CrIS Trace Gas Data Users Workshop: Goals and Agenda

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College Park, Maryland

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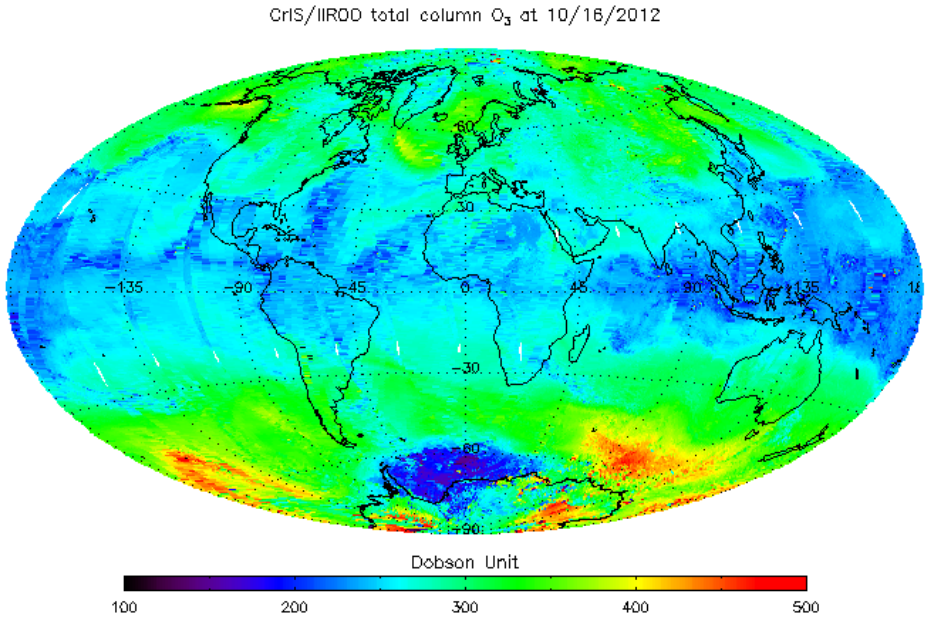
Why are we here?

- Trace gas retrievals from thermal infrared (TIR) sounders (e.g., TES, AIRS, MOPITT, IASI) are used extensively by scientists studying:
  - Atmospheric Chemistry
  - Air Quality
  - The Carbon and Nitrogen Cycles
  - Climate Change
- All of the NASA EOS TIR sounders (TES, AIRS, and MOPITT) are past their design lifetimes, and there are no current plans at NASA to replace these instruments.

Cross-track Infrared Sounder

- Fourier Transform Infrared (FTIR) Spectrometer aboard Suomi-NPP
- NOAA is planning to launch future versions on JPSS-1 (2017), JPSS-2 (2022), …
- NOAA NUCAPS produces retrievals of O_3, CO, CO_2, CH_4, N_2O, HNO_3, and SO_2
- AER prototype retrieves NH_3
- But the current products are not extensively used by the science communities and they need to be further evaluated.

