# LAKE CHAMPLAIN 2009 HALLOWEEN GALE

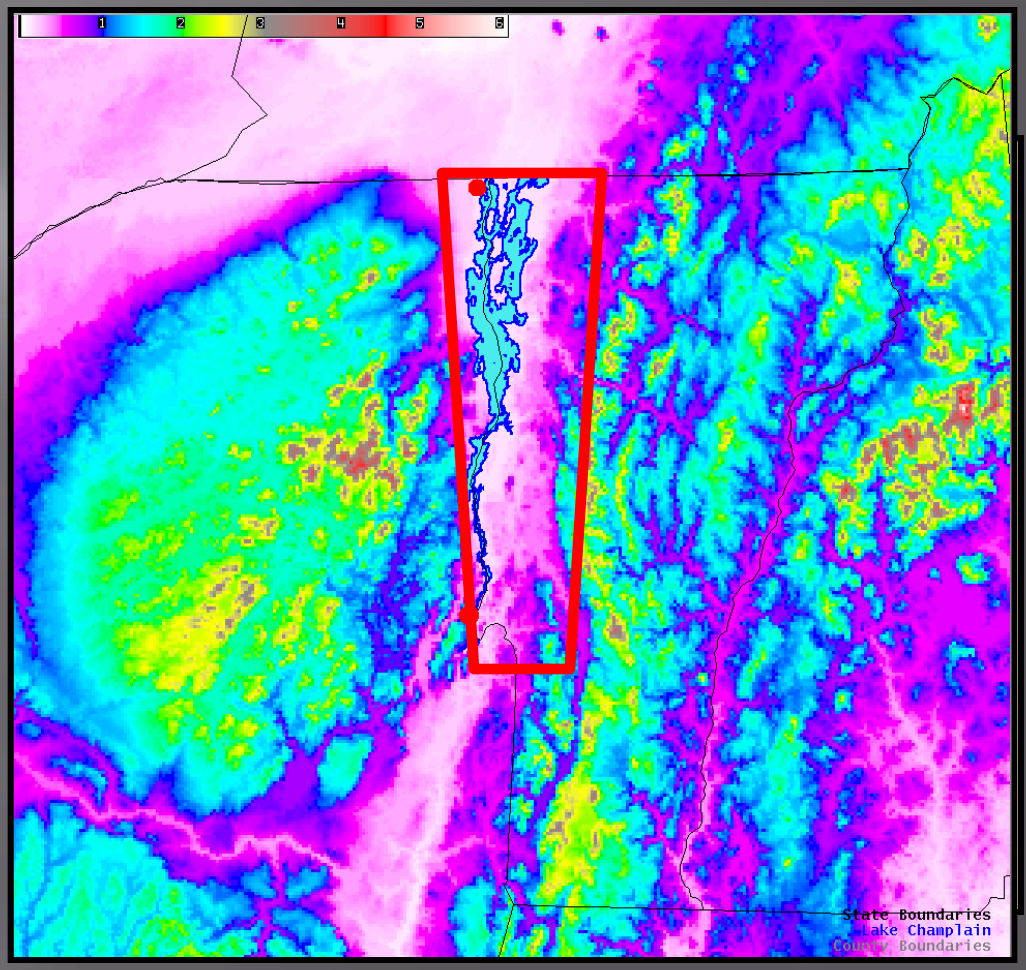
John Goff
NOAA/NWS Burlington, VT

# OVERVIEW

- Strong pre-frontal southerly wind channeling event in the Champlain Valley on 31 October 2009.
- Gale force winds on Lake Champlain for over 9 hours, and force 9 or strong gale for ~ 4 hours.
- Scattered wind damage throughout the North Country.

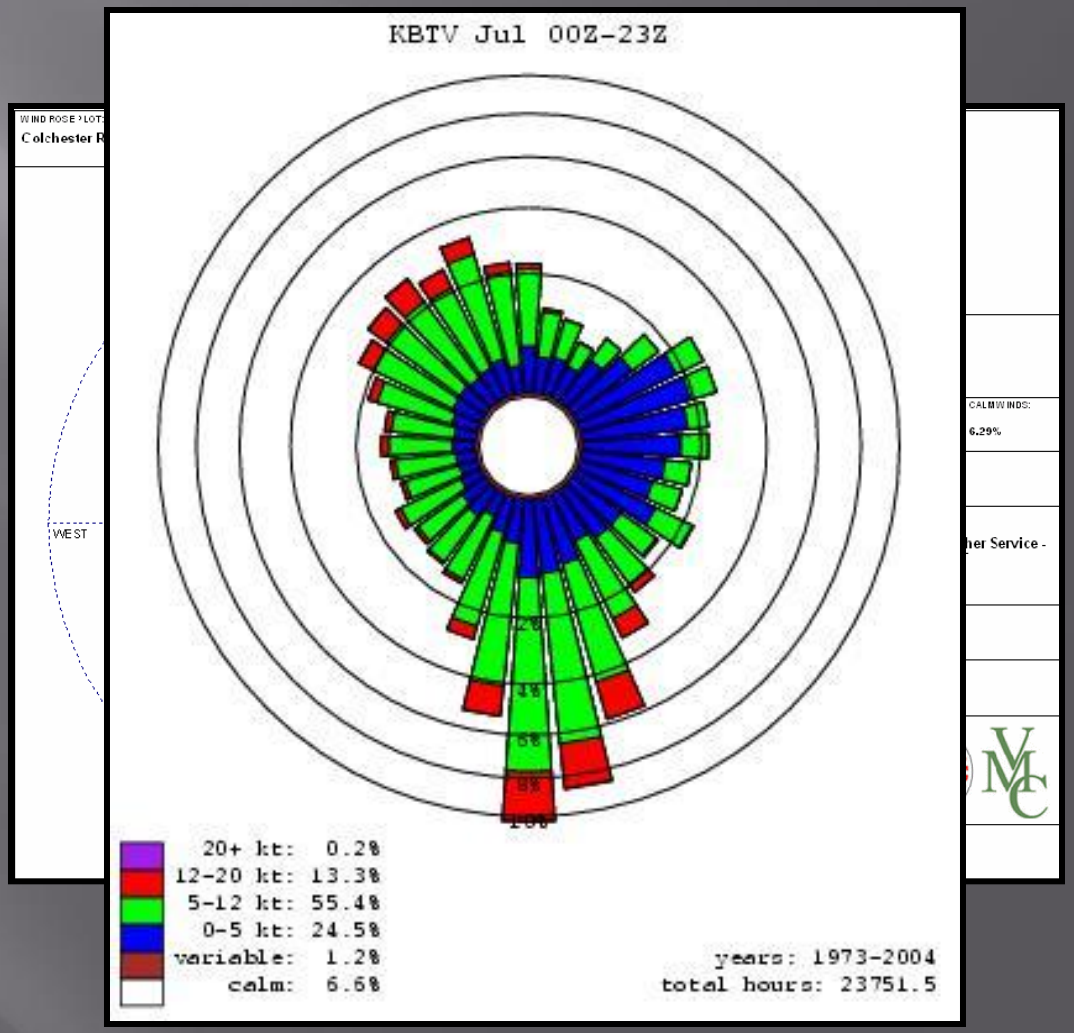
# CHAMPLAIN VALLEY FORCED CHANNELING

- Review of concepts
  - Valley oriented N-S
  - Constricted by mtns east & west
- Promotes forced channeling of winds under geostrophic southerly or northerly flow.



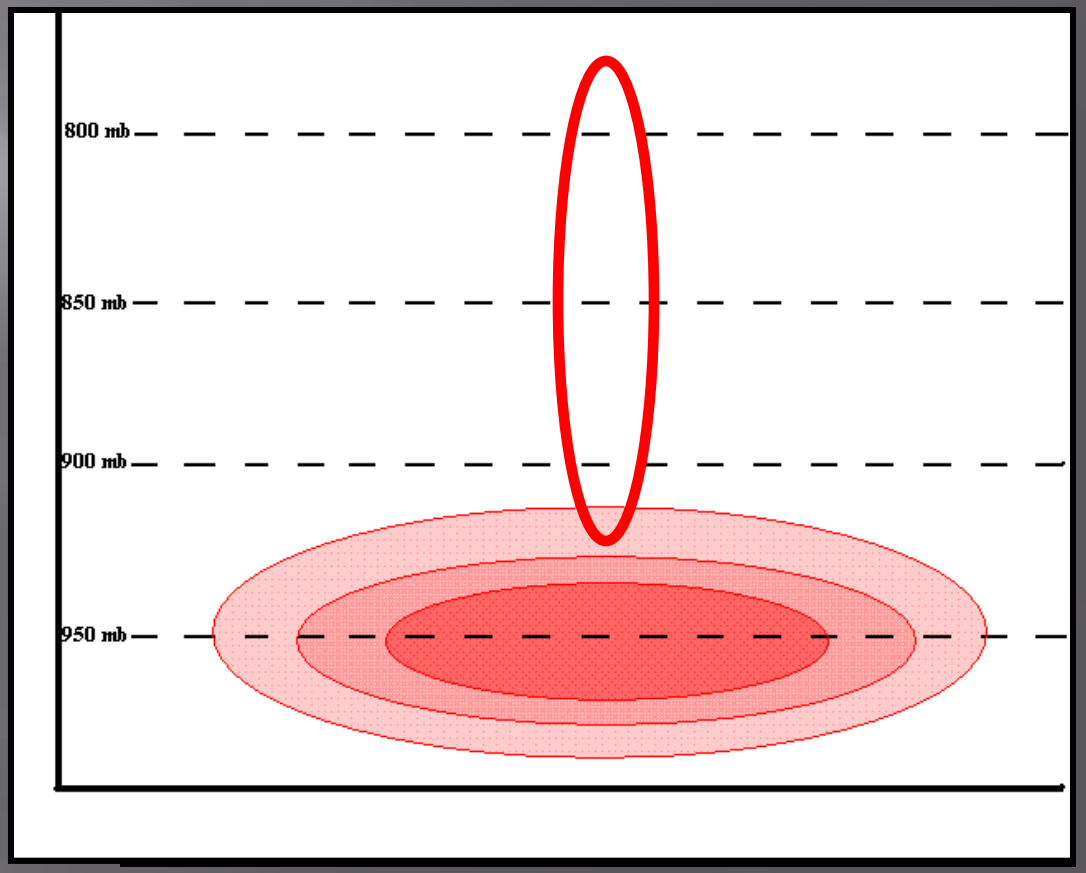
# CHAMPLAIN VALLEY FORCED CHANNELING

- Topography and forced channeling create a strong N-S bi-modal signature in the valley's climatological wind regime.



