Atlantic Multidecadal Variability and North Atlantic storm track

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Scientific Goal

Establish the influence of the Atlantic Multidecaldal Variability (AMV) on North Atlantic storm track and related impacts on European climate via a coordinated analysis of available idealised simulations

Rationale

The AMV-related SSTs modulates the air temperature in the sector and the temperature gradient in the high baroclinicity region, making it weaker in the case of AMV+ and vice versa. These changes impact wind and storms ([1], [2]).

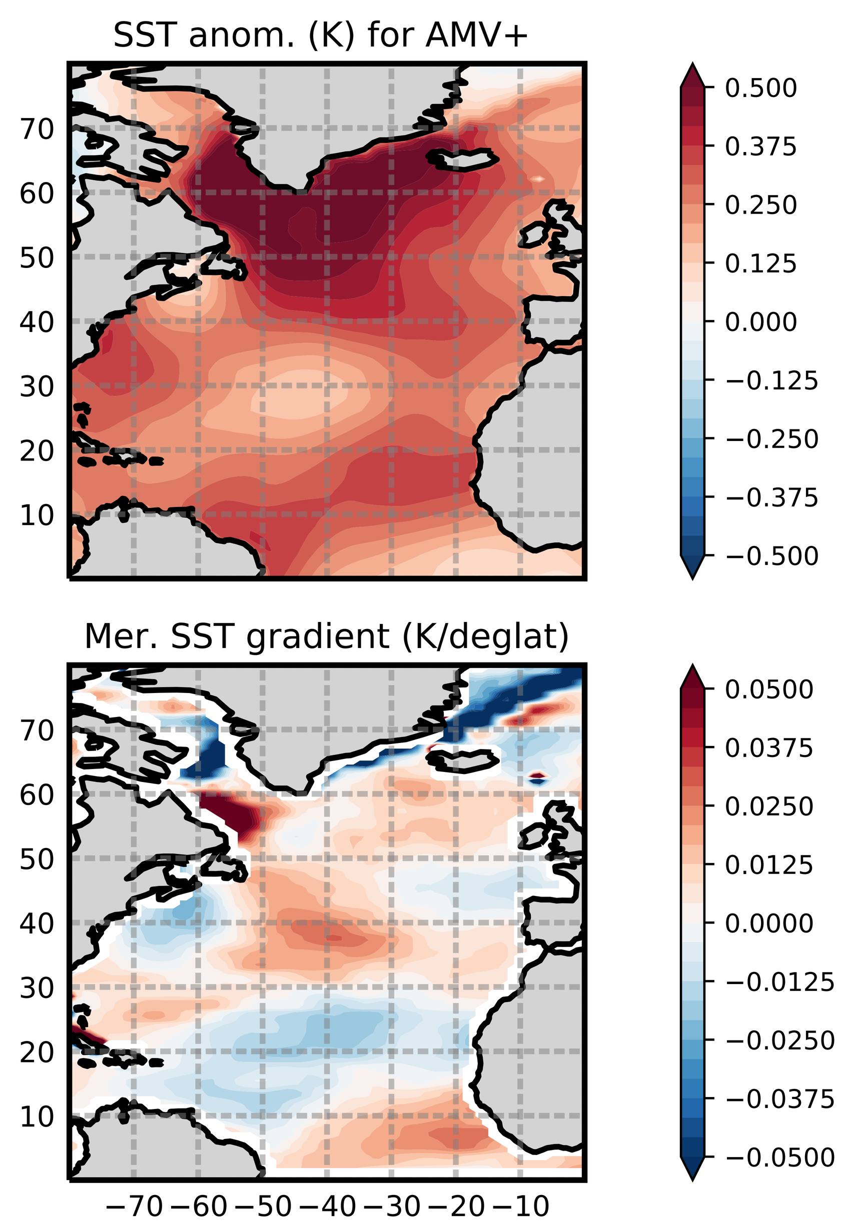

FIGURE 1: Anomalous SST field and gradient.

Multi-Model Ensemble

Data used are obtained from a set of idealized pacemaker experiments. The ocean surface in the North Atlantic is restored to a state obtained by imposing the AMV+ (see figure 1) and the AMV- anomalies onto the model climatology. SST patterns have been extracted from a version of the Extended Reconstructed SST dataset (Ersst_v3 or Ersst_v4) and correspond to an estimation of the internal component of the observed variability. Details on the setup can be found in [3].

