Hydrosat and IrriWatch: water management from space

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Managing dwindling water resources responsibly and protecting crops from adverse growing conditions in the face of climate change are key challenges for sustainable and robust agriculture everywhere in the world. Thermal infrared remote sensing to measure canopy and soil temperatures in the field has a tremendous potential to directly track the water cycle in crops and soil, and directly monitor crop stress. In contrast to thermal infrared, visible and near-infrared spectral bands only detect crop stress too late, once irreversible damage is already done.

Hydrosat is launching a thermal infrared satellite constellation to provide daily, global, and high-resolution land surface temperature measurements targeting a spatial resolution of 50 m. We currently employ multi-sensor data fusion techniques and sophisticated numerical water balance models to bridge the gap until Hydrosat's full constellation is fully operational.

IrriWatch is Hydrosat's irrigation management decision support system, combining empirical and biophysics-based models with daily satellite data. IrriWatch allows growers to track the water demand and growth progress of their crops down to individual pixels in near-real-time, enabling cost savings and yield increases by optimizing irrigation and fertilization operations.

We present recent validation studies comparing output from the IrriWatch algorithms to ground truth data obtained from in-field sensors and drone flights, showcasing the capabilities and limitations of monitoring agricultural fields from space. For example, while we find that thermal sharpening works well under suitable conditions, it cannot replace native high-resolution data. From space imagery we observe excellent agreement between predicted and actual dry matter accumulation, even compared to high-resolution yield maps obtained from combine harvesters. IrriWatch also typically provides realistic estimates of root zone soil moisture from space, including forecasts of irrigation water demand and monitoring of total applied water. We find that water balance calculations are mostly limited when soil parameters and rainfall data are inaccurate, and we present recent developments to overcome these limitations.