Jicamarca Highlights 2009-2010

J. Chau and A. Calle

Outline

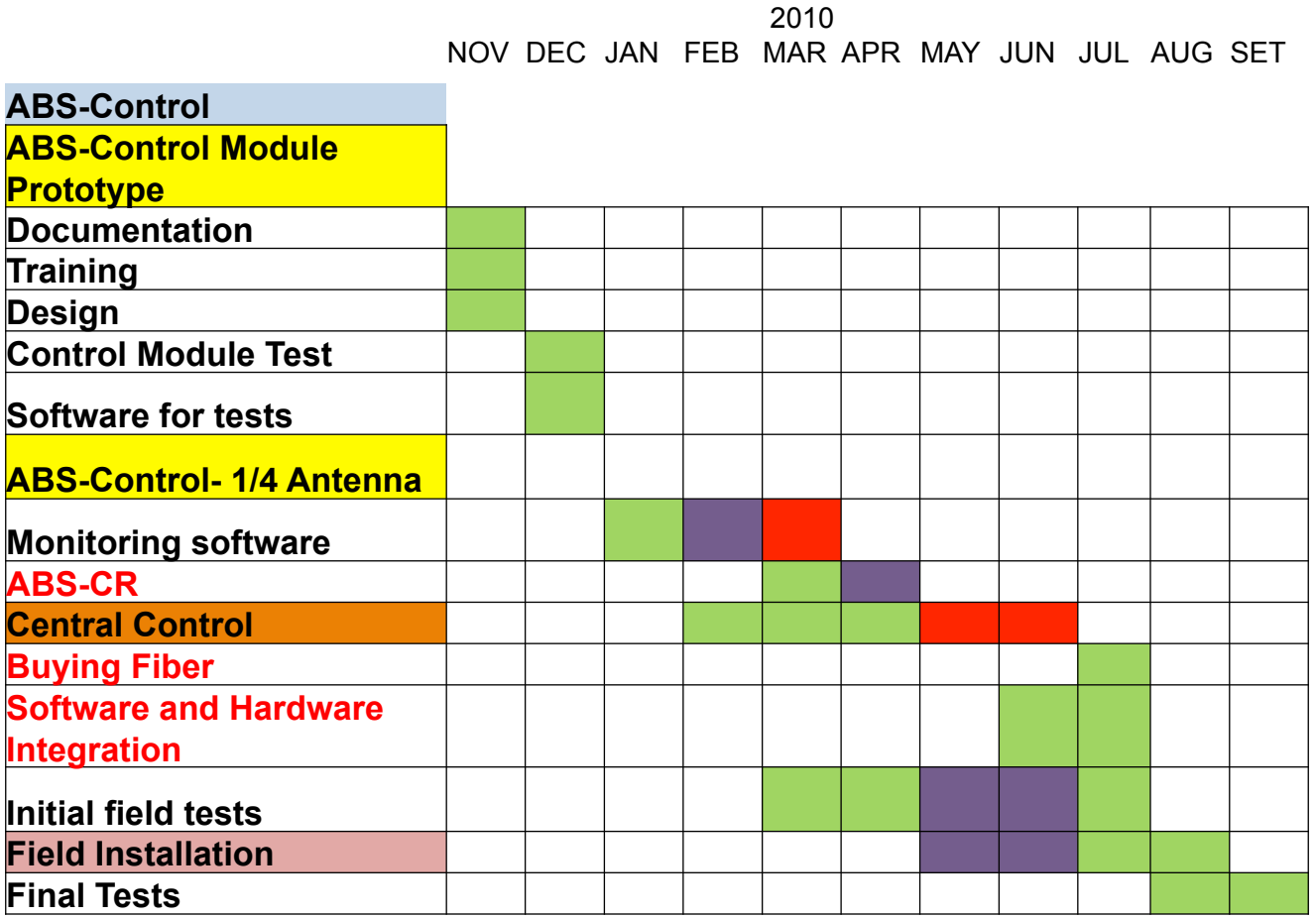
- Major Hardware Improvements
  - Antenna Beam Switching
  - Solid State T/R switch
- Other Radar Developments
- Database/Web Improvements
- Optical Activities
- Radar Operations and Experiments
- Students and Trainees

Antenna Beam Switching (ABS)

Parameter	Current	New
Switching	Manual	Electronic
Quarters	Four	One
Time for switching	2-4 hours	10 ms
Positions	2-bits + 5 for MST	3 bits
Use of Ues	Yes	No
Peak power per module	100 kW	50 kW
Control	Manual	Electronic
Verification	Manual	Electronic

