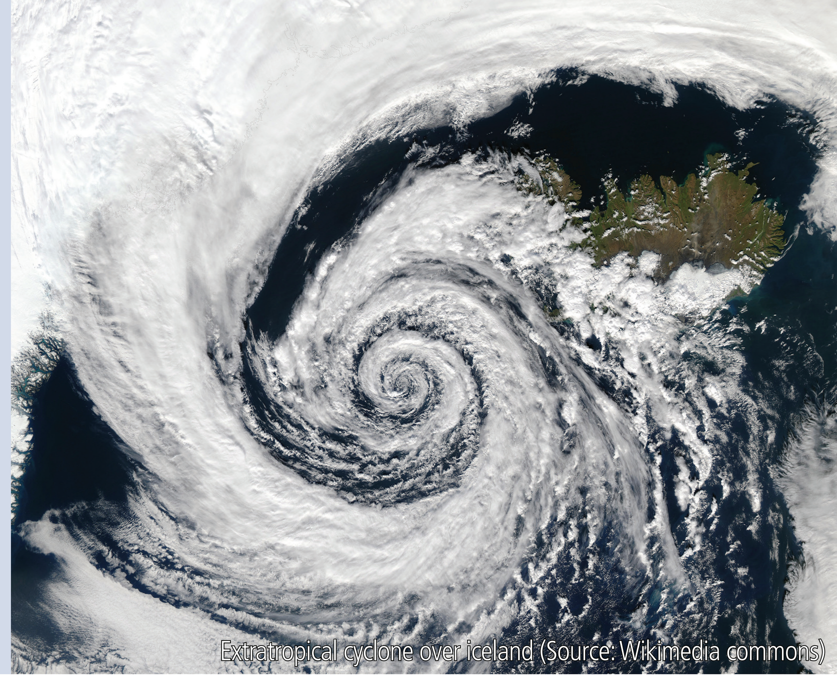
Intercomparison of mid latitude storm diagnostics (IMILAST)

U. Neu[1], A. Chernokulsky[2], S. Kew[3], M. Akperov[2], I. Mokhov[2], R. Caballero[4], J. Hanley[4], M. Inatsu[5] and the IMILAST Team

[1] ProClim– Forum for Climate and Global Change, Swiss Academy of Sciences, Bern, Switzerland (urs.neu@scnat.ch)
[2] A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences, Moscow, Russia
[3] Environmental Sciences, Wageningen University, Wageningen, The Netherlands
[4] Department of Meteorology, University of Stockholm, Stockholm, Sweden
[5] Department of Earth Science, School of Science, Sapporo, Japan



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-latidude 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 intensity might depend on the detection and tracking methods used (Ulbrich et al. 2009, Raible et al. 2008).

Intercomparison project

In 2010 the intercomparison project IMILAST has been started to assess due to the choice of methodology. Main aims are:

- To derive quantitative information about methodological uncertainties in different metrics of mid latitudinal cyclone activity.
- To distinguish robust and uncertain metrics with regard to the choice of analysis methodology.

Activities

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

- ERAinterim reanalyis, 1.5° resolution, 1989-2009 (Neu et al. 2013)
- GCM ECHAM5/OM1, A1B scenario, 1961-2000 and 2061-2100 (Ulbrich et al. 2013)
- ERA interim, 1.5° resolution, 1979-2009 (thematic cluster in **TELLUS A**: http://www.tellusa.net/index.php/tellusa/pages/view/thematic)
- 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 not 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 pressure-based algorithms), troughs (more relevant for winter 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.

