The Use of the RGB Products at the HPC, OPC, NHC, and SAB Proving Grounds During the 2011 Atlantic Hurricane Season

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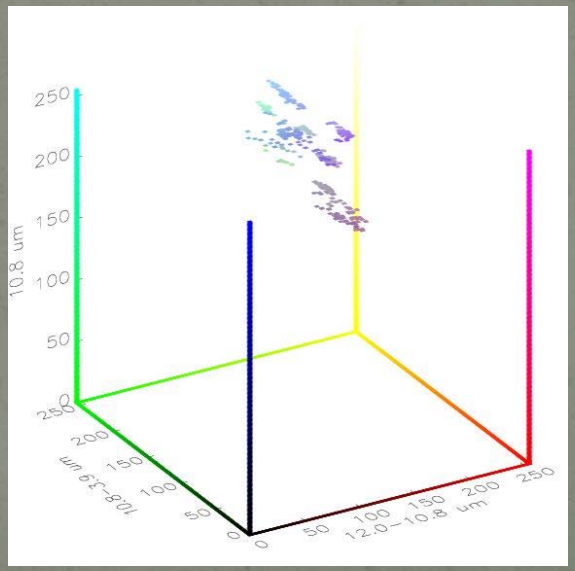
RGB Applications

RGB Applications	
General Land and Atmospheric Features	
Interpreting surface and atmospheric features, such as vegetated areas, deserts, clouds, snow, ocean	True Color, Natural Color, False Color
Cloud and Fog	
Cloud analysis	Day Microphysics
Distinguishing clouds from snow cover during daytime	Cloud Over Snow
Viewing low clouds at night (given sufficient moonlight)	Nighttime Visible
Helping to classify clouds & detecting fog/low cloud during day & night	Fog & Stratus
Distinguishing between high and low clouds	Visible/Infrared
Volcanic Ash: Detecting ash, sulphur dioxide, and ice crystals from volcanic eruptions and tracking plumes for long distances downstream of an eruption	Volcanic Ash Dust
Dust: Monitoring the evolution of dust clouds day and night	Dust
Fires	
Viewing fires	Nighttime Visible
Detecting fires	Fog & Stratus Day Microphysics
Snow	
Viewing low clouds & snow cover at night given moonlight	Nighttime Visible
Distinguishing clouds from snow cover during daytime	Cloud Over Snow Day Microphysics
Cyclones and Air Masses	
Monitoring the evolution of cyclones during both day and night (in particular, rapid cyclogenesis, jet streaks, and PV anomalies), and obtaining information about the middle and upper levels of the troposphere	Air Mass
Convection: Identifying microphysical trends in convection during day and obtaining information about the middle and upper levels of the troposphere	Day Microphysics Convection

RGB Imagery

- The colors in RGB images have direct physical correlations.
- A channel or channel difference is assigned to a color (red, green, or blue).
- The contribution of each color to a pixel in the image is proportional to the contribution of its assigned channel/channel difference.
- EUMETSAT has developed RGB techniques for use with SEVIRI which have been adapted to MODIS by SPoRT.



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Air Mass

- Air mass product helps to distinguish among synoptic-scale features, such as fronts and jets.
- Utilizes MODIS channels/channel differences:
  - 6.2 µm-7.3 µm
  - 9.7 µm-10.8 µm
  - 6.2 µm (inverted)
- Current techniques
  - Single channel water vapor imagery (GOES 6.7 µm)
- GOES-Sounder Channels
  - The recipe uses channels 8 (11.03um), 9 (9.71um), 10(7.43um), and 12 (6.51um) as follows:
    - RED Ch12 - Ch10 -25C to 0C
    - GREEN Ch9 - Ch8 -40C to 5C
    - BLUE Ch12 243K to 208K

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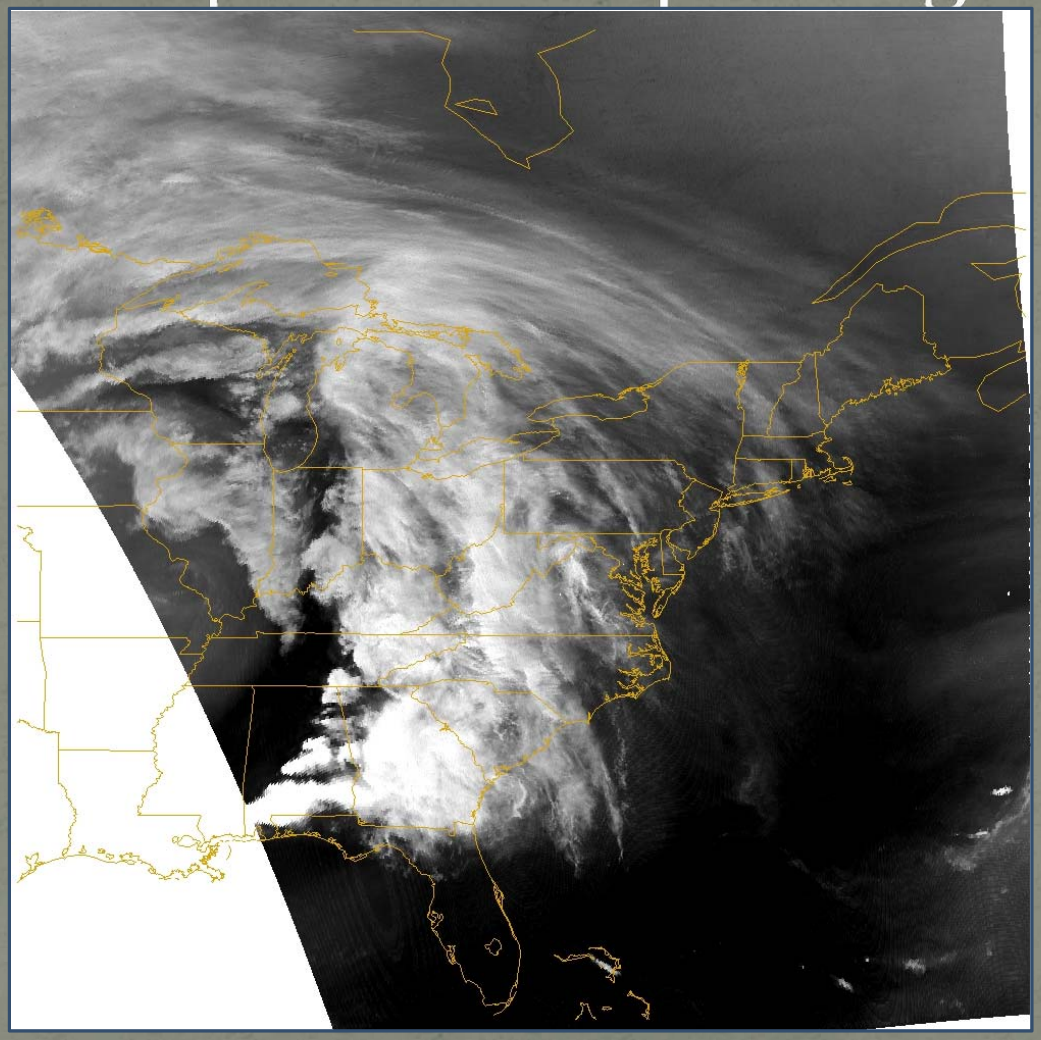
Case Study: 16 April 2011, 0315Z

