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# Catchment scale near-surface and root zone soil moisture dynamics and the processes controlling their spatial and temporal distribution

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Soil moisture is a key variable within earth system dynamics, exerting considerable influence on many hydrological and pedogenic processes, and water and energy balances of land surfaces. Research attempts to improve our understanding of the spatial and temporal distribution of soil moisture is critical, particularly within surface soil layers where biological, chemical and physical processes are most active. Near-surface (0-50mm) and root zone (0-300mm) soil moisture are highly variable, both spatially and temporally. The factors and processes controlling moisture conditions at these two soil soil depths are often varied. In this paper we examine the spatio-temporal distribution of near-surface and root zone soil moisture, including the ability of soil moisture conditions at depth within the soil profile to be estimated using near-surface observations. In addition, the effect of sampling design (high spatial, low temporal resolution versus low spatial, high temporal resolution) for the determination of catchment scale soil moisture dynamics is addressed in this paper. We monitor catchment scale near-surface (0-50mm) and root zone (0-300mm) soil moisture over a four-week period for a 150ha experimental catchment in the Upper Hunter region, New South Wales, Australia. Over 500 measurements of near-surface soil moisture recorded at various resolutions on 4 sampling occasions throughout the study period, are compared with near-surface and root zone soil moisture data monitored within a network of seven continuously recording sensors. Catchment-average near-surface soil moisture derived from these two different data sources, with their distinct spatial and temporal scales, were found to be significantly correlated, suggesting catchment-scale soil moisture

estimates could be reliably obtained using continuously recorded data at a limited number of monitoring sites located throughout the catchment. Catchment-average root zone soil moisture was also found to be significantly correlated with near-surface soil moisture. The primary factors considered to be influencing the spatial and temporal distribution of soil moisture in the near-surface and root zone were aspect, and topography and soil type respectively. The results of this study indicate that despite the different factors and processes underpinning soil moisture dynamics at different soil depths, near-surface soil moisture observations can provide an indication as to what is occurring below within the root zone. This study has also shown that point based observations recorded at a limited number of monitoring stations throughout the catchment were able to provide accurate estimates of catchment scale average soil moisture both in the near-surface and root zone, as opposed to detailed spatial measurements. Such a finding signals the potential for estimates of catchment-average soil moisture levels to be derived on a daily basis without the need for labour intensive and time consuming catchment-wide measurements. Such information at the catchment scale is invaluable, particularly given the key influence of soil moisture on many hydrological and pedogenic processes, vegetation dynamics and biogeochemical cycling (e.g. carbon cycle).

**Keywords:** soil moisture, near-surface, root zone, catchment scale, NAFE'05, SASMAS.