



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



Global Hydrodynamic Model

CESM1.2 model

Atmosphere: CAM5

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

Experiments:

- PMIP4 *lig127*
- CMIP6 pre-industrial

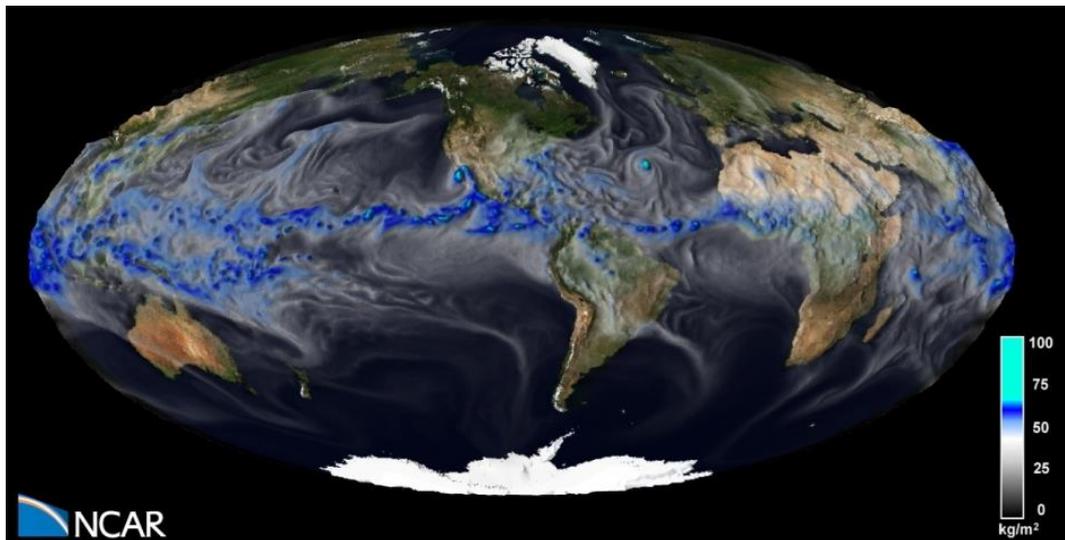
Variables:

