

Limits of the DCPD AMV-experiments

Yohan Ruprich-Robert

Rym Msadek, Tom Delworth
and

Fred Castruccio, Steve Yeager, Gokhan Danabasoglu

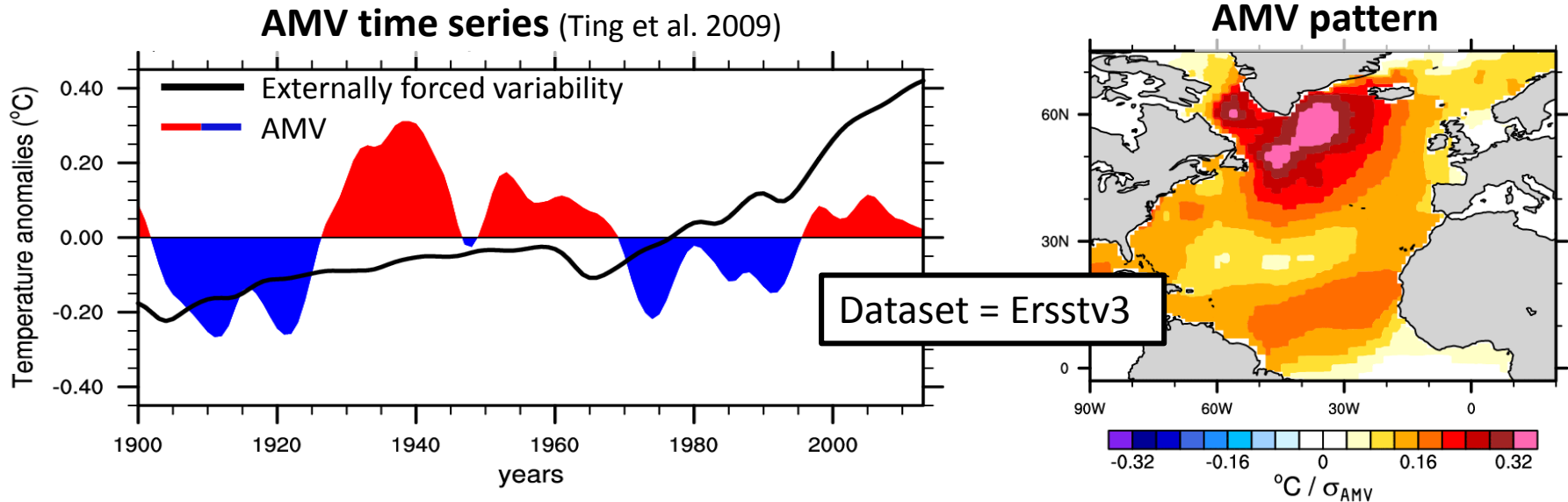
Primavera GA3, November 23rd 2017



Limits of the DCPD AMV-experiments

- WP5
- Yohan Ruprich-Robert
- BSC / GFDL – Princeton University
- Climate impacts of the AMV
 - Global impacts
 - Impacts over Europe
- Context
 - Standard protocol DCPD-like to estimate the climate AMV impacts
- links of this work to WP1 / WP2 / CMIP6 DCPD-C

AMV impacts on climate



Atlantic Multidecadal Variability (AMV)

- Droughts over North and South America
- European summer temperature
- Sahel drought
- Arctic sea-ice
- Occurrence of weather extremes
- Tropical cyclone activity
- Hiatus

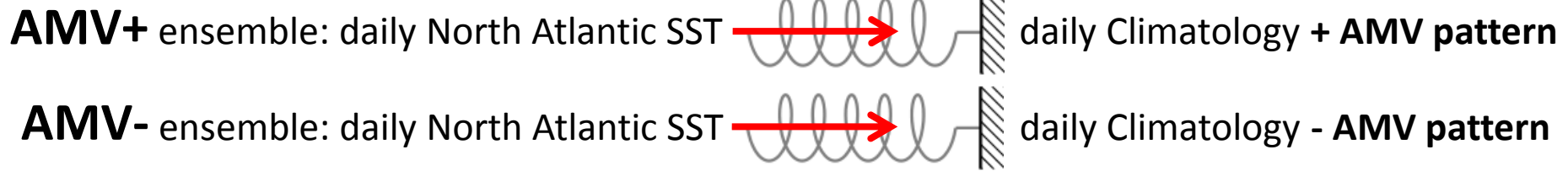
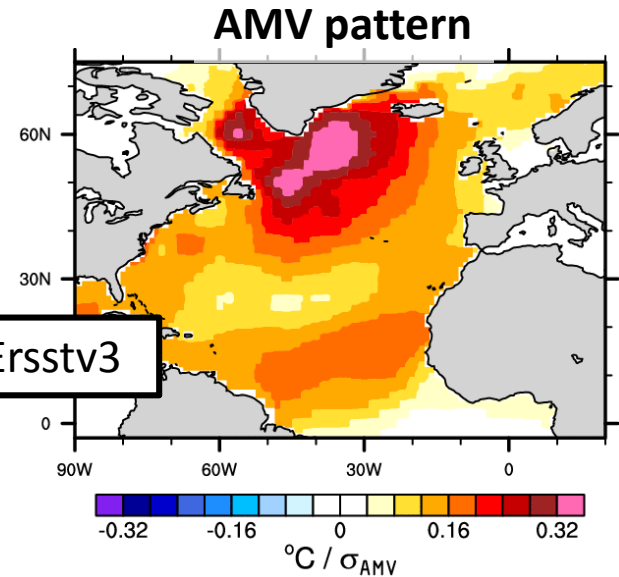
AMV impacts on climate

North Atlantic SSTs (5°N-70°N) restored to the **observed AMV pattern** with a 5/15-day restoring time scale

