

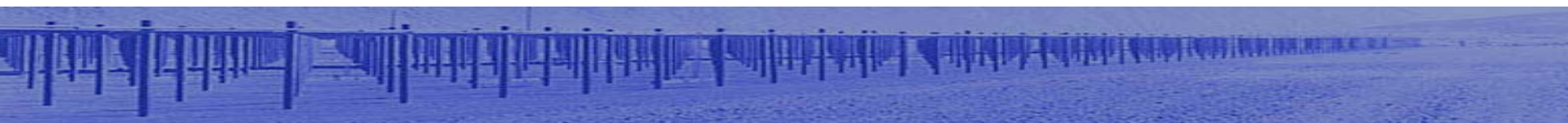
Equatorial ionospheric profiles: A comparative study between IRI model and measurements over Jicamarca

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- Future Work
- Conclusions
- Future Work



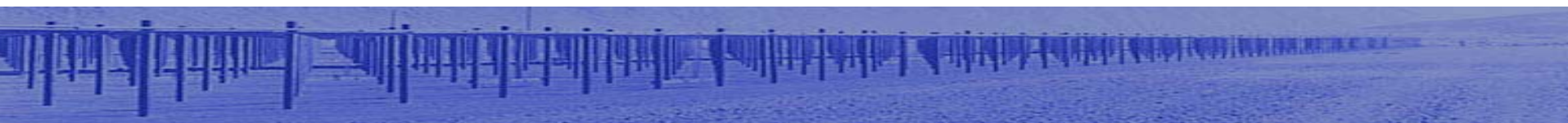
Data Used

STATION	LAT. GEOG.	LON. GEOG.
JICAMARCA	11°57'	76°53' (under magnetic equator)
TIME PERIODS	During the World Days (only 14 days)	
MONTHS	June	August September December
YEARS	2002 (Rz = 107.7)	2003 (Rz = 65.7)

Ionospheric characteristics: Obtained from ionograms with intervals of 15 minutes. A manual scaling was necessary in order to get a suitable true height electron density profile using NHPC [Huang and Reinisch, 1996] embodied in the SAO-X program.

ISR: Running in 'oblique mode' [Farley, 1969; Hysell, 2000] to get electron density, ion temperature, electron temperature, and ionic composition which can be retrieved from MADRIGAL database.

IRI model: The IRI2001 Fortran code available from NSSDC has been used to generate the modeled data [Bilitza, 2001]. In order to reach a more accurate specification of the actual electron density, we have used the ionosonde ionospheric parameters for the E, F1 and F2 region modeled.



Jicamarca Incoherent Scatter Radar



- Measurements of:
- Electron Density.
 - Ionic Composition.
 - Electron Temperature
 - Ion Temperature
 - Drifts (Electric Field)
 - Magnetic Field

Statistical
Characterization
of the Signal

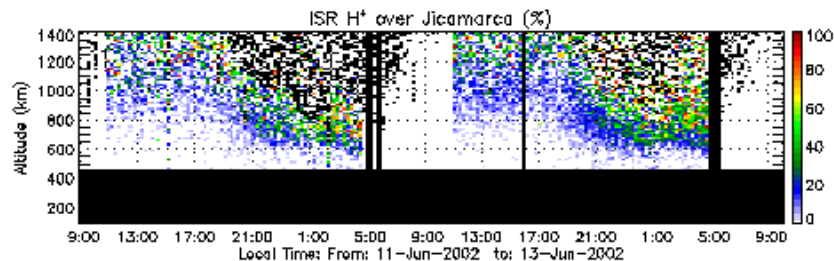
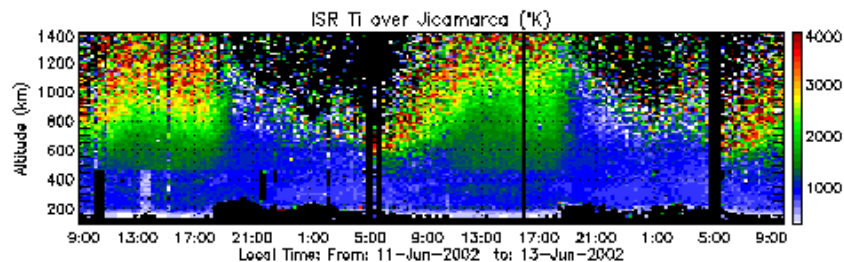
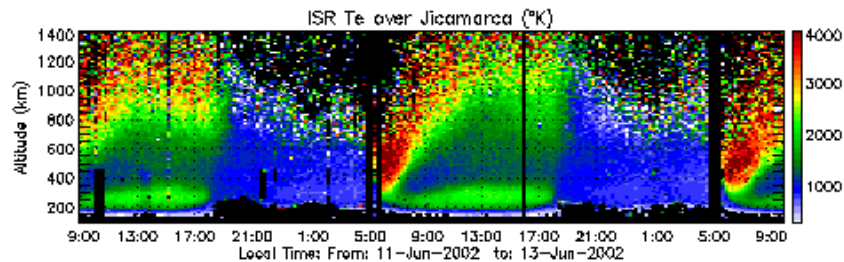
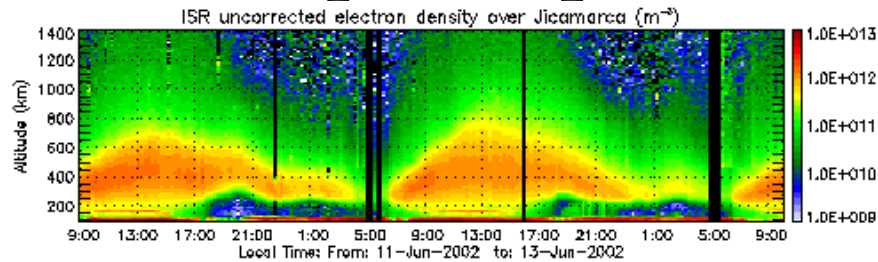


$$C_h(t) \propto \hat{\rho}_h(\vec{k}_B, \tau; n_e, [n_i], T_e, T_i, \vec{V}_\perp, \vec{V}_\parallel, \vec{B})$$

