Strategies for describing change in storminess – using proxies and dynamical downscaling.

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Wind, hydrology and outlook

For assessing ongoing change of the occurrence of extremes as being (partly) not within the range of natural variations („detection") and for attributing most probable causes to such changes („attribution"), we need homogeneous descriptions of past variability – for hundred and more years, and projections of possible futures.

For planning suitable adaptation measures, such descriptions and projections need to be regional or local.

For the case of wind-storms, methods have been developed – and likely, such methodology may be transferred to hydrological issues.

Two approaches: proxies + downscaling

Challenge

Storminess best represented by wind and precipitation short-term statistics but such time series are almost always

- inhomogeneous
- too short

For assessing changing storm conditions, principally **two approaches** are possible:

- Use of proxies, such as daily and sub-daily air pressure readings.
- Empirical or dynamical downscaling of large scale information.

Usage of weather analyses, incl. re-analyses and proxies such as damages are not suitable.

Proxies: Geostrophic stats

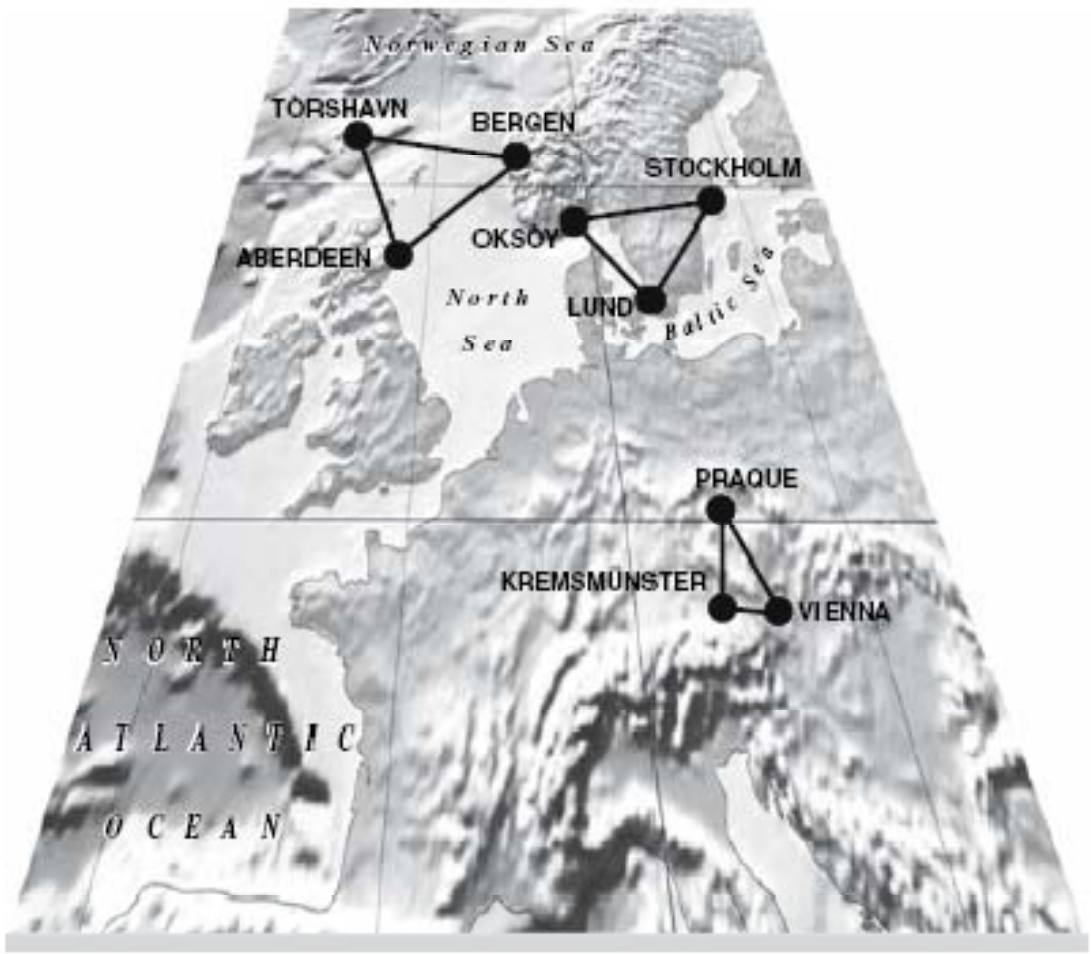
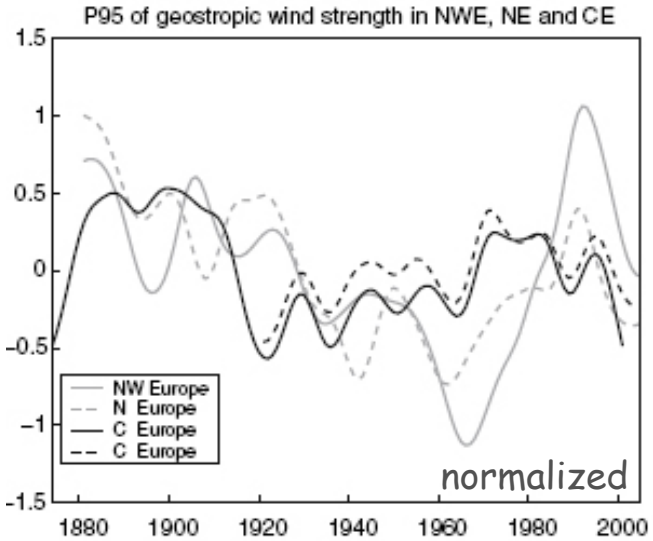
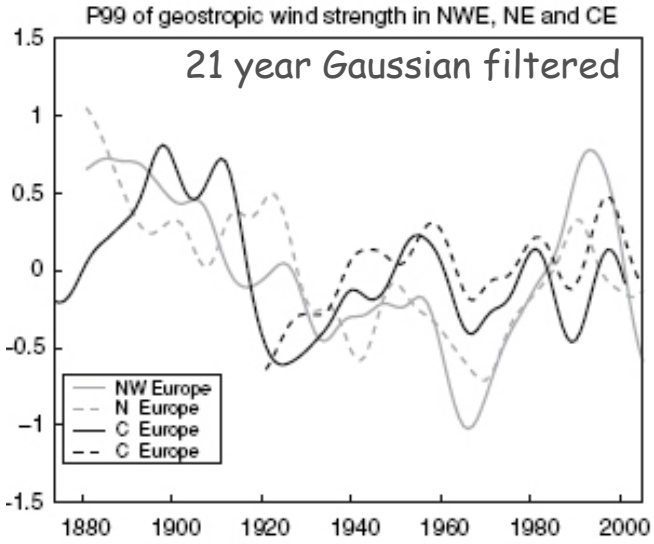


