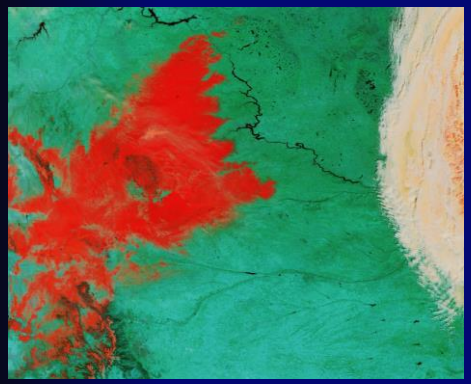
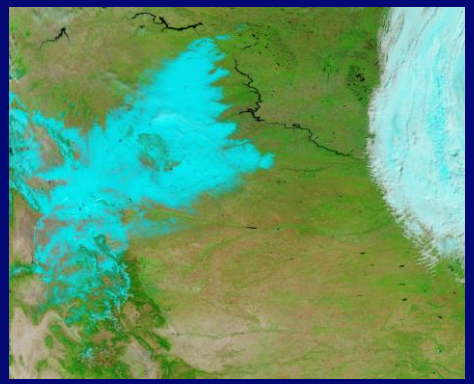
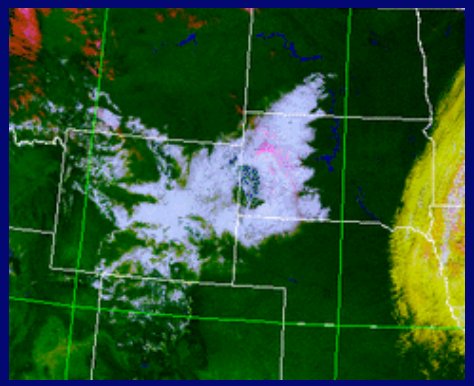
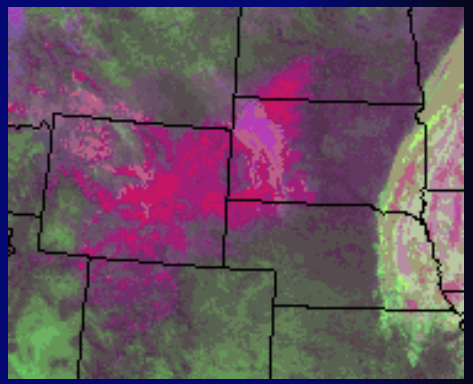
Identifying Snow with Daytime RGB Satellite Products

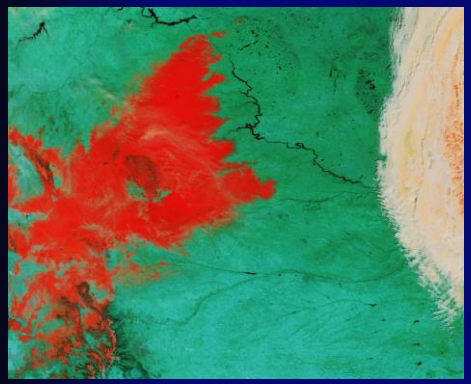
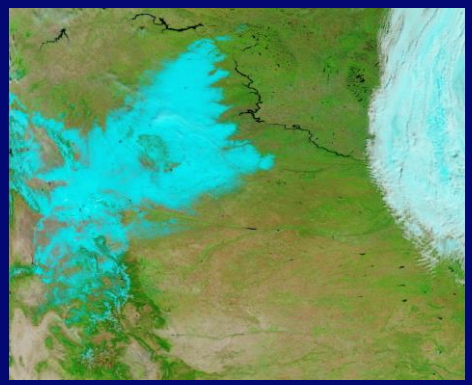
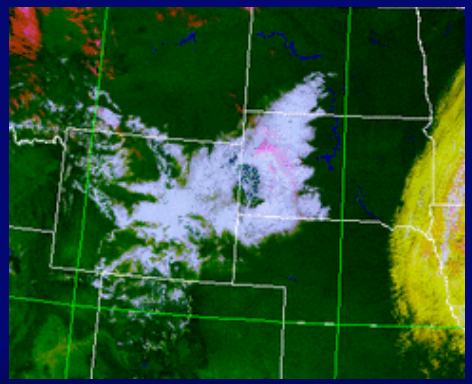
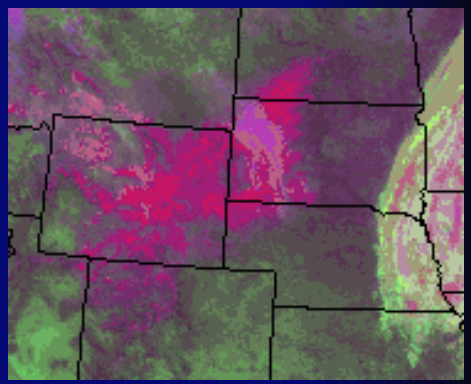
Bernie Connell

Cooperative Institute for Research in the Atmosphere
Colorado State University

How can snow be determined from day-time multispectral imagery?

AND

How many different RGB combinations are available?

Why are there different techniques?

- Purpose of product:
  - To discriminate snow
  - To distinguish something else (ie clouds); snow was a (bonus) bi-product
- Not an easy solution:
  - Different developers, different ideas, different visual capabilities
- Algorithm mask for input to models or GFE VS. contextual visualization
- Different sensors, different channels available

Which one(s) have you seen?

Polar Orbiting (MODIS and VIIRS) based

- CIRA / Naval Research Laboratory (NRL)
  Cloud Layers & Snow Cover Discriminator
- SPoRT / NASA Rapid Response / CIMSS
  False Color Snow
- CIMSS / NASA Rapid Response
  False Color (similar to EU Natural Color)

GOES and SEVERI based

- CIRA – Snow / Cloud Discriminator
- EUMETSAT – Natural Color

Notes…

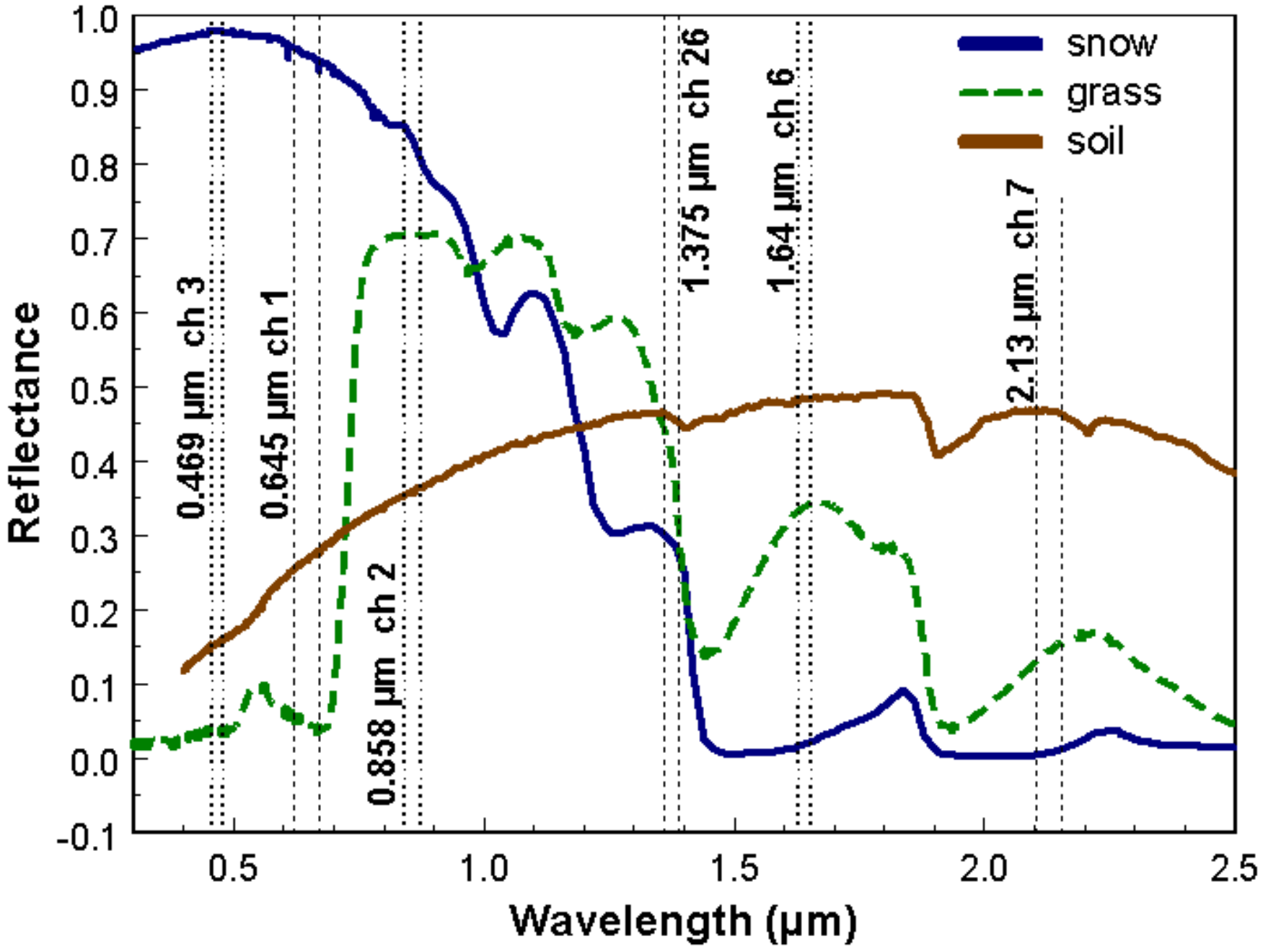
- RGB imagery is being promoted by the GOES-R and JPSS Proving Grounds to help interpret multi-channel information
- The presenter does not know of an "officially designated" snow RGB
- RGB imagery cannot currently be created in AWIPS I
- Creation of RGB imagery in AWIPS II is a goal

How are they similar?

