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Sensitivity of typhoon intensity to the ocean in atmosphere-ocean coupled/non-coupled experiments

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Intensity of typhoons is greatly controlled by air-sea interaction with the ocean through the sea surface, with affecting the sea temperature distribution through mixing/upwelling in the upper layer in the ocean. To investigate the intensity change of typhoons with air-sea interaction, umerical experiments were performed utilizing with atmosphere-ocean regional coupled/non-coupled model; slab ocean model was for one dimensional coupled experiments and CReSS-NHOES was for three dimensional coupled experiments.

In the comparison of the results, remarkable differences of intensities resulting from air-sea interaction were represented, with successfully simulating typical structures of typhoons. Especially, the deepening of the central minimum pressure of typhoons was suppressed resulting in the ocean circulation caused by the typhoons. The magnitude of the central pressure deepening in the mature stage was more in the three-dimensional ocean coupled experiment including upwelling, compared to that in a slab ocean experiment of one-dimensional vertical mixing heat transfer in the ocean upper layer, and was much more compared to that in fixed sea surface temperature experiment without time variation.

In the western North Pacific, passing typhoons are greatly affected the local sea surface temperature around the warm Kuroshio currents where meridional sea temperature gradient is sharp. Sensitivity experiments employed meridionally smoothed sea surface temperature were performed to investigate to consider the effect by the Kuroshio currents in addition to the coupled/non-coupled experiments. The intensity of the typhoon was suppressed passing around the Kuroshio current and showed weak deepening of the central minimum pressure in the experiment with smoothing sea surface temperature. The experiment employed zonally averaged meridionally smoothed showed quite weak deepening of the central minimum pressure toward the mature stage. These appeared in the typhoons, especially ones which moved slowly around the Kuroshio currents.

We will discuss intensity suppression of typhoons, not only the difference of the sea surface temperature but also the difference of the latent/sensible heat flux around the center of the typhoons and the ocean heat content in the ocean surface layer.

Keywords: tropical cyclone, typhoon, air-sea interaction, atmosphere-ocean coupled model, cloud resolving mesoscale regional model, Numerical experiment