

# Assessing Hyperspectral Retrieval Algorithms and their Products for Use in Direct Broadcast Applications

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University of Wisconsin-Madison, USA

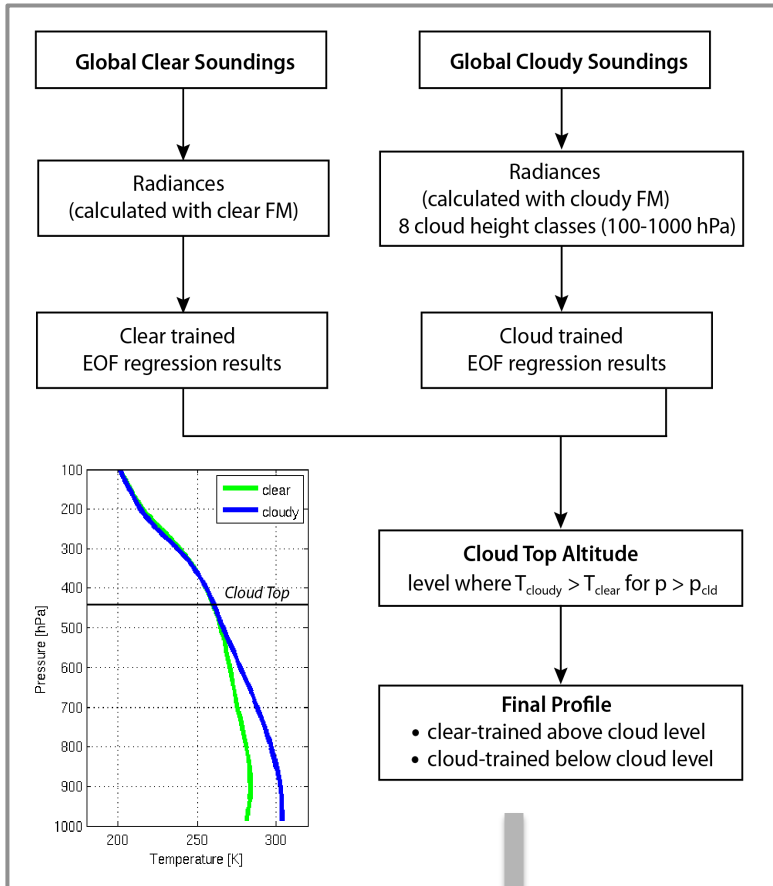
ITSC-20, 28 October – 3 November, 2015, Lake Geneva, Wisconsin, USA

# Hyperspectral Retrieval Software in CSPP

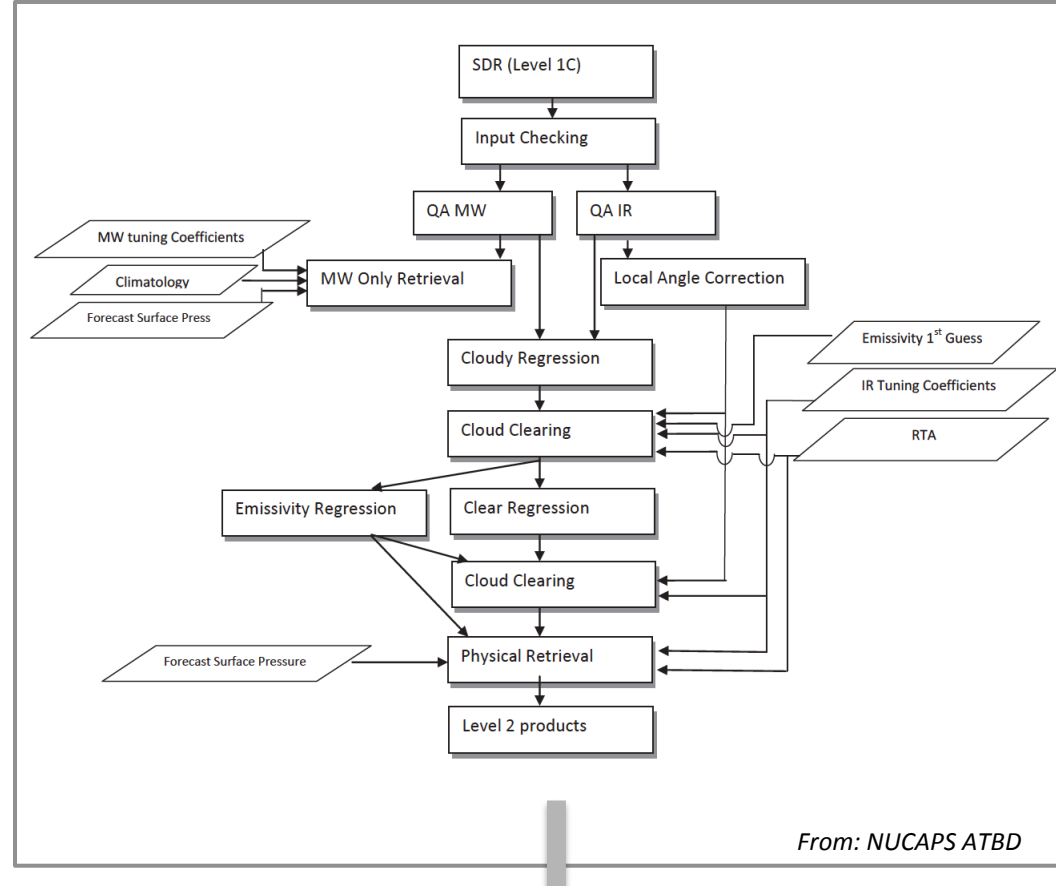
**University of Wisconsin-Madison CrIS, AIRS and IASI Hyperspectral Retrieval Software** (latest version April 2014)

