

# **The Assessment of Climate Models using Numerical Weather Prediction**

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**CFMIP/EUCLIPSE meeting**

**Egmond aan Zee, Netherlands**

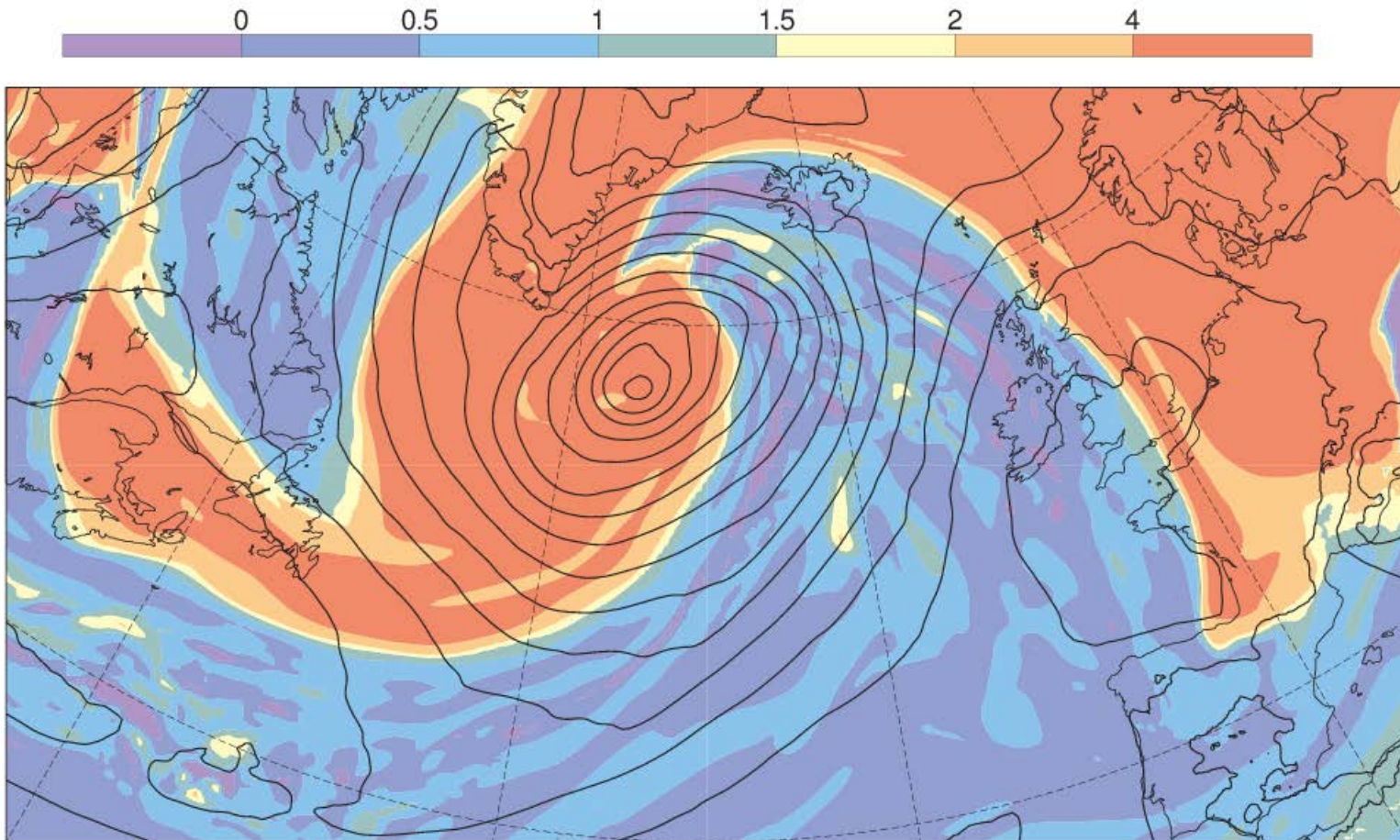
