Simultaneous observation of plasma bubble using ground-based GPS receiver networks and low earth orbit satellites

Michi Nishioka[1]; Akinori Saito[1]; Yuichi Otsuka[2]; Takuya Tsugawa[2]

[1] Dept. of Geophysics, Kyoto Univ.; [2] STELAB, Nagoya Univ.

Plasma bubble was observed simaltaneously using ground-based GPS receiver networks and low earth orbit satellites data. Spatial structure whose scale size was 100km-1000km was investigated with the data. Ground-based GPS receiver networks are provided by International GNSS Service and Japan Agency for Marine-Earth Science and Techonology. Plasma bubble was observed with Total Electron Contents data over 700km above one station. It is known that plasma bubble is generated after the sunset and drifts eastward at the speed of about a hundred kilometers. When the drift speed of plasma bubble was assumed, zonal distributions of plasma bubble after sunset were extrapolated over 2,000km for one station. We used seven receivers located between 77E^o-145E^o, therefore, it was possible to extend the field of view of ground-based GPS networks to 10,000km between 60E^o-150E^o. Zonal distributions of plasma bubble were estimated within 10,000km of 60E^o-150E^o in 2003. These results suggest the condition of ionosphere or lower atmosphere to generate plasma bubbles. We found that typical zonal width of plasma bubble was 150km-200km. A few plasma bubbles appeared as cluster, whose scale size were about 400km. Intervals of the clusters were also about 400km. Low earth orbit satellites data was used to investigate the spatial distribution of plasma bubble. Zonal distribution of plasma bubble was studied using 135.6nm airglow data, which was observed from TIMED satellite. A global map of 135.6nm emission was obtained for the post-sunset time. Zonal distribution of plasma bubble studied using airglow image data was almost the same as that was studied using GPS data. Ion deisity data at 600km and 850km altitude which were measured with DMSP and ROCSAT-1 satellites, respectively was used. On March 16, 2003, density depletions were observed with DMSP and ROCSAT-1 data. Zonal distribution of plasma bubble detected by ROCSAT-1, whose inclination is 35^o, was consistent with the those derived by ground-based GPS receiver networks data. Latitudinal distribution of plasma bubble is investigated with DMSP data, which is polar orbit satellites. Depletion of ion density was observed from 2.5N^o to 15.9N^o with DMSP data. The ion depletion was located at 105E^o. Plasma bubble was not observed between 95E^o-102E^o, which was field of view of ground-based GPS reveivers. This supported that the zonal width of plasma bubble was less than 300km. The spatial distributions of plasma bubble occurrences reflect the spatial structure of electric fields in the ionosphere or atmospheric activities in the lower atmosphere. These results suggest the condition of ionosphere or lower atmosphere to generate plasma bubbles.