Checking The Weather

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Meteorologist, CBC

Transport Canada Safety Seminar
October 17, 2007

Outline

- Overview of Aviation Weather
- The tools available to pilots
  - METARs, TAFs, GFAs, PIREPs
  - Satellite
  - Radar
  - Upper Level Charts

Outline

- Checking The Weather - A System For Pilots
- Lake Effect Snow (LES) - Case Study
- General Notes On Weather
- Questions

Sources Of Weather Information

Classic Weather Information

- METARs

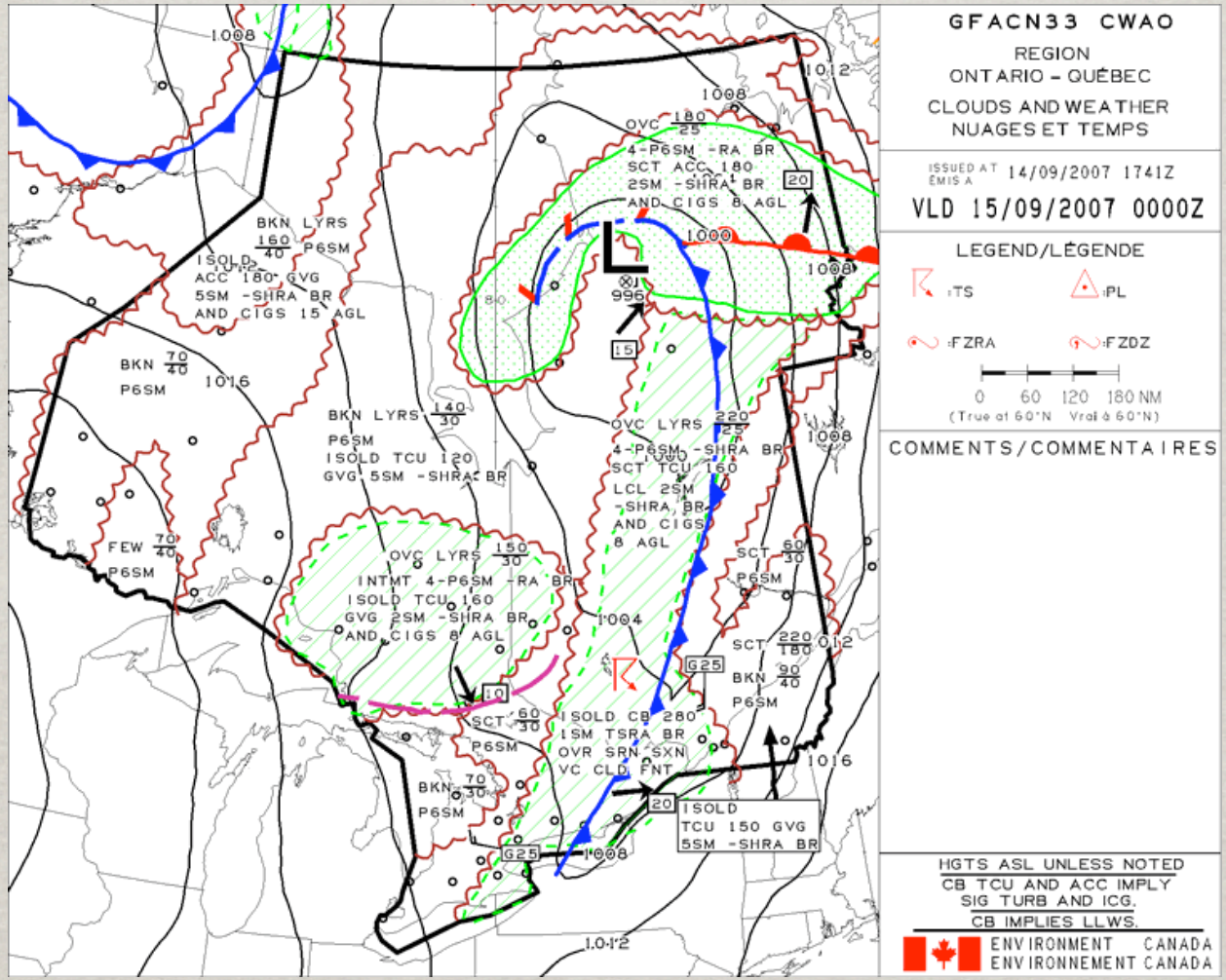
METAR CYWG 172000Z 30015G25KT 3/4SM R36/4000FT/D -SN BLSN BKN 008 OVC M05/M08 A2992 REFZRA WS RWY 36 RMK SF5NS3 SLP 134

Classic Weather Information

- TAFs

TAF AMD CYHM 050349Z 050324
04005KT 1/4SM FG VV001 TEMPO
0314 2SM BR SCT001 FM1400Z
08006KT P6SM SCT040 TEMPO 1416
2SM BR SCT001 BECMG 2123
19008KT RMK NXT FCST BY 06Z=

Classic Weather Information



Classic Weather Information

- PIREPS

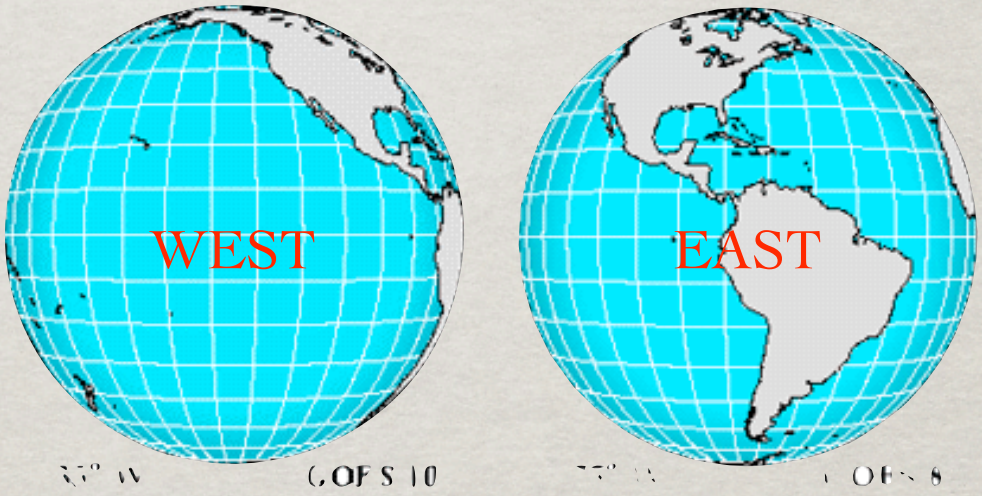
UACNN01 CYGK 142124
YZ
UUA /OV CYKZ /TM 2056 /FLDURD /TP C208 /TB LGT-MDT /RM WND SHR +/- 10 KTS FINAL RWY 33

UACN10 CYYB 142047
YZ
UA /OV CYYB 130065 /TM 2047 /FLDURD /TP SW4 /TB MDT FL120-080 /RM TB FM YXI TO 20 NW YXI

UACN10 CYSN 142038
YZ
UA /OV YSN /TM 2038 /FL020 /TP B06 /TB LGT-MDT CYTZ-CYSN

Satellite

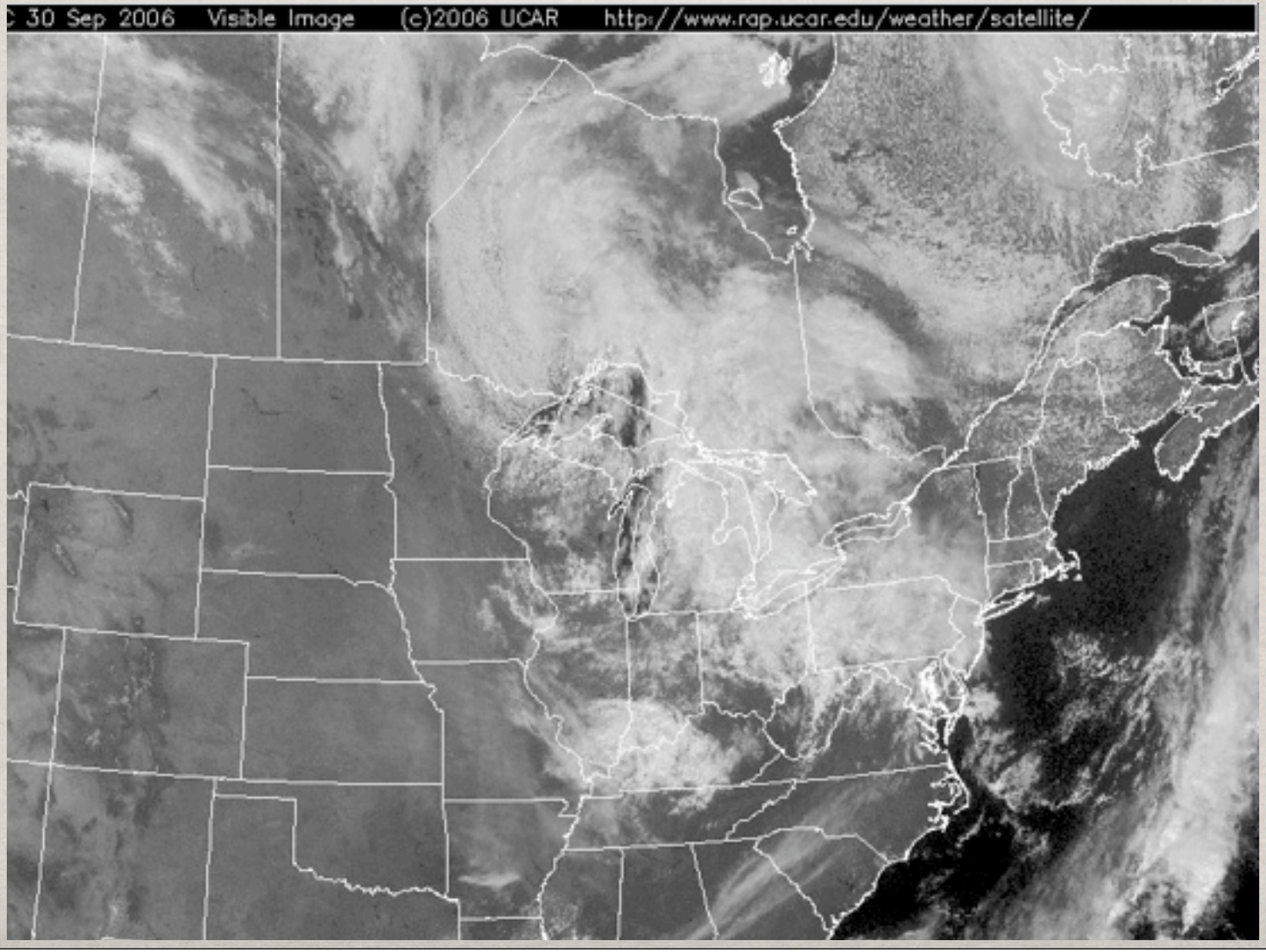
- Two Basic Types Of Scanning Strategies
  - GOES
  - POES



Satellite

Imager Instrument Characteristics (GOES I-M)					
Channel No.	1 (Vis)	2 (SW)	3 (WV)	4 (IR)	5 (IR 2)
Wavelength (um)	0.55-0.75	3.80-4.00	6.50-7.00	10.20-11.20	11.50-12.50
IGFOV	1 km	4 km	8 km	4 km	4 km
Radiometric calibration	Space and 290K infrared internal blackbody				
Imaging Rate	Full earth disc, less than or equal to 26 minutes				

Satellite Visible



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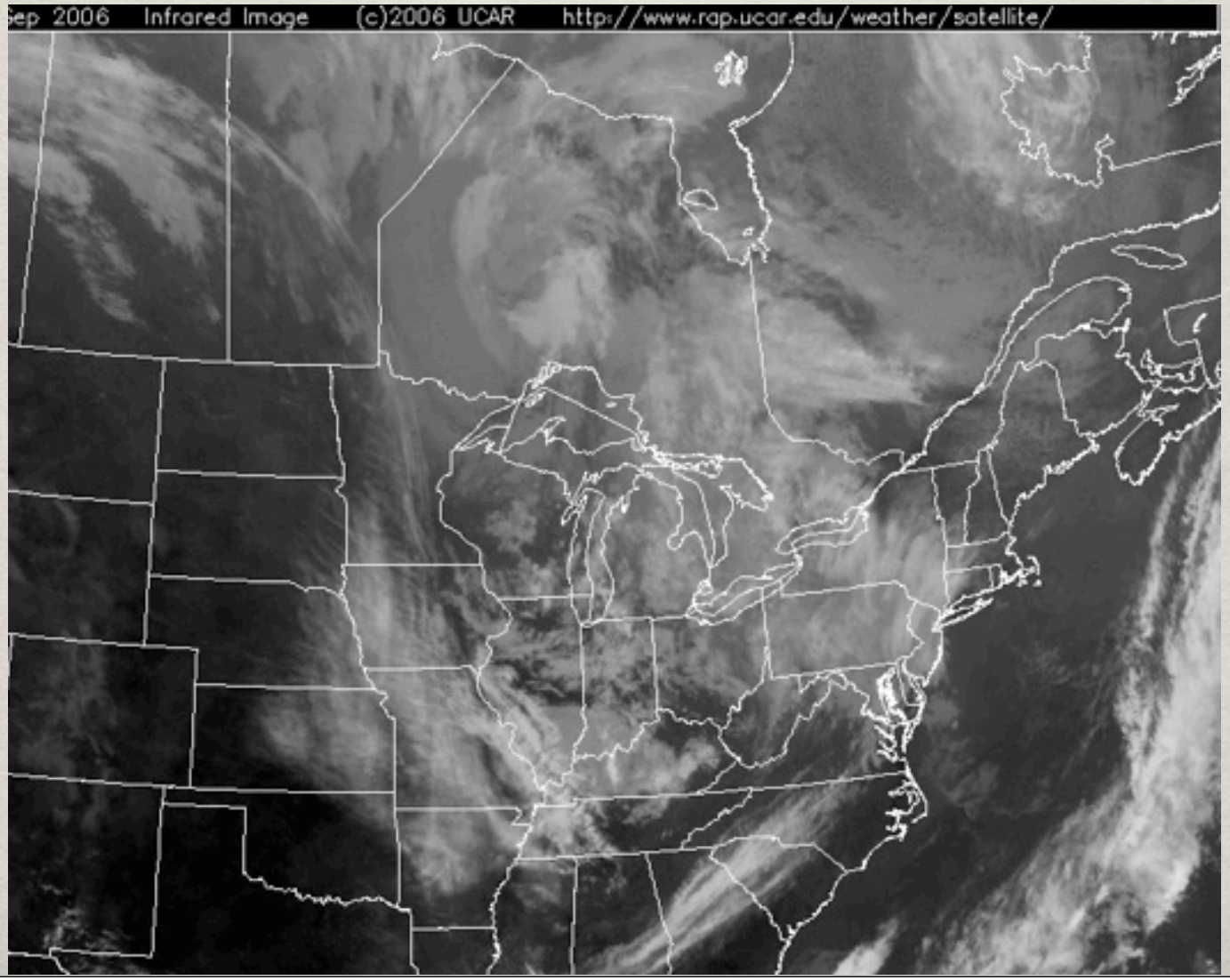
Satellite Infrared