**10 July 2014**

# Strong mid-latitude cyclone

MSLP and PV330K

21 July 2012

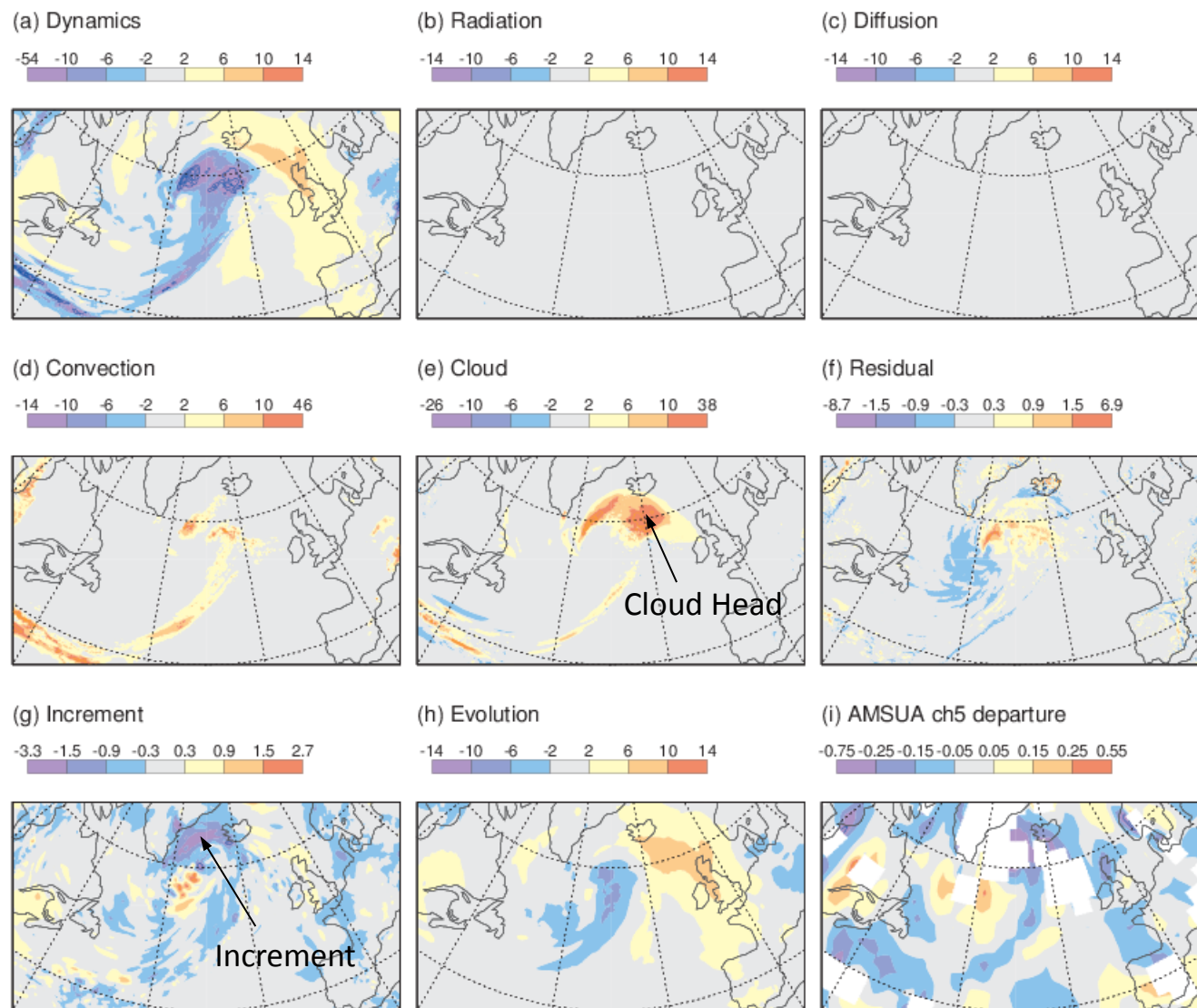
MSLP (contour = 4hPa) and Potential Vorticity at 330K (shaded PV units)



Clear baroclinic development, but what about the physics?

