Knowing When to Spray: Monitoring the Weather

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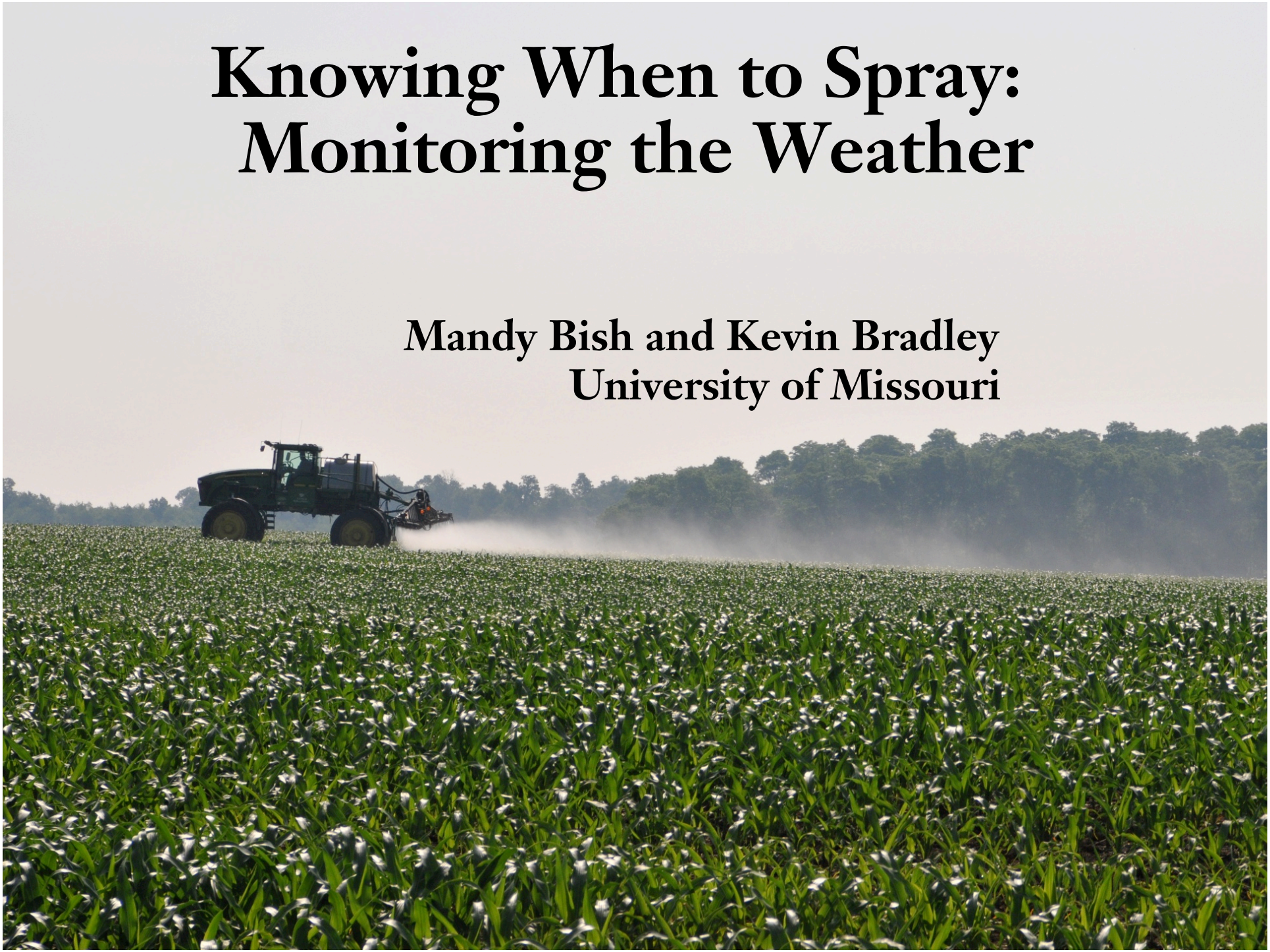
University of Missouri



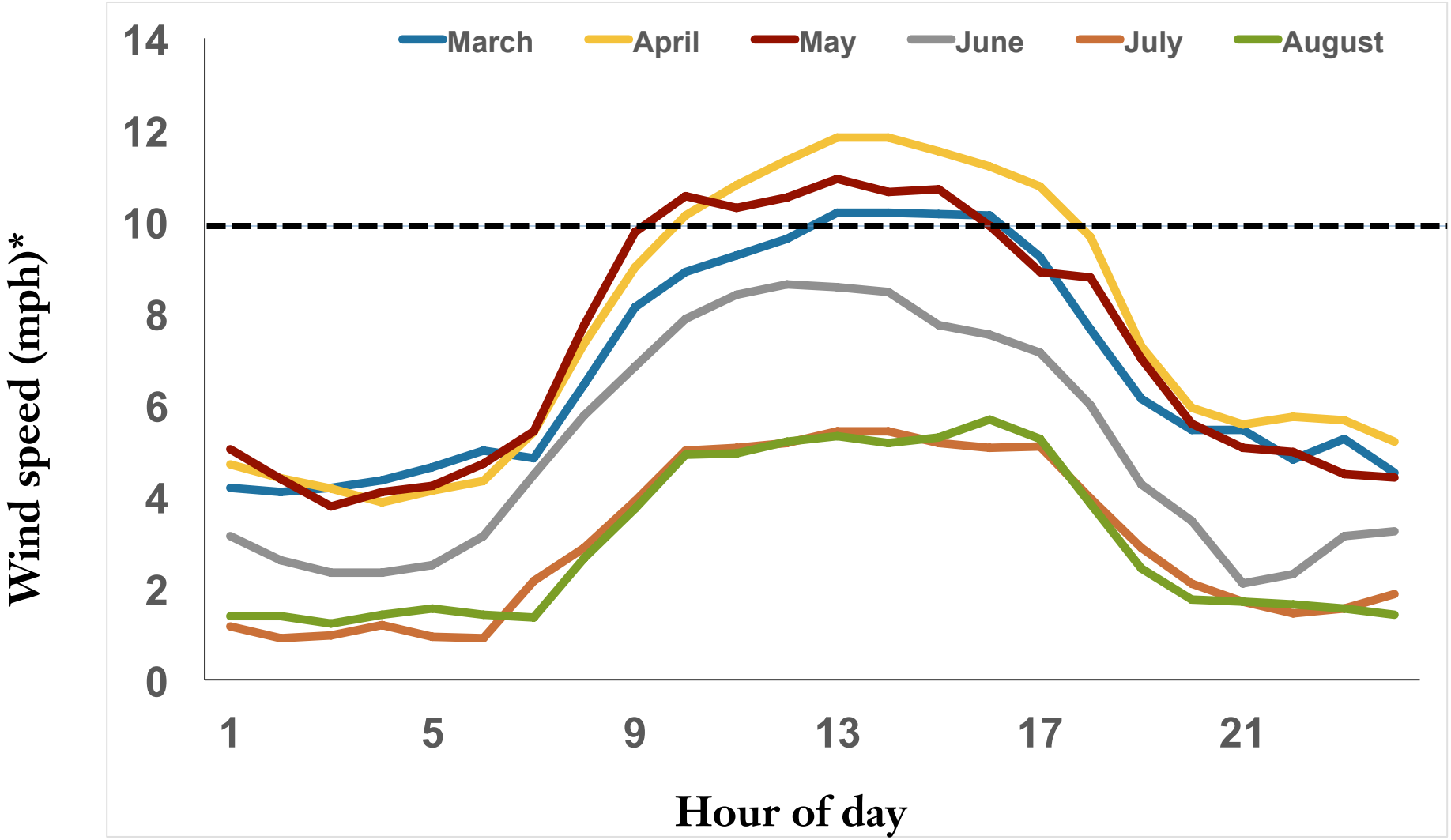
Physical Drift

Movement of herbicide particles due to wind

All pesticides can physically drift—regardless of formulation!!

