


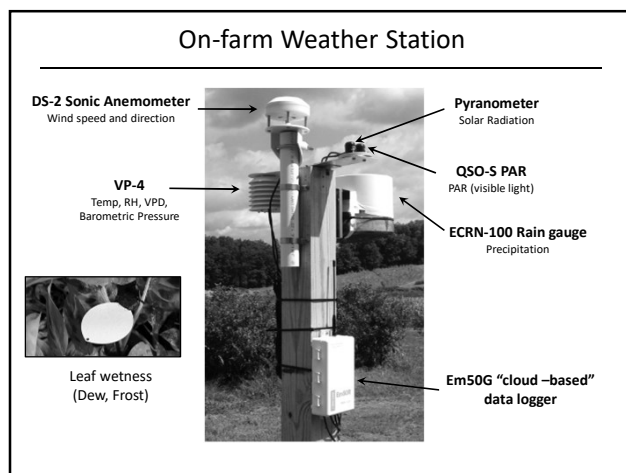
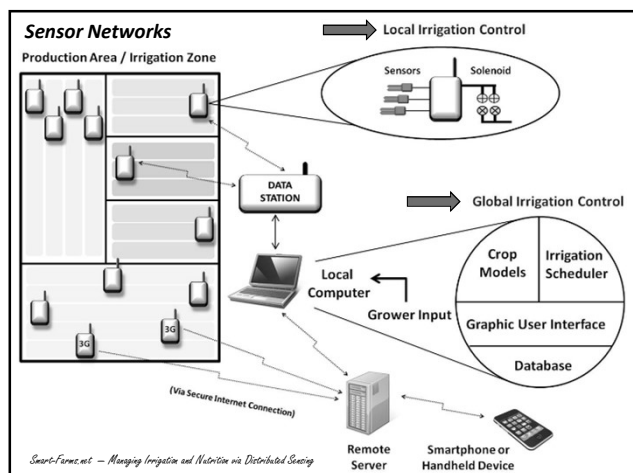
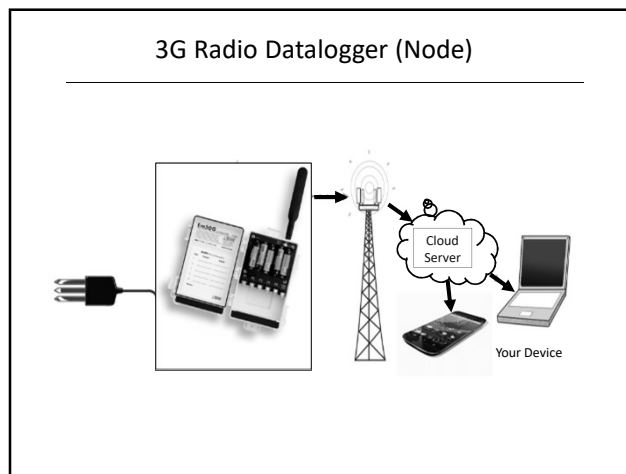
Using Sensors for Better Irrigation Management Decisions... and More....



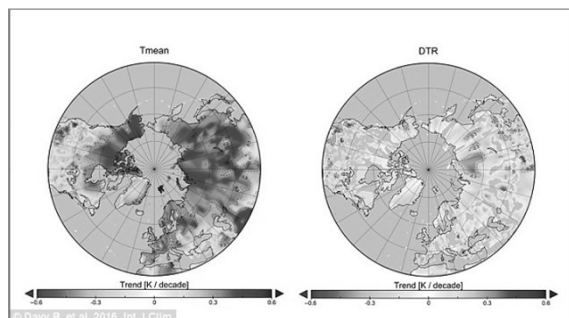
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Smart Farms
 SCRI-MINDS—Managing Irrigation and Nutrition via Distributed Sensing

USDA NIFA United States Department of Agriculture National Institute of Food and Agriculture
 USDA NIFA SCRI Award no. 2010-5181-0076



