

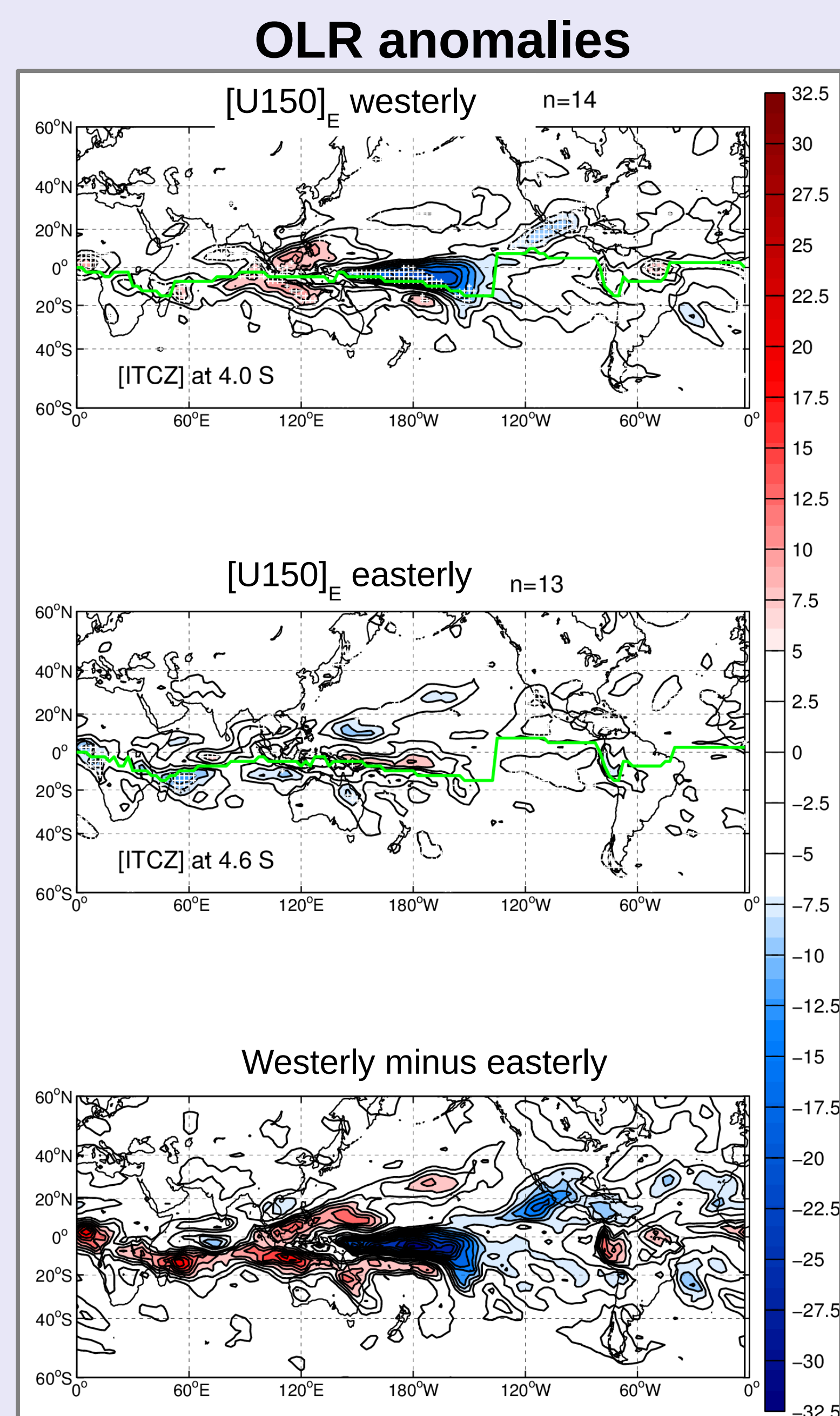
# Extratropical Influence of Upper Tropospheric Equatorial Zonal Wind

EGU Vienna, 12.-17.04.15  
 CL4.2, Tropical Climate Variability and  
 Teleconnections: past, present and future

Gereon Gollan and Richard J. Greatbatch – contact: ggollan@geomar.de  
 GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel

