The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific
and Cultural Organization

International Atomic
Energy Agency

Spring Colloquium on
'Regional Weather Predictability and Modeling'
April 11 - 22, 2005

1) Workshop **on Design and Use of Regional Weather Prediction Models,** *April 11 - 19*

2) Conference on **Current Efforts Toward Advancing the Skill of Regional Weather Prediction. Challenges and Outlook,** *April 20 - 22*

301/1652-13

Dynamic tropopause perspective of an Atlantic - Mediterranean Teleconnection Event of November-December 2001

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Israel

Dynamic tropopause perspective of an Atlantic - Mediterranean Teleconnection Event of November-December 2001

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***Conference on* Current Efforts Toward Advancing the Skill of Regional Weather Prediction. Challenges and Outlook,**
April 20 – 22, Trieste Italy

References

Krichak, S.O., P. Alpert and M. Dayan (2004) Role of atmospheric processes associated with hurricane Olga in December 2001 flash floods in Israel. J. Hydrometeorol., vol. 5, no. 6. pp. 1259-1270

Krichak, S.O., P. Alpert and M. Dayan (2005) Dynamic Tropopause Effects of a December 2001 Atlantic-Mediterranean Teleconnection Episode (submitted)

-Considering the time interval
Nov. 24th at 00z – Dec. 5th 2001

- The period was characterized by
(a) Intense rainfall in Israel
(b) Hurricane Olga

- Using the NCEP reanalysis data NNRP (Kalnay et al. 1996) and Meteosat-7 images

UNUSUALLY INTENSE RAINS IN ISRAEL

260 mm of rain during about 24 hrs (annual precipitation in the region = ~ 650 mm)

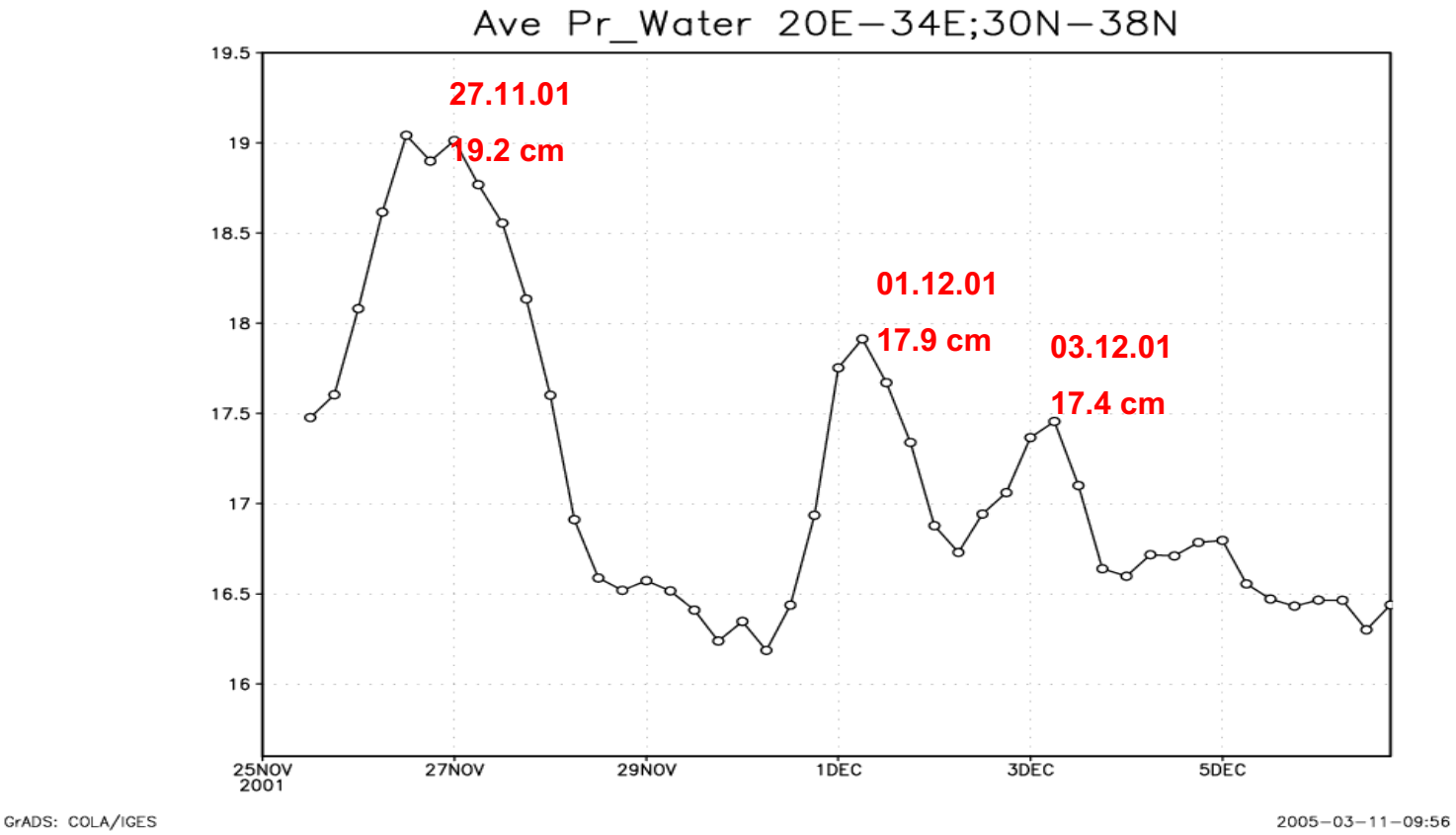
WHY?

Analysis of NNRP data

- Precipitable water is the column integrated water vapor

$$PRWT = \frac{1}{g} \int_{p_1}^{p_2} w \, dp$$

NNRP PRWT


Ave Pr_Water 20E−34E;30N−38N
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19.2 cm
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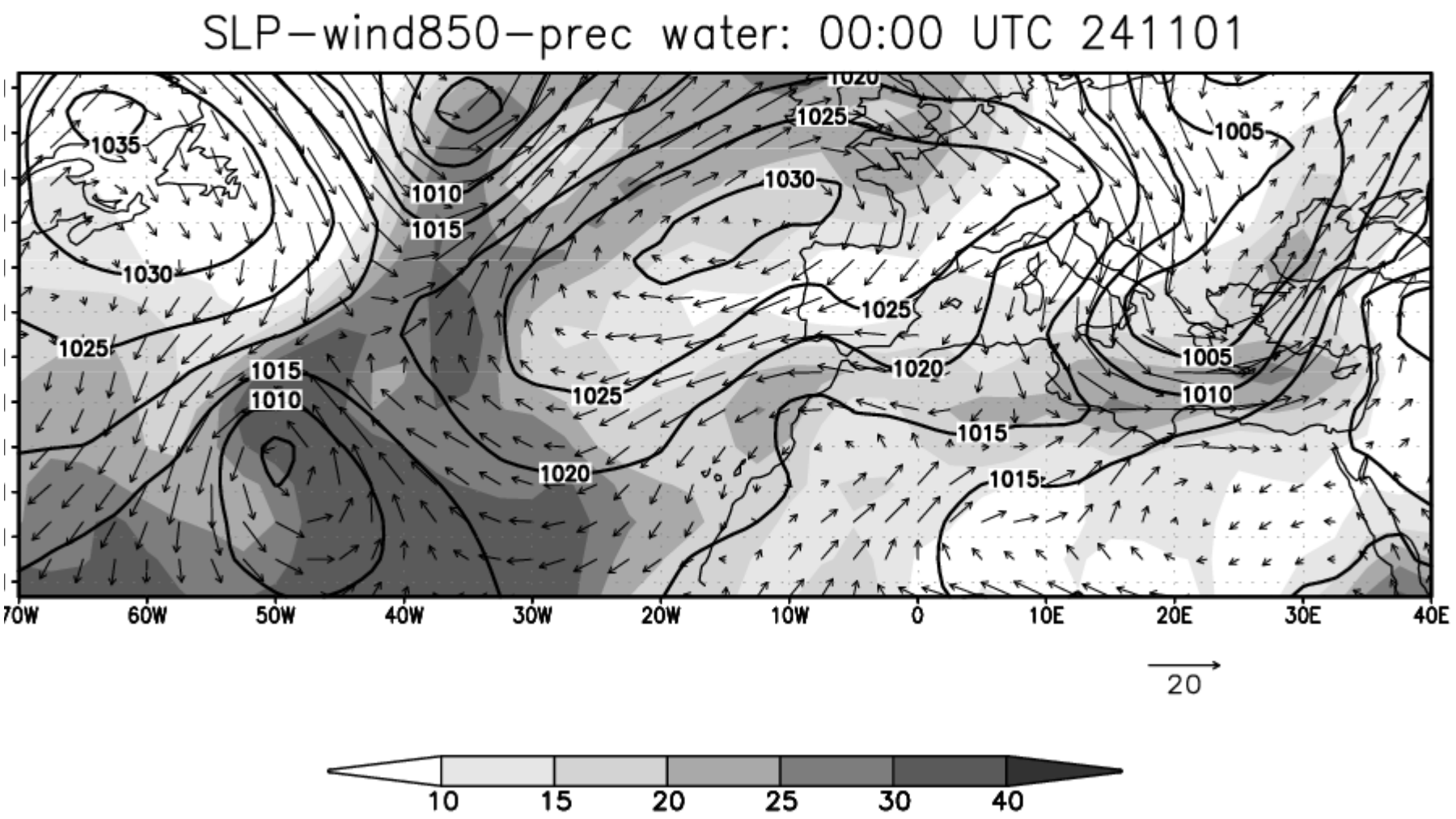
GrADS: COLA/IGES
2005−03−11−09:56

NNRP

SLP/ WND850 / PRWT

patterns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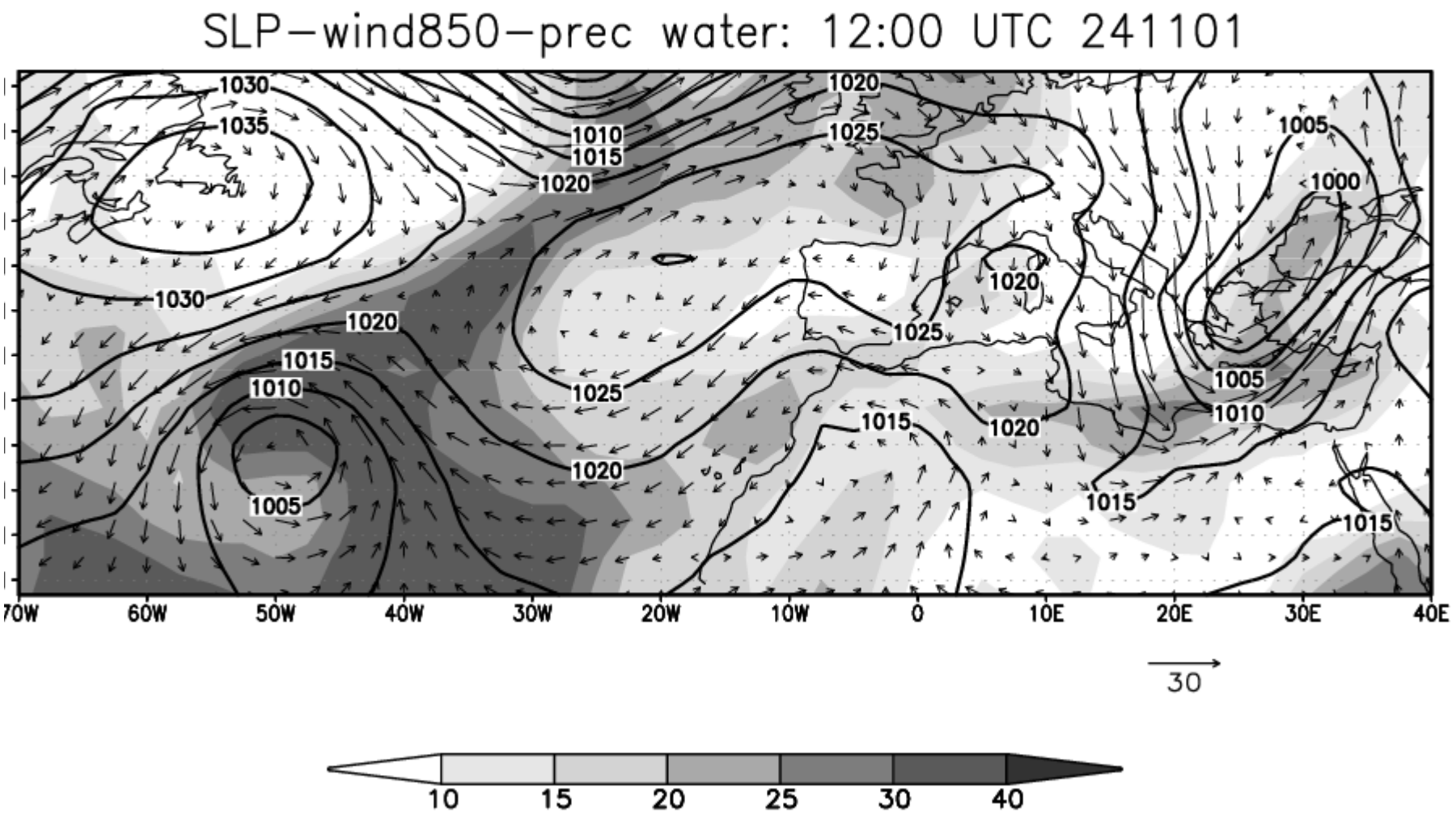
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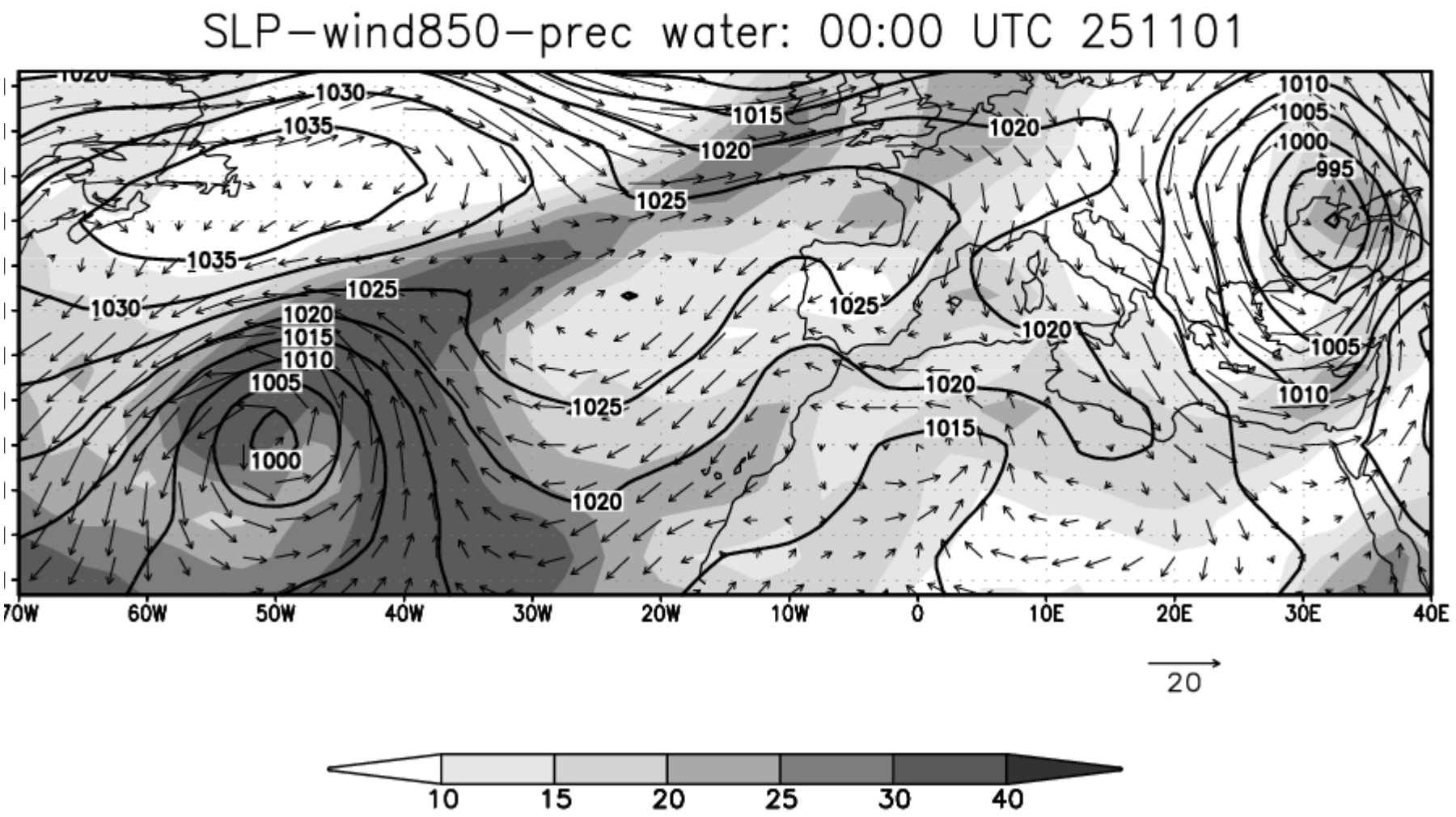
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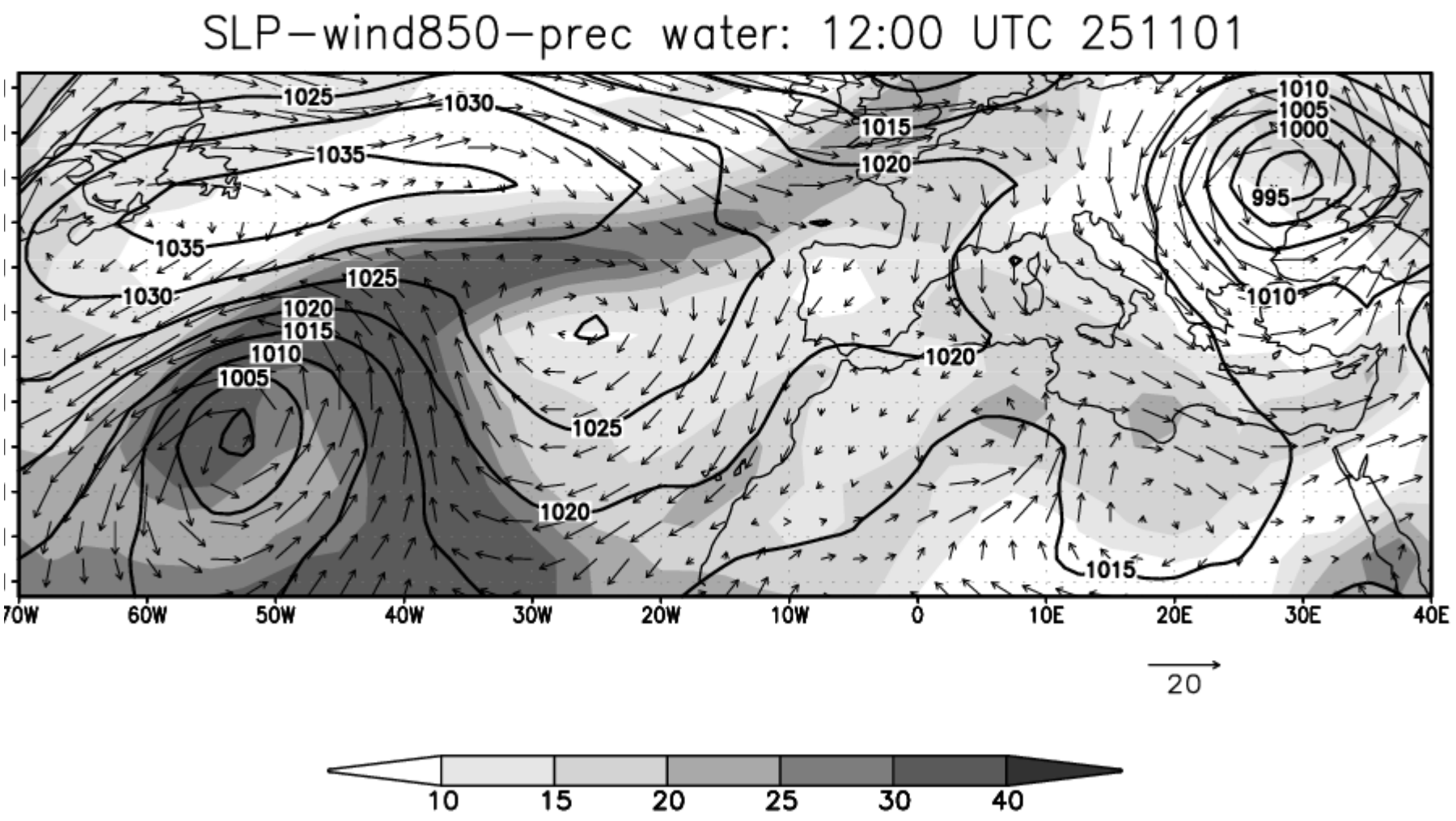
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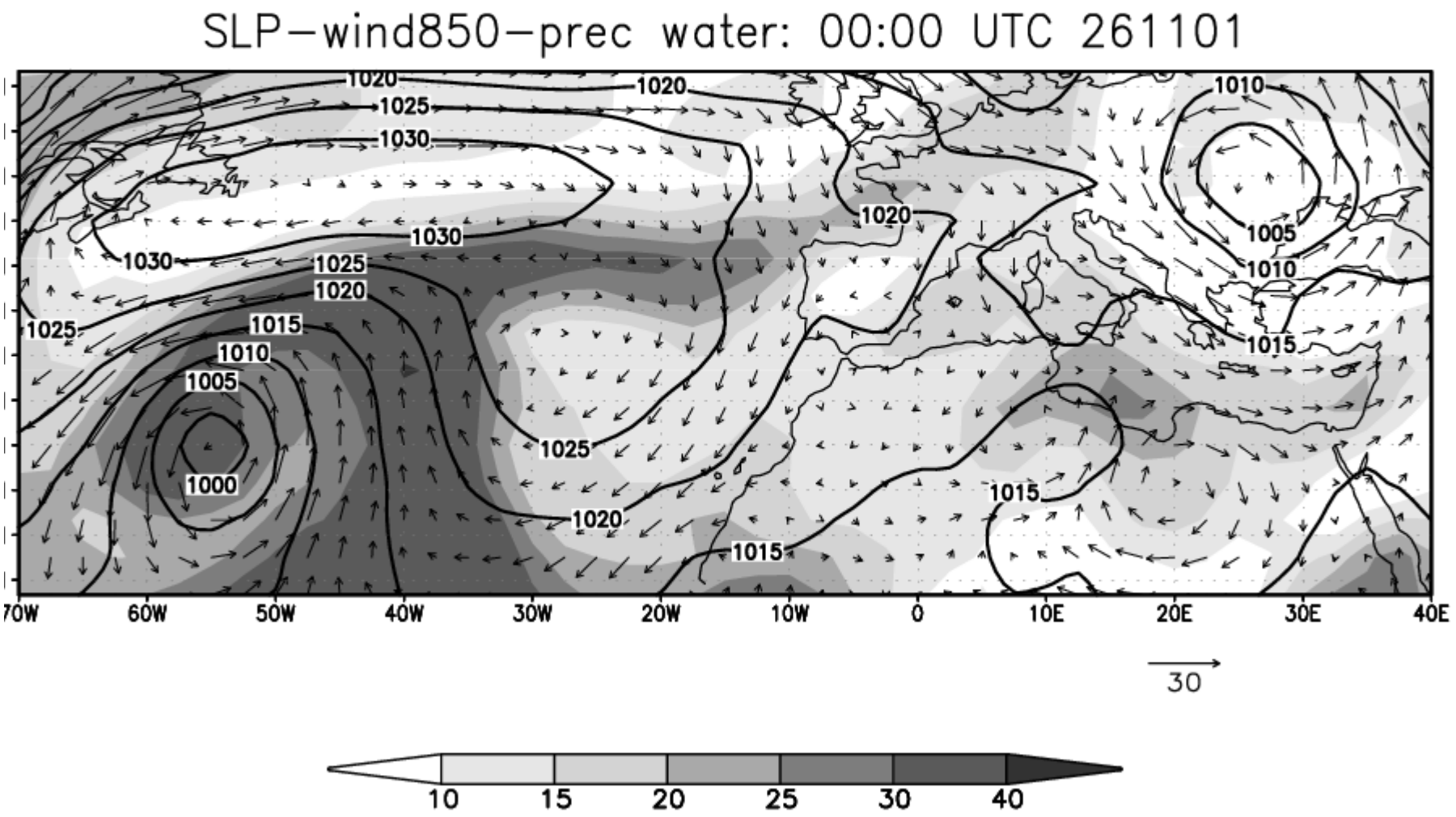
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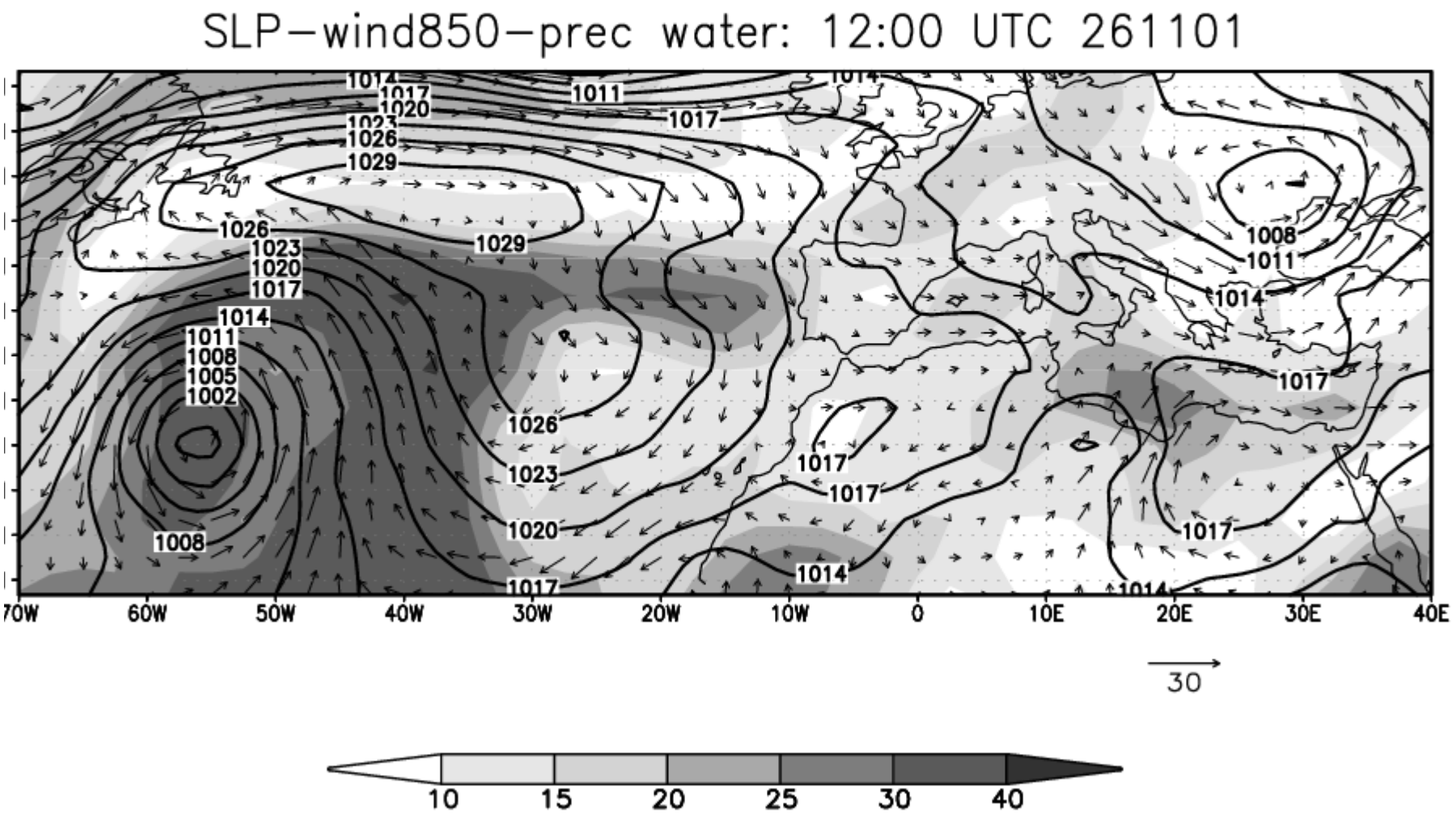
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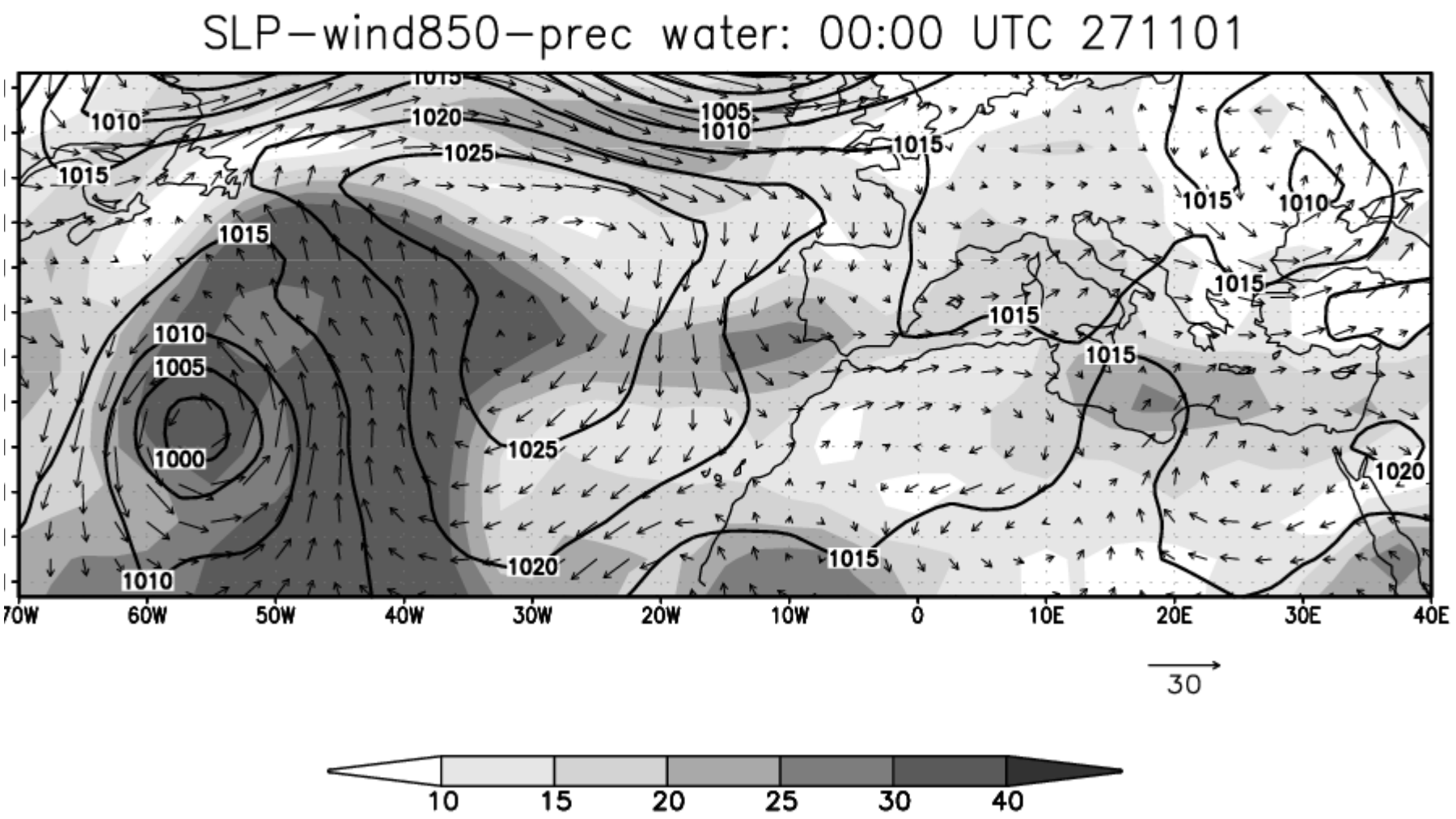
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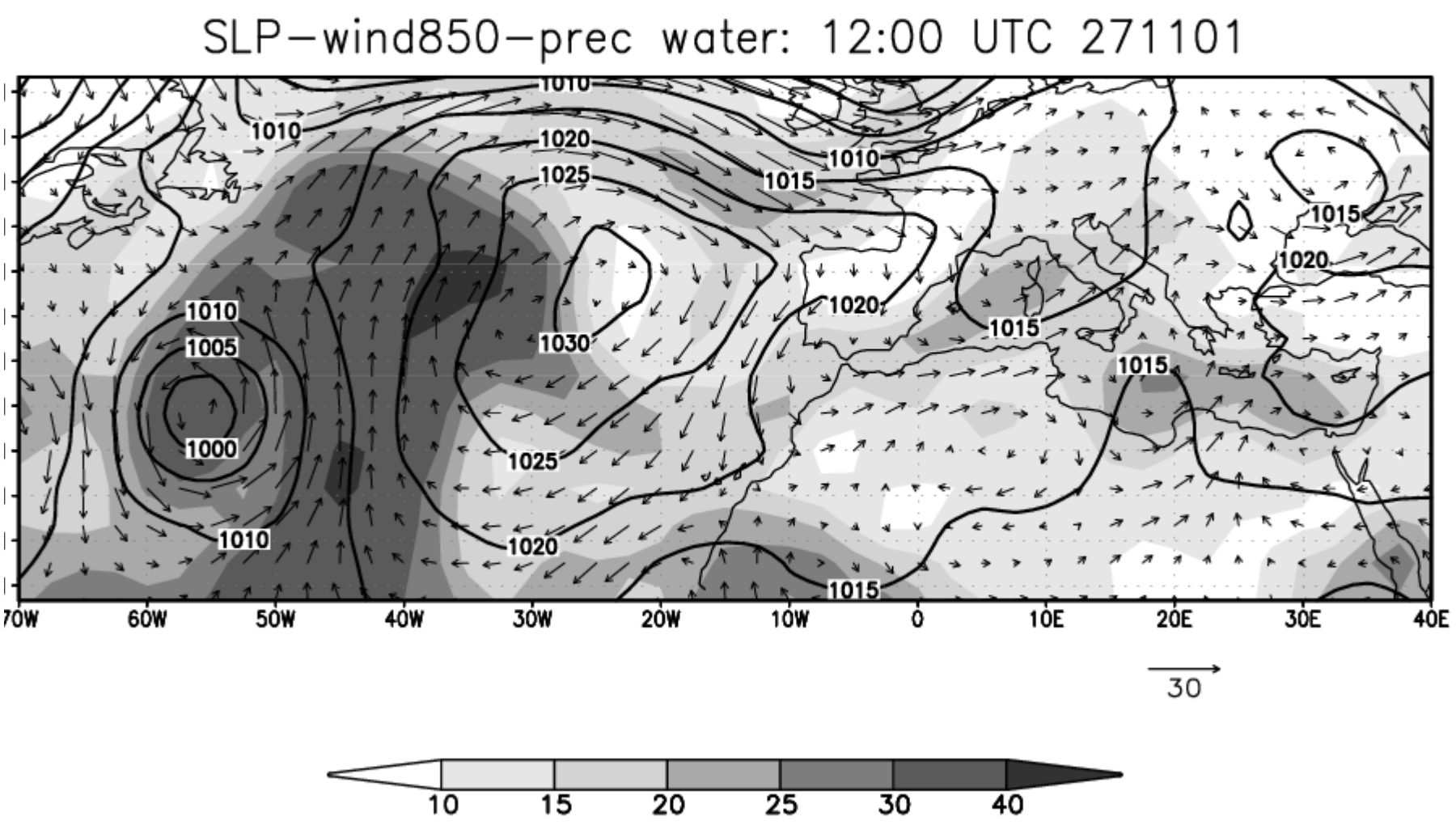
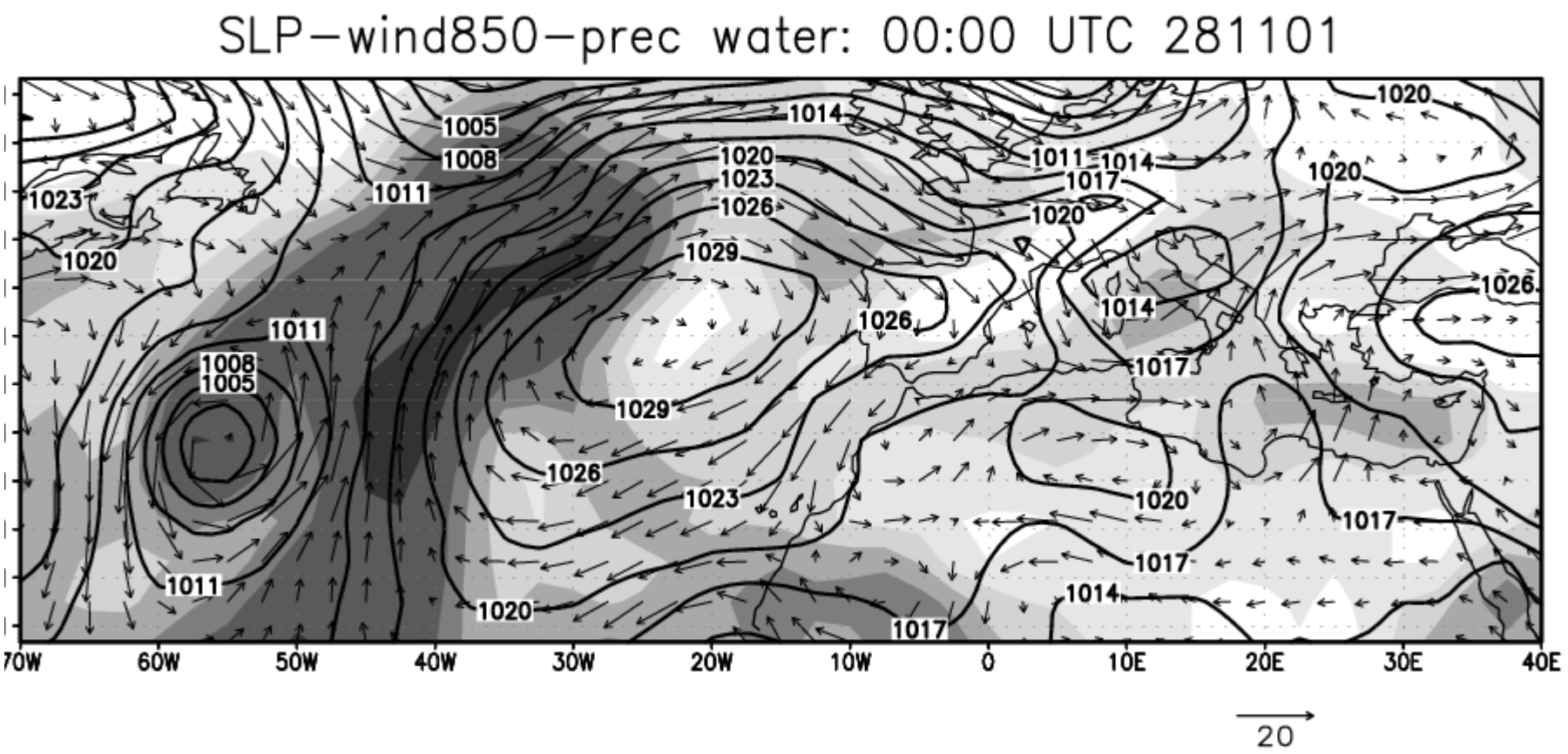
27.11.01

