

The Perfect Tornado: Priming the Environment for the 10 January 2008 Vancouver Tornado and Supercell

William Schneider, Jonathan Wolfe, Charles Dalton, Paul Tolleson, David Elson, Julia Ruthford, Kirsten Elson,

*National Weather Service Forecast Office
5241 NE 122nd Avenue
Portland OR*

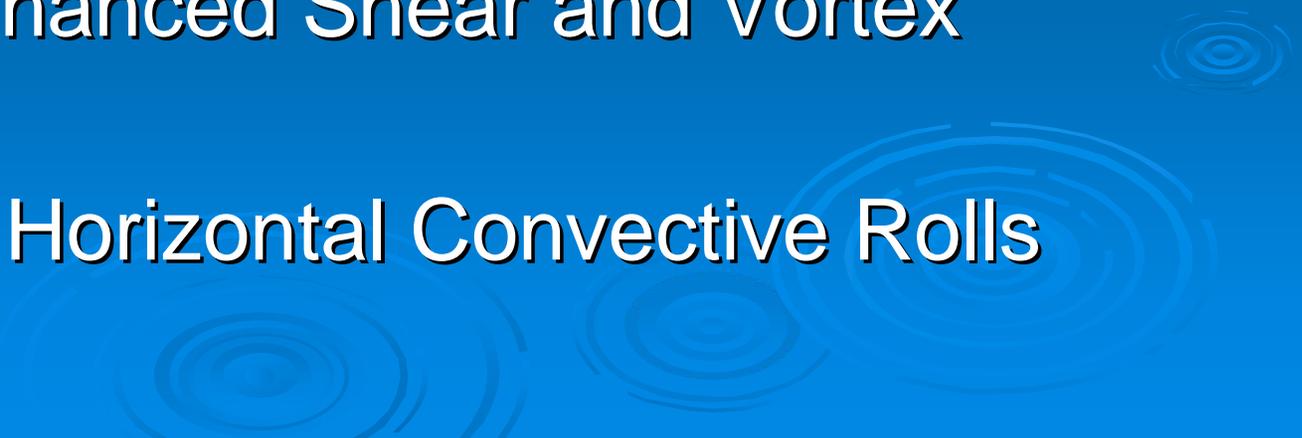


Pre-Storm Environment

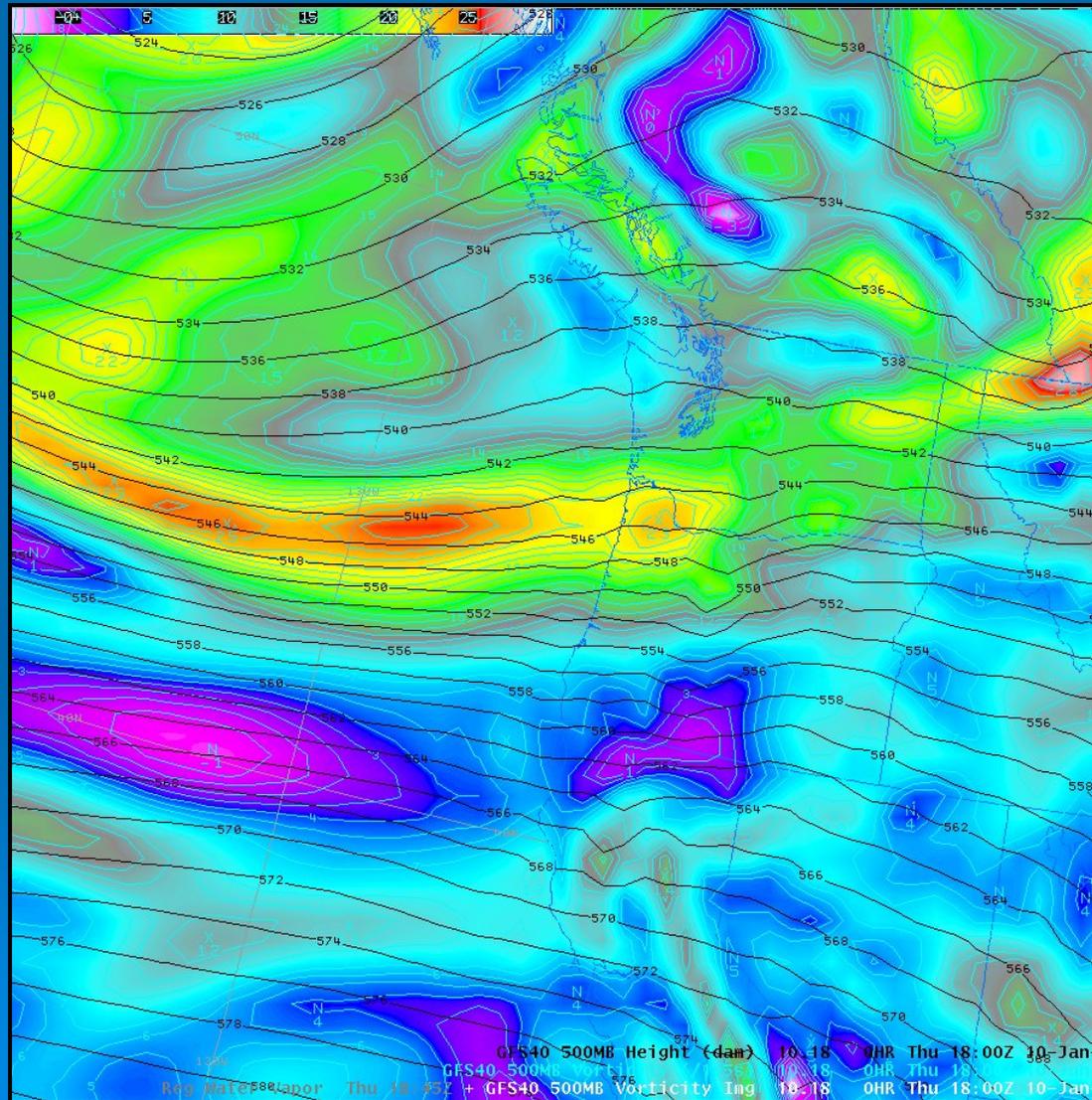
- Appeared to be a Typical Day
- Early morning Cold Frontal Passage
- Post frontal showers
- Isolated Morning Thunderstorms
- Why did severe convection develop and produce a Tornado?