- u and v windspeed
- Sea level pressure

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

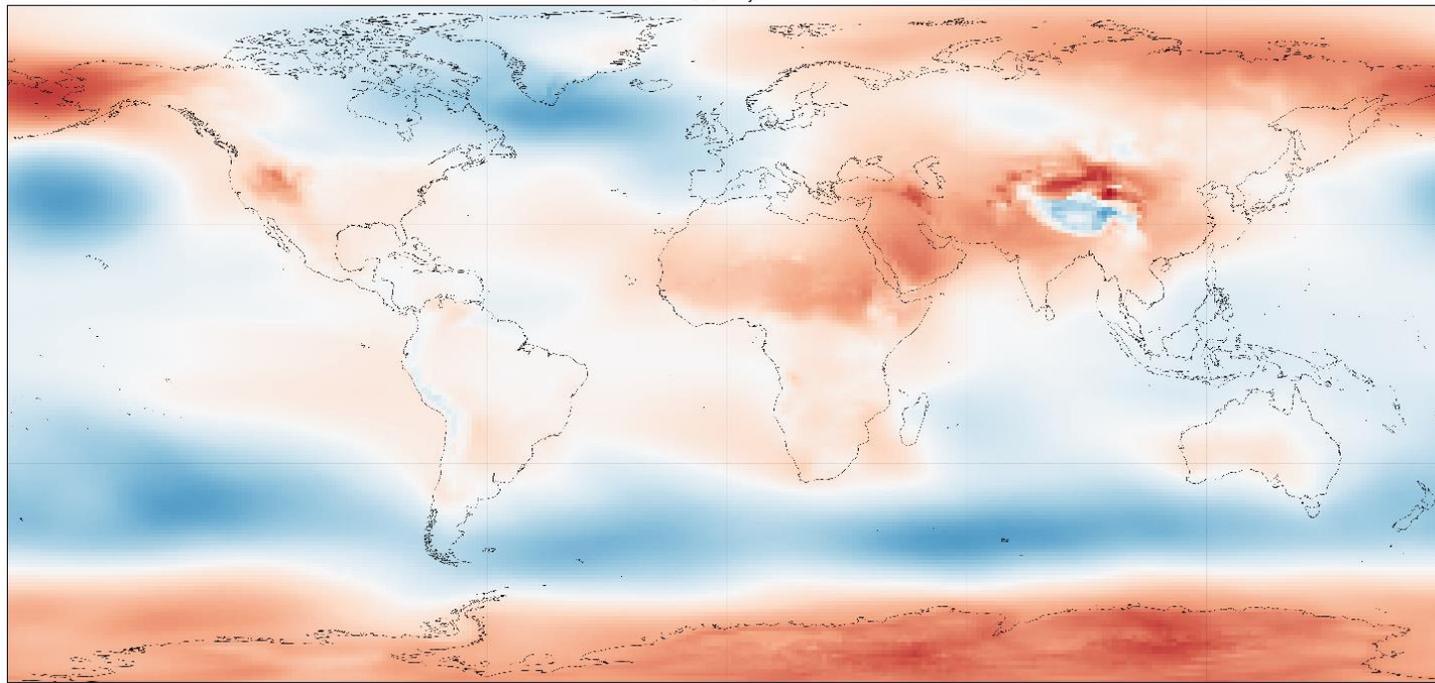
Delft3D Flexible Mesh software

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

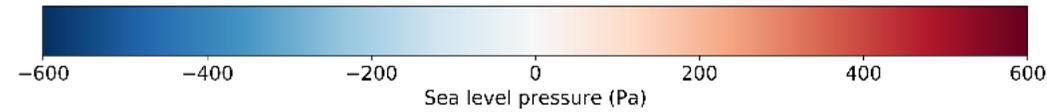


GCM results

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

