

WAVE OPTICS ALGORITHMS FOR PROCESSING RADIO OCCULTATION DATA IN THE LOWER TROPOSPHERE: A REVIEW AND SYNTHESIS

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The structure of wave field measured in radio occultation experiments may be very complicated due to effects of diffraction and multipath propagation caused by strong lower-tropospheric gradients of atmospheric refractivity. For interpretation of radio occultation data it is necessary to extract the geometric optical ray structure of the wave field. This allows for the simplification of the formulation of inverse problems of reconstruction of atmospheric parameters. We discuss the following methods of the interpretation of lower-tropospheric data: 1) Canonical transform method; 2) Radio-optics method. Canonical transform method is based on the connection between geometrical optics and wave optics. In the geometric optics rays are described by a Hamilton system in the phase space, where geometrical coordinate and corresponding momentum are introduced. Multipath propagation arises when there are multiple rays with the same geometrical coordinate. Multipath propagation is resolved by the canonical transform to the ray coordinates (impact parameter and refraction angle), where each ray always has a unique geometrical coordinate (impact parameter). The wave function is transformed by the Fourier integral operator associated with this canonical transform. The transformed wave function can be written in single-ray representation, and refraction angle is then equal to the derivative of its phase. This method is very convenient for automated data processing, because it allows for the achievement of very high accuracy and resolution and it does not contain tuning parameters. The radio optics method uses the Fourier analysis of the signal in sliding apertures. Maxima of the amplitude of the local spatial spectra of the wave field are then associated with the rays. This data analysis method can be very convenient for fast data visualization. We validate the methods using simulated radio occultation data. We show examples of processing real radio occultations from the GPS/MET and CHAMP experiments.