Weather charts
II. Upper level Analysis and Contour

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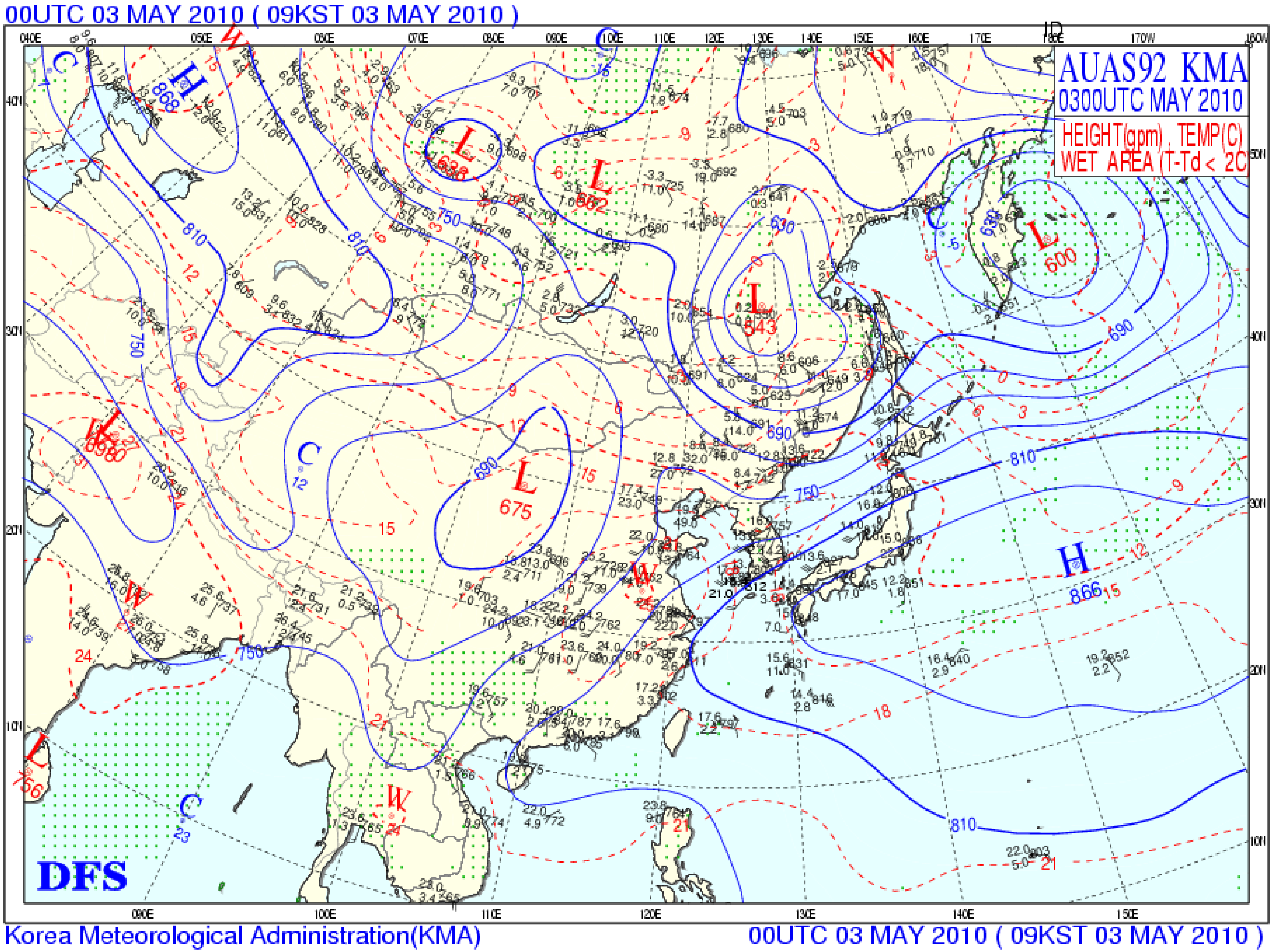
Weather Charts

Upper Level (Mandatory)

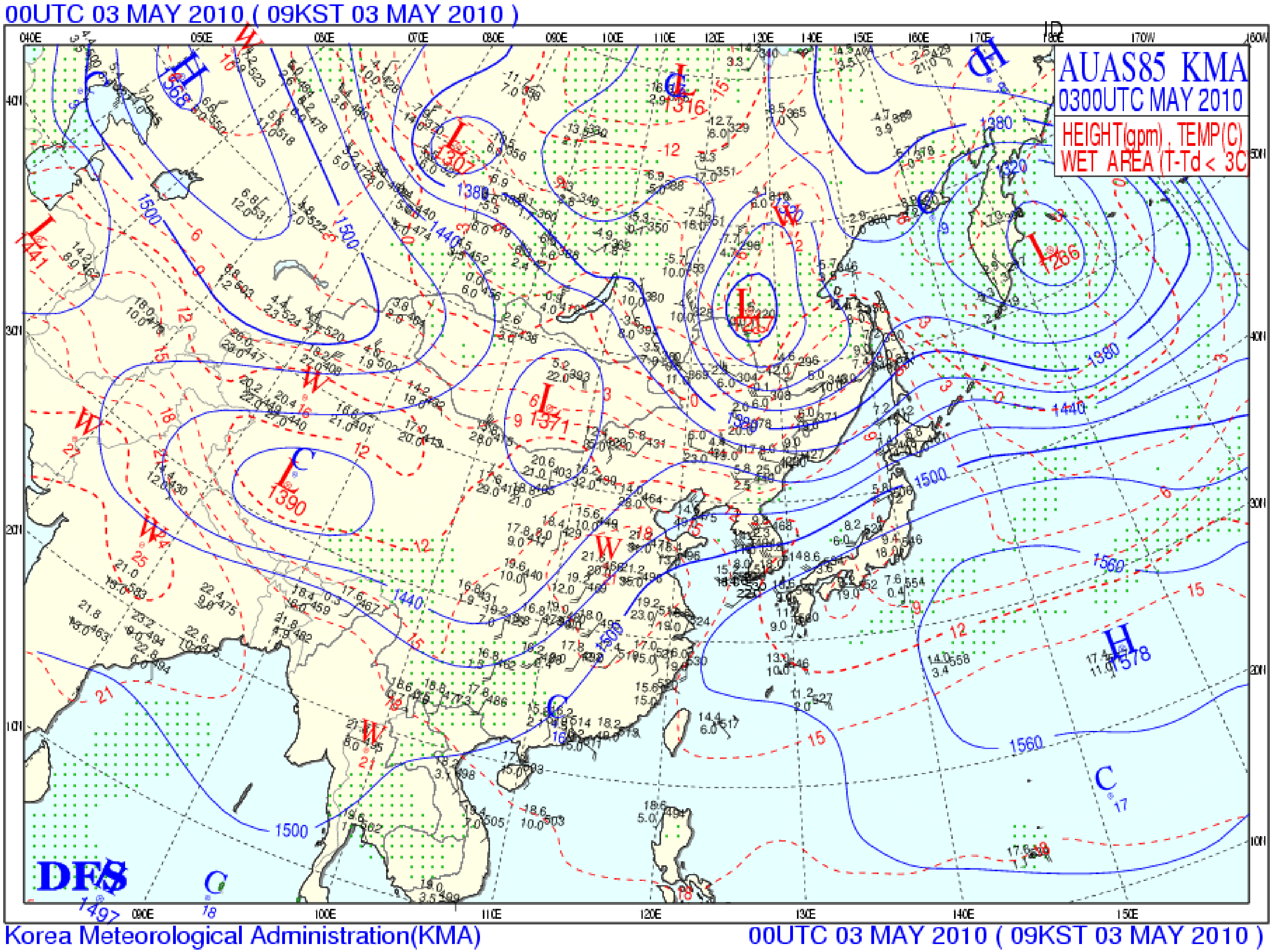
- 925 hPa (corresponding to an average level of about 750 m)
- 850 hPa (corresponding to an average level of about 1500 m)
- 700 hPa (corresponding to an average level of about 3000 m)
- 500 hPa (corresponding to an average level of about 5500 m)
- 300 hPa (corresponding to an average level of about 9100 m)
- 200 hPa (corresponding to an average level of about 11.8 km)
- 100 hPa (corresponding to an average level of about 16 km)

(according to the International Standard Atmosphere)

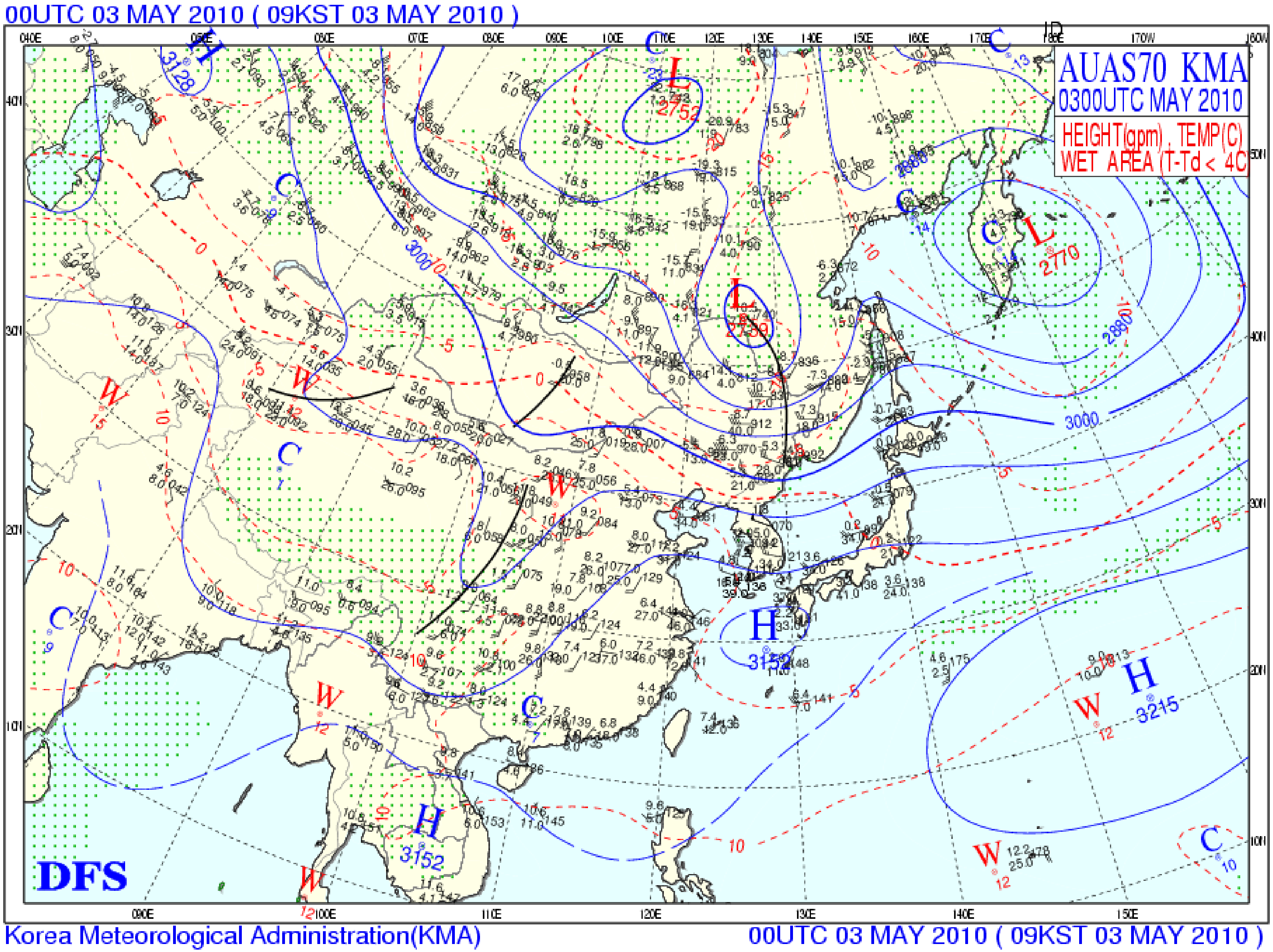
Weather Charts (925 hPa)



Weather Charts (850 hPa)

