The University of Georgia Weather Analysis Help Menu

20:35:19 Z (03:35:19 PM Local)

When preparing a weather forecast, you probably already know that there are tons of data available to you on the internet. The weather analysis menu page was designed to help compile much of that information for you. But even so, for a beginning forecaster this information may leave you wondering where to begin. First and foremost, practice utilizing the forecast funnel method and be sure to consult the wx discussion procedures and synoptic analysis and forecast procedures pages. After you become familiar with these pages, go back to the weather analysis menu and simply follow the layout of the page:

1. **Verification**: verify the previous day's high/low temps, precip record, and report the normals. How do they differ?

2. **Discussions**: discussions are excellent ways to get familiar with synoptic patterns. Practice reading them daily, not just on your discussion day!

3. **Upper-Air Analysis**: start by examining the *hemispheric* longwave patterns to get a feel for the flow. Then start focusing in a little bit by examining the North American maps. Finally, zoom in to the United States and critically analyze each pressure surface beginning with a jet stream analysis and work your way down to 850 mb. (*You may find it very useful to print out some Difax maps and do your own [hand] analysis!*)

4. **Surface Analysis**: first just think about all the information you can find from a surface station plot. Look at temps, dew points, winds. Then identify fronts, cyclones, etc...Also look at additional fields such as moisture convergence and Theta-E advection.

5. **Satellite Data**: look at visible, infrared, and water vapor loops to help identify flow patterns, areas of moisture, and other features such as shortwaves, etc...

6. **Radar Data**: obviously useful if precip is moving into the area of interest or is current over the area of interest.

7. **Model Data**: By this point, you should have a nice understanding of the synoptic environment and how various upper-air and surface features may couple to affect your forecast. Now examine some of the models to see how well they are handling the forecast. Do the models agree with each other? Disagree? If so, how? Be sure to check out the Model Bias and Model Verification pages too so you can become more comfortable with how each model handles certain types of weather events.

8. **NWS Forecast**: In can be really tempting to see what the pros are calling for before you start your analysis...you know, to get a good idea of what to expect. But by doing so you're effectively spoiling

your own analysis. So what do the professional forecasters look at when they begin their analyses? You got it! They follow very closely to the format described above, just as you should. Once you completed your analysis, record your forecast. This way you will have more confidence about your numbers. Then if you feel it's necessary, check and see what the NWS is calling for to see how their forecast differs from yours.

**if you come up with the exact forecast as the NWS, don't be tempted to change it. In cotrast, many beginners will look at the NWS numbers and slightly alter the numbers to call them their own...that's a big no no!*

Now as you can clearly see, preparing a good forecast doesn't happen in 5 mins. Keep in mind that forecasting is like a scientific art. It takes practice because it's never concrete. So be sure to continue to practice, even on "off days". And when it's your turn to give a weather discussion, be sure to follow the format in the discussion above.

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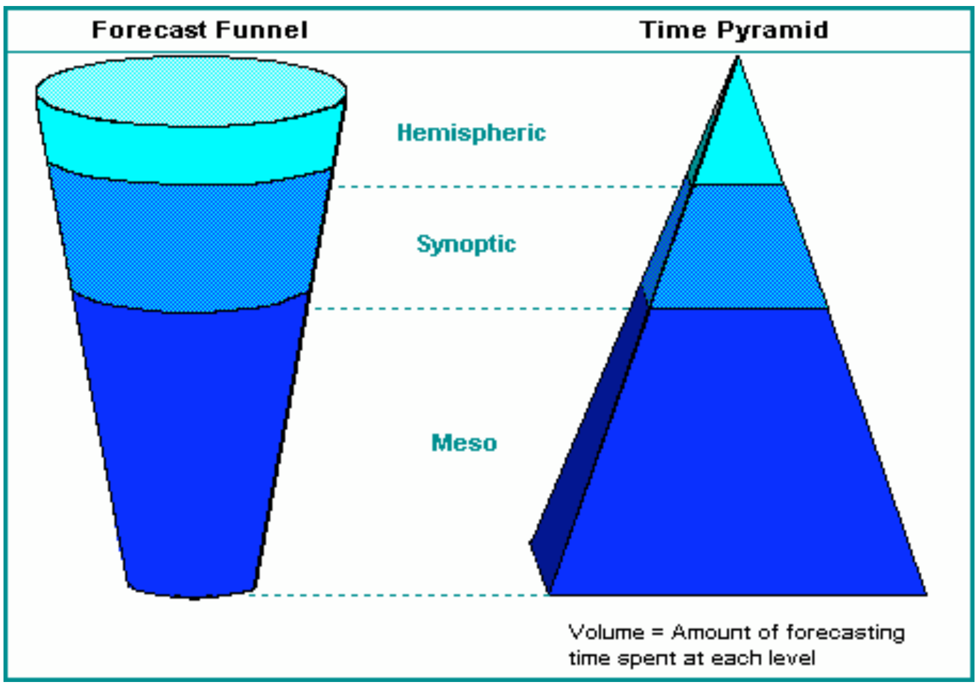
The Forecast Process

The Forecast Process

Use the *Forecast Funnel* to focus your attention from the large scales on down to the local scale.

