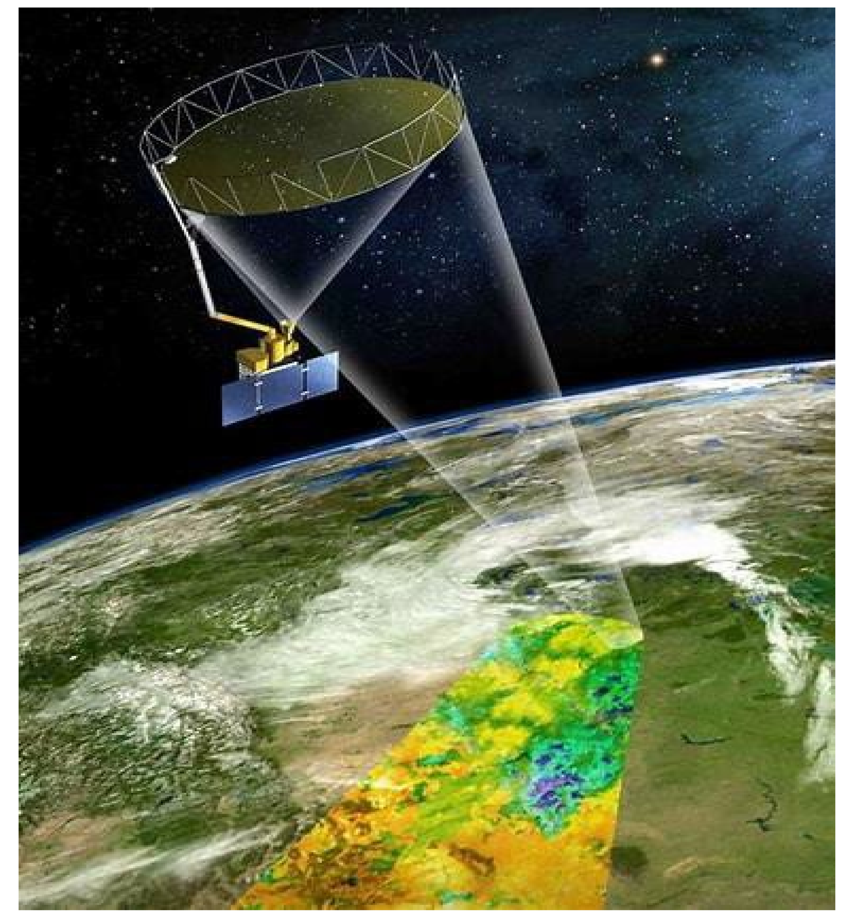
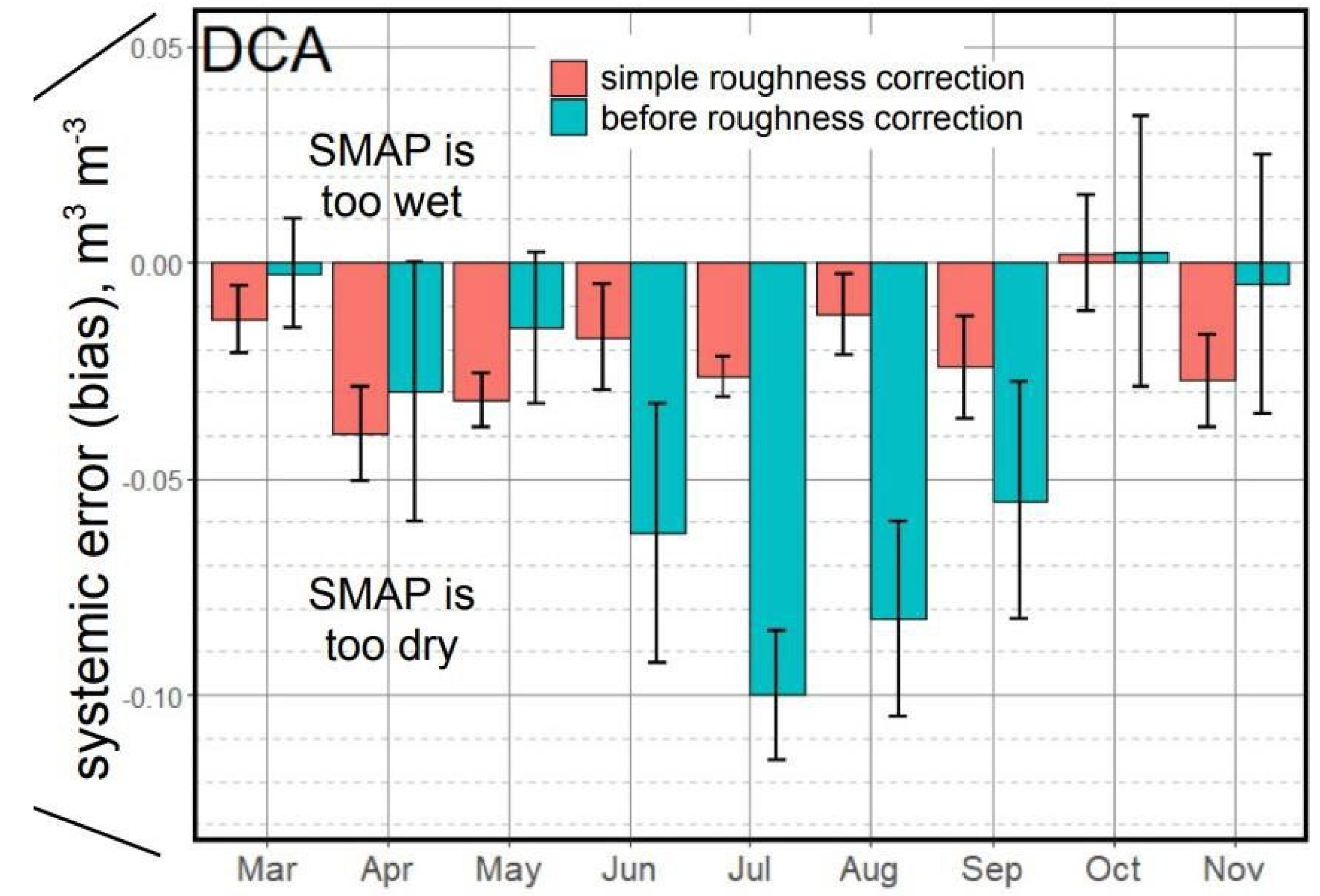
Sap flow measurements are an important part of understanding the water stored in crops during the growing season. Last summer, my group used sap flow sensors developed by the East 30 company (shown above) to monitor sap flow in corn. Sap flow is directly related to transpiration and plant water storage. The water stored in crops changes throughout the growing season, which impacts SMAP vegetation optical depth (VOD) retrievals during the growing season. Essentially, the water in crops attenuates microwave radiation emitted by the Earth, which impacts SMAP soil moisture readings



