

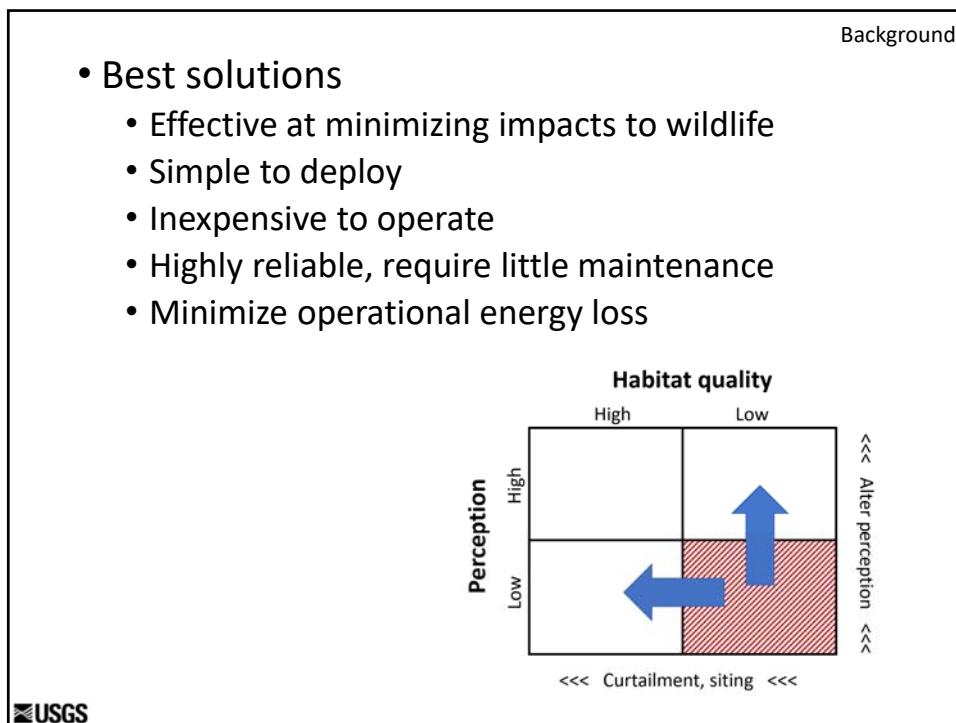
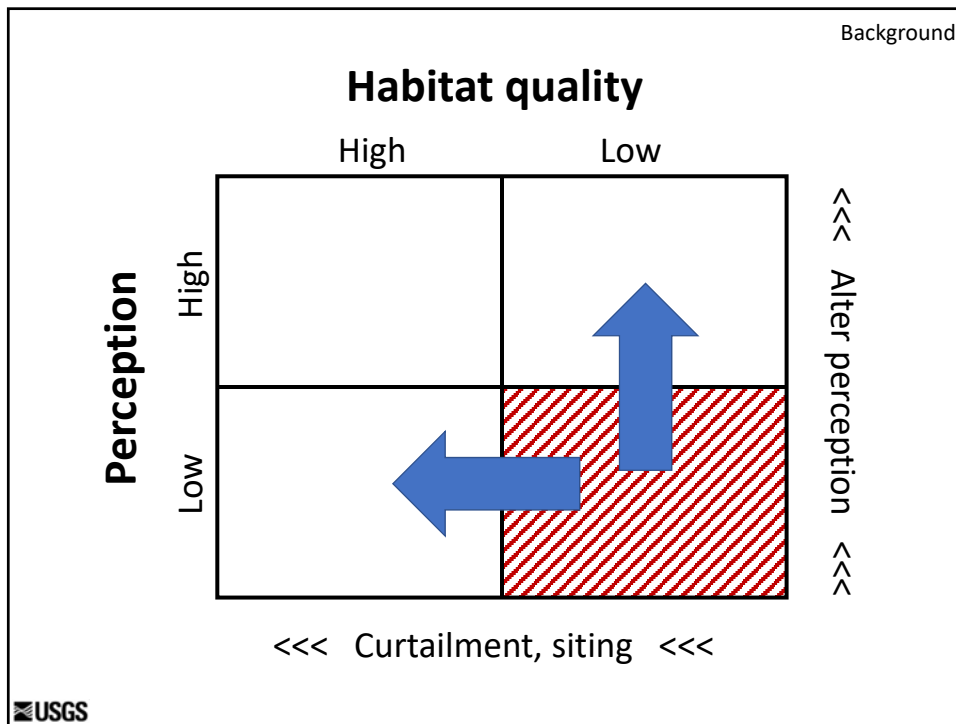
## Managing bird and bat turbine strikes using weather radar