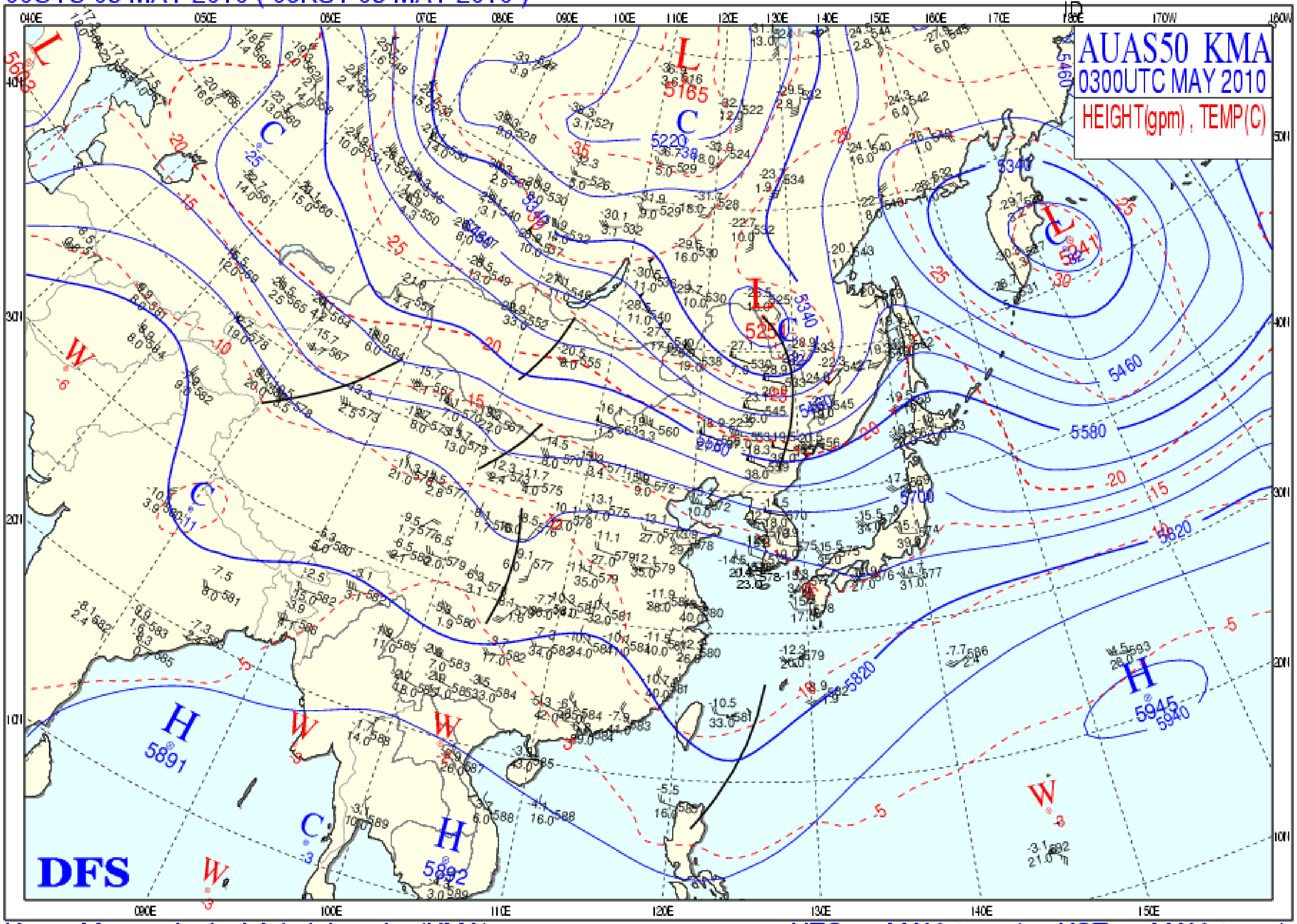


Weather Charts (700 hPa)



Weather Charts (500 hPa)

00UTC 03 MAY 2010 (09KST 03 MAY 2010)



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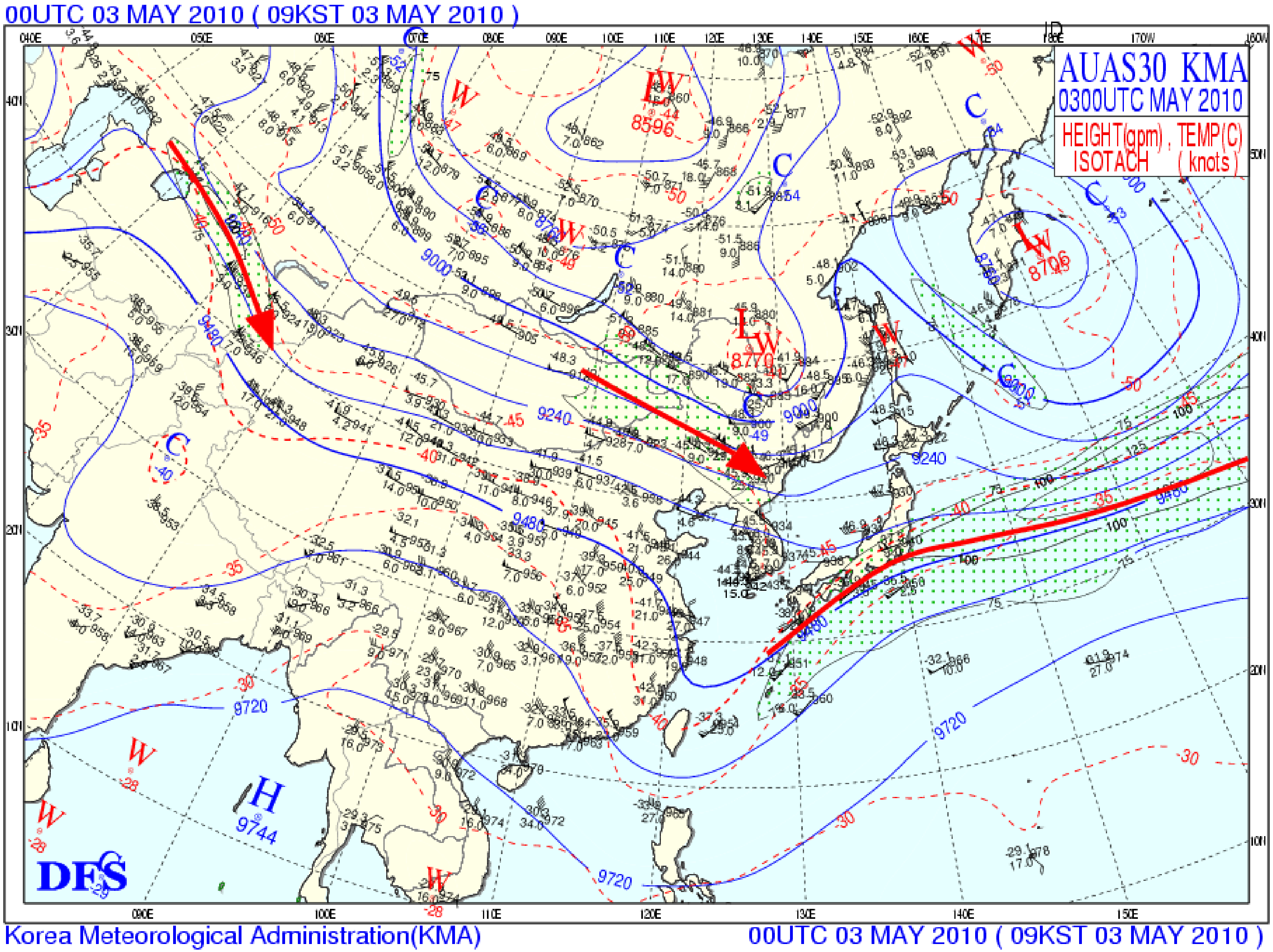
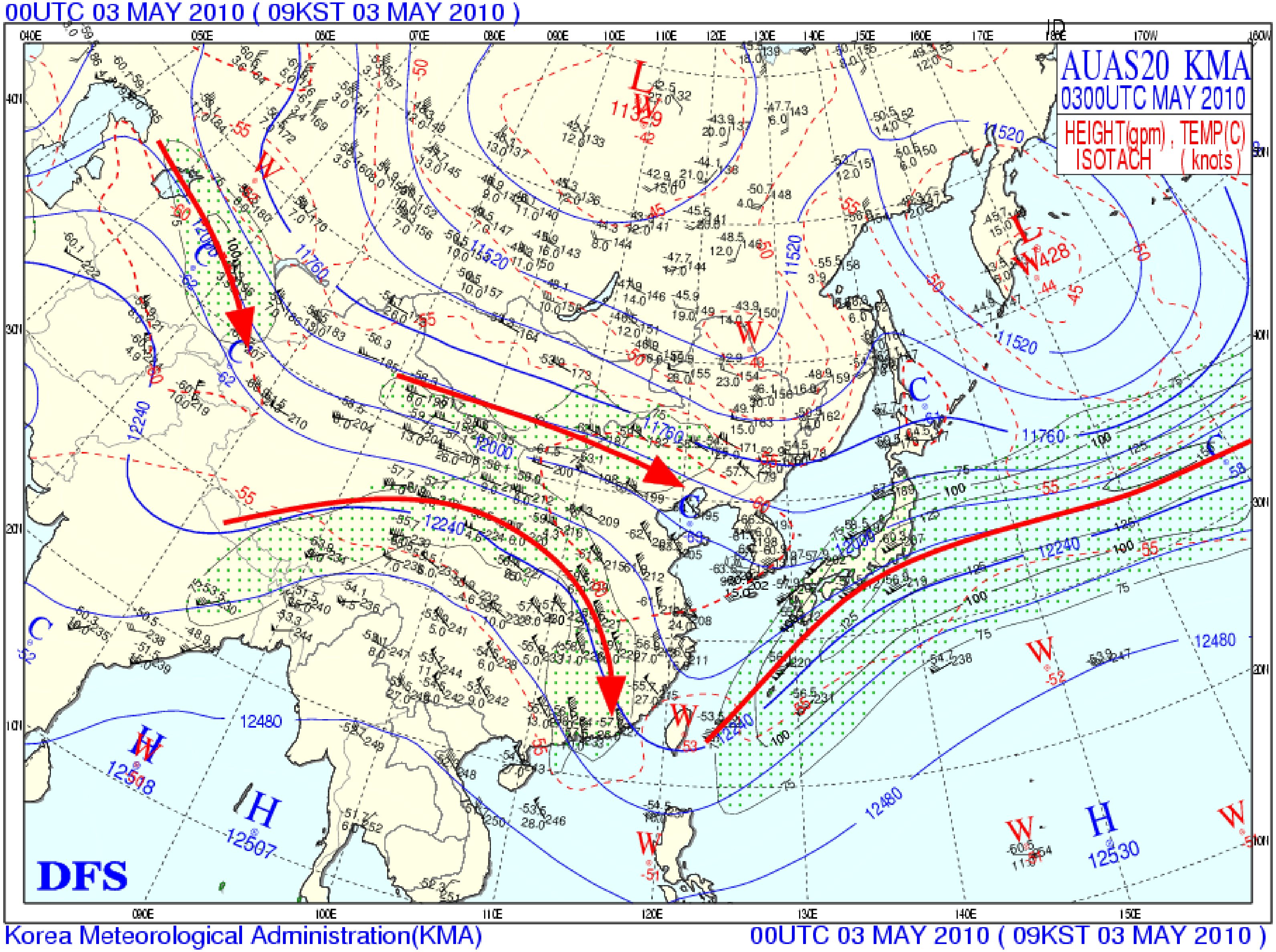
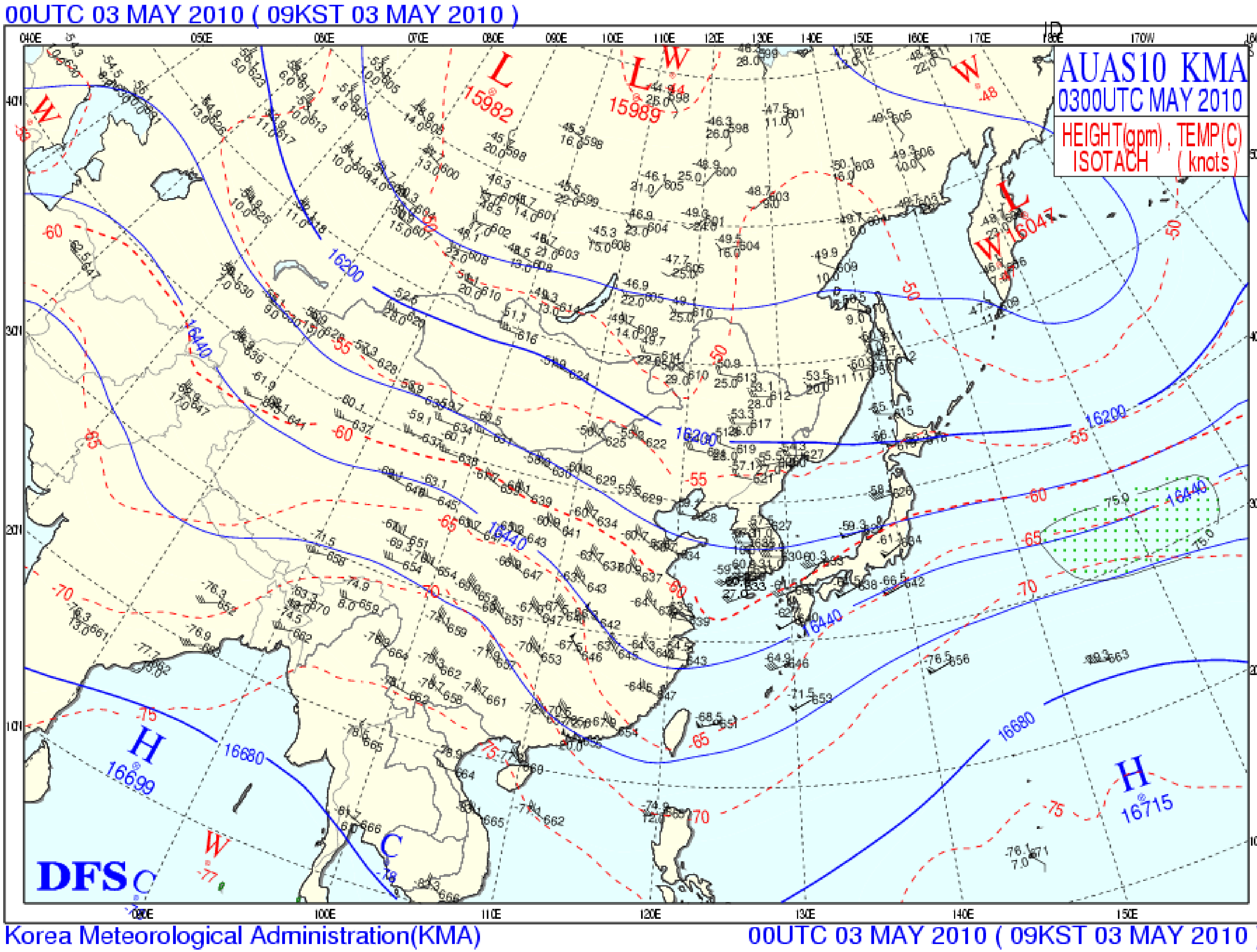
Weather Charts (300 hPa)



