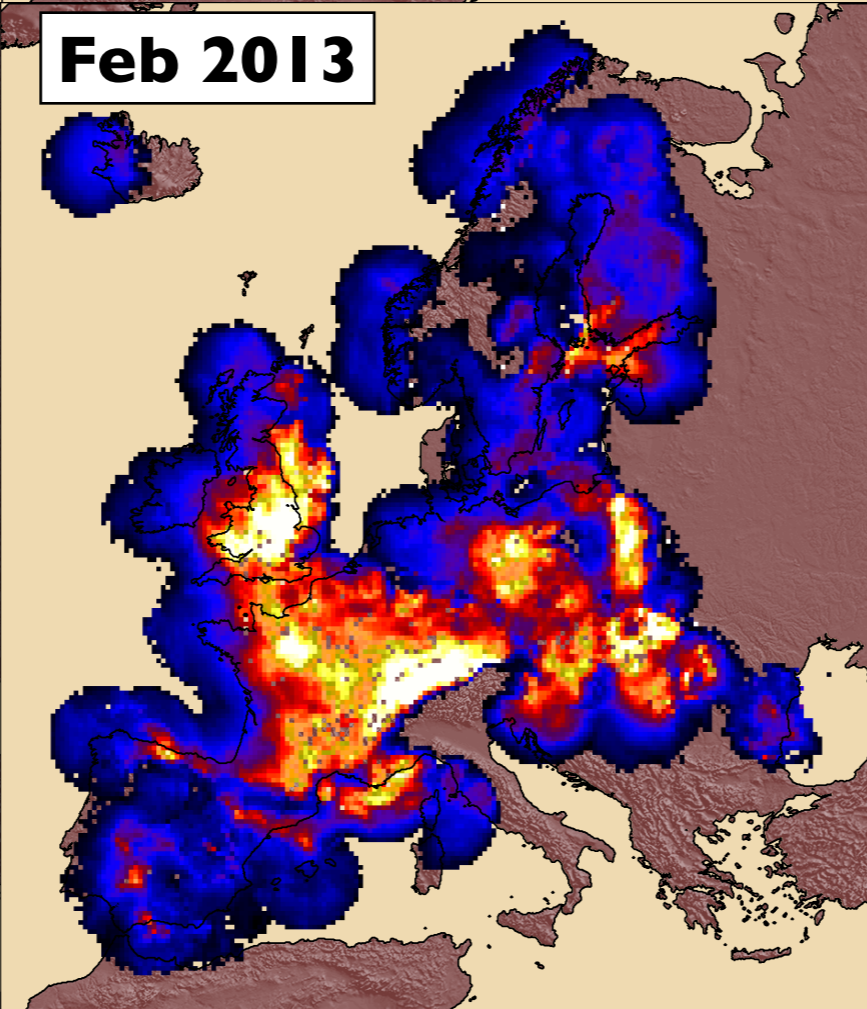
**Oct 2012**



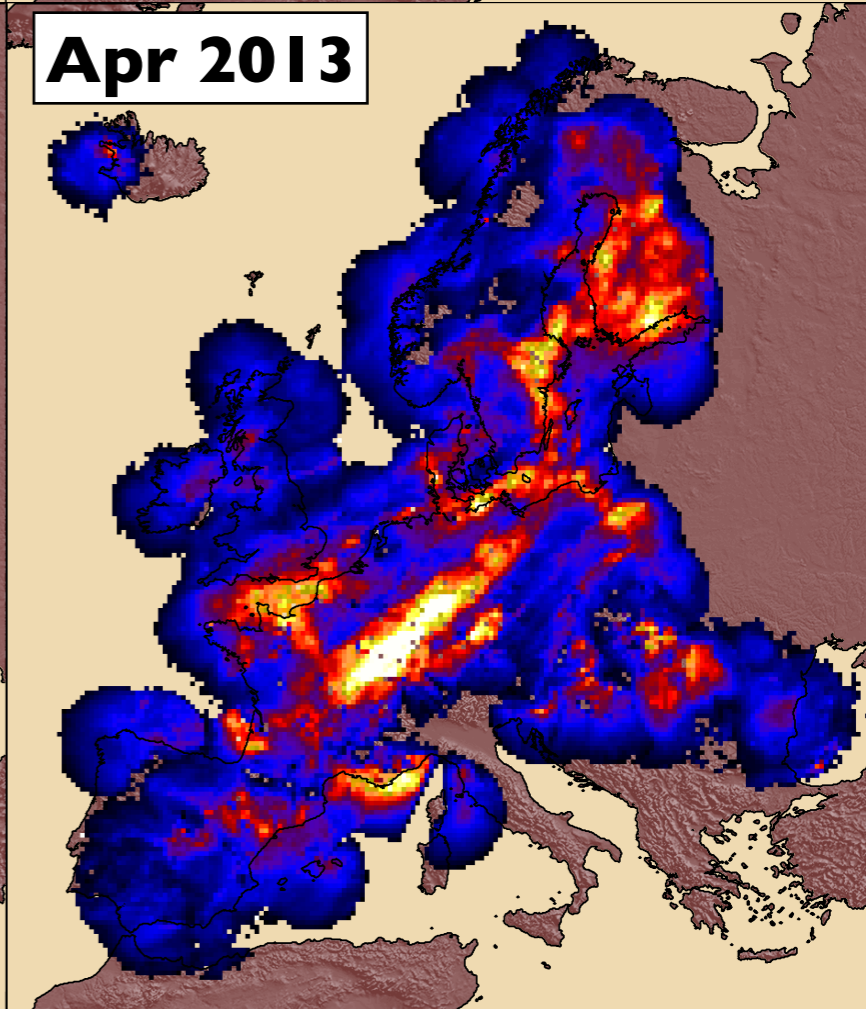
**Dec 2012**



**Feb 2013**

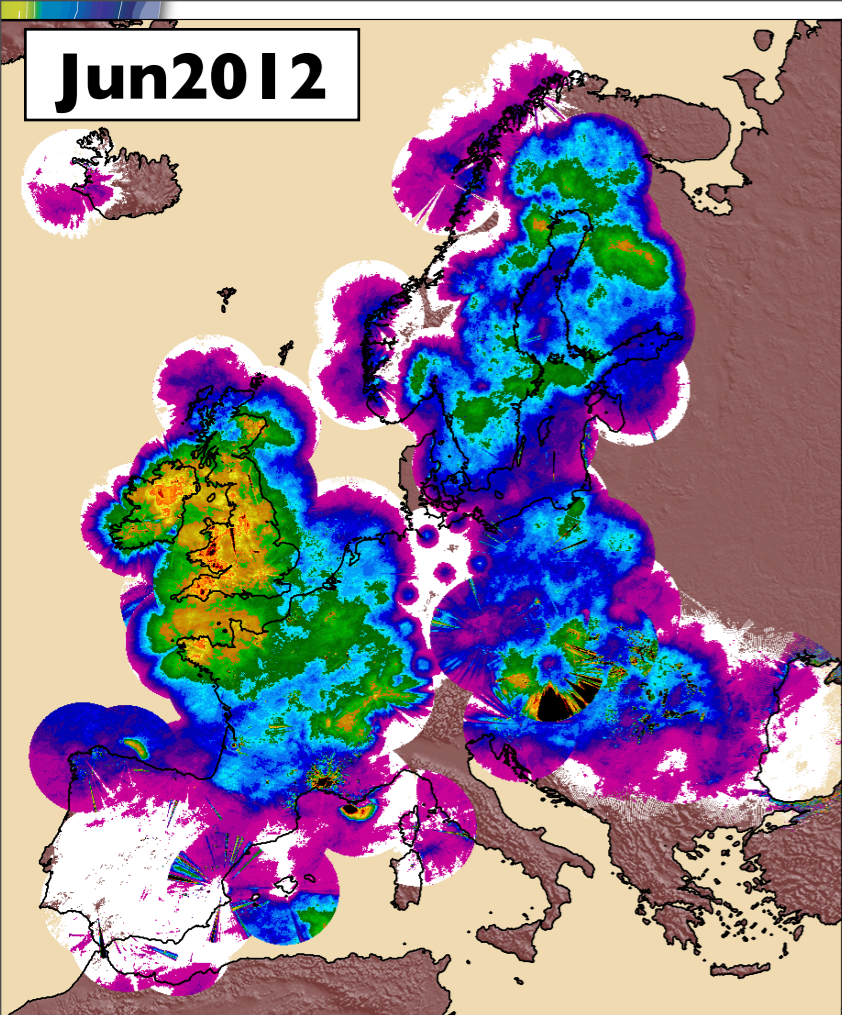


**Apr 2013**

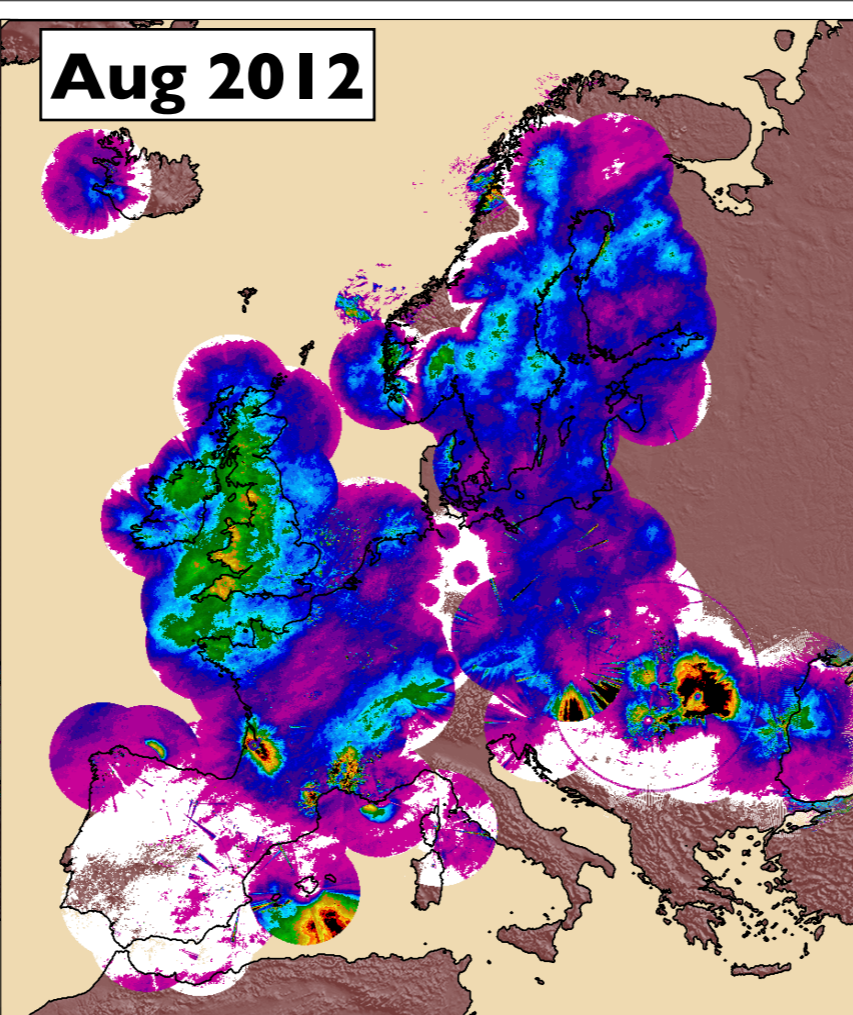




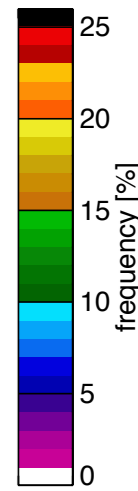
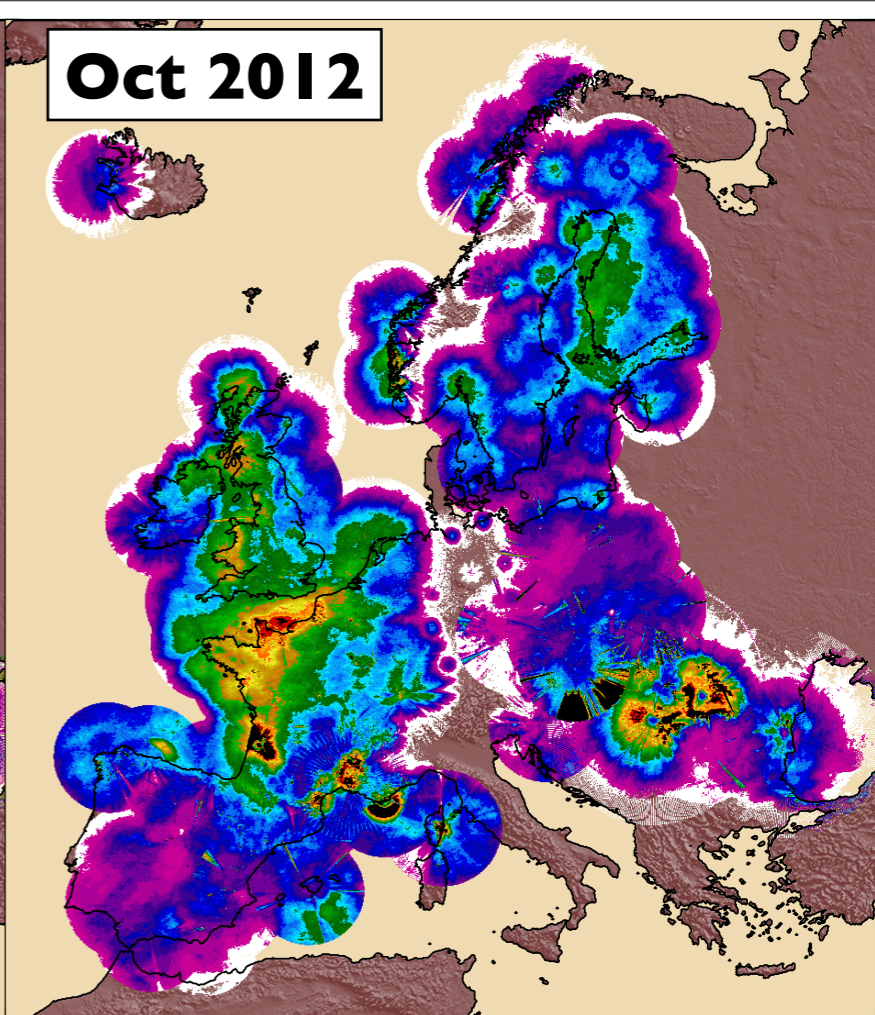
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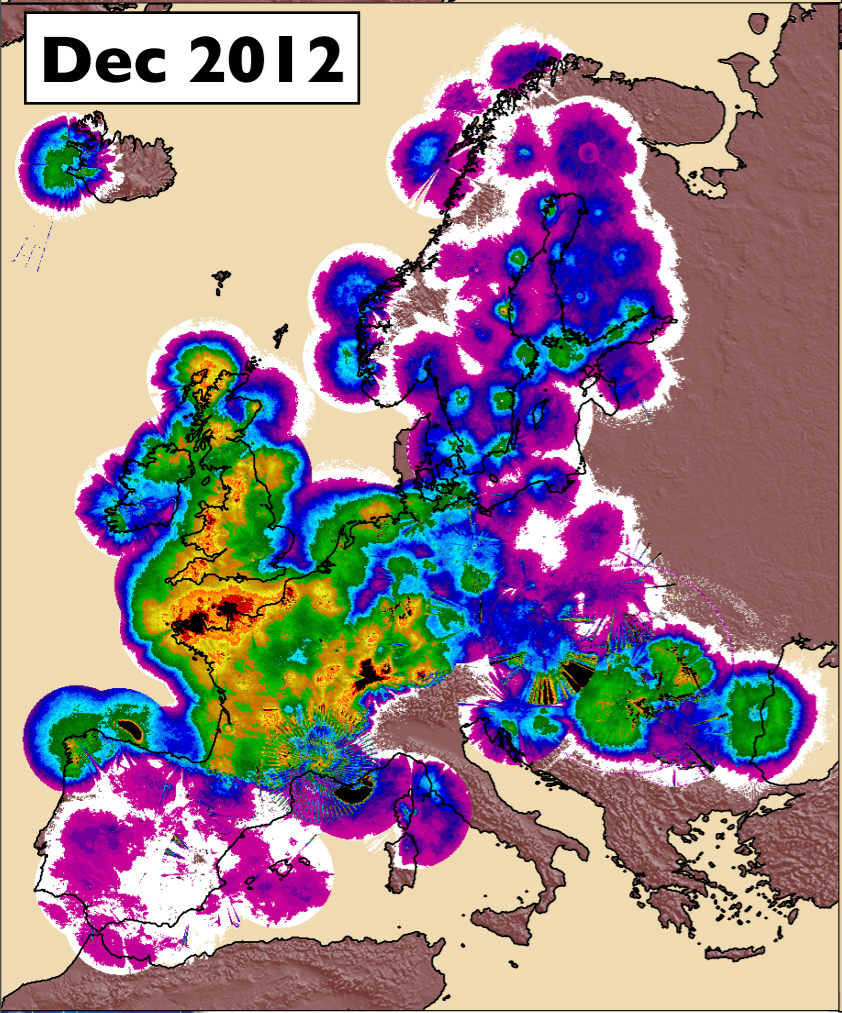
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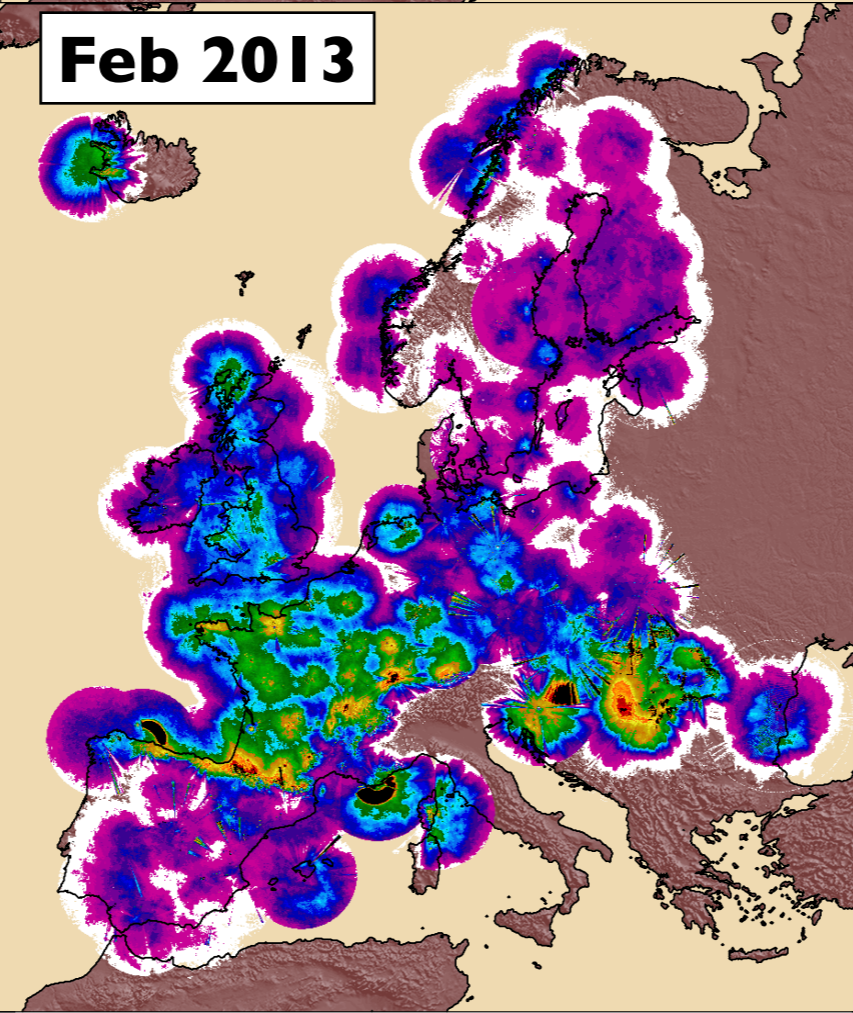
