Display Material

The effects of reduced Atlantic and Pacific land-sea thermal contrast on the extratropical circulation

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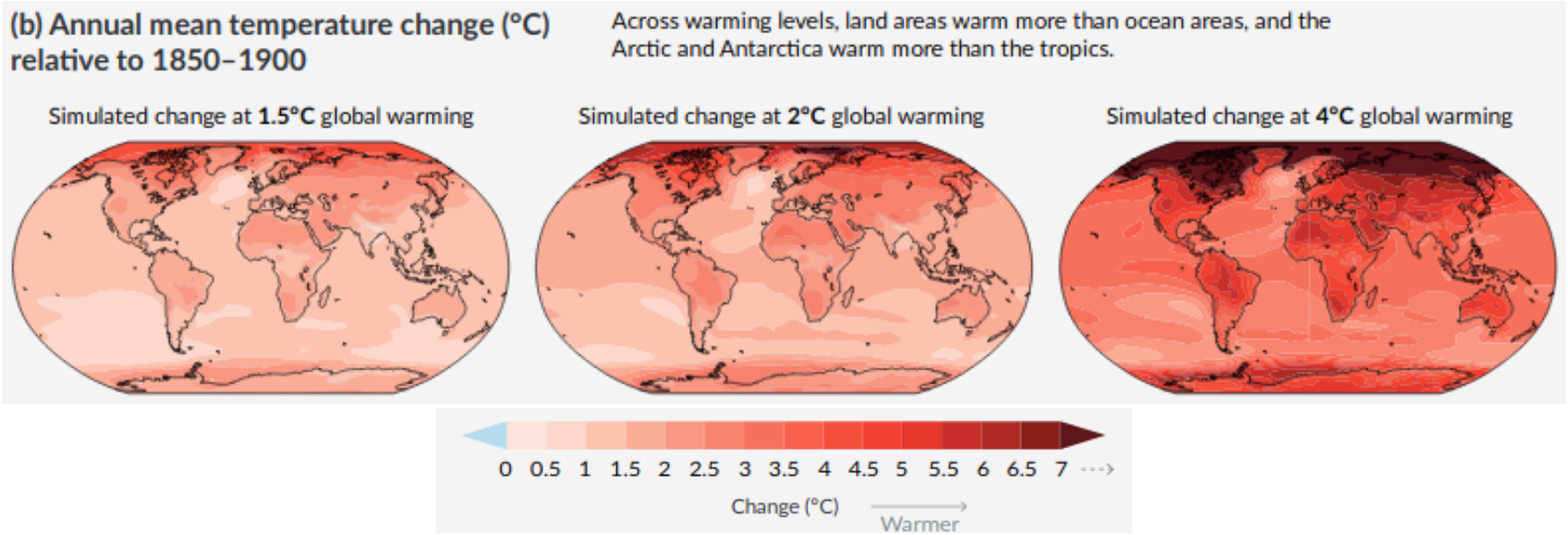
Alice Portal[1,2] **(a.portal@campus.unimib.it),**
C. Pasquero, F. D'Andrea, P. Davini, M. Hamouda, G. Rivière

[1] **DISAT, Università Milano - Bicocca**
[2] **Laboratoire de Météorologie Dynamique, IPSL, Paris**

Introduction

IPCC AR6 *WGI*



- Northern Hemisphere, winter season
- From long-term projections we expect a **decrease in the mid-latitude thermal land-sea contrast (LSC)**