Use the *Time Pyramid* to gauge the amount of time that you should invest at the different scales of interest.



Hemispheric Scale

The hemispheric or large scale spans a distance of approximately 10,000 km or more. Atmospheric features at this scale range in wavelength from 70 to 360 degrees of longitude and are best observed on charts covering at least 180 degrees of longitude. The effective forecast period is 24 hrs to 7 days. Models are integrated out to two weeks now, though skill is limited.

Hemispheric Questions

When beginning a forecast discussion, it is imperative to set the stage by examining the long wave pattern and asking:

What is the hemispheric pattern and what effect will it have on my forecast?

In other words, what is my *hemispheric scale problem* of the day?

In order to determine the above, one should ask

- What is the pattern of the westerlies?
- How is the pattern evolving?

What is the pattern of the westerlies?

To answer this question, you should check the animated hemispheric 500 mb height and animated satellite imagery to determine the upper air flow pattern. The hemispheric 500 mb height analyses and prognoses will show the migratory troughs and ridges that are being guided by the long wave pattern.

How is the pattern evolving?

The troughs and ridges in the westerlies will either be stationary, retrogressing, or progressing.

A stationary pattern is one where the long waves remain in virtually the same place over several days or longer. Progressive patterns are those in which the long waves evolve from west to east. If the system is retrogressive, the long waves undergo a discontinuous east to west movement whereby an existing long wave trough weakens and moves eastward as the short wave trough, while an upstream shortwave strongly deepens, developing into a stationary long wave trough west of the original long wave position. Discontinuous retrogression is usually associated with strong cyclogenesis as the upstream short wave intensifies.

Once the long wave pattern is clearly identified, it is safe to proceed down the funnel to the synoptic scale because the framework within which the migratory systems are evolving has been established.

Hemispheric Conceptual Models

At the hemispheric level, flow regimes can be grouped into conceptual models regarding either

- Consolidated flow patterns
- Split flow patterns

Consolidated Flow

When the upper level flow is consolidated (often referred to as a "broad belt of westerlies"), the primary concerns are the amplitude and propagation speed of the imbedded troughs and ridges.

The term "low zonal index" is used to describe hemispheric flow characterized by a large amplitude four or five long wave pattern. The long waves are mostly stationary, but occasionally progression or retrogression is possible.

Conversely, a "high zonal index" is characterized by a high speed, low amplitude, long wave pattern. In this situation, the long waves are usually progressive.

Split Flow

This occurs when the upper level flow is divided in two, with both branches having significant energy. The strongest manifestation of a split flow is called a blocking pattern. In these situations, the split in the flow covers 30 to 40 degrees longitude. Blocking patterns are very persistent (> 7 days), and result in the migratory systems being forced to circumnavigate the associated warm high or closed cyclone, respectively.

Hemispheric Tools

Three of the most useful tools at the hemispheric scale include looped times series of

- 500 mb Height Analyses and Prognostic Charts
- Satellite Imagery

Other tools which can be useful at the hemispheric level include

- Isallohypse (24 hr. 500 mb Height Change) Analyses
- Analyses and Prognoses of 500 mb Height Departures from Normal

Primary Tools

Constant Pressure Charts, such as the commonly used 500 mb map, are a good way to assess the overall character of the westerlies. Animating a loop of past analyses with the current prognoses allows the observer to note the motion pattern of systems moving through both stationary and/or changing westerly flow. Assuming that the prognoses verify well, this type of loop can begin to indicate the possible forecast problem facing the meteorologist.

Animated Satellite Imagery at the hemispheric scale provides a powerful platform from which a forecaster can observe the actual position, character, and evolution of long wave troughs and ridges by noting the changes in the cloud patterns associated with the migratory systems. The initiation and demise of the cloud cover gives great insight into the evolution of the large scale pattern.

Secondary Tools

Isallohypse Charts depicting 24 hour 500 mb height changes can be used to trace out the long wave pattern. When the usual rise and fall couplet pattern breaks down, it is a signal that the long wave pattern is changing.

Both analyses and prognoses of the Departures from Normal in the height field at 500 mb are useful in locating the position of long wave troughs and ridges. Areas of below (above) normal heights are often associated with long wave troughs (ridges), especially if they remain stationary or move slowly over several days.

The Synoptic Scale

The synoptic scale spans a distance of approximately 1,000 to 8,000 km. Synoptic scale features are best identified on charts that span 30 to 45 degrees of longitude. This scale can also be referred to as the "national scale." The effective synoptic forecast period covers the 24 to 48 hr range.

Synoptic Questions

The important synoptic level questions to ask are probably many of the same ones you find yourself asking each time you work a shift. The most important question to ask in making a good forecast is:

> *What is the problem of the day?*

In order to answer this question at the synoptic level, other questions must be asked:

- What and where are the weather-producing features?
- How well do the numerical models represent these features?
- How are they going to evolve?

Determining the Problem of the Day

It is necessary to relate the various weather features to the large scale pattern and determine if they will affect your forecast area.