# Tendency budget for cyclone (0-12h)

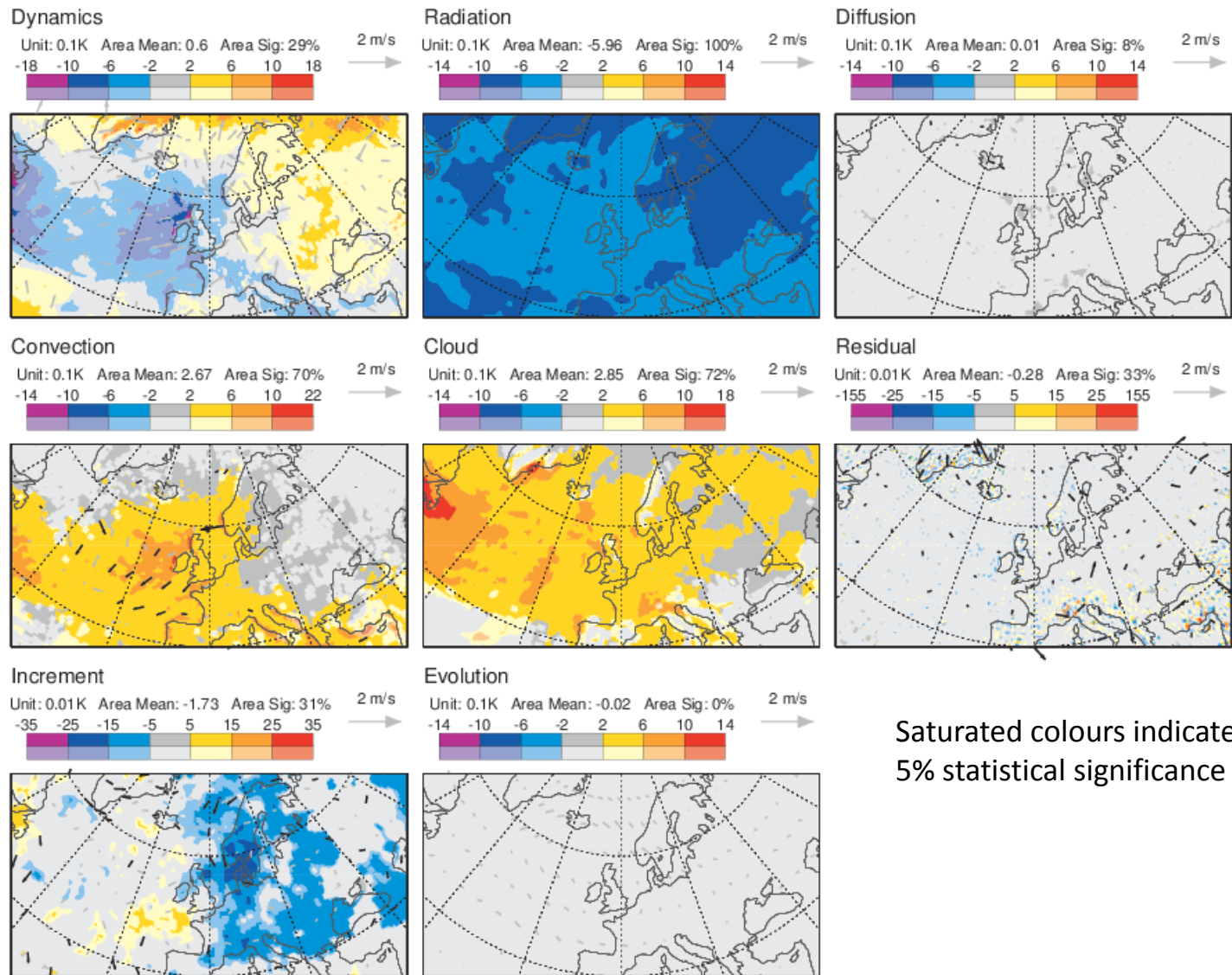
T500  
21 July 2012



Increments suggest too much heating around cloud-head? Note lack of key observations (panel i)