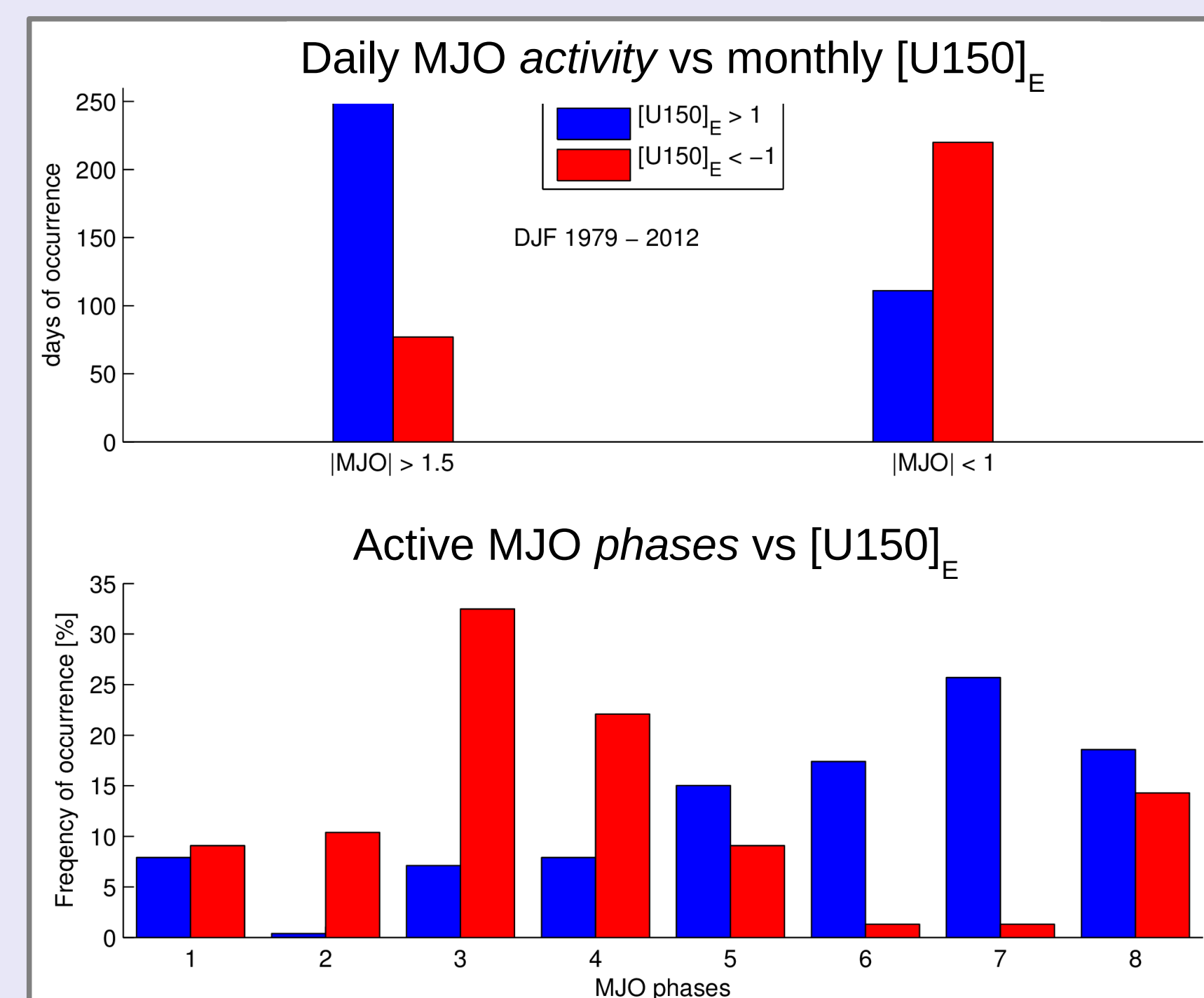
## What is $[U150]_E$ ?

- The Madden-Julian Oscillation (MJO) has been shown to have influence on the extratropics by many previous studies – but measuring the MJO is not trivial.
- The upper tropospheric zonal mean zonal wind over the equator is mainly influenced by the MJO - during boreal winter also by shifts of the ITCZ (see the two figures in this section).
- Our simple index  $[U150]_E$  is defined as the **monthly mean** zonal mean zonal wind at 150 hPa during DJF, with the monthly seasonal cycle removed. ENSO effects are also linearly removed from U150, using the NINO3.4 index from NOAA Version3-SST. The standard deviation of  $[U150]_E$  is  $\sim 1.7$  m/s.



Composites for the different phases of  $[U150]_E$ , contour interval is  $2.5 \text{ W/m}^2$ . ERA-Interim, 1979-2013. Green line indicates composite ITCZ: minimum of total OLR (total = climatology plus composite anomaly)

**More details** can be found in:  
 Gollan G. and Greatbatch R.J., 2015,  
 "On the Extratropical Influence of Variations  
 of the Upper-Tropospheric Equatorial Zonal-  
 Mean Zonal Wind during Boreal Winter",  
 Journal of Climate



Wheeler & Hendon (2004) MJO index 1979-2012 is used.