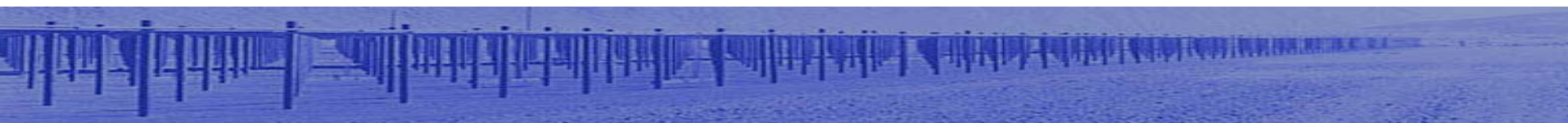
Plasma Fluctuation
of the Medium



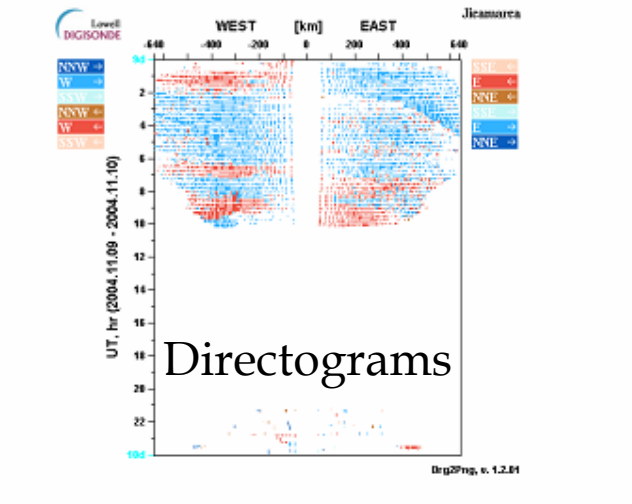
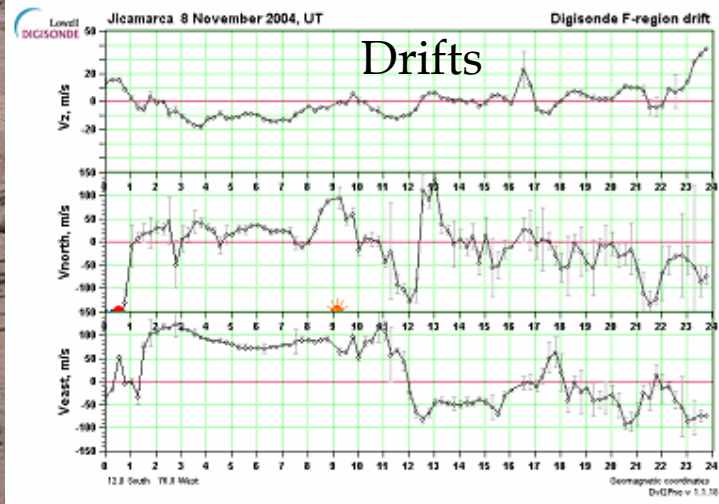
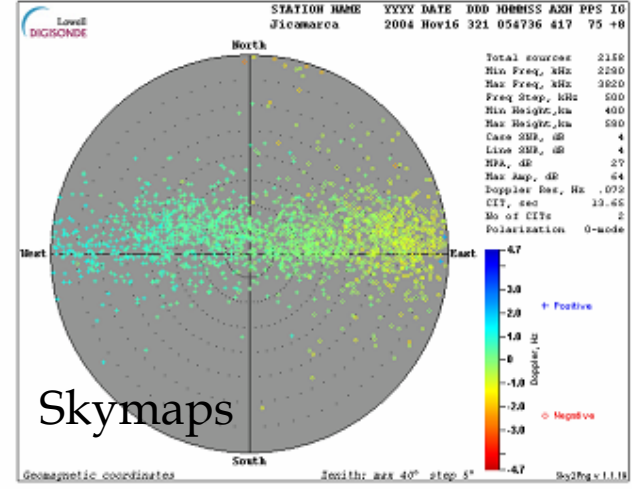
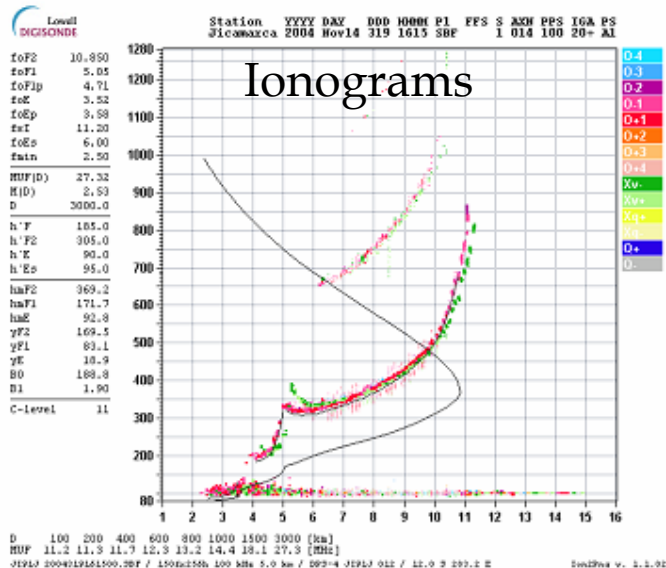
ISR Oblique Experiments

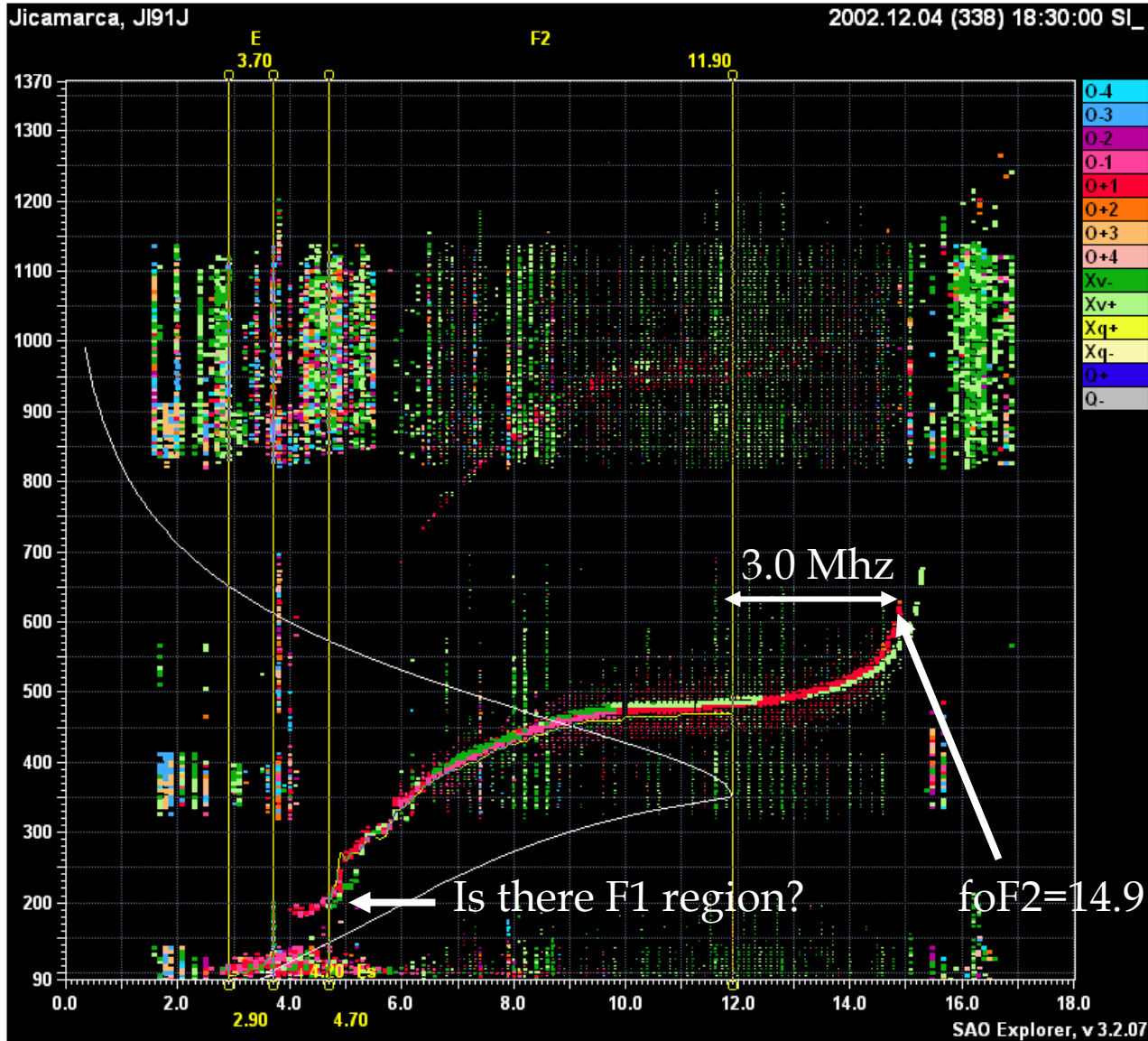


- Faraday Double Pulse
 - Traditional mode (since 1960)
 - Improved analysis after *Sulzer and Gonzales* [1999] work.
- Faraday DB – Alternating Codes [*Hysell*, 2000]
- Faraday DP – Long Pulse [*Hysell et al.*, 2005]
 - Excelent for Topside study.



Jicamarca Digisonde DPS-4



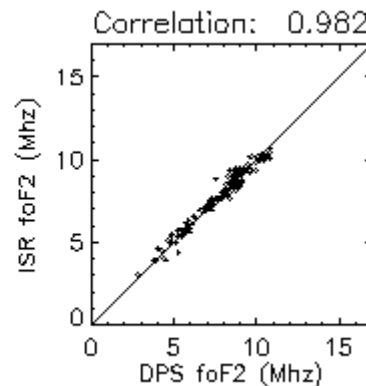
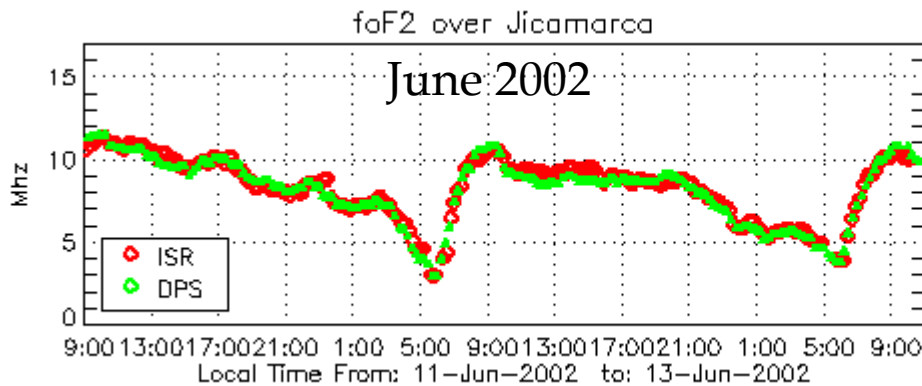


