Temperature Inversions and Pesticide Drift

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Ontario

- Working to reduce pesticide wastage and off-target contamination
- Developing methods to spray crops consistently
- Developing educational resources for sprayer operators

Andrew Thostenson

- **In 2012 Andrew Thostenson, Pest Program Specialist (North Dakota State University Extension) spoke on temperature inversions in Boise, Idaho.**

- **Andrew graciously allowed me to base this presentation on his.**

the basics

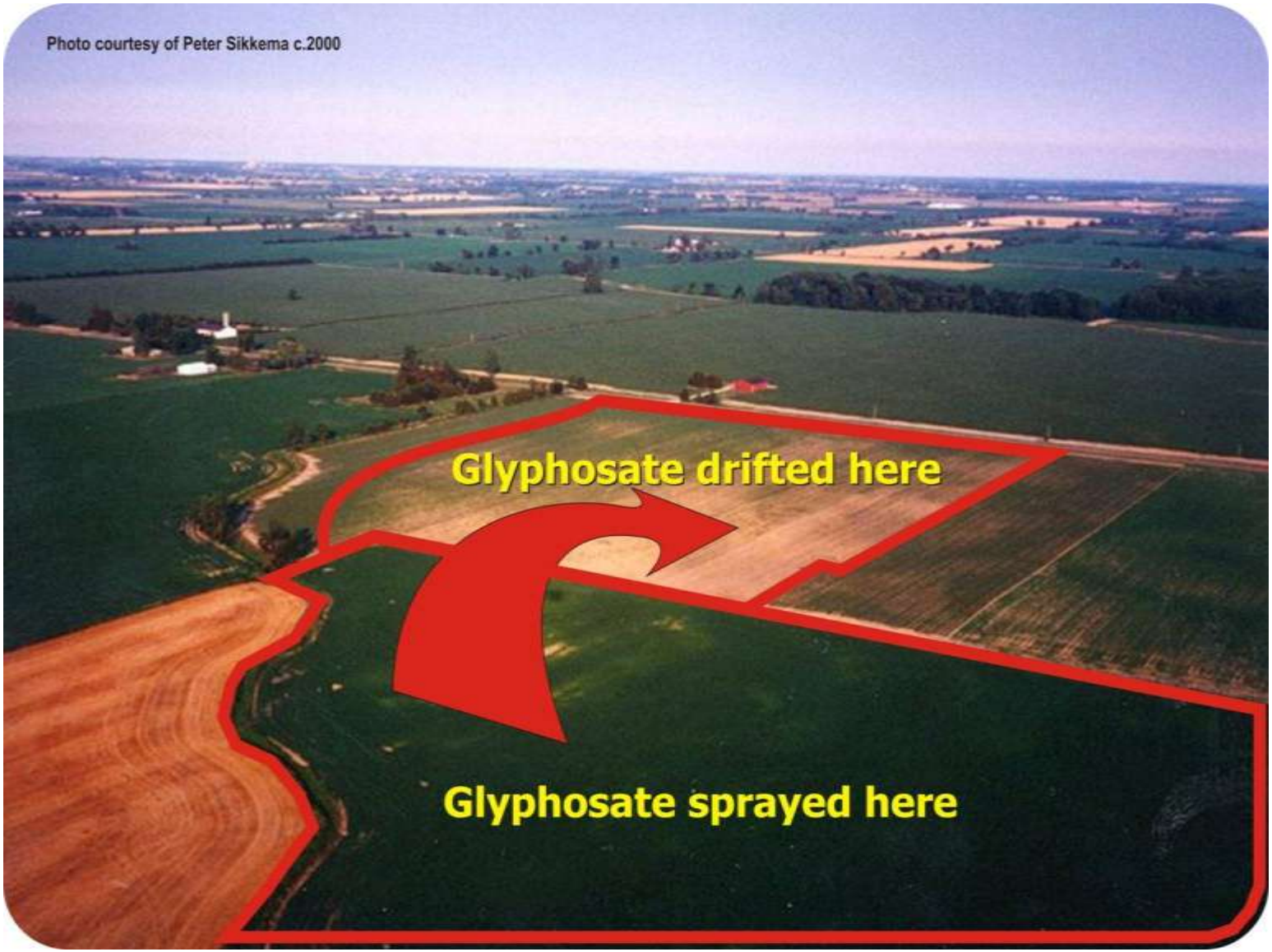
- **Particle drift is the off-target movement of pesticide droplets (or solid particles). This occurs at the time of application, and while it is generally on a scale of tens-of-metres, inversions can carry it much farther**

the basics

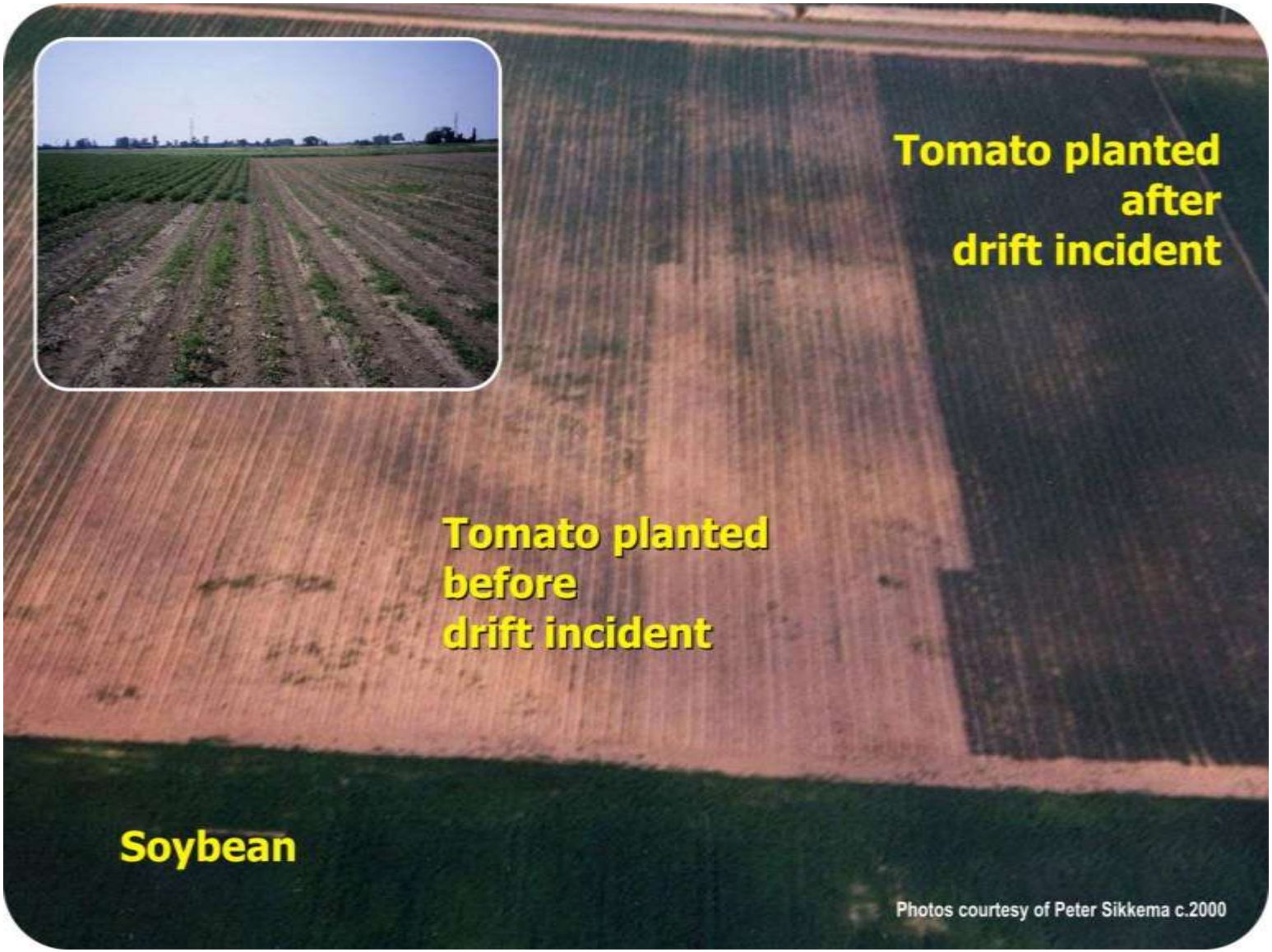
- **Vapour drift is the off-target movement of pesticide vapours. This generally occurs in hot conditions after the application and if caught up in an inversion or redistributed by rain, movement is on a scale of kilometres**

