GOES-R AWG AAA Team: Ozone
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Presented By: Christopher C. Schmidt[1]
[1] UW-Madison/SSEC/CIMSS

Ozone Product Team

- **AWG AAA Team Chair:** Shobha Kondragunta
- **Ozone Product Team**
  - *Chris Schmidt (Lead)*
  - *Jay Hoffman*
  - *Jun Li*
  - *Jinlong Li*
  - *Xin Jin*
- Others
  - » Shanna Sampson (AIT)
  - » Brad Pierce (Proxy data)

Outline

- Executive Summary
- Algorithm Description
- ADEB and IV&V Response Summary
- Requirements Specification Evolution
- Validation Strategy
- Validation Results
- Summary

Executive Summary

- The Ozone Total Algorithm generates the Option 2 Ozone product.
- Version 5 to be delivered in June. ATBD (100%) is on track for a July delivery
- The GOES I-P Sounder Ozone regression algorithm served as the basis for the ABI Ozone Algorithm.
- The Ozone regression relies on long-wave IR brightness temperatures above 4 microns (especially an ozone band) and other predictors (latitude, surface pressure, month, percentage land in the pixel, and a temperature profile).
- Primary source of proxy data is SEVIRI.
- Analyses indicate spec compliance for the product.
- Option 2 product on a baseline product schedule.

Algorithm Description

Algorithm Summary

- The Ozone Total Algorithm generates the Option 2 Ozone product.
- This is a clear sky product producing total column ozone (reported in Dobson Units).
- The Ozone Algorithm is a regression algorithm that uses long-wave IR bands above 4 microns and other predictors (month, latitude, surface pressure, percentage of land in the pixel, and a temperature profile).
- The product is clear-sky.
- At the end of the Ozone Algorithm, the product result is quality checked.

Motivation for Algorithm Channel Selection

- The Ozone Algorithm builds on the GOES Sounder Ozone regression.

- The Ozone Algorithm utilizes ABI bands 8-10 and 12-16 (excluding 8.5 μm).

- Based on sensitivity studies done for the GOES Sounder, the "ozone band" (~9.6 μm) provides about 75% of the information in the ozone regression. The other bands, which have sensitivity to upper atmospheric temperatures, provide more information. ABI lacks a CO_2 band, so a temperature profile from a model is used to make up for the lack of that band.

- The **GOES-R ABI** provides similar bands to the GOES Sounder, but at better resolution in space and time. *It lacks a CO_2 band, which is compensated for by using a temperature profile.*

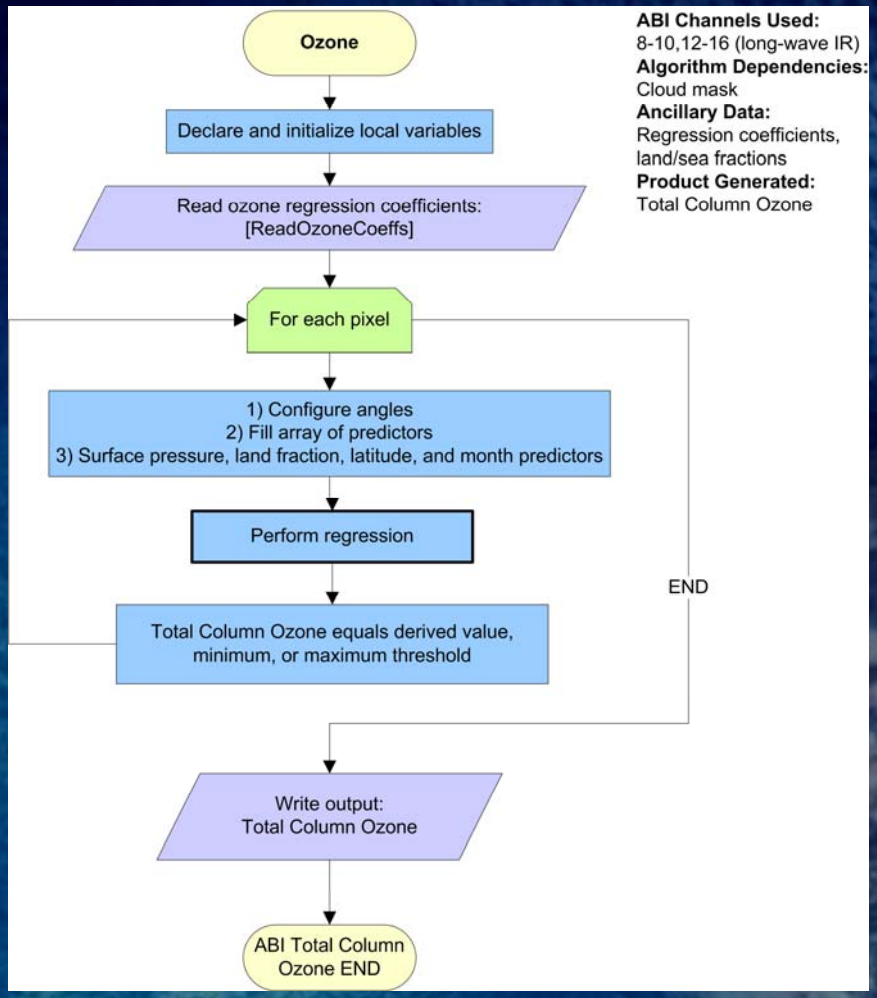
Expected ABI Performance Relative to Other Sensors