- They all use at least one visible or near IR channel in which snow is highly reflective

  (0.4, 0.6, or 0.8 μm)
- They all use at least one channel in which snow is highly absorptive (ie not reflective).
  - MODIS, VIIRS, and SEVIRI products use a near-infrared band (either 1.6 or 2.1 μm)
  - GOES uses the short wave infrared band (3.9 μm)

Visible to Near Infrared



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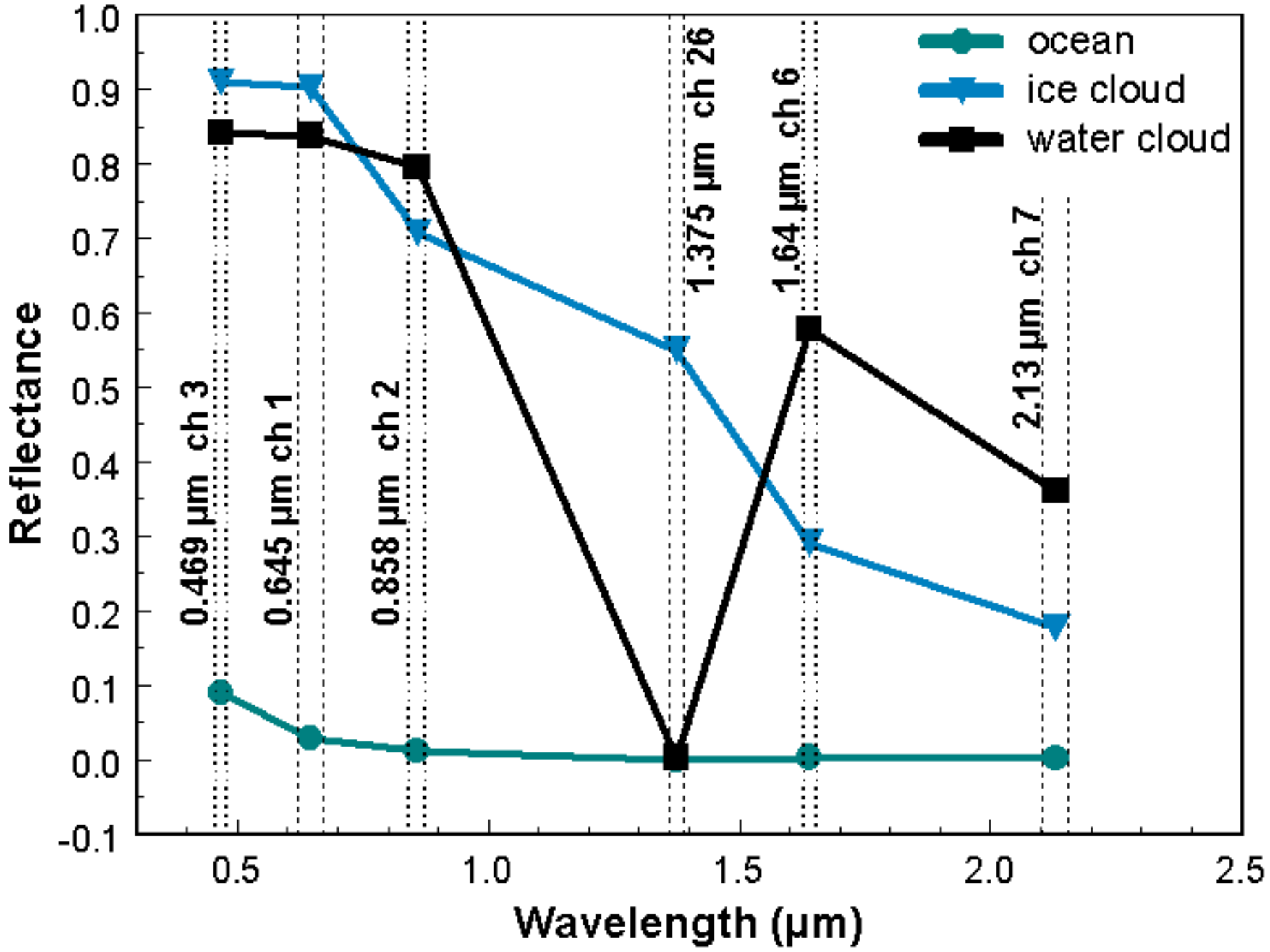
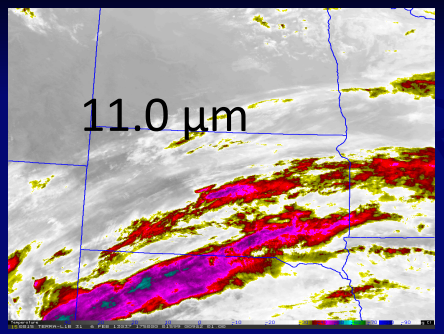
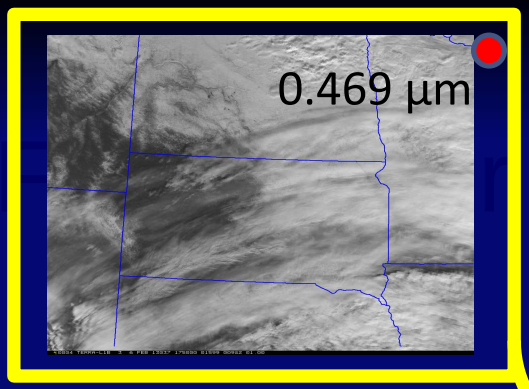
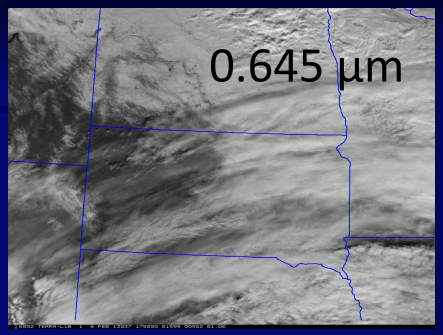
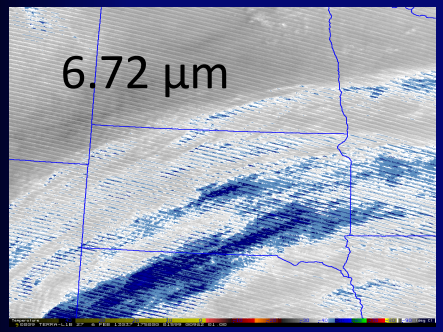


