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

D. Janches (SWL-NASA/GSFC)

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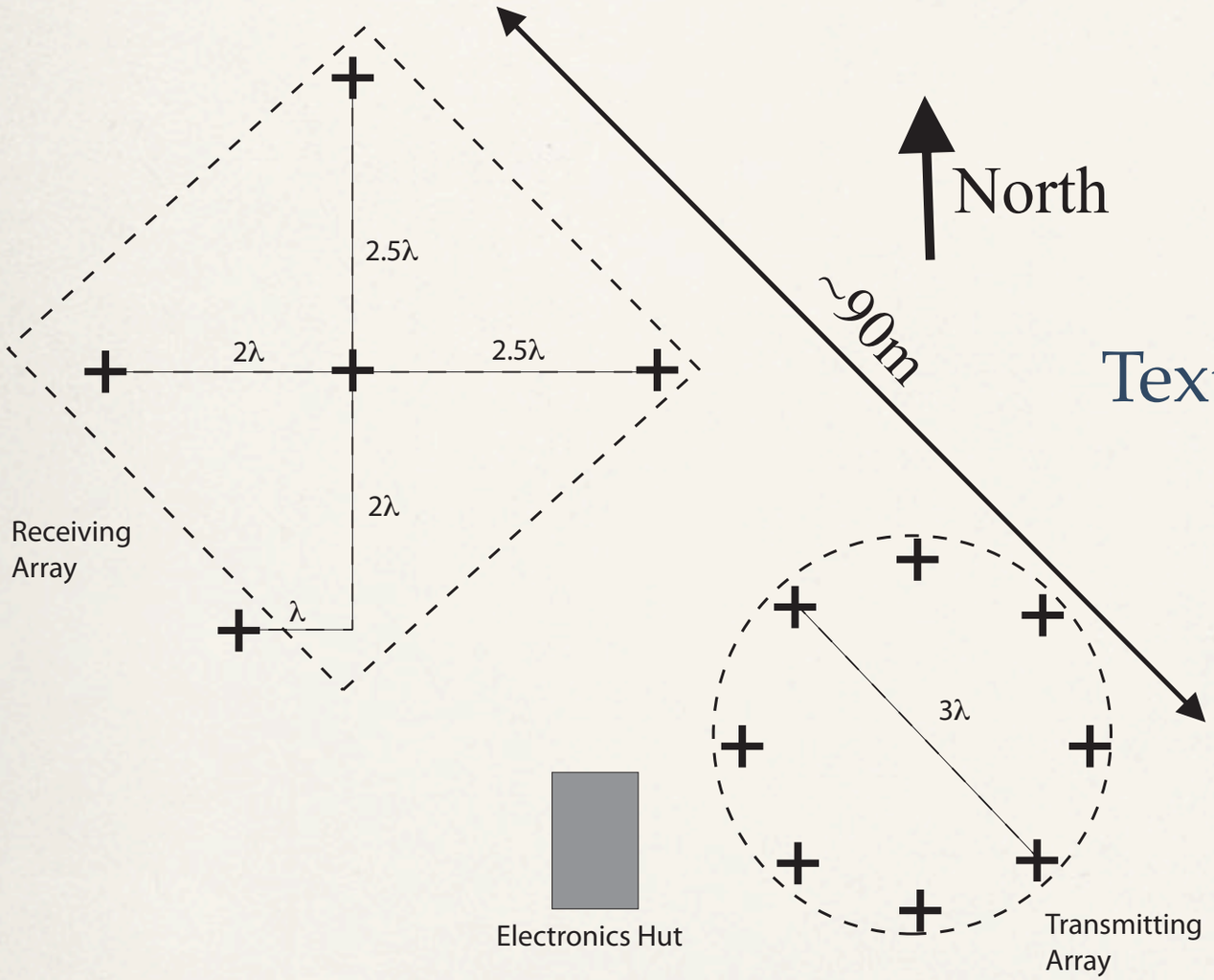
MST Workshop, INPE, Sao Jose Dos Campos, May 25-30, 2014

SAAMER System Design

(Fritts et al, 2010a,b)

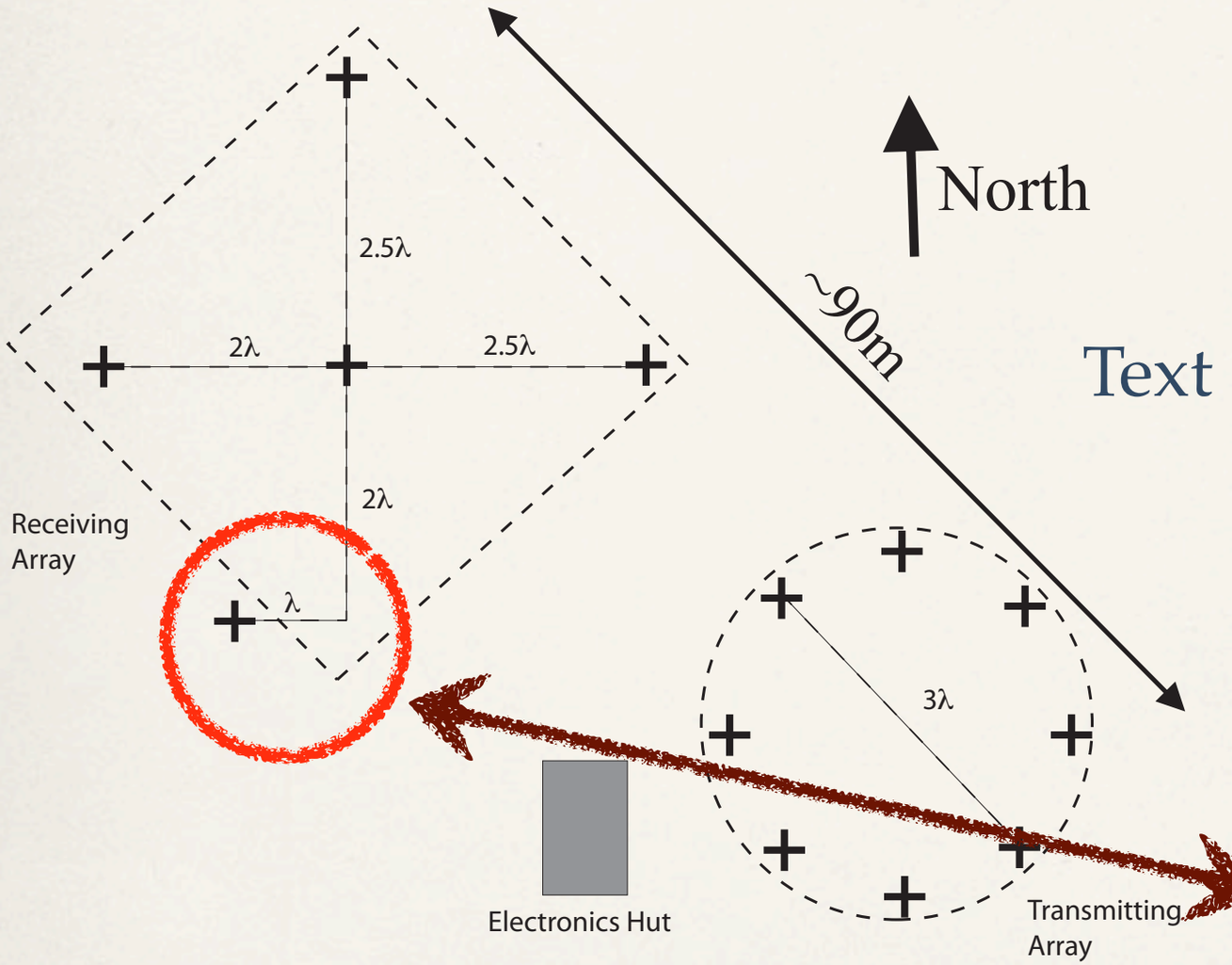


Text

- deployed May 2008
- 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

SAAMER System Design

(Fritts et al, 2010a,b)



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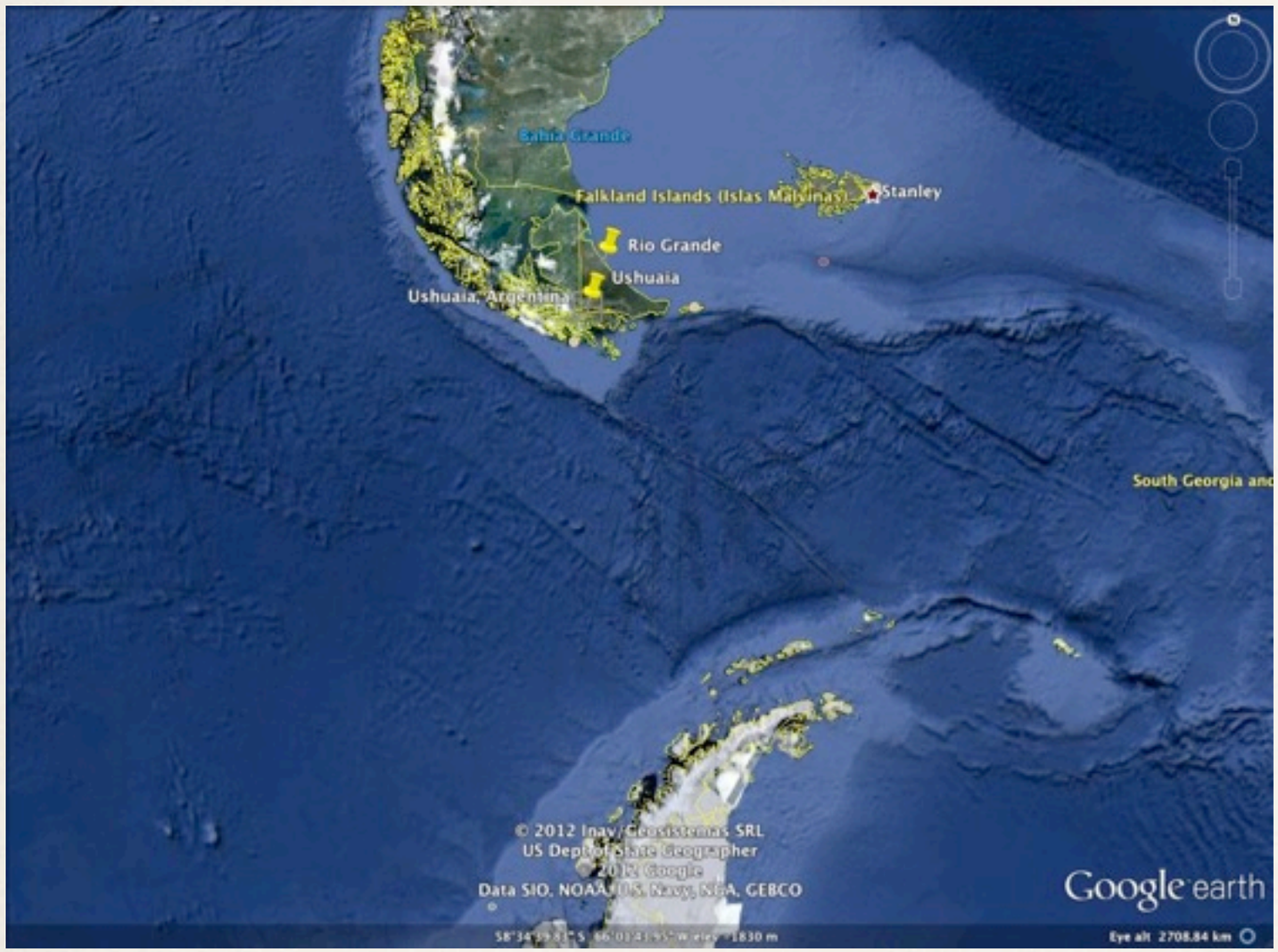
SAAMER Location 53 S, 67 W



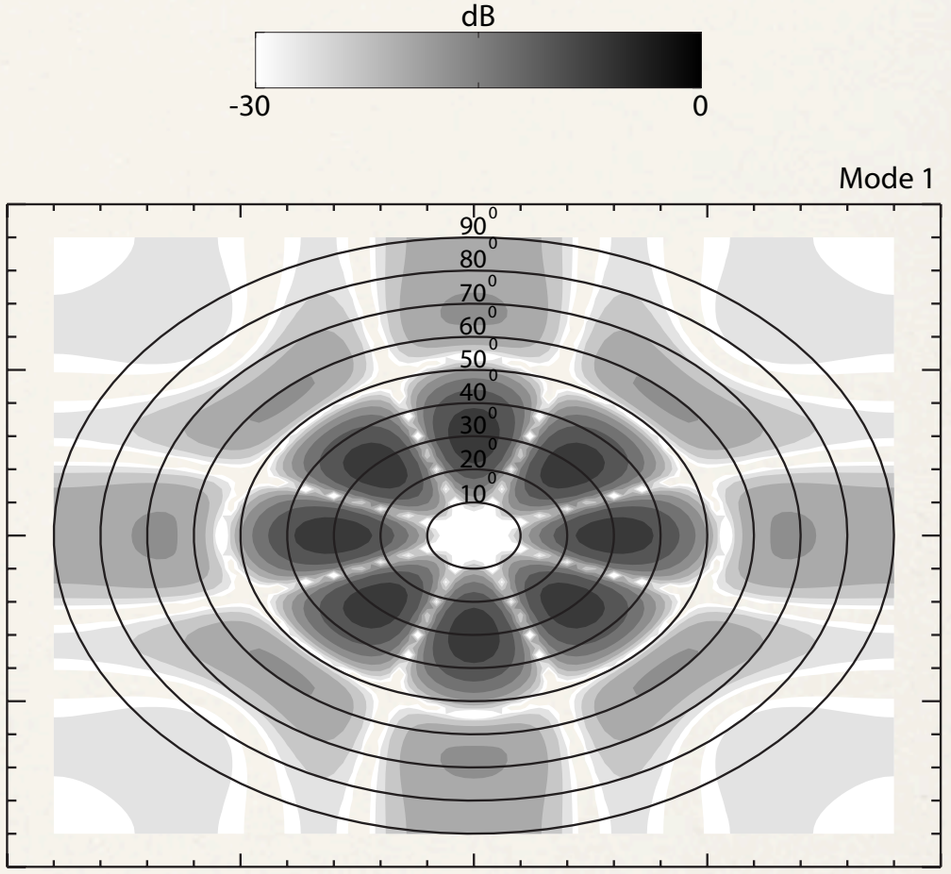
SAAMER Location 53 S, 67 W

MST Workshop, INPE, Sao Jose Dos Campos, May 25-30, 2014

TX Mode 1: Opposite phasing

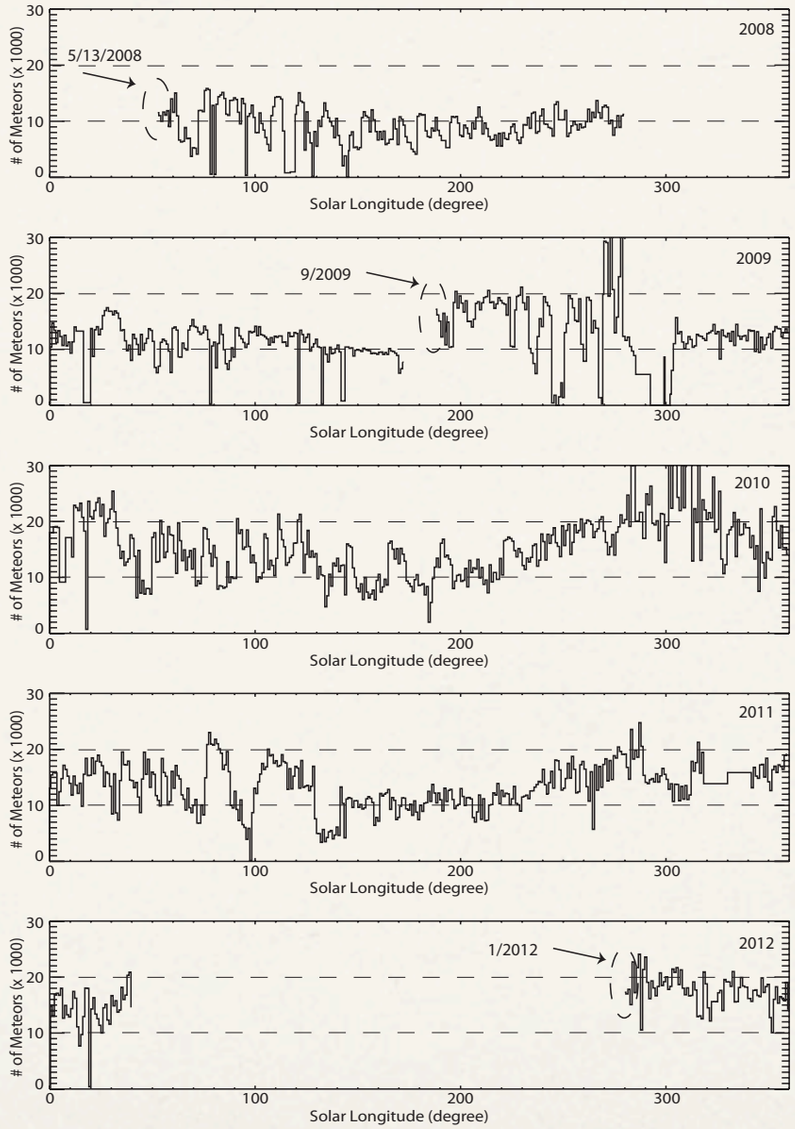
(Fritts et al, 2010, Janches et al., 2013)

