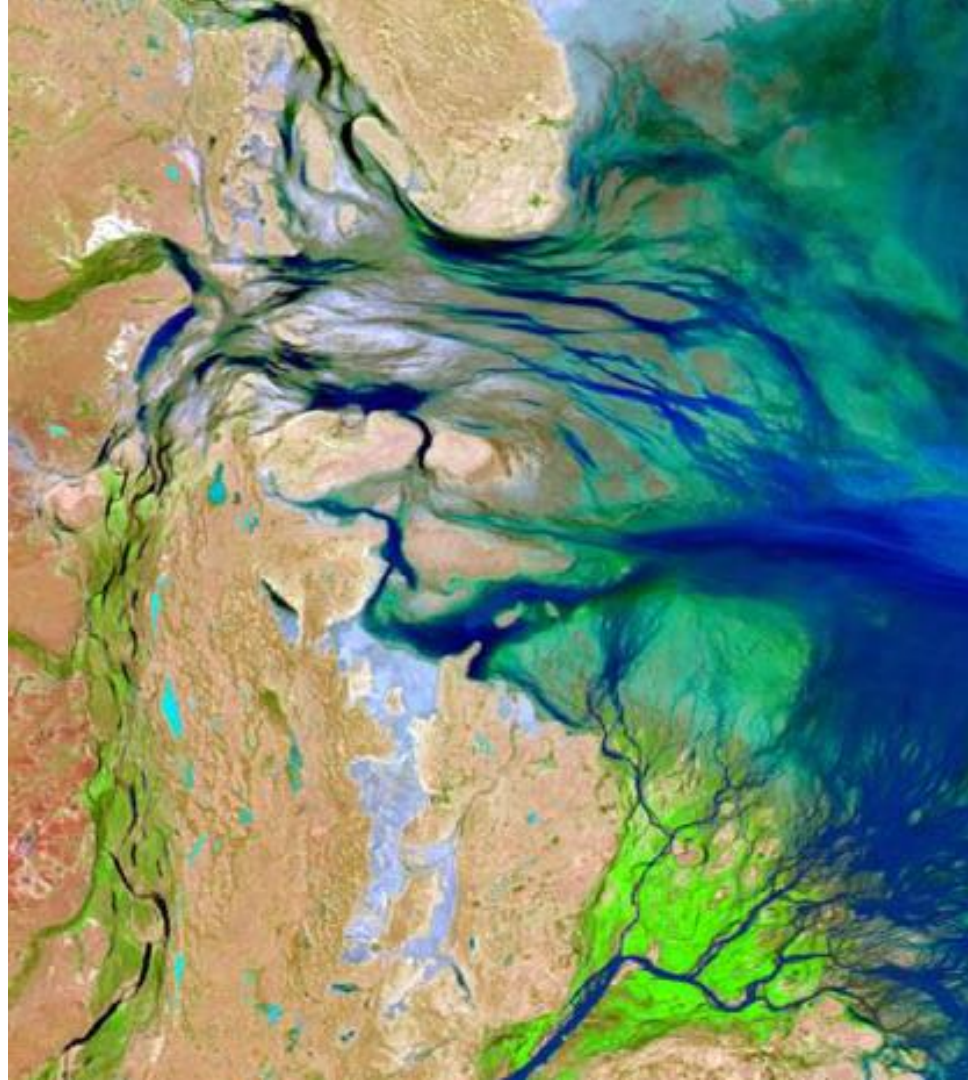# Remote sensing for landscape and water management
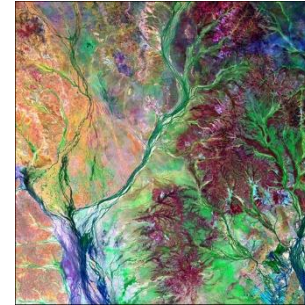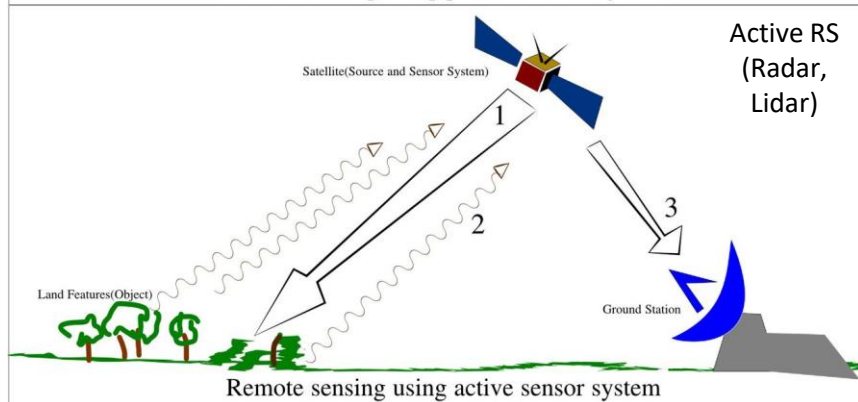