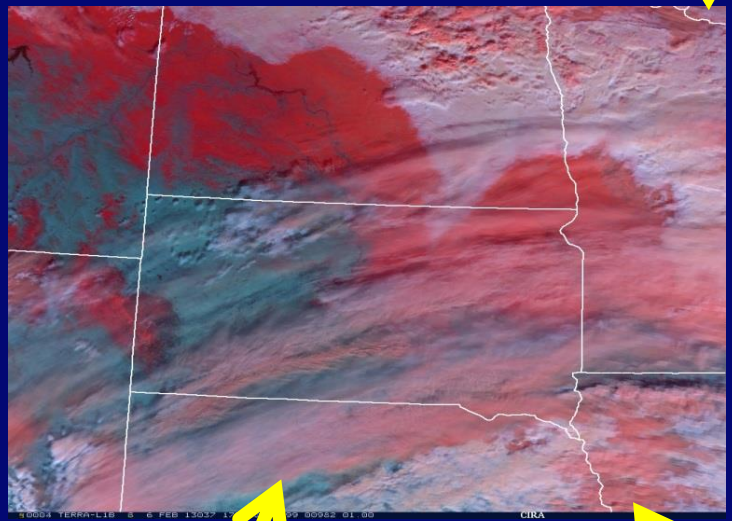


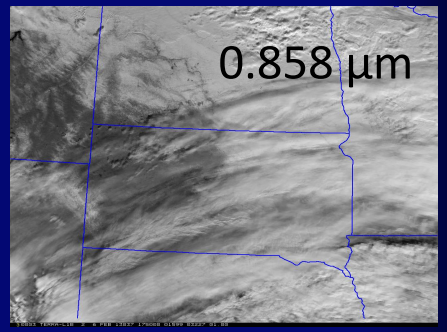


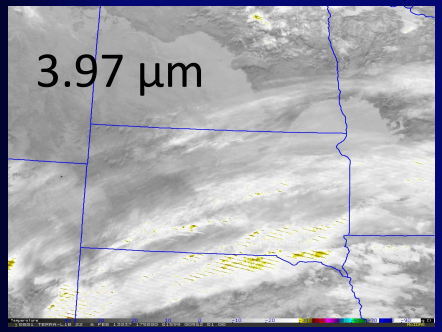


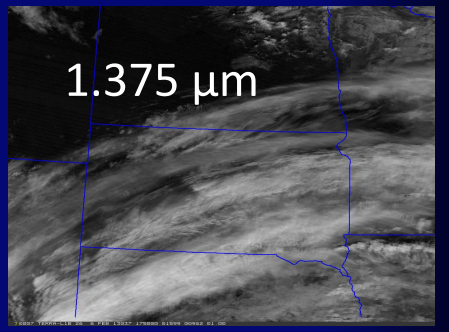


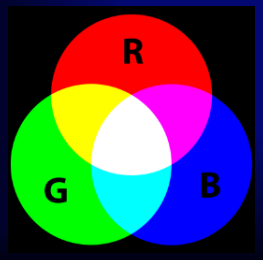
SPoRT /NASA RR /CIMSS
False Color Snow

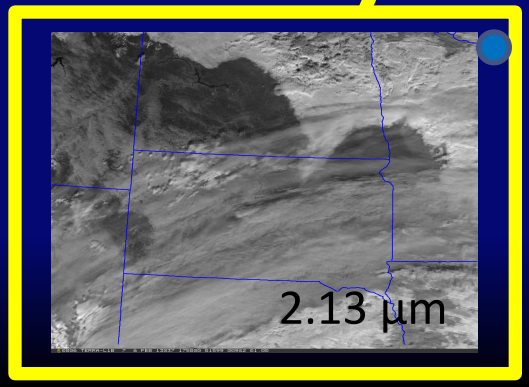


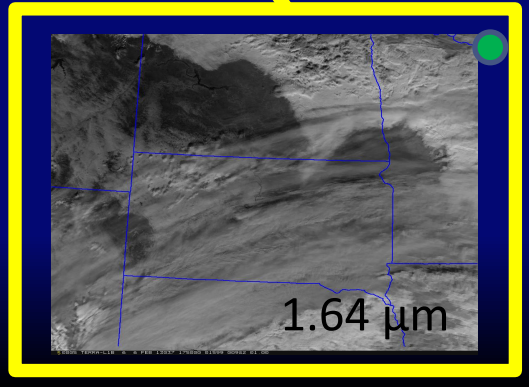


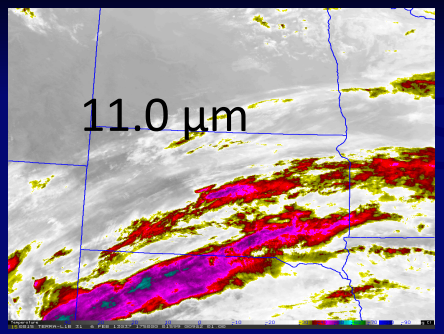


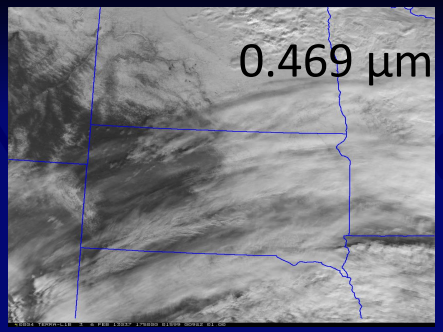


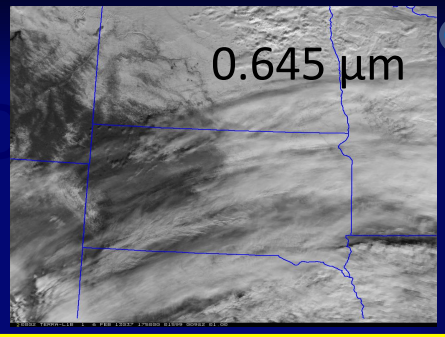


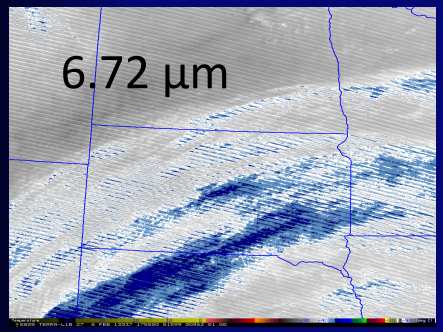




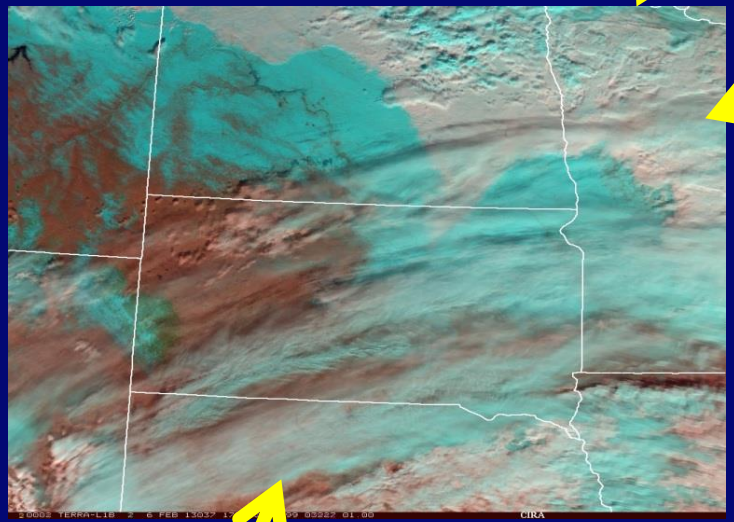


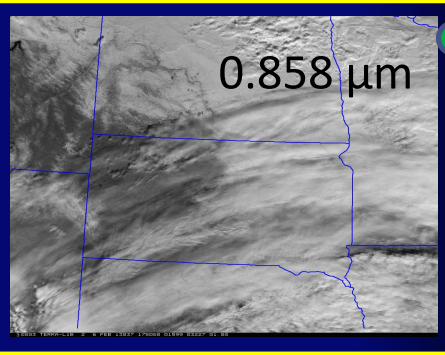


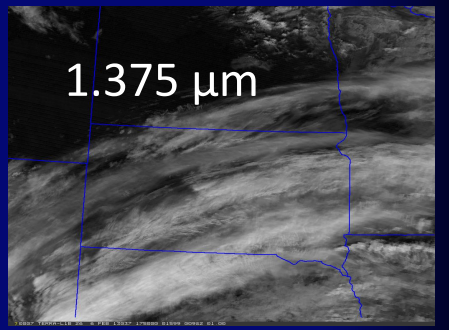


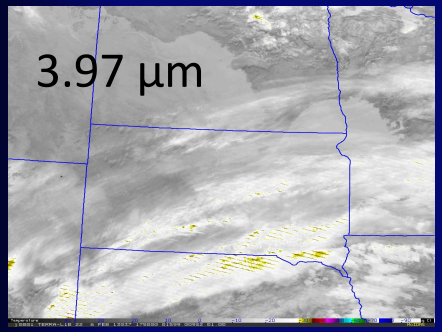


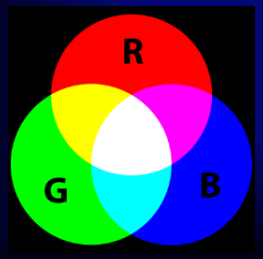
CIMSS /NASA RR
False Color

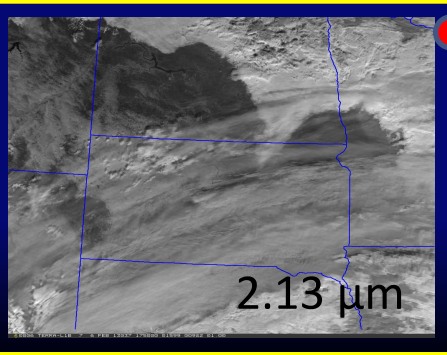


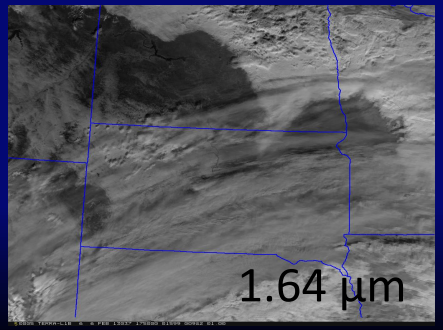


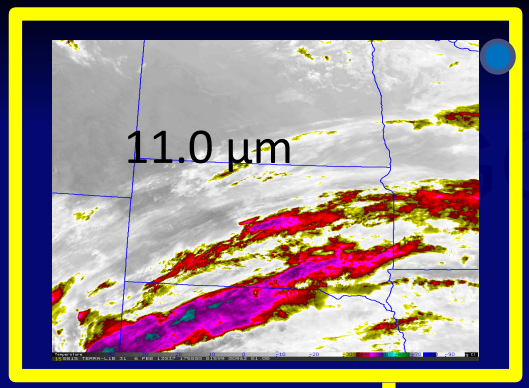