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



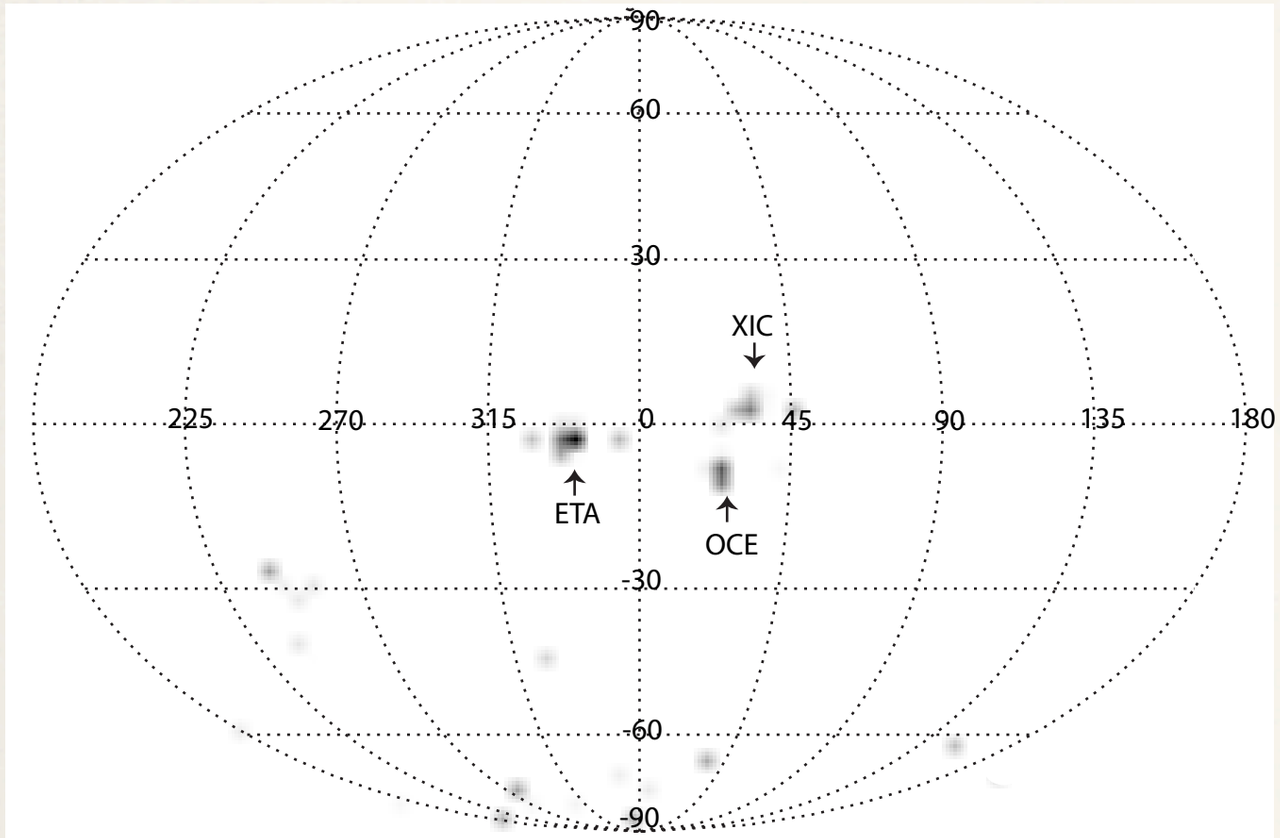
SAAMER Meteor Rates

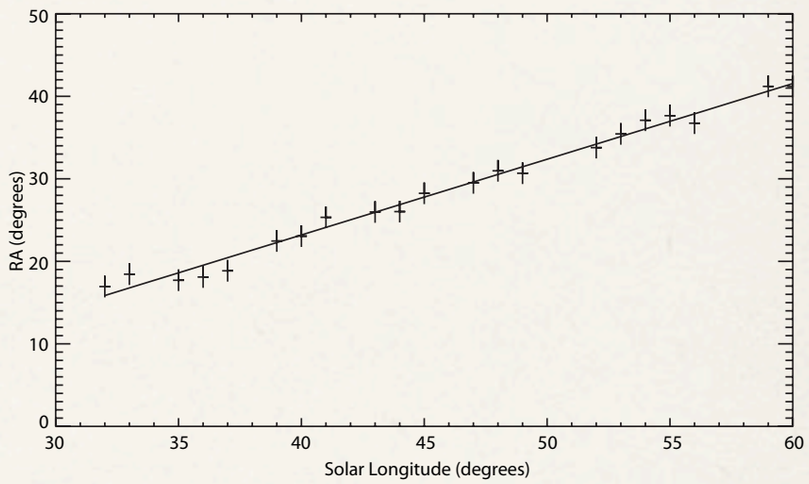
(Janches et al., 2013)

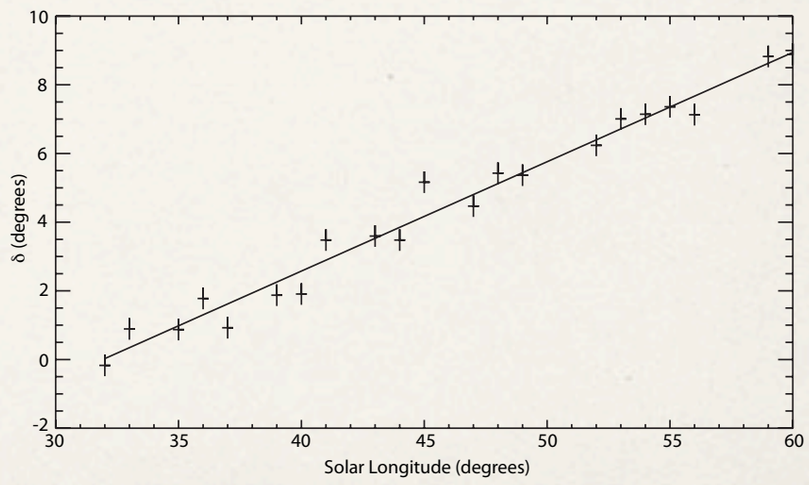


SAAMER Shower Radiant Survey

(Janches et al., 2013)







Only 10% of shower surveys performed from SH

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SAAMER Shower Radiant Survey

(Janches et al., 2013)

Name	IAU	λi	λf	RAi	RAf	δi	δf	ΔRA	Δδ
Day. April Piscids	APS	21	27	359	3.1	0.9	4.4	0.7	0.4
Day. ξ Cetids	XIC	32	60	16.9	41.2	-0.2	8.9	0.9	0.3
η Aquarids	ETA	35	59	329.6	346.5	-4.5	3.6	0.7	0.3
South. Day. ω Cetids	OCE	40	57	16.5	32.1	-9.1	-1.9	0.9	0.4
α Scorpiids	ASC	58	61	249.7	250.2	-28.4	-29.8	-0.1	-0.2
South. μ Sagitariids	SSG	67	94	255.2	278.5	-30.2	-33.9	0.9	0.1
Day. Arietids	ARI	71	85	39.52	48.36	21.6	25.8	0.63	0.3
South. June Aquiliids	SZC	74	113	304.4	327.7	-37.4	-28	0.6	0.3
North. June Aquiliids	NZC	85	95	297.9	303.3	-9.2	-6.6	0.6	0.3
South. σ Sagitariids	SSS	84	100	286.6	298	-28.4	-23.5	0.6	0.3
Capricornids	CAP	96	113	305.3	318.8	-7.1	-2.5	0.9	0.2
July Phoenicids	PHE	100	123	20.6	43	-55.2	-40.1	0.8	0.7
Microscopiids	MIC	108	125	311.8	327	-23.1	-21	0.9	0.08
σ Capricornids	SCA	110	128	297.3	304.9	-15.1	-11.2	0.5	0.2
Piscis Austrids	PAU	114	127	332.8	350.7	-21.4	-24	1.5	-0.4
99 Aquarids	NNA	124	134	353.8	357.2	-26.9	-21.4	0.5	0.5

SAAMER Shower Radiant Survey

Cont.

(Janches et al., 2013)

Name	IAU	λi	λf	RAi	RAf	δi	δf	ΔRA	Δδ
August β Piscids	BPI	126	167	325	359.9	-10.8	1.9	0.9	0.3
South. δ Aquarids	SDA	130	141	342.8	352.7	-17.4	-14.3	0.8	-.0.3
North. δ Aquarids	NDA	126	138	342.1	345.7	-3.5	0.9	0.2	0.3
ω Piscids	OPC	162	172	0.4	5.9	1.5	3.6	0.5	0.2
South. Taurids	STA	178	212	17.6	43	-0.06	7.2	0.8	0.2
Day. Sextantids	DSX	179	194	148.8	159.4	0.07	-6.2	0.7	-0.5
Orionids	ORI	205	212	92.2	97.7	15.1	16	0.8	0.03
November ω Orionids	NOO	241	246	86.5	90.4	14.4	14.4	0.80	0.02
Geminids	GEM	259	262	110.1	113.6	30.3	30.5	1.1	0.03
South. σ Sagitariids	SSS	84	100	286.6	298	-28.4	-23.5	0.6	0.3
η Carinids	ECR	280	291	159.4	169.3	-51.5	-53.3	0.9	-0.2
ζ Puppids	ZPU	234	240	124.6	127	-45.4	-43.9	0.3	0.09
γ Puppids	PUP	247	264	131.7	142.1	-48.1	-55.4	0.8	-0.5
b Puppids	PVE	274	264	131.7	142.1	-48.1	-55.4		
January α Pixids	APY	299	301	129.9	133.2	-33.7	-37.1	1.6	-1.7
Day. ξ Sagitarids	XSA	288	293	281.3	285.7	-19.5	-19.5	0.7	0.04
Cay. Chi Capricornids	DXC	291	300	299.8	302.8	-33.9	-32	0.4	0.2

SAAMER Shower Radiant Survey

Cont.

(Janches et al., 2013)

Name	IAU	λi	λf	RAi	RAf	δi	δf	ΔRA	Δδ
August β Piscids	BPI	126	167	325	359.9	-10.8	1.9	0.9	0.3
South. δ Aquarids	SDA	130	141	342.8	352.7	-17.4	-14.3	0.8	-.0.3
North. δ Aquarids	NDA	126	138	342.1	345.7	-3.5	0.9	0.2	0.3
ω Piscids	OPC	162	172	0.4	5.9	1.5	3.6	0.5	0.2
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Cay. Chi Capricornids	DXC	291	300	299.8	302.8	-33.9	-32	0.4	0.2

Total of 32 shower radiants, two of which were not part of the IAU commission 22 meteor shower working list (now obtaining orbital information too - see Poster!)

SAAMER Meteor Orbital System

(Pifko et al., 2014)

August 2010

MST Workshop, INPE, Sao Jose Dos Campos, May 25-30, 2014

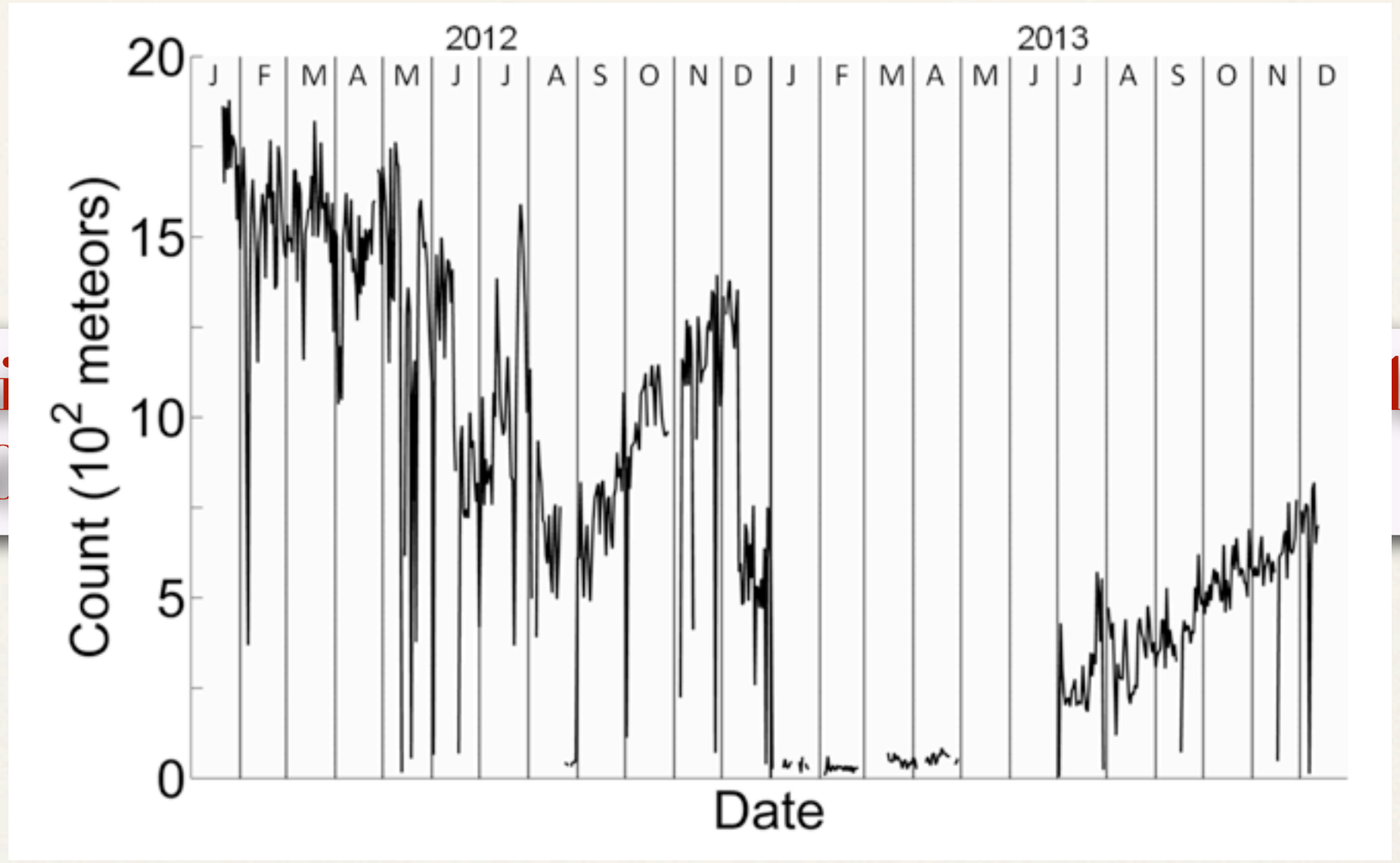
SAAMER Meteor Orbital studies

(Pifko et al., 2014)