ABS New: Current Deployment

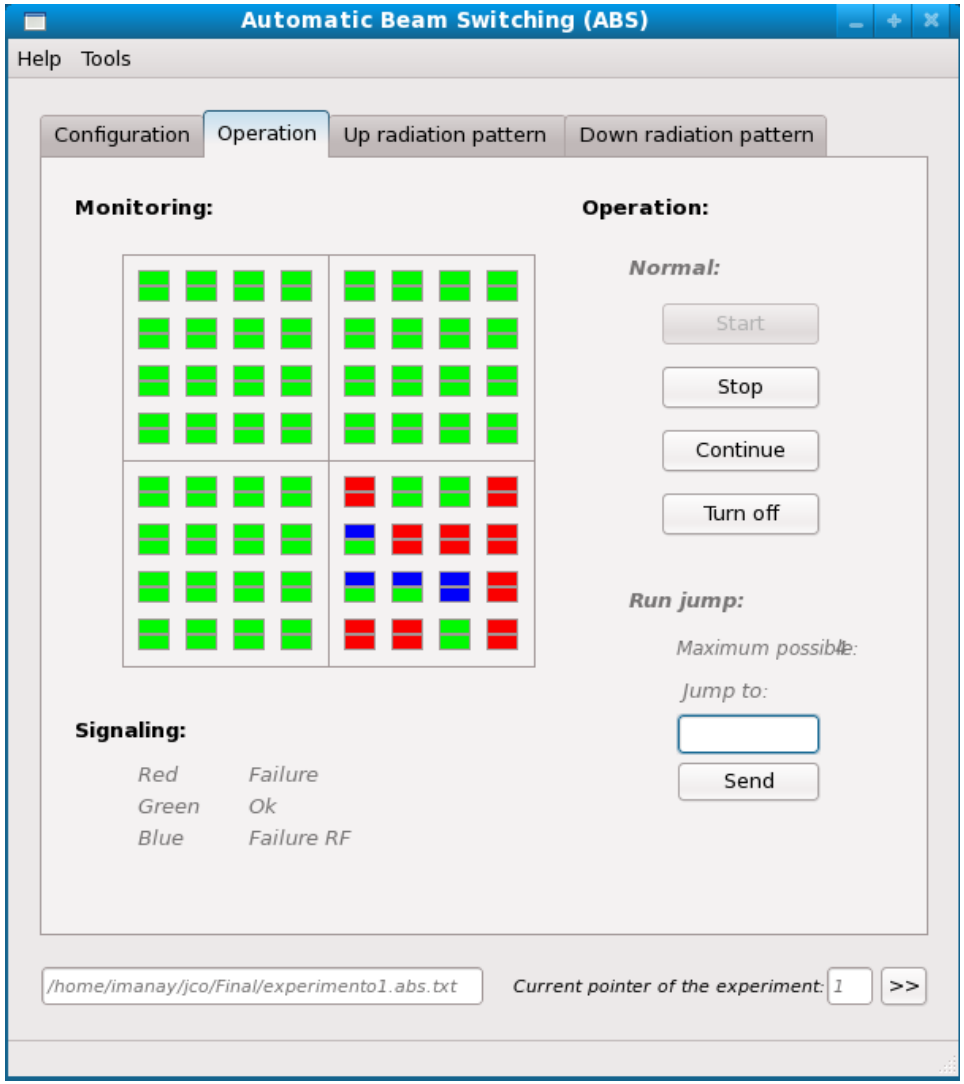
ABS Control – Gantt Diagram



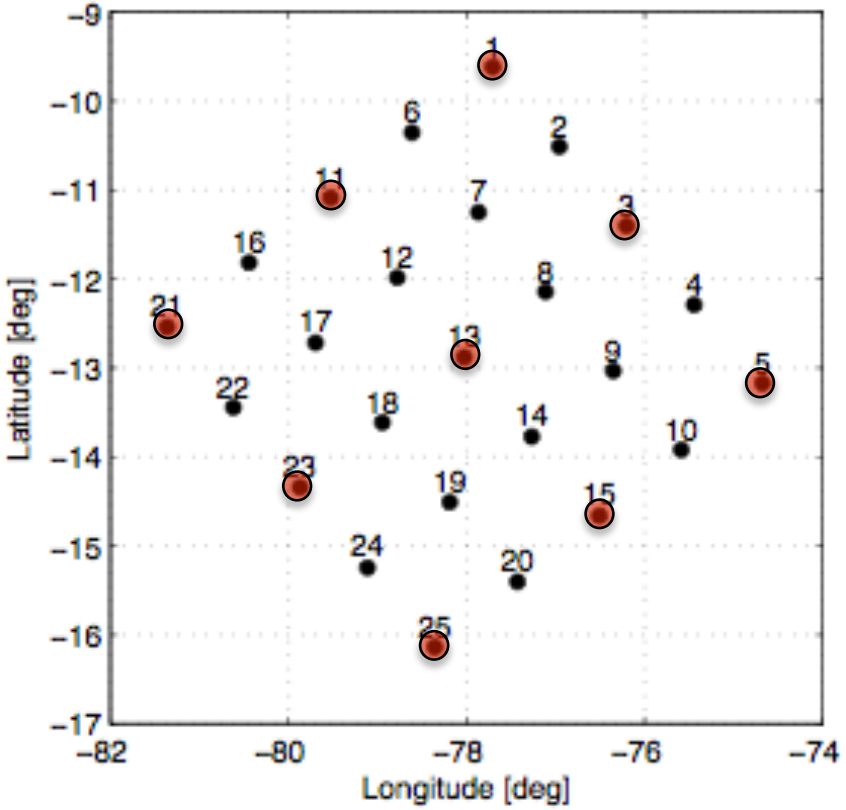
ABS Control: Monitoring Module

Color code:

