A multi-static meteor radar at Andes Lidar Observatory

Poster #: ITMA02

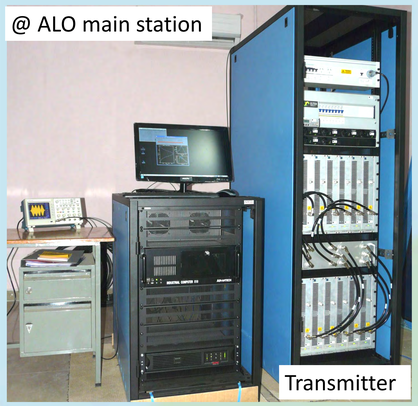
Zishun Qiao[1,*], Alan Z. Liu[1], Javier Fuentes[2], Chris Adami[3], Fabio Vargas[4]

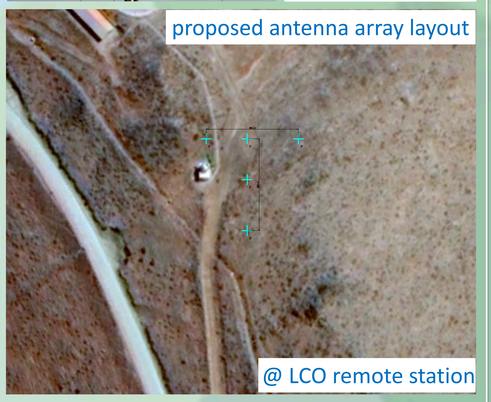
[1]Department of Physical Sciences, Embry-Riddle Aeronautical University; [2]Gemini Observatory, AURA; [3]ATRAD Pty. Ltd.;

[4]Electrical and Computer Engineering, University of Illinois at Urbana-Champaign; *Email: qiaoz1@my.erau.edu

Abstract: With the support of an NSF MRI grant, a multi-static meteor radar will be installed around Andes Lidar Observatory in Cerro Pachón, Chile (30.3S, 70.7W, ALO). The main transmitter will be at ALO, and two remote stations at Las Campanas Observatory 137 km to the north and Southern Cross Observatory 108 km to the south. This system will provide 24-hr continuous horizontal wind measurement in a region where mountain waves are frequently generated. Together with the Na wind-temperature lidar and airglow imagers at ALO, they provide comprehensive measurements of the MLT atmosphere at a broad range of spatial and temporal scales. The details of the instrument, deployment sites, and expected data product will be presented.

Enhanced Meteor Detection Radar by ATRAD





- Consists of a transmitter, and 3 receiving systems.
- The transmitter and one receiving system at ALO; two remote receiving systems at two remote sites.
- The antenna spacings are 2λ and 2.5λ in a cross or T-arrangement.

Pulse Repetition Freq:	5 kHz (max)
Sounding Range:	70-220km; 110 at 80°
Range Resolution:	100m - 4,000m
Transmitter power:	40 kW
Transmitter/Receiver Freq:	35 MHz

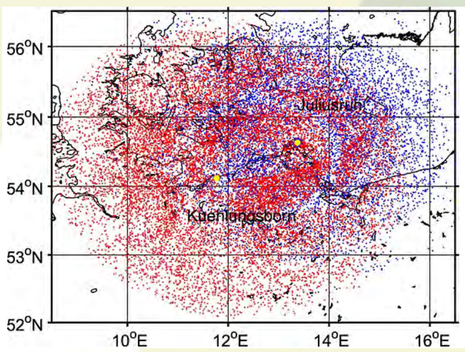
Multi-Static Meteor Radar Technique

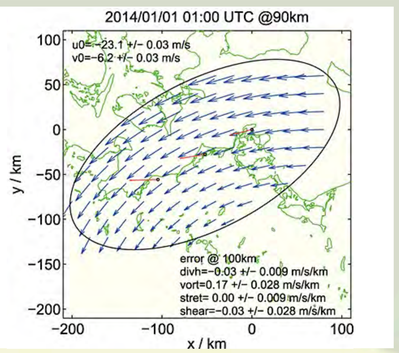
A typical backscatter Specular Meteor Radar (SMR) consists one transmitter and one receiving system; the Multi-Static Meteor Radar technique however, adds interferometry to each receiver station, and adds forward scatter capability to a typical SMR system.

The forward scatter approach added to the typical SMRs allows us to:

i. increase the number of detections and the altitudinal coverage;