After locating the features of concern, it is important to check the quality of the numerical models' initializations. This can be quickly accomplished by comparing satellite and other observation data with the initial panels of the model runs.

Next, the evolution of the features of interest needs to be considered. Output from the numerical models, as well as the latest trends in the observations, are the main tools used to do this.

Finally, armed with this information, the forecaster will likely have a good perspective of the general aspects of the problem or problems of the day.

Synoptic Conceptual Models

The pool of conceptual models, upon which meteorologists rely, is primarily composed of concepts relating to synoptic scale phenomena.

Some of the more important models include:

- Quasi-Geostrophic Theory Relationships
- Frontal Models
- Upper-Level Jet Structure
- The Baroclinic Leaf (as observed in satellite images)

Quasi-Geostrophic Theory Relationships

Developed by theoreticians, but based on observations, quasi-geostrophic theory is probably the best application of dynamics to synoptic meteorology. After making several assumptions, it can be shown that above the ground, where the effects of friction are negligible, the coriolis and pressure gradient forces are NEARLY balanced. Therefore, the atmosphere is NEARLY geostrophic, or in other words, quasi-geostrophic.

Because they eliminate meteorologically insignificant wave motions in order to better isolate synoptic scale phenomena, the quasi-geostrophic vorticity and thermodynamic equations enable meteorologists to understand the physical processes at work in midlatitude synoptic scale weather systems.

Frontal Models

Frontal classifications include: cold fronts, warm fronts, stationary fronts, and occluded fronts. Further subdivisions of frontal types include: anafronts, katafronts, split fronts, and labels referring to the level where they occur in the atmosphere. Occluded fronts can be either warm or cold type occlusions. The conceptual models of these frontal types lay the foundation for many of the phenomena forecasters encounter daily.

Upper-Level Jet Structure

Due to their nature as narrow regions of strong flow in the upper atmosphere, jets play important roles in both horizontal and vertical motions in the atmosphere. Both the polar-front jet and the sub-tropical jet impact forecasting in midlatitudes. Local isotach maxima imbedded in the upper level flow are referred to as "jet streaks." Straight jet streaks are associated with a four cell pattern of vertical motion, whereas curved jet streaks exhibit more of a two cell ascent/descent pattern. Jet streak conceptual models are important in forecasting phenomena as diverse as severe convection and cyclogenesis.

Baroclinic Leaf

A more focused model than some of the ones mentioned above is that of the baroclinic leaf. This phenomenon, when observed as a low amplitude "S" shape in the clouds or water vapor satellite imagery, should conjure up a conceptual model of the dynamics that are responsible for its formation. Baroclinic leaves are usually associated with significant cyclogenesis.

Synoptic Tools

Tools useful for observing, analyzing, diagnosing, and forecasting at the synoptic scale are the ones that meteorologists have traditionally relied on the most.

Some of the more important tools at this level include a mixture of old and new:

- Surface and Upper-Air Objective and Subjective Analyses; Cross-section Analyses
- Satellite Imagery
- Numerical Weather Prediction (NWP) Output
- Soundings
- Wind Profiler Data
- Lightning Data and Large Area Radar Summaries

Analyses

Because they provide meteorologists a means to quickly see weather patterns, objective and subjective analyses are useful tools when examining data. Reams of information are available in both the surface and upper air analyses of the actual observations. When time series of these products are examined, they provide an effective means for tracking the observed evolution of fronts, jets, cyclones and anticyclones. However, care must be taken to not assume that the details of the objective analyses are correct. Consulting satellite data in combination with these products leads to more informed use, often indicating that a partial reanalysis may be necessary. Analyzing areas of concern by hand is still a good idea, and can lead to further insight regarding the particular features of interest, and the accuracy of their representation in NWP guidance.

Using constant theta surfaces is an excellent way to represent the true three dimensionality of the atmosphere. Unlike isobaric surfaces, which usually represent a nearly constant altitude, isentropic surfaces can slope greatly! Since many atmospheric processes are approximately adiabatic, isentropic surfaces can act as material surfaces making it easier to infer 3-D motions.

Cross-sections provide an superior means to assimilate data in the vertical. Weather features of interest can fall between the cracks of standard constant pressure and isentropic surfaces, but do appear in a coherent manner in vertical cross-section analyses.

Satellite Imagery

Using animated satellite imagery is an efficient way to quickly locate the "weathermakers", and to obtain an initial feeling regarding the intensity trends of individual weather systems. Satellite data can also have an important role in the verification of model analyses and prognoses. By examining satellite imagery, a meteorologist can determine if features of concern are located properly and/or propagating and developing at the rate predicted by the models.

NWP Output

Since the equations of motion cannot be integrated manually, forecasters rely heavily on numerical models to determine the future state of the atmosphere. Now, and even more so in the future, meteorologists will have improved sophisticated numerical models at their disposal. Numerical models usually produce reasonably accurate forecasts of the large scale features of the atmosphere. Longer range forecasting, beyond 48 hours, is generally handled well enough by NWP to allow the meteorologist more time to assess smaller scale phenomena relevant to the short term forecast. However, there will always be a need to understand NWP and it's limitations, and to know how to verify the initializations and adjust model output accordingly. It should never be acceptable to use NWP blindly.

