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Added value of RCMs

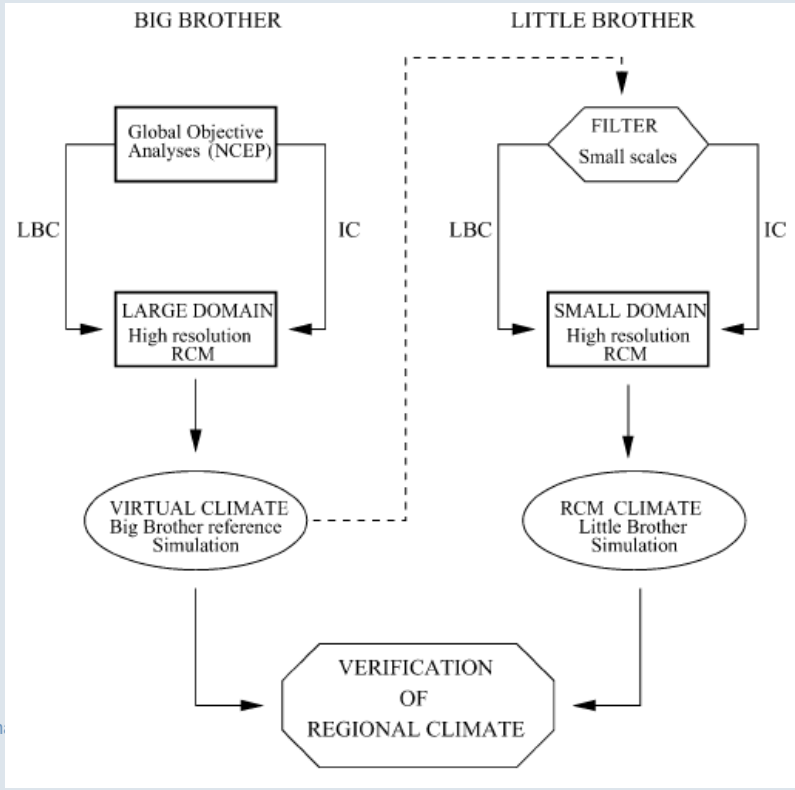
Can RCMs add skill beyond the resolved scales of the GCM? To what degree?

Can RCMs add skill to the large-scales that are resolved by the GCMs?

Can RCMs add skill compared to that added from other methods of downscaling (SD)?

RCMs can generate small-scale variability in a realistic way

Evidence supported by Big-Brother experiment (Denis et al. 2002, 2003, Antic et al. 2004)