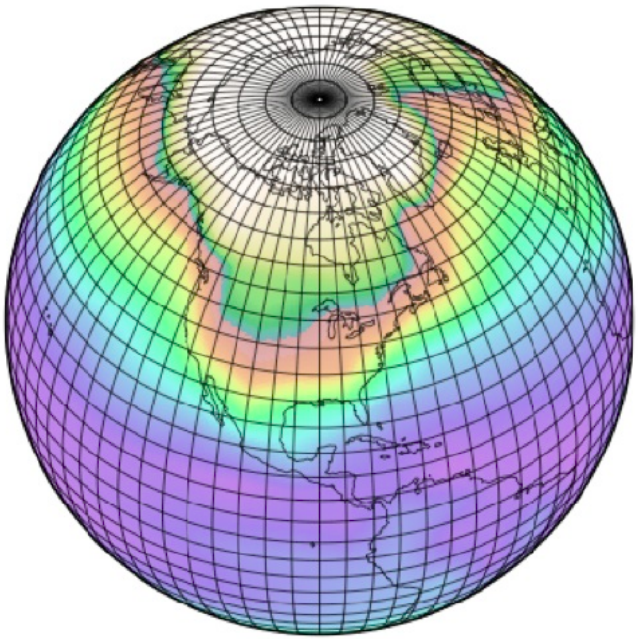
$\Rightarrow$ Effects on the extratropical large-scale circulation?

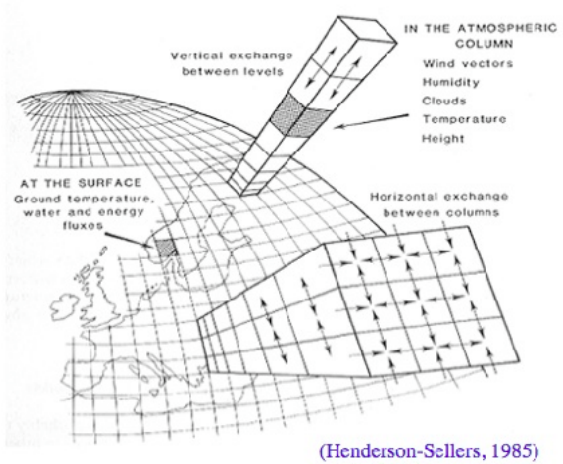
Model

SPEEDY: intermediate-complexity AGCM

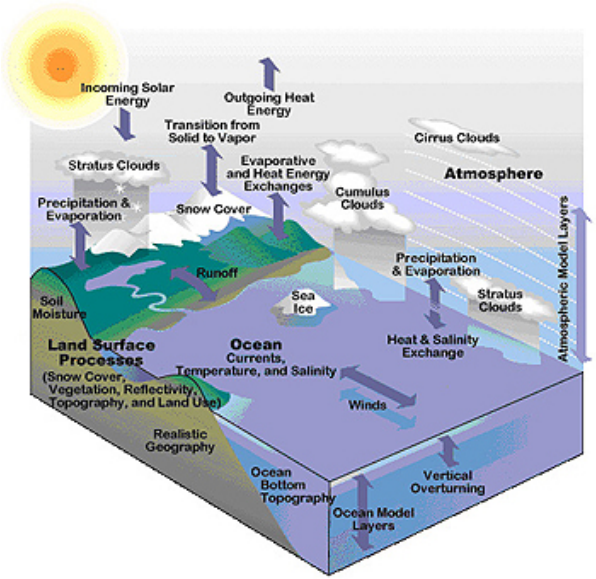
1. Resolution: 8 levels, 96 $\times$ 48 grid points
2. Prescribed surface variables (SST, LST)
3. Perpetual winter (Jan or Feb)