Historical Wind Speeds

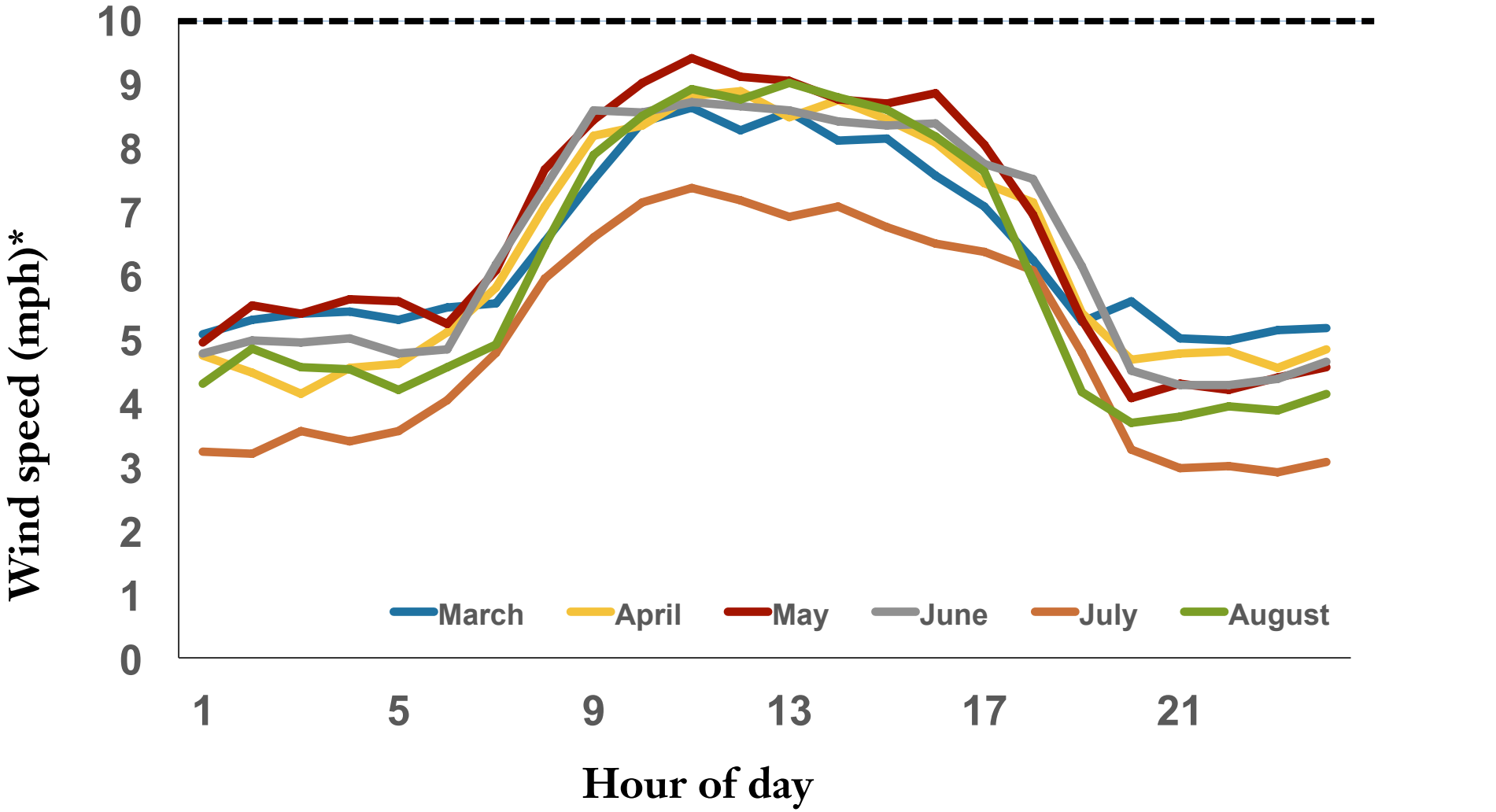
Southeast Missouri



*Hourly wind-speed averaged from the years 2000 to 2015

Historical Wind Speeds

Southwest Missouri



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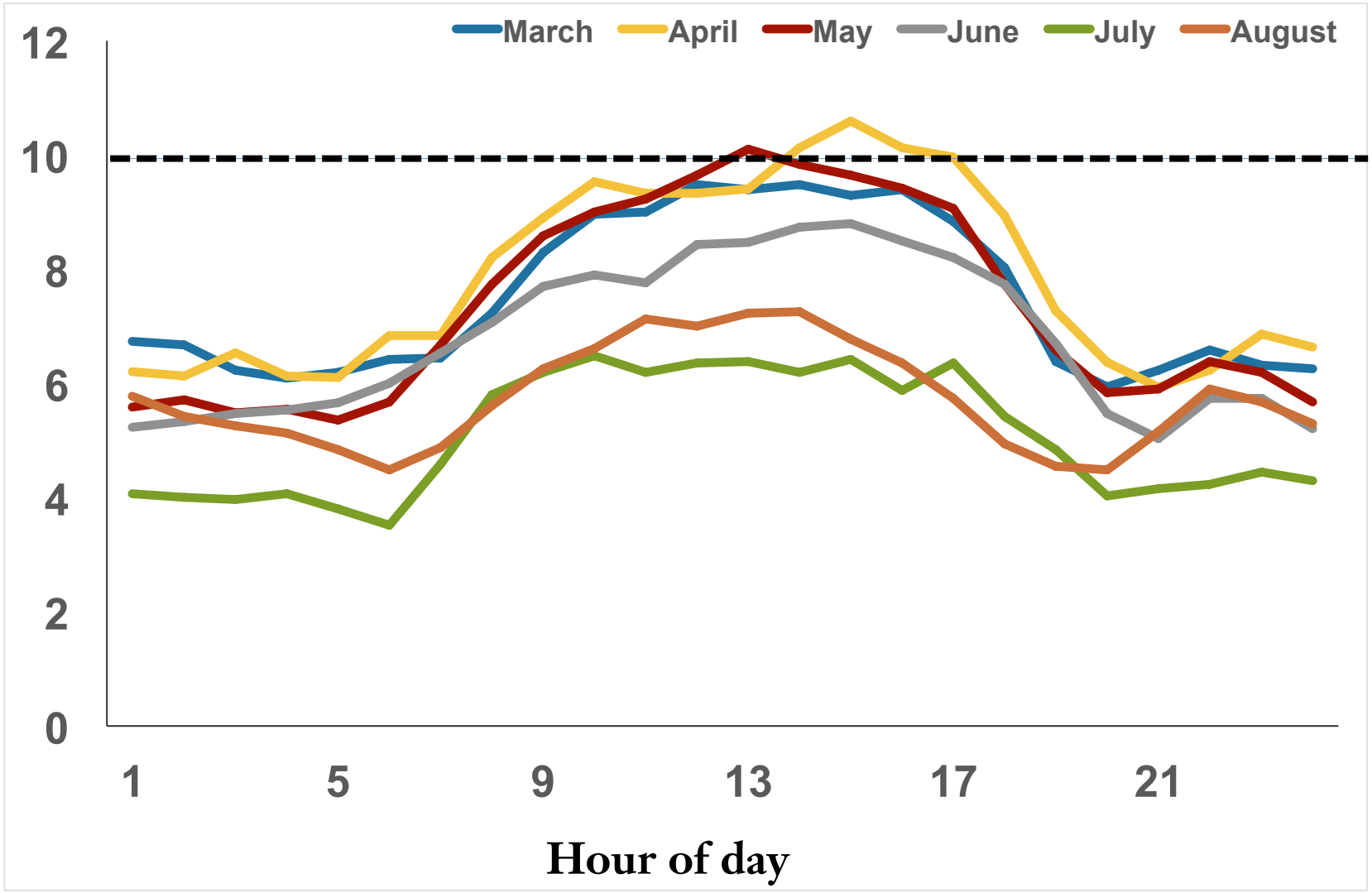
Historical Wind Speeds