The Soil Moisture Active Passive (SMAP) satellite (shown above) is a passive microwave remote sensing instrument that estimate soil moisture across the globe (Entekhabi et. al, 2010). Microwaves can penetrate vegetation, and their emission is dependent on the moisture content of the soil, making them a valuable tool for predicting droughts, floods, and crop stress. However, it is sensitive to water in vegetation and changes in soil texture throughout the year, which can lead to errors that we are attempting to correct.

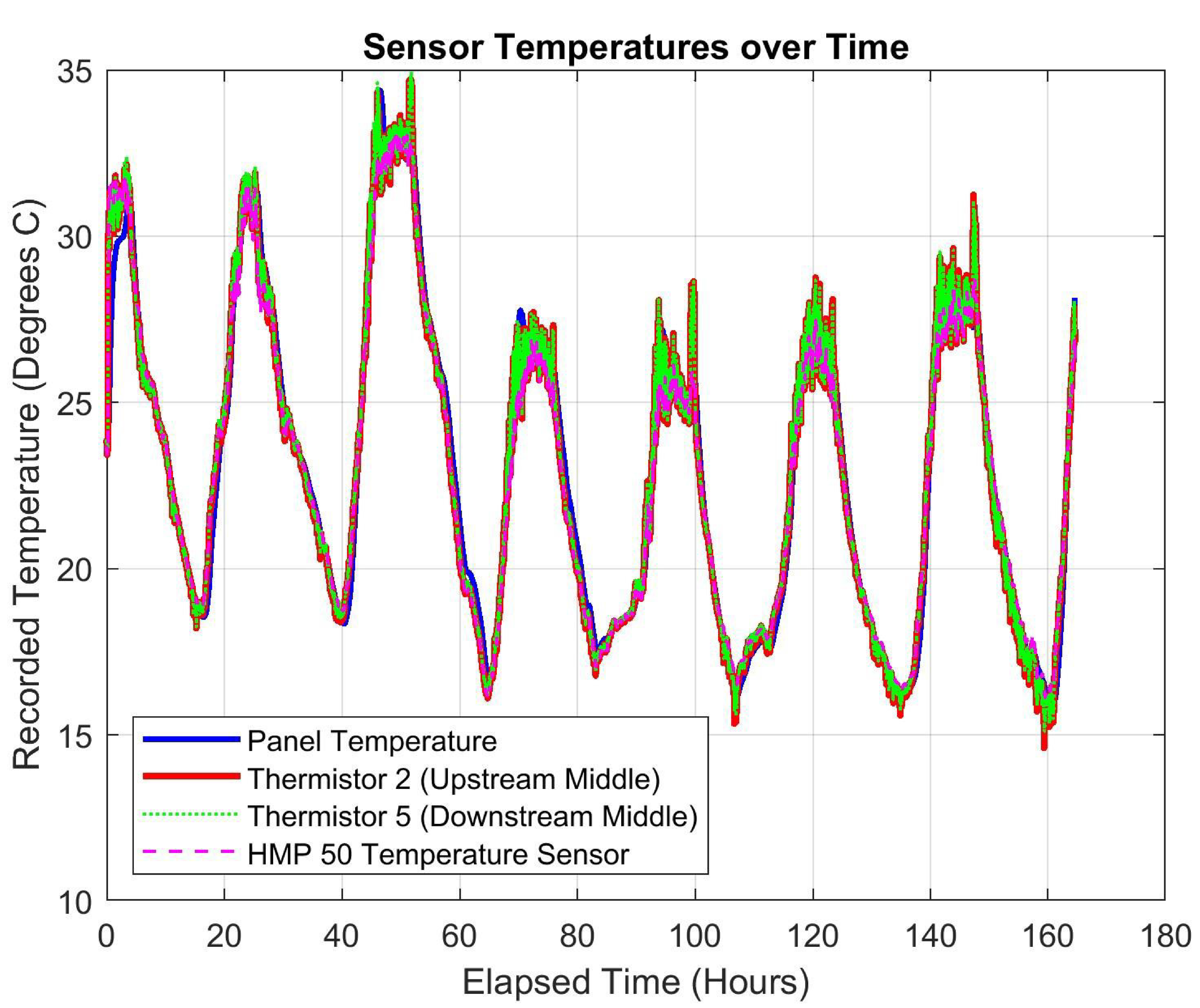


The above graphic shows the results of a correction algorithm tested with SMAP (Walker et. al, 2019). It can be seen that the greatest improvements to SMAP soil moisture retrievals occurred in the summer months,. However, some months worsened, most notably March, April, May, and November. As can be seen in the figure below, the months that saw increases in error are dominated by variable soil roughness rather than crop cover. At present, SMAP does not account for variations in land cover, which occur due to practices such as soil tillage and erosion. Additionally, the transitions from stages 1 to 2 occur rather abruptly and can vary significantly between years. The goal of this project is to develop a new algorithm that allows for SMAP prediction of the transition times of the year, as well as a dynamic soil roughness model that improves soil moisture measurements when crops are not present.