Daily orbital determination since January 2012
~500 -1500 daily orbits

SAAMER Meteor Orbital studies

(Pifko et al., 2014)



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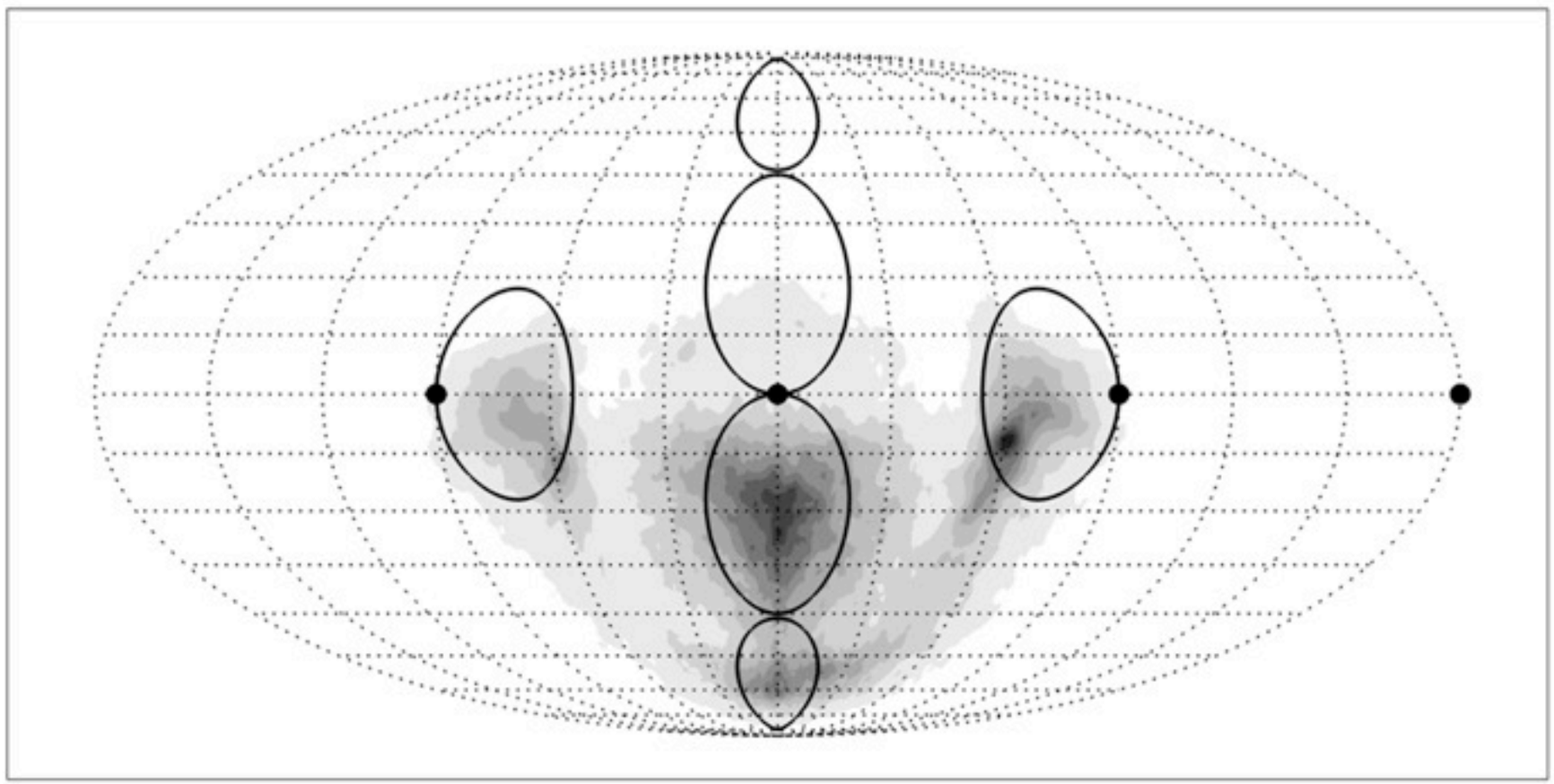
SAAMER Meteor Orbital studies

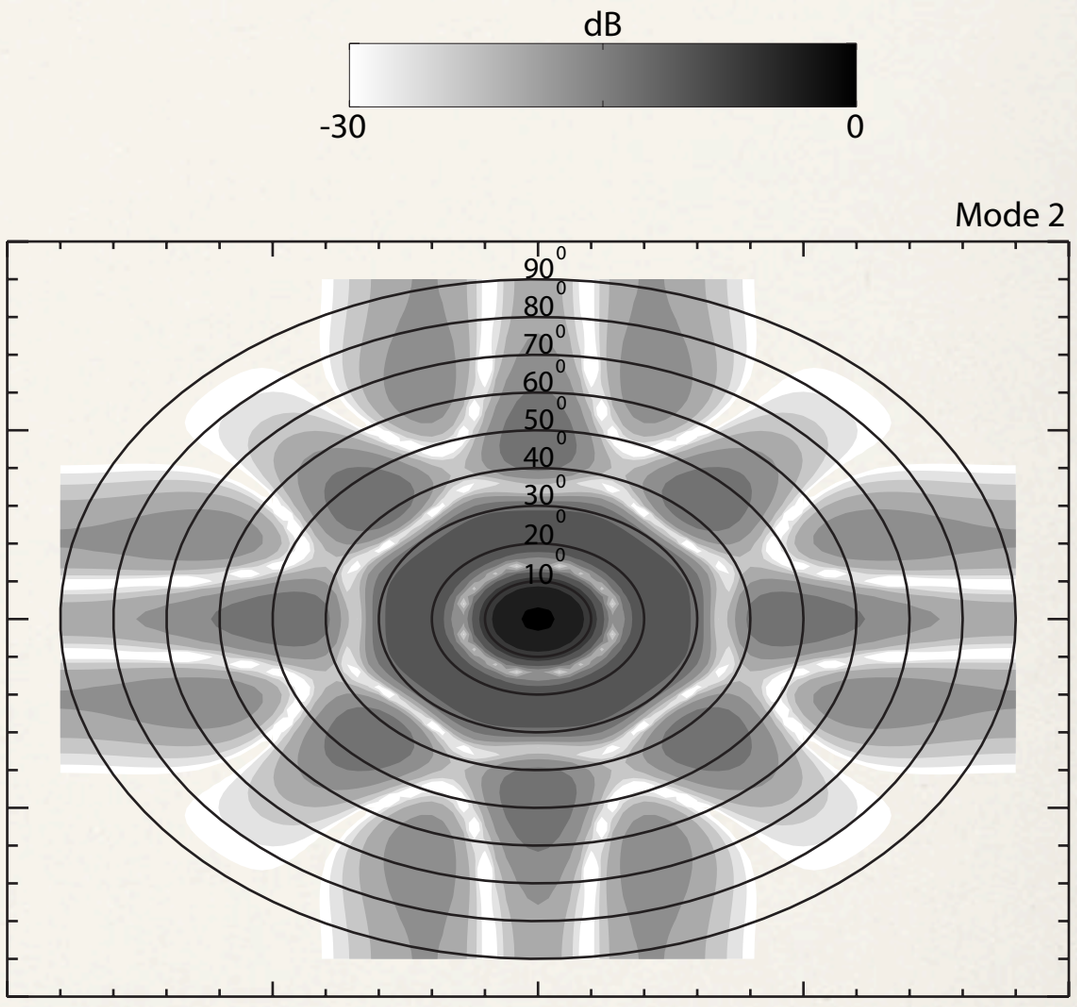
(Pifko et al., 2014)



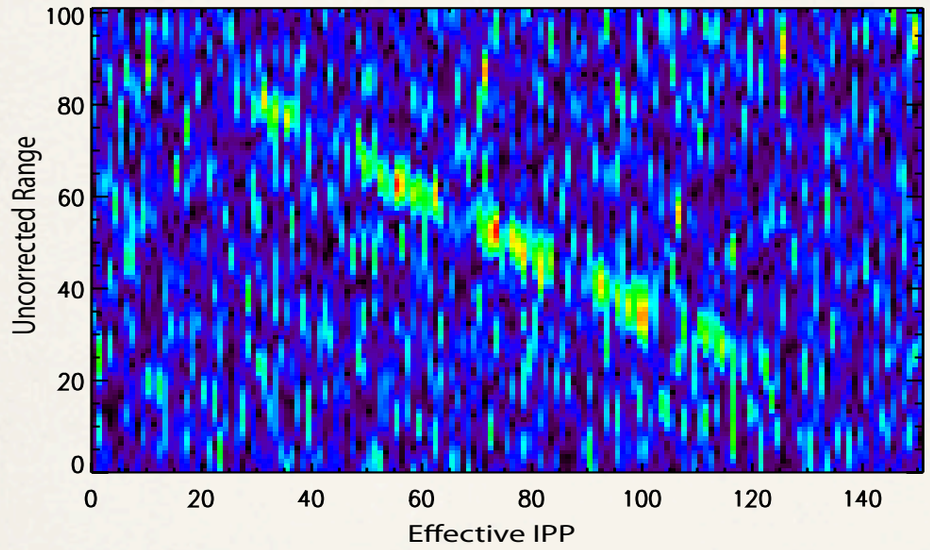
Pushing the envelope: TX Mode 2 Same phase

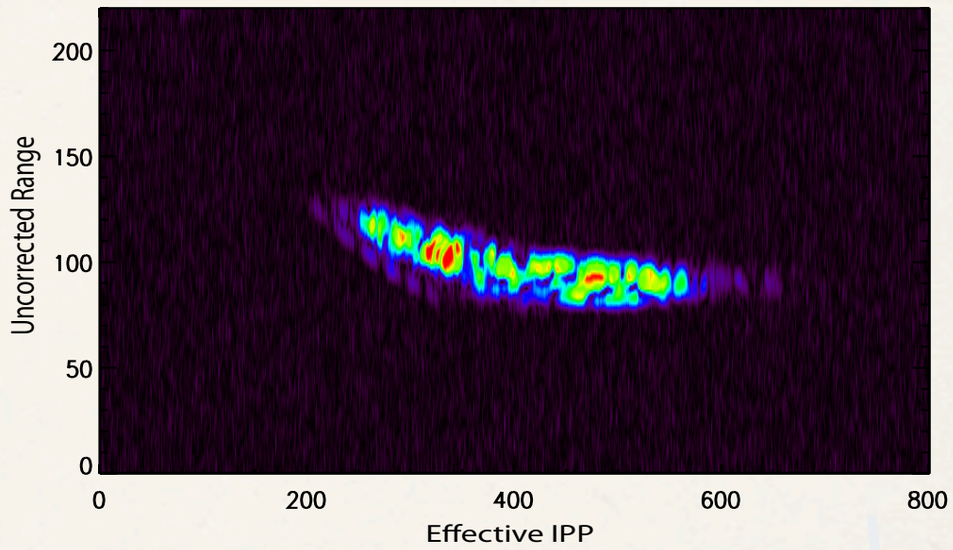
(Janches et al., 2014)

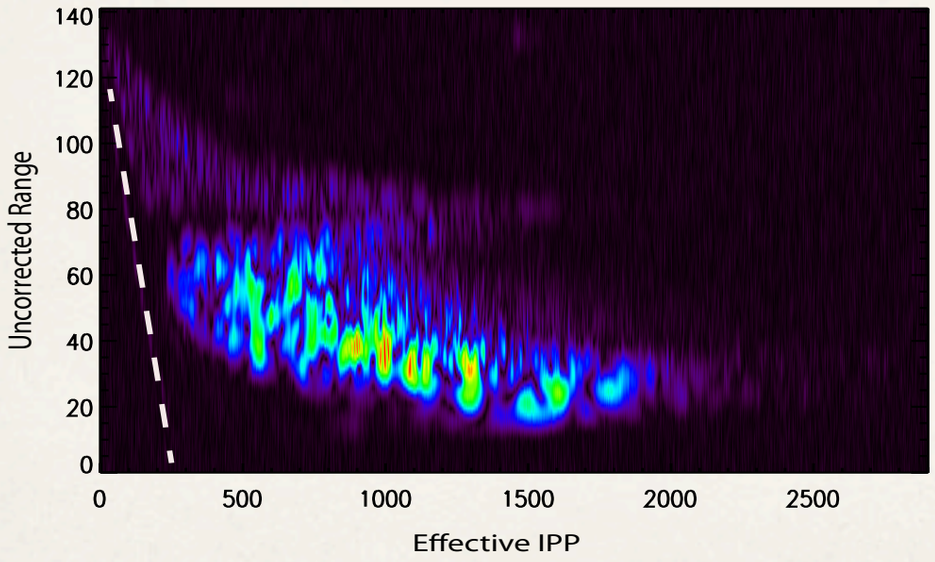
Quantity	
Latitude (degree)	53.8
Longitude (degree)	67
Frequency (MHz)	32.55
PRF (Hz)	**500**
TX Peak Power (kW)	60
Bandwith (MHz)	0.3
Coherent Integrations (# IPP)	2
Pulse Code	Barker
Pulse Length (ms)	13.6
Sample resolution (m)	**250**