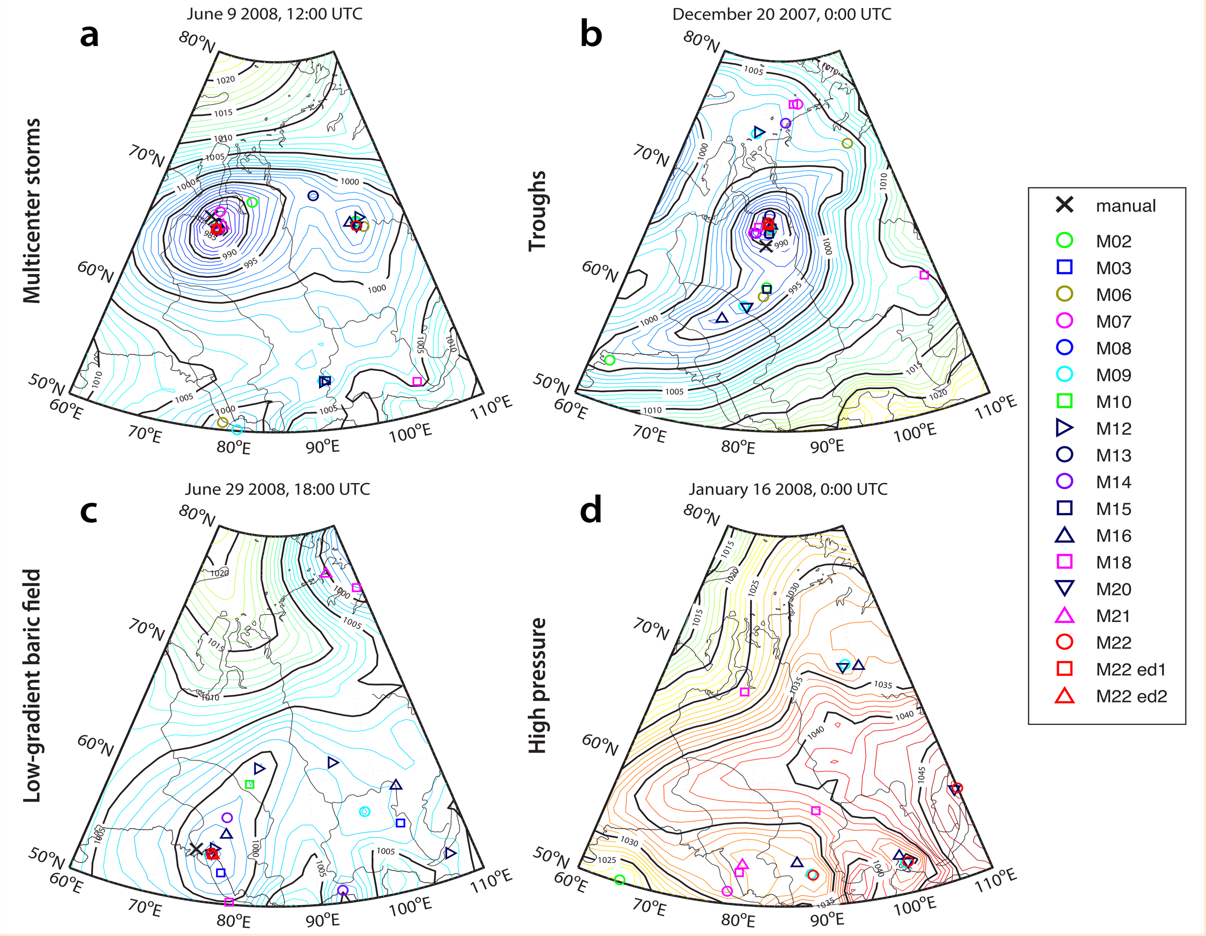


Figure 1: Isobar contours and locations of cyclones according to manual tracking and different IMILAST algorithms for particular dates with typical synoptic conditions with a large discrepancy among the algorithms: (a) June 9 2008, 12:00 UTC (multicenter storm), (b) December 20 2007, 0:00 UTC (troughs), (c) June 29 2008, 18:00 (low-gradient baric field) and (d) January 16 2008, 0:00 UTC (high values of MSLP).

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.