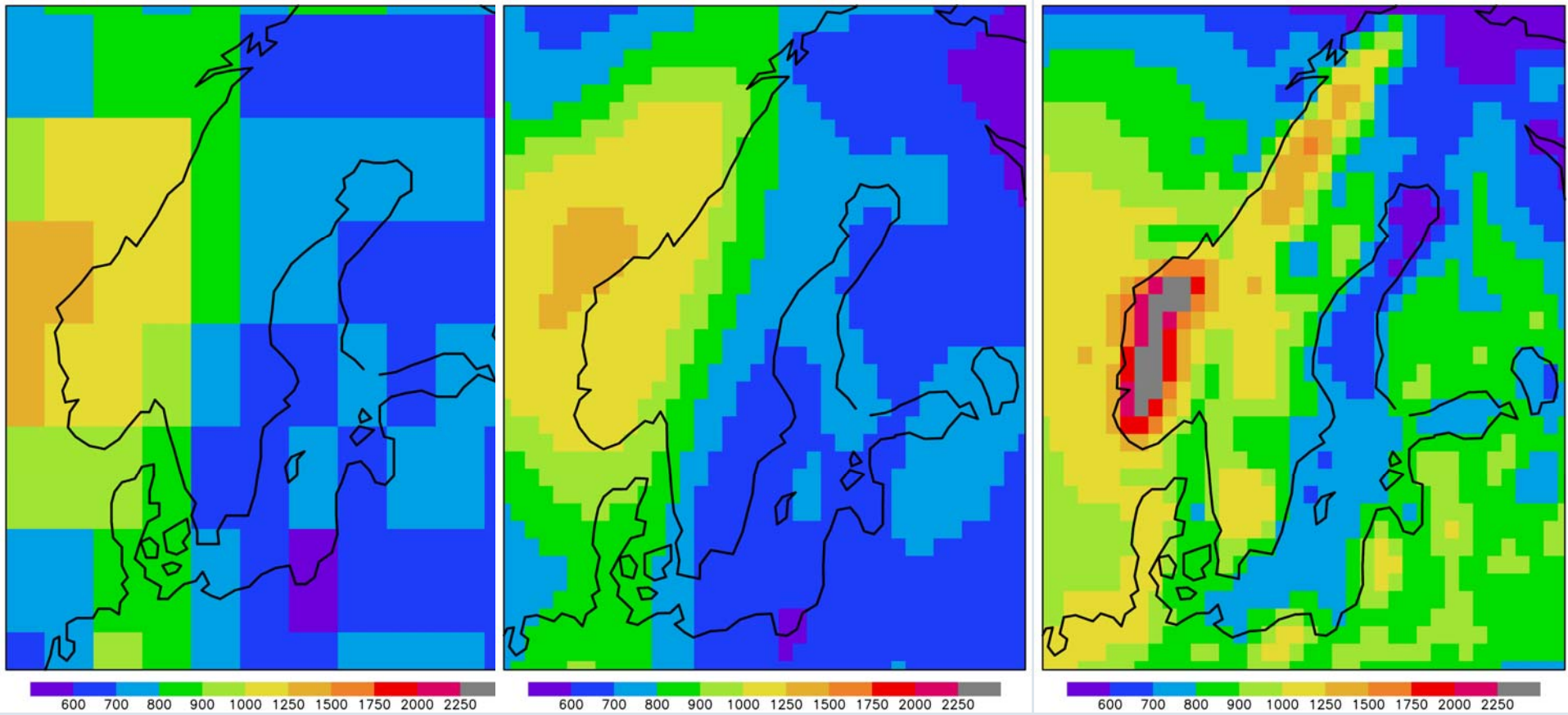
"The downscaling ability of the Little Brother is also significant for transient eddies, as well as for the stationary components."

"Complex topography enhances the downscaling ability of precipitation compared to the results of Denis et al. (2003) obtained over the east coast of North America."

Added value of regional modelling

(simul. Annual mean precip.)

GCM/T42 **GCM/interp. to 50 km** **RCM/50 km**



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Improving smaller scales but not larger ...

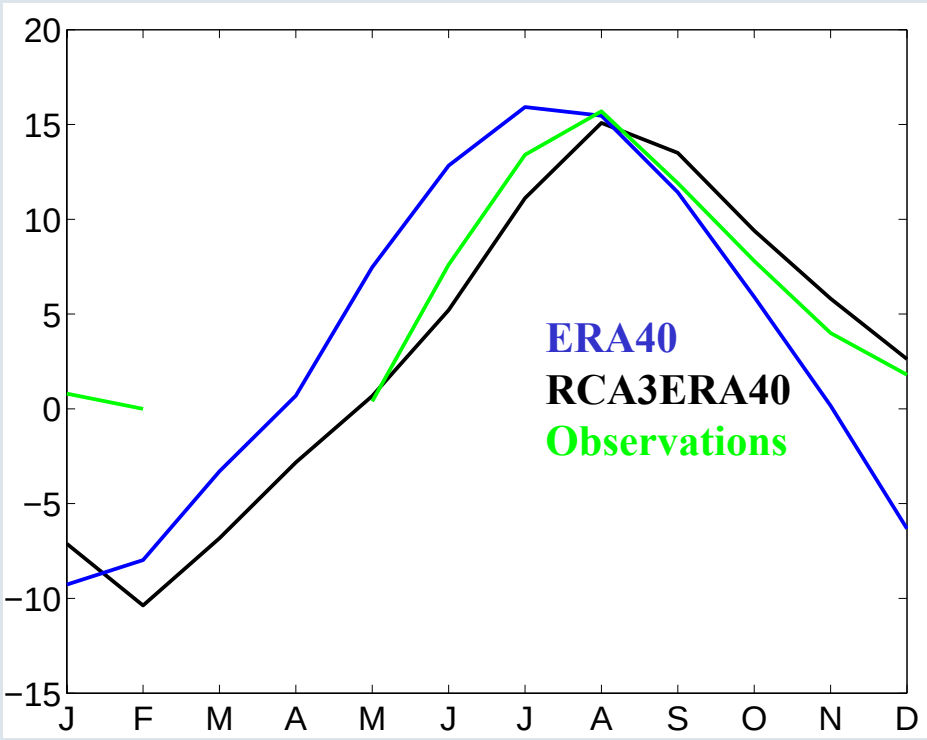
By ‘‘value retained’’ we mean how well the RCM maintains fidelity with the large-scale behavior of the global model forcing data. By ‘‘value added’’ we mean how much additional information the RCM can provide beyond the highest resolved wavelength of the global model. (Castro et al. 2005)

