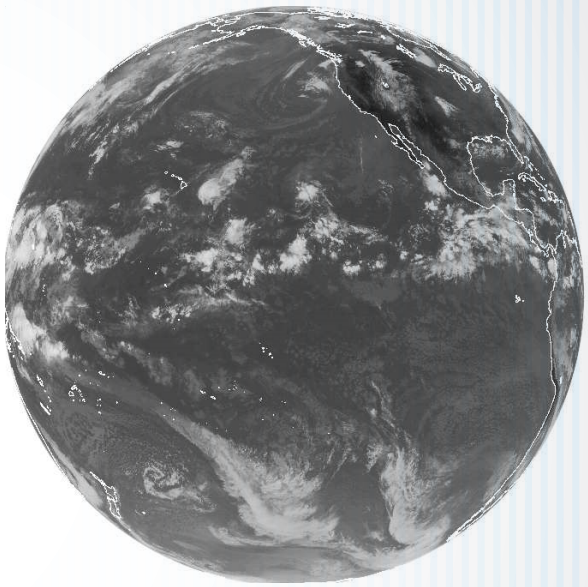
ALASKA DIRECT BROADCAST QUICK GUIDES
Pixel Growth and Other Gotchas

OVERVIEW

The spatial resolution of imagery, from both geostationary and polar orbiting satellites, is sharpest directly under the satellite, at nadir. Spatial resolution then degrades as the viewing angle increases away from nadir toward the limb, or toward the edge of a polar orbiter's swath. Another consequence of viewing at angles far from nadir is "limb cooling" or "limb darkening" when the signal detected by a satellite's instruments comes from higher in the atmosphere. While every imager suffers such issues away from nadir, each instrument exhibits its own specific performance; the characteristics of imagers on polar-orbiter satellites used by the NWS will be described in this quick guide.

GOES WEST, YOUNG MAN

The image at right is a GOES West longwave IR image from 1800Z August 12, 2015, and shows the challenge of observing Alaska from an equatorial orbit. Pixel growth increases as a function of latitude and becomes a significant problem in Alaska, especially northern Alaska. Parallax must also be considered when monitoring convective activity, or any phenomenon having a substantial vertical profile. The arrival of the GOES-R series of geostationary satellites will bring a substantial improvement in spatial resolution across the field of view, even in Alaska. Unfortunately, the upgrade to GOES-R will not mitigate the problem of parallax.



PIXEL GROWTH: SOME IMAGERS ARE MORE EQUAL THAN OTHERS

The six AWIPS screen captures on side two of this quick guide illustrate pixel growth and the associated degradation in spatial resolution as the look angle from a polar orbiter progresses from nadir out to the limb of the swath. These six screen captures represent three pairs of images, with a pair of images each from the VIIRS, MODIS, and AVHRR's visible channels centered near the 0.64 μm wavelength. Since these pictures come from three different satellites, and since polar orbiters fly over different parts of Alaska at different times, these images do not cover the same area nor the same time and are not intended to be compared in that sense. Rather, the take-home message here is simply that pixel growth affects these three instruments very differently. The VIIRS instrument is the most modern of the three and suffers the least from pixel growth. MODIS and AVHRR, on the other hand, exhibit much more degradation in spatial resolution out at the limb of their swaths.

ADDITIONAL REFERENCES

This COMET module describes the capabilities of the VIIRS instrument in comparison to the MODIS, AVHRR, and OLS instruments regarding factors such as pixel growth and other edge-of-scan effects: https://www.meted.ucar.edu/satmet/viirs/

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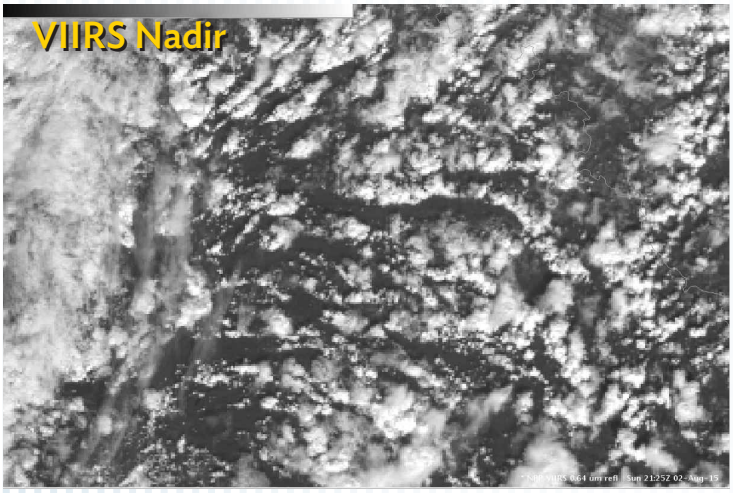