agricultural impact

agricultural impact



agricultural impact



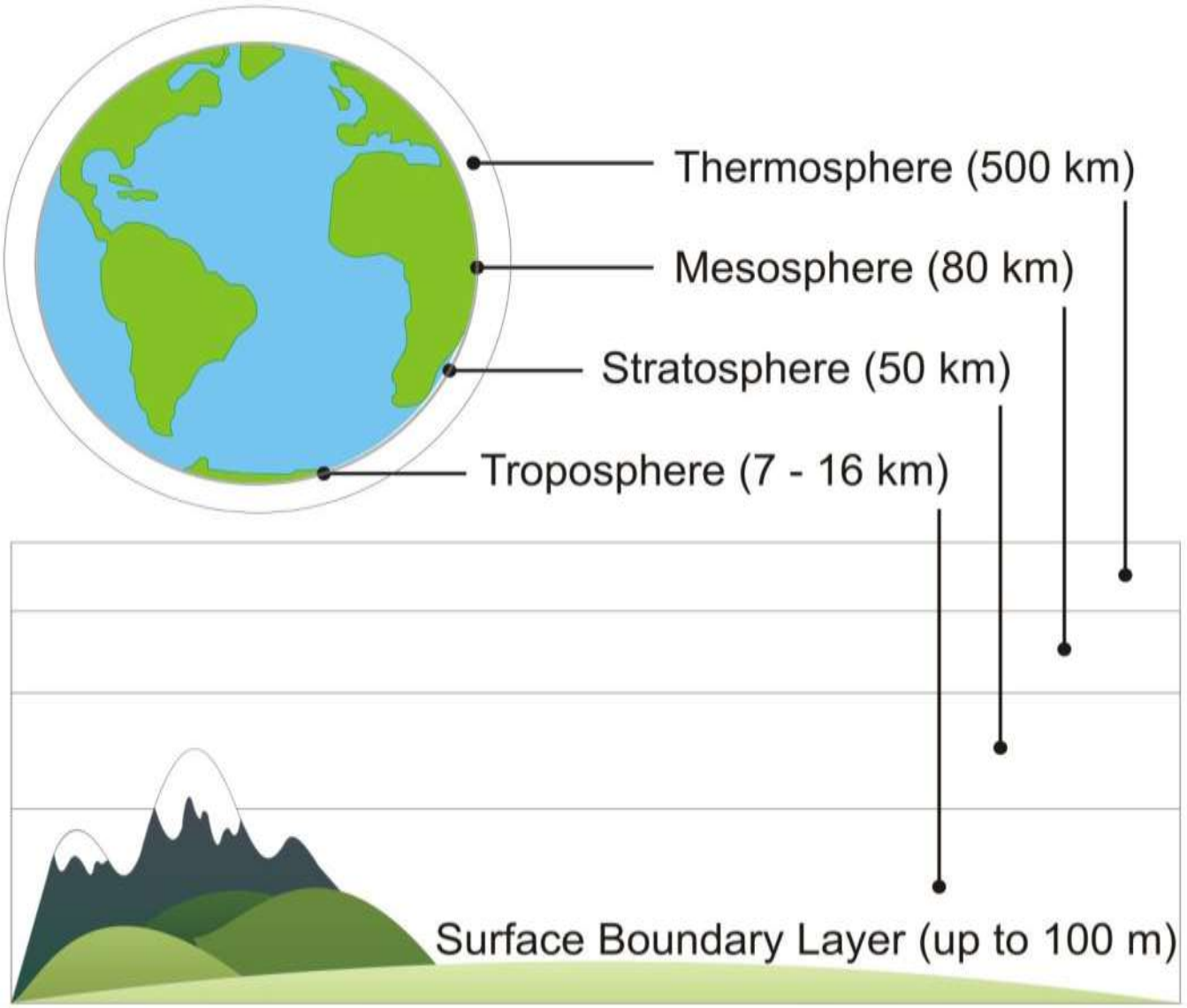
- **When pesticide drift warrants legal action, it can have a monetary penalty, affect insurance, and destroy neighbourly relations**

environmental conditions

- **We've heard the classic environmental warnings.**
- **Don't spray if:**
  - **temperature is too high**
  - **humidity is too low**
  - **air is calm**
  - **wind is too high**
  - **insects are pollinating**
  - **…or if anyone is watching…**

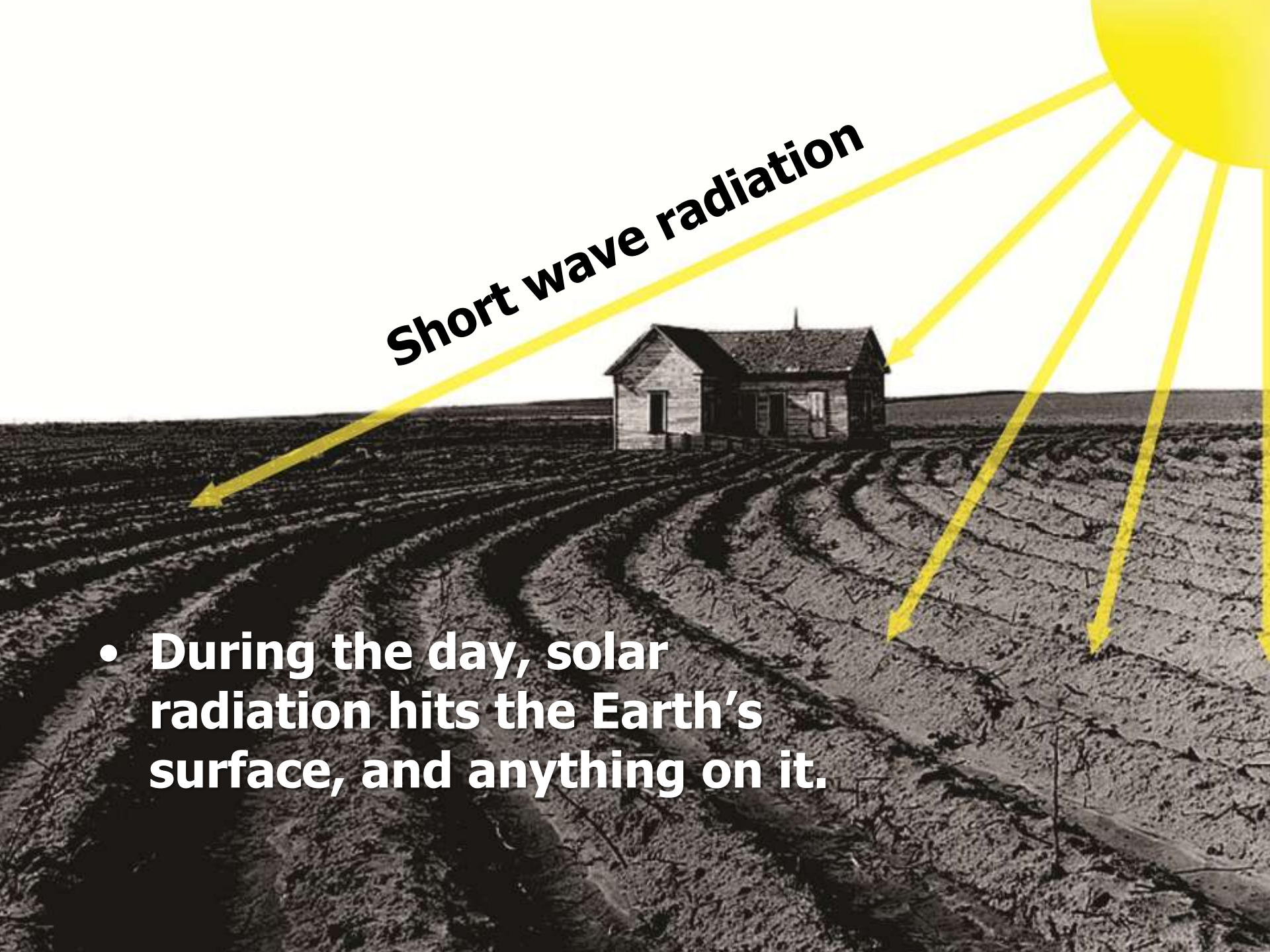
- **What about temperature inversions?**

