Modulation of the winter atmospheric response to Arctic sea-ice loss by the Pacific decadal variability

G. Gastineau[1], A. Simon[1] and C. Frankignoul[1], V. Lapin[2], P. Ortega[2], E. Manzini[3], D. Matei[3], K. Lohmann[3], E. Tyrlis[3], Y.-C. Liang[4], Y.-O. Kwon[4], O.H. Ottera[4], Y. Gao[5]

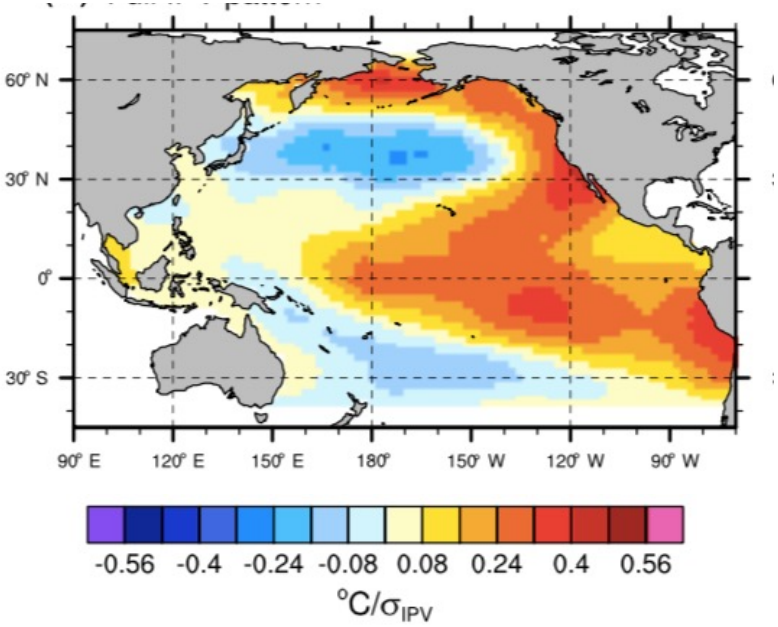
[1]LOCEAN, Sorbonne Université, CNRS/IRD/MNHN, Paris, France
[2]Barcelona Supercomputing Center, Barcelona, Spain
[3]Max Planck Institue for Meteorology, Hamburg, Germany
[4]NORCE, Bergen, Norway
[5]NERSC, Bergen, Norway

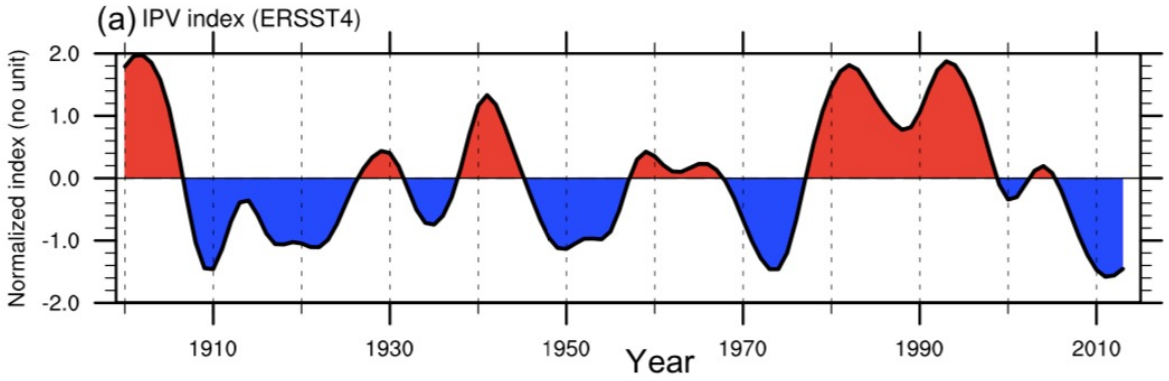
BLUE ACTION

www.blue-action.eu
@BG10BlueAction

Introduction

Interdecadal Pacific Variability (IPV)





IPV index = first EOF SST 40°S – 60°N in Pacific (low pass filtered using 13-yr cutoff period); signal to noise EOF to remove external forcing (DCPP-C; Boer et al., 2016)

What are the links between the teleconnections associated to the IPV and the Arctic sea ice changes?

- > Screen and Francis (2016) show that PDO modulates the response to Artic sea ice loss in observation and models.

