Classroom use of web-sourced weather maps

Mark Powers

Vergennes Union High School

http://www.uvm.edu/~swac/

Unisys Weather

- Unisys is the site I have used most in the last three years of this project. There are a number of products available on the site that are useful every day, some that can be used occasionally and some rarely or never in an introductory unit on weather data. The amount, and varying complexity of the data also allows for taking the project to higher levels of differentiation. In this presentation I will describe some of the useful locations on the site and how they can be used.
- http://weather.unisys.com/index.php

Unisys Weather Home Page
Notice navigation bar on the left

weather.unisys.com/index.php

Unisys.com | Weather Home | Analyses | Forecasts | Archives | NOAA Links | Contact Us

UNISYS

Unisys Weather

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- Satellite Images
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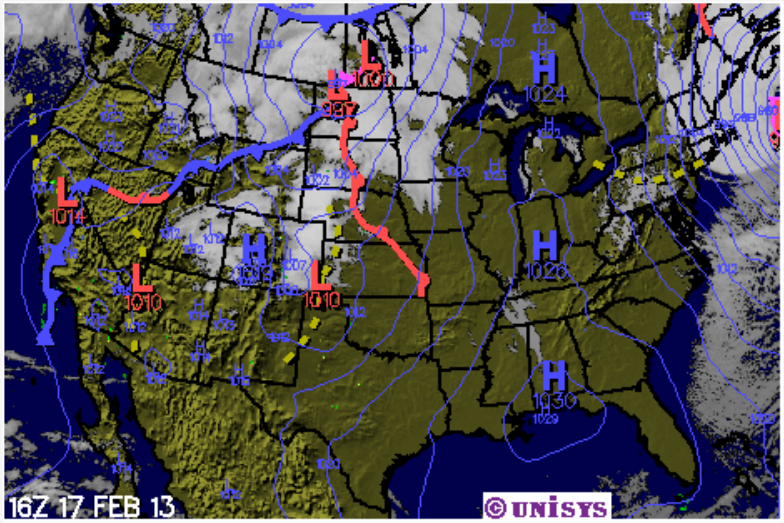
- Upper Air Data
- Radar Data

Forecasts
- Model Statistics
- NAM/Wrf Model
- GFS/Avn Model
- GFSx/MRF Model
- RAP Model



Current satellite image and surface map (Click on map for forecast) [loop]

Visible Satellite Image	Enh IR Satellite Image	Satellite Surface Map
US Radar Summary	NAM Model Forecast	GFSx 10 day Forecast

Unisys Weather News | National Weather Service

Visit us at the 93rd Annual AMS in Austin, TX!
Unisys Weather - January 4, 2013 - 8:44 PM

Upcoming NWS Tech Control Center Maintenance
Unisys Weather - December 11, 2012 - 6:30 PM

Get a Forecast

Enter a zip code or city name to get forecast:

Go | Setup

NOAA Links
- National Climatic Data Center
- Climate Prediction Center
- National Ocean Service
- NOAA Library
- NOAA Office of Oceanic and Atmospheric Research
- Earth Systems Research Laboratory

About Us
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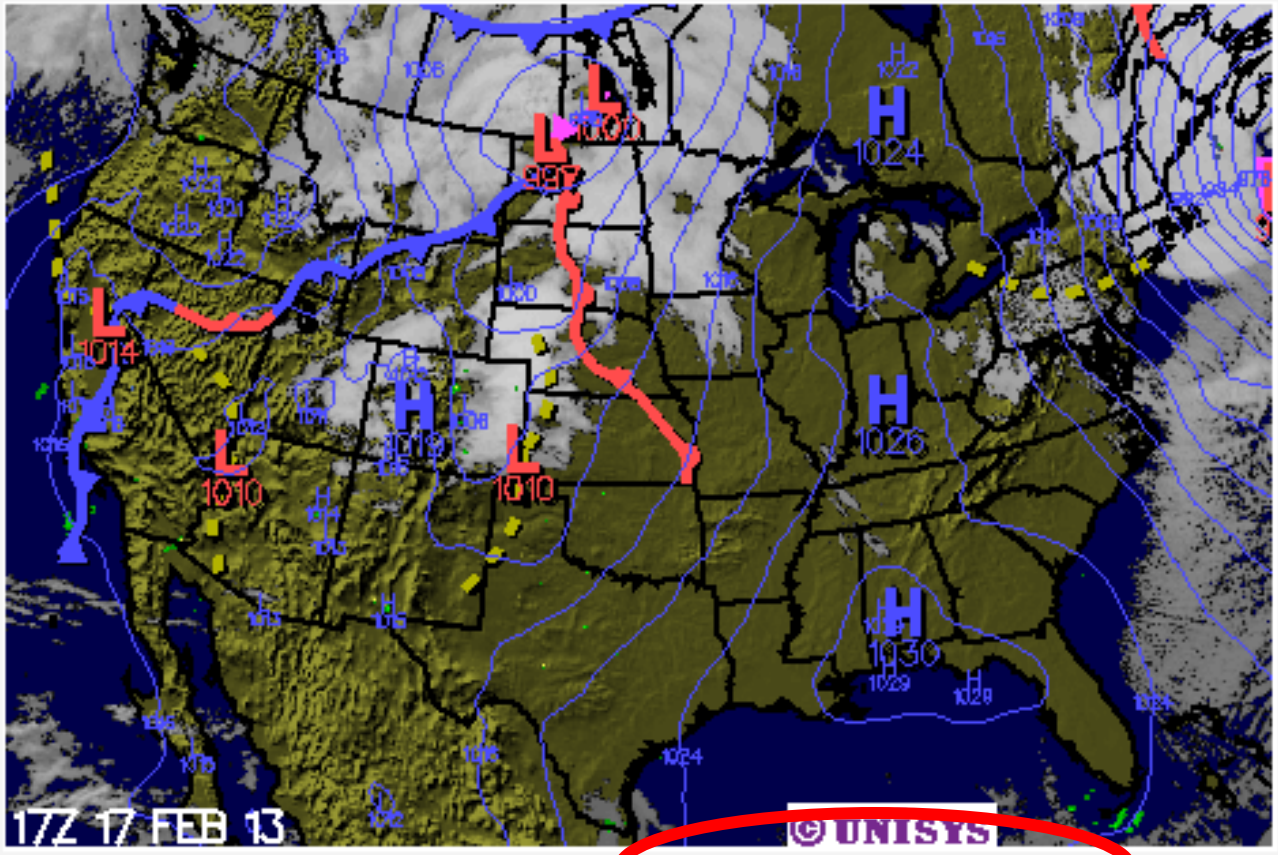
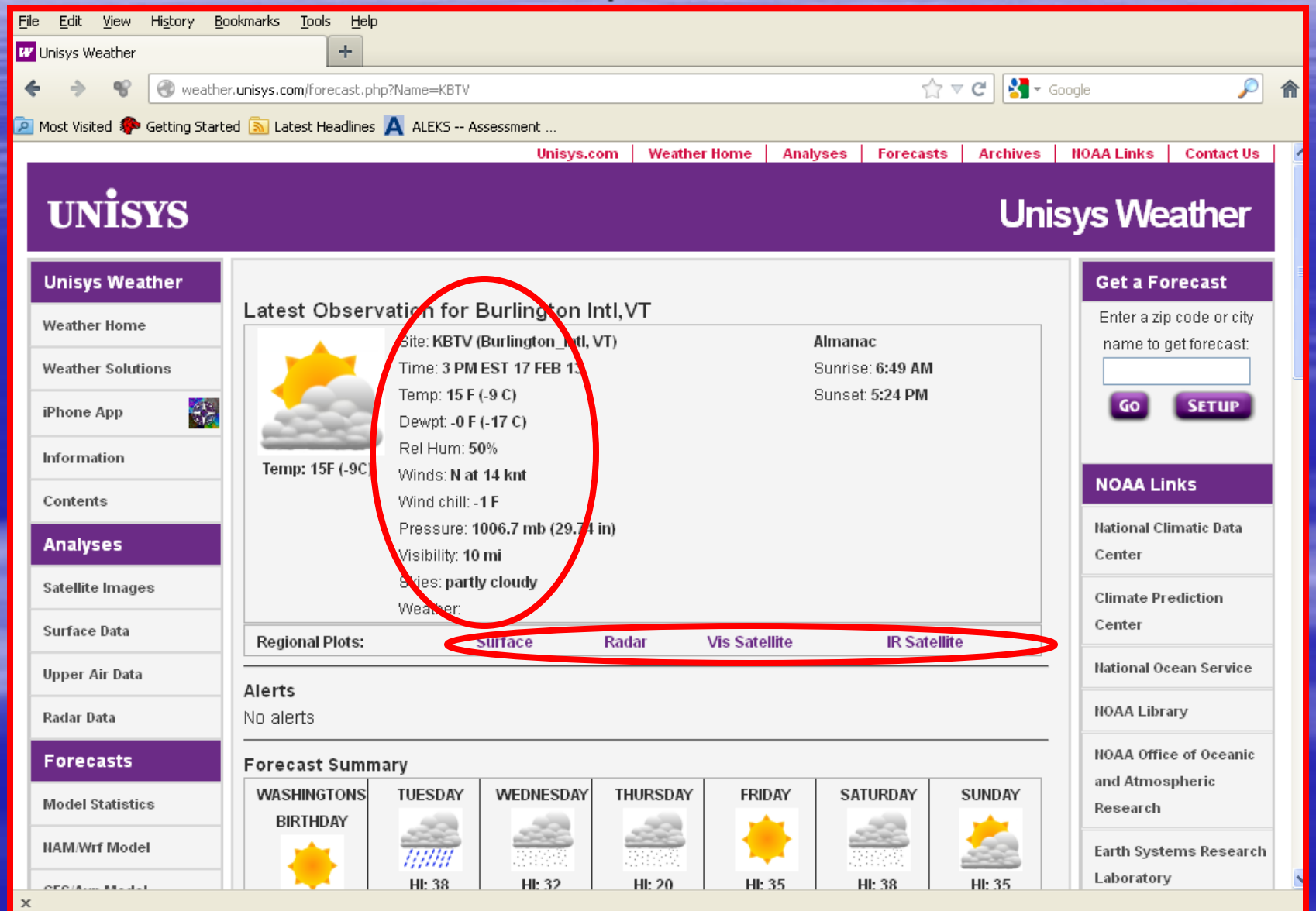
Home page shows a generalized daily weather map that has a loop capability to show weather system development, and a link to local forecasts.



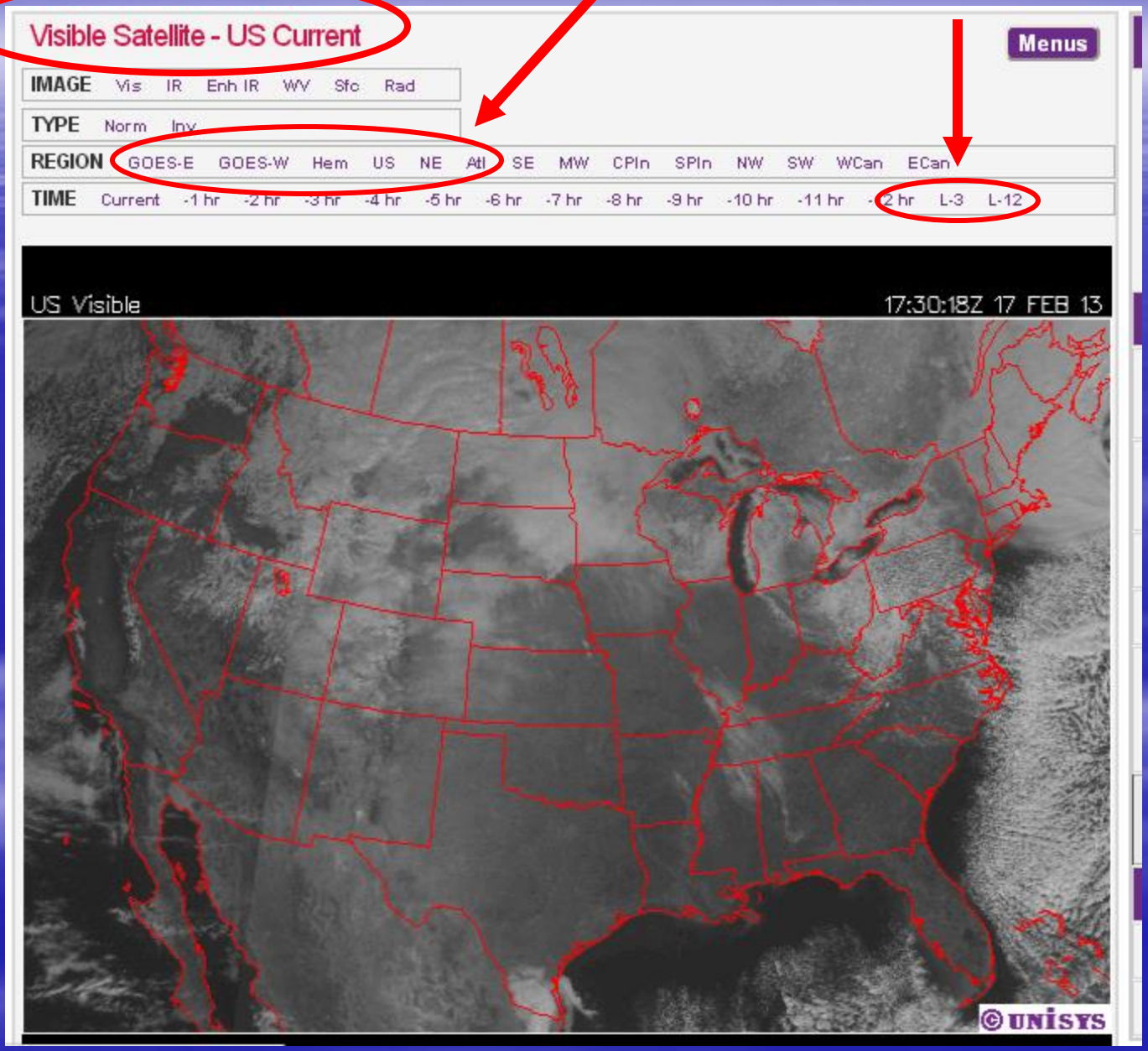
Current satellite image and surface map (Click on map for forecast) [loop]

Visible Satellite Image	Enh IR Satellite Image	Satellite Surface Map
US Radar Summary	NAM Model Forecast	GFSx 10 day Forecast