6.8 µm Water Vapor Image



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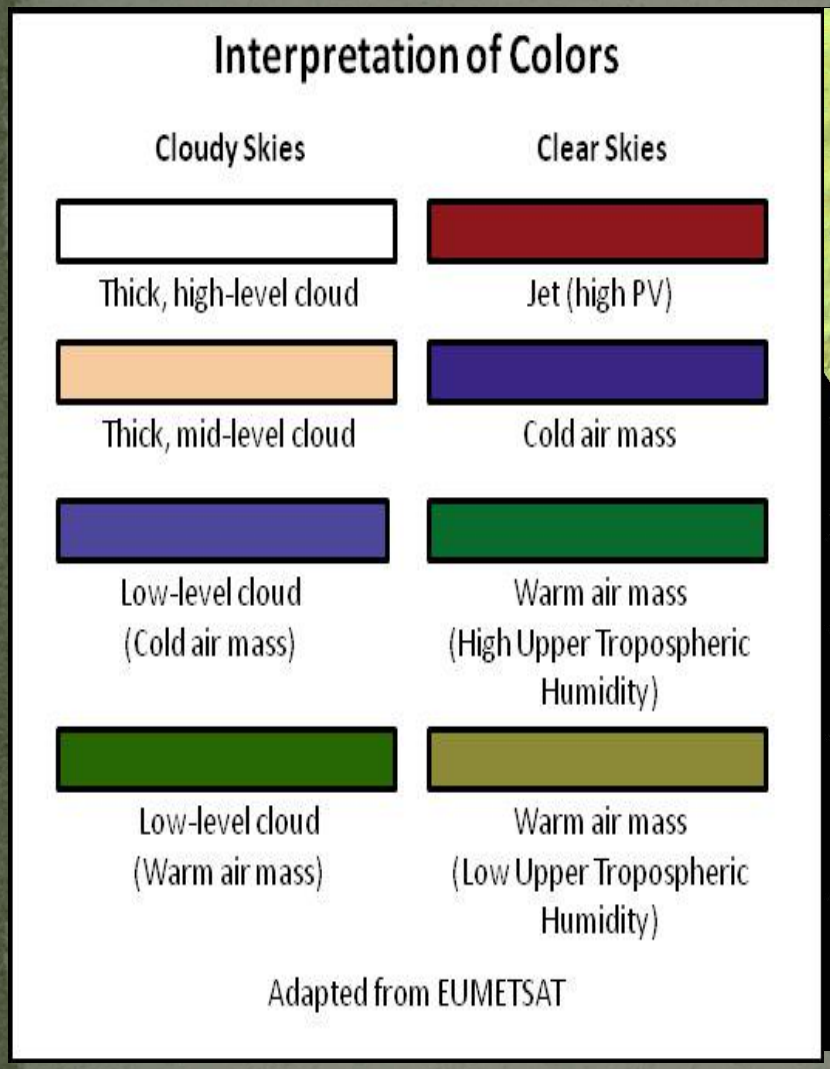
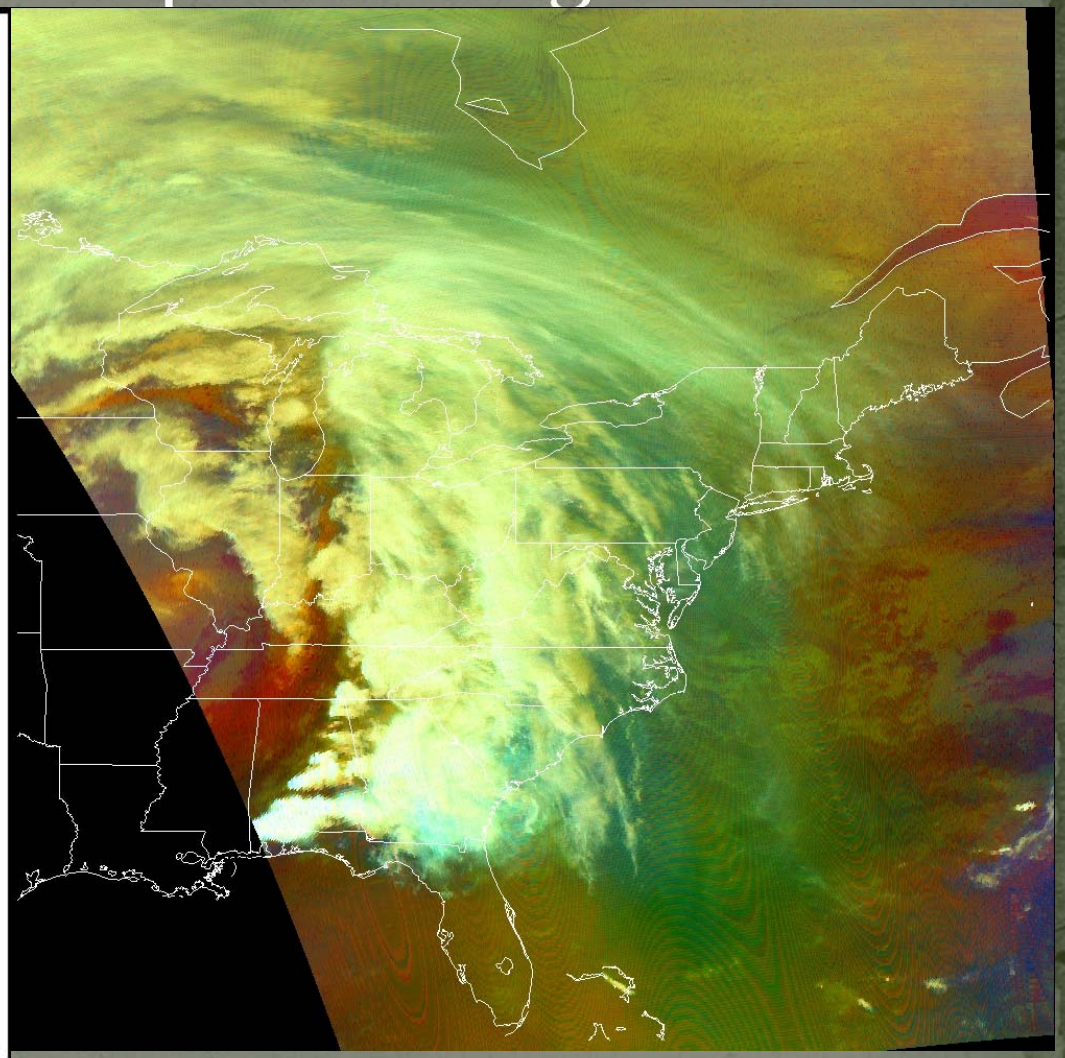
Case Study: 16 April 2011, 0315Z
Air Mass Multispectral Image





