



European
Civil Protection

HAREN



Adding value to the OPERA composites through high-resolution rainfall *nowcasting*

Marc Berenguer & Daniel Sempere-Torres

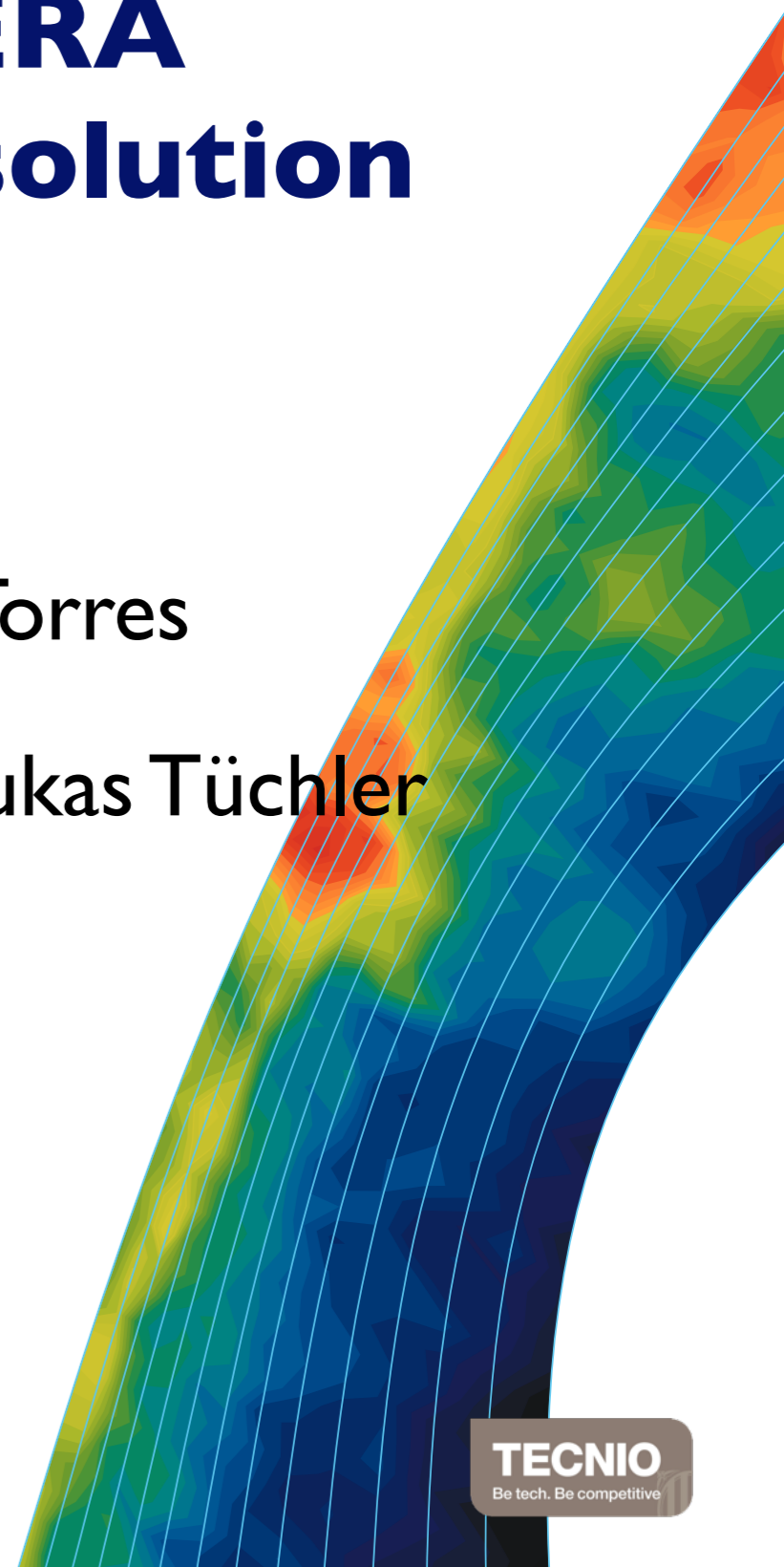
Pekka Rossi, Jarmo Koistinen, Vera Meyer, Lukas Tüchler



Centre de Recerca Aplicada
en Hidrometeorologia

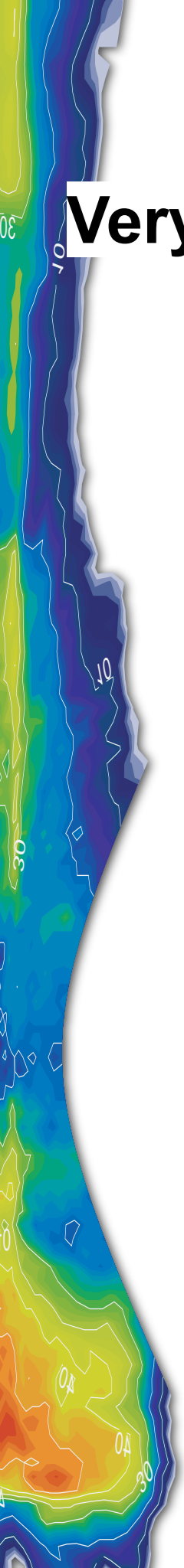
UNIVERSITAT POLITÈCNICA DE CATALUNYA

TECNIO
Be tech. Be competitive



Radar-based rainfall *nowcasting*

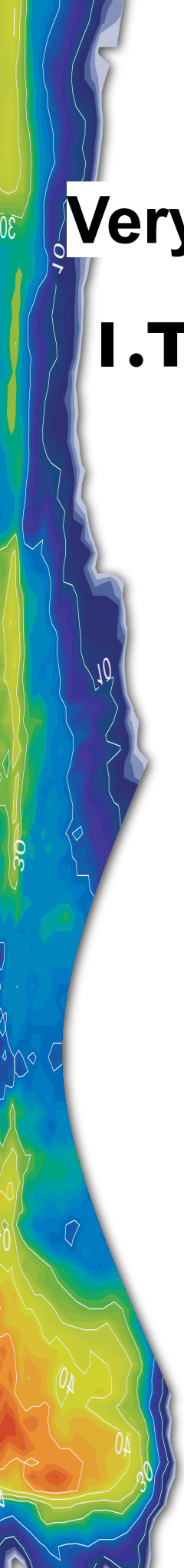
Very short-term forecasting by extrapolation of radar observations.



Radar-based rainfall *nowcasting*

Very short-term forecasting by extrapolation of radar observations.

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

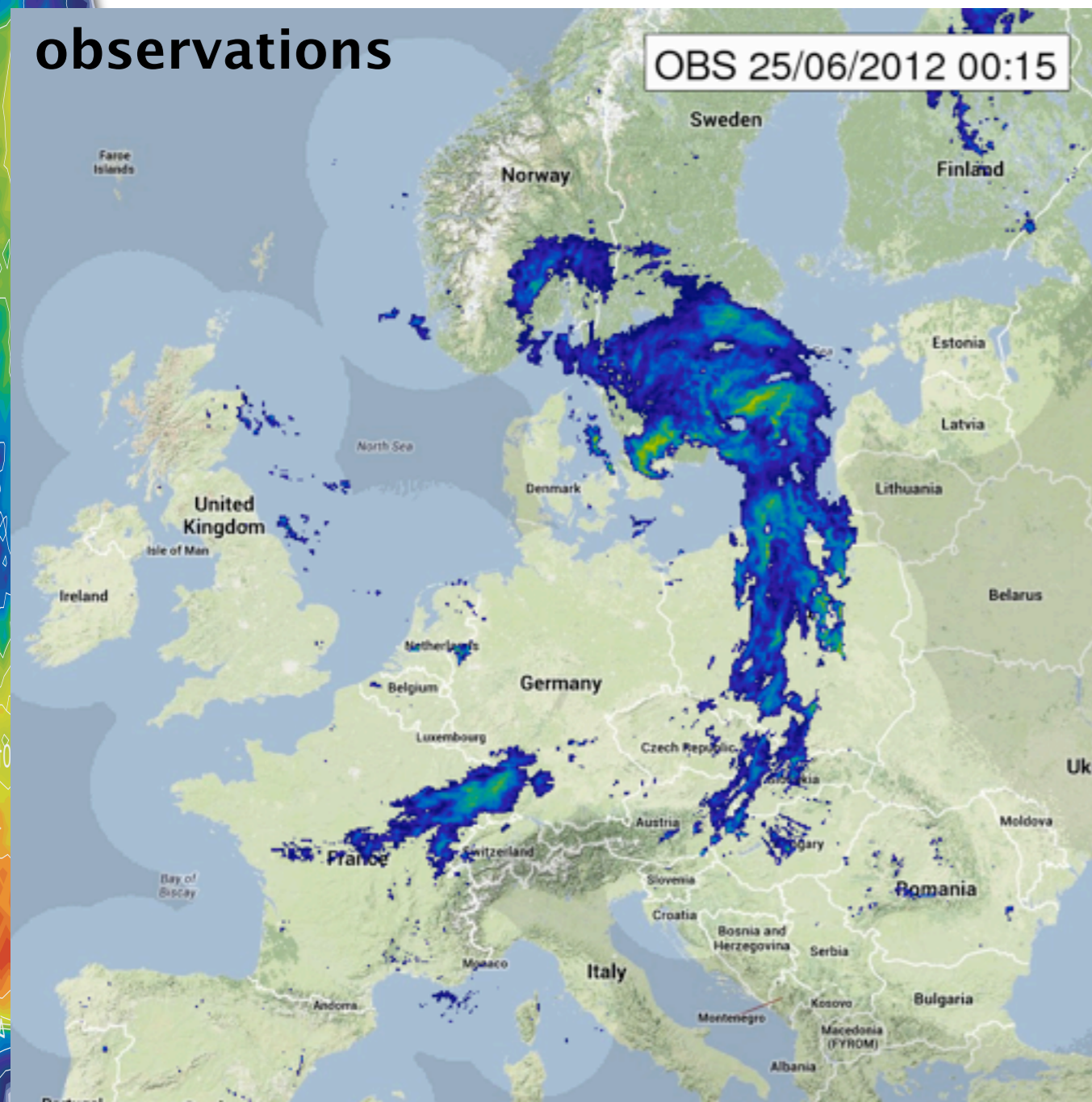


Radar-based rainfall *nowcasting*

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observations



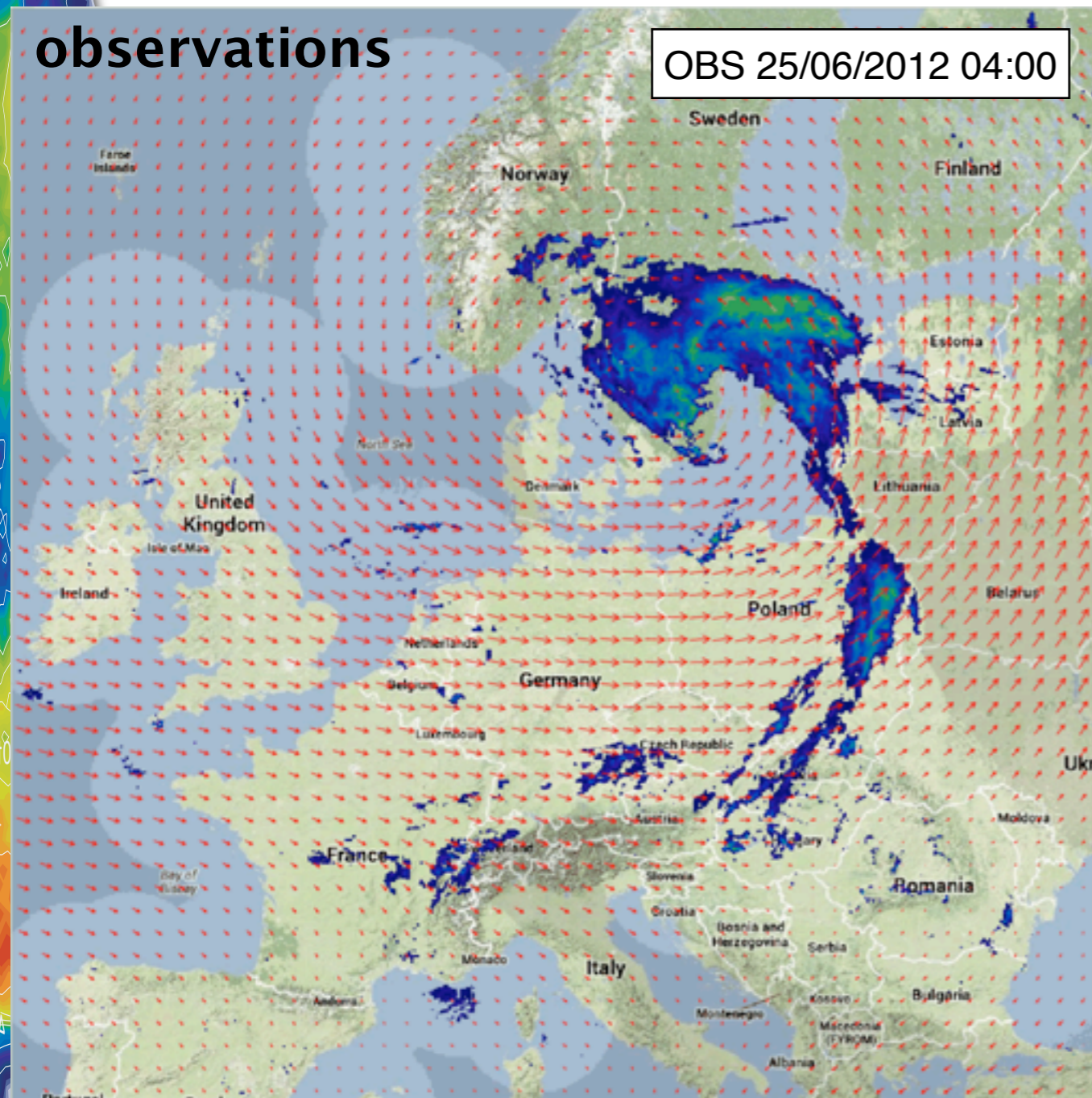
Radar-based rainfall *nowcasting*

Very short-term forecasting by extrapolation of radar observations.

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observations

OBS 25/06/2012 04:00



Radar-based rainfall *nowcasting*

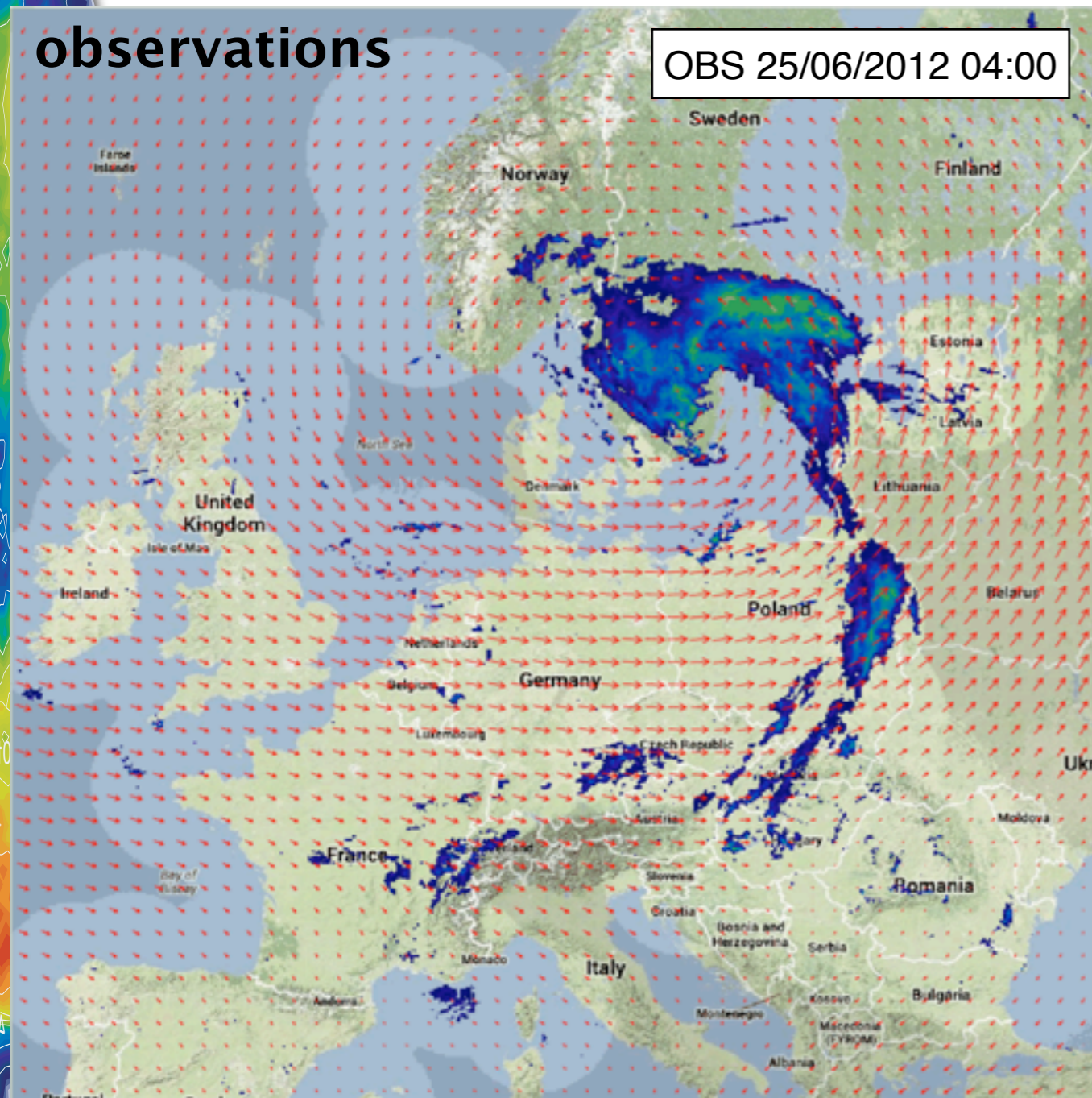
Very short-term forecasting by extrapolation of radar observations.

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2. Extrapolation: The most recent field is extrapolated accordingly.

observations

OBS 25/06/2012 04:00



Radar-based rainfall *nowcasting*

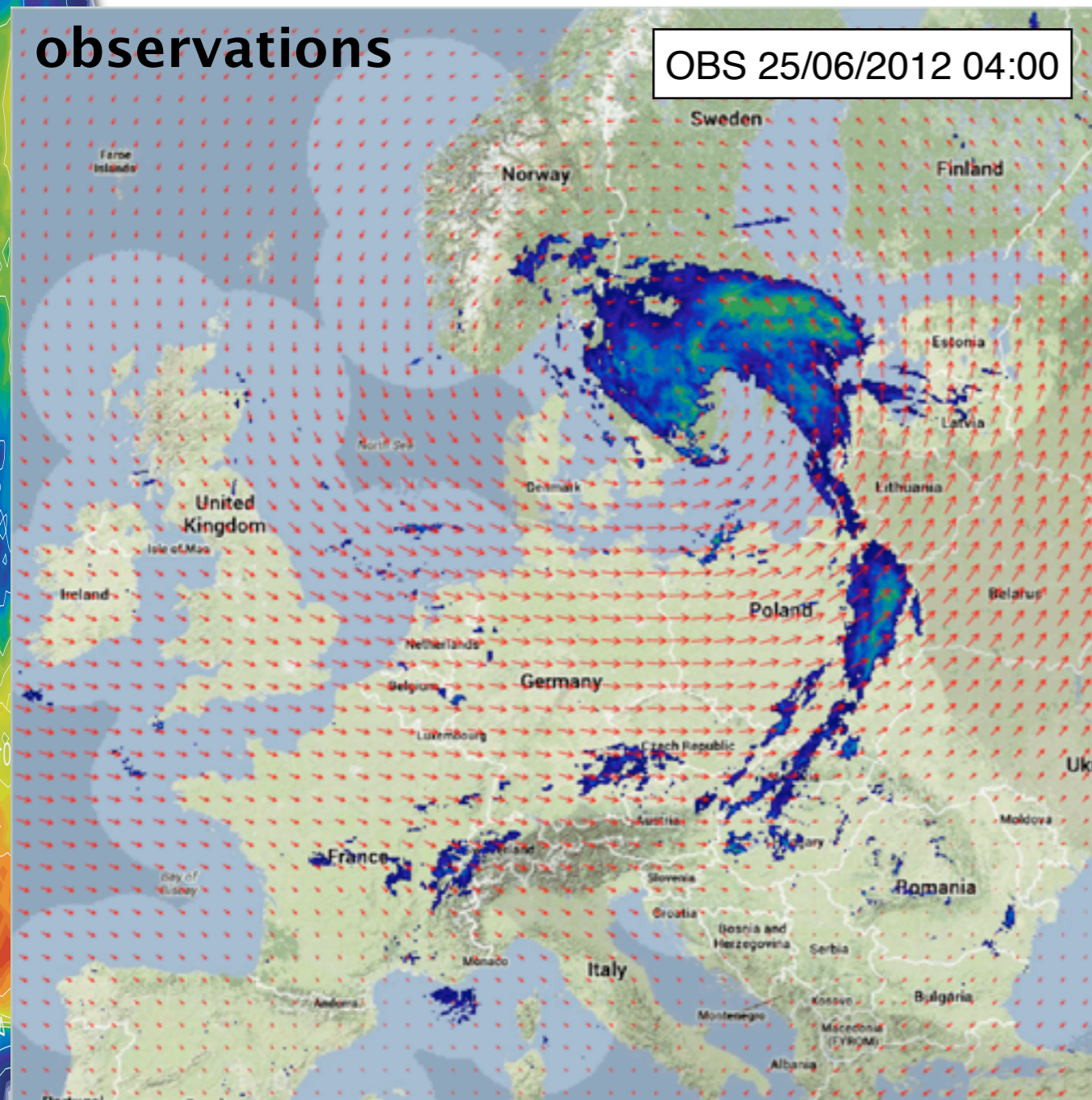
Very short-term forecasting by extrapolation of radar observations.

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

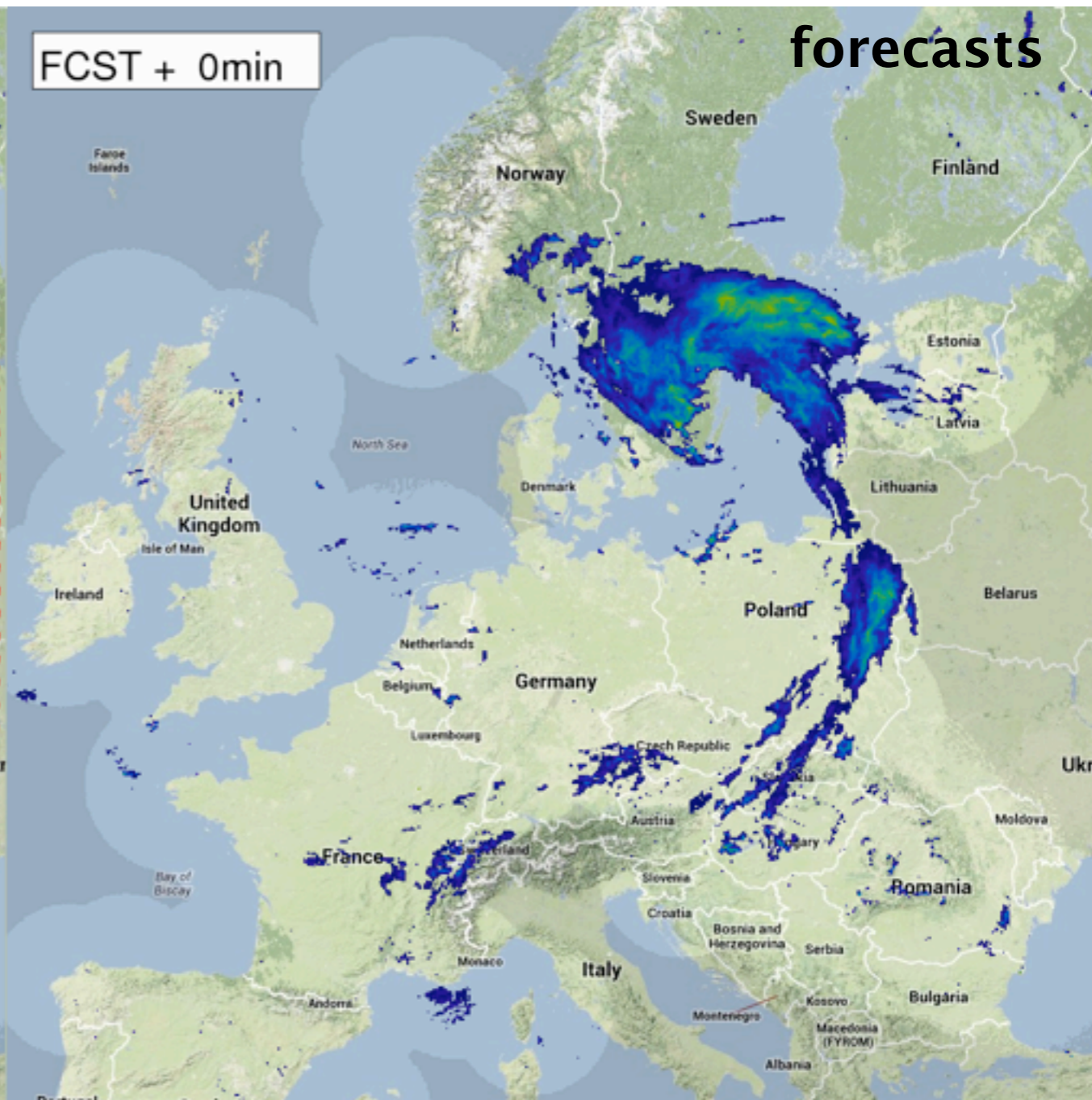
2. Extrapolation: The most recent field is extrapolated accordingly.

observations

OBS 25/06/2012 04:00

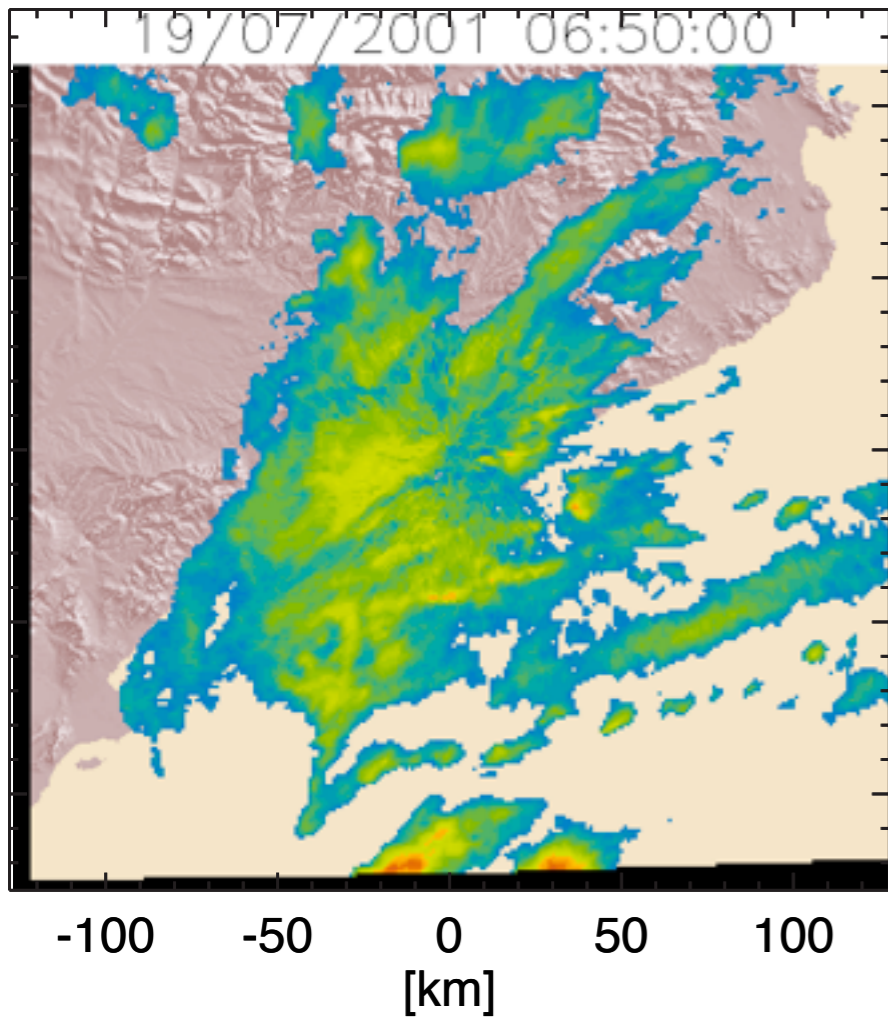


FCST + 0min

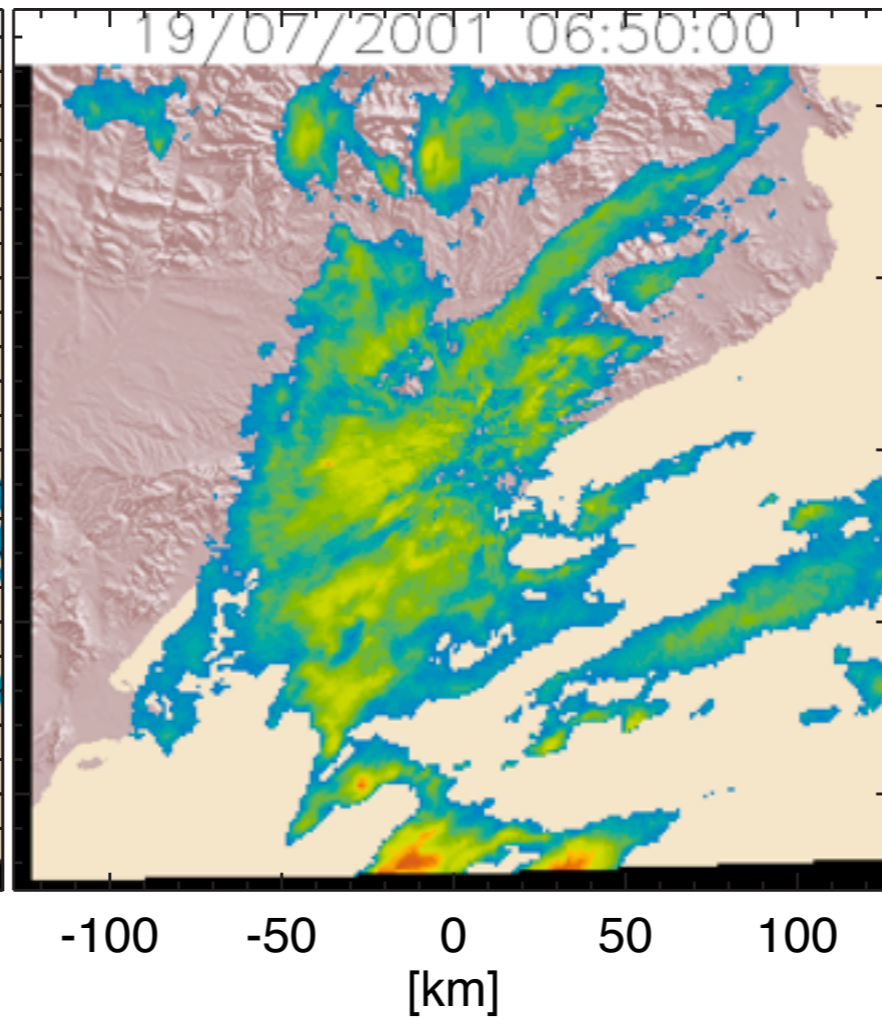


For how long?

Observations



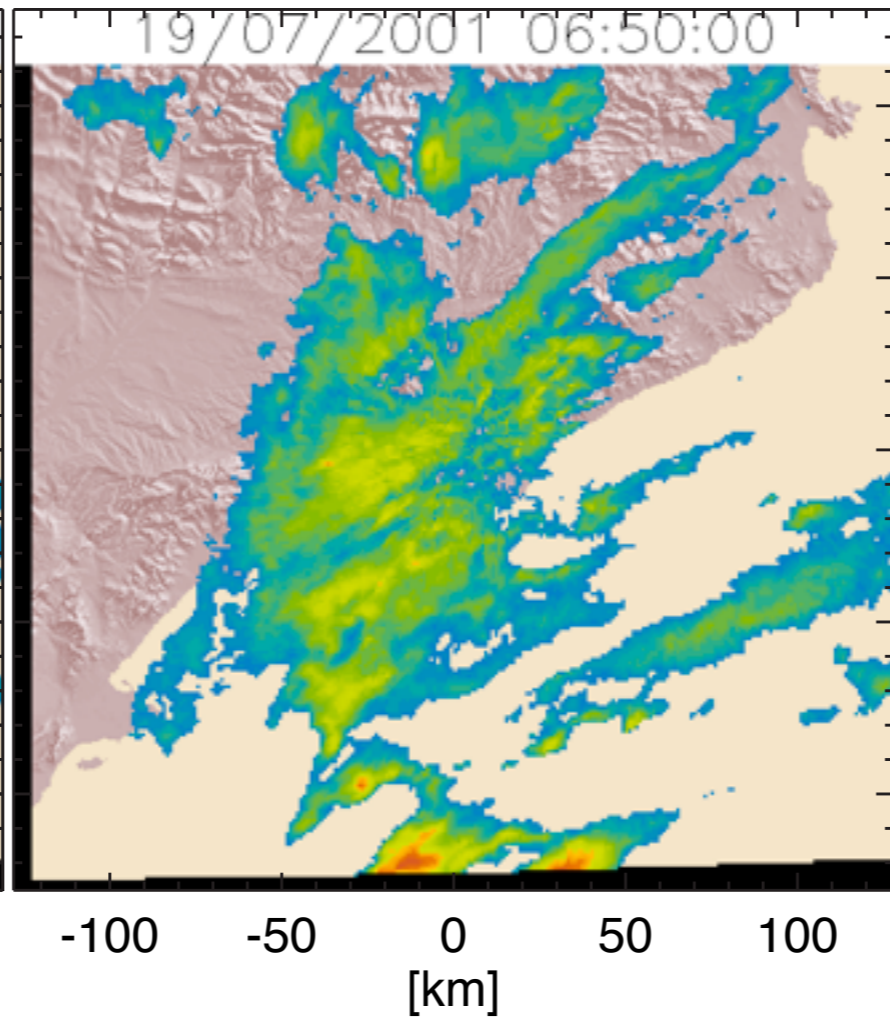
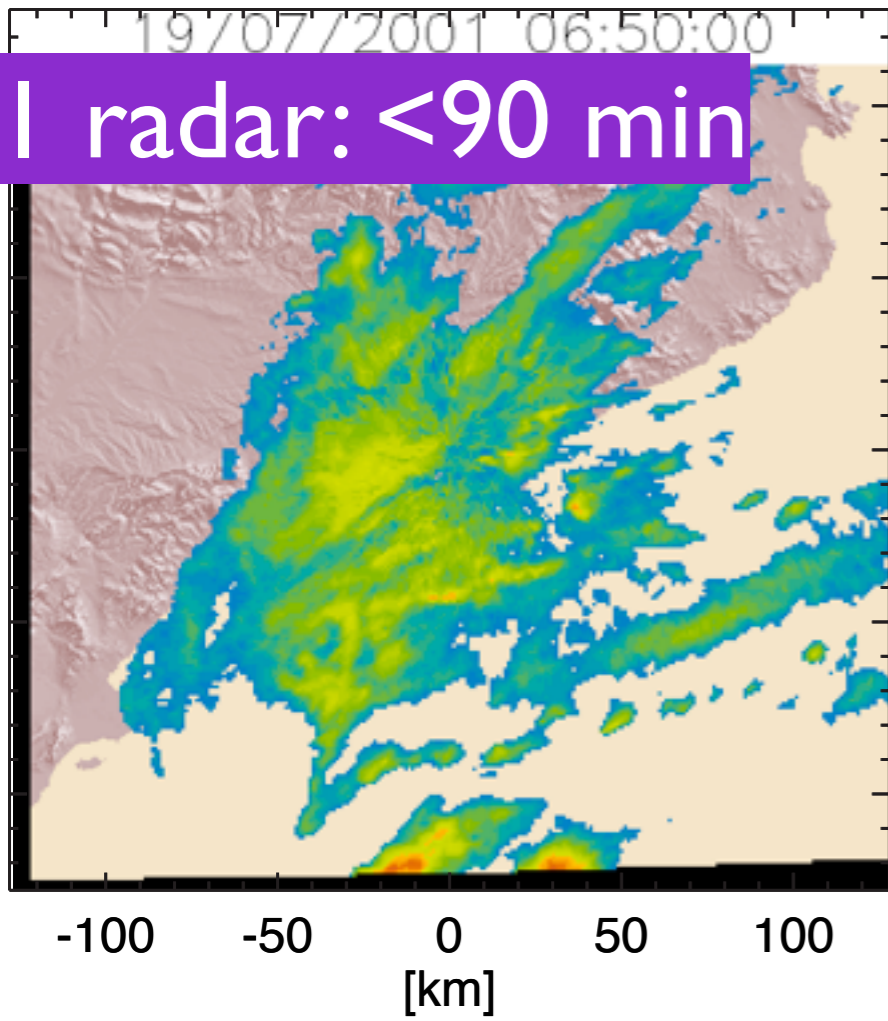
LP nowcasts



For how long?