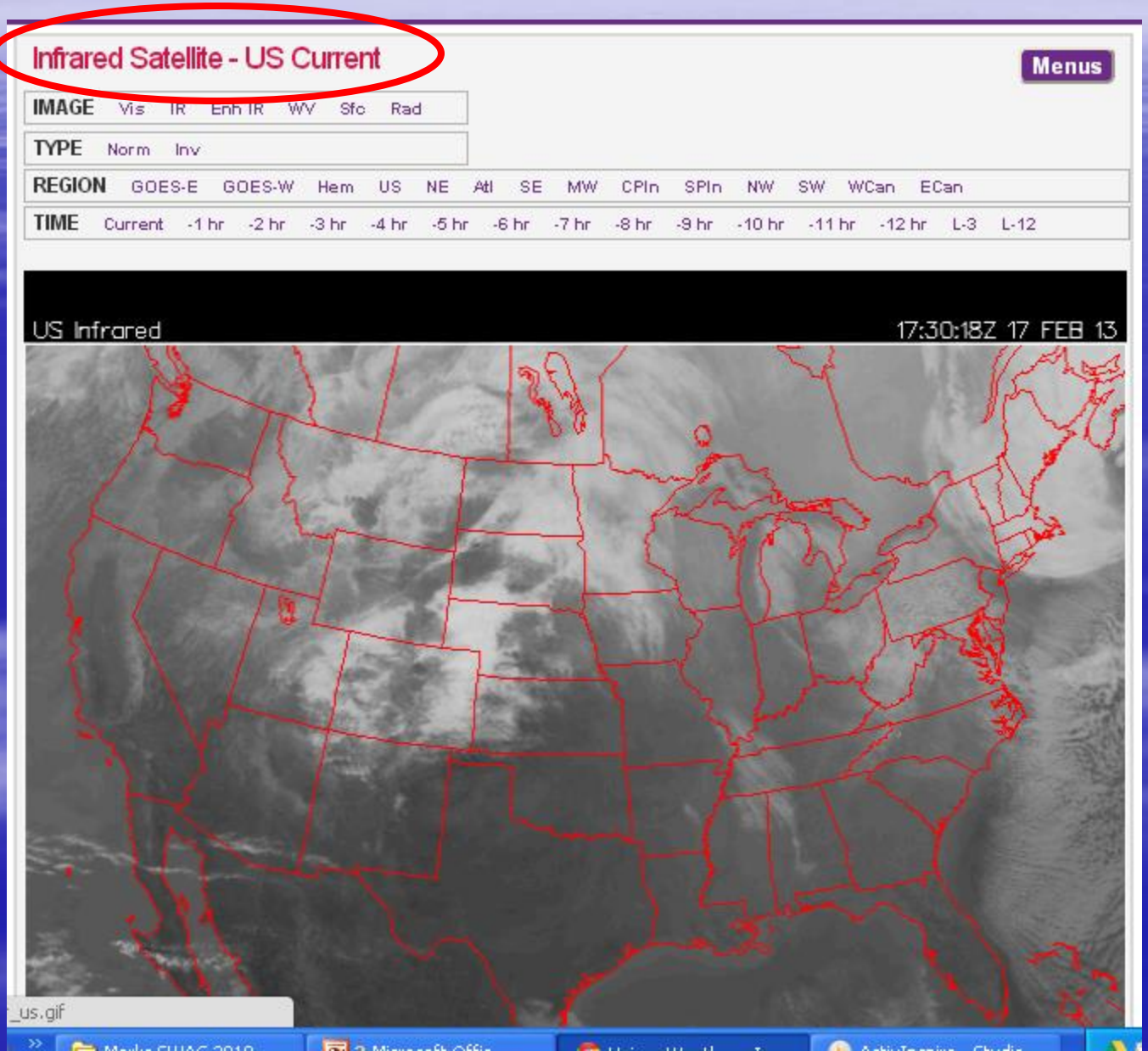
Typical link to local weather forecast, and links to regional plots



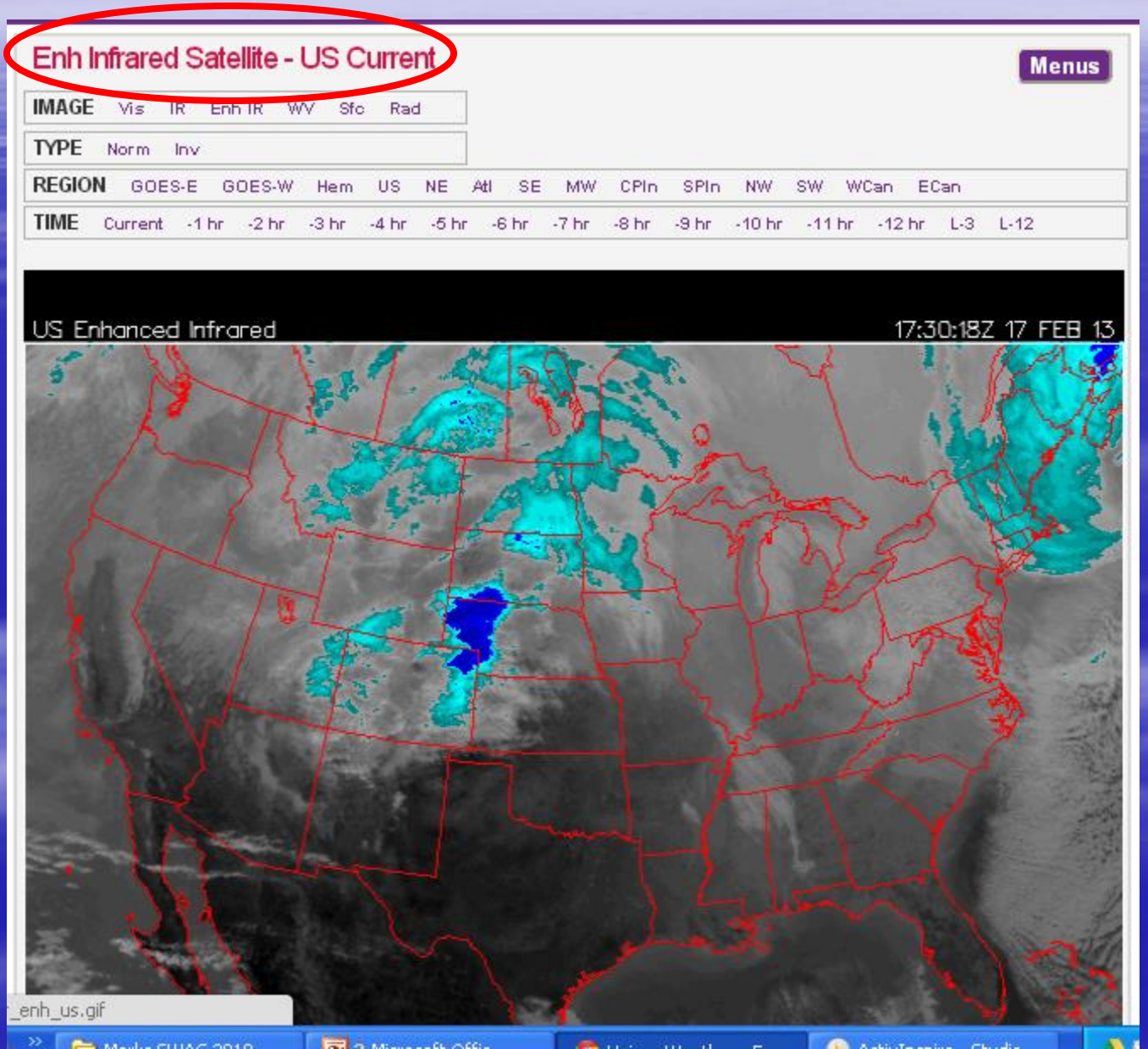
Satellite map showing regional choices and time options.



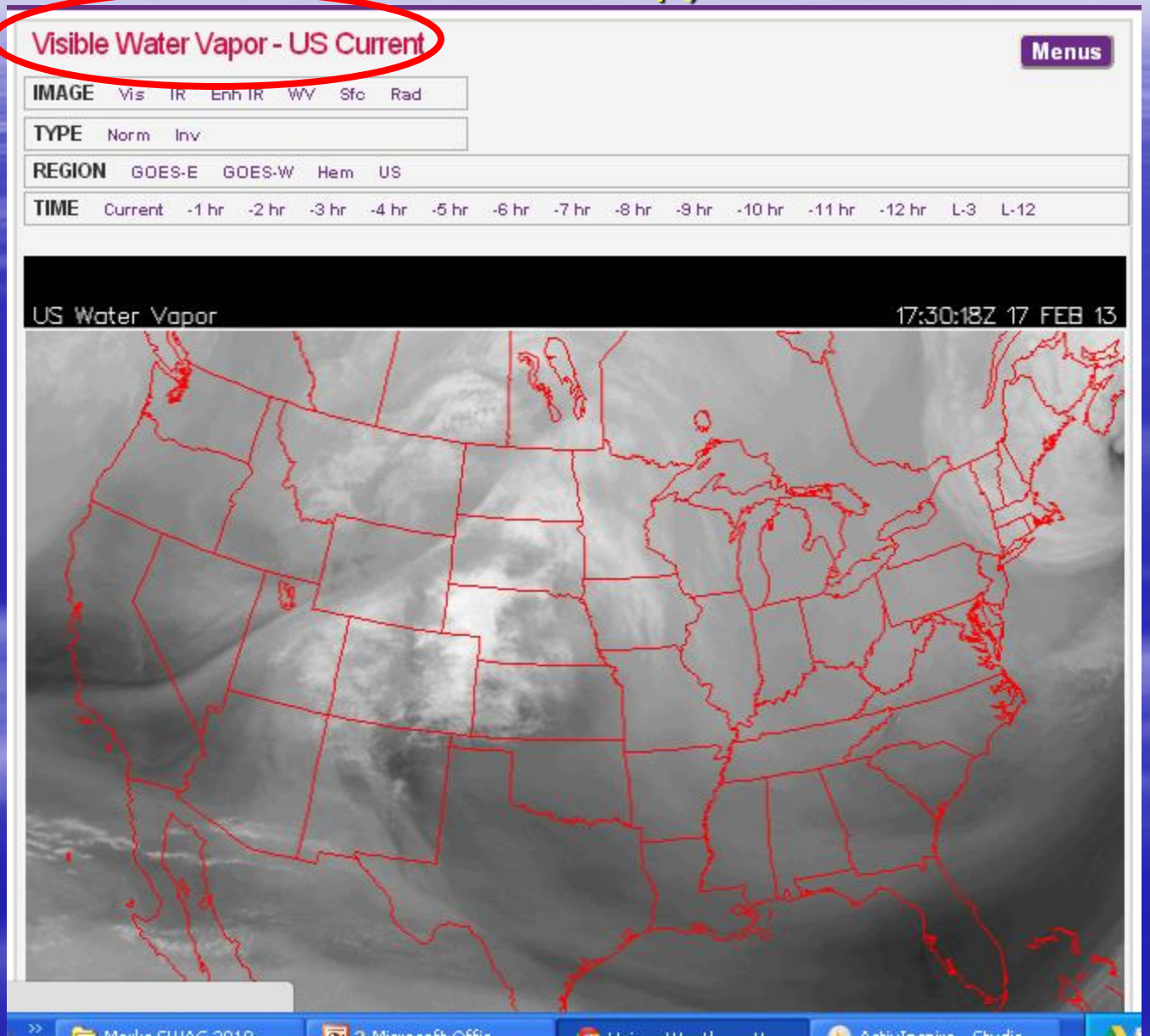
Infrared plot (compare to visible)



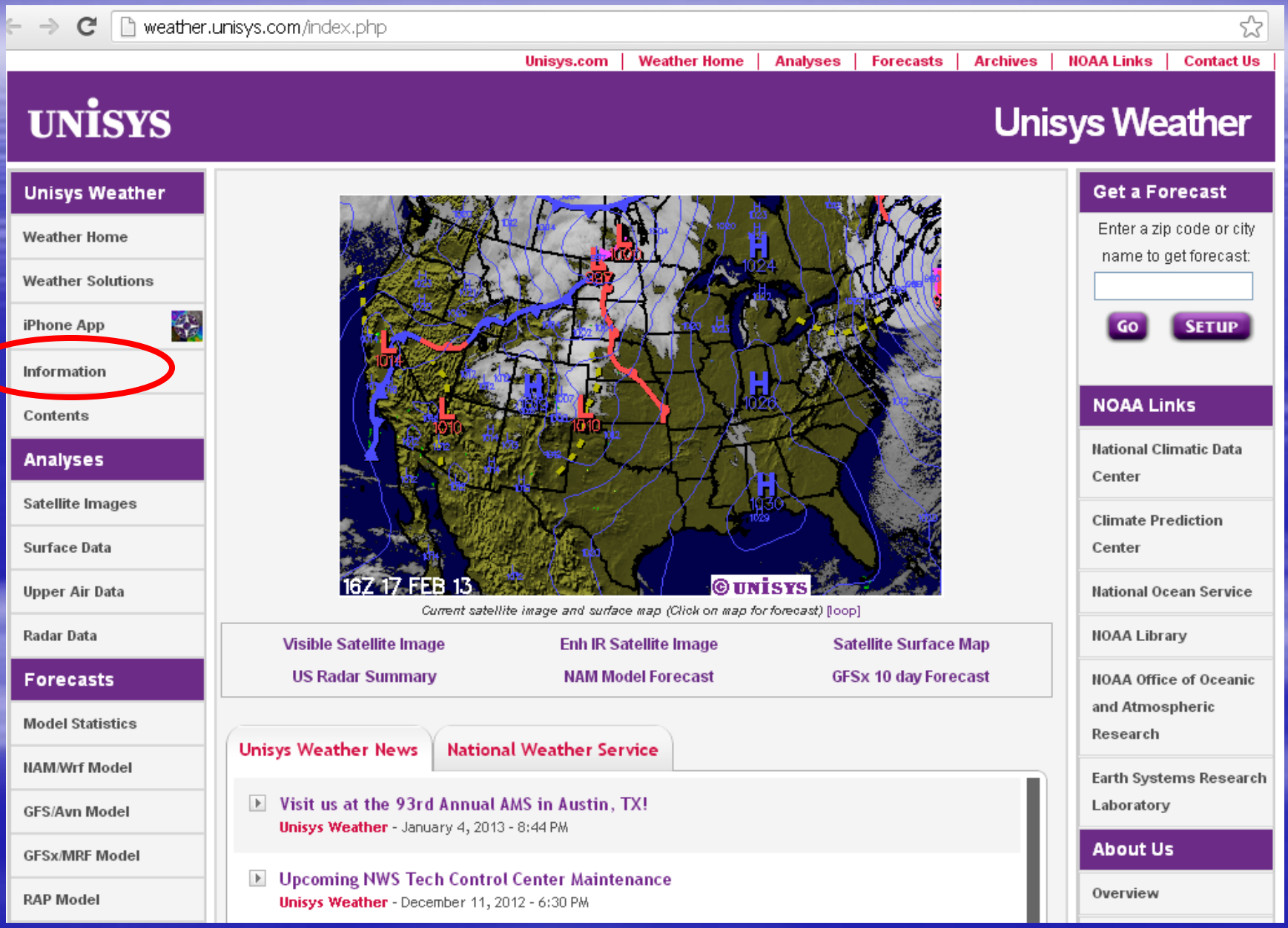
Enhanced Infrared plot (explain how Enh IR works)



