

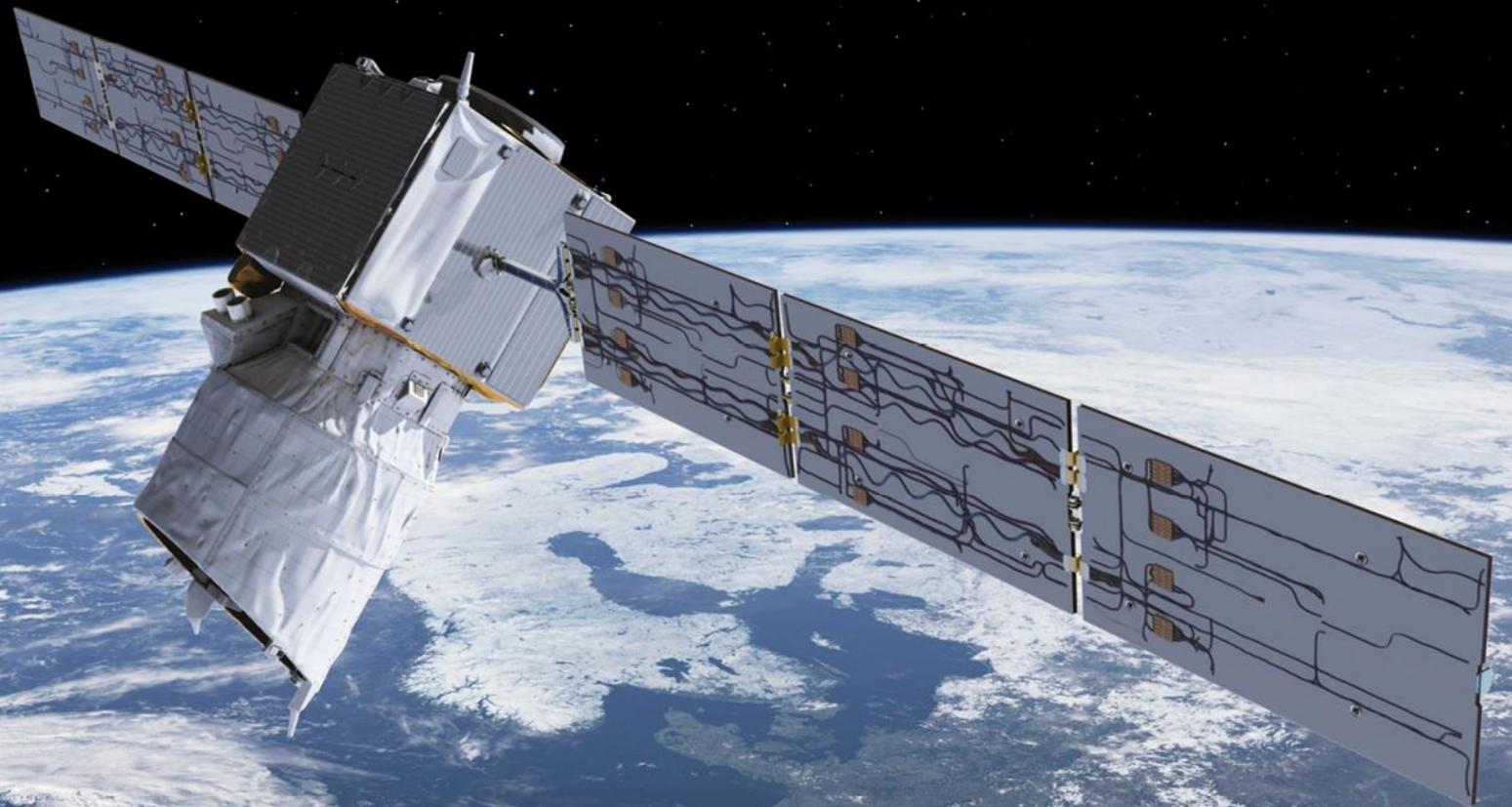
ECMWF/ESA Workshop

Tropical modelling,  
observations and  
assimilation

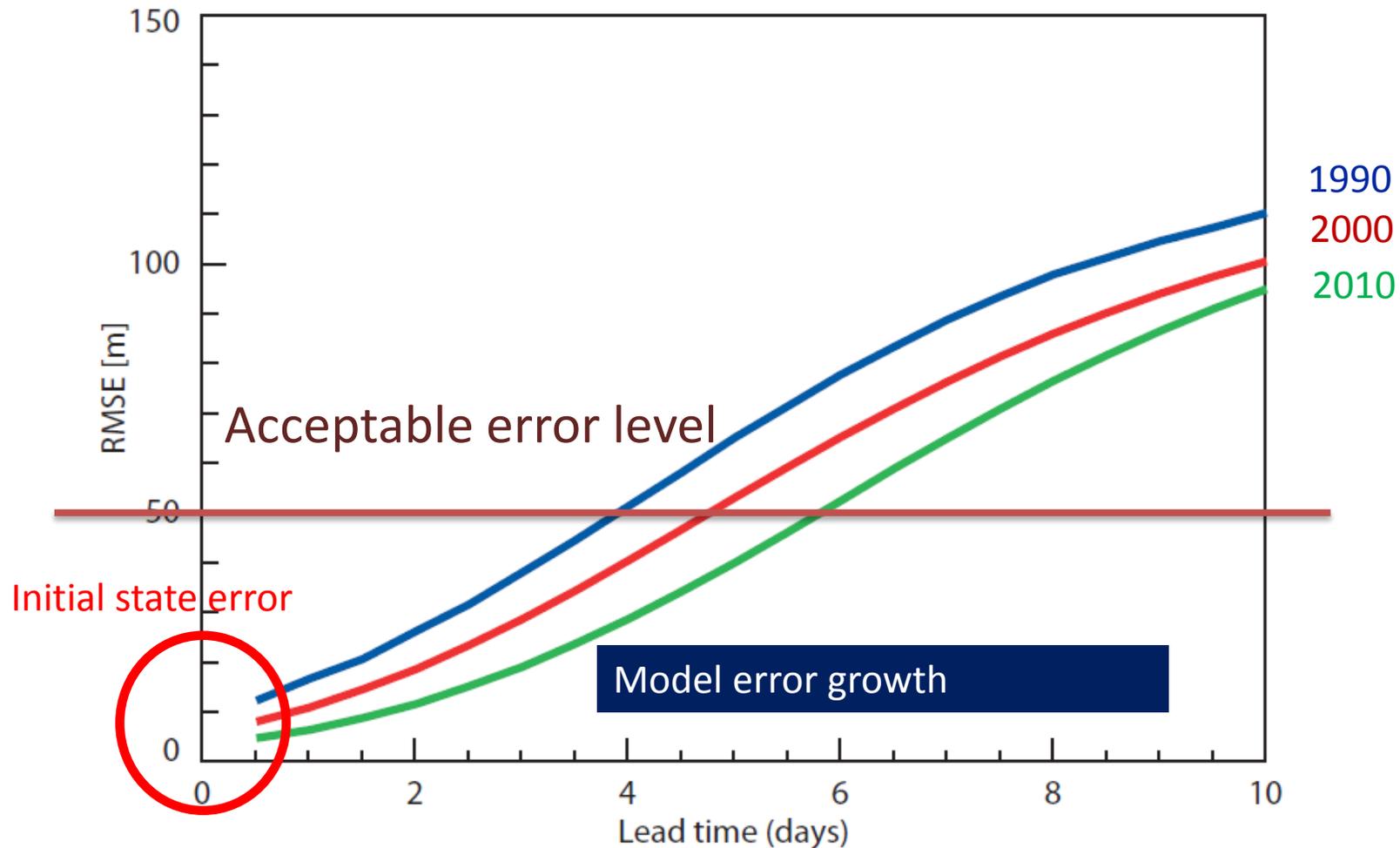
7–10 November 2016



# Welcome



# RMS error of 500 hPa height field Northern Hemisphere



# HRES headline score: 500 hPa height anomaly correlation

## HRES and ERA Interim 00,12UTC forecast skill

500hPa geopotential

Lead time of Anomaly correlation reaching 80%

NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)

T+0 T+12 ... T+240

oper\_an od oper 0001 | 00UTC,12UTC,beginning



# HRES headline score: 500 hPa height anomaly correlation

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500hPa geopotential

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# HRES headline score: 500 hPa height anomaly correlation

## HRES - ERA

500hPa geopotential

Difference of lead time of ACC reaching 80%

NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)

