MODIS Product Multi-temporal Error Assessment Workshop Summary Report

Draft: February 25, 2005

Organised by:

Centre for Remote Sensing and Spatial Information Science (CRSSIS)
School of Geography, Planning and Architecture
University of Queensland

Aims:

To provide a forum for users of MODIS land and ocean products to discuss needs for error assessment, review potential error assessment methods and to set up jointly funded error assessment programs.

Outcome(s):

- review of known errors in MODIS land and water products for Australia
- listing of available error assessment techniques and databases for MODIS products
- listing of ongoing error assessment projects for MODIS products in Australia and contacts for organizing personnel
- recommended method(s) for error assessment
- joint request for additional funding to develop and test appropriate techniques
- summary report to be produced by CRSSIS

Date/Time:

Wednesday of February 16, 2005
9.30am – 4pm

Location:

General Purpose North, rm209 in building 39A
University of Queensland, St Lucia Campus
Parking – semester hasn't started so it's not too bad, Try the area next to the pool

(i) Introduction to workshop, workshop aim and attendees

Table 1: details of MODIS product use by workshop participants

Atmos/Land/Ocean	Modis products	Group User	Area	Application	Validation Activities
Land	MOD43 Reflectance	NRME (Natasha Cronin)	Charters Towers, Queensland	Green/non-green biomass and bare-ground mapping	Planned for end of 2005, commenced sampling in 2004 with stratified sample throughout scene
	MOD43 Reflectance	NRME (Natasha Cronin)	Brisbane Valley, Queensland	Green/non-green biomass and bare-ground mapping	Planned for end of 2005
	Vegetation indicies (EVI time series)	UQ/CSIRO Rainforest CRC	Townsville to Cape York (Wet and dry tropics bioregions), Queensland	Change in vegetation cover over time	Planned for middle to end of 2005
	Vegetation indicies (NDVI time series)	NRME (Tim O'Donnell, Tony Rowland, Christian Witte)	Fitzroy Basin then most likely other Reef catchments	Land use change detection and mapping focusing on agricultural areas; selected management practices mapping (crop rotations, planting/harvesting times, potentially tillage practices)	Potential through existing DPIF field survey data; Ground truthing and validation of land use change datasets creates opportunity to check MODIS standard products - likely timeframe is April 2005 to June 2007.
	Vegetation indicies (NDVI time series)	DPIF/USQ (Armando Apan, Andries Potgeiter)	Darling Downs, Queensland	Crop type and yields	Potential through existing DPIF field survey data
	Vegetation indicies (NDVI time series)	DPIF (Bob Karfs, Townsville)	Charters Towers, wet-dry tropics, Queensland	Pasture condition and dynamics	?
	Vegetation indicies (NDVI time series)	CSIRO(Land and Water) Alan Marks	Australia wide	C	Validation with AVHRR/MODIS NDVI comparison
	Vegetation indicies (NDVI time series)	CSIRO(Land and Water) Alan Marks	Burdekin Catchment, Queensland	Catchment monitoring, grazing condition assessment, GIS Atlas and assessment of suspended sediment output	Wet/dry season spectral library, using imagery for sampling strategies and field photos
	L1 b Radiance	Earth Observation Centre	Australia wide	Data acquisition, preprocessing, storage of AVHRR-NDVI and MODIS-NDVI for data assimilation with vegetation-atmospheric models	
Ocean	Radiance product, Normalised Water Leaving Radiance Product, Geophysical Products.	CSIRO(Land and Water) Arnold Dekker, CSIRO(Marine Research) Ian Barton	Queensland sites (Fitzroy River Estuary, Mossman-Daintree Regions, Moreton Bay) and selected other sites in Australia	Mapping of reflectance (R0-) and concentration of organic and inorganic constituents of the water column (water quality parameter)	* 14 field campaigns, mainly Queensland (Fitzroy, Mossman, Daintree, Moreton Bay), field radiance measurements, to quality assure and validate to own field data, high amount of reflectance spectra collected with water quality data. * Validation of full image processing chain. * Now part of GBRMPA Chl/TSM monitoring in coop. with AIMS/new Reef CRC, Cruises for validation over 3 y period.
		AIMS (Miles Furnas)	GBR	Chlorophyll, TSM in seawaters - use in biological and physical oceanographic work in nothern Australian waters.	Validation exercise as part of ReefCRC Catchment to Reef program. Ongoing collaboration in sea-truthing validation excercises with CSIRO in GBR region and elsewhere to improve product.

