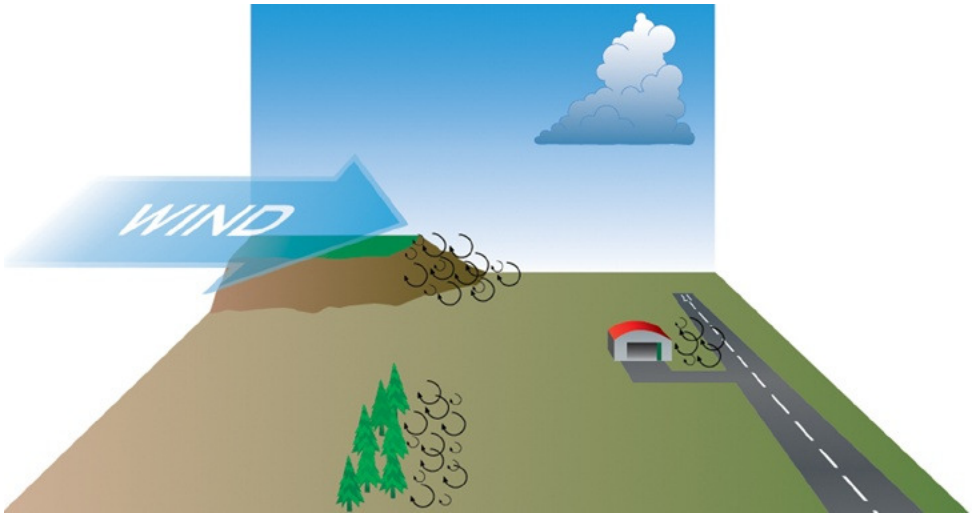
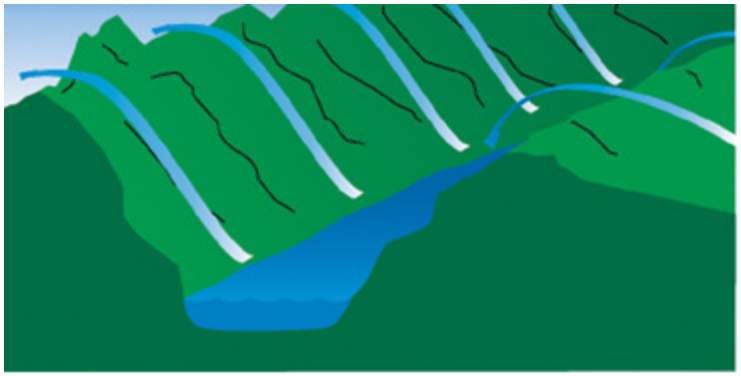
METEOROLOGY – WEATHER HAZARDS
TURBULENCE

Low Level Turbulence (usually less than 15,000 ft)

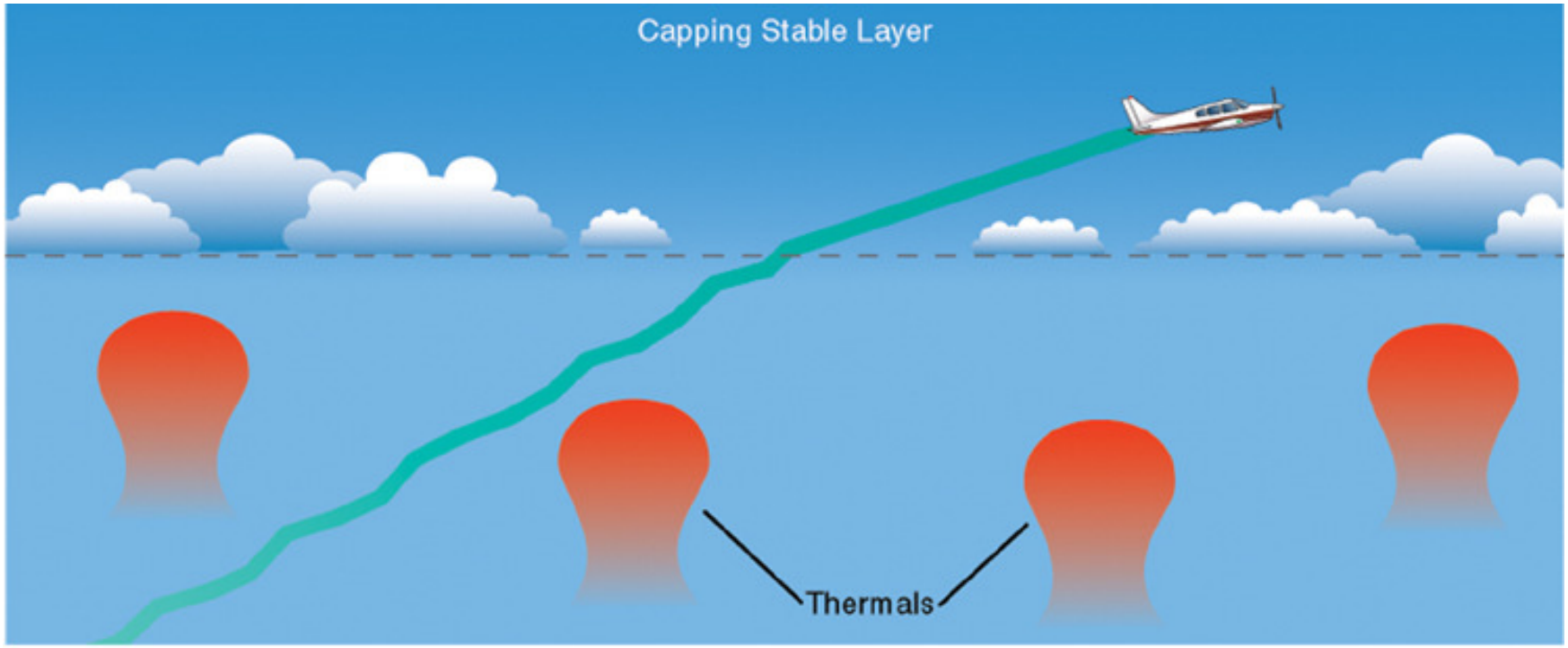


<u>Mechanical Turbulence</u>
Friction, Surface Winds, Valley Winds, etc

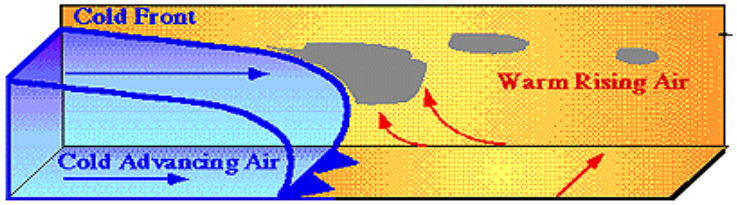
Interesting side note: These winds interact with earths rotation and can slow the rotation of the earth by friction effects causing difference in rotation of earth by several milliseconds a day.



METEOROLOGY – WEATHER HAZARDS
TURBULENCE



Convective (also referred to as Thermal) Turbulence
TURBULENCE BELOW – SMOOTH ABOVE



Frontal Turbulence (fast moving cold fronts can produce 3000 fpm updrafts.

METEOROLOGY – WEATHER HAZARDS
TURBULENCE

LIGHT TURBULENCE: Causes slight, erratic changes in altitude and/or altitude.
MODERATE TURBULENCE: Expect where vertical wind shear exceeds 6 kts'100 ft.
CLEAR AIR TURBULENCE (CAT) is a high-level phenomena above 15,000 AGL and not associated with cumuliform cloudiness.

- CAT typically found in the upper trough on the polar side of a jet stream
- CAT are sometimes visually identified by long streaks of cirrus clouds

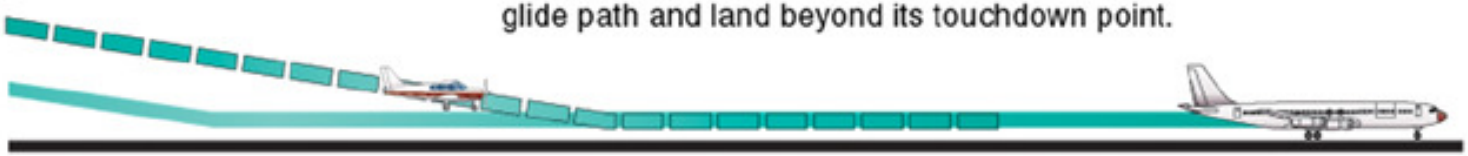
WIND SHEAR: A change in wind direction and/or speed within a short distance in the atmosphere. It can be both a vertical and horizontal direction.

Hazardous wind shear is commonly encountered during periods of strong temperature inversion and thunderstorms. Low-level WS may occur when there is a low-level temperature inversion with strong winds above the inversion.

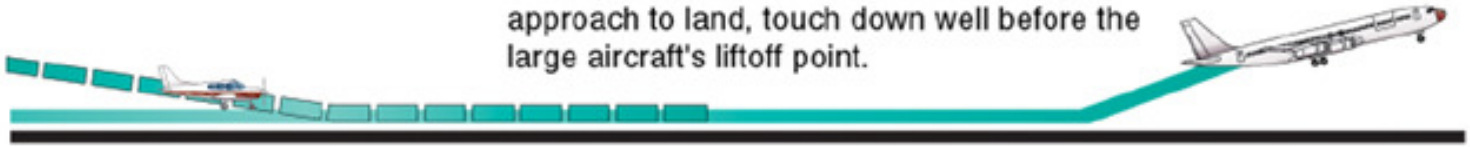
During an approach, possible wind shear is indicated by changes in power and vertical velocity required to remain on the proper glide path. A sudden decrease in headwind results in a loss of indicated airspeed equal to the decrease in wind velocity. You could suddenly STALL. While approaching for landing when either possible wind shear or convective turbulence is indicated, you should increase approach airspeed slightly above normal to avoid stalling

METEOROLOGY – WEATHER HAZARDS
WAKE TURBULENCE

To avoid turbulence when landing behind a large aircraft, stay above the large airplane's glide path and land beyond its touchdown point.



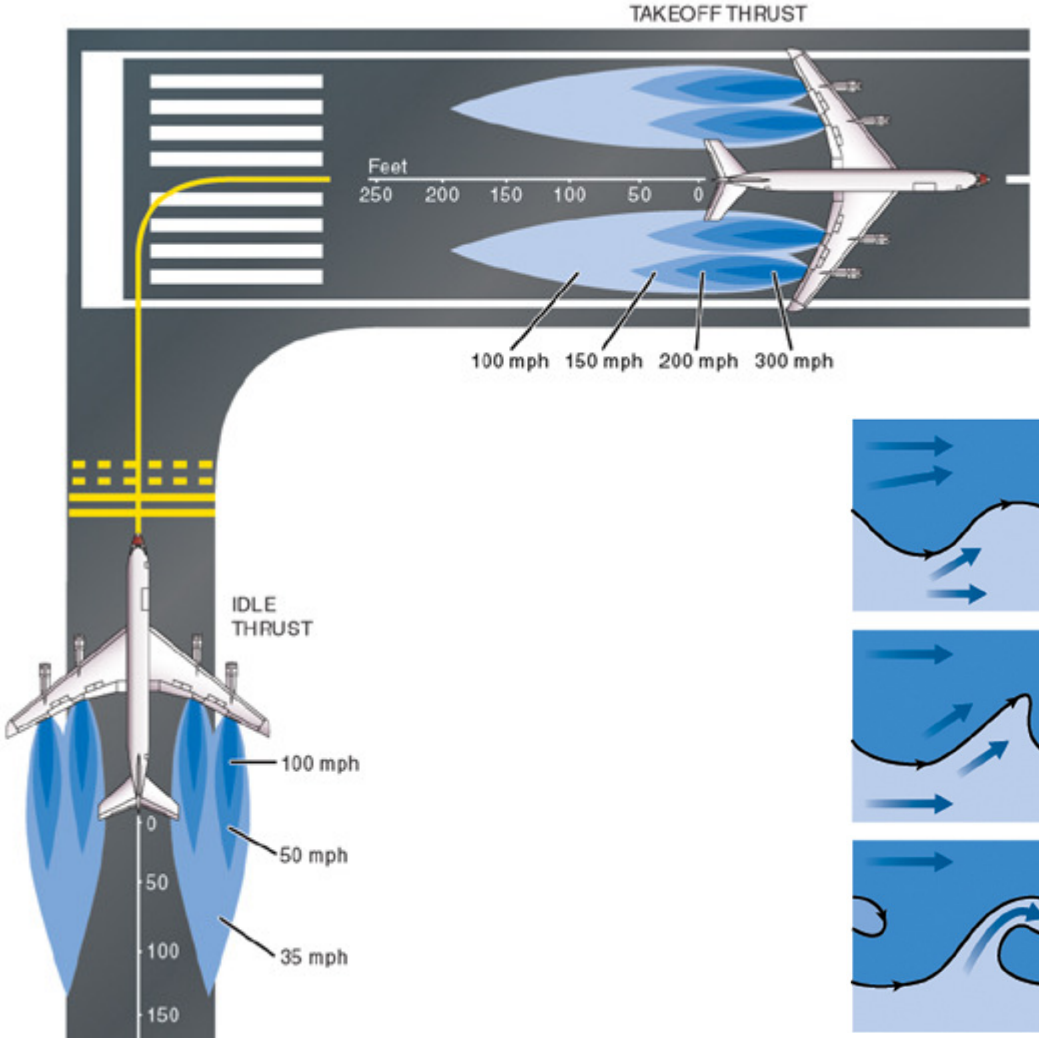
If a large airplane has just taken off as you approach to land, touch down well before the large aircraft's liftoff point.



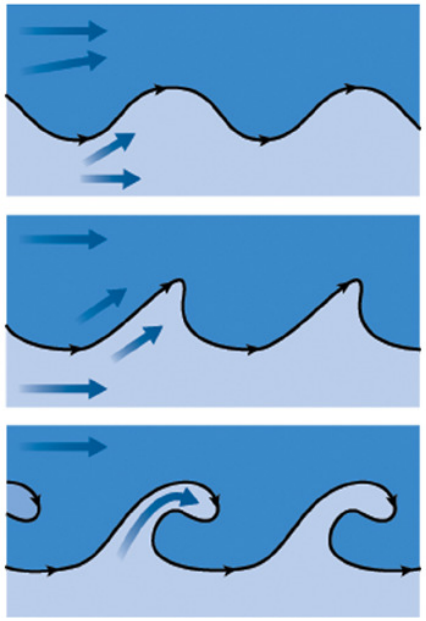
When departing after a large aircraft has landed, lift off beyond its touchdown location.

When taking off behind a large aircraft, lift off before the large airplane's rotation point and climb out above or upwind of its flight path.