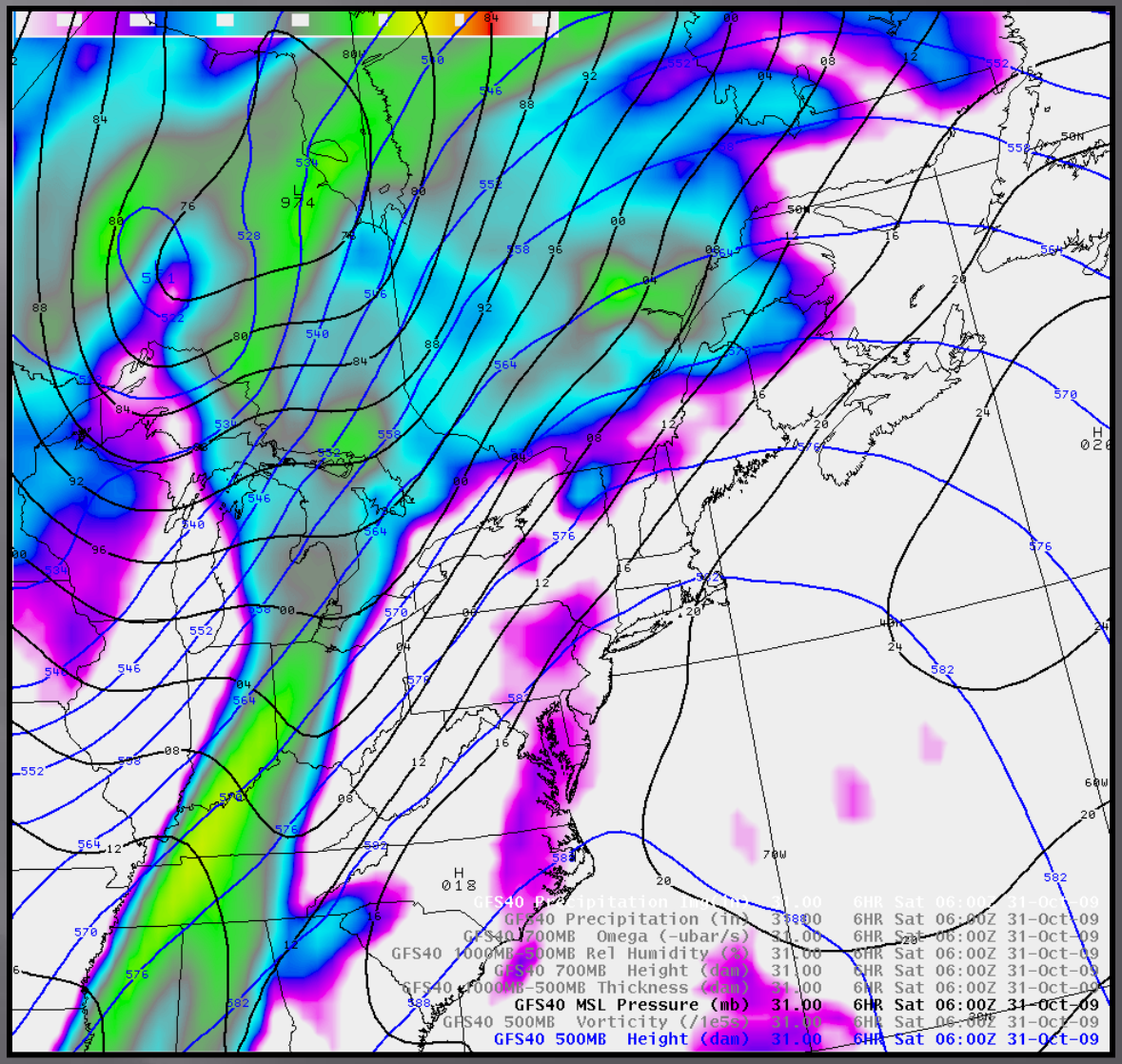
# LOW LEVEL JET FORMATION

- Channeling the strongest below 900 mb (~ below 3 kft)
- Displaced east due to topography of valley
- Often supergeostrophic and typically strongest at night