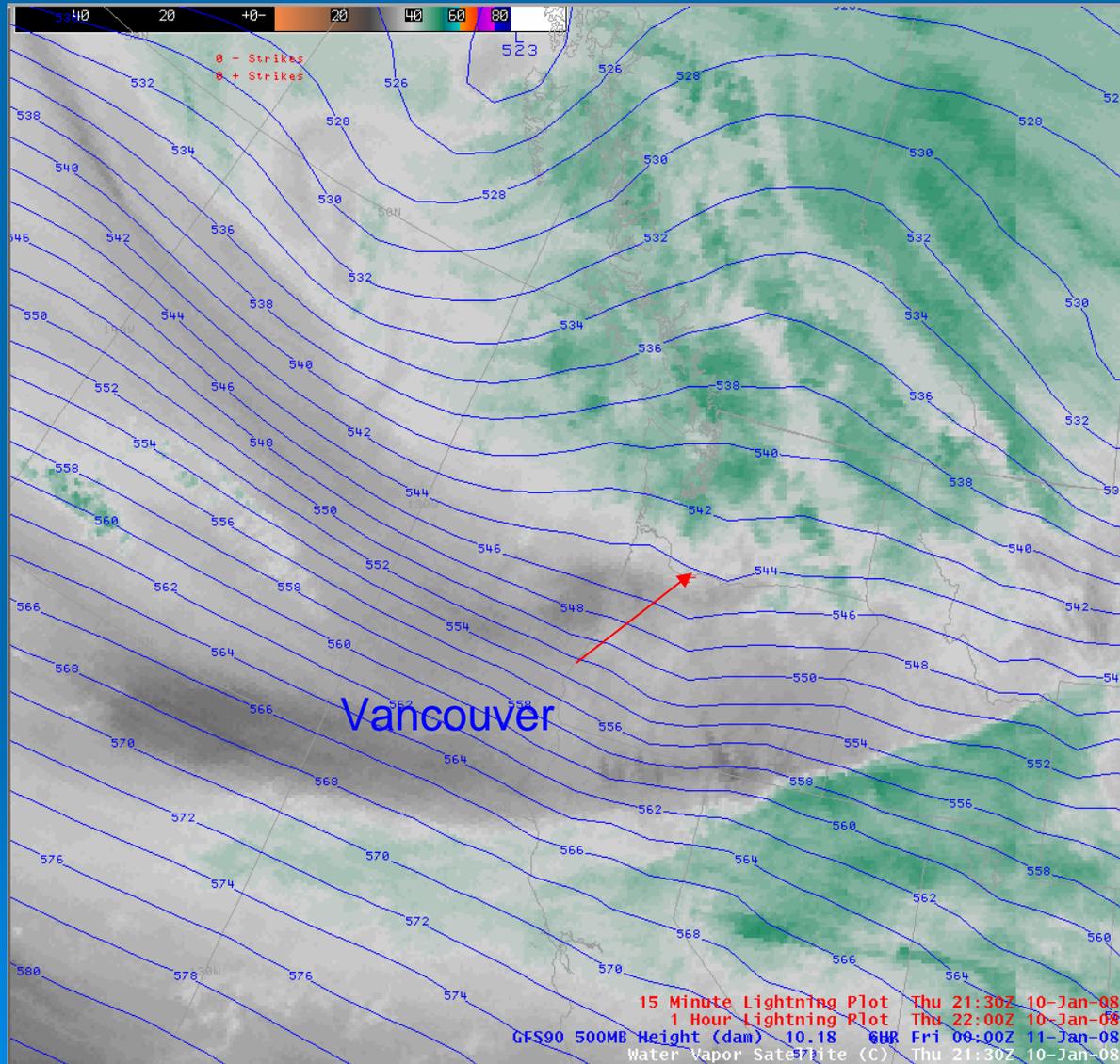
The Perfect Mix

- Upper Level Short Wave/Vort. Max
 - Low Level Warming - Destabilization at Surface
 - Low Level Shear Enhanced by Easterly Surface Wind Component
 - Terrain Enhanced Shear and Vortex Stretching
 - Persistent Horizontal Convective Rolls
- 