19.2 cm

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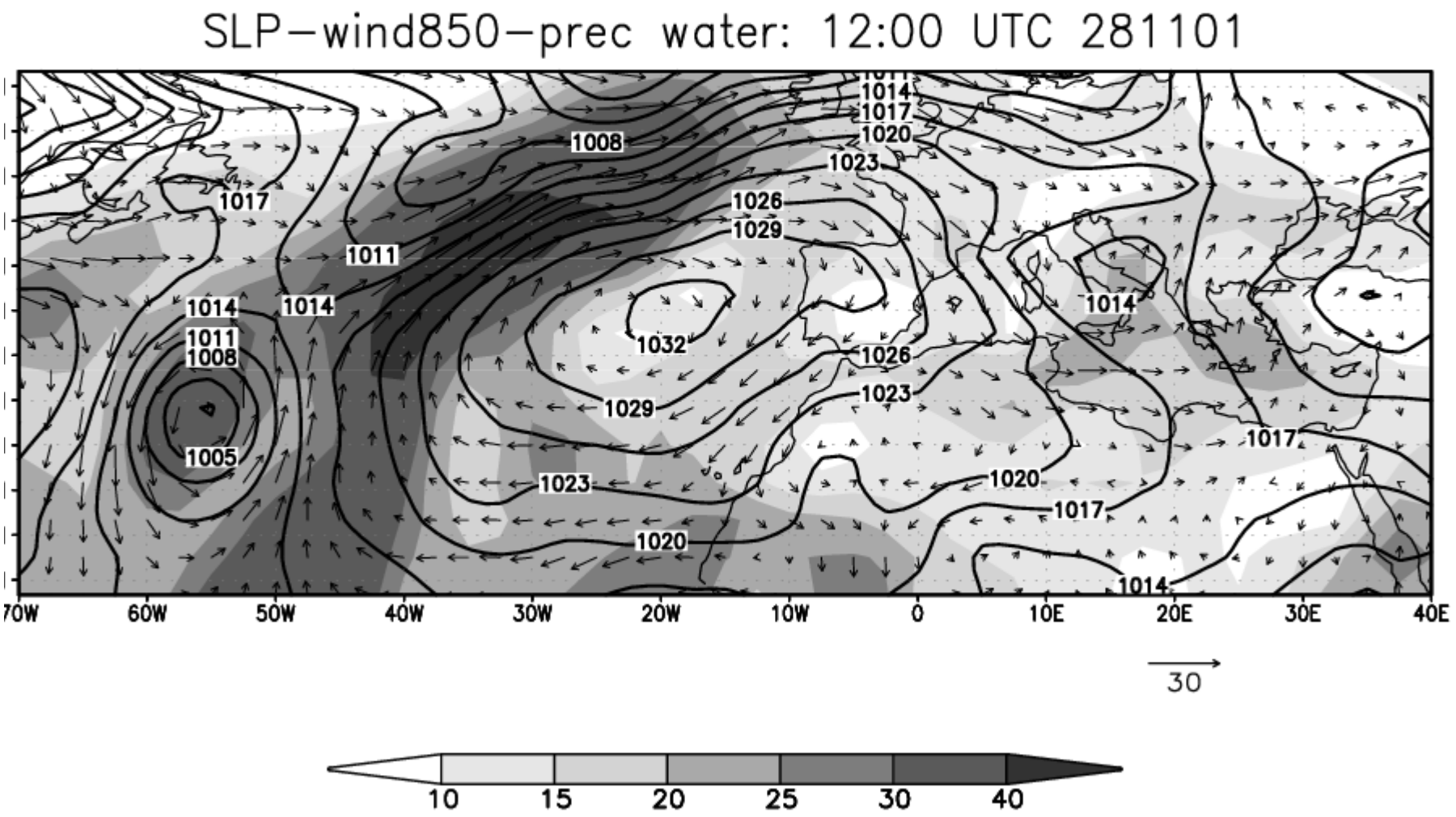
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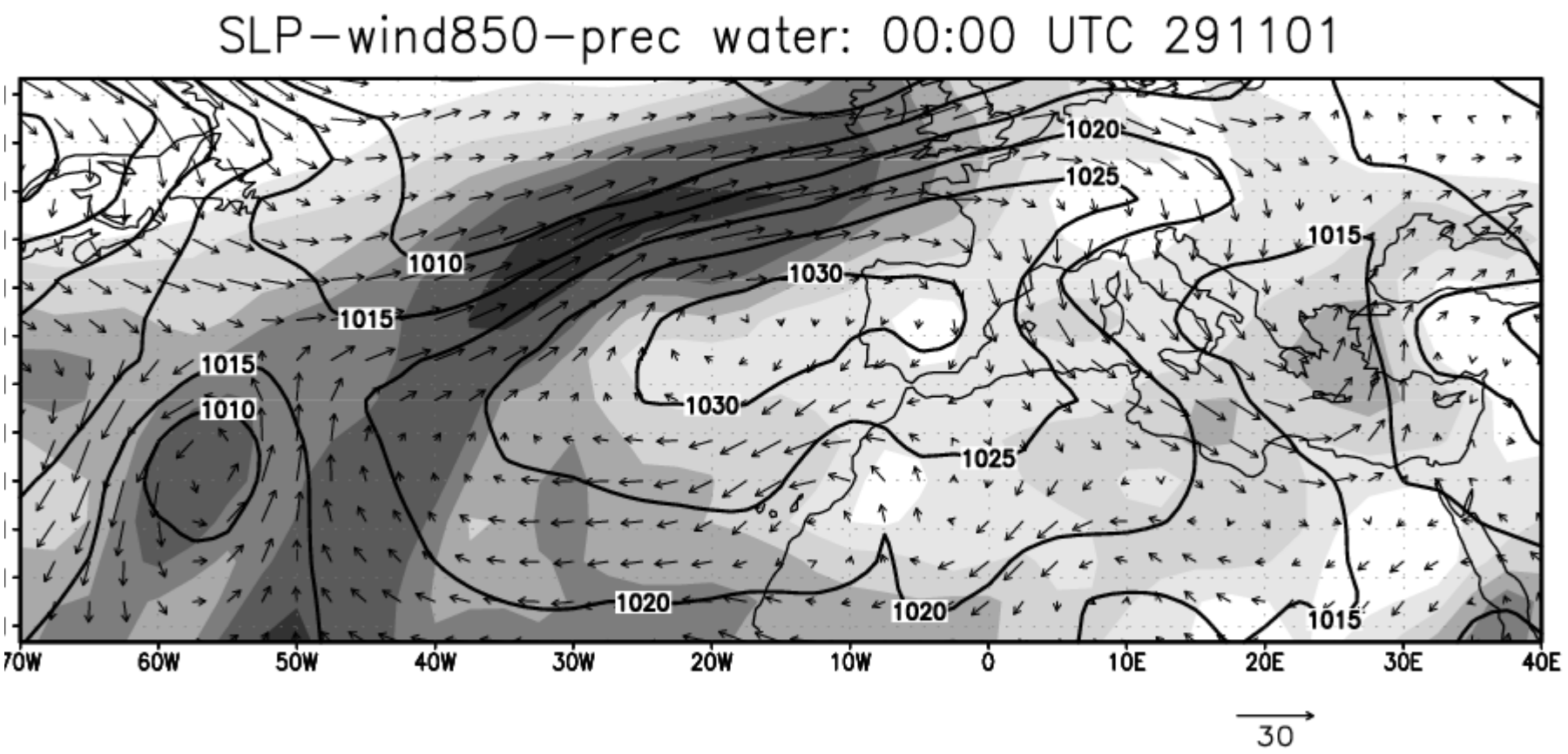
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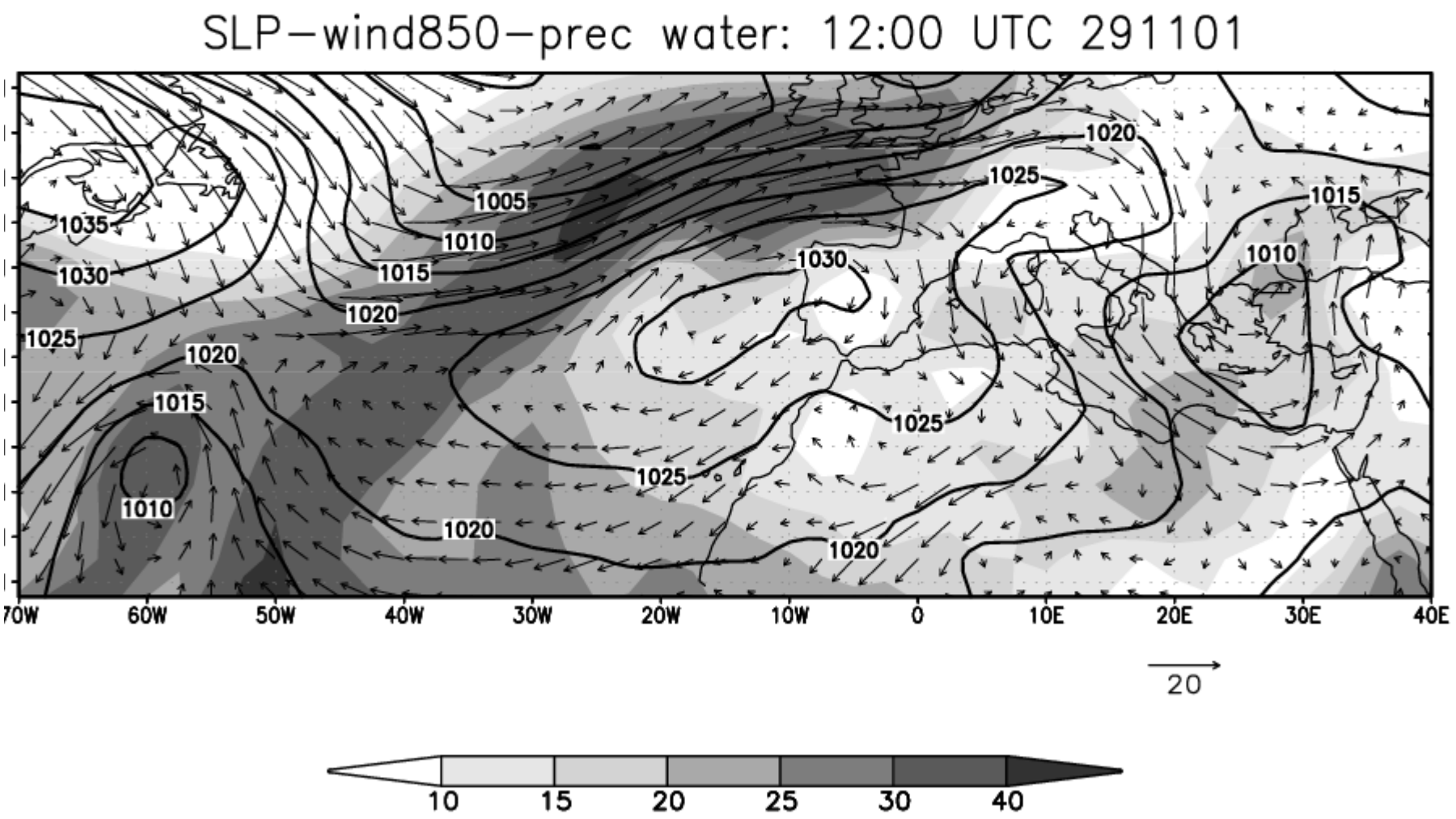
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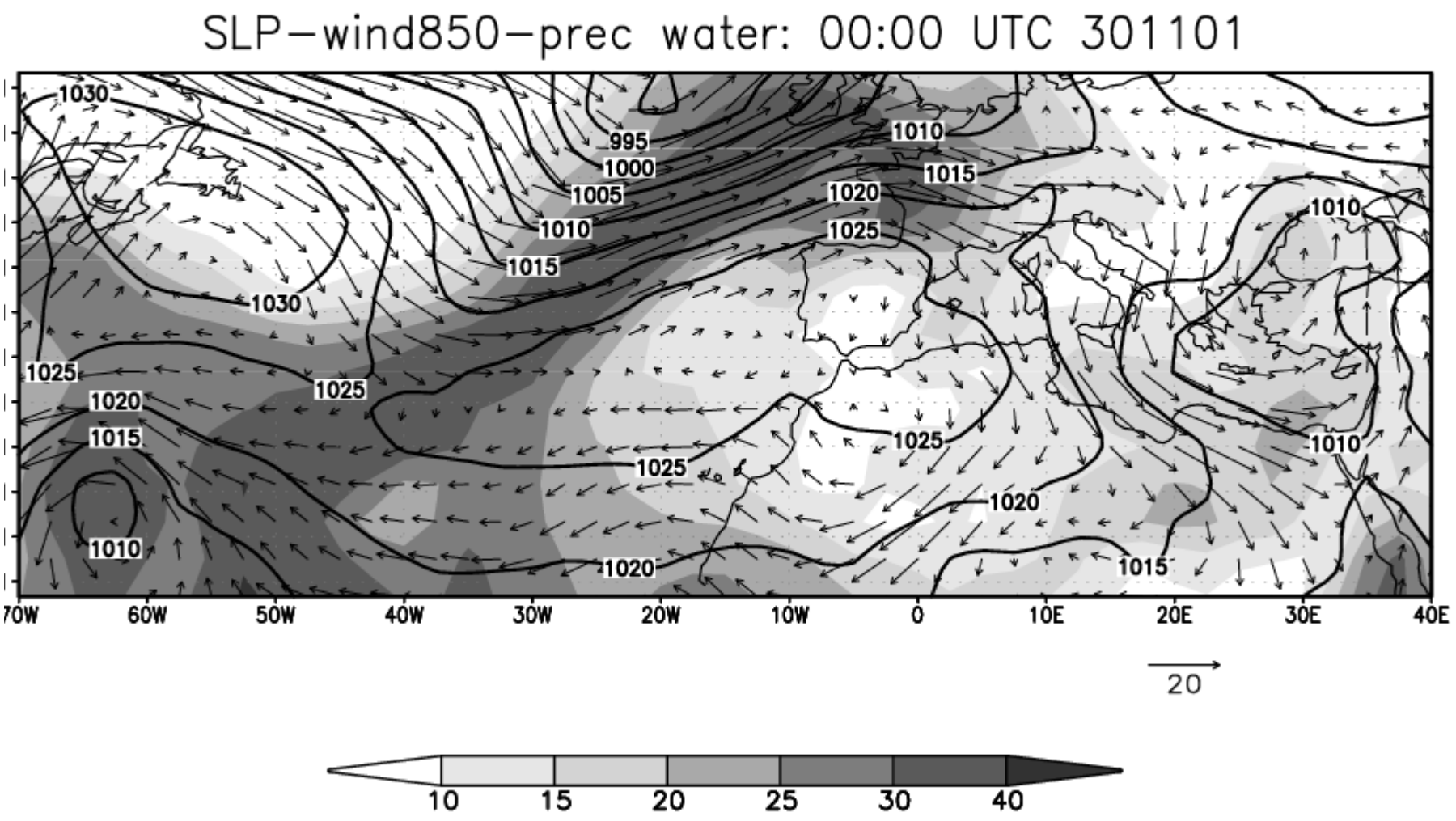
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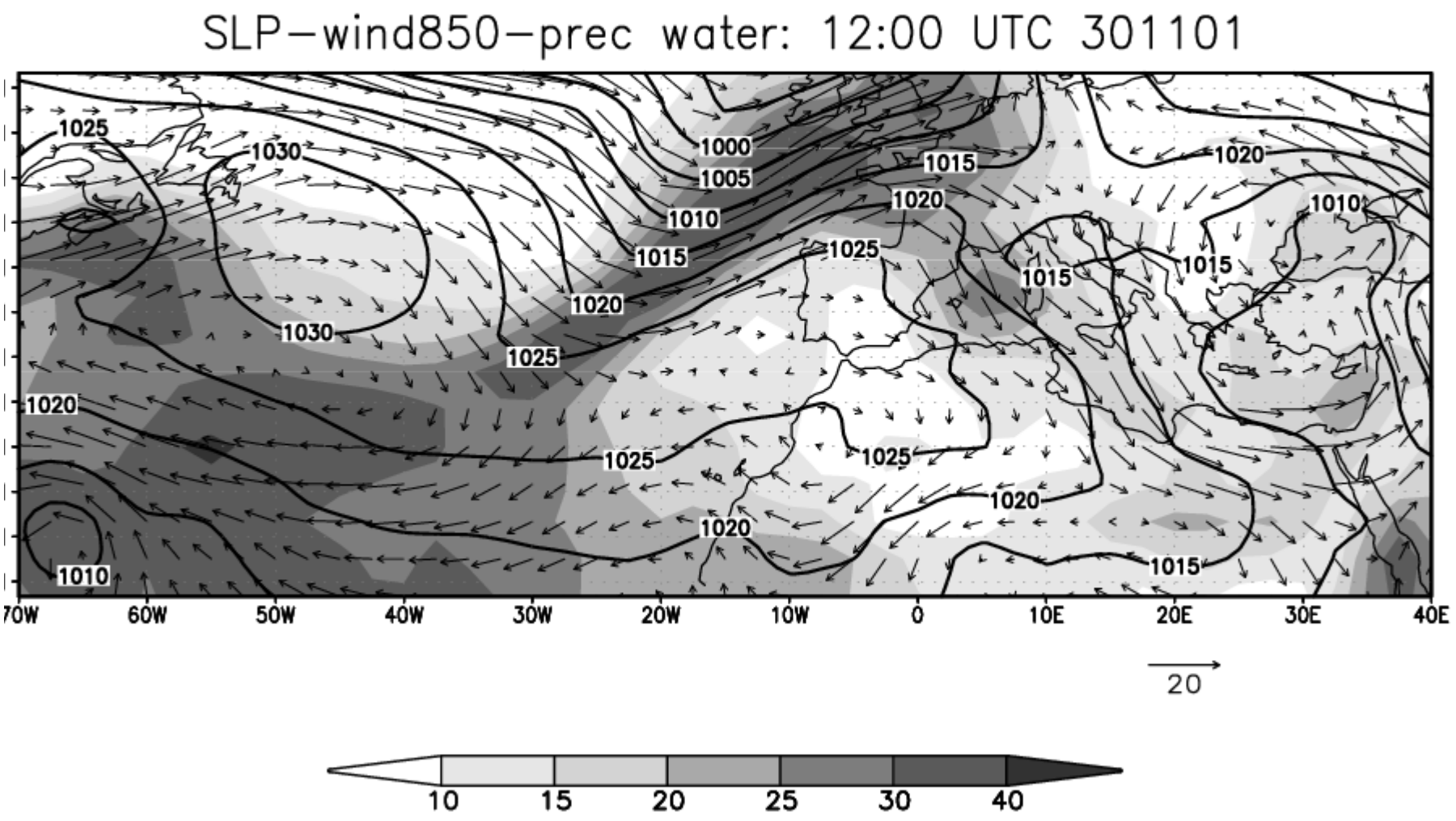
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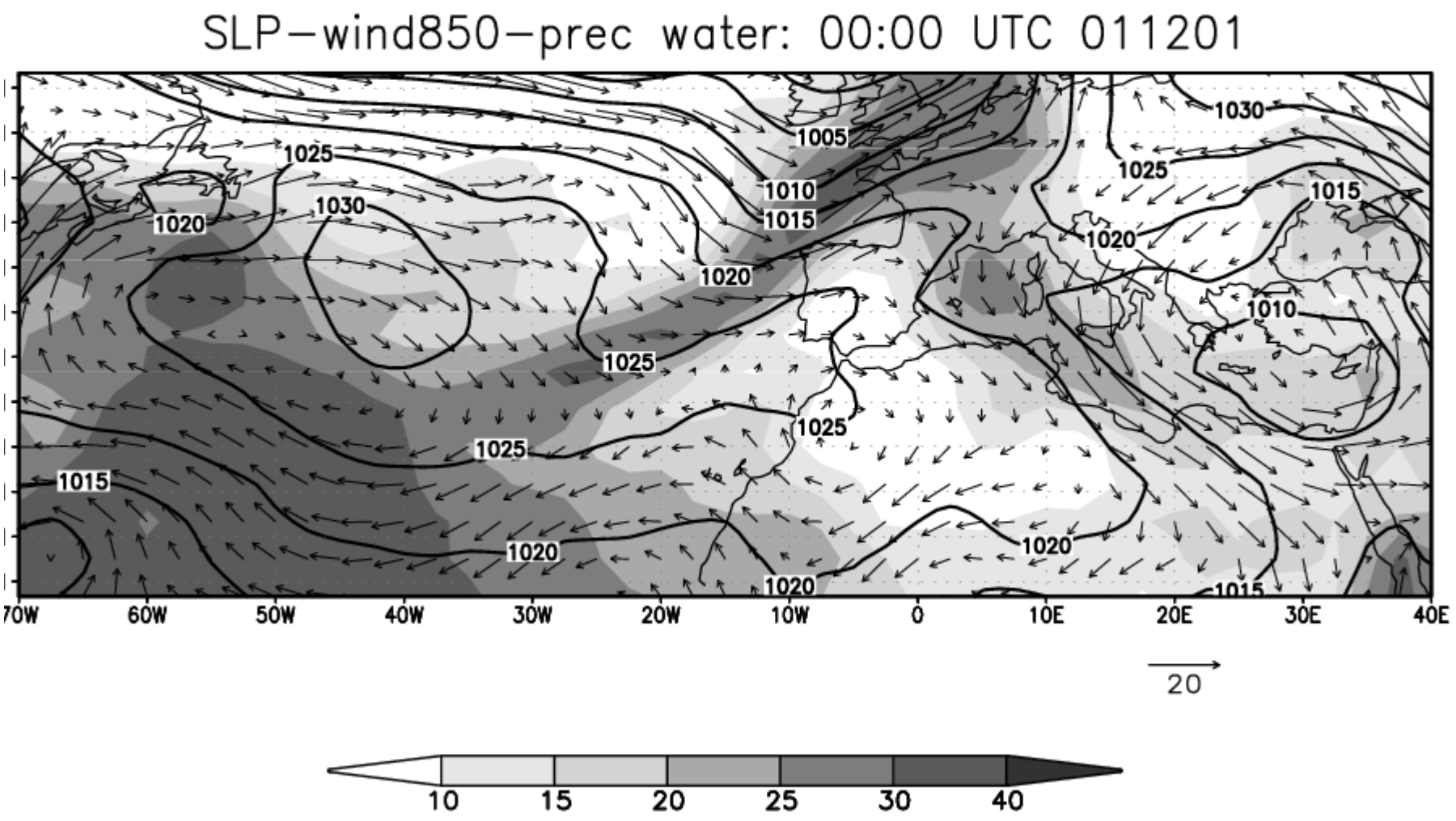
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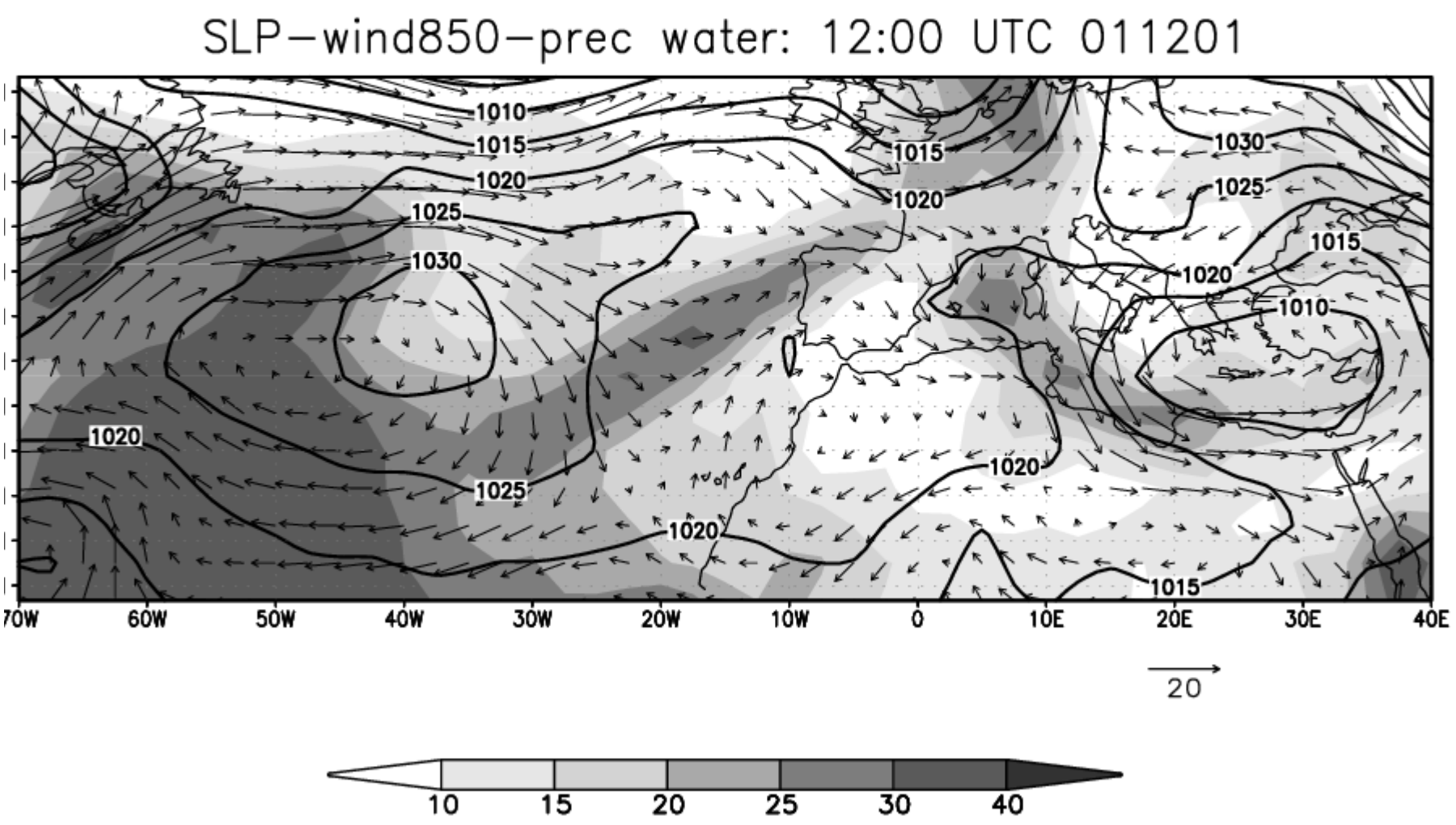