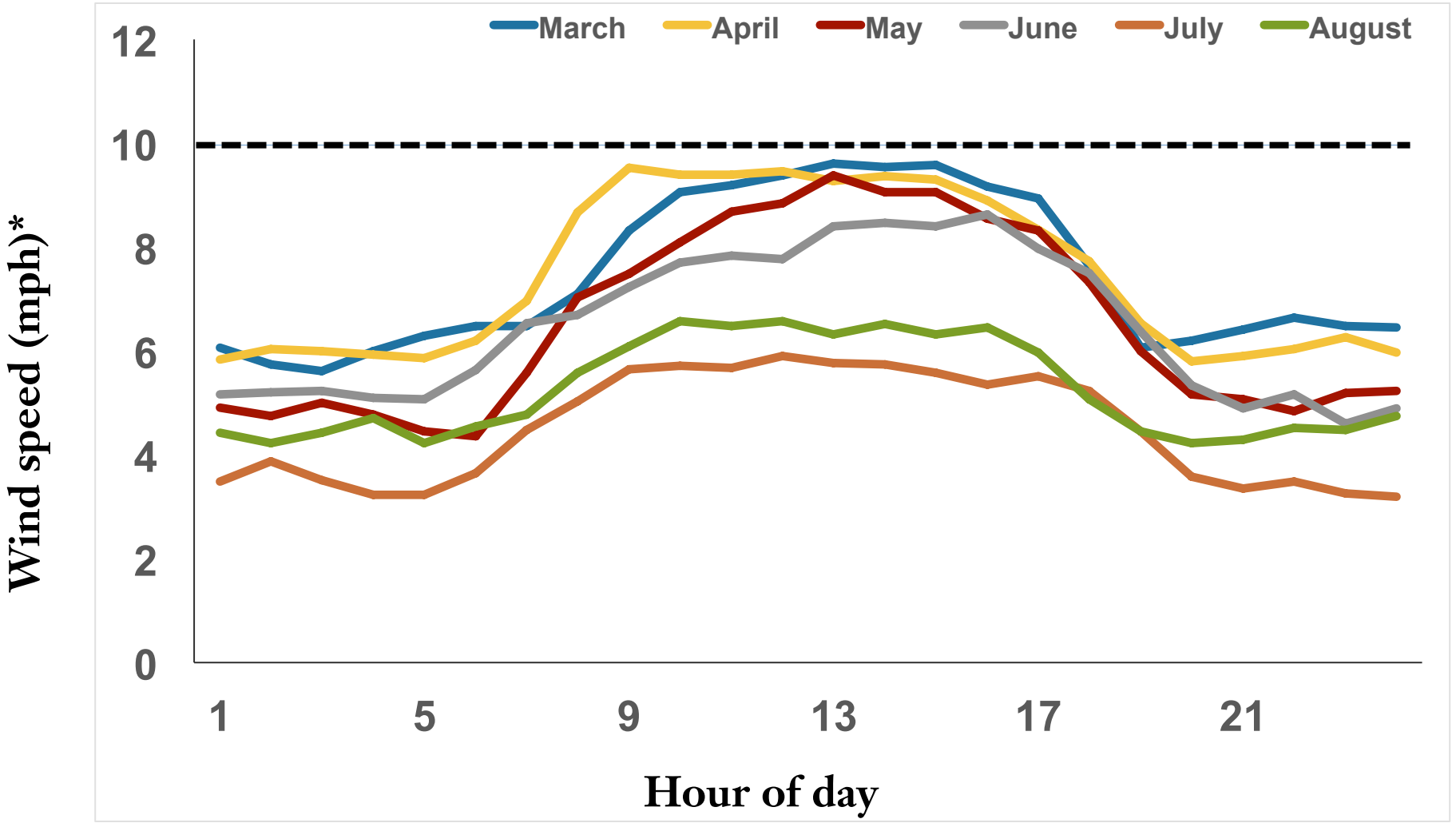
Mid-Missouri



*Hourly wind-speed averaged from the years 2000 to 2015

Historical Wind Speeds

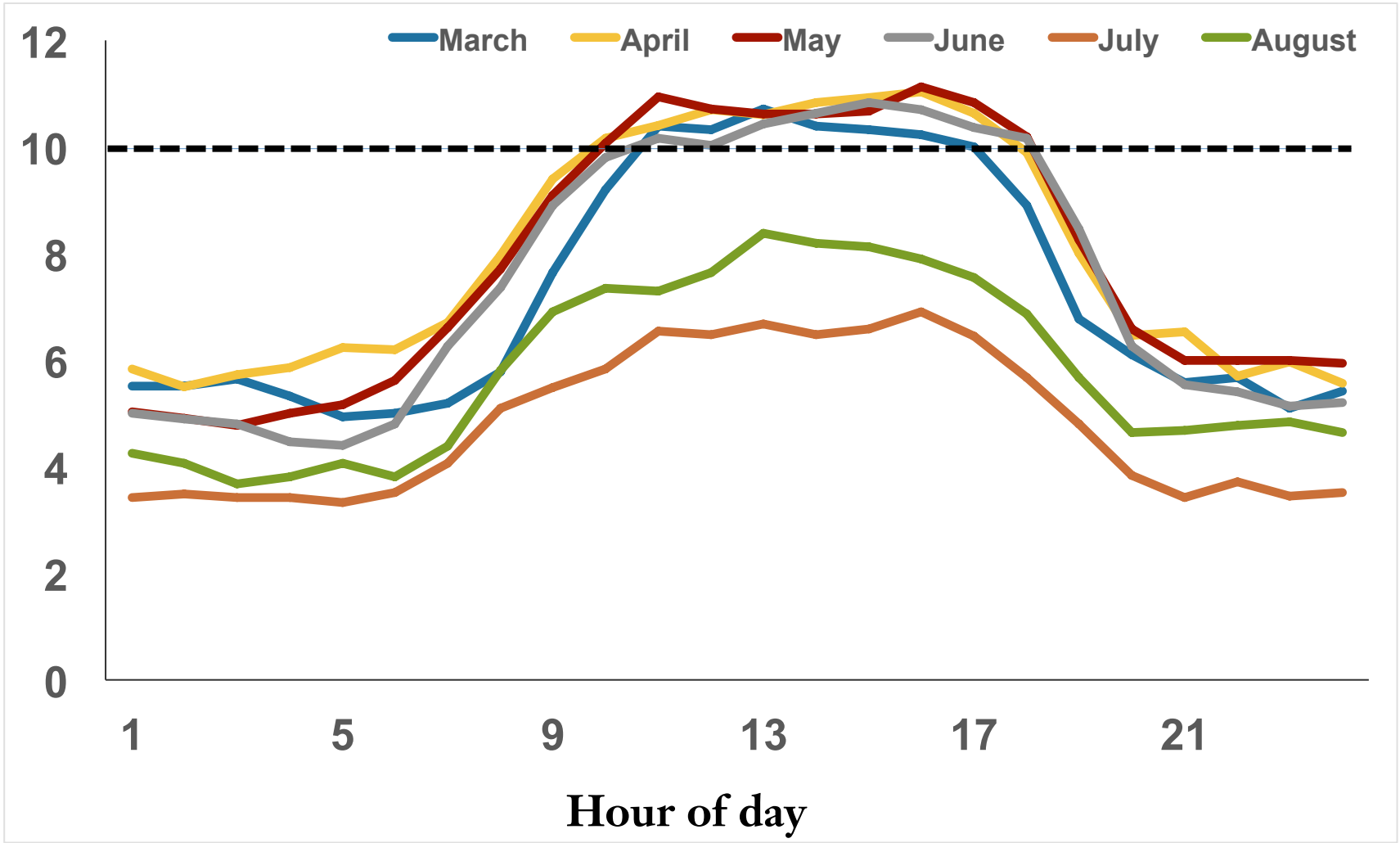
Northeast Missouri



*Hourly wind-speed averaged from the years 2000 to 2015

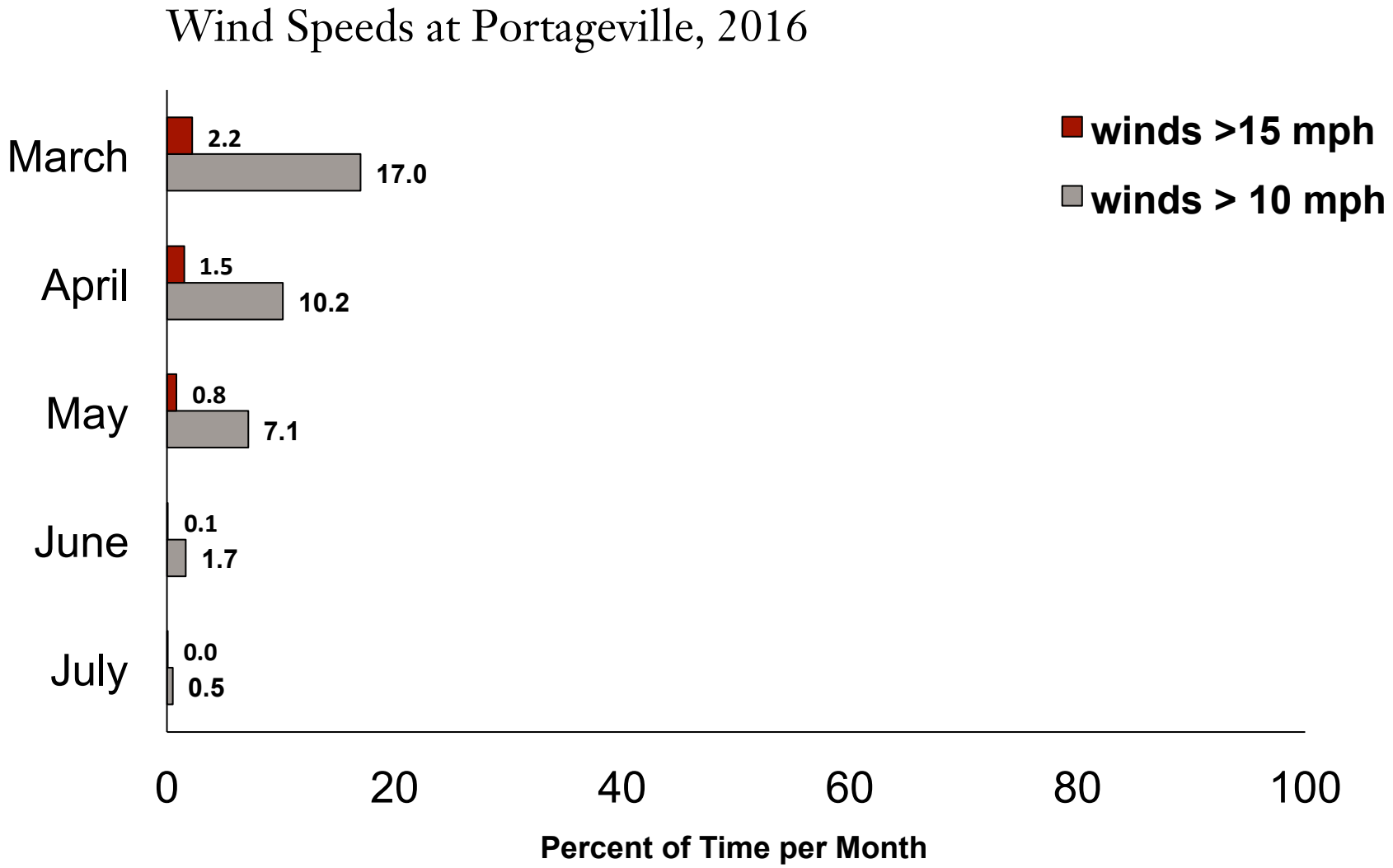
Historical Wind Speeds

Northwest Missouri



*Hourly wind-speed averaged from the years 2000 to 2015

How Often were Wind Speeds too High to Spray in Southeast Missouri in 2016?