our atmosphere (to scale!)

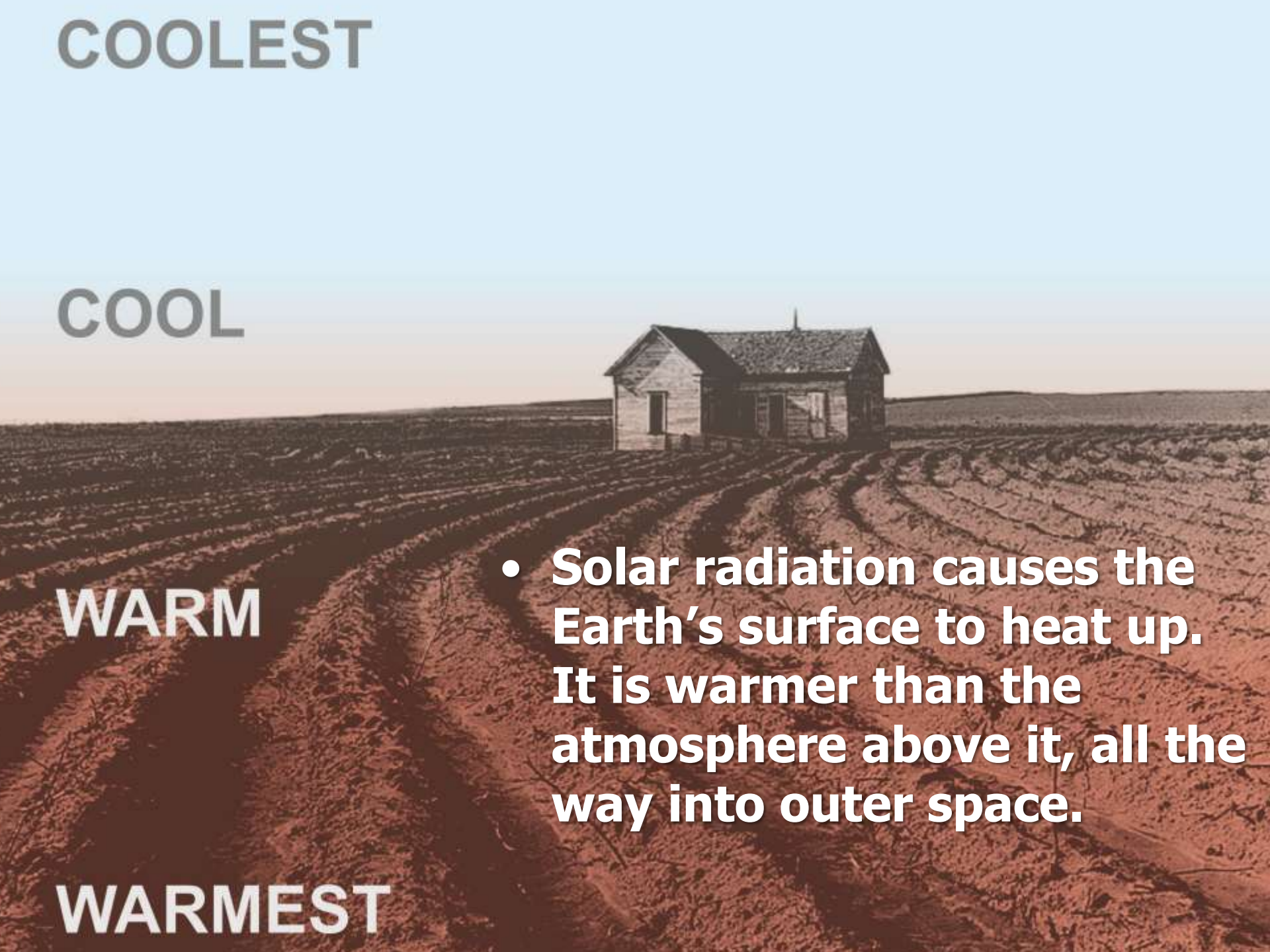



On a clear, relatively calm morning…

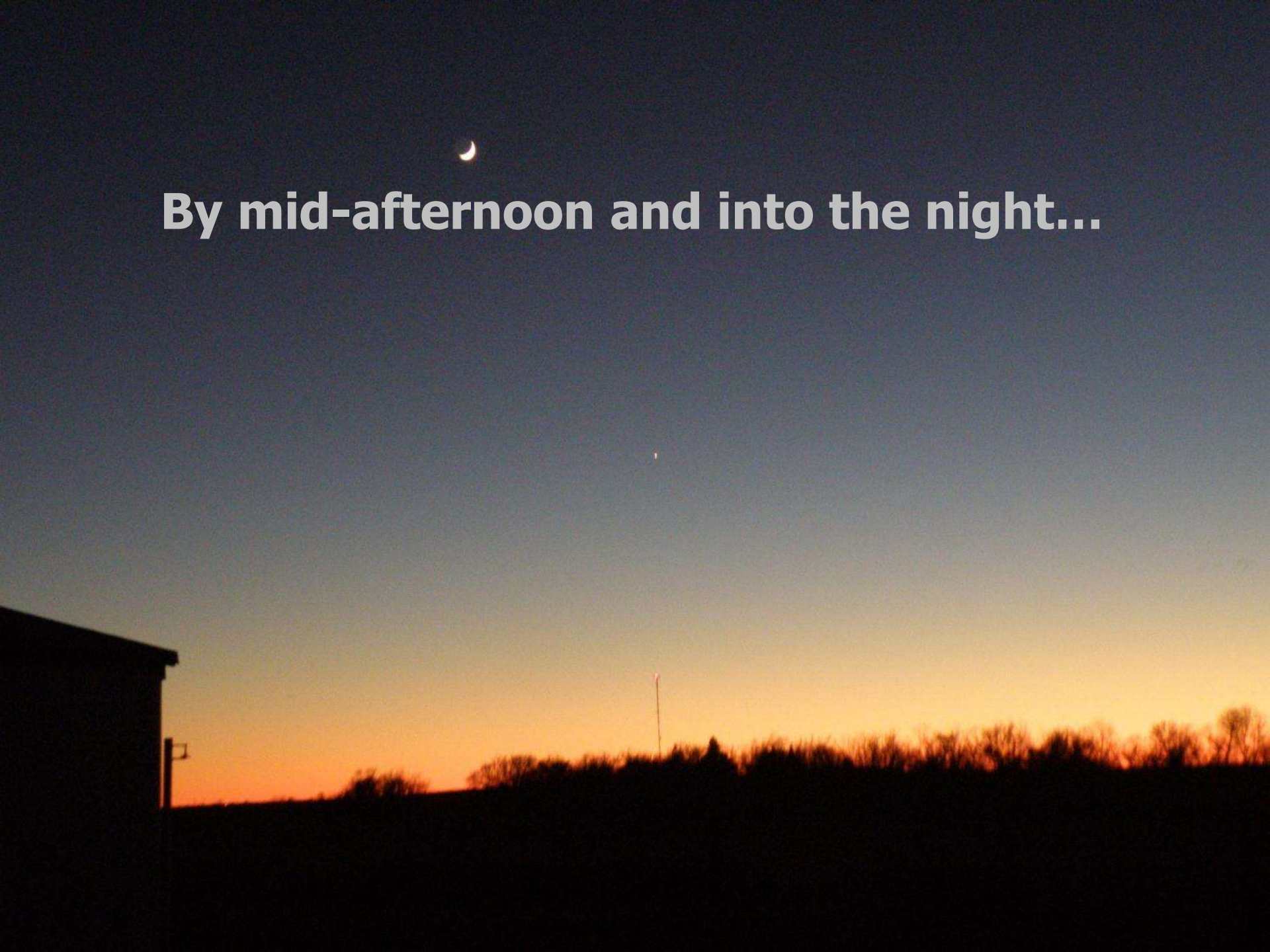
Picture the Earth's surface…



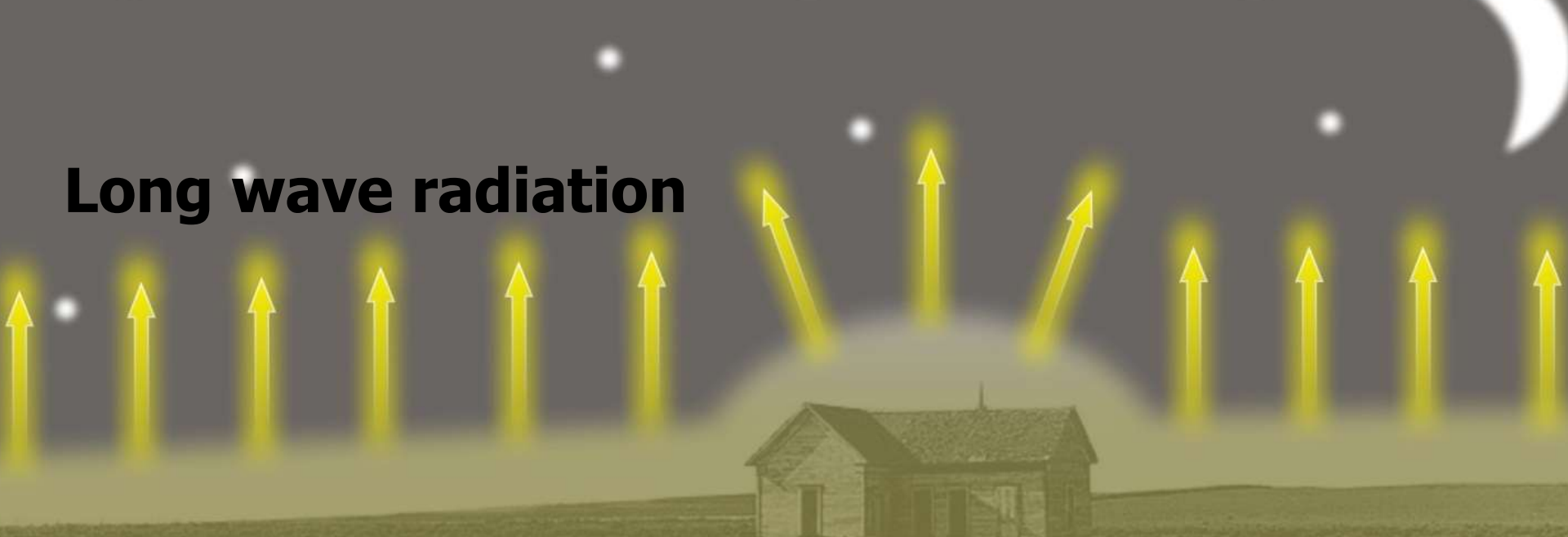
