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An Observational and Modeling Analysis of a Sea Fog Event over the Yellow Sea During Spring

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Abstract
A sea fog event in the Yellow Sea from April 13 to 15, 2016 is observed and simulated using WRFv3.5 model. The GOES-9 visible satellite imagery is used to observe the evolution process of the sea fog event. The atmospheric circulation, temperature field, wind field, air-sea temperature difference and atmospheric stability were analyzed. It is concluded that this sea fog event was mainly due to the warm air blowing to the cold sea surface. This fog event can thus be classified into an advection sea fog. In northern part of the Yellow Sea, The prevailing Northerly winds result in the rapid dissipation of sea fog in the northern part of the Yellow Sea, whereas in the southern region, sea fog maintained longer. In addition, this present study suggests that when the air-sea temperature difference is between 1 and 3 [U+2103], it is the most favorable condition for sea fog formation over the Yellow Sea. Based on the analysis of the station data, the results suggest that the inversion layer has an important influence on the formation and development of sea fog. Finally, this sea fog event is simulated by using WRF model (v3.5). The simulation results are in good agreement with the satellite cloud image. The horizontal and vertical distributions of cloud-water mixing ratio were analyzed. The results show that sea fog are denser in the southern part of the Yellow Sea. The height of the fog layer is about 950 hPa, right under the top of the inversion layer. There also exist some problems in terms of this simulation. In the simulation, sea fog dissipated earlier than that in the observation. In the eastern part of Yellow Sea, the WRF model cannot reproduce the distribution of sea fog as in the satellite imagery. Three sensitivity tests were conducted with WRF model: SST+2K, SST-2K and no surface flux. In the warmer sea surface, the fog patch tends to be smaller. The cooler the sea surface, the larger the fog patch. The results suggested that with cooler sea surface, it is more favorable for advection sea fogs to form. Without surface flux, when southerly winds prevail, the fog tends to be stronger, whereas the northerly winds prevail, the fog tends to be weakened.