Decision-Support Maps for Corn Planting Date and Crop Maturity in Mississippi

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INTRODUCTION Mississippi's shift in cropping system dominance from upland cotton (*Gossypium hirsutum* L.) to corn (*Zea mays* L.) has caused variably-scaled challenges (at the field-, farmscape-, and regional-scales) for producers and other crop care professionals. Geospatial integration of a 4-year corn production footprint (derived from 2013-2016 Cropland Data Layers (CDLs)) with a series of updated temperature-based planting date probability maps enables farmers and other crop professionals to adapt management strategies, minimize risk, and help improve farm-gate earnings.

Fig. 1. Historical profile of corn acreage planted in Mississippi. At its peak, in 2007, 930,000 acres were planted to corn. The 5-year interval (2009-2013) selected for a more comprehensive study in all likelihood has effectively "captured" the extent of the corn acreage footprint in Mississippi by accommodating for 2-, 3-, and 4-year rotation cycles; the aerial extent was estimated at 2.4 million acres. *http://www.nass.usda.gov/Quick_Stats/*

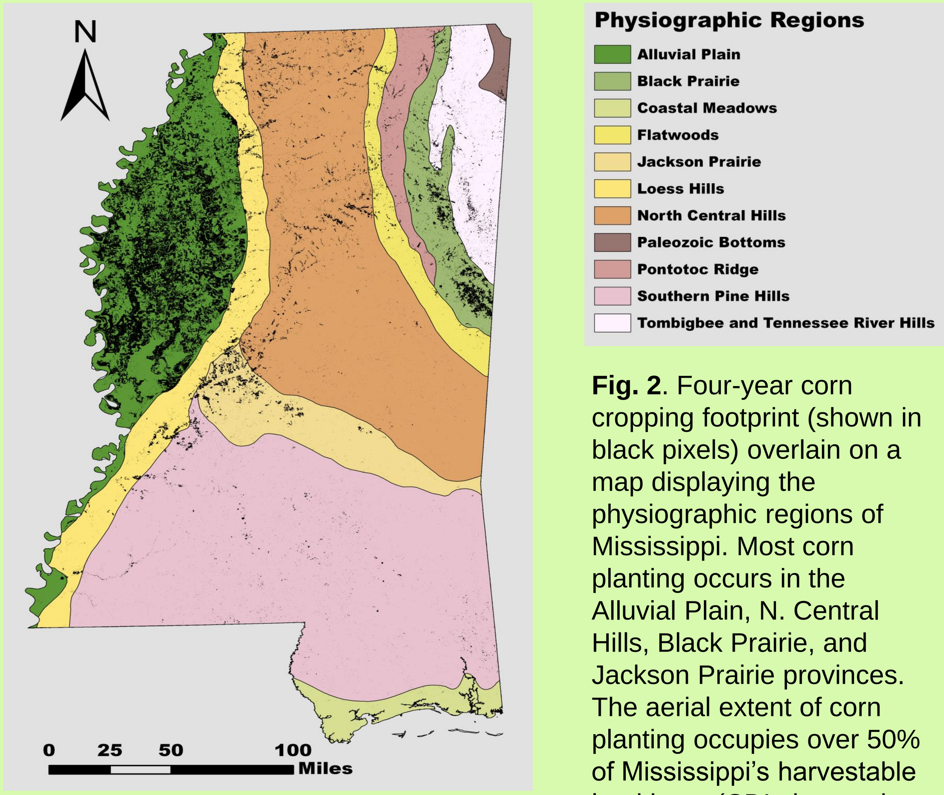

Fig. 2. Four-year corn cropping footprint (shown in black pixels) overlain on a map displaying the physiographic regions of Mississippi. Most corn planting occurs in the Alluvial Plain, N. Central Hills, Black Prairie, and Jackson Prairie provinces. The aerial extent of corn planting occupies over 50% of Mississippi's harvestable land base (CDL time series 2013-2016). CDL datasets are posted at *http://nassgeodata.gmu.edu /CropScape/*

MATERIALS and METHODS A 4-year corn cropping footprint was constructed from the 2013-2016 CDL time series (as posted on CropScape); a "clump and sieve" model constrained and partially correct remotely-sensed crop recognition errors while retaining fields as small as 3 acres (DeFauw *et al*. 2012). One set of planting date probability maps was derived from 30-year climate data ("moving window" by target year) using 60 in-state stations and 270 surrounding stations. PRISM (Parameter-elevation Relationships on Independent Slopes Model) climate data were used to construct the other map set. Day of the year (DOY) data for the last time the temperature was at or below a specified threshold between January and July were compiled from the 30-year dataset at each station or PRISM-grid unit. An inverse probability distribution was used to calculate the dates for a specific risk level. The growing degree day accumulation map was based on corn exhibiting physiological maturity at 2700 growing degree units (GDUs).