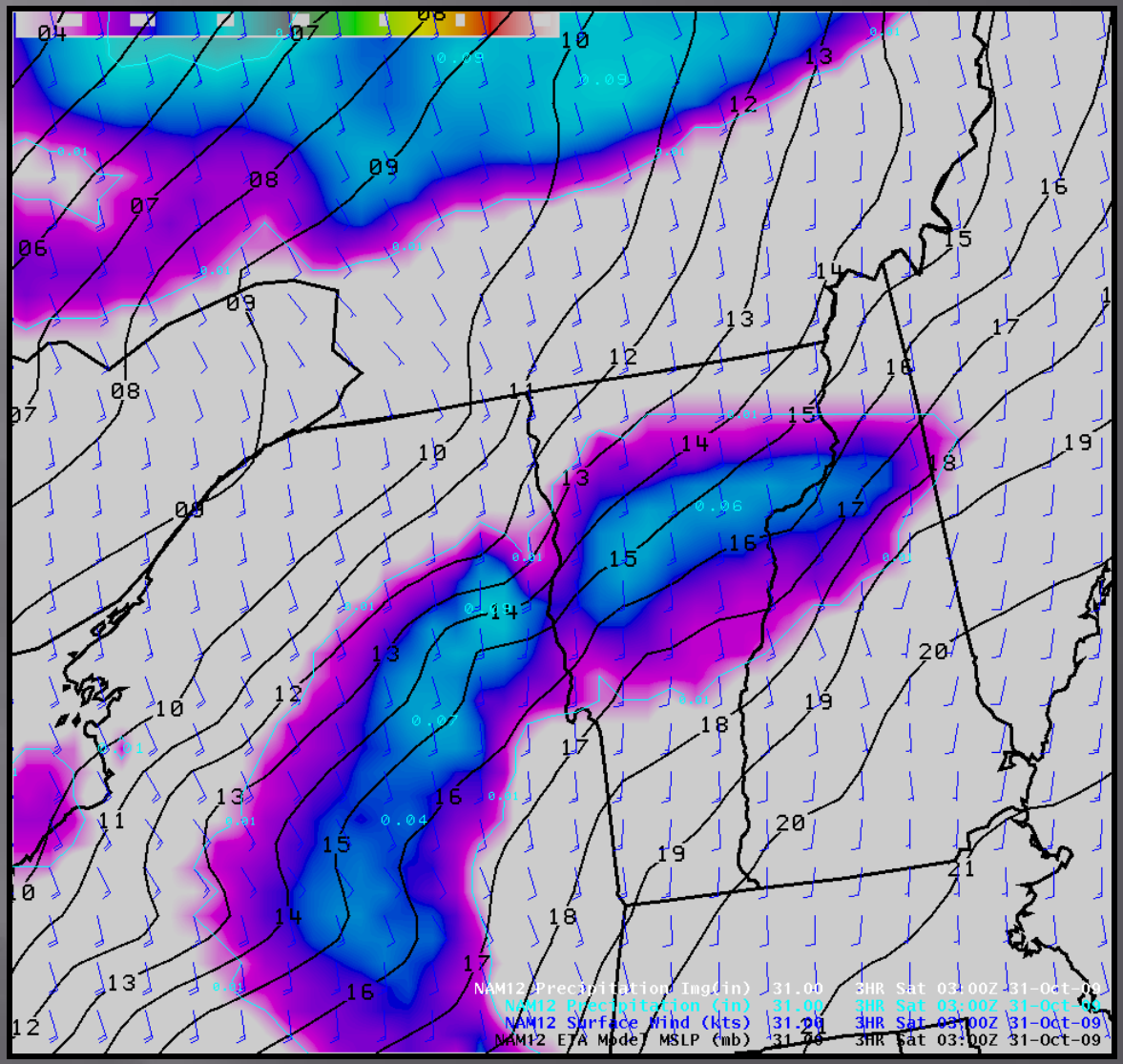
# SYNOPTIC OVERVIEW

- 00Z 31 October 2009 GFS40 MSLP, 500 hPa heights, pcpn



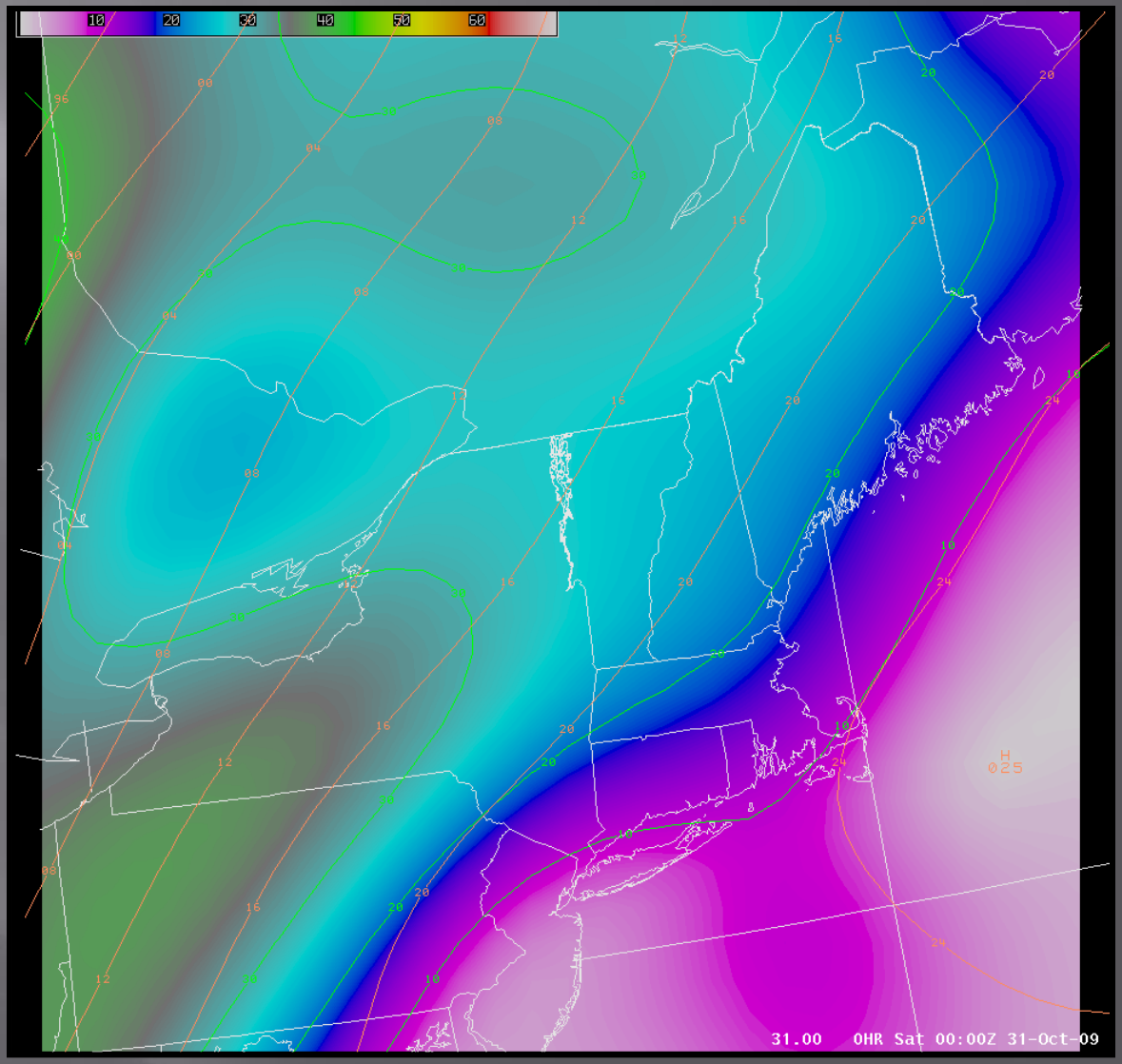
# SYNOPTIC OVERVIEW

- 00z 31 October 2009 NAM12 MSLP, surface winds



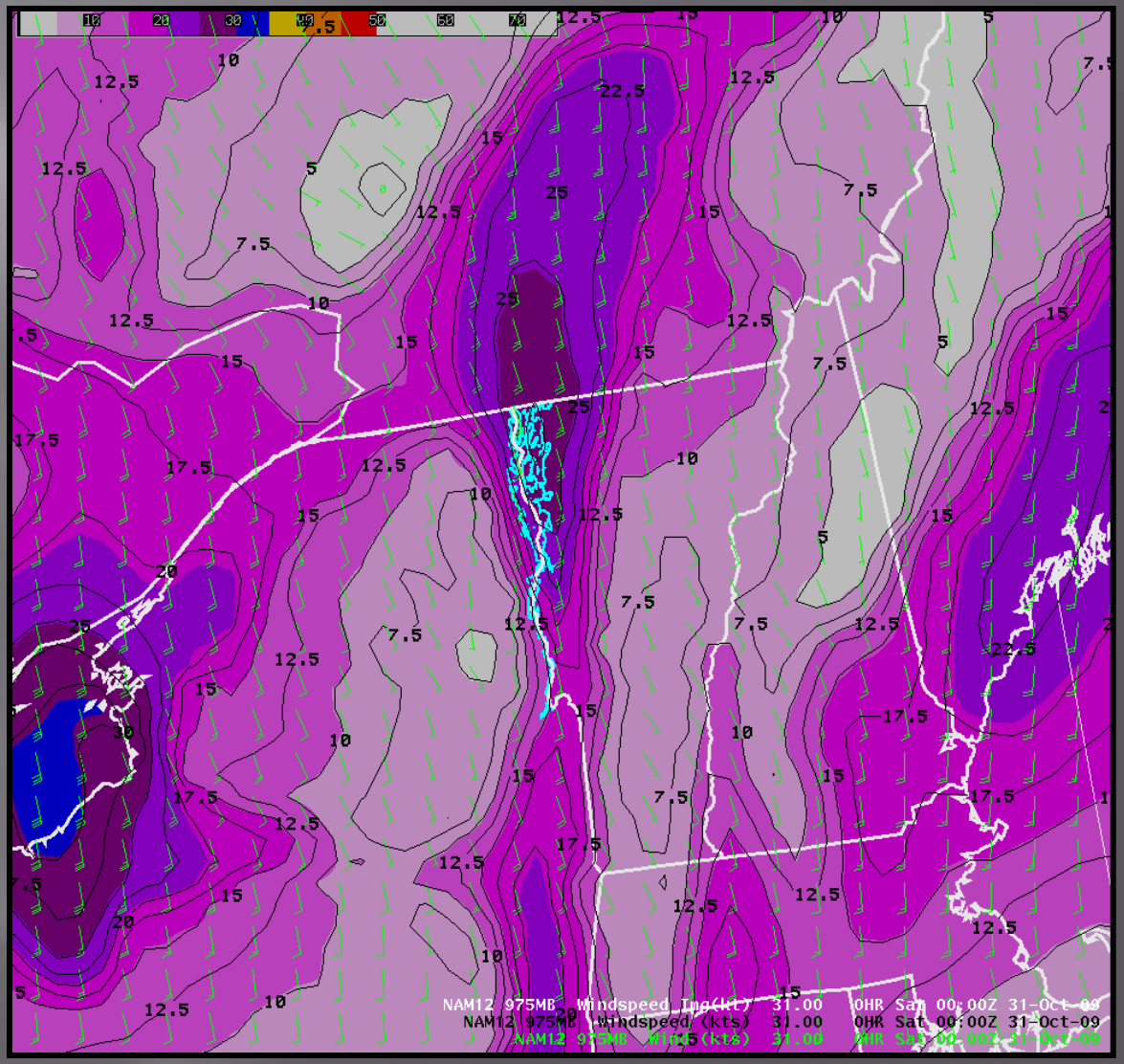
# SYNOPTIC OVERVIEW

- 00Z 31 October 2009 GFS40 Pressure Gradient Magnitude



