

Simulated response of the AMOC and Northern Hemisphere temperature to NAO variations on interannual to centennial time scales

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Premises:

- NAO variations are a key driver of AMOC variability
- A model's response to NAO variability is related to its internal AMOC variability
- Such AMOC variability can influence hemispheric climate

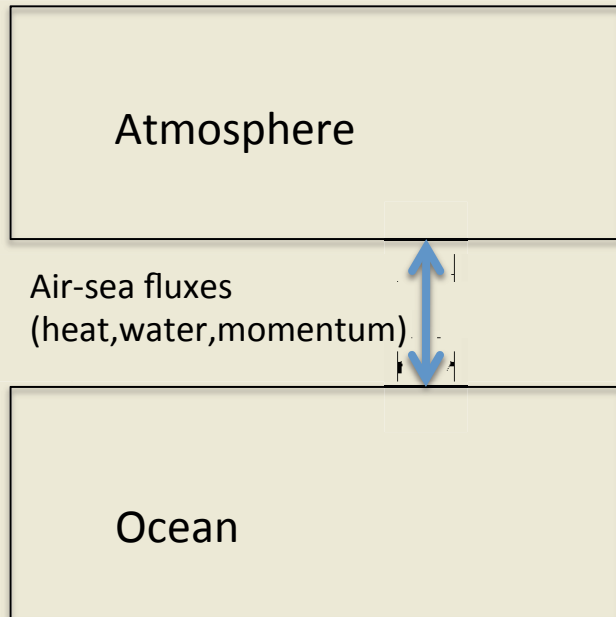
Experimental design

➔ *Use coupled model to evaluate model response to NAO forcing. Difference between “Perturbed” and “Control” experiment is due to NAO-related fluxes.*

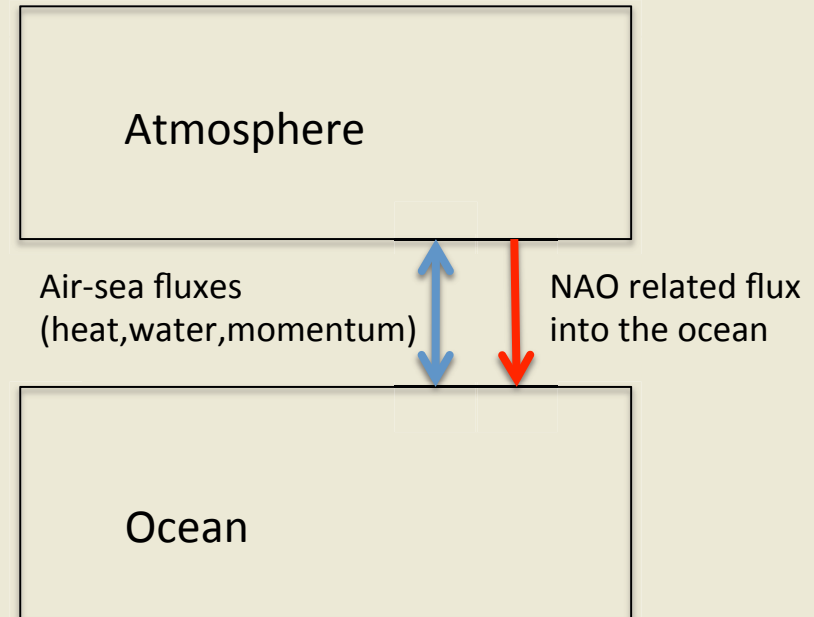
Ten-member ensembles to increase signal to noise ratio.

Use both constant radiative forcing experiments (Controls) or experiments with changing forcing (such as 20th century runs)

