Atmos. Meas. Tech. Discuss., 8, C2653–C2654, 2015
www.atmos-meas-tech-discuss.net/8/C2653/2015/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Ionospheric correction of GPS radio occultation data in the troposphere" *by* Z. Zeng et al.

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Received and published: 20 August 2015

On p 7788, line 10 the authors assert that Healy and Culverwell (2015) found that, "at heights lower than the maximum by two height scales the response is well approximated by (z0-h)^{-3/2}, ie is the same as those (sic) from the delta function". This is not the case. (No bending angles are shown in that paper, only the residual errors on them.) In fact, one needs to be about 15 ionospheric scale heights below the peak height before the delta function solution is even within 10% of the true bending angle, at least for the Chapman layer ionospheric model that we developed. The delta function is therefore an instructive theoretical limit, but it is of little use in practice. (Of course, if the delta function response is scaled by a coefficient that can adjusted by fitting to the

data then it is not such a bad model: the shape (slowly increasing upwards) is roughly right, even if the magnitude isn't.) This is why Culverwell and Healy (2012) discussed a better model ("Z(l)") to describe the bending caused by a Chapman layer ionosphere. It is therefore stretching things a bit to say, as Zeng et al do, that the D (z_F2 - h)^{-3/2} term in Eqn 7 is "similar" to that used by C&H in 2012. Perhaps "analogous" would be more accurate?

Nor is it quite fair to say that the Z(l) of C&H 2012 is a model for extrapolating alpha_1 - alpha_2. In can be used as such, but in fact it is a model of alpha_1 and alpha_2 individually. It can be used, for instance, even if alpha_2 is completely absent, which (alpha_2 - alpha_1) extrapolation techniques such as that discussed by Zeng et al clearly cannot. It does this because it contains an explicit, very simple, model of the ionosphere, whose characteristics, in an assimilation context, are recovered as part of the retrieval process - because they are part of the forward model.

(Incidentally, the 'integrated by parts' version of the Abel integral in Eqn 6 should read [delta(z-z0)/sqrt(z-h)]_h^inf + 1/2 int_h^inf delta(z-z0)/(z-h)^3/2 dz.)

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 7781, 2015.