Green: OK
Blue: Control Pointing failure
Orange: RF Failure
Red: Total failure

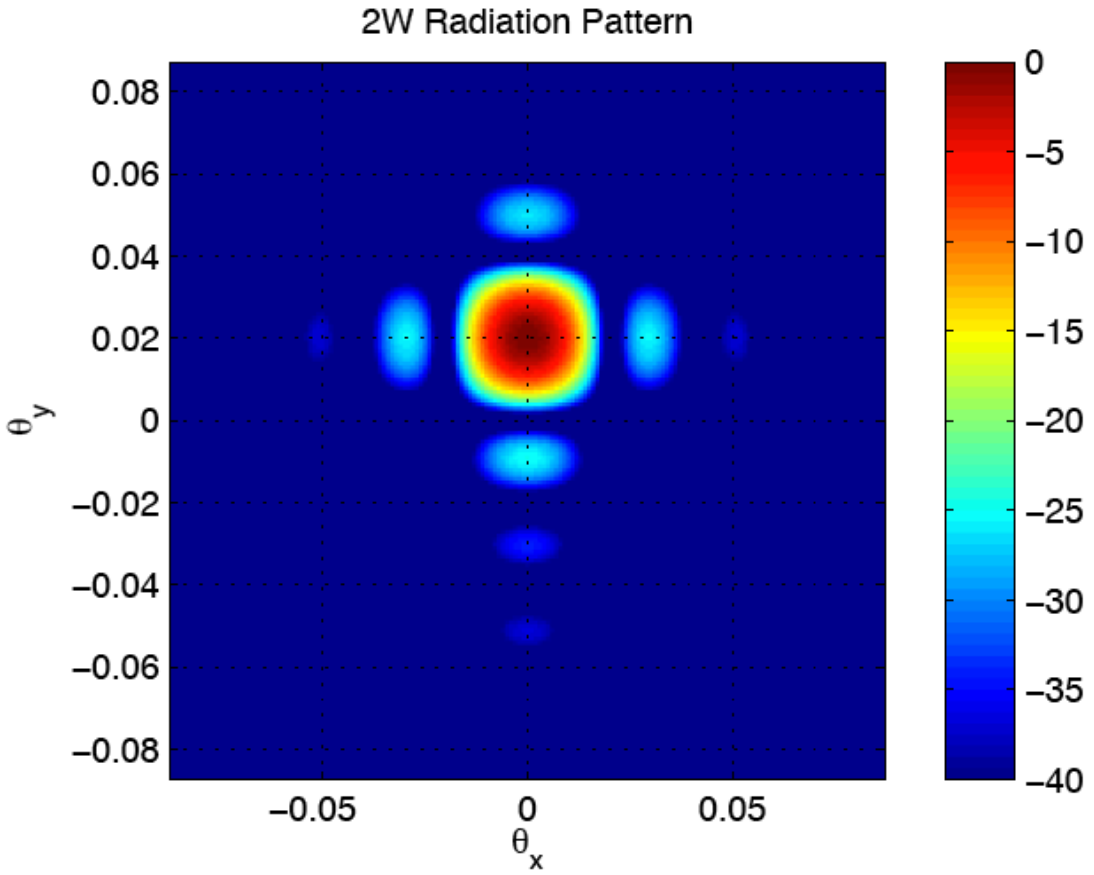


ABS New: Antenna positions



	Declination	Hour Angle	Angle off ⊥	2W-Direc [dB]	ABS [m^2]
1	$-9.62°$	$-3^m20.1^s$	3.27°	85.44	15591.6
2	$-10.51°$	$0^m20.5^s$	2.59°	86.83	21048.6
3	$-11.40°$	$2^m40.4^s$	2.31°	87.29	23369.2
4	$-12.29°$	$5^m42.6^s$	2.59°	86.83	21048.6
5	$-13.17°$	$8^m46.2^s$	3.27°	85.44	15591.6
6	$-10.36°$	$-6^m57.8^s$	2.59°	86.83	21048.6
7	$-11.25°$	$-3^m58.4^s$	1.64°	88.22	28444.2
8	$-12.14°$	$0^m57.6^s$	1.16°	88.69	31593.8
9	$-13.03°$	$2^m4.4^s$	1.64°	88.22	28444.2
10	$-13.92°$	$5^m7.7^s$	2.59°	86.83	21048.6
11	$-11.09°$	$-10^m36.7^s$	2.31°	87.29	23369.2
12	$-11.99°$	$-7^m37.5^s$	1.16°	88.69	31593.8
13	$-12.88°$	$-4^m37.0^s$	0.00°	89.15	35098.5
14	$-13.77°$	$-1^m35.2^s$	1.16°	88.69	31593.8
15	$-14.66°$	$1^m27.8^s$	2.31°	87.29	23369.2
16	$-11.82°$	$-14^m16.8^s$	2.59°	86.83	21048.6
17	$-12.72°$	$-11^m17.9^s$	1.64°	88.22	28444.2
