



NUCAPS Soundings in AWIPS

How to view them, How to Modify Them

Laboratory Exercise, GUAM WFO April 2018

Jordan Gerth, Liam Gumley,
Scott Lindstrom, Kathy Strabala



Cooperative Institute for Meteorological Satellite Studies
(CIMSS) at UW-Madison

NUCAPS (**NOAA-Unique Combined Atmospheric Processing System**) Vertical Profiles, or Soundings, are generated from Infrared and Microwave Sounders that are on board Suomi NPP and NOAA-20 (CrIS and ATMS) or on board Metop A and Metop B (IASI and AMSU/MHS).

NUCAPS profiles are generated from first a Regression that uses static base coefficients that relate the Infrared and Microwave sounding information to vertical profiles of temperature and moisture (and other trace gases that are unavailable in AWIPS) in the best statistical sense. These initial profiles are then used in a retrieval that adjusts the profile match results from a Radiative Transfer Model. This last step is done iteratively until it converges to a solution.

NUCAPS Soundings from Suomi NPP are created from observations collected at 0130 and 1330 Local Time, approximately. 15z and 03z in Guam, if I'm computing correctly. Thus, you receive vertical profiles at a time that is different from the Synoptic Observations at 0000 UTC and 1200 UTC for upper air soundings. This can give you important information in situations where thermodynamics are changing with time (Note: NUCAPS does not provide winds).

Where are these data in AWIPS? The familiar image on the next page shows AWIPS – under the 'Satellite' tab you will find an 'NPP Products' Entry, and on clicking that selection, a further menu that shows 'NUCAPS Sounding Availability'. Click on it.

