GOES-9: THE USE OF 3.9 um IMAGERY DURING DAYTIME (5 Jan 96 CASE)

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The use of GOES-9 multi-spectral data to detect clouds over snow during the day

Can you find an area of low, water clouds over a region of snow using Figs. 1-3? Hint: the most prominent region is in Montana. Figs. 4-6 contain plots of surface data that may help make the determination easier.

The area of low, water cloud over snow is located in east-central Montana just south of the Alberta/Manitoba/Montana border. What image type was most useful in making this determination?

The 3.9 um image is most useful in this determination. The visible image can show the region that is either snow cover or cloud cover (both snow and clouds show up white). The 3.9 um image allows the detection of water clouds since water clouds are highly reflective in this wavelength (show up bright in 3.9 image) while ice clouds and snow cover are poorly reflective (show up dark). The IR imagery is of little use in this case since surface temperature are so cold and the clouds are quite low that there is little difference between the surface (over the snow) temperature and the cloud top temperature. The IR imagery is useful to estimate cloud top temperatures. In this case the cloud top temperatures and between -10 C and -20 C. Therefore, it is likely that this is a supercooled water cloud, which could have seriuos impacts on aviation.

Figs. 7-9 show the 3 image channels 4 hours later at 2201 UTC. It is now evident in the visible image (Fig. 7) that the cloud deck is casting a shadow onto the snow cover. This shadow was not evident earlier since the image was near noon local time. It is also obvious that the cloud deck has moved slightly to the east between 1801 UTC and 2201 UTC.

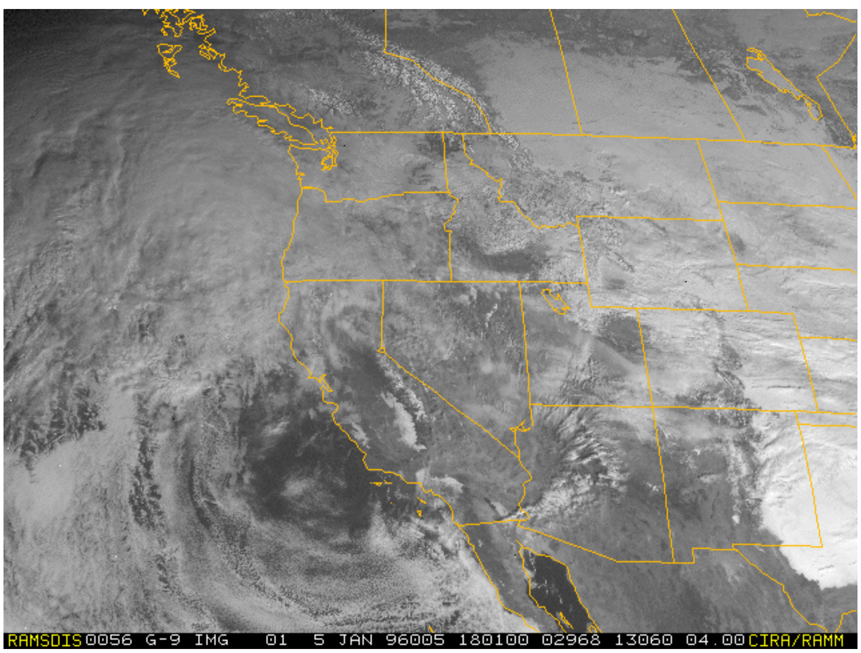
IMPORTANT NOTES: This technique only works during daylight when the 3.9 um wavelength image has input from solar reflection. The enhancement used on the 3.9 um imagery is a simple inversion of the normal color table for IR imagery so that low reflectance shows up as dark and high reflectance shows up as light (this is the scheme that is used on RAMSDIS).