- During the day, solar radiation hits the Earth's surface, and anything on it.



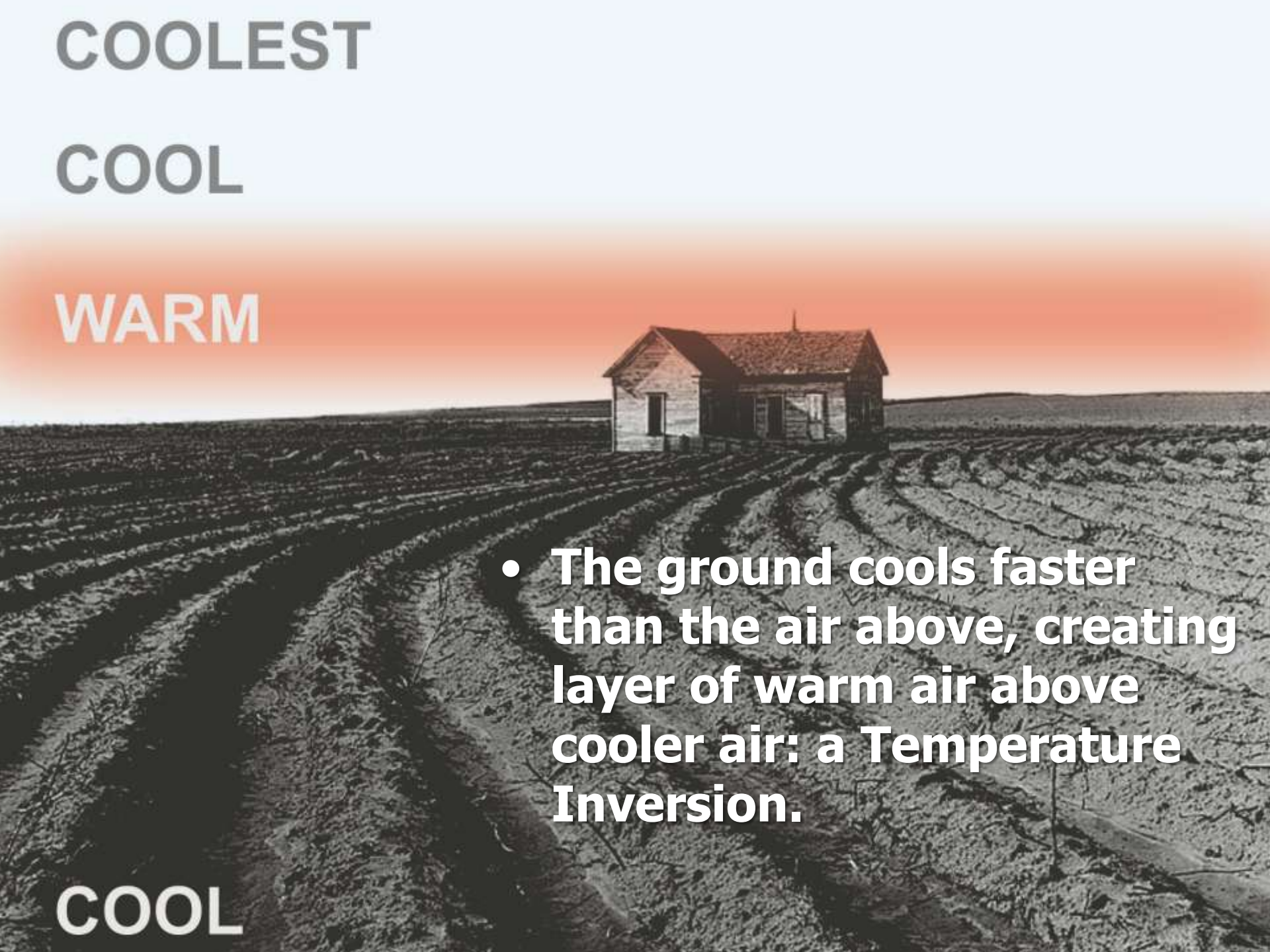
- Solar radiation causes the Earth's surface to heat up. It is warmer than the atmosphere above it, all the way into outer space.


