Developing mobile applications for agricultural decision management support

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With mobile devices becoming the predominant method of Internet access, location-based applications are now being used to assist farmers in making important decisions that could affect the yield and quality of their crop. The REACCH cyberinfrastructure team has developed a set of tools that growers will be able to access on mobile devices out in the field, providing them with information that will help them make informed decision on how they can best protect their crops against pests.

IMPACT

A changing climate could have a significant impact on appropriate weed and pest management decisions in the Pacific Northwest. Mobile applications offer growers the ability to use decision support tools directly in their fields to make informed choices relating to their agricultural practices.

Using our developed ArcGIS Server/javascript/python model), we developed a mobile responsive base interface to enable the integration and analysis of REACCH datasets. Our initial foray into this area has focused on integrated pest management in combination with climatic weather parameters generated from 1979 to the present (Figure 1).

A REACCH application development team was created in 2014, consisting of members of the cyberinfrastructure, biotics, and extension teams. The groups worked to come up with a strategy to best serve growers' decision support needs, with the extension team working to determine the information growers would like to have and the biotics team working to provide phenological information about insects and plants. The cyberinfrastructure team developed a data process, in conjunction with the REACCH modeling team, to process weather parameters every three days to provide data for agricultural decision support analytics.

Crop growth and its relationship to weather parameters is an important component of the REACCH effort. As such, the calculation of growing degree days, which is a measurement of average heat accumulation used to predict plant and animal development rates, has been critical to the development of these decision support tools. We have created a REACCH growing degree day mobile application that displays a map of growing degree days for

