Forecasting Wheat Basis using Soil Moisture Measurements

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Introduction

- Check out the interactive crop basis tool at agmanager.info: https://agmanager.info/grain-marketing/interactive-crop-basis-tool

- Lots of variables impact basis prices
  - Current inventories
  - Transportation costs
  - Local weather
  - Global production/trade

- Question: *"How do we determine what next year's harvest basis price be?"*

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Price forecasting is hard

- Answer: *"Use last year's price - maybe."*
- Prior research showed 5 year avg. of harvest basis for wheat is most accurate
  - Can current market info be used to predict post-harvest basis?
  - If market is ***fully efficient***, then the market price reflects all available information; adding info shouldn't improve forecast

Efficient market?

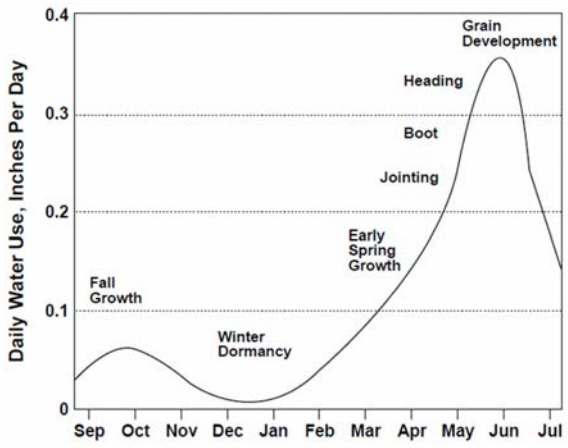
- What happens when official reports are out of sync w/ conditions on the ground?
- Case in point: this year's corn harvest
  - June '19 WASDE → corn futures prices ↓ 4%
  - August '19 WASDE → corn futures prices ↓ 6%

Big data in forecasting

- Can we leverage 'big data' for more accurate forecasts?
- Satellite data on soil moisture for the United States
- *Goal:* Use weekly averages of soil moisture data around the grain elevator to get a sense of supply conditions

Price forecasting

- *Reasoning*
  - Soil moisture important for crop growth/development
  - If certain parts of the growing season conditions are too dry/wet → low supply



Price forecasting

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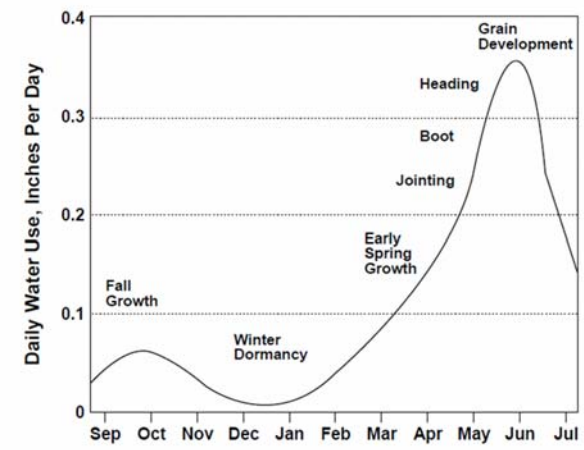
  - Low supply → higher cash prices → narrow basis



Leveraging 'big data'