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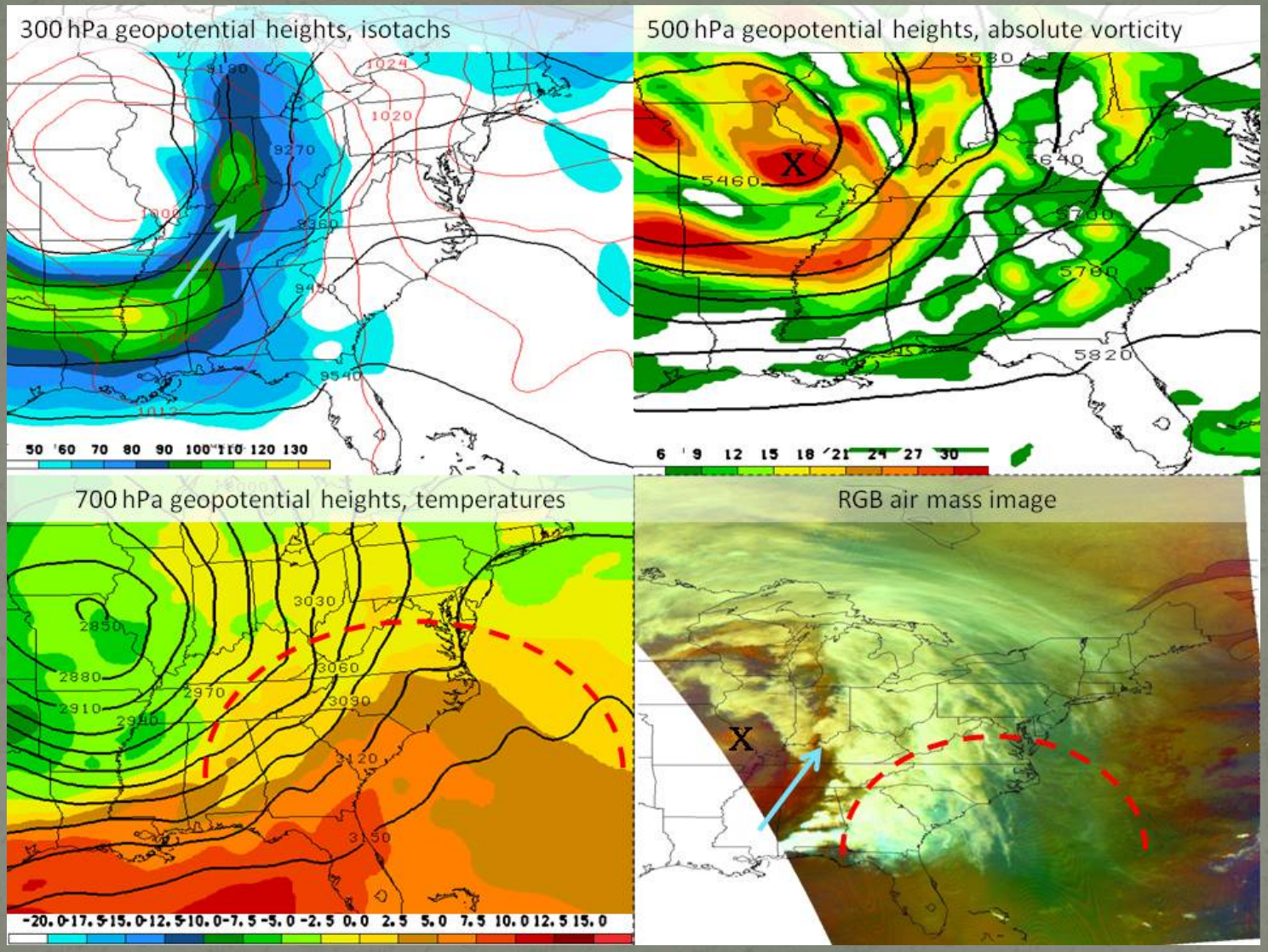
RUC Analysis Comparison