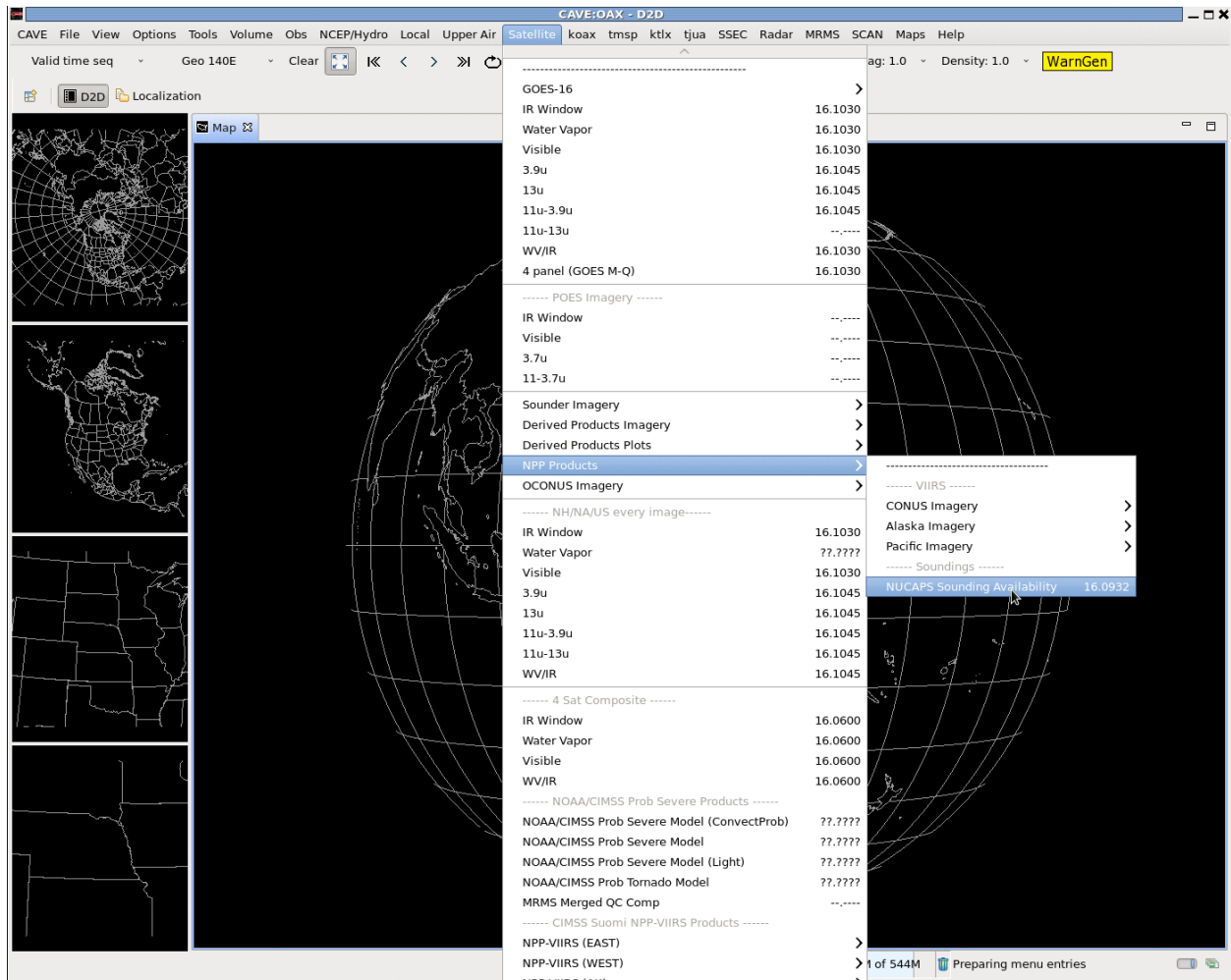


Figure 1: AWIPS Screen with Satellite -> NPP Products -> NUCAPS Sounding Availability selected

NUCAPS Soundings are presented in AWIPS as colored dots that show the location of the vertical profile that is created from up to 9 clear fields of regard from CrIS (See Figure 2). You will see Green, Yellow and Red Dots on the screen.

1. **Green Dots:** Both Infrared and Microwave retrievals succeeded. Data are useful
2. **Yellow Dots:** The Infrared retrieval did not converge. The microwave retrieval did converge. Microwave information only are included in the sounding
3. **Red Dots:** Both Infrared and microwave retrievals failed. Parts (or all) of the sounding may not show useful information.

Once you have loaded the points, they will look something like Figure 3. Zoom in to a region over Guam. There are 30 different points (retrievals) along each approximately east-west oriented scan line, and that different colored dots can be related to cloud cover/precipitation in the region. That is, green points are generally in regions of clear (or mostly clear) skies, red points are where precipitation is occurring, and yellow points are in cloudy regions.

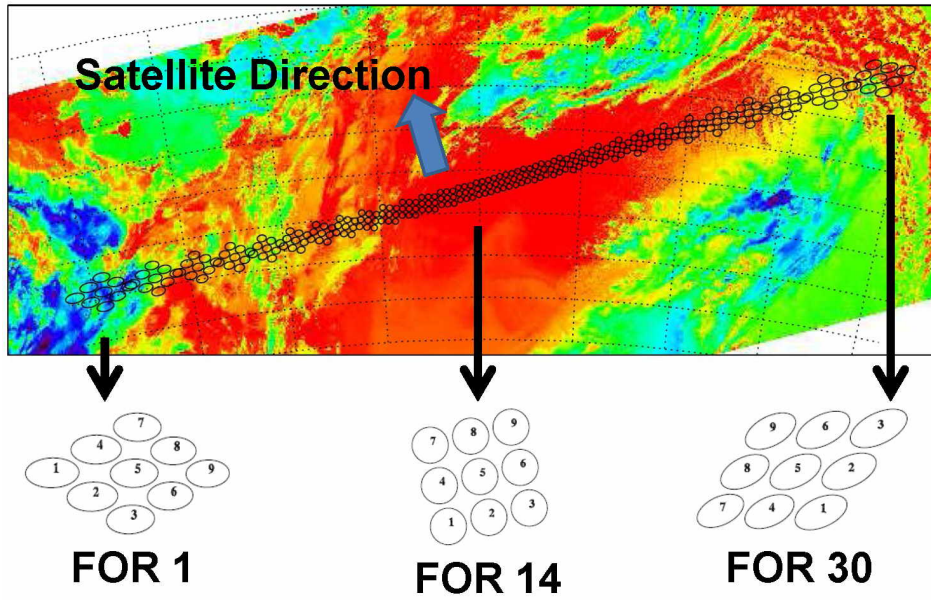


Fig. 2: A CrIS scan line from Suomi-NPP superimposed on a VIIRS image at the same time. CrIS does not scan to the edge of the VIIRS image. The 30 Fields of Regard (FOR) on CrIS are of variable size, depending on distance from nadir (where the satellite is pointing straight down). Any non-cloudy FORs are used in the 30 NUCAPS Vertical Profiles that will be computed along the CrIS scan.

