K&C Phase IV – Status Report: Land Cover and Change in Papua New Guinea



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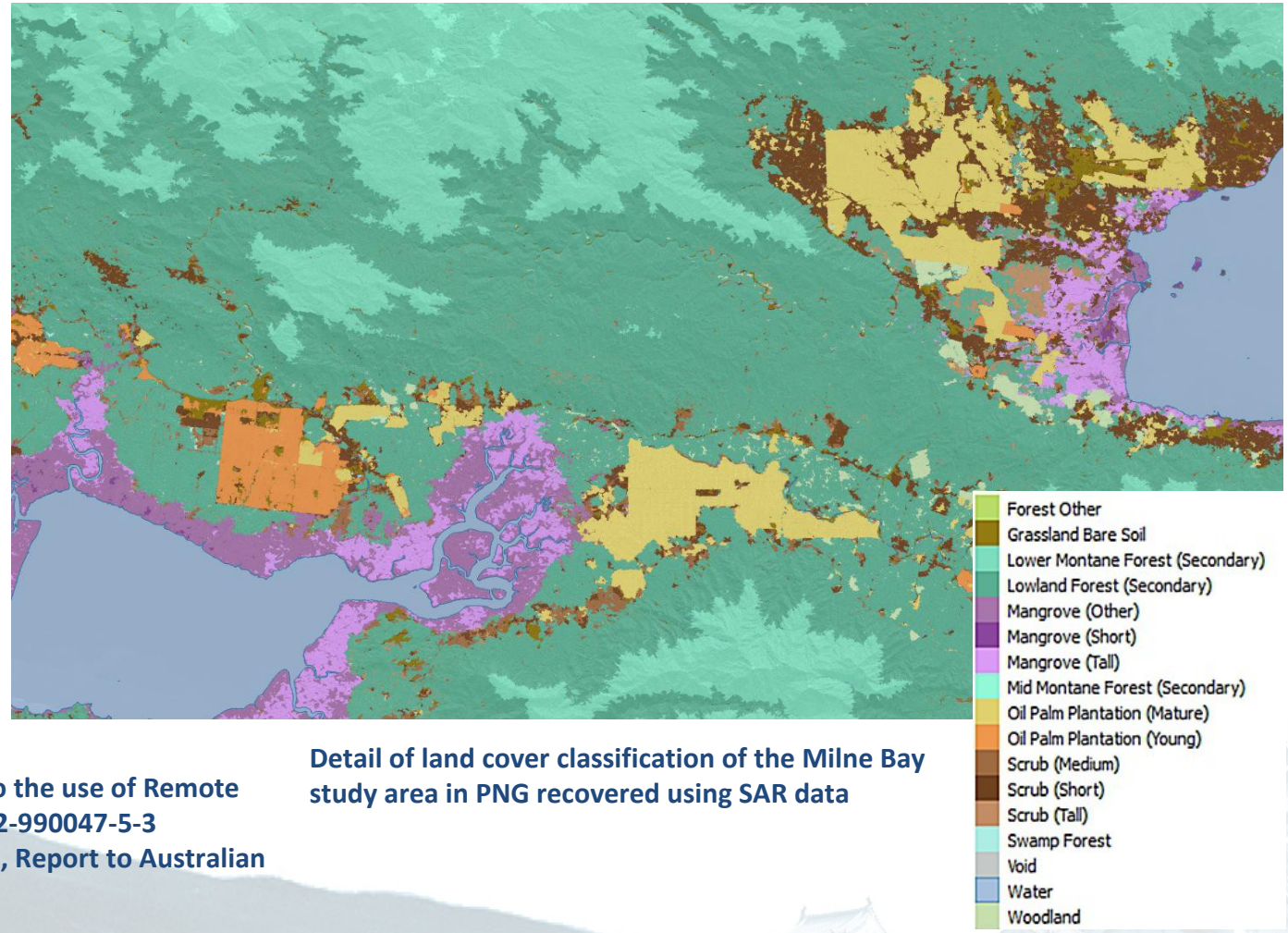
THE UNIVERSITY OF NEW SOUTH WALES

