

# Global storm surges during a past warm climate, the Last Interglacial

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## Last Interglacial (ca. 125,000 years before present)

- Most recent period warmer than present - at least in the Northern Hemisphere
- Global sea level higher by 6 to 9 m (Dutton et al. 2015)
- Where storms different? Where there even *superstorms*? (Hansen et al. 2016; Rovere et al. 2017)





## Global Climate Model

CESM1.2 model

Atmosphere: CAM5

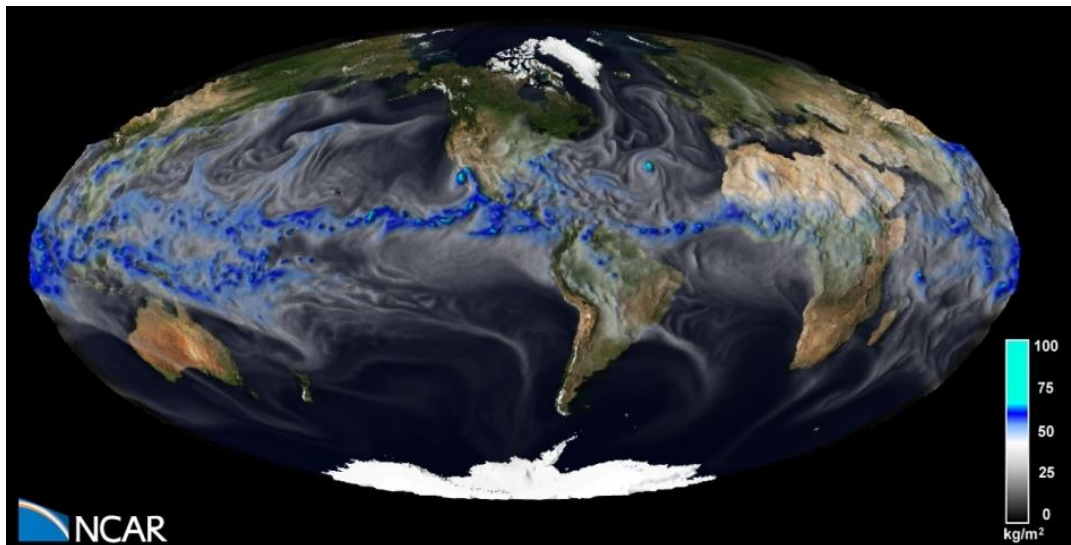