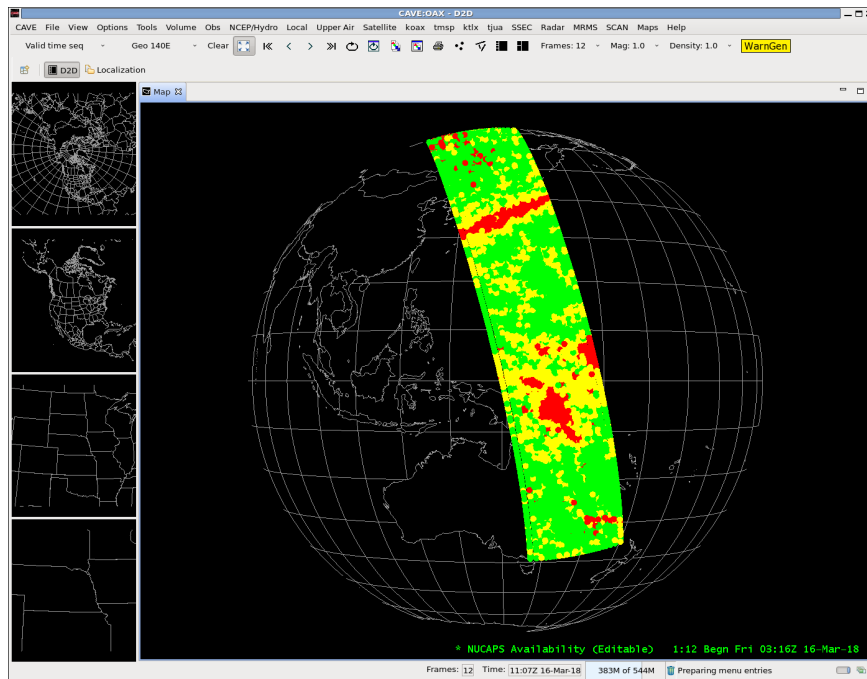


Figure 3: NUCAPS Sounding points from one Suomi NPP pass over the eastern Hemisphere. Sounding point colors are Green (likely acceptable data: both IR and MW retrievals completed), Yellow (questionable: IR retrieval failed) and Red (use with caution, both retrievals failed)

Zoom in further on Guam, and you see something like this. Count the number of points in a horizontal line: 30! Note that both red, yellow and green points are present in this image. I will show you the 5 points boxed in blue, starting at the green point to the north and moving south to the red point. So, green, yellow, green, yellow, red. For this lab I've done this by clicking on the point and saving the image. In real life, I would use Pop-up SkewTs in AWIPS to quickly scan through the imagery.

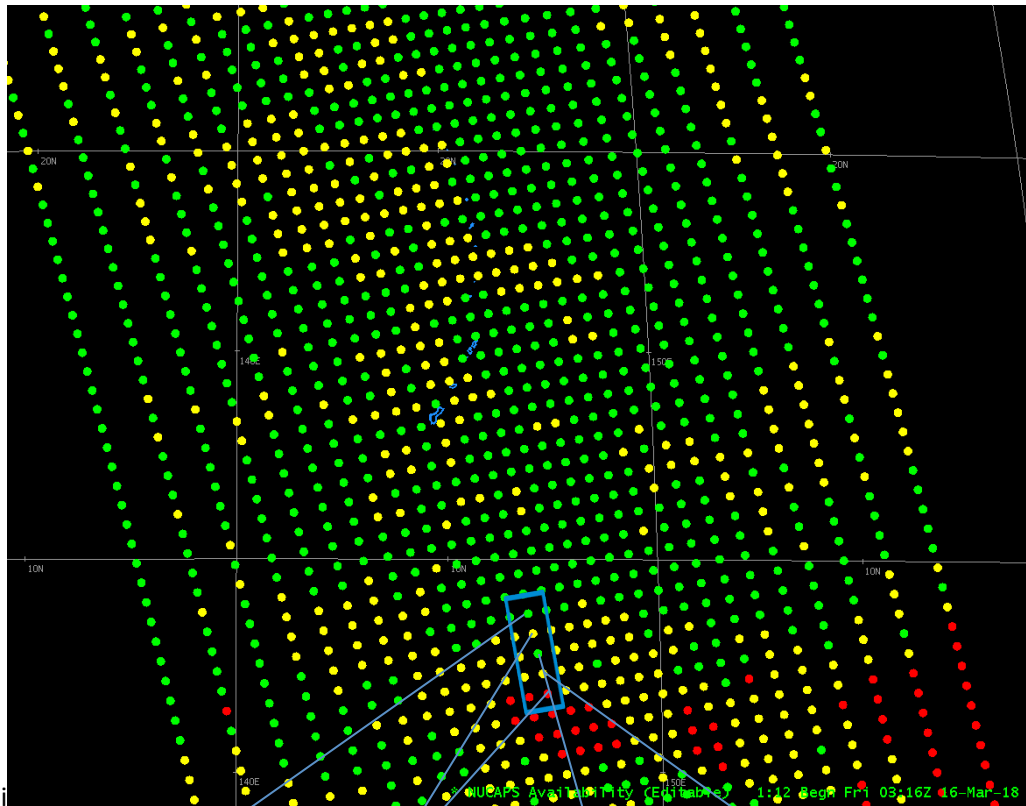
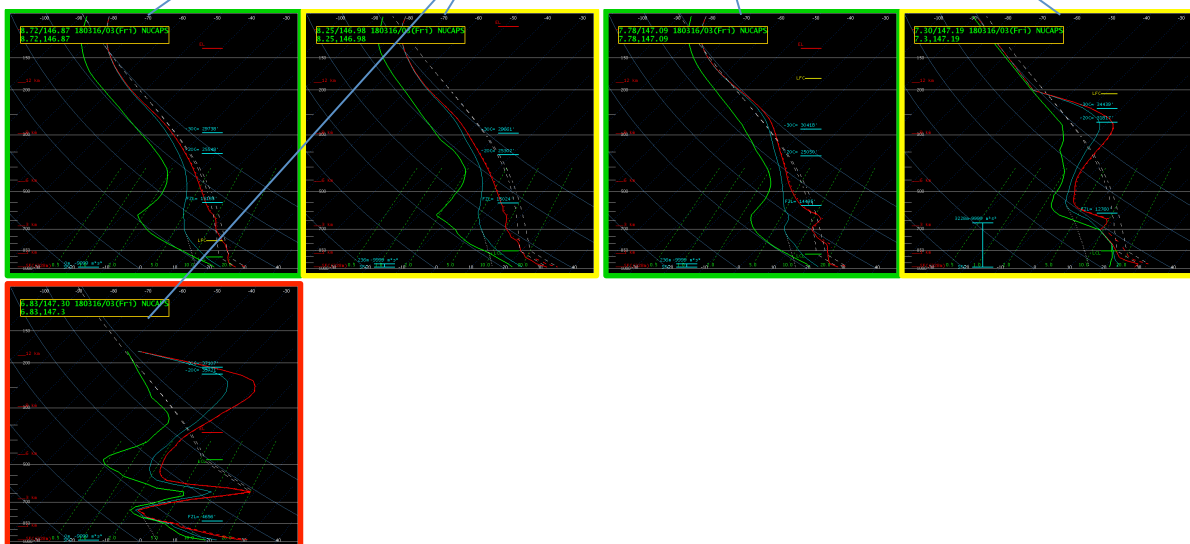