Sometimes ionograms are not autoscaled in a correct manner

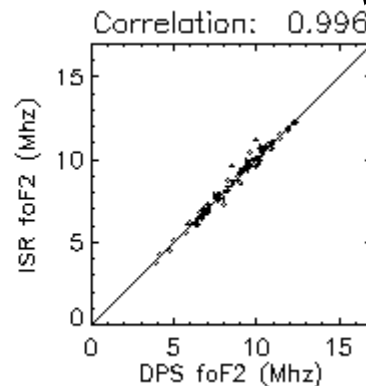
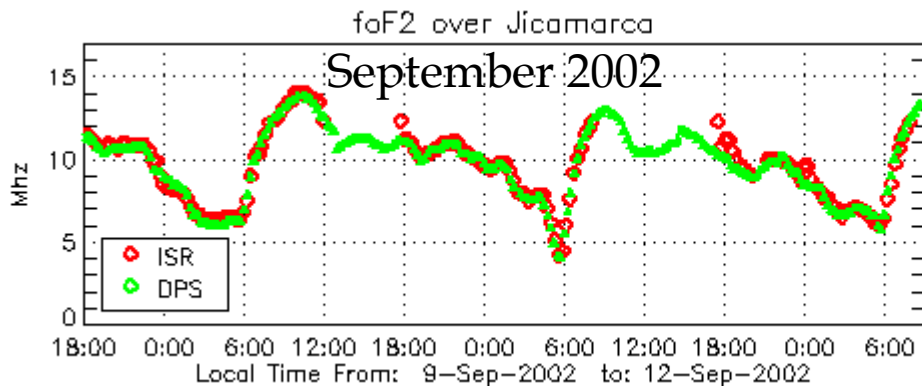
This example shows an ionogram when the automatic scaling software truncates the F region trace (the correct value of foF2 is ~15 Mhz, and the program give us 11.9 Mhz). Also, the F1 region trace has not been recognize.

F peaks: ISR against DPS (edited ionograms) (1)

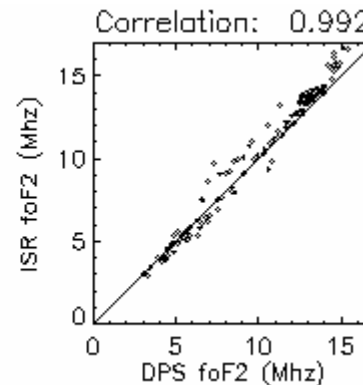
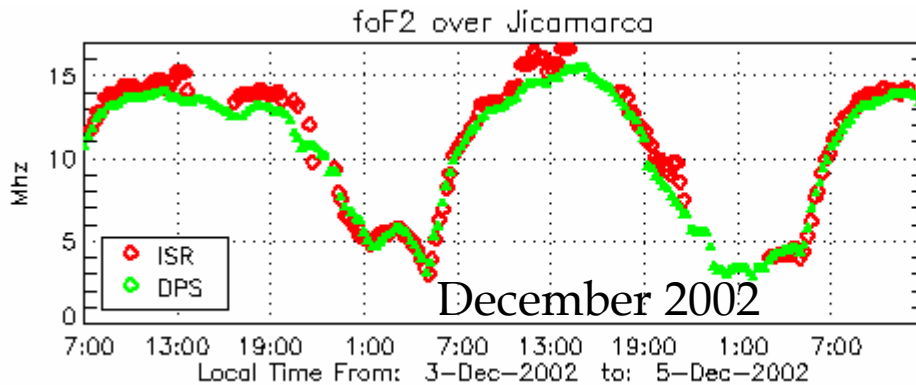
June - September 2002



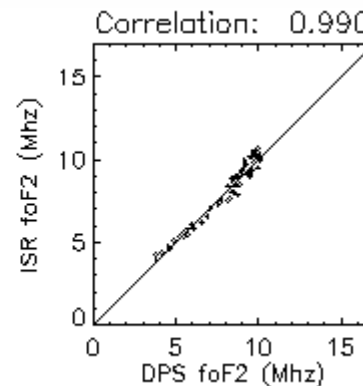
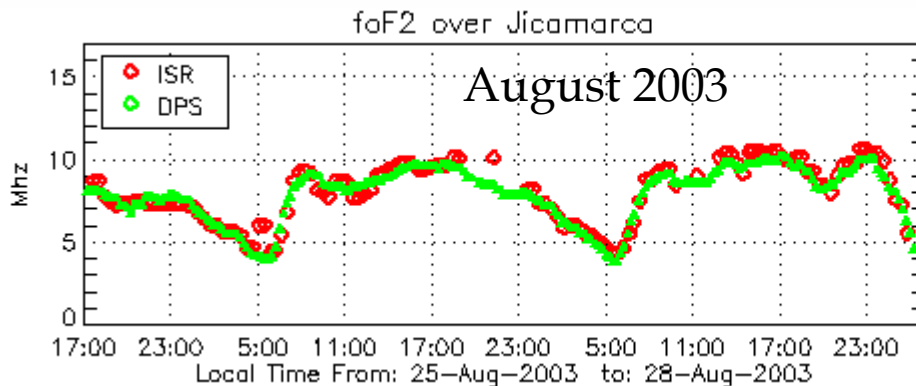
A high correlation index with ionograms manually edited



F peaks: ISR vs DPS (edited ionograms) (2) December 2002 – August 2003

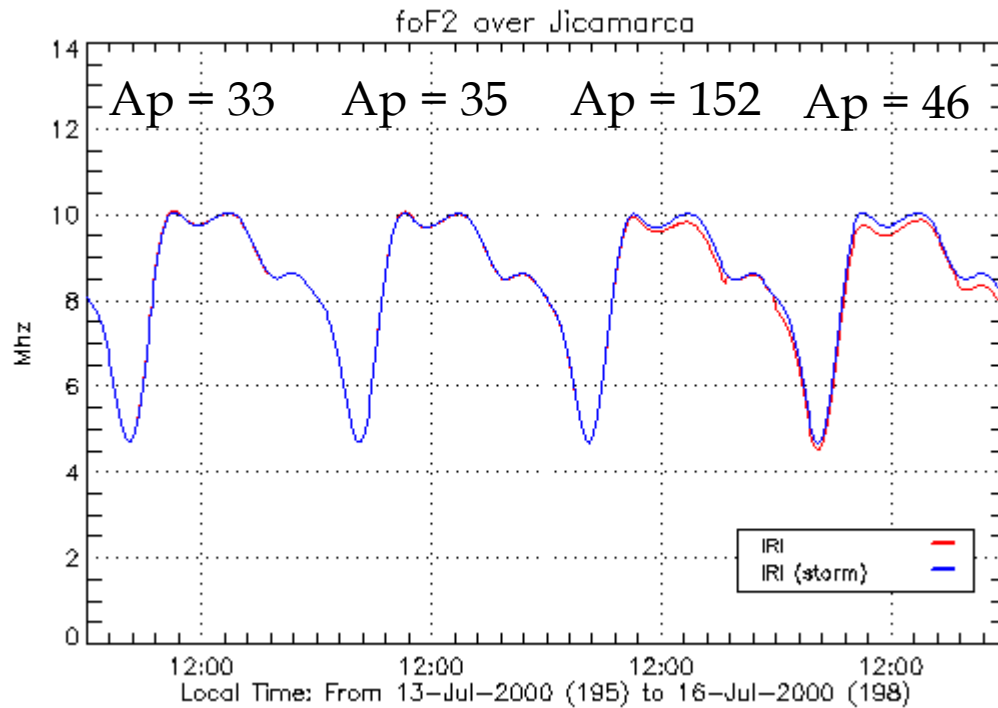


A high correlation index

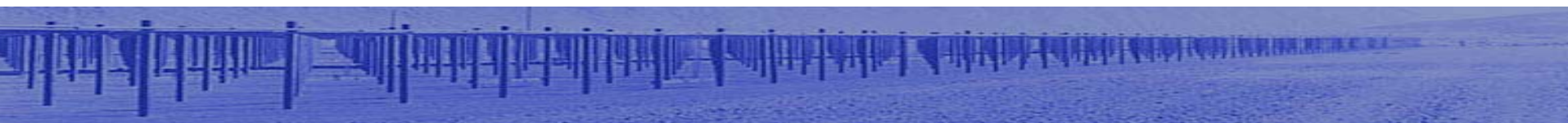


F-peaks values from ISR or DPS measurements can be used with a good confidence to upgrade IRI model predictions

