

# Transforming Research in Ecosystem

Dr Peter Isaac<sup>1</sup>, Simon Yu<sup>2</sup>, Virginia Gutierre<sup>3</sup>, Calvin Chow<sup>4</sup>

<sup>1</sup>Monash University, Victoria, Australia, Peter.Isaac@monash.edu

<sup>2</sup>Monash University, Victoria, Australia, Xiaoming.Yu@monash.edu

<sup>3</sup>Monash University, Victoria, Australia, Virginia.Gutierre@monash.edu

<sup>4</sup>Monash University, Victoria, Australia, Calvin.Chow@monash.edu

## SUMMARY

Ecosystem research is about the Australian ecosystem dynamics: the role of Australian ecosystems in the cycling of water and carbon between biospheric and atmospheric stores and the response of these ecosystems to changes in these cycles. Effective research is hampered by the lack of coordination in data collection, archiving and quality control from measurement stations across remote Australia that has been implemented independently.

Underpinning this initiative was the need for a more collaborative research environment to address global climate challenges. This presentation will review the systems in place that will provide an integrated research data access and facilitate collaborative approach for researchers by addressing the following key principles:

- standardisation and automation of the data collection, archival and quality control of measurements from a network of measurement stations;
- integration of complementary data streams from different sources into a single data and metadata repository;
- facilitation of the linking the data into a common research data space, through the Australian Research Data Commons to encourage re-use of research data.

## CHALLENGES IN CLIMATE RESEARCH

Climate researchers establishing remote measurement stations to observe energy, carbon and water exchange measurements have historically tolerated a range of challenges. Some of the problems facing the researchers at these locations were isolation, equipment failure and systems unable to keep up with advances in the science.

The existing network of measurement stations has developed in isolation with other sites as individual researchers have been successful in obtaining grants from the ARC or funding from their parent institutions. Most of this funding has been short term and the development of the sites has been opportunistic resulting in sporadic coordination of effort across the various groups. This has led to individual Principle Investigators devising their own data collection, archiving and quality control techniques.

The disparate measuring systems in these ecosystem stations make it is difficult to synthesise data collected by the different groups. Typically, it may take months before the data collected can be analysed. A typical scenario would be for the scientist to be contacted to post a CD with CO<sub>2</sub> data from the savannah sites. As the measurement stations can produce data in various formats, significant effort in pre-processing on the files would be required to standardise into a Network Common Data Form (NetCDF) format before analysis could begin especially if comparisons are to be made between sites. This original system of physically collecting and posting data is all but obsolete.



**Figure 1: Monitoring Measurement Stations across Australia and New Zealand**

### **A COLLABORATIVE AND INTEGRATED APPROACH TO RESEARCH**

Scientists from Monash University's School of Geography and Environmental Science have overcome such diverse challenges and are now at the forefront of development of a coordinated network of measurement sites, known as 'OzFlux'. OzFlux is a \$2.3M initiative - part of the Terrestrial Ecosystem Research Network (TERN) - providing measurements of energy, carbon and water exchange between the Australian biosphere and the atmosphere above it.

The Monash researchers are also leading an important IT project that has standardised the data processing techniques used for OzFlux, resulting in improvements to final data quality and greater public accessibility to collected data.

Dr Peter Isaac and Associate Professor Jason Beringer have spent the last 12 months working in close collaboration with IT specialists from Monash University's eResearch Centre, the Australian National Data Service (ANDS), and in consultation with CSIRO Marine and Atmospheric Research, developing the data pathway and web-based data portal that would process, archive and deliver ecosystem data from up to 20 sites.

With the new system, the site scientist responsible for data collection and maintenance of the data remotely collects and processes the data and then uploads this to the central server for external users. The web portal has options to control user access rights, includes descriptive metadata information about precisely how the final data was collected and also lists all the associated research projects and national competitive grants of the site scientist.

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### Introduction

OzFlux is a national ecosystem research network consisting of 10 flux stations at present with a further 6 planned for installation in 2011, all funded under the TERN 1 initiative. Funding for 6 more sites has been requested under the TERN-EIF initiative. The final network of 21 sites will provide the Australian and global ecosystem modelling communities with nationally consistent observations of energy, carbon and water exchange between the atmosphere and key Australian ecosystems. OzFlux is part of an international network (FluxNet) of over 500 flux stations that is designed to provide continuous, long-term micrometeorological measurements to monitor the state of ecosystems globally.

A Central Node administered by CSIRO Marine and Atmospheric Research coordinates the OzFlux network, determines protocols for measurements, data processing and quality control, provides a database to archive data from each site and provides training to site operators as required. A 7 member Steering Committee chaired by Dr Helen Cleugh (CMAR) and Associate Professor Mike Liddell (James Cook University) provides scientific leadership for the network and coordinates logistics as required.



**Figure 2: OzFlux Site**

**REFERENCES**

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2. *Australian and New Zealand Flux Research and Monitoring - OzFlux*. Available from: <http://www.ozflux.org.au>, accessed 27 June 2011.

**ABOUT THE AUTHOR(S)**

Dr Peter Isaac (presenting) is part of the Monash Weather and Climate Group and School of Geography and Environmental Science, Faculty of Arts, Monash University. Peter specialises in micrometeorology and numerical modelling of land surface and his research interest is in climate science. Peter is interested in the detection of changes in the environment and vegetation and its influence on surface energy and trace gas exchanges and ecosystem processes - especially in Australia's Northern Territory, tropical savanna region. Dr Peter Isaac is a research fellow and lecturer at Monash University.

Simon Yu is a Senior Software Developer at Monash eResearch Centre since 2007. He is the lead developer for Ecosystem platform. Prior to that, he was the lead developer for the ARCHER project and a java developer on the Persistent Identifier Linking Infrastructure (PILIN) project. Simon has a Master of Technology (Internet and Web Computing) from RMIT University.

Virginia Gutierrez is Research Systems Facilitator at Monash eResearch Centre. She is the senior business analyst on the Ecosystem project and the other 7 ANDS Data Capture projects. Virginia has a honours degree in Software Engineering and Commerce from University of Melbourne.