Integration of Weather, Soil and Remote Sensing Data for Soil Profile Moisture Modeling

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3rd Canadian SMAP Workshop

Limitations and Opportunities

- Continuous soil moisture monitoring network is limited in Western Canada
- Soil moisture sensors that provide continuous real time data are expensive and often require soil-specific calibration

- Increase in the number of automated weather stations on the Prairies that report weather data in real time
- Great potential in using models to estimate soil moisture content from the information provided by these weather stations

Why models?

- Models are used to predict the outcomes or to fill the gap between the known and the unknown
- They are cheaper and less laborious when compared to the cost of instrumentation for direct measurement
- Soil moisture sensors are often useful for making point measurements

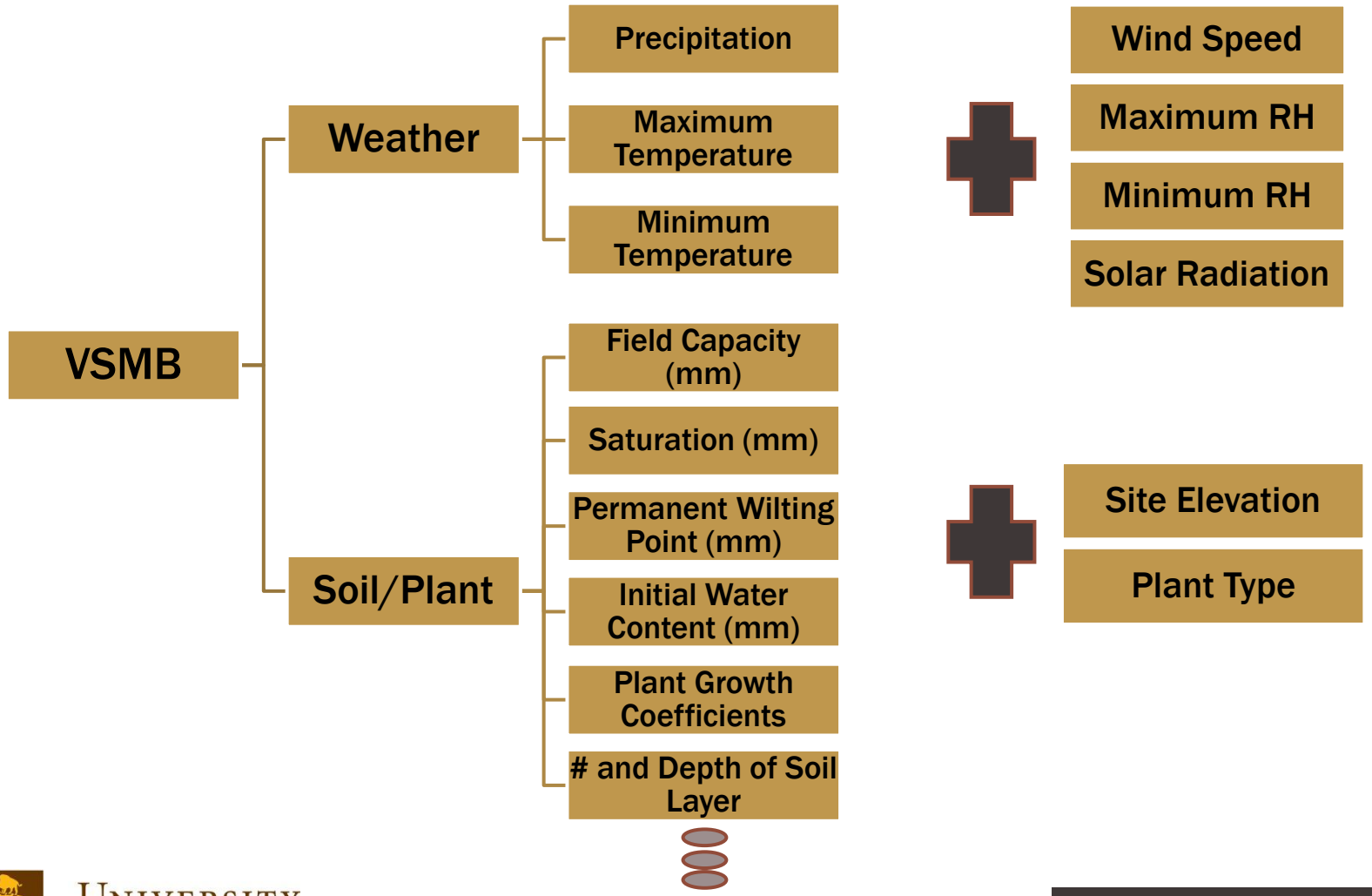
The VSMB

