



## WESTERN REGION TECHNICAL ATTACHMENT NO. 97-16 MAY 27, 1997

---

### GOES SOUNDER DATA DISPLAYED AS SKEWTs

Kevin J. Schrab - WRH/SSD Salt Lake City, UT

#### Introduction

GOES sounder data is available to Western Region (WR) forecast offices in two forms. The first is DPI (derived product imagery) of LI and PW (see TA 96-17). The second form is what will be discussed in this TA. That form is GOES-9 data displayed as SKEWTs (i.e., in a format used to look at RAOBs). These data are available on the WR homepage at <http://www.wr.noaa.gov/rets>. It should be noted that the presence of clouds prevents the calculation of GOES soundings.

#### GOES Sounding Generation Background Information

Much of the information in this section is summarized from <http://cimss.ssec.wisc.edu/goes/sounder/products.html> (the figures in this section were also taken from this link).

GOES soundings are generated using data from the GOES sounder data and Eta model forecasts. The GOES sounder is made up of 19 channels at distinct wavelengths (Fig. 1). Each of these channels senses radiation from a different layer of the atmosphere. This can be seen by looking at a graphical representation of where most of the energy comes from in each of the 19 channels (Fig. 2, Fig. 3, Fig. 4). It is quite apparent that the atmosphere is well sampled between the surface and 100 mb. However, it should be noted that some of the layers sampled are quite deep. The GOES sounder does not give pressure level information, but rather pressure layer information.

Using the GOES data with the Eta forecasts temperature and moisture soundings can be retrieved. Thus, the soundings are often called GOES retrievals. The retrievals are made on an hourly basis since this is the scanning frequency of the sounder. A flow chart of the entire retrieval process is shown in Fig. 5. First, it is determined which field of views (FOVs are 10 km resolution) are clear. Eta model 6 - 18 hr forecasts and surface observations are then used as boundary (first guess) conditions for the radiative

calculations necessary to obtain a retrieved sounding. For example, to obtain a 15Z GOES sounding, the following information is used:

- 1) GOES sounder data from 15Z,
- 2) Eta 15 hour forecast from the previous 00Z model run, and
- 3) 15Z surface data.

Figure 6 shows a flow chart of the GOES retrieval algorithm. So, to summarize, the Eta first guess sounding for a particular point is modified based on what the GOES sounder is sensing so that the retrieval calculated matches what the GOES sounder is sensing.

Some examples of GOES soundings plotted as SKEWTs will be shown and explained in a later section.

### **Goes Soundings Ingest And Display**

The GOES-9 soundings are sent on an hourly basis from the NESDIS Forecast Product Development Team's server to the WR fileserver. The data file that contains all GOES-9 soundings (covering the western US and the eastern Pacific) is received on the WR fileserver by about 1 hour after product valid time (i.e., the 15Z GOES sounding file is on the WR fileserver at about 16Z). The data are then requested by two RAMSDIS machines in WR SSD at 3 minutes past the hour. Two different types of products are produced: RAOB/GOES sounding comparisons and hourly GOES soundings. One RAMSDIS machine processes the RAOB/GOES sounding comparisons and the other processes the hourly GOES soundings.

The RAOB/GOES sounding comparisons are generated twice a day with 0Z and 12Z data. These are generally available on the WR homepage at 02:40Z (0Z comparisons) and 14:40Z (12Z comparisons) daily. Figure 7 shows an example RAOB/GOES sounding comparison at SLC. The legend on the upper left of the SKEWT shows what each colored line represents. The gold lines are the GOES sounding temperature (solid line) and dewpoint (dotted line) profiles. The cyan lines are the RAOB temperature and dewpoint profiles. The dark blue lines are the Eta first guess temperature and moisture profiles (Note: only the portion of the Eta first guess that is different than the GOES sounding is shown in the SKEWT plots). The vertical line on the right is the RAOB wind direction and speed profile. The GOES sounding location, time, and date are in the lower left corner on the plot. The lat/lon of the requested location (i.e., the site indicated in the lower left corner) and the actual location of the closest GOES sounding to the requested site are indicated at the bottom of the plot. The distance and direction of the GOES sounding from the requested location is indicated at the top of the plot. Note, that the Eta first guess plotted is the 12 hour forecast from the previous model run.

Hourly GOES soundings are generated each hour beginning at 6 minutes past the hour. The SKEWT saved in GIF format for each site takes about 20 seconds to generate. The soundings over the WR are then sent to the WR homepage server at about 20 minutes past the hour. The soundings over the Pacific Ocean are then generated and sent to the WR homepage server at about 30 minutes past the hour. Therefore, for example, an 18Z GOES sounding at OAK (or other WR site) will be available at about 19:20Z on the WR homepage. An 18Z sounding over the Pacific Ocean would be available from the WR homepage at about 19:30Z. Figure 8 shows an example of an hourly GOES sounding for SLC. The legend on the upper left of the SKEWT shows what each colored line represents. The gold lines are the GOES sounding temperature (solid line) and dewpoint (dotted line) profiles. The cyan lines are the Eta first guess temperature and moisture profiles (NOTE: only the portion of the Eta first guess that is different than the GOES sounding is shown in the SKEWT plots). The lat/lon of the requested location (i.e., the site indicated in the lower left corner) and the actual location of the closest GOES sounding to the requested site are indicated at the bottom of the plot. The distance and direction of the GOES sounding from the requested location is indicated at the top of the plot. Note, that in this example, the Eta first guess plotted is the 15 hour forecast from the 00Z model run.

The GOES sounding data are accessible via the WR homepage at: <http://www.wrh.noaa.gov/rets>. When you click on the "Look at retrieval/RAOB comparisons" link, you get to choose either a 0Z or 12Z comparison and then get an imagemap (Fig. 9) on which you can click on the red locations to get a RAOB/GOES sounding comparison. When you click on the "Choose retrievals by time, then by site" option, you get a timetable to choose which hour you wish to load. Once you click on the desired time, you see an imagemap (Fig. 10) that allows you to choose a white site as a location for a GOES sounding. The yellow dots on this imagemap represent the locations of actual GOES-9 retrievals. A retrieval will be returned from a white site if a GOES retrieval (yellow dot) is within 50 nmi of the requested (white) site. When you click on the "Choose retrievals by site, then by time" option, you get an imagemap (Fig. 11) that allows you to click on any red site to get a GOES-9 sounding. When you click on a site, you will get the 0Z GOES sounding for that site. Soundings for other times can be chosen using the links to the right of the SKEWT. Using these links and the back and forward features of your web browser, you can make a simple loop-type feature for the soundings.

