



**Quick Look Analysis of Broadband Aeronautical Data  
obtained from the Kuiper Airborne Observatory**

by

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# K/Ka-Band ACTS Aeronautical Experiments

## . AERO-X Experiments:

- Purpose: Test viability of speech/data transmissions at: 2.4, 4.8, 9.6, 64 kbps
- Link: NASA Learjet - ACTS - HBR-LET at LeRC
- Aircraft antennas: electronically steerable phased arrays
- Where: Between Cleveland and Washington, DC
- When: Spring/summer 1994

## .Broadband Aeronautical Terminal (BAT) Experiments:

### A Rockwell International Aeronautical tracking and high data rate experiments

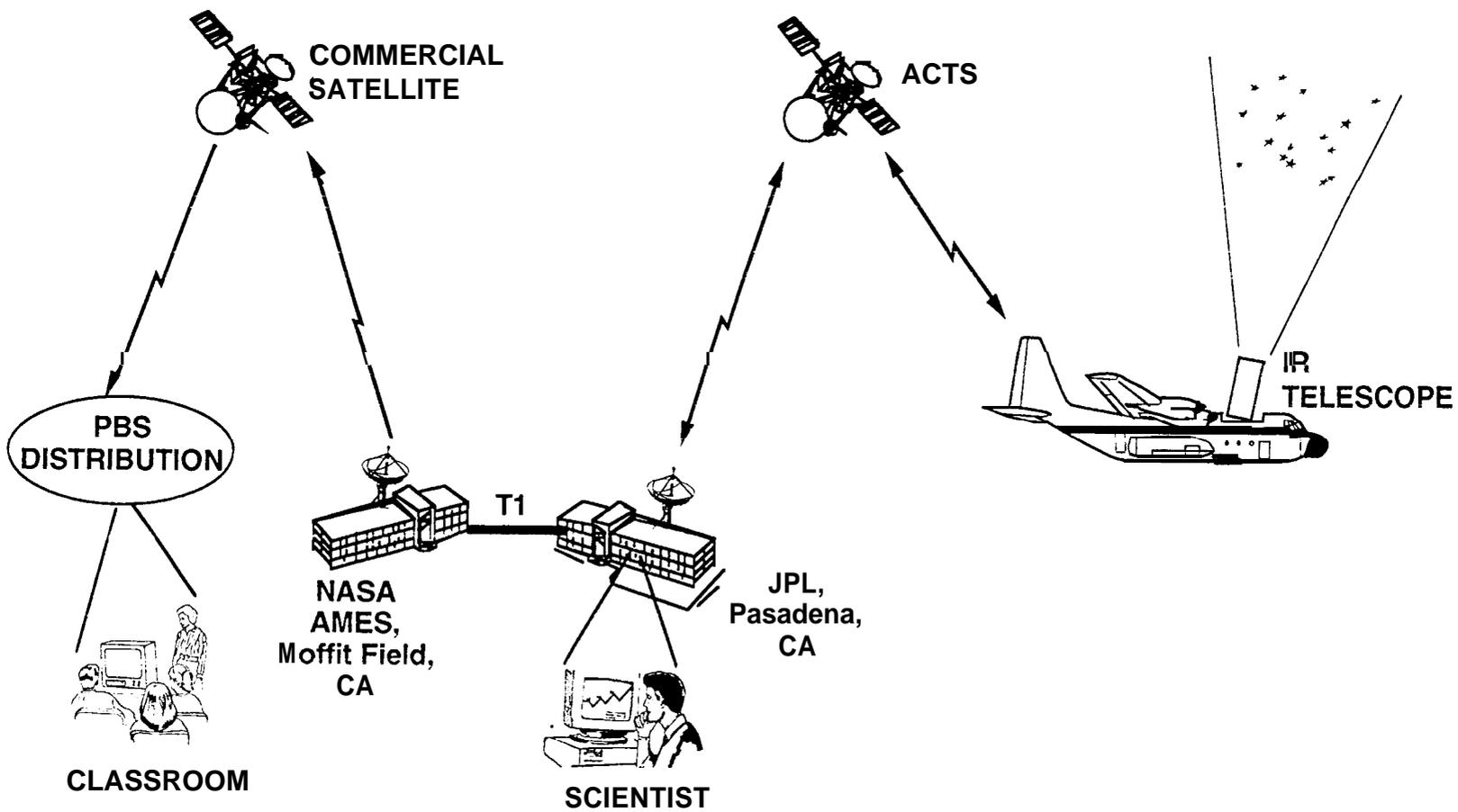
- Purpose: Test viability of high data rate transmissions at: 512, 768 kbps
- Link: Rockwell Sabliner- ACTS - JPL
- Aircraft antennas: mechanically steerable (az-el tracking)
- Where: Midwest
- When: August 1995

