High Latitude Dynamics workshop
Rosendal, 23-27 March 2015

The high resolution in seasonal climate predictions with EC-Earth

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IC3 R

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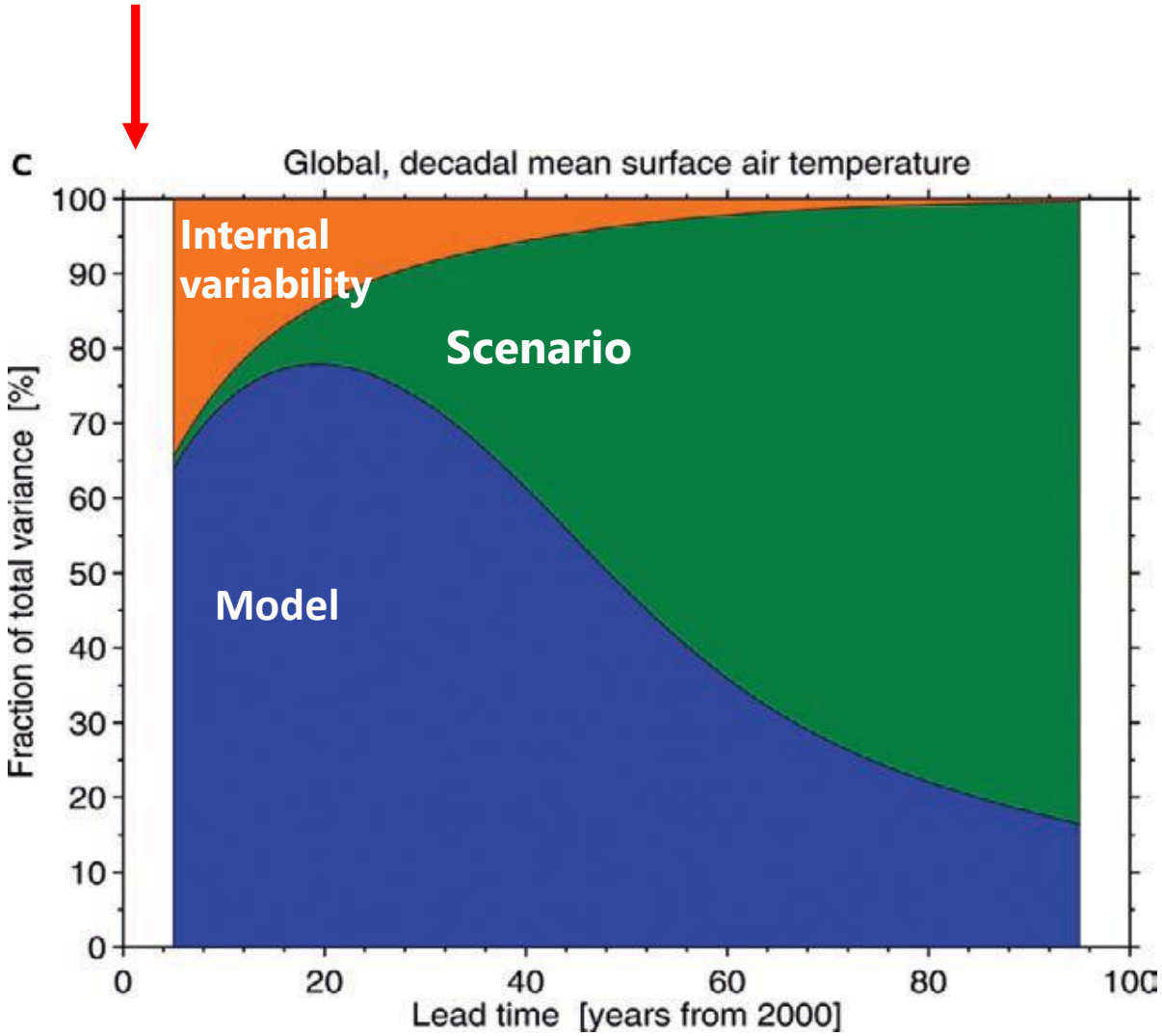
Skillful **seasonal** predictions rely on
« good » initial conditions and
« good » models



The fraction of total variance in decadal mean surface air temperature predictions explained by the three components of total uncertainty (Adapted from *Hawkins and Sutton, BAMS, 2009*)

Where to invest computational resources is an ubiquitous question in seasonal prediction

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

Phil. Trans. R. Soc. A (2012) **370**, 1087–1099
doi:10.1098/rsta.2011.0307

Model complexity versus ensemble size: allocating resources for climate prediction

