HUMIDITY CONVERGENCE ZONES INFLUENCE IN THE SEASONAL VARIABILITY OF THE TROPOSPHERIC ZENITHAL DELAY IN THE SOUTH AMERICA

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The Zenithal Tropospheric Delay (Z_{TD}) is an important error source in the observable involved in the positioning methods using artificial satellites. The humidity convergence zones are characterized by an extensive precipitation band and high nebulosity almost stationary. In South America there are two main convergence zones that have strong influence in the troposphere variability, the ITCZ (Inter Tropical Convergence Zone) and the SACZ (South Atlantic Convergence Zone) zones. While the first is located near the equator, over the Amazonian Region, the second occur between -18º and -25º of latitude over Brazilian littoral. The physical processes associated with these convergence zones associated with the penetration the cold front from Antarctic pole into the continent present strong impacts in the seasonal variability of wet component (Z_{WD}) of Z_{TD}. In 2010 a new navigation and administration system of the air traffic, denominated CNS-ATM (Communication Navigation Surveillance - Air Traffic Management) should be running operationally in South America. This new system will basically employ the positioning techniques by satellites to the management and air traffic control. However, the efficiency of this new system demands the knowledge of the behavior of the atmosphere, more specifically the characteristic of the main factors that influence the oscillation of Z_{TD} components in regional scale. The predictions of Z_{TD} values from Numeric Weather Prediction (NWP), denominated "dynamic modeling", permit assessing the temporal and spatial variation of Z_{TD} values. Brazilian Center for Weather Forecasting and Climate Studies (CPTEC) of the National Institute for Space Research (INPE), jointly with UNESP (São Paulo State University), has generated operationally prediction of Z_{TD} values over the South America Continent (available in the electronic address: http://satelite.cptec.inpe.br/htmldocs/ztd/zenital.htm). The available regional version is obtained using ETA model (NWP model with horizontal resolution of 20 km and 42 levels in the vertical). The aim of this presentation is to investigate the Z_{TD} seasonal variability over South America continent using NWP and the humidity convergence zones influence in the Z_{WD} values. This work contributes with Z_{TD} modeling over South America continent using NWP identifying where and when the Z_{TD} values present lower predictability in this region, and consequently, minimizing the error in the GNSS (Global Navigation Satellite System) positioning that apply this technique.

Dynamic modeling of Zenithal Tropospheric Delay

•The Tropospheric Delay is:

$$D_{TROP} = S - S_g = 10^{-6}\int Nds \quad (1)$$

•Applying mapping function obtain:

$$Dztrop = Z_{HD} + Z_{WD} \quad (2)$$

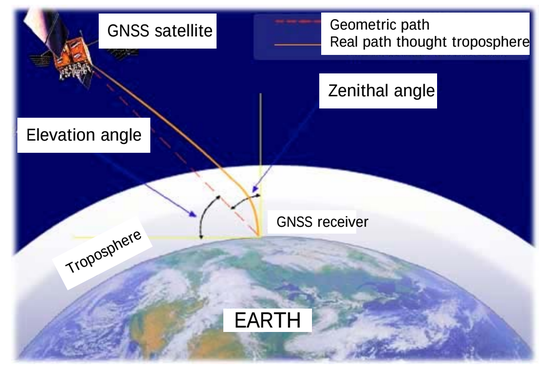
•Where

$$Z_{HD} = 10^{-6}\int_{h_0}^{\infty}(k_1 R_h \rho)dh \quad (3)$$

is the Hydrostatic component and

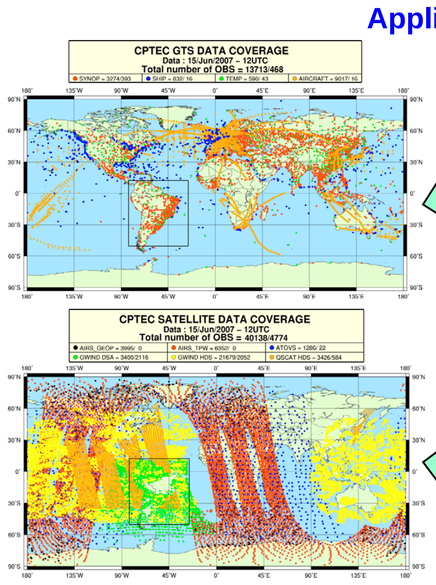
$$Z_{WD} = 10^{-6}\int_{h_0}^{\infty}(k_2^{'}\frac{e}{T}Z_w^{-1} + k_3\frac{e}{T^2}Z_w^{-1})dh \quad (4)$$

is the Wet component.