LIST OF MODELS

NAME	CLIMATE	SST	MEMBERS
CNRM-CM6	1850	Ersst_v4	40
CMCC-CM2	1850	Ersst_v4	32
CESM1	1850	Ersst_v3	30
CNRM-CM5	1850	Ersst_v3	40
IPSL-CM6-LR	1850	Ersst_v4	25
EC-EARTH3.2.2	1950	Ersst_v4	25

Results 1

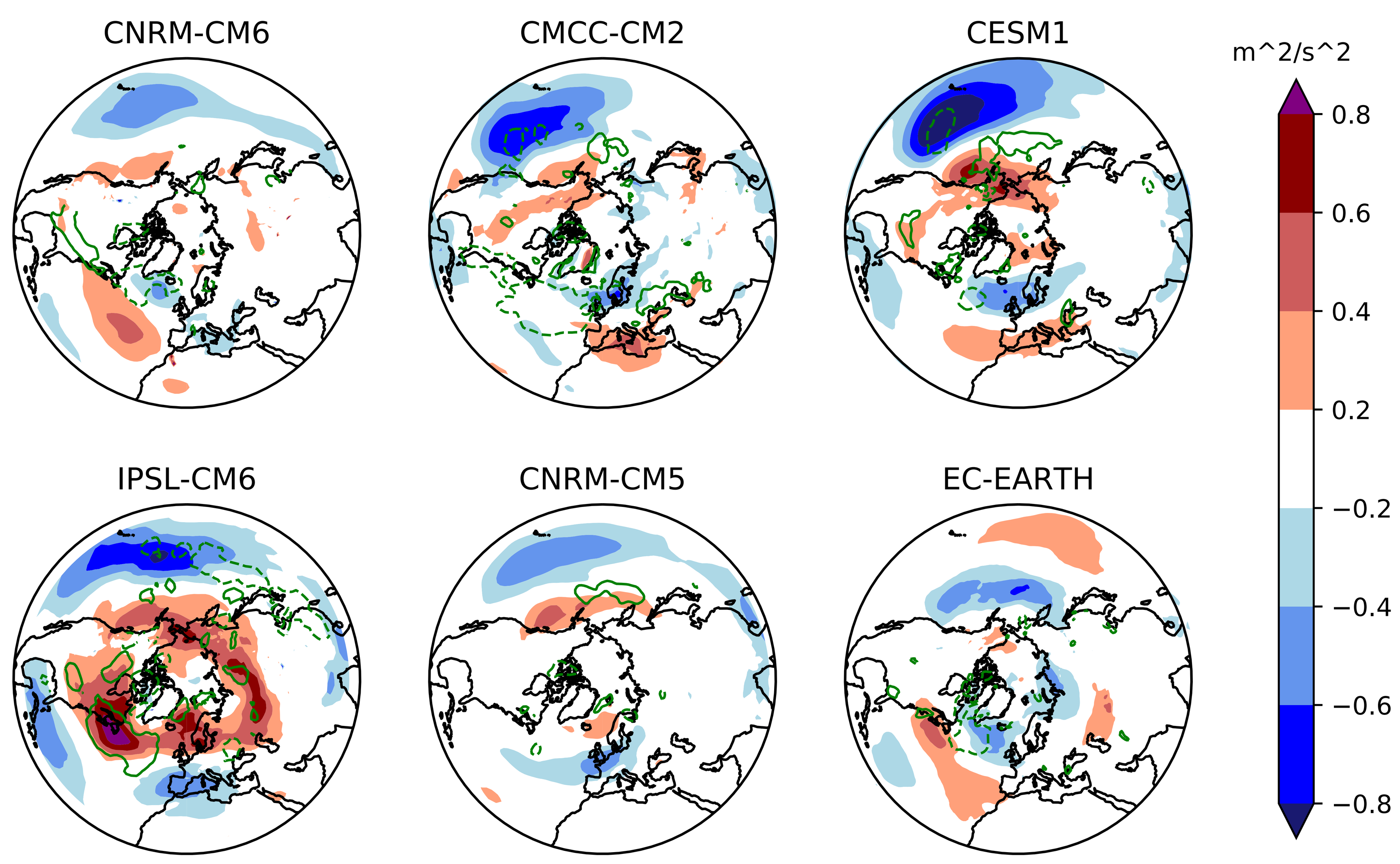

FIGURE 2: Difference (AMV+ - AMV-) of zonal wind (shading) and transient eddy heat flux (contours) at 850 hPa . Stippling indicates statistical significance (95%, t-test).

In the Pacific Ocean, 5 out 6 show a poleward displacement of the jet. In the Atlantic Ocean, a cluster of 4 models (CMCC, CESM, CNRM-CM6 and EC-EARTH) shows an equatorward displacement. CNRM-CM5 indicates a moderate poleward displacement and an overall weakening. In IPSL an annular signature is found. 4 out of 6 models indicate a reduction of the transient eddy heat flux in correspondence of the high baroclinicity region of the North Atlantic (see also figure 4 below).