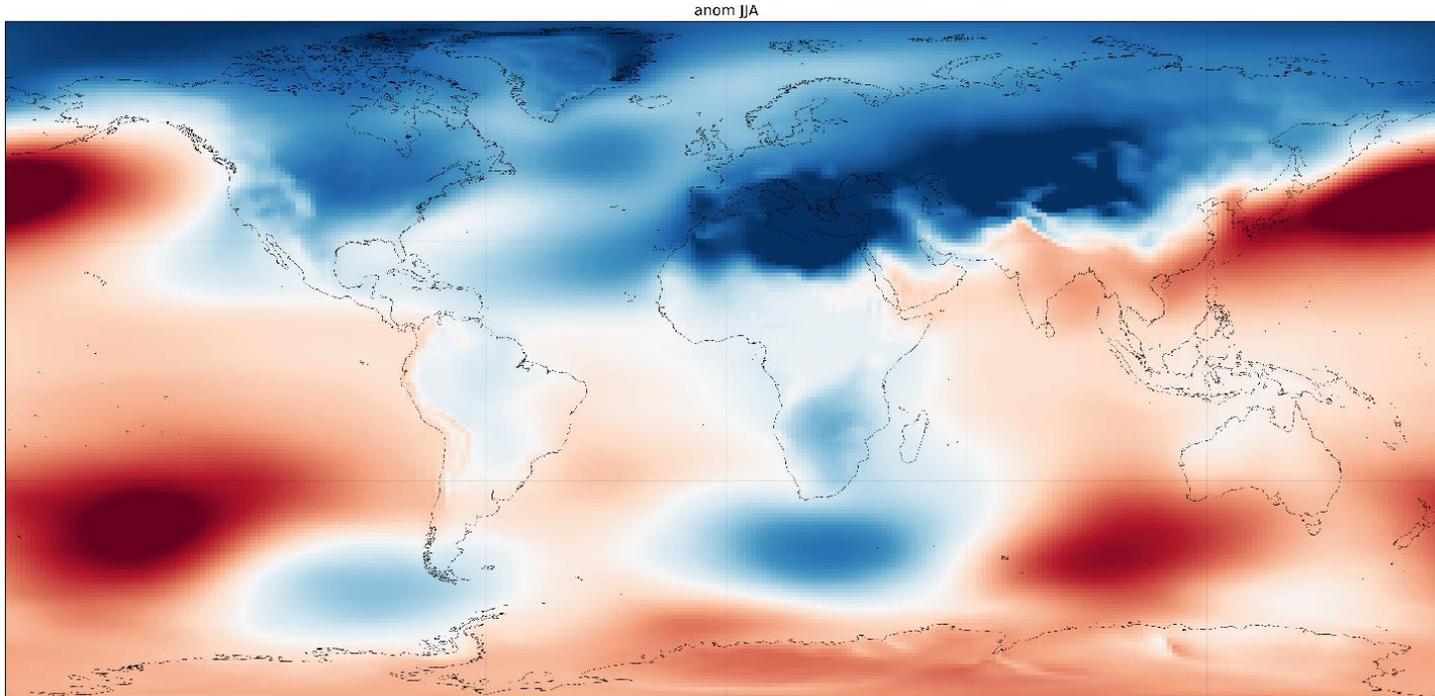


Anomalies in sea-level pressure



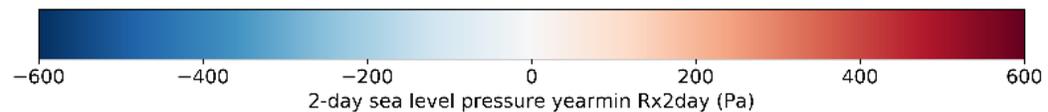
Lower in LIG simulation

Higher in LIG simulation



GCM results

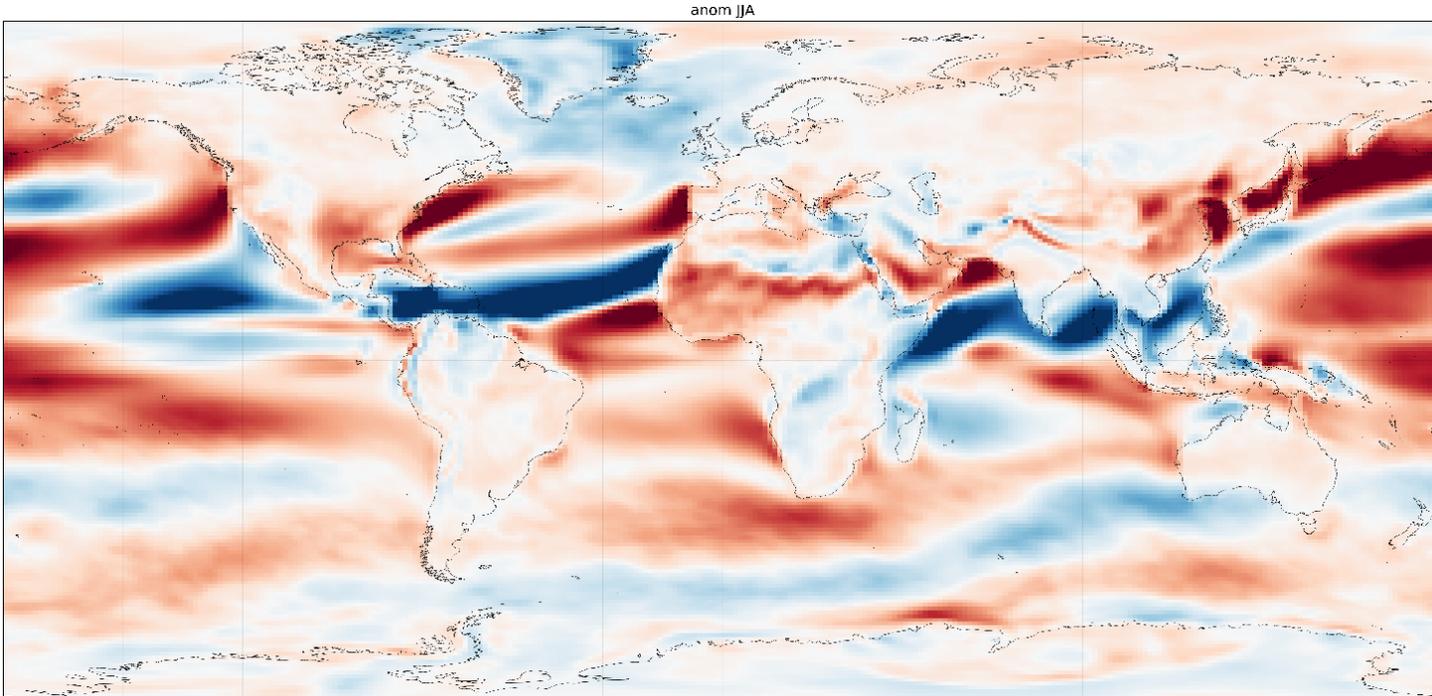
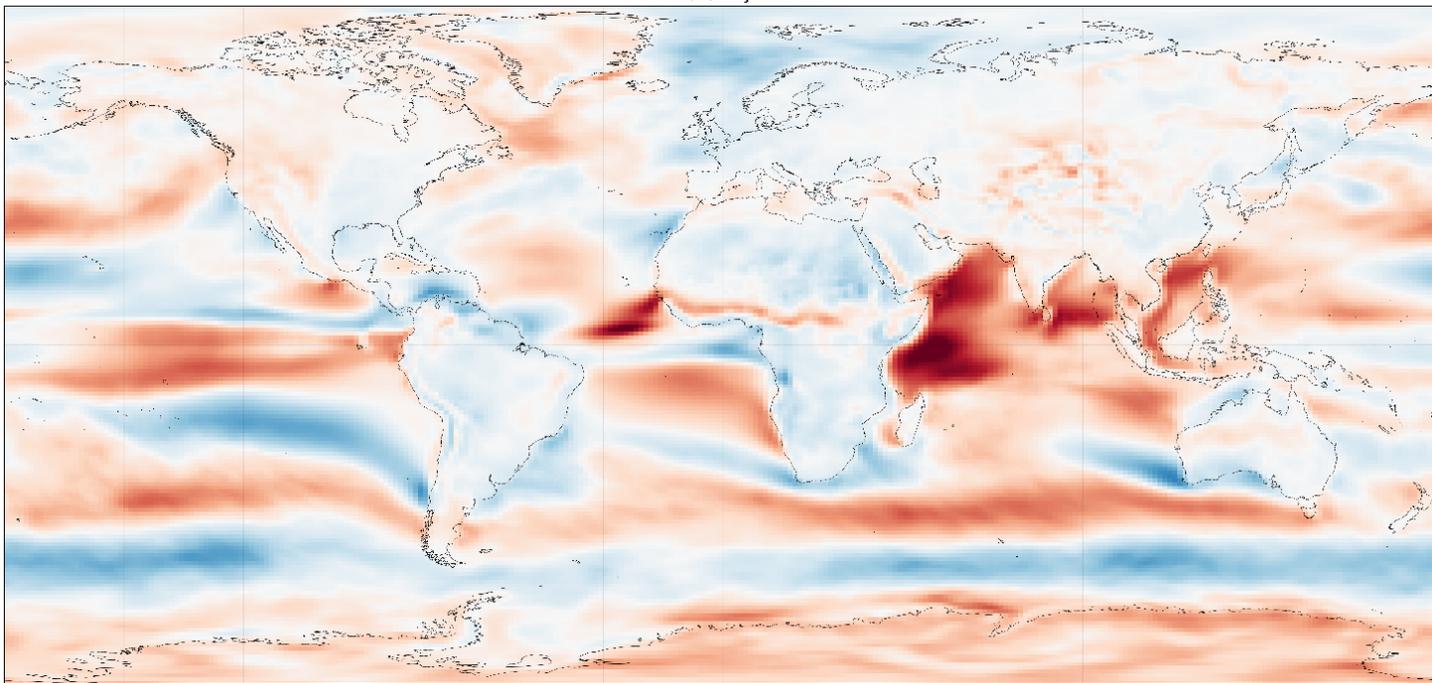
Anomalies in inter-annual mean of annual
2-day minimum sea-level pressure