By mid-afternoon and into the night…

Long wave radiation

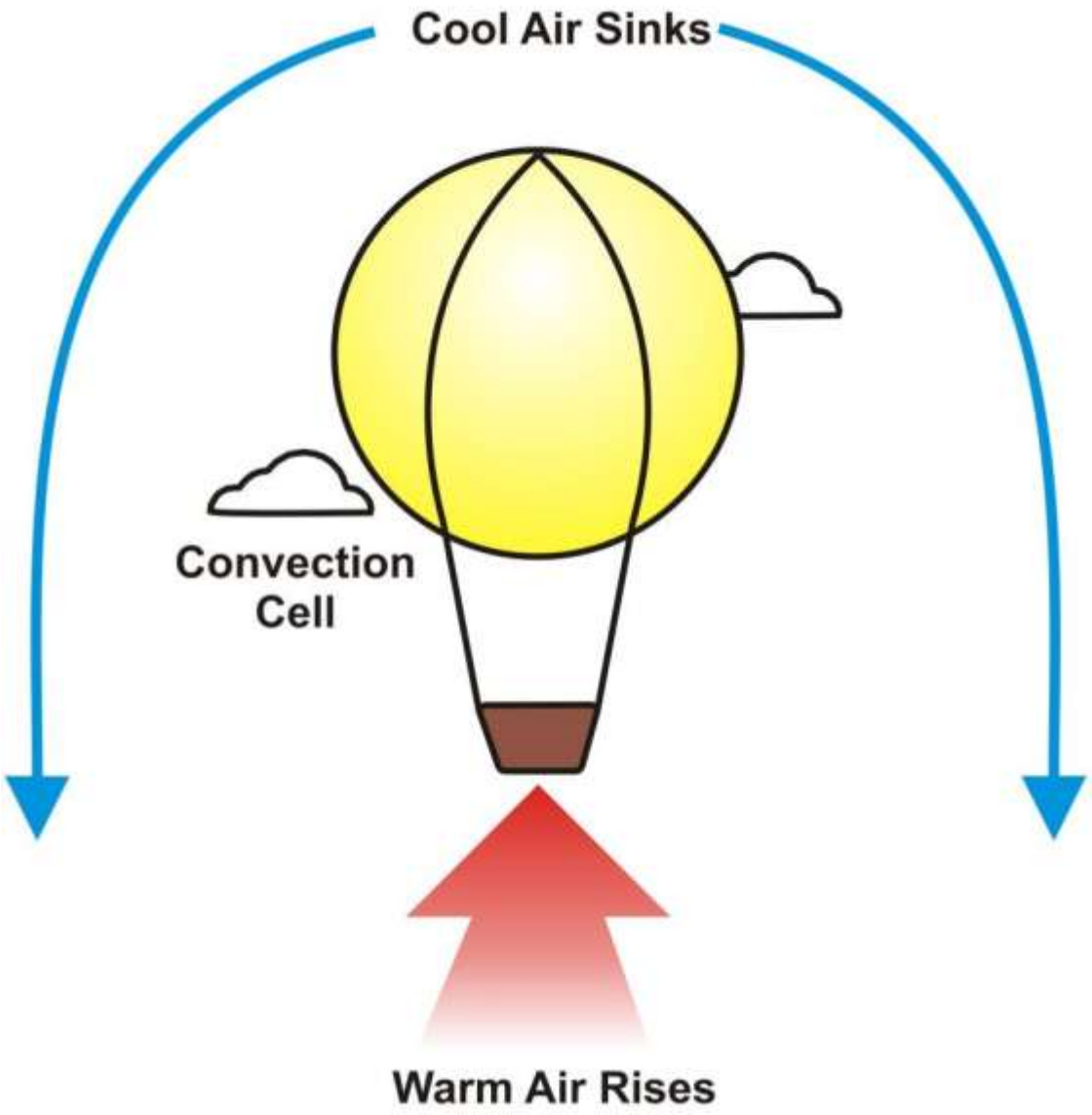


- As the sun moves west, there is less sunlight and the Earth's surface starts to lose that energy.



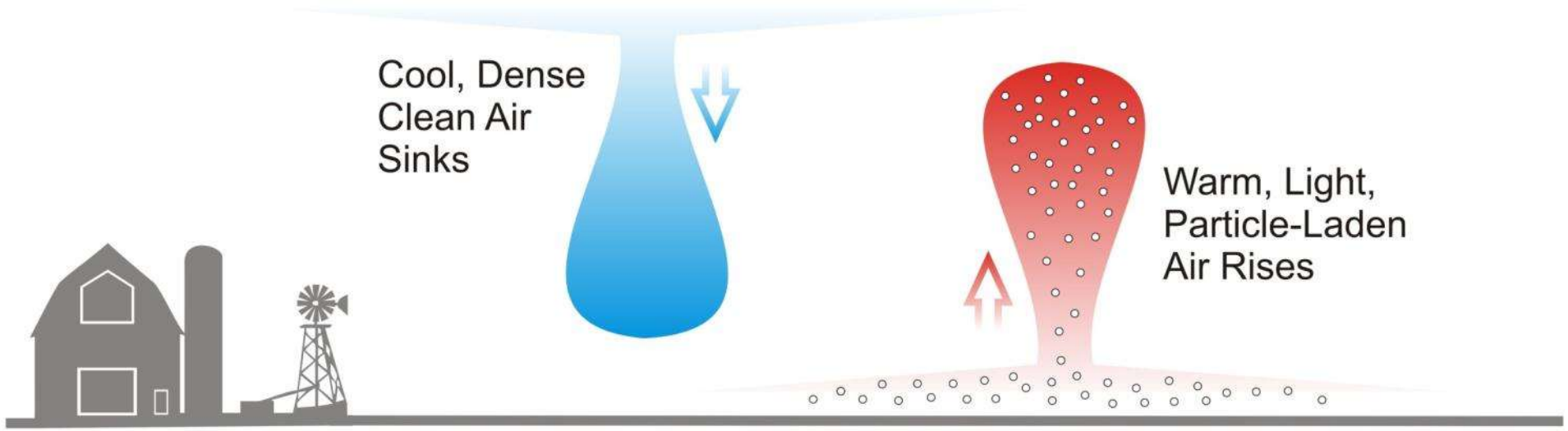
- The ground cools faster than the air above, creating layer of warm air above cooler air: a Temperature Inversion.

