



THE SOUTHERN ARGENTINA AGILE METEOR RADAR (SAAMER): A PLATFORM FOR COMPREHENSIVE METEOR OBSERVATIONS AND STUDIES

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Meteoroids 2016, Noordwijk, The Netherlands, June 6-10, 2016



SAAMER Location 53 S, 67 W



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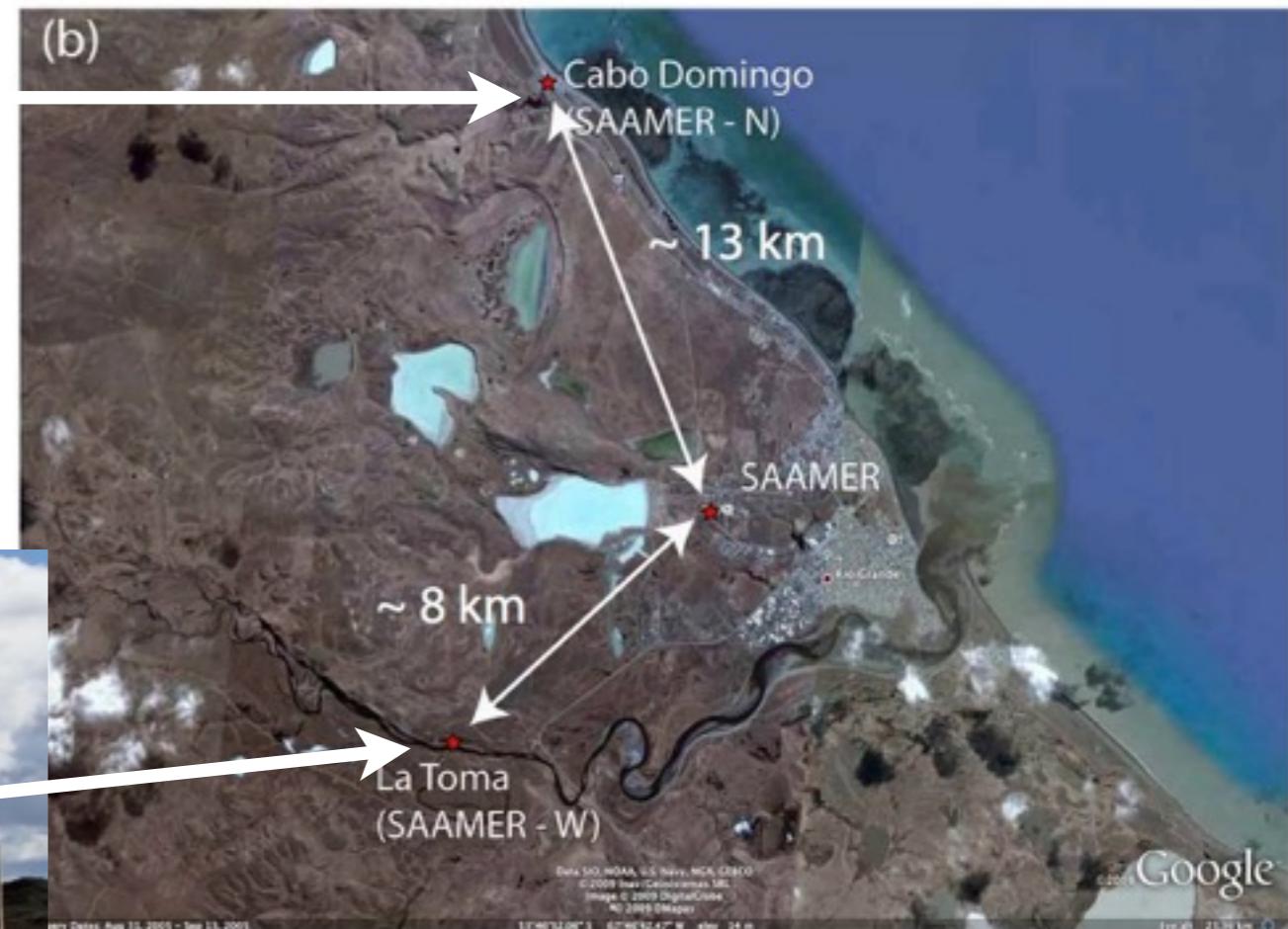
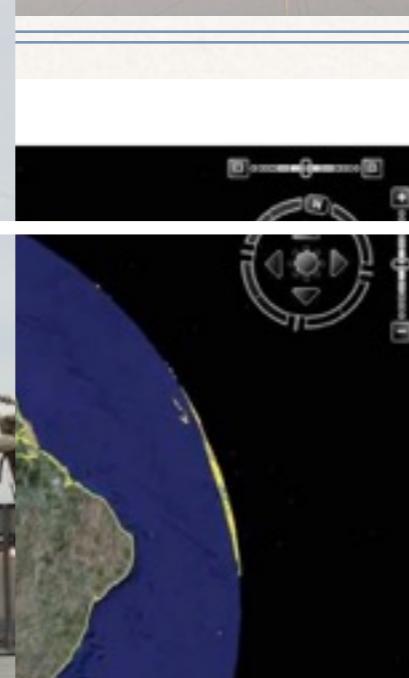
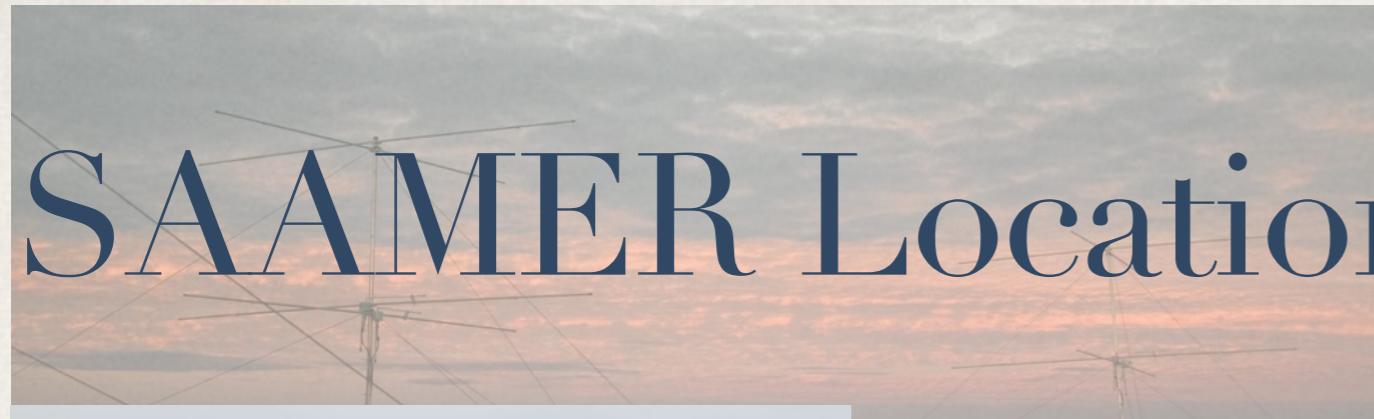


SAAMER Location 53 S, 67 W



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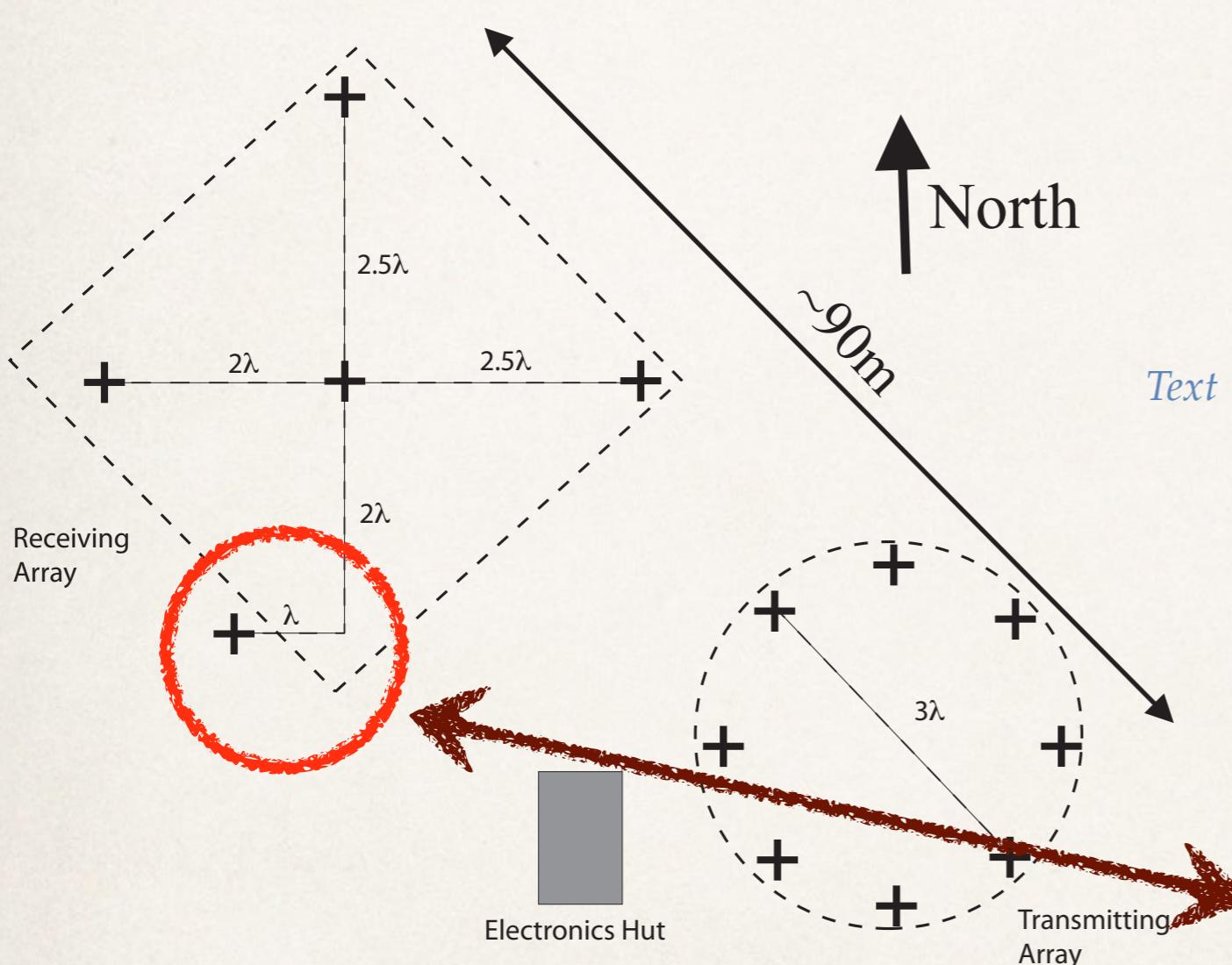






SAAMER System Design

(Fritts et al, 2010a,b)



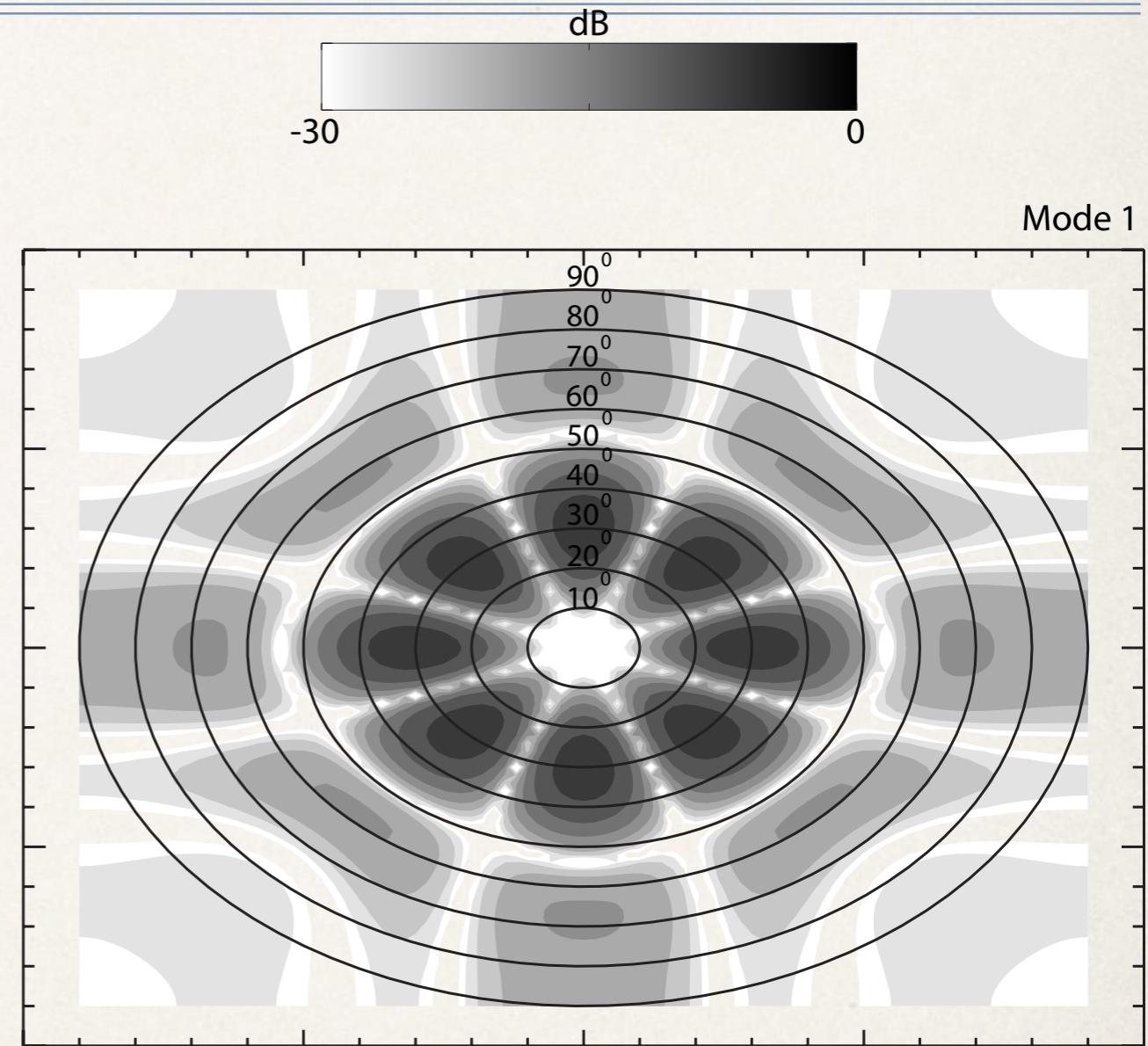
- main site deployed May 2008
- remote sites deployed in August 2010
- Funded through NSF-AGS and AST awards
- high power, 60 kW peak (instead of 6-15 kW)
- 32.55 MHz
- 8-beam TX array (cross-Yagis, instead of one) - near-zenith sensitivity for GW MFs
- T/R switch adds capabilities for PMSE, meteor head echo, and tropospheric studies
- (near) cross RX interferometer



TX Mode 1: Opposite phasing

(Fritts et al, 2010, Janches et al., 2013)

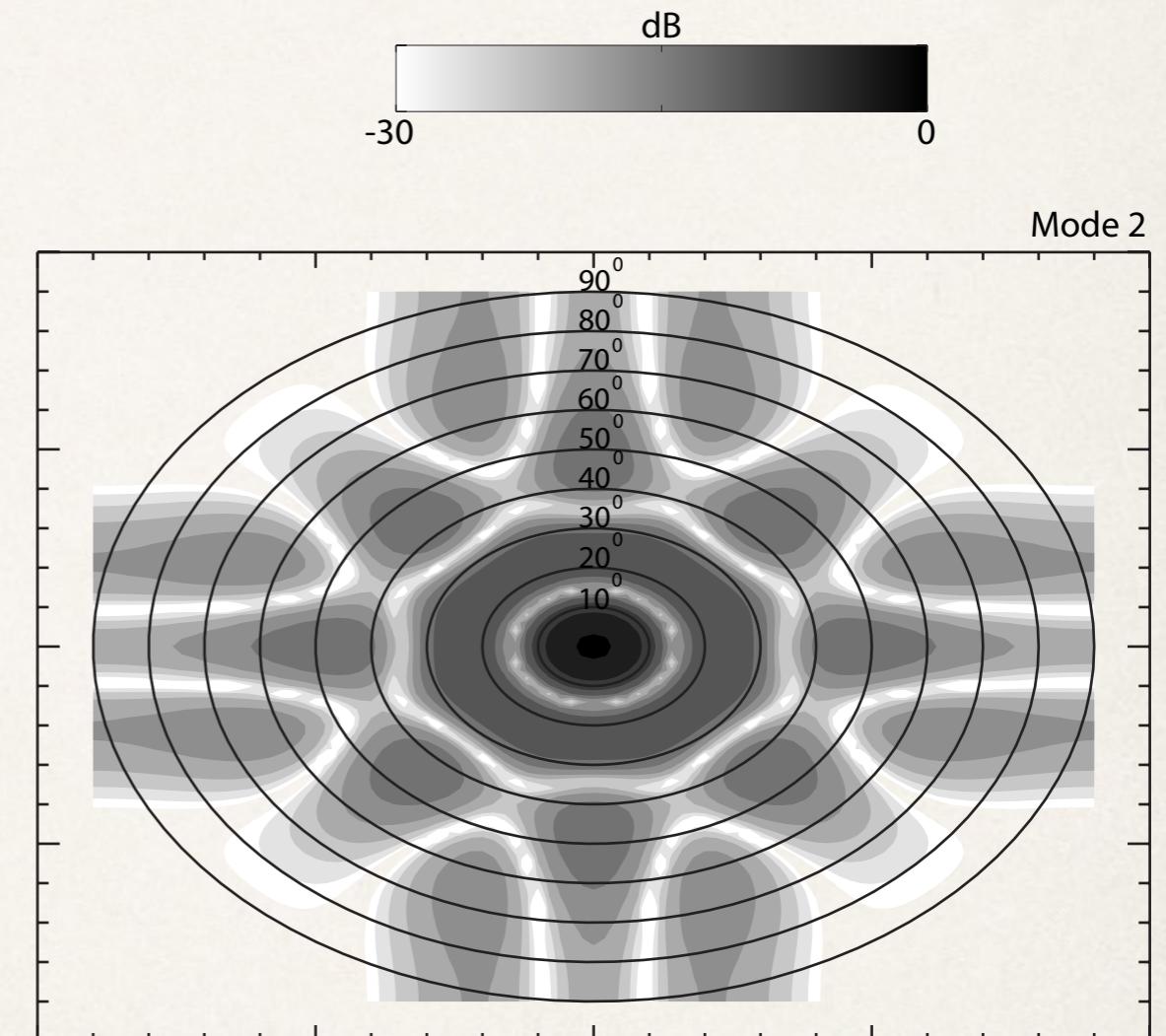
Quantity	
Latitude (degree)	53.8 S
Longitude (degree)	67 W
Frequency (MHz)	32.55
PRF (Hz)	2144, 1765 (after 9/9)
TX Peak Power (kW)	60
Bandwidth (MHz)	0.3
Coherent Integrations (# IPP)	4
Pulse Code	monopulse, 2-bit (after 9/9)
Pulse Length (ms)	13.6
Sample resolution (m)	2000