# Tendency budget for stormy winter (0-12h)

T500,  $\nabla$ 500  
DJF 2014

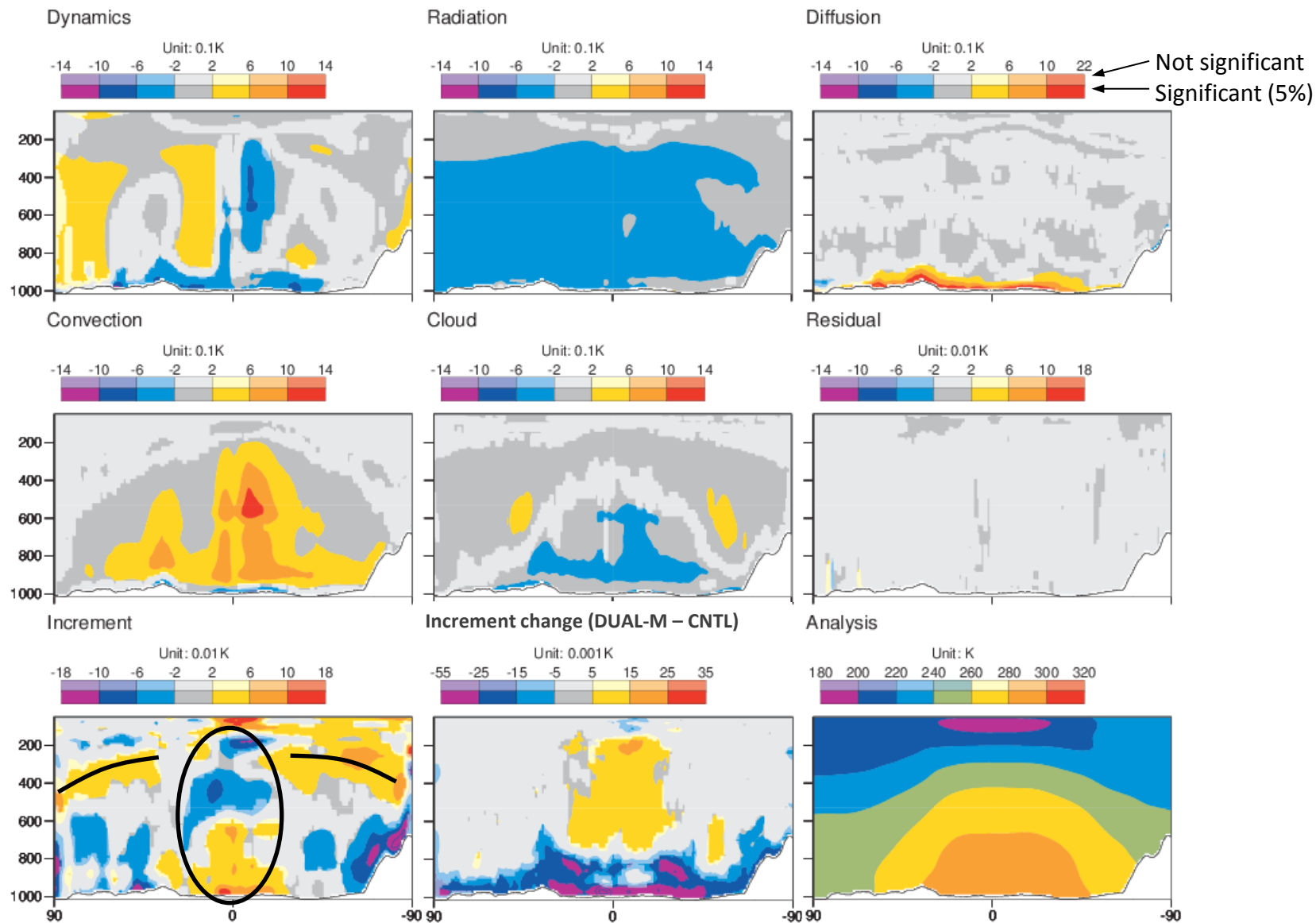


Increments again suggest too much heating (now significant) ... and precipitation?



