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GOES-R ABI Synthetic Imagery at 3.9 and 2.25 µm

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Introduction

For the past several years, synthetic satellite imagery has been produced at the Cooperative Institute for Research in the Atmosphere (CIRA) in collaboration with the NOAA/NESDIS/StAR Regional and Mesoscale Meteorology Branch. The imagery serves two primary purposes: 1) to serve as proxy data for future sensors such as the GOES-R Advanced Baseline Imager (ABI), and 2) synthetic imagery is an excellent visualization tool for high resolution numerical model output, allowing forecasters to easily and quickly see forecast cloud locations.

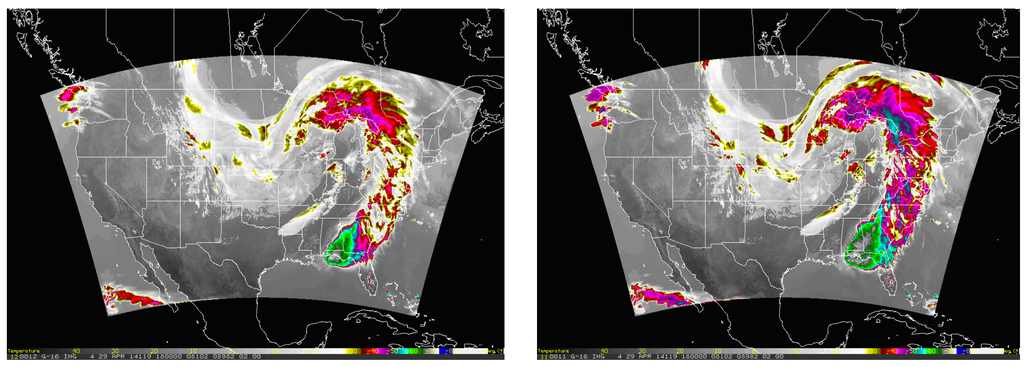
This poster provides examples of synthetic GOES imagery generated from the National Severe Storm Laboratory's (NSSL) 4-km Weather Research and Forecasting-Advanced Research WRF (WRF-ARW) forecast model. Imagery is generated with both on Observational Operator that was developed at CIRA and the Community Radiative Transfer Model (CRTM).

Synthetic Imagery Production

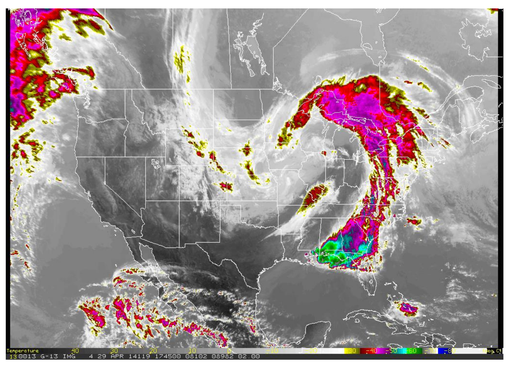
- Output from the 4-km model, including geo-potential height, temperature, water vapor, and microphysical variables such as cloud water and pristine ice are sent to CIRA
- This data is used as input to the CRTM, which then outputs simulated satellite brightness temperatures at various wavelengths/bands
- The brightness temperature fields are converted to various formats to be used by the National Weather Service's operational display software

Comparisons between the CRTM (V2.1.3), the CIRA Observational Operator (CIRA-OO), and Observations
29 April 2014 – 18 Z – based on WRF forecast – Thompson microphysics

CIRA-OO **10.35 µm ABI band** CRTM

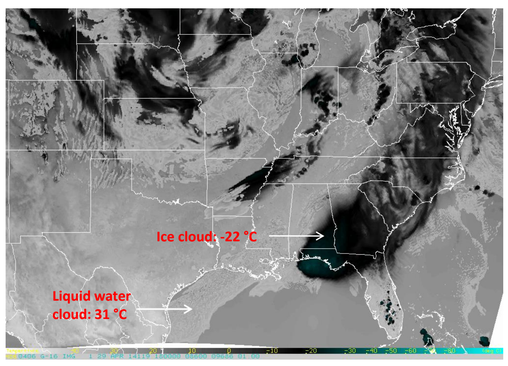


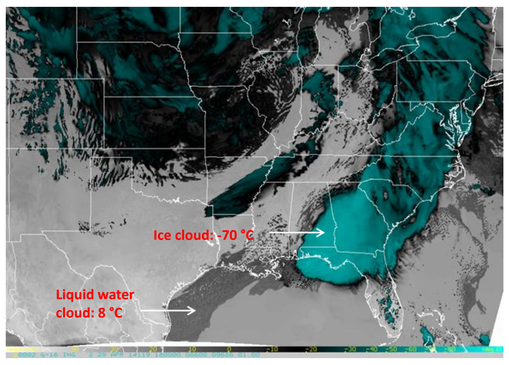
GOES-13 Observations (10.7 µm)