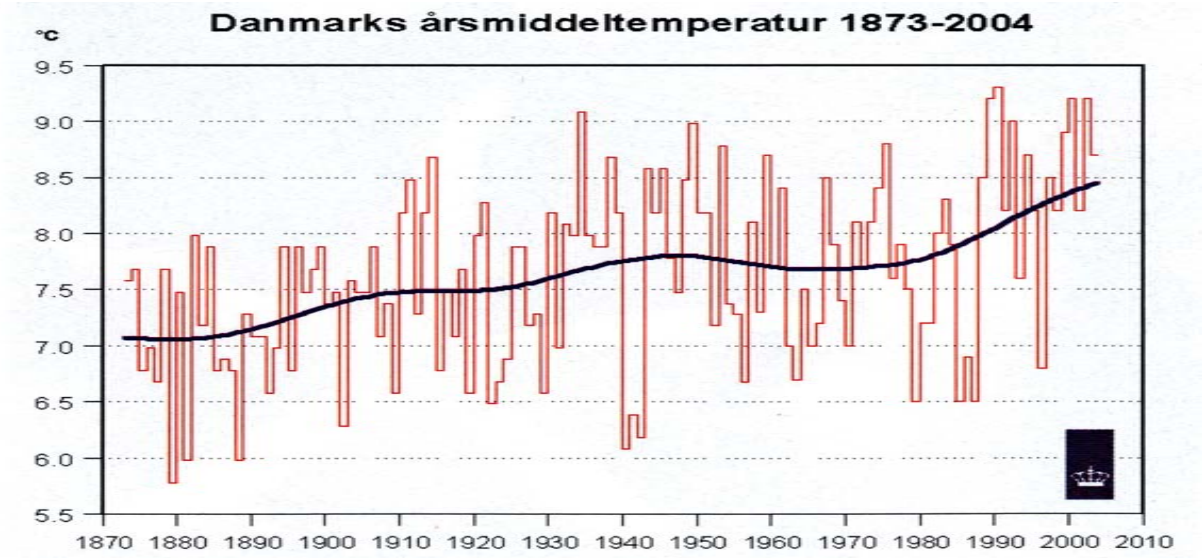
Fig. 2 Location of employed stations and assembled *triangles*

