apsimr: Extending Agriculture Simulator Capabilities with *R*

Bryan Stanfill[1] and Jody Biggs[2]

[1] CSIRO Computational Informatics, Dutton Park QLD Australia [2] CSIRO Ecosystem Sciences, Dutton Park QLD Australia

COMPUTATIONAL INFORMATICS
www.csiro.au

Introduction

The **A**gricultural **P**roduction **S**ystem s**IM**ulator (APSIM) is a widely used, powerful and highly complex computer program. Based on information about weather, soil properties, farming practices and land use, APSIM can predict crop and environmental outcomes such as yield, nitrogen runoff and sediment loss as a function of time and space.

APSIM is currently run either from a clunky and unappealing user interface (see Figure 1) that has limited analysis and visualization tools available or from the command line which requires a high level of familiarity with APSIM. The `apsimr` package includes functions to create, edit, run and analyze APSIM simulations easily using *R*.

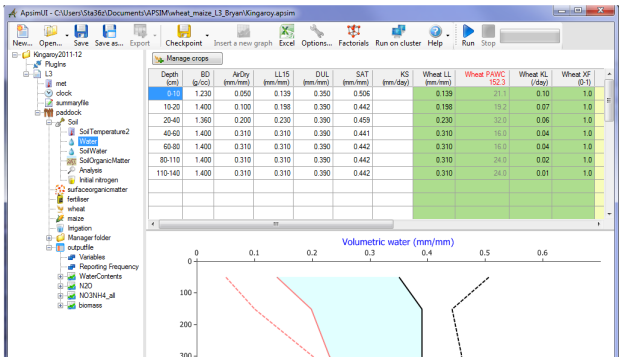

Figure 1: Existing APSIM user interface

The apsimr Package

Capabilities

- APSIM includes basic simulations to build upon, `example_apsim` copies those files into your working directory for modification and execution
- `edit_apsim` allows for easy manipulation of APSIM simulation files, a necessary function for fast and automated uncertainty/sensitivity analysis
- `apsim` runs multiple APSIM simulations and returns a list of data frames with class `"apsim"`
- APSIM returns `.out` files that are automatically read into *R* then cleaned before being returned by `apsim`
- *R* includes a plethora of data analysis and visualization tools that are not available in the APSIM UI
- Dates are parsed using **lubridate** for easy plotting and manipulation
- `plot.apsim` illustrates the results of an APSIM simulation à la `plot.lm` using **ggplot2**
- The user can cycle through plots by hitting `<Return>` or all response variables can be plotted simultaneously with `one_plot=TRUE`, see Figure 2

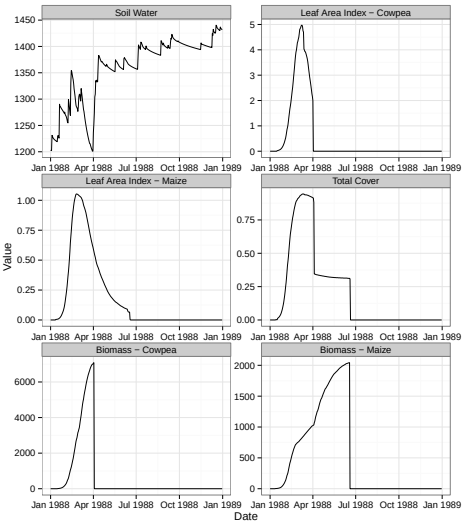

Figure 2: Example output of `plot.apsim` with `one_plot=TRUE`

Limitations

- Editing APSIM simulation and module files requires intimate knowledge of the structure and content of those files
- Running an APSIM simulation requires the explicit file path to the executable with little forgiveness for typos
- APSIM can take a long time to run but no speed-up capabilities are built into **apsimr** yet

Future Work

- APSIM is a deterministic and dynamic simulator which makes uncertainty quantification difficult
- Future versions of **apsimr** will include functions to quantify the uncertainty of APSIM simulations
- `plot.apsim` will then be extended to reflect the estimated uncertainty, see Figure 3

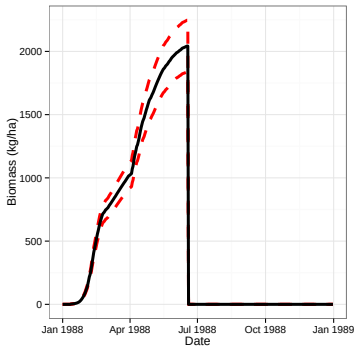

Figure 3: Estimated wheat biomass from 1988-1989 with uncertainty bounds

- Uncertainty analysis generally requires a large number of computer runs, updating **APSIMBatch** and linking it to **apsimr** could significantly decrease computing time

FOR FURTHER INFORMATION
Bryan Stanfill
t: +61 7 3833 5727
e: Bryan.Stanfill@csiro.au
w: www.csiro.au

ACKNOWLEDGEMENTS
This research is supported by the Science and Industry Endowment Fund

SCIENCE AND INDUSTRY ENDOWMENT FUND