



Satellite Products Guide

For the Alberta Hail Suppression Project

Revision 1: 27-May-2024



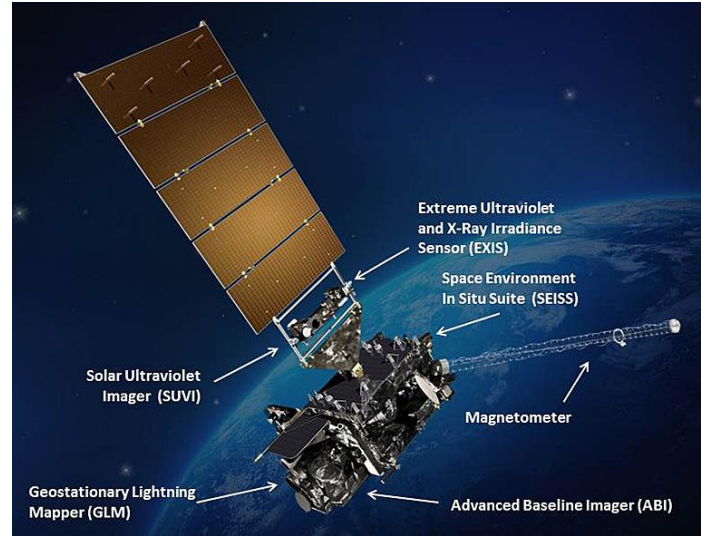
Contents

GOES	<u>3</u>
Geocolor/IR Sandwich	<u>4</u>
Day Convection/Severe Storms	<u>5</u>
Simple Water Vapor	<u>6</u>
Satellite Parallax	<u>7</u>
ABISR/SuperResolution	<u>8</u>

