FNQ Rainforest Supersite

How the Fluxes link to the other components.

Presentation by:
Associate Professor Mike Liddell
James Cook University
email: michael.liddell@jcu.edu.au
ph: 07 4042 1275

TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.
What is a Supersite?

- Intensive field station in a **typical and important biome**
- Building(s) and physical instrumentation.
- Scientists and technical support staff.
- Transect (ecological gradients/contrasts, 10km - 400km)

**Core activities**

- Ozflux system
- Plant physiological and soil measurements
- Long term vegetation monitoring
- Long term faunal monitoring
Australian Supersite Network

Aim of the Facility

- Establish a **nationally consistent** network of **Supersites**.
- Provide data streams with **high temporal/spatial resolution**.
- Provide a **comprehensive suite** of ecosystem measurements (vegetation dynamics/stocks, biodiversity, microclimate, fluxes, hydrology and biogeochemistry)
- Provide **process based information** on ecosystem function.
- Provide key data for **Scaling/Integration** and **Auscover**
- To serve **land managers, scientists** and inform the **public**
Key Ecosystem Questions being Addressed

**Question 1** What are the current stocks and fluxes of energy, carbon, water and nutrients between the terrestrial (and aquatic) ecosystem components and the atmosphere/hydrosphere/geosphere?

1a. response to management/disturbance/inter-annual variability?
1b. **key processes** that determine ecosystem/non-biosphere exchanges?
1c. key processes expected to respond to **future environmental change**
1d. **general trends** across the network?

**Question 2** What are the current patterns and dynamics of terrestrial biodiversity (and aquatic)?

2a. response to management/disturbance/inter-annual variability
2b. biodiversity response to future environmental change?
2c. **general patterns Δabundance/biodiversity** across the network?
FNQ Rainforest

Wet Tropical Rainforest
(Upland / Lowland)

Robson Creek / Daintree Rainforest
(base nodes)

Major clines in
Altitude
Rainfall
Temperature
Wet Tropical Rainforest
Robson Creek (Upland)
Daintree (Lowland)

Mike Liddell (JCU)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Role</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike Liddell</td>
<td>Fluxes, Micromet</td>
<td>Asso. Prof.</td>
<td>JCU</td>
</tr>
<tr>
<td>Steve Williams</td>
<td>CTBCC faunal transects</td>
<td>Prof., CTBCC</td>
<td>JCU</td>
</tr>
<tr>
<td>Michael Bird</td>
<td>Freshwater geochem</td>
<td>Prof, Fed. Fellow</td>
<td>JCU</td>
</tr>
<tr>
<td>Paul Nelson</td>
<td>Soils, Hydrology</td>
<td>Sen. Lect.</td>
<td>JCU</td>
</tr>
<tr>
<td>Marc Le Blanc</td>
<td>Hydrology</td>
<td>Sen. Lect.</td>
<td>JCU</td>
</tr>
<tr>
<td>Dan Metcalfe</td>
<td>Veg. survey, phenology</td>
<td>Senior Scientist</td>
<td>CSIRO Sust. Eco.</td>
</tr>
<tr>
<td>Dave Westcott</td>
<td>Avian monitoring</td>
<td>Senior Scientist</td>
<td>CSIRO Sust. Eco.</td>
</tr>
<tr>
<td>Roger Kitching</td>
<td>Invertebrate monitoring</td>
<td>Prof.</td>
<td>Griffith</td>
</tr>
<tr>
<td>Pete Green</td>
<td>Seedling dynamics</td>
<td>Lect.</td>
<td>La Trobe</td>
</tr>
<tr>
<td>Owen Atkin</td>
<td>Plant physiology</td>
<td>Prof.</td>
<td>ANU</td>
</tr>
<tr>
<td>Jorg Hacker</td>
<td>Airborne remote sensing</td>
<td>Prof.</td>
<td>Flinders Uni</td>
</tr>
</tbody>
</table>
The FNQ Rainforest Supersite will focus on **two representative transects** in the Wet Tropics rainforests. The transects span the **lowland** and **upland** rainforests. A **process based** understanding will be developed. These rainforests are recognised as a **major repository of Australian terrestrial biodiversity** and they are under threat from climate change. **Longevity** is required and a **MOU with WTMA/DERM** will ensure a route to this.
Key Research Questions