Figure 4: NUCAPS Sounding points from one Suomi NPP pass near Guam. There are 30 points in each scan line. Soundings from the 5 points in the box are shown below



Note that sometimes – not in this case – the Red or Yellow sounding might have valuable information above a cloud deck. For example, it might give good information about the tropopause height, but fail because of non-convergence somewhere farther down in the atmosphere.

Now, let's zoom in even more onto Guam, shown below. Note there is a green sounding (circled) located northwest of Ritidian Point. The Temperature/Dewpoint at the nearby airport is 87 / 75. Remember: data at a point are for a volume from up to 9 Fields of Regard centered on that point.

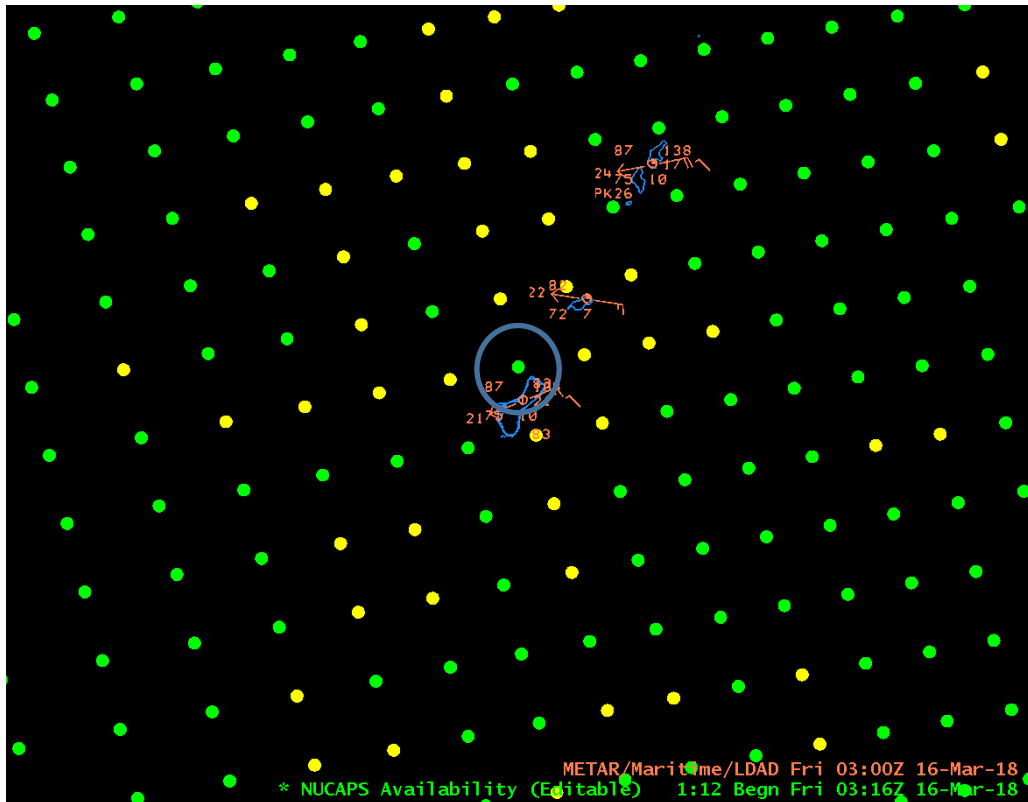


Figure 5: NUCAPS Soundings around Guam, ~0300 UTC on 16 March 2018

Click on that point and the Sounding will appear. Compare it to the Guam sounding from 0000 UTC, just below. A couple things: NUCAPS Soundings are smooth in the vertical. But the overall 'feel' of the soundings is that they are comparable. Don't expect to see thin layers in a NUCAPS profile. There is information for about 4-6 layers of moisture, and maybe 10 layers of temperature in the troposphere.