The Planetary Boundary Layer



Davey et al., 2016 *Int. J. Clim.*

The Planetary Boundary Layer

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RESEARCH ARTICLE

Diurnal asymmetry to the observed global warming

Richard Davy¹, Igor Esau, Alexander Chernokulsky, Stephen O'Brien, Sergey Zhuravich

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Cited by: 3 articles

Abstract

The observed warming of the surface air temperature (SAT) over the last 50 years has not been homogeneous. There are strong differences in the temperature changes both geographically and on different time frames. Here, we review the observed diurnal asymmetry in the global warming trend: the night-time temperatures have increased more rapidly than day-time temperatures. Several explanations for this asymmetric warming have been offered in the literature. These generally relate differences in the temperature trends to regionalized feedback effects, such as changes to cloud cover, precipitation or soil moisture. Here, we discuss a complementary mechanism through which the planetary boundary layer (PBL) modulates the SAT response to changes in the surface energy balance. This reciprocal relationship between

The Planetary Boundary Layer

PLANETARY BOUNDARY LAYER

According to climatologists, the reason for the rapid increase is a band of air close the ground, called the planetary boundary layer (PBL).

This thin layer of the Earth's atmosphere is distinct from the upper layers and changes in thickness over the course of the day-night cycle.

At night the solar radiation absorbed by the surface over the course of the day is released into space.

The researchers explain that as more carbon dioxide has been added to the atmosphere from man-made activities, such as burning fossil fuels, this has meant less heat escapes from the atmosphere at night, and the warmer atmosphere heats the thin PBL below.

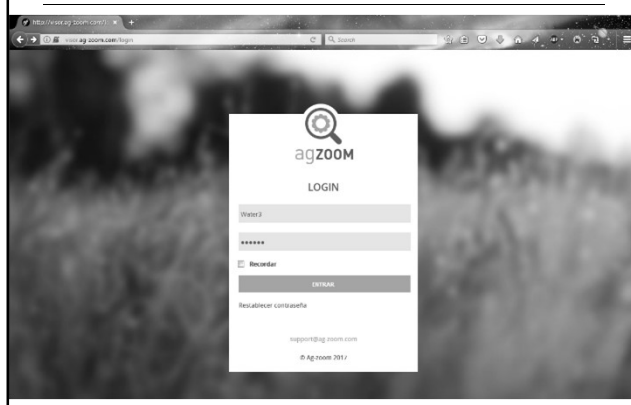
Because the layer is so thin at night, the warming effect is much more pronounced, adding extra energy to the climate system

Agricultural Implications of Increased Night Temperatures

1. Increased respiration rates
 - Decrease in yield
 - Decrease in food quality
2. Disruptions in pollination, fruit set
3. Increase in soil temperatures, microbial respiration rates, decrease in organic matter content
4. Increase in relative humidity, fungal disease
5. Increased weed pressure
6. Increased number of pest life cycles