- The Versatile Soil Moisture Budget (VSMB) was developed to simulate vertical, one-dimensional soil moisture flux
- VSMB source code was written in Fortran language and it works on a daily time-step with the soil profile divided into user-defined number of layers
- The model uses water balance method to quantitatively determine soil moisture

VSMB Applications

- The VSMB has been widely applied in agrometeorology and hydrology applications such as:
  - Estimation of evaporation from grassland (Hayashi et al, 2010)
  - Impact of water use on crop yields (Qian et al, 2009)
  - Number of field work days for manure application (Sheppard et al 2007)
  - Impact of climate change scenarios on the agro-climate of the Canadian prairies (McGinn and Sheppard, 2003)

VSMB Input Data



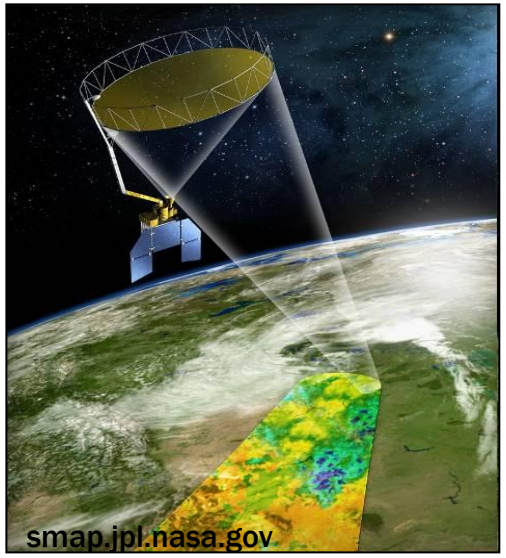
Objective

Create a soil-vegetation-weather integration (e.g. map) with changes in weather and vegetation affecting soil moisture status over the growing season.