**NOAA Unique CrIS/ATMS Processing System (NUCAPS) EDR Software** Version 1.0 Release (February 2015)

## HSRTV Dual-Regression



## NUCAPS

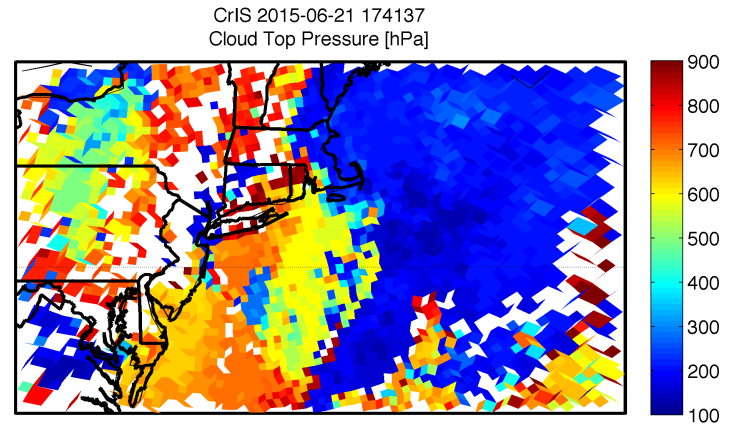
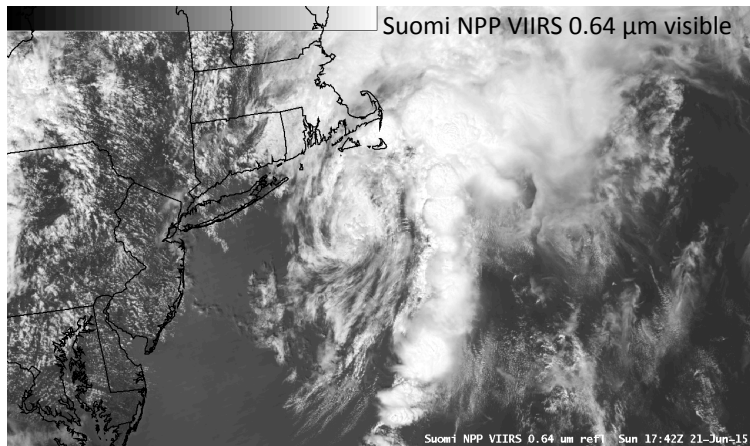
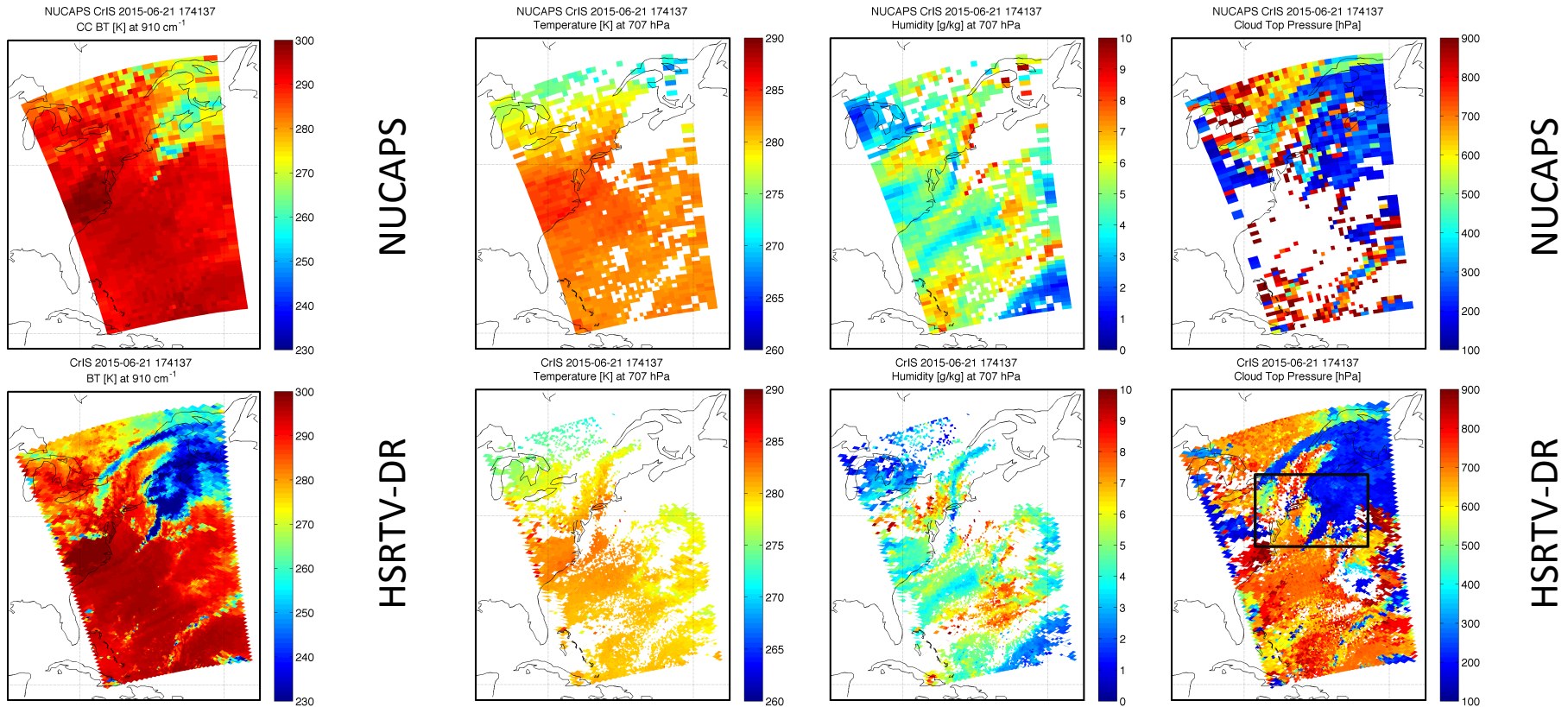


L2 Products: temperature, water vapor and ozone profiles, cloud and surface parameters. NUCAPS also outputs trace gas retrievals such as methane and carbon monoxide.

# Main Differences

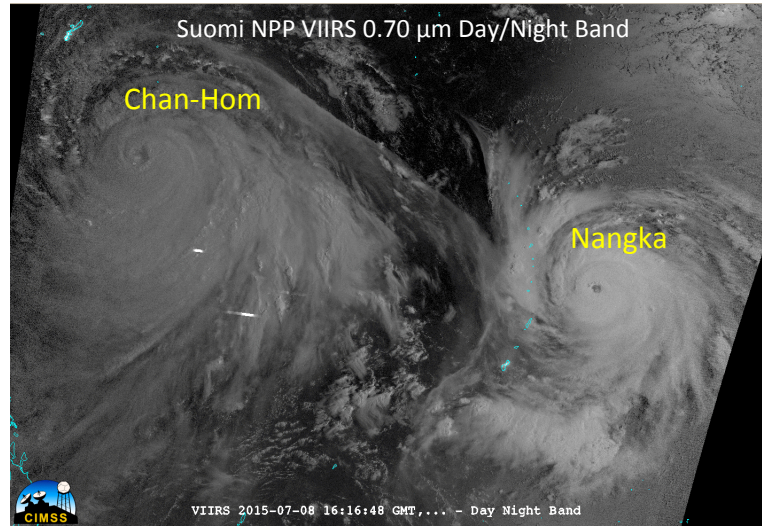
Dual-Regression (UW/CIMSS)	NUCAPS (NOAA)
Research	Operational
Regression solution	Optimal estimation solution
Optimized for speed	Optimized for accuracy
Infrared only	Infrared plus microwave
Single FOV resolution (~14 km at nadir)	3x3 array (~50 km at nadir)
No retrievals below thick clouds	Retrievals below clouds
Multi-instrument (AIRS, IASI, CRIS)	Single instrument (CrIS)

# Case Study: Remnants of Tropical Storm Bill (21 June 2015)



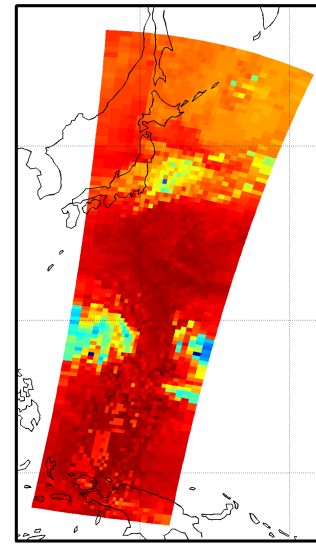


# Case Study: Typhoons Chan-Hom and Nangka (08 July 2015)

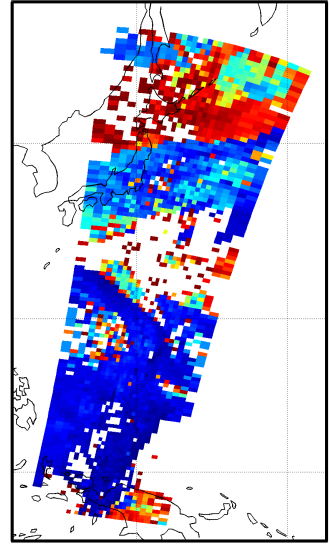


NUCAPS

NUCAPS CrIS 2015-07-08 161112  
CC BT [K] at  $910\text{ cm}^{-1}$

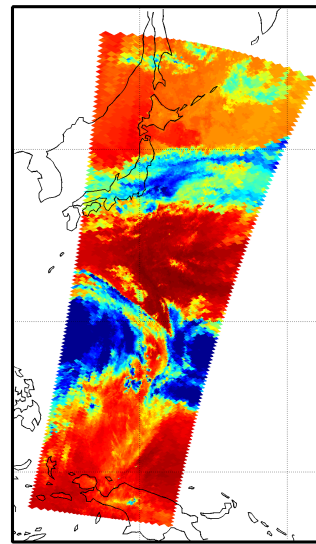


NUCAPS CrIS 2015-07-08 161112  
Cloud Top Pressure [hPa]

