Characterization of Bidirectional Reflectance of the Sonoran Desert using Historical GOES Data for Vicarious Calibration of GOES-R ABIS Sensor

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Advanced Baseline Imager (ABI) in GOES-R

	ABI	Current GOES Imager
Spectral Coverage	16 bands	5 bands
Spatial Resolution		
0.64 µm Visible	0.5 km	~ 1 km
Other visible/near-IR	1.0 km	n/a
Bands (>2 µm)	2 km	~ 4 km
Spatial Coverage		
Full Disk	Every 15 min	Every 3 hour
CONUS	Every 5 min	Up to every 15 min
Mesoscale	Every 30 sec	n/a
On-orbit Calibration	Yes	No

TABLE 1. Summary of the wavelengths, resolution, and sample use and heritage instrument(s) of the ABI bands. The minimum and maximum wavelength range represent the full width at half maximum (FWHM or 50%) points. [The Instantaneous Geometric Field Of View (IGFOV).]

Future GOES imager (ABI) band	Wavelength range (µm)	Central wavelength (µm)	Nominal subsatellite IGFOV (km)	Sample use	Heritage instrument(s)
1	0.45–0.49	0.47	1	Daytime aerosol over land, coastal water mapping	MODIS
2	0.59–0.69	0.64	0.5	Daytime clouds fog, insolation, winds	Current GOES imager/sounder
3	0.846–0.885	0.865	1	Daytime vegetation/burn scar and aerosol over water, winds	VIIRS, spectrally modified AVHRR
4	1.371–1.386	1.378	2	Daytime cirrus cloud	VIIRS, MODIS
5	1.58–1.64	1.61	1	Daytime cloud-top phase and particle size, snow	VIIRS, spectrally modified AVHRR
6	2.225–2.275	2.25	2	Daytime land/cloud properties, particle size, vegetation, snow	VIIRS, similar to MODIS
7	3.80–4.00	3.90	2	Surface and cloud, fog at night, fire, winds	Current GOES imager
8	5.77–6.6	6.19	2	High-level atmospheric water vapor, winds, rainfall	Current GOES imager
9	6.75–7.15	6.95	2	Midlevel atmospheric water vapor, winds, rainfall	Current GOES sounder
10	7.24–7.44	7.34	2	Lower-level water vapor, winds, and SO_2	Spectrally modified current GOES sounder
11	8.3–8.7	8.5	2	Total water for stability, cloud phase, dust, SO_2, rainfall	MAS
12	9.42–9.8	9.61	2	Total ozone, turbulence, and winds	Spectrally modified current sounder
13	10.1–10.6	10.35	2	Surface and cloud	MAS
14	10.8–11.6	11.2	2	Imagery, SST, clouds, rainfall	Current GOES sounder
15	11.8–12.8	12.3	2	Total water, ash, and SST	Current GOES sounder
16	13.0–13.6	13.3	2	Air temperature, cloud heights and amounts	Current GOES sounder/ GOES-12+ imager

GOES-R ABI applications related to
- Weather/climate, oceans/land
- Hazards
  - Fires
  - Volcanoes
  - Hurricanes
  - Storms that spawn tornados

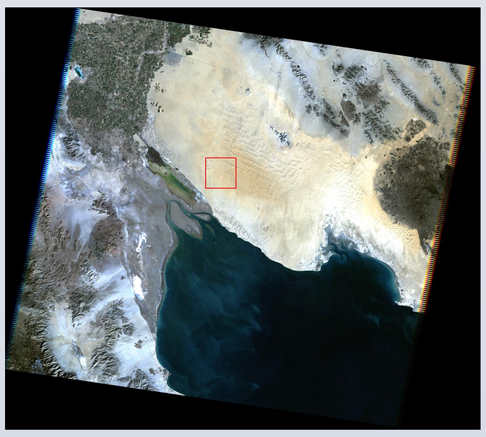
Current benefits from the ABI are projected to be **$4.6B** over the lifetime of the series due to improved **tropical cyclone forecasts**, fewer weather-related **flight delays** and airline incidences **with volcanic plumes**, improved production and **distribution of electricity and natural gas**, increased efficiency in irrigated **water usage in agriculture**, and higher protection rates for **recreational boats** in the event of a tropical storm or hurricane

ABI Calibration/Validation

The ABI will be calibrated to an accuracy of **3%** (1 σ) radiance for visible and near-infrared wavelengths. For infrared channels, the ABI will be accurate to **1K** (1 σ) at 300K.