The Abdus Salam International Centre for Theoretical Physics

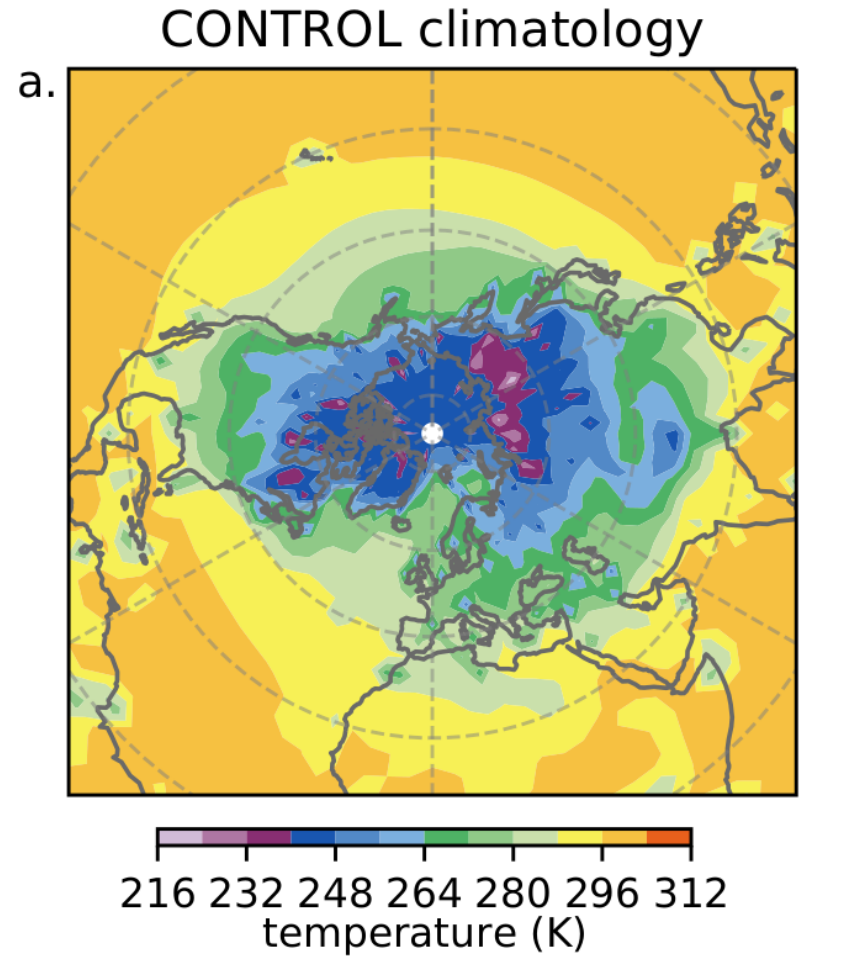




(Henderson-Sellers, 1985)



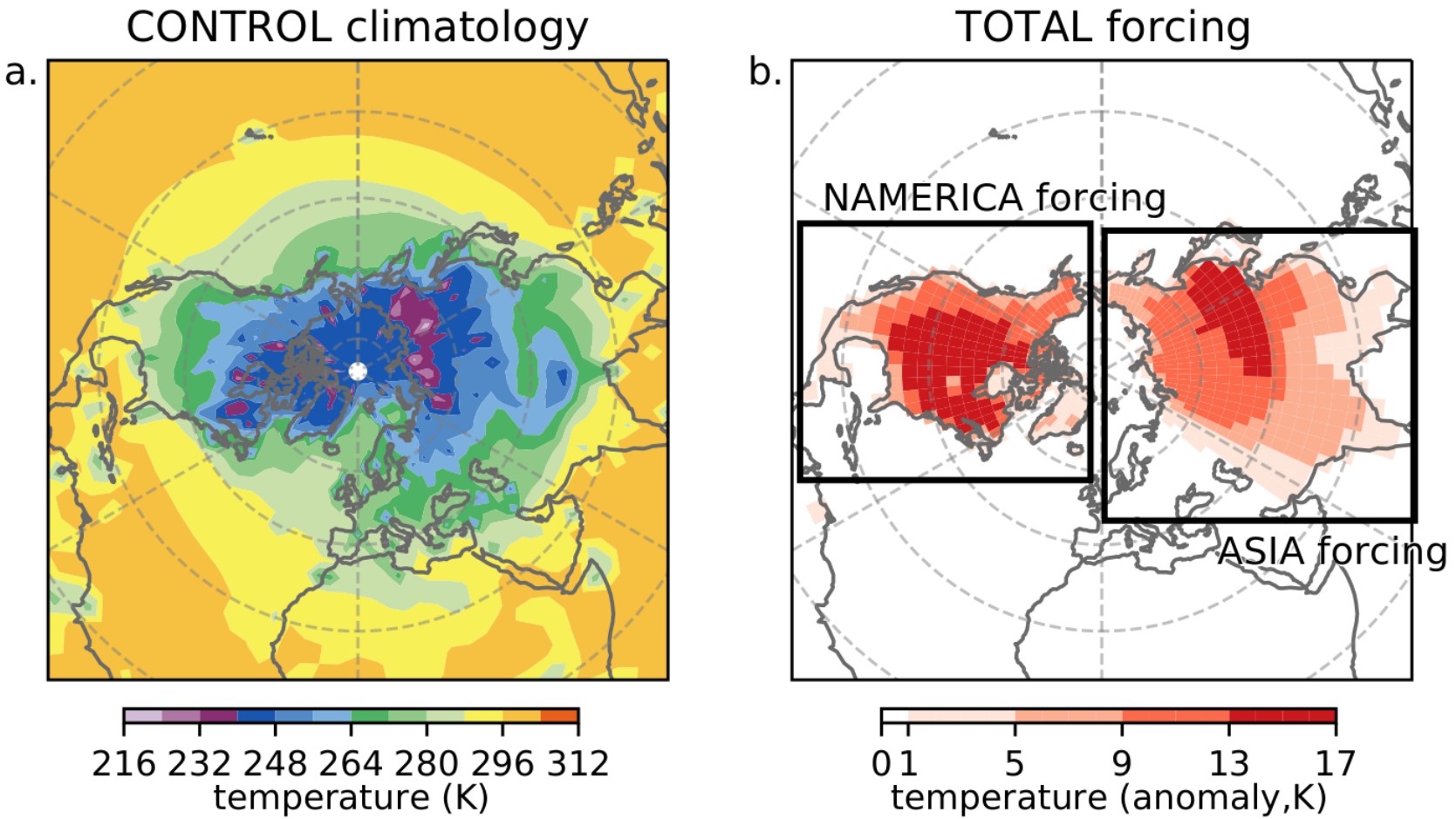
Idealised Experiments (Jan & Feb)



SST HadISST climatology 1979–2008

LST average model field over a 10-member ensemble forced with HadISST 1979–2008

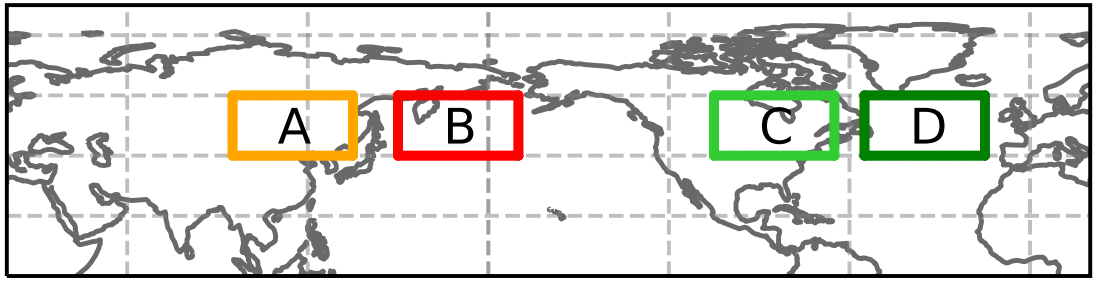
Idealised Experiments (Jan & Feb)



Molteni et al. 2011

LSC index (Jan & Feb)

