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AE491

Agricultural Management Options for Climate Variability and Change: AgroClimate[1]

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This series of EDIS publications provides information about different agricultural management options available to improve resource-use efficiency and adapt to climate variability and change. To see the complete series of publications, visit http://edis.ifas.ufl.edu/topic_series_agricultural_management_options.

Introduction

Adapting to climate variability and change can be achieved through a broad range of management alternatives and technological advances. While decision making in agriculture involves many aspects beyond climate, including economics, social factors, and policy considerations, climate-related risks are a primary source of yield and income variability. Existing strategies can help producers minimize the risks associated with climate variability and change as well as improve their resource-use efficiency. This series of EDIS publications gives information on these existing technologies, and this publication focuses on the use of AgroClimate (http://www.agroclimate.org/) to improve management of crop production systems.

What is AgroClimate?

AgroClimate is a web-based climate information and decision-support system. The website includes seasonal forecasts, expected impacts of management options for different crops and climate scenarios, and a wide variety of interactive tools that help producers monitor current conditions and plan for the season ahead. AgroClimate has been developed to serve agricultural stakeholders in the Southeastern states of Florida, Georgia, Alabama, South Carolina, and North Carolina. Users can monitor variables of interest such as growing degree days, chill hours, disease risks for selected crops, and current and projected drought

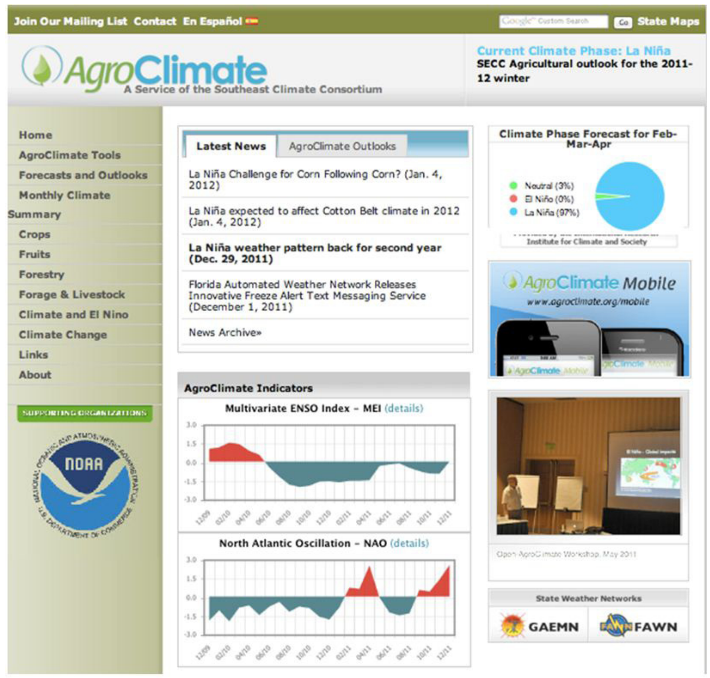

Figure 1. The AgroClimate main page (http://www.agroclimate.org) displays links to tools, news, climate outlooks, 90-day ENSO phase forecast probabilities, and indicators for ENSO and North Atlantic Oscillation (NAO).
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conditions. Users can also learn about the forecast of climate cycles affecting the Southeastern United States, such as the El Niño Southern Oscillation (ENSO) phenomenon. Water and carbon footprint calculators can provide estimates of how efficiently water and energy are being used. AgroClimate can help producers develop a strategy for the coming season and track current climate conditions affecting crop development and yield (Fraisse et al. 2006).

How does AgroClimate reduce climate-related risks?

AgroClimate provides climate information that is closely related to agricultural production. Using the climate information, producers can change many management practices to reduce risks from climate. Based on the expected seasonal climate outlook or other climate information, producers could change crop selection, planting dates, plant population, cover crop management, input purchasing, nutrient management, and others. The following list highlights the main ways that the information and tools available in AgroClimate can help agricultural producers reduce production risks associated with climate variability:

- Keep track of what climatologists are saying about the expected climate for the season (Figure 2).
- Understand how expected climate conditions may affect crops commonly grown in the Southeastern U.S.
- Explore how El Niño and La Niña phases have historically affected crop production in the Southeastern U.S.
- Learn how El Niño and La Niña events affect the climate in the region and in individual counties.
- Explore the best planting dates for selected crops according to the expected climate forecast.
- Monitor disease risks for selected crops.
- Monitor soil moisture conditions using several drought indices.
- Receive alerts by e-mail or mobile phone.

