



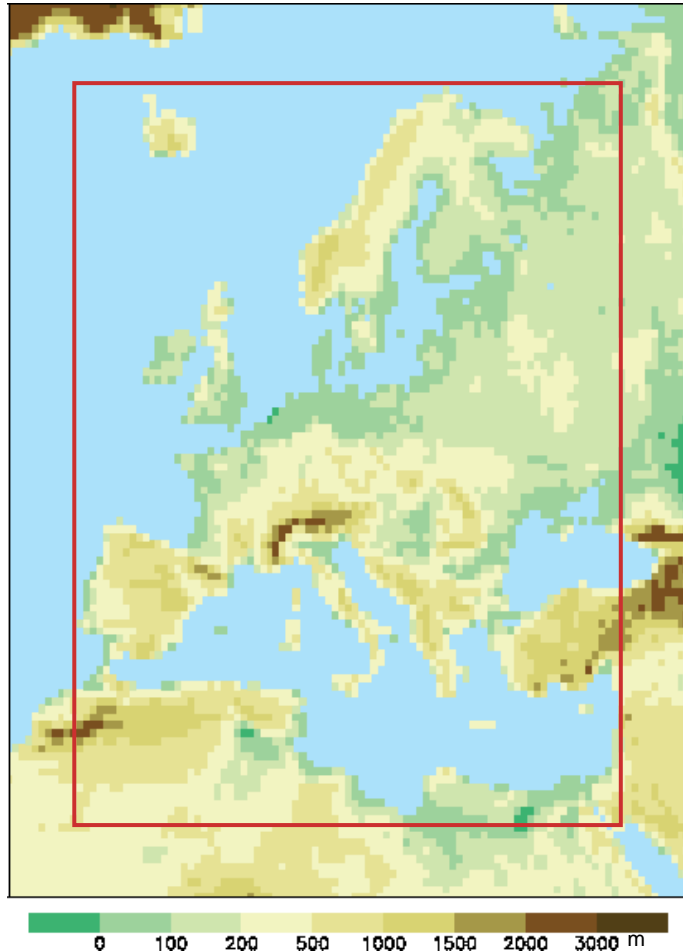
Verification of simulated near surface wind speed by a multi model ensembles with focus on coastal region

Ivonne Anders, Hans von Storch, Burkhardt Rockel

- Introduction
- ENSEMBLES project and model data
- Observation data and homogeneity
- Results
- Conclusion and outlook



- study by *Winterfeld (2008)*: open ocean areas shows no adding value for RCM modeling compared to reanalysis forcing in the wind speed frequency distributions, whereas in coastal regions RCM results - especially for higher wind speed percentiles - are closer to the observations than the forcing data.
- focused on near-surface wind speed over Europe and identified that most of the RCMs have not been able to simulate wind velocities above 8 Bft. (*Rockel and Woth (2007)*)



Simulationsgebiet – Orographie Europa

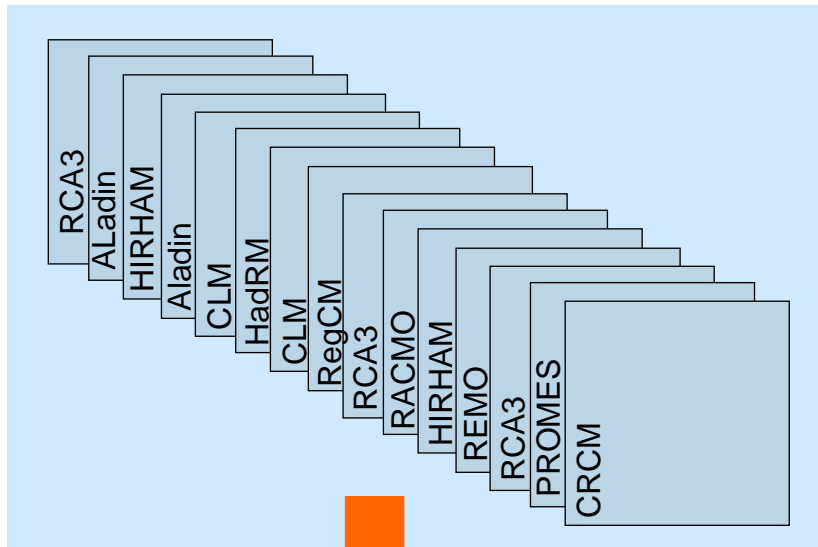
14 European und 1 Canadian Institutions

= 15 Regional Climate Models



- Simulation area Europe
- Spatial Resolution 50km und 25km
- ERA40 Reanalysis data as forcing data
- time period 1961 - 2000.

Model data from RCMs



Wind speed at 10m height
(daily means 1961-2000)

Observation data at German and Dutch Coast (DWD and KNMI)



Wind speed at 10m height
(hourly data partly 1951-2008)

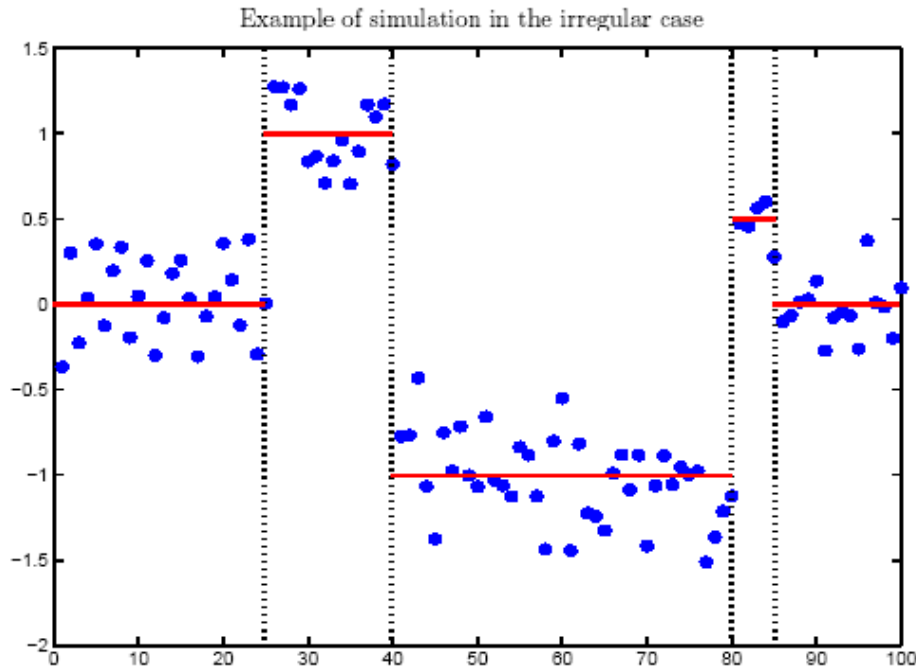


- hourly values for the mean speed and the mean direction of the wind over the last 10 minute period in the preceding hour

Wind speed at 10m height
(hourly data partly 1951-2008)

- measurements strongly influenced by changes in e.g.:
 - surface roughness
 - by shadowing effects from trees and buildings
 - changes in the instrument, the measuring height or the location
- homogenization of wind measurement critical due the measurements are influenced by local wind effects.
- Stations history often incomplete, changes in the stations surrounding (growing trees, new buildings in the neighbourhood) rarely documented.