### **Discussion of GOES Soundings Characteristics**

A discussion of GOES soundings accuracy can be found in the "Product quality" section of <http://cimss.ssec.wisc.edu/goes/sounder/products.html>. Initial use of the GOES-9 soundings by WR forecast offices has produced the identification of some common characteristics seen in all GOES soundings.

- \* The moisture information from GOES-9 sounder can change the Eta first guess quite significantly. Not enough data has been looked at yet to know if these changes are correct.
- \* The time change seen in the GOES-9 soundings can be useful in assessing the change in moisture availability and stability for the development of convection.
- \* The use of the GOES-9 soundings can be very useful in determining the vertical structure (especially moisture) of the atmosphere over the data sparse region of the Pacific Ocean.
- \* The Eta can be critiqued with the use of the GOES-9 soundings to determine if the model is picking up on the correct vertical structure of moisture.

## **Summary**

The use of GOES-9 soundings is available via the WR homepage server at: <http://www.wrh.noaa.gov/rets>. Currently, 41 over-land soundings are being produced, while 26 soundings are produced over the eastern Pacific Ocean. The use of this new data set can be very useful in assessing the vertical structure of the atmosphere and assessing how well the Eta is forecasting the vertical structure of the atmosphere.

Comments on the usefulness of the GOES-9 soundings are encouraged and will be greatly appreciated. Comments can be sent to: Kevin Schrab ([kevin.schrab@noaa.gov](mailto:kevin.schrab@noaa.gov)).

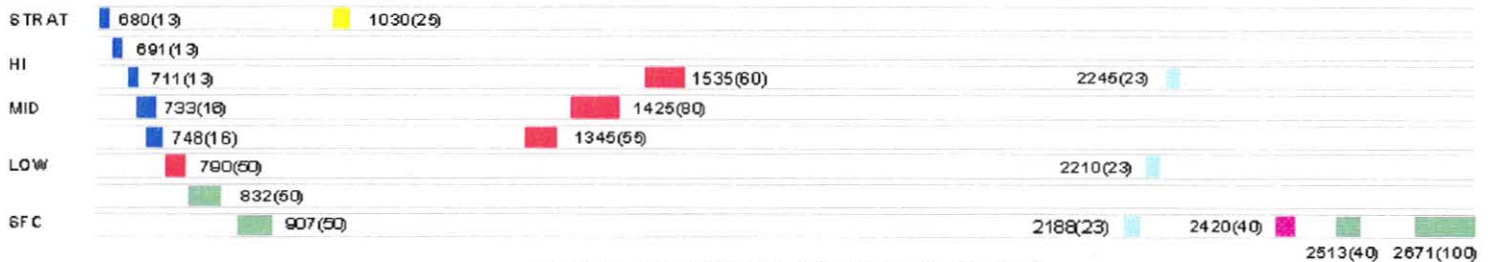
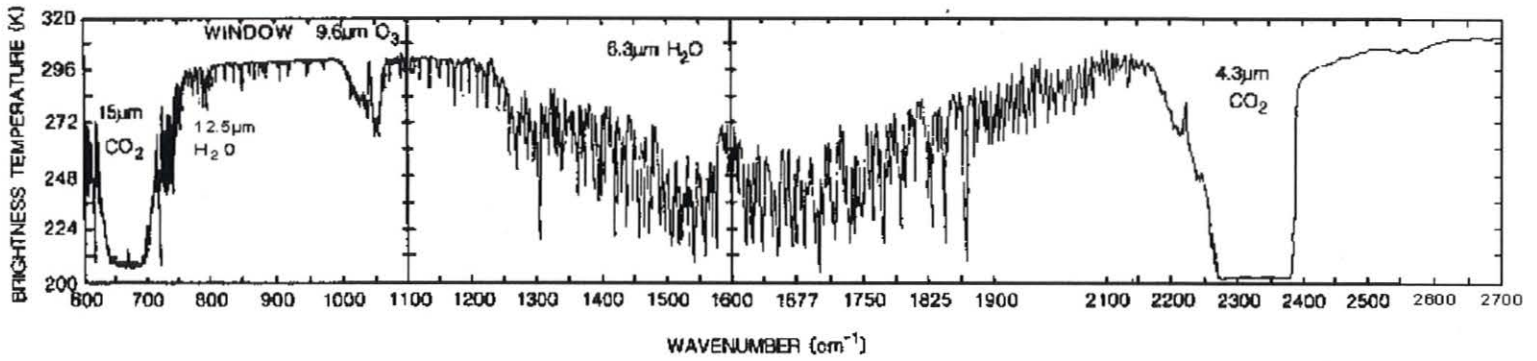
## **Acknowledgments**

I would like to thank Dr. Don Gray and the NESDIS/Forecast Products Development Team for their support to make this product available.

## **References**

Schmit, Timothy J., Gary S. Wade, Robert M. Aune, and Anthony J. Schreiner, 1997: Automated GOES Sounder Products. Proceedings of the Satellite Applications Conference March 4-6, 1993, Asheville, NC.

### EARTH EMITTED SPECTRA



GOES-H SOUNDER SPECTRAL BANDS

Figure 1. Wavelengths of the 19 GOES sounder channels.



