

Heating rates among reanalysis

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The reanalyses

ECMWF

- FGGE, ERA-15, ERA-40, ERA-Interim, ERA5
- ERA-CLIM,
- CERA (with ocean)
- CAMS-Interim (chemistry)

NOAA

- NCEP NCAR (R-1)
- NCEP DOE (R-2)
- CFSR
- 20CR, 20CRV2

JMA

- JRA-25
- JRA-55 (JRA-55, JRA-55C, JRA-55Amip)
- JRA-3Q

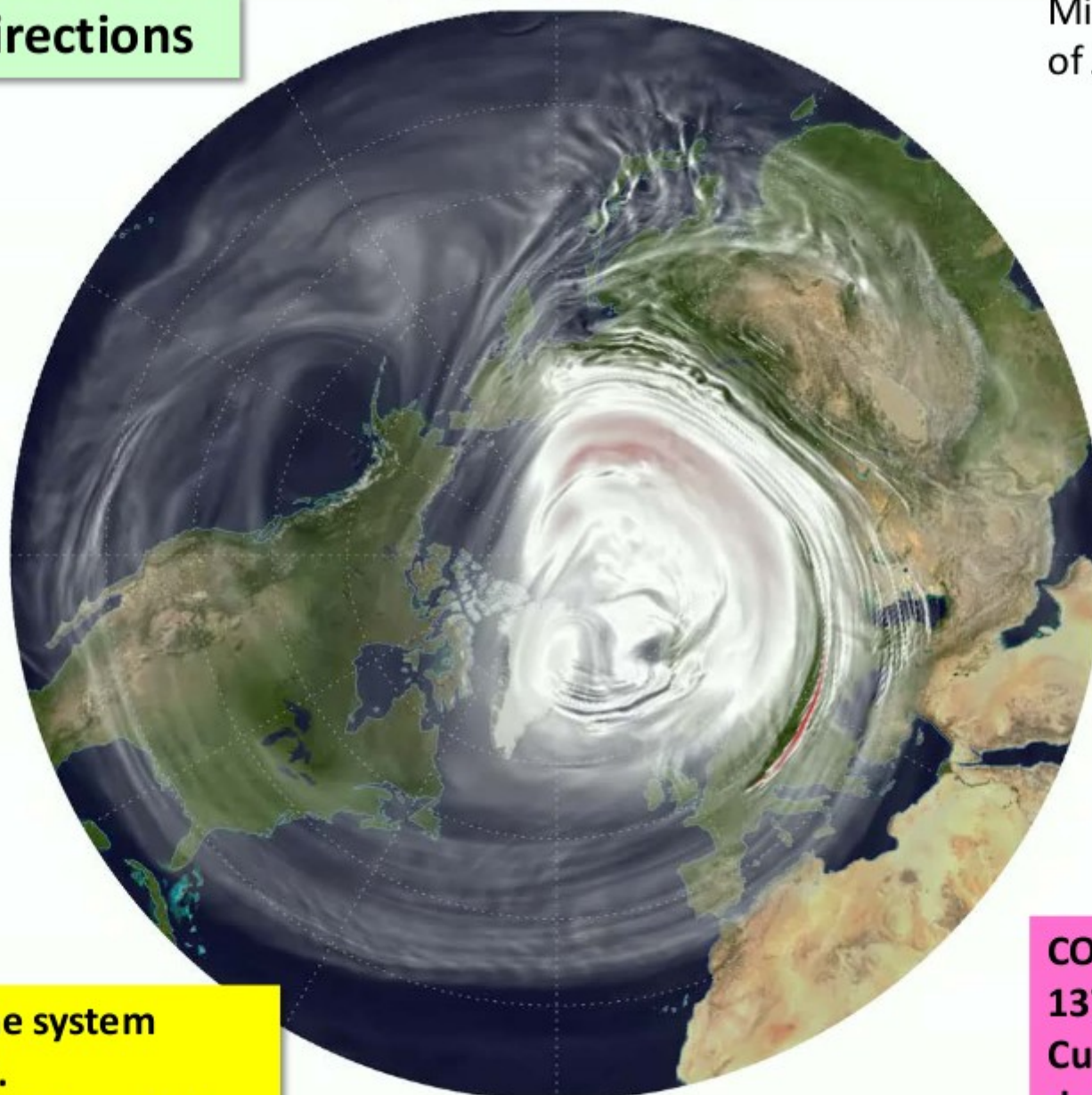
NASA

- MERRA, MERRA-2

25 Dec 2014 00UTC

Future Directions

Minor Warming
of January 2015



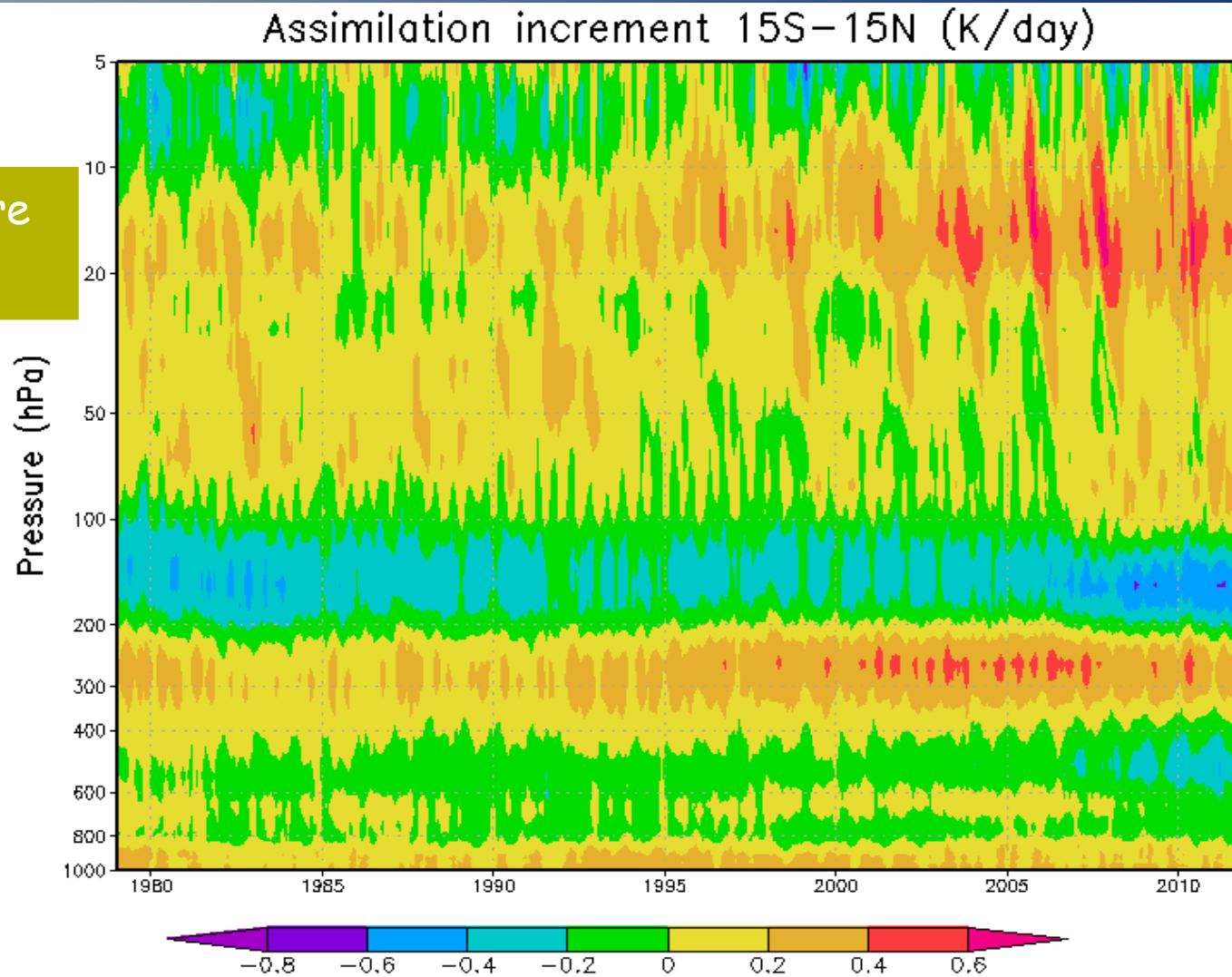
Near-real-time system
development.
12 km horizontal resolution.