Observations

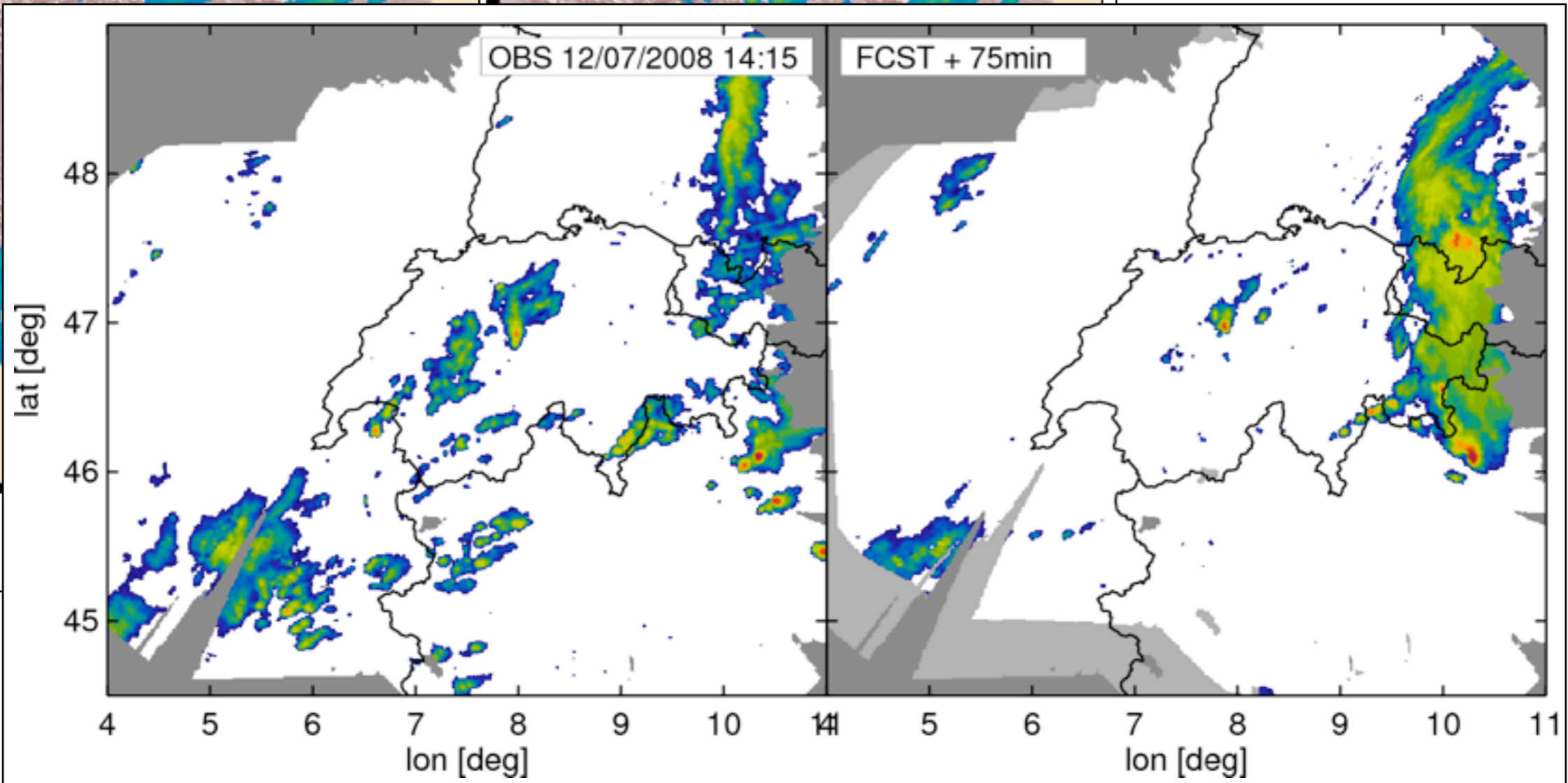
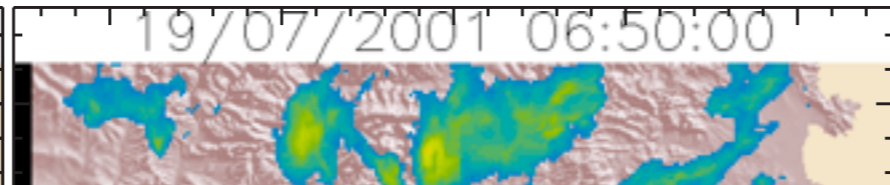
LP nowcasts



For how long?

Observations

LP nowcasts



-100

For how long?

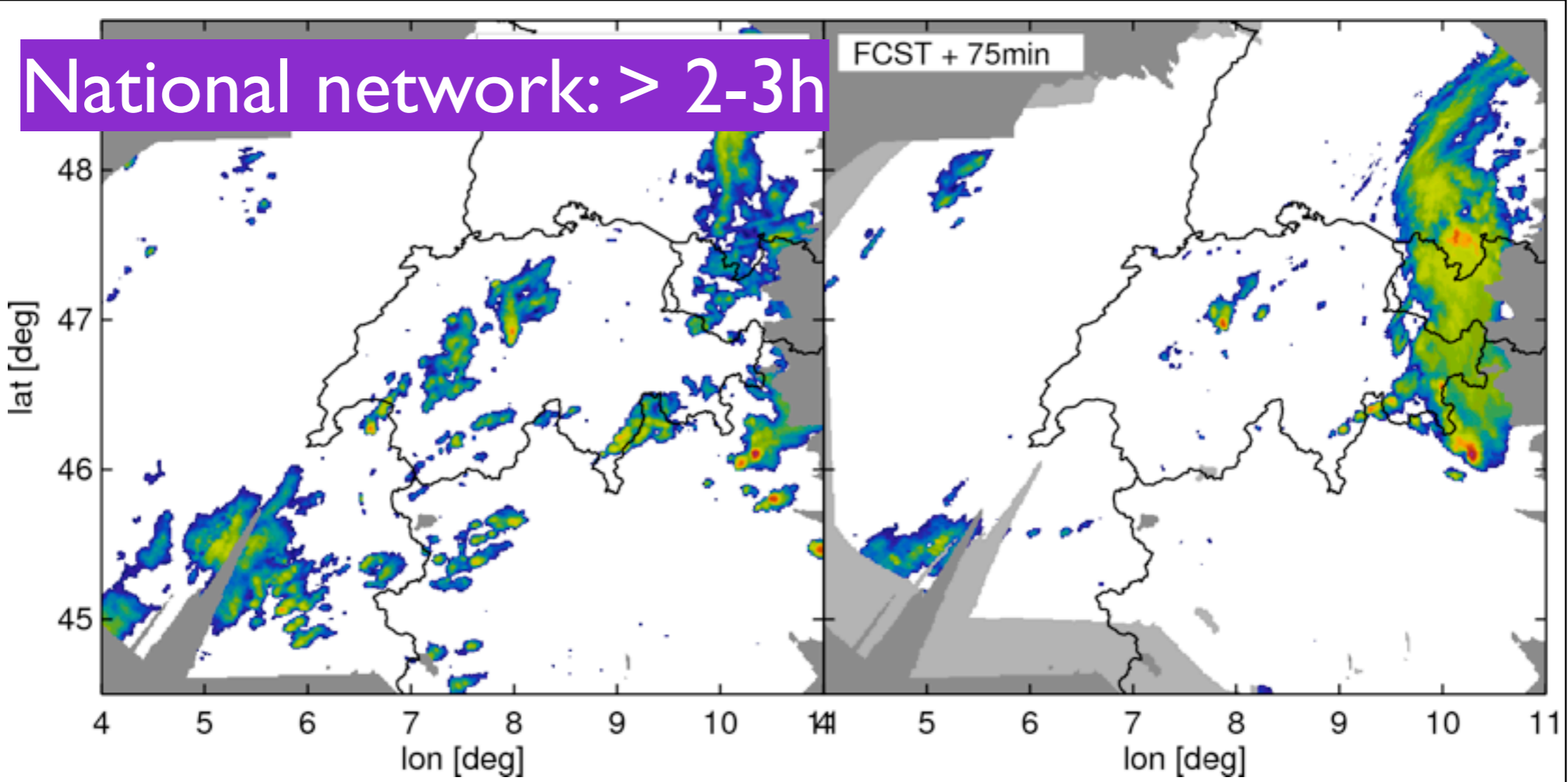
Observations

LP nowcasts

I radar: <90 min

National network: > 2-3h

FCST + 75min



-100

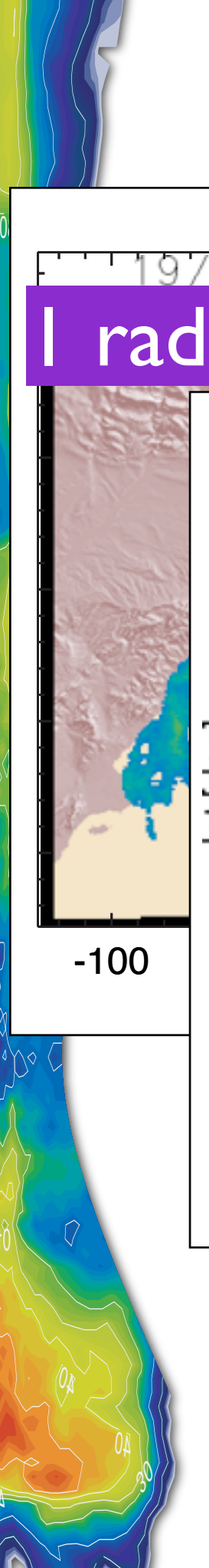
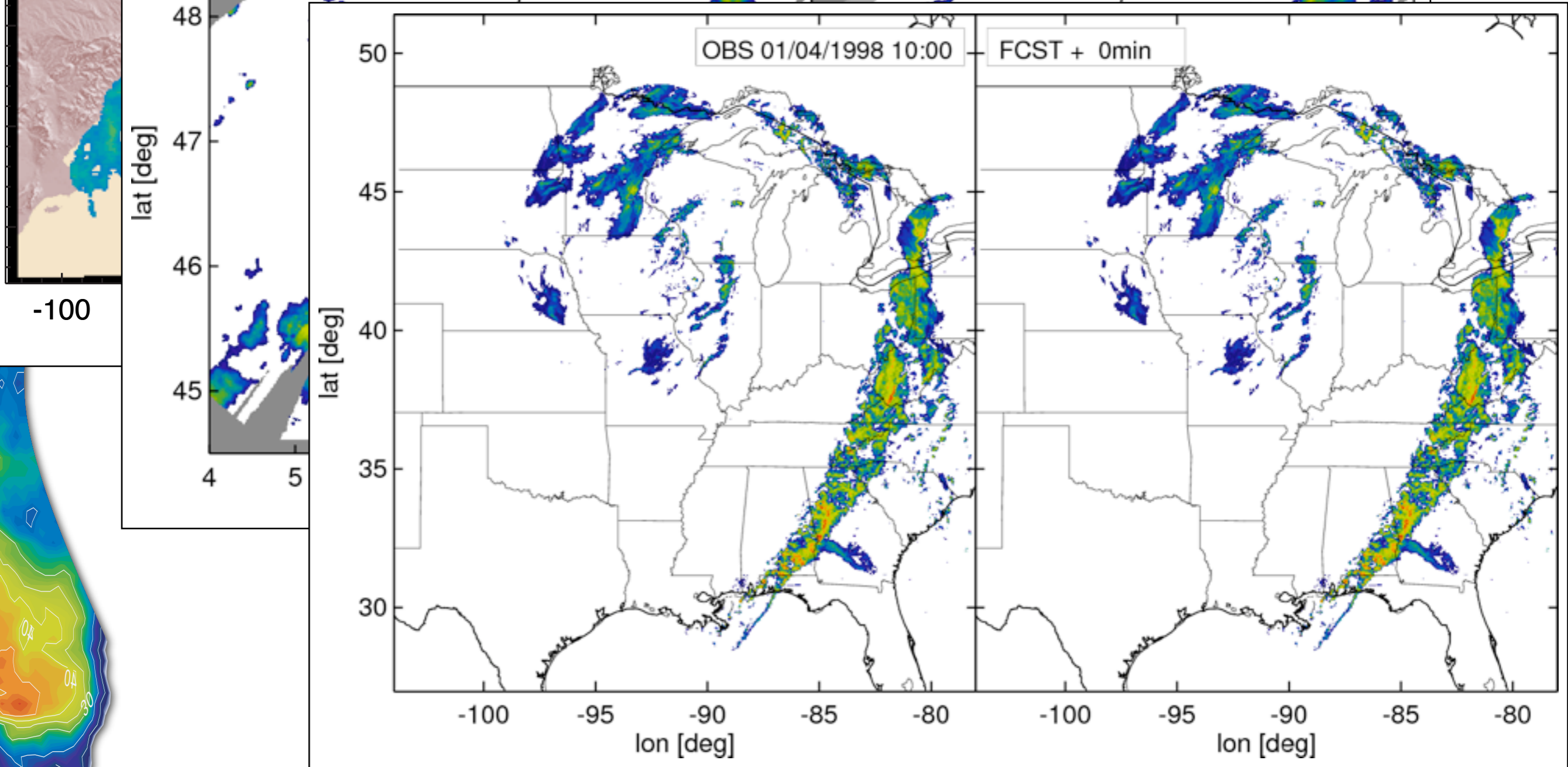
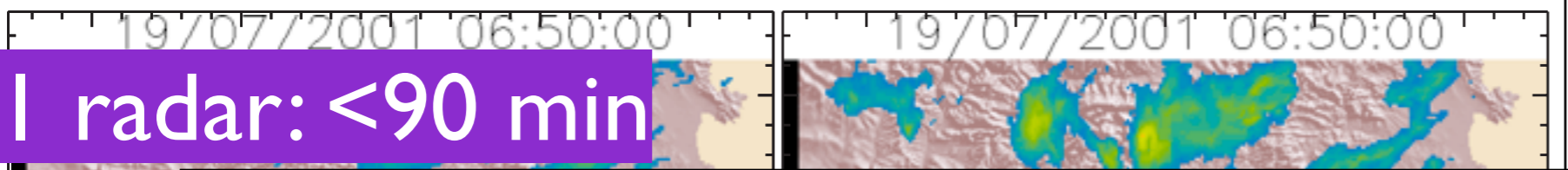
For how long?

Observations

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For how long?

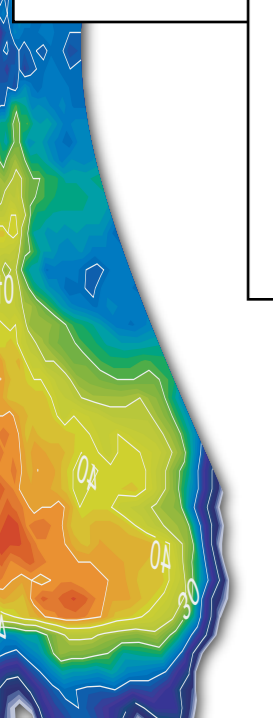
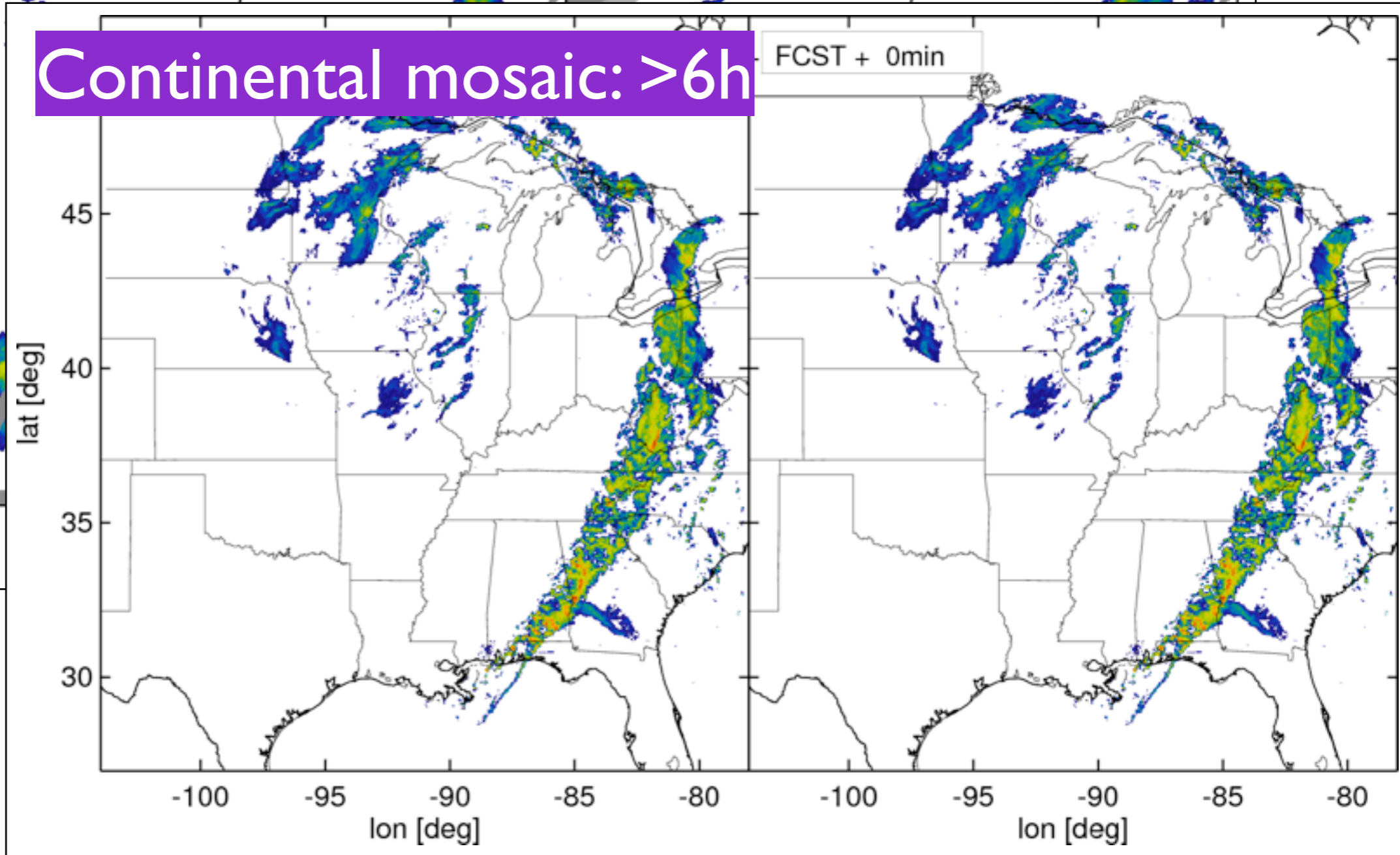
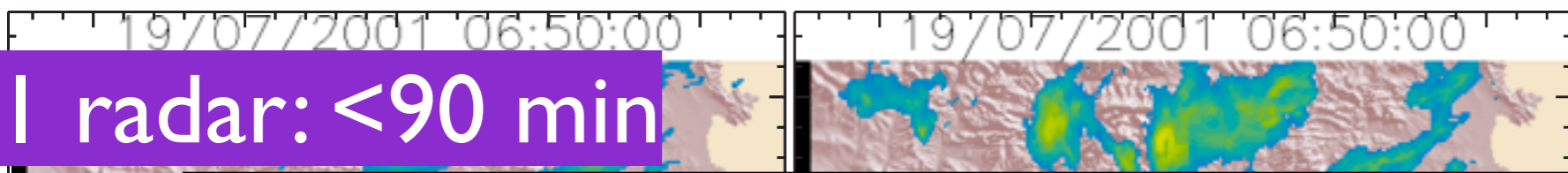
Observations

LP nowcasts

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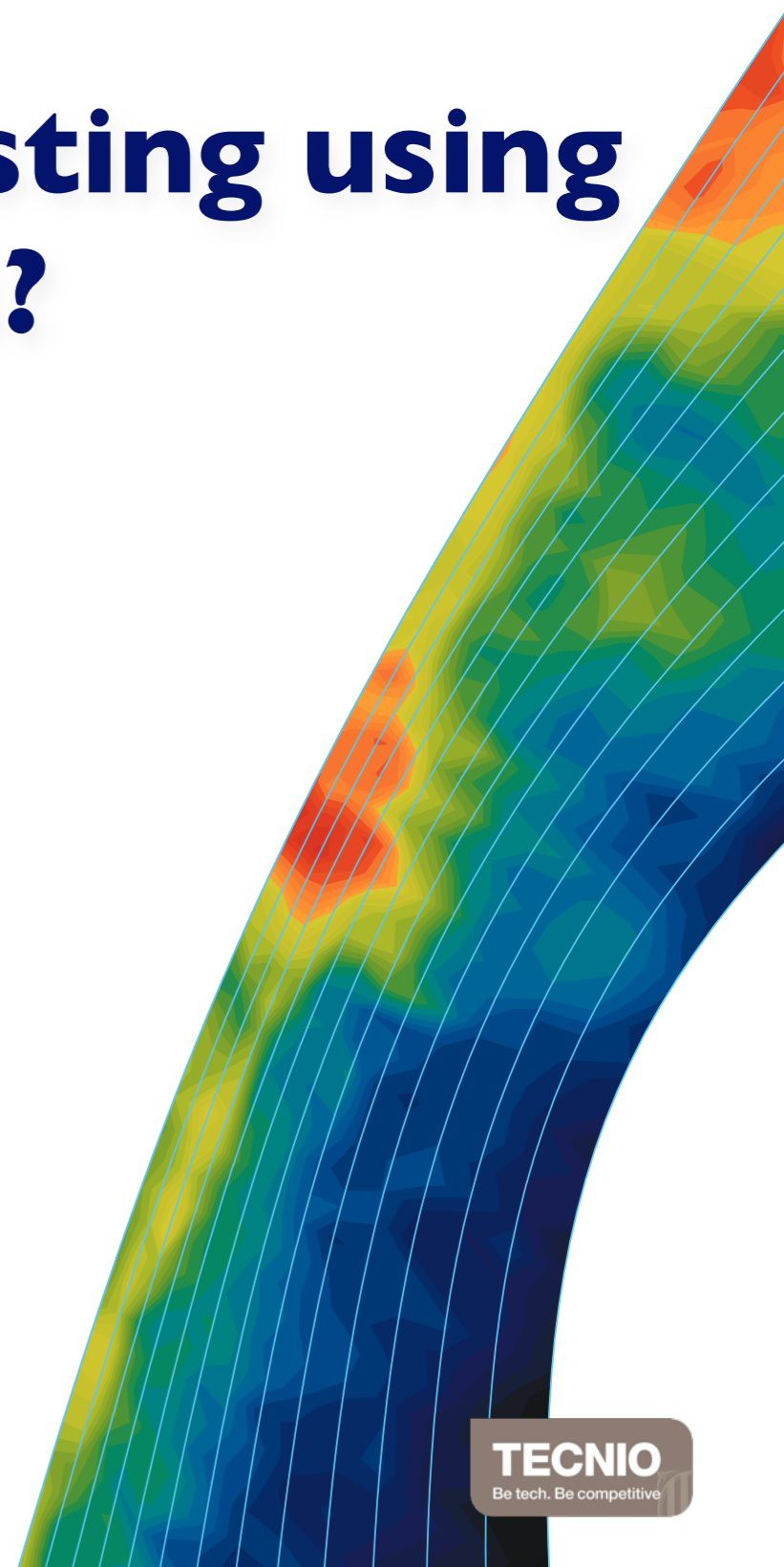
National network: > 2-3h

Continental mosaic: >6h





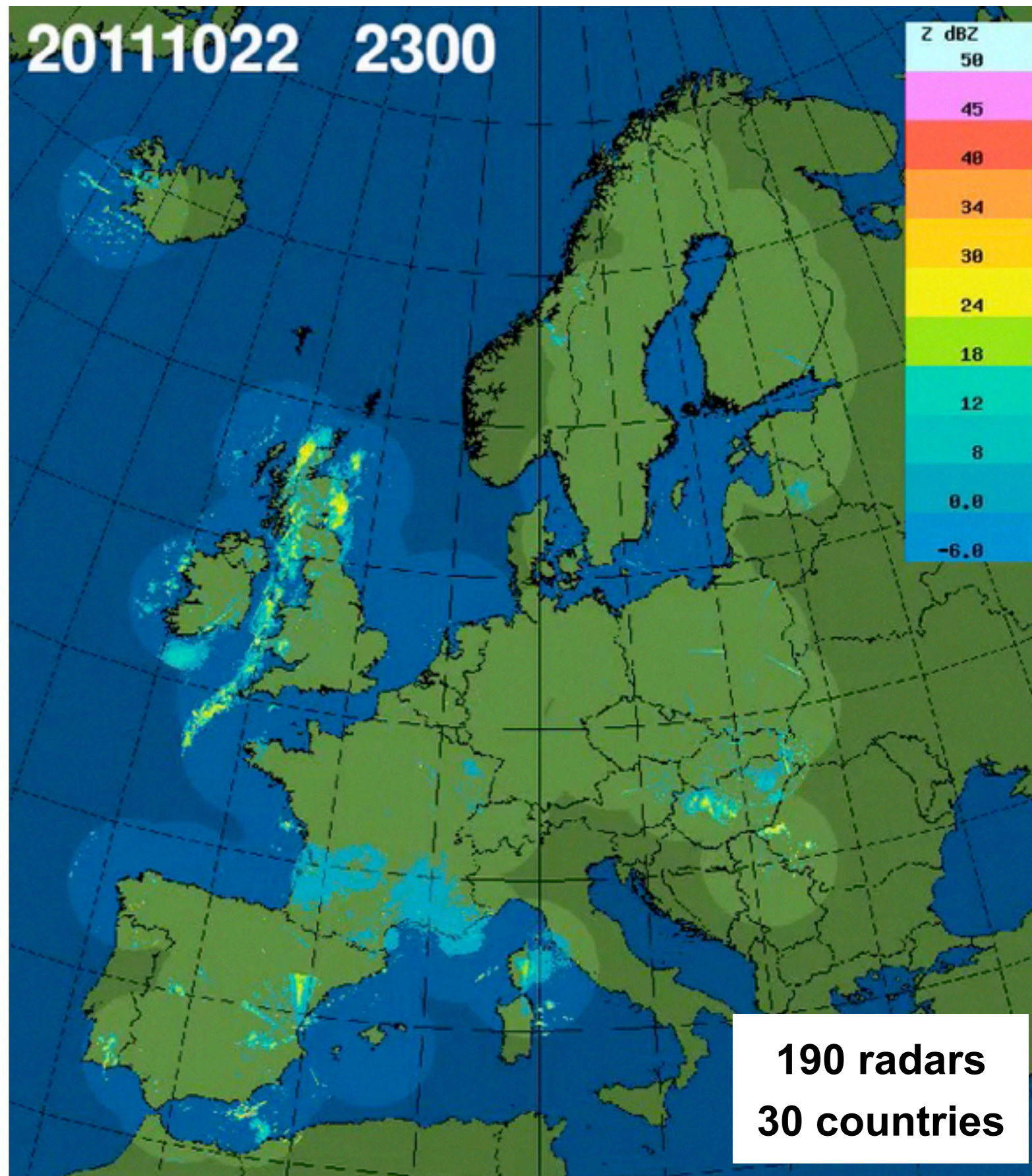
What about rainfall nowcasting using European mosaics?



EU radar mosaic (OPERA)

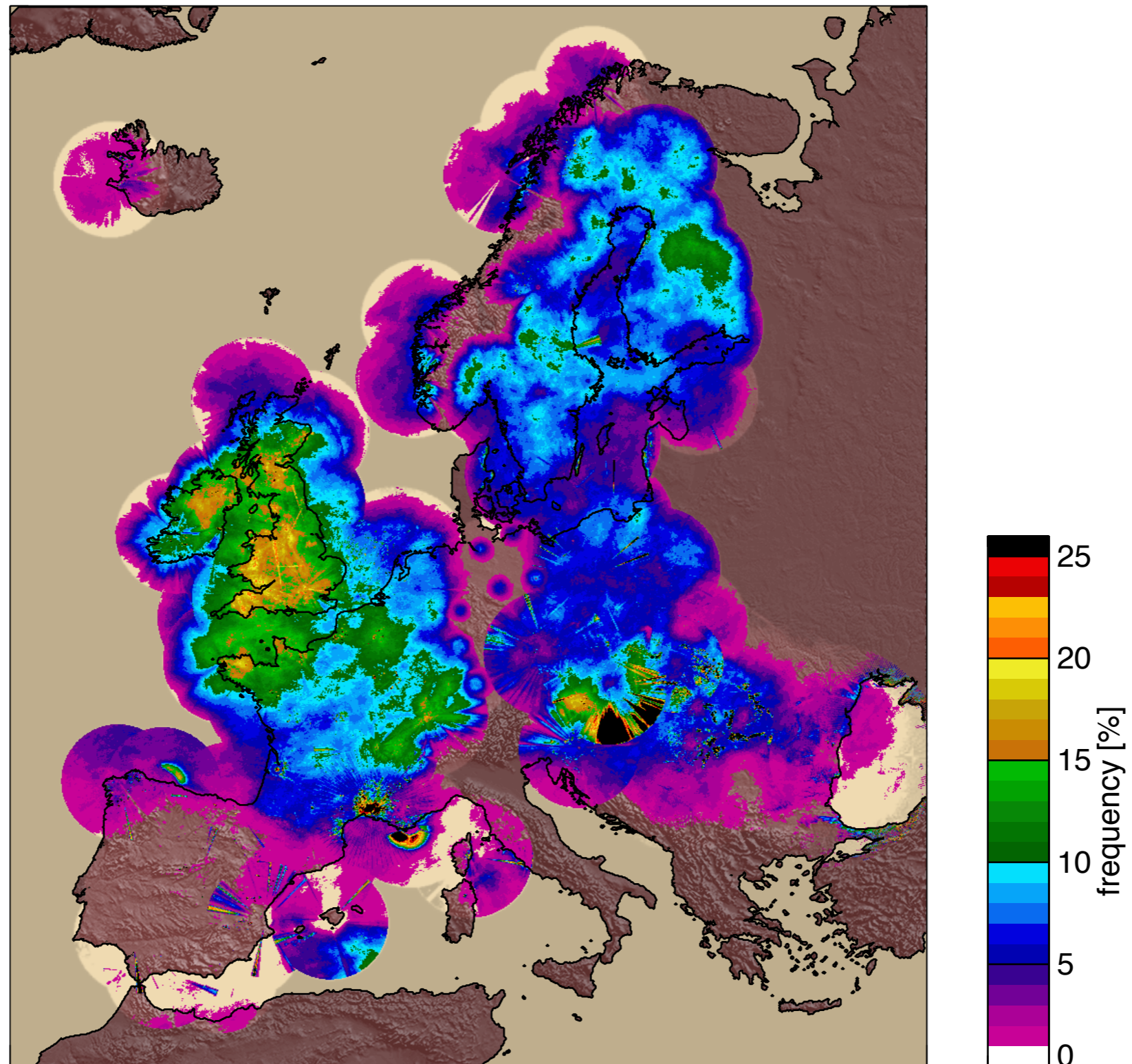
OPERA radar mosaic:

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

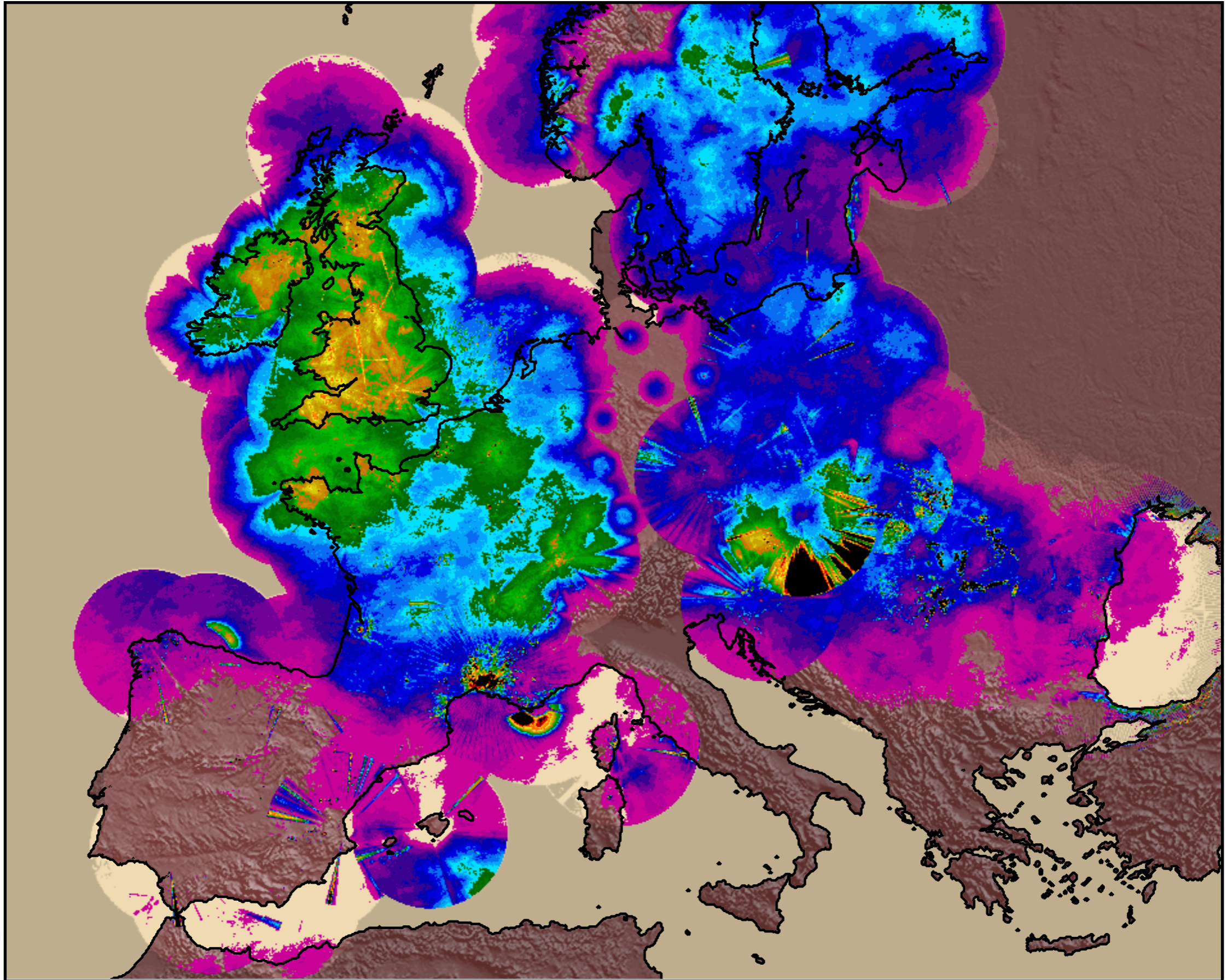


Frequency dBZ > 10 dBZ

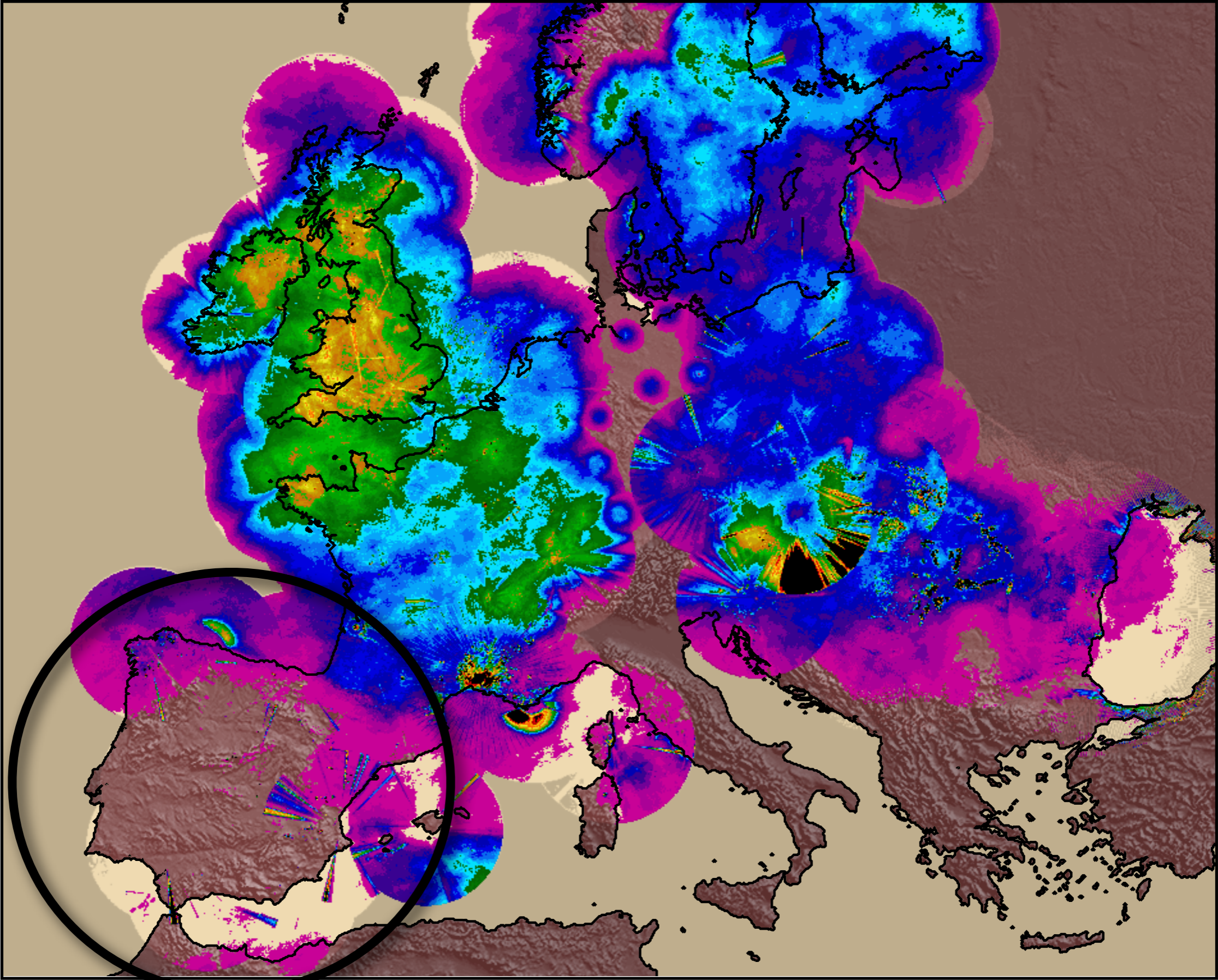
in the period **01 June - 31 July 2012 (5856 maps)**