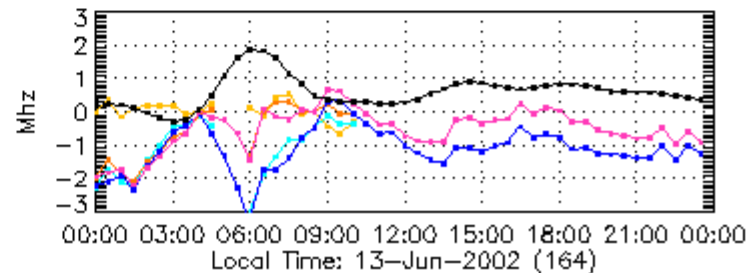
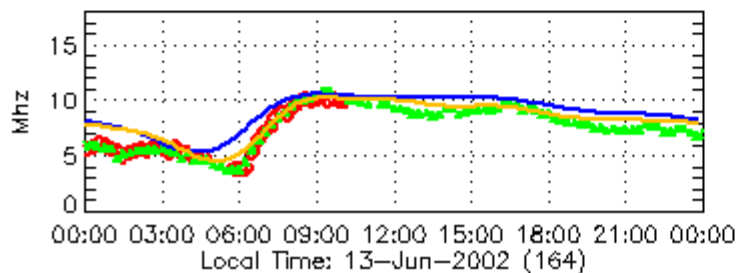
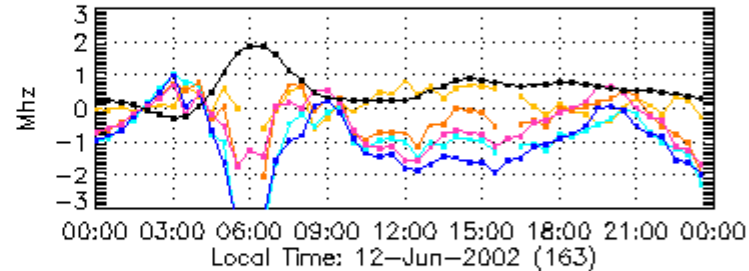
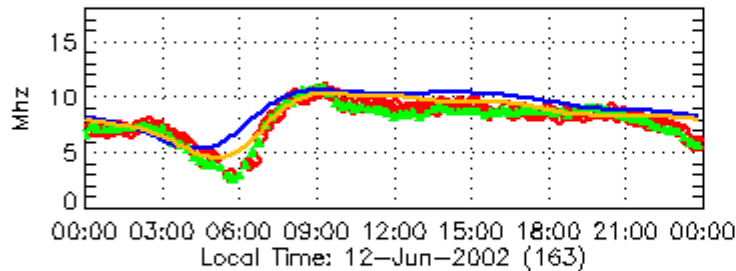
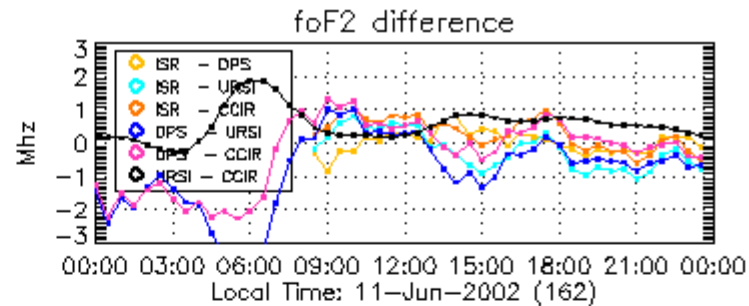
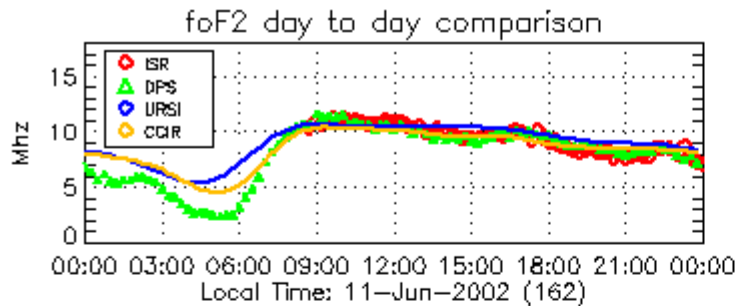
IRI standard vs IRI Storm



There is no strong discrepancies between IRI model without magnetic dependence and IRI model with the 'storm option' turned on at Southern Hemisphere, and this is different for another latitudes, where is possible reproduces the storm effect in foF2 as reported [Araujo-Pradere and Fuller-Rowell, 2004].

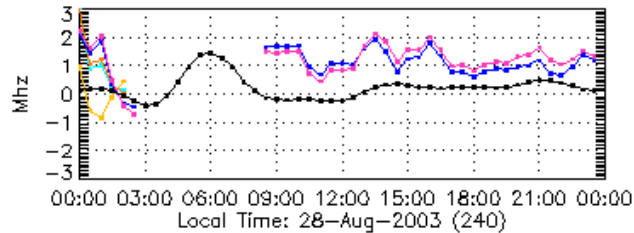
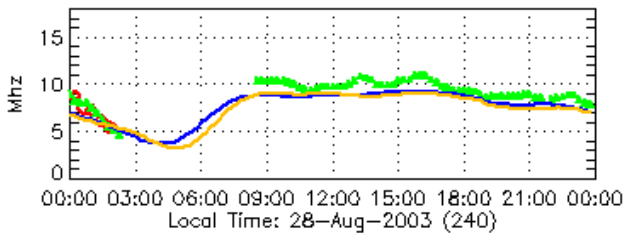
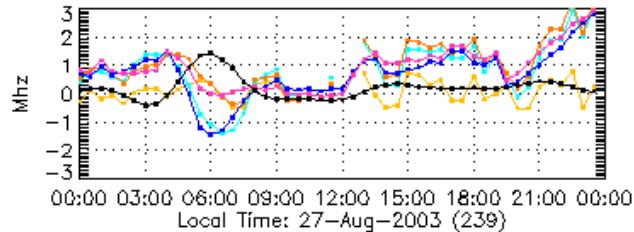
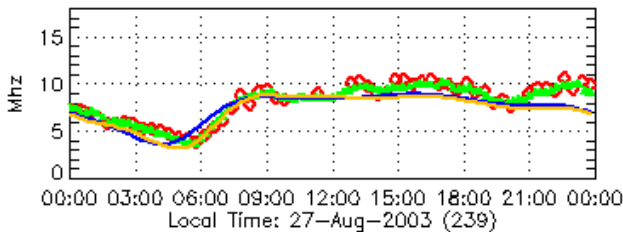
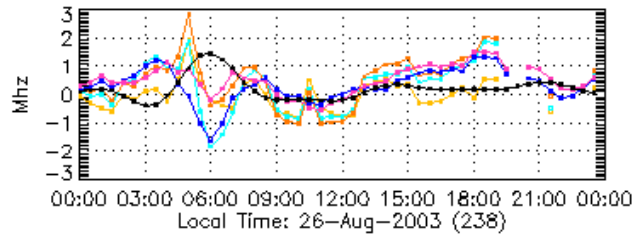
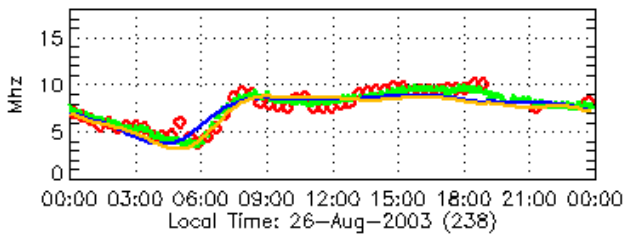
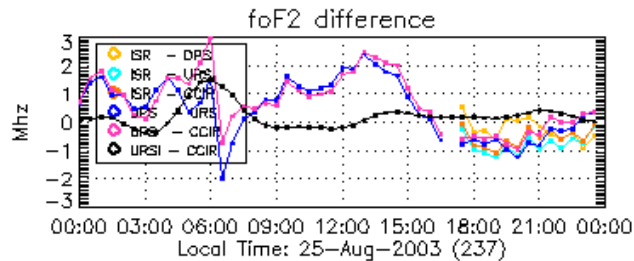
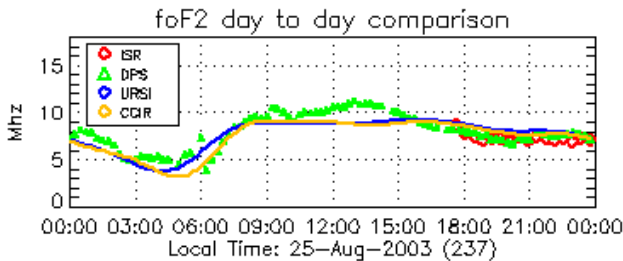


Day-to-day variability of foF2 (1)