By Christopher A. T. Ferro[1,2,*], Tim E. Jupp[2], F. Hugo Lambert[2], Chris Huntingford[3] and Peter M. Cox[2]

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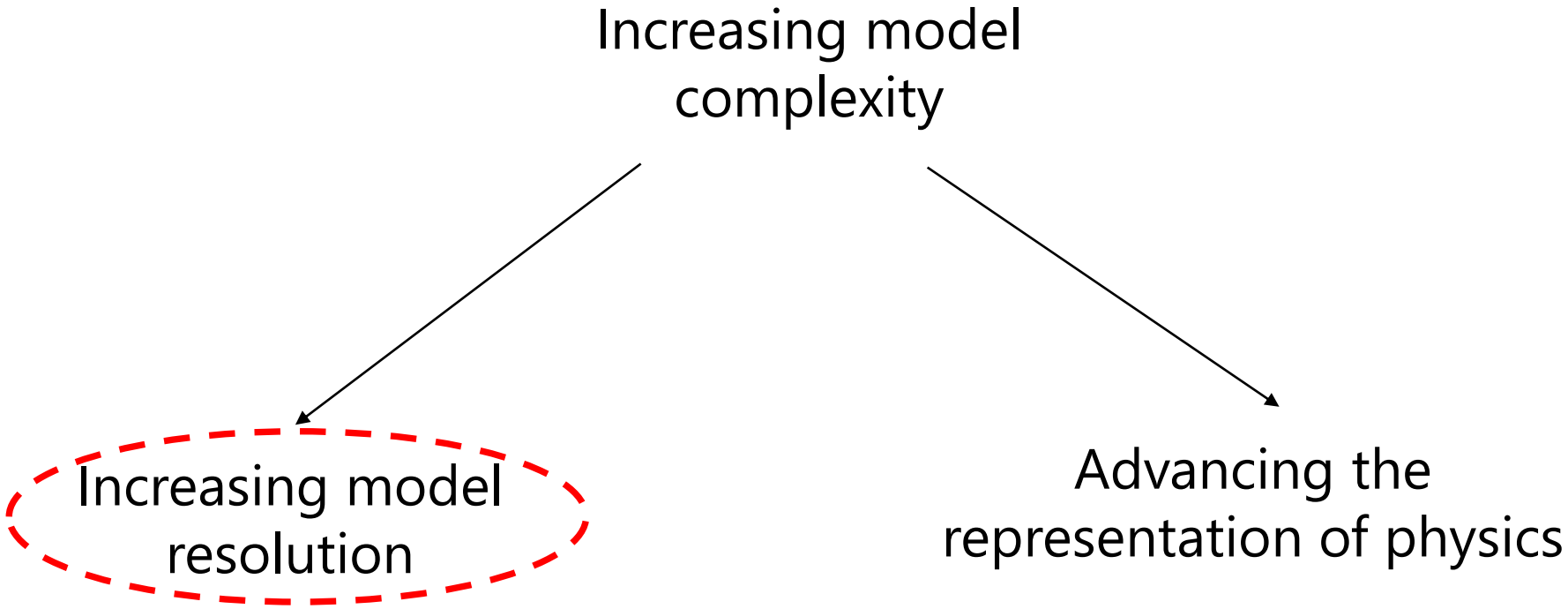
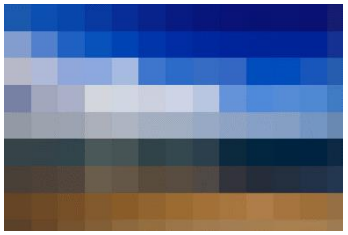


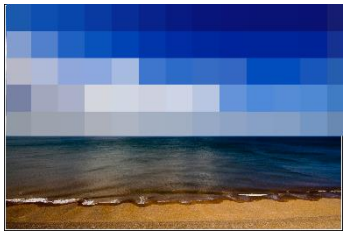
PRIMAVERA H2020 project:
PRocess-based climate s**IM**ulation: **A**d**V**ances in high-resolution modelling and **E**uropean climate **R**isk **A**ssessment

At high latitudes, what is the pure sensitivity of a GCM to increased resolution?

