The GOES-R ABI (Advanced Baseline Imager) and continuation of GOES-N class sounder products

Timothy J. Schmit
tim.j.schmit@noaa.gov
NOAA/NESDIS
SaTellite Applications and Research (STAR)
Advanced Satellite Products Branch (ASPB)
Madison, WI

James J. Gurka
NOAA/NESDIS, GOES-R Program Office
Greenbelt, MD

Jun Li
Cooperative Institute for Meteorological Satellite Studies (CIMSS)
University of Wisconsin-Madison
Madison, WI

Kevin Schrab
NOAA/NWS, Office of Science and Technology
Silver Spring, MD

Thanks also to…

W. P. Menzel, NOAA/NESDIS/STAR
Mitch Goldberg, NOAA/NESDIS/STAR
Tom Renkevens, NOAA/NESDIS/GPO
Mat Gunshor, CIMSS
Allen Huang, CIMSS
Dick Reynolds, Short and Associates

The views, opinions, and findings contained on this poster are those of the authors and should not be construed as an official National Oceanic and Atmospheric Administration or U.S. Government position, policy, or decision.

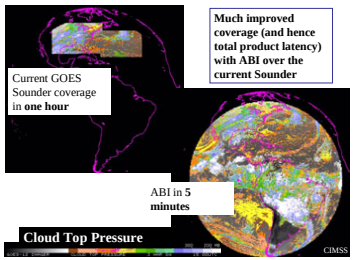
Product	Temporal Latency	Spatial	Accuracy	Overall	Comments
Radiances	ABI ~ 20X faster	Comparable (when averaged)	Comparable	Comparable	Only 1 CO2 band on ABI. Similar number of moisture bands.
TPW	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	ABI product quality helped with model info
Lifted Index	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	ABI product quality helped with model info
Skin Temperature	ABI ~ 20X faster	Comparable (when averaged)	Comparable	Comparable	ABI has additional window band
Profiles	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	Worse upper-level T and lower-level moisture
Clouds	ABI ~ 20X faster	ABI Finer	Sounder more precise	Comparable	More CO2 bands gives a better height
Moisture winds	ABI ~ 20X faster	ABI Finer	Comparable	Comparable	

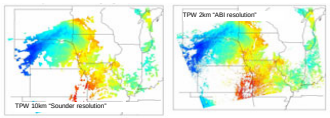
Operational Products from the current GOES Sounder and how the ABI could help produce legacy products. Some attributes would be improved, while others slightly degraded.

The GOES Sounders have provided quality hourly radiances and derived products over the continental U.S. and adjacent oceans for over 10 years. The products derived include: clear-sky radiances; temperature and moisture profiles; Total Precipitable Water vapor (TPW) and layer PW; atmospheric stability indices such as Convective Available Potential Energy (CAPE) and Lifted Index (LI); cloud-top properties; clear-sky water vapor winds via radiance tracking; and total column ozone. These products are used for a number of numerical weather prediction and forecasting applications.

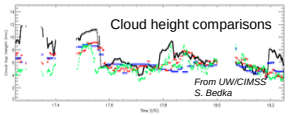
With respect to the imager, the next generation geostationary satellite series will offer a continuation of current products and services and enable improved and new capabilities. The Advanced Baseline Imager (ABI) on the next generation GOES-R will improve upon the current GOES Imager with more spectral bands, faster imaging, higher spatial resolution, better navigation, and more accurate calibration. The ABI expands from five spectral bands on the current GOES imagers to a total of 16 spectral bands in the visible, near-infrared and infrared spectral regions. There will be an increase of the coverage rate leading to full disk scans every 15 minutes. ABI spatial resolution will be 2 km for 10 infrared (IR) spectral bands and 0.5 km for the 0.64 µm visible band.

Current plans call for no HES (Hyperspectral Environmental Suite) on the GOES-R series. So, the question becomes how to produce legacy products that are used by the NWS and others from the current GOES Sounder. These products can be generated from ABI data with comparable attributes, when produced in conjunction with the information from the short-term numerical model forecasts. Ideally, any legacy sounder on GOES-R would improve on as many of the attributes (temporal, spatial, spectral or radiometric) as possible. For example, a much faster coverage rate or an improved signal-to-noise ratio are options.

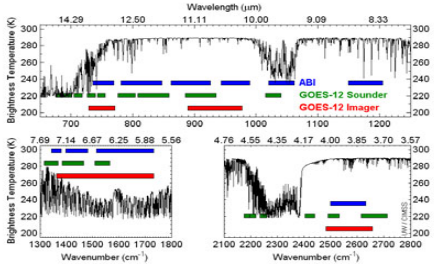




Improved spatial resolution with ABI over the current Sounder. These images are simulations generated from MODIS data.

