



The Jicamarca Radio Observatory

J. L. Chau, D. T. Farley, D. L. Hysell, W. E. Swartz

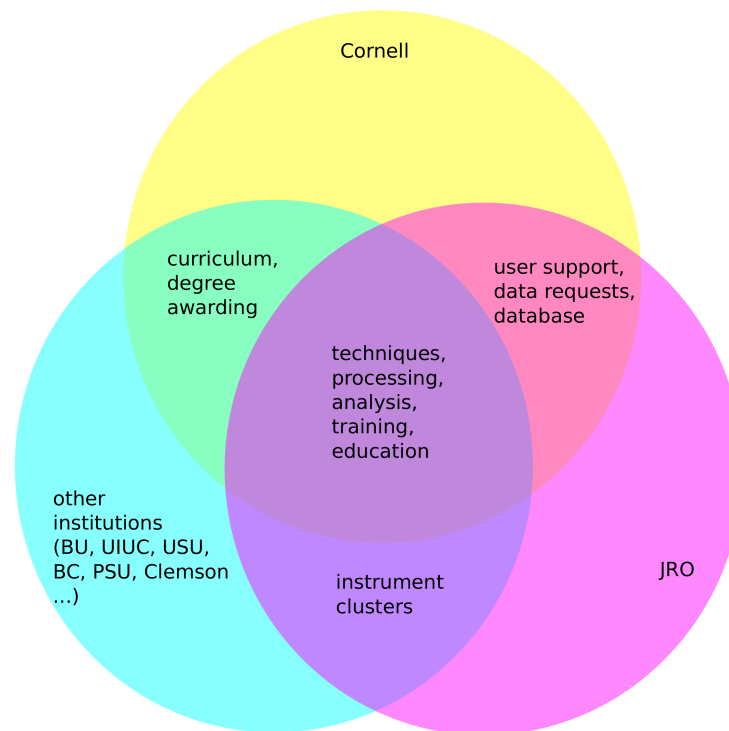
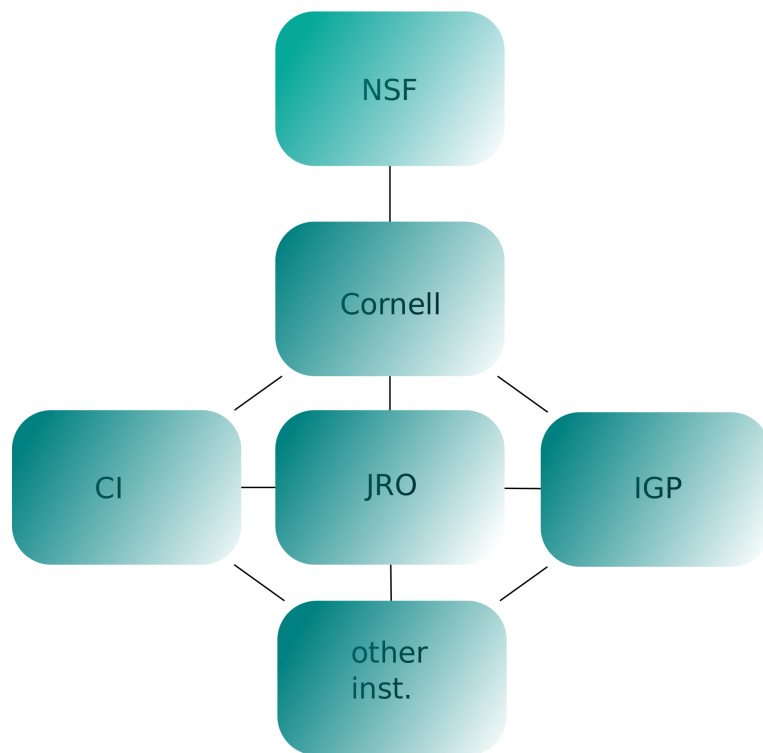
Instituto Geofísico del Perú, Lima

Cornell University, Ithaca, NY

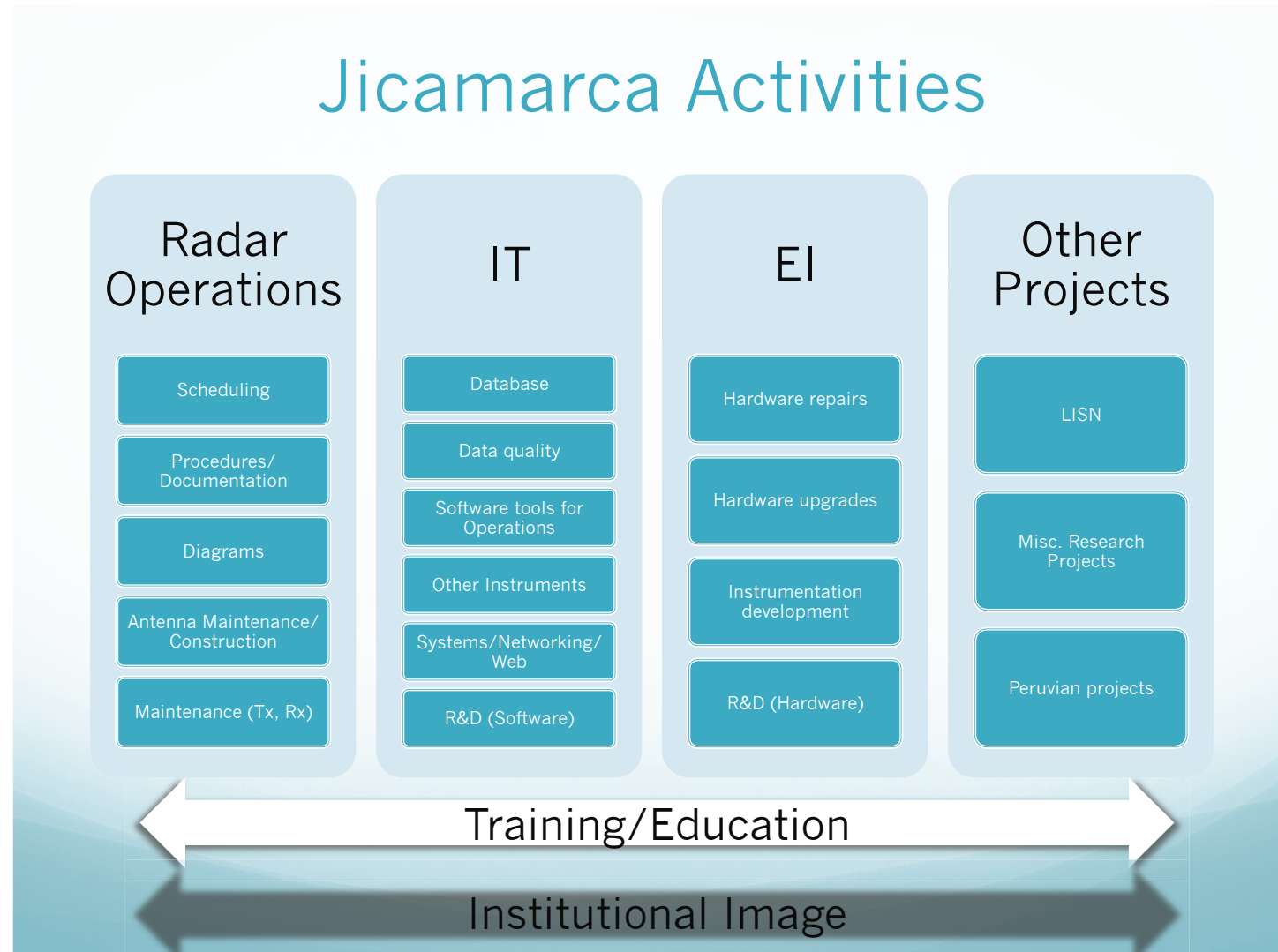
The Jicamarca Radio Observatory was constructed over four decades ago to study the ionosphere using emerging theories of the incoherent scattering of radiation by plasmas. It exists today with the mission of

- deepening our understanding of the equatorial and low-latitude atmosphere and ionosphere and the systems to which they are coupled
- fostering the creation of avant-garde radar and radio remote sensing techniques
- training and educating new generations of space physicists and radio scientists and technicians
- expanding its own capabilities through upgrade and invention, and increasing its influence internationally.

