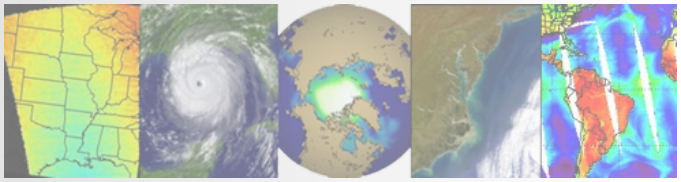
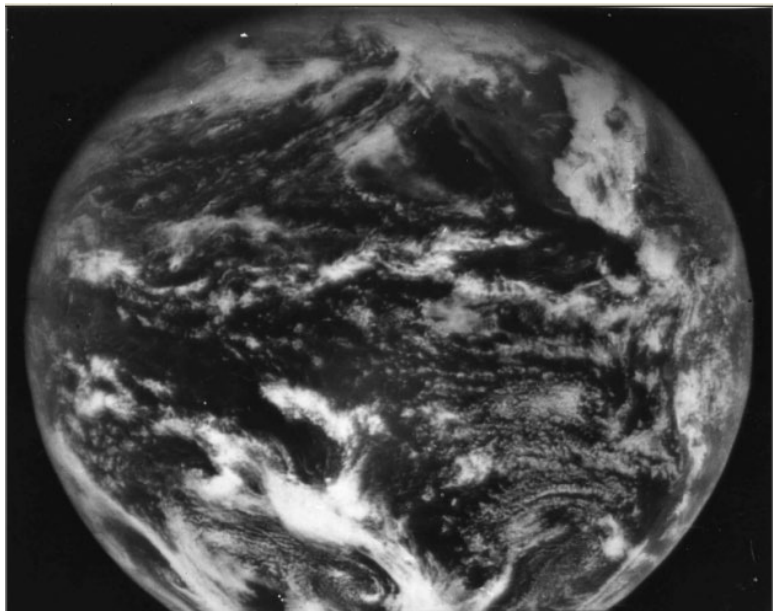
CIMSS

Cooperative Institute for Meteorological Satellite Studies

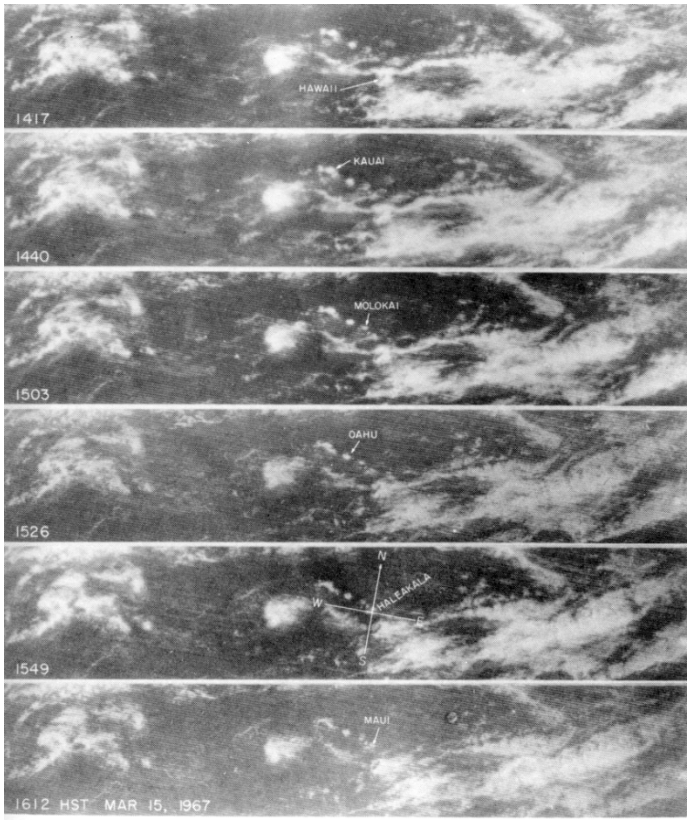
The Birth of Satellite Meteorology



The first geostationary camera was developed by Profs. Verner Suomi and Robert Parent, was launched on ATS-1 in Dec 1966, and produced instant replay of weather systems.



