

# UNAVCO/IRIS/NASA COLLABORATIVE EFFORT TO UTILIZE VSAT TECHNOLOGY FOR REMOTE DATA TRANSFER

Collaborative Agencies Include: UNAVCO, NASA, Incorporated Research Institutions for Seismology (IRIS), Universite des Sciences et Techniques de Masuku - Franceville Gabon, Geological Survey, Mines Department and Ministry of Energy and Mineral Development - Entebbe Uganda, Charles Darwin Foundation - Galapagos

Oivind Ruud<sup>1</sup>, Mike Jackson<sup>1</sup>, David Stowers<sup>2</sup>, Ronald Muellerschoen<sup>2</sup>, Warren Gallaher<sup>1</sup>, Victoria Andreatta<sup>1</sup>

1. UNAVCO/UCAR 3340 Mitchell Lane Boulder, CO 80301

2. Jet Propulsion Laboratory, California Institute of Technology 4800 Oak Grove Drive Pasadena, CA 91109

The Jet Propulsion Laboratory (JPL) and the University NAVSTAR Consortium (UNAVCO) Boulder Facility both on behalf on NASA collaborated with Incorporated Research Institutions for Seismology (IRIS) and several overseas institutions to utilize Very Small Aperture Terminal (VSAT) technology in the best interests of a multi-disciplinary science community. By integrating high accuracy GPS and meteorological sensors with seismic installations, researchers now have an opportunity to investigate geological and tectonic events using several data sets. It is our hope that the scientific value of data from collocated instruments will be greater than individual data sets in differing locations. In addition, the cost share reduces the fiscal burden of each organization without sacrificing science goals. VSAT technology is particularly suited to areas that lack commercial or private Internet infrastructure but would otherwise be good candidates for providing sensor data, for reasons of geographic or geological uniqueness. For these locations, VSAT is currently the only viable solution for real-time or near real-time data transfer. VSAT collaborations have demonstrated the feasibility of operating solar powered installations in remote areas and have produced new knowledge and technology achievements for future remote GPS/Seismic installations. Great thanks and acknowledgments are also due to the various host organizations for help in accommodating and facilitating the installation of these VSAT stations.

