Mechanism of internal Atlantic Multidecadal Variability (AMV) at 2 resolutions of HadGEM3-GC3.1

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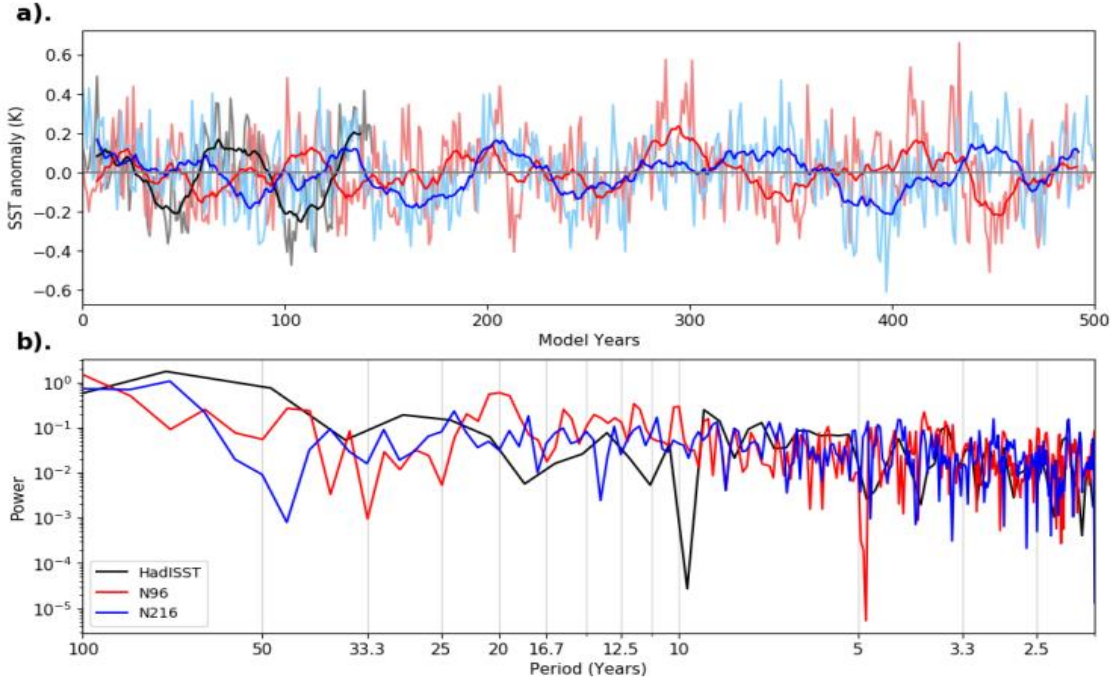
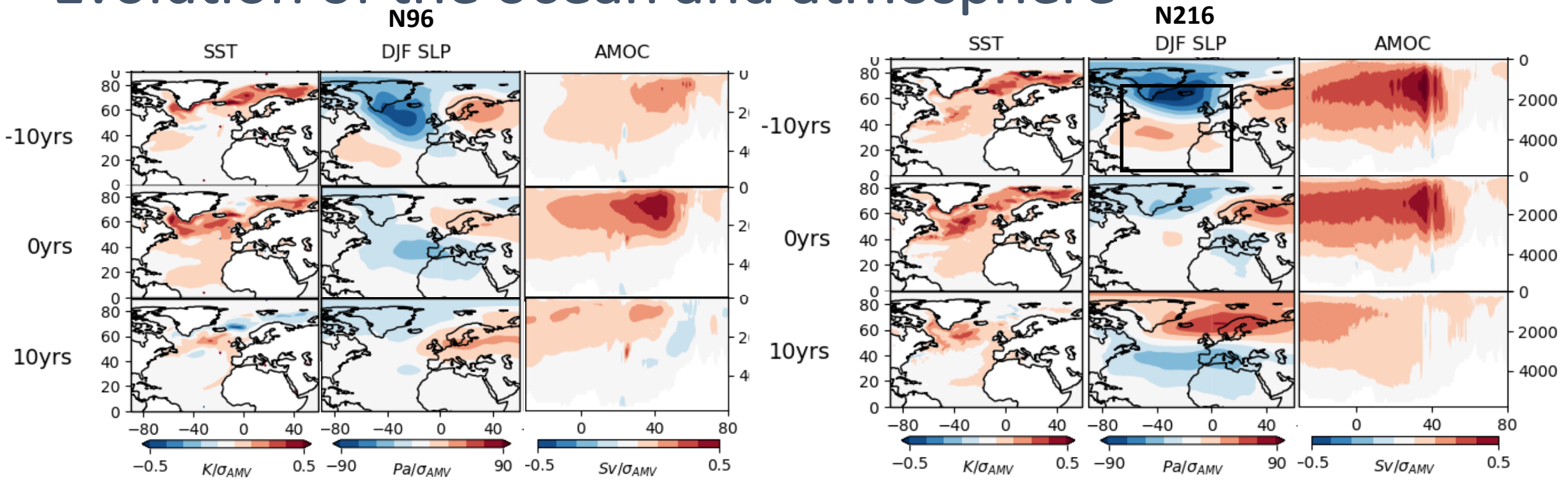
- **The AMV is a major mode of variability with significant climate impacts around the world (e.g. Ruprich-Roberts et al., 2017), but its physical mechanism is still not well understood.**
- **Taking advantage of the close physical resemblances between different resolutions of the HadGEM-GC3.1 model, we assess the effects of model resolution on the mechanism of the internal AMV.**



