The impact of assimilating satellite surface soil moisture data on modelled root zone soil moisture and ET over a six year period: Assessment across an in-situ soil moisture monitoring network in the Murray-Darling Basin, Australia

Robert Pipunic[1], Dongryeol Ryu[1], Jeffrey Walker[2]

[1]*Department of Infrastructure Engineering, The University of Melbourne, Parkville, Australia*

[2]*Department of Civil Engineering, Monash University, Clayton, Australia*

The importance of root zone soil moisture is recognised for its role in partitioning of rainfall between infiltration and run-off, drainage to groundwater, and as a water store accessible to plant roots contributing to evapotranspiration. Thus accurate predictions of moisture content over this zone will have enormous benefit for a range of land and water management practices including agriculture, flood forecasting and also weather forecasting. While this has been long known, it is still very difficult to consistently achieve desired accuracies (that will significantly improve decision making) with spatially distributed Land Surface Models (LSMs) run at <10km spatial resolution for regions, especially over the important deeper soil profile incorporating the root zone.

Data assimilation techniques have undergone much research in recent decades for improving LSM predictions of states such soil moisture. The proliferation of remotely sensed data provides instantaneous snap-shots of spatially distributed information at disparate yet relatively regular time intervals – well suited for combining with models via data assimilation. However, remotely sensed soil moisture products considered most reliable (from passive microwave sensing) are limited by a large spatial footprint (>10 km) and shallow measurement depth (top ~1-2cm of soil). Past studies have shown that assimilating surface soil moisture observations has the potential to improve root zone soil moisture predictions. Many of these have been idealised synthetic studies, though some recent studies have shown marginal improvements from assimilating real remotely sensed surface soil moisture data and further research is needed.

We present a study where a remotely sensed surface soil moisture data product was assimilated into the CABLE (CSIRO Atmosphere Biosphere Land Exchange) model

(Kowalczyk *et al*., 2006) and assess whether root zone soil moisture predictions are improved as a consequence. CABLE was developed by the CSIRO (Commonwealth Scientific and Industry Research Organisation) in Australia and implementing it in Australia's climate and weather simulation system is planned.

Our focus is a 100km x 100km region dominated by agriculture in the south eastern Murray Darling Basin, Australia, within which a network of 13 in-situ monitoring stations are measuring soil moisture content down to a depth of 90cm at 30 minute intervals. A six year simulation was performed here at 5km resolution and 30 minute time steps using locally measured meteorological forcing. The 25km scale AMSRE remotely sensed surface soil moisture product (Owe *et al*., 2008), representing the top ~1-2cm of soil, was assimilated once per day (where available) into the top soil layer of CABLE (2.2cm thick). Using data from the 13 validation sites, statistical analyses were applied to test for significant improvements to model predicted quantities of soil moisture over the deeper root zone. Assessment of predicted evaporative fluxes for a ~18 month period will also be assessed at two locations where eddy covariance instruments were operating. The impact of different spatial scales between model resolution and the AMSRE product on soil moisture was also analysed.