but not very distant...

Recent developments in remote sensing at the Tumbarumba flux station

Tumbarumba
Hyper
sp**E**ctral
Monitoring
System

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What THEMS does

- Observes the forest from the top of a 70 m tower at visible & infrared wavelengths:
  - 300 .. 1100 nm
  - 4 .. 8 um

- At (usually) five Sun synchronous ‘reference’ times:
  - Sun rise & sunset
  - Solar noon
  - A fixed solar elevation angle that occurs every day

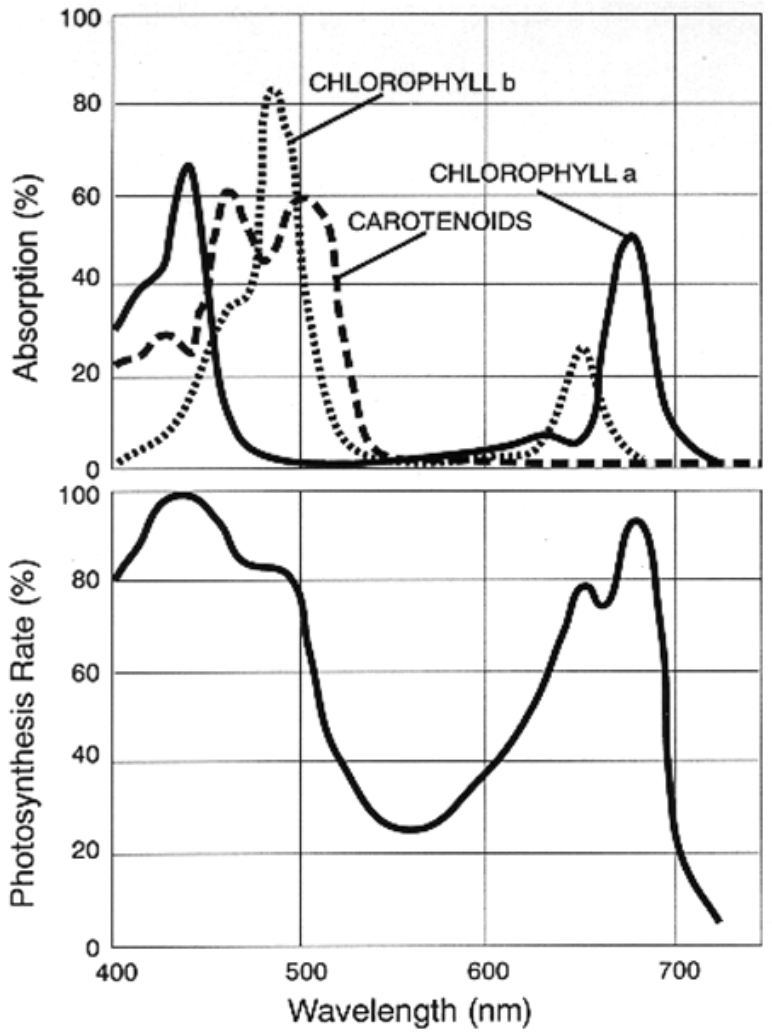
- With optional hourly measurements.

Why might THEMS be useful?

- THEMS spectral response covers interesting range of Photosynthetic Active Radiation

- Collects images, not just point measurements

- High spatial & temporal resolution; individual tree crowns and branches visible in image



http://www.life.uiuc.edu/govindjee/paper/gov.htm

THEMS hardware

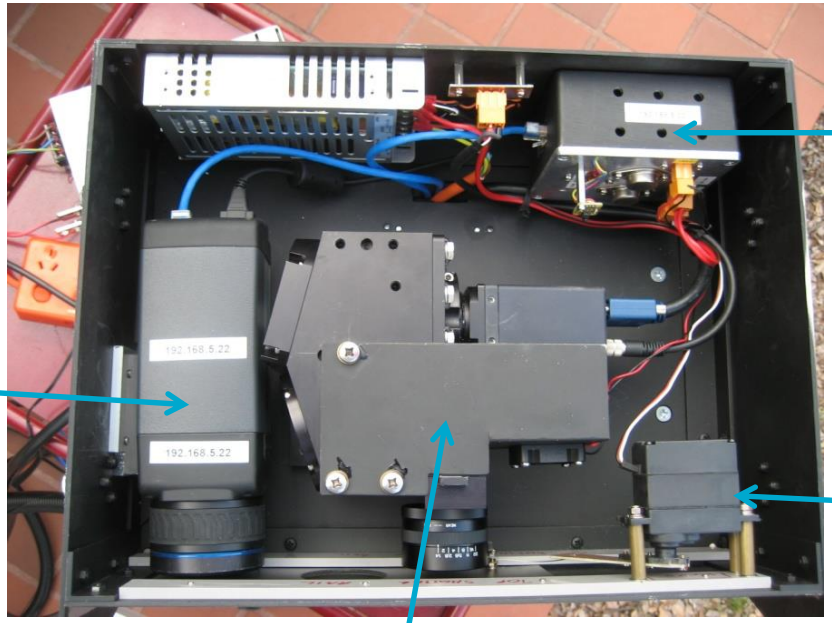
•The hardware is a Headwall Photonics Inc. hyperspectral line scanner and a FLIR Inc. thermal imaging camera.