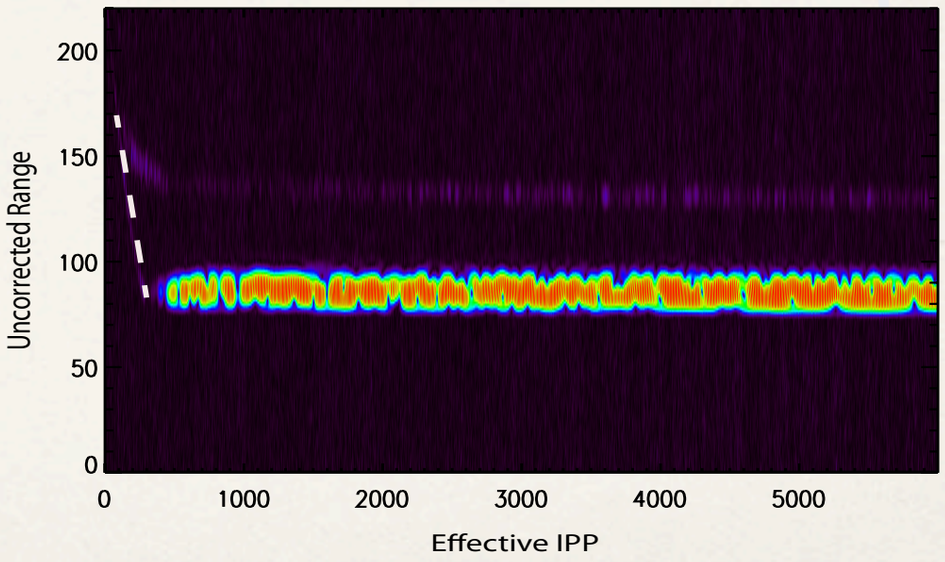


Unexpected capabilities: Non-Specular Trails, Diff. Abl. and









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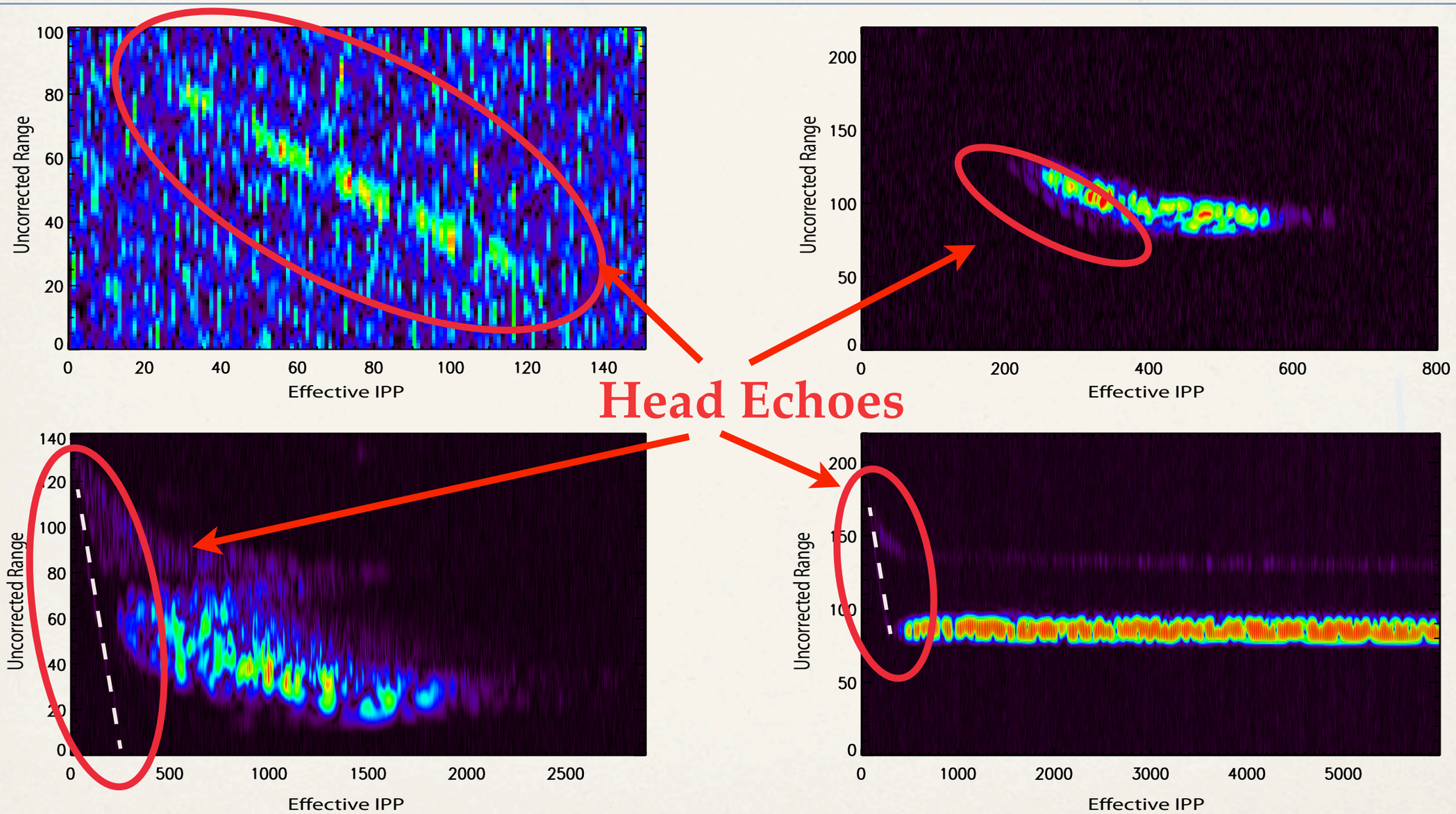

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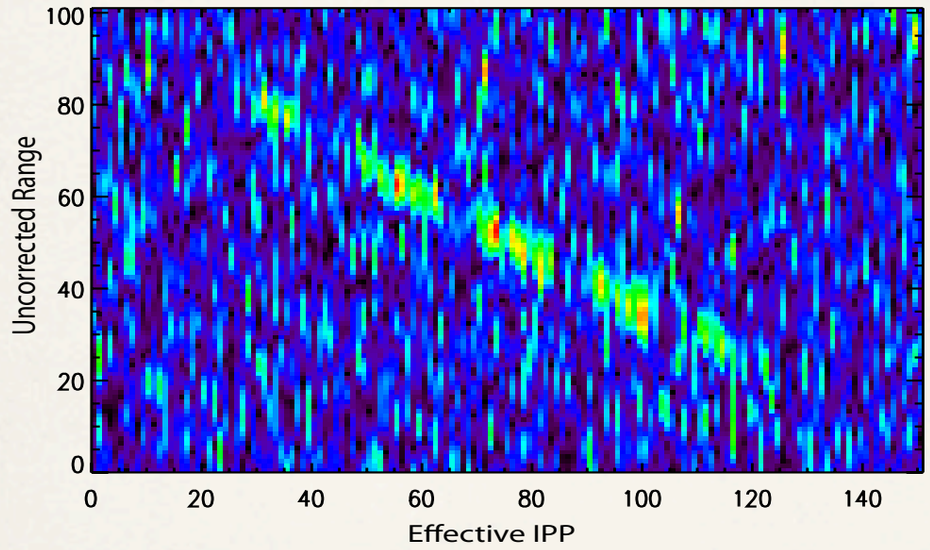

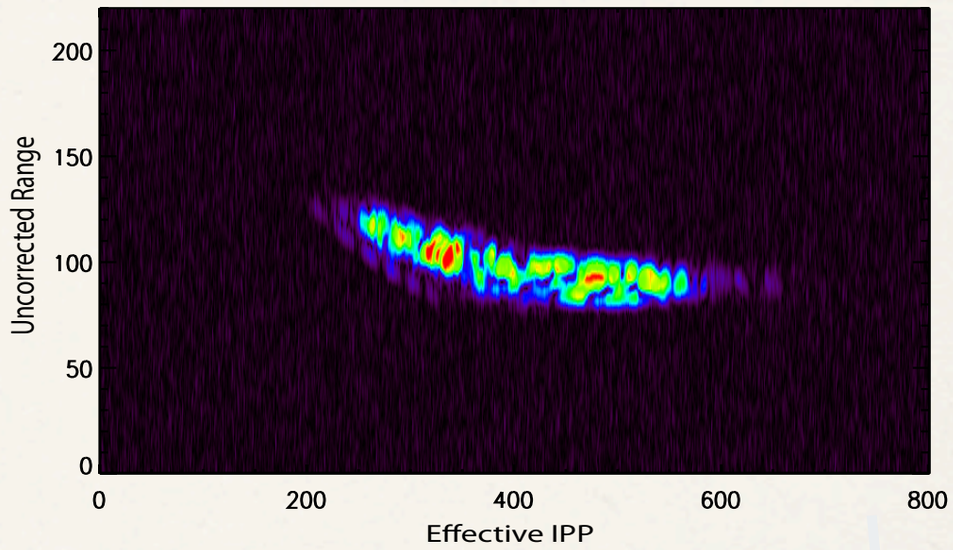

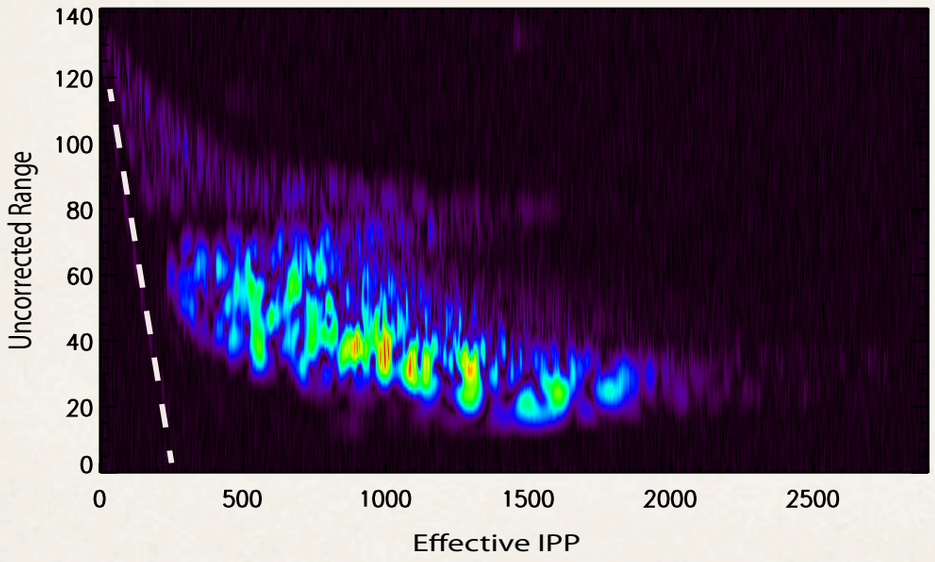

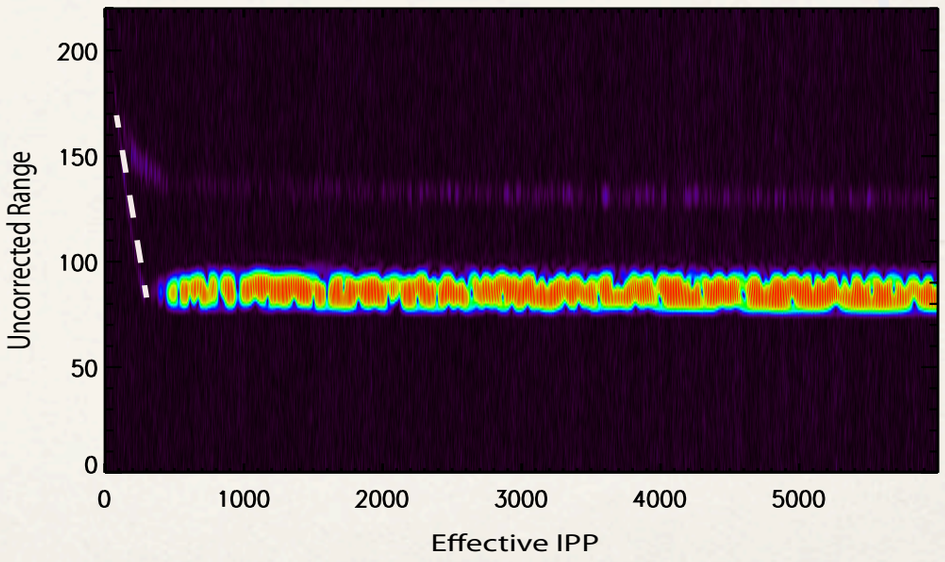

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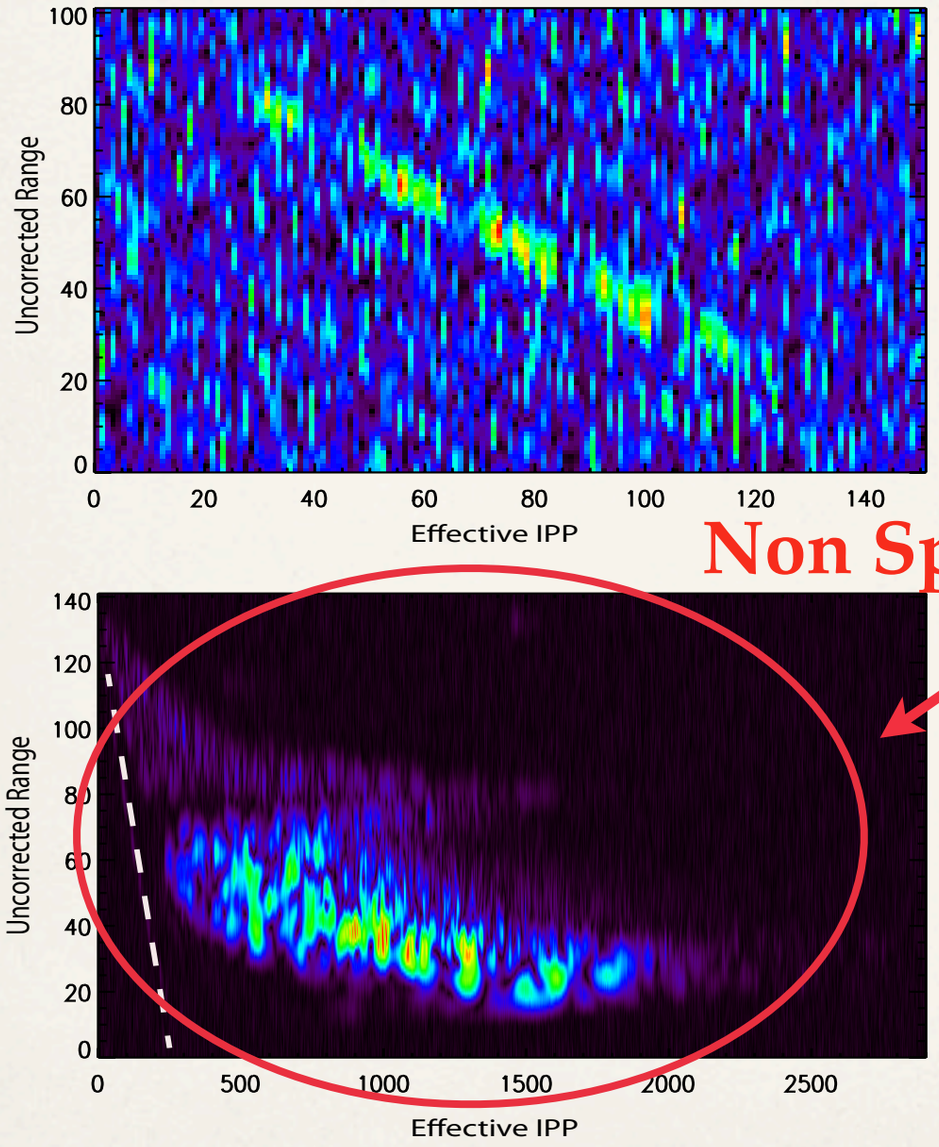