T+0 T+12 ... T+240

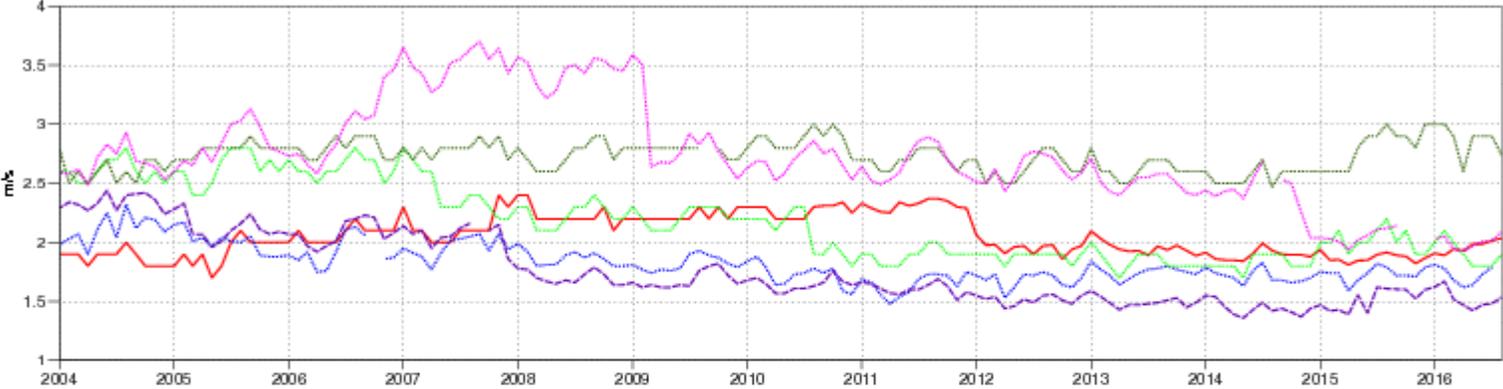
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# HRES: tropics, wind 850 hPa verification against analyses

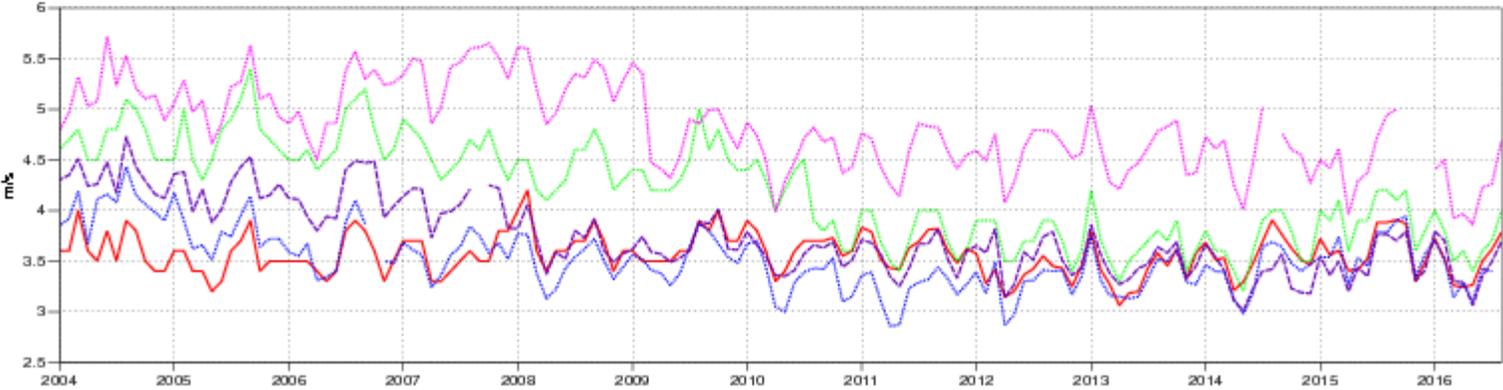
850hPa vector wind  
 Root mean square error  
 Tropics (lat -20.0 to 20.0, lon -180.0 to 180.0)  
 against analysis

--- NCEP 00UTC T+24     --- JMA 12UTC T+24  
--- UKMO 12UTC T+24     --- CMC 00UTC T+24  
--- ECMWF 12UTC T+24     --- Météo-France 00UTC T+24



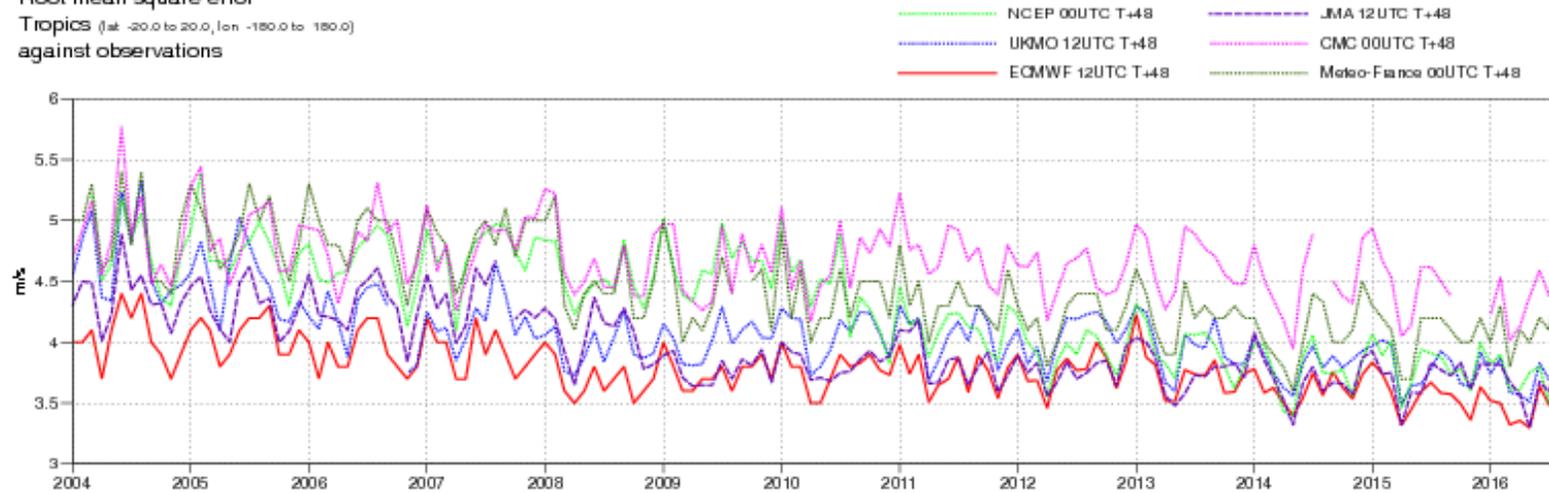
850hPa vector wind  
 Root mean square error  
 Tropics (lat -20.0 to 20.0, lon -180.0 to 180.0)  
 against analysis

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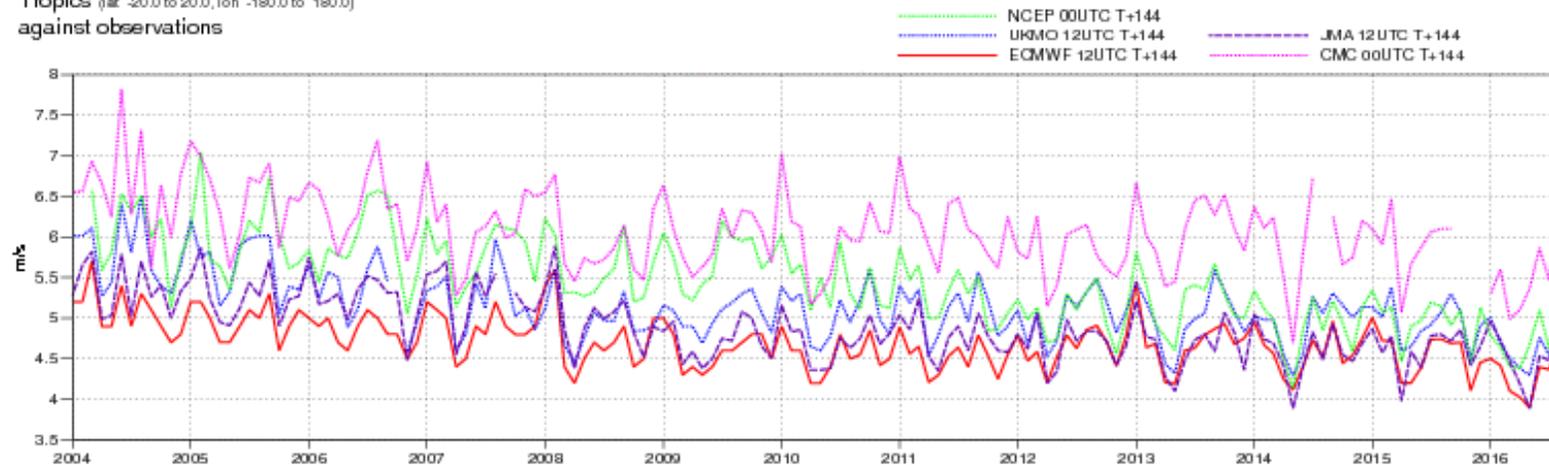


