High wind alerts for Purdue campus based on observations from the X-band Teaching and Research Radar (XTRRA)

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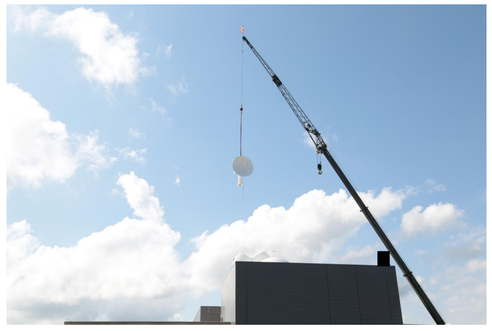
Live XTRRA images

Background:

- As a result of the 2011 Indiana State Fair stage collapse incident, Purdue University enacted a new wind restriction (13 m s^{-1}) for tents during outdoor events (M. Baldwin 2019, pers. comm.).
- Currently, winds are monitored by volunteers using handheld weather meters.
- The recent installation of the X-band Teaching and Research Radar (XTRRA) at Purdue may allow these alerts to be automated.
- **Our objective in this study is to develop a prototype automated high wind alert system based on XTRRA observations.**



← The XTRRA radar being installed on top of Wang Hall on 20 June 2018. Photo courtesy of the Purdue College of Science.

Parameter	Value
Center frequency	9.41 GHz
Half-power beam width	1.0°
Polarization scheme	Dual linear; STAR
Peak / average transmitted power	16 kW / 24 W
Maximum unambiguous range	50 km
Maximum unambiguous velocity (dual-PRT)	30 m s^{-1}
Range resolution	50 m
Azimuthal range	0 - 360°
Elevation range	0° - 180°
Antenna diameter	2.4 m
Antenna gain	45 dB

Methodology:

Raw Doppler velocity data

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3-dB SNR threshold, texture filter

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Height restriction, median filter

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Statistical outlier removal

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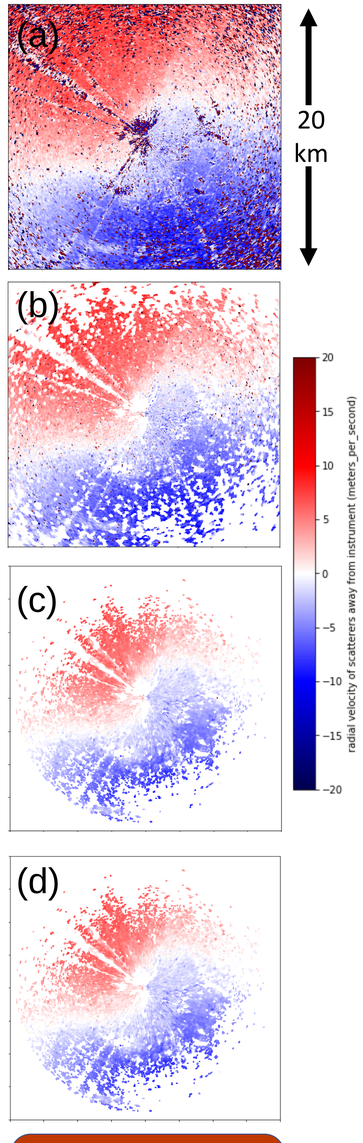
Velocity threshold (13 m s^{-1})

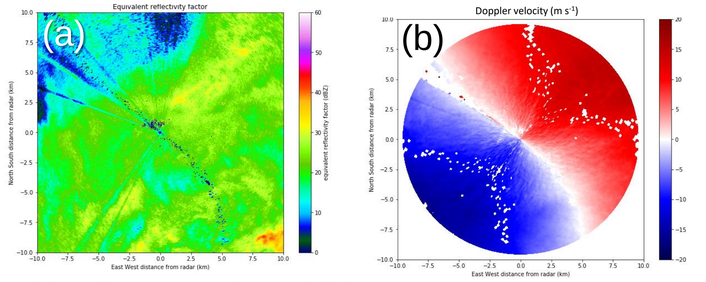
→ **High Wind Alert**

Example:



Results:

- Our prototype system appears to work well, with strong signals for real high wind events. (Example below)



(a) Reflectivity in dBZ and (b) Doppler velocity in m s^{-1} at 1330 UTC on 21 September 2018 at 1.3°. (c) Time series of gates that exceeded the velocity threshold.

Conclusions:

- We developed a prototype high wind alert system based on 22 days of XTRRA velocity observations.
- Some additional challenges remain in minimizing false alarms.
- Eventually, we hope to send automated text alerts to interested parties when high winds threaten campus.

Acknowledgements:

Prof. Michael Baldwin (EAPS) provided information regarding the wind speed limits for outdoor events. The College of Science provided the photograph of the XTRRA being installed.

References:

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