- *Reasoning*
  - Soil moisture important for crop growth/development
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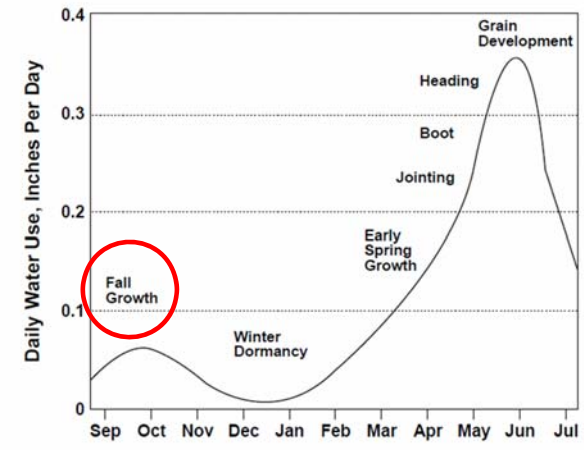
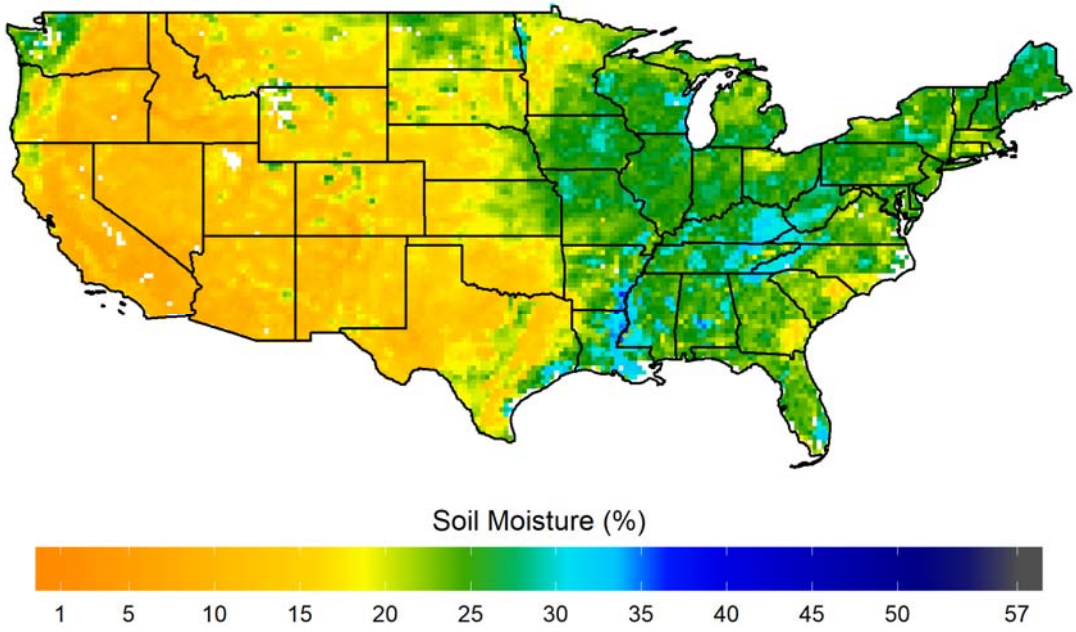
  - Low supply → higher cash prices → narrow basis
  - *Implementation:* Include soil moisture readings around an elevator from the fall growth period in our price forecast