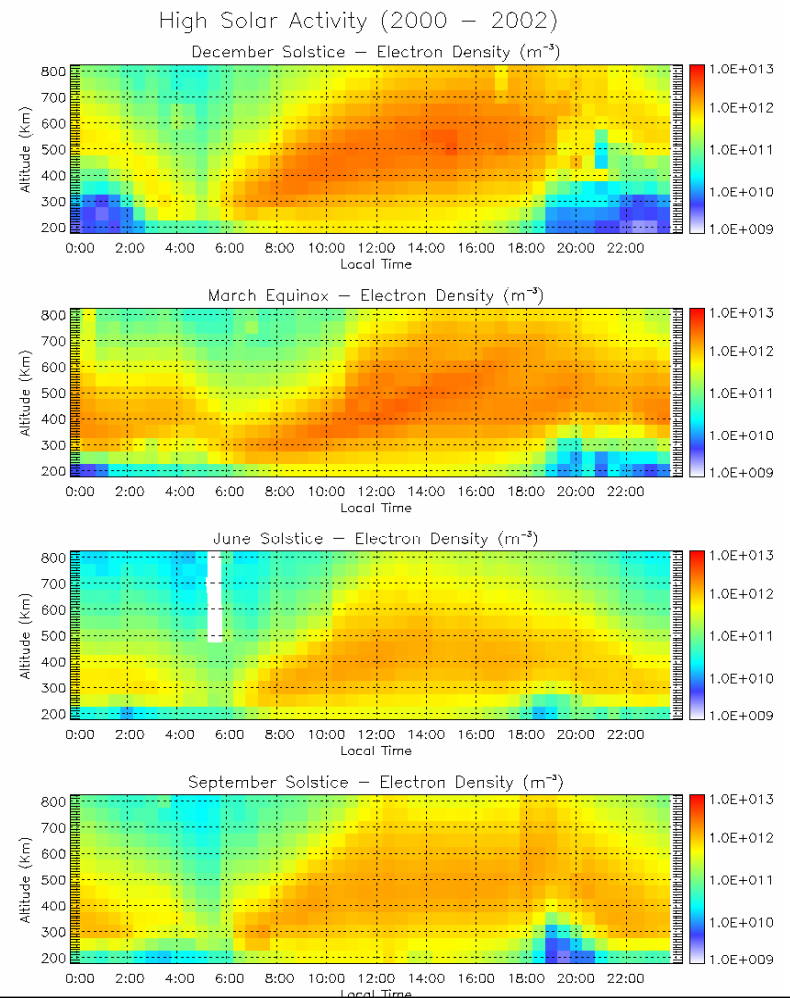
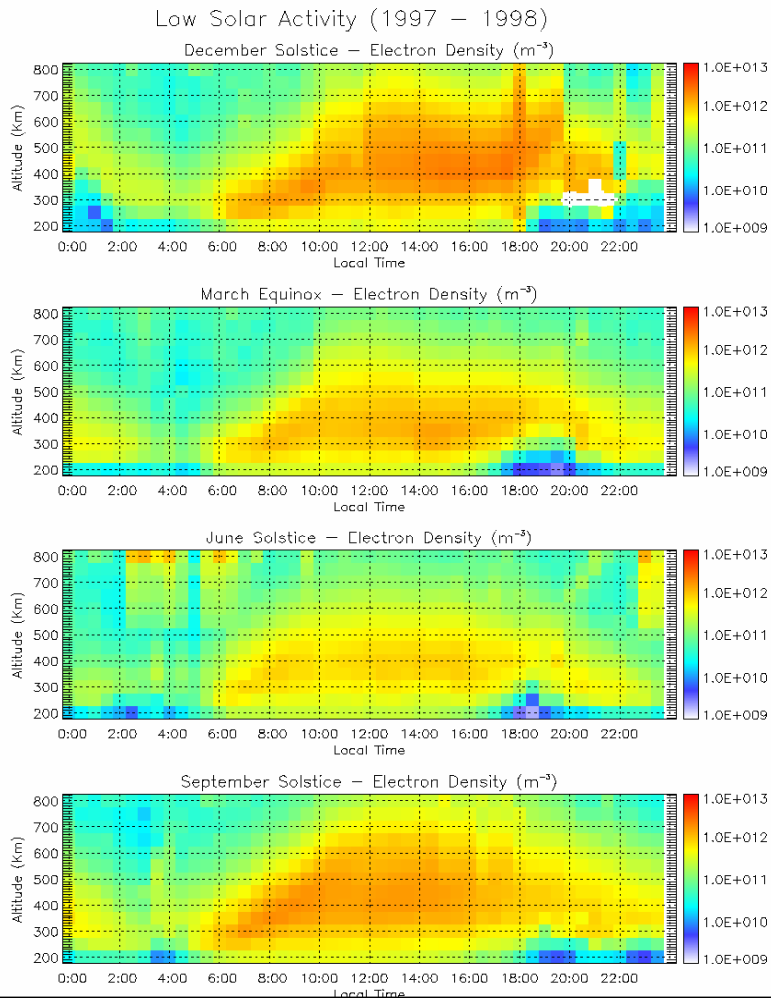
IRI model with CCIR and URSI choices are reasonably good a daytime hours and sometimes at the night hours.

Day-to-day variability of foF2 (2)



- Differences between ISR and DPS (from edited ionograms) are around 1 Mhz in the most of the cases.
- CCIR foF2 maps used by IRI model seems to be the best selection. It shows a better agreement with data than URSI maps around sunset, although URSI shows the same behavior all the day, as well.

ISR Electron Densities: Seasonal Variability

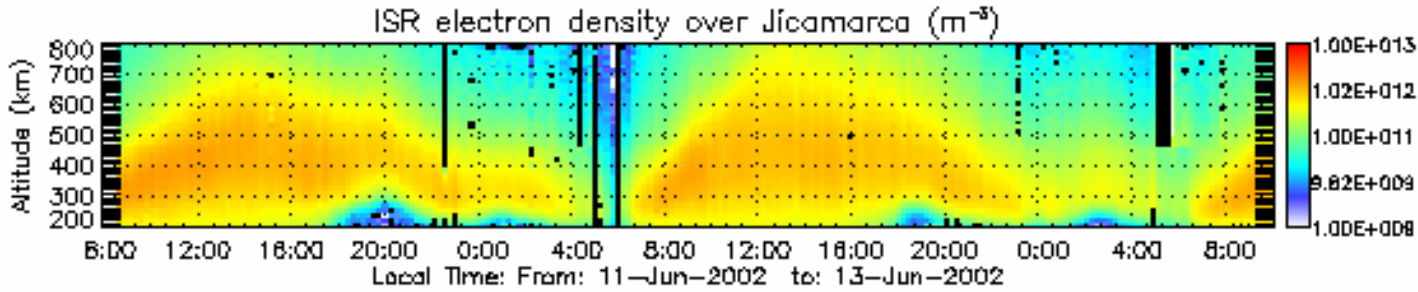


Radio Observatorio de Jicamarca, Thu Jun 23 13:50:01 2005

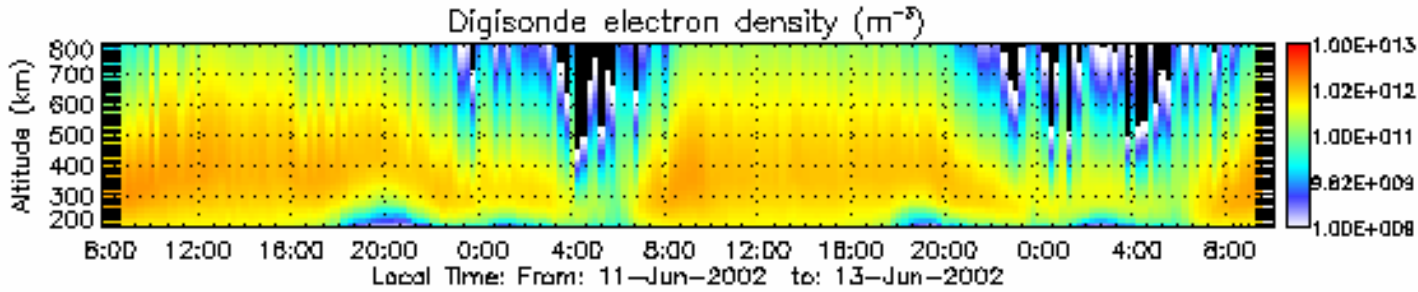
Radio Observatorio de Jicamarca, Thu Jun 23 13:50:11 2005

Electron density contour plots with local time and altitude recorded by Jicamarca ISR for two different periods of solar activity