Homogeneity of observation data - Jumps detection -



Source: Picard et al. (2005)

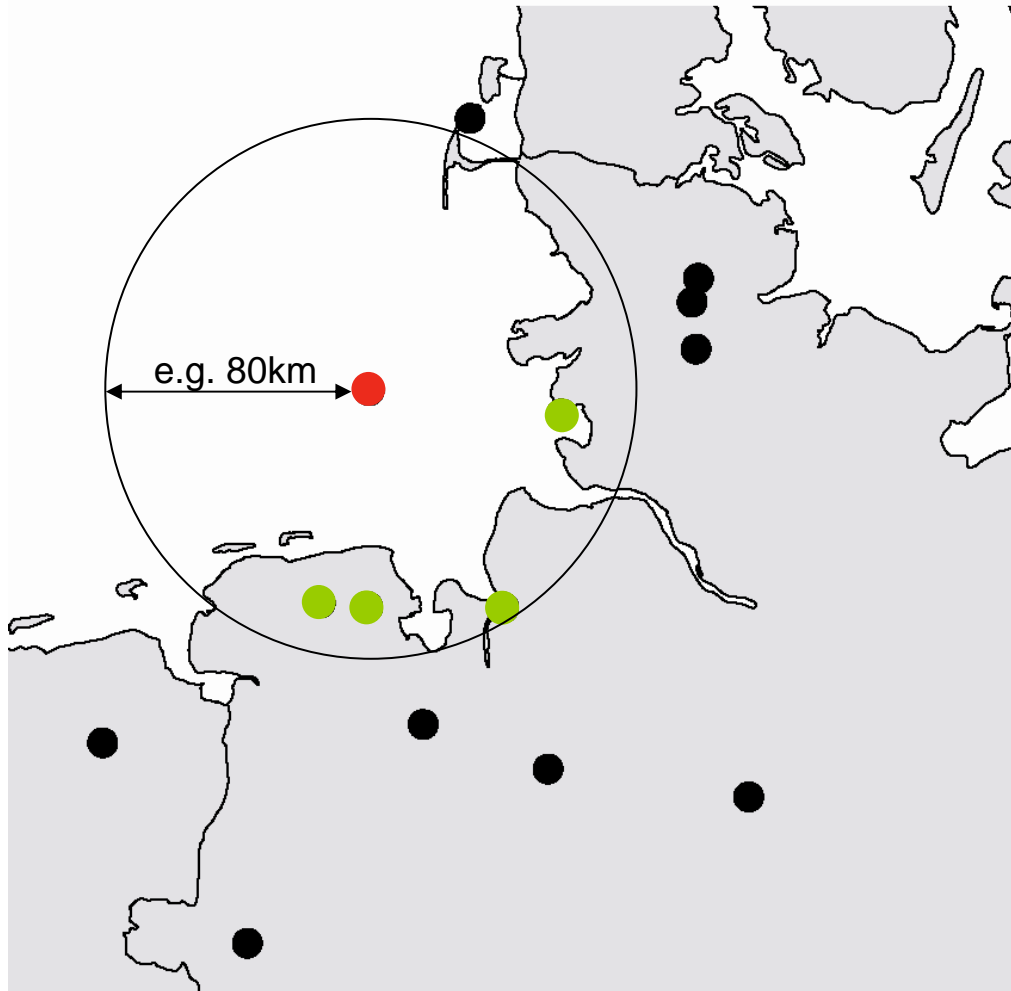
References:

Caussinus, H. and Mestre, O., Detection and correction of artificial shifts in climate series, *Appl. Statist.*, Vol. 53, Part 3, pp. 405-425, 2004

Picard et al. A statistical approach for array CGH data analysis. *BMC Bioinformatics*, 6:27, 2005

- identifying segments with specific mean and variance or segments with specific mean and common variance
- easier to find segments if the variance is low compared to the jump in the mean.

Homogeneity of observation data - Jumps detection -



Example: Helgoland

Step1

create new time series as e.g. **differences between the observation at Helgoland and reference observation data** in Büsum, Wittmundhafen, Jever and Cuxhaven

Step2

jump detection in each time series from Step 1

Homogeneity of observation data - Jumps detection -

ratx 1040 Helgoland vs 9007 Wittmundhafen

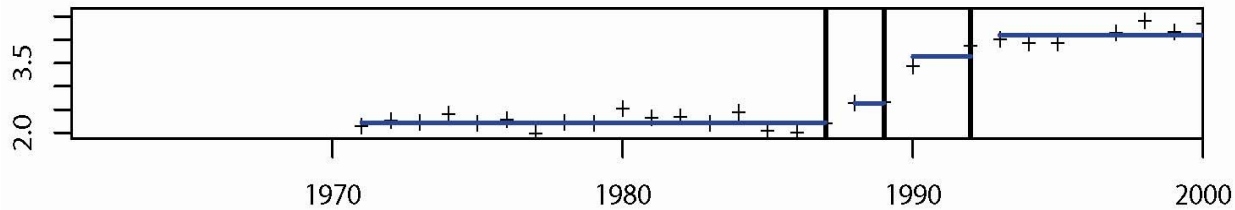
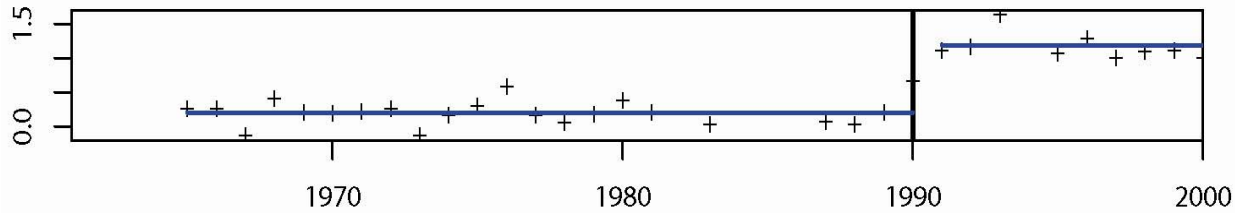
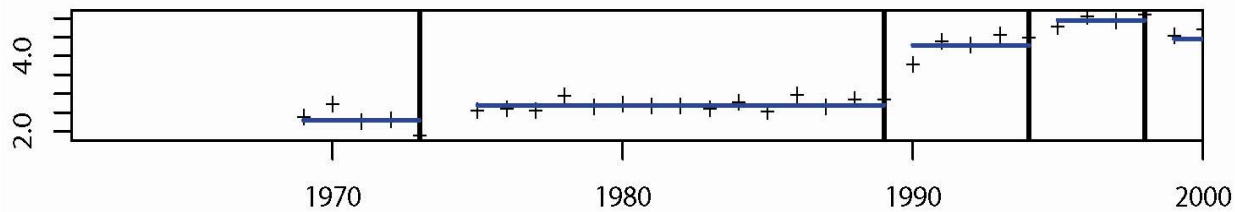