[a]Measurements taken at 3-second intervals and averaged over 5 minutes. The 5-minute data was used for analysis.

Physical Drift due to Wind

- Historically, wind speeds in Missouri do not typically exceed the 10 and 15 mph thresholds over extended periods of time.
- **However,** prolonged high wind speeds as well as days with high wind gusts do happen from time to time in Missouri.
- Wind is not the only factor in physical drift. Boom height, spray droplet size, sprayer speed can all play a role in physical drift.

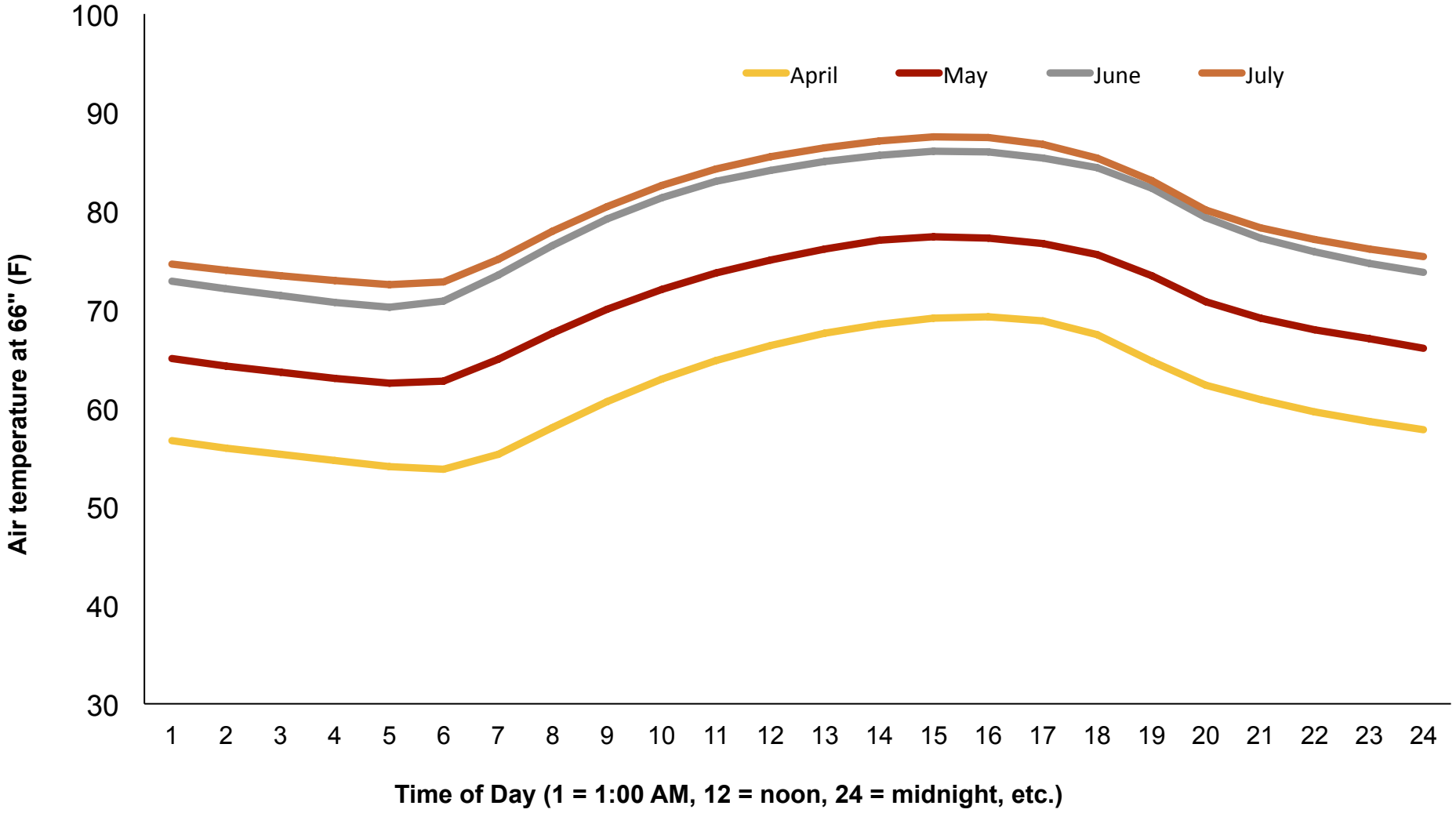
Volatility

Evaporation of herbicide particles into the air; largely driven by the sun (high air temps).

Some pesticides are more prone to volatility than other pesticides

Historical Air Temperatures

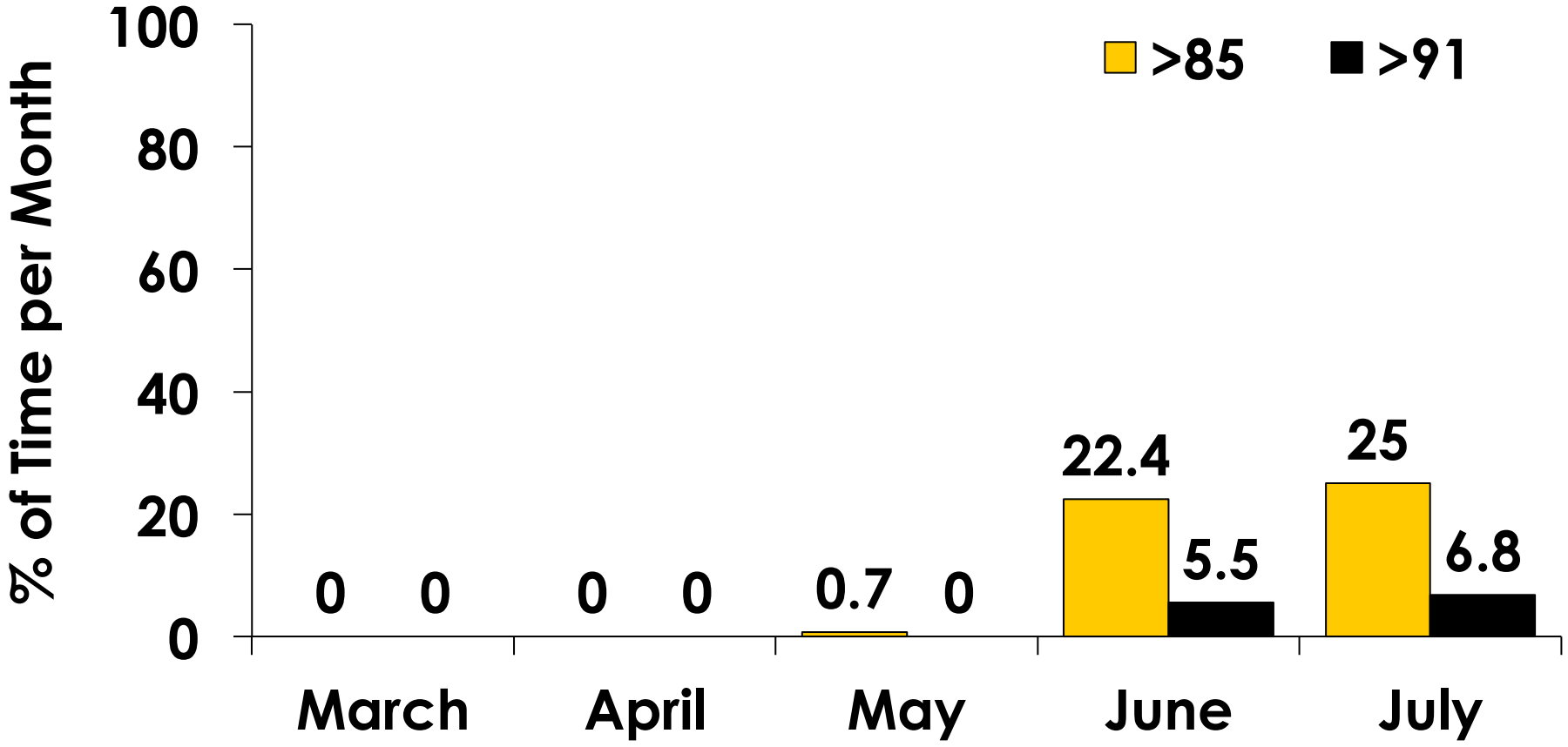
Southeast Missouri



*Hourly air temperatures from the years 2000 to 2016

How Often did Temperatures Favor Volatility in Southeast Missouri in 2016?

Time that air temperatures exceeded 85 or 91°F in Portageville, MO in 2016.