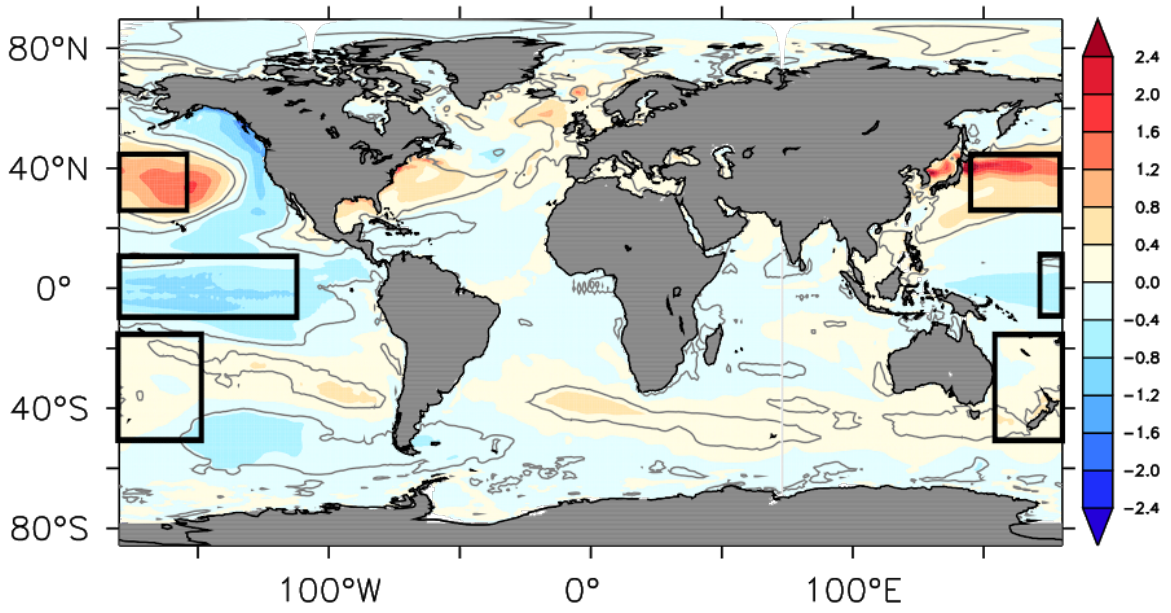
Methodology

Coupled time-slice experiments with PAMIP forcings using the **IPSL-CM6A-LR** model (atm 2.5°x1.3° L75 / top at 0.01hPa; oce 1° L79): 14 month, external forcing from 2000, and sea-ice concentration constrained. 200 members each.

-> pdSIC or **PD** = present day sea ice from PAMIP
-> piArcSIC or **PI** = preindustrial sea ice from PAMIP
-> futArcSIC or **Fut** = future sea ice from PAMIP

Initialisation from existing historical runs (CMIP6, 32 historical) : 200 start dates selected within 1990-2010 based on low pass filtered IPV and AMV indices.

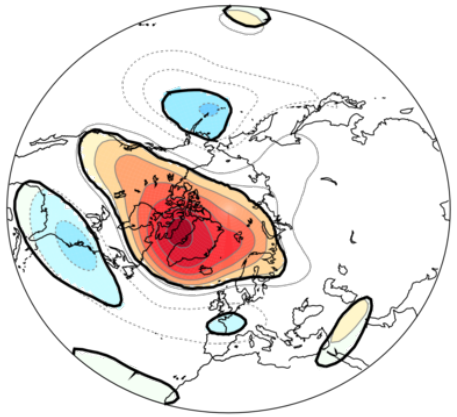
DJF SST (°C)
$IPV-_{50}$ minus $IPV+_{50}$ in PD



