Modification of midlatitude storms by Gulf Stream SSTs in simulations with and without resolved weather fronts

Background:

- Global climate models (GCMs) don't resolve frontal processes occurring on ~10-20 km scales

- A storm-resolving model with high-resolution over the North Atlantic shows a larger response (compared to typical GCMs) of the jet stream to Gulf Stream sea-surface temperature (SST) anomalies, due to greater ascent in fronts

Research questions:

- How are the frequency and trajectories of midlatitude cyclones modified by Gulf Stream SSTs and how does this depend on resolution / whether weather fronts are resolved?

- What are the processes by which these storms shift the mean state (jet stream)?
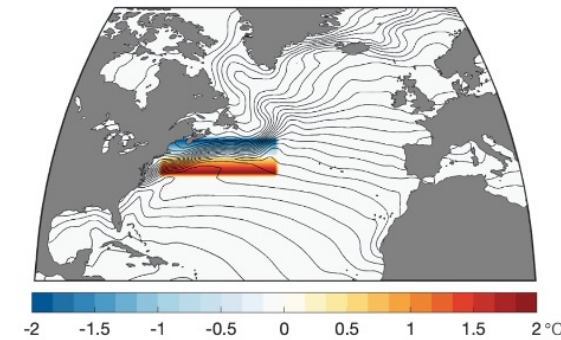
Data and methods:

- Output from mesoscale-storm-resolving global climate model simulations with CESM2
- Methods: Lagrangian cyclone tracking (bash, Fortran, Python) and composite analysis (Python) of North Atlantic storms
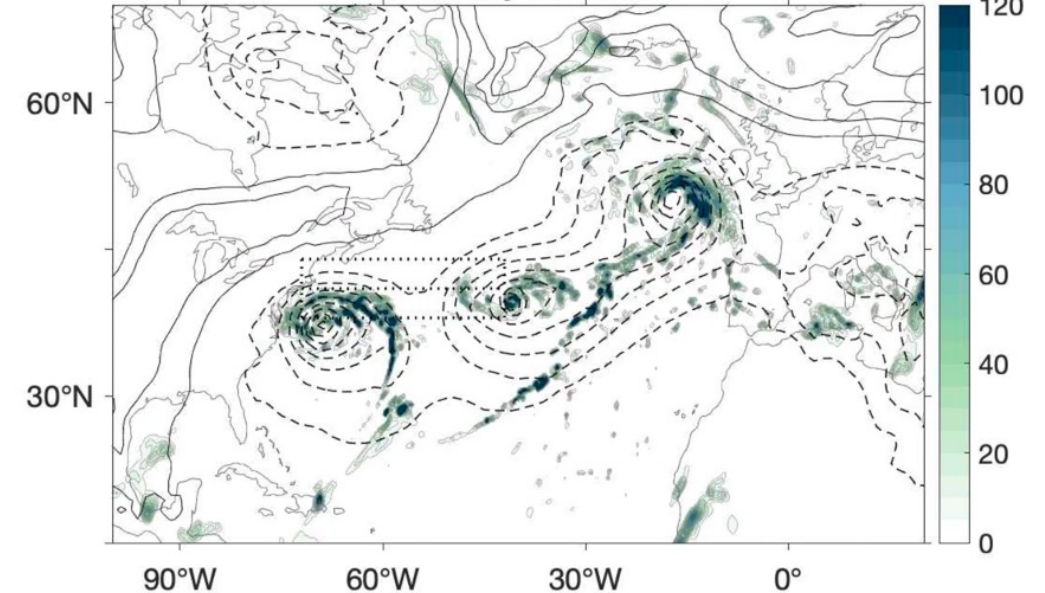
Supervision: Joas Müller, Robb Jnglin Wills, and Michael Sprenger

Variable Resolution North Atlantic Grid
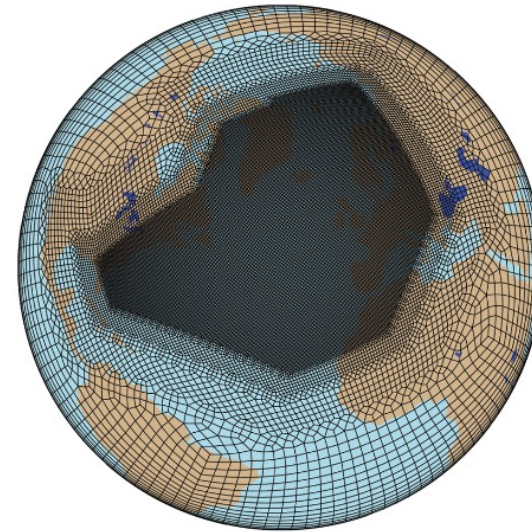
SST Anomaly

5 February 12:00 UTC

Assessing monsoon trends in high- and low-resolution simulations

Background:

- The tropical oceans play a crucial role in the global climate system, affecting monsoon rainfall (which provides rainfall to ~½ of the world's population) and circulation patterns in both hemispheres
- Tropical Pacific SST changes over the last decades are poorly simulated by standard resolution global climate models but are more realistically captured by a high-resolution climate model

Research questions:

- How do the simulated (historical and future) monsoon trends in the Northern and Southern Hemispheres differ between standard and high-resolution models?
- How do the modeled historical trends compare to observations in terms of magnitude, spatial pattern, and seasonality?

Data and methods:

- Output from simulations performed with three configurations of the CESM1 climate model with different atmospheric and oceanic resolutions (of up to 0.1°); observational datasets of rainfall and SST
- Statistical data analysis (Python) to investigate monsoon rainfall trends and to analyze the mechanisms underlying their differences across datasets

Supervision: Nora Fahrenbach and Robb Jnglin Wills

High resolution atmosphere and ocean

Observed

ΔSST (K) ΔSLP (hPa) ΔP (mm/day)