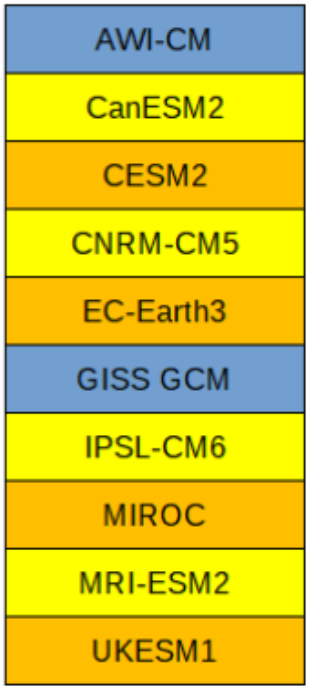
The North Atlantic Oscillation in (a subset of of 10) CMIP6 models:

Position and intensity of the NAO Index is not always well reproduced and ESMs lack long-lived persistent NAO anomalies.

This implies that these Earth System Models underestimate both high melt summer seasons and high accumulation winter seasons with consequent impact on SMB.



blue: only historical simulation available

yellow/orange: historical simulation and future projections SSP245 and SSP585

Ruth Mottram, Susann Ascheneller[2], Florian Sauerland[2], Rasmus Pedersen, Peter Thejll, Peter Langen, Fredrik Boberg, Martin Stendel, Nicolaj Hansen[3] and S huting Yang

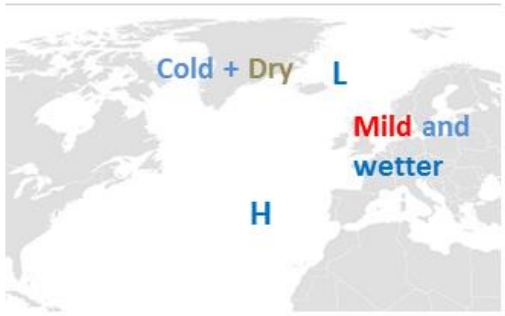
Danish Meteorological Institute
[2]University of Bonn, [3], Danish Technical University

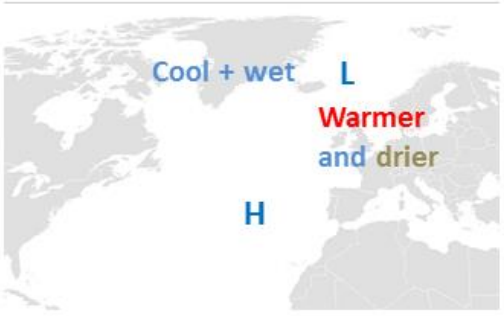
North Atlantic Oscillation has different tendencies on the Greenland ice sheet in winter and summer