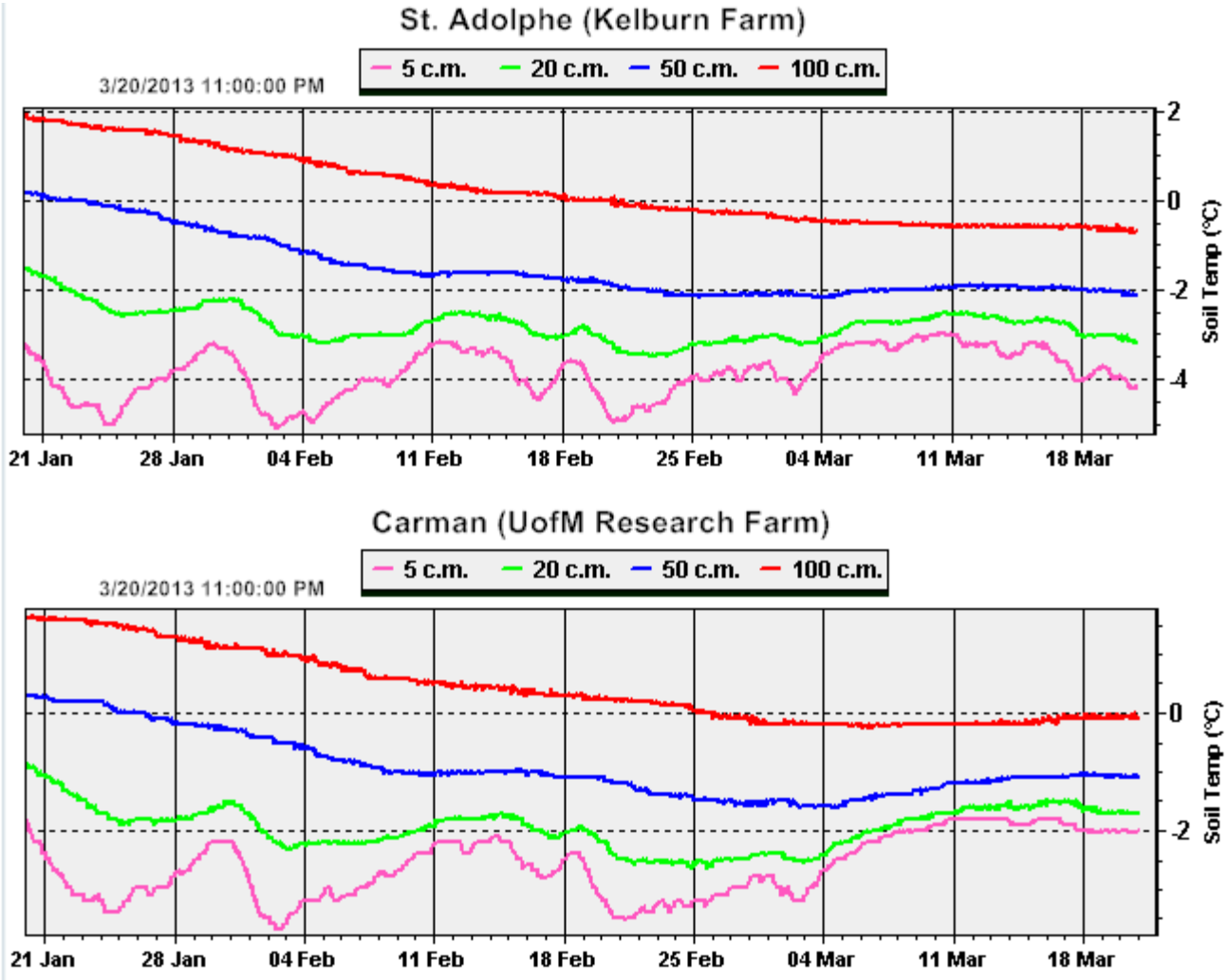
Observed Soil Moisture

- Specific point measurement, small sensing volume
- Great results with proper calibration
- High temporal measurement