“the weather moves - not the satellite”
Verner Suomi



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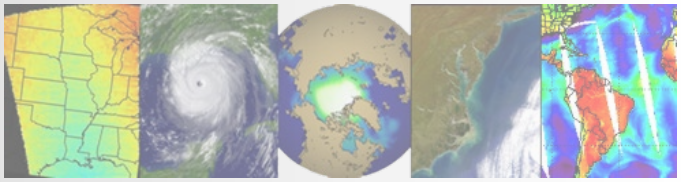
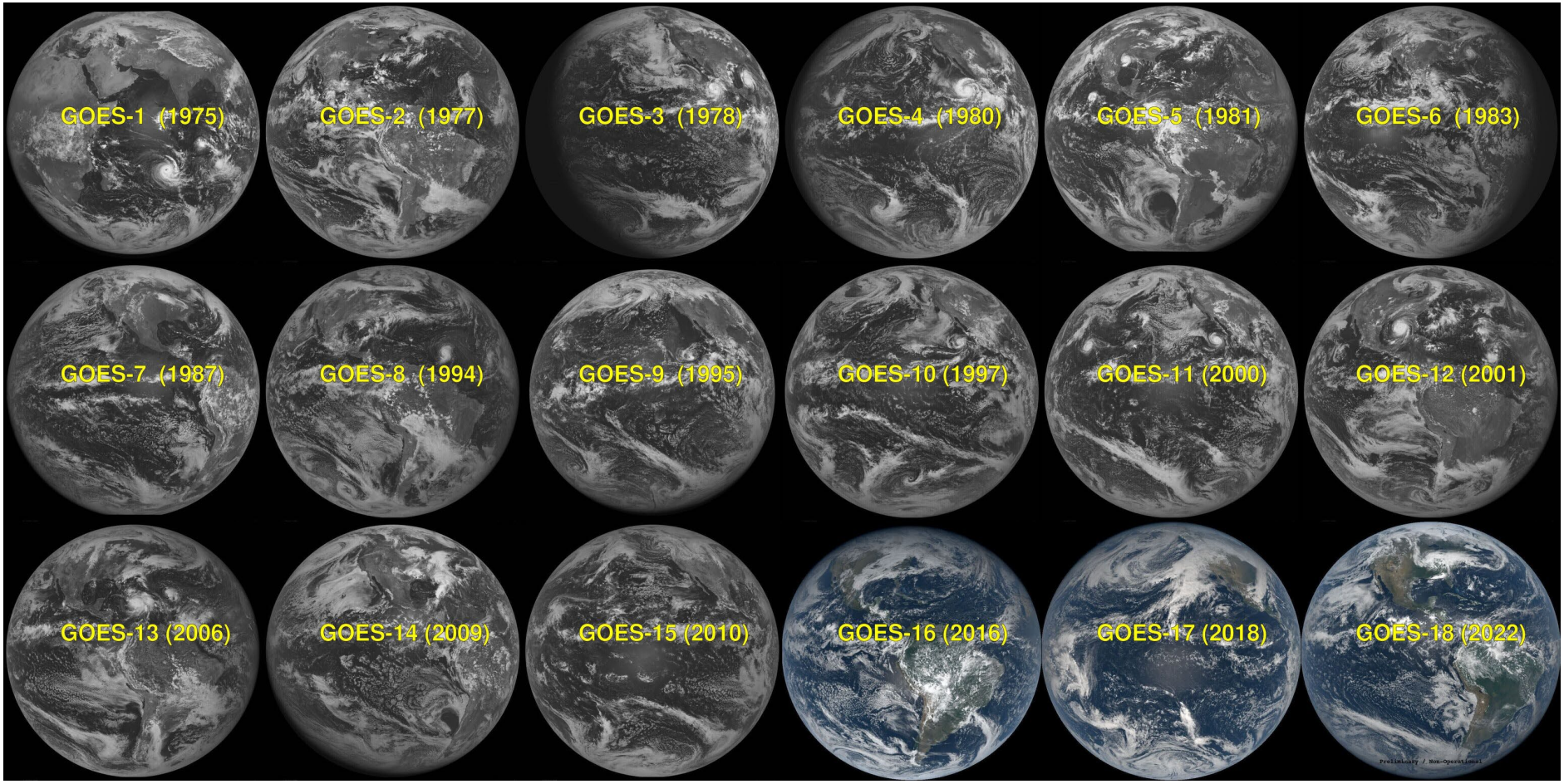
Home of Satellite Meteorology



UW/CIMSS/SSEC have played, and continue to play, key roles in the on-orbit check-out, display and use of all the Geostationary Operational Environmental Satellites (and numerous LEO platforms)



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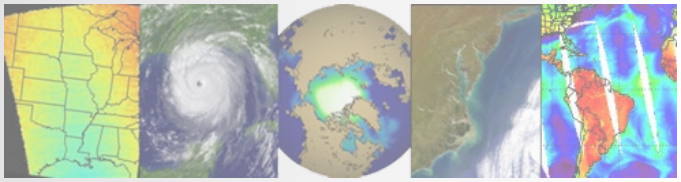
CIMSS Theme Areas



- Satellite Meteorology Research and Applications

  To support weather analysis and forecasting through participation in NESDIS product assurance and risk reduction programs and the associated transitioning of research progress into NOAA operations.

