

## Can Thunderstorms Impact Global Warming?— The secret of gullwing cirrus

The research team led by Director Pao K. Wang of Research Center for Environmental Changes, Academia Sinica, recently explained successfully the formation mechanism of the gullwing-shapes cirrus clouds observed by the new type satellite CALIPSO using a 3D numerical thunderstorm model simulation. The model results prove that storms can transport water substance efficiently up into the stratosphere via the internal gravity wave breaking mechanism. Vigorous internal gravity waves are excited at the top of the storm cloud due to strong convective motion. These gravity waves are internal because they form in a density-stratified fluid such as the atmosphere. When these waves break, matters such as water vapor and ice particles in the storm can be transported irreversibly into the stratosphere that form the cirrus clouds observed by the CALIPSO satellite. The gullwing shape is due to the wave's vertical propagation manner and the fact that wave breaking occurs at the crest. Due to the dryness of the stratosphere, the ice particles will soon evaporate, leaving water vapor in the stratosphere. Since water vapor is a strong greenhouse gas that can absorb and re-radiate infrared and this interaction is especially strong in the lower stratosphere, it can effectively shield the terrestrial IR radiation from escaping, causing additional surface warming in addition to the CO<sub>2</sub> effect. The research results were published on April 4 in *Journal of Geophysical Research-Atmospheres*, a main periodical of American Geophysical Union (AGU). On June 21, the results were put on spotlight by AGU's weekly newsletter *EOS* in its Research Spotlights via a special article that highlights the key findings.

### Related Information:

Streich, L. (2016), When thunderstorms have wings, *Eos*, 97, doi:10.1029/2016EO054323. Published on 21 June 2016. (URL: <https://eos.org/research-spotlights/when-thunderstorms-have-wings>)

Wang, P. K., K.-Y. Cheng, M. Setvak, and C.-K. Wang (2016), The origin of the gullwing-shaped cirrus above an Argentinian thunderstorm as seen in CALIPSO images, *J. Geophys. Res. Atmos.*, 121, doi:10.1002/2015JD024111.

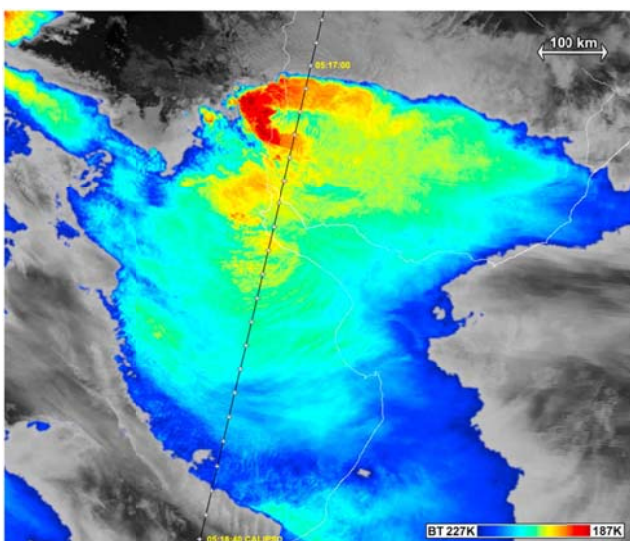


Figure caption: The infrared image of a thunderstorm occurred on 23 December 2009 over Argentina captured by the MODIS instrument on board of NASA satellite AQUA. Red represents cold region whereas yellow, green and blue, in this order, represent warmer regions. The slant line is the trajectory of another satellite CALIPSO.