Pushing the envelope: Same phase

TX Mode 2
(Janches et al., 2014)

Quantity	
Latitude (degree)	53.8
Longitude (degree)	67
Frequency (MHz)	32.55
PRF (Hz)	500
TX Peak Power (kW)	60
Bandwidth (MHz)	0.3
Coherent Integrations (# IPP)	2
Pulse Code	Barker
Pulse Length (ms)	13.6
Sample resolution (m)	250

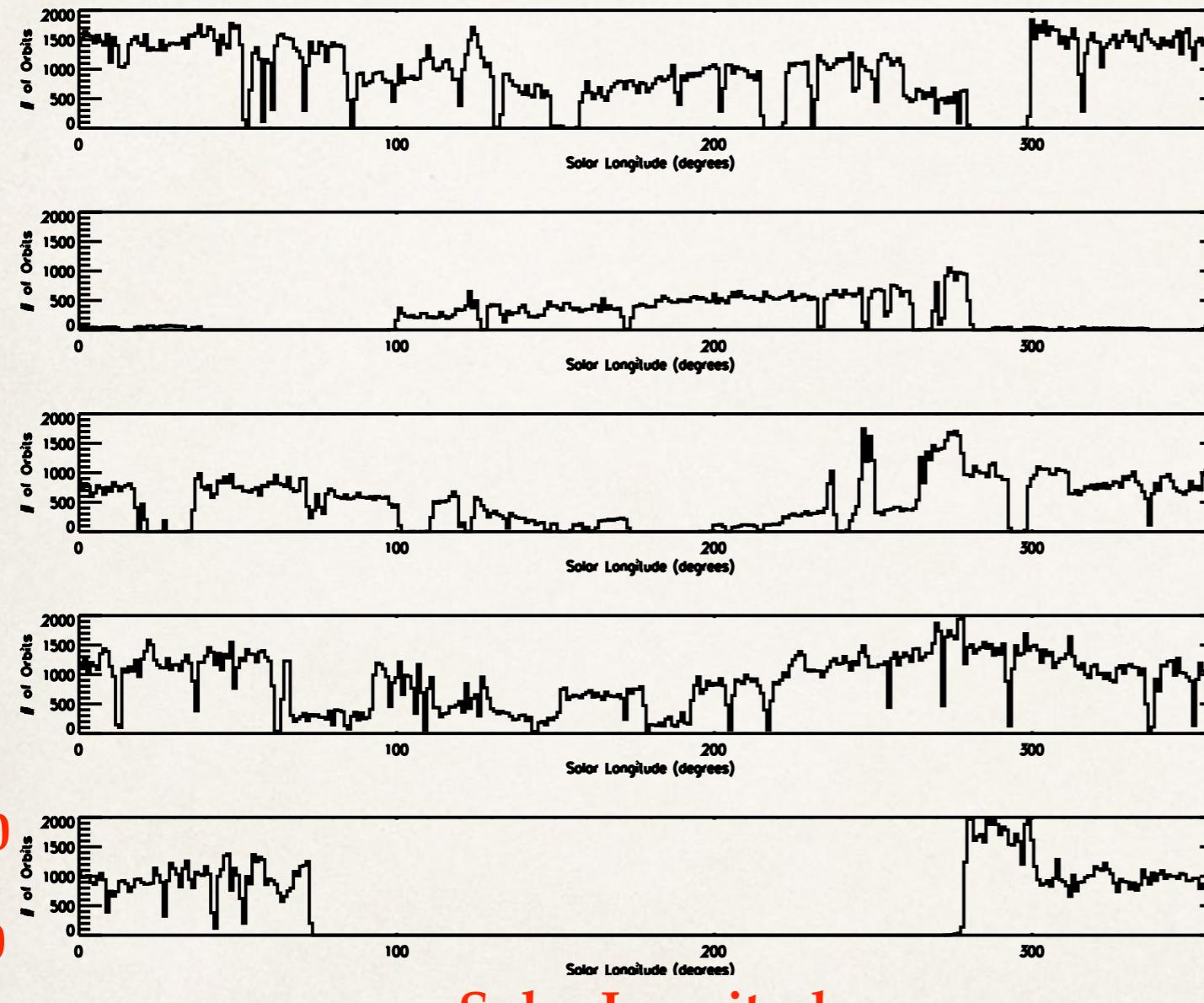




SAAMER Meteor Orbit Rates

(Janches et al., 2013; Janches et al. 2015)

Orbit



2012

2013

2014

2015

2016

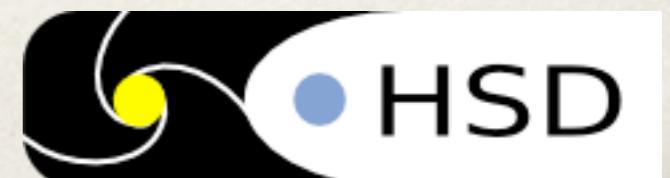
- As of 5/6/2016 a total of 1,184,541 orbits recorded.
- 1000-2000 daily orbits

2000



Solar Longitude

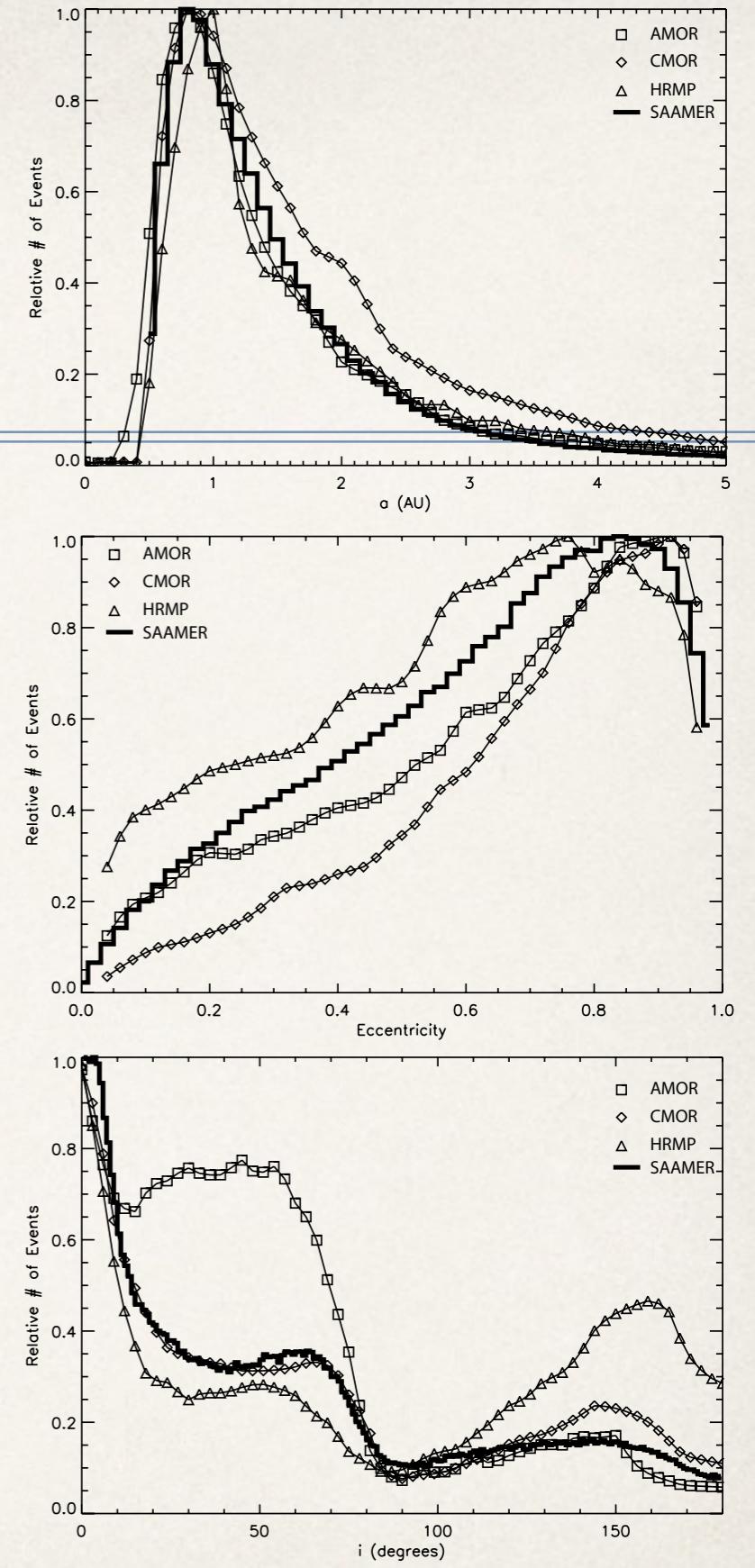
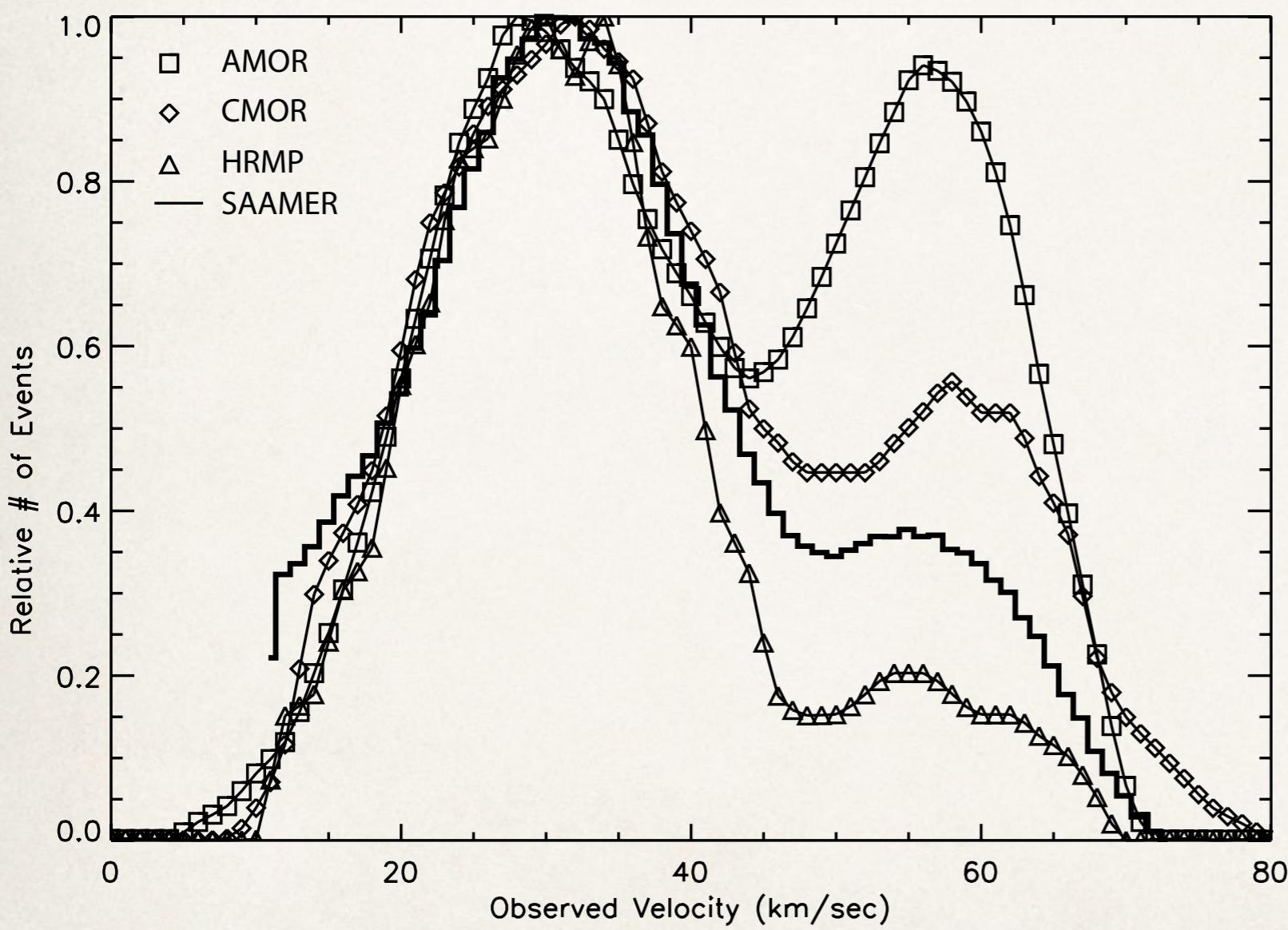
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Observed distributions