SAR for Forests

- Tropics in particular benefit from SAR because of cloud cover, and SAR is sensitive to forest Above-Ground Biomass (AGB)
- SAR can be used for fine Land Cover and Forest/Non-Forest classification and change detection
- SAR couples to forest biophysical parameters, particularly at low frequency (L-Band, P-Band)
- SAR can be used to recover forest height information (using PolInSAR, dual-Band InSAR) which is an important indicator of forest AGB
- **SAR coherency (both polarimetric and interferometric) can be used to enhance detection of changes in the forest**



Detail of land cover classification of the Milne Bay study area in PNG recovered using SAR data

GFOI (2013): Review of Priority Research & Development Topics: R&D related to the use of Remote Sensing in National Forest Monitoring. Pub. GEO, Switzerland, 2013 ISBN 978-92-990047-5-3
T. Milne, M. L. Williams, A. L. Mitchell and M. Watt, Robust Imaging from Space, Report to Australian Space Policy Unit, October 2012

GEO Forest Carbon Tracking Tasmania National Demonstrator

Prof. A K Milne, Dr A L Mitchell, Dr I Tapley, Prof K Lowell,
Dr M L Williams, Dr P Caccetta, Dr E Lehmann, Dr Z-S Zhou, Dr A Held

Study on Interoperability of SAR and Optical data used NCAS: national archive of calibrated Landsat TM/ETM+ data from 1989 to 2006. The NCAS was designed to provide consistent classifications for monitoring forest cover extent and changes over the Australian continent using time series Landsat imagery.

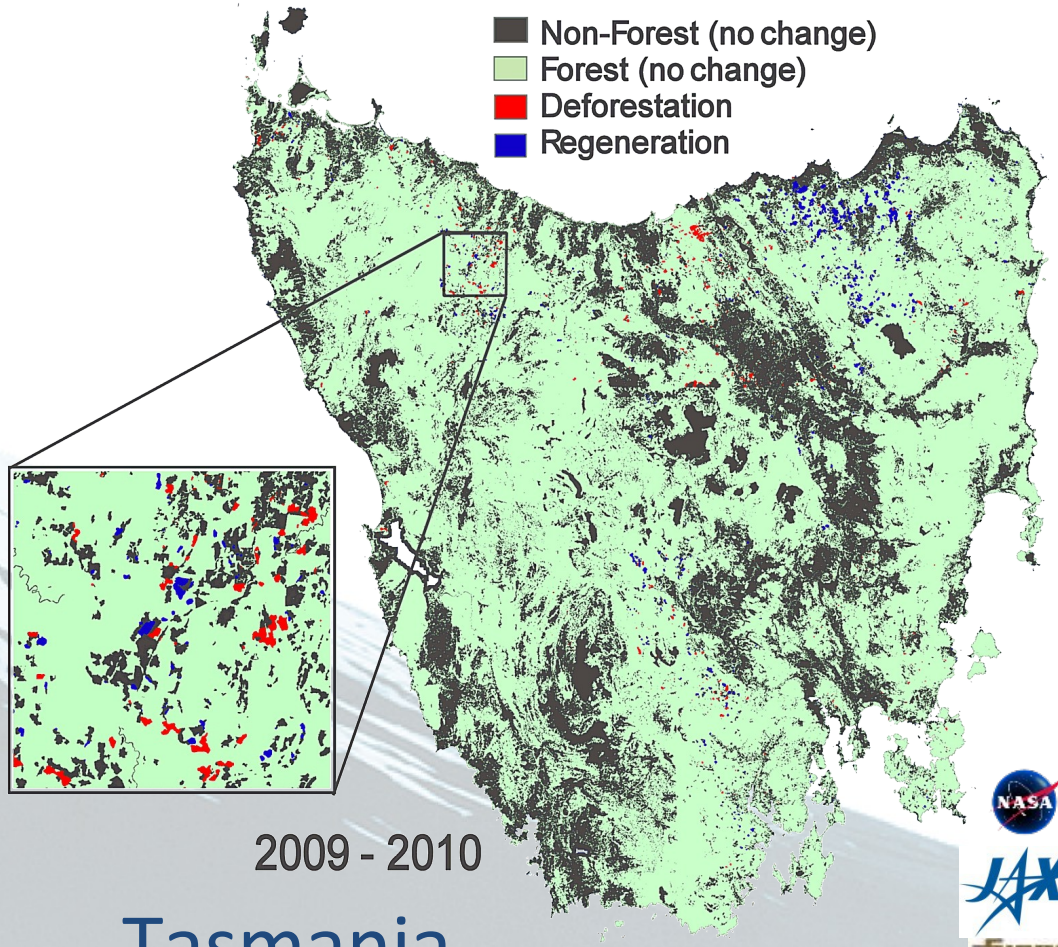
The Kokoda Track and Owen Stanley Ranges Remote Sensing Project

