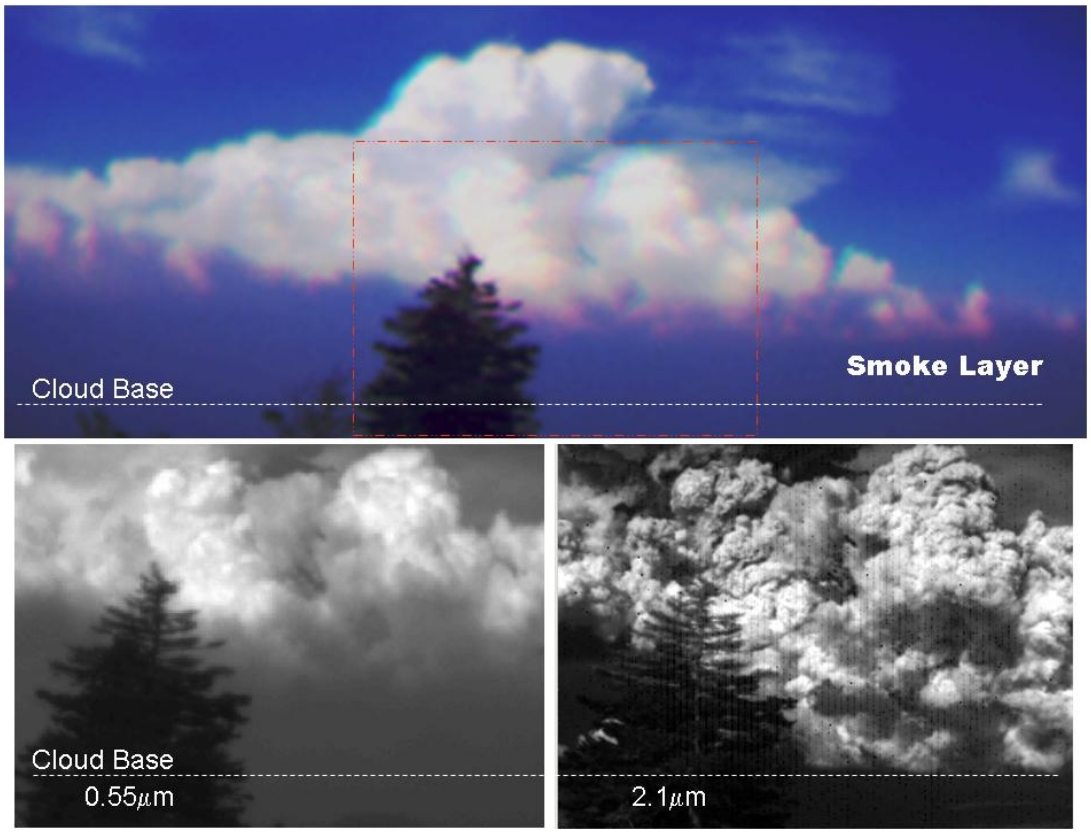
Your eyes can trick you: Where is the cloud base?



The top image is a color composite of blue (410nm), green (550nm) and red (670nm) images on the background of a thick smoke layer. The cloud base is not visible in the smoke background and the smoke itself is confused with the blue sky and the horizon. The two pictures on the bottom contain (a) the visible (550nm) and (b) the near infrared (2100nm) pictures of a piece of the same cloud (red box in the top image) showing the different details covered by both wavelengths. The visible picture (a) shows a cloud structure like we see with our eyes (as the color composite). The 2100nm picture (b) shows two very distinct characteristics as compared to the visible one. 1- The 2100nm picture (b) can see through the smoke and clearly shows a much lower cloud base, which is completely ignored by a naked eye observer or by the analysis of the visible picture. This happens because smoke particles are on average much smaller than 2100nm, producing a weak interaction between light at this wavelength and the smoke. 2 - Picture (b) also shows enhanced details in the cloud structure that cannot be observed in the visible one. The structure in 2100nm makes the cloud appear like a volcano or a smoke plume. This characteristic comes from the fact that light at 2100nm is “strongly” absorbed by cloud droplets and on average undergoes much fewer scattering events inside the cloud than light in visible wavelengths. In contrast, visible wavelengths are subjected to “negligible” absorption by the cloud droplets and produce a much smoother picture. In reality, the 2100nm picture shows more realistic details of the cloud dynamic and microphysical structure, which gets lost in the smoothing effect produced by visible light. These pictures were taken in July 2007, during a field campaign in Mount Gibbes/Mount Mitchell, North Carolina, in collaboration with the North Carolina State University. These were the first tests of the NASA Goddard/UMBC cloud side imagers. This system was designed for the study of the interaction between aerosol particles and clouds. There is strong evidence in the literature showing how man made pollution and other aerosols can affect clouds and precipitation. The system also allows for quantitative measurements of the size of the cloud droplets, and for the discrimination of the cloud thermodynamic phase (ice, water, or mixed phase).

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