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A Proposal to Construct an EOS Direct Broadcast Reception Facility at the University of Wisconsin-Madison Space Science and Engineering Center

Liam E. Gumley
Co-Investigator and Program Manager
Space Science and Engineering Center (SSEC)
University of Wisconsin-Madison

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Objective

To procure and implement an Earth Observing System (EOS) direct broadcast ground system to support an initiative to provide EOS direct broadcast data and products to the scientific and educational community.

Highlights

A SeaSpace TeraScan SX-EOS groundstation was installed at SSEC in August 2000 in order to receive direct broadcast from Terra and Aqua. The system was declared operational on January 1, 2001, and since then has routinely acquired every Terra pass above 5 degrees elevation. A near real-time processing facility was established to automatically process the MODIS data and produce quicklooks for distribution on the World Wide Web. By the end of 2001, the system had acquired over two thousand Terra passes.

Procurement and Installation Details

SSEC requested bids from industry to supply an antenna system capable of acquiring the direct broadcast signal from the Terra and Aqua spacecraft. The lowest bid which met all requirements was tendered by SeaSpace Corporation of San Diego CA, who were subsequently selected to provide a turn-key system including antenna, radome, and related processing hardware. The bid requirements called for the antenna and radome to be placed atop a 40 ft. tower on the roof of the 15-story SSEC building.

In order to obtain the best possible view to the horizon from the SSEC rooftop (avoiding existing satellite antennas), a 40 ft. tower was procured by SSEC. Consulting engineers Arnold and O'Sheridan conducted a structural analysis of the antenna/radome, tower, and building support structure to verify the integrity of the proposed installation, and to verify that the pointing accuracy of the antenna would be sufficient for reliable reception of X-band data. General contractors J.P. Cullen & Sons were contracted to assemble and install the tower. Due to the height and downtown location of the SSEC rooftop, the decision was made to use a helicopter to lift the tower sections to the roof. Industrial airlifting specialists Carson Helicopters were selected to provide the helicopter lift services.

Following the installation of rooftop hardpoints anchored to the SSEC building frame, the tower was assembled in a parking lot adjacent to the SSEC building. On 27 November 1999, the helicopter

lift took place. The roof support beams and tower sections were disassembled before the lift into 3 pieces, each of which were lifted separately. The specially modified Sikorsky S-61 helicopter lifted the 3 sections to the roof within one hour.

On 5 August 2000, the antenna and radome supplied by SeaSpace were successfully lifted onto the tower atop the SSEC building. Once again, general contractors J.P. Cullen & Sons and airlift specialists Carson Helicopters provided installation and lift services. The SeaSpace TeraScan SX-EOS system was first assembled on the ground, and the radome enclosure was then built around the antenna (Figures 1 and 2).

During August and September 2000, the finishing touches were made to the tower. Electrical service, lighting, and walkways were completed. The radome is rated to handle 150 mph wind loads. The antenna is completely shielded from winds, rain, and snow by the radome, which allows work to be done on the antenna in comfortable and safe conditions (Figure 3). A GPS receiver on the antenna platform relays accurate time codes to the control computer located on the 6th floor of the SSEC building (Figure 4).

Acceptance Testing

On December 29, SSEC completed the 30 day acceptance test of our SeaSpace system. The system was required to automatically acquire all Terra passes (day and night) during this period without any human intervention. A total of 146 passes were acquired successfully during the test, which happened during the snowiest December on record for Madison (it was also the 4th coldest December on record).

Automated Data Processing and Distribution

The automated Terra MODIS quicklook system implemented at SSEC produces calibrated Level-1B data and remapped images over the continental US, Canada, and the Gulf of Mexico within 90 minutes of the end of each overpass. For nighttime passes, infrared window images are generated at a variety of map scales. For daytime passes, visible images created from single bands, and true color composites created from multiple bands, are produced at a variety of maps scales over the USA (Figure 5). A list of target geographic locations and band combinations is queried for every MODIS overpass, and if the location was seen by that pass, a quicklook image is created. The list may be edited to add regions of special interest. An example is the flooding in the US upper midwest during the Spring of 2001 (Figure 6).

The MODIS Level-1B data are made available to the public at no cost. A rotating archive of the most recent 7 days of data are always online for download. For access to the quicklook images and Level-1B data, see the following website: http://eosdb.ssec.wisc.edu/modisdirect/

Conclusion

SSEC has successfully procured, installed, and verified an X-band ground station for receiving Terra and Aqua direct broadcast data. The system has performed reliably and continuously since December 2000, acquiring all Terra passes above 5 degrees elevation day and night. Automated data processing provides quicklook images and calibrated Level-1B data for each pass to the world via World Wide Web and FTP servers.