Dr M L Williams, Prof. A K Milne, Dr A L Mitchell, Dr I Tapley,
Dr J Fox, Dr Cossey K Yosi

The Milne Bay Remote Sensing Project

Dr Masamichi Haraguchi , Dr M L Williams, Prof. A K Milne,
Dr A L Mitchell, Dr I Tapley

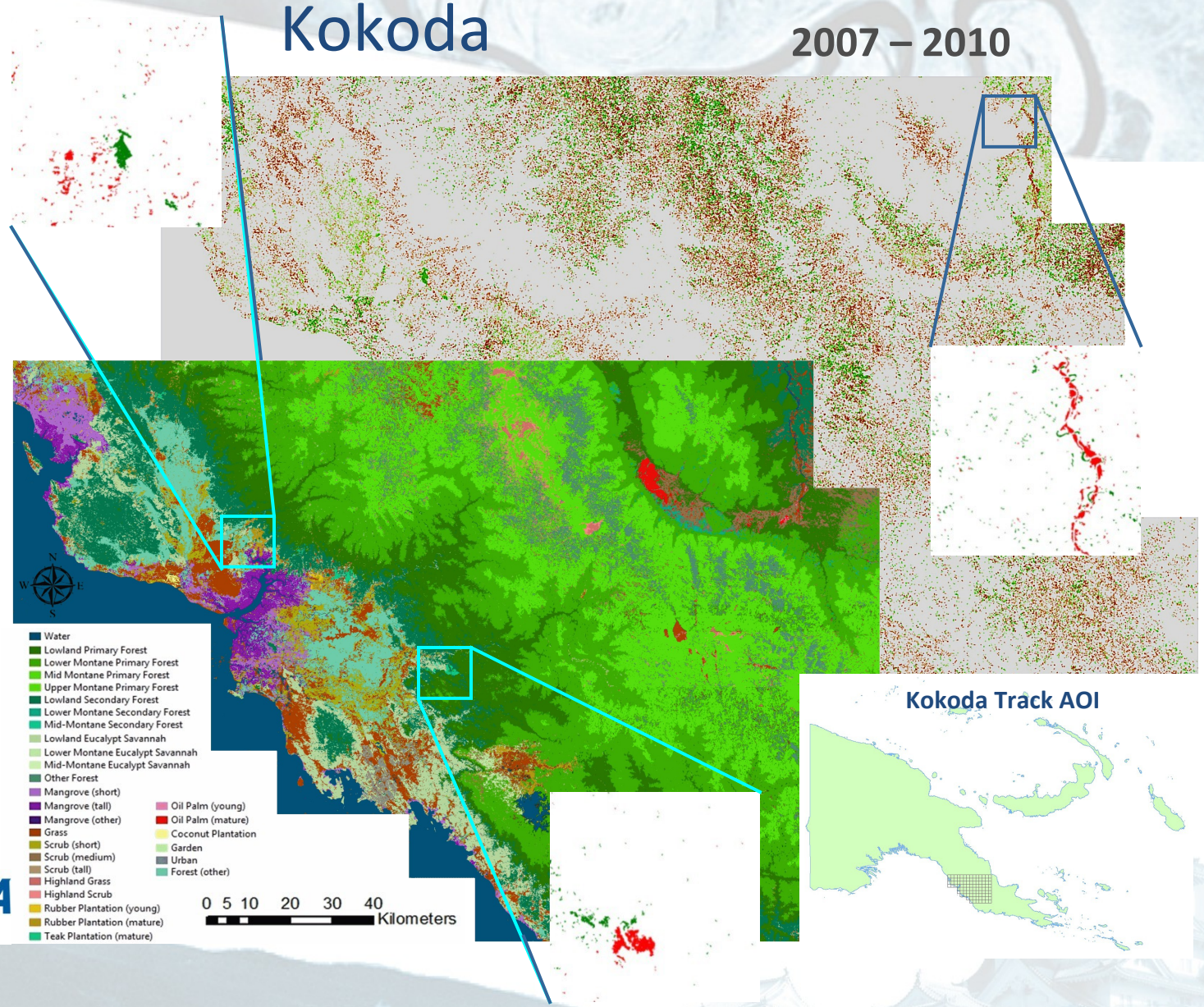