METEOROLOGY – WEATHER HAZARDS
TURBULENCE

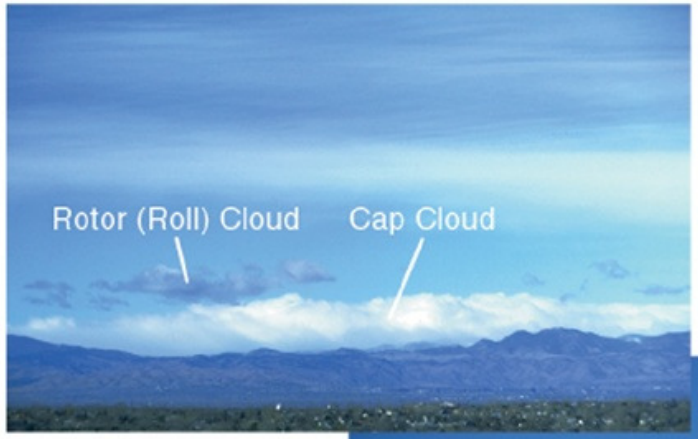


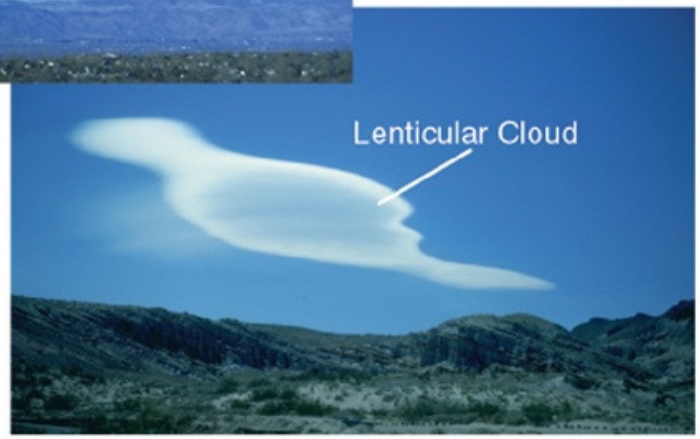
Jet Blast

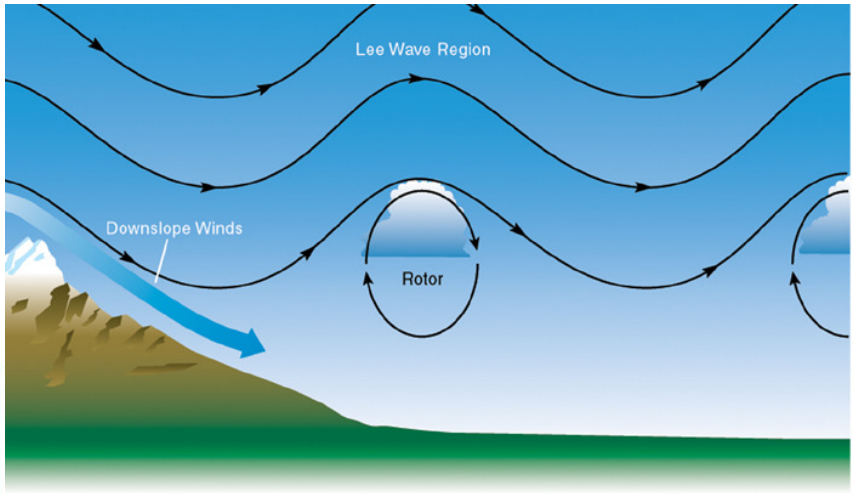


CLEAR AIR TURBULENCE

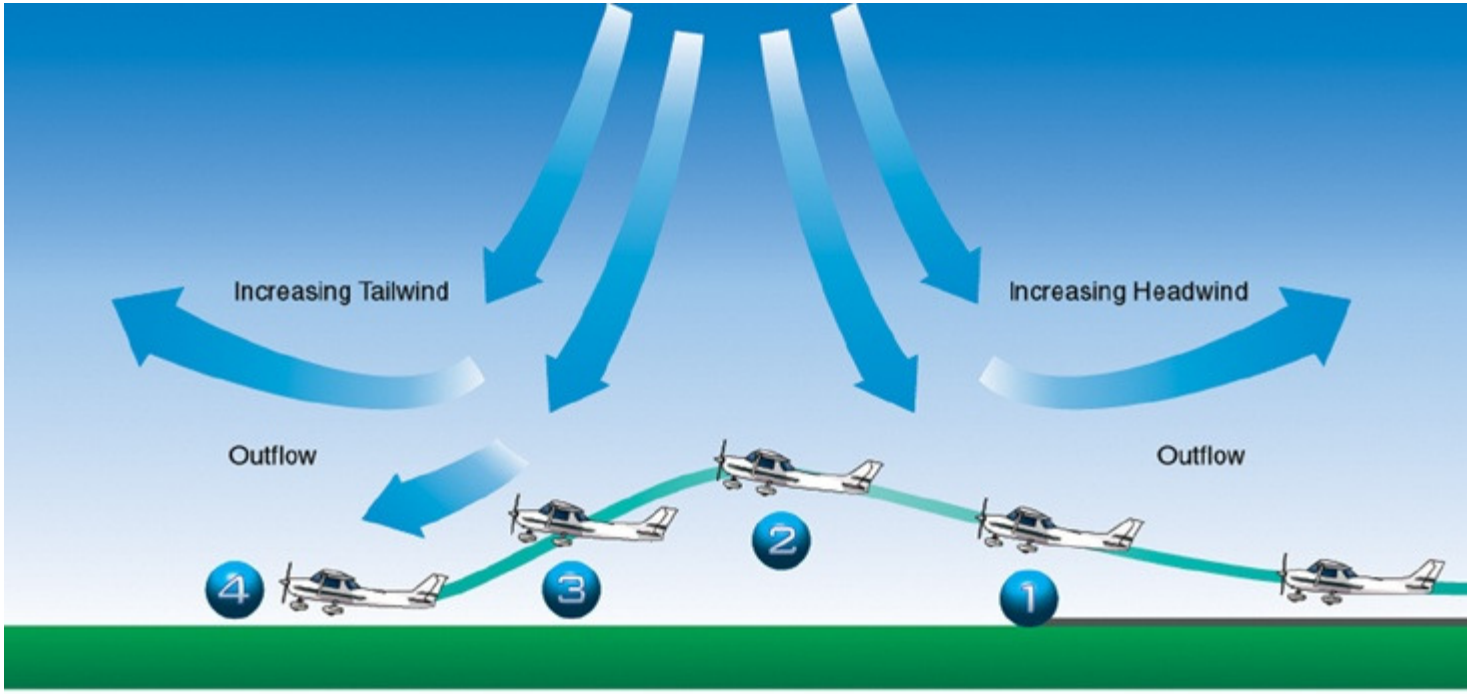
METEOROLOGY – WEATHER HAZARDS
TURBULENCE







METEOROLOGY – WEATHER HAZARDS
TURBULENCE – WIND SHEAR



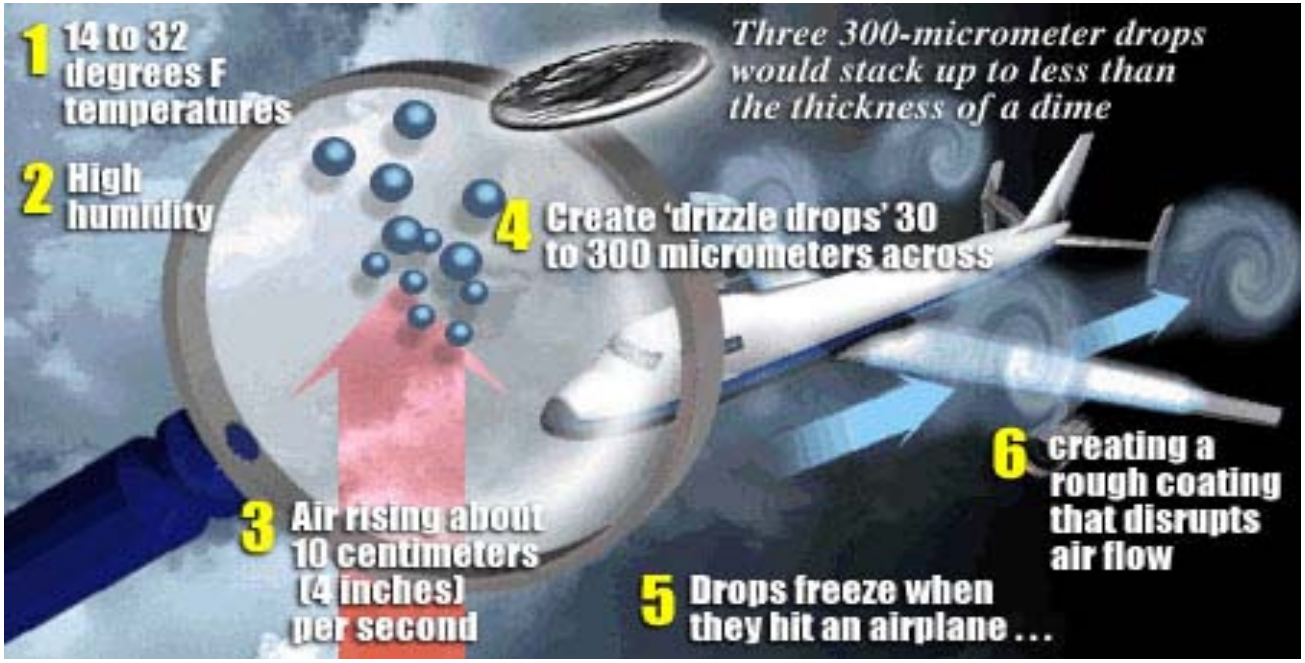
1. Headwind, 2. Downdraft, 3. Downdraft & tailwind, 4. Impact

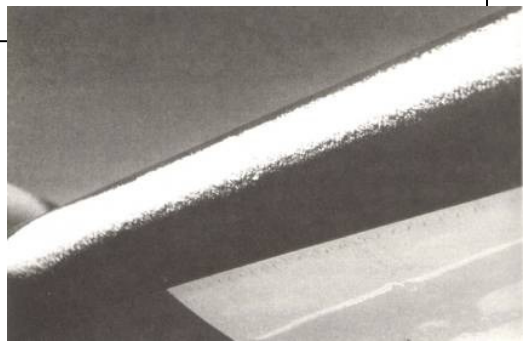
Around MICROBURSTS, brief (15m) with 1000-6000 fpm downdrafts, wind 25-100 kts.

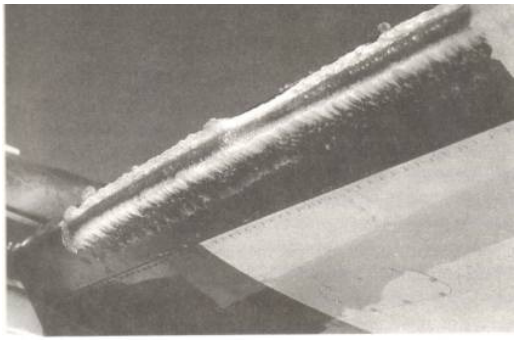
LLWAS and Doppler Radar assist in detection. In-flight – watch for rain shafts.

METEOROLOGY – WEATHER HAZARDS: ICING

RIME -15 to -20 c	Rough, milky, opaque ice formed by instantaneous freezing of small super cooled water droplets. Similar in appearance as FROST – ALWAYS REMOVE FROST BEFORE FLIGHT
CLEAR 0 to -10 c	A glossy, clear or translucent ice formed by the relatively slow freezing of large super cooled water droplets. Caution: Ice pellets below good indication of super cooled water droplets above – serious icing hazard.
MIXED -10 to -15 c	Mixture of rime and clear ice.
FROST	Temperature & dew point lower than freezing







METEOROLOGY – WEATHER HAZARDS
ICING

RISK/ TYPE	CUMULUS	STRATIFORM	RAIN DRIZZLE
HIGH	**0 to -20 C**	**0 to -15 C**	**0 and below**
MEDIUM	**-20 to -40 C**	**-15 to -30 C**	
LOW	Less than -40 C	Less than -30 C	

DON'T UNDERESTIMATE ICING AND EFFECTS

1. Check the AIRMETs, SIGMETs, METARs and TAFs. YOU HAVE THE RESPONSIBILITY TO KNOW THE ICING LEVELS ON YOUR FLIGHT.
2. Check for icing on the aircraft when on ground.
3. Use your pitot heat and if necessary carburetor heat.
4. Be extra careful when flying in:
    - Temperatures below 0 degrees Celsius
        - Cumulonimbus or stratiform clouds
        - Rain
        - Snow
        - Ice pellets
        - Haze
        - Hail
5. Use anti-icing equipment if you suspect that icing might arise.
6. If encountering moderate or severe icing, ask for another altitude.
7. If you encounter light icing and suspect it might get moderate and severe ask for a change too.

METEOROLOGY – WEATHER HAZARDS
RESTRICTED VISIBILITY

HAZE (HZ), SMOKE (FU), SMOG , DUST (DU) , AND VOLCANIC ASH (VA)

Haze/Smoke from Above

Visibility below is very restricted

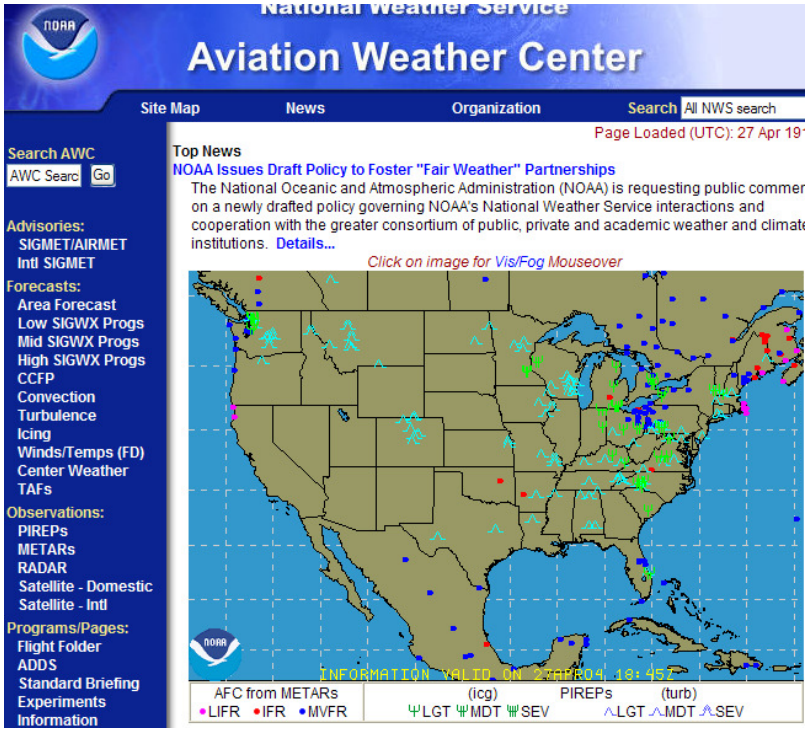
DVD REINFORCEMENT LEARNING

METEOROLOGY – PRINTED REPORTS & FORECASTS

Getting Weather Reports and Forecasts

BY TELEPHONE – TALK TO A HUMAN BEING ☺
1-800-WX-BRIEF Flight Service

INTERNET
http://avaitionweather.gov http://www.aopa.org/members/wx/

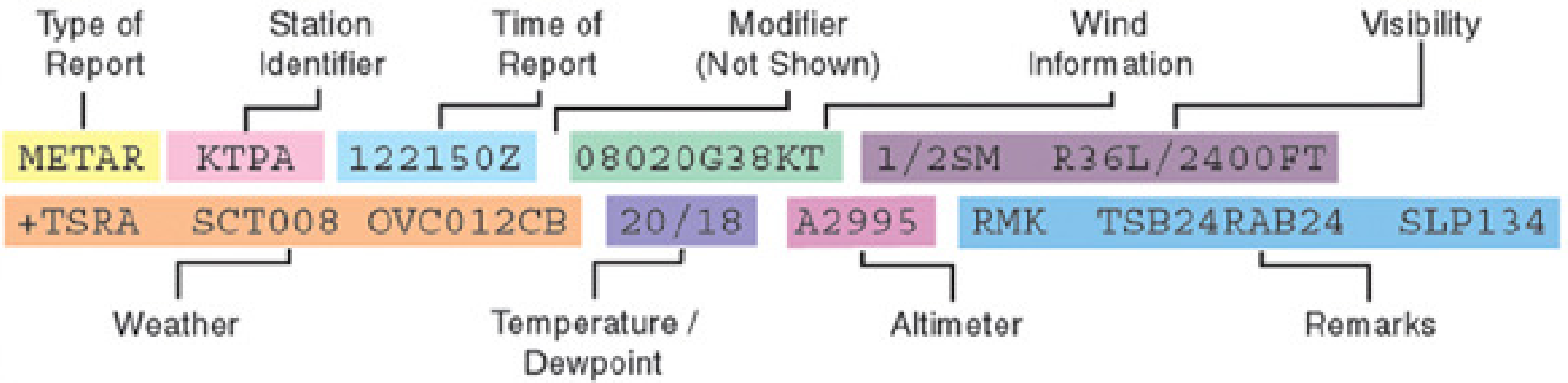


METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)

Hourly report of weather conditions ***at the specific reporting station***.

WHY: NEED TO KNOW WHAT TYPE OF WEATHER IS AT DEPARTURE, DESTINATION AND ALONG ROUTE OF FLIGHT (SHOULD WE NEED TO DIVERT TO AN DESTINATION).



FORMAT

METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)

Types: standard "METAR" or "SPECI" for special notification (change)

Identifier (USA always begin with letter "K"

Date/Time: DDHHMM (Day#, ITC "Zulu Time" HHMM ending "Z"

Modifier: none=manual input, or AUTO (check remarks A01/A02 or COR meaning automated facility with no remarks.