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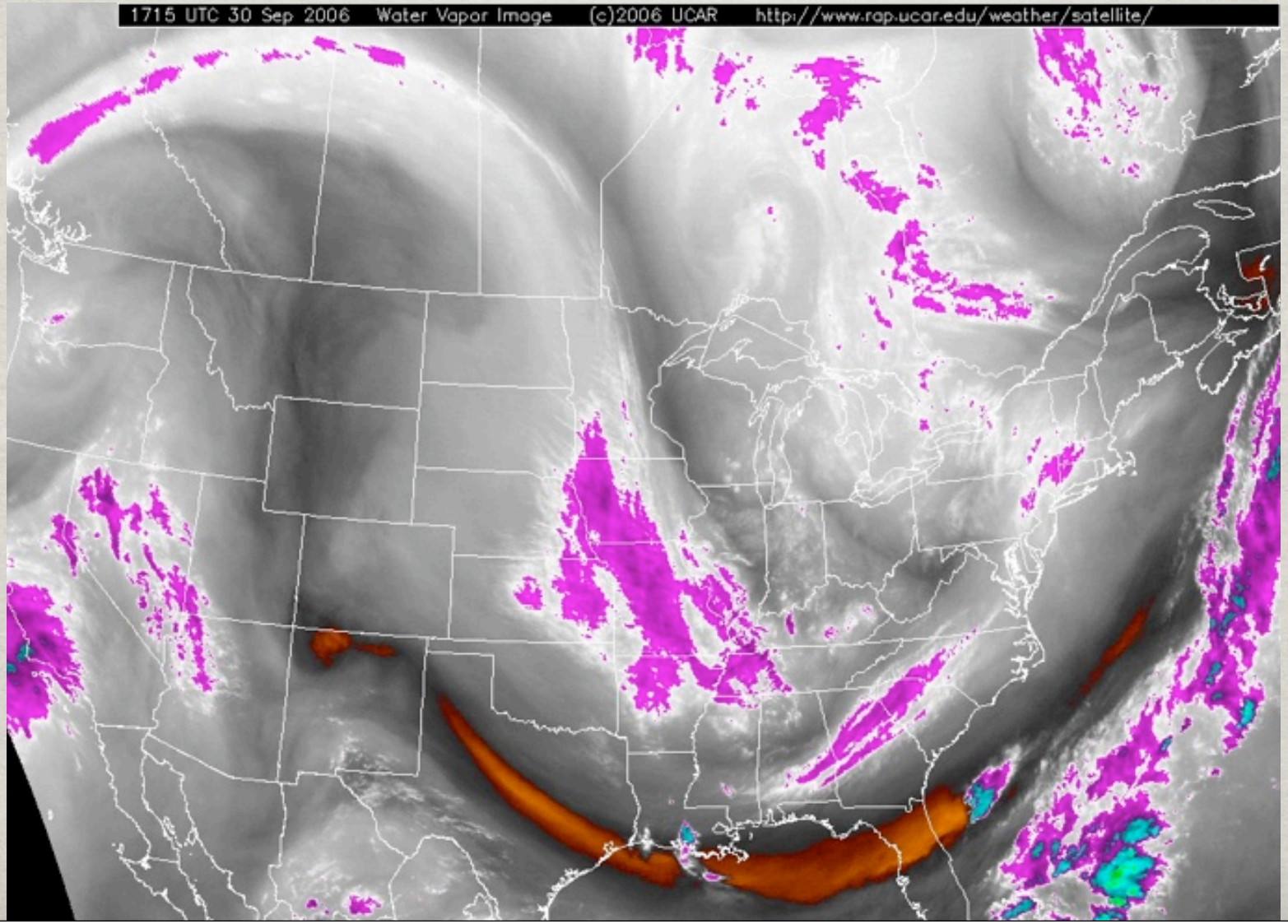
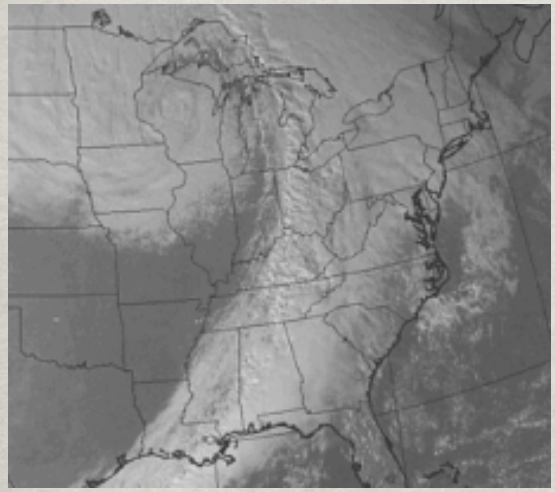
Satellite Water Vapour



Satellite

Visible



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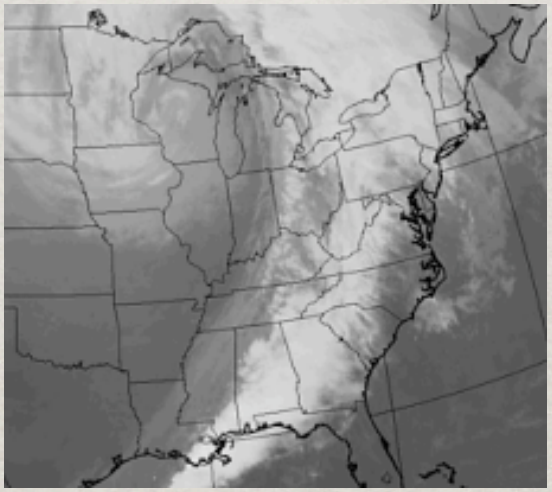

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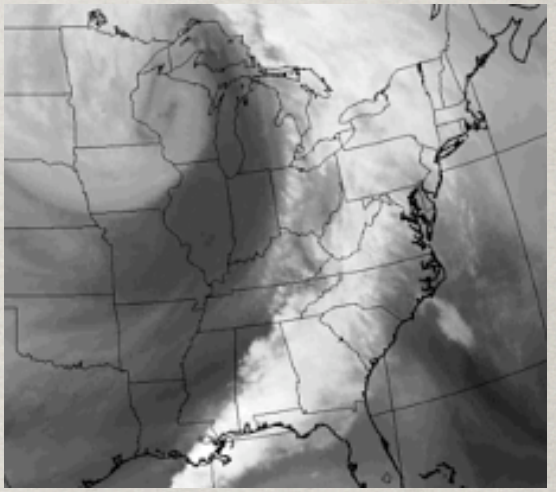

Satellite

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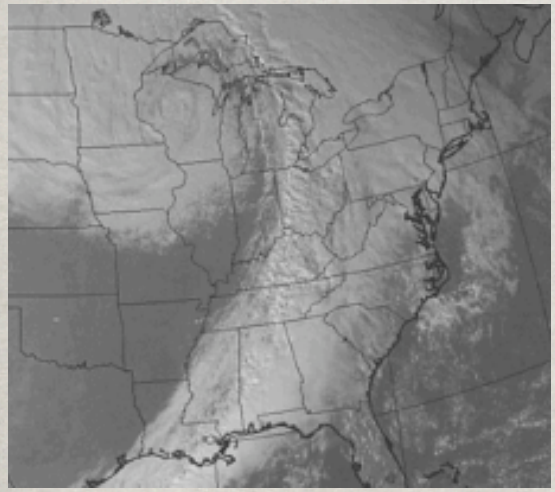

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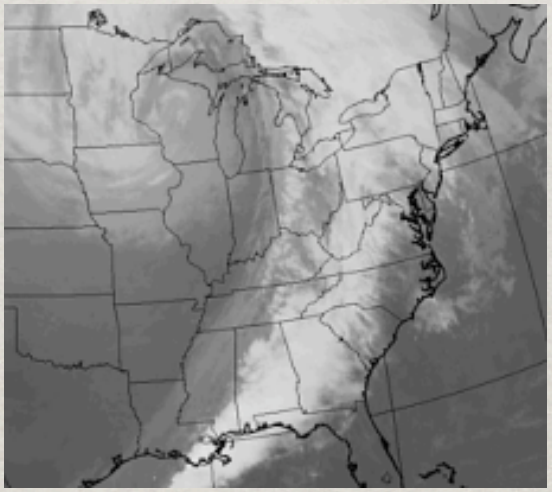

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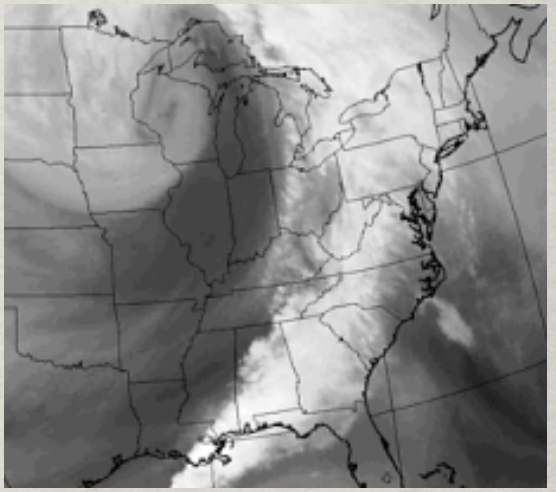

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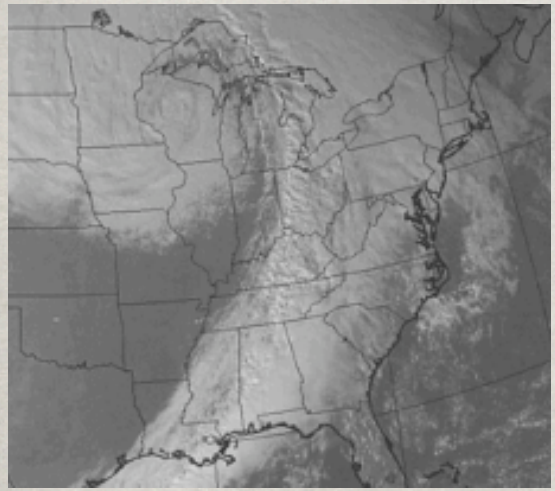

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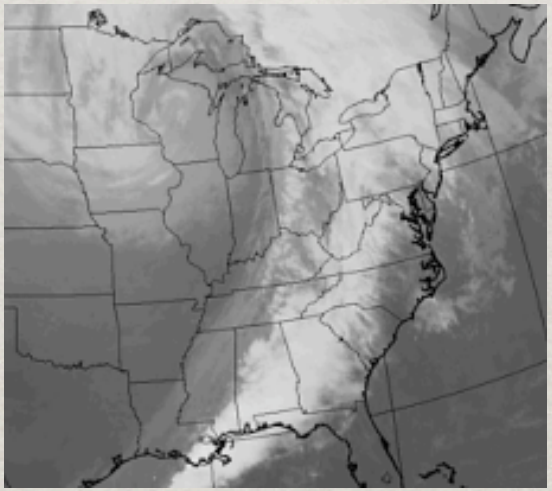

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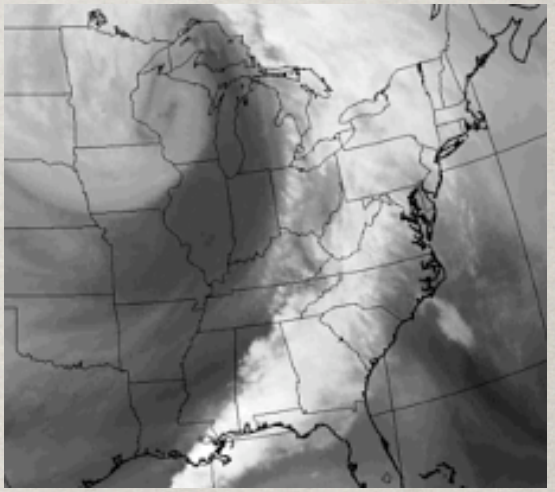
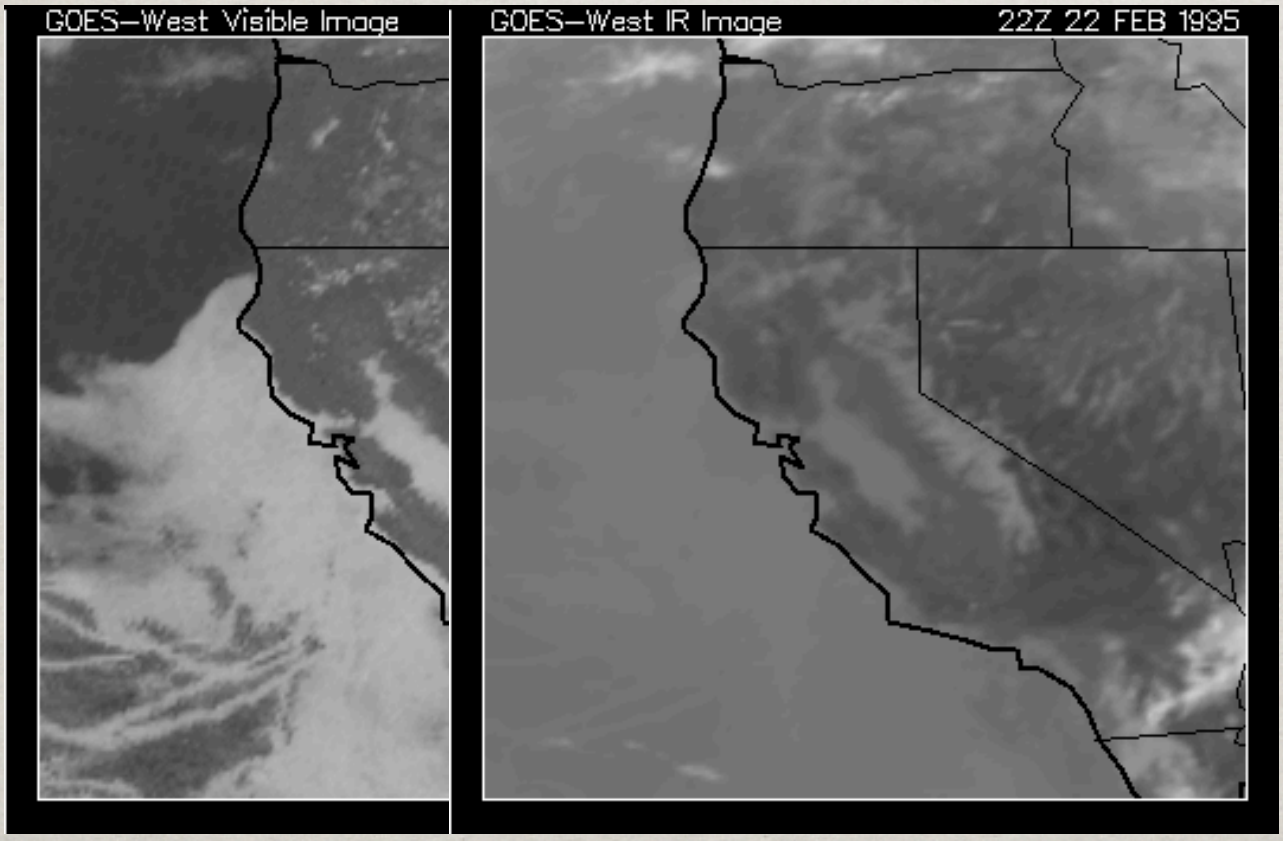


Satellite IR vs. Visible



Satellite

- Satellite Errors
  - Position Error Due To Parallax

  - Viewing Side of Clouds
  - Overlap Between Pixels
  - Sensor Lag

Weather Radar

- Pulsed Weather Radar
  - Transmitter
  - Antenna
  - Receiver
  - Processor & Displays

Weather Radar

L	15-30 cm	ATC Enroute
S	7.5-15 cm	Weather Surveillance - Terminal
C	3.75-7.5 cm	Weather Surveillance
X	2.4-3.75 cm	Weather Surveillance - Ships
Ku	1.67-2.4 cm	Weather Avoidance
K	1.13-1.67 cm	Small Aircraft
Ka	.75-1.13 cm	Cloud Detection

