Recommended Practices to Achieve Bankable Data from SoDAR

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A Brief History

- 2004: Kathleen Moore (IEDat) & Bruce Bailey (AWST) drafted a set of “best practices” guidelines. Reviewed by about 2 dozen sodar users in the industry
- 2007: International Energy Agency conducted a workshop on Remote Sensing in Wind Energy at Riso. It was agreed to use the existing best practices document as a basis for the IEA Recommended Practices
- 2009: A second meeting of the IEA Remote Sensing group agreed to update the RP with theme of “bankability”
- 2010: Updated RP circulated to 24 experts

Goal of the Recommended Practices

- Outline the requirements for a sodar data set to be bankable (bankability is a property or feature of the *data*: a) absolute accuracy and b) uncertainty as low as, or lower than, anemometry
- Key elements:

1. Siting (fixed echoes, complex terrain)
2. Maintenance
3. Calibration/test/audit: documentation, traceability
4. Understanding the data that come from the sodar

State of the Art of SoDAR for Wind Resource Assessment

- Phased-array: (alphabetical order):

  Atmospheric Research and Technologies, LLC, Atmospheric Systems Corporation, Metek, Remtech, Second Wind Triton, Scintec

- Non-phased array:

  AQ Systems (Sweden)

Possible Applications of SoDAR

- Prospecting/Tower Placement Decisions
- Shear Parameters At Tower Sites
- “Mobile Met. Tower”: wind speed relative to tower locations
- Hub height wind speed and direction (stand-alone)
- Detection of Rotor-plane Phenomena (e.g. LLJ, ramps, extreme shear in speed & direction)

SoDAR for Wind Resource Assesment

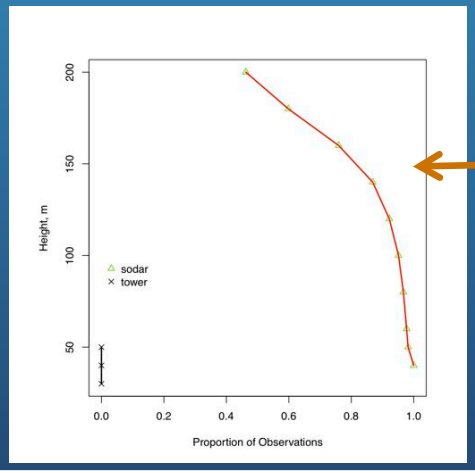
- Wind speed at hub height (80-100 m)
- shear parameter
- Weibull parameters, TAB file (Frequency of U by direction)
- turbulence intensity
- synthetic time series (“8760”) with representative properties (autocorrelation, Weibull, etc..)

**Use in conjunction with tower data, stand-alone, or some combination

****Ultimate goal is “bankable” data which reduce uncertainty

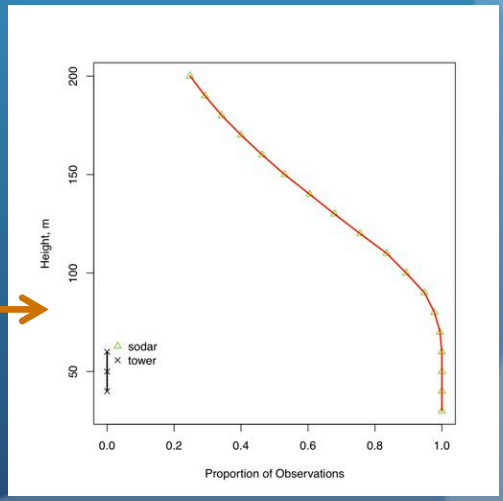
Considerations: Availability

- Operating continuously?
- Rain/snow
- Altitude performance = f (hour, U, RH) : which observations qualify?
- Filter with tower?



