Geophysical Research Abstracts
Vol. 19, EGU2017-1915, 2017
EGU General Assembly 2017

On the Effect of Extratropical Wind Stress Forcing on Pacific Subtropical Cells and Tropical Climate

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The influence of extratropical atmospheric dynamics on the tropical ocean state is a classical example of ocean-atmosphere teleconnection. One way to influence tropical climate is through oceanic SubTropical Cells (STCs), shallow overturning circulation structures connecting the Equatorial Ocean with the subtropical regions. STC are responsible for large mass and energy transports, and their influence on tropical climate, and consequently on the global climate, is fundamental both on the mean and its variability. These circulation structures are present in all basins across the Tropics (Pacific, Atlantic, and Indian Ocean), with different properties and strengths due to the features of each basin.

We focus here on the effect of off-equatorial winds on the Pacific STCs, which are the largest and have been previously studied for their potential role in driving low-frequency Pacific variability. Using the Modular Ocean Model version 5 (MOM5), we force the ocean surface with idealized wind stress and wind stress curl anomaly patterns, in order to highlight the influence of subtropical and extratropical forcing on STCs dynamics, and, eventually, on some aspects of Pacific tropical climate. Results have been compared with a control simulation, in which a climatological forcing has been applied at the ocean surface.

Our simulations show an increased (reduced) meridional water transport for positive (negative) wind stress anomalies in the Subtropics; the structure of the thermocline at the Equator is modified as well, where cold (warm) anomalies appear. Those signatures result from anomalous values of Equatorial UnderCurrent (EUC), which is partly fed by the STCs. Meridional ocean heat transport is influenced too, showing larger (weaker) values for stronger (weaker) subtropical wind stress. Anomalous circulations are further analyzed for the interior and western boundary transports, and scalings are derived linking subtropical wind stress, STC transports and tropical anomalies.