Atm. resolution:  $0.93^{\circ} \times 1.25^{\circ}$ , 30 levels

Experiments:

- PMIP4 *lig127*
- CMIP6 pre-industrial

Variables:

- u and v windspeed
- Sea level pressure



## Global Hydrodynamic Model

GTSM model v3.0 (Muis et al. 2020)

Delft3D Flexible Mesh software

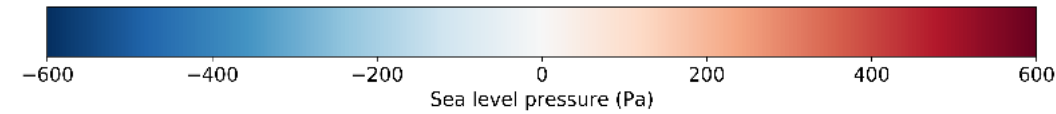
Resolution: 50 km offshore, 2.5-1.25 km at coast



# GCM results

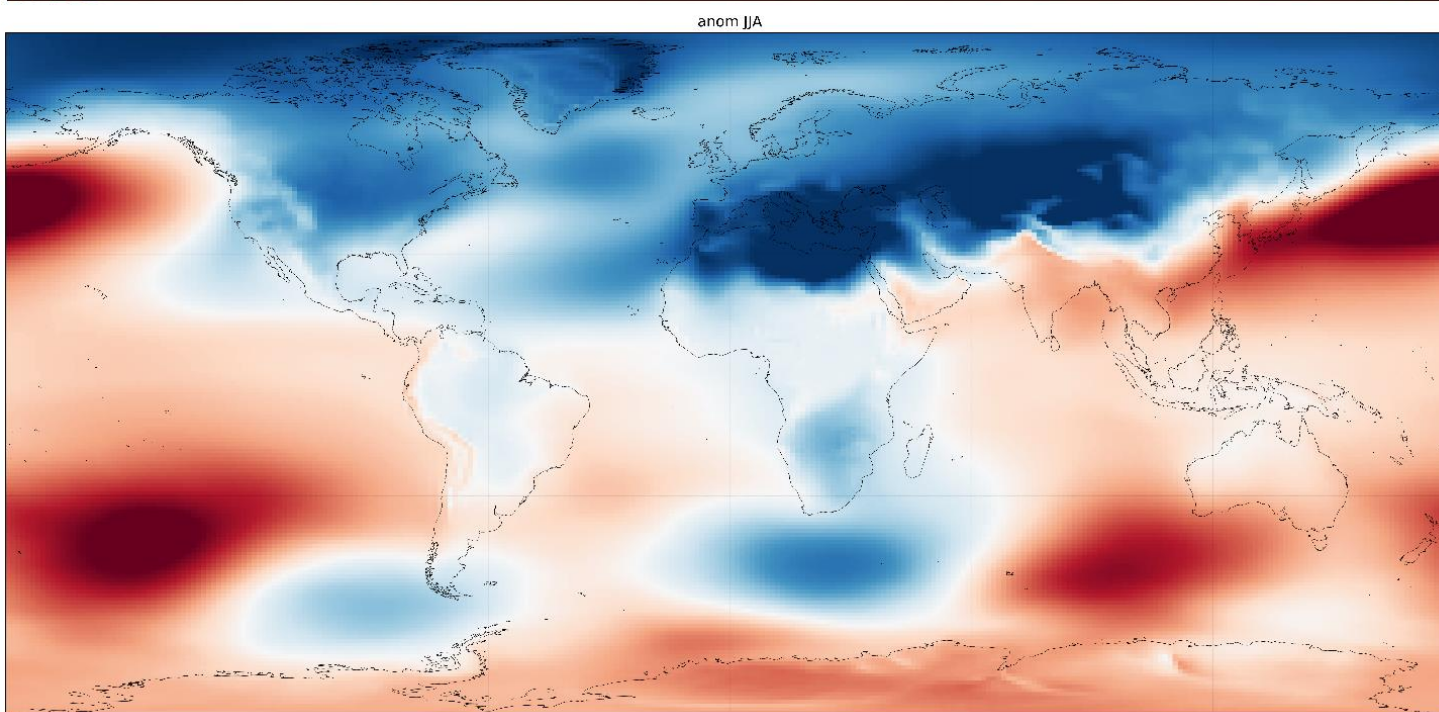
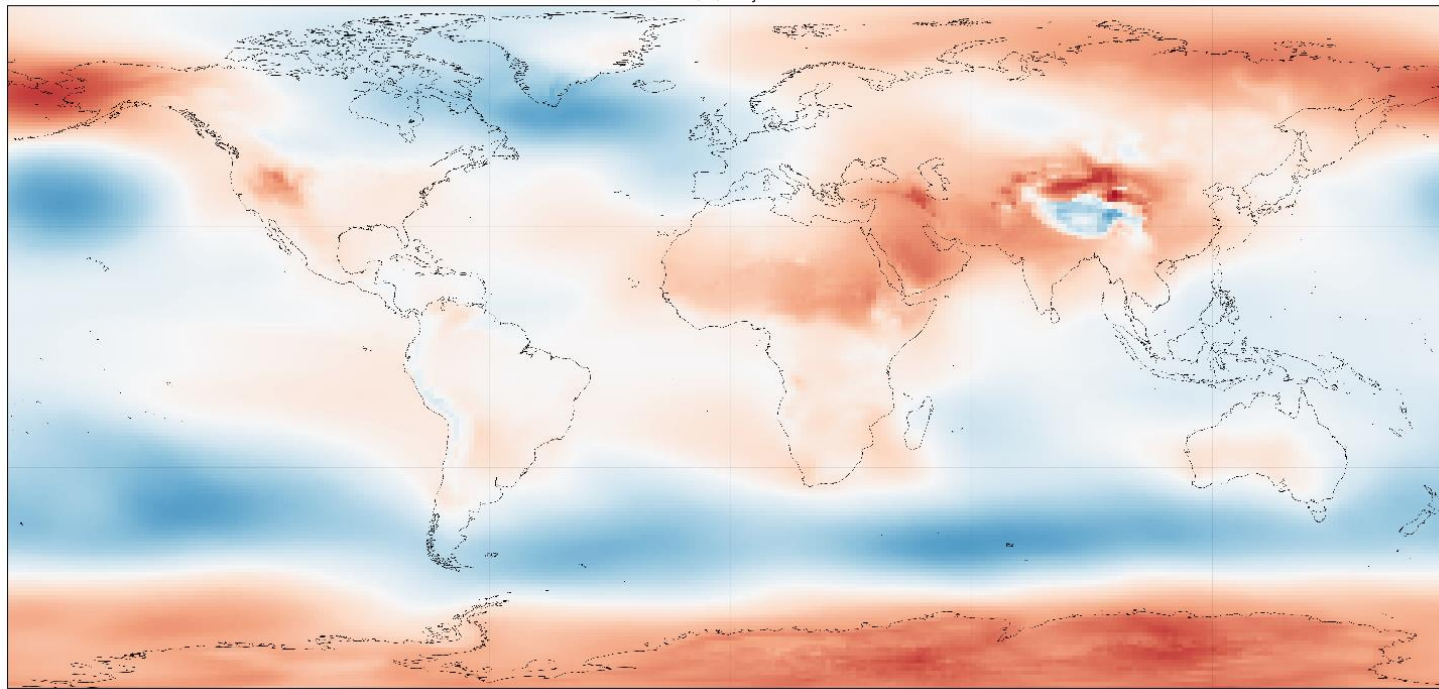
All results are anomalies between the Last Interglacial and pre-industrial simulations