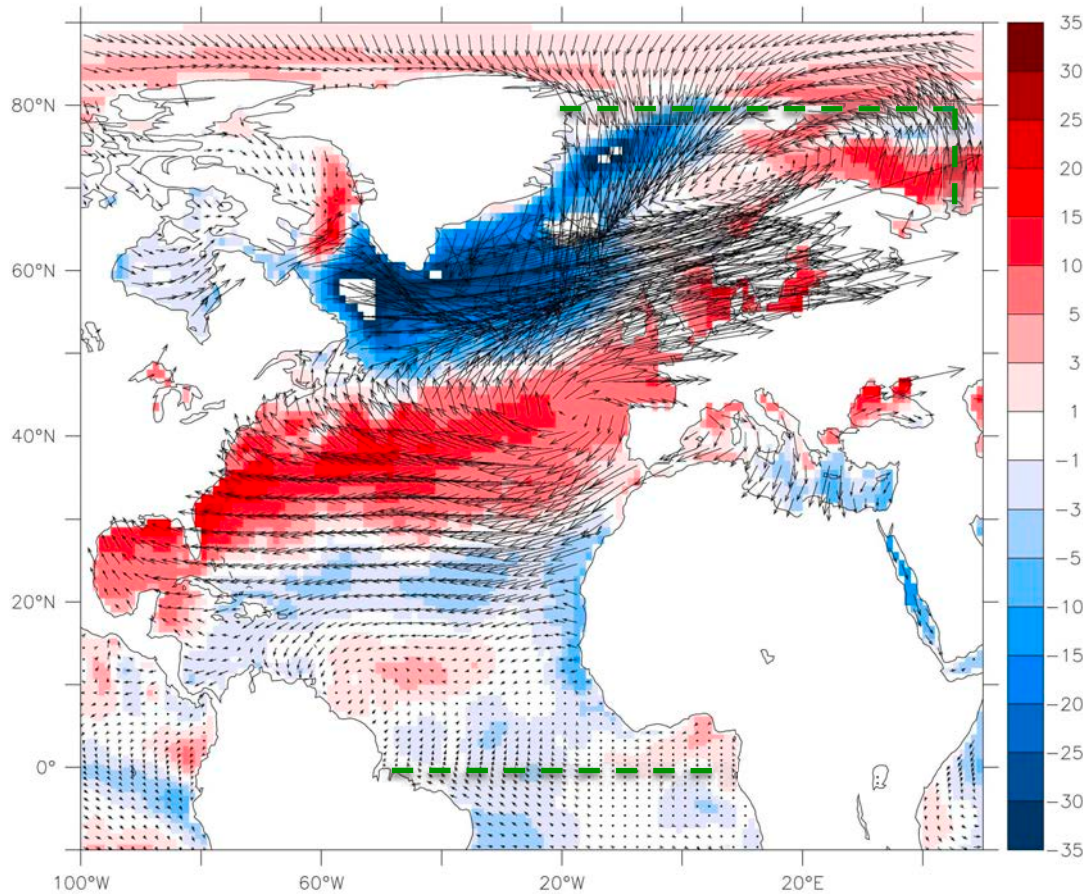
“Control” experiment



“Perturbed” experiment



ECMWF-Interim reanalysis derived NAO
related fluxes (DJFM)



MODELS USED

(a) GFDL CM2.1 model

(1° ocean, 200 Km atmosphere)

This model has characteristic AMOC timescale of ~20 years

(b) GFDL CM2.5_FLOR model

(1° ocean, 50 Km atmosphere)

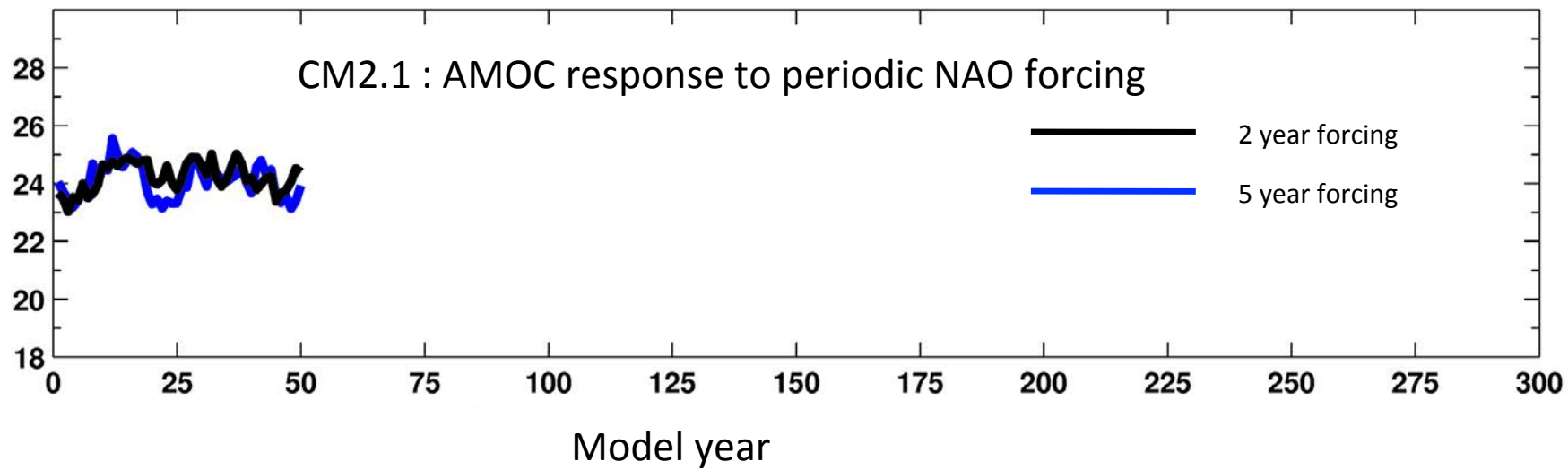
This model has somewhat longer characteristic AMOC timescale