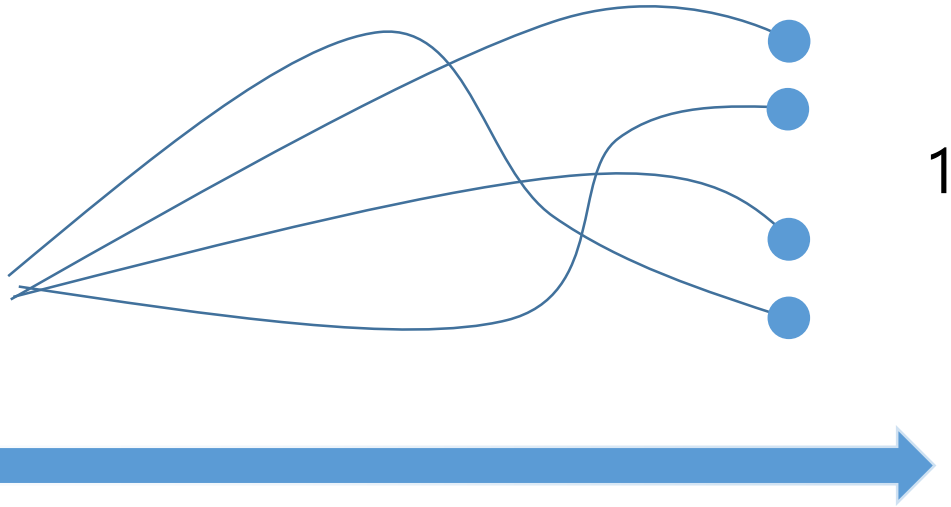
Low (T255/ORCA1)



Mixed (T255/ORCA025)



High (T511/ORCA025)



10 members

1993-2009: 17 seasonal experiments, initialized in May or November (4-month predictions)

1. Systematic model biases

2. Seasonal prediction skill

3. Ensemble spread

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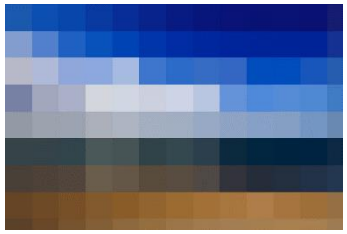
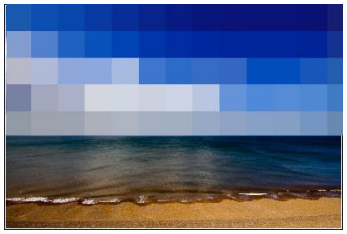
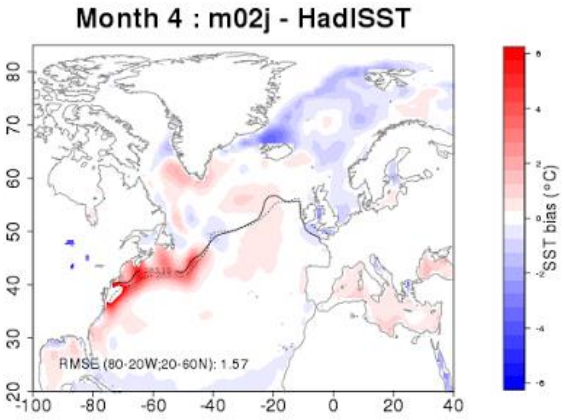
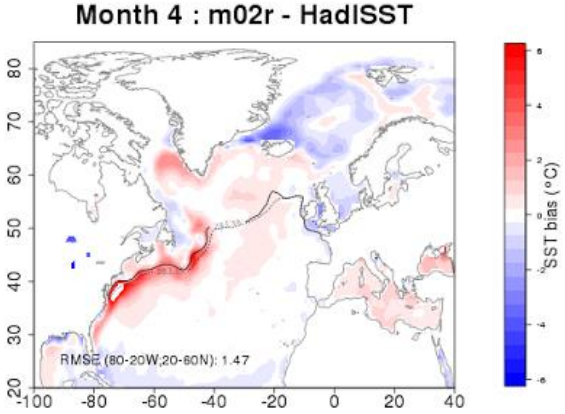
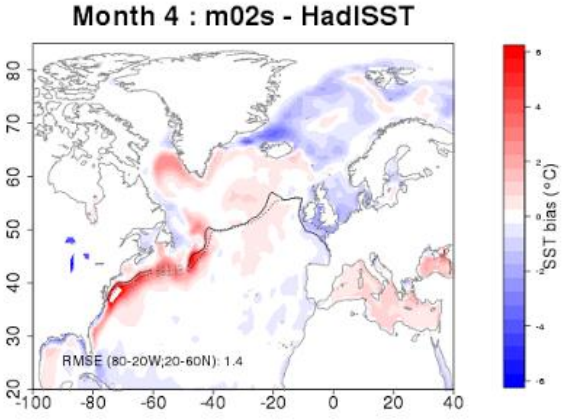
Bias in SST prediction: very slight reductions