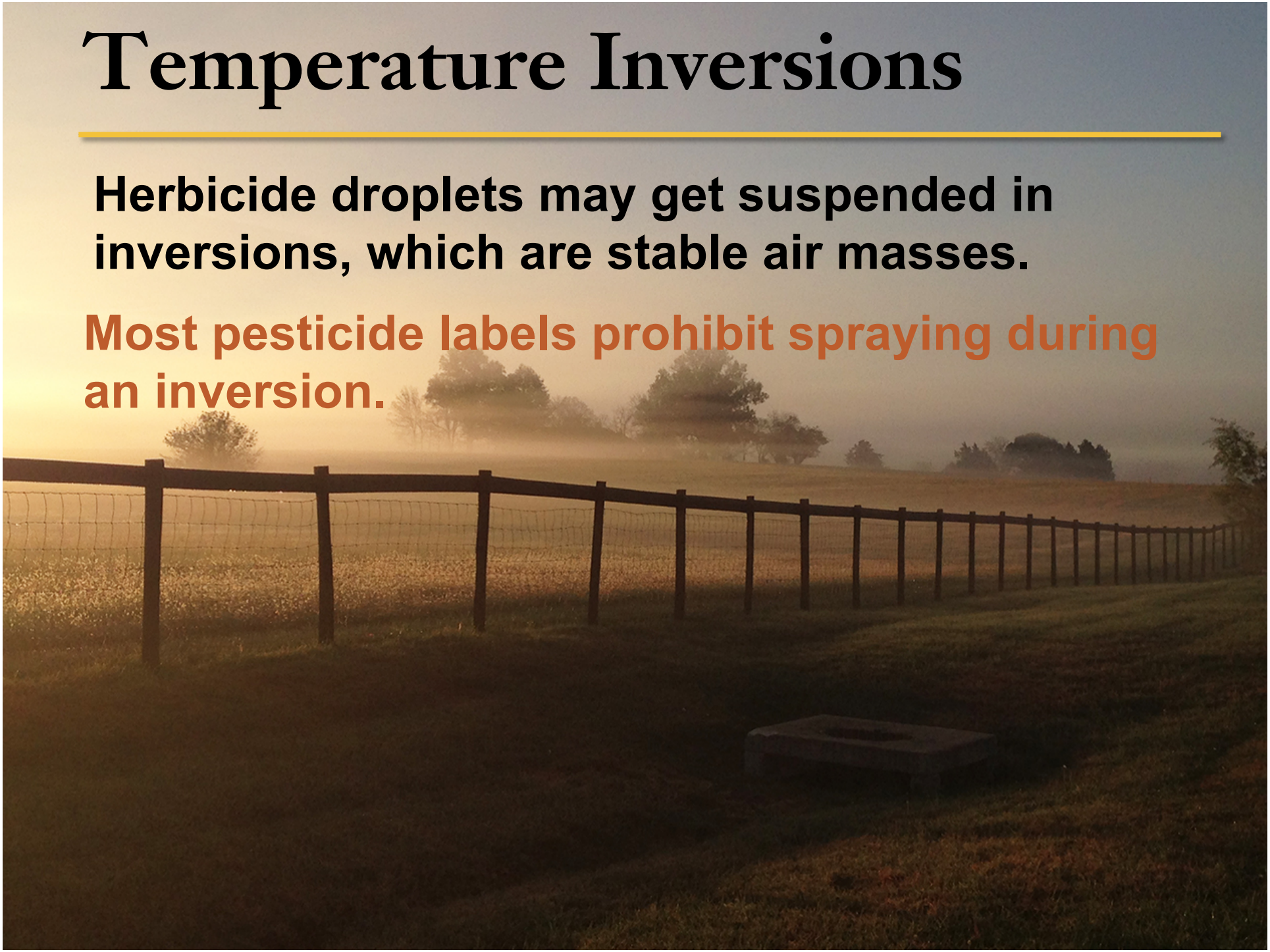


[a]Measurements were taken at 3-second intervals and averaged over 5 minutes. The 5-minute data was used for analysis.

Temperature Inversions

Herbicide droplets may get suspended in inversions, which are stable air masses.

Most pesticide labels prohibit spraying during an inversion.



Inversions are stable air masses where the cooler air is near the earth's surface and warmer air is on top

Cooler air

Warmer air

NO INVERSION

Warmer air

Cooler air

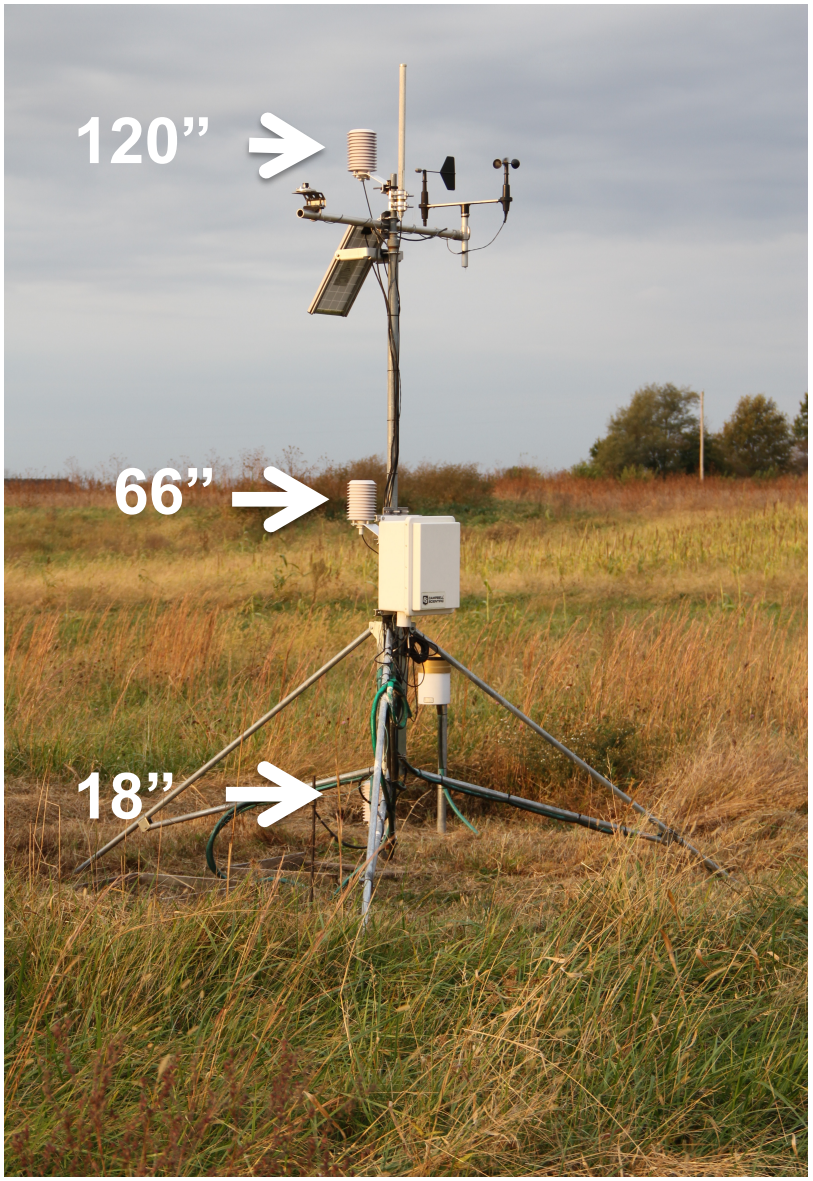
INVERSION

Indicators of a Temperature Inversion

1) Clear skies (no clouds)
2) Calm (wind < 3 mph)
3) Closer to sunrise or sunset
4) Dew present
5) Horizontal smoke patterns
6) Ground fog in low-lying area

Detecting Surface Temperature Inversions

Measuring air temperatures at 3 heights



How Common are Surface Temperature Inversions in Southeast Missouri?

Southeast Missouri

	Number of Inversions[a]		Typical Start Time[b]	
	2015	2016	2015	2016
March	21	22	4:00-5:00 p.m.	5:00-6:00 p.m.
April	23	27	4:00-5:00 p.m.	5:00-6:00 p.m.
May	17	25	4:00-6:00 p.m.	6:00-7:00 p.m.
June	16	24	5:00-6:00 p.m.	6:00-7:00 p.m.
July	22	20	6:00-7:00 p.m.	7:00-8:00 p.m.

[a]Inversions were classified as air temp at 46 cm above surface < air temp at 168 cm < air temp at 305 cm; temperature differences had to occur for > 1 hour in duration and intensity had to be > 1.0°C between 305 and 46 cm air temperatures.

[b]Mode was used to determine typical start times

Bish and Bradley, unpublished

How Common are Surface Temperature Inversions in Mid-Missouri?

Mid Missouri

	Number of Inversions[a]		Typical Start Time[b]	
	2015	2016	2015	2016
March	25	18	5:00 to 6:00 p.m.	5:00 to 6:00 p.m.
April	21	16	5:00 to 6:00 p.m.	6:00 to 7:00 p.m.
May	14	16	5:00 to 6:00 p.m.	6:00 to 7:00 p.m.
June	13	14	6:00 to 8:00 p.m.	6:00 to 7:00 p.m.
July	15	15	6:00 to 7:00 p.m.	7:00 to 8:00 p.m.

[a]Inversions were classified as air temp at 18” above surface < air temp at 66” < air temp at 120” & temperature differences had to occur for > 1 hour in duration and intensity had to reach > 1.8°F between 120” and 18” air temperatures.
[b]Mode was used to determine typical start times

Bish and Bradley, unpublished

How Common are Surface Temperature Inversions in Northwest Missouri?

