The importance of cloud feedback for inter-hemispheric tropical Atlantic climate variability

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Over the tropical Atlantic during boreal spring, typical inter-hemispheric differences in sea-surface temperature (SST) coincide with a coherent pattern of interannual to interdecadal climate variability resembling that associated with the Atlantic Meridional Mode. This includes anomalous dipoles of SST and sea-level pressure roughly symmetric about the equator, as well as anomalous cross-equatorial surface winds. Over the regions of maximum marine boundary layer cloudiness in both hemispheres, enhanced cloudiness associated with this variability is co-located with cool SST, and reduced cloudiness is associated with warm SST -- indicative a positive cloud feedback that reinforces the underlying SST anomalies. The simulation of this feedback varies widely among models participating in phase 5 of the Coupled Model Intercomparison Project. Models that simulate a cloud feedback magnitude that is approximately three-to-four times weaker than that observed in nature substantially underestimate the amplitudes of typical inter-hemispheric tropical Atlantic variability in SST, cloudiness, and atmospheric circulation. Models with a realistic feedback magnitude generally produce higher and more realistic amplitudes of variability. Marine boundary layer clouds therefore appear to be a key element of springtime coupled atmosphere-ocean variability over the tropical Atlantic. The simulation of this variability in climate models may be improved by better representing boundary layer cloud processes.

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