COOPERATIVE INSTITUTE FOR METEOROLOGICAL SATELLITE STUDIES

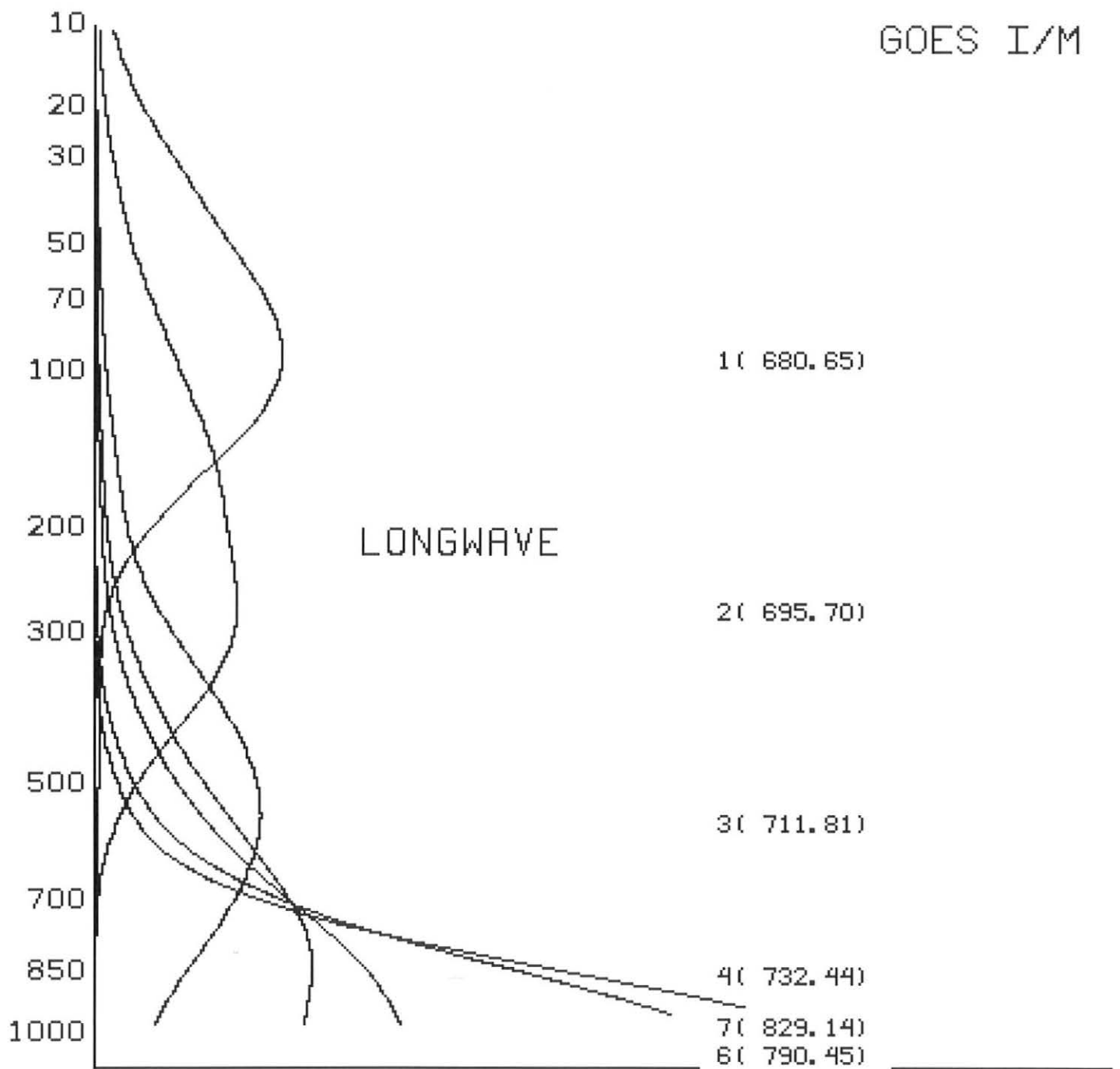


Figure 2. Graph of where energy originates for channels 1-7.

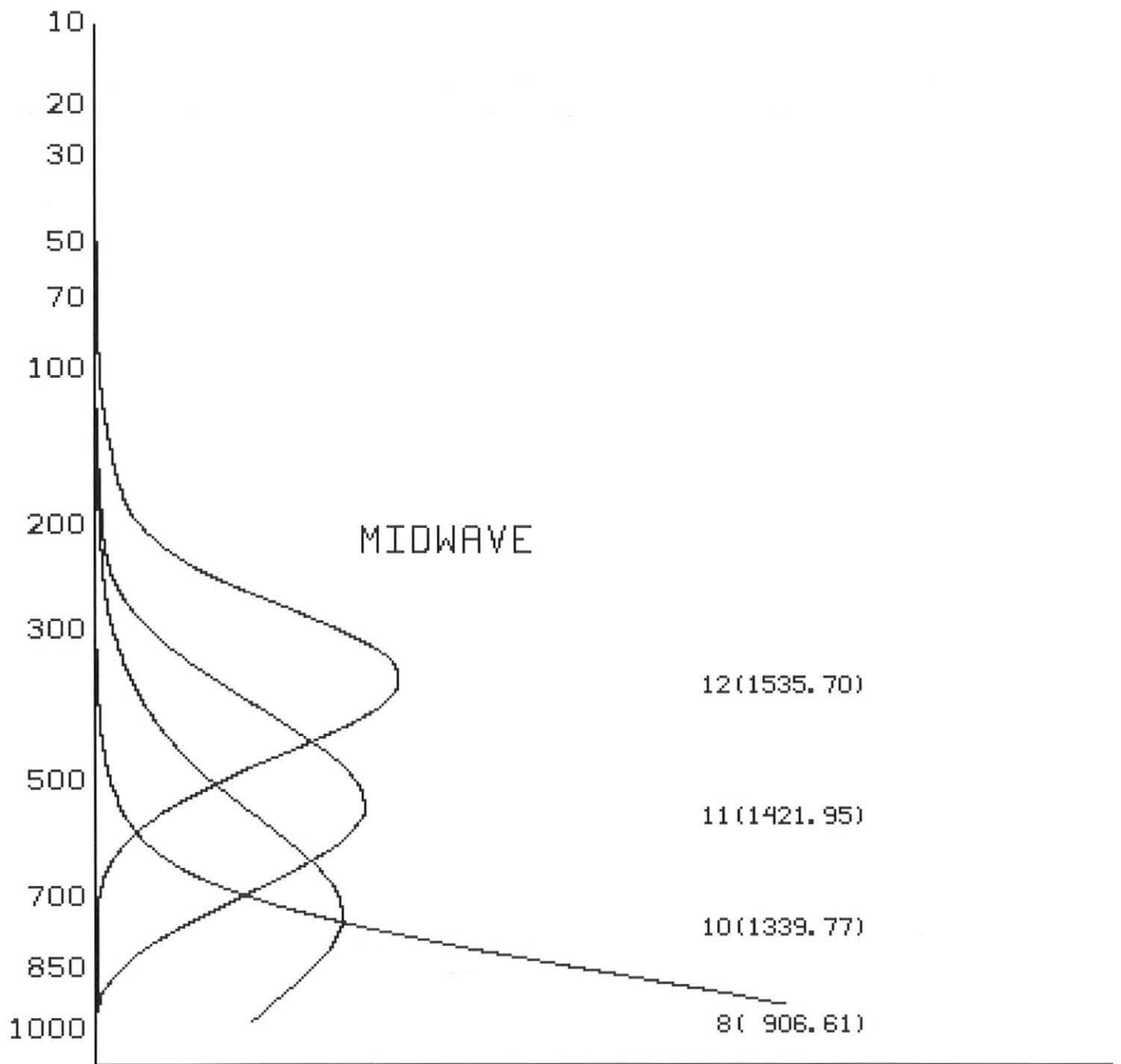


Figure 3. Graph of where energy originates for channels 8, 10-12.