- Compared with SEVIRI and current GOES, ABI has better temporal and spatial resolution, better navigation, and lower noise. ***ABI will perform better than previous geostationary sensors for total column ozone.***

- Polar orbiters such as MODIS can also perform IR regression for ozone and have better spatial resolution.

- Instruments that utilize ultraviolet bands such as OMI, polar-orbiting only for the foreseeable future, will continue to provide the best measurements from space but are limited to sunlit regions only.

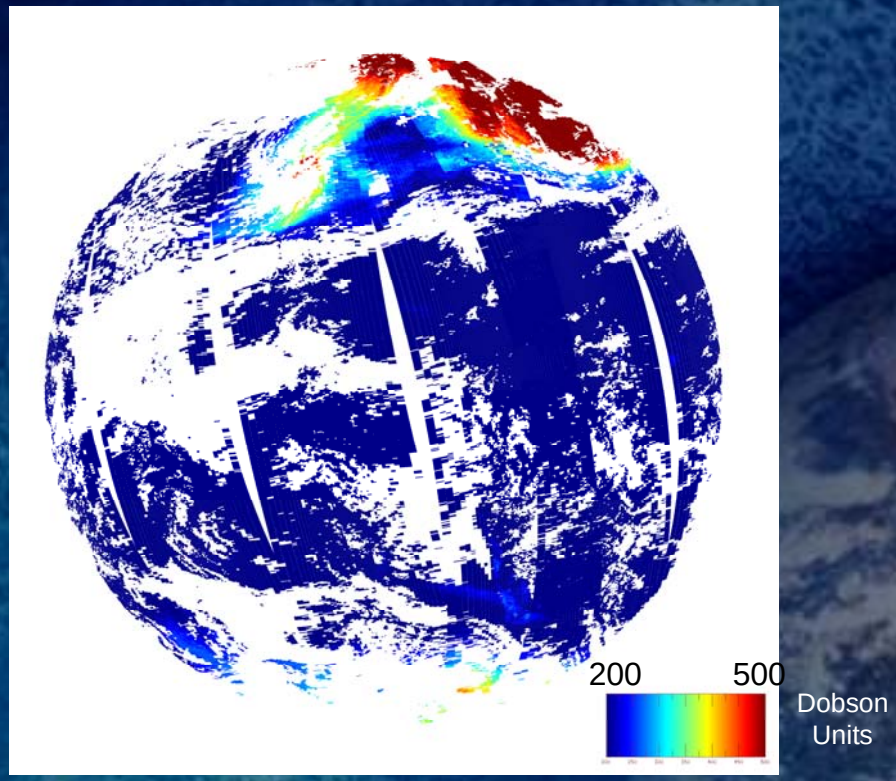
Ozone Processing Schematic



Example Ozone Output

SEVIRI total column ozone on 14-15 February 2006

Footprints matched, Cloud Team cloud mask used



Algorithm Changes from 80% to 100%

- Updated code per AIT recommendations.
- No substantial changes to the science.
- Metadata output added.
- Quality flags standardized.

ADEB and IV&V Response Summary

- All ATBD errors and clarification requests have been addressed.
- Primary concerns on ATBD regarded missing figures and information on testing with proxy data. This has been added.
- No feedback required substantive modifications to the algorithm.

