Geophysical Research Abstracts, Vol. 9, 10787, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10787

Potential for estimation of river discharge through assimilation of wide swath satellite altimetry into a river hydrodynamics model

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Satellite swath altimetry measurements of surface water elevations from space have the potential to revolutionize the type, frequency, and spatial scale of global surface water observations. One complication is that satellite altimeters can measure surface water elevation, but not streamflow, directly with high accuracy. The most effective use of satellite-based methods for estimation of stream discharge may be through data assimilation, where surface elevation is the observed variable. Hydrology and river hydrodynamics models can be used to model surface water profiles and discharge, then adjusted as satellite altimetry observations become available, and subsequently fed forward to estimate discharge. We describe our use of a synthetic data assimilation framework to evaluate the potential for such a strategy. Simulated surface water elevation profiles for a reach of the Ohio River were ingested by the Jet Propulsion Laboratory Instrument Simulator to represent satellite swath measurements of surface water altimetry fields with errors representative of those that would be inherent in observations from a dual-sensor Ka-band wide swath altimeter that is being considered jointly by U.S. and European agencies. The Ensemble Kalman filter, with a raster-based river hydrodymnamics model, LISFLOOD-FP, as its dynamical core, is used to assimilate the synthetic observations. The filter was able to recover water depth and discharge successfully from a corrupted LISFLOOD-FP simulation by assimilation of the synthetic water surface observations. A simple autoregressive error model was used to correct boundary inflows, and which increased the persistence of the assimilation's benefits in time. In addition, the sensitivity of water depth and discharge estimation errors with assumed observation errors and assimilation frequency (i.e. satellite over-

pass frequency) was examined. Results showed modest sensitivity to the observation error magnitude within the range explored (which was dictated by plausible instrument performance); while as expected the shorter update frequency simulation gave the best overall results.