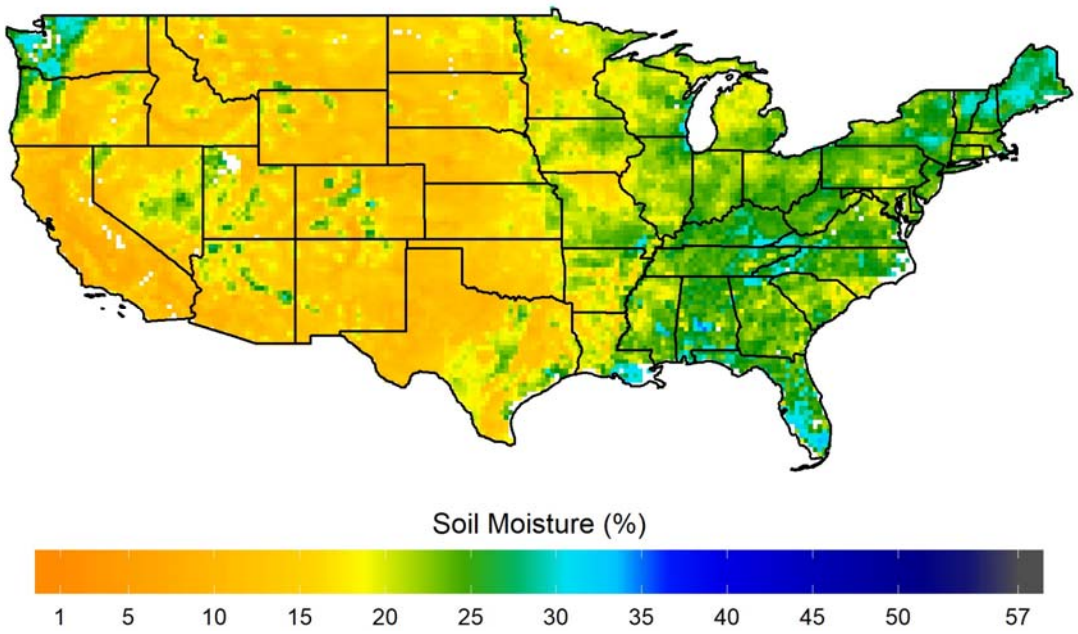
Weather data

- Soil moisture
  - European Space Agency (ESA)
  - Satellite data, 17 x 17 miles grids
  - Good coverage during planting/harvesting
  - Only use for initial 3 weeks (September) in marketing year

Initial soil moisture (09-03-2014)

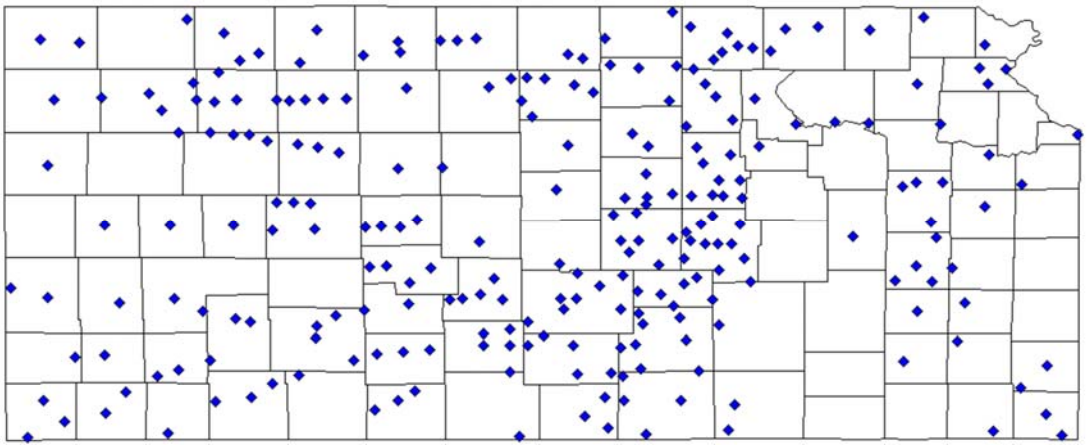


Initial soil moisture (09-01-2013)

