

The occurrence of seedable clouds in the warm season for mitigating water shortage problems

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Water shortages have recently become a serious problem for many cities in Japan. Since 2006, the Japanese Cloud-seeding Experiments for Precipitation Augmentation (JSCEPA) have been conducted in Japan with the aim of mitigating summer water shortages. To select an intensive observation area, we identified areas with frequent drought and frequent occurrence of potential clouds for seeding by examining geostationary meteorological satellite and ground observation data for the period 1994 to 2008. A water shortage period was defined as a period when water supplies were limited, and a seedable cloud was defined as a cloud that did not bring heavy rainfall. The Sikoku area was identified as a candidate for observations.

To investigate cloud occurrence, we chose a square area, 25×25 km that almost covered the catchment area of the Sameura dam. Figure1 shows cloud that covered 80% of the grid area from May to September in 2006 and 2007. The figure includes 'cold cloud' and 'warm cloud.' Cold cloud has a high cloud top with brightness temperature defined from -25 to -5°C, suggesting the potential for precipitation augmentation by an ice water process. Warm cloud has a low cloud top with brightness temperature from -5 to 10°C, suggesting the potential for a warm rain process. A drought occurred from May 25 to July 5, 2007. Comparison of cloud occurrence in June 2006 and 2007 showed similar occurrence of cold cloud in the two years but a higher occurrence of warm cloud in 2007 than in 2006. Table 1 presents a summary of the comparison. Average rainfall was computed from Automated Meteorological Data Acquisition System (AMeDAS) radar data.

Comparing months with and without water shortages, total rainfall was low in the water shortage months, while the occurrence of clouds did not differ. For convenience, precipitation efficiency was defined as the ratio of the area rainfall rate to the occurrence of clouds. Clouds in months of water shortage had low precipitation efficiency. Nevertheless, potentially seedable clouds existed in the period of water shortage.

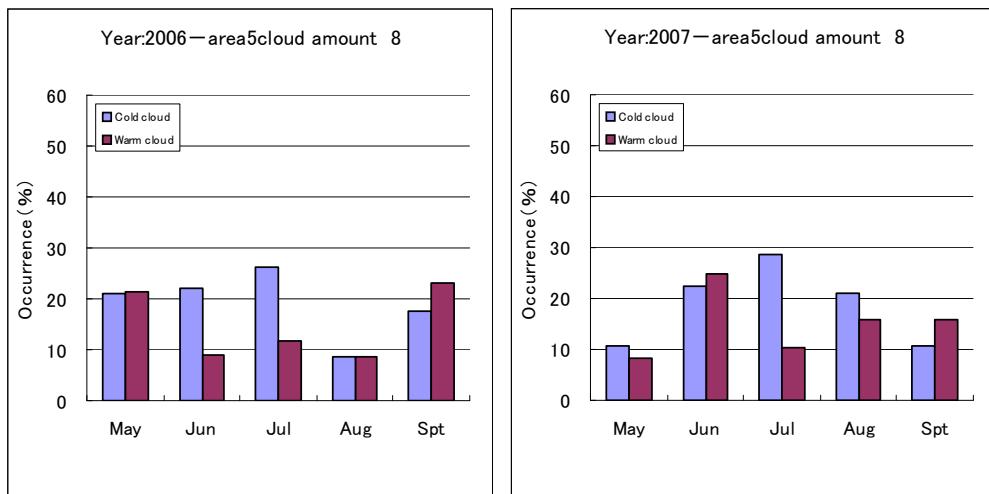


Figure1. Cloud occurrence in summer 2006 without water shortage and in summer 2007 with water shortage (May 25 to July 5).

Table1. Summary of cloud occurrence and average rainfall

	Warm cloud		Cold cloud	
	Number of occurrences	Average rainfall (mm/h)	Number of occurrences	Average rainfall (mm/h)
June 2006	21	0.74	53	0.51
June 2007	60	0.13	54	0.28