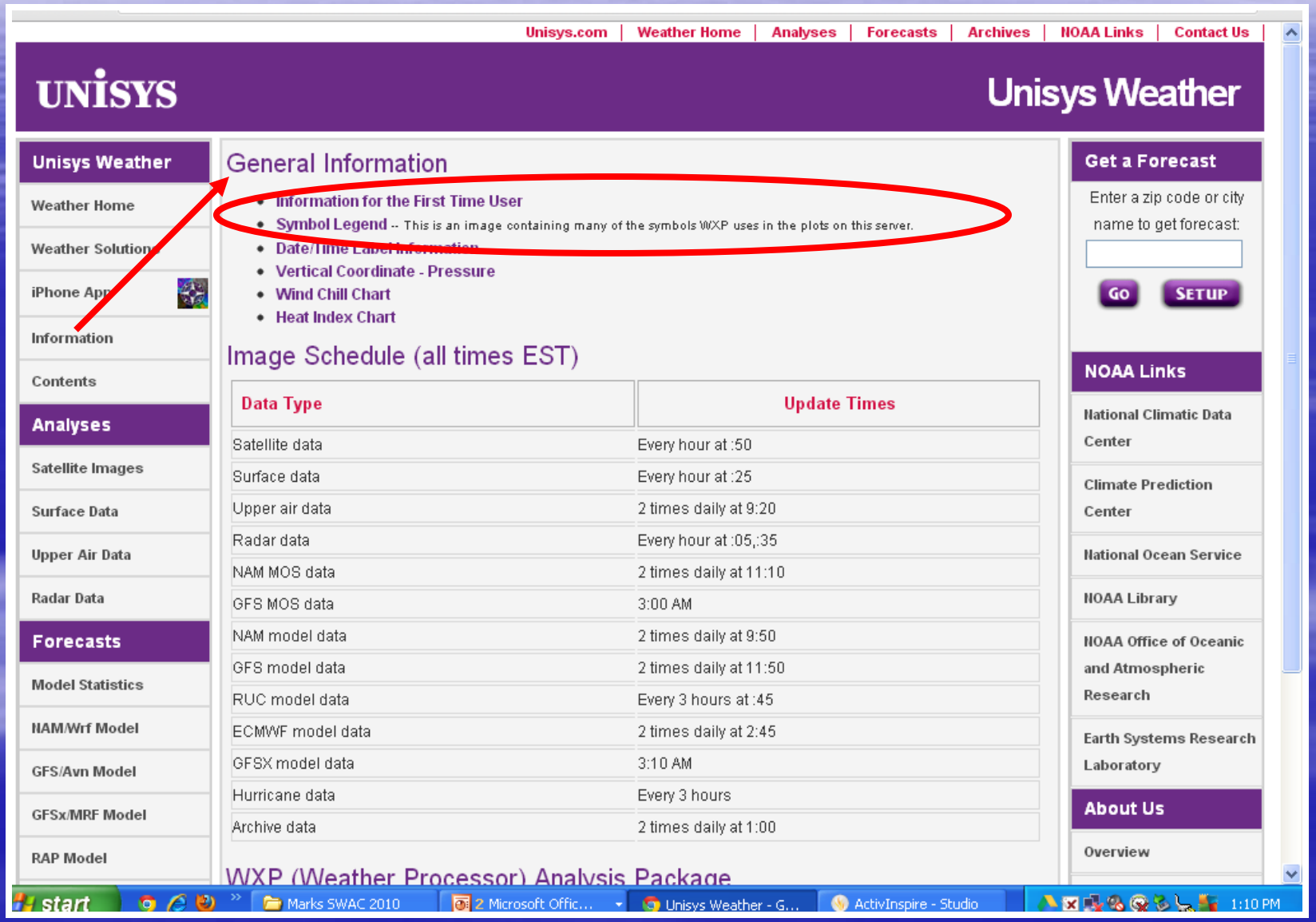
Visible water vapor plot (compare to location of fronts on main map)



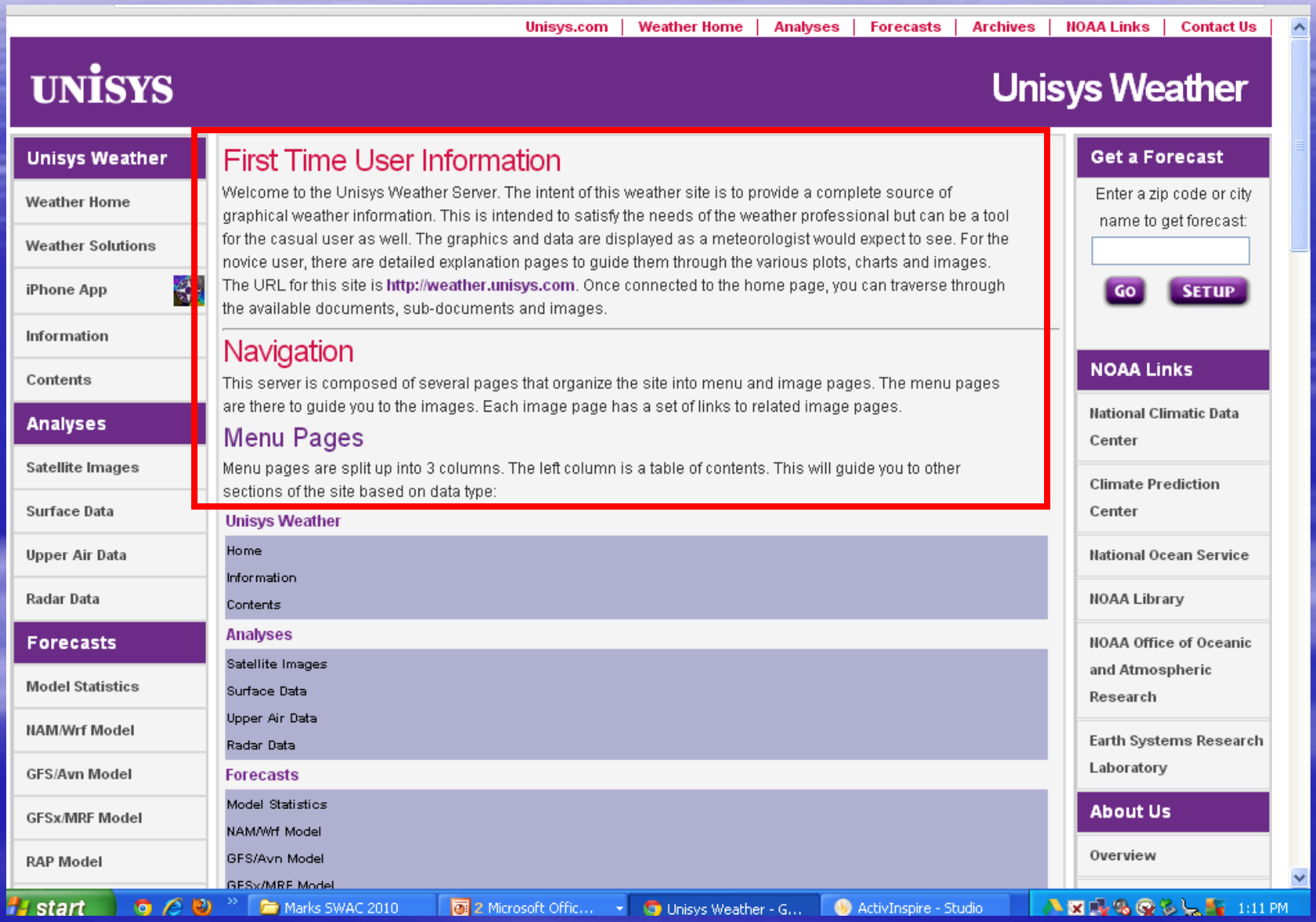
Link to general information about the site.



This linked page will be shown in the next several slides



Good page to inform users of various levels of the site features.



Archive information can be useful in a variety of applications.

Link to images

Daily Plots

Surface Meteograms

Information

Update Status

The "Plots" section will take you to image pages. The "Index" section will take you to other sub-menu pages. The "Information" section will take you to specific information pages on the generation of the images such as an update status. The update status page gives you the times each image was last generated.

Image Pages

Image pages contain the actual images. Each image page is split into three sections. The top section is the menubar section. This links to other similar images for quick navigation through the site.

PLOT	Temp	NA-Temp	24-Temp	WChill	Heat	Pres	3-Pres	Dewp	Wspd	Stream	QConv	TYPE	Norm	Inv

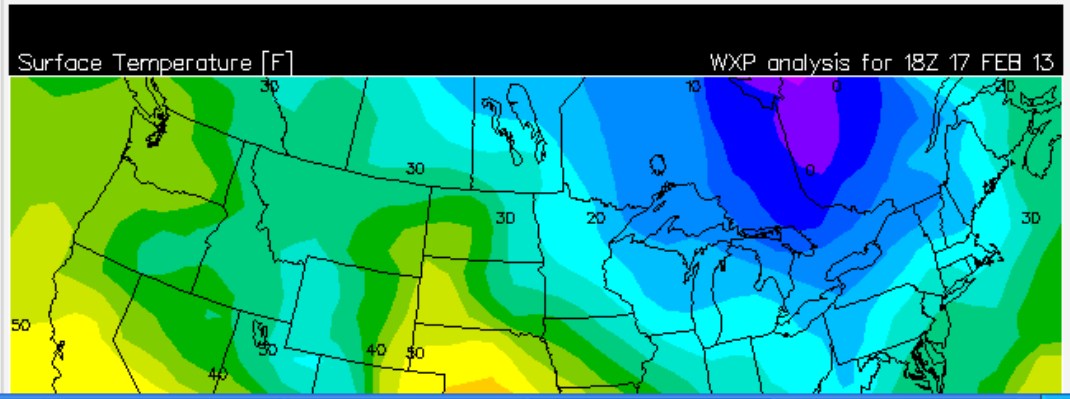
TIME	Current	-1hr	-2hr	-3hr	-4hr	-5hr	-6hr	-7hr	-8hr	-9hr	-10hr	-11hr	-12hr

The menu bar links to plots from other regions, other models, to other similar plots, to inverted plots (white background), and to archived images from previous hours.

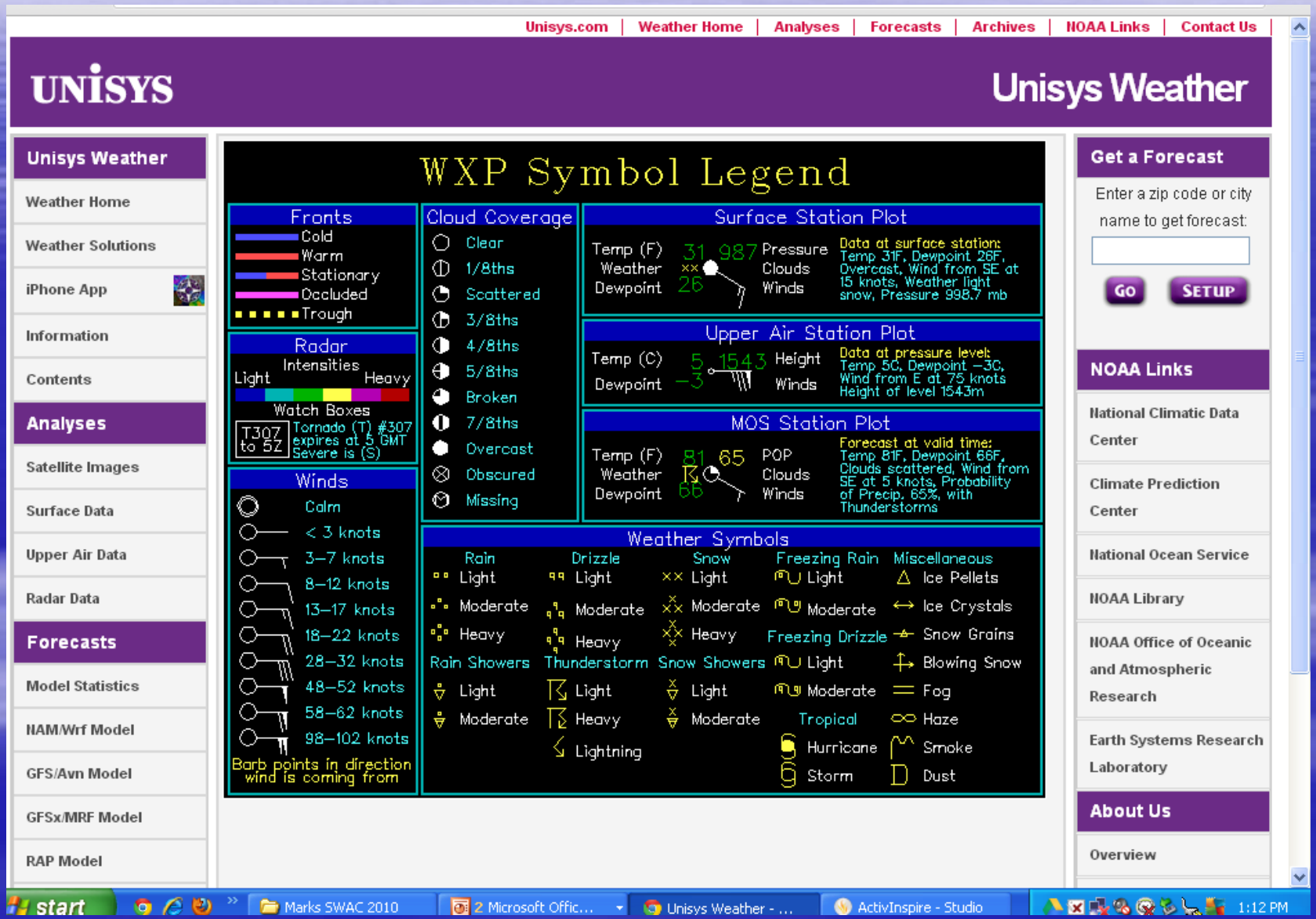
The second section is the image itself (see below).

The last section of the image page is a description section. In some cases, additional information to help interpret the plot will be contained in this section. The details pages will be more complete (see More information in the menu pages).