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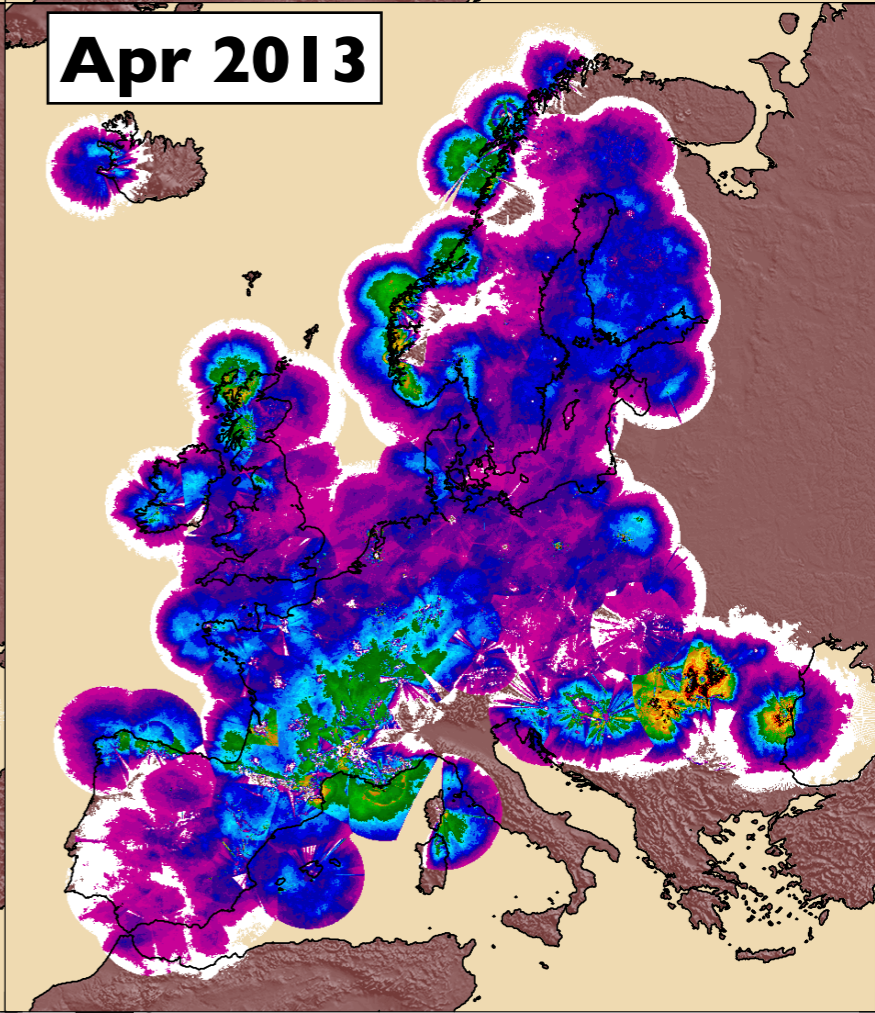
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**Feb 2013**



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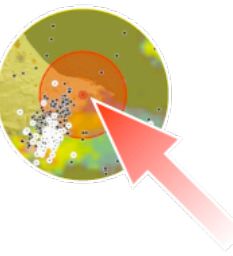






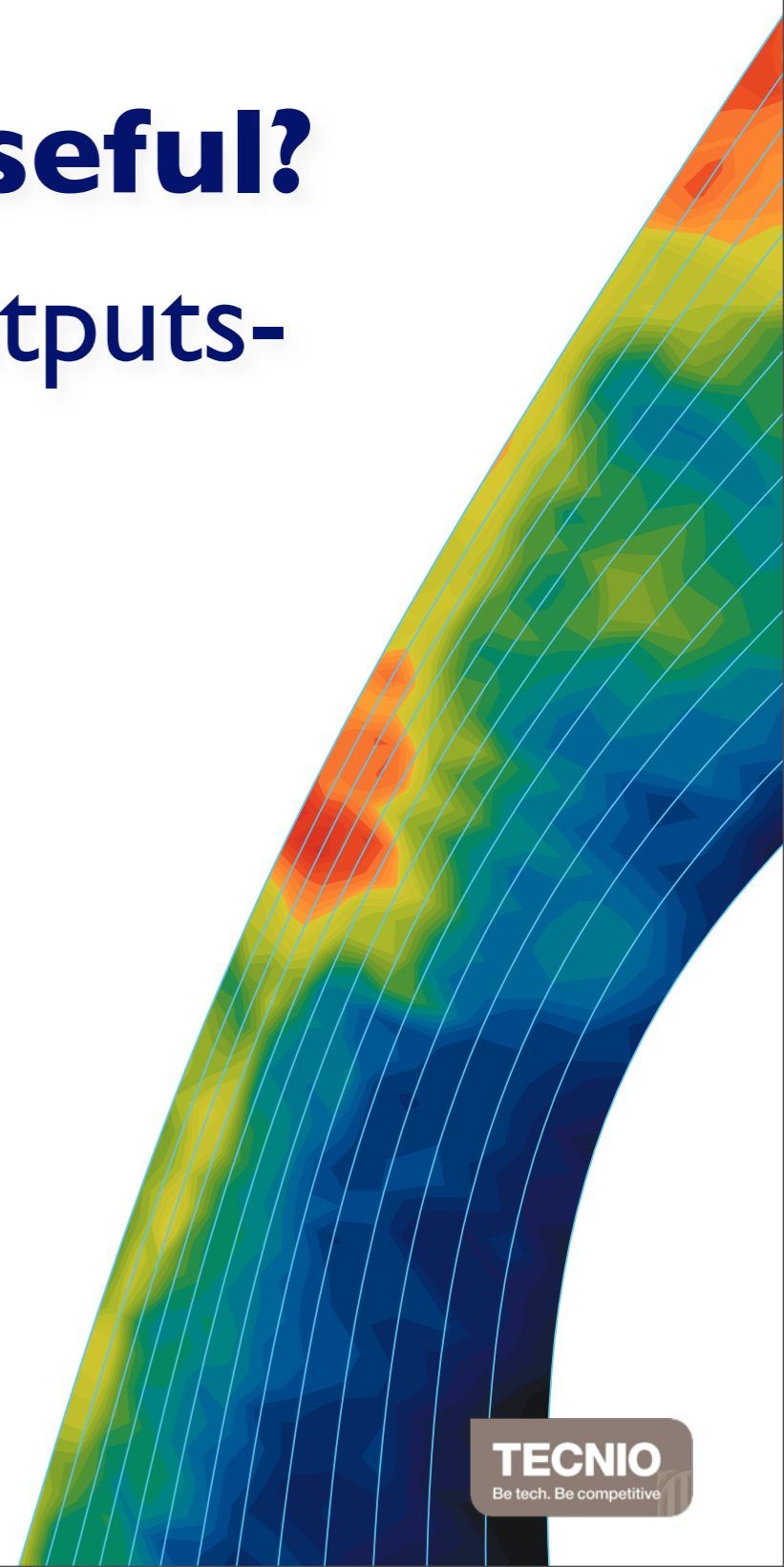
European  
Civil Protection

# HAREN



## When is nowcasting useful?

-comparison with NWP outputs-



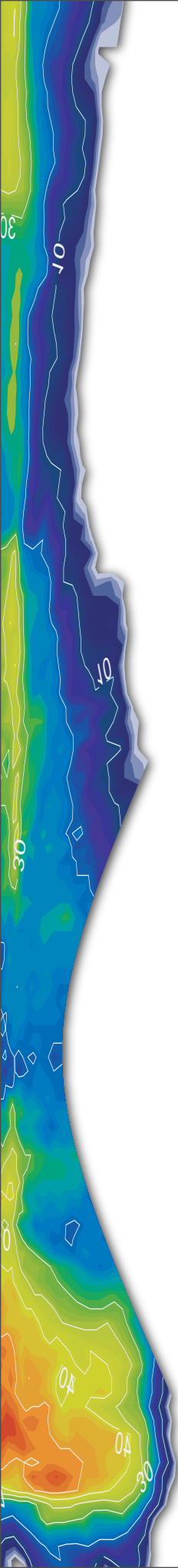
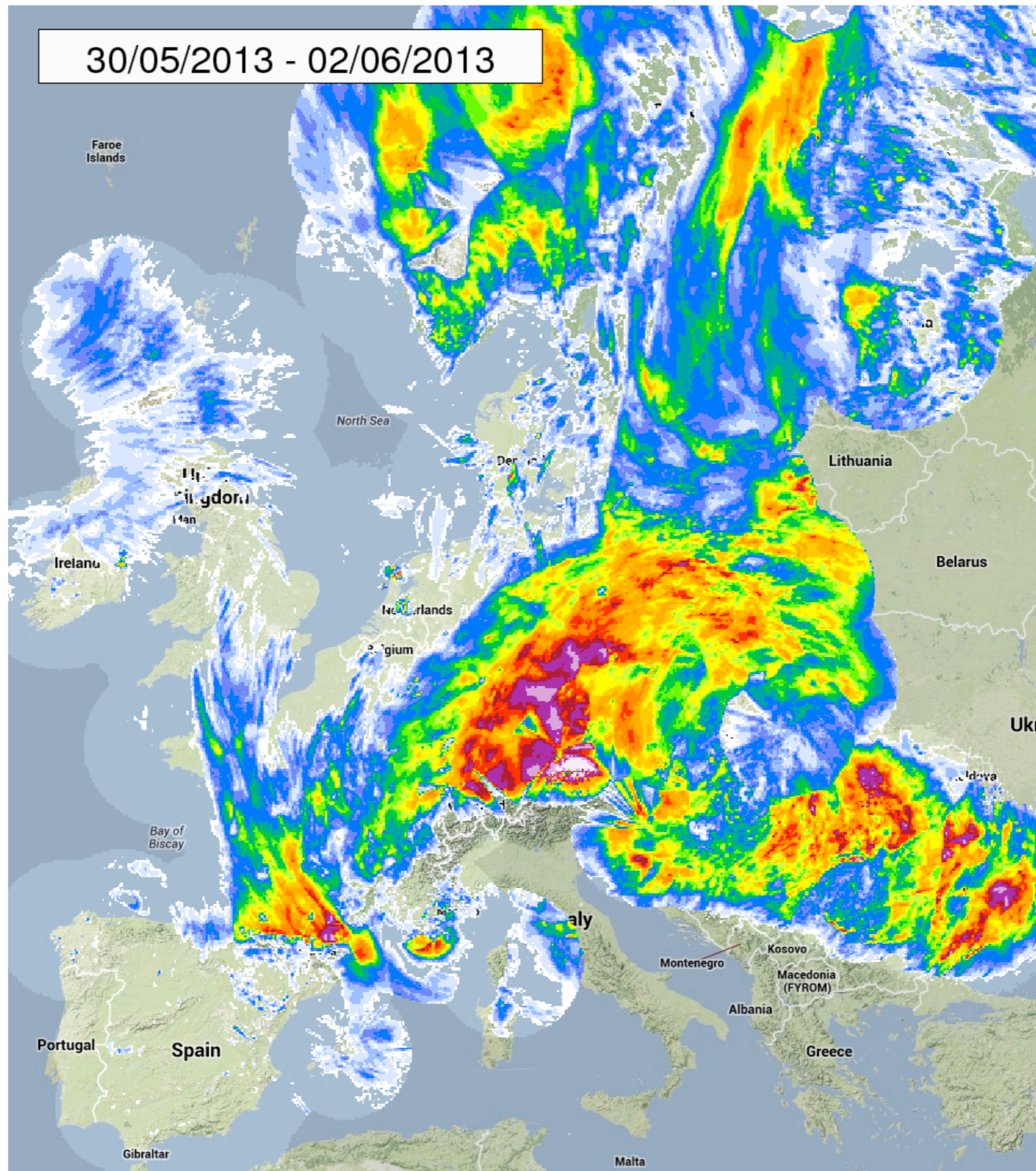
Centre de Recerca Aplicada  
en Hidrometeorologia