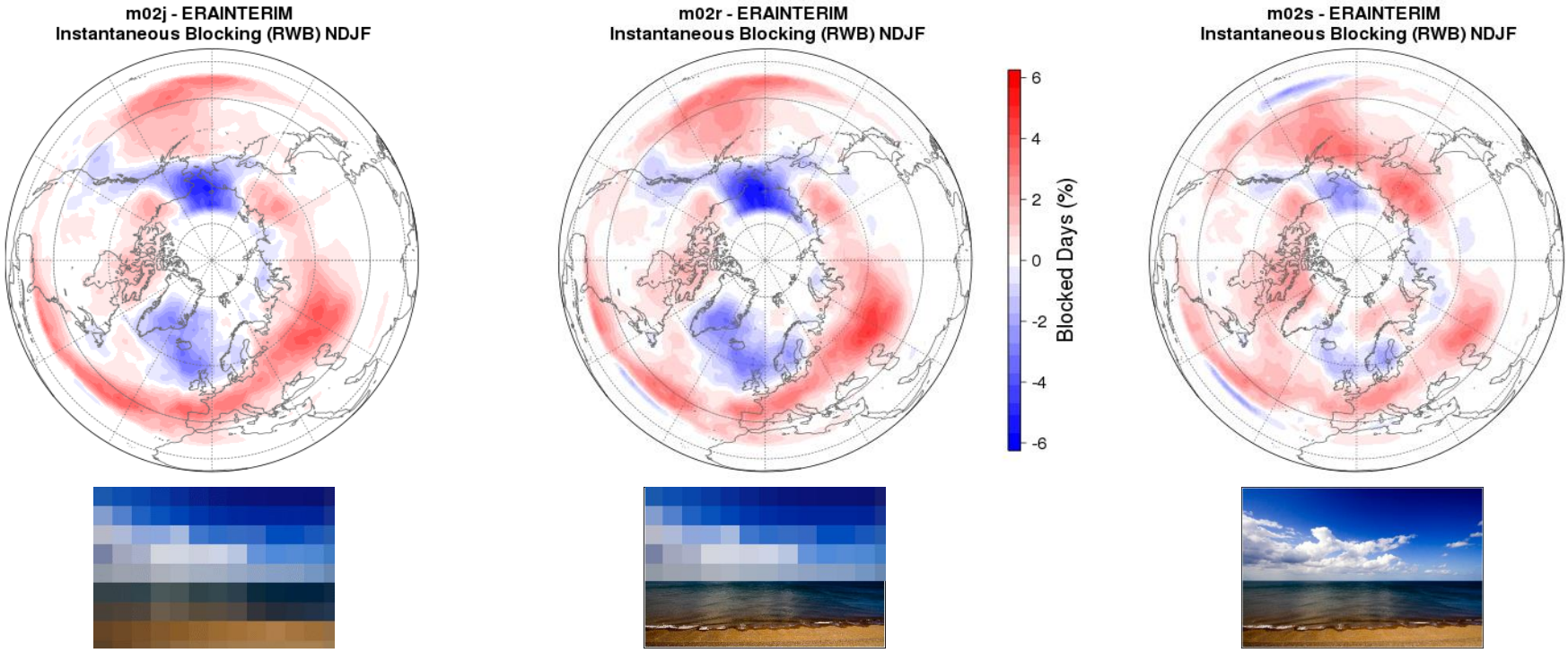
RMSE: 1.57°C

RMSE: 1.47°C

RMSE: 1.40°C

Bias in blocking index is reduced when both atmospheric and oceanic resolutions are increased

Blocking index is here defined as in Davini et al., 2011, J. Clim.



