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An Overview of the GOES-N Science Test

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1. INTRODUCTION*

The next three Geostationary Operational Environmental Satellite (GOES) to be launched: GOES-N/O/P will have instruments similar to the GOES-8/12 instruments, but will be on a different spacecraft bus (Figure 1). The new bus will allow improvements both to the navigation and registration, as well as the radiometrics. The first of this new series, GOES-N will become GOES-13 after successfully obtaining the geostationary orbit. Current plans call for GOES-N to become operational sometime after the on-orbit spare, GOES-11, is used.

By supplying data through the eclipse, the GOES-N/O/P system addresses one of the major current Imager limitations which are eclipse and related outages. This is possible due to spacecraft batteries. Outages due to Keep Out Zones (KOZ) will be minimized.

There will be radiometric improvements. The GOES-N+ instruments (Imager and Sounder) will be less noisy. A colder patch temperature is the main driver. In addition, there is a potential reduction in striping to be achieved through increasing the Imager scan-mirror dwell time on the blackbody from 0.2 sec to 2 sec.

There will be improvements in both the navigation and registration on GOES-N+. The GOES-N navigation will be improved due to the new spacecraft bus and the use of star trackers (as opposed to the current method of edge-of-earth sensors). In

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general, the navigation (at nadir) will go from between 4-6 km with today's Imager to less than 2 km with those on the GOES-N/O/P satellites. Both within-frame and frame-to-frame registration will also be improved.

All these enhancements will be monitored during the NOAA post-launch Science Test. As with other GOES check-outs, there are several main goals for the GOES-N Science Test. First, the quality of the GOES-N data will be investigated. This will be accomplished by comparison to other satellite measurements or by calculating the signal-to-noise ratio. The second goal will be to generate products from the GOES-N data stream and compare to those produced from other satellites. These products may include several Imager and Sounder products: visible and shortwave albedo, land skin temperatures, temperature/moisture retrievals, total precipitable water, lifted index, cloud-top pressure, atmospheric motion vectors, and sea surface temperatures. The third goal is to investigate the impact of the recent instrument changes. For example, the better navigation, improved calibration and the operation through eclipse periods will be investigated. In addition, rapid-scan imagery of both severe weather and hurricane/tropical storm cases will hopefully be investigated as part of GOES-R Risk Reduction activities.

2. POST LAUNCH TESTING

Similar to previous GOES checkouts following launch, there will be a pre-operational period, during which the instruments are run in various routine schedules to provide radiance measurements to be validated, as well as to generate products from the radiances. These post-launch check-out periods are essential to the subsequent operational use of the satellite assets. A number of groups within NOAA NESDIS and its Cooperative Institutes take part in the Post-Launch Tests (PLT).

The PLT schedule is being planned, but will not be firmed up until GOES-N is launched. The Science Tests follow maneuvers to reach geostationary orbit and follow most of the engineering tests that must take place first. This means that the Science Tests do not occur until at least a month after launch of GOES. Unfortunately, the launch of GOES-N has been delayed many times. Originally planned for early 2005, the launch is currently scheduled for November 2005 at the time this is being written. If the launch occurs then, the Science Tests will not occur until late December or January 2006. That means that no test results are available at this writing. Therefore, this paper outlines the proposed Science Tests that will be accomplished. The first Science Test results may be available in poster form at the Satellite Conference. But, with further launch delays, there may be no Science Test results available at that time either. In either case, the results will be presented in a *NOAA NESDIS Technical Report* very similar to the ones produced for GOES-11 and GOES-12 (Daniels et al. 2001; Hillger et al. 2003, and Figure 2).

This is one of three papers at this conference dealing with the GOES-N Science Tests. For the other two papers, see Daniels et al (2006) and Schmit et al (2006) for more details on the Imager and Sounder, respectively.

2.1 Proposed Schedules

The satellite operations schedule for the Science Tests will include choices of image sectors and the timing of those sectors. Choices will range from operational-type schedules to super-rapid-interval (rapid-scan) imagery that might otherwise not be available during normal operations of the satellite.