We find for this particular case, dynamical downscaling with RAMS does not retain value of the large scale over and above that which exists in the larger global model or reanalysis. If the variability of synoptic features is underestimated or there is a consistent bias in the larger model, no increased skill would be gained by dynamical downscaling with RAMS. The utility of the RAMS-RCM, then, is not to add increased skill to the large scale, rather the value added is to resolve the smaller-scale features which have a greater dependence on the surface boundary.

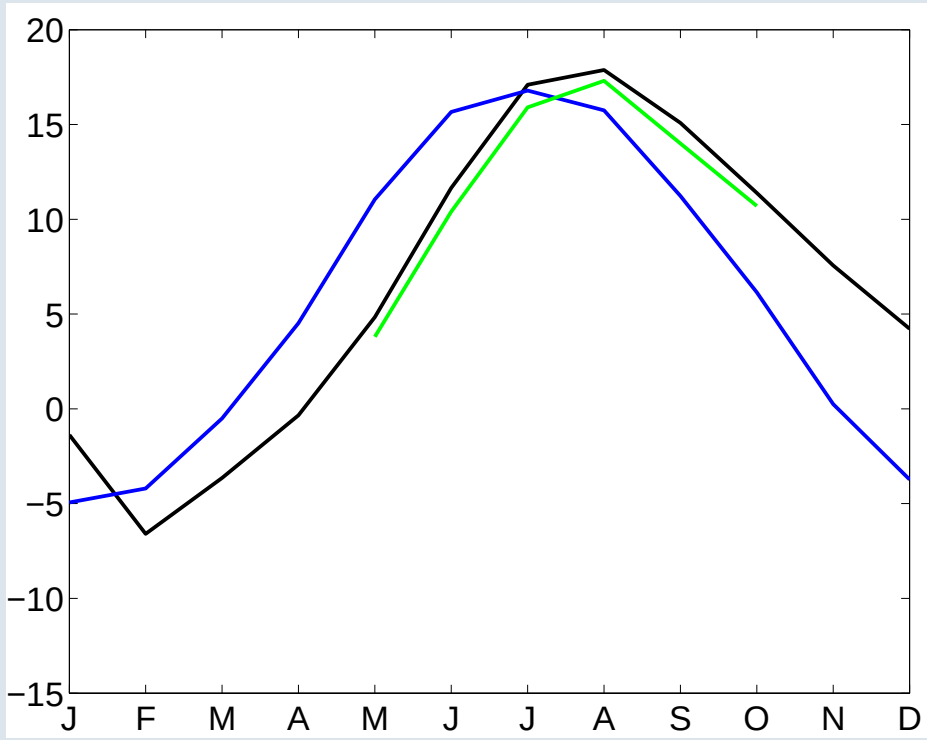
More detailed processes/models operating on local and regional scales can be included

RCA3 contains a lake model (FLAKE).