Figure: Example for breaks detected in difference in wind speed series (in m/s) from Helgoland vs. Wittmundhafen, BÜsum, Jever and Cuxhaven.

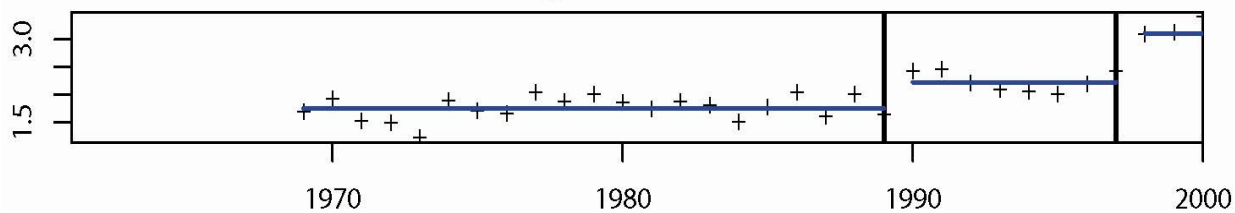
ratx 1040 Helgoland vs 1446 Buesum



ratx 1040 Helgoland vs 1065 Jever

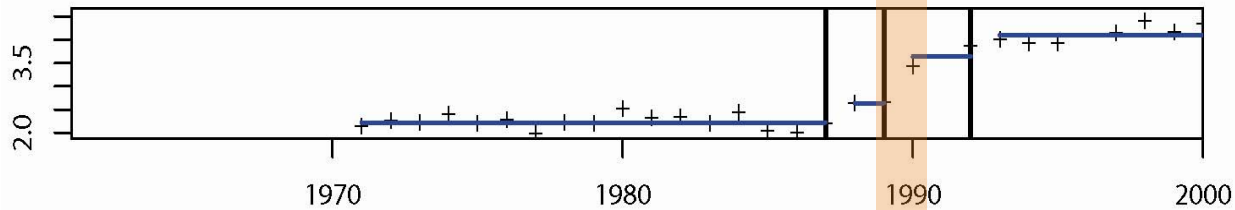


ratx 1040 Helgoland vs 1478 Cuxhaven

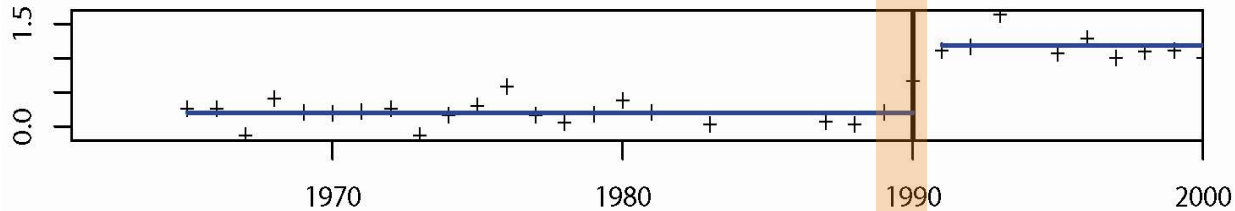


Homogeneity of observation data - Jumps detection -

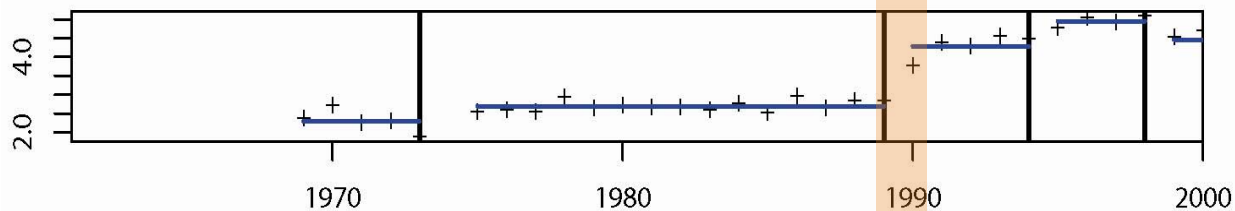
ratx 1040 Helgoland vs 9007 Wittmundhafen