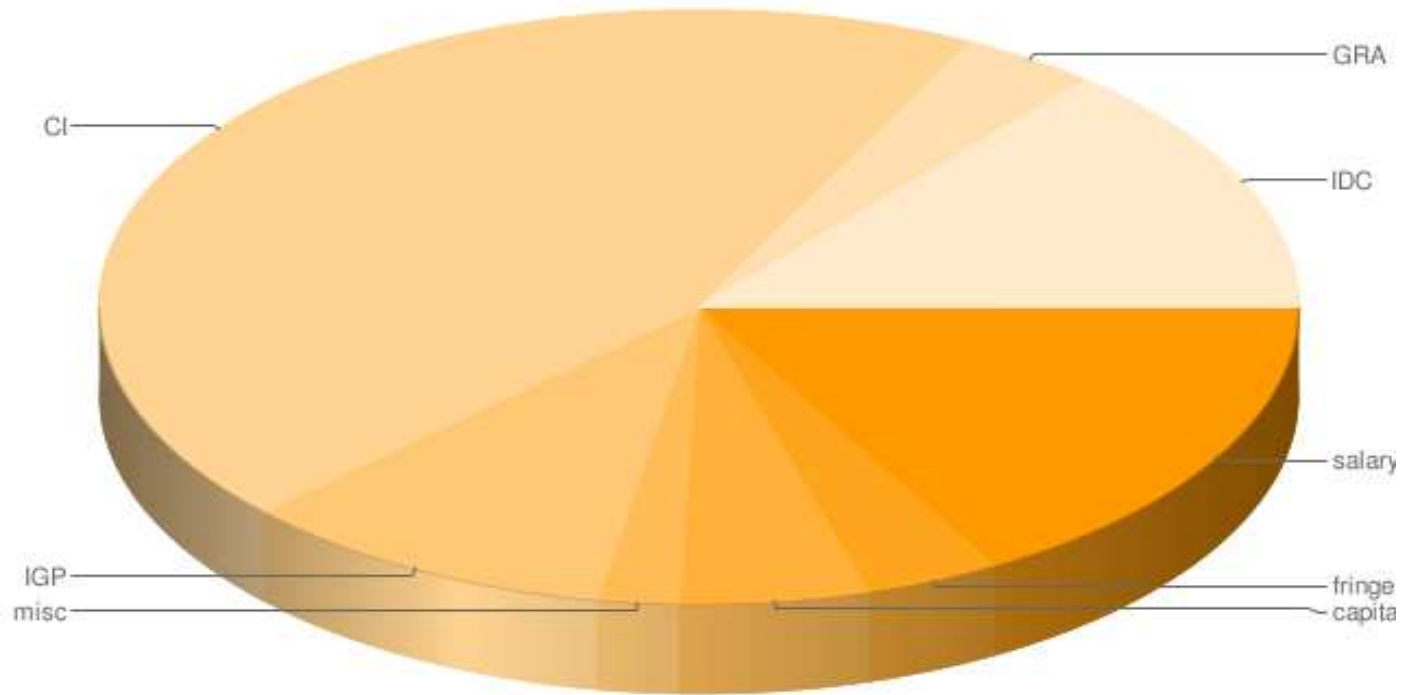
organization



Jicamarca Activities



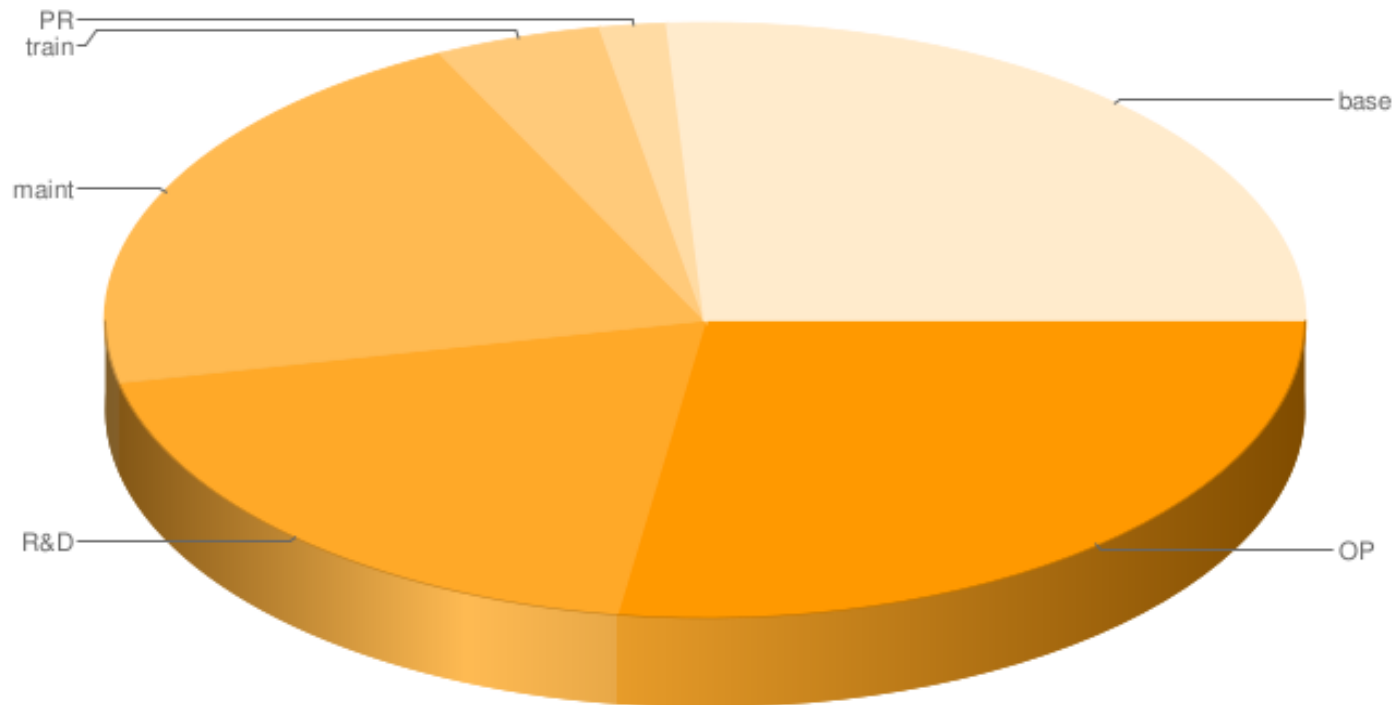
'09 budget



budget challenges

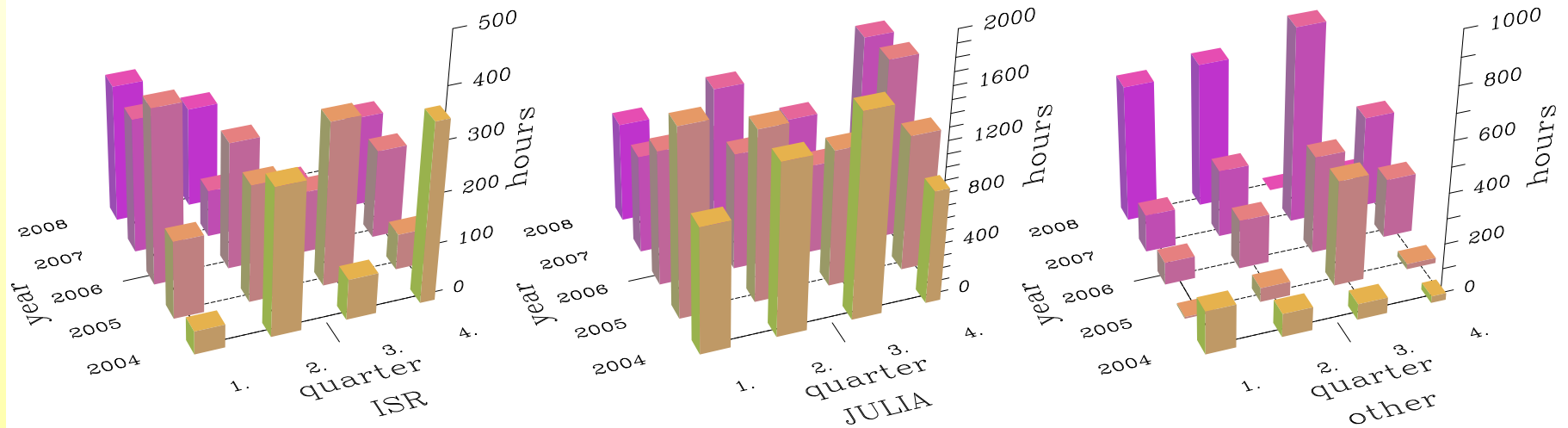
- Cornell IDC, GRA formulas increasing

local budget



budget challenges

- exchange rate (2004–2008 17% decline)
- fuel costs (transportation)
- wage inflation



- On track for 6300 hours in 2008!
- “Other” includes aspect sensitivity and imaging, meteor heads, multistatic meteors, JASMET, solar echoes, passive modes, tests, skymaps.

