The Near-Specular Altimeter Waveforms of Small Surface Water Bodies

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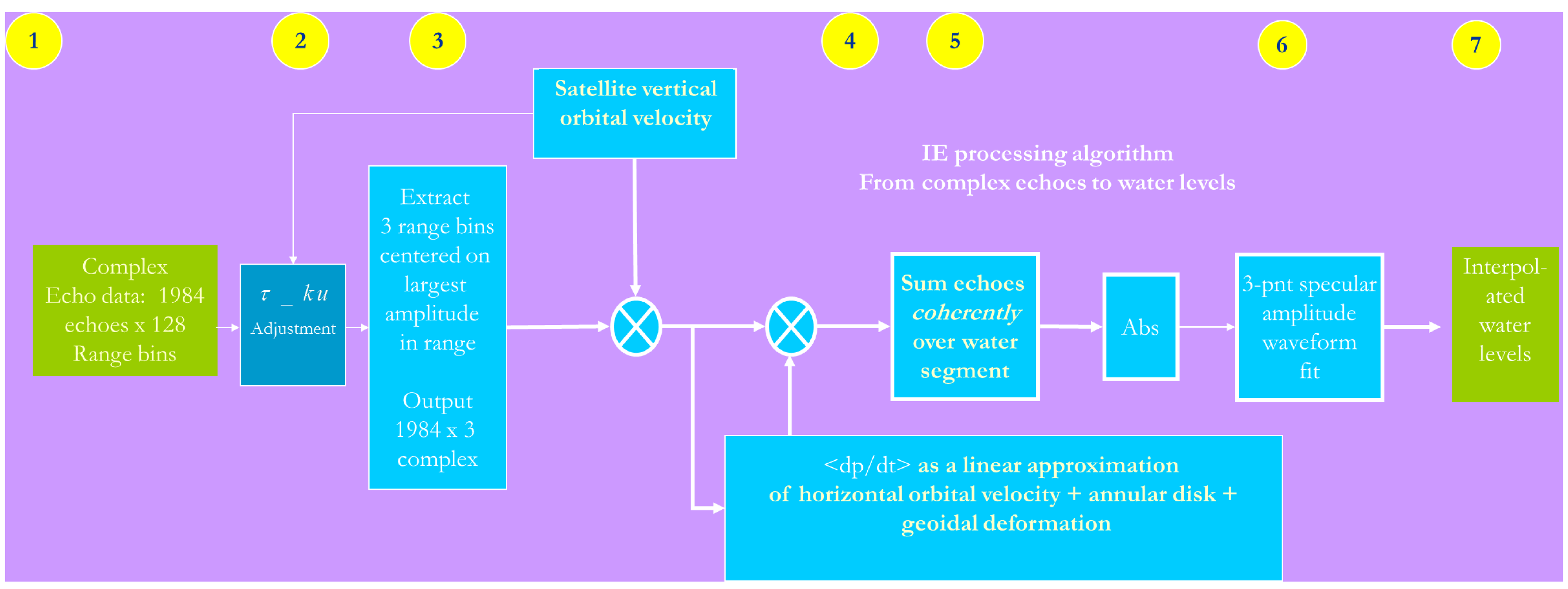
Introduction

In this poster, we investigate how satellite radar altimeters can be best utilized to monitor small water surfaces (lakes ~200 m diameter, rivers ~200 m or less wide, floodplains). Such water surfaces are often near-specular and detected only near nadir. We propose an algorithm to retrieve water level using complex individual echoes as input.