### A Kuiper Airborne Observatory (KAO) live TV broadcast

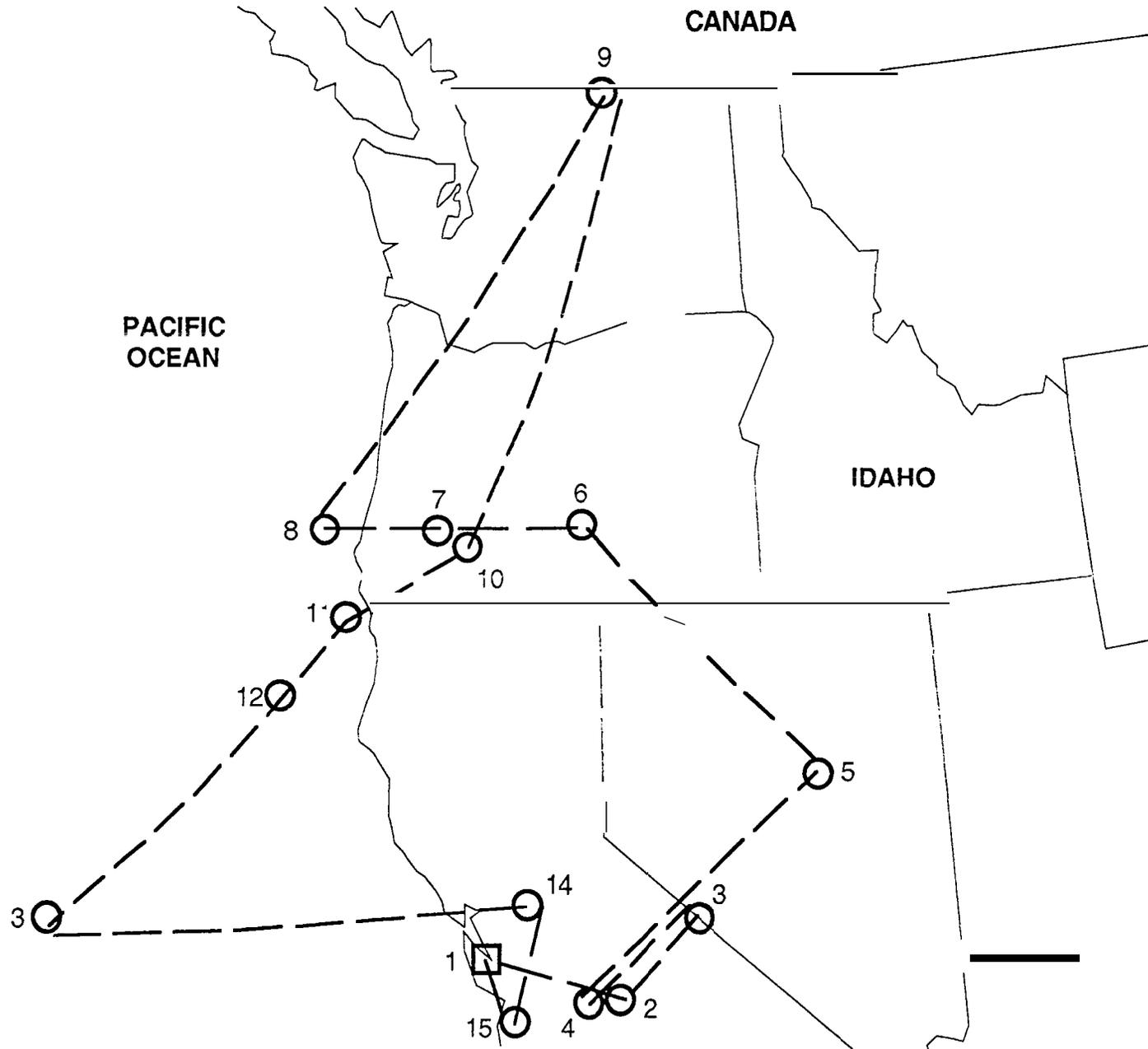
- Purpose: Test viability of high data rate transmissions to/from turbojet up to 384 kbps
- Link: KAO (C-141) - ACTS - JPL -( T1)- NASA AMES - CornSat - Classrooms
- Aircraft antennas: mechanically steerable (az-el tracking)
- Where: Northwest US + Houston, TX
- When: Summer/Fall 1995