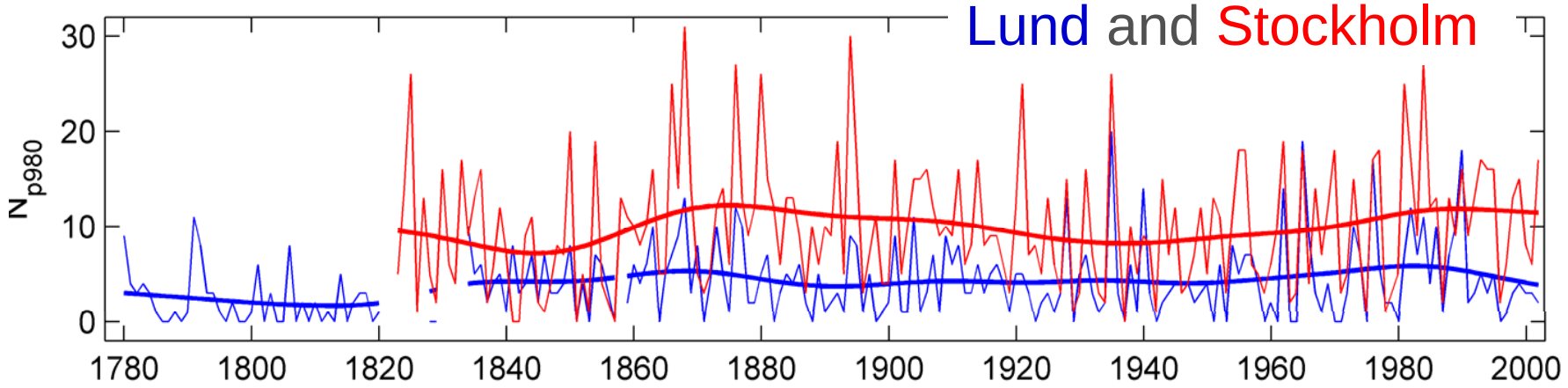




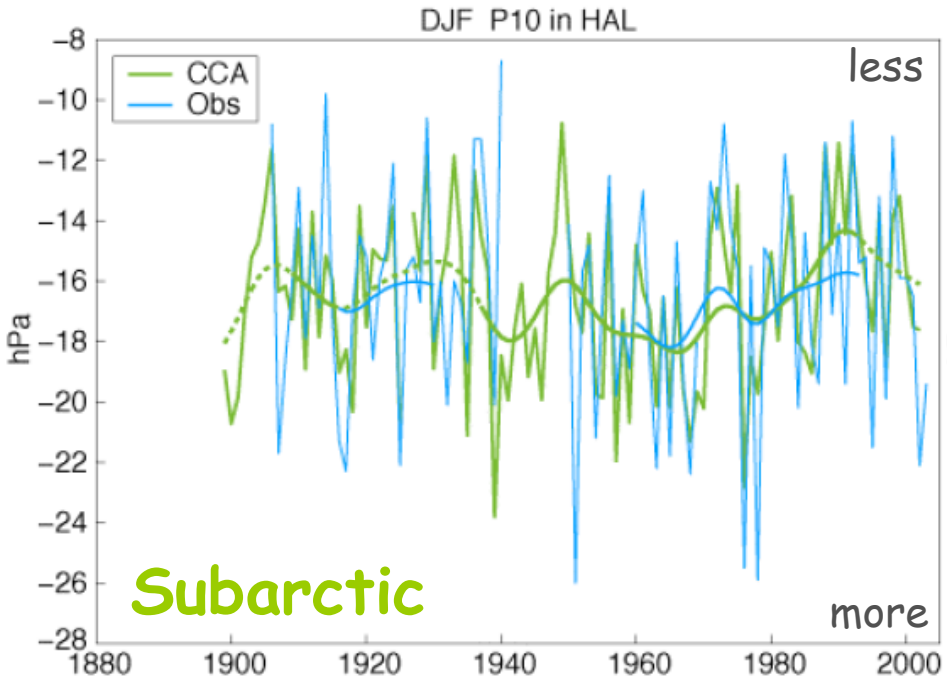
Regional development of storminess and temperature

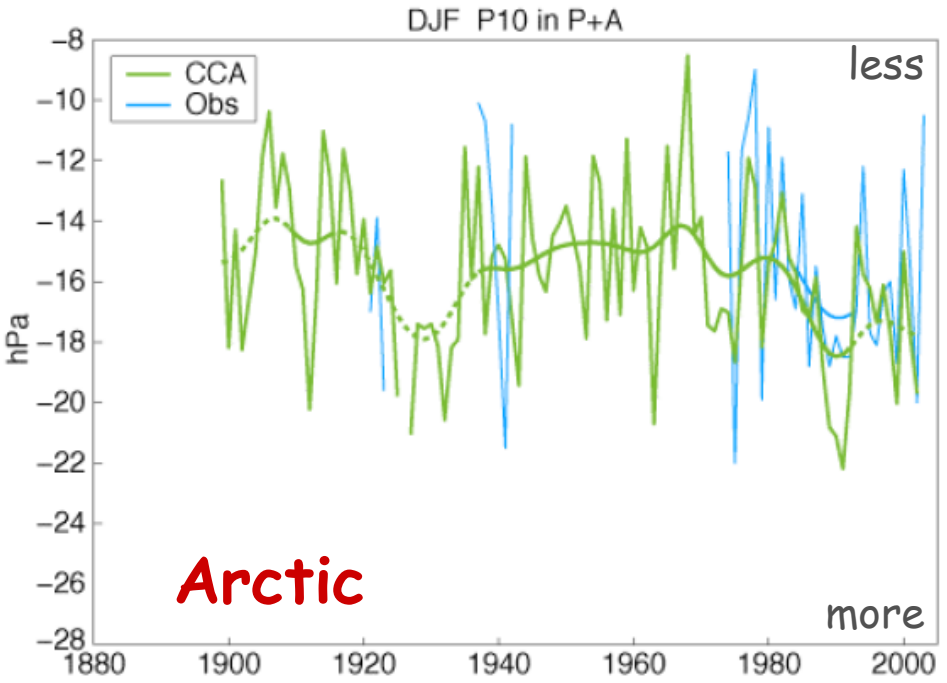
Unchanging extratropcial storm conditions is not contradicting the fact that temerpature is rising,





Pressure Proxies E Canada

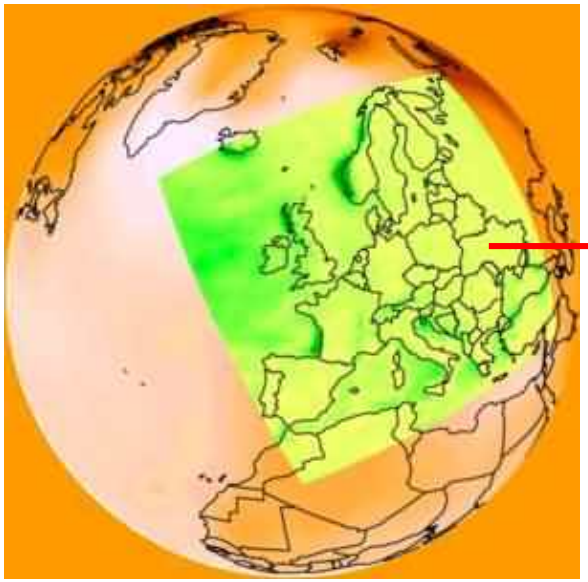




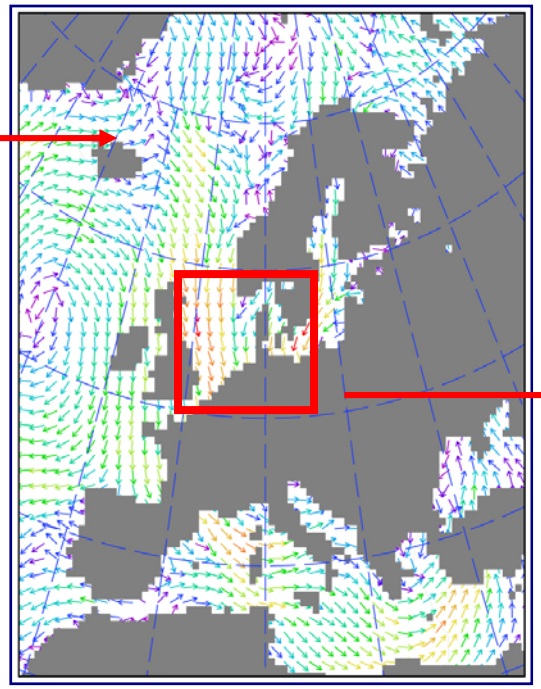
Change of intra-winter 10%-ile of pressure readings at E Canadian stations Halifax and PondInlet in the Arctic.