Weather Charts (200 hPa)



Weather Charts (100 hPa)



Sounding Instruments

Radiosonde is a balloon-borne instrument used to measure and transmit simultaneously meteorological data while ascending through the atmosphere. The instrument consists of sensors for the measurement of pressure, temperature and relative humidity.

Rawinsonde is a radiosonde that is tracked to provide wind speed and direction.

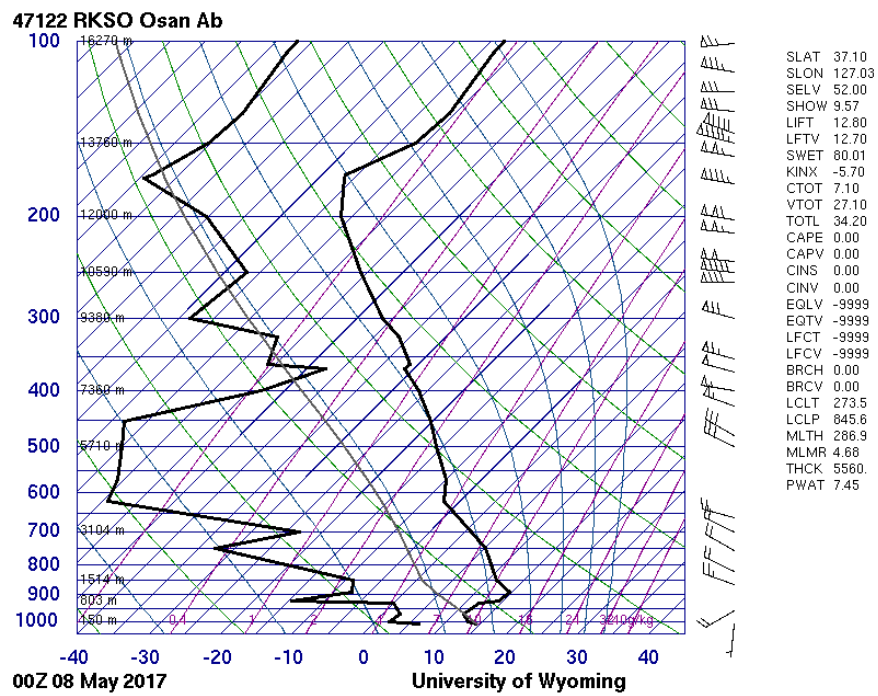
Pibal (Pilot balloon) is an uninstrumented balloon that is tracked to provide information on wind speed and direction.

Mandatory and Significant Levels

All soundings must include the Standard Pressure Levels (Mandatory Levels) of 1000, 925, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10 hPa.

Significant Levels are additional levels that appear in soundings.

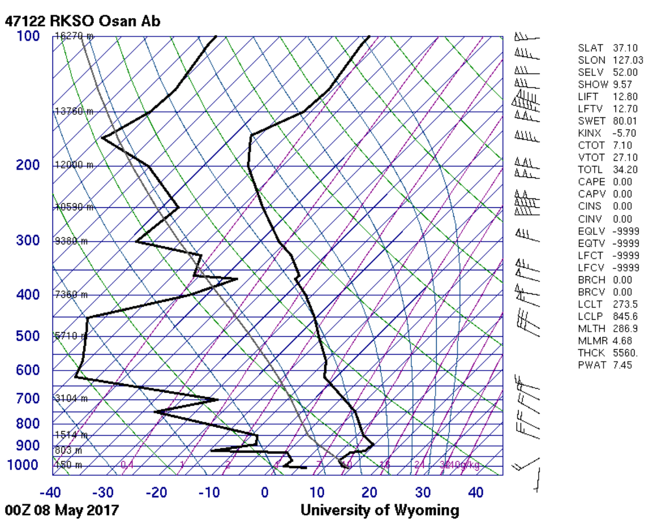
Ex.: international database in real time:
http://weather.uwyo.edu/upperair/sounding.html



Tropopause and Max. Wind Level

In a sounding the tropopause is the first (i.e. the lowest) level at which the lapse rate decreases to 2°C/km, and the average lapse rate from this level to any higher level within the next 2 km does not exceed 2°C/km.

The maximum wind level is any wind level with a wind speed of 60 knots or greater and whose wind speed is 20 knots faster than any level above or below it.



Geopotential Height

The heights reported from rawinsonde observations are geopotential heights.

Geopotential is the energy per unit mass needed to lift air from mean sea level to height, z.

Geopotential height is an adjusted height that takes into account the gradual decrease of gravitational acceleration as distance from the center of the Earth increases.

Geopotential height approximates the actual height of a pressure surface above mean sea-level in meters. For example a geopotential height of 1500 at 850mb surface is the number of meters above sea-level one would have to be to reach a pressure of 850mb.

Rawinsonde Report (Sample)

```
TTAA 53001 72201 99008 29050 16005 00085 28446 16006 92773 22446 17009 85504
17836 19012 70141 09056 18517 50585 06507 18040 40755 17359 19043 30965 31757
19060 25091 42957 18558 20237 55159 19558 15416 66559 18543 10655 73558 21006
88130 73158 18541 77236 18563 40710 51515 10164 00001 10194 17009 19015
TTBB 53000 72201 00008 29050 11950 23624 22942 23447 33744 11234 44719 10058
55710 09450 66683 08058 77668 06849 88635 04860 99610 02259 11605 01617 22594
00835 33566 01522 44555 01757 55544 02910 66511 06107 77465 09708 88452 12308
99446 13357 11435 15159 22414 17370 33400 17359 44374 21165 55364 21758 66345
24561 77323 27556 88200 55159 99130 73158 11104 74558 22100 73558 31313 05102
82307 41414 35476
PPBB 53000 72201 90012 16005 16008 17508 90346 17009 18010 19515 90789 19515
19514 19016 91246 18017 18022 18527 9205/ 18040 19044 93057 19058 18556 18563
9449/ 20039 18542 95024 18539 18520 20508
TTCC 53002 72201 70863 67559 08019 50069 64160 11511 30385 59964 07518 20642
55571 08028 10088 50177 88999 77999
TTDD 5300/ 72201 11986 73558 22869 77157 33831 73958 44751 73158 55661 64359
66279 60364 77245 54768 88184 56172 99100 50177 11099 50177
PPDD 53000 72201 9559/ 22003 07013 96258 08022 08018 11512 97015 08510 07512
10018 978// 07517 989// 08533 99038 09031 09032 07525 1001/ 08524 08524
```

Upper Air Codes

- TT indicates temperature coded message
- PP indicates upper wind coded message

- AA indicates mandatory levels below 100 hPa
- BB indicates significant levels below 100 hPa
- CC indicates mandatory levels above 100hPa
- DD indicates significant levels above 100 hPa

- For a detailed comprehension of codes, please consult the manual at this site

Contour Analysis

Maps depicting weather and ocean conditions are drawn based on **simultaneous observations (using UTC or GMT time)** made at many places throughout the world.

Accurate portrayal of these observations is the key to a correct interpretation of the data.

Contour analysis is used to visually explain the information the data is providing.

Contour Analysis

An isopleth is a line of equal value (a Greek word *iso* - equal; *pleth* - value).

Contouring is the process of drawing isopleths. A weather map contains isopleths of different weather parameters.

For example, maps of forecasted high temperatures have contours of constant temperature, or isotherms (*iso* - equal; *therm* - temperature).

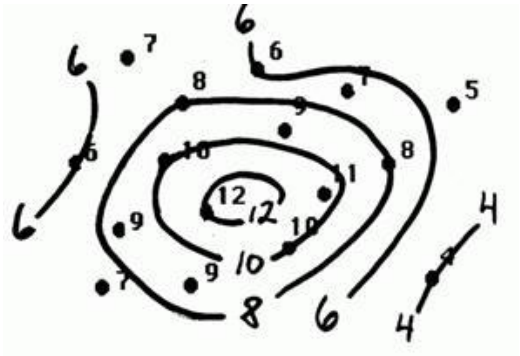
Contour Analysis (Isopleth)

Isobar	Pressure
Isotherm	Temperature
Isotach	Wind Speed
Isogon	Wind Direction
Isoshear	Wind Shear
Isodrosotherm	Dew point
Isohyet	Precipitation Accumulation
Isohaline	Salinity
Isopycnic	Density
Isohume	Humidity
Isoneph	Cloudiness
Isohel	Sunshine

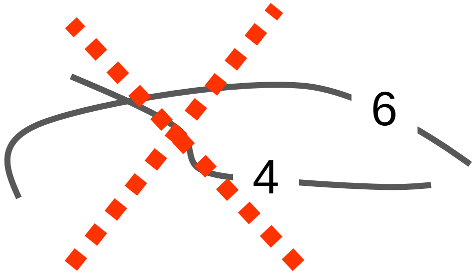
Contour Analysis

General rules of contouring

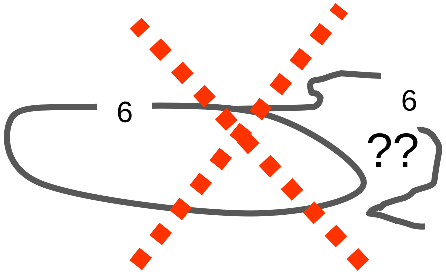
- Draw lines which keep higher values on one side and lower values on the other



- Isopleths should never cross
    - (in the crossing point, two values exist!!!)



