

# **GOES-R Product Training Document**

for the  
***GOES-R Proving Ground***  
***Aviation Weather Testbed 2013 Winter Experiment***

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## **GOES-R Product:** *NSSL/WRF Advanced Baseline Imager Bands*

**Product Overview:** Several variables (i.e., temperature, water vapor, and other physical and microphysical parameters) from the 0000 UTC NSSL 4-km WRF-ARW runs are sent to CIMSS and CIRA where the synthetic imagery is generated and available daily starting at 1200 UTC. The best use of the product is to compare the morning simulated imagery (1200-1500 UTC) with that of the observed to determine if the model has similar timing and location of meteorological features (e.g., shortwaves, jet streaks, etc.). If they are similar, then confidence should increase that the remaining model forecast output is a viable solution. The 10.35 minus 3.9  $\mu\text{m}$  fog product discriminates low-level clouds from high clouds.

### **Product Strengths:**

- Satellite imagery can be viewed before the simulated time actually occurs.
- Multiple water vapor bands allow different atmospheric levels to be viewed.
- Realistic depictions of GOES-R ABI imagery.

### **Product Weaknesses:**

- Synthetic imagery is only as accurate as the model forecast.

### **Products to be displayed within N-AWIPS:**

- *Band 8 (6.19  $\mu\text{m}$ ):* Upper-level Tropospheric Water Vapor
- *Band 9 (6.95  $\mu\text{m}$ ):* Upper/Mid-level Tropospheric Water Vapor
- *Band 10 (7.34  $\mu\text{m}$ ):* Lower/Mid-level Tropospheric Water Vapor
- *Band 11 (8.5  $\mu\text{m}$ ):* Cloud-top Phase
- *Band 12 (9.61  $\mu\text{m}$ ):* Ozone
- *Band 13 (10.35  $\mu\text{m}$ ):* Clean Infrared Longwave
- *Band 14 (11.2  $\mu\text{m}$ ):* Infrared Longwave
- *Band 15 (12.3  $\mu\text{m}$ ):* Dirty Infrared Longwave
- *Band 16 (13.3  $\mu\text{m}$ ):* CO2 Infrared Longwave
- *10.35 minus 3.9  $\mu\text{m}$ :* low-level cloud and fog detection

### **Training Resources:**

- <http://rammb.cira.colostate.edu/visit/video/goesr101/player.html>
- [http://rammb.cira.colostate.edu/training/visit/training\\_sessions/synthetic\\_imagery\\_in\\_forecasfore\\_severe\\_weather/video/](http://rammb.cira.colostate.edu/training/visit/training_sessions/synthetic_imagery_in_forecasfore_severe_weather/video/)

## **GOES-R Product:** *NAM Nest Advanced Baseline Imager Bands*

**Product Overview:** Several variables (i.e., temperature, water vapor, and other physical and microphysical parameters) from the 0000 UTC NAM Nest 4-km runs are sent to CIMSS and CIRA where the synthetic imagery is generated and available daily starting at 0930 UTC. The best use of the product is to compare the morning simulated imagery (1200-1500 UTC) with that of the observed to determine if the model has similar timing and location of meteorological features (e.g., shortwaves, jet streaks, etc.). If they are similar, then confidence should increase that the remaining model forecast output is a viable solution.

### **Product Strengths:**

- Satellite imagery can be viewed before the simulated time actually occurs.
- Multiple water vapor bands allow different atmospheric levels to be viewed.
- Realistic depictions of GOES-R ABI imagery.
- Extends out to 60 hours

### **Product Weaknesses:**

- Synthetic imagery is only as accurate as the model forecast.

### **Products to be displayed within N-AWIPS:**

- *Band 9 (6.95  $\mu\text{m}$ ):* Upper/Mid-level Tropospheric Water Vapor
- *Band 13 (10.35  $\mu\text{m}$ ):* Clean Infrared Longwave

### **Training Resources:**

- [http://rammb.cira.colostate.edu/templates/loop\\_directory.asp?data\\_folder=dev/indsey/loops/namnest\\_fcst\\_ir&image\\_width=1020&image\\_height=720](http://rammb.cira.colostate.edu/templates/loop_directory.asp?data_folder=dev/indsey/loops/namnest_fcst_ir&image_width=1020&image_height=720)

## **GOES-R Product:** *UW-CIMSS Fog and Low Stratus*

**Product Overview:** The GOES-R Fog and Low Stratus (FLS) probability product is a merged product blending satellite (GOES E/W), numerical weather prediction model (GFS and RAP), static ancillary (e.g., DEM, surface emissivity) and daily SST data using a Naïve Bayesian model. Based on instrument flight rules, it outputs a probability of Instrument Flight Rules (IFR) and Low Instrument Flight Rules (LIFR), as well as an estimated cloud thickness. Unlike the traditional BRD product, the FLS is available both during the day and at night

### **Product Strengths:**

- Available during the day and during the night
- The quantitative approach of the FLS probabilities gives a higher confidence that IFR conditions are present
- The FLS thickness product can be used to estimate dissipation time after sunrise for radiation fog events
- The FLS products can also be applied to higher resolution MODIS data, allowing for the detection of smaller scale fog events

### **Product Weaknesses:**

- There will be inconsistencies in the FLS probabilities at the day/night transition as different predictors are used for day and night, but probabilities will always be available
- There will be inconsistencies in the FLS probabilities at the RAP domain boundaries (outside of CONUS) where the NWP being used changes to the GFS
- The FLS thickness is not available just after sunrise and just after sunset

### **Products to be displayed within N-AWIPS:**

- *Probability of IFR conditions:* 0 – 100%
- *Probability of LIFR conditions:* 0 – 100%
- *Cloud thickness:* meters
- *Cloud-top phase:* dark/light blue = liquid water, neon green = supercooled water, dark green = mixed phase, orange = thick ice, magenta = bad data/unknown.