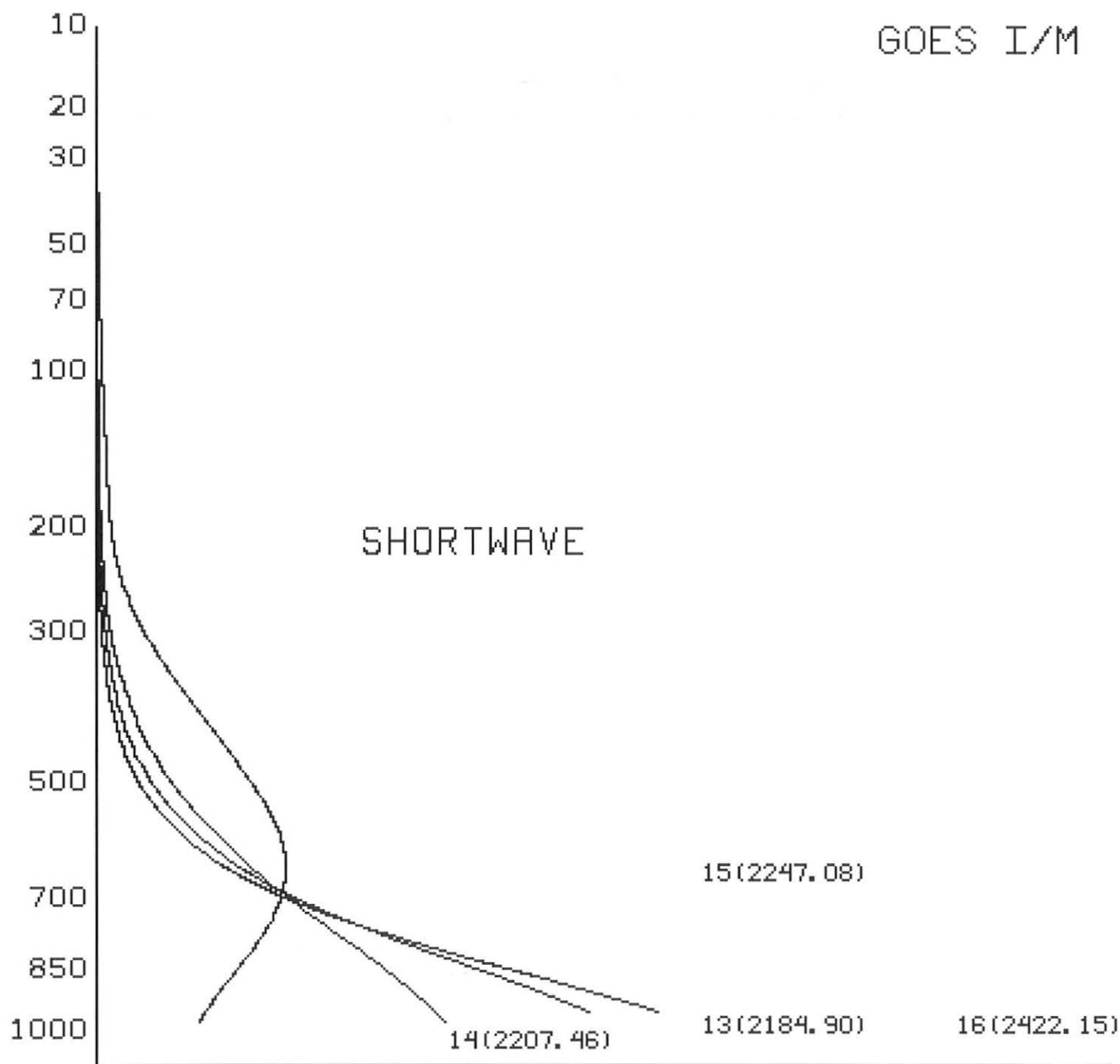


Figure 4. Graph of where energy originates for channels 13-16.