18	$-13.61°$	$-8^m17.7^s$	1.16°	88.69	31593.8
19	$-14.51°$	$-5^m16.2^s$	1.64°	88.22	28444.2
20	$-15.40°$	$-2^m13.4^s$	2.59°	86.83	21048.6
21	$-12.54°$	$-17^m58.2^s$	3.27°	85.44	15591.6
22	$-13.44°$	$-14^m59.5^s$	2.59°	86.83	21048.6
23	$-14.34°$	$-11^m59.6^s$	2.31°	87.29	23369.2
24	$-15.24°$	$-8^m58.4^s$	2.59°	86.83	21048.6
25	$-16.14°$	$-5^m55.9^s$	3.27°	85.44	15591.6

ABS New: Antenna Pattern Example

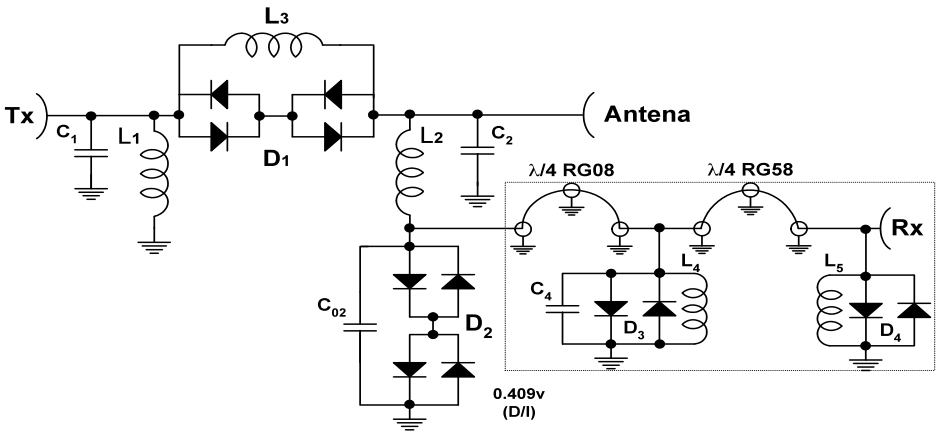


Antenna Position: 8
Longitude: $-77.11°$
Latitude: $-12.14°$
Hour Angle: $0^{m}57.6^{s}$
Angle off $\perp$: $1.16°$
2W-Directivity = 88.69 dB
ABS factor = 31593.8 m^2
Phase Configuration:

3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TR Switch: Solid State

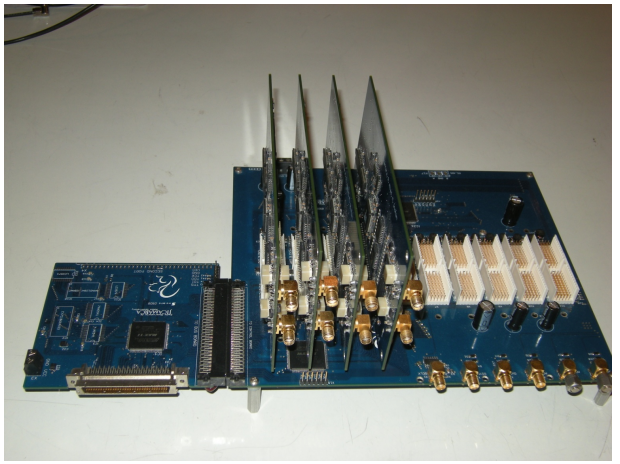
Parameter	Old	New
Technology	“Spark Gaps”	Solid state
Tuning	Manual	None
Isolation Tx/Rx	40 dB	60 dB
Time response	180 ns (b), 2 us (e)	6 ns (b), 0.2 us (e)
Peak Power	1000 kW	800 kW
Duty cycle	6%	6%