Results 2

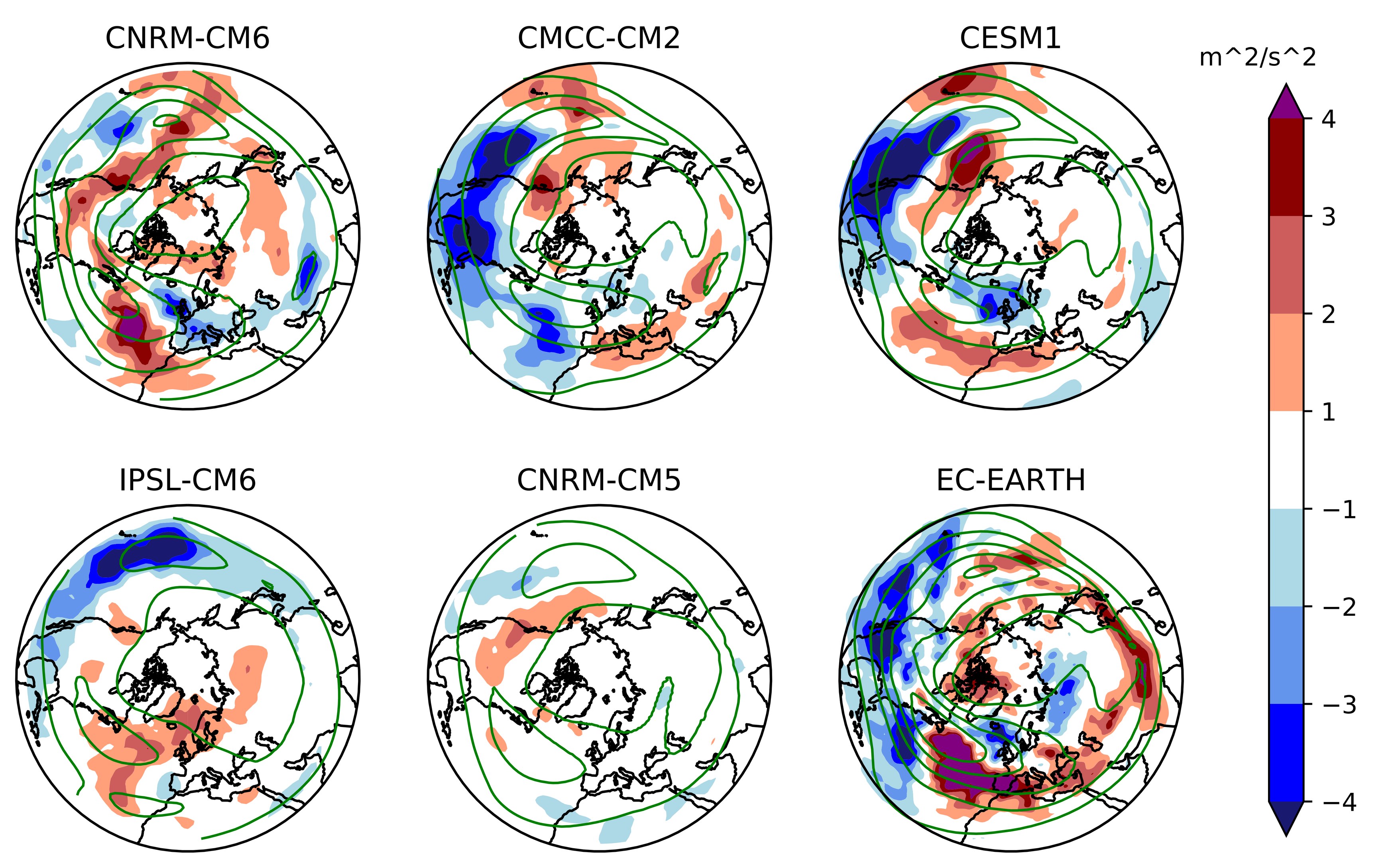

FIGURE 3: Difference of eddy kinetic energy (shading) at 200 hPa (250 for EC-EARTH) between AMV and AMV-. Contours (drawn every 35 m^2s^{-2}) indicate the climatology of eddy kinetic energy in AMV-