UNIVERSITAT POLITÈCNICA DE CATALUNYA

**TECNIO**  
Be tech. Be competitive

# Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

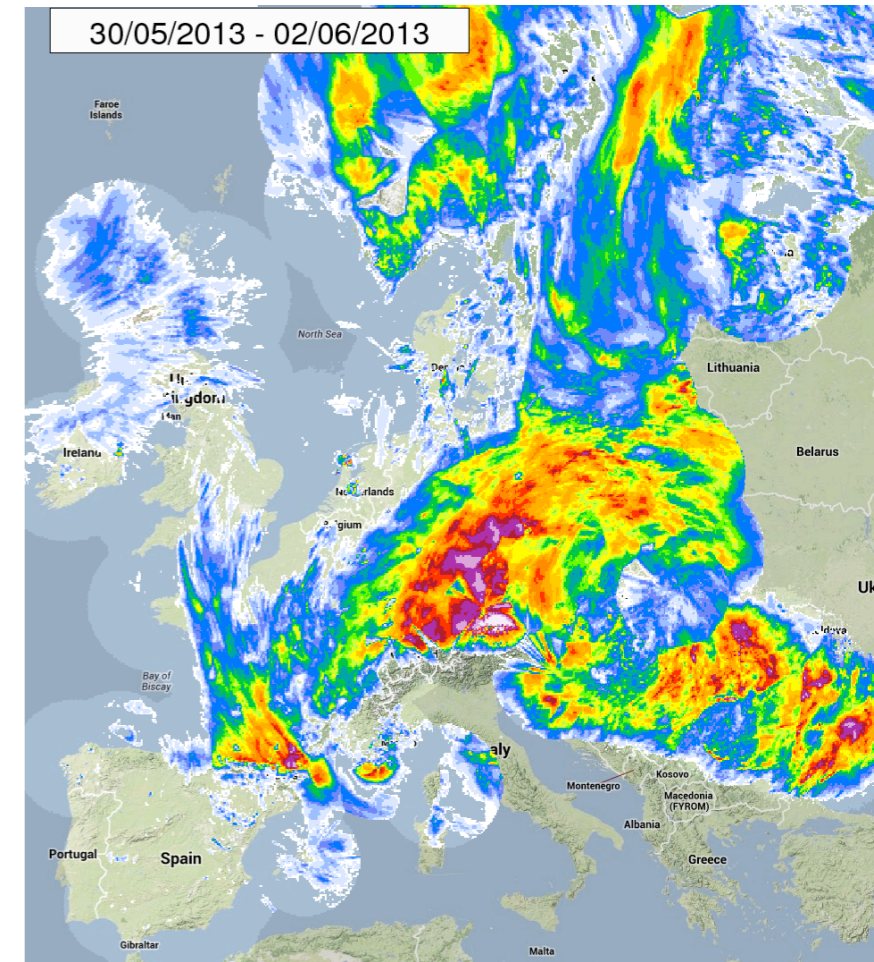




# Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

Comparison between rainfall forecasts and observations

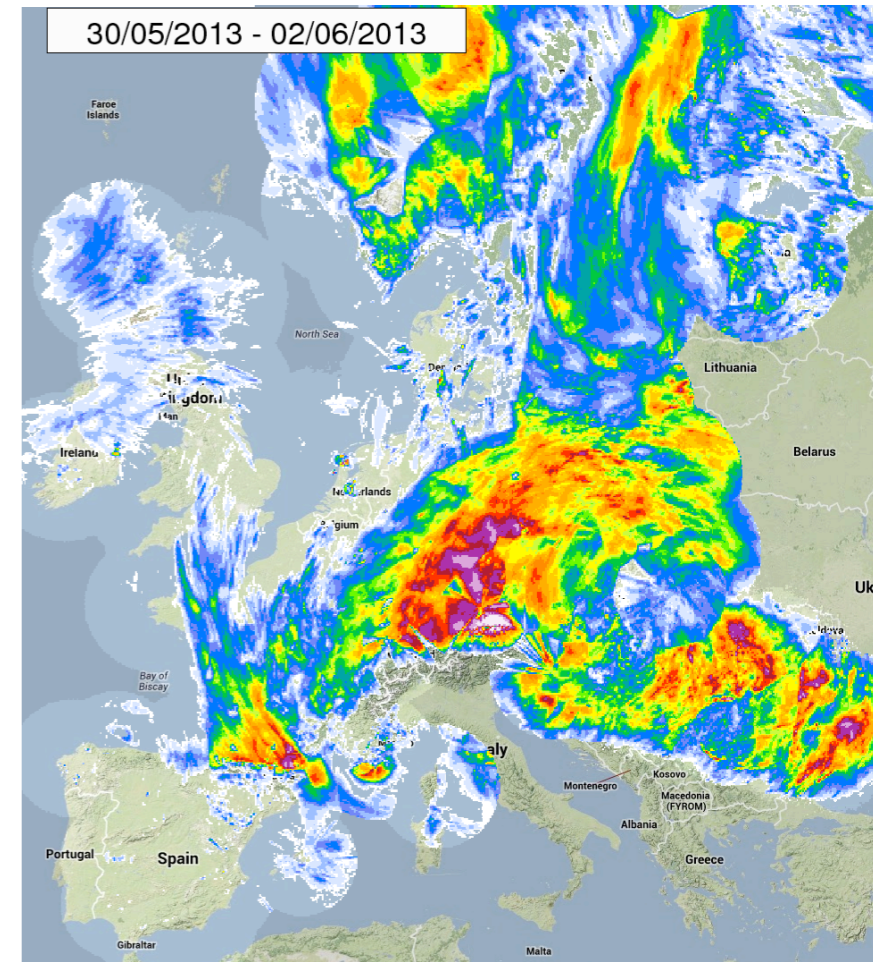
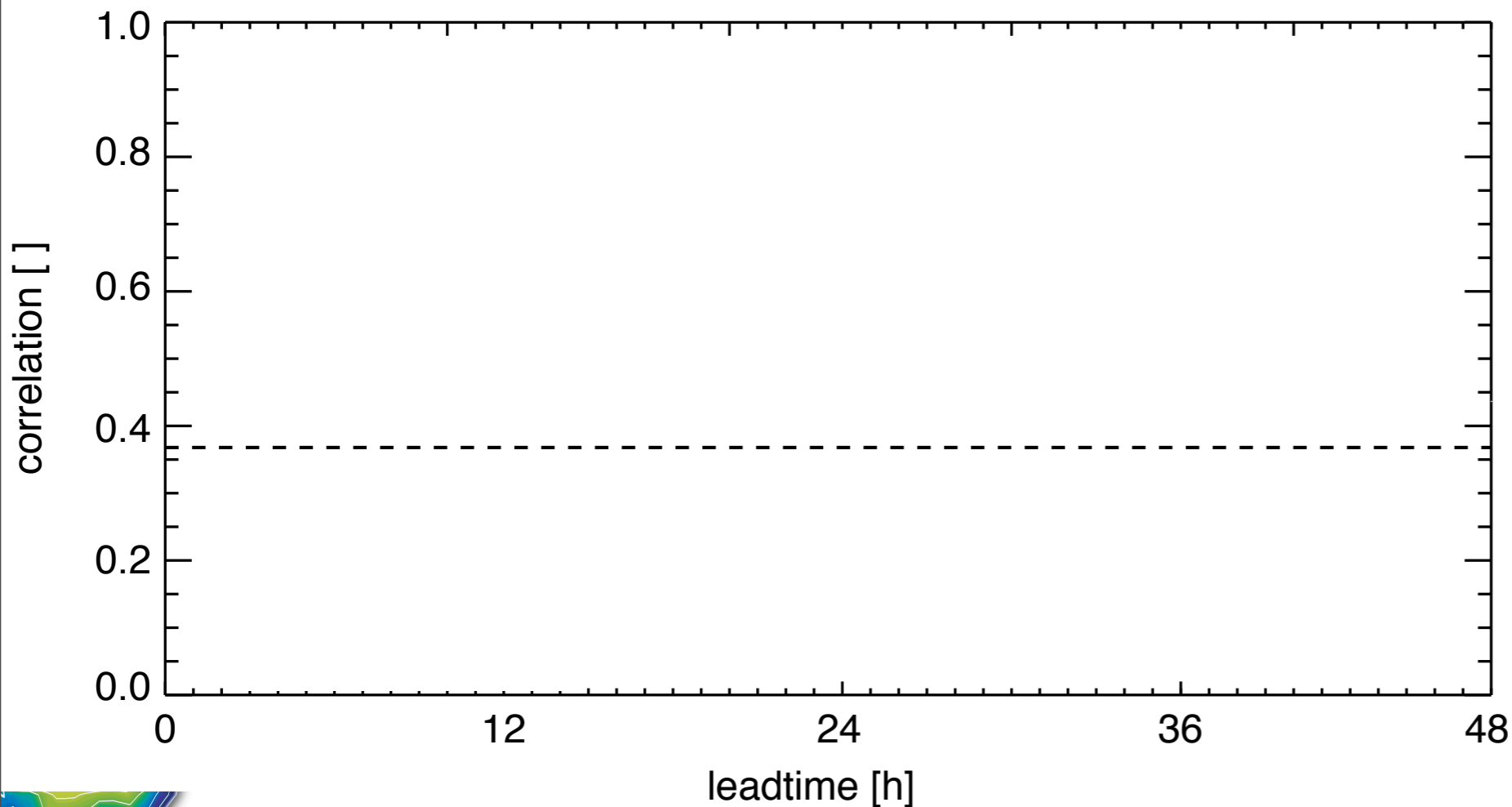


# Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

## Comparison between rainfall forecasts and observations

--- NWP (HIRLAM)

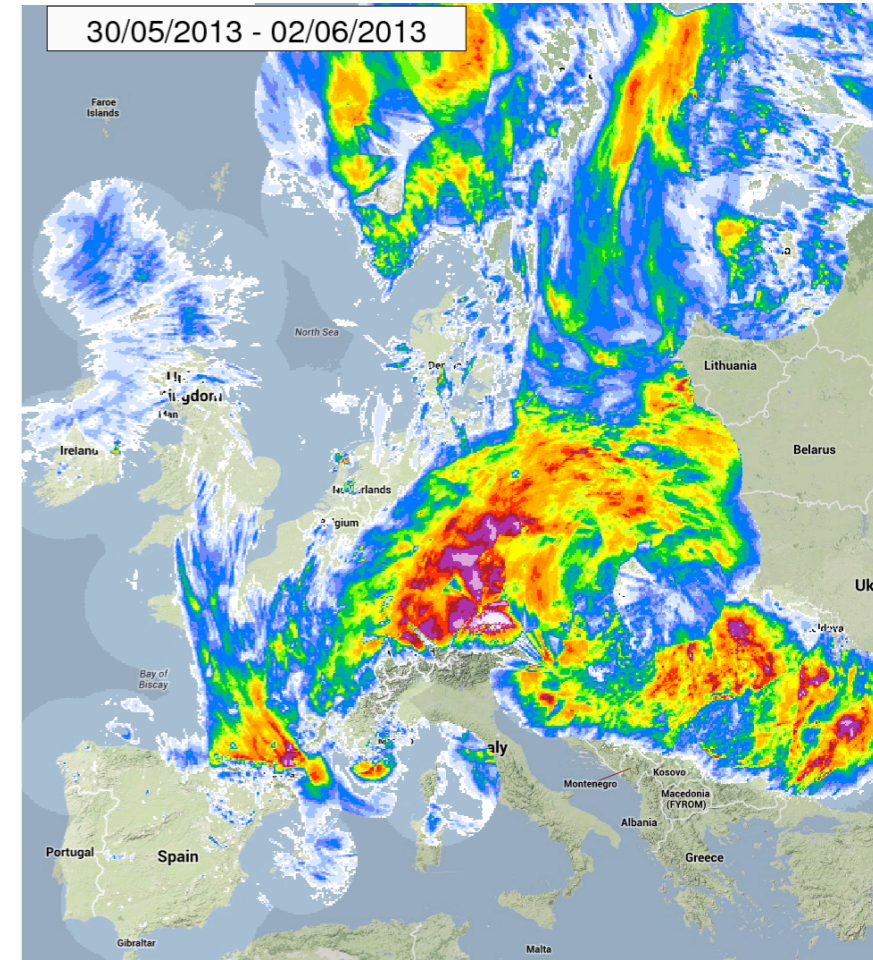




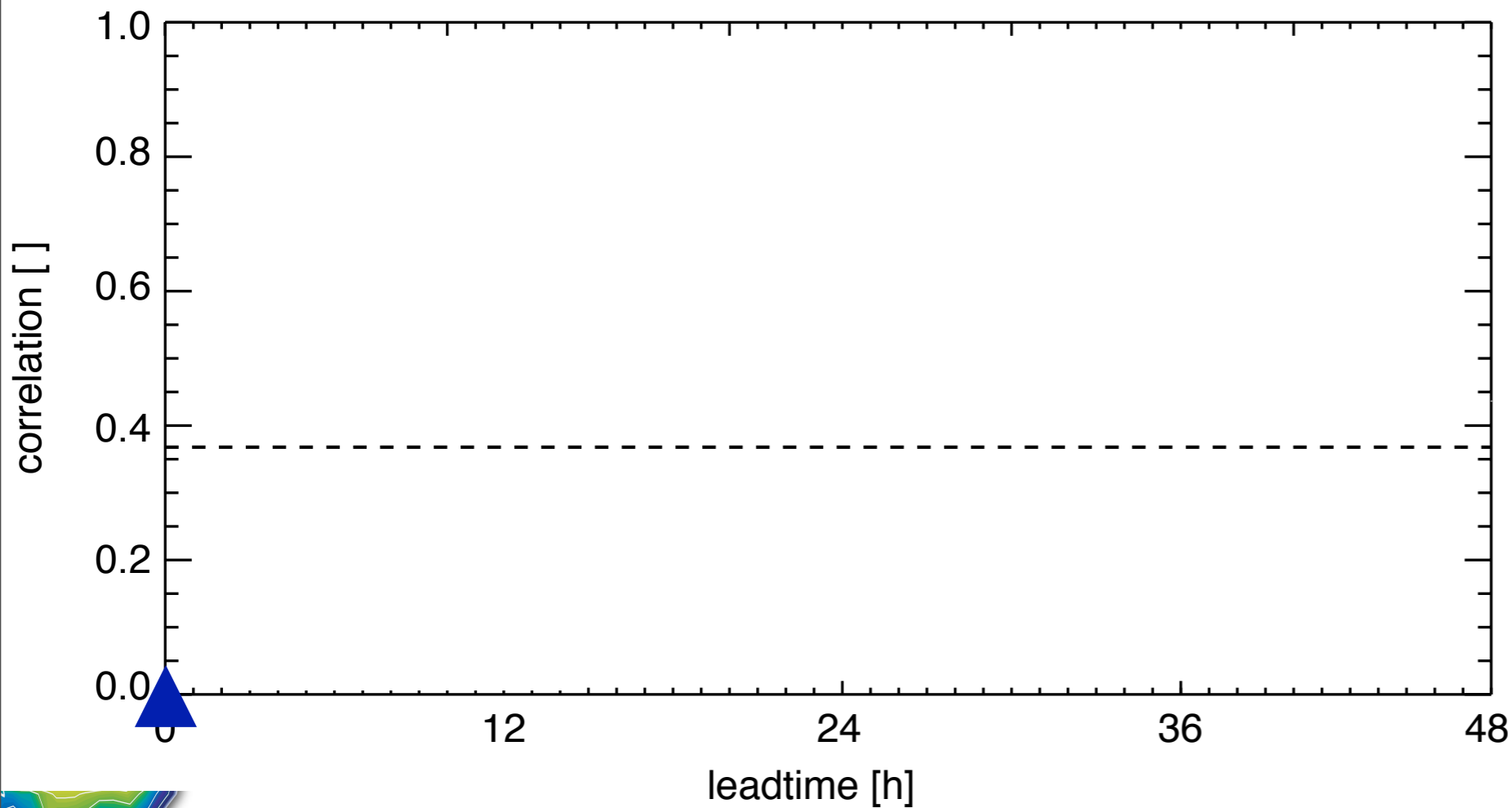
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01 June 2013 - 48 hour evaluation

## Comparison between rainfall forecasts and observations



--- NWP (HIRLAM)