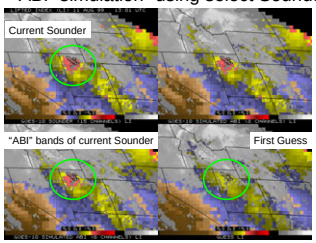


Cloud Phase LIDAR (BLACK) **GOES Sounder (BLUE)**
GOES Imager (RED) **MODIS (GREEN)**

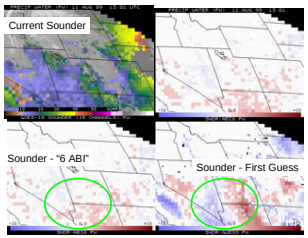


ABI (blue) and current GOES sounder (green) spectral coverage over a high spectral resolution brightness temperature spectrum. Note that the ABI has an additional window band centered at 10.35 um.

ABI "simulation" using select Sounder bands:

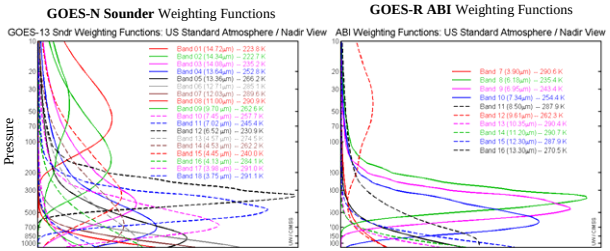


Lifted index simulations using GOES sounder



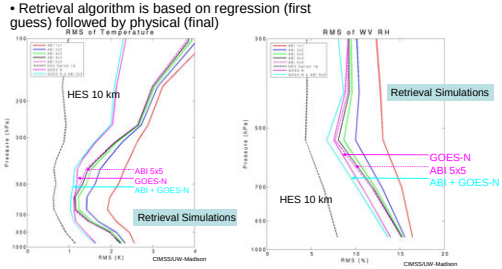
Precipitable Water - differences (mm)

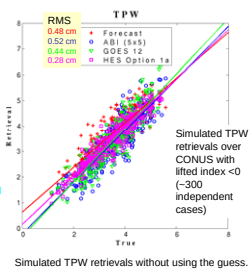
The above images demonstrate an ABI "simulation" using the current GOES sounder data. No attempt was made to use the exact ABI spectral response functions. Only channels on the current sounder are being turned off or on within the retrieval. The lower-left panel is the "6 Channel ABI" that uses 3.9, 6.5, 7.0, 11.0, 12.0 13.3 um channels. Several bands on the ABI were not simulated, for example the 10.35 um band. For the Lifted Index, note that the '6 band ABI' correctly captured the unstable region over Salt Lake City, while the background (first guess) image less so. For the TPW, there are differences between the full (15 channel) Sounder image and that from the '6 ABI' image (lower-left panel). Yet, these differences are smaller that the guess compared to the full sounder image (lower right panel).



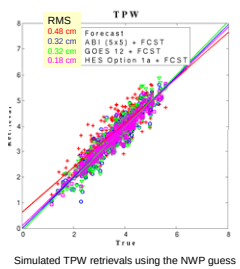
Note that both the current sounder and the ABI have three broad "water vapor" bands. The current sounder has more CO_2 and shortwave bands.

- Near Global Radiosonde Observations (RAOBs)
- 600 independent sounding retrievals
- Retrieval algorithm is based on regression (first guess) followed by physical (final)





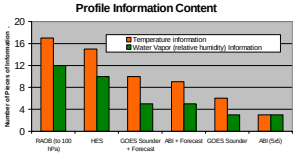
Simulated TPW retrievals without using the guess.



Simulated TPW retrievals using the NWP guess

Profile information content analysis

The relative vertical information is shown. In general, note that the moisture content is similar between the ABI and the current GOES Sounder. The Sounder does show more temperature information than the ABI. This information content analysis does not account for any spatial or temporal differences.



Product	Temporal Latency	Spatial	Accuracy	Overall	Comments
Total Column Ozone	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	Sounder better dur to several CO2 bands
Microburst potential	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	Need profiles
Other stability products	ABI ~ 20X faster	Comparable (when averaged)	Sounder more precise	Comparable	Need profiles
Upper-level SO2	ABI ~ 20X faster	Comparable (when averaged)	ABI more precise	Comparable	ABI has additional band
Any new products	ABI ~ 20X faster	?	?	?	?

Research Products from the current GOES Sounder and how the ABI could help produce legacy products.

Ideally, any legacy sounder on GOES-R would improve on as many of the attributes (temporal, spatial, spectral or radiometric) as possible. For example, a much faster coverage rate is one option. An improved legacy sounder, in conjunction with the ABI may give the best overall performance until advanced sounding capabilities from the geostationary perspective is realized. The ABI adequately provides all current GOES-N operational meteorological services, however it does not meet sounding requirements posted for numerical weather prediction (hourly hemispheric radiances enabling profile retrievals high vertical resolution. High spectral observations will be needed for these and many other applications. The ABI also does not meet sounding requirements needed for severe weather applications. Without a high-spectral resolution infrared sounding capability in geostationary orbit, forecasters and regional models will not have sufficient information regarding the fine scale 3-D structure of atmospheric water vapor and capping inversions to forecast the formation of individual thunderstorm cells. Both real and simulated data have shown the benefits of high temporal with high vertical data.

Nov 2006