# Tendency budget for January (0-6h)

[T]  
Jan 2012

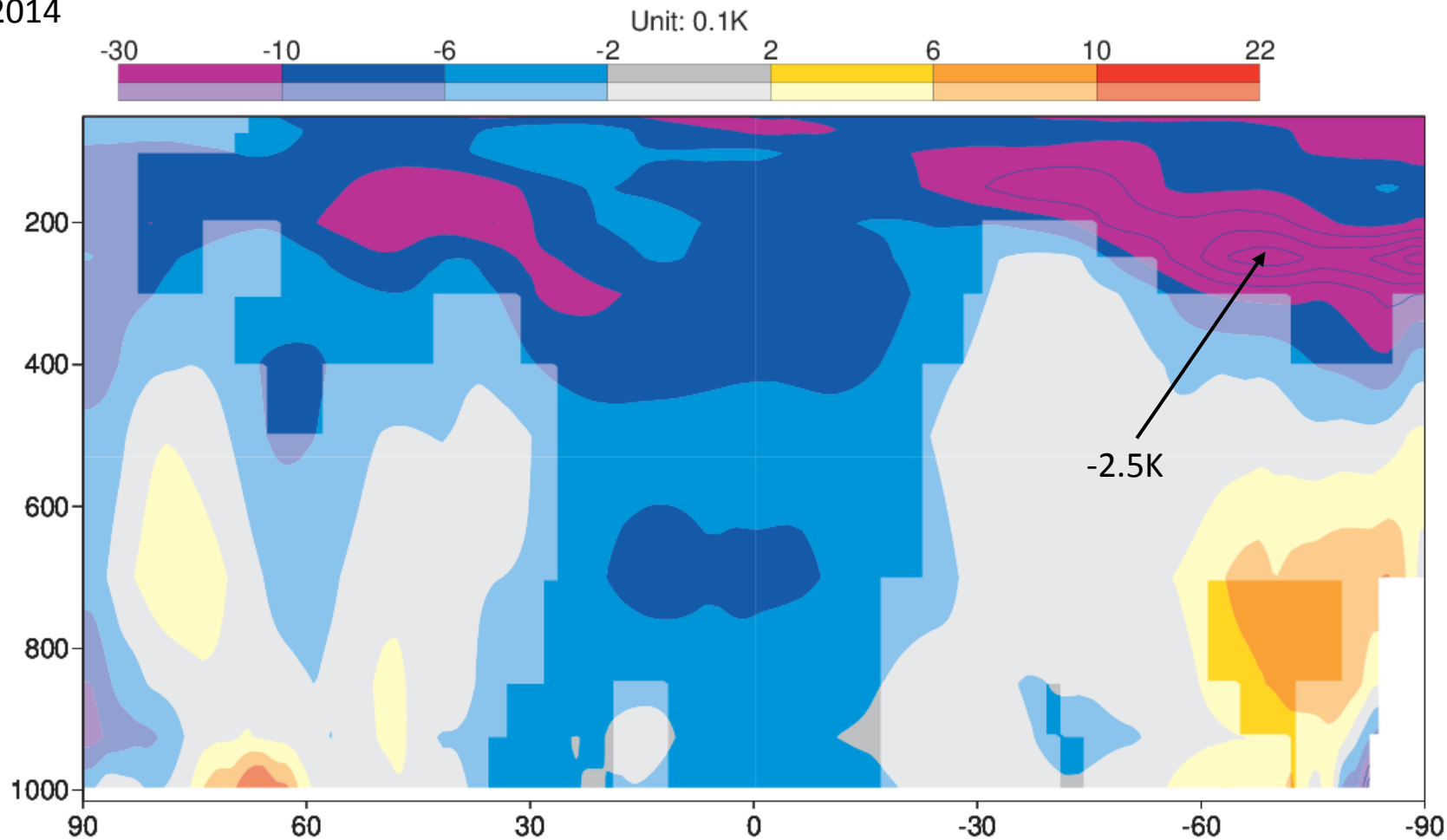


Increments: Tropics improved with DUAL-M. Extratropical upper-troposphere → Day 10 error