lidar

sodar



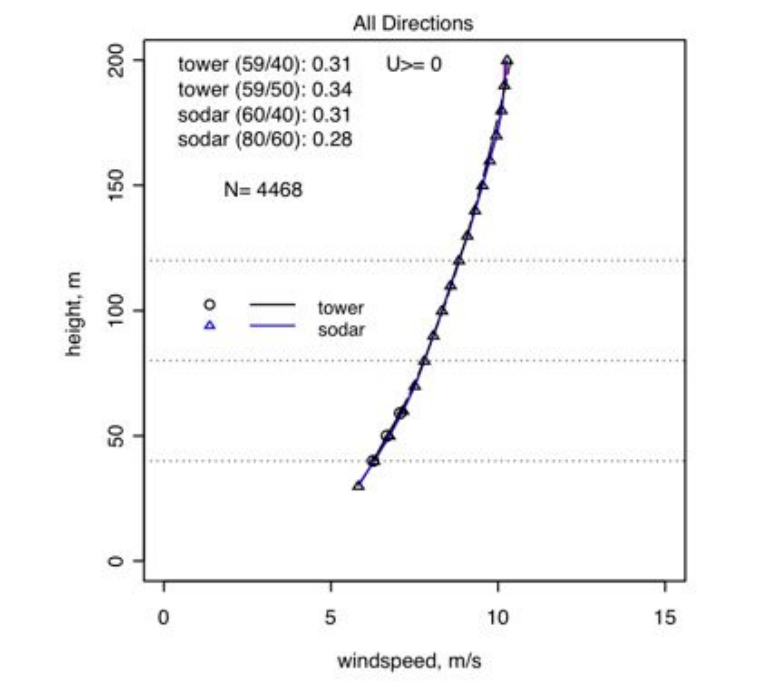
Examples

- Sodar near 60-m met. tower for 2 months

- Sodar at a site 4-5 km from two 60-m met. towers

- Lidar 14 km from a 50-m met. tower for 1.5 months

Sodar/tower comparison, 2 months



- Availability reflects joint tower/sodar
- Some uncertainty in tower shear is revealed (DFW)
- Stable estimate of shear above tower top is obtained
- Statistics on how change in shear is related to stability, etc.

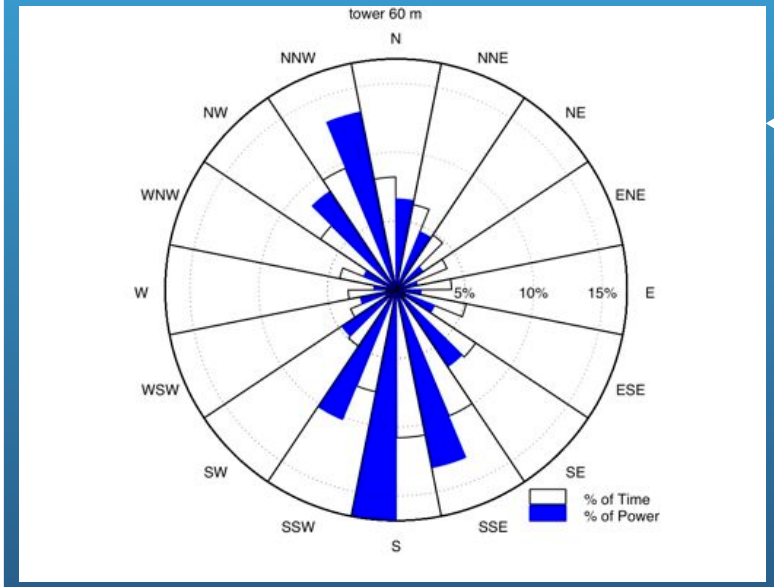
Sodar: December-April

	After filtering with tower	Sodar only (screened)
U80	7.8 m/s	7.7 m/s
α 80/60	0.22	0.23
α 100/60	0.23	0.23
N	9,495	12,354
N collected	17,495	17,495
Total N poss.	18,496	18,496
Weibull A,k	8.430,1.898	8.435,1.802

- Sodar operated 95% of the time
- 4% of sodar data disqualified due to rain or snow
- Winter operation, so tower icing accounts for another 4.5% loss
- Some bad anemometers
- Altitude performance varies with hour of day, wind speed, humidity
  (11% didn't reach 100 m)

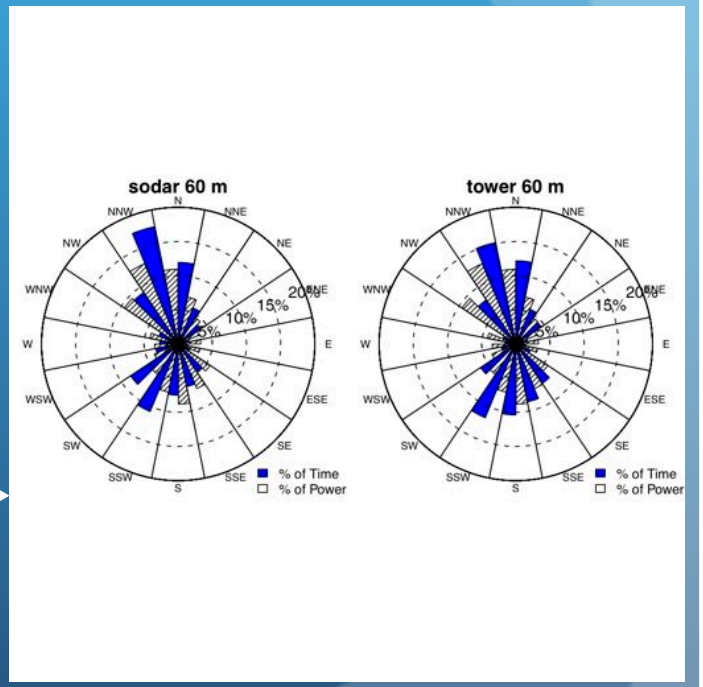
Annualizing Shear

- Average sector-wise shear by annual energy rose (4-month sodar campaign before averaging: 0.22; after: 0.24)