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Bozeman, MT

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National Renewable Energy Lab  
National Wind Technology Center  
Golden, CO

## Background

- Growth in wind energy production
- Mortality via....
  - **Attraction**, turbines likely become so-called 'ecological or evolutionary traps'
  - **Incidental contact**
- Options
  - **Alter the environmental cue**, i.e., change how turbines are perceived  
....or....
  - **Alter the environment**, i.e., curtailment



# Can NEXRAD be used as a real-time platform for informing curtailment?

**NEXRAD**  
NEXT generation weather RADar

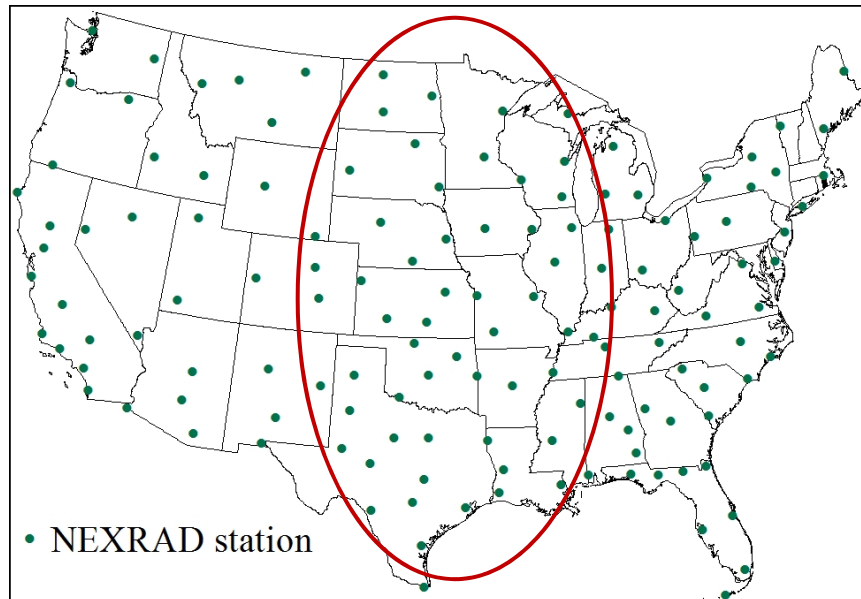


KLOT, Romeoville, IL

**TDWR**  
Terminal Doppler Weather Radar



Las Vegas, NV (credit: Simpson)



• NEXRAD station

e.g., Van Doren and Horton 2018



## NEXRAD metrics

- >140 stations in continental US
- Six measures
  - Reflectivity, radial velocity, spectrum width, differential reflectivity, correlation coefficient, differential phase
- Updates nationally every 6-10 minutes
- Range limited by altitude of birds and bats, not sensitivity



## Forecasting v. Real-time

- What is the time horizon for a potential NEXRAD-based curtailment scheme?
- Forecasting
  - Van Doren and Horton (2018) *Science*
  - Weather-based model that can forecast a day in advance with 80% accuracy
- Real-time
  - More accurate, requires constant vigilance
- Hybrid scheme
  - Shifting accuracy as the movement event approaches
  - Integrates planning (forecasting) with realization (real-time)



## Advantages and disadvantages of using NEXRAD

### Advantages

- Existing embedded radar network requires no support
- Highly reliable
- Data is free and centrally archived
- Considerable advances in data processing in recent years