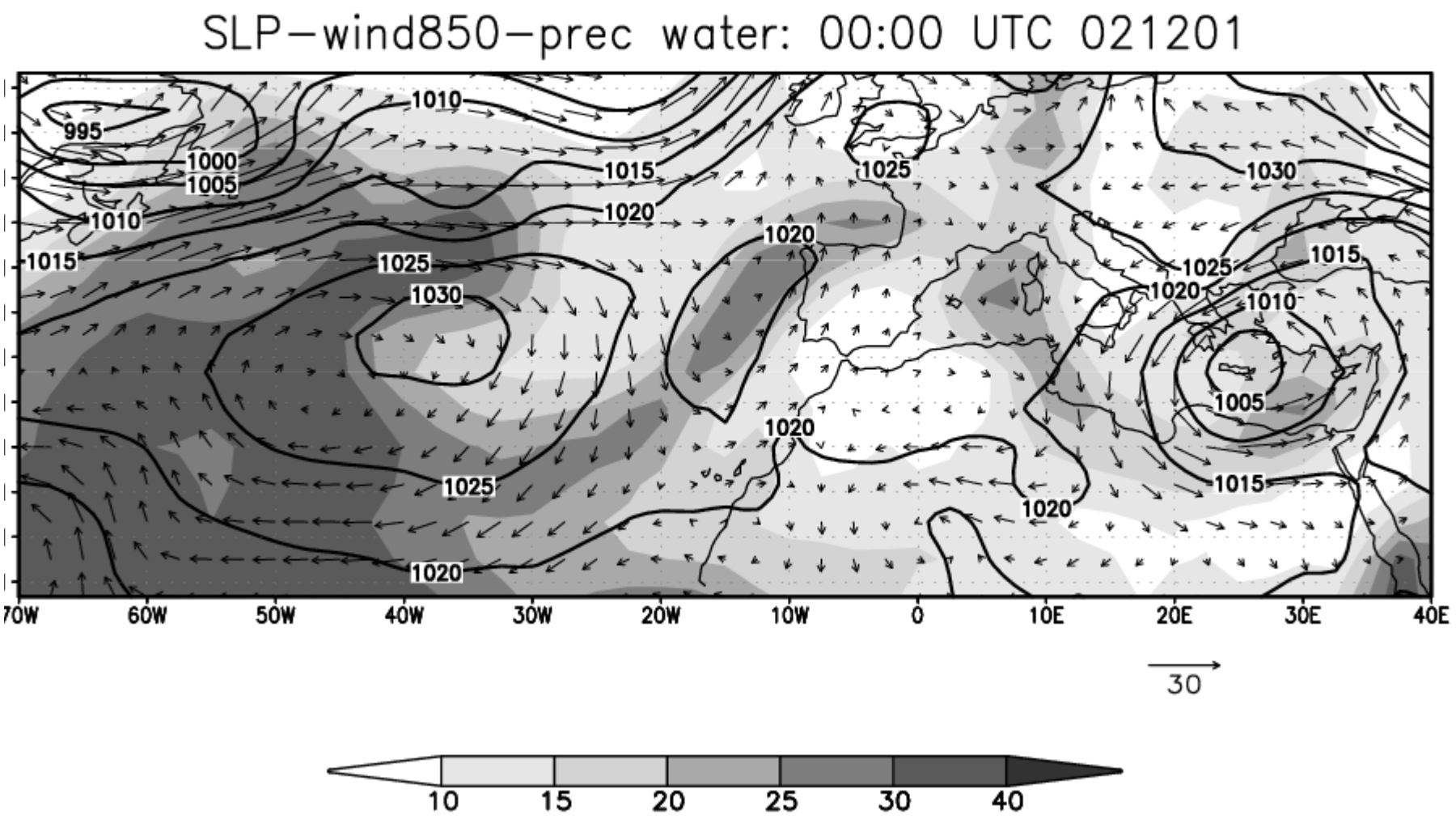
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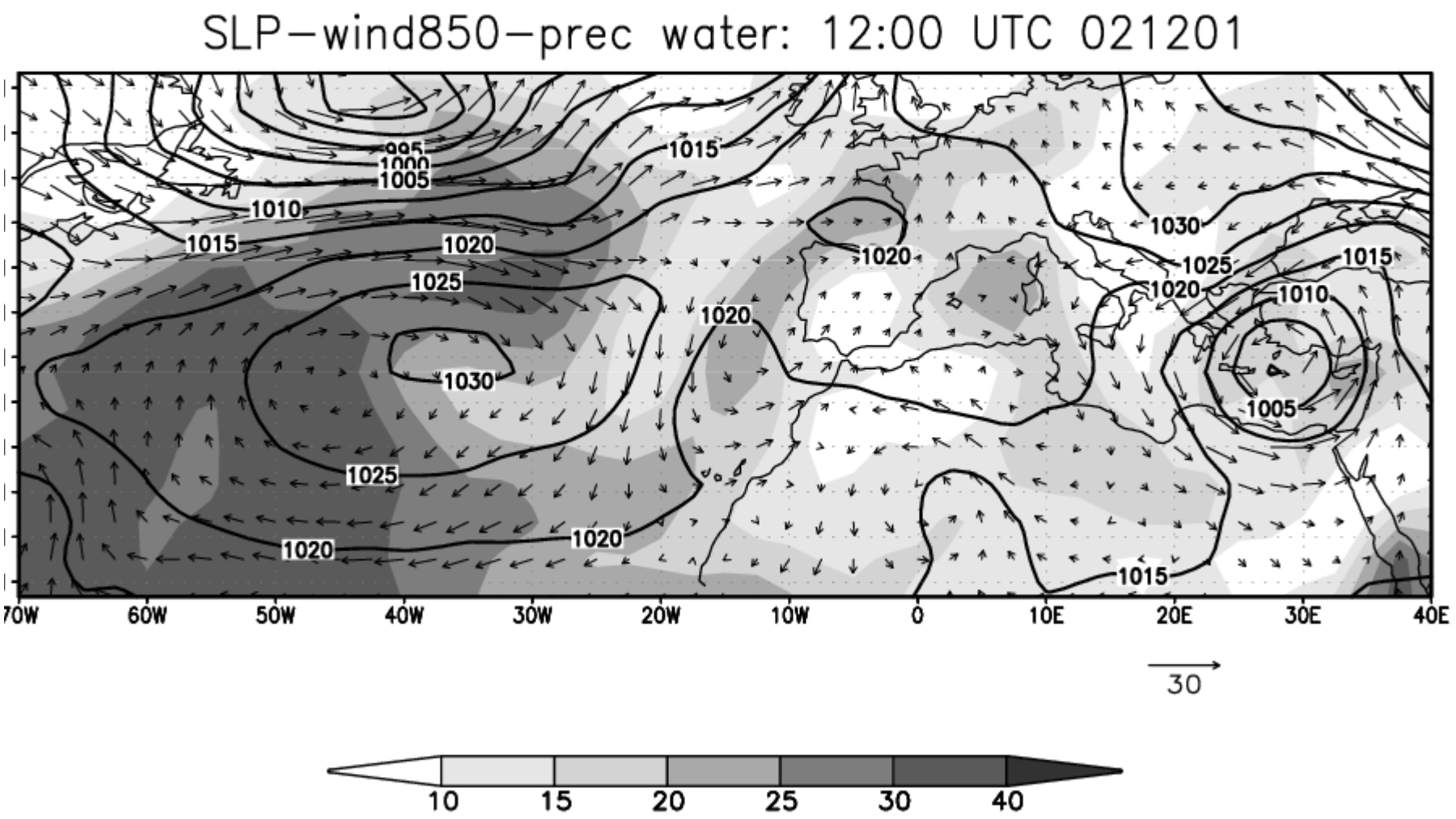
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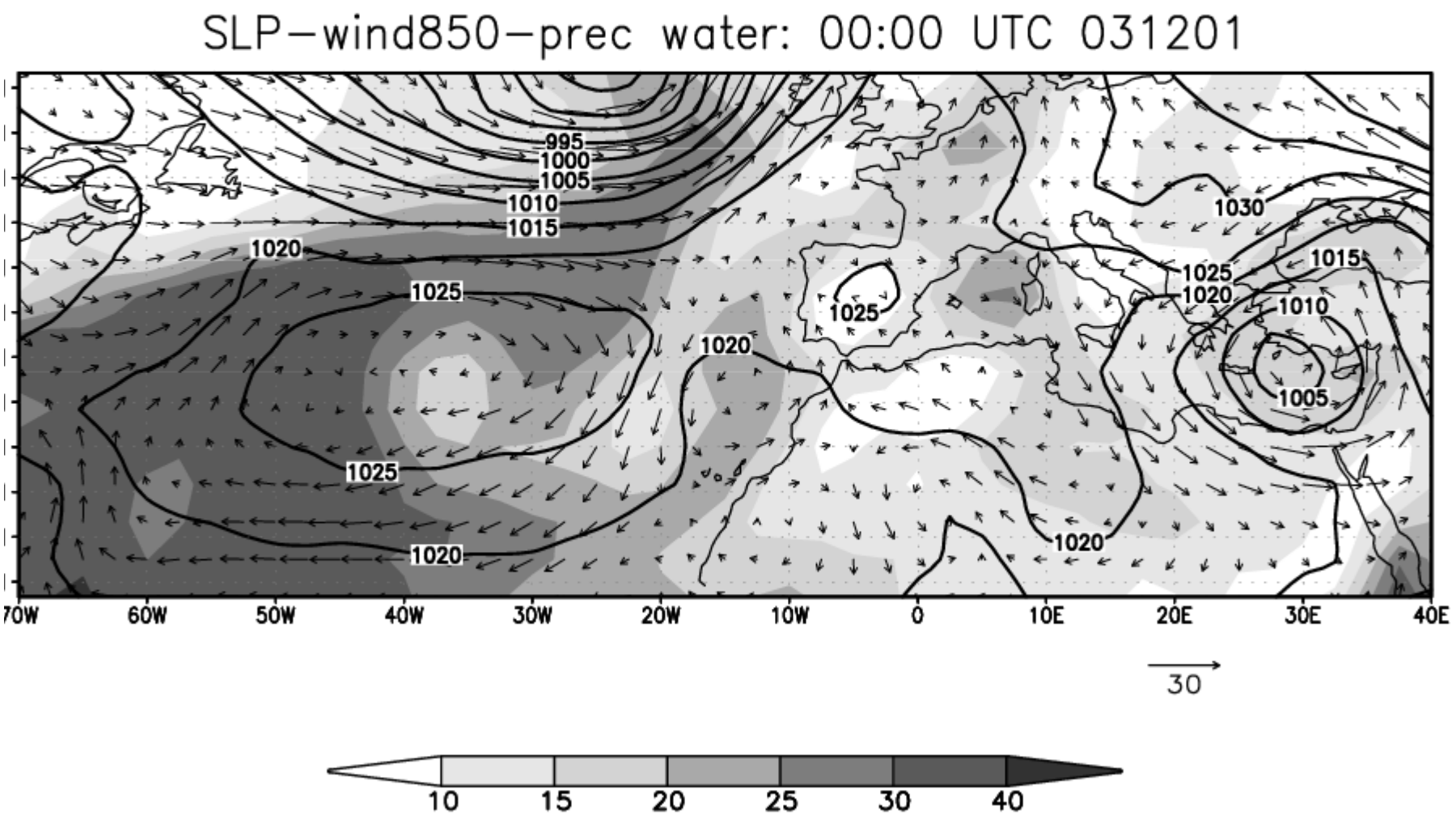
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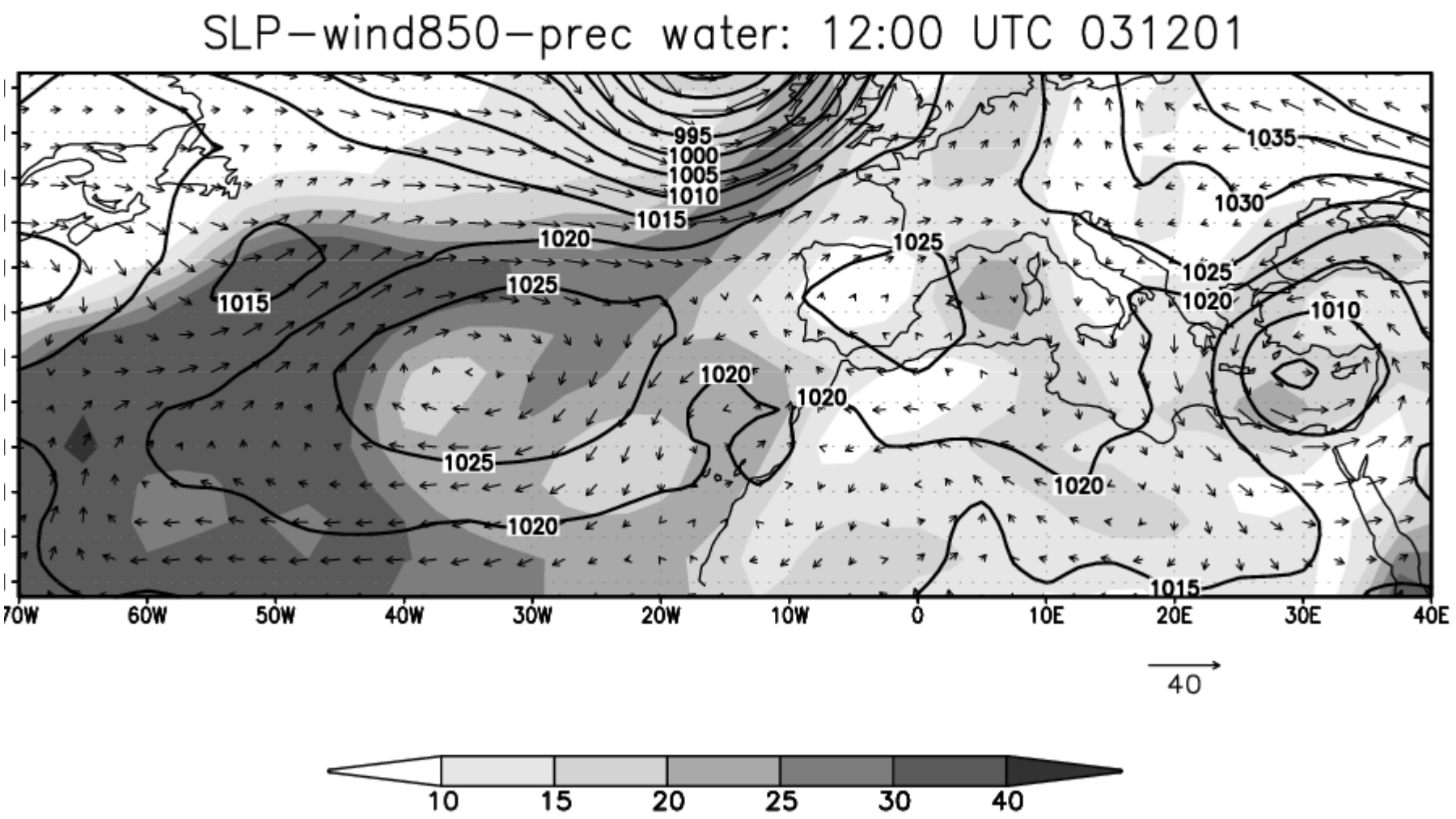

