

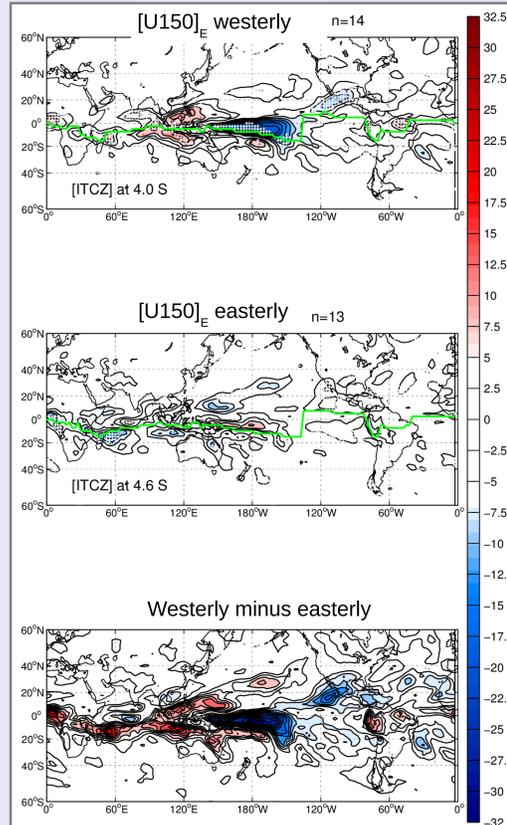
Extratropical Influence of Upper Tropospheric Equatorial Zonal Wind

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What is $[U150]_E$?

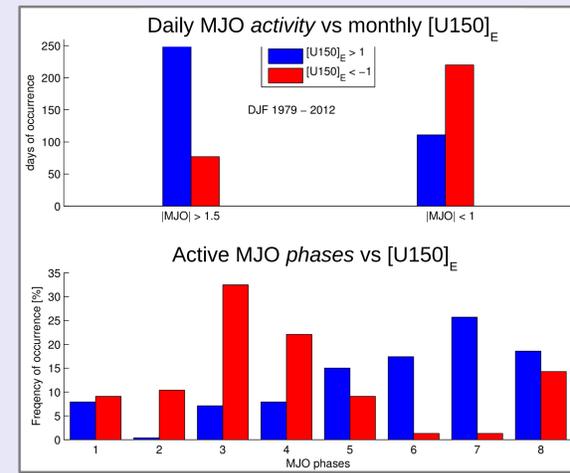
- The Madden-Julian Oscillation (MJO) has been shown to have influence on the extratropics by many previous studies – but measuring the MJO is not trivial.
- The upper tropospheric zonal mean zonal wind over the equator is mainly influenced by the MJO - during boreal winter also by shifts of the ITCZ (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 ~ 1.7 m/s.

OLR anomalies



Composites for the different phases of $[U150]_E$, contour interval is 2.5 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



$[U150]_E$ 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...

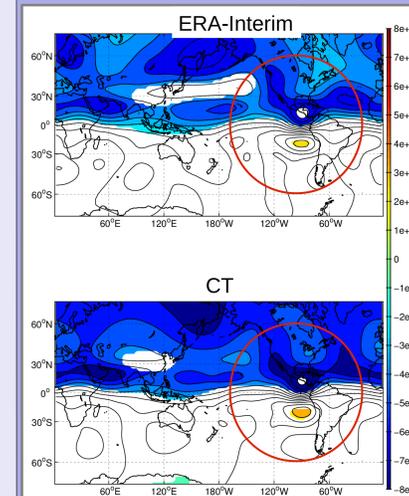
- Aleutian trough
- Rossby waveguide from Pacific towards Atlantic
- Rossby wave-breaking over Europe (→ blockings)

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)

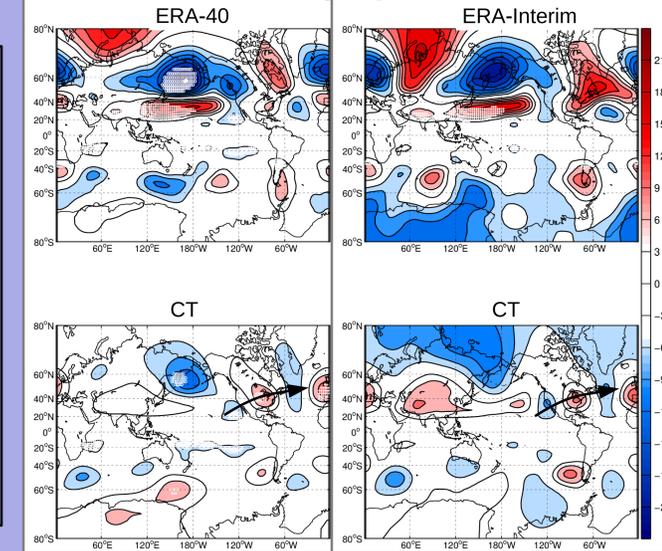
During anomalously westerly $[U150]_E$...

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

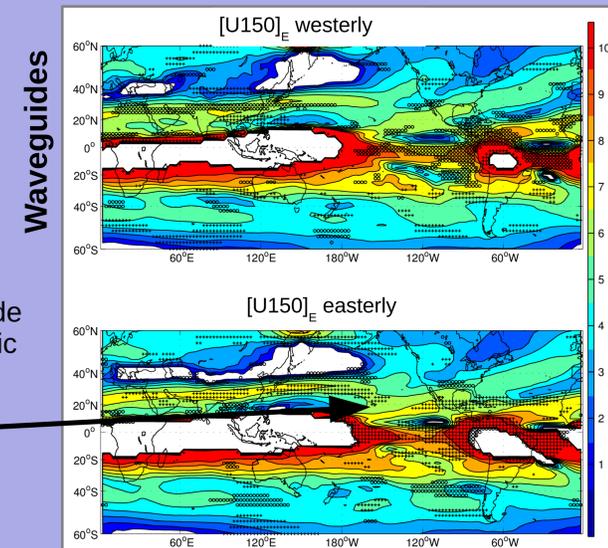
Stronger and more continuous waveguide between North Pacific and North Atlantic during *easterly* $[U150]_E$...

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



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