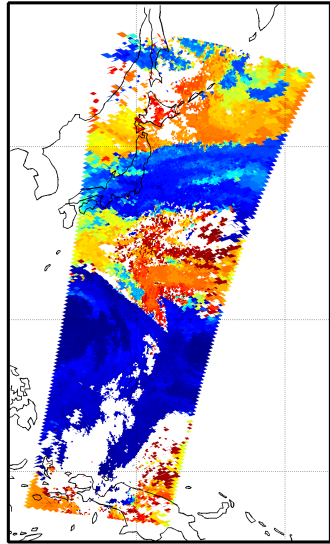


HSRTV-DR

CrIS 2015-07-08 161112  
BT [K] at  $910\text{ cm}^{-1}$

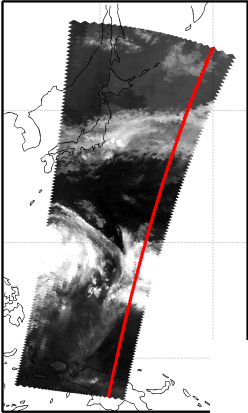


DR CrIS Cloud Top Pressure [hPa]  
20150708 161112-161912



# Temperature and Relative Humidity Cross-sections

Footprints 9

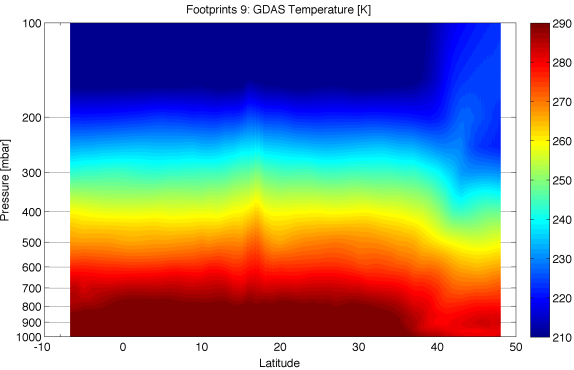
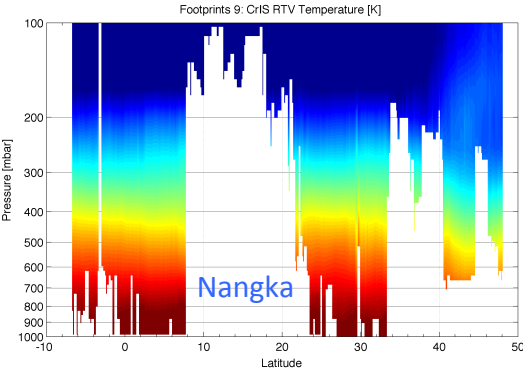
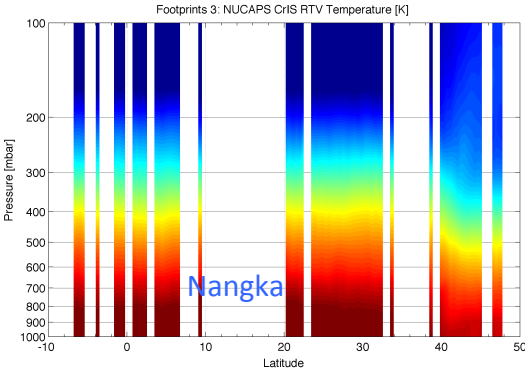


### NUCAPS

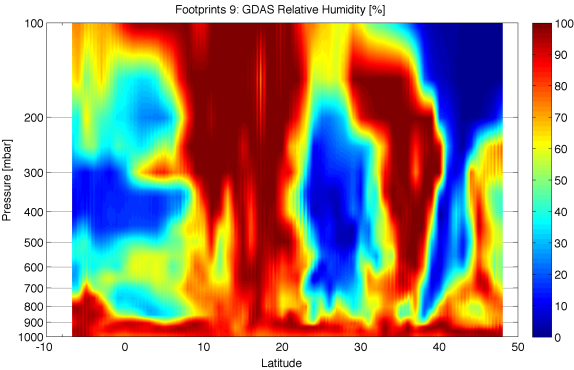
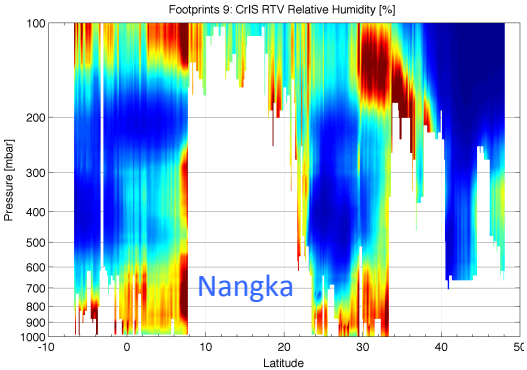
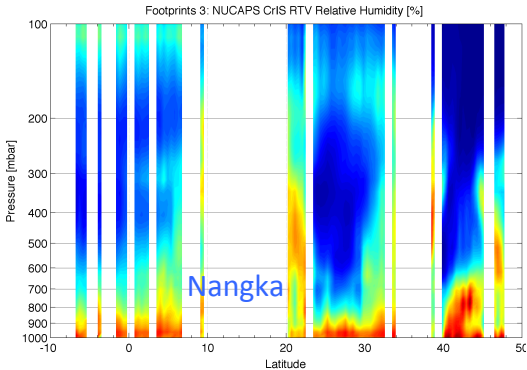
### HSRTV-DR

