Earth System Research Laboratory
Global Systems Division

The New Role of CRTM in LAPS

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2012 LAPS Workshop – Boulder CO
23-26 Oct 2012

Satellite Data in LAPS

- Historically LAPS was primarily a CONUS-Based system (Geo based)

- Imager and sounder data primary historical use

- Imager – cloud analysis; Sounder – moisture.
  - Sounder data dropped in lieu of PW product data from which gradients are extracted. This was found to be better than 7-channel assimilation for moisture.
  - No direct radiance assimilation has been performed for thermal info from sounder data.
  - This will likely change with variational LAPS.

The OPTRAN Environment

- OPTRAN was integrated into the initial LAPS – for several reasons.
  - Control
  - Ease of interface
- Users didn't have to do anything special.
- Became outdated with new GOES instruments (imager mainly).
- Not quite, we just accommodated by using similar channels on old satellites for the new satellites

Implications

- Pluses with OPTRAN
  - We had permission for distribution
  - We didn't have to license the software.
  - Main reason we DID NOT USE RTTOVS
- Problems
  - New satellites changed (GOES imager channel 5)
  - We didn't keep current – will really be out of date with GOES R. Desire for other sat apps.

Satellite Needs in LAPS

- Need better polar capability
- With SOS/global export versions now interests are in multi-national geo, and polar
- There is an answer

Changing Satellite Status in LAPS

- OPTRAN still used (out of date) will be replaced
- Enter **CRTM** (community radiative transfer model).
- Project by EMC/JCSDA (Paul van Delst)
- Version 2.0.4/2.0.5 used and 2.1 released 24 Sept 2012.

LAPS and CRTM

- LAPS is being restructured to use CRTM

- Important changes – things to keep in mind
  - CRTM is not FAB's code
    - CRTM is obtained from JCSDA.
    - ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/
  - Offers visible – enhancement to cloud analysis
  - Offers ability to experiment
  - Be aware of export limitations on US software.

Check about Embargoed Countries

Countries as of May 2012:

Côte d'Ivoire/Ivory Coast, since 1986 (see Côte d'Ivoire–United States relations)

Cuba, since 1962 (see United States embargo against Cuba)

Democratic Republic of the Congo, since 1998 (see Democratic Republic of the Congo–United States relations)

Iran, since 1979 (see Sanctions against Iran)

Libya, since 2011 (now applied only against parties closely associated with the former Gaddafi regime;[3] see Libya-United States relations)

Republic of the Congo (see Republic of the Congo-United States relations)

Somalia, since 1990 (supplies arms to the Transitional Federal Government, but no general trade. See Somalia-United States relations)

Myanmar, since 1997 (see Burma–United States relations)

North Korea, since 1950 (see North Korea–United States relations)

Sudan, since 2002 (see Sudan–United States relations)

Syria, since 1986 (see Syria–United States relations)

Also check individuals or entities.

Implications using CRTM

- New plan
  - User obtains and maintains CRTM.
  - Compilation of CRTM separate from LAPS/STMAS.
  - We are developing interface modules for the system
    - Cloud analysis will be using this
    - STMAS variational solutions are being developed to use K-Matrix

What this means for users

- Users must work with EMC and JCSDA to acquire and build and maintain CRTM
- Plan for 2Gbytes of space for coefficients. These come both in big and little endian. Or trim your coefficient files to only those that correspond to the CPU and satellite(s) you use.
- Currently written in F95-2003
- Package comes with test code so you can see if it installs correctly.

What this means for US

- We will be working to an interface for CRTM.
- CRTM will continually change as new satellites are launched and existing satellites change. We will have to keep current.
- We will strive to keep our interface consistent but there may be times we lag.
- We welcome user help

Keep in Mind

- It is conceivable that we will lag when a new release of CRTM comes out.

- Does not prevent USERS from helping develop interface changes between LAPS and CRTM with a new release.

- Welcome the improvement into the LAPS code repository if it addresses “our” collective needs. Need for evaluation.*****

***Topic for group discussion**

Pointers for using CRTM

- High atmosphere state more important than lower troposphere above 100 hPa to 0.005hPa.