NASA /GMAO - f513a_rt
EPV at 10 hPa

COMING SOON:
137 Levels
Currently under
development.

Biaises in the ERA-Interim

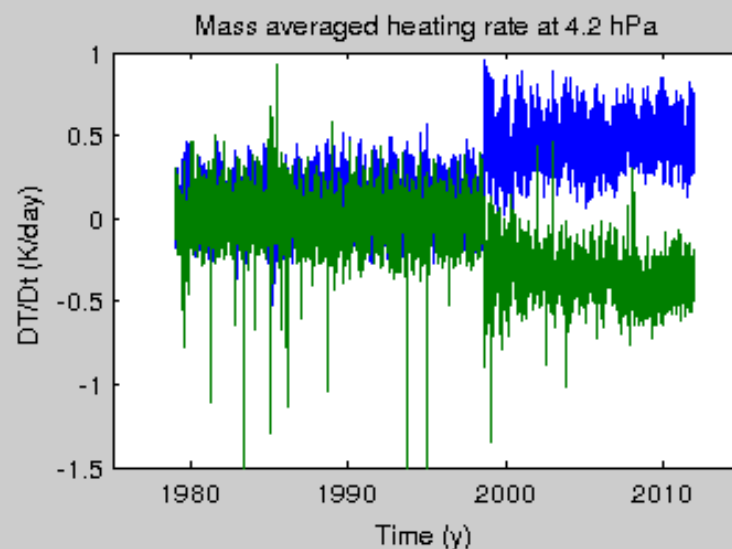
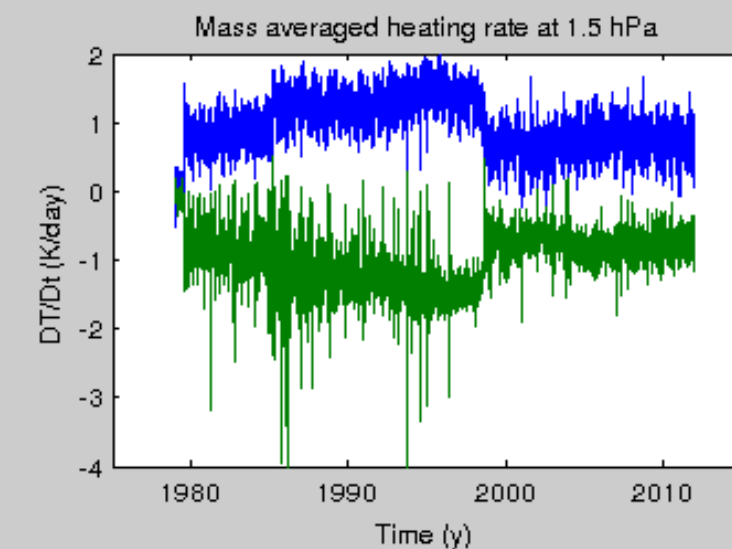
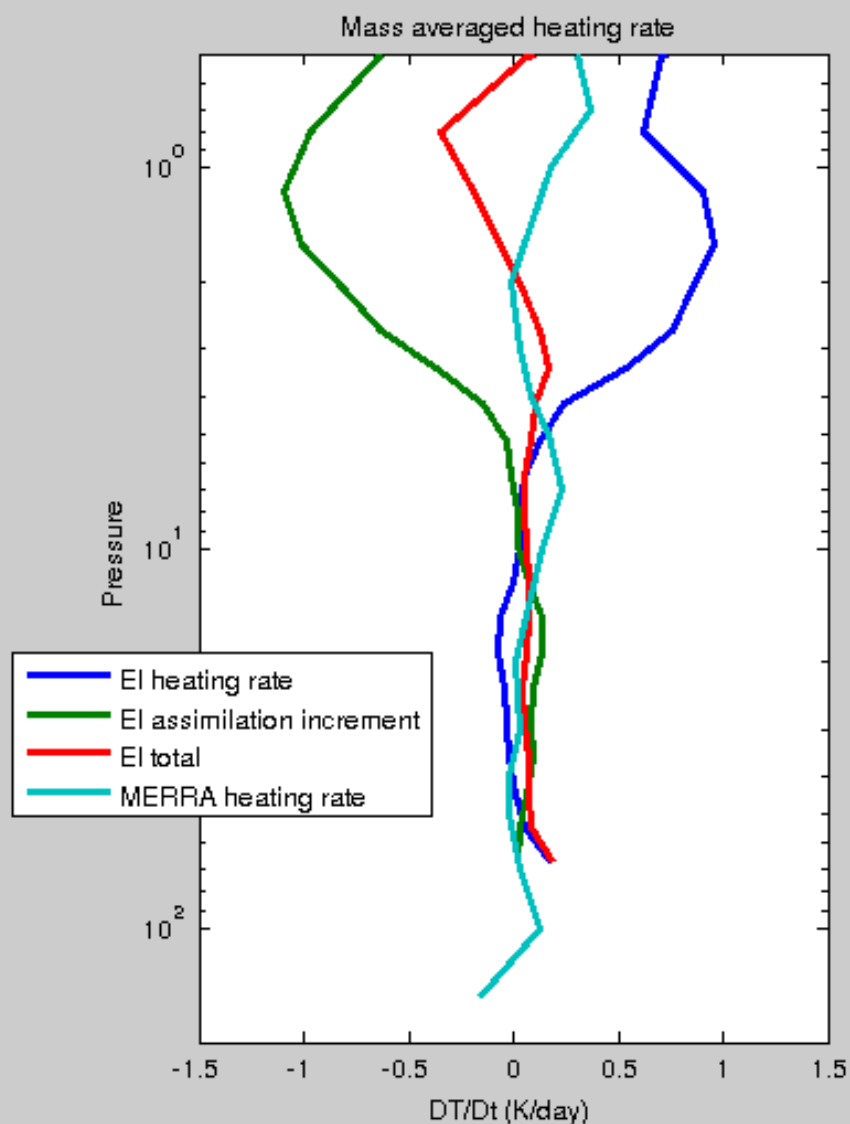
Temperature
increment