### NCEP GDAS

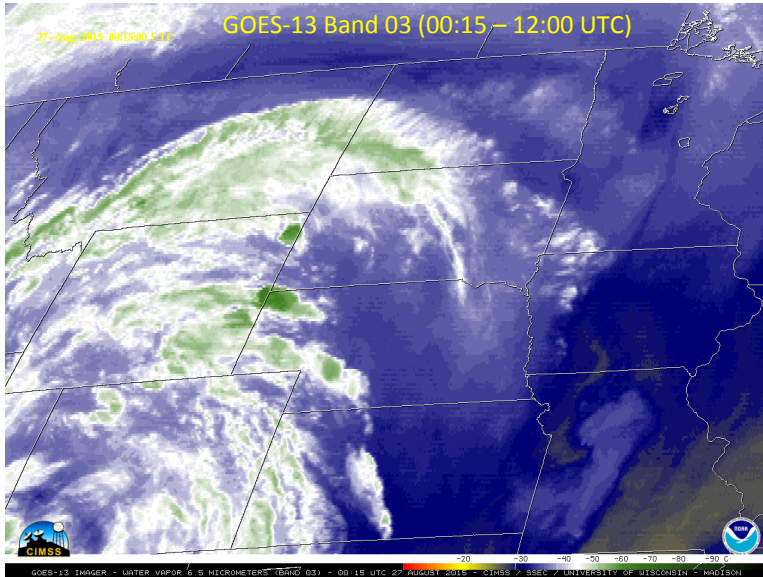
Temperature



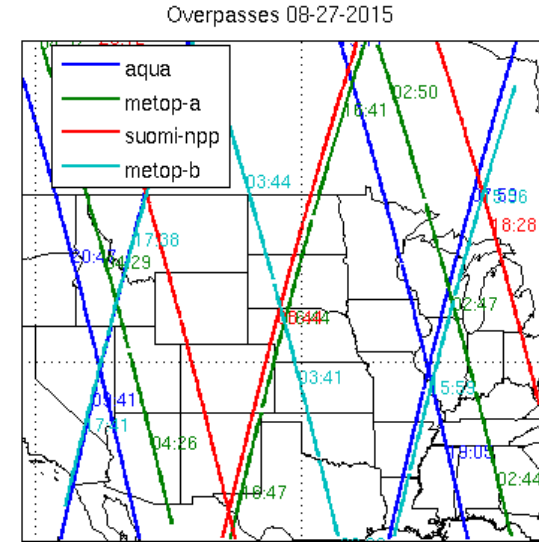
Relative Humidity



# Case Study: Mesoscale Convective System (South Dakota, 27 Aug 2015)

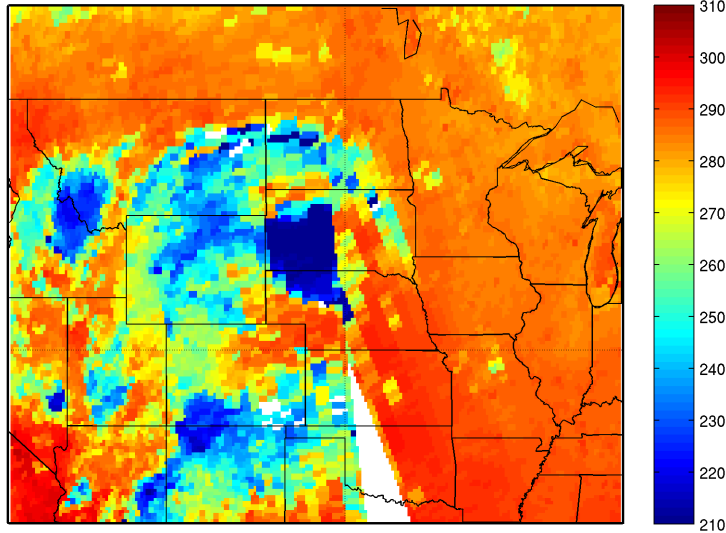


<http://cimss.ssec.wisc.edu/goes/blog/archives/category/severe-convexion>



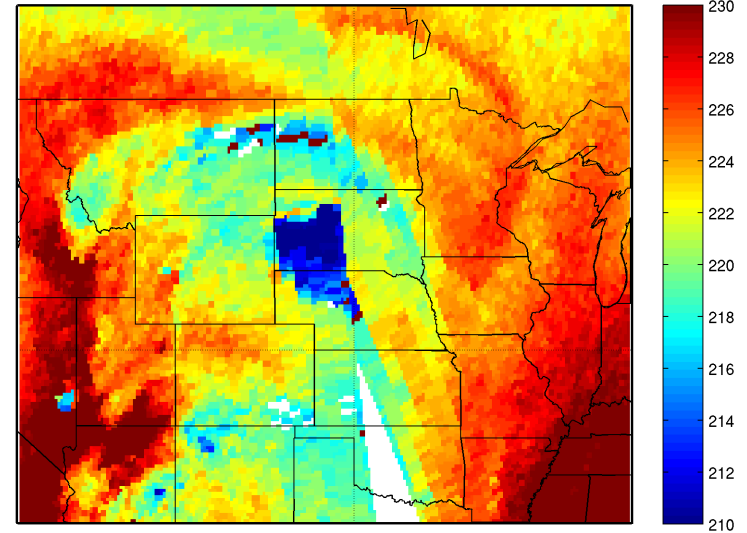
BT@910 cm<sup>-1</sup> Animation (IASI-A, IASI-B, AIRS, CrIS)  
02:44 to 20:41 UTC

IASI Metop-A 2015-08-27 024453,042653

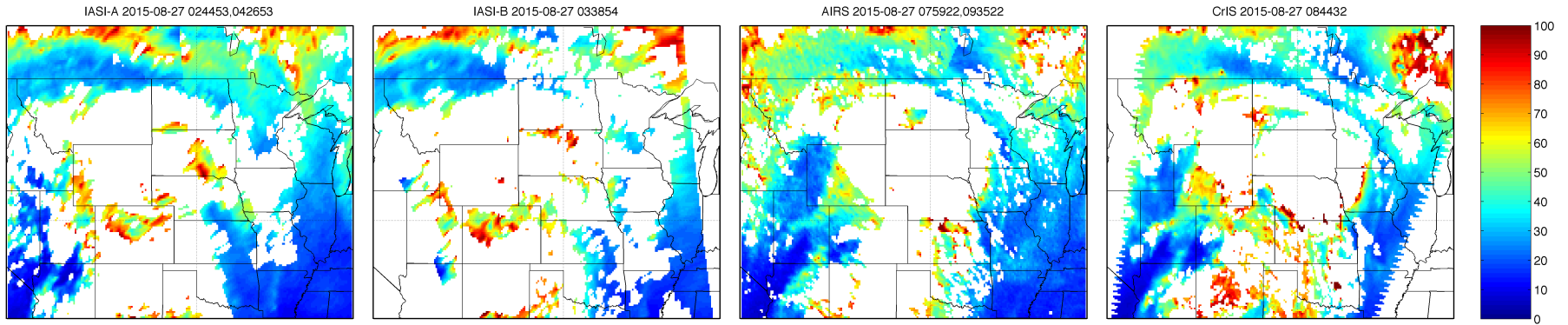


BT@1410 cm<sup>-1</sup> Animation (IASI-A, IASI-B, AIRS, CrIS)  
02:44 to 20:41 UTC

