Synthetic Aperture Radar for Land Cover Observation

Recent Activities for Agriculture, Environmental Applications

Remote Sensing and Image Integration Team, Data61

www.data61.csiro.au

Building on well developed continental and regional optical remote sensing capabilities over last three decades, the team have conducted novel research into radar remote sensing techniques and their applications for agriculture mapping and environmental monitoring.

Digital Surface Model (DSM) from TanDEM-X Imagery

The very high resolution TanDEM-X (TDX) Spotlight data were used to generate DSMs for Perth City. Detailed comparisons of DSMs from TanDEM-X Stripmap and Spotlight mode data and 1 arc-second SRTM, 5m the stereo mapping satellite ZY-3, 0.2m Urban Monitor products from aerial photography can be observed in Figure 1. The Stripmap 5m DSM has shown significant improvement comparing to 1 sec SRTM DSM. The Spotlight 5m DSM has a comparable or better accuracy than the 5m ZY-3 DSM. The Spotlight 2m DSM shows even better accuracy. The relative height accuracy of the 2m Spotlight DSM is about 0.7m.

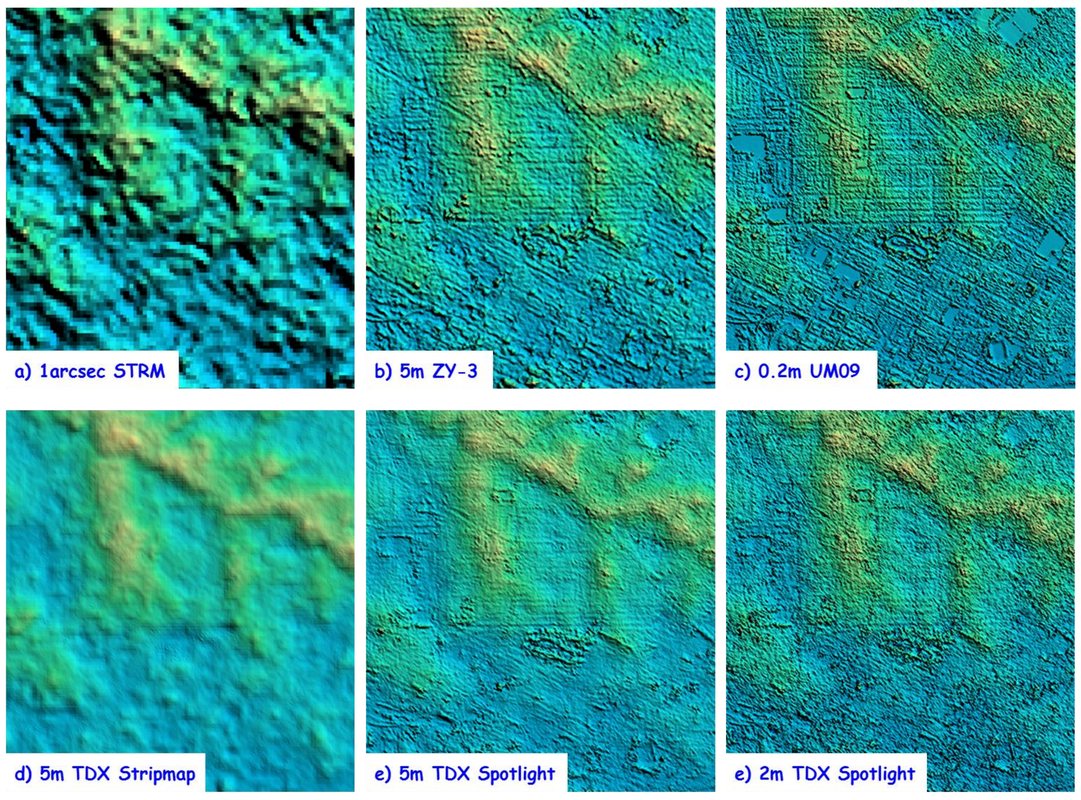

Figure 1: Comparison of DSMs from TanDEM-X Stripmap and Spotlight modes and 1 arc-second SRTM, 5m ZY-3, 0.2m Urban Monitor [1]

Rangeland Pasture Biomass Mapping

A pilot study in Spyglass Queensland has demonstrated that combining the available multi-wavelength (X-, C- and L-band) and multi-polarisation radar remote sensing data can provide useful information on pasture biomass distribution for rangelands. More accurate pasture biomass information were derived from C- and X-band cross-pol data. In particular, the combination of C-band, X-band and L-band data enables the landscape to be more accurately stratified into land cover types, which improves the biomass calibrations against field data.