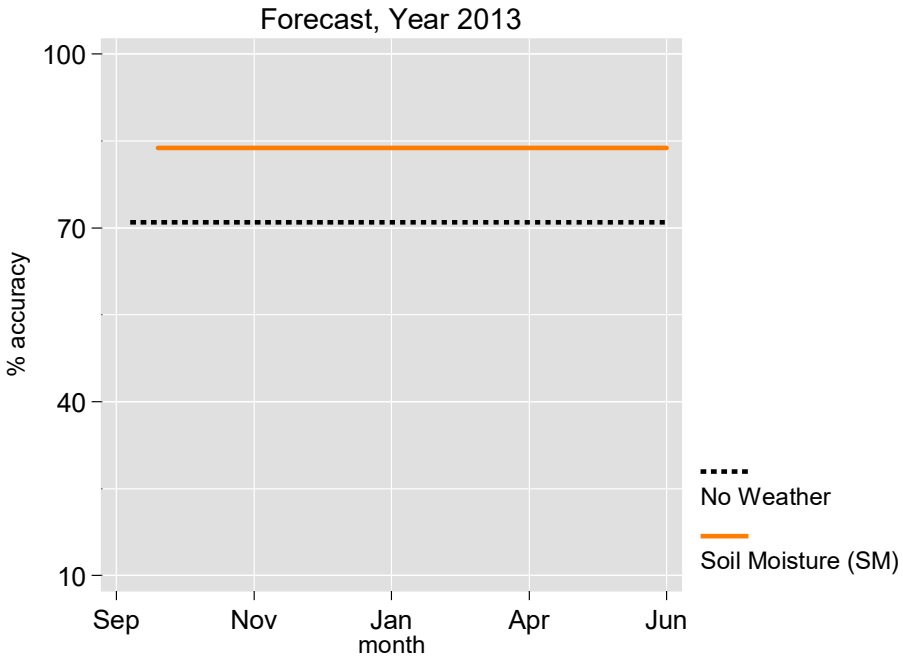


Price data

- *Basis price = cash - futures*
- Cash prices, 482 Kansas Elevators
- Futures prices for July delivery, Kansas City Board of Trade



Dry growing season



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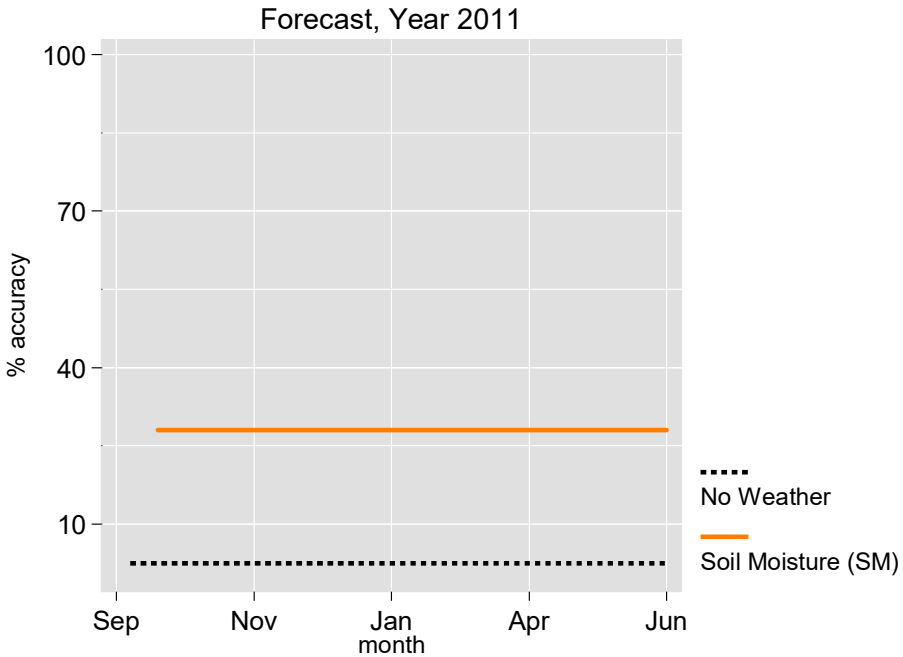