RESULTS Federal incentives of 2007 caused a spike in acreage dedicated to corn in Mississippi (Fig. 1). Corn production, based on CDL time-series 2013-2016, occupies over 50% of Mississippi's harvested land base. Actually, since 2007 over half of the counties in the Delta have invested between 60-85% of their arable land in corn across the 4-year study interval (Fig. 2). For display purposes only the 2013-2015 maps have been included here. Risk probability maps (at the 10% risk level), generated from National Weather Service (NWS) station-derived data maps, indicate 2-3 week delays in corn planting dates for two areas in the southern half of Mississippi (Fig. 3). These NWS-based probability maps also show 7-21d differences in planting date just spanning the Alluvial Plain. PRISM (Parameter-elevation Relationships on Independent Slopes Model) climate data maps highlight notable zonal differences in south Mississippi (Fig. 4). Based on PRISM models (at a resolution of 16 km^2), spatial analysis indicates ~20% of the statewide acreages could advance planting dates 1-3 weeks at a very low risk of 10% (Fig. 5).

CONCLUDING REMARKS Sustainable intensification hinges on the optimization of crop initiation coupled with earlier harvests and rotational systems that generate higher yields to improve financial outcomes for Mississippi farmers. Traditionally, producers in the mid-Delta initiate planting early to mid-March. However, planting "timely" incurs modest yield penalties from year-to-year in midwestern Corn Belt states (Irwin *et al*. 2015; Nafziger, 2012). PRISM-model-based spatial analyses indicate that close to 20% of the statewide acreages could advance planting dates 1-3 weeks at a very low risk of 10%. Decision-support models that integrate time to crop maturity using growing degree units (GDUs - as shown in Fig. 6) with optimal planting date intervals are the next logical steps to help producers maintain a competitive edge in corn commodity markets. Some maps presented here are posted on the MSU-DREC website *www.deltaweather.msstate.edu/ ag_weather_products/ cornplanting.htm*

