Talking points for discrete storms

1. Title slide
2. Learning objectives
3. Outline
4. Now we will step through the visible band at 0.64 microns, the IR band at 10.4 microns and the 3 water vapor bands from the Himawari satellite as proxy data for GOES-R to compare the various bands for a scene typical of convective activity. The cumulus lines away from the storms show up clearly since they are reflective. In the 10.4 micron IR band those same cumulus lines are much more subtle for two reasons, they are emissive rather than reflective in this band, and the spatial resolution of this band is coarser than the visible band. In the lower water vapor band at 7.3 microns, those same cumulus lines are undetectable in the eastern parts of the scene, while they show up in a subtle way over the western part of the scene. This is the water vapor band that would have the best chance at showing low-level features such as cumulus lines, however keep in mind the weighting function profile, it varies and this explains why we see the cumulus lines in only portions of the scene. In the mid and upper level water vapor bands, the cumulus lines are undetectable since the weighting function profile is primarily above the level of the cumulus. Next let's consider cumulonimbus clouds and compare how they appear between the various channels. The IR imagery will generally show cumulonimbus clouds as larger than visible imagery indicates. This is due to the resolution of the sensor and the cold cirrus temperatures. Now let's consider cirrus clouds, first consider thick cirrus clouds. Thick cirrus is easy to identify in the visible image since it's highly reflective and shows up readily as colder cloud tops in the IR and water vapor bands. Now let's consider thin cirrus. In the visible band, the thin cirrus is quite subtle since it's not as reflective as thick cirrus. If we switch to the IR band, the thin cirrus stands out due to colder cloud top temperatures. Compare thin cirrus between the IR band and the 3 water vapor bands. The degree to which the cirrus stands out depends on the background temperature, for example, in the IR band the the cirrus is observed against a warmer background which is the surface. Of the 3 water vapor bands, the thin cirrus will likely show up most clearly in the lower water vapor band at 7.3 microns, as we move up in altitude to the 7.0 and 6.2 micron bands, the background gets progressively colder, therefore there is progressively less contrast between the cirrus and background.
5. This is a schematic of a supercell with satellite signatures that you may see at times in the visible imagery. We have our familiar anvil cirrus with overshooting top, and downstream from the overshooting top the above anvil cirrus. The flanking line is typically observed southwest of the main updraft. The last 2 features are of primary interest here and indicate that a storm is undergoing intensification or is at or near peak intensity. East of or downshear of the flanking line, you may observe inflow feeder clouds as depicted in the visible image. Much like the enhanced-V satellite signature, they are not necessary for severe weather occurrence, there's a number of reasons why you may not observe them, but if you do, think of it is a bonus and keep these numbers in mind. A study found that if inflow feeder clouds are observed, there is a 77% chance of severe weather within 30 minutes, and that number goes up to 85% if coupled with mesocyclone detection from the MDA. West of or upshear of the flanking line you may observe

lines of towering cumulus that form above an invigorated RFD. These clouds do not act as inflow into the storm the way inflow feeder clouds behave, instead they develop above the RFD and are an active area of research. What we know at this time is that when you do observe these clouds, the storm is intensifying and/or near peak intensity.

6. 21 May 2014 1-minute loop 2031 – 2210 UTC: As proxy data for GOES-R, we analyze 1-minute imagery from GOES-14 SRSOR for this case from May of 2014 over Colorado. The most obvious aspect of this loop is the intensification of an isolated storm near Denver that is moving eastward. What specific indications are we looking for other than growth in areal coverage of anvil cirrus and overshooting tops? The storm has a crisp and distinct edged anvil on the upshear (or southwest) side of the storm. We observe a flanking line southwest of the storm, and east of the flanking line we notice lines of cumulus moving rapidly towards the storm. We also observe inflow feeder clouds in the later portion of the loop, east of the flanking line. West of the flanking line we observe an invigorated field of cumulus that forms above the RFD. These clouds (as well as the inflow feeder clouds) are indications of an intensifying storm, near its mature phase. The invigorated field of cumulus west of the flanking line doesn't last long as it dissipates about midway through the loop, however note what we can see once those clouds dissipate. These are not clouds since they aren't moving, this is a hail swath caused by the storm which produced a significant depth of hail over a large enough area to be seen in the visible channel due to its higher reflectance. The 1-minute imagery helps make this appear more readily.
7. Now let's look at some satellite signatures of discrete storms from the IR perspective. This is the Himawari 10.4 micron band for discrete storms over Bangladesh. The overshooting tops are indicated and easy to spot as localized of minima of brightness temperatures indicating the storm updraft. The enhanced-v signature is inside of the box, relatively warmer brightness temperatures exist immediately downshear of the overshooting top with colder brightness temperatures on either side to form a v-shape. The enhanced-v signature indicates the storm is most likely severe, however, much like other satellite severe storm signatures we discussed there are a number of reasons why one may not see the enhanced-v signature so one cannot conclude the storm is not severe in the absence of the enhanced-v signature.
8. 4 June 2015 case – Part 1
9. 4 June 2015 case – Part 2
10. Cloud top cooling trends to assess storm intensity can be obtained from the IR band at 10.4 microns. The tracking meteogram tool in AWIPS can be used to display cloud top cooling trends. In this example from Himawari over southeast Asia, we place the AWIPS cursor for the tracking meteogram tool over a discrete storm that develops. The plot of brightness temperatures with time are plotted on the right. As you gain experience in using this tool, you will gain a better understanding for what cloud top cooling rates are significant for your CWA.
11. We now switch gears to highlight some applications of baseline products to discrete storms. We begin with 1-minute visible imagery coupled with lightning : At the 2016 spring experiment at the Hazardous Weather Testbed forecasters analyzed proxy GOES-R data for real-time events. This included 1-minute 1-minute visible imagery from GOES-14 SRSOR and lightning data from an LMA for an event over northern Alabama as proxy for the GLM. The forecaster was analyzing

a line of storms that looked pretty much equal until there was an overshooting top in the 1-minute imagery along with a lightning jump in the flash rate data. The forecaster warned on the storm based off this information and quarter sized hail was observed. This example illustrates the value of blended baseline products with 1-minute imagery to improve warning effectiveness.

12. The next baseline product we'll discuss are the derived motion winds. These winds are derived from cloud motions from satellite imagery and will be useful in the GOES-R era with its higher spatial and temporal resolution. The winds are calculated based on the level in the vertical of the cloud, so that a variety of cloud heights will provide winds at a variety of vertical levels, which can provide useful information on the vertical shear profile. You may also be able to identify regions of localized low-level convergence and associated boundaries for convective initiation or intersections with existing storms. You may also use the winds to validate familiar model analyses or forecasts.
13. Other applications of derived motion winds include assessment of storm motion, upper level diffluence and as depicted in this loop you can detect developing and intersecting boundaries in the winds therefore this data source provides a more rapid update compared to familiar hourly model analyses.
14. Interactive exercise
15. Summary