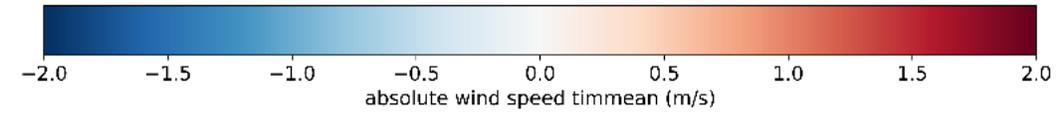
Lower in LIG simulation

Higher in LIG simulation

GCM results



Anomalies in absolute wind speed

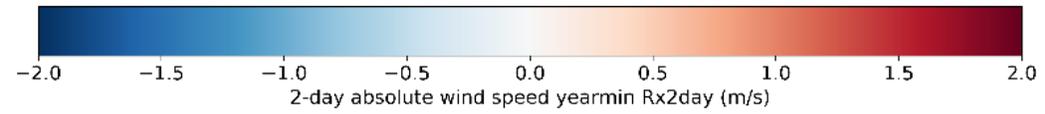
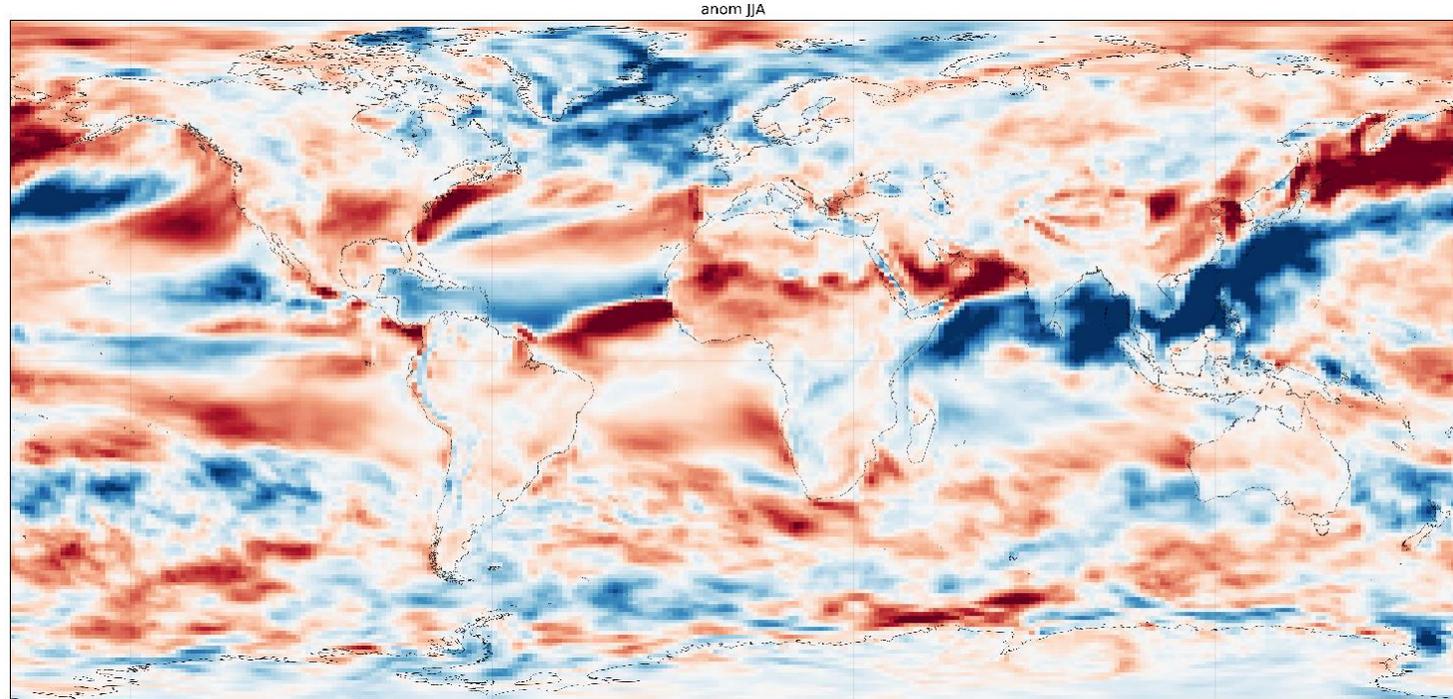
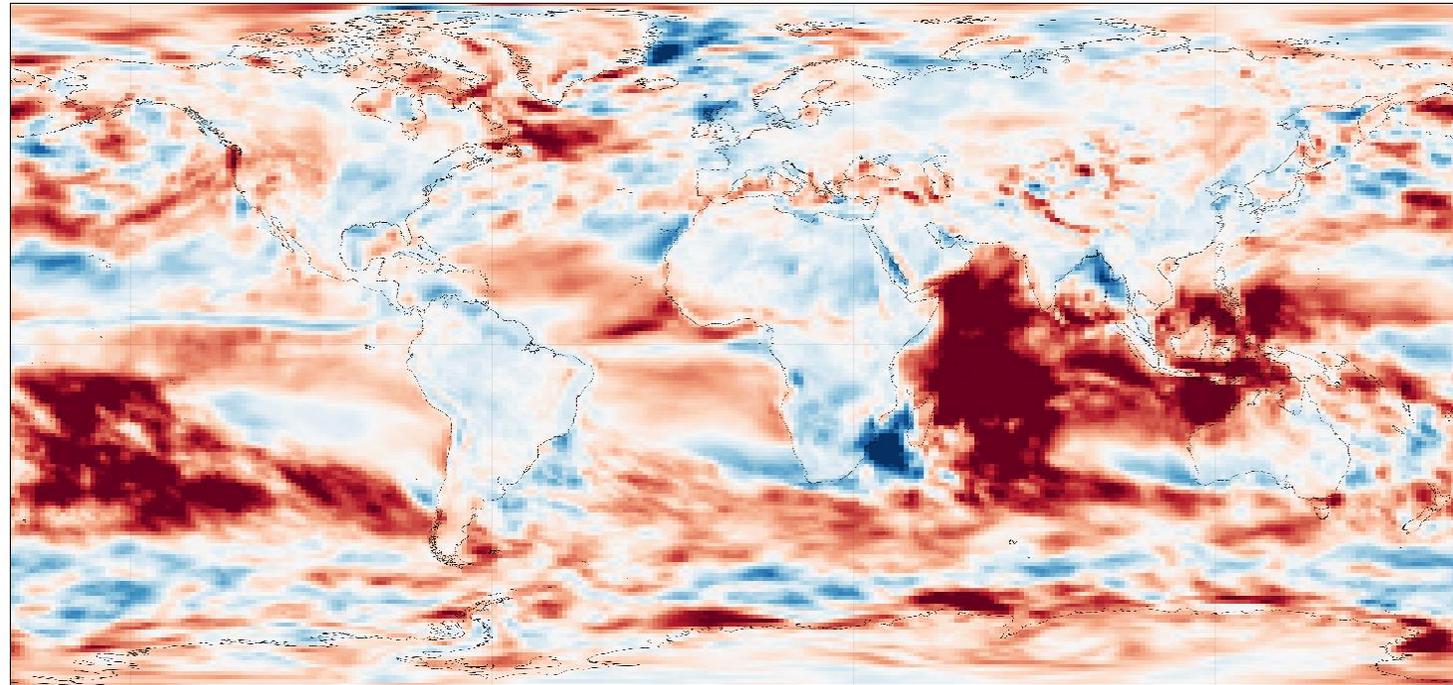