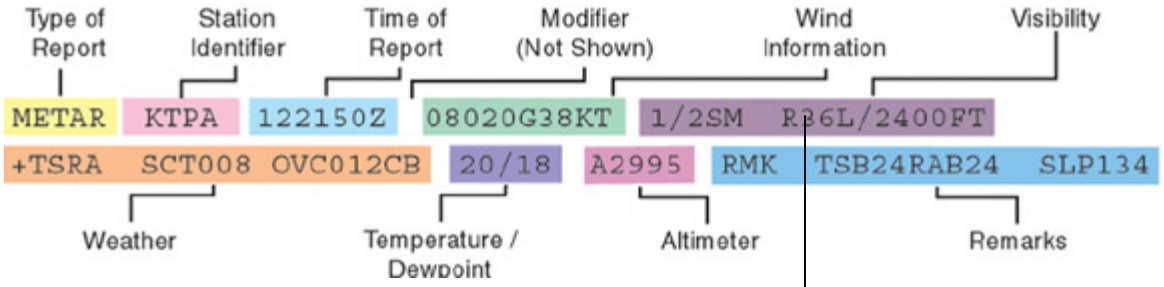
Wind: XXX(direction) YY (speed) G=GUST TO ZZ=speed minimum 5 digits (1st 3 direction, next 2 speed) end KTS.

samples

00000KT	Wind calm
20014KT	Wind from 200° at 14 knots
15010G25KT	Wind from 150° at 10 knots, gusts to 25 knots
VRB04KT	Wind variable in direction at 4 knots
210103G130KT	Wind from 210° at 103 knots with gusts to 130 knots

METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)



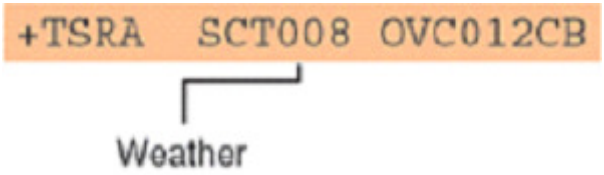
WIND INFORMATION

<u>Prevailing Visibility</u> in Statue Miles. If preceded by "P" (i.e., P2SM) it means "greater than" (P2SM = visibility greater than 2 stature miles). "M" preceding visibility is translated "less than." (i.e., M2SM = less than 2 SM)

<u>Runway Visual Range</u> (how far can a pilot see down a runway) giving as Runway / feet of visibility above is Runway 36 Left visibility 2400 ft. if given as R36L/2400V3600FT it means 2 measures were taken with the lowest visibility at 2,400 ft and the greatest visibility at 3,600 ft

METEOROLOGY – METAR (Aviation Route Information Report)

Weather: Describes conditions and cloud coverage. These codes are the most complex and require some study



Sky Cover	Contraction
Less than ⅛ (Clear)	SKC, CLR, FEW
⅛-⅜ (Few)	FEW
⅜-⅝ (Scattered)	SCT
⅝-⅞ (Broken)	BKN
⅞ or (Overcast)	OVC

Qualifier		Weather Phenomena		
Intensity or Proximity 1	Descriptor 2	Precipitation 3	Obscuration 4	Other 5
– Light	MI Shallow	DZ Drizzle	BR Mist	PO Dust/sand whirls
Moderate (no qualifier)	BC Patches	RA Rain	FG Fog	SQ Squalls
+ Heavy	DR Low drifting	SN Snow	FU Smoke	FC Funnel cloud
VC in the vicinity	BL Blowing	SG Snow grains	DU Dust	+FC Tornado or waterspout
	SH Showers	IC Ice crystals (diamond dust)	SA Sand	SS Sandstorm
	TS Thunderstorms	PL Ice pellets	HZ Haze	DS Dust storm
	FZ Freezing	GR Hail	PY Spray	
	PR Partial	GS Small hail or snow pellets	VA Volcanic ash	
		UP *Unknown precipitation		

The weather groups are constructed by considering columns 1–5 in this table in sequence:
intensity, followed by descriptor, followed by weather phenomena (e.g., heavy rain showers(s) is coded as +SHRA).
* Automated stations only

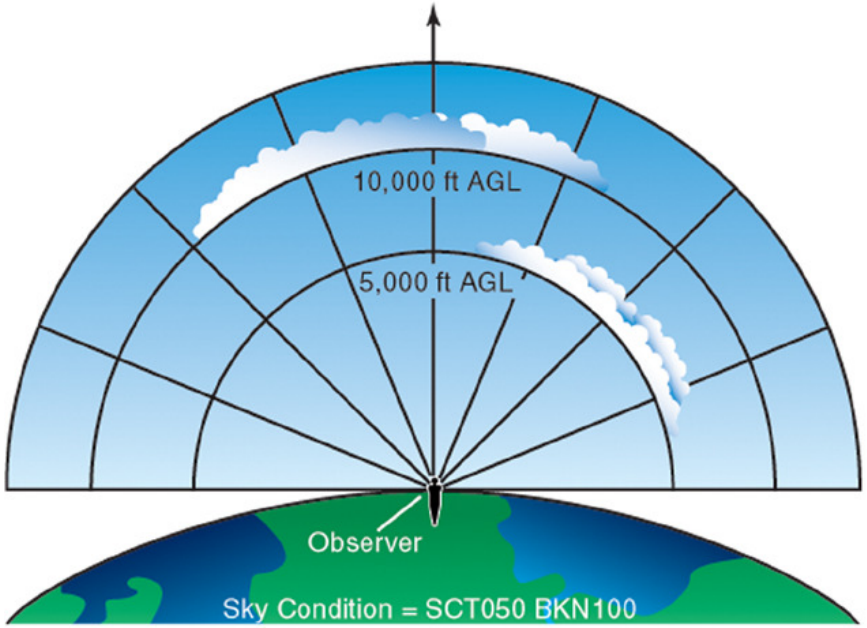
METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)

VISIBILITY AND HEIGHT INFORMATION

CLEAR (SKC OR CLR)
0-1/4 = FEW
3/8-1/2 = SCT
5/8-7/8 = BKN
OVERCAST = OVC

>50% coverage = "ceiling"



+TSRA SCT008 OVC012CB ← **Type (CB)**

Weather

Height (AGL): add 2 zeros

20/18 A2995

Temperature / Dewpoint

Altimeter

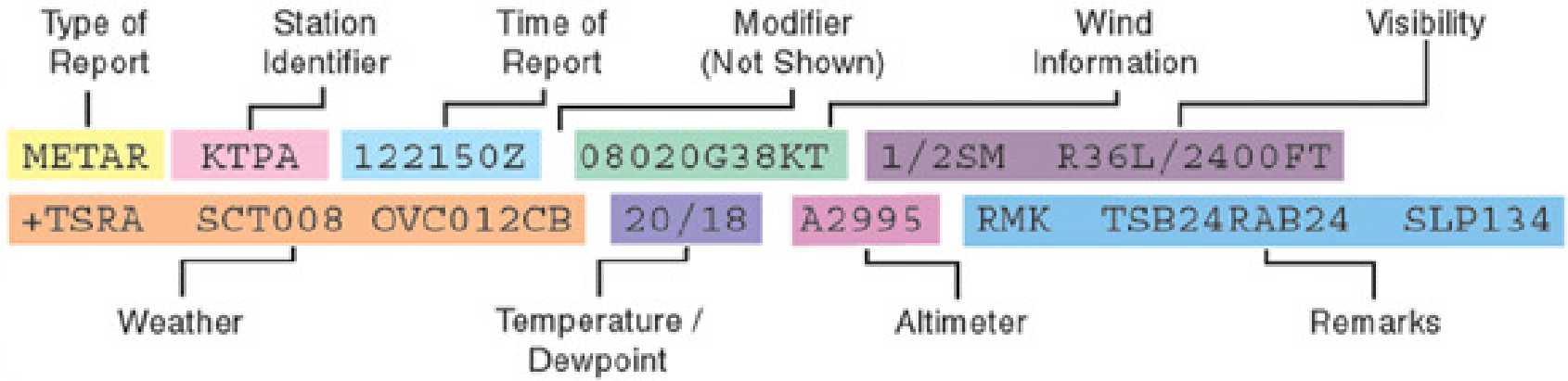
Barometric Pressure preceded with "A"

WHY SHOULD WE CARE ABOUT THE DEW POINT ? **FOG** **& PREDICT CEILINGS**

Calculation for expected cloud base AGL = ((Temp (F) – Dew point (F)) / 4.4) x 1000
With temp/dp spread of 20/18, we can expect cloud bases as low as (2/4.4x1000) 455 ft AGL

METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)



REMARKS HAVE GREAT VARIETY AND TAKE PRACTICE TO INTERPRET AND MASTER .. BE PATIENT

A02	Automated station with precipitation discriminator	
PK WND 20032/25	Peak wind from 200° at 32 knots, 25 minutes past the hour	
VIS 3/4V1 1/2	Prevailing visibility variable 3/4 to 1 and 1/2 miles	
FRQ LTG NE	Frequent lightning to the northeast	*Since the first digit after the T is a 0, it indicates that the temperature is positive; the dewpoint in this example is negative since the fifth digit is a 1.
FZDZB45	Freezing drizzle began at 45 minutes past the hour	
RAE42SNB42	Rain ended and snow began at 42 minutes past the hour	
PRESFR	Pressure falling rapidly	
SLP045	Sea level pressure in millibars (hPa), 1004.5 mb (hPa)	
T00081016	Temperature/dewpoint in tenths °C, .8 °C/–1.6 °C*	

METAR Oddities: not easily recognized

Peak Wind (PK_WND)
Wind Shift (WSHFT_time)
BINOVC (Breaks in Overcast)
BINOVC denotes a few, small clear patches in the overcast sky
Tower or Surface Visibility (TWR_VIS SFC_VIS)
CIG (Ceiling=Lowest BKN/OVC layer or height of VV)
V (Variable)
i.e. BKN V SCT, VIS 2V3 [2 variable 3 miles], CIG 025V030 [2500 ft-3000ft])
Lightning (Frequency_LTG-type)
CG: Cloud to ground
IC: Intracloud
CC: Cloud to Cloud
CA: Cloud to Air
OCNL: Occasional
FRQ: Frequent
CONS: Continuous
Beginning/Ending of Thunderstorms/Rain/Snow (TSB, SNE, RAB, etc)
Thunderstorm Location (TS_LOC_(MOV_DIR)
LOC=Location (N, NE, S, VC, OHD [Overhead], ALQDS [All Quadrants])
DIR=Direction (N, NE, S, etc)
Hailstone Size (GR_[size])
Virga (VIRGA_[DIR])
Cumulonimbus or Cumulonimbus Mammatus (CB or CBMAM_LOC_(MOV_DIR).
Towering cumulus (TCU_[DIR])
Altocumulus castellanus (ACC_[DIR])
Standing lenticular or Rotor clouds (CLD_[DIR])
Pressure Rising or Falling Rapidly (PRESRR/PRESFR)
Sea-Level Pressure (SLP###)
Aircraft Mishap (ACFT_MSHP)
Snow Increasing Rapidly (SNINCR_amount this hour/total)

Hourly Precipitation Amount (P####).
3- and 6-Hour Precipitation Amount (6####)
24-Hour Precipitation Amount (7####).
Snow Depth on Ground (4/###)
Water Equivalent of Snow on Ground (9####)
Hourly Temperature and Dewpoint (Tsn###sn###)
T=Temp
sn=Type (0=above zero celcius, 1=below zero celcius)
###=celcius temperature to nearest tenth of a degree
6-Hourly Maximum Temperature (1sn###)
6-Hourly Minimum Temperature (2sn###)
24-Hour Maximum and Minimum Temperature (4sn######)
First three numbers=maximum temp to nearest tenth of a degree celcius
Last three numbers=mimimum temp to nearest tenth of a degree celcius
-Hourly Pressure Tendency (5a###)--see table below for a (type)

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

METEOROLOGY – PRINTED REPORTS & FORECASTS

METAR (Aviation Route Information Report)

METAR PRACTICE

KAPF	242253Z 28004KT 10SM FEW035 31/23 A2998 RMK AO2 SLP150 T03060228
KBCT	242148Z 13006KT 10SM CLR 30/24 A3000
KBKV	242253Z AUTO 28007KT 10SM CLR 29/24 A2998 RMK AO2 LTG DSNT N AND E SLPNO T02940239
KCEW	242253Z AUTO 20005KT 10SM CLR 32/24 A2999 RMK AO2 SLP152 T03170239
KCOF	242255Z 12011KT 7SM FEW022CB FEW100 FEW240 28/25 A3001 RMK WND DATA ESTMD CB DSNT S-SW MOV S SLP162
KCRG	242253Z 12009KT 8SM FEW095 28/23 A3000 RMK AO2 SLP157 T02830233
KCTY	242253Z AUTO 06003KT 32/22 A2997 RMK AO2 SLP149 T03220222 PWINO TSNO $
KDAB	242253Z 06009KT 10SM CLR 28/23 A3002 RMK AO2 SLP166 CB DSNT S-SW T02780228
KDTS	242253Z AUTO 21005KT 10SM CLR 29/23 A2998 RMK AO2 SLP150 T02940233
KEYW	242253Z 10006KT 10SM FEW031 31/25 A2998 RMK AO2 SLP151 T03060250
KFLL	242253Z 14006KT 10SM FEW030 SCT120 29/23 A2999 RMK AO2 SLP155 T02940228
KFMY	242253Z 26006KT 10SM SCT055 31/24 A2997 RMK AO2 LTG DSNT NW-E SLP149 T03110244

METEOROLOGY – PRINTED REPORTS & FORECASTS
SD RADAR WEATHER REPORTS

***Issued* 35 minutes passed each hour**

- Location and time (UTC)
- Echo pattern: CELL = single cell; LN = line;
- Coverage in tenths
- Type intensity and trend of weather
  - TRW++/+ = Thunderstorm, very heavy rain showers/increasing intensity
- Azimuth (true north) and range (nm) of points defining the echoes
- Pattern movement
- Maximum tops
- Remarks

Example: **LIC 1825 CELL RW/NEW 162/30 D8 MT 180 AREA 1R-/NC 14/104 105/72 298/56 C3005 MT U140 ISOLD R ^JM11 KM1 LM121 MO1 NN2=**

INTERPRETATION AS FOLLOWS:

LIC (LIMON, CO) RADAR WEATHER REPORT AT 1825 UTC

A CELL OF ECHOES OF RAIN SHOWERS, NEWLY DEVELOPED 162 DEGREES, 30 NM, 8 MILES IN DIAMETER MAX TOP18000 FT
AN AREA OF ECHOES 1 TENTH COVERAGE OF LIGHT RAIN NO CHANGE 14 DEGREES, 104 NM/105 DEGREES, 72 NM AND
298 DEGREES, 56 NM

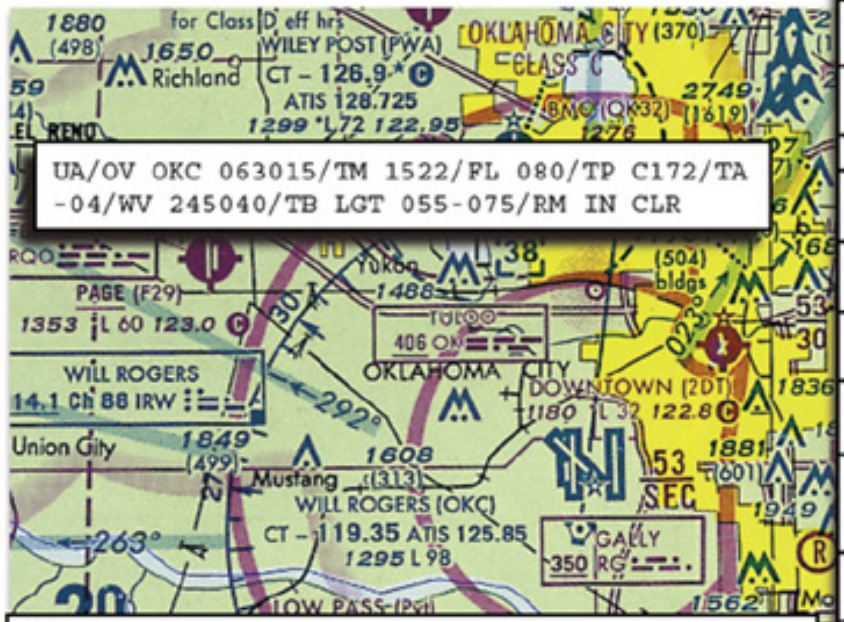
CELL MOVEMENT FROM 300 DEGREES AT 5 KNOTS. MAXIMUM TOP UNIFORM 14000 FEET

REMARKS:ISOLATED RAIN

SYMBOL	MEANING
R	Rain
RW	Rain Shower
S	Snow
SW	Snow Shower
T	Thunderstorm
SYMBOL	**INTENSITY**
-	Light
(none)	Moderate
+	Heavy
++	Very Heavy
X	Intense
XX	Extreme
CONTRACTION	**OPERATIONAL STATUS**
PPINE	Radar is operating normally but there are no echoes being detected.
PPINA	Radar observation is not available.
PPIOM	Radar is inoperative or out of service.
AUTO	Automated radar report from WSR-88D.

