UNIVERSITY OF GOTHENBURG

REGIONAL CLIMATE GROUP

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How well do Regional Climate Models simulate and parametrize surface wind speed and wind gust across Scandinavia?

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INTRODUCTION

Ulbrich et al. (2013): In Europe windstorms and extreme wind events cause more than half of the economic loss associated with natural disasters

Ulbrich U., G. C. Leckebush, and M. G. Donat, 2013
Windstorms, the most costly natural hazard in Europe

Nikulin et al. (2011): “Unfortunately there is no available observational database to evaluate the simulated maximum wind gust”

Nikulin et al., 2011
Evaluation and future projections of temperature, precipitation and wind extremes over Europe in an ensemble of regional climate simulations

AIM

Focused on wind conditions across Scandinavia:

- Near-surface wind speed (WS) – daily means
- Daily Peak Wind Gust (DPWG) – *the highest near-surface wind gust speed recorded in 24 hours*

Research questions:

1) What are the observed climatologies of DPWG and WS across Scandinavia?
2) How well do models capture the observed climatologies?

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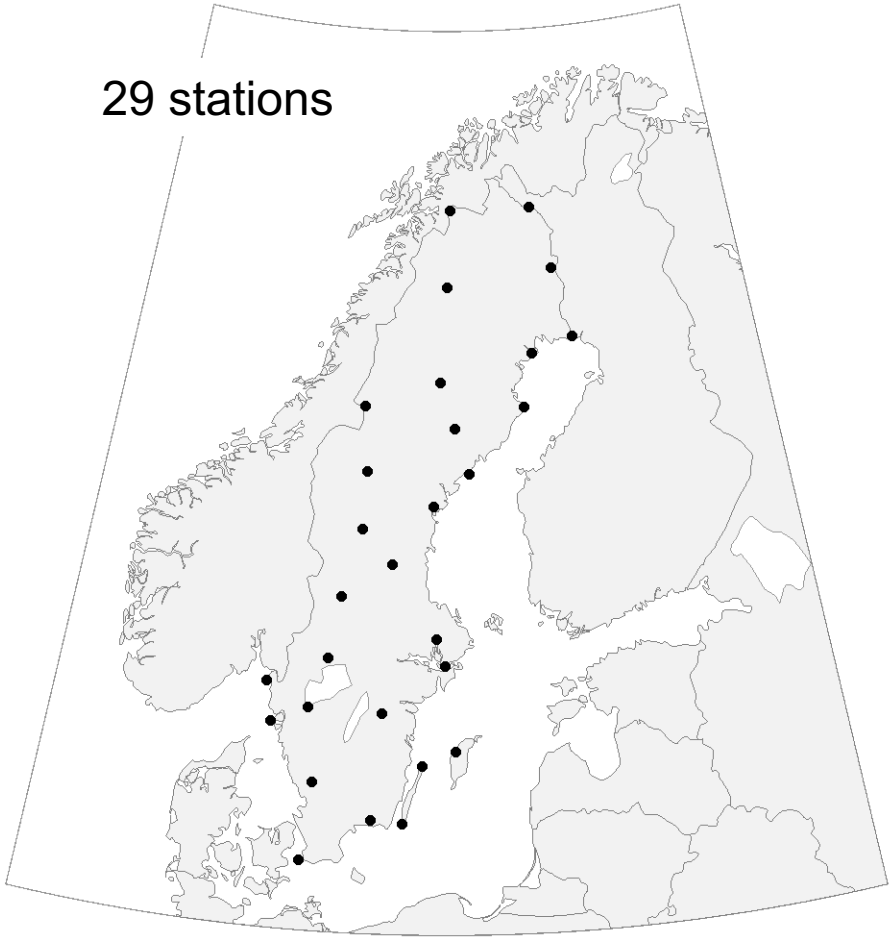
STATION-BASED OBSERVATIONS