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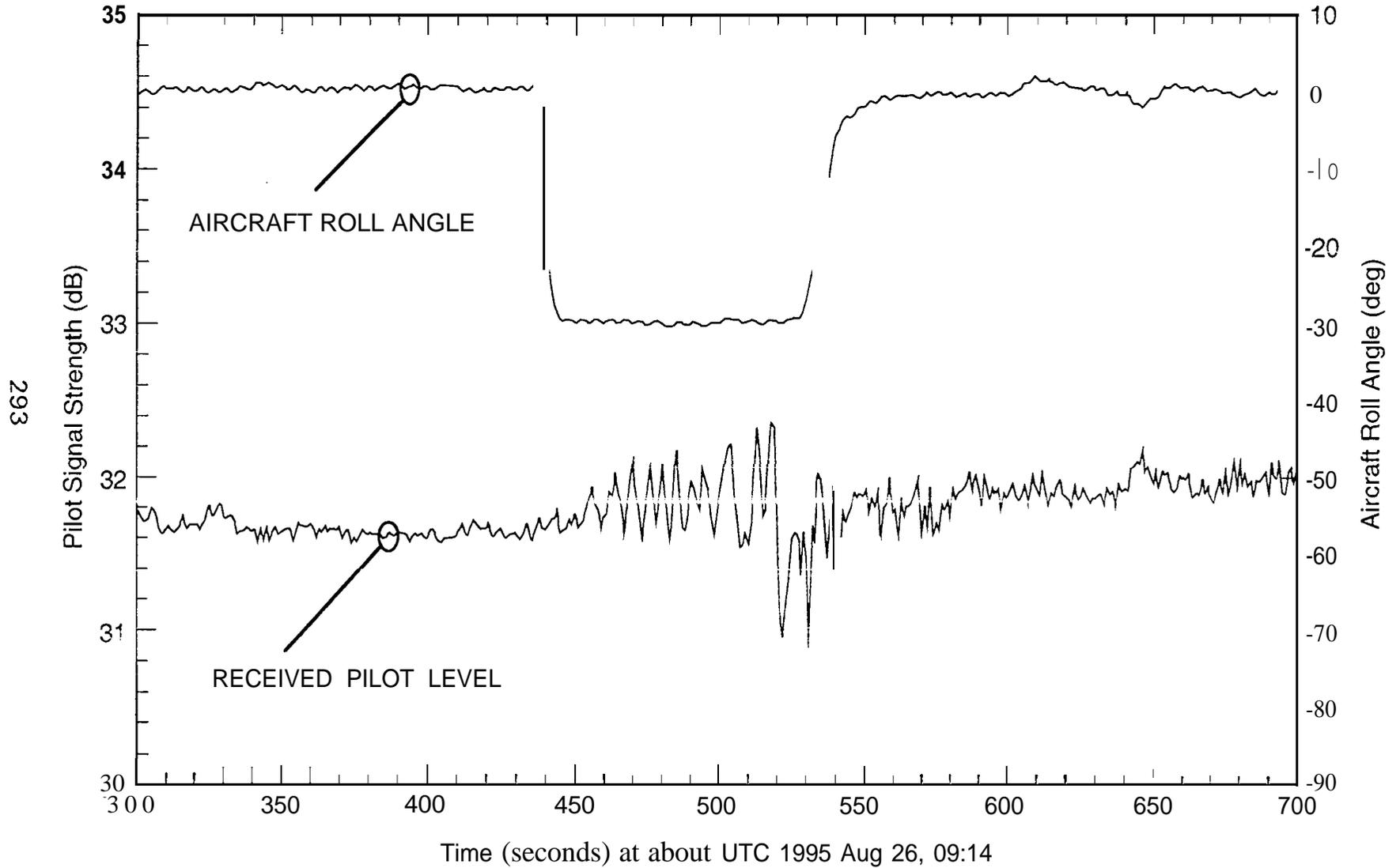
# KAO Experiment Configuration



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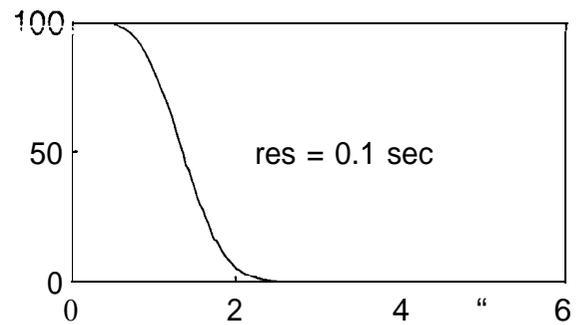
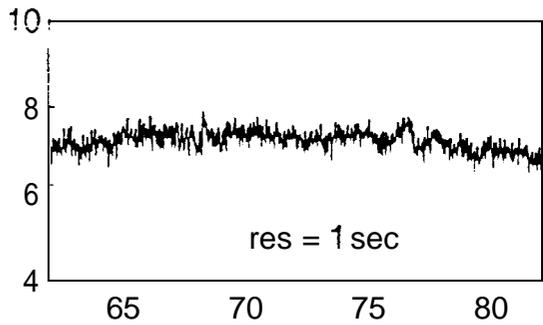
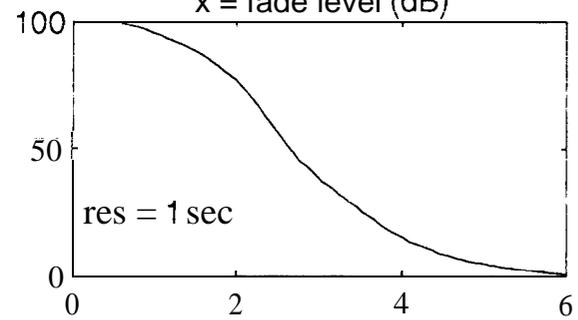
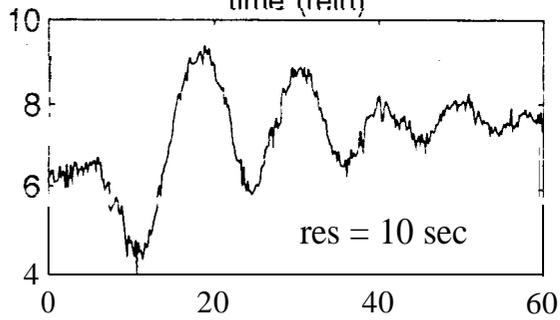
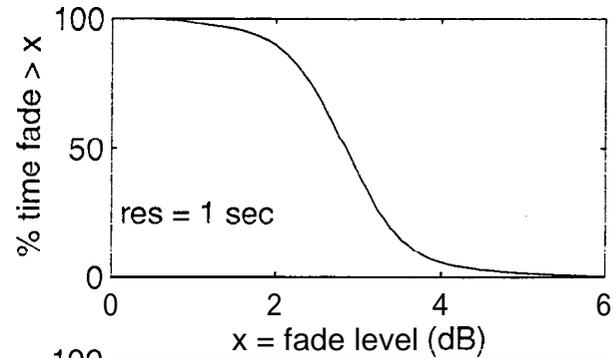
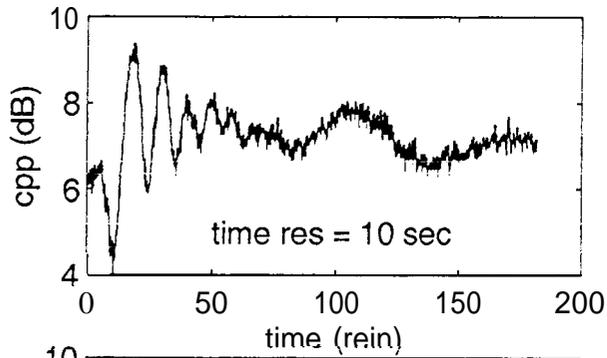