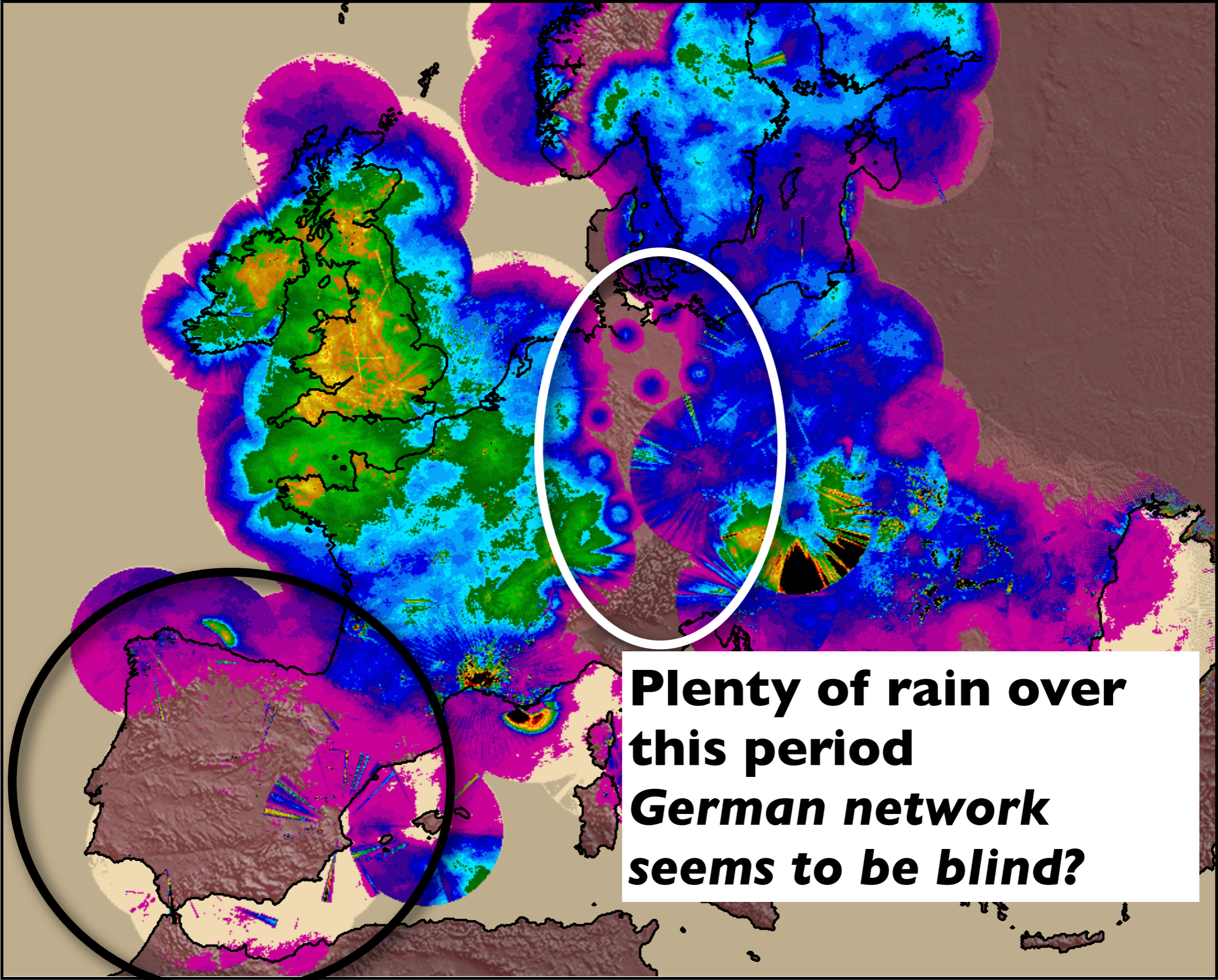
Frequency dBZ > 10 dBZ



Frequency dBZ > 10 dBZ

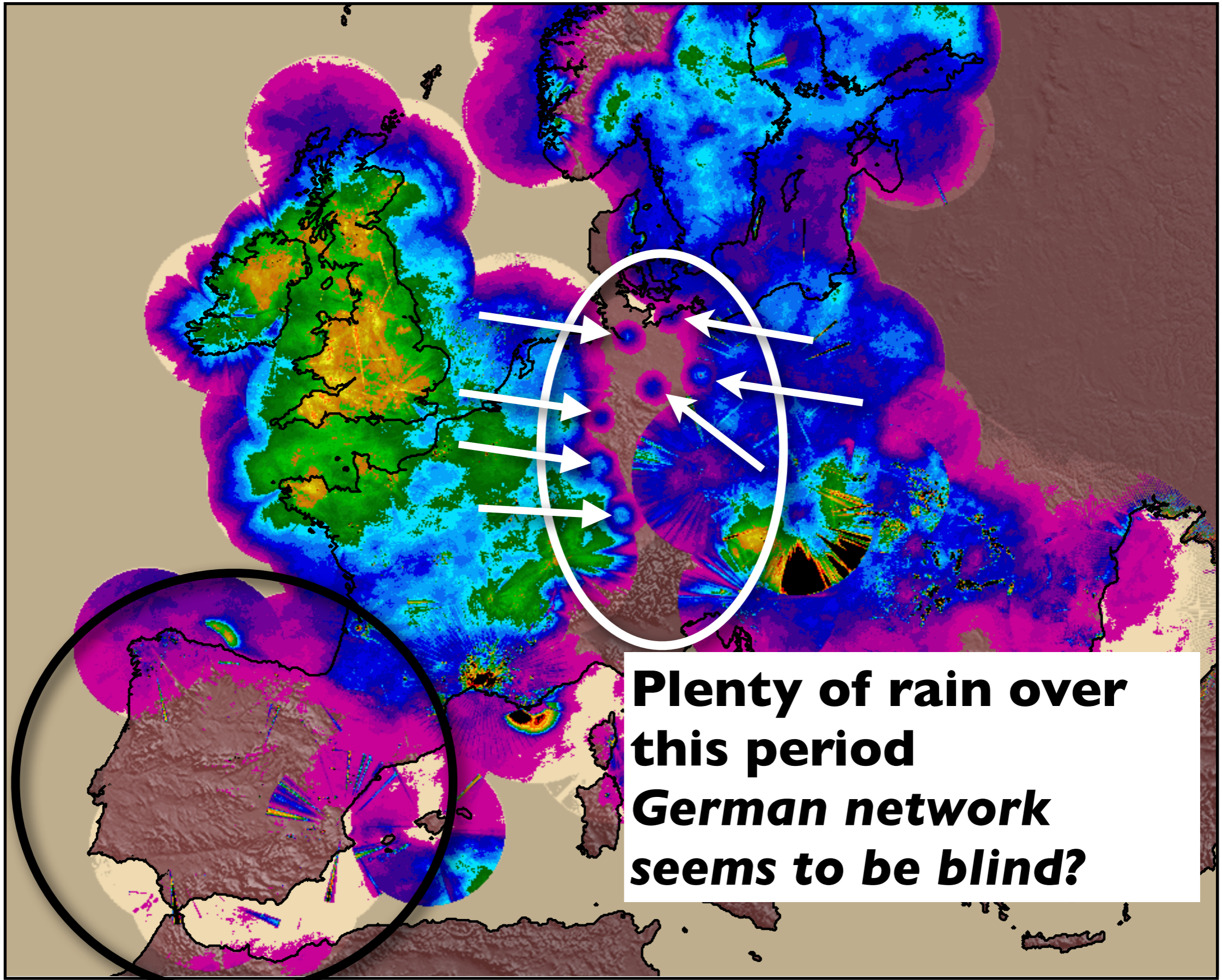


Frequency dBZ > 10 dBZ



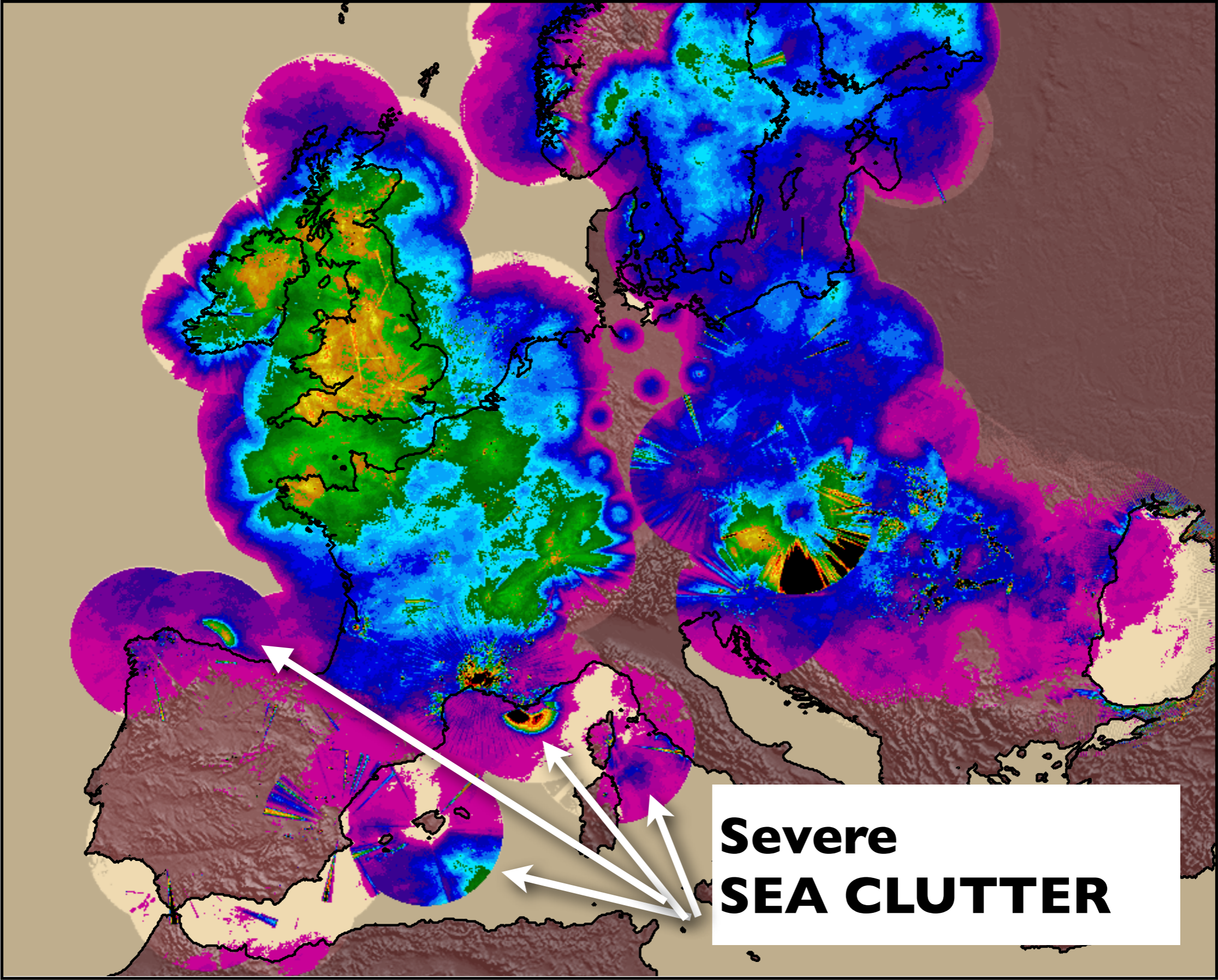
**Plenty of rain over
this period
German network
seems to be blind?**

Frequency dBZ > 10 dBZ

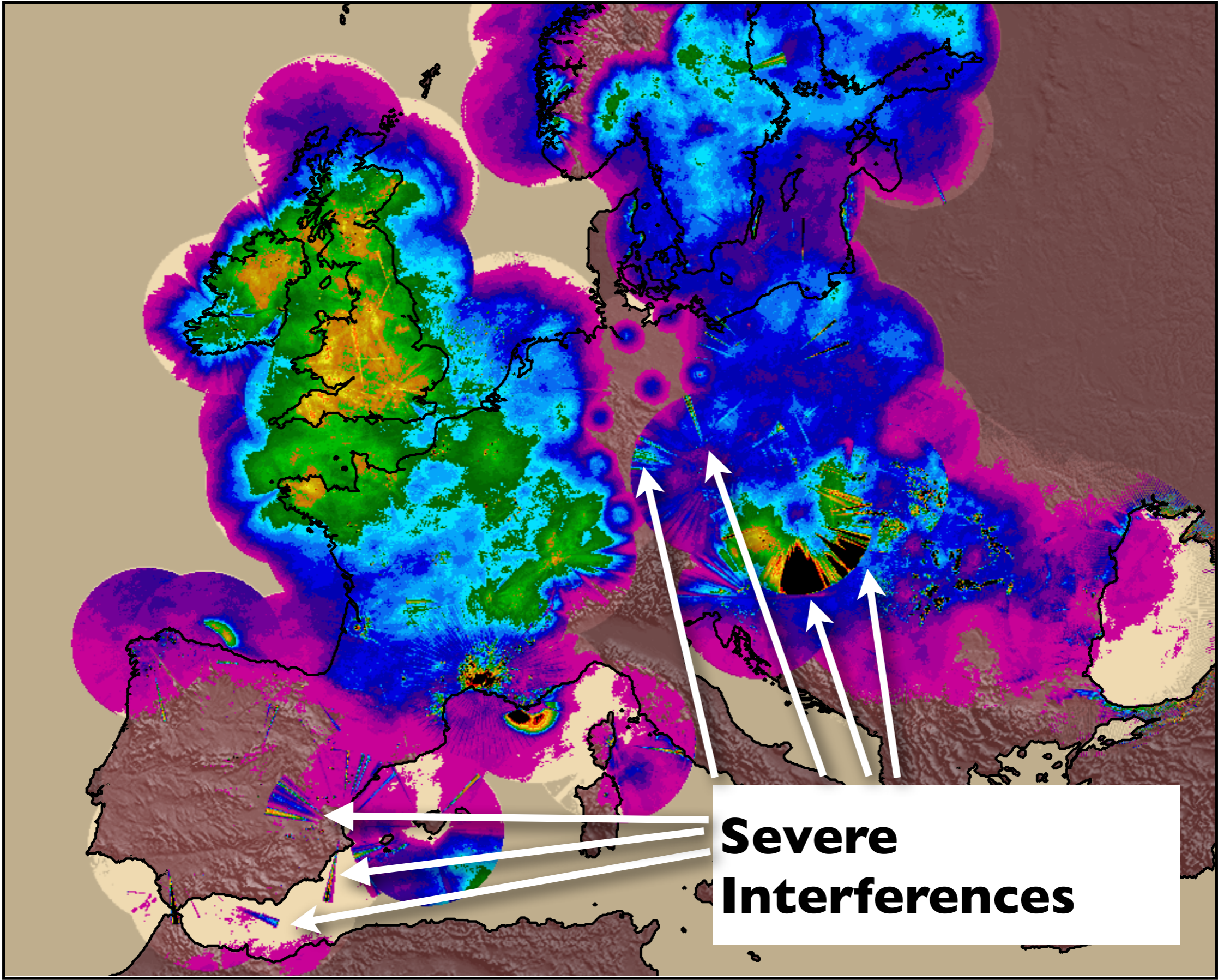


**Plenty of rain over
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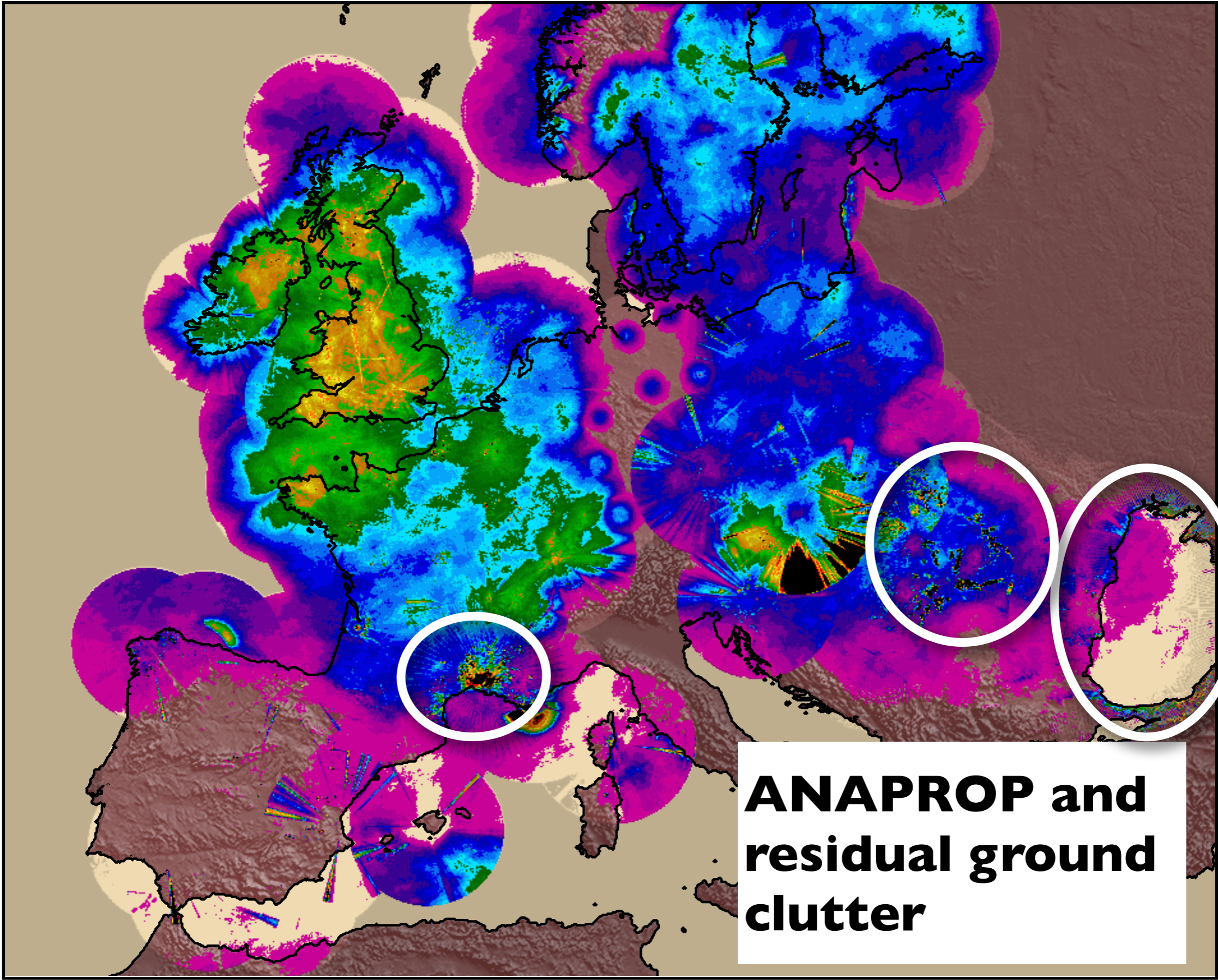
Frequency dBZ > 10 dBZ



Frequency dBZ > 10 dBZ



Frequency dBZ > 10 dBZ



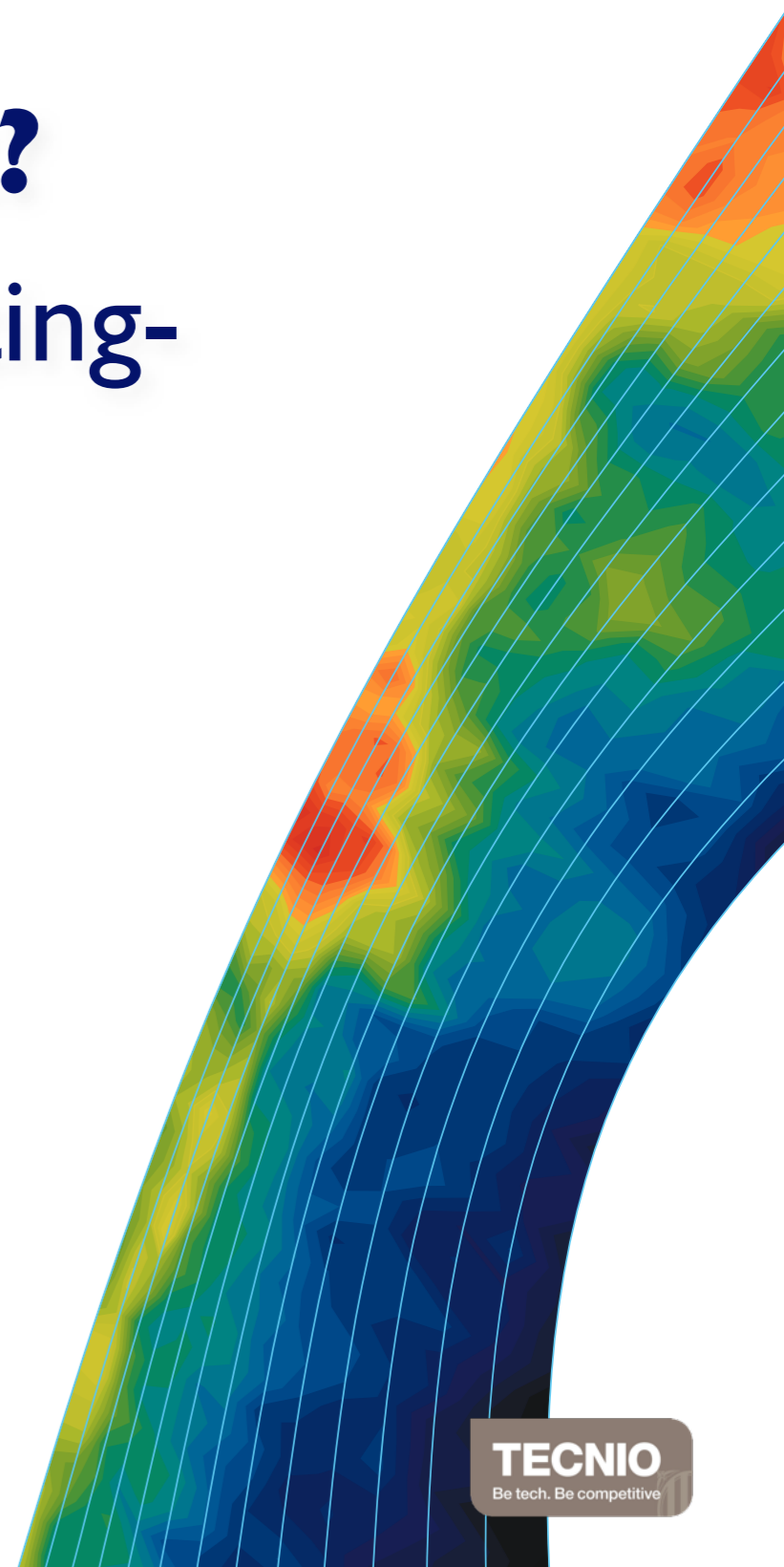


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How does it work? -performance of nowcasting-



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Be tech. Be competitive

Nowcasting evaluation

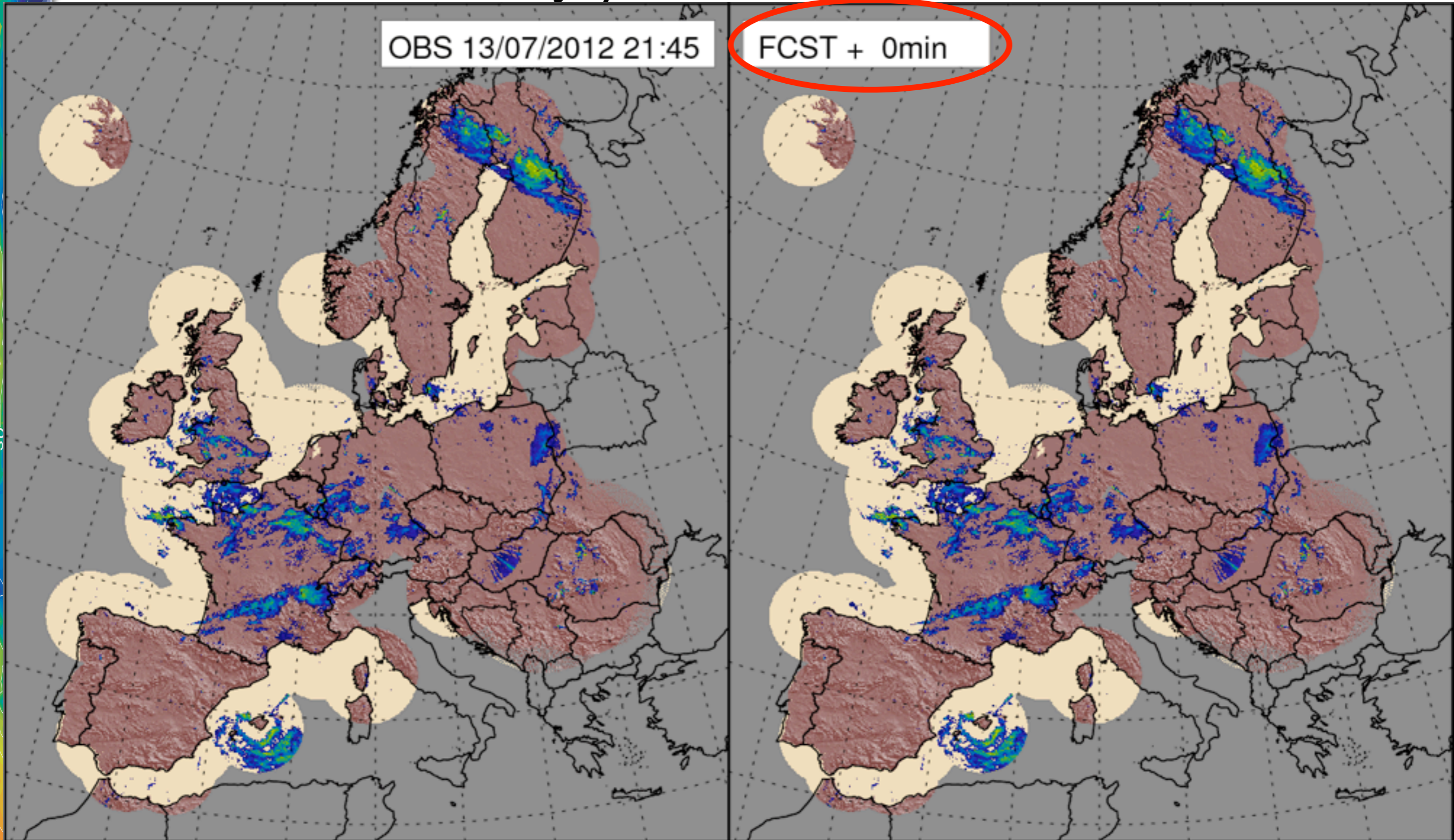
Observations

13 July 2012 21:45 UTC

Forecasts

OBS 13/07/2012 21:45

FCST + 0min

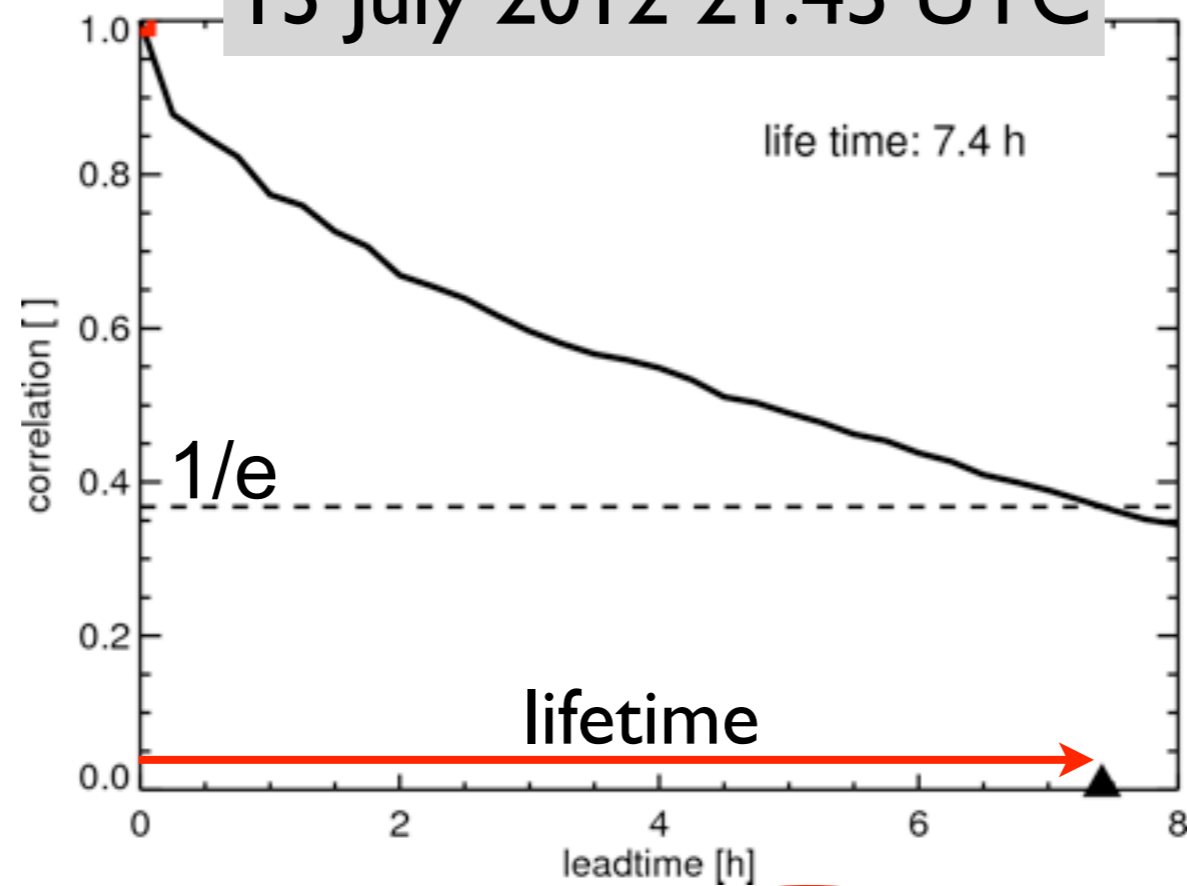


Observed

Forecasted

Nowcasting evaluation

13 July 2012 21:45 UTC

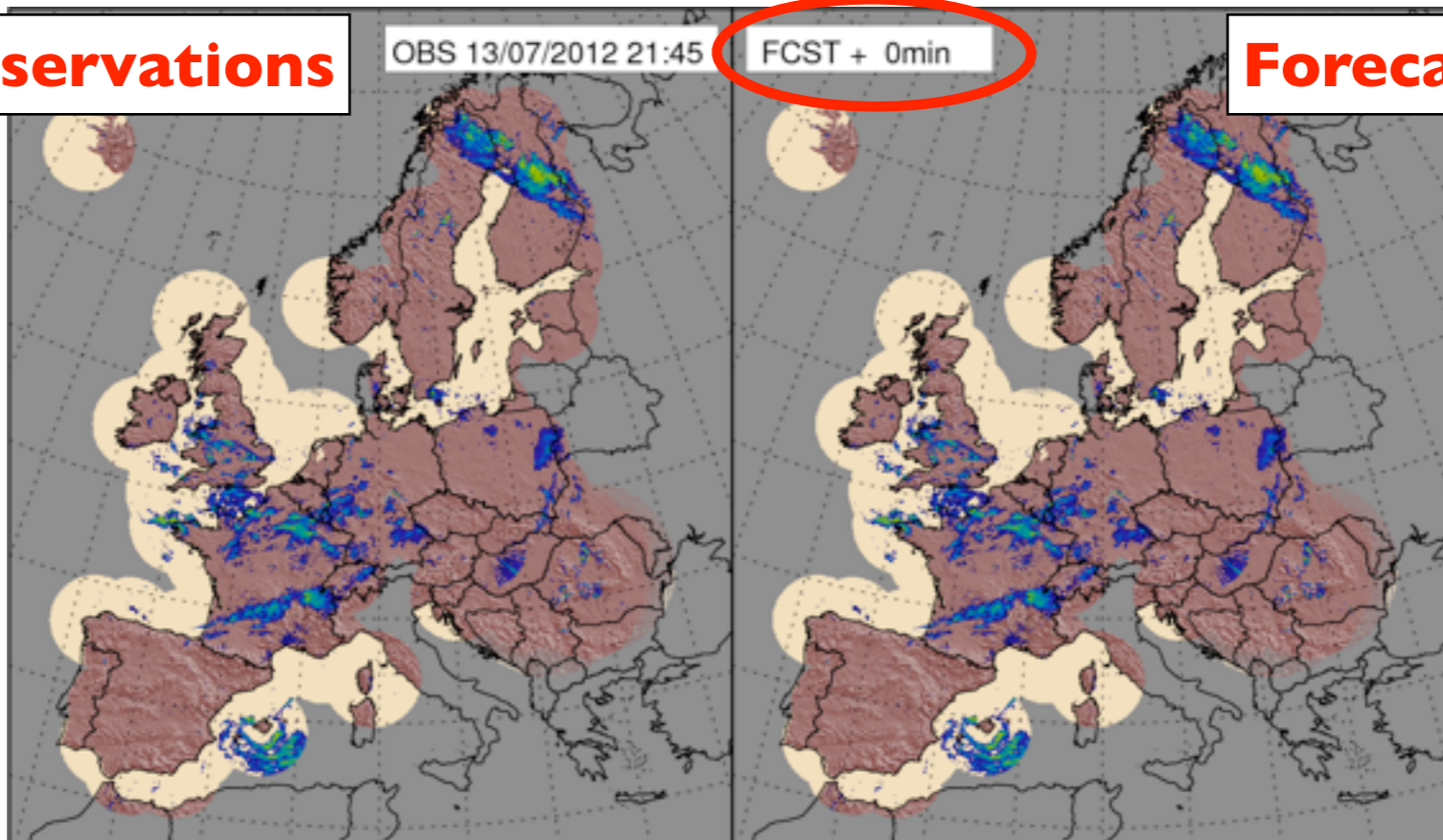


Observations

OBS 13/07/2012 21:45

FCST + 0min

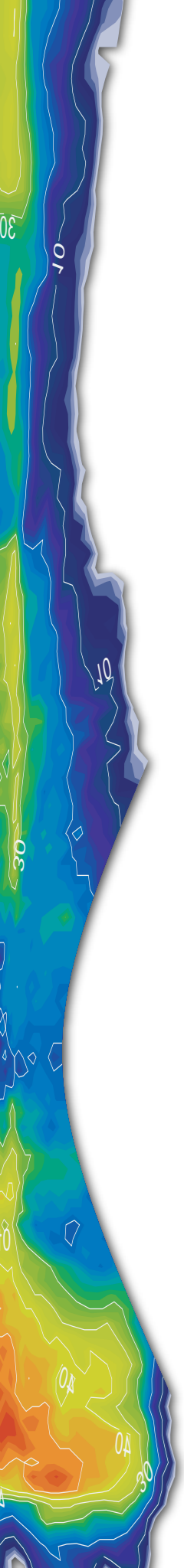
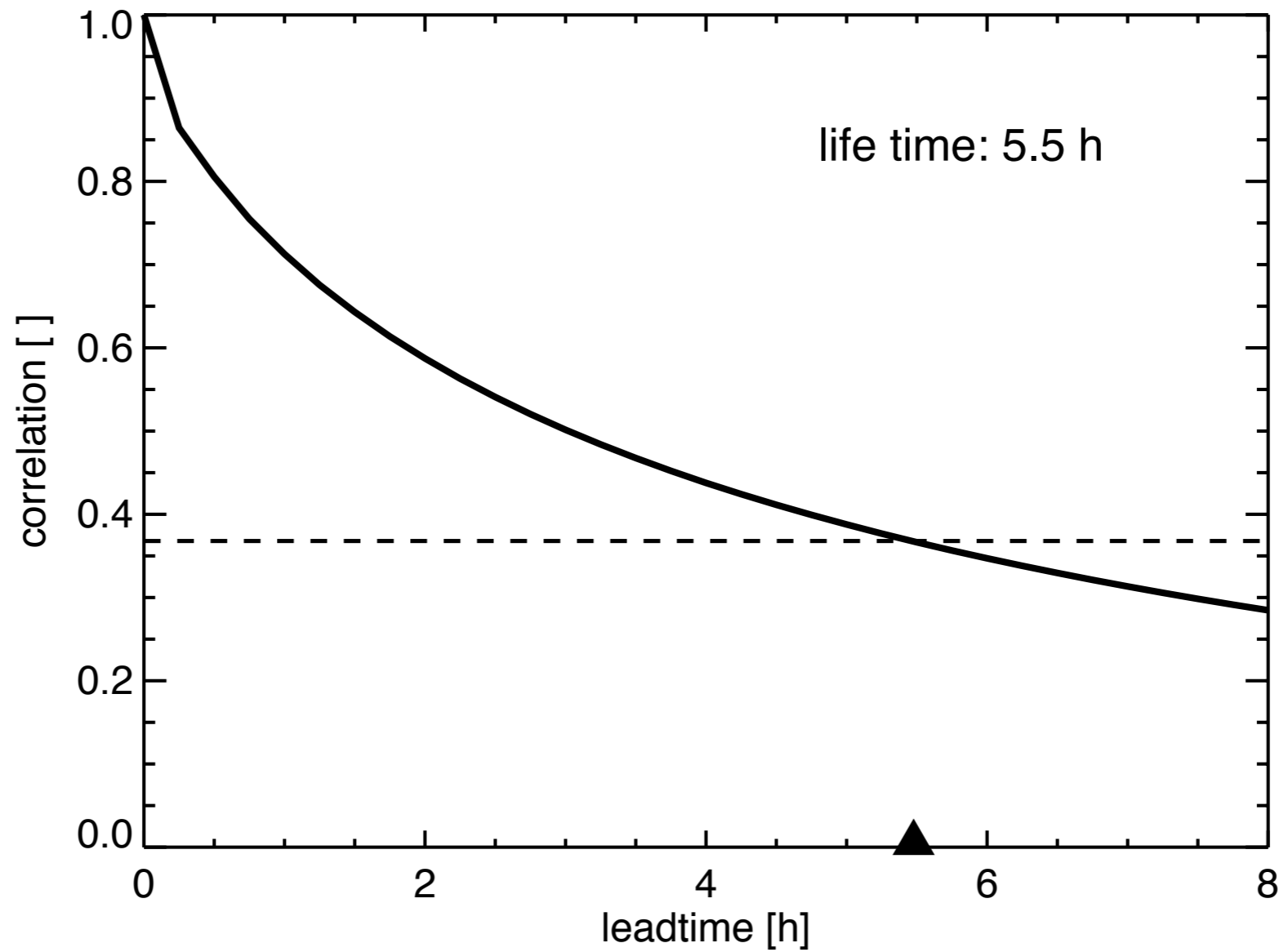
Forecasts