Applications: past and future marine weather in N Europe

downscaling cascade for constructing variable regional and local marine weather statistics

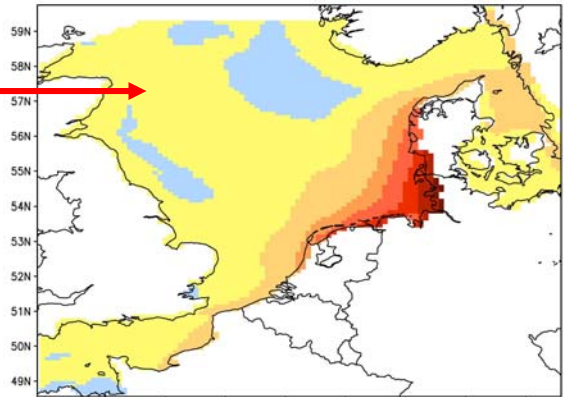


Globale development (NCEP)



Dynamical Downscaling REMO or CLM

Simulation with barotropic model of North Sea

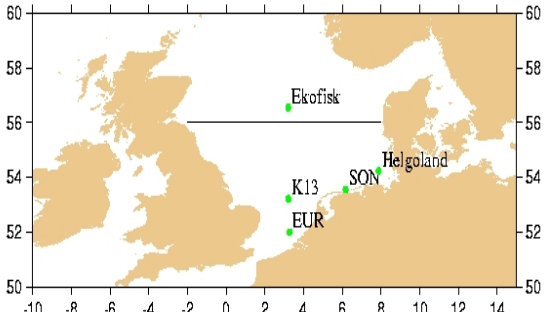


Cooperation with a variety of governmental agencies and with a number of private companies

Dynamical Downscaling: Baroclinic storms

Problem solved for synoptic systems in N Europe in CoastDat@GKSS, using RCM spectrally nudged to NCEP

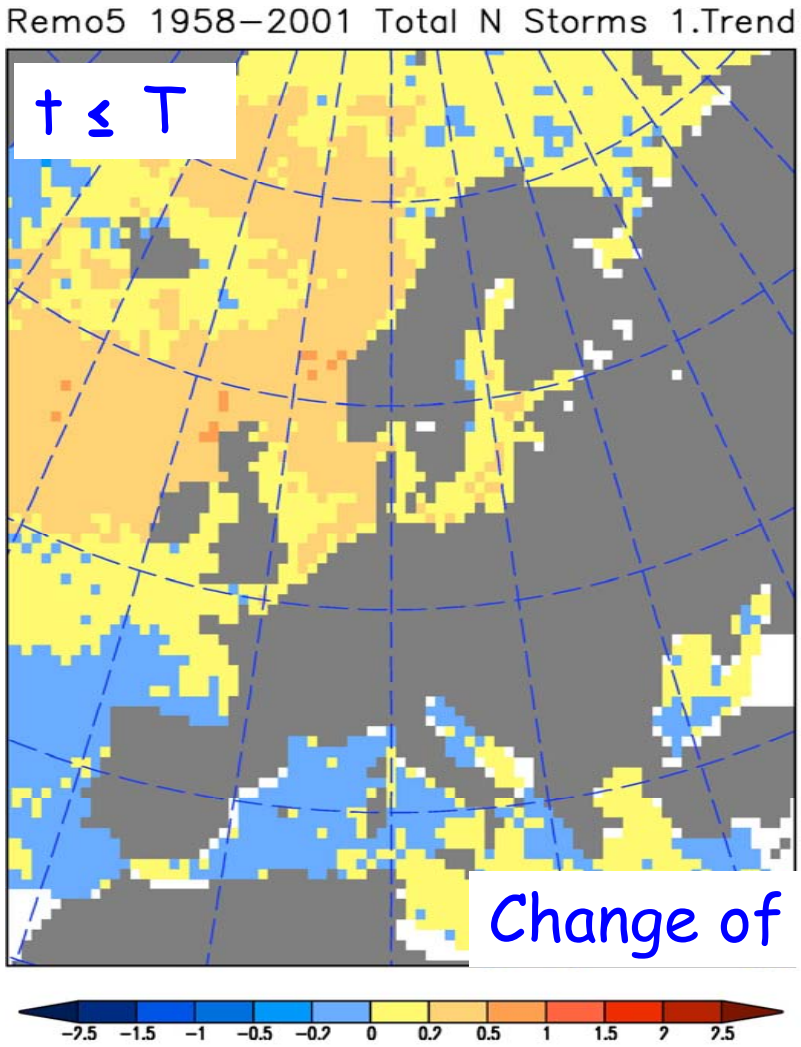
- retrospective analysis 1958-2005
- good skill with respect to statistics, but not all details are recovered.