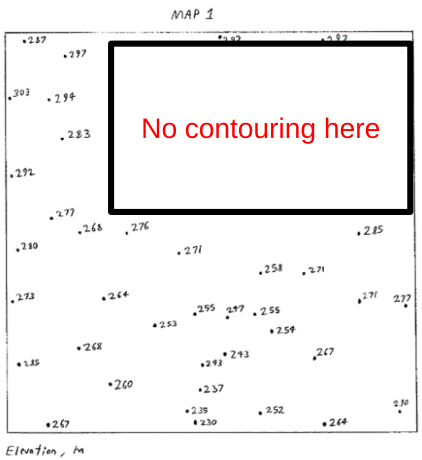
- isopleths should not branch or fork



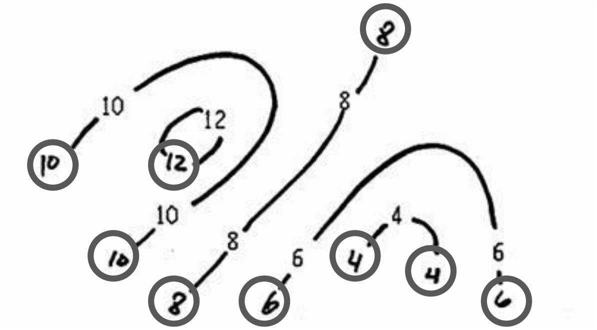
Contour Analysis

General rules of contouring

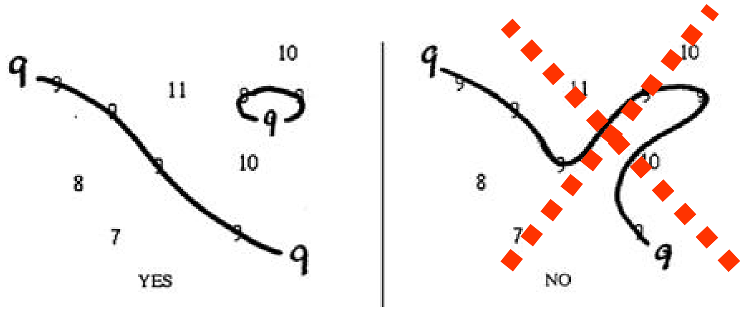
- Only the area on the map that has data should be contoured



- Label all isopleths with their value



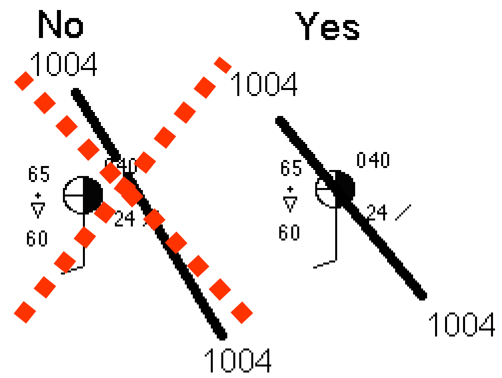
- Avoid narrow necks. In general, do not pass an isopleth of value N between two observations of value N+1 or N-1. The isopleth here is a line of value 9:



Contour Analysis

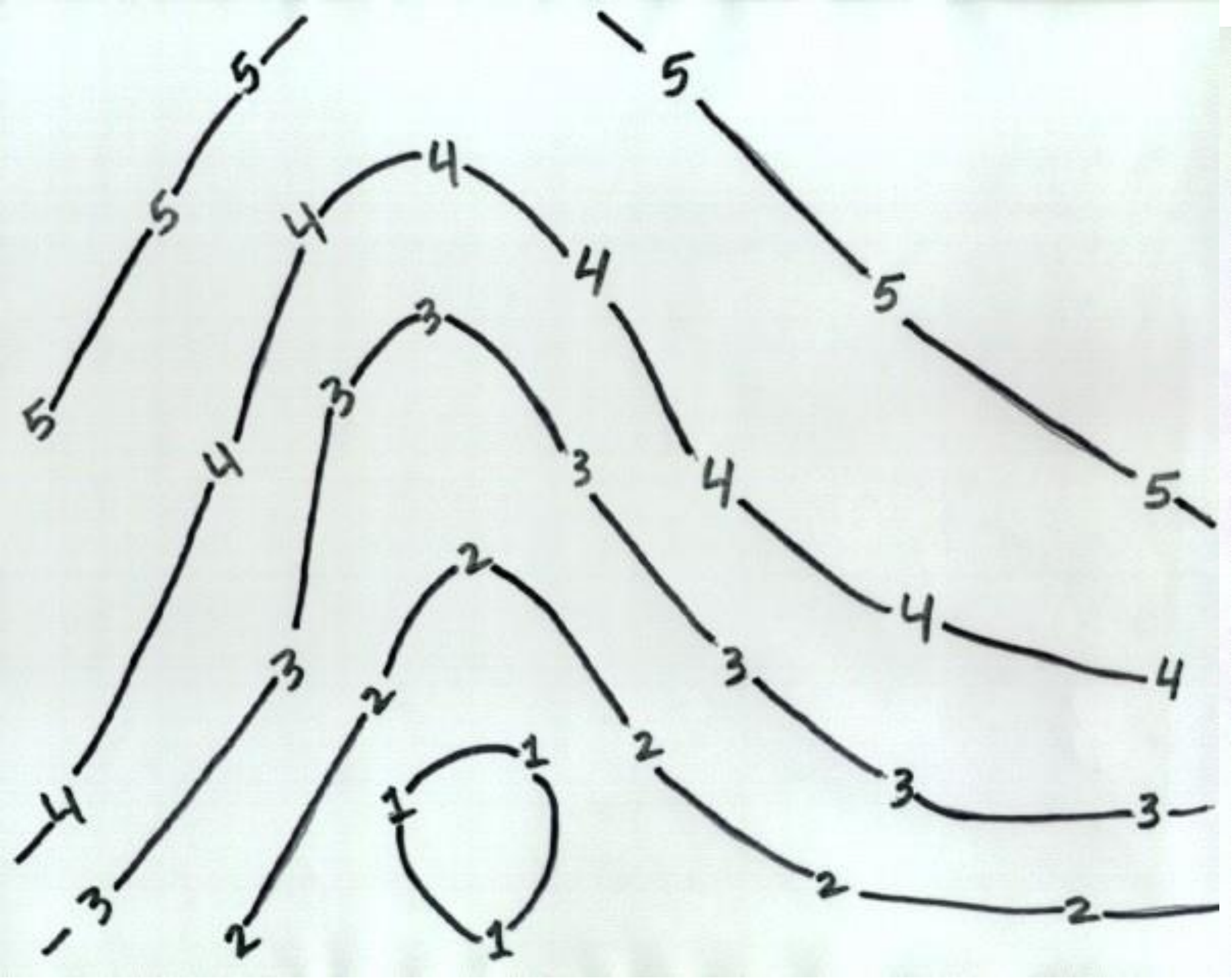
General rules of contouring

- If a station has the exact value of the label, track the isopleth over the station, not nearby

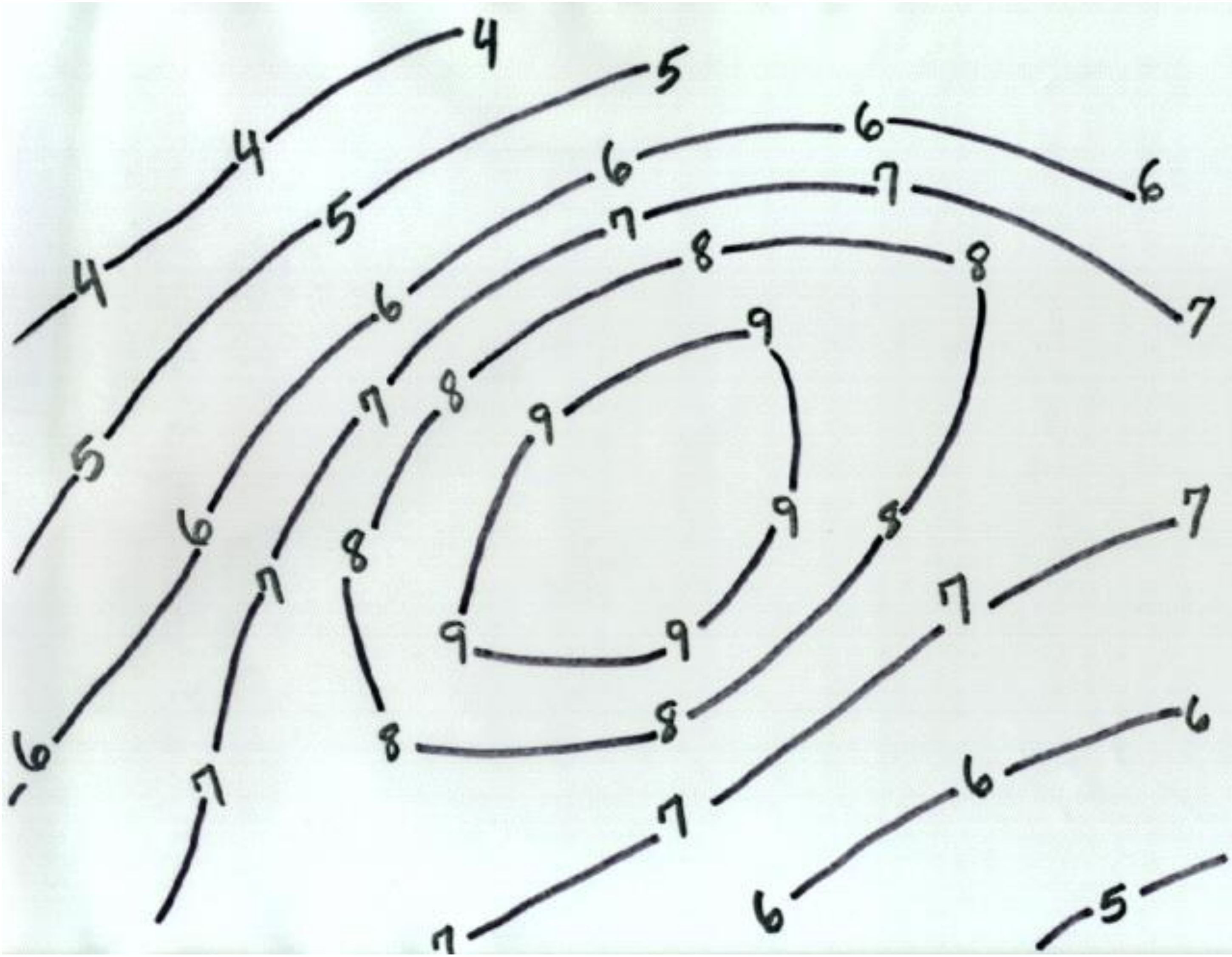


- Draw isopleths lightly in pencil so you can erase and redraw easily if mistakes are made. Ink or draw over in colored pencil only after you are sure of your analysis. (that's not a "rule". It's just a suggestion)

Examples of contour: easy



Examples of contour: medium



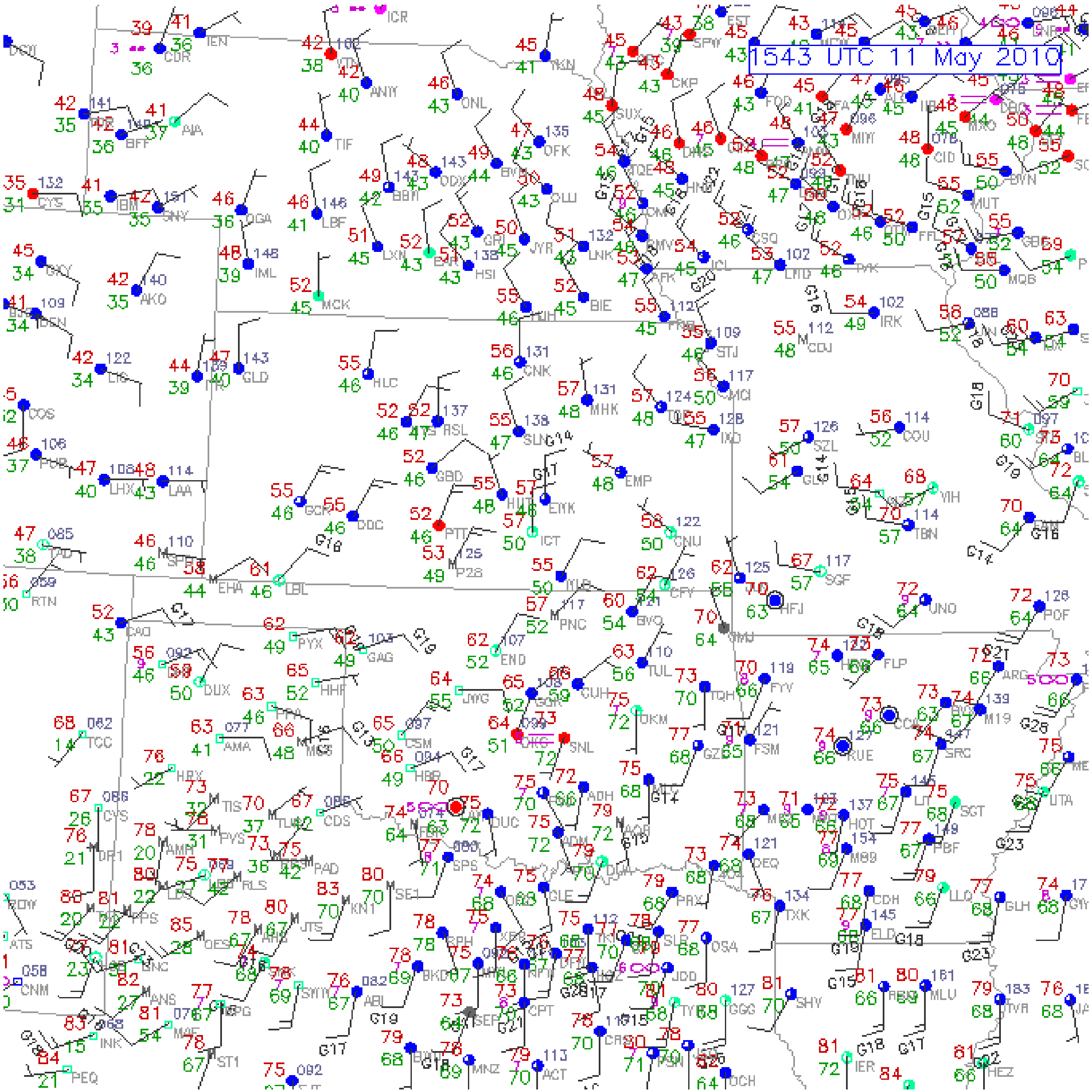
Isobar Analysis of the Surface Map

Perhaps the most fundamental synoptic analysis is the drawing of isobars on a surface weather map.

