

Advances in Fog Microphysics Research in China

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Fog microphysical research in China based on field experiments obtained many important results in recent 50 years. With the fast development of China's economy, urbanization in the last 30 years, special features of fog microphysical structure also appeared, which did not appear in other countries. This article reviews the fog microphysical research around China, and introduces the effect of urbanization on fog microphysical structure and the microphysical processes as well as macroscopic conditions of radiation fog droplet spectral broadening. Urbanization led to an increase in fog droplet number concentration but decreases in fog liquid water content (LWC) and fog droplet size, as well as a decrease in visibility in large cities. Observations show that the radiation fog could be divided into wide-spectrum one, which is all extremely dense fog with the spectral width more than $40 \mu\text{m}$, and narrow-spectrum one, most of which is dense fog with the spectral width less than $22 \mu\text{m}$, according to droplet spectral distribution. During developing from dense fog to extremely dense fog, the wide-spectrum radiation fog is characterized by explosive deepening, that is, within a very short time (about 30 min), the droplet concentration increase by about one order of magnitude, droplet spectral broadening across $20 \mu\text{m}$, generally up to $30\text{--}40 \mu\text{m}$, or even $50 \mu\text{m}$. As a result, water content increased obviously, visibility decreased to less than 50 m, when dense fog became extremely dense fog.

We believe in the near future, the following several aspects need to strengthen: (1) The measurements of fog microstructure characteristics: extensive fog microphysics measurements are needed, although there are many efforts focusing on fog microphysics, their physical understanding is still in question in different cases and different environments. (2) The fog-haze transformation microphysical processes and mechanisms need be revealed. Most of the past researches divided the fog and the haze, however the haze transformed to fog need further observation and analysis. (3) The fog spectral widening is another question need to be revealed. Since the explosive features would appear in larger areas, the synchronous observations in larger ranges would be carried out in the future. (4) The relationship between fog microphysics, radiation, nocturnal boundary layer, turbulence, and pollutions need to be further uncovered. (5) Artificial influence fog microstructure could achieve the goal of weakening or even dispersing fog and haze. (6) Further studies could use the acquired microphysical parameters to improve the numerical models which could further improve the fog forecast.

Key words: Fog microphysics, China, droplet spectral broadening, urbanization effect;