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

Jens Grieger[1], Mareike Schuster[1], Christopher Kadow[1,2], Andy Richling[1] and Uwe Ulbrich[1]

1 FU, Berlin | 2 DKRZ, Hamburg

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

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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

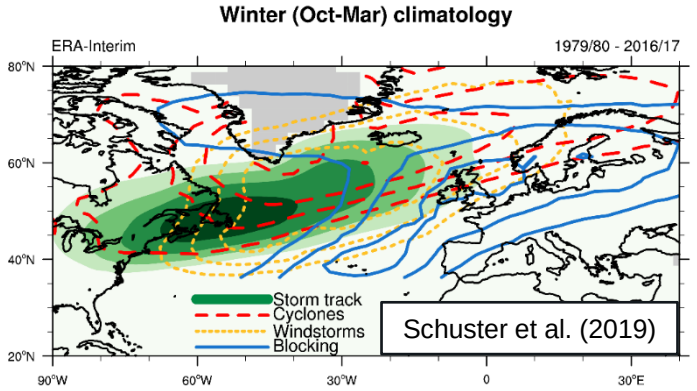
	LR	HR
model	MPI-ESM	
atmosphere (ECHAM6.3)	T63 L47 (~1.8°)	T127 L95 (~0.9°)
ocean (MPI-OM1.6.2)	1.5° L40	0.4° L40
initialization atm.	full field (ERA40, ERA-Int)	
initialization ocean	anomaly (ORAS4, NSICD)	
forcing	CMIP5 external forcing (greenhouse gases, aerosols)	

