

# What causes disagreement of upwelling in the TTL among CMIP5 models?

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Climatology of upwelling in the tropical tropopause layer (TTL) in current climate simulations and in future climate projections is examined by using models participated in the Coupled Model Intercomparison Project Phase 5 (CMIP5). Large intermodel upwelling difference in the TTL, corresponding to annual cycle of the upwelling in reanalysis, appears in the current climate simulations. According to upwelling diagnosis based on the zonal momentum budget and composite analysis, the meridional eddy momentum flux due to tropical planetary waves and midlatitude synoptic waves generally control the intermodel upwelling difference.

Future climate simulations indicate that upwelling changes in the TTL are strongly tied with magnitude of the upwelling in the current climate simulation. The models with strong TTL upwelling in the current climate simulations tend to project strong upwelling enhancement in the future simulations, and vice versa. Diagnosis of the upwelling shows that intermodel difference in upwelling change comes from same dynamical factors as the current climate cases.

Contributions of the sea surface temperature (SST) to the upwelling difference is examined by SST prescribed simulations in CMIP5. The contributions of intermodel SST difference to the upwelling is smaller than that of intrinsic atmospheric model difference. Although relative contributions of main dynamical forcing to the upwelling are altered with latitudinal range, correlation of the upwelling in between the current climate simulations and future changes is significantly high for all latitude ranges.

Key words: Tropical tropopause layer, CMIP5, upwelling, future changes