# HRES: tropics, wind 850 hPa verification against observations

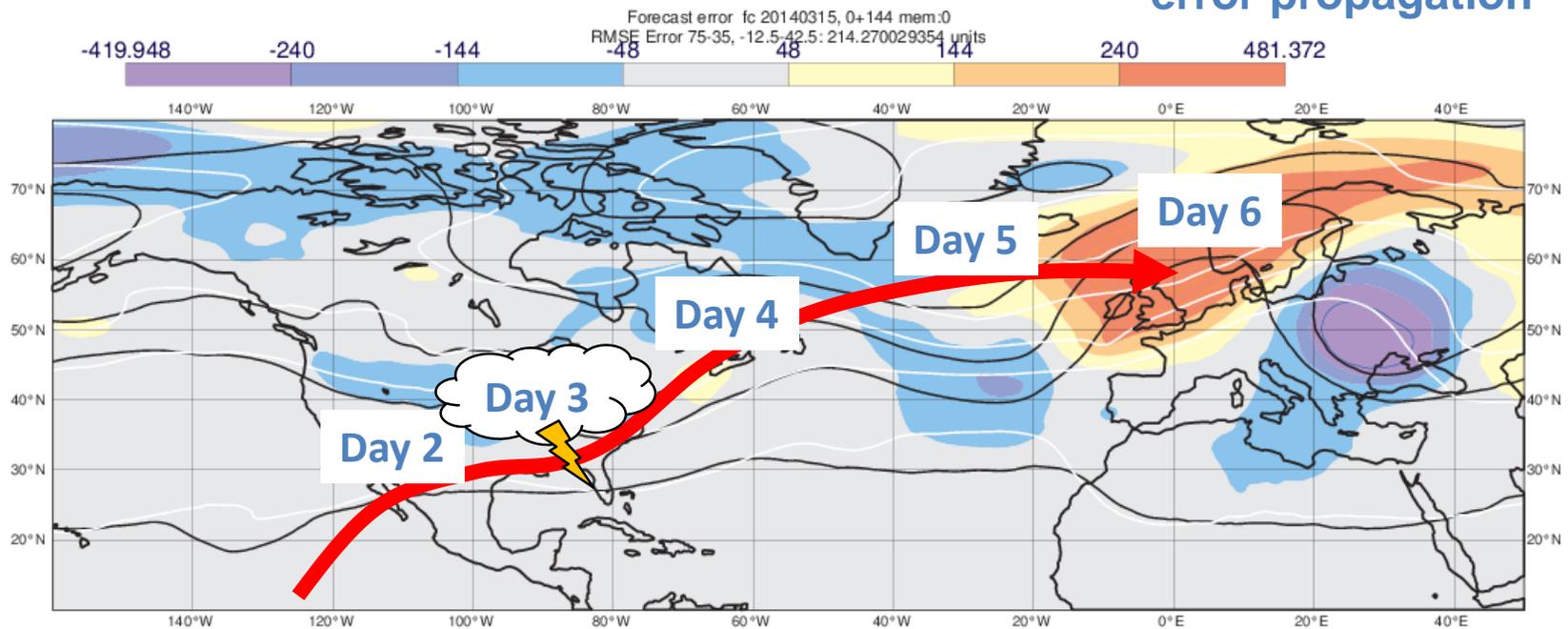
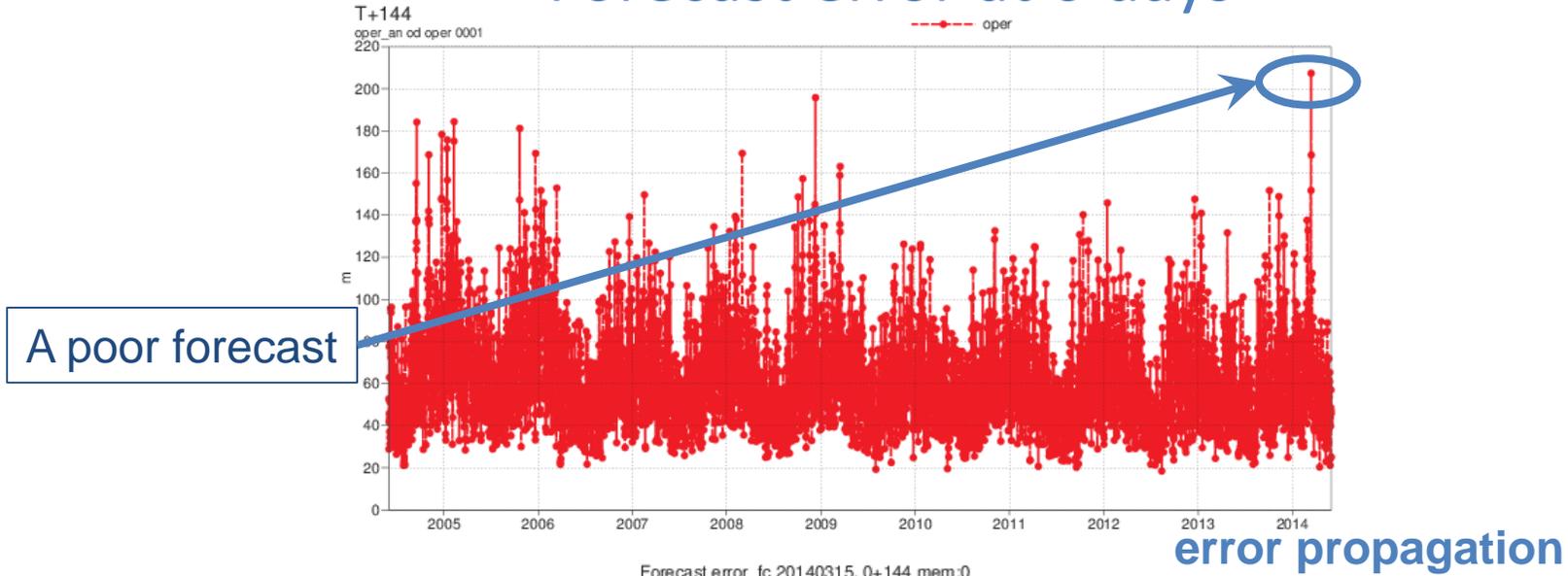
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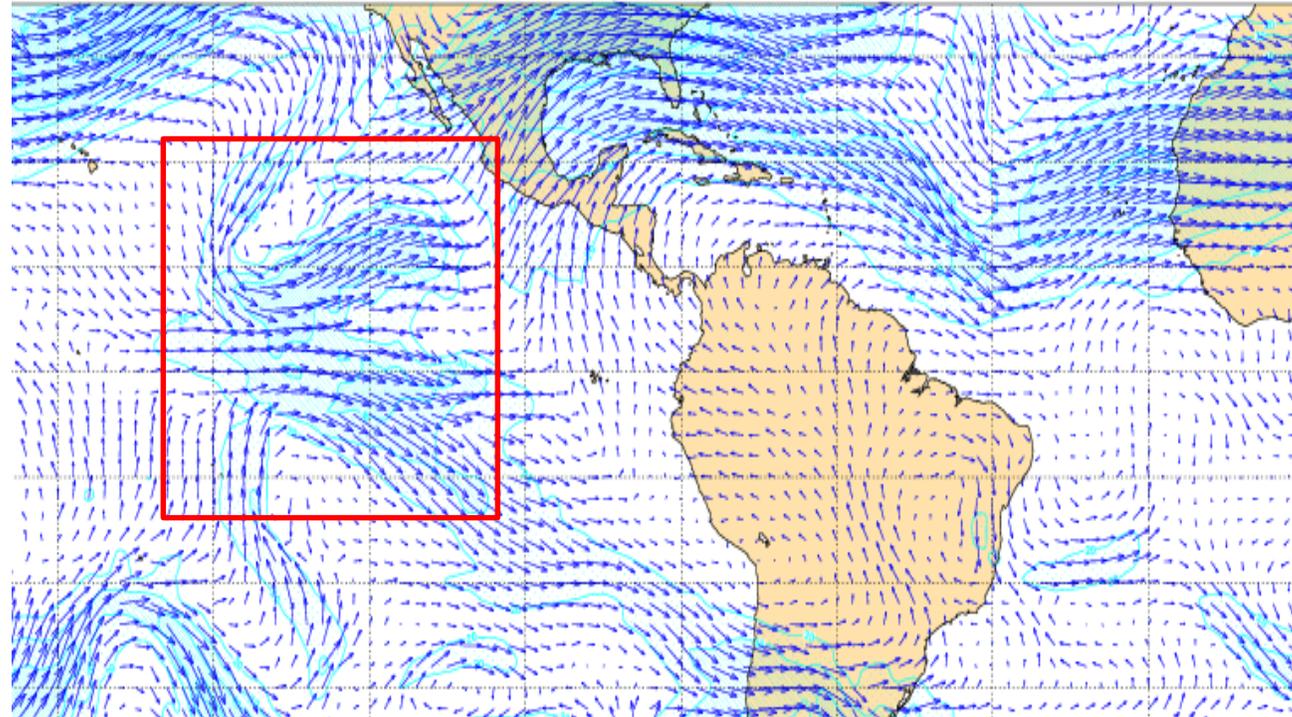
850hPa vector wind  
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Tropics (lat -20.0 to 20.0, lon -180.0 to 180.0)  
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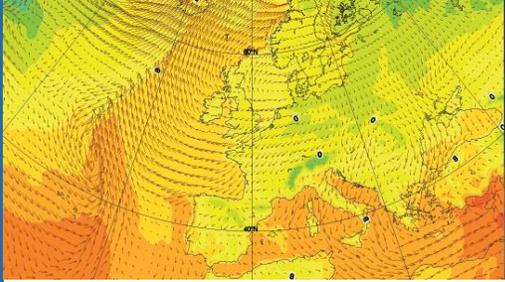