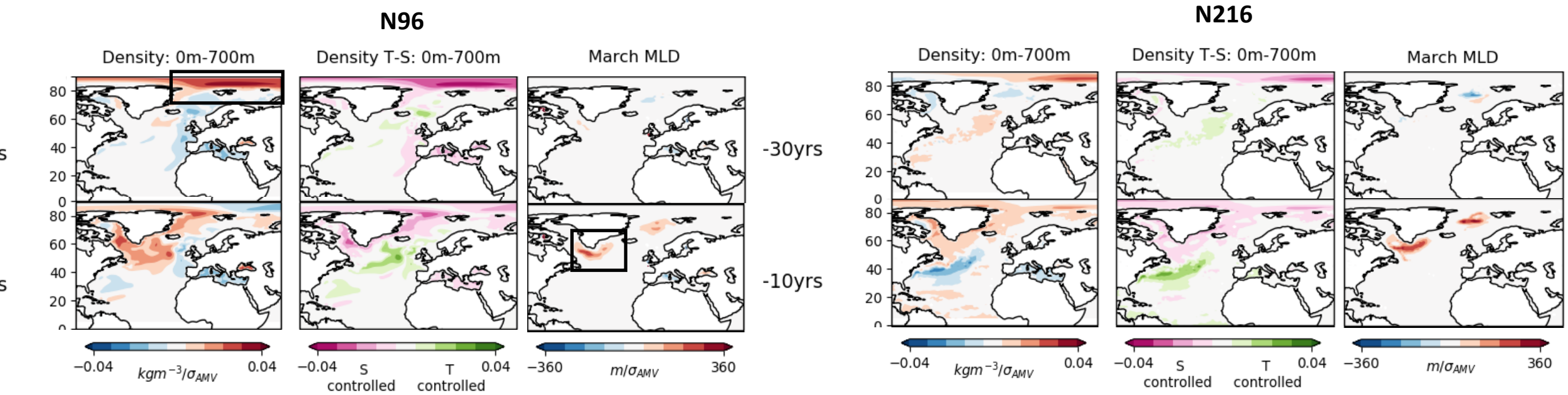
- Timescale and magnitude of the simulated AMV is largely comparable to observations.
- Periods of 50-100 years in the HadISST and 80-100 years in both versions of the model.