Northwest Missouri

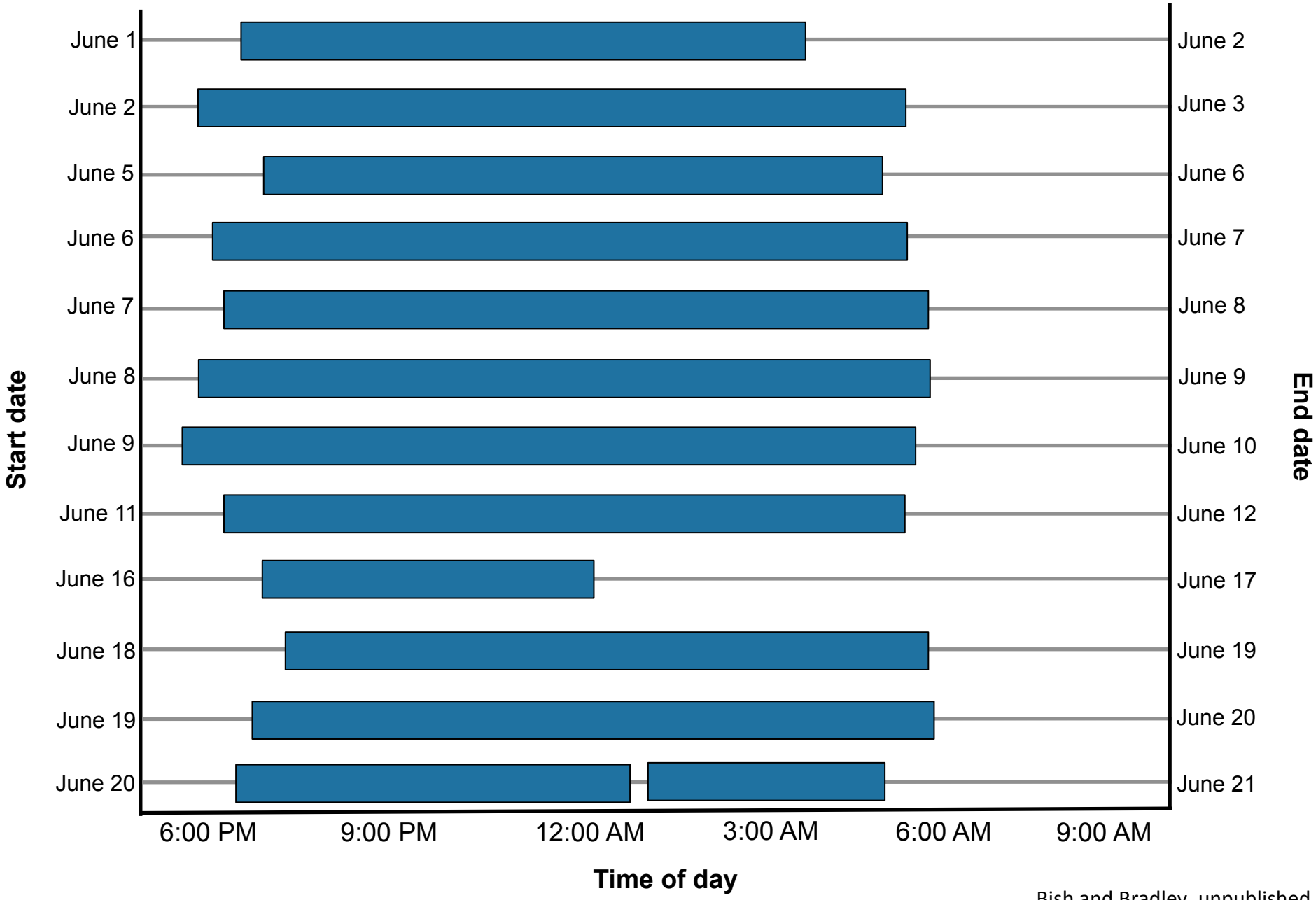
	Number of Inversions[a]		Typical Start Time[b]	
	2015	2016	2015	2016
March	24	15	5:00 to 6:00 p.m.	5:00 to 6:00 p.m.
April	23	13	6:00 to 7:00 p.m.	6:00 to 7:00 p.m.
May	15	24	6:00 to 7:00 p.m.	6:00 to 7:00 p.m.
June	13	29	6:00 to 7:00 p.m.	6:00 to 7:00 p.m.
July	12	14	6:00 to 8:00 p.m.	7:00 to 8:00 p.m.

[a]Inversions were classified as air temp at 46 cm above surface < air temp at 168 cm < air temp at 305 cm; temperature differences had to occur for > 1 hour in duration and intensity had to be > 1.0°C between 305 and 46 cm air temperatures.

[b]Mode was used to determine typical start times

Bish and Bradley, unpublished

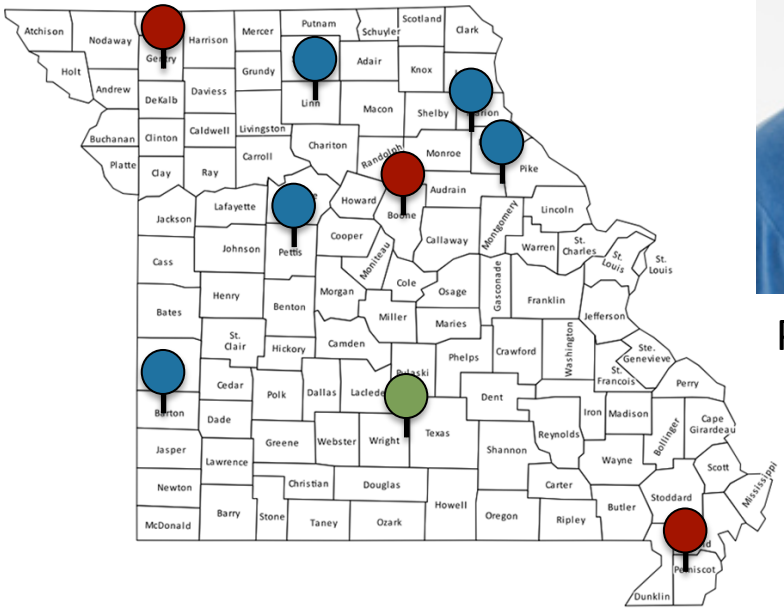
Detecting Potential Inversions in Columbia, Missouri from June 1 to 21, 2017



Bish and Bradley, unpublished

Monitoring Surface Temperature Inversions in Missouri

Expanding the Network in 2017



Pat Guinan

John Travlos

MISSOURI SOYBEANS

How Common are Surface Temperature Inversions in Missouri?

Expanding the Network in 2017[a]

Which evenings did air temperatures favor inversions?[b]

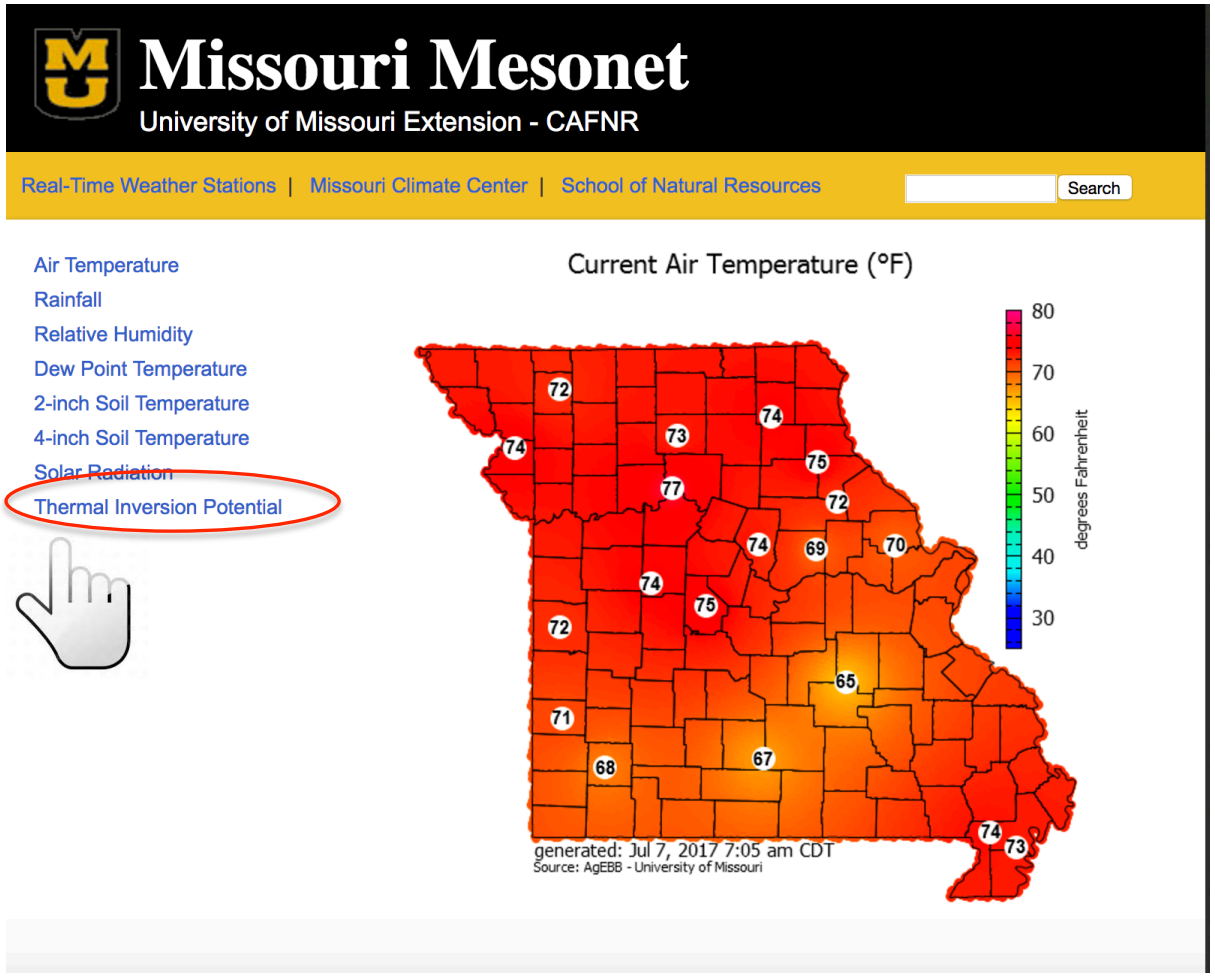
	June 2017 dates						
Location	22	23	24	25	26	27	28
Albany	No	No	Yes	Yes	No	No	.[c]
Columbia	No	No	Yes	Yes	No	No	No
Green Ridge	No	Yes	Yes	Yes	Yes	No	No
Hayward	No	Yes	Yes	Yes	Yes	Yes	Yes
Lamar	Yes	Yes	Yes	Yes	No	No	Yes
Linneus	Yes	Yes	Yes	Yes	Yes	No	No
Monroe City	No	Yes	Yes	Yes	Yes	Yes	No
Vandalia	No	Yes	Yes	Yes	Yes	Yes	No

