Global median model of the ionospheric critical frequency f_oF2 based on GPS radio-occultation and ground-based sounding data

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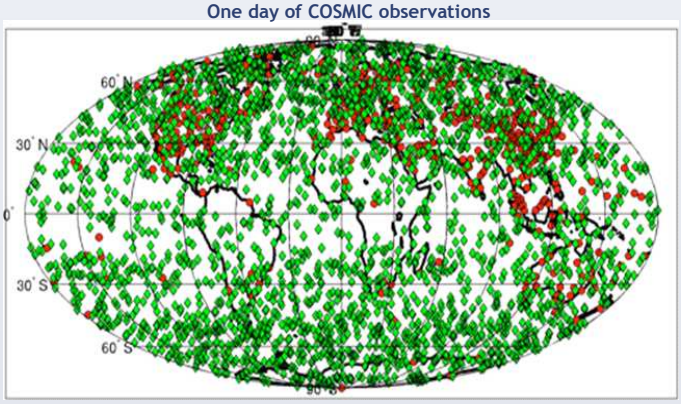
Initial Data

Radio-occultation data:
CHAMP (2001–2008) – 300 000 profiles (http://op.gfz-potsdam.de/champ)
GRACE (2007–2010) – 100 000 profiles (http://op.gfz-potsdam.de/grace)
COSMIC (2006–2012) – 2 800 000 profiles (http://www.cosmic.ucar.edu)

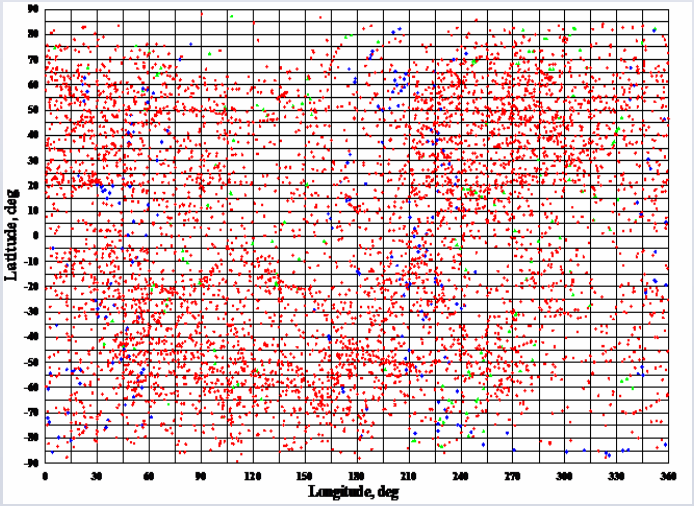
Ground-based data:
Digisondes (1957–2012) – 230 stations (http://spidr.ngdc.noaa.gov)

Data Coverage

One day of COSMIC observations



COSMIC, CHAMP, GRACE Data Distribution
for January, 00 UT, Low Solar Activity (860 bins)



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Mathematics

foF2 Legendre Series Expansions

$$f_0F2(\mu,\lambda,UT_i)=\sum_{m=0}^{M}\sum_{l=m}^{L}\left[g_l^m(UT_i)\cdot\cos(m\lambda)+h_l^m(UT_i)\cdot\sin(m\lambda)\right]\cdot P_l^m(\sin(\mu))$$

P – Legendre associated functions
UT – Universal Time
λ – Longitude
μ – Modified dipole latitude:

$$\mu=\arcsin\left(\frac{I_{300}}{\sqrt{I_{300}^2+\cos\varphi}}\right)$$

φ – Geographic latitude
I_{300} – Geomagnetic field inclination on 300 km

Number of coefficients
On latitude: L = 12, on longitude: M = 8

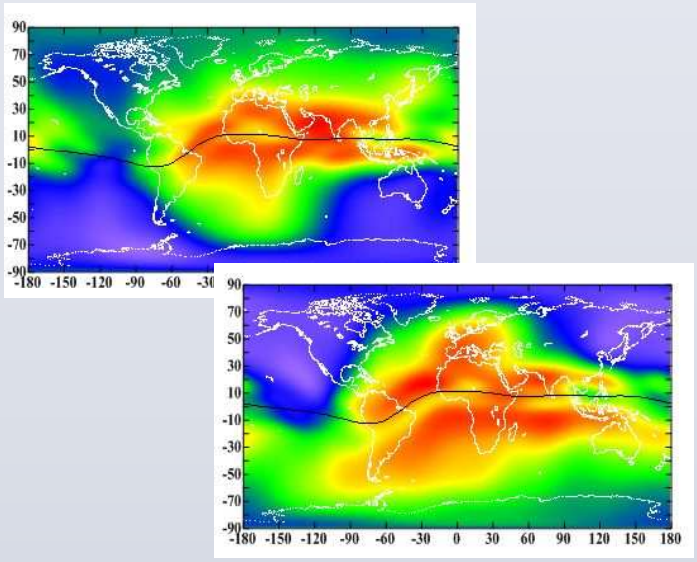
Total number of expansion coefficient g and h:
$M\cdot(2L-M+1)+L+1=149$

Dependency on solar activity:

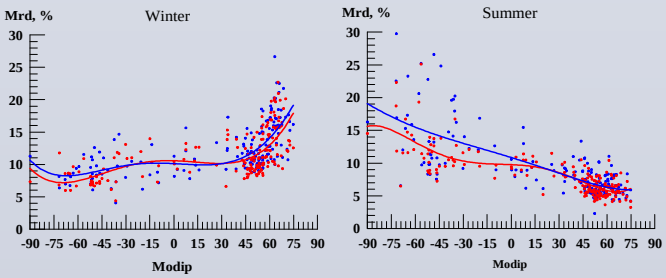
$$f_0F2_i(\lambda,\mu,UT_i,month,F_{10.7A})=A\cdot\ln(F_{10.7A})+B$$

Results

Maps for June and December 2013



Comparison



Mean relative deviations from Digisonde Data
Blue line and dots – IRI (URSI coefficients)
Red line and dots – SDMF2