Anomalies in sea-level pressure



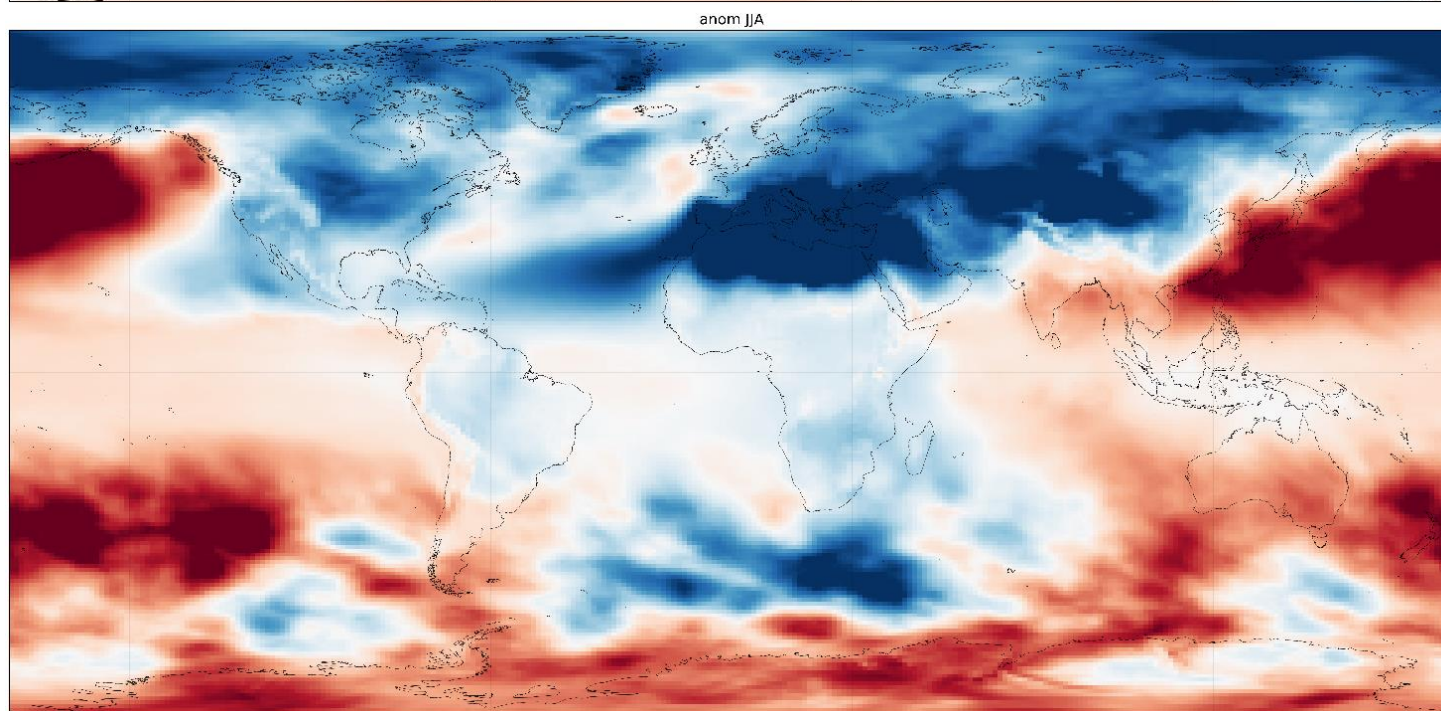
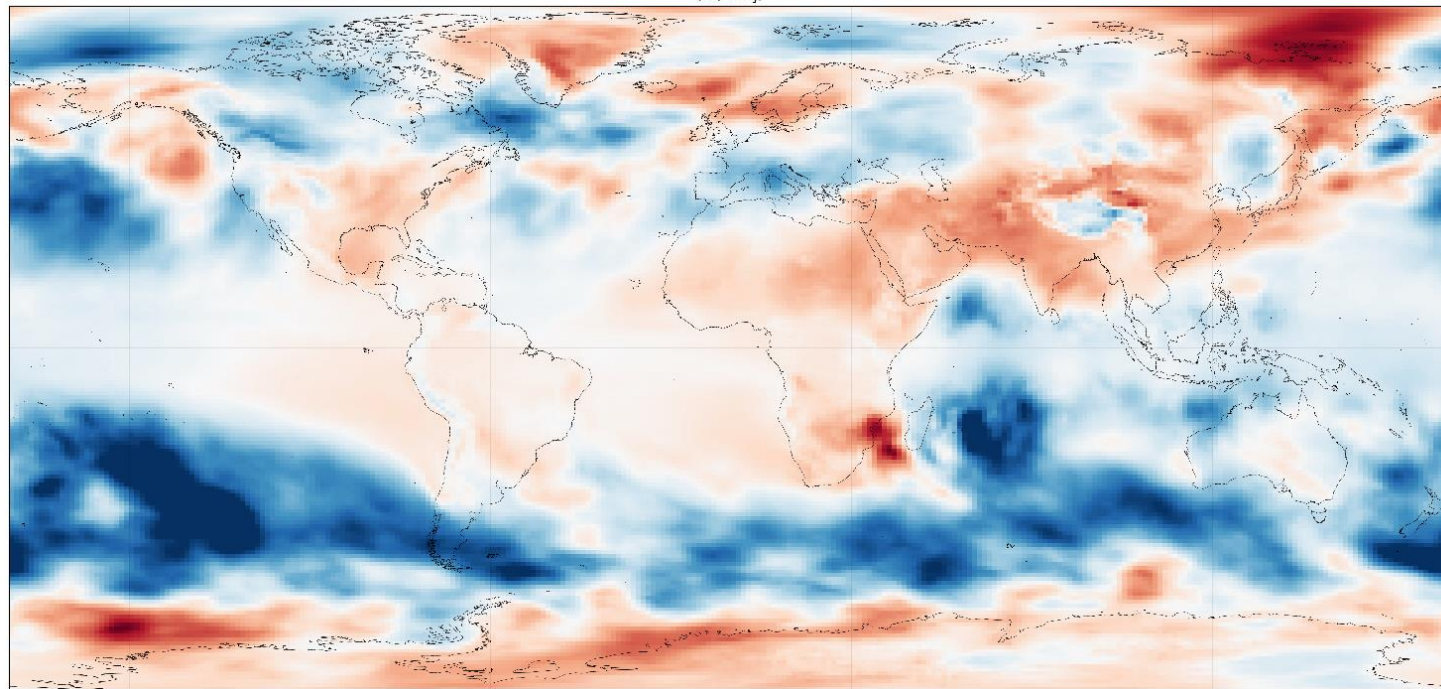
Lower in LIG simulation