Nowcasting evaluation

Mean Lifetime

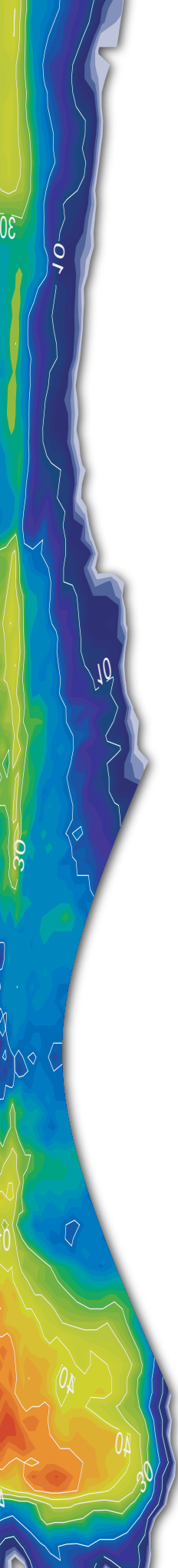
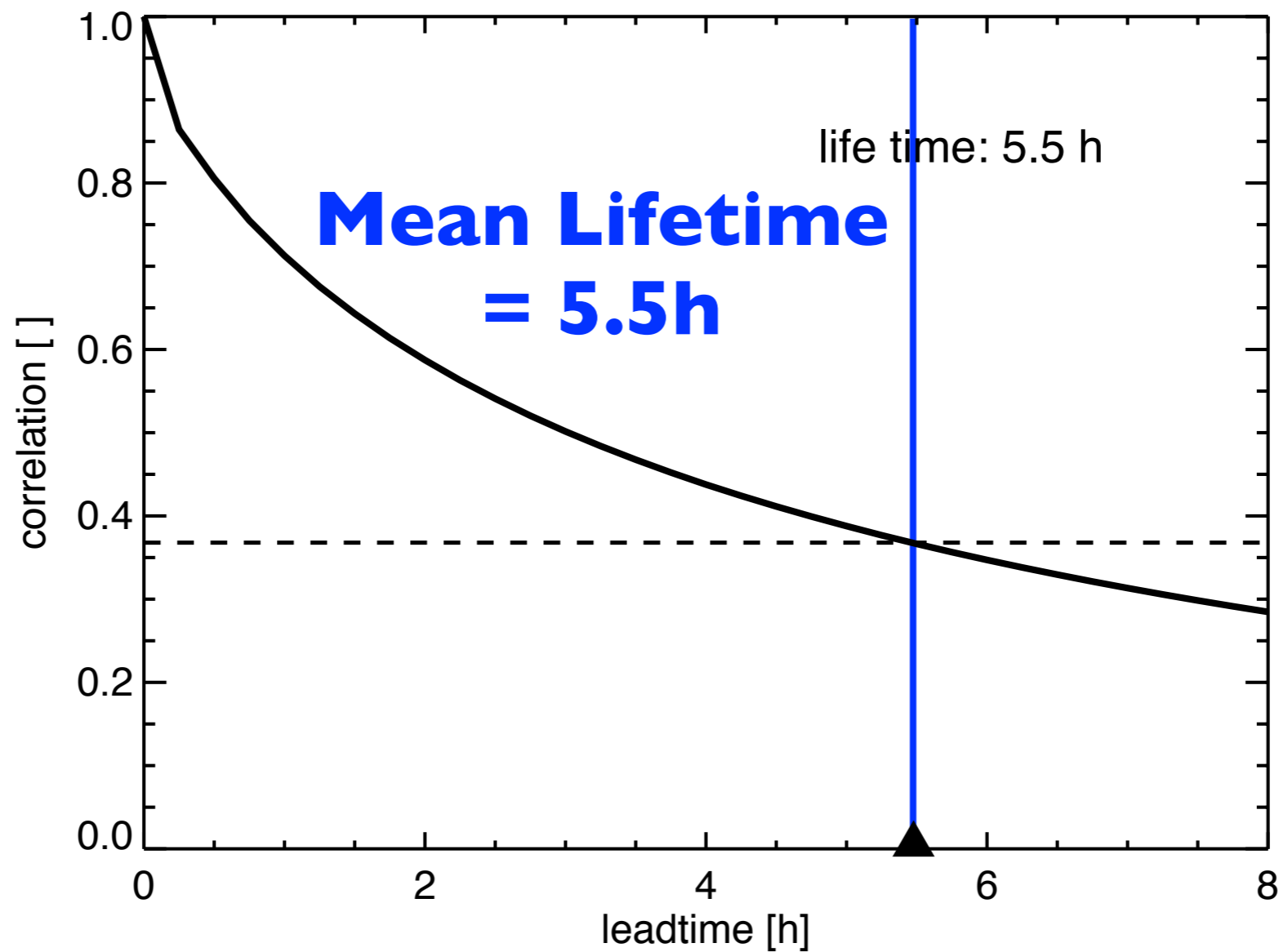
in the period **01 June - 31 July 2012**



Nowcasting evaluation

Mean Lifetime

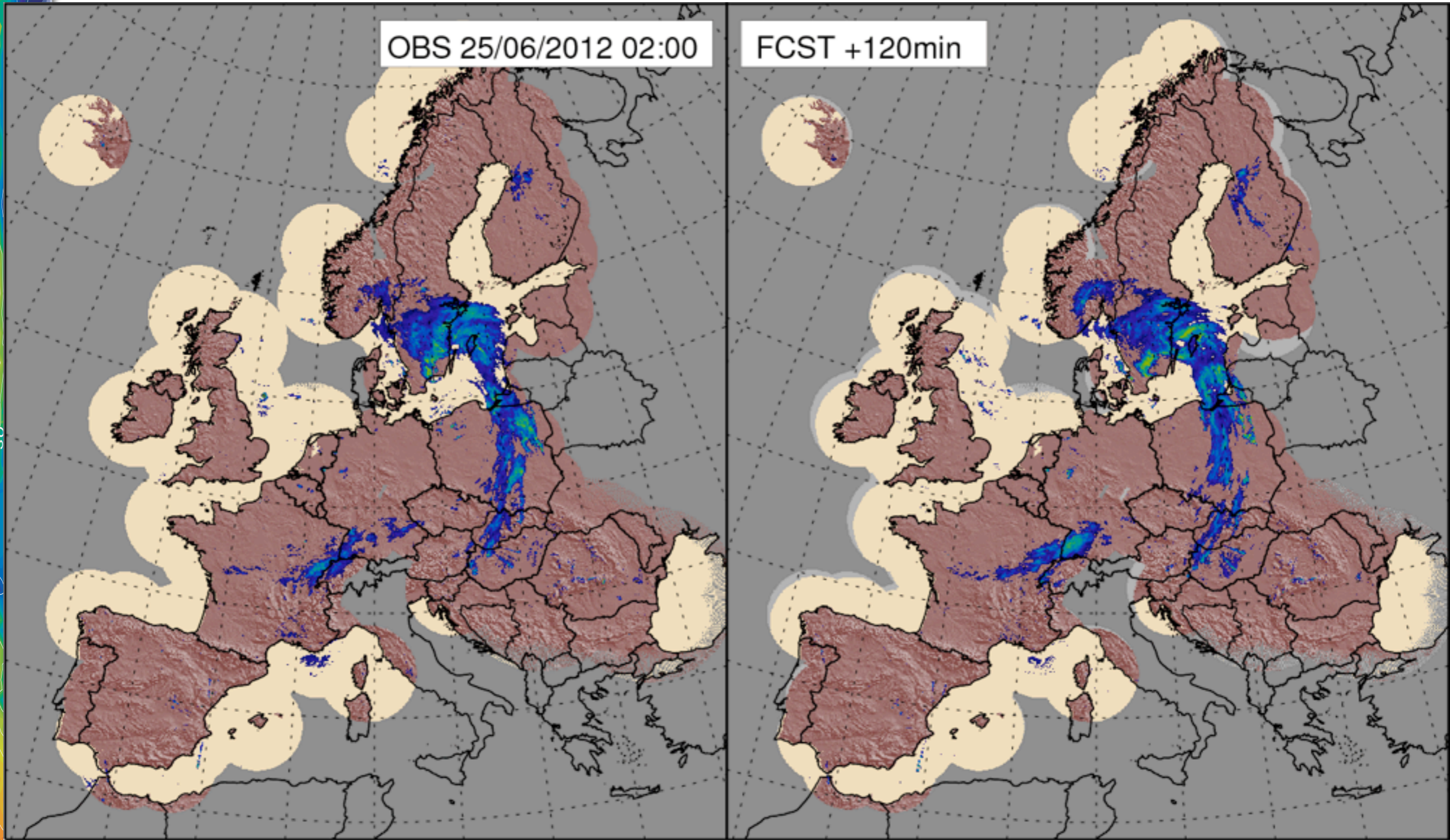
in the period **01 June - 31 July 2012**



25 June 2012 - 2h forecasts

Observations

Forecasts



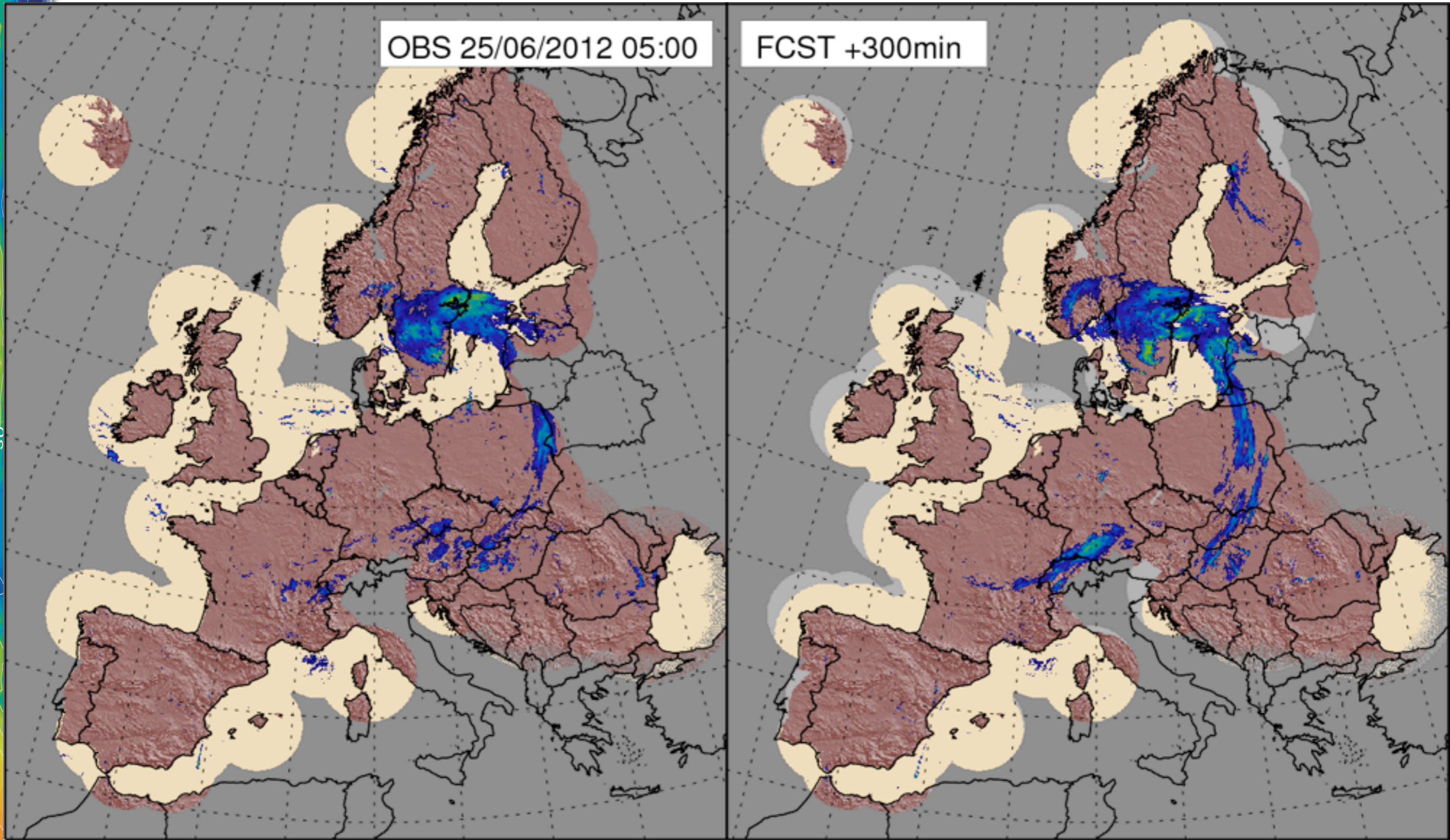
5 10 15 20 25 30 35 40 45 50 55 60 65 70

Reflectivity (dBZ)

25 June 2012 - 5h forecasts

Observations

Forecasts



OBS 25/06/2012 05:00

FCST +300min



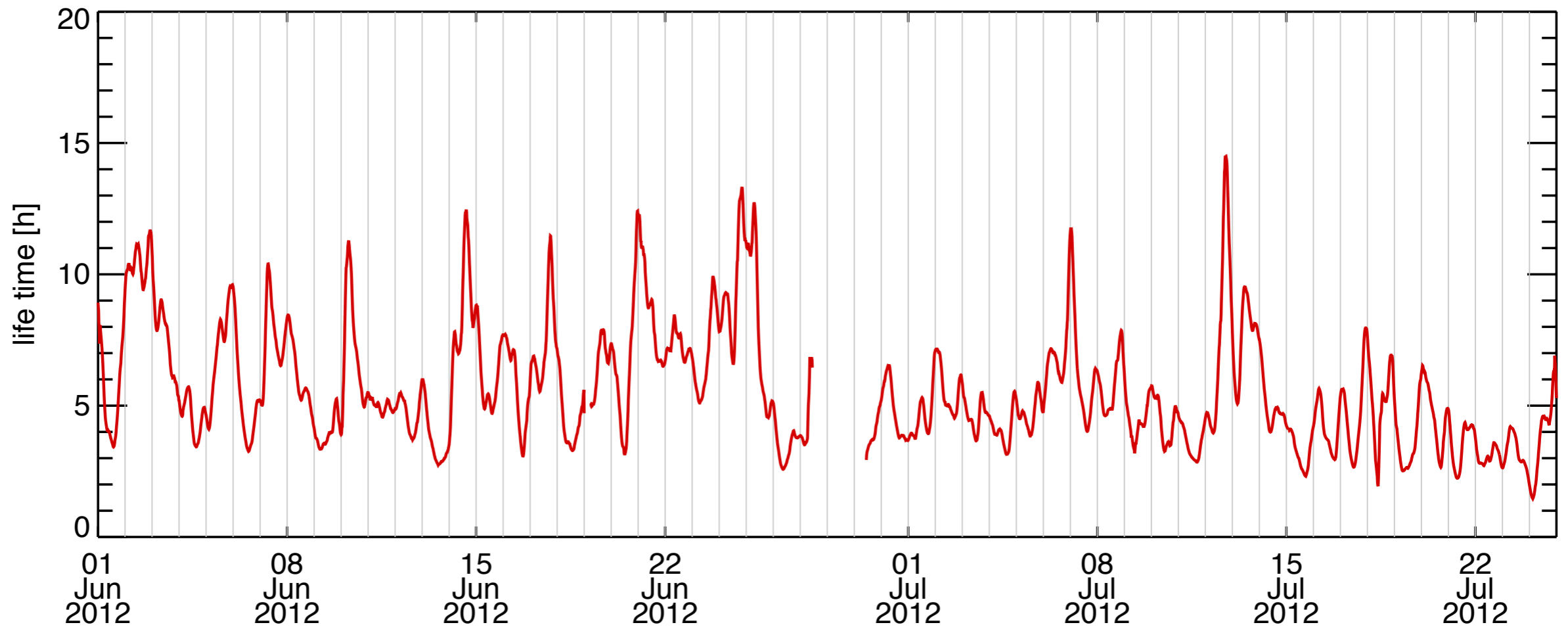
5 10 15 20 25 30 35 40 45 50 55 60 65 70

Reflectivity (dBZ)

Evolution of the life time

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

Lifetime mostly between 4 and 10 h

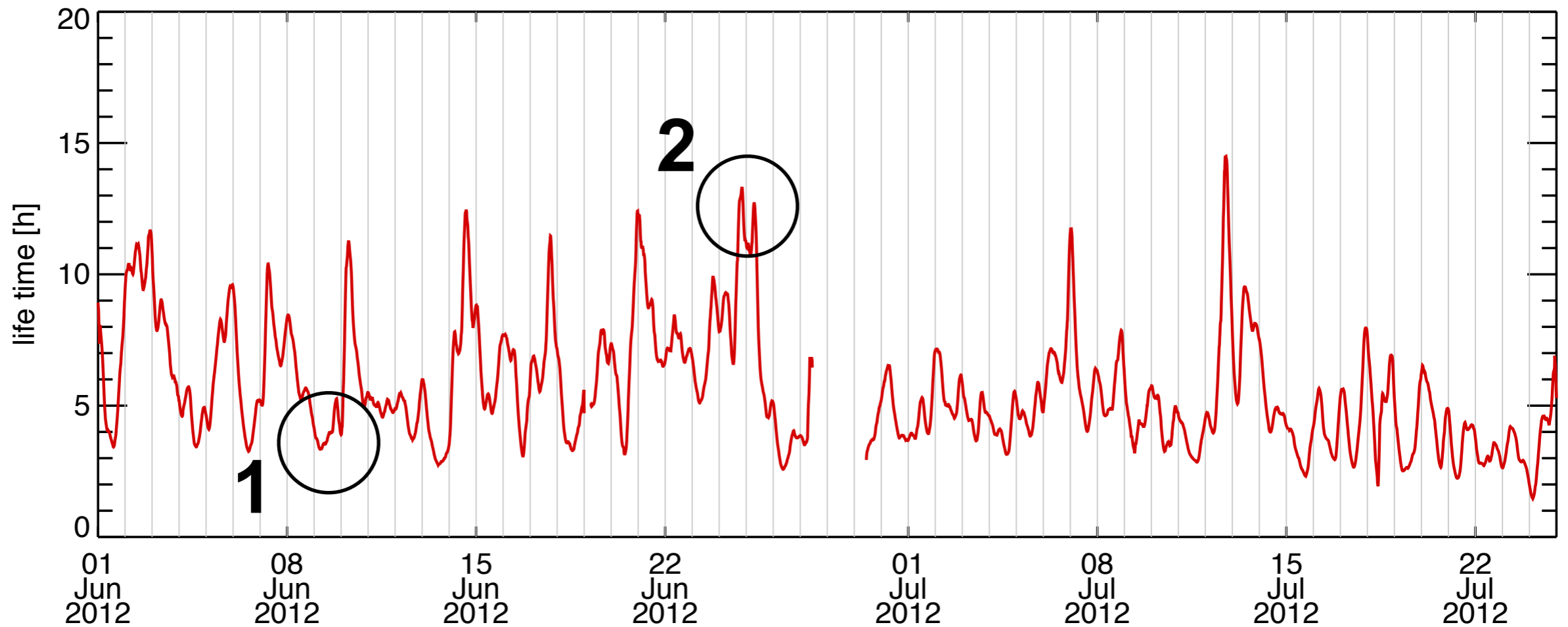


Predictability varies with the event

Evolution of the life time

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

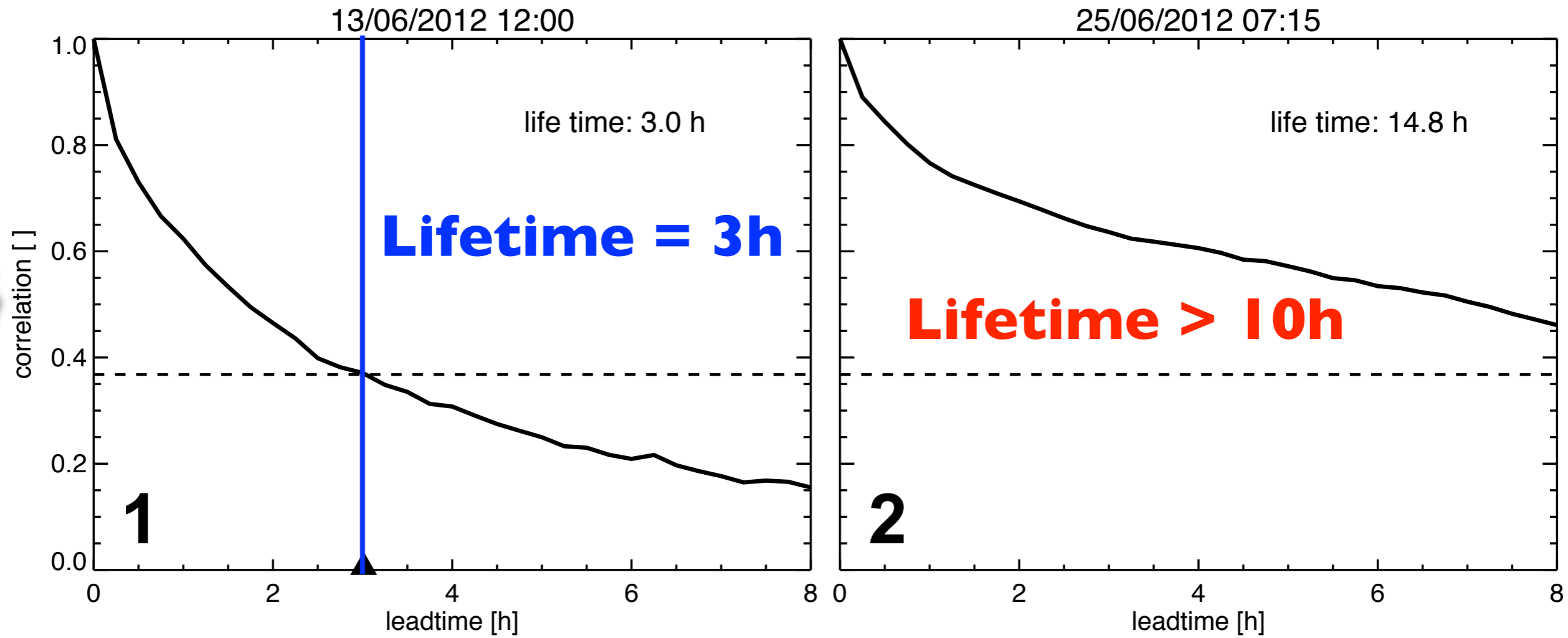
Lifetime mostly between 4 and 10 h



Predictability varies with the event

Evolution of the life time

in the period 01 June - 31 July 2012

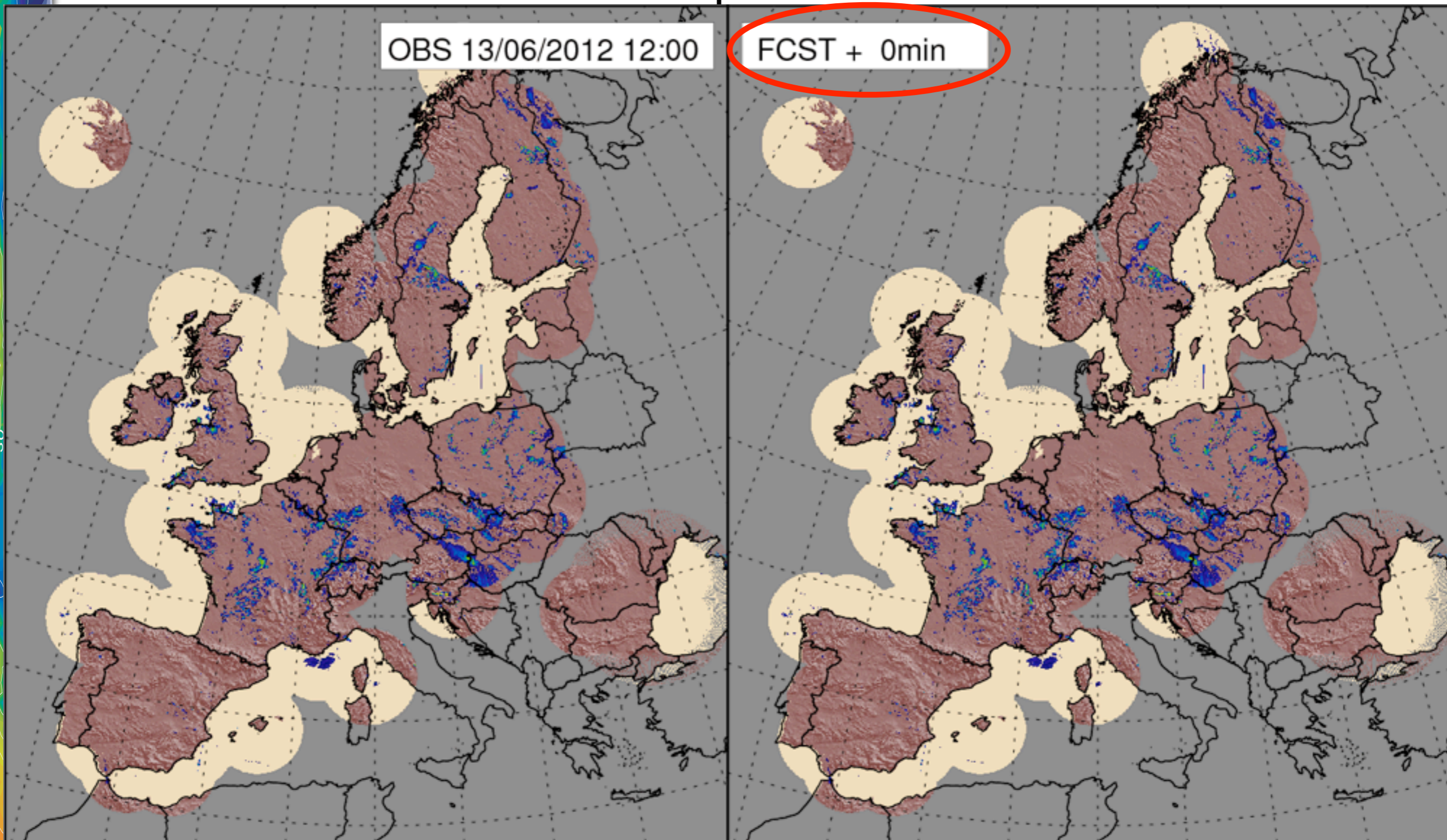


I) 13 June 2012 12:00 UTC

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

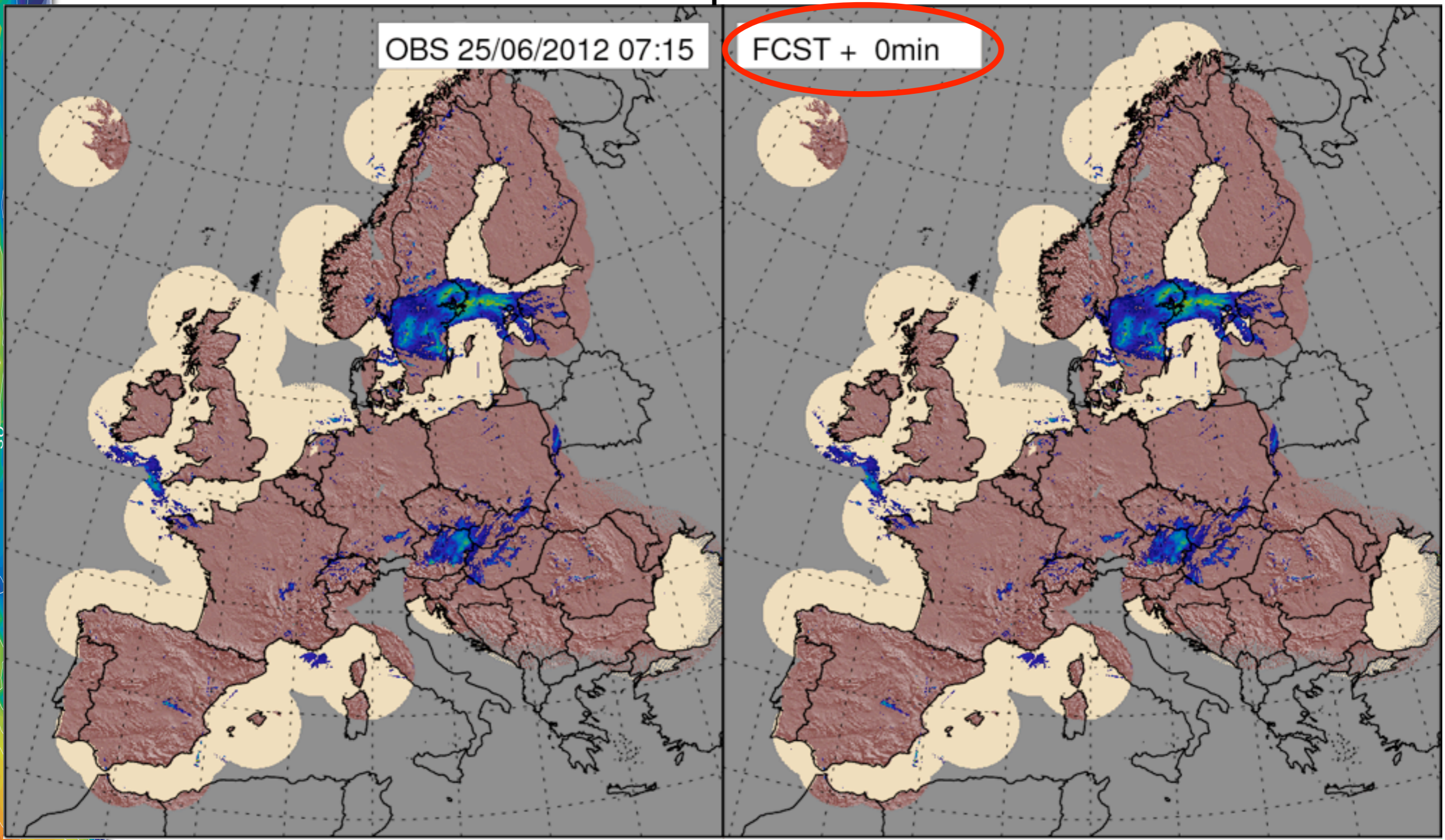
Reflectivity (dBZ)

2) 25 June 2012 07:15 UTC

nowcasts up to 8 hours

OBS 25/06/2012 07:15

FCST + 0min

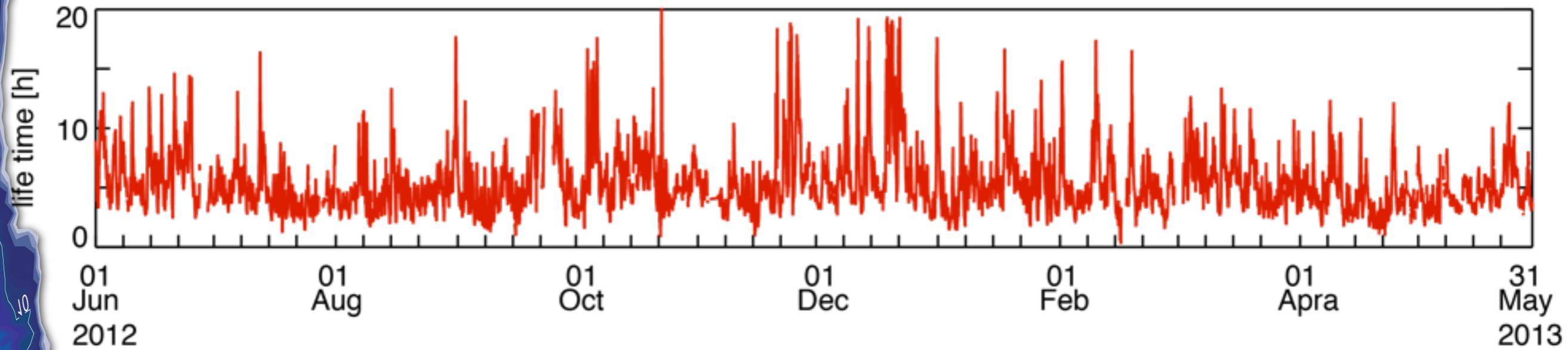


5 10 15 20 25 30 35 40 45 50 55 60 65 70

Reflectivity (dBZ)

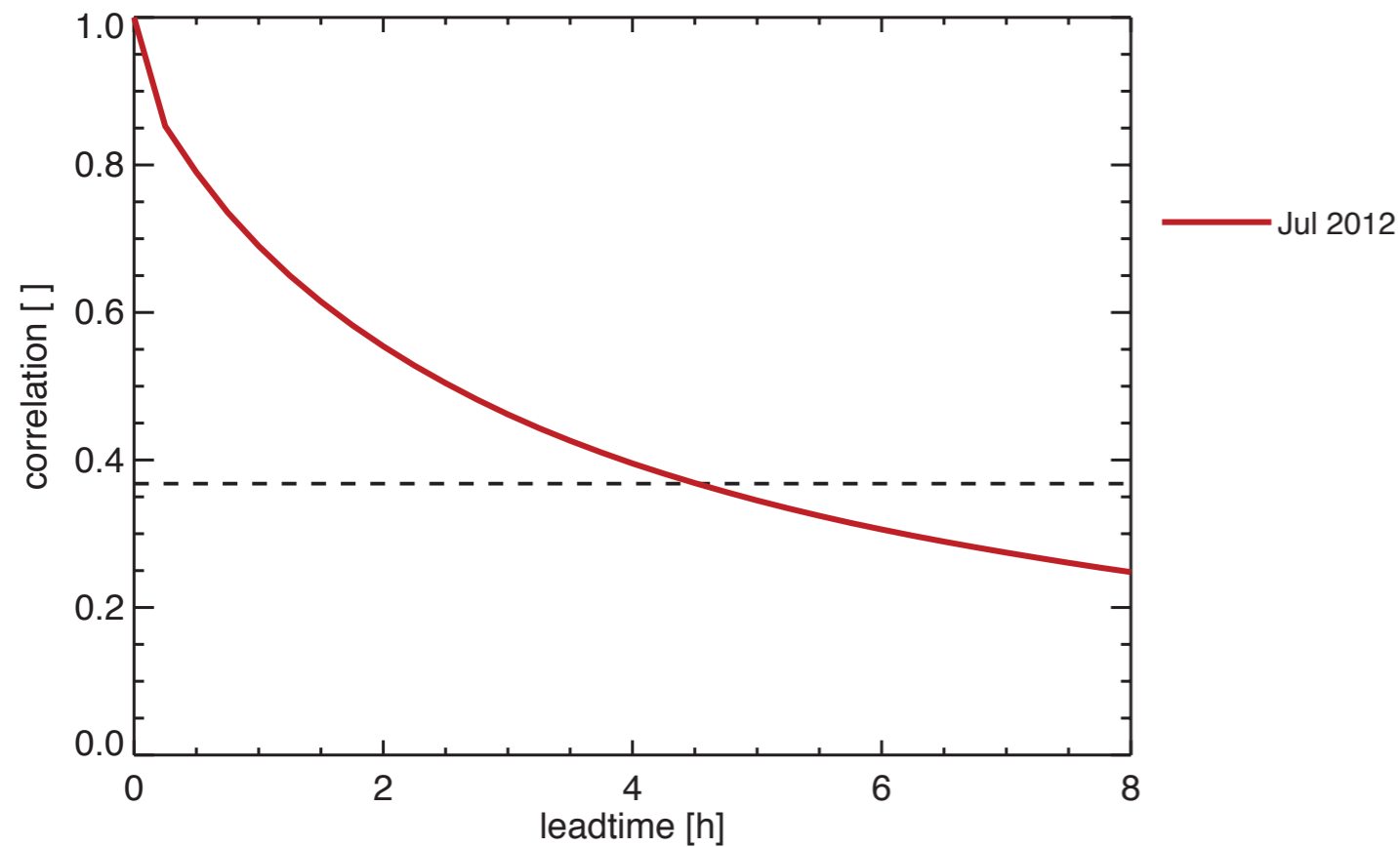
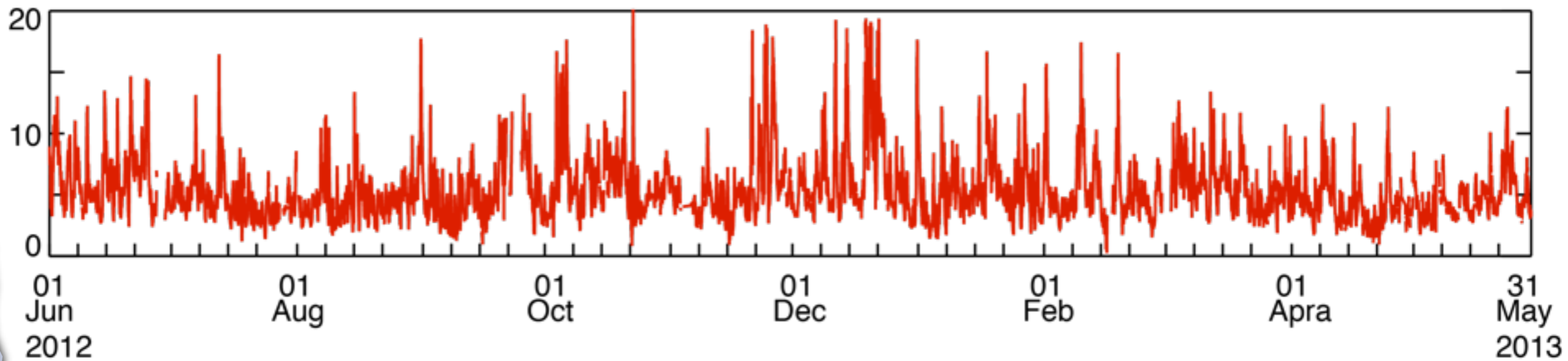
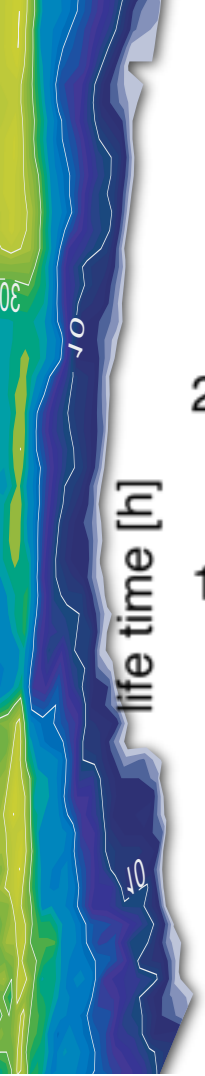
Long-term evaluation