Requirements Specification Evolution

Current requirements:

Product	*Accuracy*	*Precision*	*Latency (CONUS, Full Disk)*	*horizontal resolution*
Ozone Total Column (Dobson Units)	15 Dobson Units	25 Dobson Units	4.4 min	10 km*

Former requirements:

% changed to units for current requirements

Ozone Total Column	8%	8%	4.4 min	10 km*

* The 10 km resolution is a legacy of the cancelled GOES-R sounder.

Qualifiers

The qualifiers have not changed:

- Day and Night
- Quantitative out to at least 65 degrees LZA and qualitative beyond
- Clear sky product

Validation Strategy

Validation Approach

There are three potential sources of validation data

Satellite collocations of ozone values

- SEVIRI proxy data allows for validation against polar-orbiting UV-based ozone detection from Ozone Monitoring Instrument (OMI)
- OMI footprints are estimated based on building rectangles around OMI locations in OMI space
- SEVIRI pixels within the footprints are averaged
- Method applicable to ABI and polar orbiting ozone instruments in the future
- OMI is extensively validated against ground-based Dobson Photospectrometers, %RMSE less than 2%

Ground based detection

- Dobson photospectrometers provide total column ozone at certain sites around the world, typically at solar noon
- Global network is shrinking

Model-generated proxy data

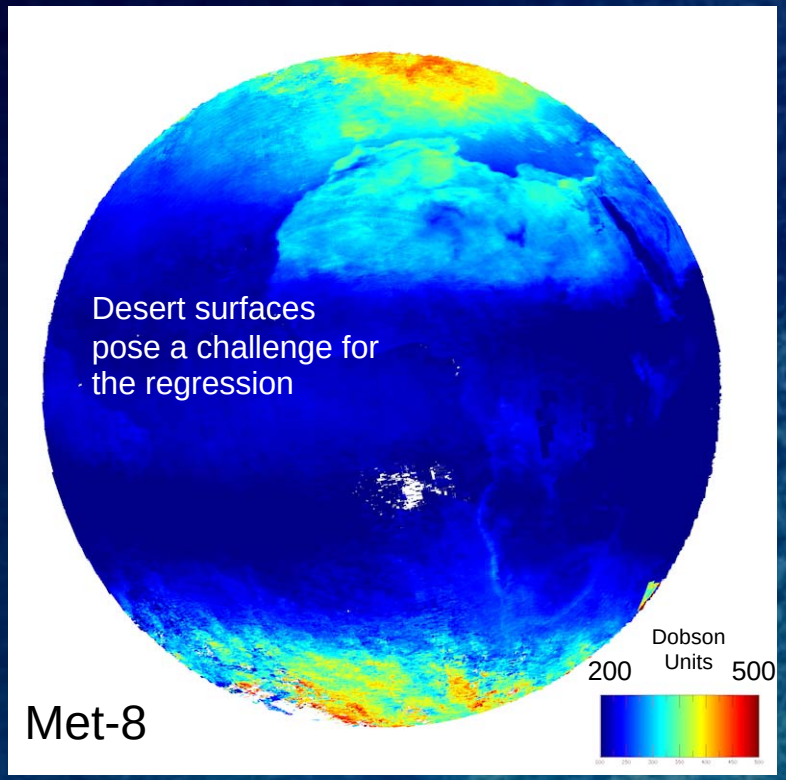
- Difficult to generate, numerical weather prediction models typically use climatological ozone
- Some is available and will be used