10yr long large ensemble experiments

Free ocean-ice-land-atmosphere interactions outside the Atlantic

Dataset = Ersstv3



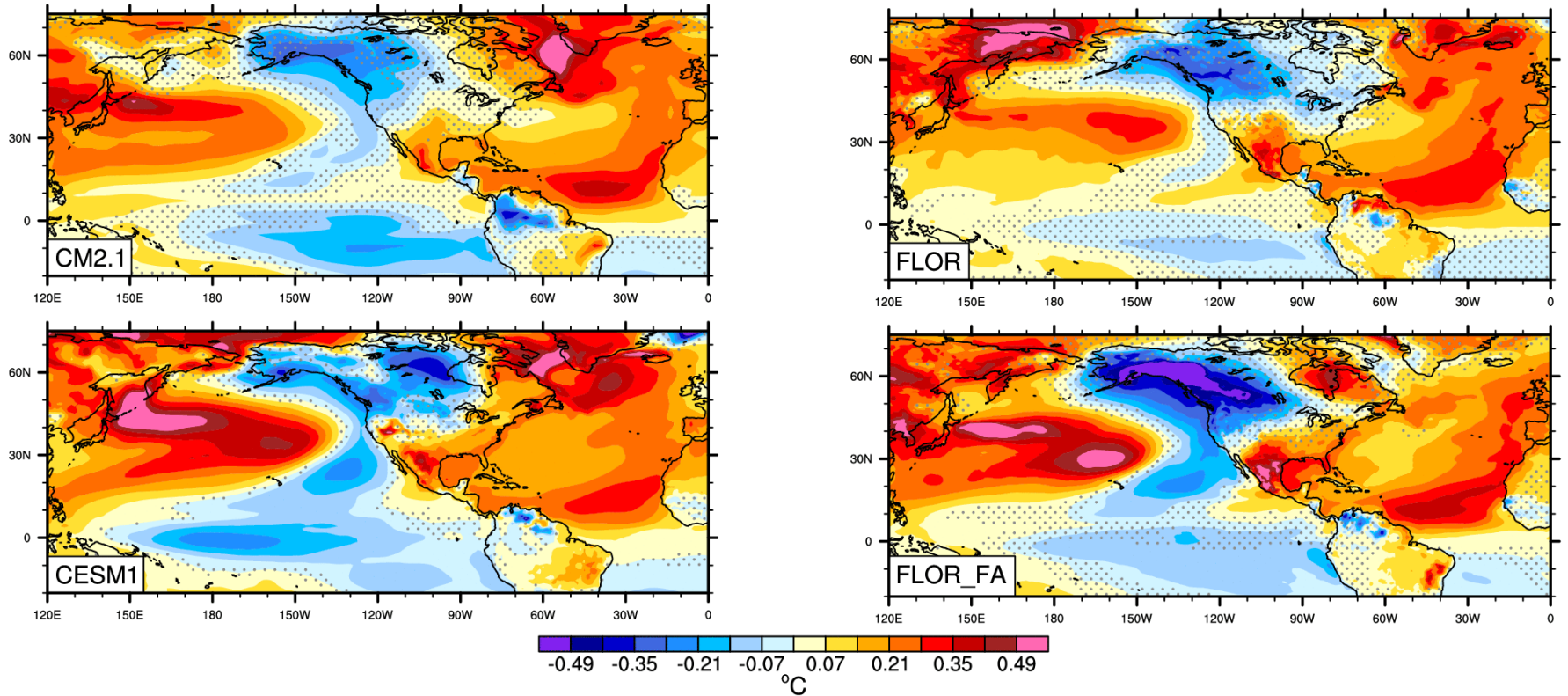
4 climate models

- GFDL-CM2.1 = 1° ocean / **200km** atmo \rightarrow 100 members
- NCAR-CESM1 = 1° ocean / **100km** atmo \rightarrow 30 members
- GFDL-FLOR = 1° ocean / **50km** atmo \rightarrow 50 members
- GFDL-FLOR_FA = GFDL-FLOR + surface flux adjustment to reduce mean SST bias

Same protocol as for Primavera except observed dataset (ersstv3 vs ersstv4) + 1850 external forcing

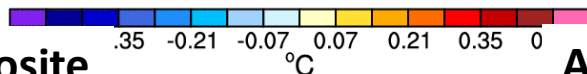
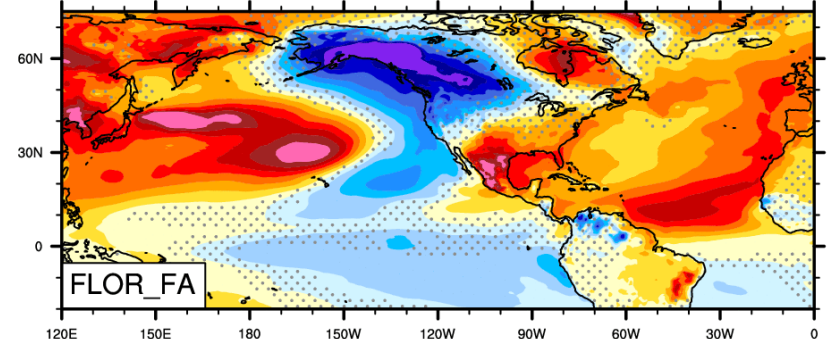
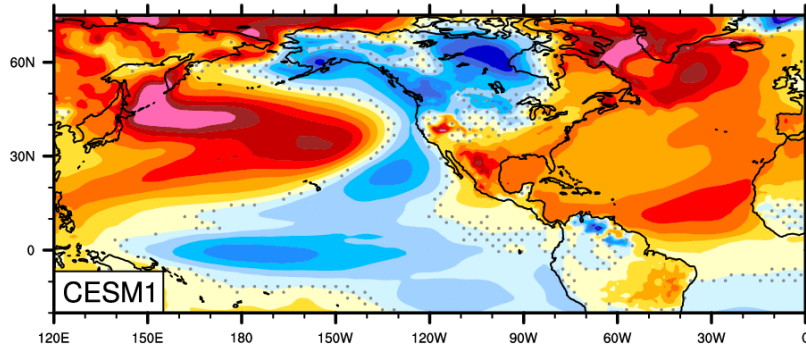
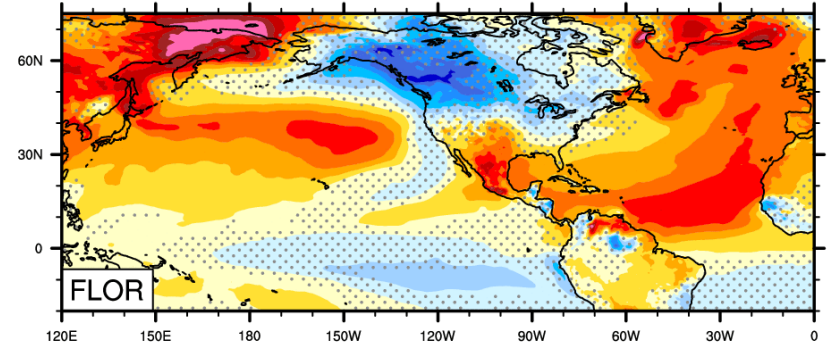
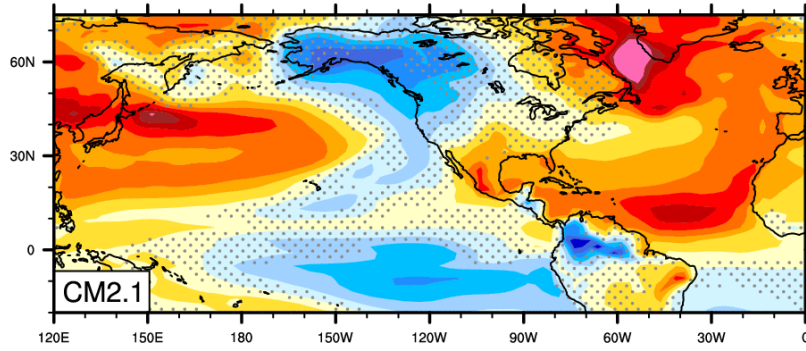
AMV impacts on Pacific