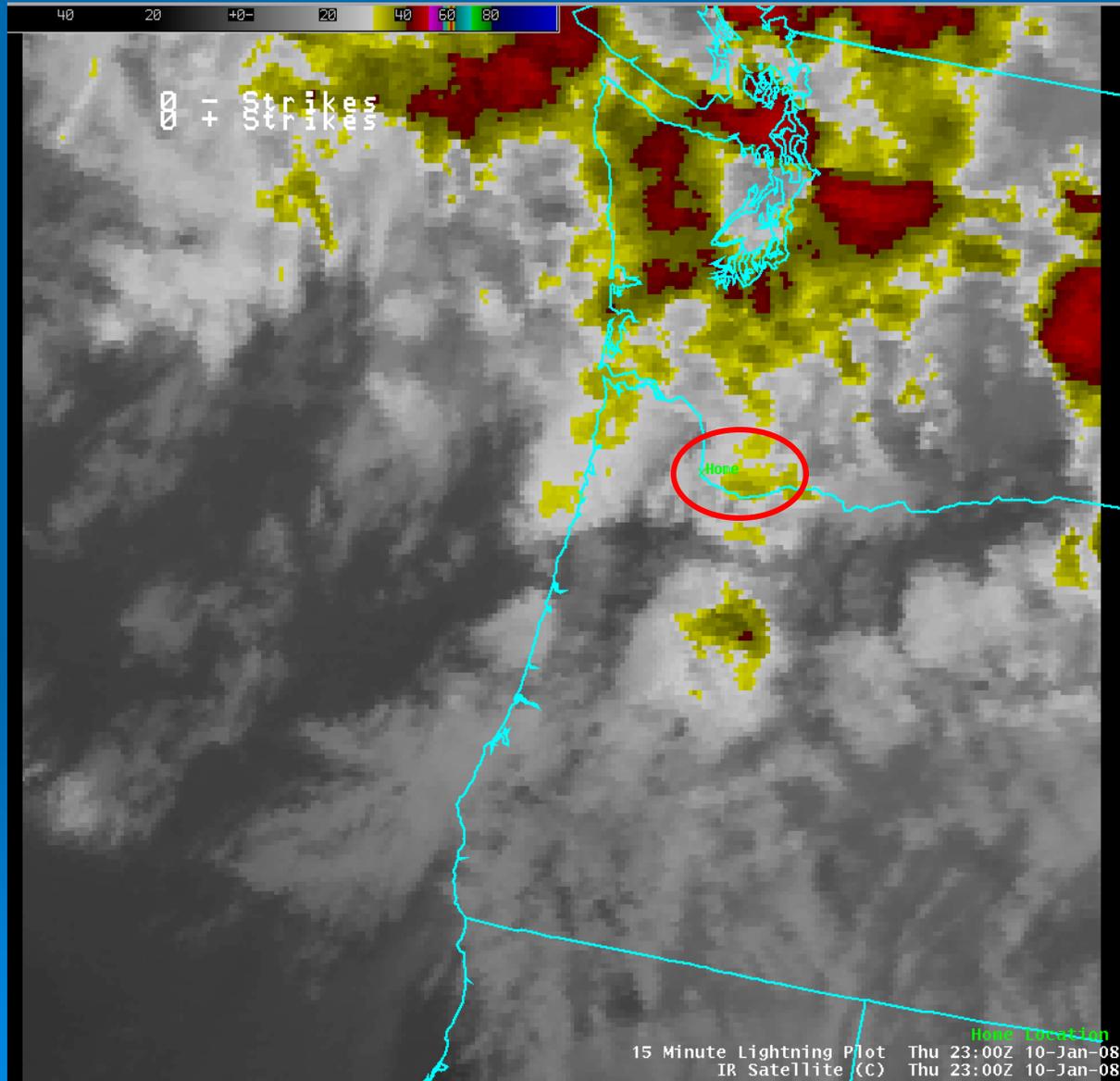
Upper Level Shortwave



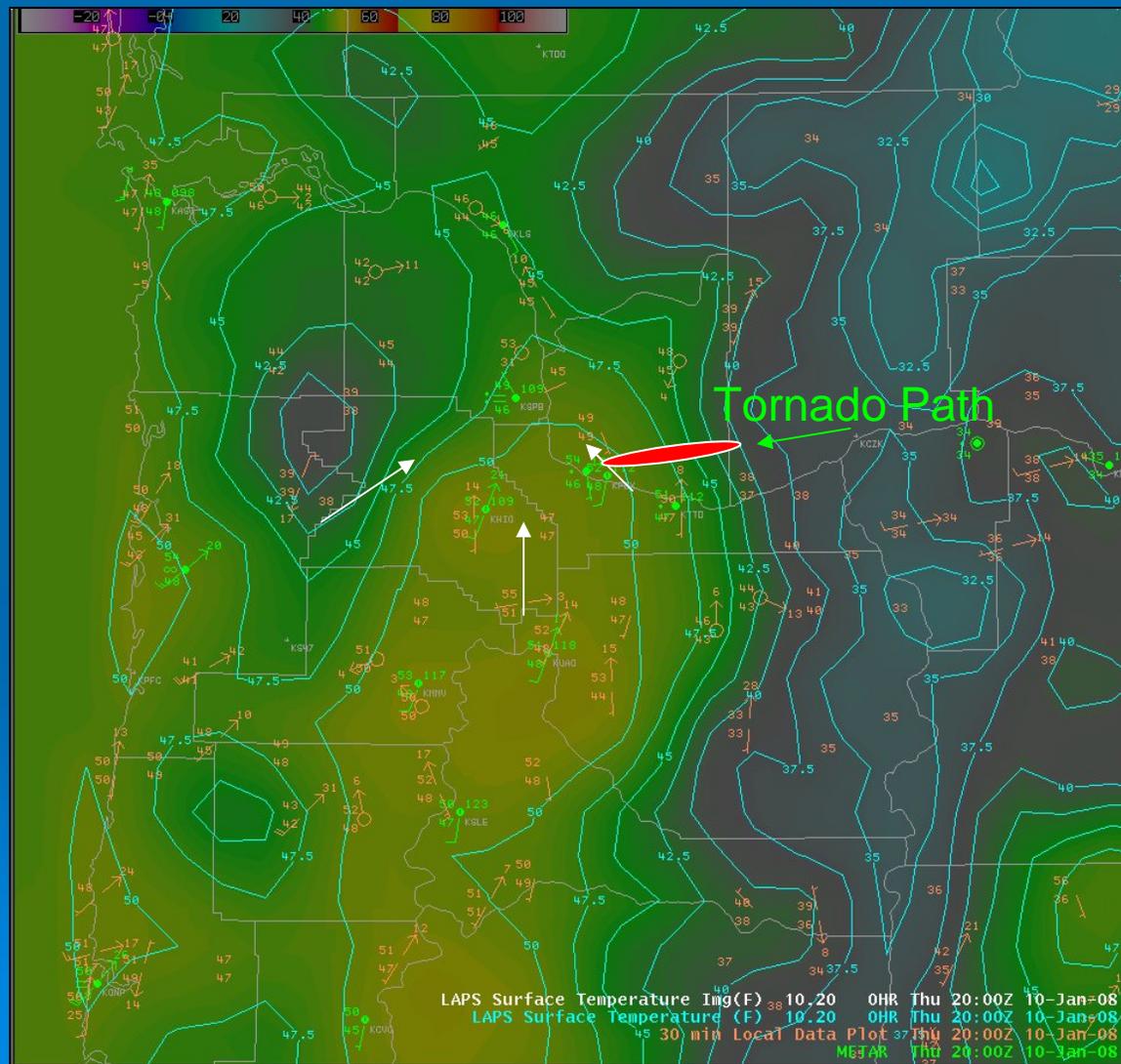
Shortwave on WV



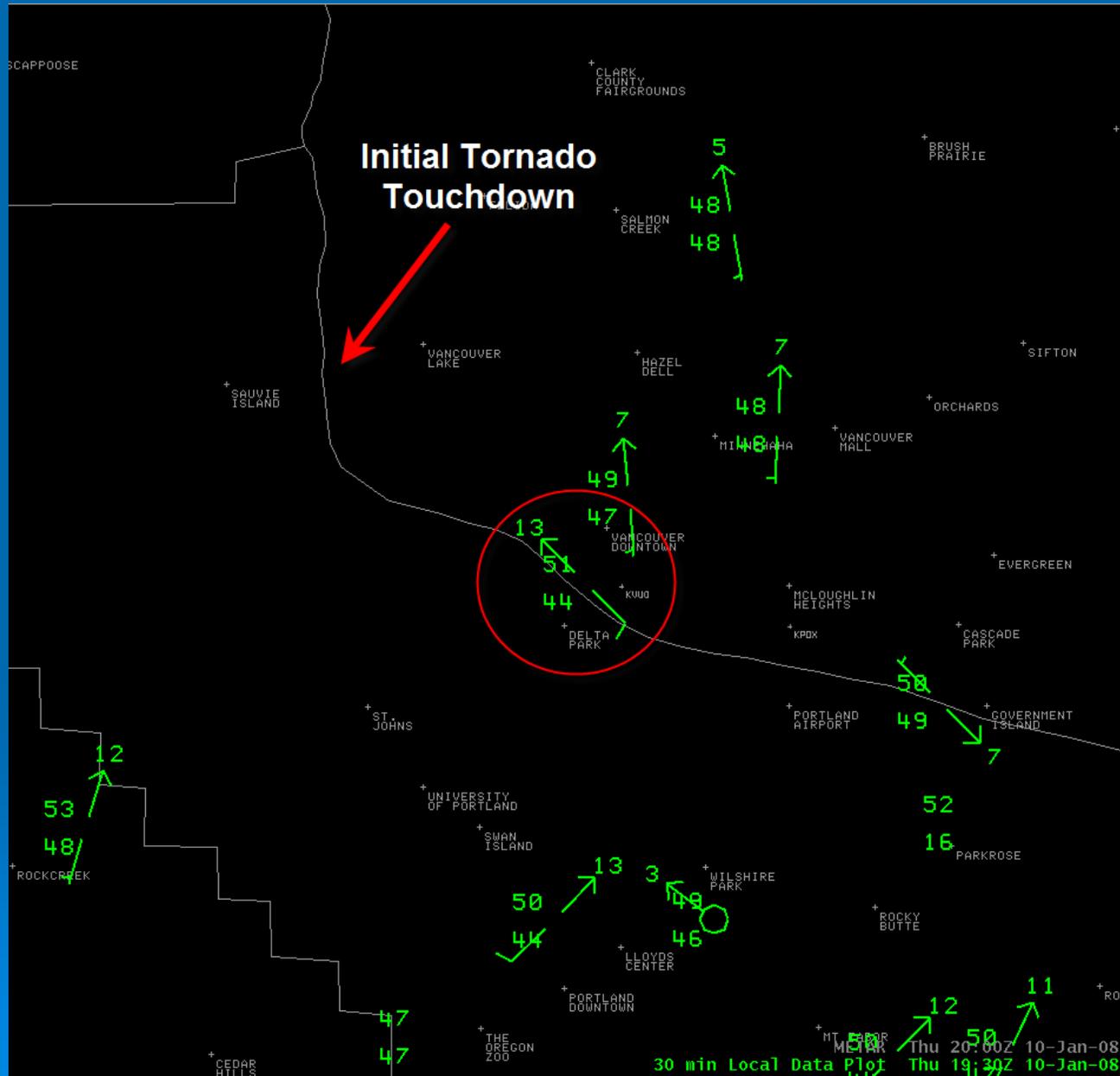
Convection on IR