ratx 1040 Helgoland vs 1446 Buesum



ratx 1040 Helgoland vs 1065 Jever



ratx 1040 Helgoland vs 1478 Cuxhaven

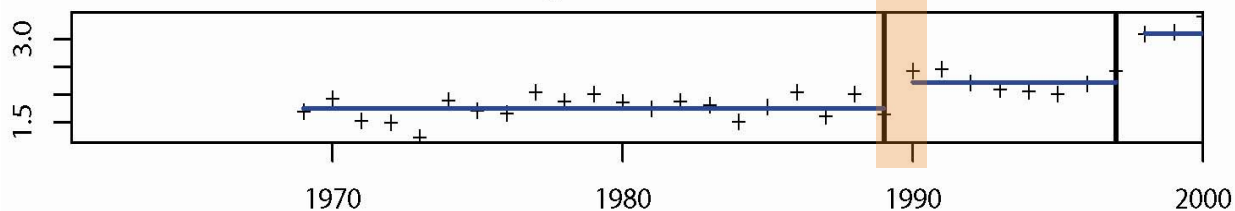
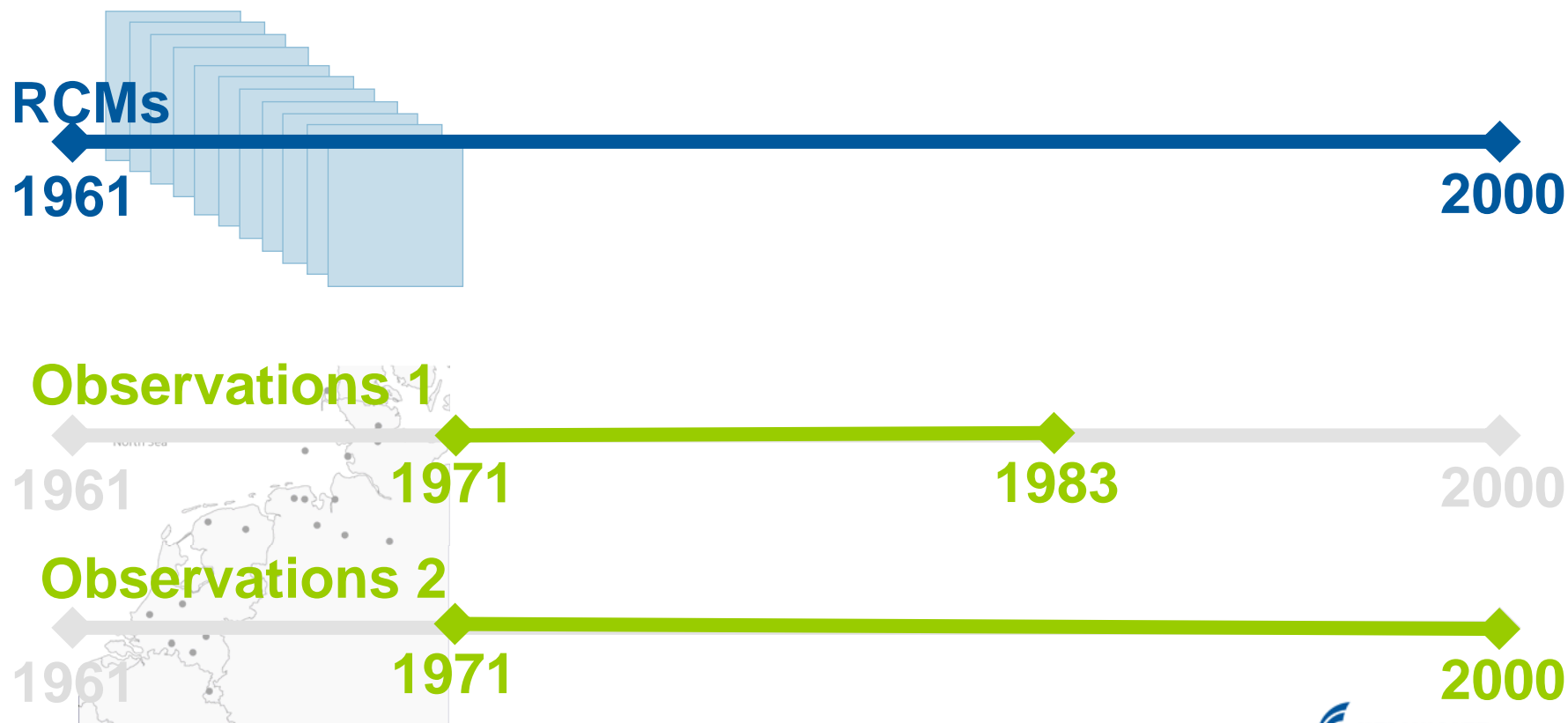


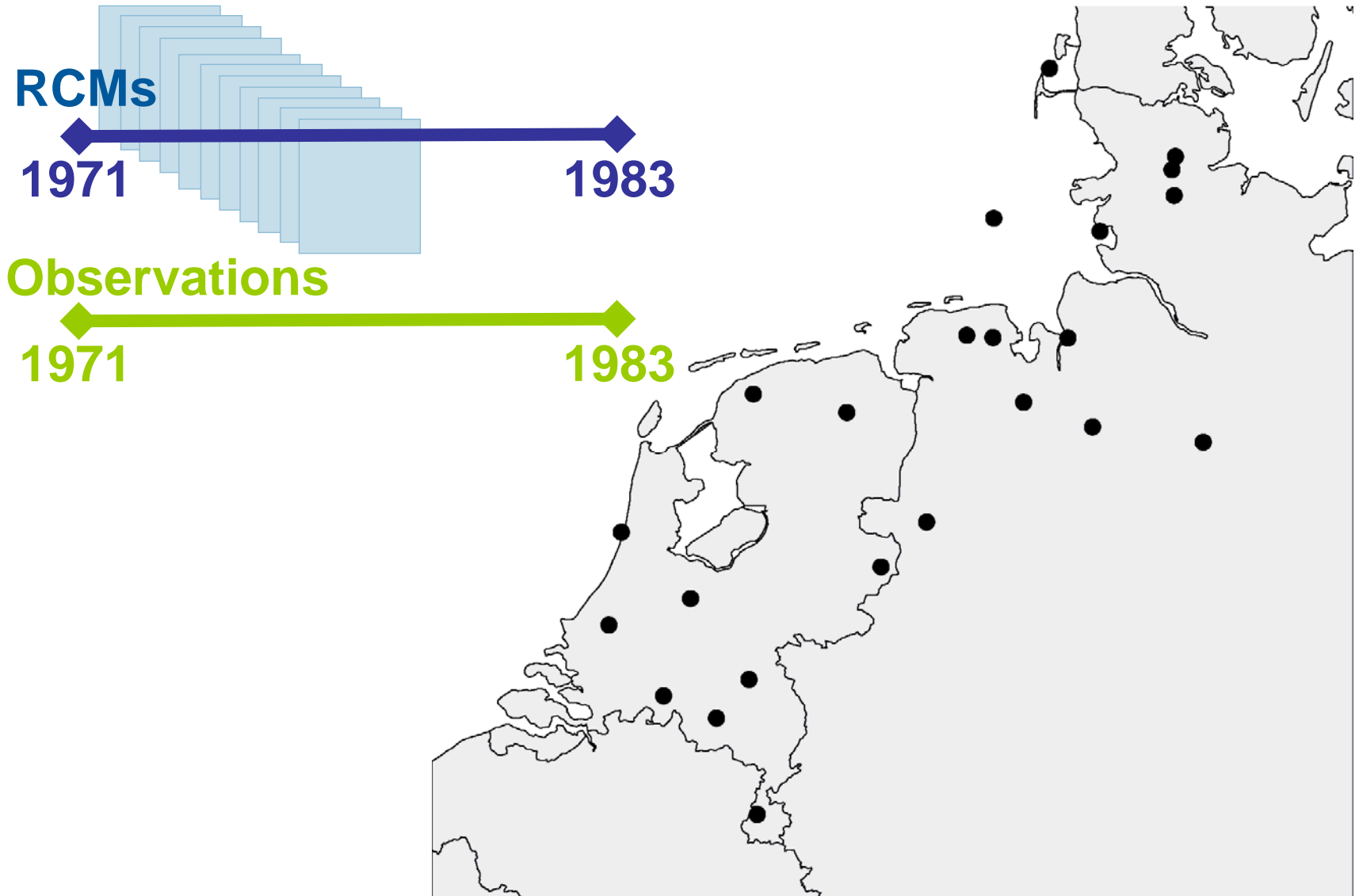
Figure: Example for breaks detected in difference in wind speed series (in m/s) from Helgoland vs. Wittmundhafen, BÜsum, Jever and Cuxhaven.