August, 2010

Other Radar Developments

- Home made digital receiver (8 channels, 1 MHz each) (JARS 1.0) (see R. Abad's poster)
  - 10 channels under test
  - Internal RFi to be solved.
- Migration of radar software from IDL/C/Fortran to Python (e.g., Over_JRO)
- Optimization of radar Imaging processing software:
  - Modular, Object Oriented
  - Optimization of matrix operations (factor of 3)
  - Use of available CPUs in a single PC



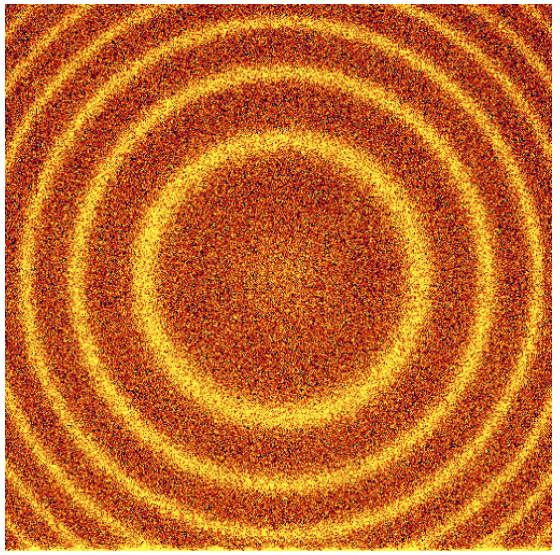
1316 ranges, 4 FFT, 20 s
Before: 225 s
Now (1CPU): 85 s
Now(8CPUs): 12 s
PC: QUAD4, 2000 MHz

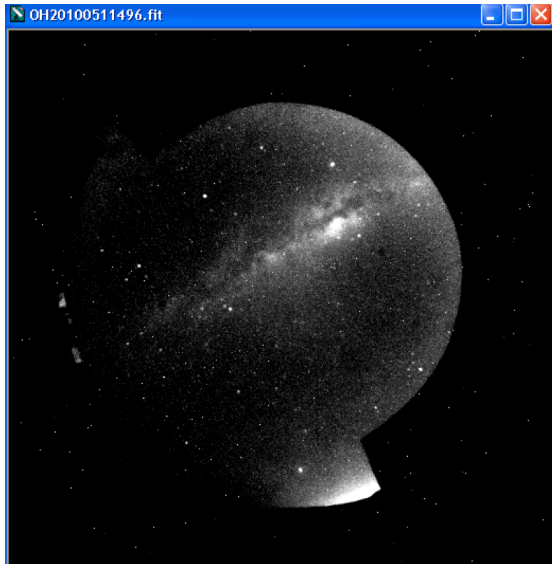
Database/Web Improvements

- Migration of other formats to CEDAR formats and therefore accessible via Madrigal:
  - JULIA ESF,
  - JULIA 150-km
  - Magnetometers
  - Bistatic system
- Web tools to upload data to Madrigal
- Adaptation of Madrigal plotting routines to work with other data formats:
  - wind profiler data.
- Standardization of web programs:
  - SO2
  - empirical drift models, …
- New look for JRO Newsletter: *Inside Jicamarca*
- Web cams for security (e.g., MeriHill Observatory)

