

1. This is the Satellite Foundational Course for JPSS - the Joint Polar Satellite System. This module discusses ways to use VIIRS imagery from Suomi NPP and JPSS-1.
2. JPSS has superior spectral and spatial resolution to GOES-16's better temporal resolution. This is especially true as you move towards the Poles. In addition, VIIRS includes a Day Night band that allows visible imagery at night.
3. This list of training topics is short, and it shows what is discussed in this training. This short list will be expanded upon in the future. If you find a novel use for JPSS data, let us know!
4. Light from the Sun, or from the Moon, can reflect off water. The bright region of sunglint or moonlint can be used to infer surface properties. In this example from AHI, you can see internal waves in the ocean in regions of sunglint. An animation of this image is available at the link shown. For geostationary satellites, this works only near the Equator. But Polar Orbiters can detect sunglint or moonlint in mid-latitudes, or near the Poles. Read more about this at the references listed.
5. Differences in Moon Glint or Sun Glint can be used to infer the state of the lake surface/sea surface. When there are wind-driven waves - reflection is in all directions and water will look grey. Where the lake surface is flat - because there is no wind - reflection is mostly in one direction and the water is darker. In mid-latitudes, the position of Polar Satellites with respect to the Sun and the observation point allows these dark patches to be observed. A view of this image from GOES-12, then operational as GOES-East, showed no dark patch.
6. So this dark region is a region with no wind
7. And a wind analysis confirms that. It's not just visible reflectance that's affected by the sea state! There is less 3.9 micron reflectance in the calm region, so the inferred brightness temperature is cooler than the adjacent regions where there is more reflectance of solar radiation. If there is no reflectance at all, the 3.9 micron brightness temperature in the calm region would be close to the actual emitting surface temperature.
8. If there is no wind, there is no mixing of water. This allows a thin film of water on the surface to warm up. Observed Sea-surface or Lake-surface temperatures will warm considerably compared to adjacent regions where winds will mix warm surface and cooler sub-surface waters.
9. Moonlint works just as well as sunglint in identifying regions of calm
10. Figure out cloud heights from the shadows!
11. Day Night Band imagery can identify low-level circulation centers at night. This is very handy for tropical cyclones if sheared systems have deep convection very much separated from the low-level circulation.
12. Here is a tropical system that is east of Hawaii. The precise location of the storm is vital for its insertion into a model
13. Where is the center based on IR Imagery? It's hard to tell.
14. Did you place it where the 'x' is? It's pretty simple to see the circulation in the visible (at night) Day Night Band image. It's difficult to infer its location from the infrared imagery.
15. It's not uncommon for sheared systems to have a circulation displaced from the main convection. The Day Night Band imagery - with ample lunar illumination - reveals the low-level circulation.

16. Here's another example. Where would you expect the circulation center to be in this infrared window image from VIIRS?
17. Did you imagine the circulation center to be where the 'X' has been placed?
18. The Day Night Band image reveals a distinct low-level swirl in the clouds. This is the center of this sheared tropical system.
19. Here are two images of Tropical Storm Bonnie from 2016, Infrared and Day Night Band Visible Imagery. The low-level swirl that is the center of sheared Tropical Storm Bonnie from 2016 is masked in the infrared image by the cirrus clouds above it, but the cirrus is thin enough that it's easy to find the center of this system in the night time visible! (Also: Note the shadows from the convective towers on the Moon Glint! Again -- you can infer convective cloud height from this!)
20. Here's one more example of a sheared storm. In this case, only Earth Glow is illuminating the cloud field -- and you can still find a circulation center! Note also the streaks of lightning in the deep convection. Lightning shows as a streak because it is detected as it occurring in just one swath. When VIIRS was scanning poleward and Equatorward of the lightning location -- at slightly different times, the lightning was not occurring.
21. In visible wavelengths, land is not very reflective -- you know this because it appears quite dark in visible imagery. Land is a lot brighter in near-infrared. There is more reflectance from grass and dirt -- compared to the visible -- in the .86 and in the 1.61 bands. Thus, vegetated features, and bare ground, will appear bright. This is important because water is dark -- and the contrast between bright and dark means flooded regions can be identified.
22. This example shows flooding on the S. Platte River in CO shortly after torrential rains hit Boulder. The contrast between the reflective land and the river water is very distinct. If you're familiar with the region, and know what the river usually looks like, this is helpful to in interpreting the scene.
23. A bonus scene occurred on this day! This region benefited from two sequential passes, about 90 minutes apart. So you could see the progress of the flood crest, maybe even calculate its speed!
24. It's few days later: how far has the flood crest moved?
25. Of course, clear skies help. Here's the view on the 17th. The flood has almost reached Nebraska.
26. VIIRS data can be used to create an inundation product as well, and this image from 11 October 2016 shows flooding related to Hurricane Matthew.
27. VIIRS has higher resolution imagery than Geostationary satellites -- this is especially true as you move to higher latitudes. VIIRS is therefore better positioned to detect stratus and fog events in narrow valleys. The Day Night band can give you information in the visible about the horizontal extent of the stratus, and the infrared can as well by exploiting the emissivity differences at shortwave and longwave infrared channels of water droplets as found in stratus clouds .
28. The brightness temperature difference field here shows fog / stratus starting to appear in the river valleys of SW Wisconsin. Not quite yet on the Mississippi river, however. VIIRS can give an early alert to the formation of fog if the overpass is timed right.
29. GOES Imagery from the next morning shows more widespread fog locations.