Jump in 1989:
Changing the
location of the
measuring site

- definition of two time slices for comparison between observation data and wind speed data from RCMs



Observation data for the comparison

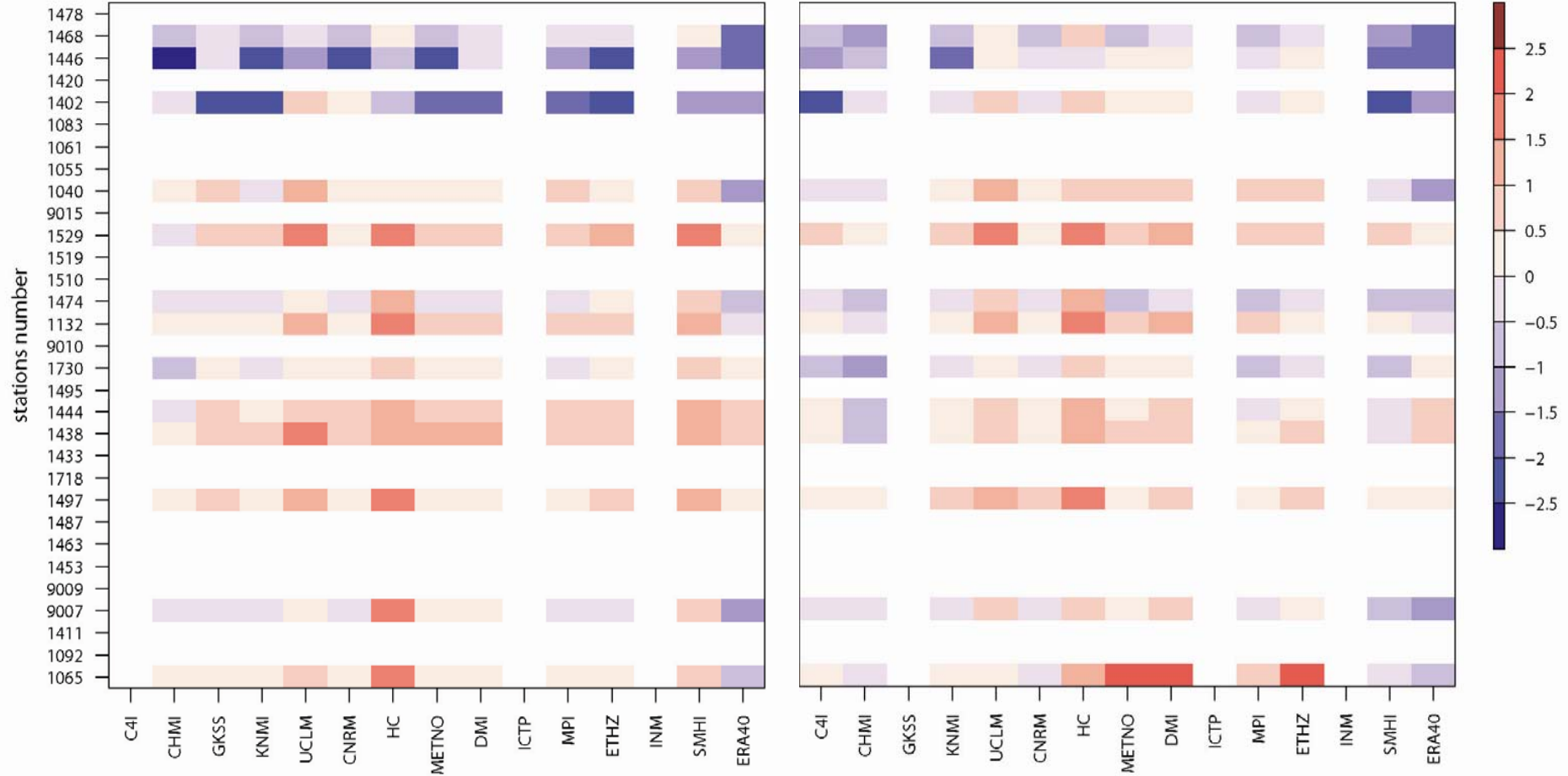


BIAS

1971-1983

50km

25km



BIAS at certain stations