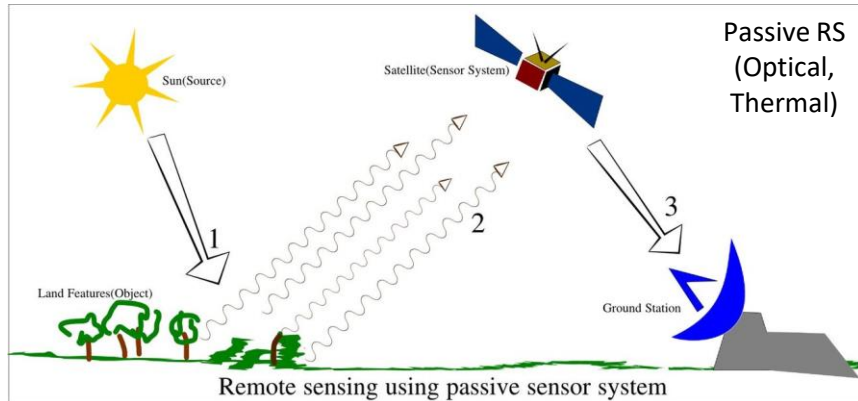
Tim Malthus | CSIRO Oceans and Atmosphere | 2020-05-28
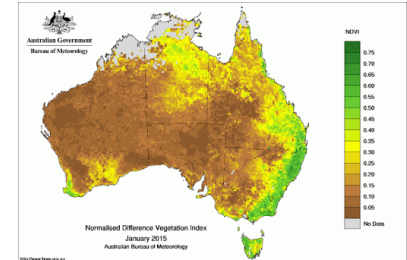
Australia's National Science Agency