GOES



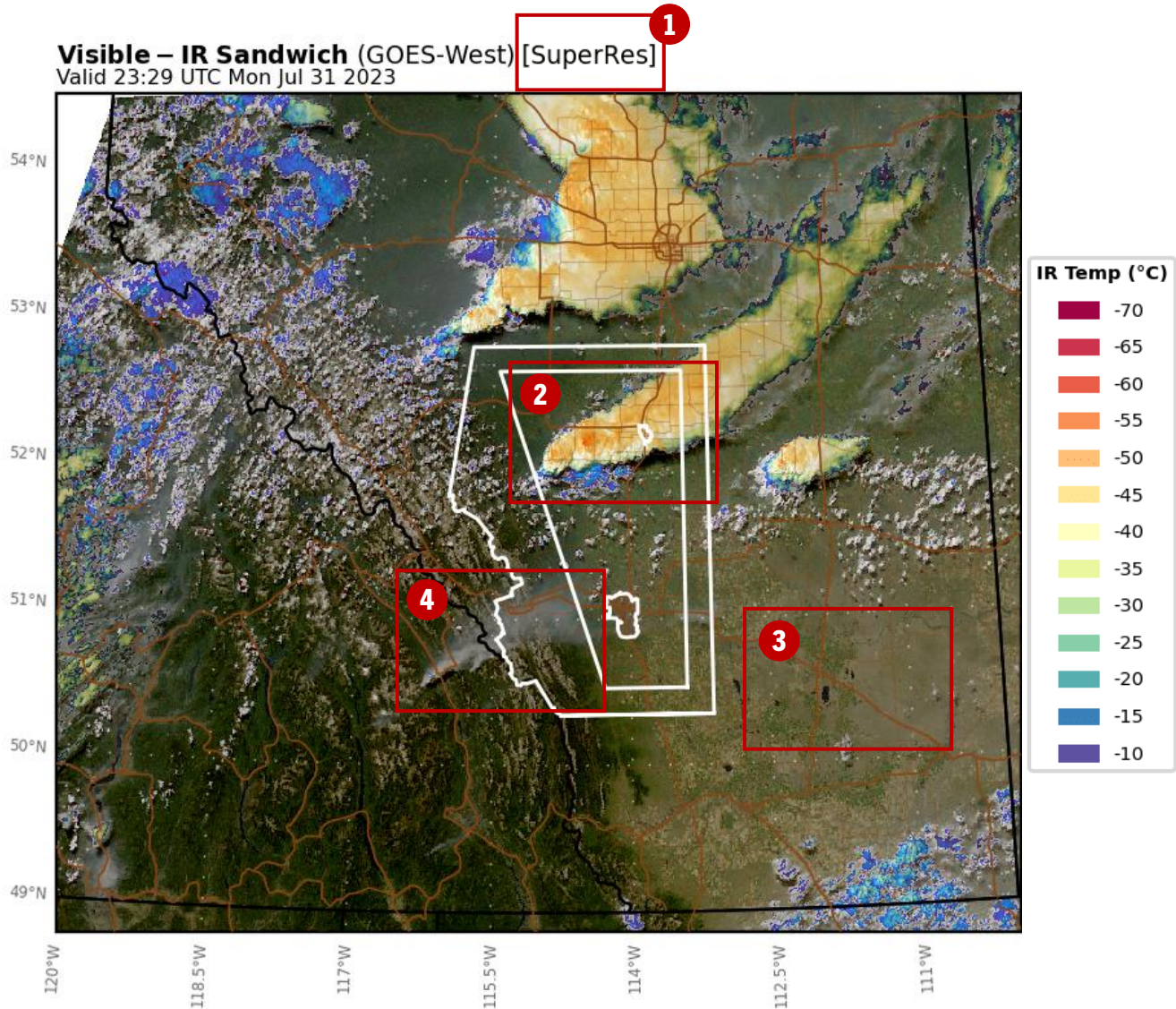
Geostationary Operational Environmental Satellites (GOES) are multi-purpose satellites as part of collaborative program between the **National Aeronautics and Space Administration (NASA)** and the **National Oceanic and Atmospheric Administration (NOAA)**. They monitor atmospheric weather through the **Geostationary Lightning Mapper (GLM)** and **Advanced Baseline Imager (ABI)**, as well as space weather through other instruments. At WMI, ABI data is primarily processed, and as of summer 2024, in its native resolution. The ABI “sees” in 16 channels, or “bands”, that have various resolutions and uses as shown in the table below.



GOES ABI Summary Chart

Band	Central Wavelength (μm)	Type	Nickname/Use	Spatial Resolution (km)
1	0.47	Visible	Blue	1
2	0.64	Visible	Red	0.5
3	0.86	Near-Infrared	Veggie	1
4	1.37	Near-Infrared	Cirrus	2
5	1.6	Near-Infrared	Snow/Ice	1
6	2.2	Near-Infrared	Cloud particle size	2
7	3.9	Infrared	Shortwave window	2
8	6.2	Infrared	Upper-level water vapor	2
9	6.9	Infrared	Mid-level water vapor	2
10	7.3	Infrared	Low-level water vapor	2
11	8.4	Infrared	Cloud-top phase	2
12	9.6	Infrared	Ozone	2
13	10.3	Infrared	“Clean” longwave window	2
14	11.2	Infrared	Longwave window	2
15	12.3	Infrared	“Dirty” longwave window	2
16	13.3	Infrared	CO ₂ longwave	2

