

## Estimating lightning characteristics by spaceborne spectrophotometric observation

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The present study analyzes satellite optical data to evaluate the effectiveness of spaceborne spectrophotometric measurement in characterizing properties of lightning flash. The main data analyzed here are those obtained by FORMOSAT-2/ISUAL limb observation and ISS/GLIMS nadir observation. While ISUAL spectrophotometer observes optical emissions of 150-280, 316, 337, 392, 762, 600-900 nm at a sampling rate of 10 kHz, GLIMS observes emissions of 150-280, 337, 762, 600-900, 316, 392 nm at a rate of 20 kHz. These data for the first time derive fine spectral and temporal properties of lightning emission observed from space. By analyzing the ISUAL optical data and ground-based radio data, we found that spectral intensity ratio is a new parameter to discriminate intra-cloud (IC) and cloud-to-ground (CG) lightning discharges: the blue/red intensity ratio of CG strokes tends to be lower than that of IC pulses. We also found similar tendency in GLIMS lightning events. A case study showed that the color of lightning turned to red when a very bright impulsive emission, which is consistent with a ground return stroke, occurred. These results consistently suggest that the color of CG component is redder than that of IC component, and we explain this as a result of the Rayleigh scattering which effectively attenuates blue light emissions in the case of light sources located at lower-altitudes such as CGs. Using this technique, we will further examine the lightning characteristics on a global level, focusing on latitudinal dependences and land/ocean contrast for example.

Keywords: lightning, CG, IC, satellite, remote sensing