instrument cluster

Instrument	Institution	Site	Misc.
JULIA	JRO	Jicamarca	many antenna arrays
scintillation Rx	AFRL	Ancon	S4, irregularity drifts
digisonde	AFRL	Jicamarca	Ne
magnetometers	JRO	Jicamarca, Piura	ΔH
ST radars	IGP, UDEP	Northern Peru	winds and turbulence
FPI	Clemson	Arequipa	nighttime winds and temps.
FPI SOFDI	Clemson, UNJ, IGP	Huancayo	24-hr winds and temps.
SOUSY radar	JRO	Jicamarca	high res., low alt. winds
AMISR proto.	SRI, JRO	Jicamarca	EEJ, ESF, meteor echoes at UHF
LISN	BC, IGP	South America	TEC, S4, irregularity drifts, ΔH
JASMET	JRO, ATRAD	Jicamarca	specular meteor radar (50 MHz)
oblique	JRO	Jicamarca	MLT winds, EEJ
bistatic	JRO	JRO/Paracas	Daytime E-region Ne

upgrades, maintenance

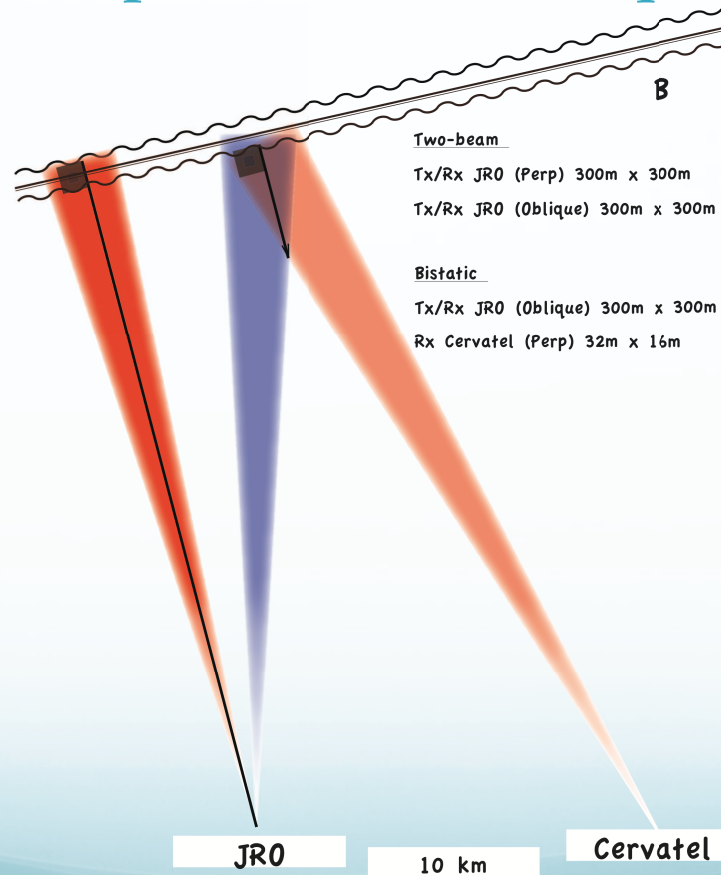
component	description	comment
main antennas	quarterly maintenance	dipoles, feed points
other antennas	new Yagi modules	150-km tristatic, meteor bistatic
T/R switches	medium power passive	replacing old spark gaps
Txs	solid-state low power driver	improved bandwidth (1 μ s)
Tx power supply	from 17 to 20 kV	improved avg. power, shape
Rxs	6 echotek + 2 homebrew	improved dynamic range, throughput, I/Q
radar controller	FPGA based	8/16 line version with GPS sync, ext. clock
DDS	AD based + μ Controller	multifrequency pulse-to-pulse

- no single-point failures

JRO improvements 2007-8

- Averaged transmitter power for two transmitters improved from ~65 kW to ~100 kW (improvement in Power supply from 17 kV to 20 kV) [O. Castillo et al.]
- Development and construction of magnetometers [O. Veliz et al.]
- Multi-static capabilities using digital receivers [K. Kuyeng et al.]
- Development of 100 kW passive T/R switches [F. Villanueva et al.]
- Development of a 16-line radar controller [J. Muñoz]
- Development of Strategic plan for Management and Operations (help from consultants)
- **Electronic beam steering**

150-km Experiments: Oblique vs. Perp.



technique development

- Hybrid ISR modes + full-profile analysis
- Radar imaging improvements: full-covariance, different receiving antennas, automatic calibration, code simplification and optimization
- Satellite (outlier) removal improvement using order statistics
- Improved noise estimation
- Meteor-head detection.
- JASMET
- Zonal drifts from 150-km echoes
- FPI analysis using 2D approach

Jicamarca experiment support

To improve operations and ensure data quality, starting in 2008, each experiment has an assigned local expert, responsible for:

- interacting with the end user and/or the Jicamarca Director to define experiment parameters, programs, and schedule
- coordinating with the Chief of Operations the experiment parameters and on-line tools
- approving the experiment configuration and performing test runs
- inspecting the first-look data quality
- processing the data and verifying data quality (routine experiments)
- uploading processed data to databases (routine experiments)
- developing tools for on- and off-line processing

experiment support

Mode	Local Expert	Area	End User
ISR oblique	L. Condori	IT	D. Hysell, J. Meriwether, C/NOFS, CITRIS
ISR perp	F. Galindo	IT	E. Kudeki et al., C/NOFS
JULIA	H. Pinedo	IT	many
bistatic	H. Pinedo	IT	D. Hysell, M. Nicolls, P. Strauss
150-km drifts	H. Pinedo	IT	D. Anderson, B. Fejer, others
BLR	L. Flores	IT	IGP
MST-ISR	K. Kuyeng	IT	E. Kudeki, G. Lehmacher, et al.
LISN ionosonde	C. De. la Jara	EL	T. Bullet, B. Livingston, C. Valladares, J. Chau
AMISR	F. Galindo	IT	D. Hysell, R. Cuevas, D. Scipion
JASMET	L. Condori	IT	L. Guo, D. Holdsworth, G. Lehmacher
meteor heads	F. Galindo	IT	J. Chau, M. Oppenheim, J. Mathews et al.

2007–8 campaigns

User	Institution	Time	Topic
C. Siefring, P. Bernhardt	NRL	Jul 2007	CITRIS cal.
M. Oppenheim, E. Bass	BU	Jul 2007	meteor heads (6 rx, 2 pol)
C. La Hoz/ V. Belyey	U. Tromsø	Jul 2007	150-km 3D imaging
J. Chau/ M. Oppenheim	JRO/BU	Sep 2007	Aurigids shower
J. Chau/ M. Oppenheim	JRO/BU	Sep 2007	bistatic meteors (heads & trails)
M. Milla/ E. Kudeki	UIUC	Apr 2008	bistatic 150-km (oblique vs. perp)
D. Hysell	Cornell	May 2008	oblique ISR
C/NOFS EWG	AFRL et al.	June 2008	vertical & zonal drifts
E. Kudeki/ P. Reyes	UIUC	June 2008	3-beam ISR
L. Guo/ G. Lehmacher	Clemson	monthly	JASMET (mesospheric winds)

● excludes World Days, low-power, passive, etc.

visitors 2007–8

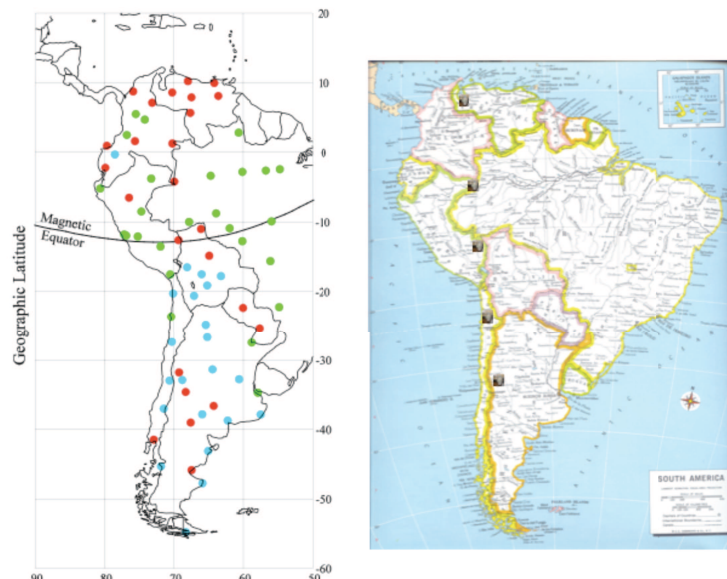
- July 2007: M. Oppenheim. Boston University
- August 2007: J.-P. St. Maurice. University of Saskatchewan
- January 2008: A. J. Gerrard. New Jersey Institute of Technology
- February 2008: J. Estela. German Spacial Agency
- March 2008: V. Belyey, C. La Hoz. University of Tromsø
- March 2008: M. Milla. University of Illinois
- April 2008: D. Hysell. Cornell University
- June 2008: B. Livingston, T. Bullet, C. Valladares, R. Grubb. LISN
- June 2008: E. Kudeki. University of Illinois

– Visitors quarters, office, computer, wireless, meals, transportation

LISN: Jicamarca role

- Overall management of instrument deployment, operations, database [E. Silvestre, J. Chau]
- Development of affordable magnetometers [O. Veliz et al.]
- Prototyping and testing ionosonde, antenna
- Importing, deploying equipment
- Feasibility study of E region density measurements around twilight with LISN ionosondes [R. Woodman, C. de la Jara]

LISN Instruments



- COSMIC O. de la Beaujardiere et al., G. Bust et al.
- DMSP (SSUSI, SSULI) J. Makela, P. Strauss, R. Heelis
- CITRIS C. Siefring, P. Bernhardt
- C/NOFS (CalVal, science) AFRL, EWG
 - electron density profiles
 - electric fields and drifts
 - temperature and composition
 - GPS radio occultation
 - radio beacon scintillation, tomography
 - ESF occurrence, behavior

database(s)

Mode	CEDAR	Madrigal	JRO web	JRO internal	other
ISR oblique	Ne Te Ti %	Ne Te Ti %	Ne Te Ti %	raw data	Cornell
ISR perp	drifts	drifts	drifts	raw data	Illinois
JULIA			SNR, drifts	spectra	Cornell
bistatic	E Ne	E Ne	E Ne	spectra	
150-km	drifts		drifts	spectra	Cornell
BLR			winds	ACFs	
Digisonde			ionograms	ionograms	Lowell
mags			ΔH	1-min	

- GPS, other
- useful online programs (sky noise, antenna patterns, indices)
- http://jro.igp.gob.pe/english/database_en.html

Jicamarca real time

- Depending on the mode:
 - averaged spectra and cross-spectra for selected pairs of channels
 - range-time plots of selected parameters: SNR, coherence, phase difference
 - range-time and averaged plots of derived parameters: vertical and zonal drifts
 - multi-radar plots, e.g., JULIA and bistatic
- electronic log-book for Jicamarca staff or external user

<http://jro.igp.gob.pe/english/radar/operation/real-time-en.php>

scheduling

http://jro.igp.gob.pe/DB_Admin/JRO_Schedule/Sc...