Soundings

Since their inception into routine meteorological observations, upper air soundings have been one of the primary tools providing synoptic scale meteorological observations above the surface. A few of the areas where soundings are helpful when used individually include: locating fronts, determining static stability, assessing the level of the tropopause, and determining vertical wind shear. Collectively, their input is used to produce both the constant pressure and isentropic analyses. Either way, sounding data continues to be an invaluable meteorological data source.

Wind Profiler Data

The best aspect of the wind profiler is its ability to provide extremely useful wind observations, at asynoptic times, in both the troposphere and the lower stratosphere. When data from multiple profilers are examined on an x-y plane at a given pressure level, the wind information between the sounding balloon launch times can greatly aid the tracking of transient weather features important to understanding the current state of the atmosphere.

Lightning Data and Large Area Radar Summaries

Lightning reports and consolidated depictions of echoes from multiple radars are helpful in calling attention to areas that need to be studied in more detail. Especially noteworthy are those times when lightning and radar echoes are reported during the early morning hours. This indicates that the convection is caused by dynamic forces that should be investigated.

The Mesoscale

The mesoscale spans a distance of approximately 2 to 2,000 km. Mesoscale features are also known as "regional scale," and have an effective forecast period of 12 to 24 hrs. The local or storm scale is a subset of mesoscale referring to a more localized area and has an effective forecast period on the order of 1 to 12 hrs.

Mesoscale Questions

The primary question at the mesoscale level is:

> *How does the mesoscale affect my problem of the day?*

In order to determine if precipitation is in the local forecast, the forecaster must ask two questions:

- What is the direction and magnitude of the vertical motion?
- Is the local airmass going to be wet or dry?

Finally, it is important to fill in the details of the forecast by asking:

How extreme or benign will the weather in my forecast area be?

Direction and Magnitude of the Vertical Motion

To determine whether there will be mesoscale ascent or descent and its strength, there are many tools and factors a meteorologist can consider, such as:

- consulting Doppler radar data to look for mesoscale convergence zones,
- examining isentropic data to look for vertical motions associated with any frontal boundaries in the region, and,
- if applicable, determining how the synoptic scale flow will interact with local topography.

Wet or Dry?

Once the anticipated direction and strength of the vertical motion has been determined, the forecaster must then forecast the local static stability and the extent of the available moisture in order to determine the likelihood of precipitation. There are many ways to accomplish these tasks. Extensive analyses of sounding data upstream of the forecast area provide insight into both moisture supply and stability. Consulting precipitable water charts and analyzing regional satellite imagery for areas with high water vapor content and/or areas of active cloud growth and decay can also be very useful. Again, using objective mesoscale analyses (of moisture parameters in this case) can be advantageous.

Severity and Type of Local Weather

Following the funnel approach, the mesoscale level is usually the step when the details of the problem of the day are determined. Here are some of the questions relevant at this step. If there are going to be thunderstorms, are they going to be severe and is a watch or warning necessary? Will there be significant temperature extremes or will the wind speed be of consequence? Will it be clear and dry? If precipitation is in the forecast, is it going to be a garden variety event, or are significant amounts worthy of a watch or warning situation possible?

Asking these types of questions, after having taken an organized approach to assimilate all of the available information, will help in making the best forecast possible.

Mesoscale Tools

Many of the tools that are important to rely on at the mesoscale level are some of the newer technology platforms for making observations.

Essential sources of data and information at this scale include

- Doppler Radar
- Lightning Data
- Mesoscale Analyses and Prognoses (including local models and grid point data)
- Soundings
- Wind Profiler Data
- Local Topographic Features

Doppler Radar

With the arrival of WSR-88D radars at numerous locations throughout the country, a new era in mesoscale remote sensing is beginning. Rapidly updated information regarding the local wind direction and speed in both the horizontal and vertical, along with detailed information on the areal extent and intensity of all forms of precipitation, will prove to be invaluable when making local forecasts.

Lightning Data

Lightning data aid the forecaster in determining where the strongest vertical motion is located, and are also helpful in assessing the severity of any convection that may be present.

Mesoscale Analyses and Prognoses

Mesoscale analyses, both objective and subjective, provide the means to organize the numerous observations available to the forecaster at this scale. Using such analyses gives the forecaster an efficient method of monitoring patterns in the observed weather parameters as well as producing derived fields such as equivalent potential temperature, moisture and wind convergence, CAPE and CIN, and pressure tendencies. These analyses are extremely useful when monitoring rapidly evolving mesoscale weather events in the local forecast area.

Soundings

Analyzing soundings, and the practice of obtaining a good prognostic sounding, are vital steps when forecasting local phenomena. Inversions, the amount of CAPE/CIN and their distribution, wind profiles and the vertical distribution of moisture can all be determined from a single sounding, making this still one of the primary tools in mesoscale forecasting.

Wind Profiler Data

Since these data are available at both synoptic and asynoptic times, the wind information provided by a growing network of profilers can be very useful when following the development and/or progression of mesoscale weather systems. Changes in the local vertical wind shear profile, as it relates to changing static stability and the possibility of severe convection, can also be effectively monitored with this tool.

