F Development of an algorithm to derive gridded dataset from GPS occultation data

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The Global Positioning System (GPS) radio occultation (RO) observations, where signals from the GPS satellites are received by low-earth-orbit satellites to measure vertical profiles of atmospheric parameters such as temperature and humidity was started in mid 1990s. It is a calibration-free method with a high vertical resolution. Until recently, GPS RO measurements were done mostly with one or two satellites at a time. Thus, its data density was not high, and the majority of past studies were based on analyses of vertical profiles. However, in April, 2006, data from the COSMIC/FORMOSAT-3 mission, which consists of six low-earth-orbit (LEO) satellites, were launched, so the data density was dramatically increased. Therefore, it is now easier to study spatial structures of atmospheric phenomena. Until one year after the launch, multiple COSMIC satellites were in a same orbit, so the data density was especially high in its vicinity. This study proposes a method to make gridded datasets by exploiting this feature.

A coordinate system based on the swath around the orbit was introduced, and an iterative algorithm to conduct the coordinate transformation of occultation data points was proposed. Gridded datasets were made by linearly interpolating among a mesh derived by the Delaunay triangulation. From the results, features of the distribution of the RO data points and its impact on the gridding were discussed. Case studies were made on the tropical tropopause layer and the northern high-latitude stratosphere. It is shown that the three-dimensional structures of mesoscale waves were captured in the gridded data. Errors due to the interpolation were estimated by using objective analysis data. If the interpolation was restricted to occur over distances less than 2000 km, the error was comparable to the error in the objective analysis itself. In this case, the ratio where valid data were obtained in the swath with a 4000-km width was a little higher than 20 %. Even in that case, the case studies showed the usefulness of the data. If more satellites were used in future missions, the method proposed in this study will be further useful by providing more complete swath data.

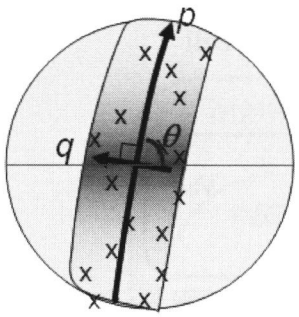

Figure 1: Schematic illustration of the coordinate along the orbits of COSMIC LEO satellites. The *p* coordinate follows the trajectory of the satellites, and it is closely related to time.

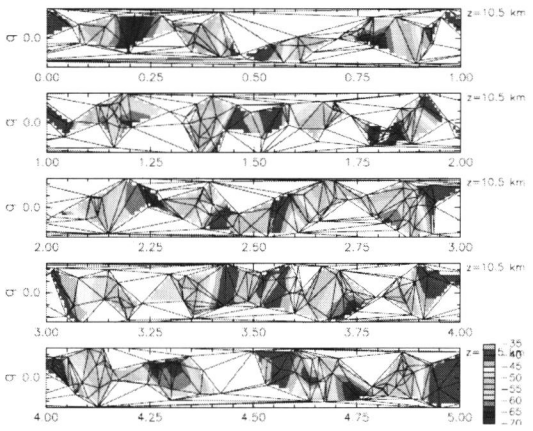

Figure 2: The Delaunay triangles and the gridded temperature at the altitude of 10.5 km obtained from the occultation data in the first 5 satellite circles in Dec 1, 2006. Here, data from 4 satellites in one orbit were used.