Geocolor/IR Sandwich

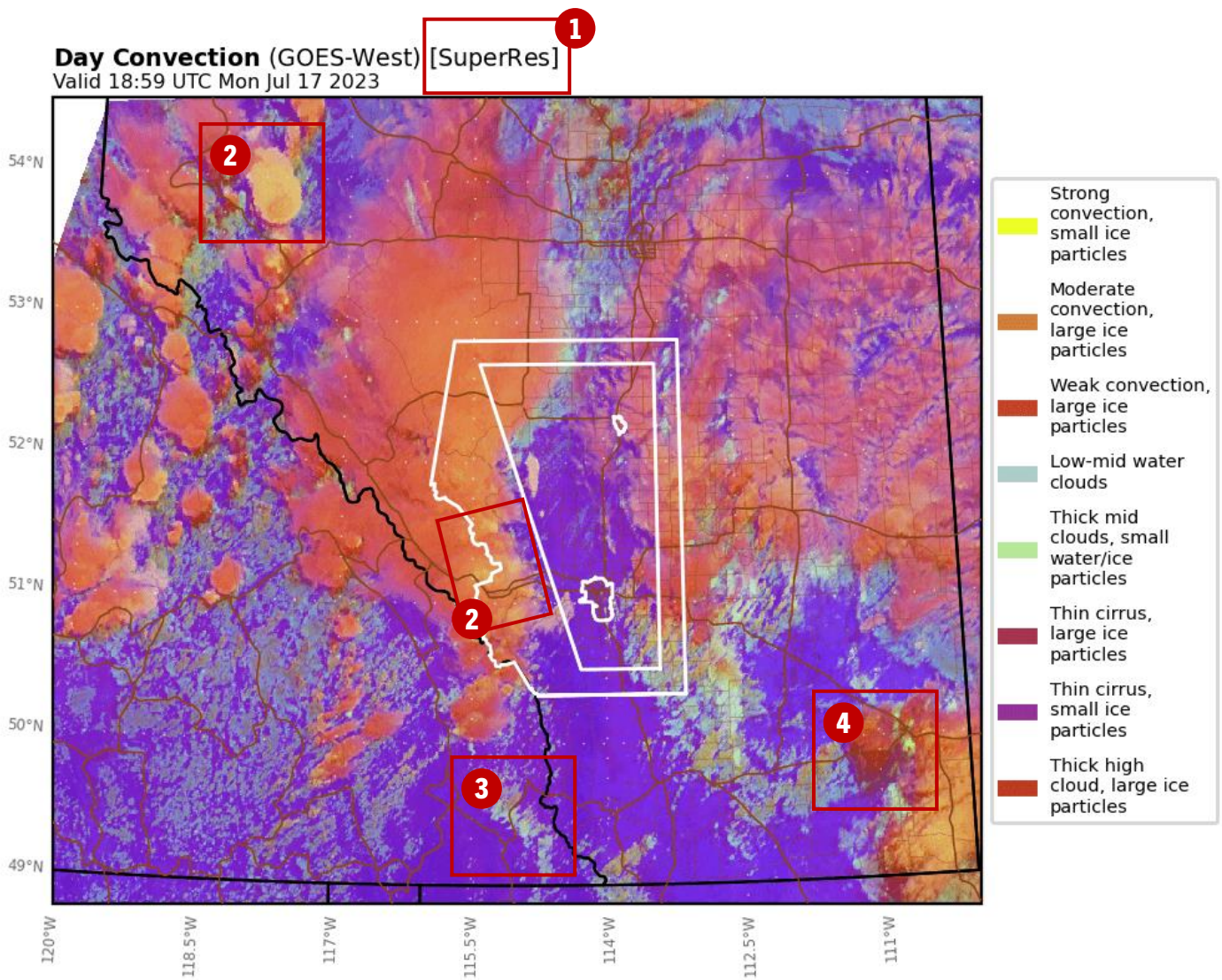


Modified “Geocolor” RGB composite with channel 13 overlaid for cloud-top temperatures.
[QuickGuide CIRA Geocolor 20171019.pdf \(noaa.gov\)](#)

Interpretation:

- 1) **SuperRes indicator.** Will show when SuperRes ([page 8](#)) product is active.
- 2) **IR Overlay.** Provides information on temperature (and height – since colder means higher) of cloud top.
- 3) **Bare ground.** Real-time true-color during the day, static “city lights” at night.
- 4) **Fires.** Because this is a multi-spectral product, smoke plumes from fires will appear more grey or brown as opposed to the white (or color-shaded) clouds.

Day Convection/Severe Storms



Day Convection/Severe Storms RGB to distinguish newer/stronger storms with microphysics diagnostics even when cloud top temperatures are similar.