Danmarks Meteorologiske Institut

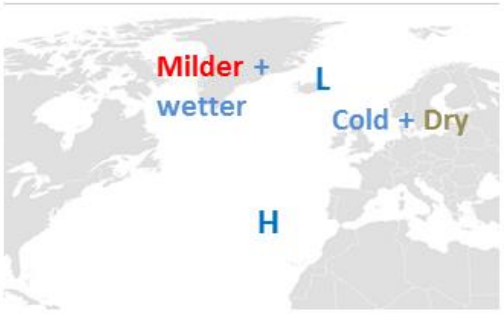
Winter

Summer

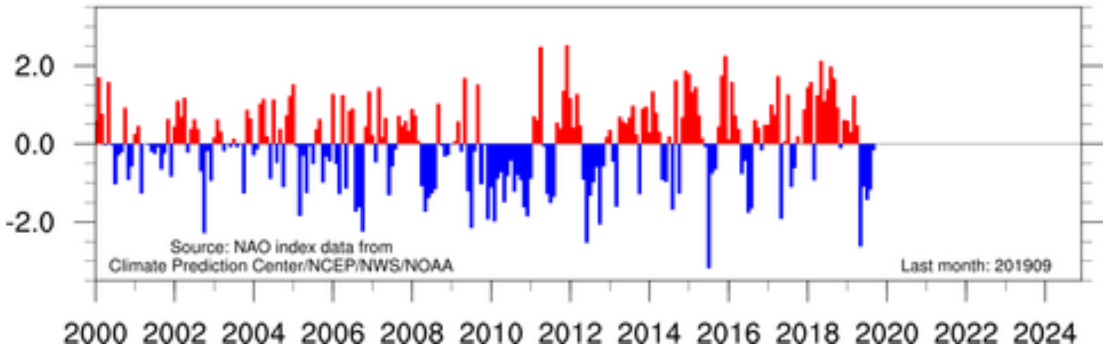




Positive



Negative



POLAR PORTAL
MONITORING ICE AND CLIMATE IN THE ARCTIC

Negative NAO + Greenland Blocking -> Summer Melt and Autumn/Winter Snowfall with longer term consequences for the Greenland ice sheet

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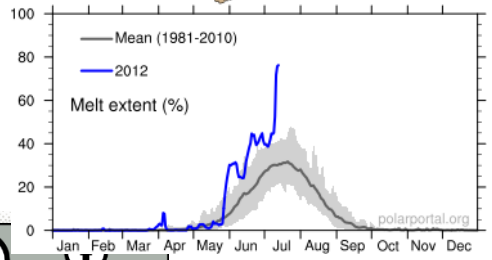
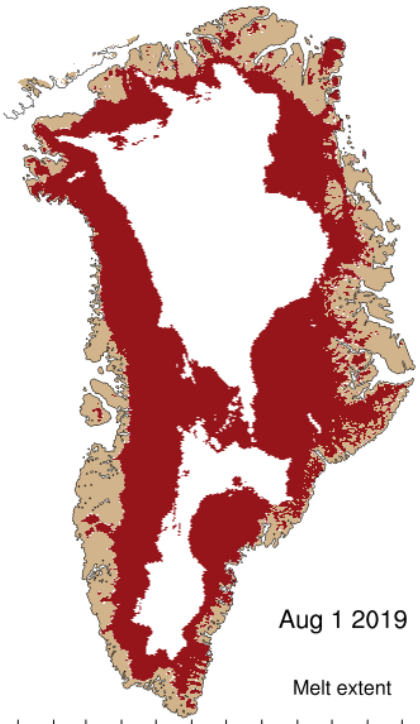
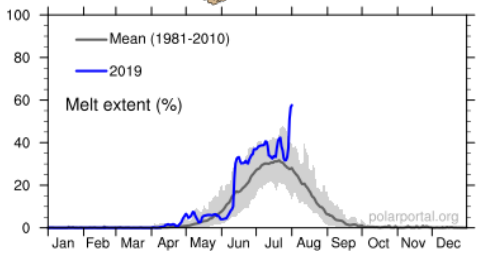
2012

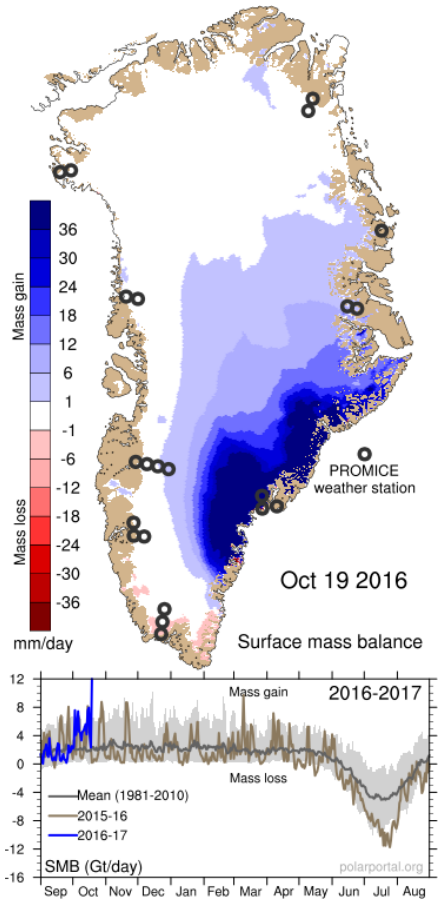
2019

2016









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Summer Temperature Bias in North Atlantic (Historical – ERA5)

