

INSTRUMENTATION WORKSHOP

Thurs 30 March

Present: Brian Markham (NASA Goddard), Gary Bastin (works with Vanessa Chewings DWE Alice Springs), Bruce Forgan (BoM Melbourne), Ian Grant (CAR Melbourne), Alan Marks (CLW Canberra), Jim Gardener (National Measurement Lab Sydney), Peter Nevotny (BoM Melbourne), Susan Campbell, Dean Graetz, Jenny Lovell (EOC Canberra), Guy Byrne, Paul Daniel (CLW Canberra), Peter Mason, Kai Yang (MMTG Sydney), Nicole Pinnel (CLW Canberra), Lisa from Griffith, Cindy (MMTG Perth), Mike Cachetta (programming, MMTG Perth), Luigi Ransoula (CMIS Perth), Rob Hewson (MMTG Perth), David Parkin, David Jupp (EOC), Jon Huntington (MMTG Sydney), Tim McVicar, Tom ? , Iain Hume (CLW Canberra).

David J: General Intro. (overheads on web later) Landsat data for Uardry ...time series data now available.

[Note: Oxygen -a @ ~760nm ...to examine again.]

Rob Hewson (WA Blue Team): thermal spectral data. clay spectra comparisons, veg spectra dry vs. ~lush. Rob uses a brass plate for thermal calibration ...similar to spectralon in the hyperspectral range. Green grass has more of a black body appearance/response.

Ian Hume (CLW Blue team): main objective ground spectra of pifs. Bright and dark targets. Unispec and GER. Dark Targets were generally lakes and water features. 1-1.5% differences between the unispec and the GER when convolved to Landsat bands. There are may be steady increases in radiance values derived from calibration targets over time. This highlights the need to take calibration readings frequently.

Guy Byrne (CLW Red Team): cross calibration between sensors. Quality assessment . Instruments Licor, GER 3700 (EOC), ASD-FR (EOC), ASD-FR (CLW), Licor weather station. Declination readings from the principal plane achieved with the ASD, ...5, 10, 15 degrees.

Dean Graetz (EOC ANU Team): convert AVHRR image to surface reflectance. Explore atmospheric correction to TOA (Total Above Atmos) values, 4km pixels. Emphasis is towards deriving reflectance rather than radiance. Much achieve +-5% calibration accuracy dictated by the AVHRR sensor. Intercalibration comparison is good between sensors (Exotech). VGT = SPOT vegetation instrument. Land site was extremely well mixed. Land was very dark due to unusually high water content.

Bruce Forgan & Peter Nevotny (ABOM Team): ASR (Absolute Spectra Radiometer ...1.2 - 1.8nm sampling) Spectra obtained. Aureole channel = 5 deg around the sun measured, Direct Channel = direct at the sun, Diffuse also measured. Langley analysis for upper atmos measurements ...to measure optical depth. Diffuse irradiance by shaded pyranometer. Pyrgeometer long wave instrument.

Ian Grant (CAR Team): Yankee = optical head had diffuser with 7 diodes with cosine functions, measures global irradiance, shading band swings across for diffuse

measurements (incl measurement immediately adjacent to the direct measurements. Aerosol and optical depth measurements, plus water vapour absorption, direct, diffuse, and global measurements. Diffuse difference of approx 25%, which indicates that errors may not all be attributed to levelling of the instrument. Diffuse to direct radiation out by about 25%. *Additional comments:* CIMEL will measure the sky radiance over a different derived range of measures, both give info on atmos transmission, O₃ water vapor, gases, optical depth, angstrom component, total water column water vapor, phase function complexities ...all inputs to atmospheric models ...automated instrumentation, issues of sensor drift over the years of deployment in the field. CSIRO has access to 4 shadowbands (Hay and Thangoo ...etc.)

Lunch

Brian Markham: "Landsat7 ETM+ Radiometric Calibration/Characterization -March 2000 update".

On-orbit characterisation, onboard radiometric calibration, sensor instrumentation. 7 band (incl thermal band 10.4 - 12.5um) plus 15m PAN, ...8bit instrument. Dark current measurement at the end of every scan. Bidirectional scanner, ...forward and back ...calibration effects appeared in Landsat5 data. Sioux Falls facilities used for image processing Landsat7 data. Internal calibrator, full aperture solar calibrator, pin-hole aperture calibrator. BRDF and reflectance measures of the calibration panels. Icing problems on calibration equipment are not as severe on Landsat7 esp in band 4 & 5. *Additional comments:* Luna and search light calibrations may not be 'targeted' for future Landsats, however opportunistic acquisitions may be an future option against EO-1.

Jim Gardner: (CSIRO National Measurement Lab) "Spectral Calibration 250-2500nm".