•Both instruments are mounted in a weather proof box on a ‘pan-tilt’ unit which can move in both azimuth and elevation.

•Solar irradiance is measured with a Ocean Optics USB2000 spectrometer. (2048 wavebands)

•Support PC, shutter system, power supply etc.

Inside the box



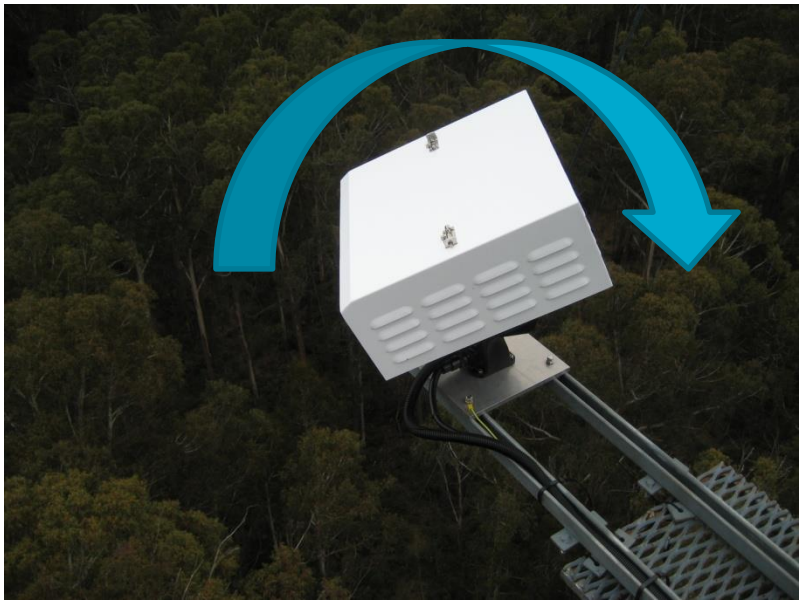
Support electronics & Arduino processor

Thermal camera 480 x 640 pixel images

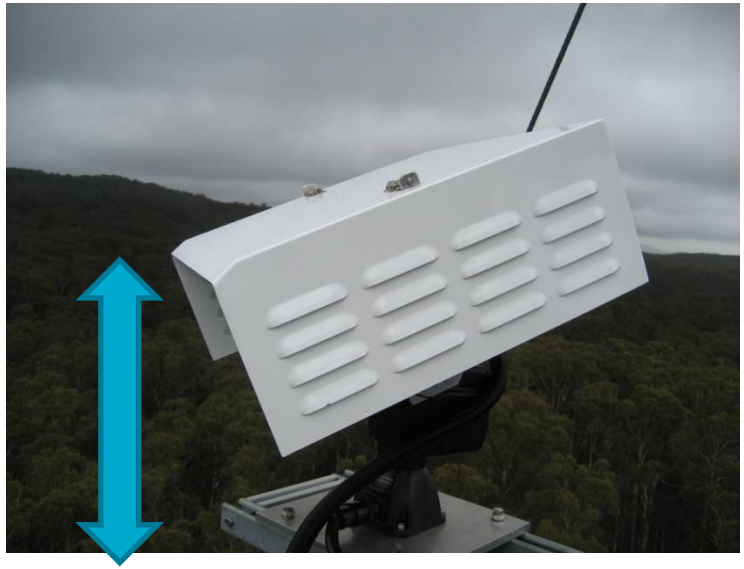
Shutter motor

Hyperspectral line scanner: 25 um slit, 1004 pixels x 1004 wavebands

On the tower



Cameras can move anywhere within +/- 160 degree azimuth +10/-80 degree elevation range.



White box is a radiation shield to minimise heat input from the sun. Unit is mounted on rails for ease of access. PC etc. is mounted in another box nearby on the tower.

Data – visible light range

- Still images covering all visible or selected wavelengths, 0.7 nm wide wavebands

- Movies in ‘wavelength space’ or time lapse i.e. can view the image as a movie sequence

- Calculate various useful ‘indices’ e.g. NDVI

- Image size 1004 x 9000 (or more) pixels with 1004 wavebands. Generate arrays of reflectance etc.

Pretty pictures!

Grey scale image (240 degree azimuth scan)

Same view as NDVI image (Rnir-Rvis)/(Rnir+Rvis)

Another view... a wavelength ‘lapse’ movie

- Each waveband is extracted from the input file, reflectance calculated and an image created.

- Image is a bit dim and scratchy as there is very little energy in each waveband.

- Recent adjustments to aperture and focus should fix problem... run movie

Issues so far

- Getting optical configuration correct:
  - Aperture, focus & instrument calibration

- Data handling:
  - THEMS can generate a *very large* amount of data; over 300 Gbyte/day... Each HS image is a 9 Gbyte 'data cube'
  - Needs careful selection of scan angles, number of acquisitions etc.
  - Consideration of data compression and methods of storage/transport/transmission/processing

It’s work in progress

- Automate/speed-up image analysis
- Decide what information and presentation format is useful
- Link image data (reflectance, NDVI etc.) with acquired fluxes?
- Comparison with other remotely sensed data – satellite?
- Analysis of IR imagery

Acknowledgements

- Eva Van Gorsel: project leadership and coming up with the idea

- Steve Zegelin: assistance with data processing, data handling and installation

- Tom Hartley: assistance with site installation

Thanks for listening

Questions?

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