MEASURING TROPICAL DEFORESTATION WITH SPACEBORNE RADAR

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Tropical deforestation is a major driver of climate warming and loss of biodiversity, so it is vital to monitor this process. Spaceborne radars seem well suited for this, since they can see through darkness, cloud and smoke, and provide guaranteed sequences of images to detect change. Particularly valuable are longer wavelength radars, such as the Japanese L-band (24 cm) ALOS-PALSAR sensor, which uses signals with different polarisations to maximise its sensitivity to forest canopies. Such radars therefore have a potentially crucial role to play in international programmes such as the Global Forest Observations Initiative and the United Nations action on Reducing Emissions from Deforestation and Forest Degradation (REDD+). However, effective use of radar data requires special methods that are unfamiliar to most users, and so we set out to develop optimal methods that not only allowed us to investigate the strengths and weaknesses of PALSAR for monitoring deforestation, but would be usable by a non-expert.

Working with WWF Indonesia in Riau province, Sumatra, we showed that the radar could replicate many of the results from optical satellite data (see Figure), and hence could be used to supplement them when cloud cover prevented their use. Performance depends strongly on whether forest is dry or swampy, since many image changes that could be interpreted as deforestation arose from flooding below the forest canopy: this greatly increases image brightness, because of strong radar scattering by a double reflection from the trunks and water surface. The radar also seemed insensitive to some types of forest disturbance seen clearly in optical data. Our automatic approach gave noisy results (see Figure) that could readily be cleaned by human intervention or rule-based automatic methods, though at this stage we have not implemented them. Full analysis is given in Whittle et al., (2012). Also, to encourage the use of radar data, we have provided a suite of free software tools for deforestation mapping and analysing PALSAR data at **www.walkhappy.co.uk/ForestWatch**.

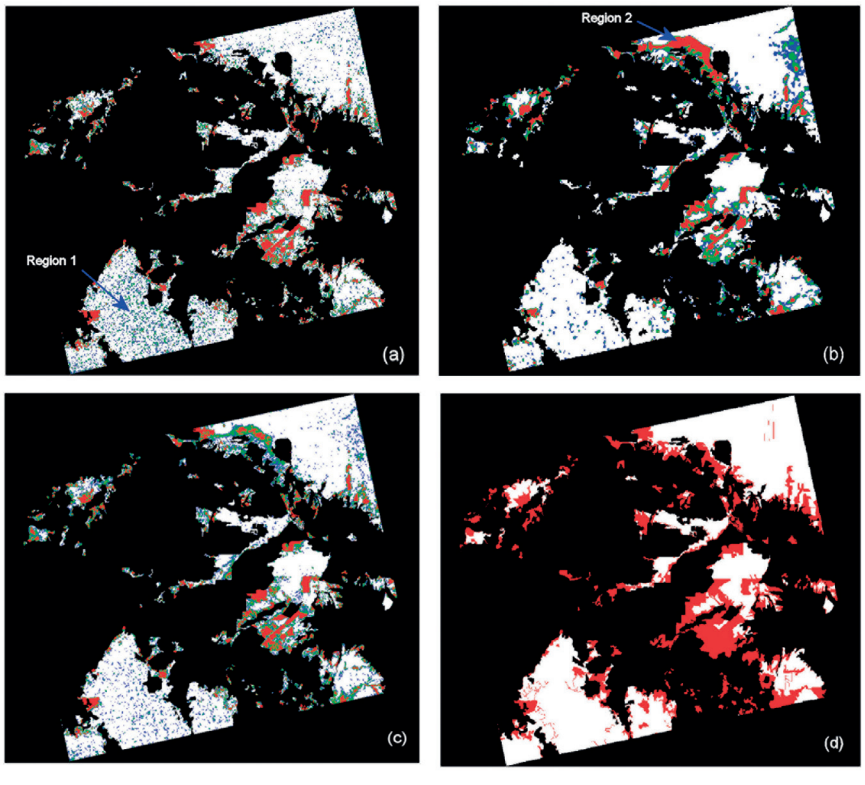

Figure 1: Automatic detection of deforestation between 2007 and 2008 in a 69.8 km x 58.6 km section of Riau province, Sumatra, using (top left) two dual-polarized high resolution images from the ALOS-PALSAR radar satellite; (top right) a 46-day repeat time series of lower resolution single polarization images; (bottom left) an optimized combination of the two. Red, green and blue indicate different levels of confidence in the detection, with blue being lowest. The black area indicates non-forest in 2007. At bottom right is a manual detection of deforestation based on Landsat optical data over roughly the same period, though the earliest Landsat image was acquired about 2 months before the first polarized ALOS image. Most of the deforestation found by human interpretation of the optical data is also found by optimized automatic detection on the radar images. The radar detection is noisier (see Region 1) though mostly with low confidence levels, improved, as can be seen, by combining the two data types, and fairly easily cleaned with user intervention. There are also some systematic false detections associated with water courses (Region 2), almost certainly caused by flooding below the forest. Similar effects are seen in the article on "Disturbance in Tropical Peat Swamp Forests" by colleagues from the University of Leicester.

References
Whittle, M., Quegan, S., Uryu, Y., Stüewe, M., & Yulianto, K. (2012). Detection of tropical deforestation using ALOS-PALSAR: a Sumatran case study, Remote Sensing of Environment (in press)