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Remote measurement and monitoring of inland water heights globally using multi-mission satellite radar altimetry

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The effective management of the Earth"s inland water is a major challenge facing scientists and governments worldwide. However, whilst demand for this often scarce resource continues to grow, the number and distribution of in-situ hydrological gauge stations is steadily falling and many catchments basins in the developing world are now entirely ungauged.

Over the past few years research has been undertaken into a space- based technique which can remotely measure river and lake heights using data from the series of satellite radar altimeters, originally designed to measure the height of the Earth""s oceans. Results over inland water were initially confined to a handful of very large lakes, where the water surface resembled the ocean sufficiently well to allow existing processing techniques to retrieve meaningful measurements. This capability has now been transformed by the development of echo processing techniques which allow that part of the returned signal originating from inland water to be separated from the return from the surrounding terrain. This has extended the scope of this technique to monitoring thousands of river and lake heights worldwide, with the access to more than a decade of historical data now permitting analysis of trends and identification of climate signatures.

This paper presents continental scale analyses of 15 years of altimeter data using results from hundreds of time series from ERS-2, EnviSat, TOPEX and Jason-1 to demonstrate the effectiveness of this technique in monitoring river and lake heights on a global scale. The extension of this technique to Near-Real-time monitoring using

data from the Envisat RA-2 and Jason-1 is also discussed.

For large lakes, which may be overflown by an altimeter several times during its orbit repeat cycle, measurements can be made every few days. However, river systems present a far greater challenge, as altimeter derived measurements at 10 day or 35 day intervals (depending on the satellite orbit repeat) may be insufficient to capture fully the temporal variability of the river heights. Accordingly, methodologies are being examined to incorporate the altimeter derived height measurements typically obtained at multiple crossing locations along river systems into a variety of river models, in order to monitor the flow and predict discharge.

The results illustrate the current capability and future potential of this approach to derive a global picture of the Earth's inland water resources and to identify both climate signatures and regions where human usage is depleting the resource beyond its capacity to recharge.