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Energy Dissipation in the Tropical Ocean and ENSO Dynamics.

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State-of-the art coupled models exhibit a wide range of behavior in the tropical Pacific, particularly when simulating ENSO. Here, we use the energetics of the tropical ocean to shed light on this issue. Previous studies have shown that winds act on the ocean by affecting the buoyancy forcing, modifying the slope of the isopycnals and changing the Available Potential Energy (APE) of the system, so that

$$\frac{d(APE)}{dt} = Wind\_Work - Dissipation$$

The present study focuses on the role of energy dissipation in this balance due to various factors including turbulent mixing and coastal Kelvin waves leaving the basin. Firstly we test the robustness of this equation by using a variety of ocean-only models and data-assimilation products, in order to establish a baseline for this relationship. With the baseline established, we apply our method to the IPCC coupled model simulations. We find that the net dissipation rates and the overall dissipative properties vary greatly from one model to the next. One of the striking differences between coupled models is in the way they partition energy between the seasonal cycle and interannual variability, which is investigated within the same framework. Further, we explore the differences in the ocean energetics that occur due to the emergence of a double ITCZ in coupled models and also investigate the relationship between the effective coupling strength of a given model and its dissipative characteristics. Ultimately, we propose this energy-based analysis as an effective diagnostic tool for assessing and improving model performance.