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Atmospheric and oceanic bridges that link the variability of meridional circulations in the Pacific and Indian Oceans

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The subtropical cells (STCs) of the Pacific and Indian Oceans are wind-driven, shallow meridional overturning circulations that connect the tropics and subtropics. They carry warm surface water poleward (primarily by Ekman flow) and colder pycnocline water equatorward (primarily by geostrophic flow). As such, they regulate meridional heat transport between the tropics and subtropics and affect climate variability on time scales longer than a few years. Ocean surface wind stress obtained from ERS-1, -2 and QuikSCAT scatterometers and sea level measurements derived from the TOPEX/Poseidon and JASON-1 altimeters are used to examine the interannual and decadal variability of these STCs and their linkages. These observations reveal anti-correlated variability in the strength of the Pacific and Indian-Ocean STCs in the past one and half decades. The changes are contributed by two processes: (1) an atmospheric linkage between Pacific and Indian-Ocean trade winds associated with the oscillation of the Walker circulation: this causes anti-correlated poleward Ekman transports in the two oceans; (2) an oceanic linkage that allows the wind-driven variation of sea level (and thus pycnocline depth) in the western tropical Pacific to transmit to the South Indian Ocean via the Indonesian Archipelago: this results in anti-correlated variation of equatorward geostrophic flows in the pycnocline of the two oceans. These atmospheric and oceanic bridges that connect the Pacific and Indian-Ocean STCs may also be at work on multi-decadal and longer time scales.