An isobar is a curve connecting places that have the same pressure. On the surface synoptic map isobars connect places that have the same sea level pressure,

On a surface weather map the standard practice is to draw isobars at an interval of 4 hPa (4 mb) beginning with 1000 hPa (1000 mb) or the closest appropriate isobar.

In cases where the pressure gradients are weak supplemental isobars are drawn every 2 hPa (2 mb).


1543 UTC 11 May 2010

Let's start with a simple one: a gridded map

1006	1005	1007	1007	1006	1009	1010
1005	1003	1001	1000	1002	1005	1008
1003	1001	999	996	998	1001	1006
1001	998	996	993	996	999	1003
1002	1001	1000	998	1002	1005	1006
1006	1004	1003	1000	1004	1007	1009
1010	1009	1008	1004	1007	1009	1011

Isobar Analysis of the Surface Map

Getting started:

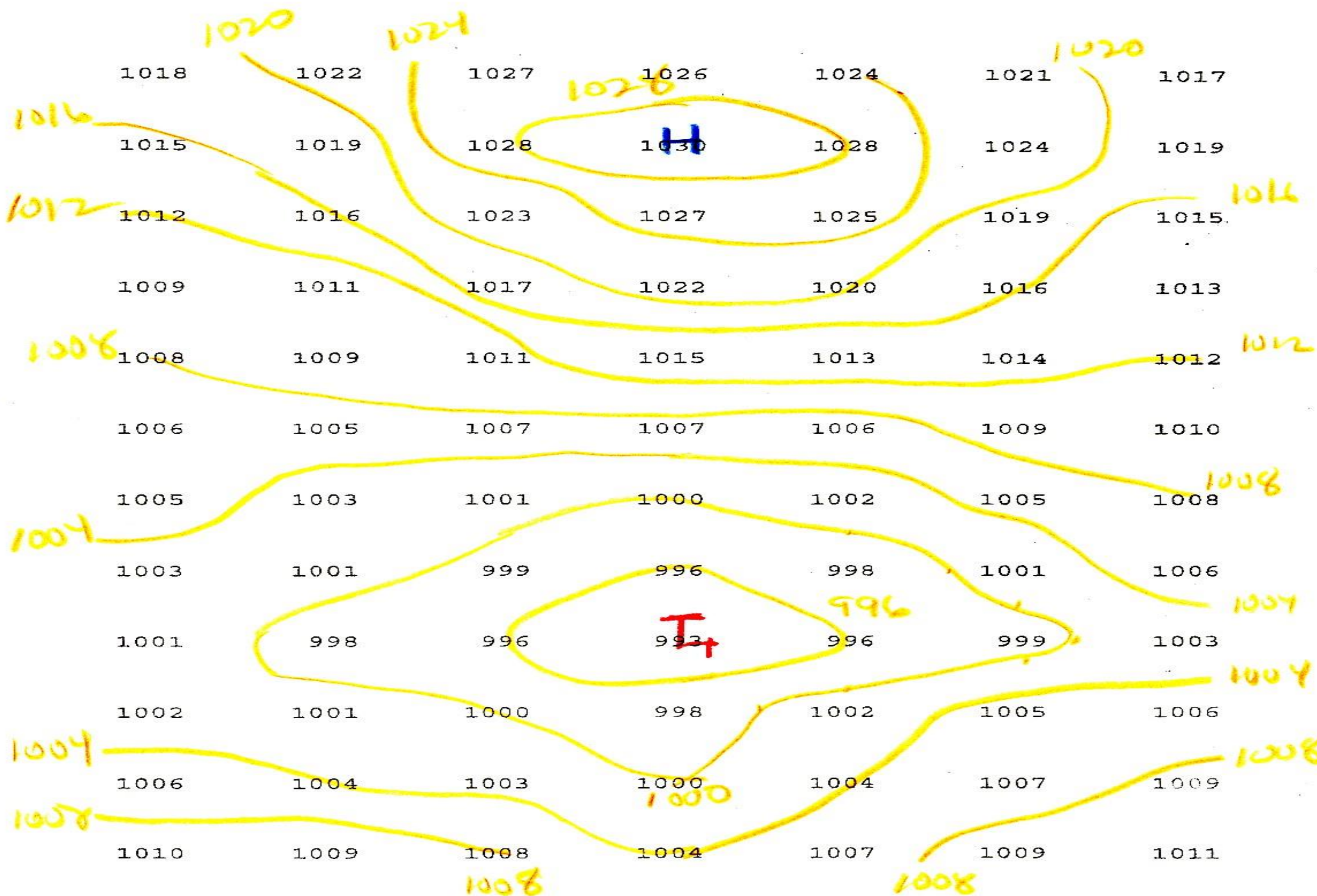
- First, locate all of the places on the map where the sea level pressure is 1000 hPa (mb) and draw an × at those locations.

1006	1005	1007	1007	1006	1009	1010
1005	1003	1001	1000	1002	1005	1008
1003	1001	999	996	998	1001	1006
1001	998	996	993	996	999	1003
1002	1001	1000	998	1002	1005	1006
1006	1004	1003	1000	1004	1007	1009
1010	1009	1008	1004	1007	1009	1011

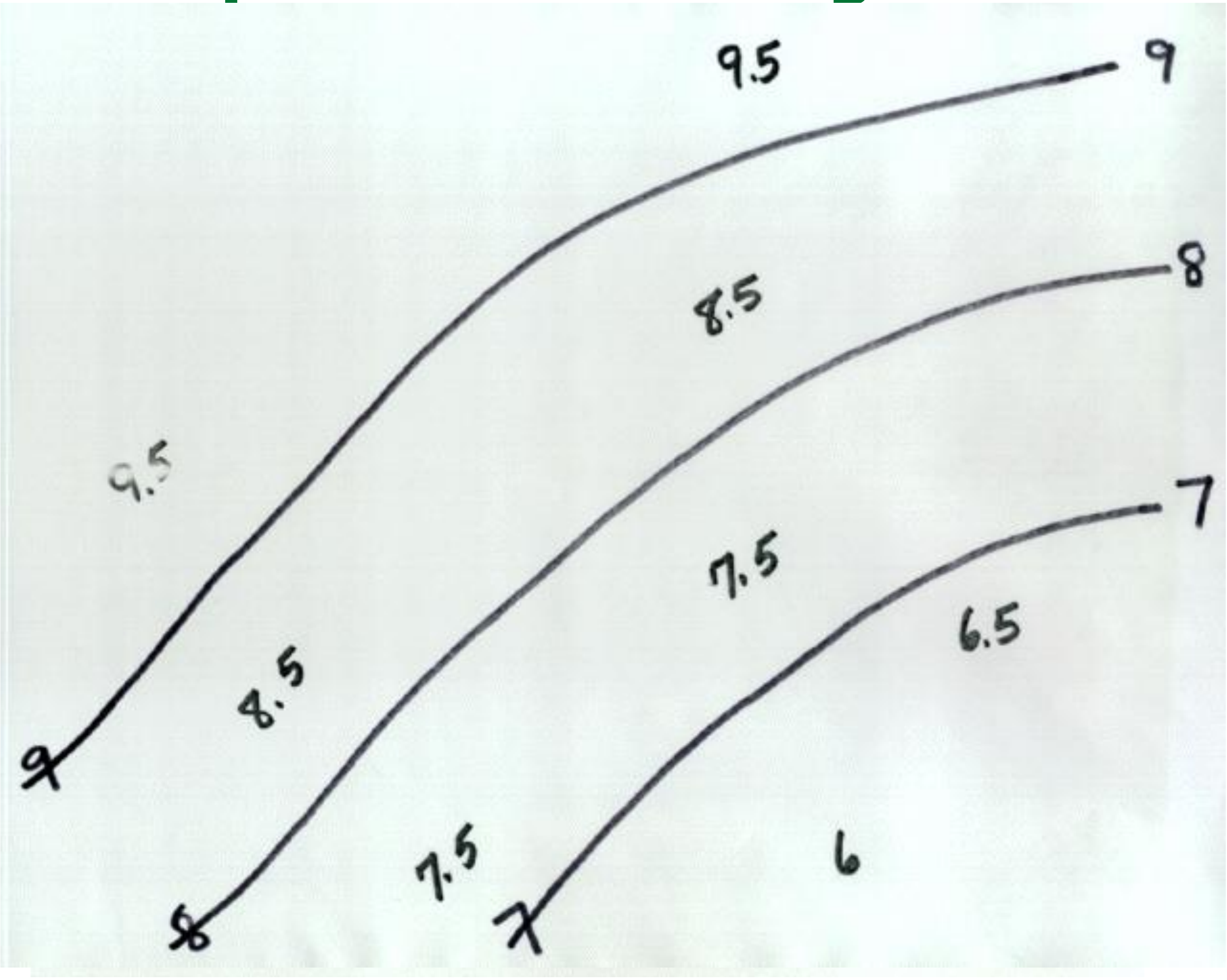
Isobar Analysis of the Surface Map

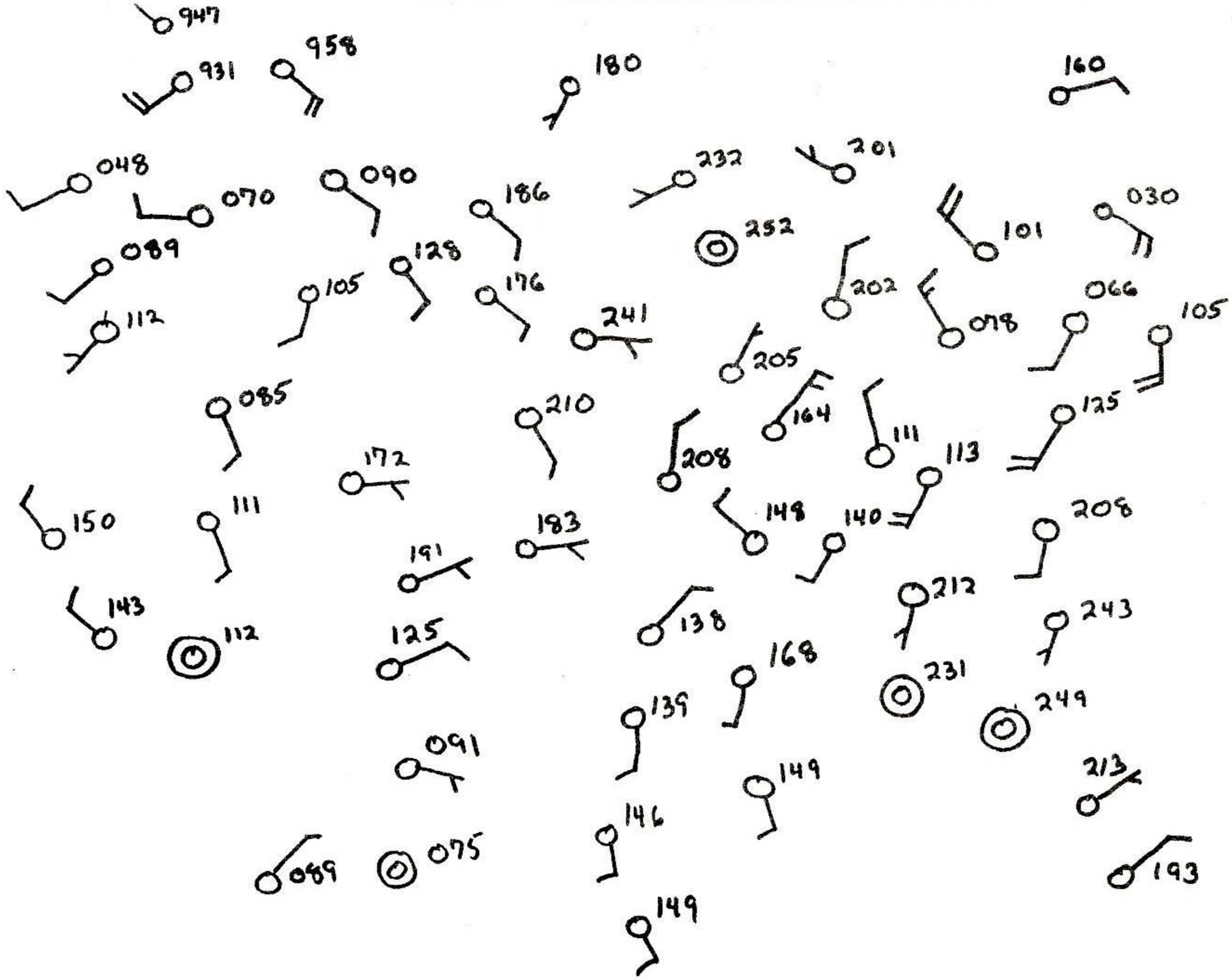
The 1000 hPa (mb) isobar

- Now draw a curve connecting all of the ×'s. You have just drawn the 1000 hPa (mb) isobar.
- Repeat the process by going up and down at a 4 hPa interval until you have drawn all of the isobars.