# Antenna Tracking Performance (KAO Flight 8-25-95)



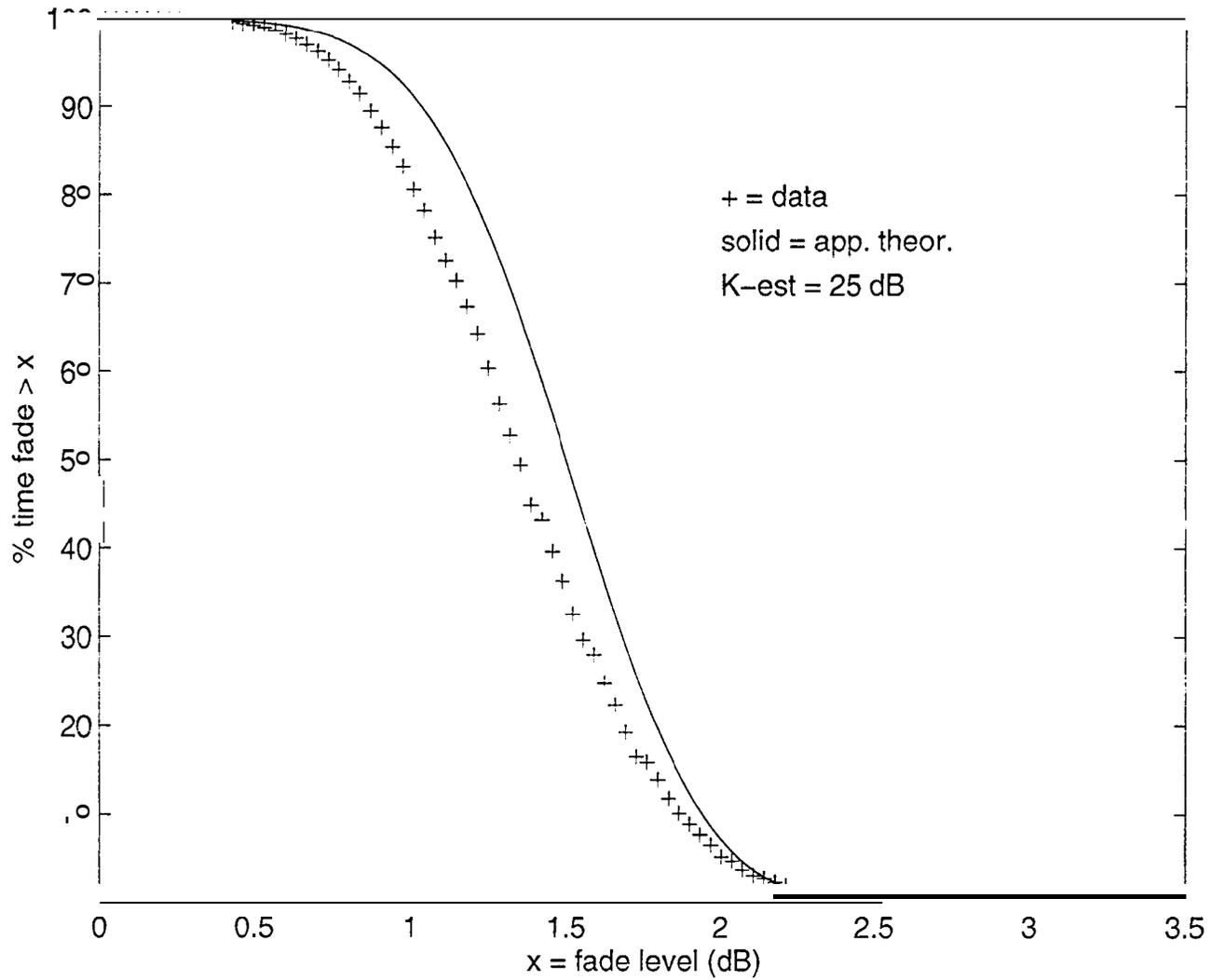


Coherent Pilot Power and Cumulative Fade Distributions  
for 12 October 1995 starting at 15:08:00