# GOES Retrieval System

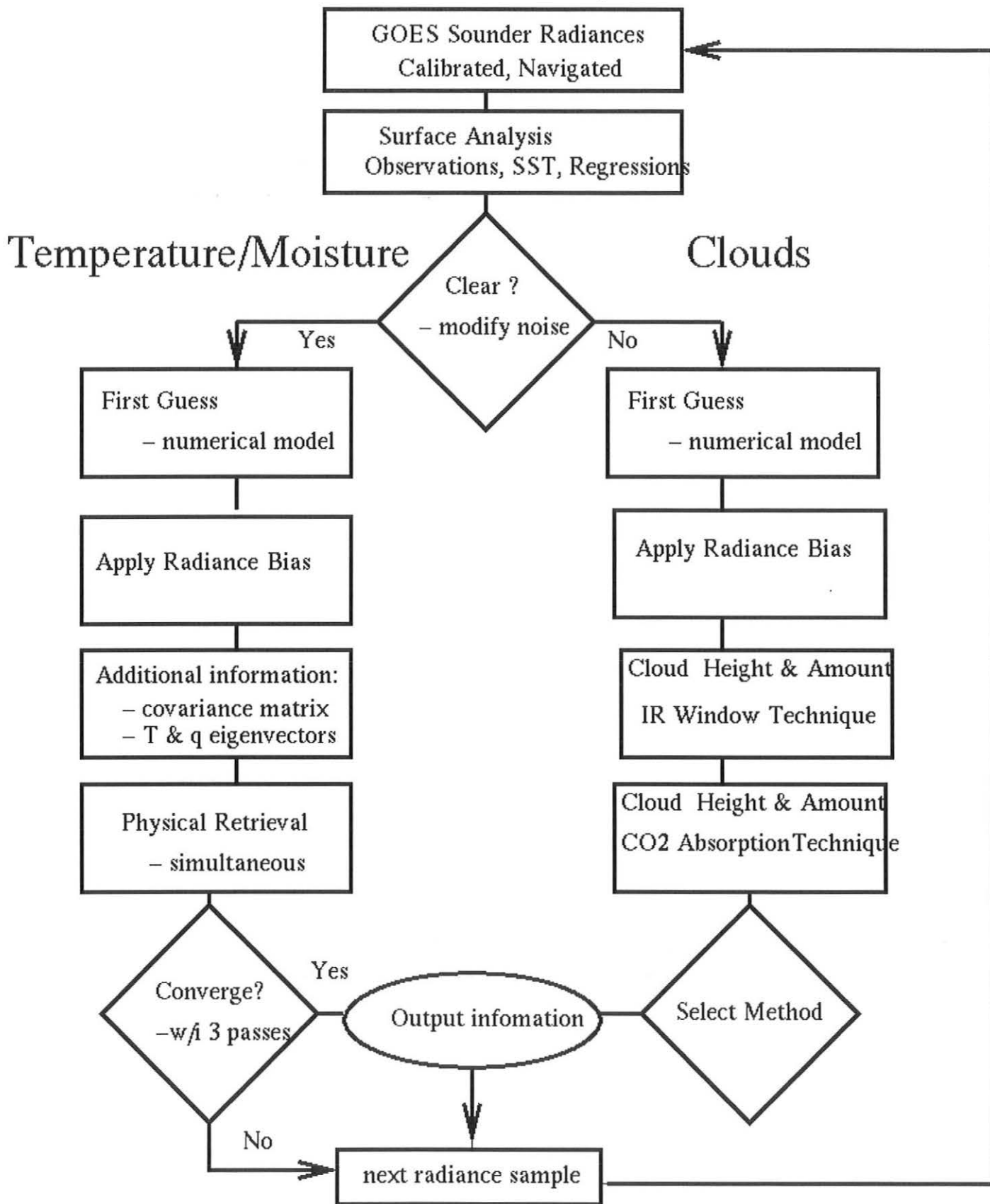


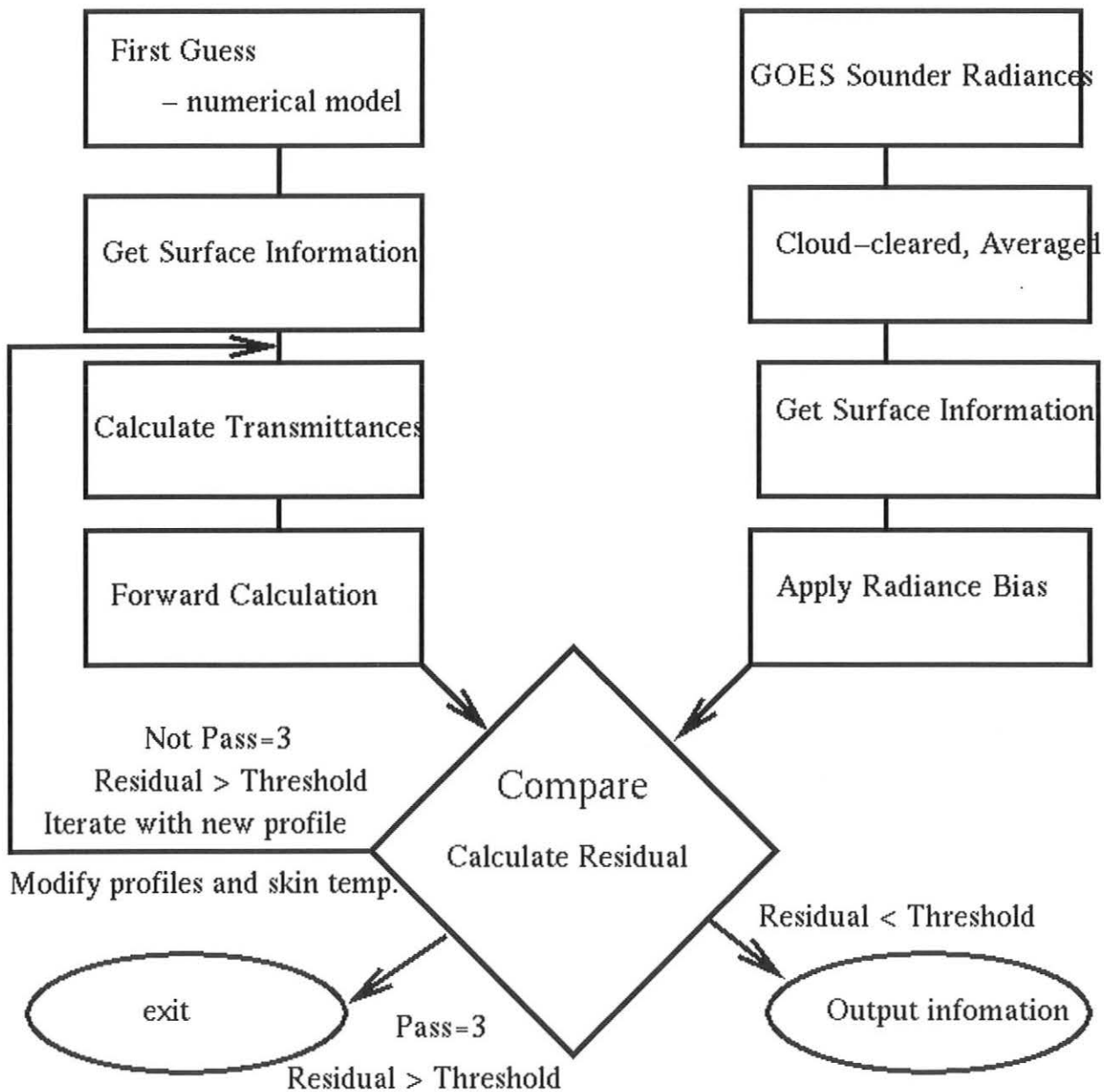
Figure 5. Flow chart of GOES retrieval process.