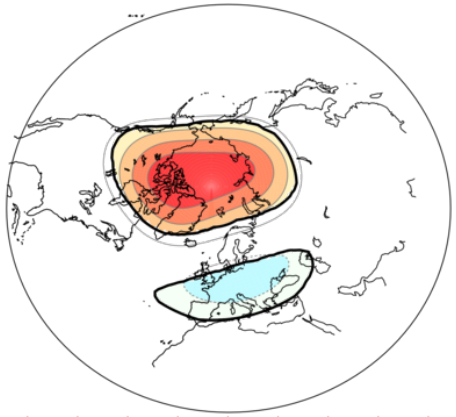
Modulation by the IPV in IPSL-CM6A-LR

$(Fut - Pi)_{IPV\text{-}50}$

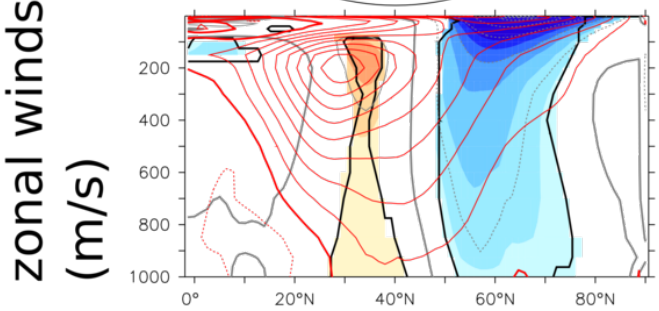
Z500 (m)



Z50 (m)



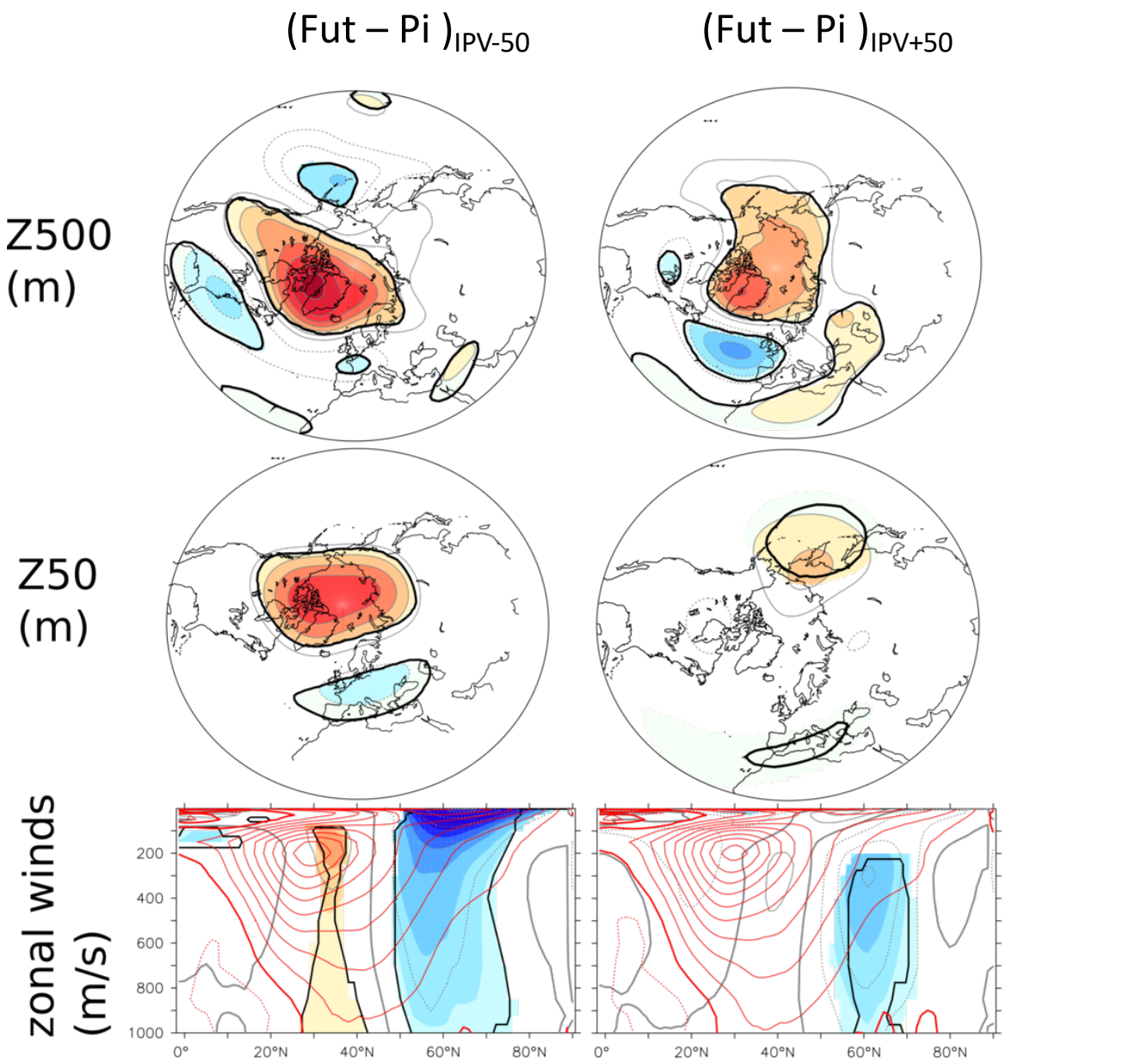
zonal winds (m/s)