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



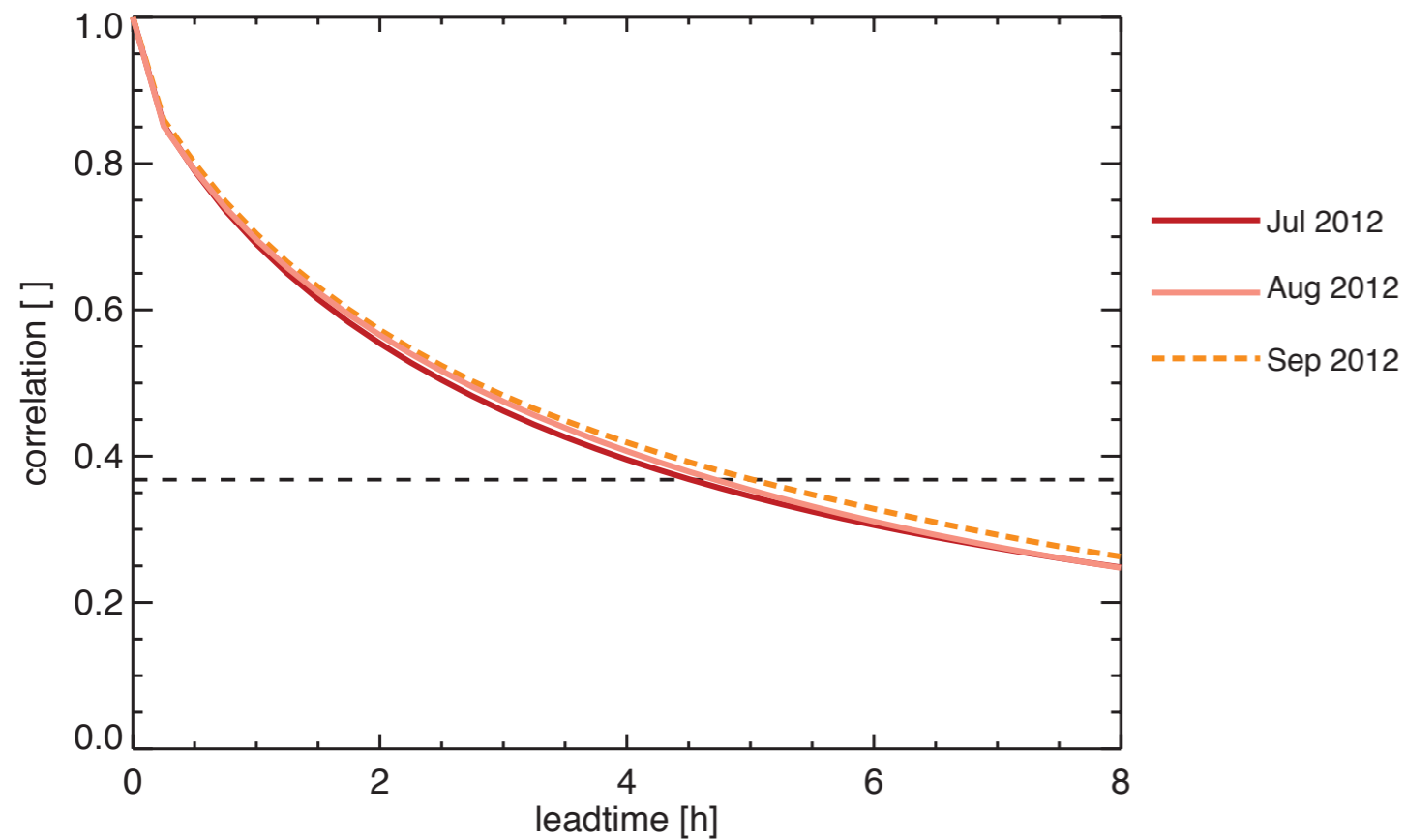
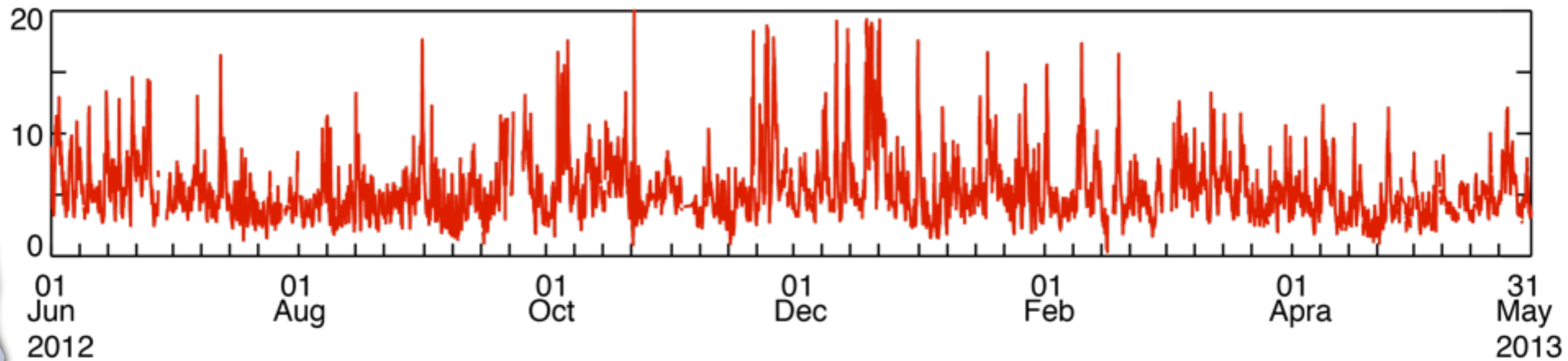
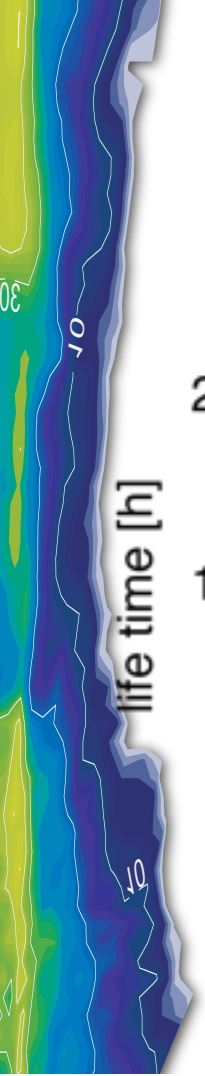
Long-term evaluation

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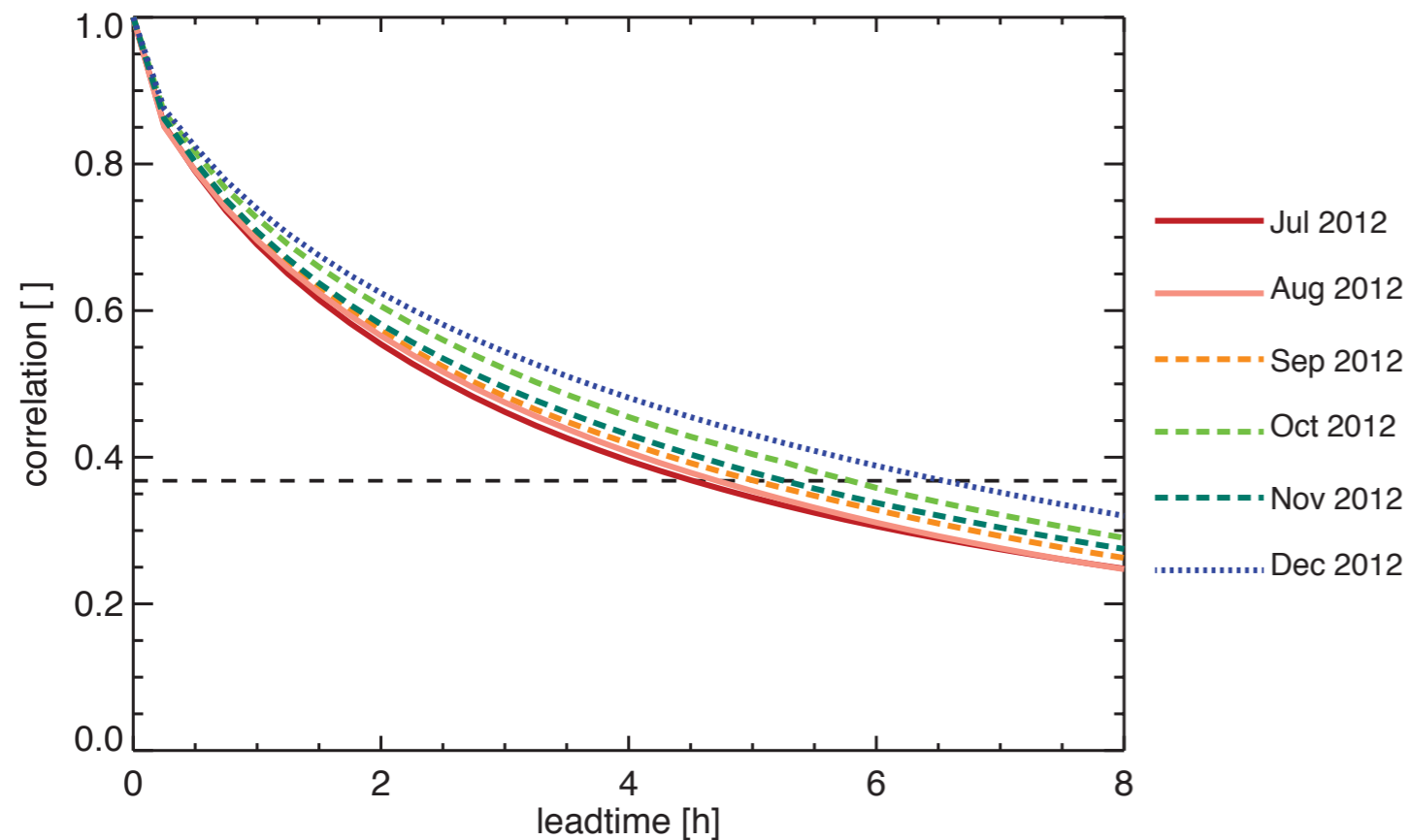
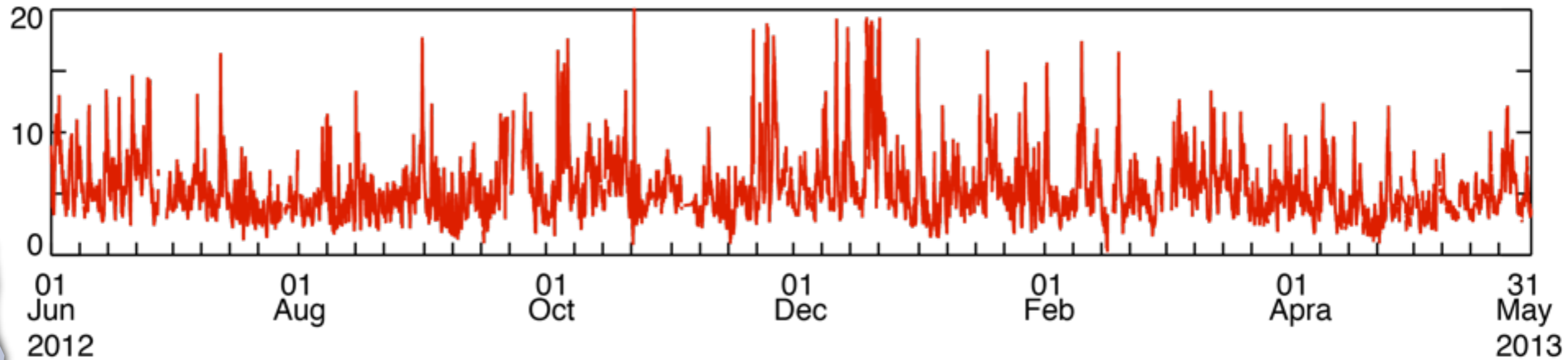
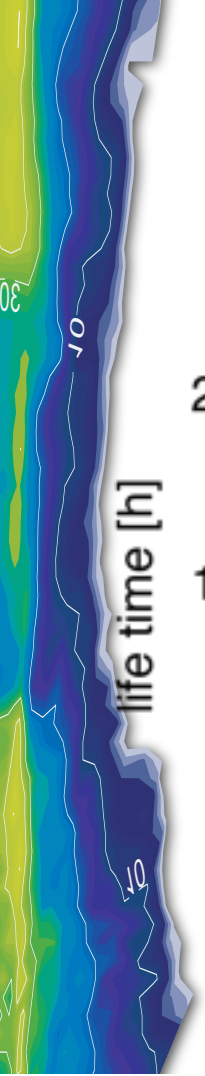
Long-term evaluation

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



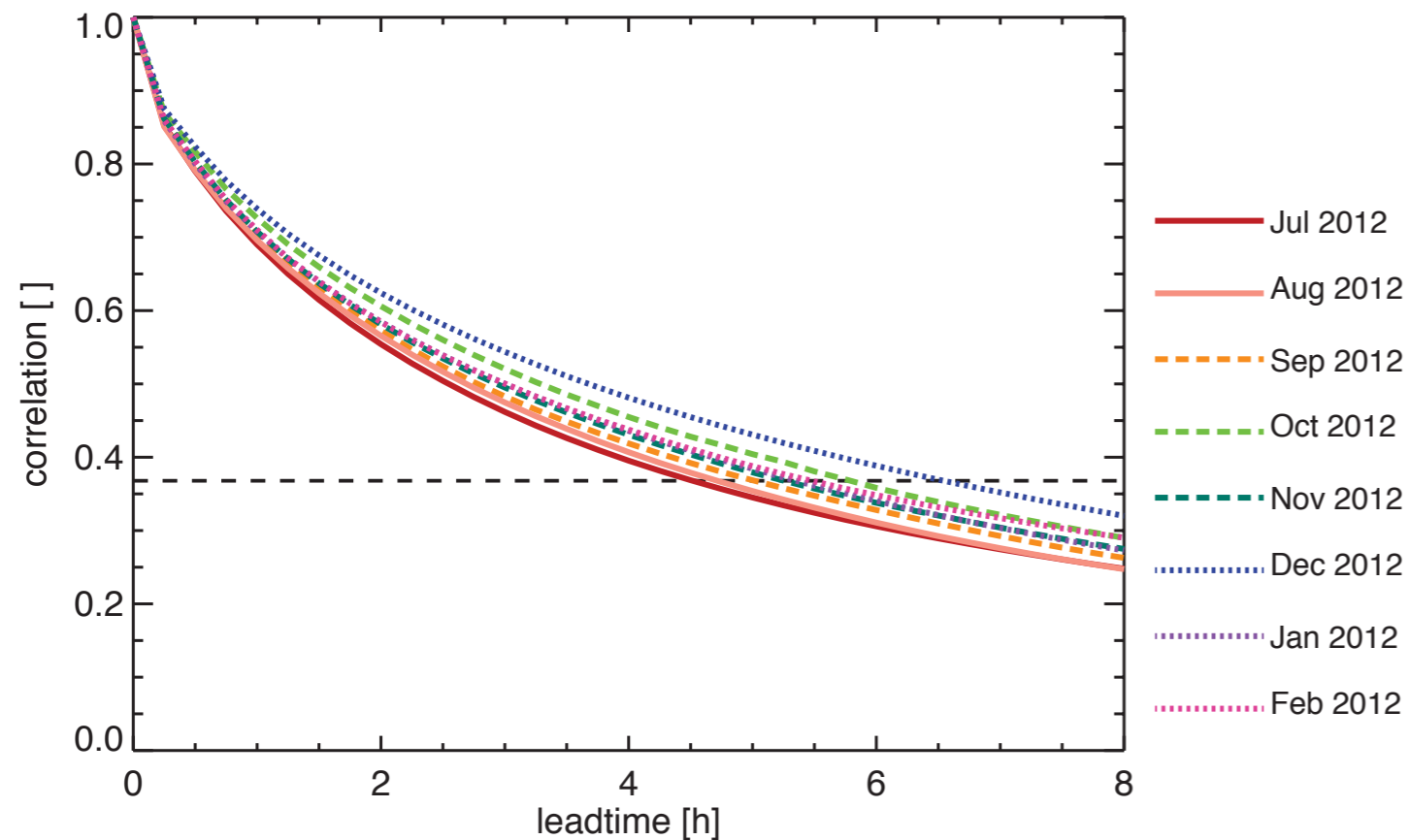
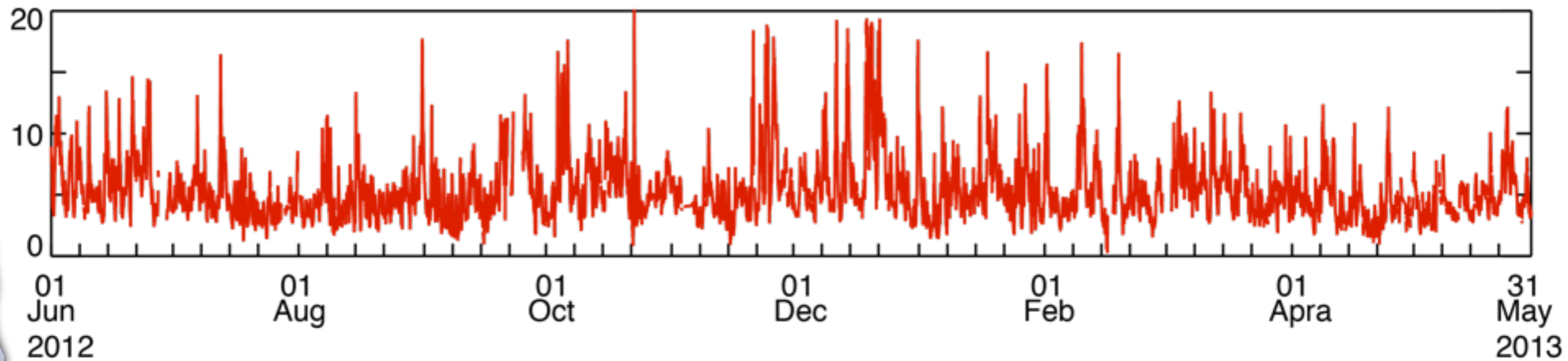
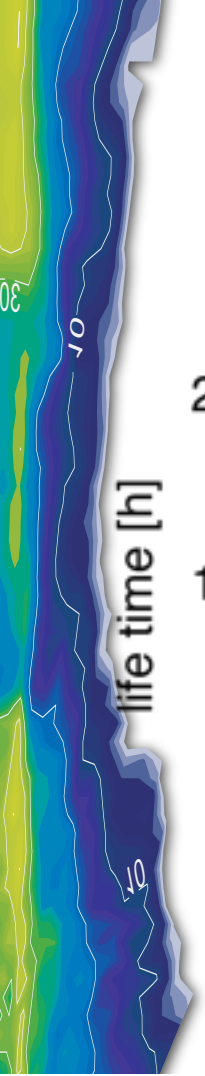
Long-term evaluation

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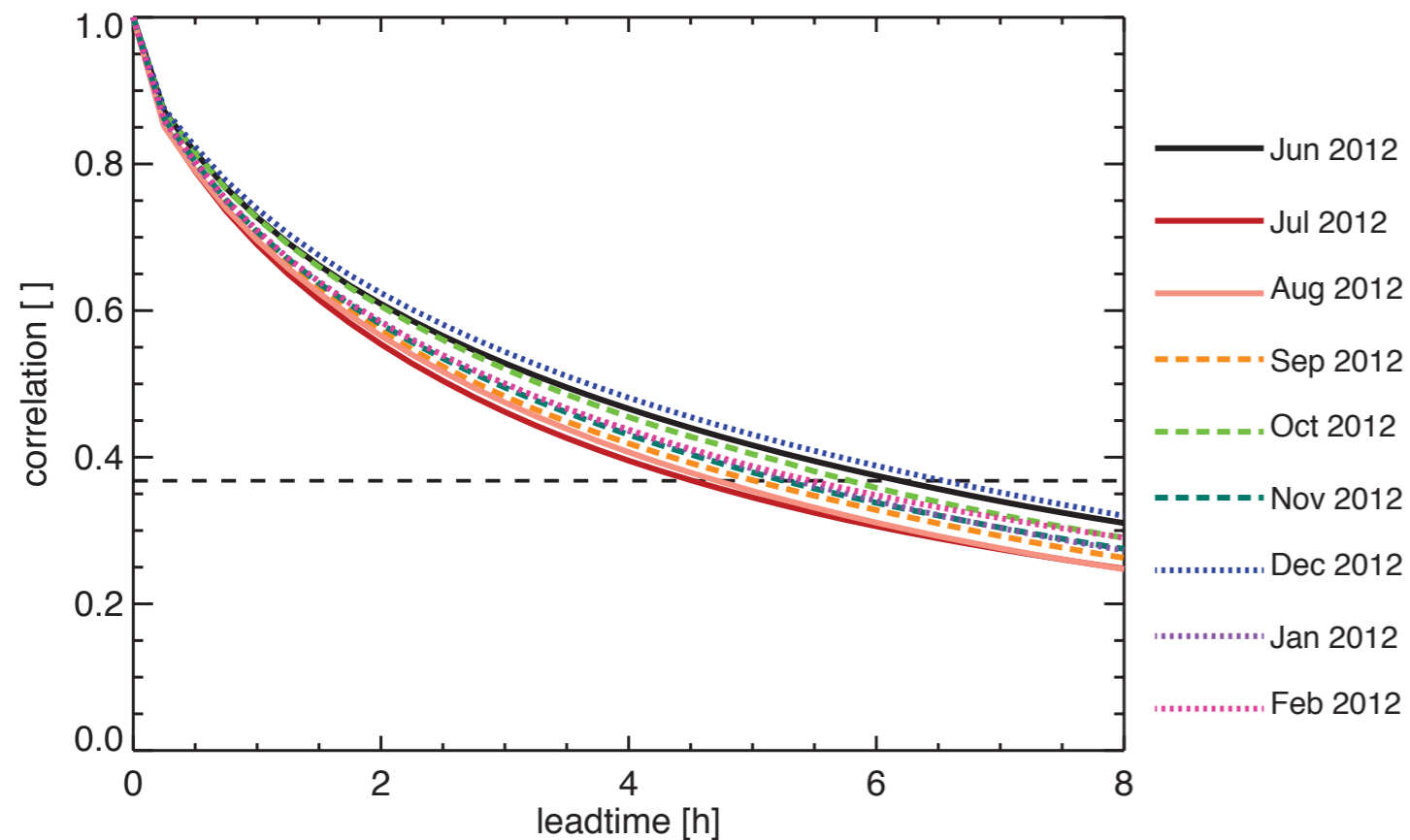
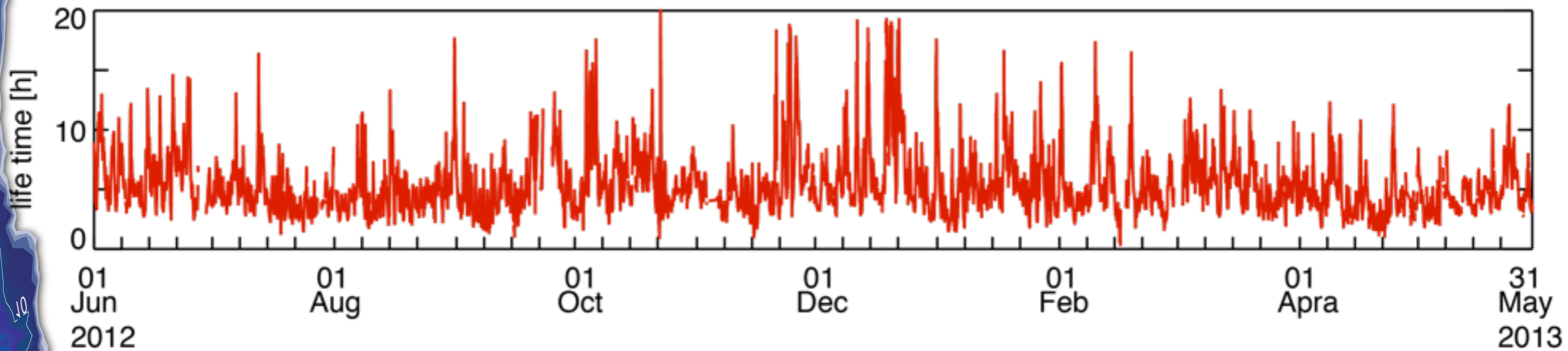
Long-term evaluation

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



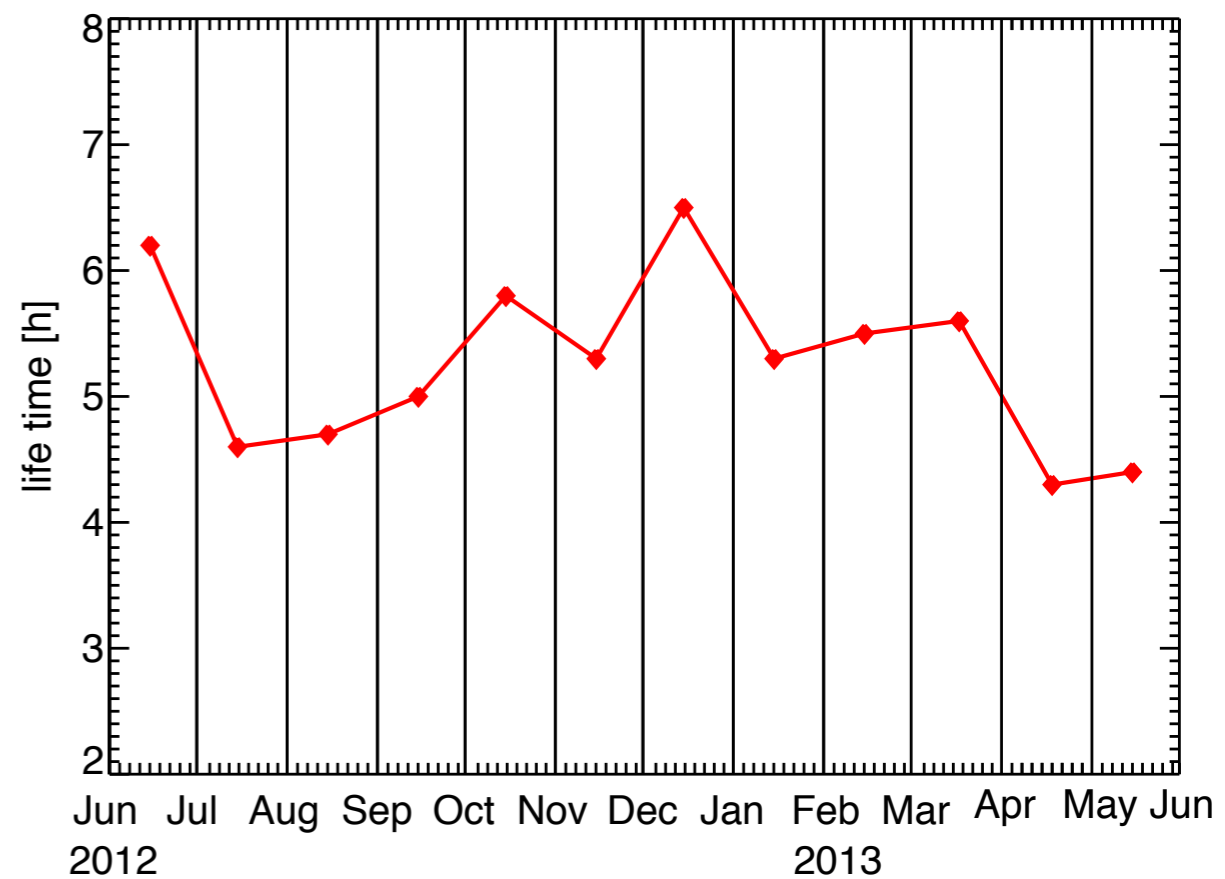
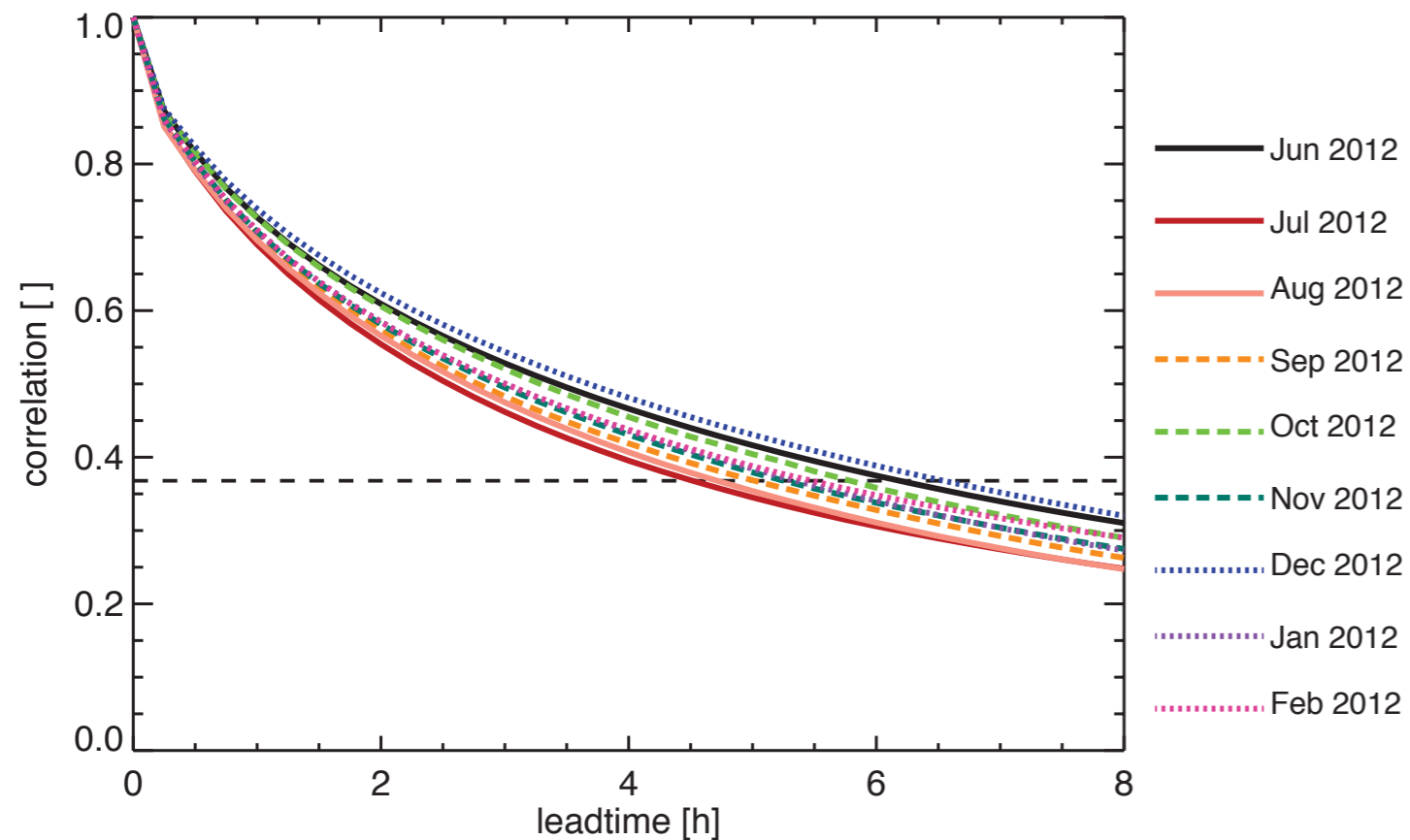
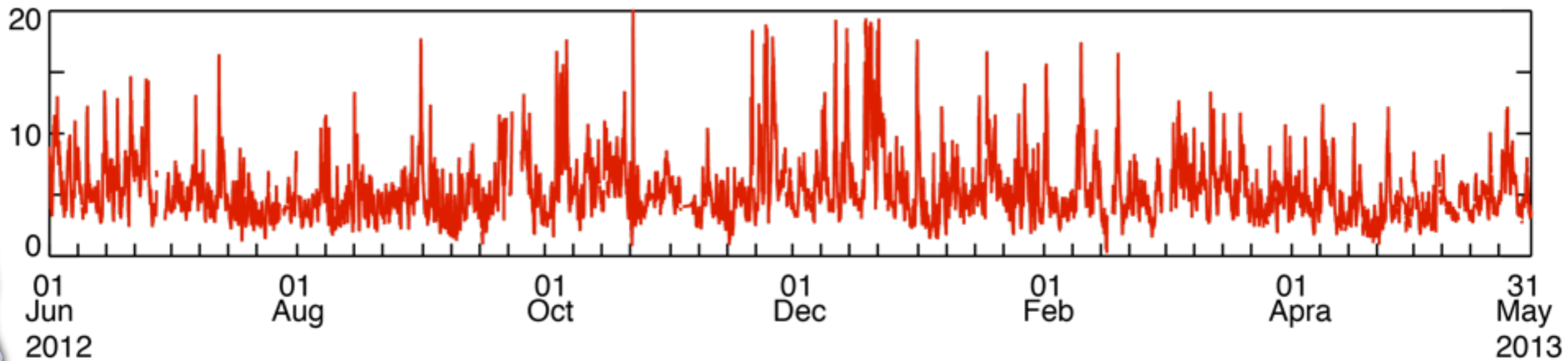
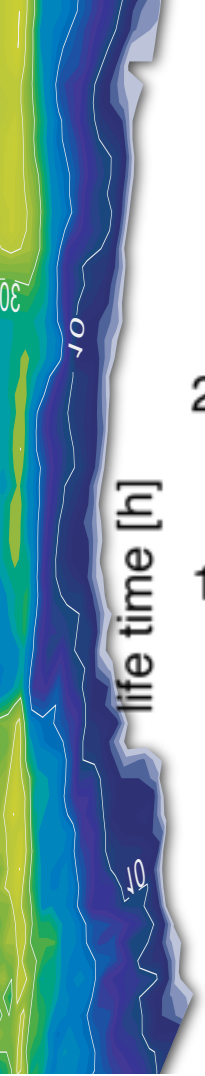
Long-term evaluation

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



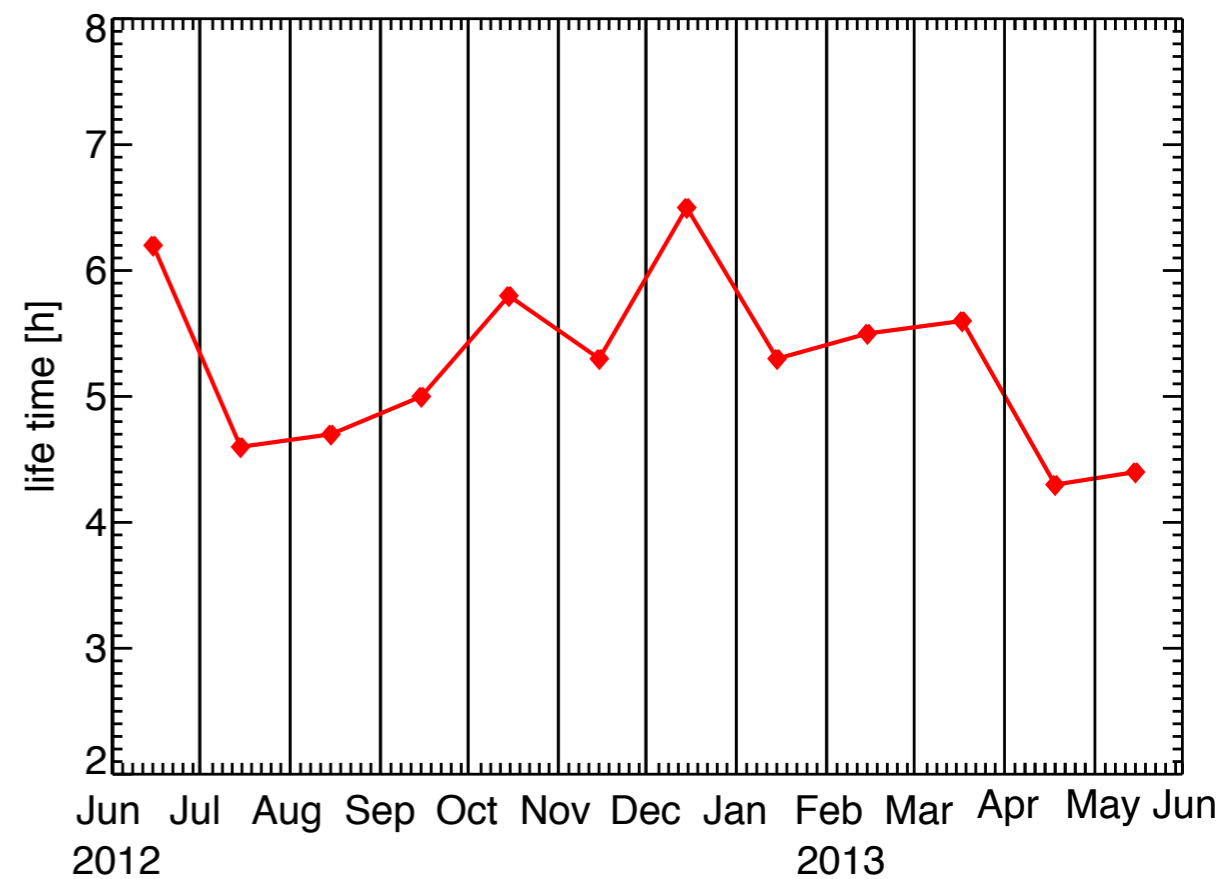
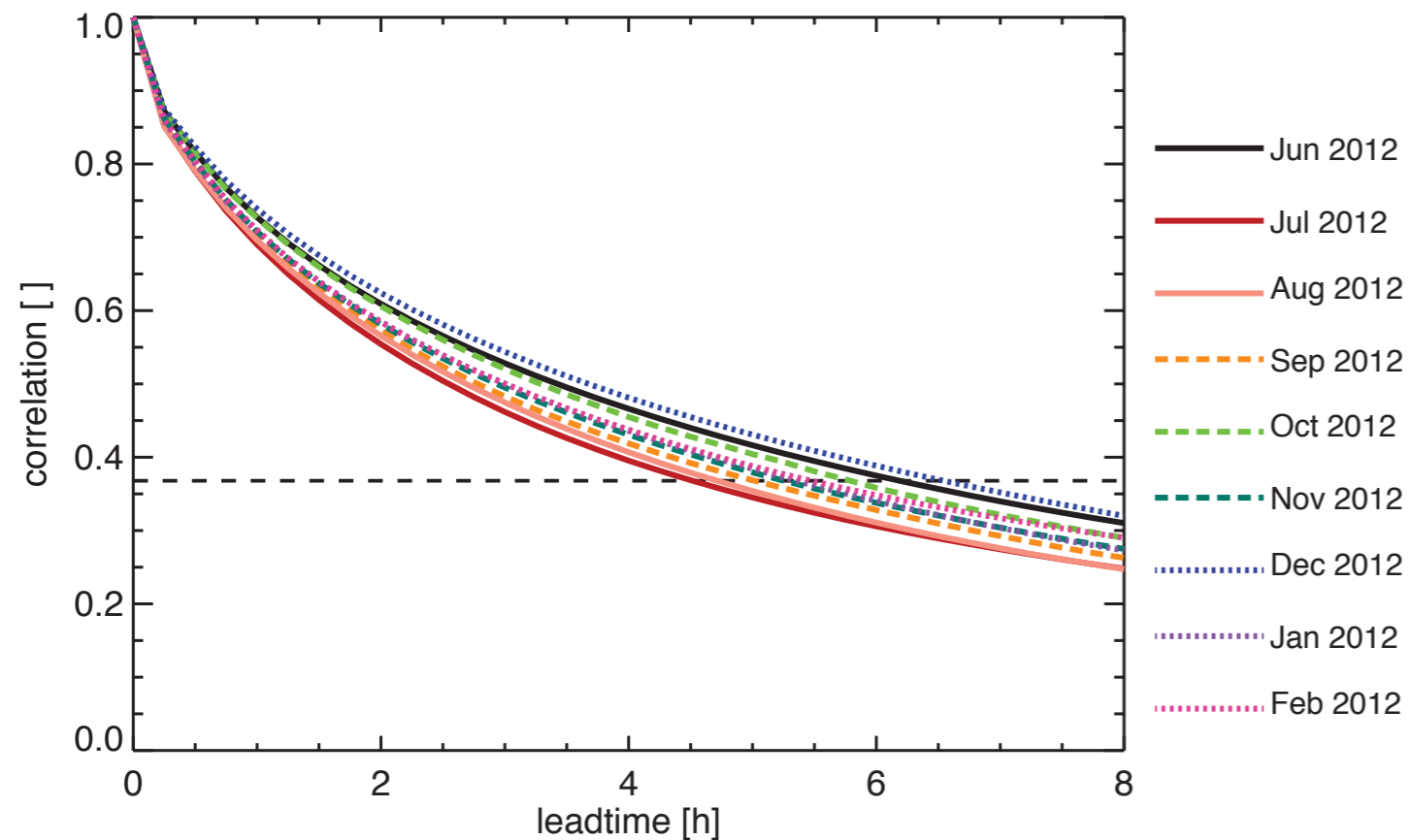
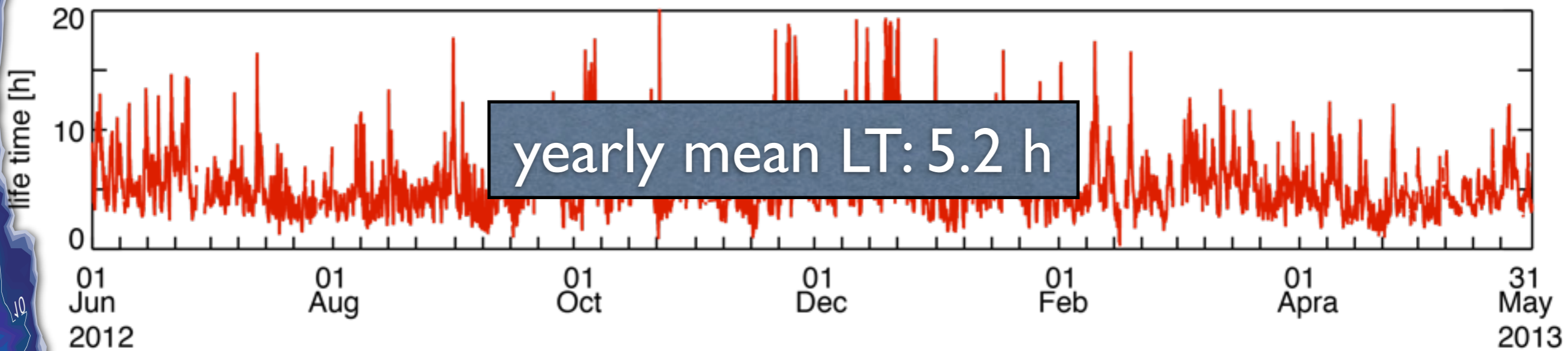
Long-term evaluation