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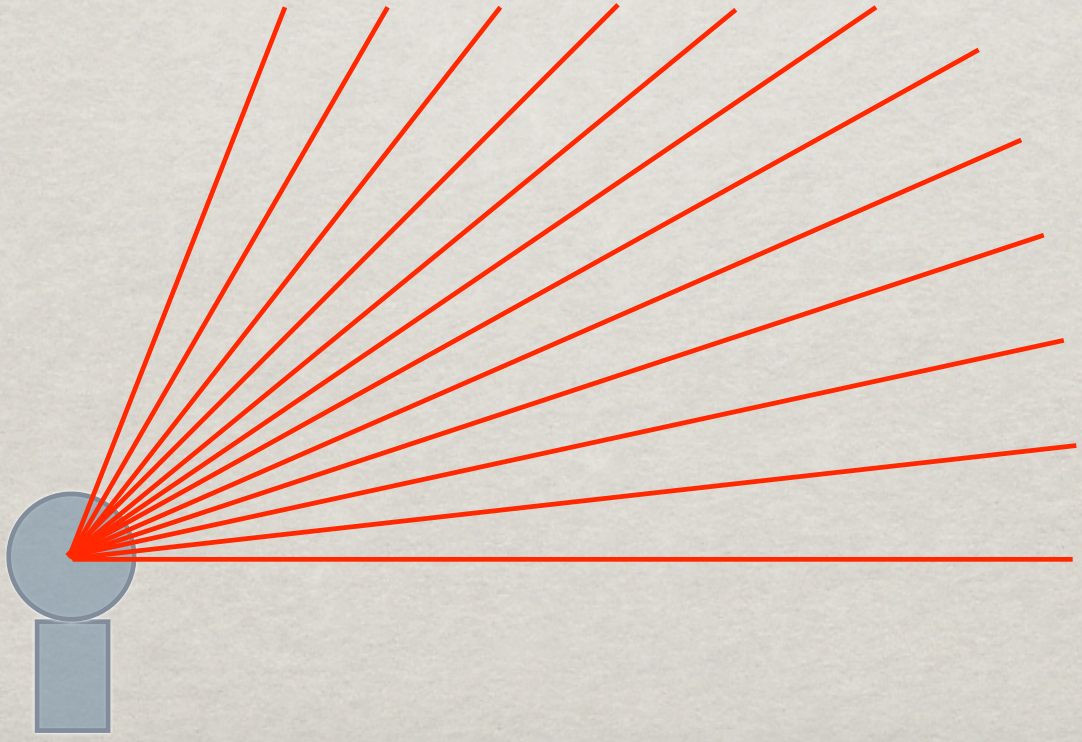
Weather Radar Scan Strategies

- Plan Position Indicator (PPI) vs. Constant Altitude Plan Position Indicator (CAPPI)



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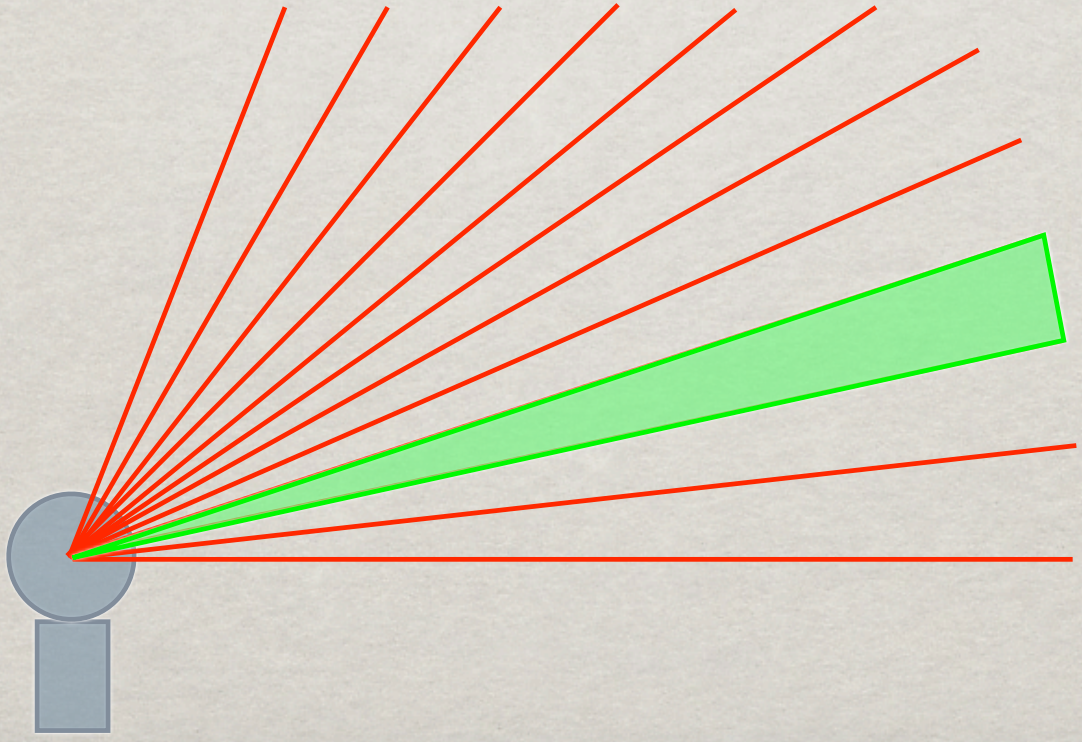

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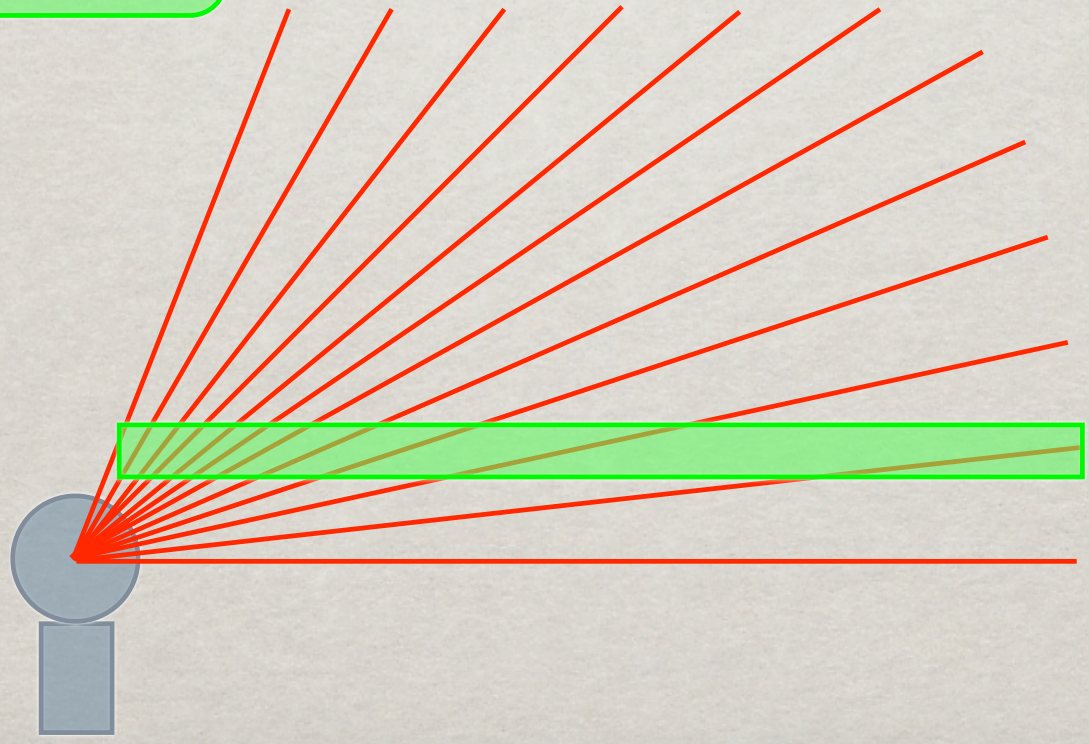
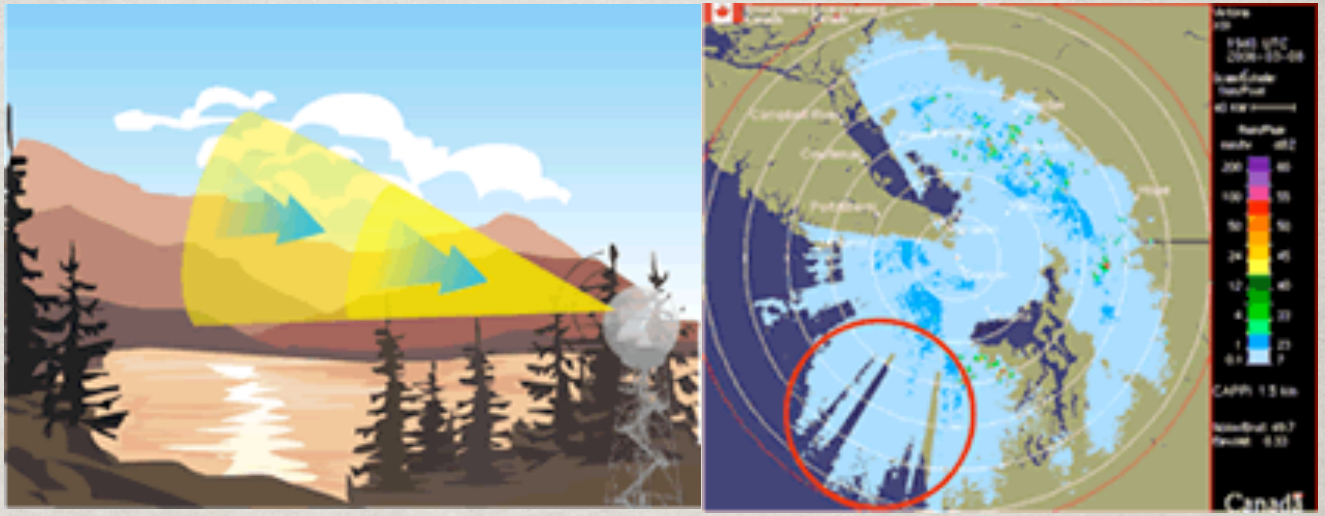
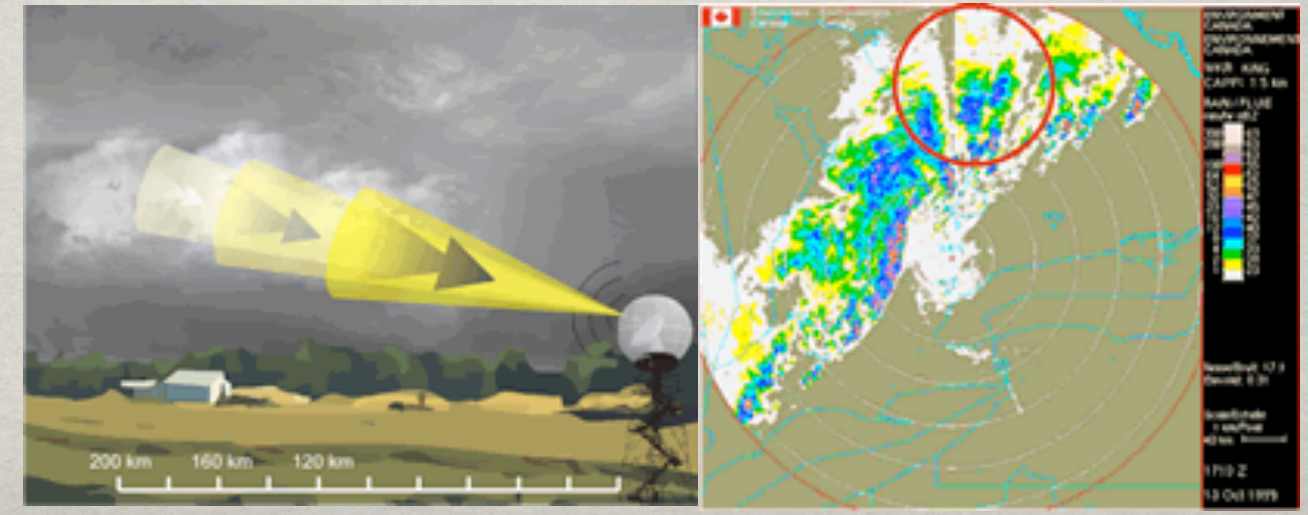