# Forecast error at 6 days



## 200 hPa winds on 15 March 2014





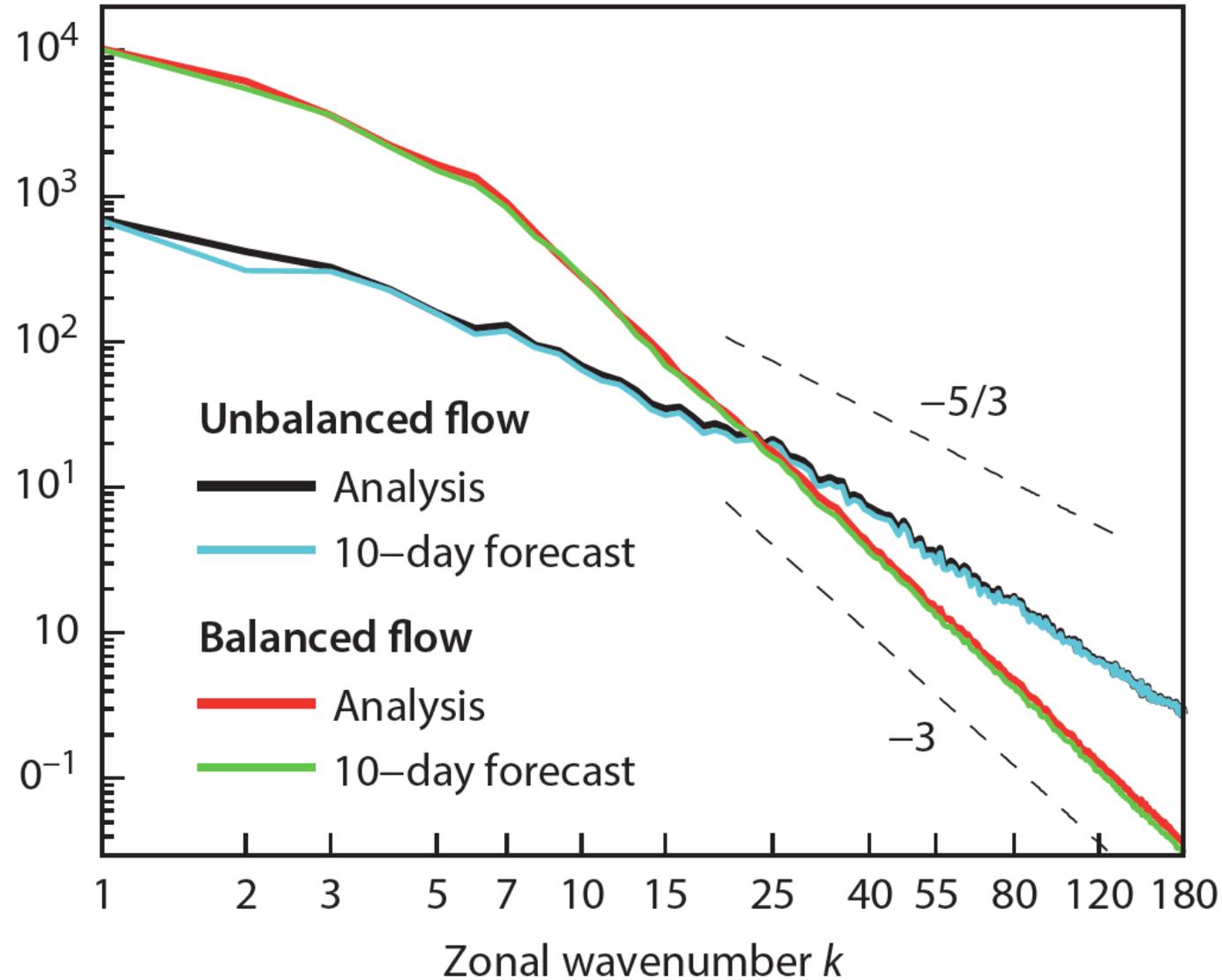
# Tropical wave dynamics and data assimilation

Erland Källén, Linus Magnusson and Nedjeljka Zagar  
*ECMWF and Univ Ljubljana*

## Mid-latitude vs. tropical wave dynamics

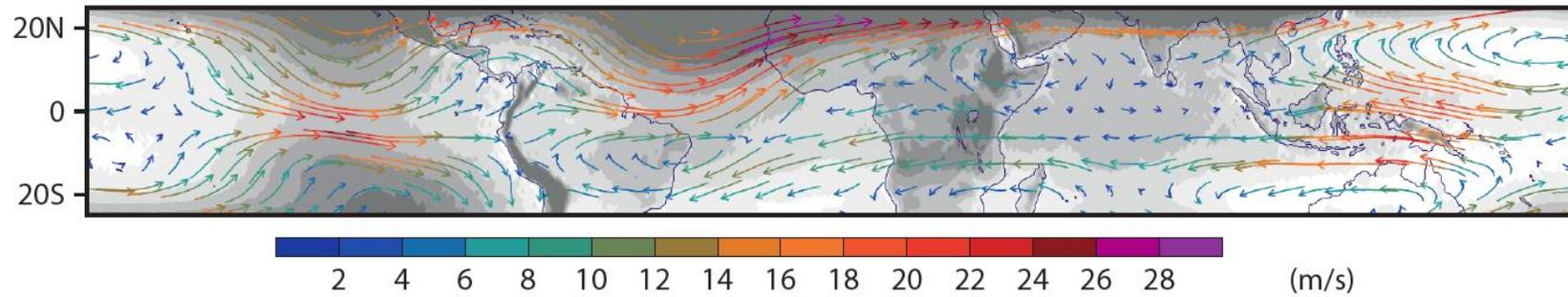
- **Balanced flow**
  - Rossby waves
  - Equatorial Rossby waves
- **Un-balanced flow**
  - Inertia-gravity waves (including Kelvin waves)

