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Regional Climate Modeling Study of Wind Variations over Western Pacific Warm Pool before El Nino Onsets

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Prior to the onset of the 2002/03 El Nino event, strong northwesterly surface winds occurred along the northern coast of New Guinea. The winds caused upwelling occurred along the coast, and this relatively cool water spread out over a wider area to the northeast toward the equator. Hasegawa et al. [2009] hypothesized the low SST in this region generated a positive zonal SST gradient together with high SST in the east, and it contributed to enhancement of the westerly surface wind in this region, leading to the onset of the 2002/03 El Nino event. To confirm their hypothesis, we have started a regional climate modeling study in the western Pacific Warm Water Pool region. The goal is to understand this region in an ocean-atmosphere coupled system. As a first step, we performed experiments with a regional atmospheric model forced with sea surface temperature (SST) as a lower boundary condition. The model used in this study was the International Pacific Research Center (IPRC) Regional Atmospheric Model (iRAM). The model covered the western Pacific Ocean with a horizontal resolution of 0.25 degree. We in particular focused on December 2001, as Hasegawa et al [2009] did in their diagnostic study. This model reproduced the strong northwesterly surface winds along the northern coast of New Guinea in the control run. To measure impacts of cold SST along the New Guinea coast, we did additional experiments to cool SST further in this region. Decreasing SST enhanced divergence of wind in the overlying atmosphere. This was favorable to the enhancement of the westerly surface wind along the equator at the eastern edge of the Warm Water Pool, supporting Hasegawa et al. [2009]'s idea. We also pay attention to the role of the high mountains of New Guinea in shaping climate around this region. The central mountains of New Guinea have a peak elevation over 4000m high. This mountain helped to enhance upward air motion and convergence near the surface in the control run. In an experiment where the orography of New Guinea was flattened, these circulations were eliminated and the northwesterly along the northern coast was weakened. This suggests the orography of New Guinea provides a good environment for the feedback between the westerly and the coastal upwelling mentioned above. The difference with and without the orography also revealed that the high mountain enhances precipitation over the northern side of the mountain ridge in this season.

Keywords: El Nino, Warm Water Pool, gegional model, air-sea coupling, orography effect, New Guinea