## $[U150]_E$ is...

- Westerly during and after strong late MJO phases
- Easterly during active early MJO phases or when ITCZ is anomalously south

## Conclusions

### $[U150]_E$ ...

- is an "easy to use" index for tropical variability that is important for northern extratropics, especially North Pacific
- is related to late MJO phases and shifts of the ITCZ
- simplifies monitoring interannual changes or long-term trends of late MJO phases

### $[U150]_E$ affects...

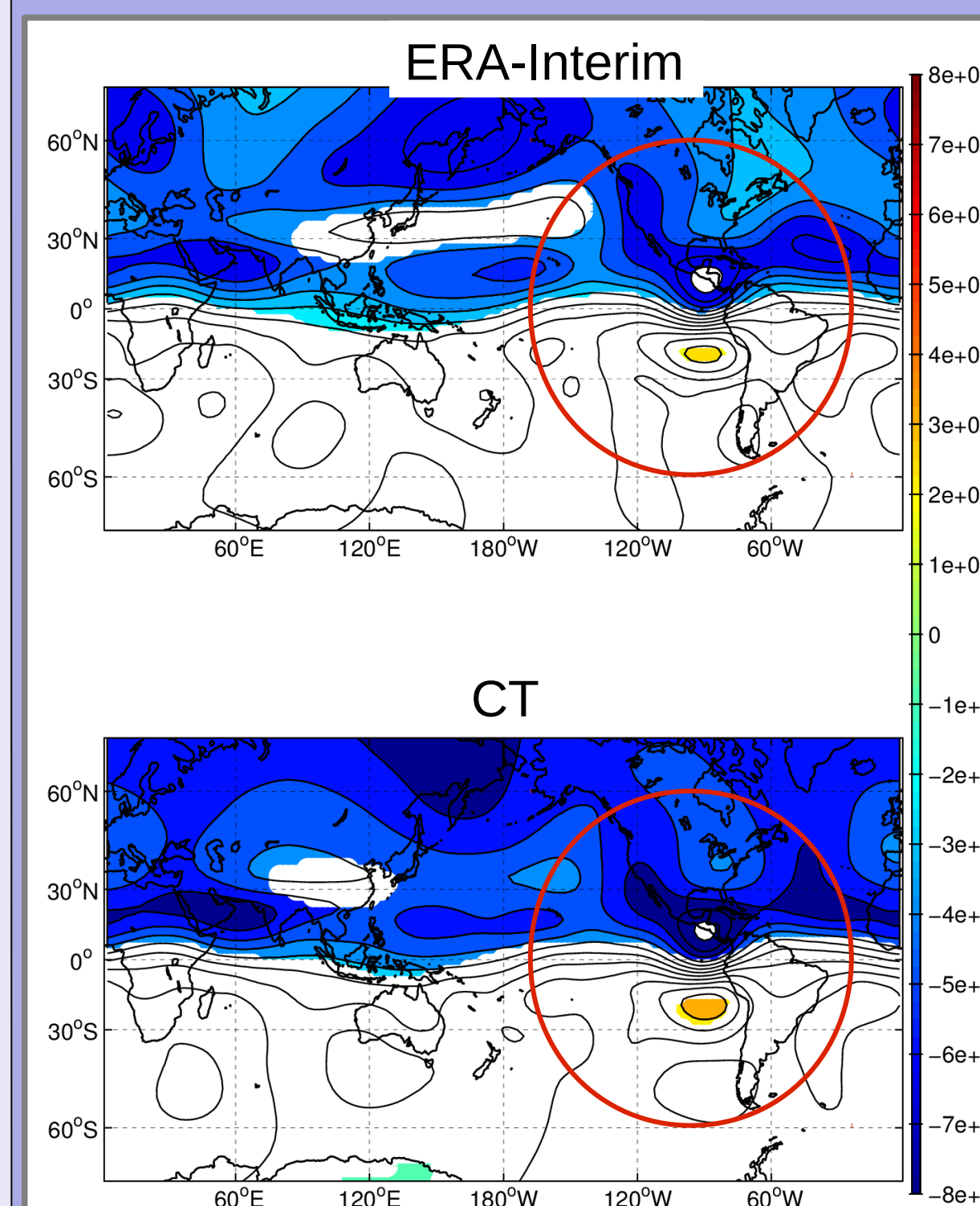
- Aleutian trough
- Rossby waveguide from Pacific towards Atlantic
- Rossby wave-breaking over Europe (→ blockings)