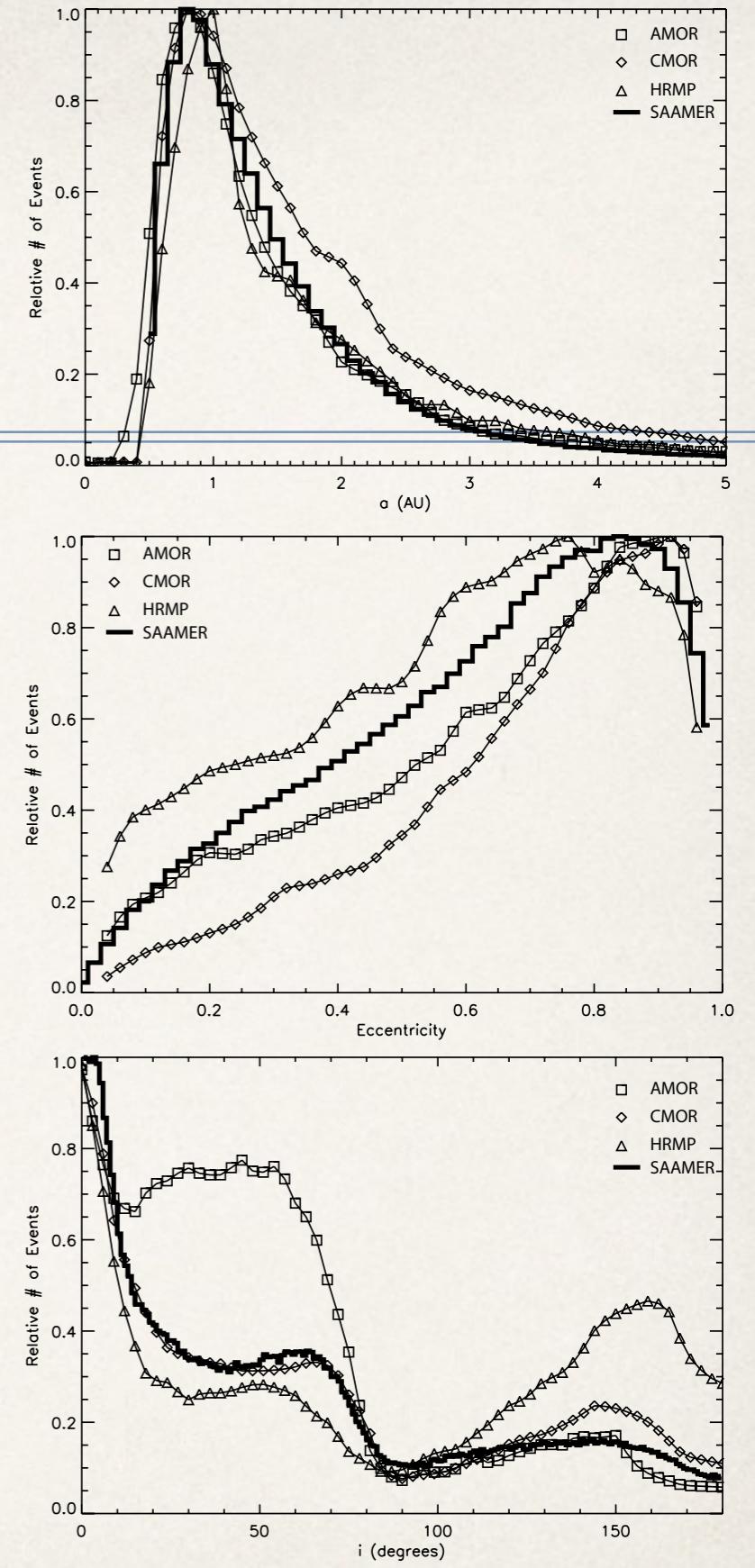
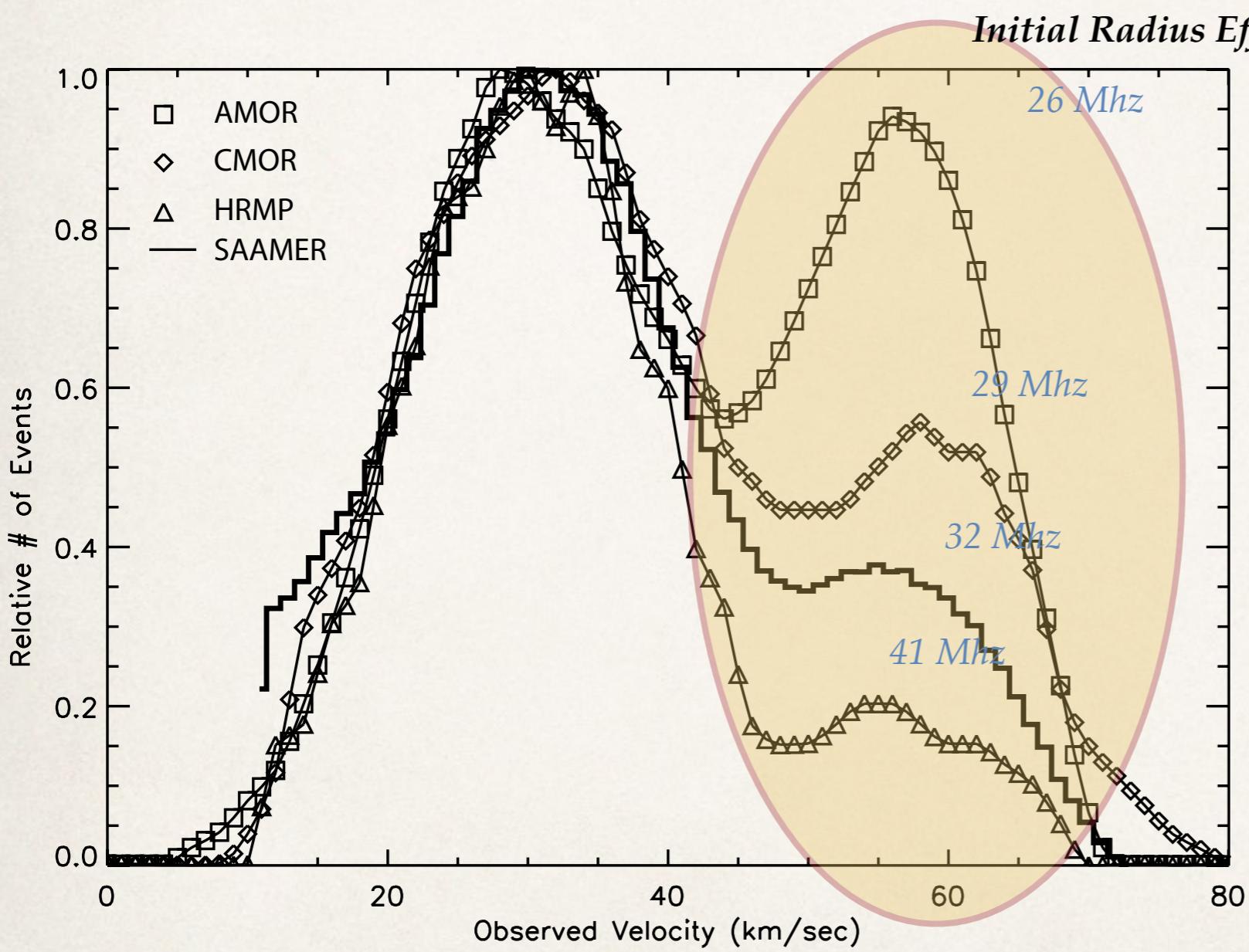
(Janches et al. 2015)





Observed distributions

(Janches et al. 2015)



Filling the Gap: Southern Hemisphere SMC

(Janches et al. 2015)

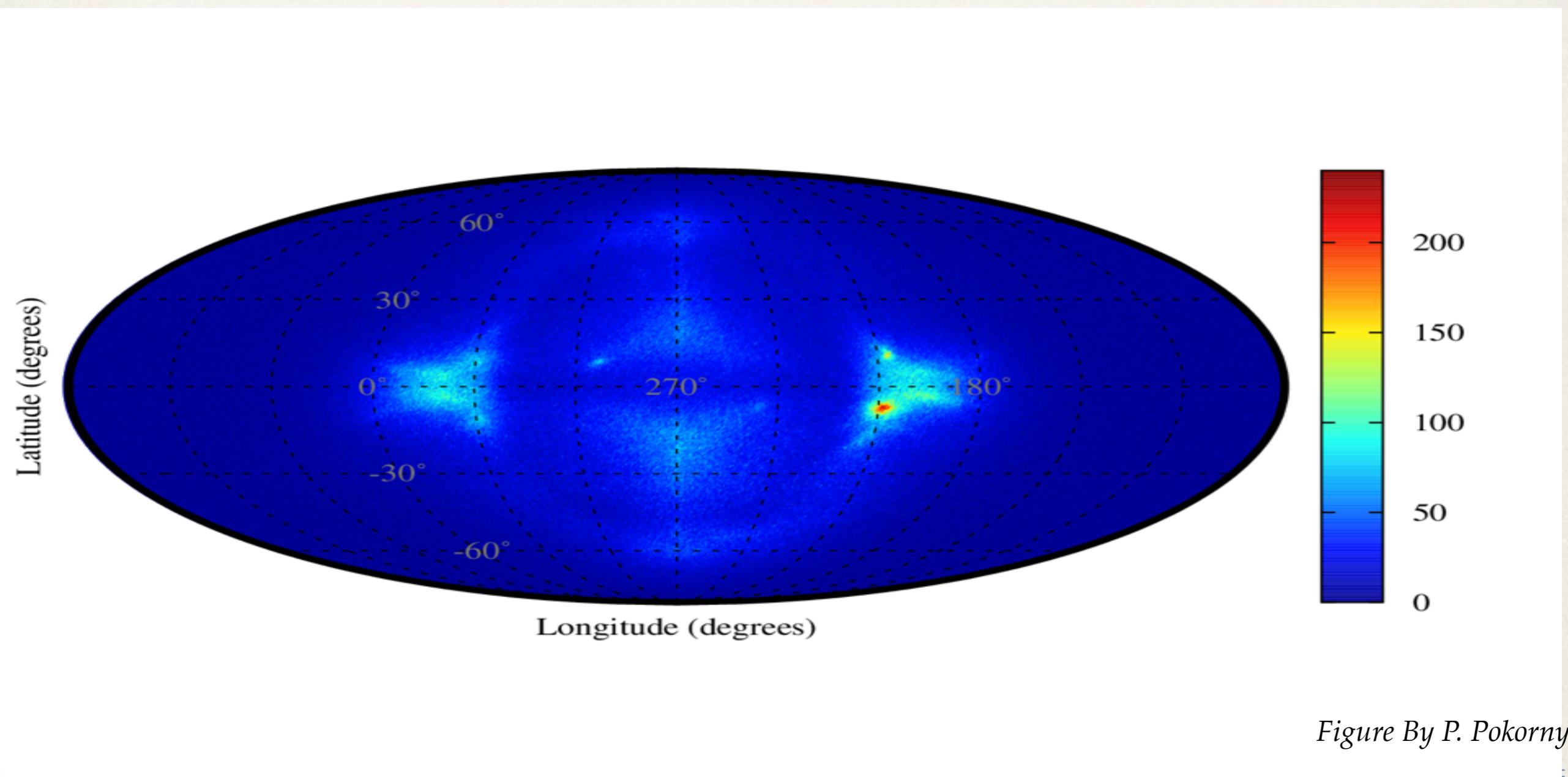
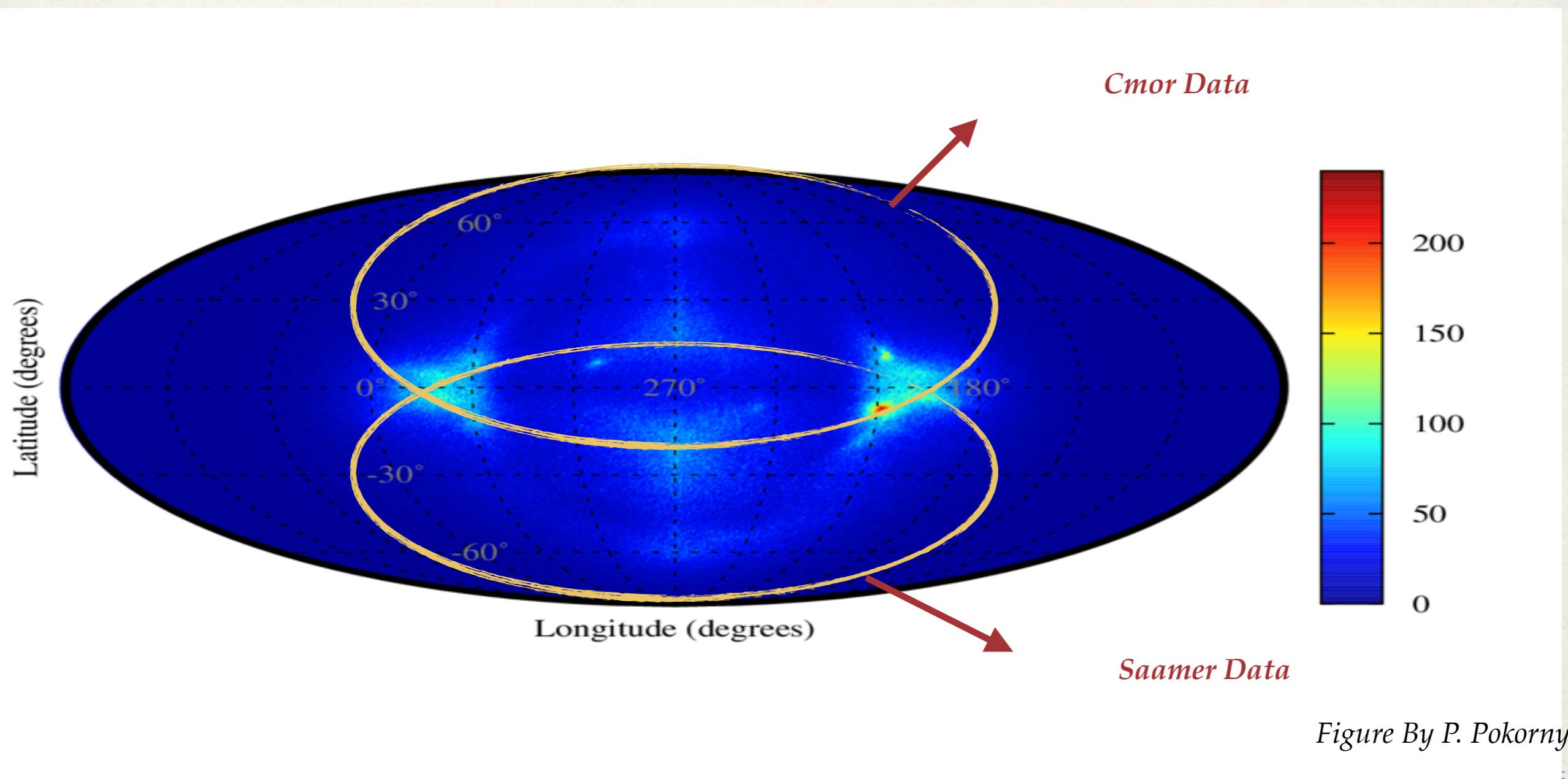


Figure By P. Pokorny

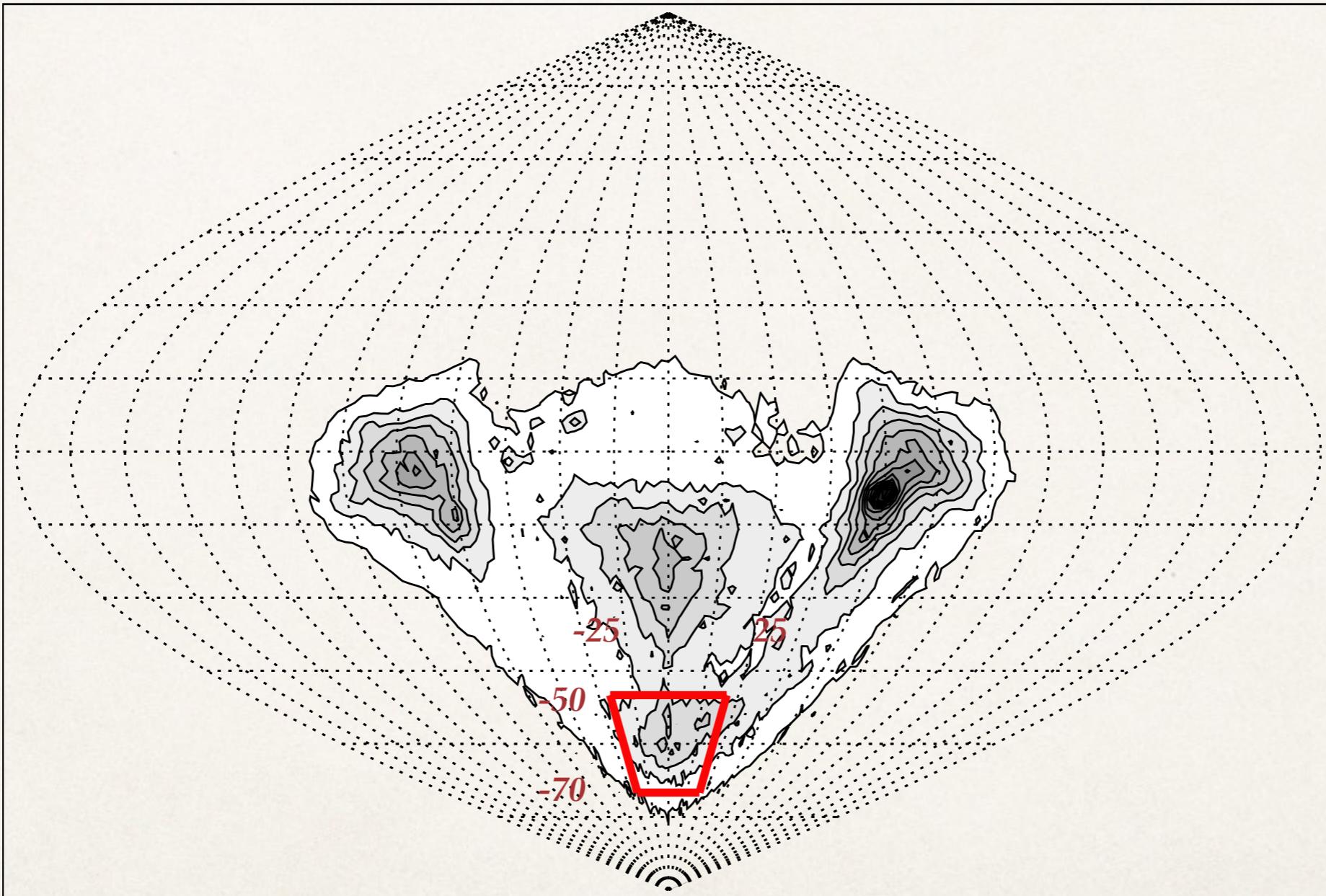
Filling the Gap: Southern Hemisphere SMC

(Janches et al. 2015)



South Toroidal Meteor Source

(Janches et al. 2015)