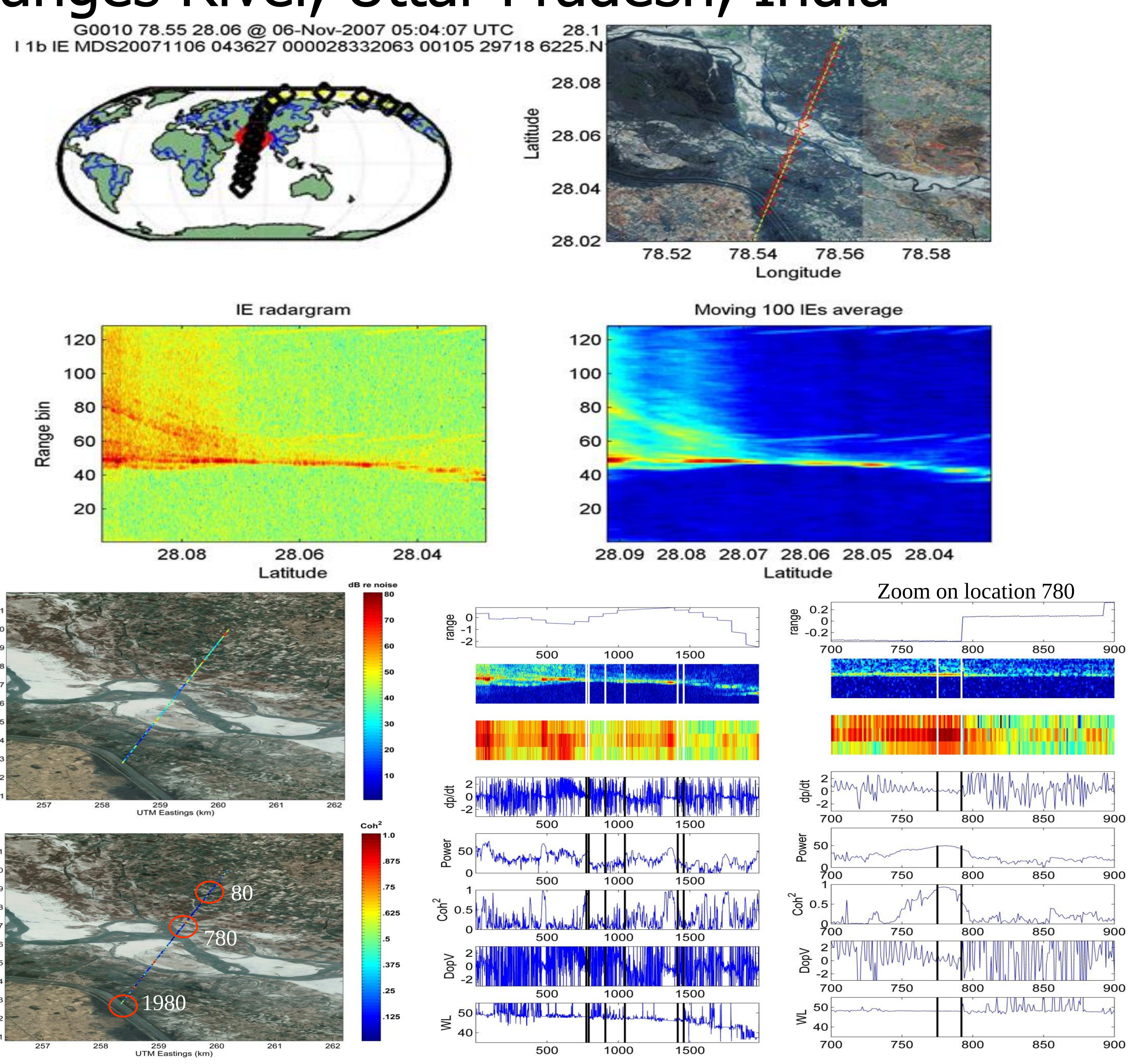


Algorithm

(1) input data is complex echoes;
(2) the range shifts done by the on-board tracker are undone;
(3) the phases are de-spun by two Doppler terms, the satellite vertical velocity, and a remainder constant dp/dt;
(4) at this point all the echoes from a specular reflector have a constant phase (zero);
(5) echoes are summed coherently in a moving N-point window;
(6) a specular waveform is fitted to the summed echoes (three range bins straddling the peak are sufficient for the fitting process) and the water level determined from the peak of the fit.

N.B.: dp/dt is a constant (to 1st order) change in Doppler (phase) as satellite is approaching or receding river shorelines; dp/dt is 0 during passage over water.