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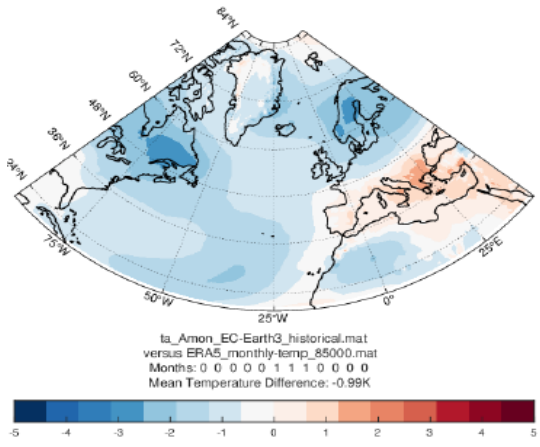
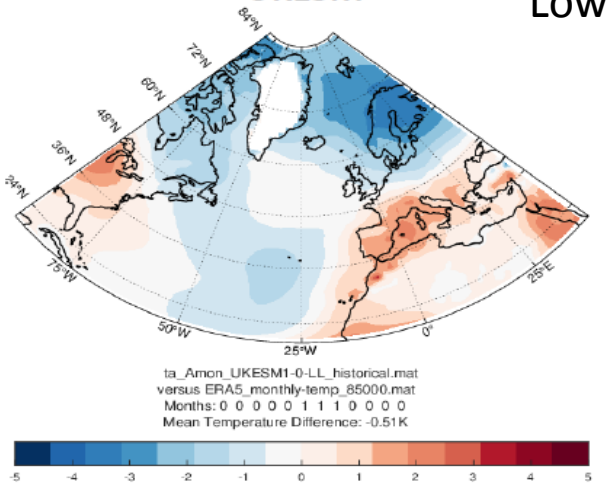
EC -Earth3