Weather Radar Errors

Beam Blocking

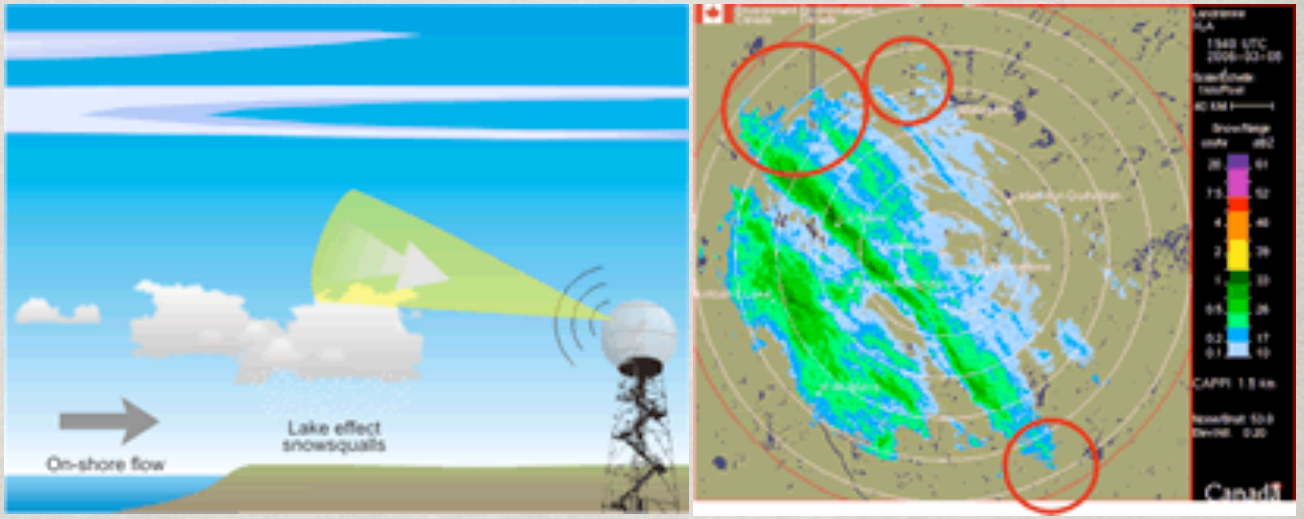


Attenuation

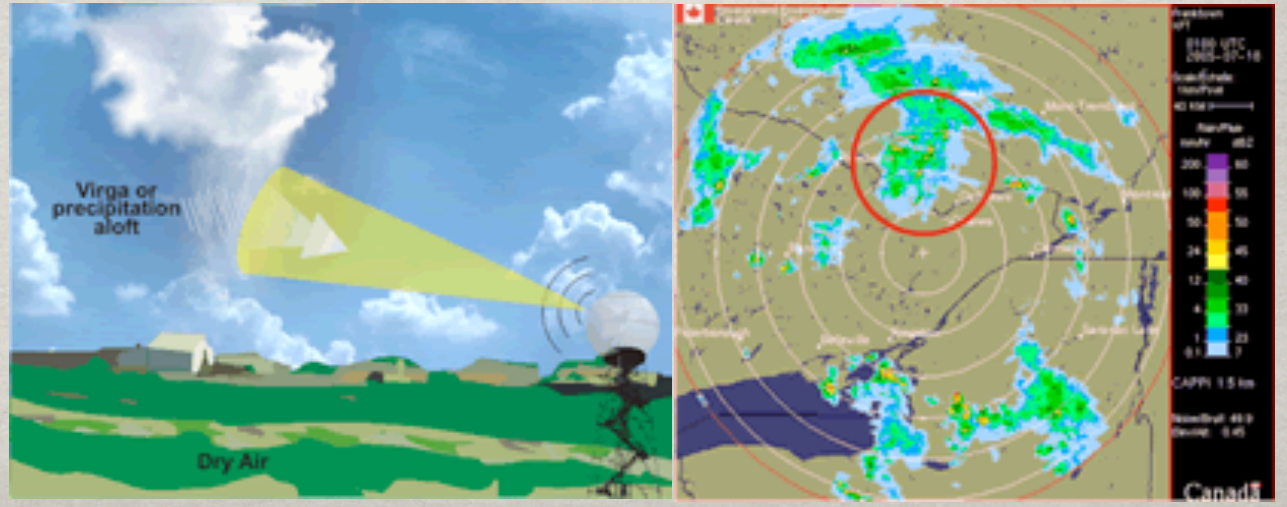


Weather Radar Errors

Overshooting Beam

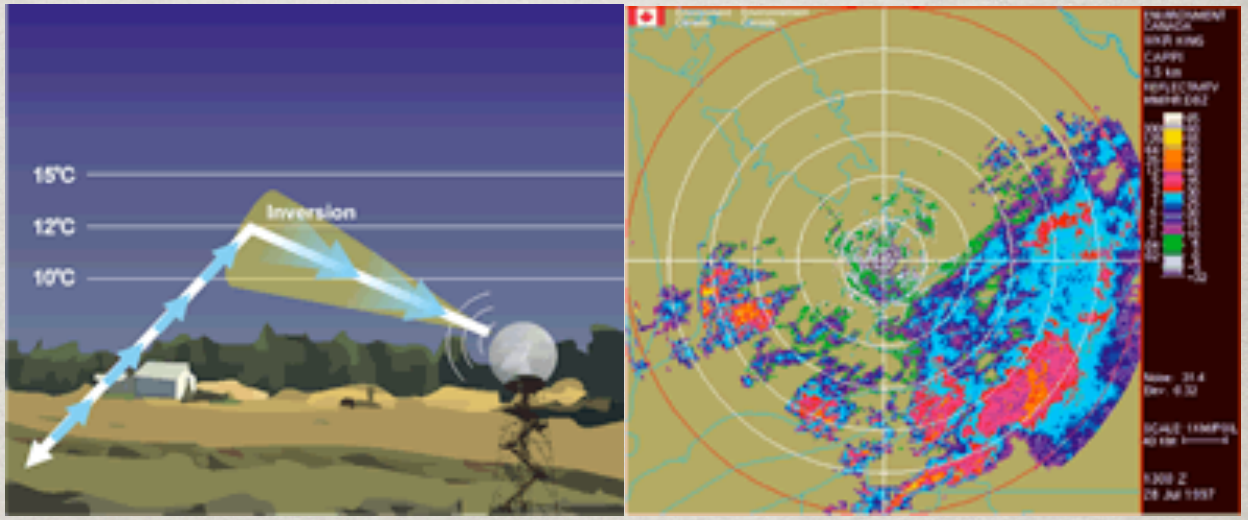


Virga

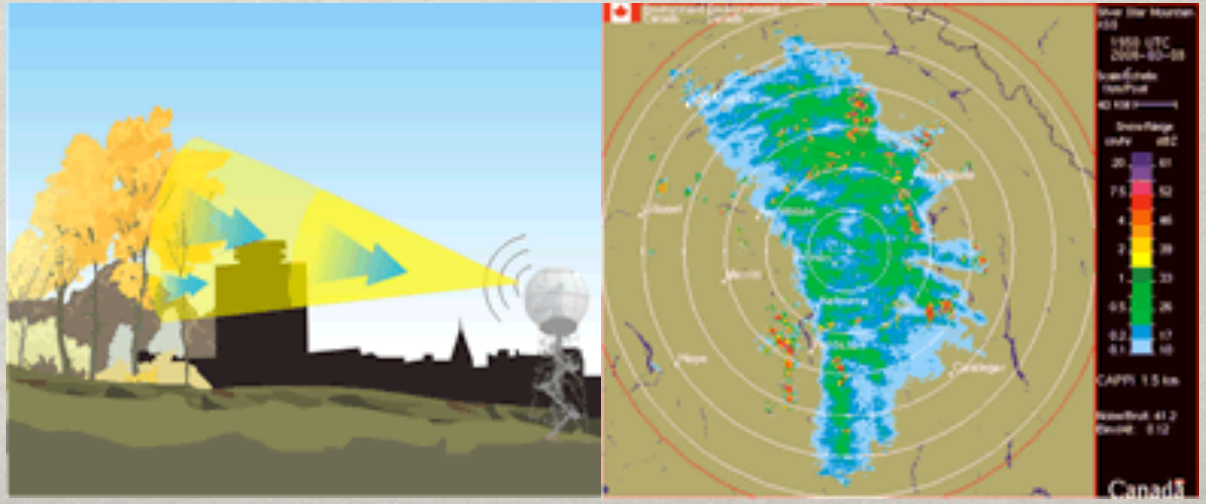


Weather Radar Errors

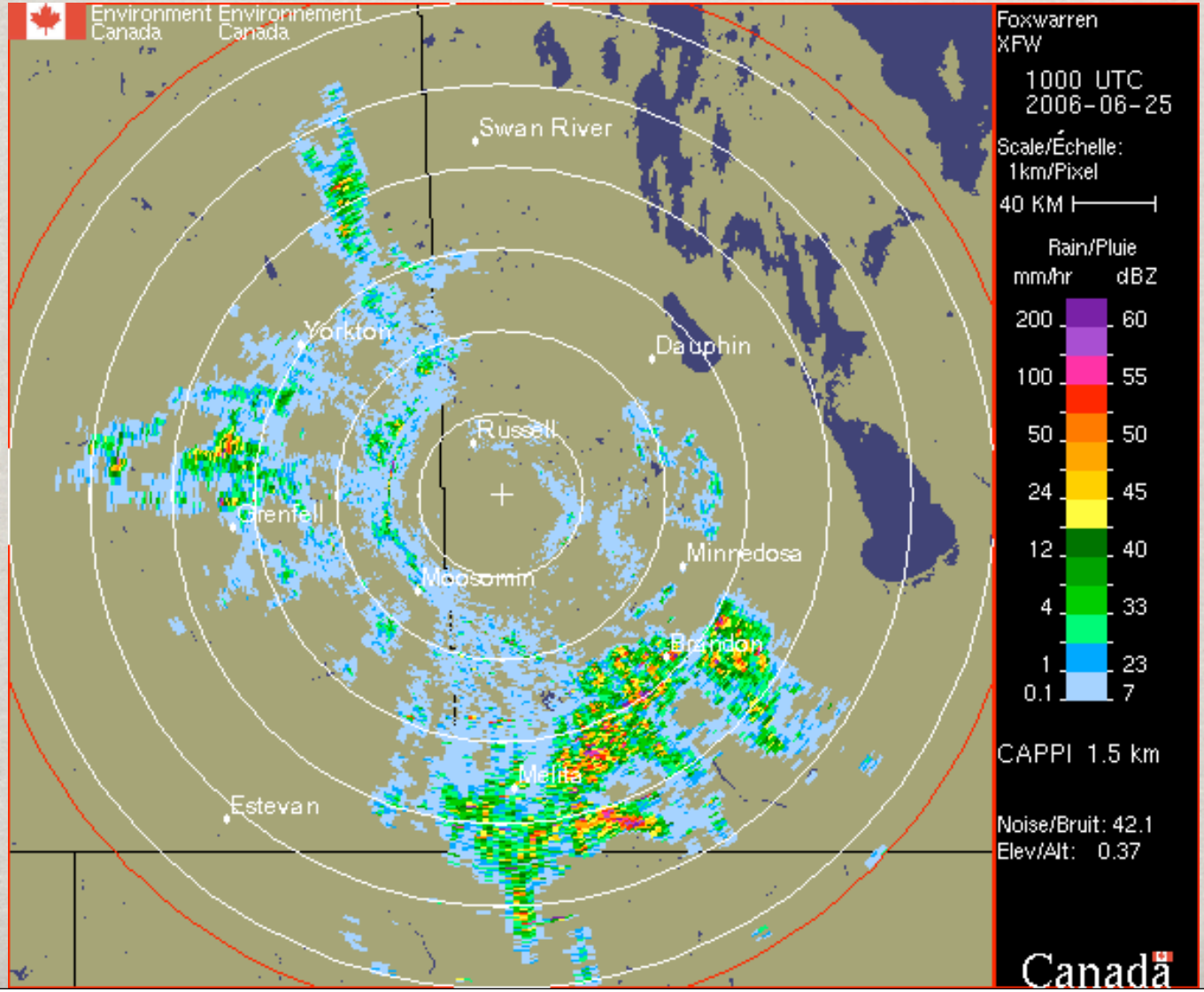
Anomalous Propagation



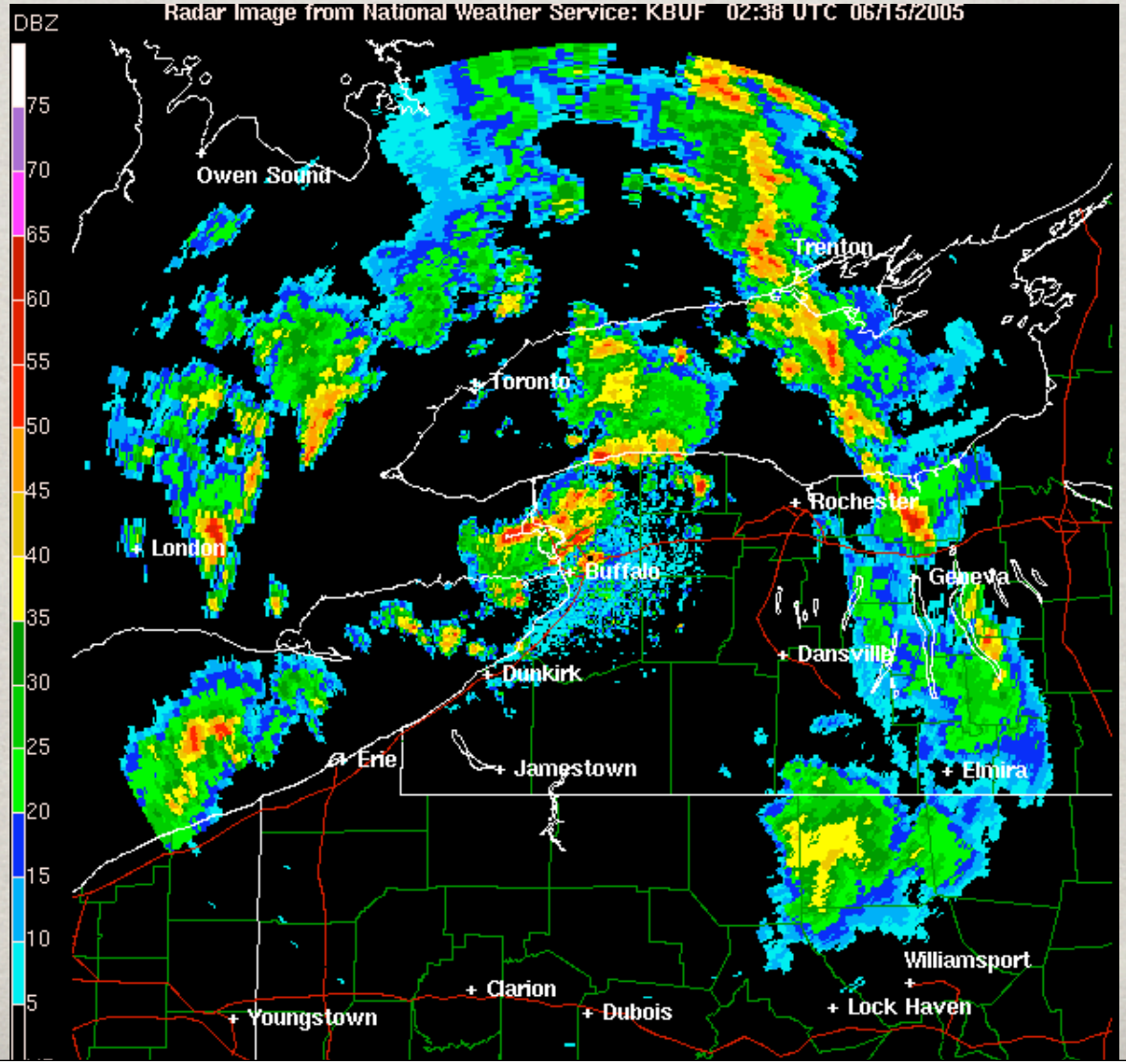
Ground Clutter



Weather Radar
Put It In Motion!



Weather Radar
Base vs. Composite



Weather Radar V.I.P.

- VIP 1 & 2 - Weak to moderate, turbulence possible, with lightning
- VIP 3 - Strong, severe turbulence possible, lightning
- VIP 4 - Very strong, severe turbulence likely, lightning
- VIP 5 - Intense, severe turbulence likely, organized wind gusts, hail likely
- VIP 6 - Extreme, severe turbulence, large hail, lightning, extensive wind gusts and turbulence

Checking The Weather

Checking The Weather

- MAIN POINT: Understand Why
- 3 Steps:
  - What is happening right now
  - General forecast of synoptic features
  - Time and location specific forecasts

Checking The Weather
A Memory Tool

3586982678129052

19 32 18 06 51 32 97 46

CHUNKING

Checking The Weather

- What is happening now?
  - General Synopsis
    - Satellite
    - National & Regional Radar
    - Upper-level charts
    - Surface Analysis

Checking The Weather

- Mesoscale Weather Analysis
  - Departure/Enroute/Destination
  - Local Satellite
  - Local Radar
  - METARs
  - PIREPs

Checking The Weather

- General Weather Forecast
  - Motion of fronts and weather systems
    - GFAs
  - Linear advection of clouds and weather
    - Radar/Satellite/History

Checking The Weather

- Specific Weather Forecast
- Chunk The Forecast
  - Departure/Enroute/Destination
  - Use GFAs/SIGMETs/FIP(ADDS)/TAFs
- Other considerations:
  - Runway in use/condition/Day or Night
  - Fog/Wind/Visibility/System history

Let's Check The Weather

An Example

Lake Effect Snow

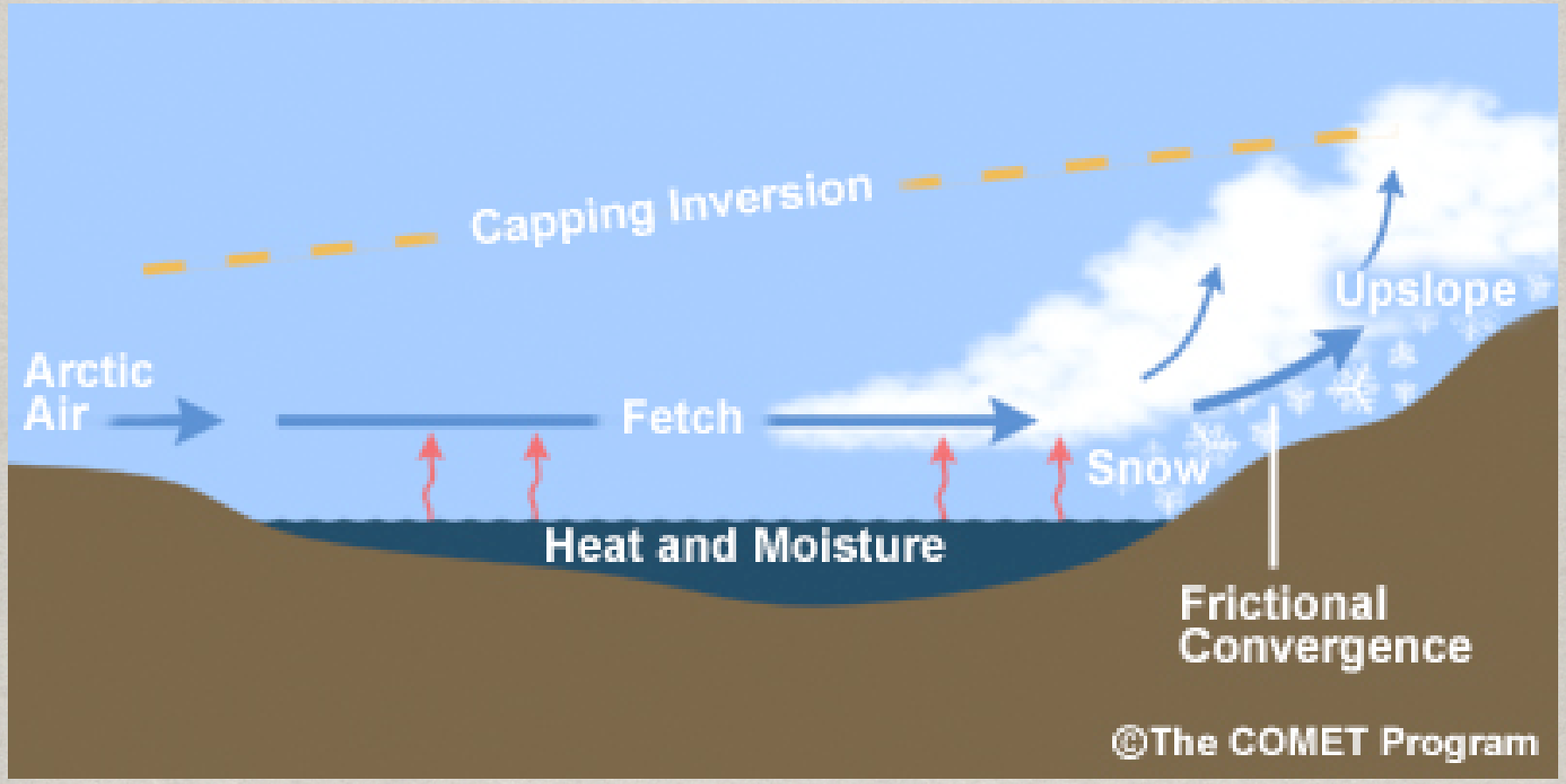
Lake Effect Snow

- Open body of water
- Cold arctic air flowing over relatively warm water
- Typically occurs when a polar vortex slides south