- We have modules that can fill in upper atmosphere using the standard atmosphere, also CRTM comes with a standard atmosphere capability.

- We also have an ozone function that will supply ozone to these high levels based on Smithsonian Tables (written early 1980s.)

Pressure Levels Successfully Used

- 49 pressure levels (layer mid-points)
- Trace gasses important to radiation absorption

0.13	27.08	416.88
0.32	33.55	457.74
0.59	41.56	500
0.95	51.49	543.5
1.38	63.49	588.07
1.89	77.58	633.51
2.47	93.84	679.58
3.14	112.27	725.93
3.93	132.94	772.11
4.88	155.9	817.52
6.04	181.15	861.38
7.49	208.65	902.63
9.27	238.33	939.95
11.49	270.15	971.66
14.24	304.05	995.65
17.64	339.89	SFC
21.85	377.55	

Pointers for using CRTM

- IR coefficient files in versions 2.0.x are named such.

- Visible coefficient files are named similarly but with the letter “v” in front of them this is changed in version 2.1.

The Future?

- GOES R maybe 2015?

Current GOES Imager and Sounder Specifications.

Two instruments are operated simultaneously.

Imager spatial resolution varies from 1 – 8km (I-M)

Sounder spatial resolution is nominal 10km

Between the two we have 22-IR and 1-visible channel

Imager Instrument Characteristics (GOES I-M)					
Channel number:	1 (Visible)	2 (Shortwave)	3 (Moisture)	4 (IR 1)	5 (IR 2)
Wavelength range (um)	0.55 - 0.75	3.80 - 4.00	6.50 - 7.00	10.20 - 11.20	11.50 - 12.50
Instantaneous Geographic Field of View (IGFOV) at nadir	1 km	4 km	8 km	4 km	4 km

Sounder Instrument Characteristics (GOES I-M)		
Channel Numbers	Wavelength (um)	Maximum Temperature Range (K)
Long wave IR		
1	14.71	space - 280
2	14.37	space - 280
3	14.06	space - 290
4	13.64	space - 310
5	13.37	space - 320
6	12.66	space - 330
7	12.02	space - 340
Medium wave IR		
8	11.03	space - 345
9	9.71	space - 330
10	7.43	space - 310
11	7.02	space - 295
12	6.51	space - 290
Short wave IR		
13	4.57	space - 320
14	4.52	space - 310
15	4.45	space - 295
16	4.13	space - 340
17	3.98	space - 345
18	3.74	space - 345
Visible 19	0.70	Not Applicable

The Planned ABI Instrument on GOES R

Unlike current GOES, there is only one instrument, the advanced baseline imager (ABI)