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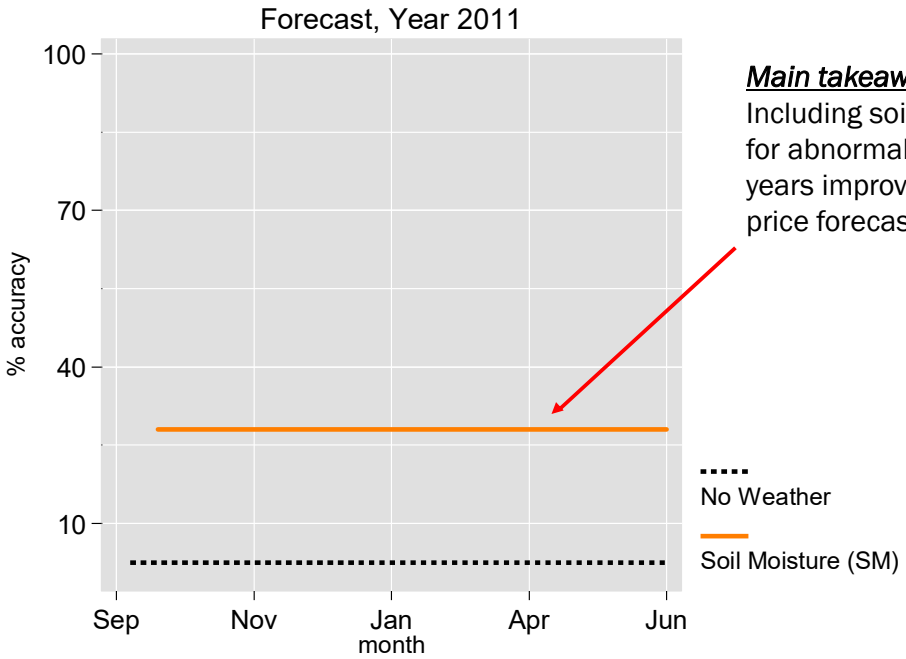
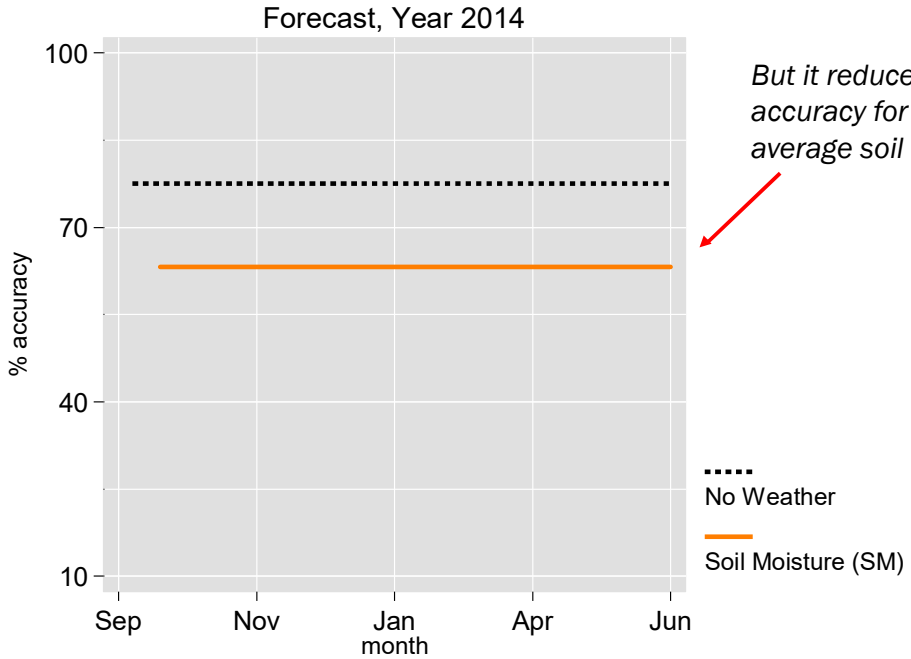


Main takeaway
Including soil moisture for abnormally dry years improves our price forecasts…

