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Total electronic contain of ionosphere and its effect on GPS Signal: stochastic approach analysis

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Use of GPS signal for Total Electronic Contain TEC measuring has been cited in different scientific works, and has been modeled by different methods.

Every method have carried out more or less an expected accuracies, good for an efficient fitting of geodetic network.

In this paper, we can cite briefly two principal methods:

Smith has proposed a method which use a monofrequency receiver.

The principle, is to observe pseudo distances Pm et Pm+1 for two epochs tm,tm+1:

$$P_m = \rho_m + \frac{I_m}{f^2} + c\delta t_{sv_m} - c\delta t_{rec_m}$$
$$P_{m+1} = \rho_{m+1} + \frac{I_{m+1}}{f^2} + c\delta t_{sv_{m+1}} - c\delta t_{rec_{m+1}}$$

Where : ρ : phase in the ordinary medium;

I : Ionosphere delay parameter (=40.30 TEC).

f : Frequency of the signal;

c : Celerity of light in the vacuum and δt the time variation

For the interval Δt= tm+1– tm , we have variation accumulation in phase, we can

compute therefore the ionosphere delay between two epochs with using the two observations Pm, Pm+1

The other method is handled by combination geometry free L4 which is featured by

Bi-frequencies observations. This combination eliminate all terms relative to the geometry (distances) and clock. However it depends essentially on ionosphere refraction and differential delays of phase (Warnant, 1996).

In case of observations, the ionosphere refraction code for every frequency depend on total electronic contain TEC. This method is used by Lanyi et al.,1987) for calibration of TEC of spatial network (Deep Space Network DSN).

Nevertheless, the two methods cited above present a lack in precision, The first, do not interest us because the use of monofrequency receiver which is not of actuality, the second omits to use a strong statistic assessment of the correlation coefficient between the ionosphere model parameters and the signal delay.

Our work intend to remedy to the inefficiency of the above cited methods and it is based on stochastic approach for the evaluation of the correlation between ionosphere layer electronics contain and GPS signal quality.

This approach calls strong analysis of the results in the case where biased phase observations are used in the data treatment by unknown term which is called ambiguity term. We can thus estimate this ambiguity in the same time that ionosphere pattern parameters (Wild et al., 1989). Else we can use the code P observations for the ambiguity calibration. We take thus in consideration the multipath effects.

The formal precision of this method is around 1 TEC (1 TECU = 10^{16} electron/m2 ,minimal value found on the earth surface). We include temporal series estimation of the TEC in order to perform its prediction.