July 2008
[Today](#)

M. Y.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
29 (181) <-> JULIA.	30 (182) <-> JULIA.	1 (183) <-> JULIA.	2 (184) <-> JULIA.	3 (185) <-> JULIA.	4 (186) <-> JULIA.	5 (187) <-> JULIA.
6 (188) <-> JULIA.	7 (189) <- 8 JULIA.	8 (190) 8-> IS COD.	9 (191) <-> IS COD.	10 (192) <-> IS COD.	11 (193) <-> IS COD.	12 (194) <-> IS COD.
13 (195) <- 8 IS COD.	14 (196) 10-15 D & F.	15 (197) 10-15 D & F.	16 (198) 10-15 D & F.	17 (199)	18 (200)	19 (201) 0-> C-NOF.
20 (202) <-> C-NOF.	21 (203) <- 24 C-NOF.	22 (204) 8-> JULIA	23 (205) <-> JULIA	24 (206) <-> JULIA	25 (207) <-> JULIA	26 (208) <-> JULIA
27 (209) <-> JULIA	28 (210) <-> JULIA	29 (211) <-> JULIA	30 (212) <-> JULIA	31 (213) <-> JULIA	1 (214) <-> JULIA	2 (215) <-> JULIA
3 (216) <-> JULIA	4 (217) <-> JULIA	5 (218) <-> JULIA	6 (219) <-> JULIA	7 (220) <-> JULIA	8 (221) <-> JULIA	9 (222) <-> JULIA

Welcome to the JRO Schedule

Click on a day or particular task for a detailed description.

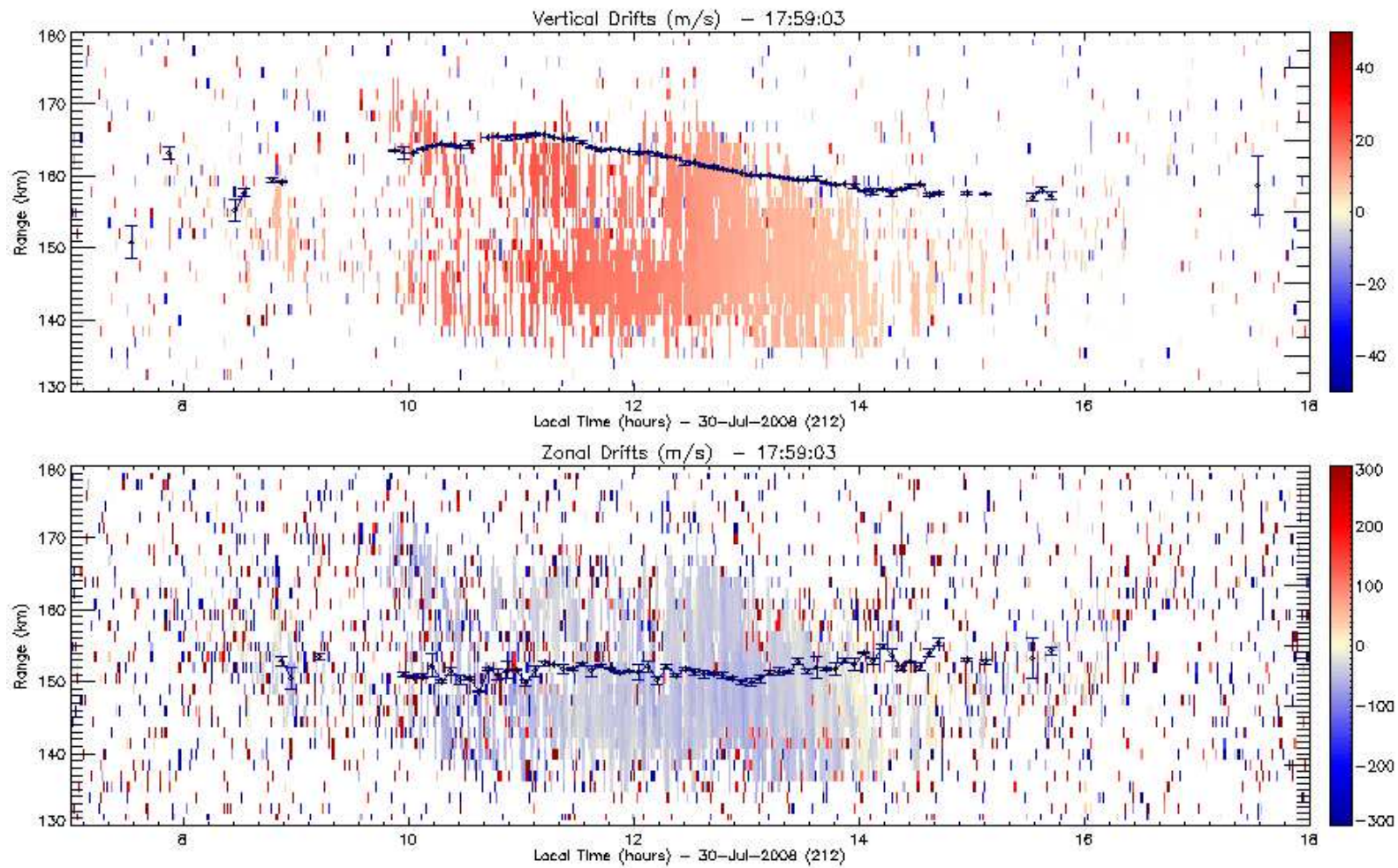
Types of tasks

- Jicamarca
- JULIA
- Maintenance
- SOUSY
- AMISR
- Bistatic System
- Antennas
- JASMET
- Other

The first 3 symbols or numbers show the starting and ending hour of a task on a particular day.
Examples:

- 6 - 8 the task starts at 6 am. and ends at 8 am.
- 7 - 14 the task starts at 7 am. and ends at 2 pm.
- 5 - > the task starts at 5 am. and continues through the next day.
- < - 20 the task has been executed since the day before and will end at 8

JRO Drifts from 150km echoes - Date: 30-Jul-2008



publications

- about 120 JRO publications since start of 2005, 160 since 2004
- about 25 of these theses
- over 50 distinct first authors, not counting theses
- Special issue of JASTP November 2004

2007–8 student support

Student	Advisor	Degree/Inst	Topic
M. Milla	E. Kudeki	Ph.D./UIUC	perpendicular ISR parameters
F. Rodrigues	D. Hysell	Ph.D./Cornell	oblique ISR parameters
P. Reyes	E. Kudeki	Ph.D./UIUC	mesosphere/150-km/perp B
E. Bass	M. Oppenheim	Ph.D./BU	meteoroid mass from heads
A. Malhorta(*)	J. Mathews	Ph.D./PSU	meteor heads, trails, spE
L. Guo(*)	G. Lehmacher	Ph.D./Clemson	“ignorosphere” parameters
R. Ilma	M. Kelley	Ph.D./Cornell	EEJ anomalous resistivity
G. Sugar	M. Oppenheim	B.S./BU	day/night trail differences
S. Flores	J. Chau	M.S./PUCP	FPI 2D anal.
N. Yoza	J. Chau	B.S./PUCP	EEJ communications
H. Pinedo	J. Chau	M.S./PUCP	high-resolution spectral techniques

- +observatory visits
- +9 additional Peruvian students

International Research Experience Program

Student	“Summer”	Degree/Inst	Topic
A. Malhorta (*)	2006	Ph.D./PSU	meteor heads, trails, and spE
L. Tracy	2006	B.S./U. W.	multifrequency DDS, passive radar
M. Mercado	2007	M.S./Polytechnic U. (PR)	WWW display tools for imaging
L. Guo (*)	2007	Ph.D./Clemson	“ignorosphere” parameters
R. Varney	2008	B.S./Cornell	<i>D</i> region experiments: ISR and CSR
B. Etzlinger	2008	B.S./Johannes Kepler	GPS disciplined clock, up-converter, filter

training/ career development

- Peruvian trainee program (2004-2008)
 - 5 trainees at the time for 3-6 months
 - 6 engineering theses
 - 3 M.S. students in Peruvian universities
 - 6 Ph.D. students in U.S. universities: Cornell (2), U. Illinois (2), U. T. Dallas (1), Oklahoma Univ. (1)
- Jicamarca International Research Experience
 - 2 Ph.D. students with Jicamarca research topics (4 papers)
 - 1 M.S.
 - 3 B.S
- Postdoc studying equatorial aeronomy at Cornell with support from Japan