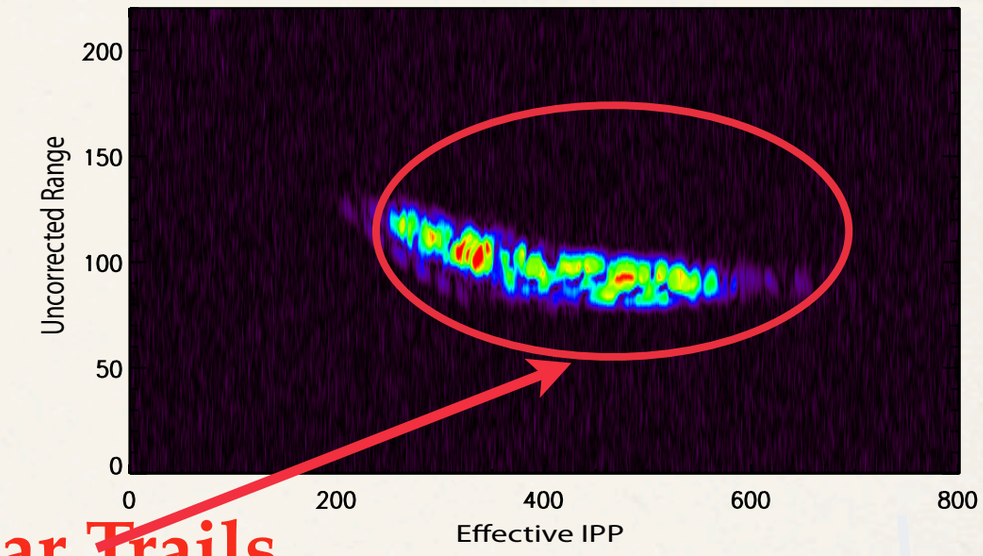

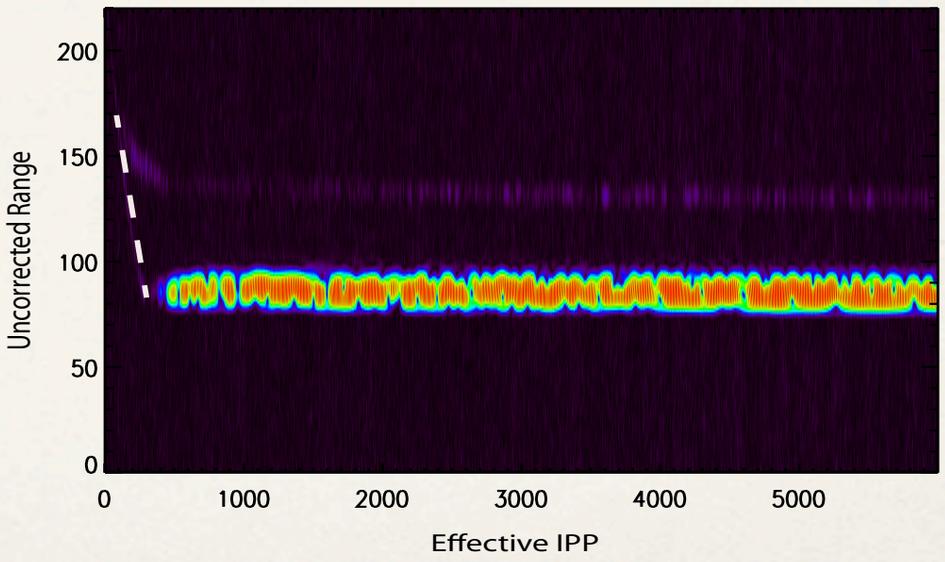

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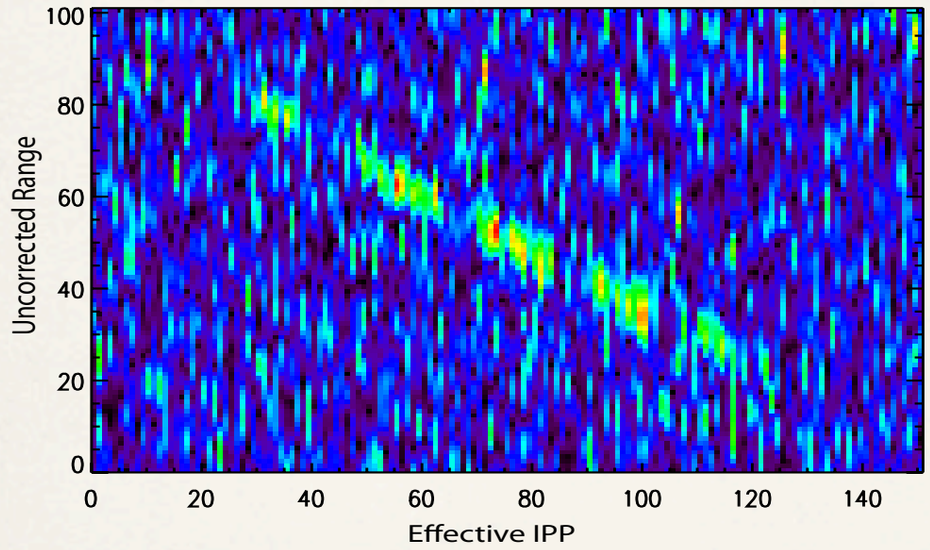

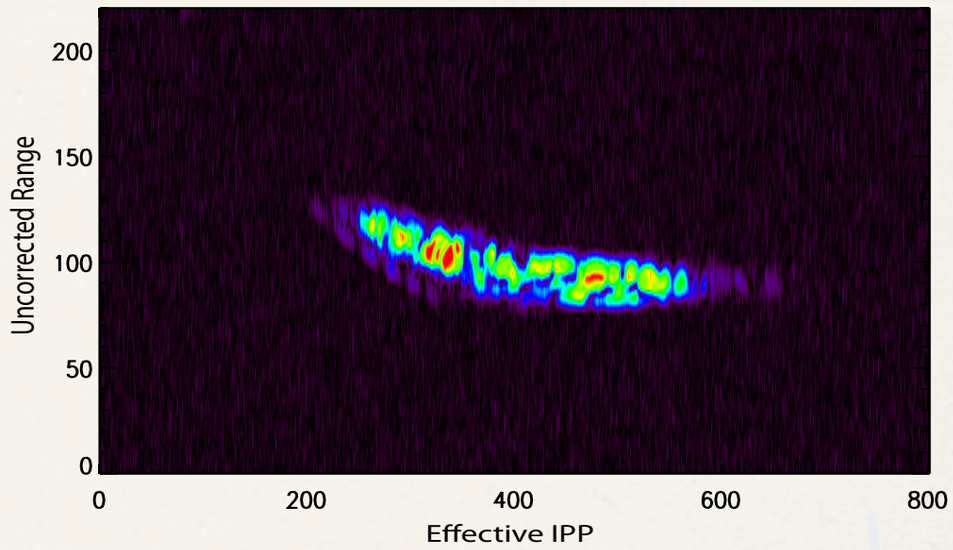

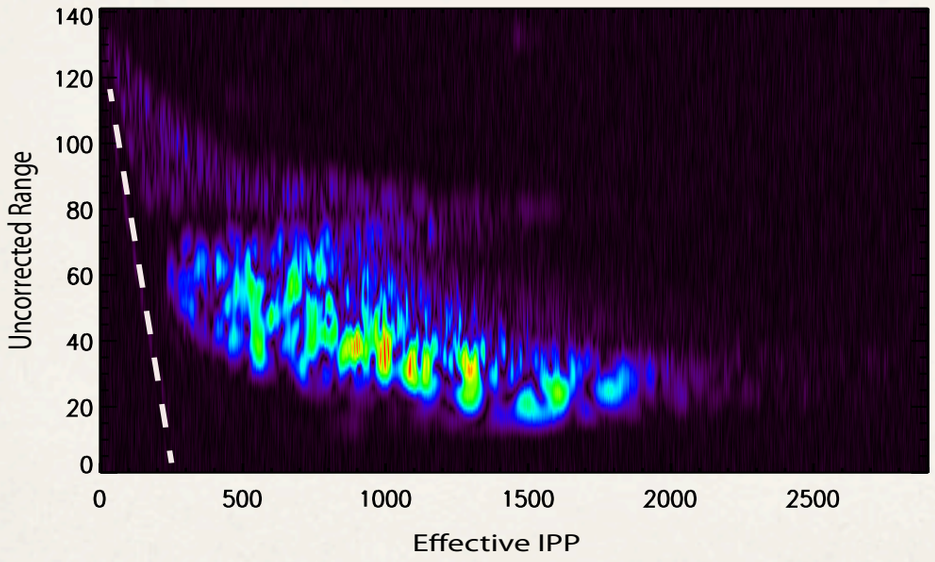

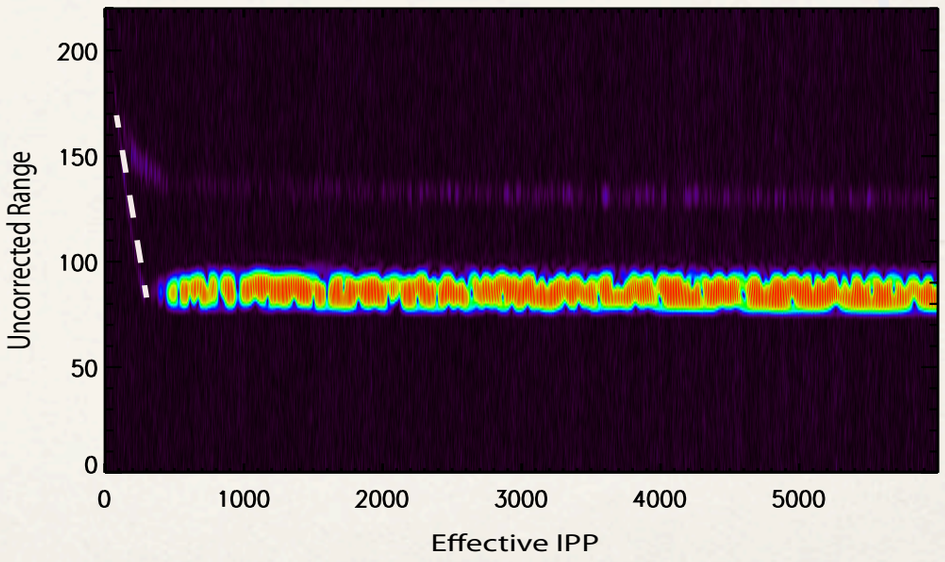

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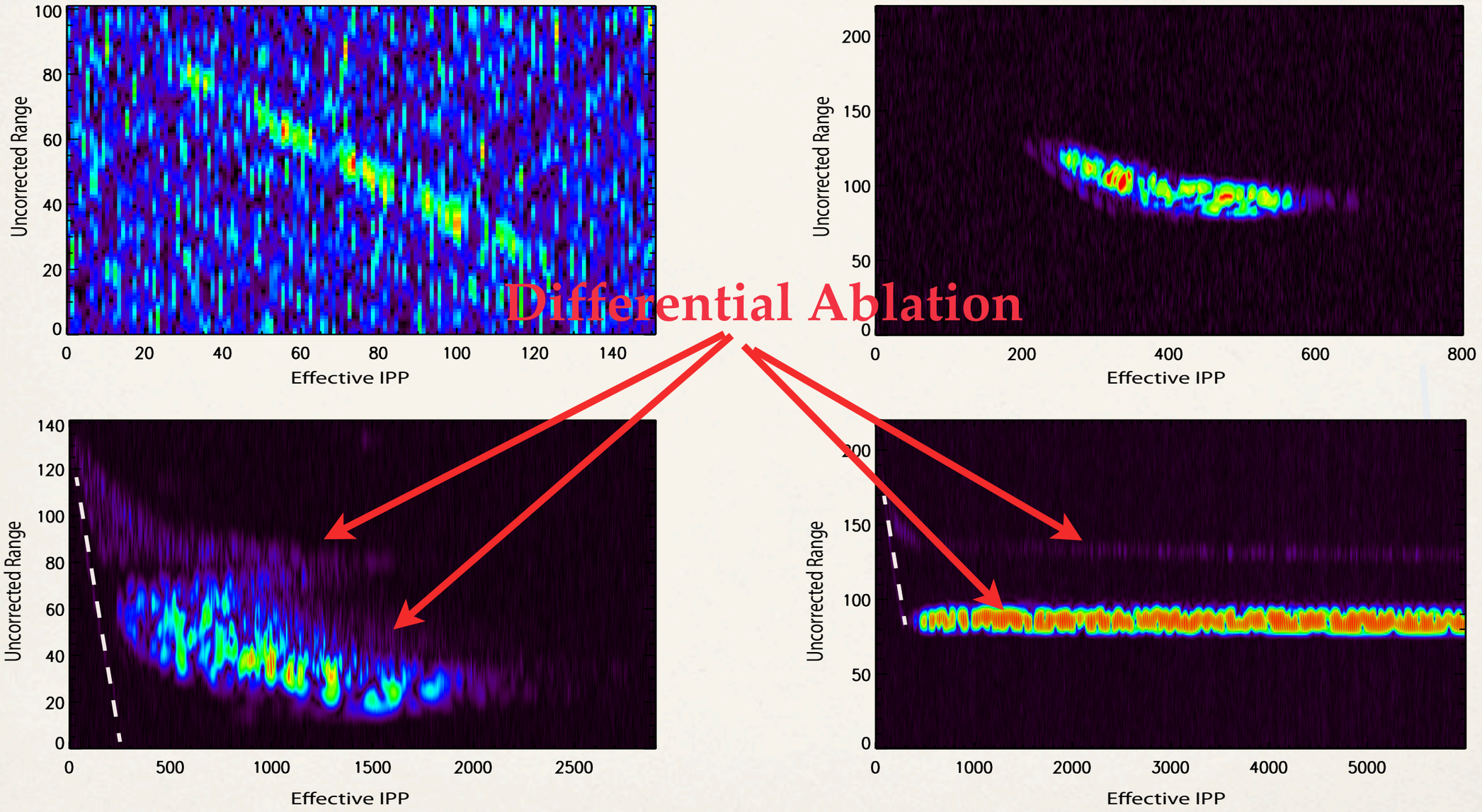
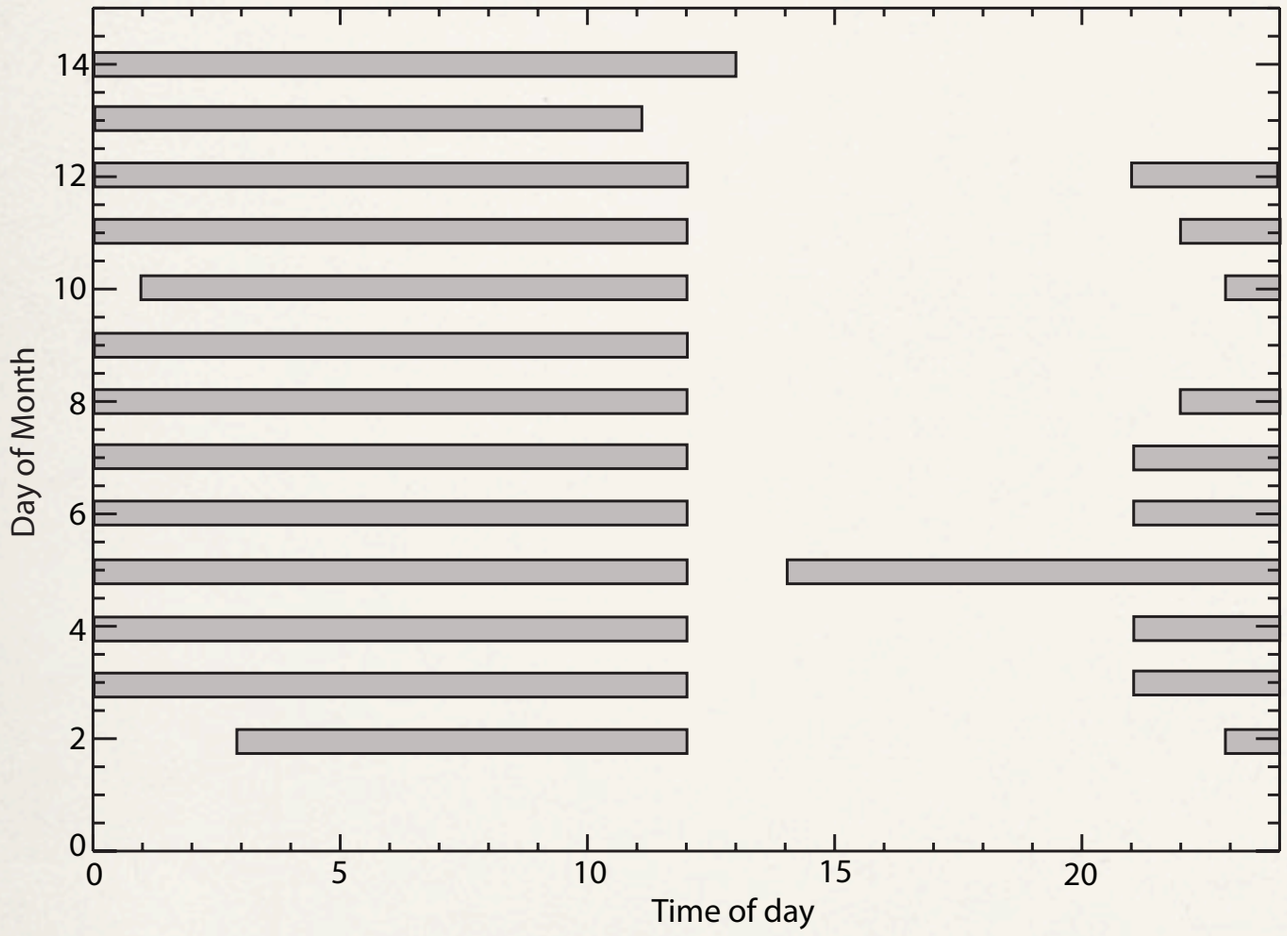
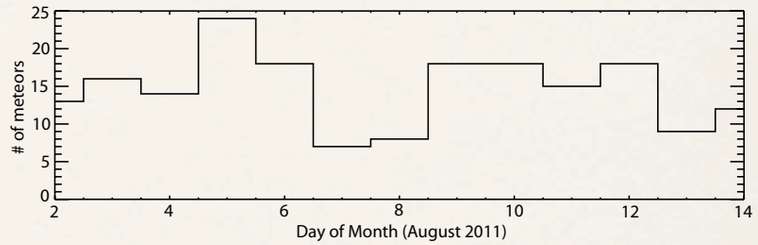
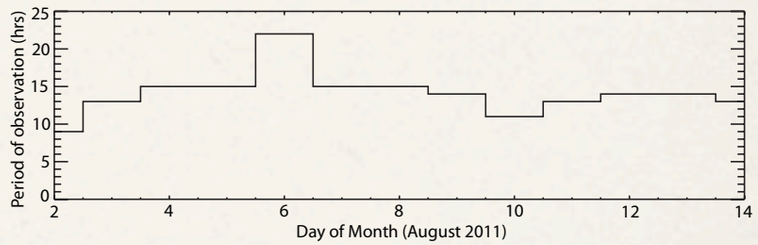