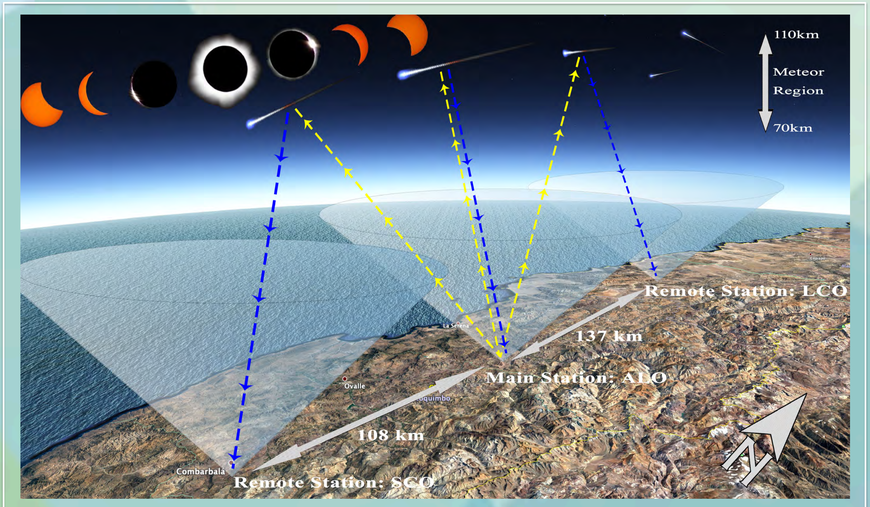
ii. relax the assumption of homogeneity of the wind field to obtain horizontal wind variability in the observed volume.





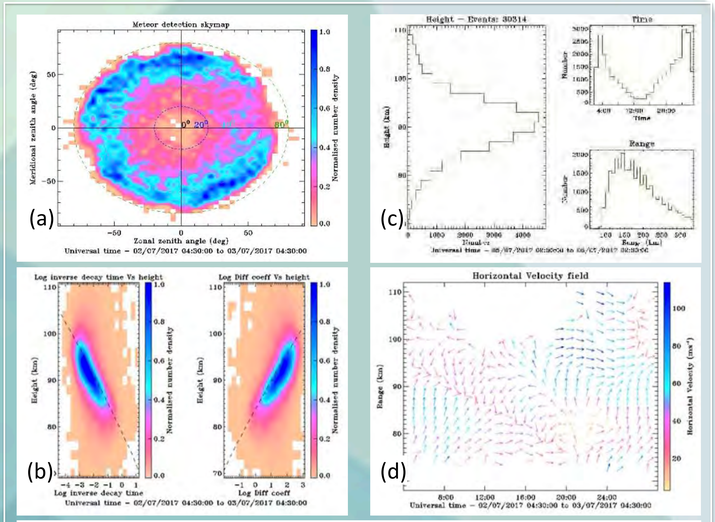
(Left) 2D specular meteor detections of two sites during 24-hr observation. (Right) The horizontally resolved wind field. [Stober, G. and J. L. Chau, 2015]

Deployment Cites



Sites	Full Name	Location	Instrument	
LCO	Las Campanas Observatory	Vallenar, Chile (29.0 S, 70.7 W)	Receiving Antenna x5	Remote receiver
ALO	Andes Lidar Observatory	Cerro Pachón, Chile (30.3 S, 70.7 W)	Transmitting Antenna Receiving Antenna x5	Transmitter & Remote receiver
SCO	Southern Cross Observatory	Combarbala, Chile (31.2 S, 71.0 W)	Receiving Antenna x5	Remote receiver

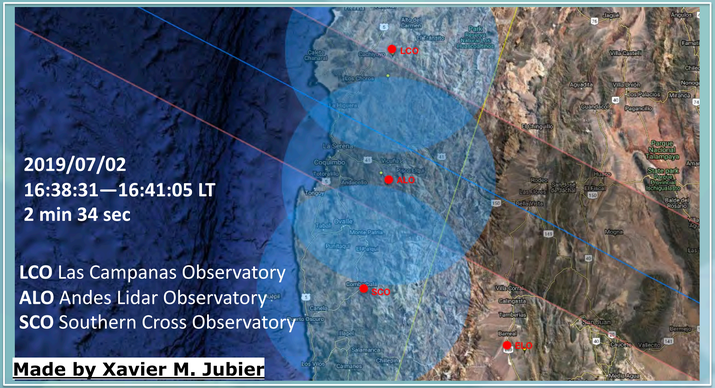
Expected Data Product



a. Sky map of one day of (31,000) meteor detections;
b. Meteor decay time and diffusion coefficient measured over a 24-hr period;
c. Meteor height & time distributions for one day;
d. Typical wind results from one day.

[Credit: ATRAD EMDR radar brochure]

South America Solar Eclipse 2019



Summary and Acknowledgements

- ❑ This new meteor radar system will provide 24/7 horizontal wind and other measurements over a large north-south coverage (>500 km) in MLT.
- ❑ Co-located Na lidar and airglow imager measurements provide comprehensive MLT measurement and cross-calibration at broad spatial and temporal scales.
- ❑ Installation at ALO and SCO station will be completed before July 2019. LCO station will get ready later after the solar eclipse.
- ❑ Data will be openly available and all research usage are welcome.
- ❑ This project is supported by NSF grant AGS-1828589. The excellent infrastructure and engineering support by AURA (Steve Heathcote, Director), LCO (Francesco Di Mille and Guilermo Blanc) and SCO (Sebastian Araya, Director) are essential for the success of the radar deployment.

References

[1] Stober, G., and J. L. Chau (2015), *A multistatic and multifrequency novel approach for specular meteor radars to improve wind measurements in the MLT region*, Radio Sci., 50, doi:10.1002/2014RS005591.

[2] ATRAD Pty. Ltd. (2015), *15-62052_1_ATRAD_EMDR_radar_brochure.pdf*