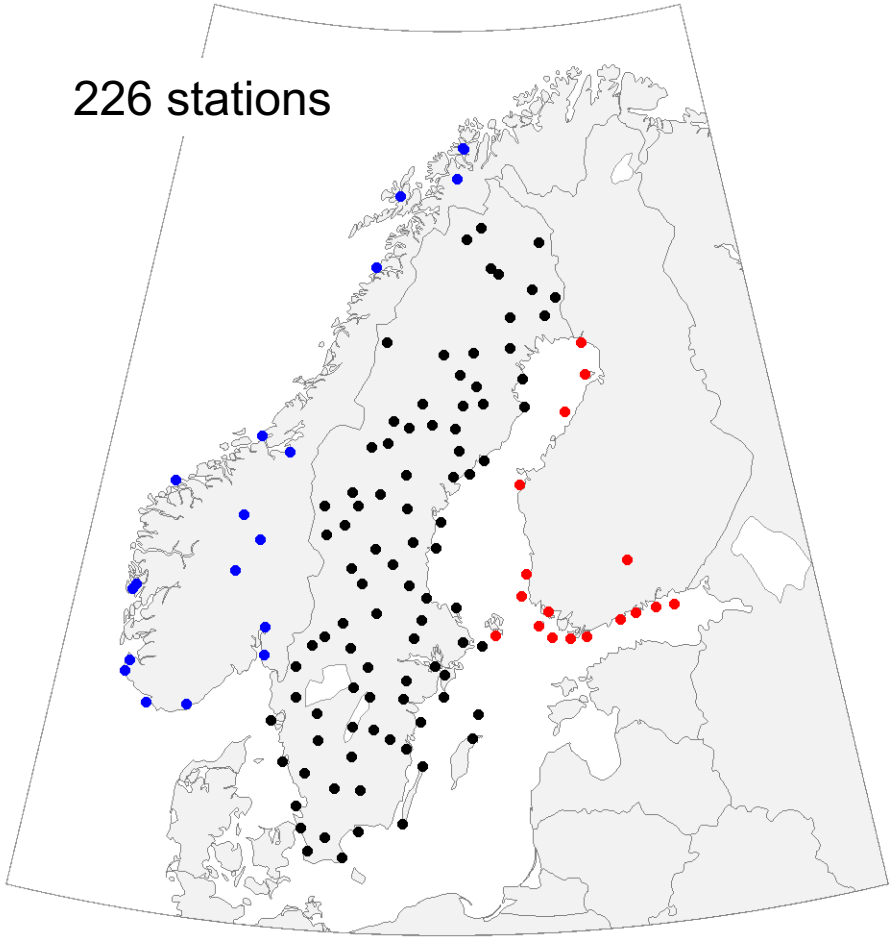
Wind Speed

29 stations



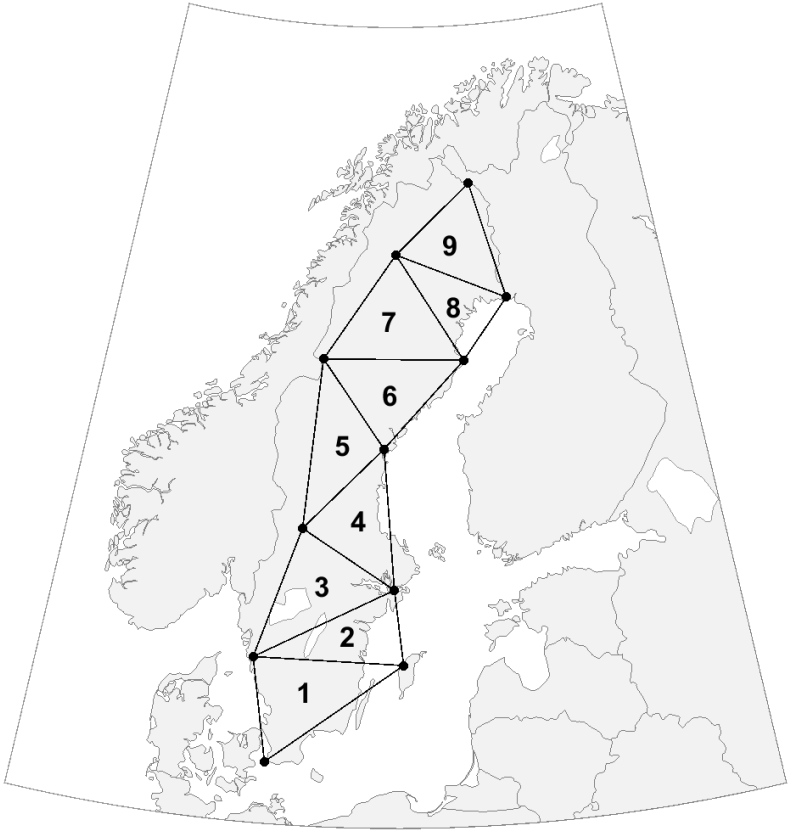
Daily Peak Wind Gust

226 stations



HOMOGENIZATION

Observed series have been corrected from inhomogeneities
(as anemometer height changes, station relocation)
using the **CLIMATOL** package (http://www.climatol.eu/)