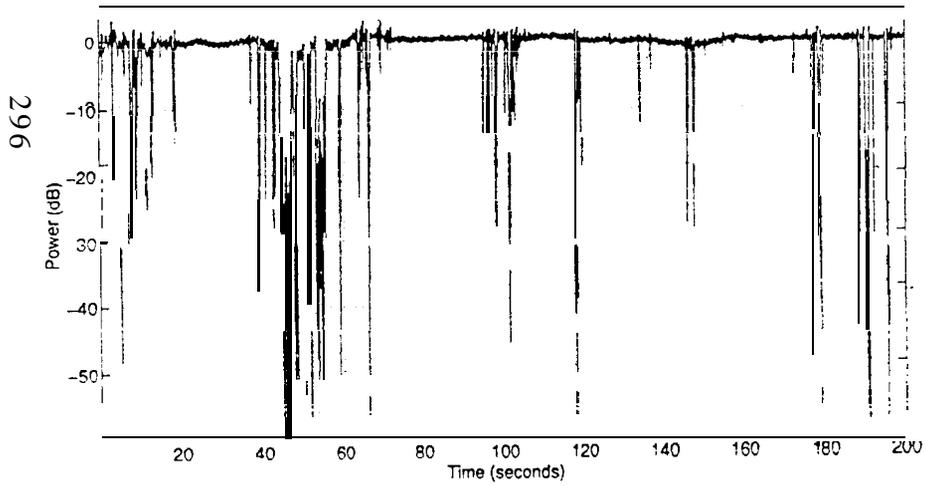
Approximate Fit Between Coherent Pilot Power Cumulative Fade Distribution and LOS Model  
for 12 October 1995 between 16:10:00 and 16:30:00 (0.1 sec sampling)



