Talking points for marine and polar mesolows

1. Title
2. Learning objective
3. Introduction
4. Our case is from 12 March 2017, we begin with a GOES-16 IR image overlay with METARs and 850 mb plots. Cold air is flowing over the relatively warm Great Lakes, there are lake-effect snowbands clearly evident over Lake Superior, however our primary focus is the existence of a mesolow over southern Lake Michigan. Note from the METARs that temperatures are in the mid-teens. Surface winds are light, which favors the development of a mesolow.
5. We'll start our analysis of the mesolow over Lake Michigan with the most familiar channel, which is the visible band at 0.64 microns. During daytime, this band is ideal since it is the highest resolution band possible at 0.5 km and depicts low-level clouds associated with the mesolow clearly, so long as there are no high clouds obscuring what is happening at low-levels. Flare ups in the convection around the mesolow can be observed, these may be associated with localized heavy snow. Also note the relatively fast moving clouds at times just west of the center of circulation, these can be associated with localized strong winds. GOES imagery is useful in tracking the mesolow for potentially moving onshore, bringing potential for localized heavy precipitation, strong winds and low visibility with it.
6. Now let's compare GOES-16 with GOES-13 which was still the operational GOES-East satellite at this time. There are some missing images so focus on the superior spatial resolution of GOES-16. In the previous GOES era, high clouds, in particular with the IR band would've made mesolow identification much more difficult.
7. With GOES-16 and 17, not only do we have superior spatial and temporal resolution but we also have additional bands which can be quite useful for mesolow monitoring during daytime hours. On the bottom panels, we have the familiar visible band in the lower left and IR band at 10.3 microns in the lower right to compare with the two new bands on top. In the upper left we have the veggie band at 0.86 microns. This band shows greater contrast between land and water, therefore coastlines become less ambiguous and small islands are much easier to see. In the upper right is the 1.6 micron snow/ice band. This band is useful for delineating clouds from ice or snow cover. Snow and ice surfaces are strongly absorbing at this wavelength so the reflectance is low (thus darker in this color table), however cloud reflectance is high, this contrast helps delineate clouds from snow or ice cover. We don't have any ice cover in this example, however this band is also useful in capturing glaciation at cloud top. Clouds composed of supercooled water will appear bright, whereas clouds composed of ice will appear dark since ice is strongly absorbing at this wavelength. Convective clouds that becoming deeper can be identified as darker in this band. This band is also commonly used in various RGB products to help identify cloud glaciation as we'll discuss later.
8. Time for an interactive exercise. In this 4 panel we have the 3 GOES-16 water vapor channels, 7.34 microns in the upper left, 6.9 microns in the upper right, 6.2 microns in the lower left and

the old GOES-13 water vapor band in the lower right. Which panels can you see the mesolow? Why can are unable to see the mesolow in some of these panels? I'll give you some time to think about this before moving forward.

9. Recall the earlier training module part of the satellite foundational course on the water vapor bands. The water vapor band that sees lowest in altitude is at 7.3 microns, while the band that sees the highest is at 6.2 microns. This is an application of knowledge of weighting function profiles for the various water vapor bands. A mesolow is a low-level feature, therefore it will show up best at 7.3 microns and is unlikely to show up in the other 2 water vapor bands due to the weighting function profile being above the altitude of clouds associated with the mesolow. This is also true for the old water vapor band at 6.5 microns, which would not have shown the mesolow even with the higher spatial resolution of GOES-16.
10. What about mesolow identification at night? We need to make use of IR bands. This loop shows the origins of the mesolow during the overnight hours in 3 IR bands, as well as a RGB product that makes use of those 3 IR bands. Let's start with the most familiar which is the 10.3 IR band in the upper right. The low-level clouds associated with the mesolow show up as gray in the default IR color table, while high clouds are color enhanced. While it is not the case in this example, at times high clouds may make it difficult to identify the mesolow. In that situation, making use of a RGB product such as the nighttime microphysics RGB can help discriminate between high clouds (in the red) versus low clouds associated with the mesolow in the yellowish / green colors. The 3.9 and 12.3 micron bands are shown at the bottom, frequently the RGB provides more contrast to features than single band images alone.
11. There are some RGB products for daytime use as well, this is the Day Cloud Phase Distinction RGB. High clouds are reddish / yellow, low clouds are white. Clouds that undergo glaciation transition from white to green since the 1.6 micron band absorbs ice, therefore darker and less blue, more green. The mesolow over Lake Michigan remains in the white colors through the loop, but this product can be useful to monitor for relatively deeper convection which may indicate locally heavier snowfall such as the green colors we see across the lake-effect snowband in southern Lake Huron. Snow cover on the ground and ice cover on the lake appears green in this RGB composite.
12. In order to better understand RGB products, make use of the AWIPS cursor readout on the RGB product and its components. Use this information along with the corresponding Quick Guide to understand why features appear certain colors.
13. GOES-16/17 aids in mesolow identification because of its greater spatial and temporal resolution compared to previous GOES. The IR and visible bands will continue to play a prominent role in mesolow identification, however there are new visible bands on GOES-16/17 that aid in mesolow identification. This includes the 0.86 micron veggie band which increases contrast between water and land, better identifying coastlines and islands. Also, the 1.6 micron band can easily discriminate between clouds and snow or ice cover, this is particularly important for mesolow identification against a typical winter background and cloud streamers over ice fields of unknown fractional coverage. RGB products are particularly well suited for shallow convection to discriminate the mesolow from ice/snow cover and make it easier to identify if partially obscured by high clouds. Be sure to make use of the 4 panel display to display multiple

satellite bands in tandem for the most complete diagnosis, similar to multiple fields of dual-pol radar display. Finally, although the mesolow shown in this case study did not come ashore and cause hazardous weather, we post a link to a blog entry in the pre GOES-R era of a relatively high impact mesolow that came ashore to cause localized hazardous weather.