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

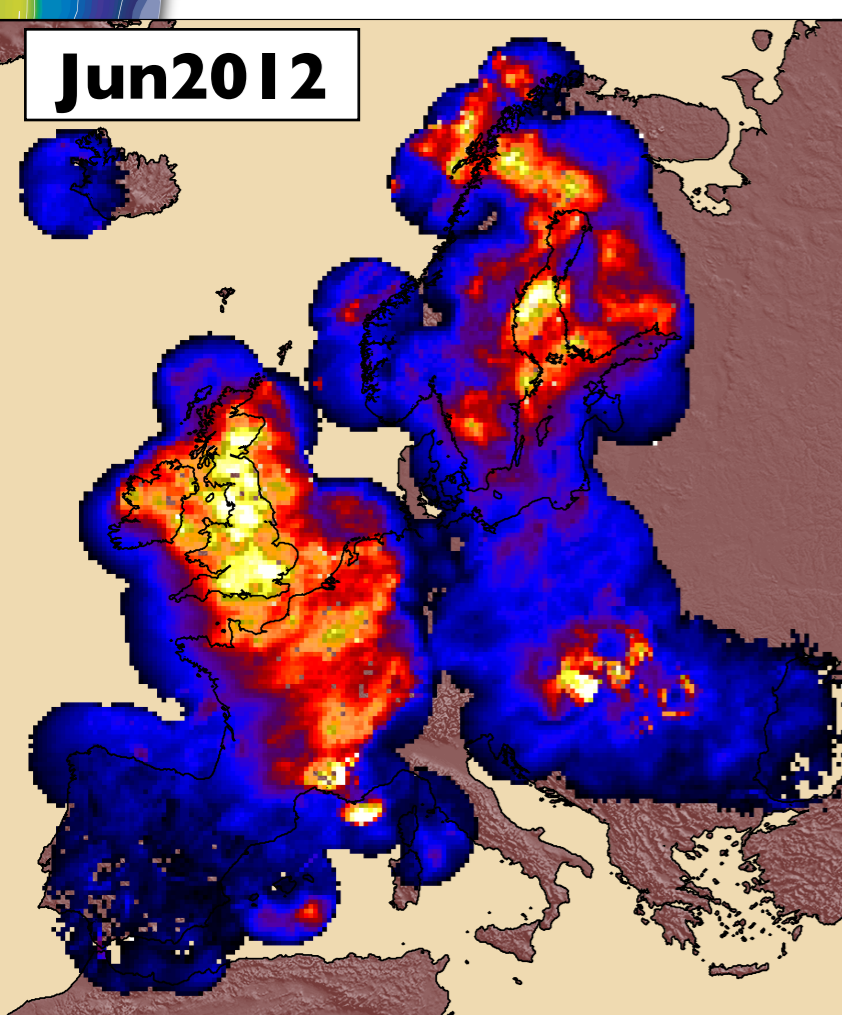


Long-term evaluation

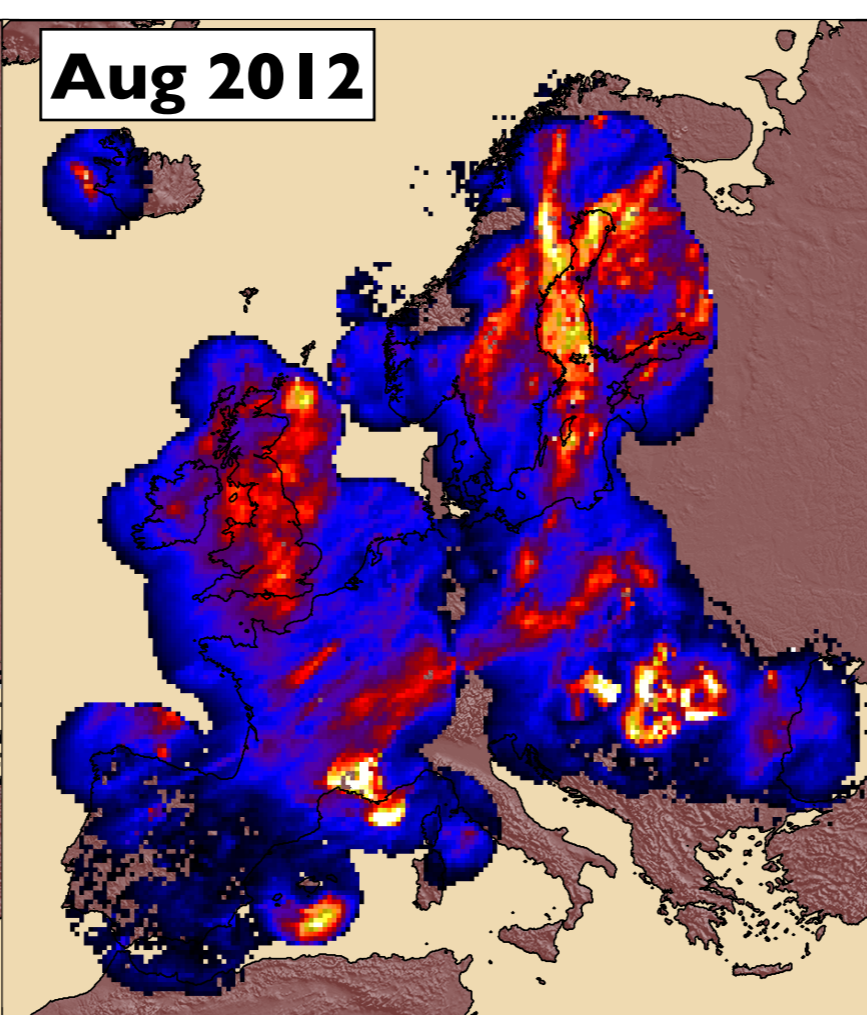
in the period **01 June - 31 May 2013**



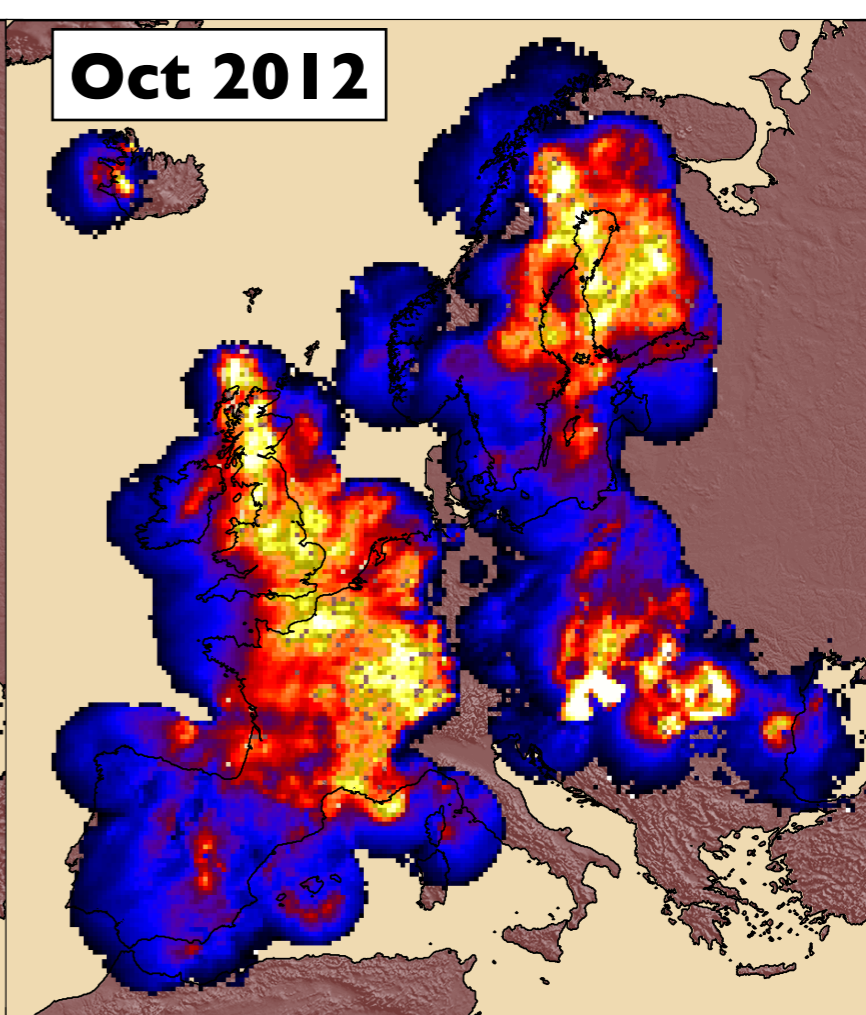
Jun2012



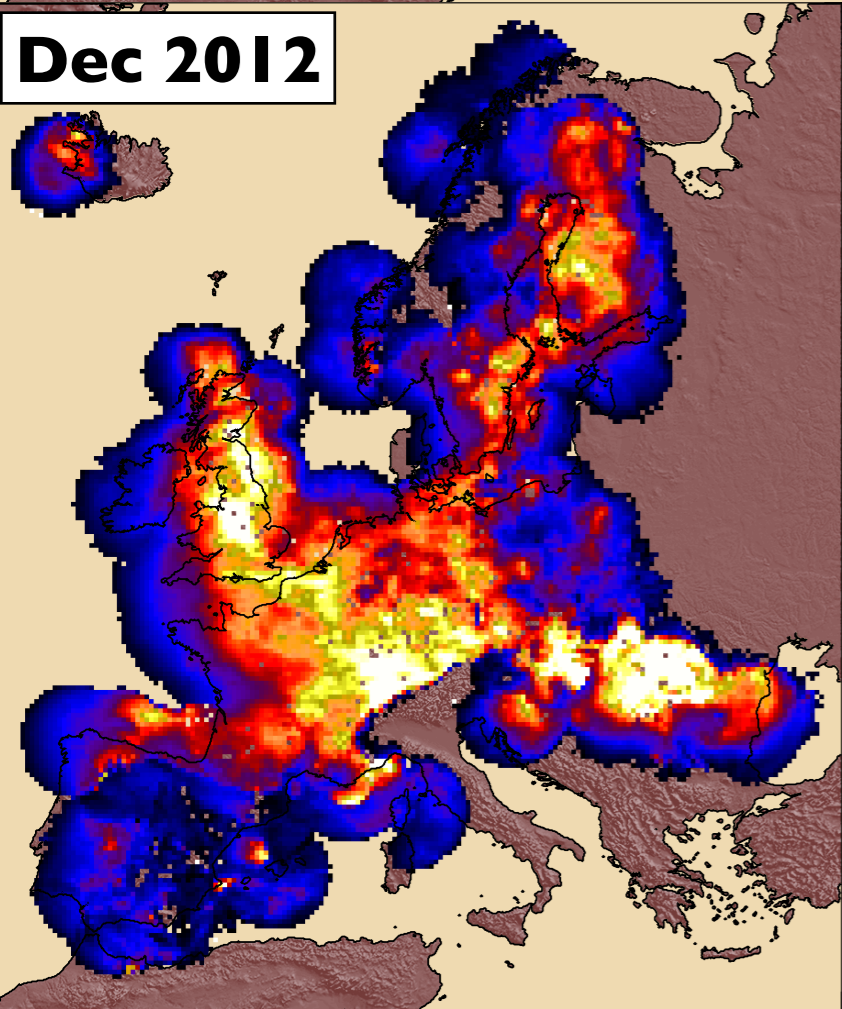
Aug 2012



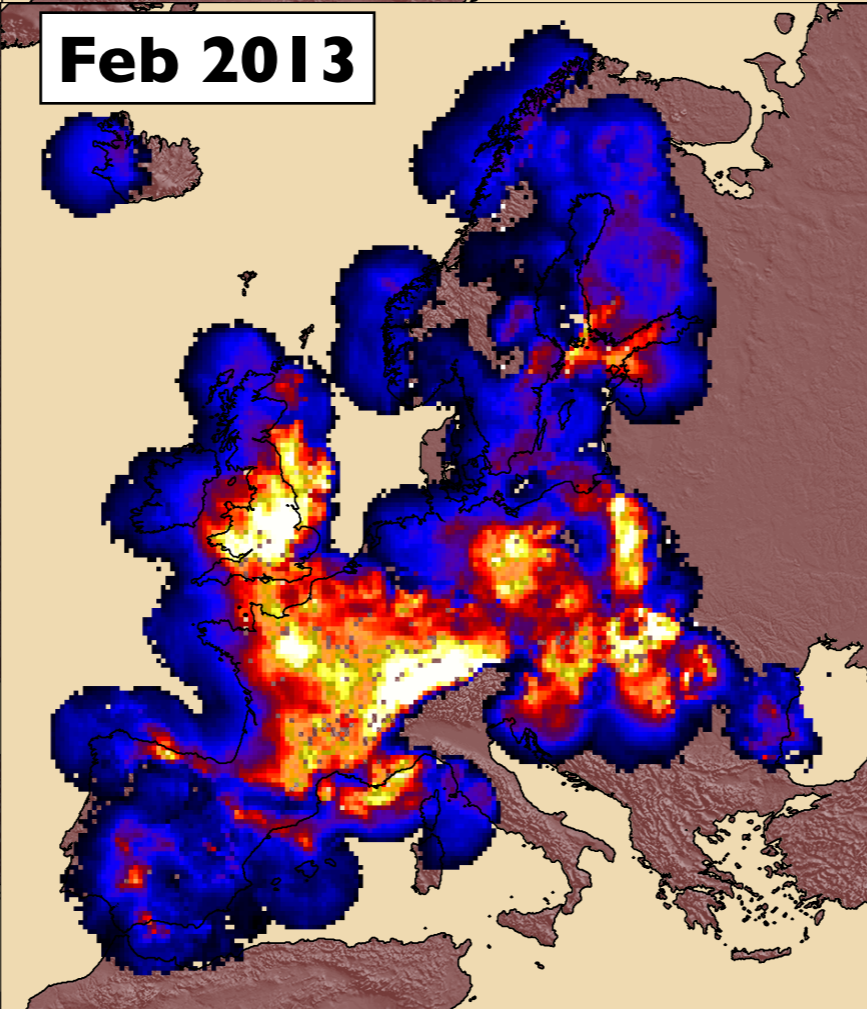
Oct 2012



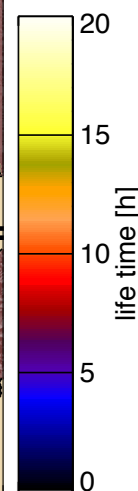
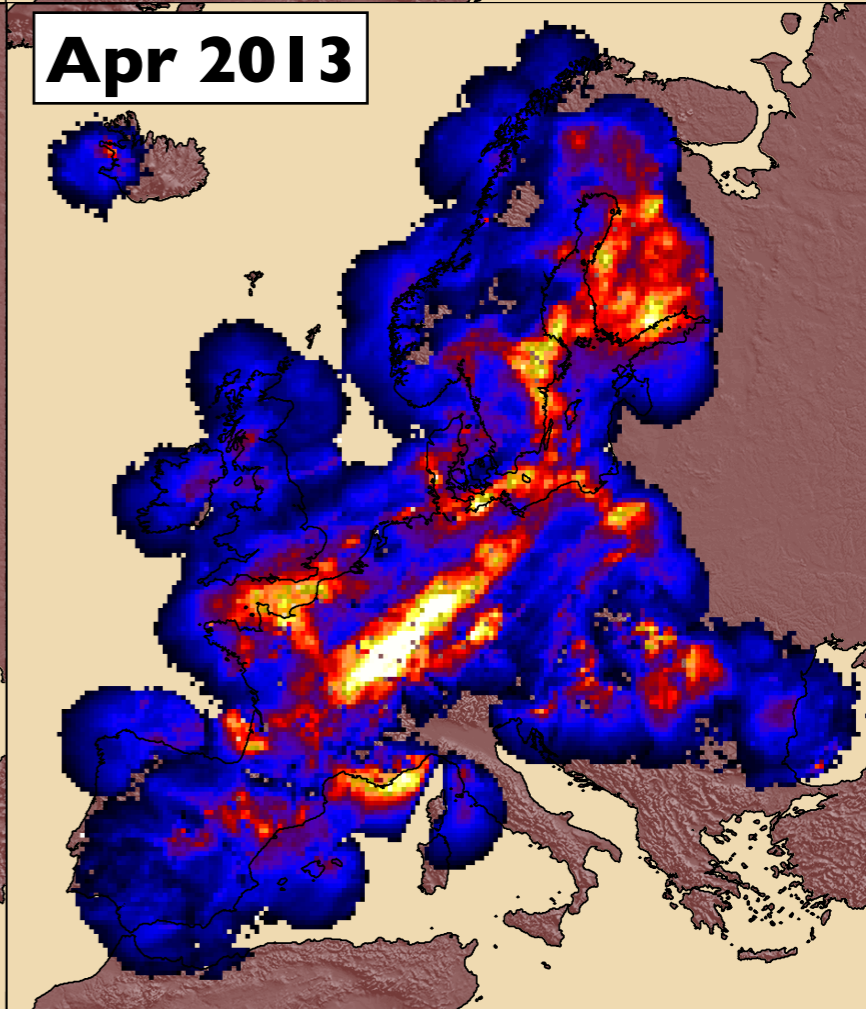
Dec 2012



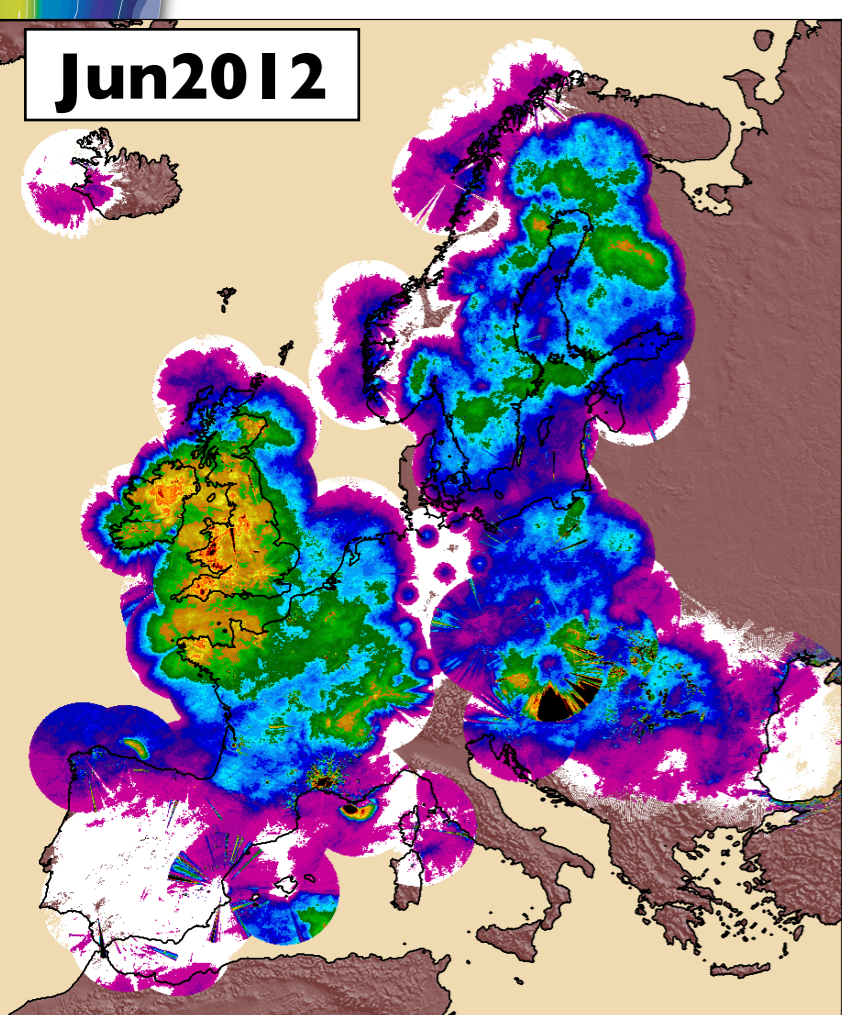
Feb 2013



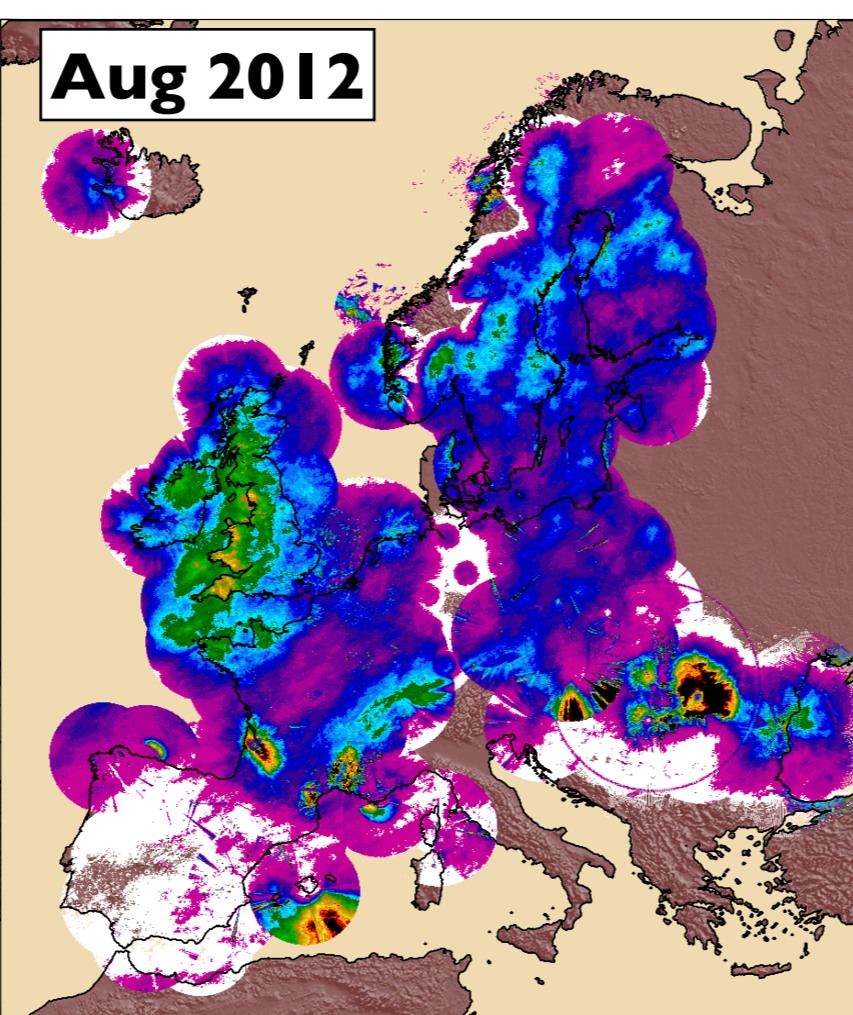
Apr 2013



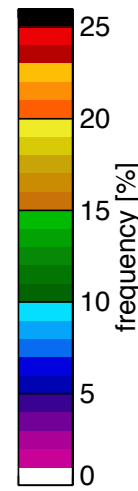
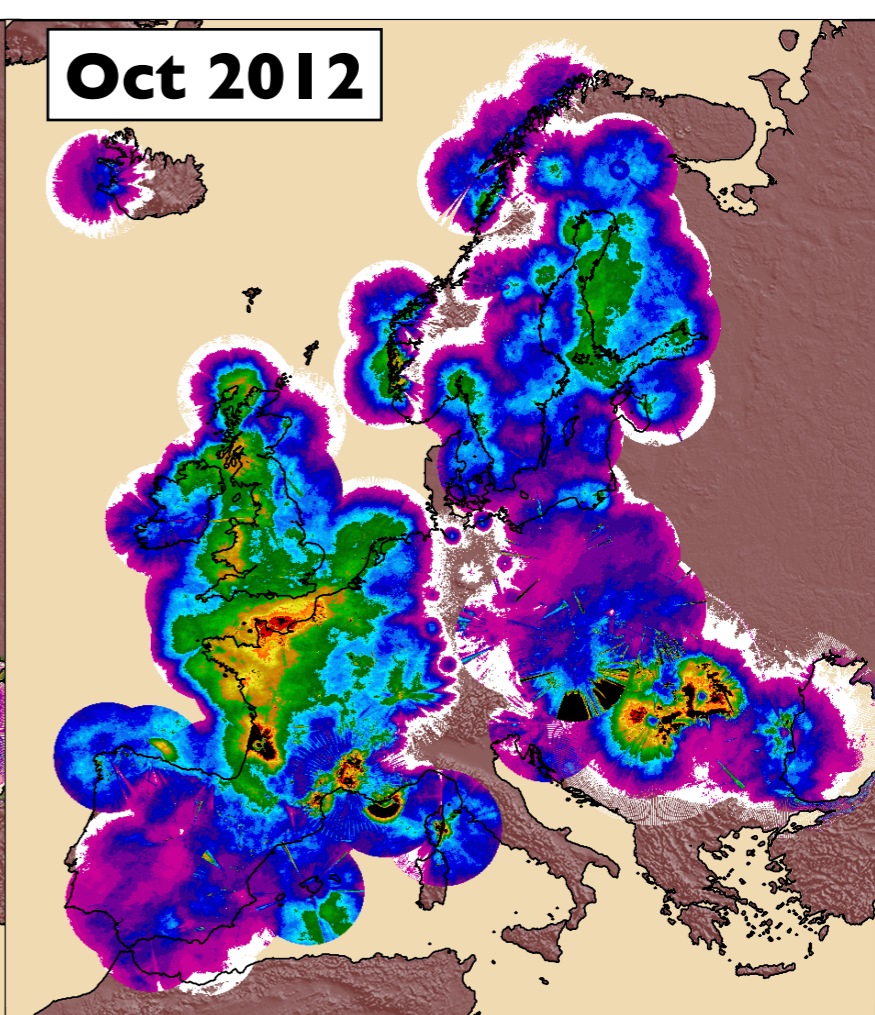
Jun 2012



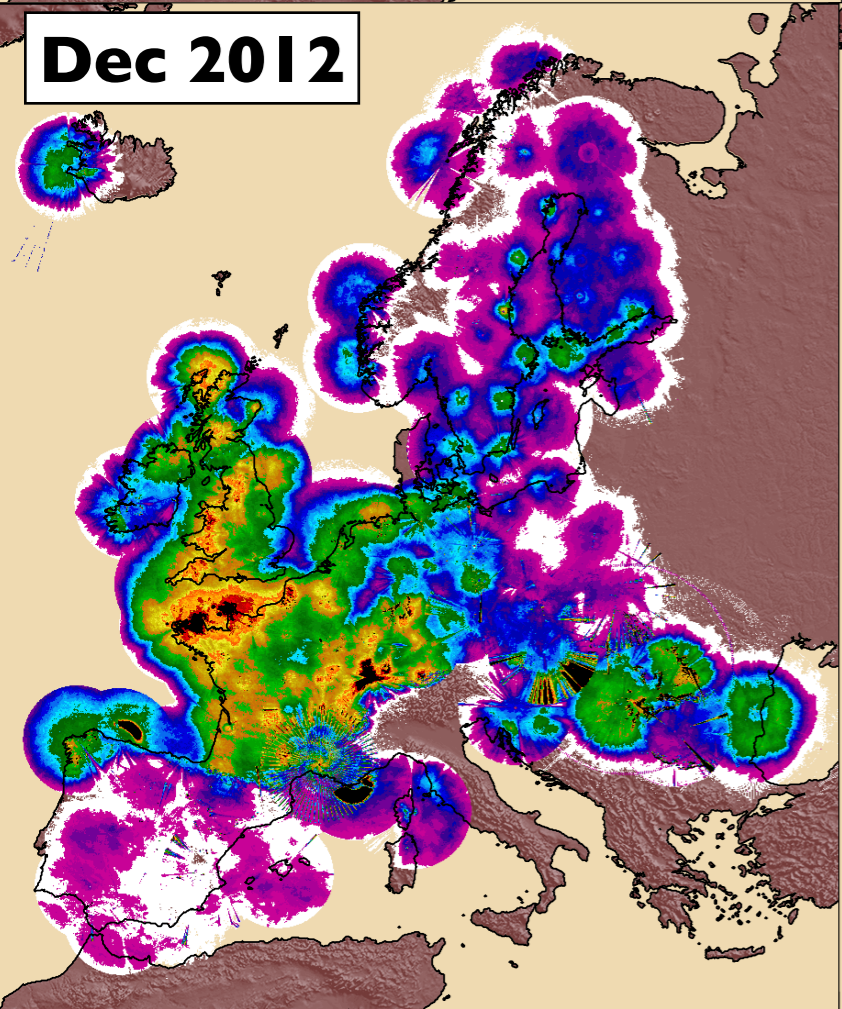
Aug 2012



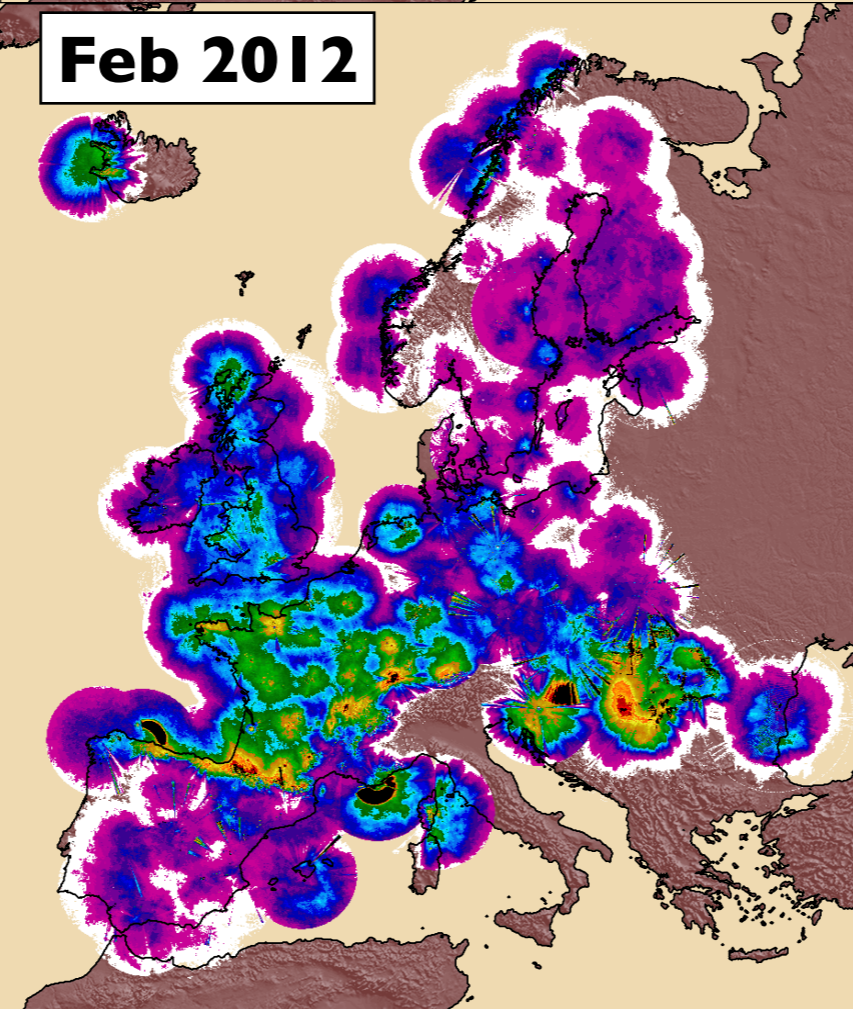
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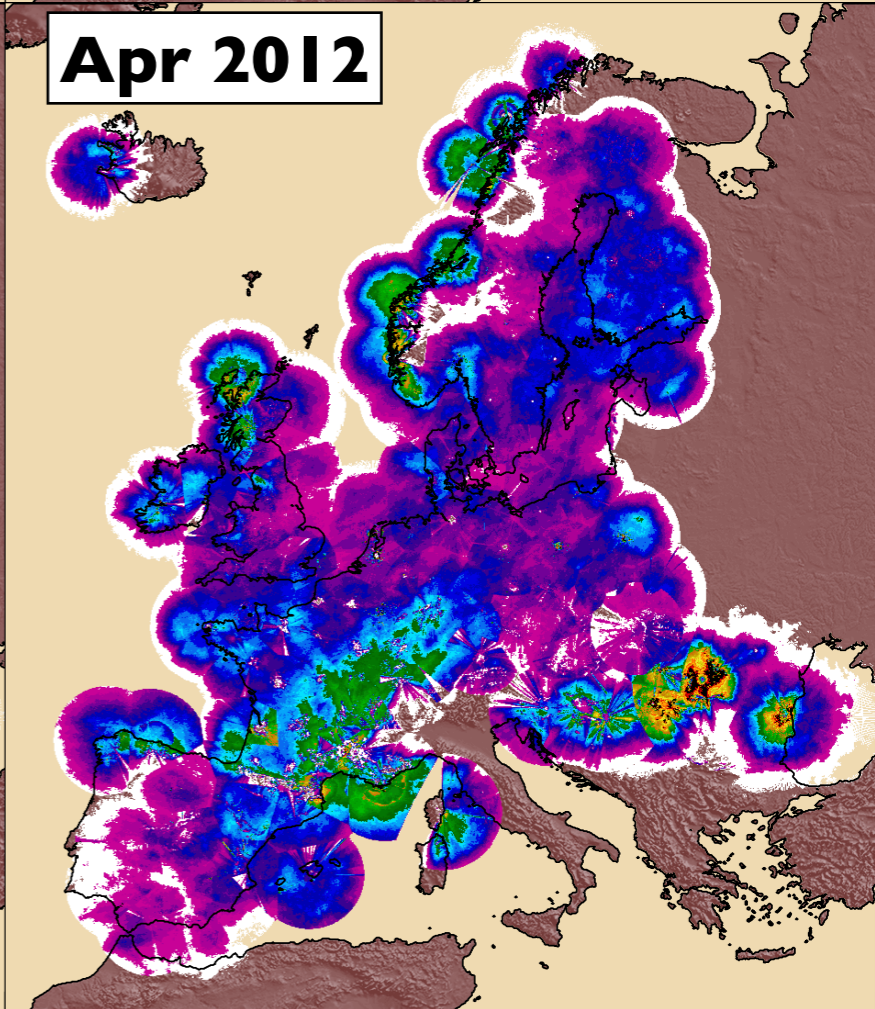
Dec 2012



Feb 2012



Apr 2012





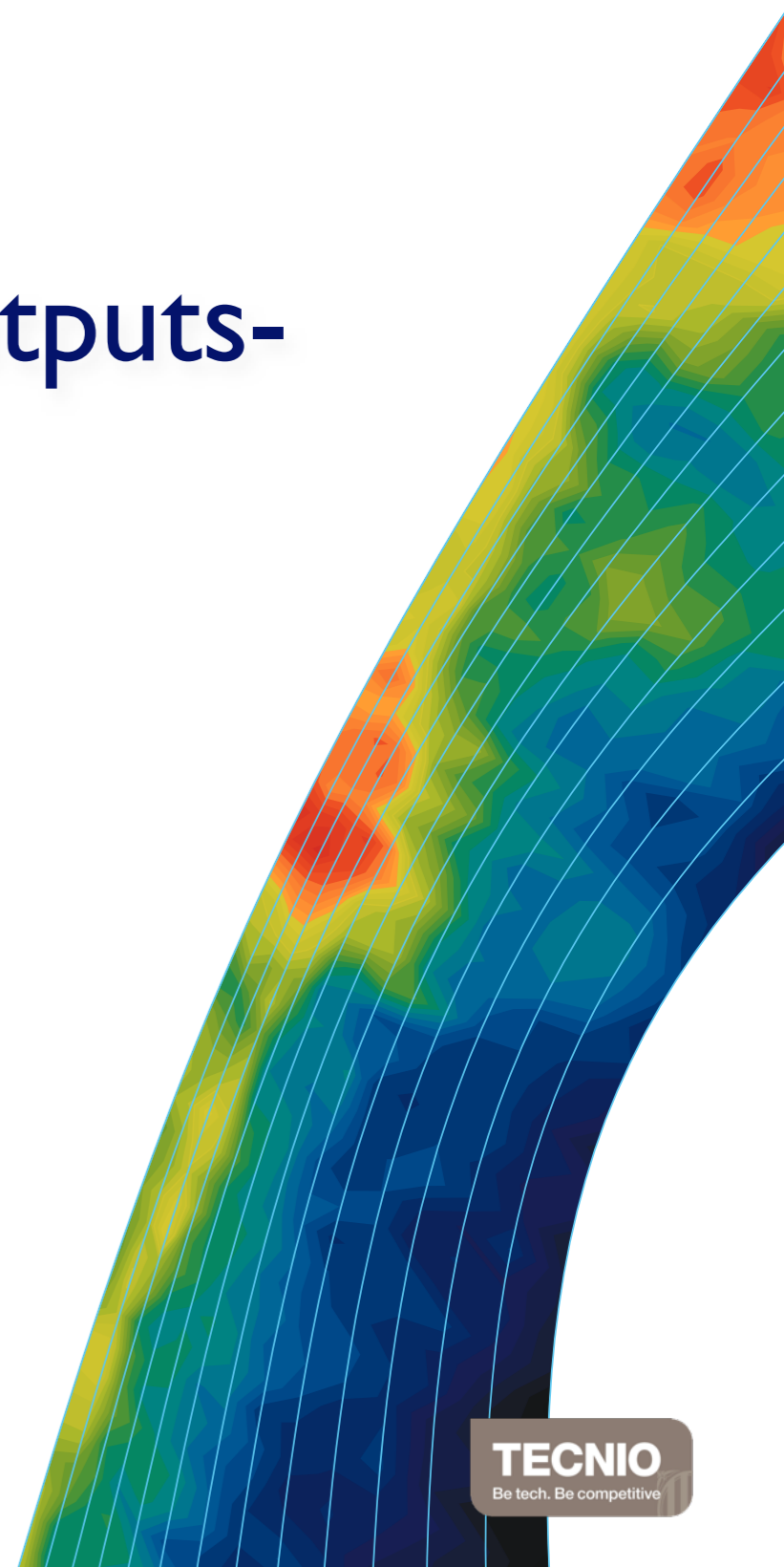
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Is it useful?