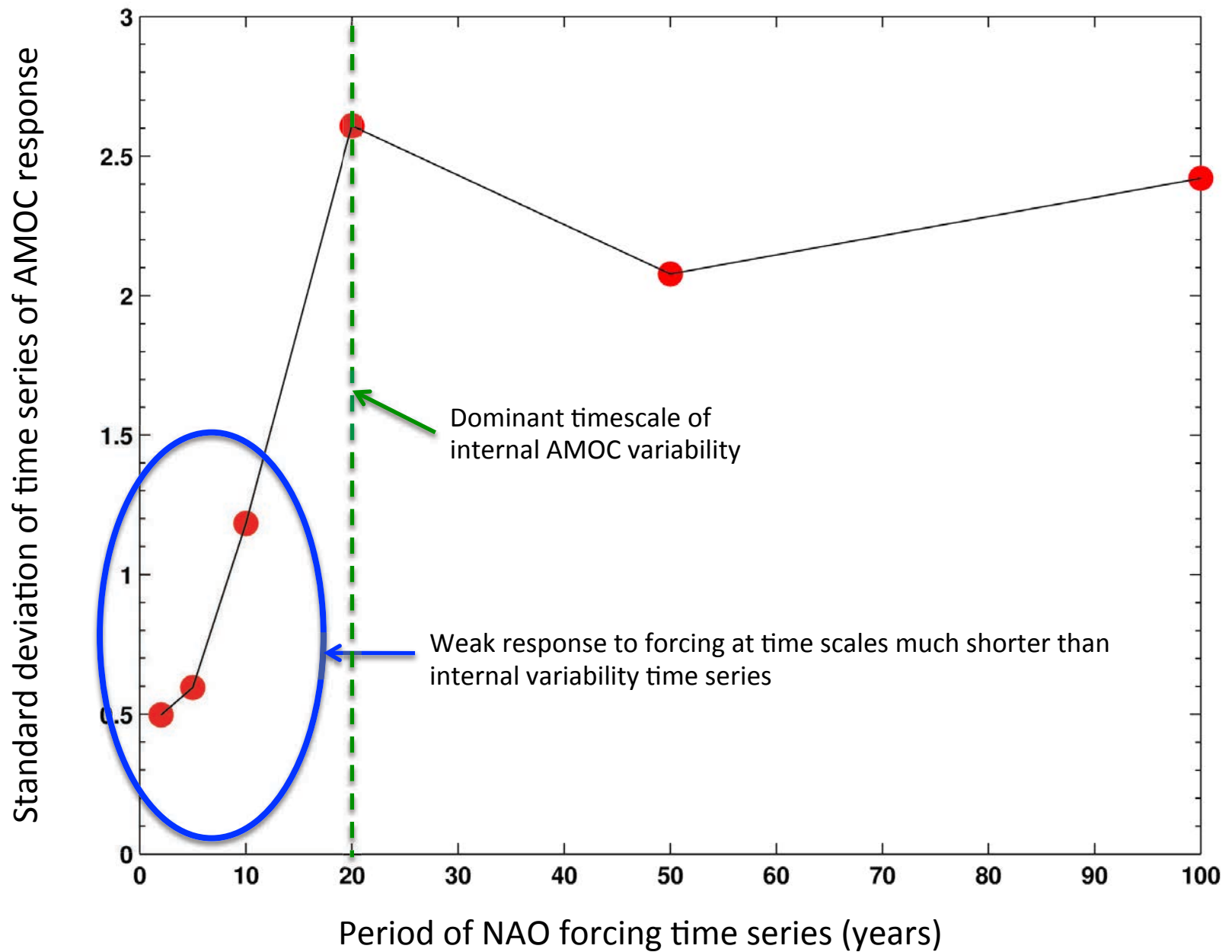
➔ See Yohan Ruprich-Robert poster

Forcing time series:

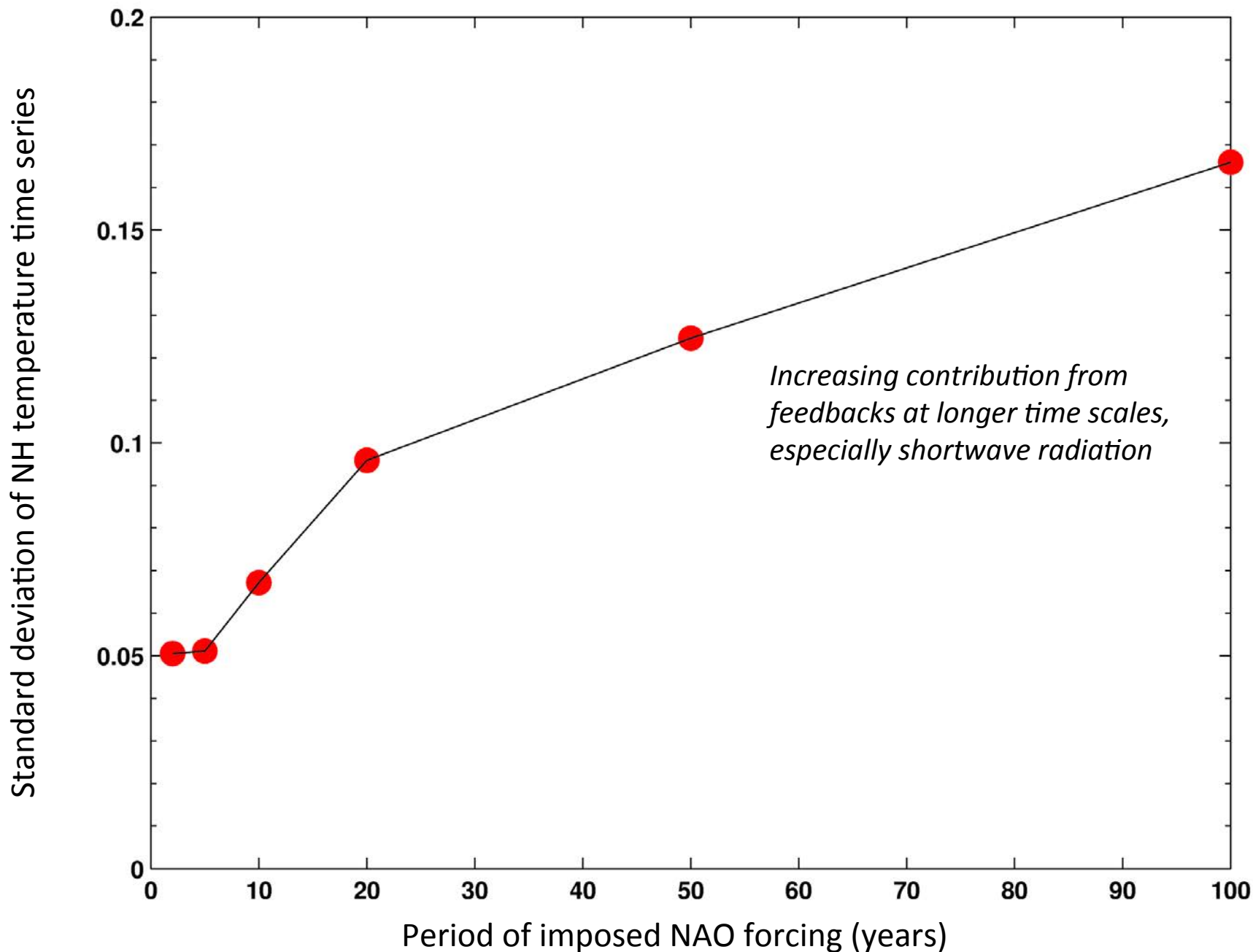
- (a) Instantaneous switch on/off
- (b) Periodic
- (c) Realistic time series based on observed NAO index

AMOC Index time series (Sv)