METEOROLOGY – PRINTED REPORTS & FORECASTS
PILOT REPORTS (PIREPS)

PILOTS ARE EXPECTED TO REPORT TURBULENCE, ICING, OR OTHER HAZARDS ENCOUNTERED.



PIREP FORM	
Pilot Weather Report → = Space Symbol	
3-Letter SA Identifier →	1. UA → _____ Routine Report UUA → _____ Urgent Report
2. /OV →	Location: In relation to a NAVAID
3. /TM →	Time: Coordinated Universal Time
4. /FL →	Altitude/Flight Level: Essential for turbulence and icing reports
5. /TP →	Aircraft Type: Essential for turbulence and icing reports
Items 1 through 5 are mandatory for all PIREPs	
6. /SK →	Sky Cover: Cloud height and coverage (scattered, broken, or overcast)
7. /WX →	Flight Visibility and Weather: Flight visibility, precipitation, restrictions to visibility, etc.
8. /TA →	Temperature (Celsius): Essential for icing reports
9. /WV →	Wind: Direction in degrees and speed in knots
10. /TB →	Turbulence: Turbulence intensity, whether the turbulence occurred in or near clouds, and duration of turbulence
11. /IC →	Icing: Intensity and type
12. /RM →	Remarks: For reporting elements not included or to clarify previously reported items

Translation:
Routine pilot report (UA)...15 n.m. on the 063° radial from the Will Rogers VOR (OV OKC 063015)...at 1522Z (TM 1522)...at 8,000 feet MSL (FL 080)...type of aircraft is a Cessna 172 (TP C172) ...outside air temperature is -4 °C (TA -04)...wind is from 245° at 40 kts (WV 245040)...light turbulence between 5,500 feet MSL and 7,500 feet MSL (TB LGT 055-075)...the aircraft is in clear skies (RM IN CLR).

Encoding Pilot Weather Reports (PIREPS)			
1	XXX	3-letter station identifier	Nearest weather reporting location to the reported phenomenon
2	UA	Routine PIREP, UUA-Urgent PIREP.	
3	/OV	Location	Use 3-letter NAVAID idents only. a. Fix: /OV ABC, /OV ABC 090025. b. Fix: /OV ABC 045020-DEF, /OV ABC-DEF-GHI
4	/TM	Time	4 digits in UTC: /TM 0915.
5	/FL	Altitude/Flight level	3 digits for hundreds of feet. If not known, use UNKN: /FL095, /FL310, /FLUNKN.
6	/TP	Type Aircraft	4 digits maximum. If not known, use UNKN: /TP L329, /TP B727, /TP UNKN.
7	/SK	Sky cover/Cloud layers	Describe as follows: a. Height of cloud base in hundreds of feet. If unknown, use UNKN. b. Cloud cover symbol. c. Height of cloud tops in hundreds of feet.
8	/WX	Weather	Flight visibility reported first: Use standard weather symbols; intensity is not reported: /WX FV02 R H, /WX FV01 TRW.
9	/TA	Air temperature in Celsius (C)	If below zero, prefix with a hyphen: /TA 15, /TA -06.
10	/WV	Wind	Direction in degrees magnetic north and speed in six digits: /WV 270045, WV 280110.
11	/TB	Turbulence	Use standard contractions for intensity and type (use CAT or CHOP when appropriate). Include altitude only if different from /FL, /TB EXTREME, /TB LGT-MDT BLO 090.
12	/IC	Icing	Describe using standard intensity and type contractions. Include altitude only if different than /FL: /IC LGT-MDT RIME, /IC SVR CLR 028-045.
13	/RM	Remarks	Use free from to clarify the report and type hazardous elements first: /RM LLWS -15KT SFC-030 DURC RNWY 22 JFK.

UA/OV GGG 090025/TM 1450/FL 060/TP C182/SK
080 OVC/WX FV 04R/TA 05/WV 270030/TB LGT/RM HVY RAIN
Explanation:
Type: .....Routine pilot report
Location: ..... 25 NM out on the 090° radial, Gregg County VOR
Time: ..... 1450 Zulu
Altitude or Flight Level: 6,000 feet
Aircraft Type: ..... Cessna 182
Sky Cover: ..... 8,000 overcast
Visibility/Weather: ..... 4 miles in rain
Temperature: .....5 °Celsius
Wind: ..... 270° at 30 knots
Turbulence: .....Light
Icing: ..... None reported

METEOROLOGY – PRINTED REPORTS & FORECASTS
PILOT REPORTS (PIREPS)

Turbulence Intensity	
Intensity	**Aircraft Reaction**
Light	Loose objects in aircraft remain at rest.
Moderate	Unsecured objects are dislodged. Occupants feel definite strains against seat belts and shoulder straps.
Severe	Occupants thrown violently against seat belts. Momentary loss of aircraft control. Unsecured objects tossed about.
Extreme	Aircraft is tossed violently about, impossible to control. May cause structural damage.

Icing Intensity	
Intensity	**Aircraft Reaction**
Trace	Ice becomes perceptible. Rate of accumulation slightly greater than sublimation. Deicing/anti-icing equipment is not used unless encountered for an extended period of time (over 1 hour).
Light	The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti-icing equipment removes or prevents accumulation. It does not present a problem if this equipment is used.
Moderate	The rate of accumulation is such that even short encounters become potentially hazardous, and use of deicing/anti-icing equipment or diversion is necessary.
Severe	The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary.

METEOROLOGY – PRINTED REPORTS & FORECASTS
PILOT REPORTS (PIREPS)

FAA facilities are required to solicit PIREPs when the following weather conditions exist, are reported, or forecast to occur:

1. Ceilings at or below 5,000 feet.
2. Visibility reported on the surface or aloft is 5 miles or less.
3. Thunderstorms and related phenomenon.
4. Turbulence of moderate degree or greater.
5. Icing of light degree or greater.
6. Wind shear.
7. Volcanic ash clouds are reported or forecast.

PIREP 1:28Z 11/18/03
DEH UUA /OV UKN/TM 0128/FL170/TP BE20/TA M08/TB MDT/IC SVR MXD

PIREP 02:34Z 11/18/03
LAX UA /OV LAX350050/TM 0234/FL240/TP FA10/TA M25/WV 33036KT

TERMINAL AERODROME FORECAST (TAF)

TAF
KPIT 091730Z
0918/1024 15005KT
5SM HZ FEW020
WS010/31022KT

FM091930
30015G25KT 3SM
SHRA OVC015

TEMPO 0920/0922
1/2SM +TSRA
OVC008CB

FM100100 27008KT
5SM SHRA BKN020
OVC040

PROB30 1004/1007
1SM -RA BR

FM101015 18005KT
6SM -SHRA OVC020

BECMG 1013/1015
P6SM SKC

091730Z Issuance time: ALL times in UTC "Z", 2-digit date, 4-digit time **091955Z**
0918/1024 Valid period, either 24 hours or 30 hours. The first two digits of EACH four digit number indicate the date of the valid period, the final two digits indicate the time (valid from 18Z on the 9th to 24Z on the 10th).
In U.S. METAR: CORrected of; or AUTOmated ob for automated report with no human intervention; omitted when observer logs on. **COR**
15005KT Wind: 3 digit true-north direction , nearest 10 degrees (or VaRiaBle); next 2-3 digits for speed and unit, KT (KMH or MPS); as needed, Gust and maximum speed; 00000KT for calm; for METAR, if direction varies 60 degrees or more, Variability appended, e.g., 180V260
5SM Prevailing visibility; in U.S., Statute Miles & fractions; above 6 miles in TAF Plus6SM. Runway Visual Range: R; 2-digit runway designator Left, Center, or Right as needed; "/", Minus or Plus in U.S., 4-digit value, FeeT in U.S., (usually meters elsewhere); 4-digit value Variability 4-digit value (and tendency Down, Up or No change) **R28L/2600FT**
HZ Significant present, forecast and recent weather
FEW020 Cloud amount, height and type: SKy Clear 0/8, FEW >0/8-2/8, SCaTtered 3/8-4/8, BroKeN 5/8-7/8, OVerCast 8/8; 3-digit height in hundreds of ft; Towering CUmulus or CumulonimBus in **METAR**; in **TAF**, only CB. Vertical Visibility for obscured sky and height "VV004". More than 1 layer may be reported or forecast. In automated **METAR** reports only, CLeaR for "clear below 12,000 feet" **OVC 010CB**
Temperature: degrees Celsius; first 2 digits, temperature "/" last 2 digits, dew-point temperature; Minus for below zero, e.g., M06 **18/16** Altimeter setting: indicator and 4 digits; in U.S., A-inches and hundredths; (Q-hectoPascals, e.g., Q1013) **A2992**
WS010/31022KT In U.S. **TAF**, non-convective low-level (≤2,000 ft) Wind Shear; 3-digit height (hundreds of ft); "/"; 3-digit wind direction and 2-3 digit wind speed above the indicated height, and unit, KT In **METAR**, ReMarK indicator & remarks. For example: Sea- Level Pressure in hectoPascals & tenths, as shown: 1004.5 hPa; Temp/dew-point in tenths _C, as shown: temp. 18.2_C, dew-point 15.9_C **RMK SLP045 T01820159**
FM091930 FroM: changes are expected at: 2-digit date, 2-digit hour, and 2-digit minute beginning time: indicates significant change. Each FM starts on a new line, indented 5 spaces
TEMPO 0920/0922 TEMPOrary: changes expected for <1 hour and in total, < half of the period between the 2-digit date and 2-digit hour beginning, and 2-digit date and 2-digit hour ending time
PROB30 1004/1007 PROBability and 2-digit percent (30 or 40): probable condition in the period between the 2-digit date & 2-digit hour beginning time, and the 2-digit date and 2-digit hour ending time
BECMG 1013/1015 BECoMinG: change expected in the period between the 2-digit date and 2-digit hour beginning time, and the 2-digit date and 2-digit hour ending time

METEOROLOGY – PRINTED WEATHER FORECASTS
TERMINAL AERODROME FORECAST (TAF)-PRACTICE

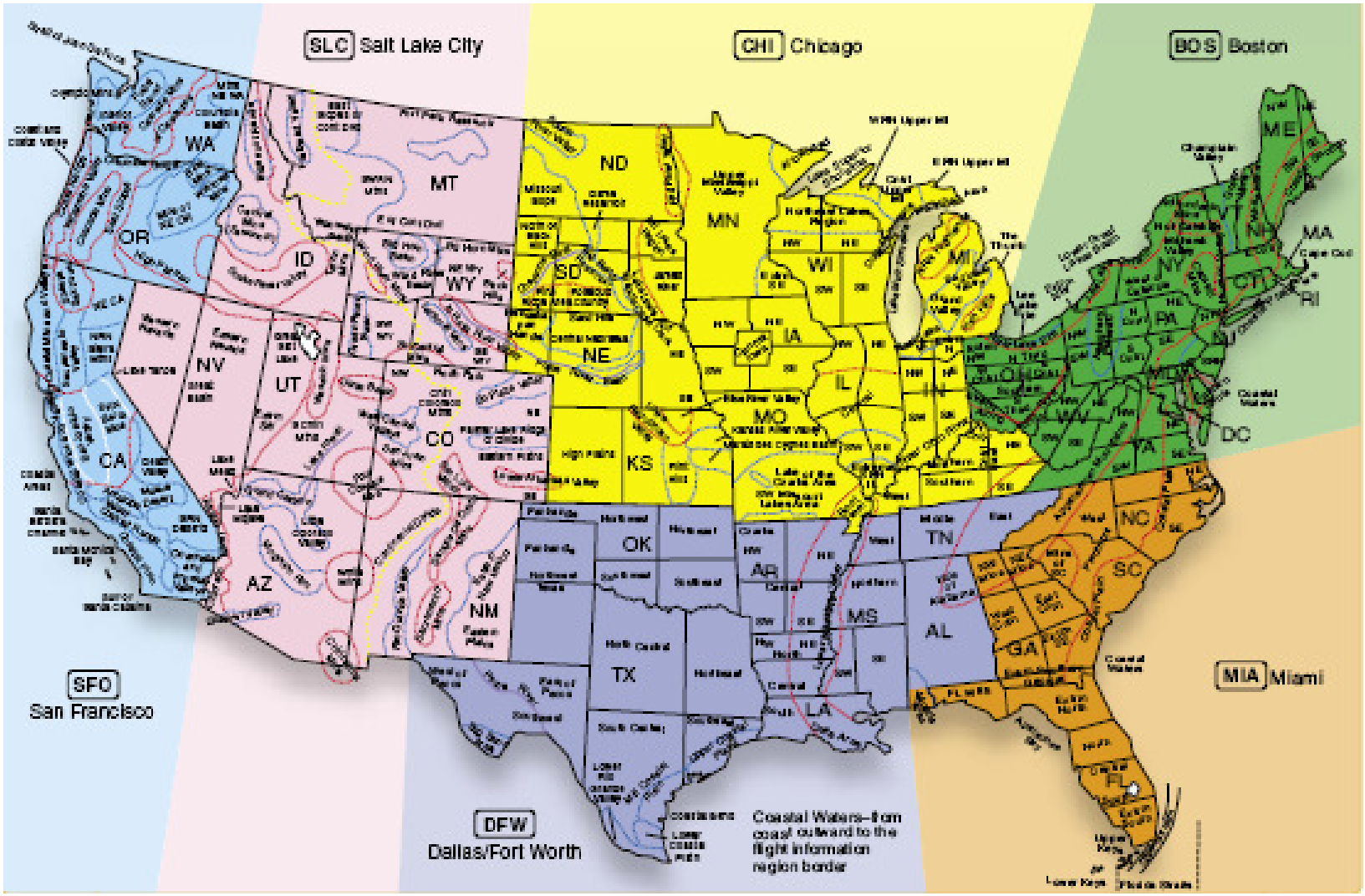
KAPF 241123Z 241212 04003KT P6SM SKC
FM1400 10004KT P6SM FEW025 SCT250
FM1600 24007KT P6SM VCTS SCT025CB SCT080 BKN250
FM1900 27007KT P6SM SCT030 SCT080
FM2200 30005KT P6SM SCT030
FM0100 06005KT P6SM SKC
BECMG 0305 00000KT P6SM SKC=

KDAB 241741Z 241818 07009KT P6SM FEW030
FM0000 00000KT P6SM FEW080
FM1300 VRB03KT P6SM FEW025
FM1600 09008KT P6SM FEW030=

KEYW 241120Z 241212 09007KT P6SM SCT025 PROB30 2124 2SM +SHRA BKN020=

KFLL 241729Z 241818 13008KT P6SM SCT025 BKN250
TEMPO 1822 3SM TSRA BKN015CB
FM2200 13005KT P6SM VCSH SCT030 BKN080
TEMPO 2224 3SM TSRA BKN015CB
FM0000 11004KT P6SM SCT030 SCT080
FM1400 14007KT P6SM SCT025 SCT250=

METEOROLOGY – PRINTED REPORTS & FORECASTS
AREA FORECASTS (FA)



REGIONAL – EACH HAS MANY STATES

METEOROLOGY – PRINTED REPORTS & FORECASTS
AREA FORECASTS (FA)

Issued 3 times daily, each covering a forecast period of 18 hours. WHY: Give us 2 very important pieces of information: projected forecast pattern and OUTLOOK (VFR, MVFR or IFR)

Each contains
- **HEADERS - WHEN AND HOW LONG VALID**
- **PRECAUTIONARY STATEMENT – EVERY FA**
- **SYNOPSIS ("OVERALL PICTURE")**
- **VFR CLOUDS AND WEATHER (…OUTLOOK…)**

S CNTRL AND SERN TX
AGL SCT-BKN010. TOPS 030. VIS 3-5SM BR. →
14-16Z BECMG AGL SCT030. 19Z AGL SCT050.
OTLK…VFR

In south central and southeastern Texas, there is a scattered to broken layer of clouds from 1,000 feet AGL with tops at 3,000 feet, visibility is 3 to 5 statute miles in mist. Between 1400 Zulu and 1600 Zulu, the cloud bases are expected to increase to 3,000 feet AGL. After 1900 Zulu, the cloud bases are expected to continue to increase to 5,000 feet AGL and the outlook is VFR.