DJFM - T2m

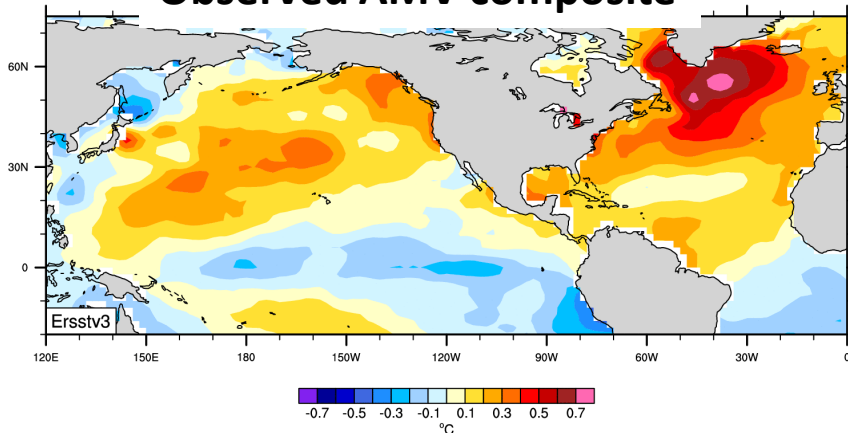


AMV impacts on Pacific

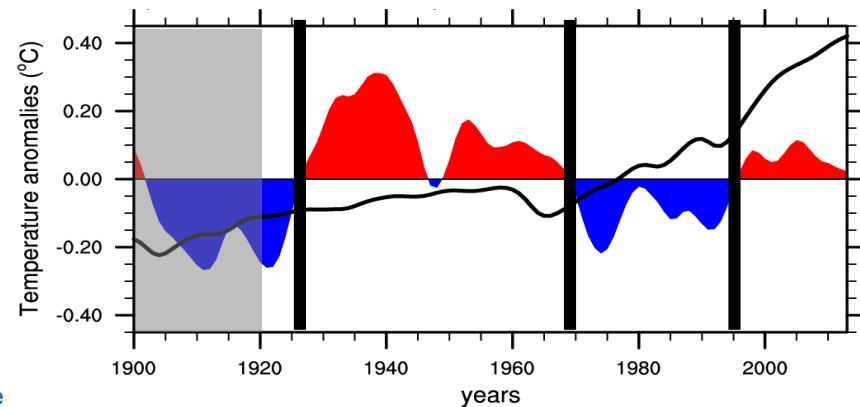
DJFM - T2m



Observed AMV composite



AMV time series (Ting et al. 2009)

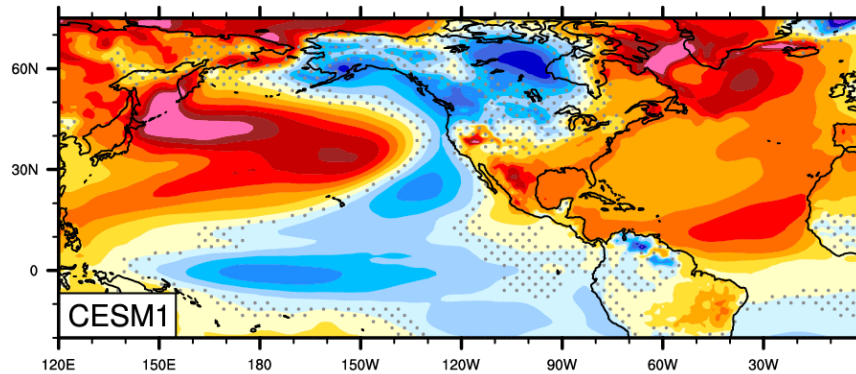


the

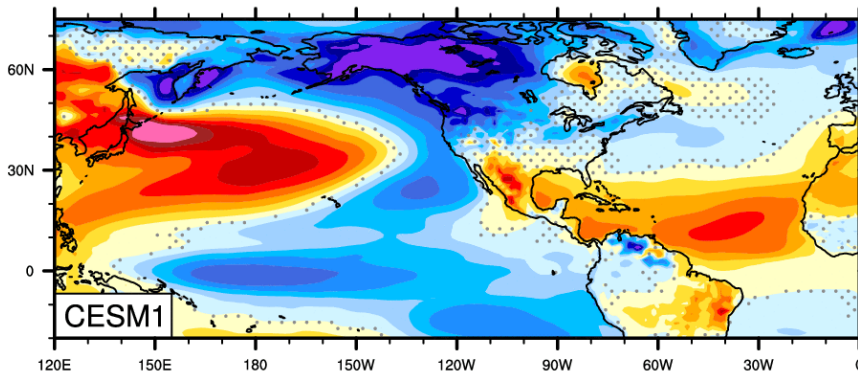
Origins of AMV impacts on Pacific

DJFM - T2m

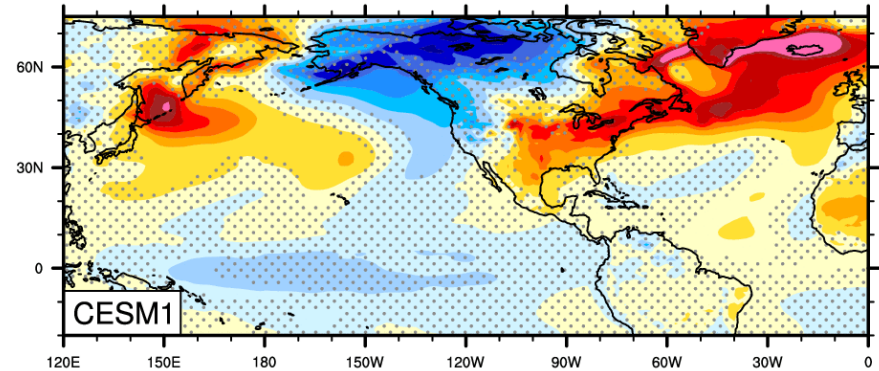
Full_AMV



Trop_AMV



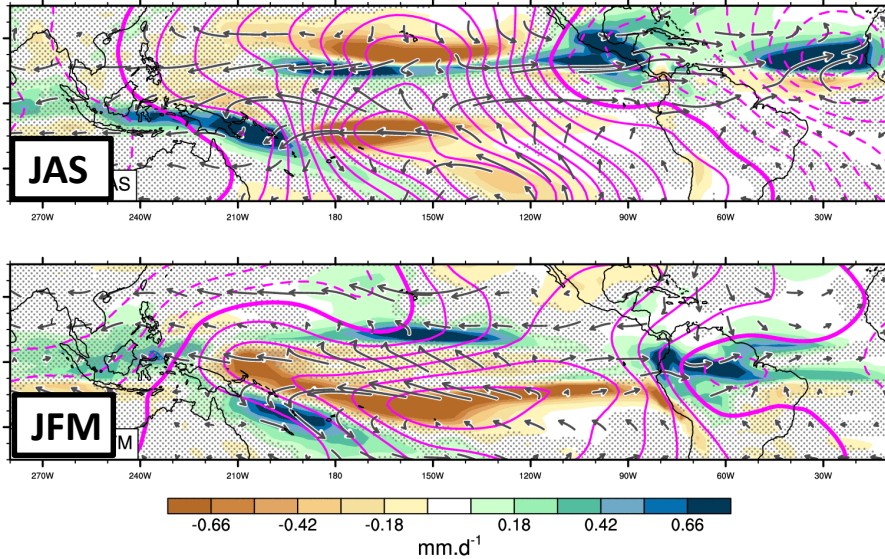
SPG_AMV



**Tropical part of AMV
forces Pacific response**

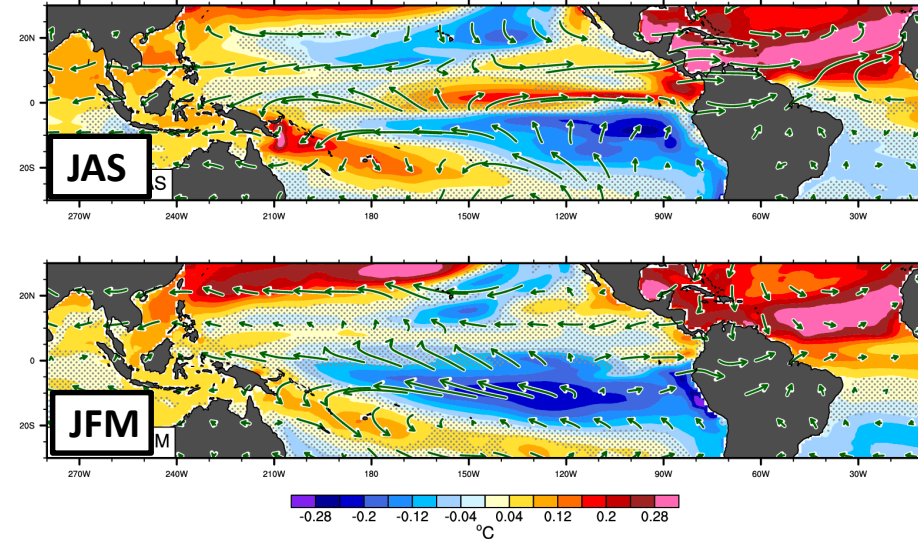
AMV impacts on Pacific: mechanism

CM2.1 – Full_AMV



Colors: precipitation
Contours: velocity potential@200hPa (wind divergence)
Arrows: wind@850hPa