Reference series:
Geostrophic wind speed
from observed Sea Level Pressure
triangles as in Minola et al. (2016)

Minola et al., 2016
Homogenization and Assessment of Observed Near-Surface Wind Speed Trends across Sweden,1956–2013

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SIMULATED WS AND DPWG

Simulated WS and DPWG from 2 different RCMs
in the Coordinated Regional Climate Downscaling Experiment (CORDEX)

RCM names	RCA4 and RACMO22E
Domain	EUR-11
Horizontal spatial resolution	0.11 degree, about 12.5 km

RCMs

1) RCA4

2) RACMO22E

Driving models

1) ERAINT

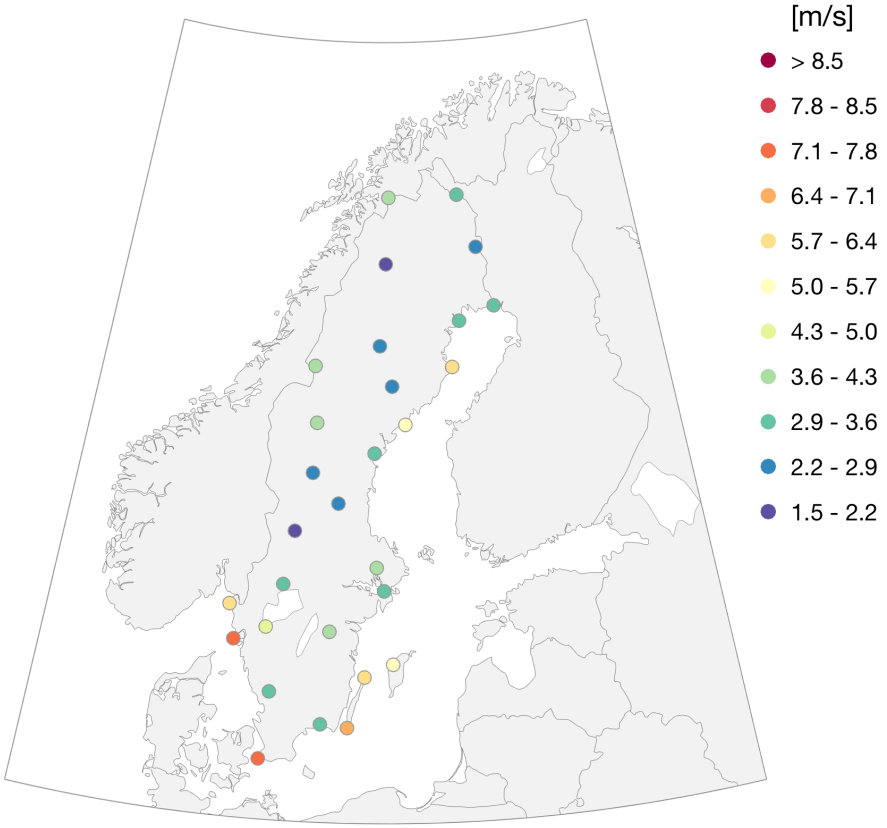
2) ICHEC-EC-EARTH

3) MOCH-HadGEM2-ES

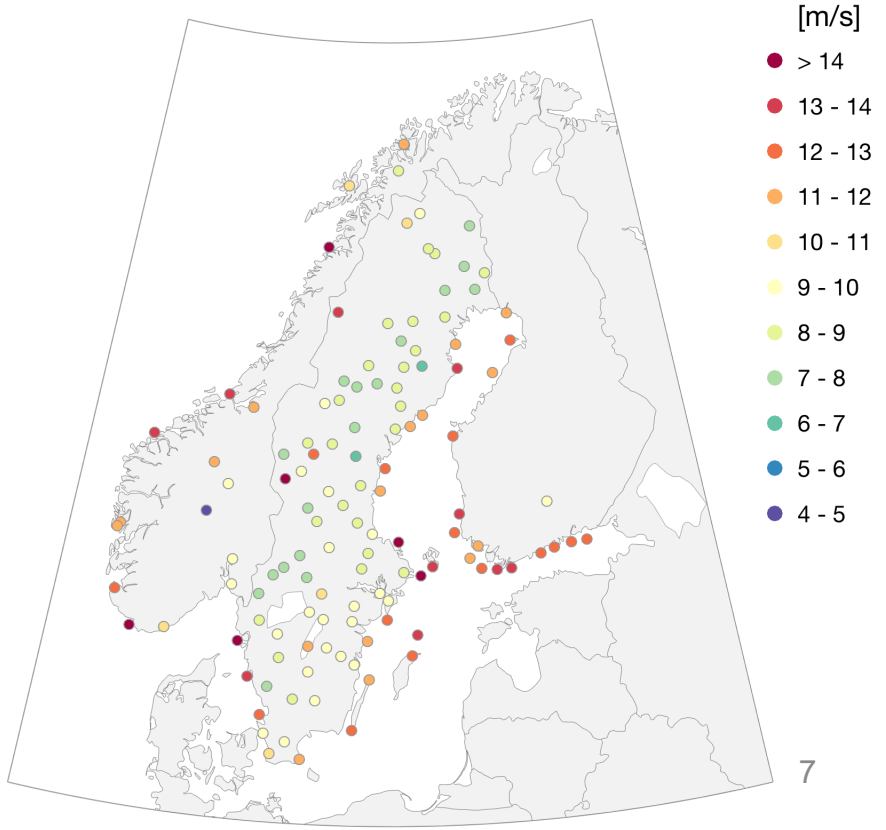
OBSERVED CLIMATOLOGIES

Differences in mean between coastline, inland, and stations across the mountain range of the Scandes