# Temperature error at day 10

[T]

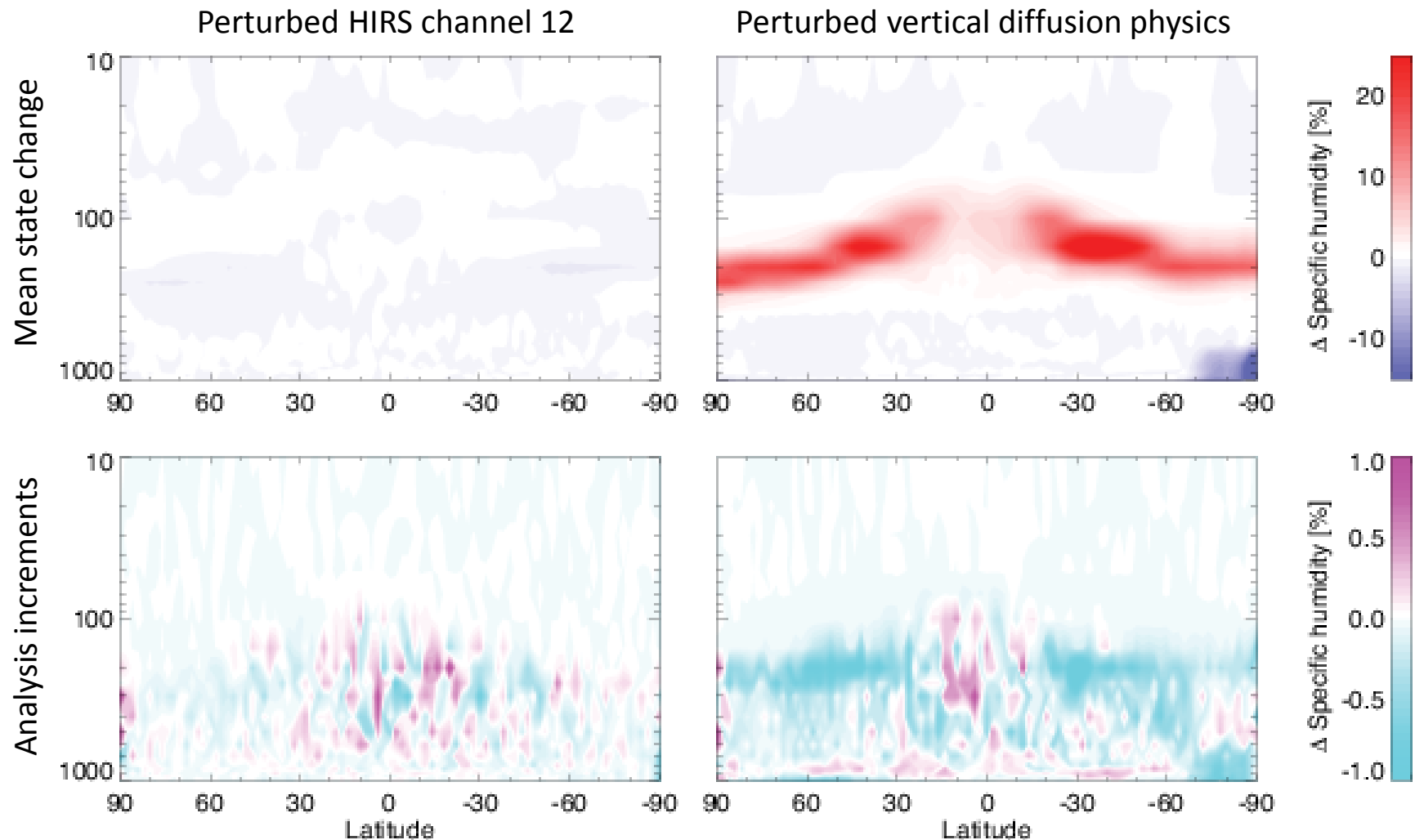
DJF 2014



Upper-tropospheric error grows radiatively, particularly in summer hemisphere ... on humidity bias?

# Assimilation perturbations

2011 April 4 – May 31



Perturbing one IR humidity channel  $\rightarrow$  Observation bias correction works (analysis unaffected)

Perturbing model  $\rightarrow$  Analysis is altered (observations poorly constrain this model error)

# Comparing NWP methodologies

$-\Delta\text{OLR}$

April & May 2011

Initial tendencies identifies entrainment perturbation ( $\div 3$ ) before signal lost due to interactions and chaos

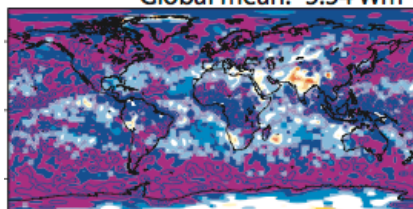
Transpose AMIP shows similar change at T+120, but does not identify reason (at shorter lead-times)

Initialising from ( $\sim 0.3\text{K}$  warmer) UKMO analysis leads to strong shock that might mask model errors, even at T+120