Local Topography

Knowledge of the local topography and its effects on sensible weather under various meteorological conditions is an important part of mesoscale forecasting. Proximity to mountains, hills, river valleys, deserts, and various bodies of water all have important consequences relevant to making a local forecast. Although topography is not a tool, it is an important consideration when forecasting due to the dramatic effect it can have on the evolution of mesoscale weather events.

Forecasting Time Table

Zero to +6 Hours (Nowcasting – reliance primarily on extrapolation)

- Mainly extrapolation of existing regional conditions and systems:
  - Thunderstorm development
  - Fog dissipation/formation
  - Time of clearing/clouding
  - Precipitation beginning/ending
  - Time of a certain threshold temperature
  - Dew dissipation time
- Reliance upon remote sensing and mesoscale analyses.

+ 6 to +12 Hours (equal reliance on extrapolation and numerical models)

- Extrapolation of regional conditions and systems + numerical model movement of systems, some conditions and inference of other conditions:
  - Essentially as above +
  - Precipitation development along a front
  - Influence of shortwave entering region
  - Cloudiness trend

  - Temperature trend

+12 to +48 Hours (Increasing reliance on numerical models, increasing generality of forecast)

- Extrapolation may work in some instances, especially nearer the +12 hour time, but development, intensification, and dissipation of continental scale systems becomes important. While in nowcasting a 100-200 mile radius may be important as we approach 49 hours, several thousand miles must be considered.
  - Specific timing of precipitation and type of precipitation (+12hrs)
  - Change of rain, could be snow??? (+48hrs)
  - Specific effects of short wave (+12hrs)
  - A shortwave is approaching, maybe just clouds (+48hrs)
  - After cold front tomorrows high -5º (+12hrs)
  - Cold air surge expected temperatures 20 below norm (+48hrs)
  - General trend of longwaves, movement, intensification etc. (+48hrs)
  - Placement of surface systems and inference about weather (+48hrs)

+48 to +108 Hours (Nearly complete reliance on numerical models, very general temperature and precipitation statements)

- Placement of surface systems, inferred from upper level computer models
- General statement about temperatures (i.e., in the sixties)
- General statement about precipitation (i.e., could be rain)
- General statement about cloud cover

+ 5 to +10 Days (Decreasing reliance on computer models, increasing reliance on statistical/climatological models)

- Above/Below Normal Temps/Precip (Probabilities of)

+10 Days to +1 Month (Some use of numerical models, heavy reliance on statistical climatological models, some historical analogs)

Elements of a Good Weather Briefing

The weather discussion should follow the following loose guidelines. Your group may choose to have one person responsible for one major area (e.g., current analysis, model discussion, site forecast and reasoning), or you may wish to collaborate across areas.

General Elements:

1. Weather maps should be briefed in the following order: **past, present, future**.
2. Follow the "**forecast funnel**." This process is outlined in a supplemental handout.
3. You may want to give a quick **retrospective look** at past weather for the last week. You should note **record, extreme, or unusual weather occurrences**, and relate them to weather maps. You should follow the weather on the Internet, and possibly on the news / weather channel / newspaper for the week preceding your discussion so that you know what has happened that is significant. Use animations of satellite imagery, surface parameters (pressure, temperature, dew point, etc.) and upper air maps to illustrate the main systems that have been affecting weather in this region.
4. Look at global or hemispheric maps showing the jet stream or 500 mb contours or other large scale pattern, to get the **big picture**.
5. Look in some detail at the present weather, focusing on United States . Look at current surface weather maps, satellite images, radar data, radiosonde observations, upper air maps, etc. Discuss the **features on the surface weather maps** (highs, lows, fronts, and their clouds and precipitation). Discuss maps starting from the downstream edge and progressing upstream. At mid-latitudes, this is from the **east toward the west**. Look at the current observations and explain them in terms of the weather patterns.
6. Introduce maps of special fields such as vorticity or vertical motion, or any other maps that can be used to **explain the physics**.
7. Discuss the expected weather over the next couple days by looking at numerical model output, and written forecasts. Relate the evolution of current storms, or the development of new systems, to the forecast. (In other words, explain what is supposed to happen.) You might wish to add ``extras'' in your weather discussion, such as: world weather events of interest, etc.
8. **Focus** on your own locale, or other points of interest.
9. During the forecast phase, give some indication of **reliability** or likely success of the forecast, and suggest **alternative forecasts** that might occur.
10. Encourage **questions** and interaction, and indicate where additional information can be found.
11. Be prepared to verify your forecast during the next forecast discussion. This means that your group is responsible for determining the actual temperatures, precipitation amounts/types, and reasons for errors in your forecast **before** the start of that day's discussion.

A good map discussion or a good briefing requires careful attention to two indispensables: Careful preparation and good presentation. Nearly everyone can learn to give a good briefing by learning the principles described below, and practicing.

Preparation:

1. **Anticipate** the needs of listeners and the kinds of questions they will ask.
2. Know your material. **Have a plan**; write down an outline of what you intend to say.
3. Plan to talk about the **things that interest you**. It is impossible to talk about everything. If you pick out those things that are interesting to you, you are more apt to make your presentation interesting to the people who are listening to you.