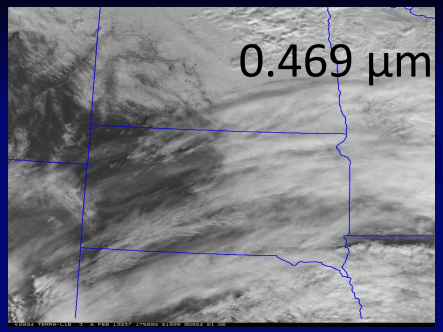


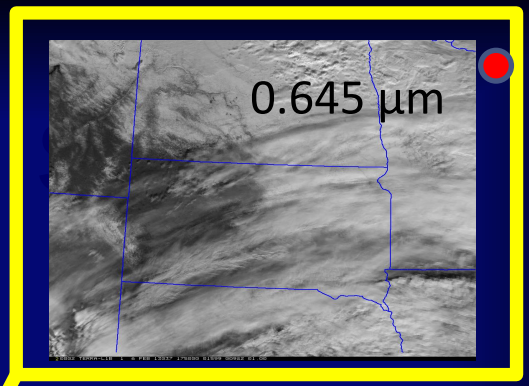


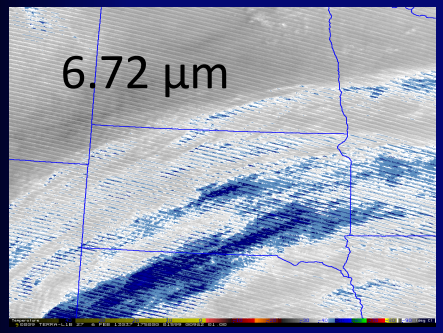




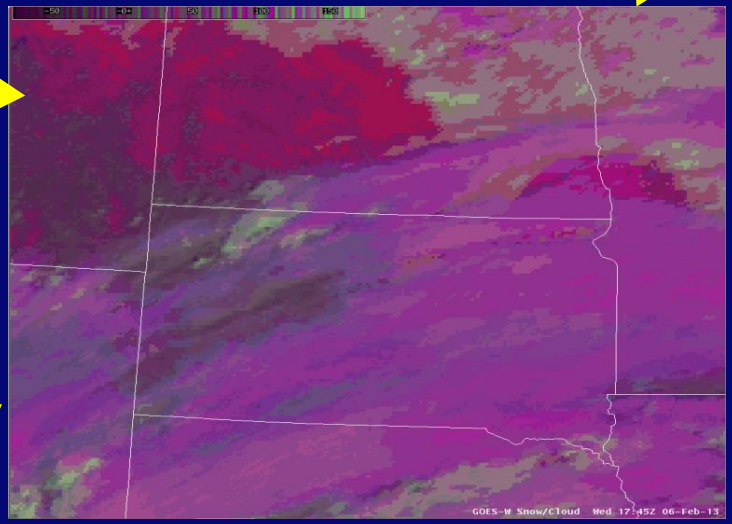


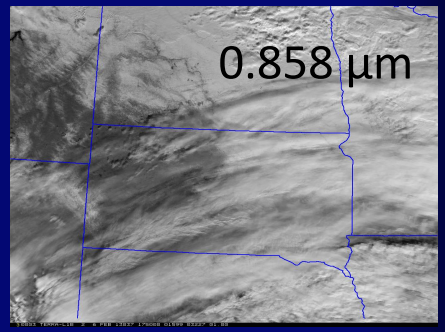


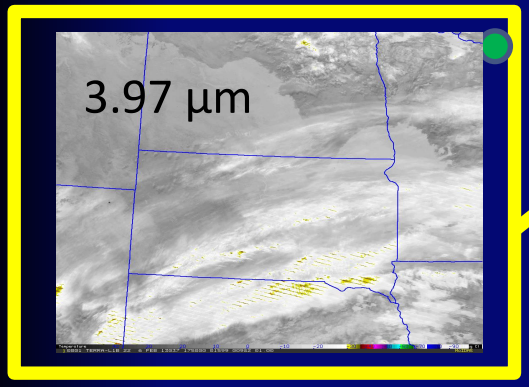


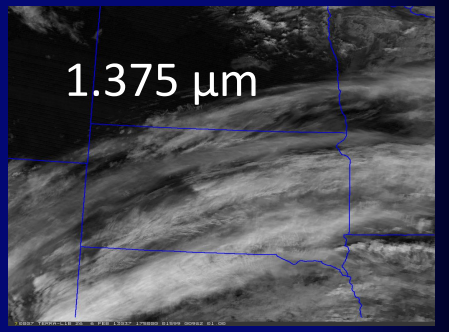


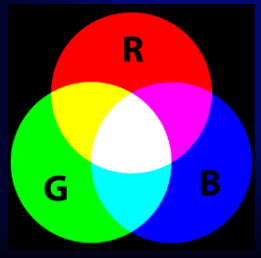
CIRA GOES based Cloud and Snow

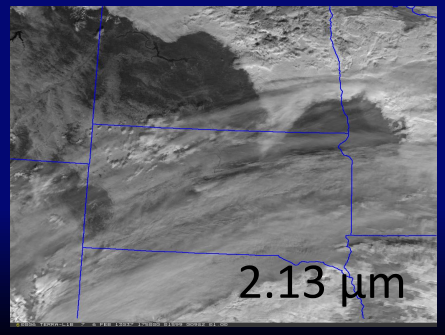


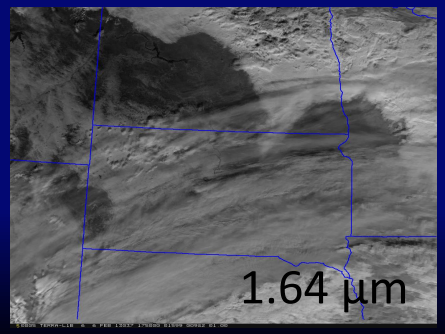


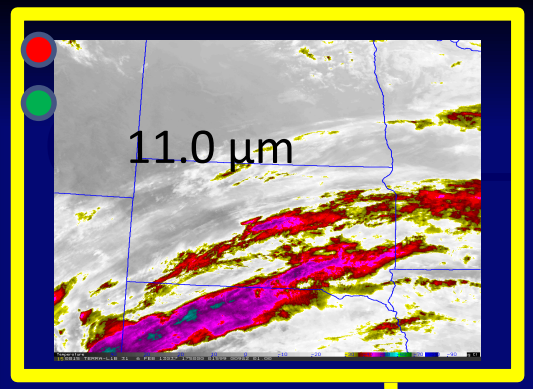


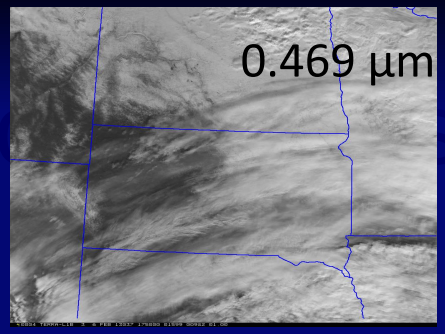


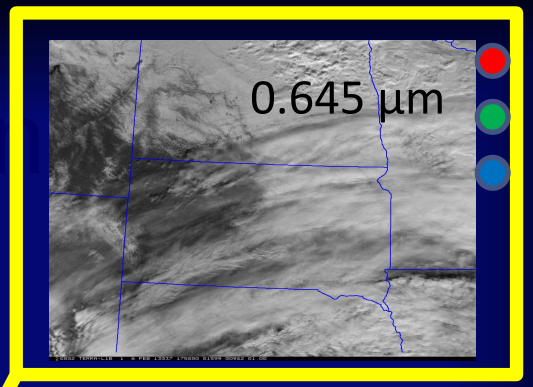


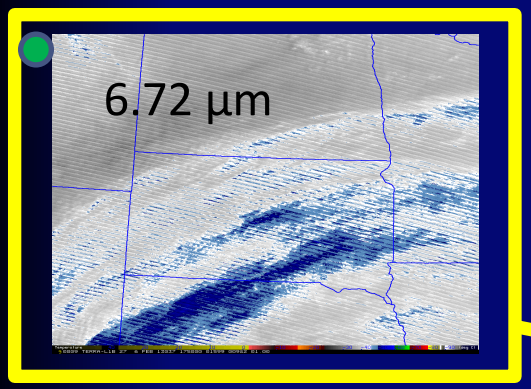




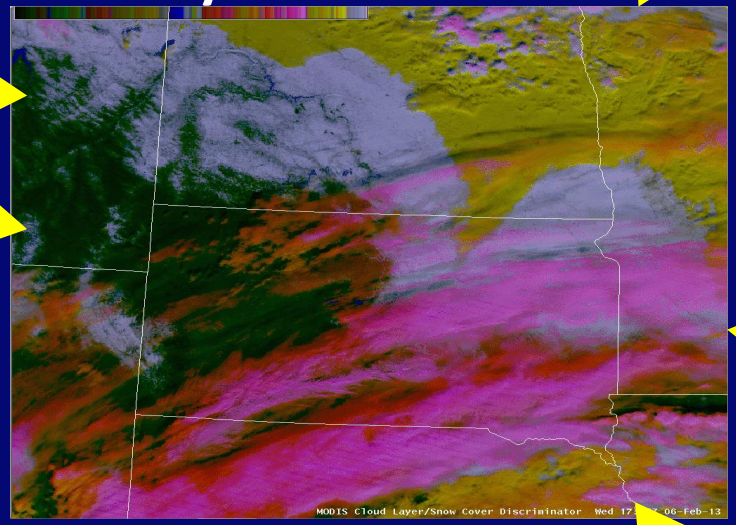


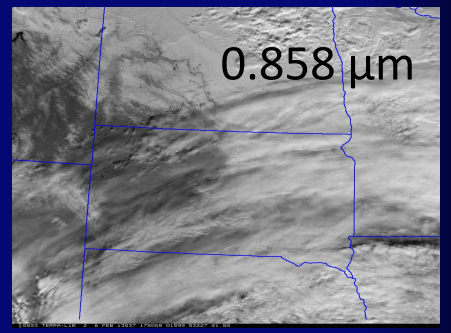


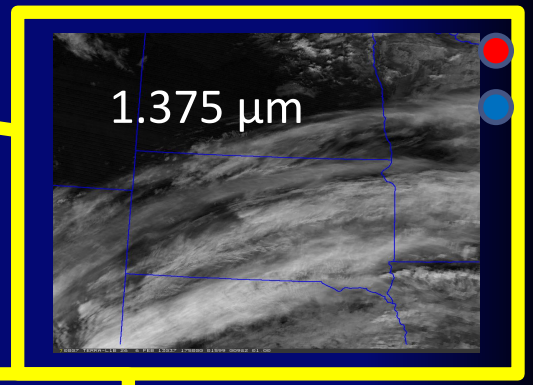


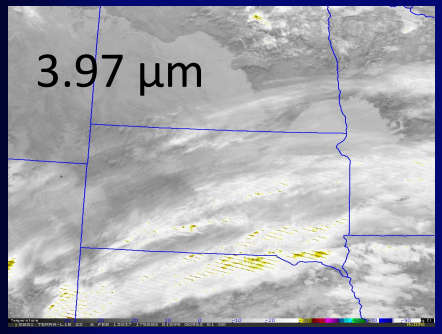


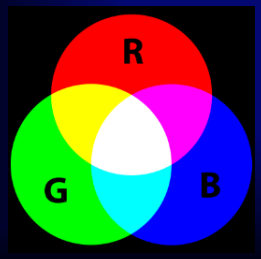
CIRA / NRL MODIS based Cloud Layers and Snow