What are the agronomic benefits?

Several indirect agronomic benefits can be achieved as a result of using the information provided by AgroClimate. For example, the Planting Date Planner tool (http://www.agroclimate.org/tools/yieldRisk/; Fraisse, Paz, and Brown 2007) can help producers explore the likelihood of low, average, or high yield depending on a range of planting date options for a variety of crops growing under Neutral, El Niño, or La Niña phases (Figure 3). Impacts of El Niño and La Niña on county-average crop yields throughout the Southeast are displayed by the Regional Yield maps (Figure 4) on AgroClimate; these can be helpful for determining

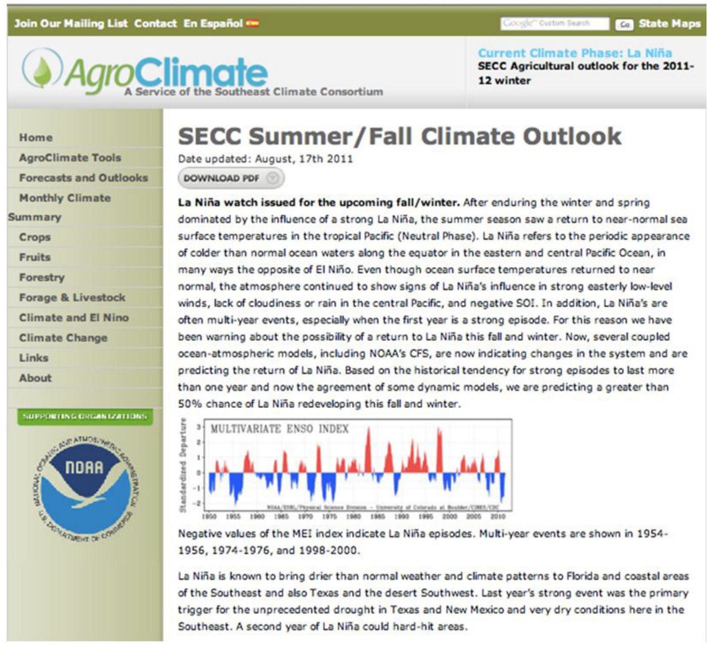

Figure 2. A partial example of a seasonal Climate Outlook on AgroClimate. See http://agroclimate.org/forecasts/current_climate_outlook.php for the latest outlook. These quarterly reports include a 90-day climate outlook, discussion of recent climate history, drought, ENSO phase and other relevant information for the Southeastern U.S.
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which ENSO phase results in the highest likelihood for top yields of a crop in a specific location. The Climate Risk tool (Figure 5) gives more information about what is going on "behind the scenes" in the Planting Date Planner and the Regional Yield maps by displaying, at the county level, the monthly changes in temperature and rainfall for Neutral, El Niño, and La Niña climate phases.

Any management modifications based on ENSO phase or seasonal climate outlooks are typically location-specific and season-specific; therefore, no general "best practices" for modifying agricultural management are available. However, producers can make some management changes when lower-than-average rainfall and higher-than-average temperatures (or higher-than-average rainfall and lower-than-average temperatures) are expected. The nature of the management adjustments will depend on a producer's system and on the direction and probability of rainfall and temperature departures from average. The following list gives management options that could be adjusted in fall and spring based on the expected seasonal climate outlook (http://agroclimate.org/forecasts/Seasonal_Forecast.php) or ENSO phase (http://agroclimate.org/forecasts/Agricultural_Outlook.php):

Fall

- Harvest management (Schedule labor and equipment to adjust timing of harvest in order to avoid damage/losses from excess rainfall.)

- Choice of winter cover crop
- Cover crop establishment (Hasten the establishment of cover crop in seasons when it is expected that cover crop growth will be reduced because of lower-than-average rainfall.)
- Fertilization of cover crop

Spring

- Insurance coverage adjustments
- Termination of cover crop (Could be early or late depending on recent and expected rainfall.)
- Crop/variety selection (Decide which cash crop(s) to plant and to what extent.)
- Planting dates of cash crops
- Plant population (Adjust seeding rates based on expected seasonal rainfall; for example, lower-than-average rainfall, lower plant population.)
- Fertilization

Figures 3, 4, and 5 give a small sample of the available tools on AgroClimate; these tools help users explore how the ENSO phase can impact the "best" planting dates, county-average yields, and climate in a selected county.