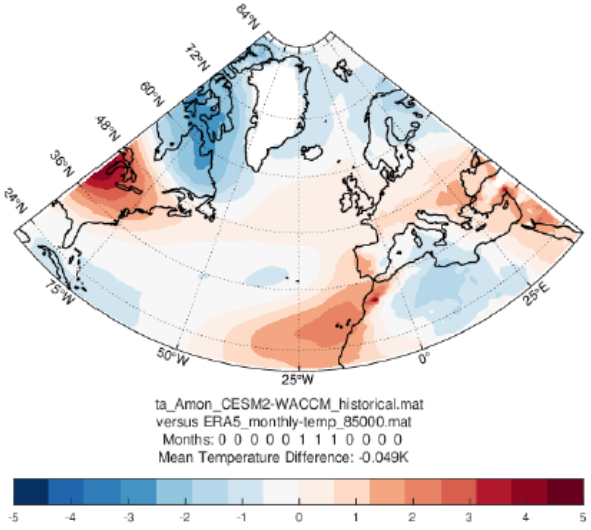


UKESM

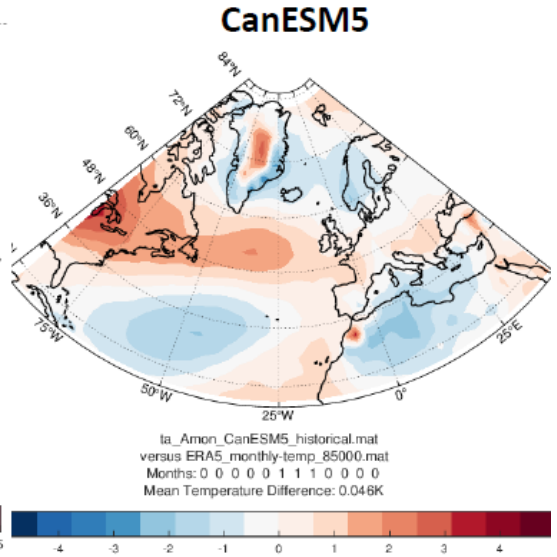


Lowest bias

CESM2

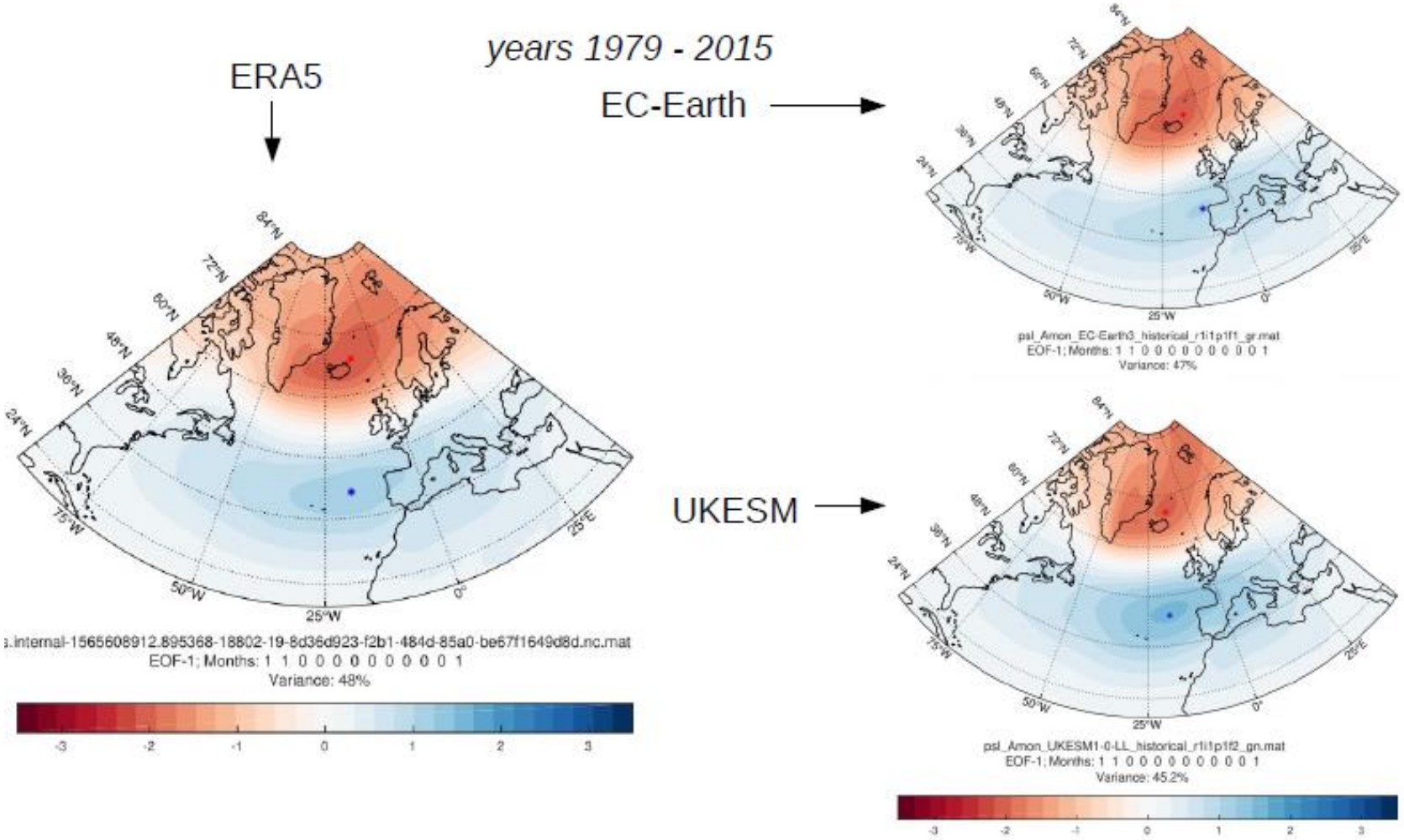


CanESM5



Highest bias

North Atlantic Oscillation:
Lowest bias in position and intensity compared with ERA5