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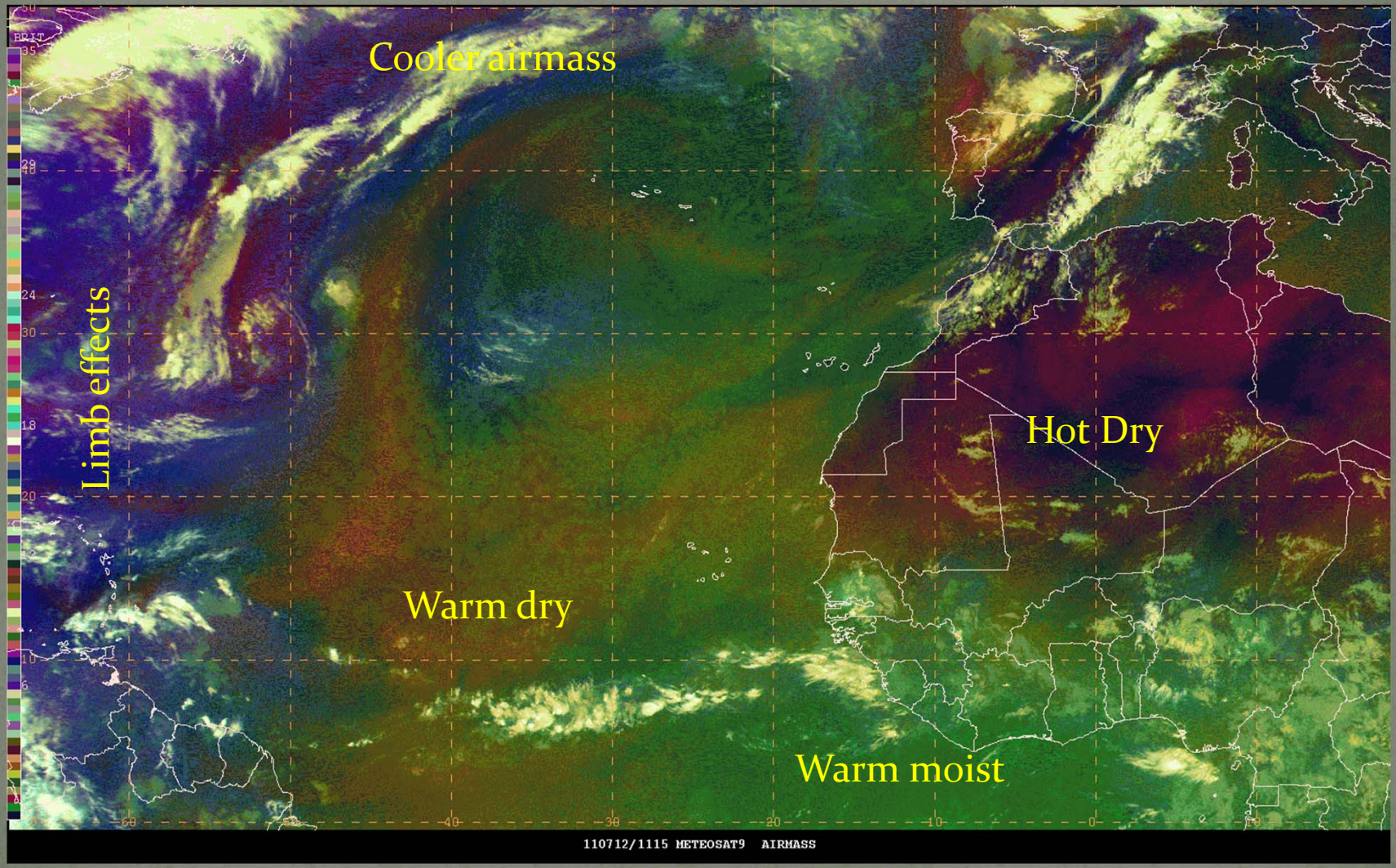
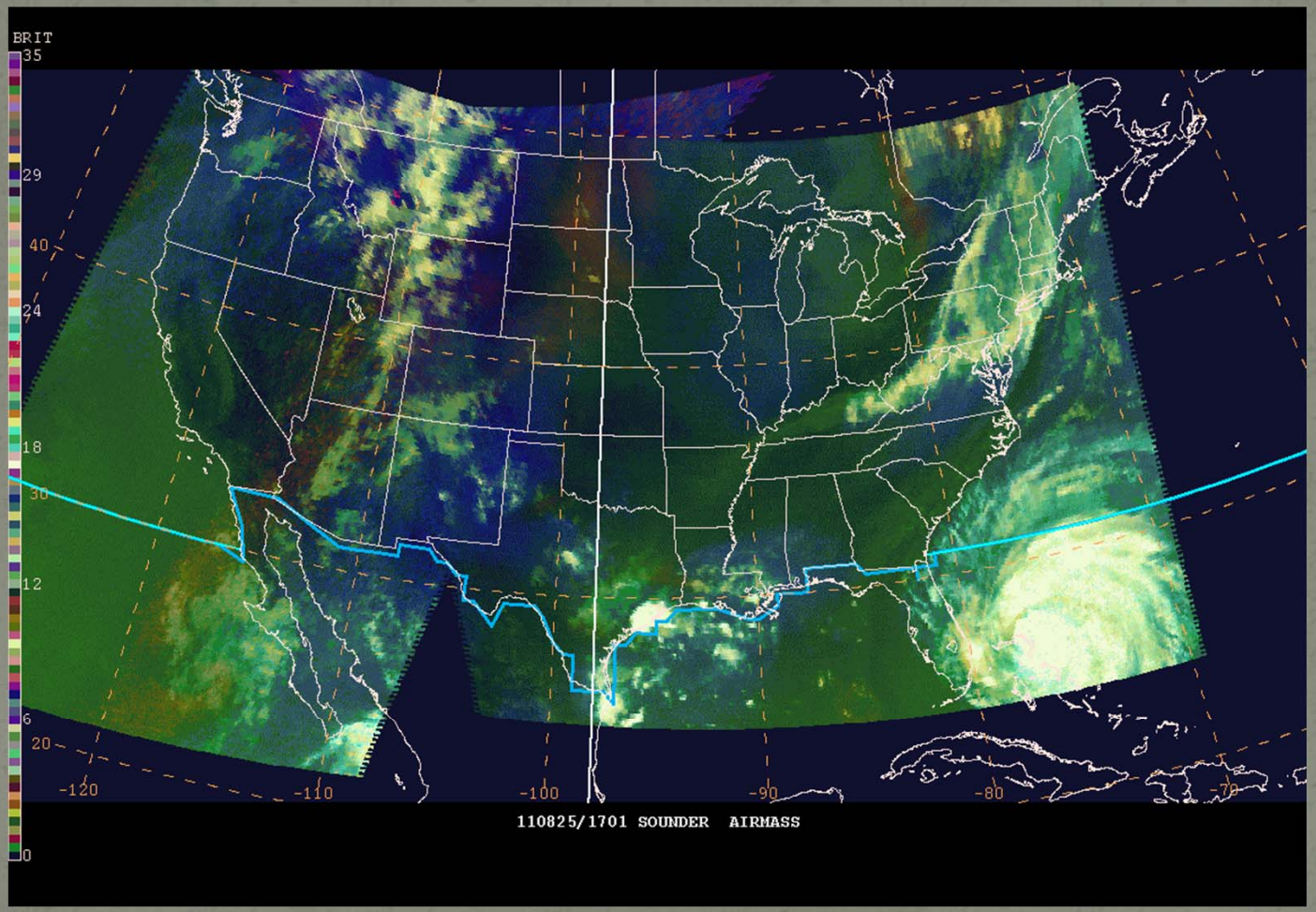
RGB Air Mass Product from SEVIRI