The use of GOES-9 multi-spectral data to detect low clouds/fog during the day

Notice the region of white in the visible image (Fig. 1) in the southeast area of the San Joaquin Valley of California (to southeast of San Francisco Bay). There is also a region of white to the north and east of the first area. Comaparing the visible image (Fig. 1) to the 3.9 um image (Fig. 3) we see that the first region of white in the visible image is generally white and that the area to its north and east is dark. This indicates that the first region is a water cloud (highly reflective in 3.9 um wavelength) and that the second region is most likely snow cover (poorly reflective in the 3.9 um wavelength) in the Sierra Nevada. The IR image (Fig. 2) shows that the temperature of this cloud is near 0 C and therefore a low cloud. The snow covered Sierra Nevada have a surface temperature of about -10 C as indicated by the enhancement on the IR image. Thus the cloud in the valley has a top that is below the level of the Sierra Nevada.

Water clouds are also detected in the southeast region of British Columbia. The visible image (Fig. 1) shows a milky appearance between the mountain ranges in that region. The 3.9 um image (Fig. 3) detects these regions as highly reflective water clouds in the mountain valleys. Once again, the IR image of little use other than to determine the cloud top temperature once the cloud has been identified using visible and 3.9 um data.

IMPORTANT NOTE: This technique relies on using visible *and* 3.9 um data. There are regions that appear bright (white) in the 3.9 um imagery that are not water clouds (i.e., southern California and Arizona). These regions are due to the reflective properties of the earth's surface (vegetation and/or soil type) in those regions.



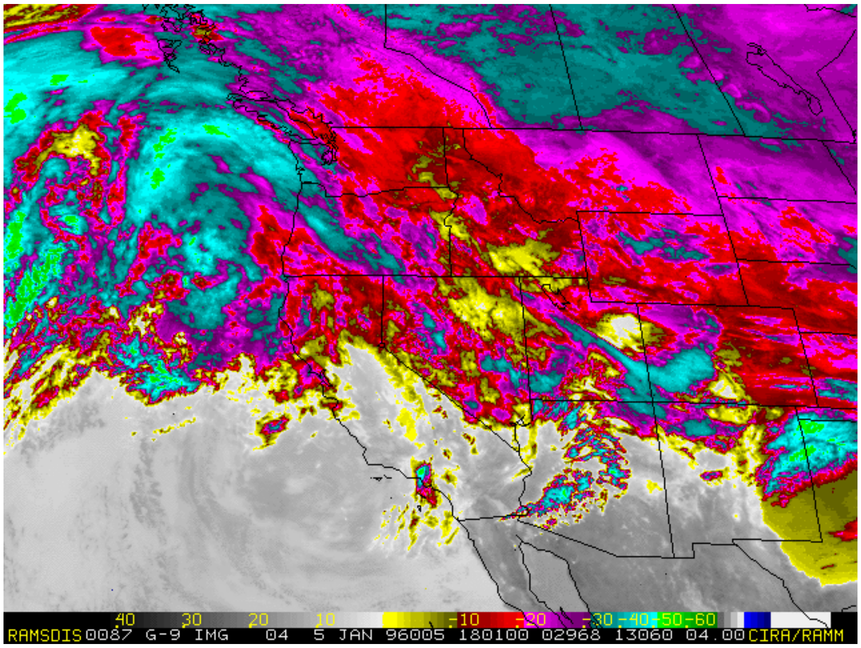
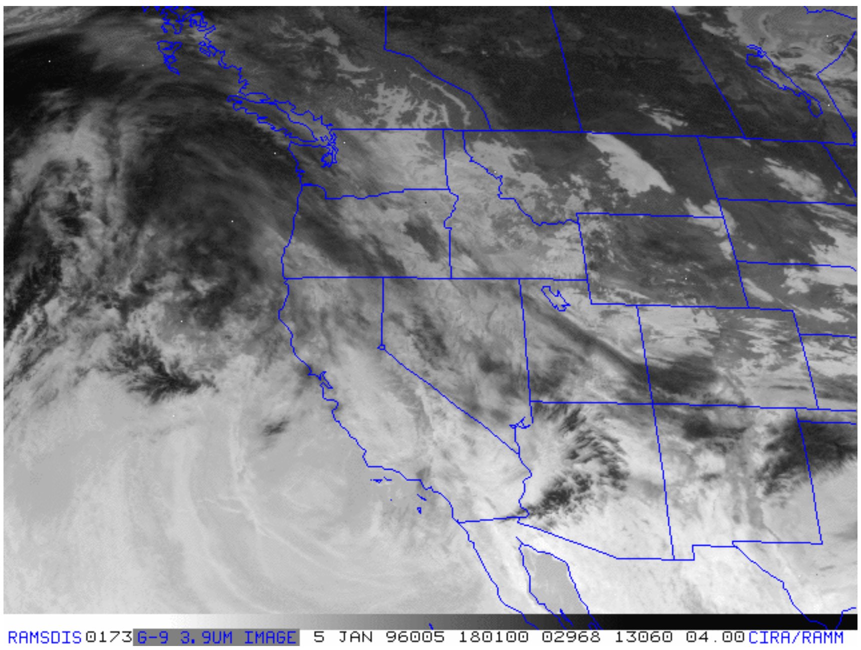