OK
PNDL AND NW…AGL SCT030 SCT-BKN100.
TOPS FL200.
15Z AGL SCT040 SCT100. AFT 20Z SCT TSRA
DVLPG..FEW POSS SEV. CB TOPS FL450. →
OTLK…VFR

In northwestern Oklahoma and panhandle, the clouds are scattered at 3,000 feet with another scattered to broken layer at 10,000 feet AGL, with the tops at 20,000 feet. At 1500 Zulu, the lowest cloud base is expected to increase to 4,000 feet AGL with a scattered layer at 10,000 feet AGL. After 2000 Zulu, the forecast calls for scattered thunderstorms with rain developing and a few becoming severe; the cumulonimbus clouds will have tops at flight level 450 or 45,000 feet MSL.

FA – Header Sample

Forecast Valid Date/s Times
Synopsis Validity date and time
CLDS/WX Validity date and time
OTLK Validity date and time

Area Forecast - Southeast1830 AMD
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 251200
CLDS/WX VALID UNTIL 250600...OTLK VALID 250600-251200
NC SC GA FL AND CSTL WTRS
.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.
.
SYNOPSIS...QSTNRY FNT FM NRN AL INTO NERN SC BECMG CDFNT AND CONTG INTO ATLC CSTL WTRS. LTL CHG THRU PD. ISOL TO WDLY SCT AFTN AND EVE TSRA WL DVLP ALG AND S OF FNT. DEEP MOIST AIRMASS WL REMAIN ACRS CNTRL/SRN FL WITH SCT DIURNAL TSRA EXP. ...POULOS...

WHY: Pilot gets a general overview over many states in planning a X/C flight or it can be used In the absence of a terminal forecast at the destination.

Area Forecast (FA) Details

SC...UPDT
MTNS...OVC030 TOP 080. ISOL -SHRA/-TSRA. CB TOP FL400. 03Z
BKN040. OTLK...MVFR CIG BR. PIEDMONT...OVC020 TOP 080.
ISOL -SHRA/-TSRA. CB TOP FL400. 04Z
SCT CI. OTLK...VFR BECMG 08Z MVFR BR.
CSTL PLAIN...SCT030. ISOL -SHRA/-TSRA. CB TOP FL400. 04Z SCT CI.
OTLK...VFR BECMG 08Z MVFR BR.

.

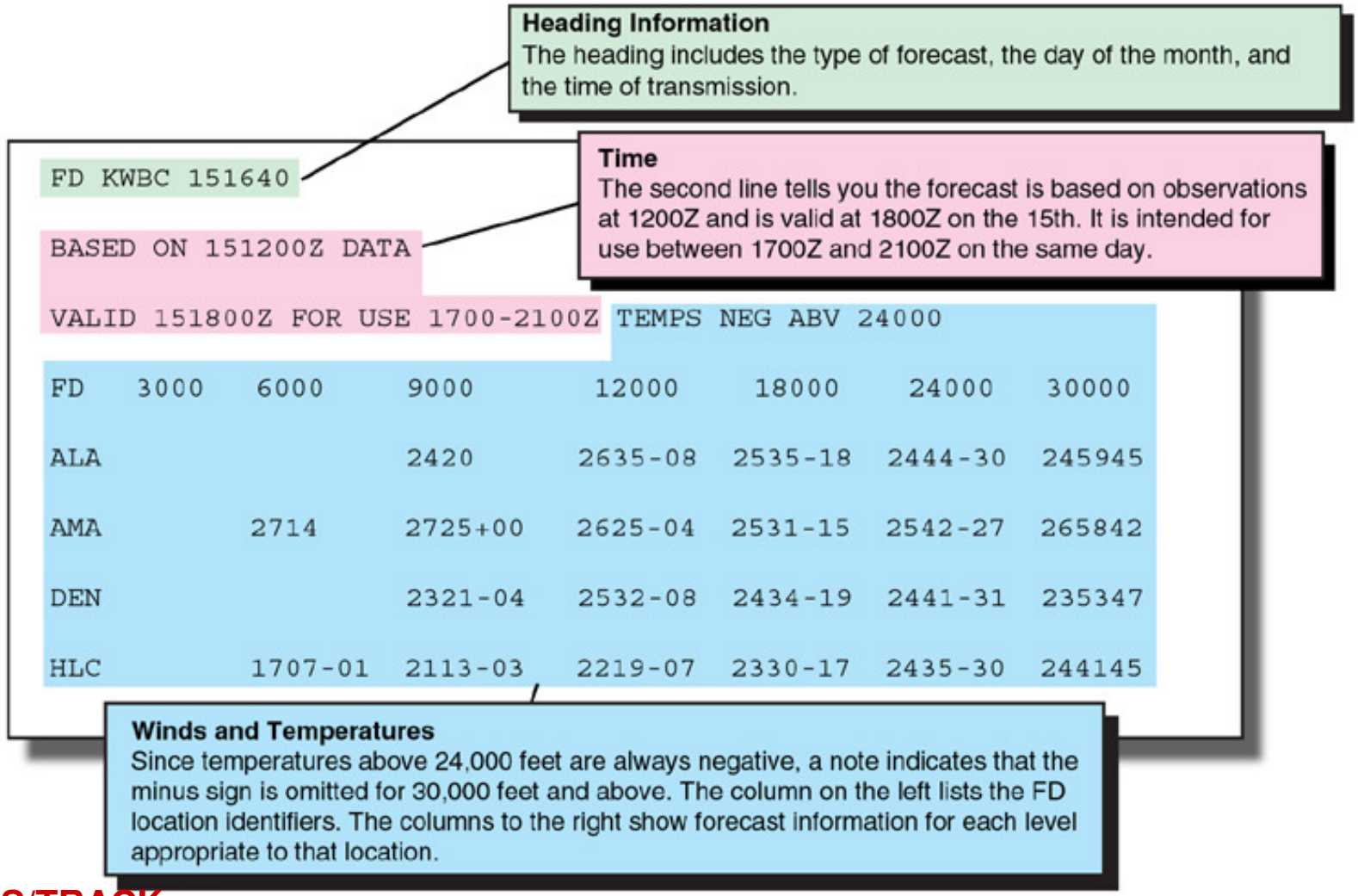
GA...UPDT
NRN...SCT-BKN050 TOP 080. ISOL -SHRA/-TSRA. CB TOP FL400. 04Z SCT
CI. OTLK...VFR BECMG 08Z MVFR BR.
SRN...SCT-BKN040. ISOL -TSRA. CB TOP FL420. 04Z SCT060.
OTLK...VFR BECMG 08Z MVFR BR.

.

FL
PNHDL/NRN PEN...SCT030. AFT 21Z OCNL BKN030 IN WDLY SCT -TSRA. CB
TOP FL420. 04Z FEW CI. OTLK...VFR BECMG 08Z MVFR BR.
CNTRL PEN...SCT030. OCNL BKN030 IN SCT -TSRA. CB TOP FL450. 03Z
FEW030 SCT100 SCT-BKN CI. OTLK...VFR.
SRN PEN...SCT025 SCT-BKN130 LYRD FL250. OCNL BKN025 IN SCT -TSRA.
CB TOP FL450. 03Z SCT025 SCT080 SCT CI. OTLK...VFR.

METEOROLOGY – PRINTED REPORTS & FORECASTS
WINDS AND TEMPERATURE ALOFT (FD)

WHY?



CALCULATE GS/TRACK

FAVORABLE CRUISE ALTITUDE

FREEZING LEVELS

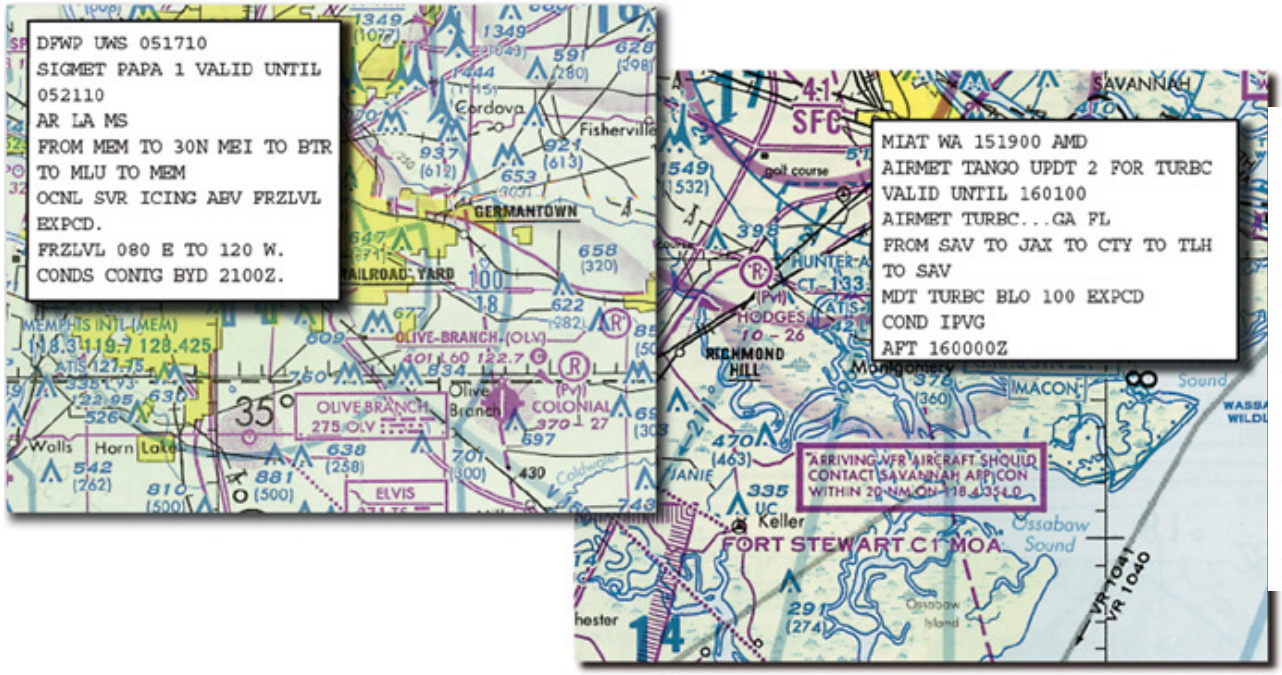
METEOROLOGY – PRINTED REPORTS & FORECASTS

WINDS AND TEMPERATURE ALOFT (FD) Practice

```
ON 241200Z
VALID 250000Z   FOR USE 2100-0600Z. TEMPS NEG ABV 24000
FT  3000    6000   9000    12000   18000   24000  30000  34000  39000
SSM 2625 2935+16 2939+10 2944+09 3044-07 3046-19 296534 296343 296353
TVC 2634 2938+18 2936+13 2948+08 3036-08 2940-18 293834 303643 303853
MKG 2437 2933+20 3041+15 3042+08 3132-07 2927-18 282534 292543 312253
ECK 2325 2830+16 3037+13 3144+08 3129-07 3136-18 304733 294843 313653
BUF 2419 2519+12 2922+10 3238+05 3245-07 3247-18 325333 316244 315555
SYR 2814 2916+10 3023+06 3037+02 3045-08 3150-19 325934 326644 327054
ALB 3018 3418+09 3225+06 3135+02 3447-09 3356-20 337434 338145 337955
PLB 2923 3325+07 3229+03 3133+00 3351-10 3368-20 328035 328544 328654
BML 2925 3231+06 3238+03 3341+00 3352-11 3261-21 327036 328245 328554
CAR 3126 3328+01 3240-02 3249-07 3269-13 3274-23 327938 328246 327451
BGR 3225 3427+05 3338+01 3349-03 3251-13 3362-22 327337 328146 327653
PWM 3119 3526+08 3332+03 3341+00 3147-13 3362-21 326836 338245 338454
BOS 3121 3422+09 3325+04 3338+01 3245-13 3360-20 336536 338045 348755
ACK 3218 3326+09 3327+05 3442+01 3247-10 3361-21 336637 347846 348355
BDL 3119 3518+10 3221+06 3232+02 3245-11 3356-20 337035 337645 338355
FWA 2324 2915+20 3329+15 3338+09 3327-07 3018-18 262433 262442 292153
IND 2316 9900+21 3518+15 3430+09 3518-07 3118-18 262333 262542 272254
CVG 2409 0506+19 0125+15 3630+09 3522-07 3221-17 271833 281943 271954
CMH 2311 3505+18 3527+14 3634+08 3434-07 3327-17 282233 282143 272554
CLE 2316 2809+16 3329+13 3439+08 3434-07 3232-17 293433 293143 293354
AGC 2306 2410+14 3316+12 3527+06 3327-06 3334-16 324333 323943 313555
```

METEOROLOGY – PRINTED REPORTS & FORECASTS
SEVERE WEATHER REPORTS/FORECASTS

HURRICANE ADVISORIES (WH) – Issued when at least 300 miles offshore.
CONVECTIVE OUTLOOK (AC) -2 day prediction of "convection" activity [THUNDERSTORMS]
SEVERE WEATHER WATCH (WW) – Notification of severe thunderstorms (preceded by "alert" AWW)
AIRMETS (WA) – Concerns for "GENERAL AVIATION PILOTS" (light aircraft hazards)
Issued for moderate icing/turbulence, winds > 30, CIG < 1000 and/or visibility < 3 over 50% area.
"Sierra" identifier used for IFR conditions & mountain obscuration.
"Tango" identifier used for turbulence, strong surface wind, LLWS.
"Zulu" identifier used for icing and freezing levels.
SIGMETS (WS) - Concerns for "COMMERCIAL AND GA PILOTS" - "SIGNIFICANT WEATHER"
Issued for severe icing/turbulence, CAT, sand/dust storms, visibility < 3, and for volcanic ash.
CONVECTIVE SIGMENTS (WST) significant convective activity and thunderstorms.



MKCC WST 221655
CONVECTIVE SIGMET 18C
VALID UNTIL 1855Z
SD NE IA
FROM FSD TO DSM TO GRI TO BFF TO FSD
AREA TSTMS WITH FEW EMBDD CELLS MOVG FROM 2725 TOPS 300
FCST TO 1855Z DSPTG AREA WILL MOV EWD 25 KT.