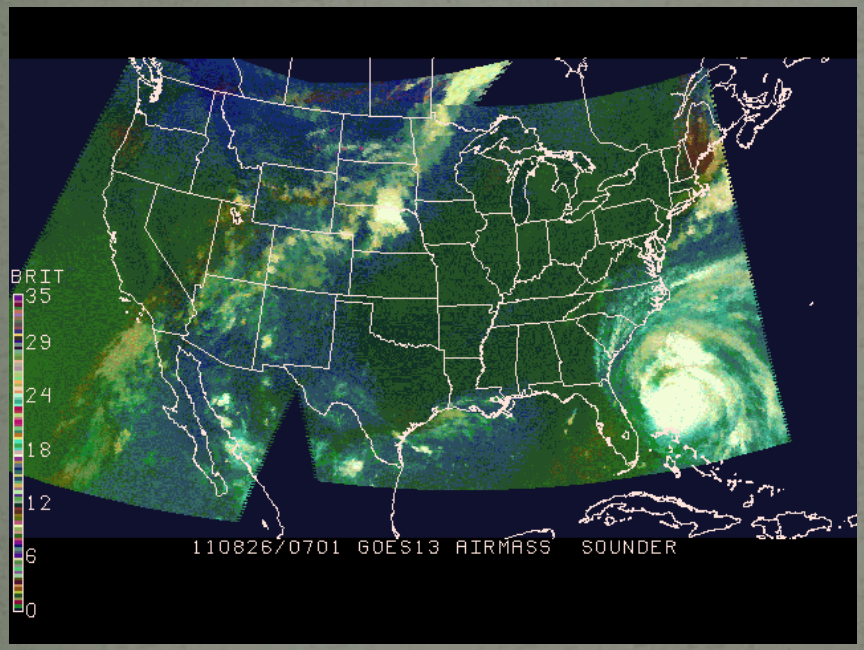


Hurricane Irene 2011
GOES-Sounder RGB Product

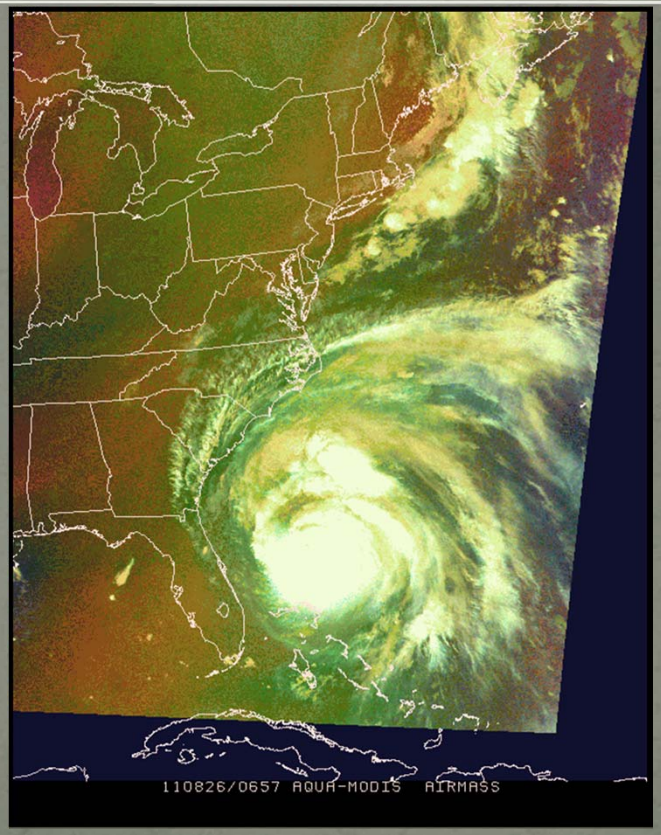


Hurricane Irene 2011

AIRS Ozone Retrieval

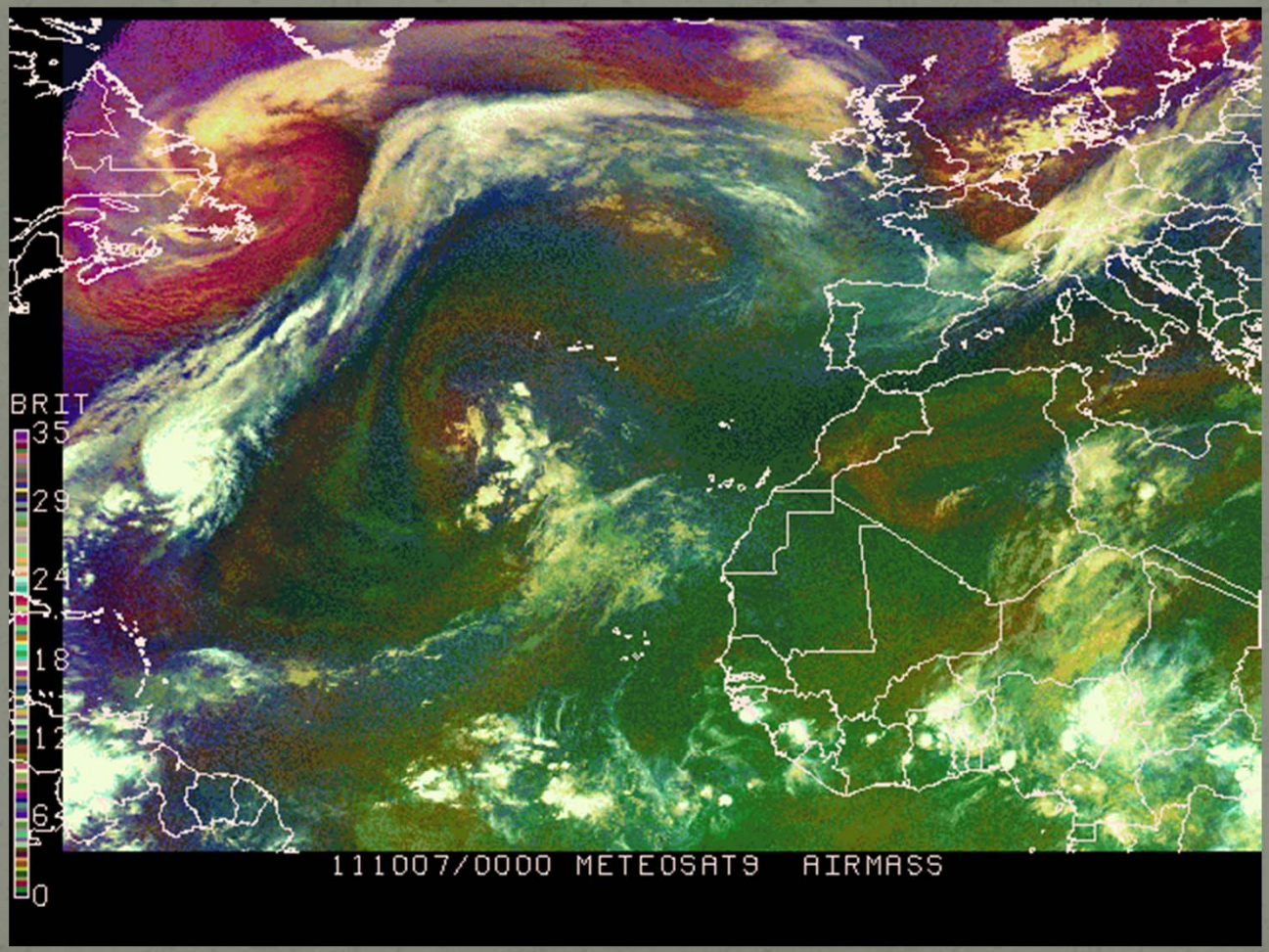


SEVIRI RGB Airmass



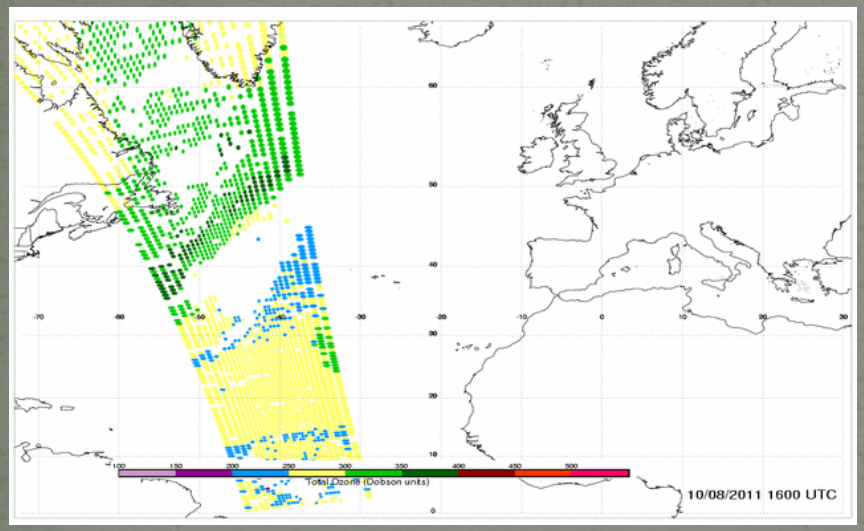
Hurricane Philippe 2011

SEVIRI (MSG) RGB Airmass Product

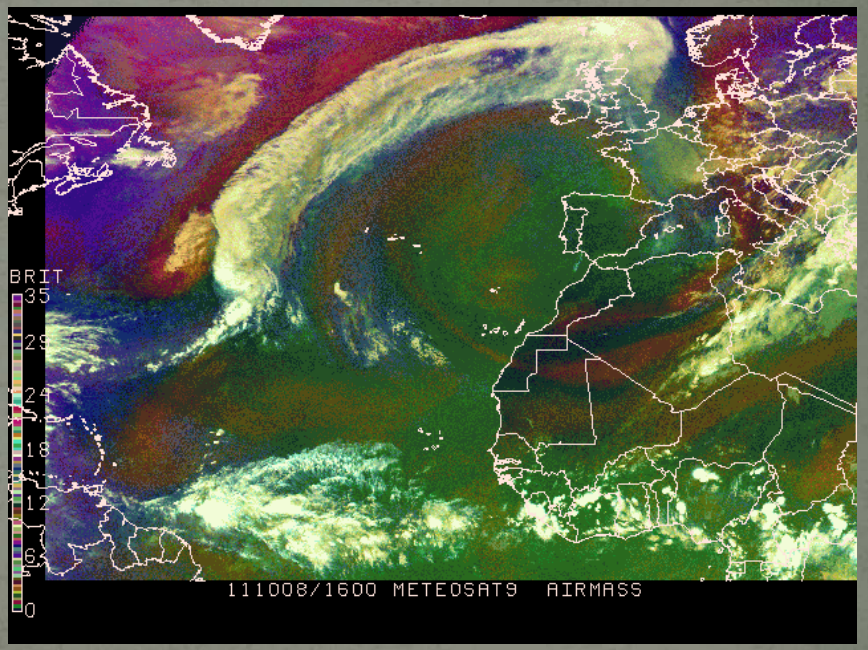


Hurricane Philippe 2011

AIRS Ozone Retrieval

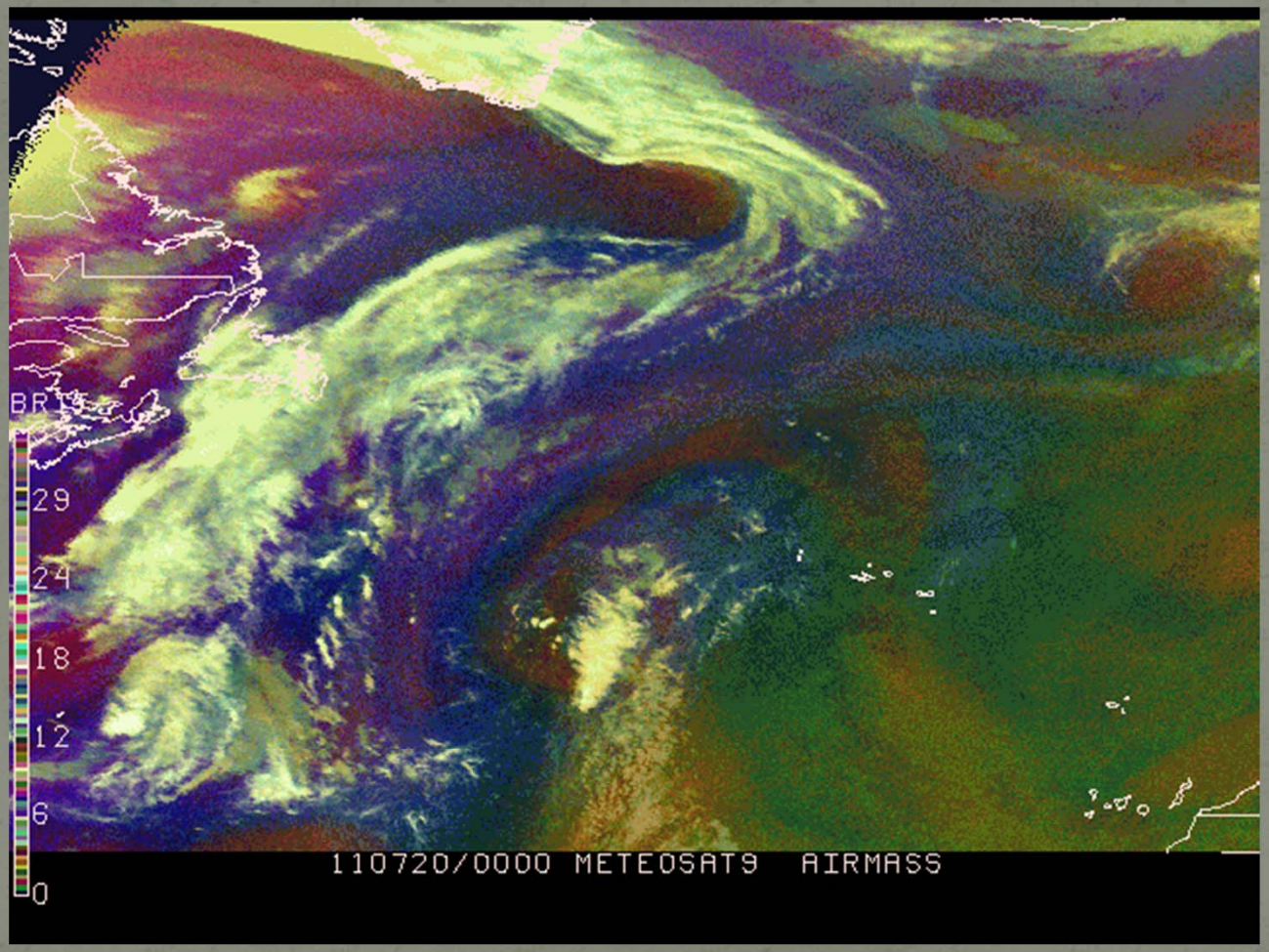


SEVIRI RGB Airmass



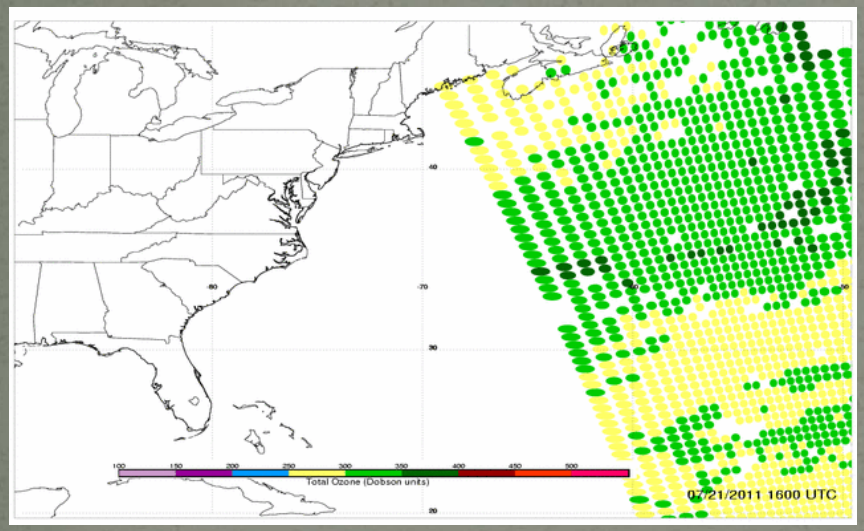
Tropical Storm Cindy 2011

SEVIRI (MSG) RGB Airmass Product

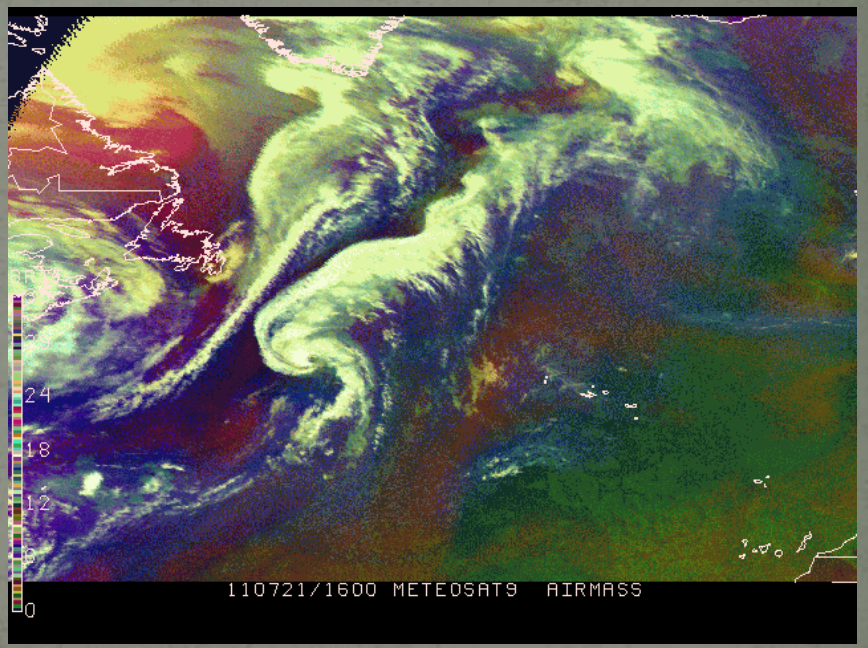


Tropical Storm Cindy 2011

AIRS Ozone Retrieval