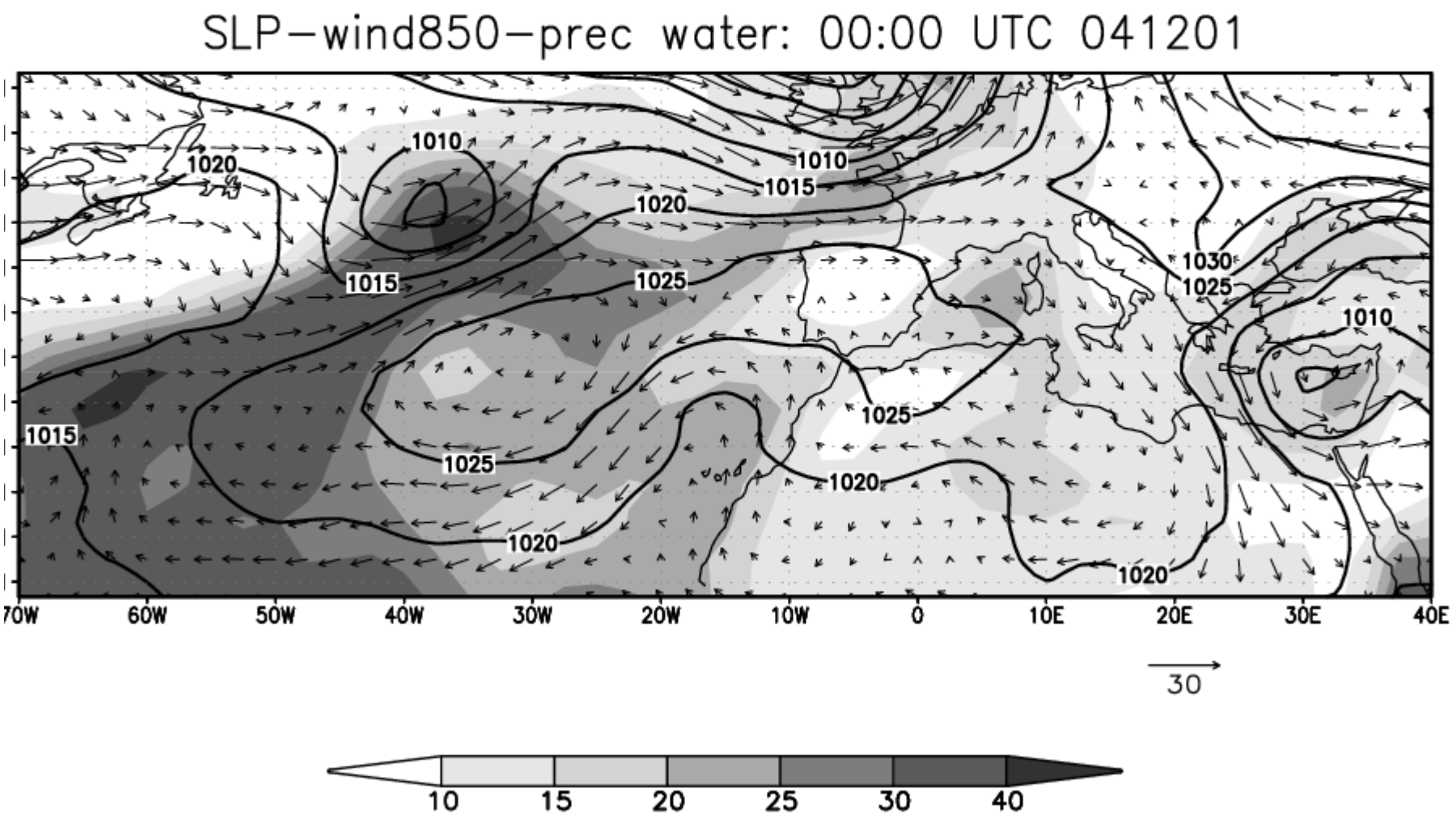
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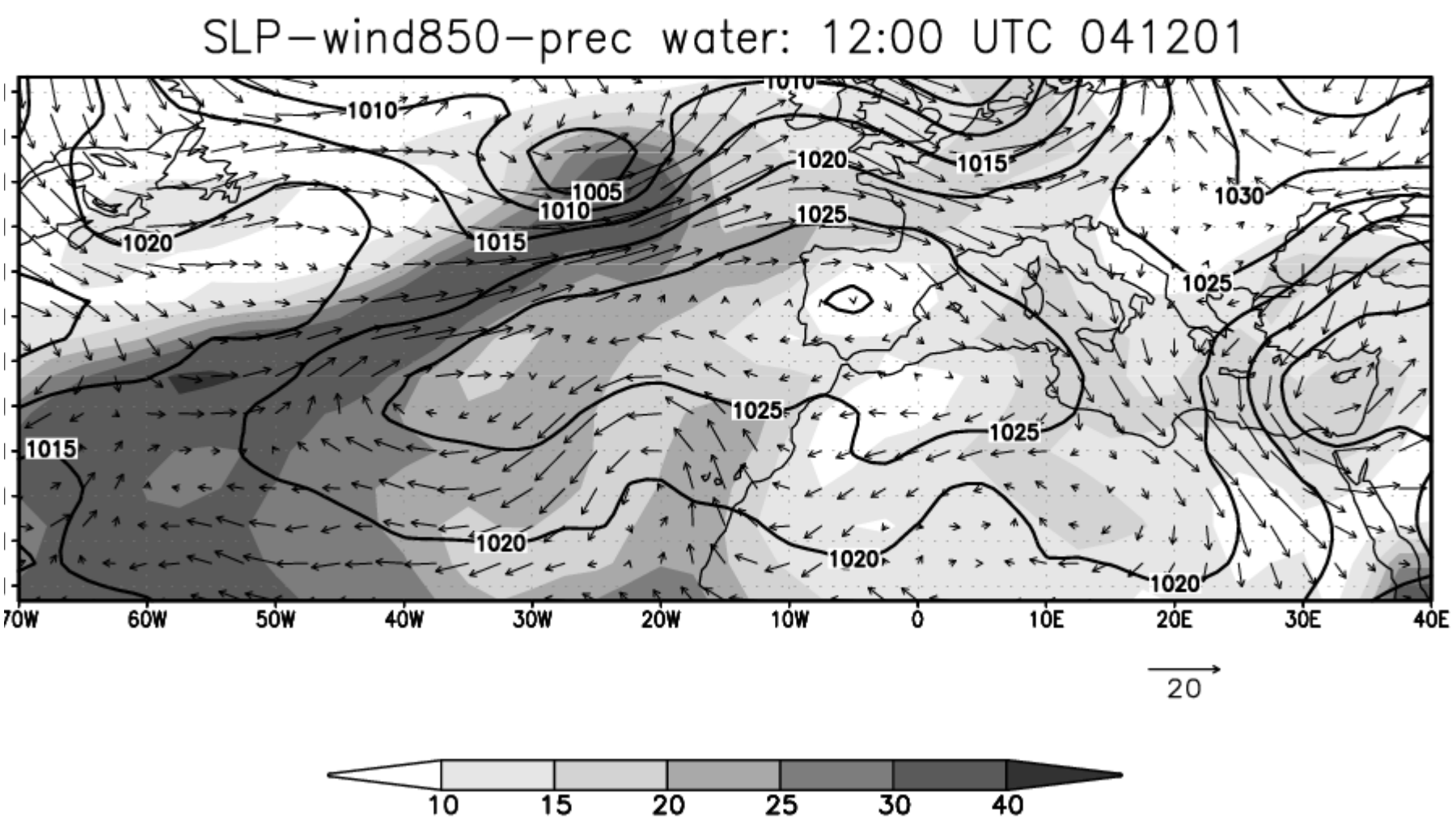
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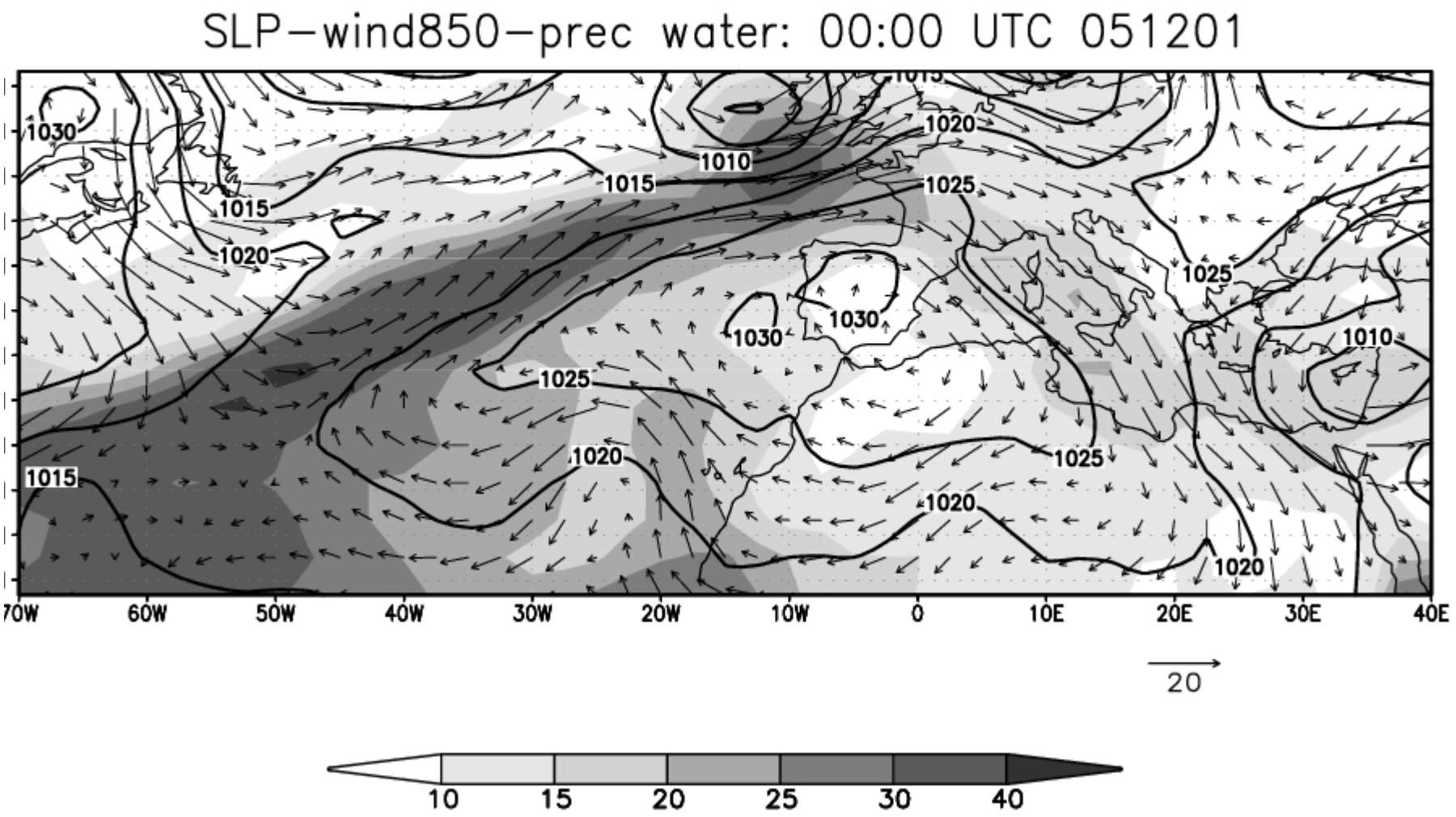
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Conclusion # 1

The PRWT is advected from the region of the Atlantic very far to the north-east. Much further than usual.

Why?

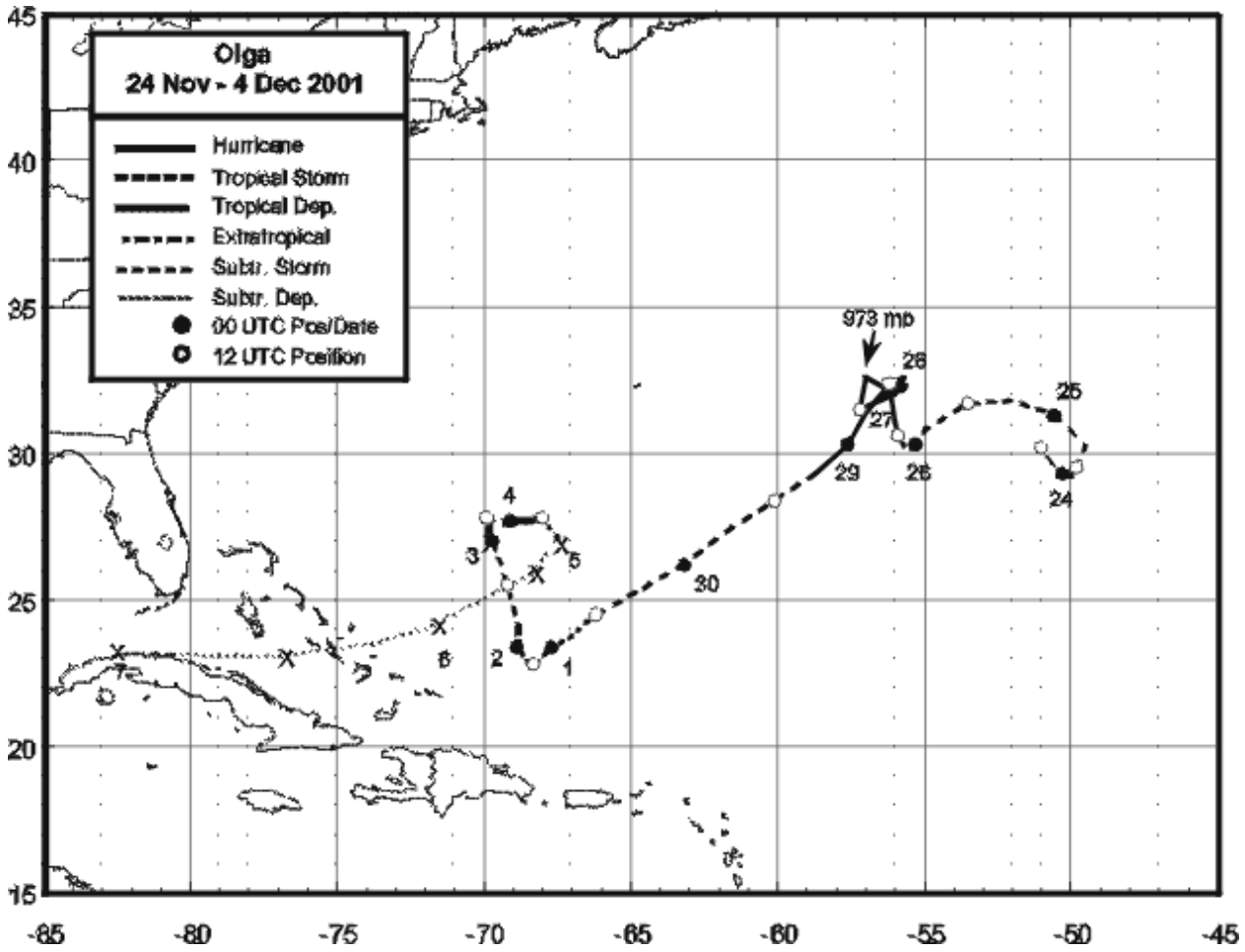
Hurricane Olga

November 24 Tropical storm;

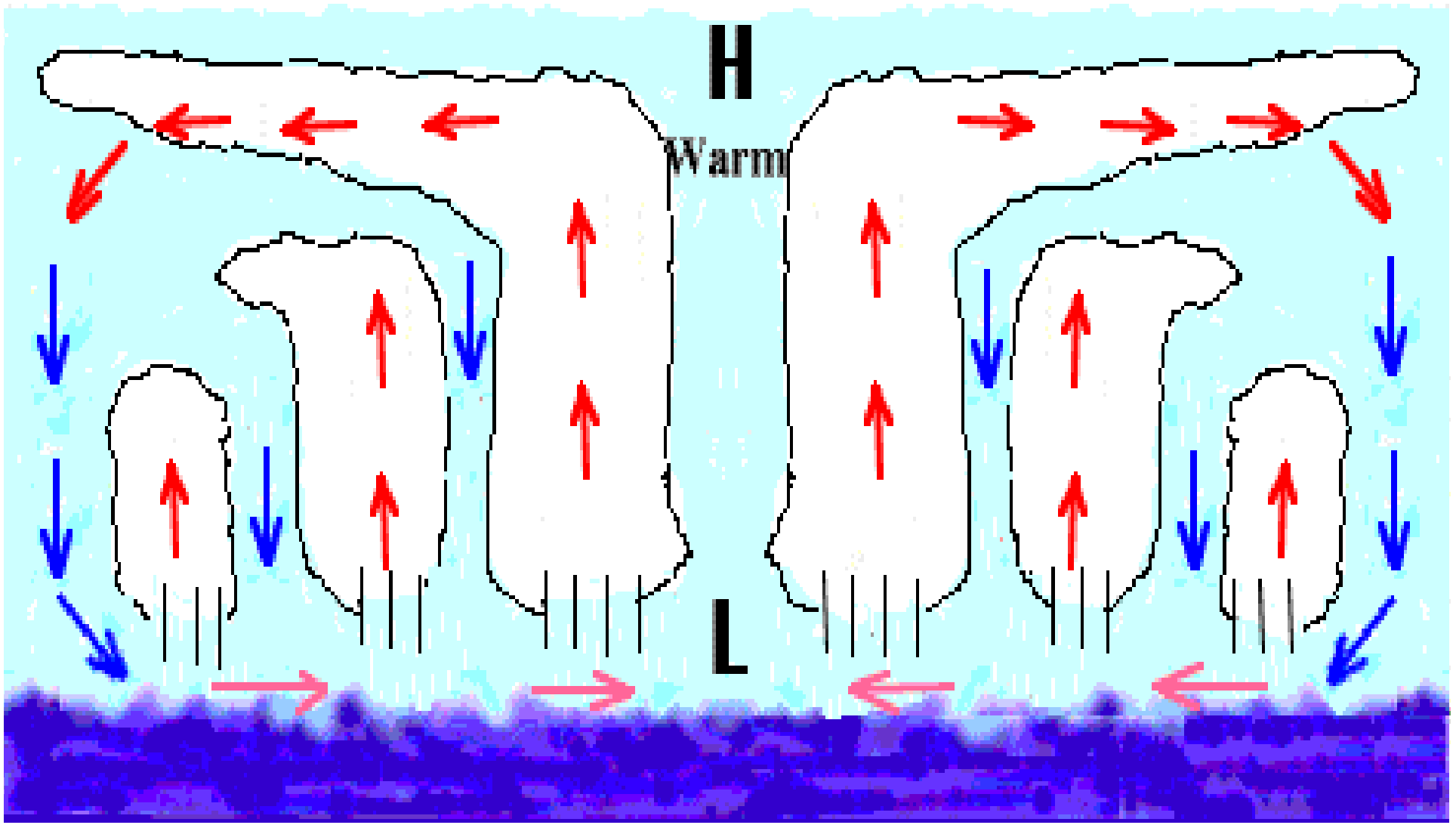
November 27 – 29 - Hurricane;

November 30 – December 4 – Tropical storm

Hurricane Olga

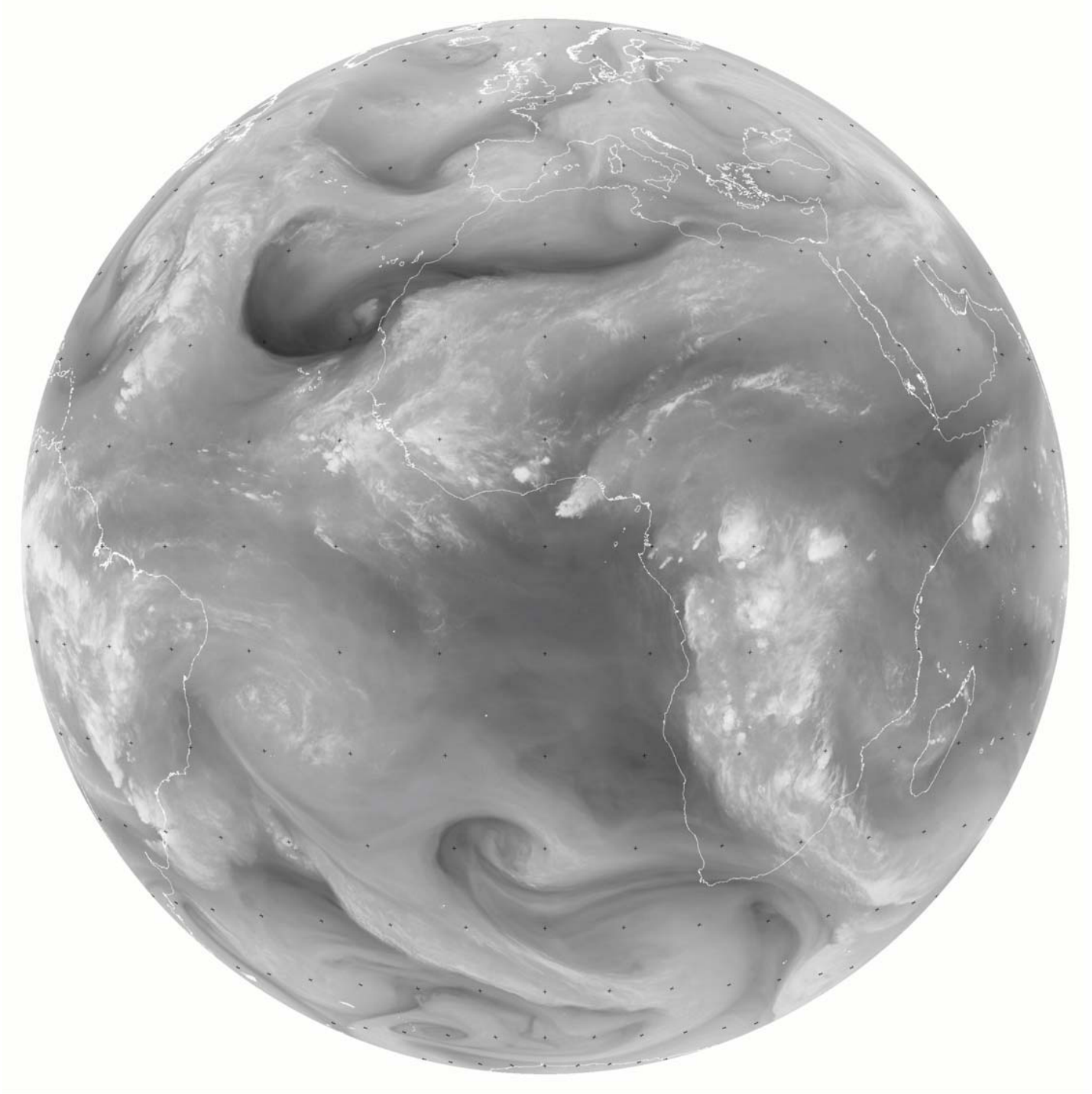


Circulation in a hurricane



Meteosat – 7

WV imageries



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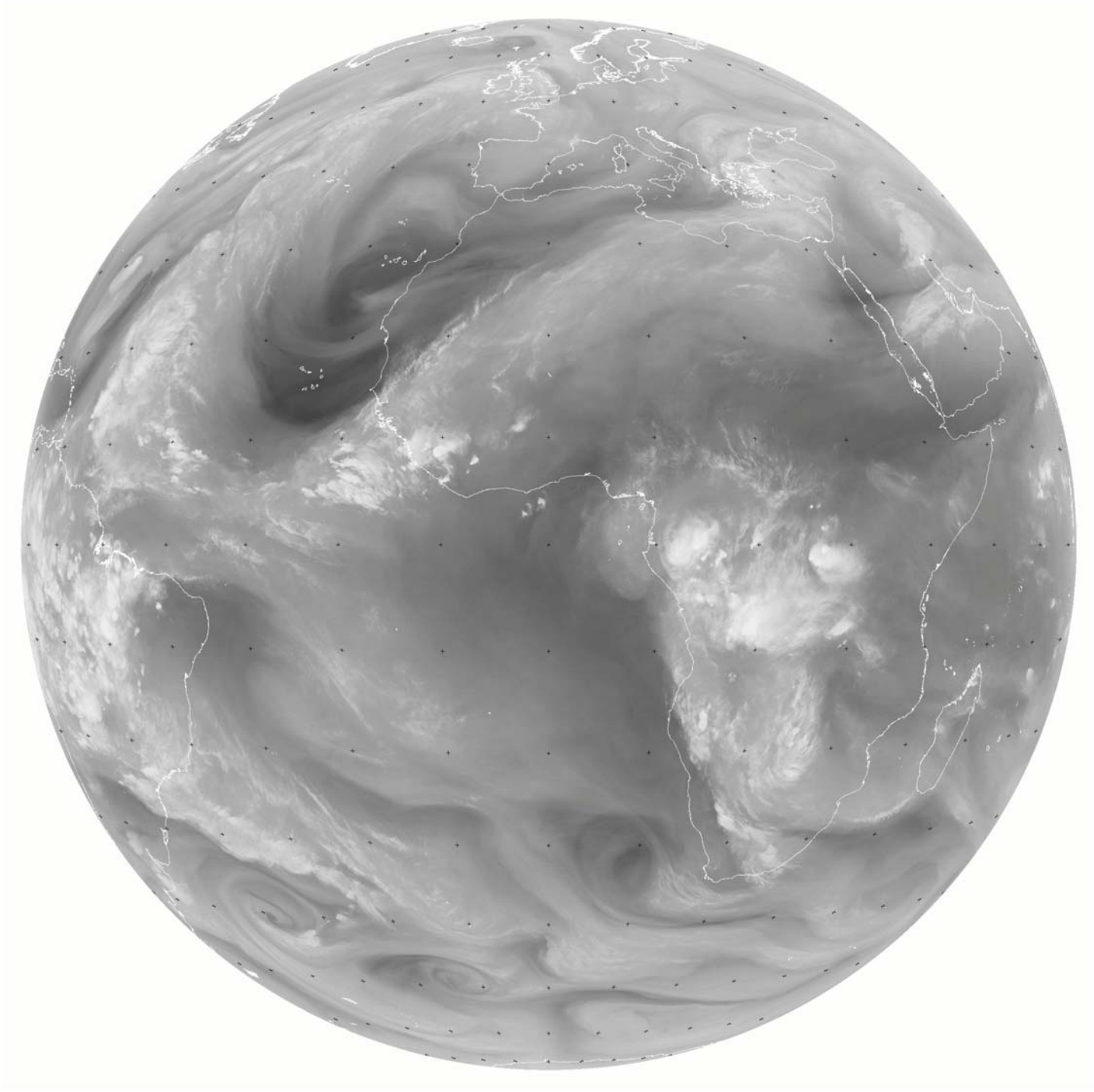

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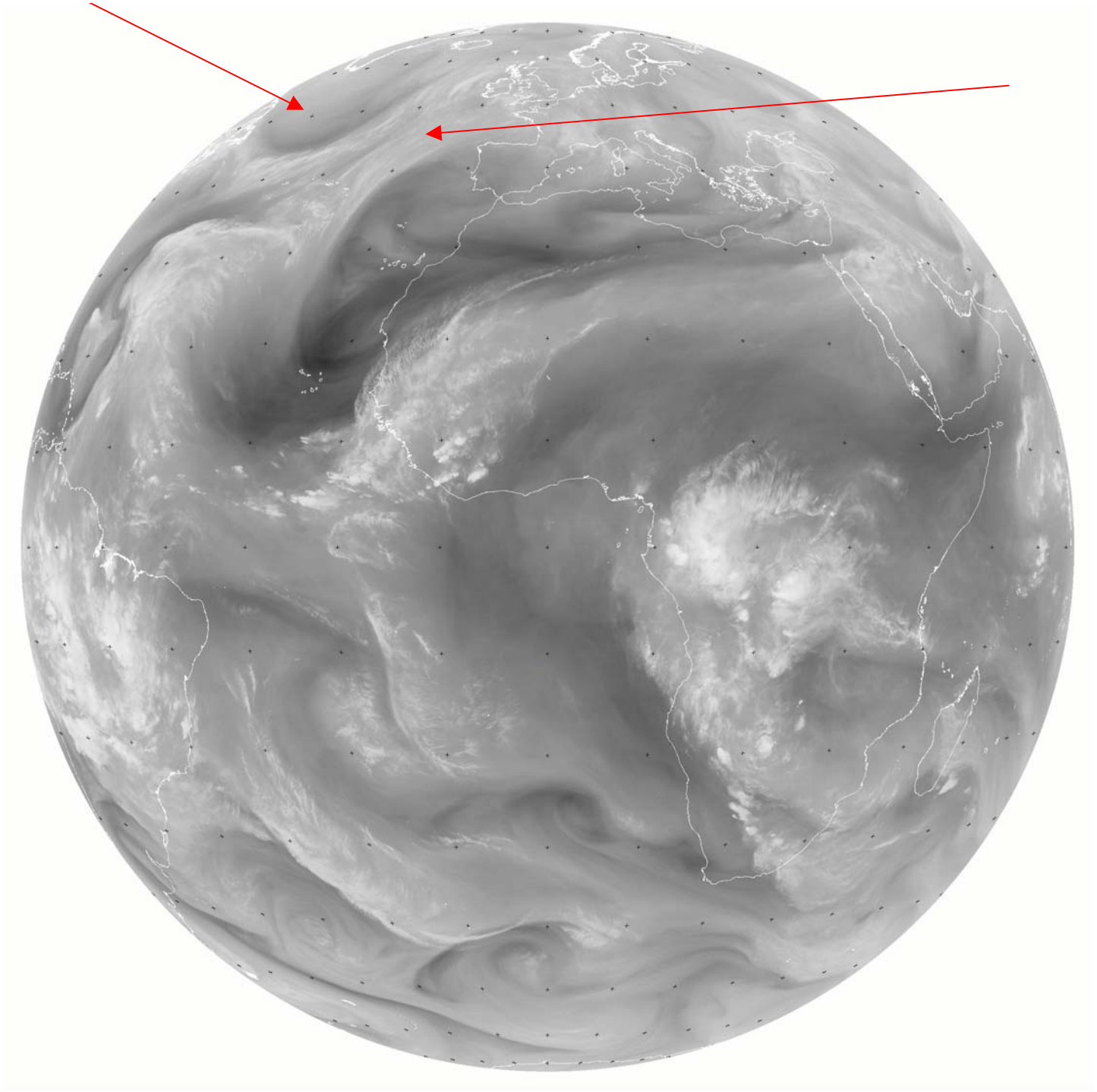