# Atmospheric energy spectrum (kinetic + potential)

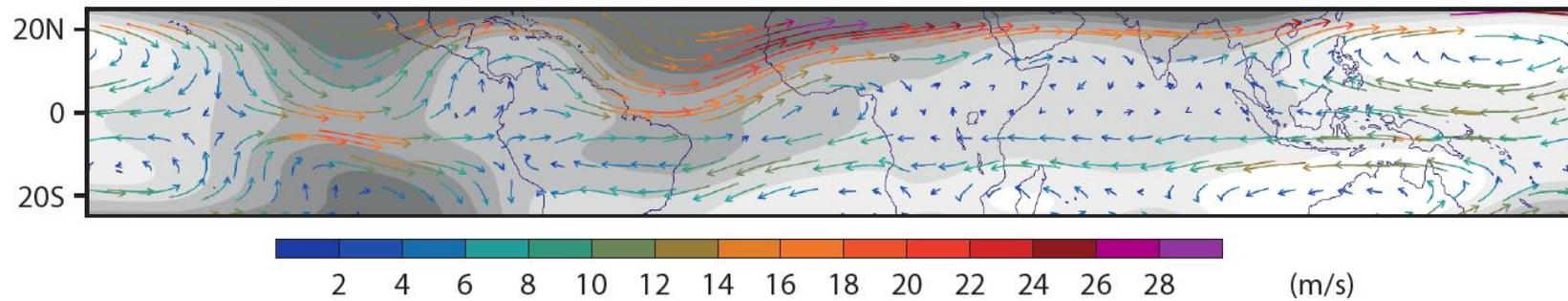


# Wind and mass field at 100 hPa, January 2015

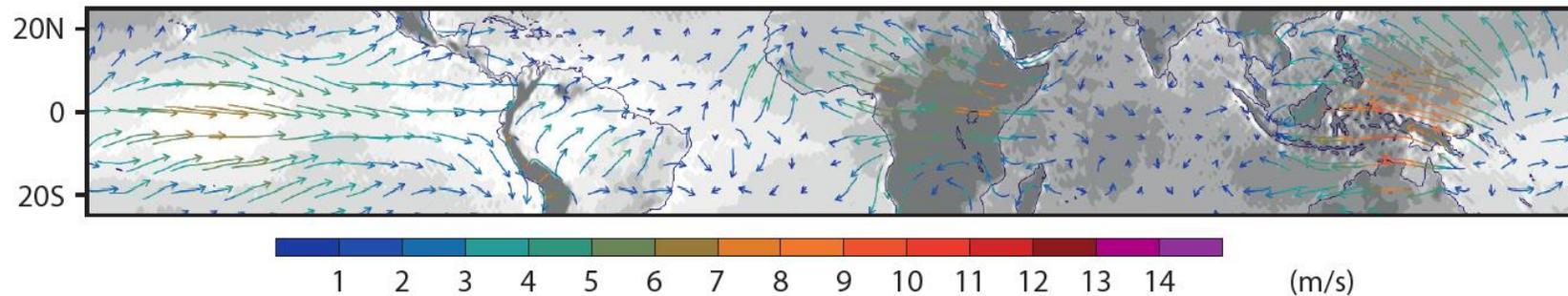
**a** January, total



**b** January, balanced

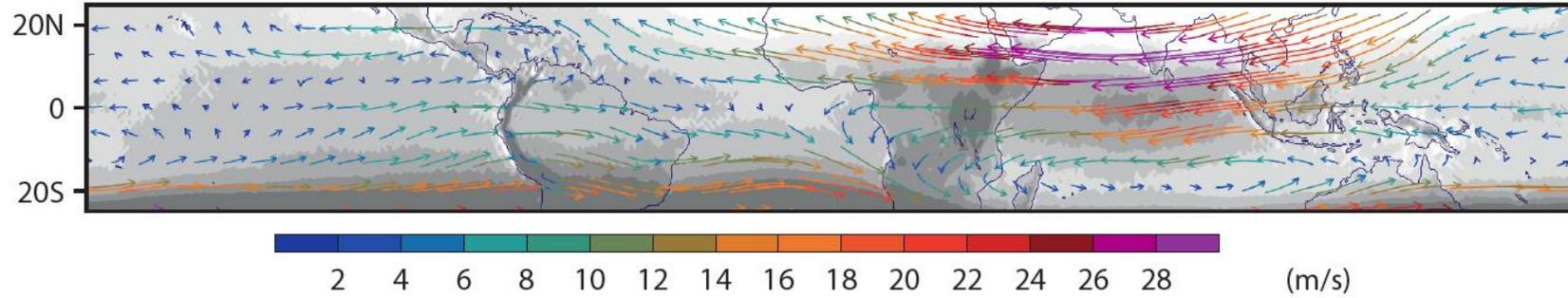


**c** January, unbalanced

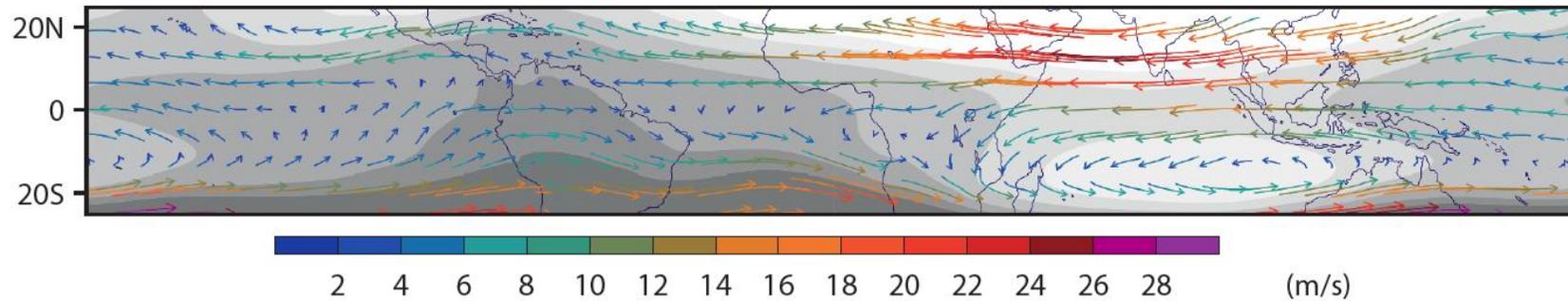