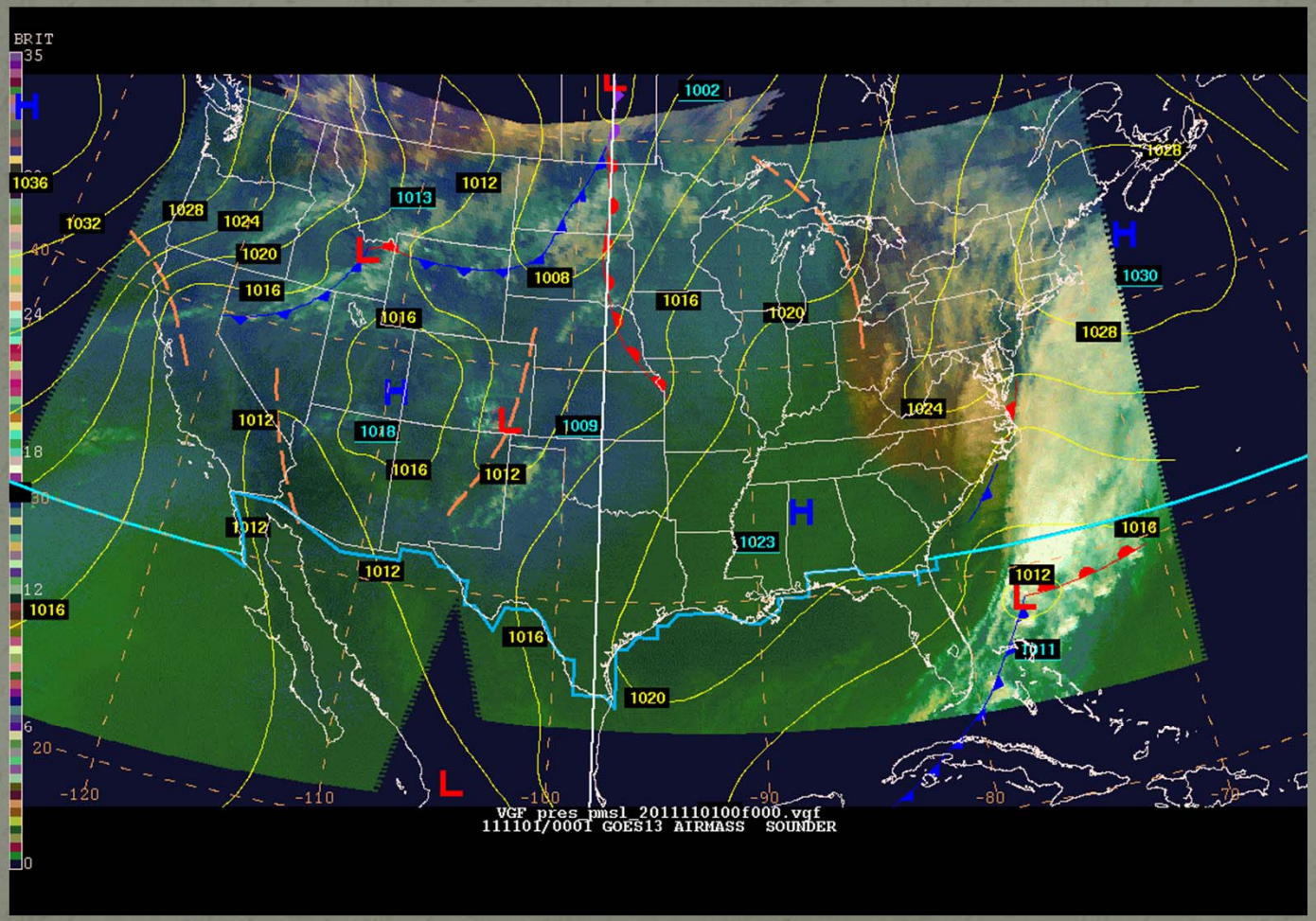


SEVIRI RGB Airmass



Tropical Storm Sean 2011

GOES-Sounder RGB Airmass Product

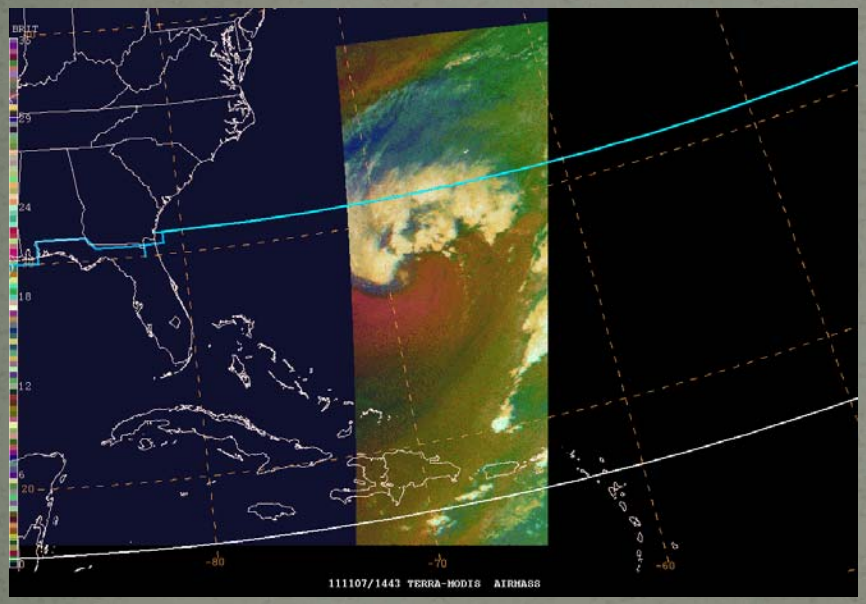


Tropical Storm Sean 2011

MODIS RGB Airmass Products

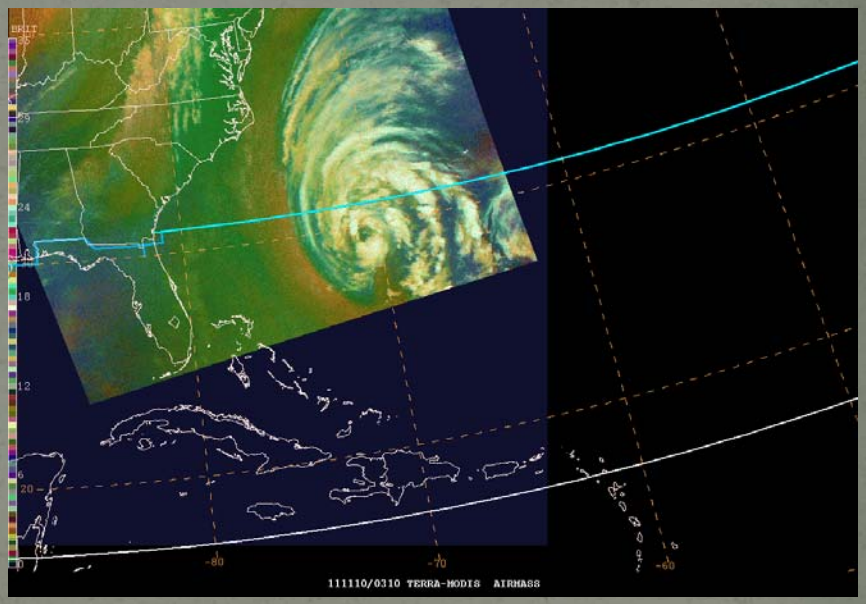
ET Phase

1443z on 11/07/11



TS Phase

0310z 11/10/11



RGB Dust Imagery

- **Why is the Dust RGB imagery important?**
  - Dust can be hard to see in visible and IR imagery because it is optically thin, or because it appears similar to other cloud types such as cirrus. The RGB product is able to contrasts airborne dust from clouds using channel differencing and the IR thermal channel. The resulting combination of colors results in a pink/magenta color in the imagery for dust.