Wolfe et al., 2018 *Climatic Change* 146: 231-245

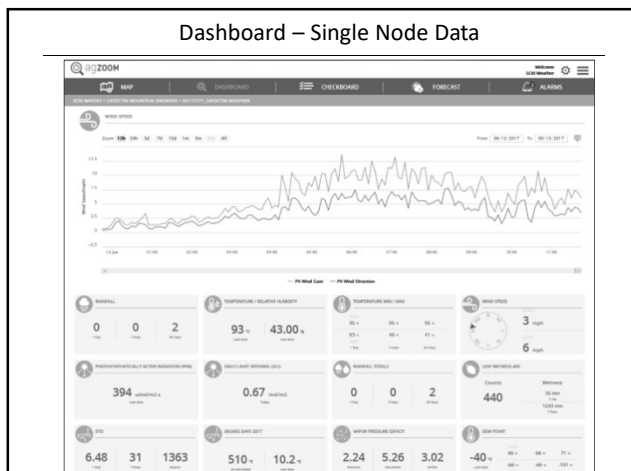
Cloud Software Capabilities: AgZoom



Geolocation of Cloud Dataloggers

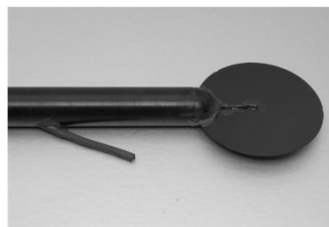


Dashboard – Single Node Data



Frost Monitoring

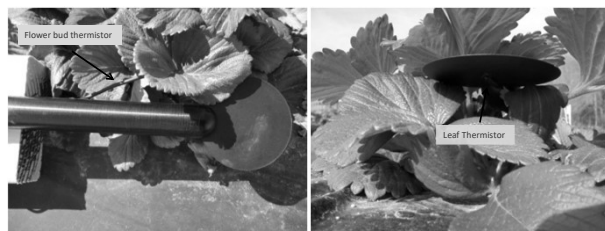
- Current frost prediction tool - Sky-Bit (Satellite data)
- Air temperature is not a reliable predictor of frost events
- Canopy temperature should be measured
- Radiative frost: $CT \ll AT$ on clear and calm nights



Apogee SF-110 Radiation Frost Sensor

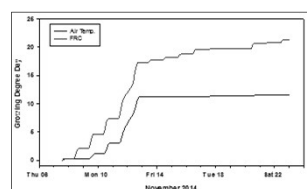
- 2 precision thermistors
- Mimic plant leaf and flower bud
- Measurement Range: -50 to 70 °C
- Accuracy: ± 0.1 to ± 0.4 °C

Radiative Frost Sensor



Flower bud and leaf thermistors (indicated with red arrows) on the SF-110 radiation frost sensor deployed within the plant canopy at Shigel Farms

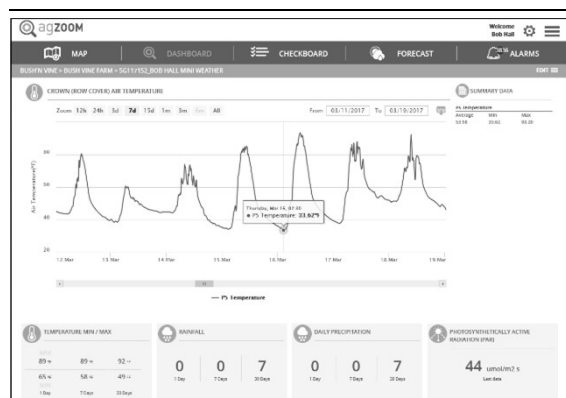
Floating Row Cover Use



Growing degree day (GDD) units recorded below and above floating row cover



Frost Events South Carolina – March 14-16, 2017



Alert Capabilities

MAP

DASHBOARD

CHECKBOARD

FORECAST

ALARMS

Home

Recent Configurations

100%

Date	Customer	Event	Device	Alerts	Variable	Status	Current Value
14-Mar-2017 14:00:00	Baugh's Farm	Baugh's Farm	16171702	Row Cover Temperature Alert	Temperature	1.36°F	23.86°F

Date

Value

Message

14-Mar-2017 14:00:00	35.18°F	35.18°F < 36°F
14-Mar-2017 14:00:01	35.24°F	35.24°F < 36°F
14-Mar-2017 13:59:59	34.32°F	34.32°F < 36°F
14-Mar-2017 13:59:57	33.96°F	33.96°F < 36°F
14-Mar-2017 13:59:54	33.86°F	33.86°F < 36°F
14-Mar-2017 13:59:42	33.89°F	33.89°F < 36°F
14-Mar-2017 13:59:36	33.63°F	33.63°F < 36°F
14-Mar-2017 13:59:31	33.96°F	33.96°F < 36°F
14-Mar-2017 13:59:01	34.14°F	34.14°F < 36°F
14-Mar-2017 13:58:01	34.32°F	34.32°F < 36°F
14-Mar-2017 13:55:40	34.79°F	34.79°F < 36°F
14-Mar-2017 13:55:34	34.85°F	34.85°F < 36°F
14-Mar-2017 13:55:29	35.04°F	35.04°F < 36°F