Lake Effect Snow

- Requirements for LES:
  - **Water surface** to **850 mb** air temperature - **MINIMUM 13 C**
  - **Low Shear** - Ideally < 30 deg, Sfc-700mb
  - **Long Fetch**

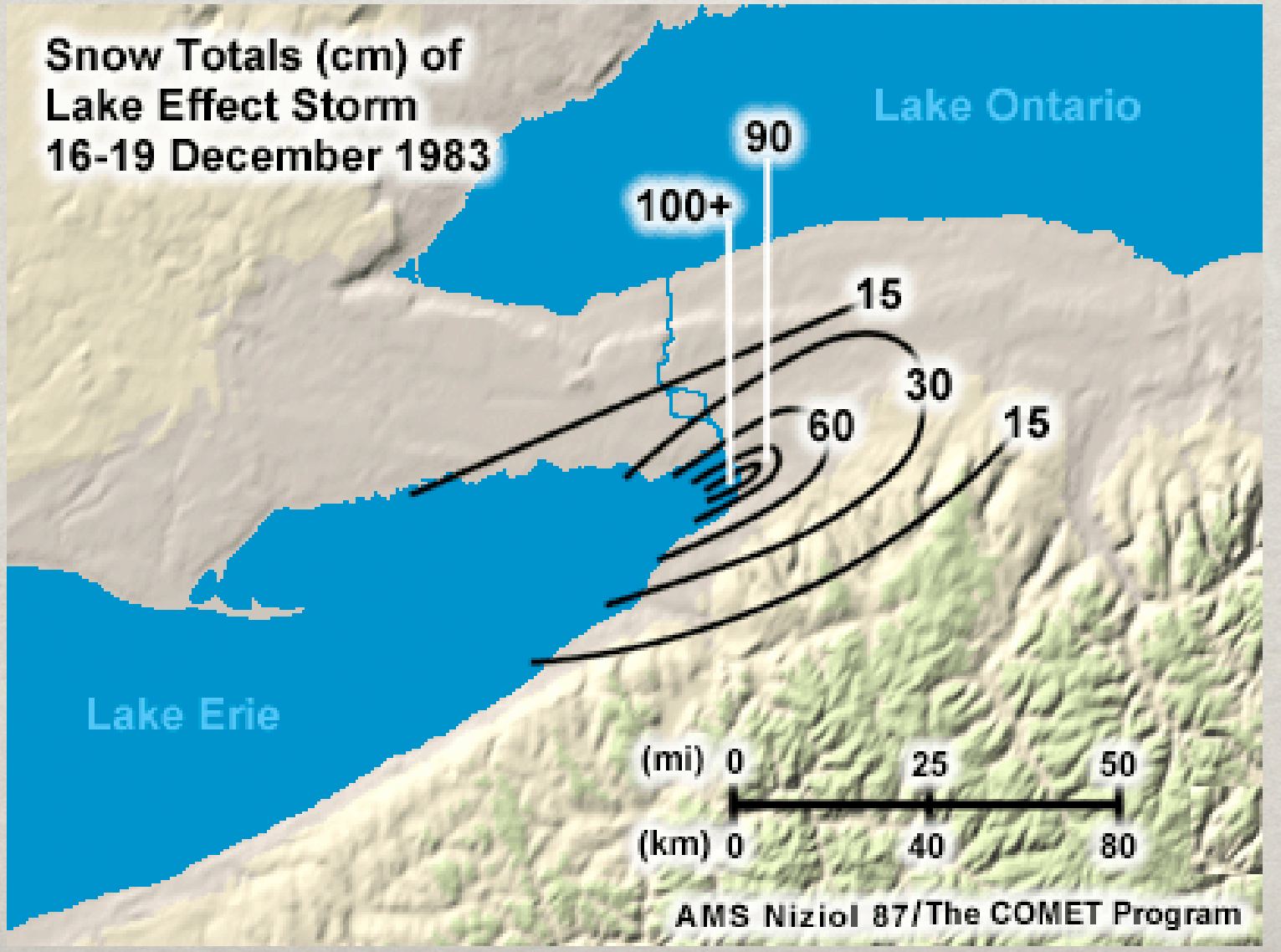
Lake Effect Snow



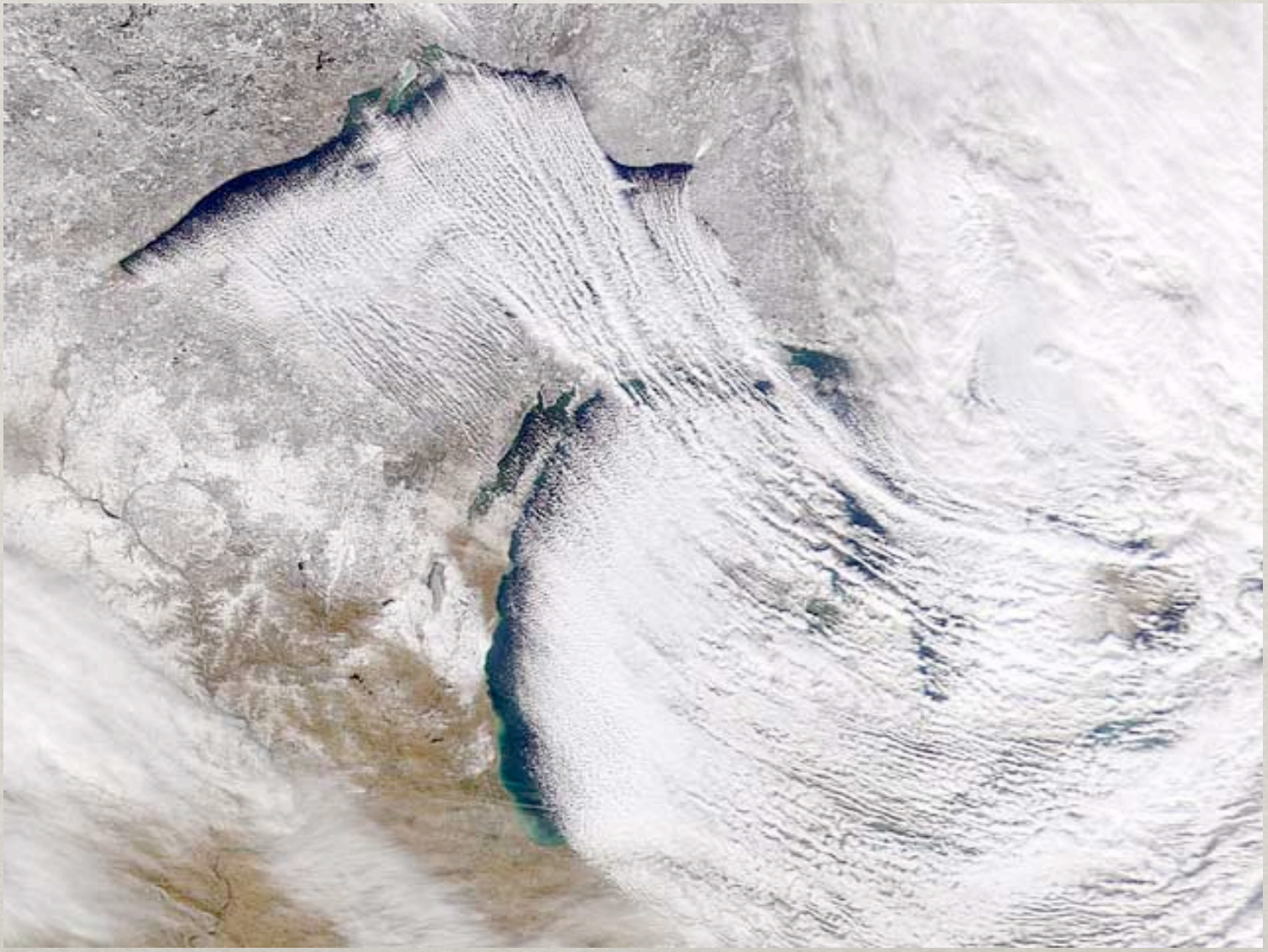
Lake Effect Snow

- Zero-zero conditions
- Severe icing - particularly near water
- Rapid snow accumulations
- Fairly low phenomenon - (5000-9000 ft)
- Generally quite localized

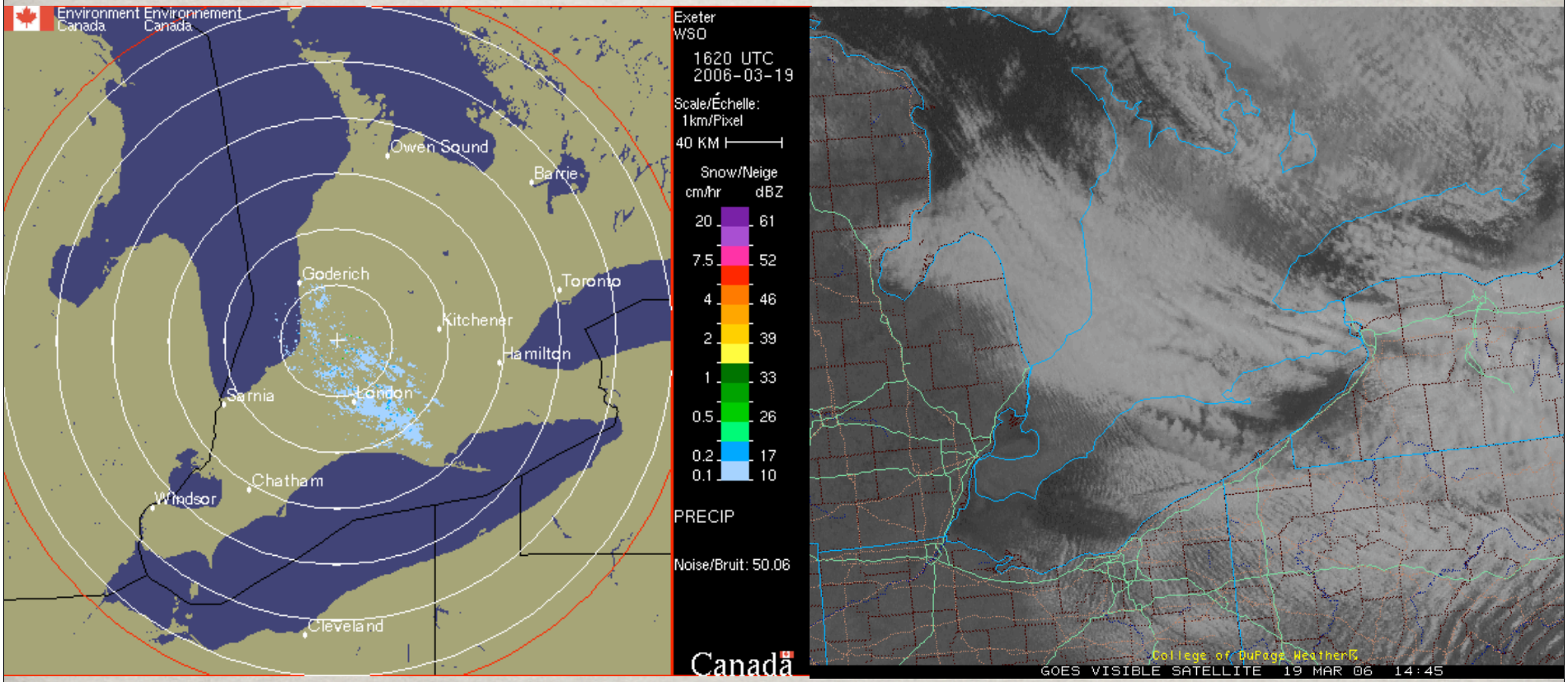
Lake Effect Snow



Lake Effect Snow



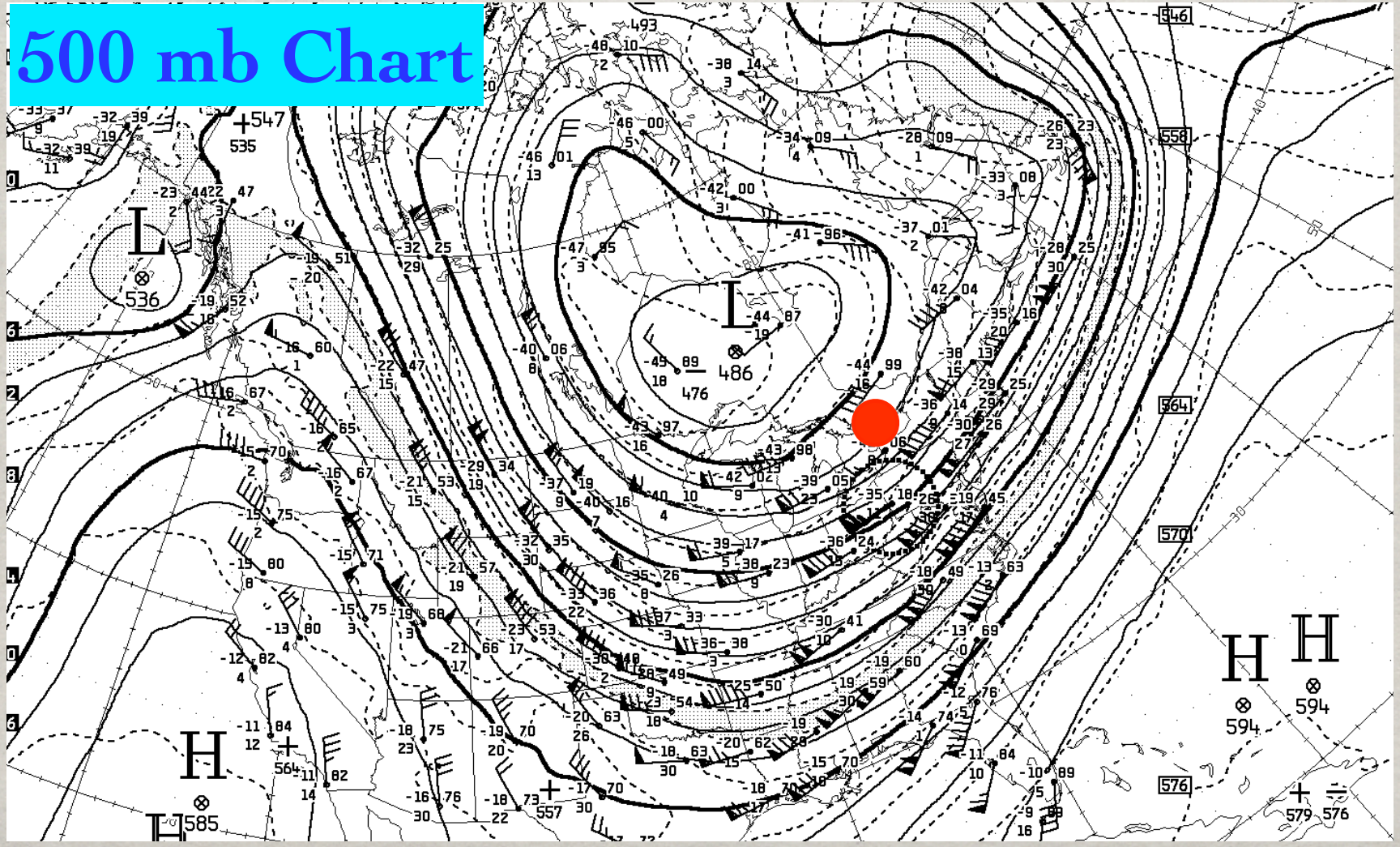
Lake Effect Snow Case Study



Lake Effect Snow Case Study

TAF CYYZ 032345 040012 24025G35KT 10SM FEW040 BKN250 TEMPO 0004 2SM -SHSN BECMG 0204 27020G30 BKN030 TEMPO 0712 2SM +SHSN OVC 020 RMK NXT FCST BY 06Z=