Land Cover and Change Detection



Tasmania

Kokoda

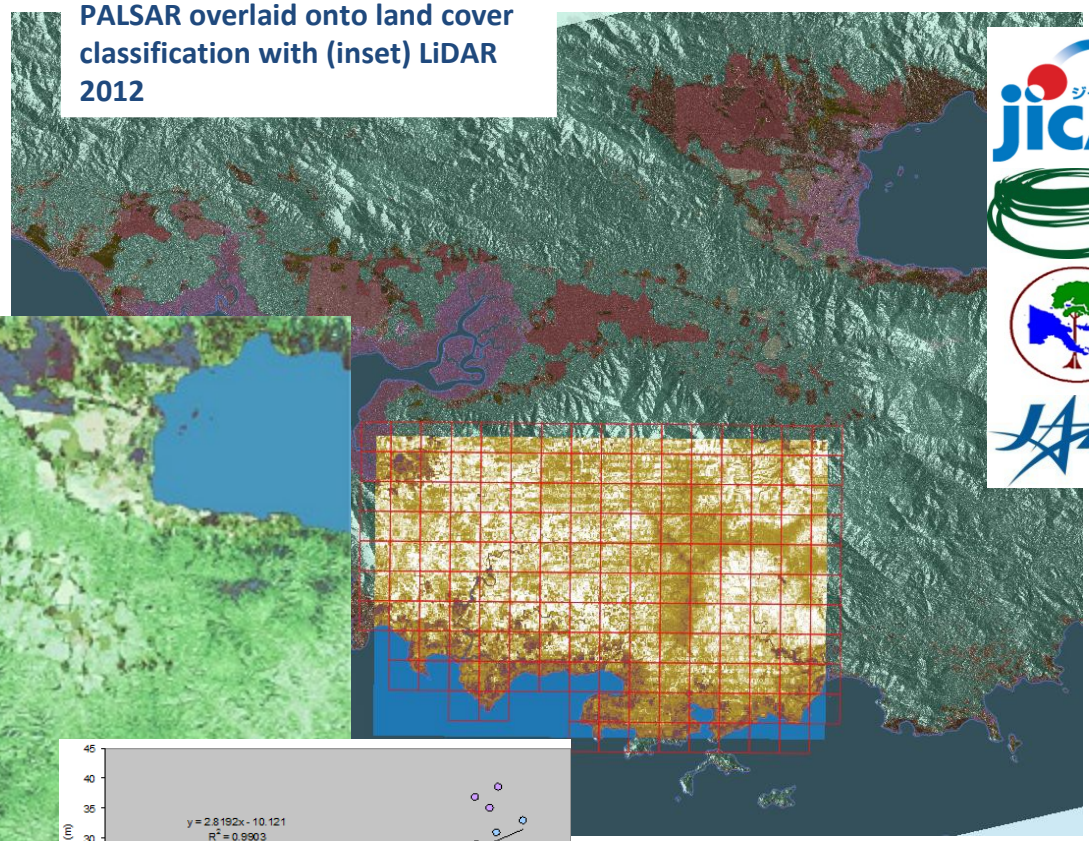
2007 – 2010

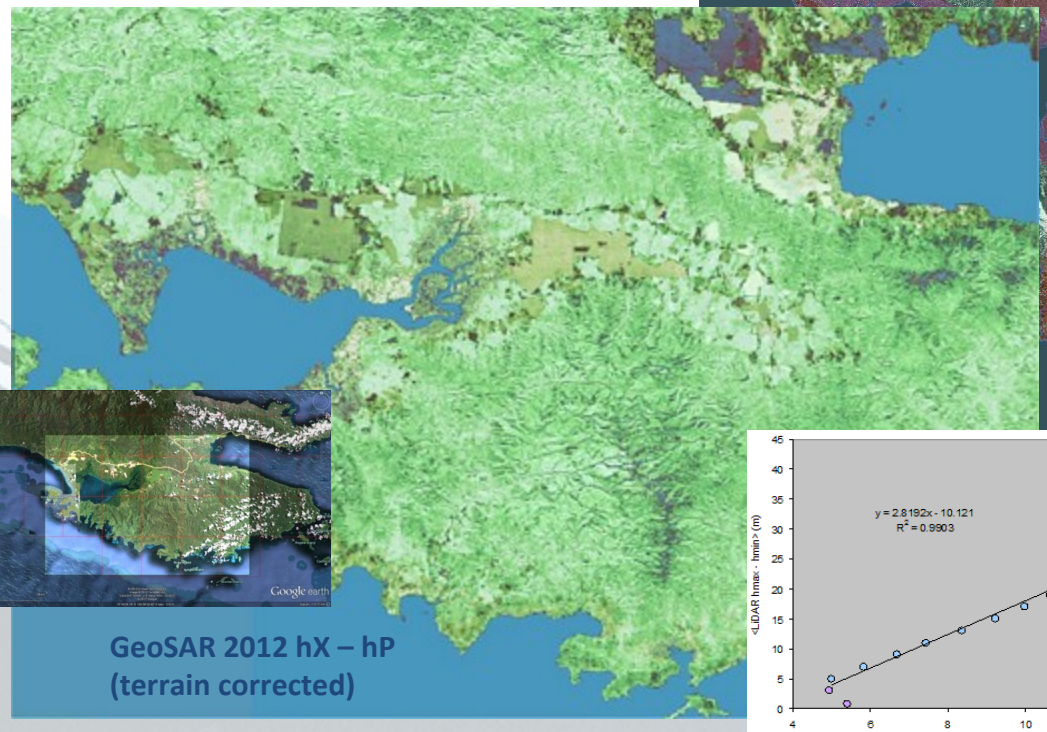


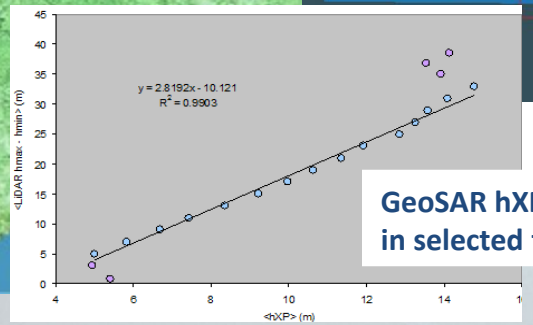
ALOS K&C Initiative

Milne Bay: Multiple Datasets

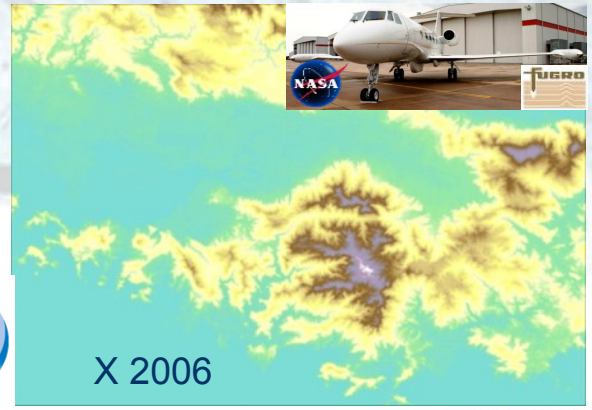
- GeoSAR 2006 X-band and airborne P-band InSAR (1.25m imagery, 5m DEMs)
- GeoSAR 2012 X-band and airborne P-band InSAR (5m imagery, 5m DEMs)
- PALSAR 2011 (12.5m FBD)
- LiDAR 2012
- PALSAR 2 2014+
- Ground Data