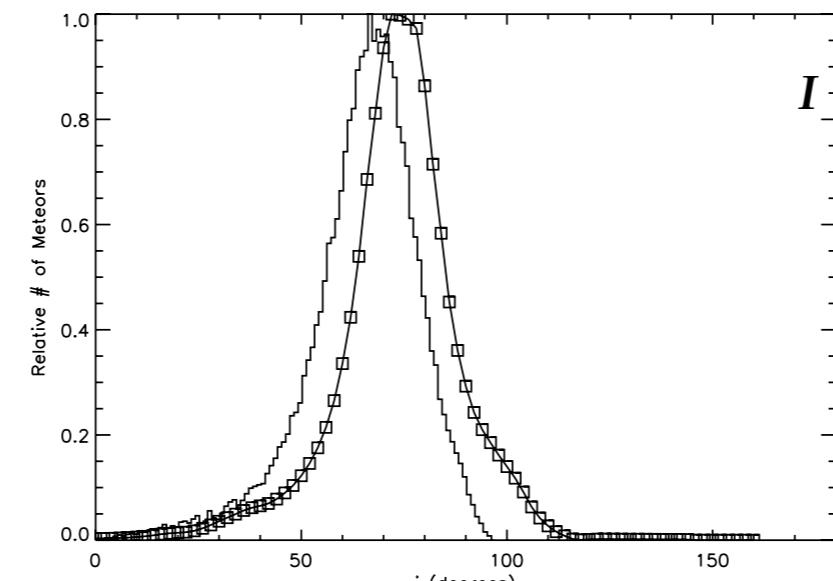
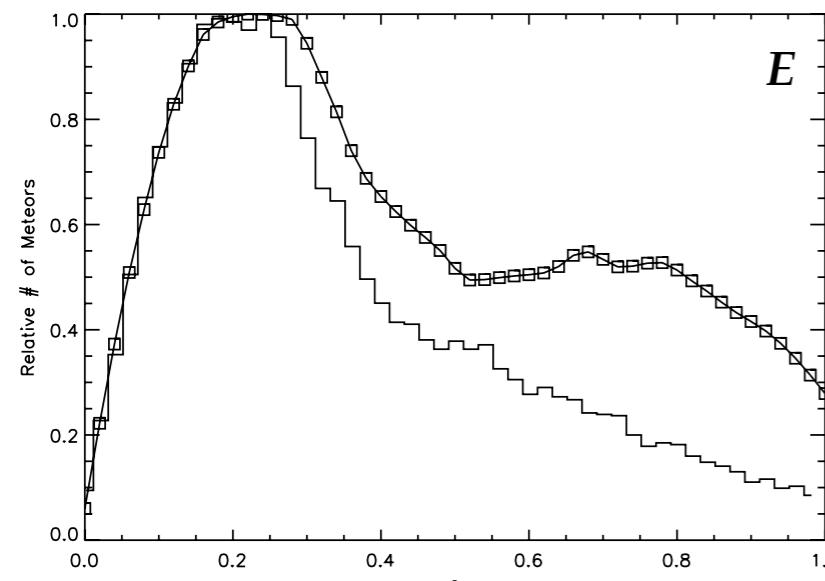
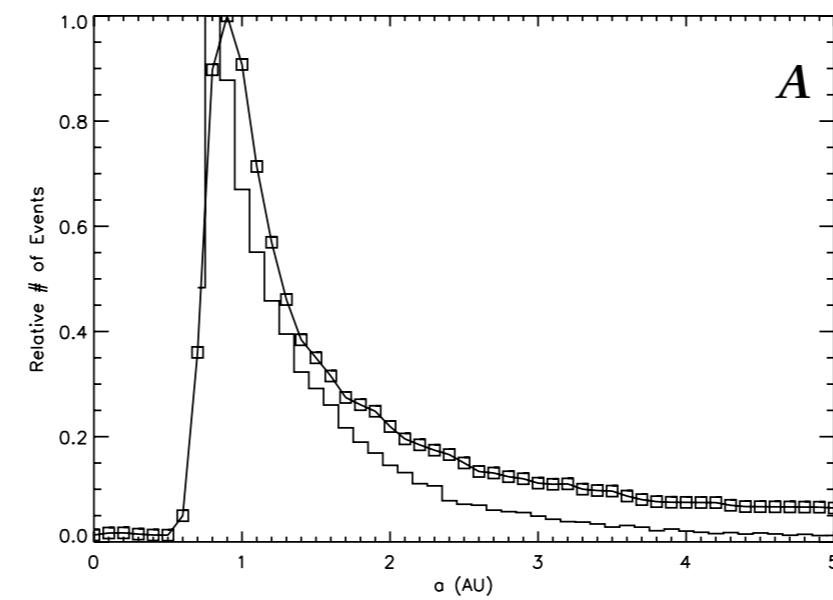
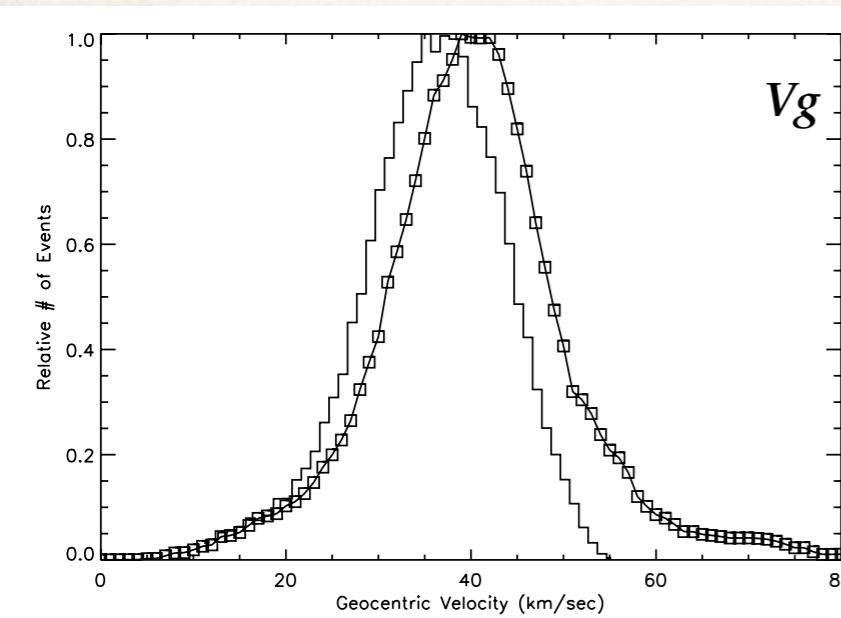
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South Toroidal Meteor Source

(Janches et al. 2015)



Solid Lines - Saamer St Data

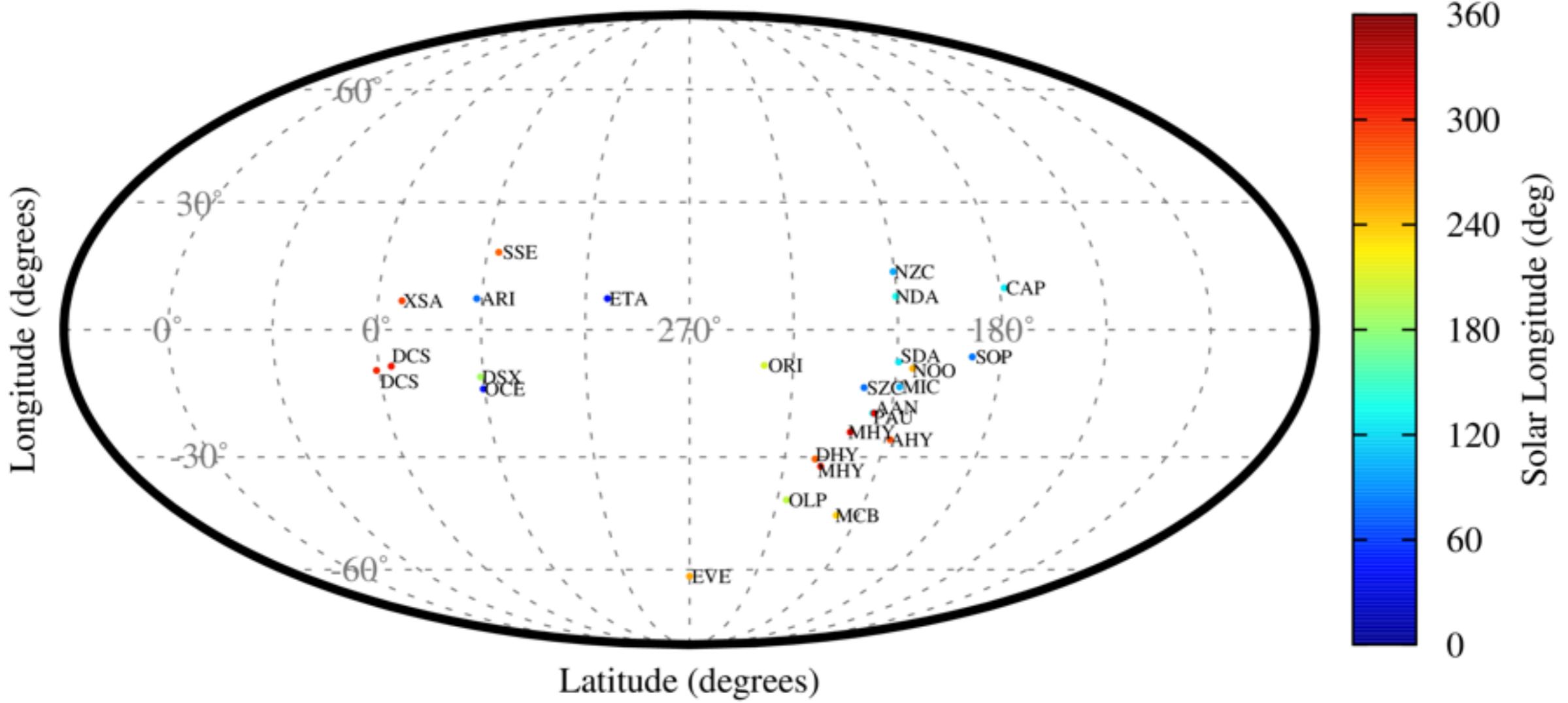
Squares Cmor Nt Data Taken From Campbell-Brown, 2009.



SAAMER Shower Radiant Survey

(Pokorny et al., 2016; See also Poster)

27 IAU Associated Showers

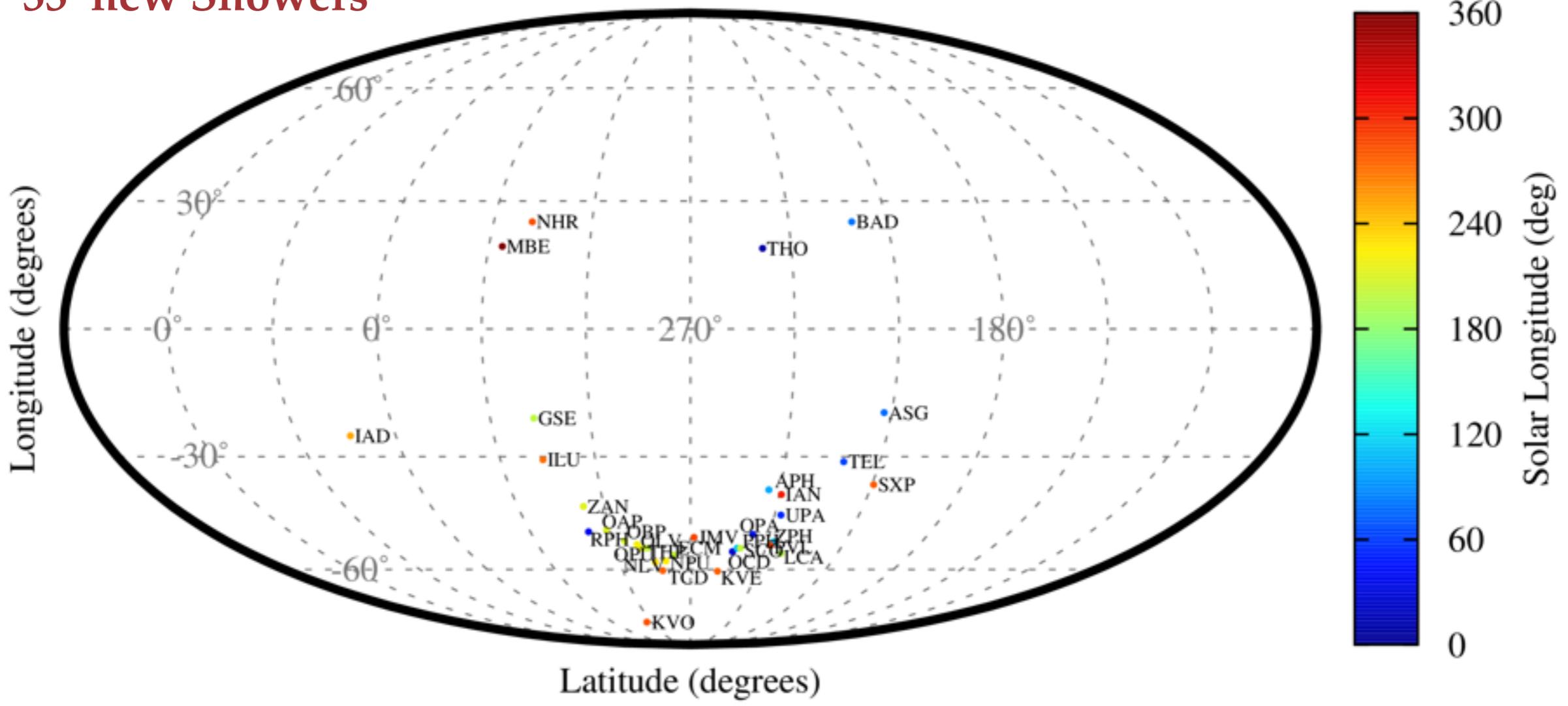




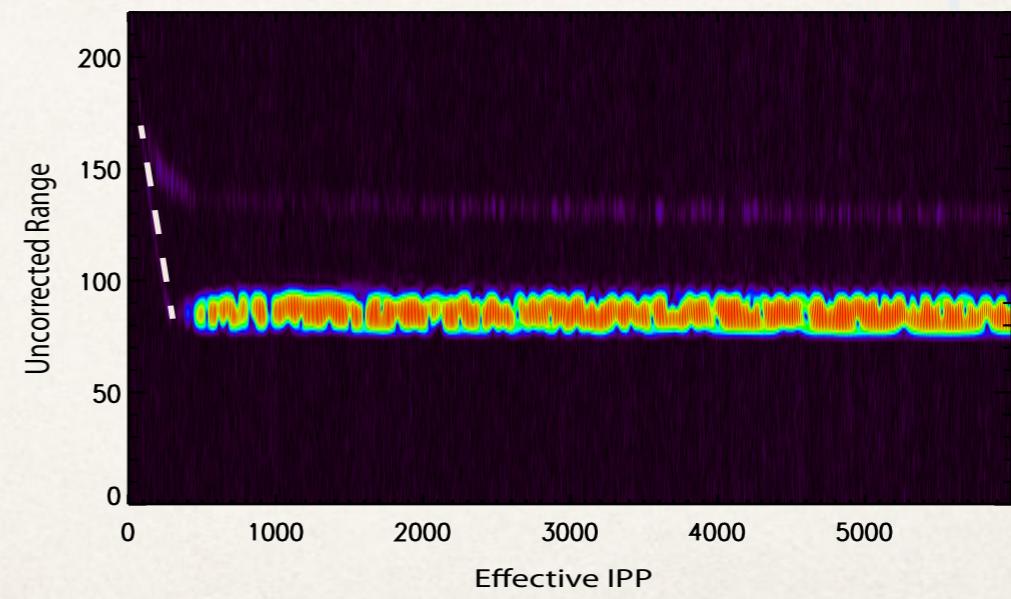
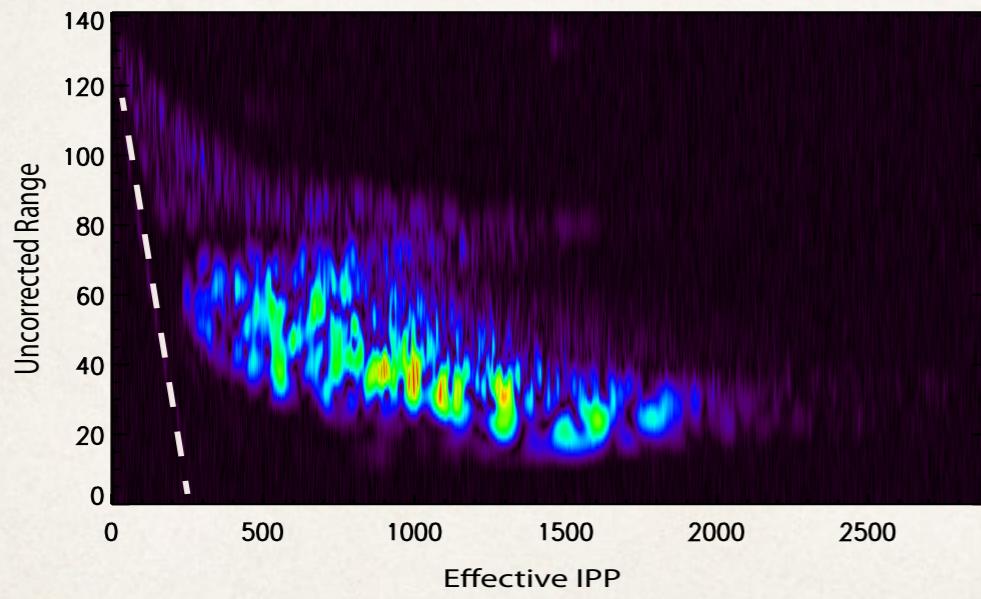
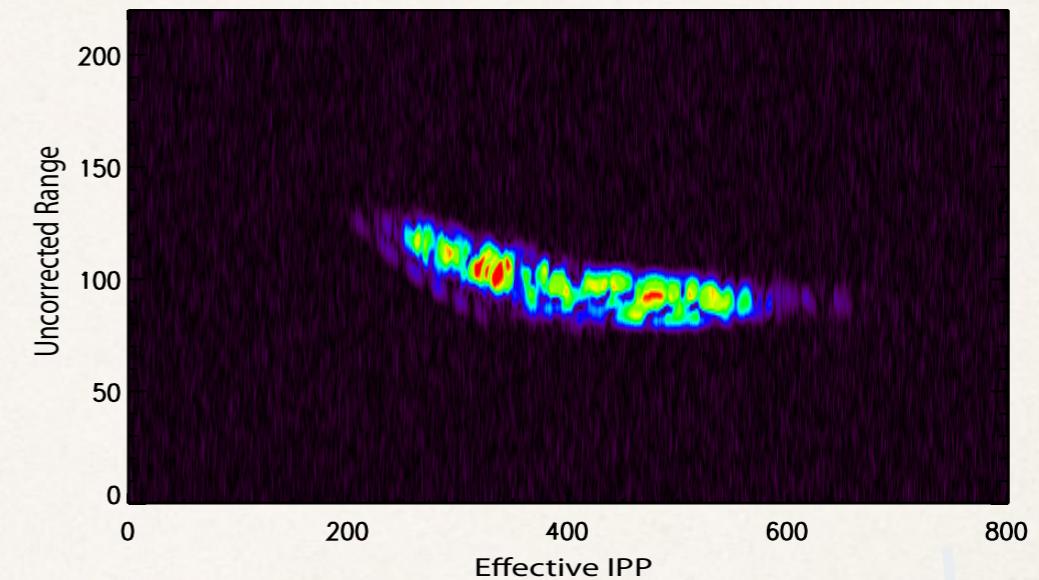
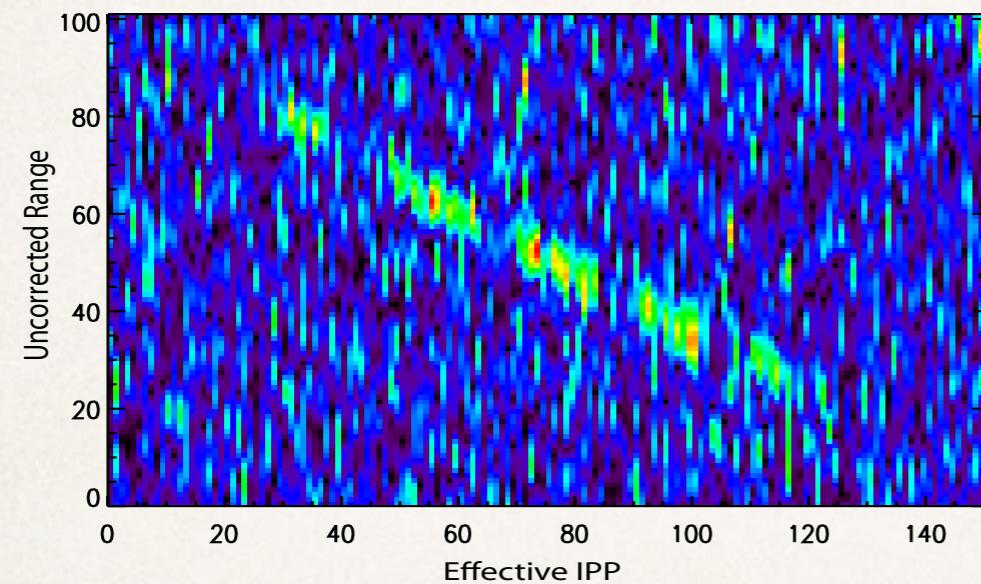
SAAMER Shower Radiant Survey

