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Integrating SEBAL with in-field crop water status measurement for precision irrigation applications

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The surface energy balance algorithm for land (SEBAL) has been demonstrated to provide accurate estimates of crop evapotranspiration (ET) and yield at different spatial scales even under highly heterogeneous conditions. The validation of the SEBAL using in-field direct and indirect measurements of plant water status represents a necessary step before deploying the model as an irrigation scheduling tool.
To this end, a study was conducted in a maize field located near the Venice Lagoon area in Italy. The experimental area was irrigated using a 274 m long Variable Rate Irrigation (VRI) system with 25 m sections. Three management zones (MZs; high, medium and low irrigation requirement zones) were defined based on soil texture and NDVI data.
SEBAL-based ET was compared to the real-time soil water balance response of soil moisture sensors installed in the field (5TE, Decagon). In addition, SEBAL results were compared to ETC estimates calculated using the Food and Agriculture Organization (FAO) method, three-dimensional soil-plant simulations (both ET and yield simulations) and in-field yield observations.
The use of SEBAL to capture the daily spatial variation in crop water needs would enable the definition of transient, dynamic irrigation management zones (IMZs). This allows producers to apply proper irrigation amounts only where and when the crop needs it increasing crop yields while mitigating water use.

Keywords: SEBAL, variable rate irrigation, evapotranspiration, water use efficiency