4. **Emphasize what you know**, not what you are unsure of. This refers to both the diagnosis *and* the forecast.
5. Prepare you visual aids so that they can be easily seen by the audience. Use analysis or highlighting techniques to emphasize the features you plan to discuss. Test all visuals ahead of time, if possible.
6. Know or find out the **geographic names** of the states or cities that you will need to describe the position and movement of synoptic features.
7. If you are presenting a forecast, lead up to it in a **logical manner**. Begin with a diagnosis of what you have concluded is the relevant features, together with your reasons. If you have rejected some feature that you know others would consider, give your reasons for that, also. Then the forecast is logical follow-on from your diagnosis. If you can see different outcomes, work them in without becoming equivocal.

Presentation:

1. Try to start with a **topic sentence** that states your main idea. At the end, be sure to summarize the major points.
2. Have a **closing line** ready. Often the toughest thing is ending.
3. **Speak and act confidently**. You know your material thoroughly, surely better than your listeners, so you have no reason to fear them.
4. Face your audience, not your visuals, and look individuals in the eye.
5. Speak in such a way that people will not need to rely too heavily on your visuals. When you put up a new visual, give them a chance to look at it and digest it before you start to talk. Always be sure people know what they are looking at. When you refer to the visual, do so specifically, by ordinate value, geography, latitude, or whatever. **Never point to a screen and say "HERE"**.
6. Be sure the audience is **oriented** when showing a map.
7. If a graph is used be sure you specifically define the abscissa and ordinate scales.
8. Be sure you **specify the level** (sfc, 850mb, 700mb, etc.,).
9. **Define map variables**.

Here are a few things to look for when examining the maps. ***You will not be able to discuss everything listed below, please be judicious with your choices!***

- Precipitation
    - **Climatology**
    - **Radar**
    - Vertical motion
        - Locations of troughs/ridges
        - Upper-level divergence/convergence
        - Frontal surfaces
        - Sea level pressure fields

        - PVA/NVA
        - WAA/CAA
        - Jet streak circulations
    - Moisture availability
        - Low-level (700mb and below) dew points or relative humidity
        - Low-level (700mb and below) wind vectors/moisture advection
    - Convective precipitation/severe weather
        - Stability
            - Soundings
            - Stability indices
        - Shear profiles
            - Soundings/hodographs
    - Precipitation type
        - Soundings
        - Thicknesses
        - Low-level (850mb and below) temperatures

- Temperature
    - **Climatology**
    - Locations of ridges/troughs
    - WAA/CAA
    - Frontal surfaces
    - Cloud cover, precipitation
    - Thicknesses, 850mb temperatures, current dew points
- Movement of systems
    - Surface
        - Surface pressure tendency
        - Upper-level (500mb) flow

  - Jet locations
  - **Satellite imagery**
- Upper-level
  - PVA/NVA
  - WAA/CAA
  - Height rises (falls)
  - **Satellite imagery**

A Final Note: ***Your participation in the weather discussions also includes asking questions of other presenters!***

Notes on Charts

Surface Chart

1. Draw or color in fronts, pressure systems, precipitation, fog, etc.
2. Do a pressure tendency analysis.
3. Do a dew point analysis.
4. Note changes from previous maps.
5. Detect movement of systems and assure continuity.
6. Pay attention to diurnal changes, such as expected falling pressures during the heat of the afternoon, or rising pressures at night.
7. Keep alert for data errors.
8. When examining the surface chart look at areas of precipitation and try to answer these questions:
   a. Where is the heaviest precipitation?
   b. Where is the rain/ice/snow line?
   c. Where are the thunderstorm areas?
   d. What is causing the precipitation
      i. PVA
      ii. Low-level warm air advection
      iii. Cyclonic curvature of isobars or contours

iv. Fronts

v. Upsloping (terrain lifting)

vi. Overrunning (frontal lifting)

vii. Surface heating (convection)

viii. Upper level cold advection (destabilization)

ix. Cold air flowing over warm surfaces

x. Lake effect

9. Do a mesoscale analysis for storm situations or when you need to isolate fronts or small scale pressure or vorticity centers.

850 mb Chart Analysis

1. Shade in moist regions.
2. Color in freezing line.
3. Do isotherm analysis.
4. Outline jet stream.
5. Delineate warm and cold advection.
6. Draw in troughs and ridges.
7. Note changes from previous maps and maintain continuity.

Further Notes About the 850 mb Chart

1. This level is good for analyzing weather in mountain regions.
2. Isotherms usually give a good indication of fronts at the surface, but fronts are in a slightly different position. The surface cold front will be slightly to the warmer and surface warm front will be further on the warm side of the 850 mb front.
3. Isotherms at this level are almost parallel to the surface front.
4. For precipitation to occur this level almost always moist.
5. Warm advection at this level usually identifies areas of rising motion and cold advection at this level is associated with sinking motion.
6. Temperatures may rise at 850 mb during heavy rain due to latent heat.
7. With precipitation onset near 0ºC, evaporation of early raindrops may cause rain to change to snow. The wetbulb temperature tells us this.
8. Look for the relationship between surface fronts and 850 mb winds, if the 850 mb winds cross the surface warm front at a large angle, precipitation will be extended up the frontal surface, while winds parallel to surface warm fronts will cause only a narrow band of precipitation.