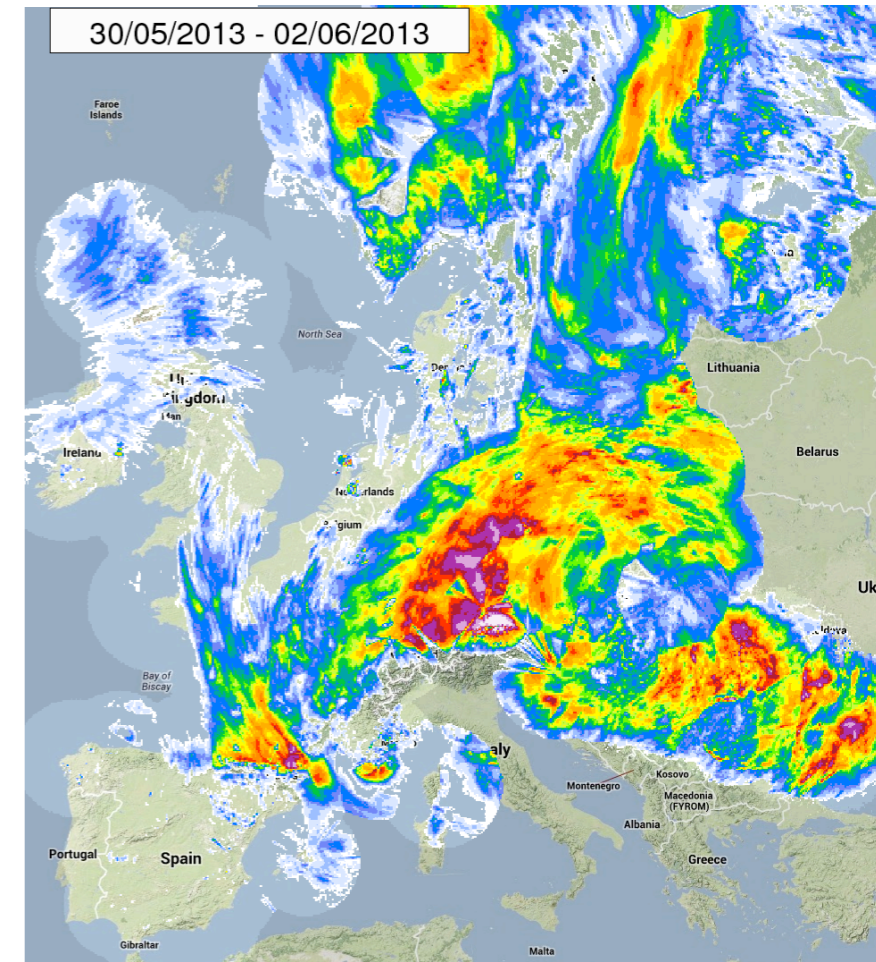
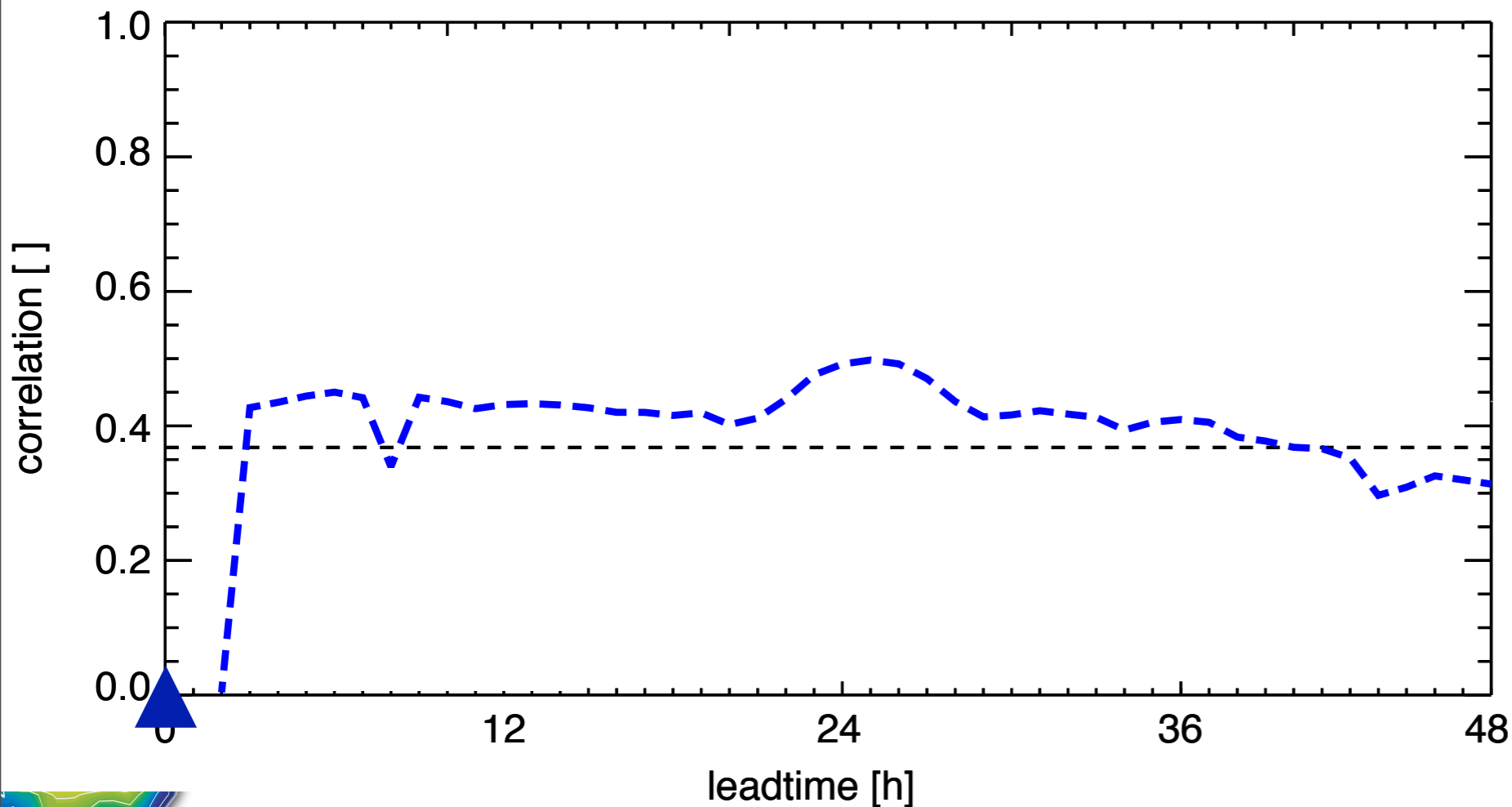


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01 June 2013 - 48 hour evaluation

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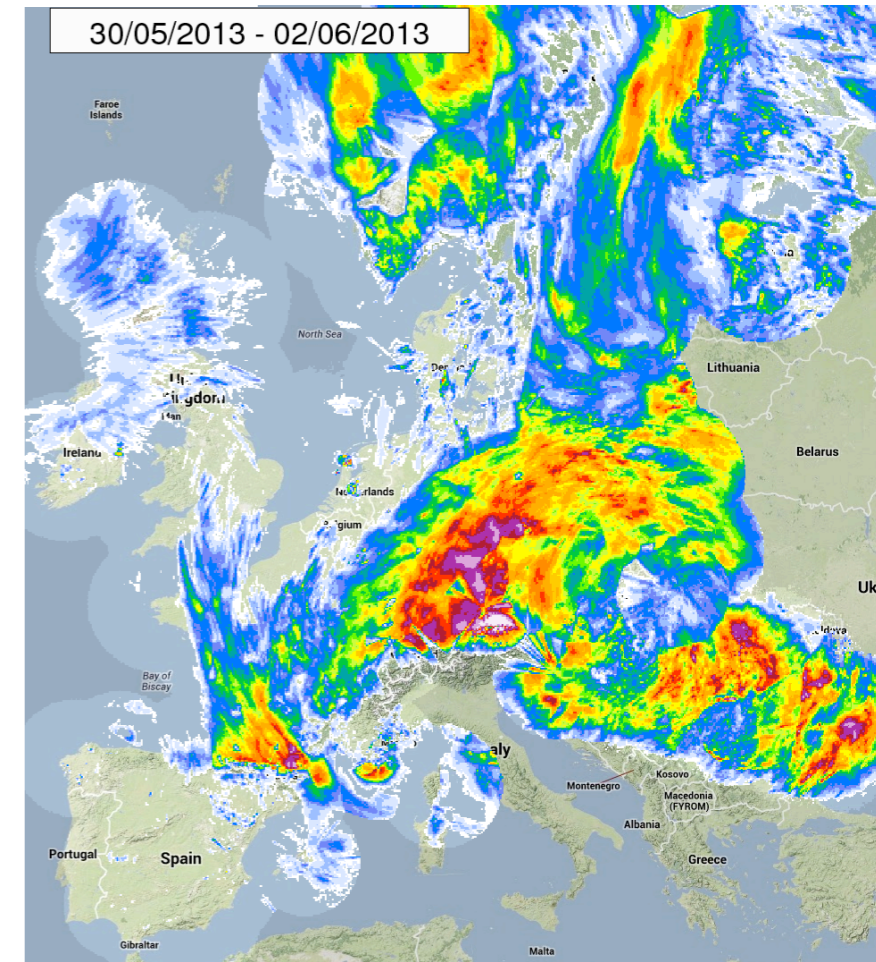
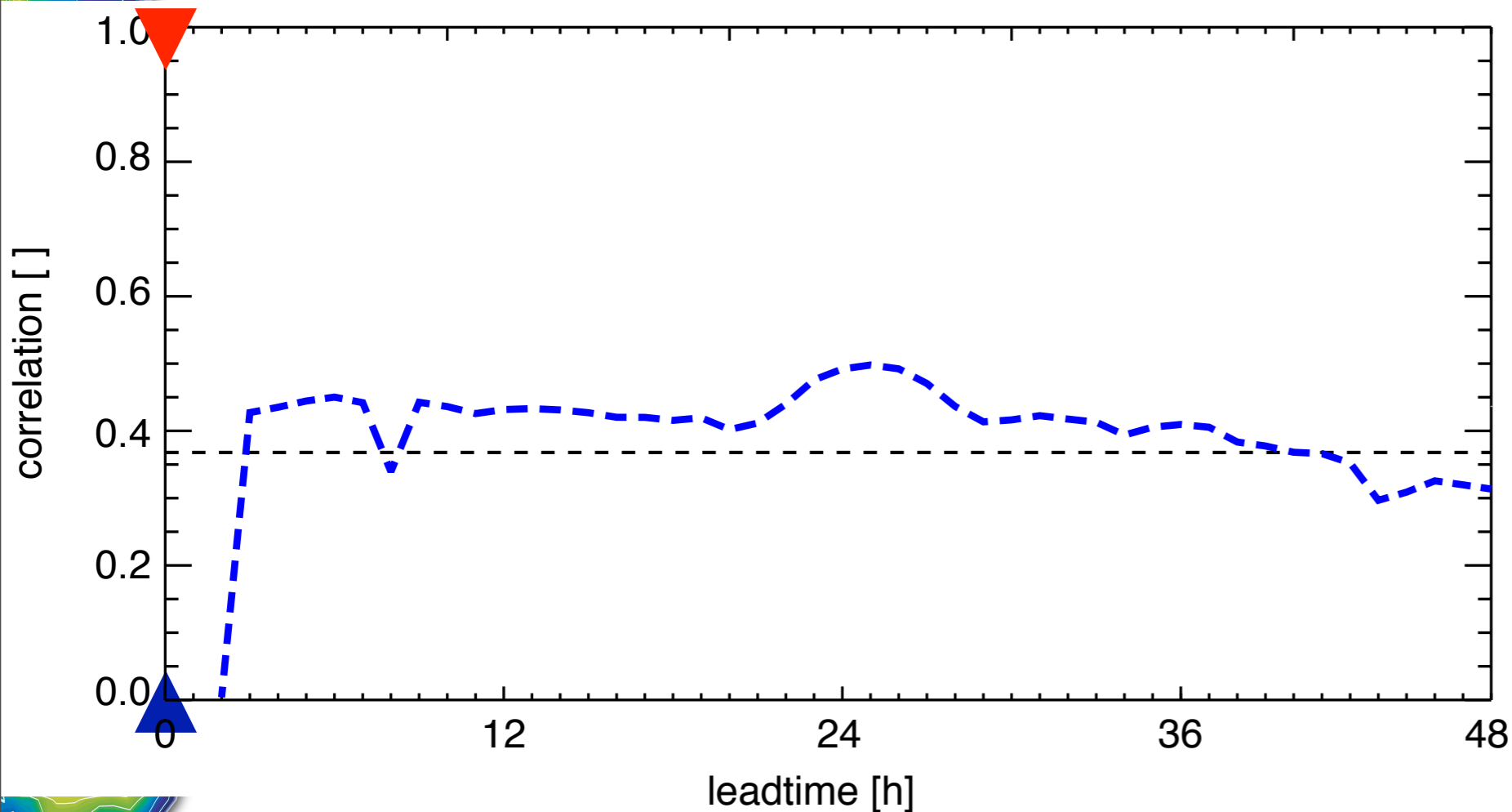
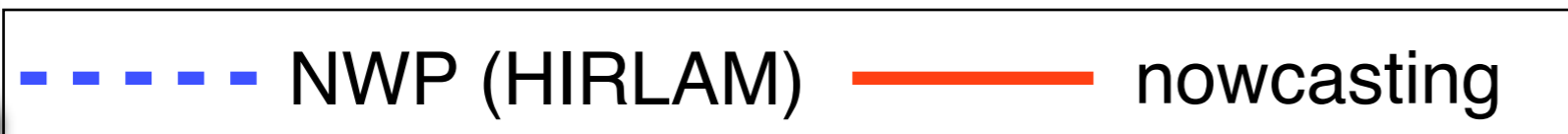