- Satellite Sensors and Measurement Techniques

  To conduct instrument trade studies and sensor performance analysis supporting NOAA's future satellite needs as well as assisting in the long term calibration and validation of remote sensing data and derived products.

- Environmental Models and Data Assimilation

  To work with the Joint Center for Satellite Data Assimilation (JCSDA) on improving satellite data assimilation techniques in operational weather forecast models.

- Outreach and Education

  To engage the workforce of the future in understanding and using environmental satellite observations for the benefit of an informed society.

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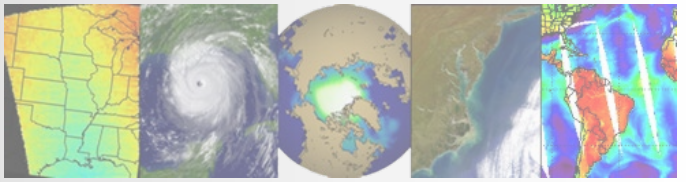
Satellite Research and Applications



Observations over the oceans are sparse.

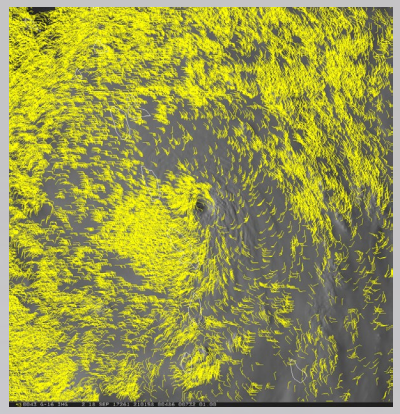
Satellites can fill in large gaps in available information in these regions.

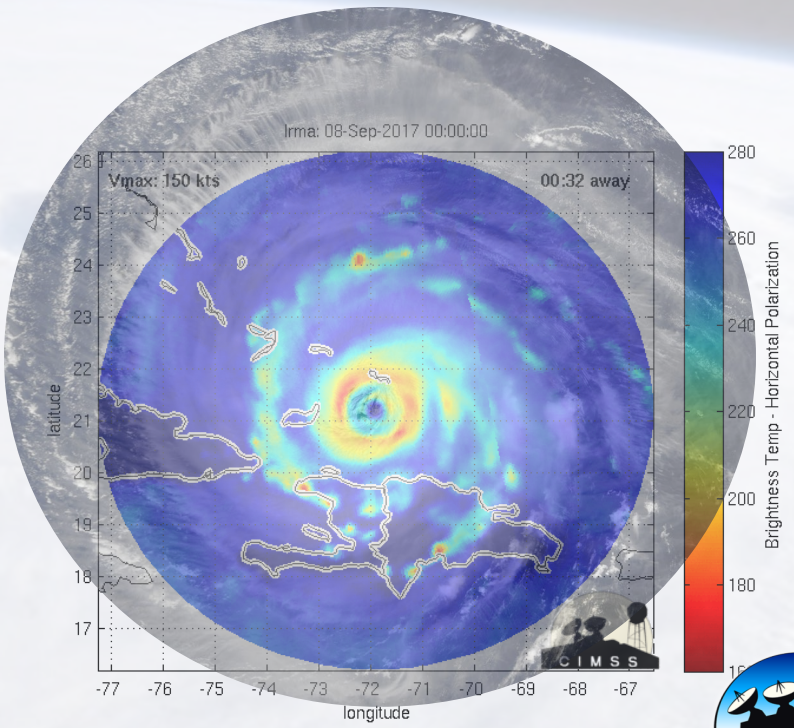
Image processing and retrieval algorithms at CIMSS tell us about the environment around the storm and the internal controls that govern its intensity.

Assimilation into weather models improves forecasts of storm track, intensity, and impacts (e.g. wind/rain).

The Midwest is impacted by tropical cyclones (TCs). TCs or their remnants can cause local flooding and impact crops.

- Upper level winds
- Dry air
- Water temperatures
- Cloud cover
- Rainfall
- Ground track