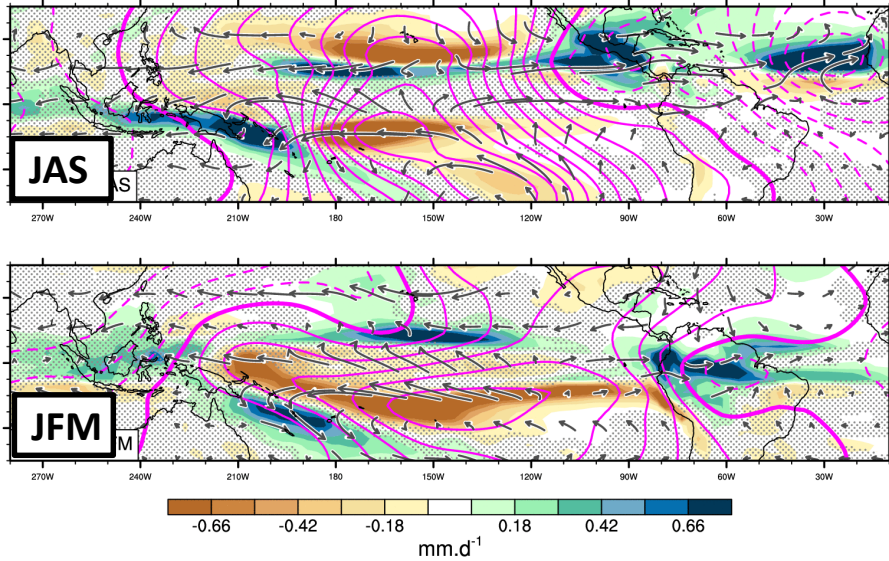
CM2.1 – Full_AMV



Colors: SST
Arrows: wind@850hPa

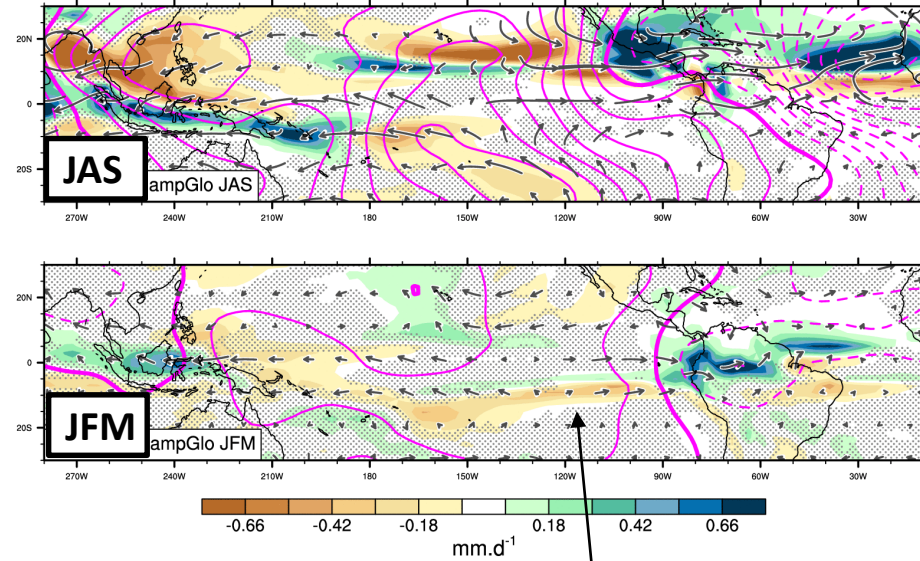
AMV impacts on Pacific: mechanism

CM2.1 – Full_AMV



Colors: precipitation
Contours: velocity potential@200hPa (wind divergence)
Arrows: wind@850hPa

CM2.1 – Damped_AMV

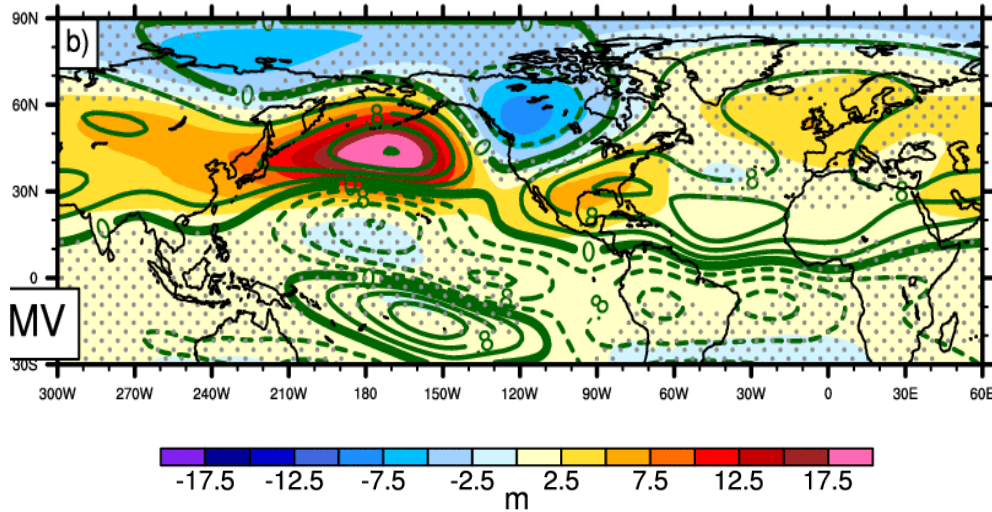


Colors: precipitation
Contours: velocity potential@200hPa
Arrows: wind@850hPa

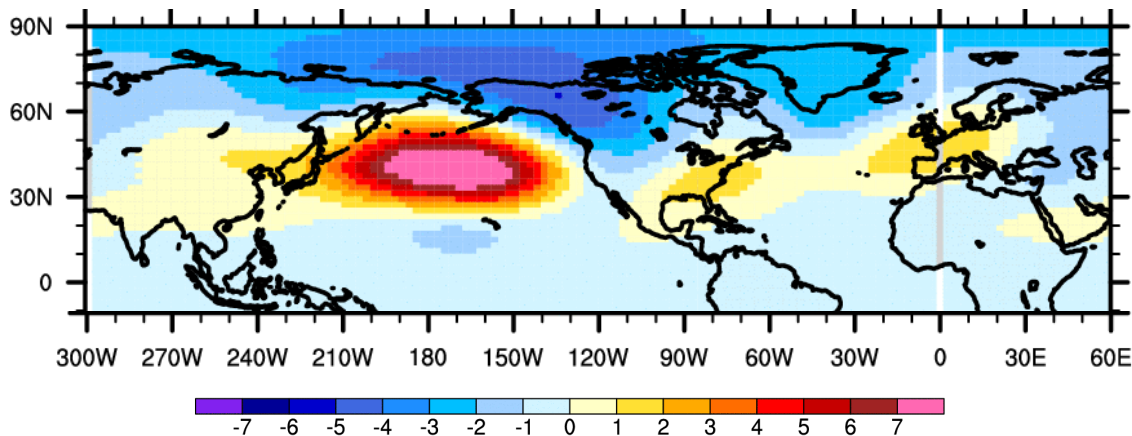
SST restored to its climatology

North Atlantic Europe impacts: extratropical vs tropical forcing...