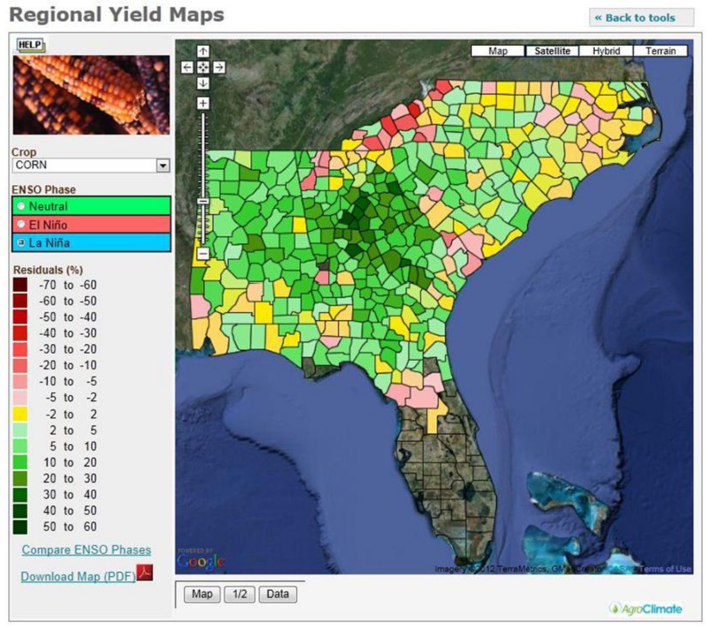

Figure 4. Regional Yield Maps (http://agroclimate.org/tools/regionalYield/) illustrate areas where yields have been above, below, or near-average for different crops and ENSO phases. Results are based on county-level historical yields (corn, cotton, hay, oats, peanut, potato, rye, sugarcane, sorghum, soybean, tobacco, and winter wheat) from the USDA National Agricultural Statistical Services (NASS). The figure above shows that La Niña results in above-average corn yields for much of the Southeast.
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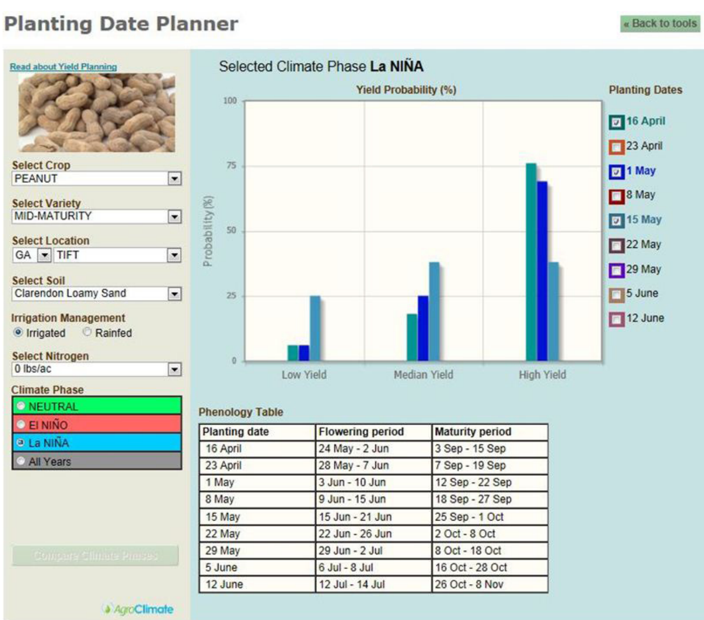