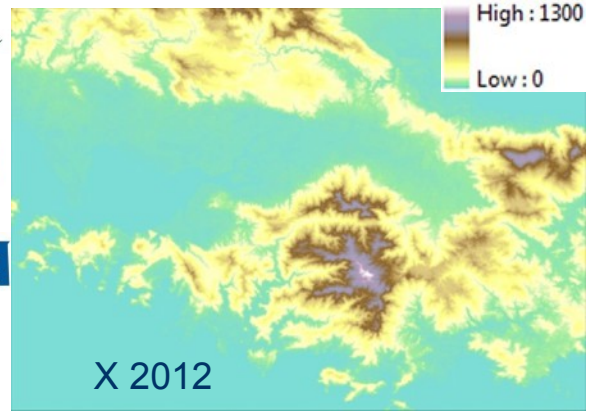


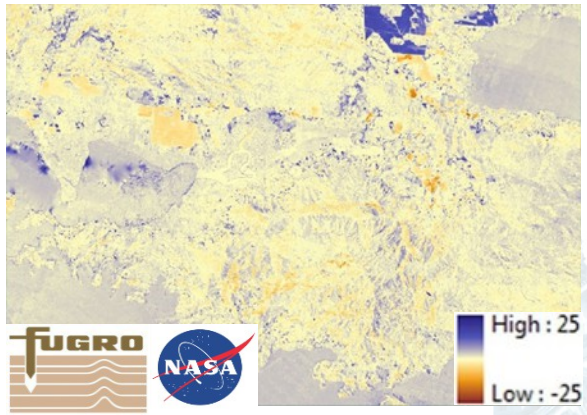




GeoSAR hXP v LiDAR height in selected flat area







hX 2006 – hX 2012

DEPARTMENT OF ENVIRONMENT & CONSERVATION

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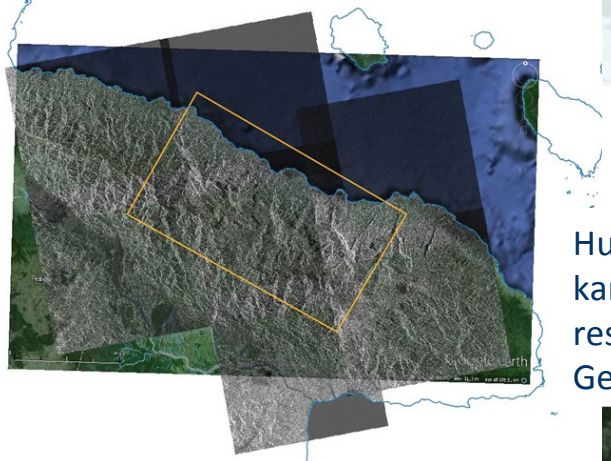
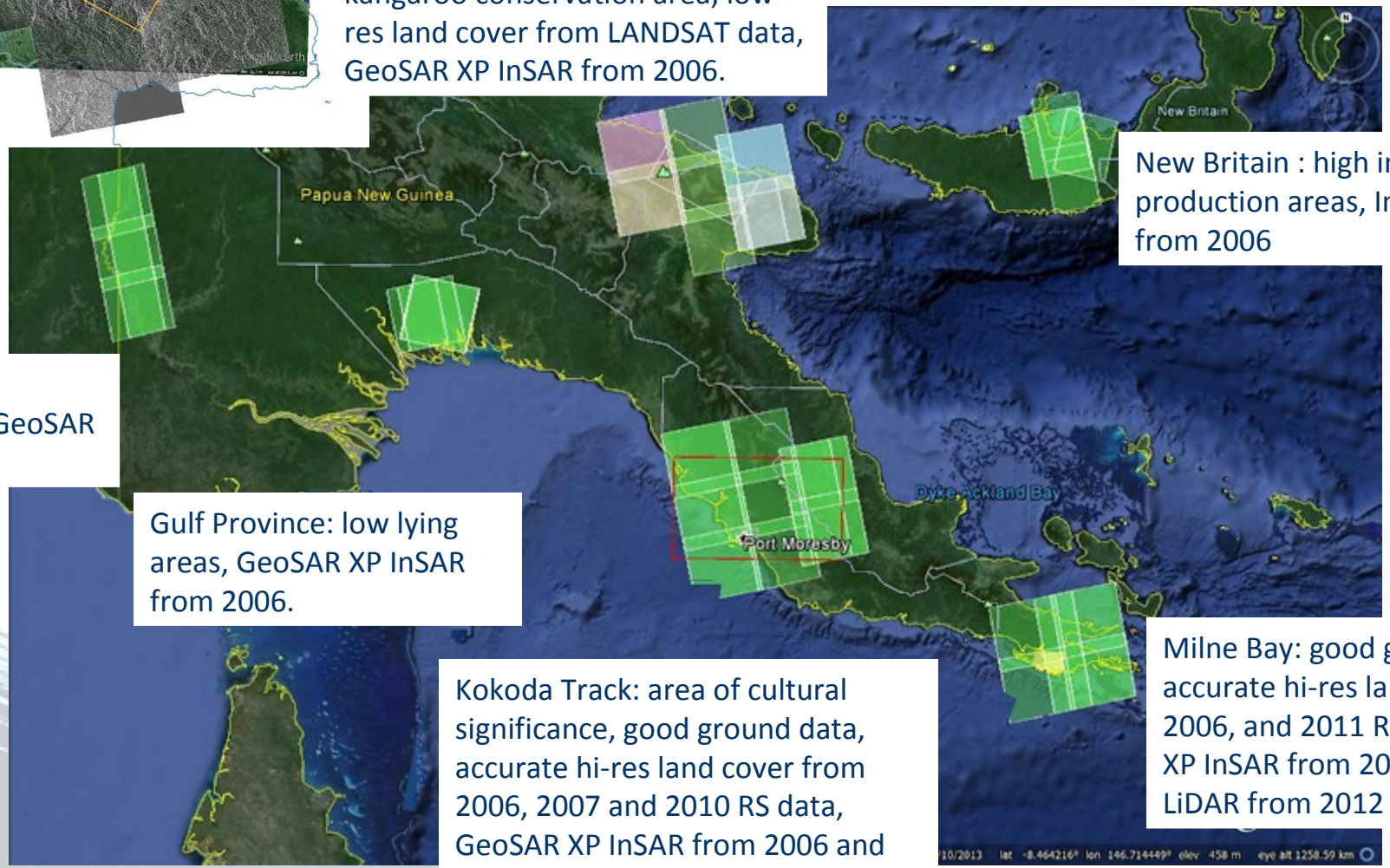
Current Areas of Interest



Huon Peninsular: YUS tree kangaroo conservation area, low-res land cover from LANDSAT data, GeoSAR XP InSAR from 2006.



New Britain : high impact Oil Palm production areas, Intermap X-InSAR from 2006

Western Province: area of significant logging activity, GeoSAR XP InSAR from 2006.

Gulf Province: low lying areas, GeoSAR XP InSAR from 2006.