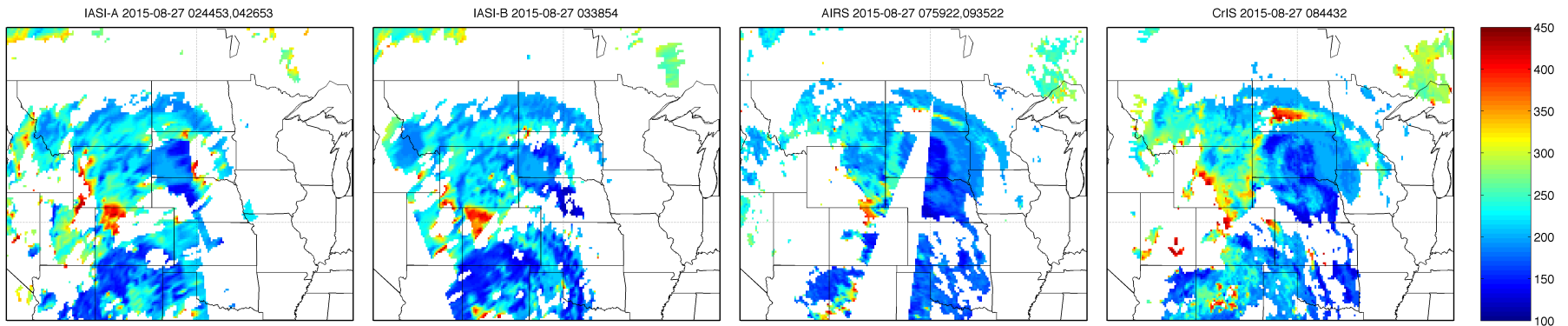
IASI Metop-A 2015-08-27 024453,042653



### Relative Humidity at 300 hPa



### Cloud Top Pressure



IASI Metop A

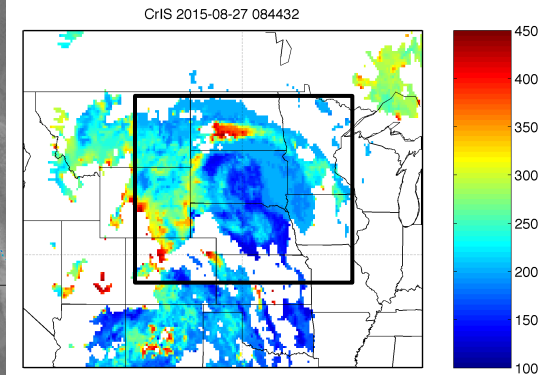
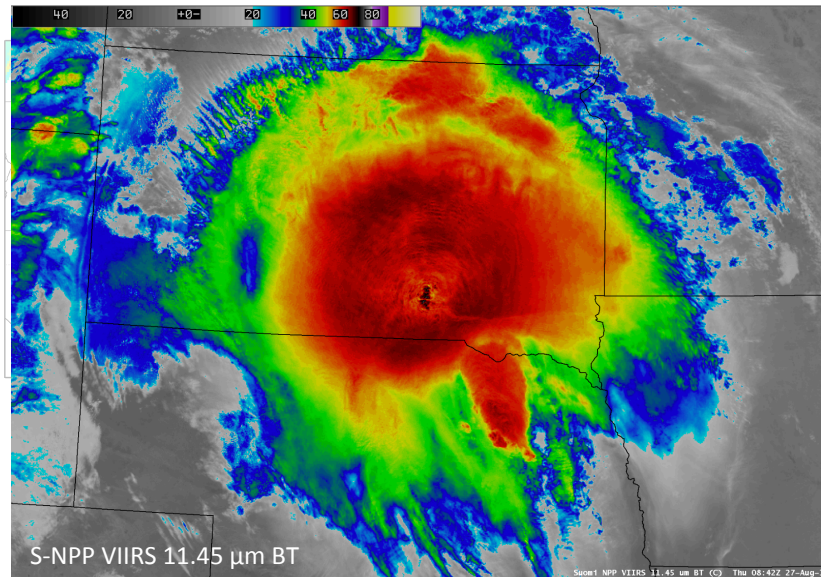
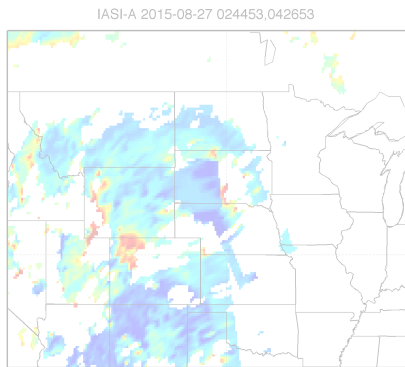
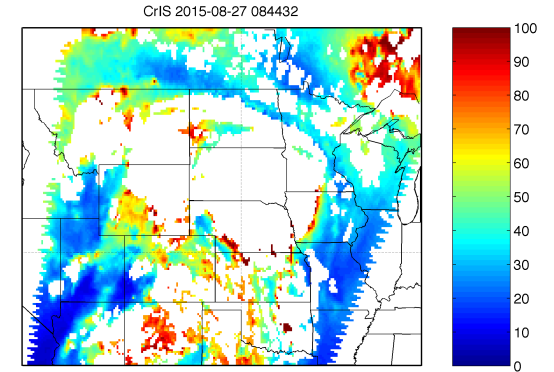
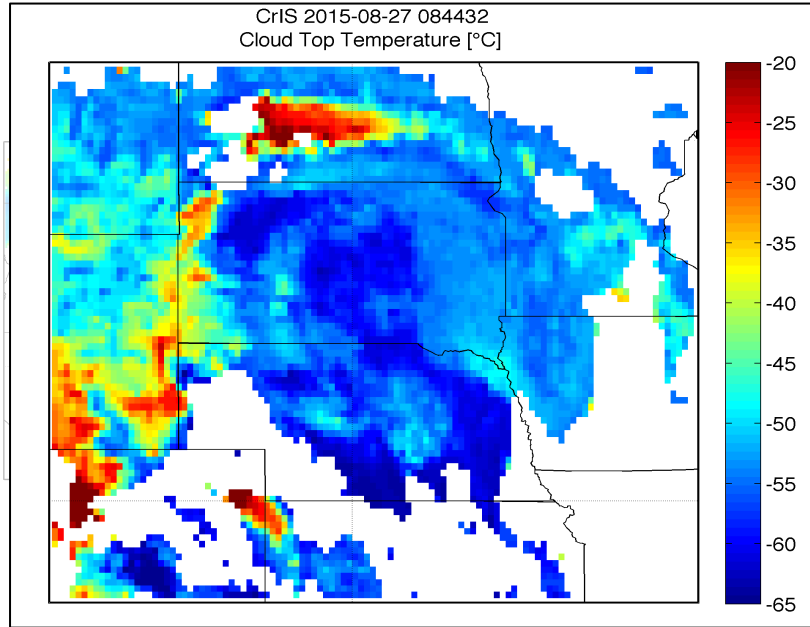
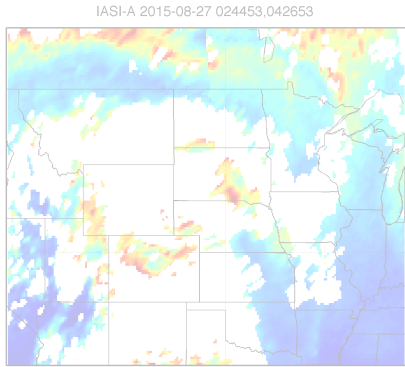
IASI Metop B

AIRS

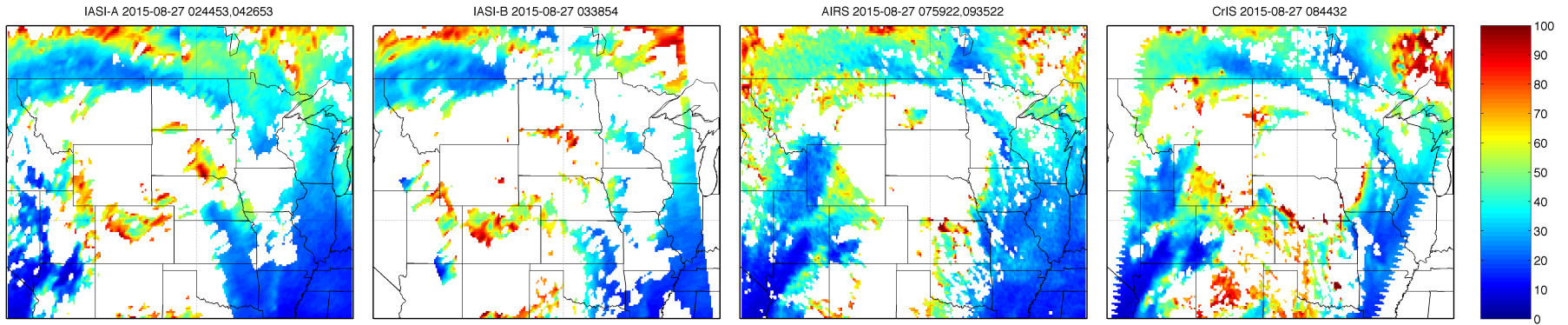
CrIS



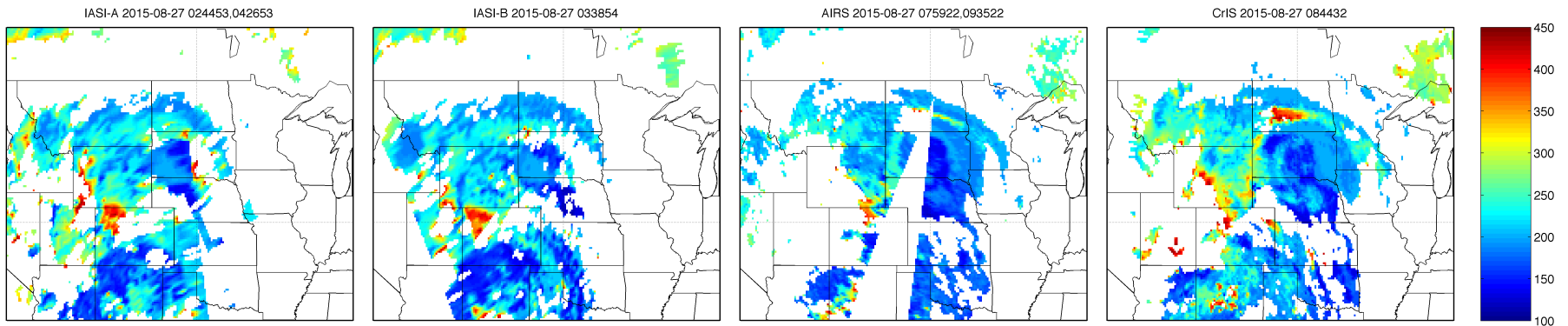
# MCS (27 Aug 2015) HSRTV-DR RH at 300 hPa and Cloud Top Pressure **Overpass 1**