convection cells



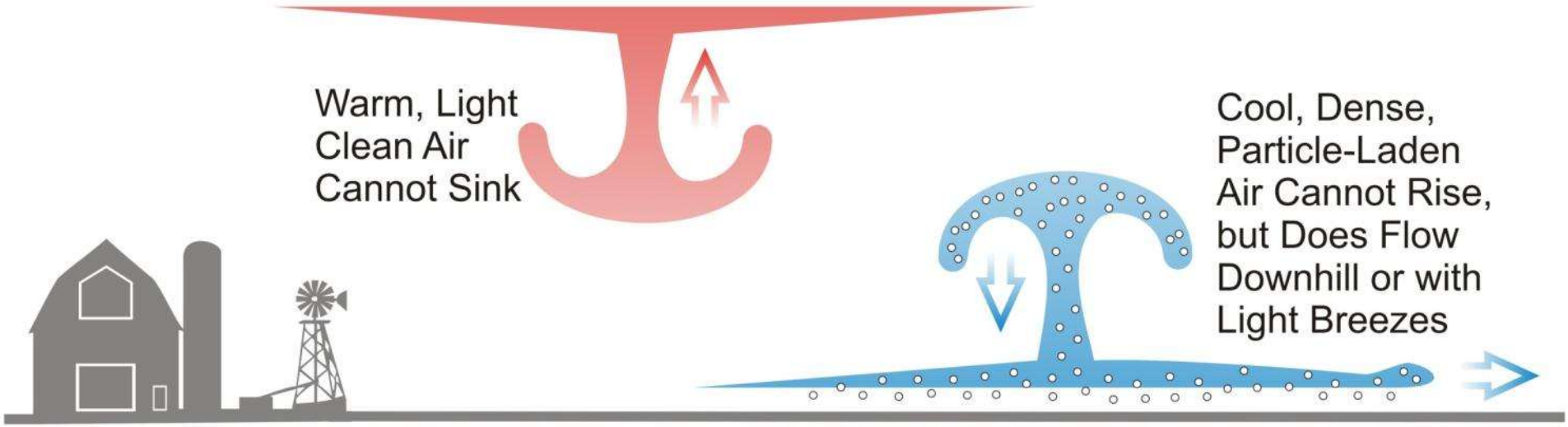
- **The air around us bubbles like the goo in a lava lamp…**

thermal turbulence

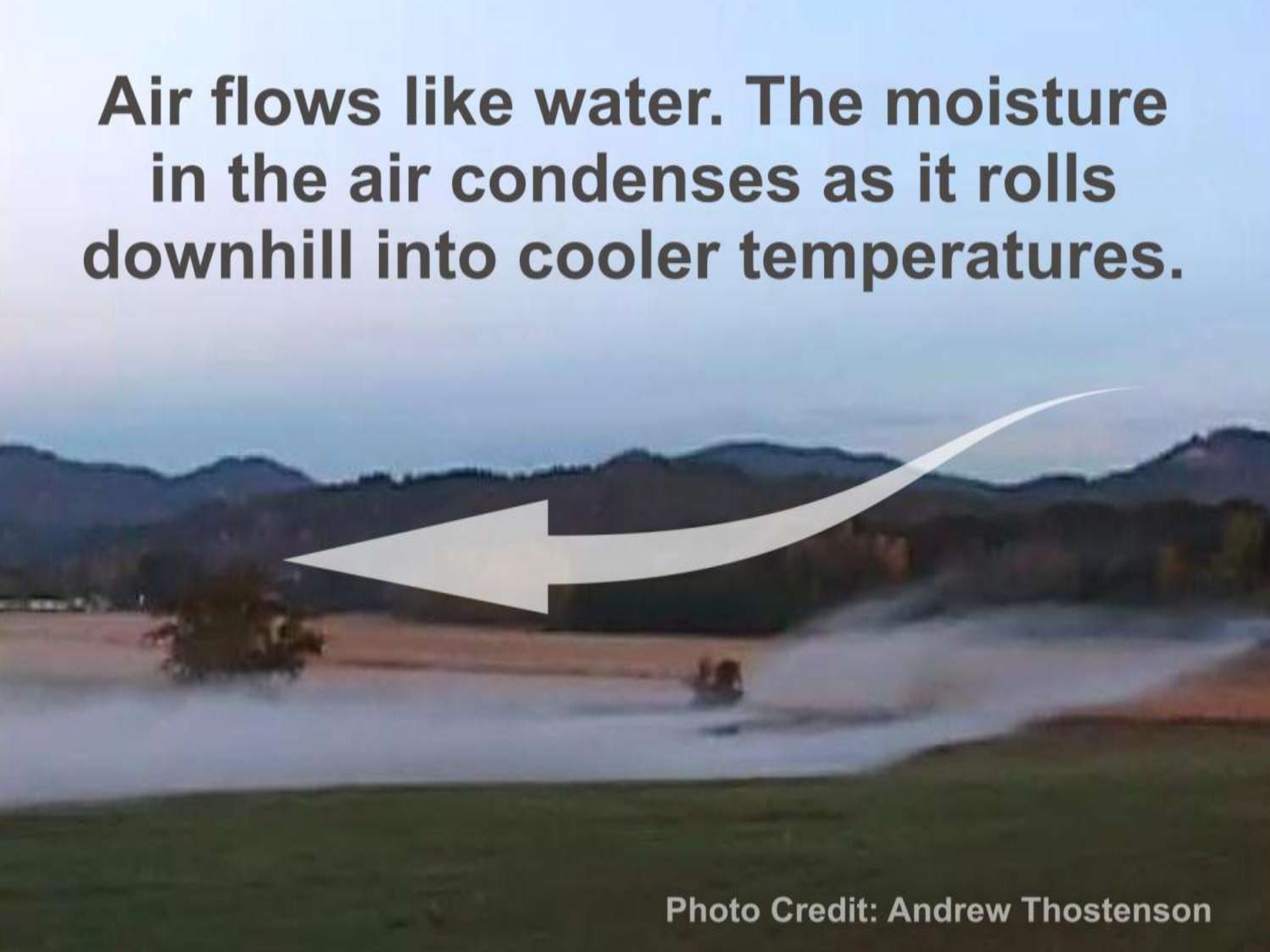


- **Spray-laden, warm air rises and dissipates as cooler, clean air falls**

temperature inversion



- **Temperature inversions supress thermal turbulence, and concentrated spray-laden air flows laterally. Either downhill (like water) or with light breezes**


Air flows like water. The moisture in the air condenses as it rolls downhill into cooler temperatures.
Photo Credit: Andrew Thostenson