Use of both a reference and a test detector/sensor system thru a narrow monochrometer (2 - 4nm). Si trap detectors, Bolometer (blue/UV). Spectral responsivity, spectral irradiance, spectral radiance, measures against international standards. Second order effects, background light are problems for optical systems rather than electronic effects. New light sources esp for in water-type calibrations. InGaAs (indium gallium arsenide , \$US1000@ detector), Si, Ge (germanium), doped silicon detectors still become extremely temperature effected around 1100nm. Beware of OH in glass and in air between detector and source in SWIR. Spectralon and Ultralon (both tephlon in a "binder") ..IR vers of ultralon and spectralon, esp at 2.um problems arrive. Matt white paint (cf. Acrylic vs oil-based) and be used as a simple substitute. Applied Optics Journal via a NASA Goddard author, published "the correct way to clean spectralon panels". Look for 2nd order effects that may resemble light source effects.

Bruce Forgan: "What is BSRN?"

BSRN = Baseline Surface Radiation Network

Looking at the diffuse component of the rereflected irradiance back into the detector. Different time constants (responses) between instruments. BSRN looked at different sampling intervals ...1sec ...5-6secs sampling. Best for network to use 1sec sampling to avoid error. Comparing instrument sampling cf. actual. Precision vs accuracy issues, linked with uncertainty. AOD = aerosol optical depth (eg. 0.0 - 0.05 values).

Peter Nevotny:

Normally \$360 per sensor to be calibrated, but to CSIRO it may be free (...although not silicon detectors). Calibration using real sun source can be carried out during summer. Licor is Si based, but instruments can be used to transcalibrated against a calibrated sensor.

Afternoon Tea

David Jupp: "Outline of Field Data Types"

Atmospheric Profiles (sonde data), Weather station (Q=solar radiation, RH, Ta, V), spectral irradiance (diffuse & direct), target reflectance (pif's), site Characterisation & environmental data. Radiosonde data (UAS=Upper Air Statistics): Upper Air Statistics (excellent ref = Maher & Lee, 1976). Diffuse to total ratio. Irradiance measures. Aerosols (turbid atmospheres). Adjacency effect ...contributions from 100m radius at aircraft height. Idea to take calibration background radiance measure by sampling horizontally (radially) in 360deg's. Reminder to check out Ozone absorption at ~600nm. Path radiance ...sun ...atmos ...sensor (R & M scattering).

Fri 31 March

Ray Merton, Alex Held, & Jill Huntington: overview of preflight planning, costings, project management, field procedures, final output products. How the instrumentation feeds into the data acquisition chain from the Hyperspectral Task perspective.

Daul Daniel: Instrument maintenance, protocols, future direction.

General comments

David Jupp: CalVal = "artificial" ...redundant measures, multiple data takes.

"Minimax" Mission = least cost to get maximum returns (what you need). Therefore "Minimax Field Work"and "Minimax Validation".

Recommendation: small group of people to do a calibration exercise to come up with a written vers of calibration.

People: Paul Daniel (leader), Ian Grant, Tiit Kutzer, Ray Merton, Rob Hewson.

Proposal: Site visits to Melbourne (CAR, ABoM), Canberra (2days at EOC), [Hobart], Sydney (Jim G.), [Perth].

Purpose: Field equipment inventory, maintenance/care, use/operation in field. Protocols and procedures. Maintenance procedures including calibration. Look at existing documents and protocols.

Recommendations: Equipment, engineering, future, training.

Time: by end of May

Peter Nevotny:

Table of Contents Discussions

BOM TQM Manual

"Table of Contents" (~recommended draft structure):

- Basis of the quality system management
- Description of testing environment (eg sea land etc), range of testing environ's
- Staff Structure and responsibility
- Quality system management
- Lab equipment quality assurance programme

- Test Item management
- Test methods
- Test records
- Test reports ...www-based and text
- Staff Training and development
- OH&S
- Charging Policy
- References

Group Discussions about instruments and direction of Working Group:

Irradiance instruments

- Pyranometer
- MMFRS
- Licor
- ASD/GER
- Weather stations
- Exotech
- Barnes MMR
- CIMEL

Reflectance/Emissivity

- ASD
- GER
- Unispec
- CDI
- Spectron (SE590)
- CAR OceanOptics
- PIMA
- IRIS
- Zeiss
- Exotech
- Barnes MMR
- Micro FTIR

Reflectance Standards (Panels)

- Spectralon
- Ultralon
- Field panels
- Brass plate (emissivity std).
- Portable/field pifs
- Materials etc (refer Jim)

Lamps

- Absolutely calib lamps
- Stable lamps
- Emission lamp
- Laser pointers
- Monochrometer

Wavelength Calibration

- Schott glass filters
- Mylar
- Polystyrene (field std.)
- Rare earth filters (dydinium filterVIS/NIR)
- Topaz

Ancillary data

- Weatherstation
- GPS
- Radiosonde
- Hydrosat
- AC9

Misc comments for the above instruments:

- Overview of what each instrument does ...1 para description
- Suggested improvements.
- Traps, solutions, hints
- Data logger
- List of manuals, key references, www sites for manufacturer
- Maintenance and calibration history
- Person responsible to maintain and how to use it.