Introduction to remote sensing (in 1 slide...)

Remote sensing using passive sensor system

Passive RS (Optical, Thermal)

Remote sensing using active sensor system

Active RS (Radar, Lidar)

Landsat scene

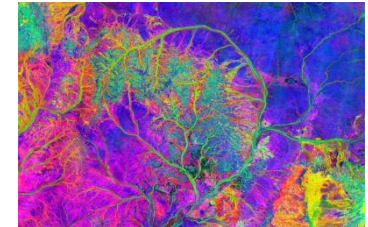Exploits spectral signature
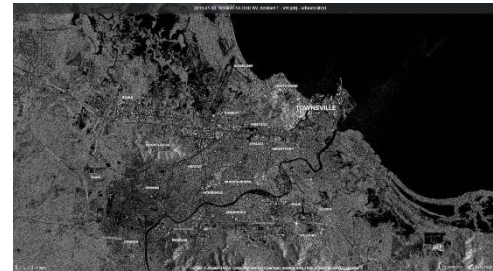
NDVI composite

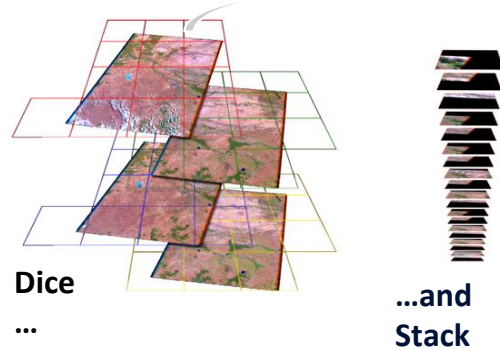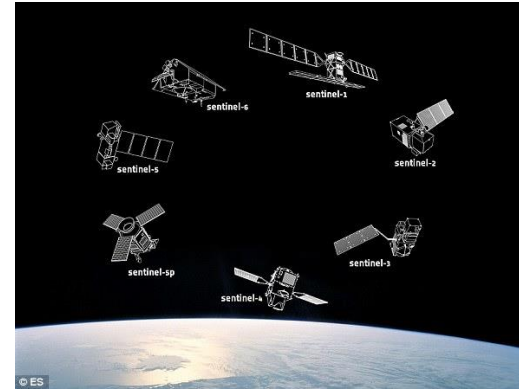Sentinel-1 scene

Exploits structural or moisture properties

Sentinel-1/2 composite

Disruptions in Earth observation

- Sustained observations
- Analysis ready data
- Data cubes
- Discoverability
- Low-cost customised micro satellites
- Automated processing
- **Lower barriers to entry**

Dice
…

…and Stack

Sensors

Active:

Passive:

Sentinel-1 (2015)