Fig. 1. 4 km VIS from GOES-9 at 1801 UTC on 5 Jan 96

Fig. 2. 4 km IR from GOES-9 at 1801 UTC on 5 Jan 96



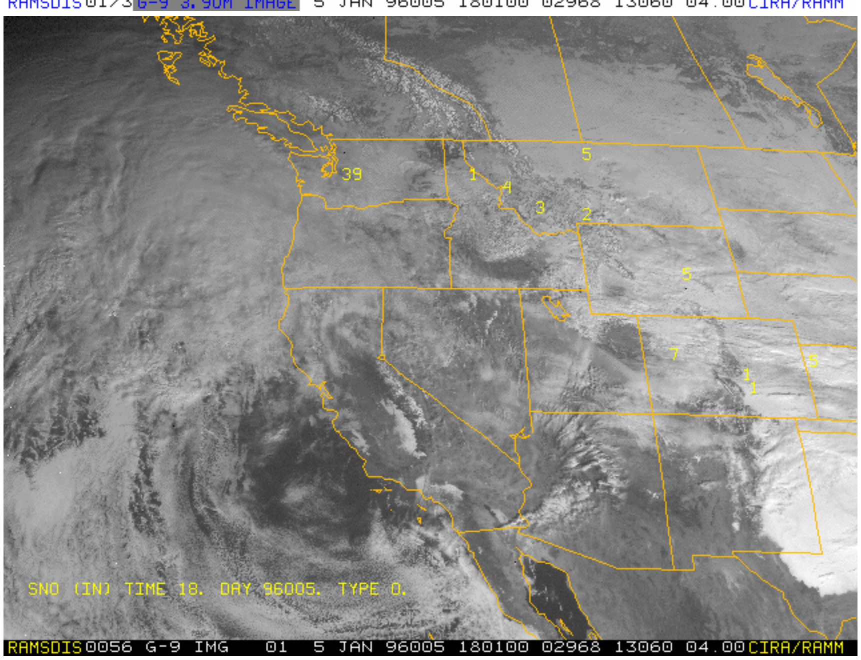
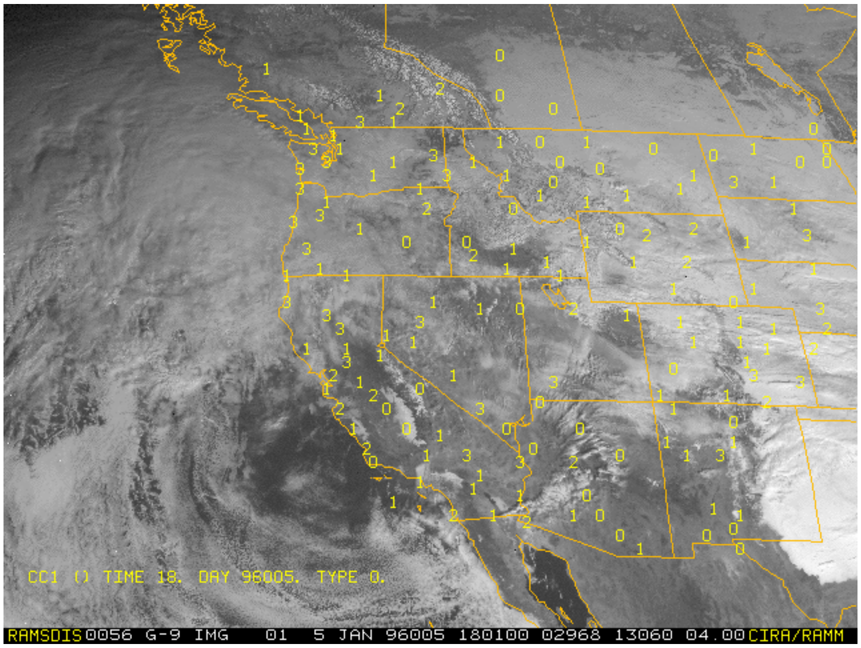