1018 1022 1027 1026 1024 1021 1017
1015 1019 1028 1030 1028 1024 1019
1012 1016 1023 1027 1025 1019 1015
1009 1011 1017 1022 1020 1016 1013
1008 1009 1011 1015 1013 1014 1012
1006 1005 1007 1007 1006 1009 1010
1005 1003 1001 1000 1002 1005 1008
1003 1001 999 996 998 1001 1006
1001 998 996 993 996 999 1003
1002 1001 1000 998 1002 1005 1006
1006 1004 1003 1000 1004 1007 1009
1010 1009 1008 1004 1007 1009 1011
1020
1024
1026
1020
1016
1016
1012
1012
1008
1008
1004
1004
1004
996
1004
1004
1008
1000
1008
1008
1008
H
L

Examples of contour: general

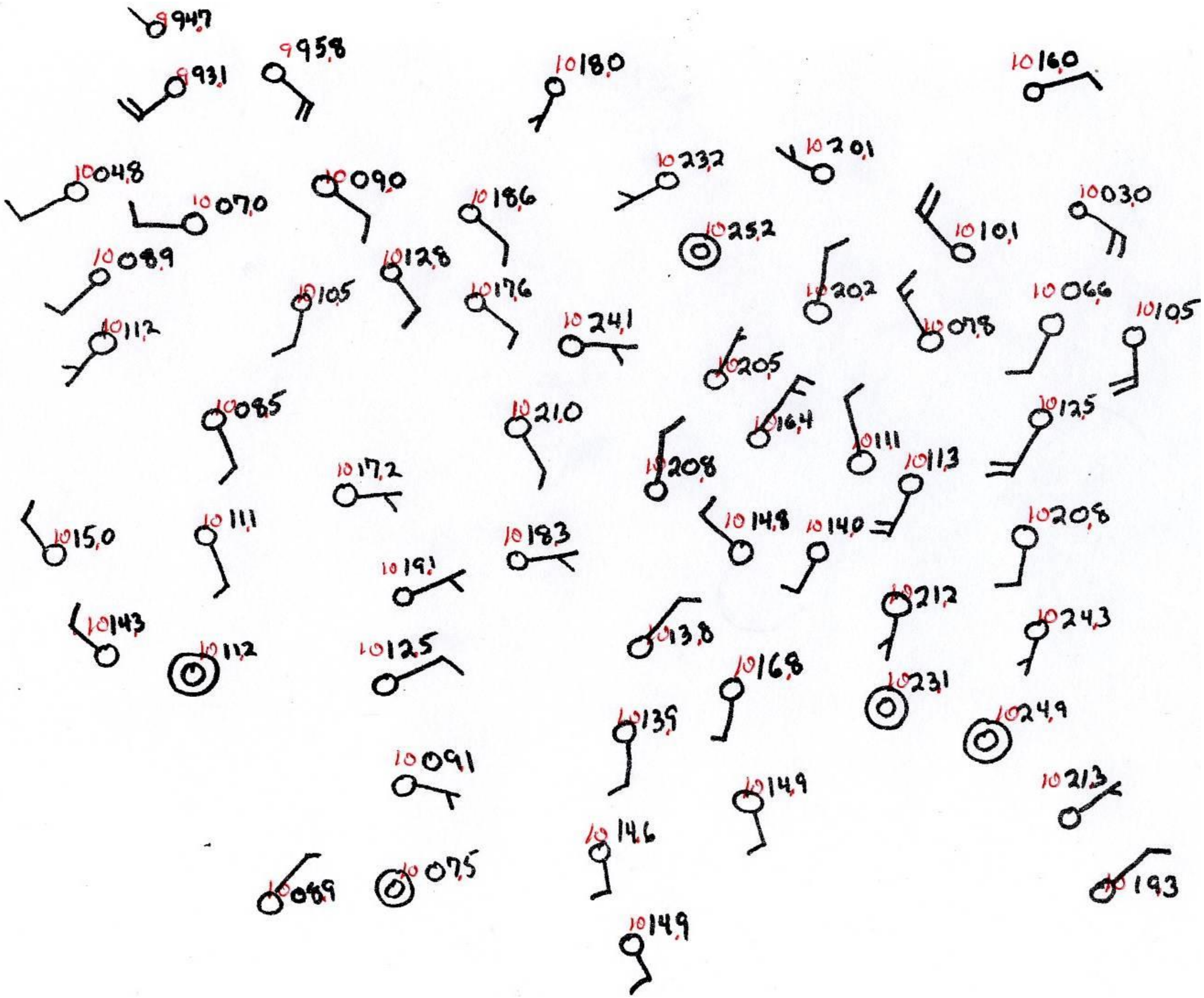


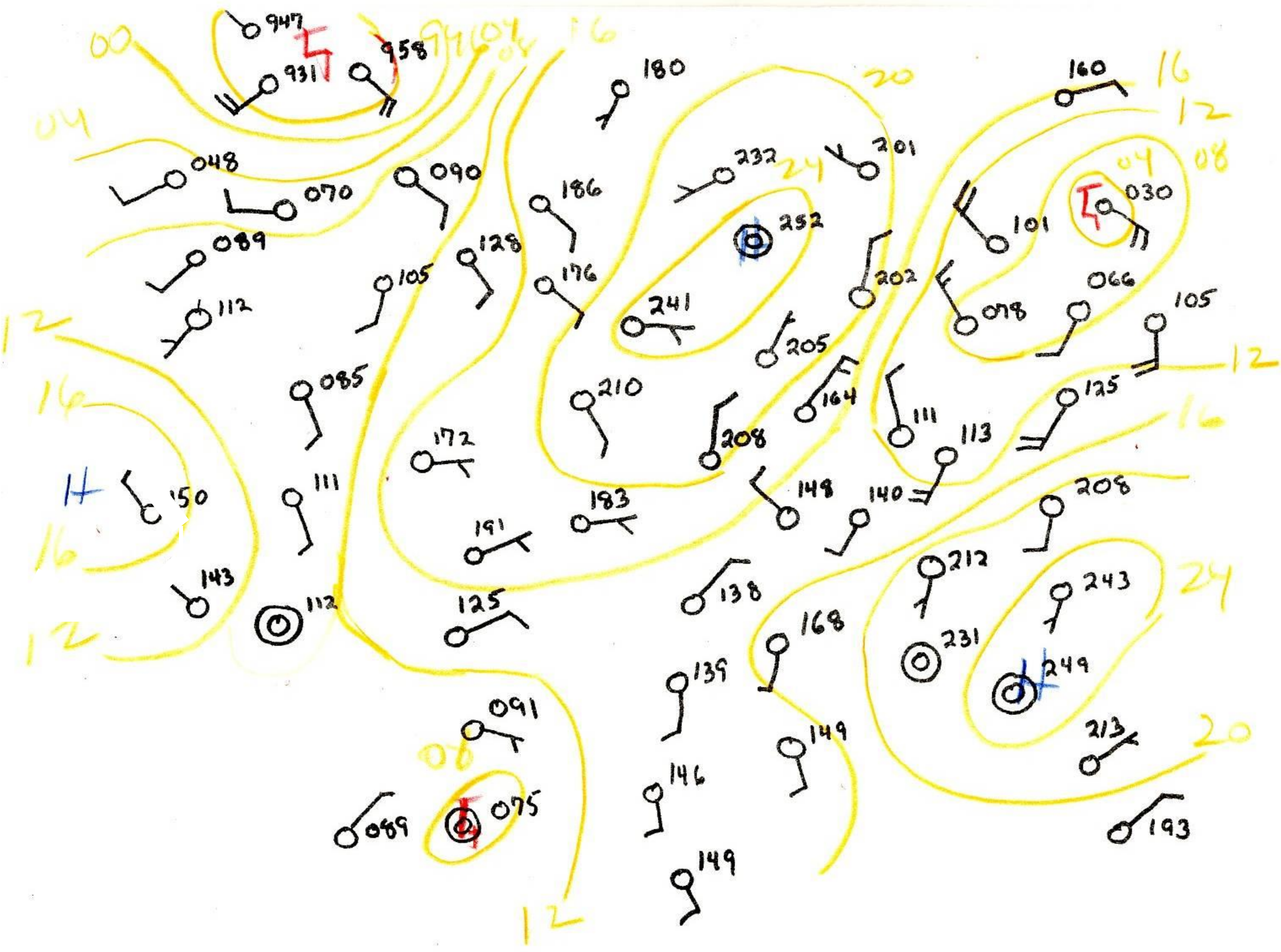

947
931
958
180
160
048
070
090
186
232
201
252
101
030
089
128
105
176
241
202
078
066
105
112
205
085
210
164
111
125
208
113
172
150
111
148
140
208
183
191
212
243
143
112
125
138
168
231
249
139
091
149
213
146
089
075
193
149

Isobar Analysis of the Surface Map

Convert SLP Code to Sea Level Pressure in hPa (mb)

- If you are not sure about how to convert the SLP code used for the surface station model in your head, it is sometimes best to convert the code to sea level pressure on the surface map before starting to draw the isobars.




H
H
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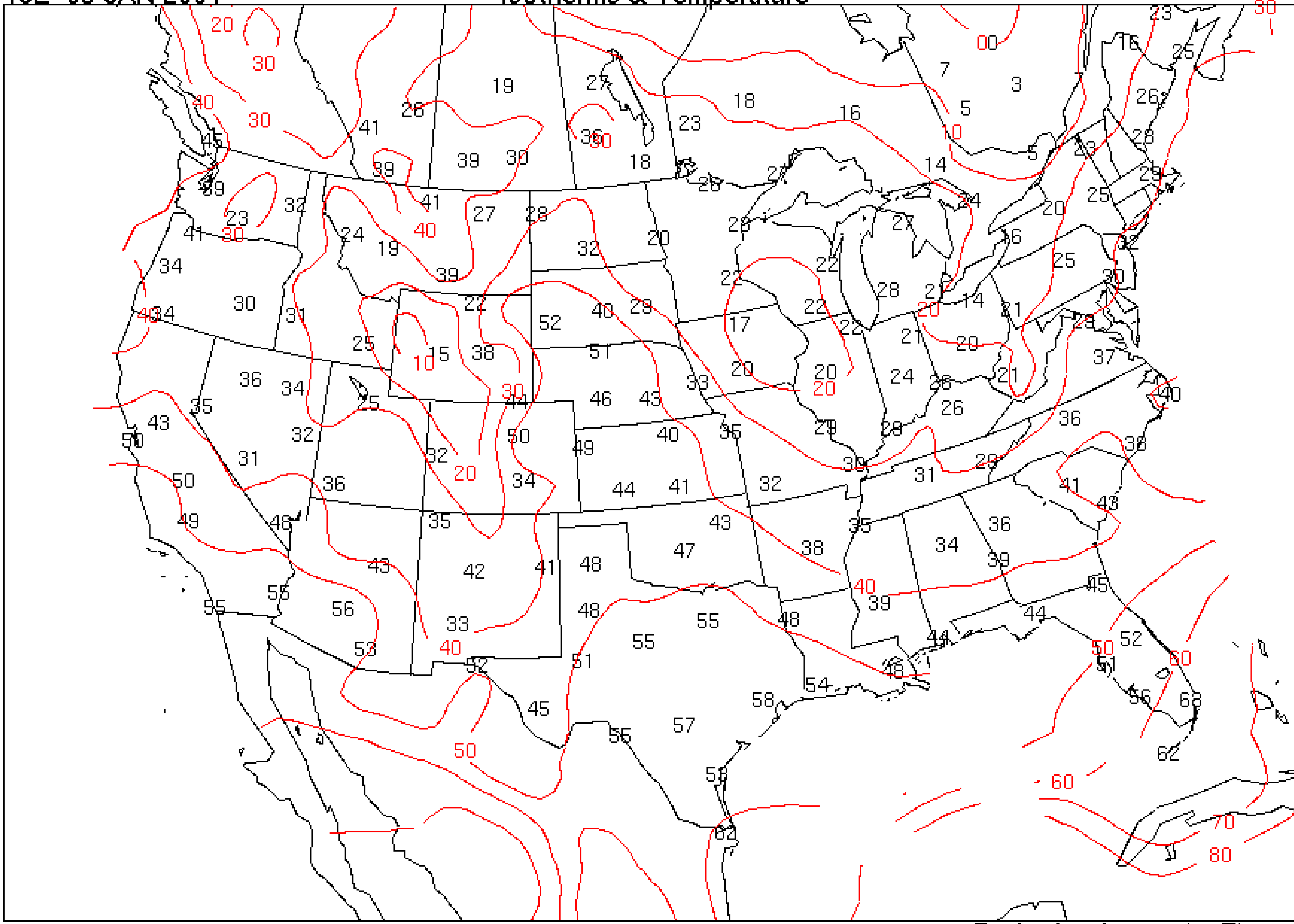
L
L