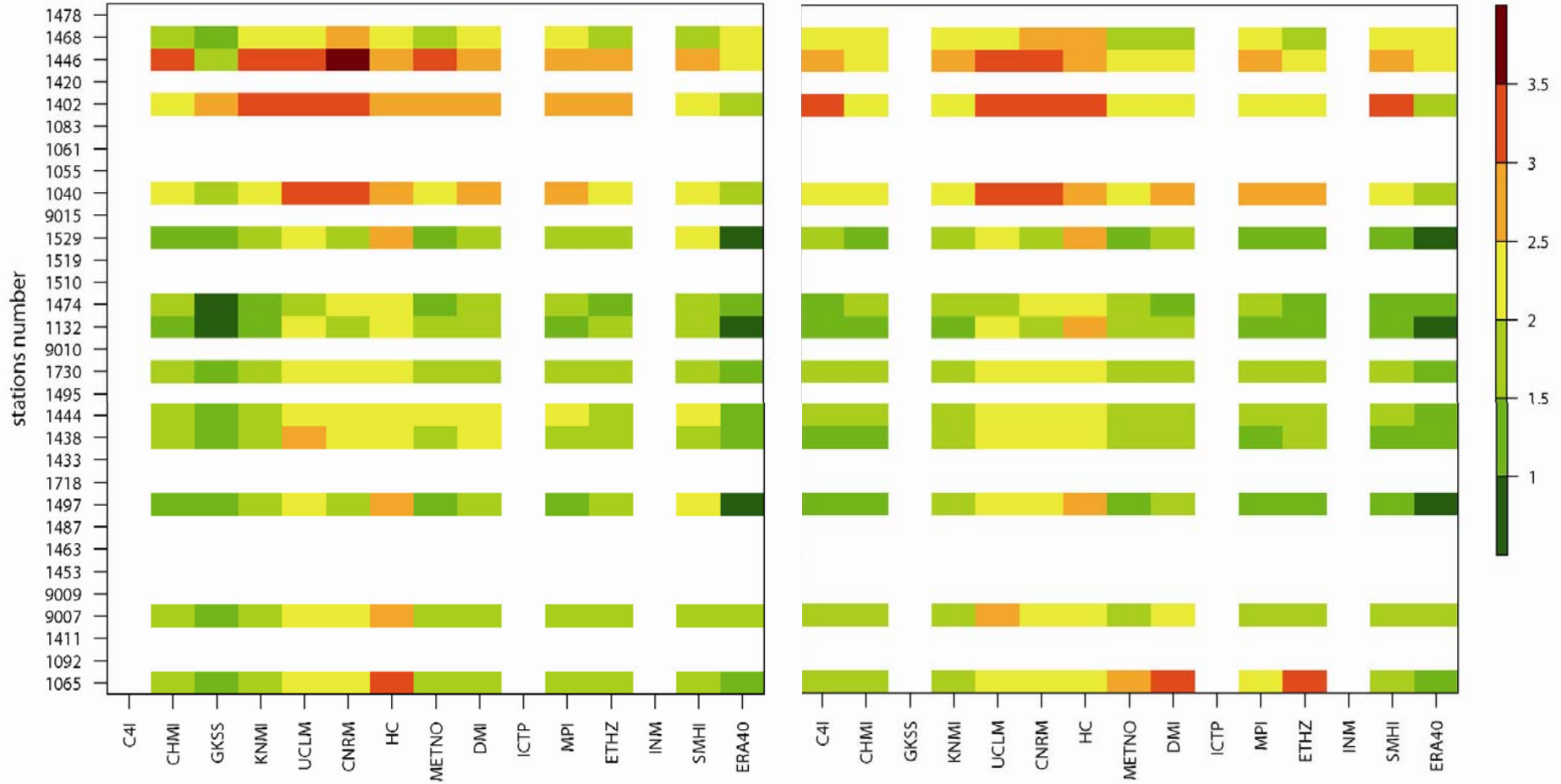


RMSE – root mean squared error

1971-1983

50km

25km

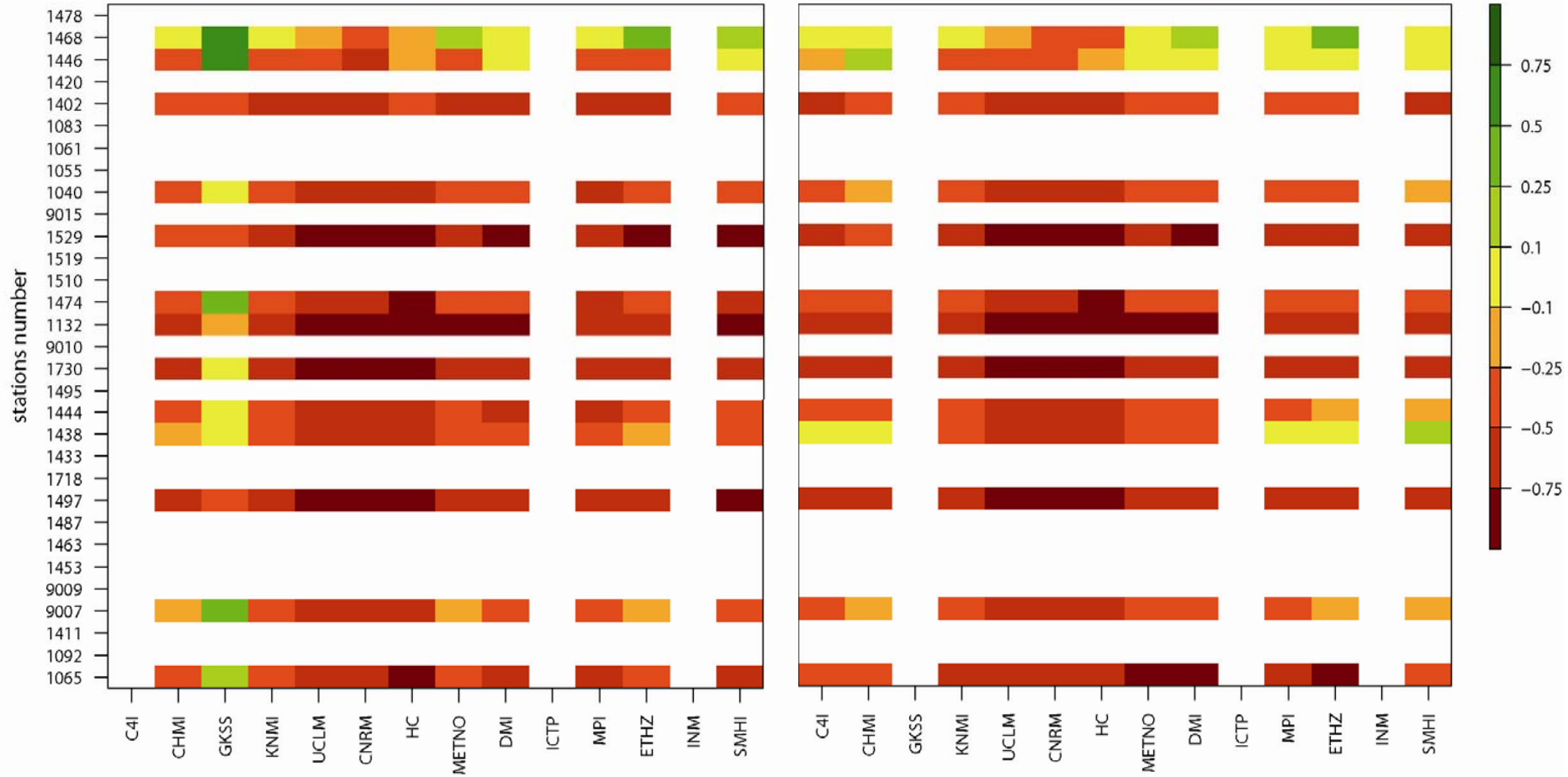


Brier Skill Score

1971-1983

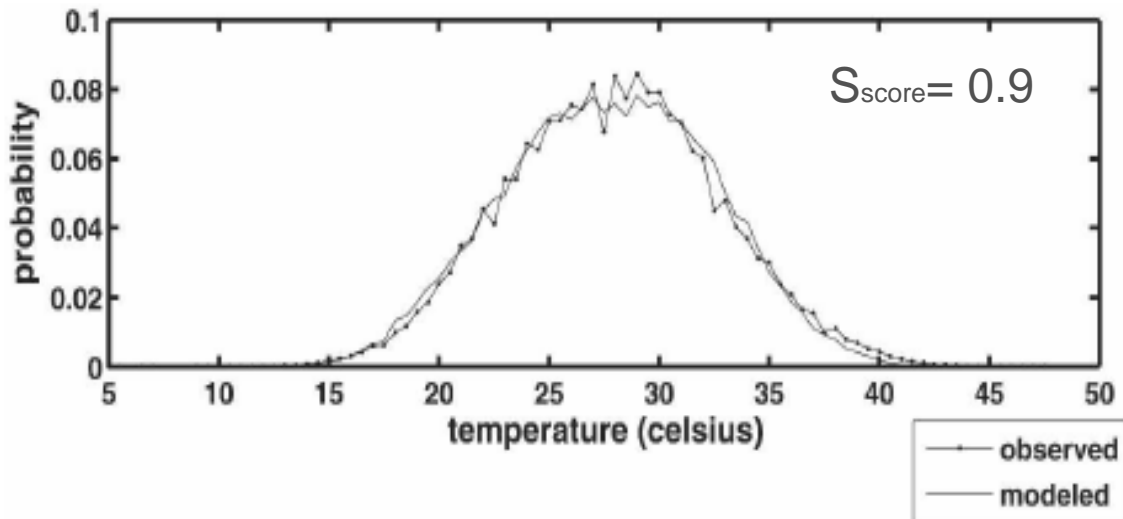
50km

25km

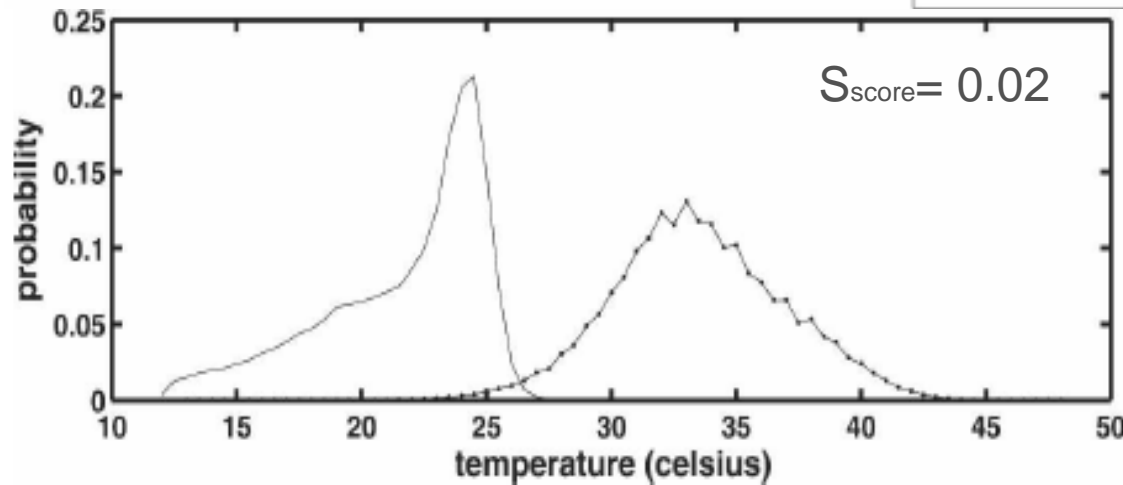


Perkins Score

1971-1983