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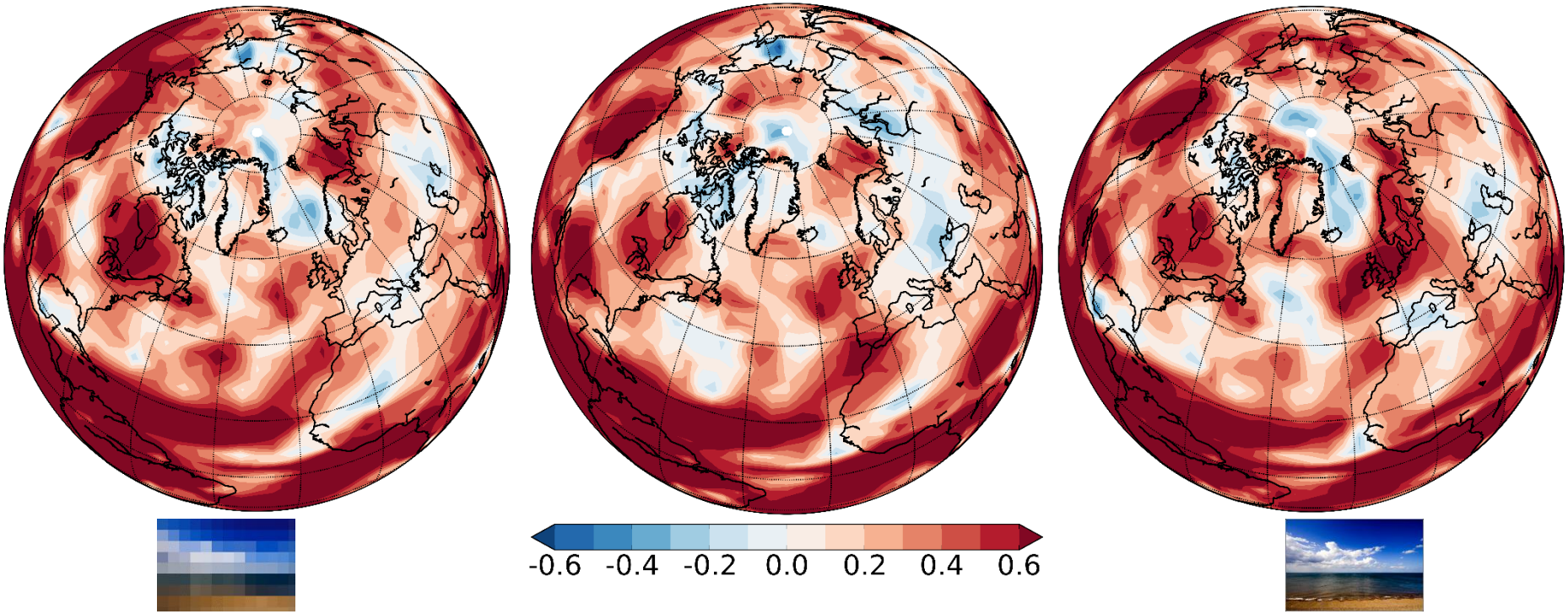
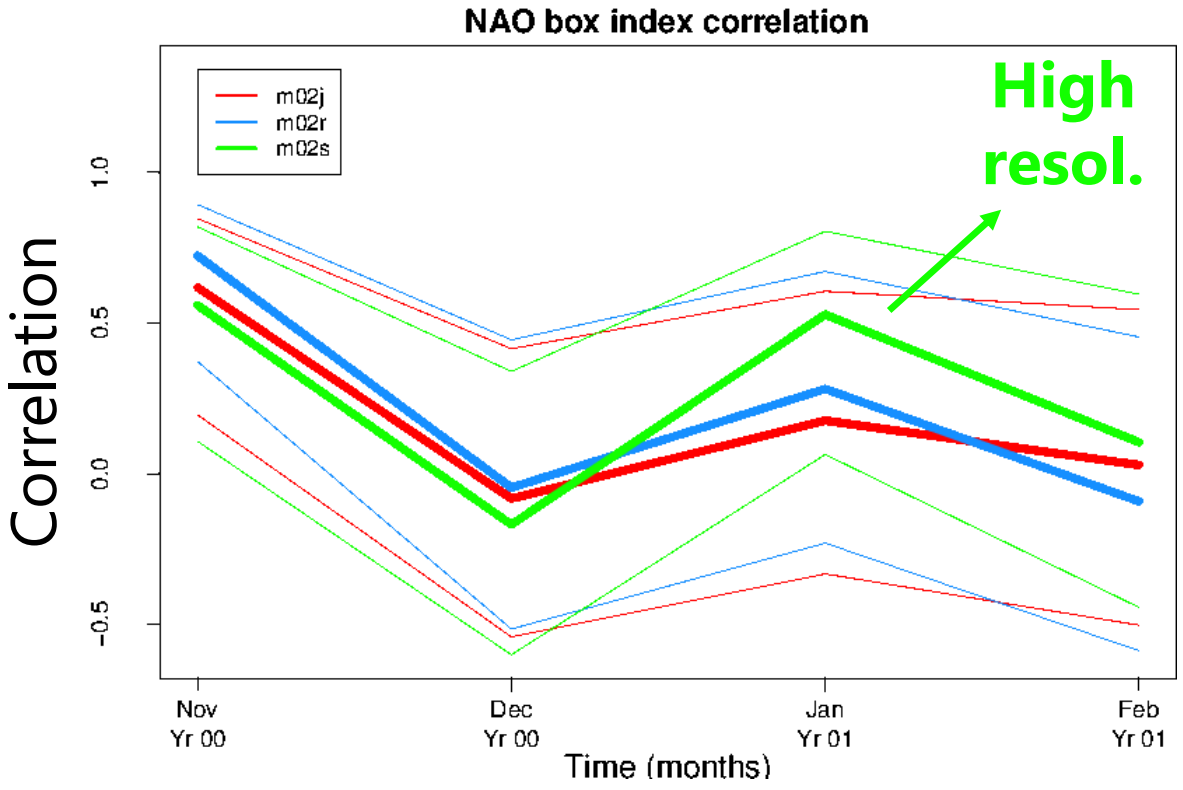
Higher oceanic AND atmospheric resolutions are necessary to increase the 2-m temperature skill in Europe