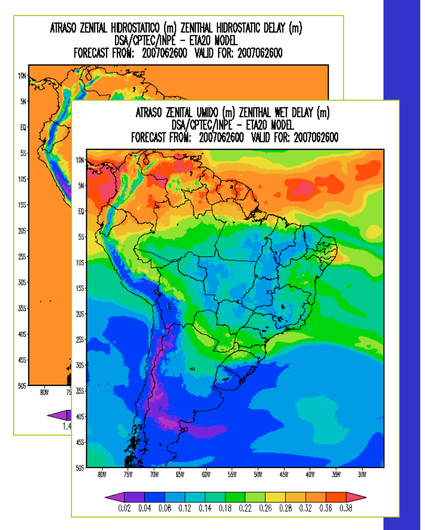
Propagation of the GNSS signal through the atmosphere produces a delay in the propagation time denominated Tropospheric Delay

Appling Numerical Weather Prediction model



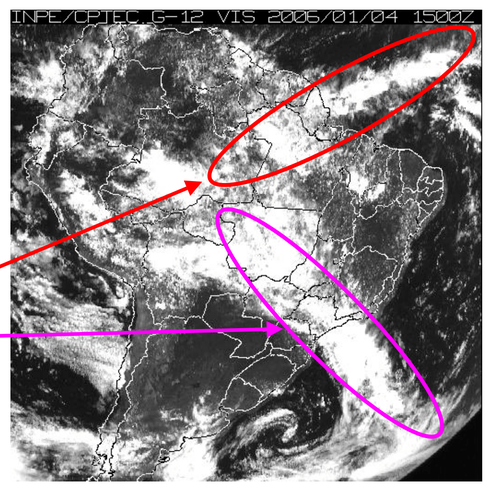
Current data coverage from conventional (GTS: Global Telecommunications System) and satellite sources at CPTEC

Data Assimilation System and Numerical Weather Prediction Models: (a)Global(100x100 km) (d) regional (20x20 km) versions and 2, 3 and 4 equations



Fields of ZTD values over South American in different components: hydrostatic and wet.

Humidity convergence zones in South American

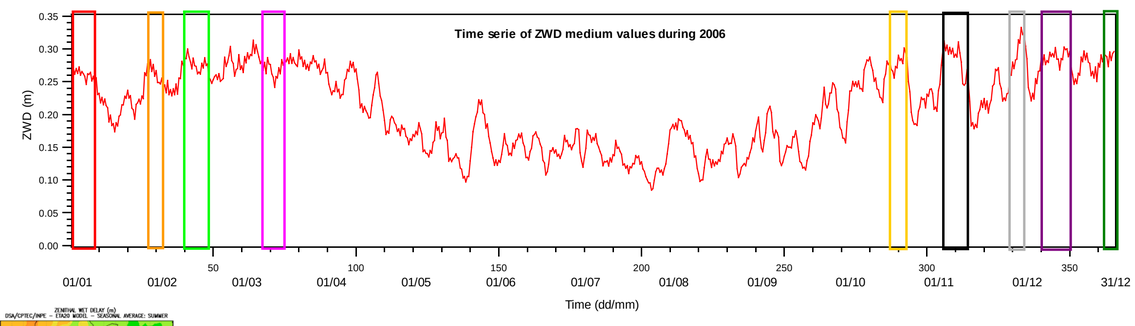


–The humidity convergence zones are characterized by an extensive precipitation band and high nebulosity almost stationary. In South America there are two zones:

–ITCZ (Inter Tropical Convergence Zone)

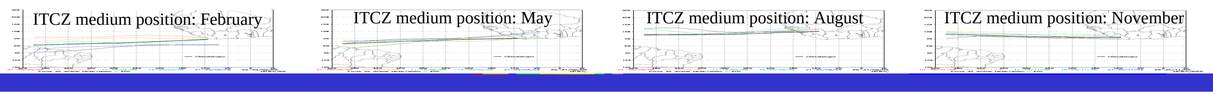
–SACZ (South Atlantic Convergence Zone)

Time series of ZWD medium values over Southeast Region of Brazil.



Time series of ZWD medium values over Southeast Region of Brazil (details about the considerated region see figure in the left). In this figure is showed the occurrence period of ZCAS to access the correlation between ZWD values and occurrence of this phenomenon.

Frequency and position of the ITCZ and SACZ occurrence



ITCZ is a phenomenon that occur during all days of year in the region that circles the Earth, near the equator. In the South American continent it occur over Amazonian region. The location of the ITCZ has an annual cycle.

SACZ occurrence during 2006. There were 4 episodes in the Summer and 5 in the Spring.

The SACZ occur over Brazilian littoral, between -18º and -25º of latitude, during some periods of years and its configuration depend of several weather aspects. The SACZ impact in the ZWD values is significant.

ZWD Seasonal Variability Study in South American

Summer: Jan/Feb/Mar; Autumn: Apr/May/Jun; Winter: Jul/Aug/Sep; Spring: Oct/Nov/Dec in 2006

Penetration of the cold front

Seasonal fields of ZWD medium values over South American continent showing the impact of humidity convergence zones and penetration the cold front from Antarctic pole into the continent in the ZWD seasonal variability.

Seasonal fields of ZWD Standard Deviation values over South American continent showing the regions where occur the largest seasonal variability of this variable and consequently where the ZTD predictability is lower.

XXIV IUGG GENERAL ASSEMBLY - PERUGIA, ITALY, 2007

Acknowledgements: