



DEPARTMENT OF AGRONOMY

TEMPERATURE INVERSIONS AND DICAMBA: WHAT WE KNOW AND WHAT WE DON'T

RICHARD GRANT

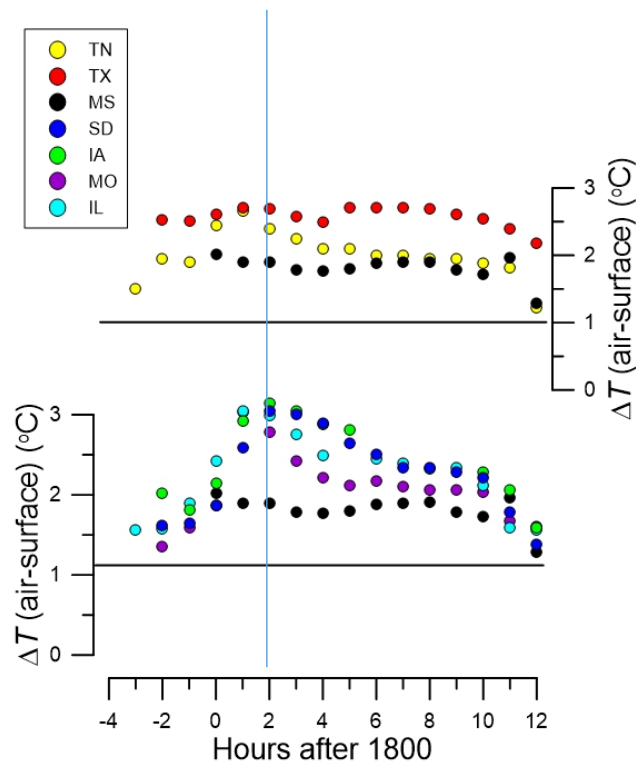
Professor agro-micrometeorology

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PURDUE
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WHAT WE KNOW: INVERSIONS

TEMPERATURE CHANGE

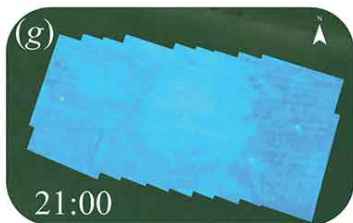
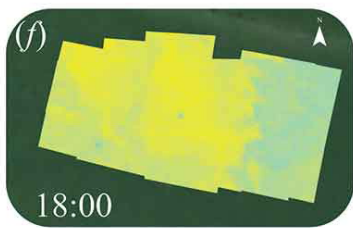
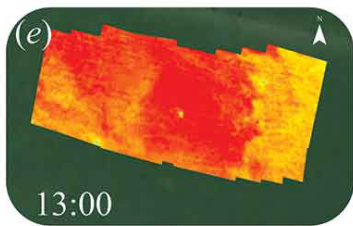


- ☀ Inversions vary a great deal across country (over grass)
- ☀ 1-3 $^{\circ}\text{C}$ temperature increase with height (2.5m)
- ☀ **Typically develop before or at sunset**
- ☀ Higher latitudes have maximum intensity around sunset (8PM)
- ☀ Inversions result from surface temperatures decreasing faster than air temperatures as sunset approaches