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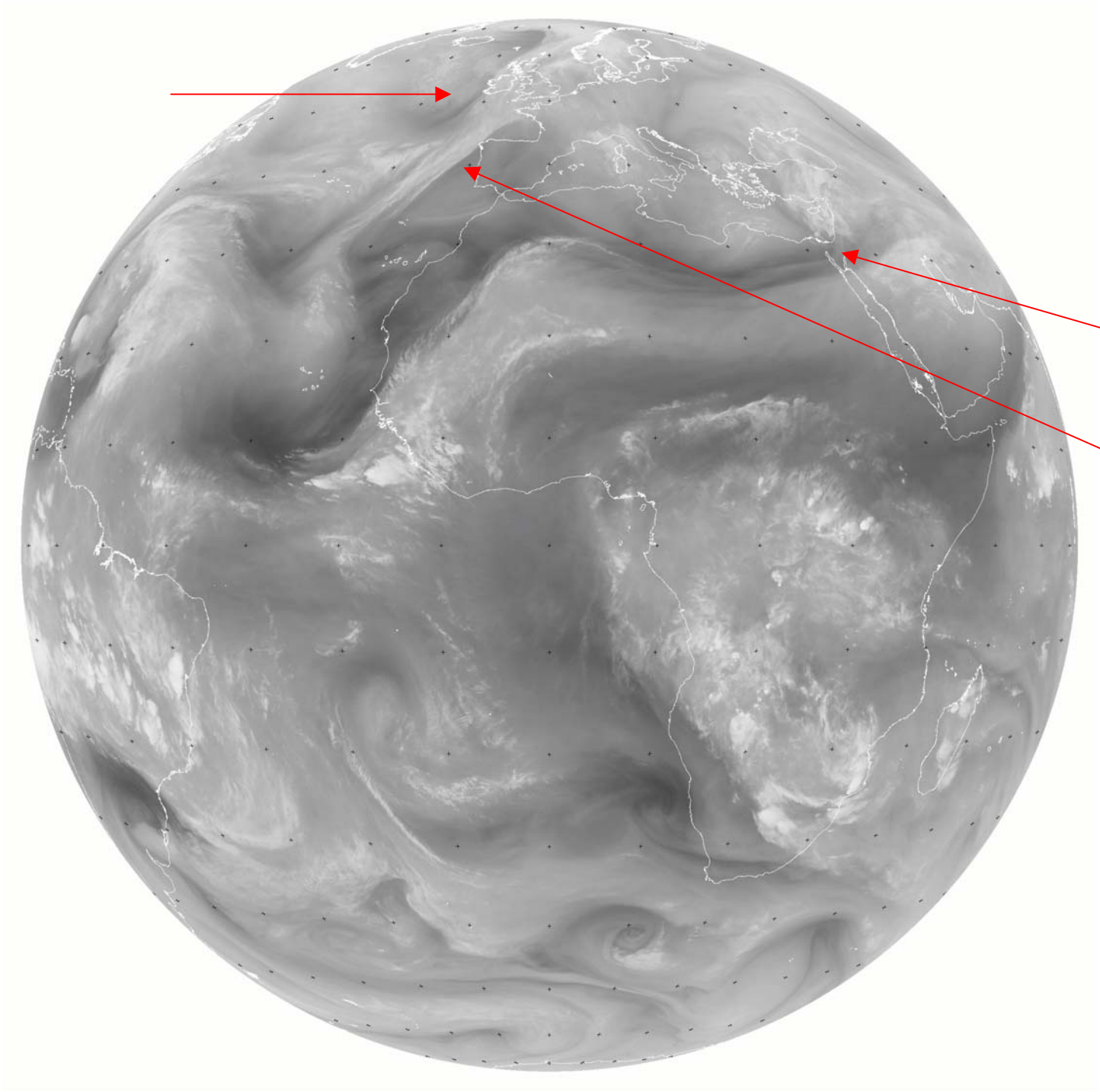
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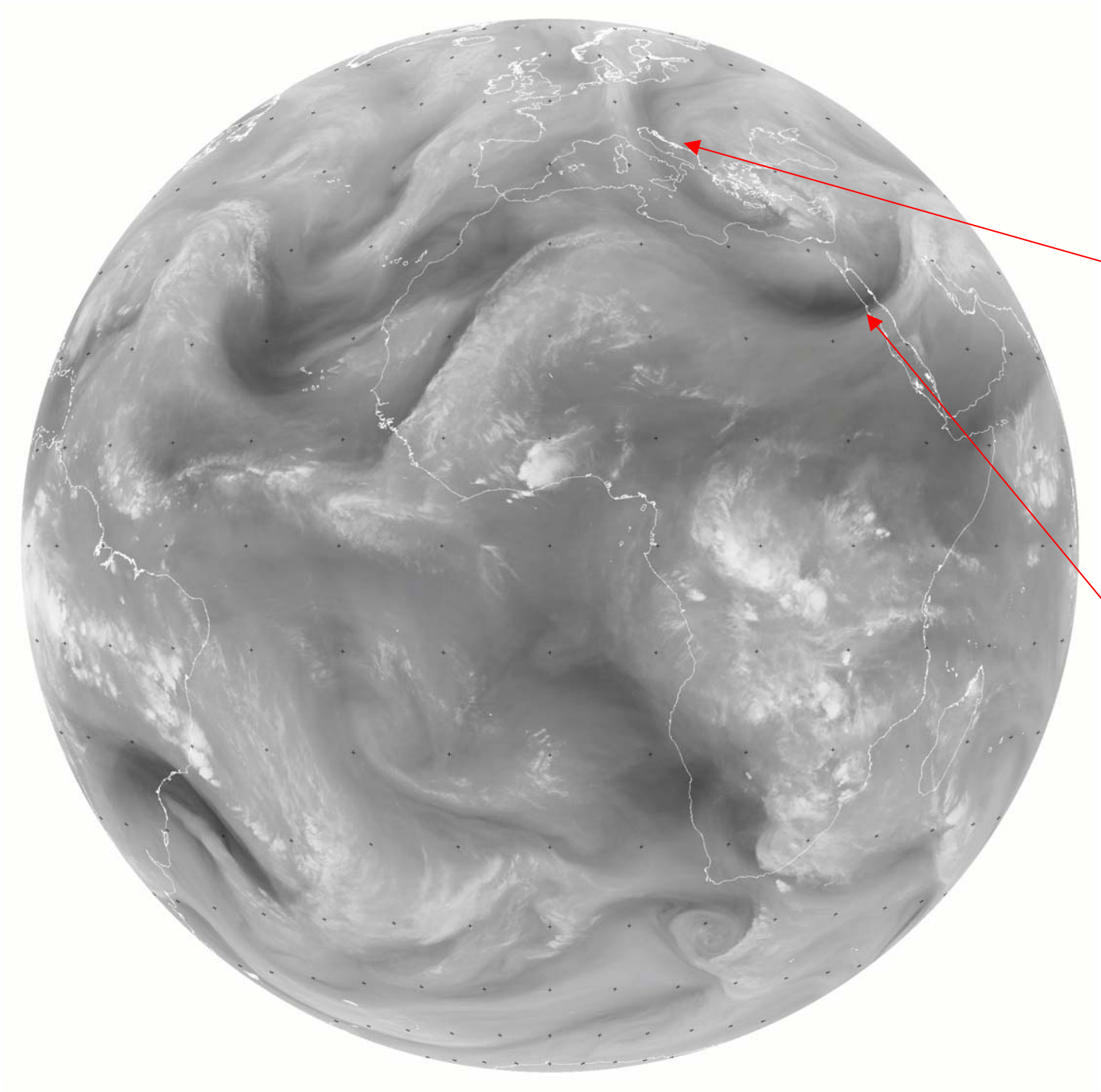
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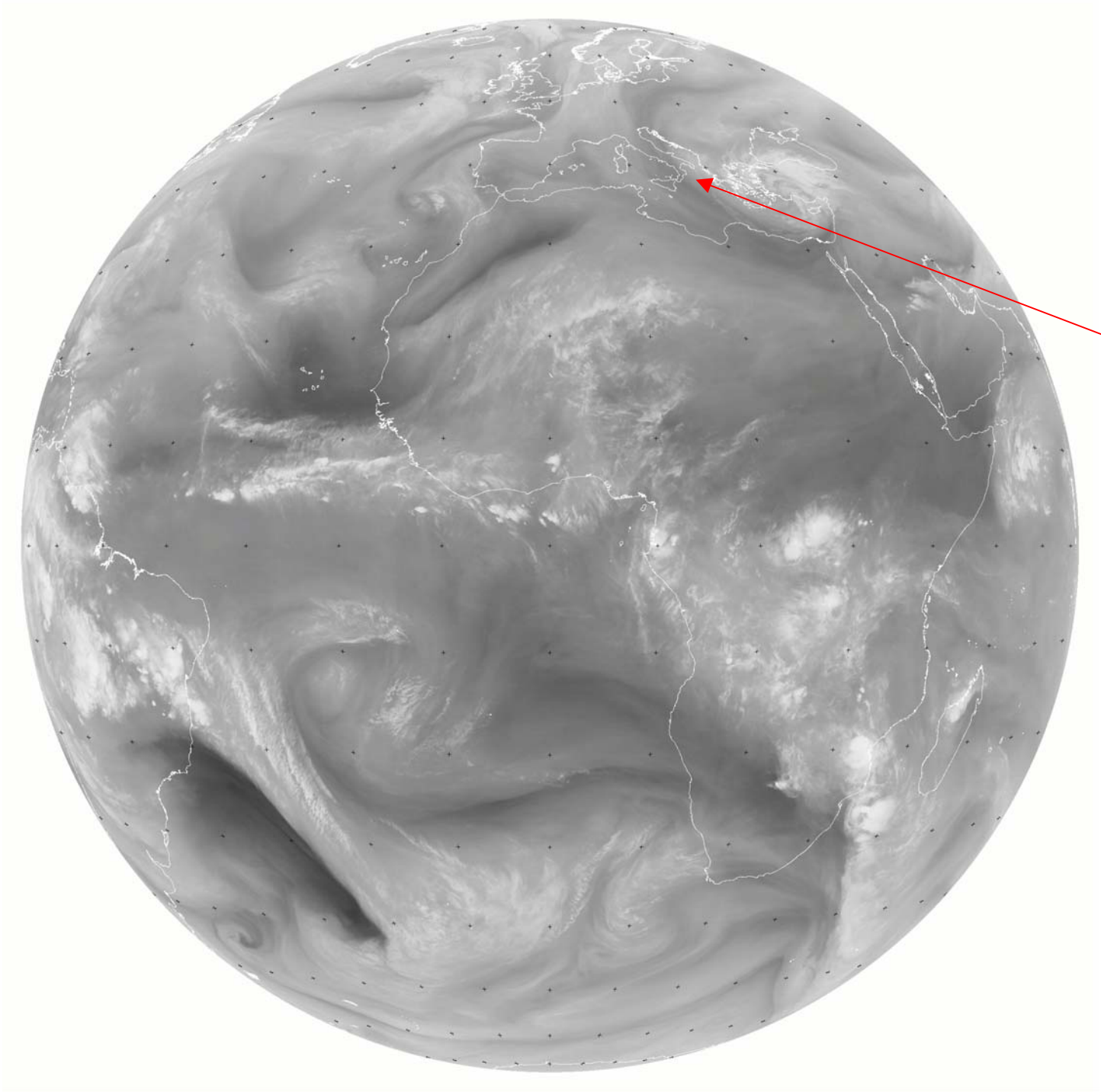
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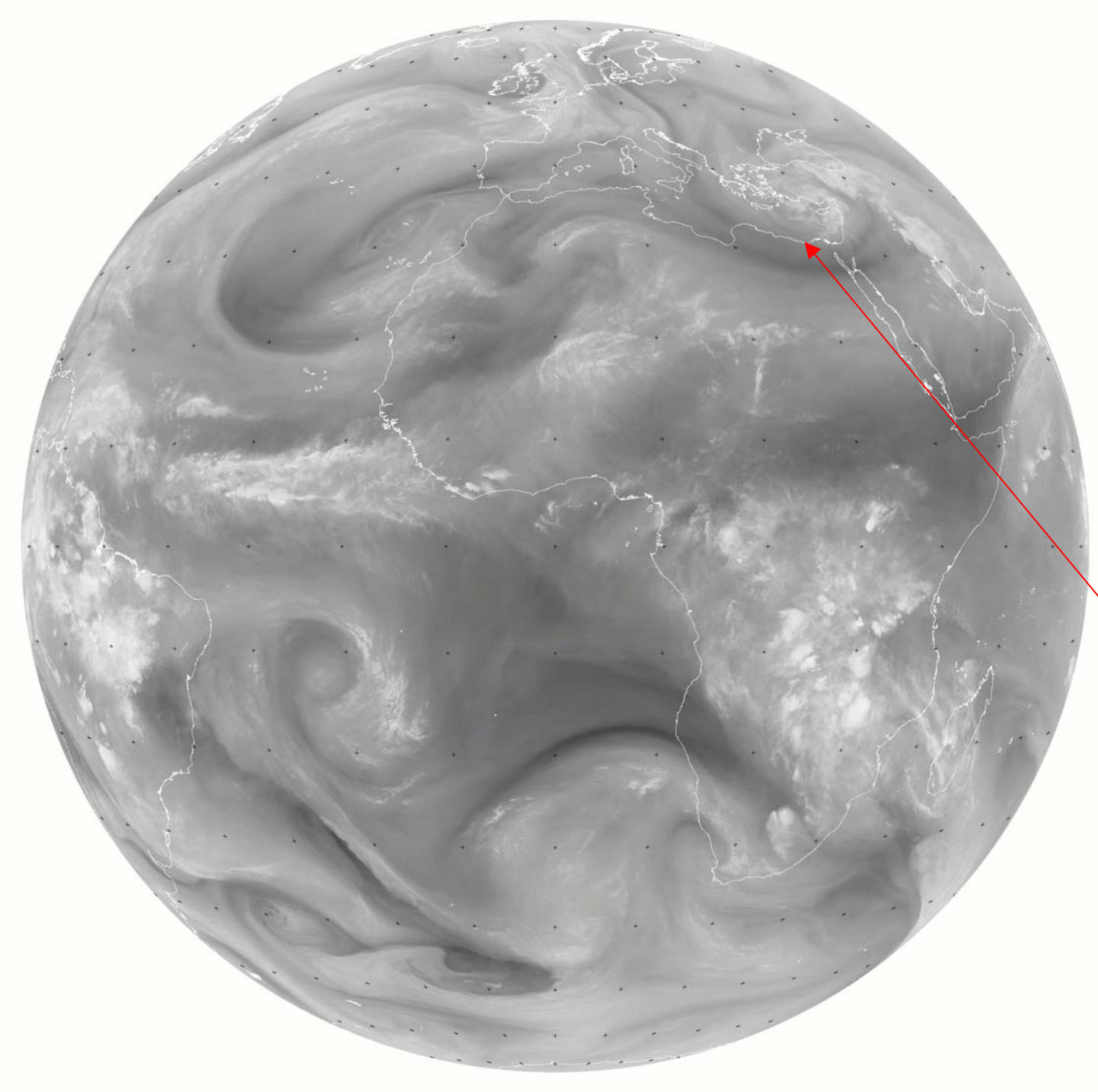
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Intensification of the Iceland Low/Siberian High system

Conclusion #2

Intensification of the Iceland Low/Siberian High system was associated with an inflow of Olga's wet air masses to the polar region;

Dynamic Tropopause analysis

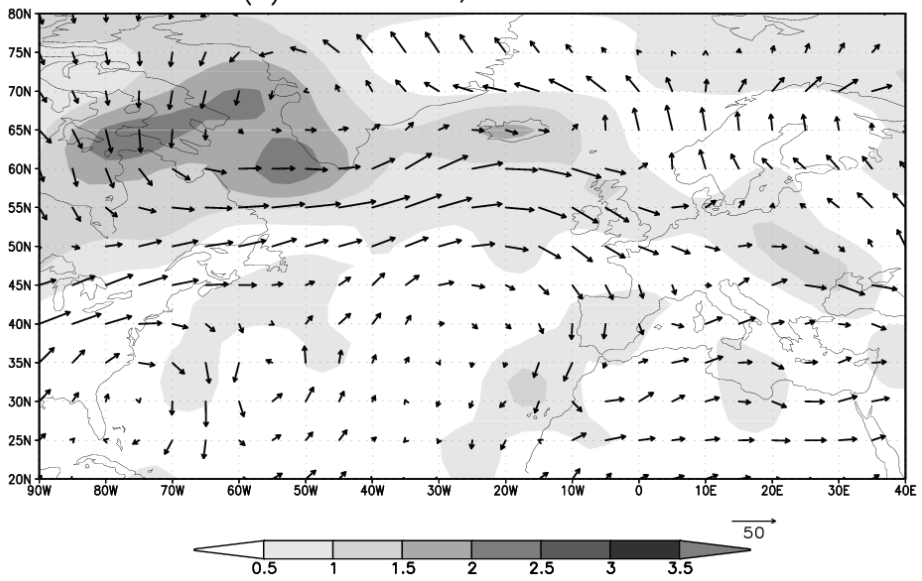
Ertel:

$$P = -g(f + \zeta_\theta)\left(\frac{\partial \theta}{\partial p}\right) \approx \frac{(f + \zeta_\theta)}{-\left(\Delta p / \Delta \theta\right)/ g}$$