Images



Weather map symbols



Link to contents page

weather.unisys.com/index.php

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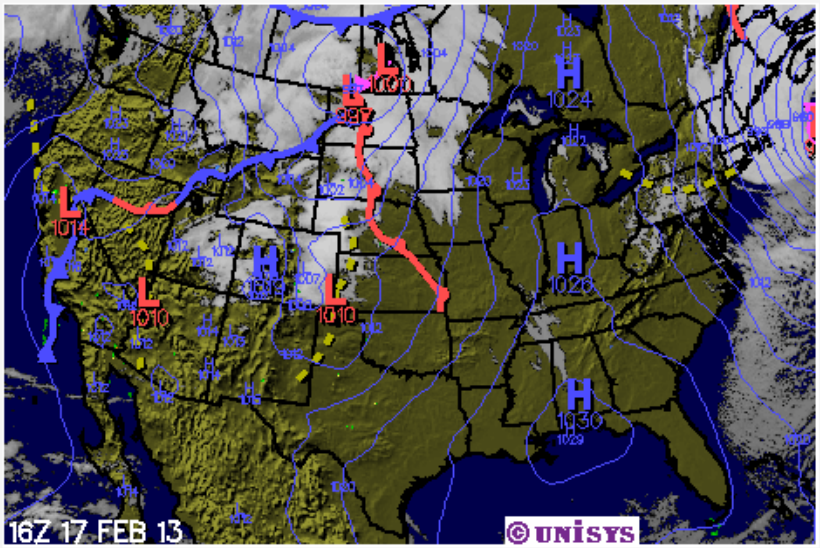

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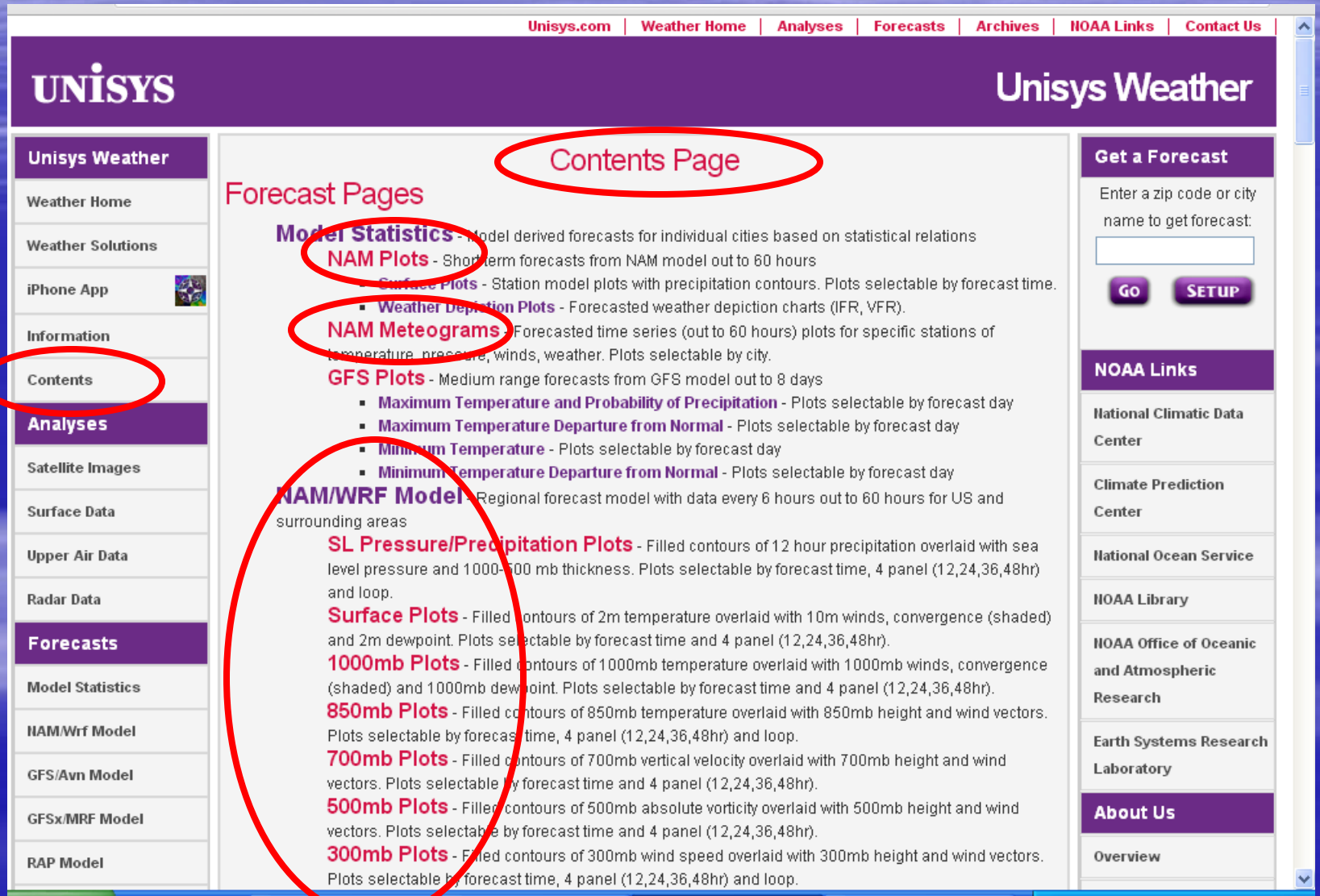
These plots are informative but are not basic.



300mb Plots - Filled contours of 300mb wind speed overlaid with 300mb height and wind vectors. Plots selectable by forecast time, 4 panel (12,24,36,48hr) and loop.

Relative Humidity/Lifted Index Plots - Filled contours of 850-500mb mean relative humidity overlaid with lifted index (shaded for negative). Plots selectable by forecast time, 4 panel (12,24,36,48hr) and loop.

4 Panel Plots - A 4 panel plot with 850mb data (upper left), 300mb data (upper right), SL Pressure/Precipitation data (lower left) and Relative Humidity/Lifted Index data (lower right). Plots selectable by forecast time.

Winter Plots - A 4 panel plot of surface temperature (upper left), wind chill (upper right), precipitation type (lower left) and snowfall accumulation (lower right). Plots selectable by forecast time on 3 hour increments.

Miscellaneous Plots

- **CAPE Plot** - A 4 panel plot of CAPE (12,24,36,48hr)
- **Helicity Plot** - A 4 panel plot of Helicity (12,24,36,48hr)
- **EHI Plot** - A 4 panel plot of Energy Helicity Index (12,24,36,48hr)
- **48 hour Precipitation** - 48 hour accumulated precipitation.
- **48 hour Snowfall** - 48 hour accumulated snowfall.

GFS Model - Forecast model with global data every 12 hours out to 72 hours

United States

- **SL Pressure/Precipitation Plots** - Filled contours of 12 hour precipitation overlaid with sea level pressure and 1000-500 mb thickness. Plots selectable by forecast time, 6 panel (12,24,36,48,60,72hr).
- **1000mb Plots** - Filled contours of 1000mb temperature overlaid with 1000mb winds, convergence (shaded) and 1000mb dewpoint. Plots selectable by forecast time and 6 panel (12,24,36,48,60,72hr).
- **850mb Plots** - Filled contours of 850mb temperature overlaid with 850mb height and wind vectors. Plots selectable by forecast time, 6 panel (12,24,36,48,60,72hr)
- **700mb Plots** - Filled contours of 700mb vertical velocity overlaid with 700mb height and wind vectors. Plots selectable by forecast time and 6 panel (12,24,36,48,60,72hr).
- **500mb Plots** - Filled contours of 500mb absolute vorticity overlaid with 500mb height and wind vectors. Plots selectable by forecast time and 6 panel (12,24,36,48,60,72hr).
- **300mb Plots** - Filled contours of 300mb wind speed overlaid with 300mb height and wind vectors. Plots selectable by forecast time, 6 panel (12,24,36,48,60,72hr)
- **Relative Humidity/Showalter Index Plots** - Filled contours of 850-500mb mean relative humidity overlaid with Showalter index (shaded for negative). Plots selectable by forecast time, 6 panel (12,24,36,48,60,72hr)
- **4 Panel Plots** - A 4 panel plot with 850mb data (upper left), 300mb data (upper right), SL

Both plots are interesting to see what similarities and differences there are in these areas.

(12,24,36,48,60,72hr)

- **4 Panel Plots** - A 4 panel plot with 850mb data (upper left), 300mb data (upper right), SL Pressure/Precipitation data (lower left) and Relative Humidity/Showalter Index data (lower right). Plots selectable by forecast time.
- **Miscellaneous Plots** - Plots of 48 hour accumulated precipitation.

Europe

6 Panel Plots

- **SL Pressure/Precipitation Plot**
- **1000mb Plots**
- **850mb Plots**
- **700mb Plots**
- **500mb Plots**
- **300mb Plots**
- **Relative Humidity/Showalter Index Plots**

4 Panel Plots - A 4 panel plot with 850mb data (upper left), 300mb data (upper right), SL Pressure/Precipitation data (lower left) and Relative Humidity/Showalter Index data (lower right). Plots selectable by forecast time.

East Asia

6 Panel Plots

- **SL Pressure/Precipitation Plot**
- **1000mb Plots**
- **850mb Plots**
- **700mb Plots**
- **500mb Plots**
- **300mb Plots**
- **Relative Humidity/Showalter Index Plots**

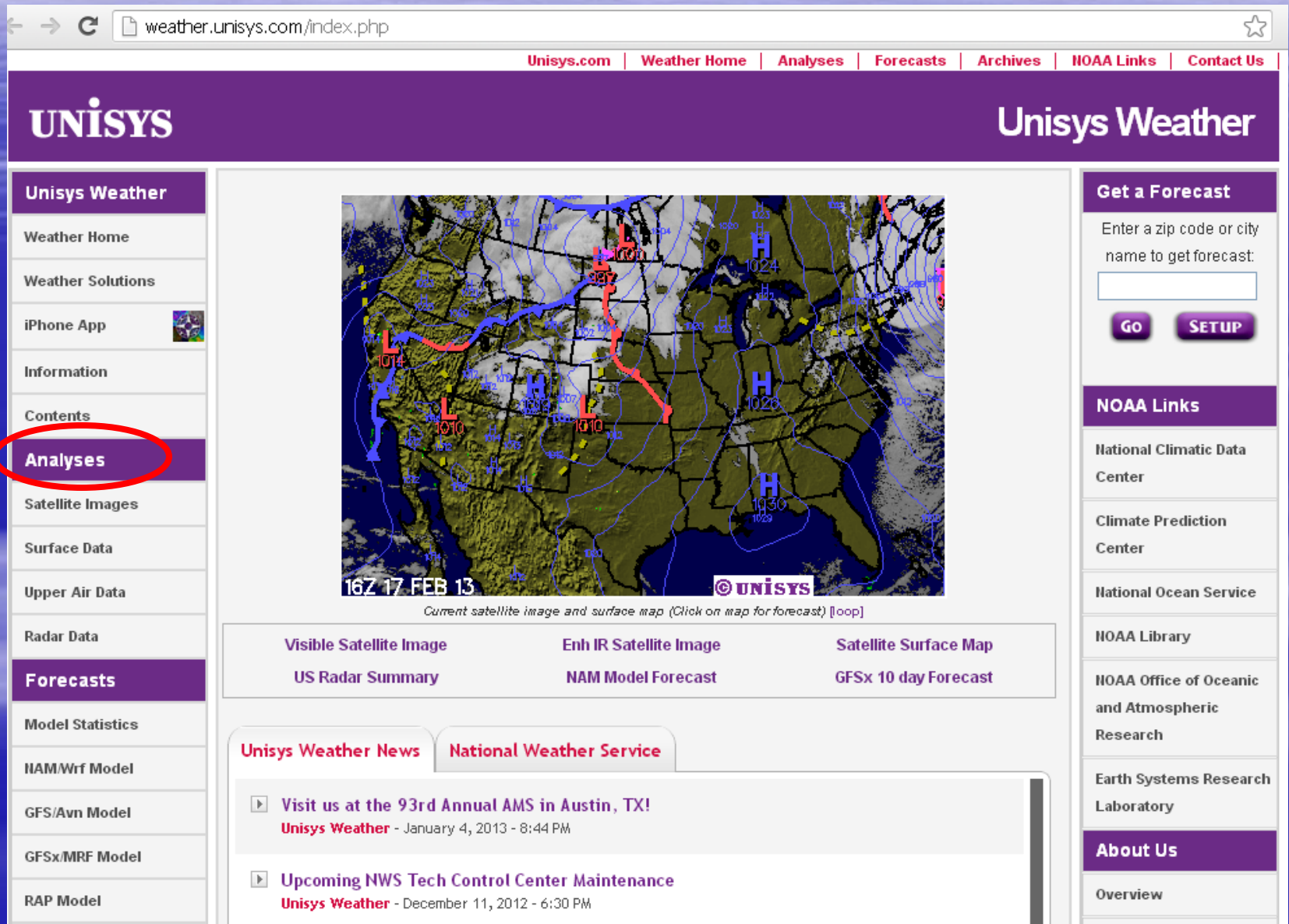
4 Panel Plots - A 4 panel plot with 850mb data (upper left), 300mb data (upper right), SL Pressure/Precipitation data (lower left) and Relative Humidity/Showalter Index data (lower right). Plots selectable by forecast time.

South America

6 Panel Plots

- **SL Pressure/Precipitation Plot**
- **1000mb Plots**
- **850mb Plots**
- **700mb Plots**
- **500mb Plots**
- **300mb Plots**

Link to analyses section where some data plots will be familiar while others may not.



I display some of these occasionally to show how graphic displays can show numerical data in another way.

Analyses Pages

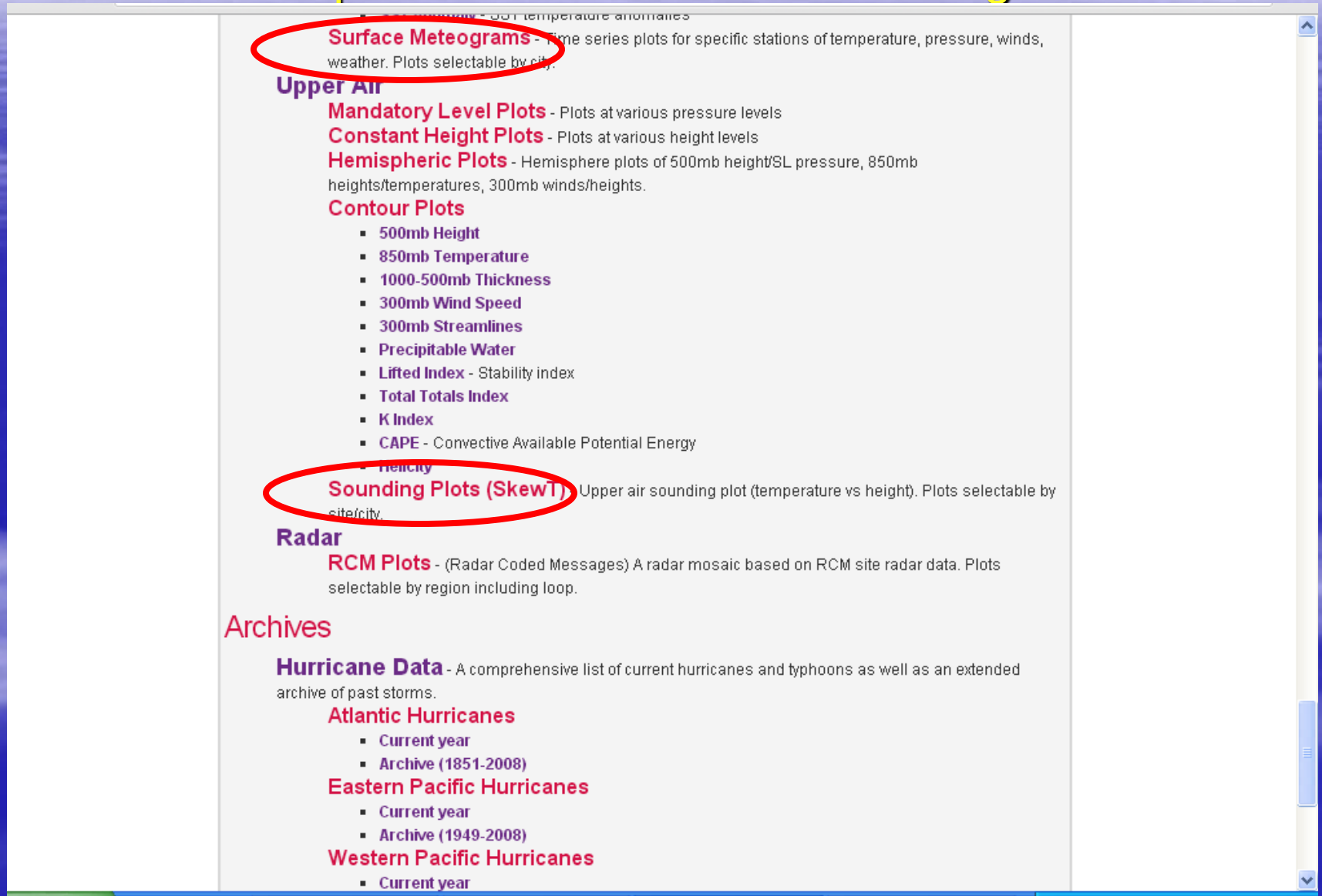
Satellite

- **Visible Images** -Images selectable by region including loop
- **Infrared Images** - Images selectable by region including loop
- **Enhanced Infrared Images** - Images selectable by region including loop
- **Water Vapor Images** - Images selectable by region including loop
- **Composite Images**
  - **Satellite Surface Map** - IR Satellite + Surface Map
  - **IR Satellite and Radar Map**

Surface

- **Composite Maps**
  - **Surface Map**
  - **Weather Depiction** - Aviation weather chart (IFR, VFR)
  - **Fronts** - Current frontal positions
- **Regional Data Plots** - Surface (station model) plots by region
- **Contour Plots**
  - **US Temperature**
  - **N Amer Temperature**
  - **US 24 hr Temperature Change**
  - **US Wind Chill**
  - **US Heat Index**
  - **US SL Pressure**
  - **US 3 hr Pressure Change**
  - **US Dewpoint**
  - **US Wind Speed**
  - **US Wind Streamlines**
  - **US Moisture Convergence**
- **Daily Plots**
  - **US High Temperature**
  - **US Low Temperature**
  - **US Daily Precipitation**
  - **US Monthly Precipitation** - Precipitation for the month so far
  - **US Snow Cover**
  - **SST Plot** - Sea Surface Temperatures
  - **SST Anomaly** - SST temperature anomalies
- **Surface Meteograms** - Time series plots for specific stations of temperature, pressure, winds

The meteograms are a good compilation display and the Skew T plots are of interest to people who have some experience with balloon soundings



- Surface Meteograms - Time series plots for specific stations of temperature, pressure, winds, weather. Plots selectable by city.