- How are the **biota** (esp. locally endemic species) changing in range and abundance (incl. plant community dynamics), and what are the drivers of change?
- What are the fundamental **vertical and lateral energy, carbon, water and nutrient stocks and flows** in the tropical forests of far north Queensland and are these stocks and flows likely to change significantly in the future?
DAINTREE RAINFOREST OBSERVATORY
Daintree Rainforest Observatory
Current Activities / Progress

- **Sub-project 1:** 1 Ha Census Plot. >10cm dbh. 2000 started, 3 census – last 2010.
- **Sub-project 2:** Canopy faunal abundance.
Daintree Rainforest
Carbon Fluxes and Drought

Flux Carbon Gap Filled ($\mu$mol m$^{-2}$s$^{-1}$)

Photosynthesis

DRO Daily Rainfall (mm)

Monthly Rainfall (mm) at the Cape Tribulation BOM station (data courtesy of BOM)
Daintree Rainforest

Fluxes: Plants

Average water balance components for Oliver Creek, Daintree Rainforest. Precipitation input pathways are shown in ellipses, evaporative losses are shown in rectangles and runoff/recharge losses are shown in hexagons. Percentages of gross precipitation are shown in brackets (McJannet, Wallace)
Flowering and fruiting phenological spectrum for 57 tree species at the DRO. C. Gross.

Temporal variation in the density of beetles (dark bars) and ants (light bars) extracted from monthly collections of leaf litter collected from the ground (5L).  *P. Grimbacher.*

Total leaf litter turnover is from 0.5 t/ha/mo dry season to 2.5 t/ha/mo wet season.
Daintree
Modelling – Climate Change

The potential C stock of rainforests in the Wet Tropics bioregion in the current climate and after 3 degrees of climate warming. The colour scaling is different between plots (a) 235-360 t C ha\(^{-1}\), (b) 193-324 t C ha\(^{-1}\) (Source: Hilbert 2010)

Season Rainfall changes (mm/day) from downscaled simulations from the Mk 3.5 GCM to 114km grid. (Source: Suppiah 2010)
Remote Sensing Links

Four Supersites have been nominally selected for Auscover Cal/Val work.
- FNQ Rainforest – Qld*
- Warra – Tas*
- Chowilla – SA*
- Great Western Woodlands – WA*

Hemispherical photos from DRO
a) February 1999 and b) November 2002 (Steve Turton)

Courtesy: Jason Beringer
Robson Creek

TERN-1

- **Sub-project 1**: Forest dynamics inventory plot. 25 Ha Census Plot (500m x 500m). >10cm dbh.
- **Sub-project 2**: Seedling dynamics transects.
- **Sub-project 3**: Insect biodiversity.
- **Sub-project 4**: Fauna transect biodiversity.
- **Sub-project 5**: Forest/atmosphere CO₂/H₂O/Energy exchange. Soil measurements. Microclimate.
Robson Creek: Current Activities

- 90 transects
- 7,319 seedlings tagged

Weatherstation (radius 10m)

90 transects
7,319 seedlings tagged
Robson Creek: Progress

TERN-1

- **Sub-project 1:** >10Ha surveyed, >6000 trees in 7Ha.
- **Sub-project 2:** 169 transects, >7000 seedlings
- **Sub-project 3:** >1600 moths, >250 morphospecies
- **Sub-project 4:** 3 transects, 200-300 vertebrates/site.
- **Sub-project 5:** Weatherstation, soilpit, bore installed

Robson Creek: Future

TERN-1/TERN-EIF

- **Sub-project 1:** Complete plot/Phenology/Avian.
- **Sub-project 2:** Complete seedling dynamics transects.
- **Sub-project 3:** Expand insect biodiversity surveys.
- **Sub-project 4:** Fauna biodiversity/new equipment.
- **Sub-project 5:** Complete flux tower.
- **Sub-project 6:** Freshwater water quality.