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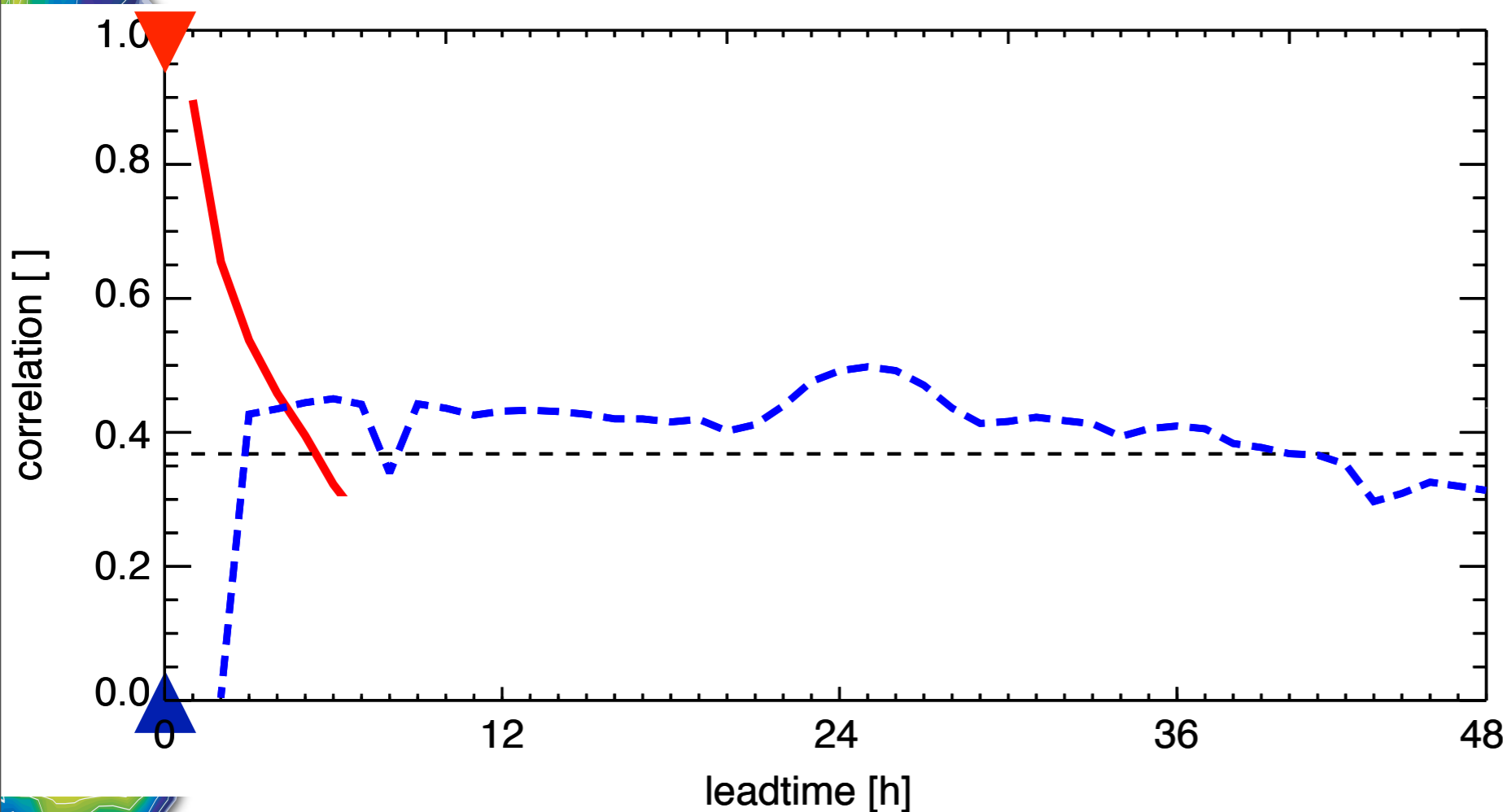
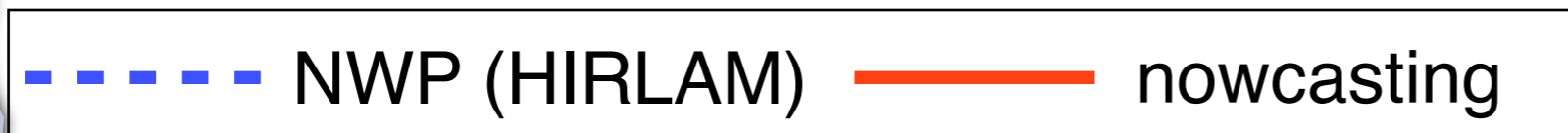
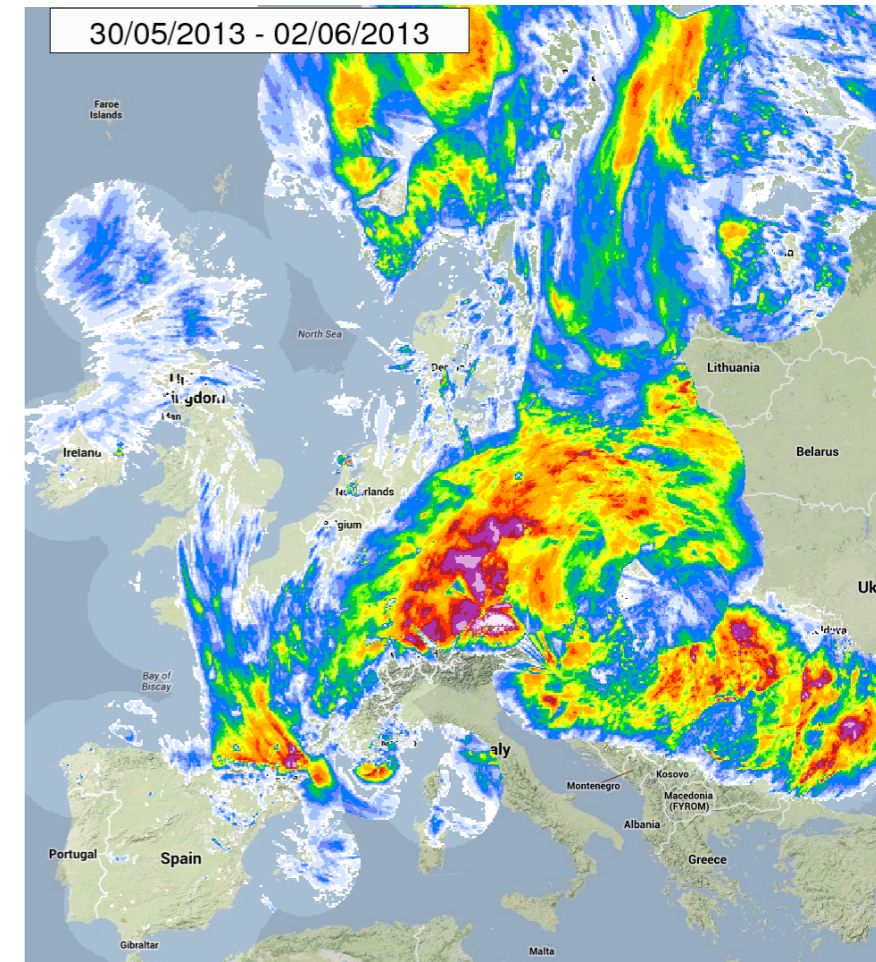
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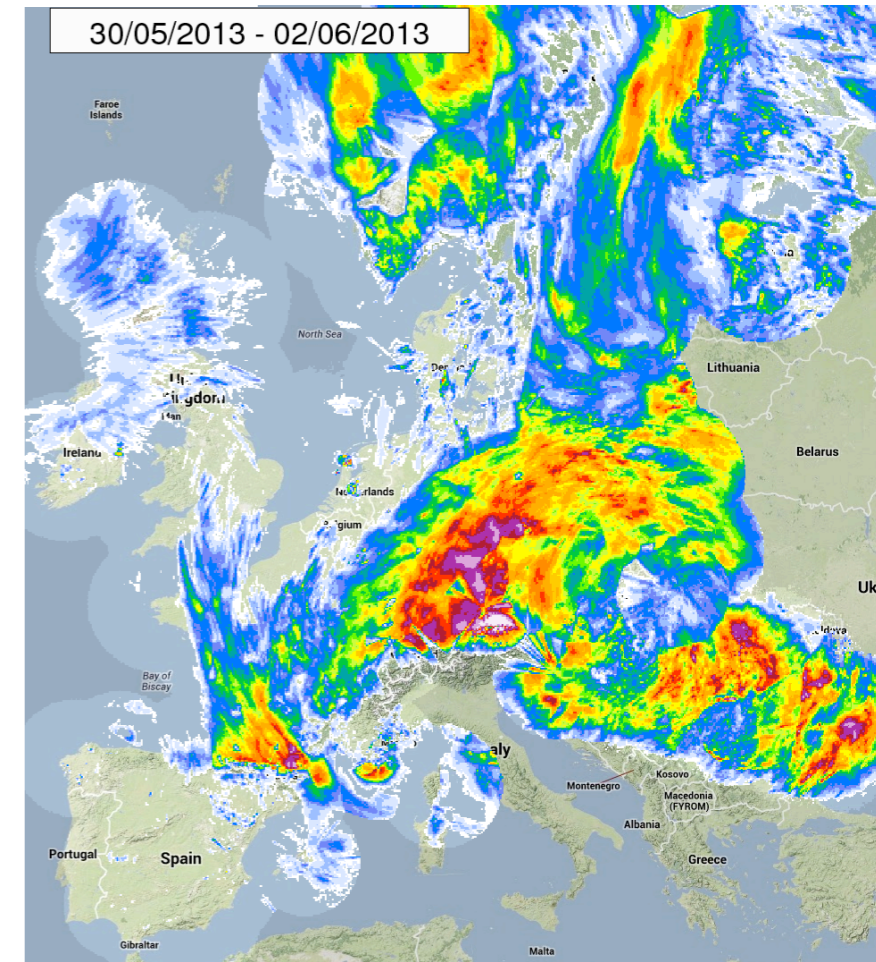
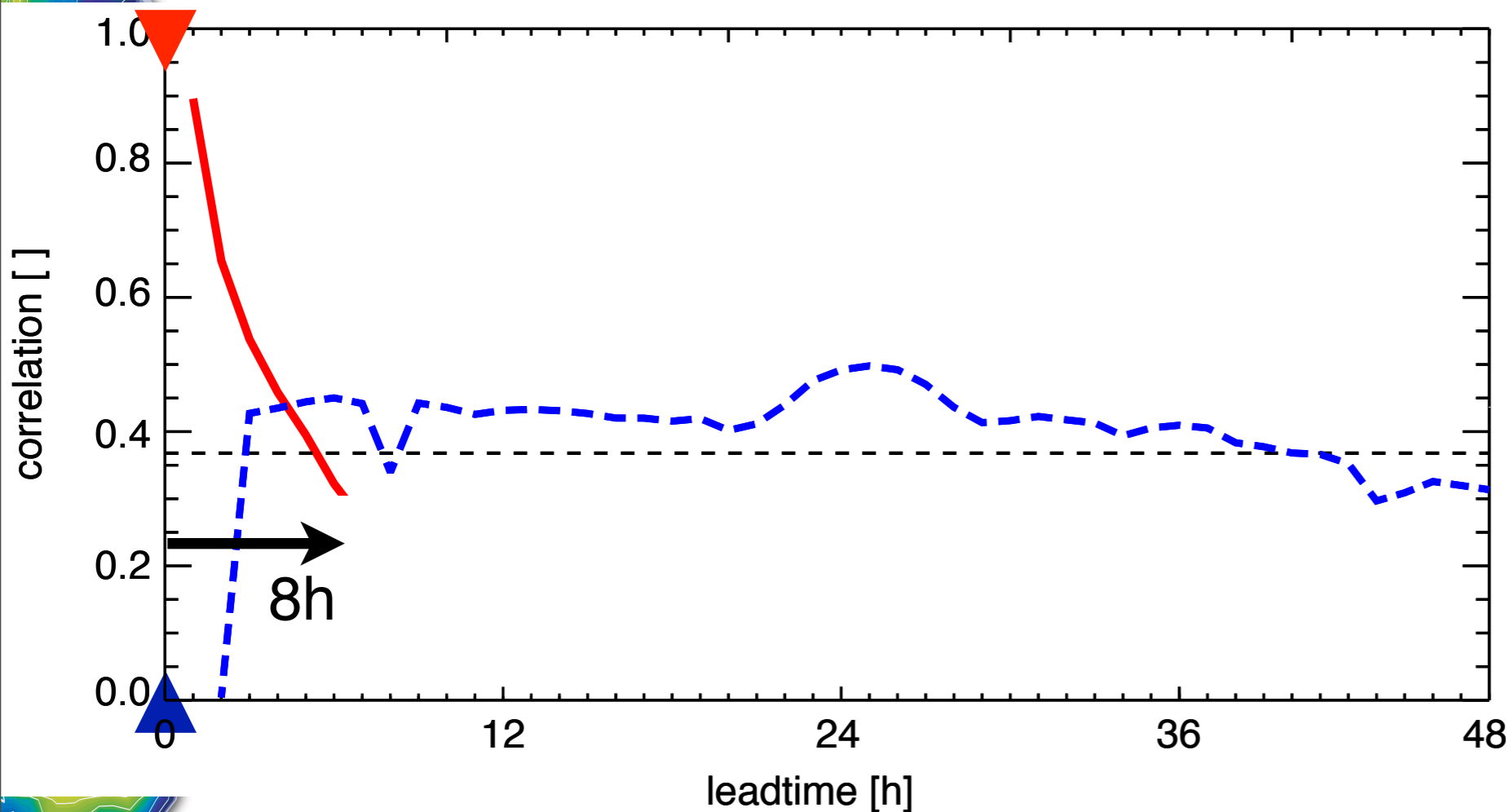
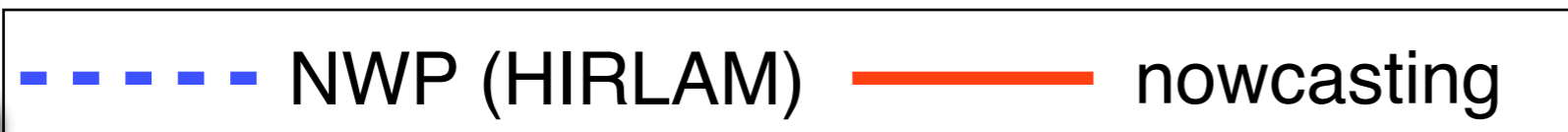




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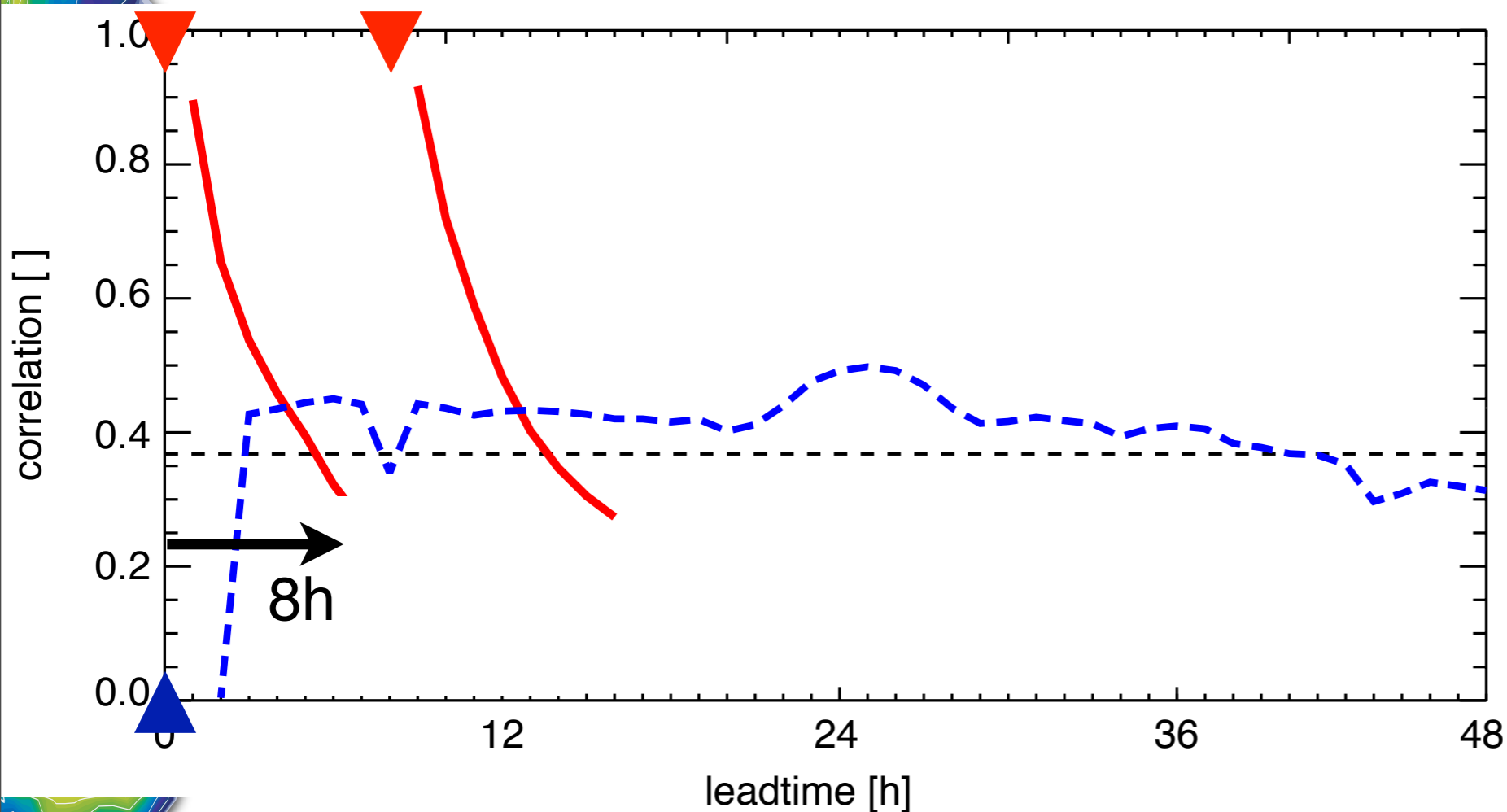
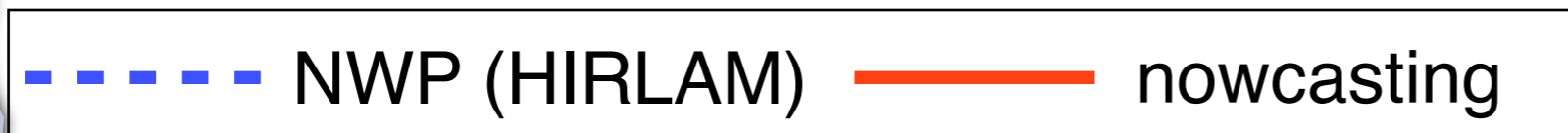
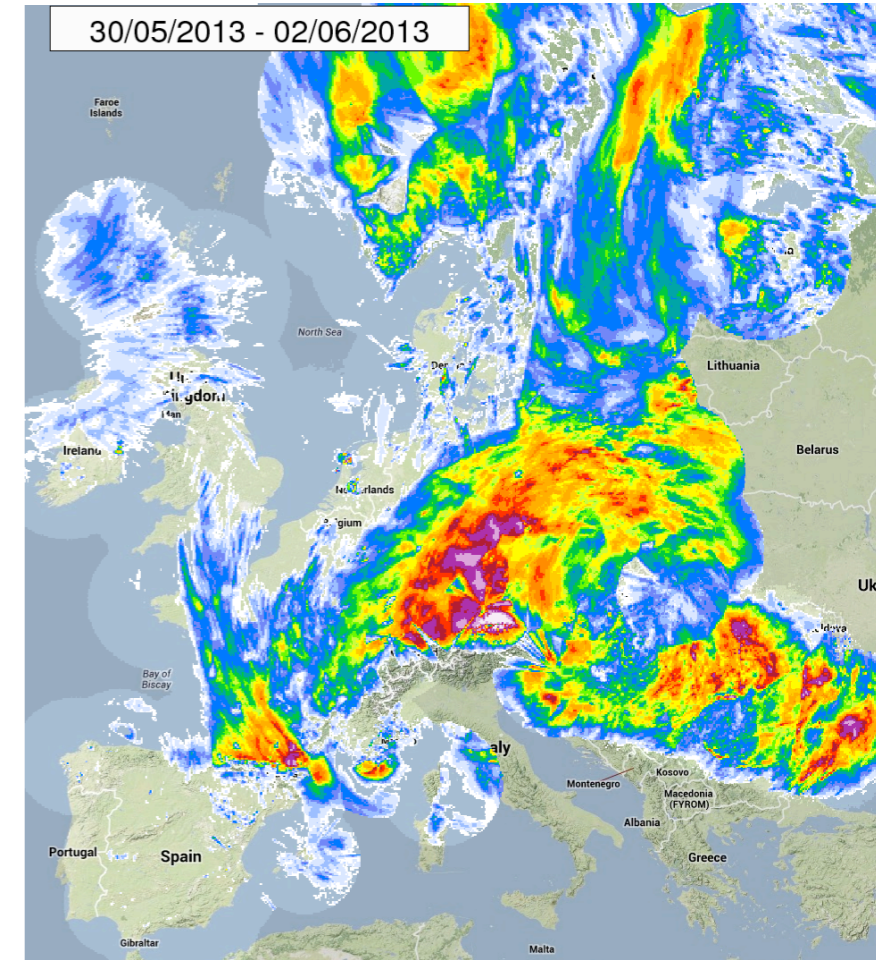
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01 June 2013 - 48 hour evaluation