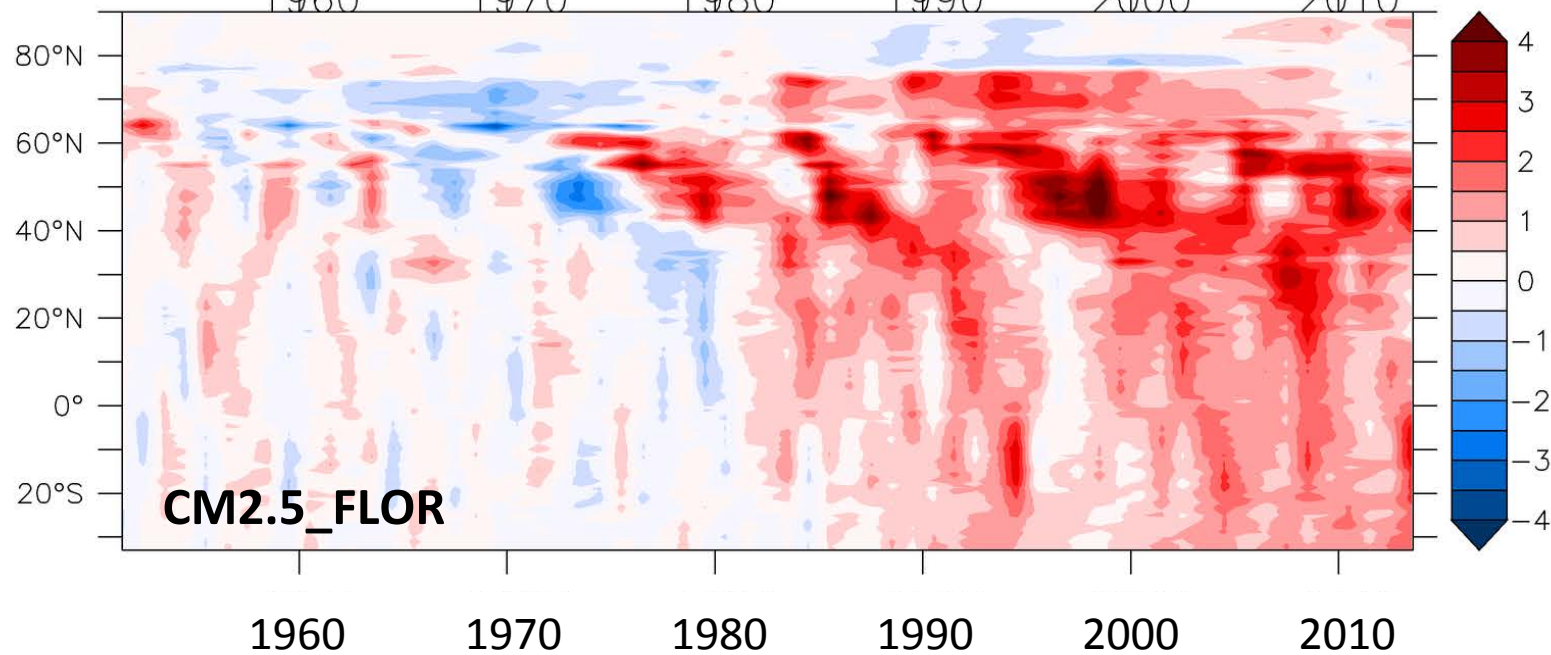
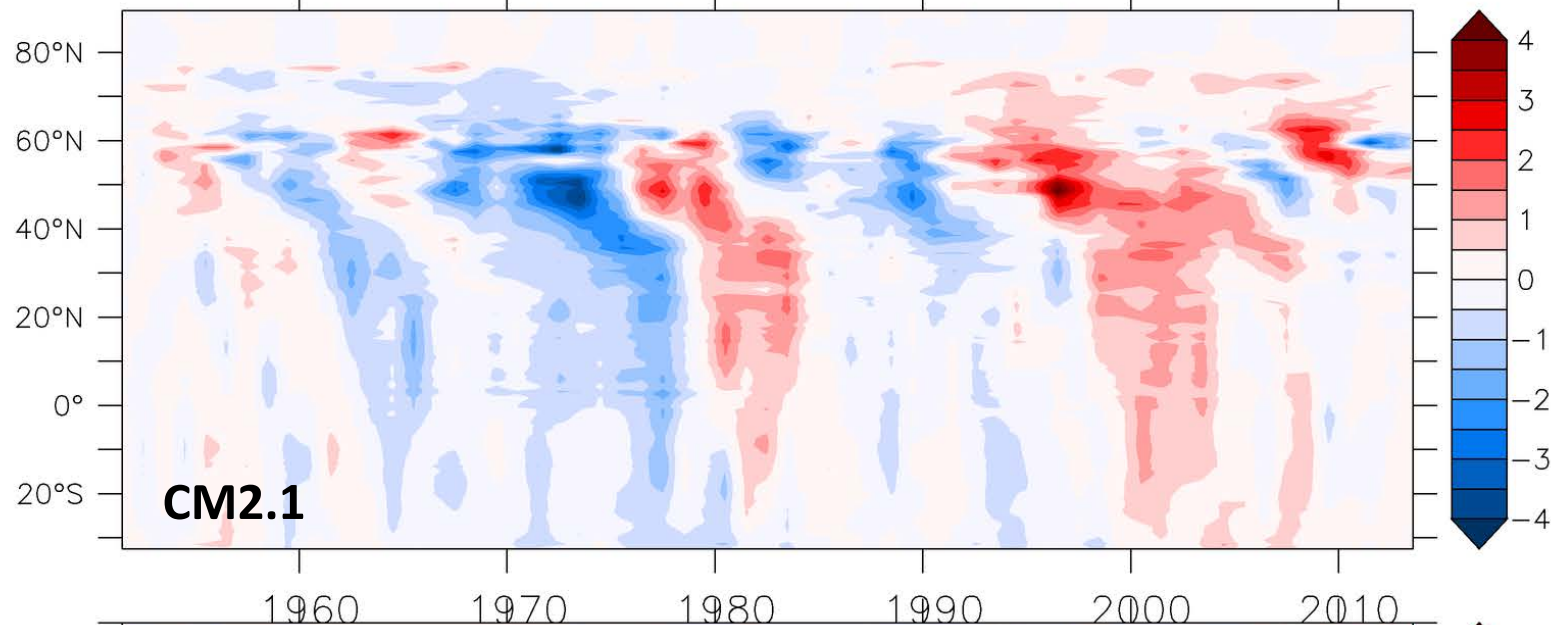