CM2.1 DJFM - Z500 / SF200



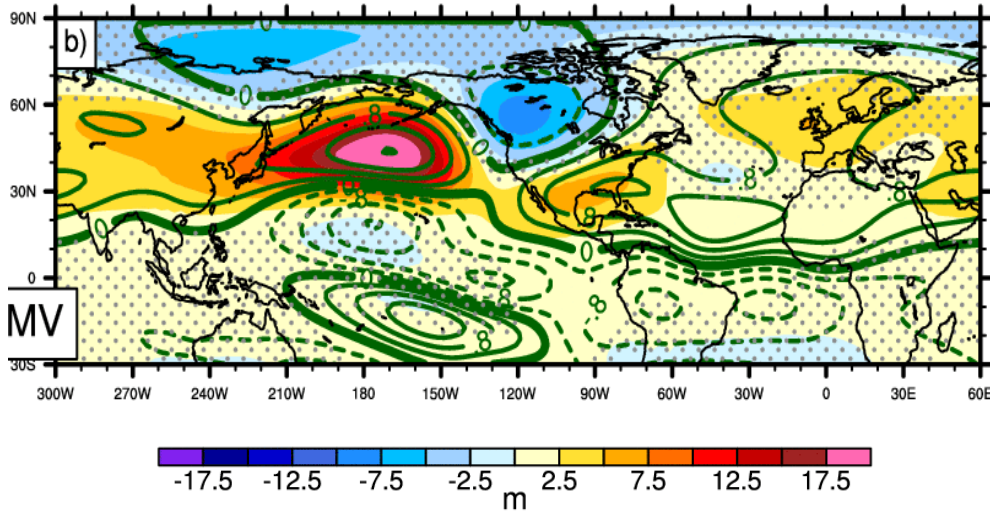
AMV+
-
AMV-



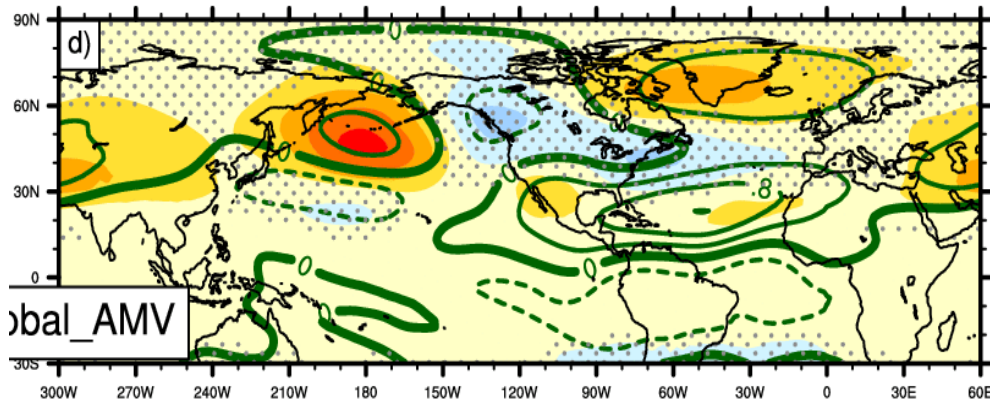
CM2.1
zg@500 regression
on PDO Index

North Atlantic Europe impacts: extratropical vs tropical forcing...

CM2.1 DJFM - Z500 / SF200



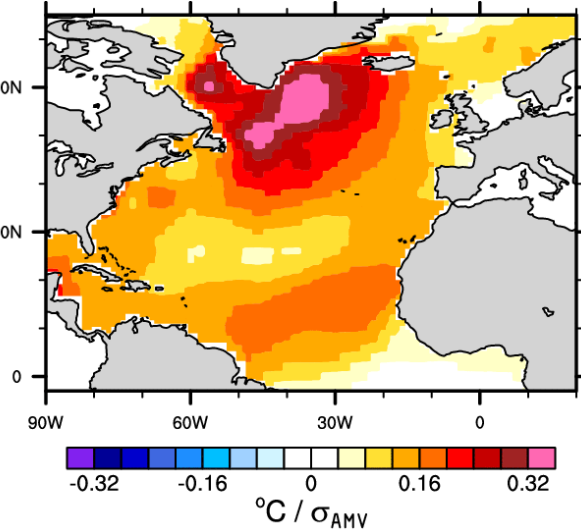
AMV+
-
AMV-



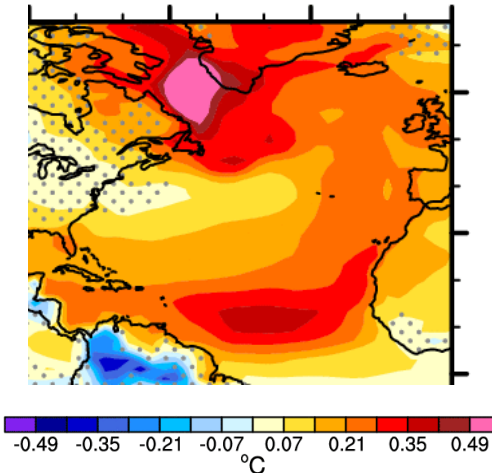
Damped_AMV+
-
Damped_AMV-

North Atlantic Europe impacts: extratropical vs tropical forcing...