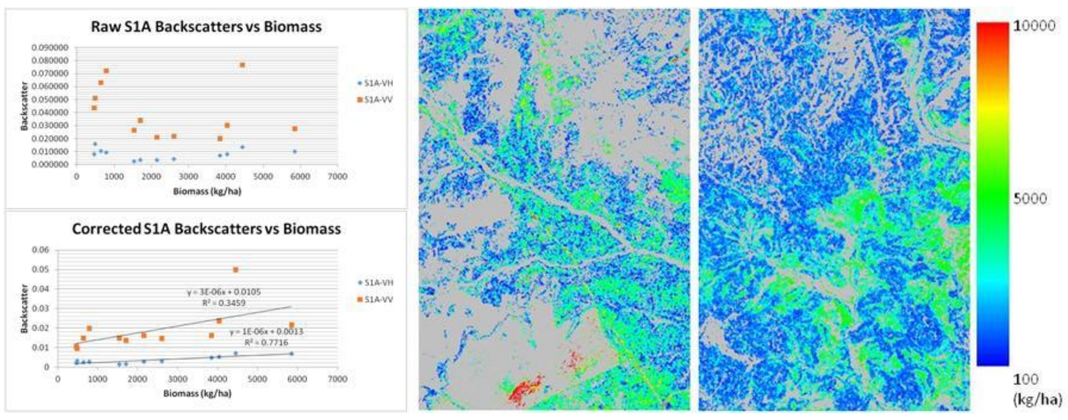

Figure 2: Sentinel-1A backscatters vs Pasture biomass: Raw (Upper left) and Corrected with a multi-temporal/spatial approach (Lower left), and Pasture biomass maps with non-grass/sparse shrubs masks for two testing patches (Centre and Right) [2]

Improved Crop Extent Mapping

For development of crop monitoring system utilising the freely available and broad-coverage Sentinel-1 C-band data, an investigation of Sentinel-1A time series combining Landsat-8 imagery for wheat crop mapping were carried out. A workflow from SAR data pre-processing to crop classification maps was developed and validated. Crop extent maps for the Warracknabeal test site in the western Victoria were produced. Initial polarimetric analysis, using phase information in addition to intensity of SAR data, provides potential for improved crop classification using single date Sentinel-1 data.

Figure 3: Images of Cropland in Warracknabeal, Victoria: Landsat-8 on 14-10-2015 B4/B5/B3 (Left), Sentinel-1A VH on 27/6/2015/14/8/015/1/10/2015 (Centre) and classification from Sentinel-1A VH&VV time series and Landsat-8 (Right), where polygons indicate the training sites.

Forest / Non-forest Discrimination

Multi-temporal methods developed as part of Australia's National Carbon Accounting System (NCAS) were used for the integration of Landsat and ALOS PALSAR data. To highlight specific operational aspects of the multi-sensor framework, this approach was demonstrated over Tasmania, one of seven national demonstrator sites defined by the Forest Carbon Tracking task of the Group on Earth Observations (GEO-FCT). L-band data are found to provide most of the forest discrimination in combination with Landsat (Figure 4).

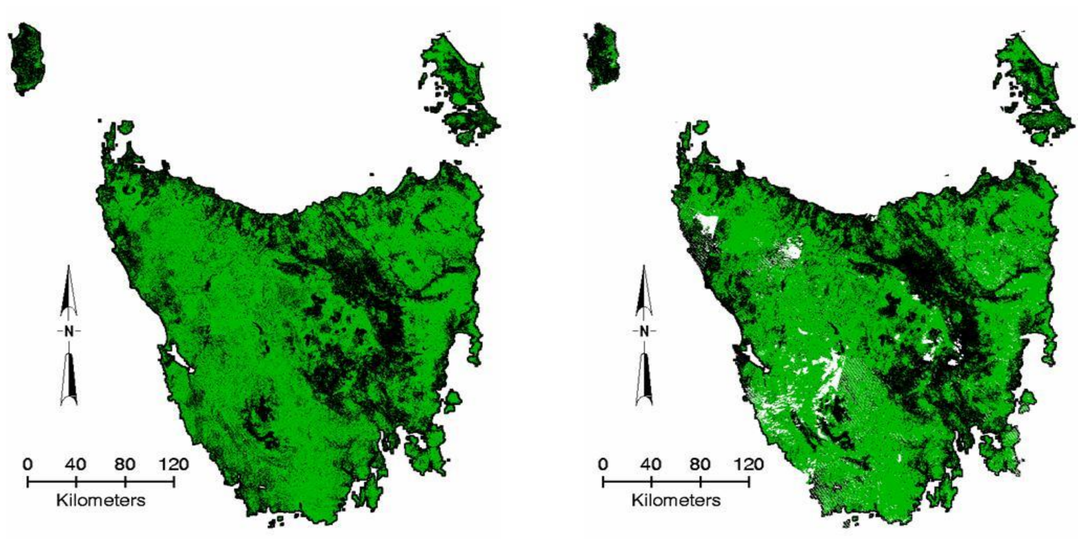

Figure 4: SAR – Optical Interoperability: Forest cover map in Tasmania derived from ALOS-PALSAR mosaic (Left) and Landsat data (Right) for 2007, with forest probabilities shown in shades of green and where white pixels being cloud masks in Landsat result [3].

Summary

CSIRO is ready to use Sentinel-1 and other data sources to develop credible methodologies for agriculture, environment, resource and marine applications in Australia and regional countries.

Remote Sensing & Image Integration Team together with CSIRO SAR CoP (Community of Practice) can assist you with any remote sensing solutions.

FOR FURTHER INFORMATION

Peter Caccetta

e peter.caccetta@csiro.au

Zheng-Shu Zhou

e zheng-shu.zhou@csiro.au

REFERENCES

[1]. Zhou et al. APSAR 2015, Sept 2015

[2]. Zhou et al. IGARSS 2016, Jul 2016

[3]. Lehmann et al. Remote Sensing of Environment, vol. 156, pp. 335–348, Jan 2015

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