東京湾の霧のシミュレーション：大気海洋河川相互作用の役割
Simulation of fog in Tokyo Bay: the role of atmosphere-ocean-river interaction

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River water often plays an important role in fog formation in the coastal ocean. Fresh and light water input from rivers makes a thin layer over the ocean around the river mouth. Even if the thin layer is cooled in a cold season, water column can keep stratification. As a result, near surface atmosphere becomes colder than the surrounding area, and an inversion layer tends to occur in the lower atmosphere. This condition leads to generate and maintain fog near the river mouth.

It is important to predict the occurrence and duration of fog for air- and sea-port operations near the coast. For example, Haneda Airport is closed about once a year due to heavy fog events. In particular, a heavy fog event on March 8, 2016 would be related to the river inflow.

This study aims to simulate the coastal fog using a coupled atmosphere-ocean-river model and to enhance our forecasting capabilities. We conducted offline coupled experiments with atmospheric and ocean models for the heavy fog event on March 8, 2016. To generate the bottom boundary condition with fine resolution for the atmospheric model over Tokyo Bay, we used the Regional Ocean Modeling System (ROMS). We performed two experiments: the RIV/CTL experiments with/without the effect of the river input, respectively. The grid spacing was chosen to be 500 m, and the atmospheric forcing was taken from the operational numerical weather prediction data of the Japan Meteorological Agency (JMA) Meso-scale Model (MSM). The obtained sea-surface temperatures (SSTs) were merged with those of the National Centers for Environmental Prediction-Final Operational Global Analysis data (NCEP FNL). By using the merged data as the lateral and bottom boundary conditions, we calculated the atmospheric states by a regional atmospheric model SCALE with three nested domains: the grid spacing in the innermost domain was chosen to be 500 m.

The results showed that relative humidity north of the Haneda Airport in the RIV experiment was larger by 2-3% than that in the CTL experiment from the night of March 7 to the morning of March 8. This feature was found over a cold SST region in the RIV experiment extended from the mouths of the Arakawa-river and the Sumida-river. The cold SST was generated by an above-normal fresh water inputs from both rivers due to precipitation in the morning of March 7. Over the cold SST region, the atmospheric inversion layer was maintained for a longer time than the surrounding regions. South-westward near-surface wind at that time potentially contributed to generate the fog over the airport by bringing the humid air.

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