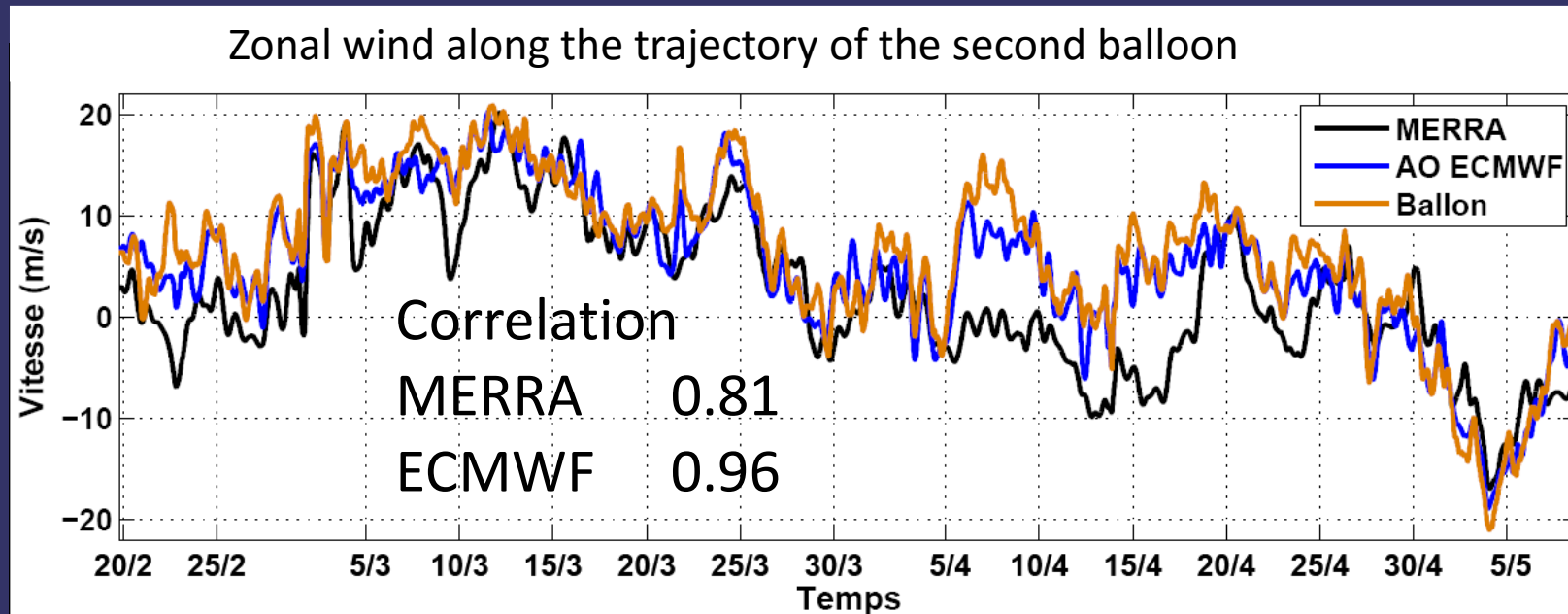
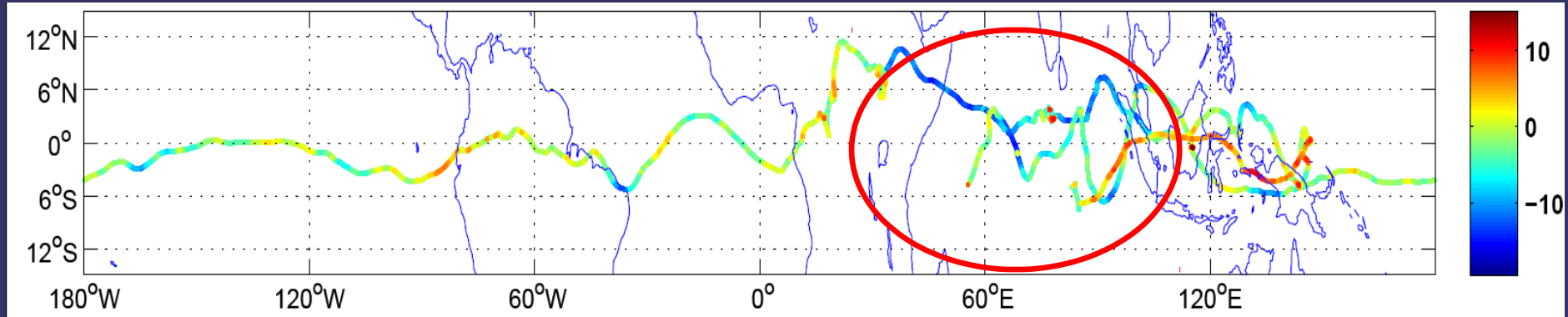
AMSU-A