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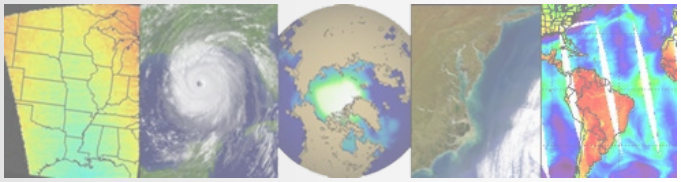
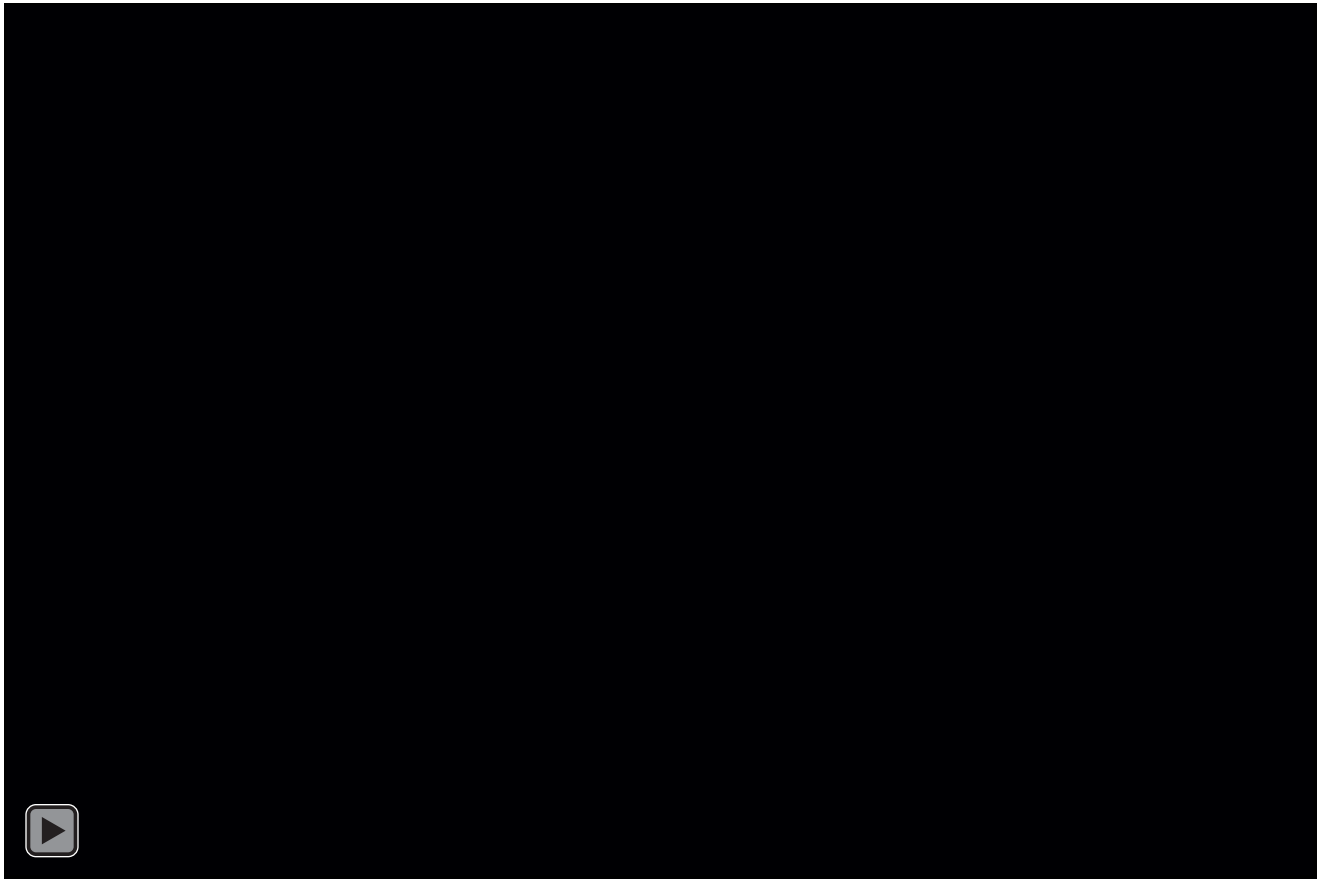
Data → Information



- Weather satellites now collect over a trillion Earth observations each day.
- Distilling this data into actionable information requires new analysis methods, incorporating data into forecasts and communicating it to the public.
- CIMSS pioneers new methods for translating vast satellite datasets into guidance for forecasters.