Correlation (1993-2009, detrended) of DJF 2-m temperatures of EC-Earth with ERA-Interim

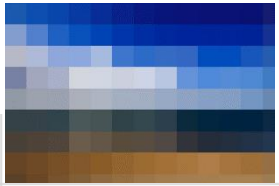


Little improvements in NAO skill, but these do not clearly emerge from noise



Sampling internal variability with many members could help discern differences (e.g., Scaife et al., GRL, 2014)

Detrended correlations of simulated and observed sea ice extent

				
AUGUST	**Arctic**	0,52	0,56	0,55
	Barents	0,55	0,76	0,63
	Antarctic	0,39	0,38	0,42
	Amundsen	0,62	0,55	0,57
	Ross	0,68	0,60	0,68
	Weddell	-0,11	0,01	0,02
FEBRUARY	**Arctic**	0,67	0,73	0,70
	Barents	0,53	0,56	0,52
	Antarctic	0,62	0,66	0,70
	Amundsen	0,49	0,62	0,61
	Ross	0,70	0,77	0,71
	Weddell	0,53	0,54	0,59

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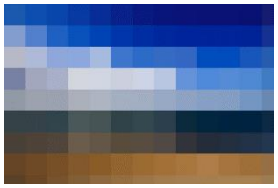
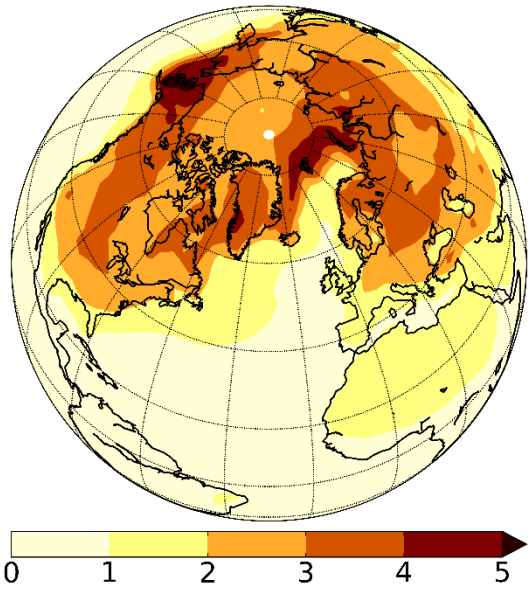
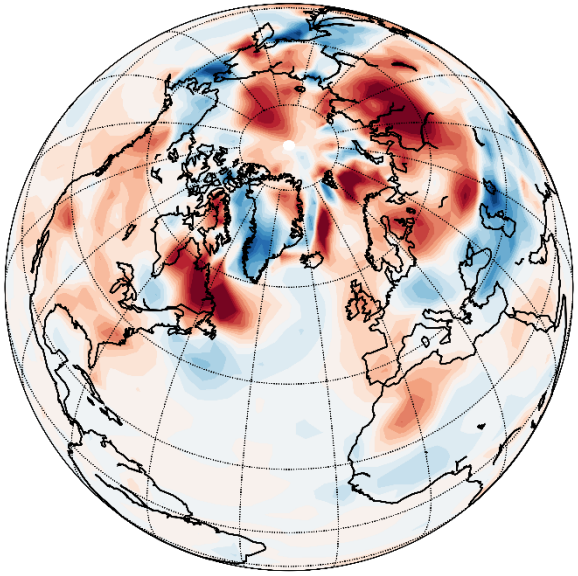
Does high resolution increase model uncertainty at high latitudes?