Radar imaging offers weather independence, structure, water delineation

GEDI – Forest Canopy Profile and Waveforms
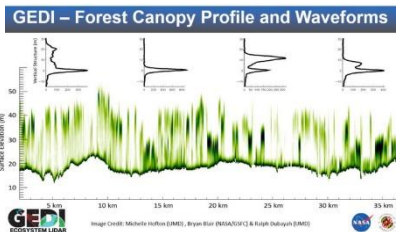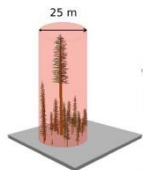
Lidar offers 3D structure, fine scale

Himawari-8 (2014)

Geostationary offers high temporal resolution, dynamic processses

Prisma (2019)

Hyperspectral offers improved parameters and reduced uncertainties

Algal bloom detection and visualization

Workflow

Lake Hume, time series, January to March 2016

Processing

Visualization

Malthus et al. (2019) Remote Sensing, 11:2954

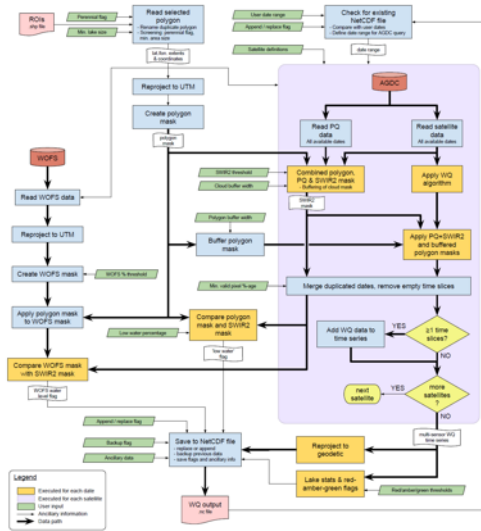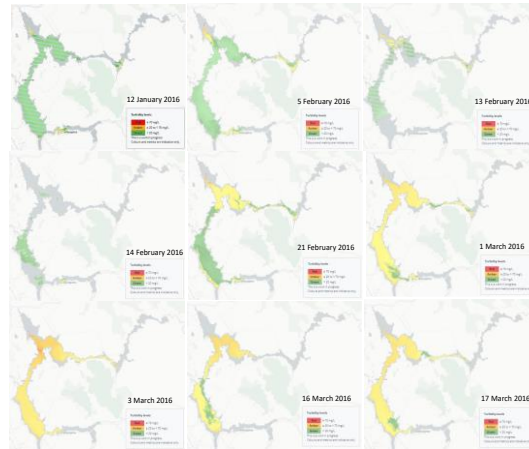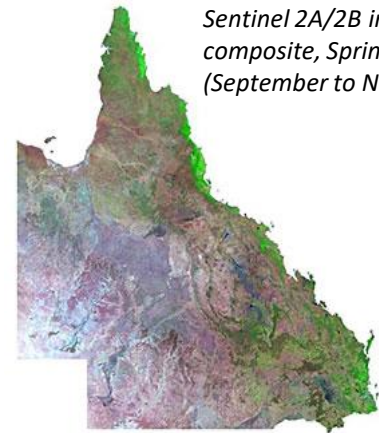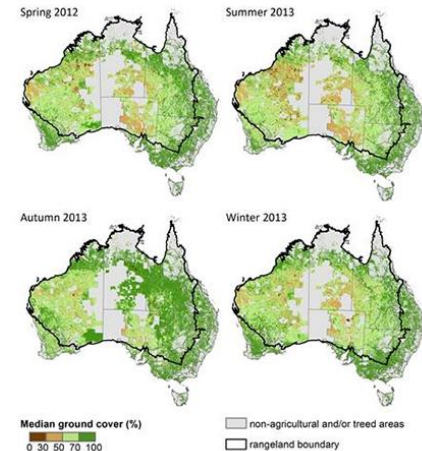# Sources of data and products

