The Limiting Accuracy of GPS-Reflection Altimetry from the Crater-Lake Experiment
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The passive, bistatic reception of GPS reflections from ocean surfaces will enable global altimetry, complementing higher-accuracy but lower-coverage capabilities. In this paper, we report altimetric measurements using GPS signals reflected from Crater Lake near the specular angle, by a stationary receiver positioned at the Cloudcap lookout point. Minimal surface-roughness and receiver-motion errors allow a determination of the limiting accuracy of the GPS altimetric technique. A single antenna was pointed at about −10 degrees elevation at the lake so that both direct and reflected signals would simultaneously be received. The physical model describing the received signal used in the analysis depends on five parameters: 1) An overall phase, 2) the amplitude of the direct signal, 3) the lag offset of the direct signal, 4) the ratio of the reflected to the direct amplitude, and 5) the path delay difference between the reflected and the direct signal. These parameters are determined with a nonlinear least-squares estimation procedure. The last parameter determines the altitude of the Lake below the Cloudcap lookout point, while the fourth parameter contains information on the surface roughness. The analysis shows that subcentimeter precision for the altimetry results from the fifth parameter after just a few seconds, but because it is essentially a phase delay, there is an overall ambiguity at the level of 5-10 m. Current analysis indicates that the ambiguity can be removed after as little as 1 minute, enabling subcentimeter altimetric accuracy. The parameter modeling and estimation procedure will be described and current results shown. The accuracy of the physical-model approach to rough ocean surfaces will be suggested by adding roughness parameters to the model.