Estimation of the Humidity in the Upper Troposphere using Contrails Formed by Airplanes

Koizumi, Hinata
Koshita, Mizuki
Furueda, Shio

Water vapor is one of the major greenhouse gases in the atmosphere along with carbon dioxide and has a great impact on the greenhouse effect. Therefore, it is very important to know distributions of water vapor even at high altitude in the atmosphere not only on the ground. However, it is very difficult to measure the distributions of water vapor at high altitude where the air temperature is extremely low. Even in the aerological observations with radiosondes by the Japan Meteorological Agency, no data of humidity below -40 ? is obtained. In this study, we propose a new method to estimate humidity at high altitude by observing the contrails formed by airplanes. Contrails are generated by the cooling of the exhaust gas released from the aircraft engine. The diameter of the contrail grows as it is mixed with the surrounding atmosphere and it disappears after mixing with sufficient amount of the atmosphere. Because the surrounding atmosphere also contains water vapor, the maximum diameter when the contrails disappear depends on the humidity of surroundings. Knowing the temperature of the surrounding atmosphere, the amount of the exhaust gas and the maximum diameter of the contrails, we can inversely estimate the humidity of the surrounding atmosphere. Following this principle, we photographed the contrails generated by airplanes passing over Aomori and measured the maximum diameter to estimate the humidity of the surroundings. This method can be applied even when the surrounding air temperature is extremely low.

Awards Won:
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