WHAT WE KNOW: SURFACE TEMPERATURES

SURFACE TEMPERATURES VARY GREATLY WITH LAND USE

☀ Variable within field

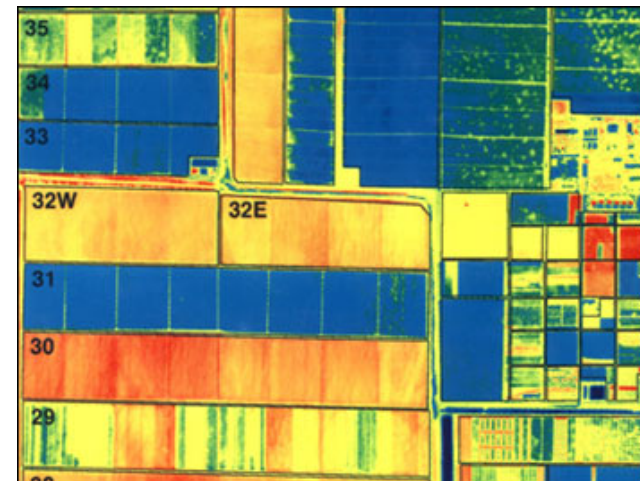


Weather:
Clear sky, sunny
 $T_{\text{amax}}: 33.7\text{ }^{\circ}\text{C}$

Sunrise: 05:33
Sunset: 21:48



☀ Variable across fields



Susan Moran, Landsat 7 Science Team

Brenner et al 2017: Int J Remote Sensing 38, 3003-3026

WHAT WE DON'T KNOW: **SURFACE CONDITIONS AND INVERSIONS**

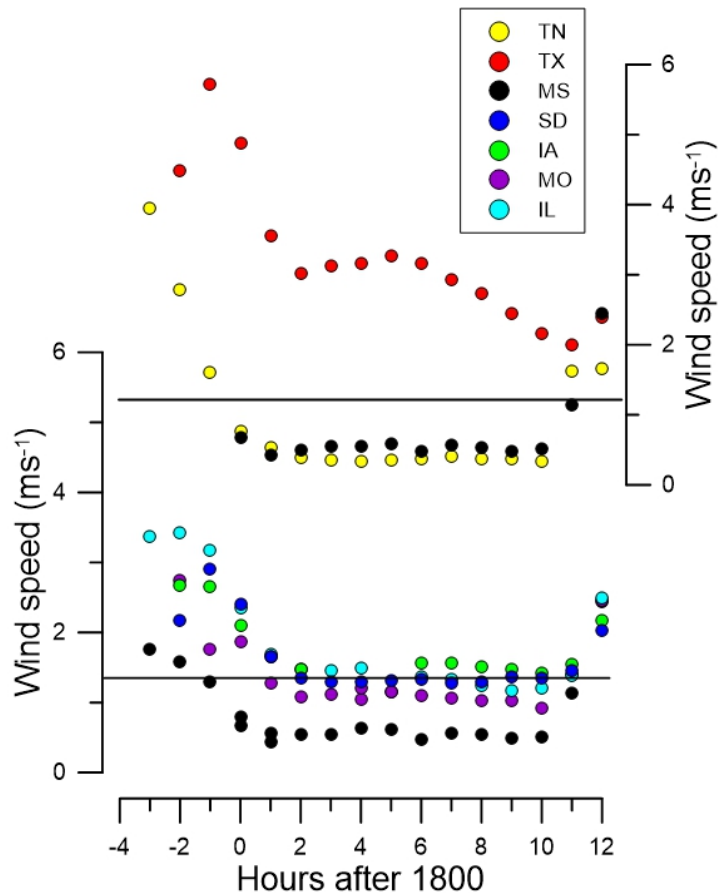
EFFECT OF DIFFERENT SURFACE TEMPERATURES ON INVERSION FORMATION ACROSS FIELDS AND LANDSCAPE

- ☀ Varying soil moisture
- ☀ Varying soil types
- ☀ Varying crops
- ☀ Variable terrain



WHAT WE KNOW: WINDS

WINDS DURING INVERSIONS



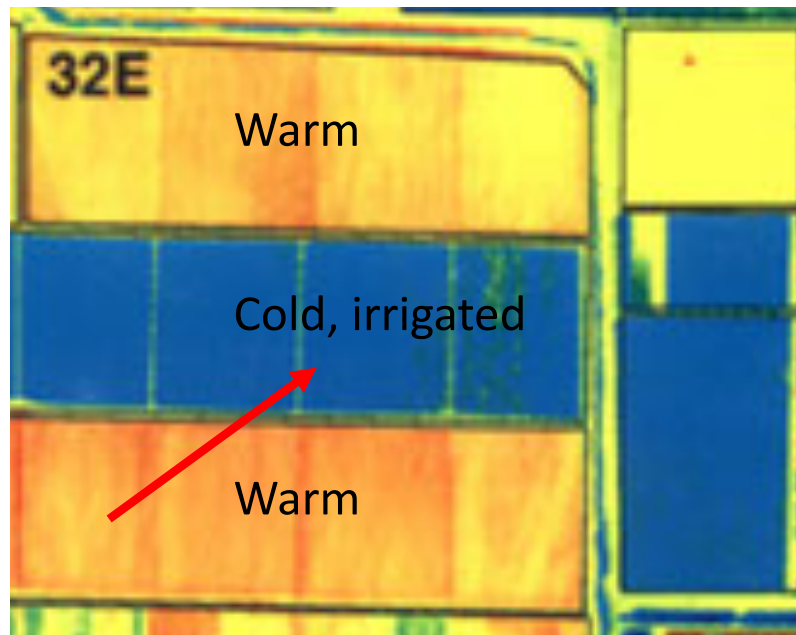
- ☀ Winds commonly above 3 mph (solid line) before sunset (8PM)
- ☀ Wind mixes the air
- ☀ Wind moving warm air over cold ground makes inversions (advective inversions)

