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Thermodynamical Coupled Modes in the Tropical Atmosphere-Ocean

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We'll present a consistent and unified solution for the two types of thermodynamical coupled modes in the atmosphere-ocean climate system, the tropical meridional mode and the subtropical dipole mode. The solution is derived analytically from a linear model that couples a simple atmosphere to a slab ocean via the Wind-Evaporation-SST (WES)feedback. For a mean zonal wind, the results show that the wind (hence latent heat flux) anomaly and the SST anomaly differ in phase such that the tropical mode propagates downwind and the subtropical modes propagate upwind, with both modes being damped by the SST-driven component of latent heat flux. Despite the existence of positive WES feedback, the large-scale subtropical modes are always stable, while the tropical mode could become unstable only when the air-sea coupling is strong and the mean wind is easterly. Furthermore, the mean meridional winds break the equatorial symmetry and enable the coupled modes to intensifyin the Southern/Northern Hemisphere for a southerly/northerly component. For realistic parameter values, these thermodynamical coupled modes have periods and damping timescales in years, hence they may play important roles in the tropical interannual-to-decadal climate variability.