## INSTALLATIONS IN:

### Mbarara, Uganda (MBAR)



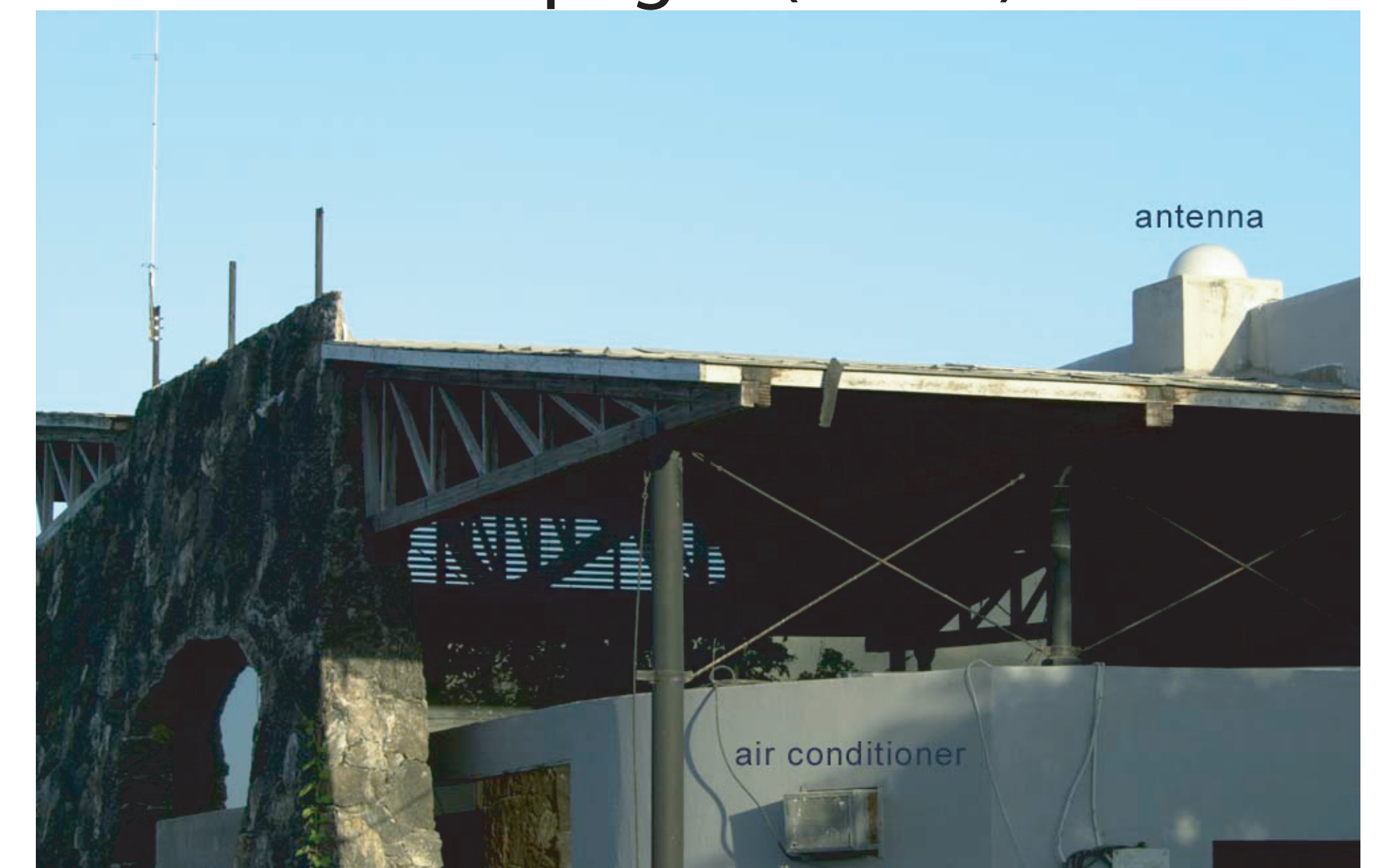
C-band VSAT dish from Meissa installed by IRIS. UNAVCO/JPL operates an Ashtech Z-XII3 receiver and a Paroscientific MET-3 system. Both VSAT & GPS equipment are powered from a self contained solar power system. The Ashtech receiver provides 1 second data which is placed in UDP packets and sent to JPL through a 19200 baud channel on the VSAT. The data collection computer is a UNAVCO designed PC-104 system running Red Hat Linux 5.2. The GPS monument was excavated to a depth of 2.2 meters and constructed of a rebar re-inforced concrete pillar. The concrete is anchored to rebar driven to refusal in the surrounding consolidated soil.