DEW
FROST

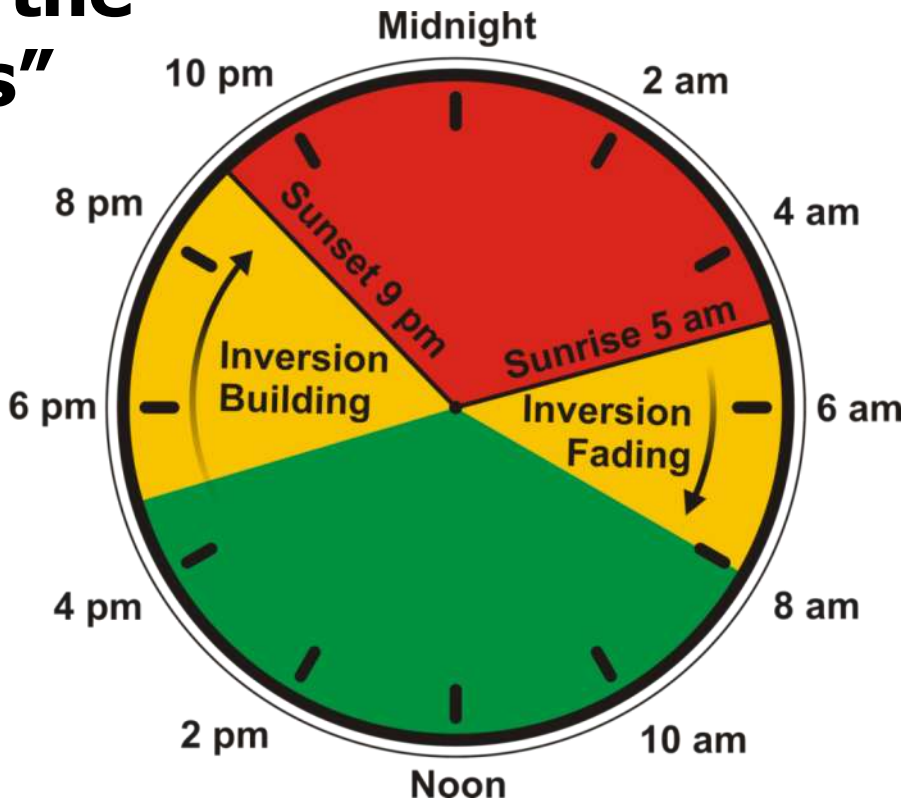

Red dye spraying
from a plane.
Photo Credit: Gail Amos


Red dye applied aerially on an afternoon in May during an inversion. Fine mist hangs above the cold ground.
Photo Credit: Andrew Thostenson

when do inversions occur?

- **Inversions, once formed, persist until the sun rises and warms the Earth's surface, or until winds increase and mix the stationary "layers" of air together**