Now, look carefully at the NUCAPS Sounding. Note how the surface values are at odds with observations. We need to edit this sounding. This can be done using a table, or graphically. To edit graphically, toggle the 'Edit Graph' button (highlighted in Figure 6) to 'on'.

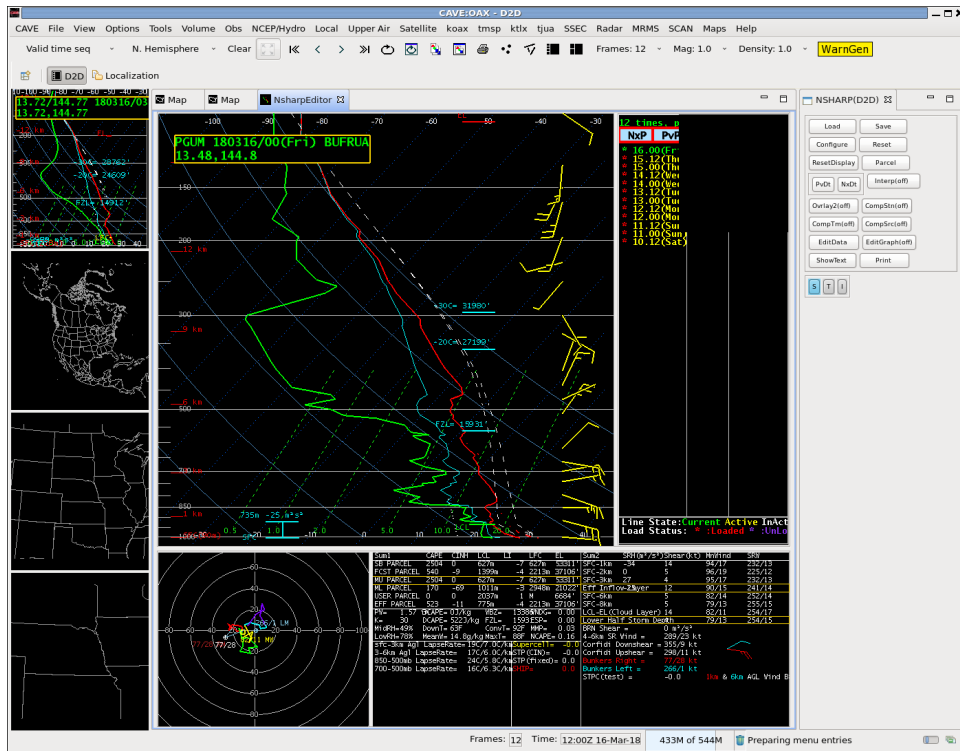
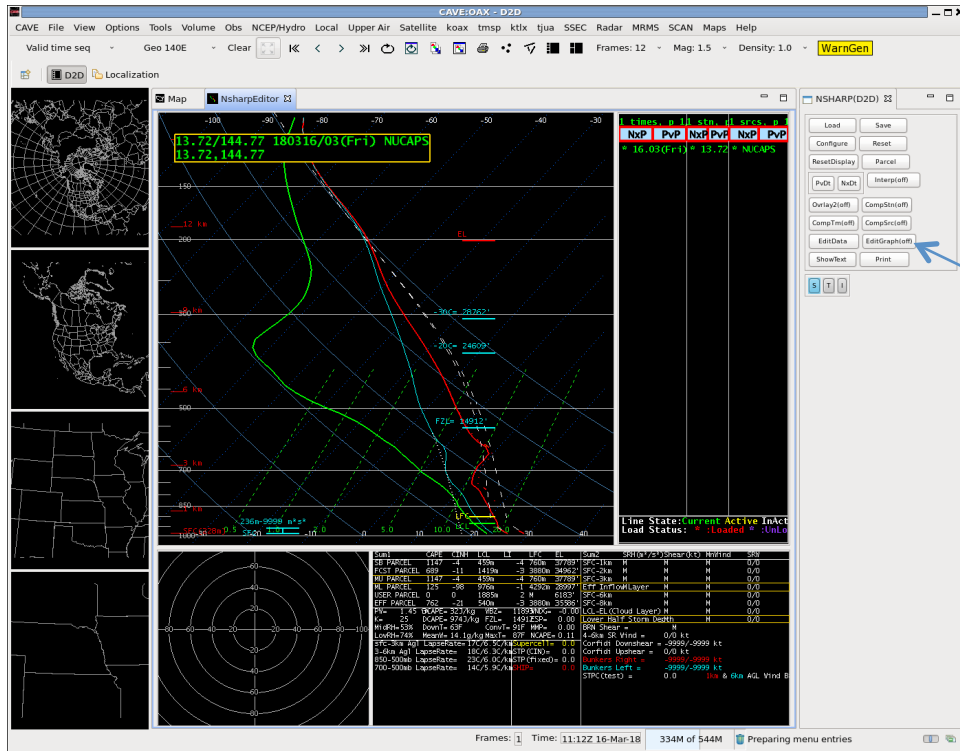