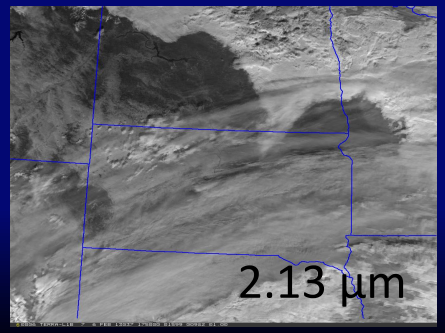


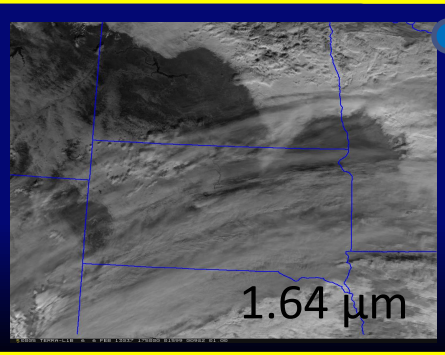


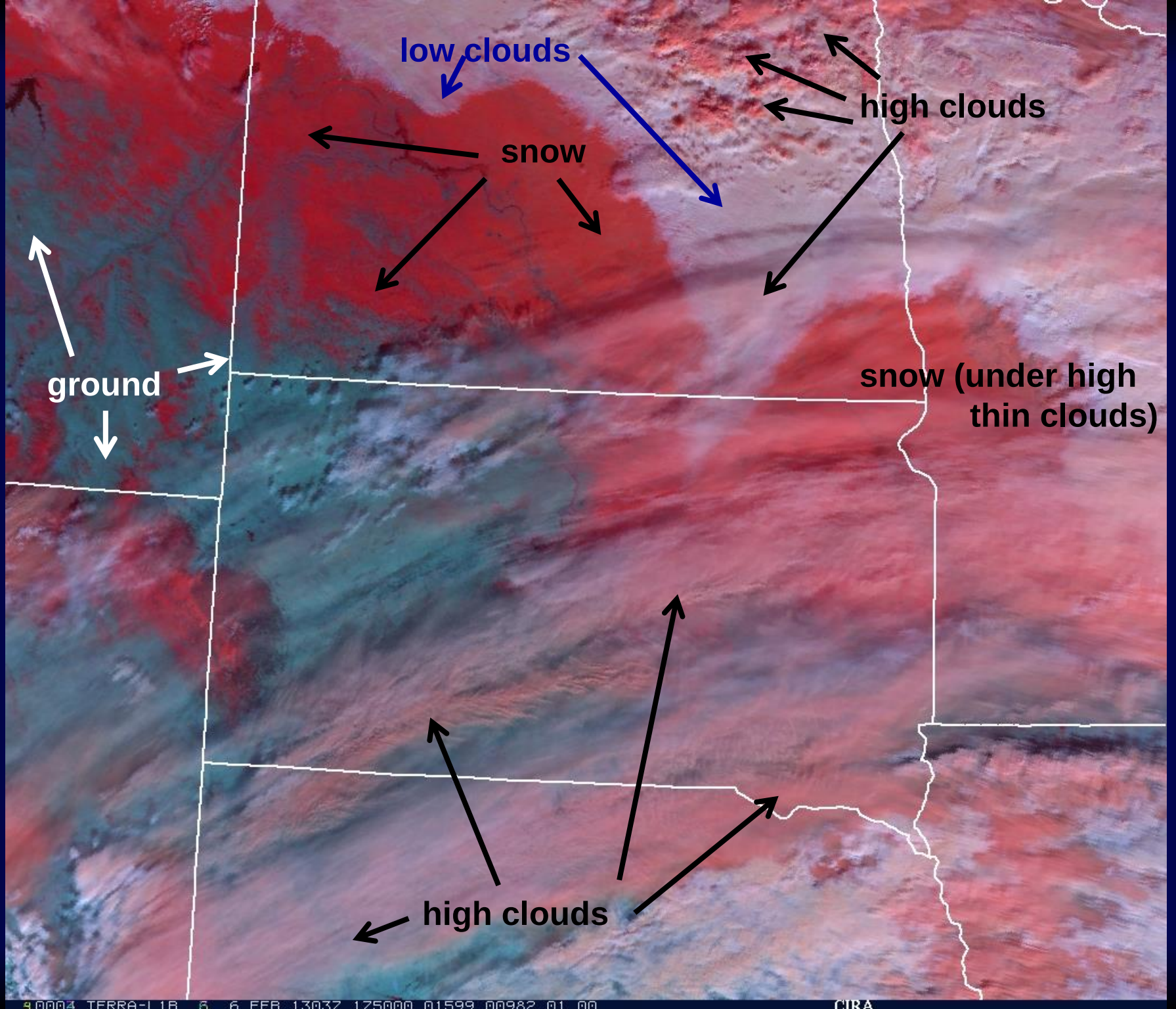






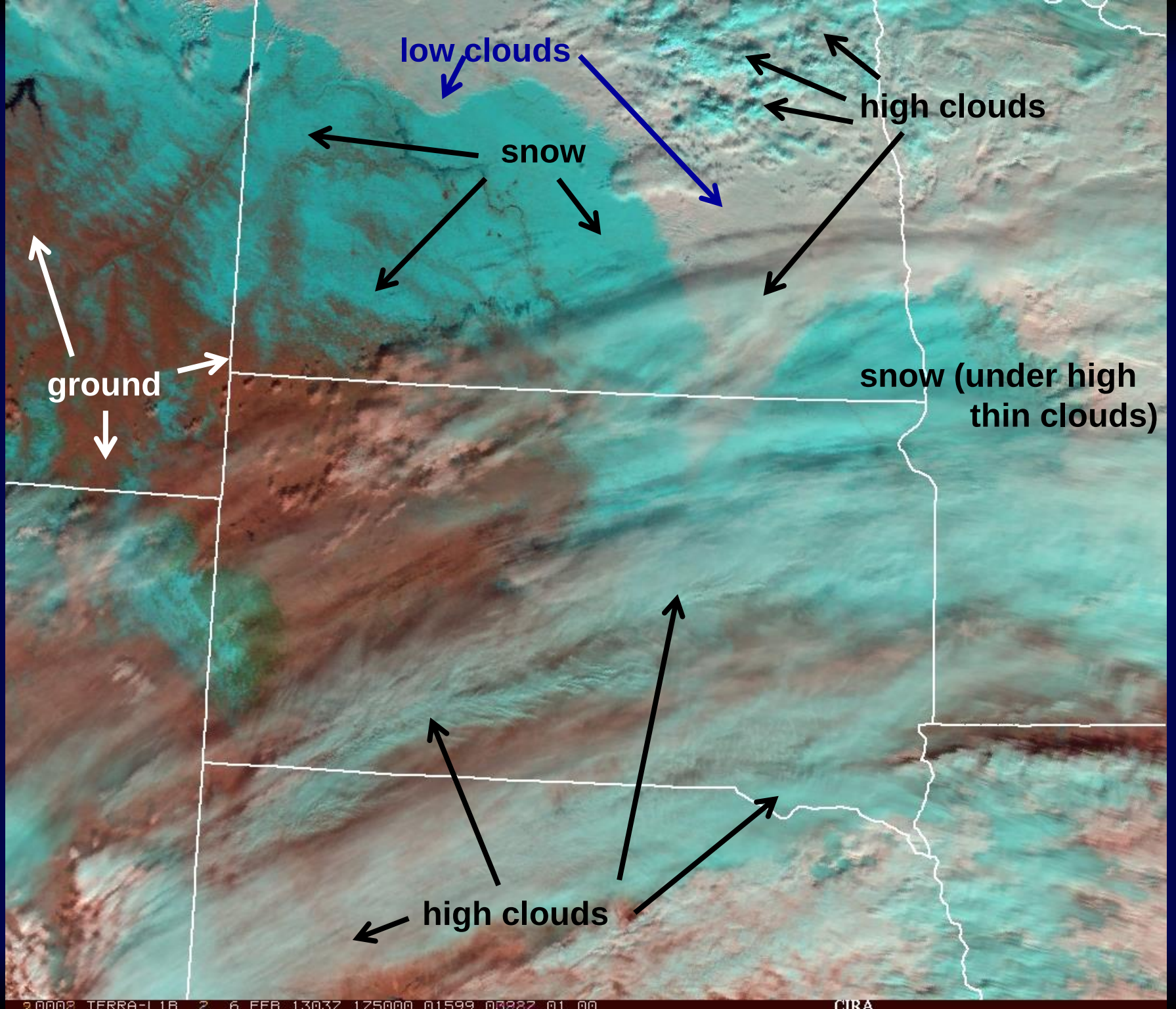






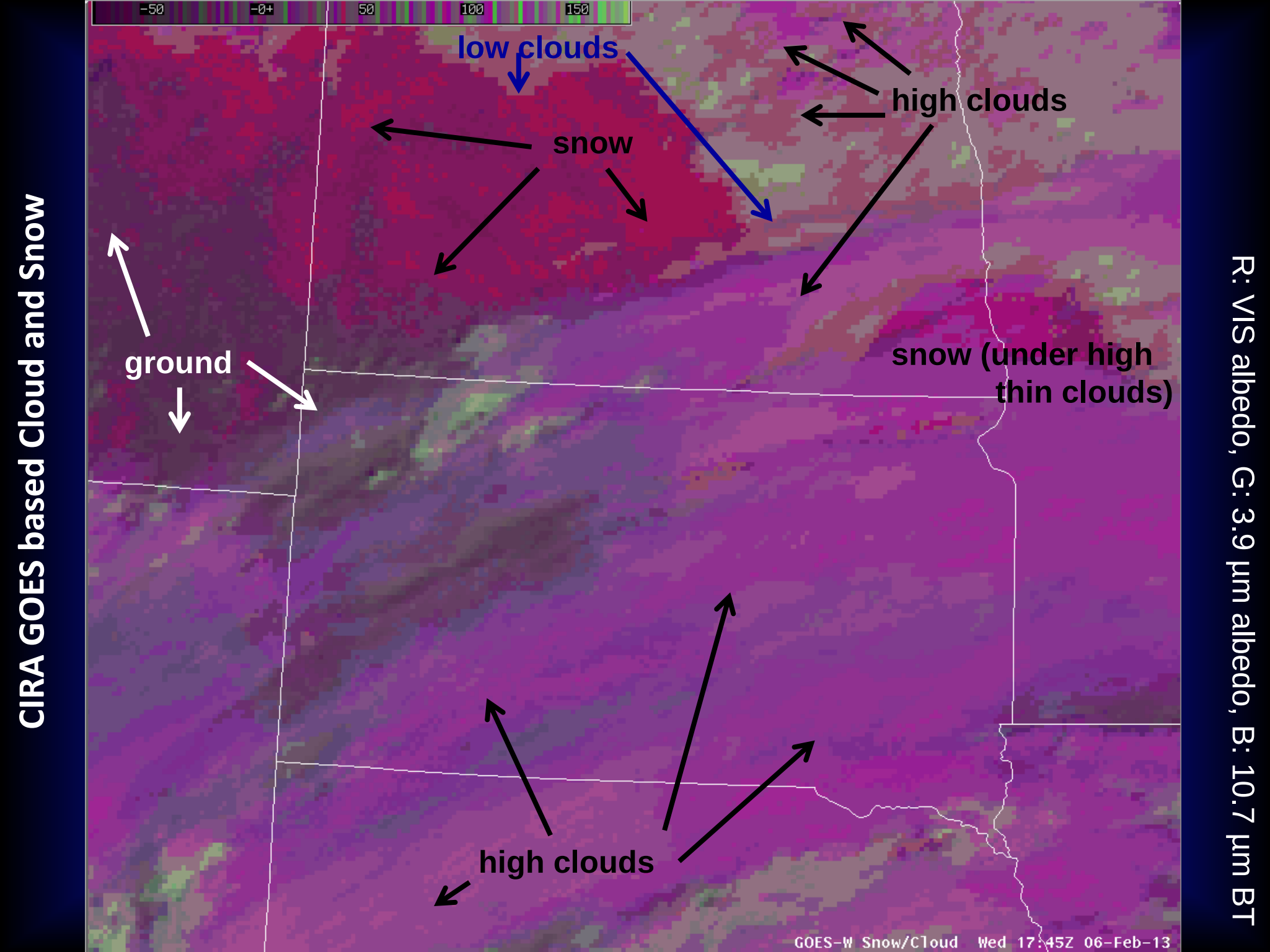
SPoRT /NASA RR / CIMSS False Color Snow

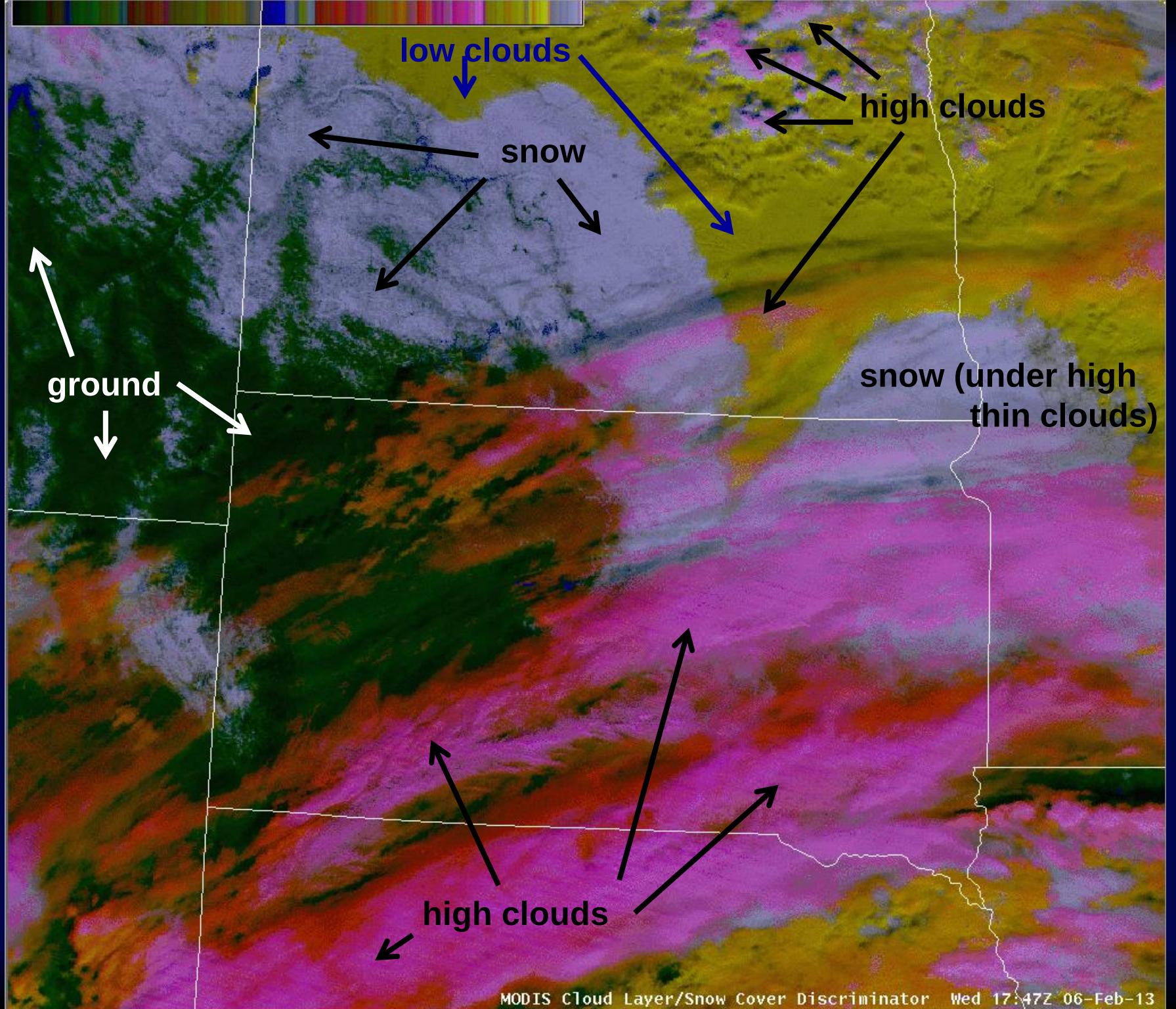
R: 0.46 µm, G: 1.6 µm, B: 2.1 µm



CIMSS /NASA RR MODIS based False Color

R: 2.13 µm, G: 0.86 µm, B: 065 µm


CIRA GOES based Cloud and Snow
R: VIS albedo, G: 3.9 µm albedo, B: 10.7 µm BT
-50
-0+
50
100
150
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds
GOES-W Snow/Cloud Wed 17:45Z 06-Feb-13



CIRA / NRL MODIS based Cloud Layers and Snow

Multichannel combinations of 0.65, 1.38, 1.64, 6.72, 11.0 µm

Feedback?

- Both positive and negative is welcome.
- Some points to keep in mind:
  - Does the product provide enough contrast to distinguish snow from other features?
    - Are some colors better than others (ie because of colorblindness)
  - Is the product consistent?
    - Does it work the same when the snow cover is deep, shallow, very cold, or near melting?