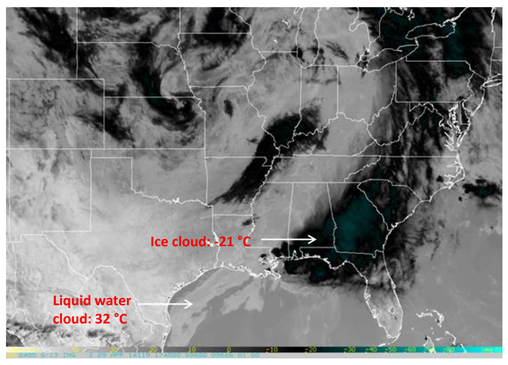
- CIRA-OO and CRTM produced very similar output, and both compare well with GOES observations

CIRA-OO **3.9 µm ABI band** CRTM





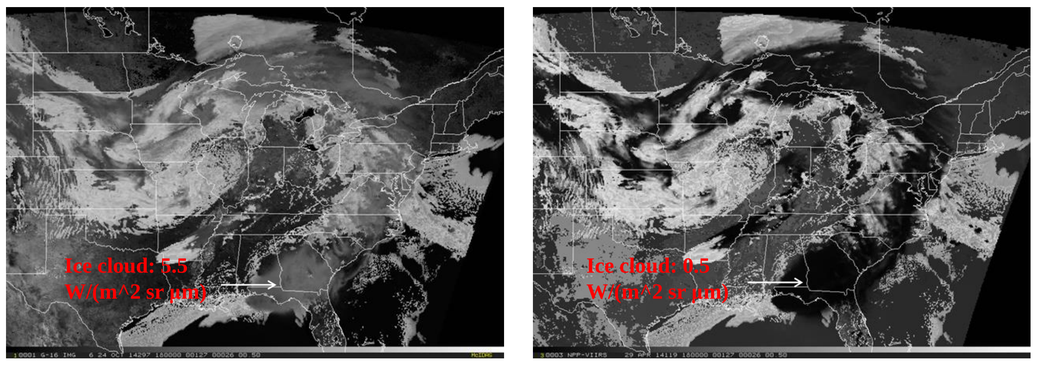
GOES-13 Observations (3.9 µm)



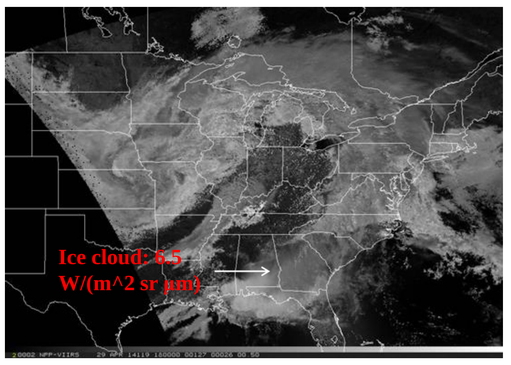
- The 3.9 µm band should include an emitted and a solar reflected component during the daytime
- Note that the CRTM ice cloud has a 3.9 µm brightness temperature similar to the value at 10.35 µm, showing that it includes no solar reflection
- Solar reflection warms the BT by ~50 °C in this case
- CRTM liquid water cloud has a 3.9 µm brightness temperature *colder* than the value at 10.35 µm, showing that "solar reflection" is not being handled correctly
- CRTM 3.9 µm BT about 24 °C colder than observations of liquid water clouds

Comparisons between the CRTM (V2.1.3), the CIRA Observational Operator (CIRA-OO), and Observations
29 April 2014 – 18 Z – based on WRF forecast – Thompson microphysics

CIRA-OO **2.25 µm ABI band v/s VIIRS** CRTM

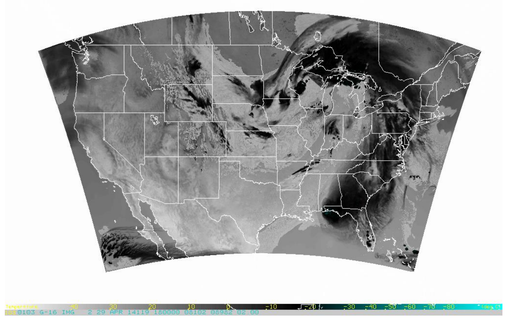


- Plotted values are radiances
- Darker colors correspond to less 2.25 µm reflectance
- CRTM has ice cloud reflectance values far too low
- Liquid water cloud reflectances are in the ballpark of VIIRS observations for both the CRTM and the CIRA-OO (both a little too large)