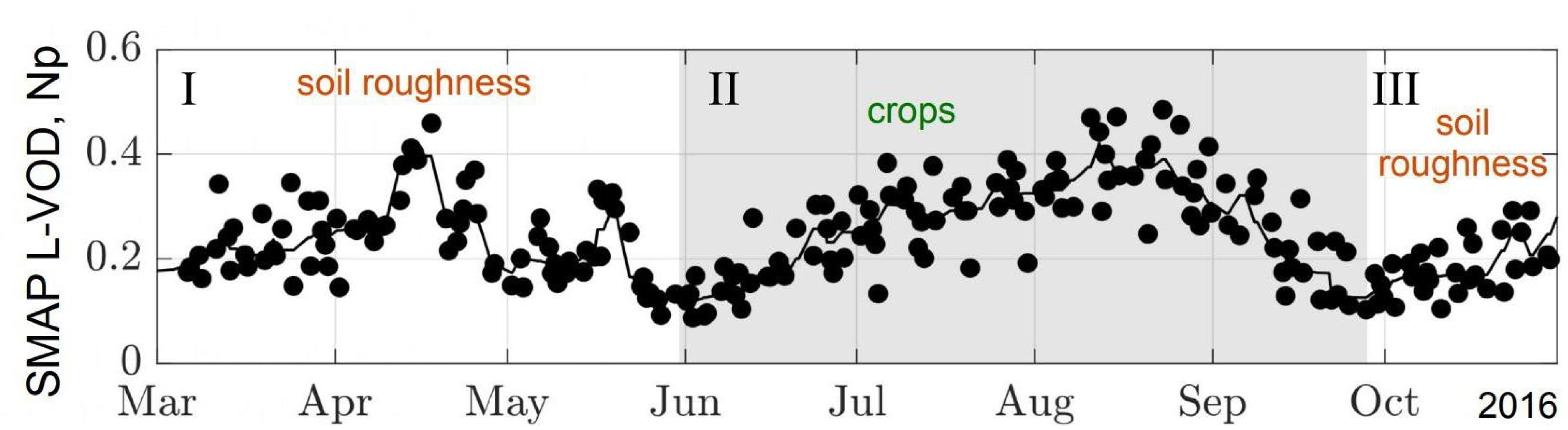
Developing A New Planting and Harvesting Algorithm for the SMAP Soil Moisture Satellite

Matt Kavanaugh

DataFEWSion Symposium 2023



When measuring sap flow, ensuring accurate readings from the sensors is critical. The figure to the left shows a sample of thermistor temperatures taken over the course of one week following calibration. As can be seen, all four thermistors demonstrated comparable readings over time, indicating that they should provide decent representations of sap temperatures within plants, which allows for better measurements of sap flow.



The goal is to correct the dry biases is the SMAP soil moisture retrievals that are seen above. As this is the time of planting and harvest, we hypothesize that there is a balance between crop cover and dynamic soil roughness at these times that must be computed. In the bottom right figure, it has been proposed that the year is divided into three periods, based on the dominant land cover in each season. A land model will be tested for various locations in the US to determine a new algorithm for soil moisture retrieval across the Corn Belt. This will help produce more accurate soil moisture readings for regional farmers as well as improved accuracy of global climate models.