Upper Air

- Mandatory Level Plots - Plots at various pressure levels
- Constant Height Plots - Plots at various height levels
- Hemispheric Plots - Hemisphere plots of 500mb height/SL pressure, 850mb heights/temperatures, 300mb winds/heights.
- Contour Plots
  - 500mb Height
  - 850mb Temperature
  - 1000-500mb Thickness
  - 300mb Wind Speed
  - 300mb Streamlines
  - Precipitable Water
  - Lifted Index - Stability index
  - Total Totals Index
  - K Index
  - CAPE - Convective Available Potential Energy
  - Helicity
- Sounding Plots (SkewT) - Upper air sounding plot (temperature vs height). Plots selectable by site/city.

Radar

- RCM Plots - (Radar Coded Messages) A radar mosaic based on RCM site radar data. Plots selectable by region including loop.

Archives

Hurricane Data - A comprehensive list of current hurricanes and typhoons as well as an extended archive of past storms.

- Atlantic Hurricanes
  - Current year
  - Archive (1851-2008)
- Eastern Pacific Hurricanes
  - Current year
  - Archive (1949-2008)
- Western Pacific Hurricanes
  - Current year

Good historic data here for a possible project.

site/city.

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RCM Plots - (Radar Coded Messages) A radar mosaic based on RCM site radar data. Plots selectable by region including loop.

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- Archive (1851-2008)

Eastern Pacific Hurricanes
- Current year
- Archive (1949-2008)

Western Pacific Hurricanes
- Current year
- Archive (1945-2007)

Southern Pacific Hurricanes
- Current year

Southern Indian Hurricanes
- Current year
- Archive (1945-2003)

Northern Indian Hurricanes
- Current year
- Archive (1945-2003)

Archive of Images - A long term archive of images stored on a 12 hour basis.

Surface Map - Surface map including station model, fronts, radar and SL pressure contours.

Infrared Satellite Image - Infrared satellite image.

Upper Air Charts - This is a 4 panel plot from the NAM model analysis with 850mb data (upper left), 300mb data (upper right), SL Pressure/Precipitation data (lower left) and Relative Humidity/Showalter Index data (lower right).

SST Plot - Sea Surface Temperature plots (including anomalies) archived on a weekly basis.

USGS Maps - A set of USGS maps made from DEM (Digital Elevation Model) data and overlaid with roads from the DLG (Digital Line Graph) data set.

SWAC modules tie in well with this section

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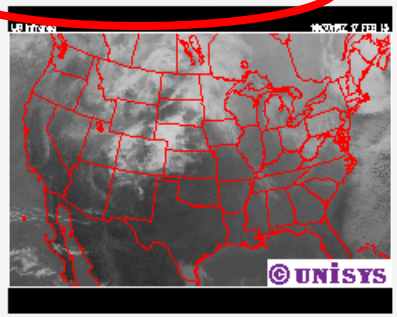

Current US infrared image

These images are generated by geostationary satellites orbitting 22,000 miles above the equator looking at the United States. These include visible, infrared and water vapor images. The images are updated once an hour at about 30 after the hour.

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A brief but helpful introduction to satellite images.

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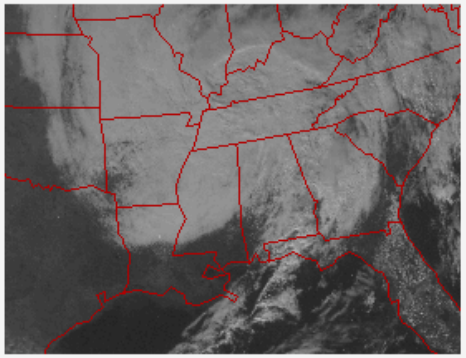
Satellite Image Details

These images are generated by geostationary satellites orbitting 22,000 miles above the equator. These include visible, infrared and water vapor images. The images are updated once an hour at 50 after the hour.

Visible Satellite Image



Sample visible image

This image is the equivalent of taking a black and white photo of the earth. The bright areas show where the sun is being reflected back into space as a result of clouds or snow cover. Clouds and snow show up white. The thicker the cloud, the brighter the color. Land surfaces show up as gray and ocean surfaces nearly black. The major limitation to visible imagery is that it is only valid during daylight.
There are 5 sectors for the visible image:

1. **East** - GOES east view centered over 75 west longitude showing eastern US and Atlantic Ocean.
2. **West** - GOES west view centered over 125 west longitude showing western US and Pacific Ocean.
3. **Hemisphere** - this is a pieced/merge view of both the GOES east and GOES west satellite views remapped to a Mercator projection.
4. **US** - this is a pieced view of GOES east and west remapped to a polar stereographic projection.
5. **Regional** - these are regional views remapped to a polar stereographic projection.

Infrared Satellite Image

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Again, a brief but helpful description.

RAP Model
ECMWF Model
Archive
Hurricane Data
Archive of Images
USGS Maps

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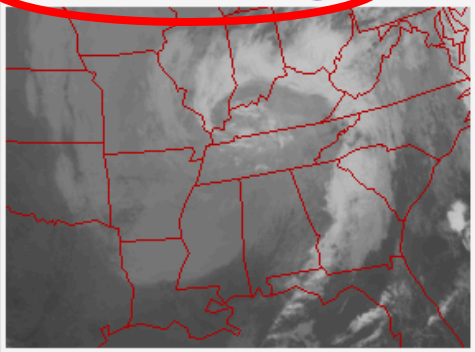
Infrared Satellite Image



Sample infrared image

This type of image shows heat based radiation from the infrared spectrum. In other words, the warmer the surface, the more infrared radiation it emits. For a satellite image, cooler surfaces are bright and warmer surfaces are dark. Since the atmosphere cools as you increase in altitude, clouds would show up as bright areas and land surfaces as dark areas. In addition, low clouds will be more gray and higher clouds will show up more white. Tall thunderstorm clouds will show up as bright white and fog will be hard to decern from land areas. A large advantage of IR is that you can view it 24 hours a day.
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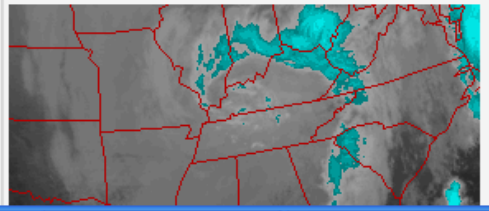
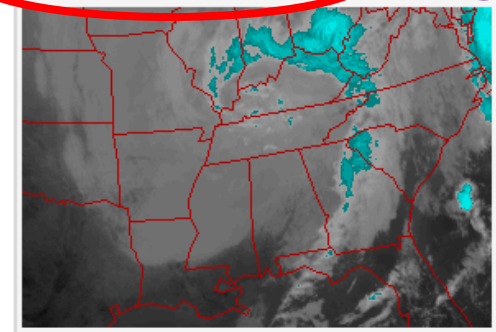
Enhanced Infrared Satellite Image



Description of the benefit of false color imagery.

Enhanced Infrared Satellite Image



Sample enhanced infrared image

This is an infrared image enhanced to highlight the cloud areas and the coldest cloud tops. Since, IR images could be used to determine cloud height, these images are enhanced to highlight the highest, coldest cloud tops. Areas of strong precipitation will show up as shades of cyan. Thunderstorms will show up in blue and green. In addition, the contrast of warmer clouds is increased so that low clouds will show up. A color bar at the bottom of the image will describe the enhancement scheme. The tick marks at the top of the bar represent 10 degree Celsius increments starting at 50C on the left and going to -110C on the right.

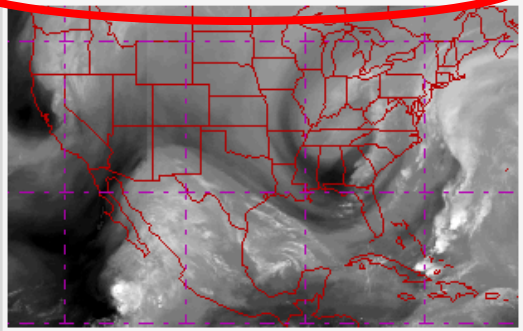
The colored regions represent:

Colors	Temps (C)	Temps (F)	Description
dark cyan	-32 to -43	-25 to -45	Jet stream and anvil clouds
cyan	-43 to -54	-45 to -65	
light blue	-54 to -60	-65 to -76	Thick jet stream clouds
dark blue	-60 to -64	-76 to -83	Strong thunderstorm tops
dark green	-64 to -70	-83 to -94	
green	-70 to -76	-94 to -105	Severe thunderstorm tops
brown	-76 to -81	-105 to -114	Strong Hurricane tops
yellow	-81 to -90	-114 to -130	

Water Vapor Satellite Image

Looping these images is often pretty interesting to see.

Water Vapor Satellite Image



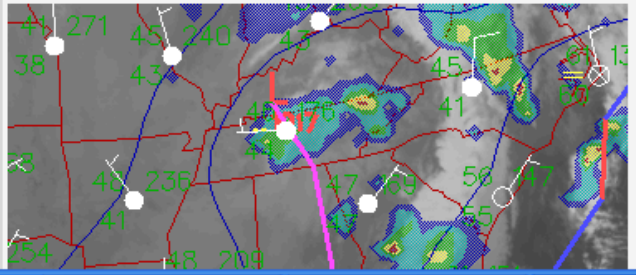
Sample water vapor image

The water vapor image show an infrared band which is affected strongly by the presence of water vapor. Essentially, the image shows the altitude of the highest moist layer in the atmosphere. Bright areas reflect the location of high clouds either due to jet stream cloudiness or due to thunderstorm activity. The dark areas reflect the location of dry are at high altitudes. This is associated with dry air intrusion and sinking motion associated with high pressure systems. This image is a decent tracer of jet stream winds which will show up as bright streaks.

There are 4 sectors for the water vapor image:

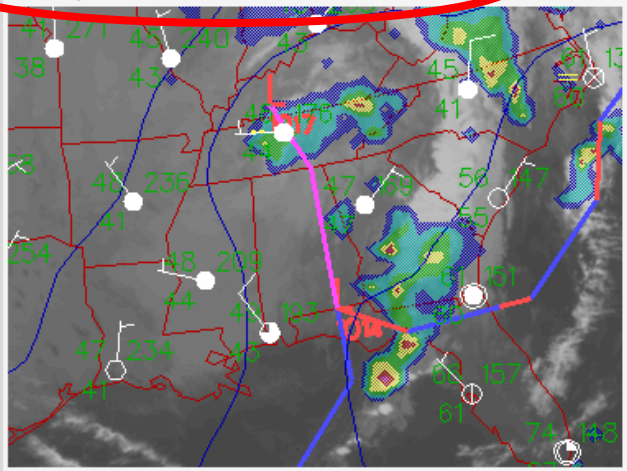
1. **East** - GOES east view centered over 75 west longitude showing eastern US and Atlantic Ocean.
2. **West** - GOES west view centered over 125 west longitude showing western US and Pacific Ocean.
3. **Hemisphere** - this is a pieced/merge view of both the GOES east and GOES west satellite views remapped to a Mercator projection.
4. **US** - this is a pieced view of GOES east and west remapped to a polar stereographic projection.

Composite Satellite Surface Map



Ways to connect data.

Composite Satellite Surface Map



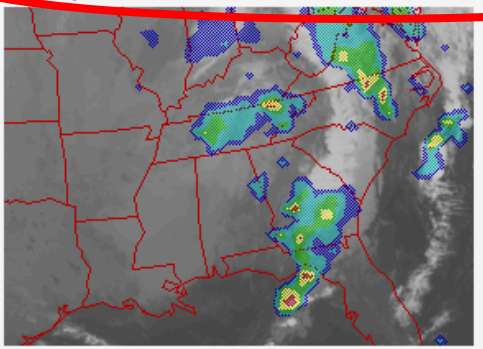
Sample satellite surface map

This is the infrared satellite image overlaid with the current surface weather map.

Infrared Satellite Image

Surface Weather Map

Composite Infrared Satellite and Radar Summary



Sample infrared-radar image

This is the infrared image overlaid with the radar summary. The infrared image will highlight the deeper/higher clouds as bright white and the radar summary allows you to correlate the high clouds with precipitation. The radar

Station models and meteograms are accessed here.

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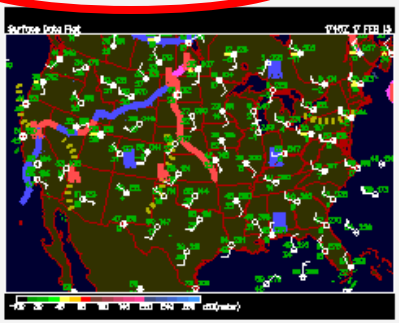

Current surface map

Surface data is reported hourly from places like airports and automated observing platforms. The types of plots using surface data include a composite surface map, weather depiction for aviation, regional plots for the US, Canada, Mexico and Alaska. Contoured analyses of various parameters including temperature and pressure. Finally, there are meteograms which are time cross-sections for individual cities. These data are updated hourly at around 30 minutes past the hour.

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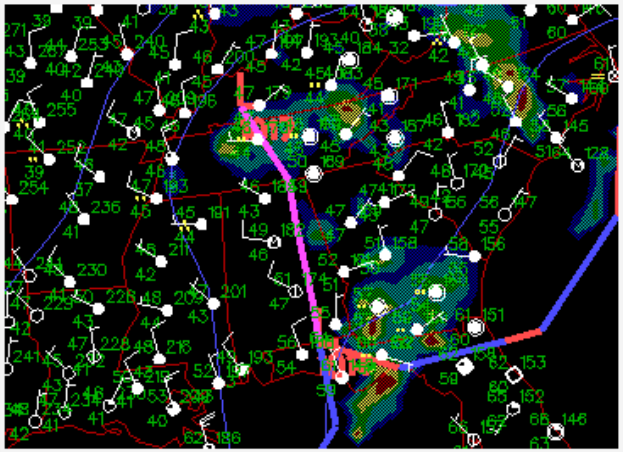
Surface Data Details

Surface data is reported hourly from places like airports and automated observing platforms. The types of plots using surface data include a composite surface map, weather depiction for aviation, regional plots for the US, Canada, Mexico and Alaska. Contoured analyses of various parameters including temperature and pressure. Finaly, there are meteograms which are time cross-sections for individual cities. These data are updated hourly at around 30 minutes past the hour.