# Wind and mass field at 100 hPa, July 2015

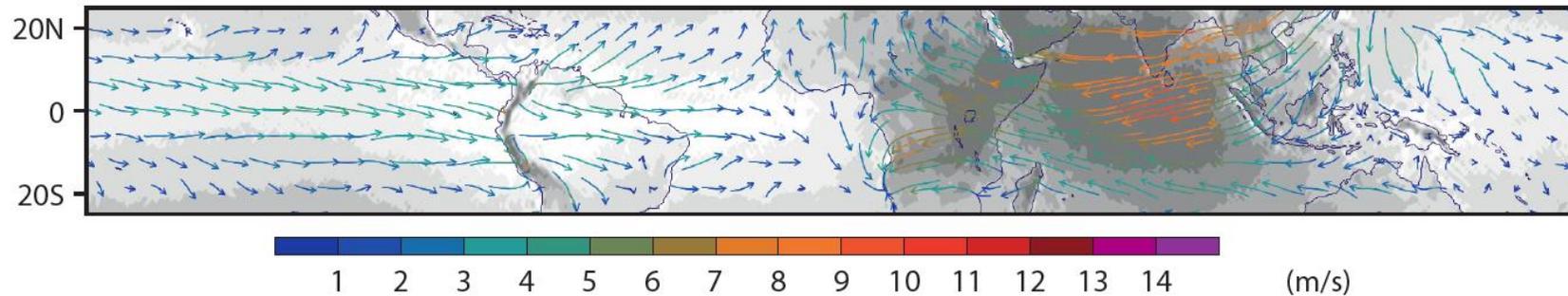
**d** July, total



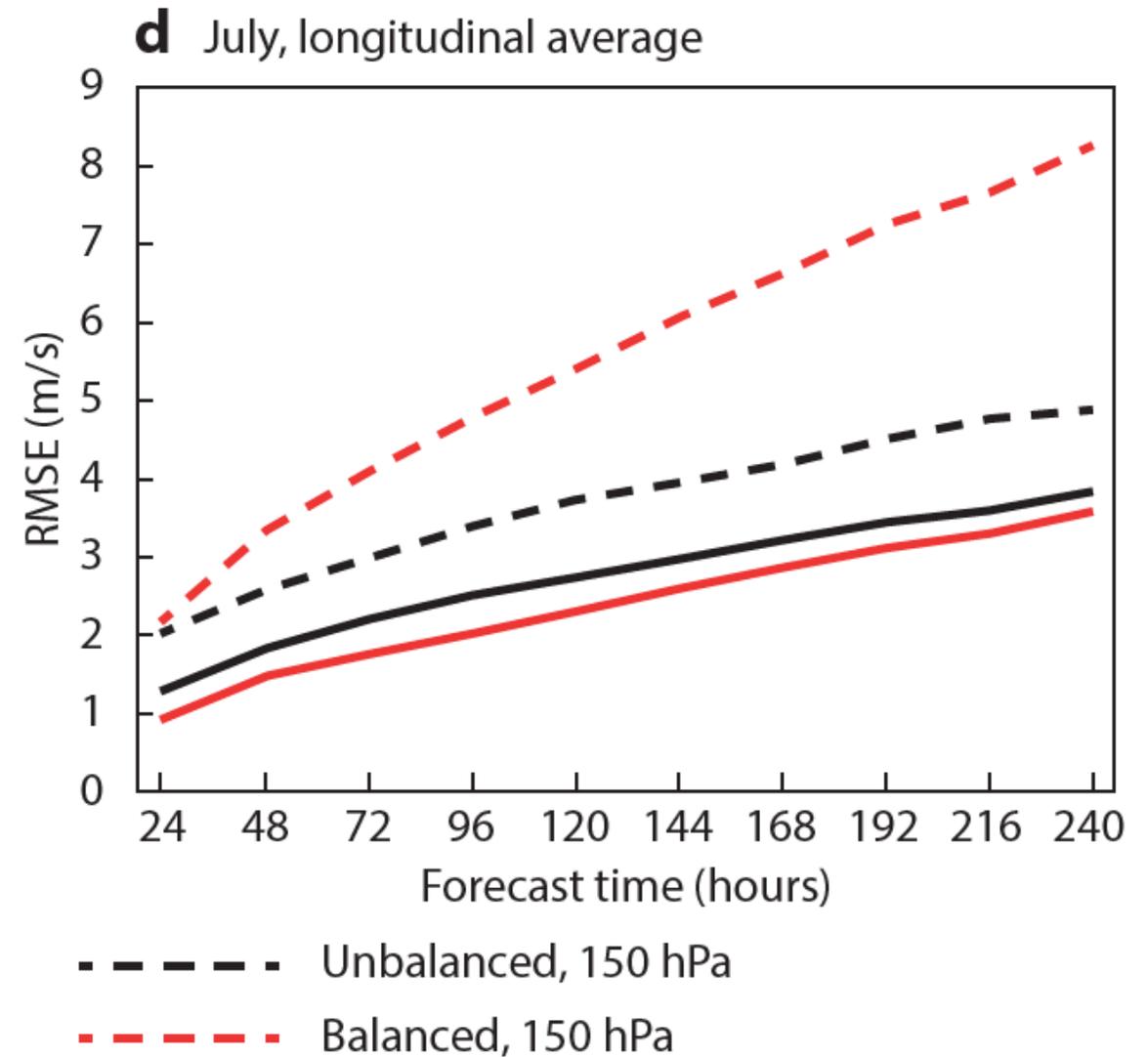
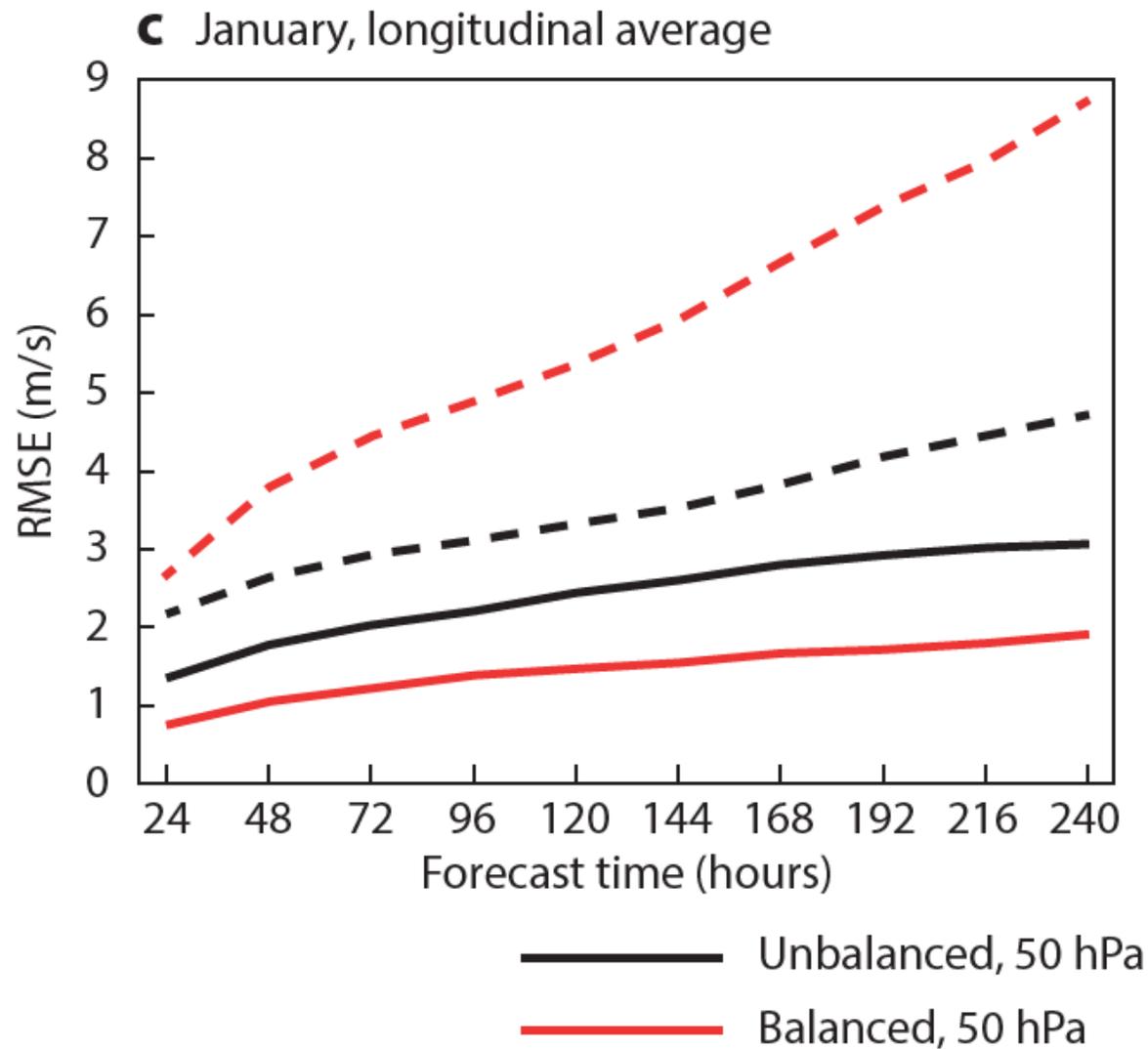
**e** July, balanced



**f** July, unbalanced

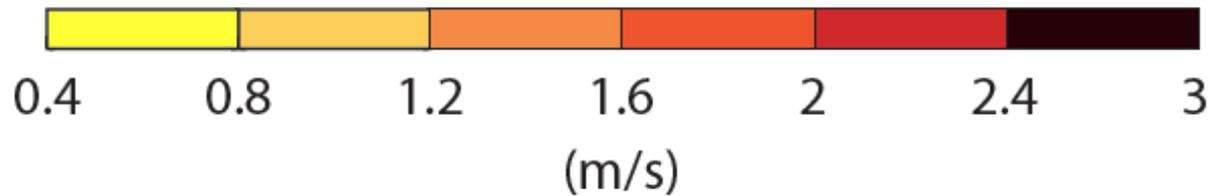
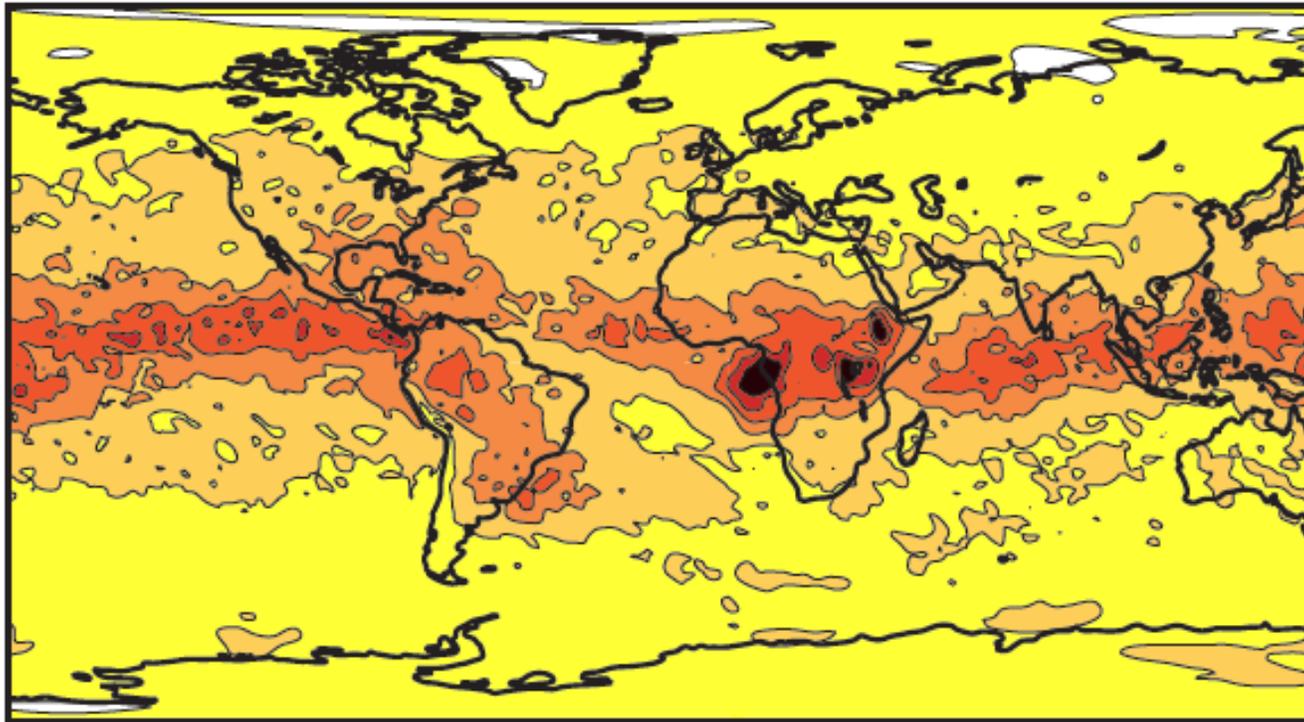