JRO staff at international meetings

Name	Meetings	Now
M. Milla	CEDAR '03–'08, ISEA 11/12, MST10, USRIGA '08	Ph.D. UIUC
D. Scipion	CEDAR '04–'08, ISEA 11, MST10, tropo	Ph.D. Oklahoma
R. Ilma	CEDAR '05–'08, IRI '06, URSIGA '05, ISEA 12	Ph.D. Cornell
P. Reyes	CEDAR '06–'08, ISEA 12	Ph.D. UIUC
F. Galindo	CEDAR '06, ISEA 12	Phys. JRO
H. Pinendo	CEDAR '07, ISEA 12, URSIGA '08	Eng. JRO
K. Kuyeng	CEDAR '06–'07, EISCAT '07	Eng. JRO
C. Dela Jara	App. Comp. EM '08 (Canada)	Eng. JRO
O. Veliz	Magnetism School '04/'07 (Mexico)	Sen. Tech. JRO
J. Muñoz	IBER CHIP '08 (Mexico)	M.S. Brazil
D. Wahl	ICRC '07 (Mexico)	Ph.D. UK
S. Daly	IBSS '04 (Italy)	Eng. U. Catolica
M. Sarango	MST10, ISEA 11	industry

Cornell curriculum

- ECE 303 — electricity and magnetism
- EAS 484 — inverse methods
- ECE 486 — electricity and magnetism II
- EAS 487 — antennas and radar
- ECE 488 — rf design
- ECE 588 — incoherent scatter
- EAS 711 — upper atmospheric physics
- various special topics classes
- + Radar and Antennas class, U. Catolica, Lima

Second Jicamarca School of Radars

- Dates: March 20-31, 2006
- Venue: JRO
- Organizers: J. Roettger, M. Sarango, J. Chau
- Lecturers: D. Farley, W. Swartz, J. Roettger, R. Woodman, J. Chau and M. Sarango
- Participants: 18 Peruvians + 1 Brazilian

First LISN Workshop and School

- Dates: August 1-9, 2007
- Venue: JRO
- Organizers: E. Silvestre, C. Valladares, J. Chau
- Participants: > 20 from different SA countries and USA.

<http://jro.igp.gob.pe/subwebs/jsr2/>

<http://jro.igp.gob.pe/lisn/workshop1/home.htm>

40th Anniversary Workshop 2001
Annual CEDAR Amigos Workshop
Jicamarca to host next ISEA

Newsletter

<http://jro.igp.gob.pe/newsletter>

The screenshot shows the top section of the Jiacmarca Newsletter website. At the top, there is a dark navigation bar with the text "Boletín Informativo" on the left, "Año 2 - Nº1 [Marzo del 2008]" in the center, and "ENGLISH VERSION" on the right. Below this is a large banner image featuring an aerial view of a coastal area with buildings and a large antenna structure. The text "Inside JICAMARCA" is overlaid on the image. Underneath the banner is a horizontal menu with several items: "[Presentación]", "[Noticias]", "[Publicaciones y Ponencias]", "[Eventos]", "[Personal]", and "[Otros]". The main content area is divided into two columns. The left column has a section titled "PRESENTACIÓN" in green, followed by a large "H" and a paragraph of text. The right column has a section titled "NOTICIAS" in green, followed by a sub-section "Conozcamos como funciona el radar principal del ROJ (1era Parte)" and a paragraph of text. At the bottom of the right column, there is a section titled "ENTREVISTA" in green.

Boletín Informativo Año 2 - Nº1 [Marzo del 2008] ENGLISH VERSION

Inside JICAMARCA

[Presentación] [Noticias] [Publicaciones y Ponencias] [Eventos] [Personal] [Otros]

PRESENTACIÓN

Hola a todos, les doy la bienvenida a una nueva presentación de Inside Jiacmarca. Como han observado hemos cambiado de diseño y de diagramación y aprovecharemos este cambio para proponernos que nuestro boletín electrónico cruce los ámbitos del Radio Observatorio y llegue a los hogares de cada una de nuestras familias y amistades. Queda en cada uno de los integrantes de esta comunidad hacer conocer un poco más la labor y la misión que tiene el ROJ en nuestra sociedad y en el mundo.

Para esta primera edición del año 2008, en la Sección de Noticias contamos con la colaboración del Ingeniero Darwin Córdoba del Área de Mantenimiento, quien ha escrito sobre el proyecto "Componentes RF en el radar . TR hecho con componentes de estado sólido"; este artículo es una introducción al tema de circuitos de conmutación y sus aplicaciones en radiofrecuencia. En posteriores ediciones, Darwin nos mostrará más componentes que son vitales para el

NOTICIAS

Conozcamos como funciona el radar principal del ROJ (1era Parte)

El radar del Radio Observatorio de Jiacmarca está compuesto por subsistemas que manejan diferentes tipos de señales y realizan diferentes

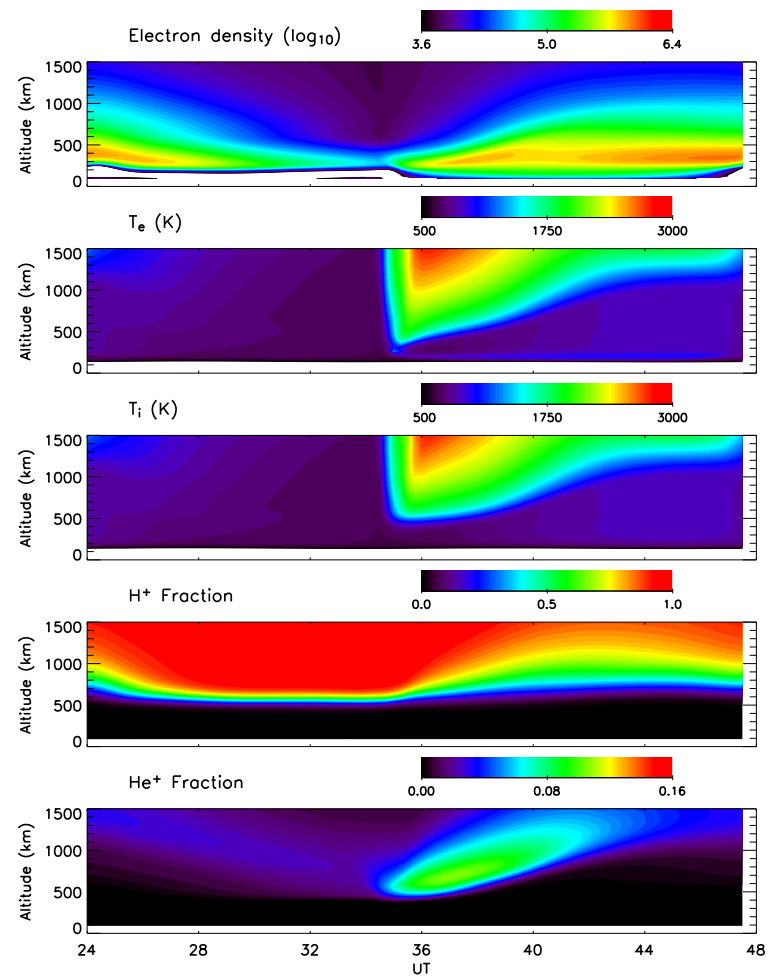
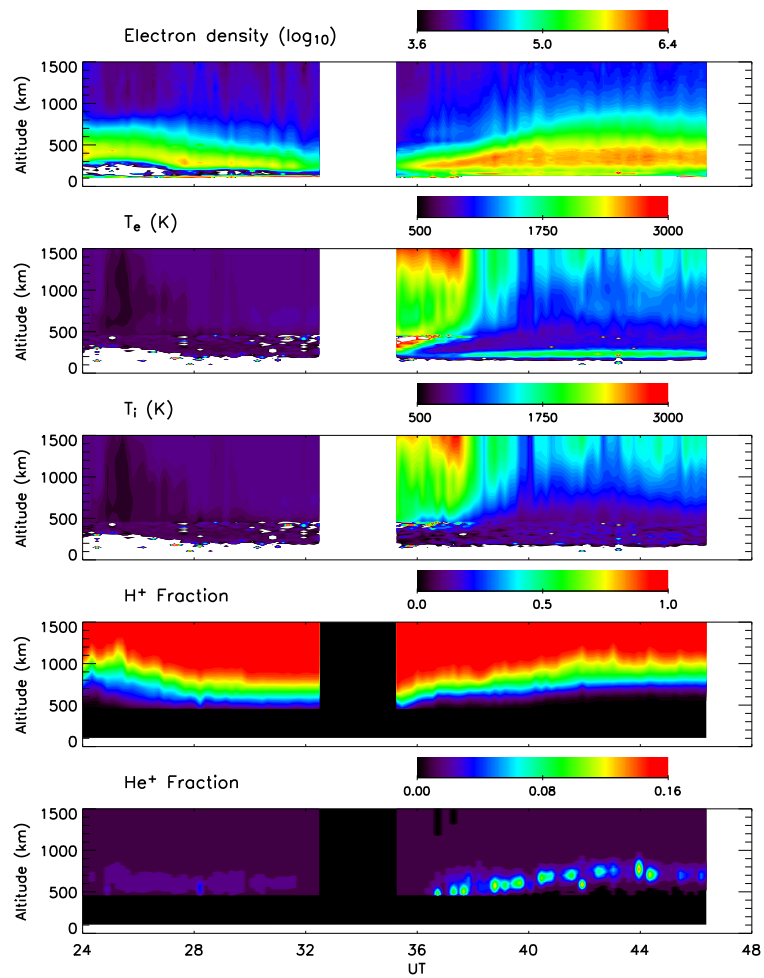
ENTREVISTA

