NWB Sensors, Inc.
80555 Gallatin Road
Bozeman, MT 59718

info@nwbsensors.com
406-579-0510

Creating a Single Source for Agriculture Water Availability

A wide variety of environmental data is available from NASA missions on weather phenomena that impacts all our lives, but many people are either unaware of these data sets or are discouraged from accessing and using the data because of the enormity and complexity of the sets. In the 2018 spring NASA Small Business Innovative Research program solicitation NASA addressed this disconnect between NASA data and consumers. In response to this call NWB Sensors has proposed the development of a data application that puts NASA's rain, snow, and water data products into the hands of consumers, with an initial focus on non-irrigated winter wheat production.

This application will allow field level predictions of snowpack, surface water availability, soil water recharge, planting times, and plant productivity. In addition to providing data the proposed platform will include a machine learning application for prediction of winter-kill, spring soil moisture, and fall yield for winter-wheat production. Training this model will utilize multiple years of winter-wheat yield, crop health, and product quality available from collaborators at Montana State University. The resulting platform current named WaterProf™ (Water Prophets: Using intelligence to define the future) will aggregate state-of-the-art data from multiple NASA missions (GPM, IMERG, SMAP, MODIS, LANDSAT) with hydrology data collected by NOAA (NOHRSC) along with local meteorology (AWOS, RAWS, local mesonets) to support data driven decision making and to make these predictions about water availability, stress, and yield on a field level. This novel decision support tool (DST) empowers growers to raise healthier crops over the growing season. Figure 1 shows a graphical representation of WaterProf with satellite and ground station aggregated by NWB into full production cycle actionable data.

Figure 1. A graphical overview of WaterProf showing satellite and ground station aggregation by NWB Sensors with a product of full production cycle actionable data.

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Applications and Local Need

The primary focus of this project will be providing information to farmers to support agriculture production and precision agriculture, specifically dealing with water availability, crop health related to water usage, and yield prediction. Agriculture is Montana's #1 industry. Montana's agricultural products including cereal grains, pulse crops, and grazing rangelands and the associated livestock. Montana has over 60 million acres of farmland, larger than the size of Minnesota. Over 95% of these lands are non-irrigated and therefore are fully reliant on local precipitation as a water source. Agricultural production in Montana generated $4.7 billion in 2015, with wheat as Montana's #1 export. As detailed by the Montana Department of Agriculture, Montana as the top producer of peas and lentils in the United States, second in durum and safflower respectively, and third in barley, all wheat, chickpeas, alfalfa hay, and flaxseed.

A secondary benefit of the proposed platform will be a benefit to NASA's weather and climate prediction applications. The proposed platform will encourage user to install personal weather stations and feed these data into the platform for improved localized data accuracy. These data can be provided to NASA and other researchers as inputs into weather prediction models. More advanced stations can be used a ground truth for data processing in satellite missions and improved climate modeling.

Technical Objectives

During the first Phase of this program to create the pipeline of NASA Earth Science data to agriculture producers NWB Sensors will achieve the following objectives:

1. Aggregate data for a input location from NASA and non-NASA sources with a focus on water and snow. NASA products will include GPM, IMERG, SMAP, MODIS, and LANDSAT. Other data will include NOAA hydrology data, local meteorology, and potentially commercial imagery.
2. Process aggregated winter data into actionable information including snow cover, snow water availability, and local temperatures to determine periods of winter stress.
3. Process aggregated spring and summer data into actionable information of current water availability, crop health, and future water availability and associated stress. This will include species-specific evapotranspiration from AgriMet (and related systems) coupled with localized precipitation history to predict of crops stress, and provide early assessment of economic impacts.
4. Utilize aggregated NASA and other data in a deep learning platform for localized crop prediction. These will utilize historical winter-wheat production data to provide information on crop sensitivity and associated yield impact through the full production cycle in winter, spring, and summer.