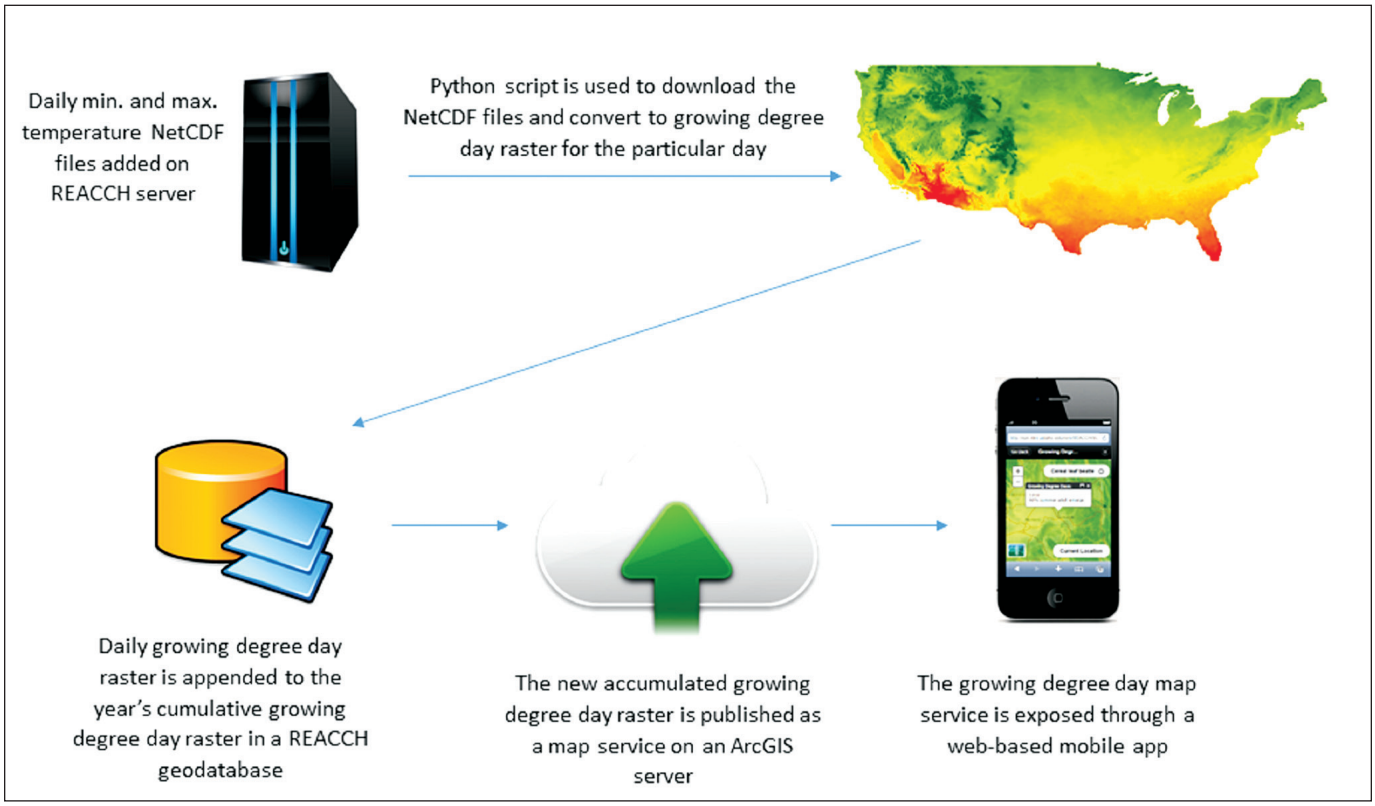

Figure 1. *The process of creating a real-time growing degree day mobile app.*

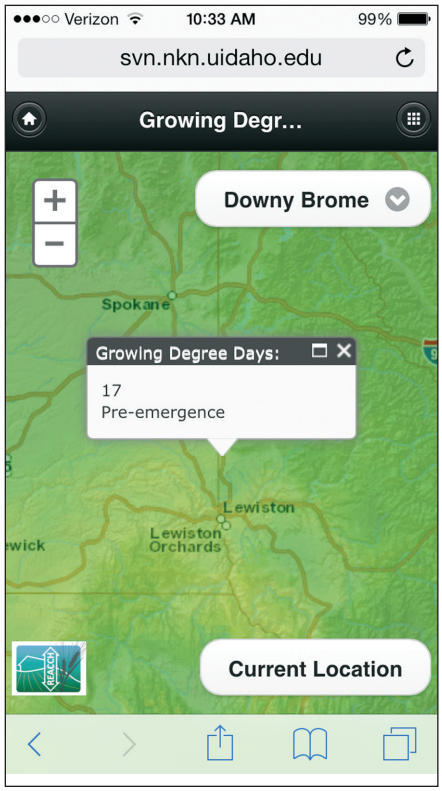

Figure 2. *Mobile app showing growing degree days for the cereal leaf beetle.*

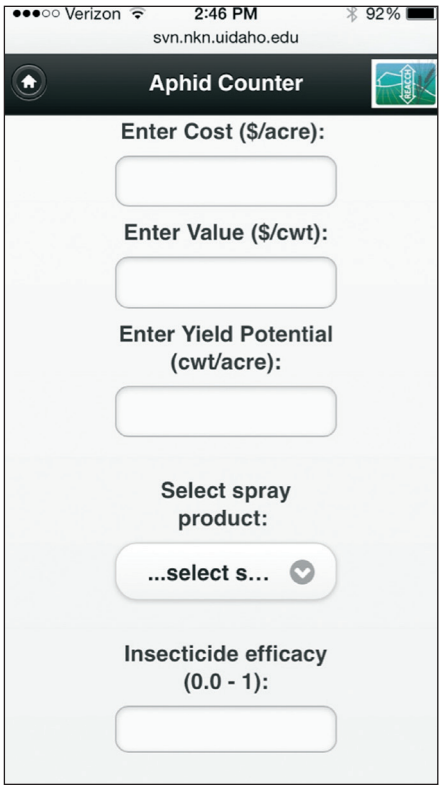

Figure 3. *Input screen for the parameters used in the Aphid Counter mobile app.*