Examples of schedules for the Imager instrument include:

- Continuous 5-minute imagery, CONUS or other fixed sector

- Continuous 1-minute (rapid-scan) imagery, plus 5-minute CONUS every hour, with movable center point
- Continuous 8-minute imagery over South America
- Continuous emulation of GOES-east operations
- Continuous 2-minute imagery, plus CONUS every hour
- Special imagery to capture the moon off the edge of the earth

Examples of schedules for the Sounder instrument include:

- 26-minute sector every 30 minutes
- Continuous 9-minute for selected sectors
- Continuous hourly for South America
- Continuous emulation of GOES-east operations

2.2 Proposed Tests

The proposed Science Tests include:

- Imager and Sounder noise estimates from space-view data, including comparisons to previous GOES and to instrument specifications
- Imager and Sounder detector-to-detector striping, including comparisons to previous GOES
- Imager to Imager comparisons for simultaneous sectors
- Imager to polar-orbiter comparisons
- Sounder bias mode
- Scan-mirror emissivity coefficients (Sounder and Imager)
- Imager to Sounder comparisons
- Various product validations
- Calibration testing using moon reflectivity

3. PREPARATIONS

In preparation for GOES-N, the spectral coverage of the four GOES-N Imager IR bands and the eighteen GOES-N Sounder bands have been plotted in Figure 3 along with the earth-emitted spectra calculated from the U.S. Standard Atmosphere. The GOES-N Imager and Sounder IR-band weighting functions are plotted in Figure 4a and b, respectively.

4. SUMMARY

The GOES-N Science Tests will take place beginning about a month after the launch of the satellite. If the satellite is launched soon, some of the results of those tests may be available in poster form at this conference. Regardless, the test results, which are the combined efforts of number of groups within NOAA NESDIS and its Cooperative Institutes, will be distributed as a new *NOAA NESDIS Technical Report* that should become available about 6 months after the launch of GOES-N.

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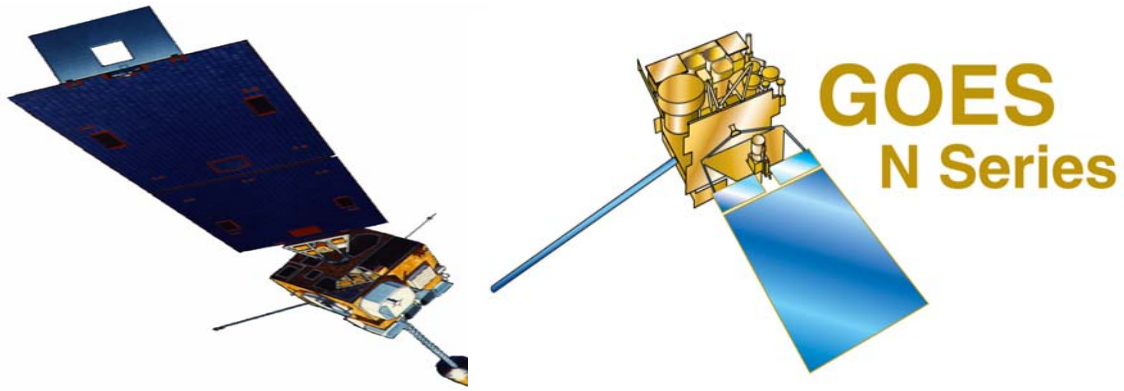

Figure 1: GOES-8/12 (left) and GOES-N (right) spacecraft. (Images courtesy of NASA.)