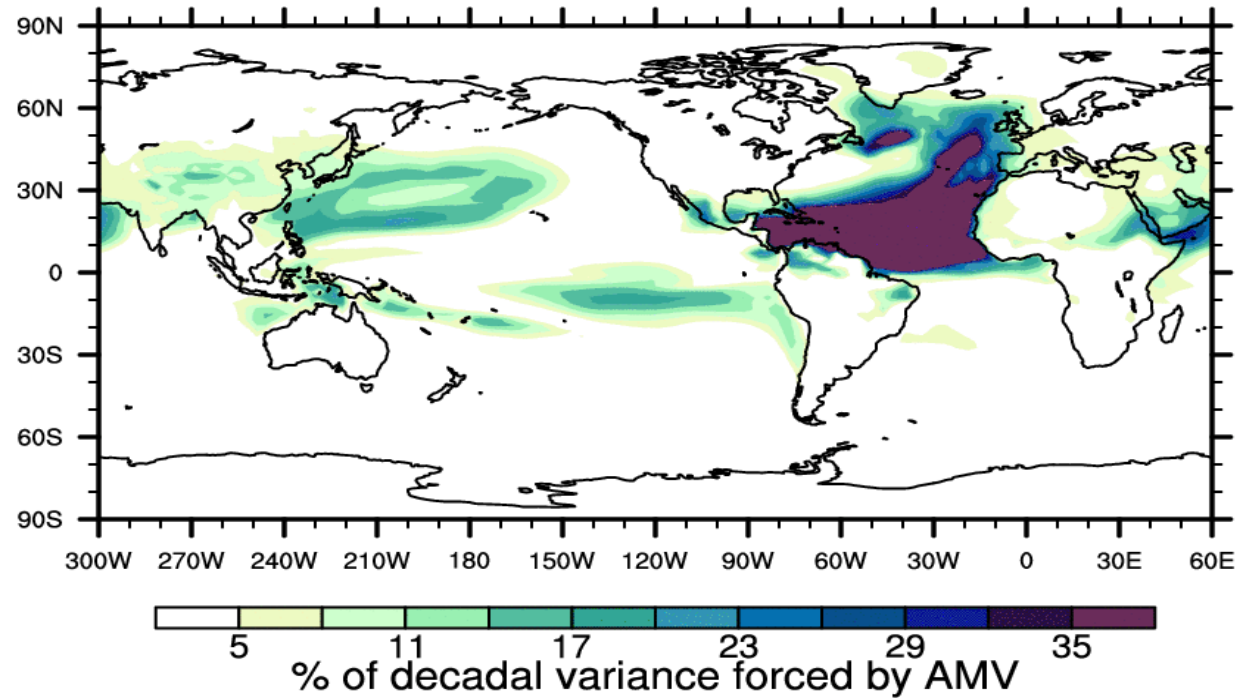
ERSSTv3 AMV



CM2.1 DJFM T2m



CM2.1 DJFM T2m - Signal to Noise Ratio



Conclusion

- AMV+ drives PDO- responses.
Tropical Atlantic = main driver of these teleconnections.
- La-Nina like response during winter:
 - delayed adjustment to summertime Walker circulation changes
 - ➔ Need coupled model to capture such a response.

Similar impacts between CM2.1, CESM1, FLOR, FLOR_FA

- Weak dynamical response over the North Atlantic – Europe region:
 - destructive interaction between tropical and Xtropical forcing?

**Experimental protocol gives more weight to tropical AMV forcing
due to latitudinal differences of mixed layer depth**

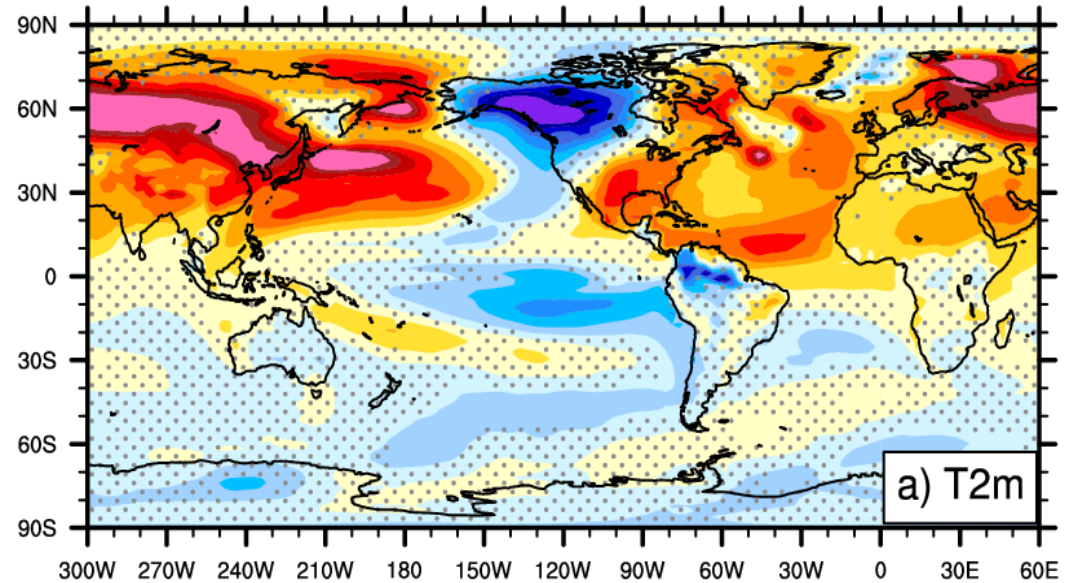
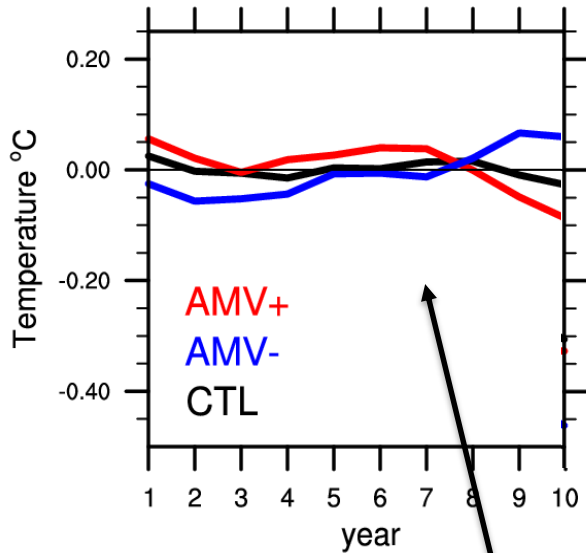
➔ Need to be careful with the methodology !!

Looking forward to...

- AMV experiments will be done with the EC-Earth model with high and standard resolutions within the next 2 months.
 - Need to change SST restoring subroutine of NEMO
- We will be interested in outputs of AMV-experiments performed by other institutes (and also by PDO-experiment outputs).
 - multi-model paper?
- Our data will be available as soon as they will have been quality controlled...
- Discussion / clarification on the common protocol to use!
 - 2xAMV ? Tropics vs Xtropics forcings.
 - sea-ice over the SPG in our LR simulation...

Avoid problems

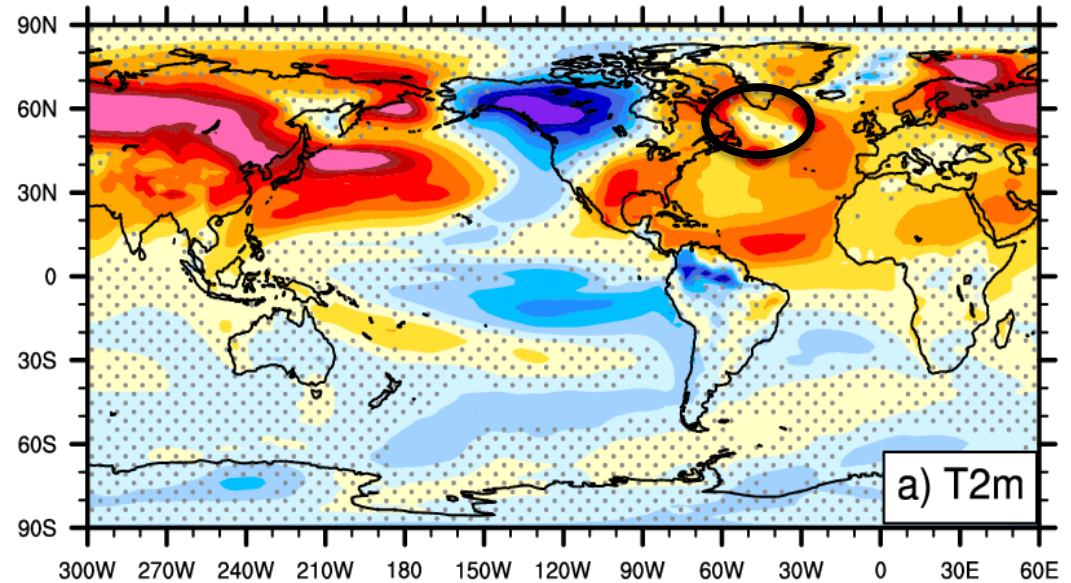
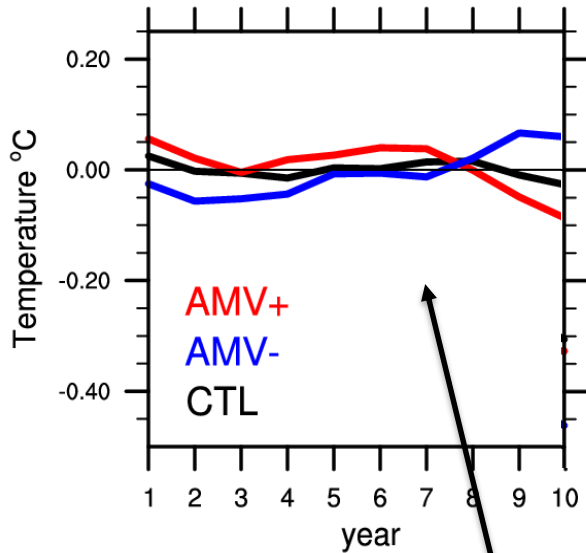
Annual SPG T@0-200 – CM2.1