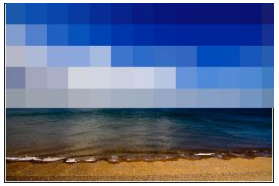


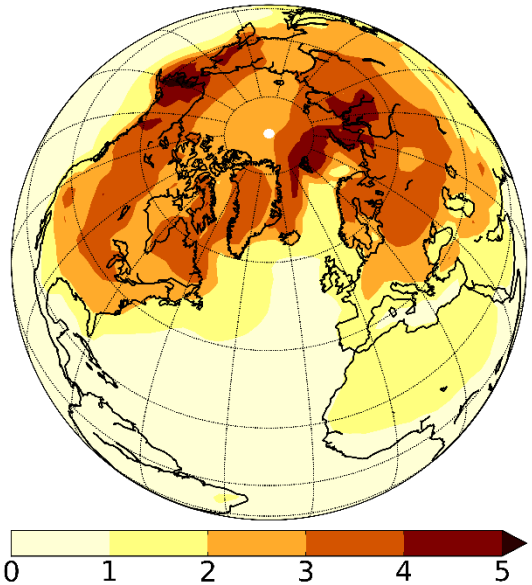


Average February member spread 2m-temperature (°C)

Difference







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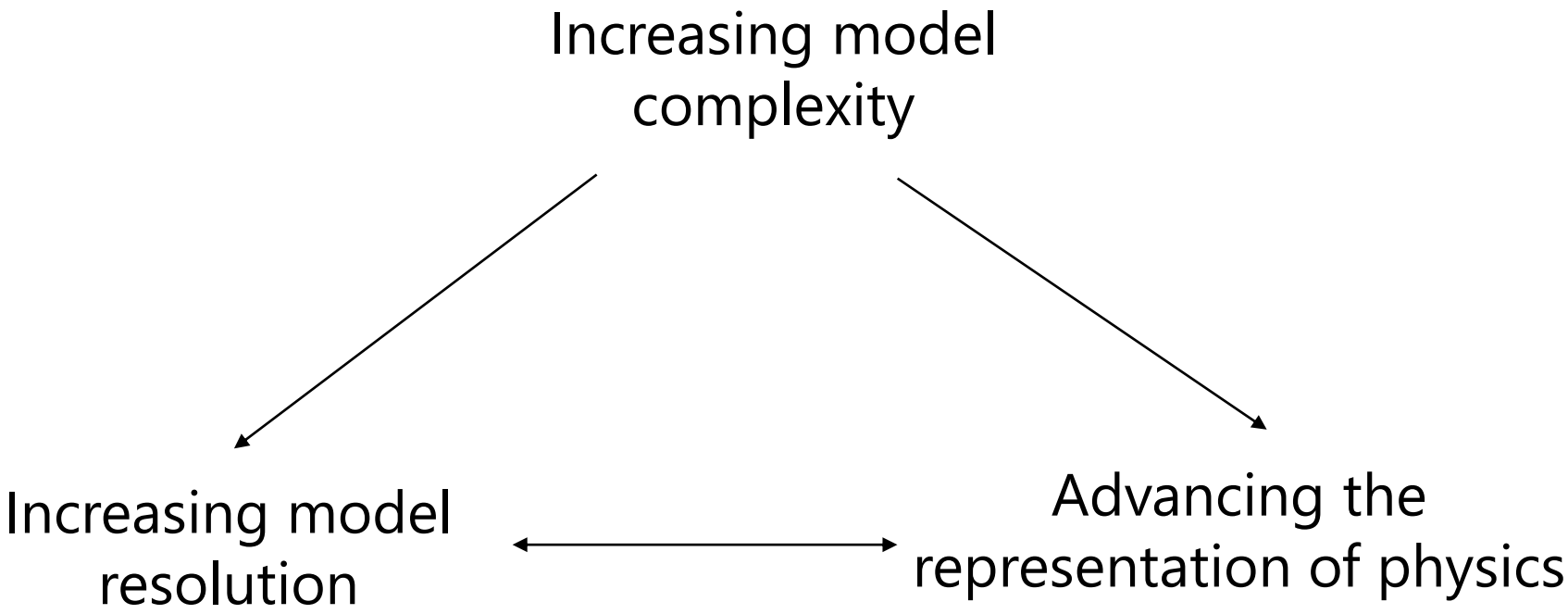
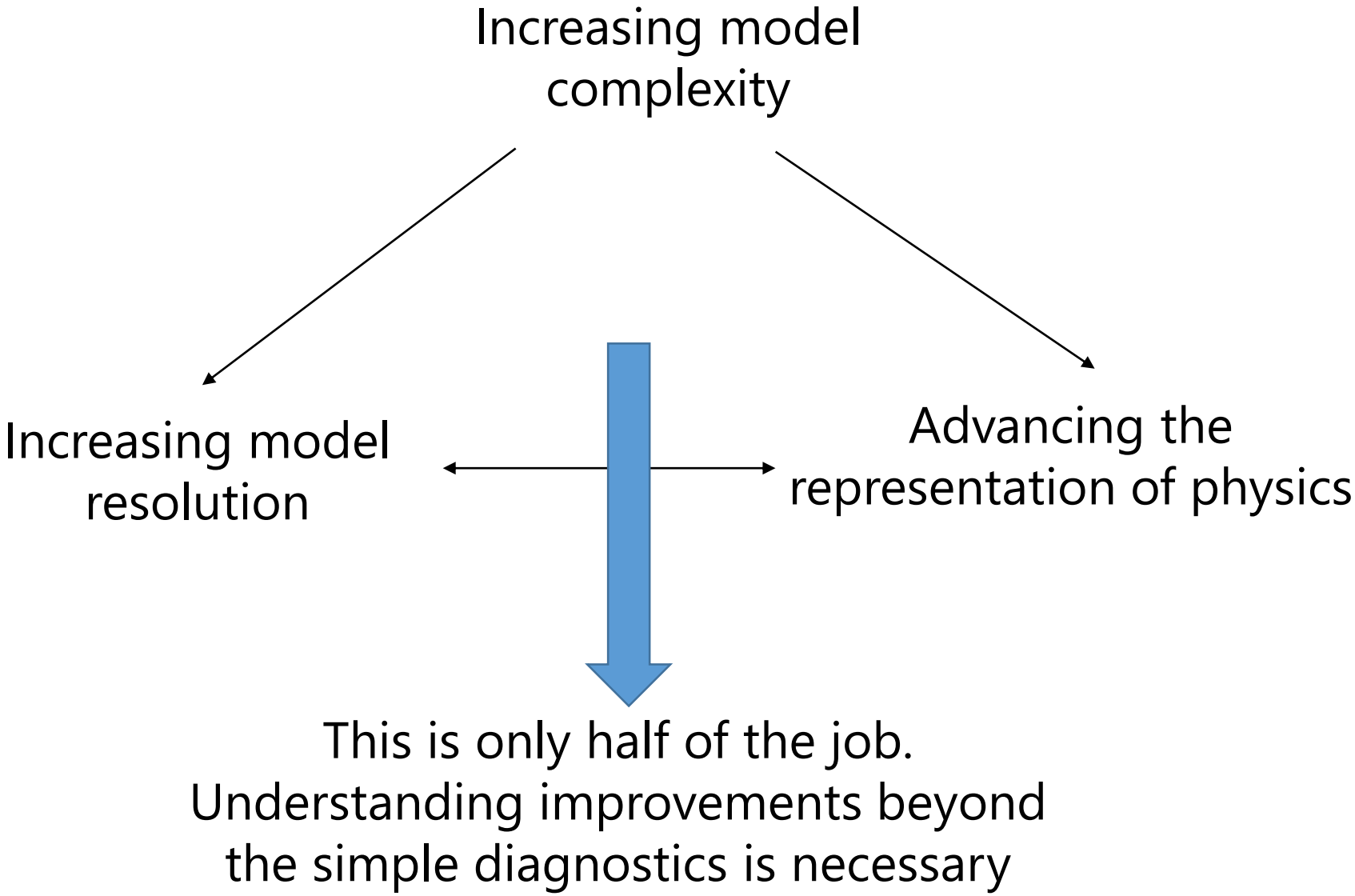

Increasing model complexity
Increasing model resolution
Advancing the representation of physics


Increasing model complexity
Increasing model resolution
Advancing the representation of physics
This is only half of the job.
Understanding improvements beyond the simple diagnostics is necessary

Conclusions

- First attempt to study systematically how **resolution** impacts **seasonal** prediction at high latitudes
- Resolution is not the magic button: parameterizations have to be switched off, or replaced
- High-resolution is not only about producing more fancy outputs, it's also about analyzing them (and this can take as much time)
- The effect of resolution is less clear at high latitudes than it is in the tropics (not shown in this presentation). Because natural variability is more pronounced at high-latitudes?

Thank you!

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