Lake Effect Snow Case Study



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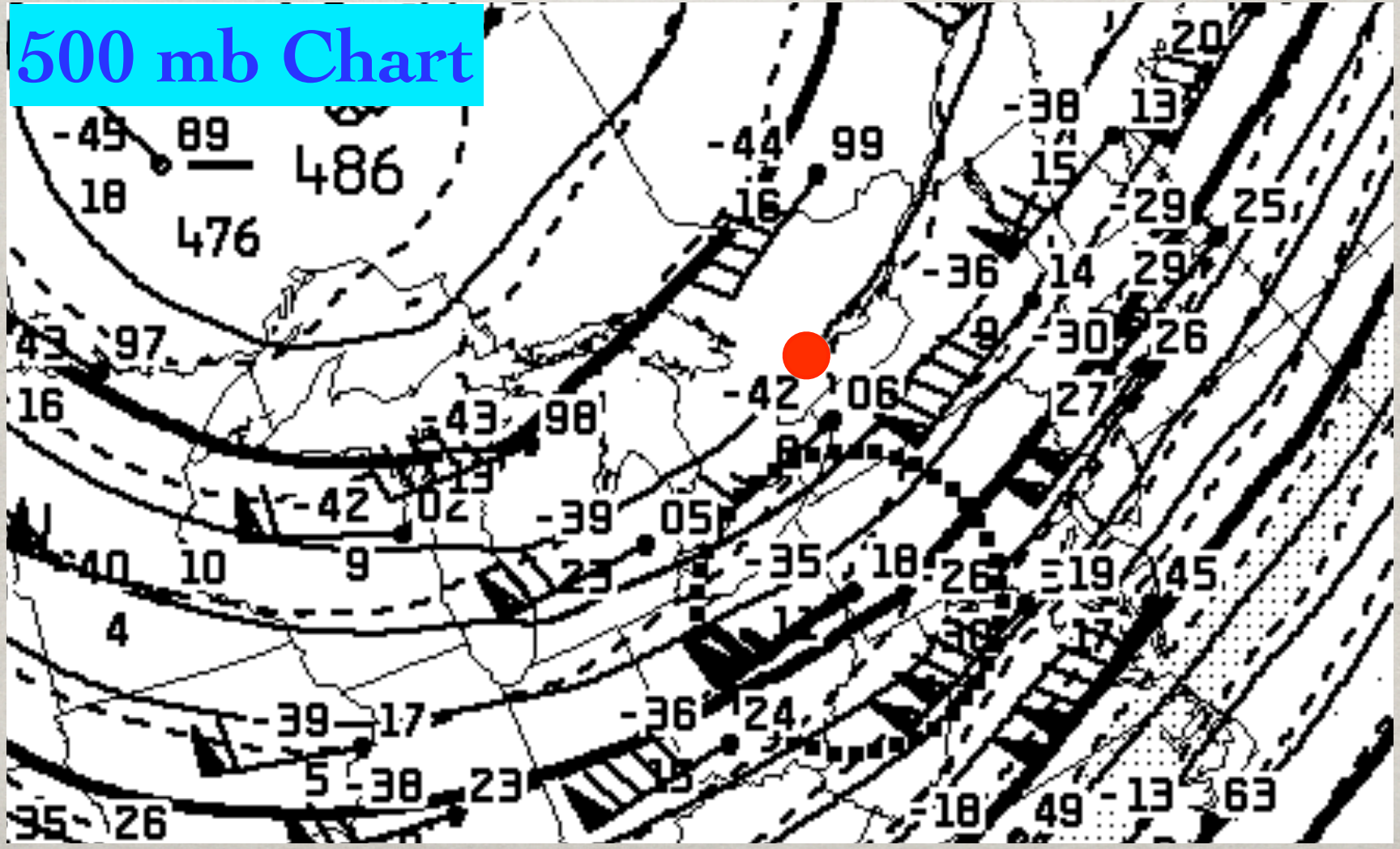

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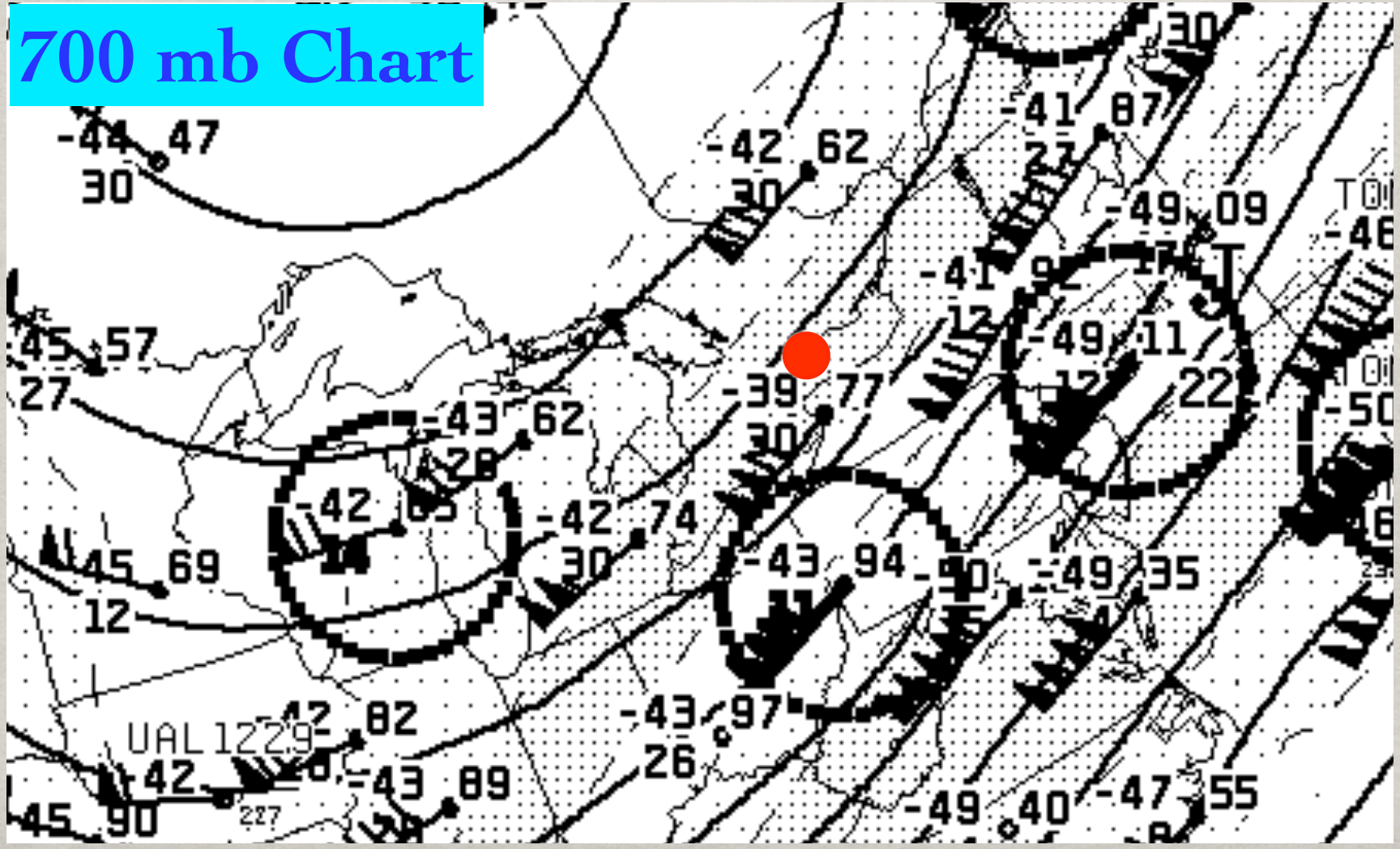

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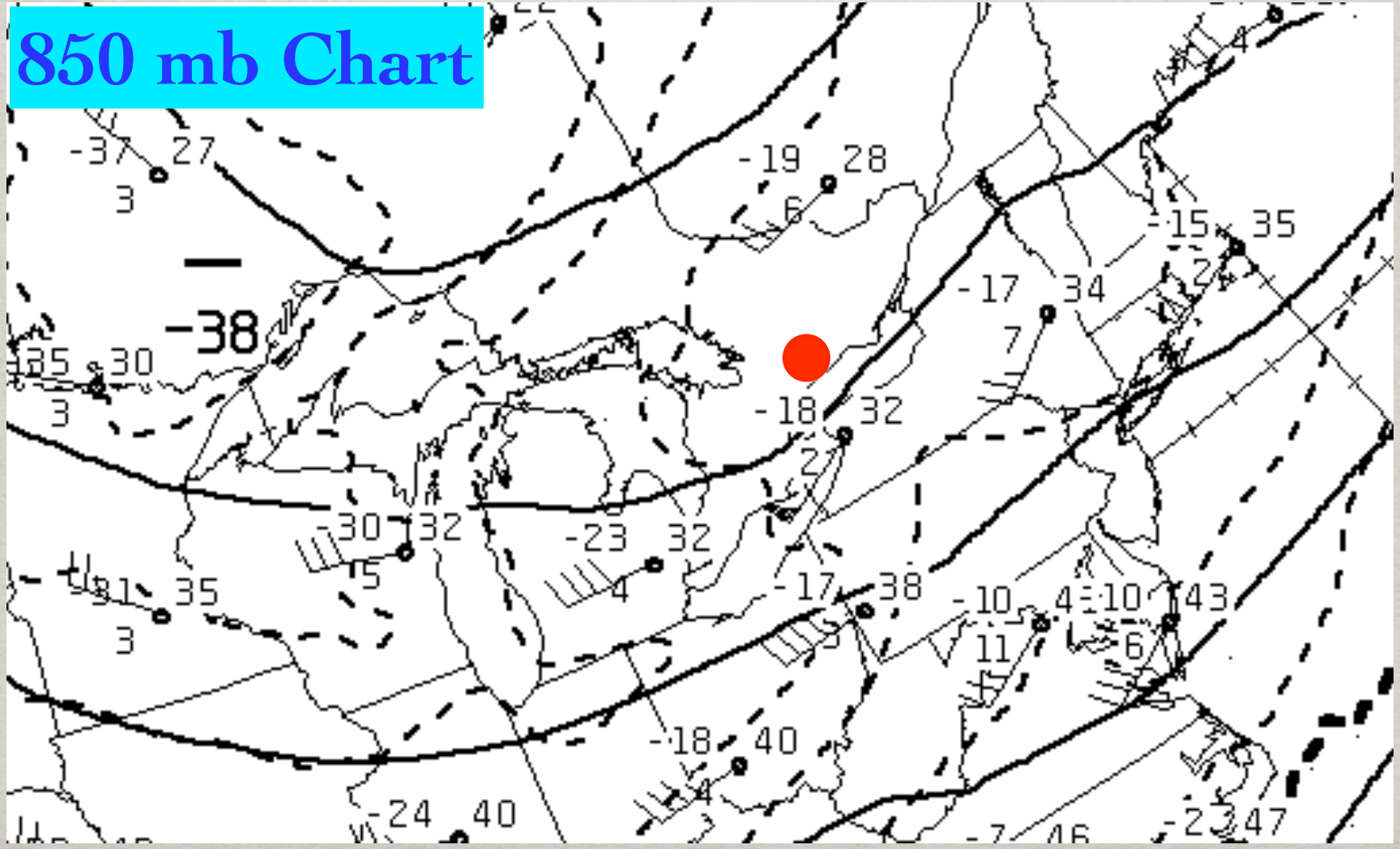


Lake Effect Snow Case Study

STN YYZ -	for use	3000	6000	9000
FDCN01 CWAO FCST BASED ON 04000 DATA VALID 040600	05-09	2844	2818-24	2616-31
FDCN02 CWAO FCST BASED ON 04000 DATA VALID 041200	09-18	2744	2822-25	2738-30
FDCN03 CWAO FCST BASED ON 04000 DATA VALID 050000	18-05	2739	3032-27	3023-35

Lake Effect Snow Case Study

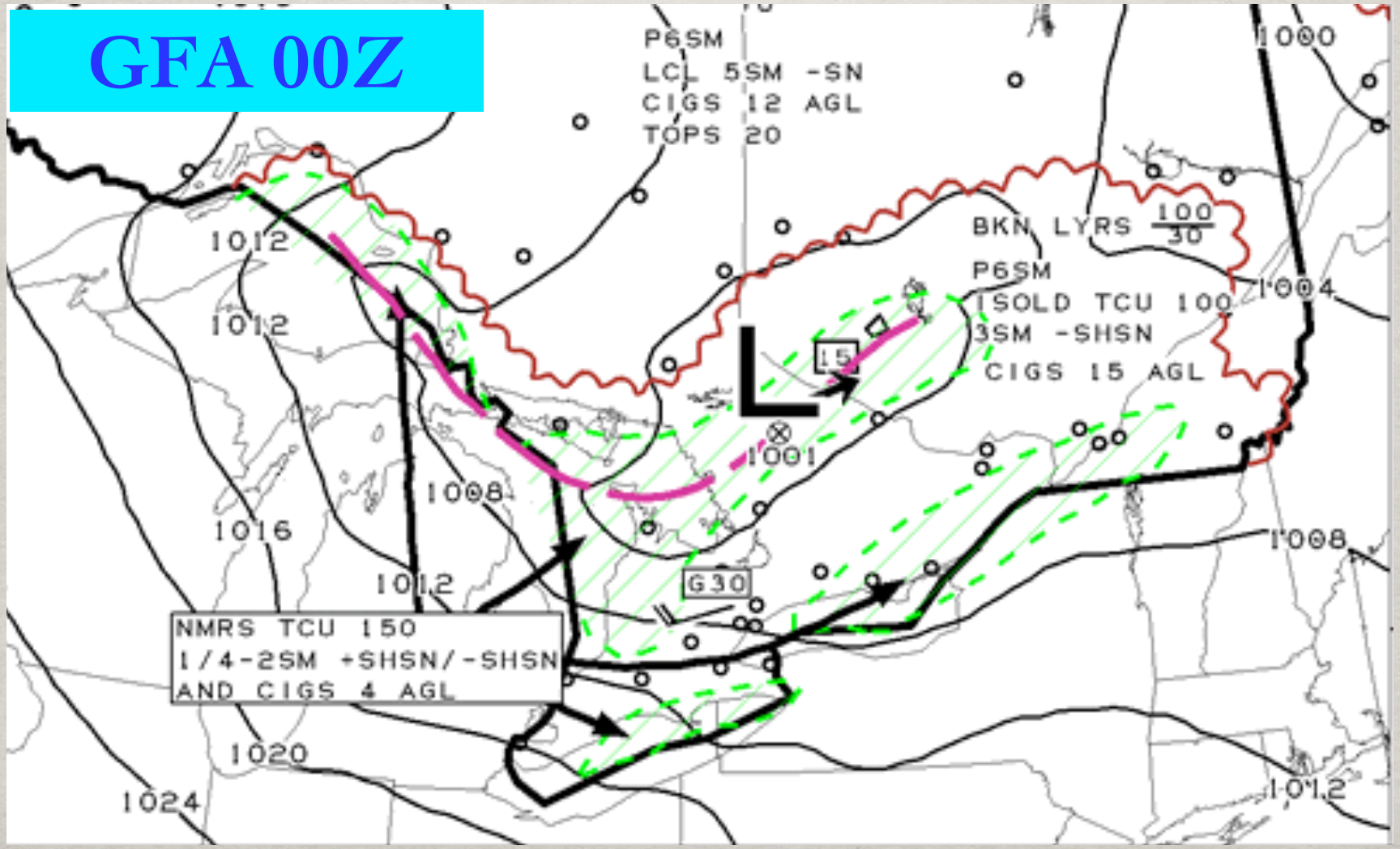
CYYZ 040300Z 26029G34KT 15SM DRSN FEW025 M12/M17 A2985 RMK SF1 SLP122