Optical Activities

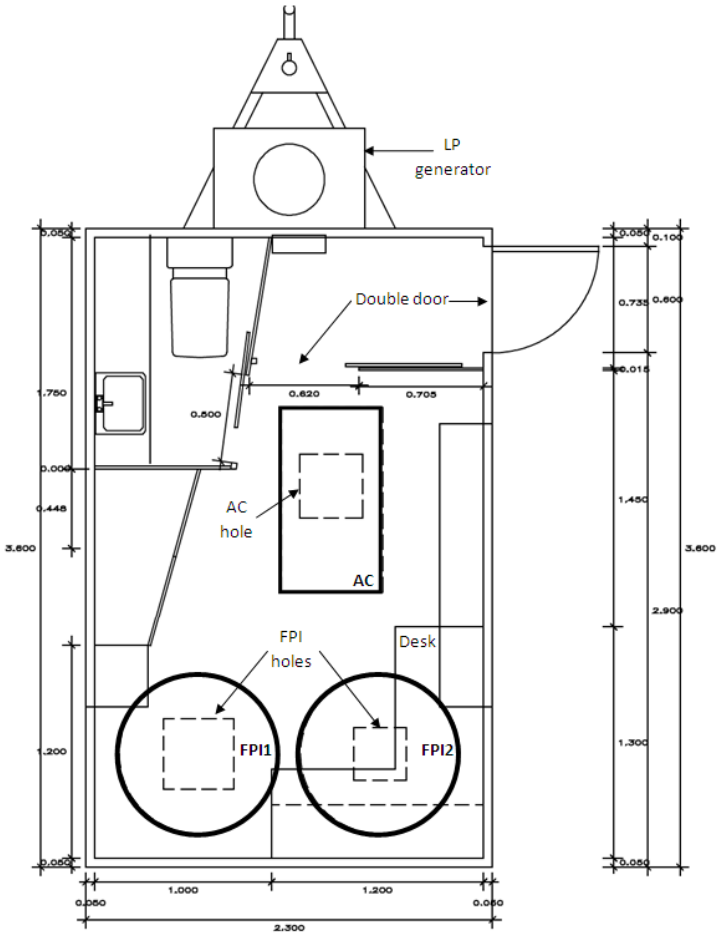
- Opening of MeriHill Observatory (Aug 15 2009):
  - MRH-FPI (F region filter) (see L. Navarro poster)
  - All-sky Imager – Mesospheric filter (UIUC)
- Operation of Arequipa FPI
- Miscellaneous tests of Huancayo FPI: SOFDI
- Portable FPI (under construction)