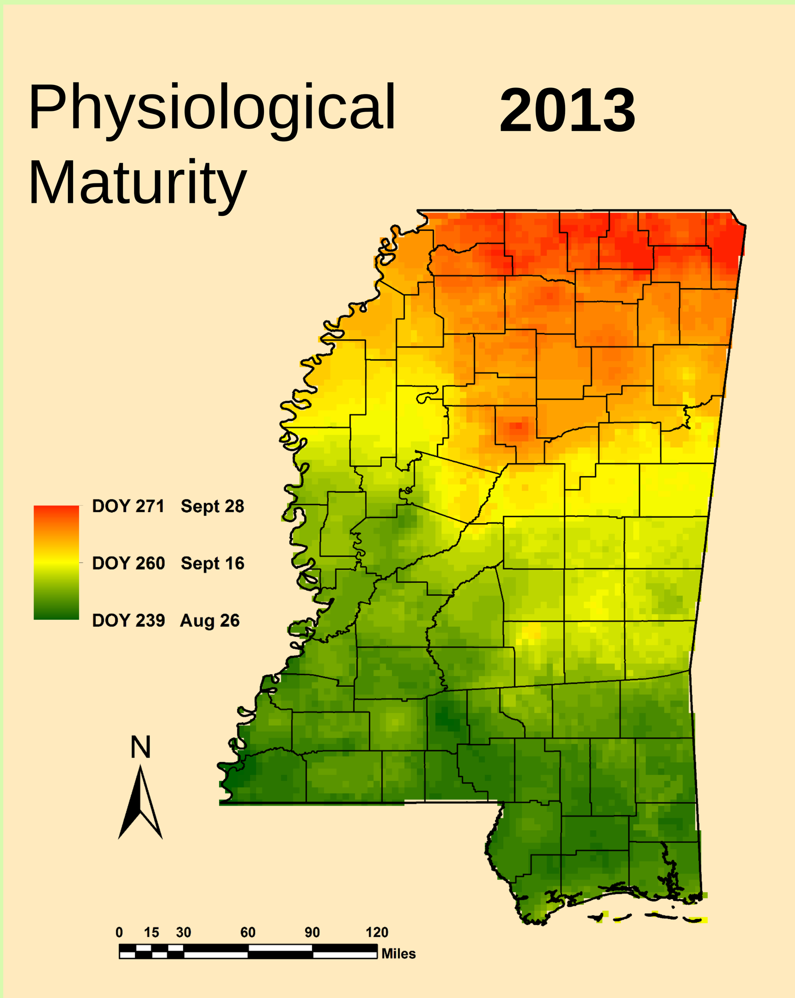

Fig. 6. A physiological maturity map for corn in 2013 based on growing degree units accumulated from the day after planting (in this example, 2700 GDUs). PRISM model temperatures were used.

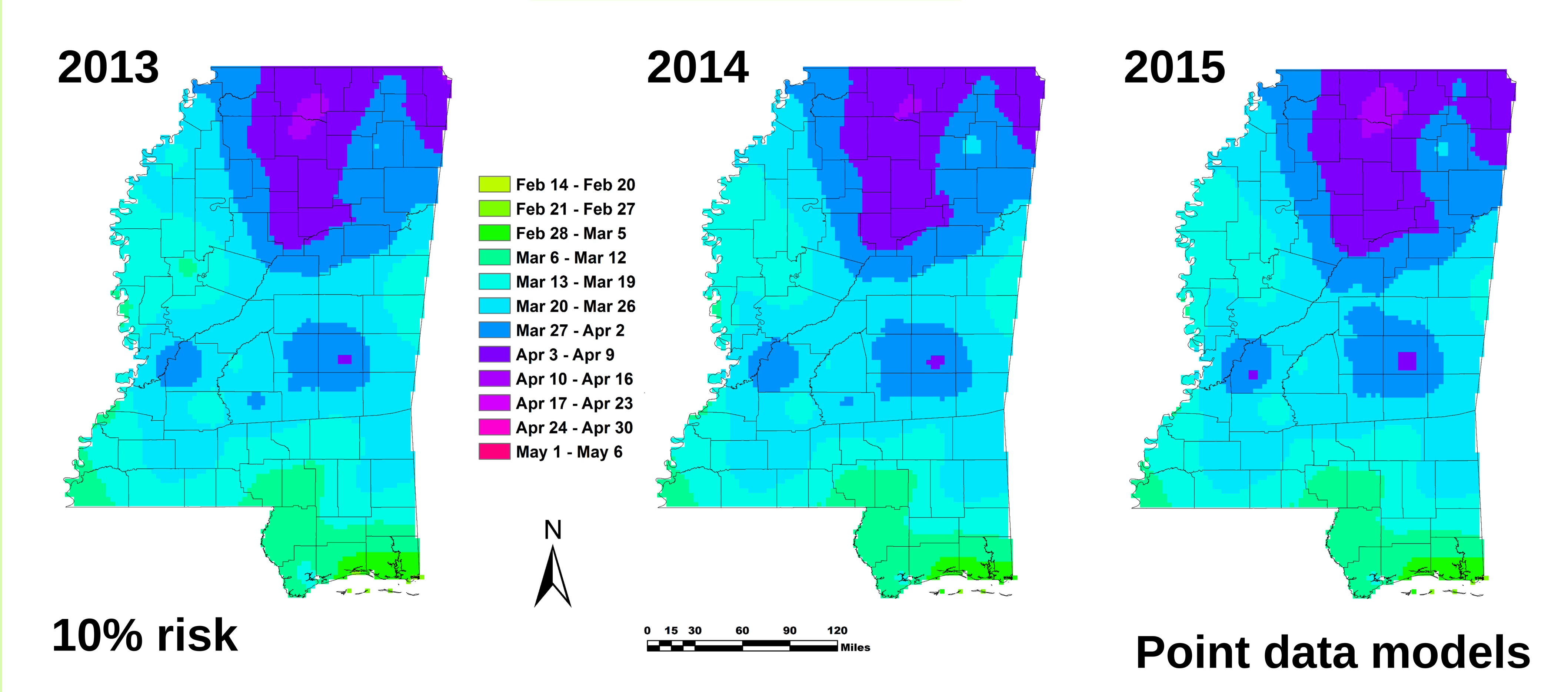

Fig. 3. Corn planting date probability maps derived from National Weather Service (NWS) weather stations. Color gradients are linked to 7-day planting date intervals that display areas with a 10% risk of temperatures falling below a critical threshold of 28°F. Day of the year (DOY) data, for the last time the temperature was at or below specified threshold between January and July, were compiled from each weather station over a 30-year interval (e.g., the 2013 map is based on 1983-2012). These risk maps were generated using interpolated point data from 60 stations within the state and 270 weather stations surrounding the state (LA, AR, TN and AL).