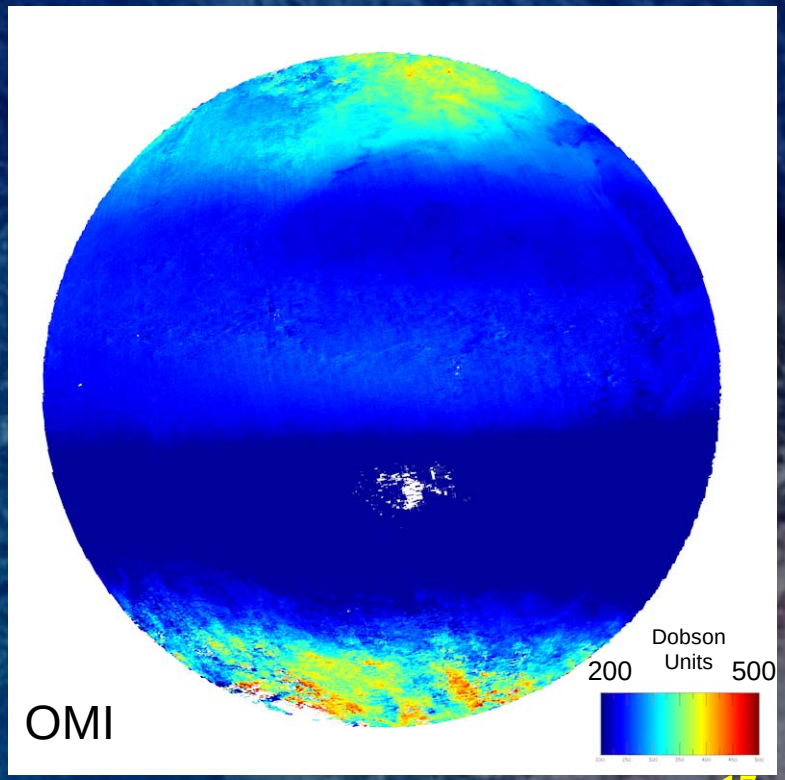
Approach: Focus on satellite collocations as primary validation.

Validation Approach

Long-term Validation Plan: Validate against UV-based satellites and ground-based network as available

August 2006 average total column ozone





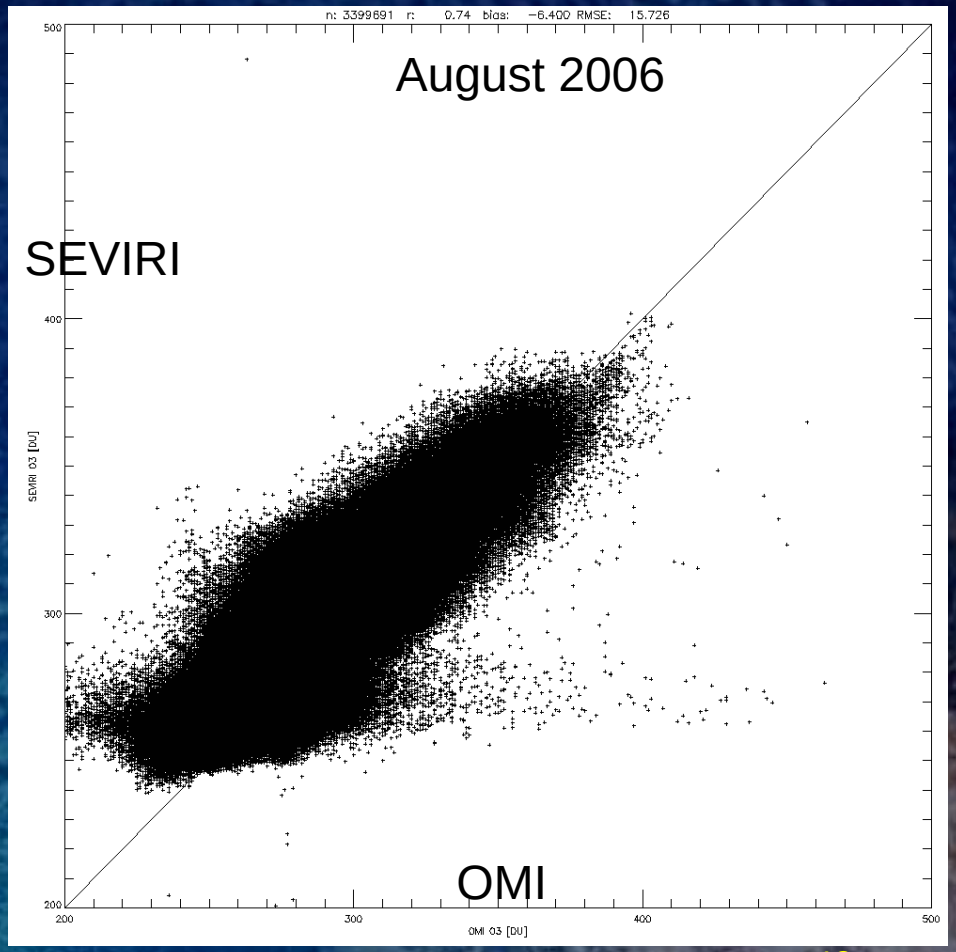
Validation Results

Ozone Validation Against Requirements

Ozone total column requirement is that precision be within 25 DU and accuracy be within 15 DU. For August 2006, precision was -15.7 DU and accuracy was 6.4 DU.