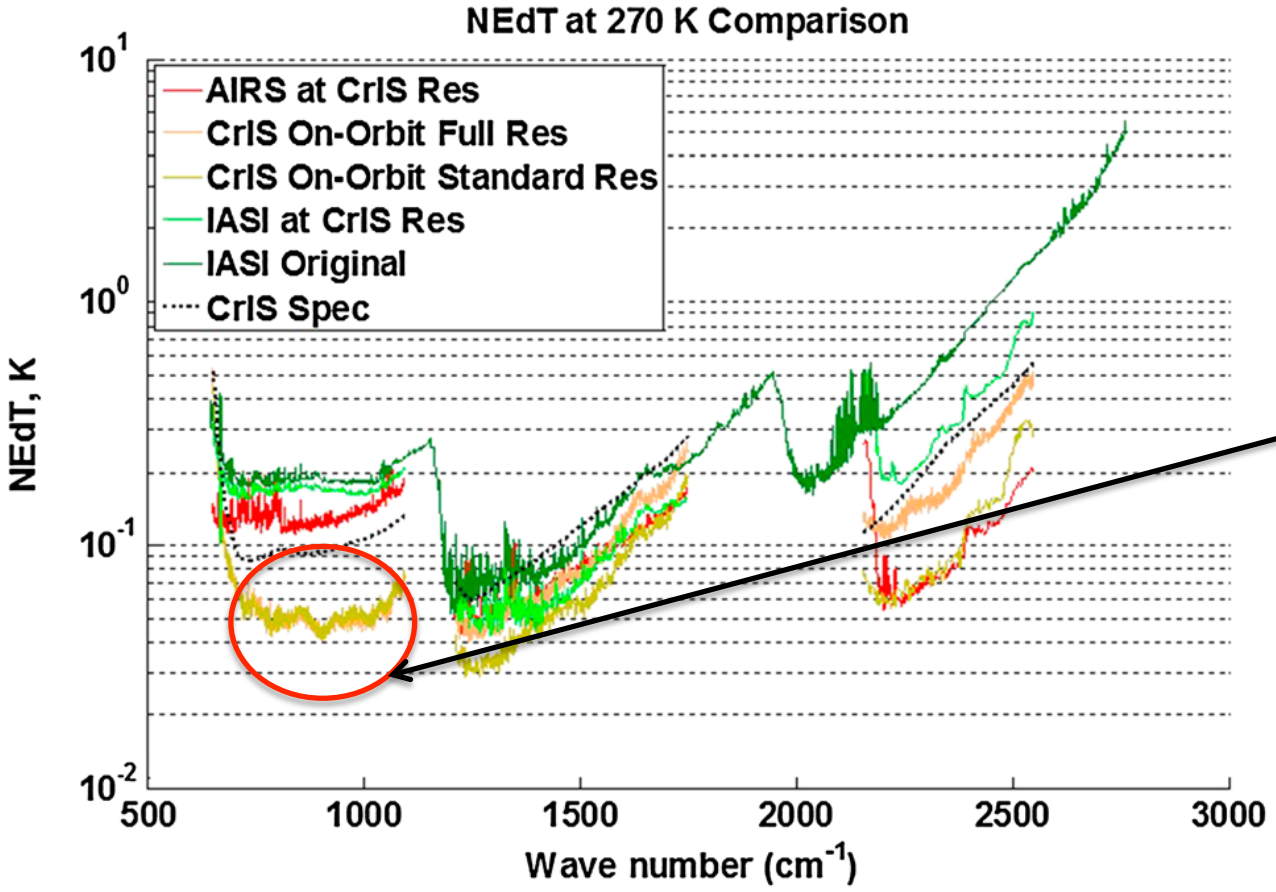


CrIS Total O_3 from Larry Flynn, NOAA/NESDIS

CrIS versus other TIR sounders

	MOPITT	AIRS	TES	IASI	CrIS
Satellite	EOS-Terra	EOS-Aqua	EOS-Aura	MetOp-A/B	**Suomi-NPP**
Launch	1999	2002	2004	2006/2012	**2011**
Technique	Gas-cell Correlation Radiometry	Grating Spectrometer	FTIR Spectrometer	FTIR Spectrometer	**FTIR Spectrometer**
Resolution	0.04 cm^{-1} (eff. res.)	0.5-2.3 cm^{-1} ($\lambda/\Delta\lambda$=1200)	0.10 cm^{-1} apodized	0.50 cm^{-1} apodized	**0.625 cm^{-1} (potential)**
Footprint	22x22km	45x45km (cloud-cleared)	5x8 km	12 km circle (2x2 array)	**14 km circle (3x3 array)**
Swath	640 km	1650 km	N/A	2200 km	**2200 km**
Global Coverage	3 days	Twice Daily	16 days	Twice Daily	**Twice Daily**
Eq. crossing (am/pm)	~10:20	~1:15	~1:40	~8:45/9:3O	**~1:30**

CrIS Noise Remarkably Low!