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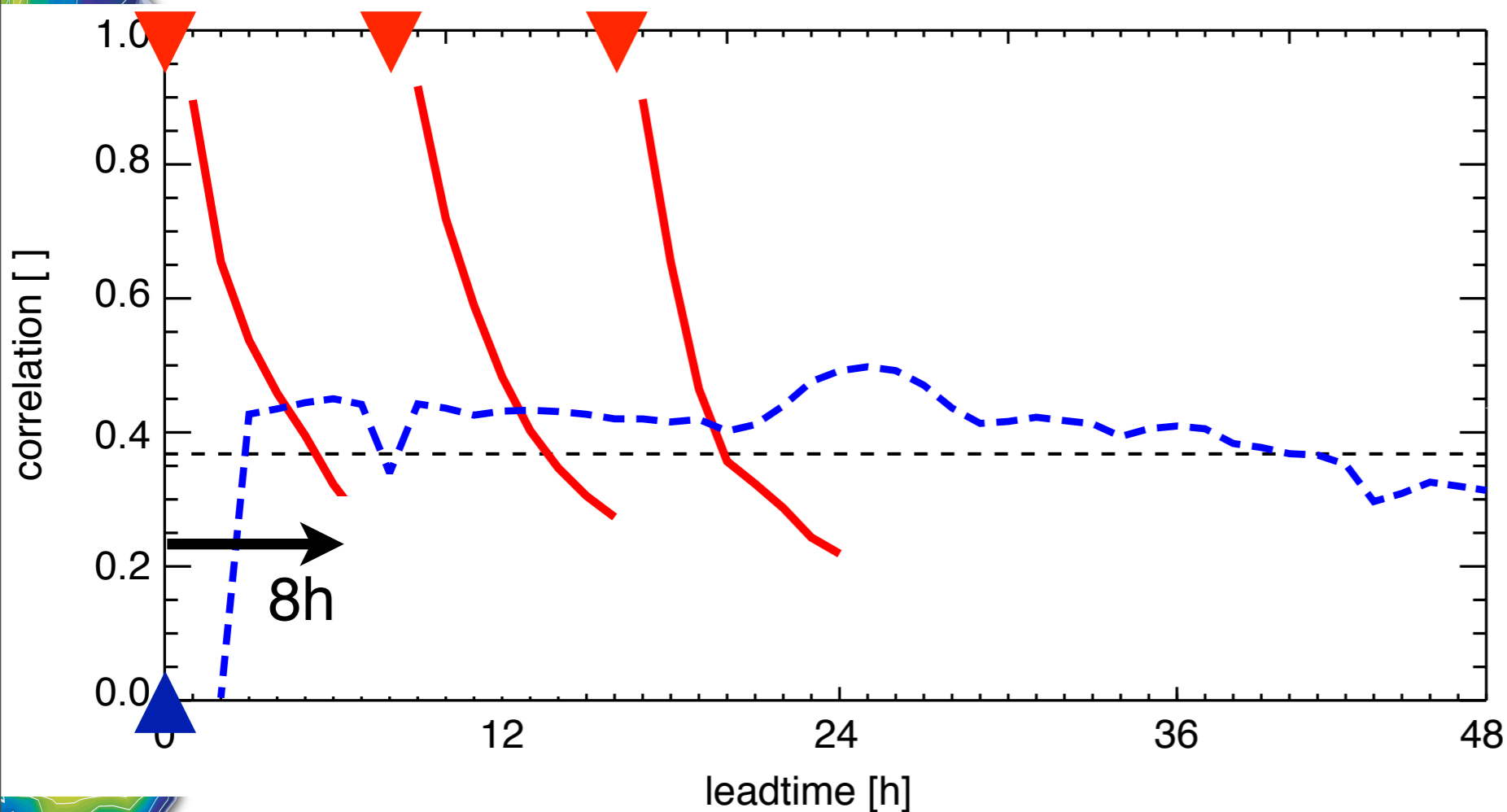
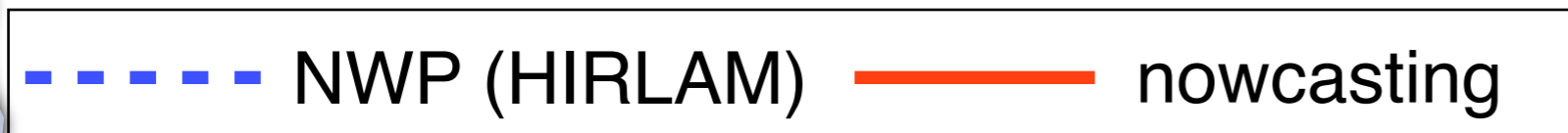
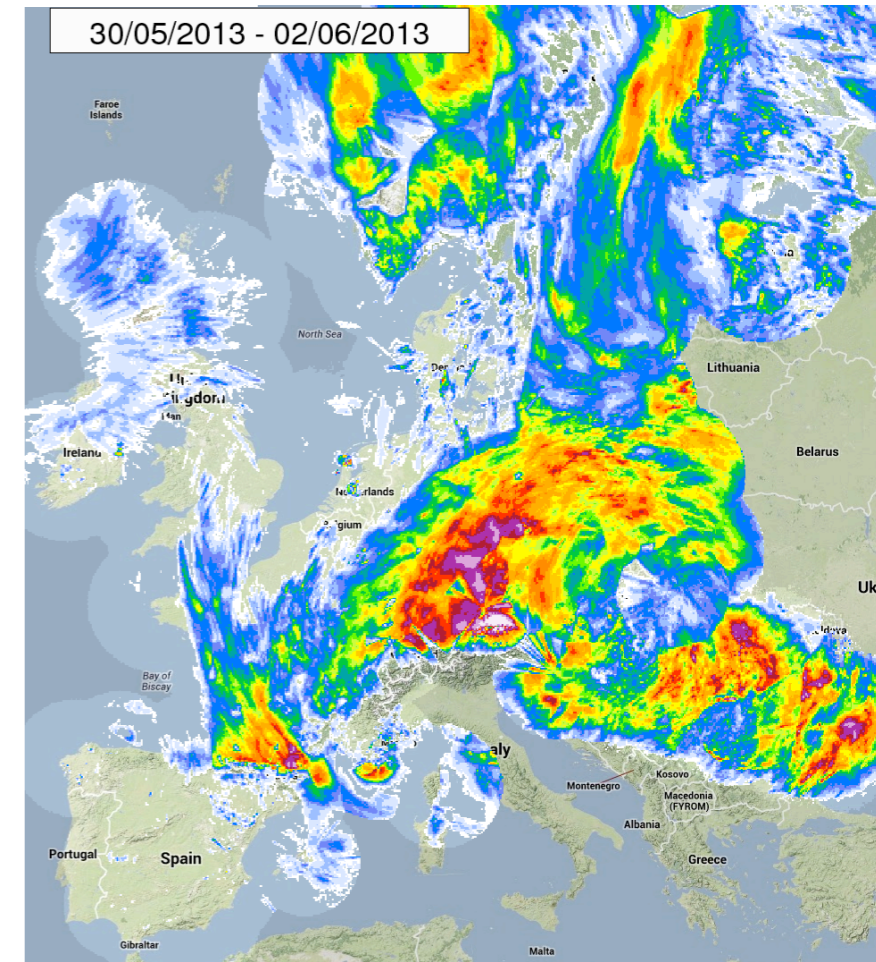




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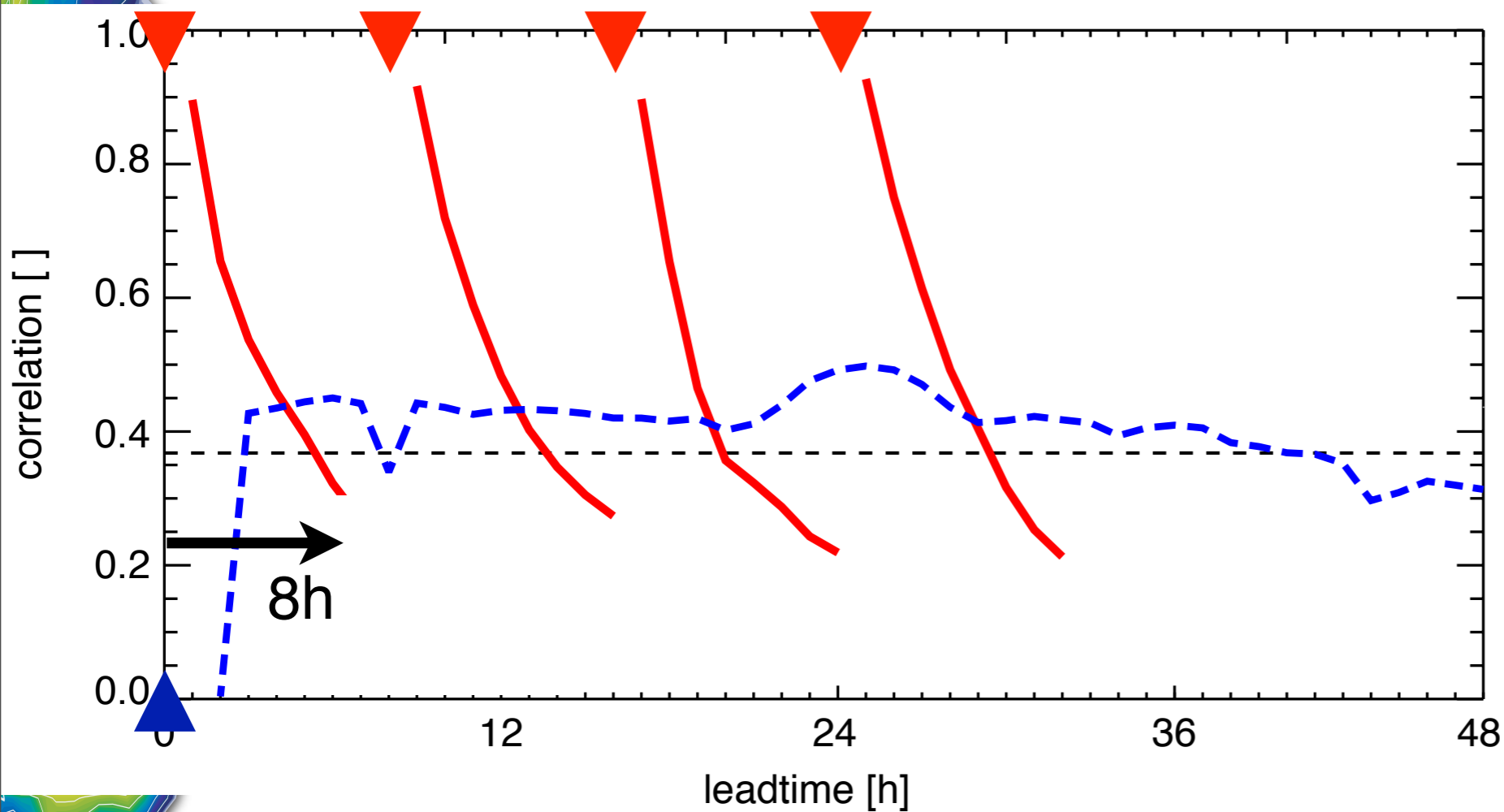
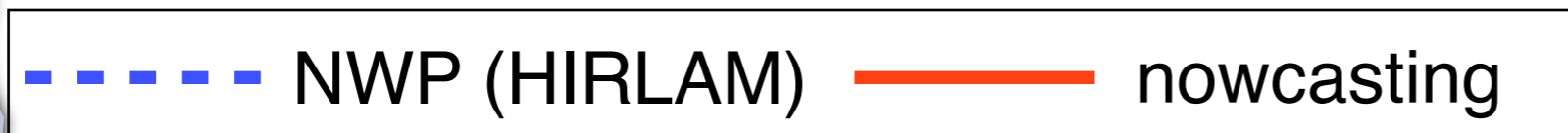
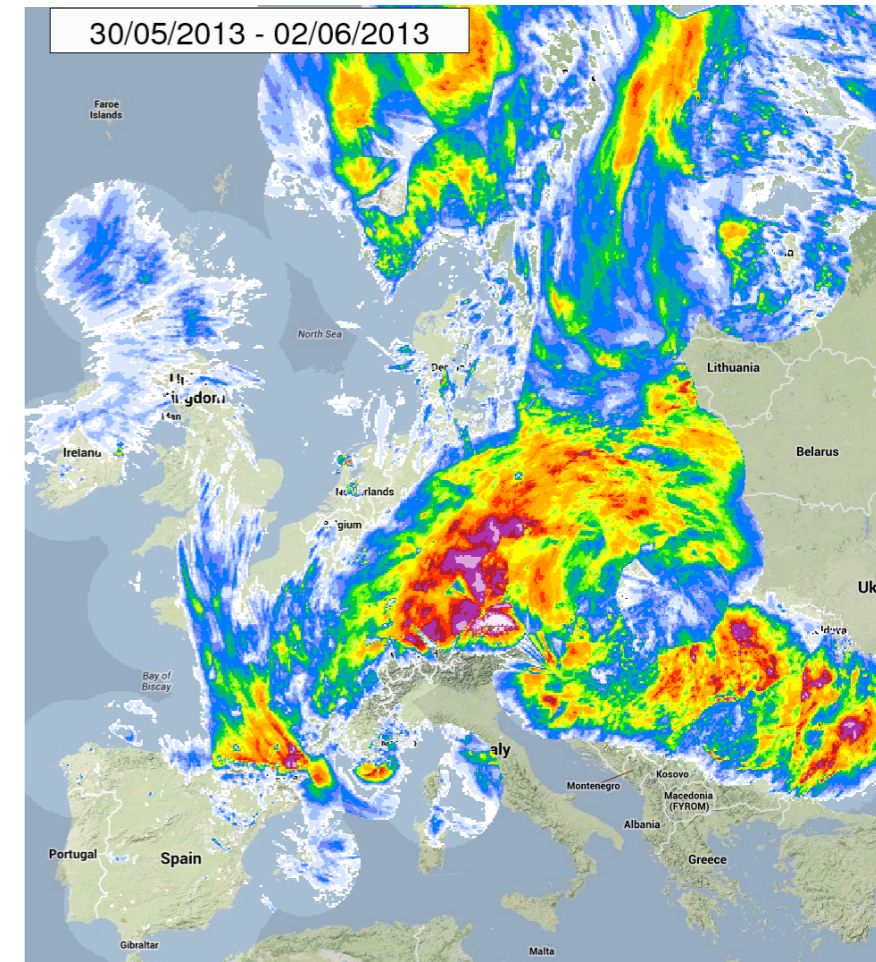
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# Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