Annual mean Wind Speed 1980-2005

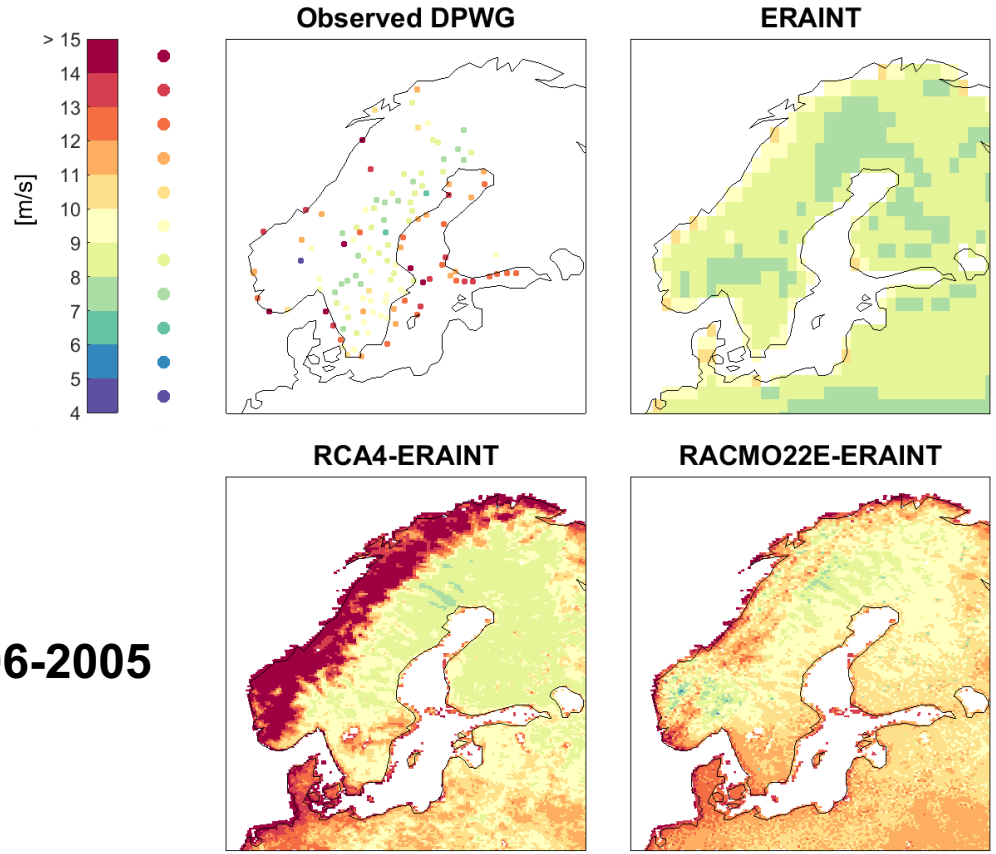


Annual mean Daily Peak Wind Gust 1996-2005



MEAN SIMULATED DPWG

Observations vs RCMs vs driving model



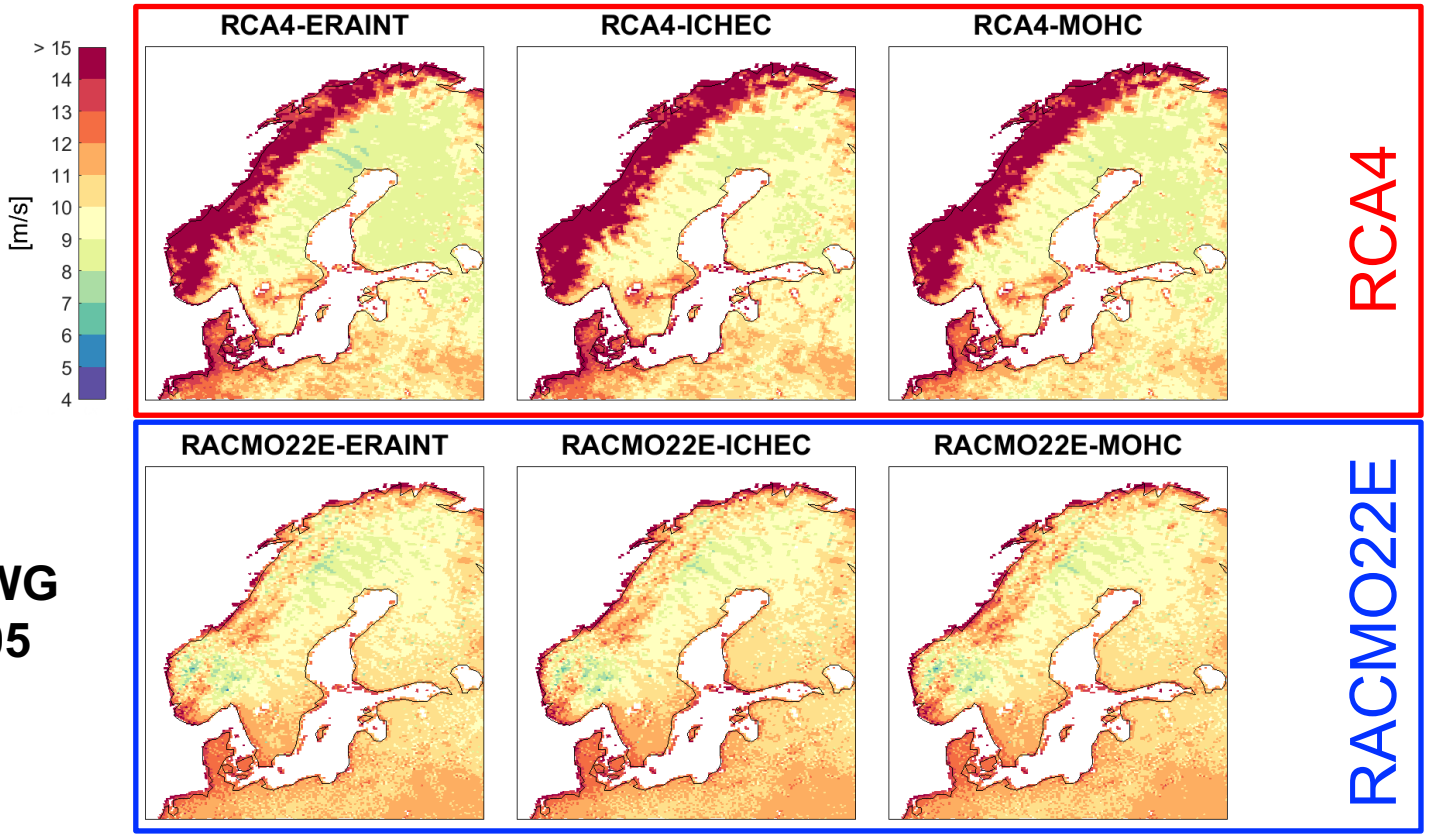
Mean DPWG 1996-2005

Downscaling of RCMs adds value compared to ERAINT

→ coastline differences and DPWG features across complex-topography regions

MEAN SIMULATED DPWG

RCMs with different driving model



Mean DPWG 1996-2005

Practically no differences between the same RCM runs with different driving model