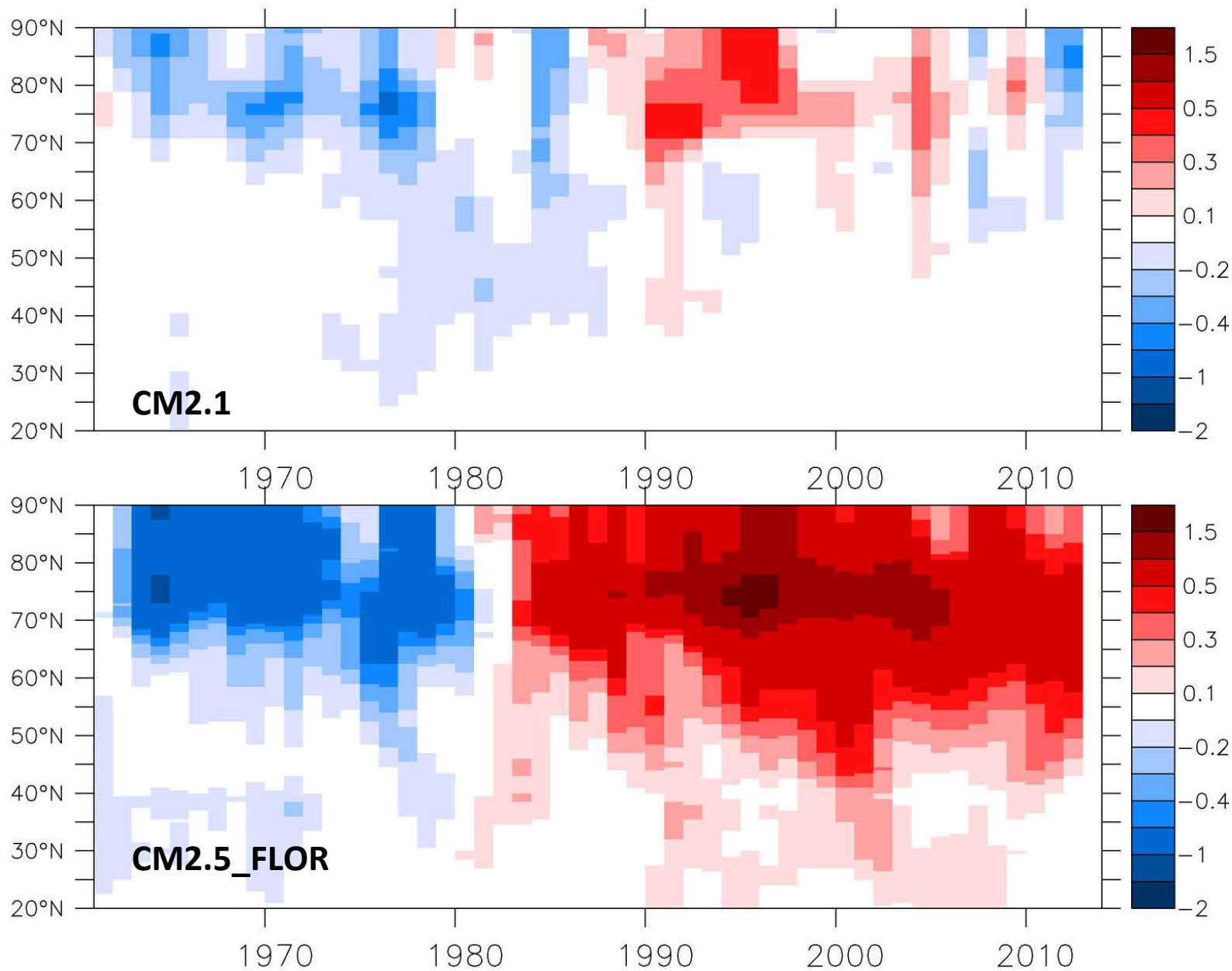
Amplitude of response of hemispheric temperature change to NAO variations



AMOC response (in Sv) to “realistic” NAO forcing time series



Zonal mean of surface air temperature response to “realistic” NAO forcing time series
(HIST_PLUS_NAO minus HIST)



Summary and Conclusions

Main purpose: *Examine response of AMOC and NH Temperature to NAO variations; useful in assessing factors contributing to observed multidecadal variability*