Created by Steve Reisser

METEOROLOGY – PRACTICE EXERCISES

STANDARD BRIEFING PRINTED PRACTICE MATERIALS

Graphic Weather Products
Winds Aloft Comparison (text and graphic)

```
(Extracted from FBUS31 KWNO 021958)
FD1US1
DATA BASED ON 021800Z
VALID 030000Z   FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT  3000    6000    9000   12000   18000   24000   30000   34000   39000
EYW 2639 2748+08 2560+06 2569+00 2583-11 7604-20 761633 761444 761957
JAX 2831 2530+00 2833-03 2844-07 2651-22 2659-34 258741 259344 259147
MIA 2543 2650+07 2572+06 2575-02 2395-13 7611-22 753734 753645 763456
MLB 2638 2553+03 2555+01 2577-03 2486-17 7504-27 755537 754947 754352
PFN 3333 3330-01 3033-05 2740-08 2747-22 2855-34 287646 288347 278347
PIE 2837 2644+00 2748+00 2659-06 2678-19 7602-29 765538 763946 753949
TLH 3231 3332-01 2938-04 2740-08 2748-22 2850-35 285947 267245 278146
ATL 3421 3324-05 3422-08 3415-12 2927-22 3128-35 352650 322252 274647
CSG 3523 3529-06 3525-07 3120-11 2929-22 3029-35 342250 293350 275746
SAV 2414 2723+01 2631-05 2531-11 2638-24 2650-37 255443 245542 246945
HAT 1152 1554+04 1856-01 2052-06 2237-17 2042-30 208446 710854 239353
ILM 0916 2019+03 2326-02 2225-07 2138-19 1951-32 176747 207451 227149
RDU 0429 0823-02 1432-04 2322-09 1829-21 1734-33 184849 205251 215150
CAE 0434 2511+00 2917-06 2509-12 2319-24 2113-37 241747 243345 255046
CHS 2612 2723+01 2627-05 2428-10 2232-23 2239-37 235543 235243 246446
FLO 0543 2014+02 2624-04 2515-09 1926-22 1825-36 204048 224645 235147
GSP 0333 3610-04 2612-06 2709-11 2108-23 2907-36 351650 271449 243448
2XG 2537 2445+04 2353-02 2457-07 2483-19 7215-30 742940 743746 742550
```

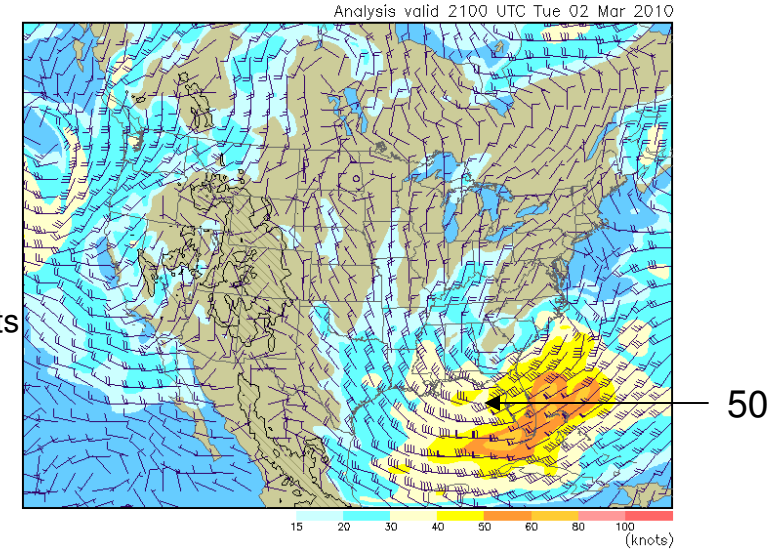
Special notes

If 9900 direction Variable and <= 5 kts

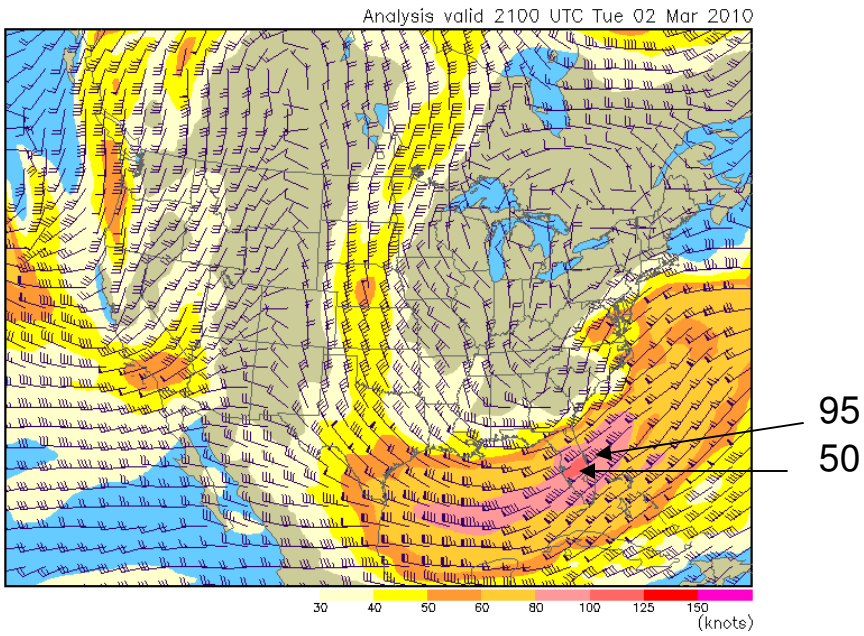
Wind direction >36 indicates that wind speed is 100-199 kts wind direction = value – 50. (7602) = 76-50= 26 and 102 kts

If wind is 99 then speed is => 200 kts

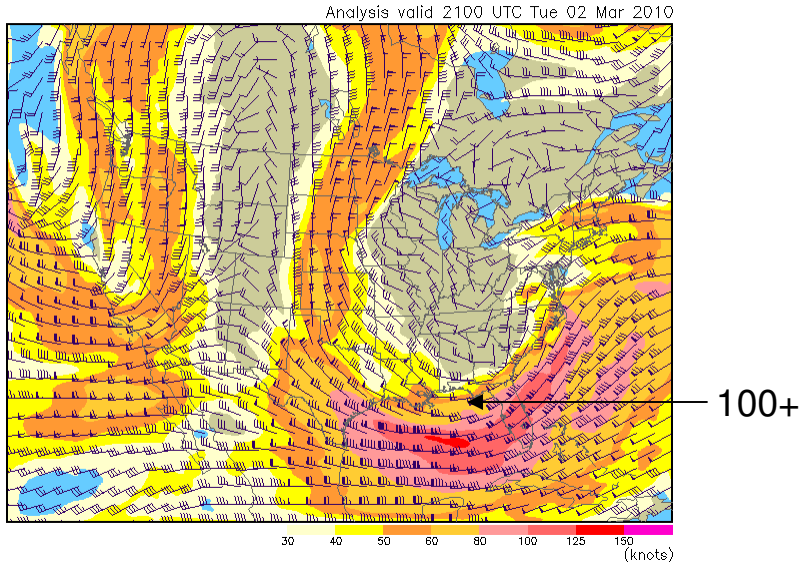
Wind speed (kts) at 6,000 ft MSL (800 mb)



Wind speed (kts) at 18,000 ft MSL (500 mb)

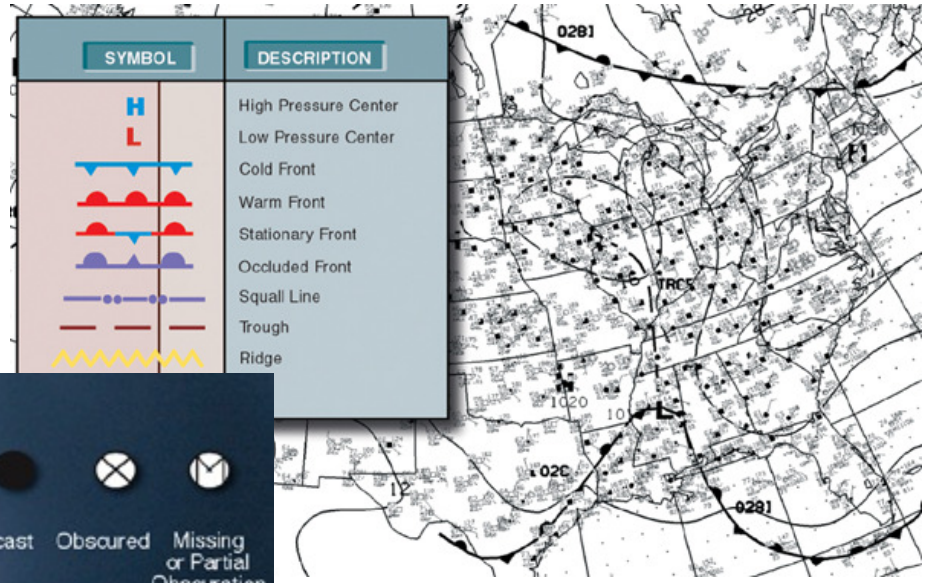


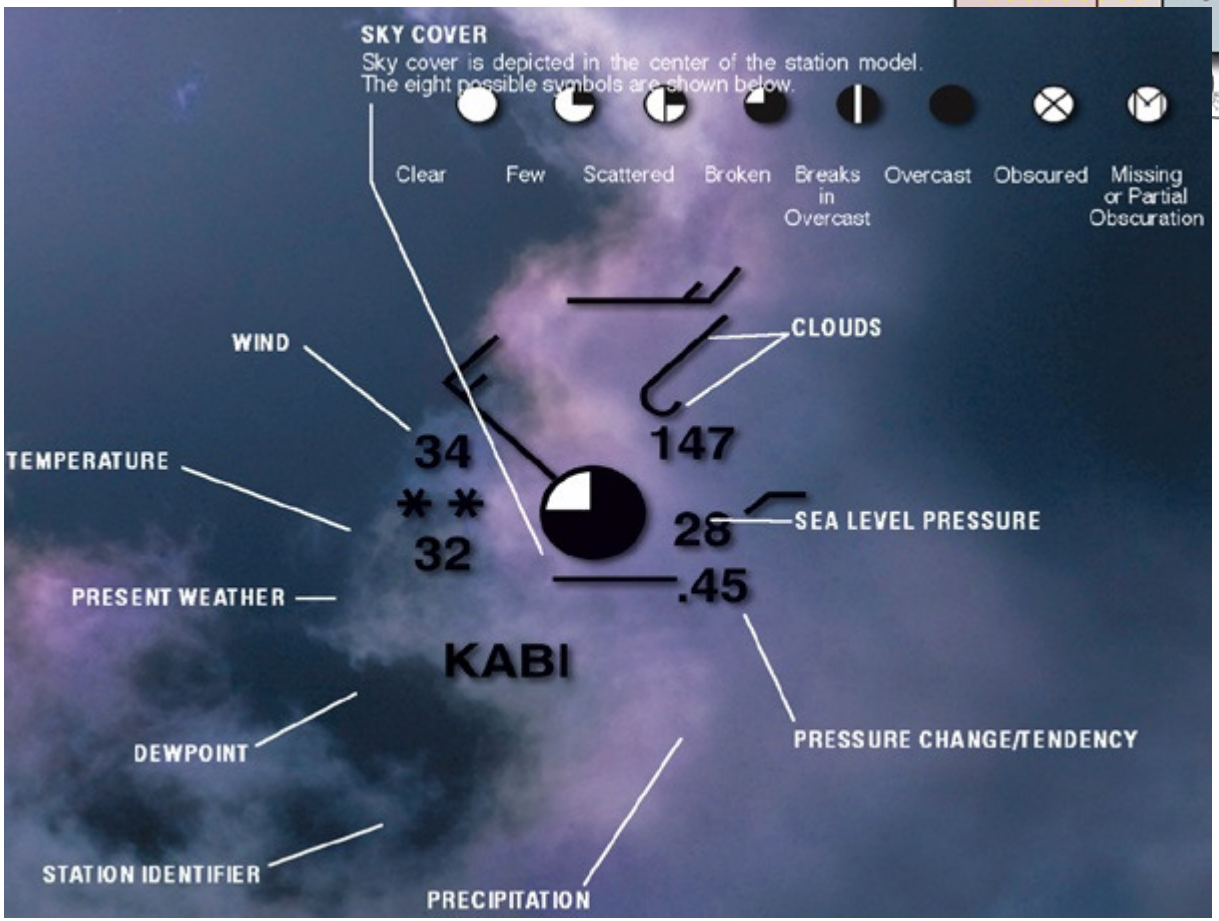
Wind speed (kts) at 24,000 ft MSL (400 mb)



METEOROLOGY – GRAPHIC WEATHER PRODUCTS

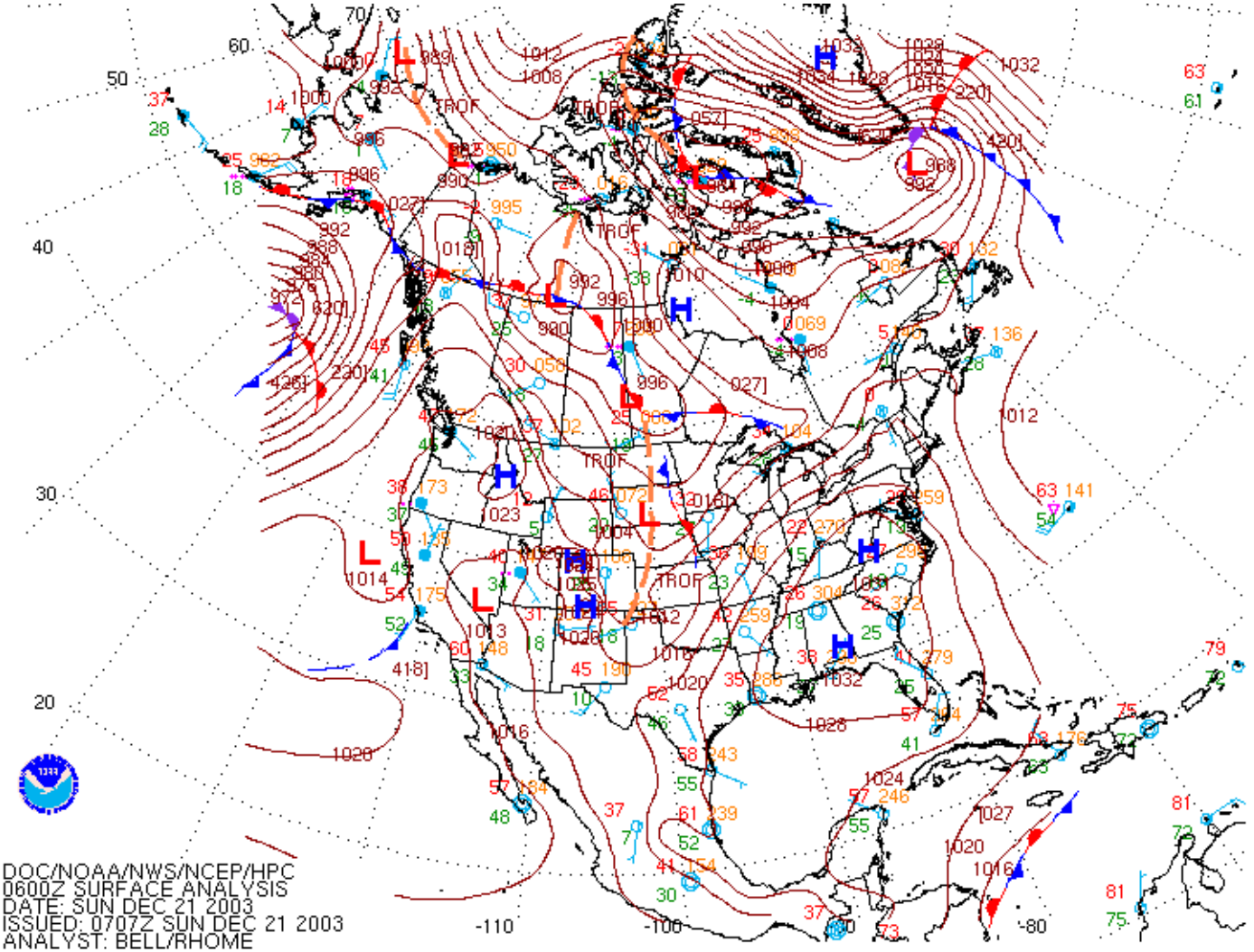
SURFACE ANALYSIS – Computer generated graphic of surface conditions. Patterns and station models help visualize conditions across the continental United States.