- Great spatial measurement
- Sensing depth ~5 cm



Soil Profile Applications



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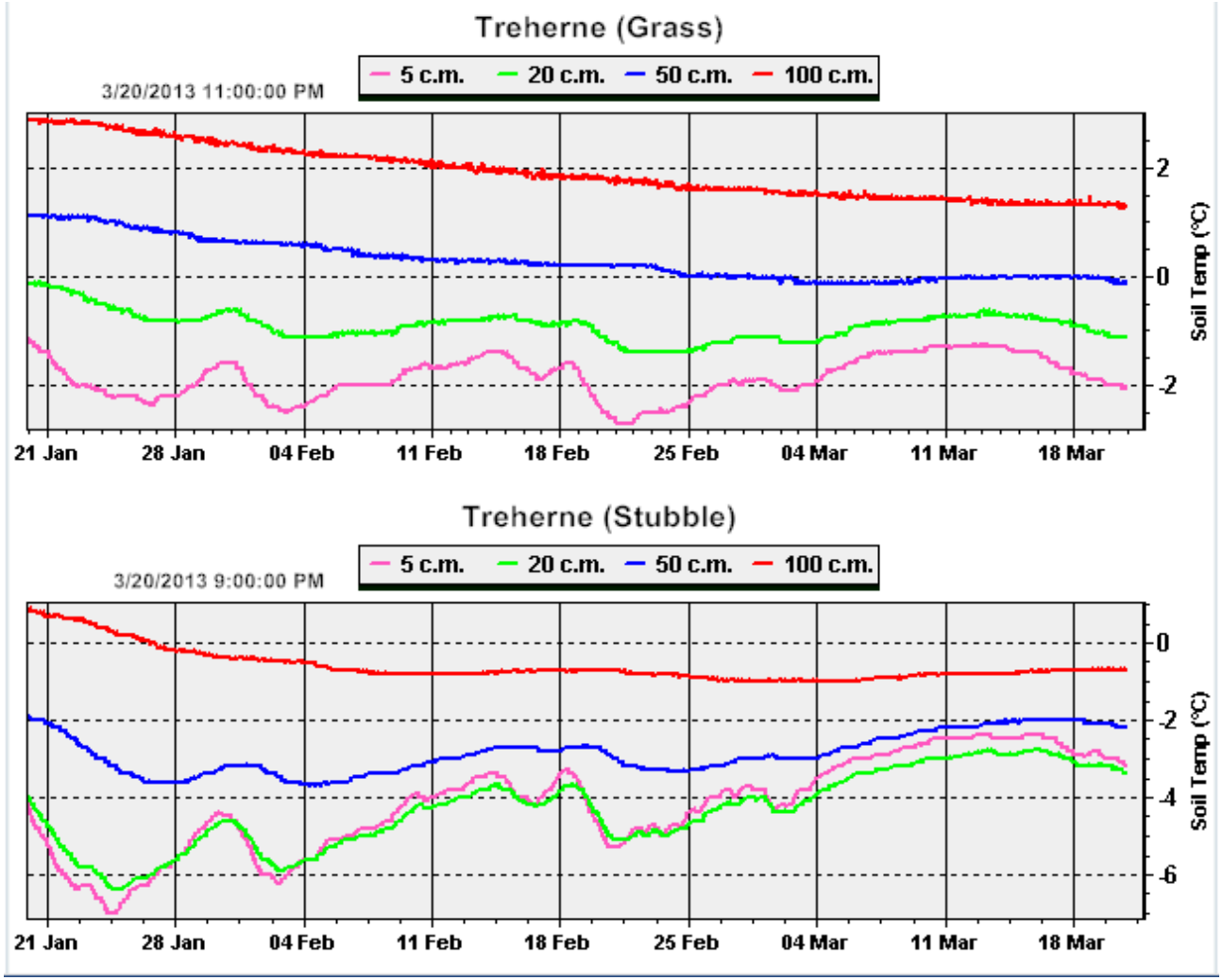
Soil Profile Applications