Lower in LIG simulation

Higher in LIG simulation

GCM results

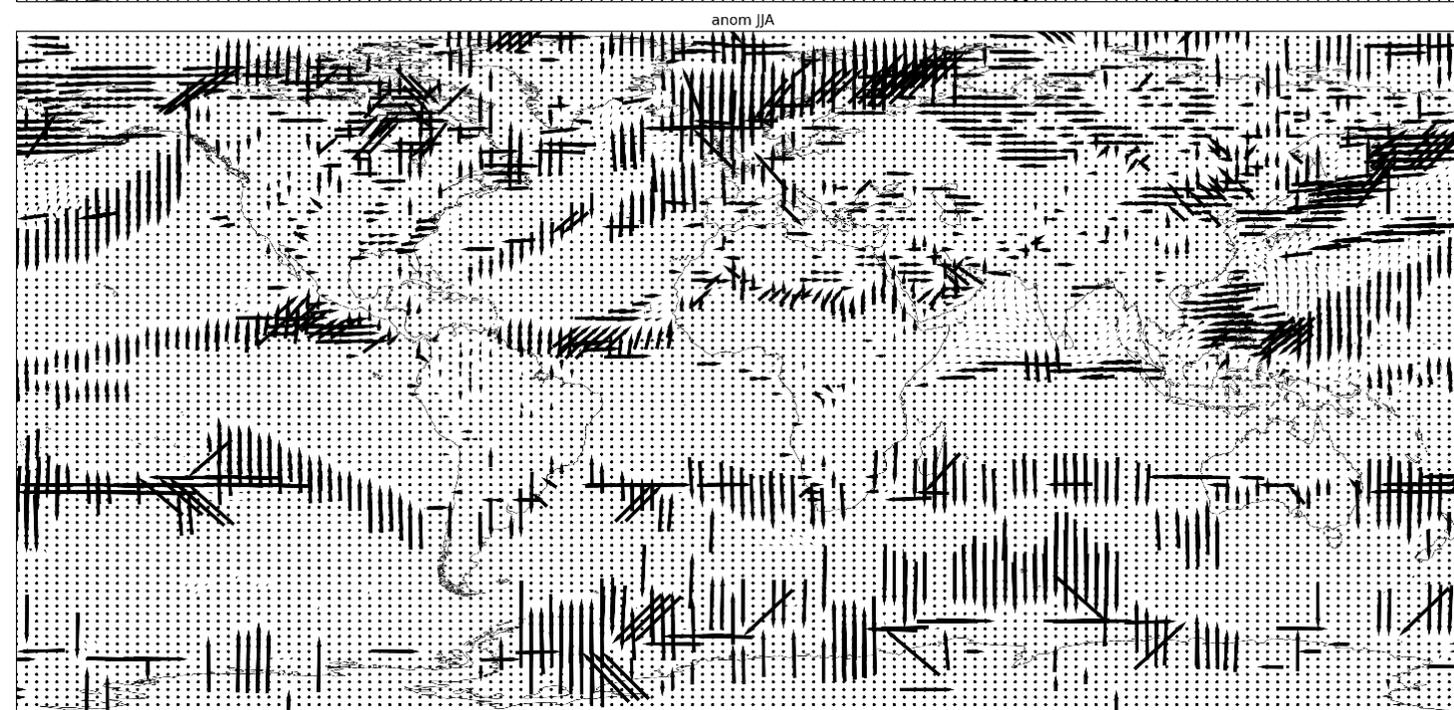
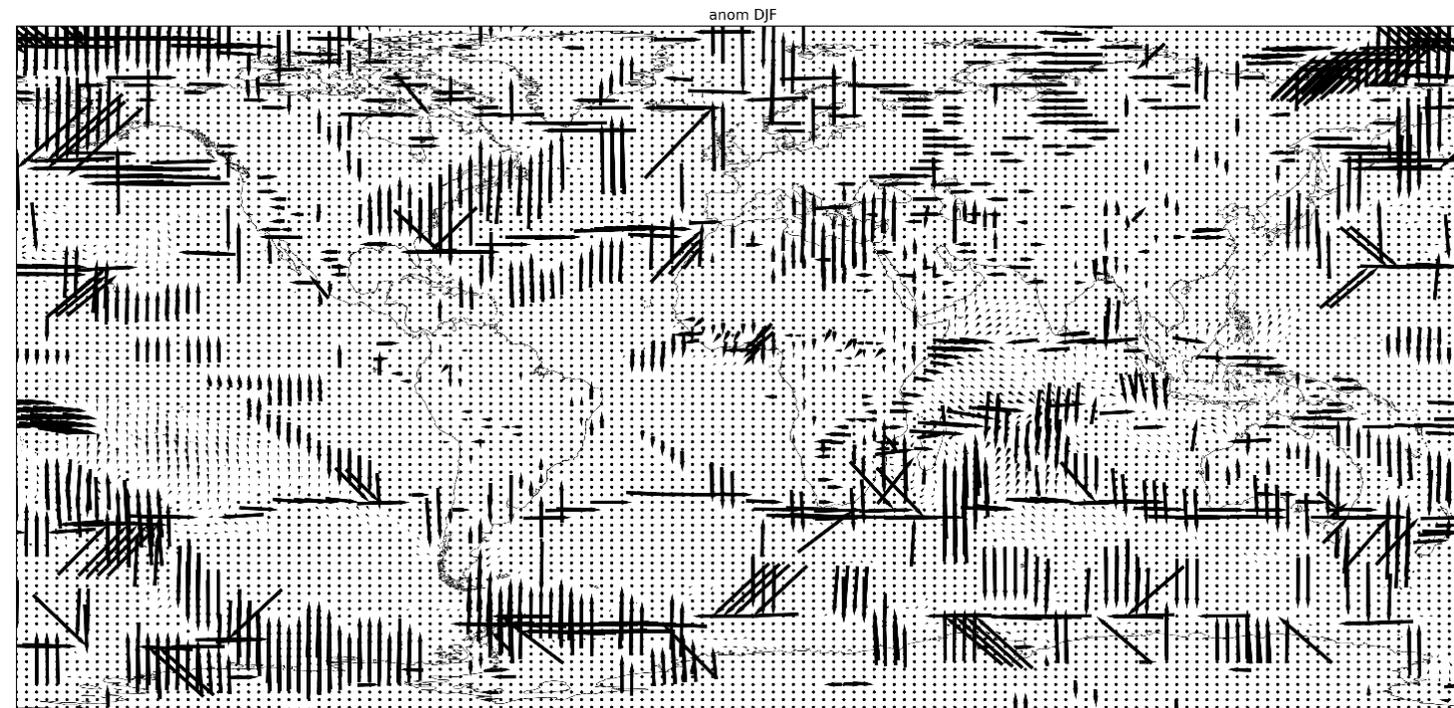
Anomalies in absolute wind speed