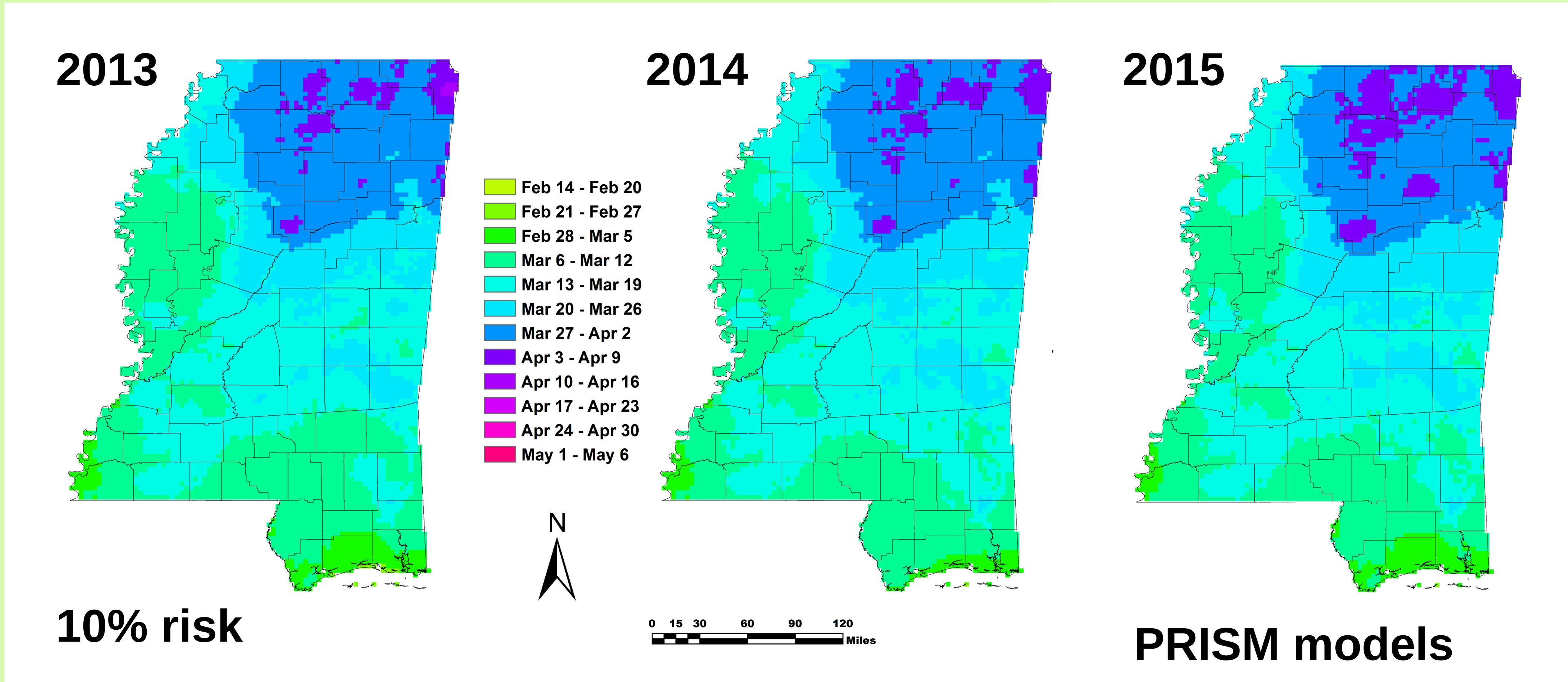

Fig. 4. Corn planting date probability maps derived from PRISM climate datasets. Color gradients are linked to 7-day planting date intervals that display areas with a 10% risk of temperatures falling below a critical threshold of 28°F. The datasets extracted using PRISM grids span 30 years prior to the date on each risk map. These PRISM grids are much coarser with different algorithms modeling slope, topography and land use applied; each grid cell covers 16 km^2 (4 km x 4 km). Comparing PRISM climate data-derived risk maps with point-derived interpolated maps from 330 weather stations shows notable zonal differences in key corn-producing counties including Washington, Yazoo, Leflore and Warren.