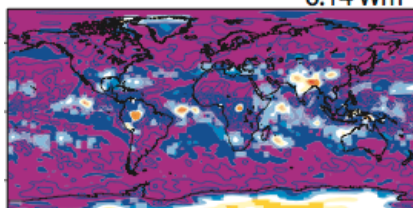
Initialised from UKMO

EC cntl from UK

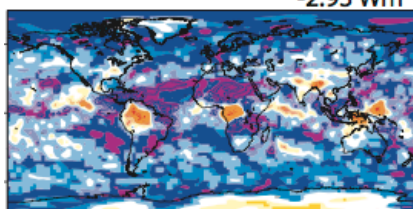
Global mean:  $-5.54 \text{ W m}^{-2}$



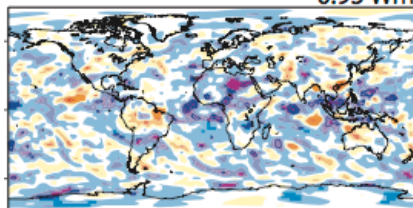
$-6.14 \text{ W m}^{-2}$



$-2.93 \text{ W m}^{-2}$



$-0.95 \text{ W m}^{-2}$

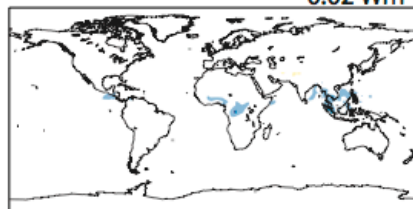


90W 0 90E

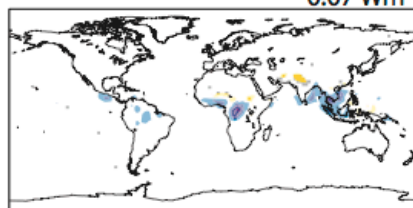
Transpose AMIP

EC pert from EC cntl

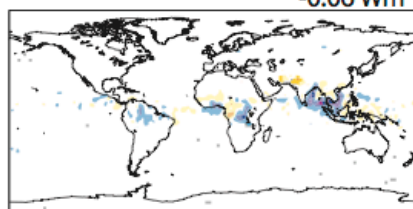
$-0.02 \text{ W m}^{-2}$



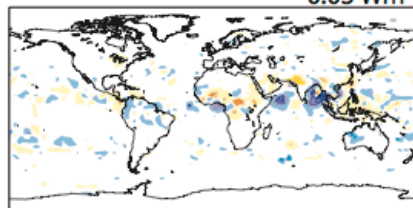
$-0.07 \text{ W m}^{-2}$



$-0.06 \text{ W m}^{-2}$



$-0.03 \text{ W m}^{-2}$

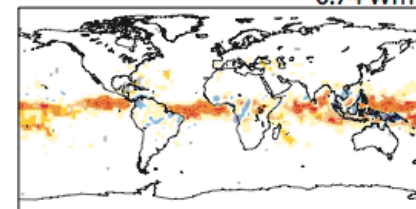


90W 0 90E

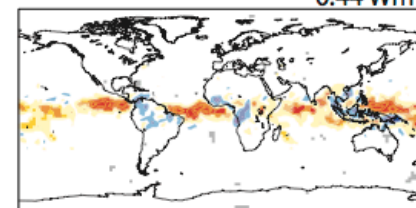
Initial tendencies

EC pert from EC pert

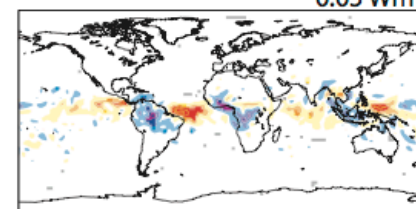
$0.74 \text{ W m}^{-2}$



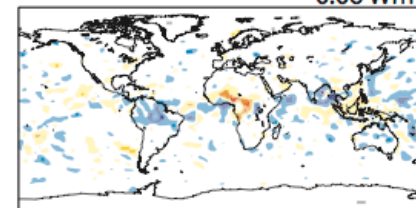
$0.44 \text{ W m}^{-2}$



$0.05 \text{ W m}^{-2}$