### Disadvantages

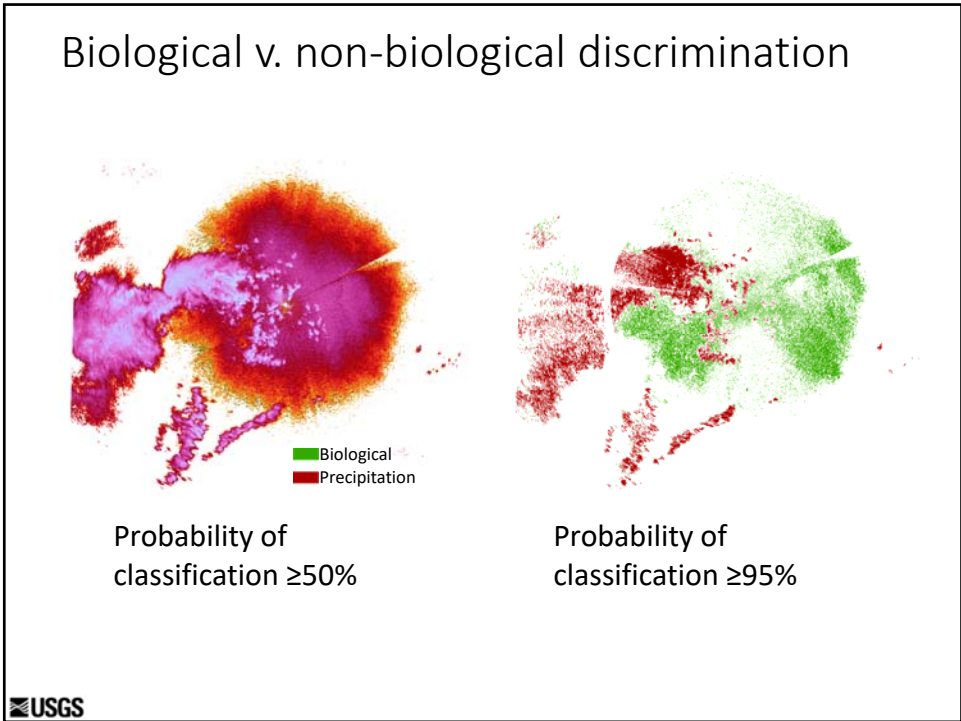
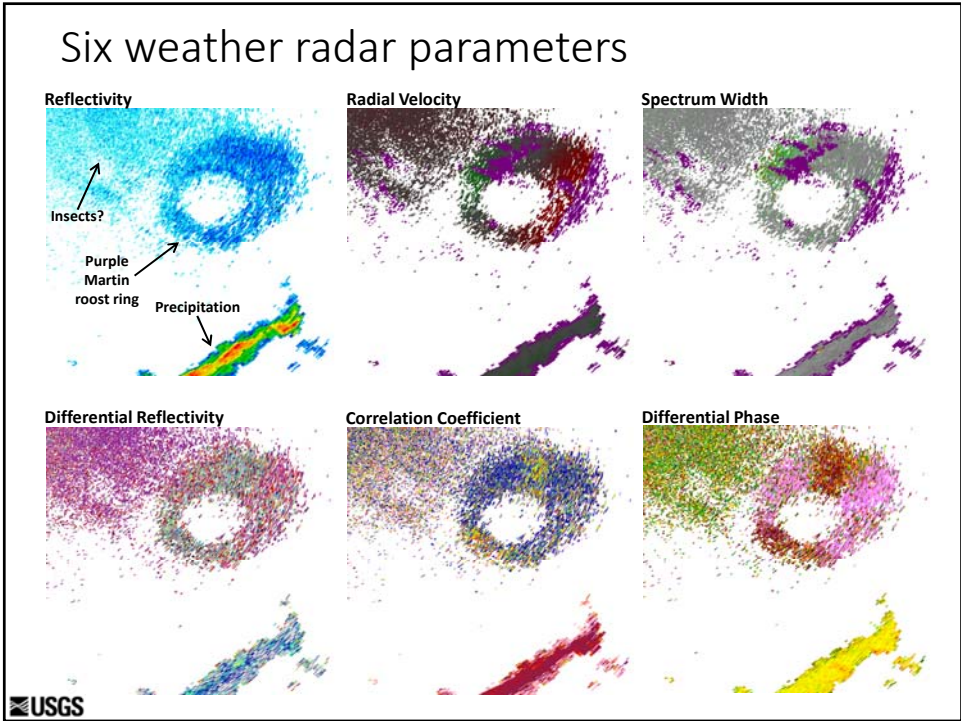
- Discriminating among target types
- Measuring low-height targets at range
- Radars do not co-occur with turbines
- Manage by strategic curtailment