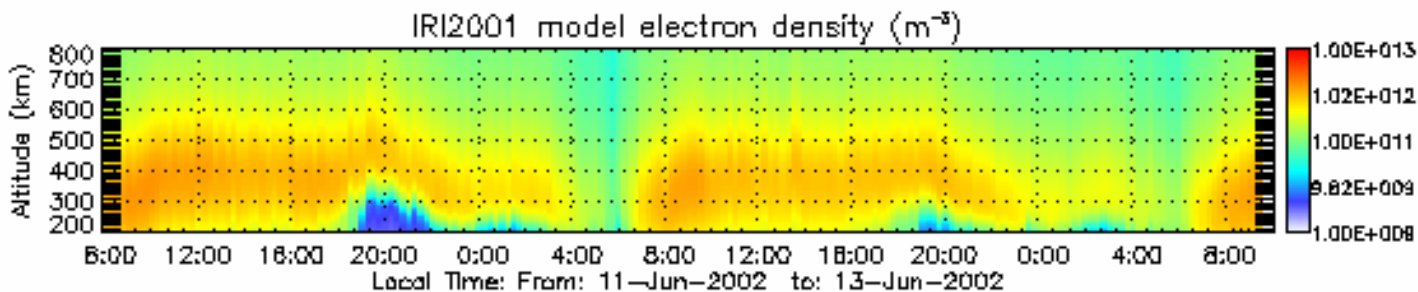
Density Comparisons (1) - June 2002



ISR



Ionosonde

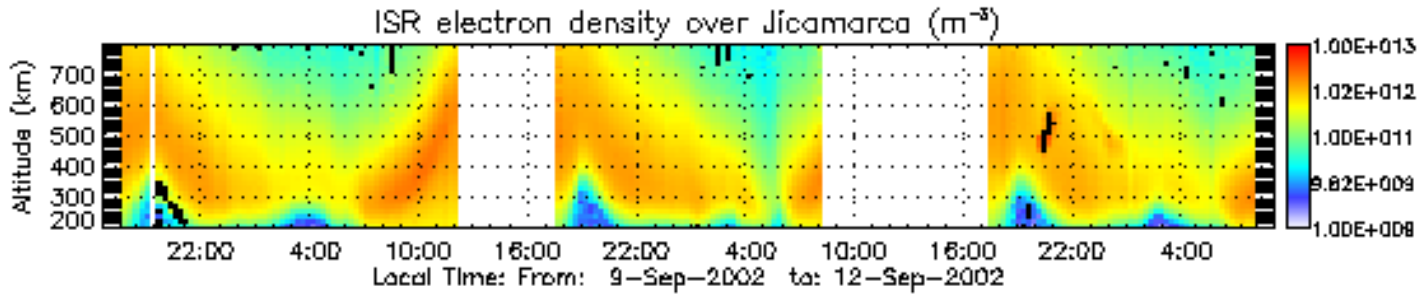


IRI 2001

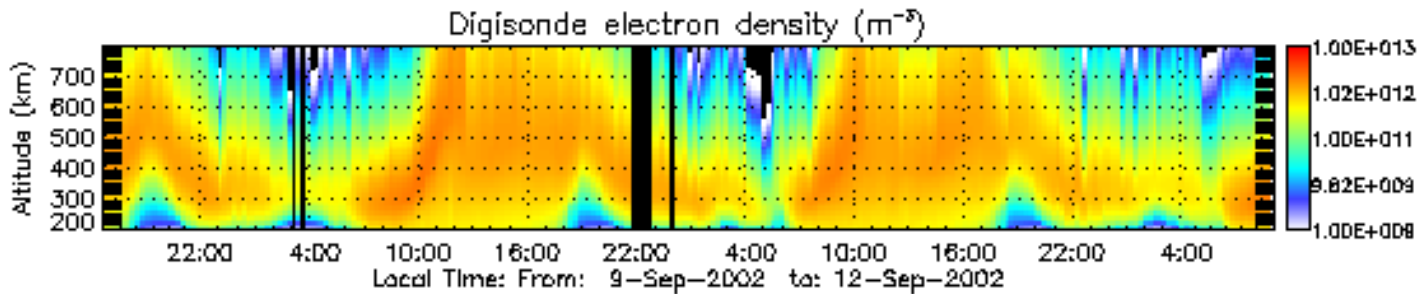
Updated with
ionospheric
values from
DPS (E, F1, F2)



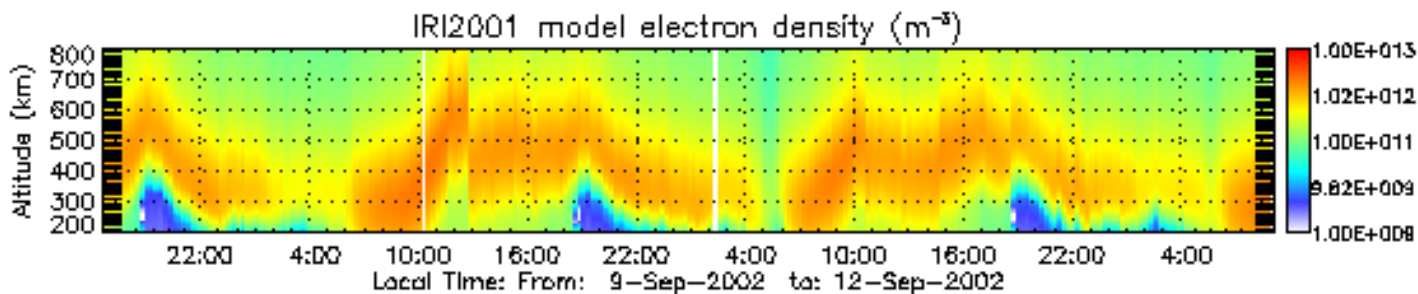
Density Comparisons (2) - September 2002



ISR



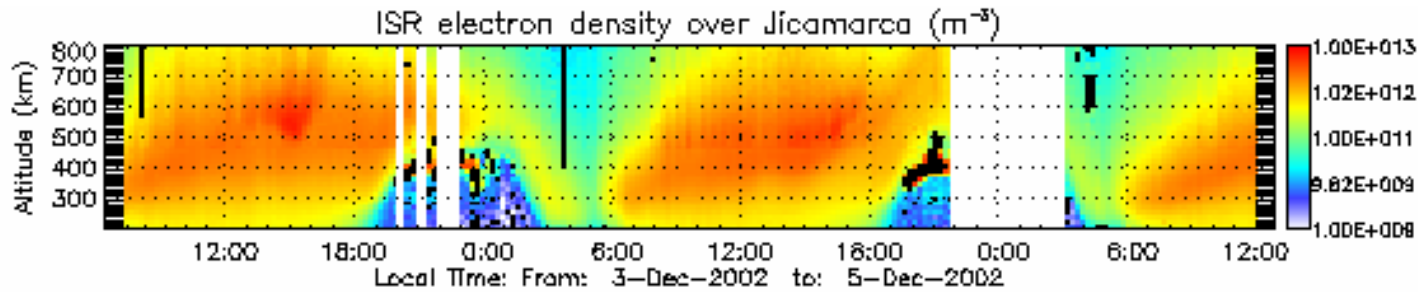
Ionosonde



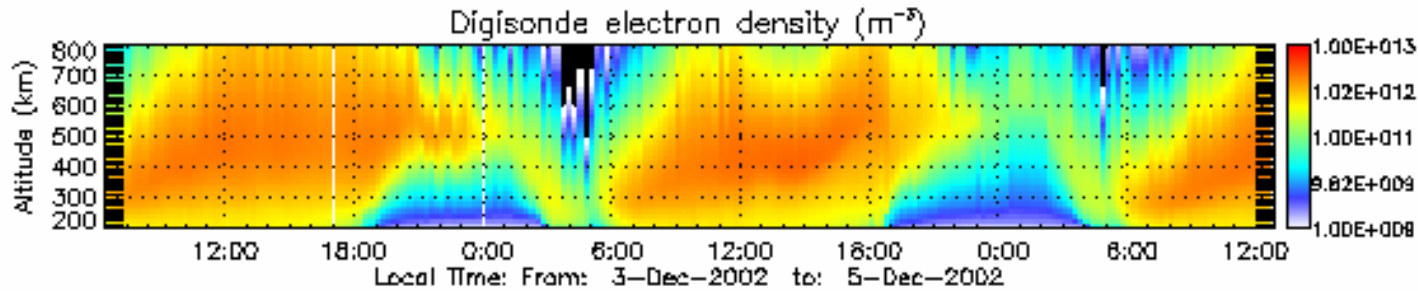
IRI 2001

Updated with
ionospheric
values from
DPS (E, F1, F2)

