Talking points for GOES-R rainfall rate baseline product

1. Welcome to the training session on the GOES-R rainfall rate baseline product. Bob Kuligowski is the developer of this product, I'm Dan Bikos and will narrate the training.
2. Learning objectives
3. Estimates of instantaneous rainfall rate are output every 15 minutes at full ABI IR pixel resolution with a latency of less than 5 minutes and are available over the full disk day and night since IR bands are utilized. Rainfall rates up to 3.9 inches per hour can be output by the algorithm.
4. The motivation for this product can be easily understood by first understanding the differences between satellite based rain-rates derived from a microwave instrument versus that from an infrared instrument. Microwave instruments of rain rate are more accurate than IR, however less timely since they are on polar orbiting satellites. IR rain rates are less accurate than microwave but more timely than microwave since they are on geostationary satellites. The solution is to calibrate an IR algorithm from a static microwave rain rate dataset to optimize accuracy, frequency and timeliness of the product. The GOES-R rainfall rate product makes use of GOES-R ABI bands and does a fixed calibration with the CPC combined microwave field known as MWCOMB. The MWCOMB dataset is used as a calibration target for data from ABI bands. ABI bands used as input include bands 8, 10, 11, 14 and 15.
5. Note that this calibration was done offline and is fixed in the initial version of the product; a future version will allow the calibration to be updated in real time using recent ABI IR and microwave rain rate data.
6. Assumptions of infrared rainfall rate algorithms include the cloud-top temperature is related to cloud-top height. Cloud-top height is related to the strength of the updraft transporting moisture into the cloud and updraft strength is related to rainfall rate. Generally speaking, colder clouds are associated with heavier rain and warmer clouds are associated with light or no rain.
7. The performance of the rain rate algorithm is improved when the data is divided into three cloud type categories – water, ice, and cold-top convective clouds, these are based on thresholds between the various band brightness temperatures given here. The data is also divided between 4 geographic regions over 30 degree latitude increments which yields 12 distinct rainfall classes in the algorithm. Additional spectral bands provide information on cloud phase and particle size which is more useful than temperature alone, especially for stratiform rainfall.
8. Other satellite QPE issues to keep in mind, remember our primary interest is in rainfall rates at ground level, satellites detect cloud top or cloud level characteristics. With the higher spatial resolution of ABI, rain rate shafts are often not vertical so the surface rainfall can be displaced by up to a few pixels from locations indicated by the IR imagery. Also, another deficiency in using satellite rainfall rates include no direct accounting for orographic effects, subcloud evaporation of hydrometeors, and subcloud phase changes. Some of these issues could be addressed with the help of NWP model data. For example, using relative humidity fields to

reduce rain rates in arid regions, or using wind fields to attempt to adjust for orographic enhancement.

9. Now we'll review strengths and weaknesses of the product. Satellite rain rate estimates are best for deep convective rain. Satellite rain rate estimates perform poorly for stratiform precipitation. Weaknesses of IR retrievals include underestimating or missing shallow stratiform clouds that are near or warmer than 0 degrees Celsius which can include orographic clouds or very shallow convective clouds such as trade-wind showers. Also, cirrus associated with convection can be incorrectly identified as rainfall regions.
10. This is an example of the GOES-R rainfall rate baseline product as displayed in AWIPS. Units are inches per hour. The proxy data used to produce this is from the SEVIRI instrument on the MSG satellite which is not quite the horizontal resolution that will be available with GOES-R, however this is being displayed at 15 minute resolution. We are looking at a case over the equatorial and southern Atlantic Ocean. Briefly look this over and consider what regions of precipitation you would have more confidence in versus regions you may have less confidence.
11. We will zoom in on a region you should have more confidence in the rainfall estimates, why? Because this is a region of convection as it moves off the coast of Africa. Generally speaking, you should have higher confidence for deep convective rain and less confidence over stratiform rain. Consider ways you would use this data for your CWA either due to radar beam blockage issues, or especially if you're a coastal site.
12. Our next example of the rainfall rate product is displayed over the Pacific in the vicinity of Hawaii. The proxy data used to produce this is the AHI instrument on the Himawari satellite. This is the same spatial resolution (2 km) that you will see with GOES-R, however this is displayed at 10 minutes rather than 15 minute temporal resolution and also makes use of a newer version of the algorithm which may make it look slightly different. Identify the regions of convection and also lines of lighter rainfall rate associated with outflow boundaries.
13. This is the Himawari IR loop at 10.4 microns for the same time period over Hawaii and vicinity. Note that much of the rainfall over Hawaii is associated with deep convection. We also see the deep convective cluster west of Hawaii that indicated rainfall in the product.
14. Now we zoom in over Hawaii and see a noticeable trend in the rainfall rate product during this loop. In light of the issues that were discussed earlier, where in this region might you be cautious when using the satellite-based rainfall estimates? You would be cautious over mountainous regions of the Hawaiian islands since orographic effects are not accounted for in the current version of this product. Let's compare the satellite derived versus observed rainfall for this point on the southeast coast of Maui.
15. This is a time series comparison of rainfall gauge in the black line and satellite derived rainfall in the green line, I'll highlight the period we just looked at in the loop. For this case, you would conclude the trend was pretty good and the rainfall from the satellite product overestimated. Keep in mind any trend and bias will vary from case to case.
16. An important cavaet
17. Summary