### What's next?

- investigate impact on mid- and high-latitude blocking

## Extratropical response to $[U150]_E$

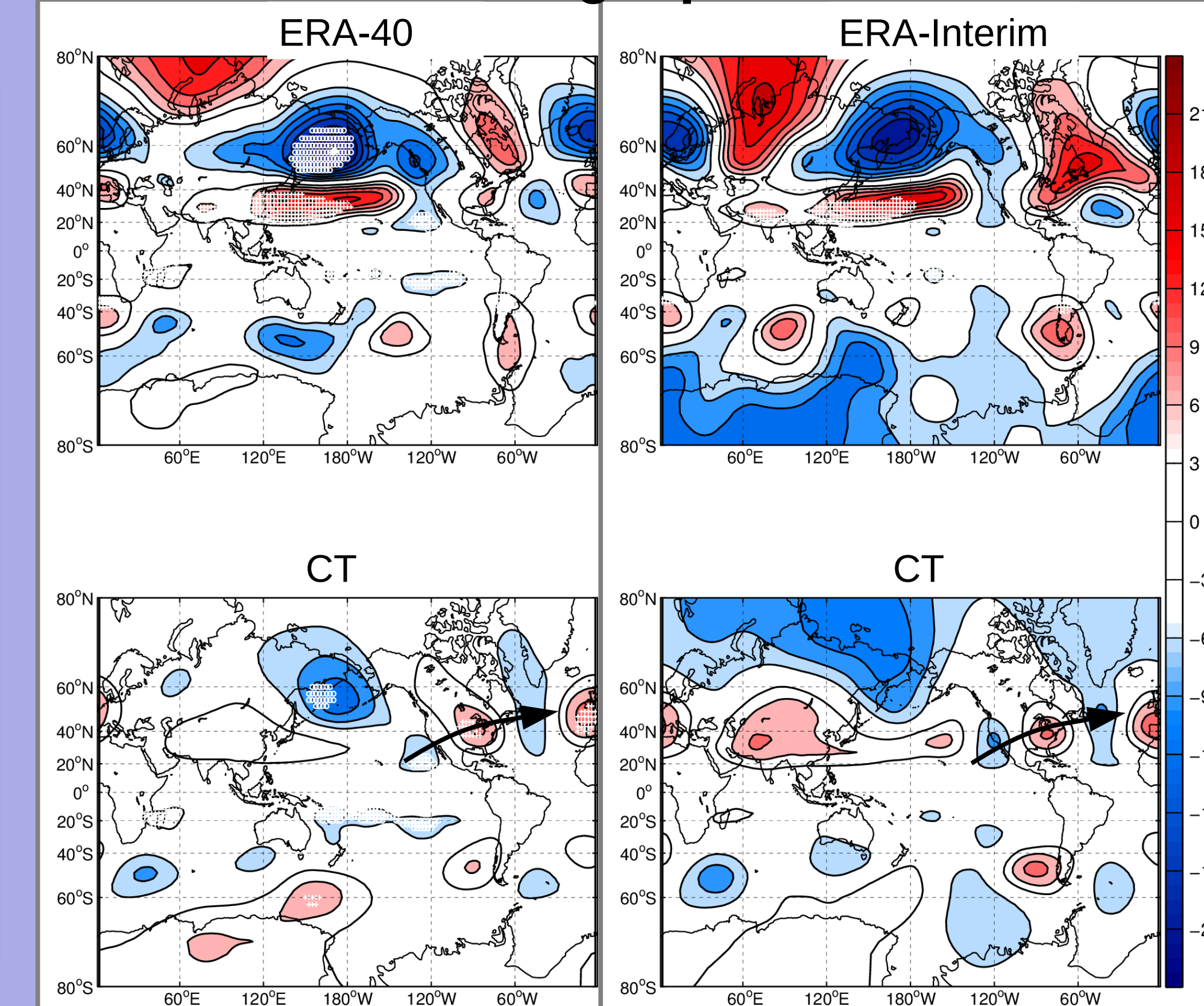
### Stream function at 200 hPa



Regression onto  $[U150]_E$ . Contour interval  $10^6 \text{ m}^2 \text{ s}^{-1}$ . Positive values indicate clockwise flow. ERA-Interim period (1979-2013)

**CT - Clim-Tropics relaxation experiment:**  
 ECMWF model (AGCM) is relaxed towards reanalysis data within the tropics (20S-20N). Horizontal wind, temperature and surface pressure are relaxed. Each winter (NDJF) is integrated separately, 12 realizations using different initial conditions. Shown here is the ensemble mean.