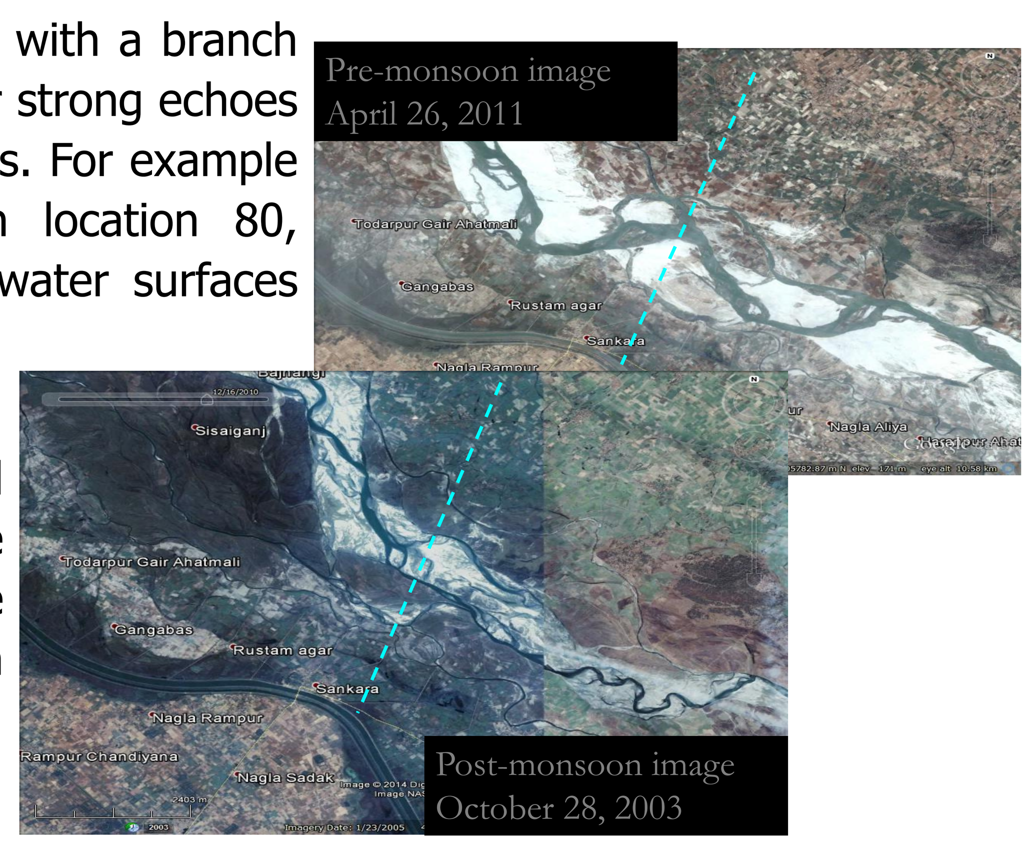
Ganges River, Uttar Pradesh, India



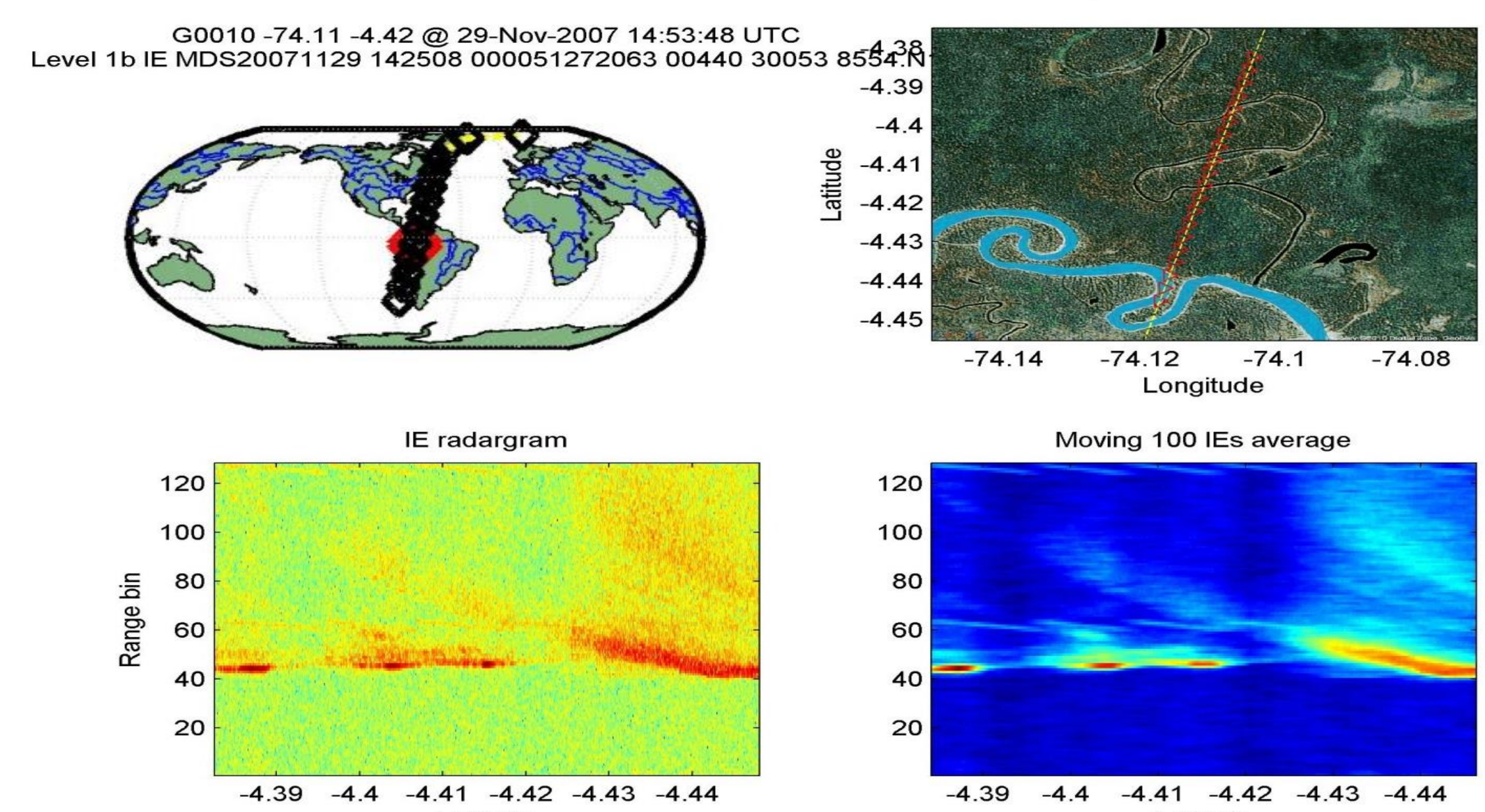
The Ganges River basin represents a complex scenario with numerous river branches, lakes, and a canal in close proximity. The vertical black bars correspond to the locations of shorelines seen in the Google image. Note, the Google image is ***pre-monsoon***, the IE data is ***post-monsoon*** (November 6, 2007).