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

Methodology

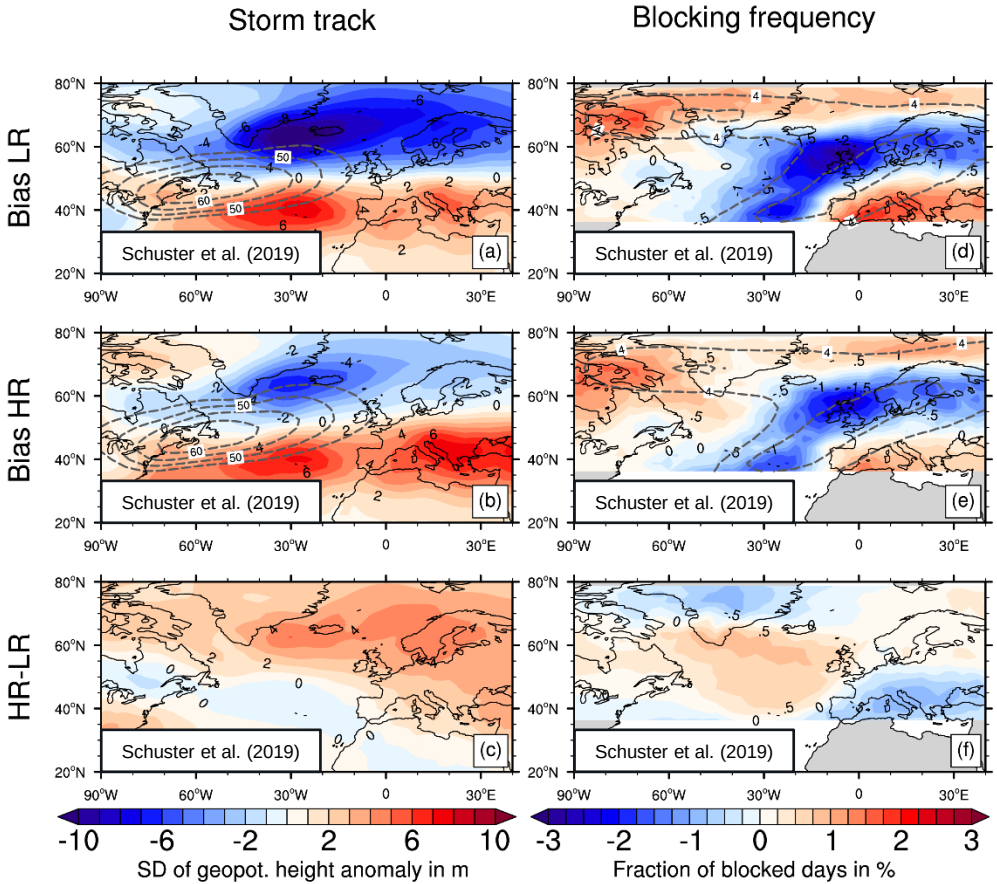
extratropical circulation

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



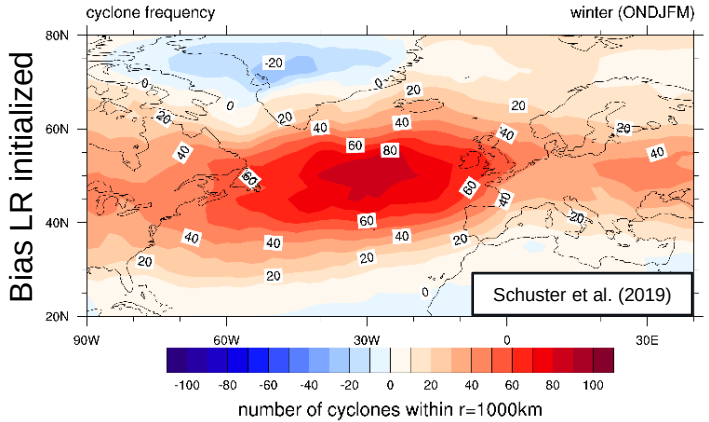
Effect of the resolution on **decadal hindcast skill**: EGU2020-5649 (Wed, 8:30)

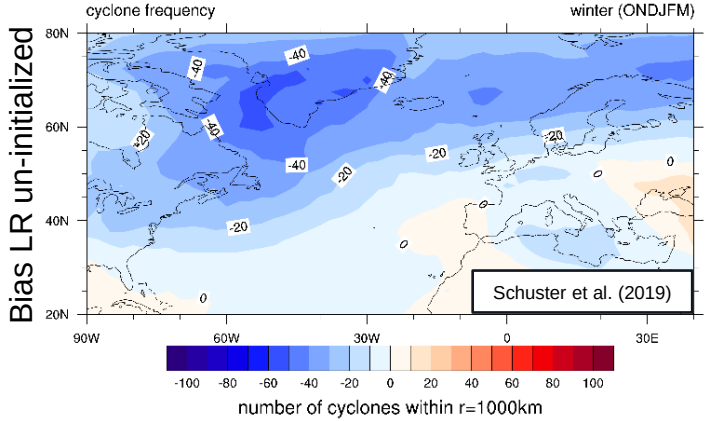
Effect of resolution & initialization on **model bias**: next slide



While **LR shows common deficits** in the climatological representation in both the initialized prediction system (top row) and the uninitialized historical projection (not shown), e.g. an overly zonal extratropical storm track and a deficit in blocking frequencies over the North Atlantic and Europe, the higher resolution version **HR counteracts these biases.**