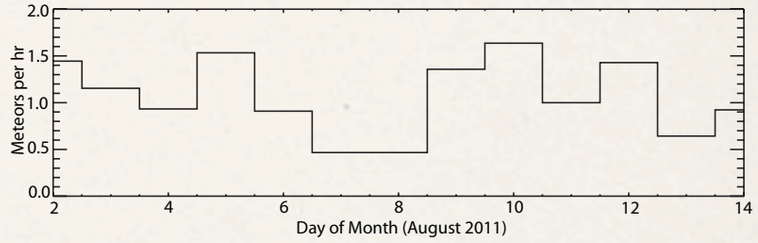
HE Observation Coverage and Detected Rates

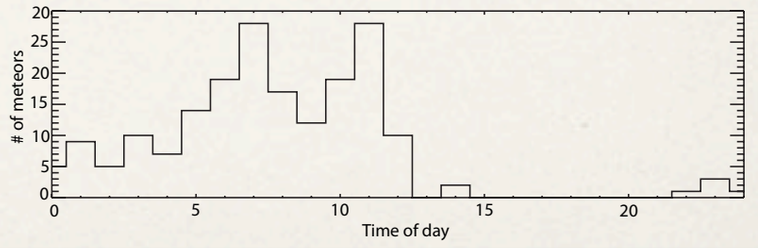
(Janches et al., 2014)









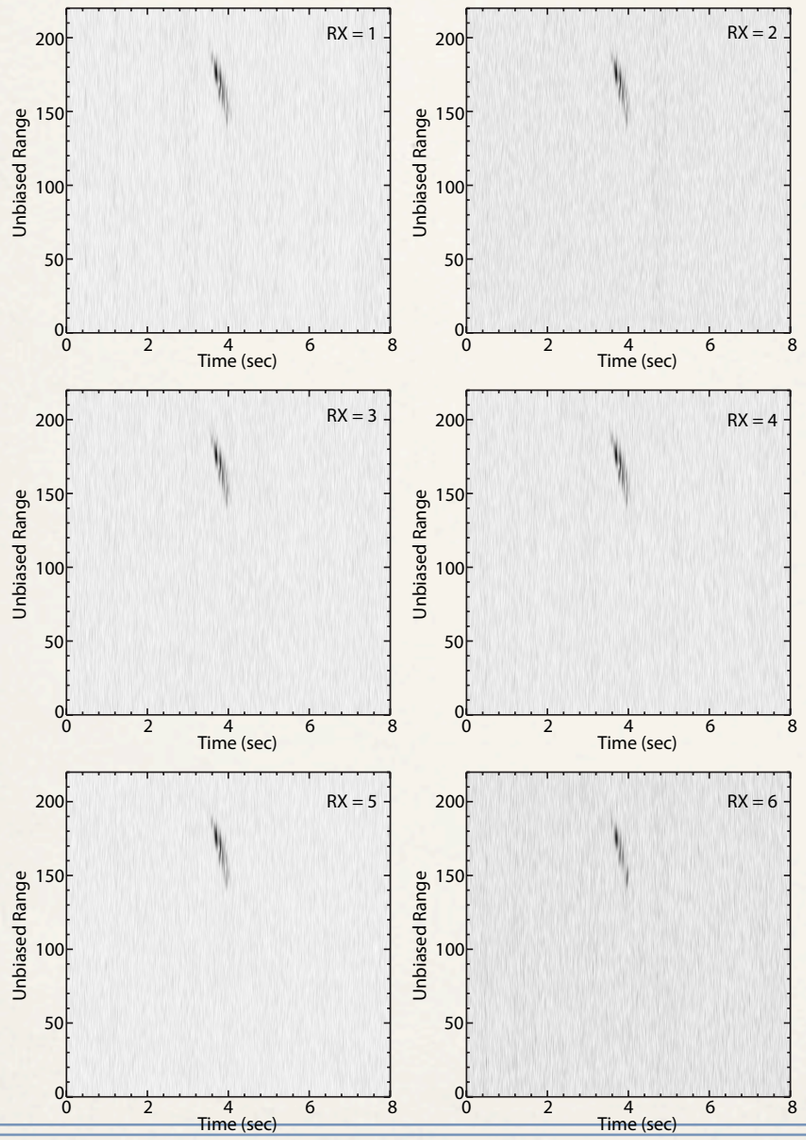


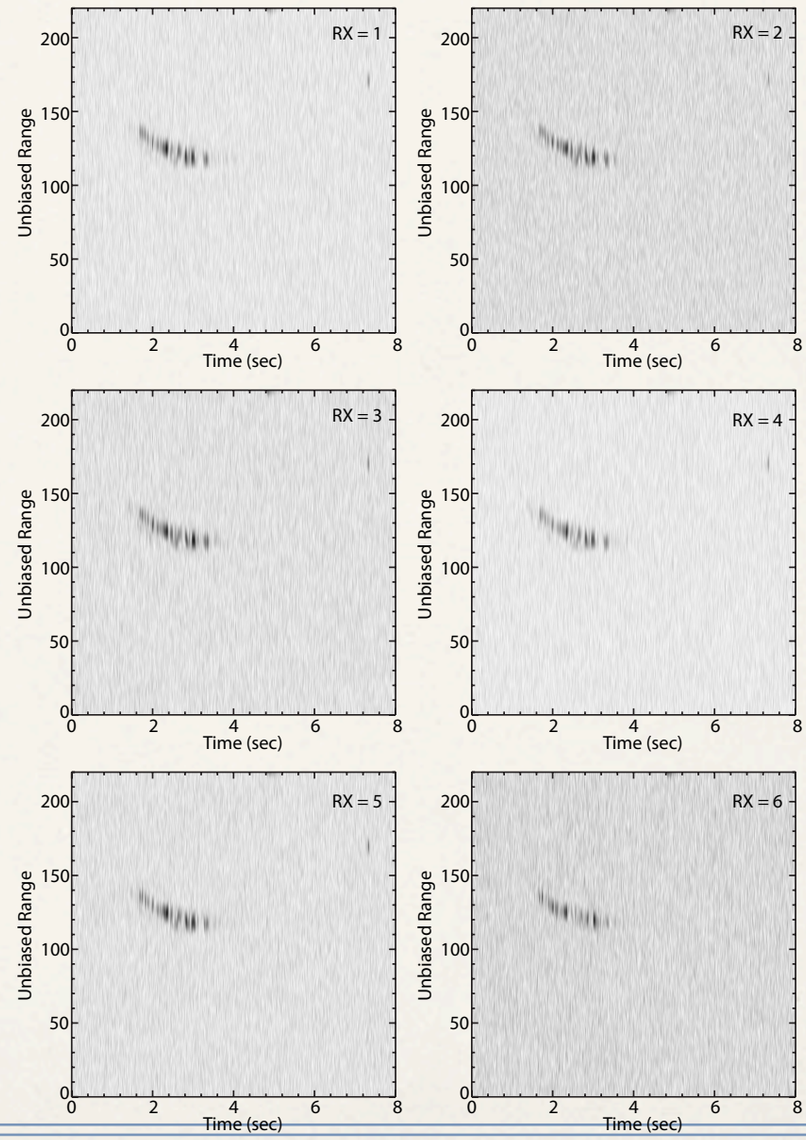
Total 190 Head Echoes observed

MST Workshop, INPE, Sao Jose Dos Campos, May 25-30, 2014

SAAMER Head-Echo Interferometry

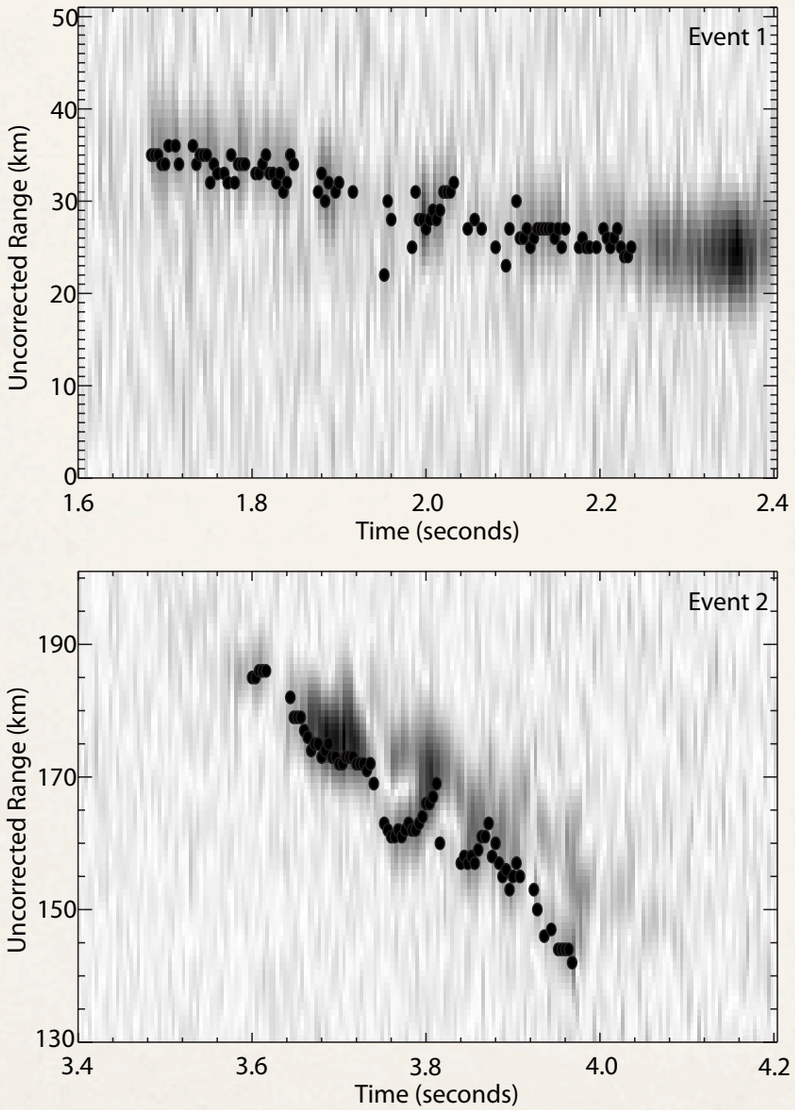
(Janches et al., 2014)

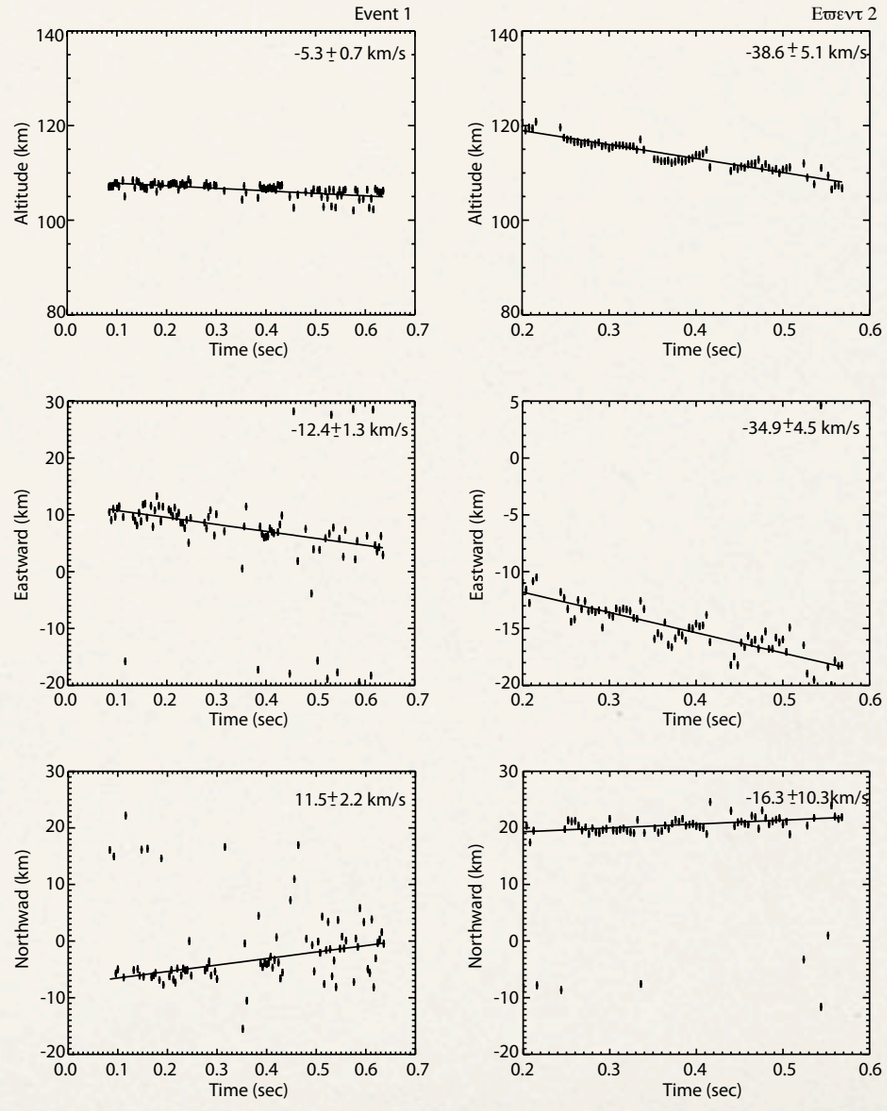




3D Velocity Determination

(Janches et al., 2014)