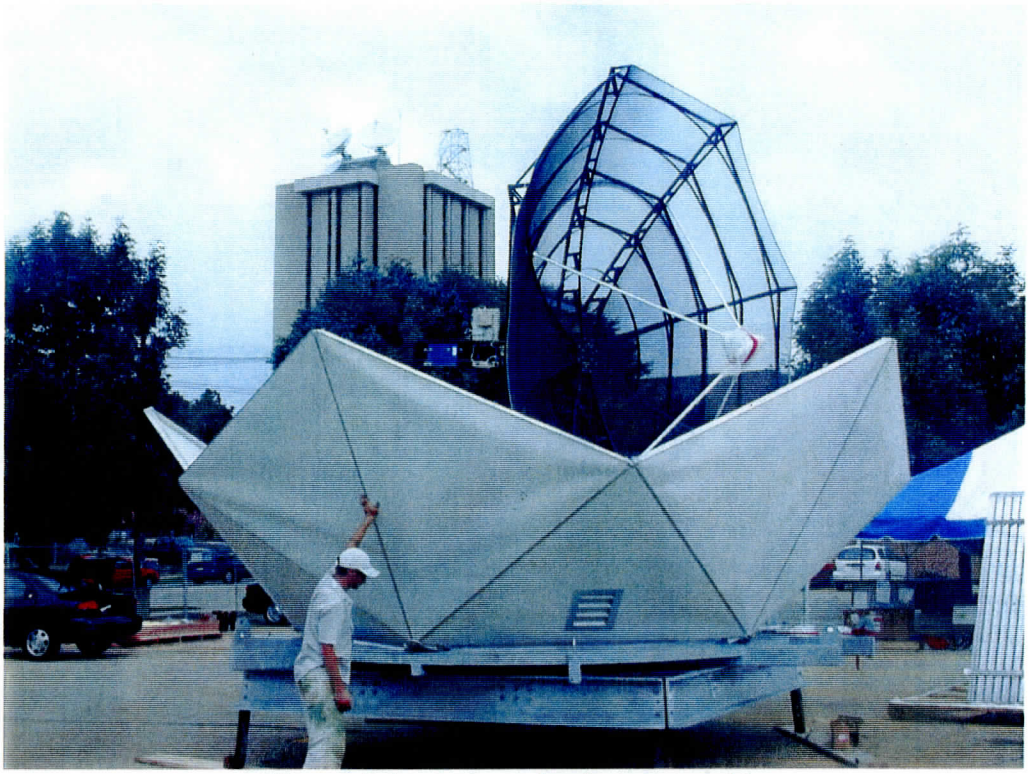

Figure 1: Antenna and radome assembly

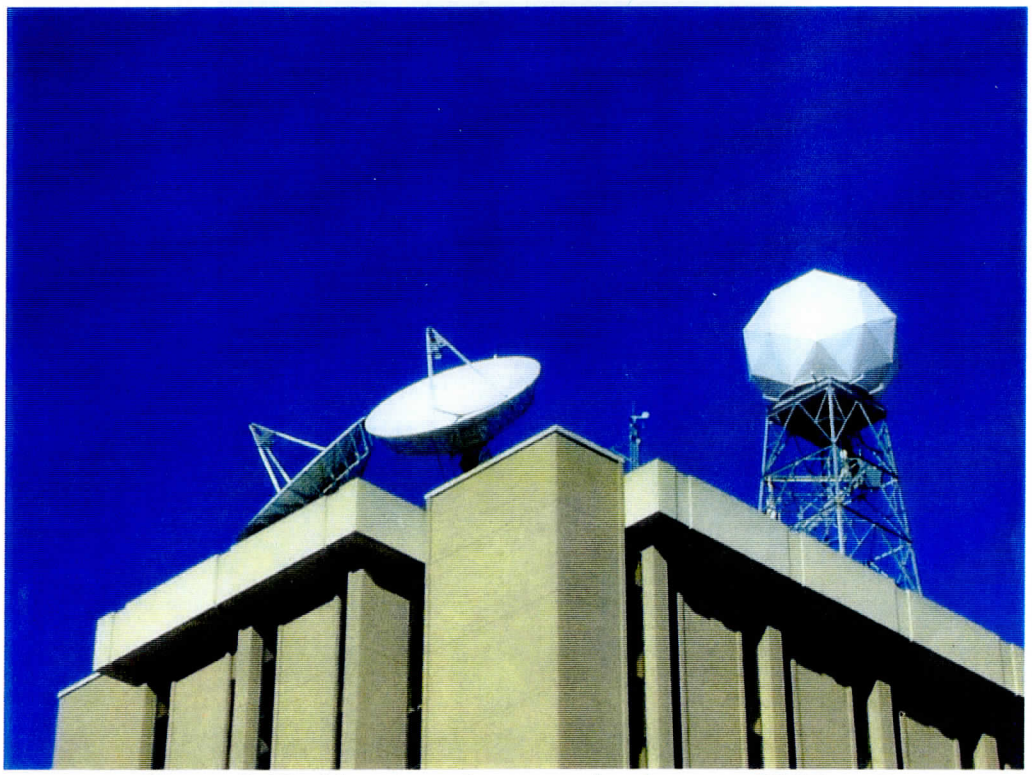

Figure 2: Final location of tower and radome on SSEC roof

