
# Assessing User Needs and Model Accuracy of Seasonal Climate Forecasts for Winter Wheat Producers in the Southern Great Plains

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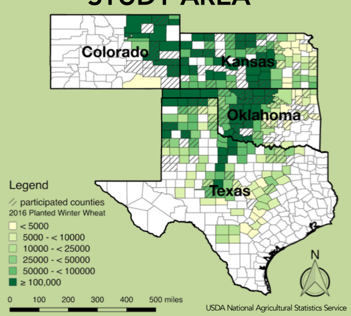
## RESEARCH QUESTIONS

1. How can seasonal climate forecasts be tailored to **serve the needs** of winter wheat producers in the south-central United States?

2. Can existing seasonal forecast models provide forecast data for these products **with better accuracy** than persistence forecasts?

## STUDY AREA




## BACKGROUND

- Drought, heat, or extreme rainfall can threaten crop growth and cause crop losses and crop failure
- Seasonal climate forecasts can warn farmers and assist in long-term decision making to adapt to and mitigate unseasonal conditions
- Problem: current seasonal forecasts lack relevant information and spatial resolution for farm decision-making
- Our approach: a mixed methods, user-driven attempt to *define forecast needs* and *assess model accuracy* of a high-resolution seasonal climate forecast model

## METHODS

### Survey

- Online survey, January to May 2016
- 360 agricultural advisors in CO, KS, OK, TX (one per county)
- 119 responses (33 % response rate)

### Forecast analysis

- Comparison of absolute model (lead 0 - 11 months) and seasonal persistence errors
- Precipitation (monthly): 1985-2011, NOAA PREC/L
- Precipitation (daily): 1985-2013, CPC Unified Gauge-Based
- Temperature: 1985-2011, GHCN CAMS
- Model: Geophysical Fluid Dynamics Lab FLOR B-01 (50 x 50 km)
- Persistence: 5-year previous average of month in question
- Bias correction of model by subtraction (temperature) and division (precipitation) using model error at lead 0

## Survey Results

### Seasonal forecast needs

*What forecast elements are ranked highest in a monthly forecast for winter wheat producers?*

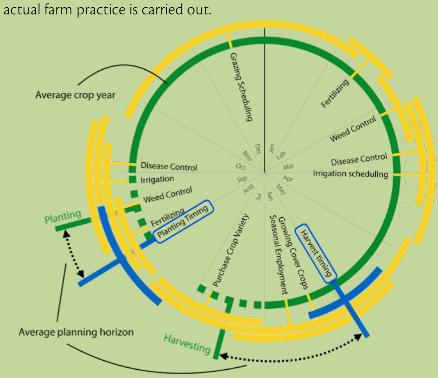
The top four forecast elements are related to precipitation. Despite the seasonality of decision-timing, month-to-month variability here is small. *Not shown: Ranking of forecast elements varies considerably across regions.*

| | **Avg.** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average precipitation | **1** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Consecutive days w/o rain | **2** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Deviation from avg. precip. | **3** | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| Chances of extreme rain | **4** | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 5 | 4 | 4 | 4 | 4 |
| Average temperature | **5** | 5 | 5 | 5 | 5 | 6 | 6 | 5 | 4 | 5 | 5 | 5 | 5 |
| Consecutive days > 100°F | **6** | 6 | 6 | 6 | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 |
| Average max. temperature | **7** | 8 | 7 | 7 | 7 | 7 | 7 | 9 | 9 | 8 | 8 | 9 | 9 |
| Growing degree days | **8** | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 7 | 8 |
| Deviation from avg. temp. | **9** | 10 | 9 | 9 | 9 | 9 | 9 | 7 | 7 | 7 | 7 | 8 | 10 |
| Average min. temperature | **10** | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 11 | 11 |
| Consecutive days < 32°F | **11** | 9 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 7 |

### Decision timing

*When are major management decisions made in winter wheat farming?*

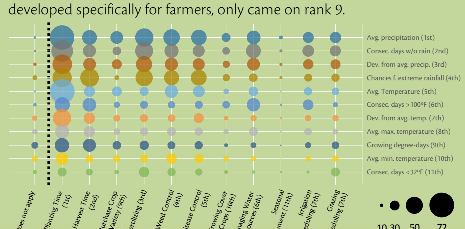
Decision timing has a strong seasonality, with some decisions made once per year, some twice. Planning is done only two to three months before the actual farm practice is carried out.




### Preferred forecast elements

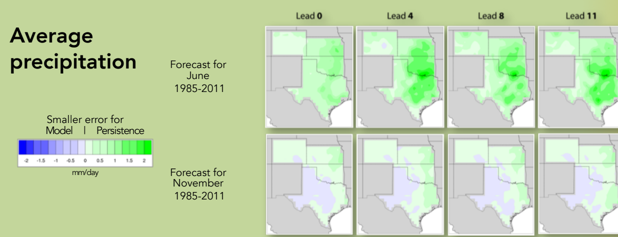
*What forecast elements assist which decisions?*

The top four requests relate to precipitation; average precipitation is the most requested forecast element. Growing degree days, a measure developed specifically for farmers, only came on rank 9.



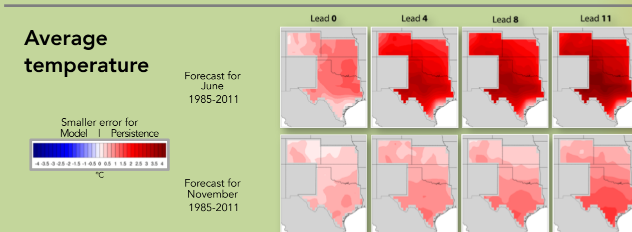

## Forecast Analysis Results

### Average precipitation



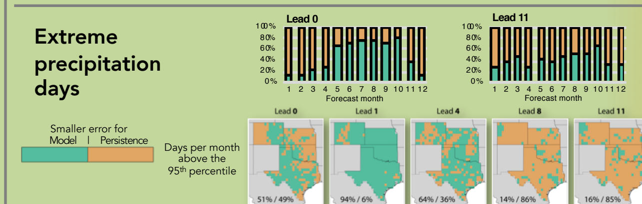

- Dichotomy: absolute persistence error smaller in summer (especially over the eastern parts of the study area), abs. model error smaller in winter (over the western parts of the study area)
- Error largely independent of lead time (more dependent on forecast month)

### Average temperature



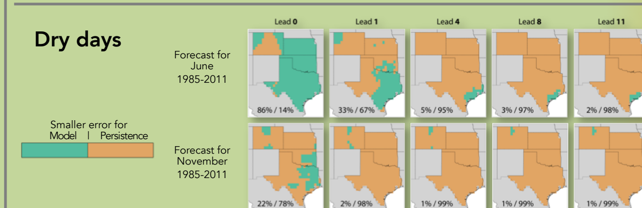

- Abs. model error almost always larger than persistence error (exceptions along the Gulf Coast)
- Absolute error dependent on lead time and forecast month

### Extreme precipitation days




- Model and persistence forecasts both greatly underestimated actual extreme rainfall amounts
- Model error was smaller on shorter lead times during summer, persistence error was smaller in winter across most of the study area

### Dry days




- Model / persistence forecasts underestimated the number of dry days per month by ca. 50 / 30 %
- Model error was smaller in summer, especially at shorter lead times and along the Texas Gulf coast

### About Toni Klemm

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