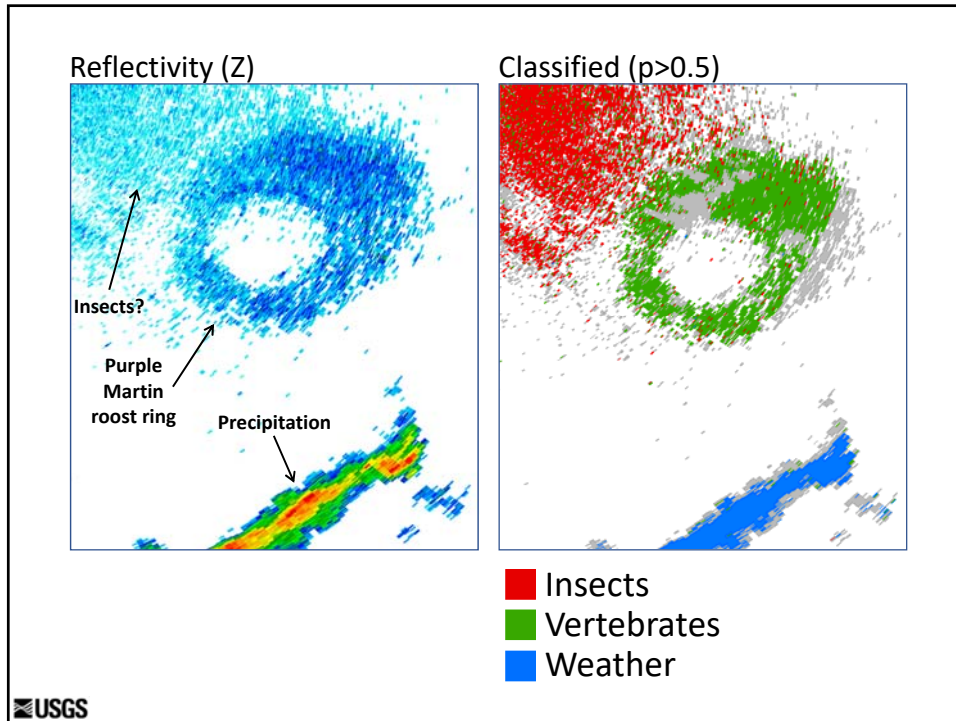


## Goals

- Are NEXRAD target identities corroborated by those on portable radar?
- Do vertebrate target densities identified by NEXRAD index bat activity?





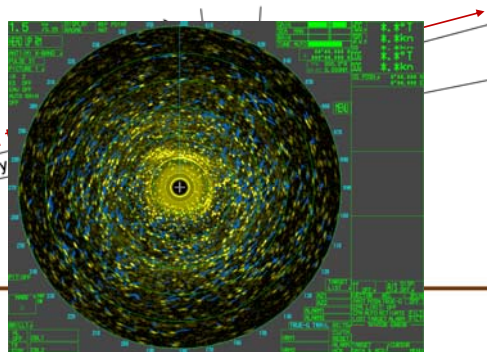
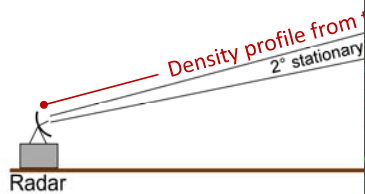


### Corroborate via portable radar, thermal imaging



#### Parabolic antenna

- Good data on speed and direction
- Good data on height
- Longer range
- Less comprehensive