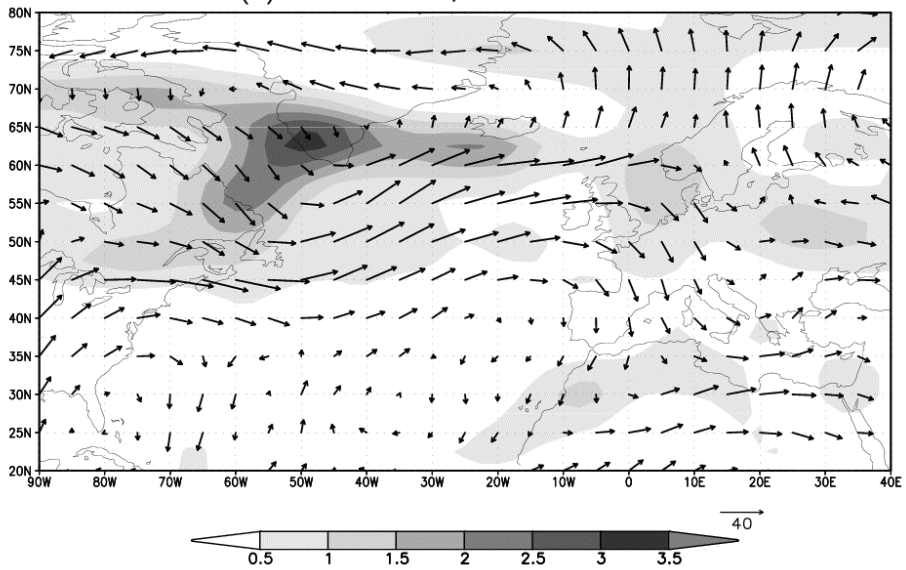
Vorticity times static stability

Formation and eastward drift of a PV anomaly

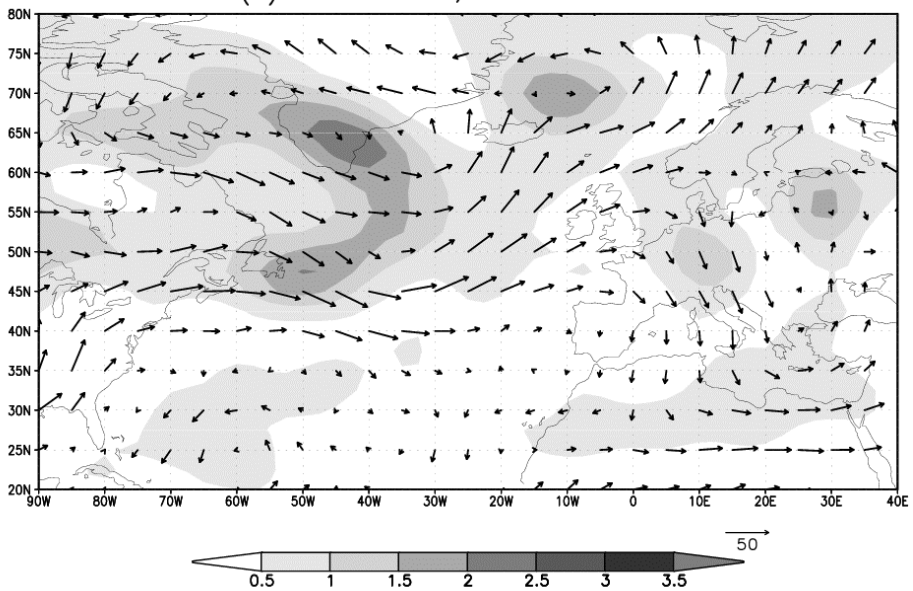
(b) PV500−600; V500 00281101



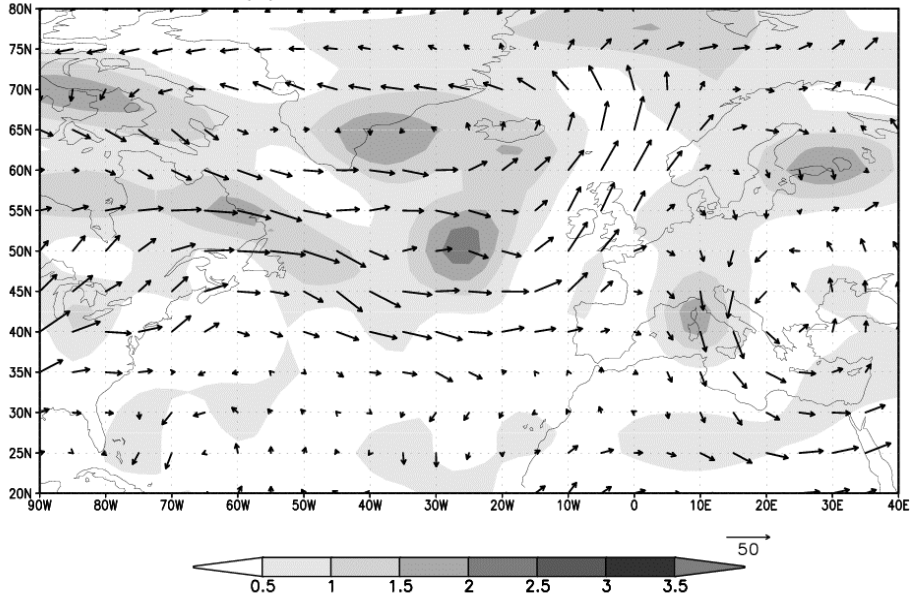
(c) PV500−600; V500 00291101



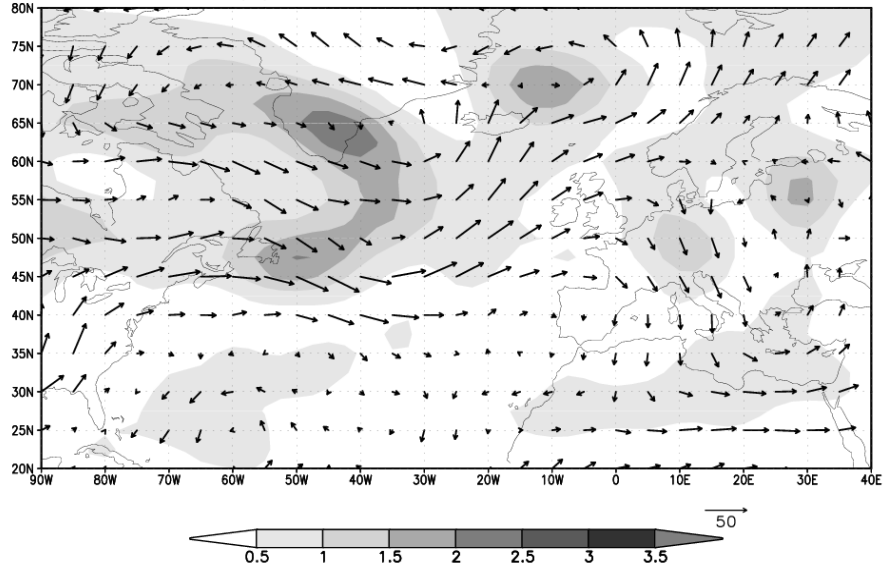
(d) PV500−600; V500 00301101



(e) PV500−600; V500 00011201

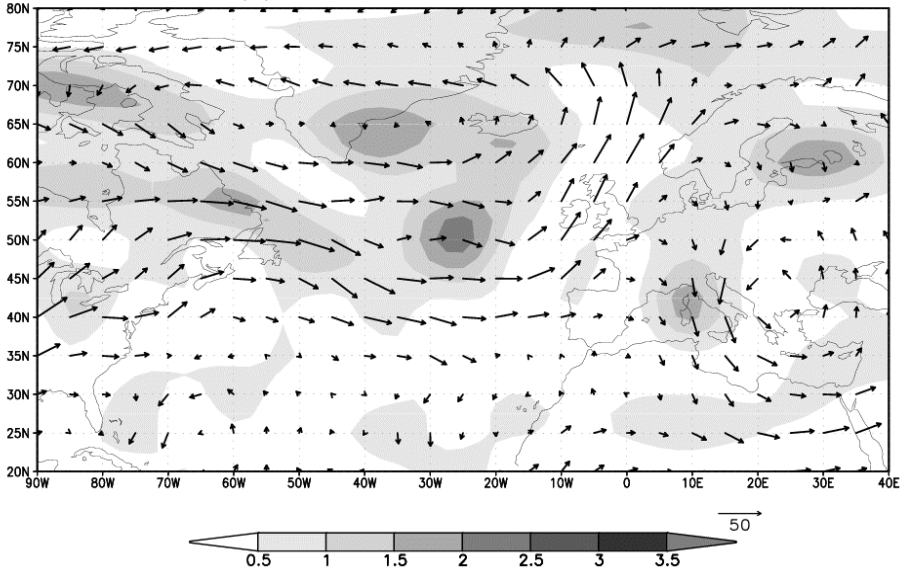


(d) PV500−600; V500 00301101

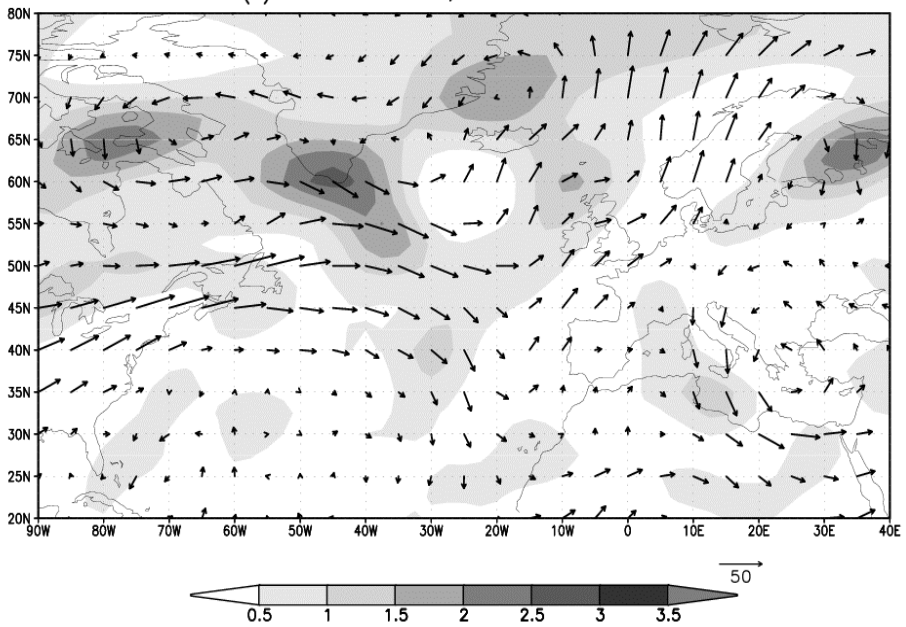


GrADS: COLA/IGES

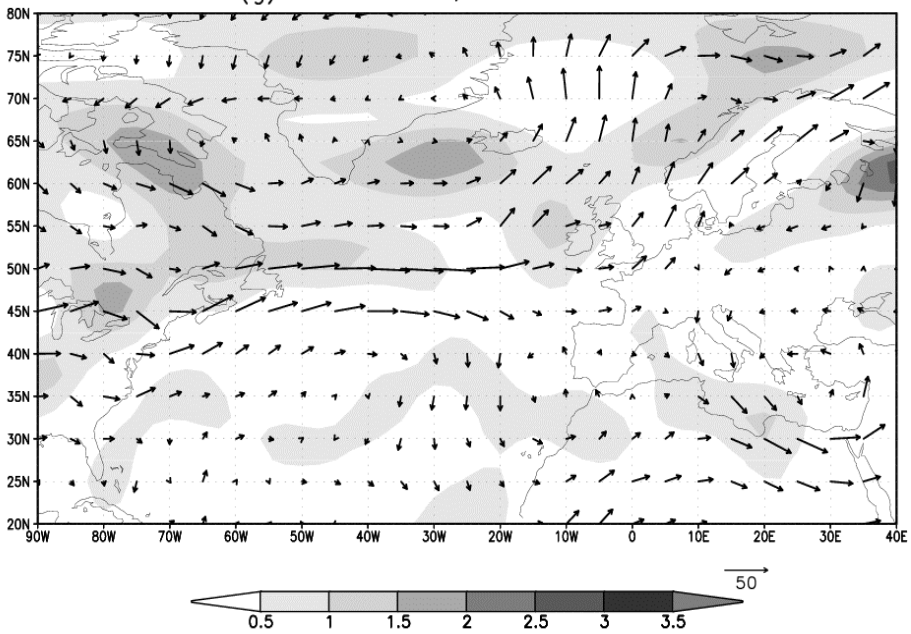
(e) PV500−600; V500 00011201



(f) PV500−600; V500 00021201

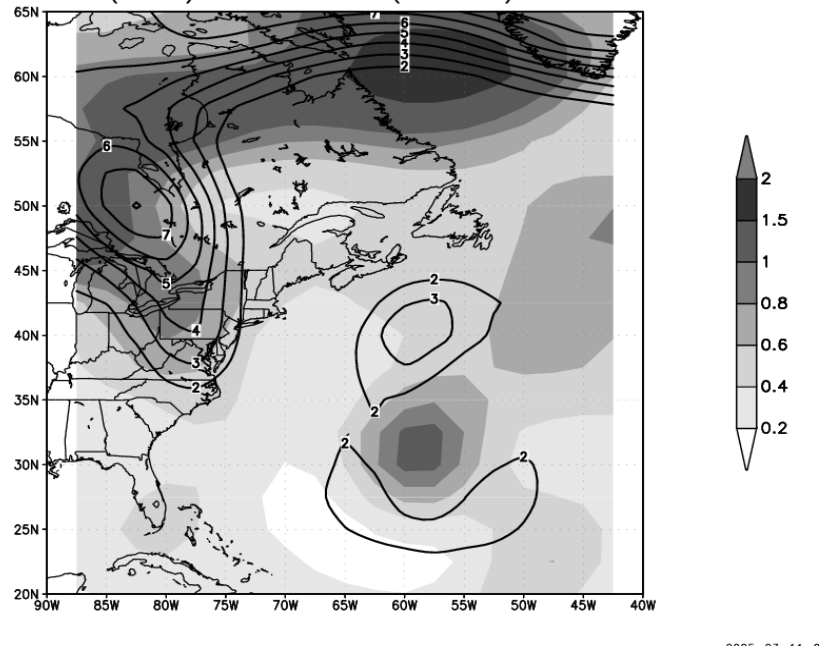


(g) PV500−600; V500 00031201

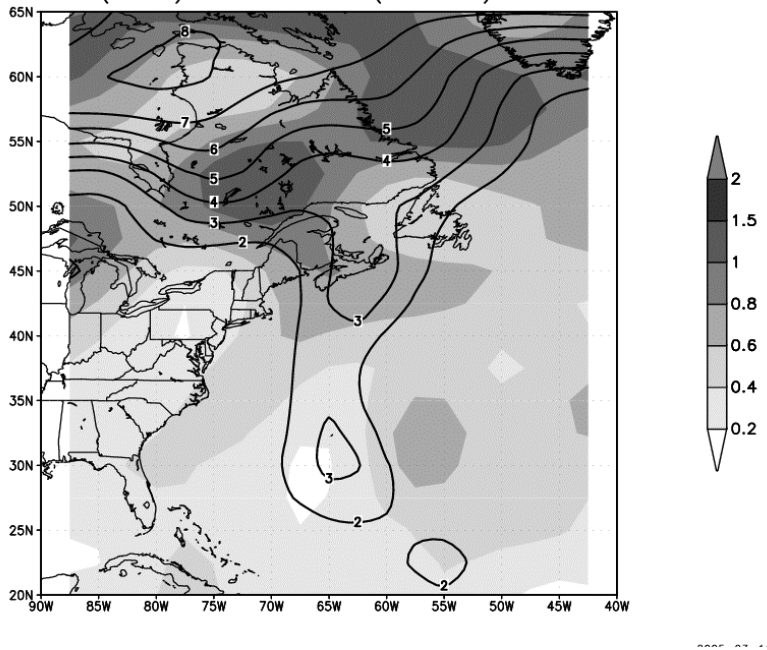


Olga’s role in the process

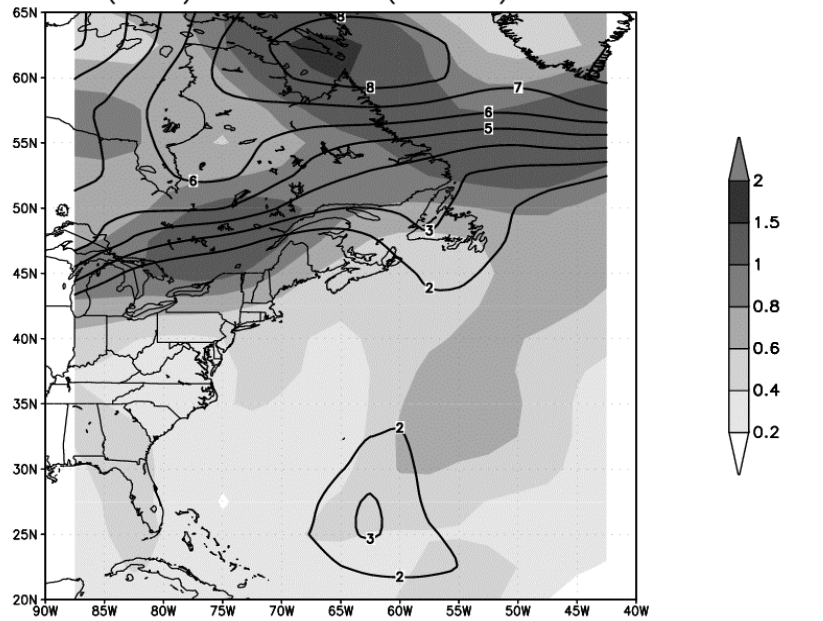
(b) PV200−300(solid) & 600−700(shaded) 00:00 UTC 261101



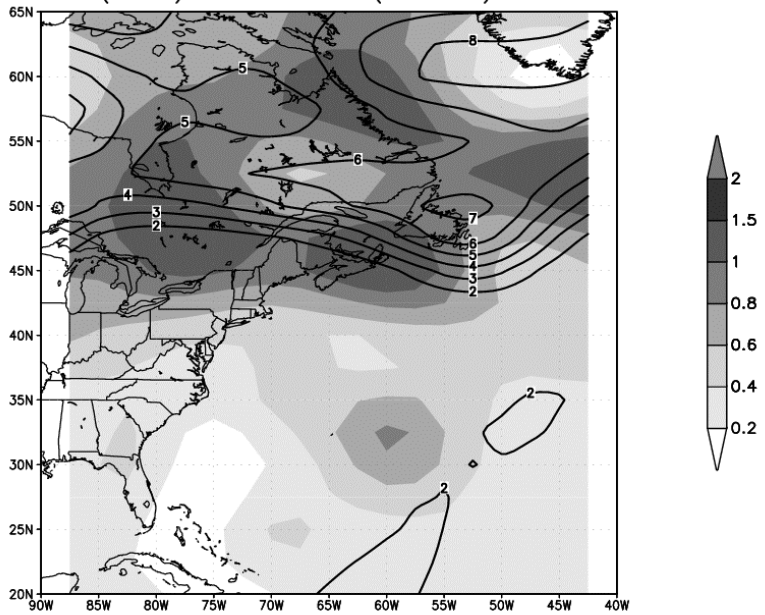
(c) PV200−300(solid) & 600−700(shaded) 00:00 UTC 271101



(d) PV200−300(solid) & 600−700(shaded) 00:00 UTC 281101



(e) PV200−300(solid) & 600−700(shaded) 00:00 UTC 291101



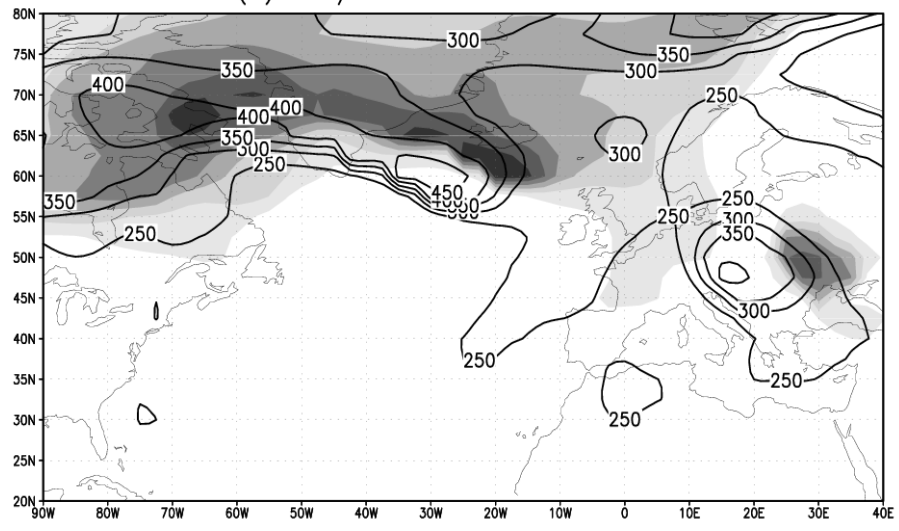
Dynamic Tropopause Maps

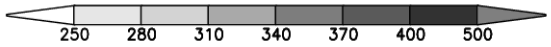
The dynamic tropopause is defined as the 1.5 PVU surface

