

THORPEX

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A World Weather Research Programme

**Doppler Wind Lidar forecast impact
during ATReC 2003 campaign**

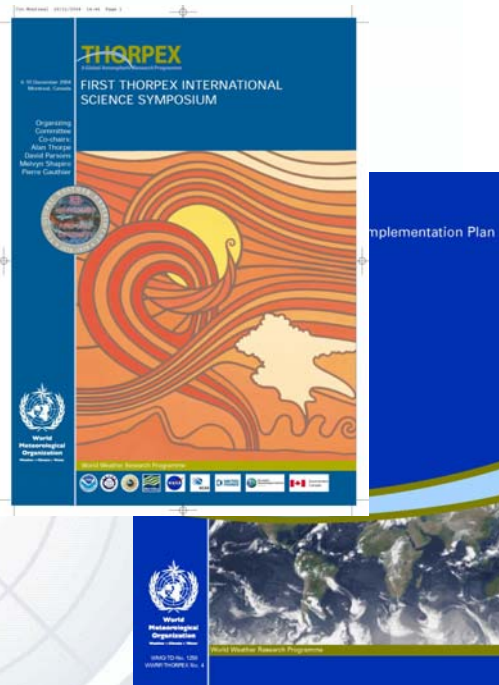
Carla Cardinali
David Burridge
Martin Weissmann

WMO
OMM

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**THORPEX contributes towards the WMO effort to mitigate the effects of natural disasters
THORPEX aims to realise the societal and economic benefits of improved weather forecast especially in developing and least developed countries**

- **Predictability and Dynamical Processes**
- **Observing Systems & Data Assimilation & Observing strategies**
- **Societal and Economic Applications**

Science and Implementation Plans
www.wmo.int/thorpex

First Symposium Montreal 2004

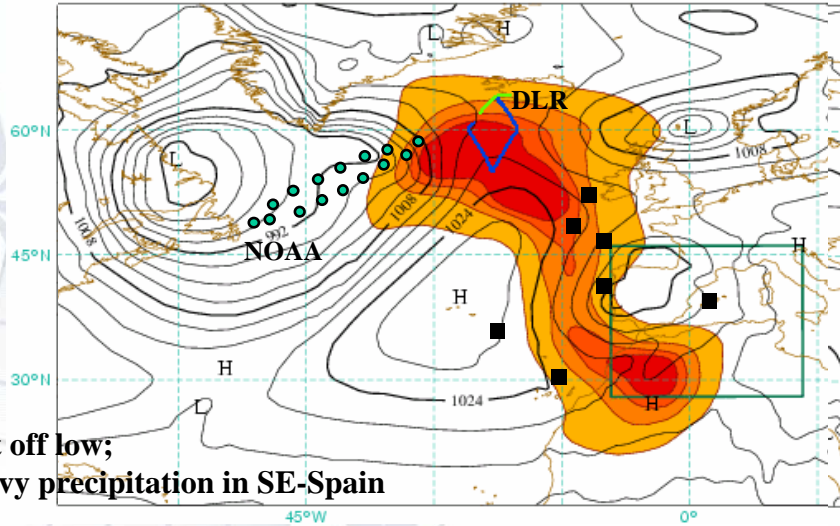
WMO
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European THORPEX activities

- ATREC (2003)
 - Basic research including societal aspects
 - TIGGE
 - Euro-GIFS
 - LAM EPS
 - ETReC 2007 (George Craig) – linked to the D Phase of MAP and COPS
 - Contribution to TPARC (DLR, EUCOS) (link to, Beijing Olympics & IPY)
 - MEDEX
 - AMMA (Sarah Jones)
 - IPY (Thor-Erik Nordeng) cluster proposal
- 2nd THORPEX Science Symposium
Winter Olympics in Canada (2010)
Tropical convection (2012)

