CLIMATE OF THE 20th CENTURY : ATTRIBUTION OF ATLANTIC MULTIDECADAL VARIABILITY TO EXTERNAL FORCING, INTERNAL VARIABILITY AND WEATHER NOISE

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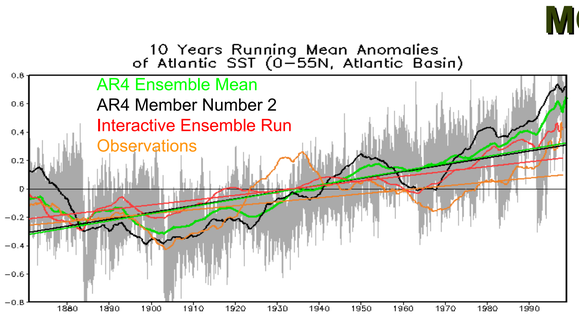
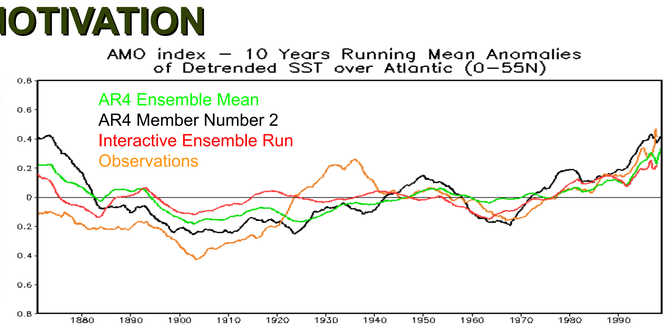
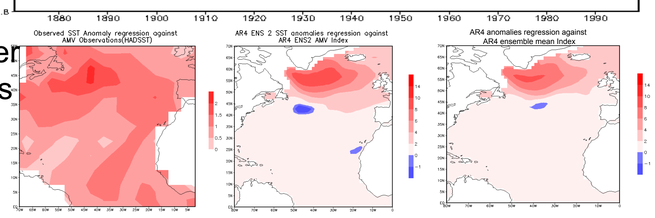
MOTIVATION





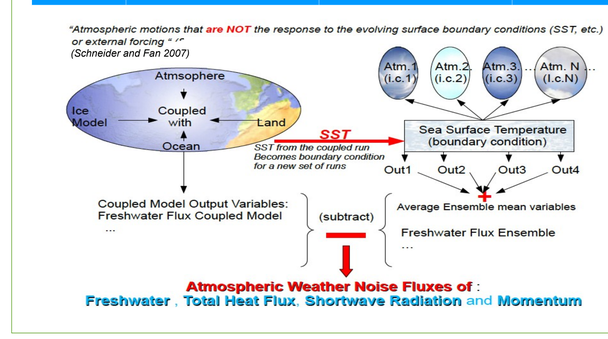


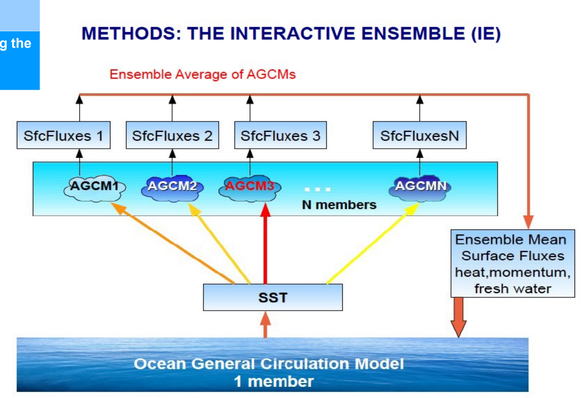
We are interested in understanding whether the Atlantic Multidecadal Variability (AMV) is internally or externally forced and what the role of weather noise forcing is in the internally forced component.

This is important since similarity of external and internal variability structure could make distinguishing the contribution of these two components on AMV difficult.

SET NUMBER	Model/Data and Time period	Experiments	Purpose
SET 1	CCSM3 AR4 ensemble T85, 1870-1999	1 atmosphere coupled to 1 ocean externally forced by the 20th century anthropogenic forcing	→ get the SST to use as boundary condition for the forced atmospheric ensembles → study int. vs ext. compnents in different variability modes
SET 2	CCSM3-IE (Kirtman et. al 2011) 1870-1999	6 CAM3 coupled with One ocean realization	→ for comparison with the noise forced IE (followin g experiments)
SET 3	CAM3 T85 1870-1999	6 different I.C atmospheres forced by the same SST	→used to extracting the weather noise