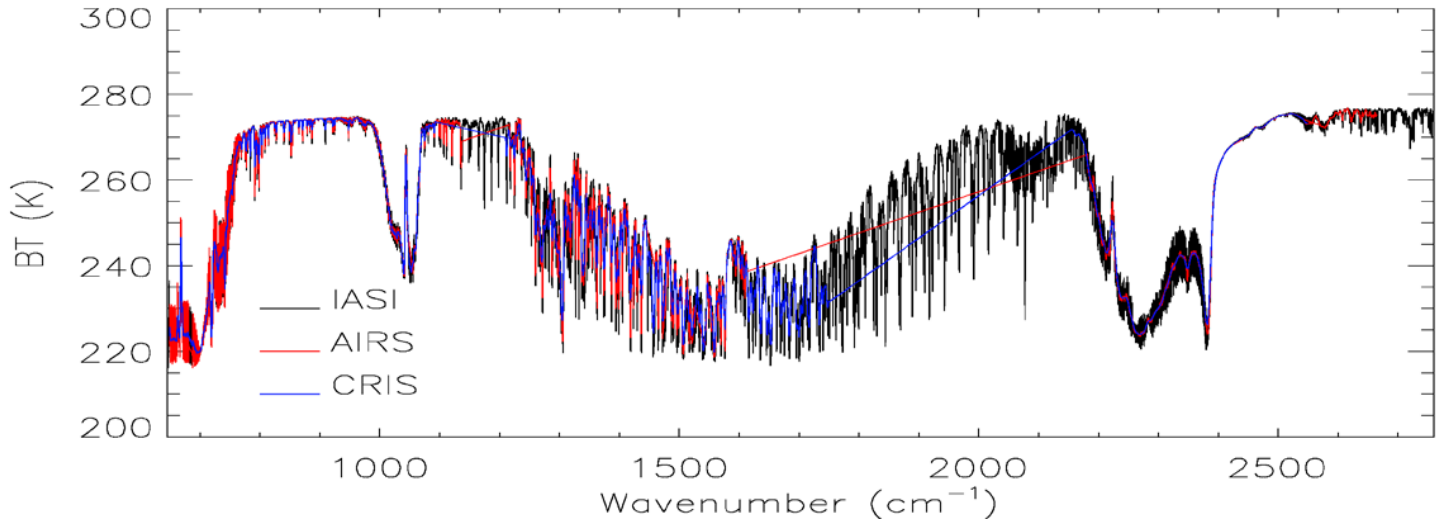
Low noise may make it possible to retrieve species difficult to see with AIRS, IASI, or TES (HCN, C_2H_2, etc?.)

[Zavyalov et al., 2013]

Spectrum Comparison

Not an instrument limitation – 0.625 cm^{-1} data for these bands coming soon!

Band	Spectral range [cm^{-1}]	Spectral range [μm]	Band width [cm^{-1}]	Resolution $\Delta\sigma$ [cm^{-1}]	MPD [cm]
LW	650 – 1095	15.4 – 9.1	445	0.625	0.8
MW	1210 – 1750	8.3 – 5.7	540	1.25	0.4
SW	2155 – 2550	4.6 – 3.9	395	2.5	0.2