Higher in LIG simulation

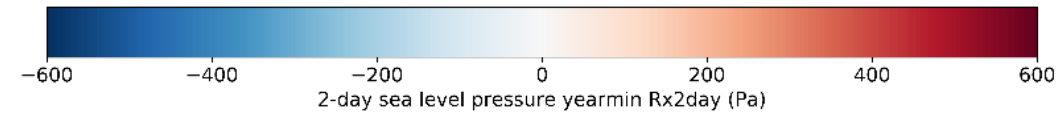




# GCM results



Anomalies in inter-annual mean of annual  
2-day minimum sea-level pressure

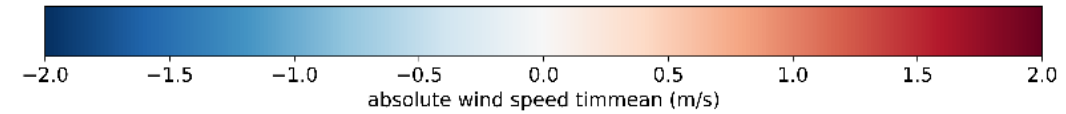
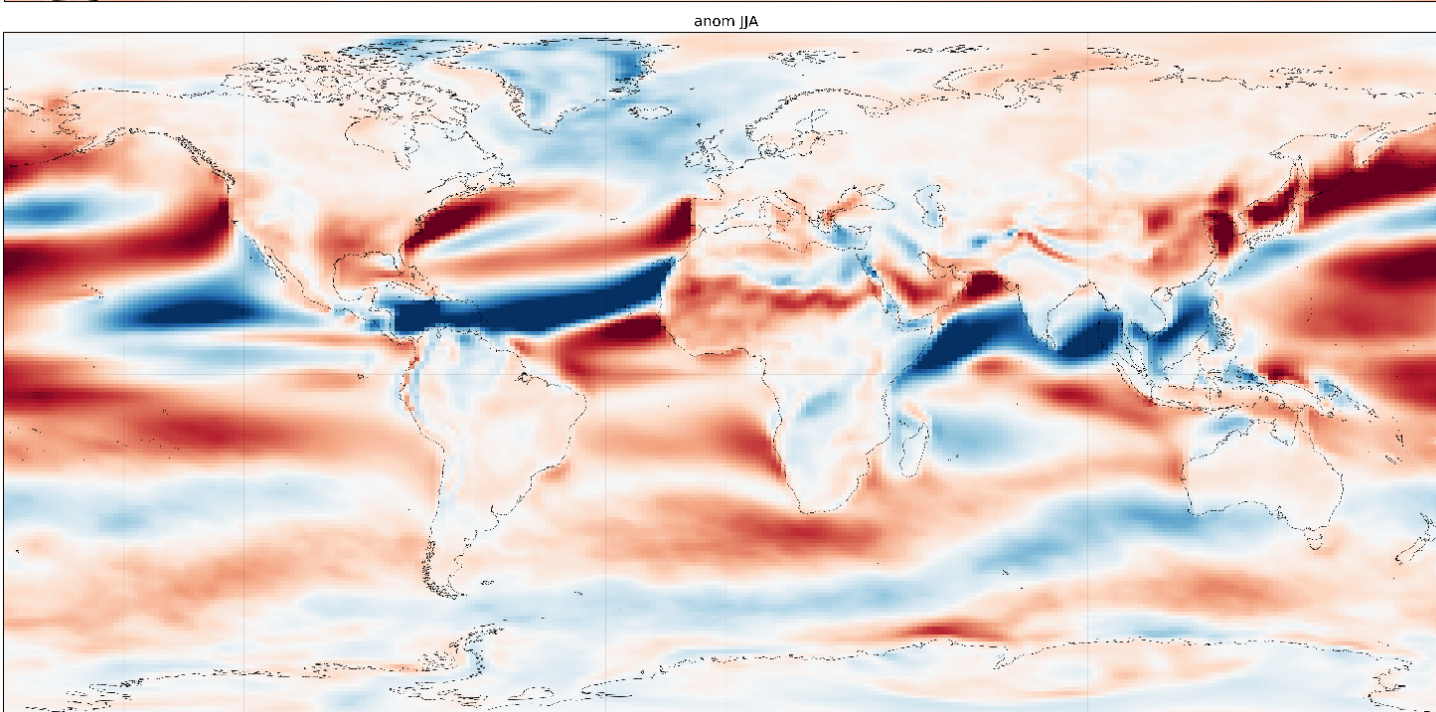
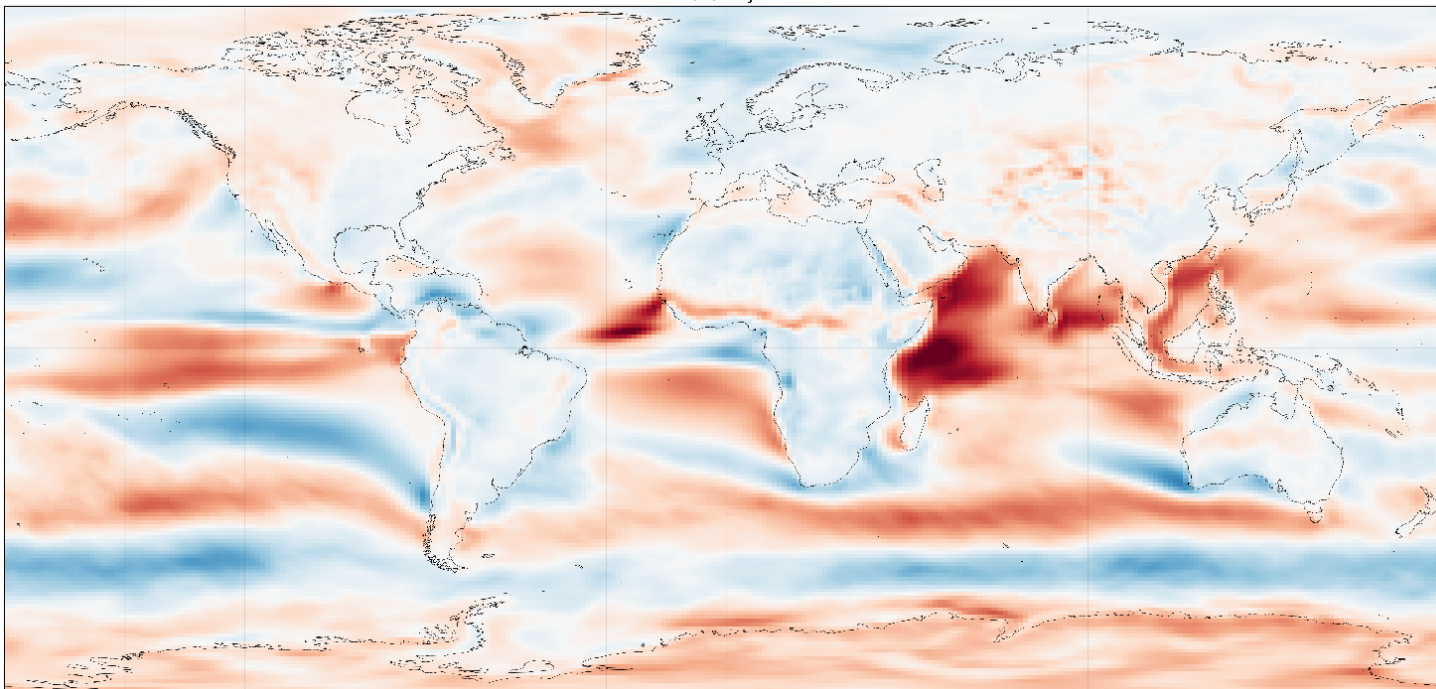