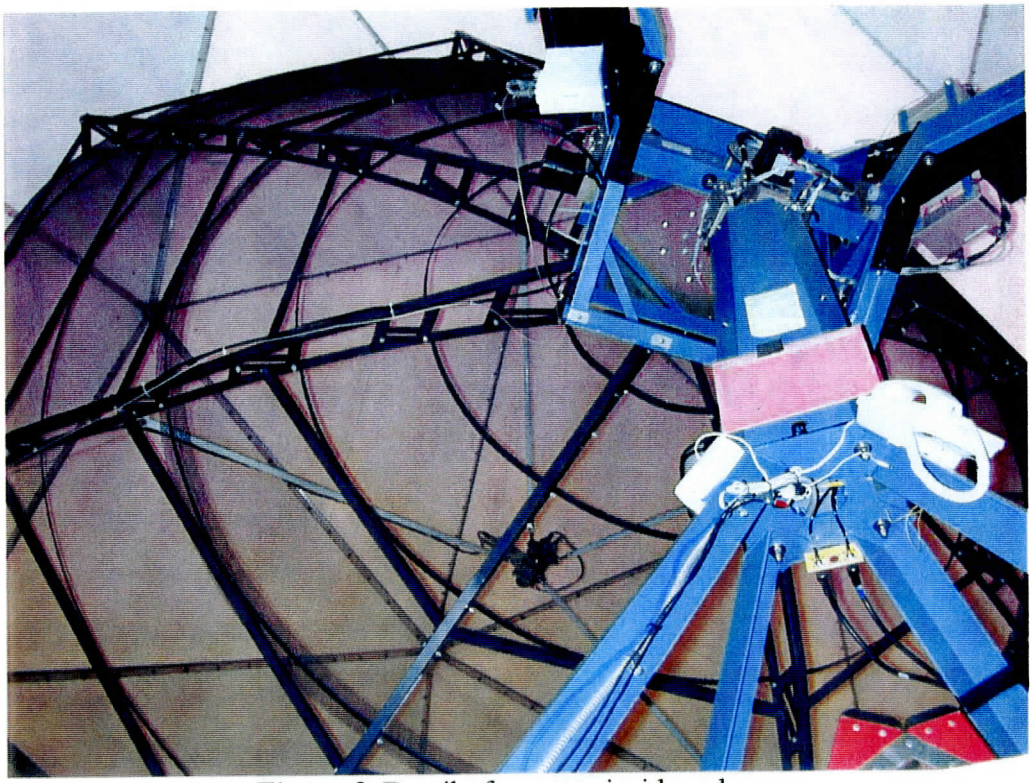

Figure 3: Detail of antenna inside radome

Figure 4: SeaSpace equipment rack (antenna controller, receiver, control computer, UPS)