# GOES Retrieval Algorithm

- physical
- simultaneous
- non-linear
- Marquardt-Levenberg
- Hayden 1988 JAM
- Ma, Smith, Schmit, 1997 JAM (Submitted)

## Retrieval

## Observations



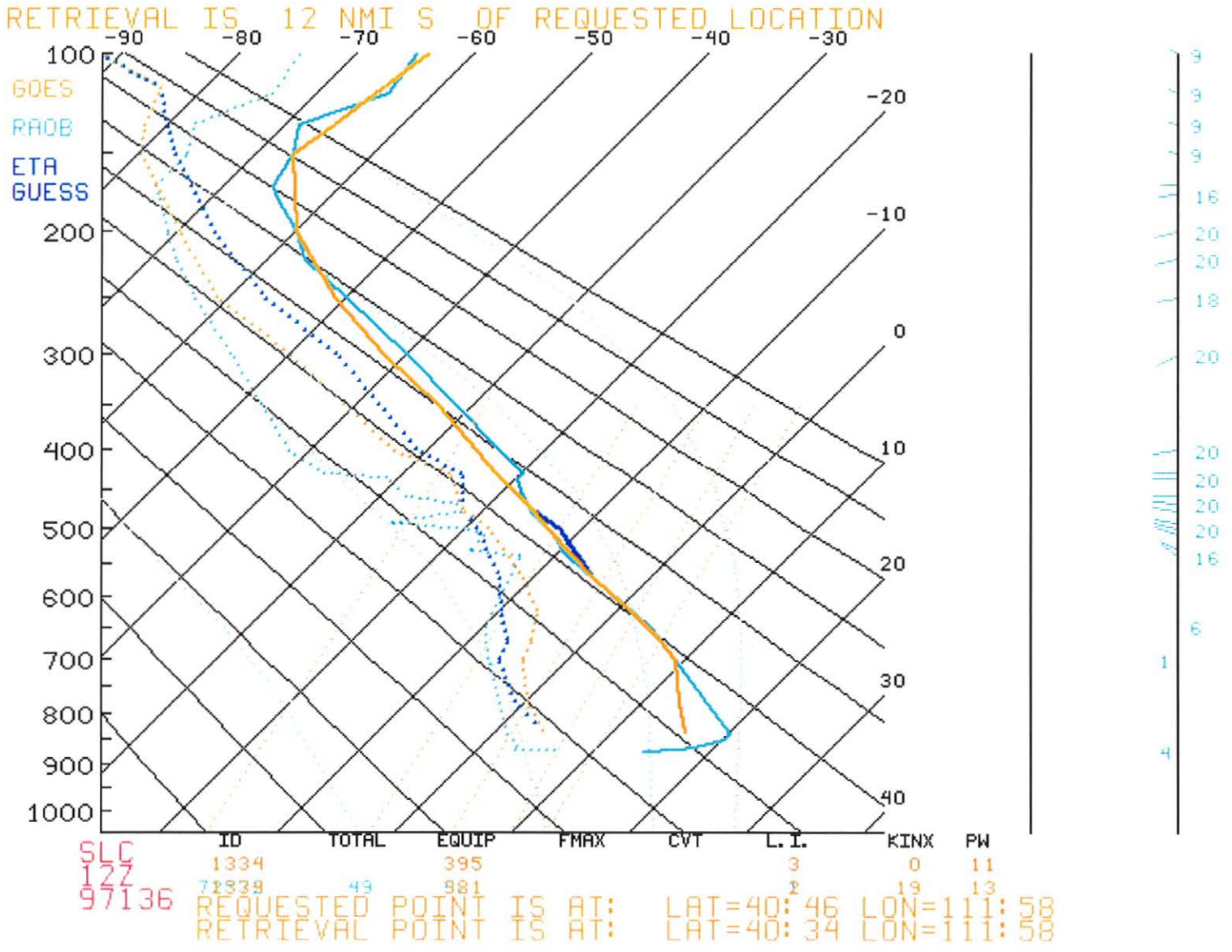


Figure 7. RAOB/GOES sounding comparison from SLC at 12Z on Julian date 97136.