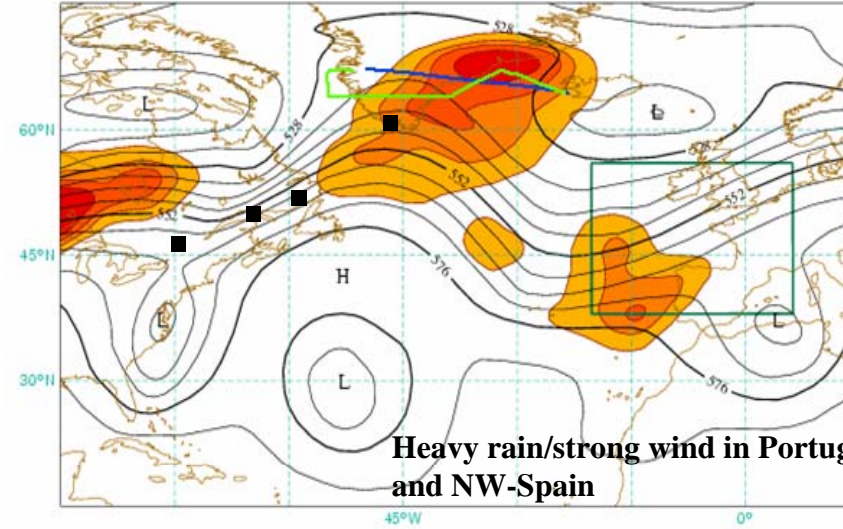
ATReC Targeting Campaigns

20031115 at 18 Step42



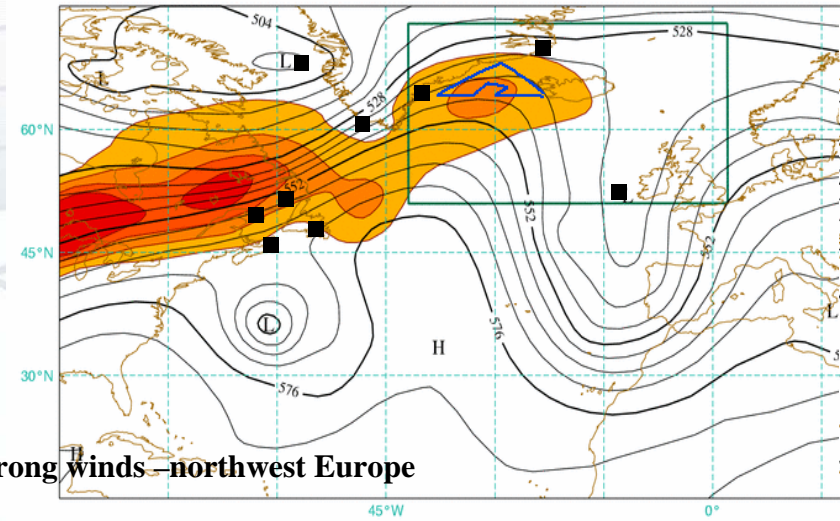
Cut off low;
heavy precipitation in SE-Spain

20031120 at 18 Step54



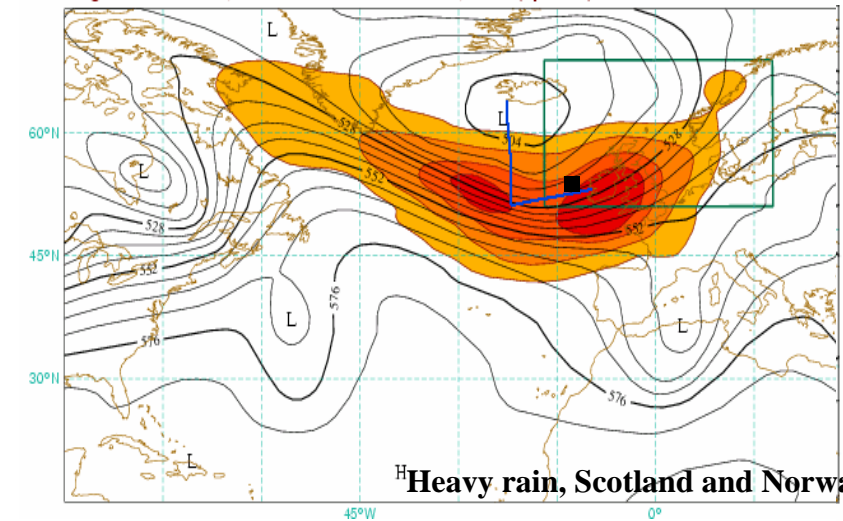
Heavy rain/strong wind in Portugal
and NW-Spain