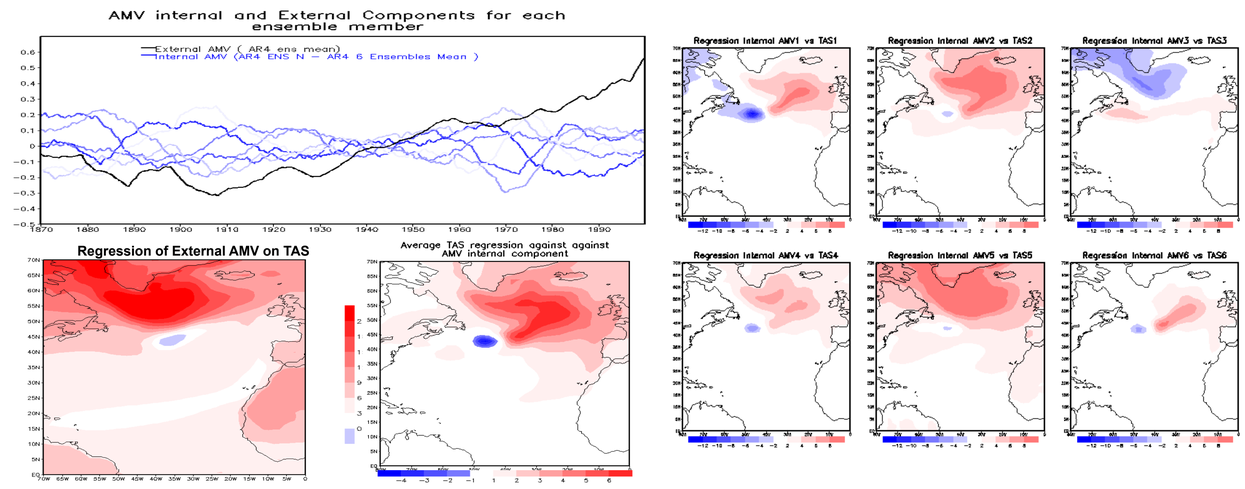
DATA,EXPERIMENTS AND METHODOLOGY





ARE THE INTERNAL AND EXTERNAL AMV VARIABILITY ASSOCIATED WITH DIFFERENT SST AND PRECIPITATION SPATIAL STRUCTURES ?
WHAT IS THE CAUSE OF INTERNAL AMV VARIABILITY ?

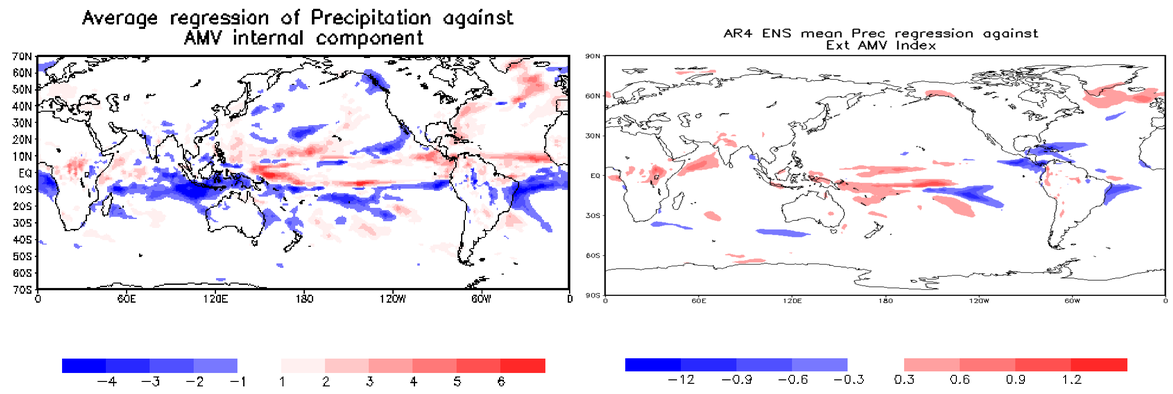
AMV INTERNAL AND EXTERNAL COMPONENTS AND THEIR STRUCTURES ON NORTH ATLANTIC 2M TEMPERATURE



External AMV is defined as the AR4 Ensemble Mean
Internal AMV is AR4 ENS N - AR4 Ensemble Mean