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Higher in LIG simulation

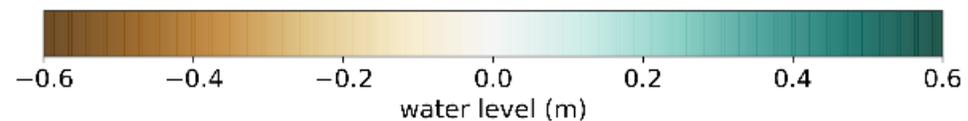
GCM results



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

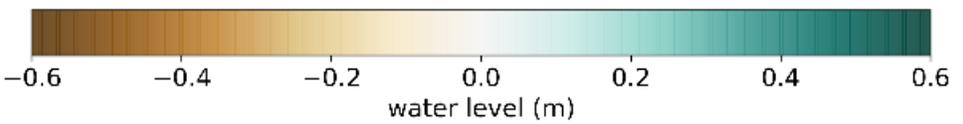
Higher in LIG simulation

DJF anom MSL-corrected - return period: 5 years

JJA anom MSL-corrected - return period: 5 years

GCM results

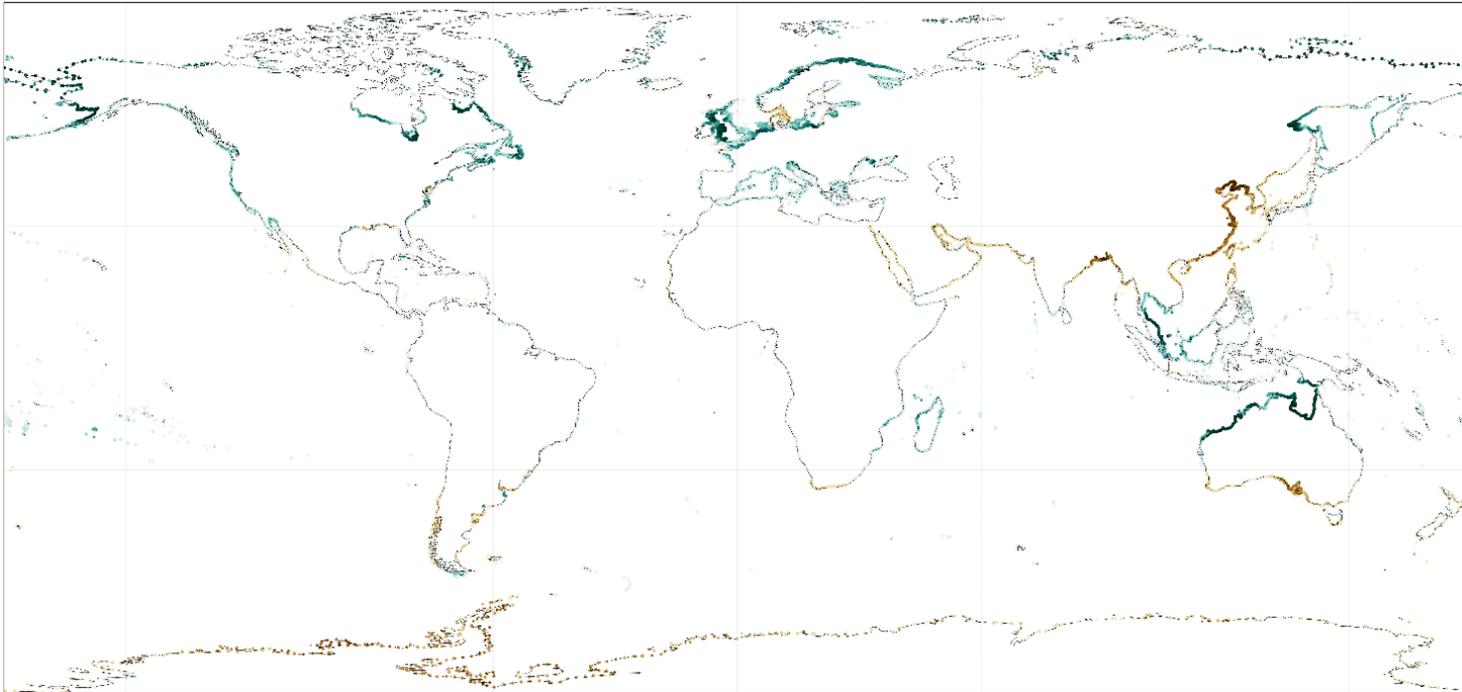
Surge-driven anomalies in sea level extremes at the **20-year** return period.



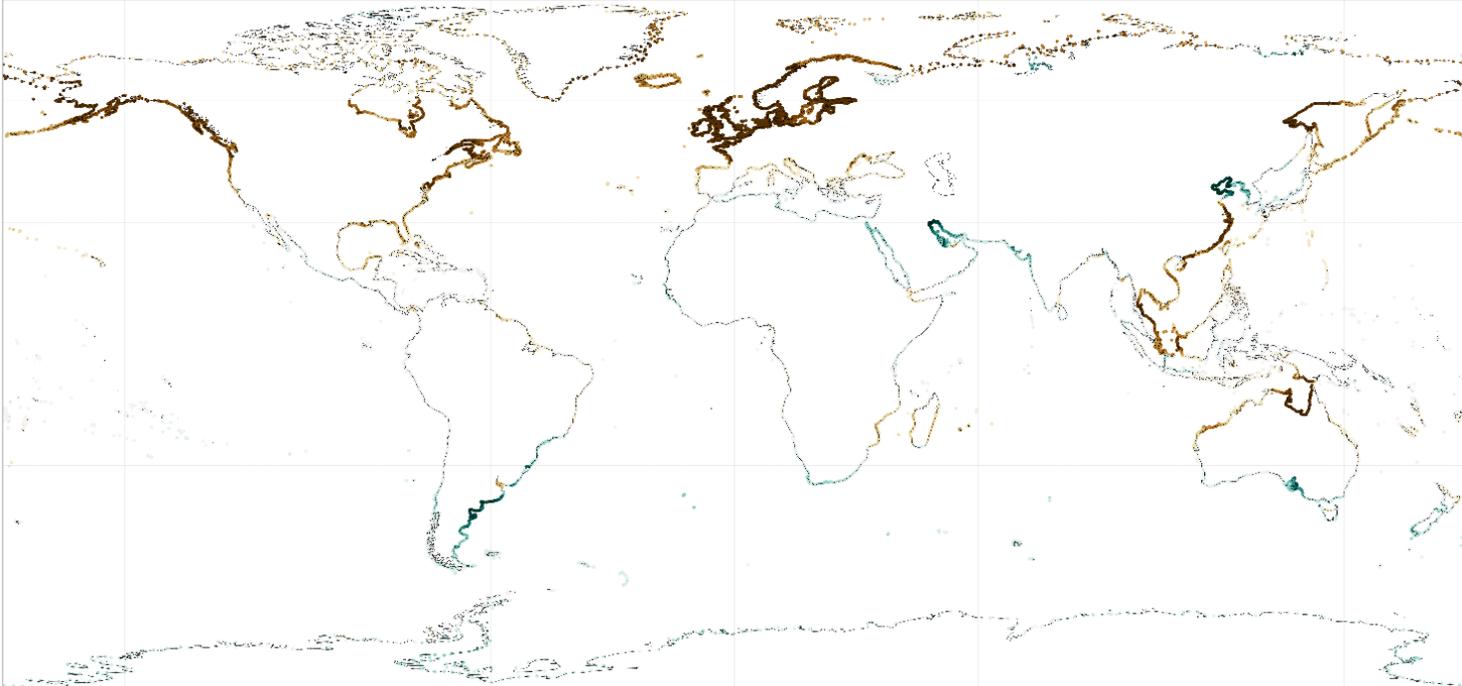
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Higher in LIG simulation

