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The Indonesian Throughflow inflow portal: Makassar Strait, its variable profile and transport

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The transfer of western Pacific Ocean water into the Indian Ocean, the Indonesian Throughflow (ITF), influences the ocean scale heat and freshwater inventories, and associated sea surface temperature (SST) pattern. The ITF effects on SST patterns link the ocean to such climate phenomena as ENSO and the Asian monsoon. A 1996-1998 and 2004-2009 observational time series of the Makassar Strait throughflow, the primary pathway for Pacific inflow into the ITF, sheds light on the nature of the tropical Pacific Ocean surface water contribution to the ITF. The depth profile of the Pacific water flowing into Makassar Strait exhibits thermocline intensification, so as the transport-weighted temperature is cooler than might otherwise be expected. The profile changes with season and interannually, and likely longer time scales. The participation of warm surface ocean water in the ITF is clearly restricted, protecting the warmest of the tropical Pacific water from leakage into the Indian Ocean. The restriction of the surface water component of the ITF is likely a consequence of the injection of low salinity, buoyant surface water from the South China Sea (SCS) into the Makassar Strait, which blocks entry of Mindanao Current surface water into Makassar Strait, diverting it into the NECC. The SCS surface water derived from the Pacific Ocean via the Luzon Strait, which is diluted with excess freshwater, before entering into Makassar Strait, both from the south through Karimata Strait and from the north by a pathway through the Sulu Sea and Sibutu Passage. The SCS throughflow (Luzon Strait to Makassar Strait) is ENSO dependent. The deeper Sulu path matches the ENSO dependence; the ~40 m Karimata path appears to be mostly forced by the local monsoon wind. During El Niño the SCS throughflow is high, blocking and hence reducing the surface layer contribution into the ITF from the Mindanao Current; during La NiÒa, the SCS throughflow is low, which allows greater contribution of Mindanao current surface water into the ITF. The SCS hydrological budget and throughflow has an impact on the larger scale SST patterns and associated climate phenomena, by exerting a 'freshwater plug' inhibiting tropical Pacific surface water (upper ~70 m) participation to the ITF.