Avg. weather growing season

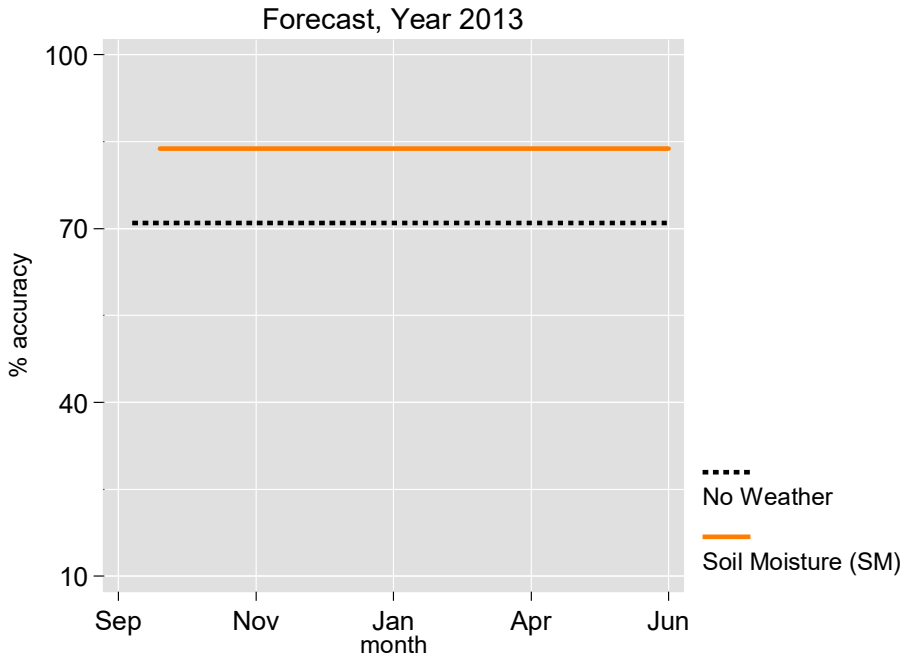


But it reduces forecast accuracy for years w/ average soil moisture

Can we do better?

- Temperature data
  - Very hot weather can lead to yield losses
  - Include a variable that measures week-to-week exposure to extreme heat
  - Min and max temps, 2.5 x 2.5 miles
  - Use up until last 4 weeks of growing season

Dry growing season



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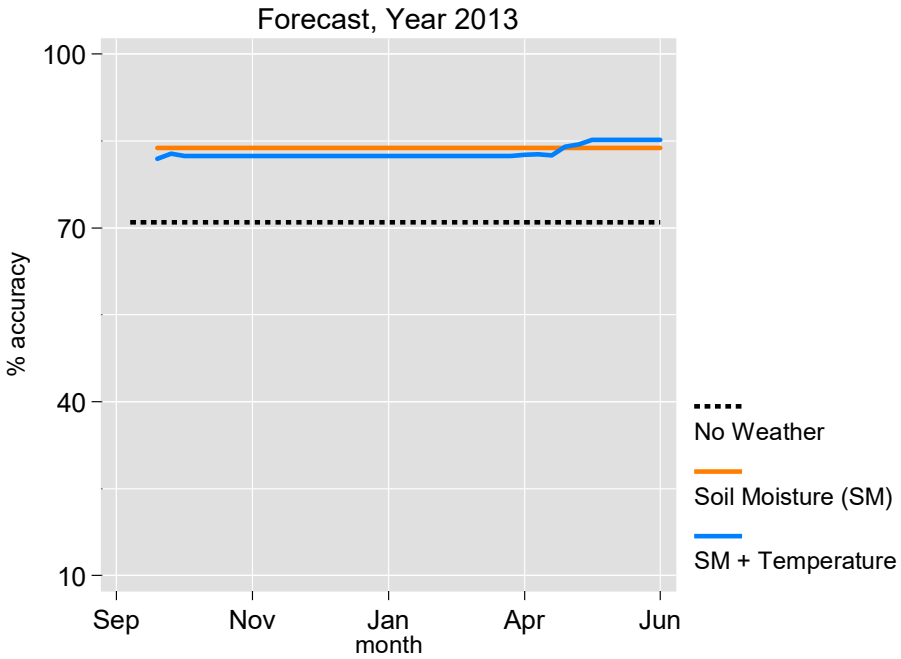