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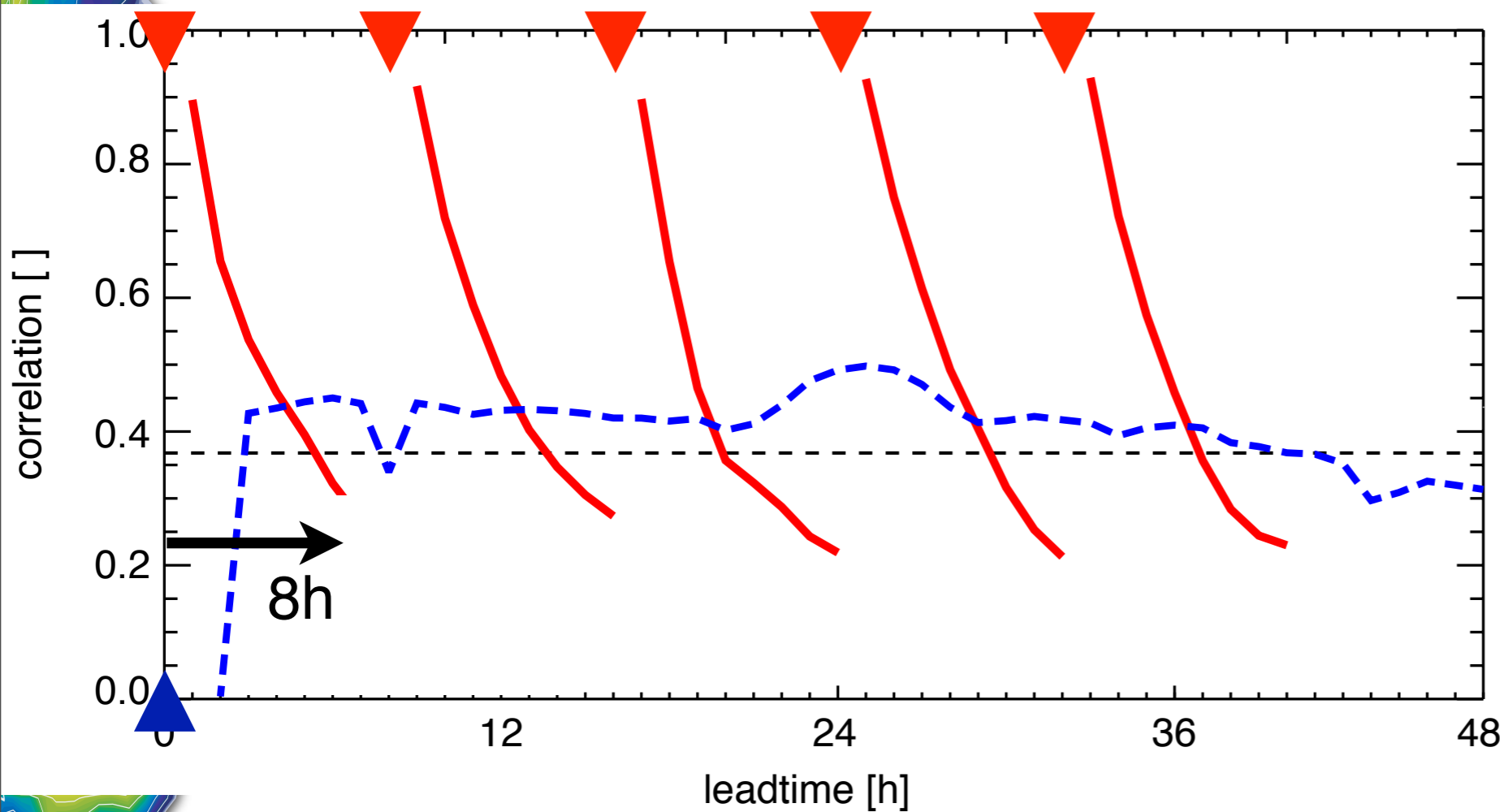
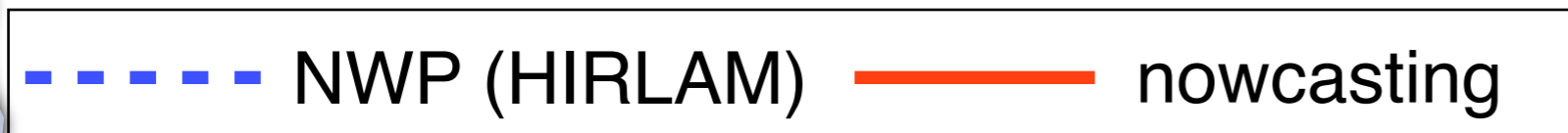
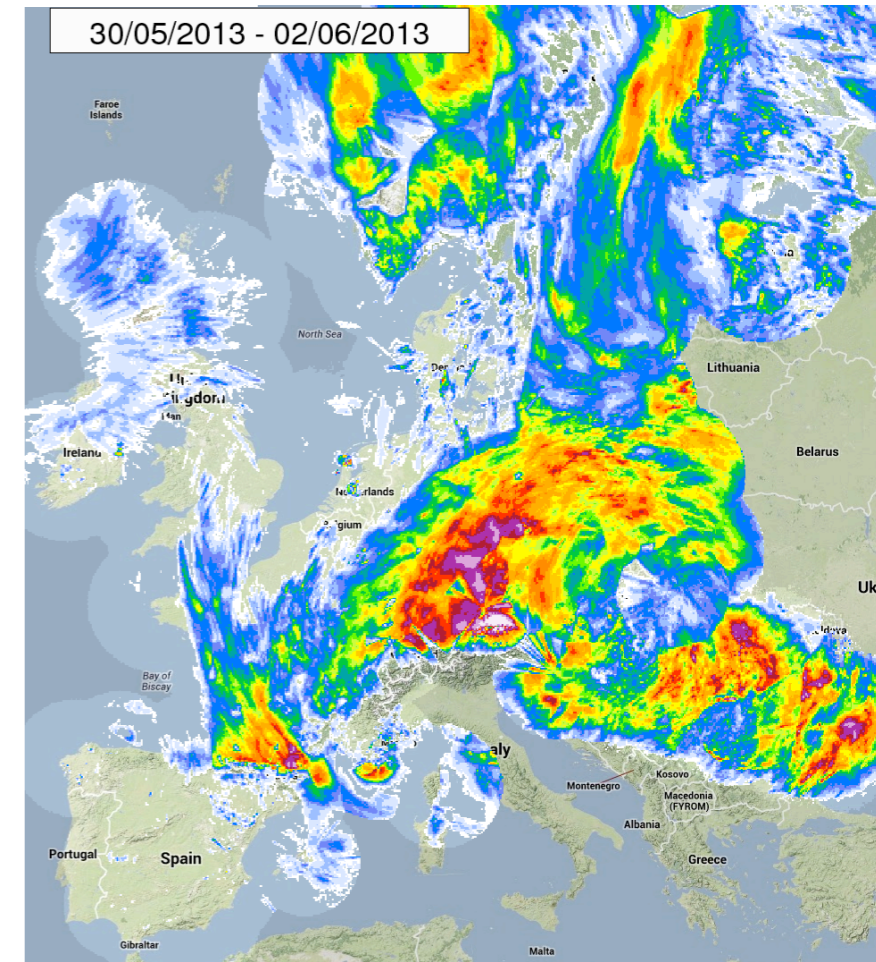




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01 June 2013 - 48 hour evaluation

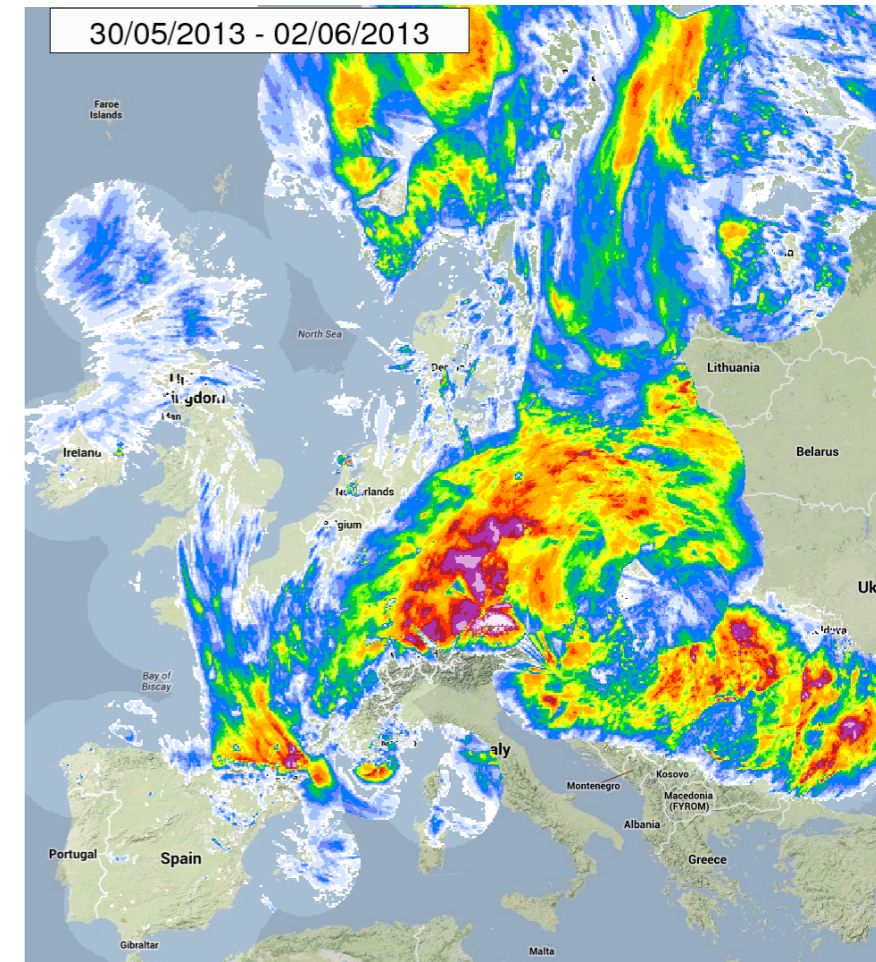
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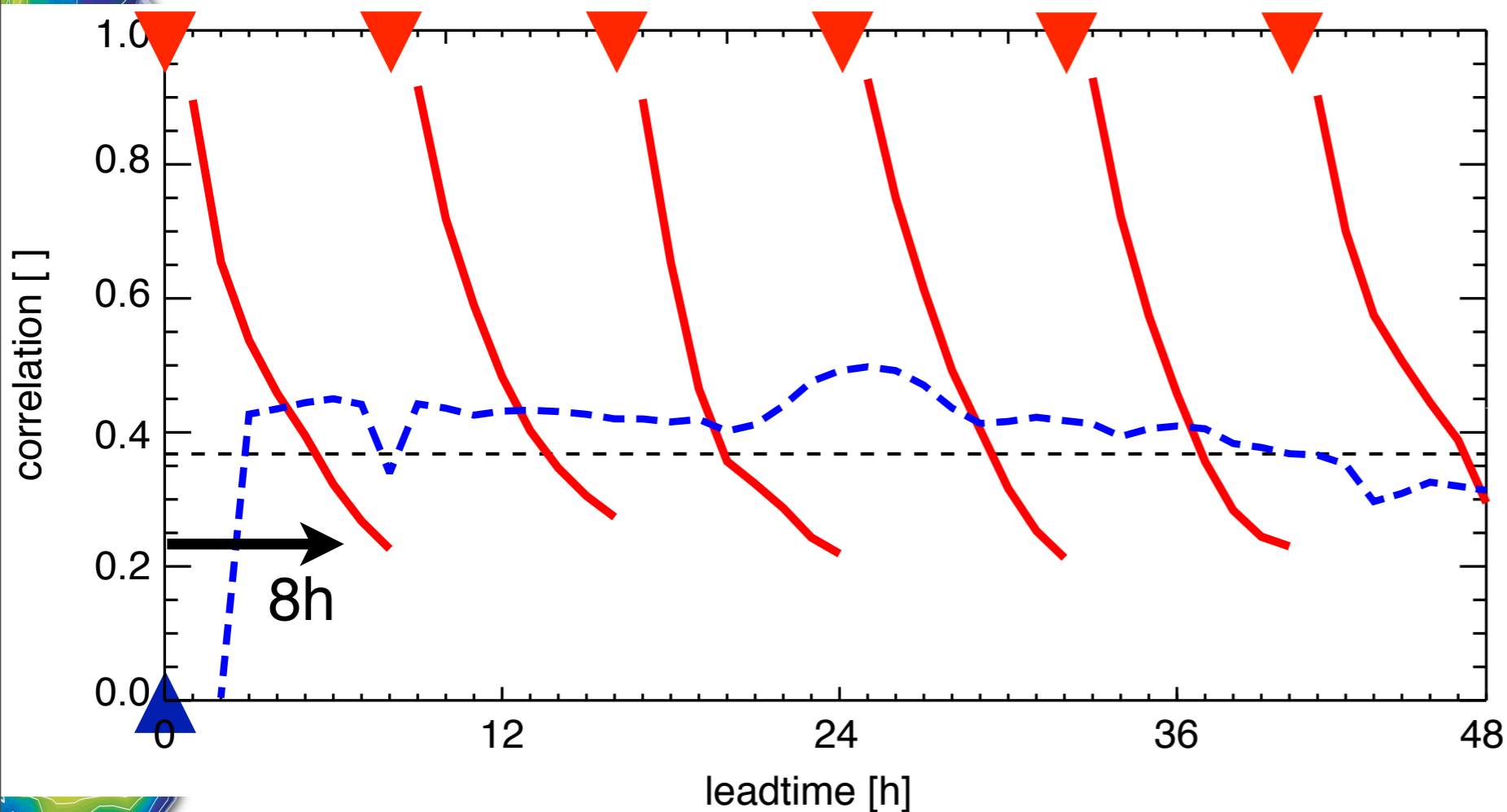
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01 June 2013 - 48 hour evaluation

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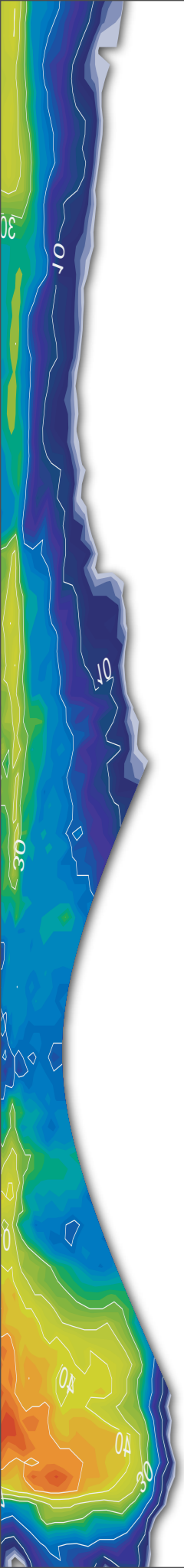


--- NWP (HIRLAM)    — nowcasting



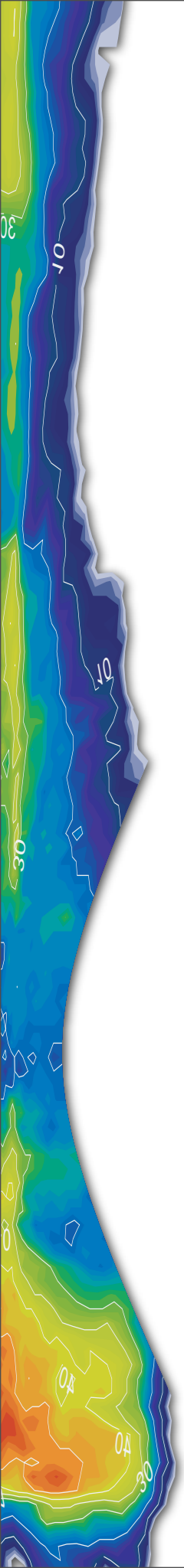


# Conclusions



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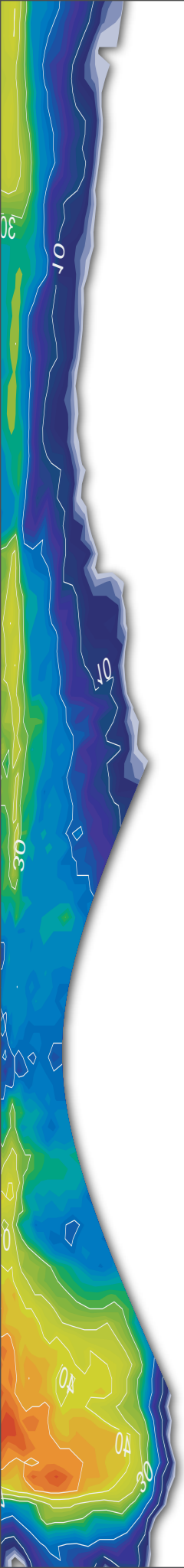
- Continental nowcasts benefit from the better capturing of motion at large scale and upstream coverage.