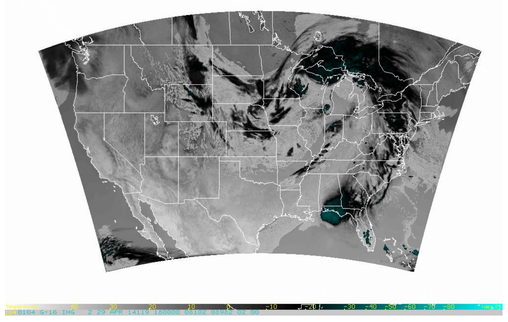


CIRA-OO 3.9 µm ABI 29 April 2014 – 18 Z – based on WRF-ARW forecast

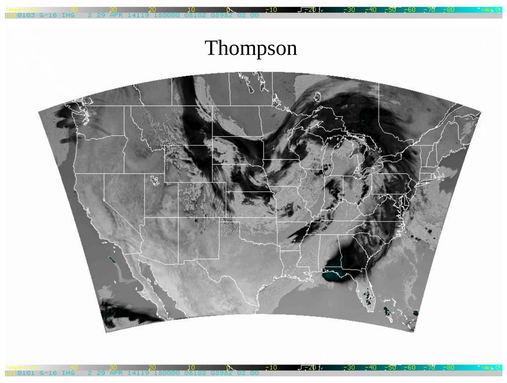
Morrison



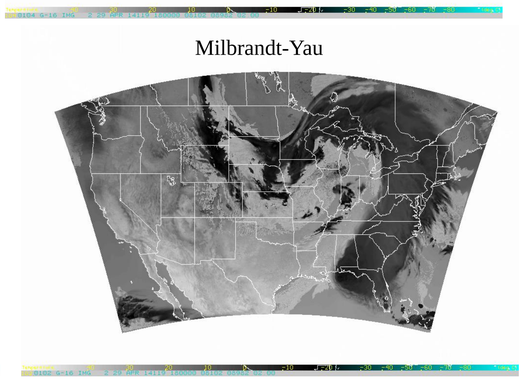
Morrison P3

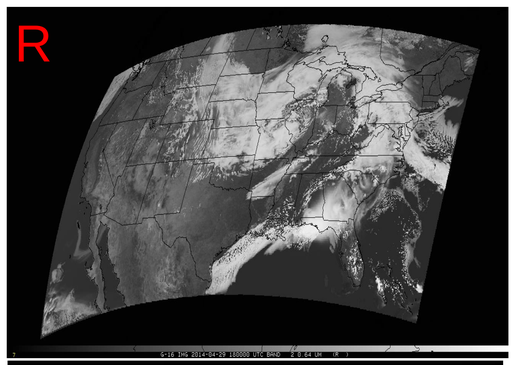


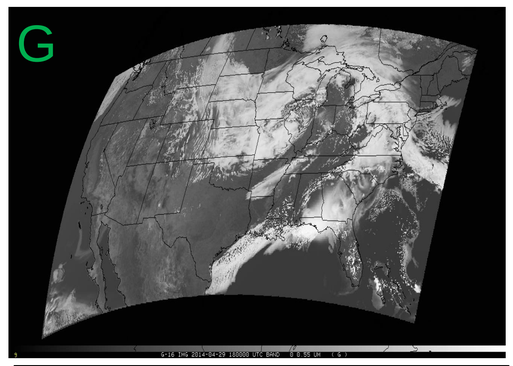
Thompson

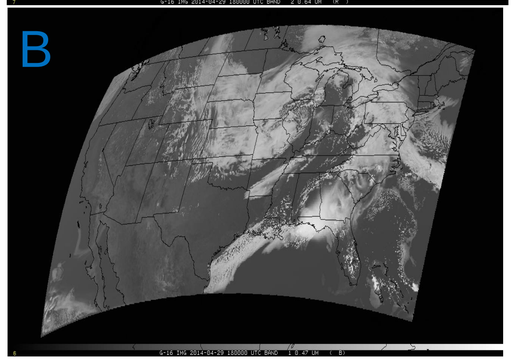


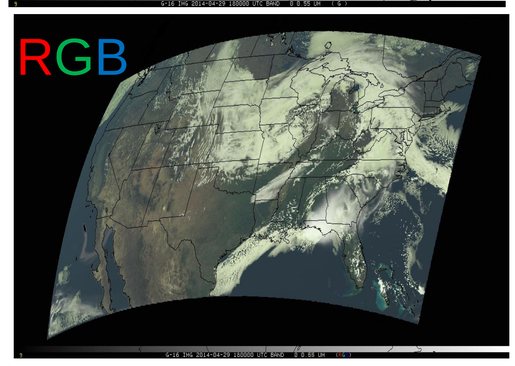
Milbrandt-Yau











Synthetic Red, Green, and Blue that are combined into an RGB image. These images serve as an example of efforts to generate true-color imagery as part of the AWG IVT project.

Related References:

Grasso, L., D. T. Lindsey, K-S Lim, A. Clark, D. Bikos, and S. Dembek, 2014: Evaluation of and Suggested Improvements to the WSM6 Microphysics in WRF-ARW Using Synthetic and Observed GOES-13 Imagery. Mon. Wea. Rev., Vol 142, No. 10, 3635-3650.

Lindsey, D. T., L. Grasso, J. F. Dostalek, and J. Kerkmann, 2014: Use of the GOES-R Split Window Difference to Diagnose Deepening Low-Level Water Vapor. J. Appl. Meteor. Climat., 53, 2005-2016.

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