DJF anom MSL-corrected - return period: 20 years

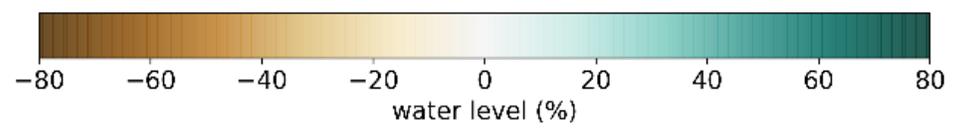


JJA anom MSL-corrected - return period: 20 years



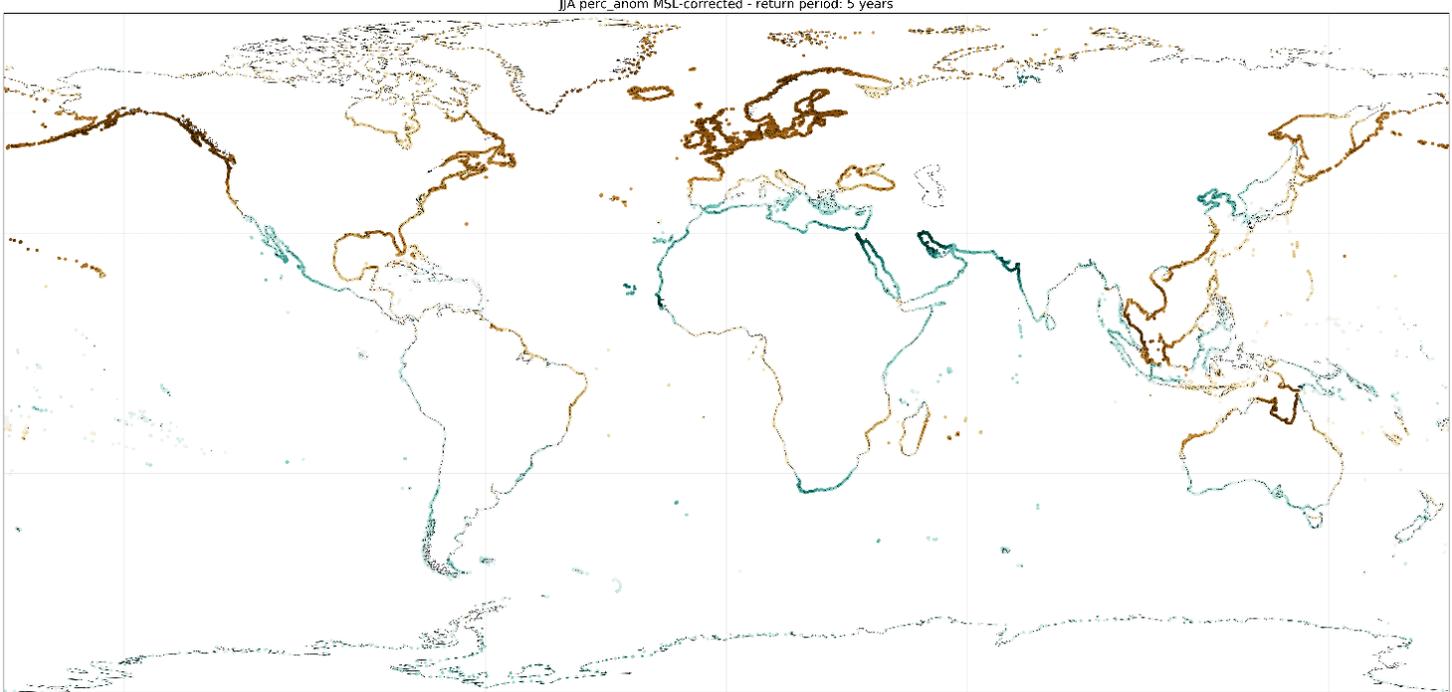
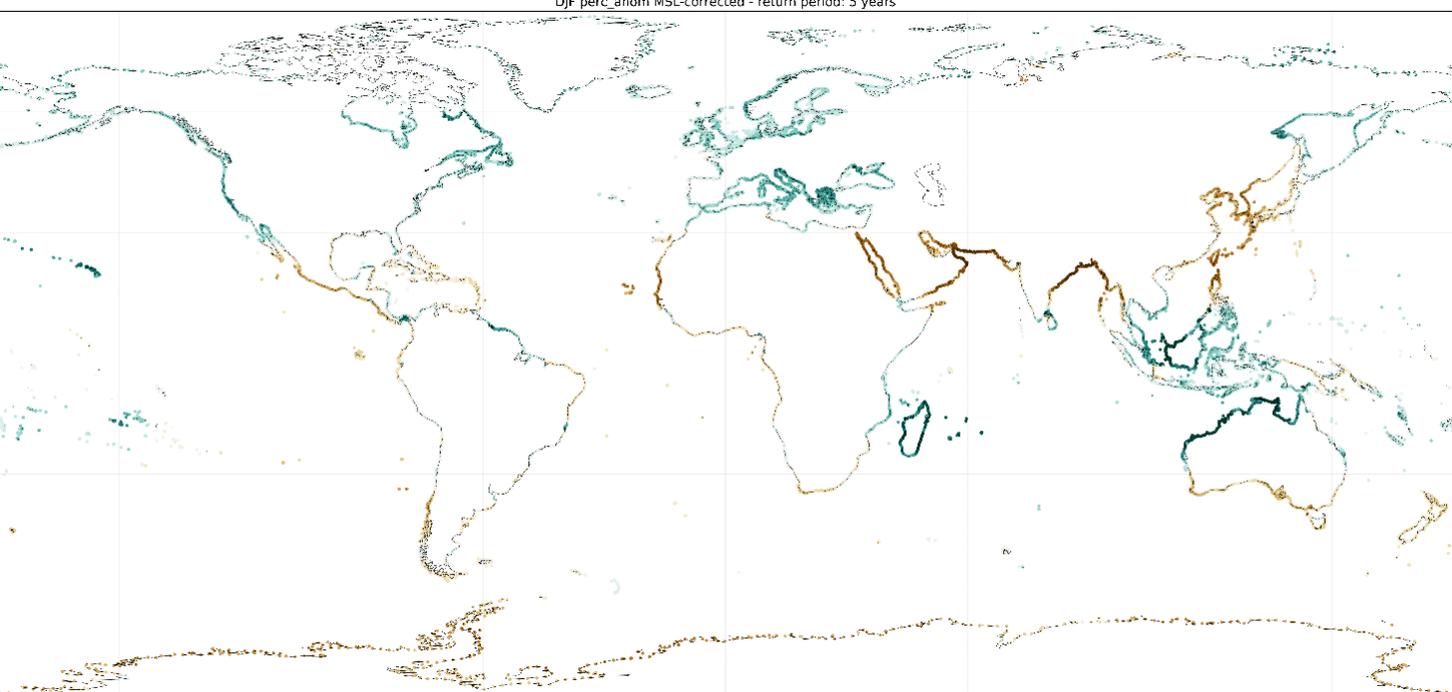
GCM results