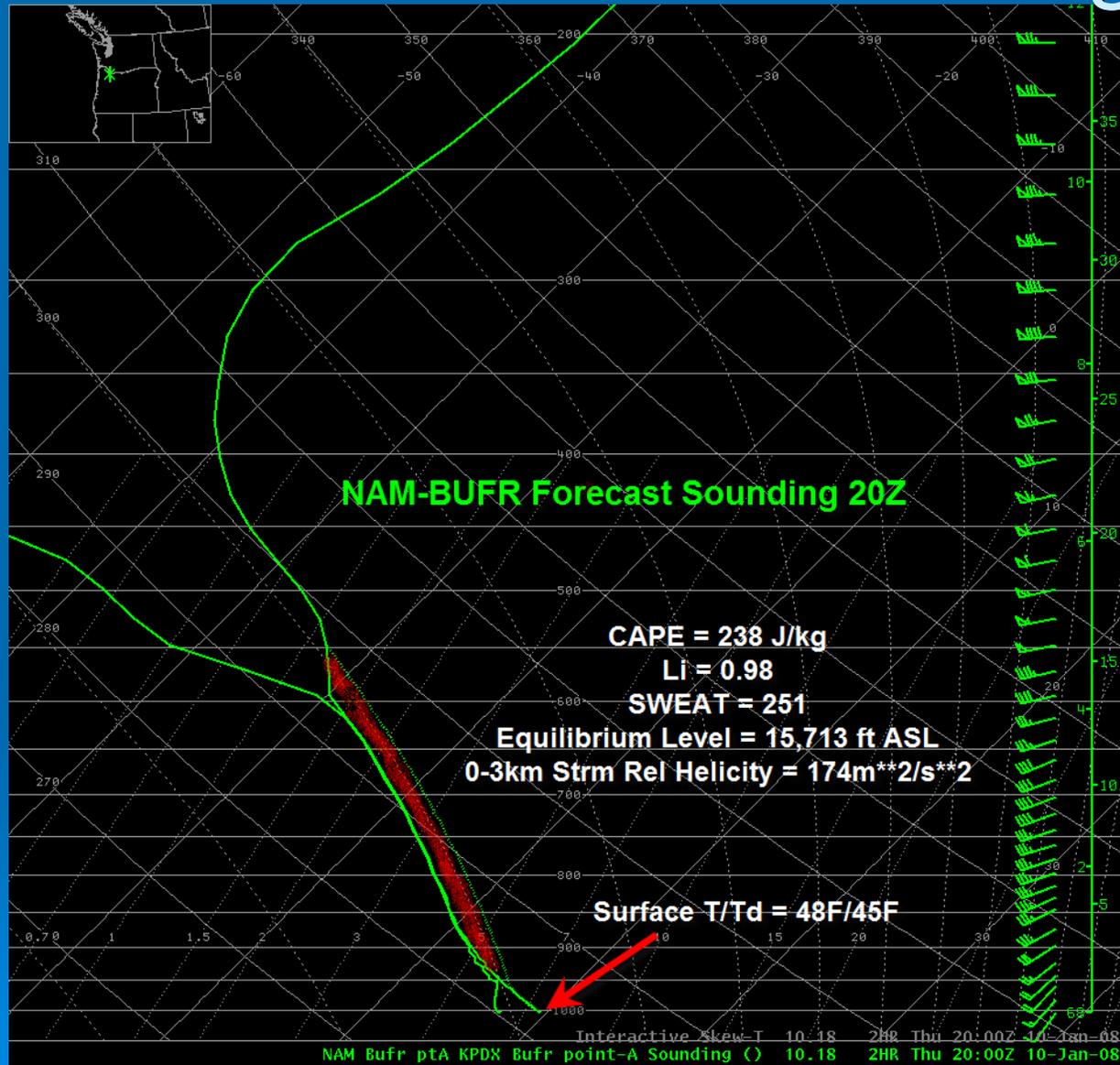
Surface Temp/Wind Analysis



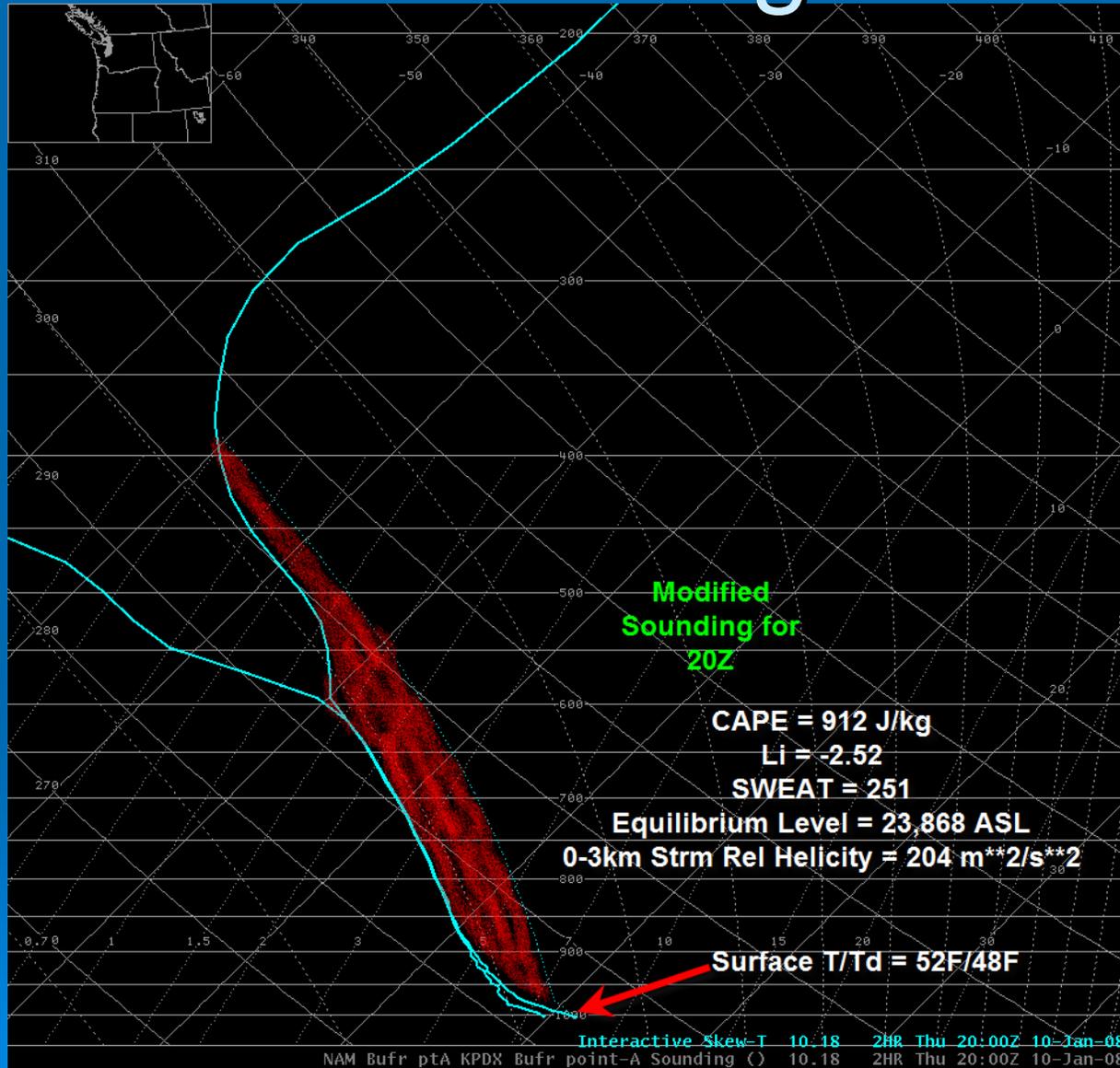
Surface Plot 1930Z



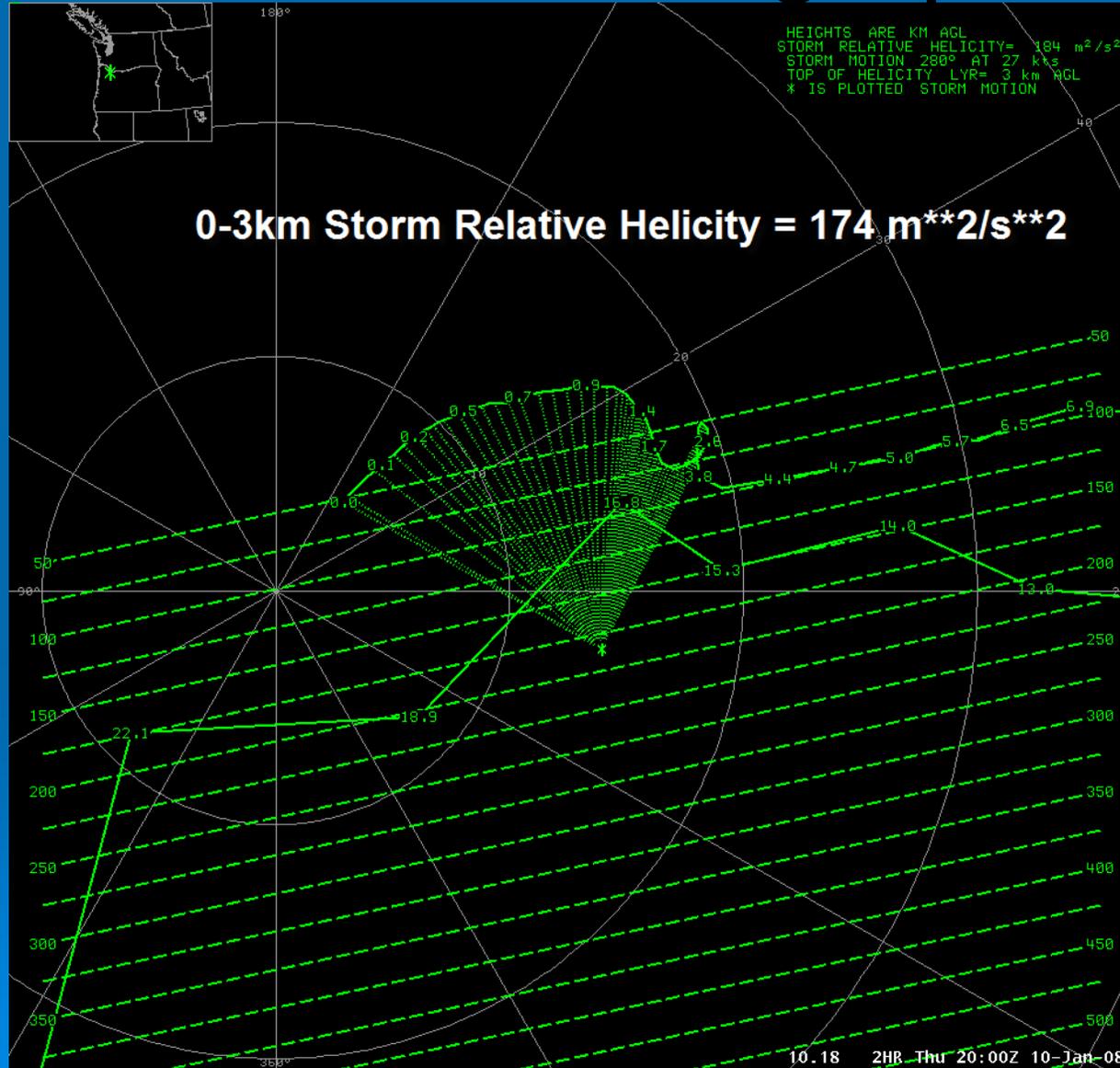
NAM BUFR Forecast Sounding 20Z