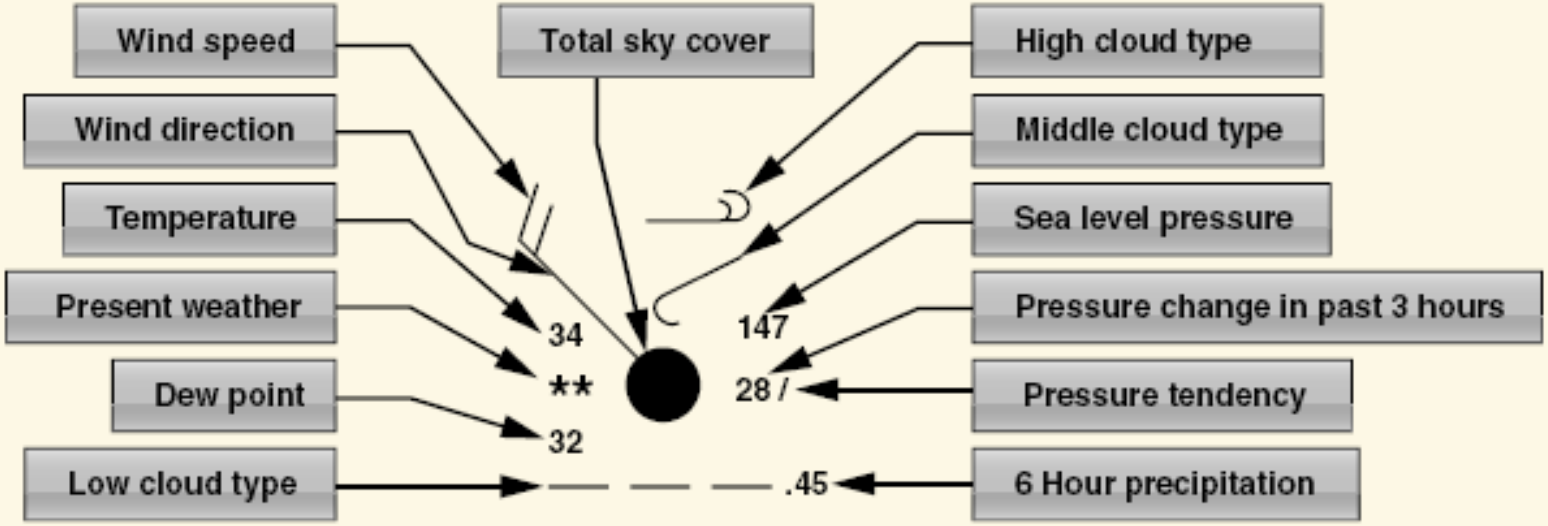
Created by Steve Reisser

METEOROLOGY – GRAPHIC WEATHER PRODUCTS



Surface Analysis Chart

The surface analysis chart depicts an analysis of the current surface weather. This chart is a computer prepared report that is transmitted every 3 hours and covers the contiguous 48 states and adjacent areas. A surface analysis chart shows the areas of high and low pressure, fronts, temperatures, dew points, wind directions and speeds, local weather, and visual obstructions.



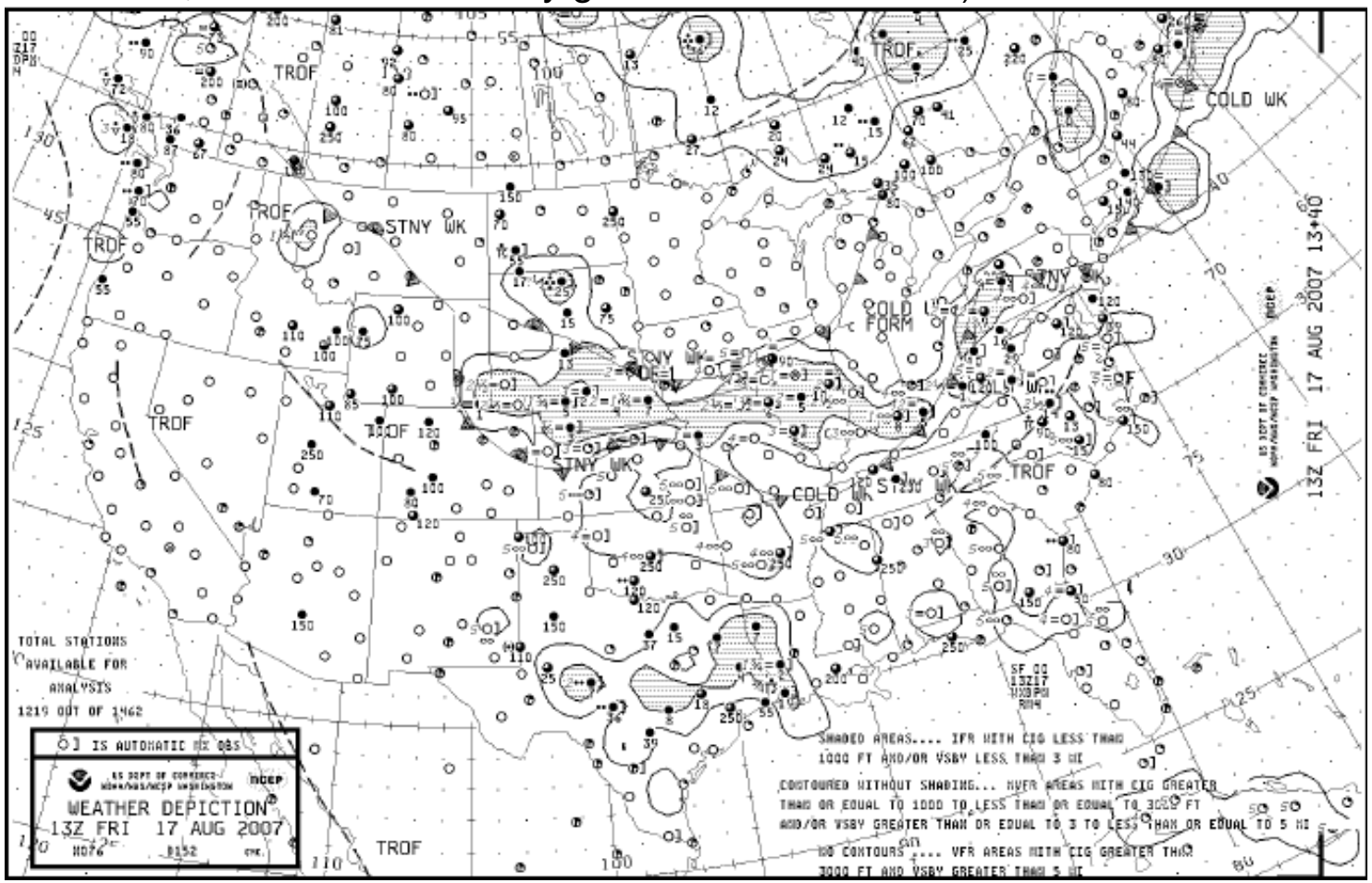
1. Total sky cover:	**Overcast**
2. Temperature/Dew point:	**34 °F/32 °F**
3. Wind:	**From the northwest at 20 knots** (relative to true north)

Examples of Wind Speed and Direction Plots

4. Present weather:	**Continuous light snow**
5. Predominant low, middle, high cloud reported:	**Strato fractus or cumulus, fractus of bad weather, altocumulus in patches and dense cirrus**
6. Sea level pressure:	**1014.7 millibars** (mb) Note: Pressure is always shown in 3 digits to the nearest tenth of a millibar. For 1,000 mb or greater, prefix a "10" to the 3 digits For less than 1,000 mb, prefix a "9" to the 3 digits
7. Pressure change in past 3 hours:	**Increased steadily or unsteadily by 2.8 mb**
8. 6-hour precipitation:	**45 hundredths of an inch.** The amount is given to the nearest hundredth of an inch.

METEOROLOGY – Weather Depiction Charts

This type of chart typically displays major fronts or areas of high and low pressure. The weather depiction chart also provides a graphic display of IFR, VFR, and MVFR (marginal VFR) weather. Areas of IFR conditions (ceilings less than 1,000 feet and visibility less than three miles) are shown by a hatched area outlined by a smooth line. MVFR regions (ceilings 1,000 to 3,000 feet, visibility 3 to 5 miles) are shown by a non-hatched area outlined by a smooth line. Areas of VFR (no ceiling or ceiling greater than 3,000 feet and visibility greater than five miles) are not outlined.



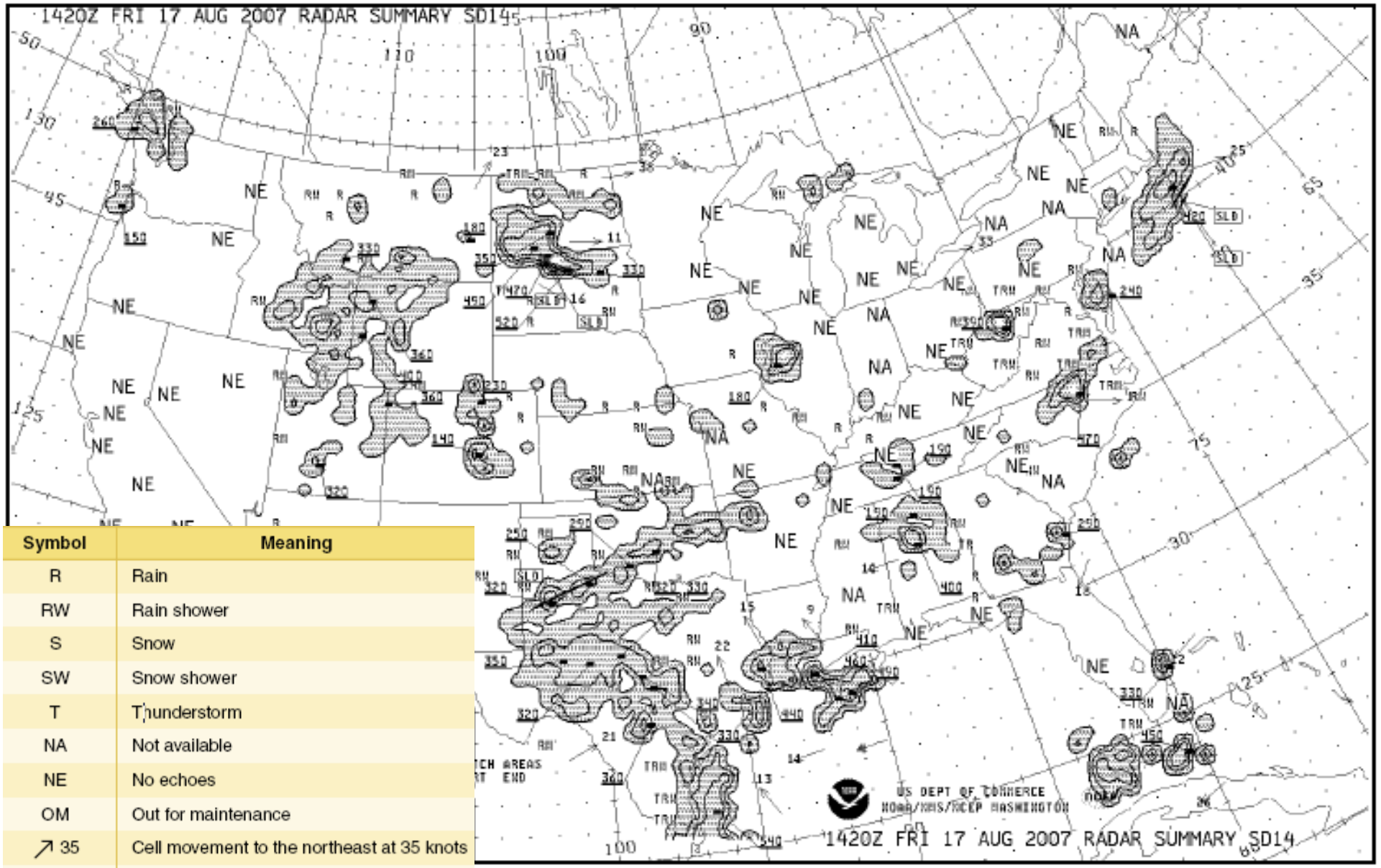
METEOROLOGY – Radar Summary Charts

RADAR SUMMARY CHARTS: Graphic depiction of RADAR SUMMARY REPORTS. Helps understand shape, size, intensity, and movement of adverse weather. Published every 35 minutes past the hour. SATELLITE WEATHER PICTURES "GREAT"

• No information—if information is not reported, the chart will say "NA." If no echoes are detected, the chart will say "NE."
• Precipitation intensity contours—intensity can be described as one of six levels and is shown on the chart by three contour intervals.
• Height of tops—the heights of the echo tops are given in hundreds of feet MSL.

Movement of cells—individual cell movement is indicated by an arrow pointing in the direction of movement. The speed of movement in knots is the number at the top of the arrow head. "LM" indicates little movement.
• Type of precipitation—the type of precipitation is marked on the chart using specific symbols. These symbols are not the same as used on the METAR charts.
• Echo configuration—echoes are shown as being areas, cells, or lines.
• Weather watches—severe weather watch areas for tornadoes and severe thunderstorms are depicted by boxes outlined with heavy dashed lines.

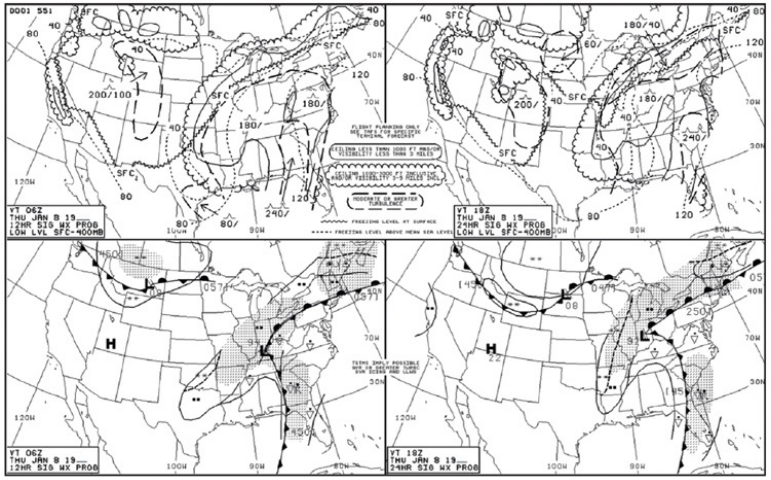
The radar summary chart is a valuable tool for preflight planning. It does, however, contain several **limitations** for the usage of the chart. This chart **depicts only areas of precipitation**. It will not show areas of clouds and fog with no appreciable precipitation, or the height of the tops and bases of the clouds. Radar summary charts are a depiction of current precipitation and should be used in conjunction with current METAR and weather forecasts.

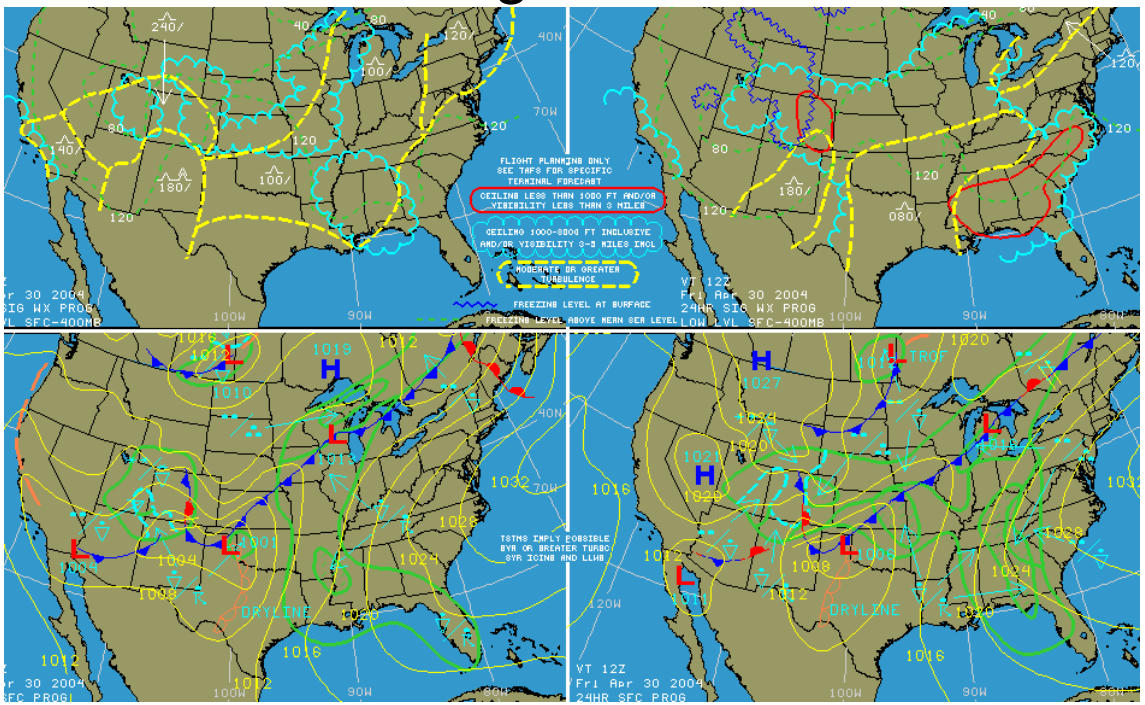


Symbol	Meaning
R	Rain
RW	Rain shower
S	Snow
SW	Snow shower
T	Thunderstorm
NA	Not available
NE	No echoes
OM	Out for maintenance
↗ 35	Cell movement to the northeast at 35 knots
LM	Little movement
WS999	Severe thunderstorm watch number 999
WT210	Tornado watch number 210
SLD	8/10 or greater coverage in a line
	Line of echoes