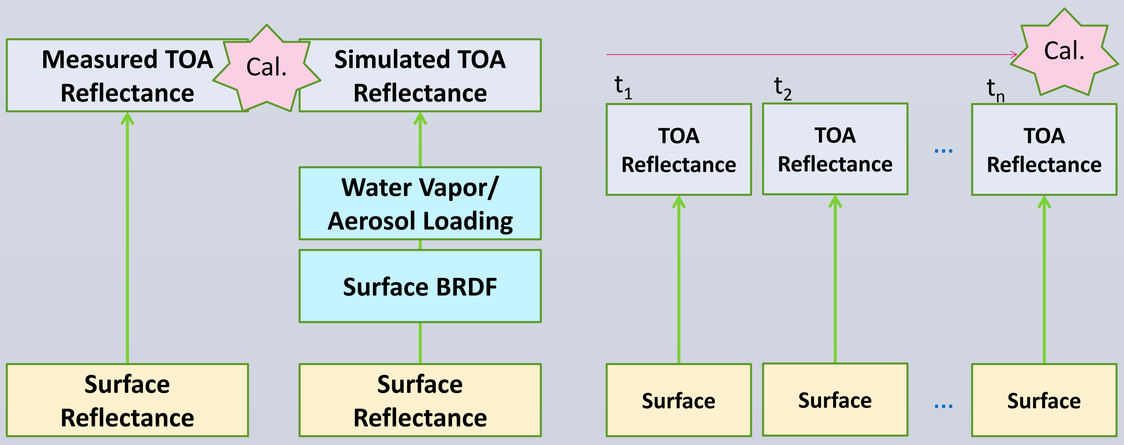
Onboard calibrator
- Solar reflective bands (6 bands)
- Thermal infrared bands (10 bands) : black body

The Sonoran Desert

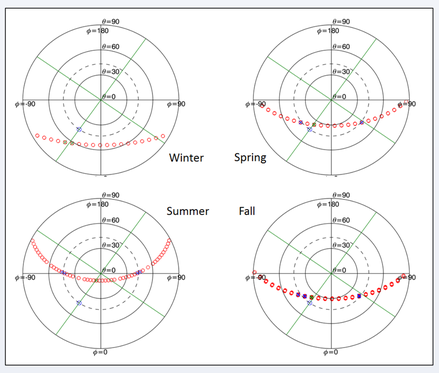


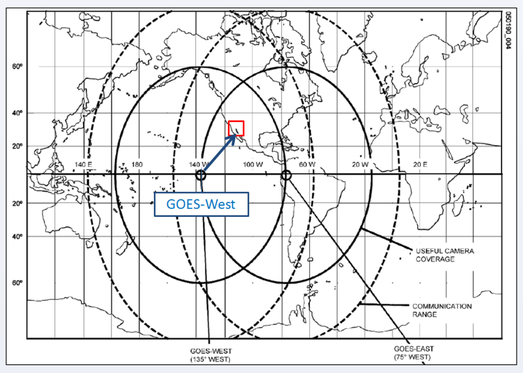
Location	Near U.S-Mexico border
Lat/Lon	31°55´N, 114°32´W
Window size	15 km × 15 km
WRS-2 path/row	38/38
Mean elevation	0.2 km above sea level
Vegetation	Sparsely distributed desert plants
Topography	Generally flat with occasional sand dunes