LSC_{Pac}=B-A, LSC_{Atl}=D-C

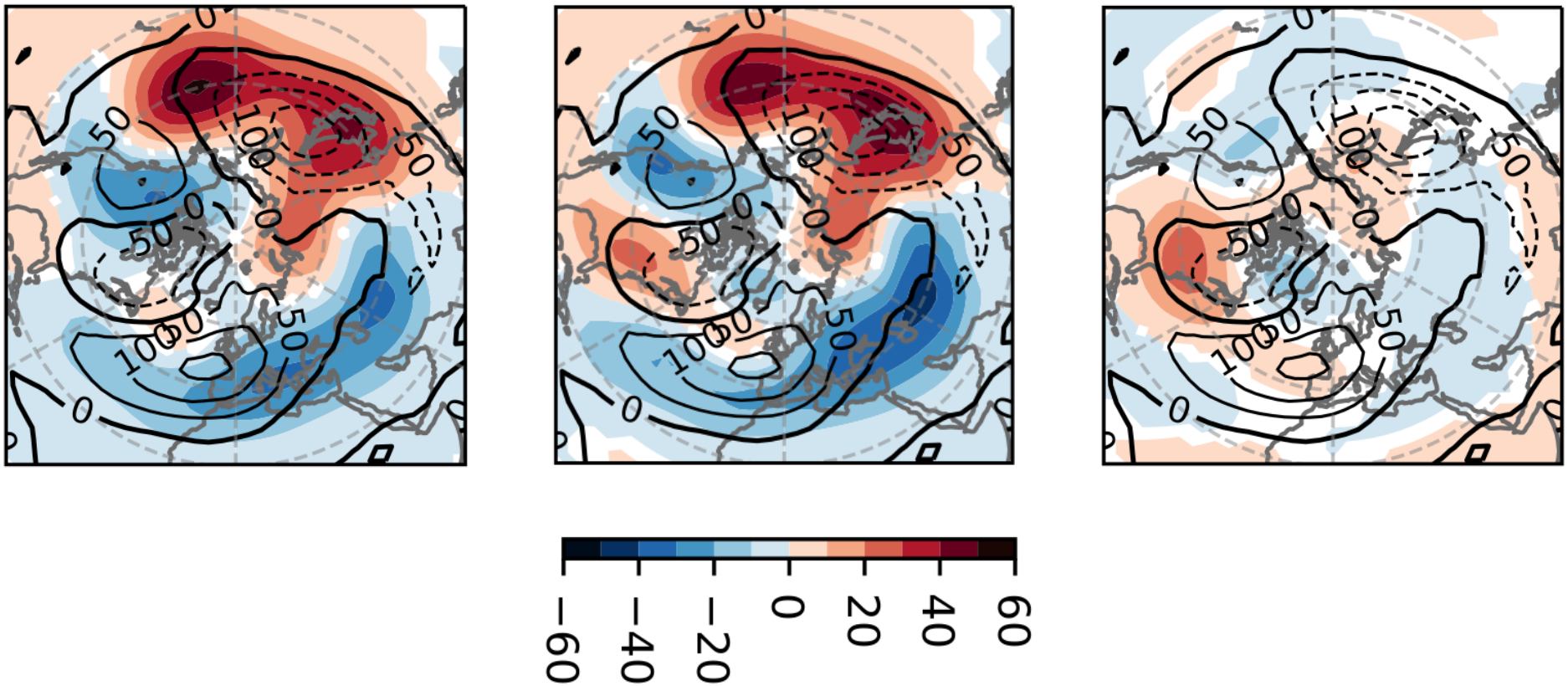


	CTRL	TOTAL	ERA5 1979–2008	CMIP5 - RCP8.5 2200–2300
LSC_{Atl}	22.4 K	13.9 [-8.5] K	23.3 ($\pm$ 1.8) K	11.1 [-12.2] K
LSC_{Pac}	21.6 K	12.8 [-8.8] K	21.7 ($\pm$ 1.9) K	16.6 [-5.1] K

Results: stationary waves

Z500 - eddy (m; CONTROL in contours, anomaly in shading)

