Lab 4 - AOS 330
Decoding and Plotting Surface METAR Reports

# 1 Objective

• Learn how to decode the primary variables in a standard METAR-format surface report.
• Learn how to plot surface reports using the standard station model.

# 2 Materials

• Large surface map of US with station IDs
• A fine pen
• Handouts describing METAR format and station model
• Selected METAR reports obtained from http://weather.noaa.gov/weather/metar.shtml

# 3 Introduction

The vast majority of routine weather observations are transmitted and collected in the form of encoded weather reports. For surface reports, there are two main formats in wide use: 1) the WMO synoptic code (SYNOP) and 2) METAR code. The first is optimized for encoding detailed weather information of interest to synoptic analysts, whereas the second is optimized for aviation use. Synoptic reports are typically issued every 3 hours by selected stations, whereas METAR reports are issued every hour by most airports in the world. Because of the high sampling density and hourly transmission, METAR reports are often used to analyze large scale weather patterns, especially over land, despite their other limitations relative to the synoptic code.

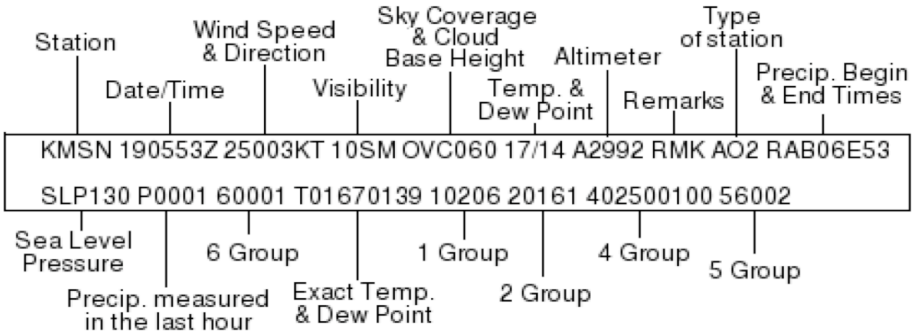
Any meteorologist working in an operational setting needs to be able to read METAR reports quickly and accurately as they come in, since sometimes, when short-term local forecasts or nowcasts are needed, one cannot afford to wait for all of the reports to trickle in before they are automatically compiled into a computer-analyzed map.

This lab is designed to give you exposure to the principle information content of METAR reports and also give you practice plotting that information using the standard station model. Despite the availability of computer programs for unpacking and plotting routine data, doing this "the hard way" a few times will make it much easier for you to quickly interpret reports and plots when you encounter them in the future.

## 3.1 Decoding METARs

METAR (Aviation Routine Weather Report, translated from French words MÉTéorologique Aviation Régulière) is an international standard code format to report hourly surface weather observations. In the U.S reports are made between 50 minutes past the hour and the top of the next hour. For example, observations taken between 1450 UTC and 1500 UTC would be included into the 1500 UTC observations. When there are significant changes in weather conditions, such as surface winds, visibility, cloud base height change, and occurrence of severe weather, special observations are reported at any time in SPECI, which is an aviation special weather report. When looking for a particular hourly observation, the rule of thumb given by the National

Weather Service METAR site is that all reports taken between (hh-1)45 UTC to (hh)44 UTC are considered to be for the hh cycle. (hh - hour)




What exactly do the group numbers mean:

**1 Group**: The 6-hour maximum temperature, precise to convert to nearest degree Fahrenheit.
**2 Group**: The 6-hour minimum temperature, precise to convert to nearest degree Fahrenheit.
**4 Group**: The maximum and minimum temperature of the last 24-hours.
**5 Group**: Pressure tendency information. See handout for more information.
**6 Group**: Precipitation measured in last 6 hours. 60000 indicated a trace amount. This group only appears on the 00, 06, 12, 18Z observations.
**7 Group**: Precipitation measured in last 24 hours. Typically appears only on the 12Z observation.

Most of the time, this is what the group numbers mean. There are exceptions, such as when you see 4/ for snow depth.