← Annual

Sodar campaign →

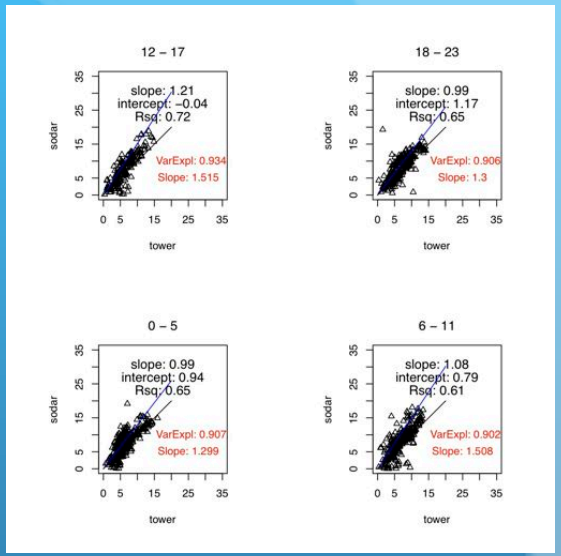


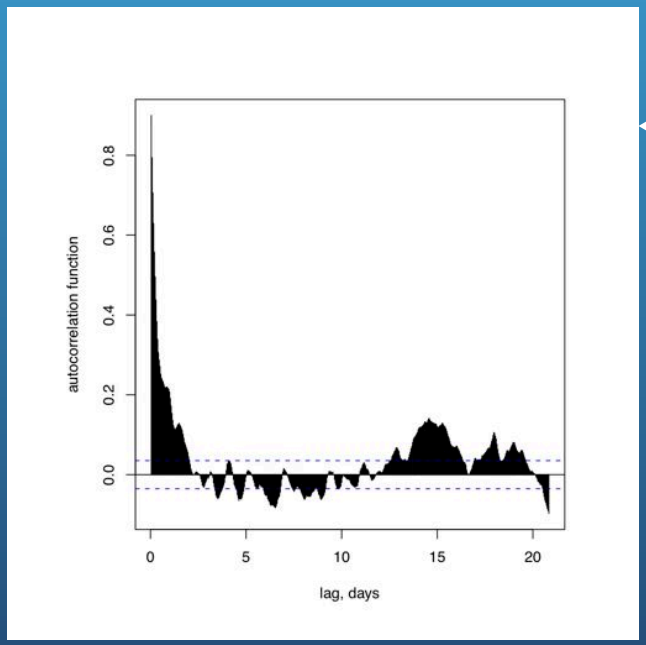
Annualizing Wind Speed

- PCA

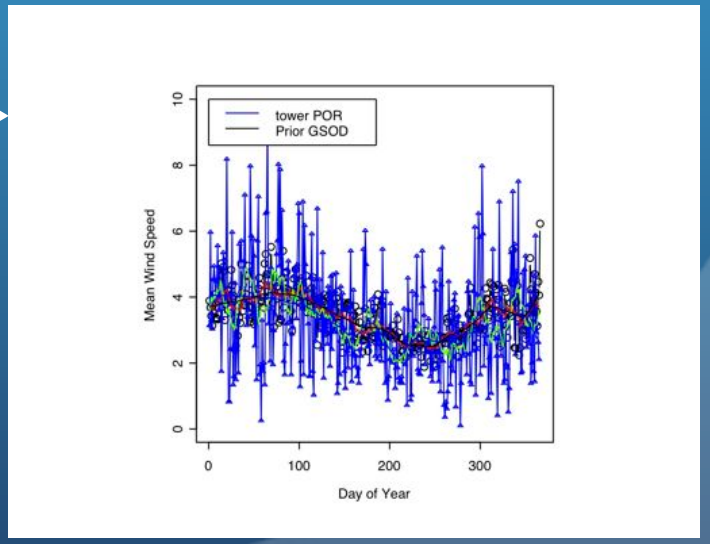
  (as in MCP) hour of day is important:

- Stochastic modeling with ARIMA





Seasonal:



Recommended Practices

- IEA Recommended Practices document:

  Calibration & testing, instrument verification, operating requirements, siting and noise, data collection & handling, *complex terrain*, uncertainty

- Decide what the purpose is, and what the desired parameters are (shear, U_{80} etc.)

- What degree of uncertainty is acceptable? How should availability be assessed? What is the impact of availability on bias, uncertainty?