- **At sunrise, the inversion will be at its maximum height**

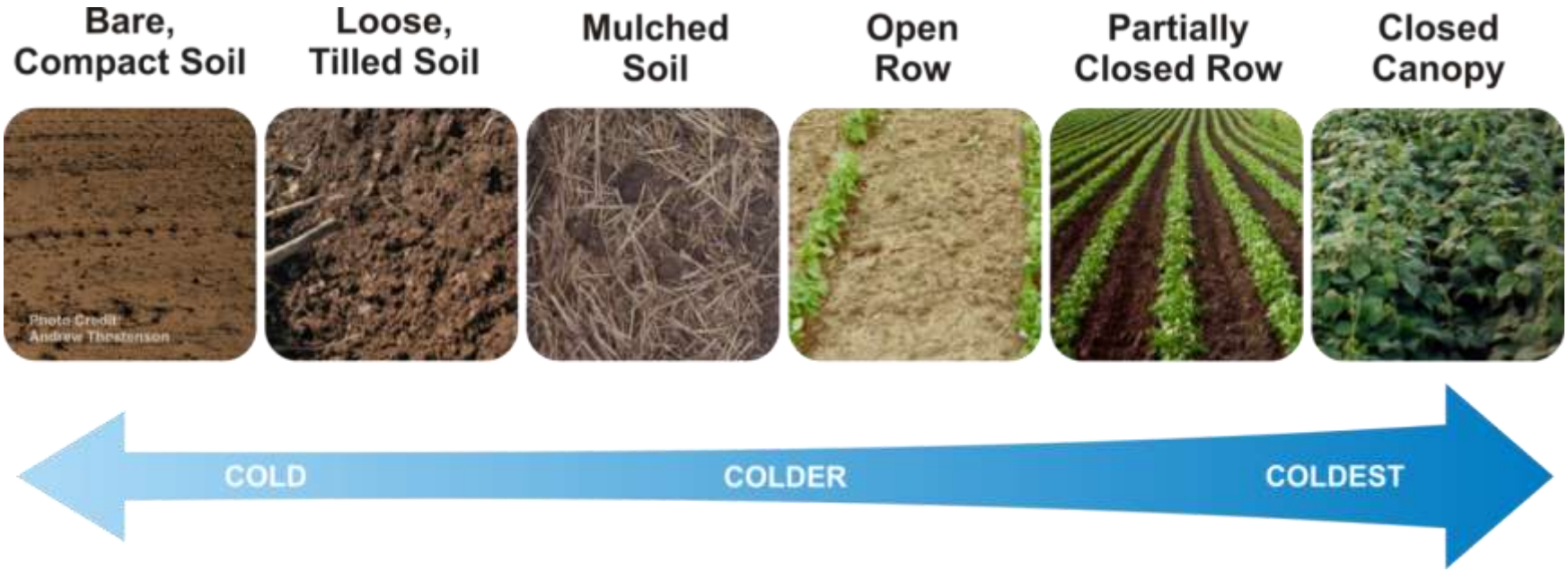


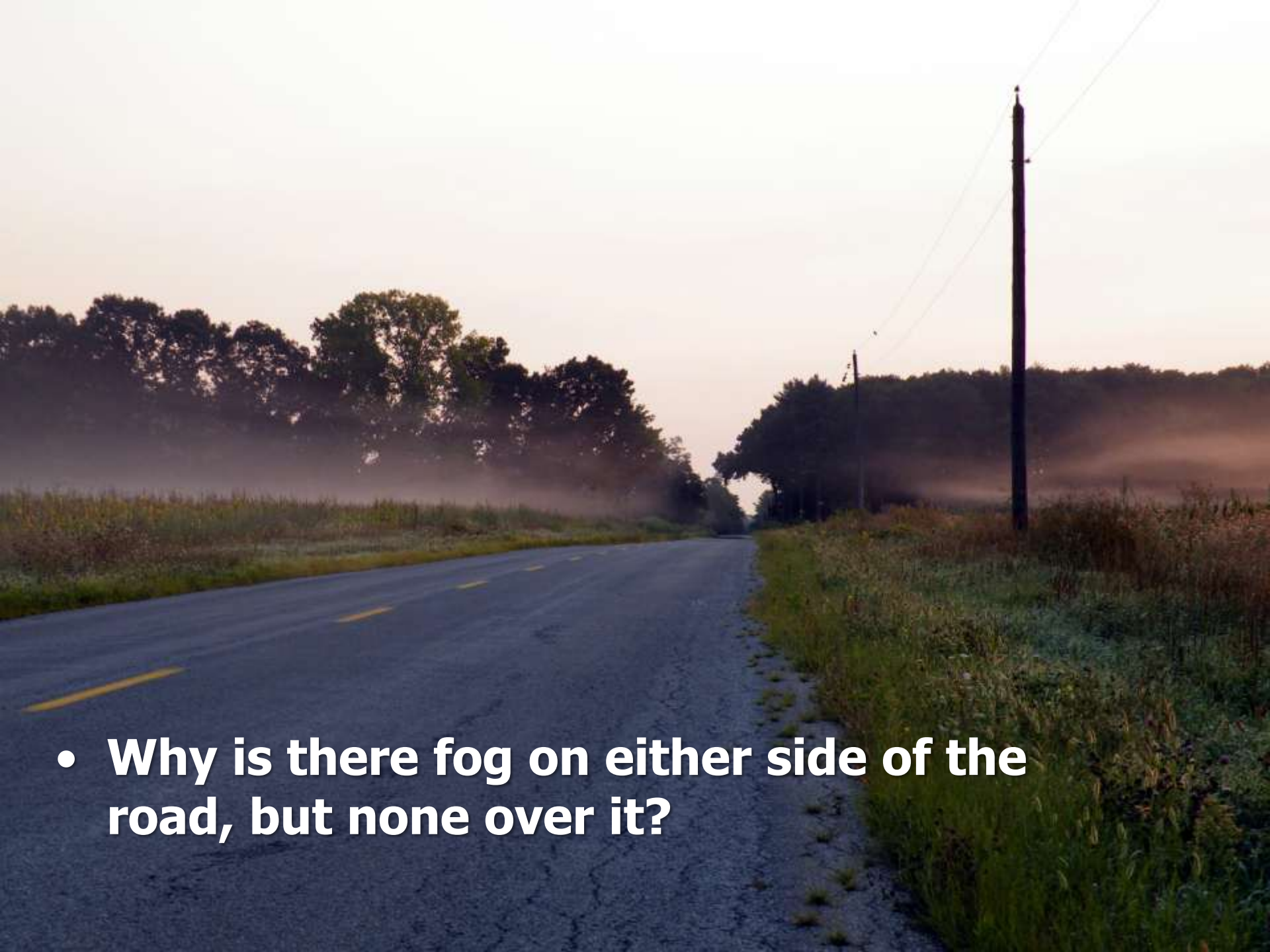
inversion intensity varies

- **Humidity slows the formation and reduces the intensity of an inversion**
- **Cloud cover bounces long wave radiation back to Earth, making it warmer and reducing inversion intensity**
- **Wind (>6 or 8 km/h) stirs the air vertically, reducing inversion intensity**

soil surfaces affect inversions

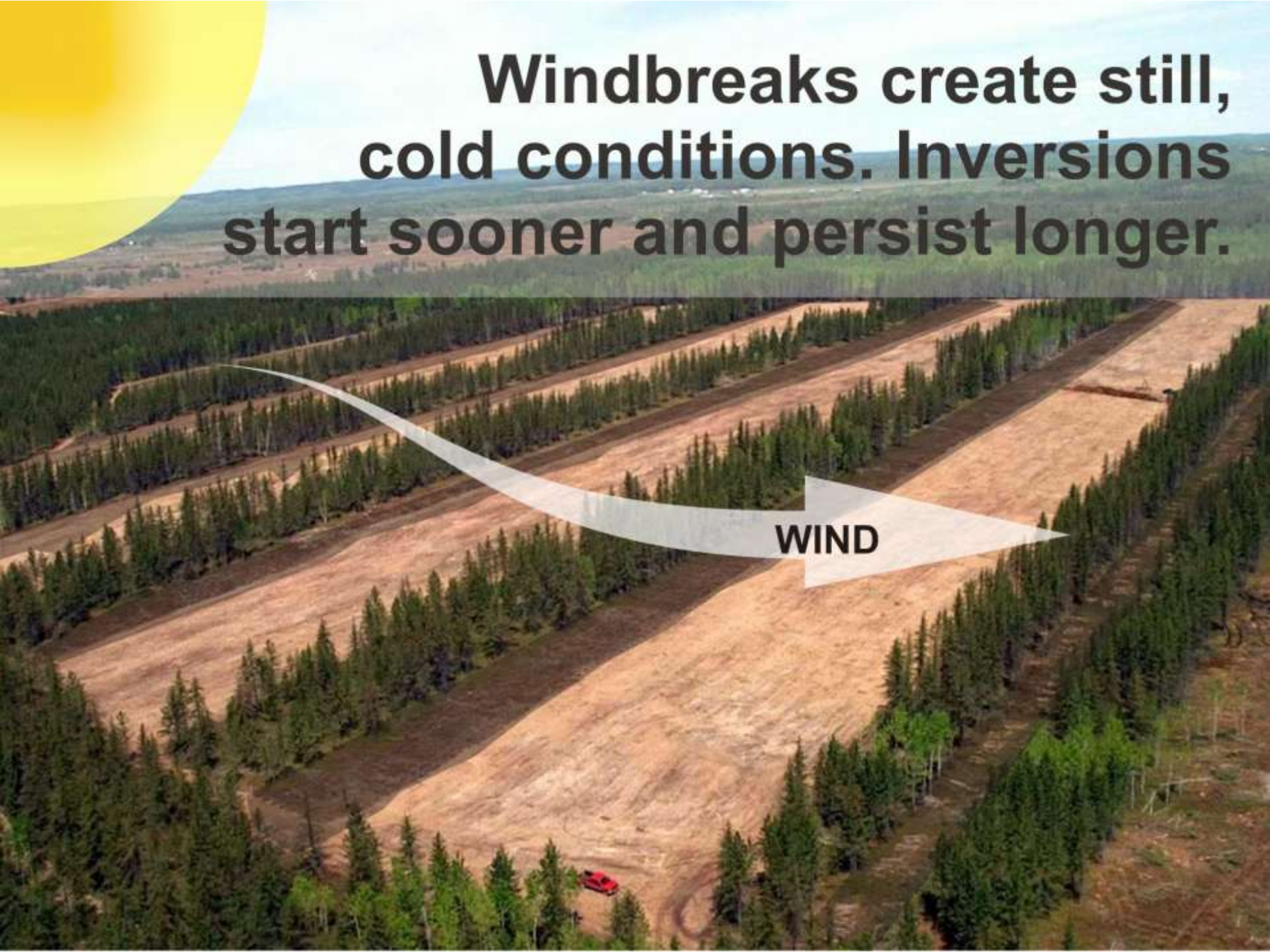
- **Surface area radiates heat and has a localized cooling effect. So, the more surface area, the faster and more intense the local inversion**





- **Why is there fog on either side of the road, but none over it?**

- **Because the canopy is colder than the road and caused moisture to condense.**


Windbreaks create still, cold conditions. Inversions start sooner and persist longer.
WIND

you can smell an inversion

you can hear an inversion

you can see an inversion

you can feel an inversion

- **Know the topography and local features surrounding where you spray (Google Earth is good for this)**

- **Dying to know more about thermal inversions and drift? Of course you are!**

- **This is great 2014 factsheet from NDSU:**

  http://tinyurl.com/NDSU-ae-1705

- **This is an article Tom Wolf and I wrote in 2014:**

  http://bit.ly/1nNpgSf

- **When possible, choose products with low volatility. When labels say to avoid spraying during warm temperatures, it may be a clue to volatility**

and there's so much more…

- **Thanks for listening. This was too much, too quickly, but hopefully it inspires you to go here to learn more:**

Sprayers101

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