[a]Funding for the additional weather stations made possible by the **Missouri Soybean Merchandising Council**.
[b]**Preliminary analysis** from June 2017; data is not quality controlled. Dates chosen based on the last station to go online, which was June 22nd.
[c]Weather station offline due to storm

Bish and Bradley, unpublished

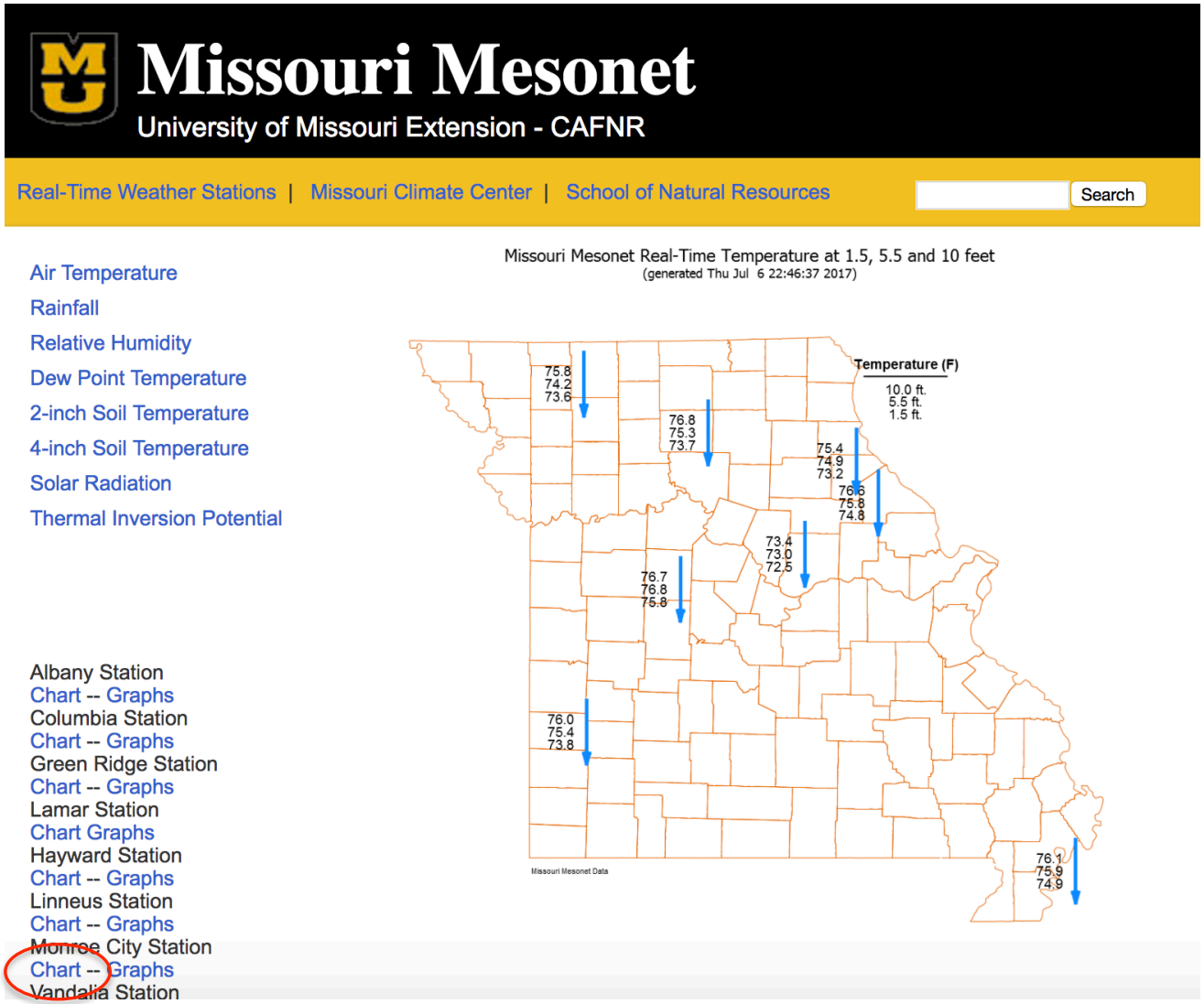
Real Time Monitoring for Inversion-like Conditions

http://mesonet.missouri.edu/



Real Time Monitoring for Inversion-like Conditions

http://agebb.missouri.edu/weather/realTime/maps/index.php#temp_inversion



Funding for this project made possible by the **Missouri Soybean Merchandising Council**

Real Time Monitoring for Inversion-like Conditions Chart Section

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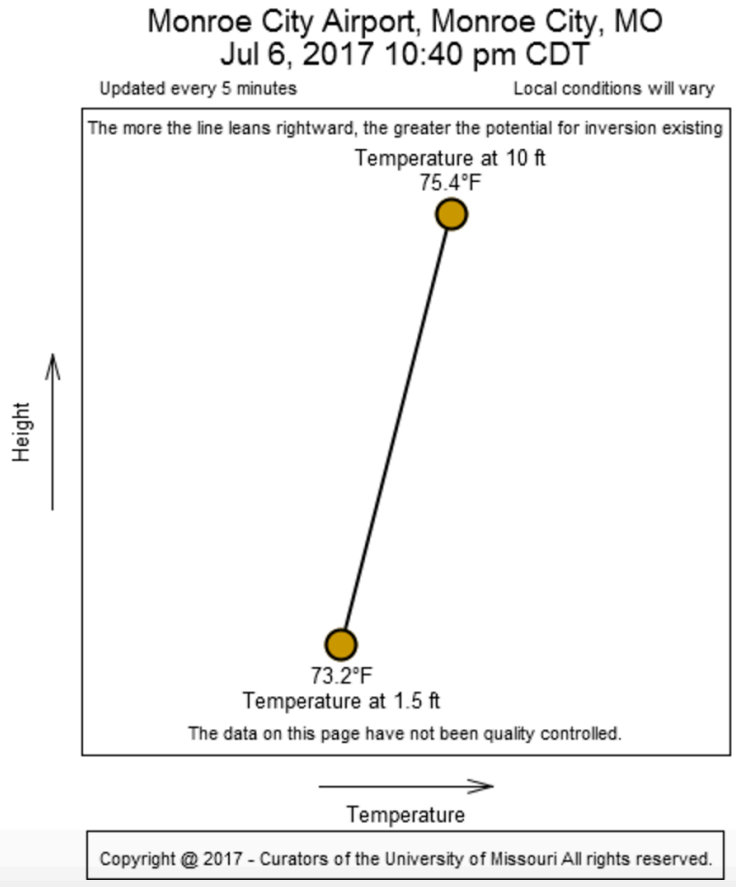


Monroe City, Missouri

Lat: 38.897236°, Lon: -92.218070°

Graph Description:

Little to No Inversion Potential:
line is vertical or slants leftward, i.e. | or \

Inversion Potential:
line slants rightward, i.e. /
(The more the line leans rightward,
the greater the potential for inversion existing)