Current Capabilities Previous



New Capabilities → New Challenges

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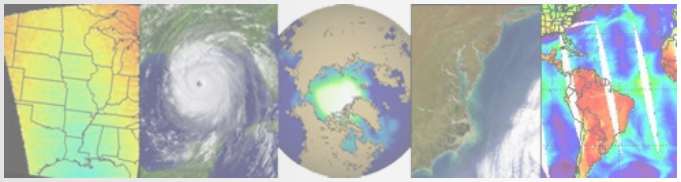
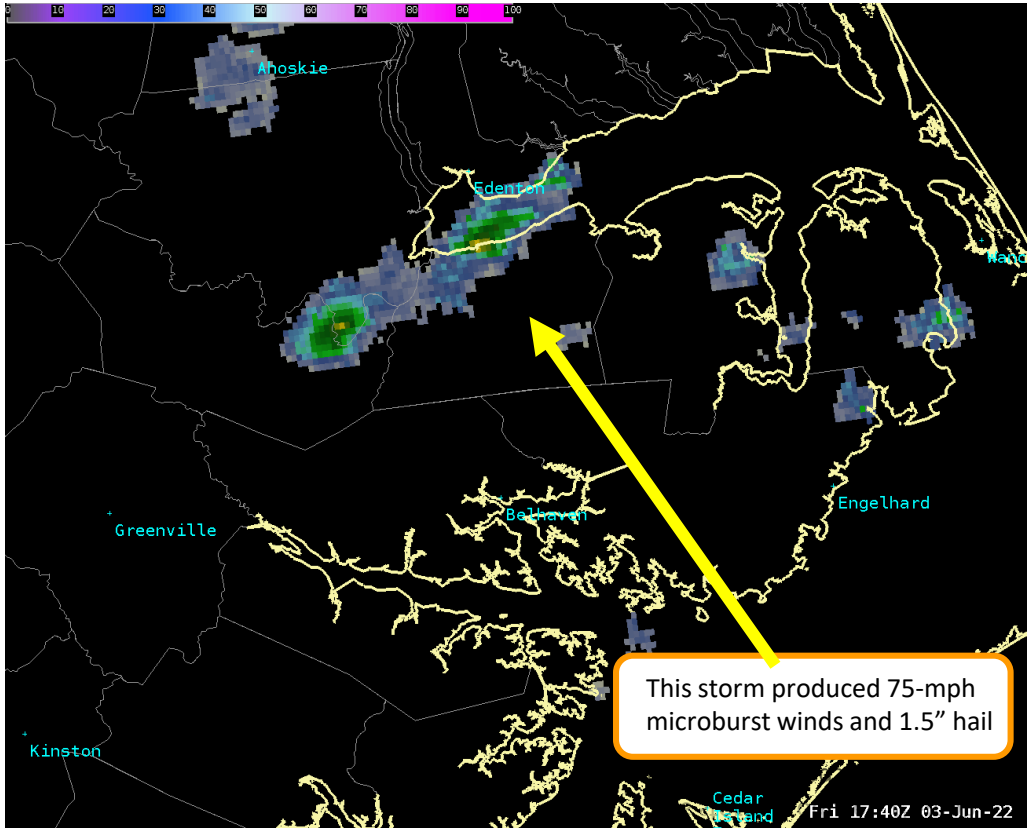
Increasing Lead Time



- ProbSevere is a collection of ML models that use radar, satellite, lightning, and short-term NWP to predict next-hour probabilities of severe weather (hail, wind, tornado)

Gives forecasters a "heads up" to imminent severe weather

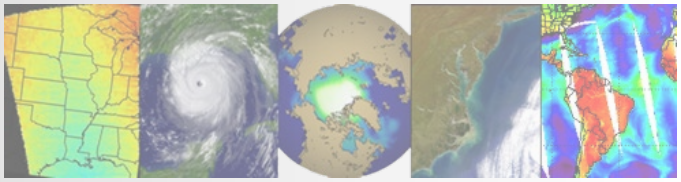


- The NOAA Hazardous Weather Testbed and Operations Proving Ground were critical in taking ProbSevere from a mid to a high Technical Readiness Level

- Three different NOAA line offices (NESDIS, NWS, and OAR) and two NOAA Cooperative Institutes (CIMSS and CIRA) made ProbSevere a success.

2022 HWT ProbSevere: Michael Pavolonis (NOAA) and John Cintineo

Satellite Sensors and Cal/Val



Infrared Sensor Calibration

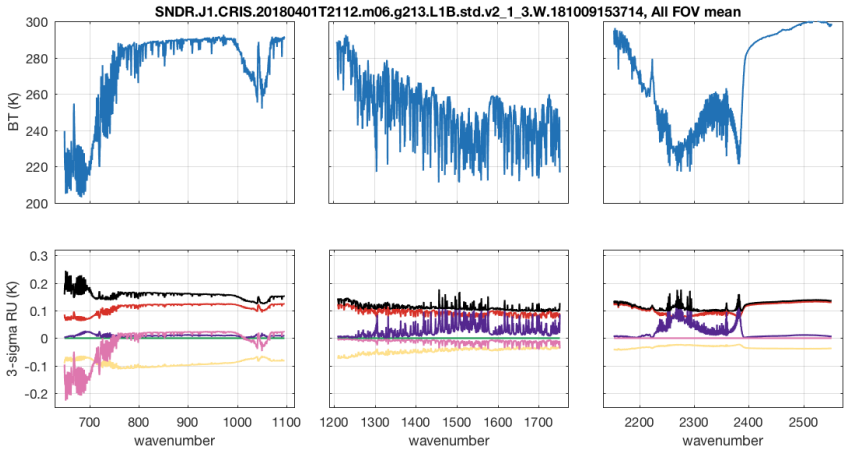
IR Hyperspectral and Imager sensor design, calibration, and cal/val, for both LEO and GEO – Dave Tobin