### Franceville, Gabon (MSKU)



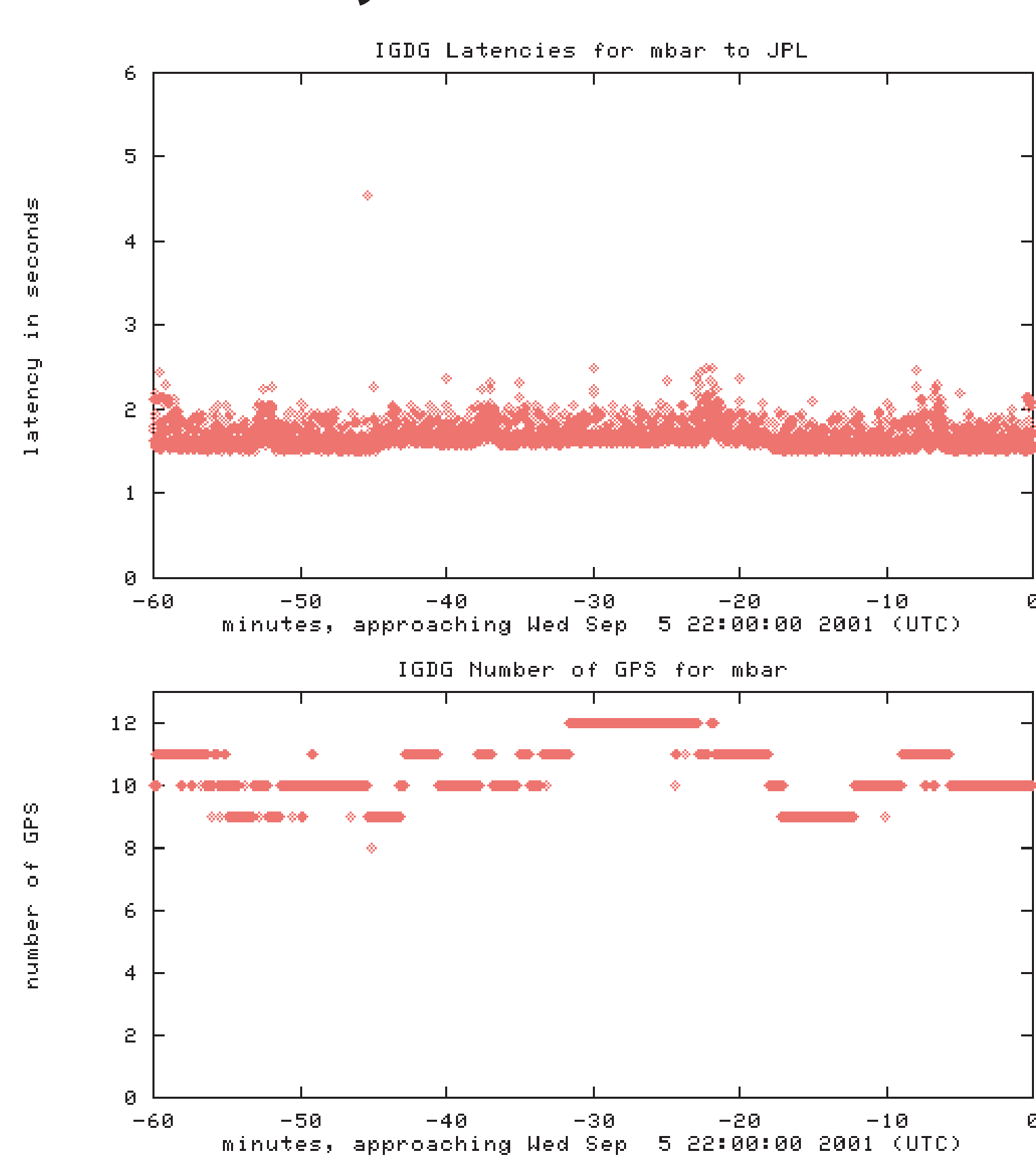
Ku-band VSAT dish from Meissa installed by IRIS. UNAVCO/JPL operates an Ashtech Z-XII3 receiver and a Paroscientific MET-3 system. The Ashtech receiver provides 1 second data which is placed in UDP packets and sent to JPL through a 9600 baud channel on the VSAT. The GPS monument is excavated to bedrock and constructed of a rebar reinforced concrete pillar anchored in bedrock.