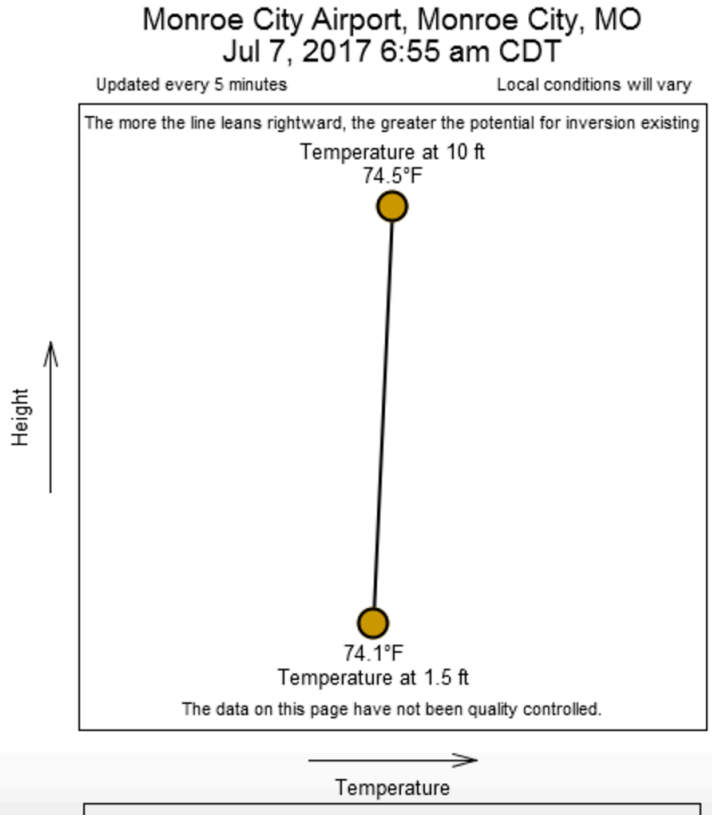
American Meteorological Society definition of
Temperature Inversion

Disclaimer

Real Time Monitoring for Inversion-like Conditions Chart Section

http://agebb.missouri.edu/weather/realTime/maps/index.php#temp_inversion

Real-Time Temperature Monitoring for Inversion Potential at
Monroe City, MO



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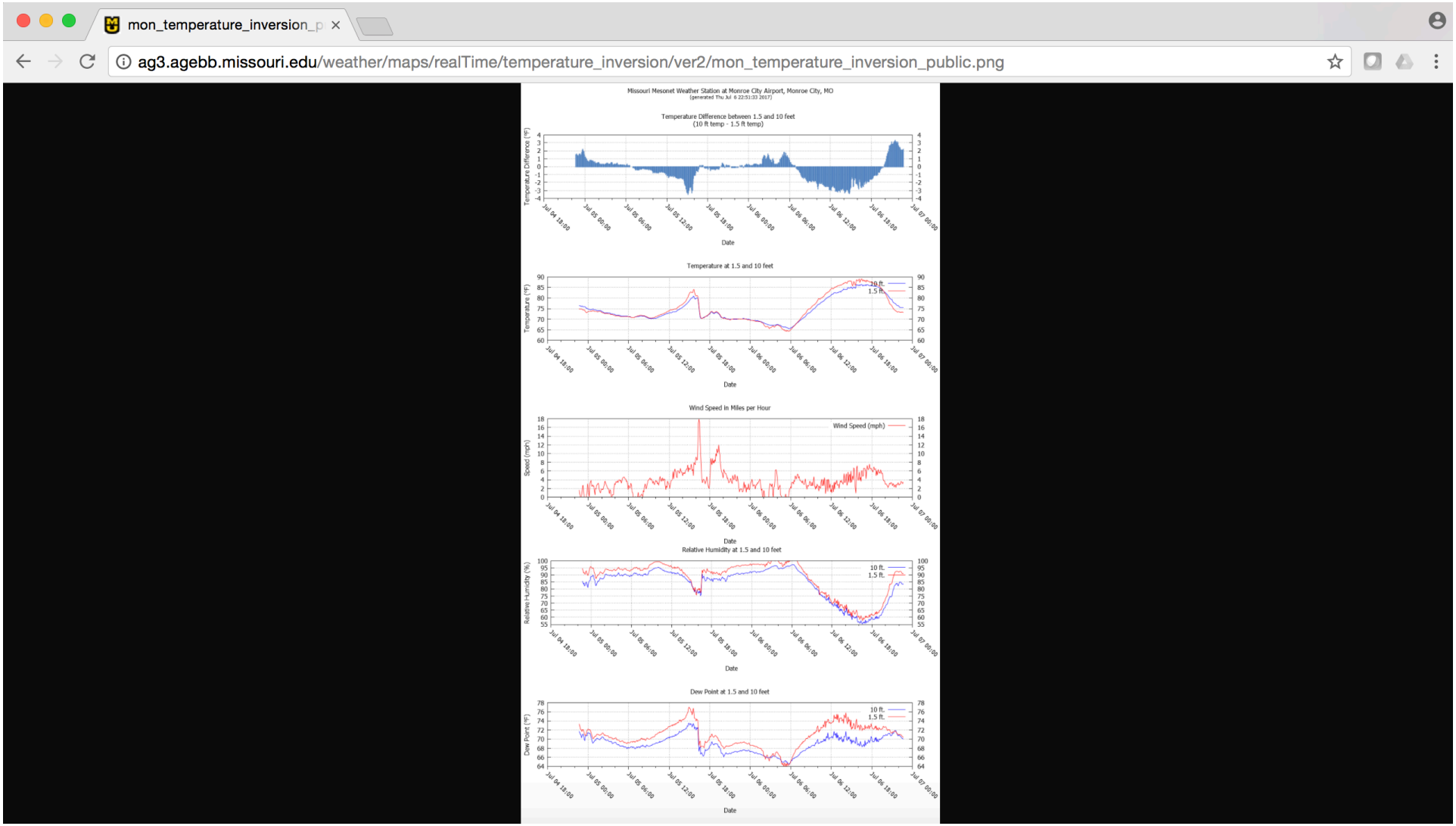

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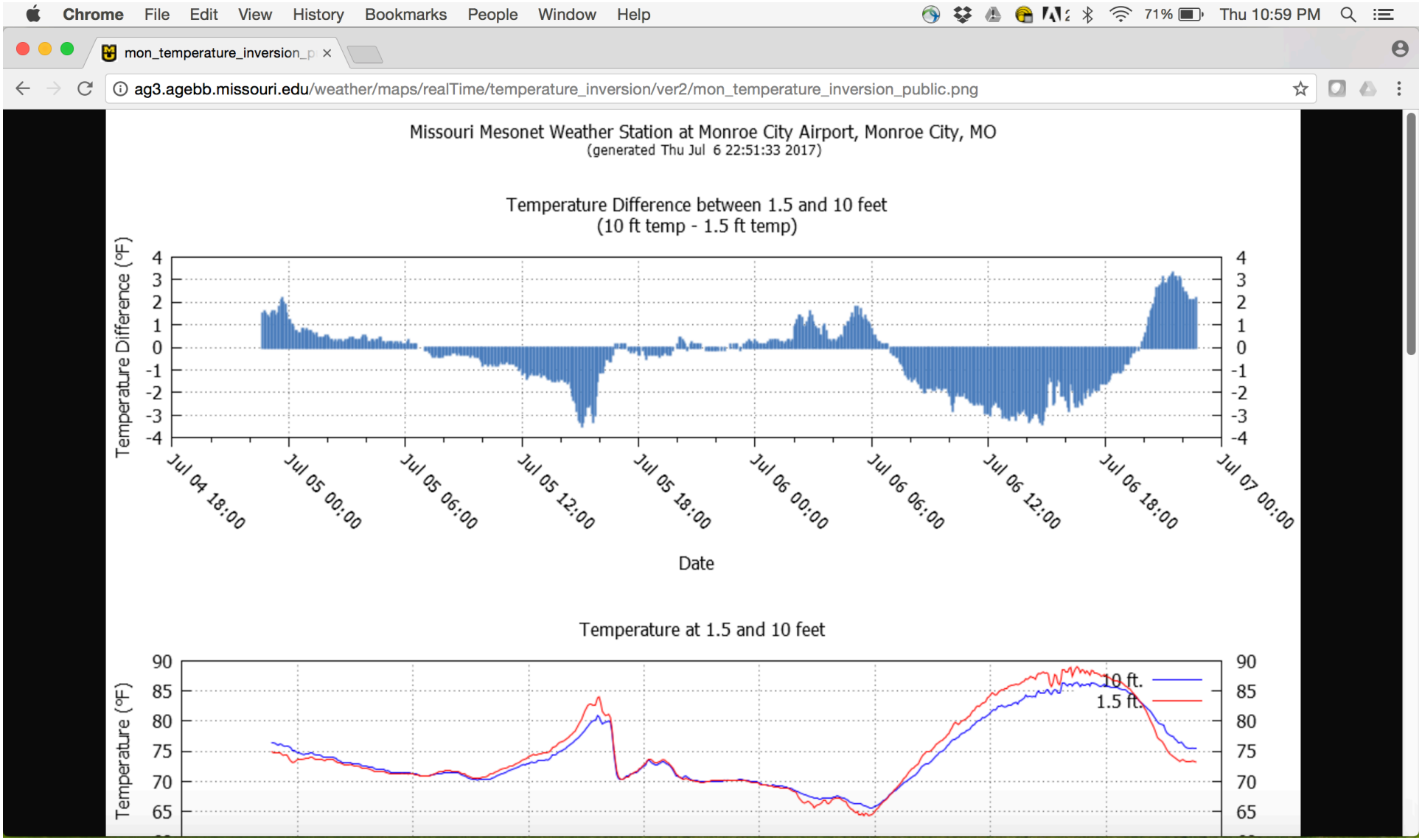

Using Smoke Grenades to Validate our Inversion Modeling (June 8, 2017)

Released at 4:00, No Inversion Present

at release

during dispersion

50 seconds after release

Released at 7:30, Inversion Present

at release

during dispersion

50 seconds after release

Temperatures at Smoke Bomb release – June 8, 2017 Bradford Research Farm