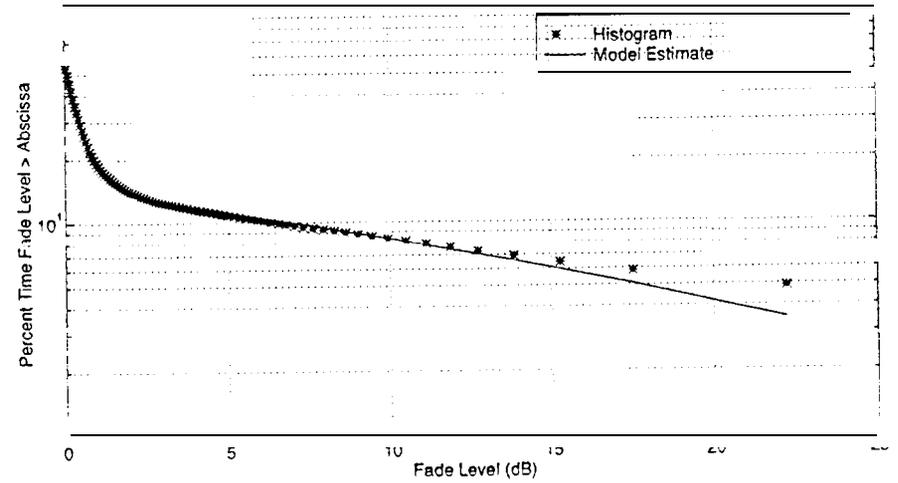


# Coherent Pilot Power and Cumulative Fade Distribution for a typical K-Band Land Mobile Satellite Channel

Time Series

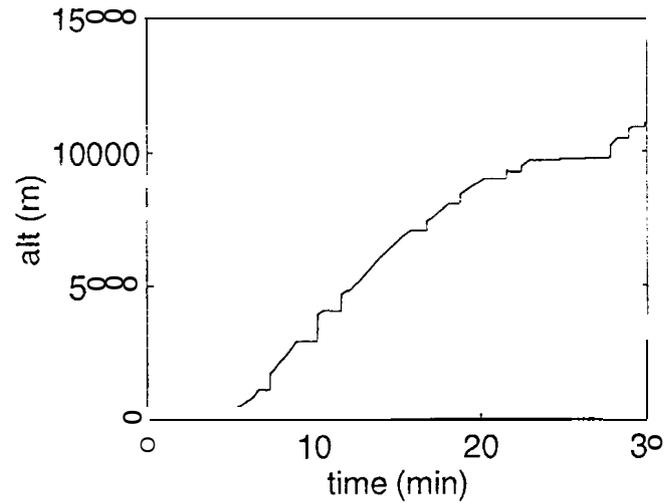
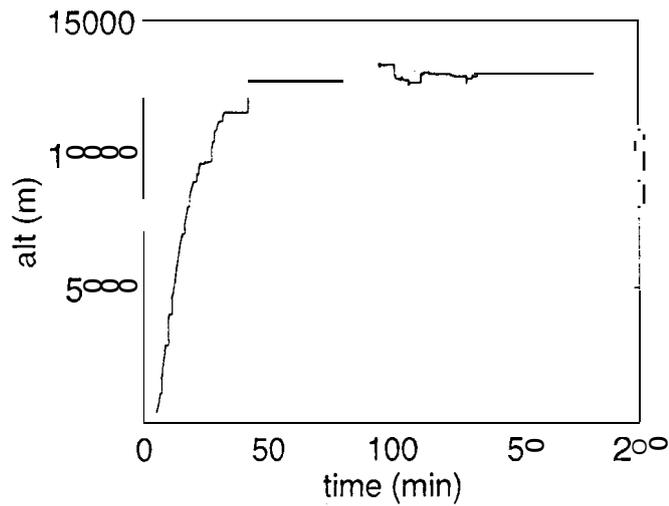
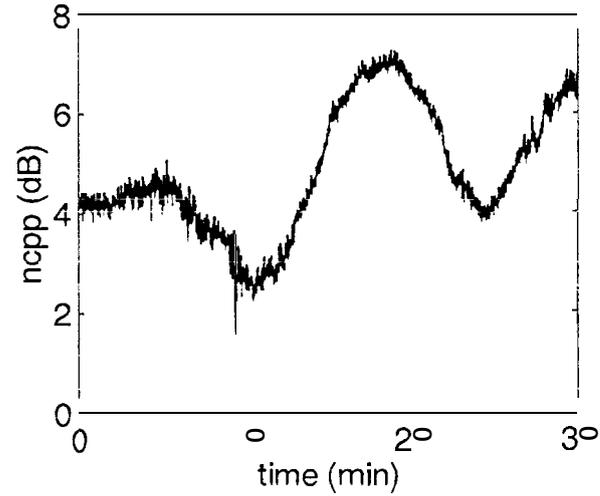
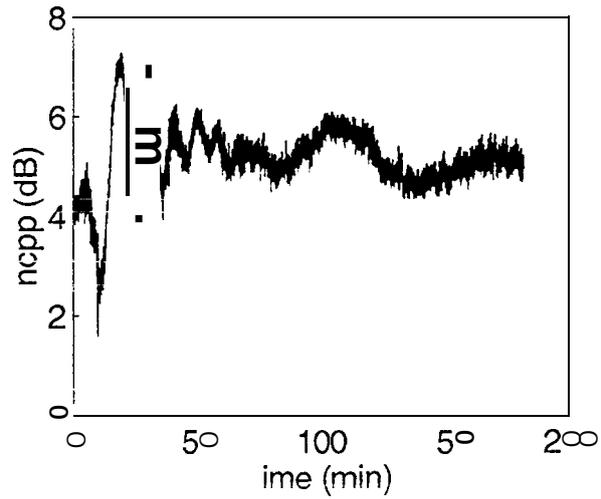