Figure 6: NUCAPS Sounding from just northwest of Guam (0316 UTC on 16 March 2018) and PGUM Sounding from 0000 UTC on 16 March 2018

When you Toggle 'Edit Graph' to On, the sounding changes and draggable points appear (See Fig. 7); you can adjust the sounding by moving the points to warmer or cooler temperatures/dewpoints. As you change the sounding temperature/dewpoint, the thermodynamic parameters in the sounding change as well (LCL, CAPE, etc).

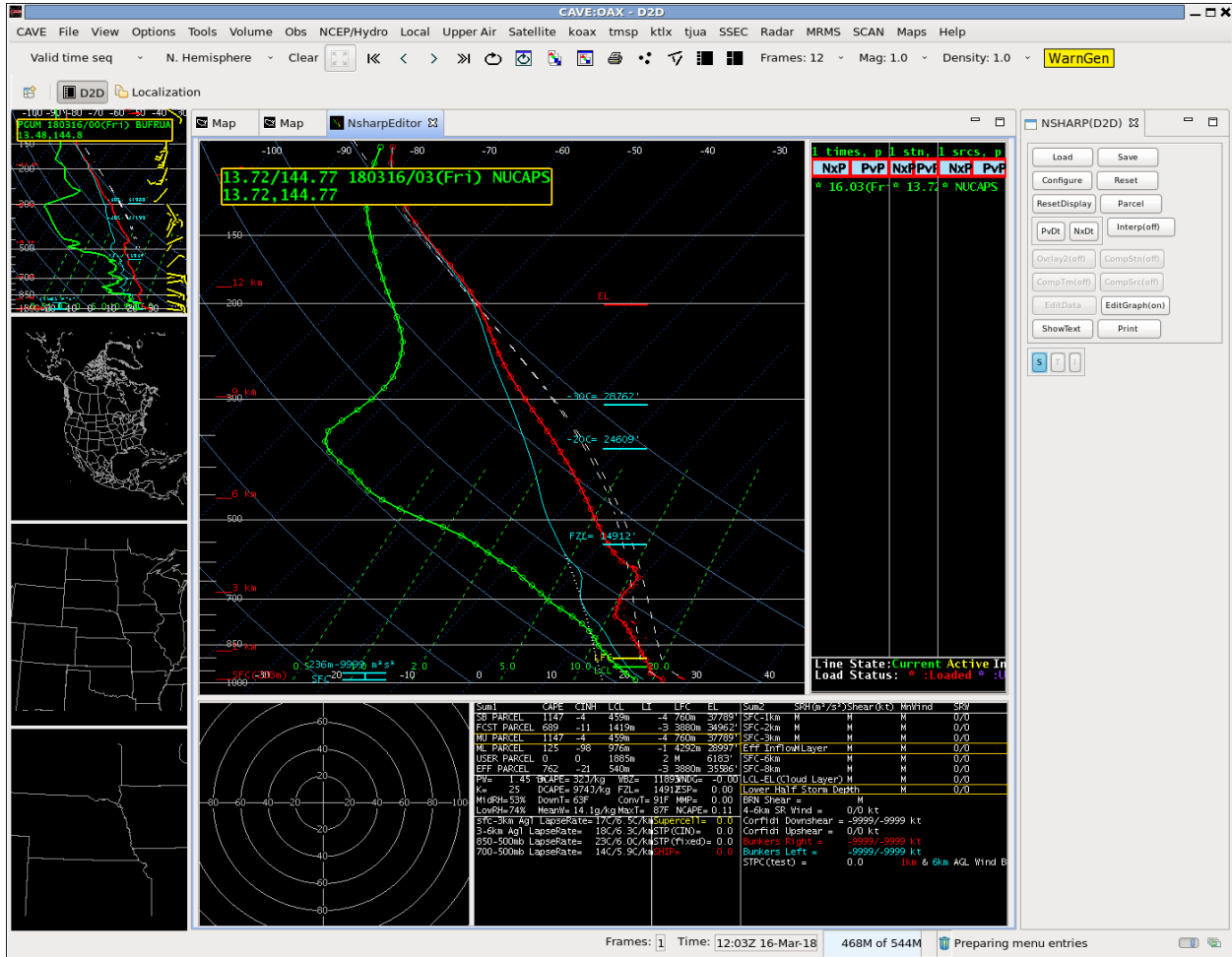


Figure 7: Draggable points on a NUCAPS Sounding.