Seasonal cycle of surface temperature (ºC)



Lake Vänern



Lake Ladoga

Kjellström et al., (2005)

Improvements emphasized where strong local forcing exists

“Bielli and Laprise (2006) performed a scale decomposition of the various terms in atmospheric water budget to isolate their respective contributions. This study reinforces the point about the relatively modest contribution of small scales to the time-mean water budget, and a suggestion that the added value of RCMs is contained mostly in the time variability, except again where there is strong localised forcing.” (Laprise, 2008)

RCMs improve small scales compared to forcing data. May also improve compared to SD methods

Higher-order statistics (Q90) for daily precip.
Comparing with a statistical bias-correction (Schmidli et al. Int. J. Clim., 2006)

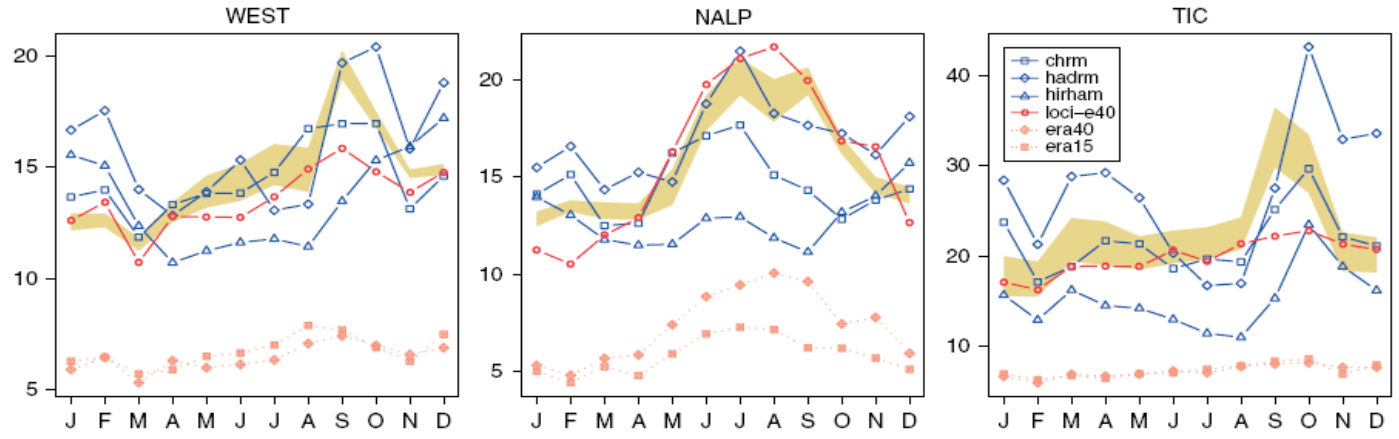
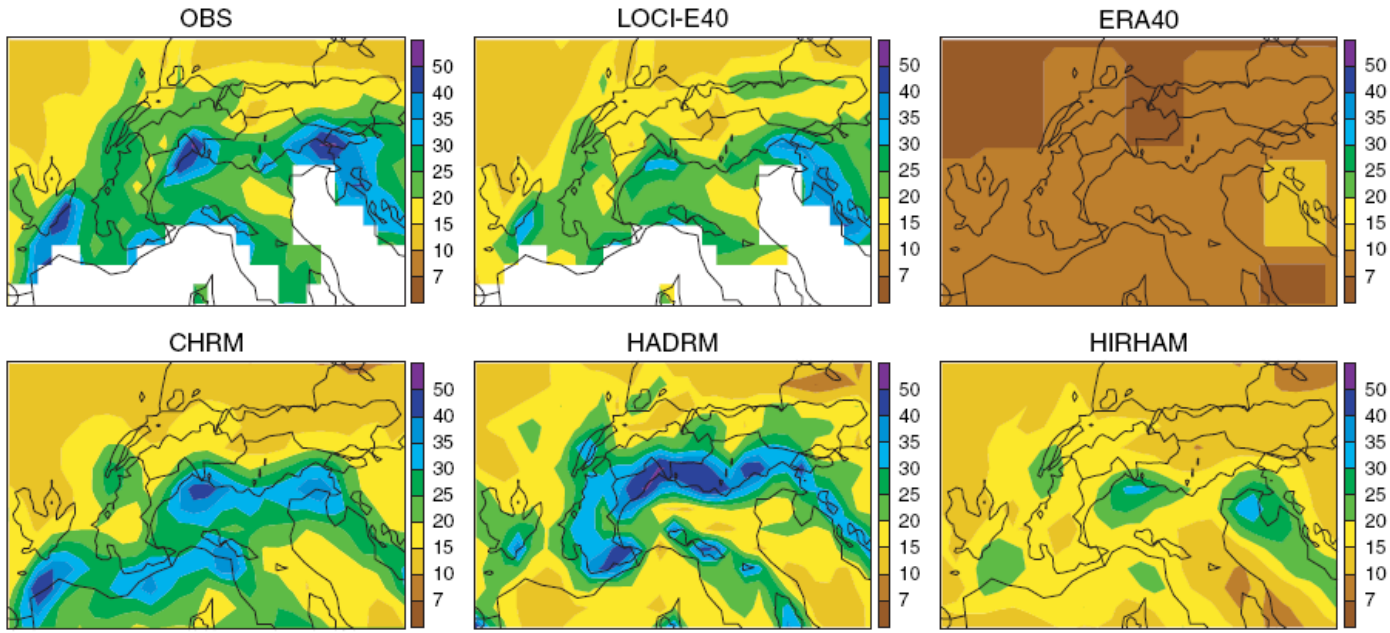