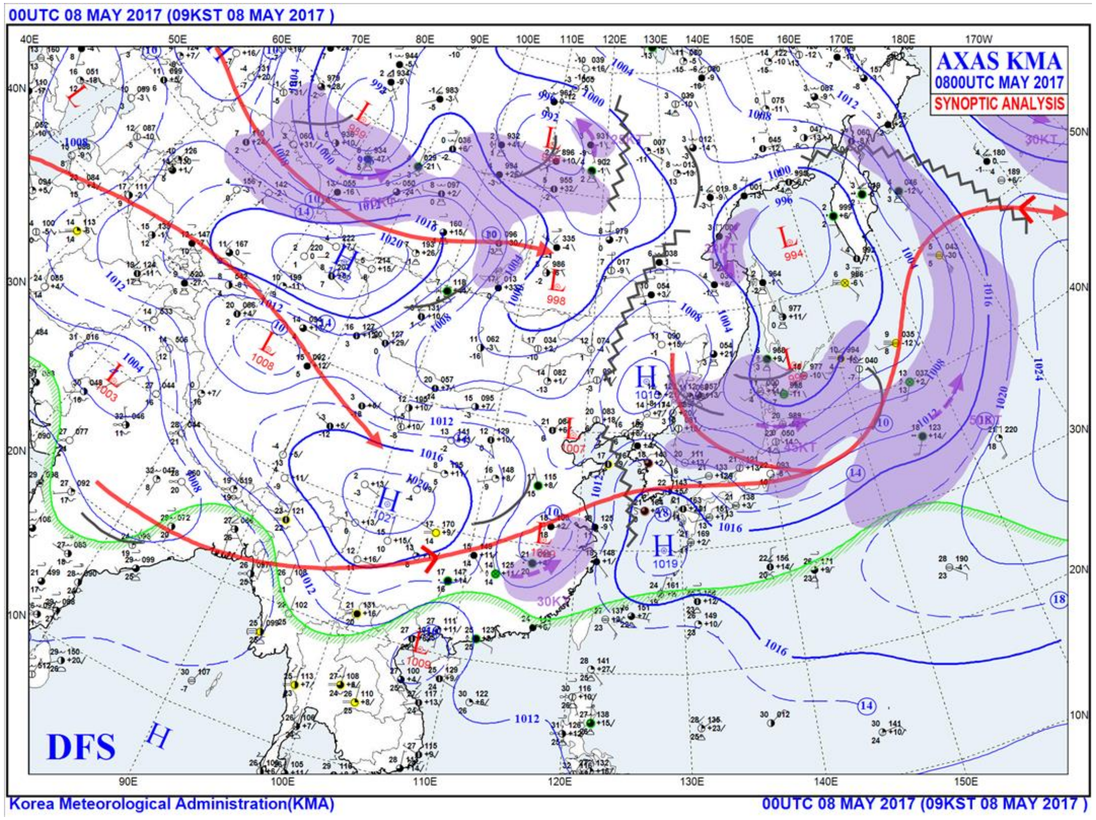
18Z 09 JAN 2001 Isotherms & Temperature



Red – Isotherms (10F)

Official KMA Surface & Upper Level Maps

http://www.kma.go.kr/weather/images/analysischart.jsp



Upper Level Maps

Three types of isolines are commonly found on constant pressure level maps based on rawinsonde data.

- Contours, Isotherms, Isotachs

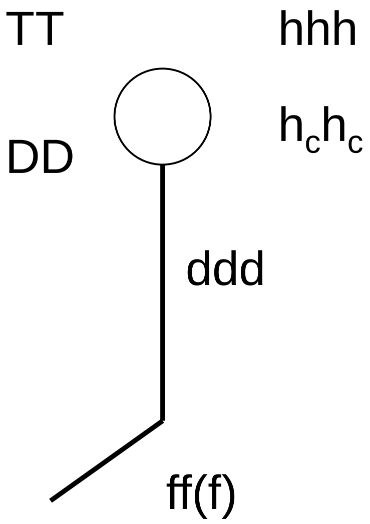
Upper Level Maps

Contour is a curve connecting locations with the same geopotential height.

Isotherm is a curve connecting locations with the same temperature.

Isotach is a curve connecting locations with the same wind speed.

Station Models on Upper Level Maps



Station Models on Upper Level Maps

TT indicates the temperature in whole degrees Ceslius (with a minus sign where appropriate).

DD indicates the dew point depression in whole degrees Ceslsius.

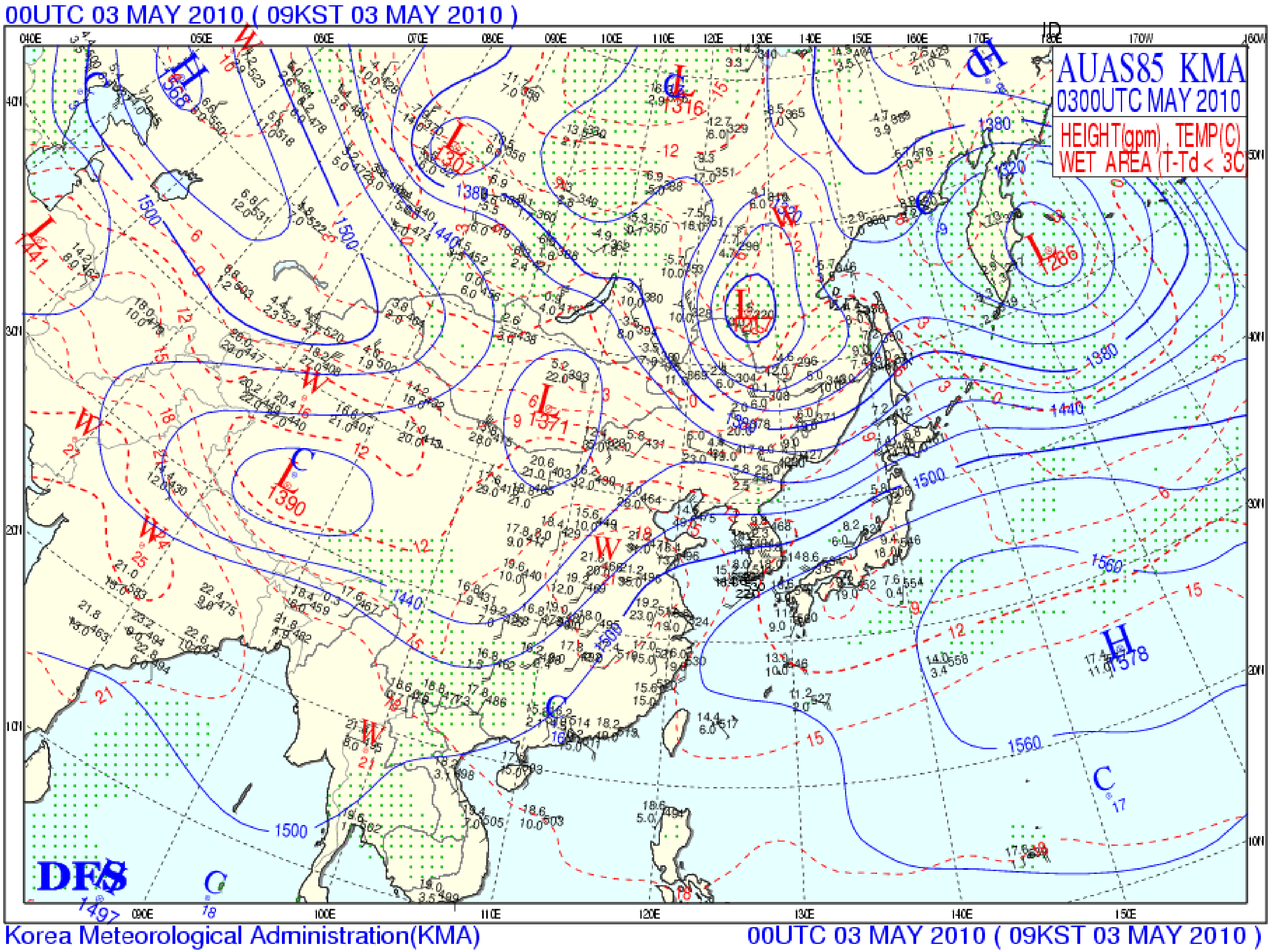
hhh indicates the three digit code for the geopotential height.

$h_c h_c$ indicates the change in the geopotential height in tens of meters during the past 12 hours.

Upper Level Maps

850 hPa (850 mb) – place a 1 front of hhh to get the geopotential height. Geopotential heights are contoured every 30 geopotential meters and isotherms are drawn every 5°C.

Upper Level Maps (850 hPa)

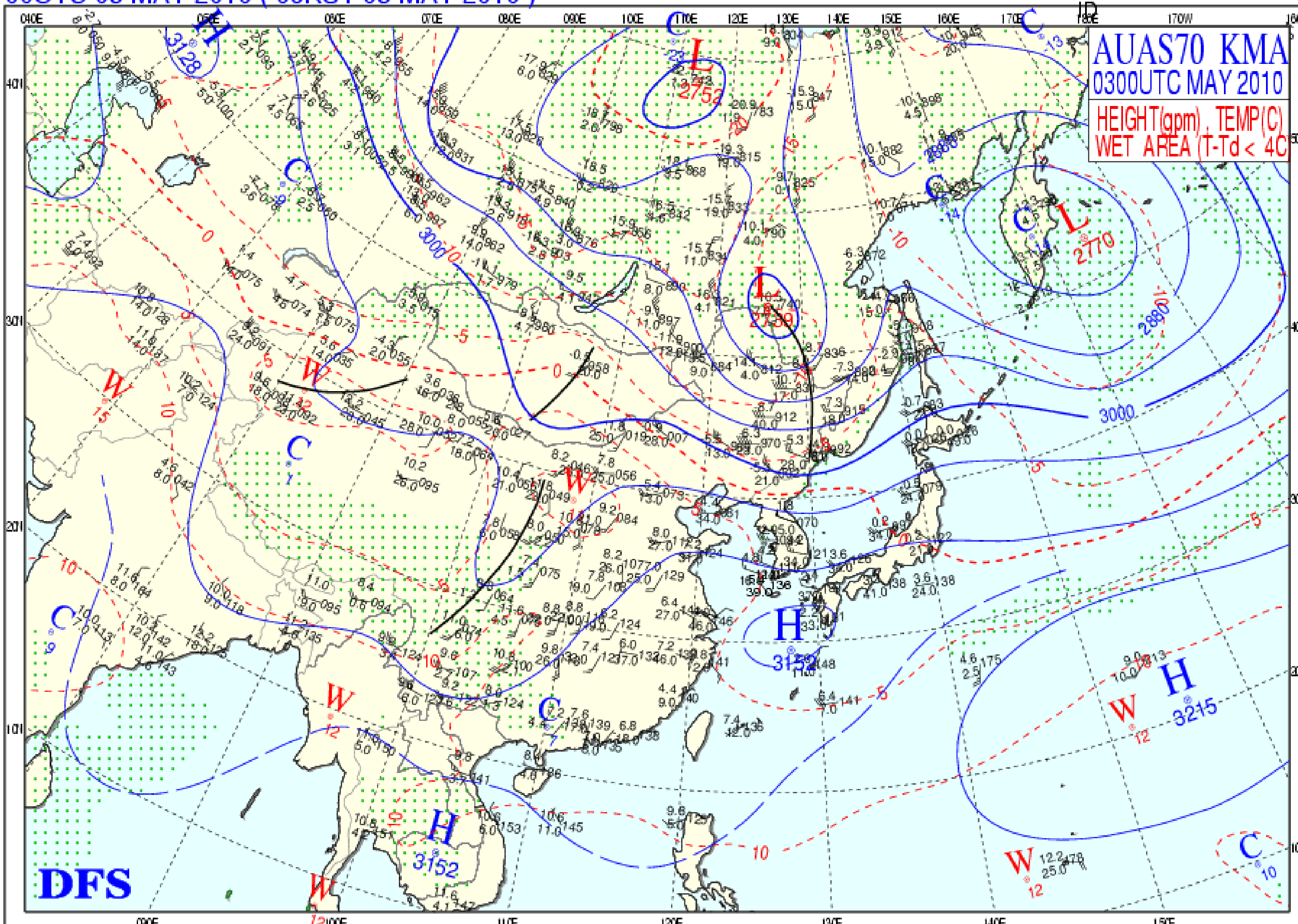


Upper Level Maps

700 hPa (700 mb) – if hhh is greater than 500 place a 2 in front of hhh, and if hhh is less than 500 place a 3 in front of hhh to get the geopotential height. Geopotential heights are contoured every 30 geopotential meters and isotherms are drawn every 5°C.