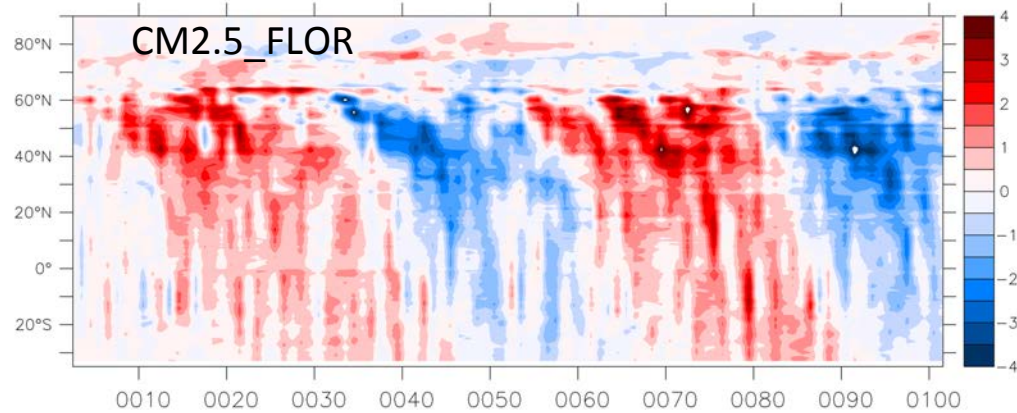
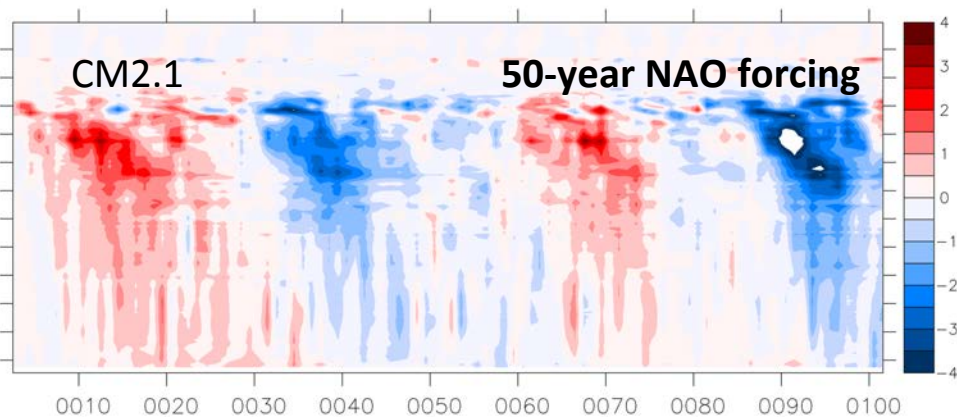
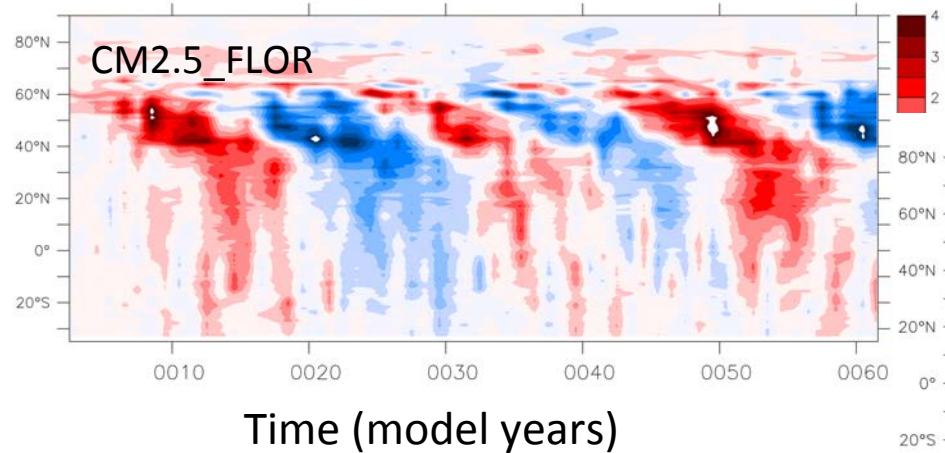
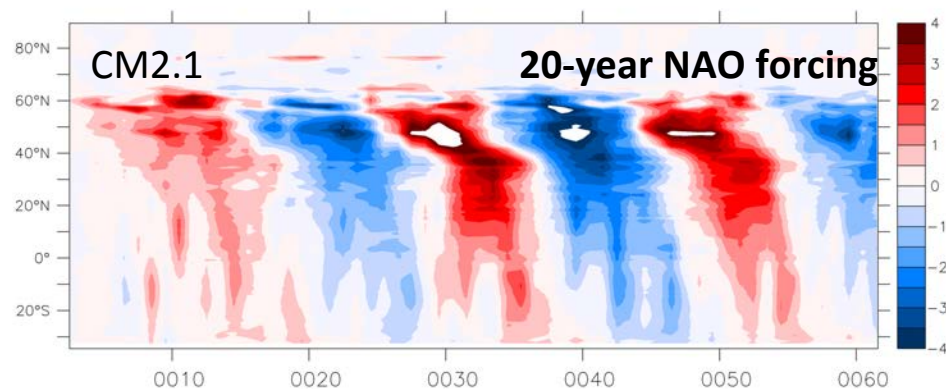
Key results:

- AMOC response strongest at time scales equal to, or longer than, internal variability time scale of the model; temperature response grows with timescale (role of feedbacks)
- Potentially important role of NAO-induced AMOC changes for NH mean temperature over historical record (cooling in 60s/70s, warming in 80s/90s)
- Interpretation of impact of AMOC on NH mean temperature depends on model's internal AMOC variability and mean state
 - in response to identical NAO forcing, two models with differing AMOC variability and mean state have different estimates of AMOC impact on NHMT

Challenges:

How widely do models differ in their response to NAO? What are the mechanisms determining this? How does this influence our interpretation of the impact of NAO variations on large-scale climate?