Session 1 (9.30am – 11am)

1. Error Assessment & MODIS products/activities overview

- Types of error and published sources
- Positional/Geolocation Error
- Measurement error
- Radiometric and Atmospheric correction
- Processing Algorithms for biophysical properties
- Others?
- Validation Procedures?

Types of error in image data considered:

- Sensor foreoptics distortion
- Detector/digitization process
- Data transfer and storage
- Radiometric calibration
- Geometric calibration and correction
- Data quality assessment from solar/sensor geometry
- Multidate binning and compositing to produce cloud free images
- Atmospheric correction
- Derivation of biophysical product (e.g. concentrations)
- Derivation of thematic or empirical product (e.g. vegetation index and landcover)

The focus of the workshop was on procedures used to validate the last two products, i.e. comparison of field sampled "reference" values to image based estimates of biophysical parameters or thematic classification.
Careful distinction was made between field validation activities and the process of obtaining "match-ups" with field data corresponding to an image acquisition time. The latter approach was more common with Ocean products

It was recognized that a number of other error sources needed to be understood prior to designing field-sampling programs and validation.

Published sources of error are contained in the ATBD (Algorithm Theoretical Basis Document) for each MODIS product are available from
http://modis.gsfc.nasa.gov/data/algorithms.html
It was noted that these documents contain pre-launch information (1999) and that users are recommended to consult more recent and appropriate literature for review, such as reviews of specific products in discipline journals such as Remote Sensing of Environment.

Summary table 1 was completed from input provided by all participants. This table demonstrates activities underway on Land products within the Queensland State Government, but does not provide a complete listing of CSIRO activities

with Land Products. The use of Ocean Products was dominated by A.Dekker's group at CSIRO in association with AIMS and the Queensland EPA.

The majority of land product users were focused on a vegetation index product being used in a multidate sequence to assess change in an environmental indicator (biomass, vegetation or bare ground cover) or establish cropping types for land-use mapping. Very limited field validation had been carried out on these products. In contrast, an extensive national field sampling program had been undertaken by A.Dekker;s group in CSIRO Land and Water, to develop and validate algorithms for mapping concentration of organic and inorganic material.

2. Land products + current approaches to error assessment

- Radiance products
- Spectral vegetation index products
- Land cover products

(Atmospheric products – e.g. aerosol optical thickness)

- Published validation procedures?
- Procedures used by workshop attendees

Refer to table 1

3. Ocean products + current approaches to error assessment

- Radiance products
- Standard products
- Published validation procedures?
- Procedures used by workshop attendees

Refer to Table 1

Session 2 (11am – 12pm, 1pm – 2pm)

4. Standard "MODIS science team" approaches to error assessment - Discussion of published science team approaches – see attached document.

This session proceeded through a review of standard approach as applied and published by MODLAND (MODIS Land Product Science validation team) for validation.

The approach presented was:

Field survey design (location of sites, sampling scheme, measurement scheme)

Field survey

Processing and analysis of field survey

Acquisition of high spatial resolution images

Processing of high spatial resolution images to map of relevant biophysical variable or thematic map accuracy.

Development of an integrated field/image technique

Validation of MODIS product

Discussion then proceeded around the validation activities completed by each group in attendance. The main points of these are presented in Table 1.