$-0.06 \text{ W m}^{-2}$



90W 0 90E

6h

24h

48h

120h



Difference is from EC control model initialised from EC control analysis



# Conclusions

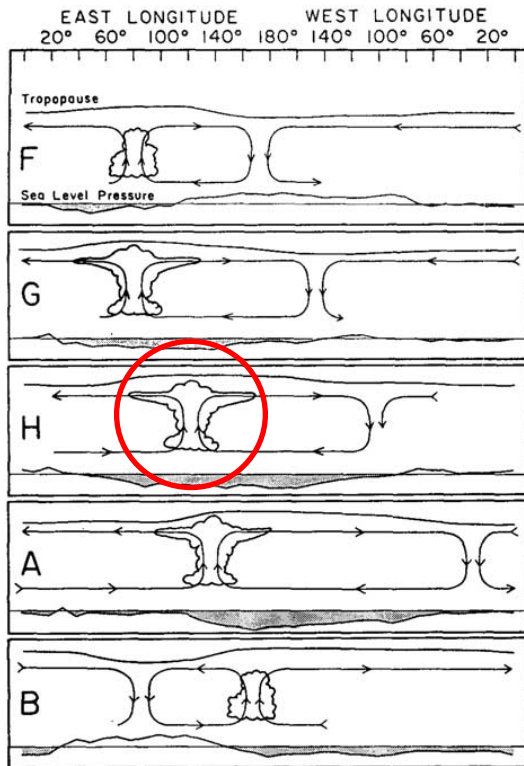
- NWP approaches (with native or non-native initial conditions) can help assess climate models
- Initialisation is critical for investigating causes of errors and native analyses greatly help here
- Further progress required for assimilating cloud-affected observations and to improve upper-tropospheric humidity



# Extra slides

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# Mean zonal wind tendency (60-180°E) during MJO



From Madden and Julian (1972)

Period : 20130201-27 (MJO  
convection active over warm-pool)

Better balance with dynamics when  
convective momentum transport is  
halved

Work with Peter Bechtold, Anton  
Beljaars, Jian Ling, Philippe Lopez,  
Frederic Vitart & Chidong Zhang