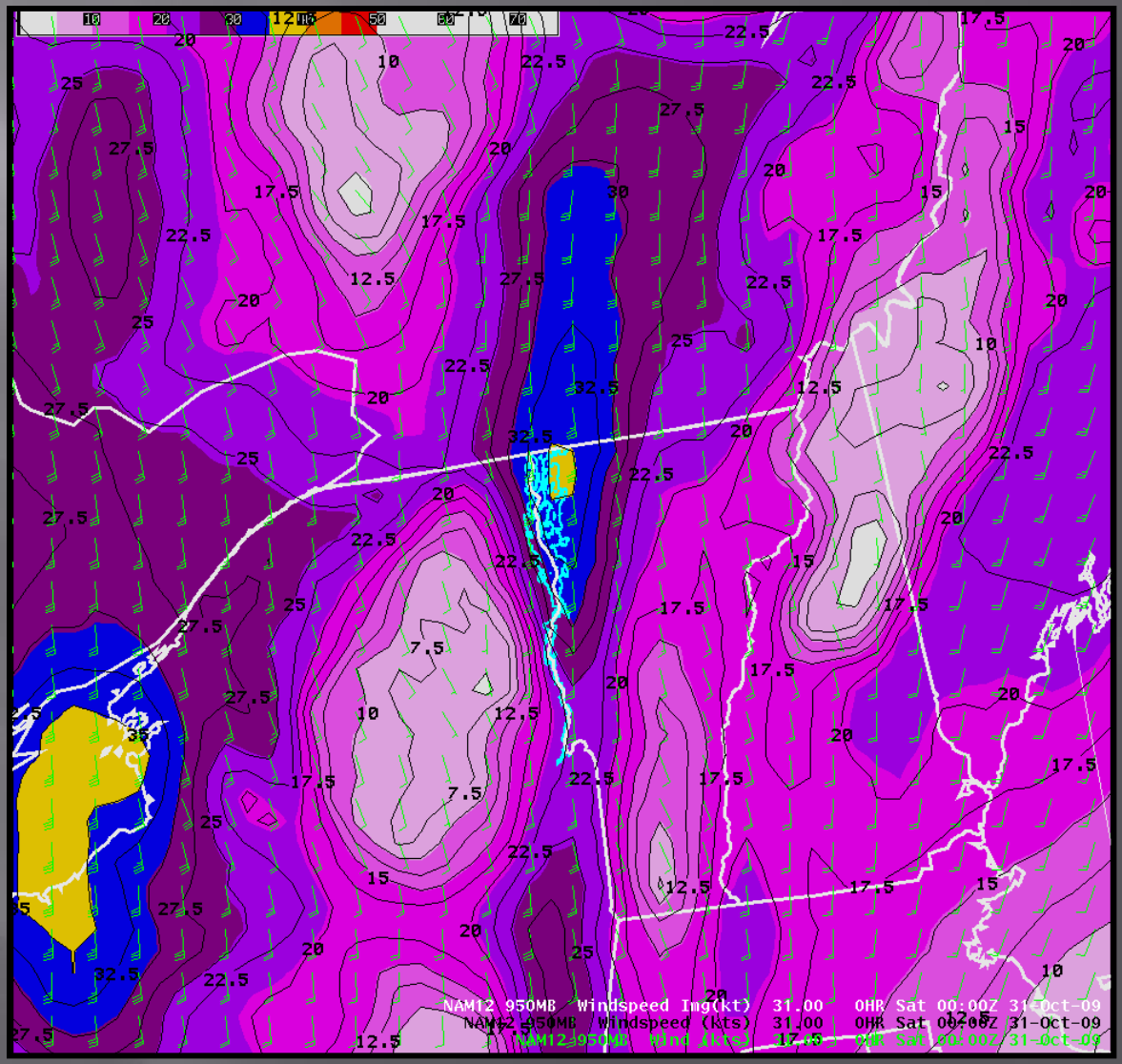
# MODEL PREDICTIONS

- NAM12 975 hPa isotach plots
- Peak at 35 to 40 knots from 6 to 12Z 31 Oct 2009

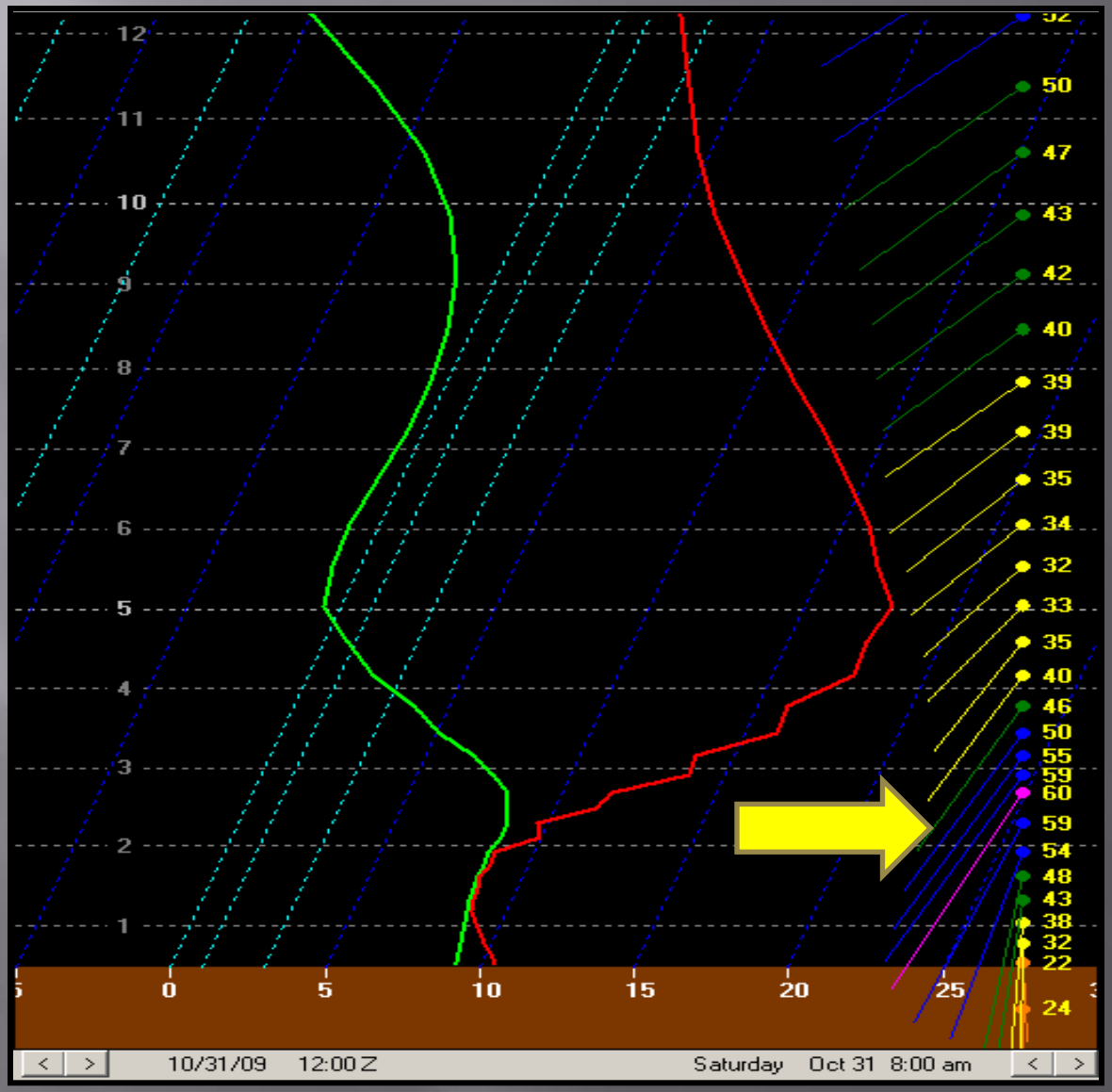


# MODEL PREDICTIONS 2

- NAM12 950 hPa isotach plots
- Peak at 43 to 48 knots from 06 to 12Z 31 Oct 2009