Lower in LIG simulation

Higher in LIG simulation

# GCM results

## Anomalies in absolute wind speed



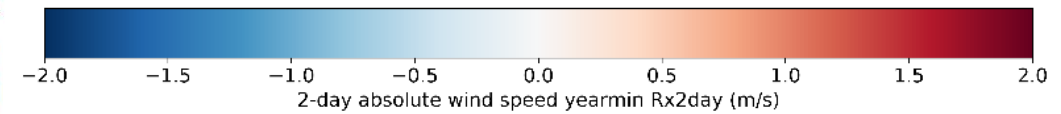
Lower in LIG simulation

Higher in LIG simulation



# GCM results

## Anomalies in absolute wind speed



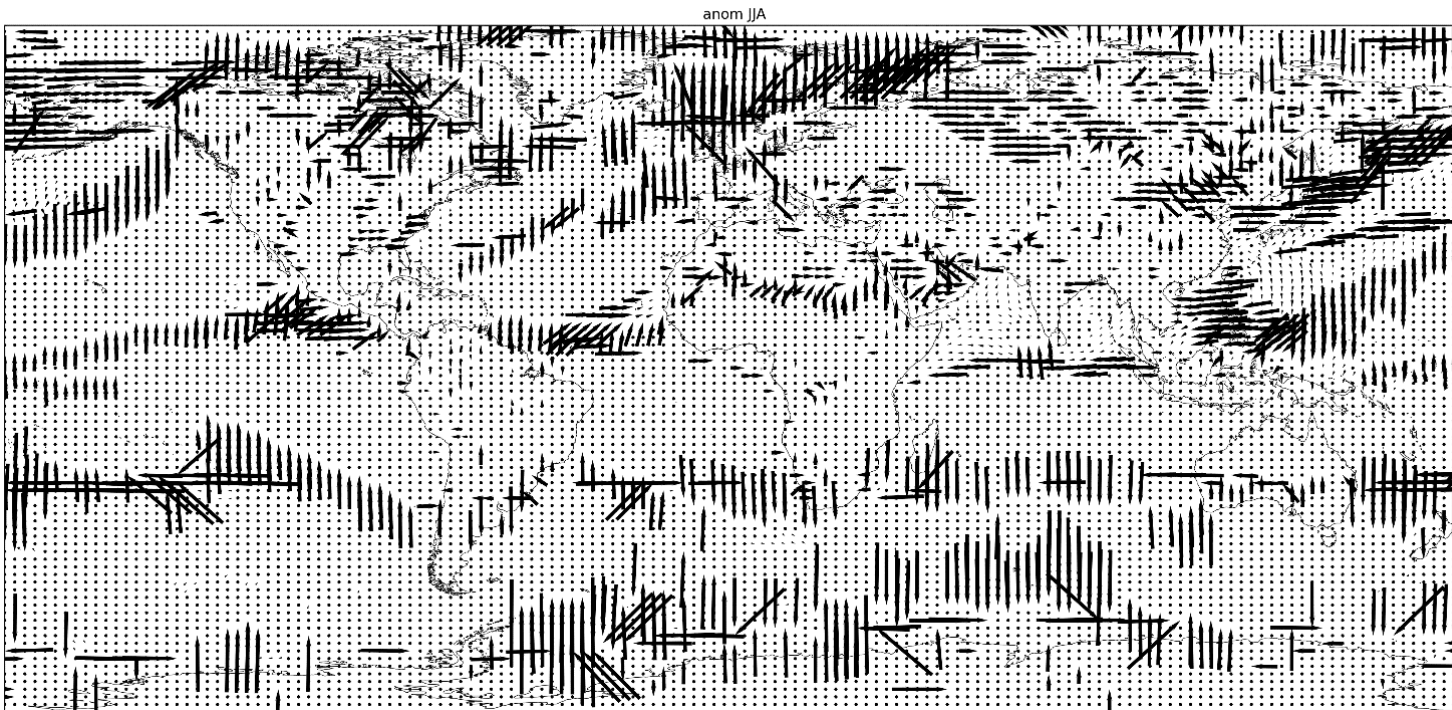
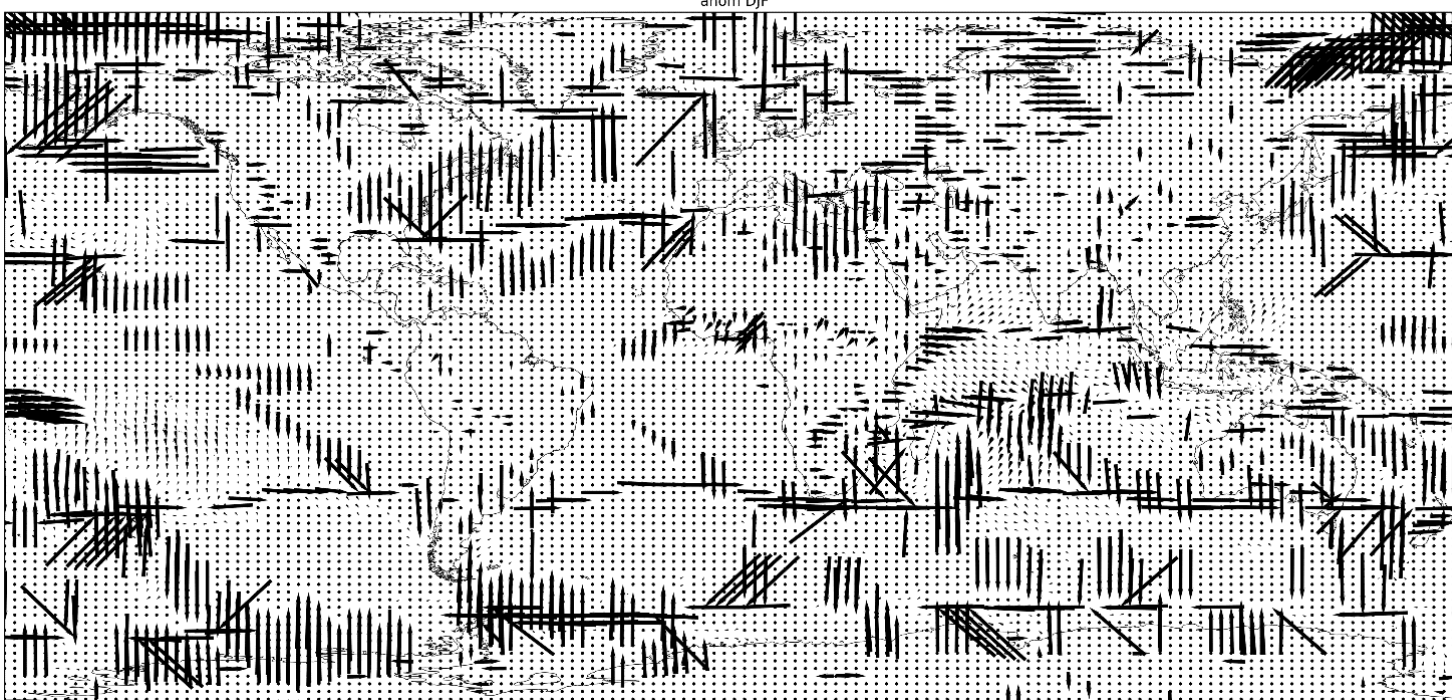
Lower in LIG simulation

Higher in LIG simulation



# GCM results

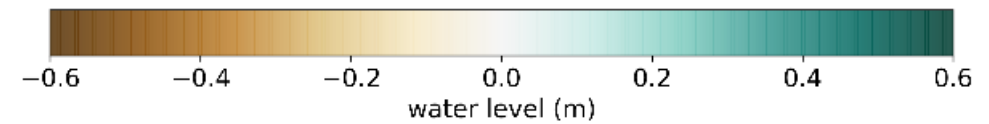
Anomalies in inter-annual mean of annual maximum zonal and meridional wind speeds





# GCM results

Surge-driven anomalies in sea level extremes at the 5-year return period. Values are corrected for anomalies in mean sea level.