-comparison with NWP outputs-



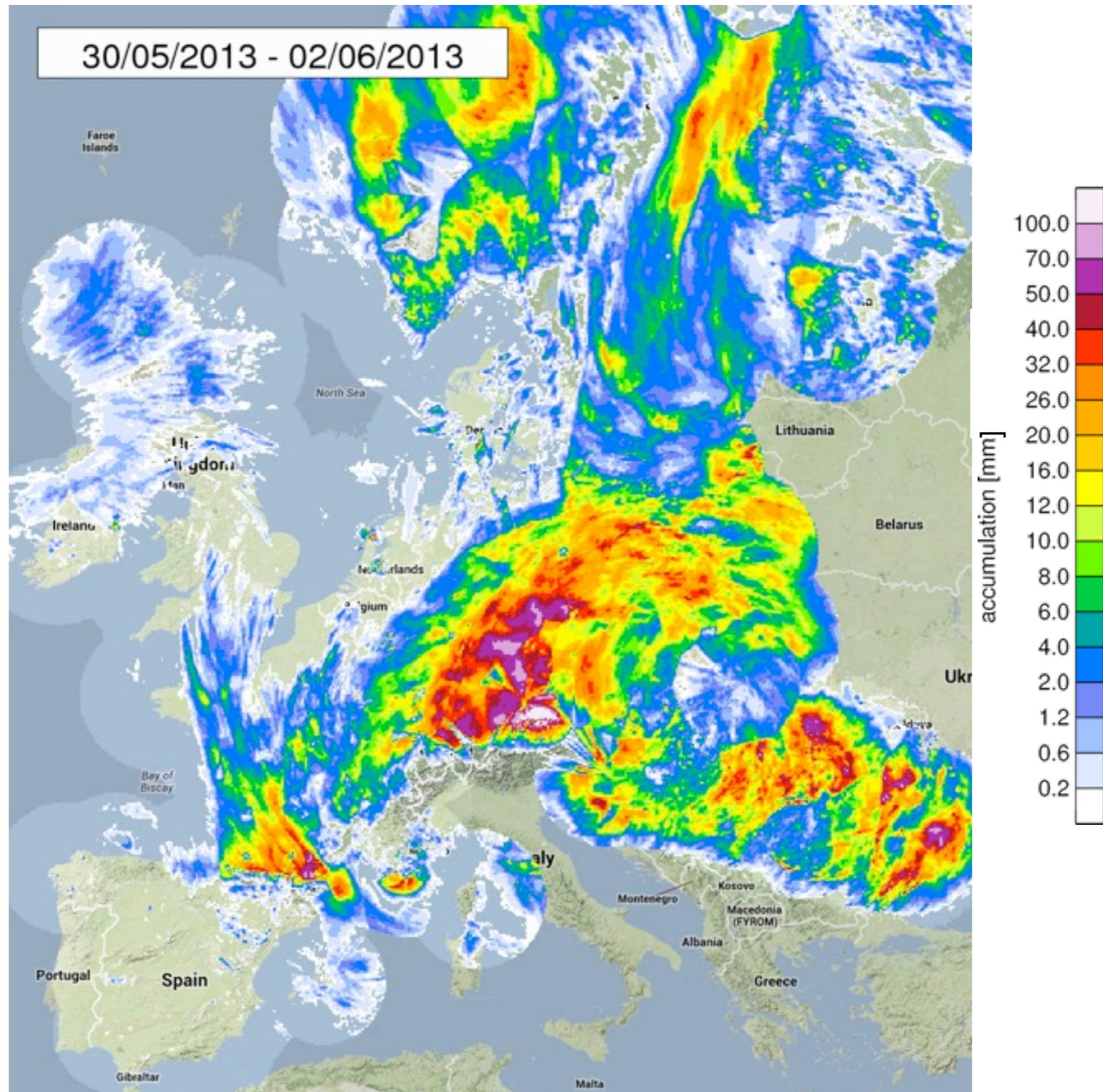
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Nowcasting vs NWP

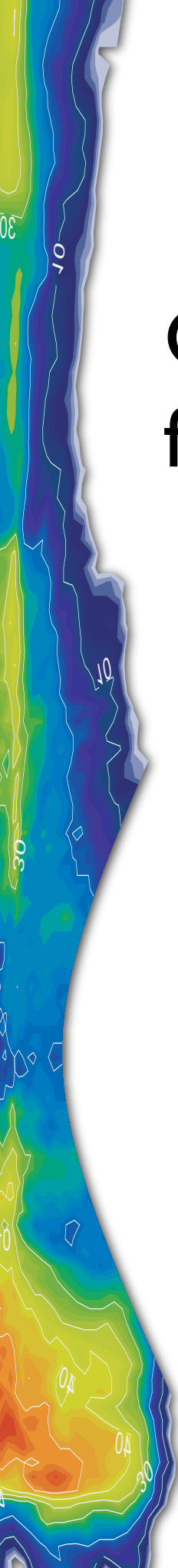
01 June 2013 - 48 hour evaluation



Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

Comparison between rainfall forecasts and observations



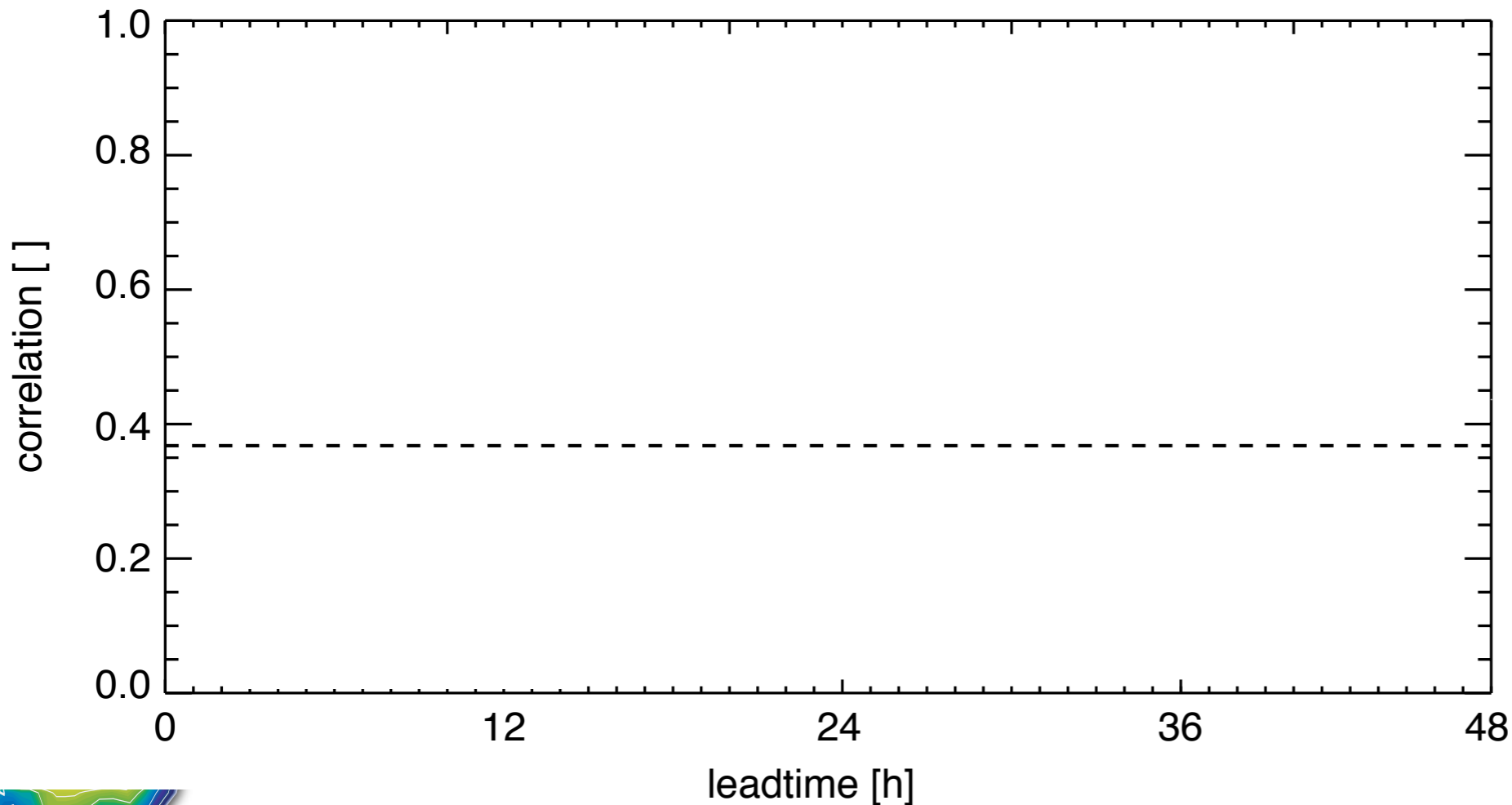
Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

Comparison between rainfall forecasts and observations



--- NWP (HIRLAM)



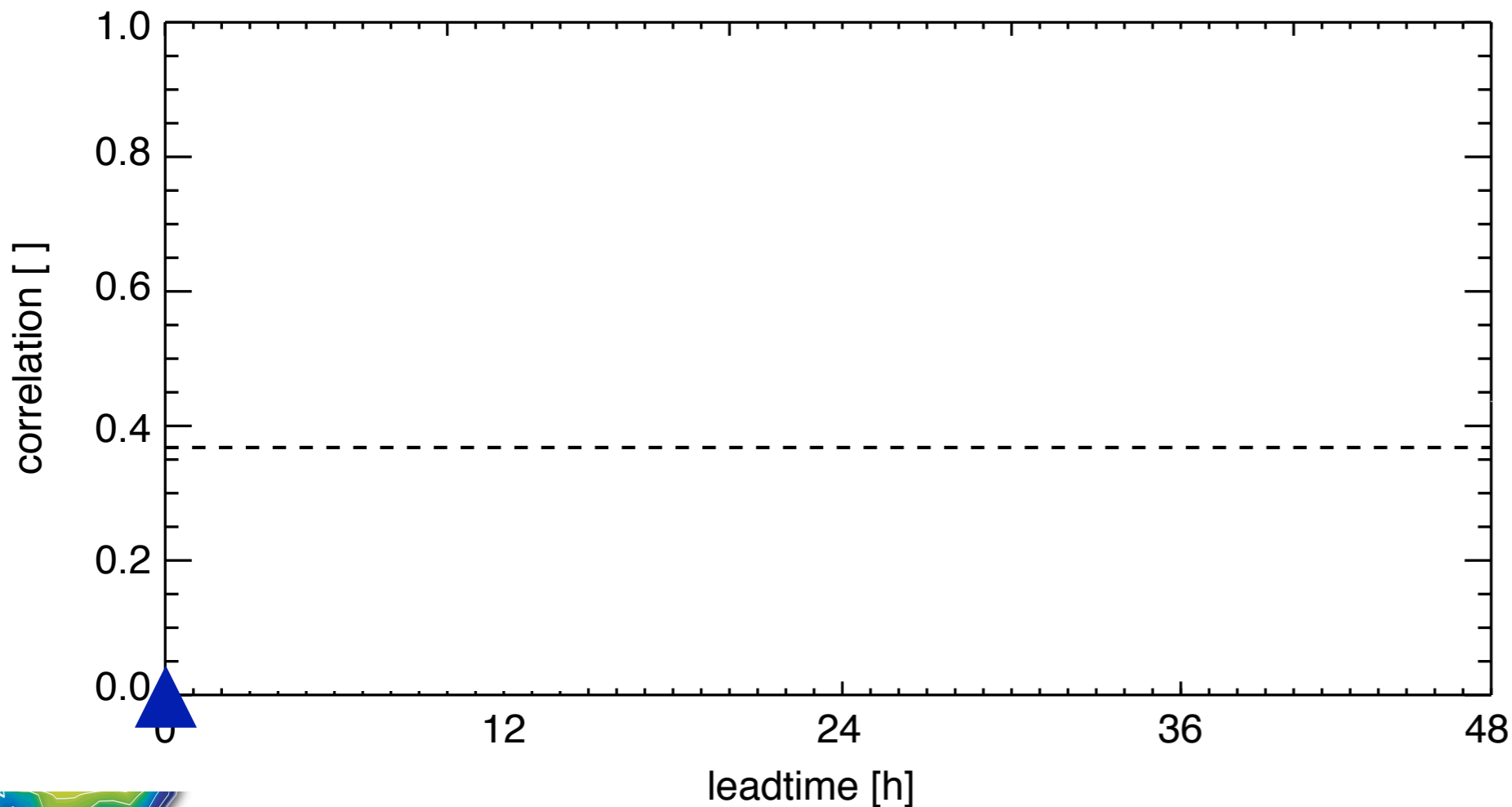
Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

Comparison between rainfall forecasts and observations



--- NWP (HIRLAM)



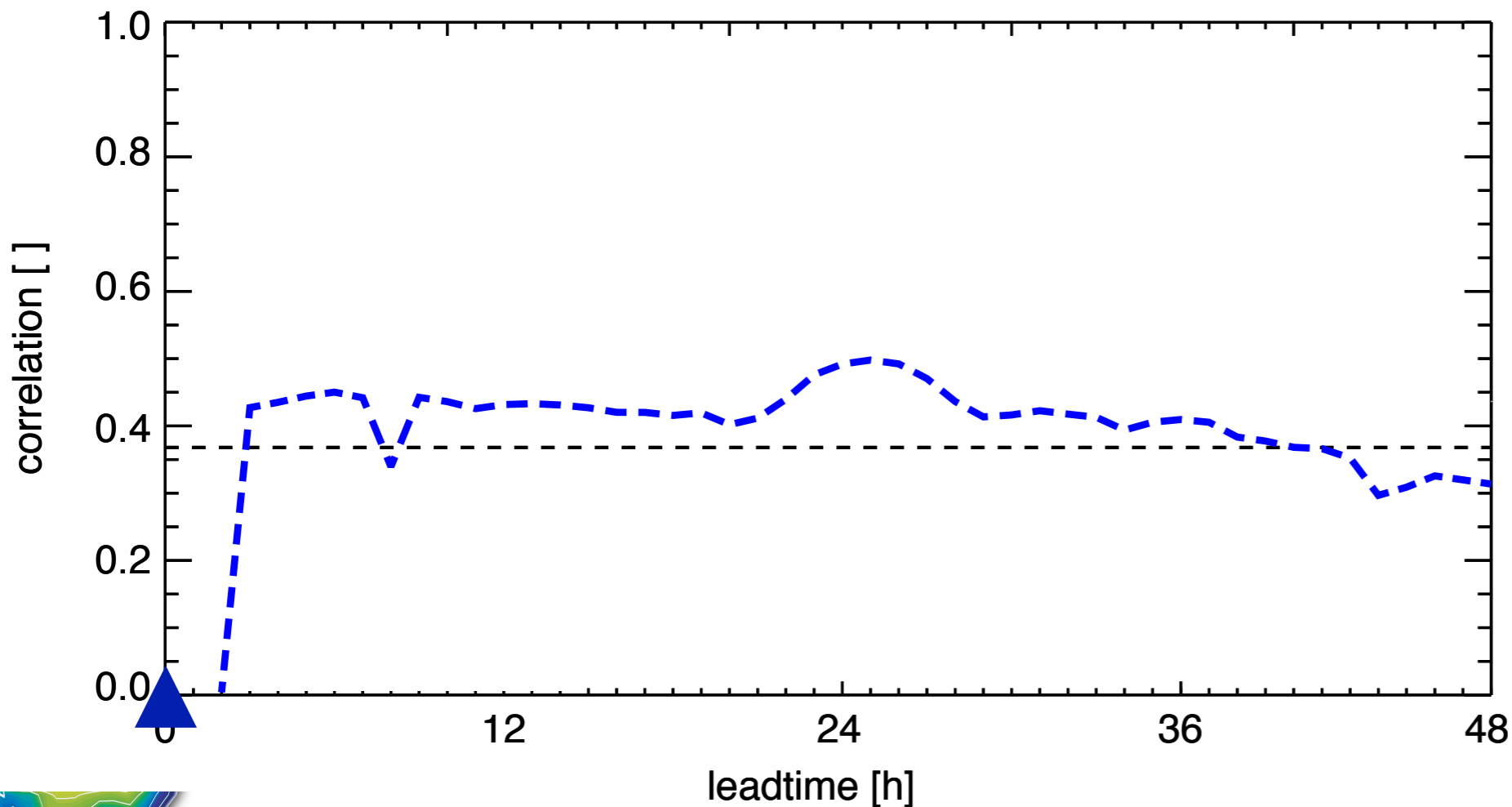
Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

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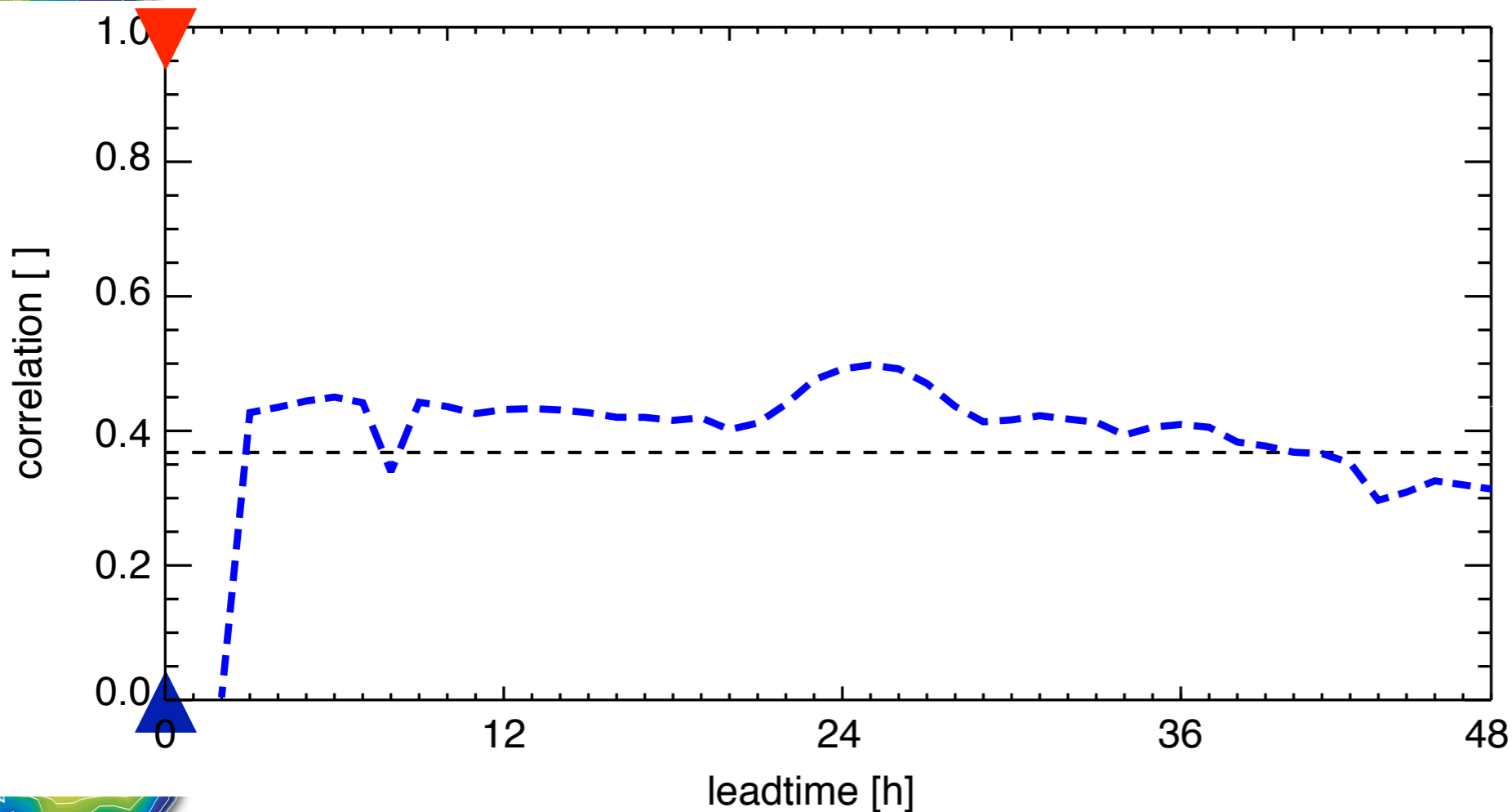
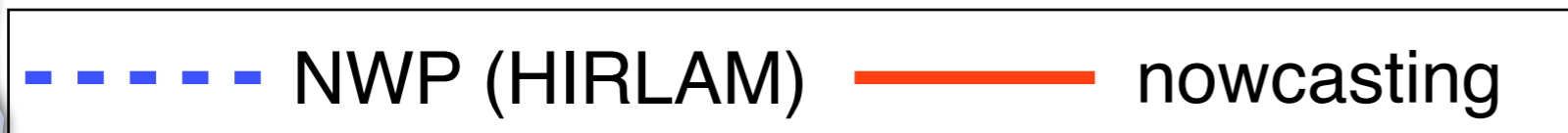
--- NWP (HIRLAM)



Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

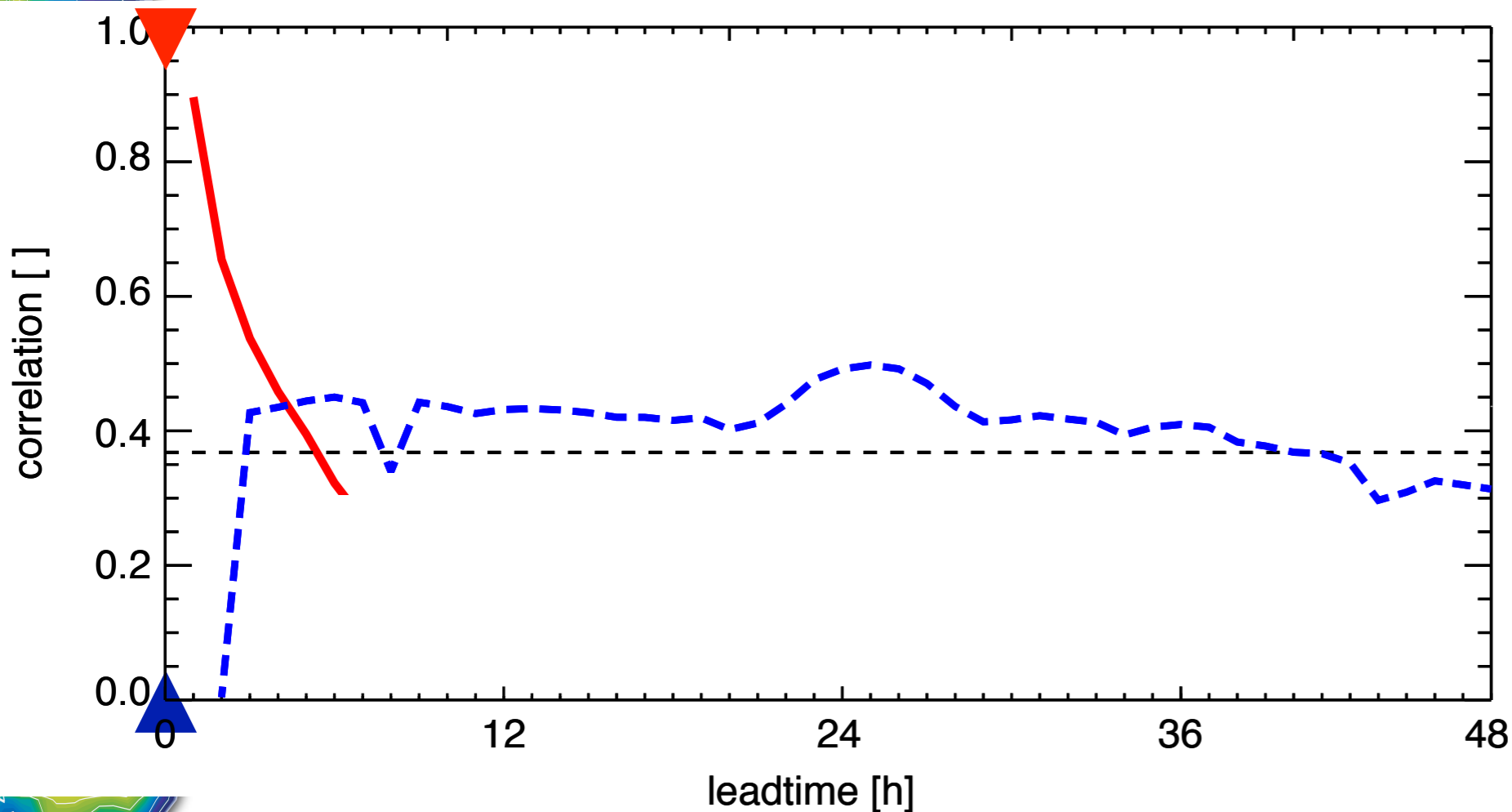
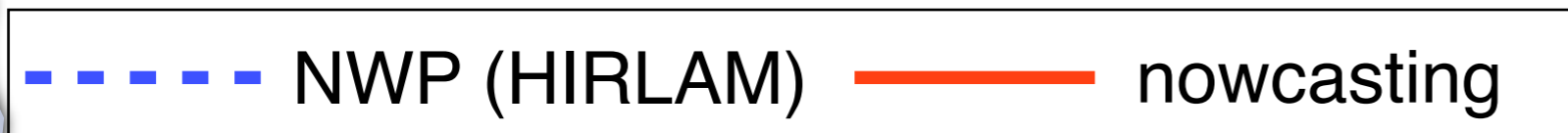
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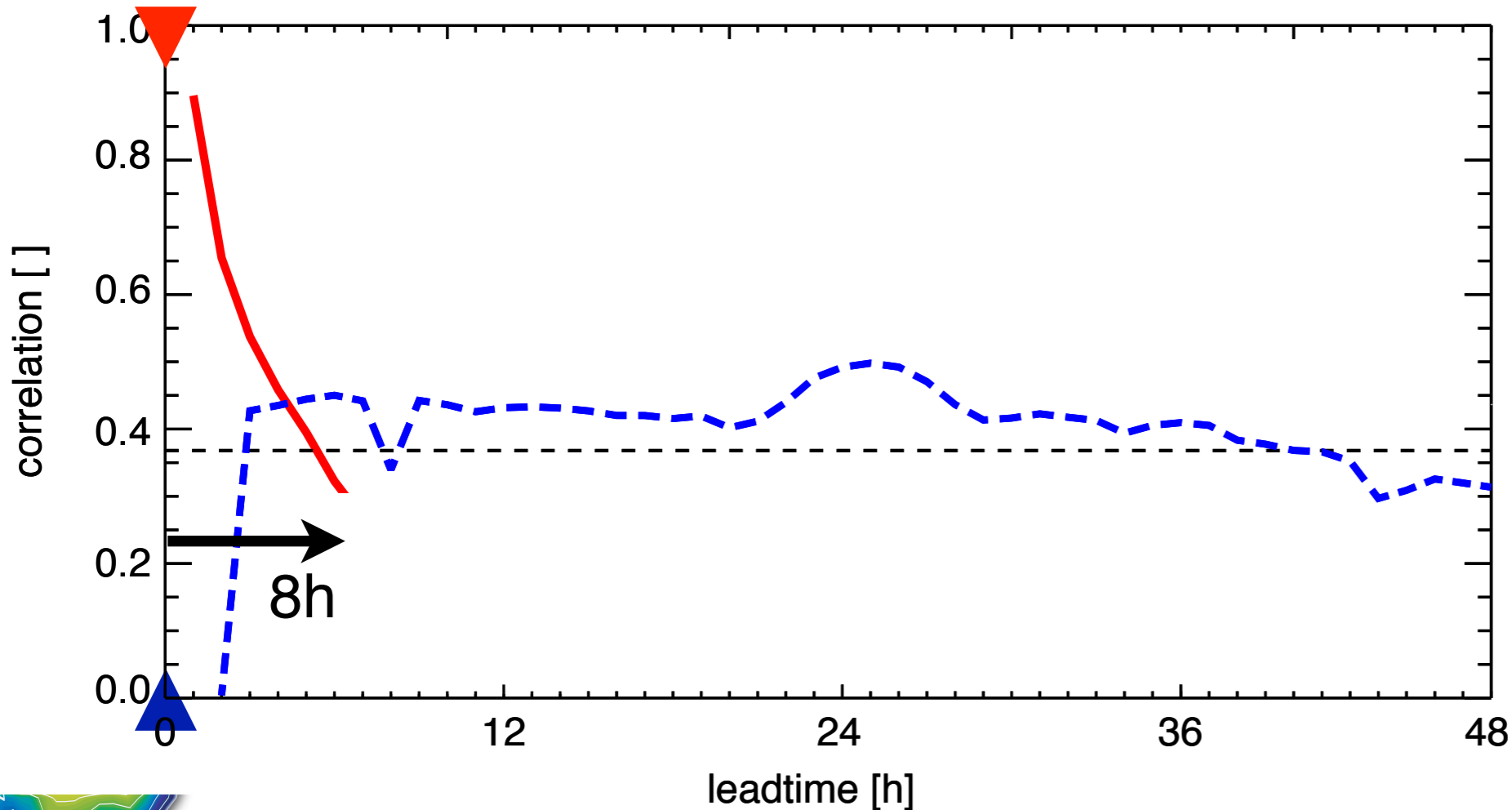
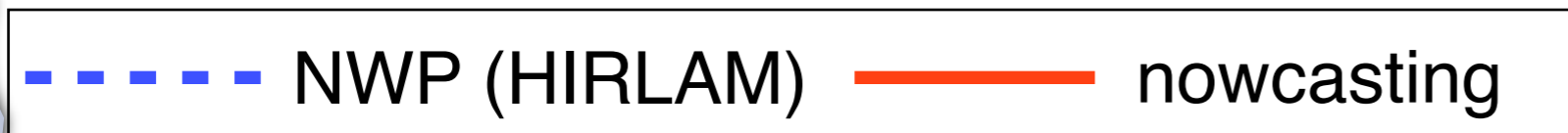
Comparison between rainfall forecasts and observations



Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

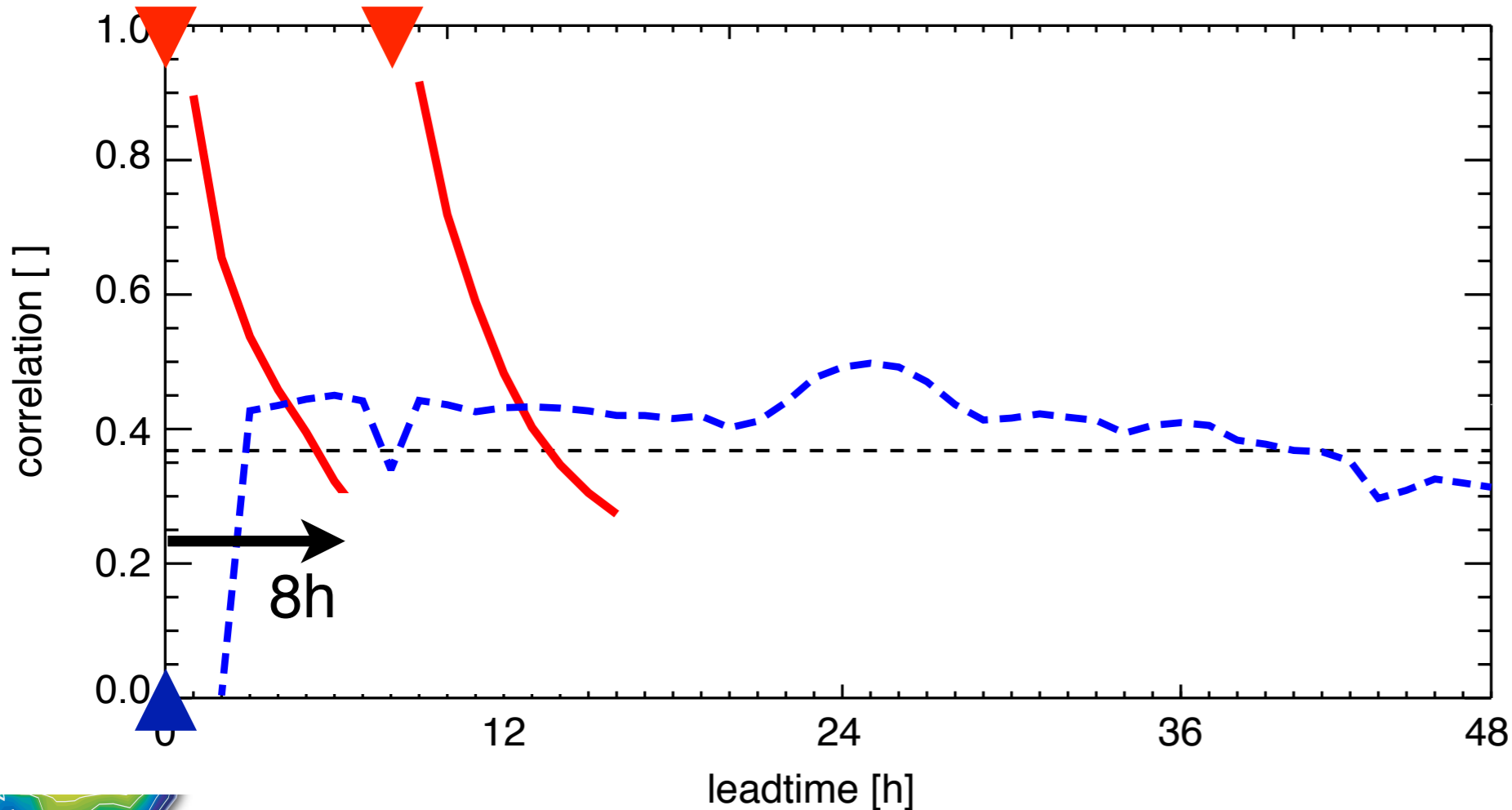
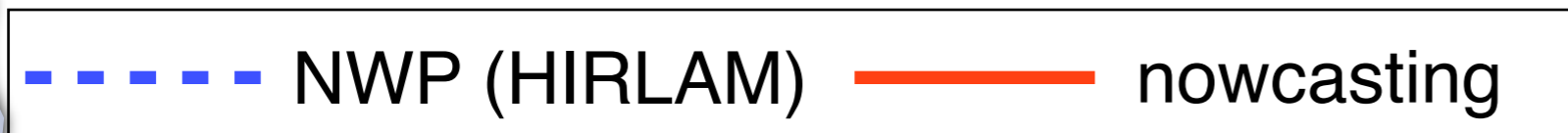
Comparison between rainfall forecasts and observations



Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

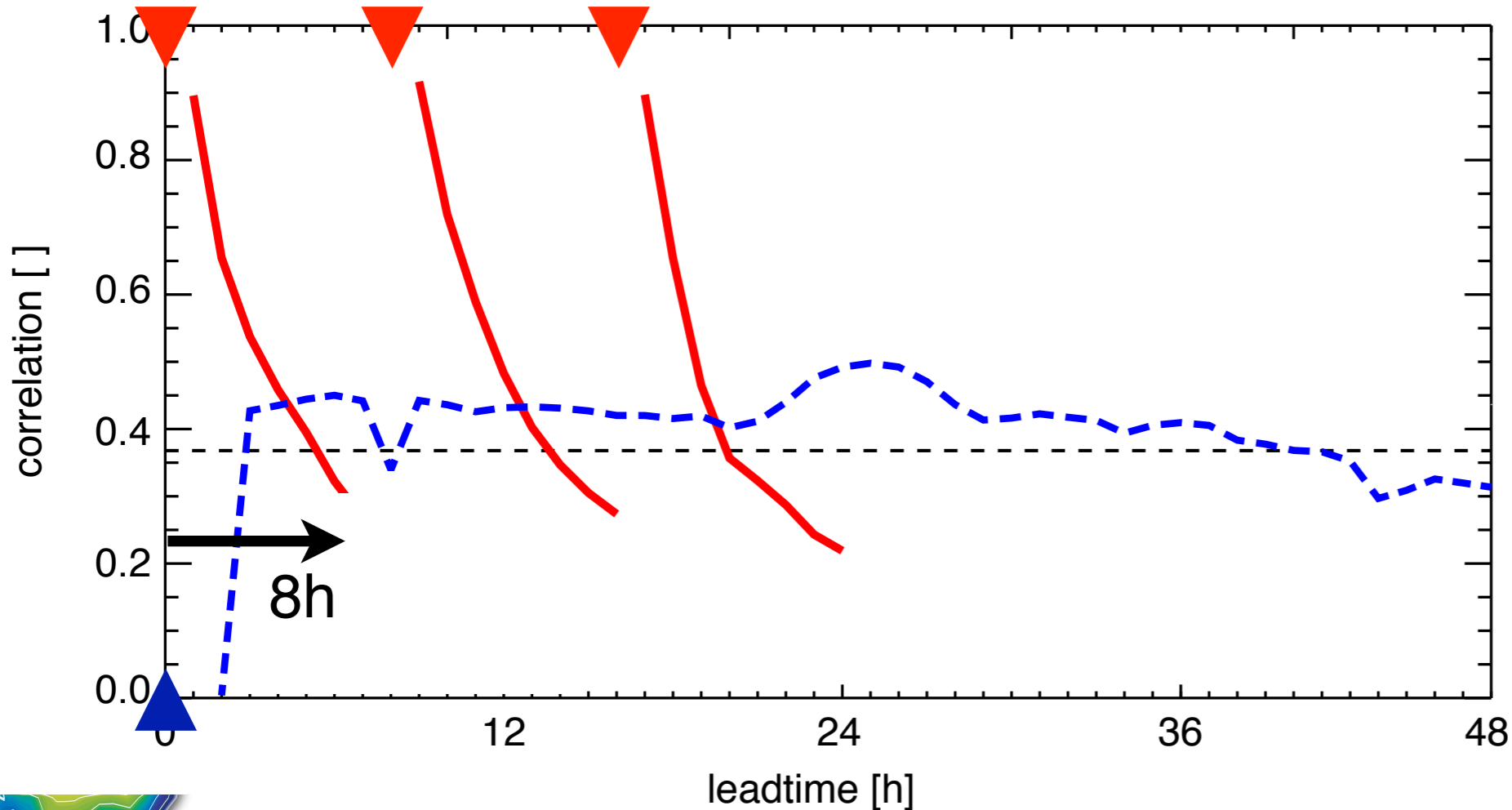
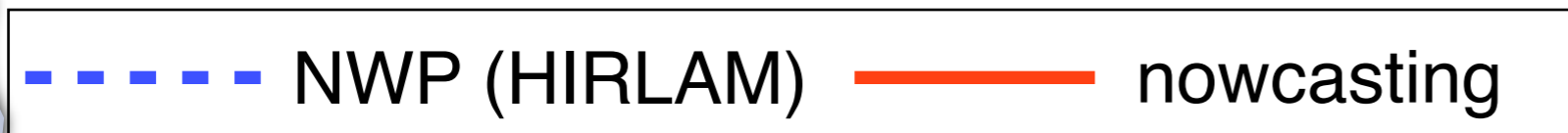
Comparison between rainfall forecasts and observations