20031122 at 18 Step66



Strong winds - northwest Europe

20031125 at 18 Step30



Heavy rain, Scotland and Norway

Forecast Sensitivity to Observations

$$\nabla_{\mathbf{x}_a} J$$
$$J = \langle \mathbf{e}_{fc}, \mathbf{C} \mathbf{e}_{fc} \rangle$$

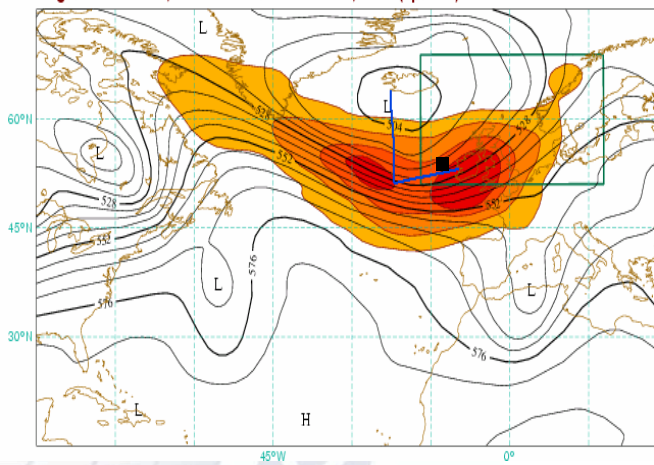
$$\Delta J = \nabla_{\mathbf{y}} J (\mathbf{y} - \mathbf{H} \mathbf{x}_a)$$

$$\Delta \mathbf{x}_a = \mathbf{K} \Delta \mathbf{y}$$

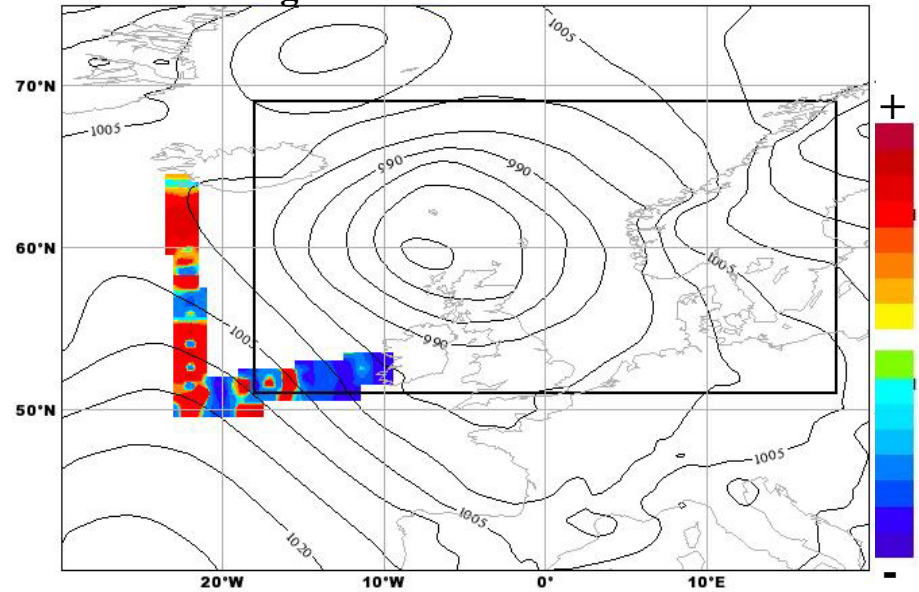
$$\nabla_{\mathbf{y}} J = \mathbf{K}^T \nabla_{\mathbf{x}_a} J$$

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Vertical Integrated Forecast Error Contribution

