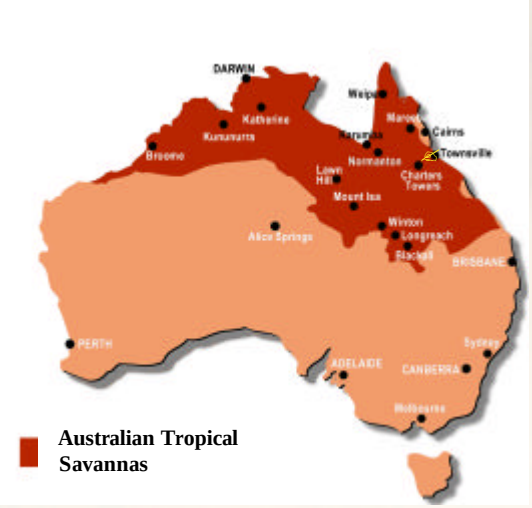
The Aims

To examine the impacts of carbon dioxide and climate change on tropical savannas, a new experimental facility (OZFACE) has been established with the following objectives:

- Determine the impacts of elevated CO_2 and altered climate on the ecosystem dynamics of tropical savannas; and
- Quantify the potential for vegetation management practices in the tropical savannas of Australia to sequester carbon to offset greenhouse gas emissions.



Outcomes

The study will provide a better understanding of the impact that climate change will have on savanna ecosystems. This will allow the industry and government to develop adaptation strategies and policies.

The Agencies and Personnel Involved

The study is a collaborative venture between Queensland Nickel Pty Ltd, James Cook University and CSIRO with support from the Australian Research Council, the Australian Greenhouse Office and the CRC for Tropical Savannas Management.

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Climate Change and Australia's Tropical Savannas:

impacts, adaptation and opportunities for carbon sequestration

OzFace:

Australian Savanna Free Air Carbon Dioxide Enrichment Experiment

A study aimed at determining the impacts of changing CO_2 levels on savanna ecosystems.

QNI YABULU REFINERY

JCU James Cook University

CSIRO

ARC Australian Research Council

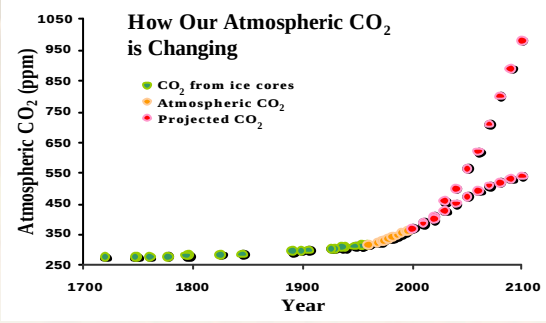
Greenhouse Office

Tropical Savannas CRC
Cooperative Research Centre for Tropical Savannas Management

The Issue: Our Changing Climate

Human activities have significantly altered the atmosphere over the last 200 years. The increase in greenhouse gas concentrations has already led to a warming of the earth (0.6ºC since 1900) and, as greenhouse gas concentrations are continuing to increase, the trend of warming will continue.

Other changes in climate, most importantly precipitation, are likely to be associated with this warming. Using the most recent scenarios available, carbon dioxide concentrations in the atmosphere will be between 525 and 705 ppm by 2070. Based on these emission scenarios, Australia is projected to warm by 1 to 6ºC by 2070. While there is a projected drying trend in winter and spring for southern Australia, the projections for summer rainfall for northern Australia represent either little change or a slight increase from current conditions (CSIRO 2001).



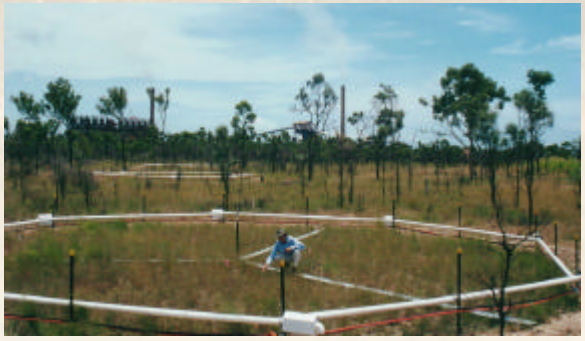
There is the potential for increases in atmospheric CO_2 and altered climate to significantly alter ecosystem dynamics in tropical savanna environments. What impact will climate change have on ecosystem productivity, plant species composition, pasture quality, soil water use and biodiversity? There are important implications for the grazing industry, which is the major user of tropical savannas, for water resources, for biodiversity, and for carbon sequestration. Tropical savannas currently account for 33% of the terrestrial carbon stores in Australia.

The Experiment

At the core of the study is a Free-Air Carbon dioxide Enrichment (**FACE**) experiment located in a coastal tropical savanna at Queensland Nickel Pty Ltd's Yabulu refinery site, 25 km north-west of Townsville.

What is a FACE system?

A FACE system is an open air system for increasing the CO_2 in an *unenclosed* natural environment. Most FACE experiments used large tanks of CO_2 that are regularly refilled from commercial suppliers, but in this study, gaseous CO_2 is pumped from the refinery via a pipeline to the experimental site.



Why do we need a FACE system?

A FACE system allows us to understand how real ecosystems are likely to respond to increases in atmospheric CO_2. We cannot create the complexity of soils, vegetation, carbon dynamics, microbes and insects in a glasshouse environment, where many climate change studies have been conducted. This FACE system is the first in Australia and the first in the world to be conducted in the tropical savannas.

The design

The FACE system consists of six rings, each 15 m in diameter. The vegetation enclosed by two rings is exposed to ambient CO_2 (370ppm), two rings are exposed to a CO_2 level of 460 ppm and the remaining two rings are exposed to CO_2 concentrations of 550ppm. Within these plot areas, one third of the area is left intact, one third is clipped to simulate grazing and one third has nutrients added to simulate higher fertility savanna locations. Local eucalypt and acacia seedlings have been planted to study woody-grass dynamics. This is a critical issue in savannas, in terms of current land management practices and the impacts of future climate. Plant and soil carbon is being measured to examine the interaction between rising CO_2 and the ability of these systems to store carbon.

Target CO_2 concentrations are achieved by controlling the amount and location of release of CO_2 from different parts of the ring according to the direction and velocity of the wind. Carbon dioxide usage is approximately 1.5 tonnes per day. The experiment is planned to run a minimum of five years – this time frame is necessary to detect changes in plant species composition and carbon dynamics.

While the FACE study will provide the necessary information on elevated CO_2 effects, a vital complementary component of the study is the use of ecosystem models to incorporate climate change projections of increased temperature and altered rainfall. The modelling approaches will also be used to extrapolate experimental results across the savanna regions of northern Australia.