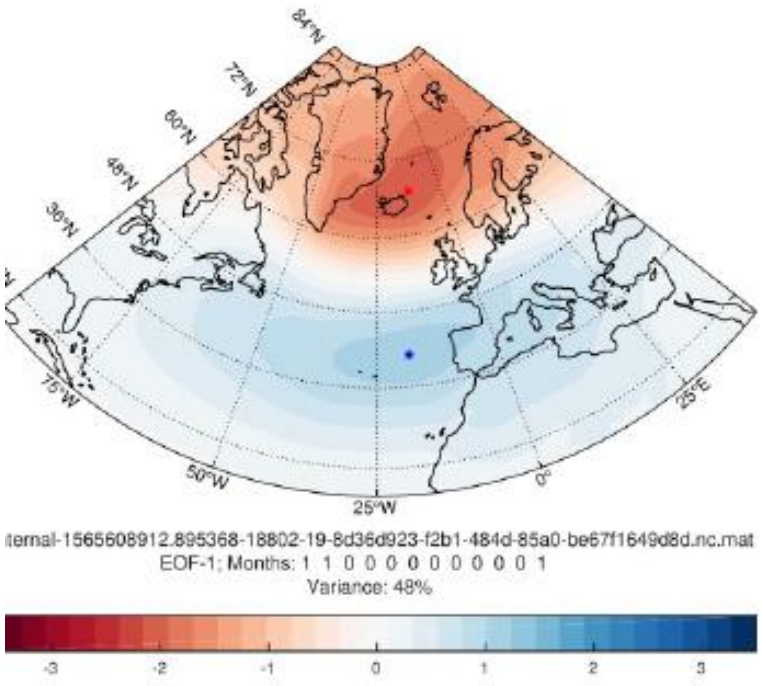


Winter NAO EOFs

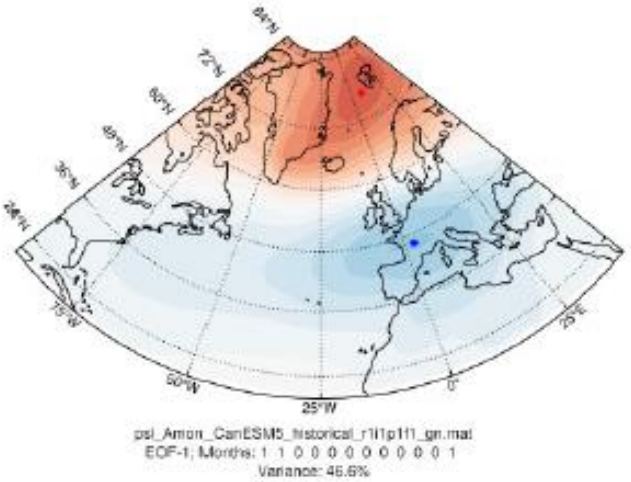
North Atlantic Oscillation:
Highest bias in position and intensity compared with ERA5