Below is a table of the information described by the second character of the "5" group:

**Table: Characteristics of Barometer Tendency**

| Primary Requirement | Description | Code Figure |
|---|---|---|
| Atmospheric pressure now higher than 3 hours ago. | Increasing, then decreasing | 0 |
| | Increasing, then steady, or increasing then increasing more slowly. | 1 |
| | Increasing steadily or unsteadily. | 2 |
| | Decreasing or steady, then increasing; or increasing, then increasing more rapidly. | 3 |
| Atmospheric pressure now same as 3 hours ago. | Increasing, then decreasing | 0 |
| | Steady | 4 |
| | Decreasing, then increasing. | 5 |
| Atmospheric pressure now lower than 3 hours ago. | Decreasing, then increasing. | 5 |
| | Decreasing then steady; or decreasing then decreasing more slowly. | 6 |
| | Decreasing steadily or unsteadily. | 7 |
| | Steady or increasing, then decreasing; or decreasing then decreasing more rapidly. | 8 |

Precipitation Type Help, sometimes followed by begin and end times:

| QUALIFIER | | WEATHER PHENOMENA | | |
|---|---|---|---|---|
| INTENSITY OR PROXIMITY<br>1 | DESCRIPTOR<br>2 | PRECIPITATION<br>3 | OBSCURATION<br>4 | OTHER<br>5 |
| - Light<br>Moderate (see note 2)<br>+ Heavy<br>VC In the Vicinity (see note 3) | MI Shallow<br>PR Partial<br>BC Patches<br>DR Low Drifting<br>BL Blowing<br>SH Shower(s)<br>TS Thunderstorm<br>FZ Freezing | DZ Drizzle<br>RA Rain<br>SN Snow<br>SG Snow Grains<br>IC Ice Crystals<br>PE Ice Pellets<br>GR Hail<br>GS Small Hail and/or Snow Pellets<br>UP Unknown Precipitation | BR Mist<br>FG Fog<br>FU Smoke<br>VA Volcanic Ash<br>DU Widespread Dust<br>SA Sand<br>HZ Haze<br>PY Spray | PO Well-Developed Dust/Sand Whirls<br>SQ Squalls<br>FC Funnel Cloud Tornado Waterspout (see note 4)<br>SS Sandstorm<br>SS Duststorm |

*Cloud Type and Base Height:*

Cloud base is reported hundreds of feet. If Towering CUmulus or CumulonumBus are reported TCU or CB will be reported.

Cloud cover is based on coverage in terms of octas of the sky.

| | |
|---|---|
| SKC | Sky clear |
| CLR | Sky clear below 12,000 feet |
| FEW | 1-2 octas obscured by clouds |
| SCT | 3-4 octas obscured by clouds |
| BKN | 5-7 octas obscured by clouds |
| OVC | 8 octas obscured by clouds |

Here is an example of decoding a METAR report.

```
KMSN 221453Z 03003KT 1 1/2SM +RA BR OVC003 17/17 A2999
RMK AO2 SLP155 P0030 60041 T01720167 53001
```

Station Identifier: KMSN (Madison, WI)
Date/Time: 221453Z (22nd of the month/ 1500 (1453) UTC)
Wind Speed and Direction: 03003KT (30 degrees at 3 knots)
Visibility: 1 1/2SM (1.5 statue miles)
Weather phenomena: + (heavy) RA (rain), BR (mist)
Sky cover: OVC003 (overcast, cloud base height at 300 feet)
Temperature: 17/** (17 degrees Celsius)
Dew point temperature: **/17 (17 degrees Celsius)
Altimeter reading: A2999 (29.99 inches of mercury)
RMK – Remark Section
Station type: AO2 (ASOS station)
Sea level pressure: SLP155 (1015.5 hPa)
Recorded precipitation this hour: P0030 (.3 inches)
Recorded precipitation last 6 hours: 60041 (.41 inches)
Precise temperature: T0172**** (0-positive17.2 degree Celsius)
Precise dew point temperature: T****0167 (0-positive 16.7 degree Celsius)
Pressure change over past 3 hours: 3 in 53*** (decreasing or steady, then increasing; or increasing, then increasing more rapidly)
Pressure change amount in tenths of hPa /mb over past 3 hours: 001 in 5*001 (0.1hPa)

For more detail information in how to decode METAR reports, visit the following website: http://www.met.tamu.edu/class/METAR/metar.html.