Complementary material and links to imagery

COMET module: RGB Products Explained
https://www.meted.ucar.edu/training_module.php?id=568

Imagery and brief descriptions:
CIRA GOES-R Product List (select ‘MODIS Cloud Layers & Snow Cover Discriminator’ AND ‘GOES Snow/Cloud Discriminator’)
http://rammb.cira.colostate.edu/research/goes-r/proving_ground/cira_product_list/

SPoRT – MODIS CONUSA Snow/Cloud
http://wwwghcc.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=modisconusa&product=conusa_snowcloud

SPoRT – VIIRS CONUSA Snow/Cloud
http://wwwghcc.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=viirsconusa&product=conusa_snowcloud

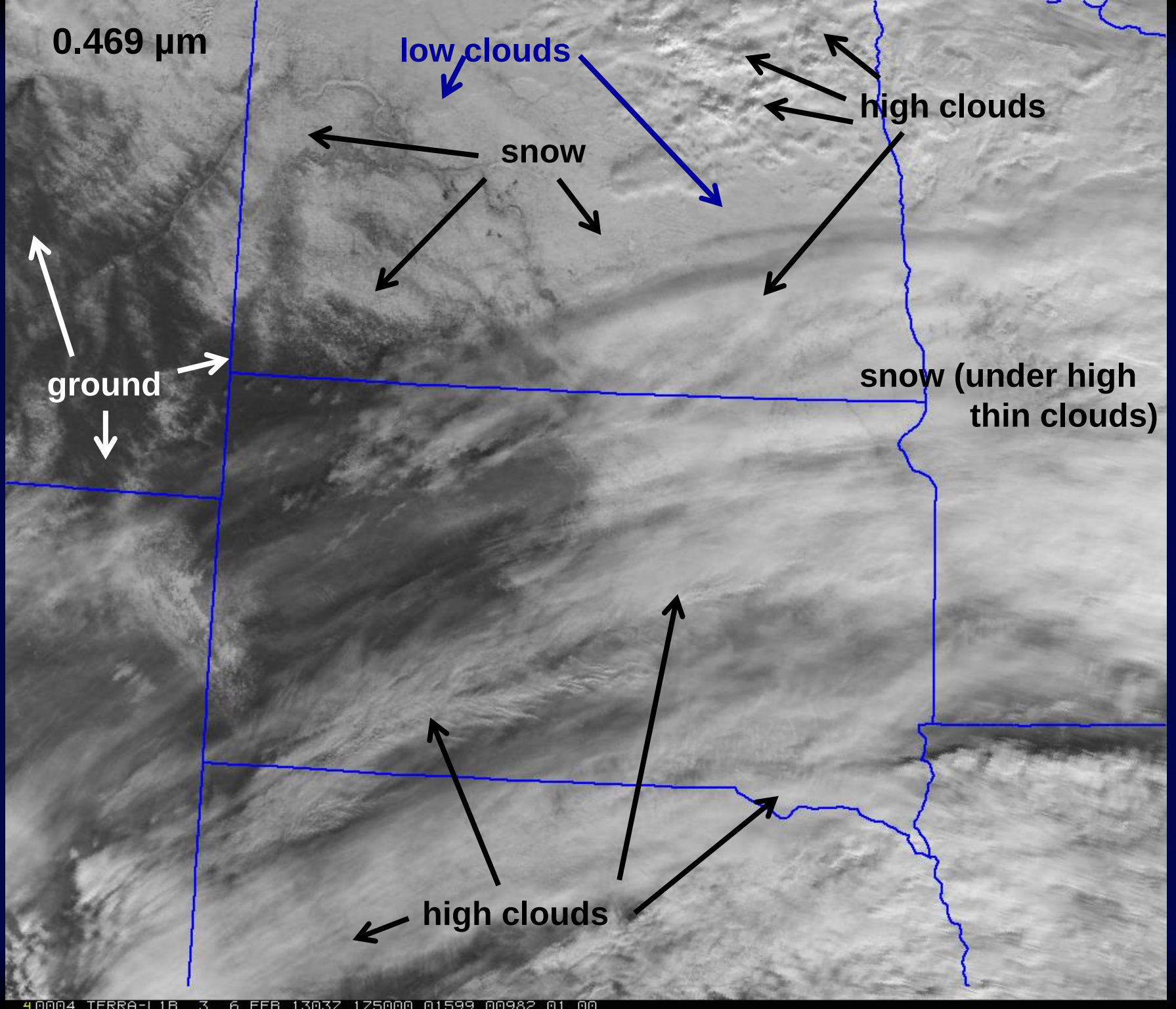
Rapid Response Near Real Time MODIS images:
http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/realtime.cgi

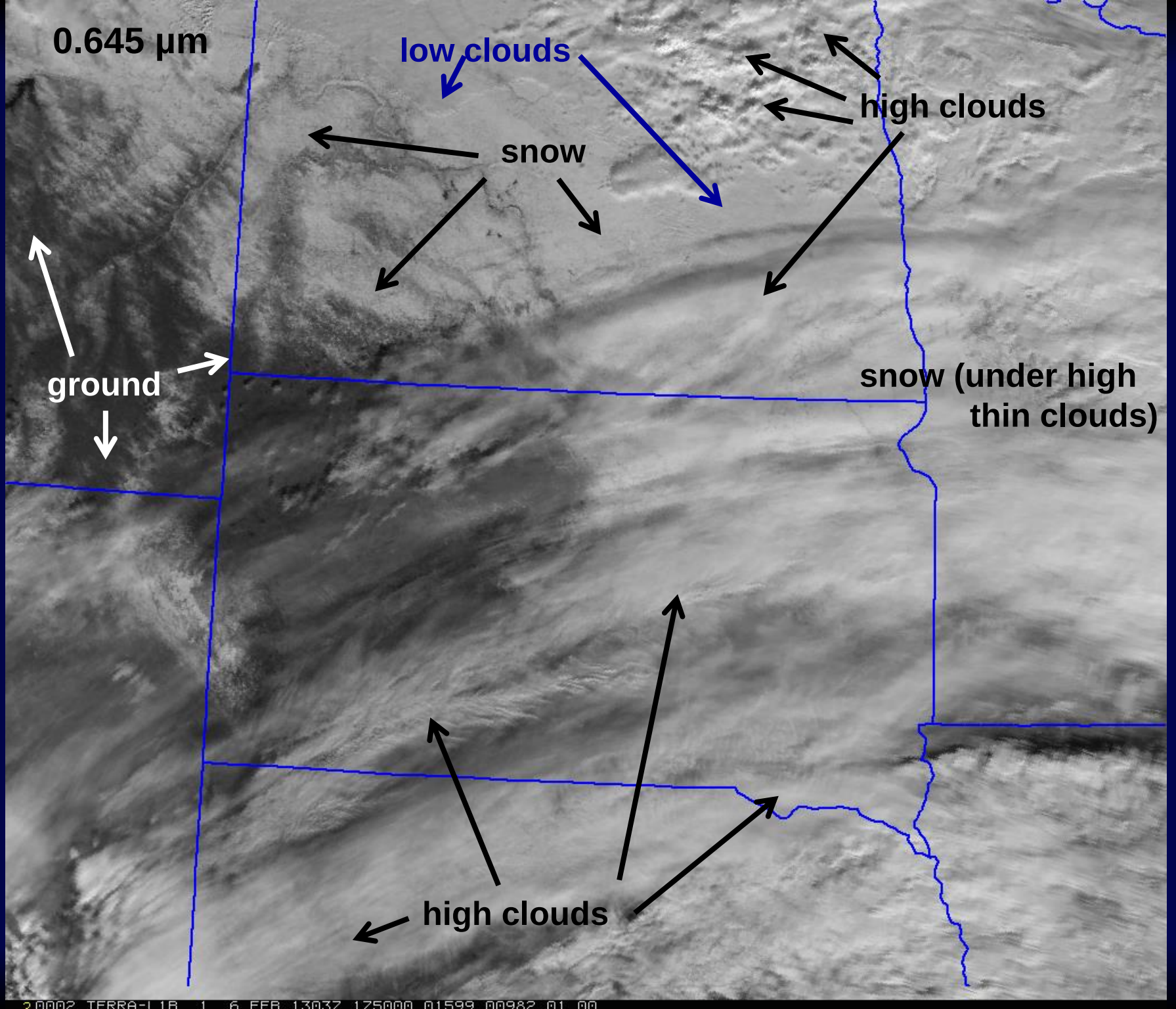
MODIS Today – CIMSS/SSEC (select False Color)
http://ge.ssec.wisc.edu/modis-today/index.php

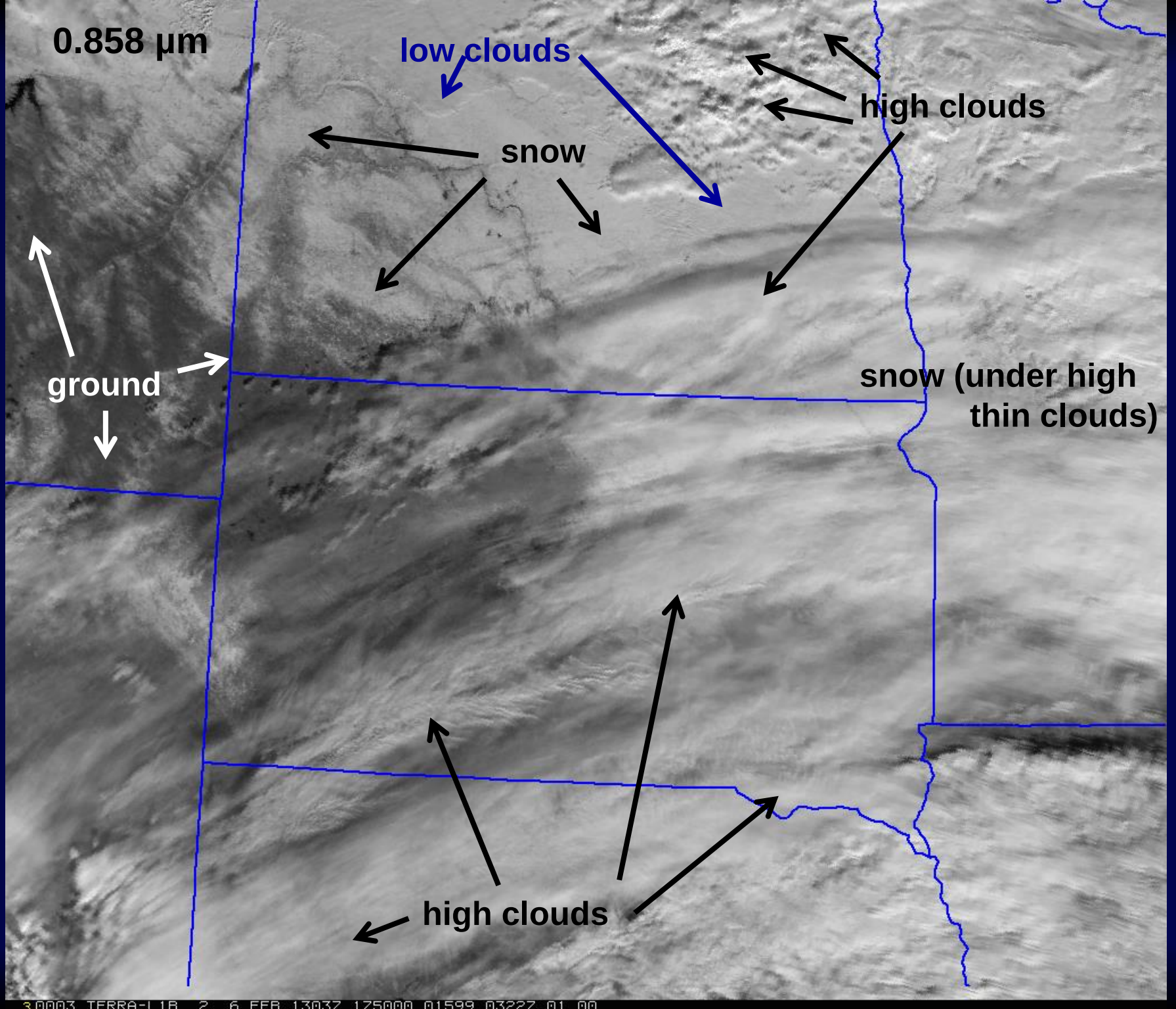
EUMETSAT Image Gallery
http://www.eumetsat.int/Home/Main/Image_Gallery/index.htm?l=en