You can also use a table to edit or add levels. 'Edit Data' loads up the data that are used to create the sounding. In the example below (Figure 8), I've decided to add something near sea level because the sounding really probably does extend below 986 mb! So I've added data at 1005 – with temperature/dewpoint values that are close to observations at the airport. If the lowest level were lower down than 986 mb, I might just have changed those values. See the result in Figure 9.

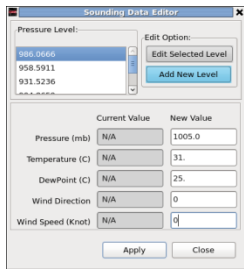


Figure 8: Sounding Data Editor text box.

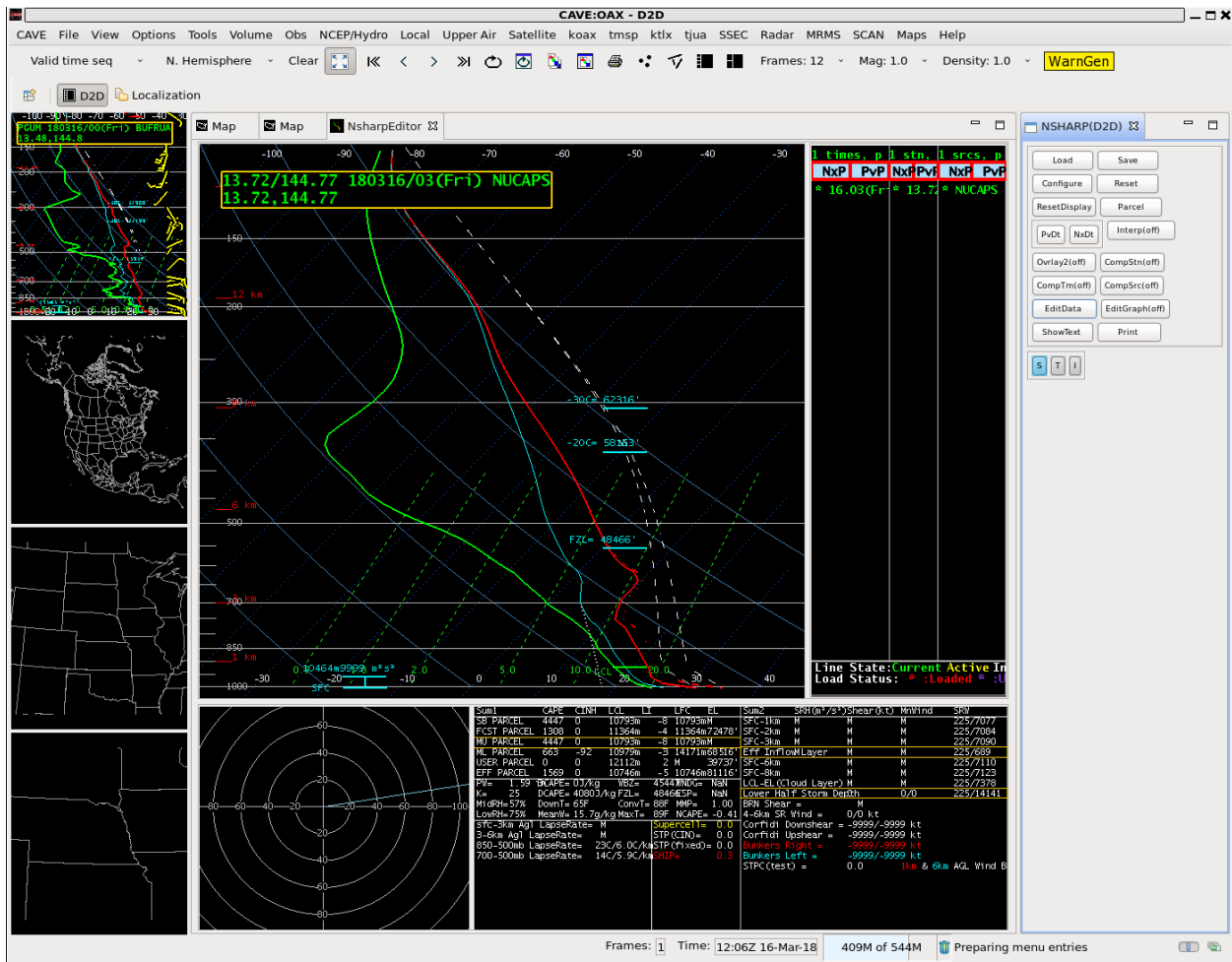


Figure 9: Sounding after including the new level, and changing the data at 986 mb as well.