Sentinel 2A/2B image composite, Spring 2017 (September to November).

- **Copernicus Regional Hub** – Source of Sentinel ARD data
- **Geoscience Australia** – DEA, WoFS, fire/flood related products…
- **DNRME, QLD Govt** – remotely sensed imagery, lidar, photography, floods
- **DES, QLD Govt** – Ground cover, land use, vegetation change, structure
- **The Long Paddock** – Met data and forecasts, fires, SST…
- **BoM** – Reef temp, eReefs marine water quality dashboard…
- **TERN** – Land cover dynamics, vegetation structure, fire related
- **IMOS** – SST, Ocean colour, altimetry, surface waves…
- **CSIRO** – NovaSAR data

Fractional cover dynamics, MODIS

Remote sensing and modelling

Remote Sensing	Models
Higher spatial and temporal coverage than in situ measurements	High spatial and temporal resolution
40+ year time series (hindcasting)	Tool for forecasting, scenario assessment
Surface view only, some structural info	3D structure
Cloud interference in optical, thermal	Cloud free, continuous
Large uncertainties	Uncertainties?
Satellite drifts, calibration for time series	Process understanding
Regional and temporal biases	

Data assimilation example - eReefs

Data assimilation system constrained using the mismatch between observed and simulated remote-sensing reflectance.
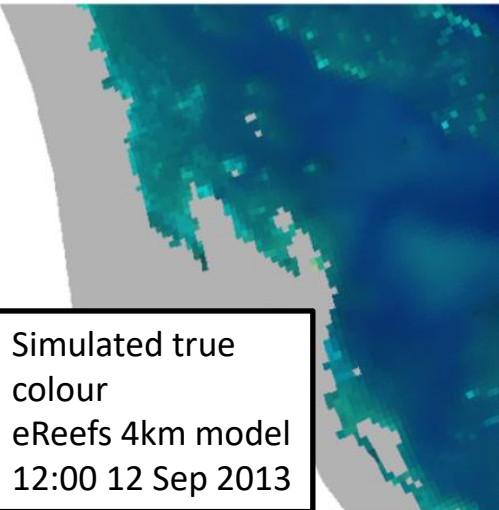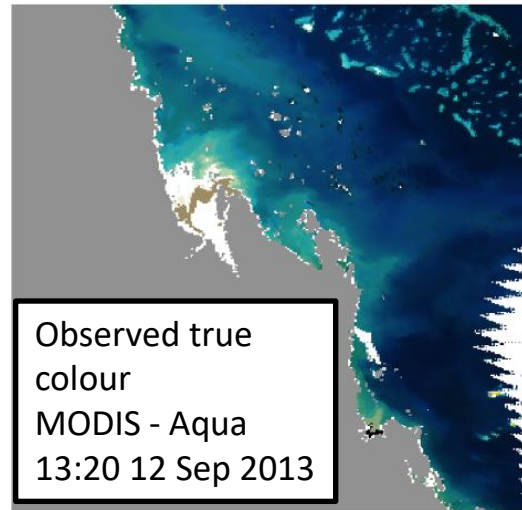
Use of remote-sensing reflectance to constrain a data assimilating marine biogeochemical model of the Great Barrier Reef
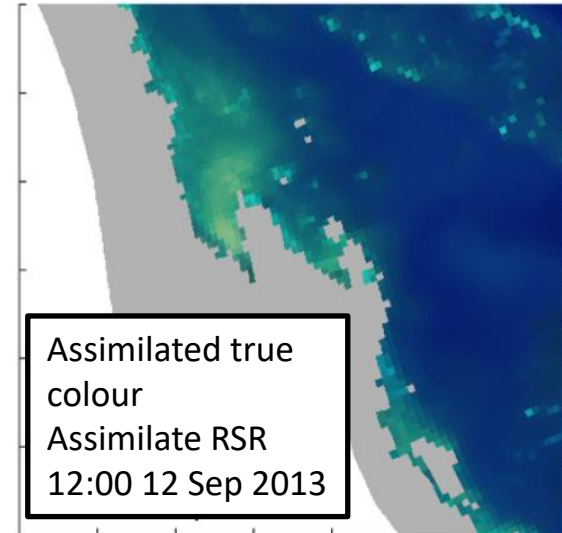
Emlyn M. Jones[1], Mark E. Baird[1], Mathieu Mongin[1], John Parslow[1], Jenny Skerratt[1], Jenny Lovell[1], Nugzar Margvelashvili[1], Richard J. Matear[1], Karen Wild-Allen[1], Barbara Robson[2], Farhan Rizwi[1], Peter Oke[1], Edward King[1], Thomas Schroeder[3], Andy Steven[3], and John Taylor[4]

Simulated true colour
eReefs 4km model
12:00 12 Sep 2013

+

Observed true colour
MODIS - Aqua
13:20 12 Sep 2013

=

Assimilated true colour
Assimilate RSR
12:00 12 Sep 2013

Remote sensing and modelling

- More sustained observations and lower barriers to entry
- An opportunity for greater synergy between RS and models
- Two way process – RS <-> Models
- Challenges need dialogue
  - Mis-match between model outputs and RS products
  - Each provides a different "measurement" inhibiting straightforward inter-comparisons
  - Uncertainties
  - Differences in terminology

- Both RS and modelling depend on in situ data

CSIRO

SMARTSAT
Cooperative Research Centre

In-Situ Sensor Pack

IoT-Sat

AquaSAT-2
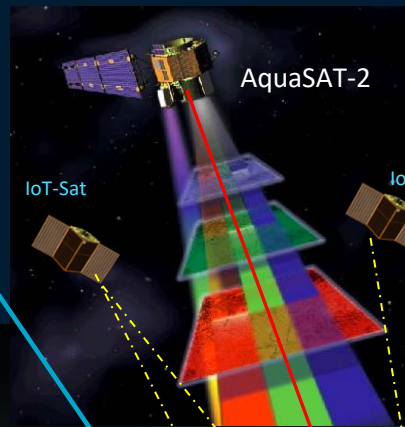
IoT-Sat   IoT-Sat   IoT-Sat   IoT-Sat

AquaSAT-1

AquaWatch
Data Integration
Facility

**AquaWatch Australia
Mission Concept**

Australia (& Global)

water monitoring system

- **Ground sensor networks + IoT**
- **New EO satellites**
- **Data integration**

Thank you

Oceans and Atmosphere
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Research Group Leader

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