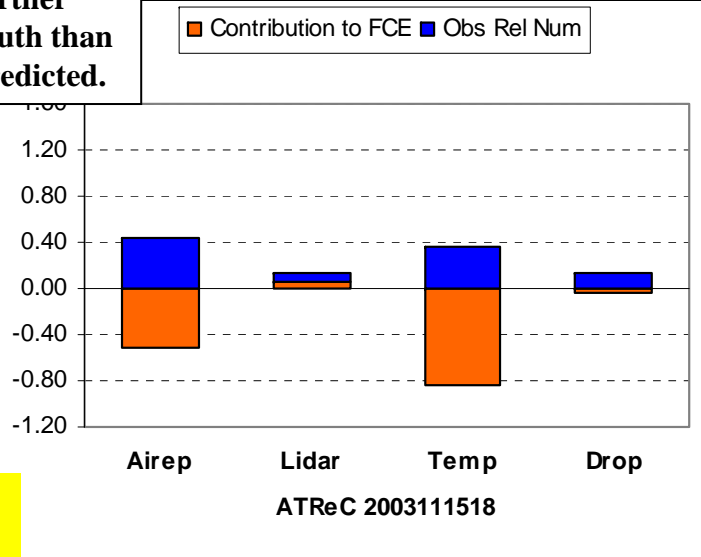


Forecast Sensitivity To Observation

Falcon DWL

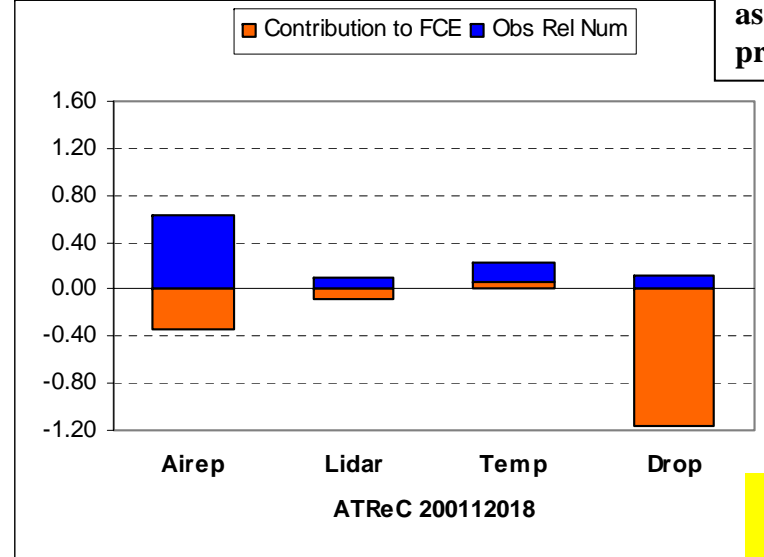
ATReC Targeting Campaigns Forecast Contribution (J/Kg)

Low was further south than predicted.

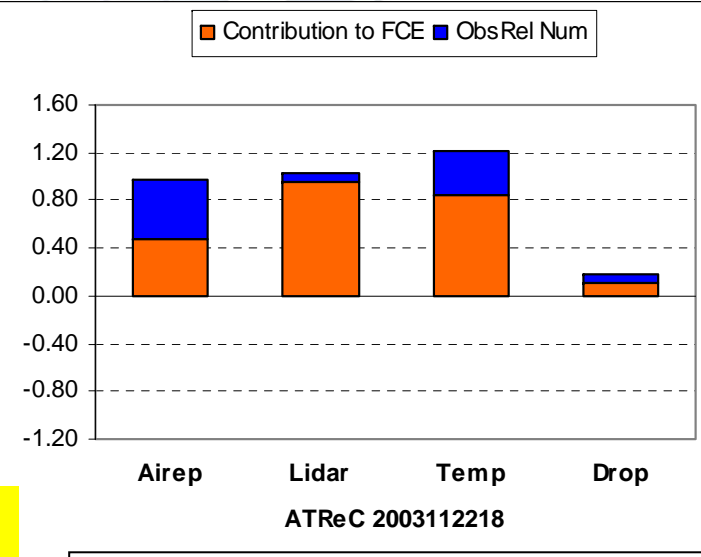


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Low was not as deep as predicted.