Black contour = p-value < 5%

Color only if FDR < 10%

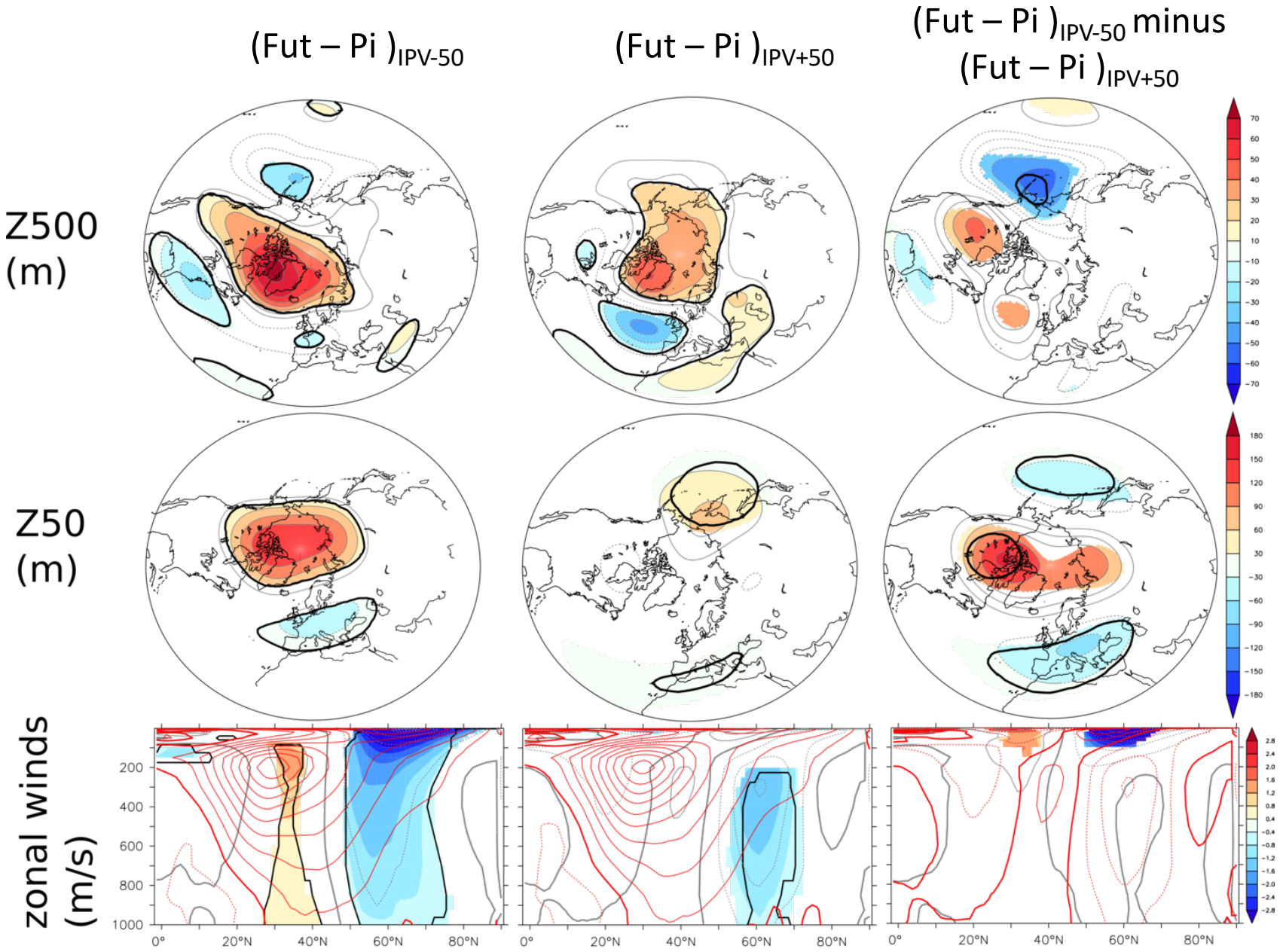
Modulation by the IPV in IPSL-CM6A-LR



Black contour = p-value < 5%

Color only if FDR < 10%

Modulation by the IPV in IPSL-CM6A-LR



Black contour = p-value < 5%

