Intercomparison of mid latitude storm diagnostics (IMILAST)

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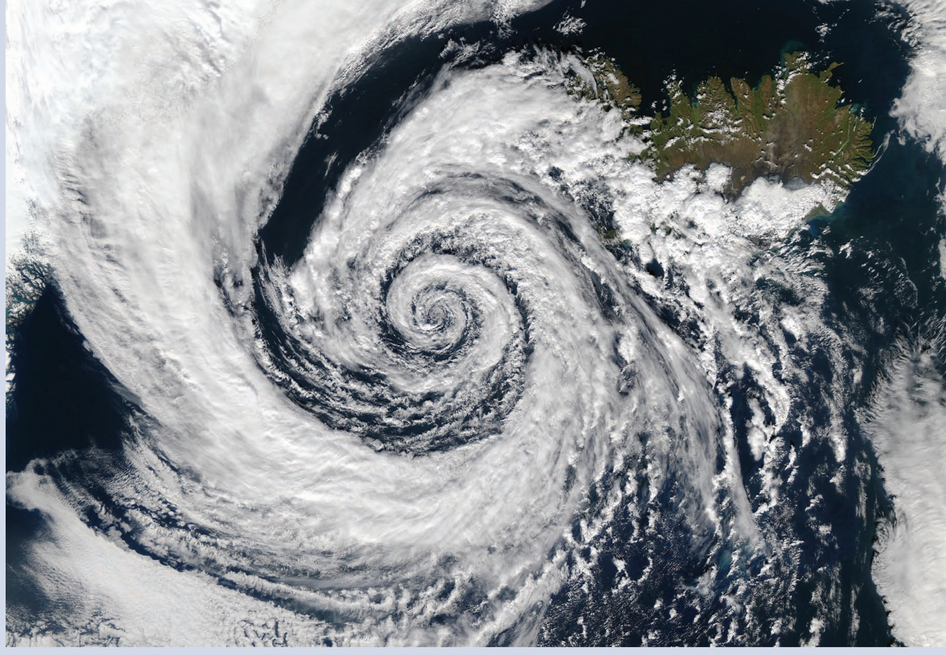


Extratropical cyclone over iceland (Source: Wikimedia commons: http://upload.wikimedia.org/wikipedia/commons/b/bc/Low_pressure_system_over_Iceland.jpg)

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** is crucial for insurance companies, risk management and adaptation planning. Future changes in the total number of storms might be small but major signals could occur in intensity, life time, or track locations (e.g. Bengtsson et al. 2009, Pinto et al. 2007).

The challenge

Mid-latidude storms are complex systems with highly variable properties. **Characteristics** of storm activity and trends **strongly depend on the methodologies used** for cyclone track detection in observational and model data. The magnitude and even the sign of linear trends of cyclone frequency or intensity might depend on the detection and tracking methods of the cyclones (Ulbrich et al. 2009, Raible et al. 2008).

Why is this a problem?
Different methods might lead to contradictory results based on the same datasets. Users of the results (politicians, (re-)assurance companies, etc.) are puzzled and do not know how to interprete the outcome of single studies.

What is the solution?
Knowledge about advantages and restrictions of different methods must be obtained to be able to provide a synthesis of results and proper interpretations.

Aims of the project

- To provide an assessment of uncertainties inherent in the mid-latitudinal cyclone tracking by comparing different methodologies.
- To intercompare the metrics of mid latitudinal cyclone activity used for different purposes.
- To point out the informations that can be drawn from specific methods.
- To discuss the possibility of an identification of a limited set of methods which can provide the most important informations.

The final report of the project will contain

- an overview of existing methods, including a description of the information contained in the results, and their limitations
- an overview of standard parameters for the quantification of cyclone activity and intensity characteristics, including their limitations
- comments on further work to be done.

Working plan

- Establish an inventory of the existing cyclone identification and tracking methods
- Intercomparison project (climatological studies using different meteorological datasets on which the schemes are applied); (ongoing)
- Workshop and discussion of first analysis results (March 2011)
- Preparation of a paper summarizing first results (submission in December 2011)
- More detailed analysis and preparation of specific papers (2012)
- Preparation of a Final Report (autumn 2012)

Questions to address

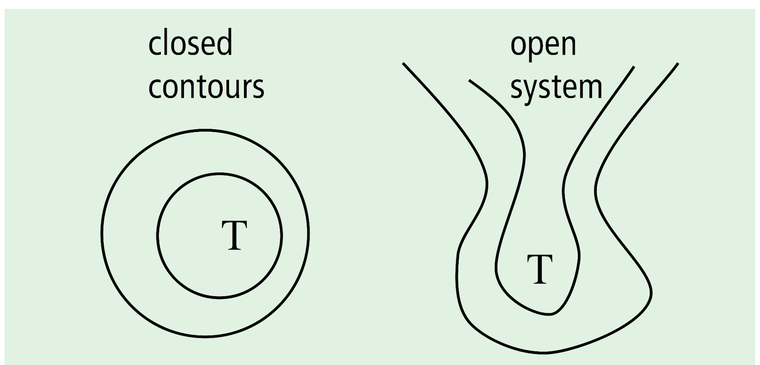
1. Uncertainties and their origin
- How large are the uncertainties between the methods?
- Where do they come from? (methods, pre-processing, post-processing, presentation)
- Spread between seasonal climatologies

2. Common climatological findings
- common features
- trends, variability, and their geographical distribution

3. Application oriented results
- How well can known extreme event related cyclones be characterized (case studies)?
- How can cyclones be characterized best with regard to their environmental impacts (other climatic variables; flooding, wave storms)?
- How can we deliver reasonable comprehensive results?

4. Understanding cyclones
- What is the significance of open systems? (e.g. for detection of extreme cyclones or climatologies; see Fig. 1)
- Can we learn something about special characteristics from different methods (merging/splitting of systems or tracks)?
- Specific processes that some methods are designed for.

Fig. 1: Some methods include 'open systems' (right), i.e. cyclones with out closed pressure contours, others only capture 'closed' systems (left). The project can show what differences e.g. in spatial distribution of track density or in overall statistics such methodological issues produce.



First intercomparison experiment

In the first intercomparison experiment, cyclone tracks have been calculated based on ERAinterim reanalysis for the 20y period 01/1989–03/2009 with 15 different methods.

First results are presented in the poster cluster on IMILAST (Posters T232 – T238).

Differences between methods

Different variables used for cyclone identification:
- sea level pressure (SLP)
- sea level vorticity (laplacian)
- 850 hPa vorticity
- 850 hPa
- combination

Different data transformations:
- grid transformation
- stereographic projection
- smoothing / band pass filtering

Different cyclone identification procedures:
- assigning vorticity maxima to SLP minima
- minimum SLP, pressure gradient maxima, cyclone radius
- geopotential contour
- minimum SLP and 10 meter wind speed

Different elimination criteria:
- vorticity
- SLP
- distance between two cyclones
- difference of min. SLP to surrounding grid points
- difference between min. SLP to background SLP
- mean gradient within 1000 km radius
- terrain height

Different tracking schemes:
- minimization of probability function for combination of systems
- maximum distance between locations of two following time steps
- "nearest neighbour" analysis
- next position calculated through steering velocity and probability of combination
- linear projection of cyclone from last displacement, determining cyclones near that point
- min. overlap of projected cyclones with identified cyclones at next time step
- cyclone in a box with defined extension around the position at time step before

Project participation
Any research group that is interested in participation in the project is highly welcome to do so.

Project homepage: www.proclim.ch/IMILAST/index.html

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