Kokoda Track: area of cultural significance, good ground data, accurate hi-res land cover from 2006, 2007 and 2010 RS data, GeoSAR XP InSAR from 2006 and 2012

Milne Bay: good ground data, accurate hi-res land cover from 2006, and 2011 RS data, GeoSAR XP InSAR from 2006 and 2012, LiDAR from 2012

Focus of Current Activity

- Helping to establish a change monitoring system based on remote sensing for the (newly formed) Conservation and Environment Protection Agency in Papua New Guinea

- Land Cover Classification and Change Detection (particularly Forests and Plantations) in Papua new Guinea

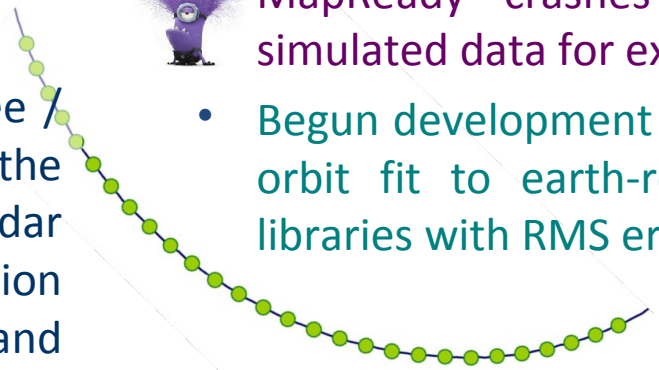
- Working towards an accessible, Free / Open Source methodology for the processing of Synthetic Aperture Radar (and other) imagery for the detection of forest degradation and deforestation (and other land use changes).

- Experiences of attempting to establish a free-ware / open source processing chain for current for LULUCF using PALSAR II.
- Ortho-rectification and co-registration of PALSAR II attempted using both esa Sentinel-1 toolbox and ASF Map Ready.

S1T could not use anything but SRTM and co-reg would produce errors when attempting to match against existing ortho-rectified data.

MapReady crashes and cannot perform FFT co-reg against simulated data for external DEM, and cannot co-register imagery.

- Begun development of ortho-rectification code, recovered elliptical orbit fit to earth-rotated PALSAR II OSV data using CLAPACK libraries with RMS error of 1.7m.



- Can use this with external DEM to perform own ortho-rectification … this stage under development … watch this space ...

Current Issues

- Seek to test coherent change detection, but this is not possible with current data: **Please may we have SLC?**
- Seek to explore the potential of full-polarisation, coherent polarimetric decomposition, and PolInSAR for forest degradation and deforestation, but this is not possible with current data: **Please may we have SLC?**
- Availability of an accessible, Free / Open Source methodology is a positive step for govt and non-govt uptake of satellite SAR data. Current tools do not work well (see opposite), alternatives are expensive and both are difficult to couple together to make a full processing chain.

	Tasmania National Demonstrator (Commercial)	Papua New Guinea Kokoda (Open Source / Proprietary)
Multi-Look Speckle Filter Co-Register Calibration Orthorectification	ENVI SARscape	 Fugro-Earthdata/NASA JPL Alaska SAR Facility: MapReady, SENTINEL-1 Toolbox
Terrain Illumination Correction	CSIRO	
Segmentation	eCognition	
Training Areas Feature Vectors Data Split	ENVI, ArcGIS, eCognition	GIMP 2.8
Supervised Classification	eCognition, Decision-tree rule sets ENVI, ImageSVM	SVM: libsvm, http://www.csie.ntu.edu.tw/~cjlin/libsvm See5 CART, http://www.rulequest.com
Performance Assessment	ENVI	
Classification Filtering	ArcGIS	
Mosaic Raster/Vector	ArcGIS www.arcgis.com	QGIS www.qgis.org

Summary

- We have established study areas with good supporting reference and additional remote sensing data
- We successfully downloaded 2014 PALSAR II data for all the sites of interest in Papua New Guinea
- We began work to develop a free / open source processing chain and ran into difficulties with existing freeware so have undertaken to develop an orthorectification scheme and couple this to our existing software for land cover classification and change detection
- We wish to investigate the utility of PALSAR II for forest degradation and deforestation detection: specifically using complex SAR data.
- **Please: we need SLC data for coherent decomposition and coherent change detection studies**.

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Thank you!