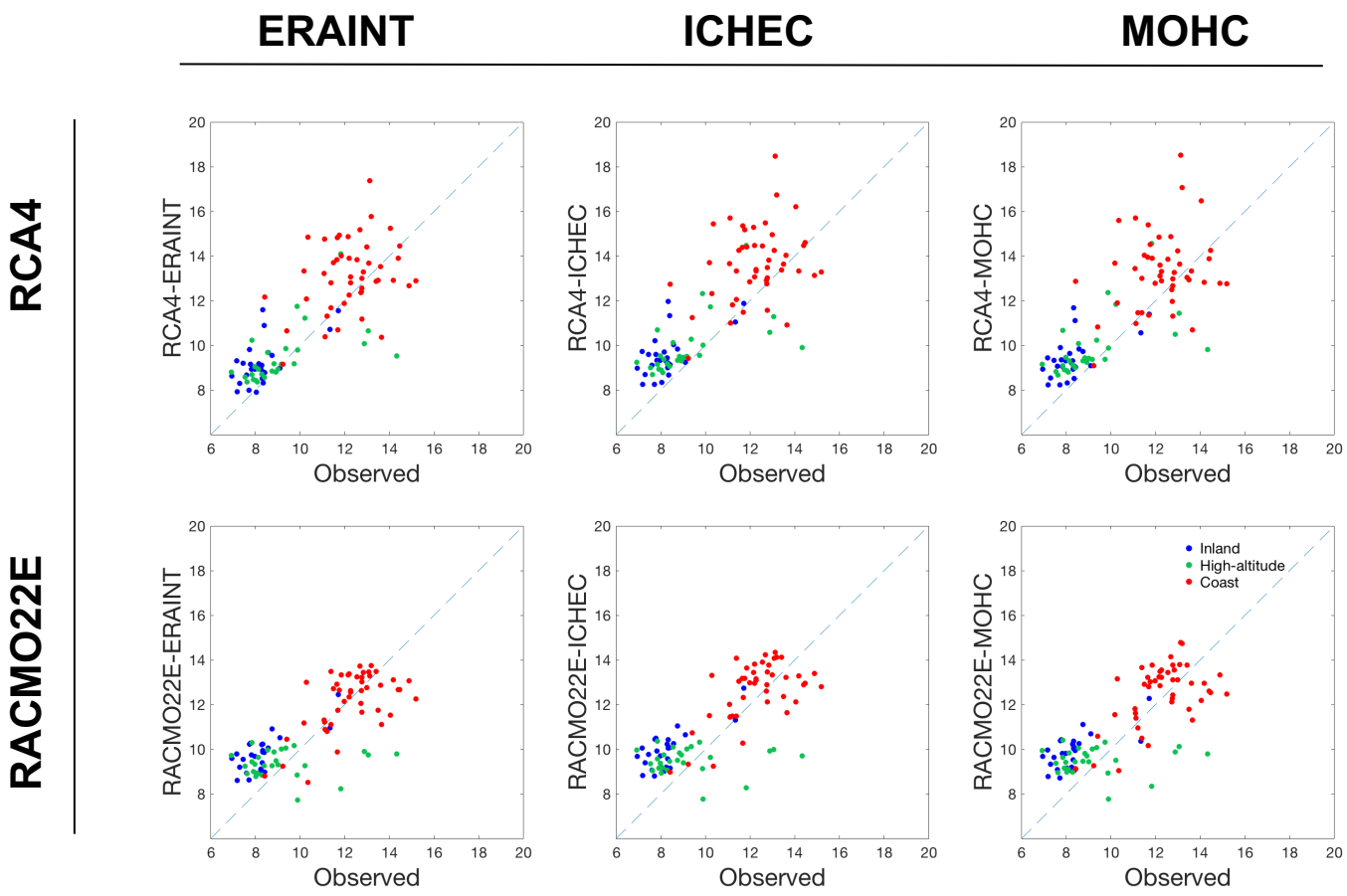
Main differences between the two RCMs

→ **modelled DPWG not sensitive to the driving models**

ANNUAL MEAN DPWG
Observations vs Simulations

Mean DPWG 1996-2005

[unit: m/s]



Location of stations matters!

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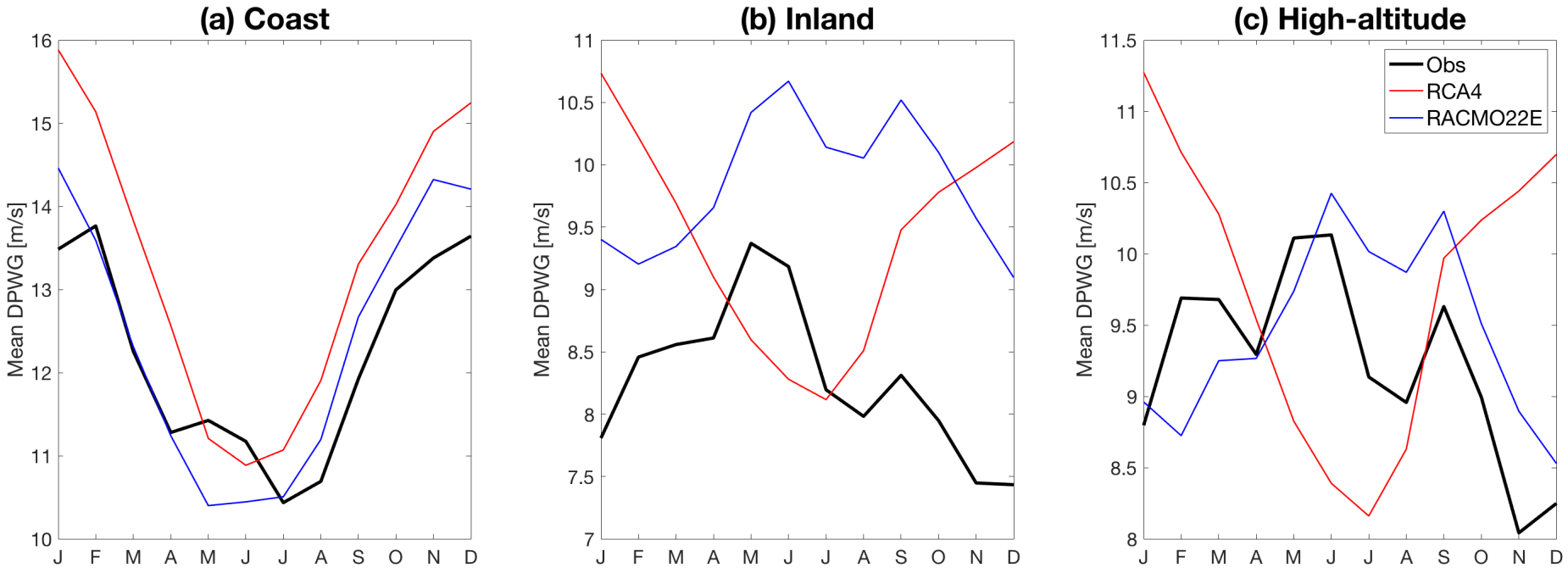
MEAN DPWG SEASONAL CYCLE

Observations vs Simulations

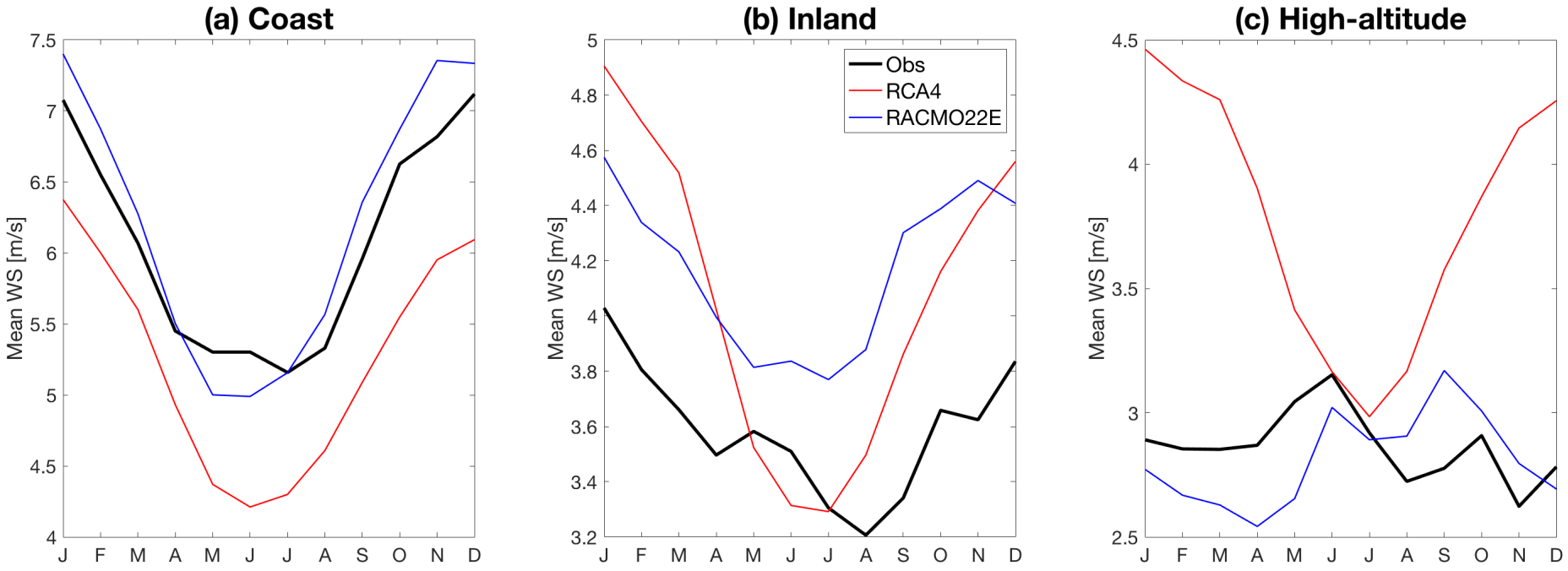
Seasonal cycle for monthly 1996-2005 means



1) Coast → dominated by large-scale circulation OKAY!
2) Inland → processes strongly influenced by land surface NOT OKAY!
3) High-altitude → processes such as localized circulation? NOT OKAY!