# SOUNDING ANALYSIS



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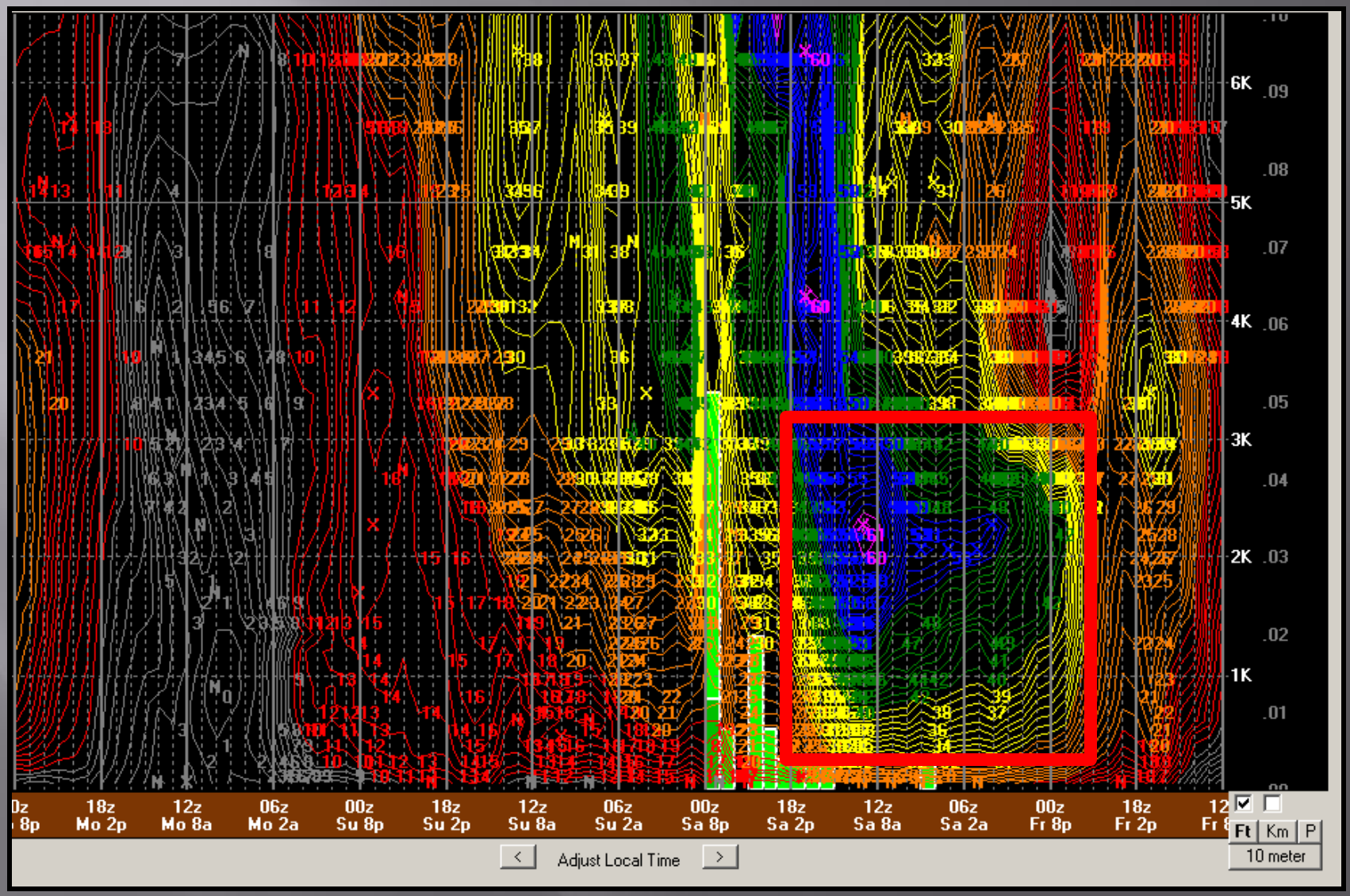
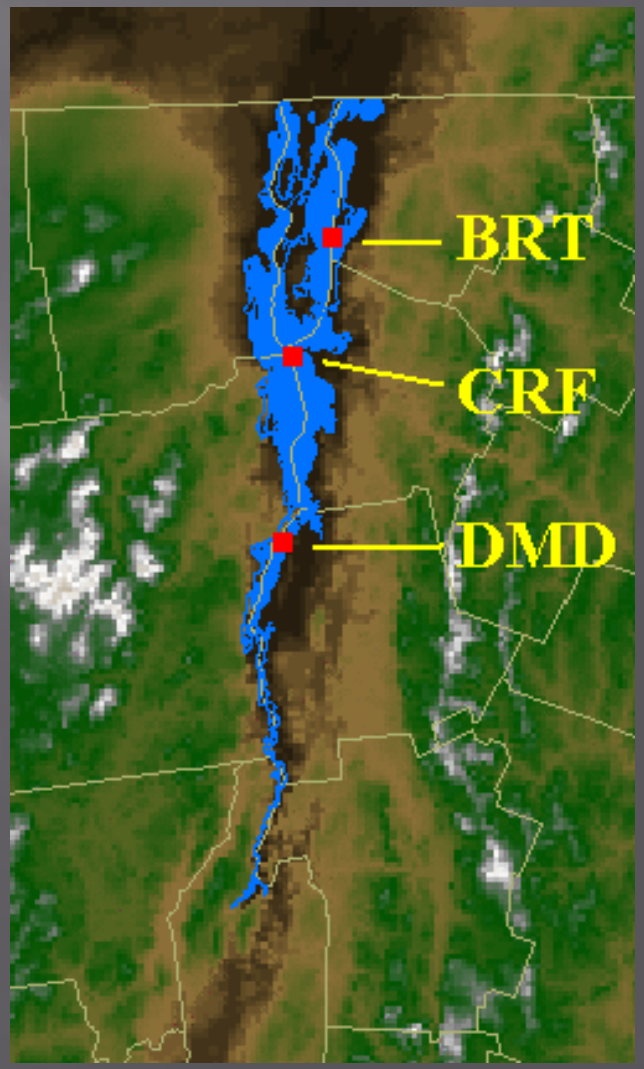
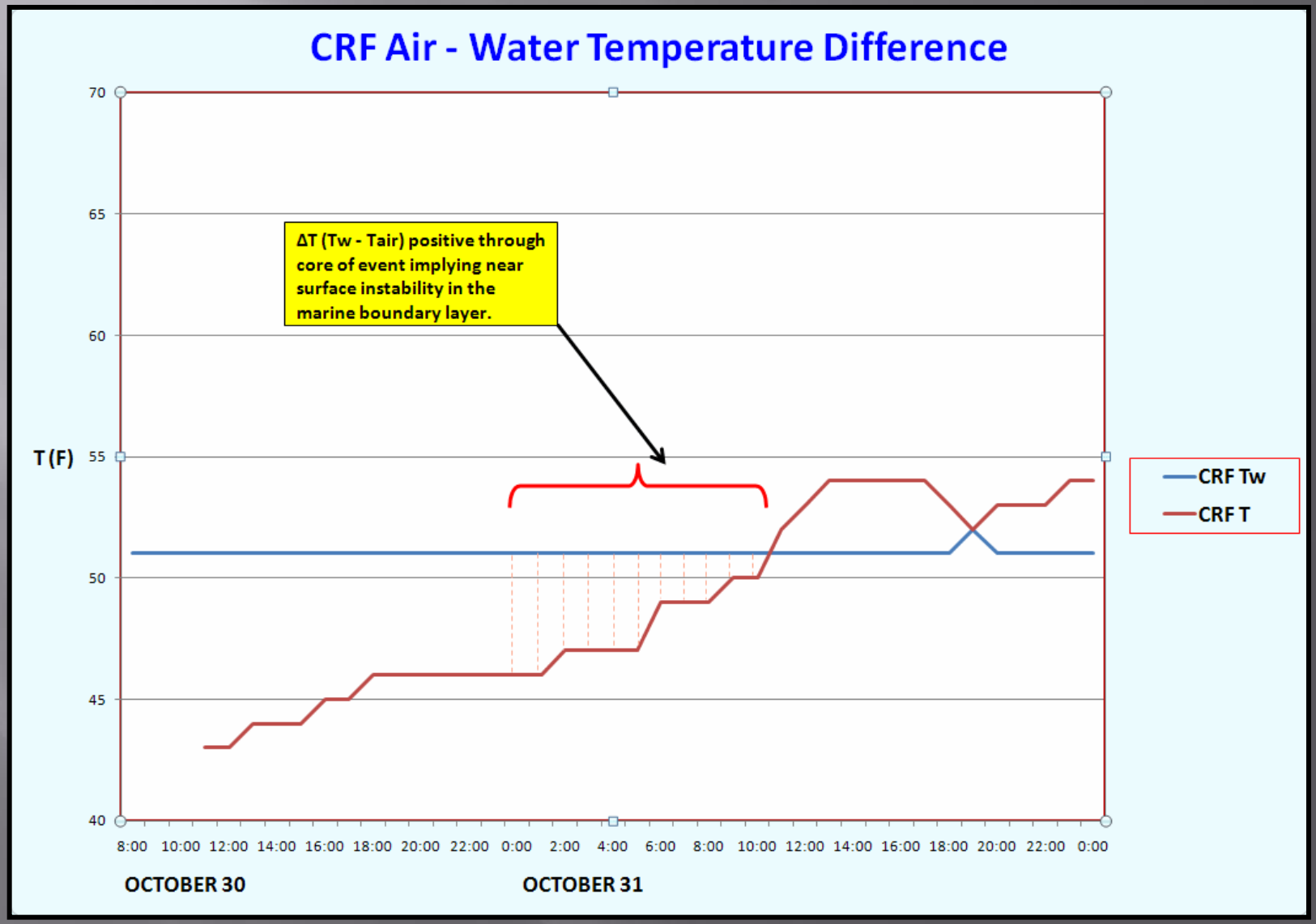


# MARINE OBSERVATION PLATFORMS

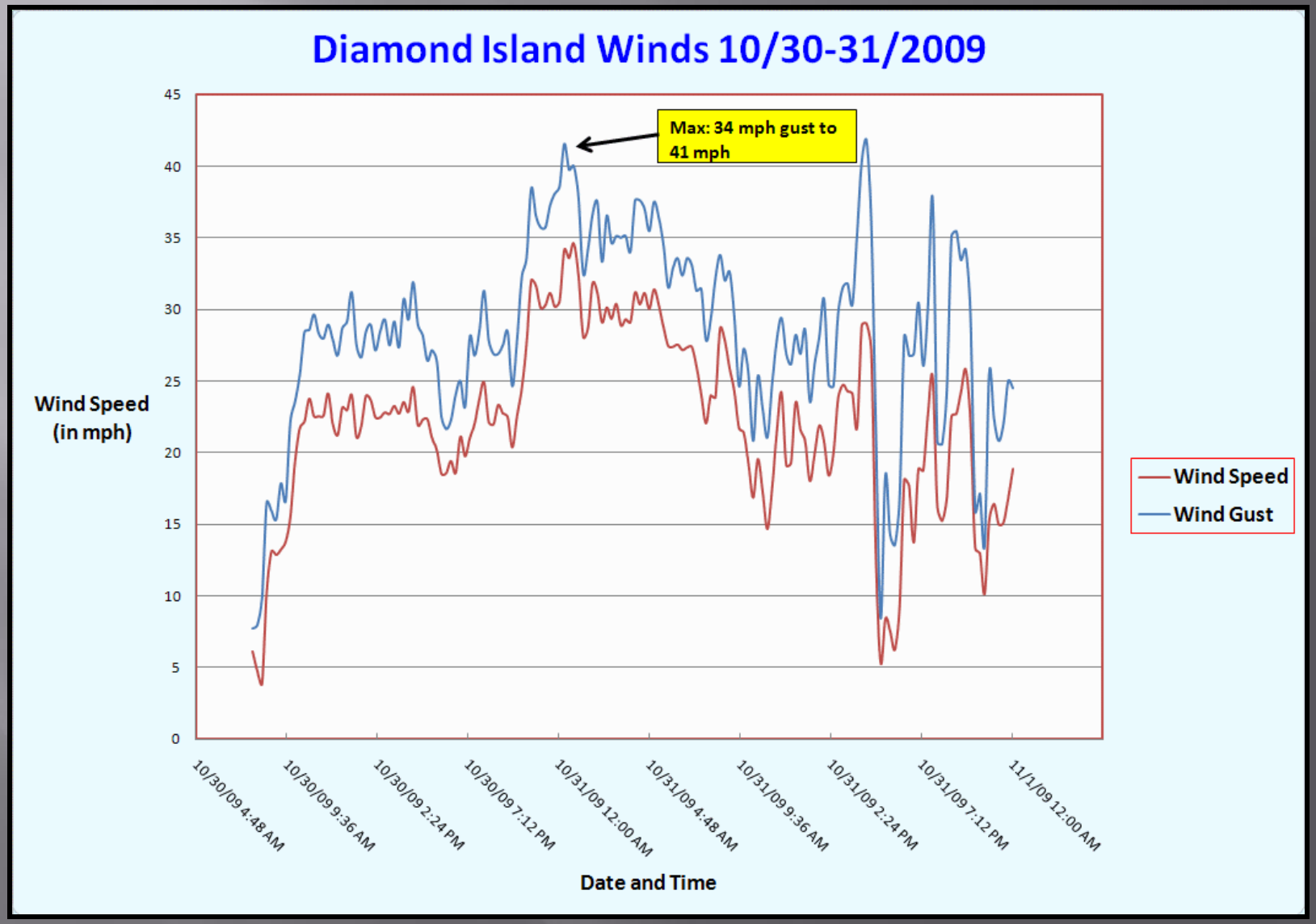
- Owned/operated by UVM/Vermont Monitoring Cooperative via NOAA Grant
- Colchester Reef (CRF)
- Diamond Island (DMD)
- Burton Island (BRT)