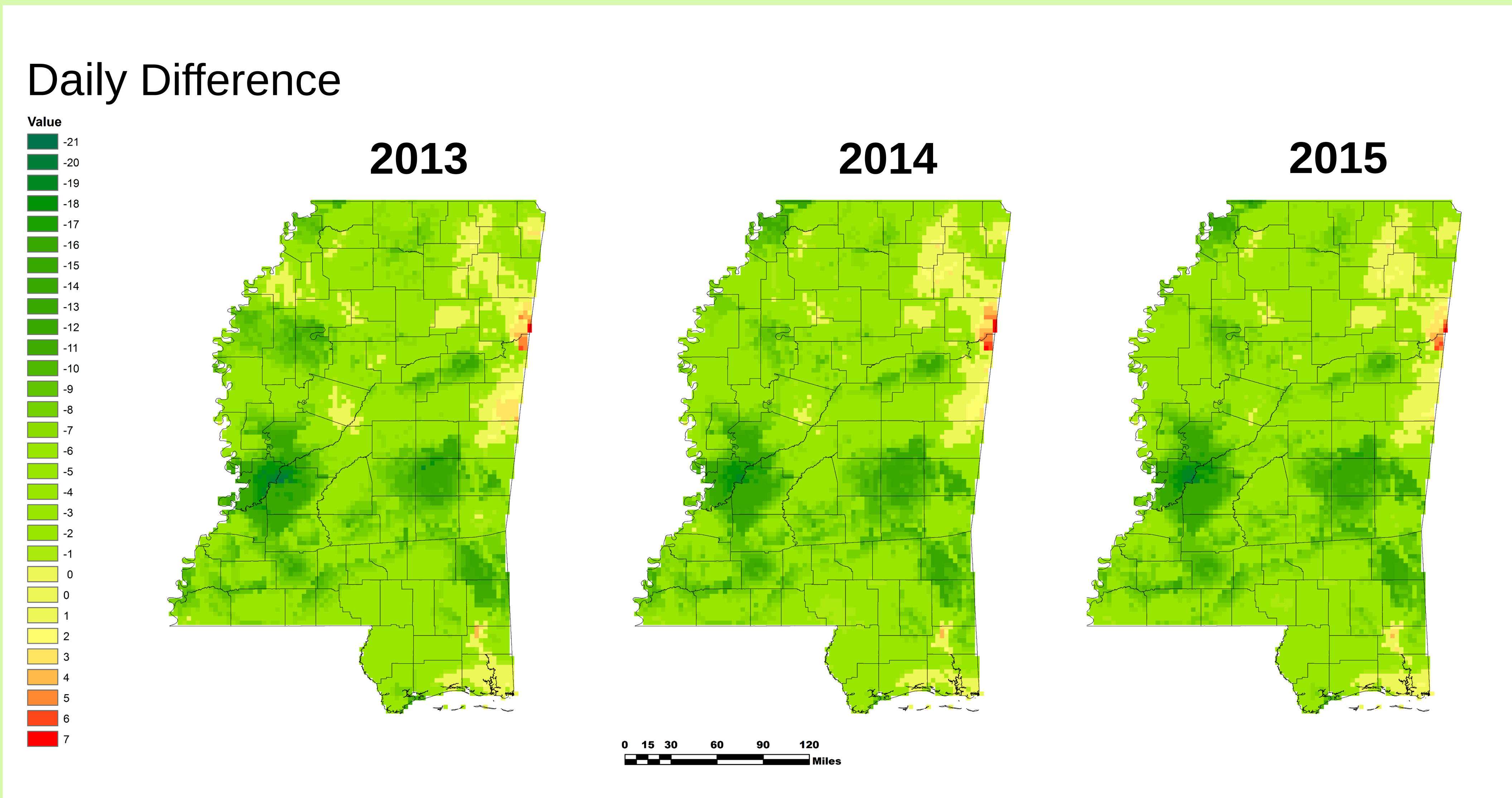

Fig. 5. Geospatial maps highlighting differences in the number of days between NWS weather station-derived corn planting dates and PRISM-derived probability maps. Based on PRISM data models, spatial analysis indicates close to 20% of the statewide acreages could advance planting dates 1-3 weeks at a very low risk of 10%.

REFERENCES

Cropland Data Layer (CDL) datasets are posted at *http://nassgeodata.gmu.edu/CropScape/*

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