GPS RO

Biaises in the ERA-Interim

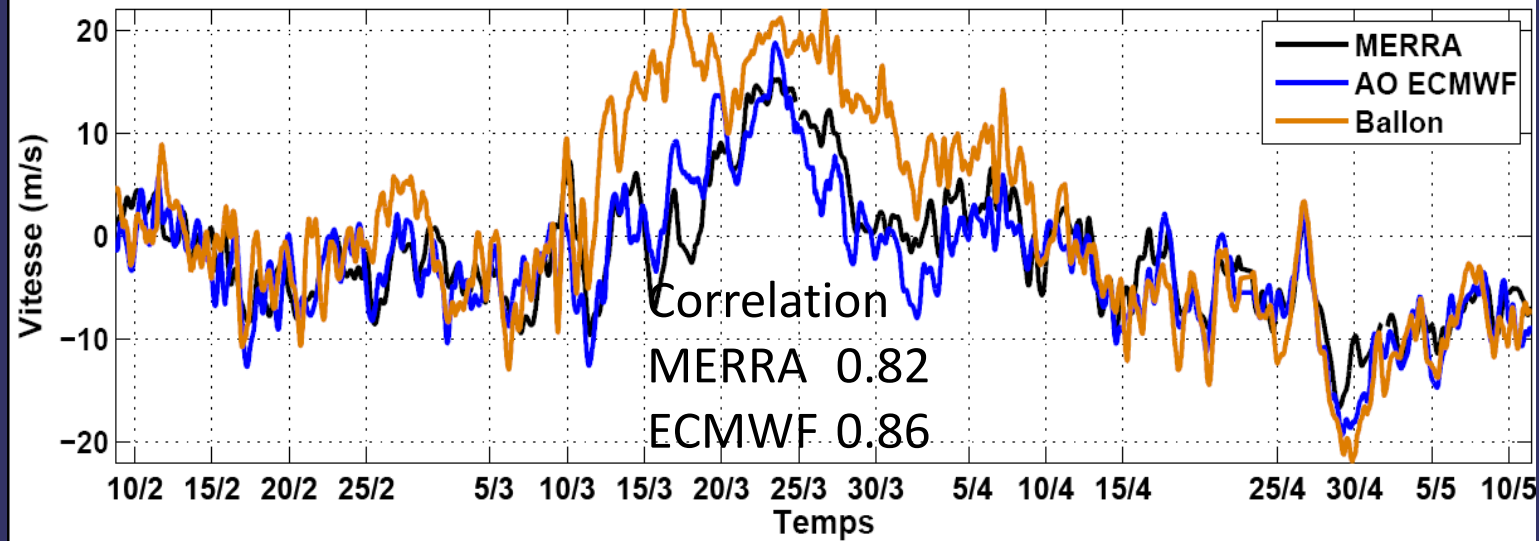


Analysed wind compared to balloon trajectory in the tropics

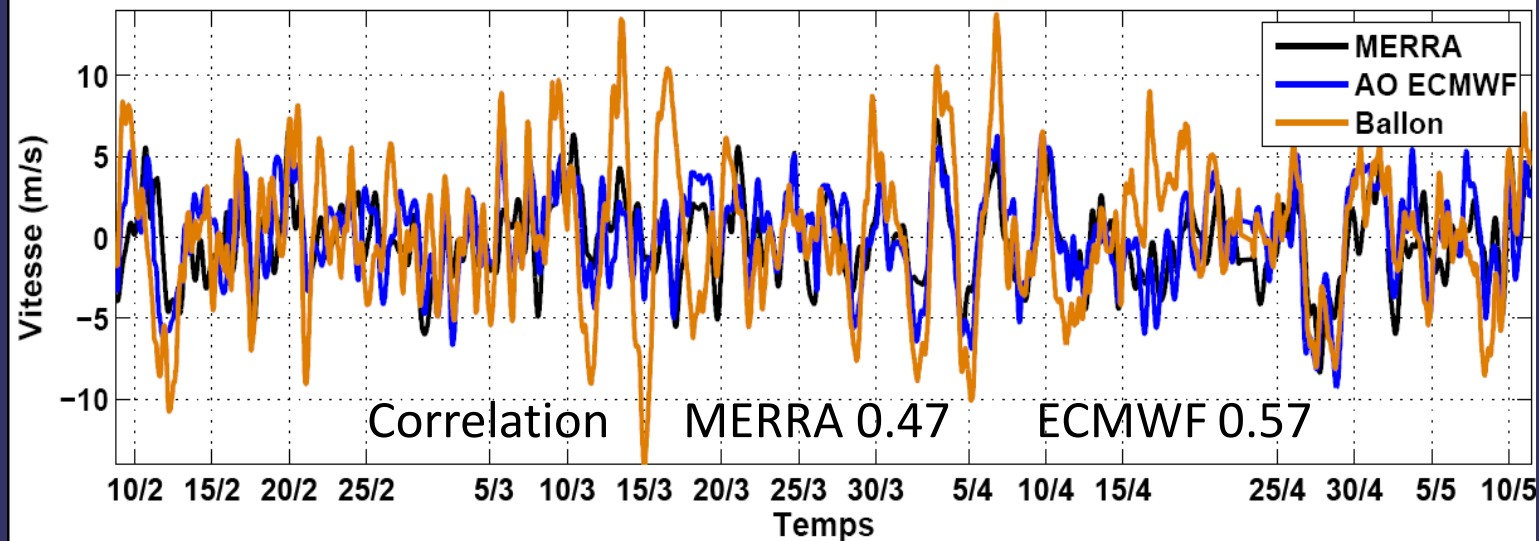


Courtesy of Podglajen, Hertzog and Plougonven, 2014

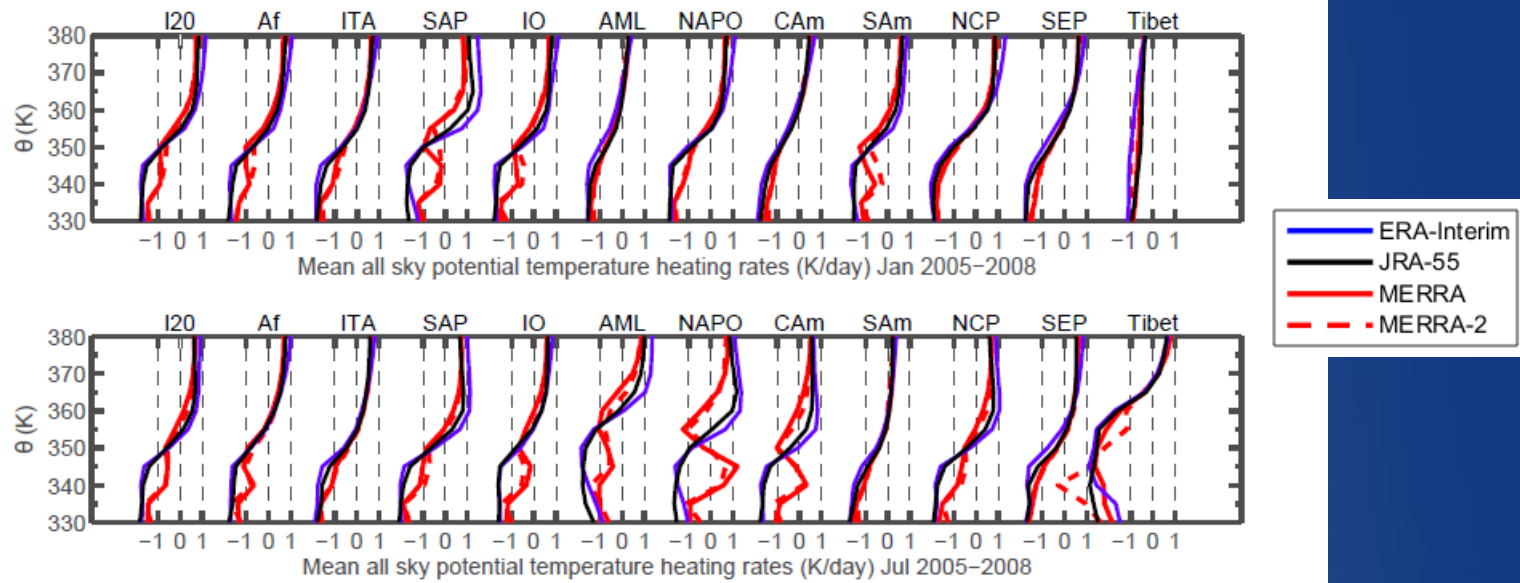
Zonal wind along the trajectory of the first balloon