Simulated CrIS spectrum overlaid with IASI and AIRS spectra

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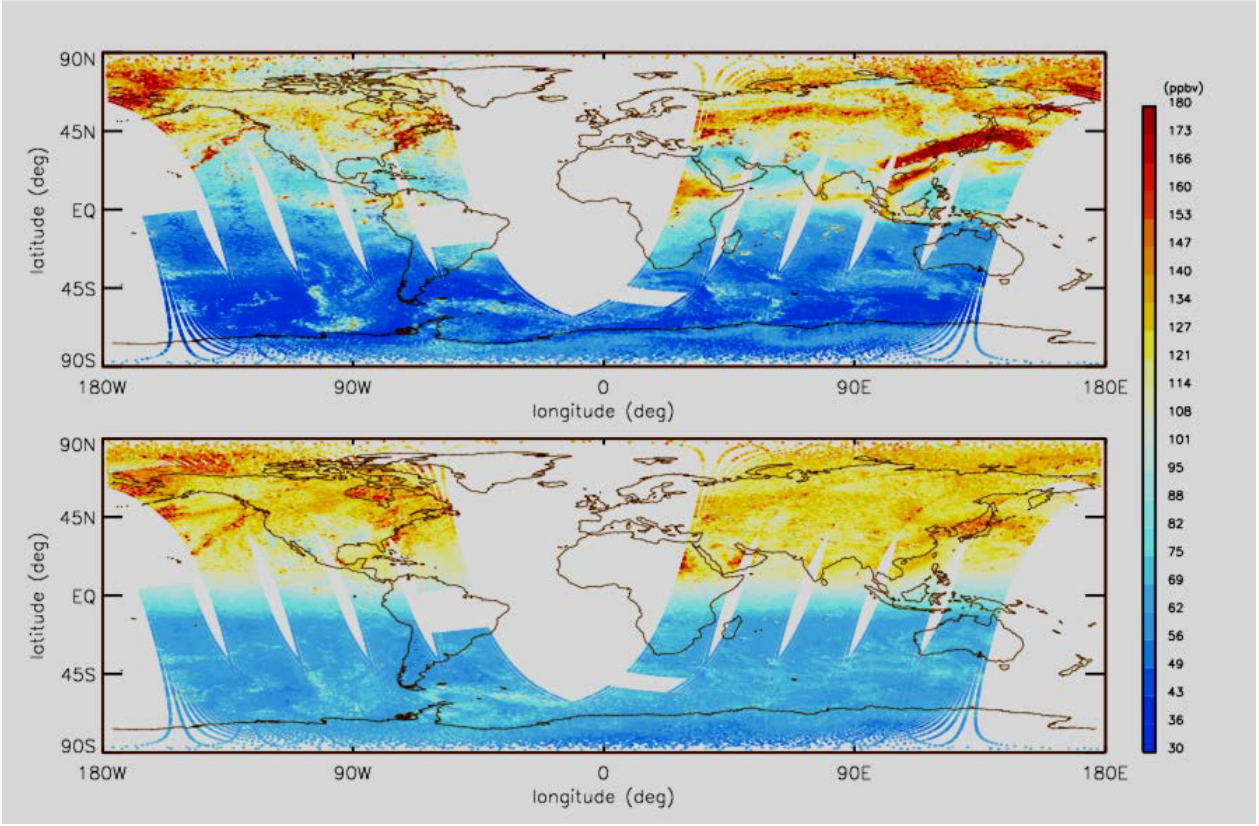
Image from Y. Han and D. Tremblay (NOAA) 2012 AMS Talk

Need For Full Resolution CrIS Data

Simulated NUCAPS CO Retrieval



0.625 cm^{-1}

2.5 cm^{-1}

[Gambacorta et al., 2014]