# Tropical zonal wind error growth (5°N, 5°S belt)

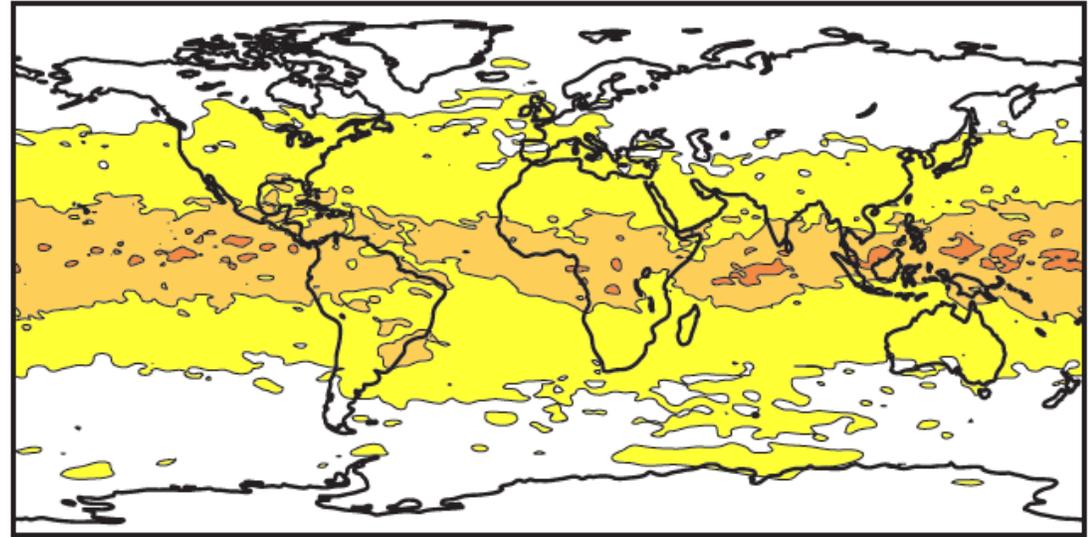


# Mean zonal wind analysis increments Sept-Nov 2015

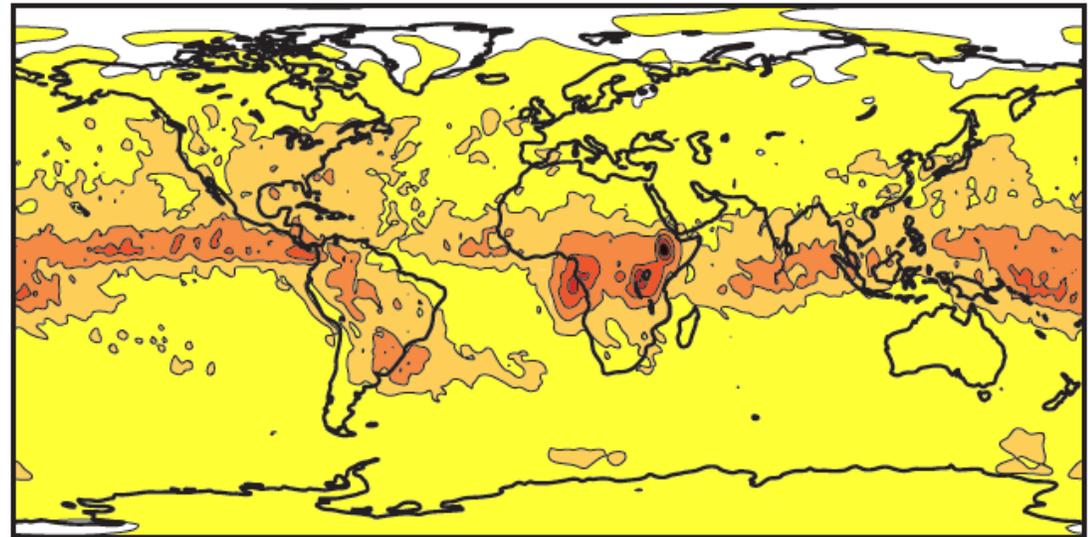
**d** Total, 150 hPa



**e** Balanced, 150 hPa



**f** Unbalanced, 150 hPa

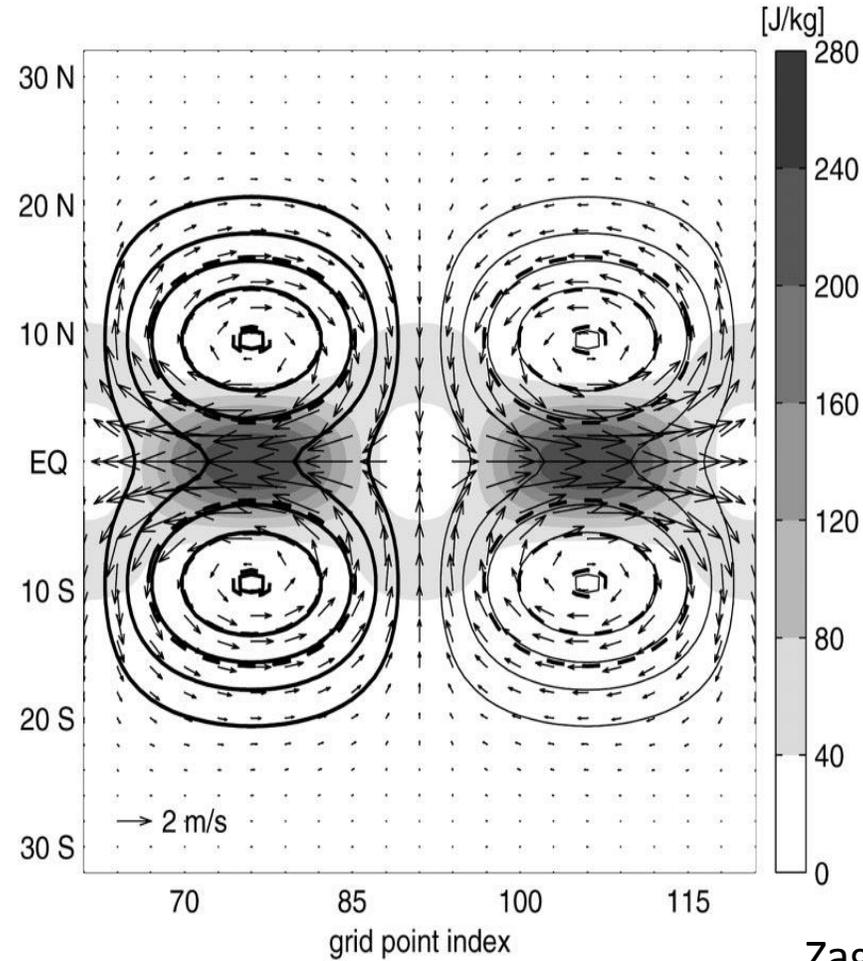


# Aeolus Doppler wind Lidar (launch 2017) (ESA Earth Explorer Mission)



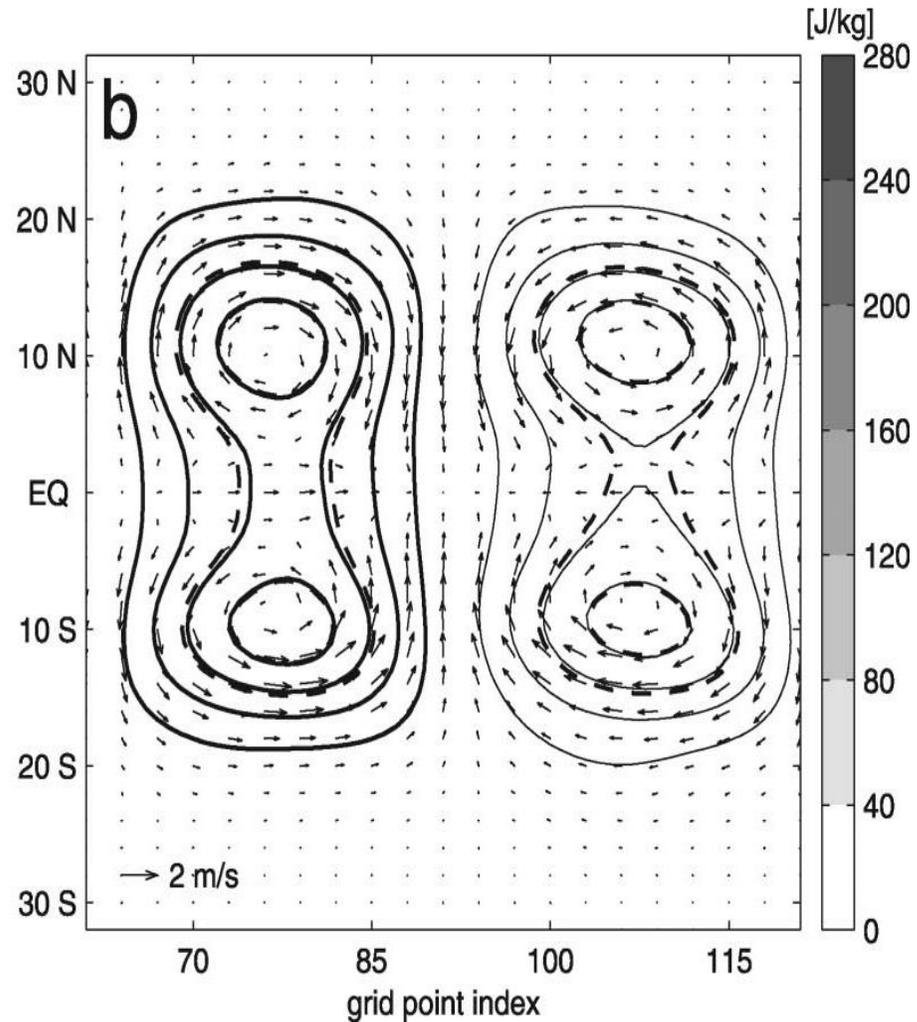