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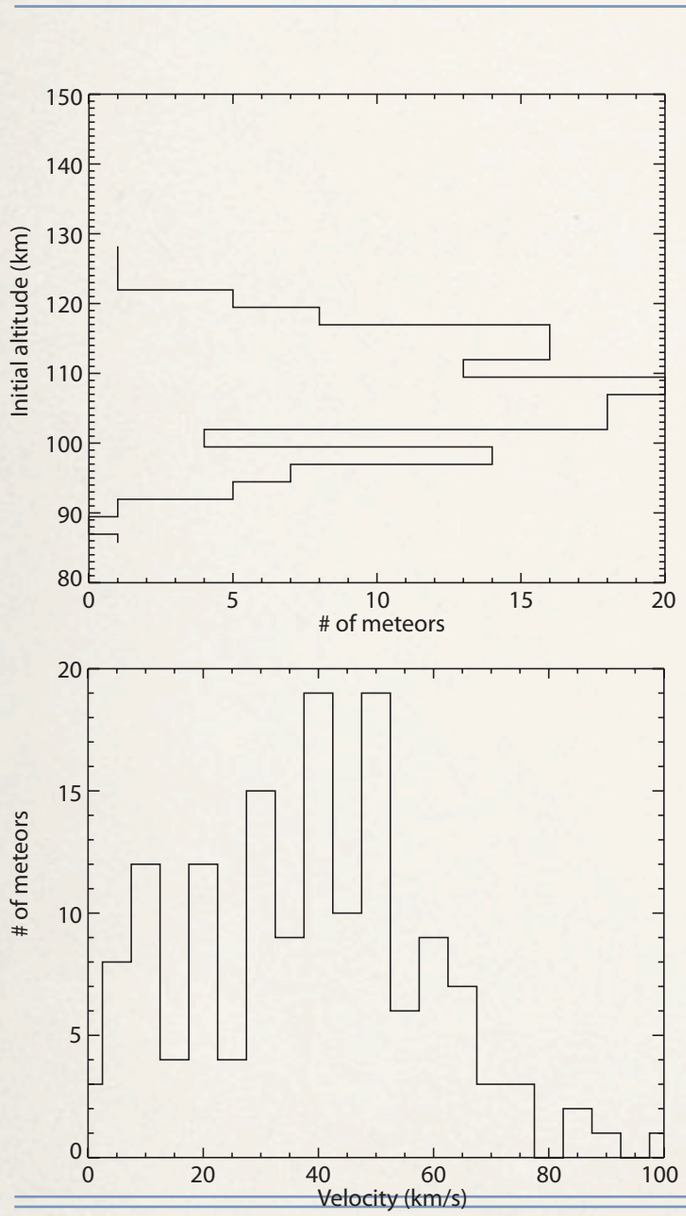
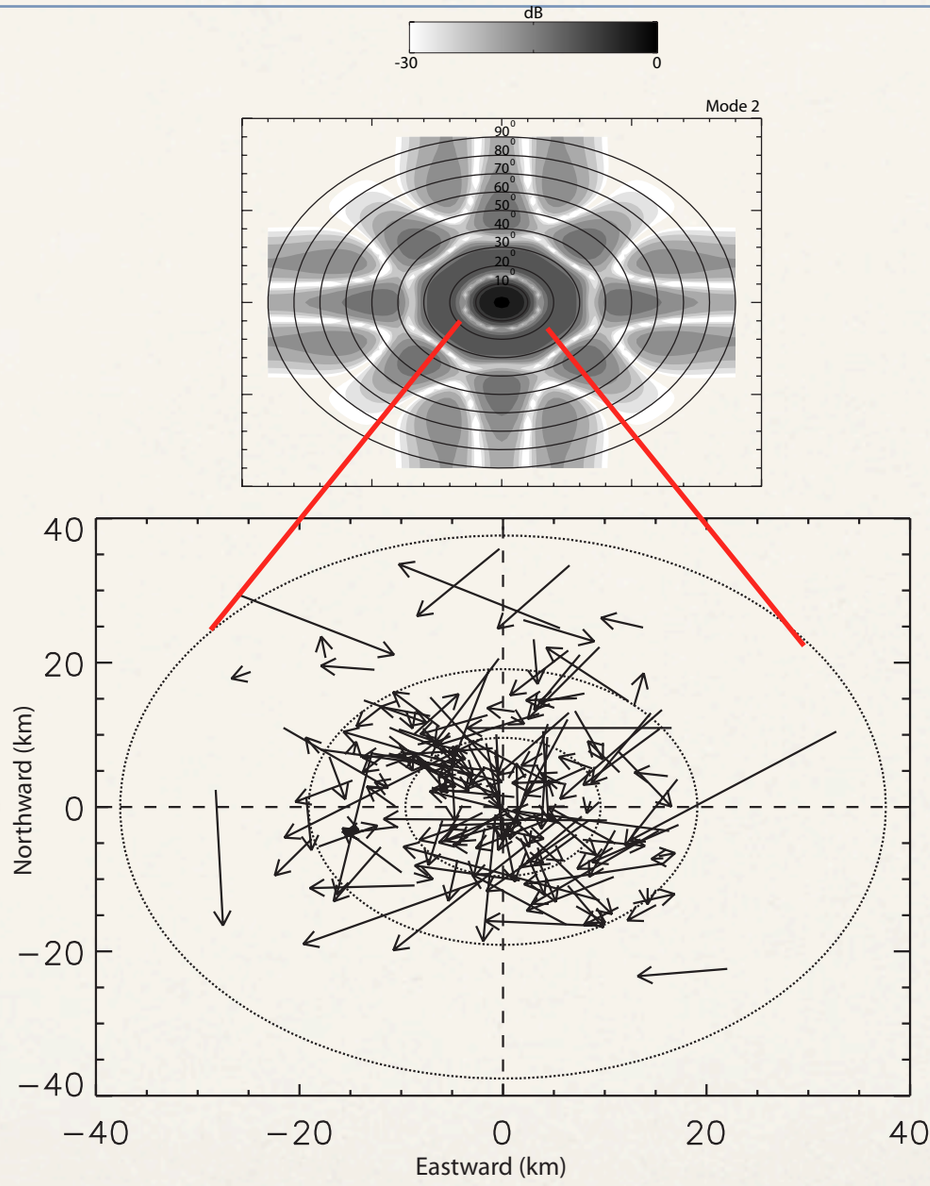
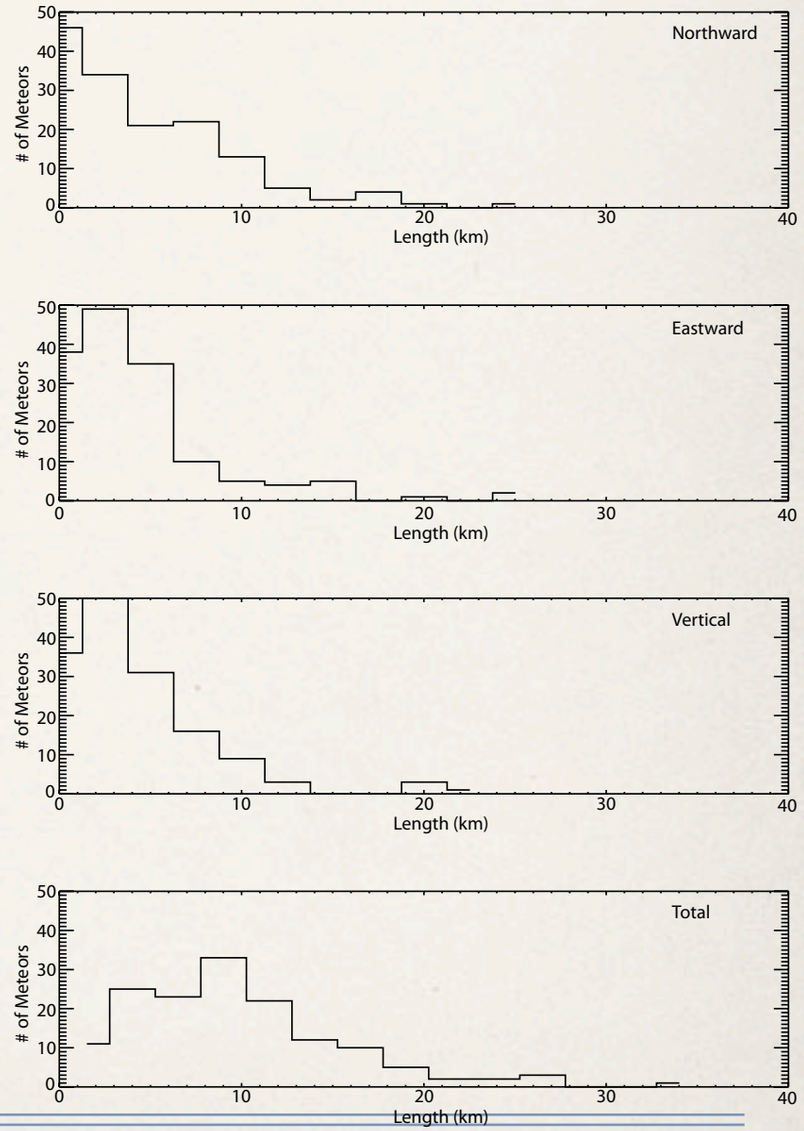
HE Altitude, Velocity and Extension

(Janches et al., 2014)



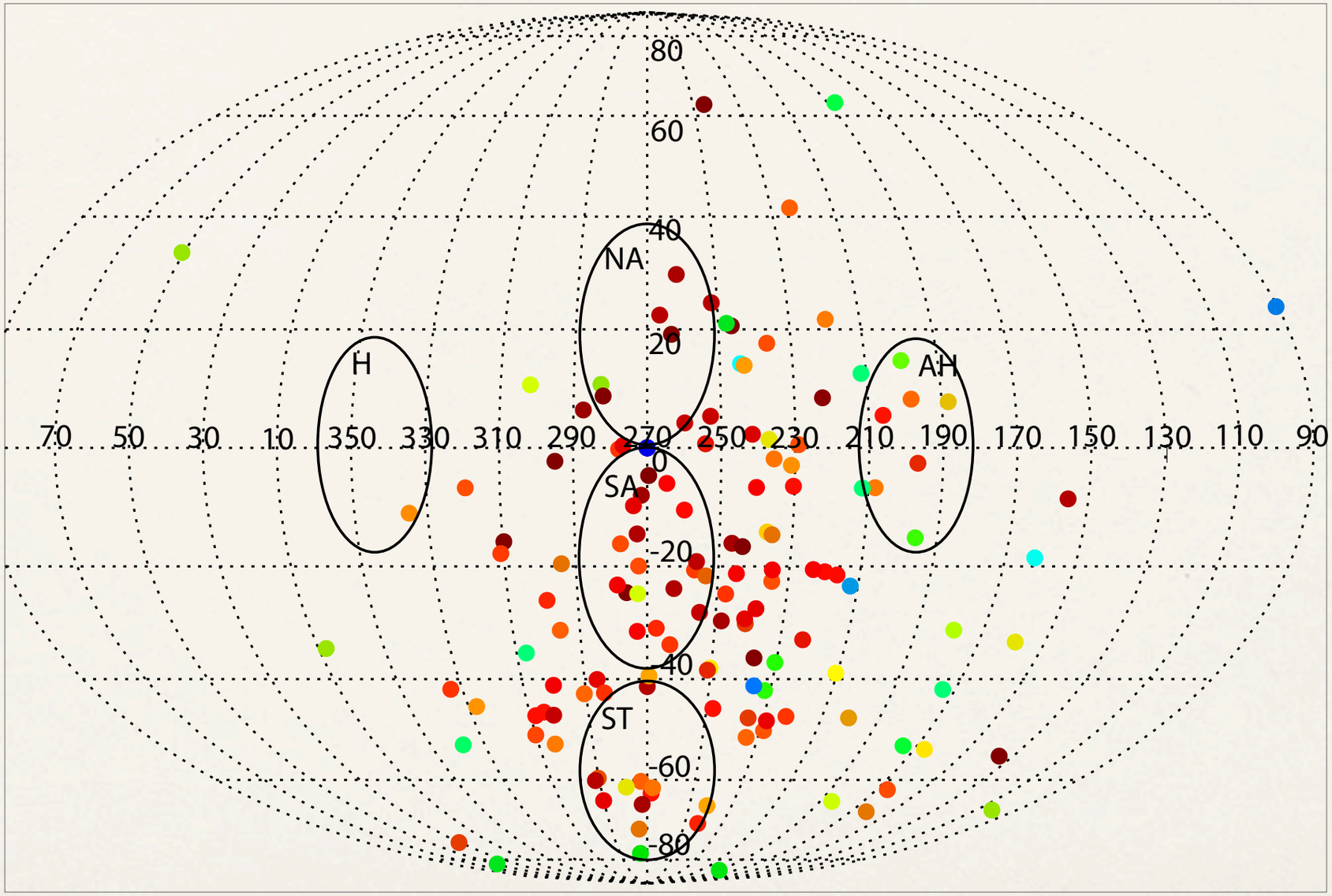




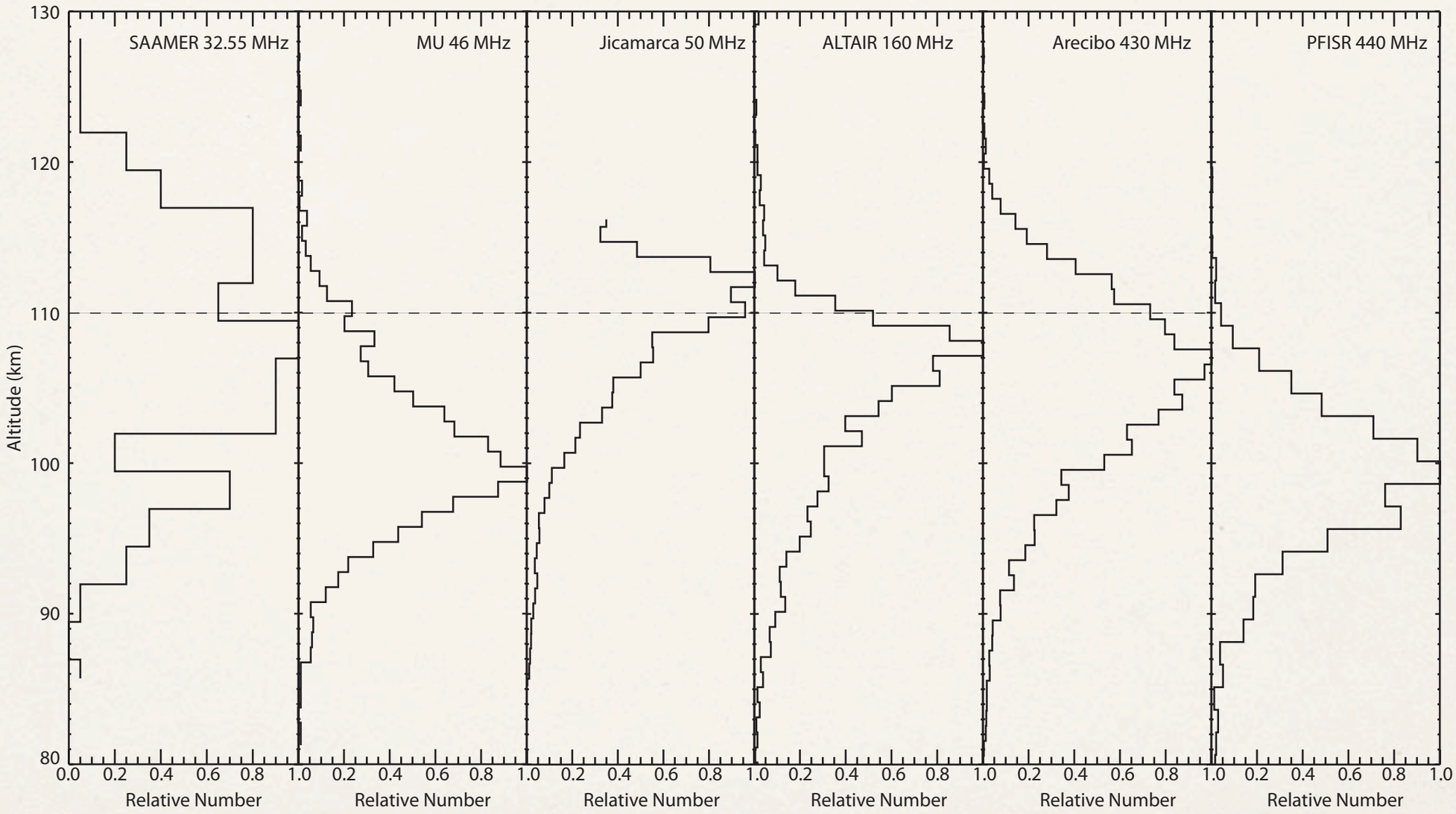
MST Workshop, INPE, Sao Jose Dos Campos, May 25-30, 2014

