A comprehensive observational filter for satellite infrared limb sounding of gravity waves

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Infrared limb sounding provides valuable observations for understanding the dynamics of the middle atmosphere. For the interpretation of gravity wave (GW) observations, the observational filter plays a crucial role. We describe a comprehensive observational filter for this technique. Both instrument visibility and observation geometry are considered in this filter with a high level of accuracy. Four main aspects that influence the GW spectrum are discussed thoroughly. They are: (1) visibility filter, (2) projection of the horizontal wavelength on the tangent-point track, (3) aliasing effect, and (4) calculation of the observed vertical wavelength. Gravity waves simulated by coupling a convective GW source (CGWS) scheme with the gravity wave regional or global ray tracer (GROGRAT) are used as an example for applying the observational filter. The observation geometries of the satellite instruments SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) and HIRDLS (High Resolution Dynamics Limb Sounder) are considered. The visibility filter is found to be the most important aspect: it strongly influences the GWMF spectrum for both instruments. The second important aspect is aliasing for SABER, and projection on tangent-point track for HIRDLS. It is shown that the retrieval (a part of the "visibility filter" process) significantly affects the vertical wavelength distribution. For some cases, the short-horizontal-scale spectrum might be projected towards longer horizontal wavelengths where the original spectrum was not located. Also, GWMF values at very short horizontal wavelengths were significantly decreased due to the observational filter. In addition, we discuss the interpretation of observed data using this observational filter, as well as its applicability to other types of instruments.