

New IGS Ionospheric Analysis Centers (CAS- IGG, NRCan and WHU)

Andrzej Krankowski*¹, Manuel Hernandez-Pajares ², David Roma-Dollase ^{2,10}, Reza Ghoddousi-Fard ³, Yunbin Yuan ⁴ Zishen Li ⁵, Hongping Zhang ⁶, Chuang Shi ⁶, Joachim Feltens ⁷, Attila Komjathy ⁸, Panagiotis Vergados ⁸, Stefan C. Schaer ⁹, Alberto Garcia-Rigo ², Jose M. Gómez-Cama ¹⁰

¹ Space Radio-Diagnostic Research Centre, University of Warmia and Mazury in Olsztyn,
ul. Prawocheńskiego 9, 10-720 Olsztyn, POLAND
(E-mail: kand@uwm.edu.pl)

² Department of Applied Mathematics IV, Ionospheric determination and navigation based on satellite and terrestrial systems research team, Jordi Girona 1-3, 08034 Bcelona, SPAIN.
(E-mail:manuel.hernandez@upc.edu, agarcia@ma4.upc.edu, droma@el.ub.edu)

³ Canadian Geodetic Survey, Natural Resources Canada, 588 Booth Street, 3rd Floor, Room: 356g,
Ottawa, Ontario K1A 0Y7, CANADA
(E-mail: reza.ghoddousi-fard@canada.ca)

⁴ Institute of Geodesy and Geophysics (IGG) of the Chinese Academy of Sciences (CAS), 340 XuDong Rd. Wuhan 430077, Hubei, CHINA
(E-mail: yybgps@asch.whigg.ac.cn)

⁵ Academy of Opto-Electronics (AOE), Chinese Academy of Sciences (CAS), No 9, Deng Zhuang South Road, HaiDian District, Beijing,100094, CHINA
(E-mail: lizishen@aoe.ac.cn)

⁶ GNSS Research Center (GRC) of Wuhan University, No.29 Luoyu Road, Hong Hill District, Wuhan City zip:430079 China, Hubei, CHINA
(E-mail: hpzhang@whu.edu.cn,shi@whu.edu.cn)

⁷ ESOC/ESA, Robert-Bosch-Strasse 5, D-64293 Darmstadt, GERMANY
(E-mail: joachim.feltens@esa.int)

⁸ JPL/NASA, 4800 Oak Grove Dr. Pasadena, CA 91109, CA, USA
(E-mail: attila.komjathy@jpl.nasa.gov)

⁹ CODE/swisstopo, Astronomical Institute University of Berne, Sidlerstrasse 5, CH-3012 Berne, SWITZERLAND
(E-mail: stefan.schaer@swisstopo.ch)

¹⁰ UB-D.Electronics, C. de Martí i Franquès, 1, 08028 Barcelona SPAIN
(E-mail: jm.gomez@ub.edu)

ABSTRACT

In this presentation two independent techniques to assess global Vertical Total Electron Content (VTEC) ionospheric models computed from GNSS data (GIMs) are applied in the context of the International GNSS Service (IGS): to the GIMs of CODE, ESA, JPL and UPC (analysis centers contributing since 1998.5), NRCAN (resuming its contribution), and, Chinese Academy of Sciences (CAS) and Wuhan University (WHU) as new contributors.

Two important and complementing aspects of the ionospheric models are assessed: On one hand the VTEC accuracy, by comparing with direct measurements of VTEC up to the orbital height of dual-frequency altimeters (around 1200-1300 km, containing the most part of electro content affecting GNSS signals), providing them over the seas (i.e. typically far from existing receivers, assessing mostly interpolation), and with almost no interruption since the beginning of the IGS ionospheric service (missions TOPEX, JASON-1 and JASON-2). And, on the other hand, the Slant Total Electron Content (STEC) provided by the GIMs, typically not far from the receivers used in their computation, is assessed versus very precise direct STEC observations taken by GNSS receivers in different regions of the world, not used in the GIMs computation.

The first VTEC assessment results obtained during the recent period of days 117 to 317, 2015, show a very good behaviour of the new GIMs (EMR, CAS & WHU) in terms of VTEC bias regarding to JASON2 direct measurements, compared with the existing GIMs, contributing since 1998.5 (CODE, ESA, JPL & UPC). From the point of view of the corresponding Standard Deviations, the new GIMs present, in general, similar, or either better precision than the existing IGS GIMs and their combinations. The extended VTEC assessment will be completed with the STEC one.

Finally the convenience of maintaining the good practice of a right assessment of ionospheric models, by using external measurements, absolutely independent from any of the compared models, will be emphasized.

It is remarkable as well the general agreement of the bias, at 1 to few TECUs level, regarding the altimeter VTEC for the most part of analysis centers. This happens among different mapping functions used (related with the general leveling) and the topside electron content climatology between the altimeter and GPS orbit (seen as variations interpreted as “inverse climatology”, $\langle \text{VTEC}_{\text{alt}} - \text{VTEC}_{\text{GPS}} \rangle$, in the time series, appearing clearly the Solar Cycle and seasonal cycles, among others

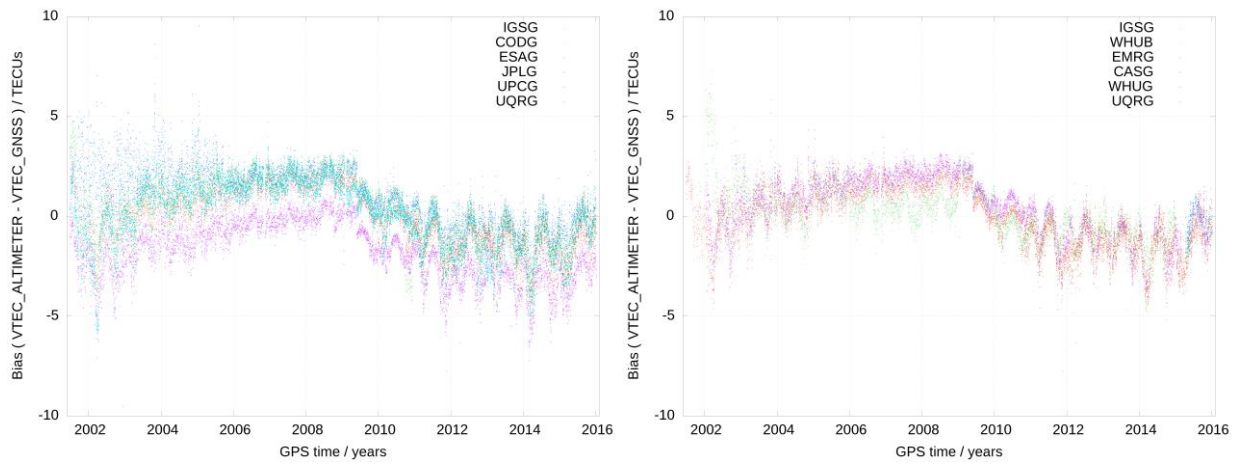


Figure 1. VTEC GIMS Bias regarding JASON* VTEC (daily values, since days 2001.6 to 2016.0)

Key words: TEC, International GNSS Service (IGS), Global Ionospheric Maps (GIMs)