Improvement in the decadal prediction skill of the North Atlantic extratropical winter circulation through increased model resolution | EGU2020-5649 | D3457

Mareike Schuster[1], Jens Grieger[1], Andy Richling[1], Thomas Schartner[2], Sebastian Illing[1], Christopher Kadow[1,5], Wolfgang A. Müller[4], Holger Pohlmann[3,4], Stephan Pfahl[1], and Uwe Ulbrich[1]

1 FU, Berlin | 2 DWD, Stahnsdorf | 3 DWD, Hamburg | 4 MPI-M, Hamburg | 5 DKRZ, Hamburg

mareike.schuster@met.fu-berlin.de

In this study, for the first time an analysis of the <u>direct impact of</u> the model <u>resolution on the skill</u> of decadal climate predictions of extratropical circulation quantities is performed under otherwise unchanged model settings (parametrization and initialization).

Published article (open access):
https://doi.org/10.5194/esd-10-901-2019

Related EGU Display:

'Representation of the extratropical circulation in the MiKlip decadal prediction system - impacts of resolution and initialization' | EGU2020-16638

Freie Universität Berlin

EGU General Assembly 2020

Objective

Previous studies show:
A coarse spatial resolution of GCMs hinders the proper representation of sub-synoptic-scale systems and thus the climate mean state and variability.

Common features of GCMs with coarse resolution are a storm track that is too zonal (stronger geopotential height gradients in the midlatitudes, increased westerlies) and reduced blocking frequencies over Europe.

Therefore, we analyze a higher resolution (HR) model and assess the impact of the increase in resolution on the representation and decadal prediction skill of the extratropical circulation.

Model

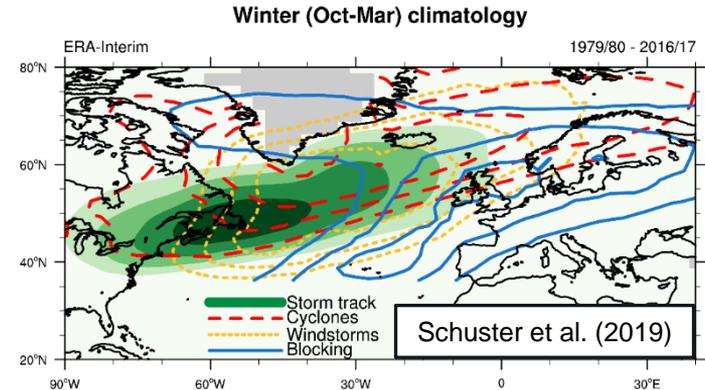|	LR	HR
model	MPI-ESM	
atmosphere (ECHAM6.3)	T63 L47 (~1.8°)	T127 L95 (~0.9°)
ocean (MPI-OM1.6.2)	1.5° L40	0.4° L40
initialization atm.	full field (ERA40, ERA-Int)	
initialization ocean	anomaly (ORAS4, NSICD)	
forcing	CMIP5 external forcing (greenhouse gases, aerosols)	

We analyze: 5 members each;
hindcast period 1978-2012;
winters 2–5 after the initialization.

Methodology

extratropical circulation
1. Storm track
2. Cyclones
3. Windstorms
4. Blocking

Winter (Oct-Mar) climatology

ERA-Interim   1979/80 - 2016/17

Storm track
Cyclones
Windstorms
Blocking

Schuster et al. (2019)

Effect of the resolution on
decadal hindcast skill: next slide

Effect of resolution & initialization on
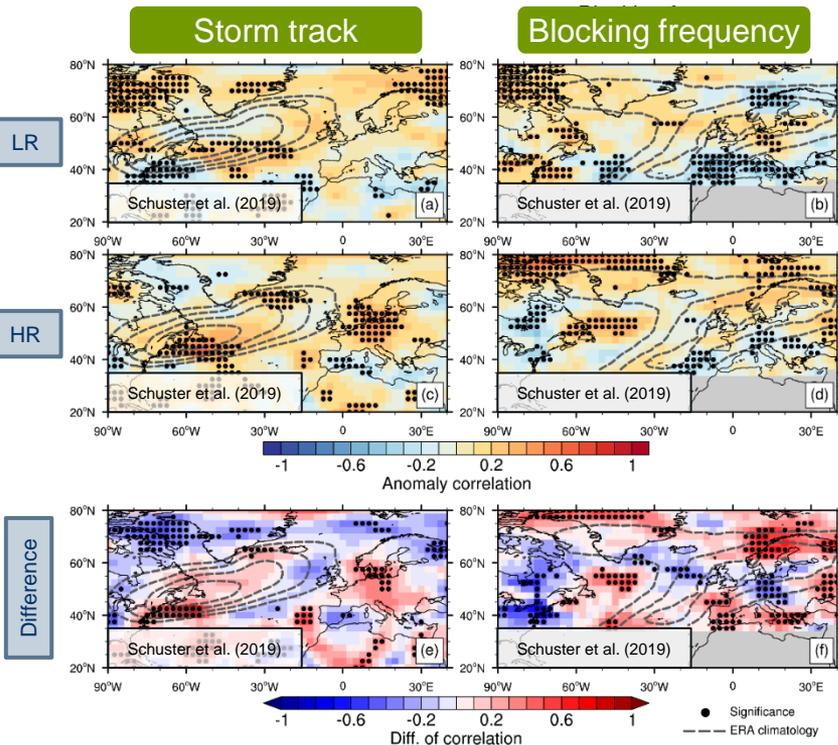**model bias**: EGU2020-16638 (Mon, 16:15)

Decadal prediction skill

The decadal prediction skill significantly improves in the HR version for all four quantities.

The increase in the model resolution leads to **an improvement of the midlatitude dynamics** in the North Atlantic region **for both**, the mean state (**climatology**) and the temporal variability (**decadal prediction skill**) for the different extratropical circulation metrics.

The **areas of improved forecast skill are crucial regions for the genesis and intensification of synoptic weather systems** over the North Atlantic and for their impact on Europe:

-   a significant improvement of the *storm track* skill along the North Atlantic Current (i.e., the source region of synoptic eddies),
-   a downstream improvement of the *cyclone frequency* skill over the central North Atlantic (where the synoptic systems intensify),
-   and finally improved skill of the *cyclone, windstorm and blocking frequencies* over the European continent (i.e., the impact area).

Not only does the prediction skill improve with a finer resolution (HR vs. LR), but the HR system itself also **offers significant deterministic decadal forecast skill**.

Decadal prediction skill

The decadal prediction skill significantly improves in the HR version for all four quantities.

Cyclone frequency | Windstorm frequency

LR · HR · Difference

Schuster et al. (2019)

Anomaly correlation

Diff. of correlation

- Significance
- -- ERA climatology

The increase in the model resolution leads to **an improvement of the midlatitude dynamics** in the North Atlantic region **for both**, the mean state (**climatology**) and the temporal variability (**decadal prediction skill**) for the different extratropical circulation metrics.

The **areas of improved forecast skill are crucial regions for the genesis and intensification of synoptic weather systems** over the North Atlantic and for their impact on Europe:

- a significant improvement of the *storm track* skill along the North Atlantic Current (i.e., the source region of synoptic eddies),
- a downstream improvement of the *cyclone frequency* skill over the central North Atlantic (where the synoptic systems intensify),
- and finally improved skill of the *cyclone, windstorm and blocking frequencies* over the European continent (i.e., the impact area).

Not only does the prediction skill improve with a finer resolution (HR vs. LR), but the HR system itself also **offers significant deterministic decadal forecast skill**.