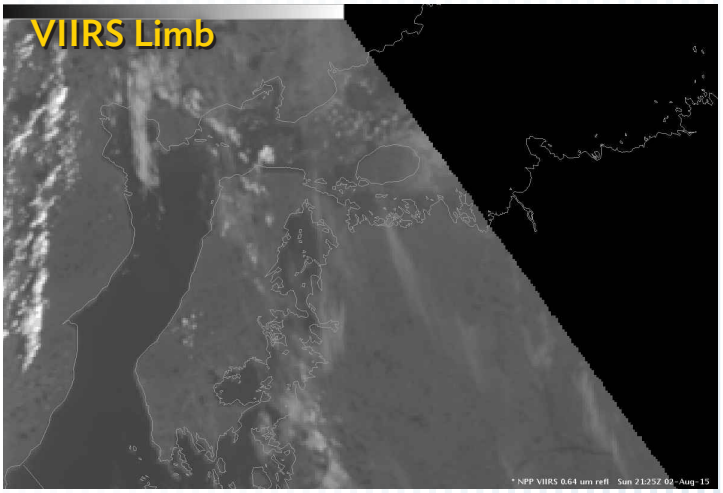

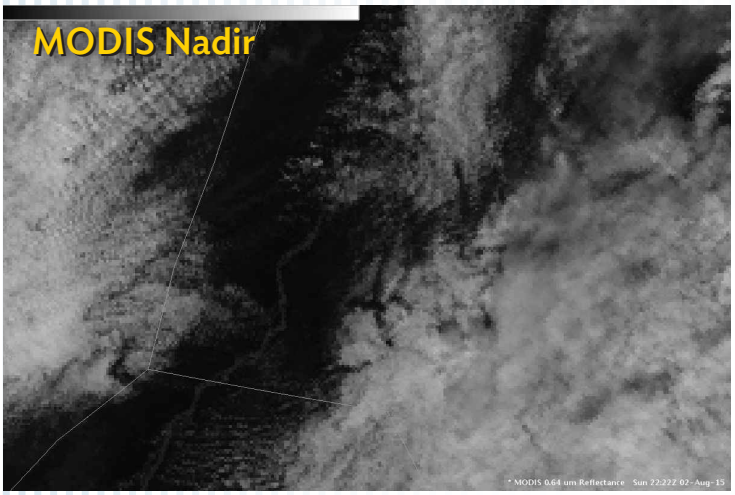

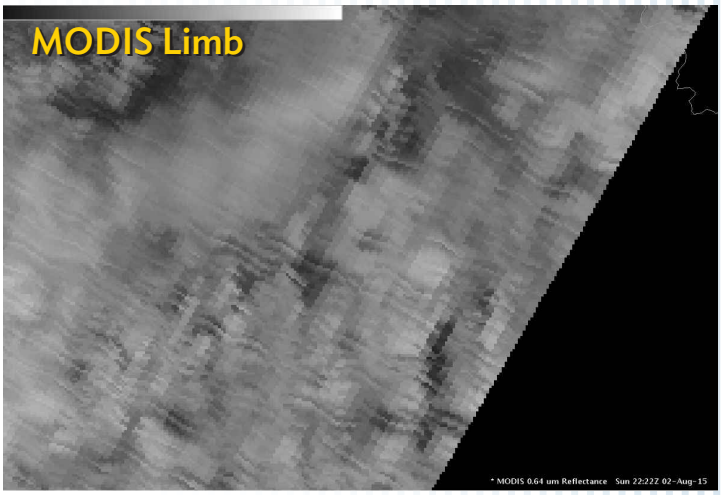

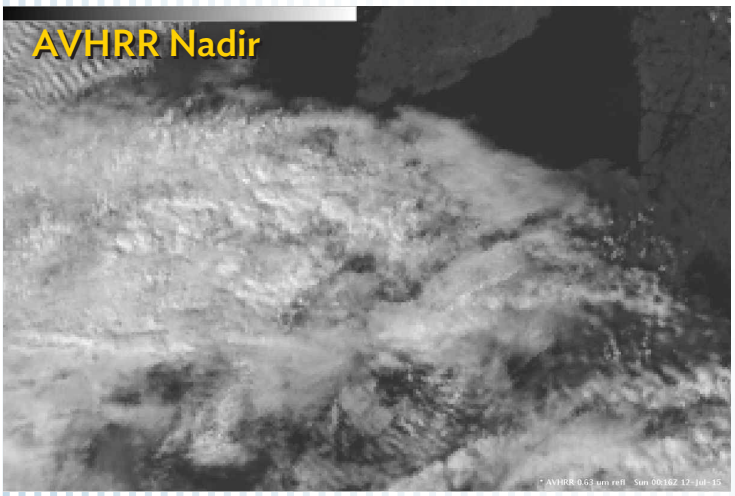

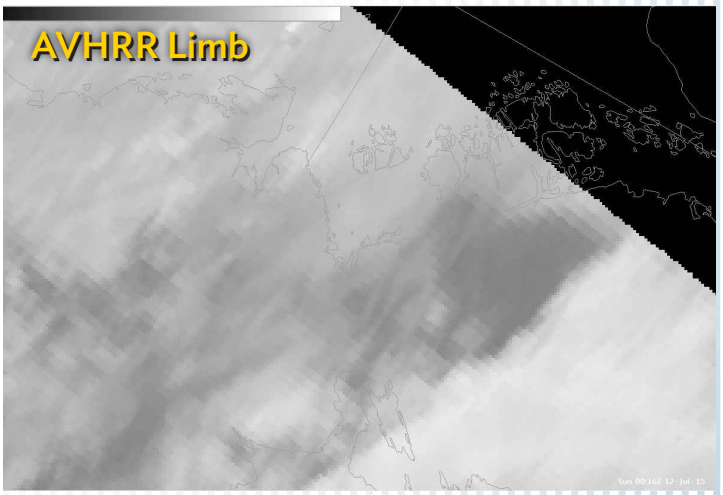

AWIPS screen captures illustrating pixel growth and the associated degradation in spatial resolution as the look angle from a polar orbiter progresses from nadir out to the limb of the swath. The image pairs are VIIRS, MODIS, and AVHRR's visible channels centered near the 0.64 µm wavelength.

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