1 PVU = 10^{-6} m^2 s^{-1} K kg^{-1}

Conventional Tropopause maps vs Dynamic Tropopause Maps

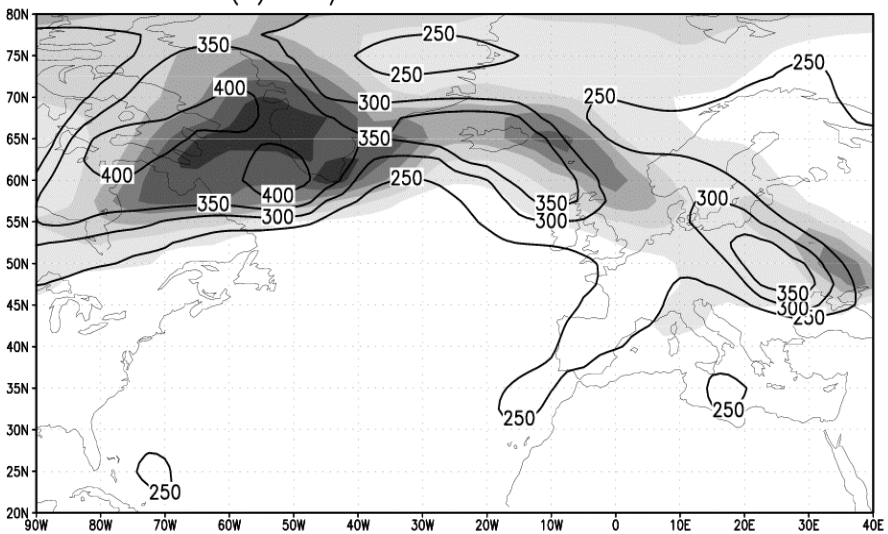
(a) DT / TT Pressures 00271101

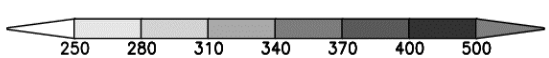




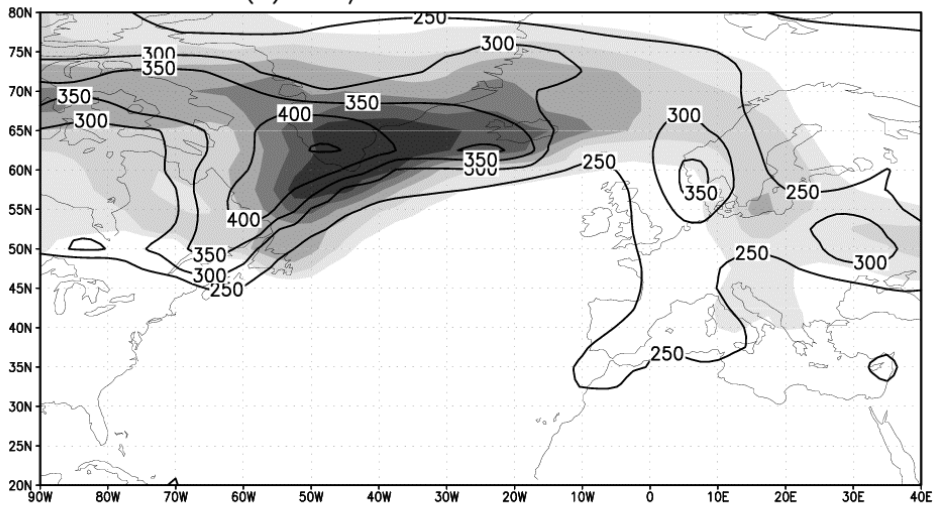
GrADS: COLA/IGES

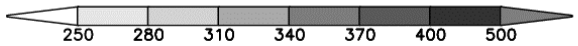
(b) DT / TT Pressures 00281101



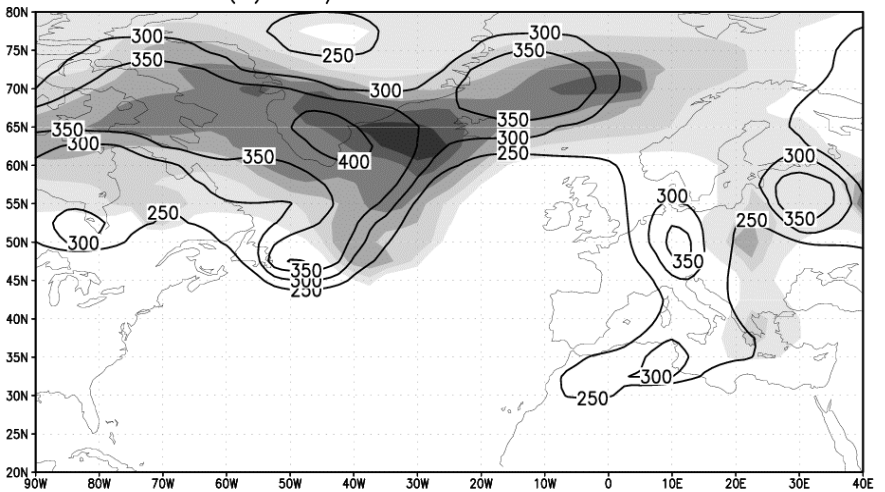


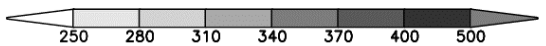
(c) DT / TT Pressures 00291101



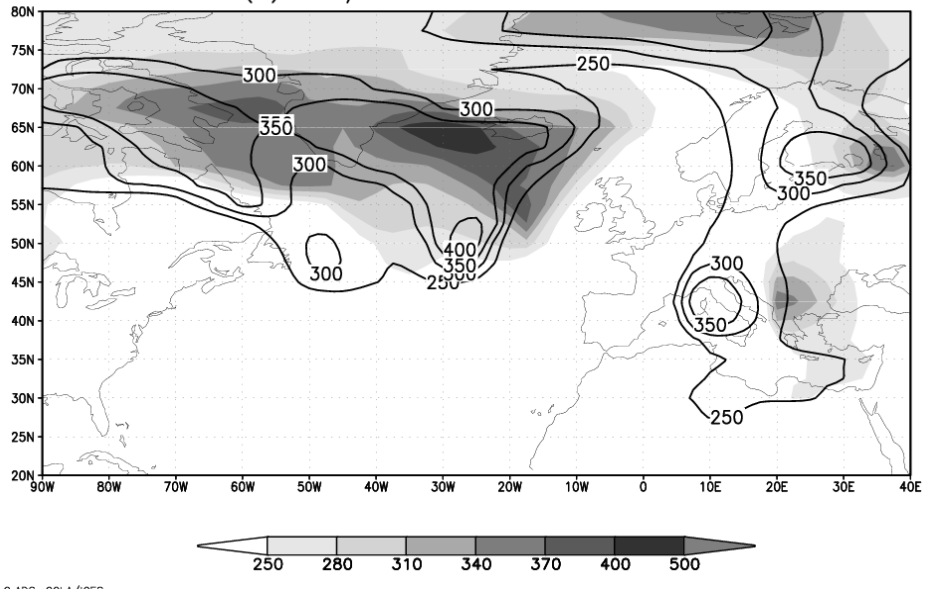


(d) DT / TT Pressures 00301101

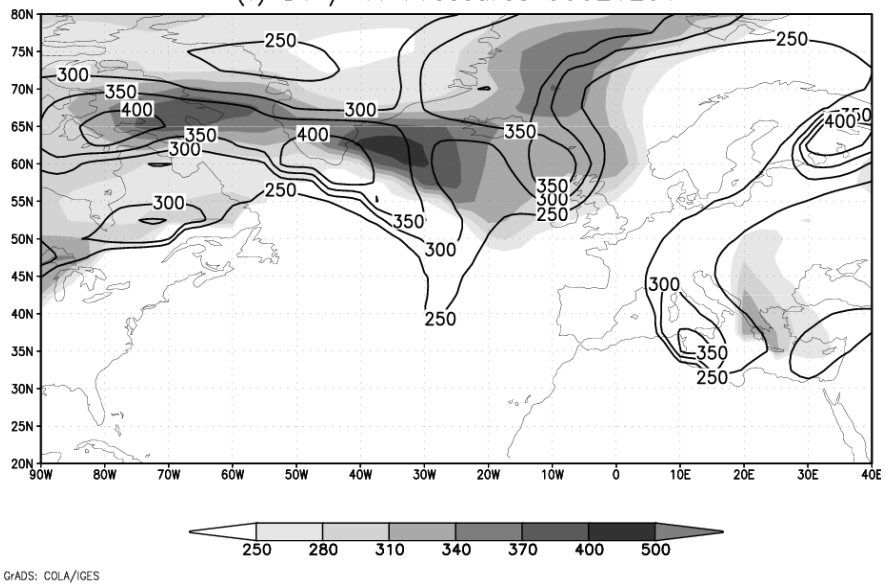




(e) DT / TT Pressures 00011201

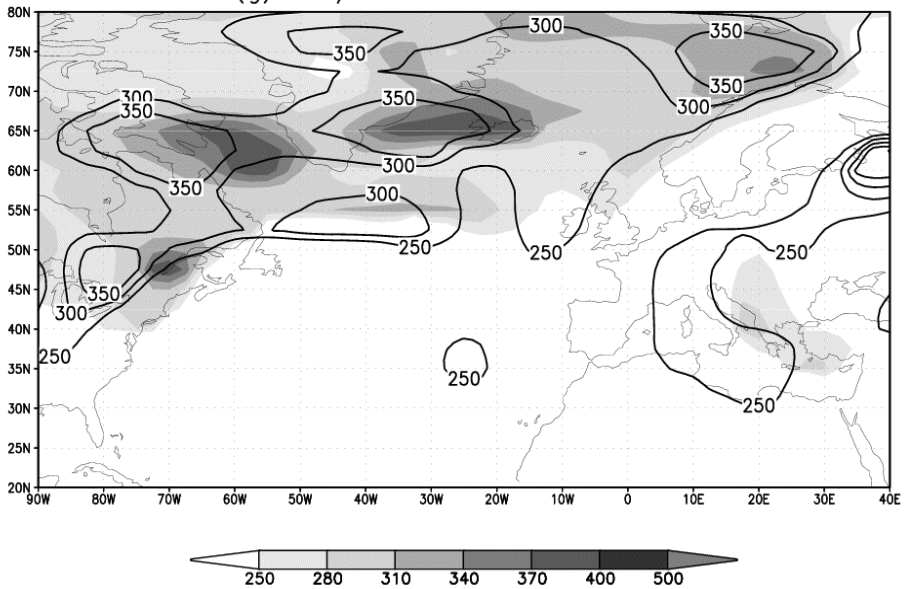


(f) DT / TT Pressures 00021201

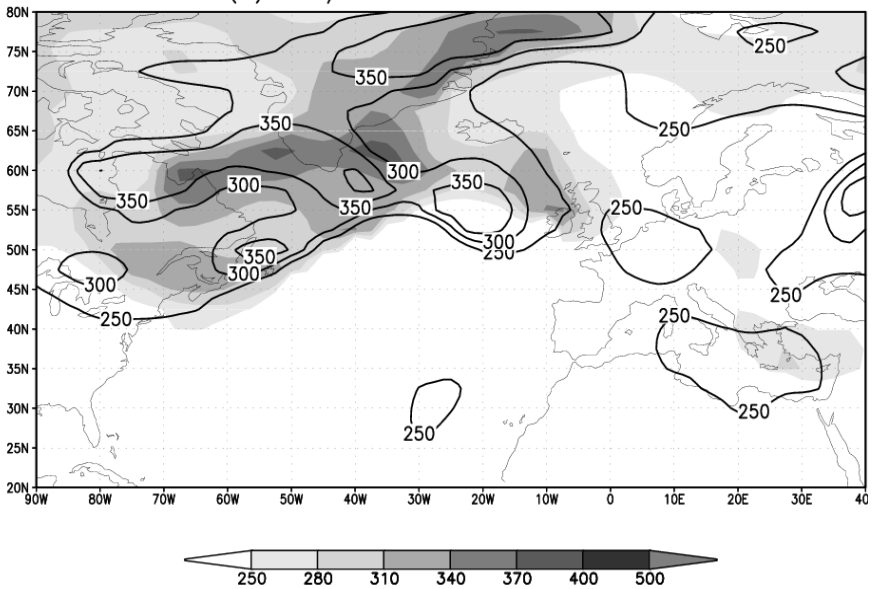


GrADS: COLA/IGES

(g) DT / TT Pressures 00031201

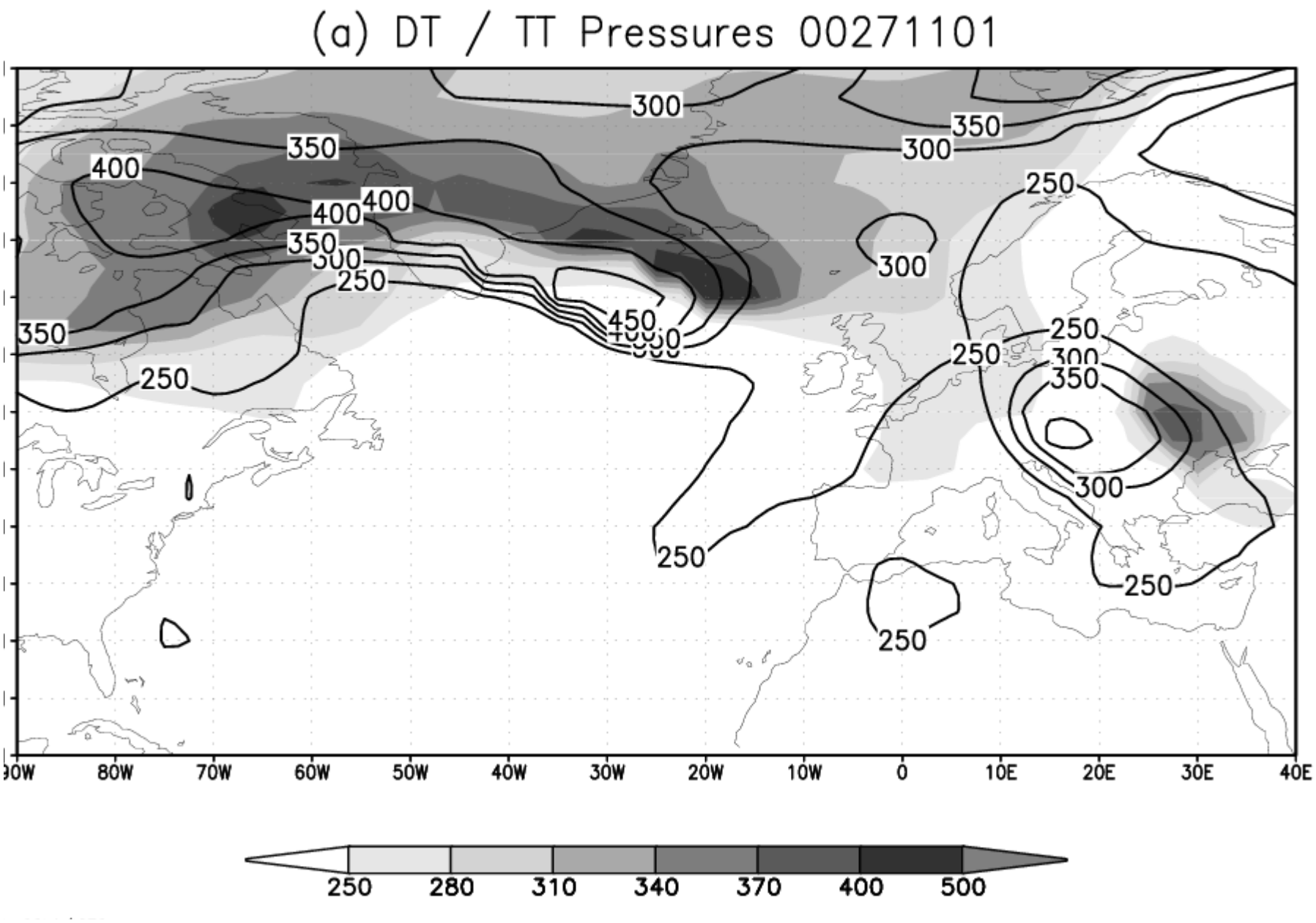


(h) DT / TT Pressures 00041201



Eastward drift of the

Olga associated DT disturbance


(a) DT / TT Pressures 00271101
300
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450
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10E
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40E
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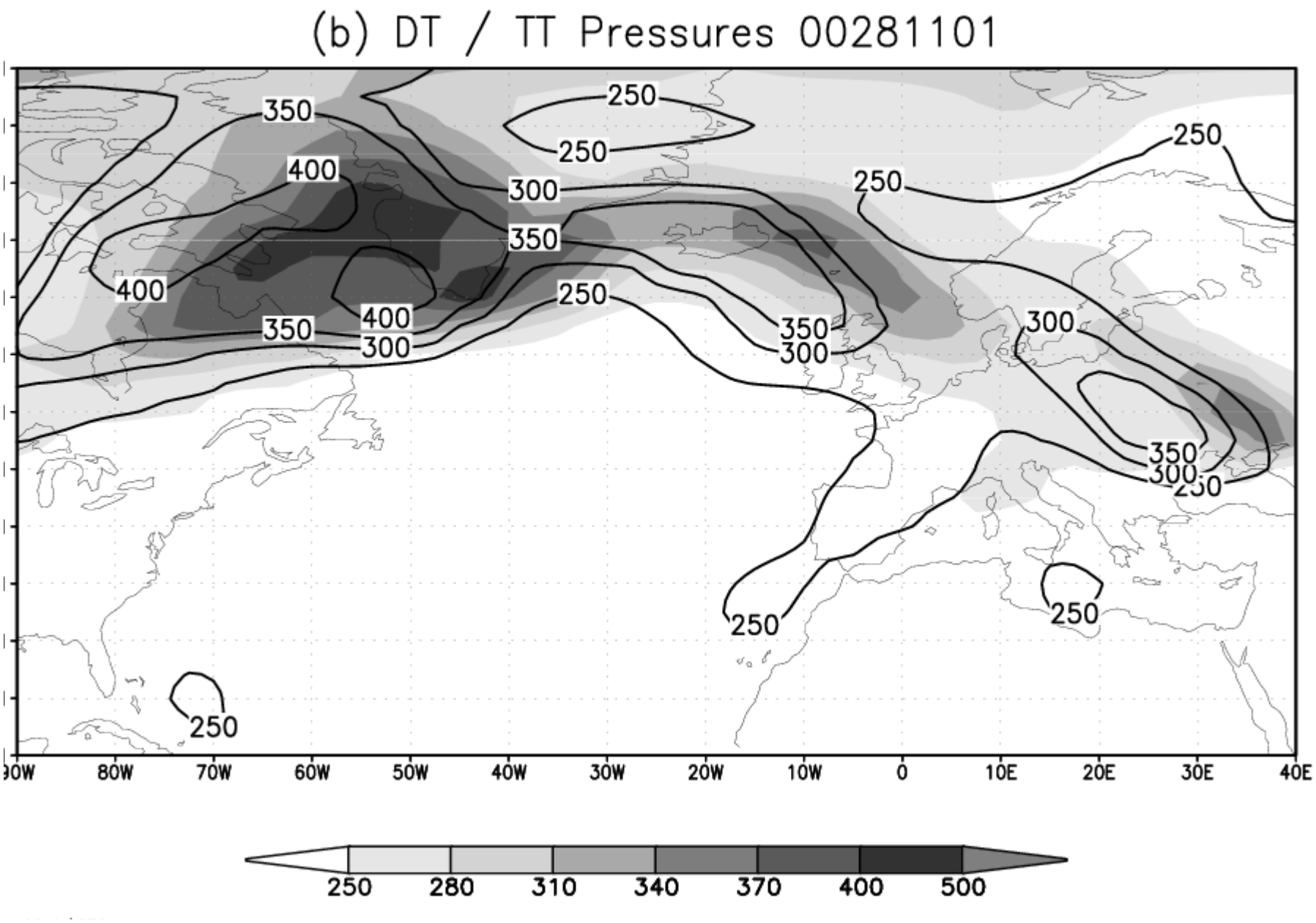
(b) DT / TT Pressures 00281101
250
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350
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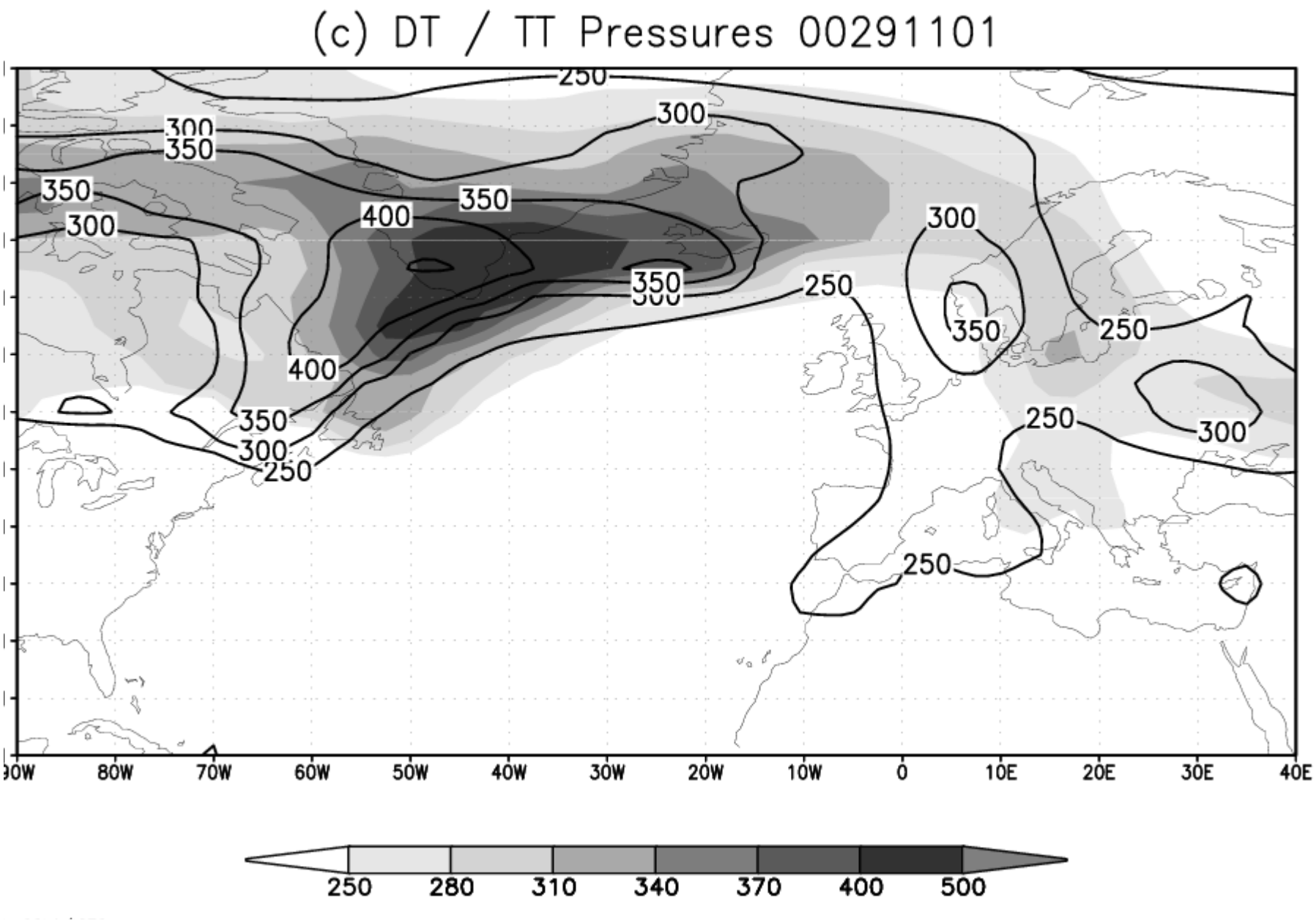
(c) DT / TT Pressures 00291101
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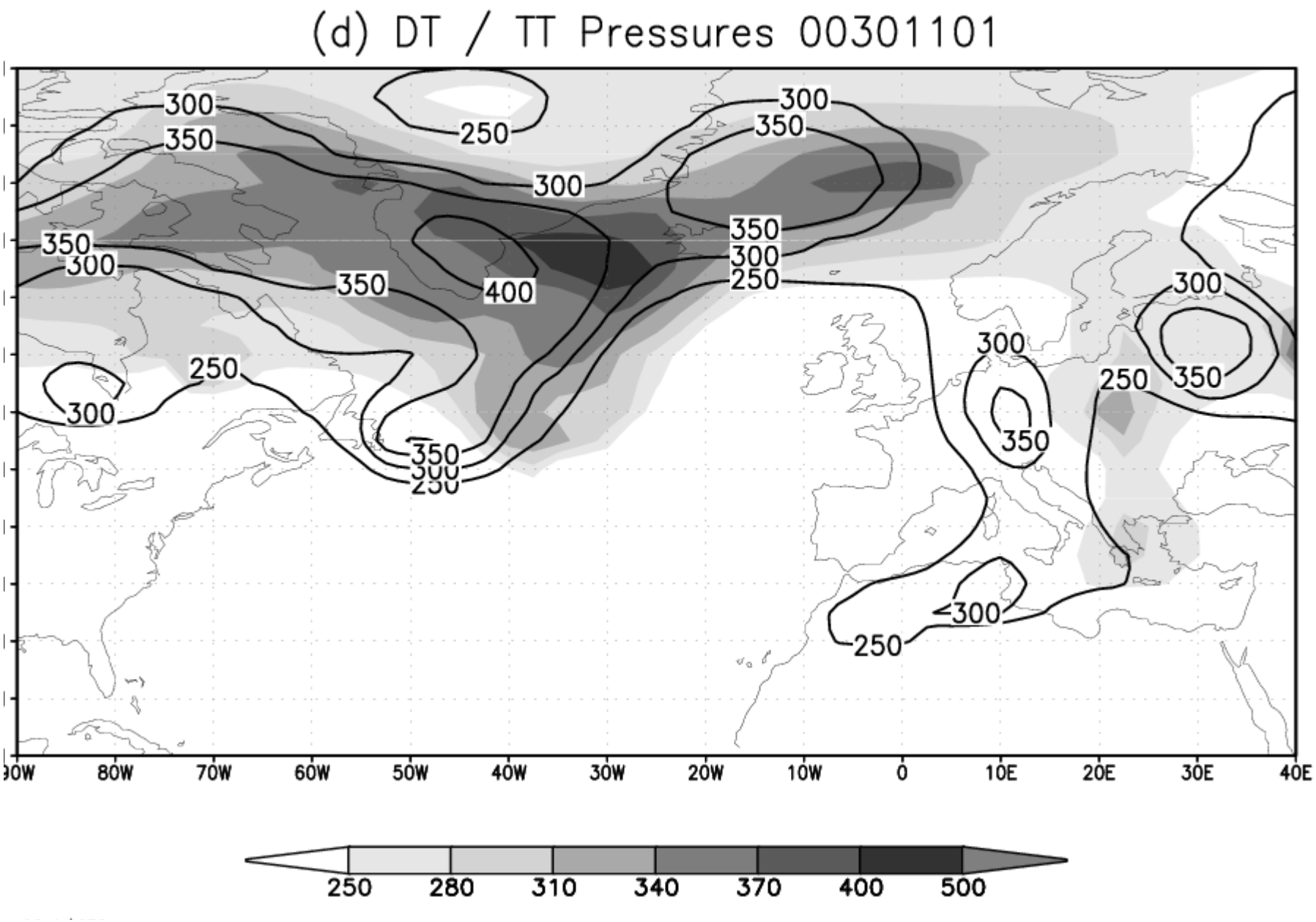
(d) DT / TT Pressures 00301101
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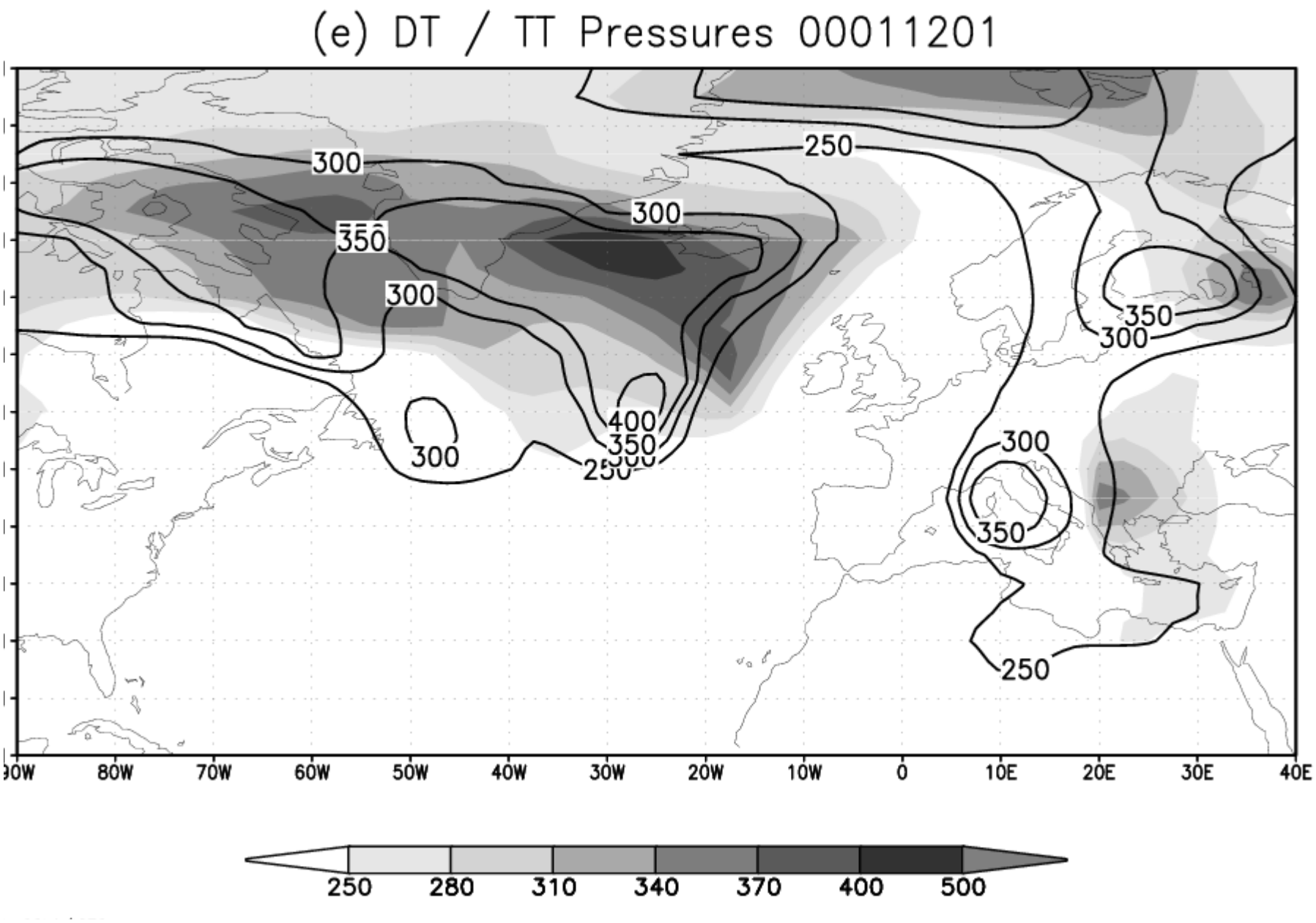
(e) DT / TT Pressures 00011201
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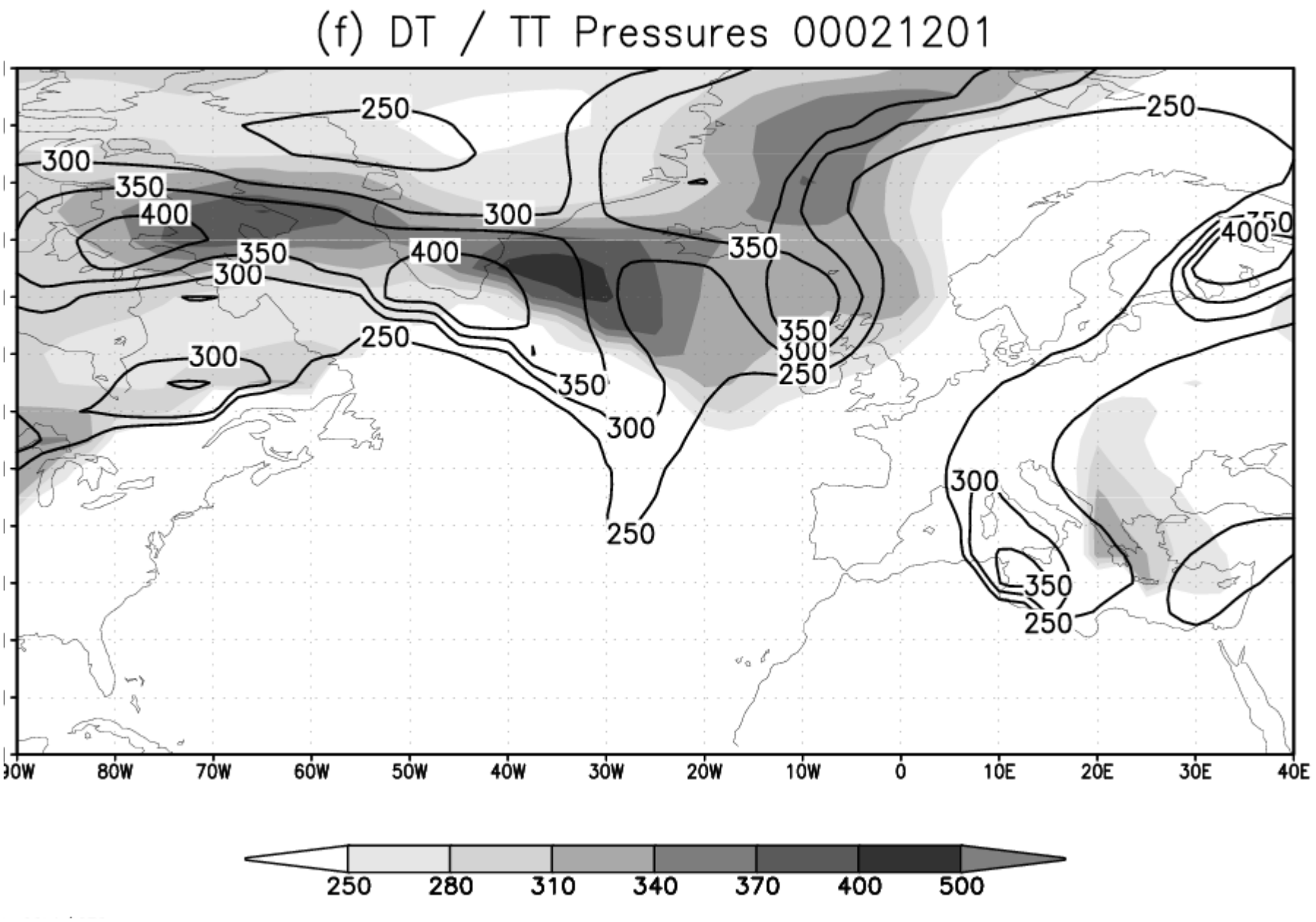
(f) DT / TT Pressures 00021201
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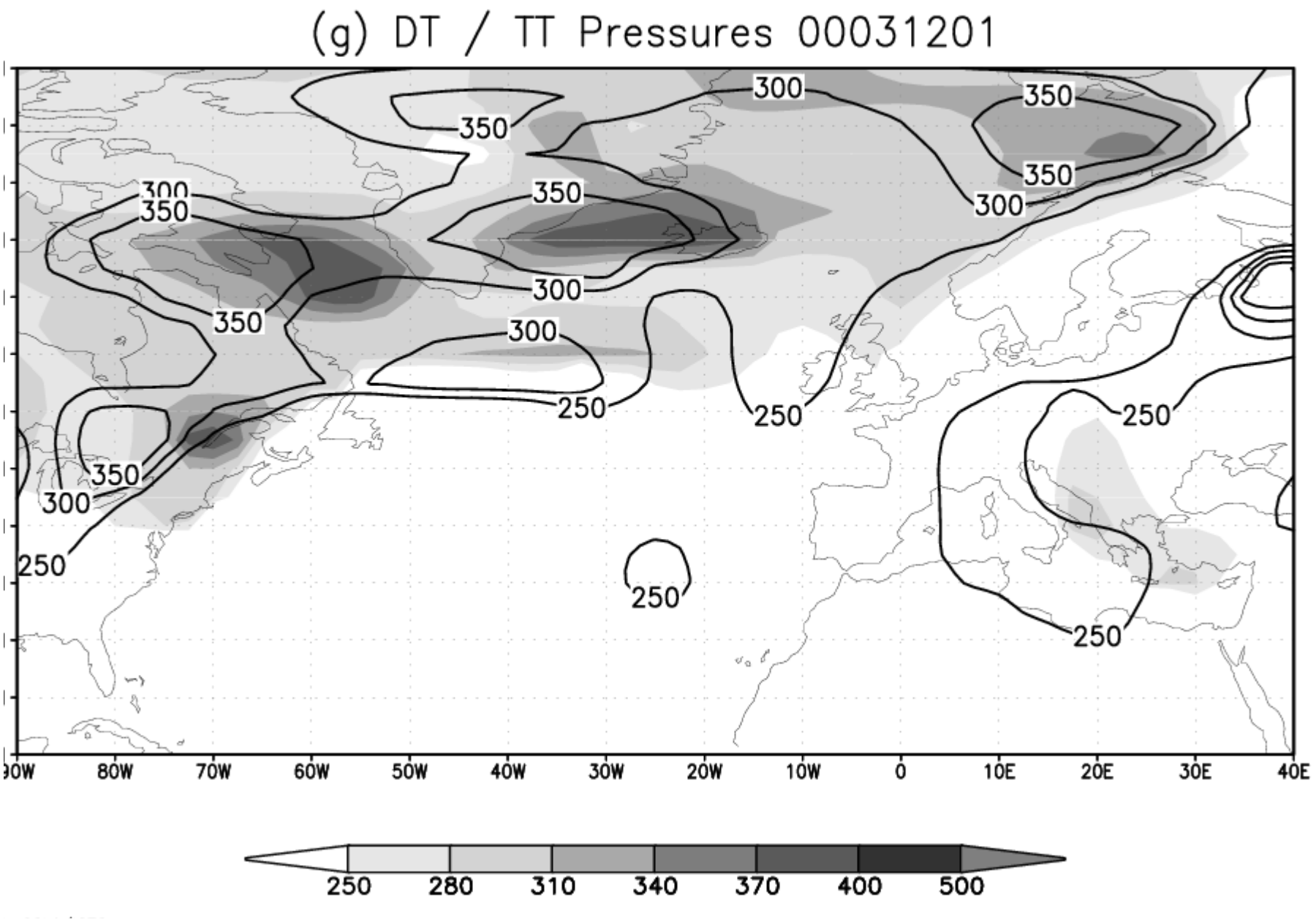
(g) DT / TT Pressures 00031201
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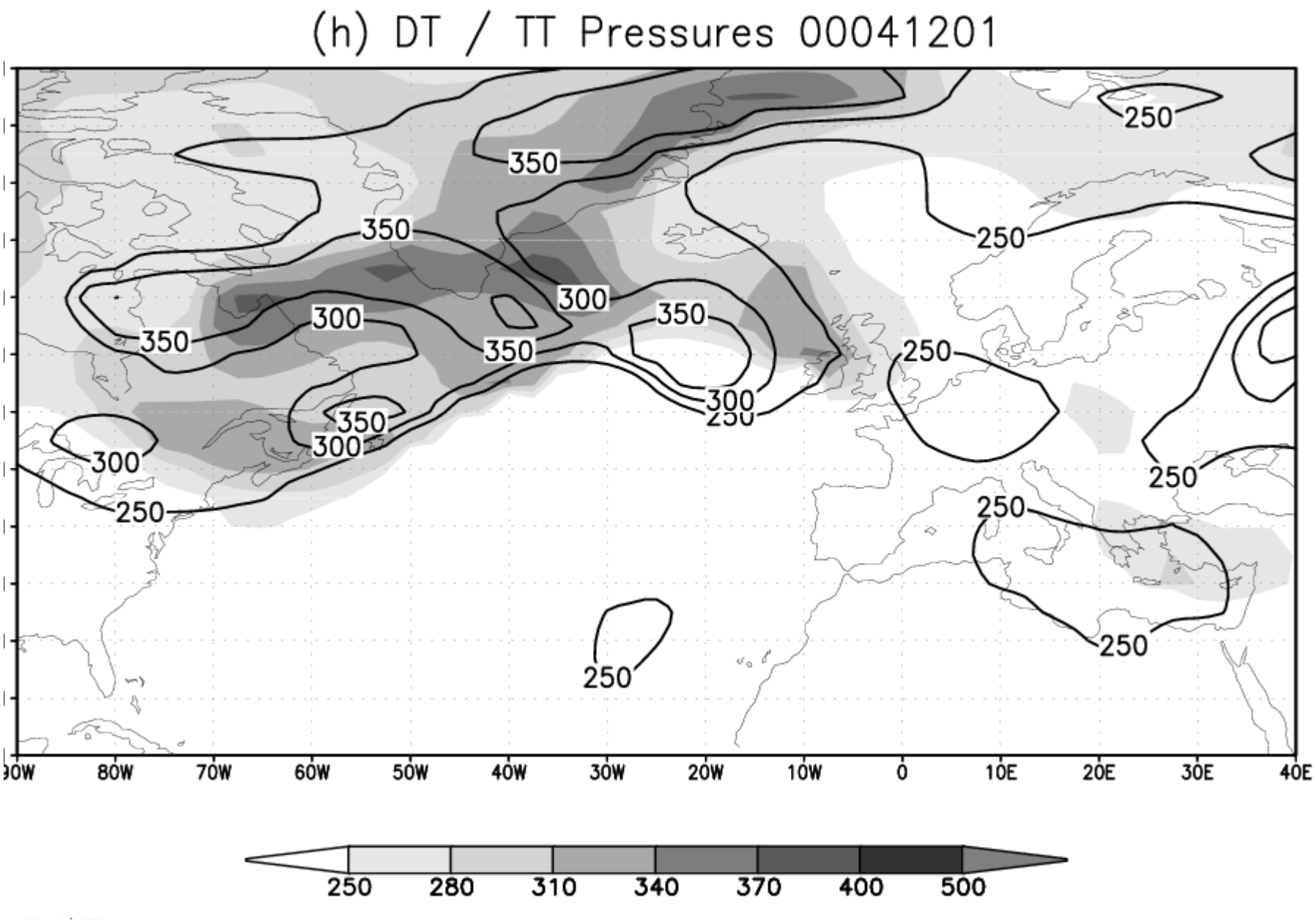
(h) DT / TT Pressures 00041201
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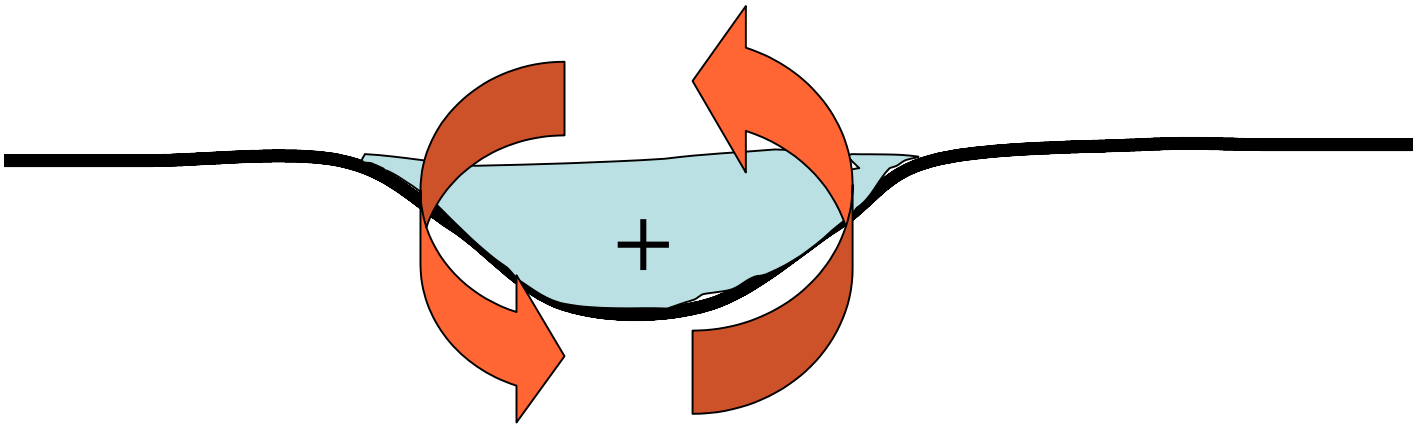
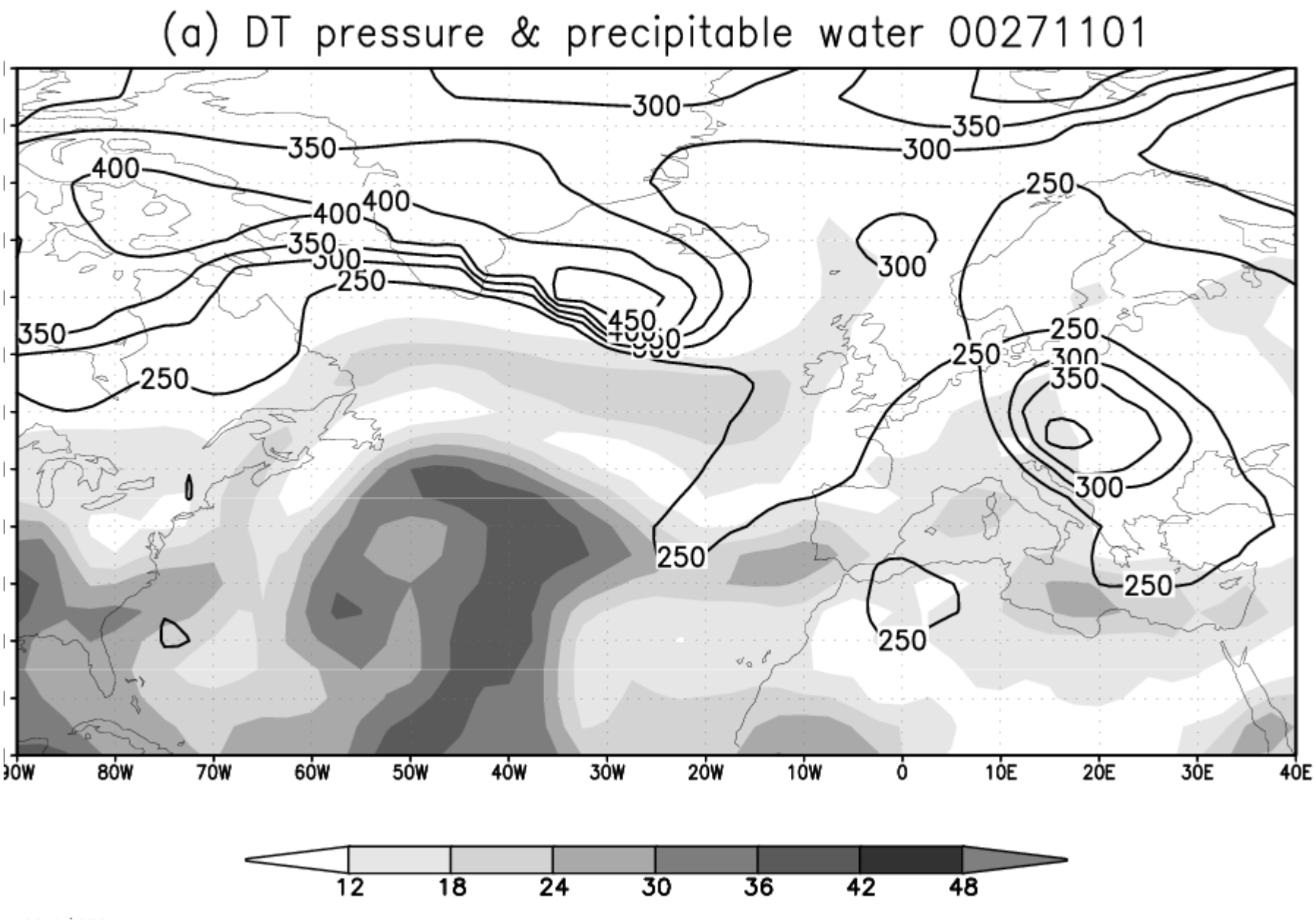