Figure 6. Annual cycle of Q90 averaged over the three regions, comparison with the RCMs. Results are valid for the evaluation period



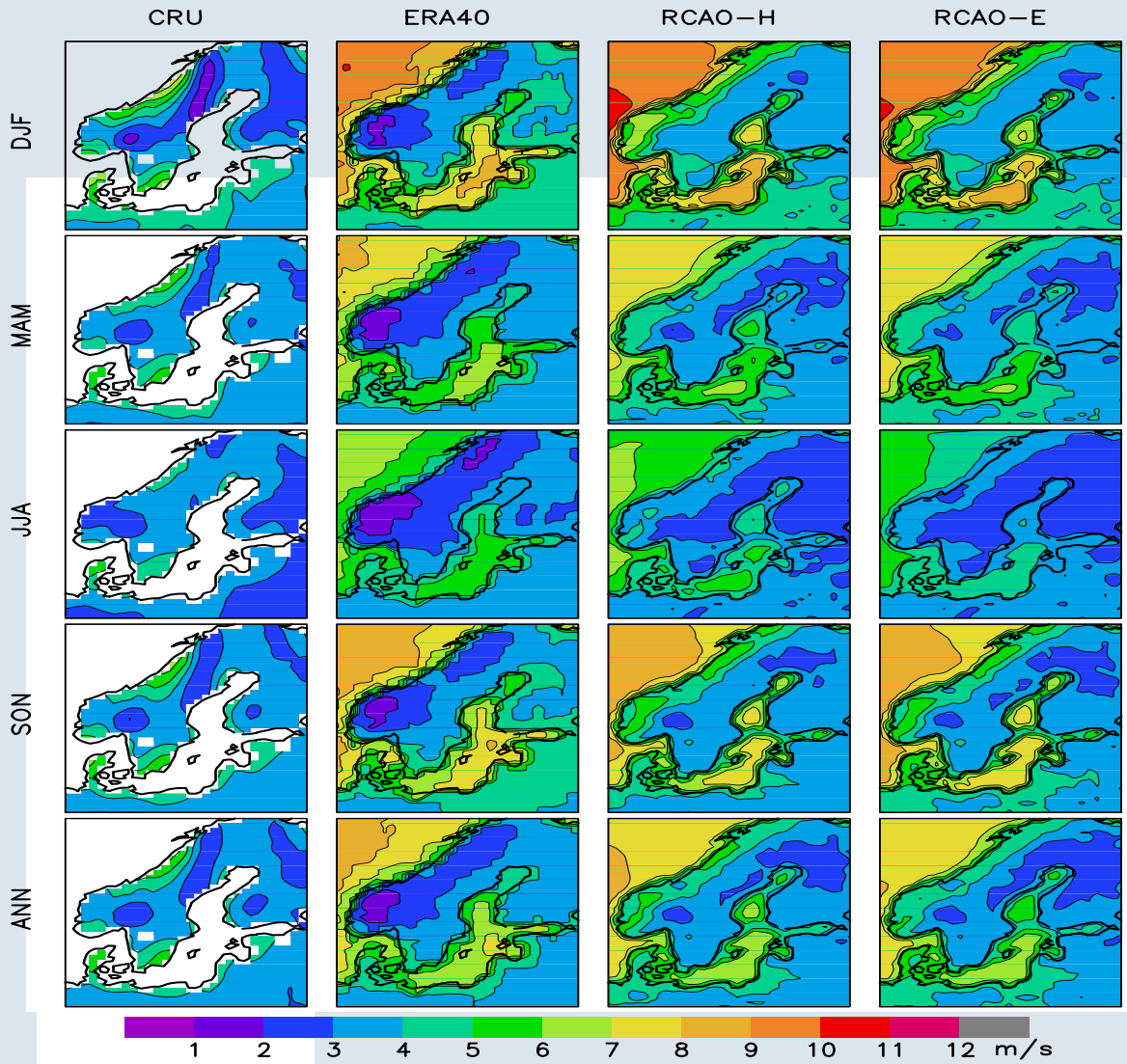
RCMs can improve the representation of variables compared to the forcing boundary conditions