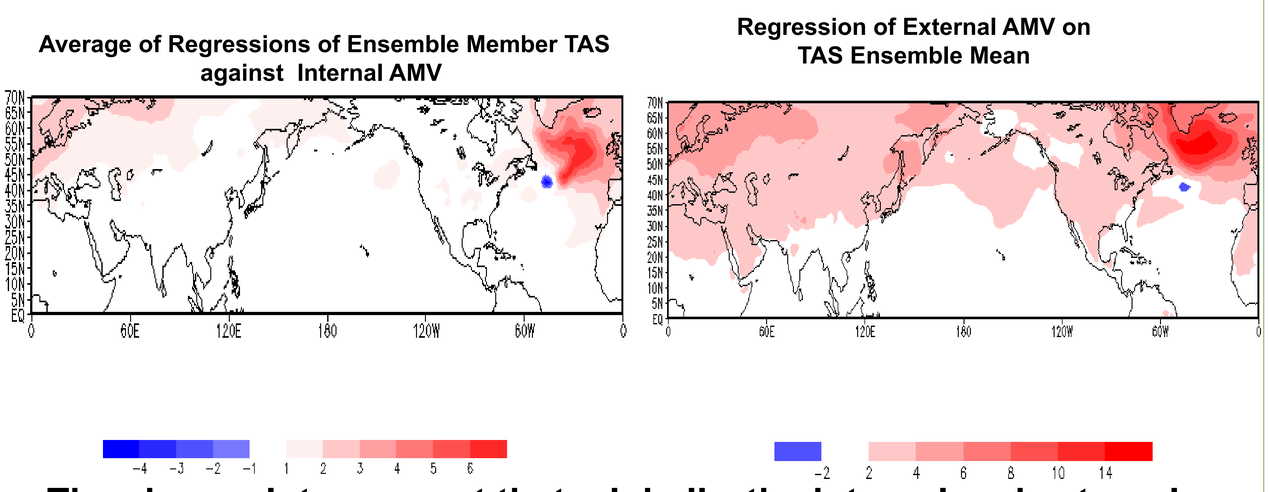
There is a pronounced eastward shift of the internal AMV pattern (mean of the regression patterns of TAS of the individual members against the respective internal AMV indices) relative to the external AMV pattern (regression of external AMV index against ensemble mean TAS).

AMV INTERNAL AND EXTERNAL COMPONENTS STRUCTURES ON GLOBAL PRECIPITATION



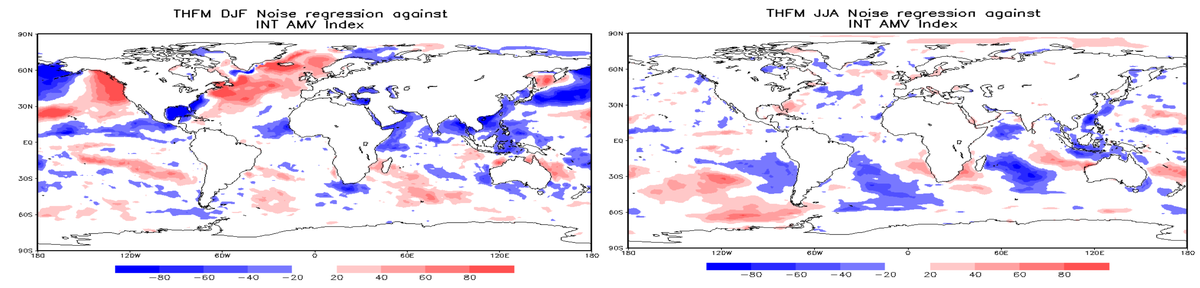
The mean of the regressions against the internal AMV indices shows a pronounced shift of the ITCZ(s) towards the north when the index is positive and towards the south when it is negative, suggestive of possible involvement of the AMOC. There is also an El Nino-like pattern in the western Pacific/Indian Ocean. The regression of the AR4 ensemble mean precipitation against the external AMV index is suggestive of a La Nina-like pattern associated with a more positive index.

AMV COMPONENTS STRUCTURES ON GLOBAL 2M TEMPERATURE



The above plots suggest that globally, the internal and external AMV components have similar structures on 2m TS. There is a difference in the magnitude of the patterns – the internal component being weaker.

INTERNAL AMV REGRESSION AGAINST WEATHER NOISE HEAT FLUX IN ENSEMBLE MEMBER 2



The internal AMV index in ensemble member 2 shows positive regression coefficients with member 2 weather noise total heat flux over North Atlantic in DJF. Our result is in agreement with Fan and Schneider (JAS 2011) which suggests that the total heat flux weather noise plays an important role in internal AMV. The fact that the correlation is bigger in winter over North Atlantic can be explained by the increased weather noise in winter over Atlantic due to more intense transient eddies activity .

Our results suggest that externally forced and internally generated AMV variability in the CCSM3 AR4 ensemble are associated with distinct SST structures in the North Atlantic. Internal AMV is associated with displacement of the ITCZ towards the warmer North Atlantic, while this behavior is not clearly associated with external AMV.