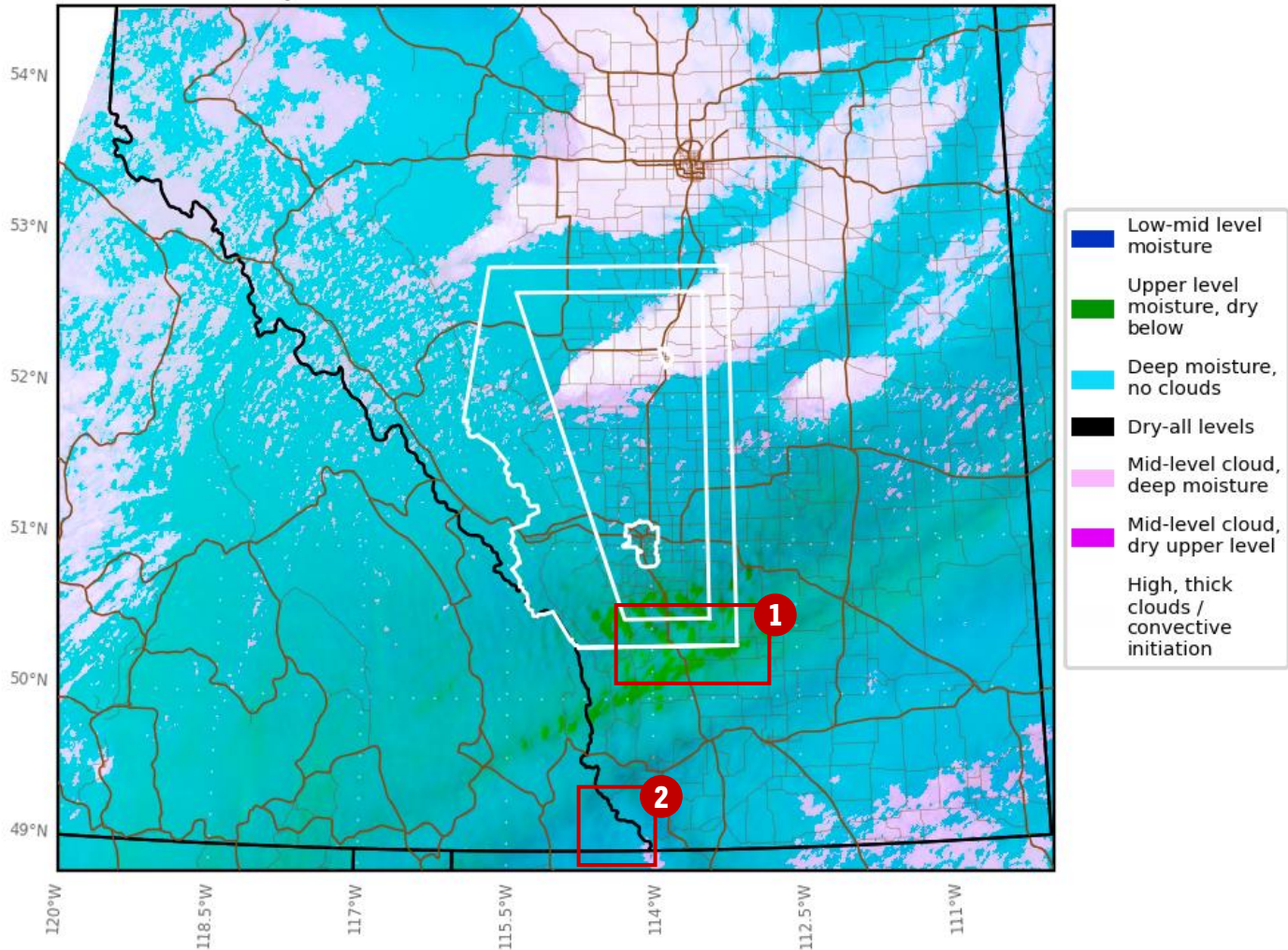
[QuickGuide_GOESR_DayConvectionRGB_final-1.pdf \(colostate.edu\)](#)

Interpretation:

- 1) **SuperRes indicator.** Will show when SuperRes ([page 8](#)) product is active.
- 2) **New/Intense Updrafts.** These will have smaller ice crystals and appear yellow.
- 3) **Building cumulus.** Clouds that have not built sufficient depth for ice appear cyan.
- 4) **Old/Weak Updrafts.** These will have larger ice crystals, appearing red.