### The Galapagos (GALA)

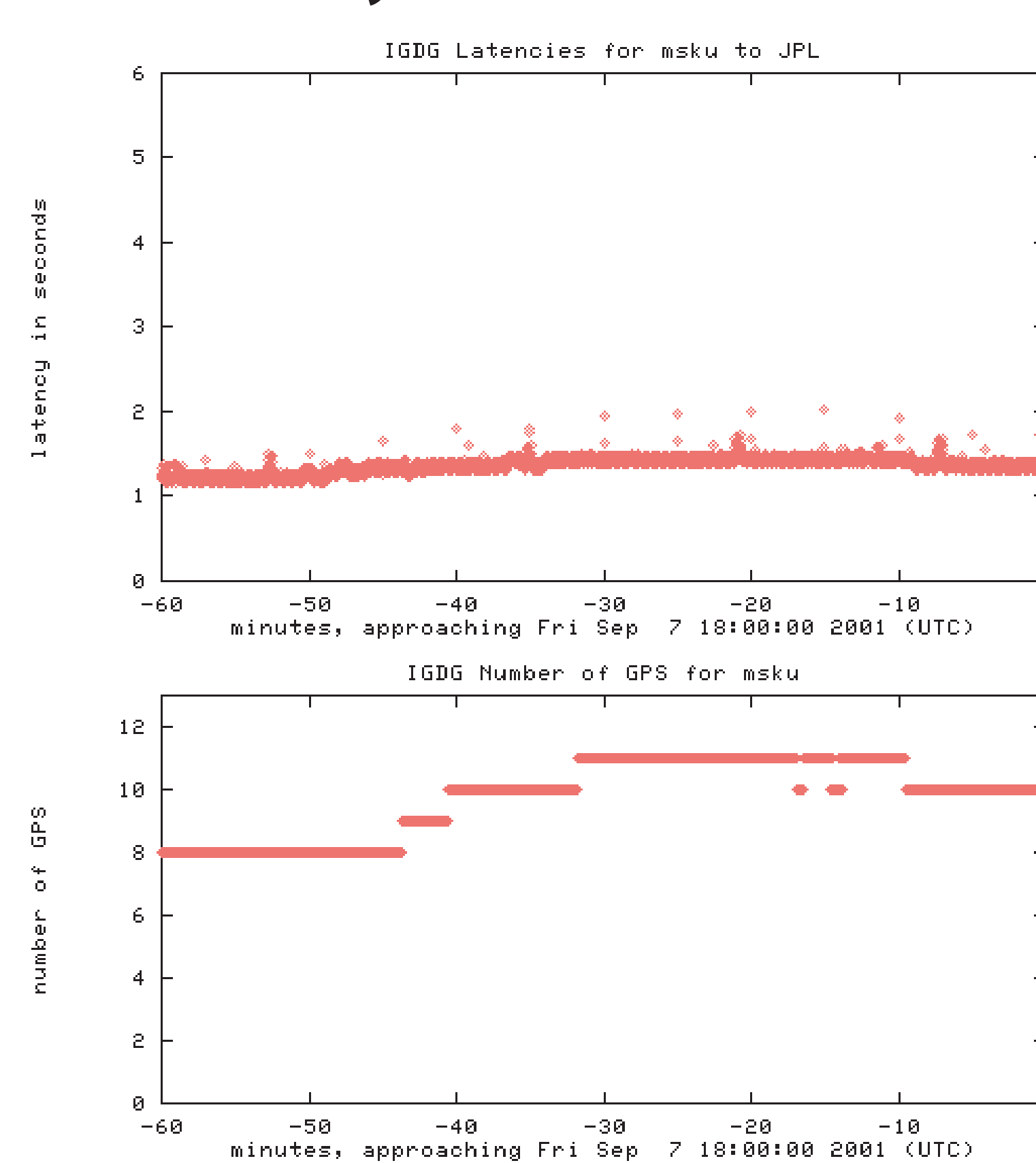


UNAVCO/JPL operates an Ashtech Z-XII3 receiver at the Darwin Station on Santa Cruz Island on the Galapagos. The Ashtech receiver provides 1 second data which is placed in UDP packets and sent to JPL through a 9600 baud channel on the VSAT system installed by IRIS.