AMOC response to periodic NAO forcing



SST

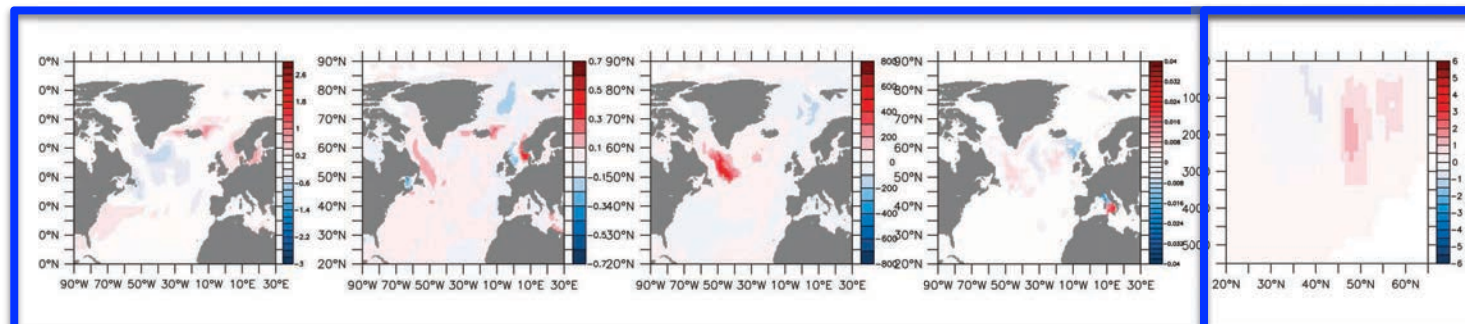
SSS

MLD

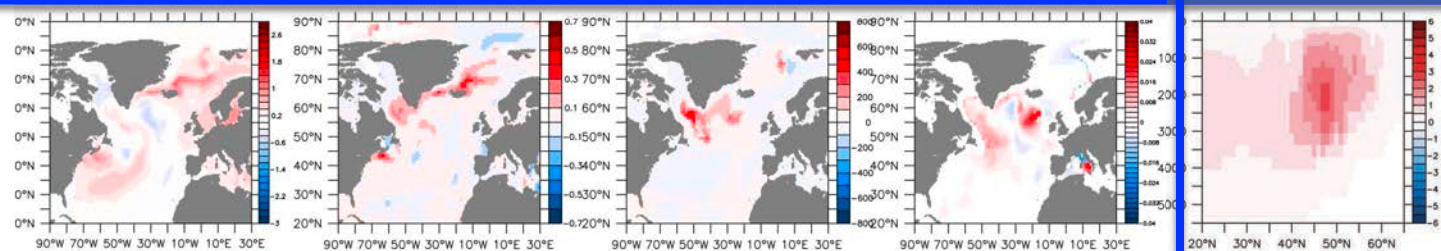
POT_RHO

AMOC

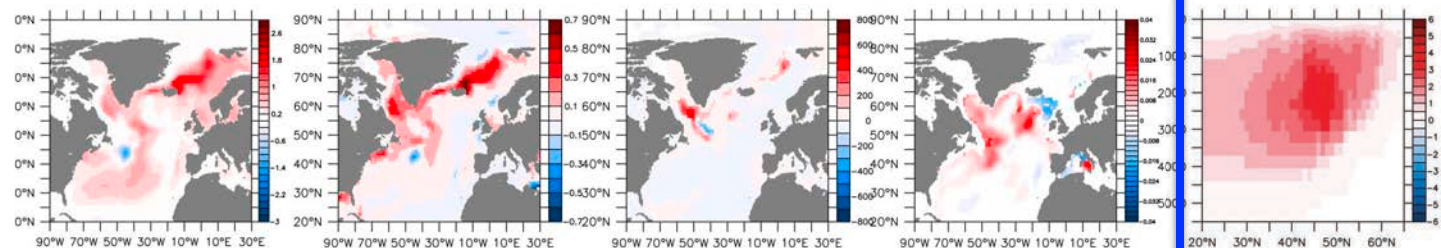
Year 2



Year 4



Year 6



Year 8