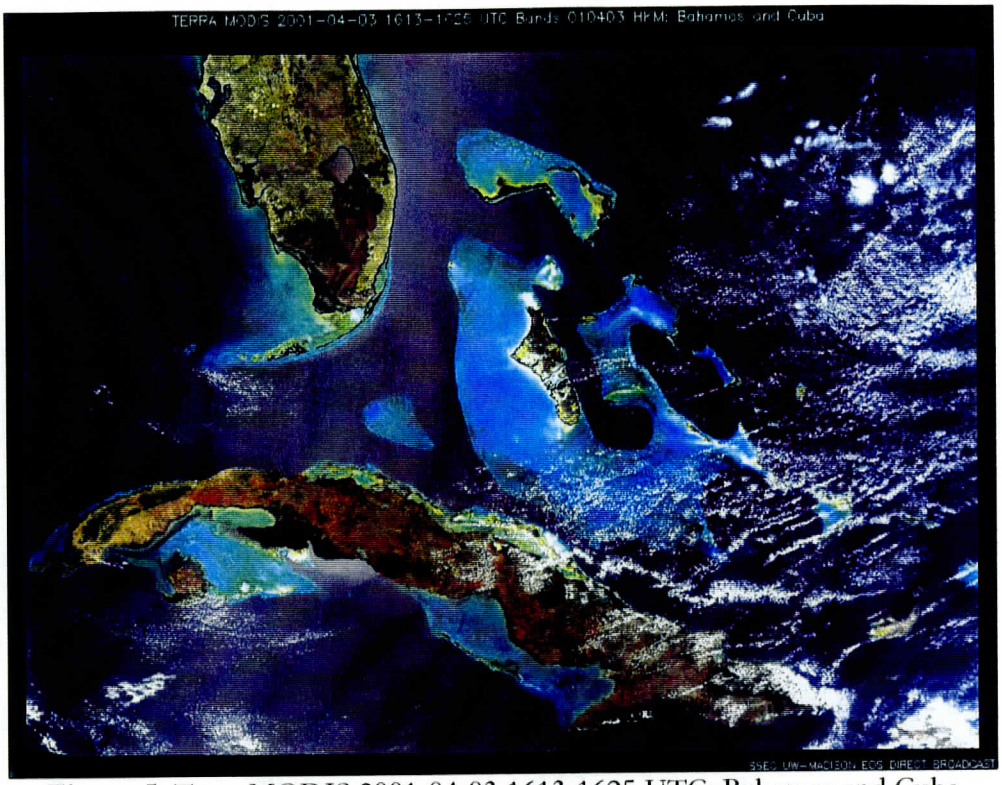

Figure 5: Terra MODIS 2001-04-03 1613-1625 UTC: Bahamas and Cuba

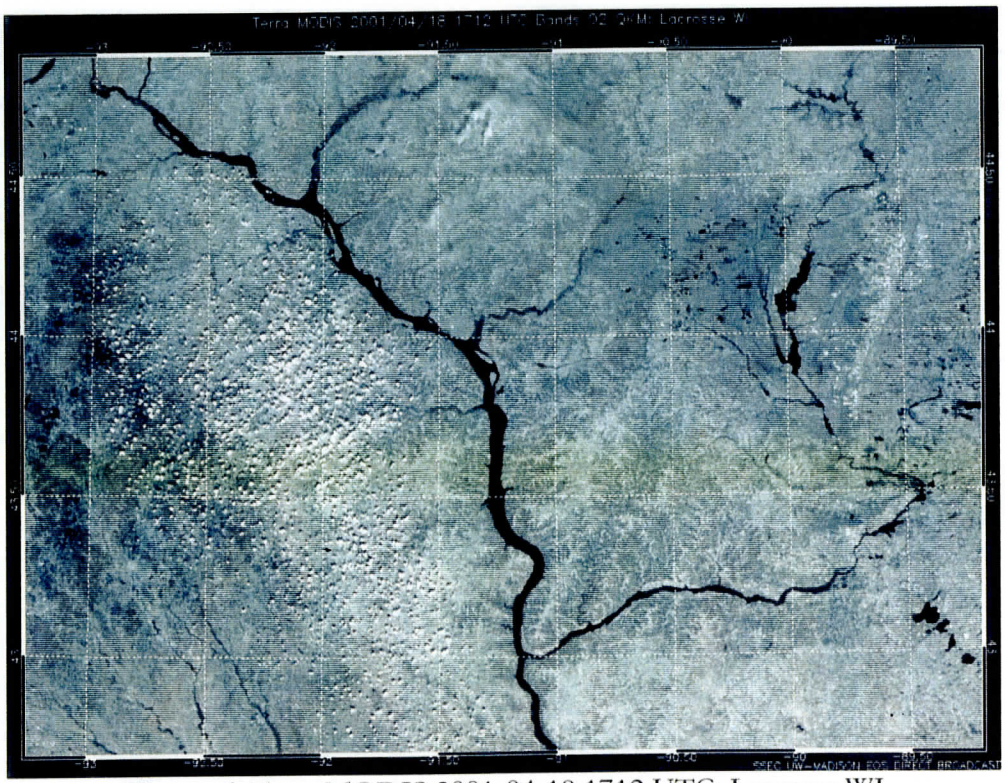

Figure 6: Terra MODIS 2001-04-18 1712 UTC: Lacrosse WI