RETRIEVAL IS 14 NMI NE OF REQUESTED LOCATION

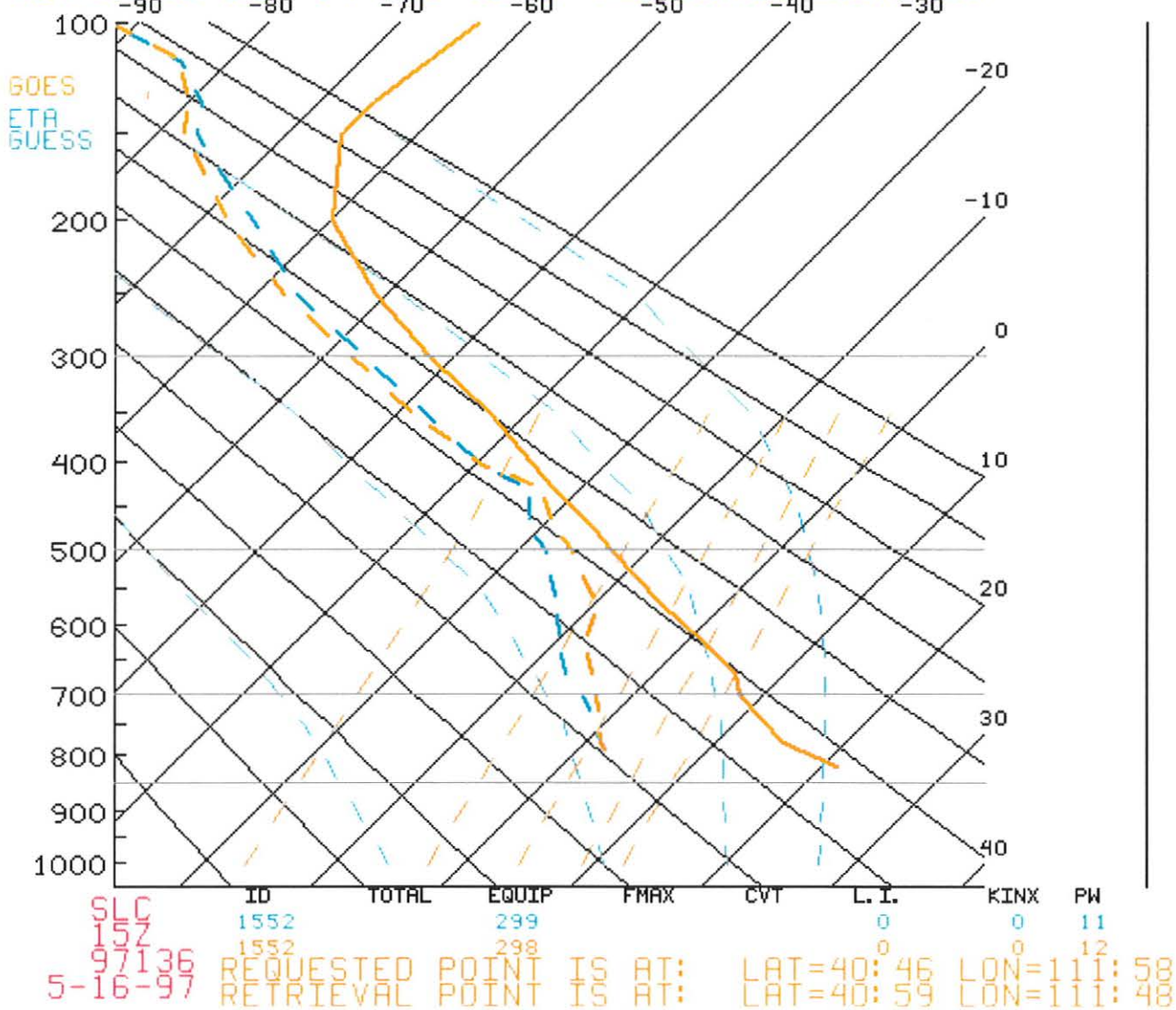


Figure 8. Hourly GOES sounding at SLC.

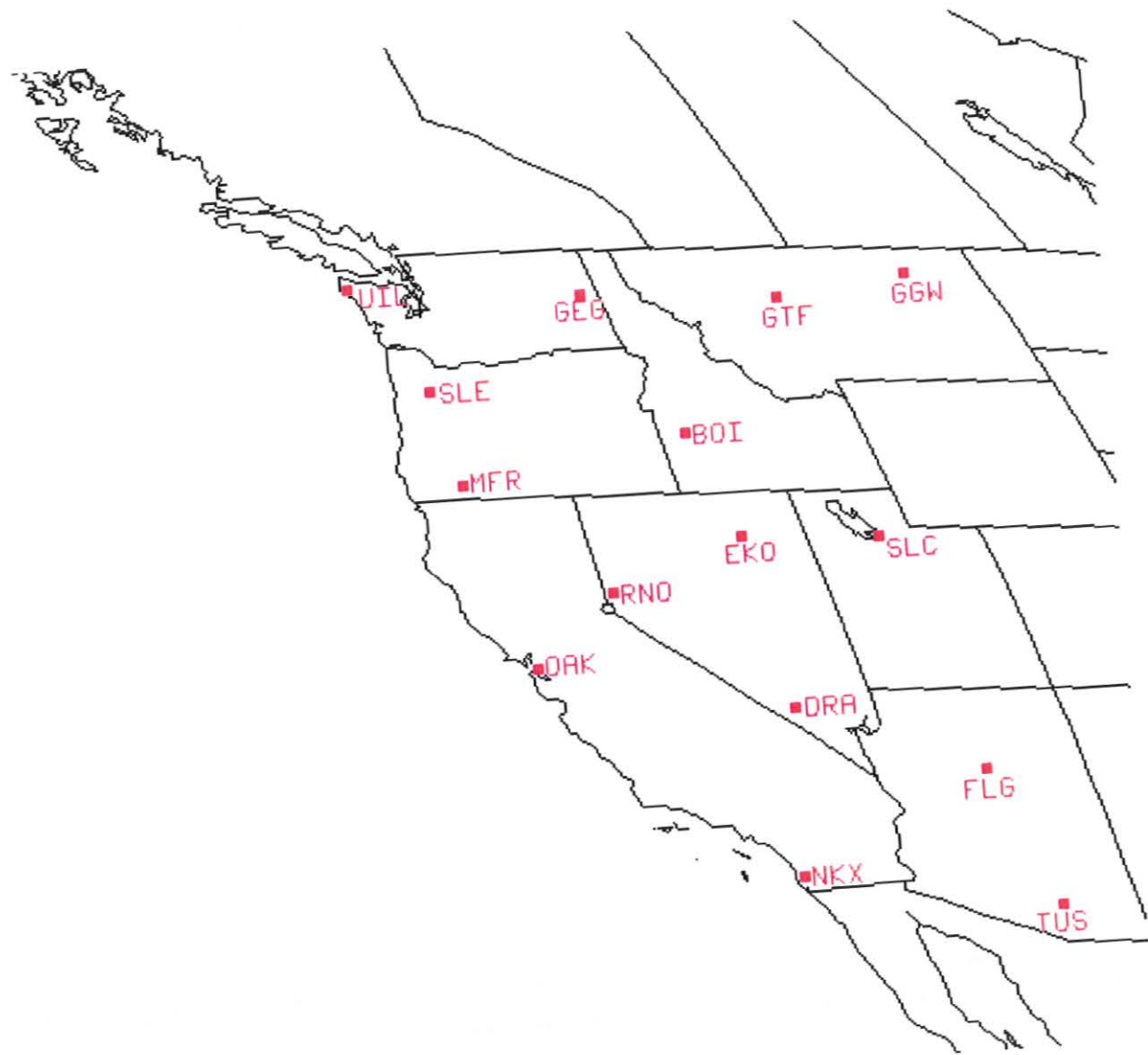


Figure 9. Imagemap for choosing RAOB/GOES comparison SKEWTs.



