Intercomparison of mid latitude storm diagnostics (IMILAST)

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Motivation and background

Storm-associated damages are amongst the highest losses due to natural disasters in the mid-latitudes. Diagnostics of the observed and knowledge of future changes in extratropical storm frequency, intensity, and tracks are crucial for insurance companies, risk management and adaptation planning.

The challenge

Mid-latitude storms are complex systems with highly variable properties. Characteristics of storm activity and trends strongly depend on the methods used for cyclone track detection in observational and model data. The magnitude and even the sign of linear trends of cyclone frequency or even the sign of linear trends of cyclone frequency or the geographical patterns of change, these are rather robust.

Activities

Four main intercomparison calculations have been performed, using the following meteorological datasets on which the different schemes have been applied:

- ERAinterim reanalysis, 1.5° resolution, 1989-2009 (Neu et al. 2013)
- GCM ECHAM5/OM1, ATB scenario, 1961-2001 and 2061-2100 (Ulbrich et al. 2013)
- ERA interim, 0.75° resolution, extreme single storms

A final report is in preparation.

Conclusions

The most informative information is about metrics that are robust to the choice of analysis and tracking methodology vs. metrics with larger uncertainties:

- Strong vs. shallow cyclones: results for strong cyclones are much more robust than those for shallow ones (for cyclone frequency as well as for life cycle, interannual variability and trends).
- Life cycle: results for the most intense part are more robust than for the periods of development and lysis (also for strong cyclones). The largest spread in life cycle characteristics is found for short living, slowly moving cyclones.
- Total number: The spread in total number of cyclones is very large.
- Geographical distribution: Differences are larger in the Northern than in the Southern hemisphere and over parts of continents (Europe, North America, the Mediterranean).
- Trends: geographical linear trend patterns are rather robust (good agreement of regions with strong trends over most methods).
- Climate change signals: particularly for strong storms and the geographical patterns of change, these are rather robust.

Other results:

- In general, it is possible to associate differences between methods in identified cyclone characteristics with particular features of the schemes. Exceptions: Filtering of cyclones over mountainous terrain and late identification both significantly reduce the total number of cyclones.
- For extreme Arctic cyclones, the location is much more robust than central pressure.

Other posters related to IMILAST: X2.395, X2.410

Example of results I: Comparison of automated with manual tracking

Extratropical storm characteristics were derived from 16 automated algorithms as well as from the manual method based on an expert inspection of weather charts, for the Siberian region (50–80N, 60–110E) for two seasons (winter 2007/08 and summer 2008) (Chernokulsky et al., in prep.). Fig. 1 presents four synoptic conditions where automated algorithms could lead to different findings than manual tracking. These are conditions with multicenter storms (more relevant for summer and for the vorticity-based methods), a low-gradient baric field (primarily for summer, favor for shallow summertime thermal lows) and a high pressure situation (mainly for shallow cyclones in winter). Most of the objective algorithms are capable to identify the majority of the manually-derived cyclones and rarely miss the whole cyclone tracks.

Example of results II: Merging and splitting of cyclones

Kew et al. (2016) have analysed the different representations of cyclone merging and splitting in different automated tracking algorithms. Figure 2 shows the response of the IMILAST ensemble to a merger event and the impact of merger on genesis and lysis uncertainty. The majority of methods place the origin of cyclone C in cyclone B, but not all (see green tracks). Merger can thus increase the tracking method-related uncertainty in the genesis location of a merged system. On the other hand, the merger of two tracks into one generally results in the termination of one or both previous tracks. Lysis events are thus clustered close to a merger event. Here, a particularly strong ensemble agreement in lysis location results from the strong ensemble consensus that track A be terminated in the formation of cyclone C. The opposite generally applies to a splitting event - splitting is locally associated with genesis, but can contribute to increased method-related uncertainty in lysis locations of the parent cyclone.

References


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