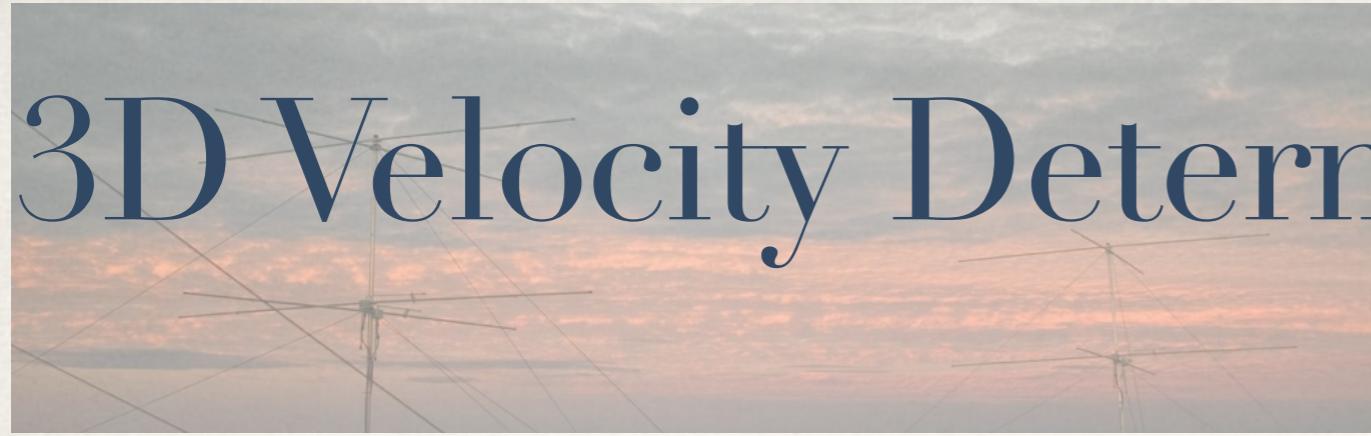
(Pokorny et al., 2016; See also Poster)

33 new Showers



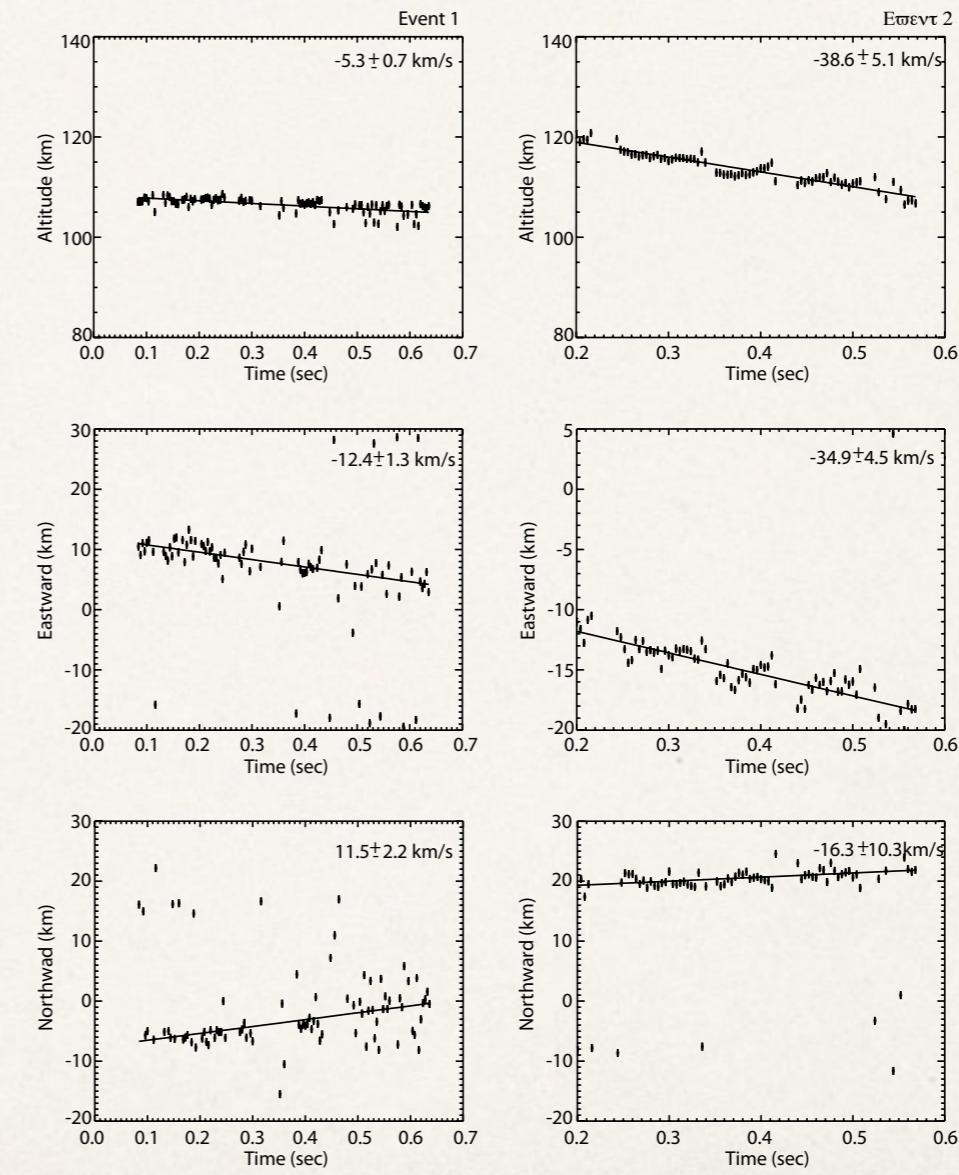
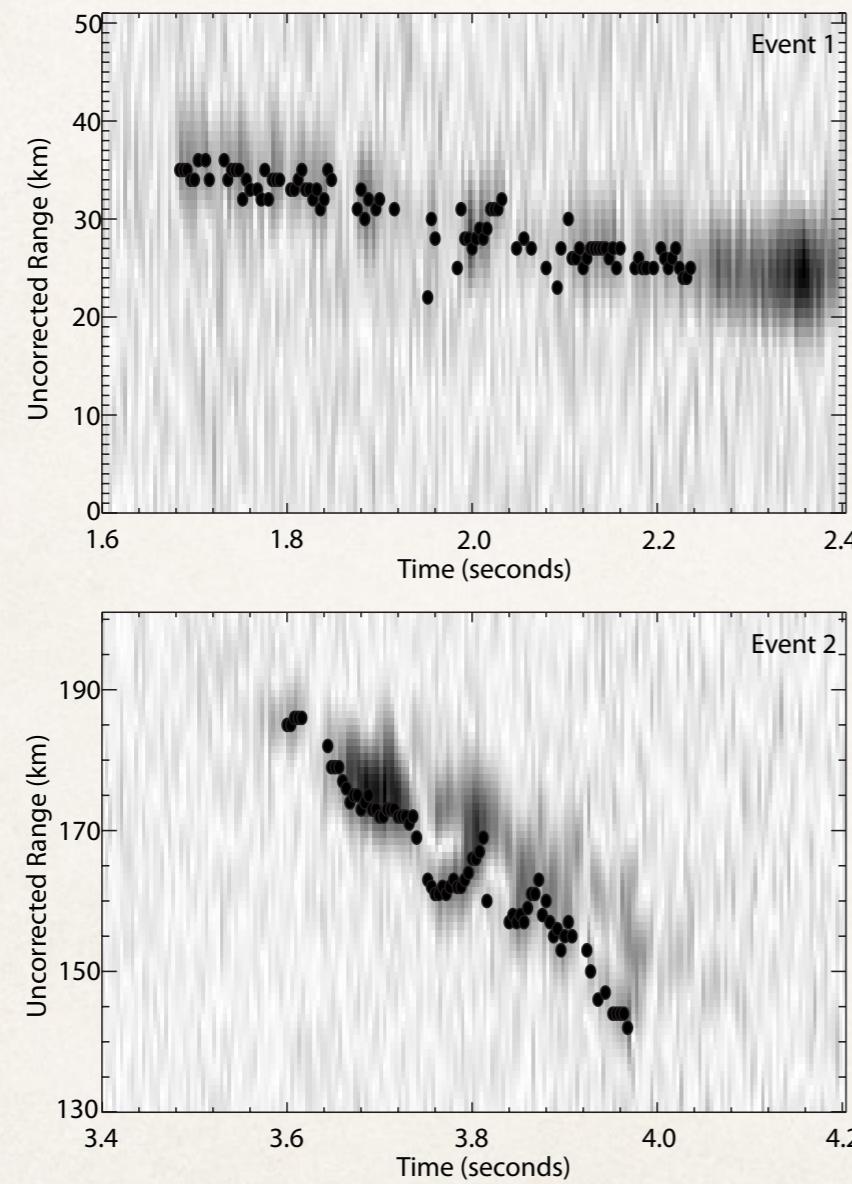
Unexpected capabilities: Non-Specular Trails, Diff. Abl. and





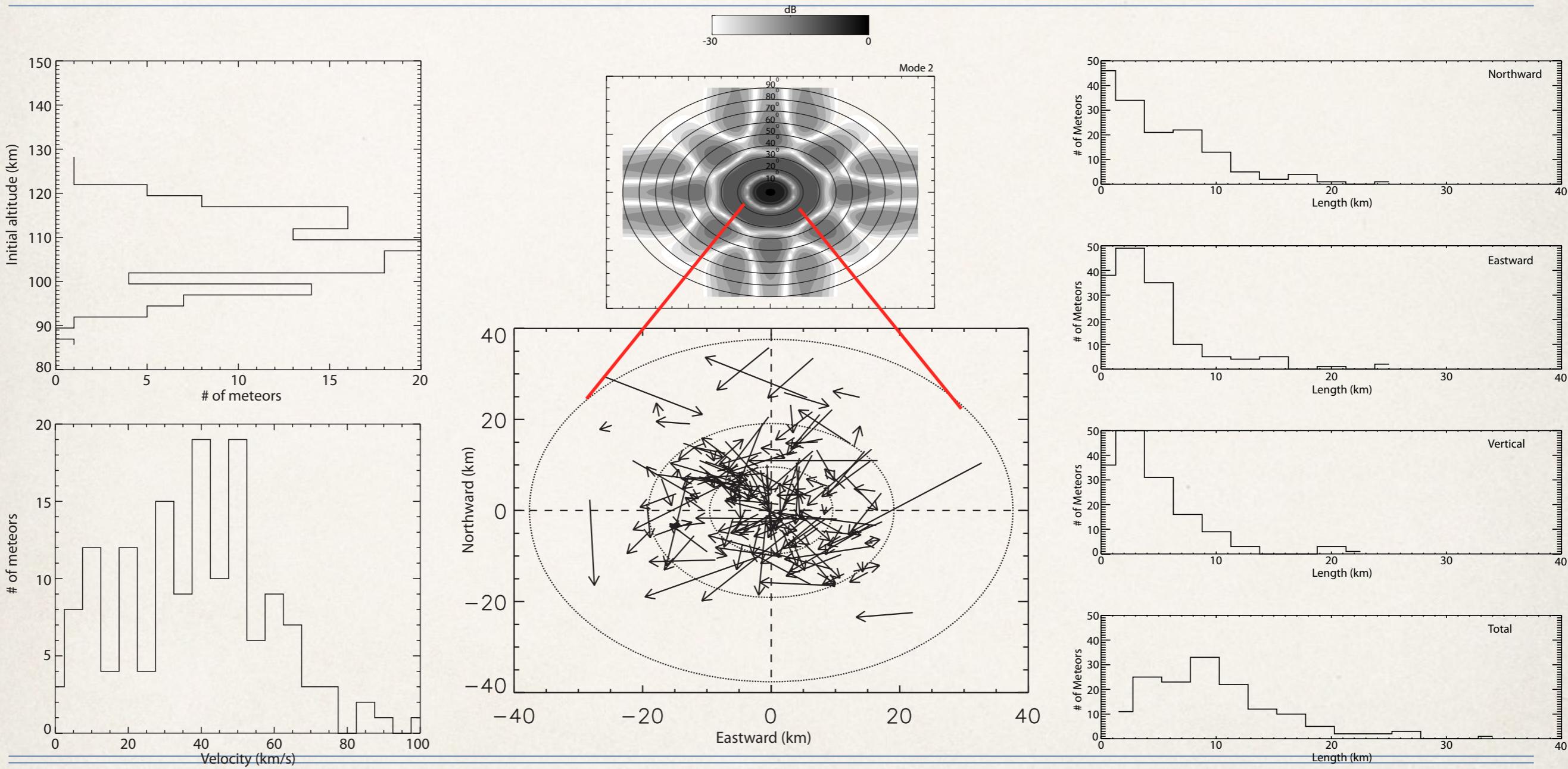
3D Velocity Determination

(Janches et al., 2014)

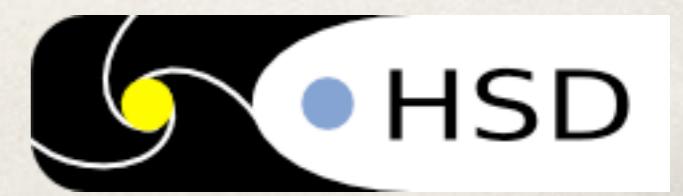


HE Altitude, Velocity and Extension

(Janches et al., 2014)