summary: instrument vs. facility

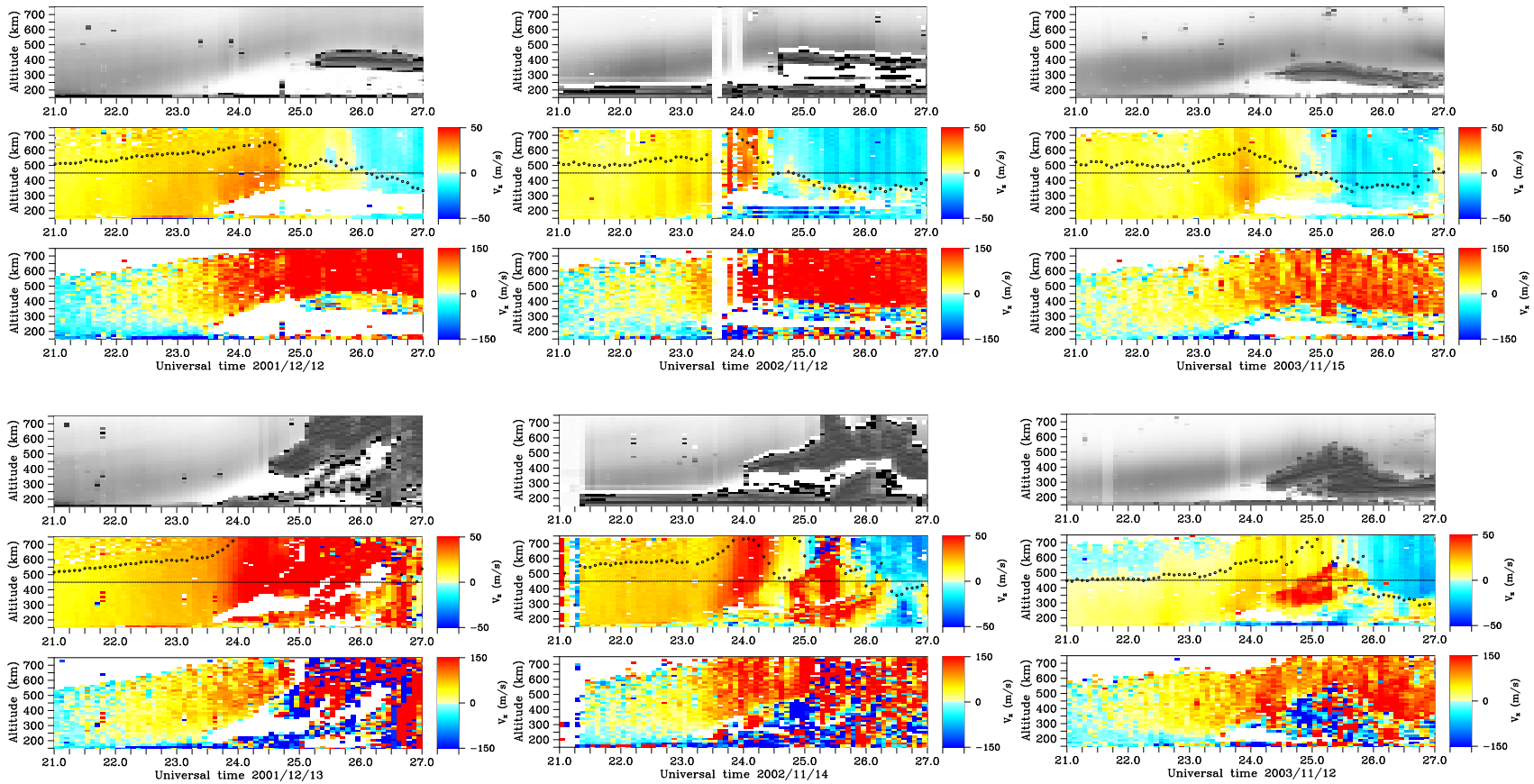
A facility should ...

- run nearly continuously
- perform preventative maint.
- avoid single-point failures
- improve and upgrade perpetually
- promote clustering
- develop instrumentation
- develop techniques
- support experiments
- run user-driven campaigns
- host visitors (aggressively)
- support other projects
- maintain database(s)
- provide real-time/ online access
- schedule actively
- cultivate publications
- support students (aggressively)
- foster career development
- generate/integrate curriculum
- host meetings
- pursue PR (newsletter)

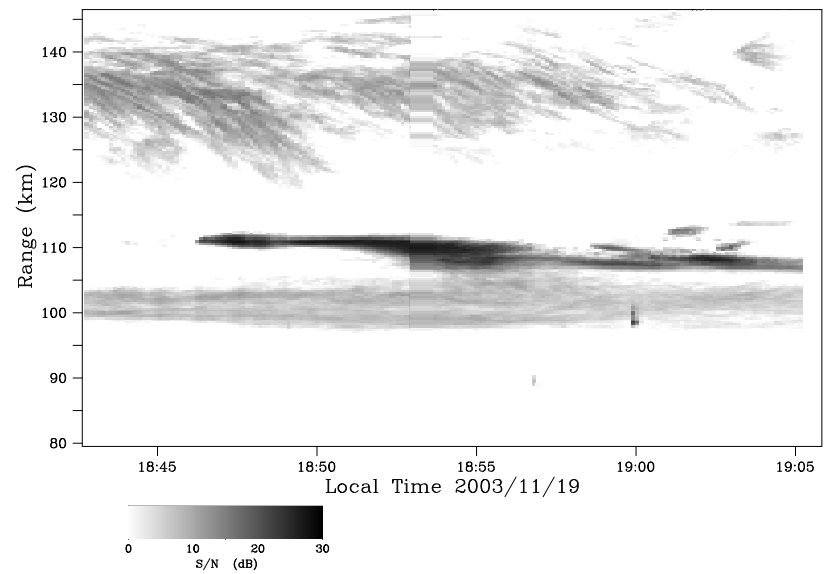
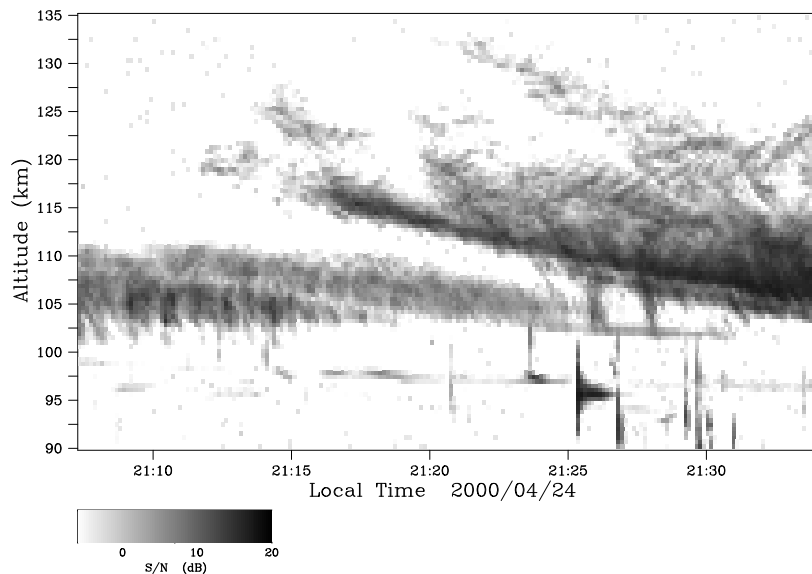
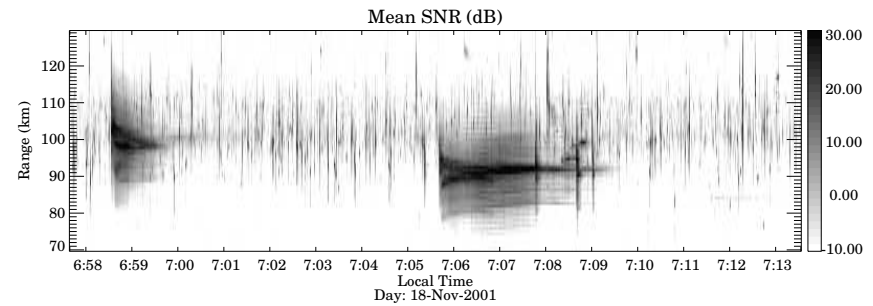
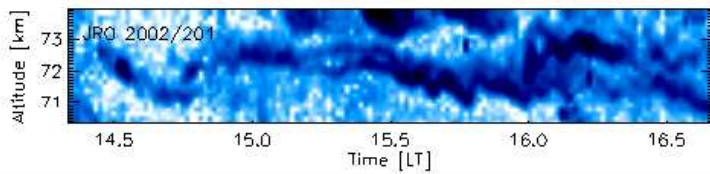
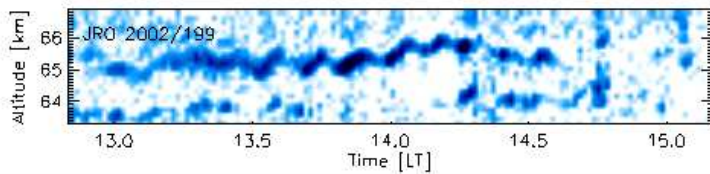
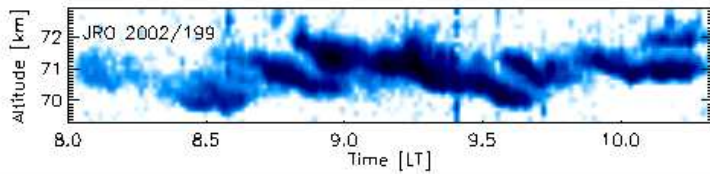
ISR parameters



