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A global inland water monitoring system from EnviSat satellite radar altimetry

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Satellite altimetry has been used for many years to measure the height of inland waterbodies; this paper assesses the contribution of the EnviSat RA-2 to global inland water monitoring. A full waveform analysis of cycles 10 to 85 of the EnviSat RA-2 SGDR dataset has been completed over inland water, retrieving 822229 crossings. The results confirm that the unique dynamic mode-switching capability of the RA-2 has enabled the instrument to maintain lock over rapidly varying terrain, thus acquiring a huge database of echoes over inland water. The vast majority of these targets were acquired in 320MHz 'ocean' mode, enabling precise retracking and allowing generation of 25636 timeseries of inland water heights. Analysis reveals that of these, 15067 have successfully retrieved the target signature.
Because these echo data were made available by ESA in Near-Real-Time, a pilot system has been running since 2005, generating river and lake height time series globally, and disseminating data to end users within 3 days of satellite overpass. This paper includes an analysis of the service provided to the worldwide userbase.
The Envisat RA-2 also has the unique capability to transmit to ground a small percentage of the retrieved echoes at the full 1800Hz acquisition rate. Global analysis of these 'individual echoes' (IEs) has revealed that even small pools of water can be identified, and height timeseries successfully retrieved from as few as 7 IEs.

This global assessment shows that the EnviSat RA-2 is a superb instrument for inland water measurement; the 15067 timeseries of water heights already retrieved represent only a fraction of the acquired echo dataset. Enhancements to the processing and retracking capability will further increase the target retrieval to enhance the inland water monitoring capability. In addition, and crucially for future missions, the unique IE dataset has shown that the high pulse repetition frequency allows even small pools of water a few metres across to be identified, and height timeseries determined from targets less than 30m across.