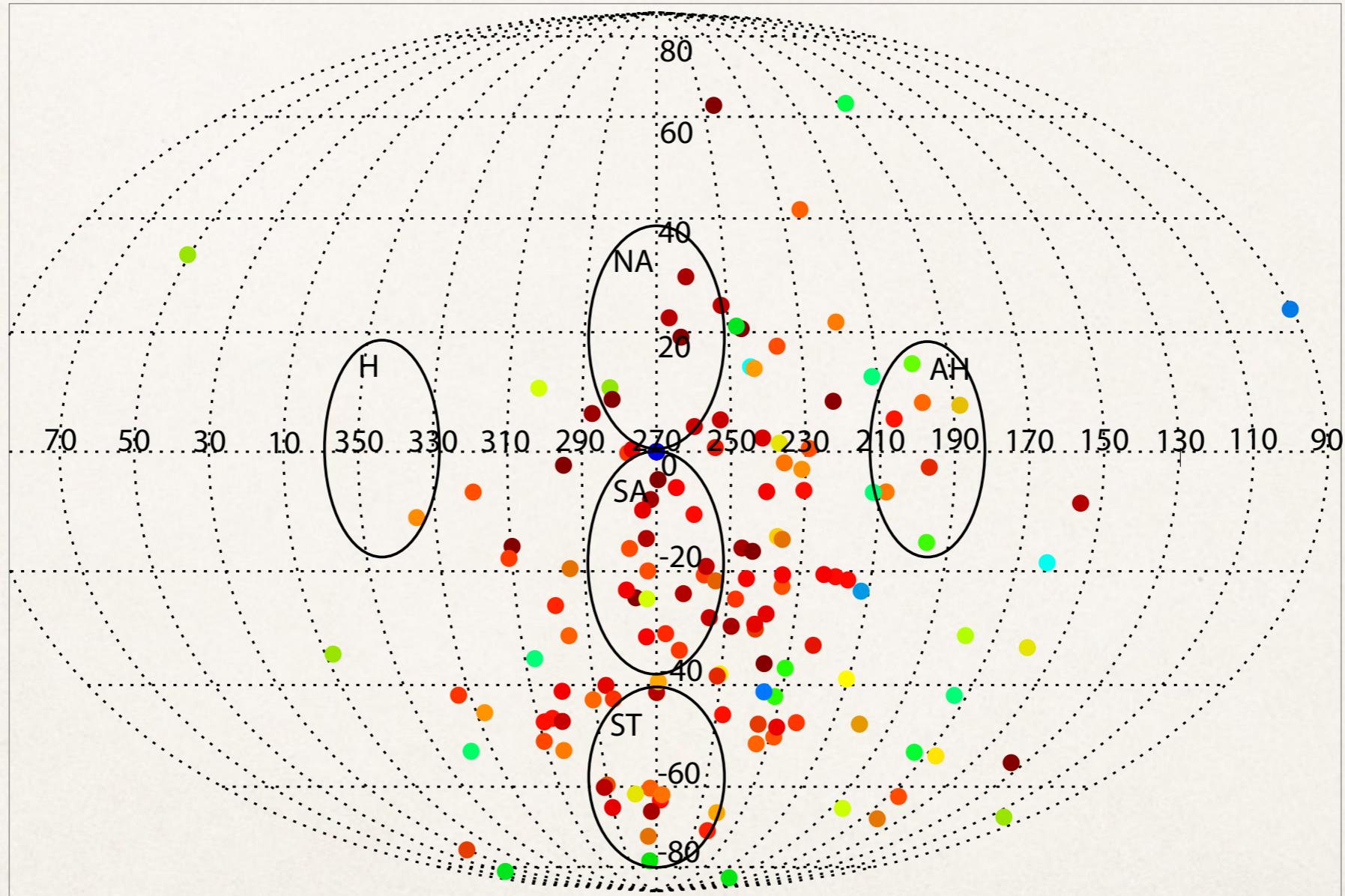


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HE Orbits

(Janches et al., 2014)





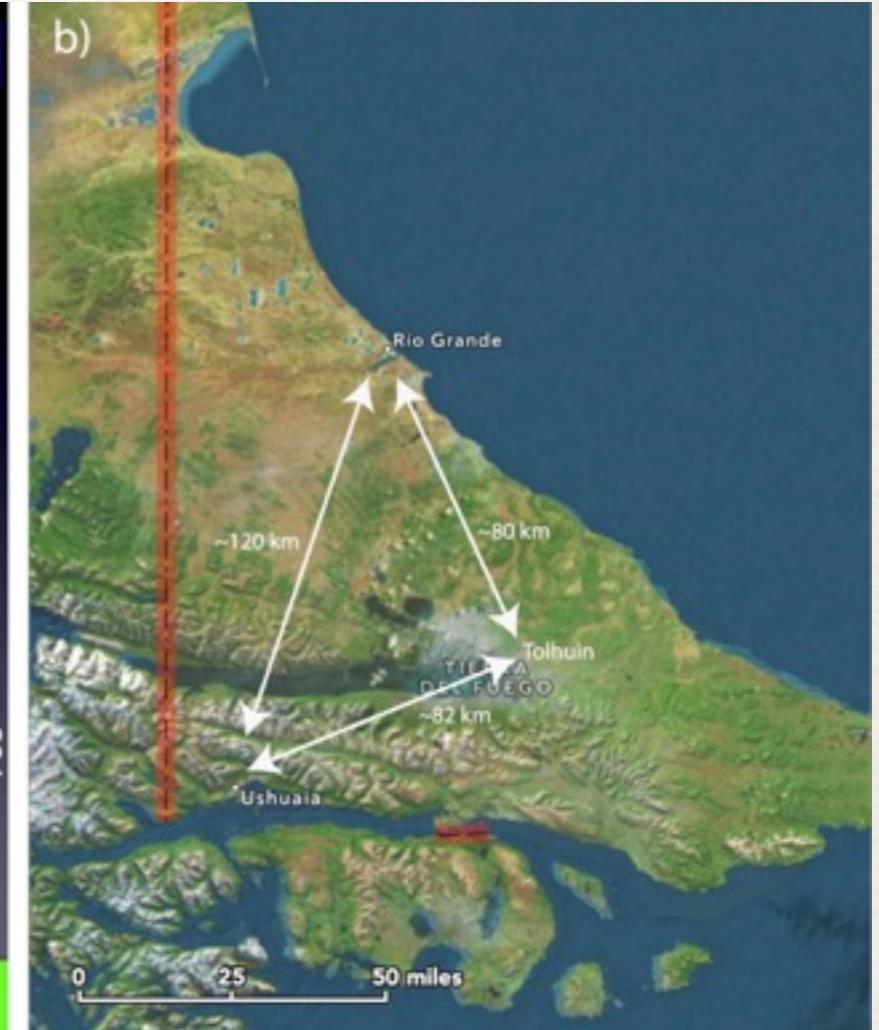
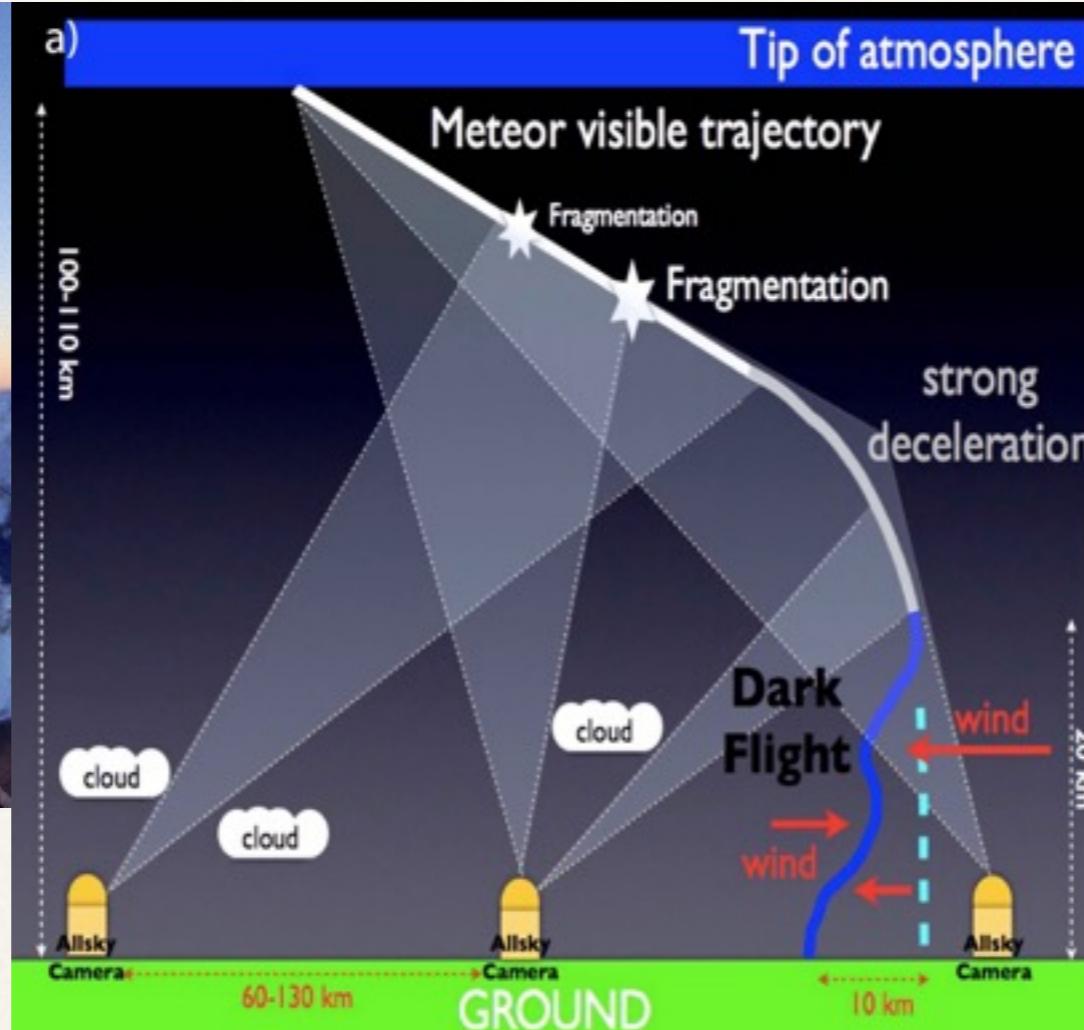
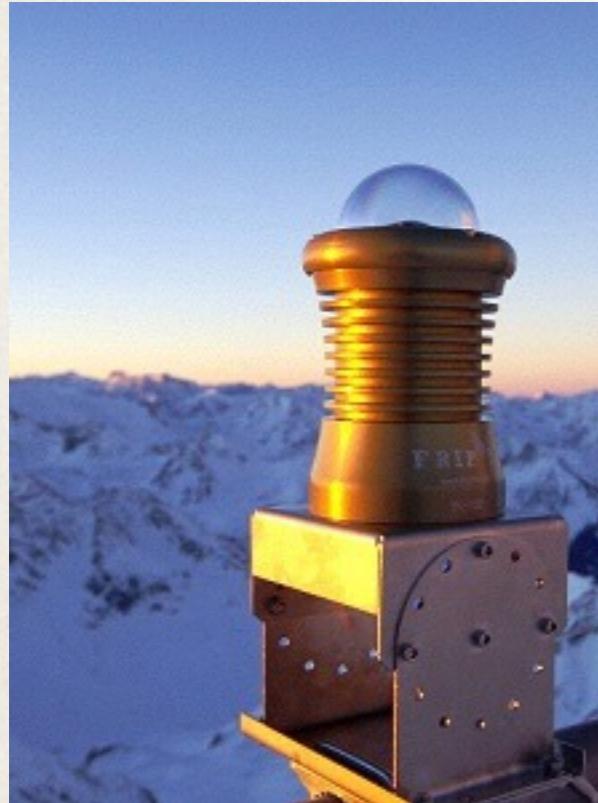
Current developments



- Nasa-Sso Proposal Awarded To Perform A Meteor Shower Survey.
- Funds Requested To Install A Third Remote Site For :
 1. Increase Orbit Counts;
 2. Increase Orbit Precision; And
 3. Contingency



Current Developments



Deploy (Extremely) Low Cost Optical Video Cameras Based On Fripon Project In Collaboration With J. Vaubalion

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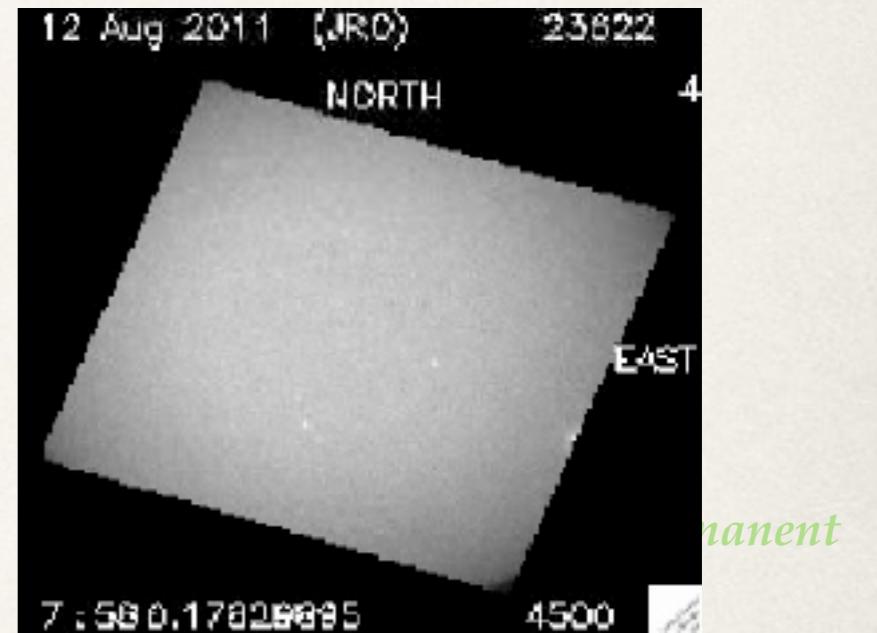




Conclusions

- SAAMER operational since May 2008, recording ~20,000 events daily
- Installation of remote sites in August 2010, fully operational since January 2012, ~1000-2000 daily orbits. Ideal for the study of ST and SA sources and meteor showers in the southern hemisphere (33 new showers identified)
- Agile TX design enables the routine detection of meteor head echoes and non specular trails, differential ablation and other processes.
- Enables to extend these studies to relatively larger masses than those detected by HPLA systems
- New remote sites and FRIPON optical cameras planned to be deployed in the Fall of 2016

SAAMER Remote Sites: Infrastructure for additional deployments

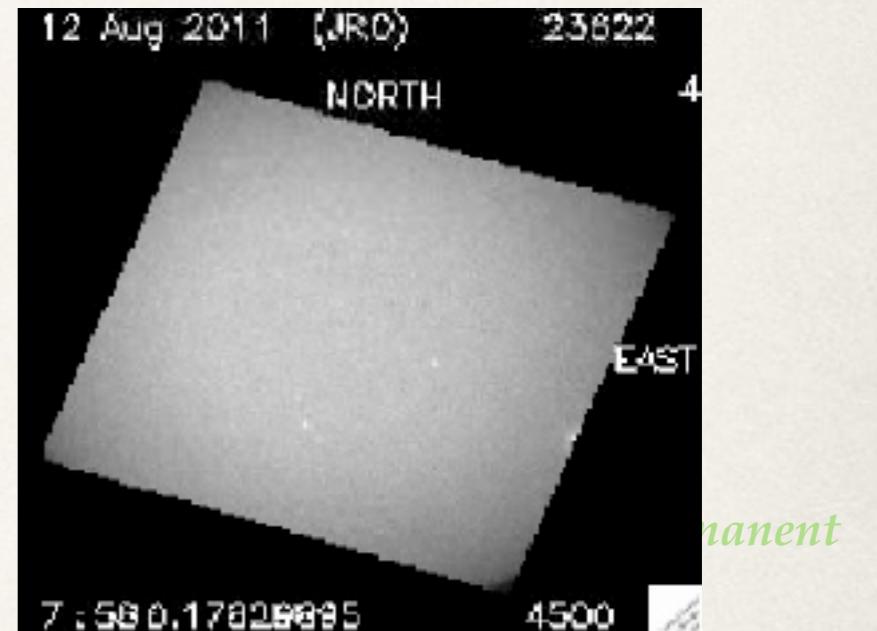


Michell Et Al., 2015

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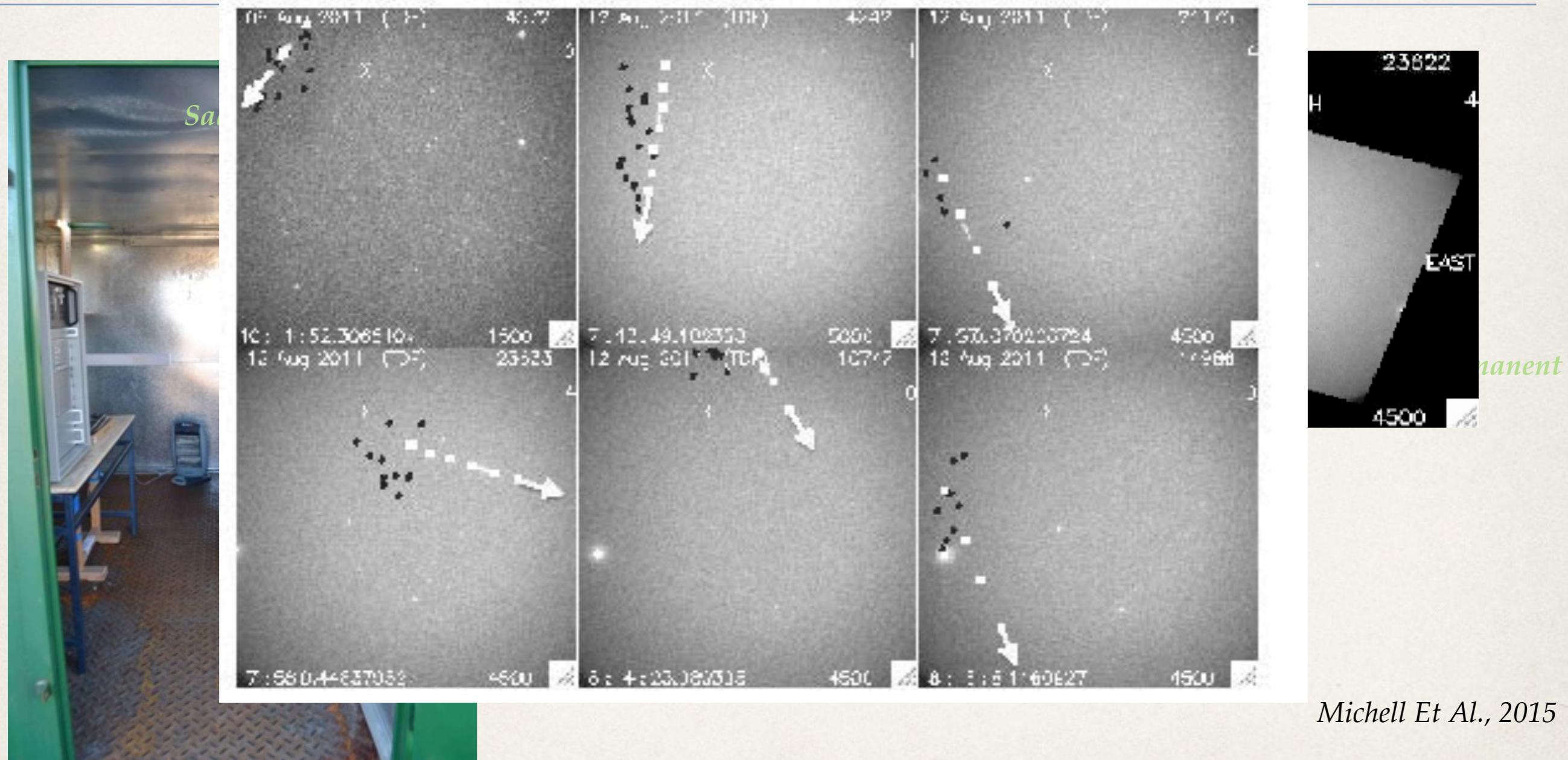