Composite Surface Map



Sample_surface_map

The composite surface map portrays as much information about surface weather conditions as possible. This composite map contain the following analyses:
Radar summary (color filled/stippled areas),
Surface data plot (composite station model),
Frontal locations (in various bold lines) and
Pressure contours (in thin blue lines).

Radar Summary Plot

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Good quick guide to radar and station model plots.

RAP Model
ECMWF Model
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Hurricane Data
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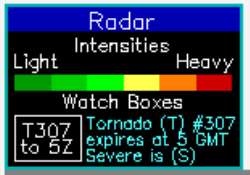
Radar Summary Plot

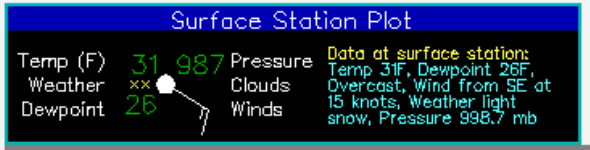
The radar summary displays areas where precipitation is falling based on returns from a weather radar. The intensity is based on color where:



Color	Intensity	Description
Blue	Light	light rain or snow
Cyan	Moderate	
Green	Heavy	light thunderstorms/moderate rain showers
Yellow	Very Heavy	moderate thunderstorms
Red	Intense	potential flooding rains/severe thunderstorms
Magenta	Extreme	flooding rains

Surface Data Plot

The surface data plot gives the following information:



Data	Description
temperature (F)	plotted upper left
present weather	symbol plotted center left (see below)
dewpoint (F)	plotted lower left
pressure (.1 mb-coded)	plotted upper right as last 3 digits (987=998.7mb, 024=1002.4mb)
cloud cover	center circle. white fill indicates % cloud coverage (see below)

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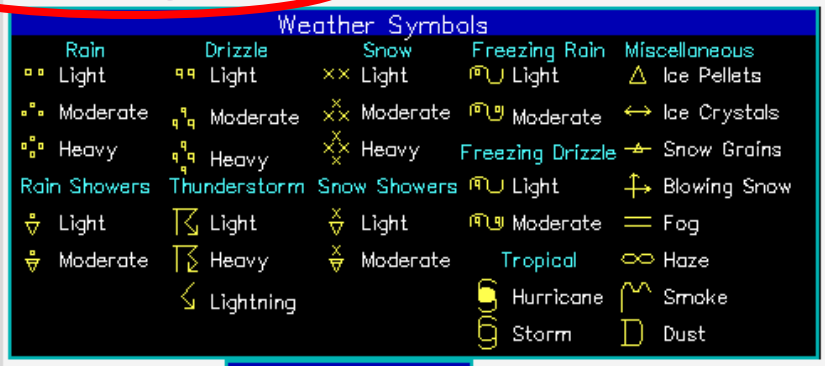
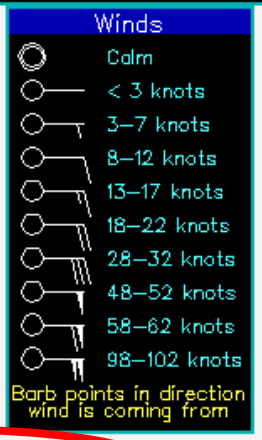
Essential symbol reference.

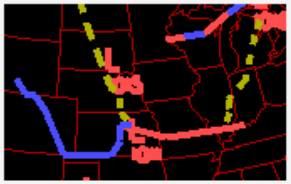
Weather Symbols





Frontal Location Plot

Frontal locations are denoted by bold lines in the following colors:



High and Low pressure systems are plotted with **H** and **L** and the associated pressure in millibars is displayed

Other essential details

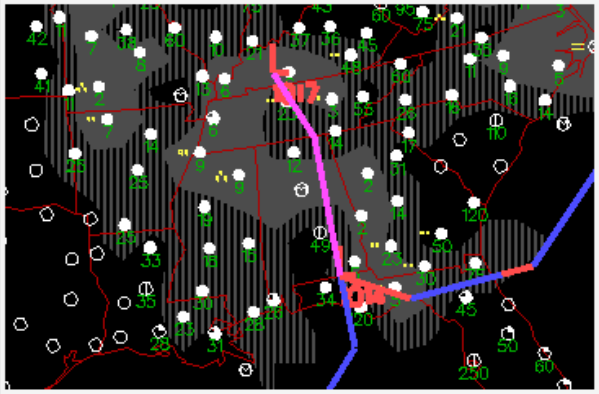
High and Low pressure systems are plotted with **H** and **L** and the associated pressure in millibars is displayed below the letter.

NOTE: Frontal data are only available every 3 hours so fronts may not exactly match the weather conditions. A label at the bottom left denotes what time the fronts are valid.

Pressure/Isobar Contours

The pressure contours (or isobars) are plotted as blue lines every 4 millibars and indicate positioning and extent of various pressure systems.

Surface Weather Depiction



Sample depiction

The weather depiction chart is a composite chart aimed at aviation. The data plotted are:

Flight rule depiction (color filled/hatched areas),

Depiction data plot (composite model),

Frontal locations (in various bold lines)

Flight Rule Depiction

Shaded and hatched areas represent current flight rules:

Plotted	Rules	Comments
gray solid	IFR	Ceiling < 1000 ft or Visibility < 3 miles
gray hatched	MVFR	Ceiling < 3000 ft or Visibility < 5 miles

Other essential data plotted with contours.

24 hour Temperature Change
Contour plot of the temperature change from current hour to the same hour the previous day for the contiguous US. Areas below 0 represent where the temperatures are currently colder and reflect the passage of a cold front. Areas above 0 represent where the temperatures are warmer and often reflect the passage of a warm front.

US Wind Chill Contour
Contour plot of wind chill temperatures (F) for the contiguous US. The wind chill is the effective temperature of the skin from heat loss due to winds at cold temperatures. Wind chill temperatures less than -20F are considered low, temperatures less than -40F are extreme and temperatures less than -60F are considered dangerous.

US Heat Index Contour
Contour plot of heat index temperatures (F) for the contiguous US. The heat index is the effective temperature of the skin due to the inhibiting effect of humidity to allow the body to cool through sweating and evaporation. Heat index values of greater than 90F are considered high, index values greater than 100F are extreme and index values greater than 110F are considered dangerous.

US Pressure Contour
Contour plot of sea level pressure (mb) for the contiguous US. The maximum and minimum values reflect the location of high and low pressure systems.

3 hour Pressure Change
Contour plot of the change in pressure from the current hour to 3 hours previous for the contiguous US. This is a good indicator of the movement and intensification of pressure systems. If the pressure change is negative in the region of a low pressure system (see above chart), the low is deepening. If the negative pressure change is out in front of the low pressure system, it indicates movement. The location of the maximum pressure drops indicate the possible direction of the low pressure system.

US Dewpoint Contour
Contour plot of the dewpoint temperature (F) for the contiguous US. The dewpoint temperature indicates the amount of moisture (or humidity) in the atmosphere. The amount of moisture in the atmosphere can affect how you feel and is used in the heat index computation (see above). Dewpoints above 65 reflect humid conditions. Summer dewpoints can reach the low 80s. Dewpoints above 50 mean that there is enough moisture in the atmosphere to generate thunderstorms. The higher the dewpoint, the easier storms form and the more potent they can become. An additional factor of low level wind convergence is also needed to help storms form (see below). Intense storms can form at dewpoints of 55 if the right conditions are in place including high convergence values.

US Moisture Convergence
Contour plot of the convergence of surface winds weighted by the moisture in the atmosphere represented by the surface specific humidity. Positive areas represent where winds are converging and thus forcing upward motion. Negative areas often reflect the presence of sinking motion. Since this is weighted by the moisture, high values of convergence can often represent areas where forced convection (possible thunderstorms) may occur.

This is a good description of how pressure not height is important in upper air plots.

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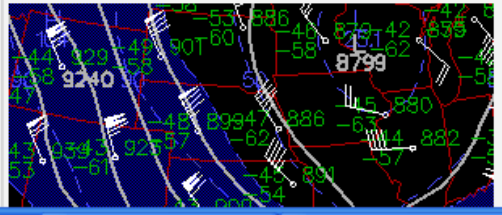
Upper Air Data Details

Upper air data is taken from balloons which measure upper air conditions over a particular location. The plots of data include plots on common mandatory and height levels, contours of various upper air parameters and a set of sounding plots for all US sites. These data update once every 12 hours at around 9:45 EST.

Meteorology uses pressure as the vertical coordinate and not height. This works out better for thermodynamic computations that are done on a regular basis. Pressure decreases in the atmosphere exponentially as height increases reaching 0 pressure in space. The standard unit of pressure is millibars (mb or hectopascals-hPa) of which sea level is around 1015 mb. Standard pressure levels and approximate heights:

Pressure	Approximate Height		Approximate Temp	
Sea level	0 m	0 ft	15 C	59 F
1000 mb	100 m	300 ft	15 C	59 F
850 mb	1500 m	5000 ft	5 C	41 F
700 mb	3000 m	10000 ft	-5 C	23 F
500 mb	5000 m	18000 ft	-20 C	-4 F
300 mb	9000 m	30000 ft	-45 C	-49 F
200 mb	12000 m	40000 ft	-55 C	-67 F
100 mb	16000 m	53000 ft	-56 C	-69 F

Mandatory Level Plots



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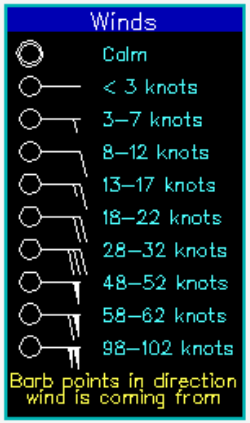
Upper air station model plot information differs from surface station model plots.

knots are once again shaded in stippled dark blue.

Upper Air Data Plot

The upper air data plot gives the following information:

Data	Description
temperature (C)	upper left
dewpoint (C)	lower left
height (m)	upper right and coded 850 mb - last 3 digits - 543 = 1543m 700 mb - last 3 digits - 972 = 2972m, 013 = 3013m 500 mb - first 3 digits - 543 = 5430m 300 mb - first 3 digits - 912 = 9120m 200 mb - middle 3 digits - 102 = 11020m
winds	wind barb (see below)



Constant Height Plots

Some interesting descriptions of the value of these plots.

Contour Plots

500 mb Height Contour

This is a contour plot of 500 mb height in meters with a interval of 60 meters. The 500 mb level is often referred to as the steering level as most weather systems and precipitation follow the winds at this level. The winds follow the height contours and generally run from 30 to 100 knots. The speeds can be roughly estimated from the 300 mb winds as roughly 2/3rds their magnitude. This level averages around 18,000 feet above sea level and is roughly half-way up through the weather producing part of the atmosphere called the troposphere.

850 mb Temperature Contour

This a contour plot of temperature in Celsius at the 850 mb level. The interval is 5 degrees. The temperature field shows where warm and cold air are located. Temperatures at this level do not show the diurnal temperature changes from morning low to afternoon high we see at the earth's surface. The 850 temperature is also a decent indicator of the type of precipitation. Since most precipitation forms at 5000 feet or above, a temperature of freezing (0 Celsius) or below would indicate snow whereas a temperature above freezing would indicate rain.

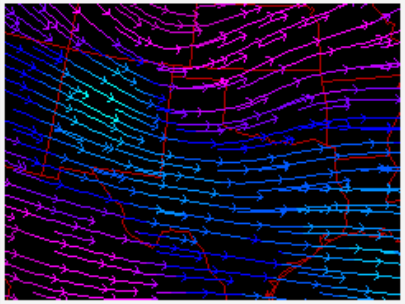
1000-500 mb Thickness Contour

This is contour plot of thickness in meters with an interval of 60 meters. Thickness is a measure of mean temperature in a layer of the atmosphere and ranges from 4900m in cold wintertime atmospheres to 5900m in warm summertime atmospheres. The 5400 meter line is often used as an indicator of the rain-snow line.

300 mb Wind Speeds

This is a contour plot of 300 mb wind speeds in knots. The contour interval is 10 knots. This level is referred to as the jet stream level. Areas of bold winds at this level (winds > 100 knots or 115 mph), commonly referred to as jets, indicate areas of high atmospheric energy. These are created by bold temperature contrasts in the lower and middle tropopause and reflect areas of potential storm development. A bold jet (winds >130 knots) can indicate the potential for the development of a bold low pressure system especially when if moves over the Rocky mountains and into the Plains states. A bold jet hitting the west coast can indicate the existence of a bold precipitation producing system.

300 mb Wind Streamlines



This is a streamline plot of 300 mb winds. The lines follow the direction of the wind. Small arrows denote actual

Skew T plots are graphic displays of balloon soundings.

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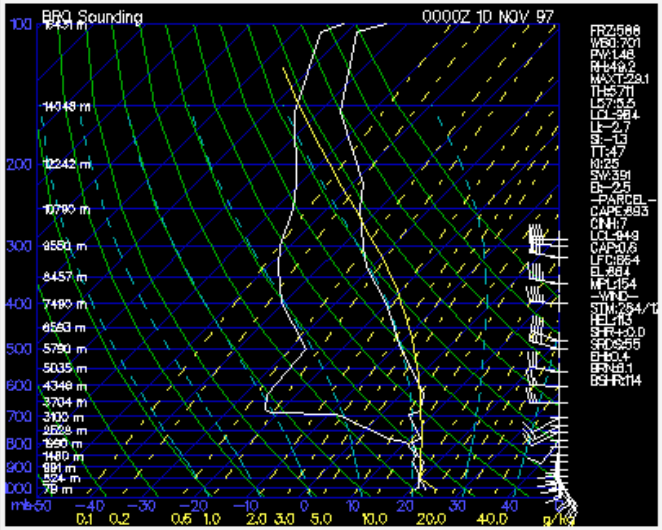
Upper Air Sounding Details

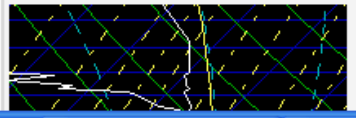
Upper air soundings are plotted data from balloons. The balloon records temperature, humidity and winds and these are plotted versus pressure/height to give details on the vertical structure of the atmosphere. The type of plot is called a SkewT and a set of SkewTs are available for most US stations. These are updated once every 12 hours at roughly 10:00 EST.

SkewT Plots



Sample SkewT plot

A Skew T plot is a standard plot used by meteorologists to analyze data from a balloon sounding. This is a plot of temperature with height as denoted by pressure.



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Sidebar legend for Skew T diagrams.

Specific sounding related parameters are plotted in the upper right. These values are:

- **TP:** Tropopause level (mb)
- **MW:** Max wind level (mb)
- **FRZ:** Lowest freezing level (mb) or BG for below ground
- **WB0:** Wet bulb zero (mb) or BG
- **PW:** Precipitable water (in)
- **RH:** Mean RH surface to 500 mb (%)
- **MAXT:** Estimated max temperature (C) using a 150mb layer
- **TH:** 1000-500mb thickness (m)
- **L57:** 700-500mb lapse rate (C/km)
- **LCL:** Lift condensation level (mb) from surface data
- **LI:** Lifted index (C) using 100 mean layer above surface
- **SI:** Showalter index (C)
- **TT:** Total totals index
- **KI:** K index
- **SW:** Sweat index
- **EI:** Energy index

-PARCEL-

This is a parcel trajectory (the yellow line on the sounding) based on 100 mb mean layer.