Lower in LIG simulation

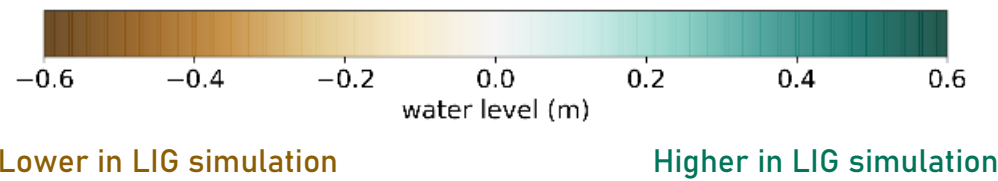
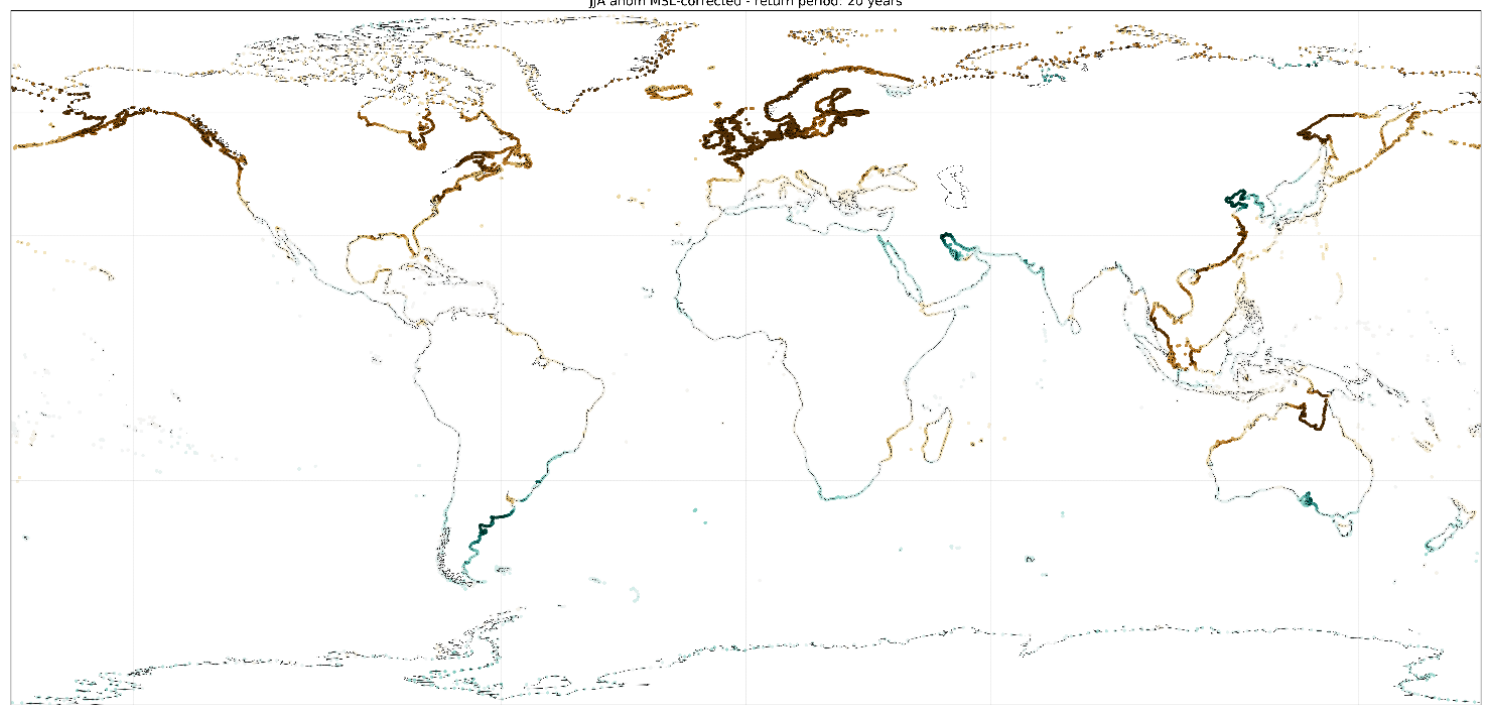
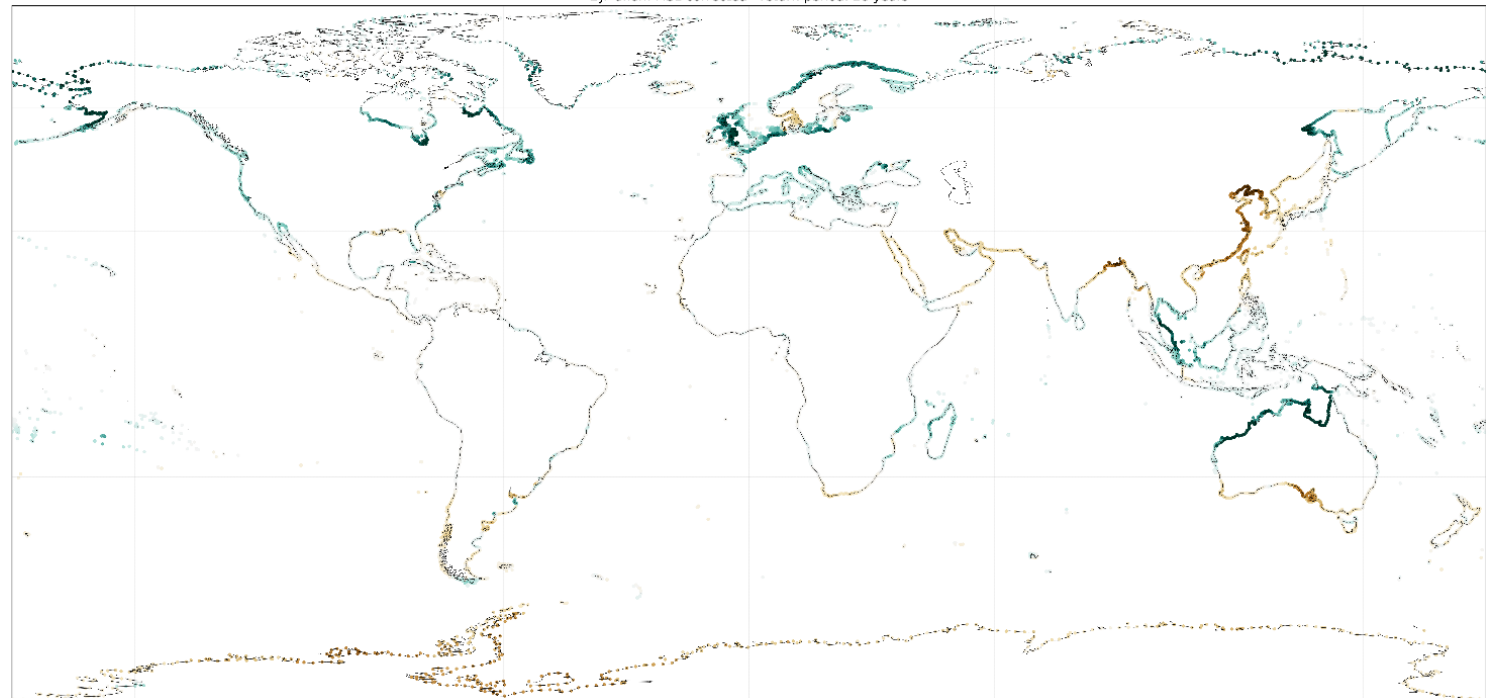
Higher in LIG simulation

DJF anom MSL-corrected - return period: 5 years

JJA anom MSL-corrected - return period: 5 years

# GCM results

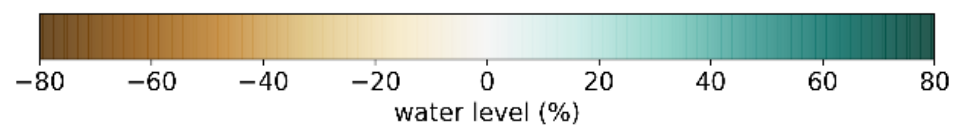
Surge-driven anomalies in sea level extremes at the **20-year** return period.