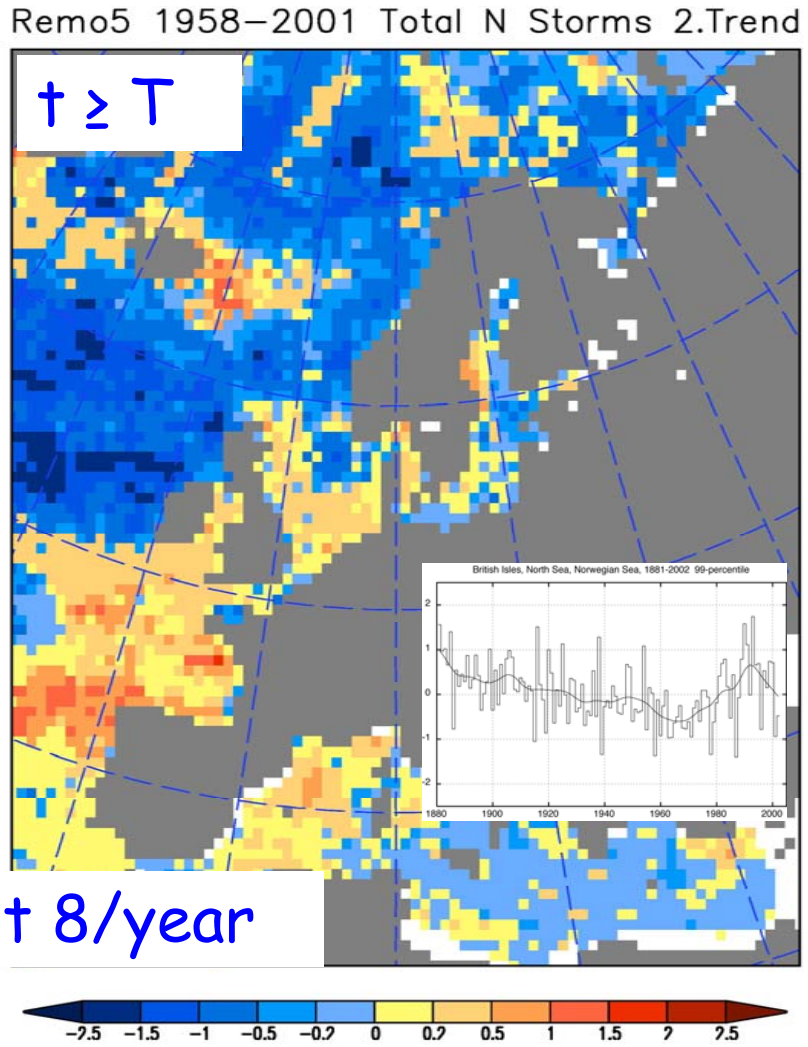


		Wind [m/s]					
		coastDat by GKSS Forschungszentrum Geesthacht			Observed		
	Years	x_γ^{90}	x_r	x_γ^{90}	x_γ^{90}	x_r	x_γ^{90}
K13	2	24.38	25.17	25.96	24.05	25.21	26.37
	5	25.86	27.28	28.70	25.75	27.64	29.53
	25	28.44	31.33	34.22	28.09	32.77	37.45
EUR	2	22.50	23.16	23.82	23.16	24.03	24.90
	5	23.76	24.82	25.88	24.33	25.94	27.55
	25	25.67	28.00	30.33	26.43	29.75	33.07

Weisse, R., H. von Storch and F. Feser, 2005: Northeast Atlantic and North Sea storminess as simulated by a regional climate model 1958-2001 and comparison with observations. J. Climate 18, 465-479