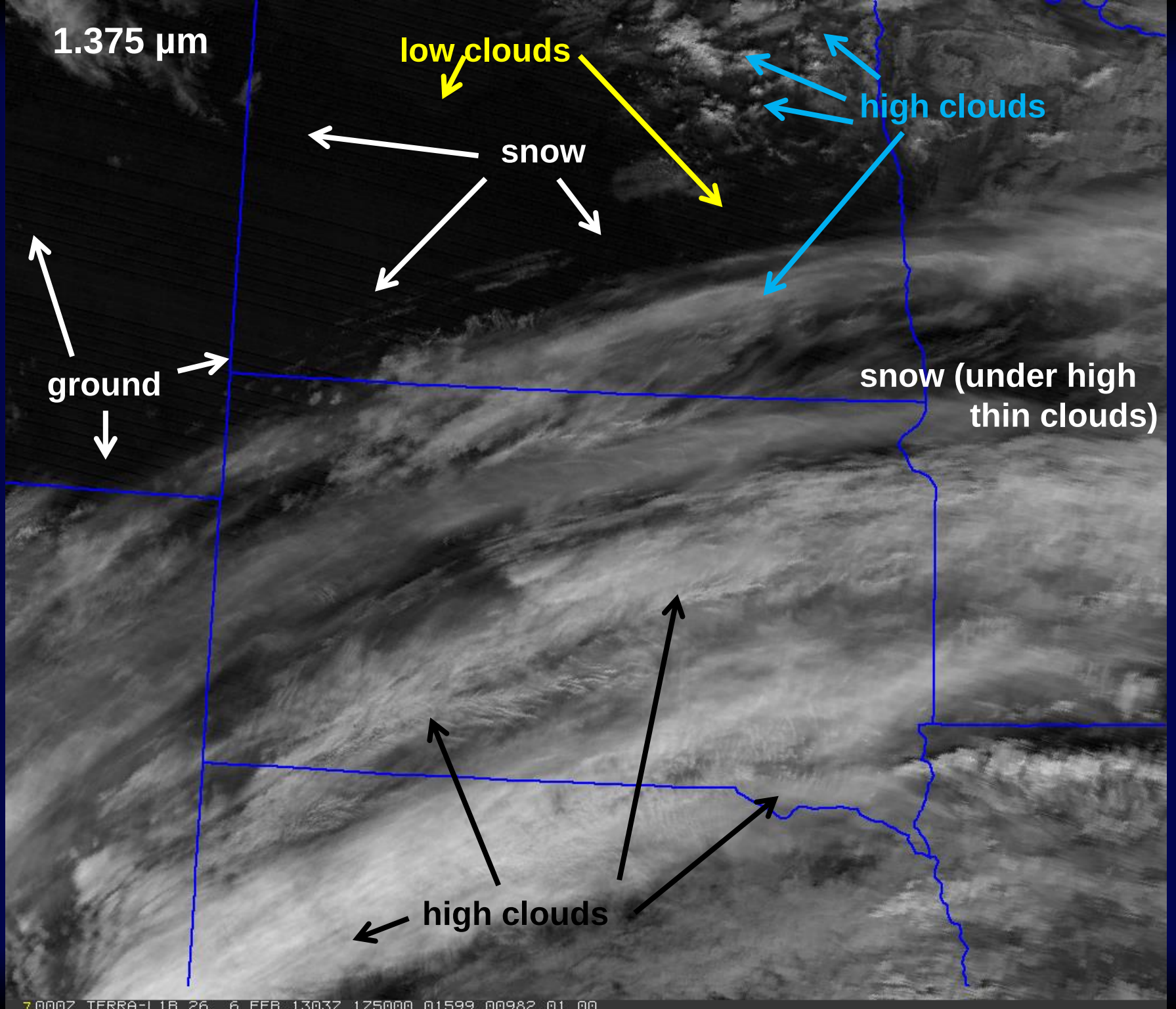
Individual Channels

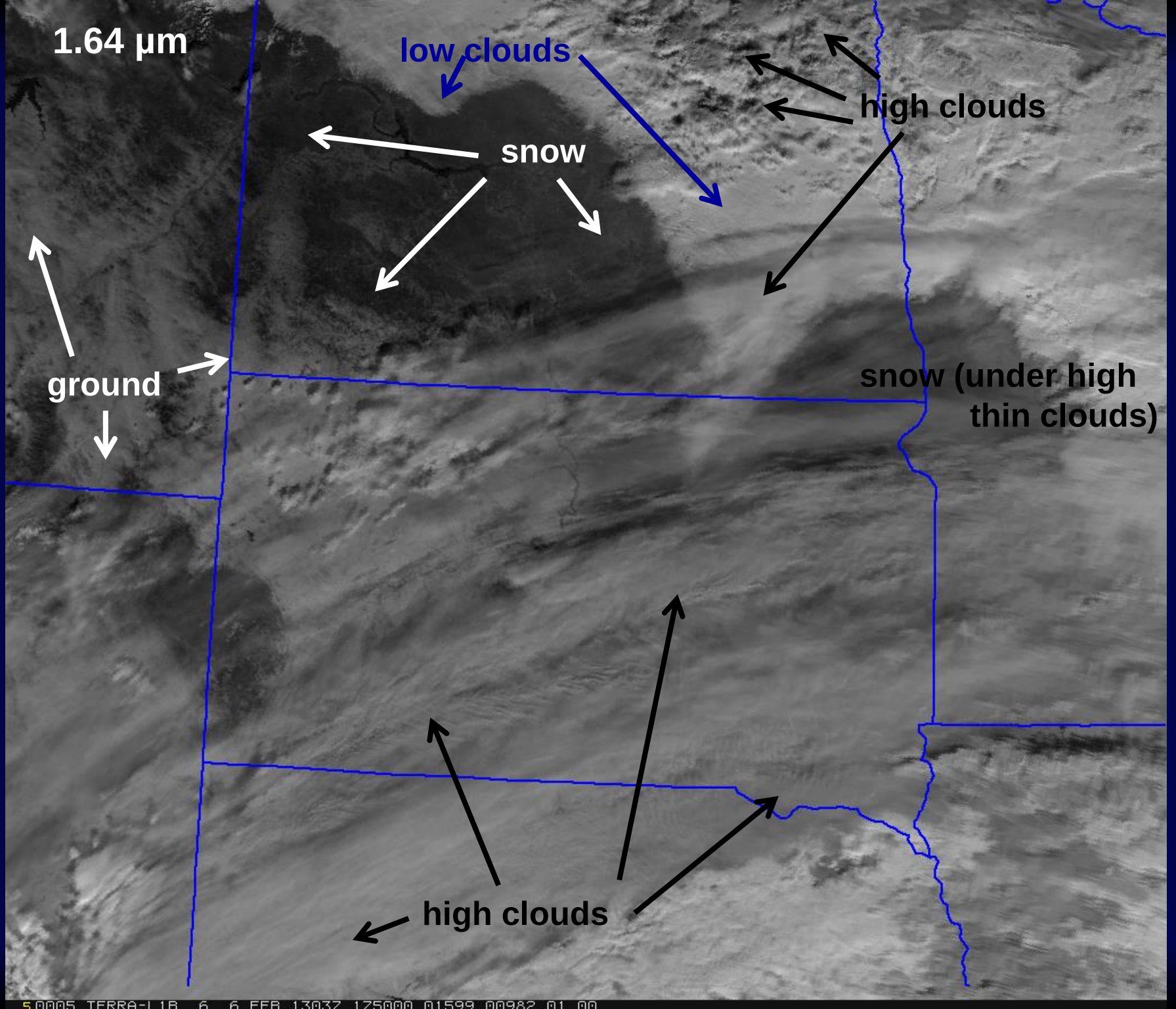
With features identified

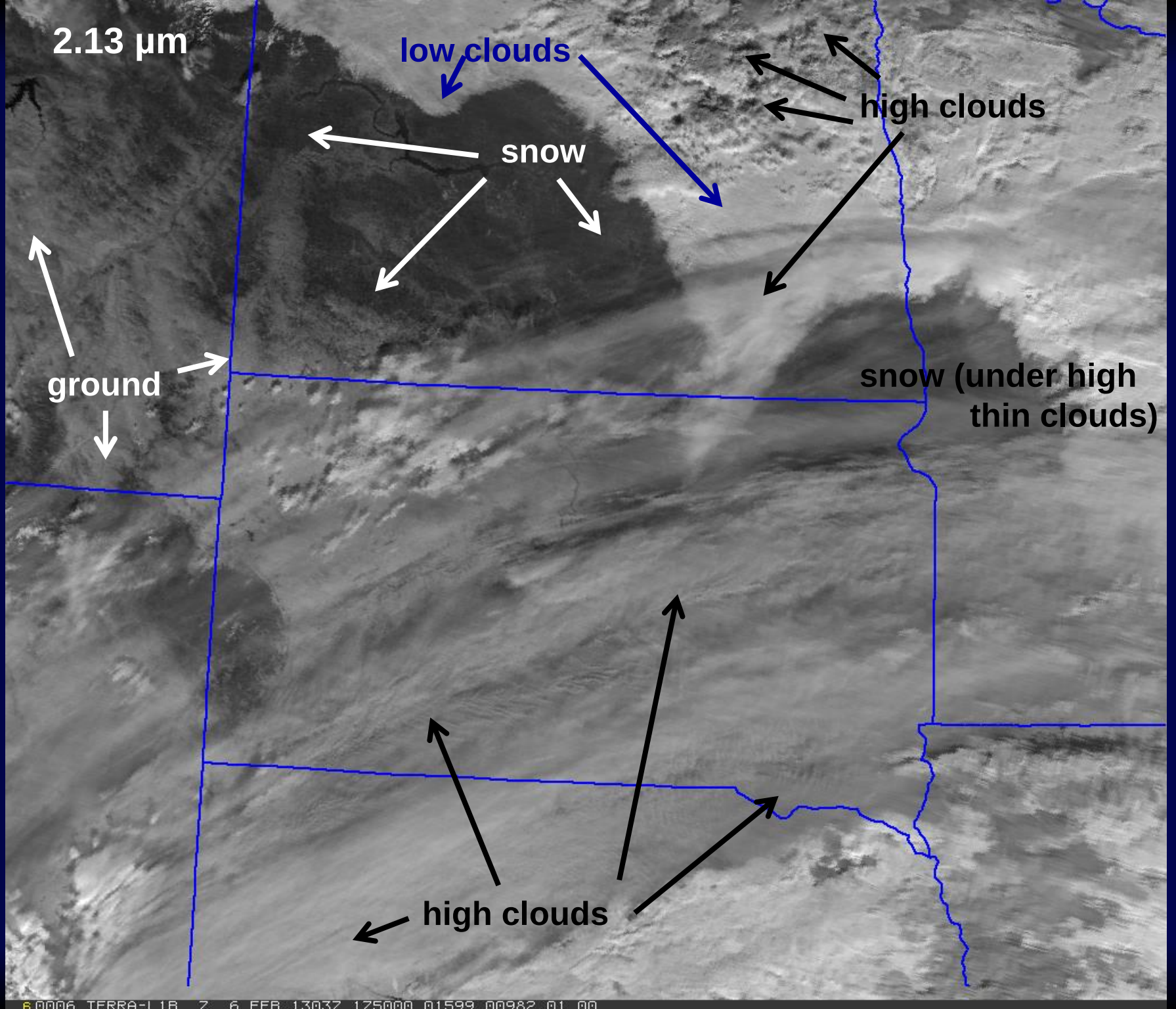

0.469 µm
low clouds
high clouds
snow
ground
snow (under high
thin clouds)
high clouds