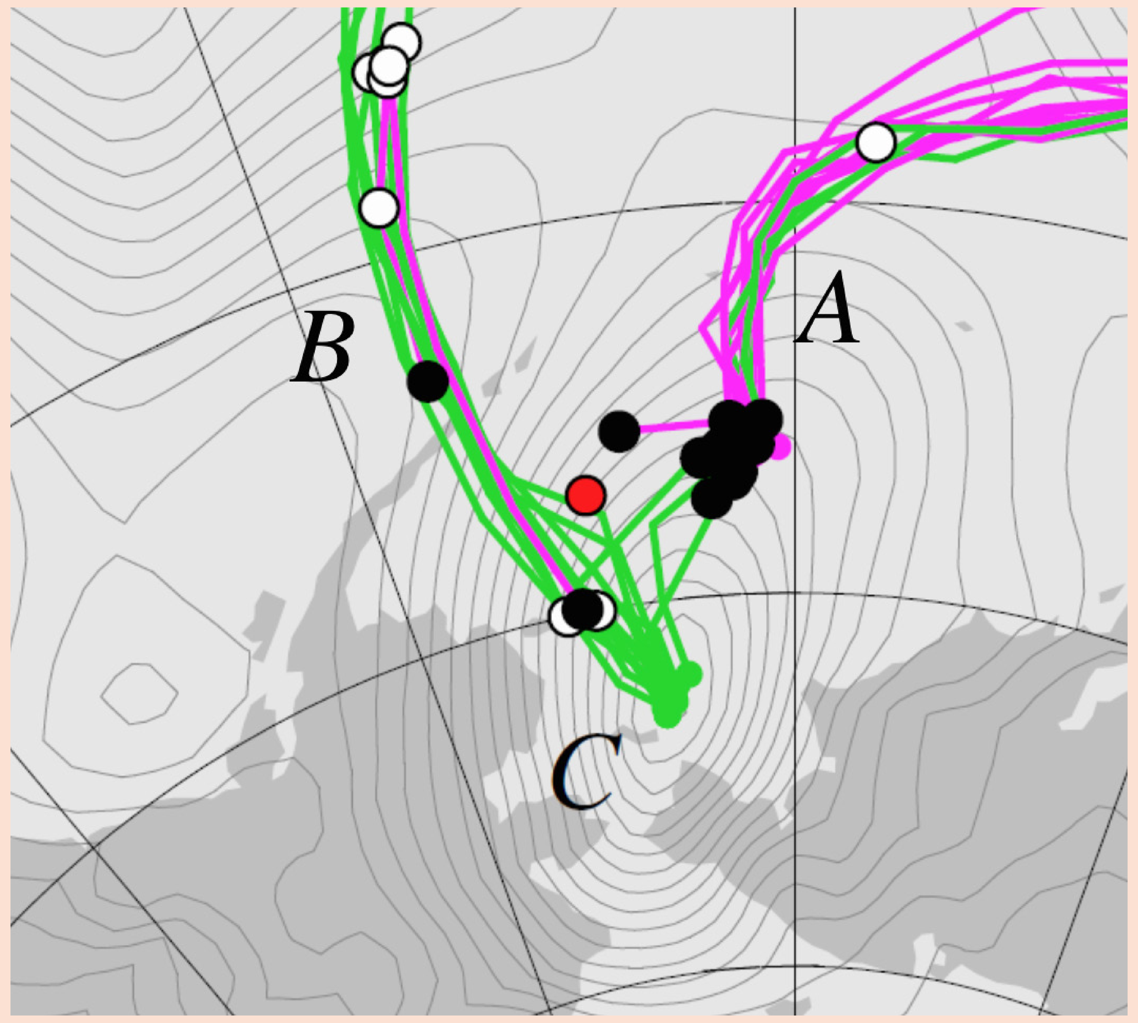


Figure 2: Response of the IMILAST ensemble to a merger event and the impact of merger on genesis and lysis uncertainty. The SLP field on 16-12-1989 00 UTC shows a cyclone C, which formed from the merger of two pre-existing cyclones A and B, together with all tracks from the IMILAST ensemble (16 methods) relating to cyclones A, B and C up to this point in time. Magenta: tracks that terminate before/due to the merger. Green: tracks that connect to the merged cyclone. White points: cyclone genesis. Black points: cyclone lysis. Red point: approximate position of merger event.

Project participation
The data of the third and fourth experiment will be made publicly available this summer for further exploration.

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

Contact:
Urs Neu, ProClim-
House of Sciences, Laupenstrasse 7 / P.O. Box
CH-3001 Bern
e-mail: urs.neu@scnat.ch

sc | nat
Swiss Academy of Sciences
Akademie der Naturwissenschaften
Accademia di scienze naturali
Académie des sciences naturelles
ProClim– Forum for Climate and Global Change

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IMILAST Project team
S. Gulev, N. Tilinina, P.P.Shirshov Institute of Oceanology, Moscow; J. Pinto, S. Ulbrich, N. Bellenbaum, University of Köln; M. Sinclair, Embry-Riddle Aeronautical University, Prescott, Arizona; X.L. Wang, Y. Feng, Environment Canada; H. Wernli, M. Sprenger, ETH Zurich; S. Kew, KNMI De Bilt; U. Ulbrich, M. Schuster, J. Grieger, F-Univ. Berlin; G. Leckebusch, University of Birmingham; R. Blender, K. Fraedrich, KlimaCampus Universität Hamburg; C. Raible, University of Bern; H. Dacre, University of Reading; R. Benestad, Norwegian Met Office, Oslo; I. Simmonds, I. Rudeva, K. Keay, University of Melbourne; I. Trigo, M. Liberato, University of Lisbon; R. Caballero, J. Hanley, University of Stockhom; T. Hewson, ECMWF; P. Lionello, M. Reale, University of Salento, Lecce; M. Inatsu, Hokkaido University; M. Akperov, I. Mokhov, M. Bardin, RAS Moscow; E. Flaounas, LMD Paris; A. Dufour, University of Grenoble.