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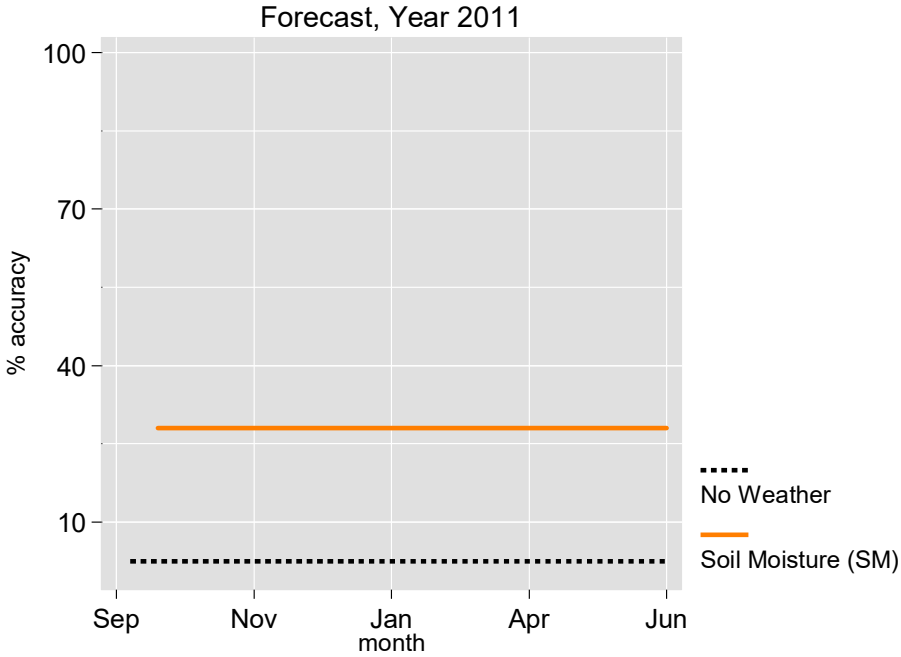

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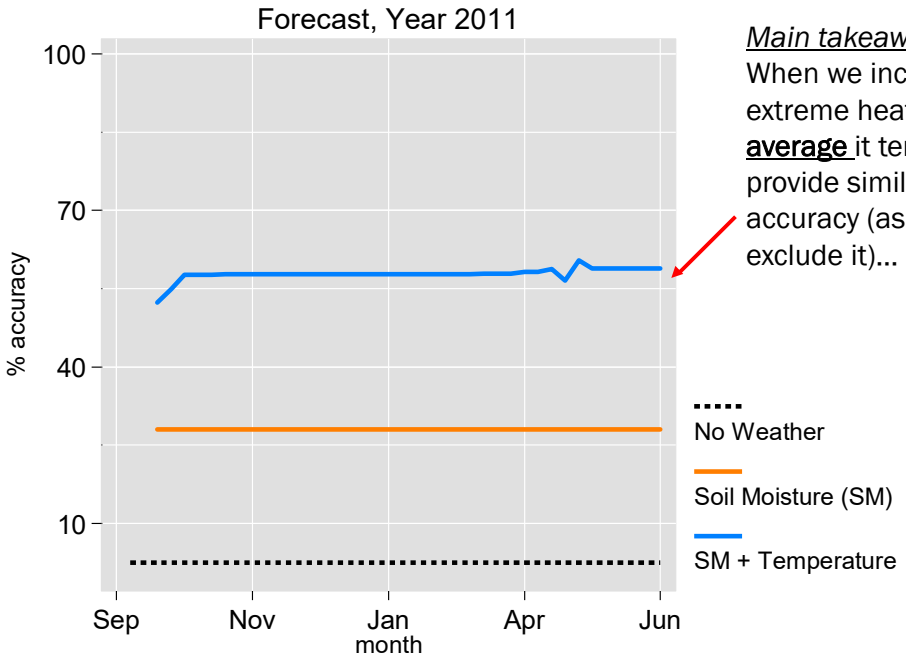

Main takeaway
When we include a extreme heat variable **on average** it tends to provide similar or higher accuracy (as when we exclude it)…