- **CAPE:** Convective available potential energy
- **CINH:** Convective inhibition (open ended)
- **LCL:** Lift condensation level (mb)
- **CAP:** Cap strength (C)
- **LFC:** Level free convection (mb)
- **EL:** Equilibrium level (mb)
- **MPL:** Maximum parcel level (mb)

-WIND-

Wind parameters

- **STM:** Estimated storm motion (knts) from 0-6000m AG mean layer, spd 75% of mean, dir

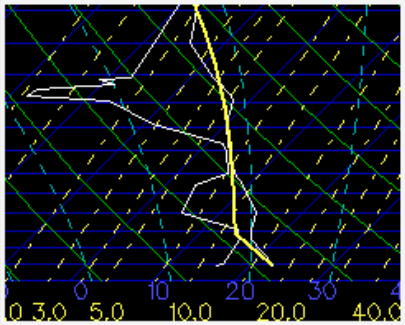
Good summary of how sounding diagrams are used but more background knowledge is helpful in understanding these plots.

weather.unisys.com/upper_air/skew/details.php

SRDS:71
EHI:2.0
BRN:29.1
BSHR:42

winds)

- **EHI:** Energy helicity index (prop to positive helicity * CAPE)
- **BRN:** Bulk Richardson number 500-6000m AG (prop to CAPE/bulk shear)
- **BSHR:** Bulk shear value (magnitude of shear over layer)



SkewT plot with parcel trajectory (solid yellow)

Sounding diagrams provide a important means for determining the stability of the atmosphere above a specific location. By using the concept of an air parcel, lifting it or lowering it and comparing the resulting parcel conditions to the conditions of the surrounding environment as defined by the balloon sounding.

Parcels of unsaturated air tend to follow the dry adiabat lines (green lines) as they ascend or descend. The saturation adiabats (light blue) lines show how parcels saturated with water vapor will ascend or descend. Descending parcels will tend to unsaturate immediately. The mixing ratio lines (yellow) relate to the amount of water vapor in a parcel in grams of water vapor per kilograms of dry air. Parcels of air attempt to maintain a constant mixing ratio as they ascend or descend. Generally, a parcel will rise, following the dry adiabat until it saturates. This occurs when dry adiabat crosses the initial mixing ratio line. This is considered the LCL. If lifting continues, the parcel cools following the saturation adiabat. If the parcel descends, it will always follow the dry adiabat as it will immediately unsaturate if saturated. By then comparing the parcel temperature to the environment, you can determine whether it is stable (parcel cooler) or unstable (parcel warmer). An unstable parcel will accelerate upwards and is the primary means for thunderstorm development. A stable parcel will decelerate and eventually descend. This is the typical atmospheric condition and it the primary condition in high pressure areas. The descending air desaturates the atmosphere and leads to clearing skies and calm conditions.

Meteograms

weather.unisys.com/surface/meteogram/details.php

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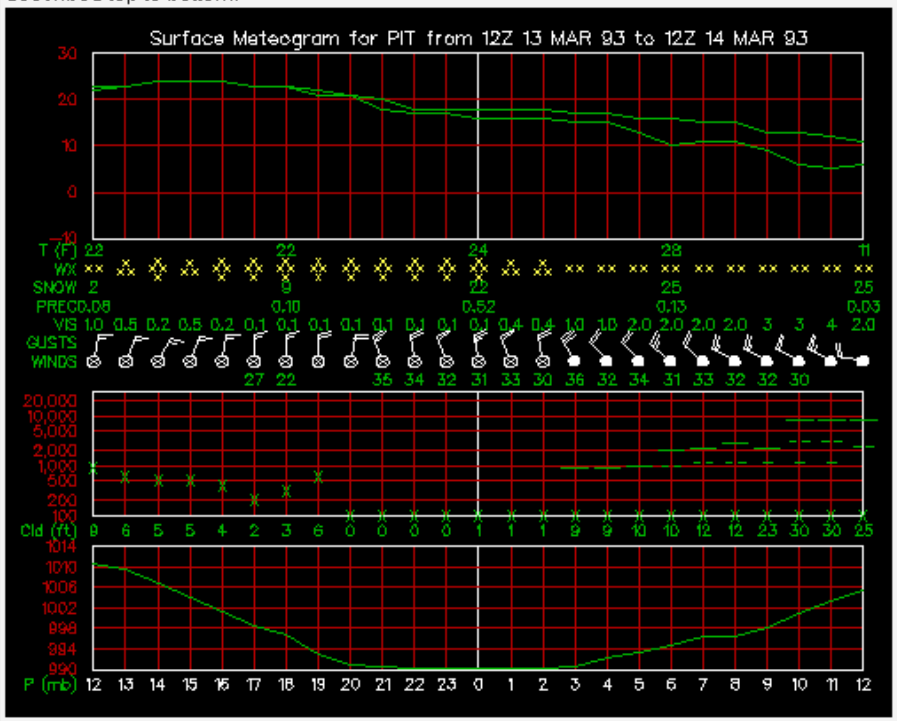
Surface Meteogram Details

A meteogram is a time cross-section of data for a specific surface reporting station. The data plotted include temperatures, winds, pressure, clouds and present weather. These data are updated hourly at around 50 minutes past the hour.

Meteograms

This is a 25 hour time series for a particular station location. The plot is divided up into several subplots described top to bottom:



Meteogram for Pittsburgh during the blizzard of 1993

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Key to some meteogram symbols.

weather.unisys.com/surface/meteogram/details.php

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SNWDP - snow depth

This shows reported snow cover in inches.

PREC - precipitation

This shows precipitation totals in inches. The values are 24 hour totals generally at 12Z, 6 hour totals at 0Z, 6Z and 18Z, 3 hour totals elsewhere.

VIS - visibility

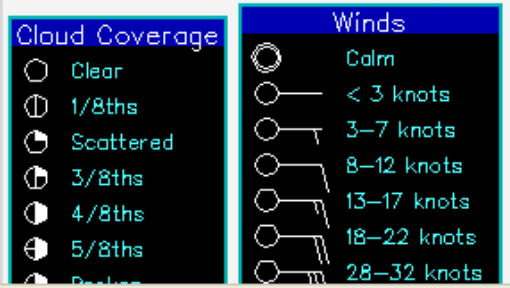
This shows the horizontal visibility in miles.

WGST - wind gusts

This reports wind gusts in knots if the winds are strong and gusty. This is generally the maximum wind reported over a several minute period during the observation of data.

WIND - winds and cloud cover

This is the standard wind and cloud cover symbols used in the surface data plots. Up is north.



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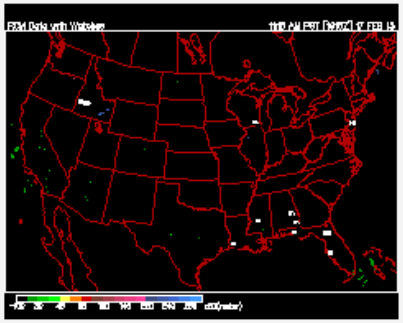
Radar Data



Current radar summary map

There are several types of radar data including Manually Digitized Radar (MDR), Radar Coded Messages (RCM) and NEXRAD data (NIDS). These data come from meteorological radars placed at various locations across the US. The RCM messages are combined into a national mosaic which is what is presented below. The images are updated twice an hour at :05 and :35.

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Doppler radar plots showing potential areas of severe weather like thunderstorms and tornadoes.

weather.unisys.com/radar/details.php

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Radar Data Details

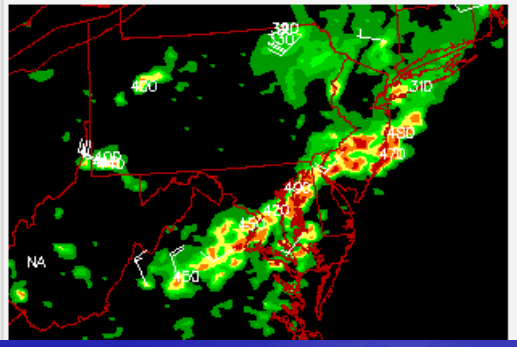
There are several types of radar data including Manually Digitized Radar (MDR), Radar Coded Messages (RCM) and NEXRAD data (NIDS). These data come from meteorological radars placed at various locations across the US. The RCM messages are combined into a national mosaic which is what is presented below. The images are updated twice an hour at :05 and :35.

Radar Coded Message Plots

These data come from NEXRAD doppler radars placed at various locations across the US. Each radar site reports a digitized assessment of the precipitation echoes displayed on the radar summary. Precipitation intensity is determined based on a scale from 1 (light) to 6 (extremely heavy). This information is recorded on a grid which covers the country and has a spacing of around 12 kilometers. This is coarse compared to the radar which can get detail of around 1 kilometer. The radar also reports echo tops, storm movement, hail probability and location of tornado vortex signatures (TVS) and mesocylones (MESO). Both TVS and MESO indicate the location of rotating areas of winds within the thunderstorm complex. TVS signatures are more concentrated and can indicate the potential for the development of a tornado.

Also, the National Weather Service provides information about severe weather watch boxes (either Severe Thunderstorm or Tornado) which can then be plotted on the radar summary. These data are updated twice an hour at 15 and 45 past the hour.

Composite Radar Summary



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Composite of different radar plots.

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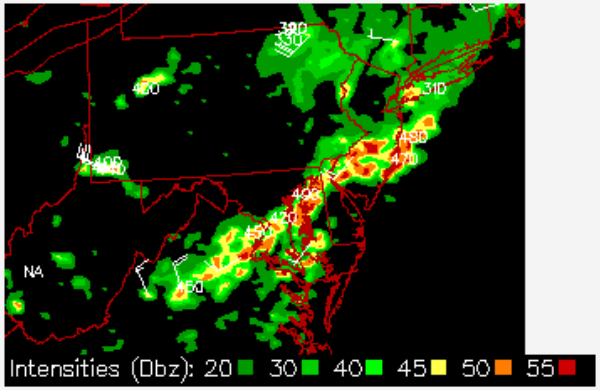
Composite Radar Summary

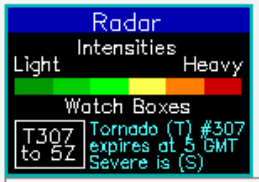


Sample composite radar summary

The composite radar summary is a plot of most of the available information broadcast as part of the RCM radar data.

Radar summary

The first plot is the actual radar summary. The radar summary displays areas where precipitation is falling. The intensity is based on color where:



Color	Dbz	Intensity	Description
DGreen	~20	Light	light rain or snow
MGreen	~30	Moderate	
BGreen	~40	Heavy	light thunderstorms/moderate rain showers
Yellow	~45	Very Heavy	moderate thunderstorms
Orange	~50	Intense	potential flooding rains/strong thunderstorms
Red	>55	Extreme	flooding rains/potential severe thunderstorm

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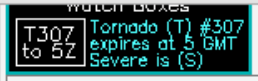

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Red	>55	Extreme	flooding rains/potential severe thunderstorm

Radar sites that don't report precipitation can report either:
NE - No echos/precipitation within the radar range.
NA - Radar data not available.
OM - Radar inoperative due to maintenance.

Storm movement

The next type of data is the individual storm movement which is plotted as a wind barb (See Weather Symbol Legend). This indicates how fast and in what direction the individual storms are moving.

Precipitation tops

The next type of data is the precipitation tops which are plotted over the top as a number in 100s of feet. This is the maximum altitude of the precipitation as seen by the radar. This can range from 10,000 feet in snow showers to 20,000 with rain showers to 40,000 feet with thunderstorms. Severe thunderstorm tops can reach 50,000 to 70,000 feet.

Severe weather watch boxes

The last type of data are the severe weather watch boxes. The area covered by the watch is enclosed by a white box. The watch number and type as well as the expiration time are also listed.

T335 to 5Z	Specifies a tornado watch #335 which expires at 5Z
S336 to 8Z	Specifies a severe thunderstorm watch #336 which expires at 8Z

The following section of slides is the NAM (North American Mesoscale Model) type of forecast product.

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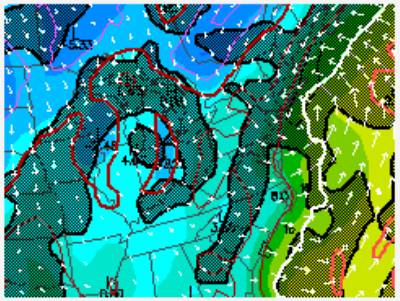
Surface Forecast (NAM only)



Sample surface Plot

The surface chart details near surface weather conditions and is intended to aid in estimation of surface conditions. The parameters plotted are temperature in Celsius (in color contours), convergence (black lines, interval=2, shaded > 0), dewpoints in Celsius (plotted in various colors) and winds plotted as vectors.

2 m above ground temperature field

The temperature field shows the location of warm and cold air near the surface of the earth and can be used to locate surface fronts or estimate high and low temperatures. It should be noted, these are rough temperatures are won't reflect exact surface tempreatures that would be reported at station locations.

10 m above ground convergence field

The convergence field shows where low level wind conditions are favorable for thunderstorm development. Positive areas (shaded) represent converging winds and result in forced upward movement of air. Thunderstorms can develop in areas where convergence is strongly positive (>;2). Negative areas (non-shaded) represent diverging air which is often a result of descending air and indicates areas of clearing weather.

2 m above ground dewpoint field

The dewpoint field shows the amount of moisture in the atmosphere. The higher the dewpoint, the higher the moisture content. These are plotted as colored lines at 5 degree Celsius intervals:

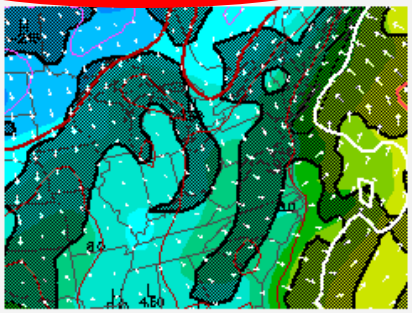
Color	Dewpoint
thick gray	-30C
thin gray	-25 and -20C
thick magenta	-15C
thin magenta	-10 and -5C

Notice again that pressure, not height is used do describe the plot location.

weather.unisys.com/model/details.php

air would advect in.

1000 mb Forecast



Sample 1000 mb Plot

The 1000 mb chart details near surface weather conditions and is plotted since most models don't report surface conditions. The parameters plotted are the same as the surface plot except for the level being 1000 mb. These include temperature in Celsius (in color contours), convergence (black lines, interval=2, shaded > 0), dewpoints in Celsius (colored lines, interval=5) and winds plotted as vectors.

1000 mb temperature field

The temperature field shows the location of warm and cold air near the surface of the earth and can be used to locate surface fronts or predict high and low temperatures. Low level instability can estimated by taking the 1000-850 mb temperature differences. A difference of 12 or greater indicates potential instability.

1000 mb convergence field

The convergence field shows where low level wind conditions are favorable for thunderstorm development. Positive areas (shaded) represent converging winds and result in forced upward movement of air. Thunderstorms can develop in areas where convergence is strongly positive (>2). Negative areas (non-shaded) represent diverging air which is often a result of descending air and indicates areas of clearing weather.