### **Training Resources:**

- [http://cimss.ssec.wisc.edu/goes\\_r/proving-ground/training/GOES-R\\_FLS\\_training\\_09072012.ppt](http://cimss.ssec.wisc.edu/goes_r/proving-ground/training/GOES-R_FLS_training_09072012.ppt)
- [http://cimss.ssec.wisc.edu/goes\\_r/proving-ground/training/GOESR\\_fog\\_low\\_stratus\\_factsheet.docx](http://cimss.ssec.wisc.edu/goes_r/proving-ground/training/GOESR_fog_low_stratus_factsheet.docx)

## **GOES-R Product: Aircraft Flight Icing Threat (FIT)**

**Product Overview:** The GOES-R FIT algorithm utilizes satellite-derived cloud properties that provide information on icing conditions and provides:

1. An icing mask (available day and night) which discriminates regions of possible aircraft icing. The icing mask is developed using GOES-R derived cloud thermodynamic phase, cloud top temperature, and cloud optical thickness products to identify which cloudy pixels are most likely to contain significant super-cooled liquid water.
2. An icing probability, estimated during the daytime only. During the daytime, the probability (low, medium, or high) of encountering icing and the intensity category [light (LGT), or moderate or greater (MOG)] are determined using the liquid water path and effective droplet size products.
3. A two-category intensity index which is also derived during the daytime only.

Optically thick clouds composed of ice crystals at cloud top may obscure possible icing conditions from the satellite view and in such cases the icing threat is deemed to be unknown from the GOES-R data alone. Larger droplets and liquid water paths are associated with a higher probability of severe icing. In the current algorithm, the MOG category always has a high probability of icing due to its strong dependence on liquid water path. However, the GOES-R Aircraft Icing Threat product will assist in resolving small-scale areas of intense icing often missed in other products.

### **Product Strengths:**

- High horizontal resolution
- Tuned to icing PIREPs
- Able to discriminate low probability and high probability icing conditions well during the daytime
- Two category severity estimate has skill during daytime

### **Product Weaknesses:**

- Limited vertical resolution. Product provides a bulk index for icing layer and estimates of the top and bottom altitude boundaries for the icing layer
- Only provides solution for un-observed boundaries for the icing layer
- Does not account/correct for ice crystals and snow below SLW tops
- False alarms more likely over snow covered surfaces
- Limited utility at night for current GOES

### **Products to be displayed within N-AWIPS:**

- *Aircraft Flight Icing Threat (FIT)*: 0 light gray = none, 2 purple = low prob light (day), 3 blue = med prob light (day), 4 yellow = high prob light (day), 5 red = high prob mod-heavy (day), 6 cyan = night icing, 7 = bad retrieval, and 8 black = missing data.
  - CIMSS version: GE single layer

- NASA single-layer: GE, GW, merged (CONUS); fit.tbl enhancement
- NASA multi-layer (utilizes optical properties to see provide data in areas of thin cirrus): GE, GW, merged (CONUS); fit.tbl enhancement
- *Supercooled Large Drops (SLD)*: yellow/cyan = 13.5 - 16 um, orange/light blue = 16 - 19 um, red orange/blue 19 - 22 um, red/purple = 22 -25 um, and maroon/magenta = 25+ um, where cooler colors provide probabilities in snow/ice surface conditions and warm colors provide probabilities in clear surface conditions; nasa\_sld.tbl enhancement
- *Cloud Top Height*: used for estimating icing top altitude

**Training sources:** Coming soon...

## **SUOMI-NPP Product: VIIRS imagery**

**Product Overview:** The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument onboard the Suomi-NPP polar satellite collects visible and infrared imagery and improves upon other high-resolution imagery collected from both the Advanced Very High-resolution Radiometer (AVHRR) and the Moderate Resolution Imagery Spectroradiometer (MODIS). Under sunlit conditions it provides imagery from approximately a dozen bands, and also provides visible and infrared imagery for several day and night cloud image applications.

### **Product Strengths:**

- High resolution data (0.375 km) allows for more in depth analysis of cloud features
- Day/night applications provide visible imagery at night
- Provides approximately 12 daytime bands as well as several infrared day/night cloud imaging applications
- Improved spatial resolution (750m across the swath) from MODIS and AVHRR

### **Product Weaknesses:**

- Temporal resolution is polar; the same region is hit only once every 12 hours.

### **Products to be displayed within N-AWIPS:**

- Band 1 (0.6  $\mu\text{m}$ ) : Visible
- Band 3 (1.61  $\mu\text{m}$ ): Shortwave IR
- Band 4: (3.74  $\mu\text{m}$ ): IR
- Band 5: (11.45  $\mu\text{m}$ ): Longwave IR
- Day/Night Band
- Fog band difference