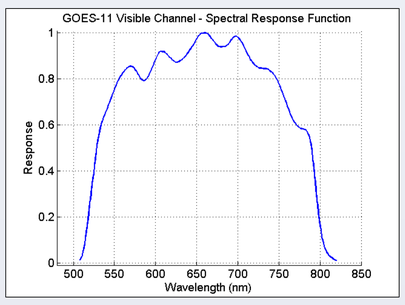
Vicarious Calibration



GOES Imager

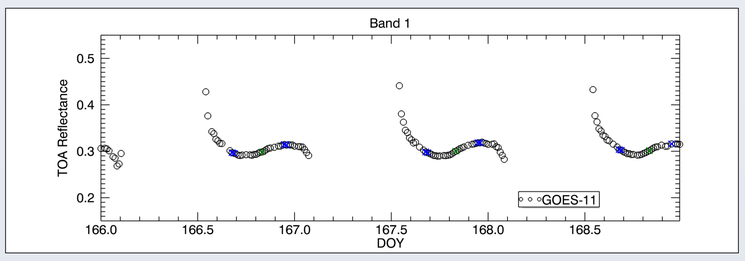






Bidirectional reflectance pattern of the ABI Band 2 in the Sonoran Desert can be pre-examined through the data from the current GOES Imager.

Data of various solar zenith/azimuth angles can be acquired even in a single day for a fixed sensor direction.



TOA reflectance time series for 3 days (June 15~17, 2011). Hotspot-like phenomena is observed in the afternoon where the angular distance between the sun and the sensor is minimum.

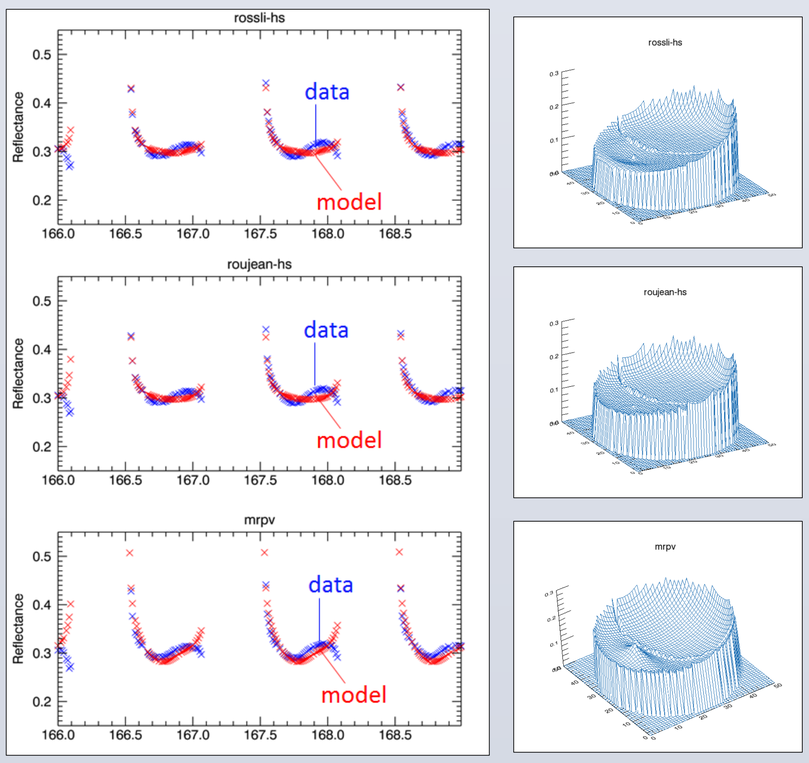
Empirical BRDF Models

Three BRDF models with hot-spot consideration have been fitted to the GOES data, where we found that all the models fail to explain the data.

RossLi – hotspot[1]

Roujean – hotspot[1]

Modified RPV[2]



ACKNOWLEDGEMENT & REFERENCE

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[2] J. V. Martonchik, et al., "Determination of land and ocean reflective, radiative, and biophysical properties using multiangle imaging," *IEEE Transaction on Geoscience and Remote Sensing*, vol. 36, no. 4, pp. 1266-1281, 1998

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