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The structures of the atmospheric boundary layer in the Yellow Sea summer fog-a comparison study with the spring fog

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The Yellow Sea is a highly foggy area in spring-summer (April to July) seasons. A Yellow Sea fog case occurred on July 7-11, 2008 is investigated by the data from the sea buoy stations, high-resolution digital sounding instruments and other observations and from a three-dimensional mesoscale model (WRF). Espcially, the boundary layer structure are analyzed and simulated, and the comparison is made between the summer fog case and a spring fog case in May 2-3, 2008. The results are as follows [U+FF1A] (1) In summer fog, the marine atmospheric boundary layer (MABL) is less stable (almost no temperature inversion)than that in spring fog and the summer fog is thicker in elevation due to the development of turbulence and plenty of moisture supply advected by the East Asian summer monsoon in the low level of the MABL; whereas in spring fog the MABL is very stable with pronounced temperature inversion and the moisture is mainly transported by a shallow local anticyclone in the Yellow Sea surface and traped close to a very low level, thus leading to thin fog. (2) In summer, the southerly air column in the MABL is of similar physical features since it comes from the southern ocean, producing the less vertical gradient both in temperature and in humidity (no obvious dry layer). In contrast, in spring the southerly sea surface air is cooling gradualy as it passes the cold Yellow Sea, but the air at about 950 hPa is westerly from inland that is dry and warm by the increased solar radiation, thus forming temerature inversion and evident dry layer over the sea. (3) The surface air temperature (SAT) is obviously higher than the sea surface temperature (SST) in the process of the summer fog, and the SAT does not derease or even increase in the fog, which is related to the weaker long wave radiation at the fog top and the huge amount of latent heat; while in spring sea fog the SAT decreases rapidly and is even lower than the SST in the peak phase of the fog due to strong long wave radiation at the fog top and the turbulence cooling, which is similar to the haar in the North Sea. The cooling effect can reach to the sea surface readily possibly due to the thin fog, the small amount of moisture, and the robust cooling at the top. (4) The turbulent layer in the summer fog is at 100 -300m high in the upper level of fog and the long wave radiation is weaker due to the inexistence of dry layer, thus the cooling effect at the fog top can hardly influence the bottom air; while in spring fog the long wave radiation cooling effect can quickly reach the bottom of the fog. These results are helpful for understanding the formation of the mechanism of the sea fogs.