Some General Rules to Remember When Using the 850 mb Chart

1. Always predict temperature falls after a trough passes.
2. In moderate to heavy precipitation, temperatures rises frequently are near 0º, due to the cooling effects of the precipitation.
3. Cold advection is advanced at about 70 to 80% of the 850 mb wind speeds.
4. Warm advection is advanced with respect to the system in which it lies.

700 mb Chart

1. Shade in moist regions.
2. Do an isotherm analysis.
3. Outline the jet stream.
4. Delineate warm and cold advection.
5. Draw in troughs and ridges.
6. Note changes from previous maps and maintain continuity.

Further Notes About the 700 mb Chart

1. Moisture at this level is important for precipitation.
2. For severe weather: a moderately dry intrusion, over more moist surface and 850 mb air.
3. Severe weather: cold advection enhances convection.
4. Winter moisture at this level is often insignificant for precipitation.
5. Isotherms here will indicate surface fronts only if the fronts strong. If a front is not evident at this level it is not strong.
6. Cold Front: if 700 mb winds are perpendicular to surface cold front, the front is probably a katafront and inactive.
7. Precipitation along a katafront will be mostly ahead of it and as soon as the front passes a location, precipitation will either end or turn to scattered instability showers.
8. 700 mb winds that cross a surface warm front can be expected to extend the precipitation up the front. Stronger winds at a nearly perpendicular angle will extend precipitation far up the front.
9. This level can be used to steer lows. Use about 70% of the wind speed.
10. Pay special attention to short waves that develop at this level.

500 mb Chart

1. Note height rises and falls.
2. Note troughs and ridges.
3. Note warm and cold air advection
4. Color in the jet stream.

Further Notes About the 500 mb Chart

1. Moisture at this level is usually insignificant for precipitation. But it can usually give advance notice of increasing moisture.
2. A surface low will move with 500 mb winds over a 3-12 hour period at about 50% of the windspeed. Be careful with this in the vicinity of jets.

3. Precipitation tends to occur east of a trough line and on the warm side of the jet.
4. Large amplitude systems, closed contour systems and systems with isotherms in-phase with contours, and of same amplitude, move slowly.

300 mb and 200 mb Charts (Summer use 200 mb; Winter use 300 mb)

1. Note troughs and ridges.
2. Color in the jet stream.
3. Note confluence and difluence.

Further Notes About the 200 mb and 200 mb Chart

1. Warm pools at 200 mb are above cold pools at 500 mb, i.e., ridges at 200 mb are above troughs at 500 mb.
2. The warmer the warm pool, the stronger the 500 mb trough.
3. Diverging contours may indicate divergence.
4. Height falls, vorticity and divergence are usually stronger here than at 500 mb.
5. Temperature:

   Strong trough   -40° to -45°

   Strong ridge   -65° or colder

6. Look at areas of 200 mb warm advection for areas of potential upward motion.
7. For #6, the greater the difference between the warm and cold air in warm advection the greater the rising motion.
8. A 200 mb warm pocket will usually have an associated vorticity maximum at 500 mb.
9. The 500 mb vorticity max will tend to move towards colder 200 mb air.
10. Extrapolation at this level generally works well.
11. If 500 mb systems are not reflected at this level, the systems are weak. (Remember that a cold low gets lower and a warm high gets stronger with height)
12. At 200 mb broad cyclonic flow covering the entire continent with embedded short waves invalidates the temperature schemes in #'s 6, 7, 8 and 9.

Outline of Synoptic Analysis and Forecasting Procedures

I. Surface Chart

a. Observe and compare the systems and associated weather from the most recent and the previous charts.

b. Highlight Fronts and Systems

   i. Blue – cold fronts, high pressure systems and ridge lines

   ii. Red – warm fronts, low pressure

   iii. Black – trof lines

c. Shade Precipitation, Clouds, and Obstructions to Visibility

   i. Green – Liquid Precipitation

   ii. Blue – Frozen Precipitation

   iii. Red – Transitional Forms (freezing rain and sleet) and Tstorms

   iv. Yellow – Fog and Blowing dust or snow if visibility is ≤ 3 miles

d. Draw isallobars on separate map and indicate movement

   i. Blue shading – pressure rises

   ii. Red shading – pressure falls

e. Compare previously analyzed surface charts to new one for

   i. Frontal movement

   ii. Precipitation area movement

   iii. Change in areal extent of transitional area

   iv. Change of rain/ice/snow line

   v. Movement of systems (deviation from isallobar predictions)

   vi. Change in rate of movement

f. For Special Purposes – follow the movement of the 32ºF surface isotherm and the 70ºF surface isodrosotherm, or other special isopleth for a particular purpose.