14-Mar-2017 14:00:00	Baugh's Farm	Baugh's Farm	16171702	Baugh's Farm Frost Alert	Temperature	1.36°F	24.86°F
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support@aqzoo.com

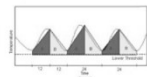
Predictive Tools for IPM, Disease Management

Agricultural Risk Management

Precision Farming is more than just GPS controlled harvesters. It also helps keeping track of pathogen development, optimize treatments to hit a disease dead on, warn of frost, and to produce an environmentally friendly as possible.

Growing Degree Days, Heat Units

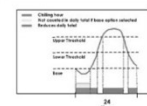
The growth and development of plants, insects, and many other invertebrate organisms is largely dependent on temperature.



In other words, a constant amount of thermal energy is required for the growth and development of many organisms, but the time period over which that thermal energy is accumulated can vary. Many organisms slow or stop their growth and development when temperatures are above or below threshold levels. The accumulation of thermal energy over time is known as degree-days or heat units. Degree-days and other heat unit measurements have been used for determination of planting dates, prediction of harvest dates, and selection of appropriate crop varieties.

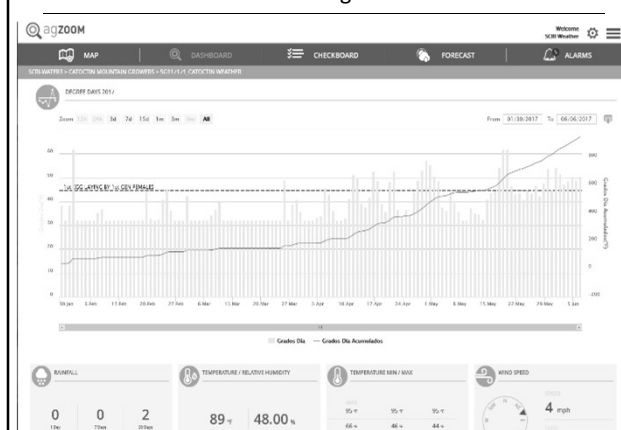
AgZoom's heat unit extension, which is part of our data visualization and distribution software addiTAGe Pro, includes the most commonly used methods for calculating heat units. The user is able to create templates based on information found in published models. The templates can include the method of heat unit calculation and thresholds levels for alarms - crucial for precise management decisions.

Calculation method Cutoff method Chilling Hours User friendly model template Download information

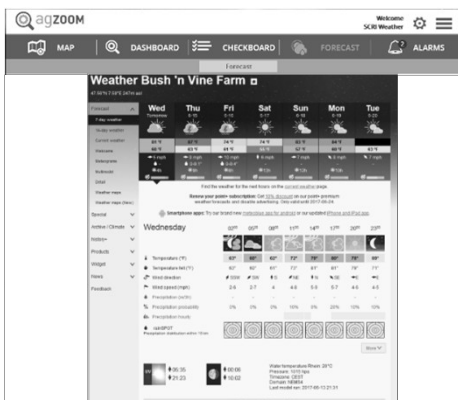


Chilling hour values are used to predict several management factors. Fruit growers are the primary users of chilling hours. Decisions such as varietal selection, pruning, and other management factors related to potential yields can be aided by chilling hour calculations.

Dashboard – Single Node Data



Geolocated 7-Day Weather Forecast



Monitoring System Considerations

1. **Prioritize your issues:** Irrigation, water quality, pests, disease
2. **Monitor with Intent:** Develop a site- / crop-specific strategy
3. **Purchasing:** Make sure any system you buy has all the components you need. *Demand quality, Don't buy cheap*
4. **Support:** Consider the time *YOU* have to invest in any system.
5. **Investment:** Start small, get comfortable, grow at your own pace.

Project Information at <http://smart-farms.net>