Sensors: VAS, HIRS, ITS, HIS, S-HIS, NAST-I, IMG, AIRS, IASI, GIFTS, CrIS, HIRAS, CLARREO, ABI, MODIS, VIIRS, ARI

Current Projects:

- Cross-track Infrared Sounder (CrIS) NASA L1B product and long-standing major contributor to the NOAA CrIS SDR calibration team, for SNPP through JPSS-4
- CrIS and Visible Infrared Imaging Radiometer Suite (VIIRS) pre-launch Thermal Vacuum Testing and calibration characterization, SNPP through JPSS-4
- Absolute Radiance Interferometer (ARI): IR CLARREO pathfinder – unprecedented accuracy demonstration in Thermal Vacuum at SSEC

Example CrIS spectra and Calibration Uncertainties



High Information content observations with low and well characterized uncertainties for climate, sounding, and composition applications

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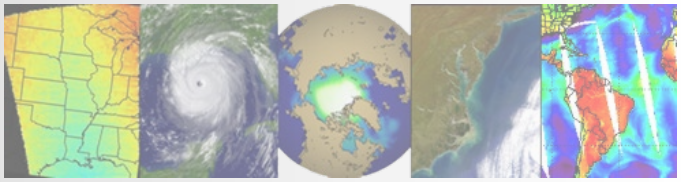
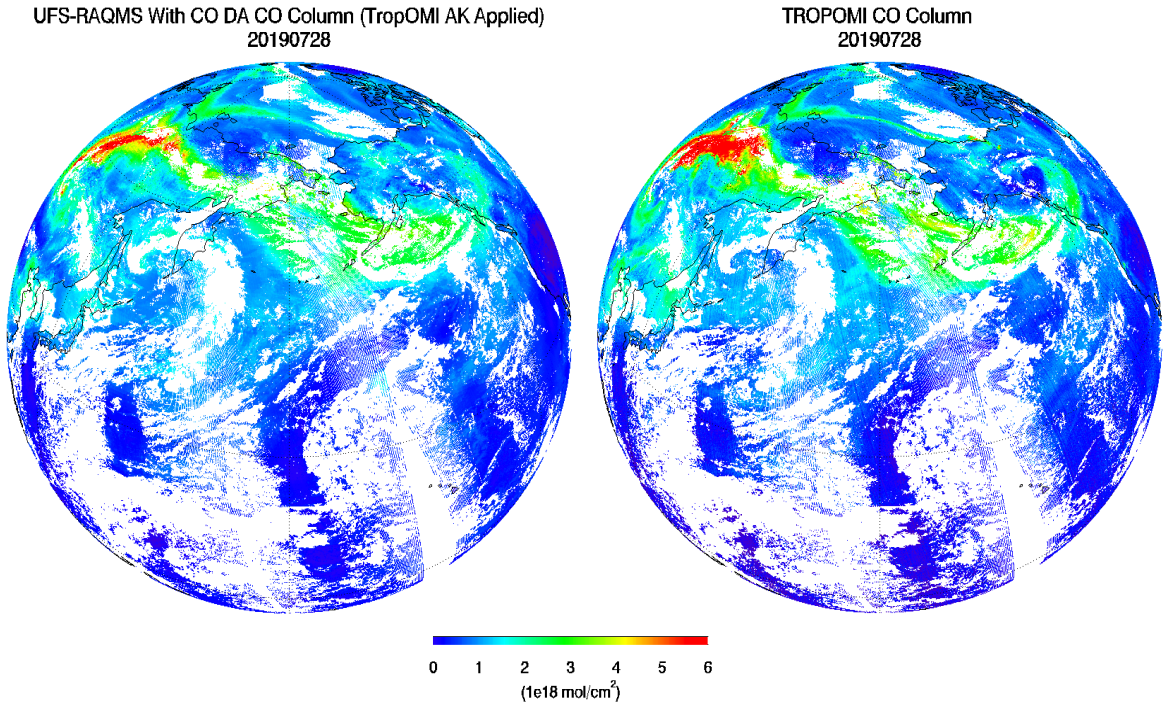
Models and Assimilation



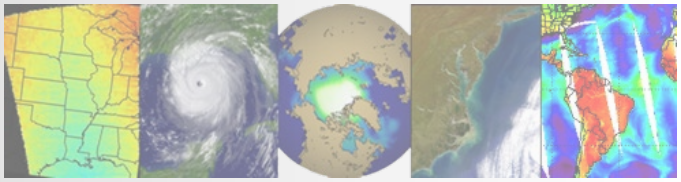
- Real-time Air Quality Modeling System (RAQMS) unified stratosphere/ troposphere chemical module incorporated in the Unified Forecasting System
- JPSS Proving Ground/Risk Reduction Project is developing capabilities for assimilation of atmospheric composition and aerosol retrievals
- Collaborating with the Global Systems Lab to transition to NOAA/ESRL for pre-operational testing



