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# The climate response to the 11-yr solar cycle in the CMIP5 historical simulations

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The variation of the incoming solar irradiance over the course of the 11-yr solar cycle is a significant source of stratospheric variability. Dynamical mechanisms could amplify and transfer solar signals from the stratosphere to the troposphere and even the surface in a "top-down" pathway. In the opposite direction, "bottom-up" mechanisms could mediate solar signals from the surface to the troposphere via air-sea coupling. The Coupled Model Intercomparison Project Phase 5 (CMIP5) provides an unprecedented opportunity to understand the climate response to the 11-yr solar cycle, as brought about from both "top-down" and "bottom-up" mechanisms, because for the first time different coupled models are driven by spectral solar irradiance and ozone changes.

We here analyse archived "historical" simulations (1850-2005) with a lead/lag multiple linear regression model, focusing onto the troposphere and oceans. Our analysis identifies a delayed warming in the troposphere and surface, which is explained by the delayed response of the oceans. In fact, the delayed warming penetrates down to $\sim$150 m from the ocean surface. A significant warming is identified over the western Pacific and Indian oceans whereas an anomalous cooling is simulated in the eastern Pacific. This meridional temperature dipole introduces changes in the Walker circulation, precipitation, convective activity with concomitant effects on the Northern Pacific. We further categorize models in "low- and high-top, depending on the inclusion or not of detailed stratospheric dynamics. This classification is found educative when the relative role of the "top-down" versus "bottom-up" forcing is investigated.