5day timescale SST restoring only

Avoid problems

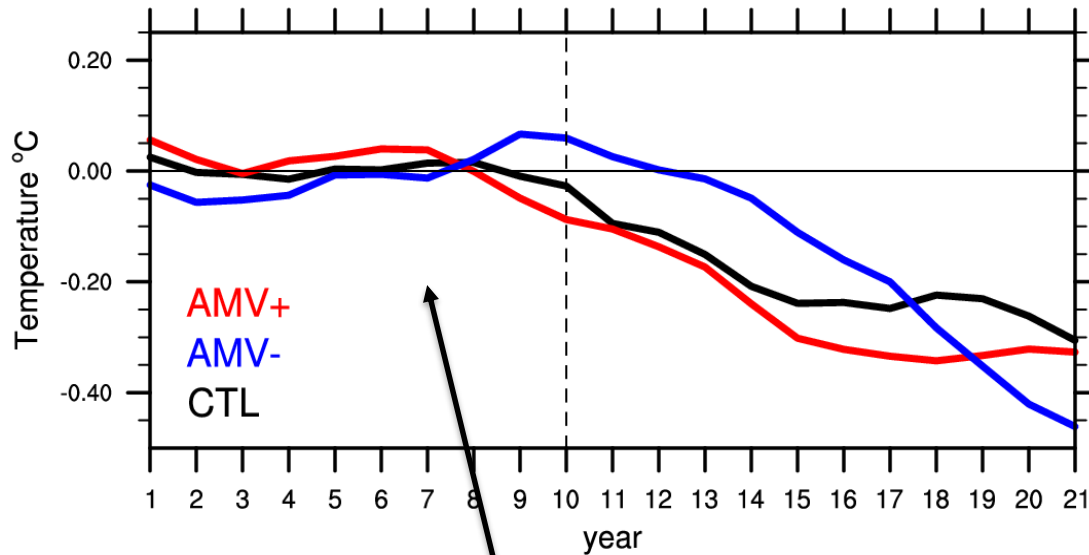
Annual SPG T@0-200 – CM2.1



5day timescale SST restoring only

Avoid problems

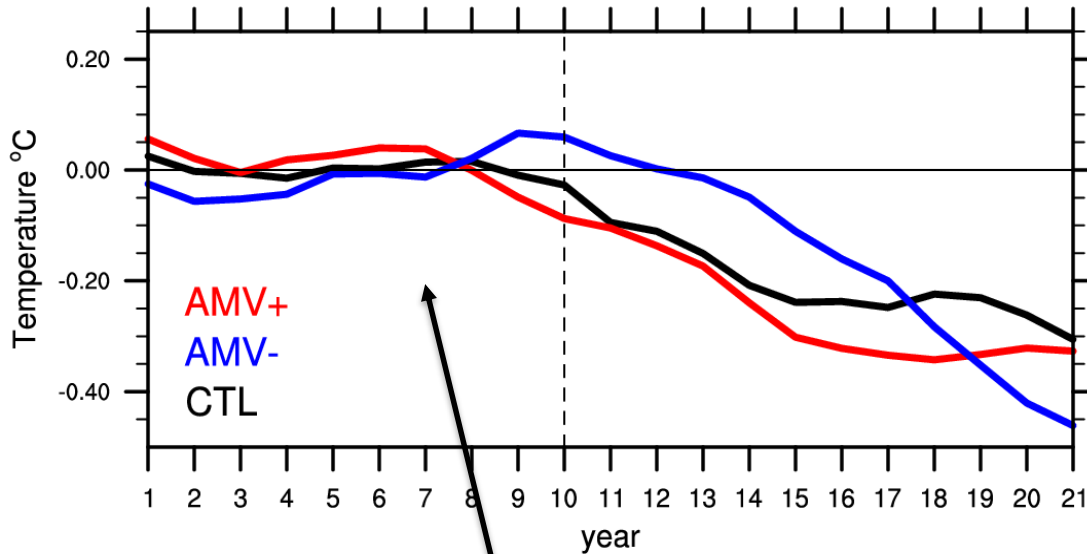
Annual SPG T@0-200 – CM2.1



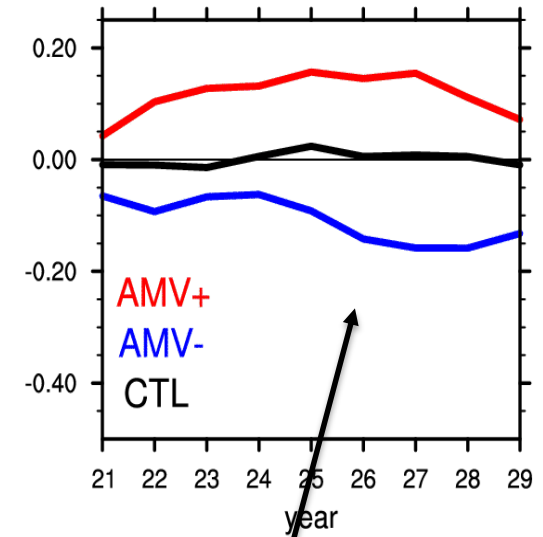
5day timescale SST restoring only

Avoid problems

Annual SPG T@0-200 – CM2.1



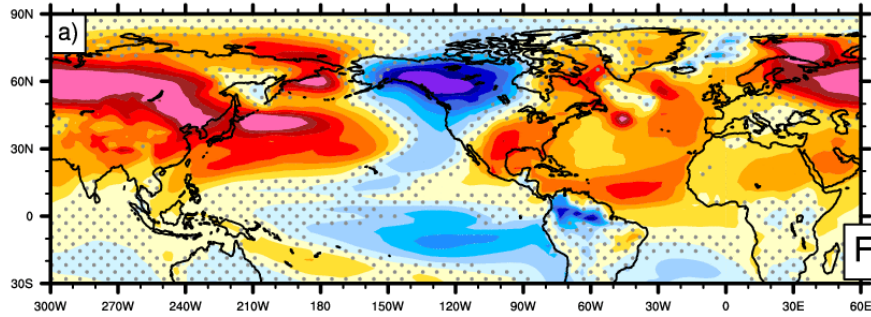
5day timescale SST restoring only



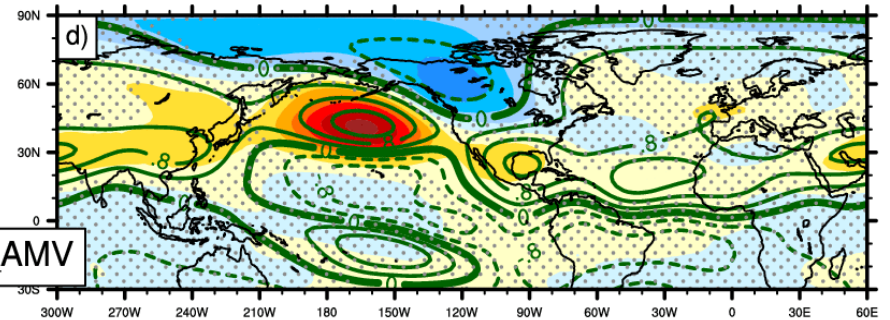
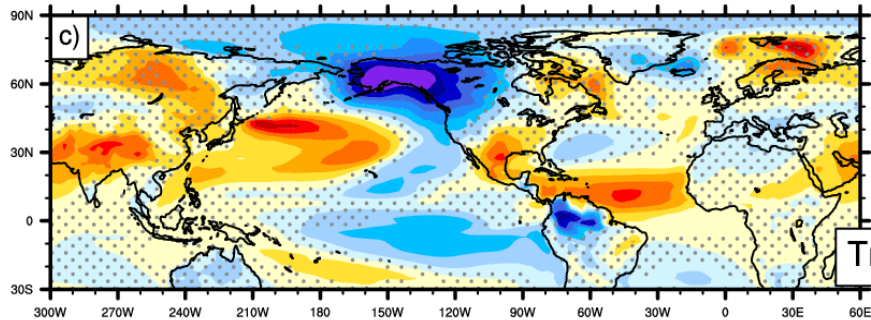