CYYZ 040200Z 26026G34KT 10SM DRSN FEW018 FEW027 M11/M15 A2983 RMK SF2SC1 SLP113

CYYZ 040100Z 24023G32KT 8SM -SHSN FEW040 BKN280 M11/M14 A2980 RMK SC1CS2 SLP105

CYYZ 040000Z 24023G31KT 15SM FEW050 BKN280 M10/M16 A2977 RMK SC1CI2 SLP096

Lake Effect Snow Case Study



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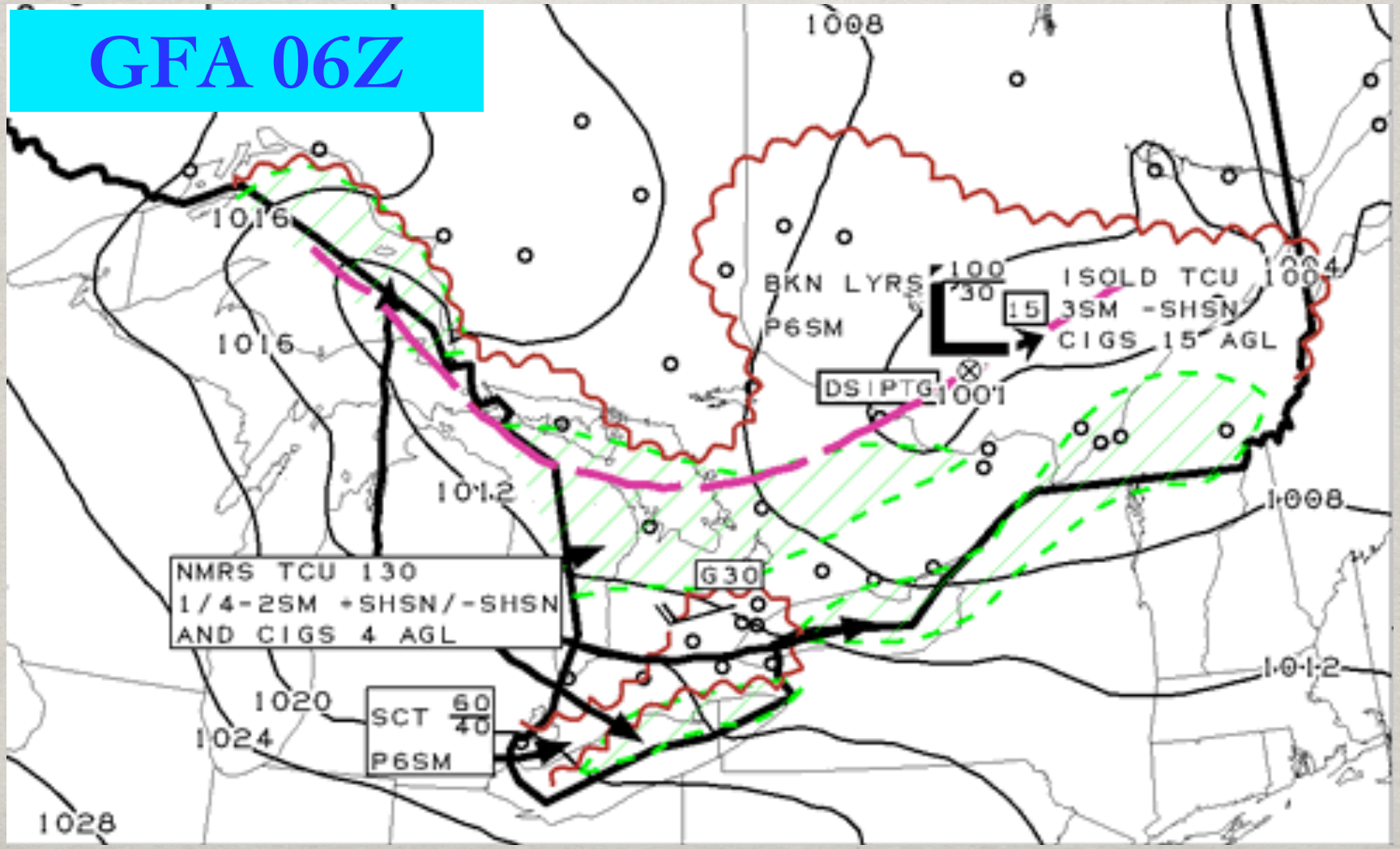

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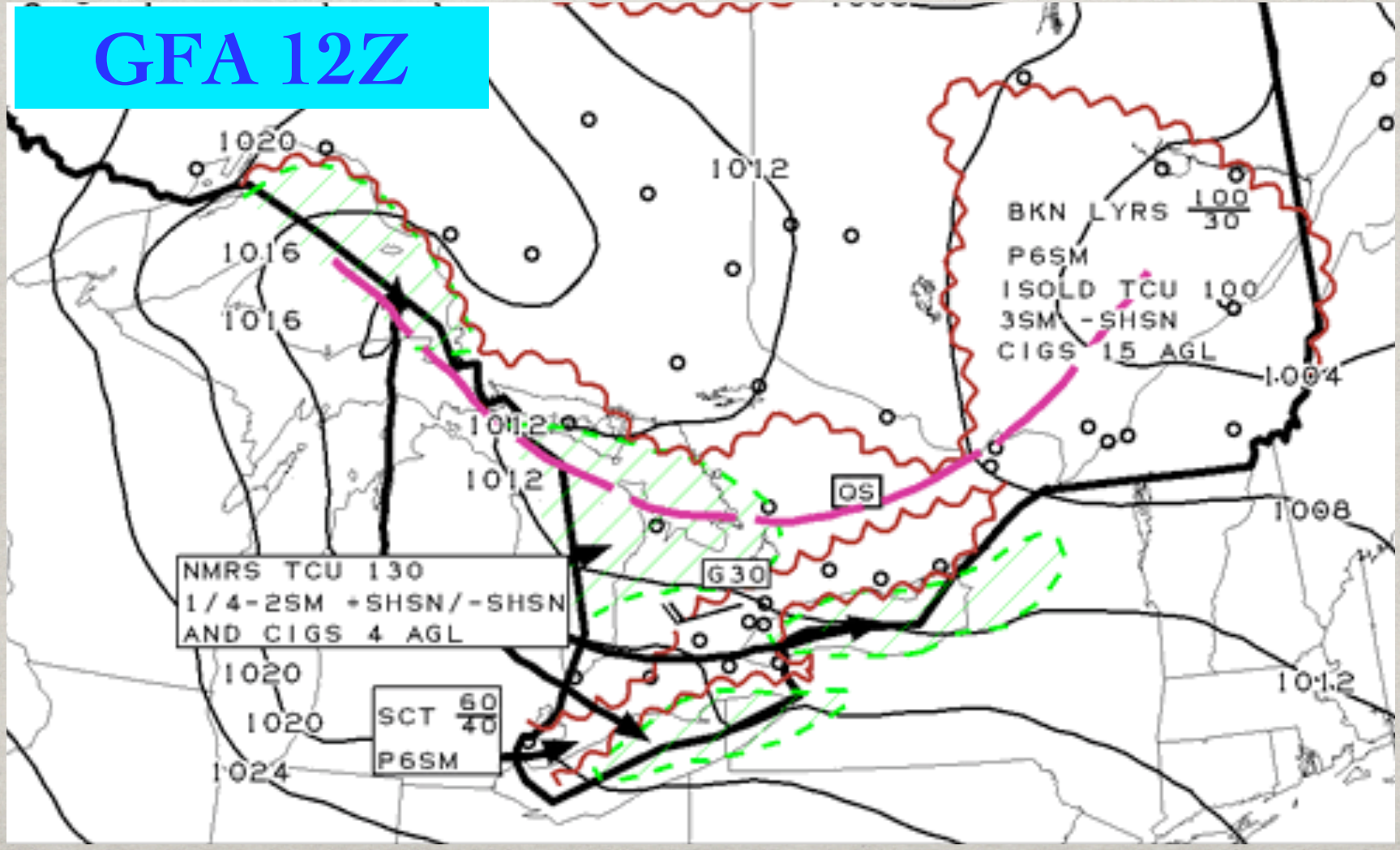

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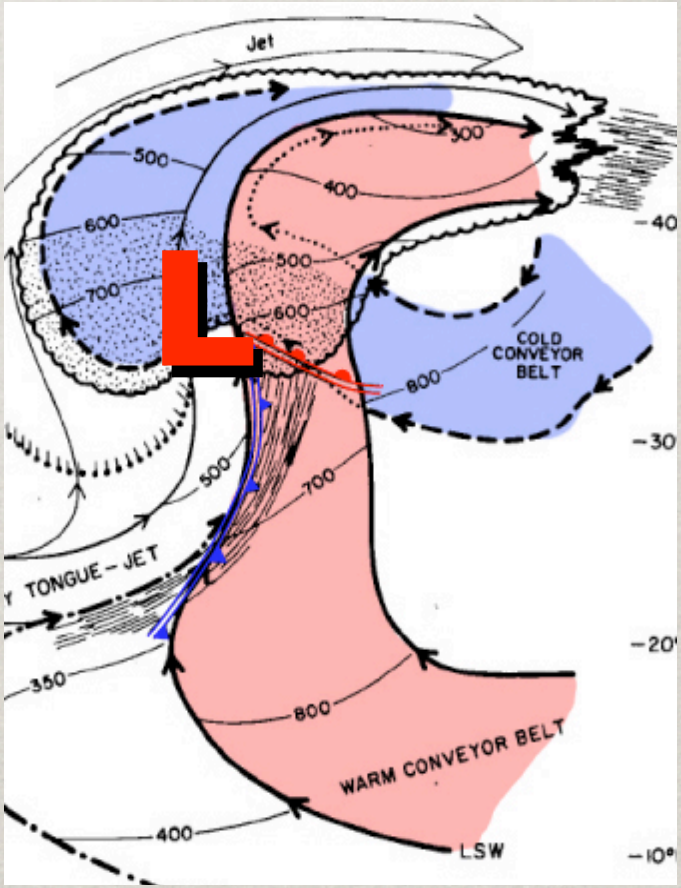
General Notes On Weather

Weather Notes
Model Of A Cyclone

- Airflow around a cyclone
  - Warm/Cold conveyor belts
- Warm conveyor belt advects higher T and Td
- Warm overriding cold - freezing rain
- Maximum precipitation and icing
  - NW quadrant



Weather Notes
Fronts

- How intense is the front?
  - Intensity of the wind shift
  - Strength of LLJ in advance of a cold front
  - Gustiness behind the front
  - Temperature gradient across front

Weather Notes
Fronts

- How intense is the weather along a front?
  - Note the dewpoints in the warm sector
  - LLJ and warm conveyor belt
  - Time of day
  - History