# Tropical wave

## Equatorial Rossby wave



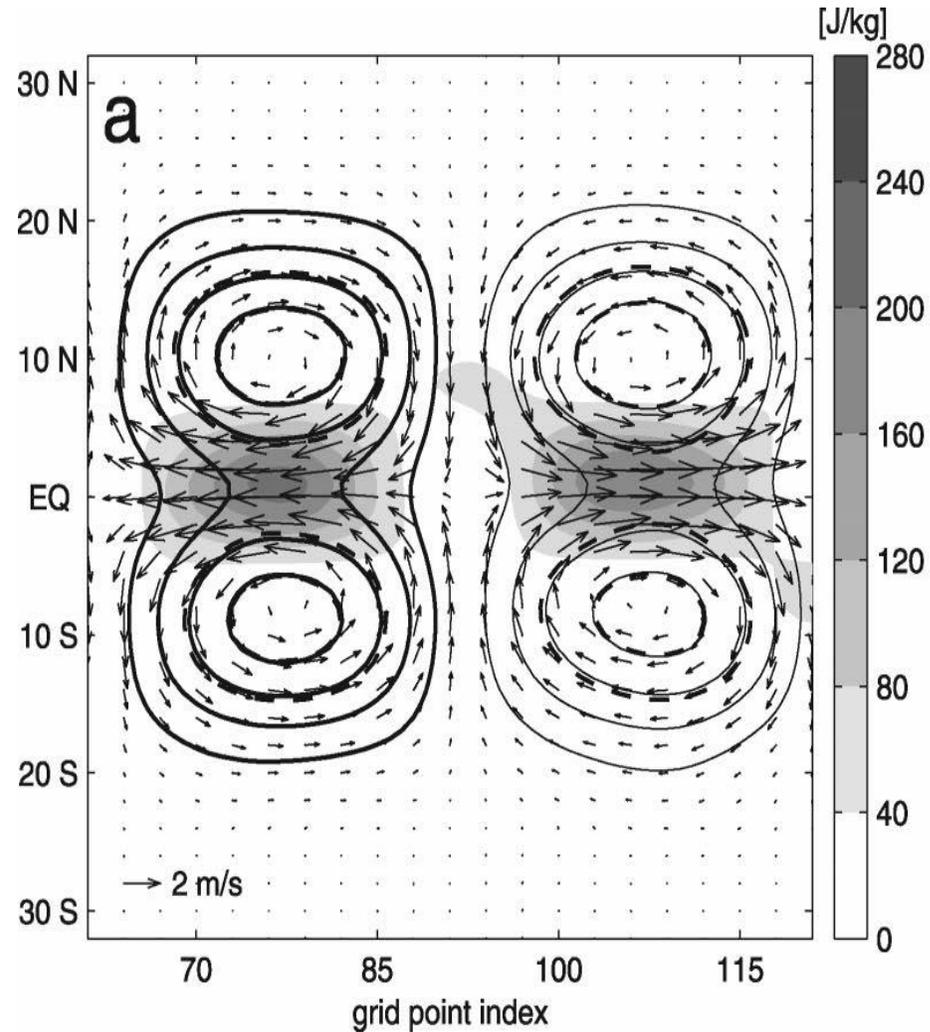
Zagar, 2004

# Assimilation using only height observations



Zagar, 2004

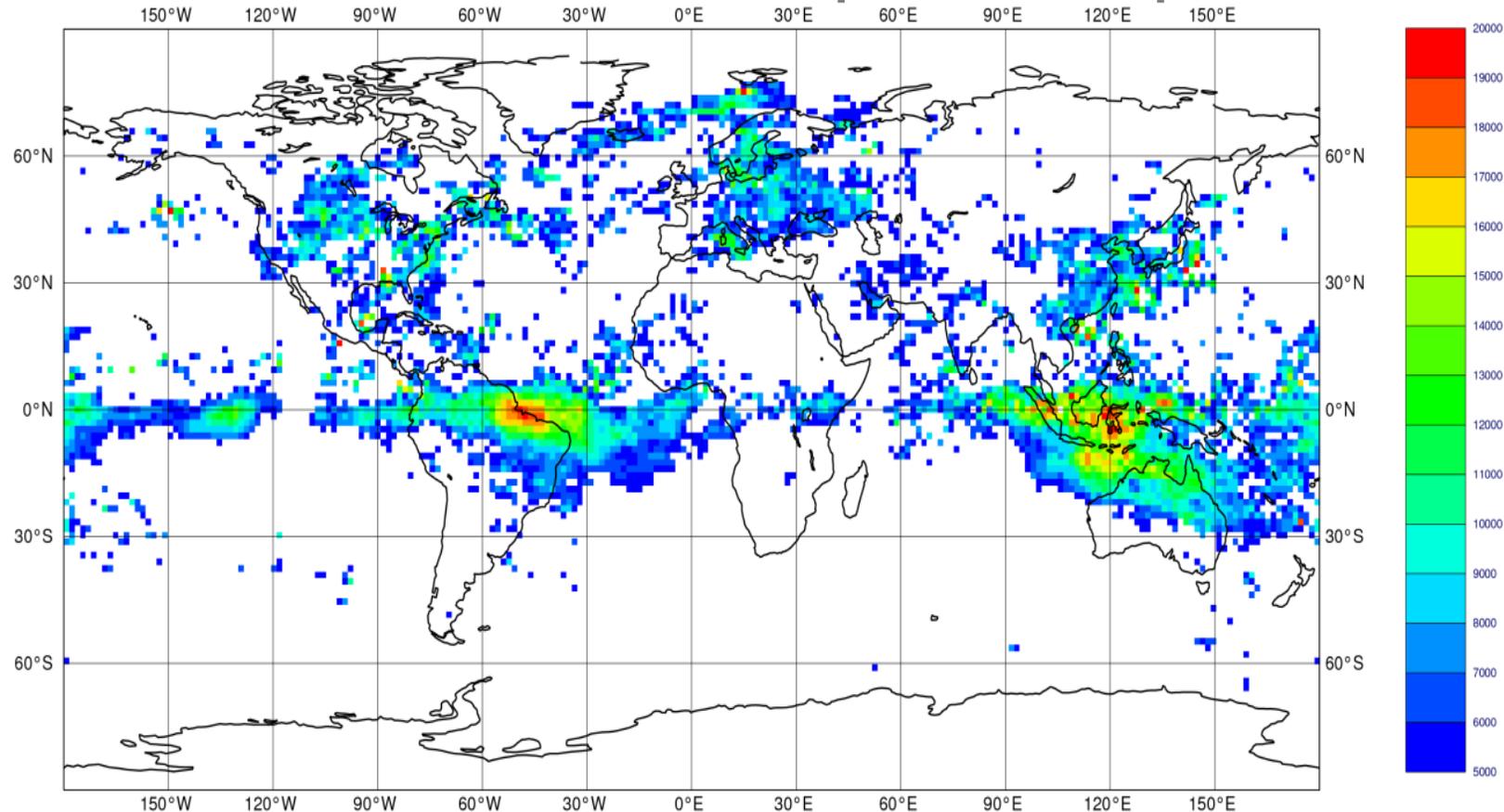
# Assimilation using height and u wind observations



Zagar, 2004

# NWP impact experiment

## Aeolus u-wind profile impacts



# Summary

- Tropical analyses need to be improved
- Medium range forecasts in mid-latitudes influenced by tropics
- Aeolus wind profiles → improved tropical analyses