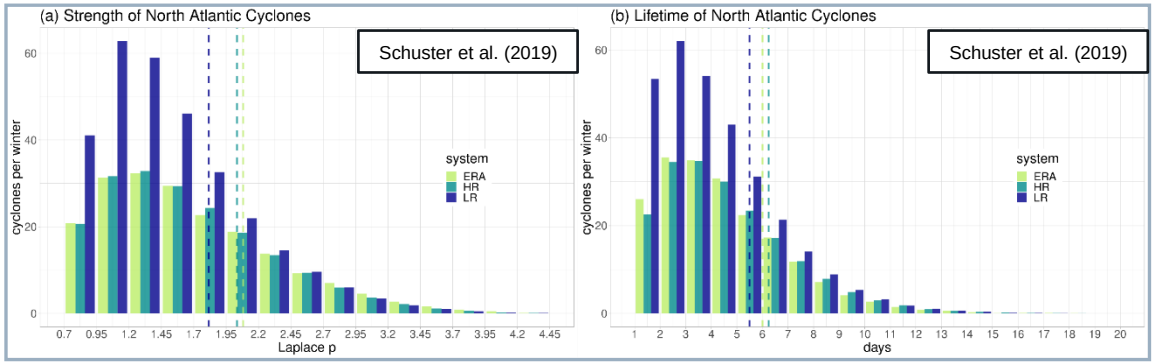
Cyclone frequency

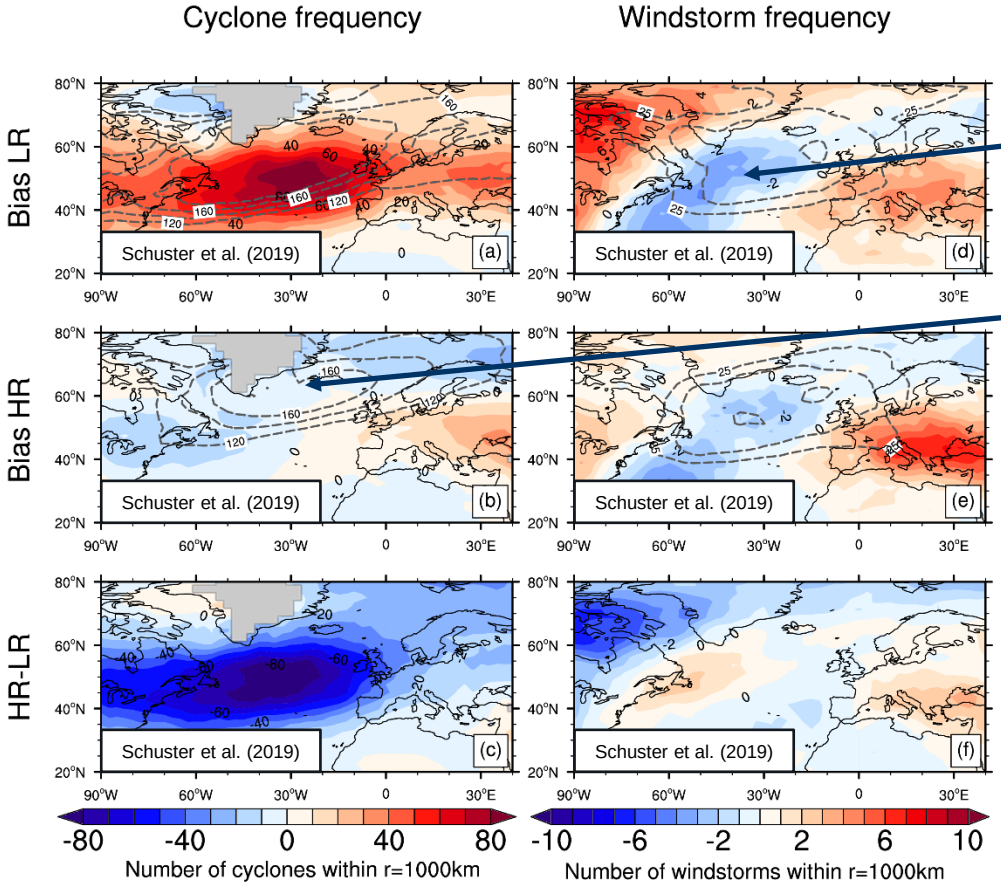




The initialized **LR** prediction system (top left) largely **overestimates NA cyclone frequency**, which is not the case for the uninitialized LR counterpart (bottom left).

This positive bias is mainly **due to weak and short-lived systems** (bottom) and is an effect of the initialization in the LR prediction system.





Similar biases **cannot be identified in the windstorm frequency** which implies that the short-lived cyclones are low of impact with respect to wind speed.

The initialization effect leading to an overestimation of weak and short-lived cyclones **cannot be found in the HR** version.

The overall better representation of the extratropical circulation in the HR version leads to an **increased decadal prediction skill**, which is measured in terms of anomaly correlation, with the increase in resolution for all four quantities. | **EGU2020-5649** (Wed, 8:30)