Fig. 3. 4 km 3.9 um from GOES-9 at 1801 UTC on 5 Jan 96

Fig. 4. 4 km VIS from GOES-9 at 1801 UTC on 5 Jan 96 with



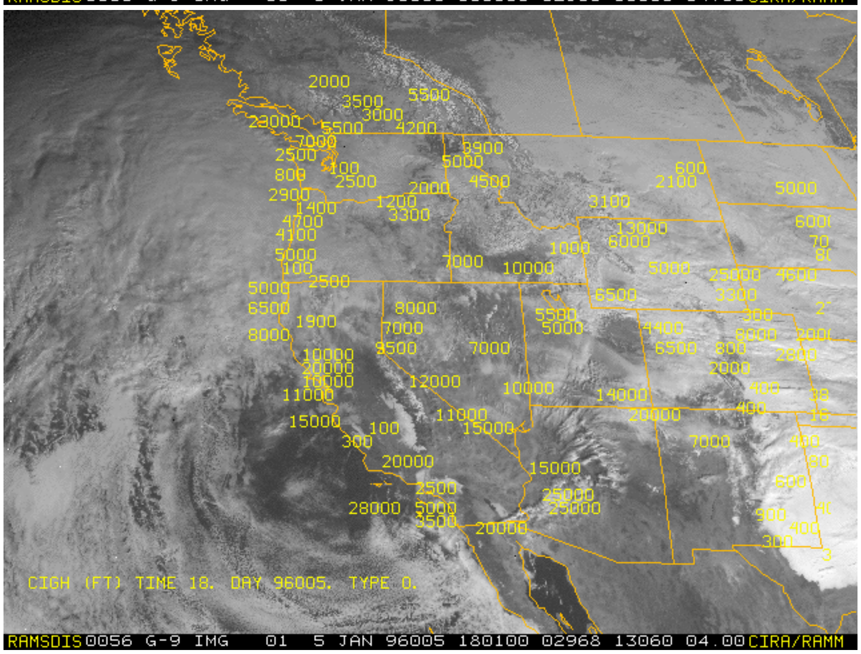


Fig. 5. 4 km VIS from GOES-9 at 1801 UTC on 5 Jan 96 with cloud cover (0=clear ... 3=overcast)

