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Derivation of the intrinsic frequency and other wave parameters from a single vertical temperature or density profile measurement in the Earth's atmosphere

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In order to derive internal gravity wave characteristics we have analyzed small-scale fluctuations of normalized temperature in the Earth's stratosphere using radio occultation data. An analysis to identify the observed fluctuations as wave-induced, assuming gravity wave shear saturation is proposed. This technique is based upon a comparison of the experimental and theoretical values of the relative amplitude threshold which is defined as the wave amplitude required for shear instability. In the case when the analyzed fluctuations are positively identified as wave-induced, then the intrinsic frequency of the monochromatic gravity wave can be determined from only a single vertical temperature or density profile measurement.

The results of the determination of the wave characteristics and their uncertainties are presented and discussed. The practical application of the proposed analysis technique is demonstrated by using the GPS/FORMOSAT radio occultation retrievals of temperature profiles in the Earth's stratosphere. For the experimental examination of the efficiency of the analysis technique proposed, the results of the simultaneous temperature and wind velocity measurements obtained in a high-resolution balloon experiment were used. By using the experimental temperature data only, we reconstructed all wave parameters. An intercomparison between observed and reconstructed wave parameters shows good agreement.

We assume that this method can be applied for the analysis of vertical temperature or density profiles measured by other techniques.