# ΔT Analysis


CRF Air - Water Temperature Difference
ΔT (Tw - Tair) positive through core of event implying near surface instability in the marine boundary layer.
T (F)
70
65
60
55
50
45
40
8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
OCTOBER 30
OCTOBER 31
CRF Tw
CRF T

# THE OBSERVATIONS



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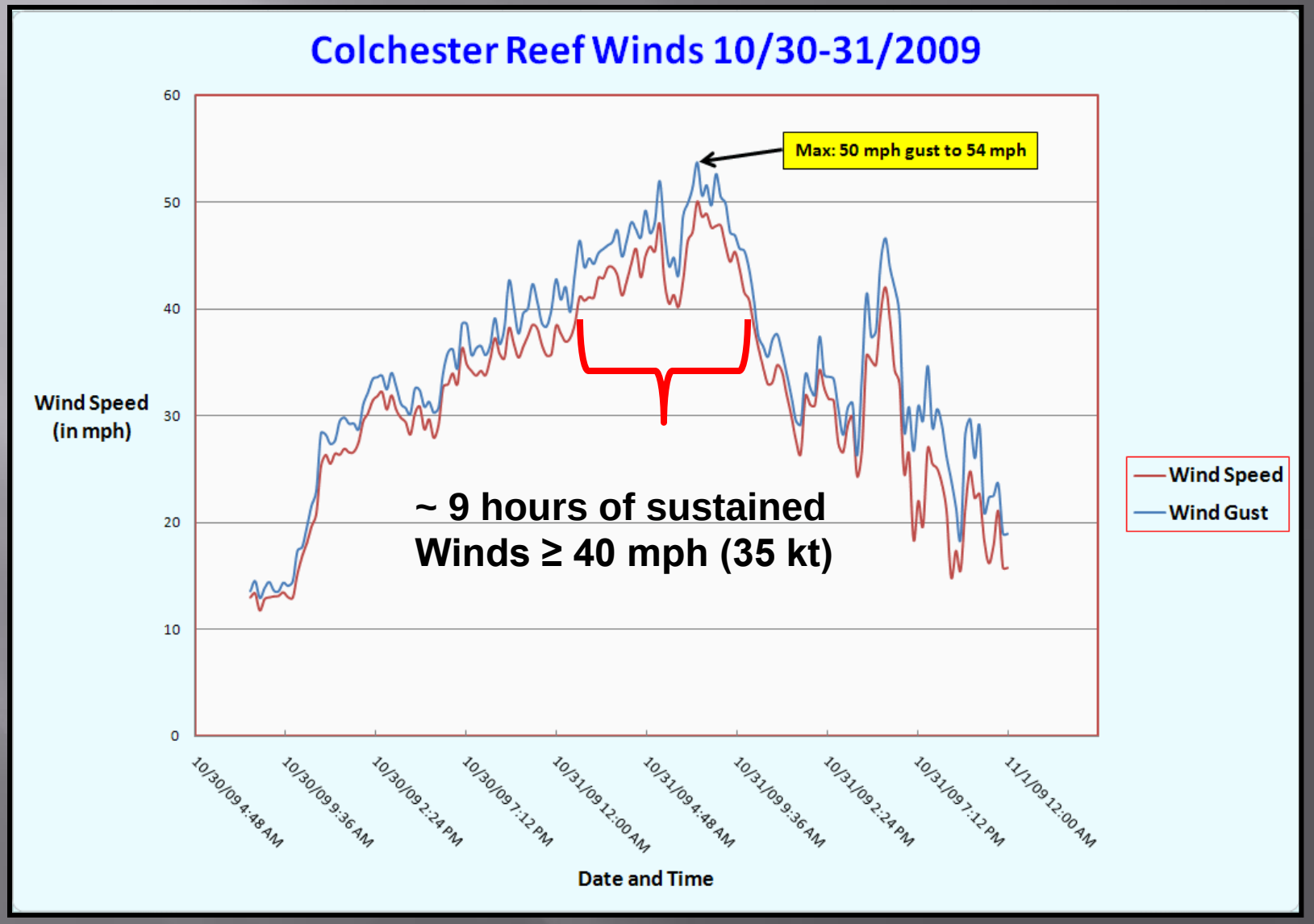

# EMPIRICAL AND OBSERVED WAVE HEIGHTS

- No automated wave measurements on the lake.
- An occasional observation from Lake Champlain ferries or UVM research vessels.
- Forecasts use empirical or model-derived values
  * ACE deep water curves
  * Grady local study (1993)
  * Lahiff local study (2004)
  * GLERL wave model (1km BTV WRF used as initial conditions).

# EMPIRICAL AND OBSERVED WAVE HEIGHTS

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SXUS41 KBTV 302349
RECBTV
NYZ028>031-034-035-VTZ001>012-016>019-311415-

RECREATIONAL FORECAST
NATIONAL WEATHER SERVICE BURLINGTON VT
749 PM EDT FRI OCT 30 2009

.THE LAKE CHAMPLAIN OPEN WATERS FORECAST...

.A LAKE WIND ADVISORY IS IN EFFECT...

.TONIGHT...SOUTH WINDS 25 TO 35 KNOTS...INCREASING TO 30 TO 40 KNOTS
AFTER MIDNIGHT. WAVES 3 TO 5 FEET...BUILDING TO 4 TO 6 FEET AFTER
MIDNIGHT. RAIN LIKELY THIS EVENING...THEN SCATTERED SHOWERS OVERNIGHT.
VISIBILITY 3 TO 5 MILES IN ANY RAIN.
.SATURDAY...SOUTH WINDS 25 TO 35 KNOTS...BECOMING SOUTHWEST 15 TO
25 KNOTS IN THE AFTERNOON. WAVES 3 TO 6 FEET...SUBSIDING TO 2 TO
4 FEET IN THE AFTERNOON. A CHANCE OF SHOWERS IN THE MORNING...THEN
SHOWERS IN THE AFTERNOON. VISIBILITY GENERALLY UNRESTRICTED...
DECREASING TO 3 TO 5 MILES IN THE AFTERNOON.
.SATURDAY NIGHT...WEST WINDS 20 TO 30 KNOTS...DECREASING TO 15 TO
25 KNOTS AFTER MIDNIGHT. WAVES 2 TO 4 FEET. A CHANCE OF SHOWERS
UNTIL MIDNIGHT. VISIBILITY GENERALLY UNRESTRICTED UNTIL MIDNIGHT.
.SUNDAY...WEST WINDS 15 TO 20 KNOTS...BECOMING NORTHWEST 10 TO
15 KNOTS IN THE AFTERNOON. WAVES 1 TO 2 FEET.