### 500 hPa geopotential

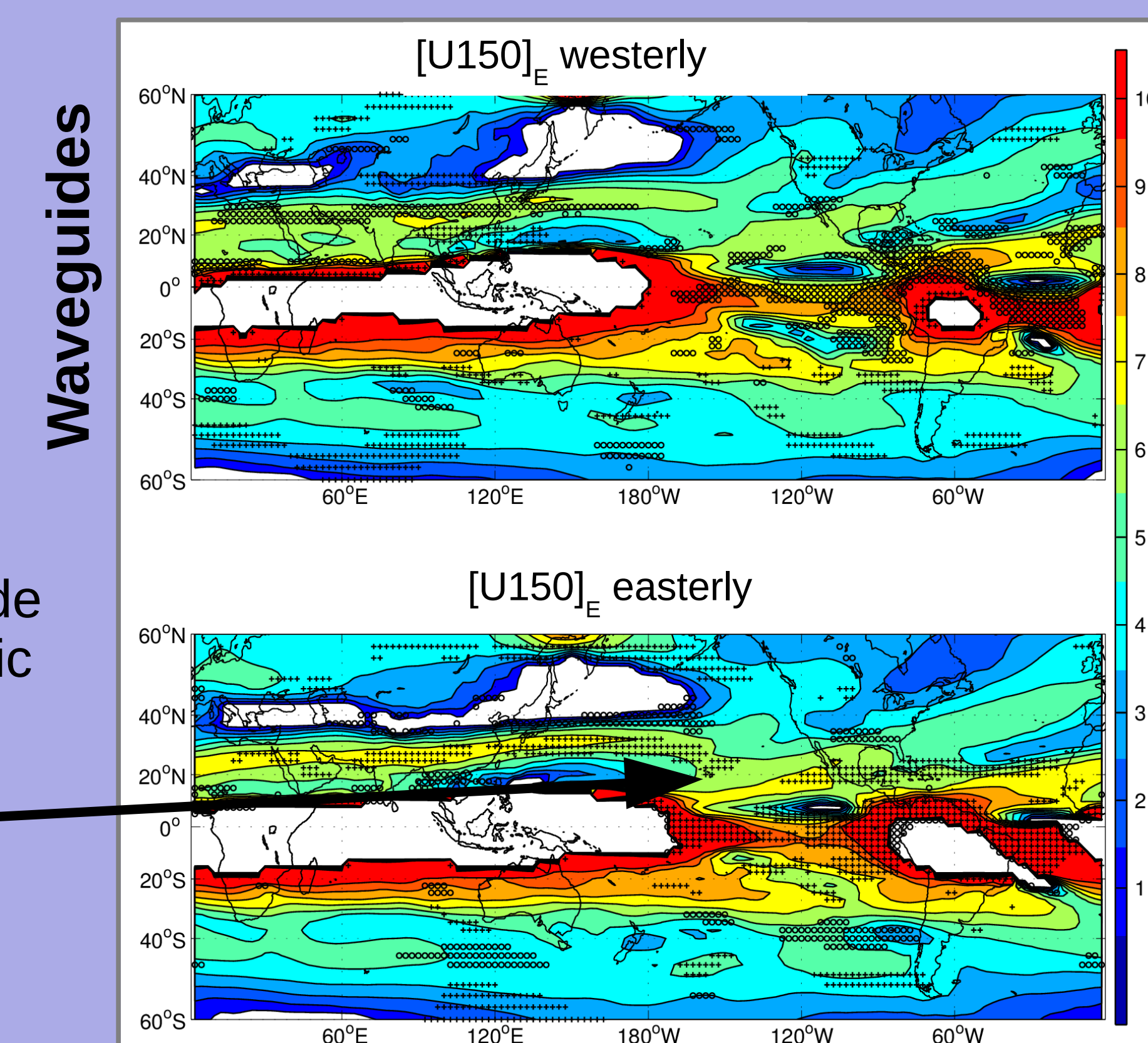


Regression onto  $[U150]_E$ . Contour interval 3m. Left: ERA-40 (1960-2001), Right: ERA-Interim (1979-2013). Top: Reanalysis data, Bottom: Relaxation experiment Clim-Tropics

### During anomalously westerly $[U150]_E$ ...

- Aleutian trough is strengthened
- Cyclonic anomalies to both sides of the Equator near Peru
- A Rossby Wave-train emerges from Pacific towards Atlantic

Stronger and more continuous waveguide between North Pacific and North Atlantic during easterly  $[U150]_E$  ...



ERA-40 Composites of refractive index  $K_s$  (zonal stationary wavenumber), showing subtropical waveguides. White indicates non-defined values. Hatching indicates 90% confidence level.



If you have any questions or comments, please ask me here or contact: ggollan@geomar.de