MEAN WS SEASONAL CYCLE
Observations vs Simulations

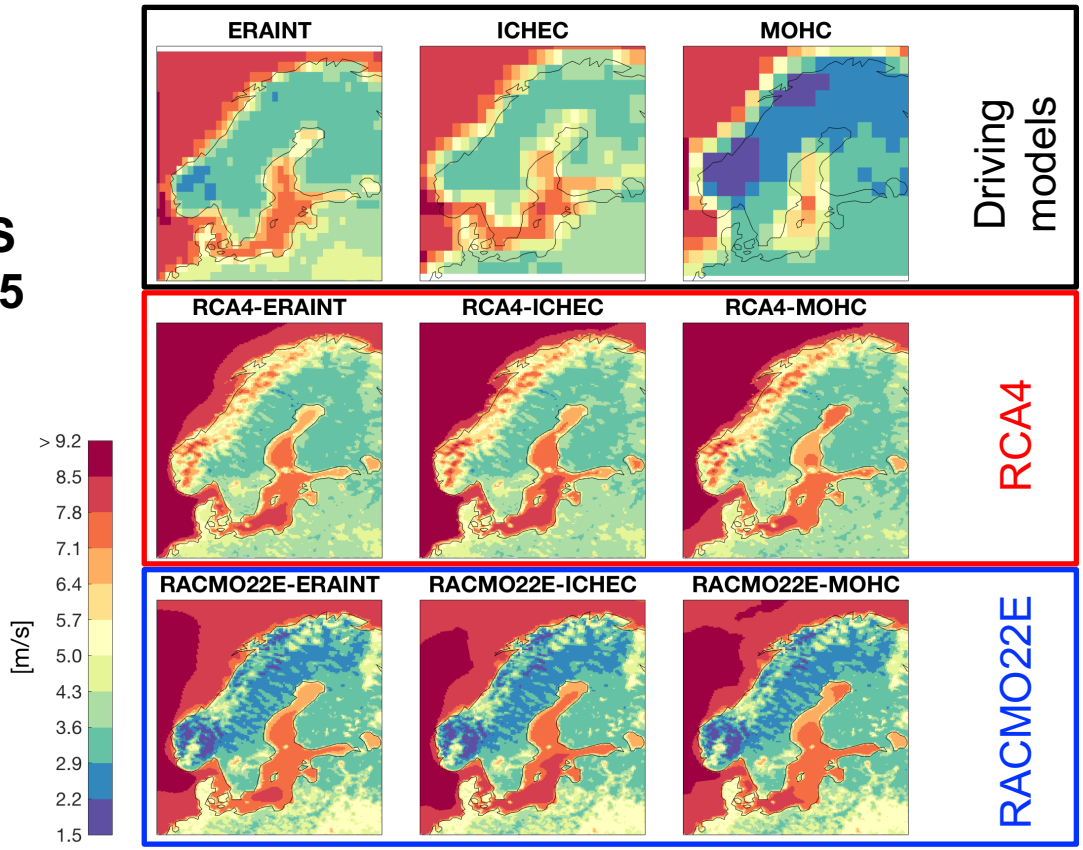
Seasonal cycle for monthly 1980-2005 means



Over land, land surface processes and localized circulation more important than large-scale circulation
→ larger discrepancies between observations and RCMs

MEAN SIMULATED WS
RCMs vs Driving models

Mean WS 1980-2005



- Large-scale circulation features (like land-sea differences and coastline) captured by both RCMs and driving models
- Differences across land, where surface forcing plays a key role

SUMMARY

1) Locations of the stations seem to be the most important factors for WS and DPWG, and it is useful to classify the location in three groups: coast, inland, and high-altitude

2) RCM downscaling is needed to distinguish the three groups and to get much more realistic simulations of wind climatologies compared to their driving models

3) The two RCMs cannot simulate the inland and high-altitude wind climate properly, which calls for a even higher resolution and/or better representations of relevant physical processes

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Thank you!

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