Upper Level Maps (700 hPa)

00UTC 03 MAY 2010 (09KST 03 MAY 2010)



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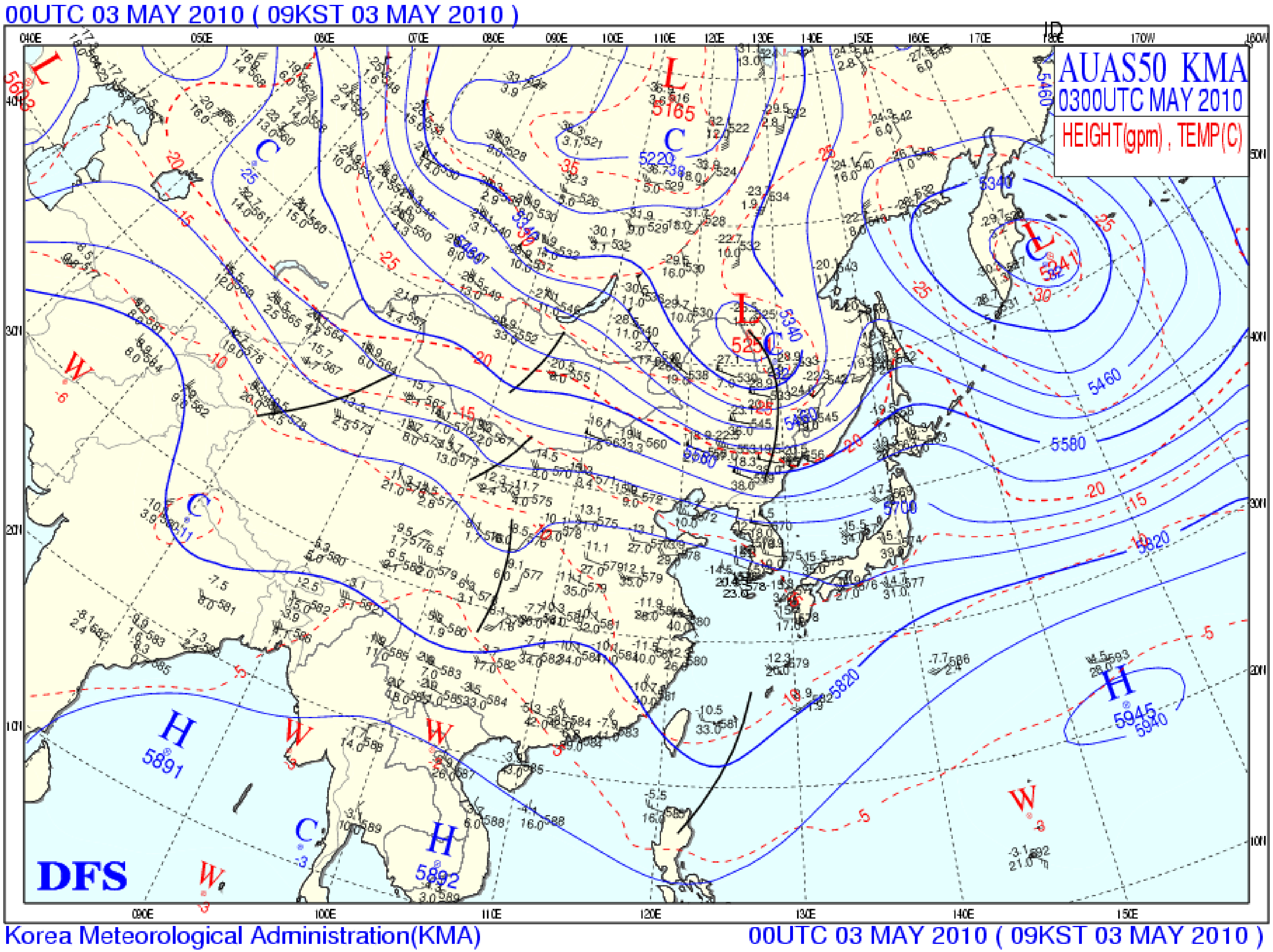
00UTC 03 MAY 2010 (09KST 03 MAY 2010)

Upper Level Maps

500 hPa (mb) – place a 0 after hhh to get the geopotential height in geopotential meters. Geopotential heights are contoured every 60 geopotential meters and isotherms are drawn every 5°C

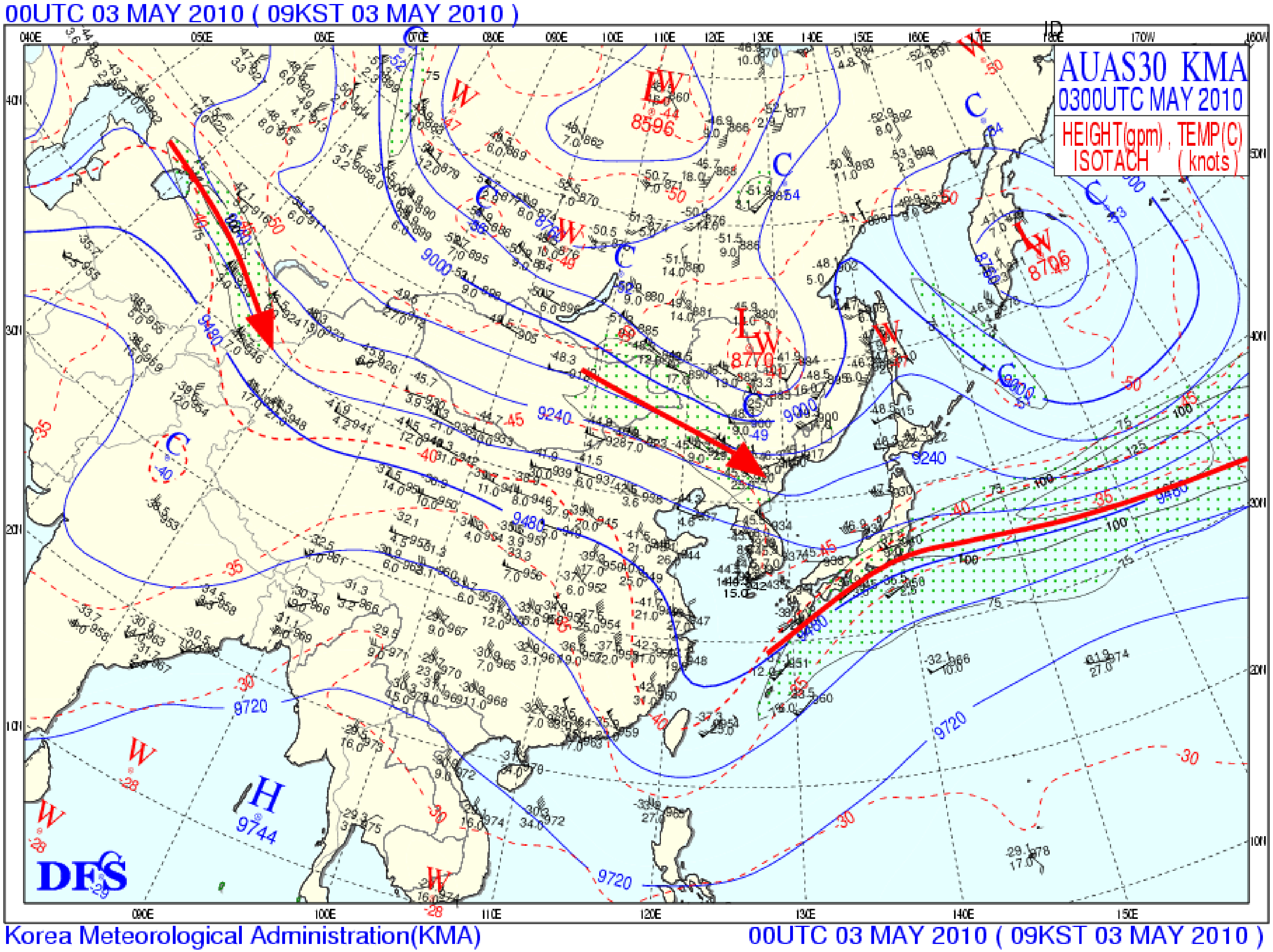
Upper Level Maps (500 hPa)



Upper Level Maps

300 hPa (mb) – place a 0 after hhh to get the height in geopotential meters. Geopotential heights are contoured every 120 geopotential meters, isotherms are drawn every 5°C, and isotachs are drawn every 20 knots.

Upper Level Maps (300 hPa)



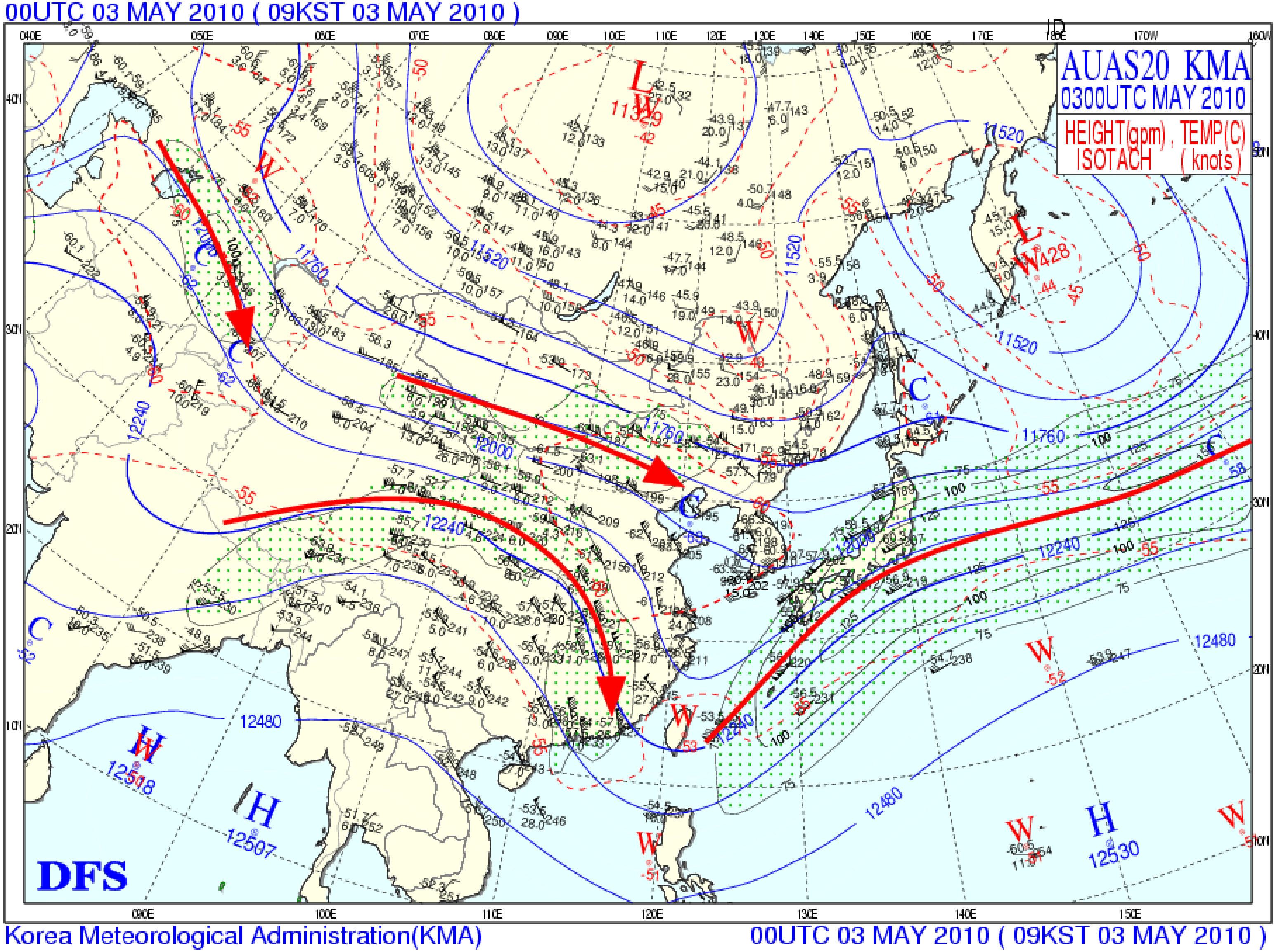
Upper Level Maps

200 hPa (mb) – place a 1 in front of hhh and a 0 after hhh to get the geopotential height in geopotential meters. Geopotential hieghts are contoured every 120 geopotential meters, isotherms are drawn every 5°C, and isotachs are drawn every 20 knots.

Isotach Shading

- Alternate bands of shading and no shading at 40 knot intervals are sued to depict regions with wind speeds greater than 70 knots (i.e. the jet streams).

Upper Level Maps (200 hPa)



Contouring the 500 hPa (mb) Map

Contours are drawn every 60 m on the 500 hPa (mb) map. It is often easier to remember if you start with some major multiple of 60 m, such as 5400 or 5700 m and then work your way up and down by 60 m increments.

Remember, 5400 m would appear as 540 in the station model on the 500 hPa (mb) map.

Contouring the 500 hPa (mb) Map

Isotherms

- Isotherms are drawn at 5°C intervals on the 500 hPa (mb) map starting at 0°C.
- Use TWO COLORS!!!!!!!