Michell Et Al., 2015

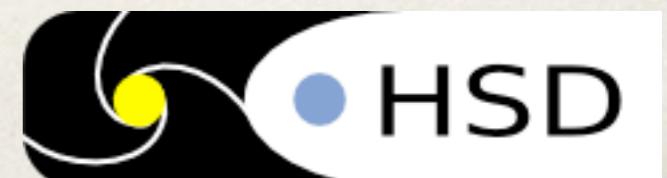
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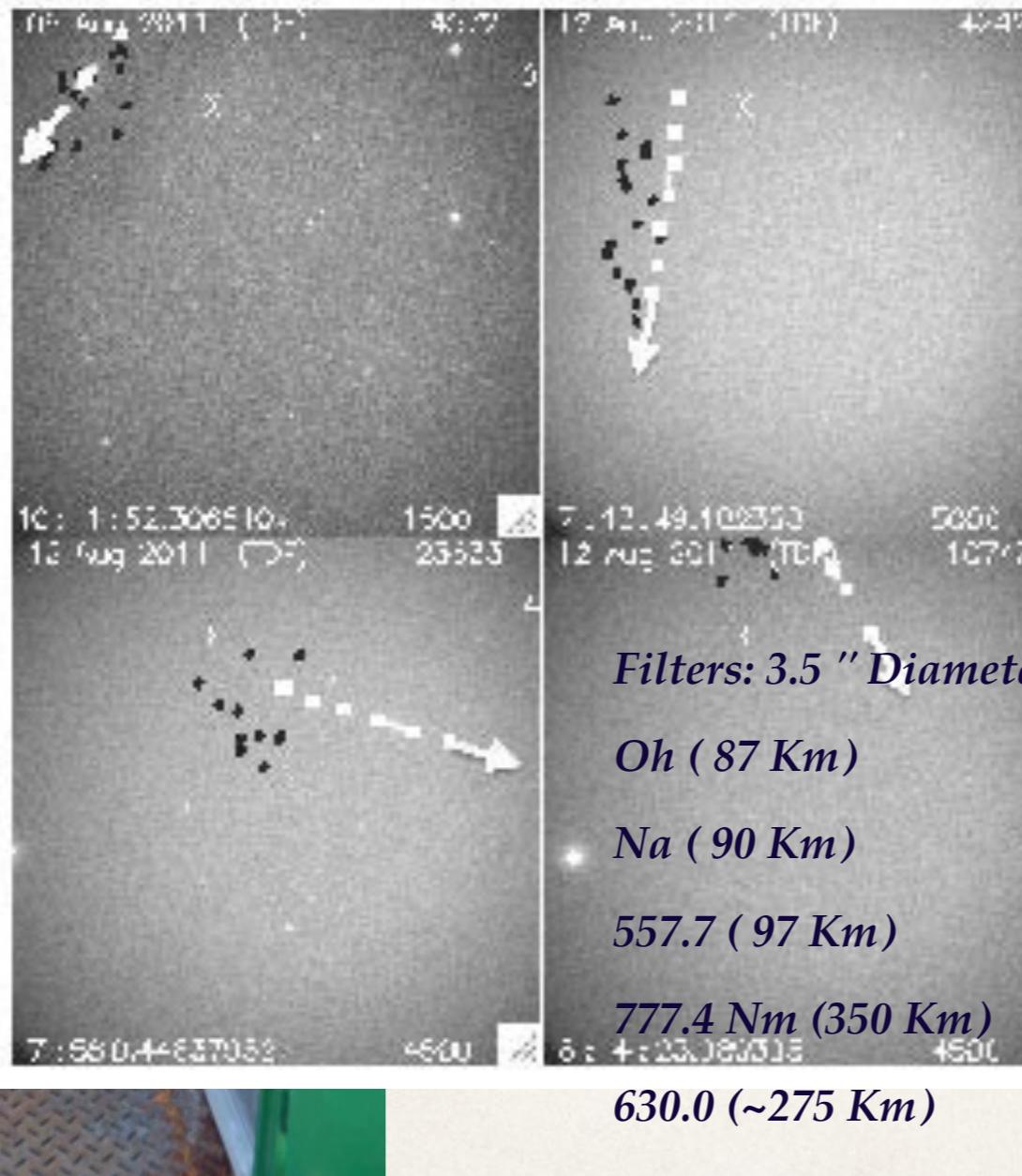
SAAMER Remote Sites: Infrastructure for additional deployments



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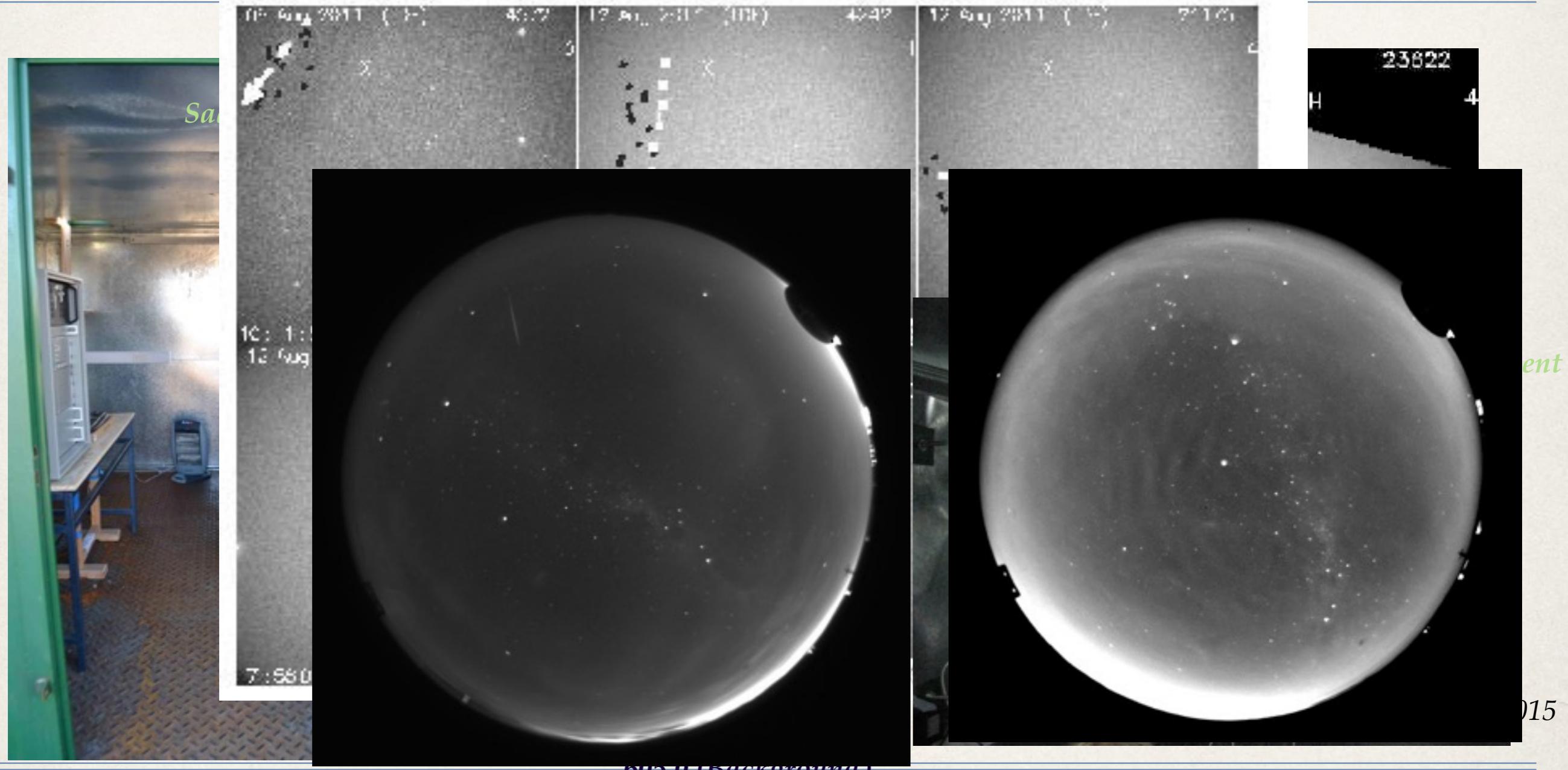
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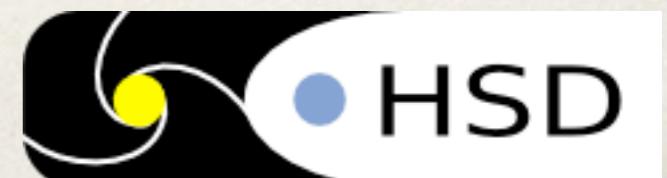
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SAAMER Remote Sites: Infrastructure for additional deployments



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SAAMER Shower In SH

(Janches et al., 2013)

- Until recently, only 10% of meteor shower surveys were performed in the SH
- The latest of these SH studies: 1) AMOR (Galligan and Baggaley, 2002a,b; only 6 streams found); 2) Younger et al. (2009) in which over 30 showers were identified; 3) Janches et. al (2013), 32 mostly known showers
- More recently only Optical Efforts (Bland et al., 2012; Jopek et al., 2010; Molau and Kerr, 2014; Towner et al., 2015, Jenniskens, 2016)



SAAMER Shower In SH

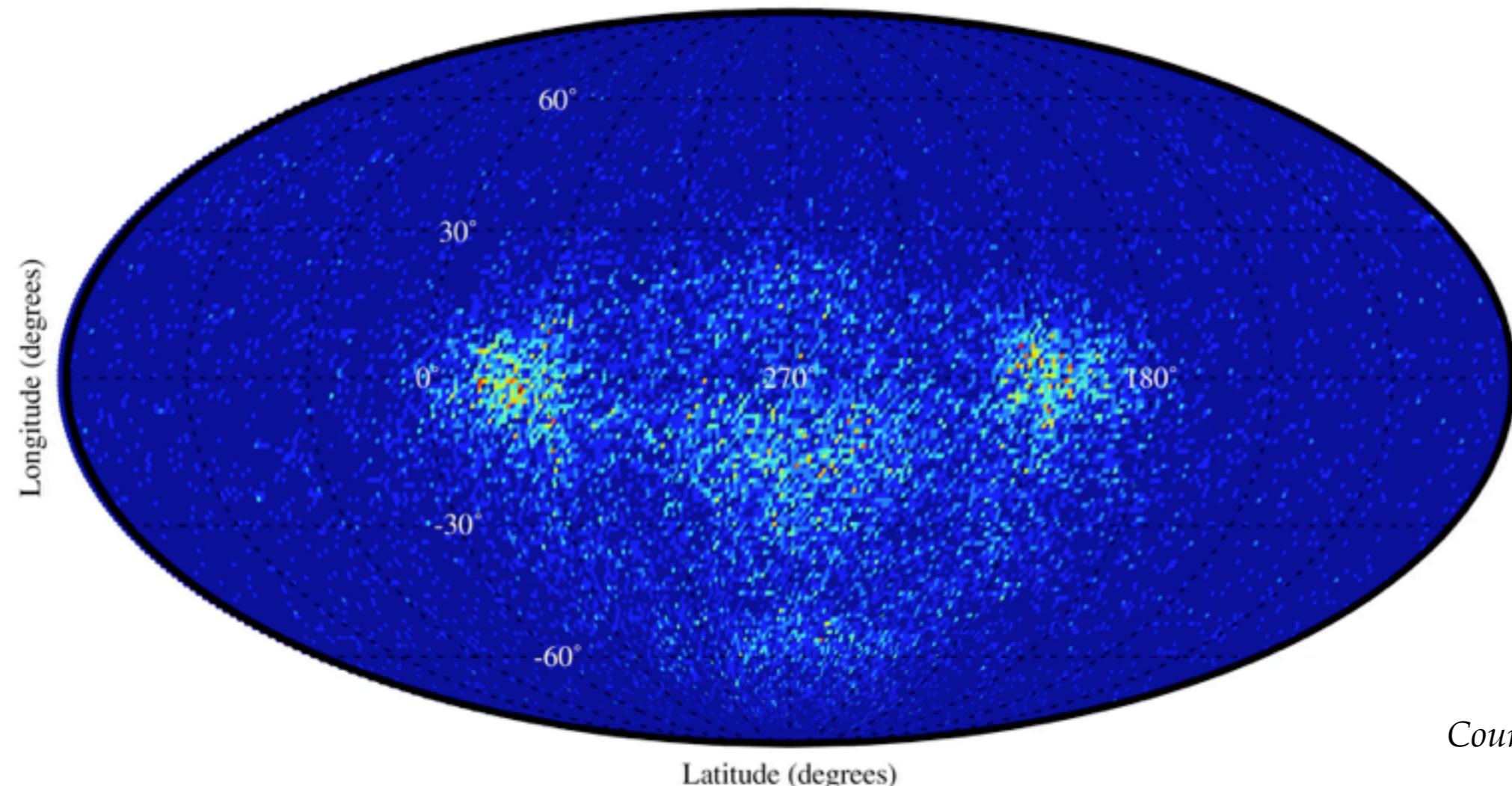
(Janches et al., 2013)

- Until recently, only 10% of meteor shower surveys were performed in the SH
- Radar Surveys are needed because: 1) the study of smaller and perhaps more dynamically evolved particles; and 2) because these observations are not limited by weather or daylight we will be able to catalog both, daytime and nighttime events.
- More recently only Optical Efforts (Bland et al., 2012; Jopek et al., 2010; Molau and Kerr, 2014; Towner et al., 2015, Jenniskens, 2016)

Filling the Gap: Southern Hemisphere SMC

(Janches et al. 2015)

Meteor activity in the Southern Hemisphere
Data from the Southern Argentina Agile Meteor Radar Orbital System
Solar Longitude = 0 - 5 deg