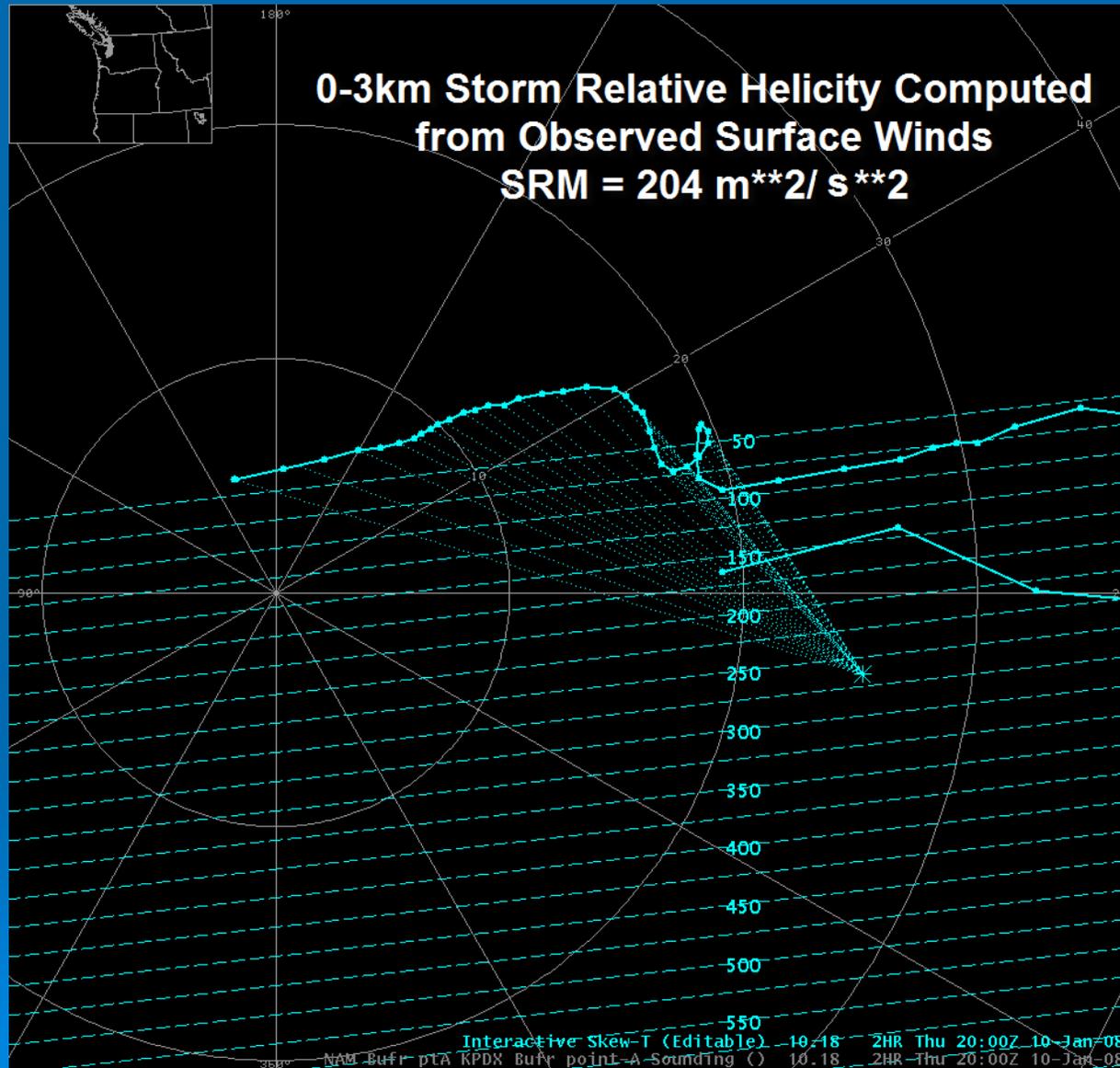
Modified Sounding for 20Z



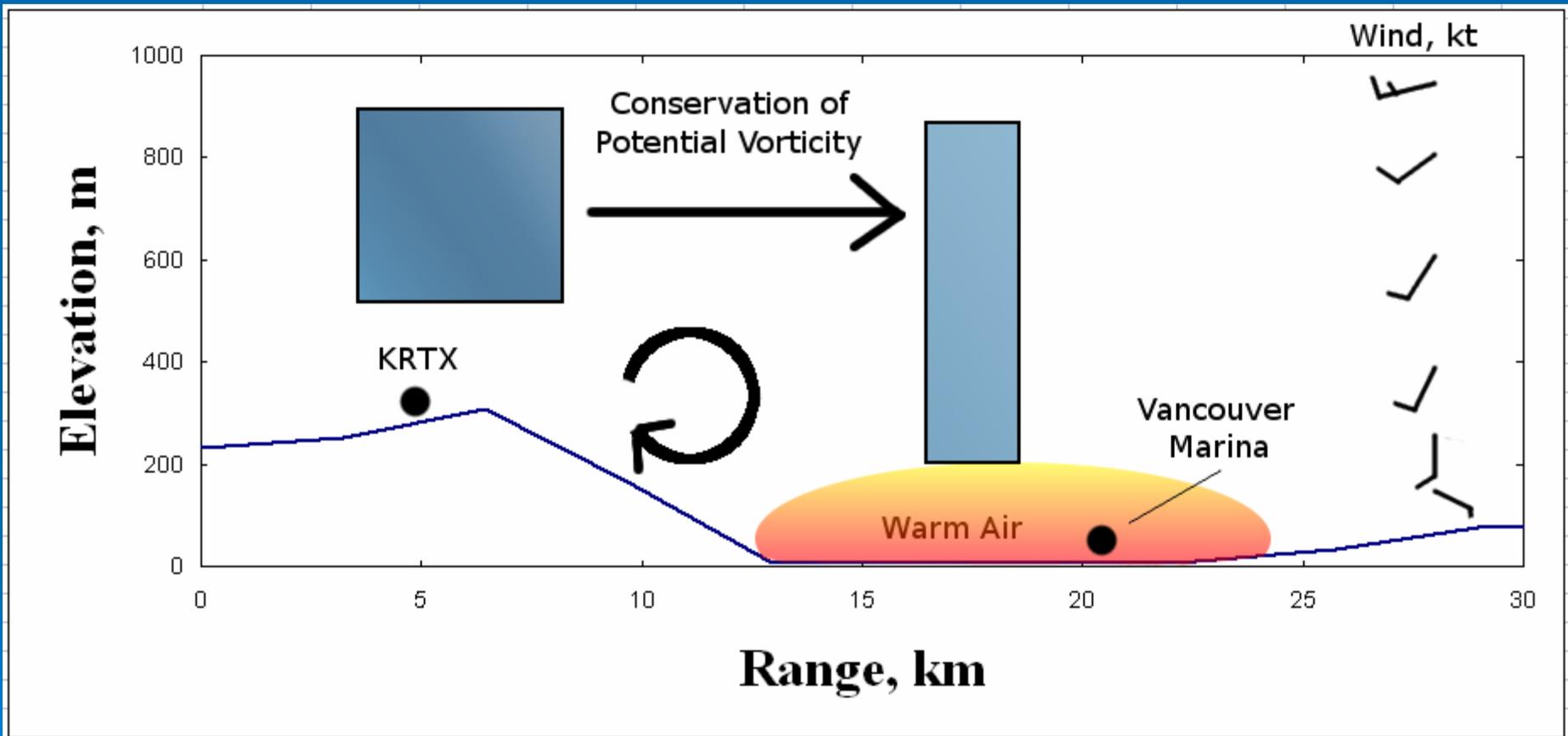
NAM-BUFR Hodograph 20Z



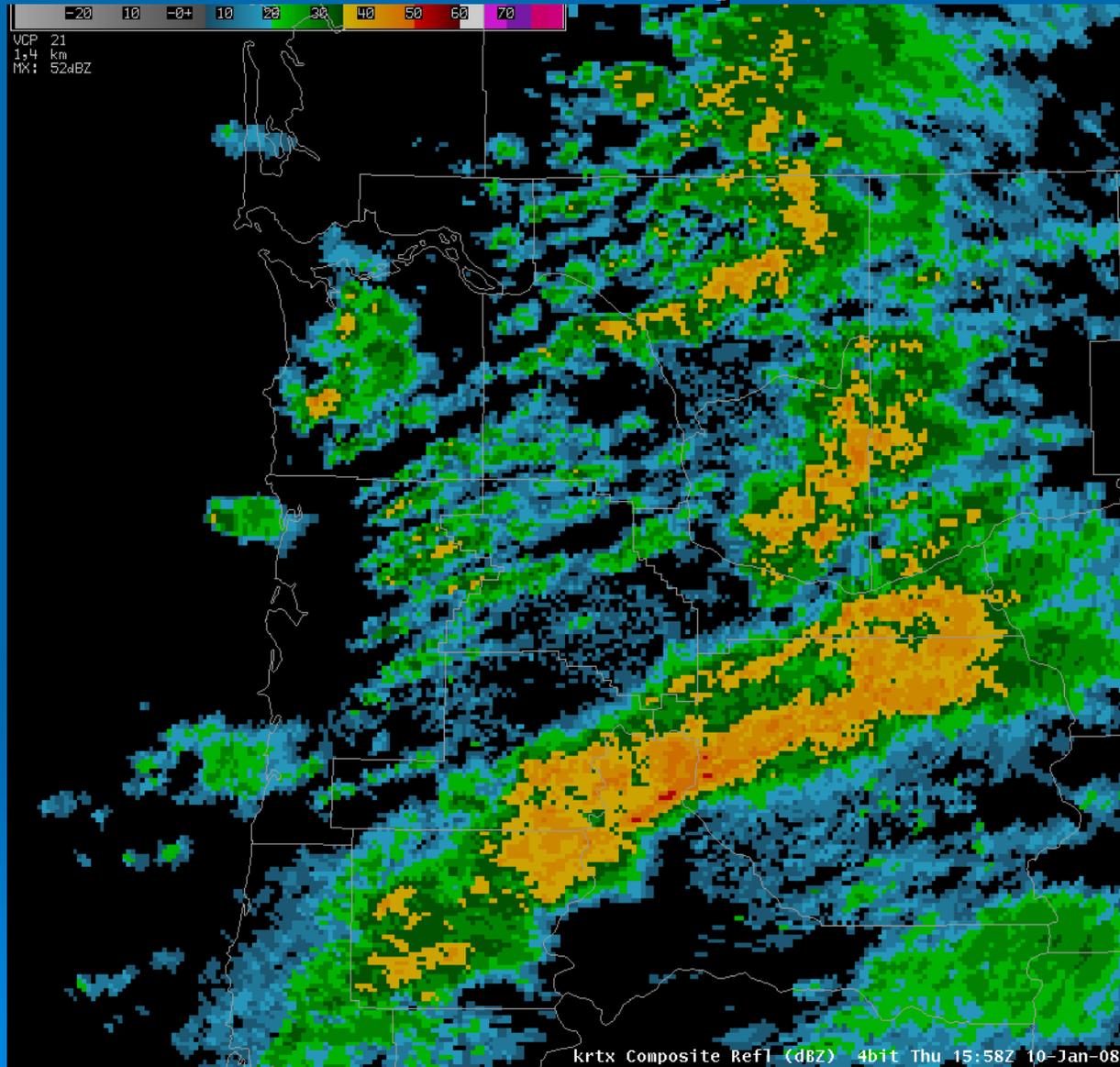
Modified Hodograph 20Z