Cumulative Distribution



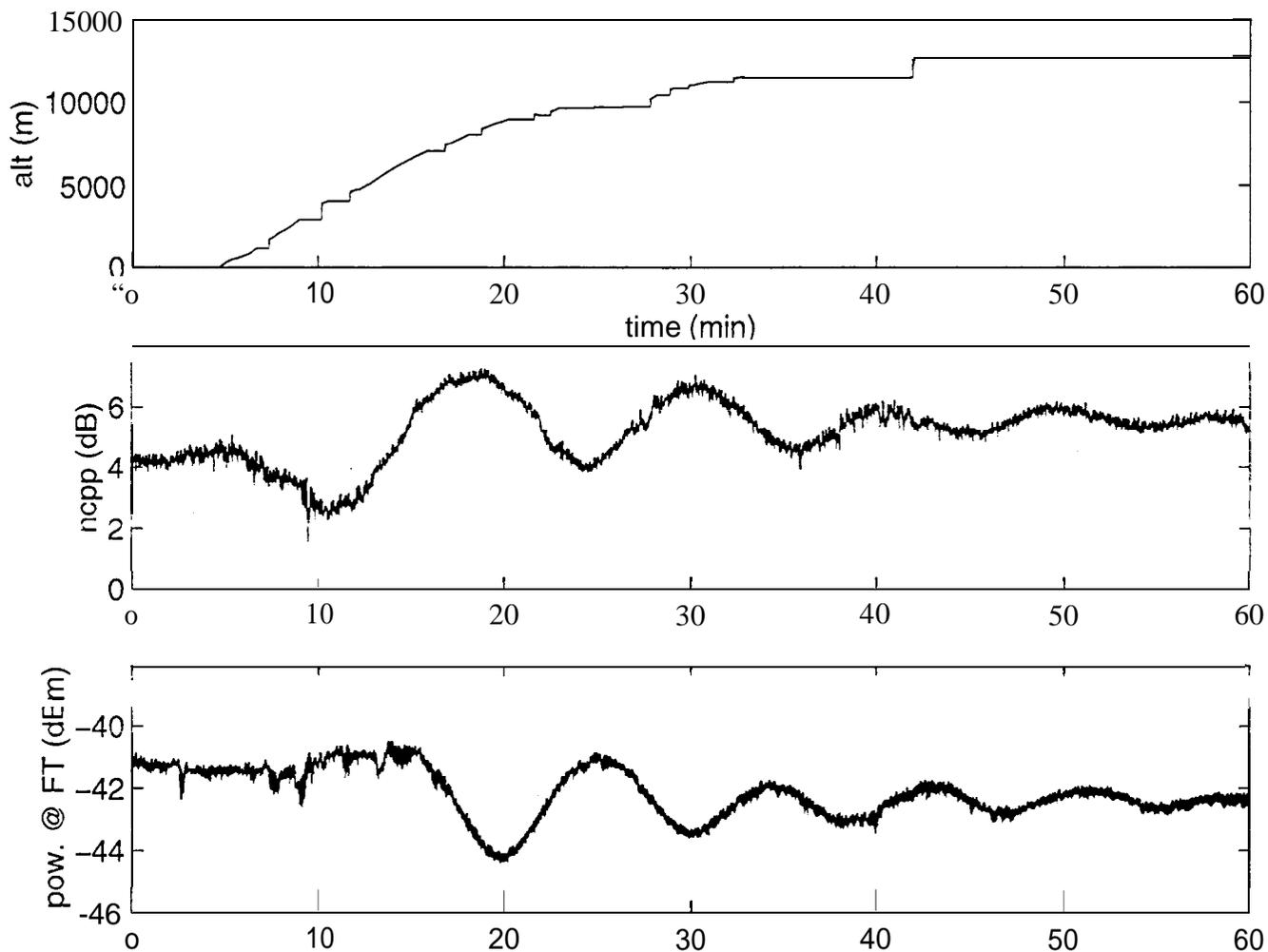


Noncoherent Pilot Power and Altitude for 12 October 1995 starting at 15:08:00



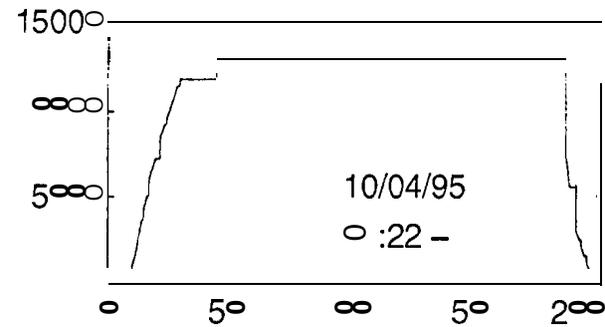
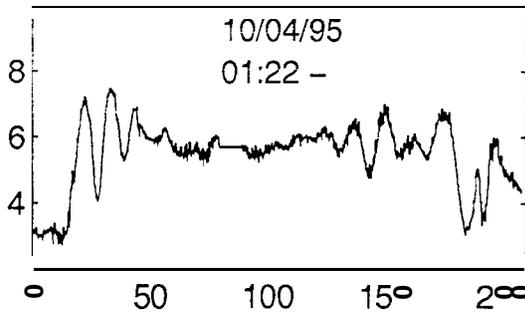
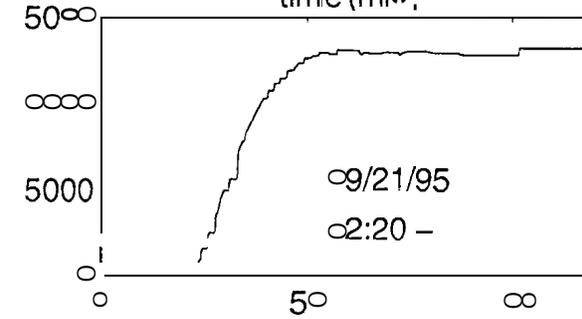
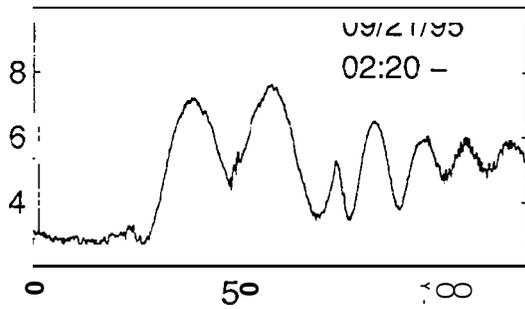
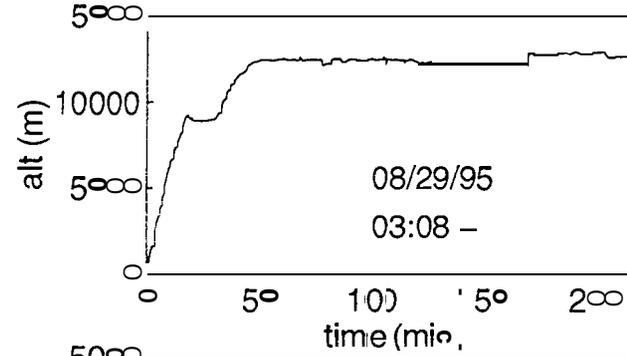
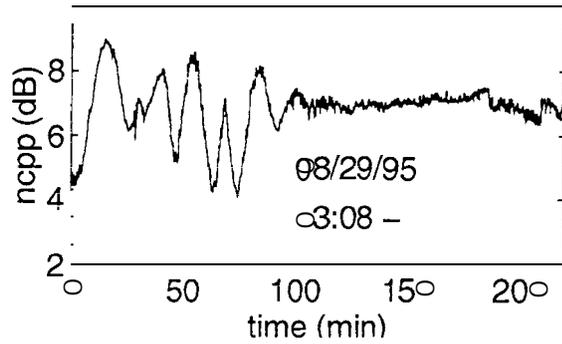


Altitude, Noncoherent Pilot Power and Received Power in the Data Channel at the FT for 12 October 1995 starting at 15:08:00