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



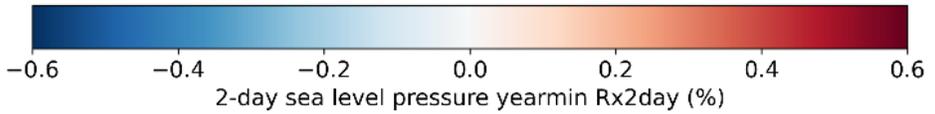
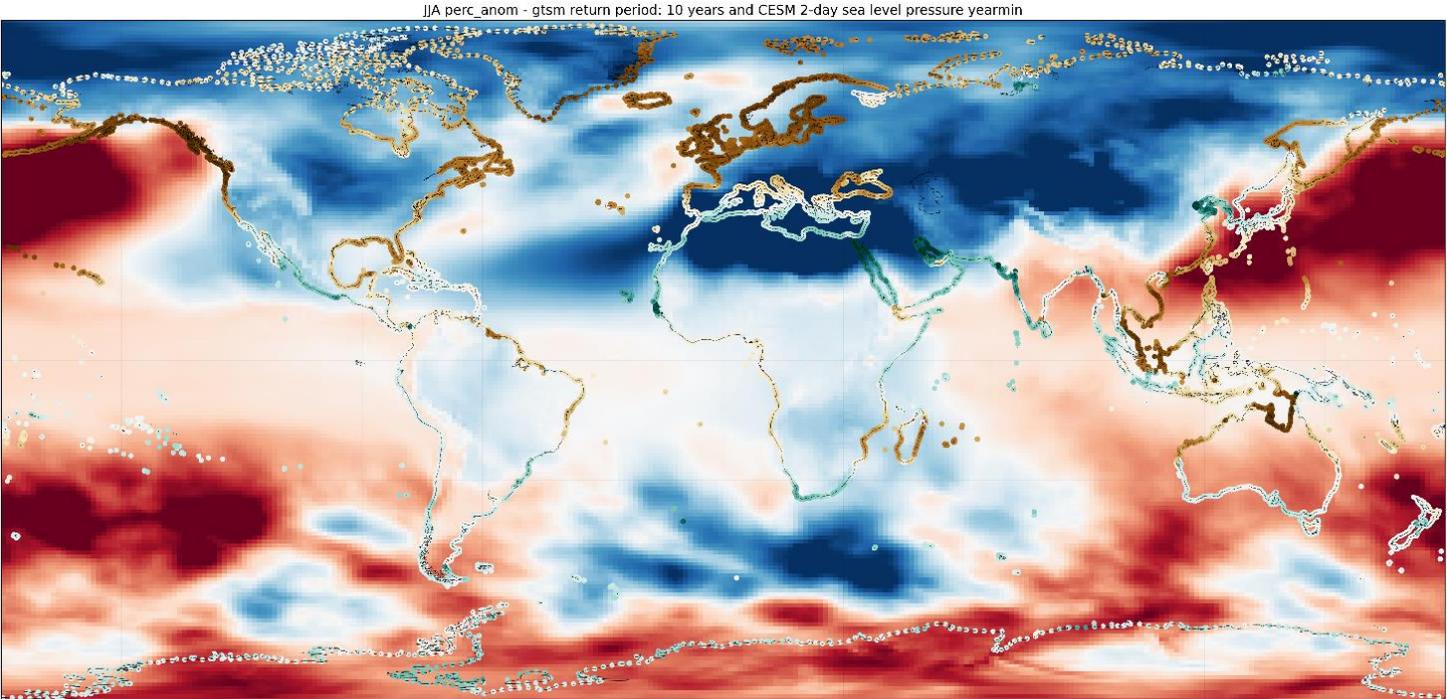
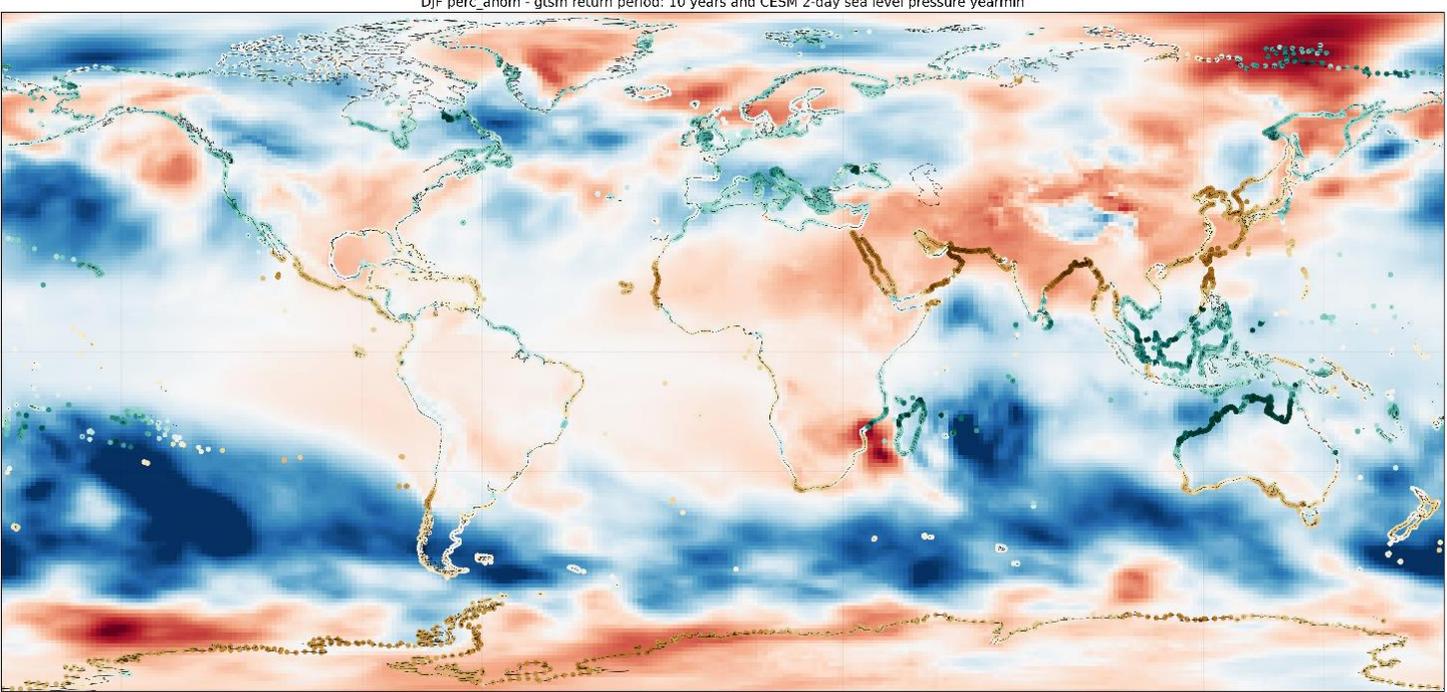
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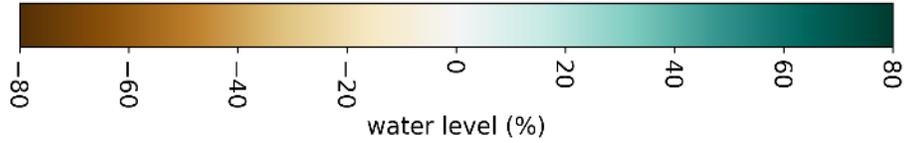
GCM results

- 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