$$S_{\text{score}} = \sum_1^n \text{minimum}(Z_m, Z_o),$$



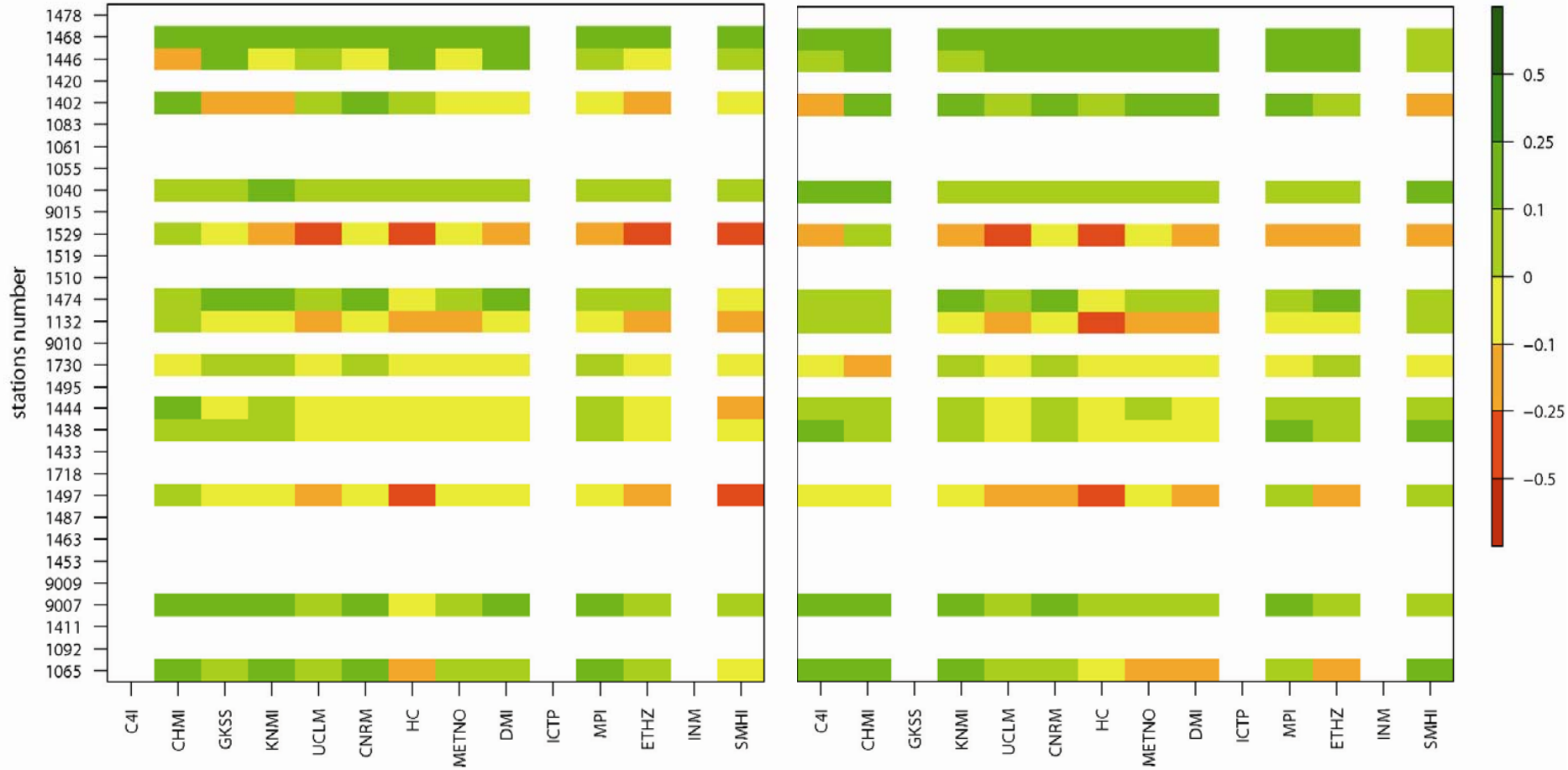
Reference: Perkins S.E. et.al, Evaluation of the AR4 Climate Models' Simulated Daily Maximum Temperature, Minimum Temperature, and Precipitation over Australia Using Probability Density Functions, *J. Clim.*, Vol. 20, pp. 4356–4376, 2007