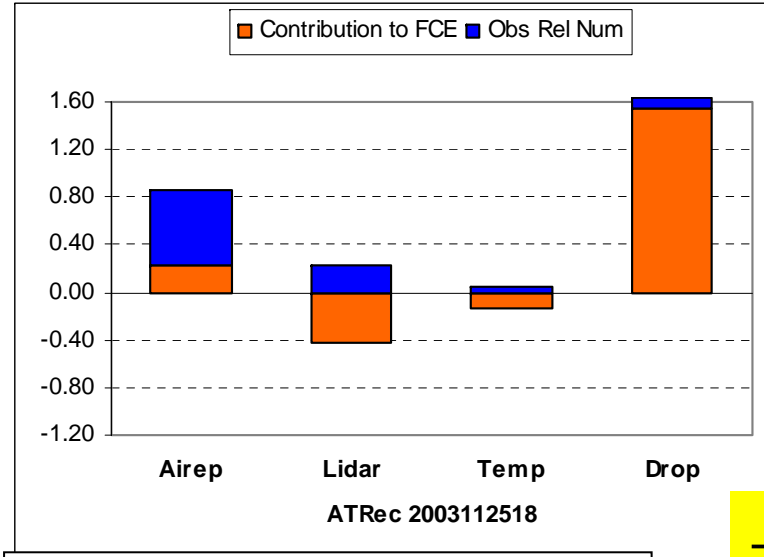


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Due to the bad weather expected for Sunday, the DLR Falcon flew already on Saturday