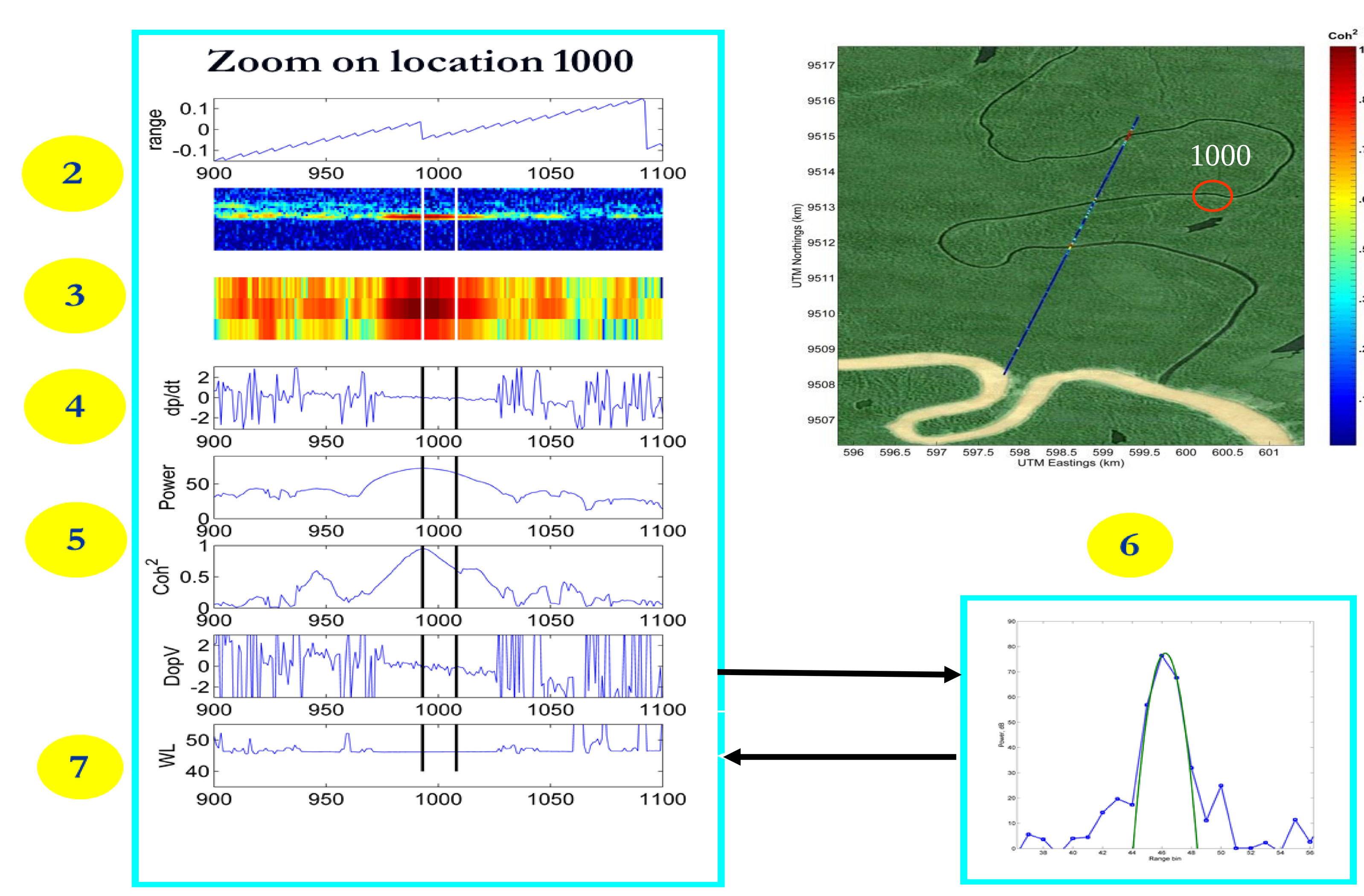
The specular return at location 780 aligns well with a branch of the Ganges seen in the satellite image; other strong echoes do not appear to be aligned with water features. For example the strongest specular echoes, centered on location 80, correspond to an area with numerous small water surfaces that are dry in the pre-monsoon image.

The reason for the misalignment of echoes and water can be explained by comparing satellite images in the pre and post-monsoon. There are large swings in water cover and location between pre- and post-monsoon.



Rio Tigre & tributary, Peru





This is the case that will be discussed in the oral presentation during 8th CAW. The interpretation of the data is as follows. There is a pronounced specular echo at every instance where the IE crosses the narrow tributary. The coherence is close to 1. The main lobe and side lobes extend beyond the physical river. The Doppler is zero when the water surface is at nadir.

Acknowledgments

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References

Abileah R, Gómez-Enri J, Scozzari A, Vignudelli S, Coherent ranging with Envisat radar altimeter: a new perspective in analyzing altimeter data using Doppler Processing, Remote Sensing of Environment, doi:10.1016/j.rse.2013.08.005, 2013.