

# GPS ionospheric scintillation measured in Vietnam

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## Introduction

Amplitude and phase scintillation have been measured at equatorial latitudes in Vietnam since 2005, using the signal transmitted by the GPS satellites. Our paper presents statistical results obtained during this period of low solar activity. Two GSV4004 stations have been installed, one in Hue (16,46°N, 107,59°E) and the second one in Ho Chi Minh City (HCMC) (10,83°N, 106.55°E). Processed data were recorded continuously with a 1 minute time resolution. S4 index and phase standard deviation ( $\sigma\phi$ ) are the parameters used to characterize the scintillations. Statistics show a maximum occurrence during spring and autumn in the local time sector 18-24 LT, in agreement with observations performed at equatorial latitudes in other parts of the world. There are similarities between s4 and  $\sigma\phi$  variations though there is not a one to one correspondence. When considering the effect of azimuth and elevation angles it is shown that peaks in occurrence appear at azimuths near 180° and 360° and mainly for elevation angle smaller than 50°. Case studies often show that scintillation occur during period of large TEC variations.

## 1 Statistical results

Figures 1 and 2 show a multivariate analysis for 2006 data recorded in Hue and Ho Chi Minh City, respectively.

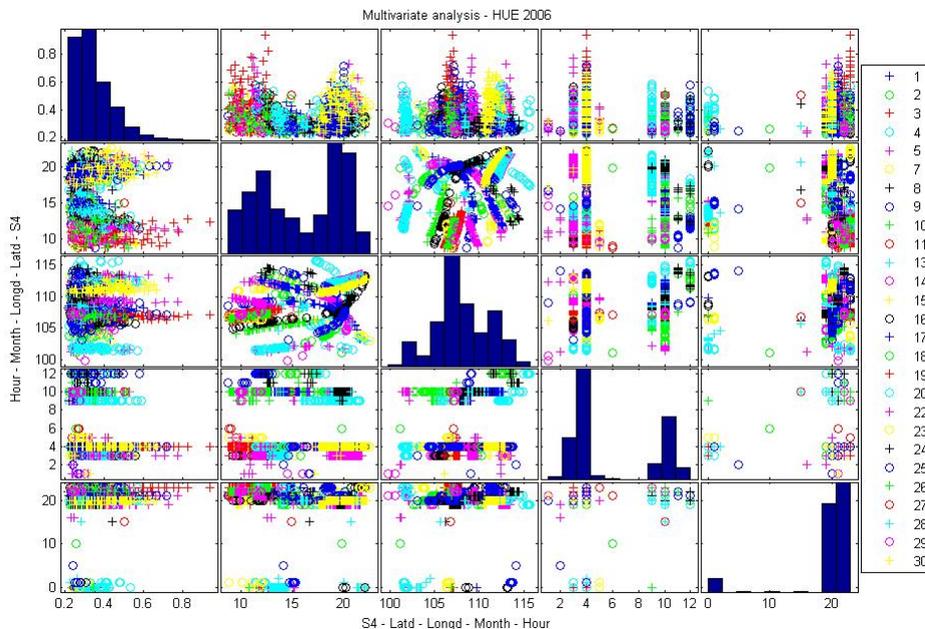


Figure 1. Multivariate analysis: Hour, month, longitude, latitude, s4 (from bottom to top and from right to left). Hue, 2006.

The scintillation events are selected using the following filters: elev.  $> 20^\circ$ , L1 time of lock  $> 240$ s and  $s_4 > 0.2$ . The effect of multipaths is reduced using the method proposed in the GSV 4004 manual. The parameters plotted in these figures are the same on the vertical and on the horizontal axis: Hour, month, longitude and latitude of ionospheric pierce point (IPP) and  $s_4$  (from bottom to top and from right to left). At the intersection of a line and a column for the same parameter the histogram is plotted. These plots confirm that at Hue scintillation are observed northward and southward while at HCMC scintillation are observed mainly northward. At Hue the distribution with latitude peaks at  $12^\circ$  and  $20^\circ$  while at HCMC it peaks at  $16^\circ$ . The seasonal and the diurnal variations are comparable at Hue and HCMC, peaking in March-April and in October in the sector 18-02 LT.

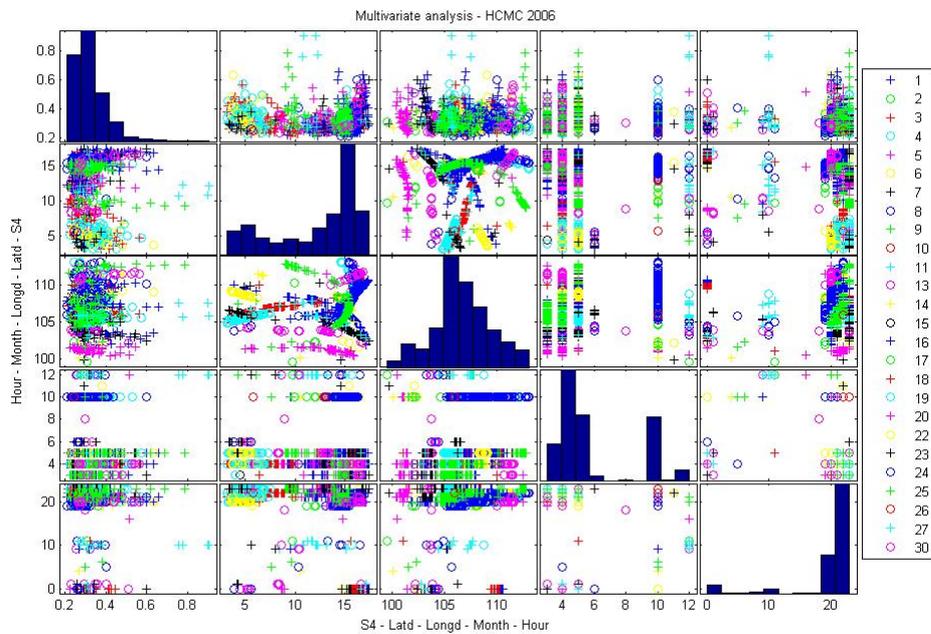


Figure 2. Multivariate analysis: Hour, month, longitude, latitude,  $s_4$  (from bottom to top and from right to left). Ho Chi Minh City, 2006.

### Reference

GPS Ionospheric Scintillation & TEC Monitor (GISTM), user's manual, GSV, Los Altos, USA.