



Validation of GRACE electron densities by incoherent scatter radar data

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This paper presents an effort to derive the electron density measurements from the GRACE K-Band Ranging system. The derived electron density data from 2002 to 2012 were subsequently validated by using incoherent scatter radar observations. It is possible to obtain the variation of the horizontal total electron content between the two GRACE spacecraft. When converted to electron density, an arbitrary bias value remains. For adjusting the bias of GRACE electron density data, the observations from EISCAT at Tromsø and Svalbard are used. The adjusted GRACE electron density are compared for validation with the observations from incoherent scatter radars at Millstone Hill and Arecibo. The results show an excellent agreement between the adjusted GRACE electron density and radar observations, yielding correlation coefficients as high as 0.97. The scale factor of GRACE data is lower by 5% and 2% compared to Millstone Hill and Arecibo readings, respectively. We consider both these differences as within the uncertainty of radar measurements. From both radars we obtain an average bias of $1 \cdot 10^{10} \text{ m}^{-3}$ for the GRACE data. Considering the resolution of the GRACE electron density observation is $1 \cdot 10^9 \text{ m}^{-3}$, the effects of the bias can be negligible.