Meridional wind along the trajectory of the first balloon

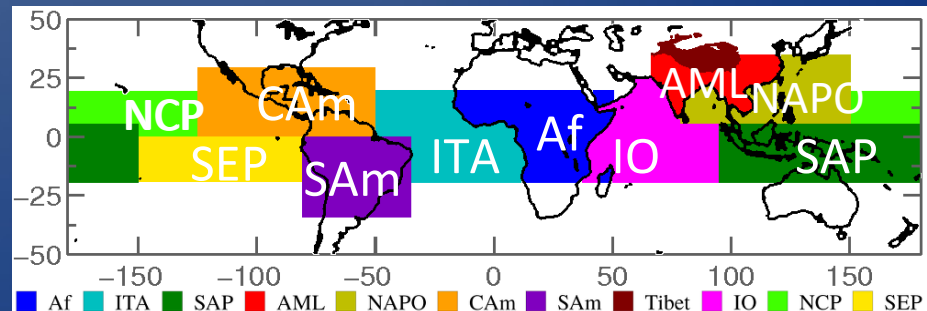


Courtesy of Podglajen, Hertzog and Plougonven, 2014

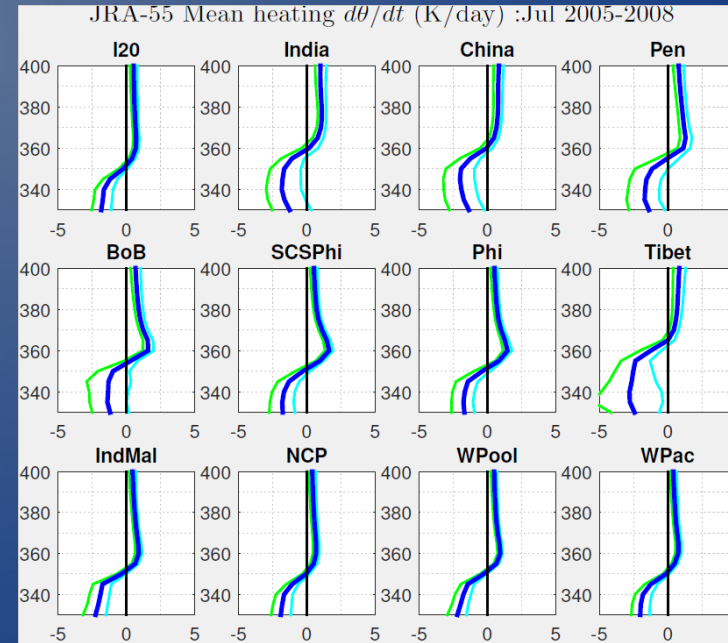
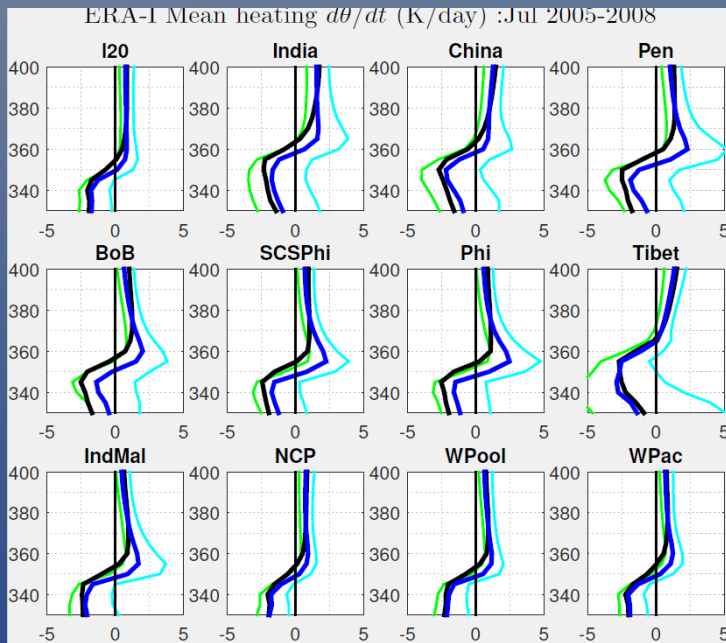
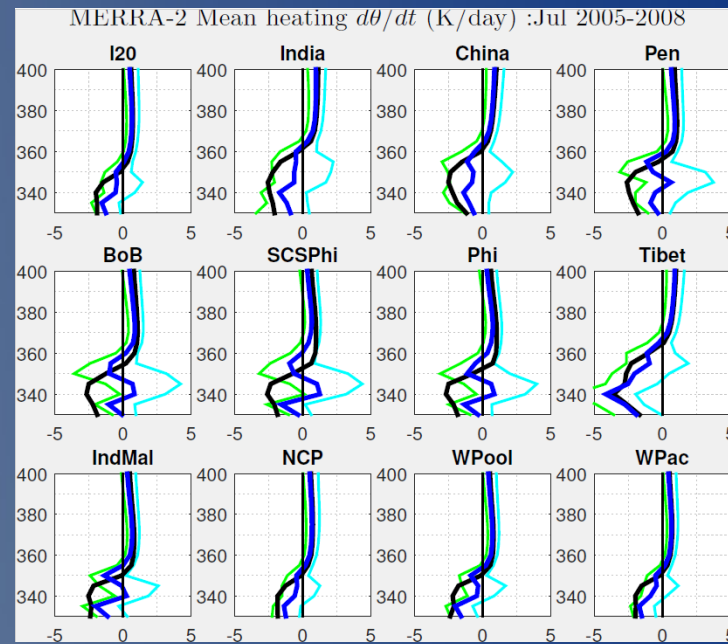
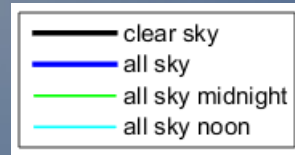
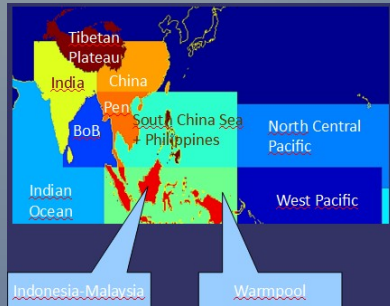


The three reanalysis all sky heating rate agree only over non convective regions. The heating rates from MERRA/MERRA-2 depart significantly from ERA-Interim/JRA-55 over convective region, especially over the Asian monsoon region.

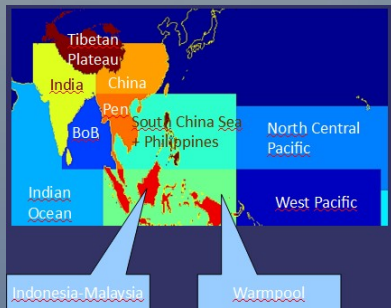
Tissier & Legras, ACP, 2016



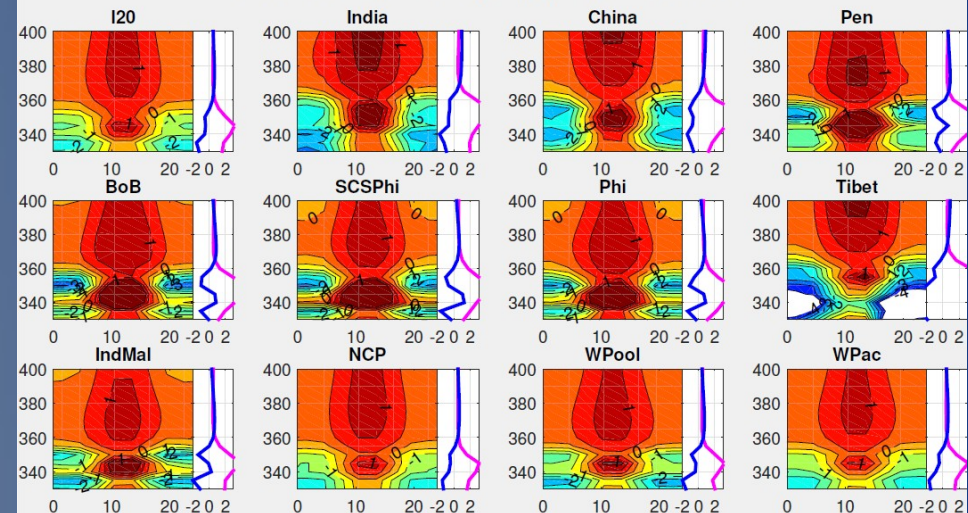
Heating rates over Asian regions



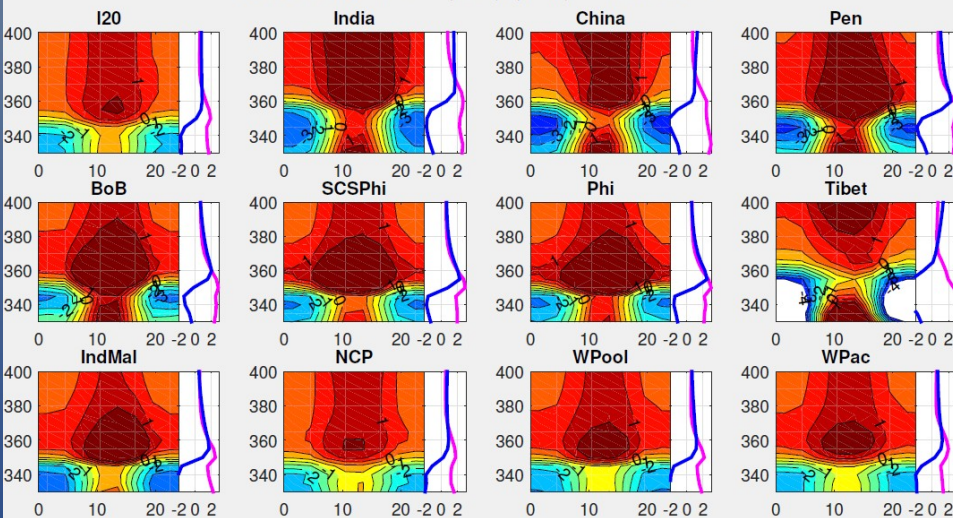
Daily cycle of the all sky heating rates (in local time)



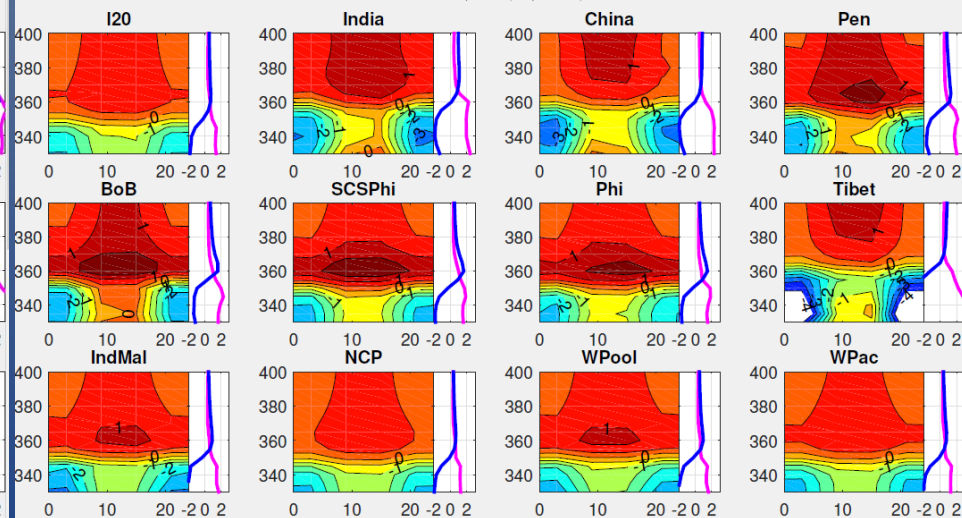
MERRA-2 Daily cycle $d\theta/dt$ (K/day) :Jul 2005-2008

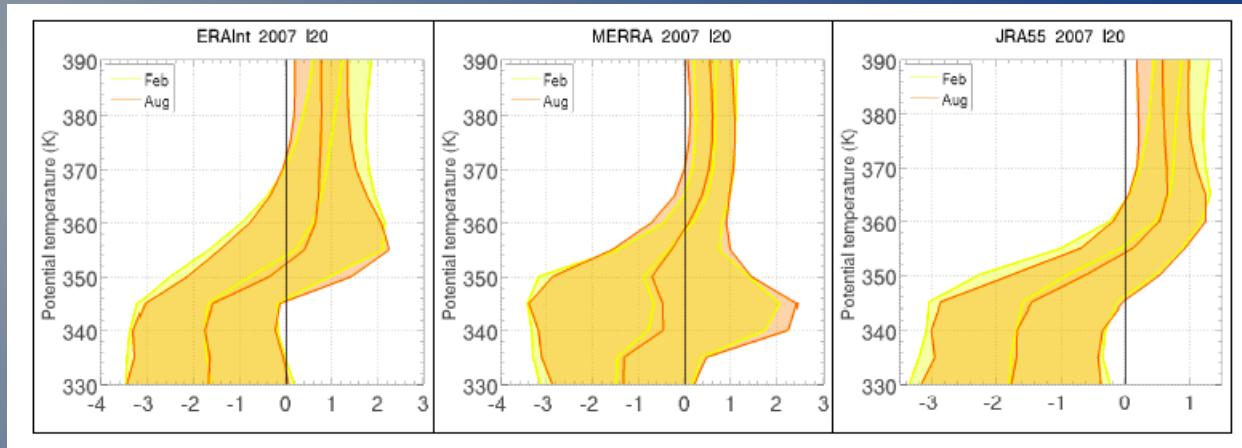


ERA-I Daily cycle $d\theta/dt$ (K/day) :Jul 2005-2008

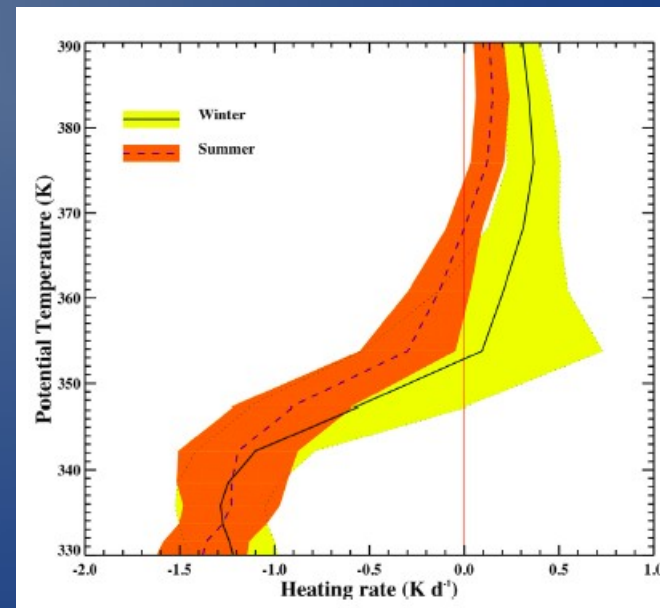


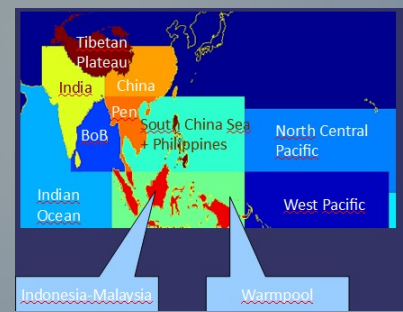
JRA-55 Daily cycle $d\theta/dt$ (K/day) :Jul 2005-2008