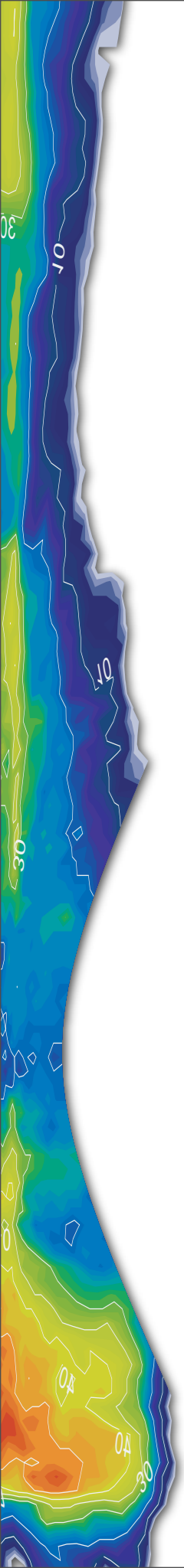
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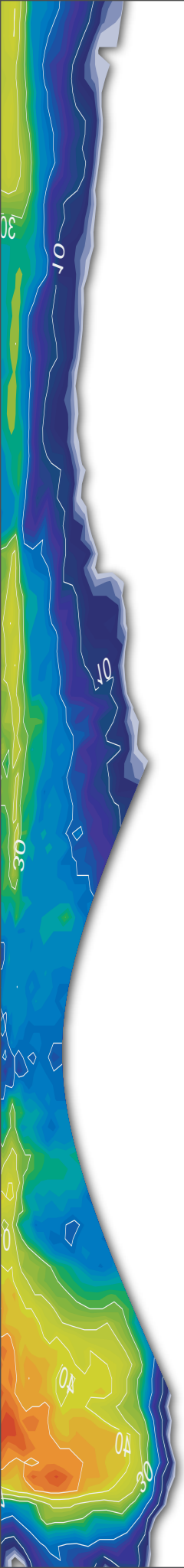
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- Time and space variability:





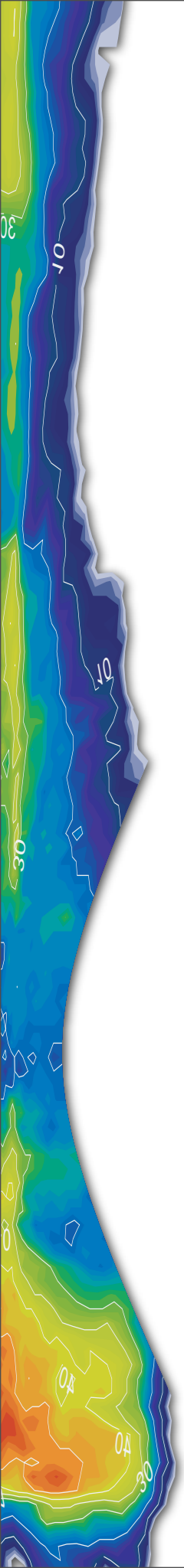
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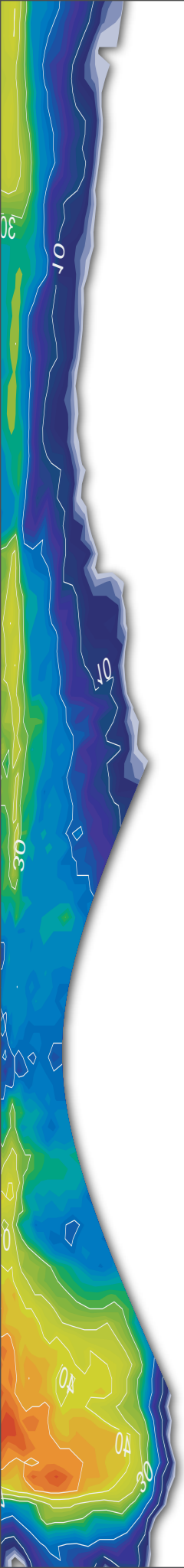
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  - ▶ Better skill in the areas with more frequent precipitation.

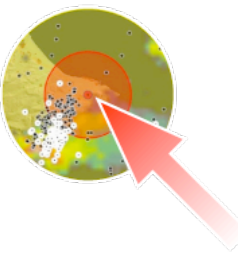




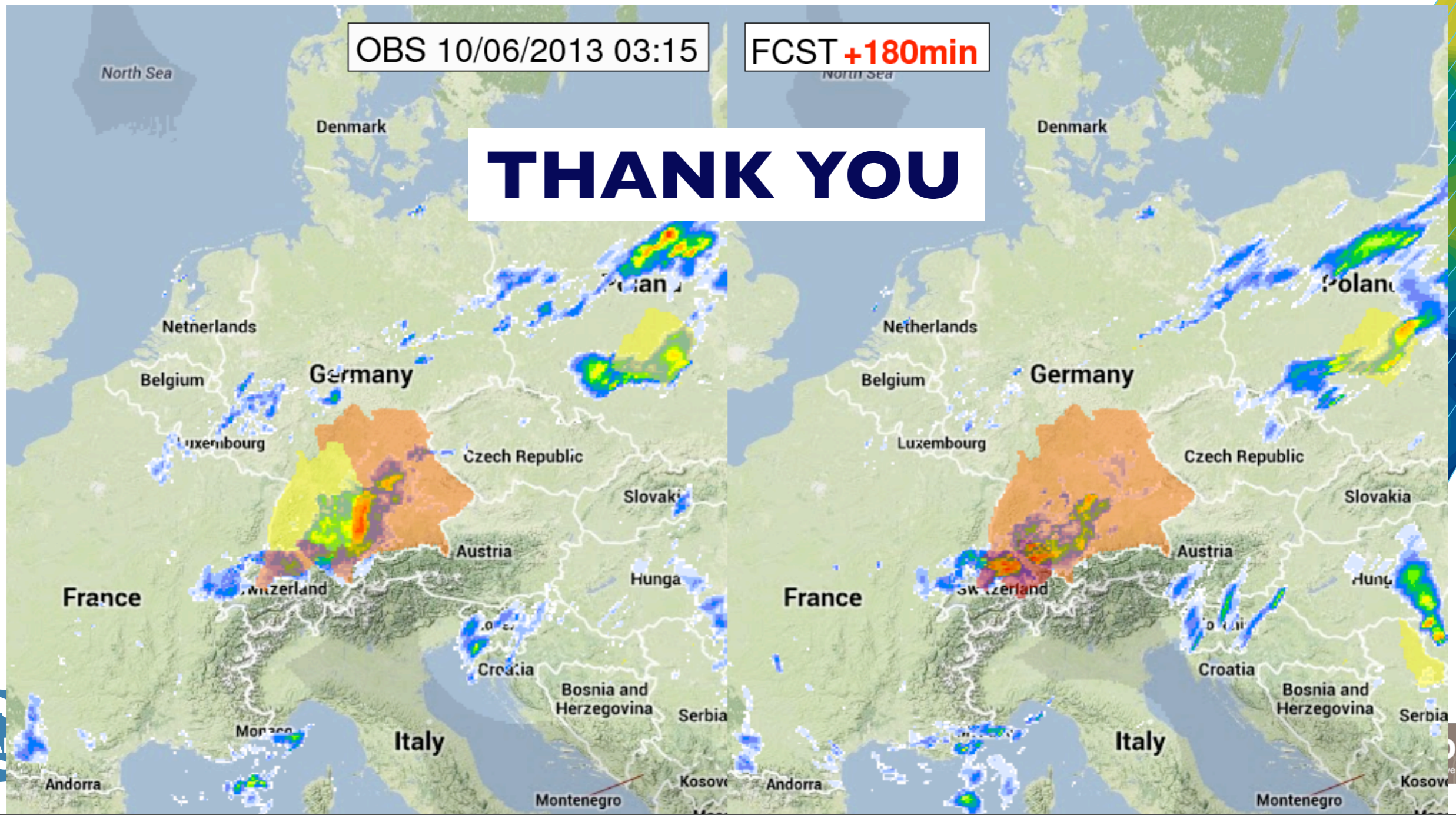
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  - ▶ Large scale systems are more predictable.
  - ▶ Better skill in the areas with more frequent precipitation.
- First comparisons against operational NWP show cross-over times ~4-5 hours.





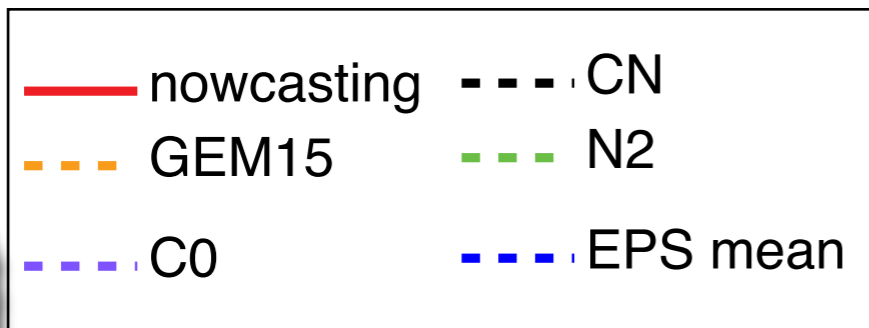
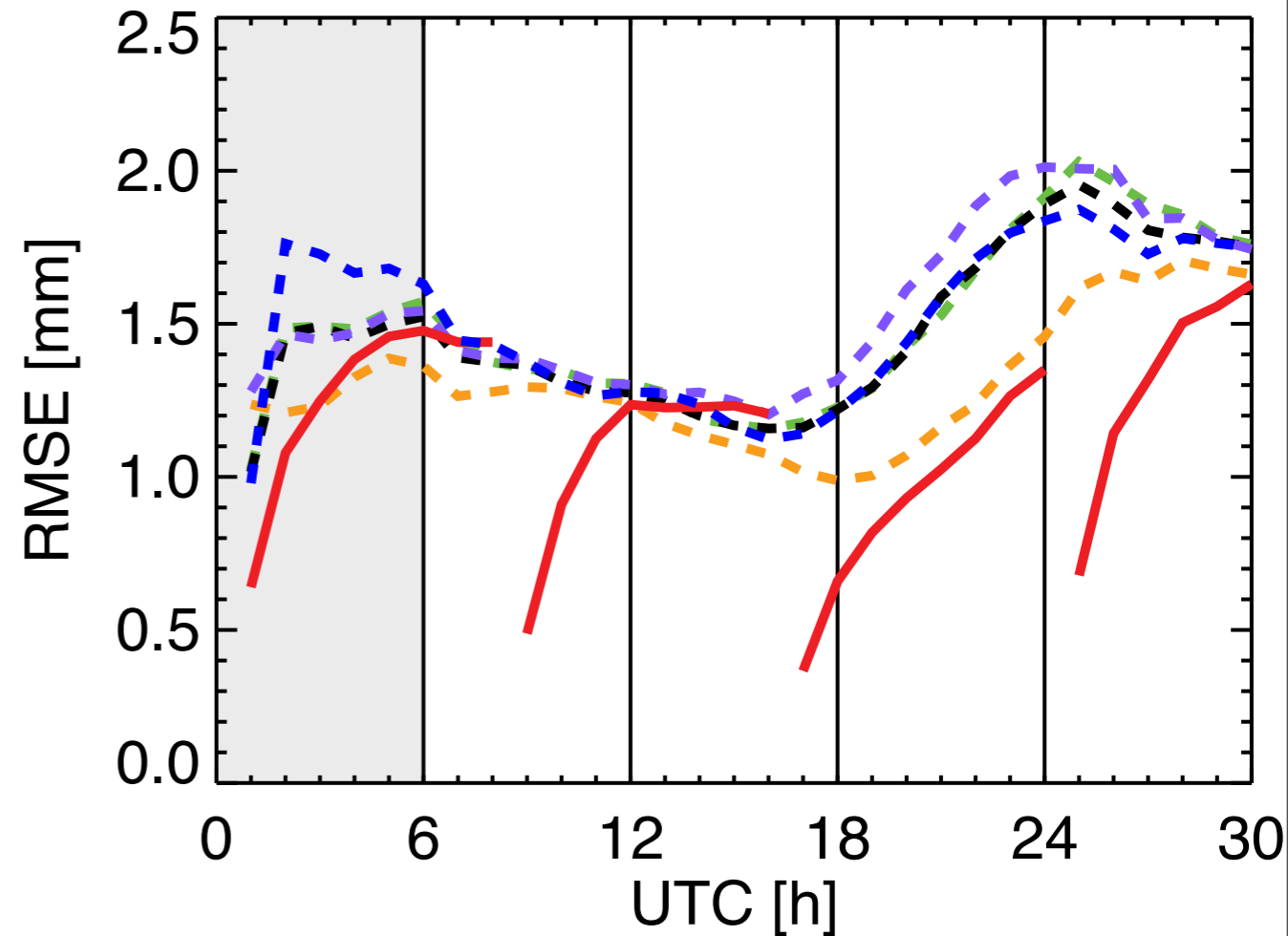
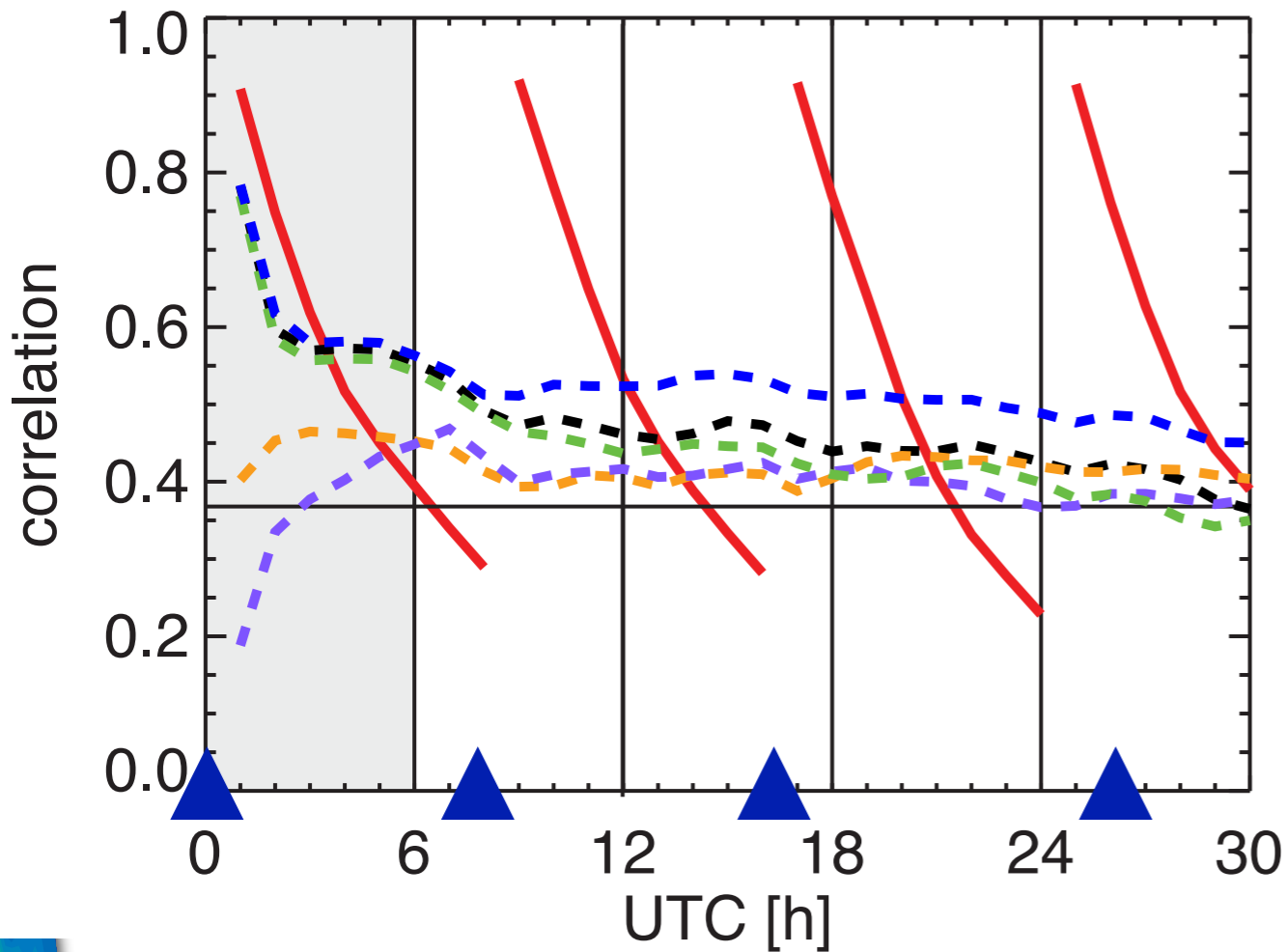
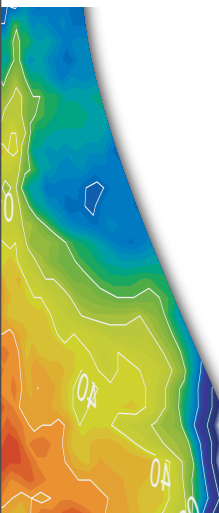
## Radar-based rainfall nowcasting at European scale long-term evaluation and performance assessment





# Nowcasting vs NWP

## Spring 2008 over North-America



- OU Storm-Scale Ensemble Forecast (10 members).
- WRF-based with perturbed configurations.
- 4-km grid.
- 9 members with 3D-var assimilation of reflectivity and Doppler velocity.