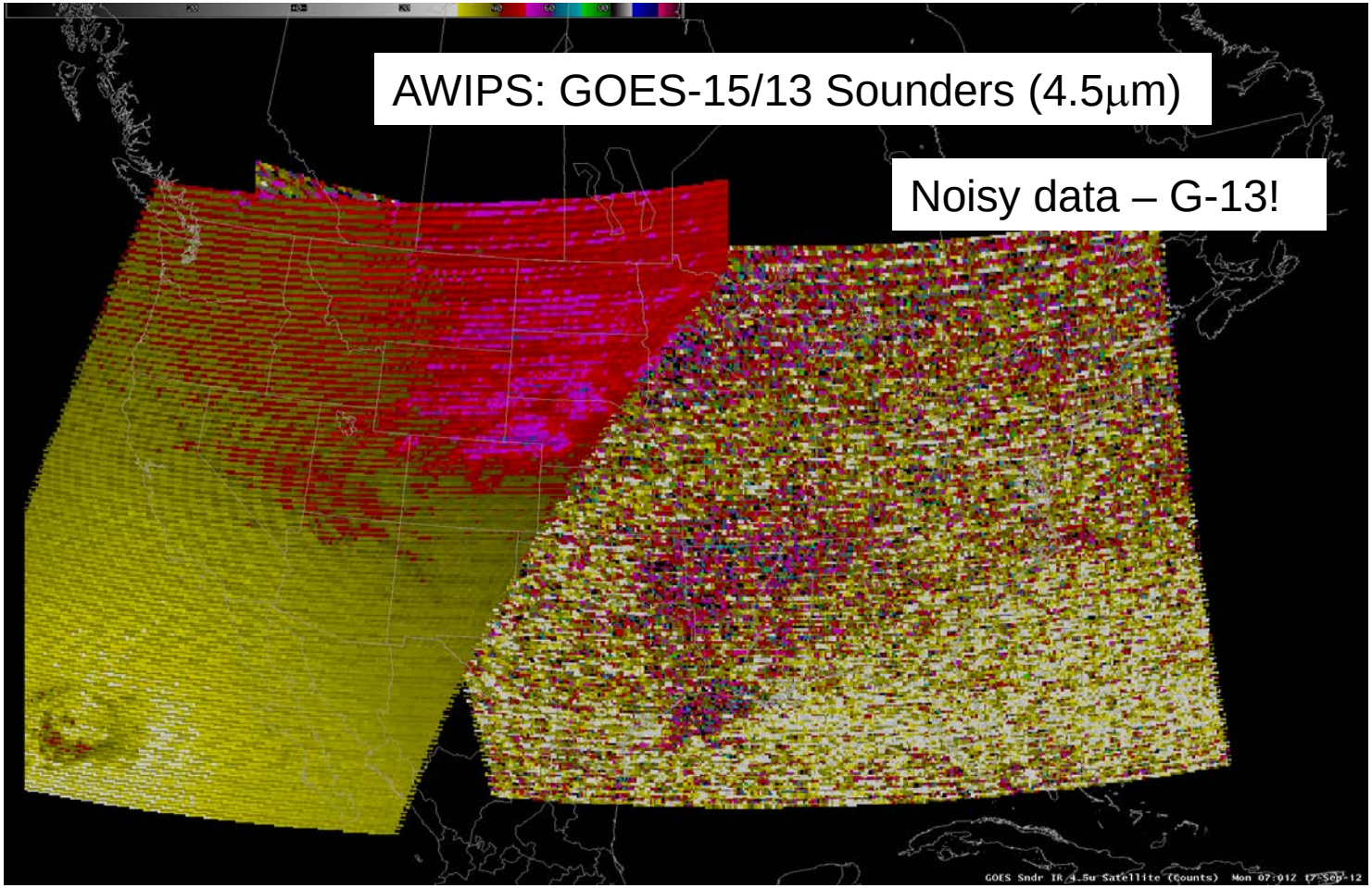
It contains a subset of the same channels of the current GOES imager and additional channels.

IR channels will be used for imaging and sounding have a spatial resolution of about 2km.

ONLY 8 channels that can be used for sounding over current 18 channel instrument!

Future GOES imager (ABI) band	Wavelength range (μm)	Central wavelength (μm)	Nominal subsatellite IGFOV (km)
1	0.45–0.49	0.47	1
2	0.59–0.69	0.64	0.5
3	0.846–0.885	0.865	1
4	1.371–1.386	1.378	2
5	1.58–1.64	1.61	1
6	2.225–2.275	2.25	2
7	3.80–4.00	3.90	2
8	5.77–6.6	6.19	2
9	6.75–7.15	6.95	2
10	7.24–7.44	7.34	2
11	8.3–8.7	8.5	2
12	9.42–9.8	9.61	2
13	10.1–10.6	10.35	2
14	10.8–11.6	11.2	2
15	11.8–12.8	12.3	2
16	13.0–13.6	13.3	2

Things Change



Courtesy Tim Schmit – CIMSS: Failing GOES 13 **17 Sept 2012**

Opportunities for Research

- CRTM was used to determine the advantage of water vapor knowledge to derive more thermal information from satellite radiances.
- More water information helps the problem.
- Consider research collaboration opportunities with CRTM and LAPS.