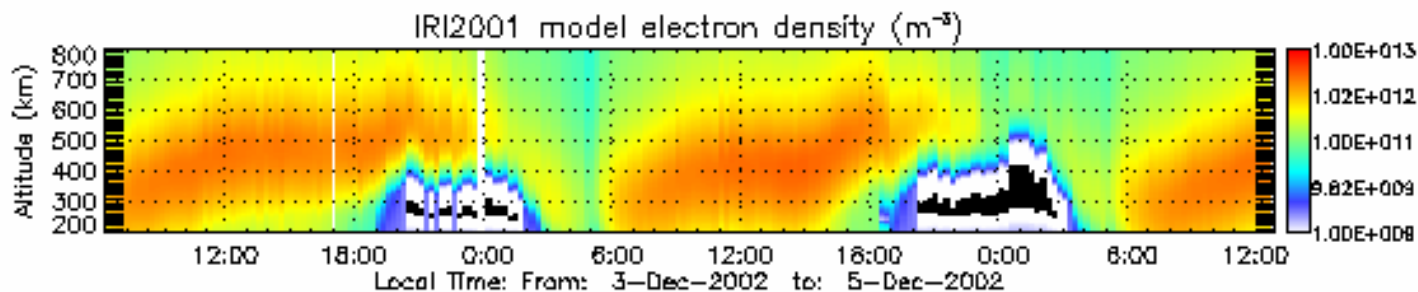
Density Comparisons (3) - December 2002



ISR

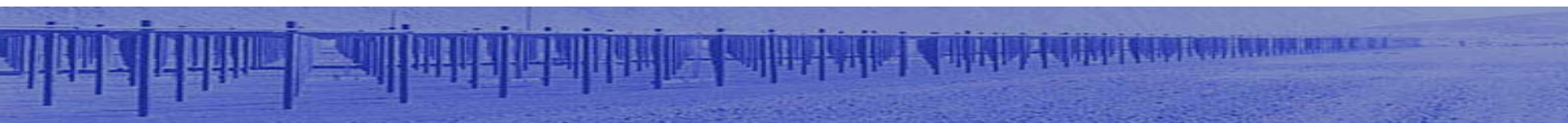


Ionosonde

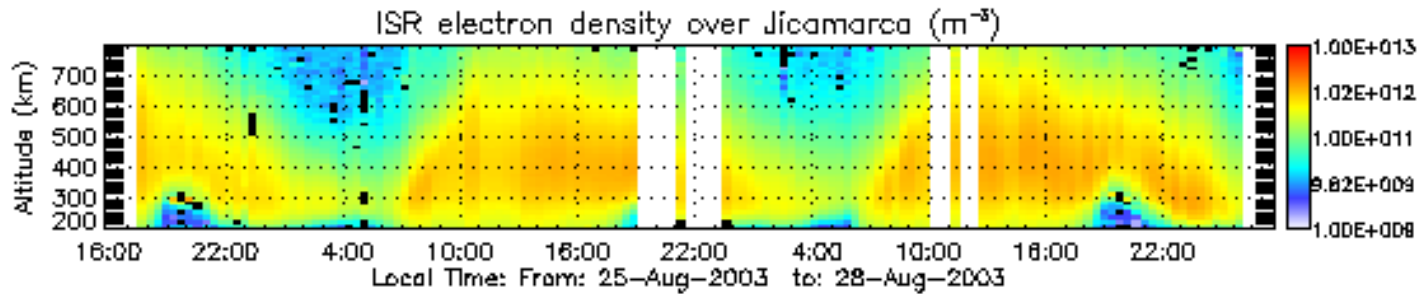


IRI 2001

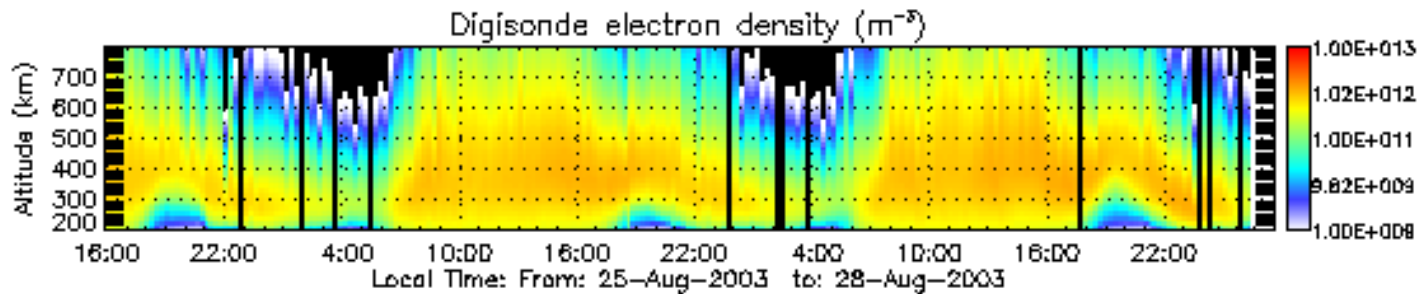
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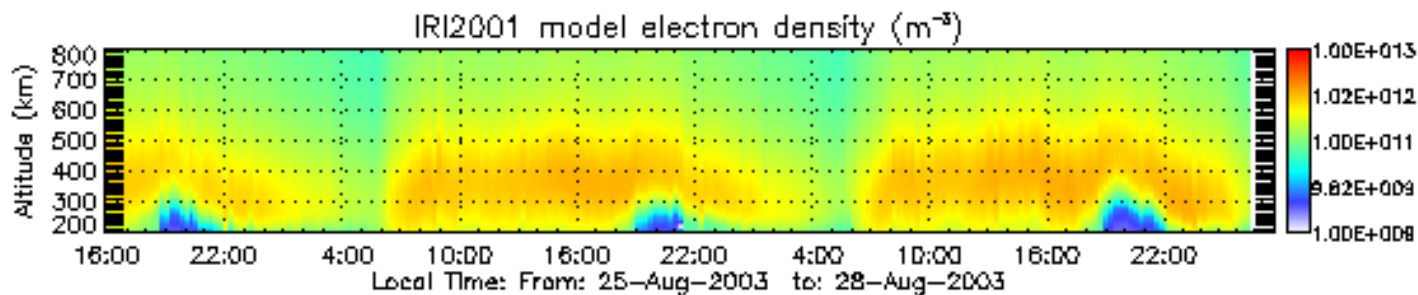
Density Comparisons (4) - August 2003



ISR



Ionosonde

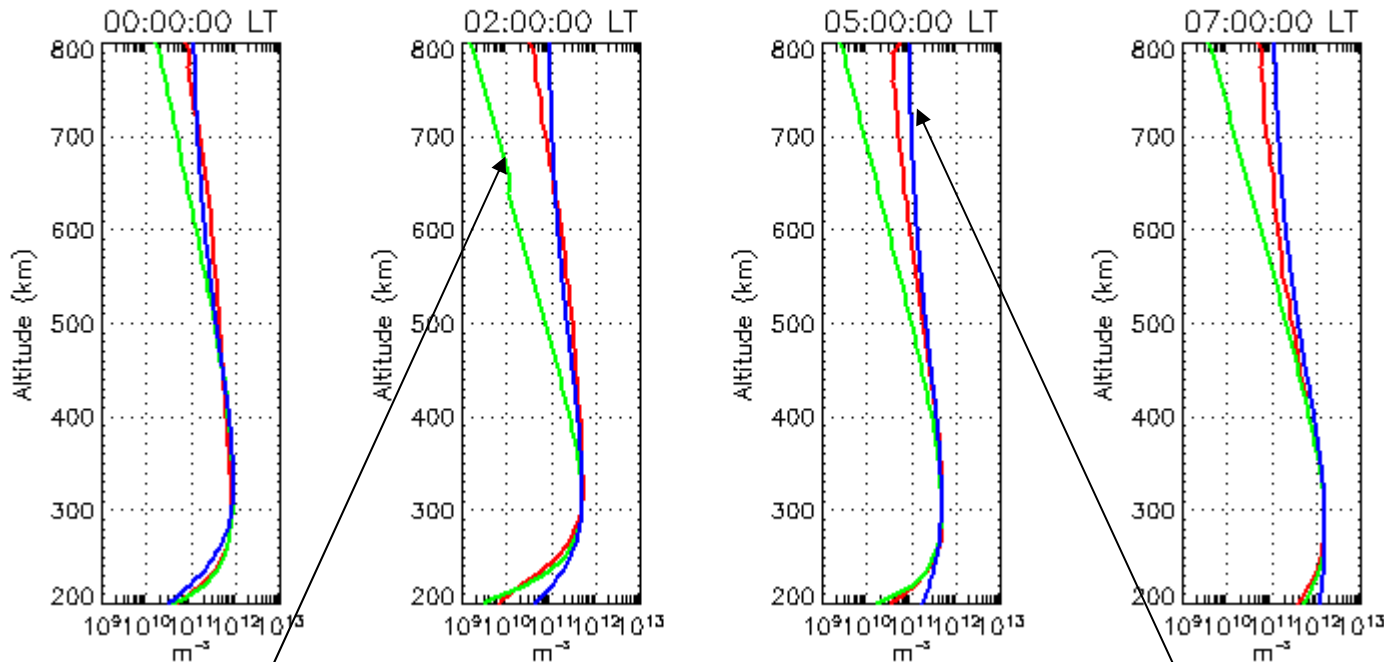


IRI 2001

Updated with
ionospheric
values from
DPS (E, F1, F2)