Simulated seasonally averaged 10m-wind speed (1961-1990)

Observations, 0.5x0.5° (CRU)

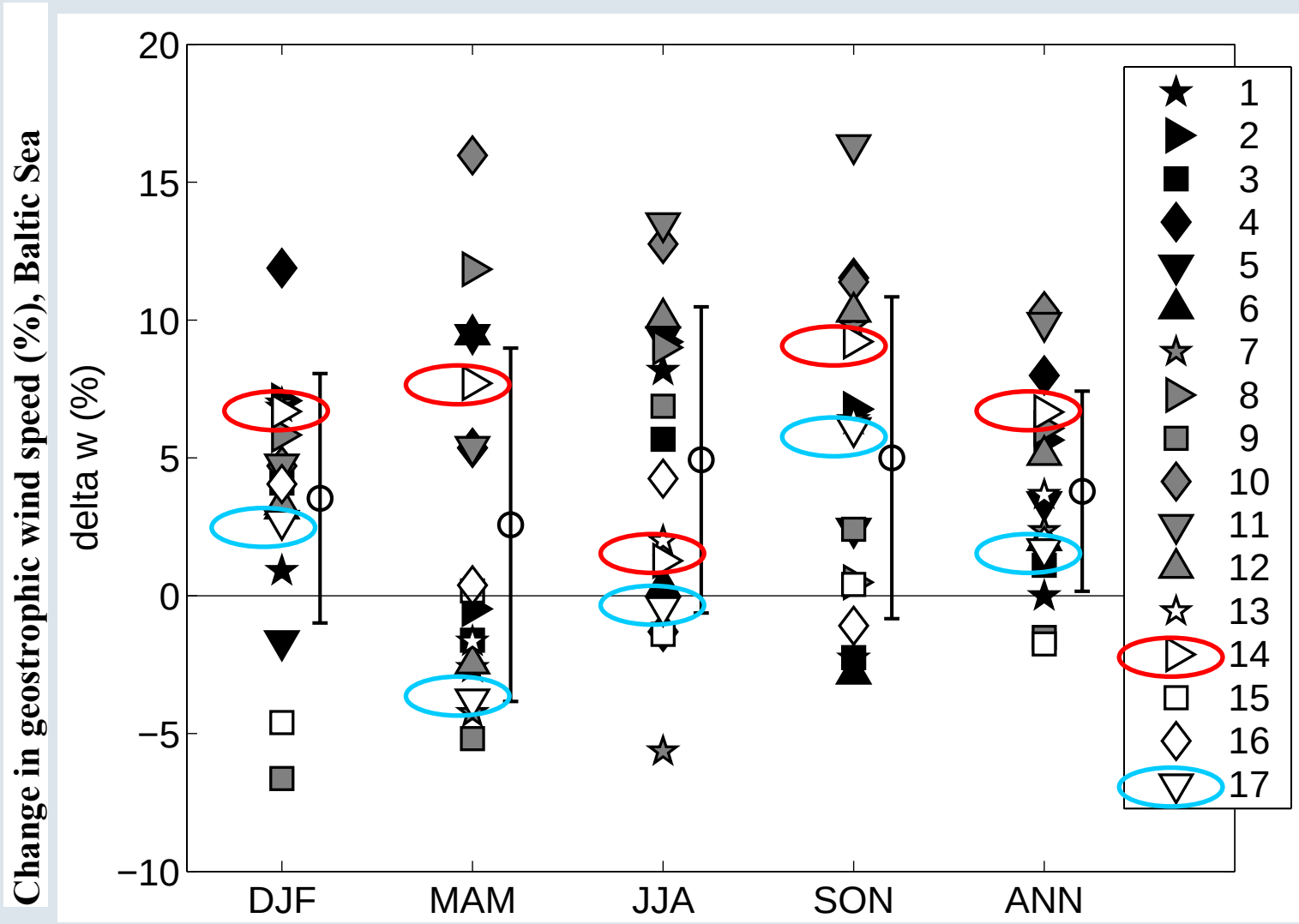
reanalysis, 125x125km (ERA40)