Perkins Score

1971-1983

50km

25km



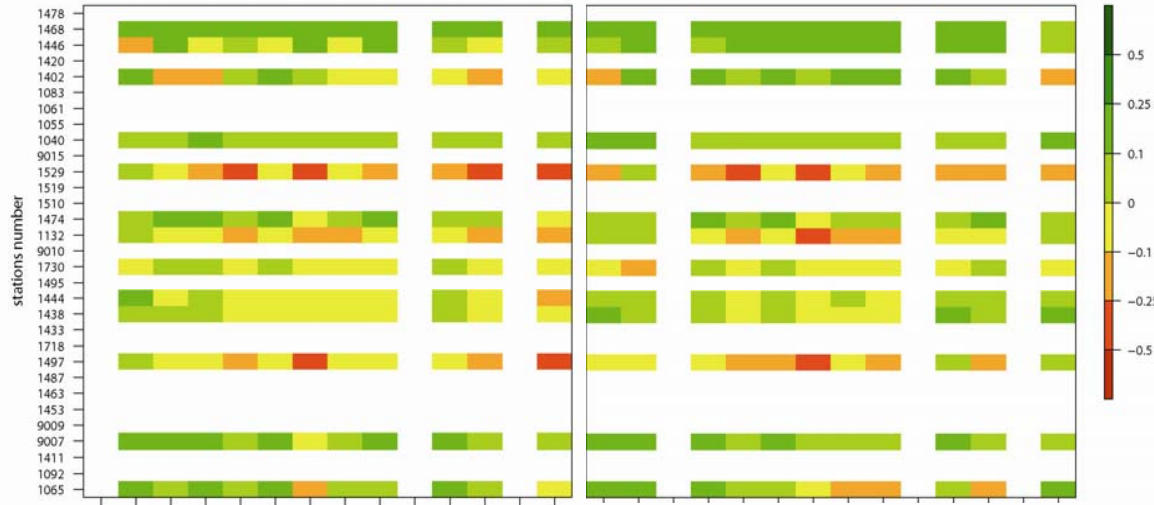
Perkins Score

1971-1983 vs 1971-2000

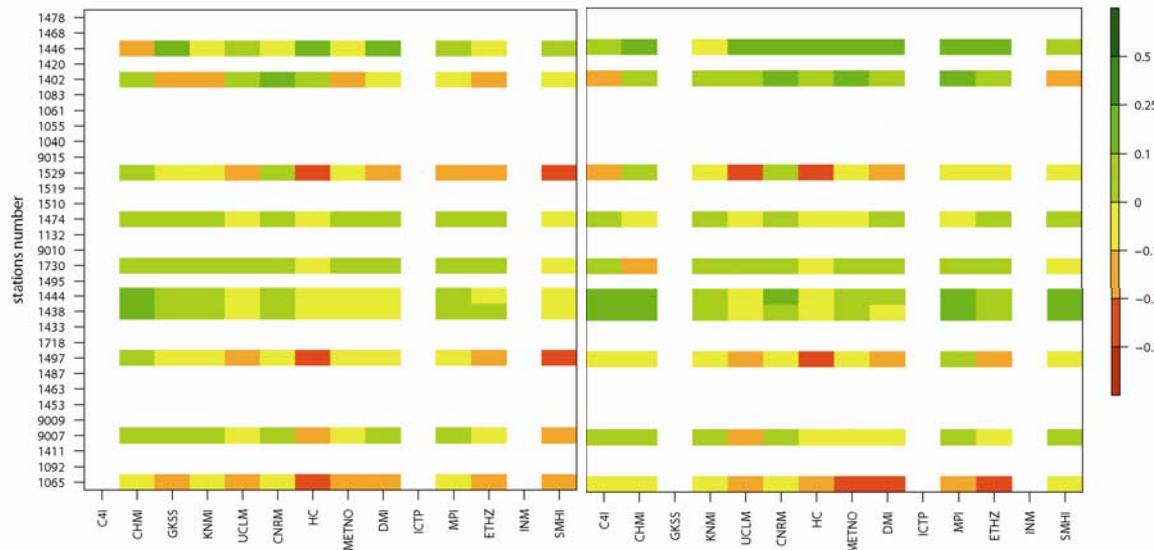
1971-1983

50km

25km



1971-2000



- bias small and most of the year at all stations positive (-1.5 - +1.5 m/s).
- at few stations directly located at the coastline negative bias over the whole year (values down to -2.5 m/s) for almost all models
- all models perform standard deviation quite well and are well correlated with station data (correlation values 0.7 and 0.8, and up to 0.9 using spectral nudging).
- RMSE values between 0.5 and 2 m/s for sites away the coast, higher values up to 3 m/s for the stations at the coastline.
- no distinct additional gain for the simulated wind speeds from grid boxes with the 25km resolution compared to the 50km. BUT REALLY COMPARABLE?
- in quantiles of the models compared to the observation varying for most of the locations with no clear behavior, at stations more than 50km RCM's quantiles fit well with the observed ones
- for the Helgoland island ERA40 reanalysis data underestimate the wind speed over all quantiles, clear added value from all RCMs in the quantiles assessment compared to the ERA40 forcing data.

- several measures and skill scores applied to analyse the RCMs performance compared to the driving field and to evaluate accuracy gain by including higher spatial resolution of the grid cell
- results for bias, RMSE, standard deviation but also for Brier Skill Score and Perkins adapted skill score don't show strong seasonal dependence. (differences can be addressed to the calm summer periods and the stormy autumn and winter months where large scale events are more important than local effects)
- testing the dependency of the results on main circulation pattern (4 main weather regimes)
- high bias at the coastal stations dependent on wind direction ? (hourly output from CLM)

Thank you for your attention!