Topside Profiles: Nighttime case

Electron Densities Profiles – Hourly Averages
 10-Sep-2002 (253)

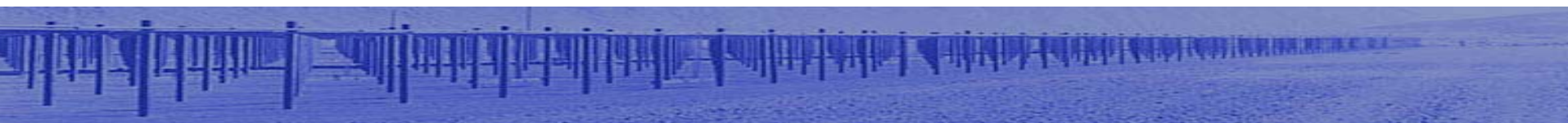


Radio Observatorio de Jicamarca, Mon Oct 24 16:21:27 2005

- Average ISR profiles
- Hourly Digisonde profiles
- IRI profile updated to ionosonde peak values
- IRI topside profile has been generated considering different options but the results were not significantly improved.

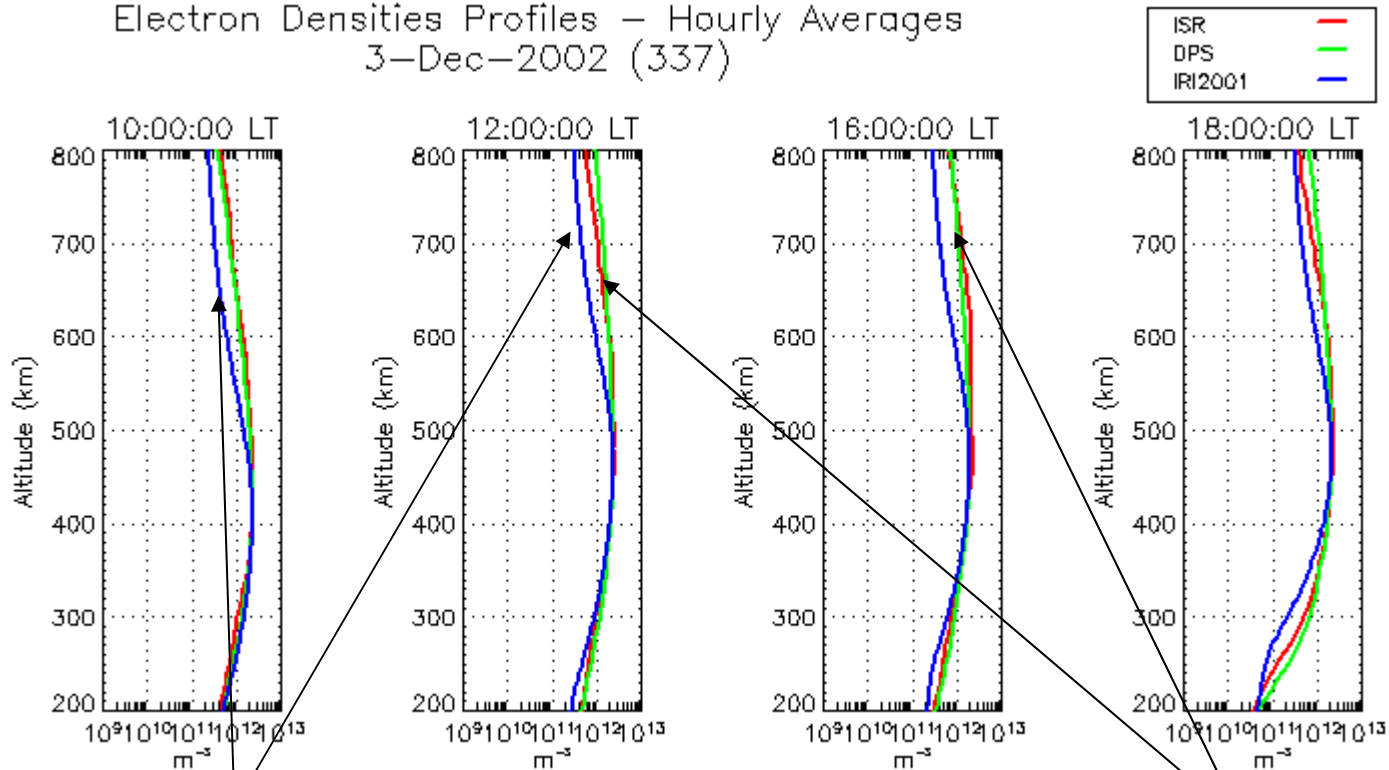
DPS vs ISR: Underestimation

IRI vs ISR: Overestimation



Topside Profiles: Daytime case

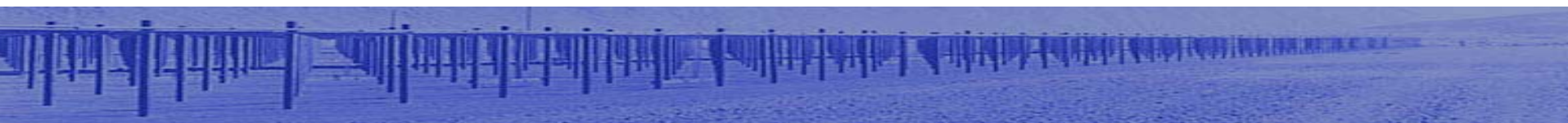
Electron Densities Profiles – Hourly Averages
 3-Dec-2002 (337)



Radio Observatorio de Jicamarca, Mon Oct 24 16:22:44 2005

IRI vs ISR: A evident understimation

DPS vs ISR: Good agreement

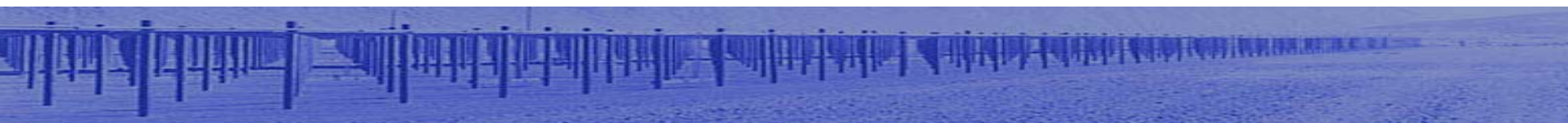


Conclusions

- IRI model shows the same trends compared with the radar data.
- It is evident that IRI model overestimates the topside electron density measured in equatorial latitudes, in special at nighttime.
- Ionosonde topside extrapolation technique have an excellent agreement with the ISR profile along daytime, but it is underestimated at nighttime hours.
- This new equatorial electron density profiles is available at MADRIGAL database (www.madrigal.org)

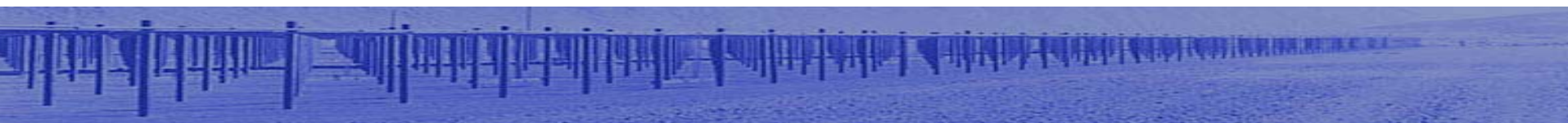
Future Work

- Get statistical characteristics of ISR densities, and temperatures using improved database since 1996, e.g.,
- To improve data quality of parameters deposited in databases.
- To derive a F region empirical model for this new densities, also with electron and ion temperatures.
- Work with IRI community to improved their equatorial estimates.
- Work with ionosonde groups to improve the derived topside densities.



References

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Thanks!