ASIA **TOTAL** **NAMERICA**

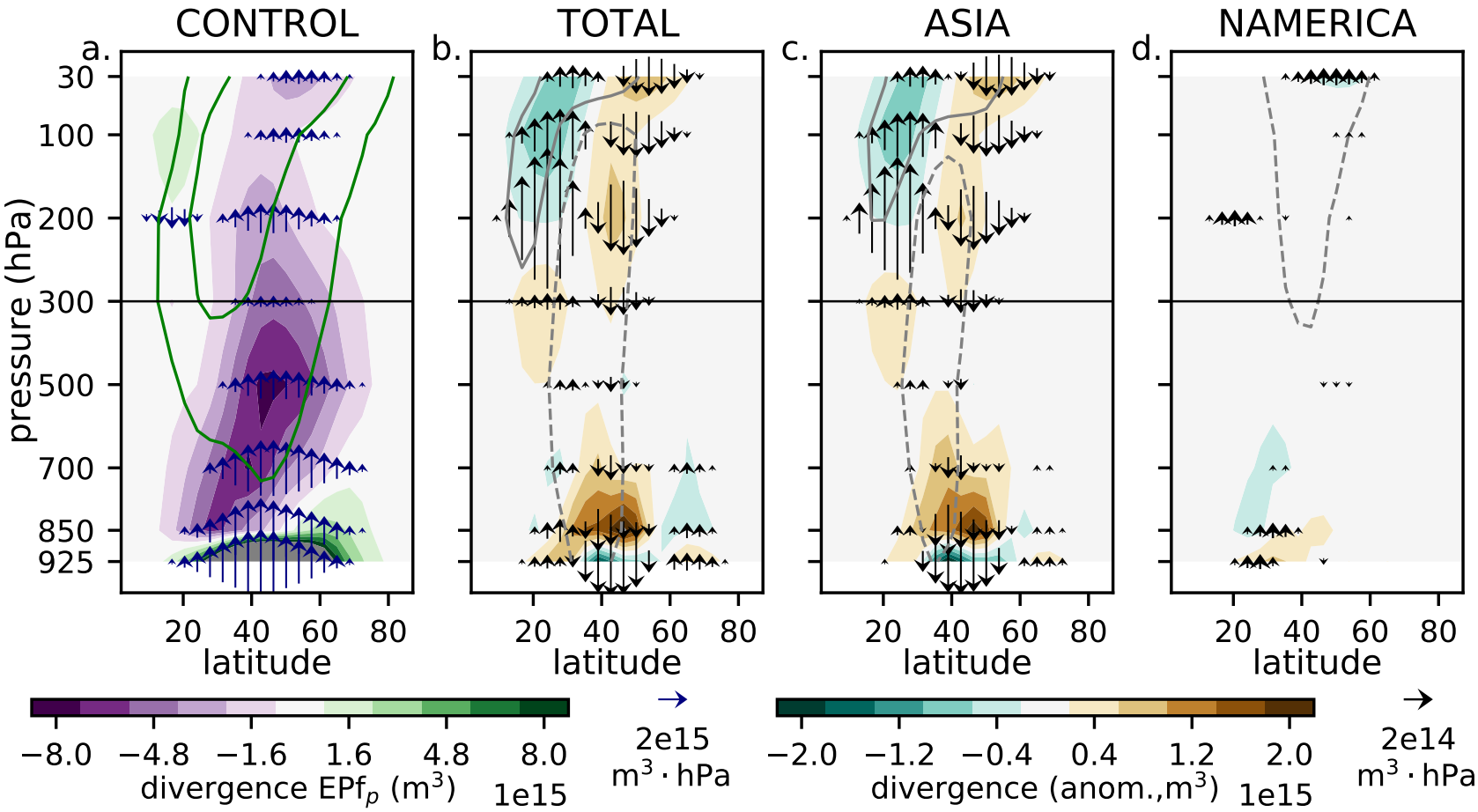


→ The signal in TOTAL is dominated by the response to ASIA warming

→ Interaction with 'thermal' and 'orographic' stationary-wave component

Results: stratosphere

vertical E-P flux (arrows) and its divergence (shading); zmU (m/s, contours)