Color only if FDR < 10%

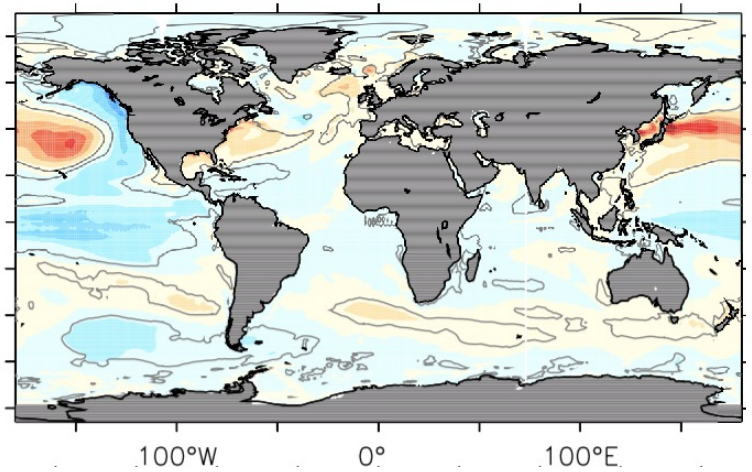
IPV Teleconnections

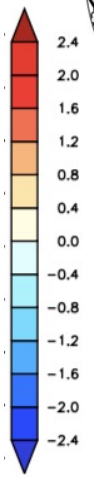
SST (°C)

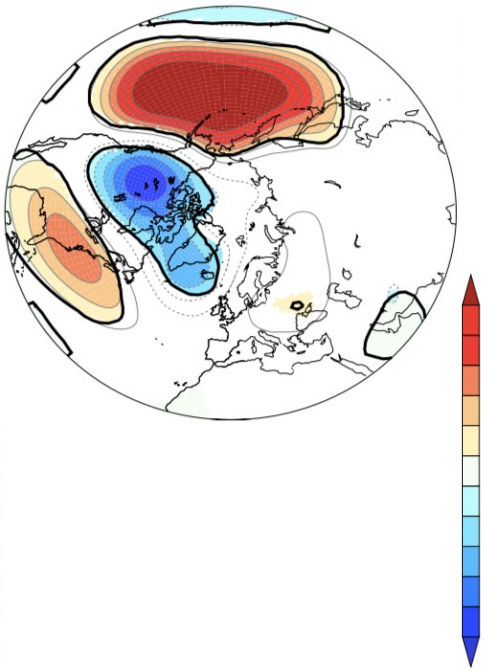
500-hPa geopotential height (m)

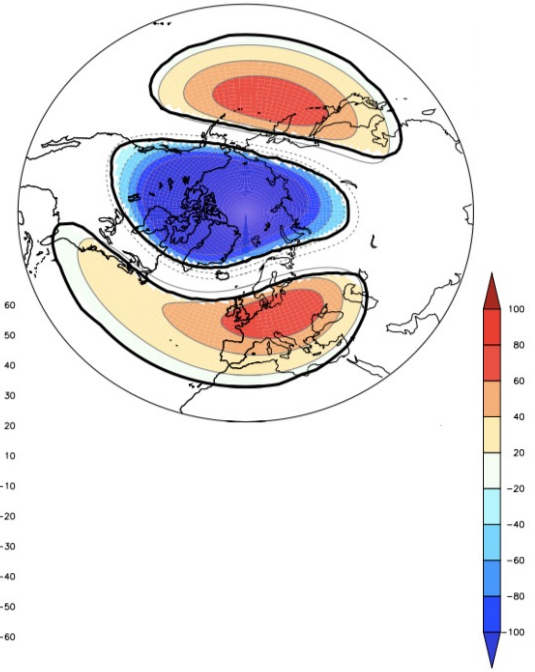
50-hPa geopotential height (m)