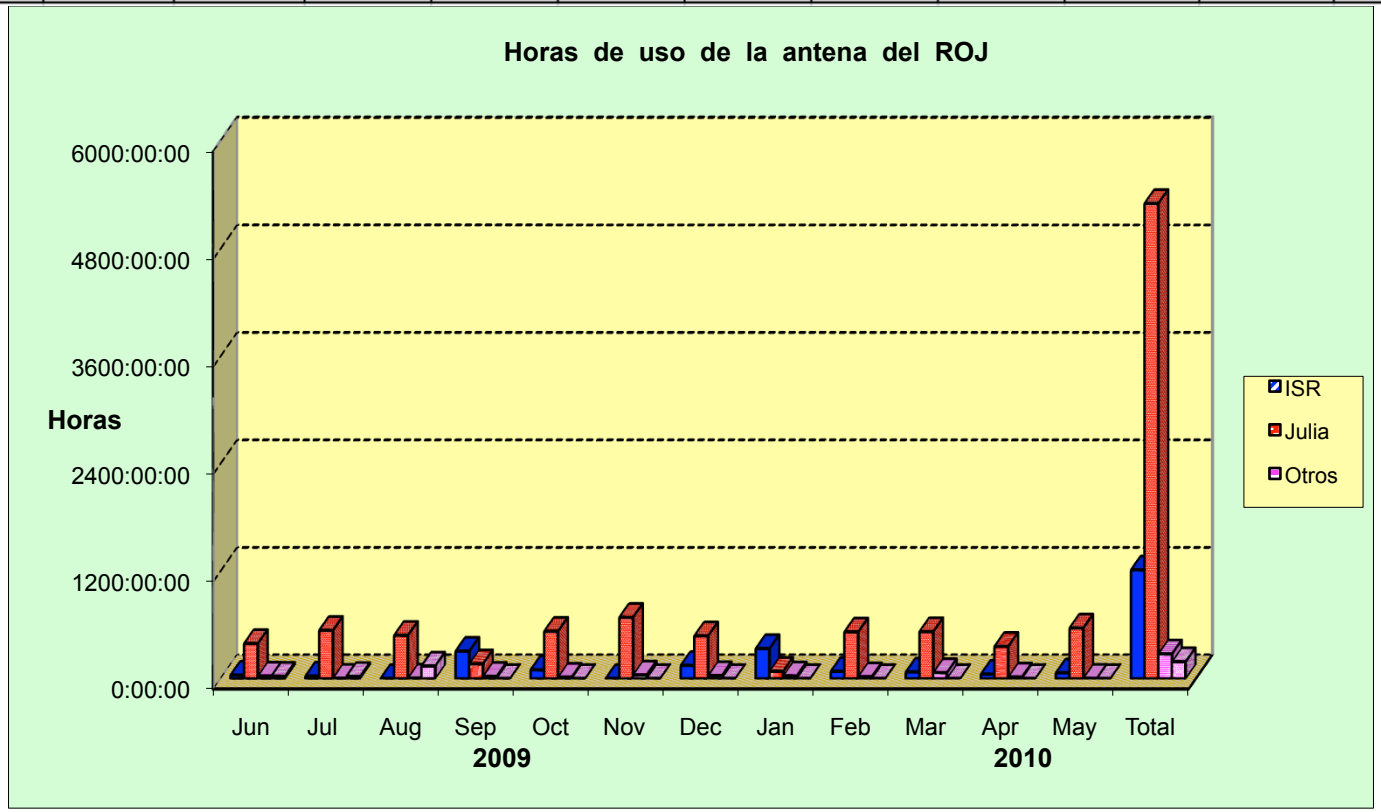
MeriHill Observatory: New road

Portable FPI: Trailer

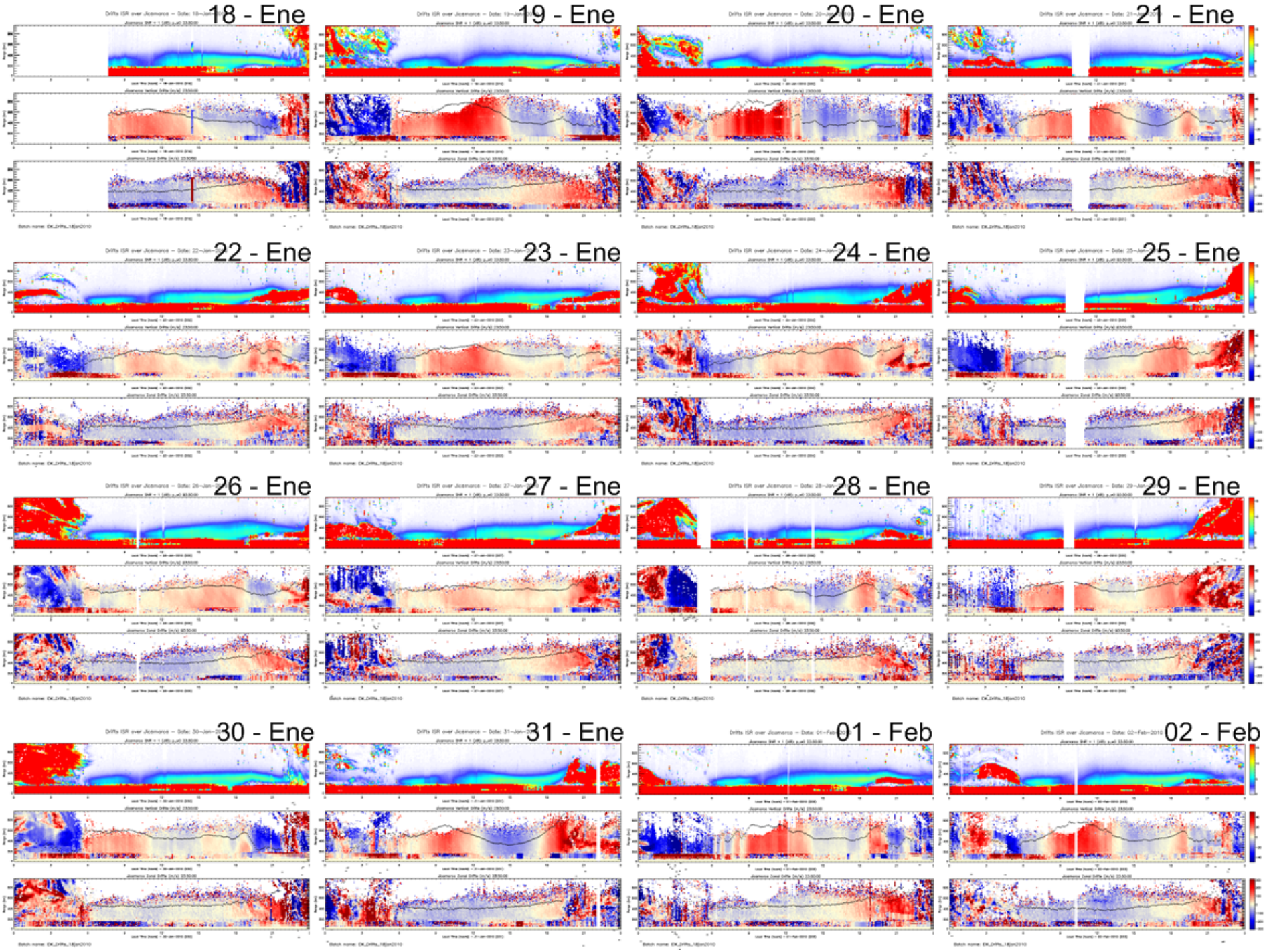


Radar Operations 2009-2010

	2009							2010					
Exp	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
ISR	37:40:00	27:50:00	0:00:00	306:00:00	96:25:00	0:00:00	145:45:00	334:05:00	80:00:00	73:15:00	48:05:00	63:35:00	1212:40:00
Julia	390:10:00	536:35:00	482:10:00	164:05:00	527:45:00	682:40:00	475:25:00	80:50:00	520:50:00	522:50:00	358:20:00	563:20:00	5305:00:00
Otros	27:10:00	2:00:00	4:45:00	23:35:00	15:25:00	39:40:00	31:25:00	28:30:00	19:15:00	64:45:00	16:30:00	1:35:00	274:35:00
Otros pas.	25:10:00	23:00:00	139:10:00	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	187:20:00
	480:10:00	589:25:00	626:05:00	493:40:00	639:35:00	722:20:00	652:35:00	443:25:00	620:05:00	660:50:00	422:55:00	628:30:00	6979:35:00



(ISR includes SSW support for 16 consecutive days)


18 - Ene
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28 - Ene
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31 - Ene
01 - Feb
02 - Feb

2009-2010 Experiments

User	Institution	Time	Topic
C/NOFS	Various	Many	CALVAL
S. González	Arecibo	Oct 2010	Topside Arecibo and Jicamarca
J. Mathews	PSU	Apr 2010	Long pulse meteor observations
D. Scipión	OU	Jan 2010	High res. ST winds and turbulence
B. Isham	IAI/PR	July 2009	Orbital Angular Momentum EEJ
J. Meriwether	Clemson	Various	ISR and FPI runs to compare Temperatures and Zonal drifts
T. Grydeland, B. Gustavsson	Norway	Sep 2009	Orthogonal Polarization Alt. Code
D. Hysell	Cornell	May/Jun 2010	OPAC+Long Pulse Full Profile
L. Goncharenko/B. Fejer	MHO/USU	Jan 2010	Strat warm campaign (16 days)