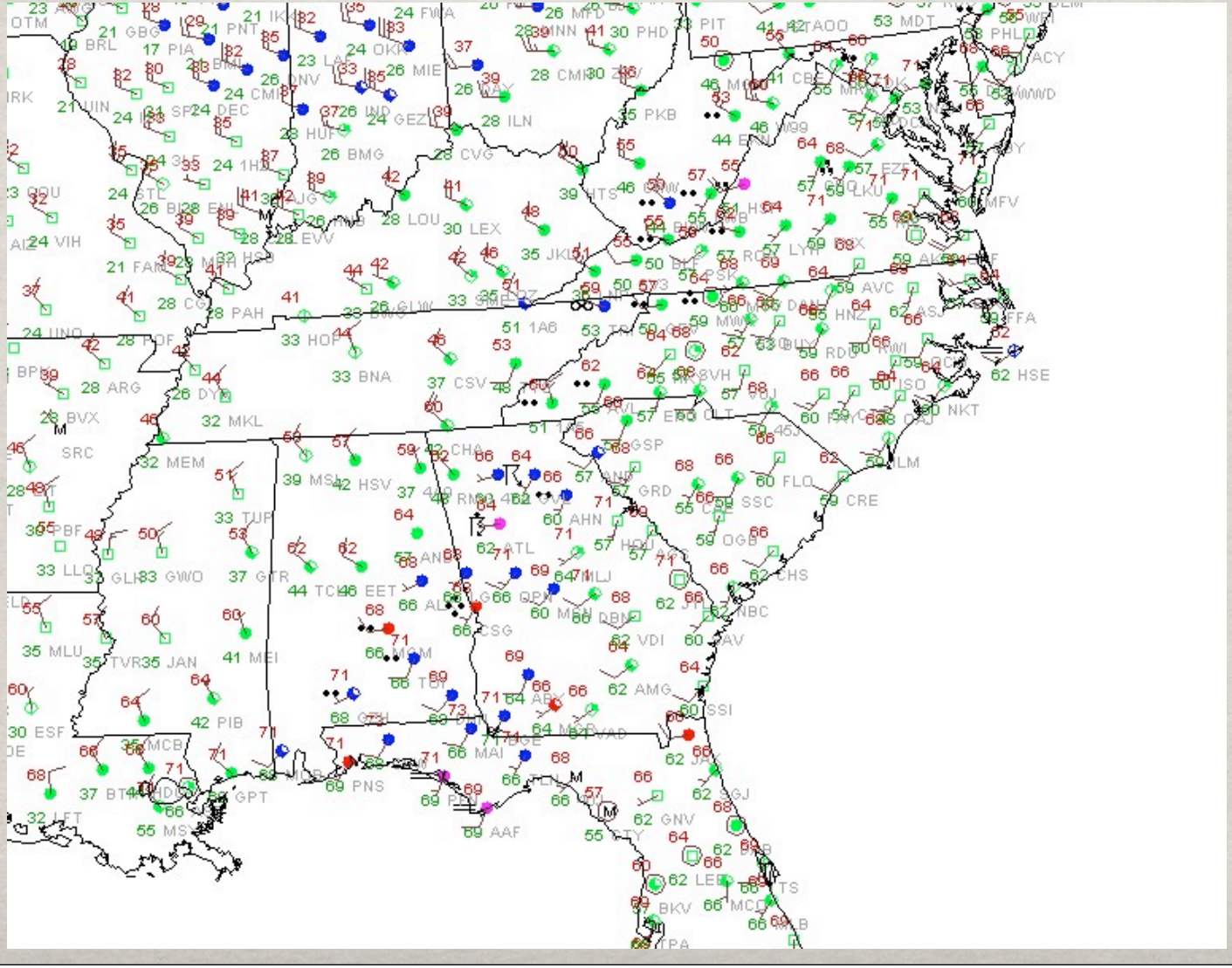
Weather Notes
Fronts

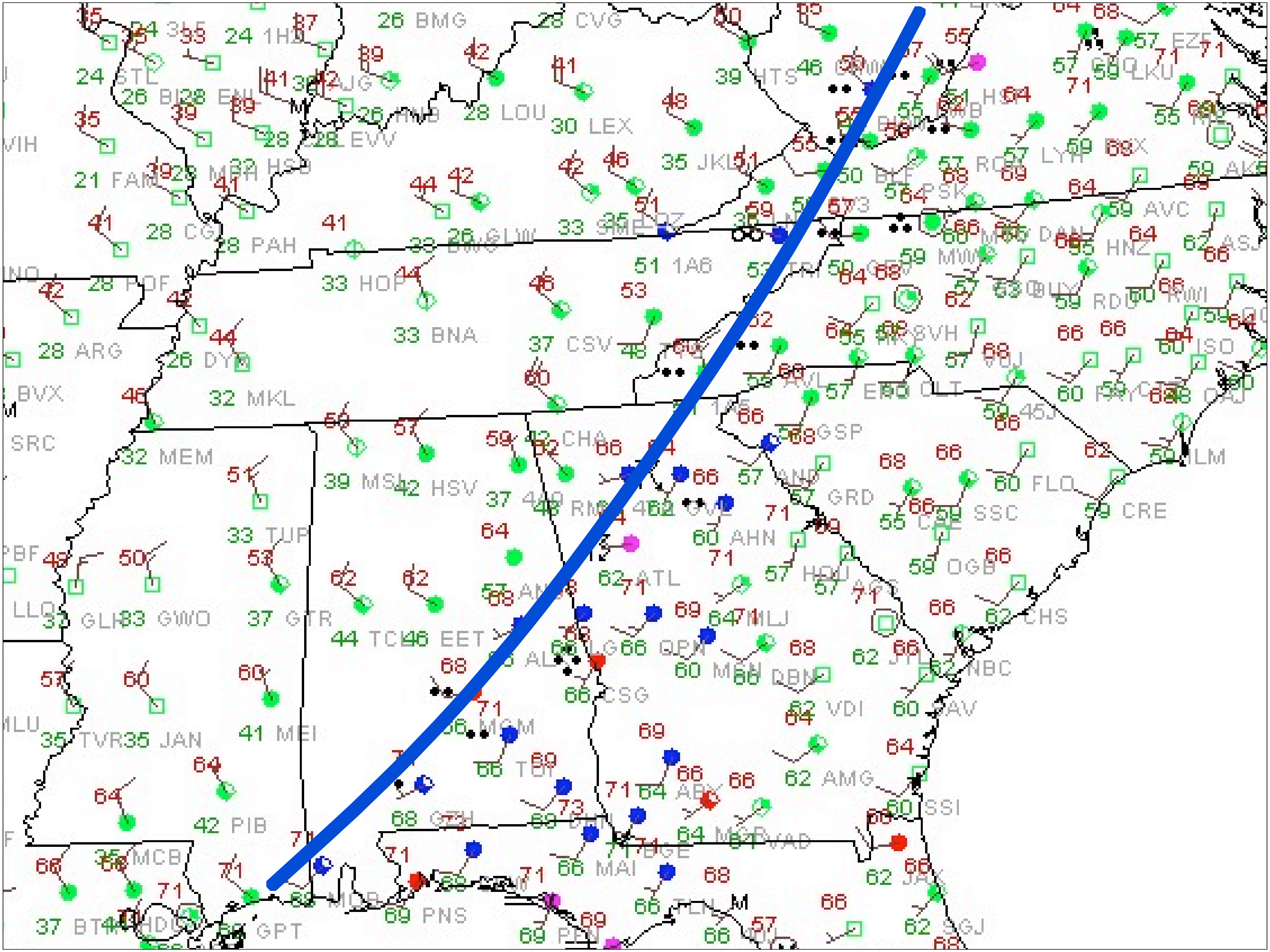
- Weather in the warm sector
  - Increased temperature/humidity
  - Decreased stability
  - Reduced visibility

Weather Notes
Fronts

- Weather behind a cold front
  - Gusty winds
  - Wind shift from SW to NW
  - Winter - clear immediately behind front BUT about 50 miles back is low stratocumulus ... ICING!!

Weather Notes
Finding The Front

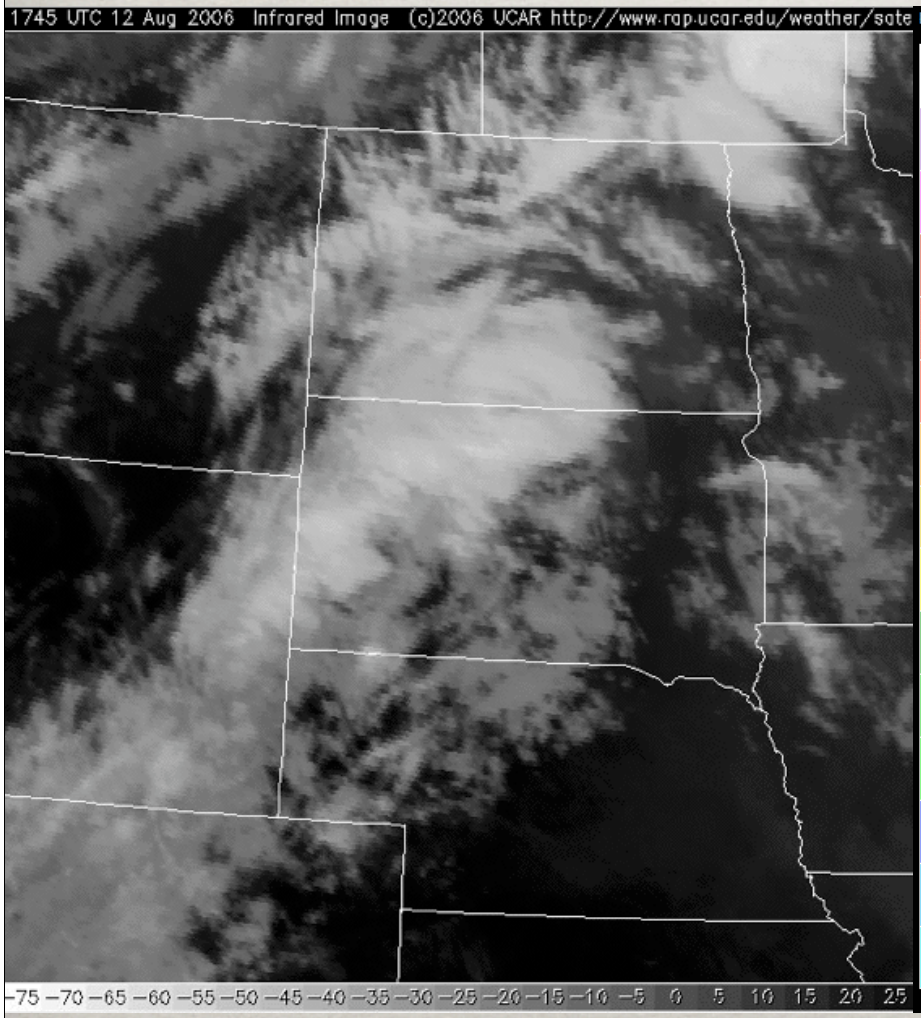


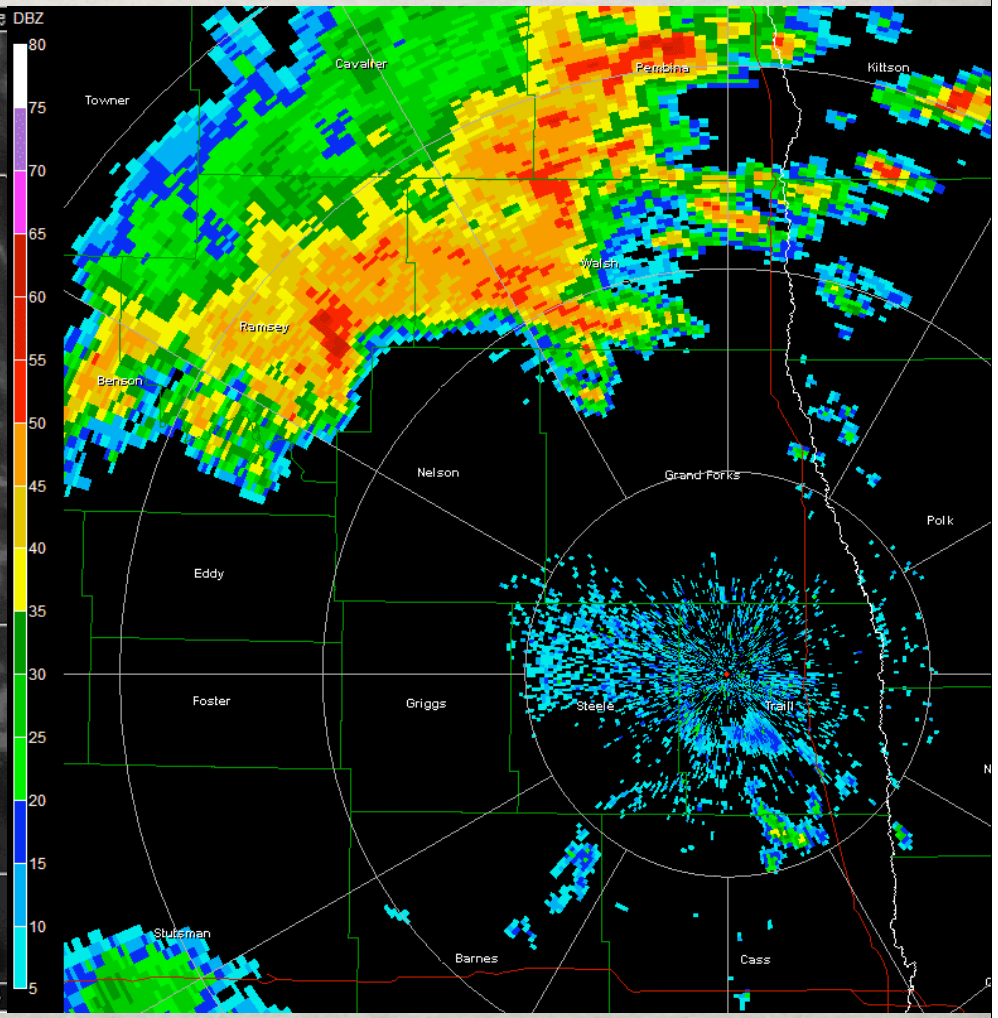

26 BMG
28 CVG
28 LOU
30 LEX
28 EVV
39 HTS
35 JKL
28 PAH
33 HOP
33 BNA
37 CSV
32 MKL
32 MEM
CHA
42 HSV
39 MSL
33 TUP
ATL
60 AHN
GSP
57 GRD
59 SSC
59 OGB
62 CHS
60 FLO
59 CRE
ILM
RDU
FAY
59 AVC
55 HNZ
DAN
LYH
62 AMG
60 SSI
62 JAX
62 SGJ
60 SAV
62 VDI
60 MEN
66 CSG
37 GTR
33 GWO
41 MEI
35 JAN
42 PIB
GPT
69 PNS
66 MAI
MGM
TOI
37 BTR
35 TVR
28 ARG
26 DYR
21 FAM
24 STL
28 CGI
33 GLH
SRC
BVX

Weather Notes
Thunderstorms

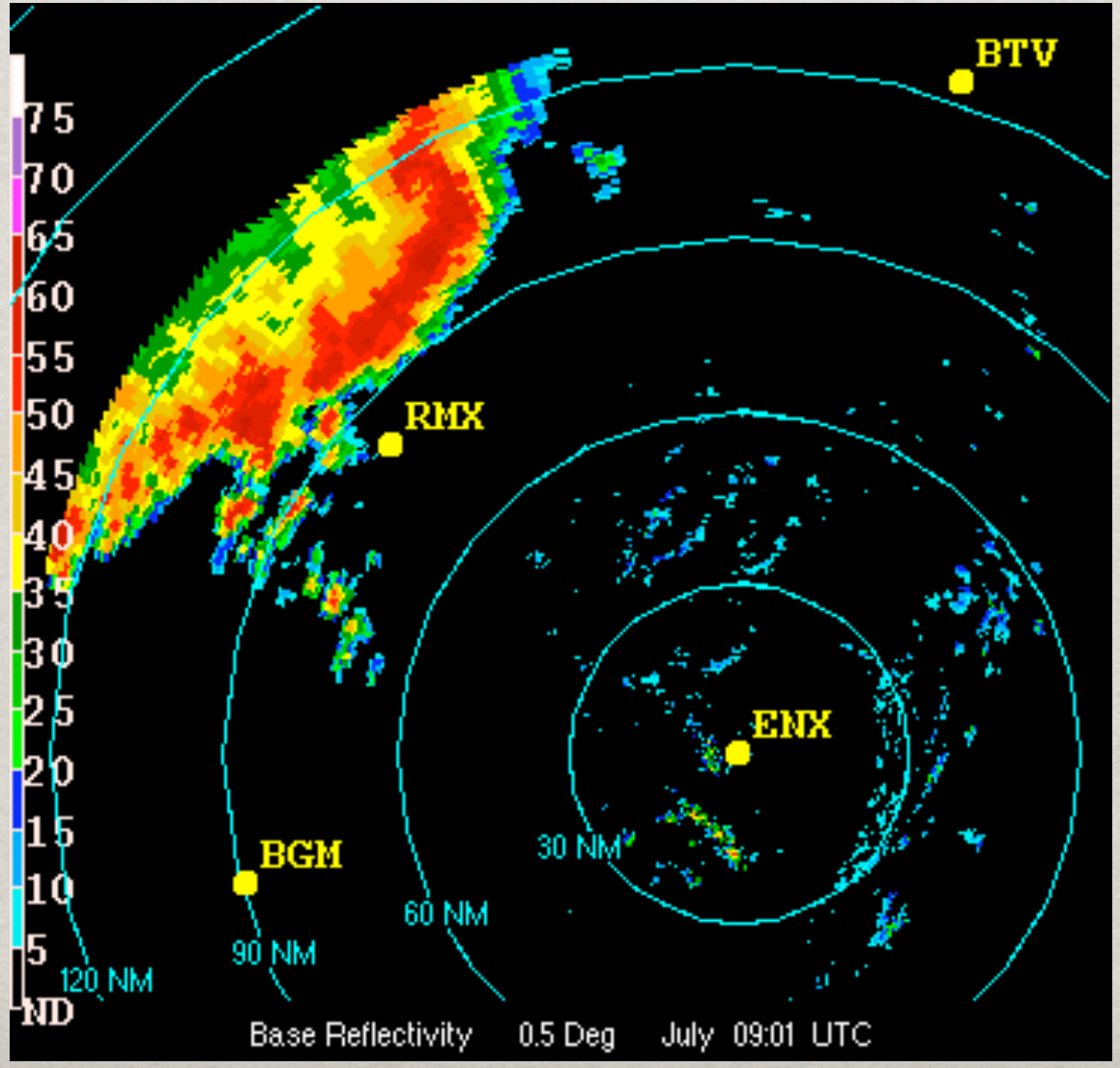
- Signposts In The Sky:
  - In the warm sector
  - High humidity
  - High temperatures
  - Morning instability
  - Altocumulus Castelanus

WEATHER NOTES
THUNDERSTORMS





WEATHER NOTES THUNDERSTORMS



Weather Notes
Thunderstorms

- Warm Fronts
  - CB bases tend to be higher
  - Tend to be less intense (not always though!)
  - More widespread
- Cold Fronts
  - More vigorous
  - More concentrated

Weather Notes
Thunderstorms

- Avoiding Thunderstorms In Flight
  - Temperature above freezing - 5 miles
  - Temperature below freezing - 10 miles
  - Altitudes above FL250 - 20 miles
- Downwind (under anvil) - possible hail
- Upwind - New cell development
- Generally - Fly upwind a distance of 1 mile / knot of wind at altitude

Weather Notes
Electrical Discharge

- Charge accumulation due to:
  - Flying through electric fields
  - Flying through precipitation - drizzle/snow
- Evidence of charge:
  - Radio static
  - St. Elmo's fire (corona discharge)

Weather Notes
Electrical Discharge

- Discharge:
  - Airplane flies through a region of strong opposite polarity
  - Produces a loud bang and bright flash
  - Usually leaves a few holes in the airplane near the wing-tip, tail come, radome

Weather Notes
Electrical Discharge

- Avoidance
  - Good luck!
  - Turn on prop alcohol
  - Key the microphone every few minutes
  - Avoid flight near +/- 4 °C
  - Avoid flight near -10 °C around storms