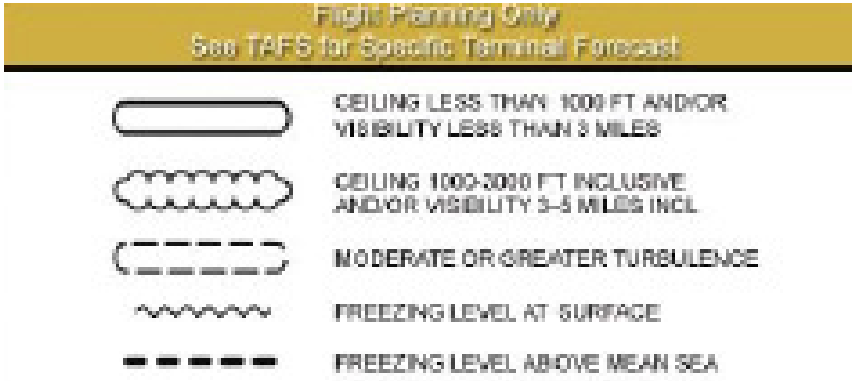
Low Level Significant Weather Prognostic Chart

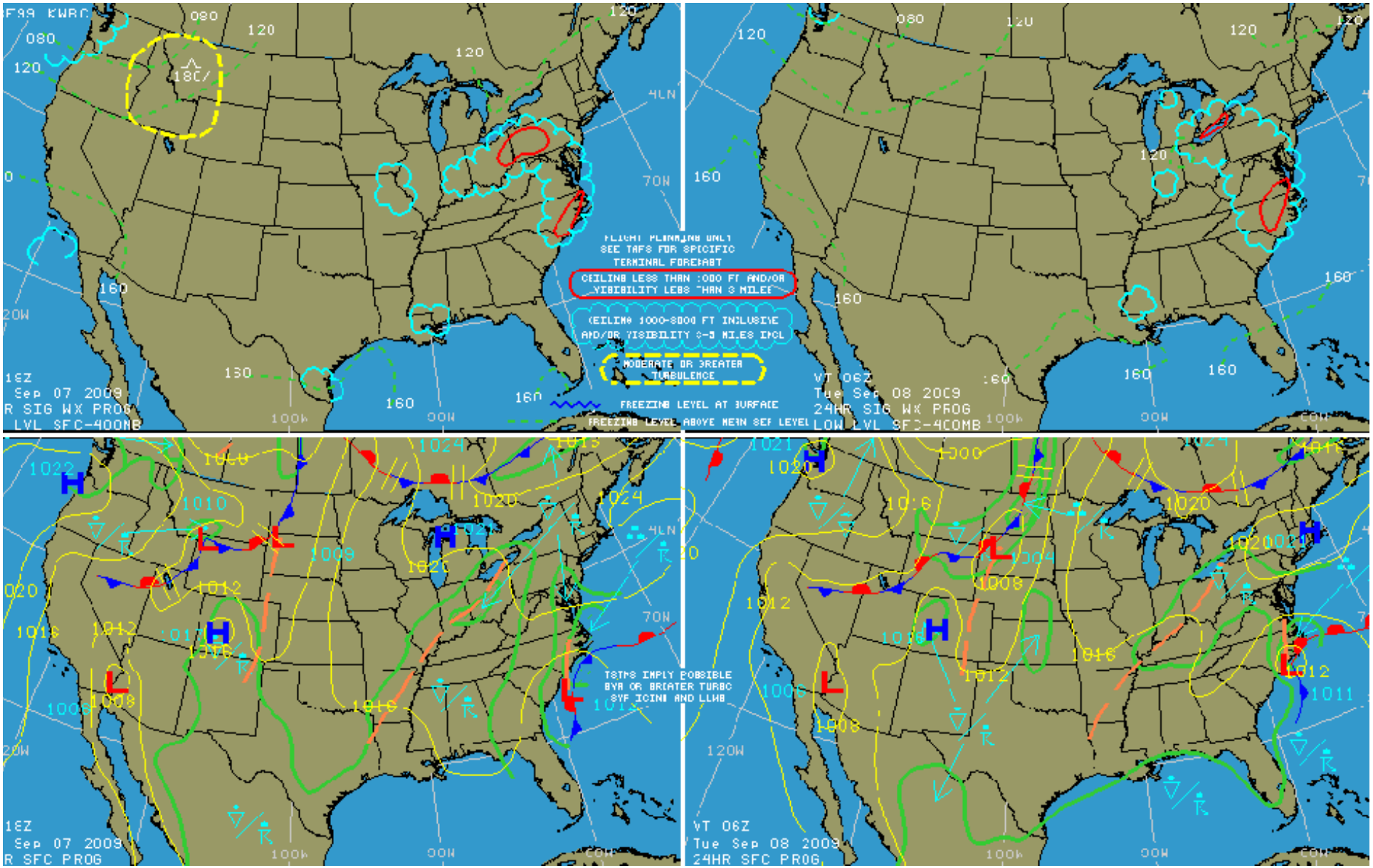
LOW LEVEL SIGNIFICANT WEATHER PROG CHART: 4 PANELS, 12/24 hr | Upper/Lower levels



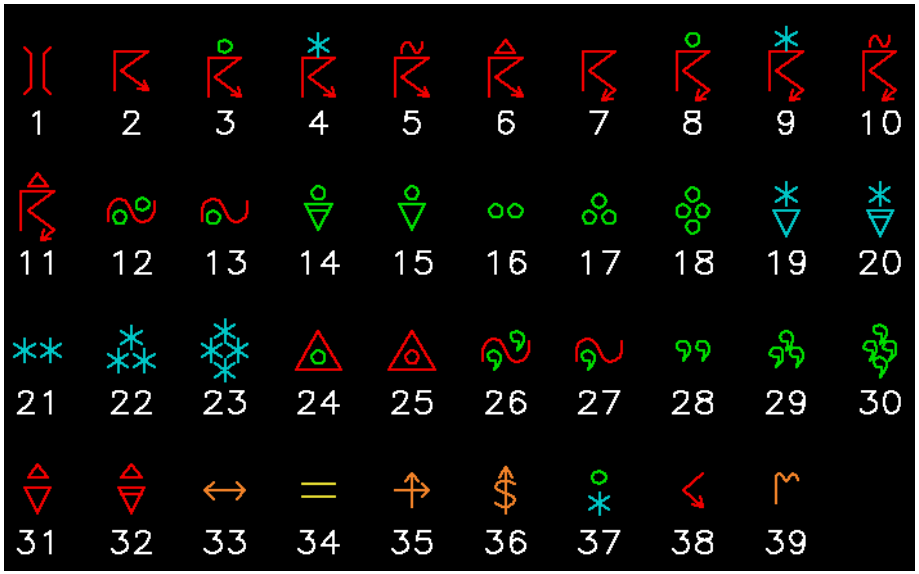


Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Intermittent snow covering half or less of the area.		Rain Shower		Severe Turbulence
			Snow Shower		Moderate Icing
	Intermittent rain showers covering half or less of the area.		Thunderstorms		Severe Icing
	Continuous rain covering more than half of the area.		Freezing Rain		Rain
			Tropical Storm		Snow
	Continuous rain showers and thunderstorms covering more than half of the area.		Hurricane (Typhoon)		Drizzle
			Moderate Turbulence		



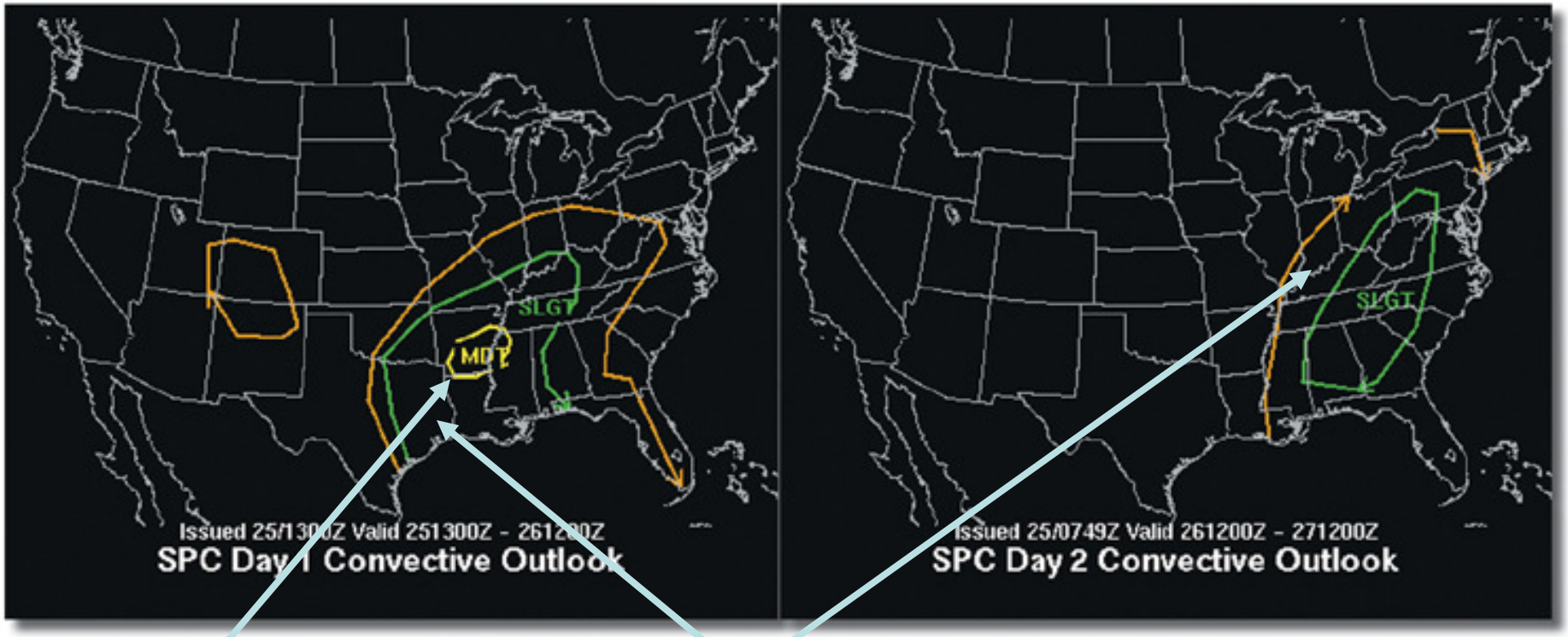

F99 KWBC
080
120
160
180/
FLIGHT PLANNING ONLY
SEE TAFS FOR SPECIFIC
TERMINAL FORECAST
CEILING LESS THAN 1000 FT AND/OR
VISIBILITY LESS THAN 3 MILES
CEILING 1000-3000 FT INCLUSIVE
AND/OR VISIBILITY 3-5 MILES INCL
MODERATE OR GREATER
TURBULENCE
FREEZING LEVEL AT SURFACE
FREEZING LEVEL ABOVE MEAN SEA LEVEL
18Z
Sep 07 2009
R SIG WX PROG
LVL SFC-400MB
VT 06Z
Tue Sep 08 2009
24HR SIG WX PROG
LOW LVL SFC-400MB
1022
1010
1009
1012
1016
1008
1020
1024
TSTMS IMPLY POSSIBLE
SVR OR GREATER TURBC
SVR ICING AND LLWS
18Z
Sep 07 2009
R SFC PROG
VT 06Z
Tue Sep 08 2009
24HR SFC PROG

METEOROLOGY – GRAPHIC WEATHER PRODUCTS SYMBOLS



1 = Tornado [not used]	14 = Moderate/Heavy rain shower	27 = Light Freezing Drizzle
2 = Thunderstorm	15 = Light rain shower	28 = Light Drizzle
3 = Thunderstorm with rain	16 = Light rain	29 = Moderate Drizzle
4 = Thunderstorm with snow	17 = Moderate rain	30 = Heavy Drizzle
5 = Thunderstorm with freezing rain	18 = Heavy rain	31 = Light sleet shower
6 = Thunderstorm with hail or sleet	19 = Light snow shower	32 = Moderate/Heavy sleet shower
7 = Heavy Thunderstorm	20 = Moderate/Heavy snow shower	33 = Ice Crystals
8 = Thunderstorm with heavy rain	21 = Light snow	34 = Fog or Mist
9 = Thunderstorm with heavy snow	22 = Moderate snow	35 = Drifting snow [not used]
10 = Thunderstorm with heavy frzg rain	23 = Heavy snow	36 = Blowing sand/dust
11 = Thunderstorm with heavy sleet/hail	24 = Light Sleet	37 = Mix of rain and snow
12 = Moderate/Heavy freezing rain	25 = Moderate/Heavy Sleet	38 = Thunder without precipitation
13 = Light freezing rain	26 = Moderate/Heavy freezing drizzle	39 = Smoke

METEOROLOGY – GRAPHIC WEATHER PRODUCTS
2 Day Convective Outlook



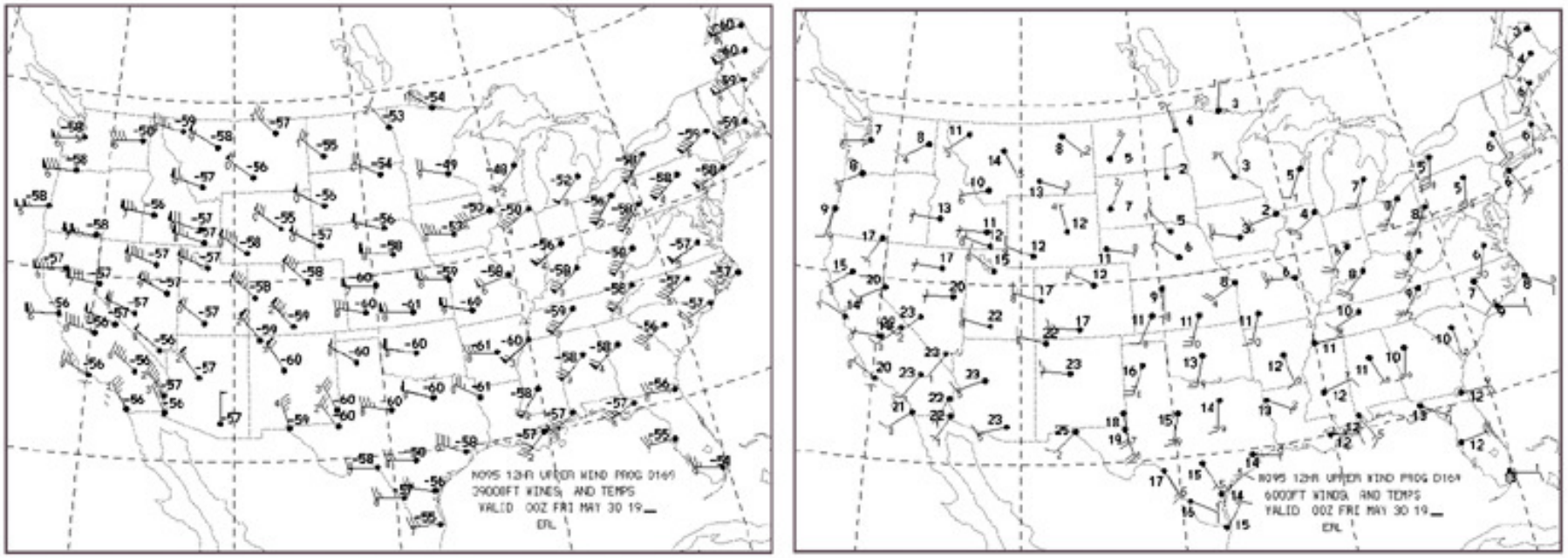
MODERATE (MDT) Convection

SLIGHT(SLT) Convection

Expect THUNDERSTORMS in areas of convective activity

HIGH not shown above

METEOROLOGY – GRAPHIC WEATHER PRODUCTS
FORECAST WINDS / TEMP ALOFT



Two of 8 panels on a 12 hour forecast winds and temperatures. Wind/Speed shown by pointers and temperature (C) indicated by numbers. They are a graphic representation of the standard winds aloft forecast (FDs).

METEOROLOGY – GRAPHIC WEATHER PRODUCTS
VOLCANIC ASH GRAPHICS