



Semaphore

A tool for the (Semi-) automatic analysis of Australian ecosystem dynamics

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Automating the science of ecosystem modelling

One way scientists study natural ecosystems is by monitoring changes in the flow of nutrients in soil and vegetation. Modelling software uses empirical data as input to simulate changes in ecosystem nutrient dynamics and predict their effects.

Semaphore is a cloud-based solution that aids the automation of ecosystem predictive modelling. While primarily geared at the simulation of carbon and nutrient dynamics, it is a general purpose scientific workflow tool to automate data transformation, model execution and calibration.

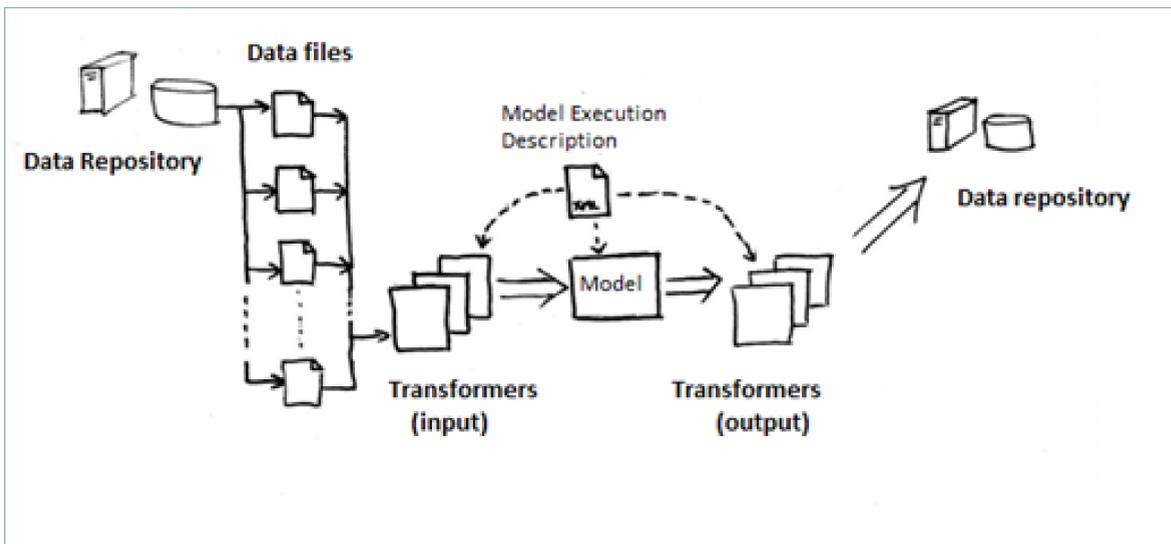
Semaphore will produce more accurate results, more efficiently by running simulations on the NeCTAR cloud. Based on the Kepler scientific workflow engine, it will provide the provenance information needed to trace and validate predictions and model calibrations.

Semaphore partners

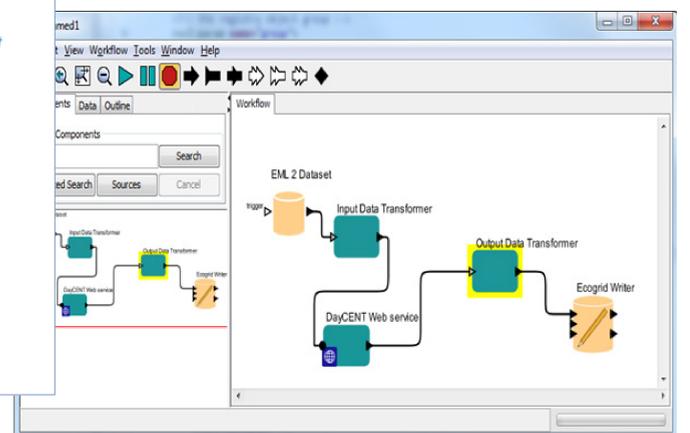
Semaphore is an extension of the work of the Carbon and Nutrient Dynamics in Australian Soils working group. The group seeks to aid environmental management decision and policy making in Australia by developing models calibrated to Australian conditions.

Semaphore will translate the models developed by the working group into scientific scripts that could be used and extended by the ecosystem modelling community in Australia. It could also serve as a standard for the publication and simulation of modelling data for carbon and nutrient dynamics.

Semaphore is a collaboration between the **Australian National Data Service**, the **Australian Centre for Ecological Analysis and Synthesis** and, **Queensland University of Technology**.



Kepler workflow for Semaphore data transformation using DayCENT



Semaphore architecture

Key Technologies

Kepler



Semaphore uses the Kepler scientific workflow software. Kepler provides a Java desktop application that allows the user to assemble workflows of processing units.

Century



The Century biogeochemistry model simulates carbon, nitrogen, phosphorus and sulfur dynamics in an ecosystem with a monthly time step through annual cycles to centuries and millennia.

DayCent is the daily time step version of Century.

Metacat



Metacat is a repository designed specifically for storing ecological research data. Data is stored in Ecological Metadata Language (EML) package.

NeCTAR



NeCTAR is the Australian Government project to develop digital research infrastructure. The final phase of the Semaphore project will see the complete workflow process run as on a NeCTAR cloud virtual lab.

Semaphore Features

Data preparation and storage

Semaphore uses reference data sets collected by the ACEAS Carbon and Nutrient Dynamics in Australian Soils working group. The data sets are stored on a Metacat repository in an EML package.

Workflow Scripts

The scientific workflows involved in performing the manual tasks of processing data and running modelling software were captured in a workflow script. Workflow scripts ensure that model runs can be reproduced easily and also capture provenance information sourced from the Data Management System sources. Semaphore uses the Kepler workflow software.

Transformation of data

Semaphore provides a tool for transforming research data from a variety of sources to a format appropriate for ecological modelling software. It also transforms output data so it can be analysed and used for further model calibration. The modelling software used in Semaphore are Century and DayCent.

Migration to the cloud

The goal for Semaphore is to provide a tool that is cloud capable with emerging NeCTAR Virtual Labs and processing capability.



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