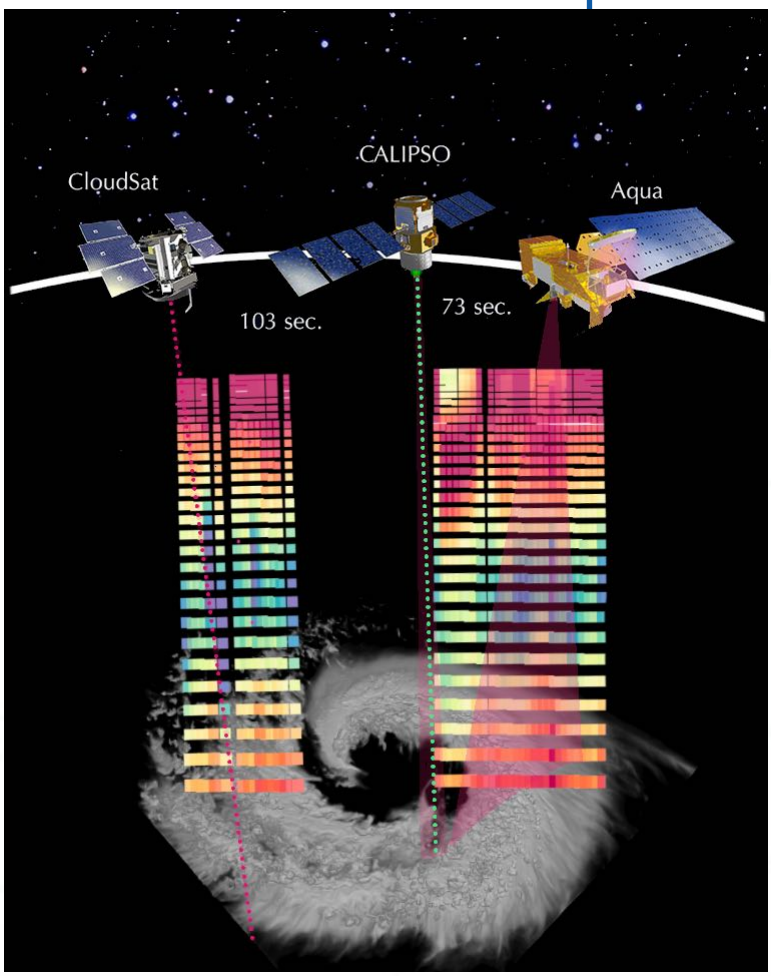
Detecting above-storm atmospheric conditions from space

Jing Feng is a Ph.D. student working with Prof. Yi Huang, an associate professor in the Department of Atmospheric and Oceanic Sciences.

Citation: *Feng, J., Huang, Y., and Qu, Z. An observing system simulation experiment (OSSE)-based assessment of the retrieval of above-cloud temperature and water vapor using hyperspectral infrared sounder, Atmos. Meas. Tech. Discuss. [preprint]. Feng, J. and Huang, Y. Impacts of tropical cyclones on the thermodynamic conditions in the tropical tropopause layer observed by A-train satellites, Atmos. Chem. Phys. Discuss. [preprint].*

Below: Temperature fields detected by the synergistic retrieval method using multiple A-Train instruments.



Deep convective storms are fundamental to human activities and the earth's climate system. The most energetic storms can greatly perturb the thermodynamic conditions in the upper-troposphere and lower-stratosphere. However, this process is poorly understood, due to a lack of observations, which are challenging especially in cloudy conditions. From the ground, the operational radiosonde system does not perform well in the cold environment at such high altitudes. From space, the presence of clouds can be an issue for the retrieval algorithm of infrared sensors, which tries to extract clear-sky radiances by contrasting neighbouring scenes. Consequently, current space-borne infrared sensors fail to capture the atmospheric properties above overcast clouds.

Recently, Jing Feng and Prof. Yi Huang have developed an innovative, cloud-assisted approach to retrieve temperature and humidity profiles above convective storms. This method takes the advantage of simultaneous observations from NASA's A-Train satellite constellation. Multiple instruments are being used, which include the Atmospheric infrared sounder (AIRS), the cloud precipitation radar (CPR), and the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP). The combination of these instruments provides the sensitivity to temperature and humidity profiles above the convective storms, as well as the vertical distribution of ice mass near the cloud top.

By applying this synergistic retrieval method, they have developed a dataset of thermodynamic profiles for tropical cyclone events passed over by A-Train satellites from 2006 to 2015. Compared to other satellite datasets, it has unique advantages in a small sampling size (~10 km) and validated precision in cloudy conditions.

Why this is important

This project develops a method to retrieve thermodynamic variables above convective storms by using satellite observations from hyperspectral infrared sounder and active sensors collectively. By applying this method, an infrared hyperspectra-based dataset of collocated temperature and humidity profiles above convective storms is constructed, which is the first of its kind.