Stormcount 1958-2001



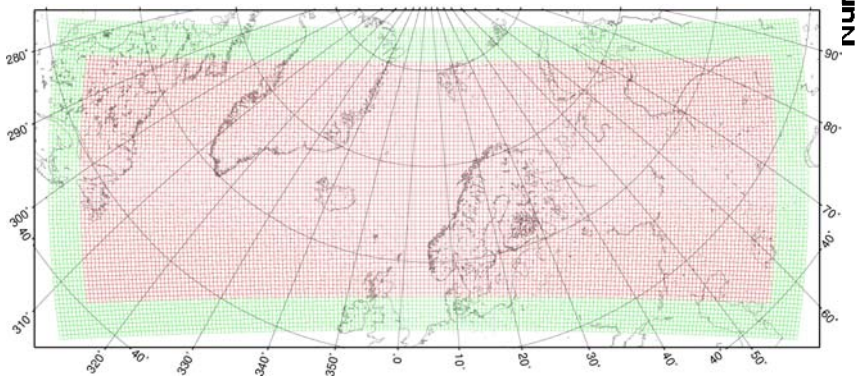


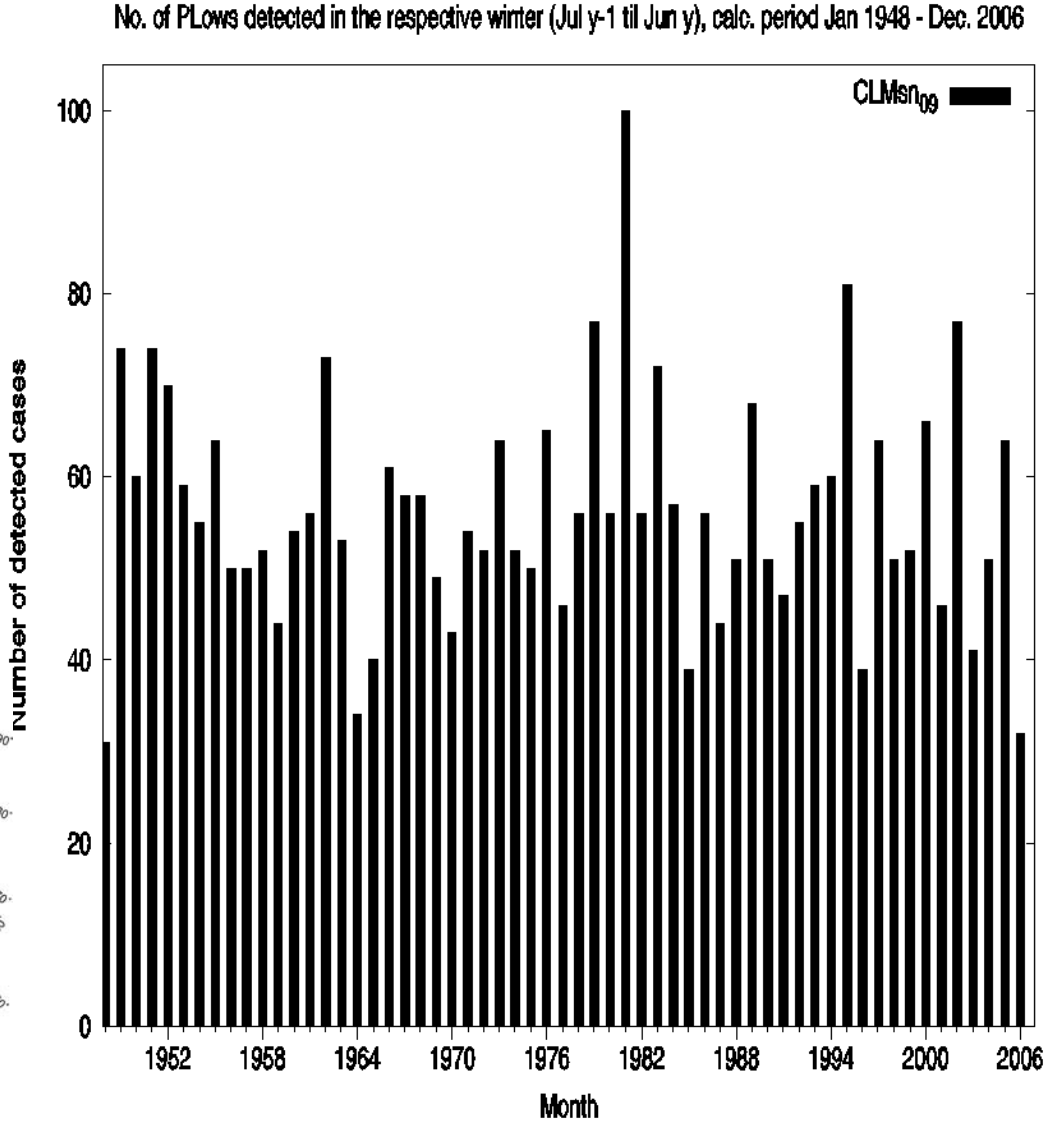
Change of # Bft 8/year

Weisse et al., J. Climate, 2005

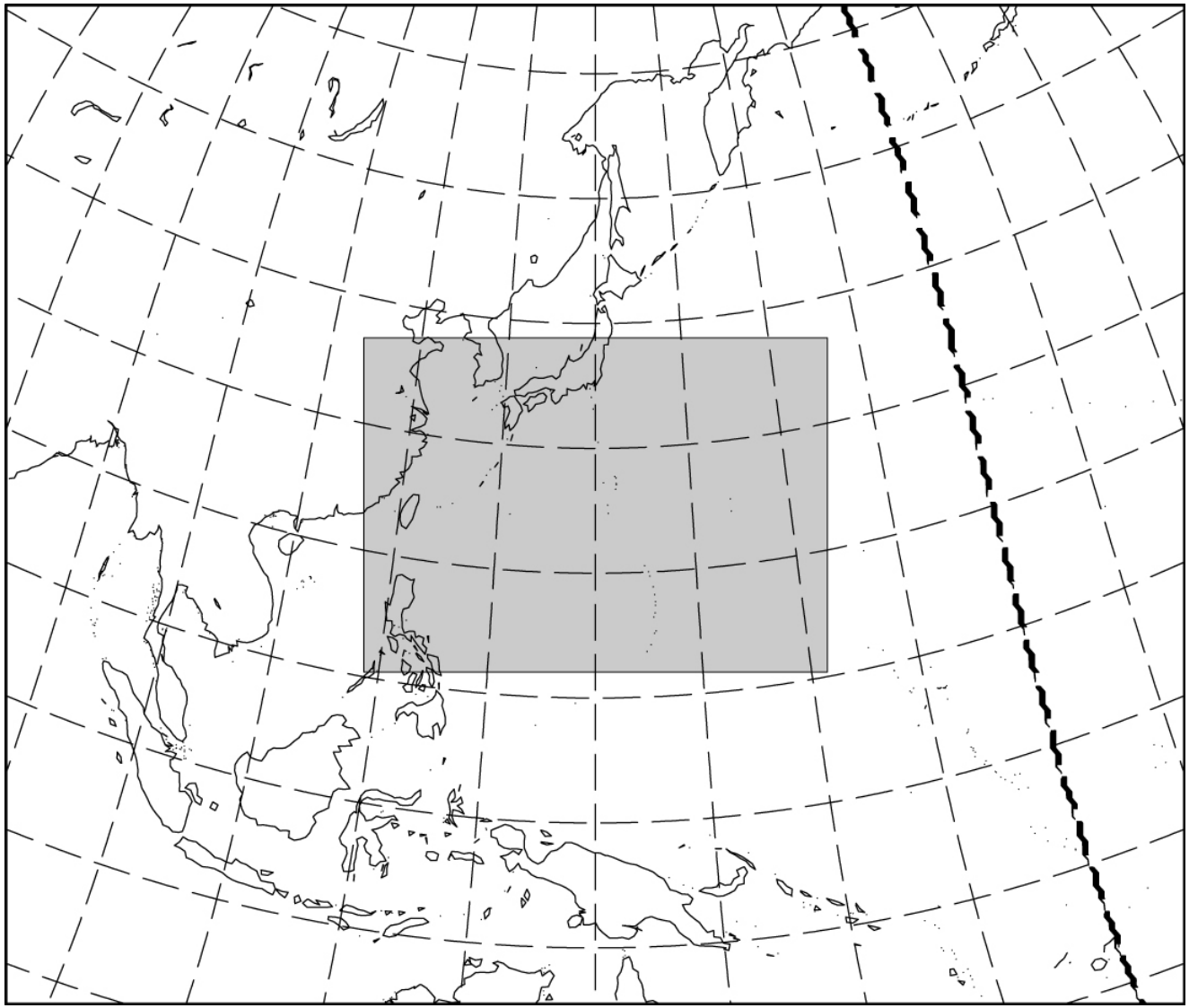
Dynamical Downscaling: Polar Lows

Continuous simulation with regional model CLM, 1948-2006, run and (large-scale) constrained with NCEP/NCAR re-analysis