The PRWT patterns again


(a) DT pressure & precipitable water 00271101
300
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400
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350
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450
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350
300
250
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250
80W
70W
60W
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10E
20E
30E
40E
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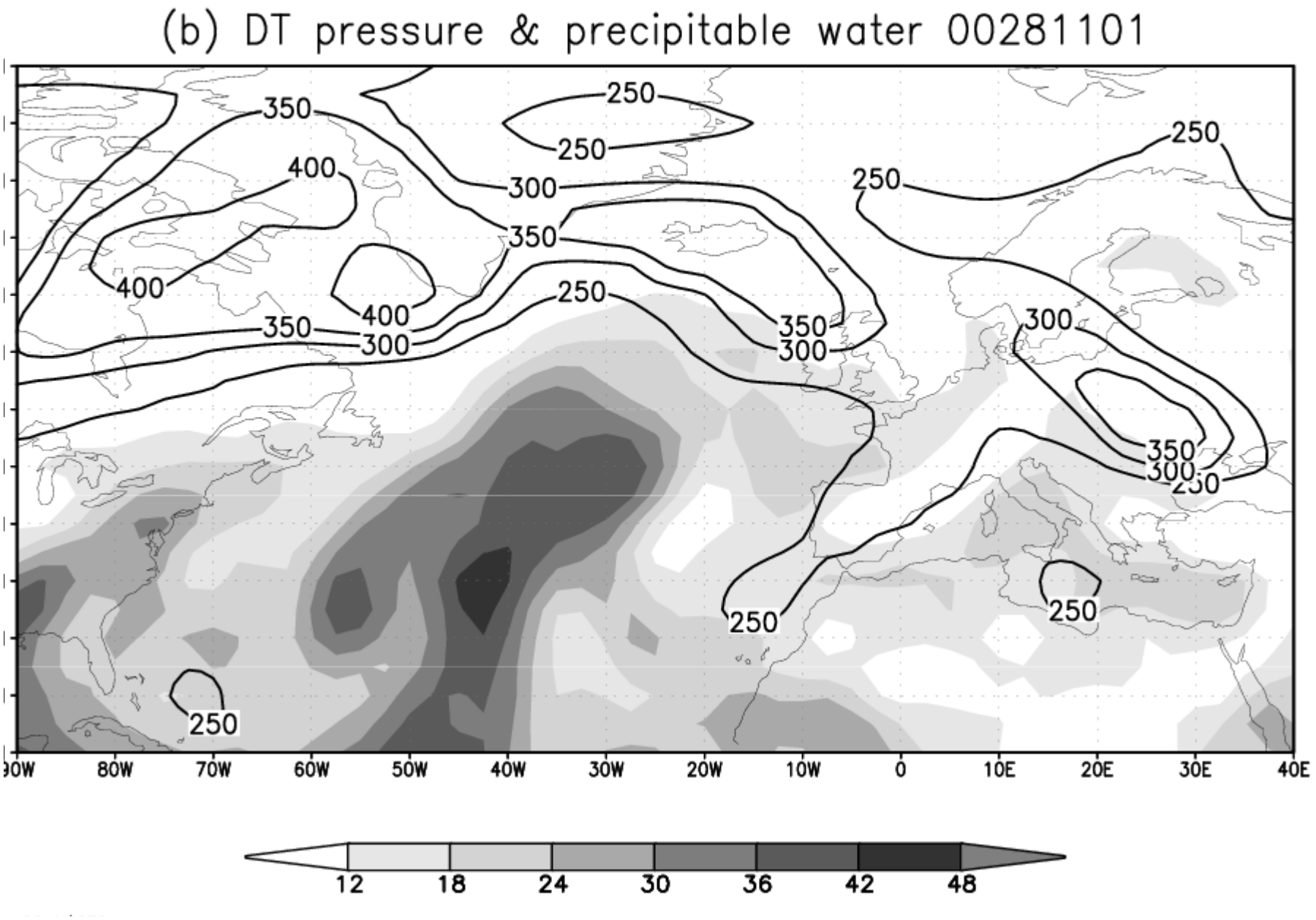
30
36
42
48


(b) DT pressure & precipitable water 00281101
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80W
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10E
20E
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40E
12
18
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30
36
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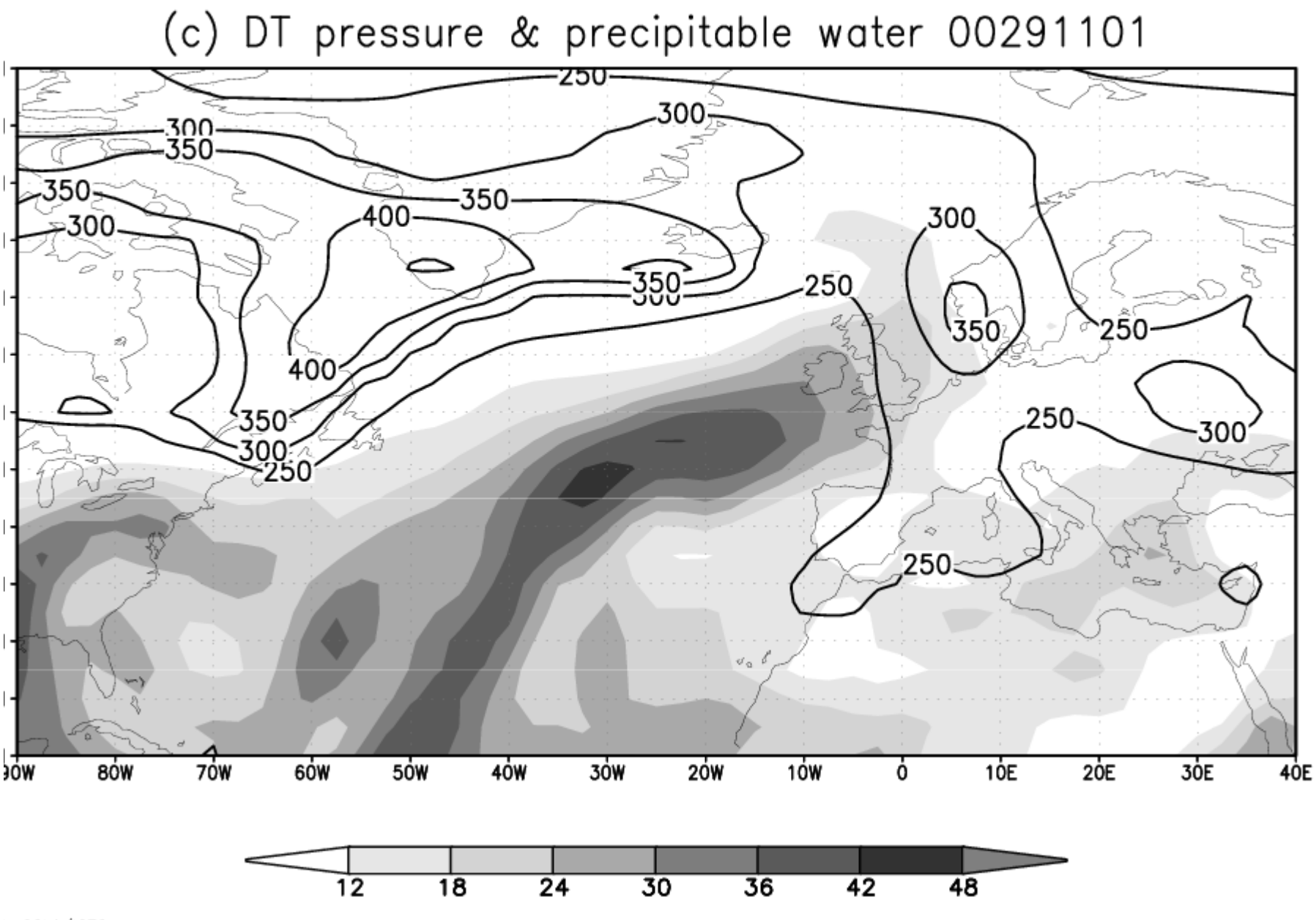
48


(c) DT pressure & precipitable water 00291101
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80W
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40E
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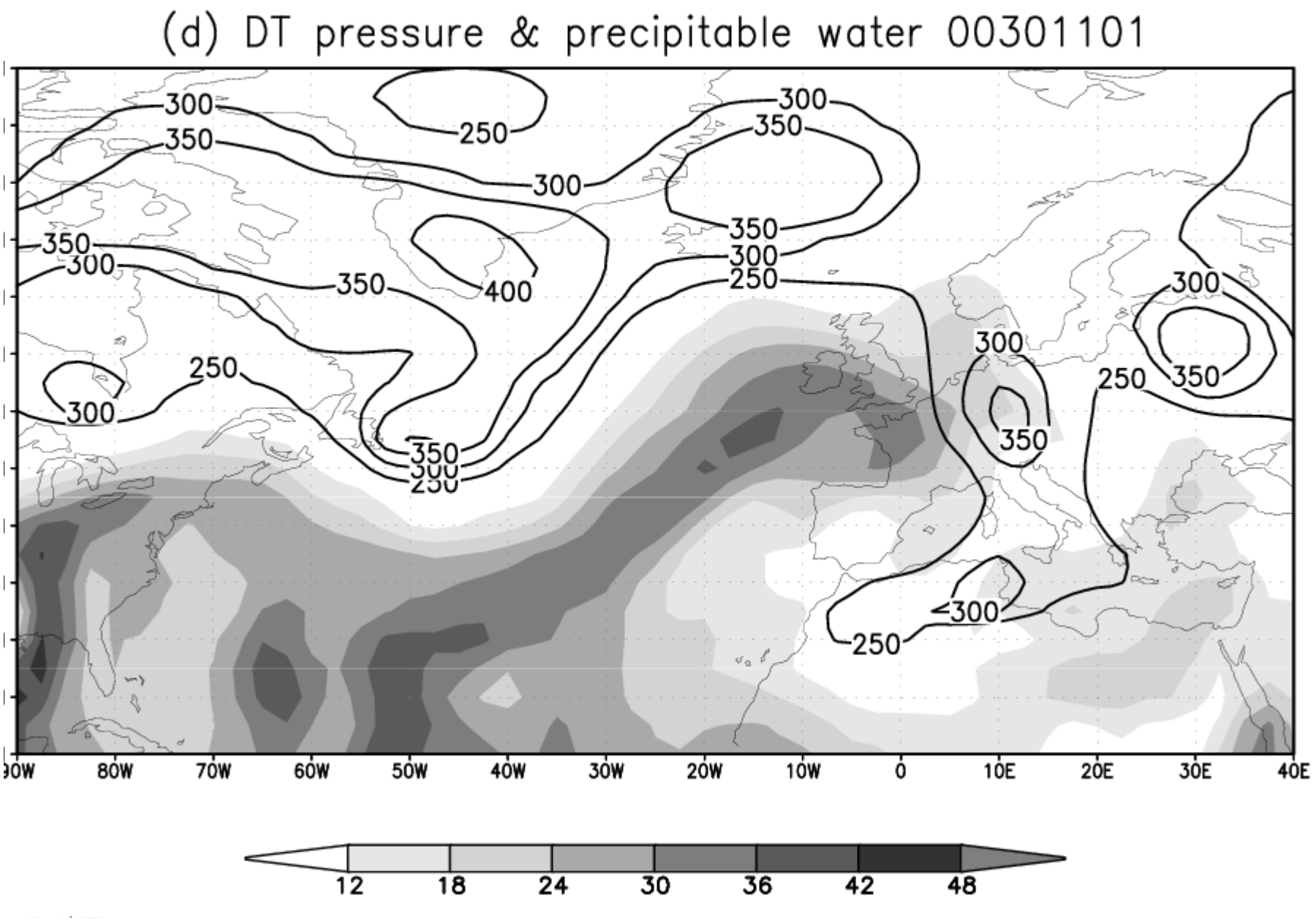
24
30
36
42
48


(d) DT pressure & precipitable water 00301101
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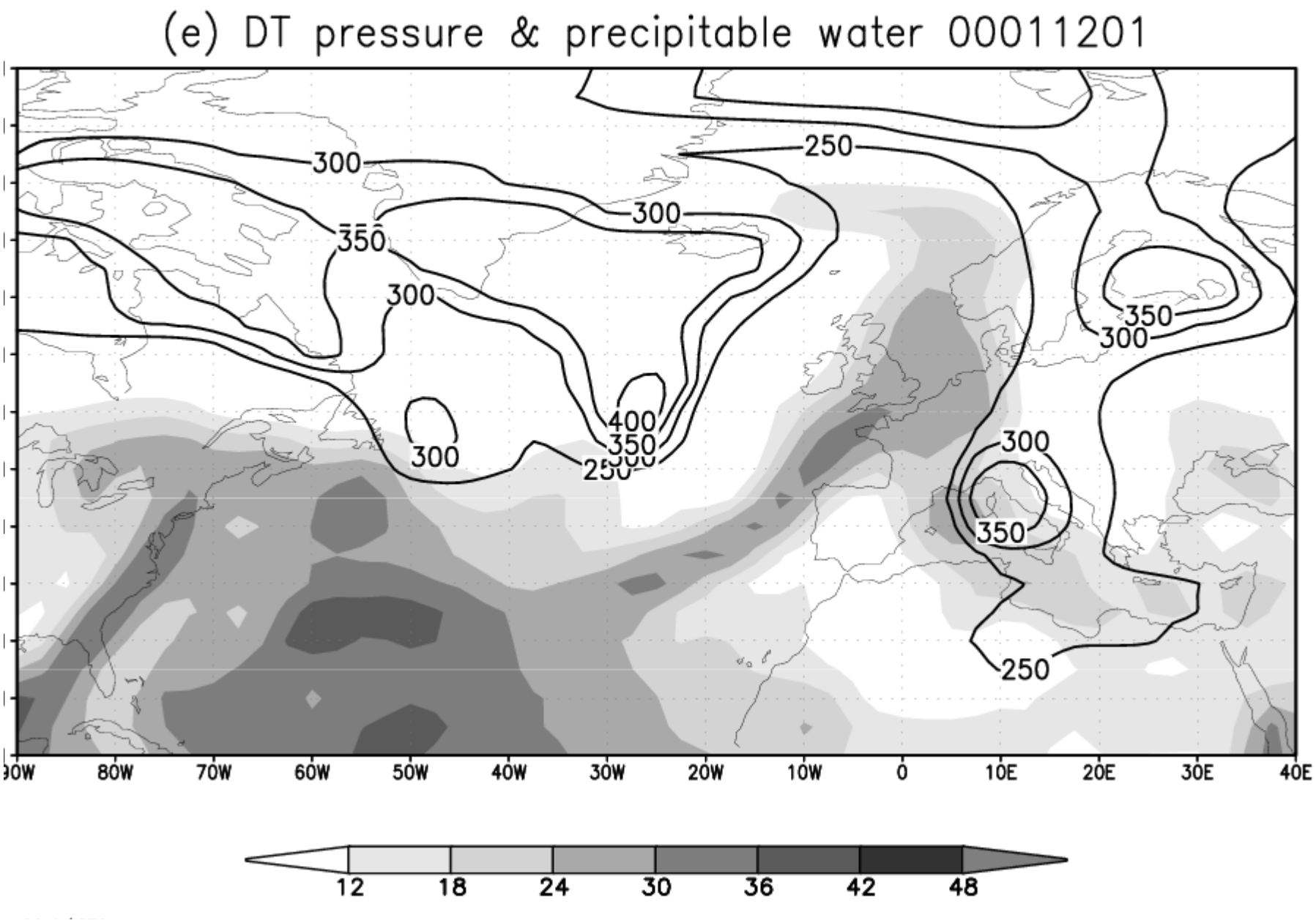
(e) DT pressure & precipitable water 00011201
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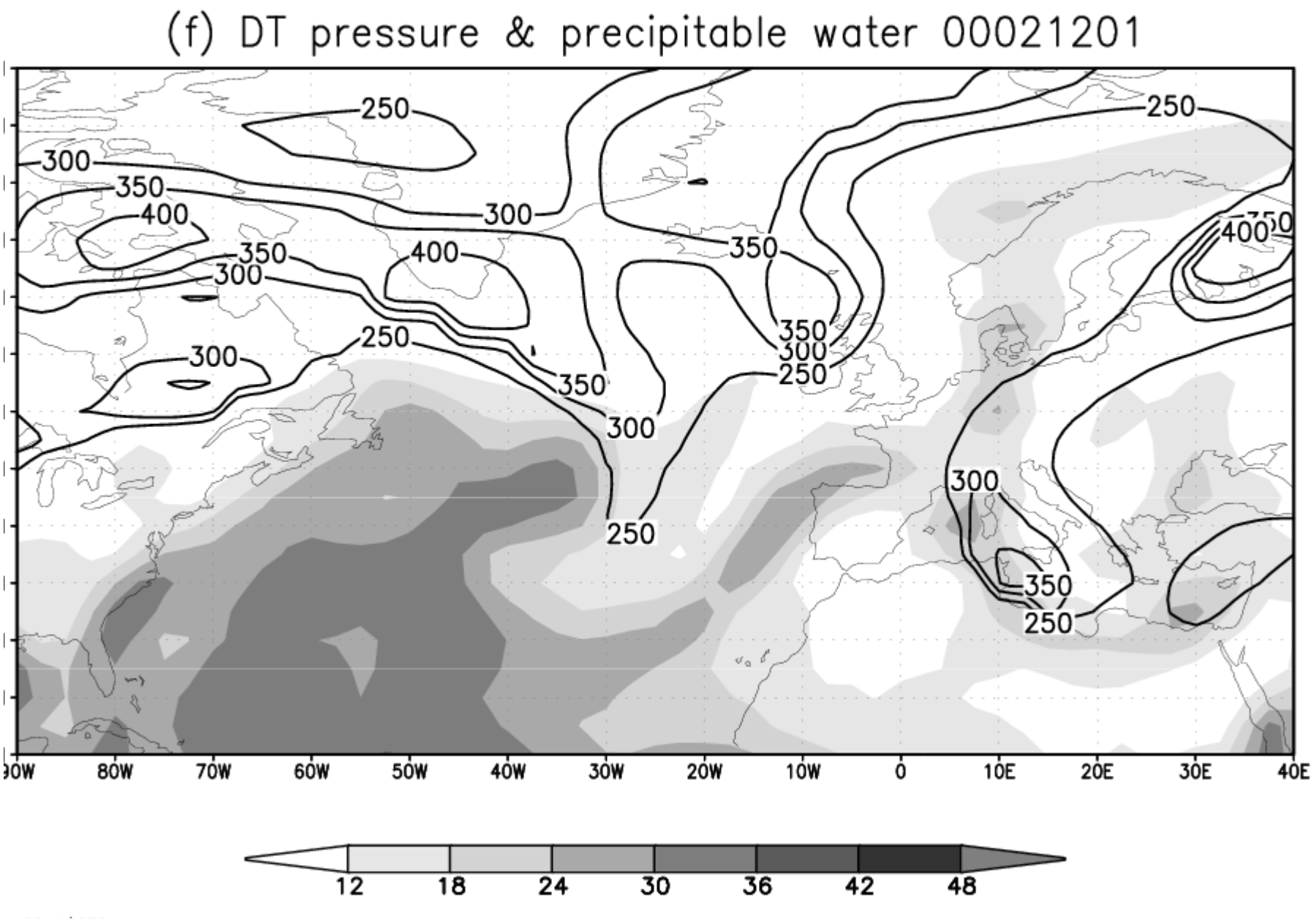
(f) DT pressure & precipitable water 00021201
250
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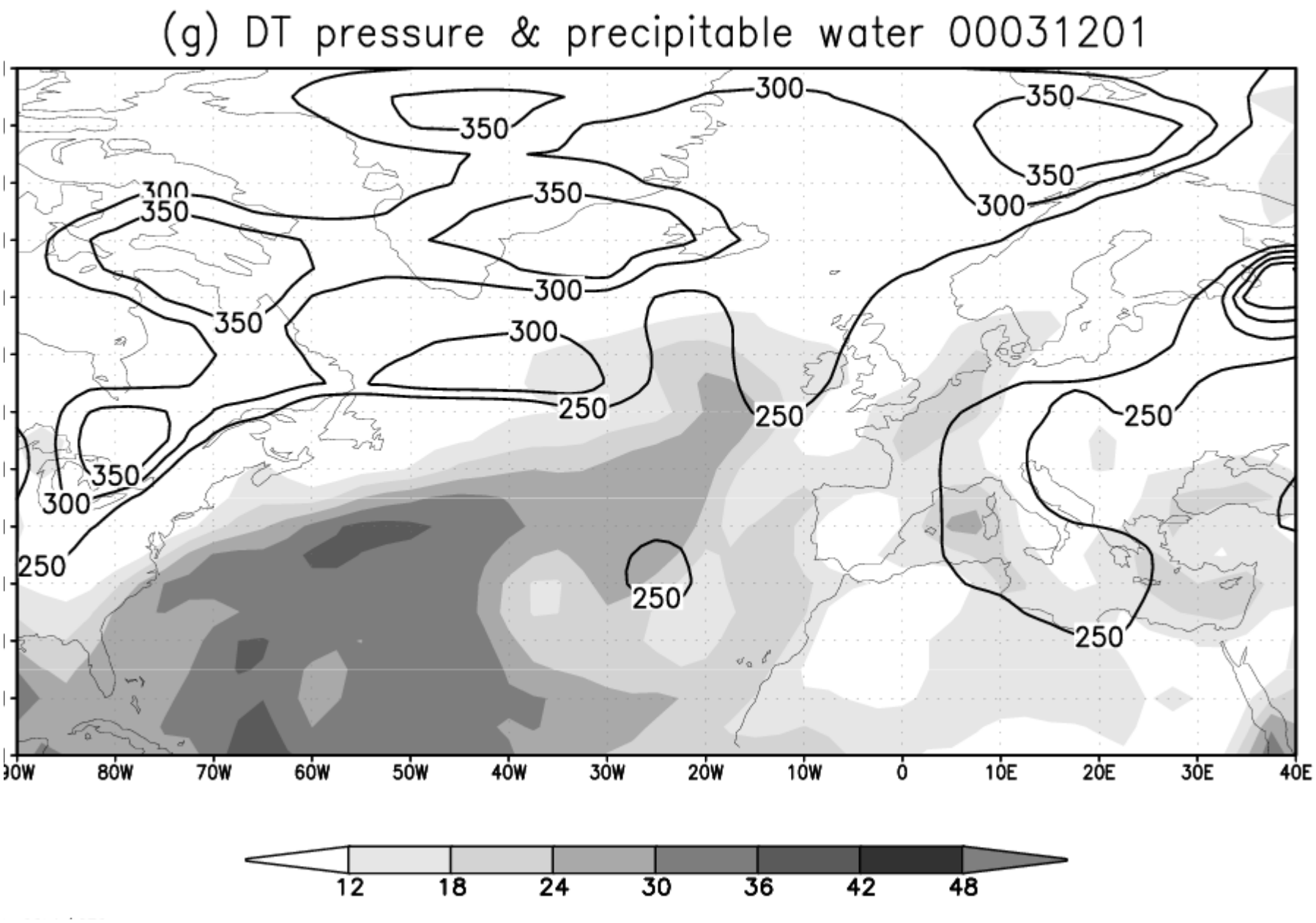
(g) DT pressure & precipitable water 00031201
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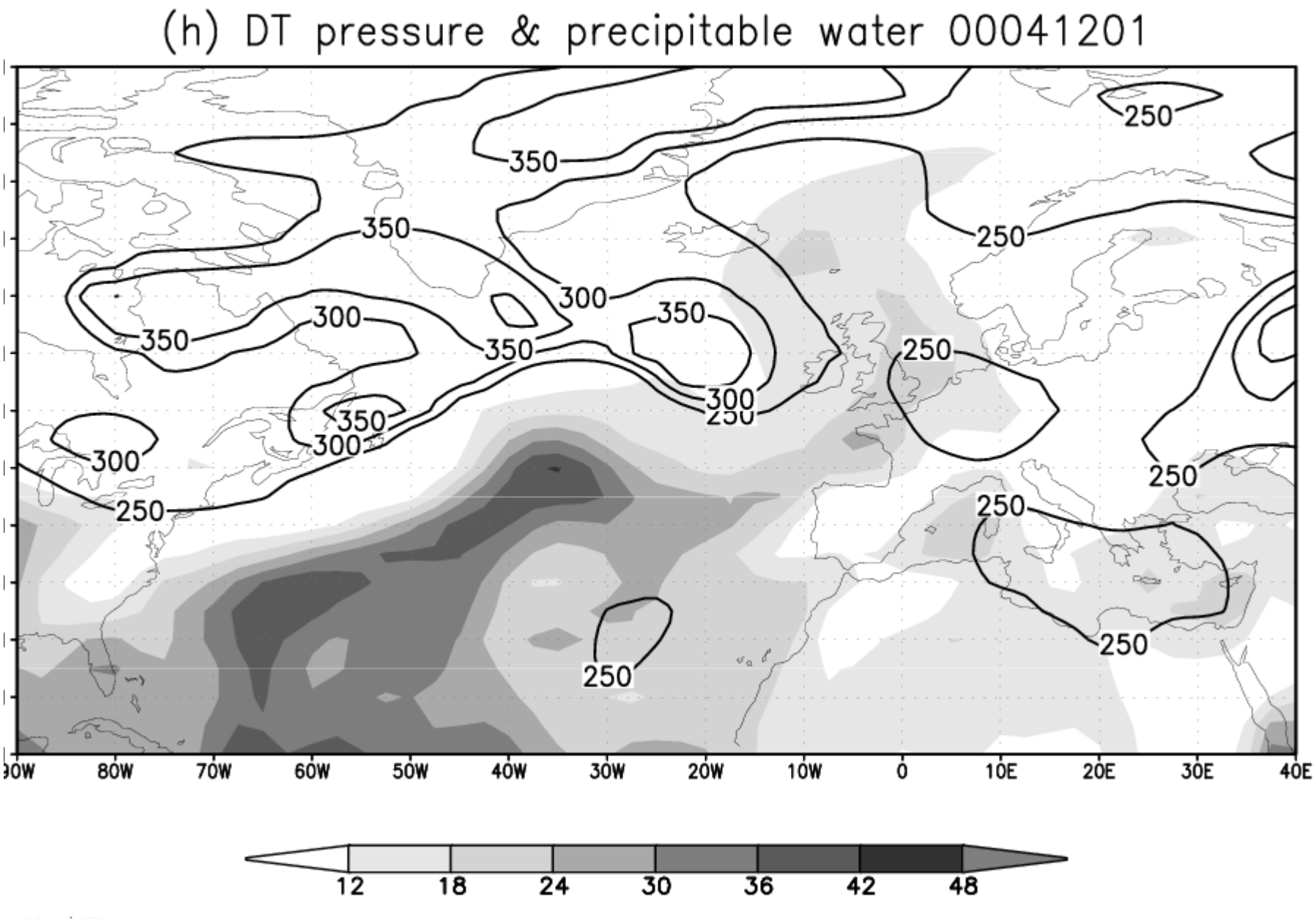
(h) DT pressure & precipitable water 00041201
350
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Summary

The process was triggered by a potent PV anomaly caused by hurricane Olga. Development of a tropopause disturbance took place.

An additional apparently very important process took place over the northern Atlantic where that the low-level environment is warmed, moistened, and destabilized by a persistent southerly flow ahead of the approaching PV anomaly.

Air-mass ascent and a lowering of the DT (also associated with a lowering of the potential temperature) ahead of the PV anomaly contribute to further destabilization.

Summary cont'd

All these effects determined the intensity of the wet and relatively warm Atlantic air-masses into the high-latitudes.

Joint contribution of these two effects lead to intensification of the Iceland Low and Siberian High large scale systems and finally the cyclogenetic process over the eastern Mediterranean region.

Intense weather processes have possibly been observed on the opposite (eastern) side of the Siberian High.

Predictability aspects

Main processes of the event

1) **Hurricane Olga;**
2) **PV anomaly;**
3) **Coherent dropopause disturbance;**
4) **Intensification of the Iceland Low/ Siberian High dipole;**
5) **Mesoscale EM cyclone**

Accurate prediction of the item # 2 on November 28 would allow that of the EM torrential rains of December 4.

Predictability aspects

Observations :

Where?

What to measure?

How accurately?

High resolution modeling: Where?
How it should be performed?

Verification: How to verify?