Control climate, 50x50km (RCAO-H & RCAO-E)



Source: Meier et al., 2006

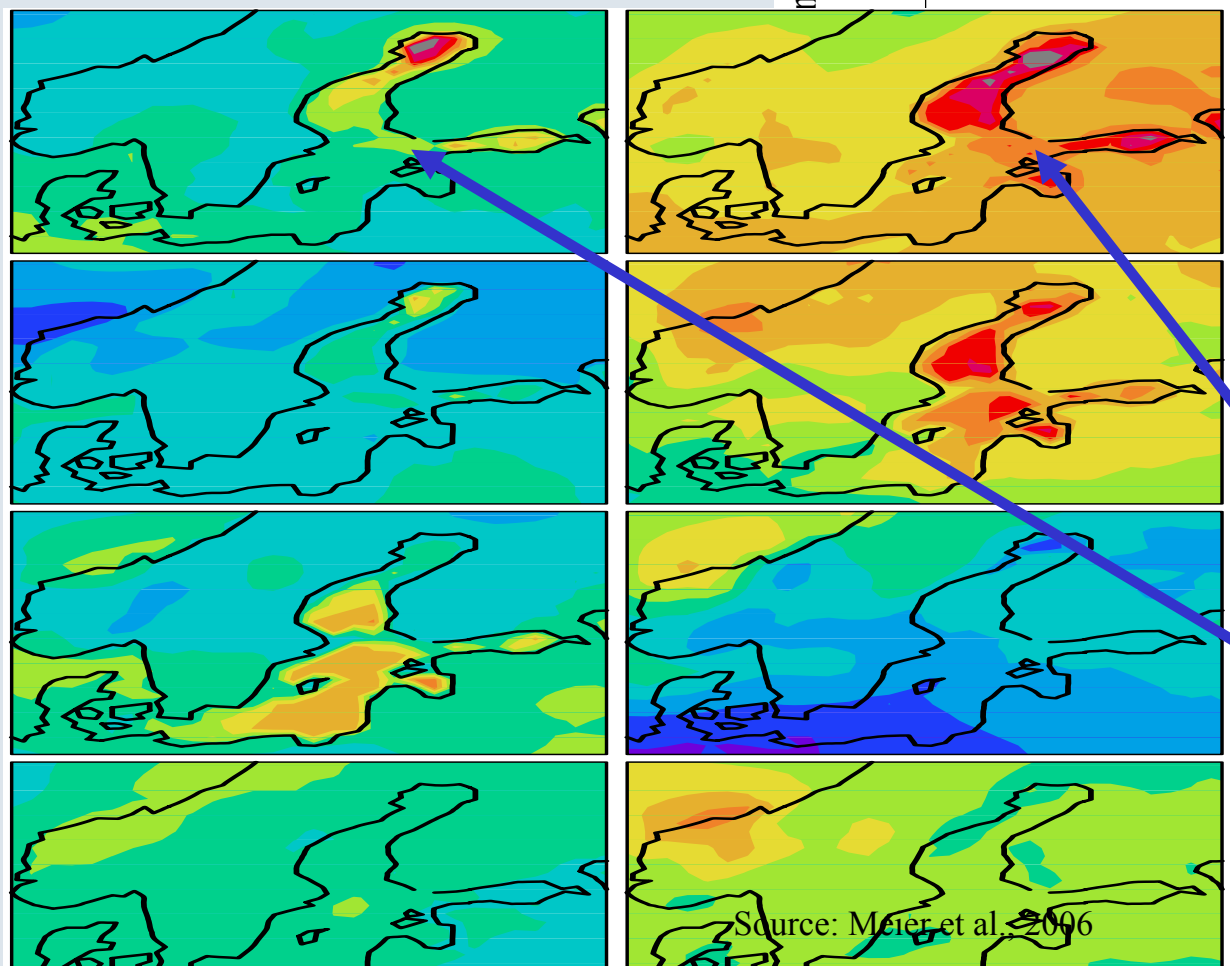
Different GCMs give different wind changes: Change in 70 years time at the time of CO_2 doubling