For the "10 week run" of standard SEVIRI proxy data, overall precision was 15.1 DU and accuracy was 3.3 DU.

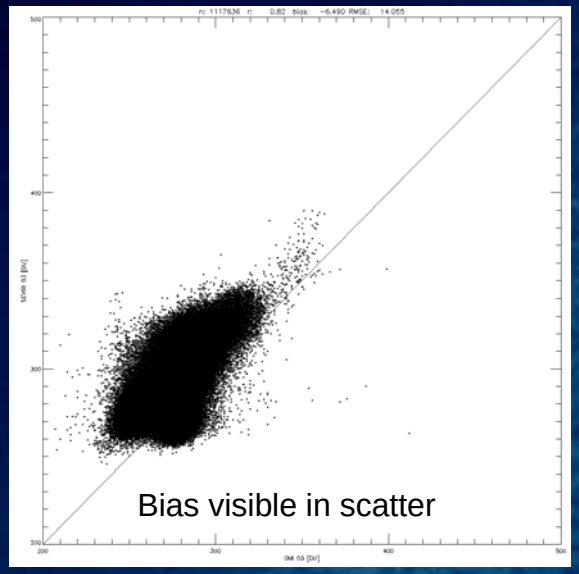
Cloud mask is from the AWG Clouds team.



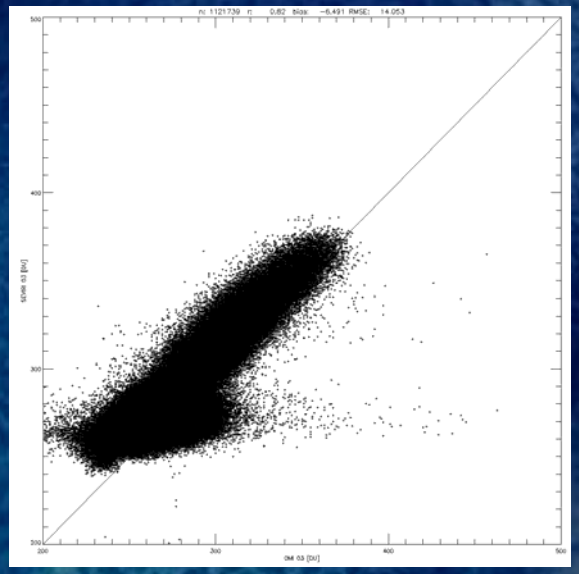
Ozone Validation

Breakdown of ozone validation against OMI by surface type
SEVIRI data compared to OMI data
August 2006

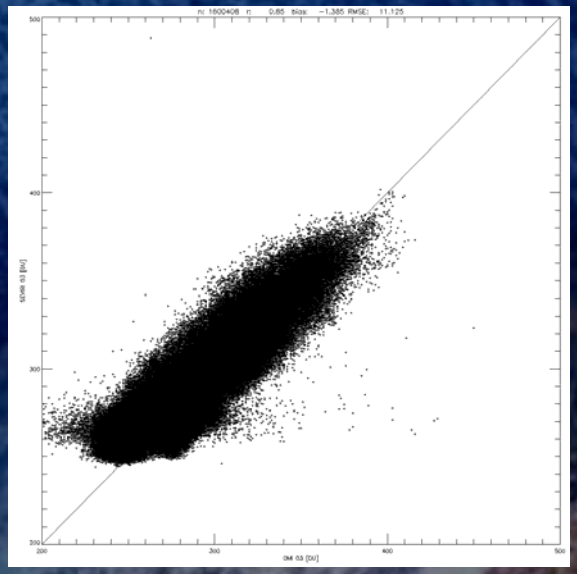
Desert only



Non-desert land



Water



OMI on horizontal axis, SEVIRI on vertical

Validation Results Summary

	Accuracy (spec)	Precision (spec)
Ozone Total	3.3 DU (15 DU)	15.1 DU (25 DU)

Summary

- The ABI Ozone Total Algorithm provides continuity in ozone detection while utilizing the new capabilities offered by the ABI
- Version 5 will soon be delivered and the 100% ATBD is coming
- The product meets specifications at 2 km resolution