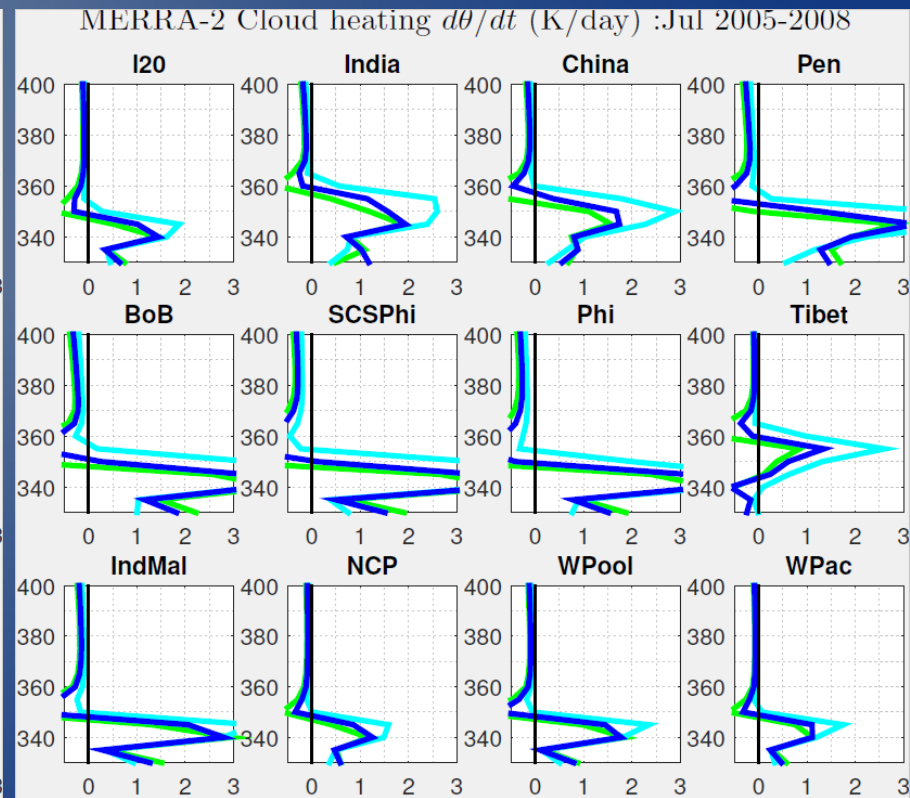
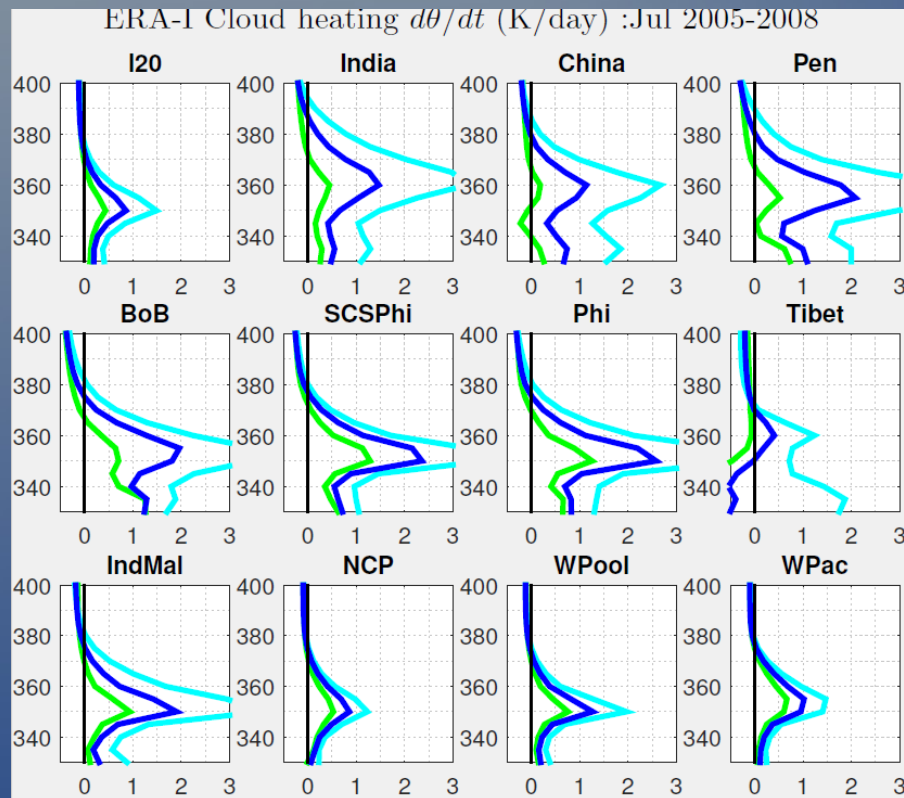
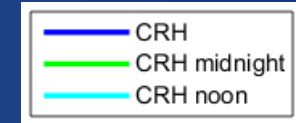


Mean heating rates \pm 1 std deviation for the three reanalysis in the tropical band and for Bergman et al., JGR, 2012 using heating rates from Yang et al., JGR, 2010 based on CALIPSO + ISCCP cloud cover