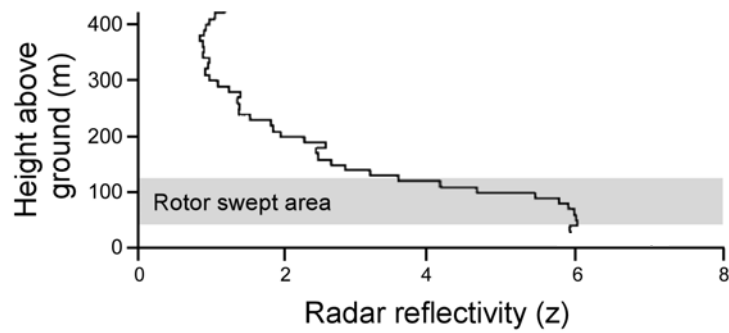


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- Are NEXRAD target identities corroborated by those on portable radar?
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- Are NEXRAD vertical profiles corroborated by those measured by portable radar?



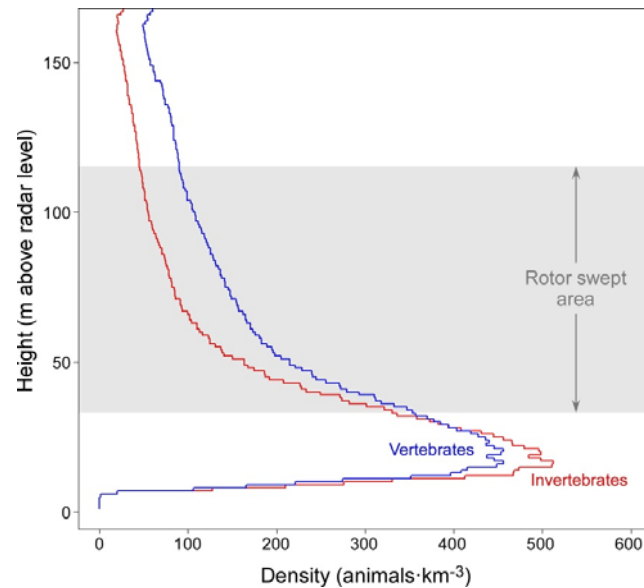
## NEXRAD density profile



see Buler and Diehl 2009



## Portable radar density profile



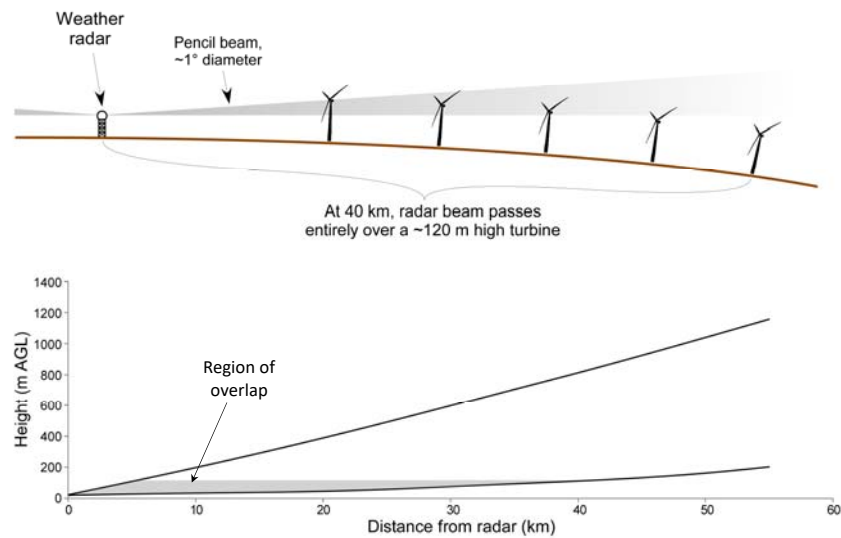
USGS

## Goals

- Are NEXRAD target identities corroborated by those on portable radar?
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- Are NEXRAD vertical profiles corroborated by those measured by portable radar?
- At what range are NEXRAD profiles still operational?
- What proportion of turbines fall within this range?

