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Different energetics of global monsoon over land and ocean

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Monsoons were traditionally considered to be land-based systems. Recent definitions of monsoons based on either the seasonal reversal of winds or the local summer precipitation accounting for more than 50% of the annual precipitation suggests that monsoon domains extend over oceanic regions as well. The concept of global monsoon combines all the monsoon domains into a single entity. Modern observations show that the variations in precipitation are nearly coherent across all the individual monsoon domains on decadal timescales. Using a transient simulation of the global climate over the last 22,000 years as well as reanalysis data of the modern climate, we have shown that tropical precipitation has different characteristics over land and ocean grids. This is due to the differences in the energetics of monsoon over land and ocean grids. With a lower thermal heat capacity, the net surface energy flux over land is negligible, whereas it is quite large over the ocean. In fact, the orbital scale variability of net energy flux into the atmosphere over the ocean is controlled by the surface energy flux. Another major difference between land and ocean grids of the global monsoon is in the vertical profile of the vertical pressure velocity. It is bottom-heavy over land and top-heavy over the ocean. This results in smaller vertical transport of moist static energy (which has a minimum in the lower troposphere) over land, and a larger vertical transport over the ocean. These differences between the land and ocean, suggest that the land and ocean grids should not be combined as is traditionally done. Global monsoon-land and global monsoon-ocean should be studied separately.