Fig. 6. 4 km VIS from GOES-9 at 1801 UTC on 5 Jan 96 with

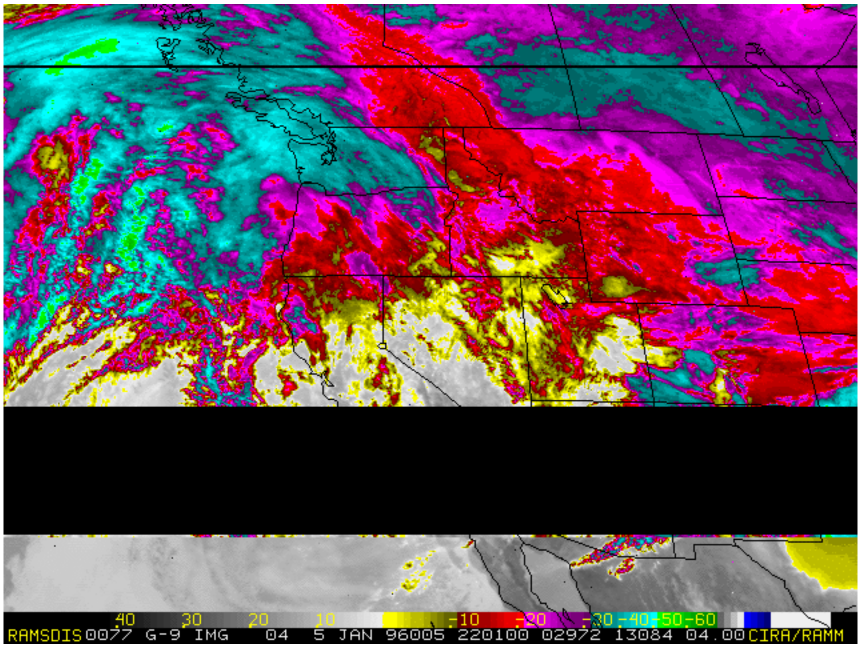


Fig. 7. 4 km VIS from GOES-9 at 2201 UTC on 5 Jan 96

Fig. 8. 4 km IR from GOES-9 at 2201 UTC on 5 Jan 96

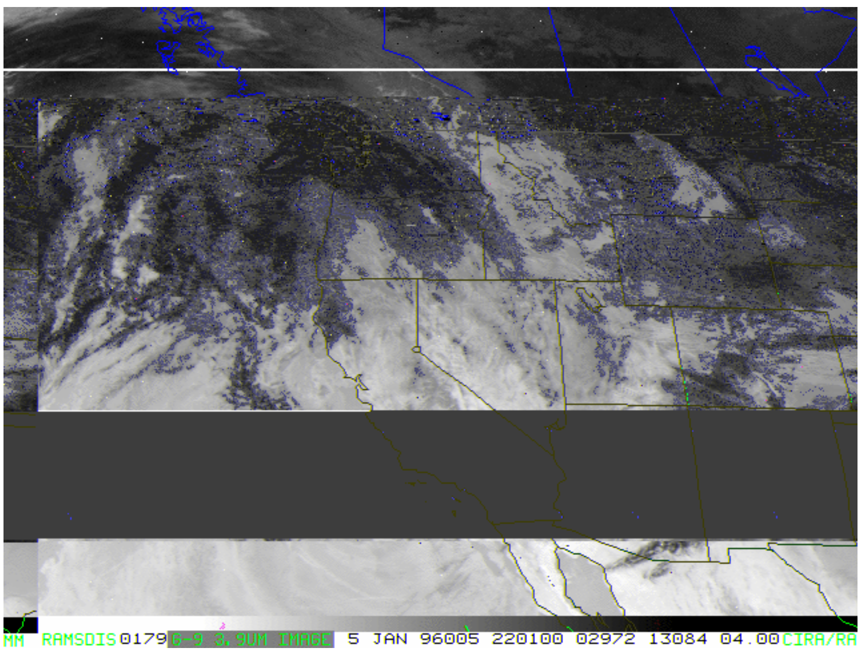


Fig. 9. 4 km 3.9 um from GOES-9 at 2201 UTC on 5 Jan 96

If you have any comments and/or questions on this tutorial please e-mail Kevin at kschrab@smtpgate.ssmc.noaa.gov This is the first in a series of tutorials that will use recent and near-realtime data (satellite, model, radar) to illustrate specific features and uses of the new technology that is now becoming available to NWS forecast offices. If you have a case that you would like to include here please let Kevin Schrab know.