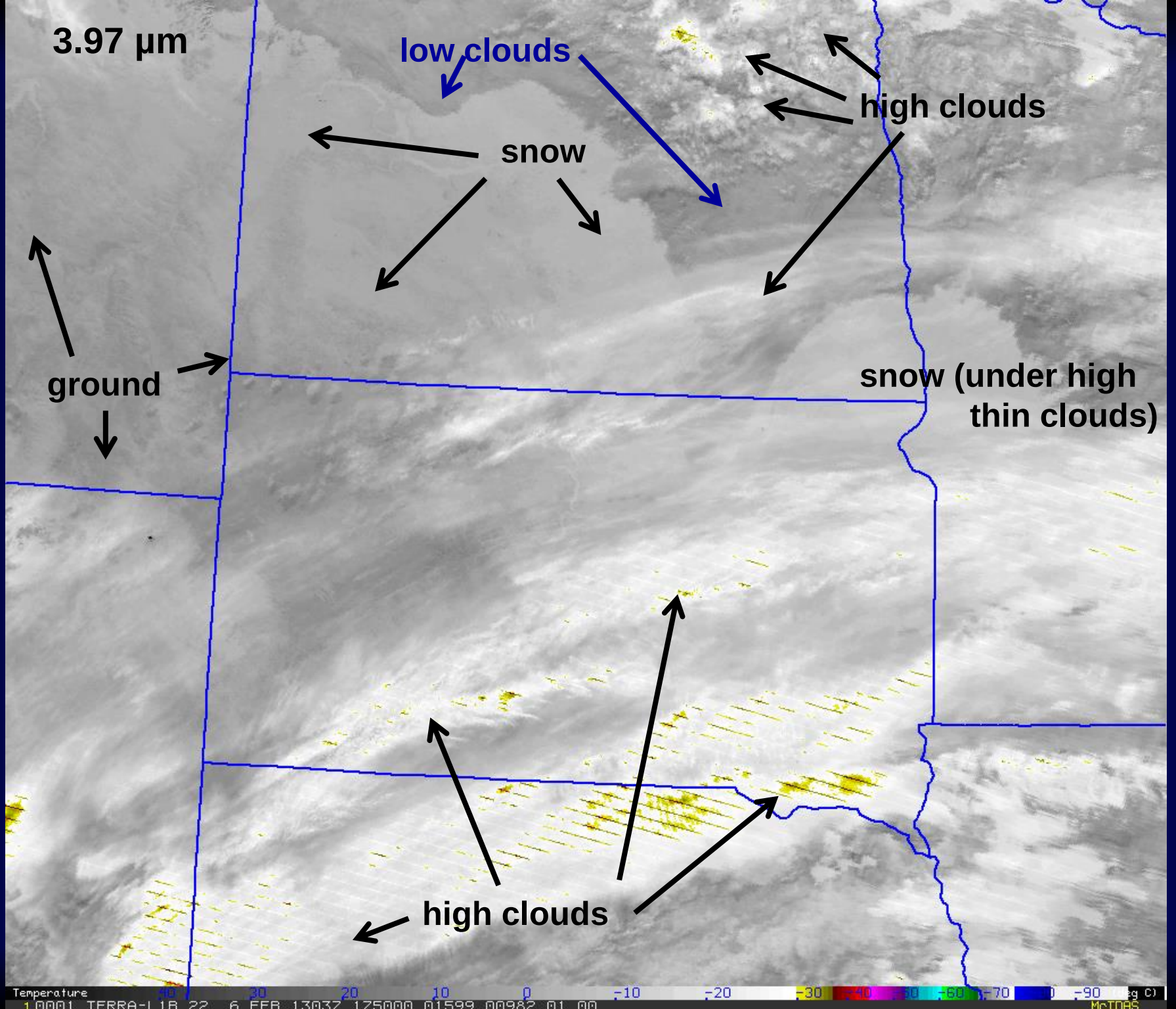

0.645 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds

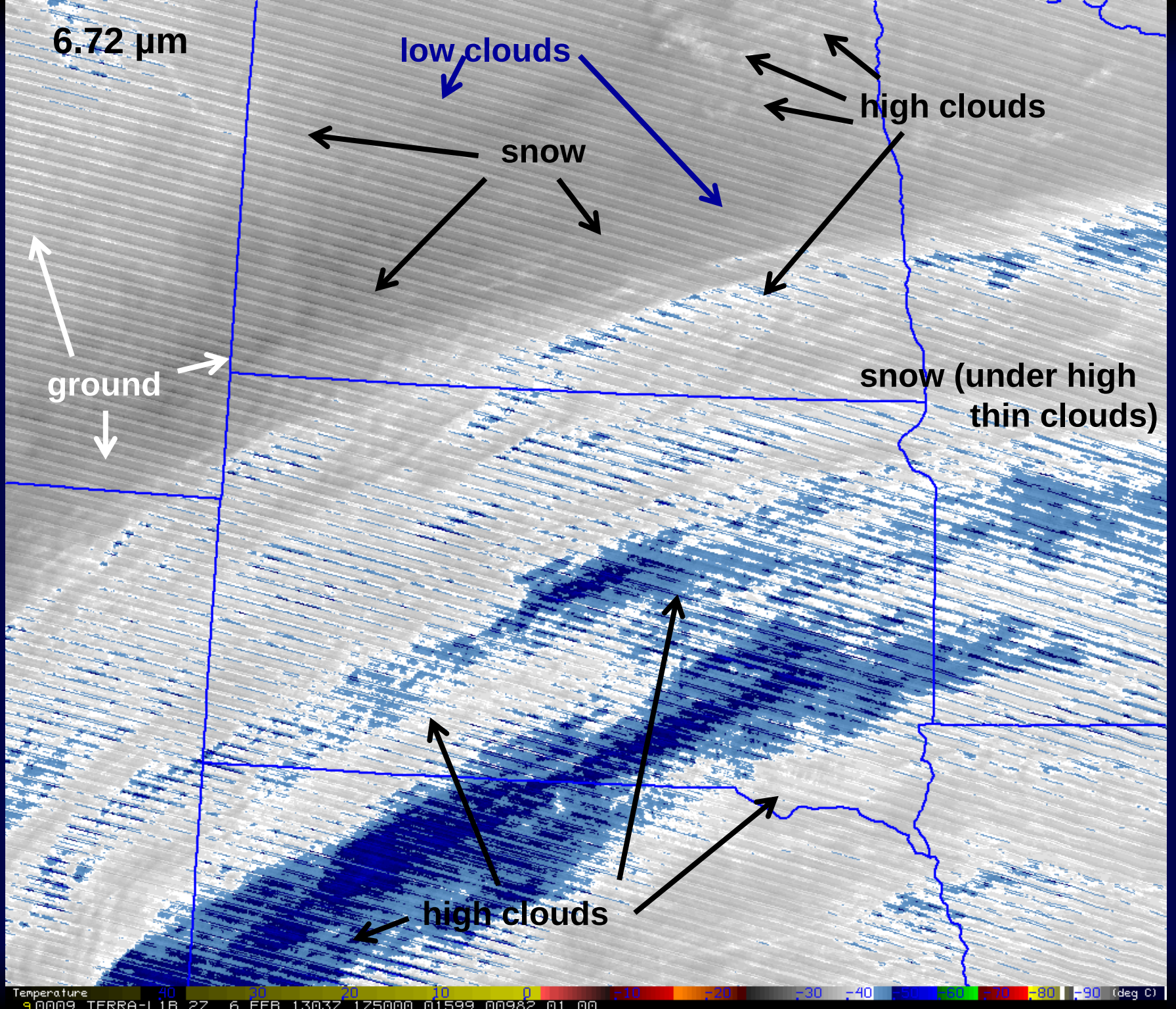

0.858 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds

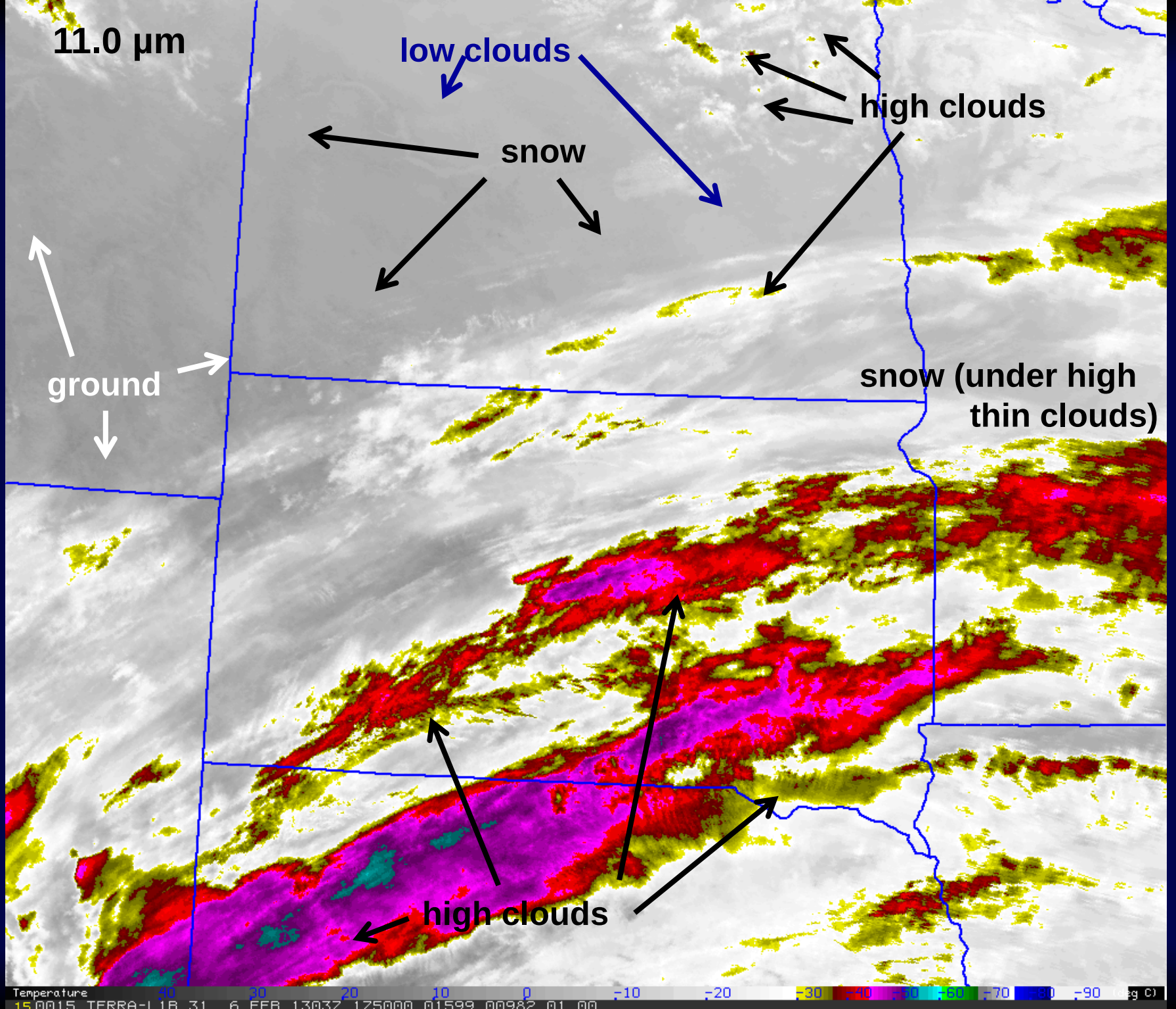

1.375 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds


1.64 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds


2.13 µm
low clouds
high clouds
snow
ground
snow (under high
thin clouds)
high clouds


3.97 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds
Temperature


6.72 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds
Temperature
-40
-30
-20
-10
0
10
20
30
40
(deg C)


11.0 µm
low clouds
high clouds
snow
ground
snow (under high thin clouds)
high clouds
Temperature