Linking Arctic stratospheric extremes to weather and climate in the Atlantic basin

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Stratospheric heat flux extremes, defined as the 10th and 90th percentiles of the daily high-latitude averaged eddy heat flux distribution at 50 hPa, are linked instantaneously to high-latitude planetary-scale wave patterns in the troposphere and zonal wind, temperature, and mean sea level pressure anomalies in the Atlantic basin. The impacts are reminiscent of different phases of the North Atlantic Oscillation. Models participating in the Coupled Model Intercomparison Project Phase 5 (CMIP5) are used to show that a degraded representation of stratospheric extremes leads to robust biases in tropospheric weather and climate relative to ERA-Interim. In particular, models with biased stratospheric extremes exhibit a biased climatological stationary wave pattern and Atlantic jet stream position in the troposphere. In addition, these models exhibit biases in geopotential height and zonal wind extremes in the North Atlantic region. The stratospheric biases are connected to model lid height, but it is not sufficient for assessing the tropospheric impacts. Our analysis reveals that the mean bias of the stratospheric heat flux is also not sufficient for assessing the representation of troposphere-stratosphere coupling. Overall, the results suggest that coupling with the stratosphere is important for determining the position of the Atlantic jet stream and stationary wave pattern in the troposphere.