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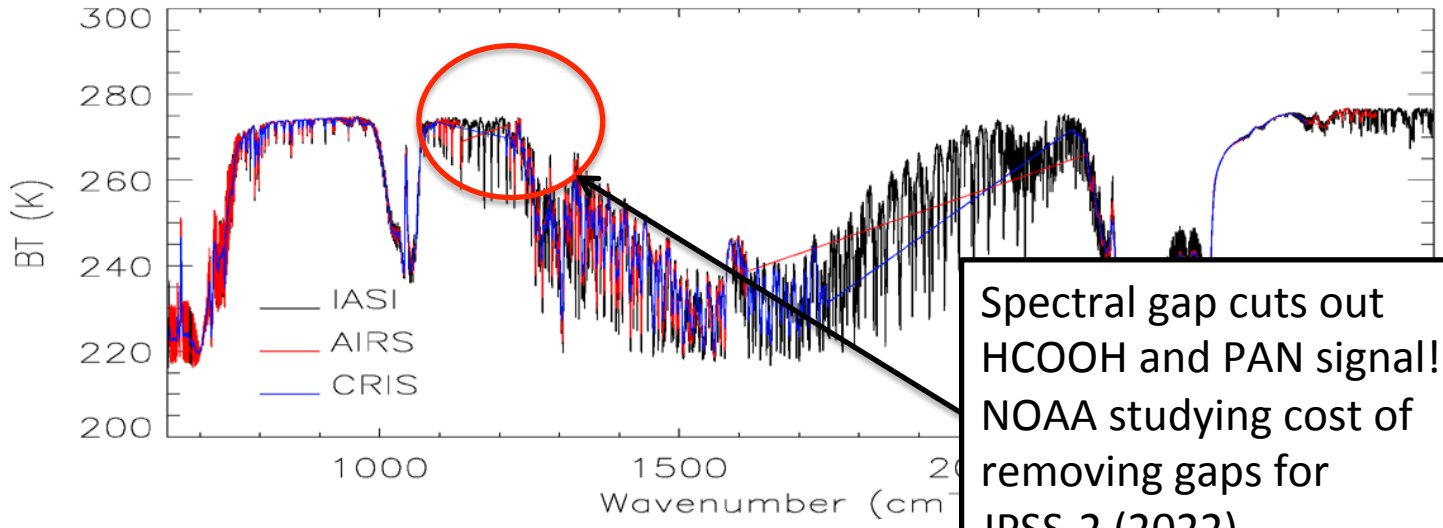
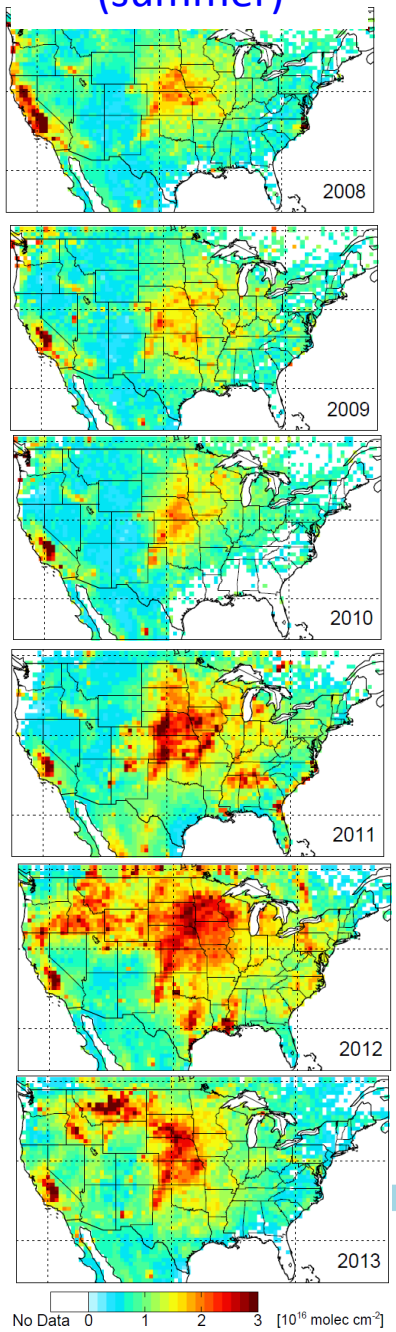


Spectral gap cuts out HCOOH and PAN signal! NOAA studying cost of removing gaps for JPSS-2 (2022).

Simulated CrIS spectrum overlaid with IASI and AIRS spectra

Image from Y. Han and D. Tremblay (NOAA) 2012 AMS Talk

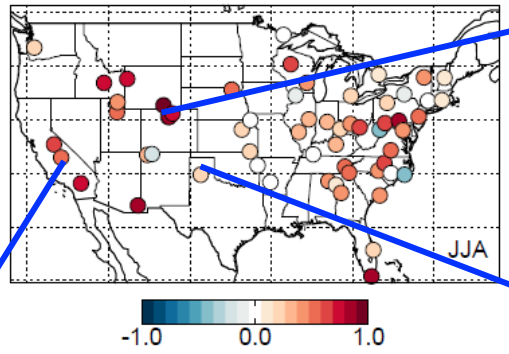
IASI NH_3 column (summer)