Nowcasting vs NWP

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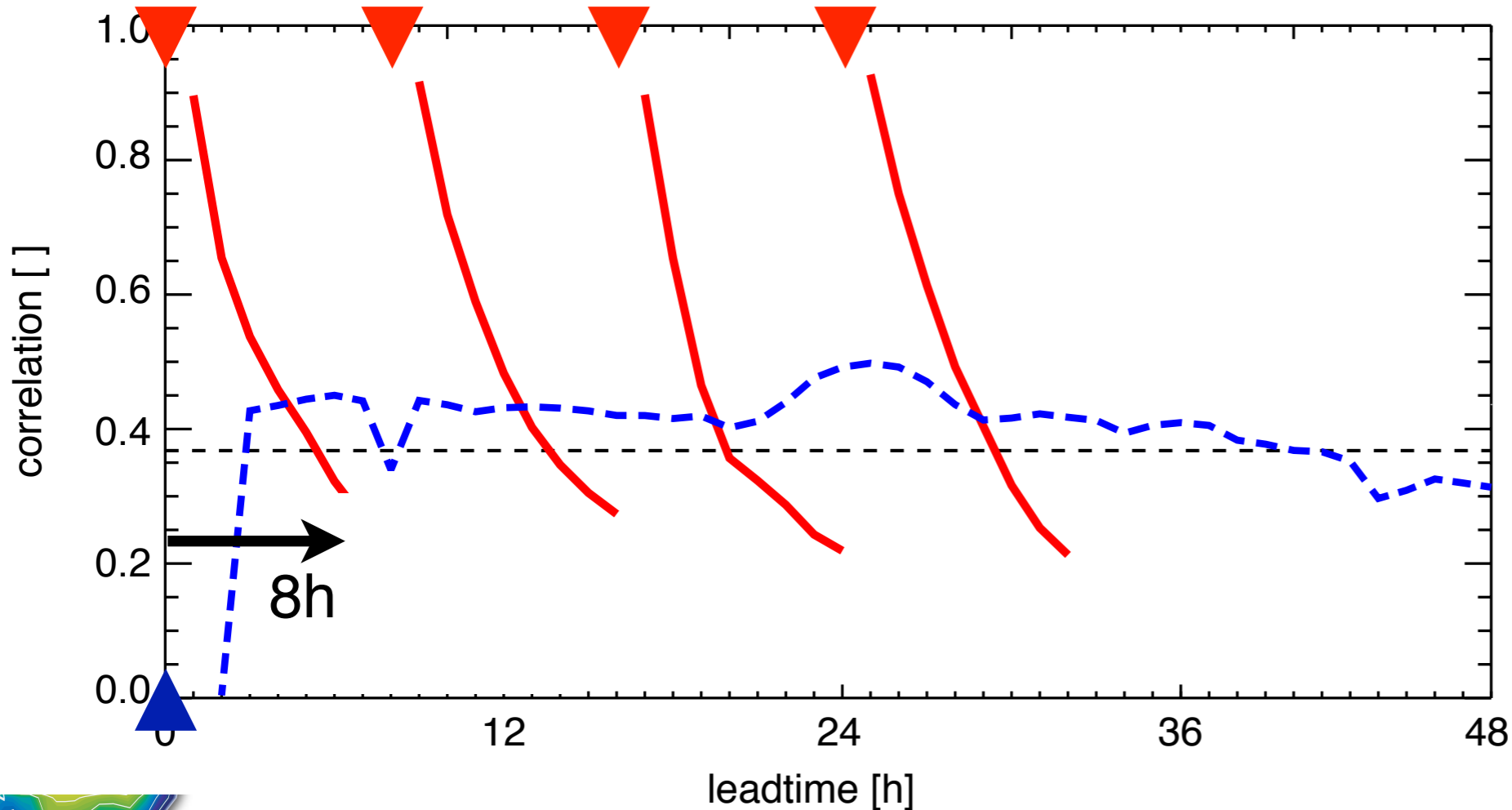
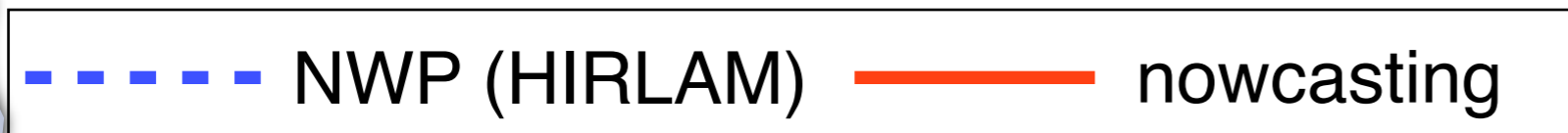
Comparison between rainfall forecasts and observations



Nowcasting vs NWP

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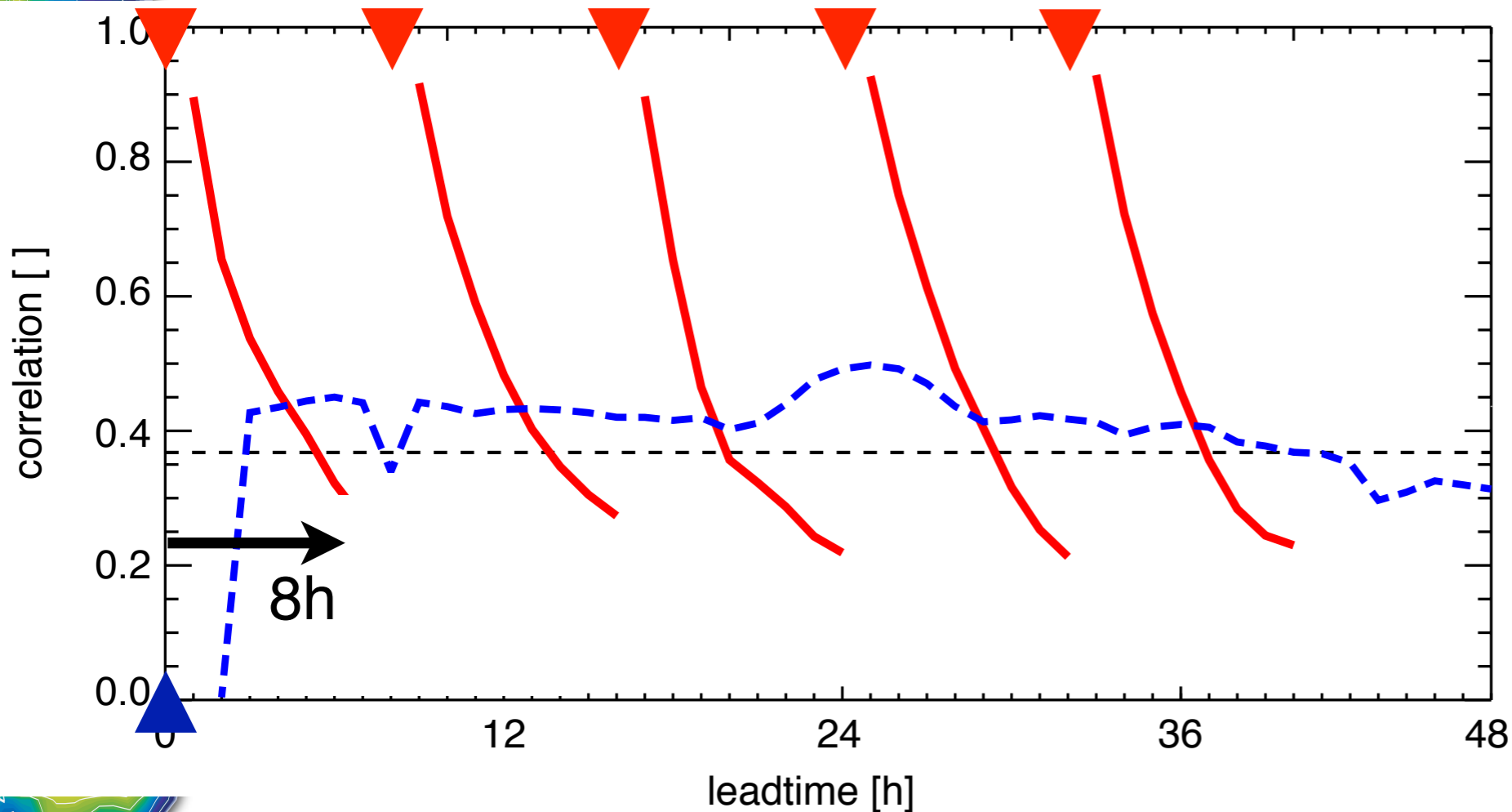
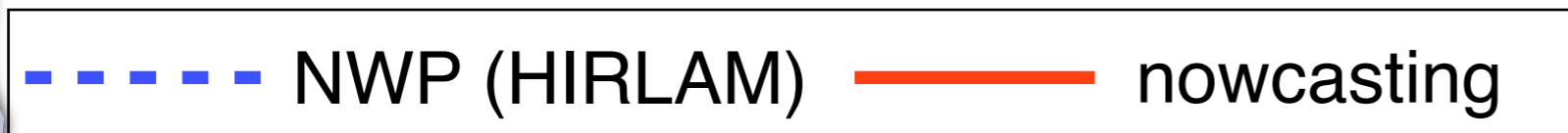
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Nowcasting vs NWP

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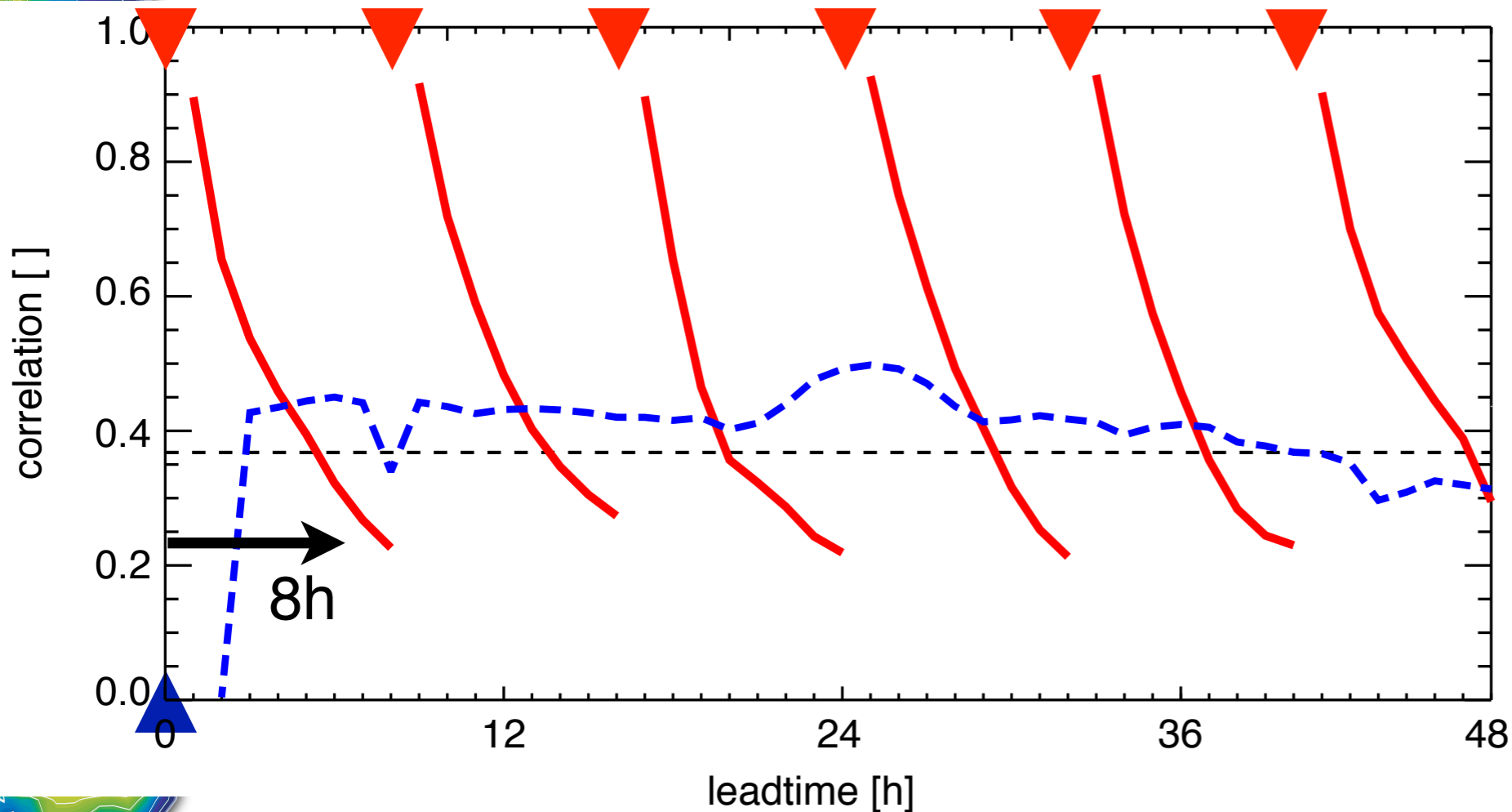
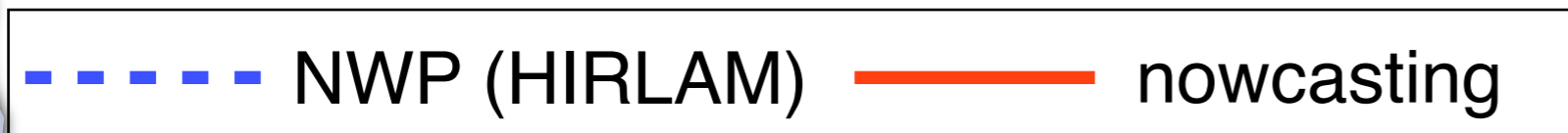
Comparison between rainfall forecasts and observations



Nowcasting vs NWP

01 June 2013 - 48 hour evaluation

Comparison between rainfall forecasts and observations



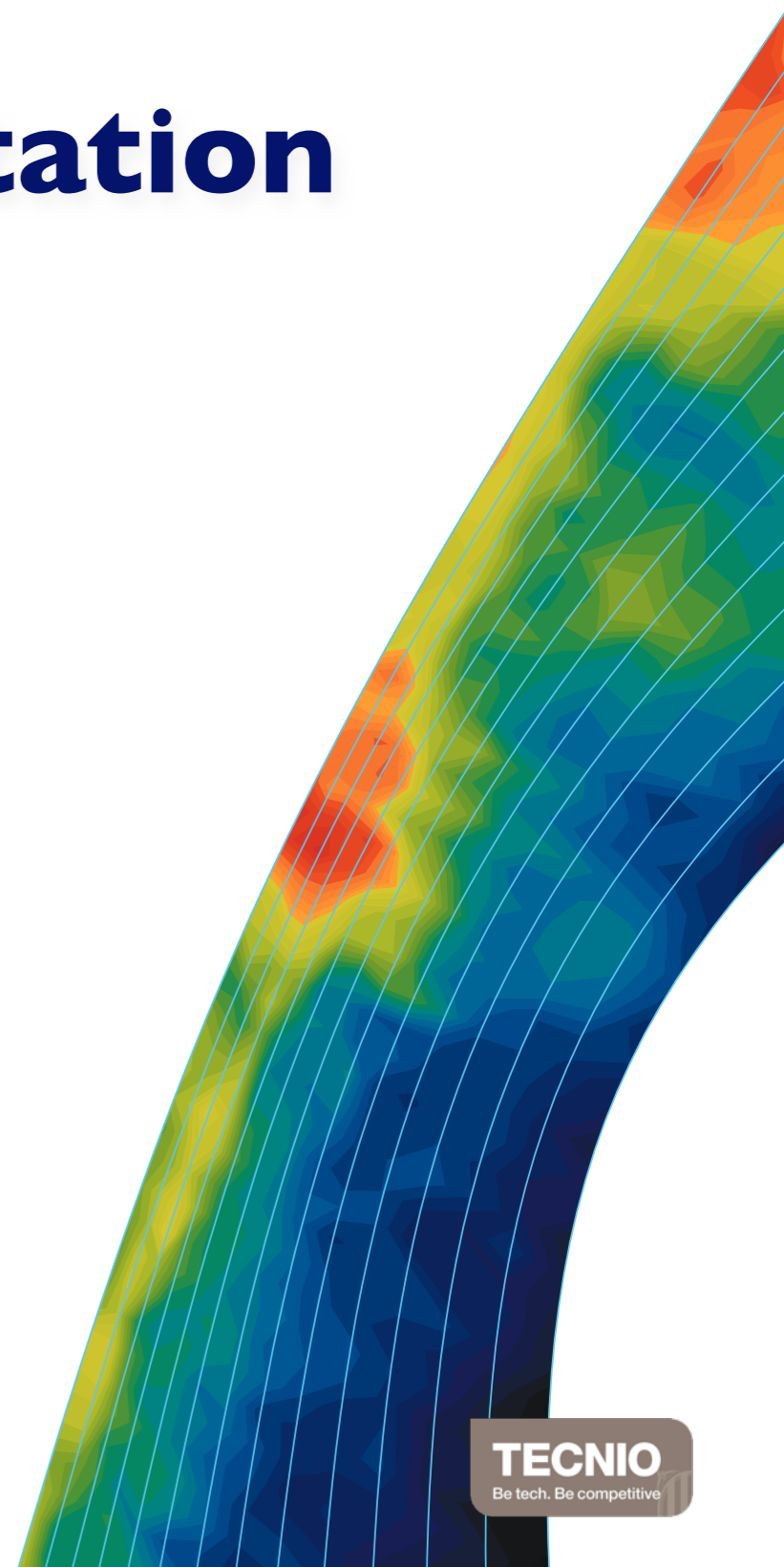


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Uncertainty in precipitation nowcasting



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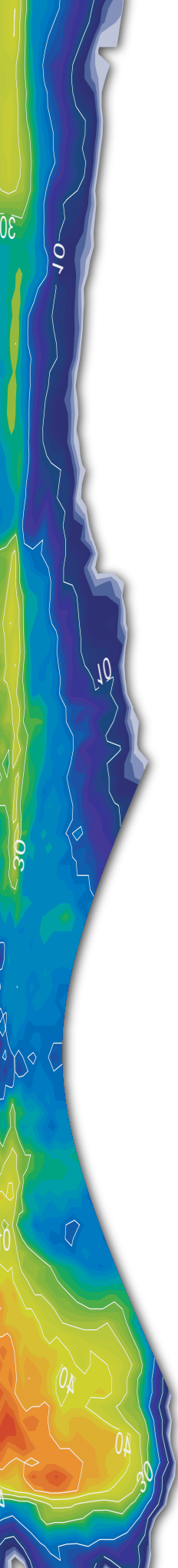
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Implementation over Europe



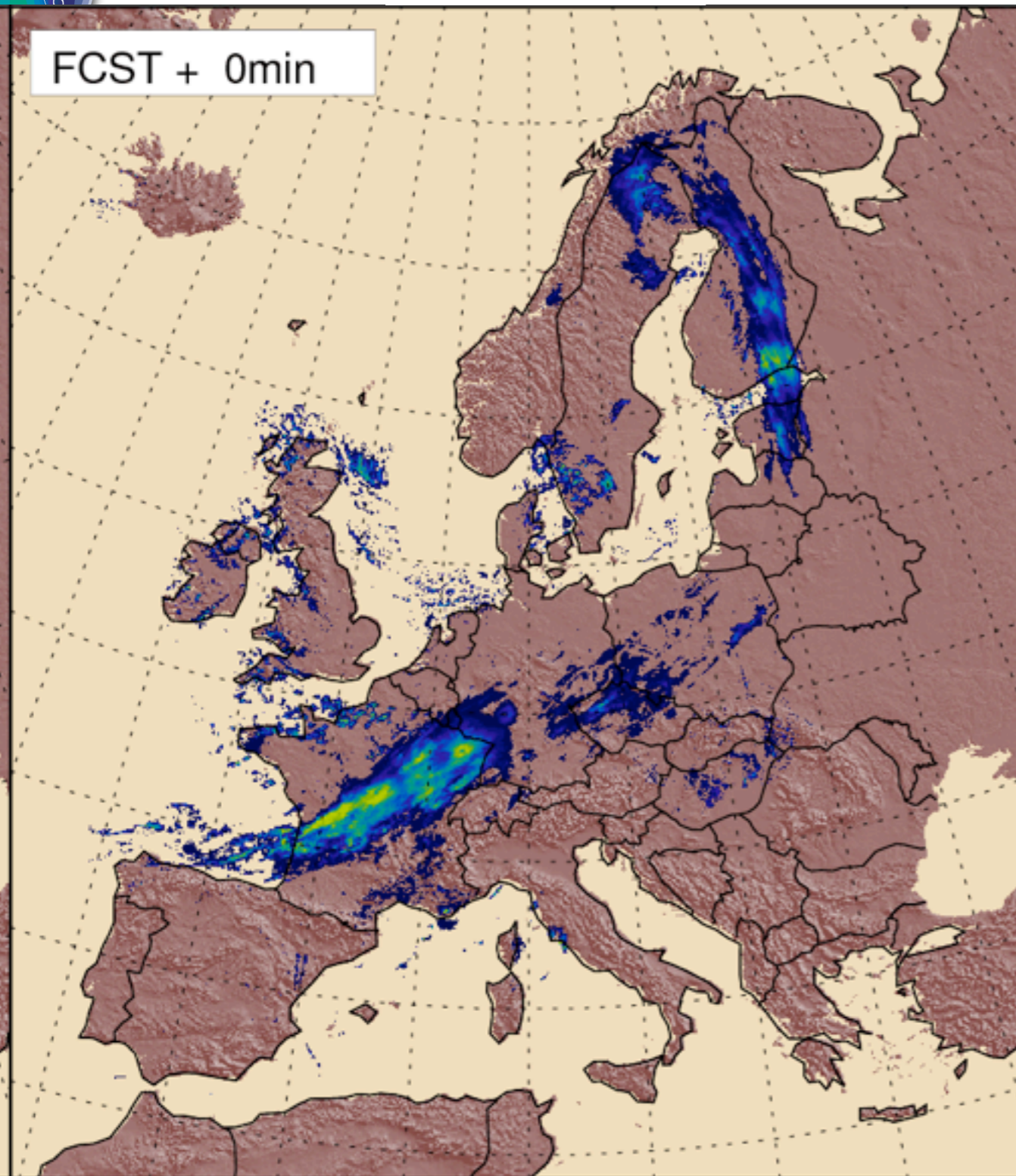
- Within HAREN,
 1. Adapted the probabilistic technique SBMcast.
 2. Implemented it at European scale using OPERA mosaics.
 3. Spatial scale analysis using the Haar wavelet (instead of Fourier).
 4. Model the time evolution of spatial scales separately.
- The product will be shown as the probability to exceed different precipitation thresholds.



Implementation over Europe



nowcasts

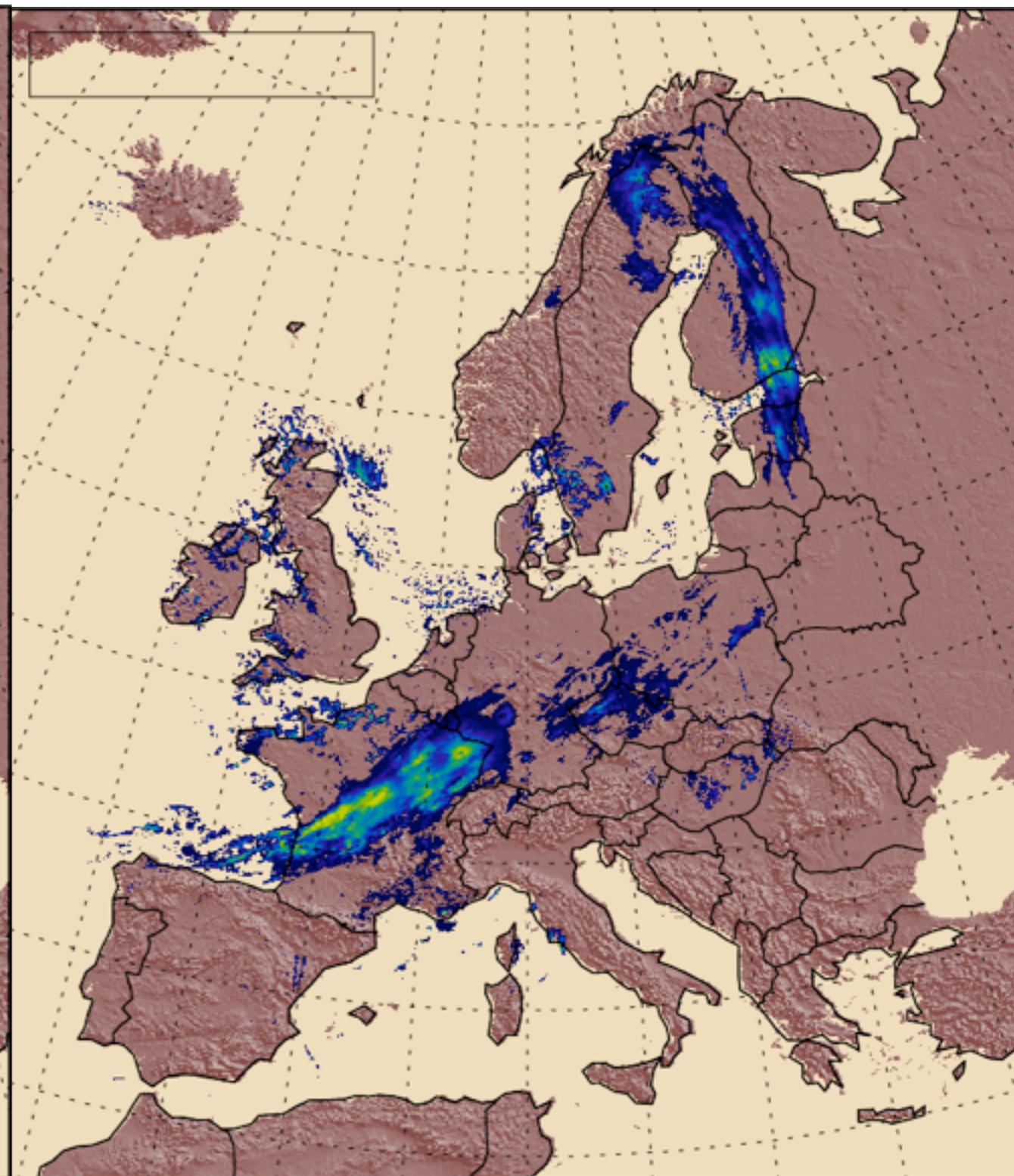
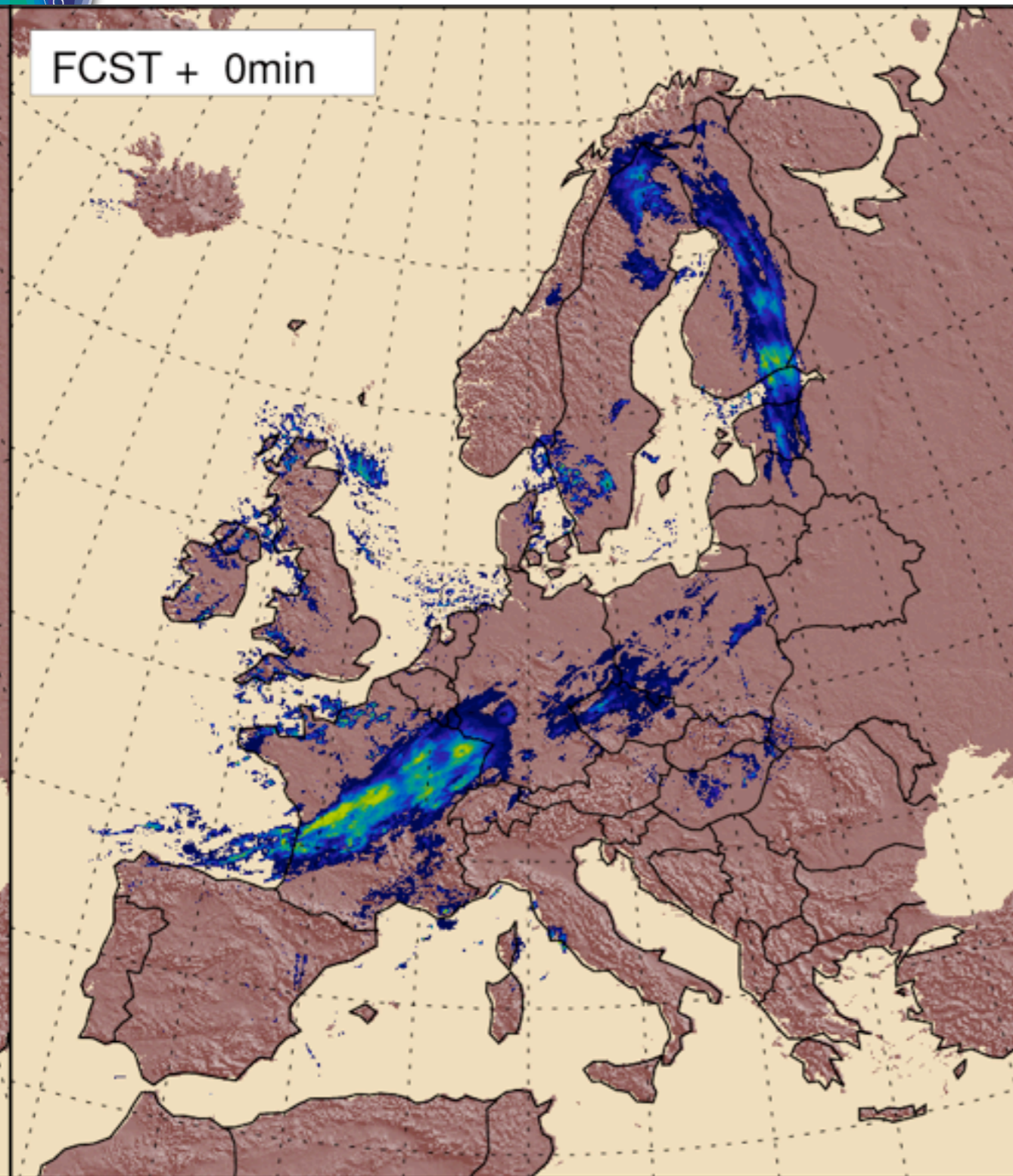


Implementation over Europe



nowcasts

SBMcast mean



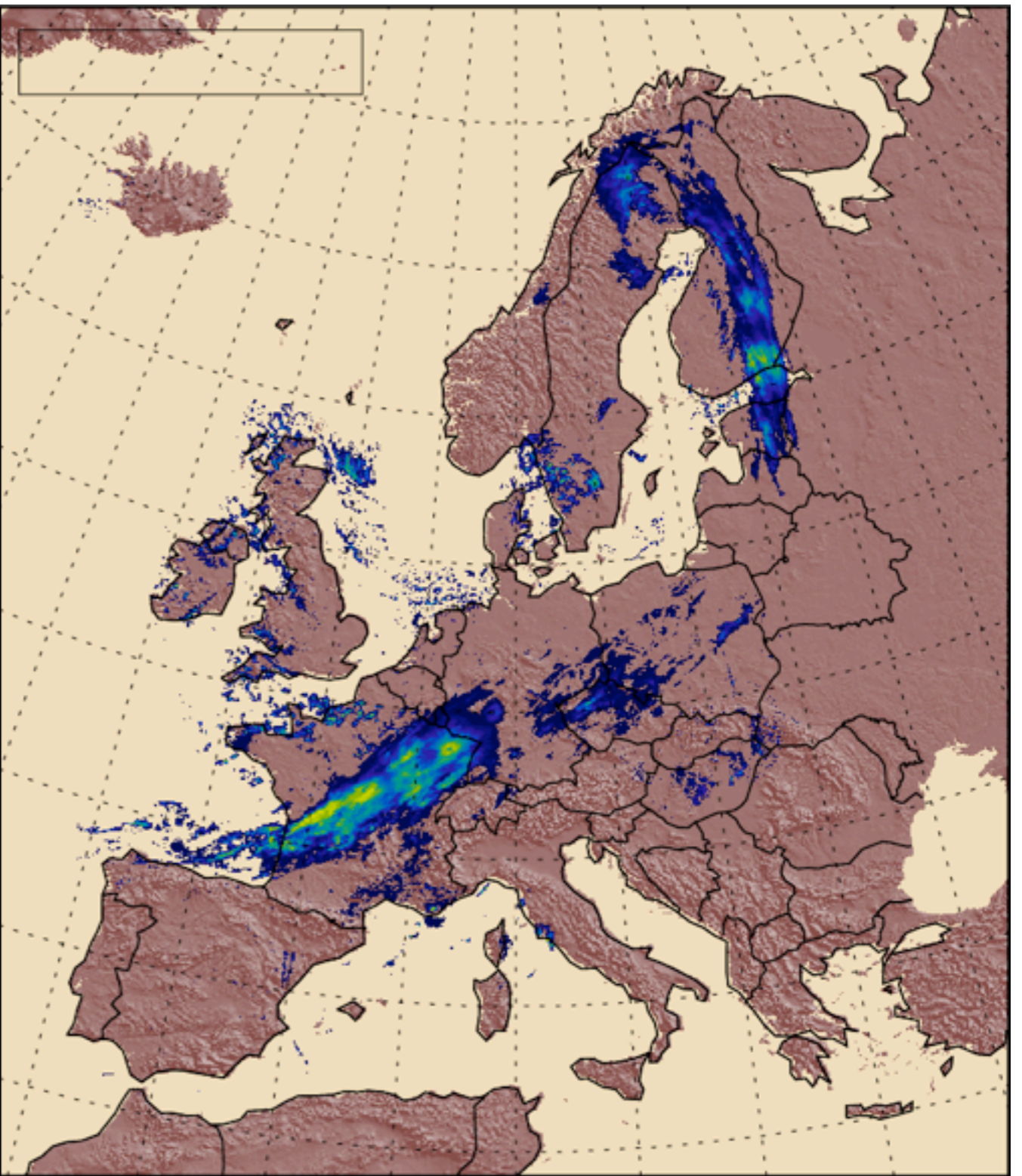
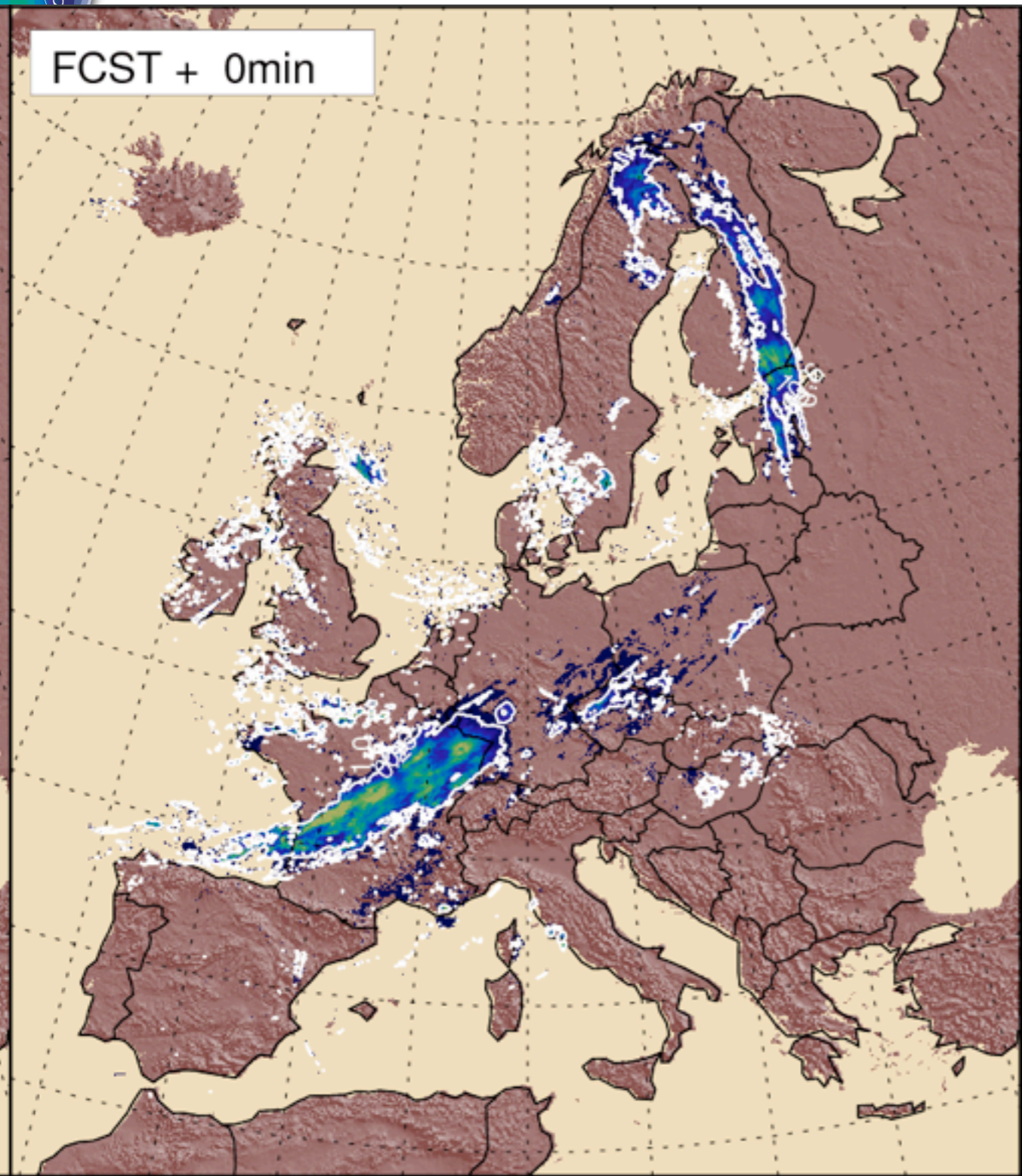
Implementation over Europe



nowcasts & $p[R > 1 \text{ mm/h}]$

SBMcast mean

FCST + 0min





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Adding value to the OPERA composites through high-resolution rainfall nowcasting

thank you



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