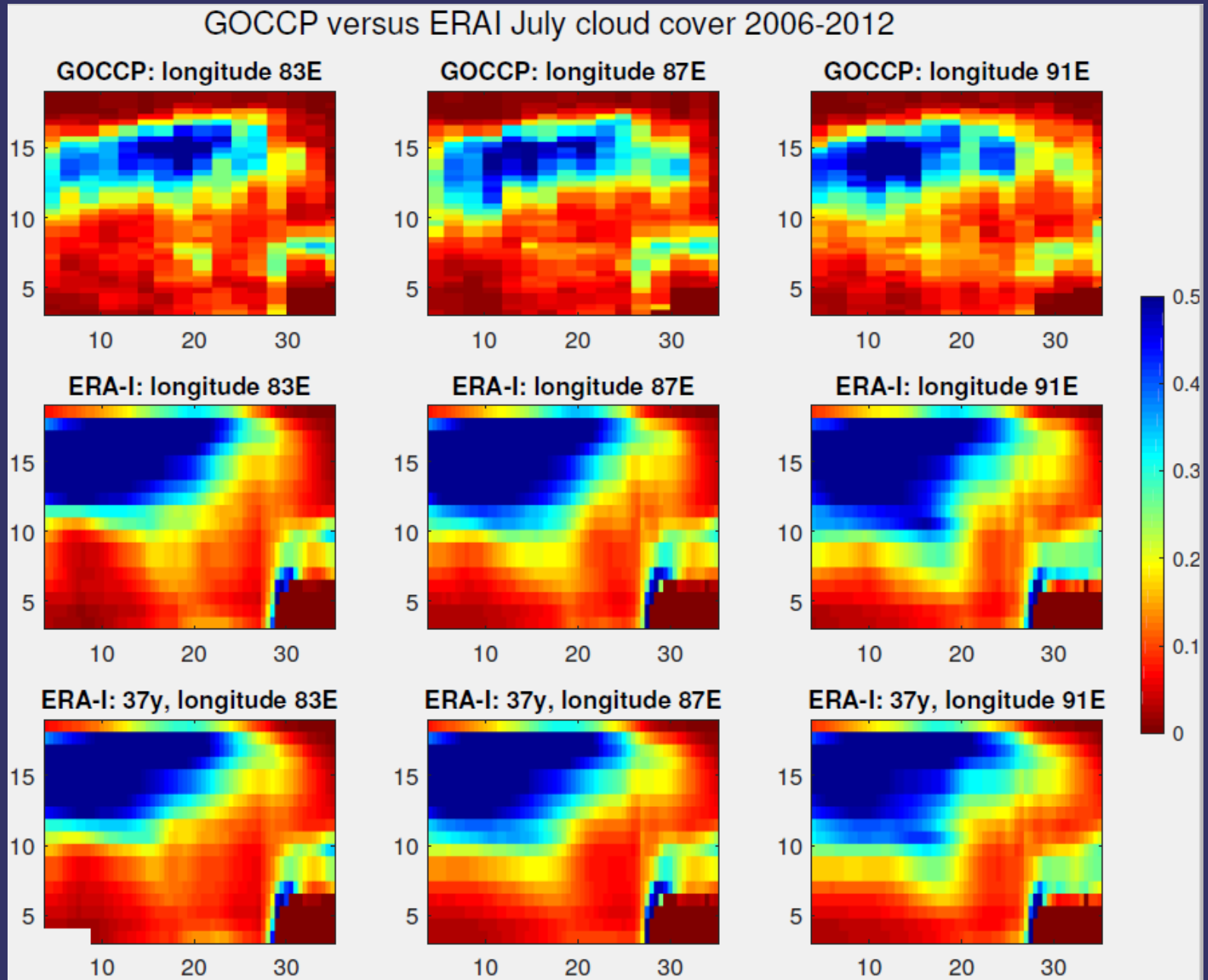




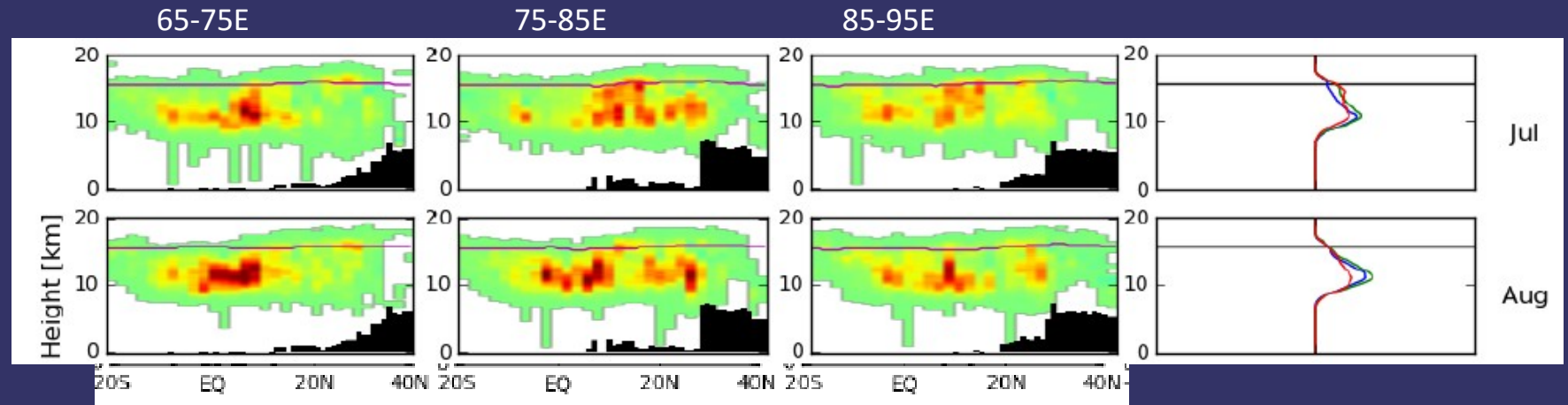
Cloud heating rate in the ERA-Interim and MERRA-2



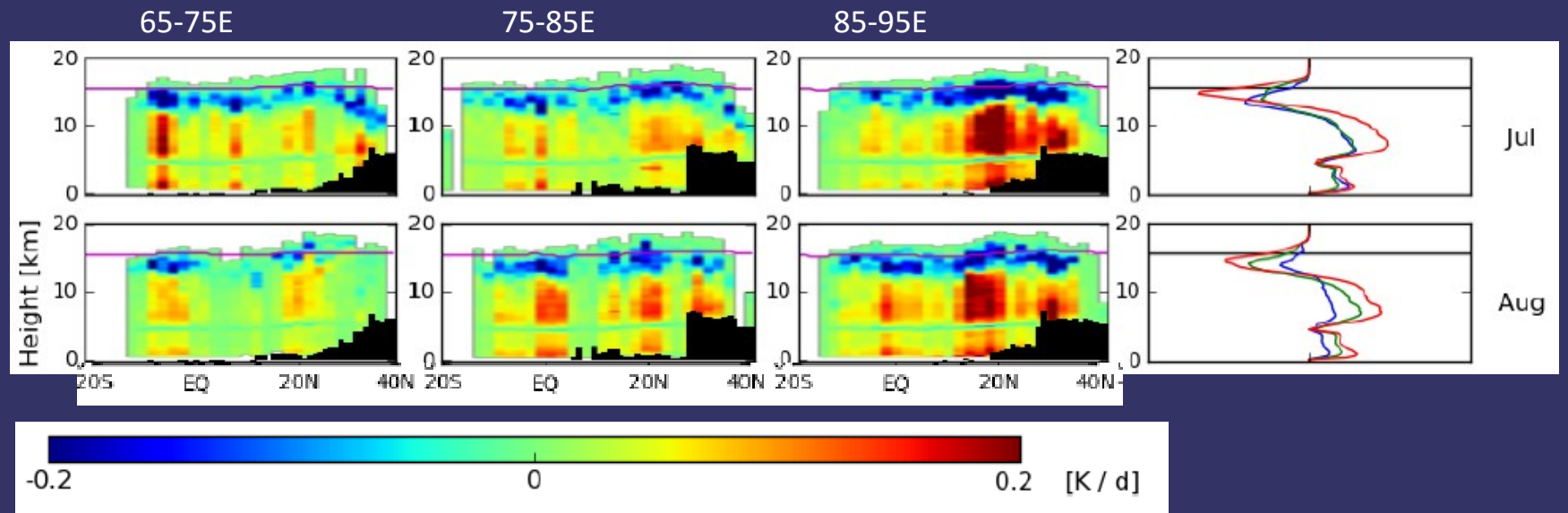
CALIPSO cloud cover (GOCCP, Cesana & Chepfer, JGR, 2013) against ERA-Interim



Heating rate due to high altitude clouds (cirrus)

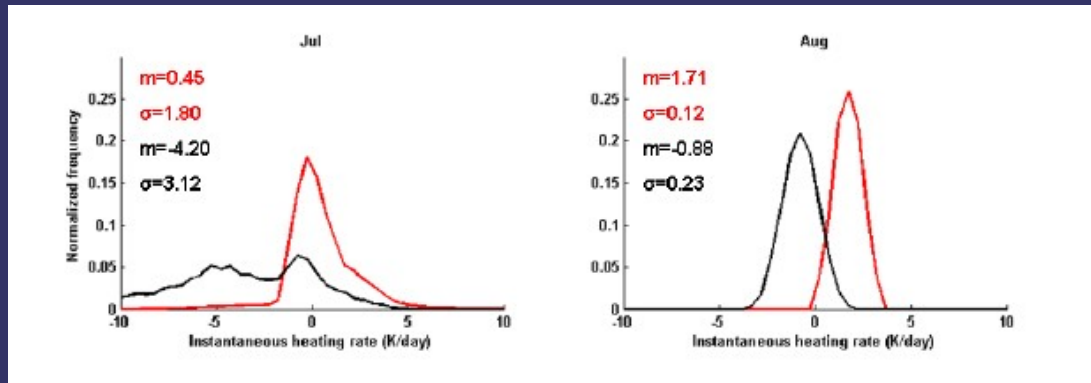


Heating rate due to convective clouds (opaque deep anvils)



Adapted from Johansson et al., ACP, 2015 using FLXHR heating rates based GEOPROF-2B-LIDAR (CLOUDSAT Science Team products)

Distribution of heating rates
in the Asian monsoon region
above the LZRH
Johansson et al., ACP, 2015



Black : convective clouds
Red : high clouds (cirrus)

Yang et al. find mostly cooling above 16 km
while Johansson et al. find dominating
warming above the clear sky LZRH.

All sky heating rate from Yang
et al., JGR, 2010