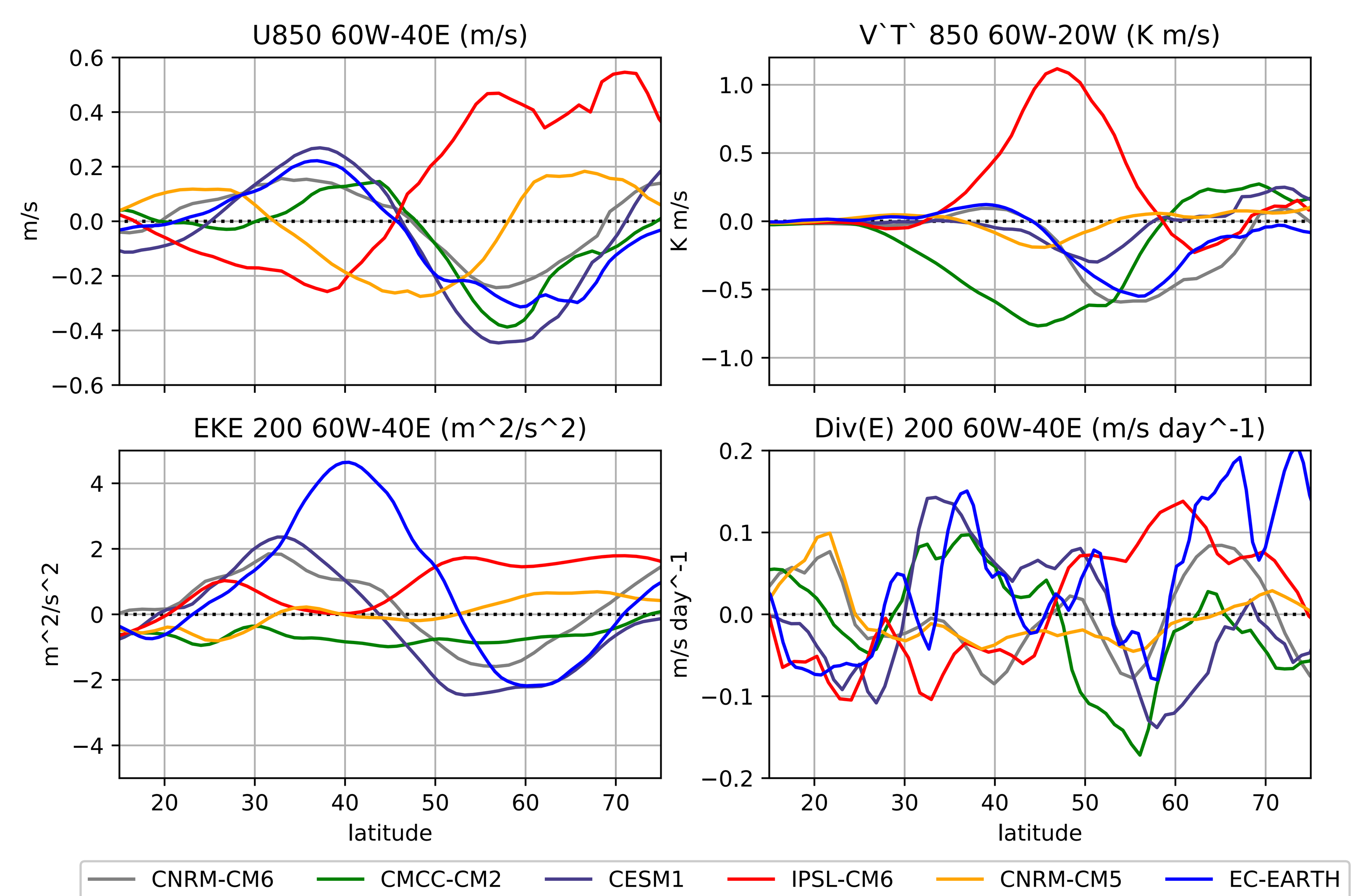

FIGURE 4: Difference (AMV+ - AMV-) of 4 variables (Wind and eddy heat flux at 850 hPa, eddy kinetic energy (EKE) and E-vectors divergenze (horizontal) at 200 hPa (250 for EC-EARTH). The lines indicate the zonal mean in the longitudinal sector in header.

The upper level eddy kinetic energy reveals that in 4 cases an equatorward shift is found. IPSL shows an intensification on the poleward side of the jet. The majority of models indicates an equatorward shift of the jet and of the EKE and a deceleration of the jet by the transient eddies (divergence of E-vectors). The most robust finding is the reduction of the meridional heat flux ($v'T'$). Further work will inlcude analysis of Eady growth rate and Eliassen-Palm flux and investigation of the relative role of tropical and extra-tropical forcing [4].

References and contact information

[1] - Msadek, Rym & Frankignoul, Claude. (2008). Atlantic multidecadal oceanic variability and its influence on the atmosphere in a climate model. Climate Dynamics.
[2] - Yannick Peings and Gudrun Magnusdottir 2014 Environ. Res. Lett.
[3] - Boer, G. J., et al. : The DCPP contribution to CMIP6, Geosci. Model Dev.
[4] - Paolo Davini et al 2015 Environ. Res. Lett.

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici
EUCP European Climate Prediction system
BLUE ACTION

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