THE LAKE CHAMPLAIN LAKE LEVEL AT THE KING STREET FERRY DOCK IN BURLINGTON
WAS 95.57 FEET...AND THE WATER TEMPERATURE WAS 51 DEGREES.
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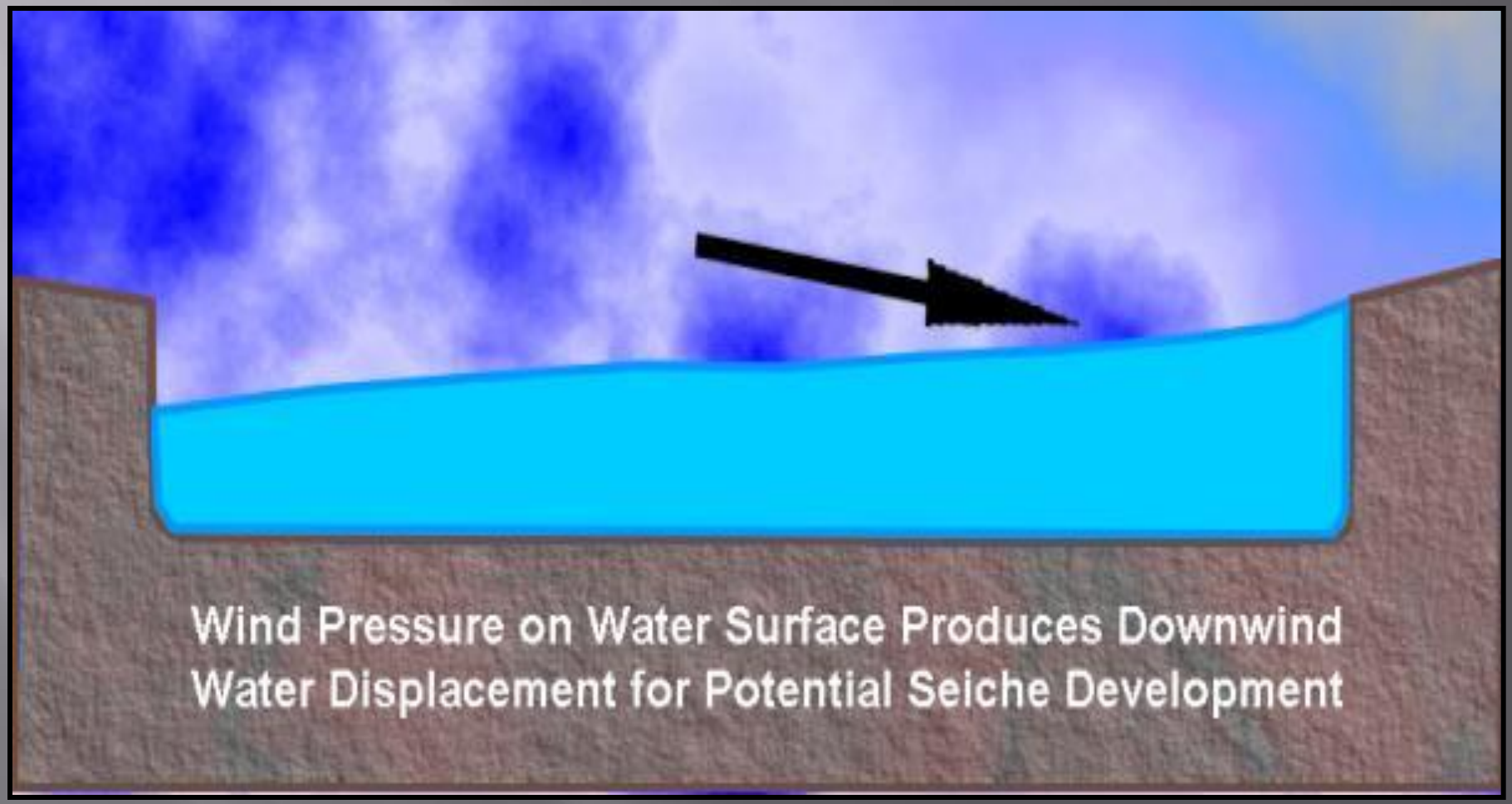
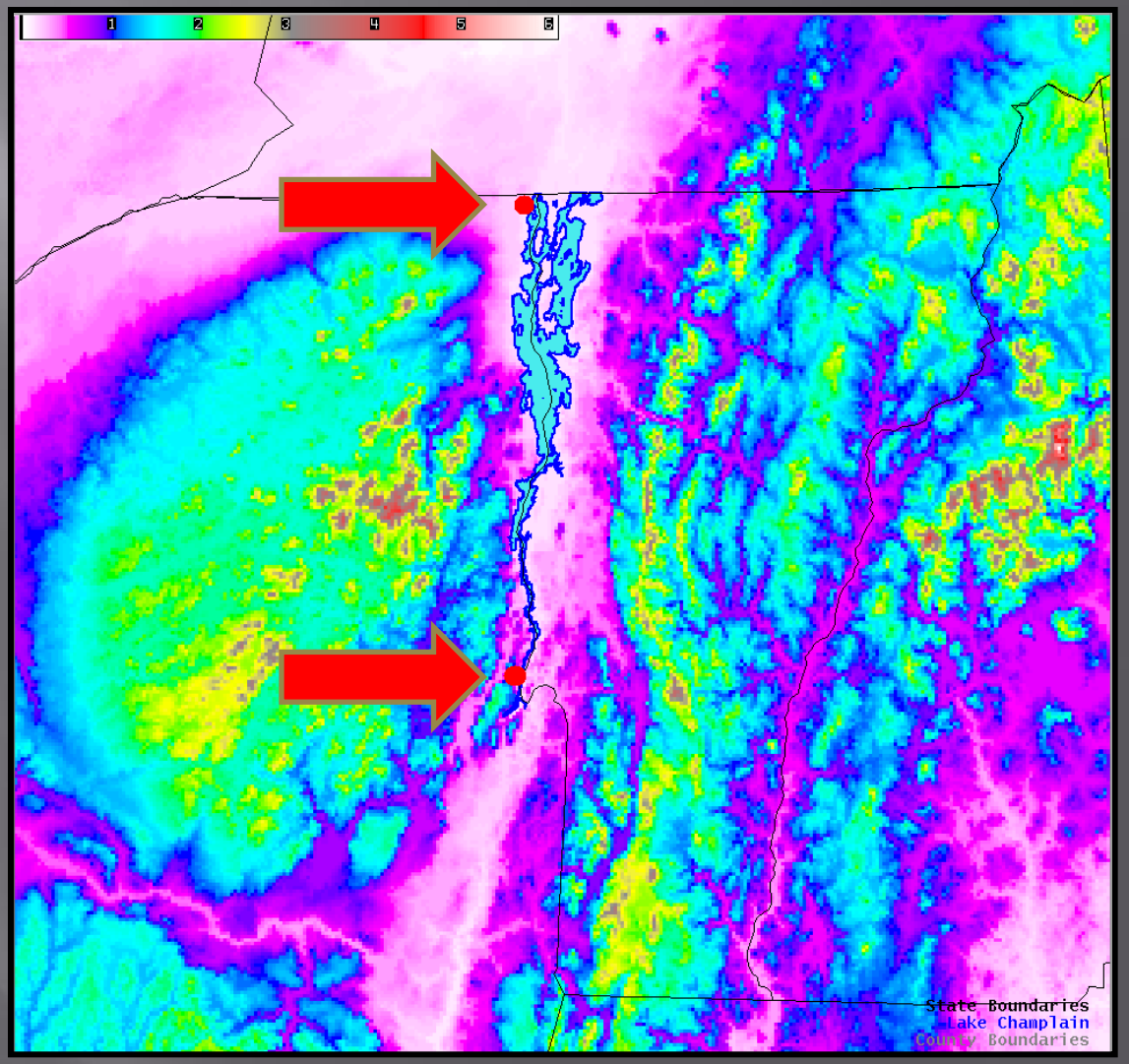
# A SIMILAR BUT LESSER EVENT