UFS-RAQMS (left) and TROPOMI (right) column carbon monoxide ($1e^{18}$mol/cm^2) on July 28, 2019

Brad Pierce, Allen Lenzen, Adtiya Kumar, and Margaret Bruckner

Education and Outreach



Education, outreach, and community training are priorities at CIMSS:

- Leadership in professional training for users (e.g. SHyMet, VISITView,
- Online instruction (education modules and MOOC)
- Satellite summer school
- k-12 education (Science on a Sphere, workshops, CIMSS summer camp, virtual science fair)
- Public engagement (Through the Atmosphere, CIMSS satellite blog, CIMSS website)
- Undergrad summer programming internships
- 15 graduate students in last 5 years

- Suomi Scholarships awarded to 7 Wisconsin students with interests in improving weather forecasts
- Nuo Chen received inaugural William Smith Graduate Scholarship Sep 2019 (3 years of graduate support); next offering: spring 2023
- Startup funding provided to Prof. Angela Rowe to support graduate student (Ian Cornejo)

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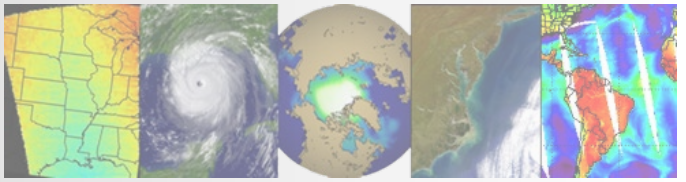
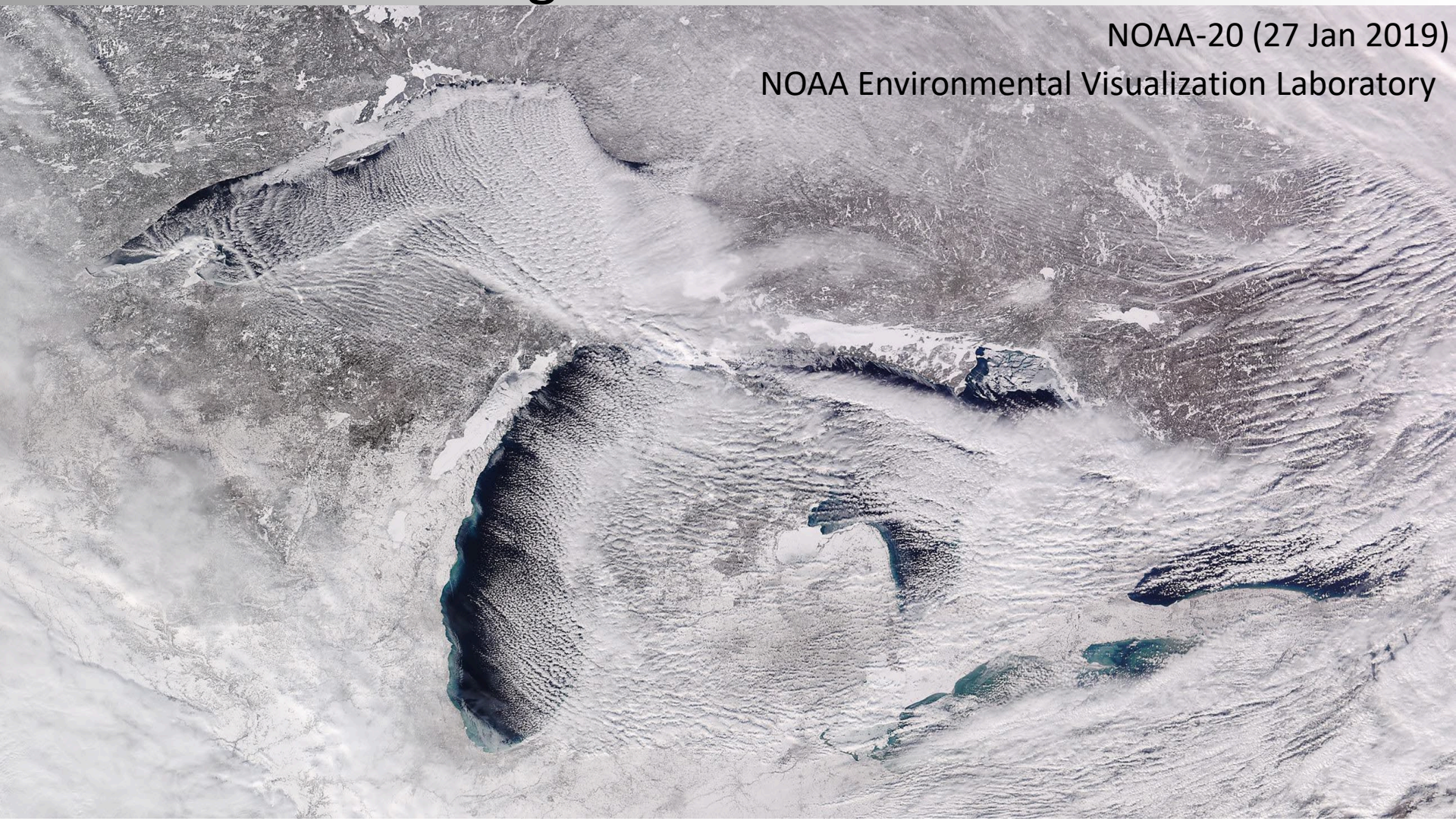
Satellite Applications in the Great Lakes Region