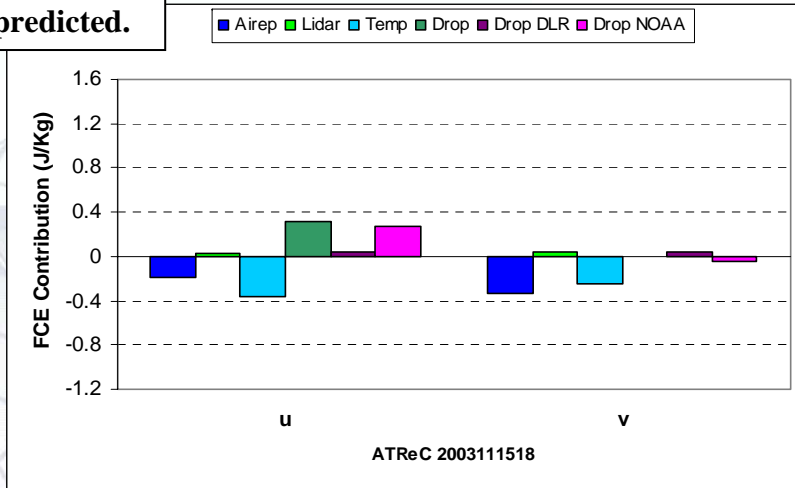


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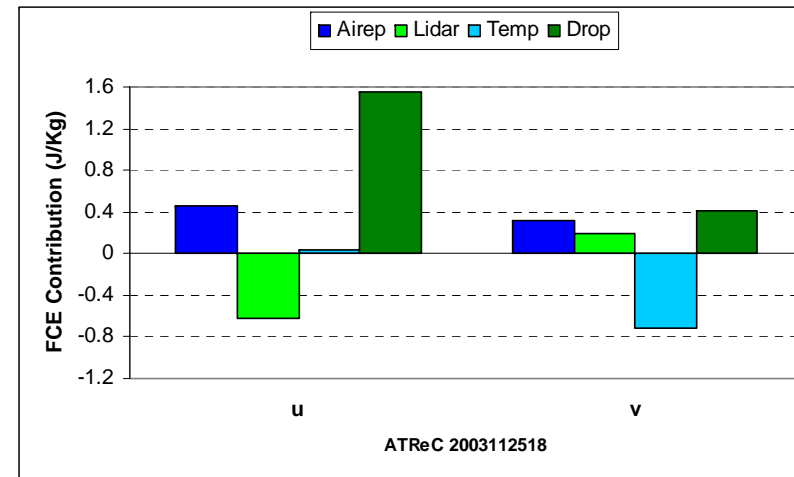
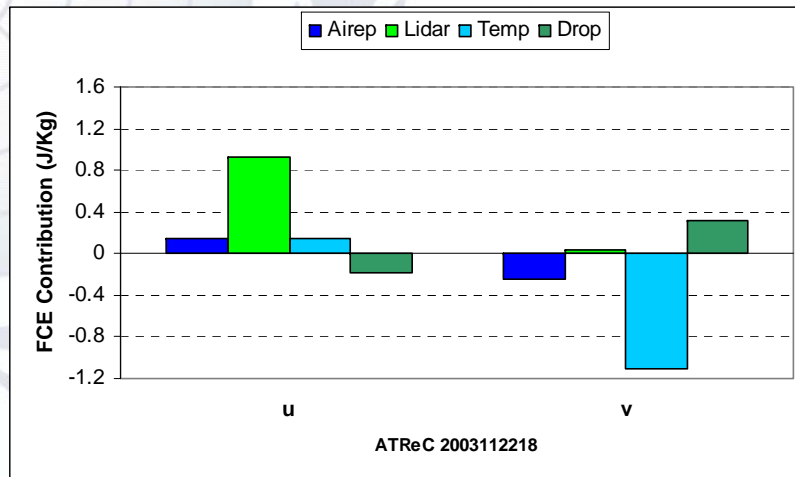
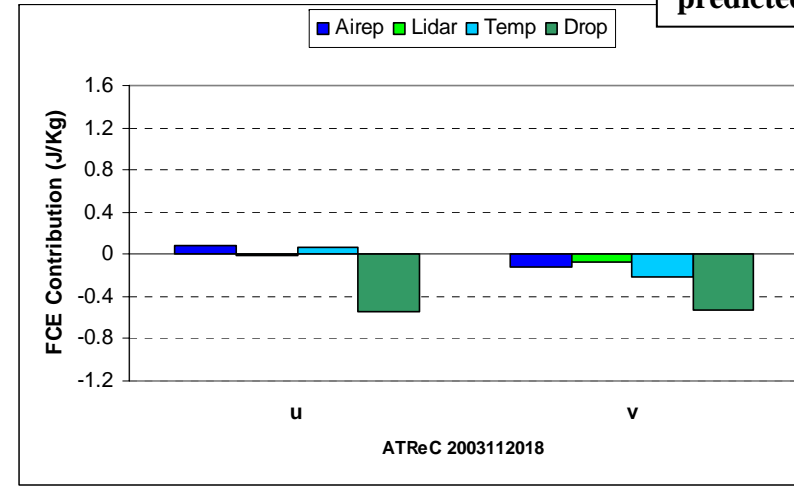
Heavy precipitation on the Norwegian coast 27 November 00 and 12 UTC

U & V Contribution to FCE

Low was further south than predicted.



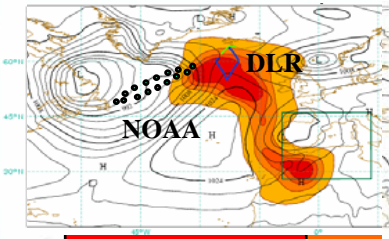
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Due to the bad weather expected for Sunday, the DLR Falcon flew already on Saturday

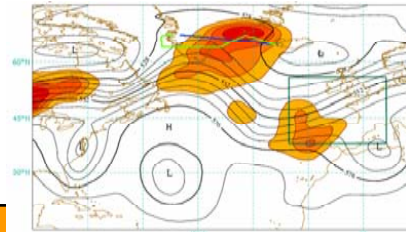
Heavy precipitation on the Norwegian coast 27 November 00 and 12 UTC