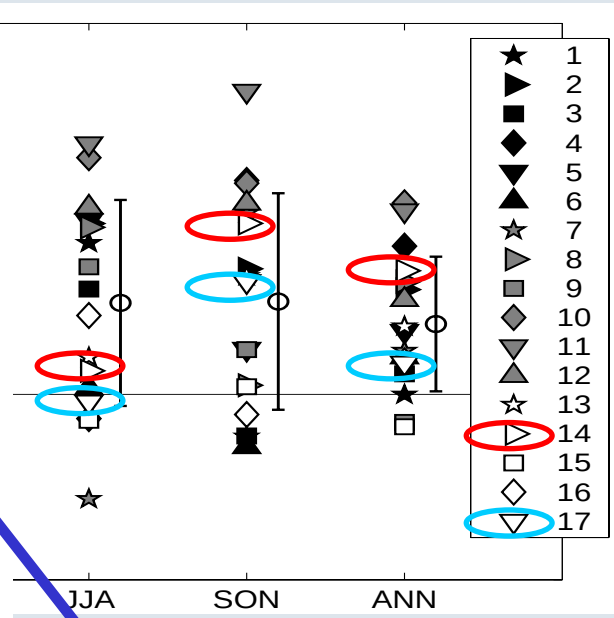


Source: Chen and Aschberger, 2006

But: RCMs can help identifying common details

RCAO simulated wind changes in SRES A2 2071-2100 compared To 1961-1990 (DJF)





Source: Chen and Aschberger, 2006

Increasing wind speed as sea ice disappears

Source: Meier et al., 2006

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Some references

Antic_et_al_2004
Castro et al 2005
climatemodels08
Denis et al 2002
Denis et al 2003
Dimitrijevic and Laprise 2005
feser_MWR_2006
Gonzalez-Ruoco et al 2008
Koltzov_et_al_2007
Laprise_2008
Lo et al 2008
Salzmann_et_al_2007
sap3-1-final-ch3
Schmidli_et_al_2005
schmidli_et_al_2006
Wilby et al 2000

http://cires.colorado.edu/science/groups/pielke/links/Downscale/