Courtesy Of P. Pokorny

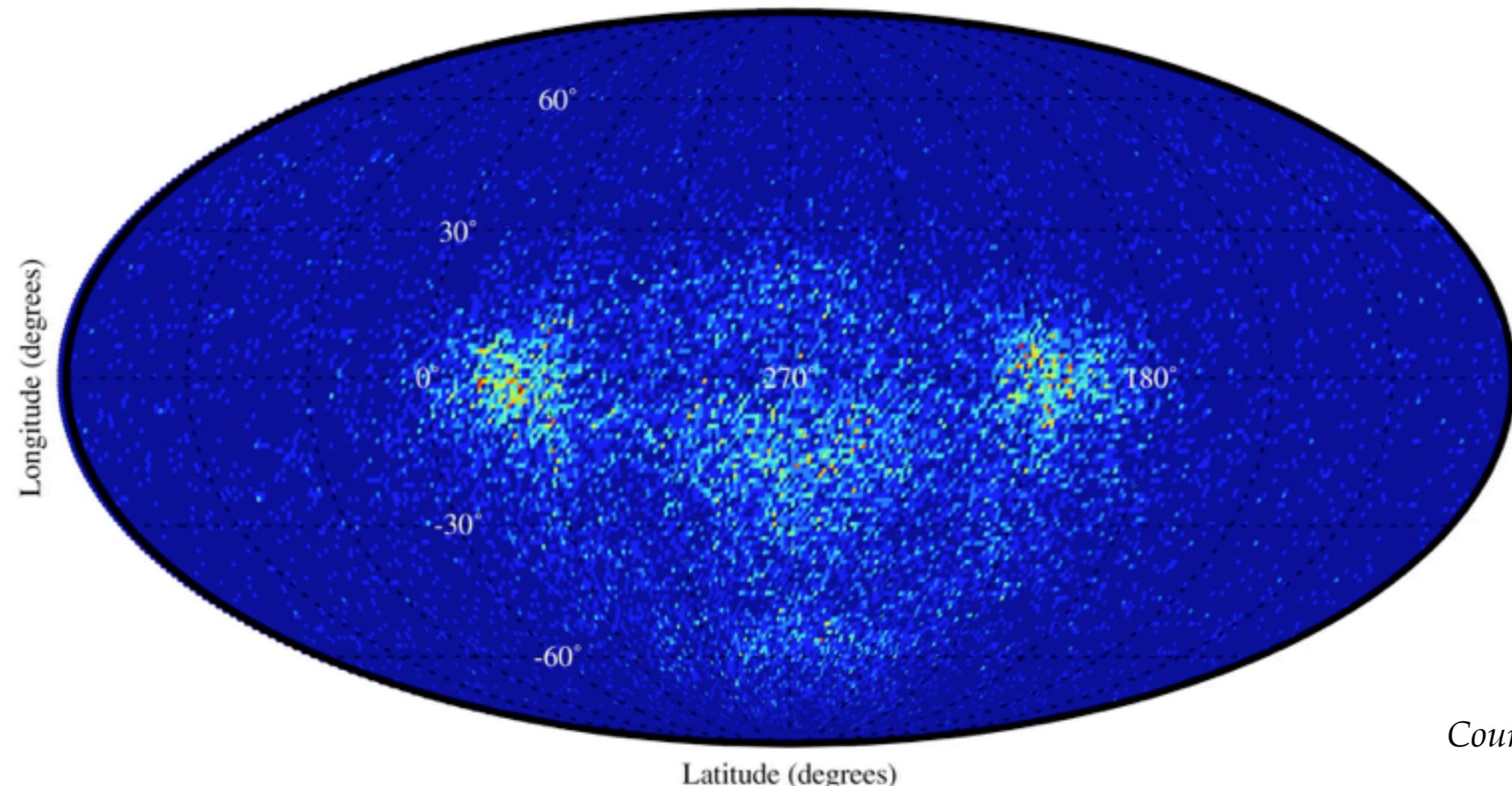
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Comparison of SAAMER and HPLA HE detections (Janches et al., 2013)

Radar	λ (m)	f (MHz)	Pt (kW)	Aperture	G (dB)	Pd (W/m ²)
SAAMER	9.7	32.55	60	74	10	0.0000005
MU	6.5	46	1000	8332.3	34	0.02
Jicamarca	6	50	2000	90,000	45	0.5
ALTAIR	1.8	160	6000	6648	44	1.23
Arecibo	0.69	430	2000	70,686	63	28.9
PFISR	0.68	440	1500	866.25	43	0.3

Mass (log ₁₀ g)	Minimum Speed (km/s)			
	MU	ALTAIR	Arecibo	PFISR
-7	80	40	25	-
-6	60	25	15	25
-5	25	15	5	15
-4	10	All	All	All
-3	10	All	All	All

Pifko Et Al., 2012, Close Et Al., 2005

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-6	60	25	15	25
-5	25	15	5	15
-4	10	All	All	All
-3	10	All	All	All

Pifko Et Al., 2012, Close Et Al., 2005

4 Oom Difference In Pd =>

2 Oom In Detected Speed =>

100 And 10,000 Micrograms Traveling At

60 And 15 Km/S

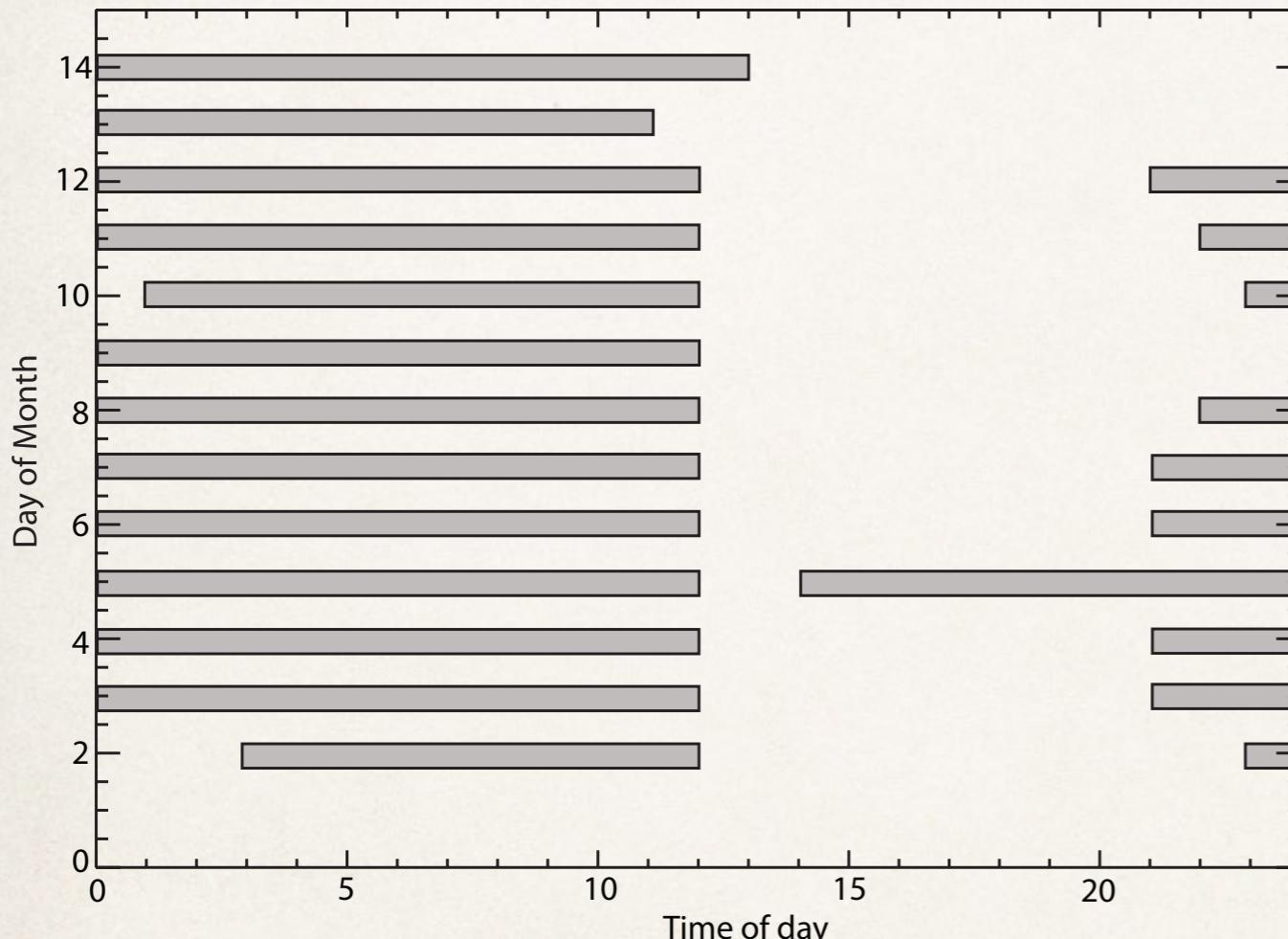


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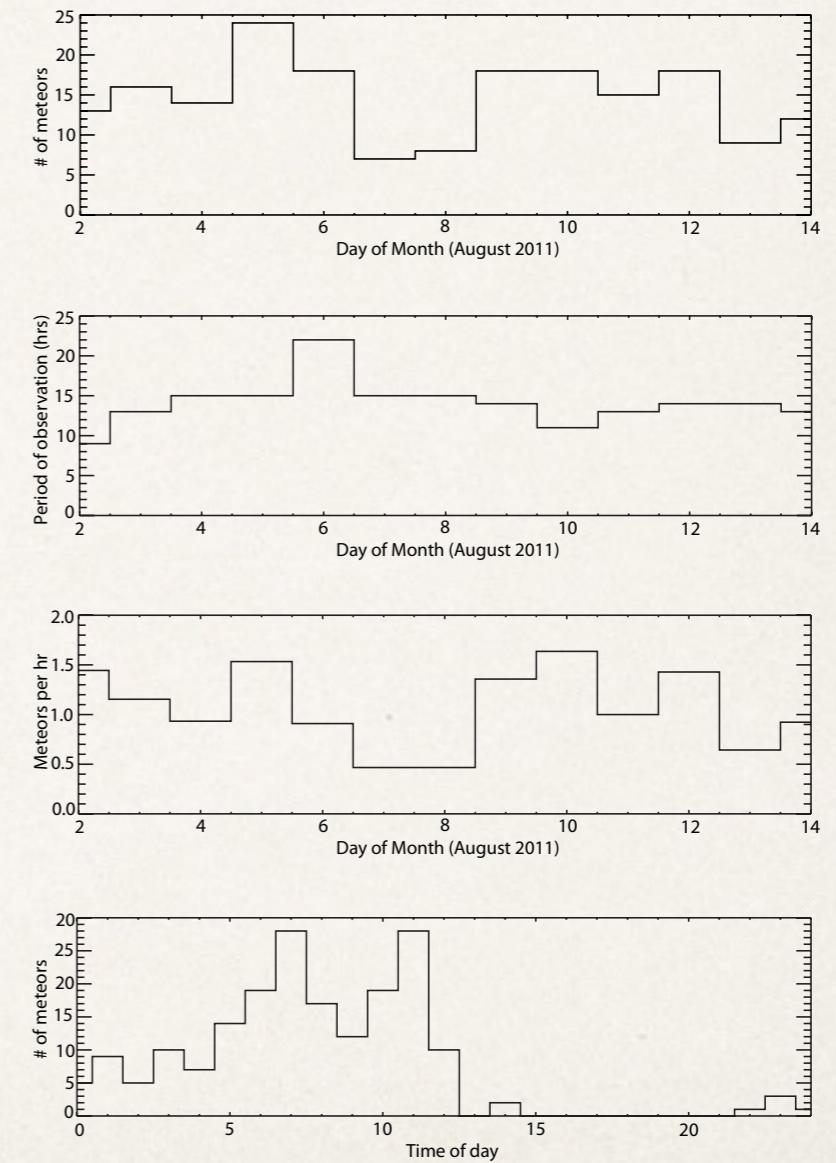


HE Observation Coverage and Detected Rates

(Janches et al., 2014)

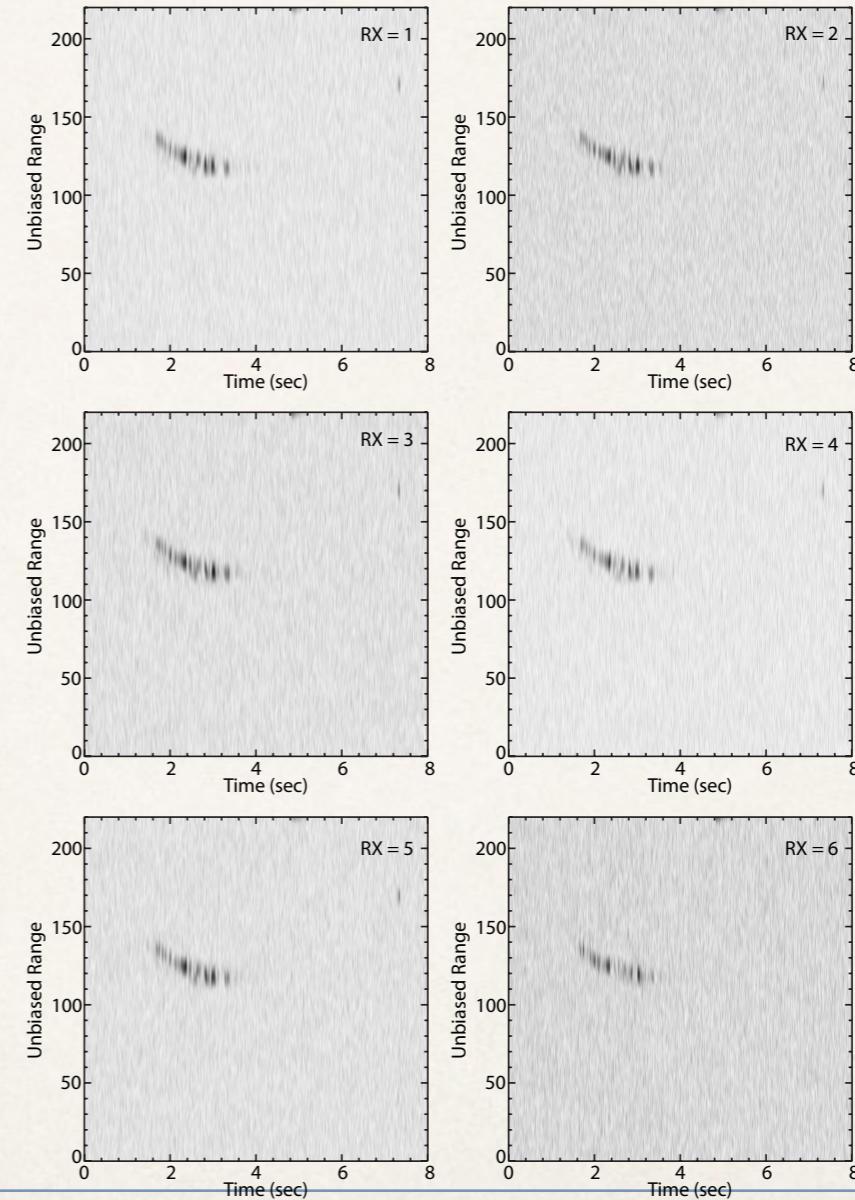
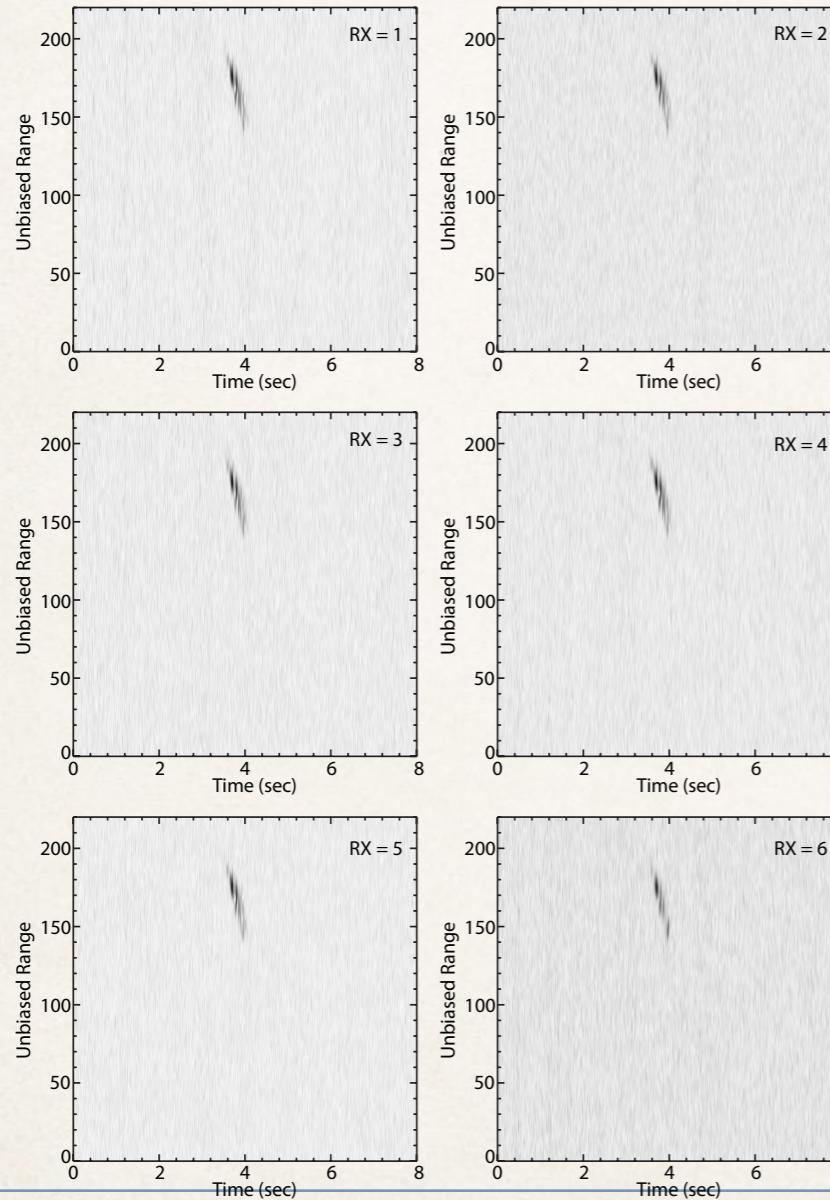


Total 190 Head Echoes Observed



SAAMER Head-Echo Interferometry

(Janches et al., 2014)



Comparison of SAAMER and HPLA HE detections (Janches et al., 2013)