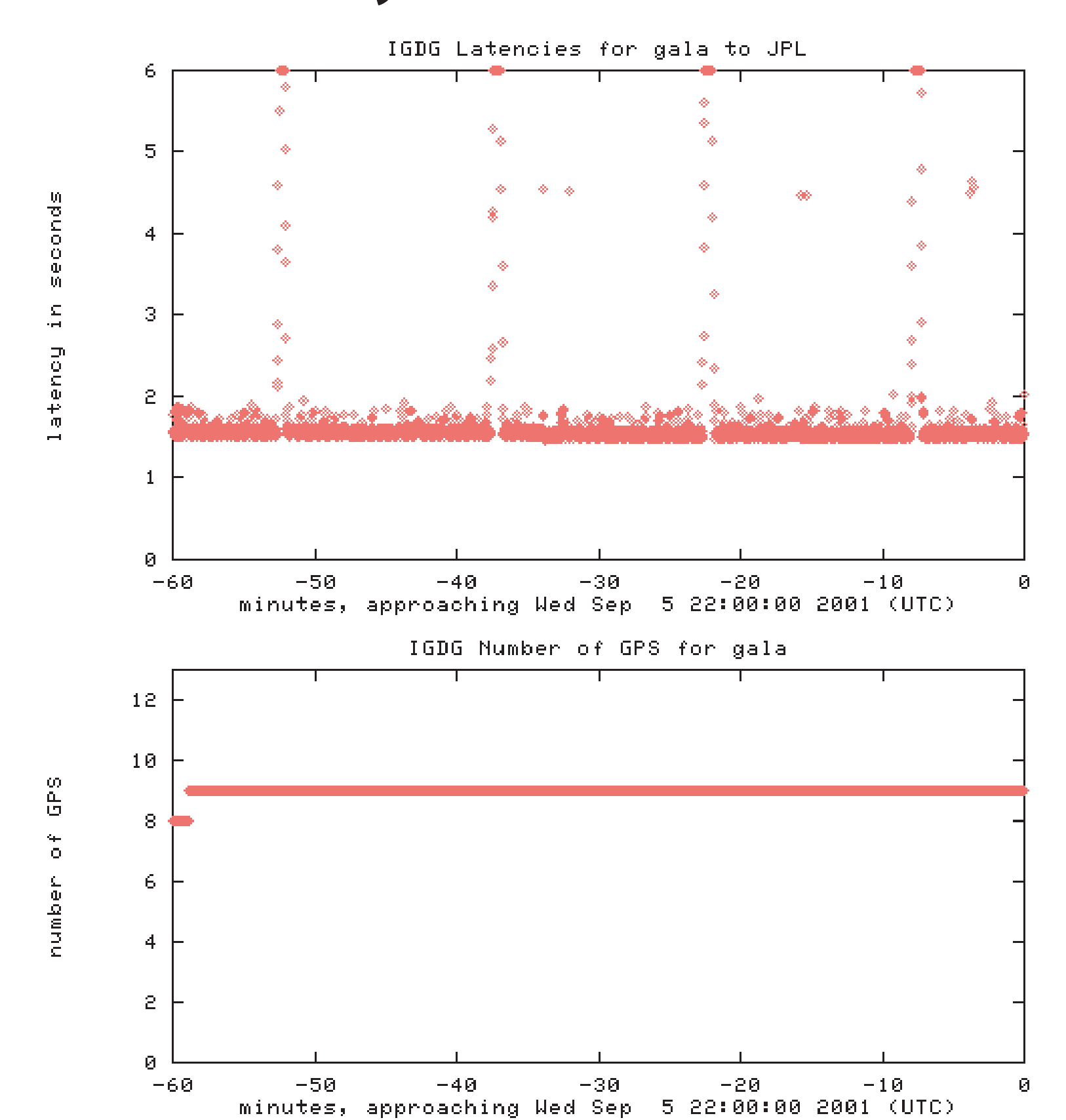
### Latency Plot (MBAR)



### Latency Plot (MSKU)



### Latency Plot (GALA)



Top plot shows latency for 1 second data received at JPL from MBAR, MSKU, and GALA. Typical latencies are about 1-2 seconds. Lower plots show number of satellites tracked. The plots are updated every 30 minutes. Spikes (increases) in latencies about every 15 minutes shows the effect of transferring the binned raw files to JPL for creation of IGS products.



## PC-104 Technology

UNAVCO developed a reliable, robust and user-friendly PC-104 DC-based download computer to address space-limited installations running on DC-only (+12 V) power. Standard PC-104 components were selected including a PCM-586 processor, and a low power 192 MB flash drive from SanDisk. The solid-state design of the drive eliminates the need for any moving parts, helping to ruggedize the assembly. The PC-104 is placed inside a metal casing on a sliding rack, making disassembly, maintenance, and card replacements easy. Standard CD-ROM and floppy drive components will work with the PC-104 motherboard and the unit can be configured with new OS or software using the external devices. The PC-104 at MBAR is running a subset of the RedHat LINUX 5.2 distribution on a single partition keeping the installation to about 100MB. The computer is running a JPL-coded GPS data offload program and a MET-3 system recording program using one serial port for each instrument. A third serial port is configured as a serial console interface using 'mgetty', allowing another PC (e.g. a field laptop) to be used to configure the PC-104 without using a separate keyboard and monitor.

