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A New Look at Low- and Mid-Latitude Ionospheric Irregularities
A new look at low- and mid-latitude ionospheric irregularities

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Topical Outline

- $F$ region irregularities at the dip equator
  - In-beam radar imaging at Jicamarca
- Equatorial electrojet irregularities
  - Long duration JULIA radar observations
- Midlatitude sporadic $E$ layer echoes
  - HF radar at Clemson University
\begin{align*}
\langle g^*(x)g(x+dx) \rangle &= \int \frac{d\psi}{\sqrt{1-\psi^2}} e^{ik(dx)\psi} \frac{|f(\psi)|^2}{F(\psi)} G(dx) \\
Prob(\text{conclusion} | \text{new data}) &\propto Prob(\text{conclusion} | \text{old data}) \\
& \times Prob(\text{new data} | \text{conclusion}) \\
P(F) &\propto -\int d\psi F(\psi) \ln F(\psi) \times \prod_j \exp \left(-\frac{(G_j - \tilde{G}_j)^2}{2\sigma_j^2} \right)
\end{align*}
Equatorial Electrojet

\[ \omega_r(k) = \frac{k \cdot (V_a + \psi V_i)}{1 + \psi} \frac{1}{1 + (k_0/k_z)^2} \]

\[ E_p(z) \approx E_0 \frac{\sigma_H(z)}{\sigma_P(z)} - B u \]

\[ V(z) = \left[ \frac{E_0/B}{1 + \psi} \left( \frac{\sigma_H(z)}{\sigma_P(z)} - \frac{\nu_a}{\Omega_a} \right) + u \right] \frac{1}{1 + (k_0/k_z)^2} \]

\[ \sigma_P = \frac{1}{2\psi + 1} \left( \frac{\Omega_a}{\nu_a} \right)^2 \left( \langle \delta n/n \rangle \right) \sigma_P \]

eg. Fejer et al. '75, '84
Ronchi et al. '90
March 1998

April 1999
Equatorial Electrojet

\[ \omega_r(k) = \frac{k \cdot (V_d + \psi V_d)}{1 + \psi} \frac{1}{1 + (k_0/k)^2} \]

\[ E_p(z) \approx E_0 \frac{\sigma_H(z)}{\sigma_P(z)} - Bu \]

\[ V(z) = \left[ \frac{E_0/B}{1 + \psi} \left( \frac{\sigma_H(z)}{\sigma_P(z)} - \frac{\nu_0}{\Omega_0} \right) + u \right] \frac{1}{1 + (k_0/k)^2} \]

\[ \sigma_{P\varepsilon} = \frac{1}{2\psi + 1} \left( \frac{\Omega_0}{\nu_0} \right)^2 \langle |\delta n/n|^2 \rangle \sigma_{P\varepsilon} \]

eg. Fejer et al. '75, 84
Ronchi et al. '90
$E^\parallel B$ (WS) FROM ELECTROJET

From 150 km ECHOES

September 8, 1996

October 11, 1998
JULIA Horizontal Drift Velocity on August 31, 1996
Conclusions

- CS radar imaging is permitting us to resolve, at long last, certain fundamental problems in ESF.
- Low power radar at the electrojet can recover information usually reserved by ISR.
- Equatorial electrojet irregularities serve as tracers of neutral winds/waves in lower thermosphere.
- Midlatitude E region irregularities surprisingly regular, intense, dynamic, and intricate.