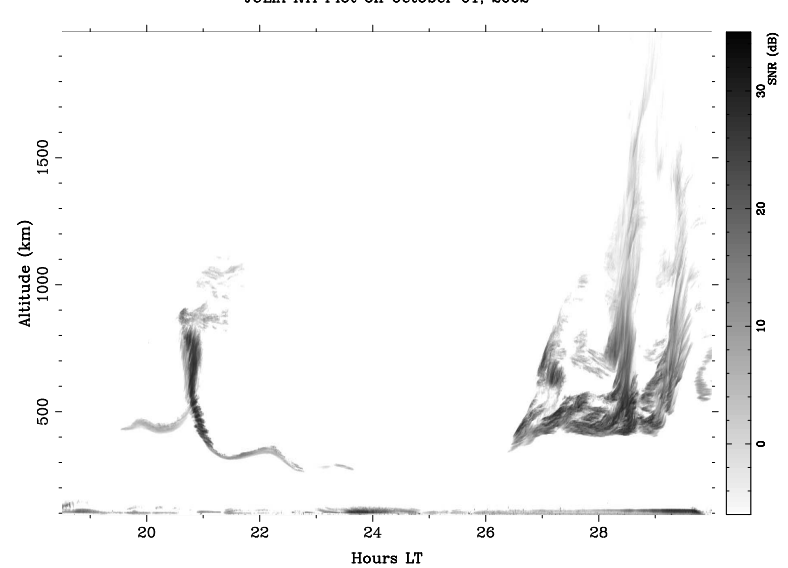
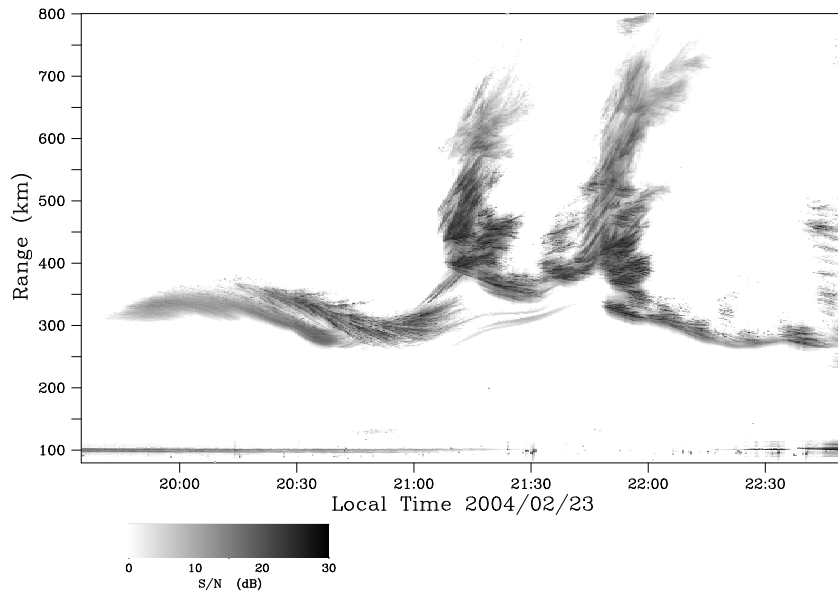
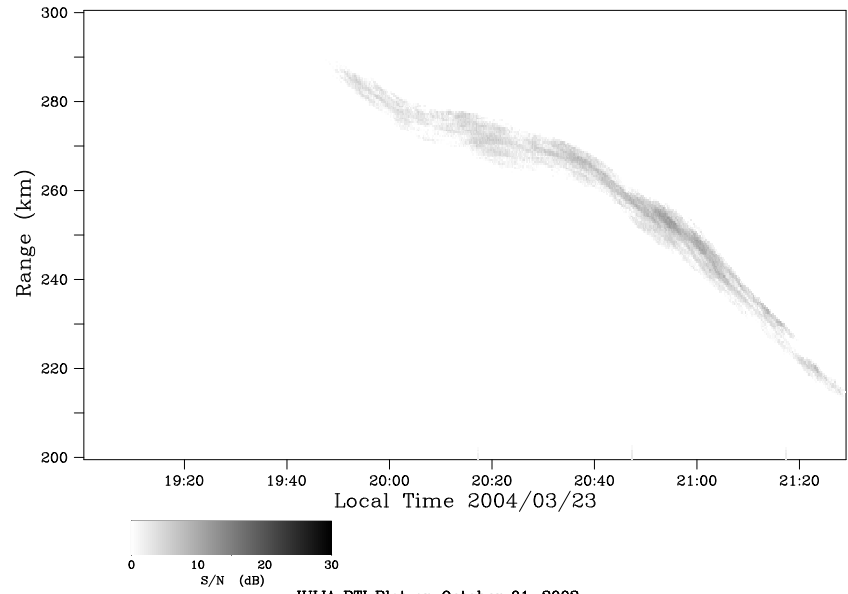
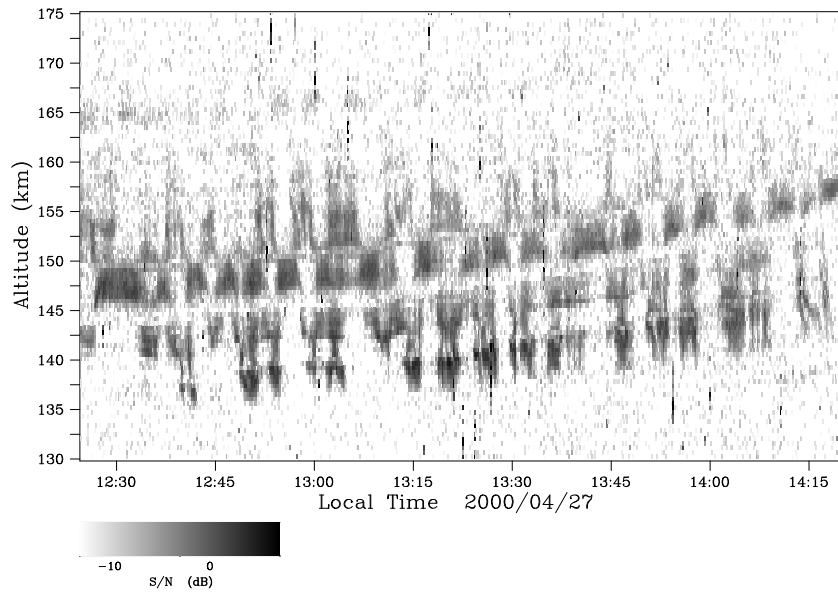
ISR drifts



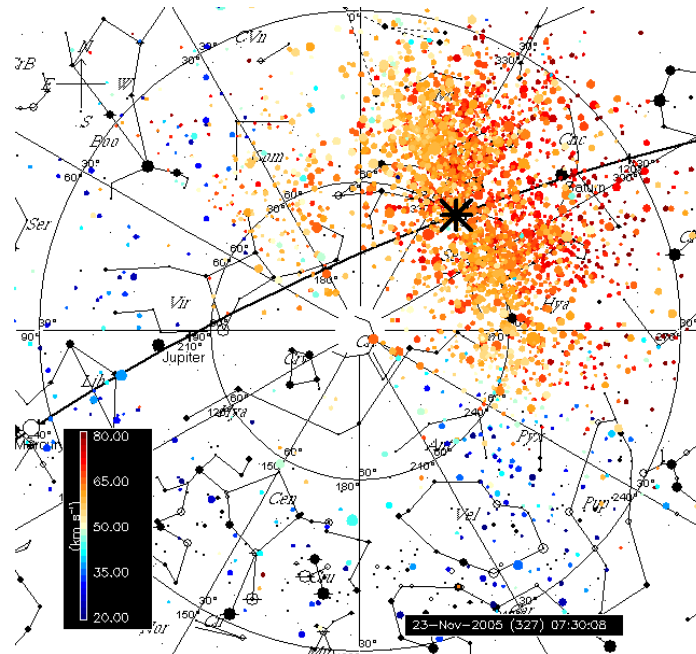
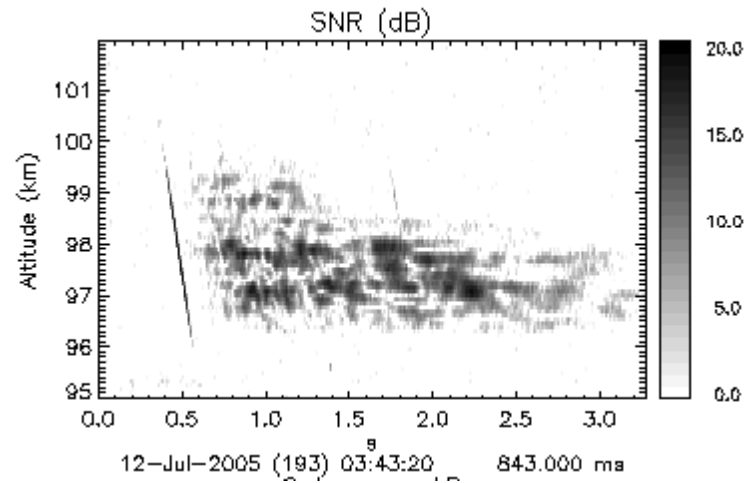
community interests i