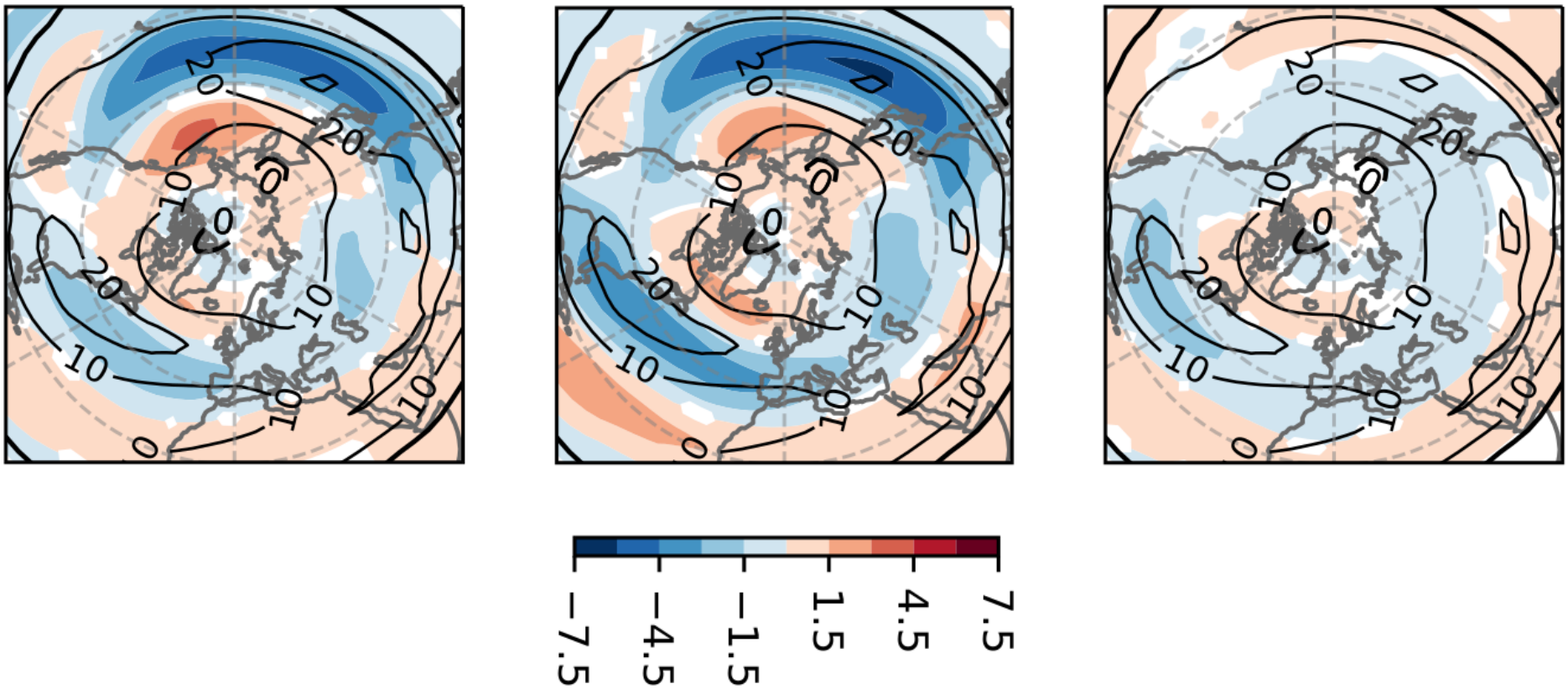
→ ASIA warming: reduced wave propagation to the stratosphere, strengthening of the stratospheric vortex winds

→ NAMERICA warming: opposite signal of weaker intensity

Results: mid-tropospheric jets

U500 (m/s; CONTROL in contours, anomaly in shading)