Figure 3. The Planting Date Planner tool (http://agroclimate.org/tools/yieldRisk/) helps producers determine which dates carry more or less yield risk depending on the location, crop, soil type, and ENSO phase. This tool is based on the results of numerous crop growth simulations. Crop choices include varieties of corn, cotton, peanut, potato, and fall, spring, and winter tomatoes. Counties in Florida, Georgia, or Alabama can be selected. Three county-specific soil choices are available. The figure above shows the results of selecting three planting date options as indicated by the check marks next to the dates in the upper-right portion of the figure. Notice that the earliest planting date (April 16) gives the greatest likelihood for high yields.
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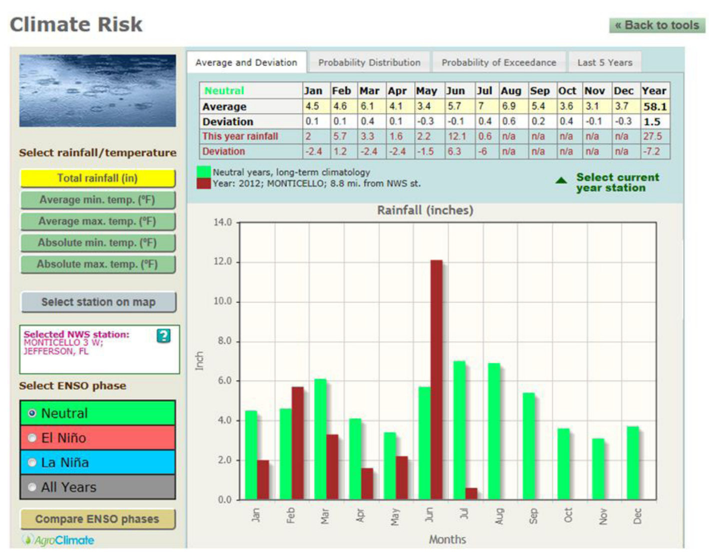

Figure 5. The Climate Risk tool (http://agroclimate.org/tools/climateRisk/) displays information about basic climatology (rainfall and minimum and maximum temperatures) for different ENSO phases. A map-based interface allows selection of weather stations in Florida, Georgia, Alabama, South Carolina, and North Carolina. For Florida and Georgia, current year conditions are also shown for comparison to historical climatology. Data presentation options include average and deviation, probability distribution and exceedance, and five-year monthly data.
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What are the impacts on production costs?

Using climate information to adjust management decisions can have modest to substantial economic value for agricultural producers (Meza, Hansen, and Osgood 2008; Letson et al. 2005; Chen, McCarl, and Hill 2002). Using AgroClimate does not increase production costs and may reduce them depending on the use of the system. For example, strawberry producers can use the system (http://agroclimate.org/tools/strawberry/) to decide about fungicide applications. This tool (the Strawberry Advisory System) lets them know when there is risk of disease infection, so fungicides can be applied accordingly. This reduces unnecessary sprays and can reduce chemical costs. As another example, if the tool shows a prediction for a drier-than-average season, row crop farmers may select a different crop variety, alter plant population, or reduce nutrient applications. The decrease in production costs can be significant depending on the season. In general, no clear methods exist to determine precisely how much AgroClimate can reduce costs; actual savings will depend on the particular use of the system, climate conditions, and cropping system.

What is the investment cost?

If you already own a computer with an Internet connection or a mobile phone, there is no cost for using AgroClimate.

What are the impacts on greenhouse gas emissions?

No field studies have been completed that directly demonstrate reduced greenhouse gas emissions from using AgroClimate. However, using AgroClimate could give opportunities to improve input-use efficiency based on climate information, which would intuitively suggest a reduction in emissions. For example, if a producer reduces nutrient applications for a cropping season when a seasonal forecast indicates high probability for below-average rainfall, the producer may achieve greater nutrient-use efficiency per unit crop yield than conventional nutrient applications.

What are the barriers and incentives for implementation?

AgroClimate is part of a broad range of tools available to producers for assisting with agricultural management decisions. As with any new technology, using a climate information system such as AgroClimate has barriers and incentives:

Barriers

- Timing of the information (for example, a seasonal forecast) may not coincide with the decision-making time for some operations.
- Forecasts are probabilistic in nature (i.e., forecasts are not 100% certain).
- Other factors such as price, crop rotation, and subsidies should always be taken into consideration and may override climate-related issues.

Incentives

There are no explicit financial incentives for using climate information in crop production. But there are good reasons that a producer should use climate information, including the nature of climate variability and the potential enhancement of extremes caused by climate change. The potential for increased yields and reduced input costs (resulting from adjustments in crop selection, timing of operations, and other management changes based on climate information) may be enough of an incentive for producers and Extension professionals to use AgroClimate.

Acknowledgments

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