Simple Water Vapor

Water Vapor RGB (GOES-West)
Valid 23:29 UTC Mon Jul 31 2023



In clear skies, shows atmospheric motion and features such as low-level moisture return, jet streaks, mid-latitude cyclone structure. [Simple_Water_Vapor_RGB.pdf \(colostate.edu\)](http://Simple_Water_Vapor_RGB.pdf(colostate.edu))

Interpretation:

- 1) **Low-level drying.** Will indicate downslope drying/dryline with green colors.
- 2) **Low-level moisture.** Low to mid level moisture/moisture return will show as shades of blue.

Satellite Parallax

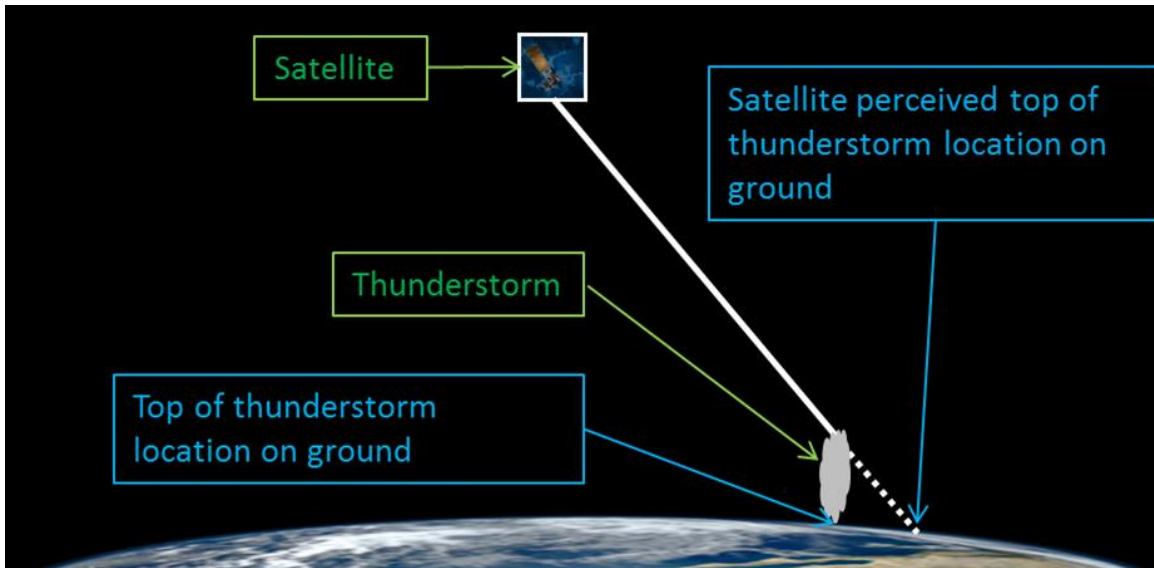
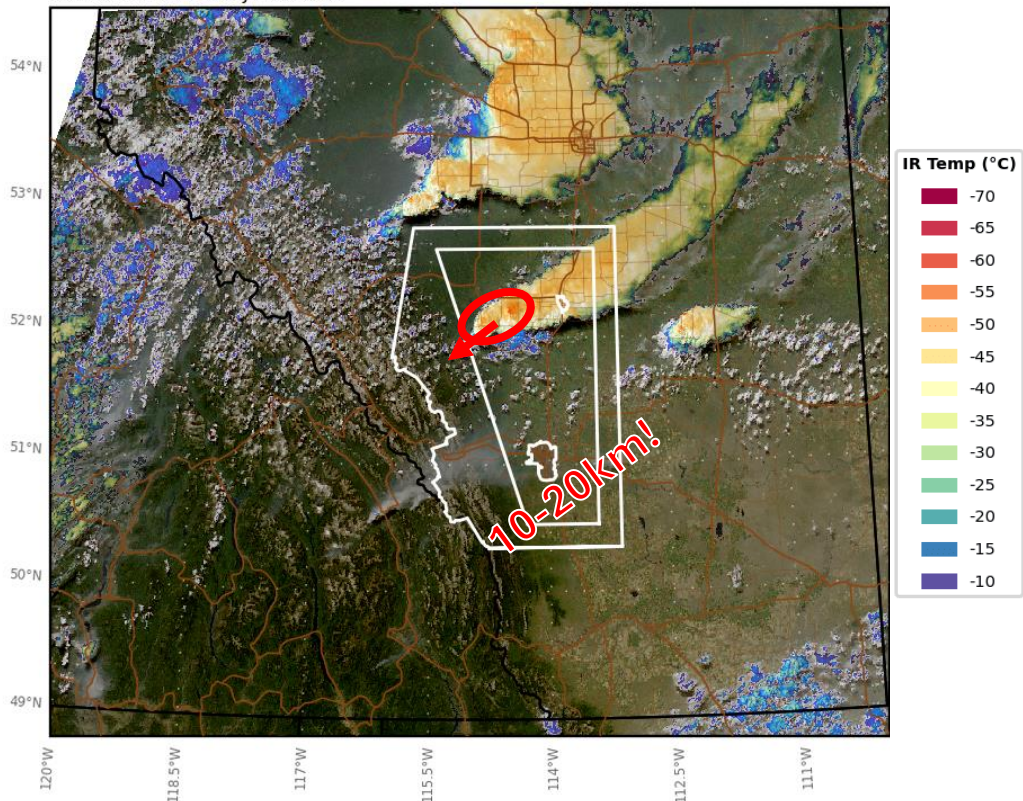