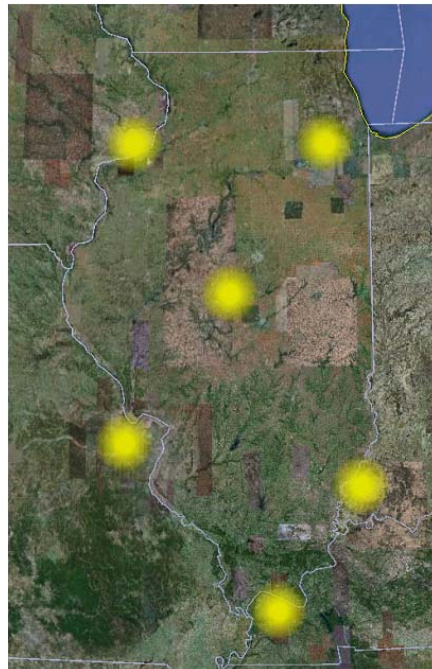
USGS

## Limited range of overlap



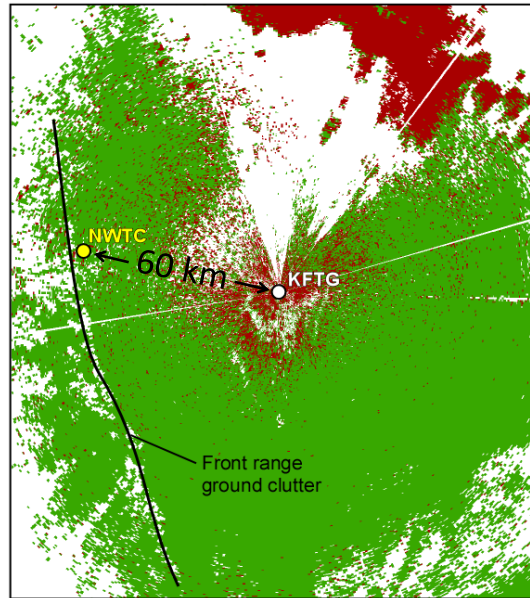
USGS

- NEXRAD installed base offers limited potential to directly monitor airspace at the height of rotor swept areas

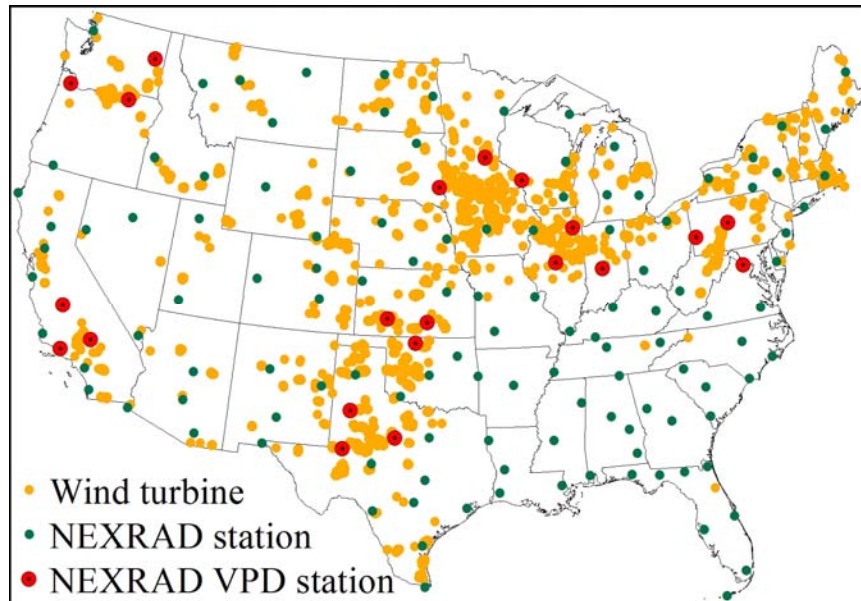


USGS

e.g., Denver radar



USGS



USGS