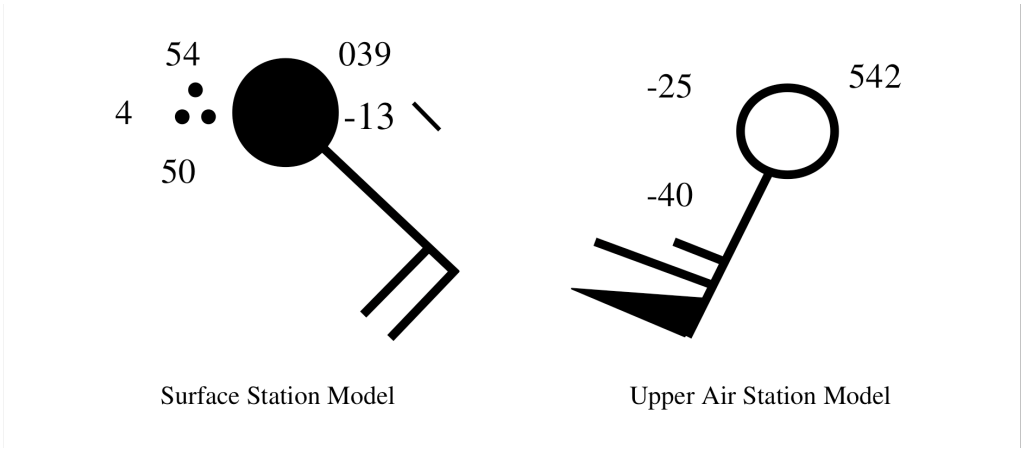
## 3.2 Station Models

For meteorologists to view and get a big picture of the atmosphere, surface and upper air observations taken from various stations are plotted and analyzed on maps. Station plot models condense all the different types of weather observation values into visual groupings for each station. These models contain same important information as from the METAR reports. Upper air plot models contain information from the radiosondes reports.

If you are not so familiar with station models, refer to the handouts or visit the following websites:

i. http://cimss.ssec.wisc.edu/wxwise/station -- Guide on surface plot models
ii. http://ww2010.atmos.uiuc.edu/(Gh)/guides/maps/upa/home.rxml -- Guide on upper air plot models

Sample station models:




Surface Station Model  Upper Air Station Model

## 4 Procedures

You will be given a surface map of the United States. Each of you will also be given a set of recent METAR reports. The reports have been trimmed and pre-sorted the reports to make your job much easier.

On the map you are given, plot at least 5 station reports in the bigger states and plot all the reports given for the smaller states **using a fine pen for maximum legibility**. Please try to distribute your reports evenly over your map.

For each station:
1. First locate the station. If you cannot find them and need a search, go to http://www.nws.noaa.gov/tg/siteloc.shtml
2. When you have located the report in question, draw a circle at the station's location. You'll probably want to draw it bigger than the printed circle so that you can more easily indicate the

cloud coverage.
3. From the METAR report, find the maximum cloud cover (CLR, SCT, BKN, OVC) and plot the appropriate symbol inside the circle. If there is more than one sky cover group, the maximum cloud cover will that given by the rightmost group.
4. Plot the appropriate wind indicator, based on the direction and speed given in the report (usually followed in U.S. reports by 'KT' for 'knots').
5. If there is an obstruction to vision or precipitation, plot the appropriate symbol just to the left of the station circle.
6. Write the temperature and dewpoint, respectively, directly above and below the present weather (if there is any) to the left of the station circle. Recall that 'M' preceding the value indicates a negative value. Although the values should be in degree Fahrenheit in the U.S, you could choose to plot them in degree Celsius if you do not want to work through all the degree Fahrenheit to degree Celsius conversions.
7. Write the visibility (usually indicated on U.S. reports by 'SM' for 'statute miles') just to the left of the present weather symbol (if present).
8. Write the 3-digit sea level pressure code (indicated by 'SLP') to the upper right of the station circle.
9. Write the past 3 hours pressure tendency (both symbol and value) to the lower right of the station circle.

Grading of this lab will be based on (a) legibility and (b) random spot checks of the accuracy of your plotted information.