Diagram from Bill Line, [Why is my GOES-16 Imagery Displaced? Parallax!](#)

The GOES-West satellite we utilize on project orbits over 22,000 miles above the earth at 135 degrees west longitude over the equator. This means not only is the satellite looking at quite an angle to see the project area, but the earth is also curving away from the satellite! This results in features appearing to be displaced to the north and east of where they actually are on the satellite image. And this effect grows with height. A cloud at a height of 15,000 ft above sea level will appear displaced ~10 kilometers to the northeast in satellite imagery. A cloud at 30,000 ft (like thunderstorm tops), will be displaced by about 20 kilometers!

[Explore the effects of parallax \(wisc.edu\)](#)

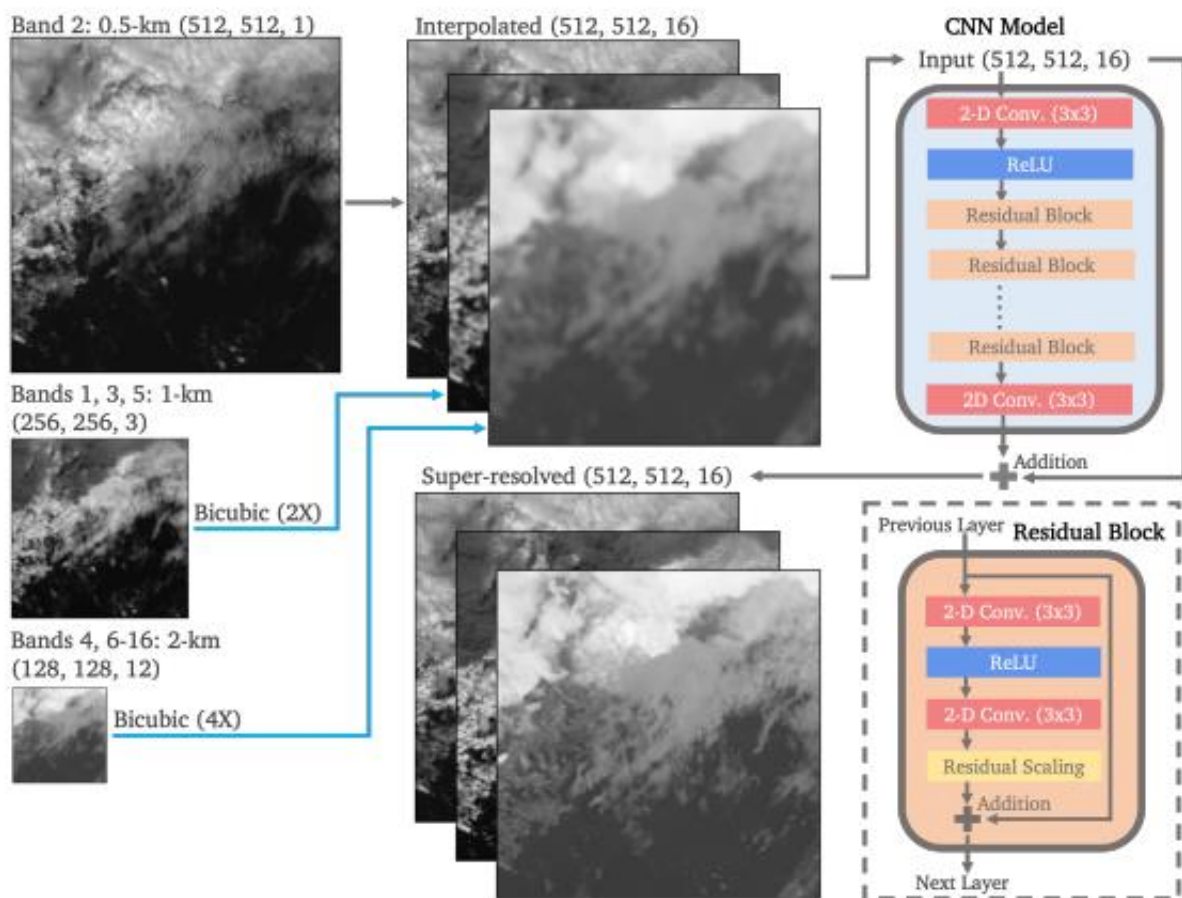
Visible – IR Sandwich (GOES-West)
Valid 23:29 UTC Mon Jul 31 2023



ABISR (SuperResolution)

Recall from the section on [GOES \(page 3\)](#), that each of the 16 bands/channels on the satellite can have different resolutions. The red visible channel (channel 2) has the highest resolution, with 0.5km pixels. While each channel is sensitive to slightly different things in the atmosphere, they aren't completely independent and do have some correlation. We can utilize these relationships plus data from higher-resolution (but less frequent) satellites to train Artificial Intelligence to upsample all channels to this 0.5km resolution! Doing so greatly aids in satellite resolution of convective structures between 0.5km and 2km scale, resulting in **more detail, crisp gradients, and restoration of minima/maxima** that were lost in the courser channels!

Since this is based on the red/channel 2 data, this will only run during the daytime, and will do so automatically, appending [SuperRes] to the title of each image it successfully runs on! This technique was developed by Charles White and others at the Cooperative Insititute for Research in the Atmosphere (CIRA). See more below.



Superresolution of GOES-16 ABI Bands to a Common High Resolution with a Convolutional Neural Network in: [Artificial Intelligence for the Earth Systems Volume 3 Issue 2 \(2024\)](#) (ametsoc.org)



Plots of 10-minute data can be found at
[WMI AHSP Web Interface \(wmiradar.com\)](http://wmiradar.com)

Questions? Visit www.weathermodification.com or email
info@weathermodification.com



Satellite Products Guide for the Alberta Hail Suppression Project
Revision 1: 27-May-2024