Evolution of the ocean and atmosphere



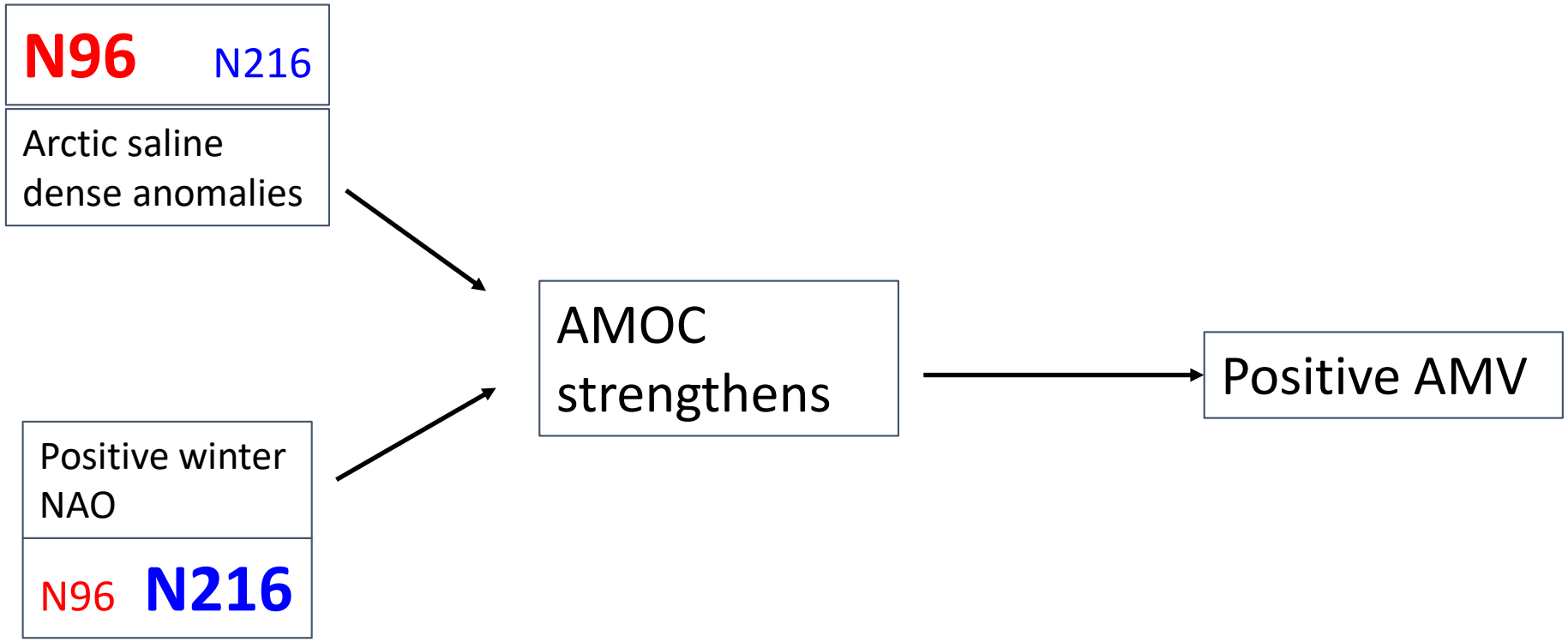
- In both models, the Nordic Seas warm first, leading the AMV by 5 years, the subpolar warms next, and the tropical region warms last (left columns).
- A NAO-like winter sea level pressure pattern (SLP), leads AMV by 10 years. AMOC strength reaches its maximum a few years later, leading the AMV by about 5 years.
- In N216, SLP anomalies are greater and maps onto the canonical NAO better, indicating that it plays a bigger role in the higher resolution.
- This chain of events, NAO -> AMOC -> AMV, is consistent with the leading proposed mechanism (e.g. Robson et al., 2012) where:
    1. Persistent positive NAO leads to increased surface cooling.
    2. Cold, dense ocean surface triggers deep convection, strengthening the AMOC.
    3. Increased Northward ocean heat transport leads to positive AMV.

Density drivers of the AMOC



- In both models, 30 years before peak AMV, dense, salty, Arctic anomalies slowly move South along the East Greenland Current pathway into the Labrador Sea (top left panels). The subsequent increase of Labrador Sea MLD indicates deep water formation and therefore strengthening of the AMOC (bottom right panels).
- The Labrador Sea MLD deepening at 10 years before peak AMV also coincides with the positive winter NAO (previous slide), suggesting that both the NAO and Arctic dense water play a role in the spin-up of the AMOC and therefore the AMV.
- The greater Arctic density anomalies in N96 indicates that this source of density play a bigger role in the lower resolution.

Summary


N96 N216
Arctic saline dense anomalies
Positive winter NAO
N96 N216
AMOC strengthens
Positive AMV