WHAT WE DON'T KNOW: LOCAL TRANSPORT- WINDS

WIND SPEED COMPARED TO MIXING AND ADVECTION

Higher winds, better vertical mixing

Higher warm winds, greater inversion potential



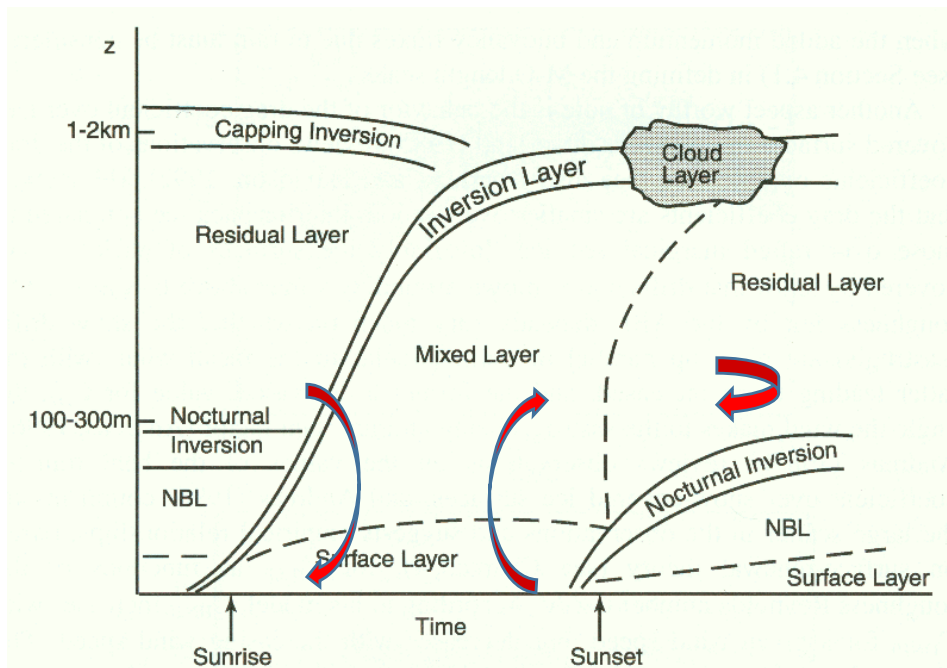
- ☀ How small a scale of land use variation matters for inversion (to what depth) due to advection?

HOW TO REDUCE LOCAL RISK?

- ☀ Have farmer measure temperatures at boom height and surface and wind speeds at boom height
 - Only verifies field of application, not surrounding
- ☀ Measure inversions at different landscape positions and cropping/land use
 - Validate existing apps
 - Develop app with modification of generalized forecasts to account for terrain and land use

WHAT WE DO AND DON'T KNOW: **NON-LOCAL** TRANSPORT

MIXING IN THE AIR



(from Wyngaard, 1992)

DO KNOW

- ☀ Efficient mixing before sunset transports air to 100-300 m
- ☀ As nighttime inversion develops, residual layer air separates from the surface (channels through the night)
- ☀ Residual layer moves long distance overnight and air mixes again with surface the next morning

DON'T KNOW

- ☀ Is herbicide in residual layer air in evening and morning?
- ☀ Does herbicide mix to surface in morning?

HOW TO REDUCE NON-LOCAL RISK?

Does the residual layer carry the herbicide?

- ☀ Measure for presence of herbicide in residual layer in evening and morning
- ☀ Measure for presence of herbicide in surface layer in morning
- ☀ If yes, develop predictive models using characteristic land use, weather, and winds

FROM HERE AND NOW

- **Inversions start before sunset and need to be separated from wind conditions: change guidance**
- **Inversions and winds should be measured at boom height/ field scale**
- **Inversions will vary across the landscape: need to know how much and predict at scales larger than field**
- **Is herbicide carried long distances in the residual layer?**



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