HE Orbits

(Janches et al., 2014)



Comparison of SAAMER and HPLA HE detections (Janches et al., 2012b)



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Radar	λ (m)	f (MHz)	Pt (kW)	Aperture	G (dB)	Pd (W/m2)
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 (log10 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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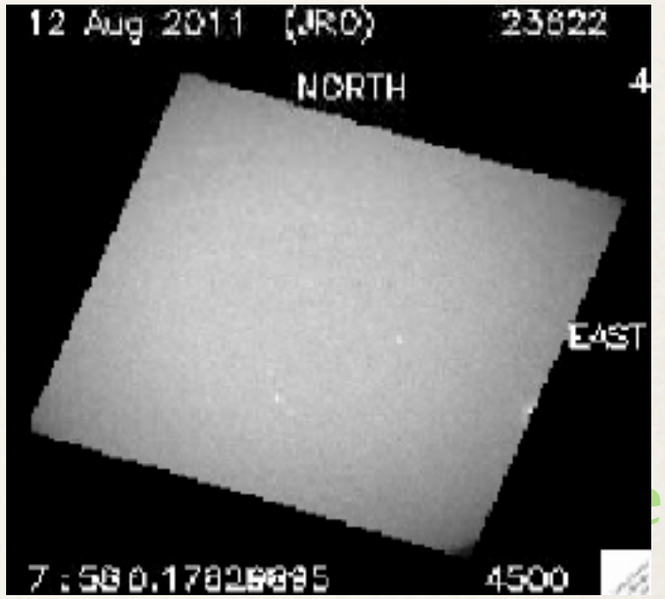
Pifko et al., 2012 … lose et al., 2005

4 oom difference in Pd =>
2 oom in detected speed =>
100 and 10,000 micrograms traveling at 60 and 15 km/s

SAAMER Remote Sites:
Infrastructure for additional deployments



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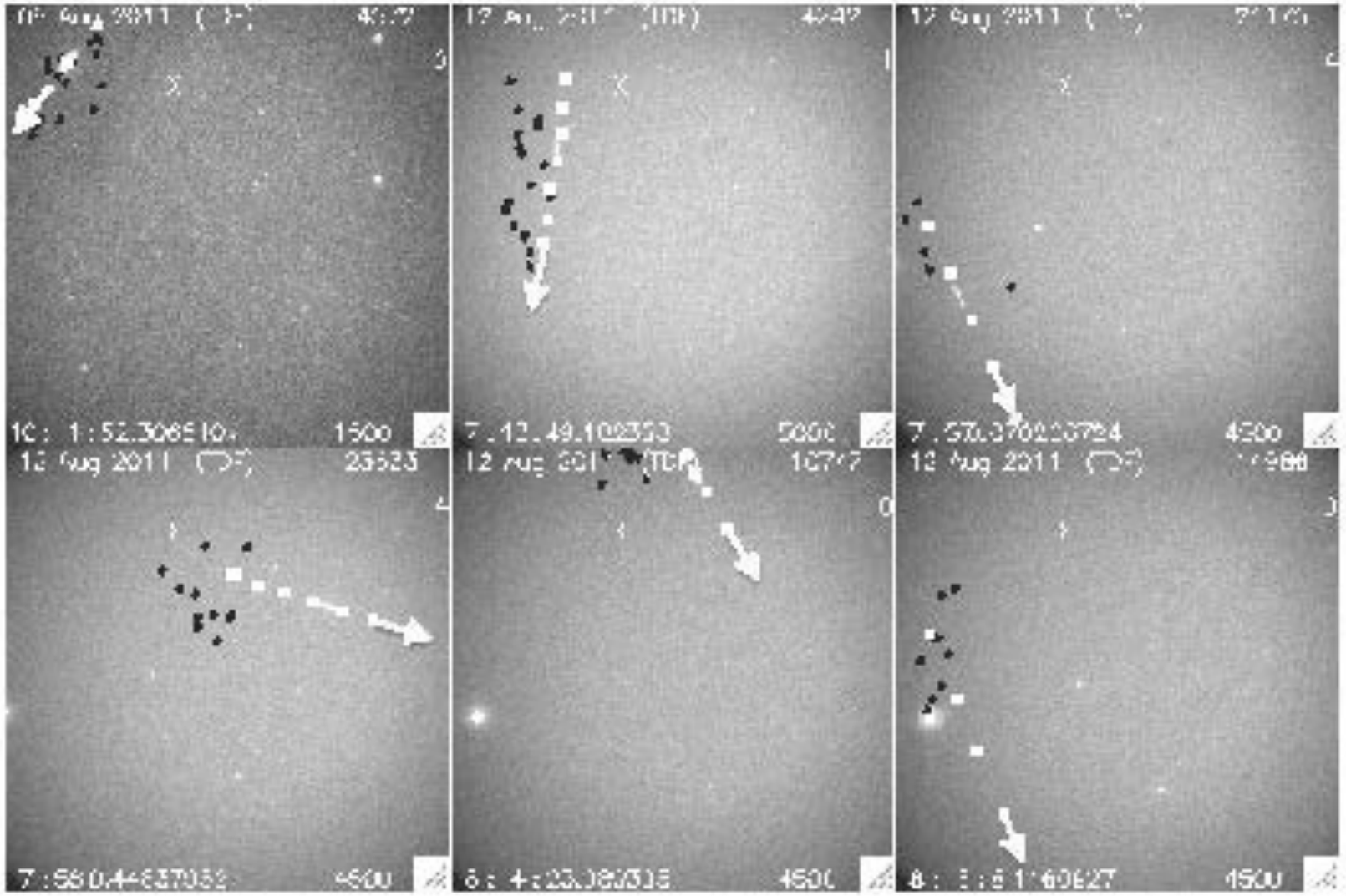

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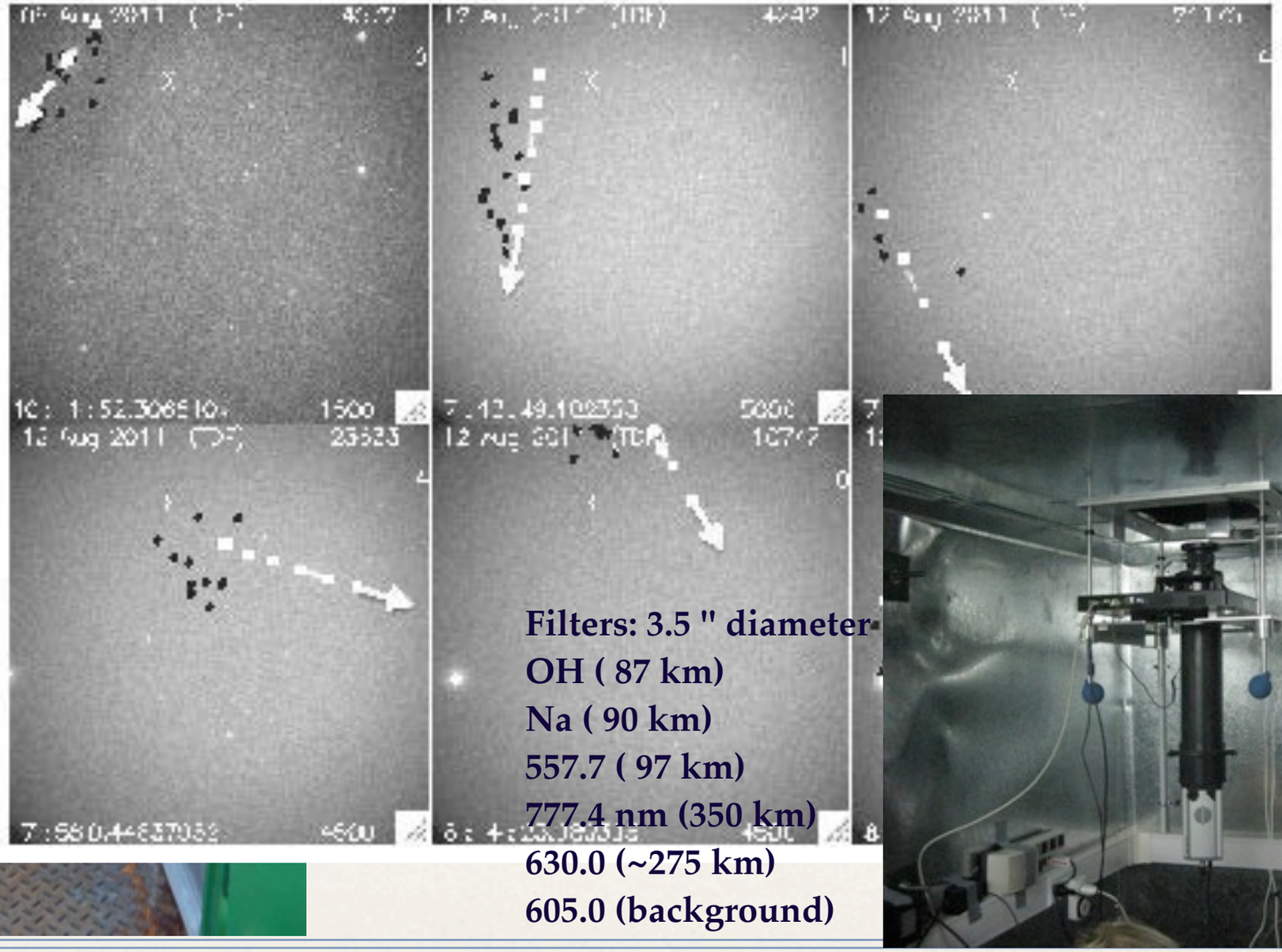
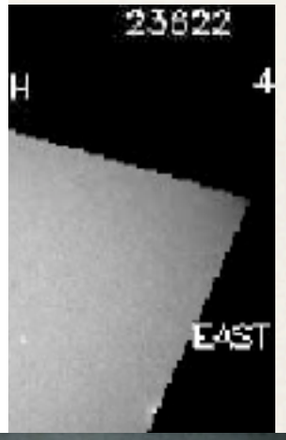
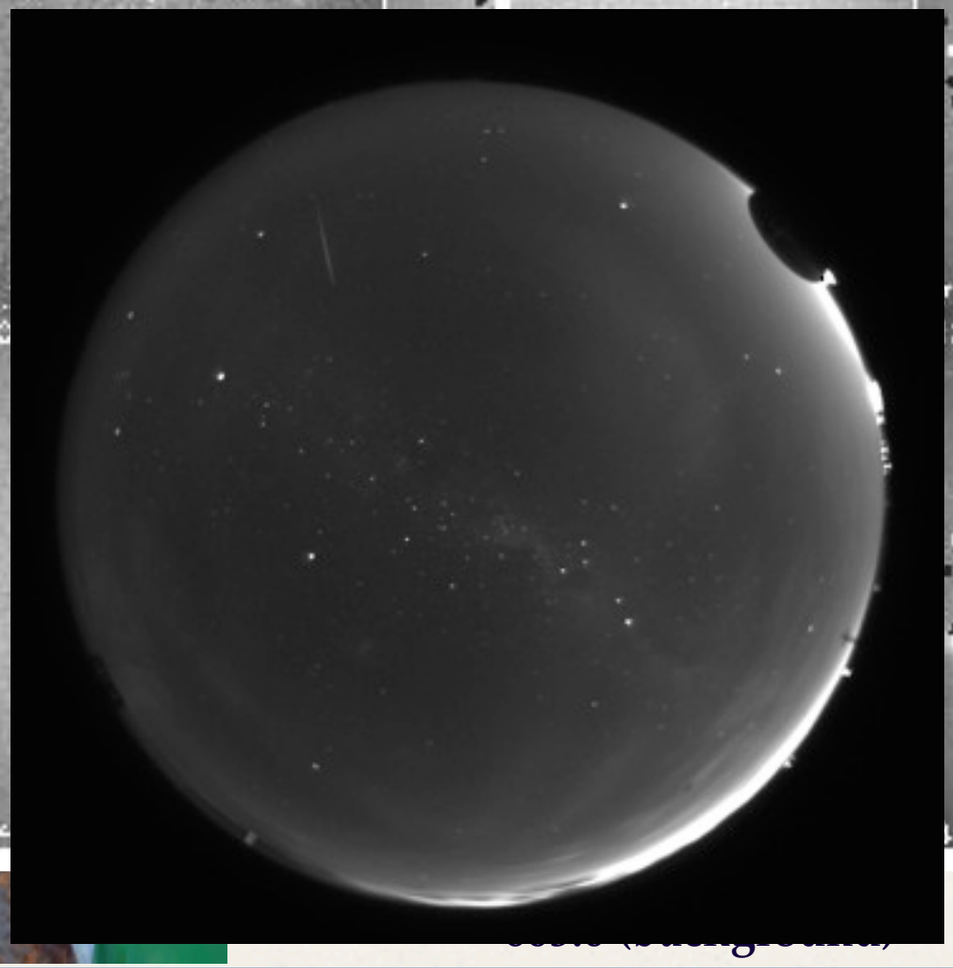
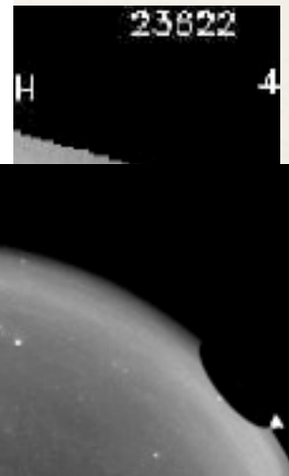




Filters: 3.5 " diameter
OH (87 km)
Na (90 km)
557.7 (97 km)
777.4 nm (350 km)
630.0 (~275 km)
605.0 (background)

SAAMER Remote Sites:
Infrastructure for additional deployments





Conclusions

- SAAMER operational since May 2008, recording ~20,000 events daily
- Four year of data enabled single station meteor shower radiant survey resulting in the identification of 32 showers
- Installation of remote sites in August 2012, fully operational since January 2012, ~2000 daily orbits
- 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
- Base for future deployments