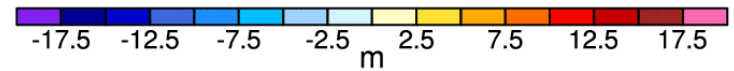
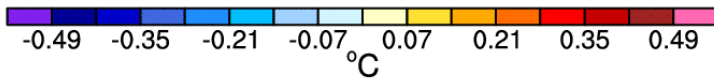
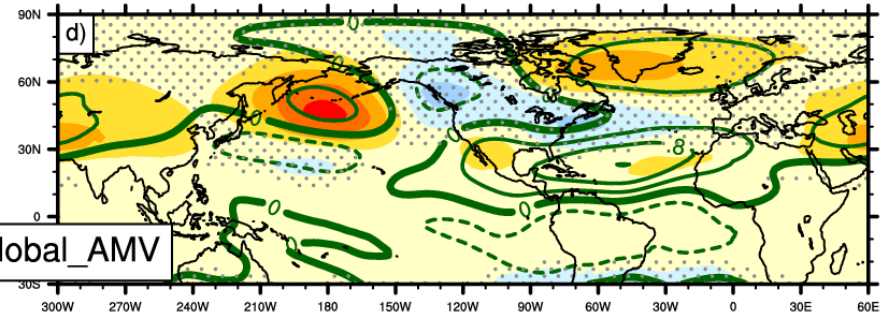
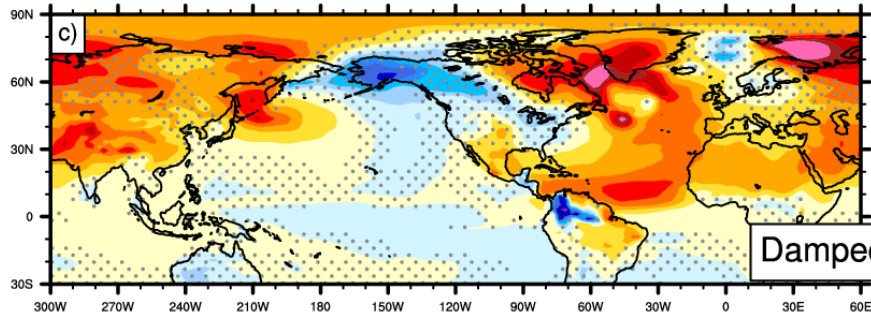
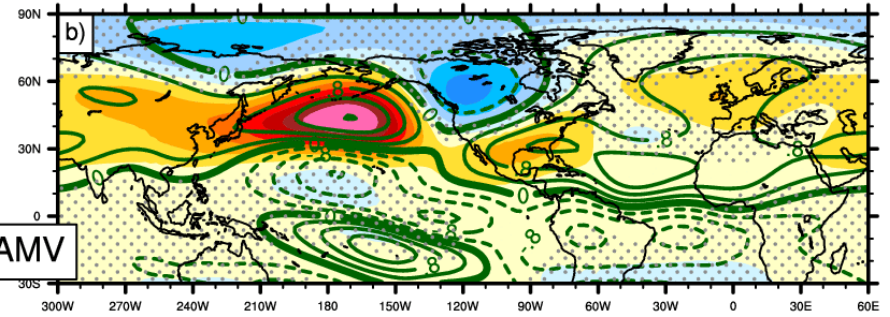
15day timescale SST&SSS restoring

North Atlantic Europe impacts: extratropical vs tropical forcing...

CM2.1 DJFM - T2m

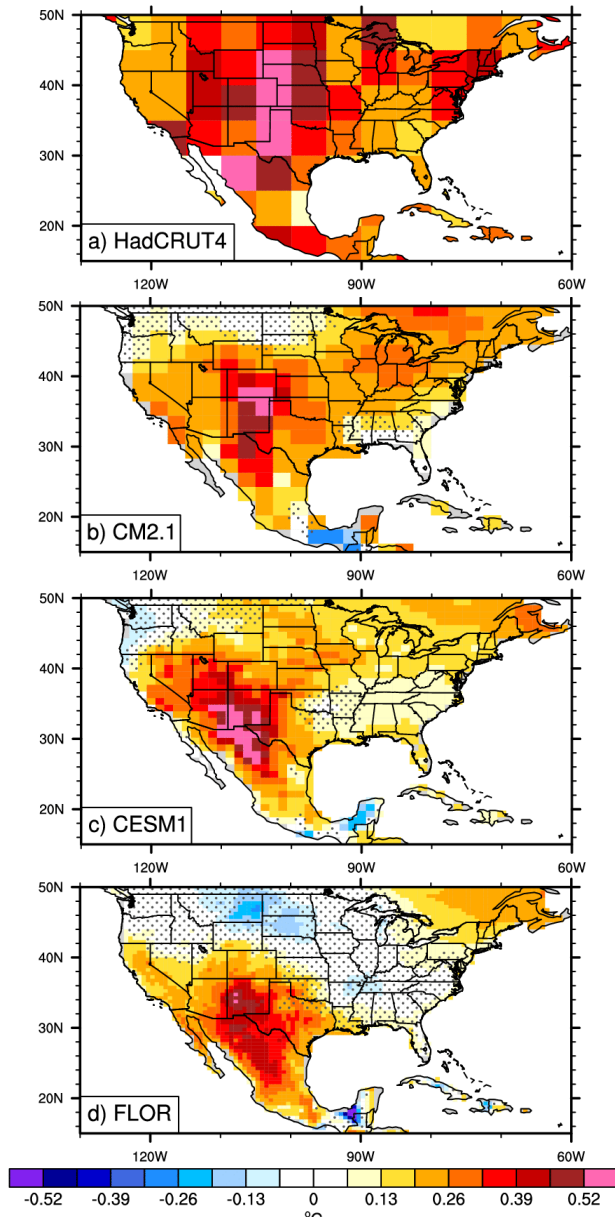


CM2.1 DJFM - Z500 / SF200



AMV impacts on North American Heat Waves

June-July-August T2m



Days of heat waves / AMV+ vs AMV-

