

Research on the characteristics of ionospheric disturbance around Japan by GPS-TEC for ionospheric correction to InSAR

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In the monitoring surface deformation using SAR interferometry (InSAR), it is a serious problem that the long-wavelength noise caused by ionospheric disturbance degrades accuracy of the detection of deformation. Since 2013, Geospatial Information Authority of Japan (GSI) have conducted a research project on the method for ionospheric correction to satellite InSAR based on TEC information obtained from two-wavelength observation data of GEONET.

For the first step, in order to understand the characteristics of ionospheric disturbance around Japan, we identified ionospheric disturbance of the period between 2000 and 2011 by GPS-TEC of GEONET and estimate characteristic values of each event.

In the manner in Munekane (2013), we first estimate zenith TEC and TEC gradient in north-south and east-west component every thirty second during the period from GEONET thirty-second RINEX data. Then, we adopted high pass filter of 3600s to remove low frequency component.

Next, based on this GPS-TEC time series, we identified ionospheric disturbance event in the period. In this step, we focus rather on revealing overall trend of ionospheric disturbance than inspecting accuracy of the characteristic value of each event.

The process of identification is as follows. First hourly RMS of TEC was calculated every hour, and, if the number of sites which hourly TEC-RMS is over threshold is more than a certain criterion, regard the epoch as a part of ionospheric disturbance event. Then, viewing the "GEONET GPS-TEC maps over Japan" on the web site of NICT, each disturbance event was divided visually into three category according to the pattern of TEC distribution, "traveling ionospheric disturbance (TID)", "plasma bubble" and "other".

After the identification of event category, we decided characteristics such as event start and end time, affected area and its temporal transition based on ten-minute RMS of TEC. Also, we estimate characteristic values associated with event category such as wavelength of a TID or northernmost latitude of a plasma bubble etc. Finally, we derived characteristics of the ionospheric disturbance around Japan statistically.

We identified 8,815 ionospheric disturbance in the period, reaching maximum of 967 events in 2001, decreasing gradually to minimum of 471 in 2007, and having increasing tendency afterwards. This trend is consistent with solar cycle. The occurrence of TID and plasma bubble is found to be consistent with solar cycle, too.

Also, it appears that TID occurs commonly from May to August, in summer season. TID occurrence also concentrates before and after two hours around 22 o'clock in local time. As for plasma bubble, the occurrence is high from the sunset to midnight in local time. These results are consistent with earlier studies.

References

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