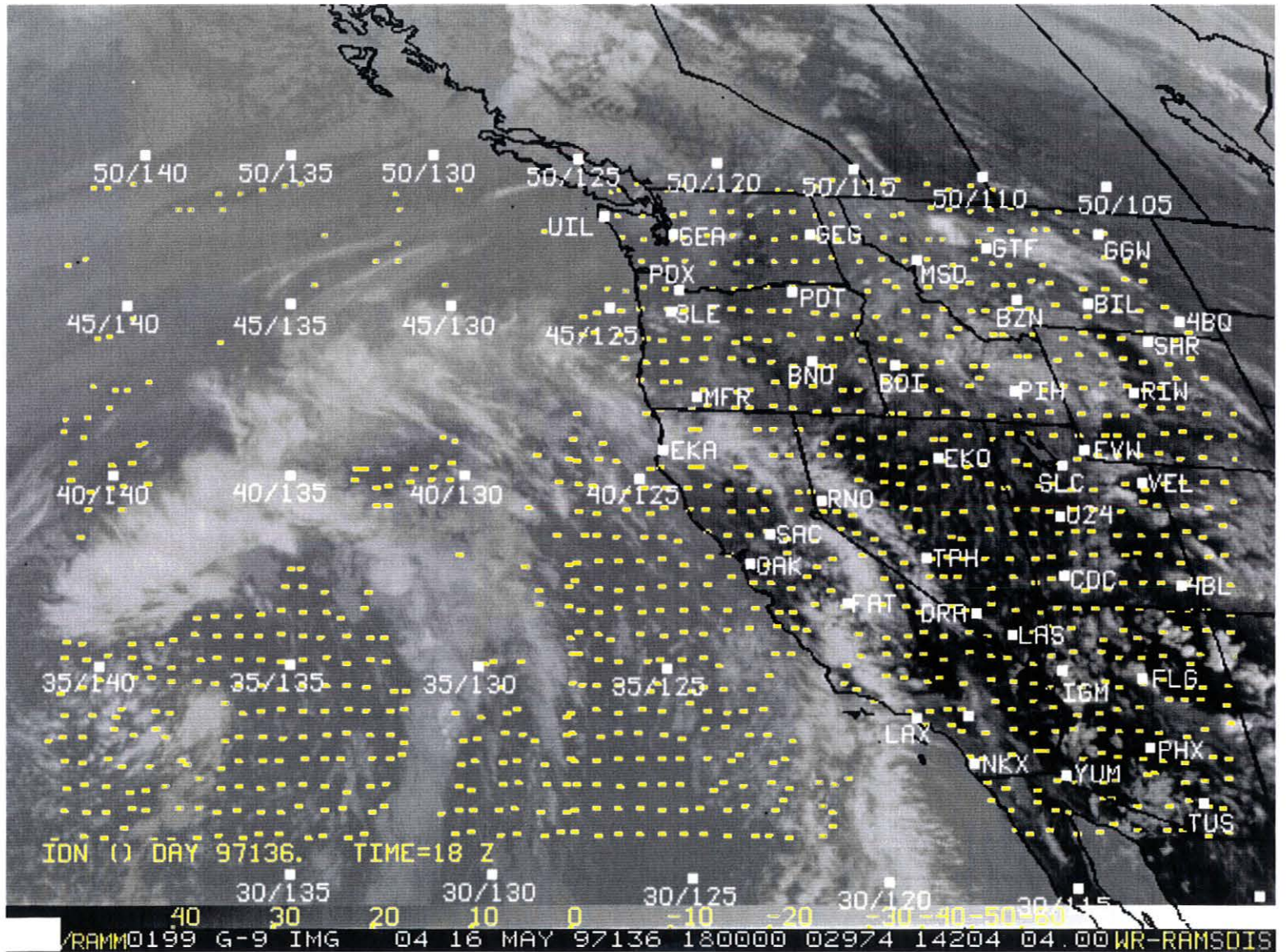


Figure 10. Imagemap for choosing a GOES soundings at a particular time.

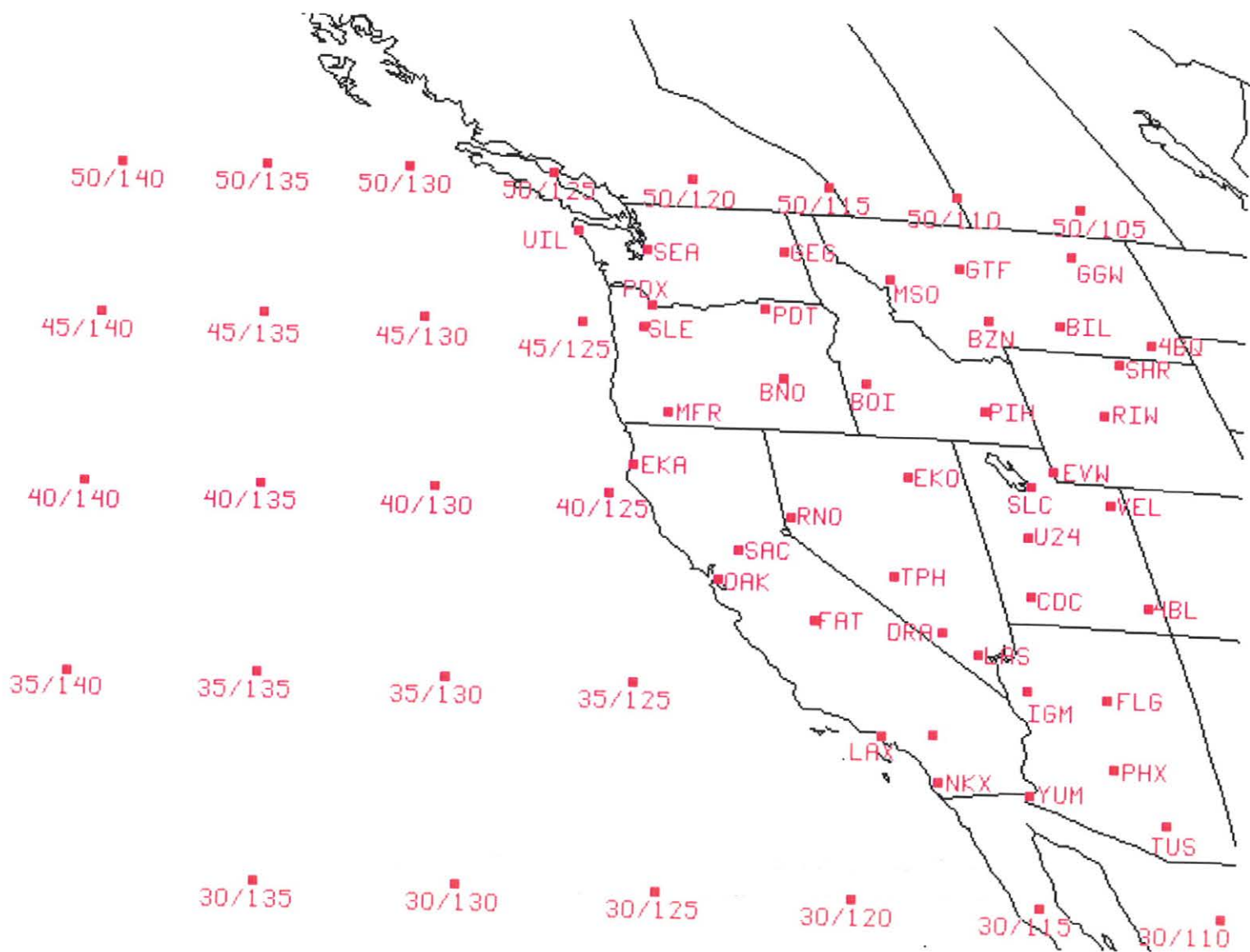


Figure 11. Imagemap for choosing a location of multiple hours of GOES soundings.