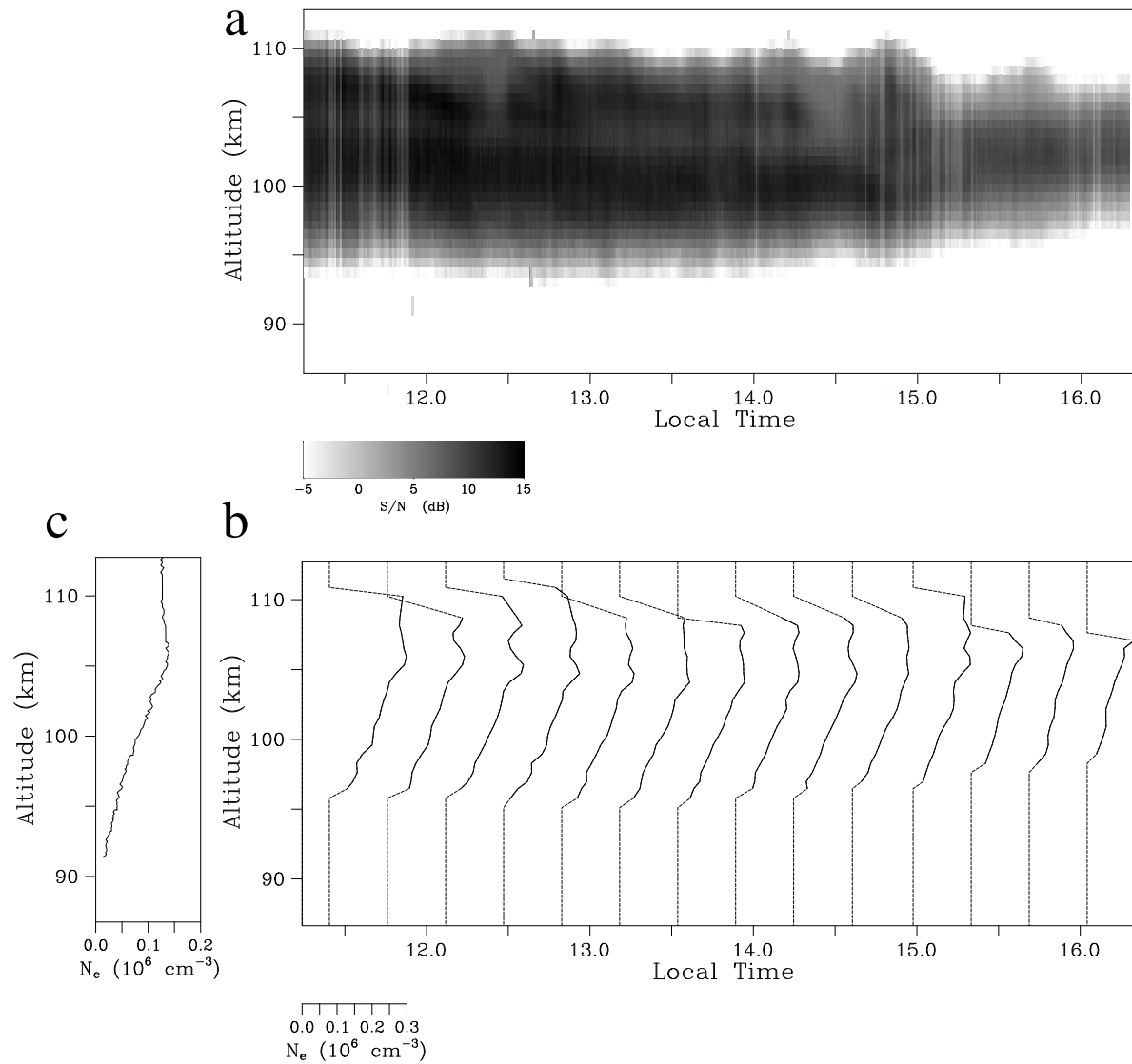
community interests ii



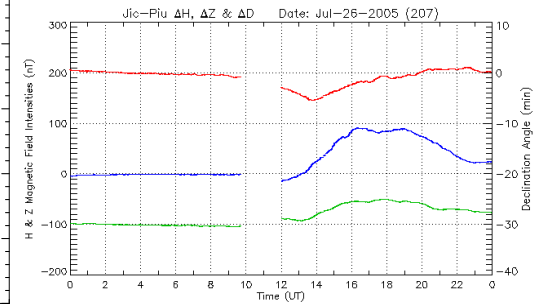
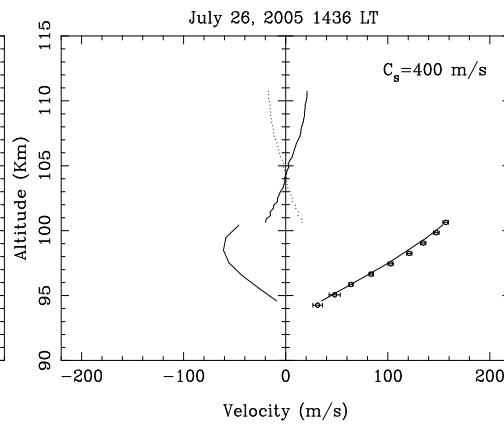
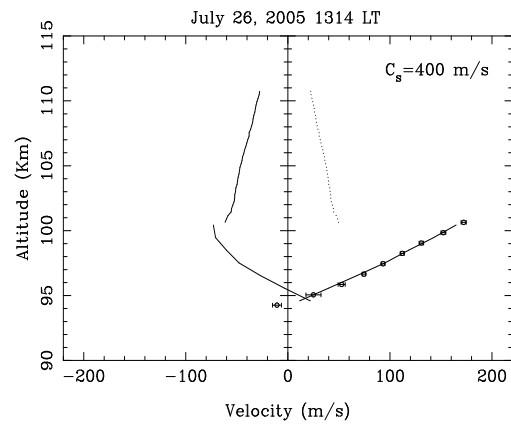
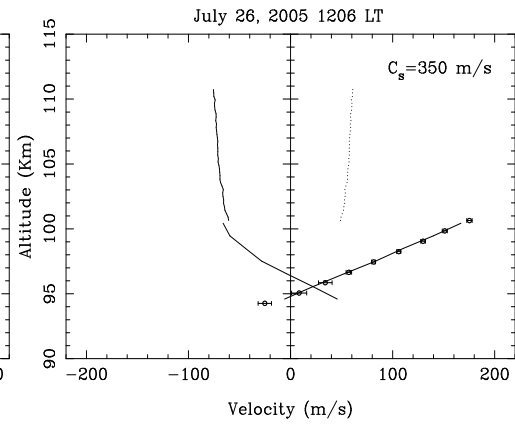
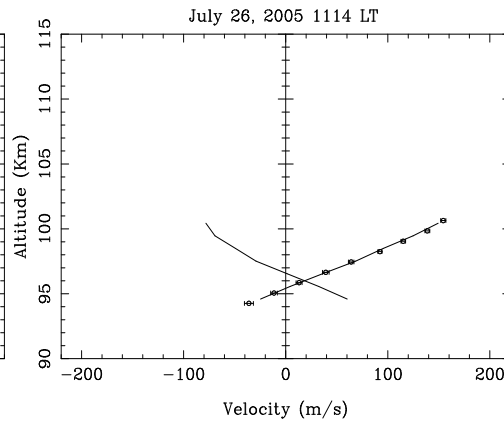
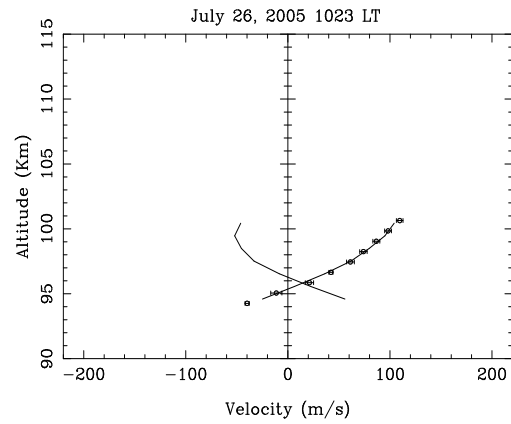
community interests iii



community interests iv



community interests v



community interests vi