The most extensive validation programs had been implemented by CSIRO Land and Water for validation of MODIS Ocean products and development of new image processing models. These programs had focused on Moreton Bay, Fitzroy River Estuary and the Mossman-Daintree region.
Natasha Cronin's (Queensland NRM&E) presentation provided a detailed description of past and planned validation being undertaken for bare ground / cover mapping around the Charters Towers area

The status of existing or planned field validation:
EPA – ongoing work in Mossman/Daintree with CSIRO Land and Water, along with development of statistically based error assessment approach with K.Mengerson at QUT
NRME– N.Cronin's work continuing with future field assessment as per stratified sampling scheme presented at the workshop. QLUMP project will use multi-date

MODIS for land-use mapping and check with existing DPI&F field data and higher resolution image data where possible.
UQ - Planned CRC Rainforest validation from higher spatial resolution Landsat and Quickbird/Ikonos data to be completed with CSIRO Land and Water (C.Ticehurst) later in 2005.
CSIRO – Ocean Products, ongoing work in Mossman/Daintree and CRC Coastal work in Fitzroy Estuary to completed in 2005. New projects with AIMS to validate GBR Lagoon water quality parameters and as part of the Reef Water Quality Protection Plan from2005.
Vegetation Indices – part of the CRC Rainforest project and also the EOC AVHRR/MODIS NDVI time series product.
Other Land Products - fire and others?

Key Points of Session :

- Error assessment approach and extent is predominantly controlled by logistics and available funding. Sampling design is conducted around these parameters and access to sample sites for ground sites, while ocean/coastal sites focus on coverage across a large area.
- All approaches implemented to date have been field based, no scaling up of image data.

5. Alternative error assessment procedures?

- Design of field data collections program
- Spatial sampling design (layout, sample area, replication)
- Need for statistical power analysis in design

Attendees were directed to the attached summary of proposed multi-scale image and field validation to be used in the wet-tropics bioregion as a basis for discussion.

Statistical advice on how to move forward was discussed with P.Kuhnert and S. Low-Choy. This covered basic sampling designs along a continuum from systematic to random, and identified the required data/logistics to implement each of these, along with their statistical robustness and ease of implementation.

A recurrent point in this discussion was the forthcoming doctoral dissertation of Robert Denham, currently with C.Witte's group at Queensland NRM&E, and supervised by K. Mengerson (QUT). Robert's thesis and its focus on error assessment approaches and scaling up from field to image data scales was identified as of significant interest to guiding validation activities within the workshop attendees and the Australian/International remote sensing community. S.Phinn will approach Robert to arrange a seminar at UQ on completion of his work and to determine how to most effectively disseminate the results from his work to the MODIS validation community.

Session 3 (2pm – 4pm)

6. Design of a suitable error assessment program and funding

No comment

7. Plans for future data collection, project collaboration and information sharing

Covered through workshop and informal contacts links made between attendees.

8. Summary wrap-up and indication of plans for collaboration in field activities and/or in seeking funds.

S.Phinn will determine the status of existing MODIS working group at CSIRO/BoM and report to workshop participants.

CSIRO EOC will be meeting in Hobart on mar 8-10, A.Dekker noted that all workshop attendees are welcome as this meeting would cover a range of MODIS applications.

A. Dekker requested all personnel to identify if regularly update mosaics would be used in their activities and if so to please send him an email requesting access to CSIRO archive. S. Phinn to draft a letter to A. Dekker on behalf of the workshop outlining critical need for access to local to national mosaic.

No joint projects were established due to early stage of projects, but the group is now aware of who is doing what and how to integrate if needed.

Attendance List:

Stuart Phinn	UQ	s.phinn@uq.edu.au
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Unable to attend:
USQ
A. Apan

EPA/CSIRO
A.Stephens

CSIRO
B. Harch
D.Barrett
C. Ticehurst
V.Brando
P.Dyce

DPI&F
A. Pottgeiter
R. Karfs

AIMS
W. Skirving
M. Furnas