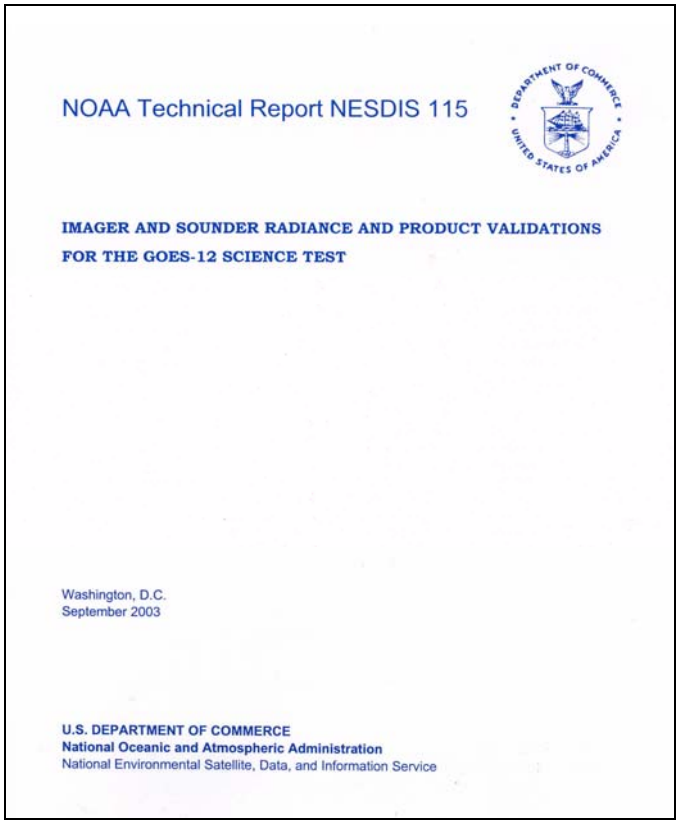

Figure 2: Cover of *NOAA Technical Report NESDIS 115*: Imager and Sounder Radiance and Product Validations for the GOES-12 Science Test

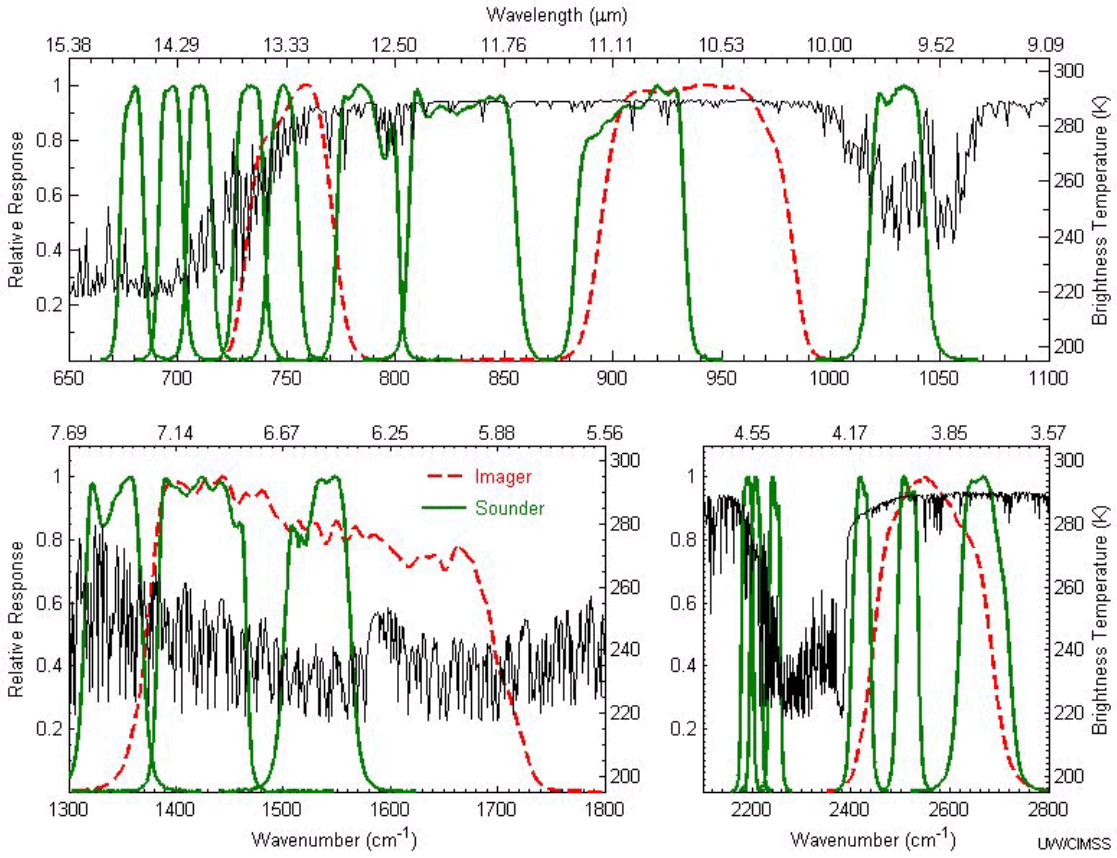

Figure 3: The spectral coverage of the four GOES-N Imager IR bands (dashed-red) and the eighteen GOES-N Sounder bands (solid-green) plotted with the earth-emitted spectra calculated from the U.S. Standard Atmosphere. (Figure courtesy of Mat Gunshor/CIMSS.)