### Relative Humidity at 300 hPa



### Cloud Top Pressure



IASI Metop A

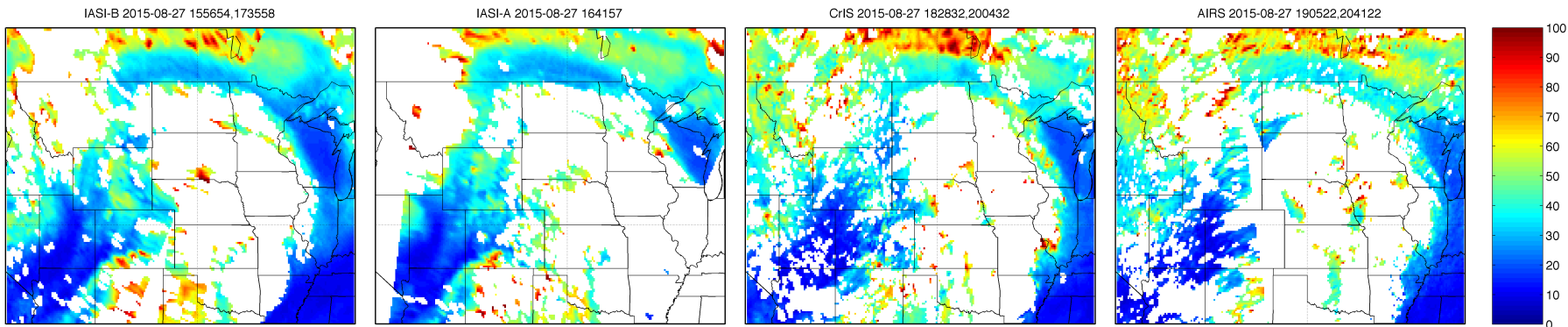
IASI Metop B

AIRS

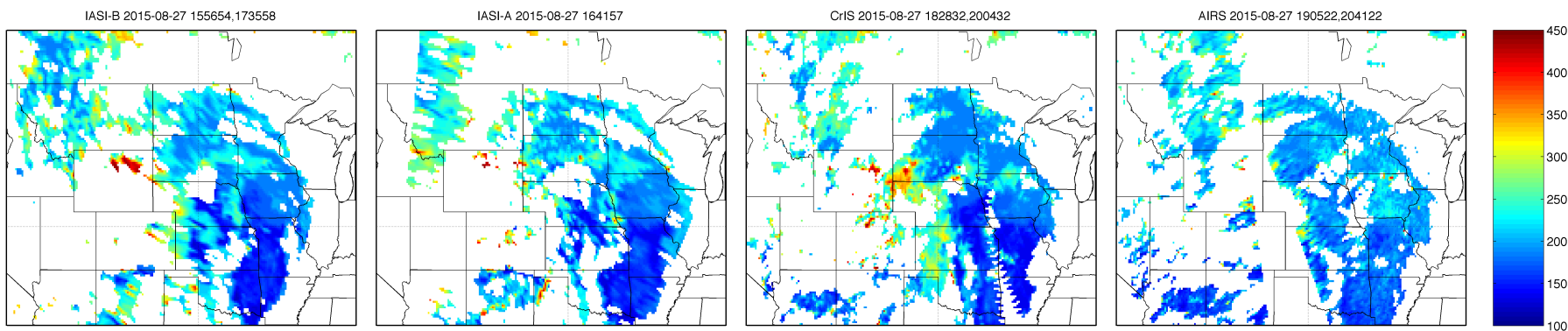
CrIS



### Relative Humidity at 300 hPa



### Cloud Top Pressure



IASI Metop B

IASI Metop A

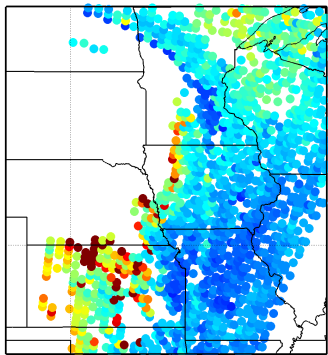
CrIS

AIRS

# MCS (27 Aug 2015) HSRTV-DR RH at 300 hPa Time Tendencies

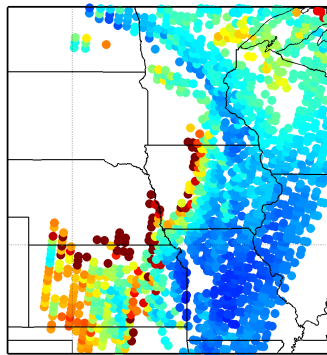
Instrument 1

AIRS 0759  
RH [%] at 300 hPa



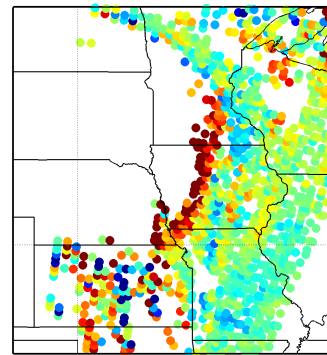
Instrument 2

CrIS 0844  
RH [%] at 300 hPa



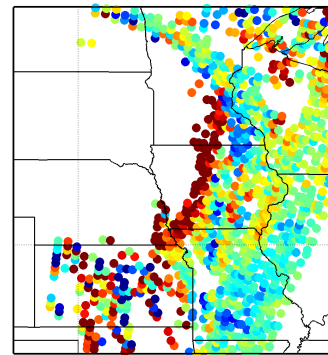
Differences

CrIS - AIRS  
RH [%] at 300 hPa

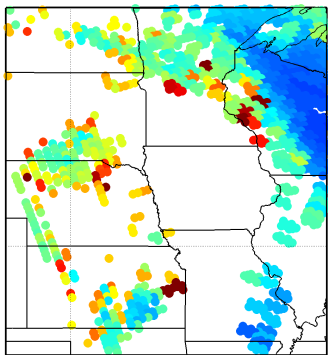


Change per hour

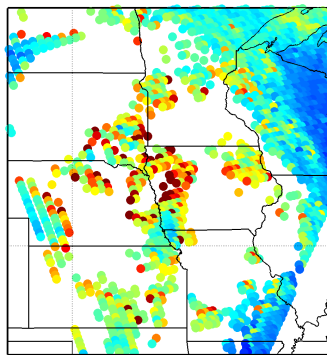
Change per hour  
RH [%] at 300 hPa



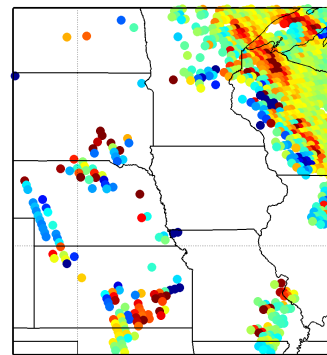
IASI Metop-A 1647  
RH [%] at 300 hPa



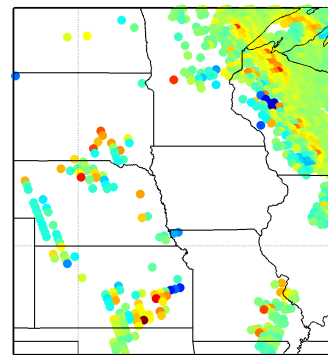
AIRS 1905  
RH [%] at 300 hPa



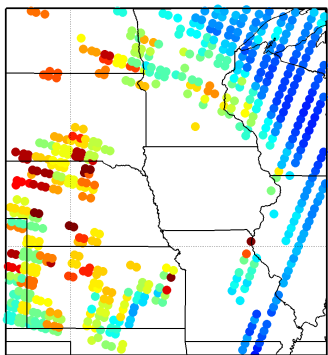
AIRS - IASI Metop-A  
RH [%] at 300 hPa



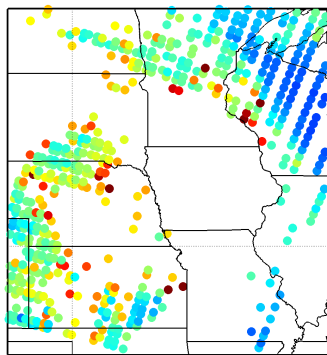
Change per hour  
RH [%] at 300 hPa



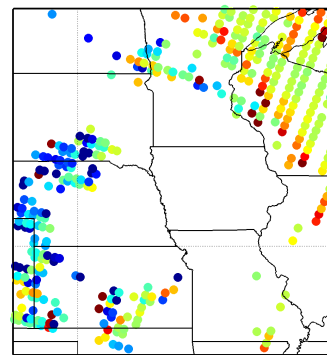
IASI Metop-B 1556  
RH [%] at 300 hPa



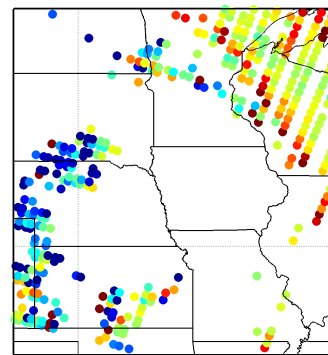
IASI Metop-A 1641  
RH [%] at 300 hPa



IASI Metop-A - IASI Metop-B  
RH [%] at 300 hPa



Change per hour  
RH [%] at 300 hPa



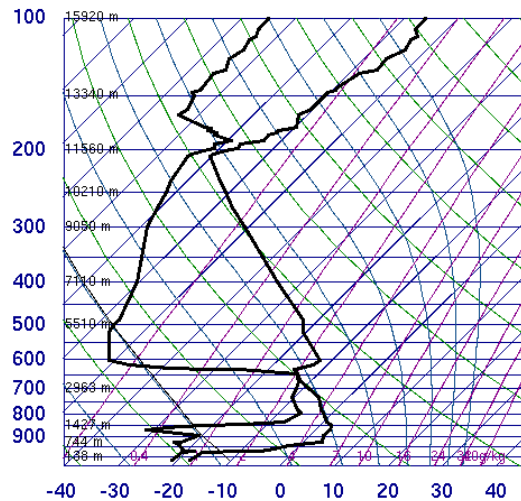
AIRS  
CrIS

IASI-A  
AIRS

IASI-B  
IASI-A

# Cold Air Aloft (CAA) – First Experiment (24 February 2014)

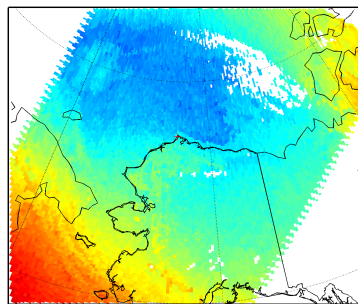
70026 PABR Barrow



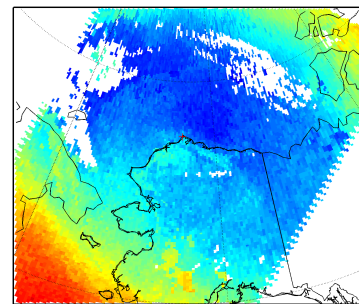
12Z 24 Feb 2014

University of Wyoming

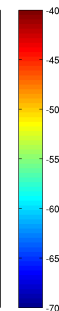
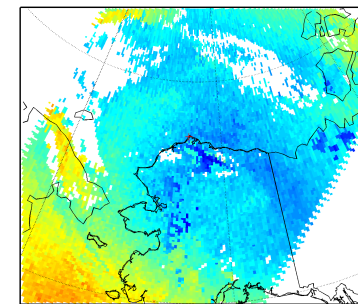
Temperature [°C] at 150 hPa