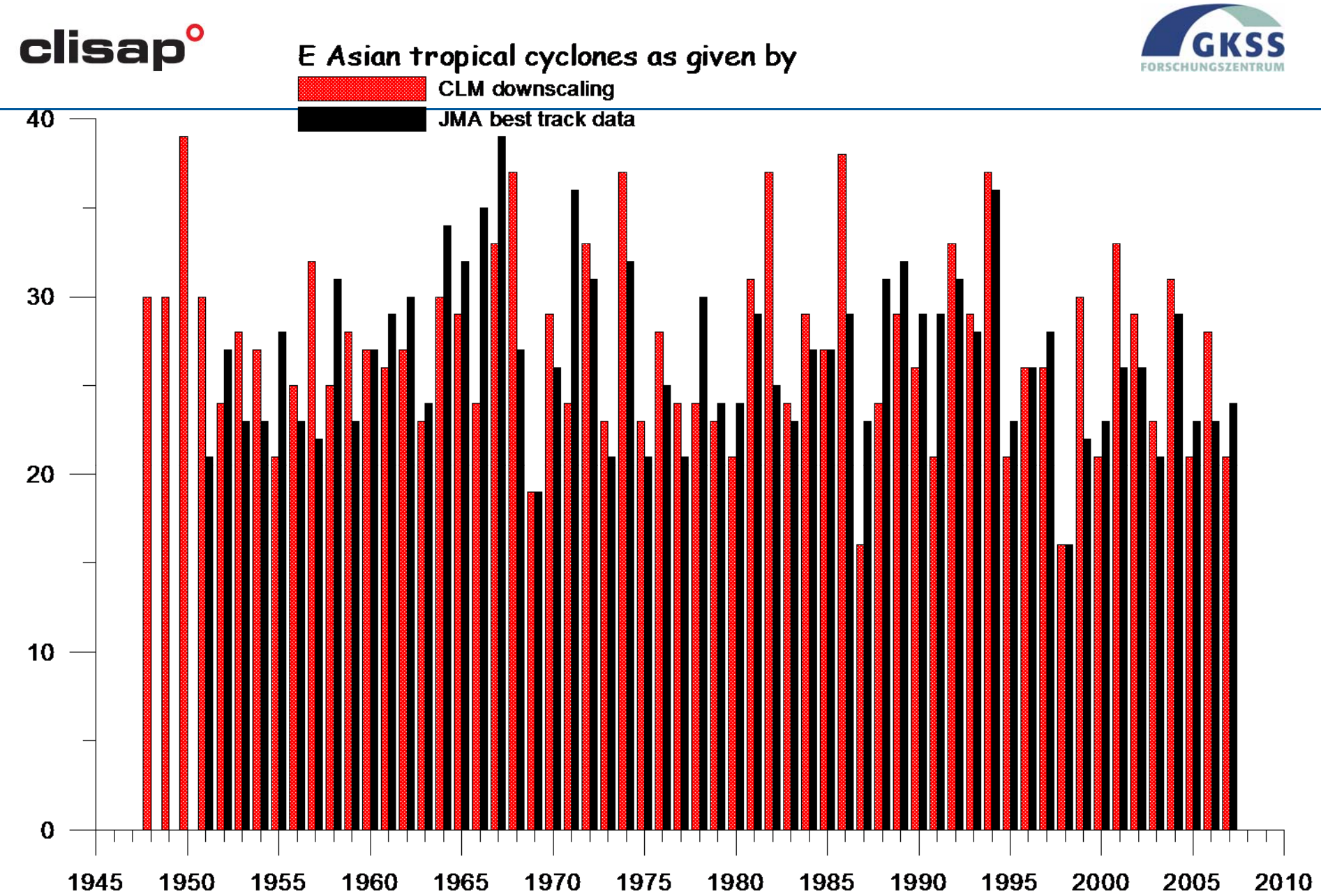


Dynamical Downscaling: E Asian Typhoons

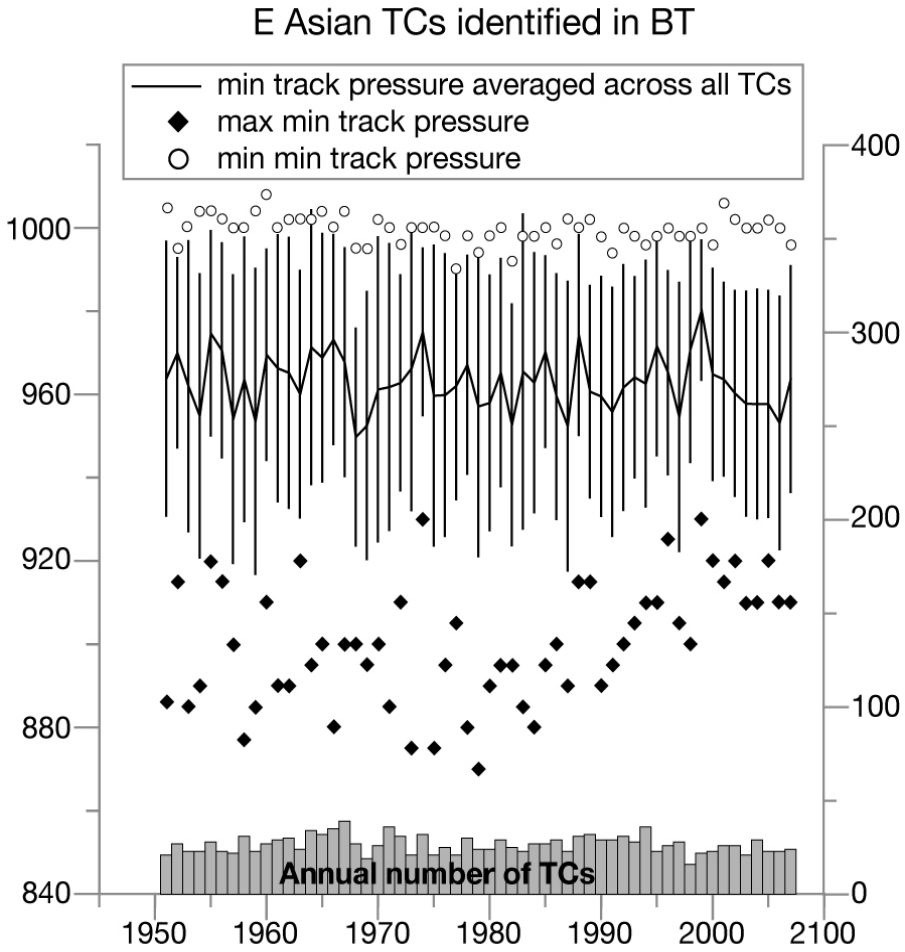


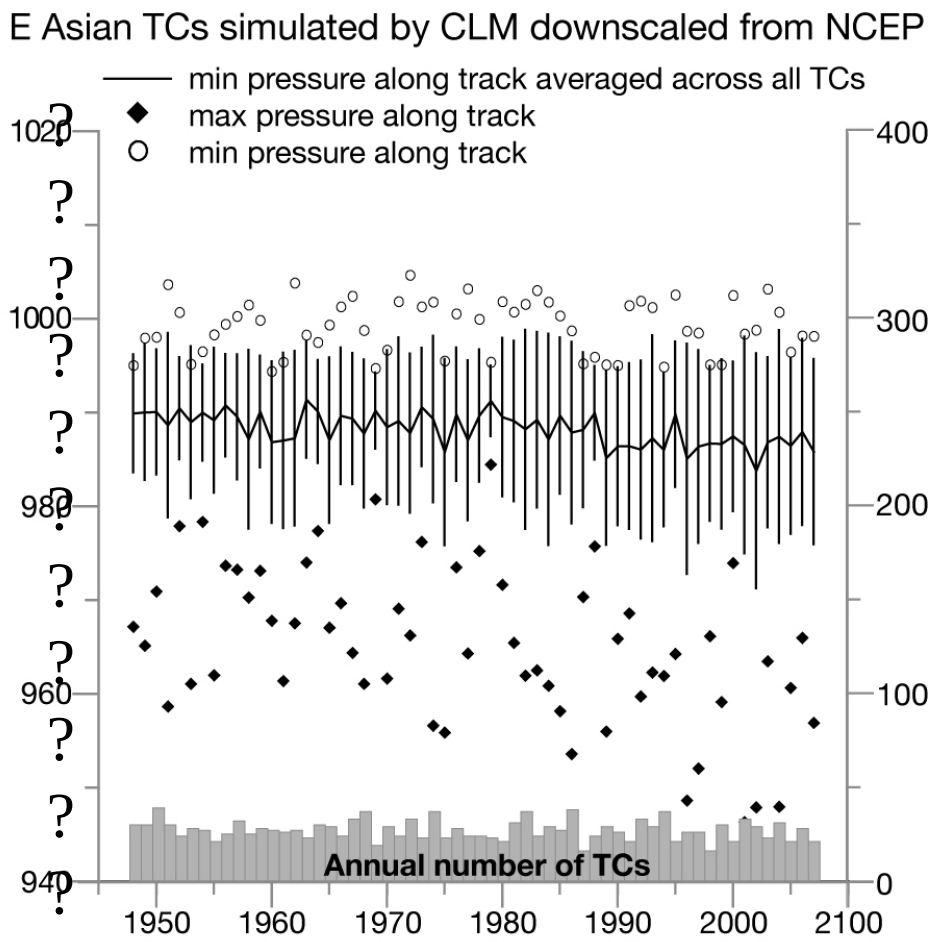
60 year simulation with 50 km grid,

Experimental case and season simulations with embedded 18 km grid.



Note: different criteria employed





Simulated pressure minima considerably too high, but significantly lower than in driving NCEP re-analysis

Conclusion: Usage of proxies

1. Monitoring extra-tropical storminess may be based on air pressure proxies.
2. This allows assessments for 100 and more years.
3. Decades long upward and downwards trends have been detected in recent years.
4. These trends are not sustained and have show recent reversals in all considered regions.
5. Recent trends are not beyond the range of natural variations, as given by the historical past, but are more of intermittent character. Regional temperatures rose significantly at the same time.

Conclusion: Usage of dynamical downscaling

1. Dynamical downscaling for describing synoptic and mesoscale variability is doable.
2. Spectral nudging, or other forms of large-scale constraint are helpful.
3. Simulation of extra-tropical baroclinic disturbances satisfying; wind my be used for simulating wave and surge climatologies and trends.
4. Meso-scale variability (Polar Lows and Tropical Cyclones) is also described, but the depth of the cyclones is not as deep as found in reality; also the winds are too weak.
5. Validation difficult, because homogeneous long term observed data do hardly exist.
6. Analysis of 60 year simulations point to strong year-to-year variability, to less decade-to-decade variability and no noteworthy trend.