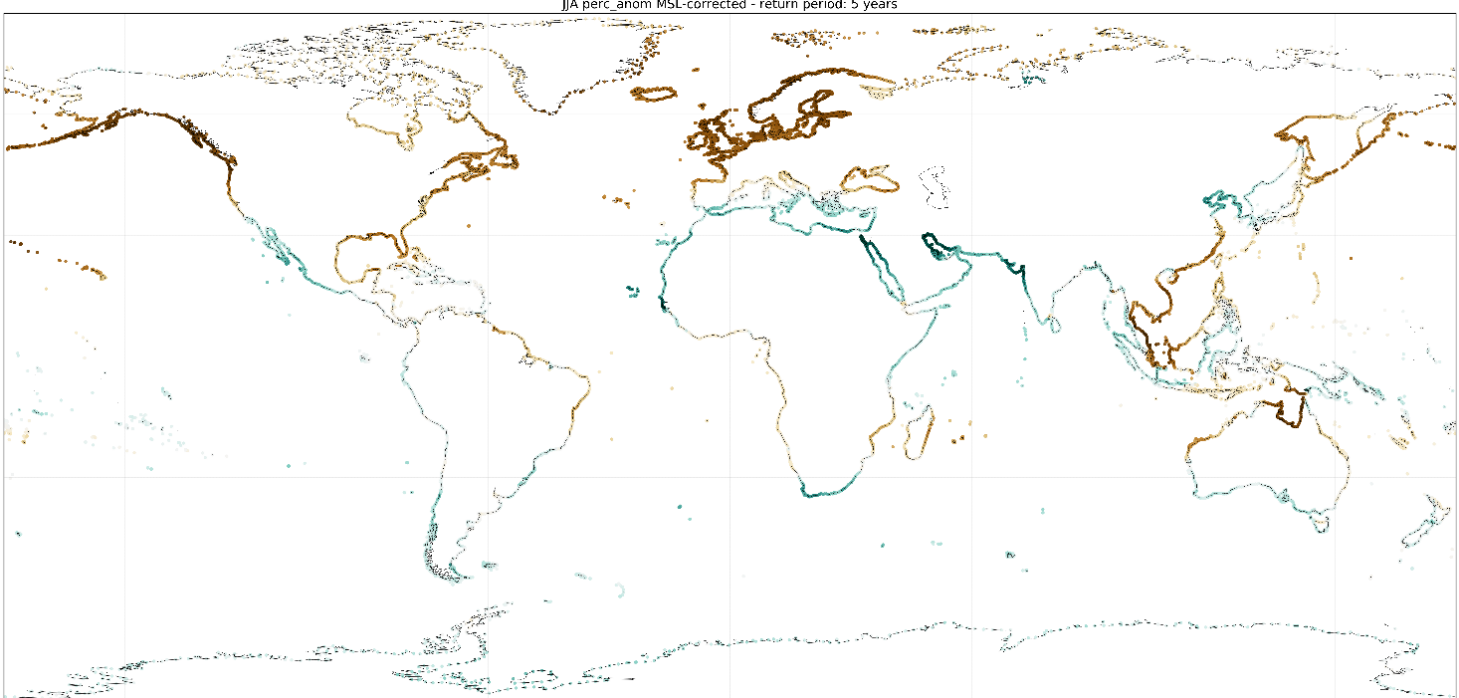
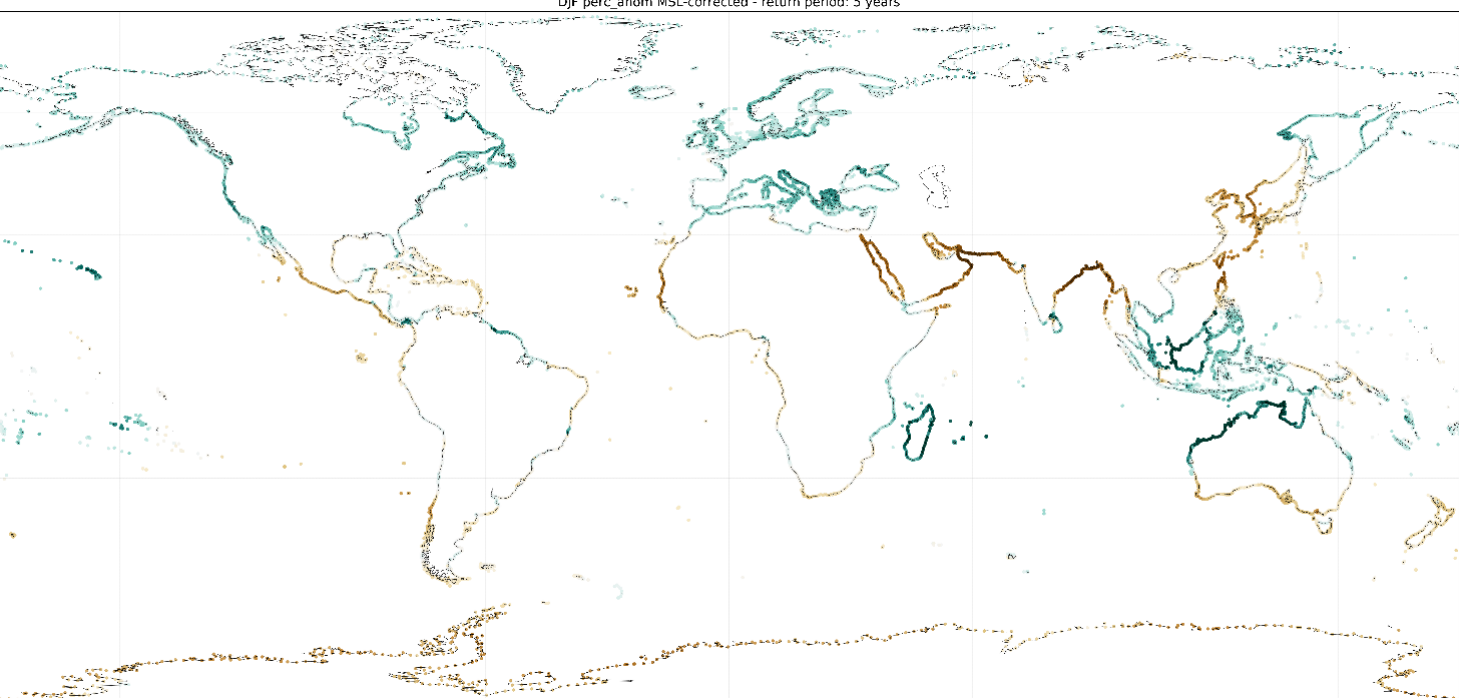
# GCM results