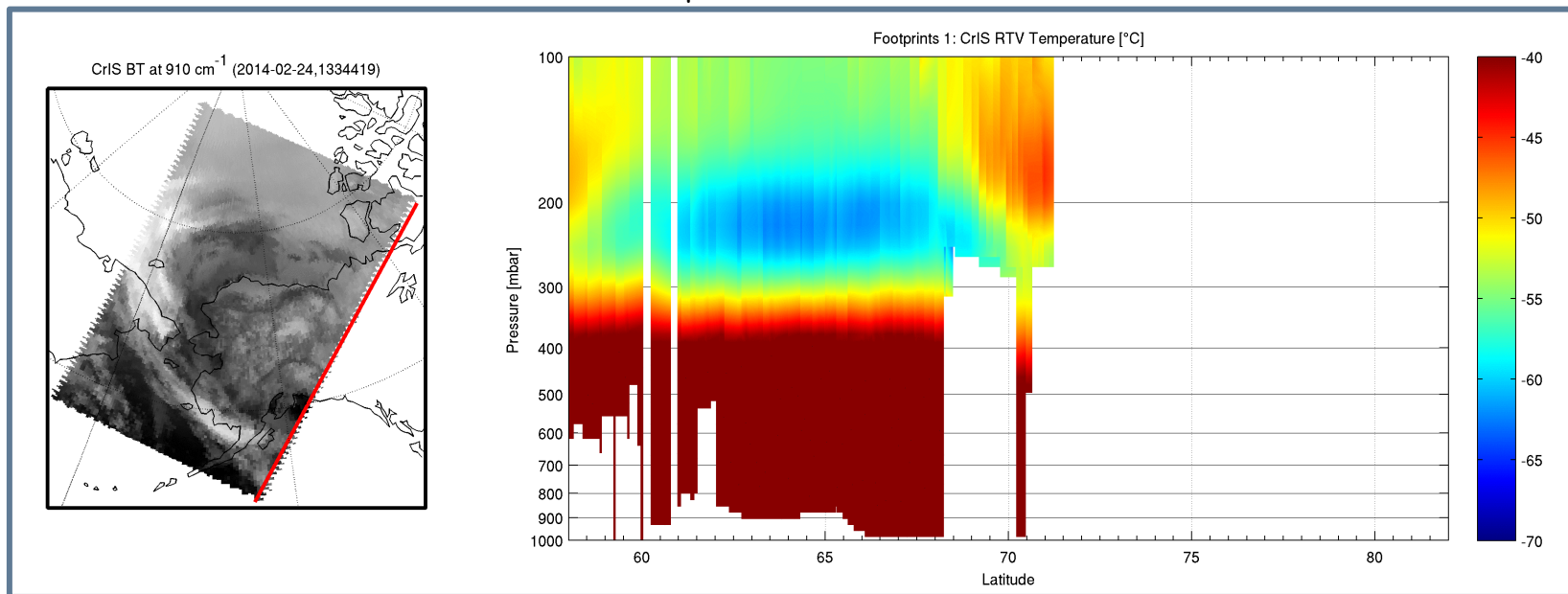
Temperature [°C] at 200 hPa



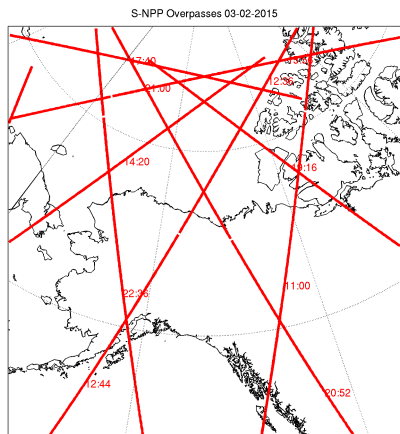
Temperature [°C] at 250 hPa



## DR CrIS Temperature Cross-Section Animation

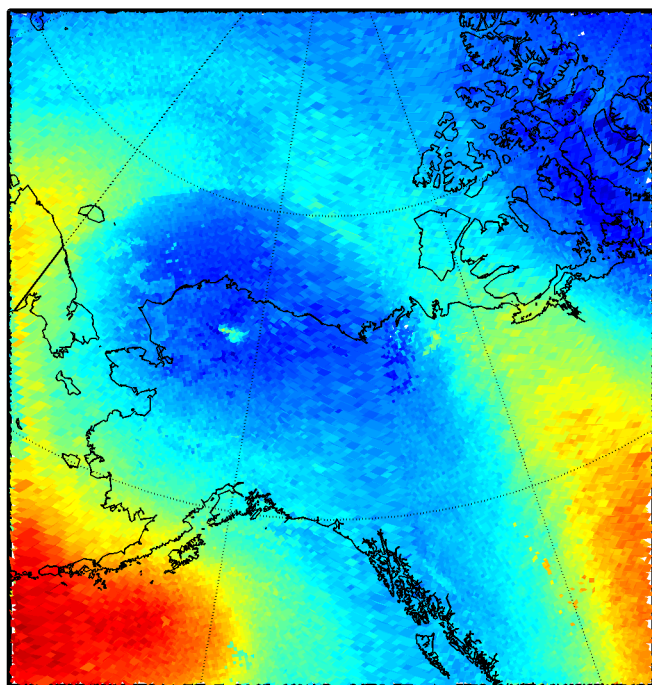


# CAA – DR and NUCAPS 200 hPa Temperature (March 2, 2015)



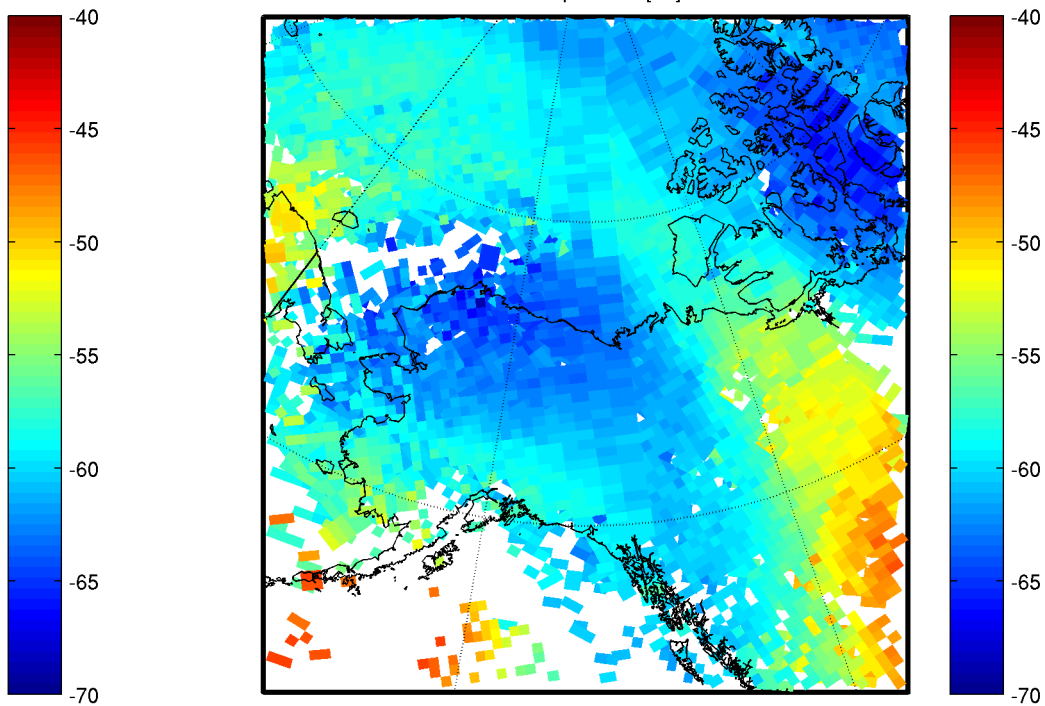
## HSRTV-DR

DR CrIS Temperature [°C] 2015-03-02



## NUCAPS

NUCAPS CrIS Temperature [°C] 2015-03-02





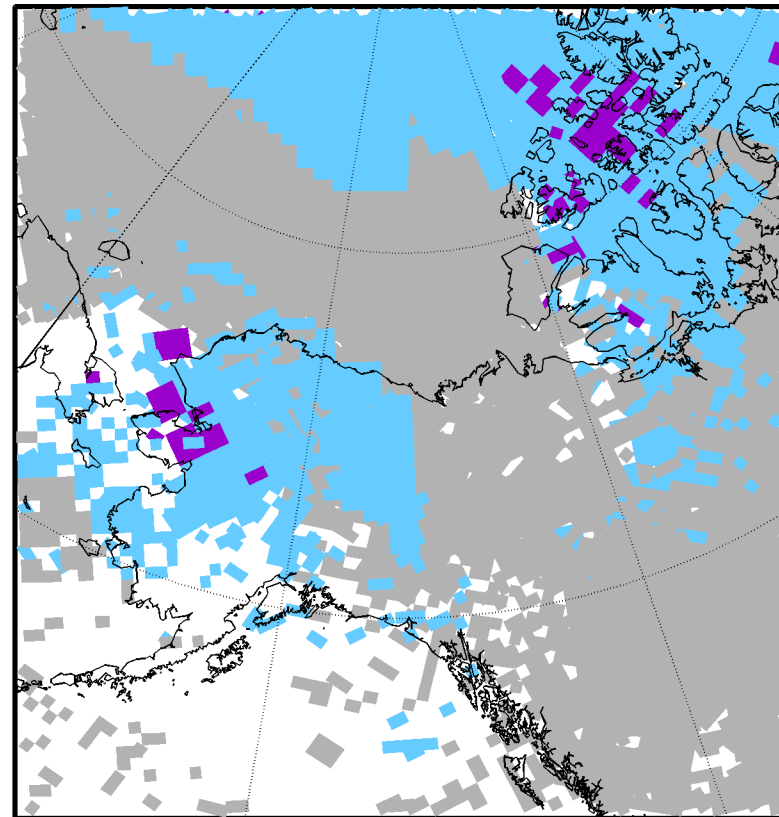
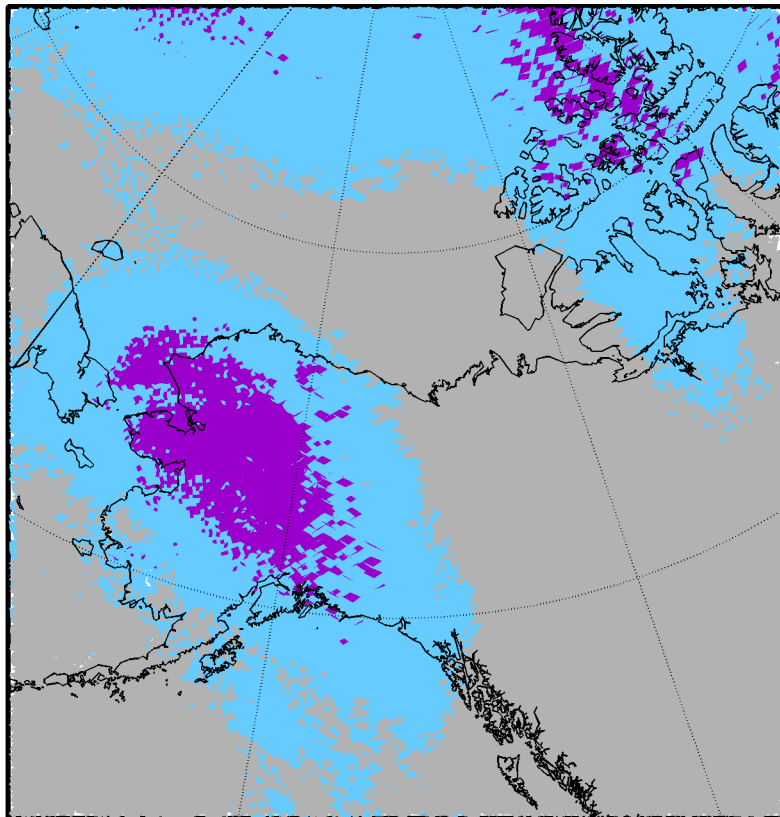
# CAA – 200 hPa Temperature Animation (March 1-31, 2015)

HSRTV-DR

NUCAPS

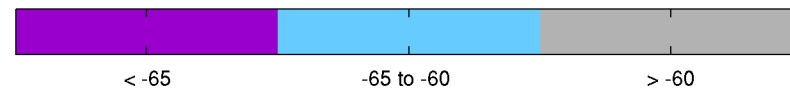
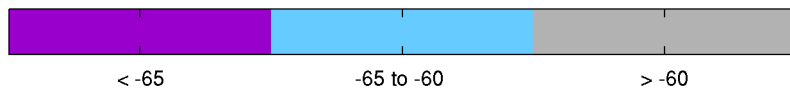
DR CrIS 2015-03-01

NUCAPS CrIS 2015-03-01



Temperature at 200 hPa [°C]

Temperature at 200 hPa [°C]



# Summary

1. Hyperspectral retrievals add independent and quantitative information to traditional data from imagers, sounders, radiosondes and models; and provide consistent near real-time soundings, surface and cloud information anywhere on the globe, at least twice by day (per instrument), even in regions where traditional data is sparse.
2. Two hyperspectral retrieval packages are available through CSPP. Both are stand-alone tools, easy to implement and provide atmospheric profiles of temperature and humidity, surface and cloud parameters.
3. The main differences and their implications are
  - NUCAPS incorporates microwave data → NUCAPS retrievals are provided at coarser spatial resolution (3x3 instead of SFOV), but are available also below clouds.
  - HSRTV-DR is based on regression, while NUCAPS uses an optimal estimation approach → HSRTV-DR allows fast real-time processing, while NUCAPS obtains more accurate trace gas retrievals.
  - DR is applicable to any of the HS sounders → temporal differences between consecutive orbits allow the study convective stability, moisture transport and atmospheric motion.
4. Ongoing work include characterization of differences and similarities at fine-scale and under more atmospheric conditions.
5. Continued communication with user community is important to understand the users' needs and to ensure the products' accuracy and relevance to their applications.