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Gathering Inputs

Soil Information

http://mli2.gov.mb.ca/soils/index.html

Soil Series

Crop Inventory

Seeding Date: Use of thermo-time

Crop Identification: Optical and SAR imagery

Crop Growth: Biometeorological time scale

Weather Data

Air Temperature

Precipitation

Humidity

Wind Speed

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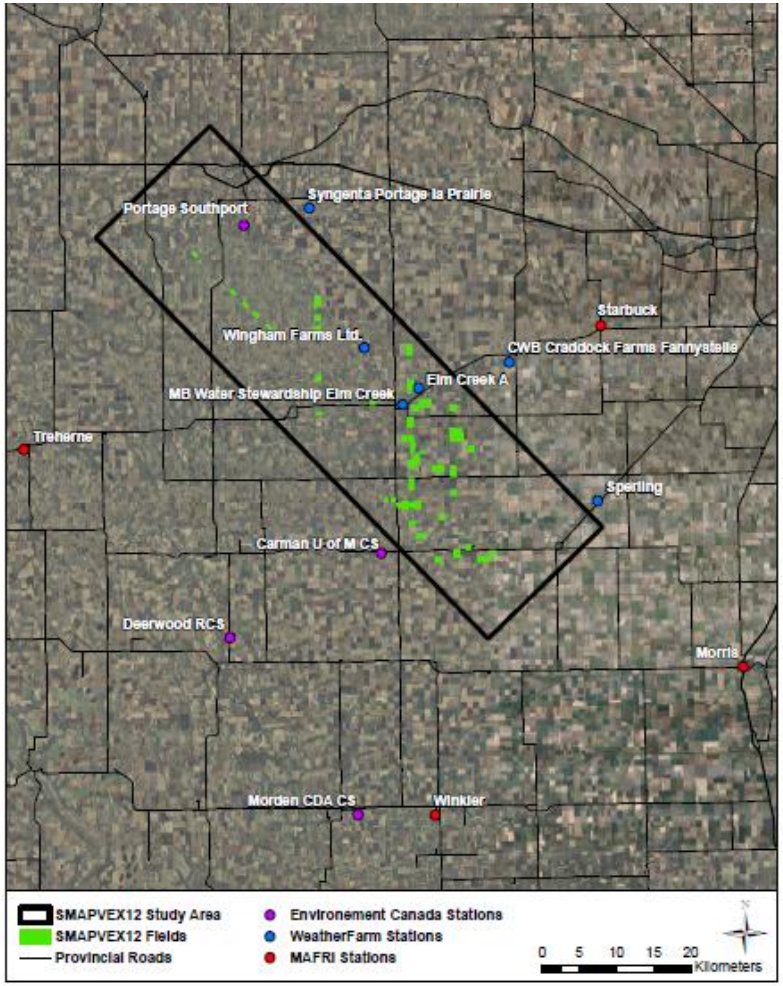
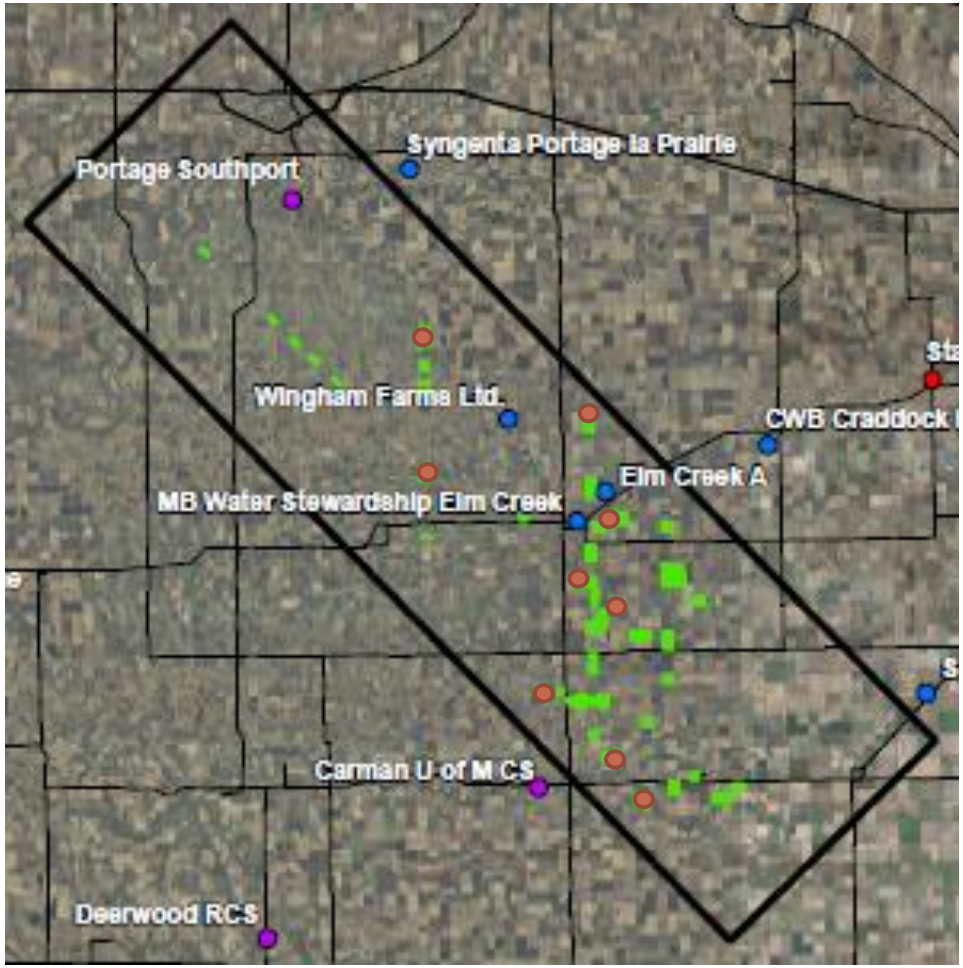
Weather Data





