The 2 pvu Contour and Tropical Cyclones
Bernhard Enz, David Neubauer, Michael Sprenger, Ulrike Lohmann
Institute for Atmospheric and Climate Science, ETH Zurich

Motivation

Figure 1: Observed Accumulated Cyclone Energy as function of calendar dates. The red line represents 2013, the blue lines represent the years 1979-2012. Adapted from Zhang et al., 2016

- The 2013 hurricane season was forecasted to be very active
- The 2013 hurricane season was, however, not very active
- Zhang et al. (2016) propose increased Rossby wave breaking frequency as the cause

Correlations of ACE with PV Fields based on HURDAT2/ERA-Interim

Figure 2: Correlation Coefficients between September ACE and a September monthly mean 350 K 2 pvu contour latitude measure ($\Phi_{TP}$) (green), between $\Phi_{TP}$ and a September monthly mean measure for the latitude of the southward extent of PV streamers ($\Phi_{PV}$) (purple), and between ACE and $\Phi_{PV}$ (brown). ACE is calculated from HURDAT2 data, the other measures from ERA-Interim data.

- ACE correlates rather strongly with the 2 pvu contour latitude
- The 2 pvu contour latitude influences ACE even in the absence of PV streamers, here used as a proxy for Rossby Wave breaking

Numerical Simulations

Figure 3: Box plots showing the distribution of September ACE within the REF and RM ensembles with 20 members each. p denotes the p-value when testing the null hypothesis that the mean of the two distributions is the same.

- Numerical simulations using ICON (Zängl et al., 2015) are performed to corroborate the HURDAT2/ERA-Interim findings
- Two ensembles are generated: REF uses regular boundary conditions, RM uses smoothed boundary conditions in the northern portion of the domain
- The RM ensemble has smoothed Rossby waves that are less prone to breaking
- According to Zhang et al. (2016), this should lead to higher ACE values
- However, the RM ensemble has lower ACE
- The adapted boundary conditions may have altered the large scale dynamical context

Change in Jet Location

Figure 4: 300 hPa horizontal wind speed difference between the RM and REF ensemble means.

- The jet is located further south in the RM ensemble
- Vertical wind shear is thus increased where North Atlantic hurricanes recurve

Conclusions

- The latitude of the 2 pvu contour on 350 K correlates with ACE during September
- A more southern 2 pvu contour in the western North Atlantic might trigger extratropical transition onset earlier in a storm’s life time, which would reduce ACE
- Earlier extratropical transition onset would be a result of high vertical wind shear further south
- Numerical simulations indicate that vertical wind shear location is more relevant than Rossby wave breaking for ACE

References