- **What are the things to watch out for?**
  - Dust obscured from view: High level clouds may obscure dust plumes closer to the surface
  - Dust or low clouds?: Low-level clouds over oceans in a warm atmosphere are light purple during the day and can look similar to areas of dust.
  - Height of dust: The height of the dust is difficult to infer from daytime imagery as the color does not vary much from magenta; however, variations of color at night can provide some information about the height level. Near-surface visibility could be okay if the plume is aloft.
  - High, thin clouds can be black or green: Thin, high clouds such as cirrus or those induced on the lee side of a mountain range will appear black (no color contributions). At times these clouds do not easily show up on Natural or True color RGB imagery. Note that the 10.7um channel's larger emissivity over deserts than the 8.7um channel, results in high cirrus clouds as green.

Courtesy of Kevin Fuell

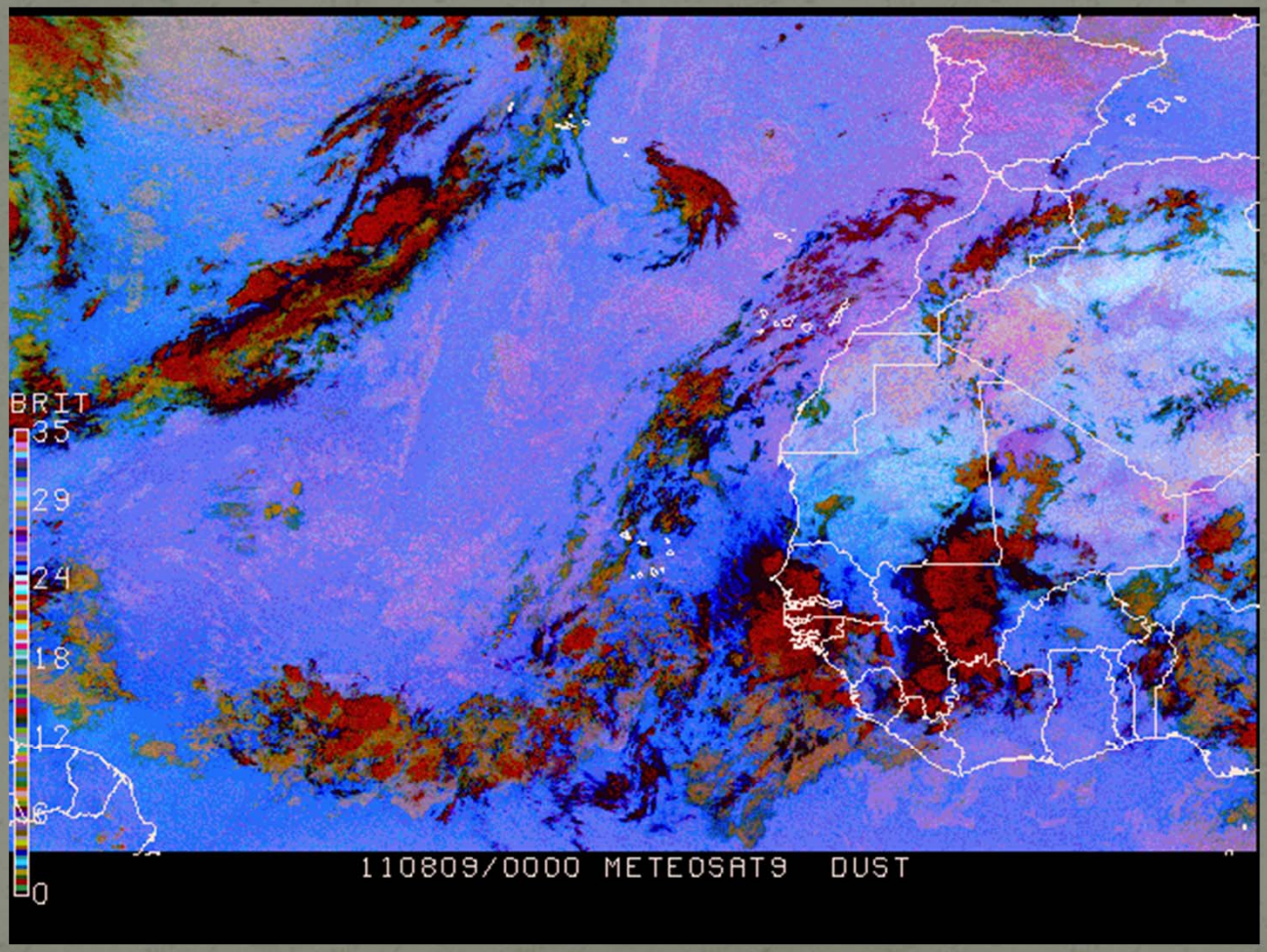
RGB Dust Definition

Color	Physical Meaning	Red	Green	Blue
	Dust at 400mb at night	255	79	150
	Dust at 700mb at night	160	80	210
	Dust at 900mb at night	136	80	239

Courtesy of Kevin Fuell

Saharan Air Layer Oubreak

August 9-13, 2011



RGB Usage Summary

- Lessons learned? – (input from NHC to be included with our PG)

Additional Case Studies

NASA SPoRT Blog