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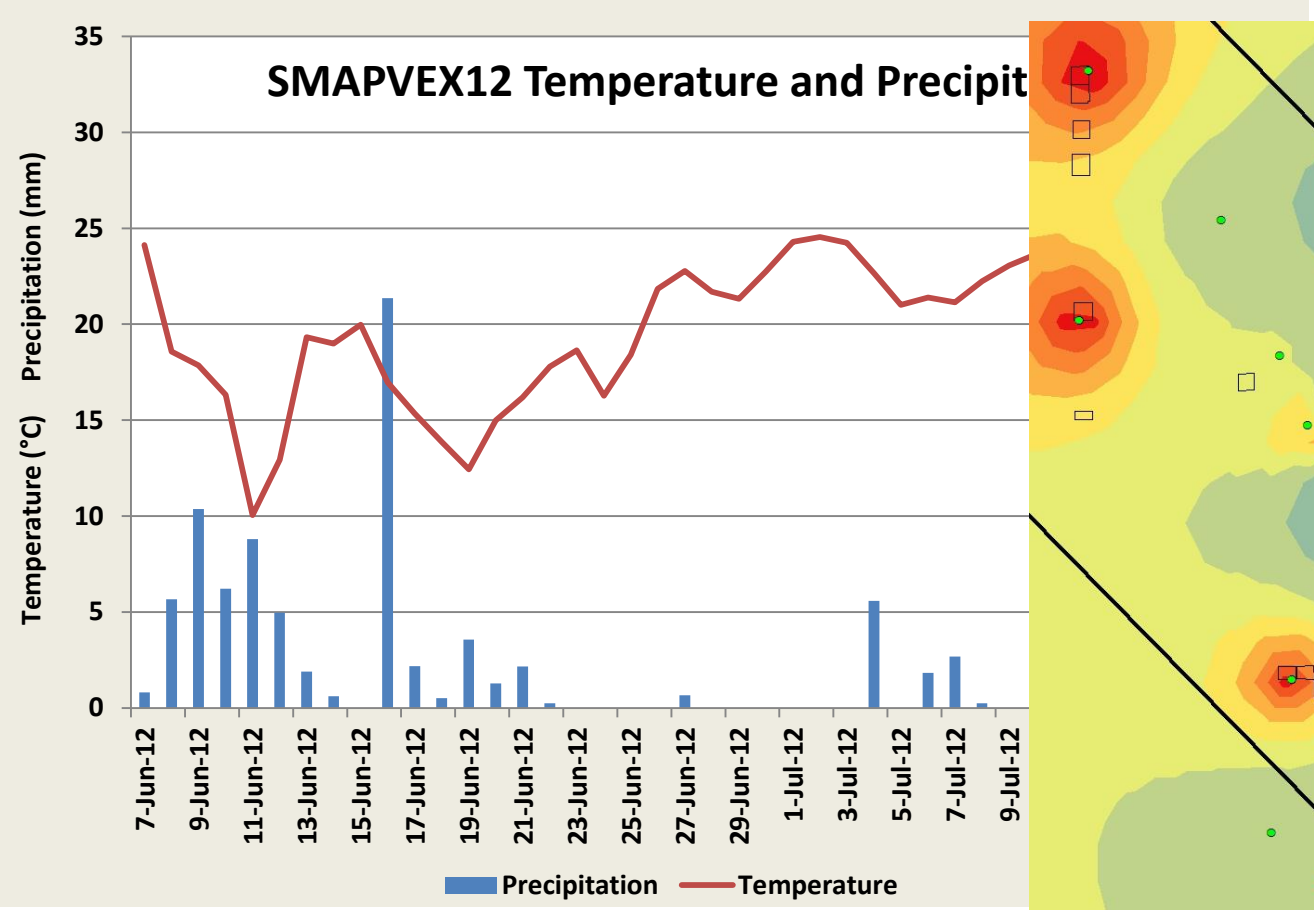
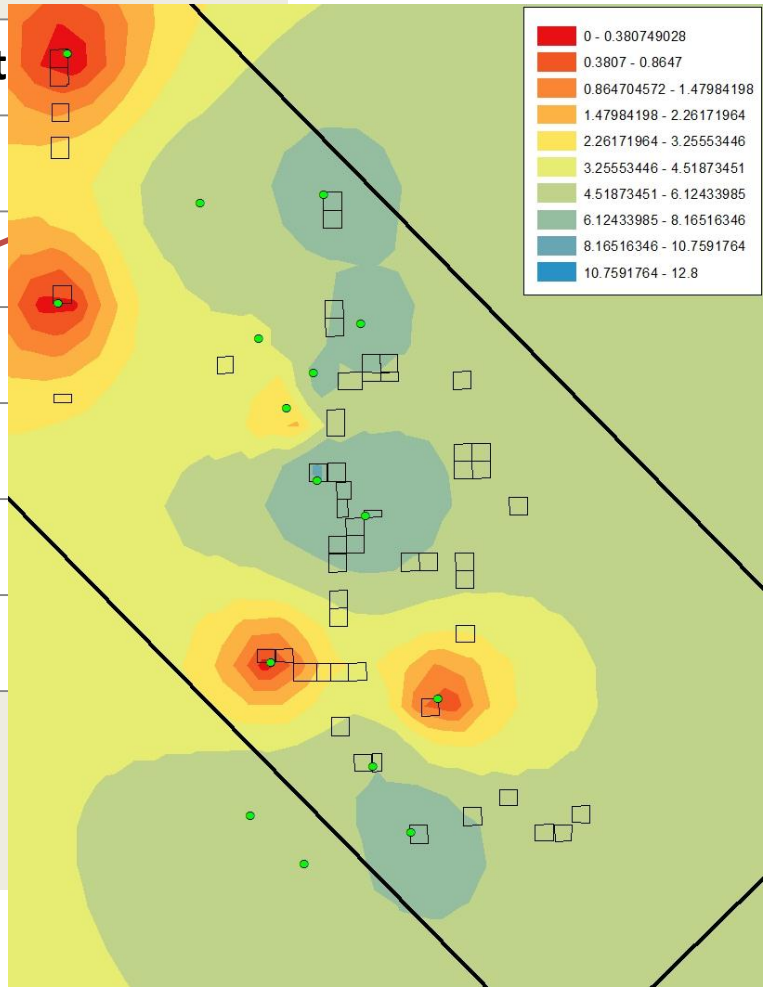
Weather Data





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Expected Outcome

Weather: Daily weather update based on data from weather stations

Vegetation: Growth updated weekly

Soil layer: Static, populate attribute table with daily soil moisture update driven by weather and vegetation data

Thank you

Thoughts & Questions?

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