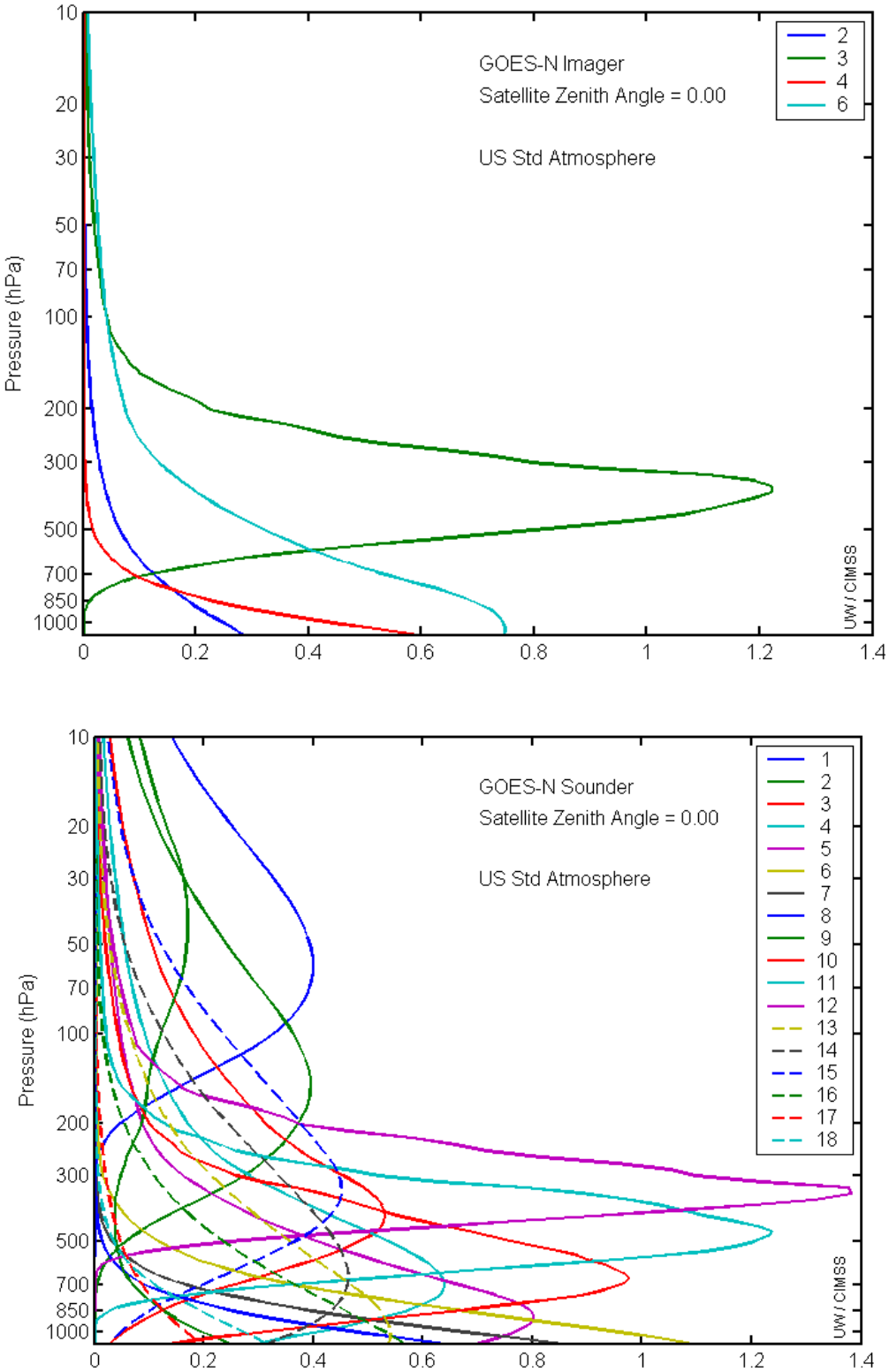

Figure 4: GOES-N Imager (top) and Sounder (bottom) IR-band weighting functions. (Figures courtesy of Mat Gunshor/CIMSS.)