$IPV-_{50}$ minus $IPV+_{50}$ in PI





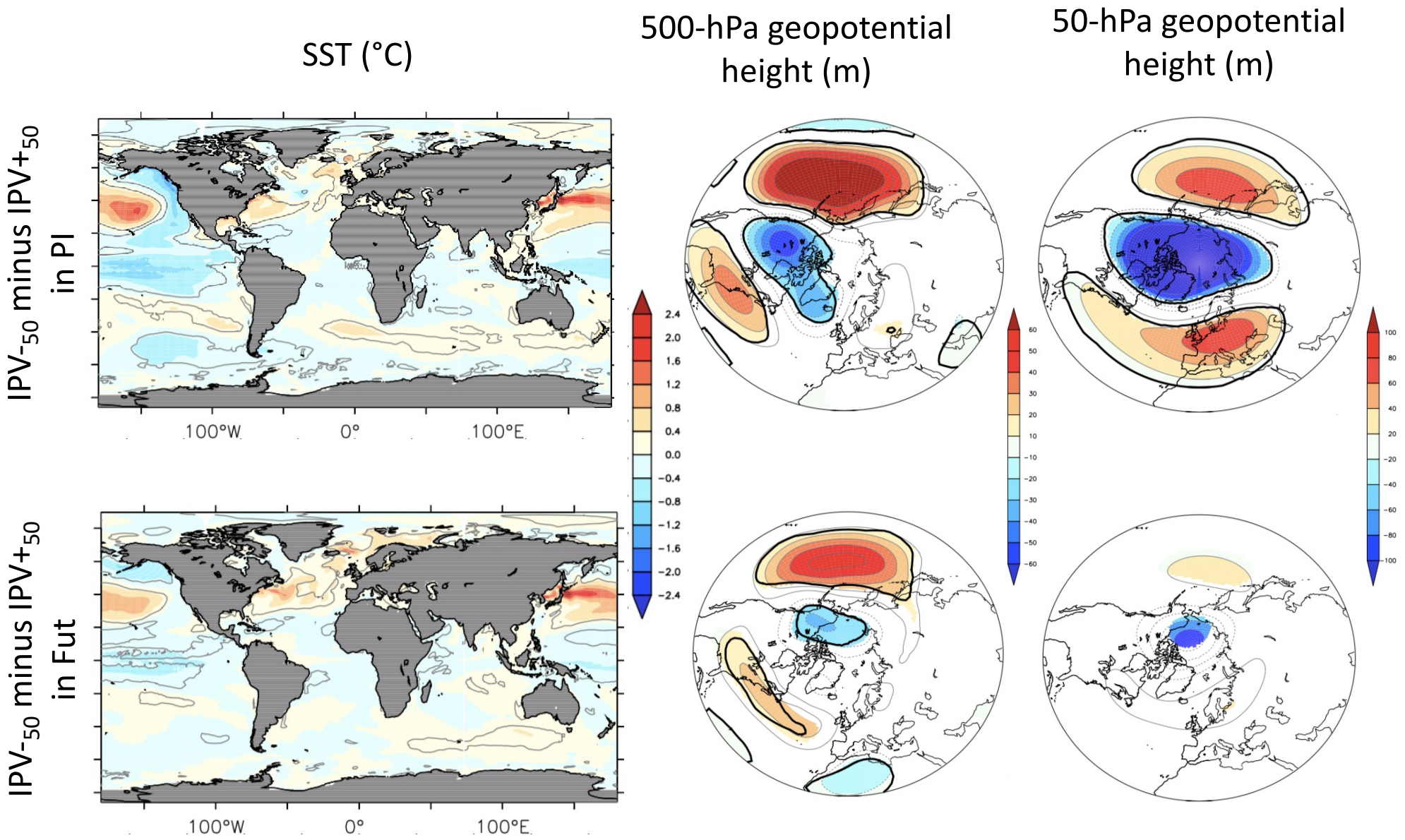




Grey contour = p-value < 5%

Black contour = p-value < 5% ; Color only if FDR < 10%

IPV Teleconnections



Grey contour = p-value < 5%

Black contour = p-value < 5% ; Color only if FDR < 10%

Discussion

Main results :

The IPV might have a model dependent influence on the Arctic – midlatitude linkages.
IPSL-CM6A-LR illustrates for negative IPV phases:

- a slightly larger tropospheric response (as in Screen and Francis 2016),
- a weaker stratospheric polar vortex.

Questions :

- Apply the analysis previously shown to other models. Are the links found robust?
- Assess whether the IPV teleconnections realistic in IPSL-CM6A-LR?
- Link with ENSO?
- What is the non-linearity of the ENSO/IPV teleconnection? Does it explain the difference AGCM / AOGCM in PAMIP experiments?

BLUE ACTION

Project Coordinator: Steffen M. Olsen, Danish Meteorological Institute, smo@dmi.dk
Dissemination, Communication, Engagement lead: Hannah Grist , SRSL, Hannah.Grist@srsl.com
Project manager: Chiara Bearzotti, Danish Meteorological Institute, chb@dmi.dk

@BG10Blueaction

www.blue-action.eu

The Blue-Action project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727852