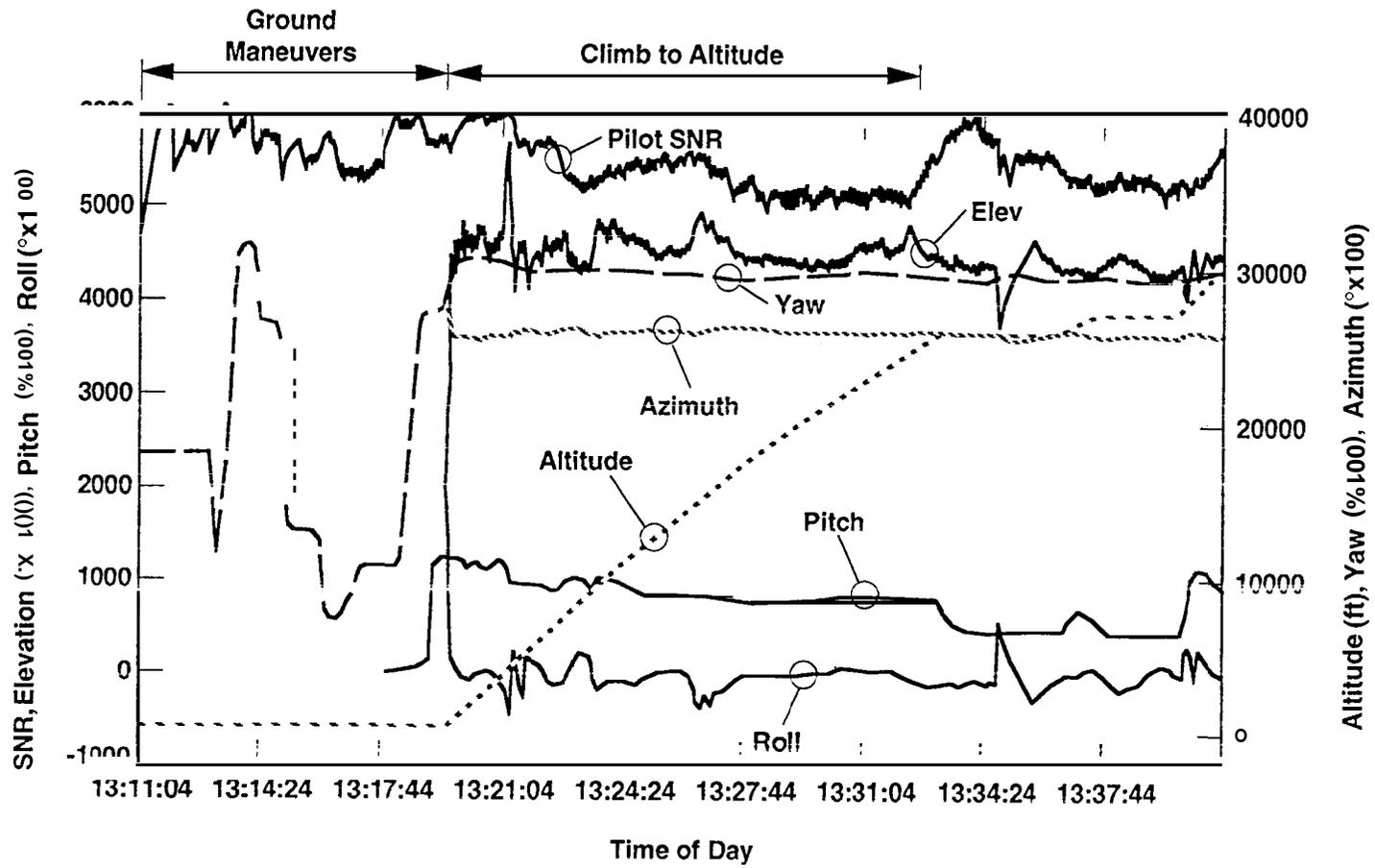
### Noncoherent Pilot Power and Altitude for Various Days





# Rockwell Sabreliner Flight Test Data for Take-off and Climb $\odot$ Altitude

300





## Preliminary Conclusions

- **Received pilot power data characterized by slowly varying amplitude ( $< \pm 2.5$  dB) during aircraft ascent/descent:**
  - Antenna tracking does not “appear” to be the cause, but final determination can only be made after antenna pointing error data are extracted
  - Temperature-induced changes in Rx/Tx gain is a possibility
  - Atmospheric attenuation is not likely since a lot of the flights were conducted under clear sky conditions
  - Shadowing/scattering from the tail structure may contribute
  - ACTS steerable beam (SB) pointing does not appear to be the cause, e.g., on 10/12/95 the SB was initially pointed to Moffett Field and was incrementally moved about 6 steps every five minutes in an easterly direction in response to the GPS inputs -- similarly for the other days
  - Comparable variability in received pilot power is not observed on ascent in the Rockwell Sabliner data set - but aircraft is much smaller
  
- **Received power in the data channel at the fixed ground terminal reveals similar variability**
  - Changes in received power at the ground terminal during ascent are not synchronous with the changes in received pilot power at the aircraft but are of the same magnitude (lack of synchronicity possibly caused in part by the difference in propagation frequencies)
  - This variability in received power at the ground station is consistent with either temperature variations in Rx/Tx gain at the aircraft or propagation-related phenomena
  
- **Over time scales  $< 10$  min and at level altitude, pilot propagation can be characterized by LOS propagation with large Rician parameter ( $> 25$  dB)**
  
- **Work is on-going to better understand this airborne propagation channel**