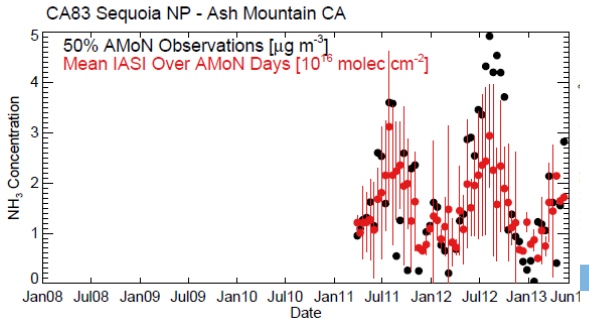


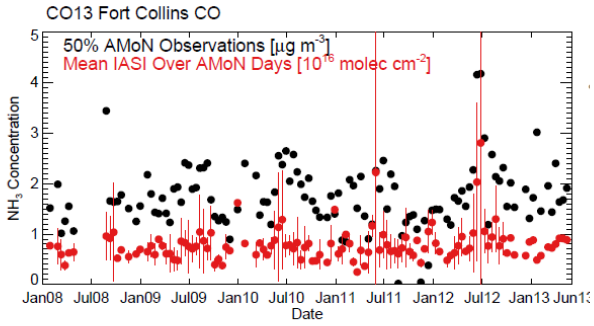
Need an "Observation Operator" to compare models with satellites (and sats w/ other obs!)

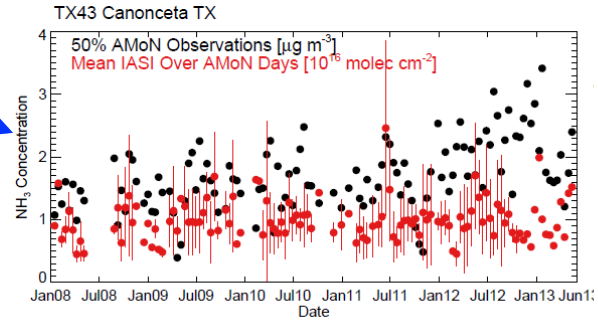
- L. Schiferl and C. Heald are investigating Interrannual variability in NH_3 using IASI and AMoN
- Challenge: new IASI ammonia product does not include averaging kernels [Van Damme et al., 2014]

Correlation of AMoN surface obs with IASI column









Figures from Luke Schiferl and Colette Heald, MIT

What is needed to increase use of CrIS trace gas products?

- Demonstrate that:
  - The scientific community needs these products
  - Operational users (e.g., AQ and chemical weather forecasters) within and outside NOAA need these products
- More communication between retrieval, science, and operational end user teams
- Validation of products
- Improvement of current products based on validation
- Development of new products

NASA Workshop on Polar Sounders: Atmospheric Composition (Nov. 2010)

- **Get full spectral resolution from CrIS**
  - Should be available by end of 2014
- **Assess the products that can be retrieved from CrIS and their potential accuracy compared to other sounders**
  - Much work has been done on retrieving gases from CrIS
  - But further validation needed and additional products may be possible
- **Use multi-spectral approaches to obtain near-surface trace gas data**
  - Lots of work done with MOPITT NIR/TIR, TES/OMI, AIRS/OMI, and CrIS/OMPS for CO and O_3, but much more work to do!
  - Combine at retrieval or assimilation level?

Agenda

- Today:
  - JPSS Overview
  - CrIS Trace Gas Retrievals
  - Use of TIR Retrievals in Atmospheric Chemistry and Climate Studies
  - Poster Session and Reception
- Tomorrow
  - Breakout Sessions
    - Greenhouse Gases (e.g., CH_4, CO_2, N_2O)
    - Air Quality (e.g. CO, O_3, NH_3)
  - Discussion
  - Assign Action Items

After the Workshop

- Keep talking!
- Community report on what needs to be done to use CrIS for atmospheric chemistry
- Op. Ed. In *EOS* or other forums
- Coordinate with field campaigns for validation activities

Logistics

- UM Shuttle
  - Back to Holiday Inn at 7:30 PM Thursday
  - From Holiday Inn at 7:30 AM Friday
  - Back to Holiday Inn at 5 PM Friday
- Meals
  - Reception at poster session tonight
  - Breakfast at 8 AM Friday
  - Box Lunch at 12 PM Friday