1000 mb dewpoint field

The dewpoint field shows where moisture is significant enough to fuel thunderstorm development. 55 F or 13 Celsius is a cutoff for strong thunderstorm development. Areas of dewpoints greater than 19 C can generate air mass thunderstorms which often aren't reliant on low level convergence for initial development.

1000 mb wind vectors

These are the estimated 1000 mb winds plotted as vectors. This shows whether the low level flow is from the south where warmer more moist air would advect into the region or whether the flow is from the north where cooler drier air would advect in.

NOTE: Most of the western third of the country have surface pressures well below 1000 mb and these charts don't apply to those regions.

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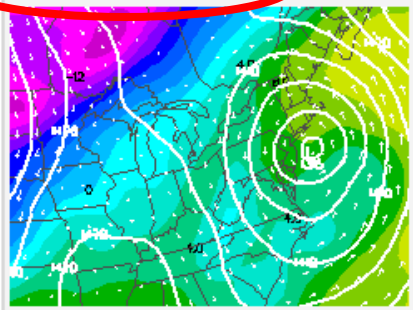
850 mb Forecast



Sample 850 mb Plot

The 850 mb chart details weather conditions at the 850 mb level or around 5000 feet above sea level. The parameters plotted are temperatures in Celsius (in color contours), heights in white lines and winds plotted as vectors.

850 mb temperature field

The temperature field shows where warm and cold air are located at the 5000 ft level. Temperatures at this level do not show the diurnal temperature changes from morning low to afternoon high we see at the earth's surface so warm and cold air advection can be more easily traced. You can estimate potential afternoon highs from these temperatures by adding: 15C in the summer, 12C in spring and fall, and 9C in the winter and converting to Fahrenheit. For example, if the 850 temp is 4C in summer, the afternoon temperature could reach 4+15=19C=67F. In the winter, 4+9=13C=55F. This algorithm does not work in the western third of the country due to its high altitude.

The 850 temperature is also a decent determiner of the type of precipitation. Since most precipitation forms at 5000 feet or above, a temperature of freezing (0 Celsius) or below would indicate snow whereas a temperature above freezing would indicate rain.

850 mb height field

The height field works very similar to the sea level pressure field. Lows and highs can found and compared to sea level locations. Strength of winds are again related to the packing of the height contours.

850 mb wind vector field

The vector field shows wind direction and speed. Often this can be used to qualitatively show areas of convergence and divergence. In the middle and upper levels of the troposphere, this can be an indicator of existing upward (from divergence) or downward (from convergence) air motion. Upward motion is often linked to precipitation and downward to clear skies.

700 mb Forecast

equivalent) is plotted instead.

CAPE Plots (NAM only)

CAPE represents the amount of energy a parcel might have if it were lifted. Often this reflects the strength of updrafts within a thunderstorm. CAPE values of greater than 2000 represent enough energy to produce thunderstorms. A value greater than 3000 represents enough energy to produce strong thunderstorms. Values <1000 denote a reletively stable atmosphere.

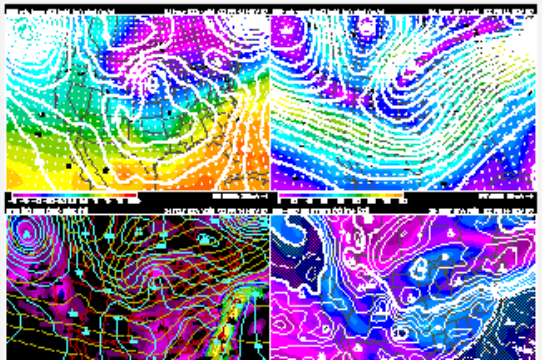
Helicity Plots (NAM only)

Helicity is used to indicate where rotation/shear is high enough to allow thunderstorms to organize into severe or supercell storms. In the lack of helicity, storms develop vertically and the precipitation will snuff out the updraft killing the thunderstorm. Severe storms need helicity to maintain an organized structure allowing hte storm to develop to severe limits. A value of 400-500 is often needed to produce severe storms. Often this is used in conjunction with CAPE to determine severe storm location.

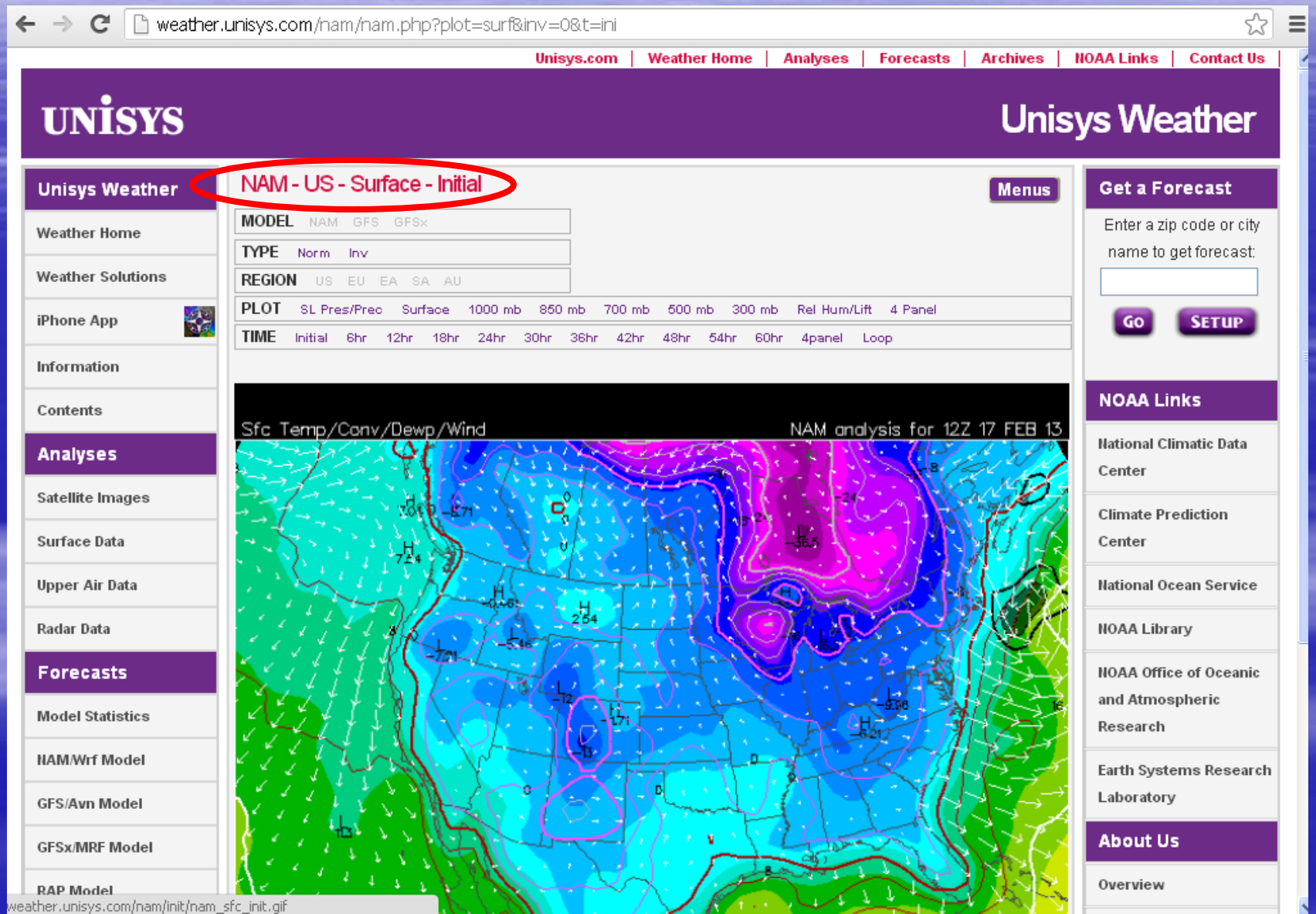
Energy Helicity Index (EHI) Plots (NAM only)

The Energy Helicity Index (EHI) is a combination of CAPE and Helicity to show where there is a potential for strong and possibly tornadic thunderstorms may form. CAPE shows the ability of the atmosphere to develop a thunderstorm. Strong thunderstorms need shear or rotation which is reflected in the Helicity value. The combination of the two not only shows where thunderstorms will develop but also where shear/rotation in the atmopshere is strong enough for tornado formation. Typical thunderstorm producing values are around 1-2. A value greater than 3 indicated the potential for strong thunderstorms. A value greater than 4 indicates the potential for tornado formation within those storms.

4 Panel Plots



What some of the NAM plots look like.



weather.unisys.com/nam/nam.php?plot=850&inv=0&t=12

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NAM - US - 850mb - 12hr

Menus

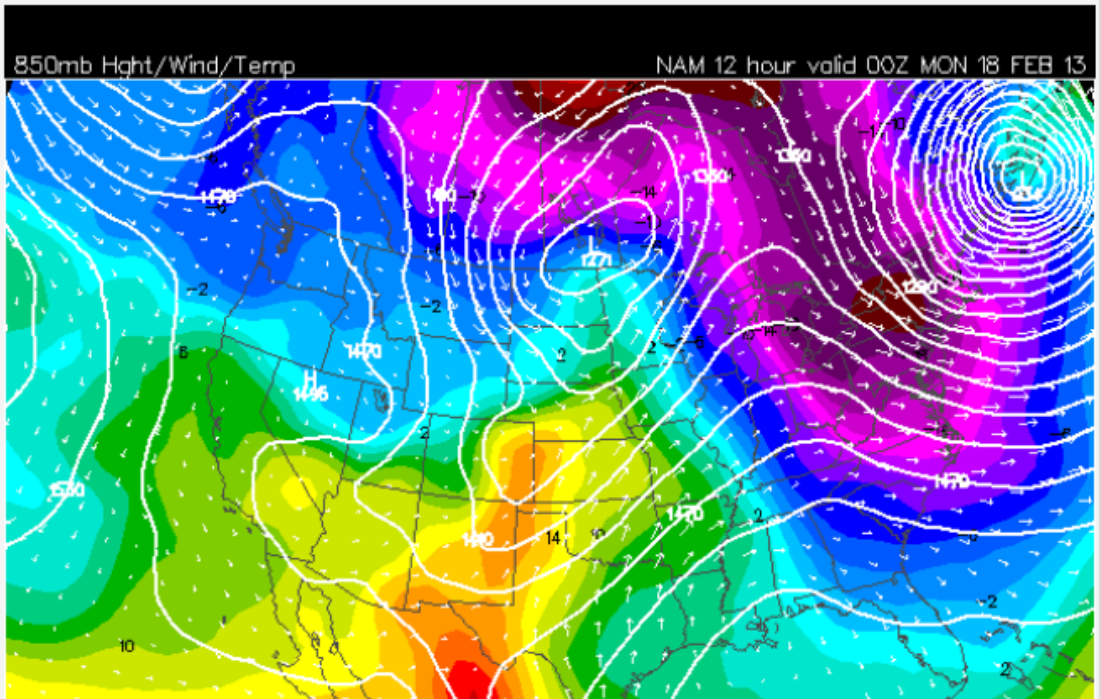
MODEL NAM GFS GFSx

TYPE Norm Inv

REGION US EU EA SA AU

PLOT SL Pres/Prec Surface 1000 mb 850 mb 700 mb 500 mb 300 mb Rel Hum/Lift 4 Panel

TIME Initial 6hr 12hr 18hr 24hr 30hr 36hr 42hr 48hr 54hr 60hr 4panel Loop



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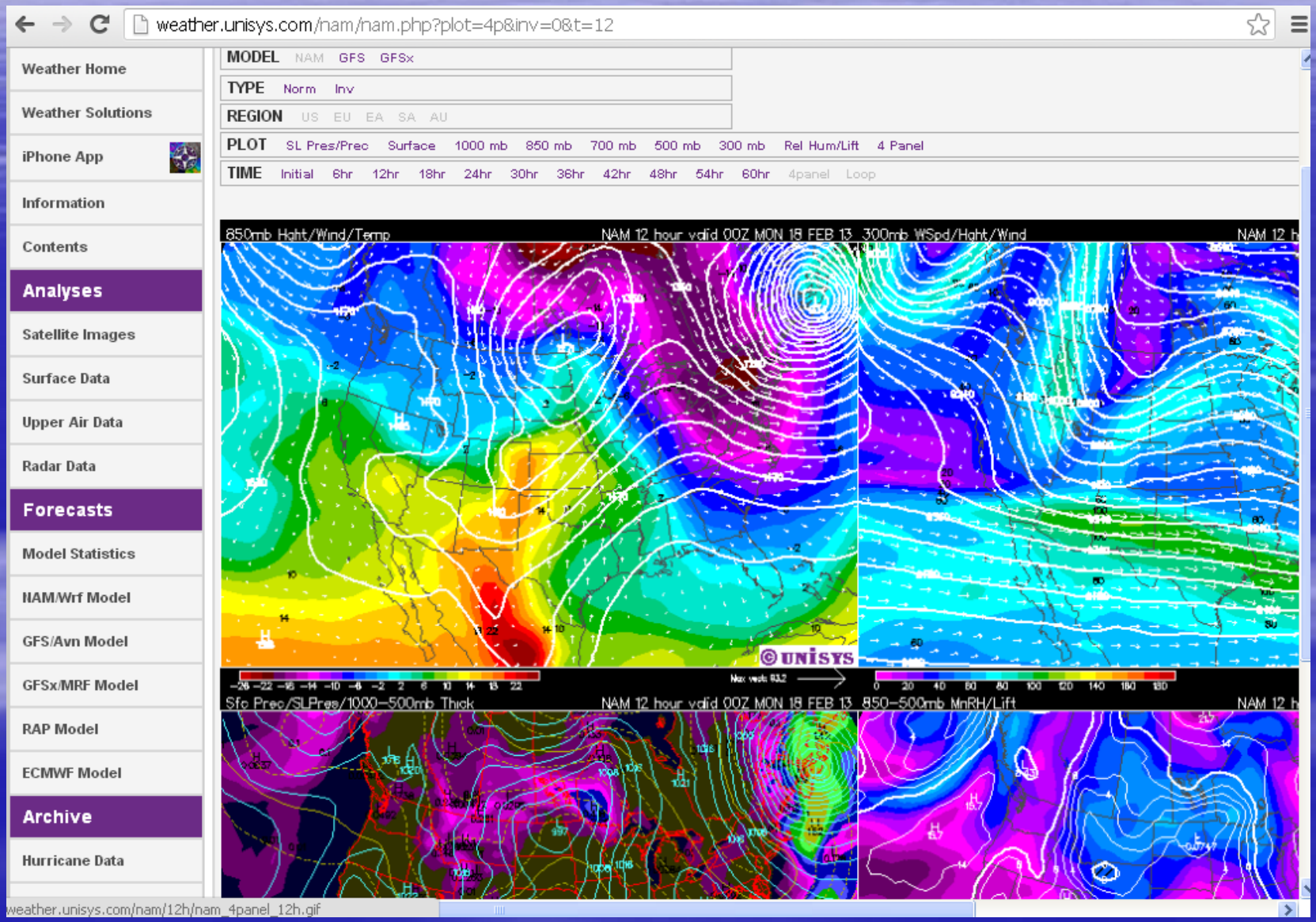
4 panel NAM plots.



National Weather Service

- The National Weather Service through NOAA is another excellent source for weather data available on the web.
- This year I have used the NWS site on a limited basis until I better understand all of its features. The site has links to information not found on the UNISYS site.

http://www.weather.gov/forecastmaps