I also changed the 986 mb values for the sounding, using the Edit Data box again, selecting the level to change, as shown below in Figure 10. (Again: Note how this changes the thermodynamic variables when it is done!)

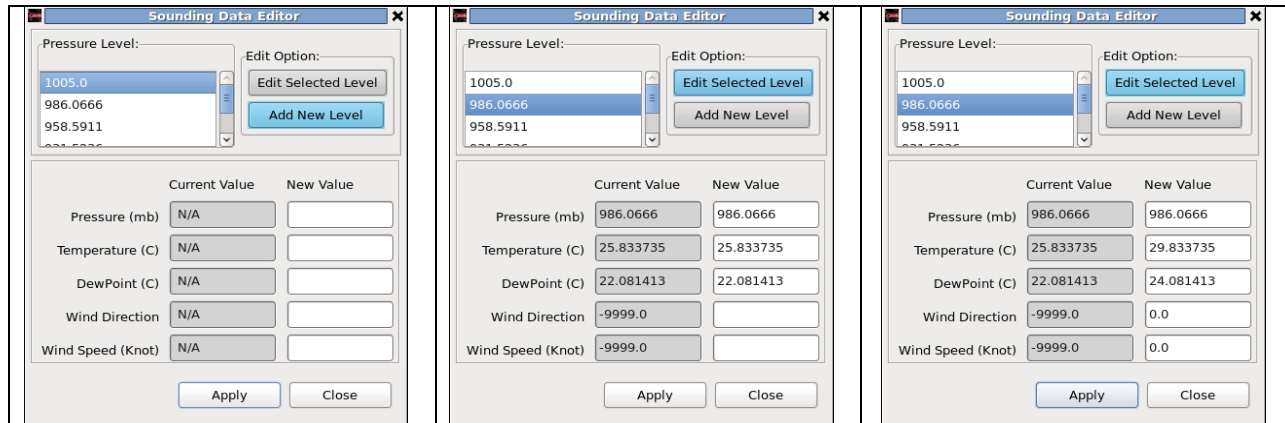


Figure 10: Edit Data boxes as a level is selected and changed

Now that you've seen an example, you will do this yourself in AWIPS.

Performance Objective:

- Learn how to interpret NUCAPS soundings and how to modify them
 - Load up NUCAPS the latest NUCAPS Sounding
 - Load up a nearby (in space and time) radiosonde
 - Adjust the NUCAPS Sounding to better match the observations.
- Additional objectives will be in bulleted list.

Not all Profiles will need to be modified!

Ideal Case Setting:

- Your goal here is to describe the atmospheric environment approaching Guam; ideally, the NUCAPS soundings will span a change in the weather that is approaching, either from mostly dry to showery, or vice versa. Alternatively, you might pick a day where shower chances are borderline, and you wonder how things are changing after the morning sounding.
- Guam is close enough to the Equator that NUCAPS Sounding gaps can appear. Don't pick the 12 hours that the gap appears in. Note: If you receive both Suomi NPP and NOAA-20 NUCAPS soundings, you won't have gaps!

Data Integration:

- *Consider what the numerical prediction is saying about shower chances; does Himawari data reveal information that allows you to infer a better (or worse) likelihood of showers? What are radar trends for the area of interest?*

Introduction:

NUCAPS Soundings show you the thermodynamics of the atmosphere at times shortly after the 0000 and 1200 UTC Soundings. Thus, you can get an approximation of the time tendency of temperature and moisture at different levels in the atmosphere.

Directions:

- As noted in the first pages of this lab, find the NUCAPS Soundings under the Satellite->NPP Products->NUCAPS Sounding Availability. These soundings flow to AWIPS via the SBN and there can be 60-90 minutes elapsing between the Satellite passing over Guam and the data appearing. If you are using the Direct Broadcast data, then the NUCAPS soundings arrive more immediately: typically within 30 minutes. Make sure you know from your AWIPS Selection where the data originates. (The Soundings themselves should be identical regardless of source, but of course less wait-time is better!)
- Compare the NUCAPS Soundings you pick to nearby soundings – nearby in space and time. If the NUCAPS soundings show discrepancies, adjust them.

How does the NUCAPS Sounding inform your decision-making? Is the atmosphere dryer? More moist? More or less stable? Is the tropopause height different? How about the freezing level?

What advantages do the NUCAPS Soundings provide?

How can NUCAPS Soundings be useful to forecasters?

Enhancement Questions

- 1.) How did your analysis of this situation improve using NUCAPS Soundings?
- 2.) Use this section to ask any additional questions to further backup the objectives of the job sheet. For example ask how they determined between two possible features. Try to keep section under 5 questions.
- 3.) *Describe how the integration of the NUCAPS data with other JPSS data (or Himawari Data) was useful in examining the problem of the day.*