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Interpreting soil moisture from passive microwave remote sensing - an analysis of published field data

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Near-surface soil moisture content estimates inferred from satellite observations of passive microwave emissions have been shown useful for hydrological analyses. The interpretation of passive microwave soil moisture (PMSM) and its assimilation into land surface models is complicated by the large observation footprint and shallow signal source. We analysed published field measurements of vertical and lateral soil moisture distribution at different space and time scales to investigate how representative PMSM is likely to be of soil moisture averaged over different depths and time scales, and how lateral variability affects PMSM. The data was from temperate pasture sites in Australia (the Tarrawarra catchment), Illinois (USA) and France. Scaling relationships for soil moisture averaged over different depths were surprisingly similar for the three sites. We conclude that for these environments soil moisture in the top few cm is a good indicator of soil moisture integrated over some decimetres, and that very thin soil surface layers may not be required in models to assimilate PMSM. A synthetic study with a microwave radiation model suggested that bias or error in PMSM due to spatial variability is likely to be small under unsaturated conditions. Of more concern is the positive bias caused by free surface water under wet conditions.