Observation Impact In & Around Verification Area



2003111518 Step42

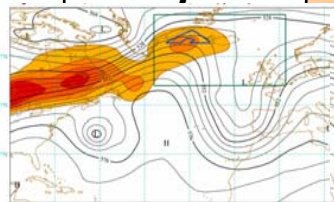
28	20	15
7	14	4
3	7	2



2003112018 Step 54

15	13	9
8	27	8
7	10	2

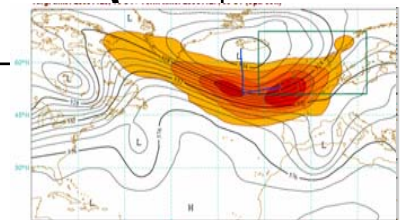
9	18	25
10	10	10
7	8	3



2003112218 Step66

8	13	6
8	37	5
5	15	3

2003112518 Step 30

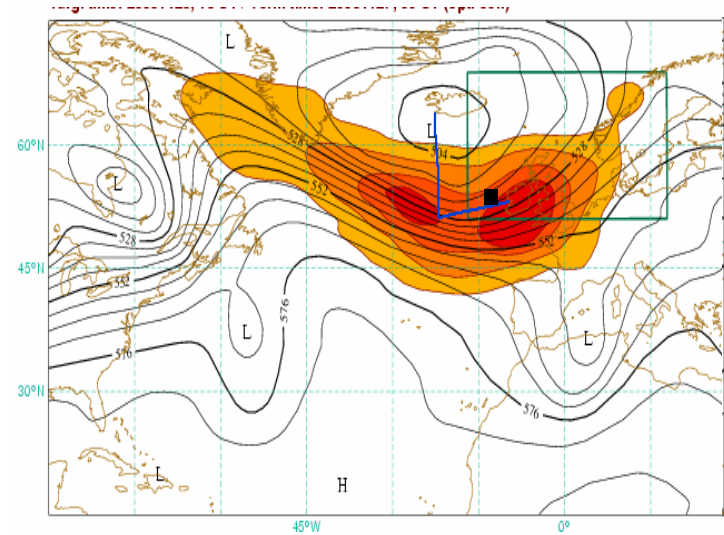
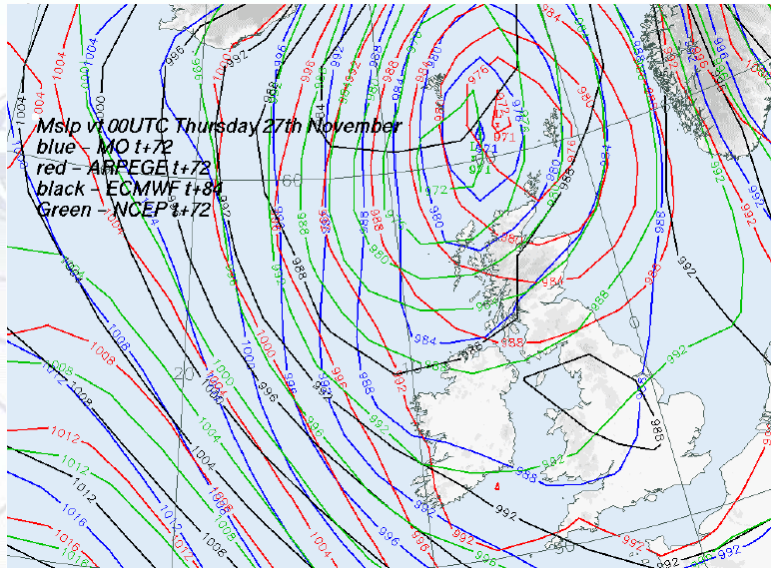


Conclusion

- The impact on the forecast of ATReC Doppler Wind Lidar Targeting observations has been evaluated at ECMWF
- The evaluation has been carried out with a 'Forecast Sensitivity to Observation tool' which allows to compute the forecast error contribution with respect to each specific measurement
- Given the Sensitivity Patterns used in the ATReC campaigns, the forecast impact of the observations released in these sensitivity regions is computed for the Verification Area
- DWL performs similar to Dropsondes
- Results show the weakness of targeting rather than the potential of DWL in NWP (see for the general impact Weissman&Cardinali 2006):
 - In 2 out of 4 campaigns the major impact was outside the verification area
 - In targeting, errors in the prediction of the flow can cause a location displacement of the expected observation impact
 - The statistical formulation of data assimilation do not guarantee that targeting is a success. Flow dependent structure functions would help

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20031125 at 18 Step30

“unlikely to have any significant deepening of the wave on Wednesday, uncertainty remains on the pressure pattern and rainfall to the rear of the wave between Norway and Scotland.

Since it was not possible to compute sensitive areas for Monday, in time to submit flight plans to Falcon, it was decided to find a target within the Falcon range for Tuesday. The priority was low as the impact was likely to be negligible.“