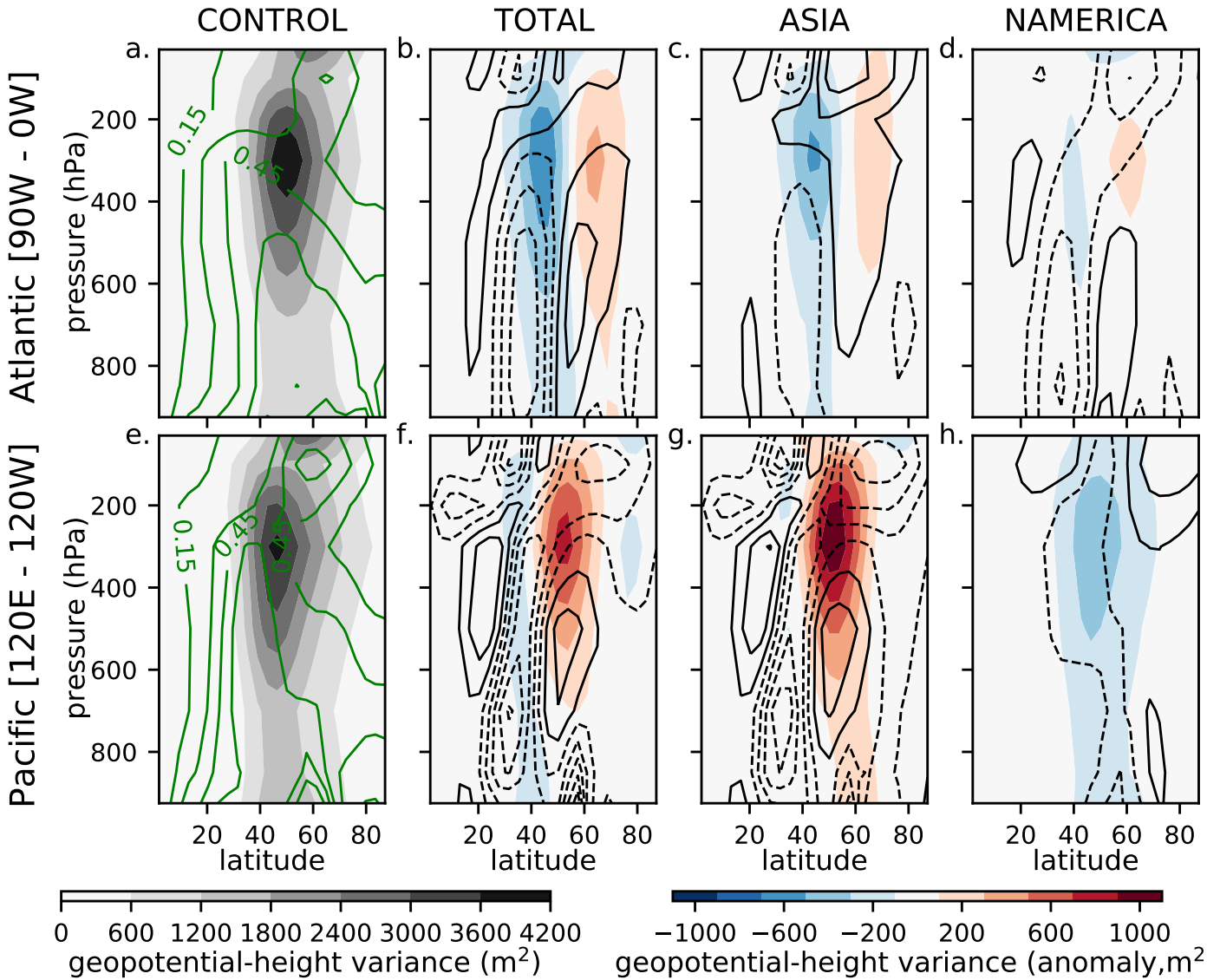
ASIA **TOTAL** **NAMERICA**



→ Weakening of the jets on their southern flanks, associated with a northward shift

Results: storm tracks and Eady growth rate

HF geopt-h variance (shading), Eady growth rate (contours)



→ Northward shift of the storm tracks

→ Weakening of the Pacific storm-track in response to NAMERICA warming

Conclusions and Perspectives

I. The influence of LSC on the extratropical planetary waves is mainly related to Pacific-sector LSC

II. Mid-latitude LSC also affects
   - the vertical wave propagation to the stratosphere
   - the position / intensity of the mid-latitude jets and storm-tracks

III. Our results may allow to understand LSC-related biases and projections of the mid-latitude circulation in the CMIP6 dataset

Influence of reduced winter land-sea contrast on the mid-latitude atmospheric circulation, article accepted in *Journal of Climate*

References

[1] Held, I. M.
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[2] Molteni, F. and King, M. P. and Kucharski, F. and Straus, D. M.
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Climate dynamics, 37, 151–170, 2011.