30. VIIRS has high spatial resolution, and if you have narrow valleys, or sharp edges to the cloud bank, you are better able to describe exactly where the fog is present.
31. You've seen a flood monitoring case where data from sequential VIIRS passes overlapped and gave useful information. Such overlap is most likely at higher latitudes. The presence of multiple satellites means that VIIRS and other imagery -- such as MODIS in this example -- can be combined to give multiple views of the same scene to determine the evolution of weather at high spatial resolution. Look at the fog in this image.
32. Here's the same scene from Suomi NPP, another polar orbiter, 2 hours later. The fog is advancing down the Salinas Valley.
33. Less than an hour later, Aqua MODIS view the scene. If you know when polar satellites are passing, you can realize high-resolution imagery for features.
34. Visible Imagery at night -- that is, the Day Night Band on VIIRS -- will view fog, clouds, smoke and city lights. You can see fog in the valleys of SW Wisconsin. Is there any fog over Chicago? Or Minneapolis? The lights of the city make it hard to tell. Is the feature spreading southeastward from the northwest corner smoke? Cirrus? Fog? You should interrogate other channels (or products) to discern that.
35. IN this case, the Brightness Temperature Difference shows stratus clouds over the river valleys of Wisconsin, and over Chicago. The Twin Cities show no fog detected. Smoke is not detected in the brightness temperature difference field (but cirrus is) -- so that feature spreading southeastward from the northwest corner is smoke from Forest Fires. Smoke detection at night is something the Day Night Band -- when there is sufficient illumination -- excels at.
36. When you suspect fog at night -- and see a signal near cities in the Day Night Band, the Infrared imagery (brightness temperature difference) can show where the fog/stratus exists over metropolitan areas.
37. VIIRS Imagery detects fires. There are multiple shortwave IR channels that can be used, and some have excellent horizontal spatial resolution, meaning small fires are detected. Smoke from fires shows up in the Day Night Band.
38. Here's an example of the Ft. McMurray fires over Alberta. This is at 56 degrees North Latitude -- far from the GOES Sub-satellite point! GOES-16 Pixel size here exceeds 5 km, so small fires cannot be detected. In this case, the fires were widespread and large at this time, but VIIRS better described their horizontal spread. IN addition, the day night band ably characterized the horizontal spread of the smoke pall, an important piece of information for air quality alerts.
39. Here's the GOES-13 Imagery for about the same time. Only one pixel is very hot, and there is no information about smoke.
40. One week later, VIIRS sees smaller -- smaller in area -- fires that might not be perceived by GOES. The Moon at this time is not providing sufficient illumination to show where the smoke plume is but the visible light emitted by the fires is obvious.
41. VIIRS is more likely to detect fires that are small in size, in this case over Idaho. There is both a thermal signature and a visible signal. The Day Night Band also shows the smoke.
42. Here's another example over California. The thermal signature is readily apparent -- and the horizontal extent of the smoke offshore is capture nicely. It can be trickier to monitor where the smoke is if it drifts over city lights

43. True Color Imagery from VIIRS depicts the smoke very well during the day time. IN addition, there are smoke and fire-related products, such as aerosol optical depth.
44. After the fires, VIIRS data can be used to detect burn scars. This is post-grassfire burn over Kansas. There is a difference in reflectivity that the Day Night Band can capture.
45. During the daytime -- you can use the .86 to see the burn scars. Compare the Day Night Band imagery to the GOES-16 .86 from the day before. (I didn't have a cloud-free VIIRS overpass view of the scene post-fire)
46. This concludes this short training on how you can use JPSS (or Suomi NPP) VIIRS imagery. Remember: VIIRS data has much better spatial and spectral resolution, and it complements GOES-16's (or GOES-13 and GOES-15's) better temporal resolution. Use them both. In particular, VIIRS has a Day Night Band that produces visible imagery at night that can help for a variety of situations. That band nicely complements other infrared channels on VIIRS to describe weather in the scene you are viewing. Thanks for Reading!