CRUCIAL: Cryosat-2 Success over Inland Water and Land

Introduction
- CRUCIAL is funded in successful response to ESA ITT ESRIN/AO/1-6827/11/NB, to investigate the application of CryoSat-2 data over land and inland water.
- Expertise in satellite radar altimetry, including generation of inland water and land heights and development of Global Digital Elevation Models.
- Expertise of River Modelling to highlight the potential of inland water.

Method and Tracks
- The Earth’s land surface is, in general, a relatively poor reflector of Ku band energy, with the exceptions of inland water, salar and ice surfaces.
- This has enabled the series of earth-orbiting satellite radar altimeters to be used for land surface applications including mapping and measurement of river and lake systems.
- With EnviSat Burst Echoes has shown that substantial high frequency information content is present at short spatial scales as the small bright reflecting patch at nadir is able to dominate the returned echoes. This effect is most strongly seen with inland water.
- The previous generation of satellite radar altimeters loses significant amounts of information due to onboard echo averaging.
- The high along-track sampling of CryoSat-2 altimeter in SAR mode offers the opportunity to recover high frequency signals over much of the Earth’s land surface, contributing to mapping applications, and transforming the inland water height retrieval capability.
- This is constrained by the limited availability of SAR FBR data from CryoSat-2 over the land.
- Selected SAR and LRM tracks are shown in Figure 1.

Mekong – LRM (Figure 2) and SAR (Figure 3) Tracks
- LRM track put through expert system tuned for Cryosat-2 LRM waveform shape recognition (Table 1).
- High proportion of complex (land/water) multi-target echoes, these are most often associated with snaggling on bright targets.
- Figure 4 shows comparisons of LRM heights and ACE2 heights.
- Good agreement apart from rough topography (e.g. 14.8⁰ N) where Cryosat-2 did not receive the echoes.

Amazon Tributary - SAR Tracks
- SAR Track over an Amazon River tributary (Figure 6 and Table 3).
- Automated identification of water echoes multi-shape gives two river crossings (Figure 7).
- Snagging occurs on bright targets.

Conclusions
Excellent progress is being made on the analysis and retracking of Cryosat-2 waveforms. A database of water heights will be developed for use in hydrology including assimilation into river basin models. This work will be extended with the future Sentinel-3 mission.

Acknowledgements: The authors thank the European Space Agency for funding the study through Contract 4000109110/13/NB
