Observational Evidence for a Weakly Coupled Mode of Pacific Decadal Variability

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We identify a weakly coupled mode that generates a decadal ENSO-like sea surface temperature (SST) pattern in climate models. We then look for observational evidence of the mechanisms involved in this mode. This mode generates SST variability via changes in the Walker circulation that are amplified by ocean surface processes only, i.e. without participation of the equatorial thermocline. The thermocline does not play a role in the growth of this mode because on decadal and longer timescales it is closer to equilibrium with the wind changes. In equilibrium, the thermocline response is dominated by the forced Sverdrup response, which has no signal in the east. Thus, coupling between winds and SST via changes in the depth of the thermocline is not possible. Moreover, the thermocline shoals in the central Pacific, the region where coupling is strongest during interannual ENSO events. Therefore, according to theory and models the wind-driven decadal changes in the thermocline depth oppose the development of SST anomalies, i.e. a negative thermocline feedback. However, on decadal timescales the Bjerknes feedback is still positive due to the wind-driven response of surface currents and upwelling resulting in a positive zonal advection and upwelling feedbacks. Unlike interannual ENSO events, the lack of delayed thermocline adjustment does not lead to a self-sustained oscillation. Thus, the weakly coupled Walker mode may require external forcing to grow. Temperature profiles, mostly provided by eXpendable BathyThermographs, are used to evaluate the role of the thermocline depth anomalies on decadal Pacific variability during the 1970-2010 period.