**Percentage anomalies in surge-driven sea level extremes at the 5-year return period.**



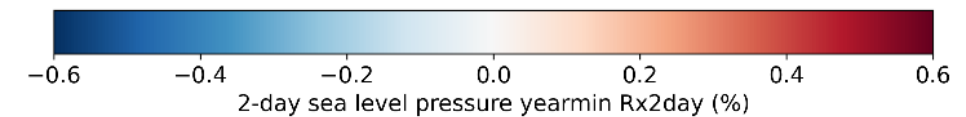
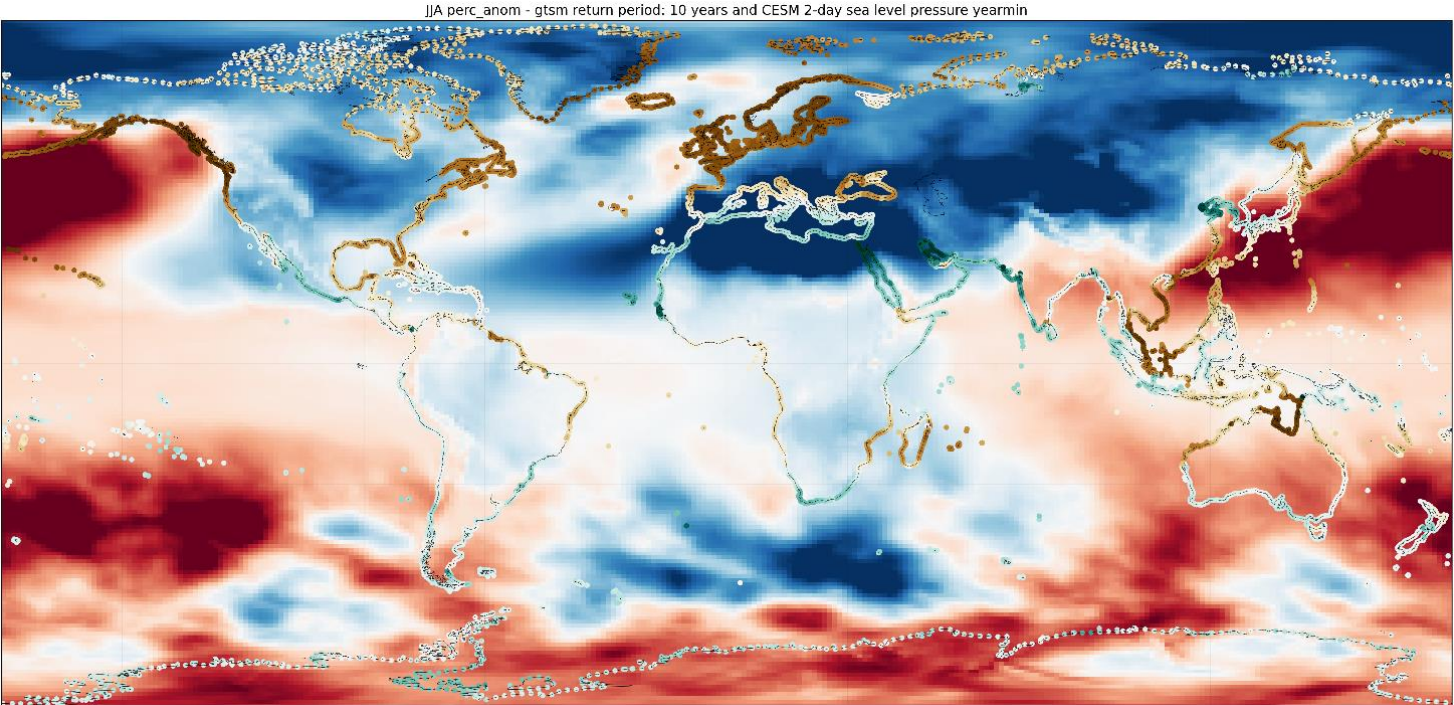
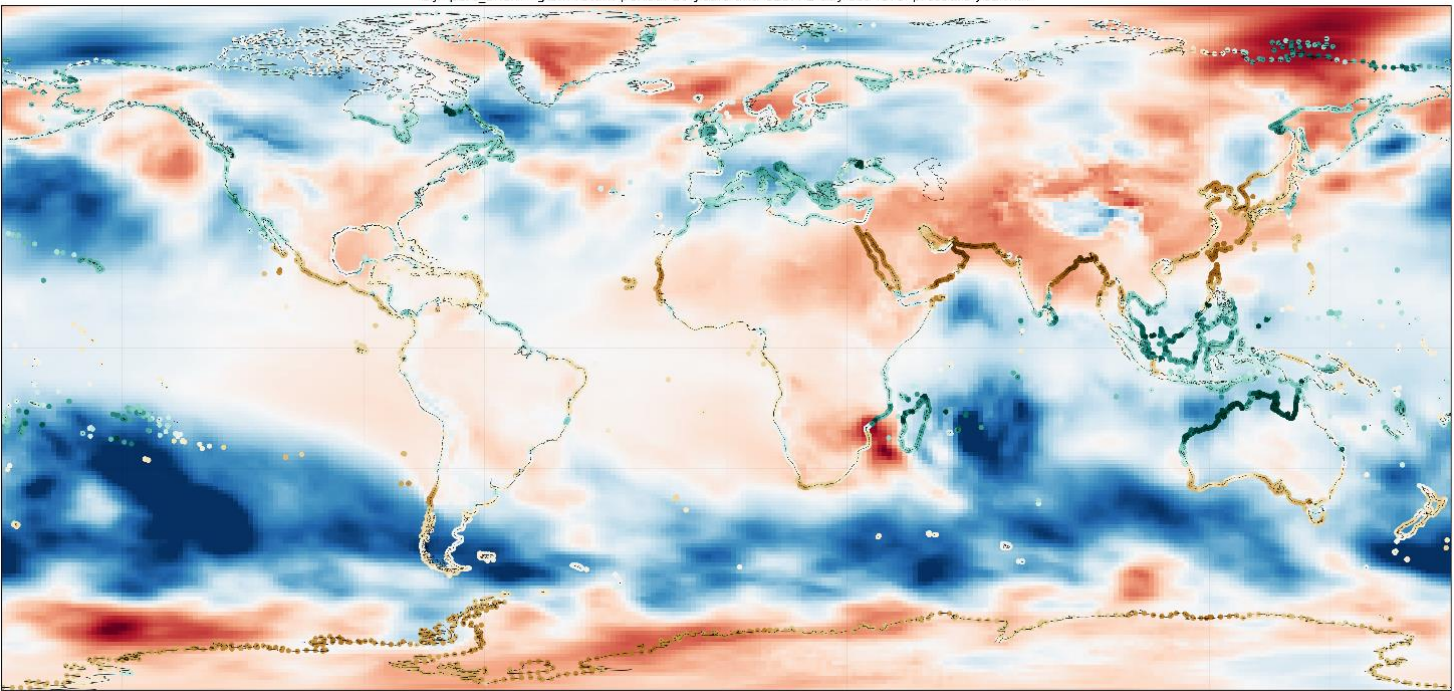
Lower in LIG simulation

Higher in LIG simulation



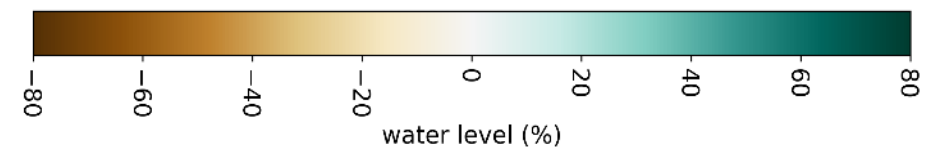
# GCM results

- Combined percentage anomalies in:
- sea level extremes at the 10-year return period
  - interannual mean of 2-day annual minima of sea-level pressure



Lower in LIG simulation

Higher in LIG simulation



Lower in LIG simulation

Higher in LIG simulation



# Provisional take-home message

There are notable anomalies in surge-driven seasonal coastal extremes between the Last Interglacial and pre-industrial simulations (up to ca. 0.5 m)

Higher Last Interglacial extremes are mostly associated with lower sea level pressure minima, and conversely

Ongoing work:

- Climatic interpretation of anomalies
- Extracting useful information for sea level indicators at key sites
- Modelling tides of the Last Interglacial, under several global sea level scenarios

DJF anom MSL-corrected - return period: 20 years