# LET'S TALK ABOUT SEICHES

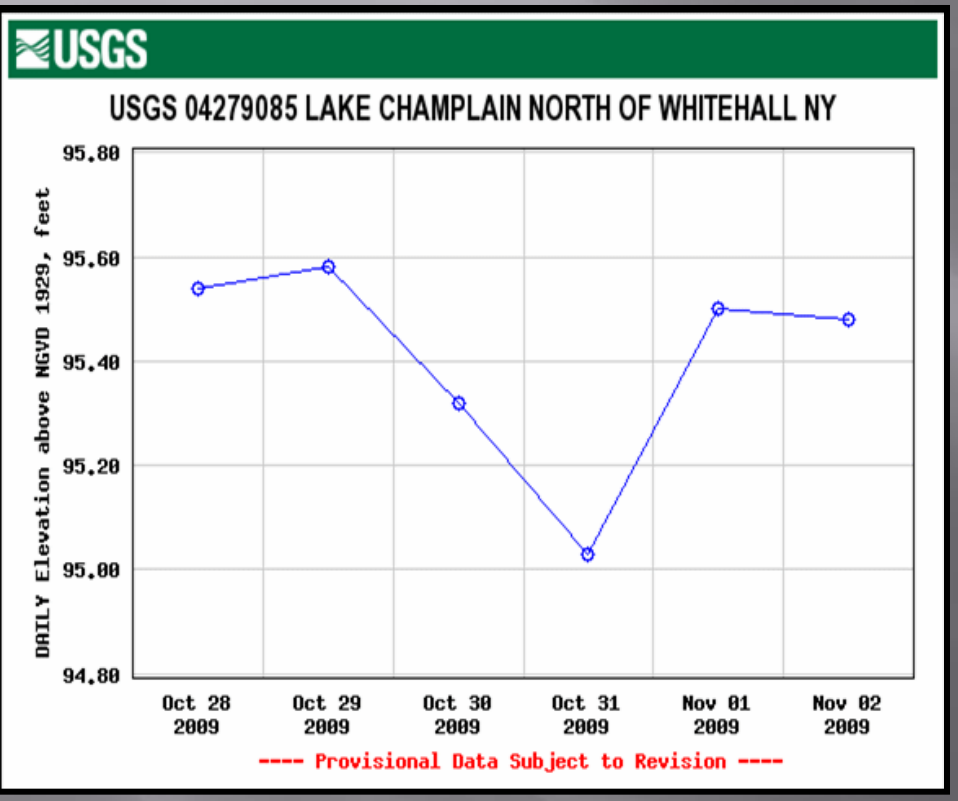


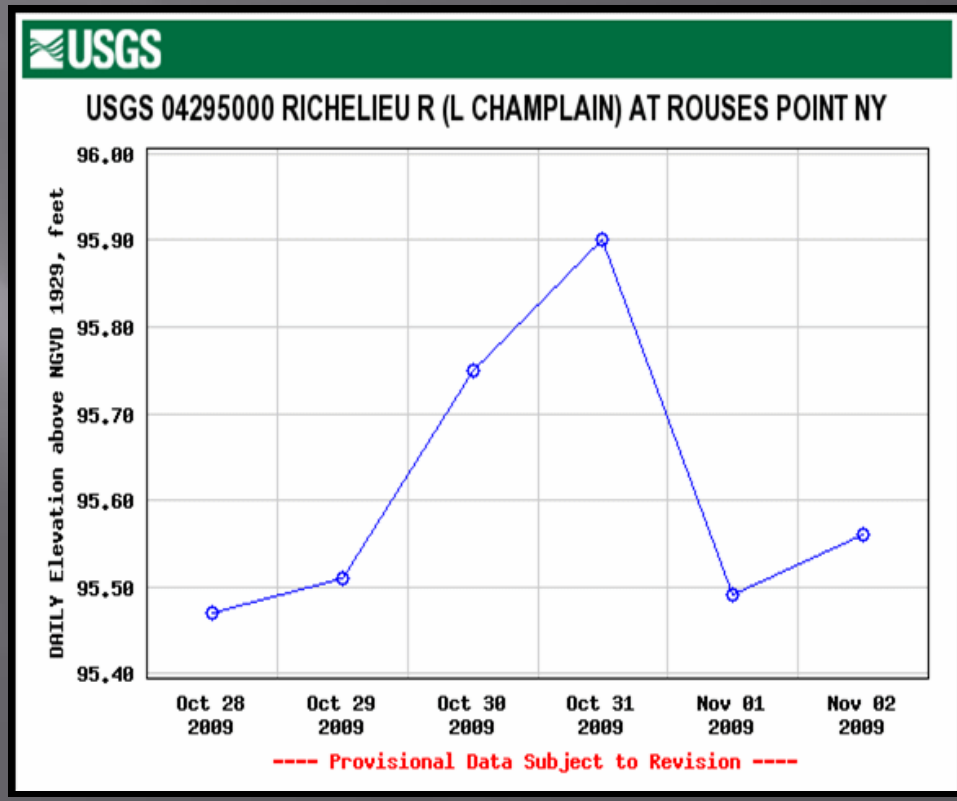
# SEICHE OF 31 OCTOBER 2009

- Whitehall and Rouses Point, NY USGS plots



# SURFACE GAGE PLOTS




Approximate 1 foot rise from south to north. Very significant to internal seiche development.

# LAKE CHAMPLAIN SEICHES

- Surface seiche typically smaller than that of larger Great Lakes.

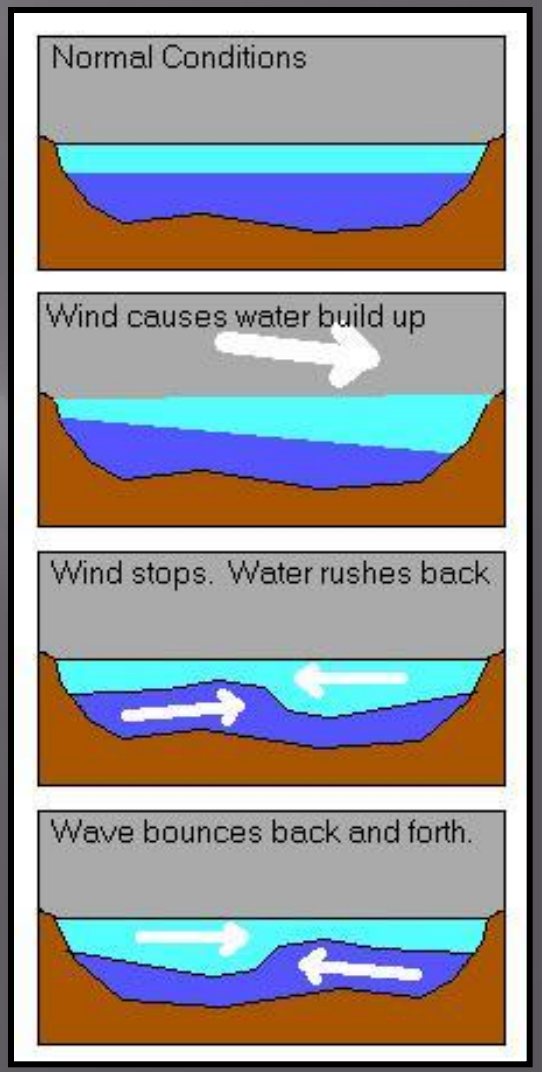
  * generally 1 foot or less on south flow

  * up to 2 feet on strong north flow due to mass constriction

- Atypical in that surface seiche events drive the development of a large subsurface internal seiche of the thermocline.
- Internal seiche amplitudes range from 20 to 40m!

# LAKE CHAMPLAIN INTERNAL SEICHE

- Modest surface seiche initiates large deep water internal seiche
- Important for hydrodynamic flow, biological response, and evolution of lake turnover

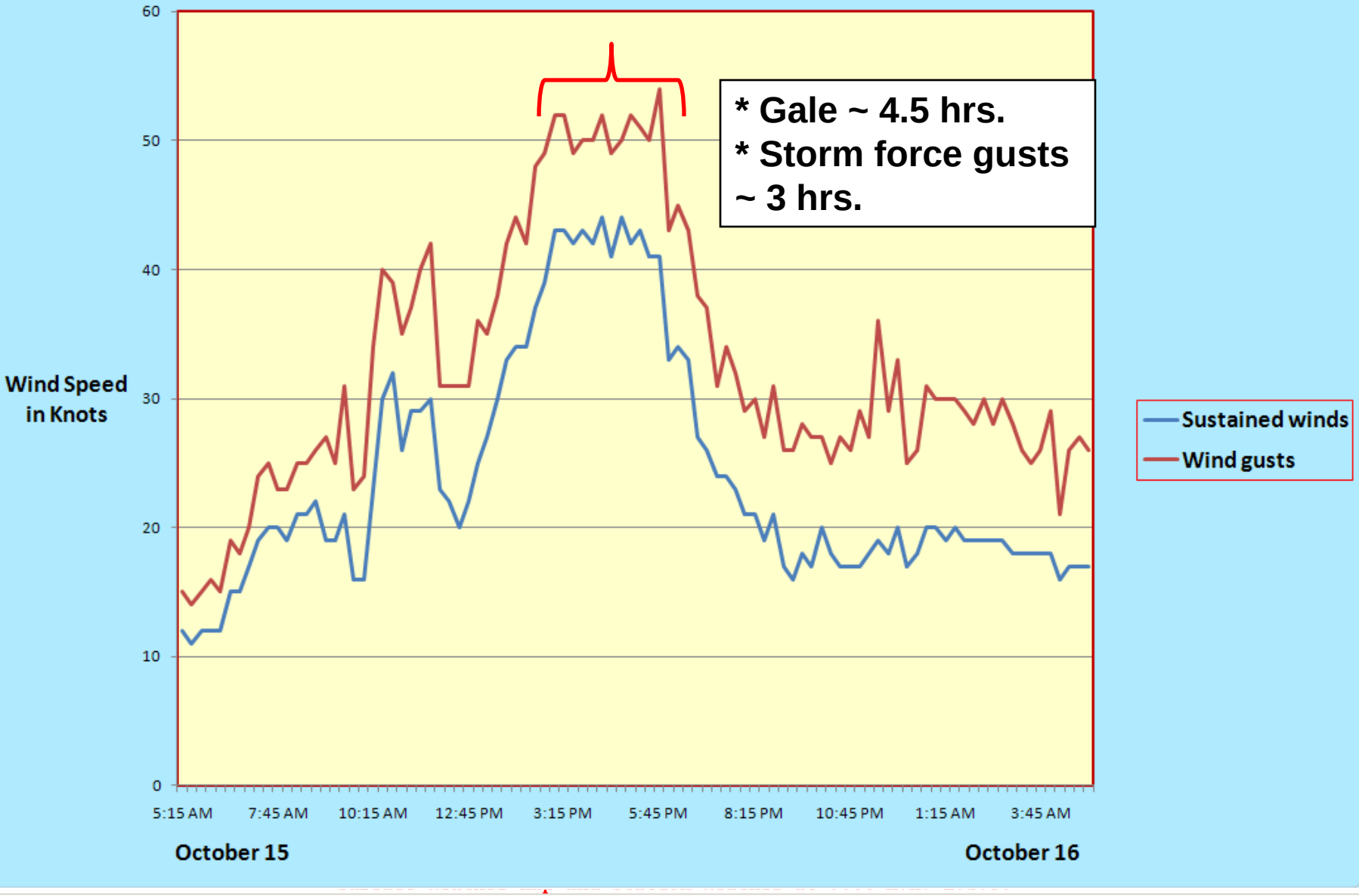


# PREDICITABILITY OF CHANNELING EVENTS

- Situational awareness is key
- Use of BUFKIT and WRF hi-resolution isotach profiles is critical in assessing potential
- Decision tree methodology
  - Are stronger south or north winds in the forecast?
  - Is there an enhanced signature present in model pressure gradient magnitude fields?
  - Are winds strong in lower levels (i.e. 950-975 hPa)?
  - Are lake ΔTs positive so as to enhance marine boundary layer mixing? Be careful here!

**HIGHER CONFIDENCE!**

# DIAMOND ISLAND WINDS



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# THANK YOU