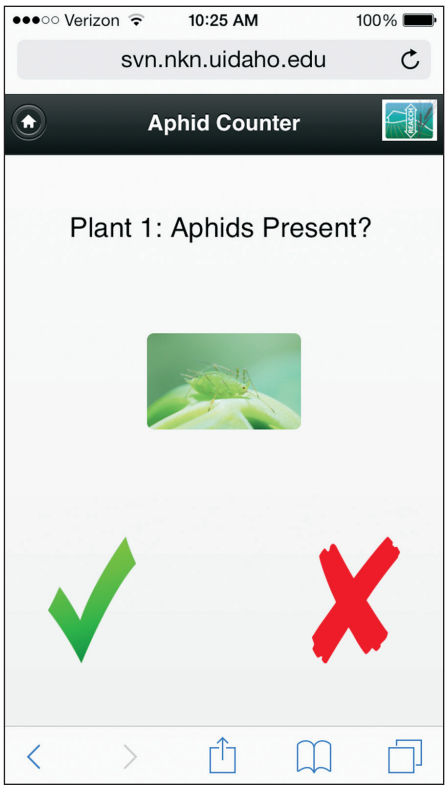

Figure 4. *Interface for the Aphid Counter mobile app.*

the entire contiguous United States, using REACCH scientist and University of Idaho associate professor John Abatzoglou's gridded meteorological datasets (Figure 2). The map is updated daily, displaying near-real-time growing degree day accumulations. The grower has the option to select the insect or plant of concern to them, and a gridded growing degree day layer will be overlaid on the map within the mobile application. They then have the option of clicking anywhere on the map to query how many growing degree days have accumulated at the selected area, as well as the corresponding phenology information for the insect or plant of interest. The grower can also simply select the Current Location button, and the GPS within the smartphone will determine the location of the grower and display the growing degree day accumulation and the associated plant or insect development stage information for that location.

Another mobile application that has been developed is a binomial sequential decision-planning application for managing pea aphids. The Palouse area of WA and ID accounts for a large percentage of the US production of dry peas. Infestations of pea aphids annually develop in nearly every dry pea field in the Palouse, which in turn reduces crop yield and quality. Variables including crop market value, cost of control, and crop yield potential are all important in determining the economic injury level to the dry pea plant or, in other words, the point at which it makes the most financial sense for a grower to spray for pea aphids. The developed mobile application allows the grower to input the cost of control, the market value of the crop, the crop yield potential, and the insecticide efficacy, which are then used to calculate the economic injury level for the crop (Figure 3). The grower is then taken to an interface where they are asked to start scouting their field, going plant by plant and tapping the check mark if the plant has any aphids present and the X if no aphids are present (Figure 4). Eventually, after a sufficient number of plants have been scouted, the tool will make a determination, based on the economic injury level of the plants and the abundance of aphids, as to whether it is economically advisable for the grower to spray an insecticide or not.

We are also currently working to make the University of Idaho's aphid tracker calculators mobile enabled. The calculators provide information such as which insecticide to use based on location, seed treatment cost, seeding rate, crop yield potential, and crop market value. There are calculators for both peas and lentils, and there are also different calculators depending on whether it is the early or late part of the growing season.

The ultimate goal of the REACCH decision support tools is to provide a user-friendly interface that allows growers to make informed decisions based on data provided by REACCH project researchers . Because the tools can be accessed on mobile devices, growers can have a set of useful decision support tools right in their pockets out in the field. We have a great start with the mobile tools currently developed, and we will continue to create new tools and make enhancements to our existing tool set. As more data are collected, we will be able to allow growers to query a growing list of insects and plants. Also, we hope to receive more feedback from growers to determine what they like or dislike about the mobile tools, in the hope that we can provide them with a product that is easy for them to use and helps them to make critical decisions for improving their agricultural practices.