NOAA-20 (27 Jan 2019)

NOAA Environmental Visualization Laboratory

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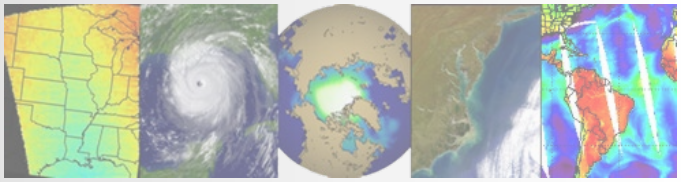
Lake Effect Snow: Mark Kulie

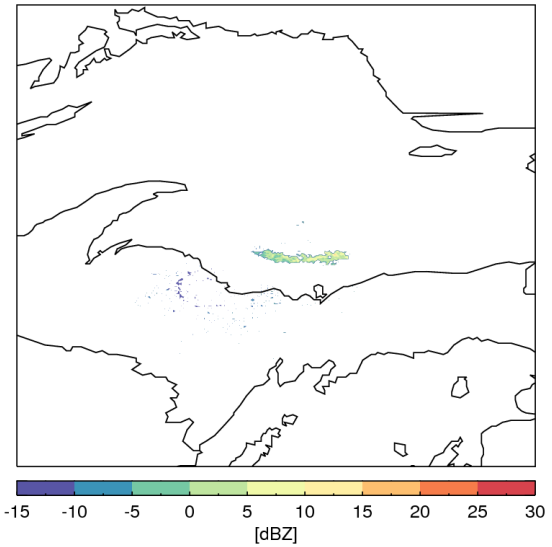
CIMSS

Satellite-Based Snowfall Estimates?

NOAA Research-to-Operations

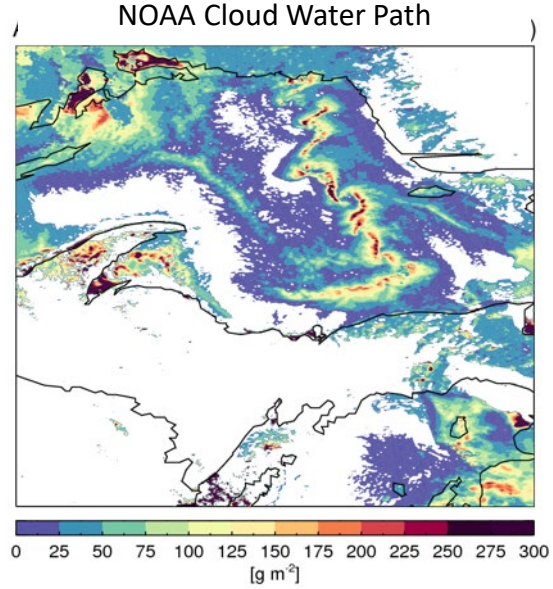


KMQT Radar (17 Feb 2013 1844 UTC)

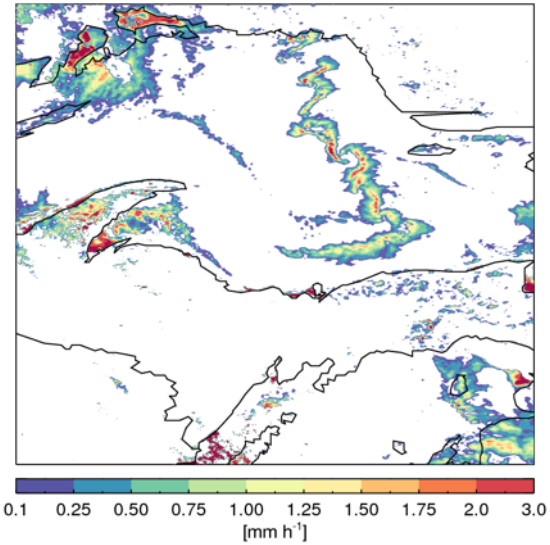


NOAA Satellite (17 Feb 2013 1845 UTC)

NOAA Cloud Water Path



Estimated Snowfall Rate (Experimental)



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