II. 850 mb Chart

a. Highlight the 0ºC isotherm in blue, it approximates the rain/snow lines

b. Highlight the warm isotherm in red

i. Winter 15ºC

ii. Spring/Fall 20ºC

iii. Summer 25º and higher

c. Shade the warmest pool of air in red

d. Shade the coldest pool of air in blue

e. Moisture – shade areas with a dew point depression ≤ 5º in green with scalloped edges. This approximates low level winter clouds an convective Tstorms in summer.

f. Fronts – compare to the surface chart:

i. Use pencil to place fronts, consistent with the surface map but where the isotherms indicated fronts should be at 850 mb.

ii. Decide if fronts are warm, cold or stationary. NOTE: a front can be all at different points. If winds on both sides are parallel to the front, it is stationary; otherwise the winds "push" the front.

iii. Estimate the speed of movement of the fronts. Max speed = 850 mb wind x .75 if wind is perpendicular to the front.

iv. Estimate if the front will intensify or dissipate. To do this, use the winds on either side of the front, much stronger winds behind a front tend to intensify it.

g. Wind Speed – look for low level jets (50 kts or greater)

h. System movement and change – estimate by comparing successive charts.

III. **700 mb Chart**

a. Moisture, areas of dew point depression ≤ 5ºC in green

b. Mid-level jet – Black draw isotachs for wind speeds ≥ 60 kts. Axis of jet should be black arrow.

c. Shade moderately dry areas, over-running surface and 850 mb moist areas, in yellow. Areas with dew point depressions between 5 and 10ºC should be considered. This is used in thunderstorm forecasting.

IV. 500 mb Chart

a. Moisture – areas with a dew point depression of 5ºC or less

b. Height change, areas with a change greater than or equal to 50 meters

i. Height Fall centers in red

ii. Height Rise centers in blue

iii. Are centers elongated or of large area associated with the movement of a long wave ridge or long wave trof?

iv. Are centers small and isolated associated with a short wave?

c. Estimate the position of vorticity centers using curvature and shear (draw isotachs for the latter).

i. Positive Vorticity – black "P" (cyclonic shear and cyclonic curvature). Note that shear has the greatest influence, so areas of great positive vorticity can be found in uncurved flow.

ii. Negative Vorticity – black "N" (anticyclonic shear and/or curvature). Note: generally the pattern has large areas with little positive or with negative vorticity and small centers with concentrations of positive vorticity.

d. Shade areas of positive vorticity advection PVA) and negative vorticity advection (NVA).

i. PVA – yellow

ii. NVA – brown

e. Calculate PVA/Divergence/Vertical Velocity (see separate sheets).

f. Estimate stable and unstable regions.

i. Deep Instability – low level moisture in a tropical air mass.

ii. Shallow Instability – Post fronts (cold front), under a 700 mb to 500 mb level cold pool.

iii. Calculate 850-500 mb thickness by subtraction of heights, lift a station from 850 to 500 mb, until saturation dry adiabatically then at the moist adiabat rate to 500 mb.

1. if T500 = Tparcel neutral

2. if T500 < Tparcel unstable (difference 1^o - 2^o some, 2^o - 4^o moderate, 5^o or more very unstable)

3. if T500 > Tparcel stable

iv. Jet Stream Axis – black curving arrow

V. **200 – 300 mb Charts**

a. Shade position of velocity maxima in yellow

b. Note delta height areas red = falls, blue = rises

c. Note cold and warm pools – highlight coldest and warmest isotherms in black felt tip pen

d. Note difference between coldest and warmest pools

VI. **Synthesize**

a. Extrapolate frontal movement and system movement for +12 hours.

i. Are fronts accelerating?

ii. Are fronts intensifying?

b. Extrapolate Moisture +12 hours

i. Is moisture increasing? i.e., are:

1. Winds blowing from a "source" of moisture or,

2. Is upward vertical motion (lifting) occurring?

ii. Moisture tends to over-run warm fronts, causing warm frontal clouds ahead of the surface position of the warm front.

iii. Moisture tend to "trickle" northward from the Gulf along a cold front.

c. Extrapolate the 850 mb 0º isotherm +12 hours.

i. Cold side – snow

ii. Warm side – rain

iii. Near the isotherm (+/-) – ice (freezing rain or sleet).

d. Extrapolate stability +12 hours. (note diurnal changes)

e. Plot Precipitation (temperature classification)

i. Snow – Blue

ii. Rain – Green

iii. Transitional – Red

f. Plot Precipitation (stability classification)

i. Stable – steady rain, drizzle, etc.

ii. Unstable – showery (indeed of 0 – -2)

iii. Very Unstable – thunder (index -3 or less)

g. Plot Precipitation (stability classification)

i. Vertical Velocity

1. down – light or none

2. weak up – light

3. strong up – heavy precipitation

h. Plot Precipitation (quantity classification)

i. Dry source flow – large amount

ii. Moist source flow

1. slow moving – large amount

2. fast moving – small amount
3. long duration/fetch – large amount
4. short duration/fetch – small amount

VII. **Written Summary** – A well organized and detailed discussion of weather around the country. The discussion should be designed for the specific user.

NOTE: This ends the synoptic forecast for a large area. The next step is to apply the local method to specifically forecast for a particular station and/or a particular need.