R. Woodman	IGP	Various	Jupiter Passive Radio Studies
J. Chau/D. Hysell	JRO/Cornell	> Nov 2009	JULIA-Imaging experiments

(in addition to World days, JULIA, JASMET)

Student Projects: 2009-2010

Student	Advisor	Degree/Inst.	Topic
M. Milla	E. Kudeki	Ph.D./UIUC	Perpendicular to B ISR Parameters
M. Olsen	B. Fejer	Ph.D./USU	Strat Warming and ExB drifts
P. Reyes	E. Kudeki	Ph.D./UIUC	Mesosphere/150-km/Perp. B
E. Bass	M. Oppenheim	Ph.D./BU	Multi-meteor echo studies and masses
R. Ilma	M. Kelley	Ph.D./Cornell	EEJ Studies
F. Galindo	J. Urbina	Ph.D./PSU	Meteor-head studies
Z. Li	A. Gerrard	Ph.D./NJIT	Stratospheric gravity waves
R. Varney *	M. Kelley/D. Hysell	Ph.D./Cornell	Topside Temperature modeling + ISR drifts
E. Dao	M. Kelley	Ph.D./Cornell	C/NOFS-JRO ExB drifts
H. Aveiro	D. Hysell	Ph.D./Cornell	3D ESF Modeling
D. Scipion	P. Chilson	Ph.D./OU	Lower atmosphere turbulence and winds
H. Pinedo	J. Chau	M.S./PUCP	Beam forming EEJ clutter
G. Sugar	M. Oppenheim	B.S./BU	Turbulence meteor trail echoes
N. Yoza	J. Chau	B.S./PUCP	EEJ Communications

International Student Programs

Lais Guizelli
Electrical Engineering
University of Taubaté (UNITAU)
Brazil
(JIREP): EEJ Spectral Fitting

Gabrielle Hellio
Geophysics
Strasburg University
France
(Geomagnetism Trainee)

Alex Chartier
Mechanical Engineering
University of Bath
UK
(JIREP): GPS TEC and Modelling

Alba Ordoñez
Geophysics
Strasburg University
France
(Geomagnetism Trainee)

Juha Vierinen
Computer Science
Helsinki University of Technology
Finland
(JIREP): Radar Techniques for Meteors and space debris

Christoph Scheidiger
Electrical Engineering
U. of Applied Sciences North-Western Switzerland
(IAESTE): Electronic Development