years 1979 - 2015

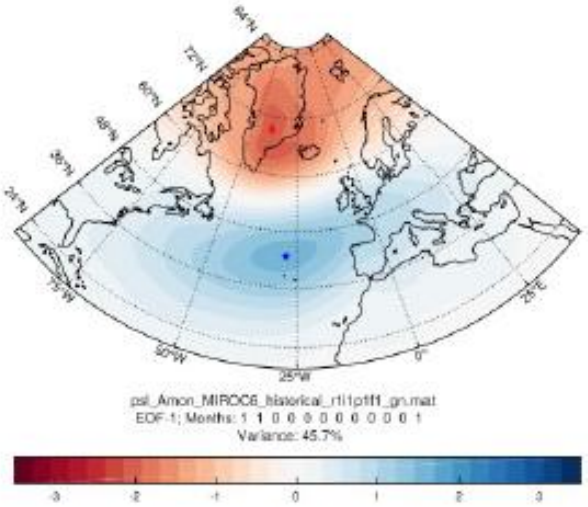
ERA5



CanESM5 →

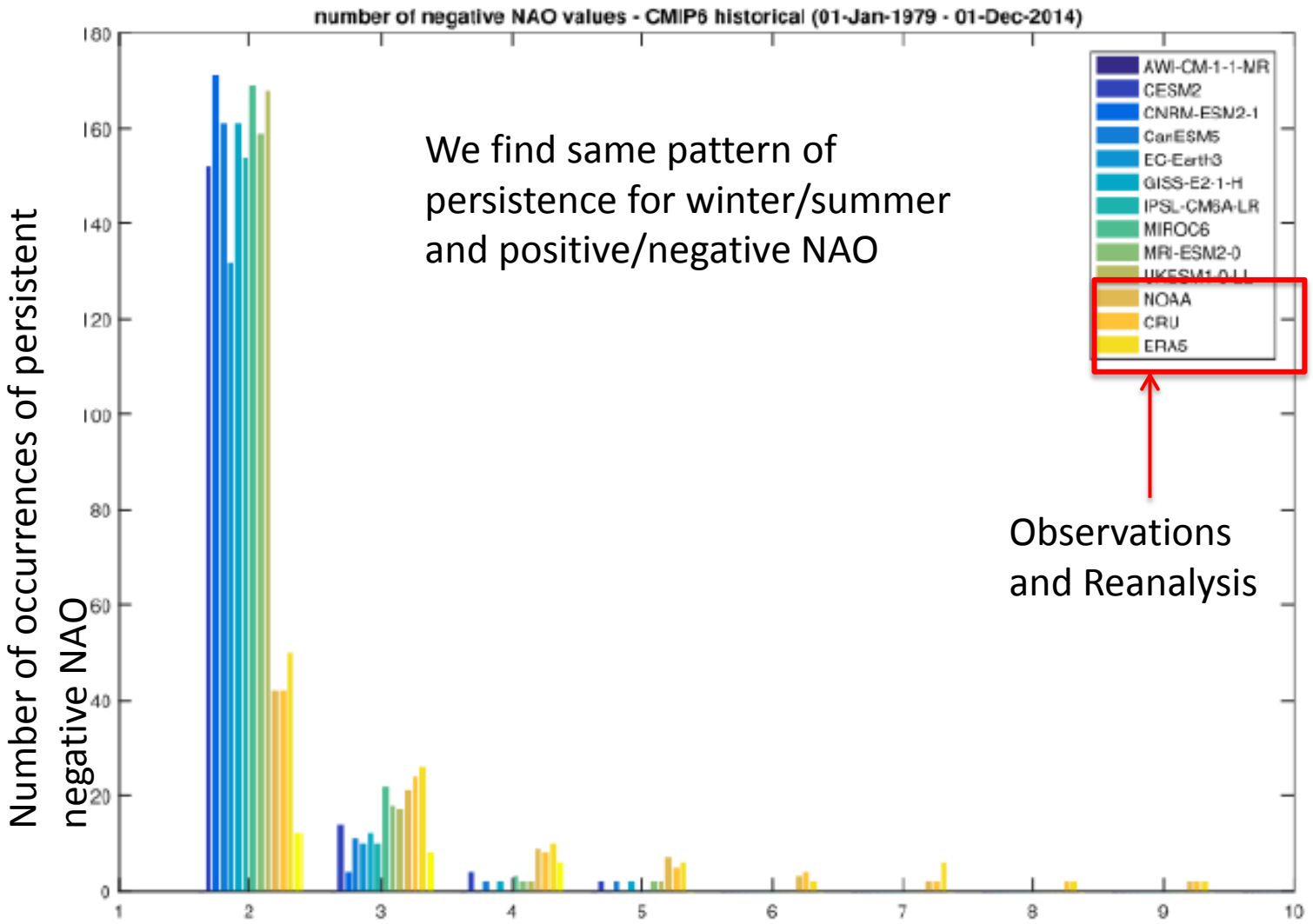


MIROC6 →

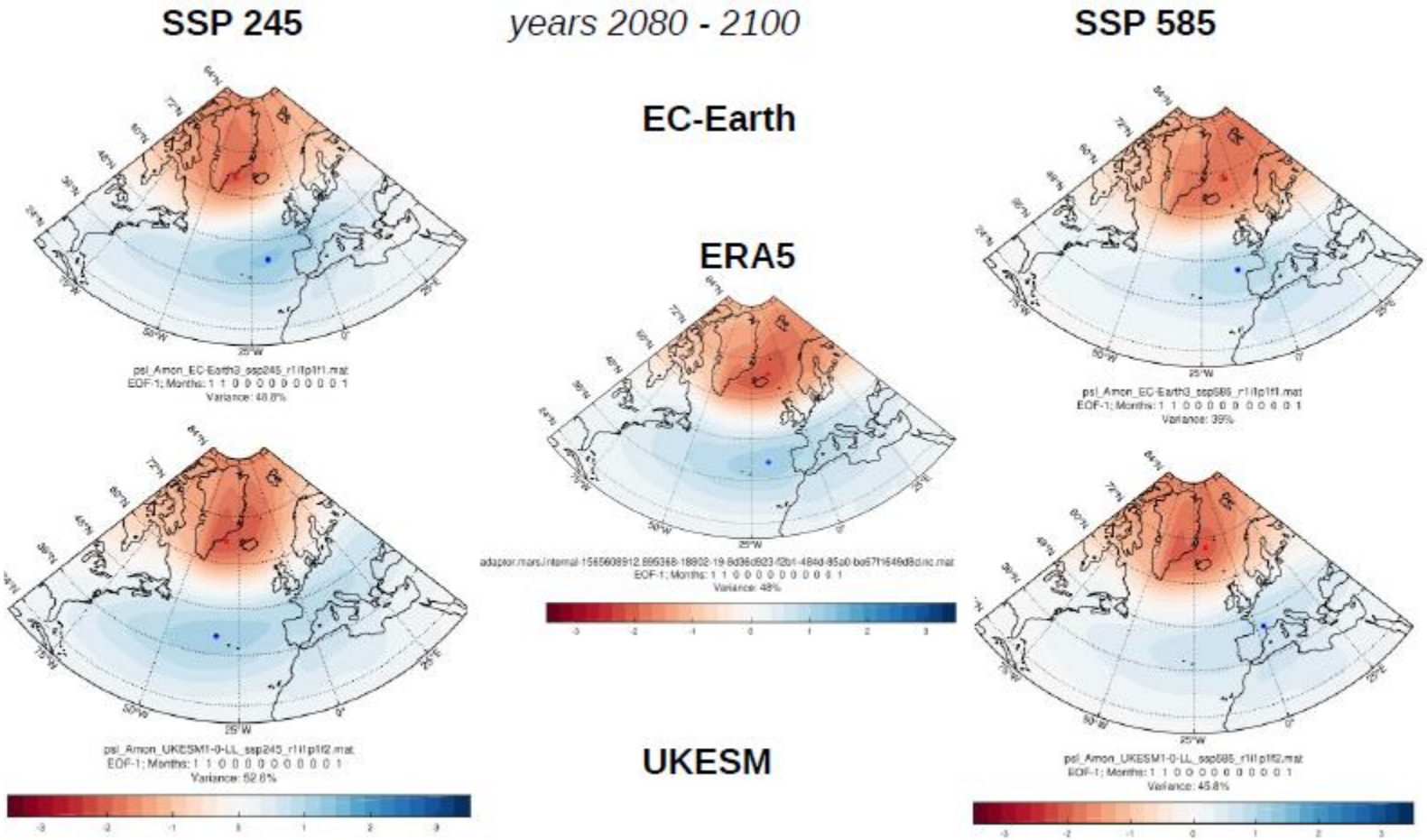


Winter NAO EOFs

CMIP6 models do not capture periods with a persistent NAO index well. These periods can be important contributors to annual surface mass balance



NAO EOF in future projections changes but is highly dependent on models and scenarios. Models closest to present day NAO see smallest change in future



Ranking based on geographical position and intensity of winter NAO

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If we rank based on temperature bias and NAO bias we get these scores:

and the winner is...

(okay, that's valid for this very special paramter...)

1	UKESM	381,03
2	EC-Earth3	741,71
3	CNRM	1041,65
4	IPSL	1111,92
5	GISS	1516,75
6	CESM2	1536,71
7	MRI	1900,37
8	AWI	1962,17
9	MIROC6	1972,86
10	CanESM5	3072,32

Next steps:

1. Greenland blocking

2. How does performance vary between members of each ensemble? (So far only one member per model).

3. Assess impact on Greenland melt and accumulation potential

4. Extend to other ESMs now available

5. Manuscript in preparation