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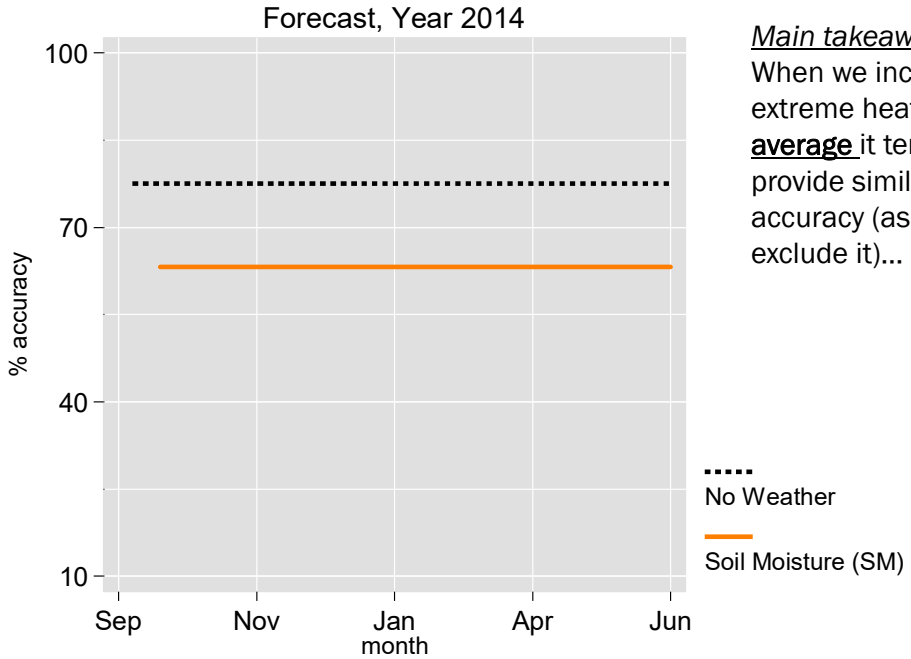

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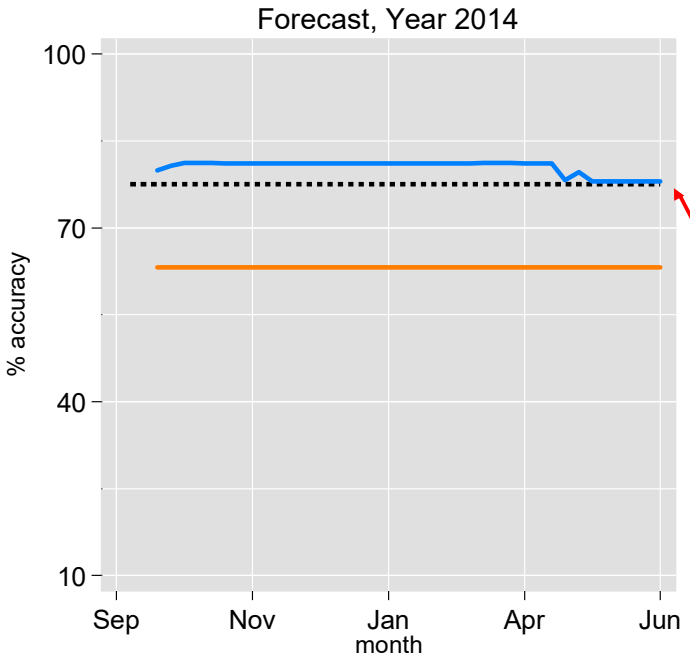

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When we include a extreme heat variable **on average** it tends to provide similar or higher accuracy (as when we exclude it)…

including during an avg. weather growing season

Example

- How big a difference does it make?
  - Depends on the elevator and the forecast year
  - Consider an elevator located in Stockton, KS

YEAR	FORECAST (w/ no weather)	FORECAST (w/ soil moisture)	FORECAST (w/ soil moisture & temps)	ACTUAL BASIS
2012	-$0.60	-$0.46	**-$0.54**	*-$0.53*
2013	-$0.63	-$0.43	**-$0.42**	*-$0.18*
2014	**-$0.58**	-$0.88	-$0.63	*-$0.22*
2015	**-$0.57**	-$0.59	-$0.61	*-$0.31*

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Implications

- Mixed results: including weather info helps during abnormally dry weather – but doesn't under avg. growing season weather

- Two potential reasons for this:

  1. The relationship between price and local weather is too complex for our models

  2. The wheat market is fully efficient – price is being continually updated with weather information

Implications

- Market for alfalfa/grass hay considered inefficient
  - Prices reported weekly, regionally
  - Lack of futures contract
  - Prices reported for regions (USDA - Ag Marketing Service)

Discussion

We welcome all questions and comments. Thank you!

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