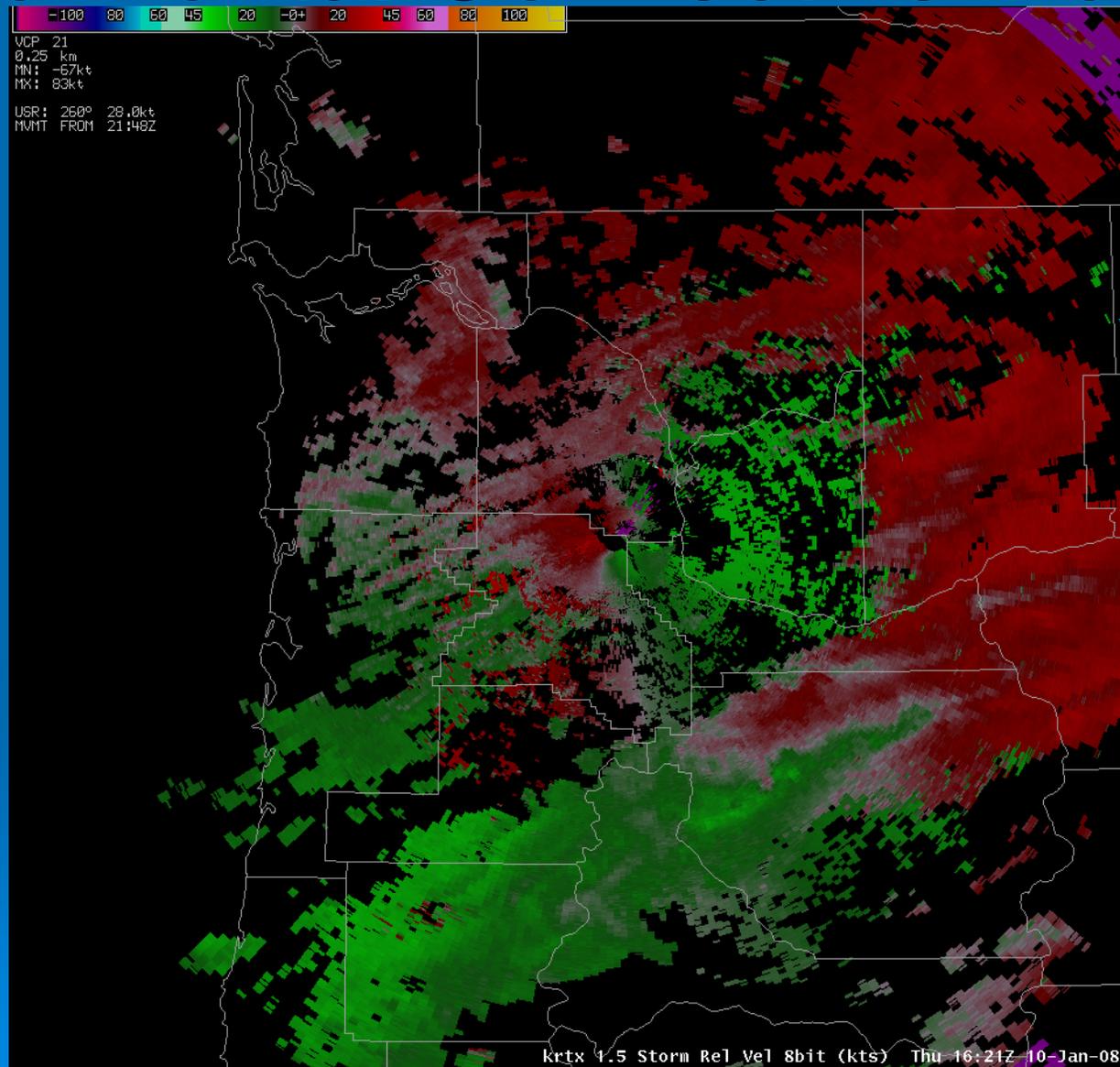
Terrain Influence



Banded Precipitation



Horizontal Convective Rolls

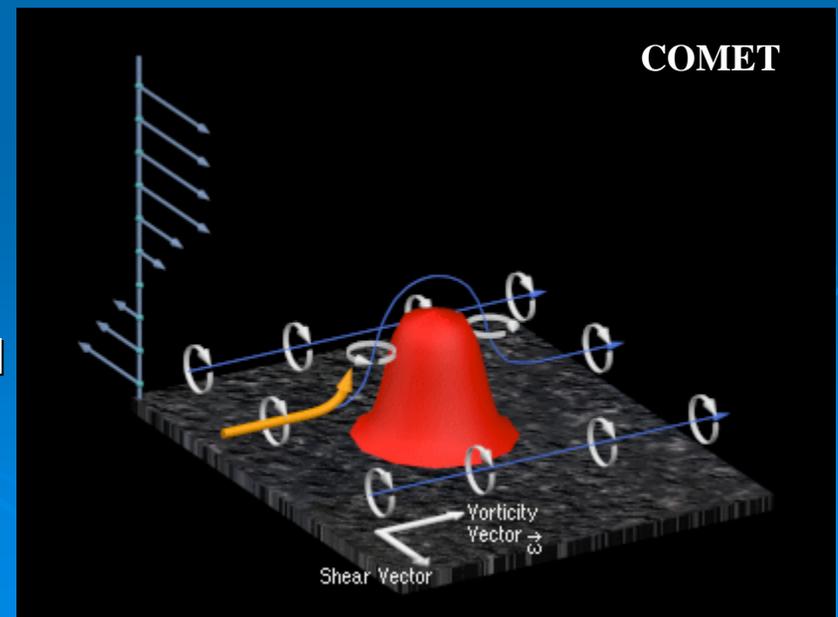


Horizontal Convective Rolls (HCR's)

- Horizontal Helicities of air flow

$$H = \int \vec{V}_h \cdot \vec{\zeta}_h dZ \quad \begin{cases} Z = \text{Altitude} \\ V_h = \text{Horizontal velocity} \\ \zeta_h = \text{Horizontal vorticity} \end{cases}$$

- Oriented parallel to mean flow and shear
- Result of Speed Shear
- Aspect ratio is normally
3:1 -> 10:1
- Updraft Strength $1-3 \text{ m s}^{-1}$
- Roll spacing: $2 \cdot \sqrt{2} \cdot BL_depth$



Horizontal Convective Rolls

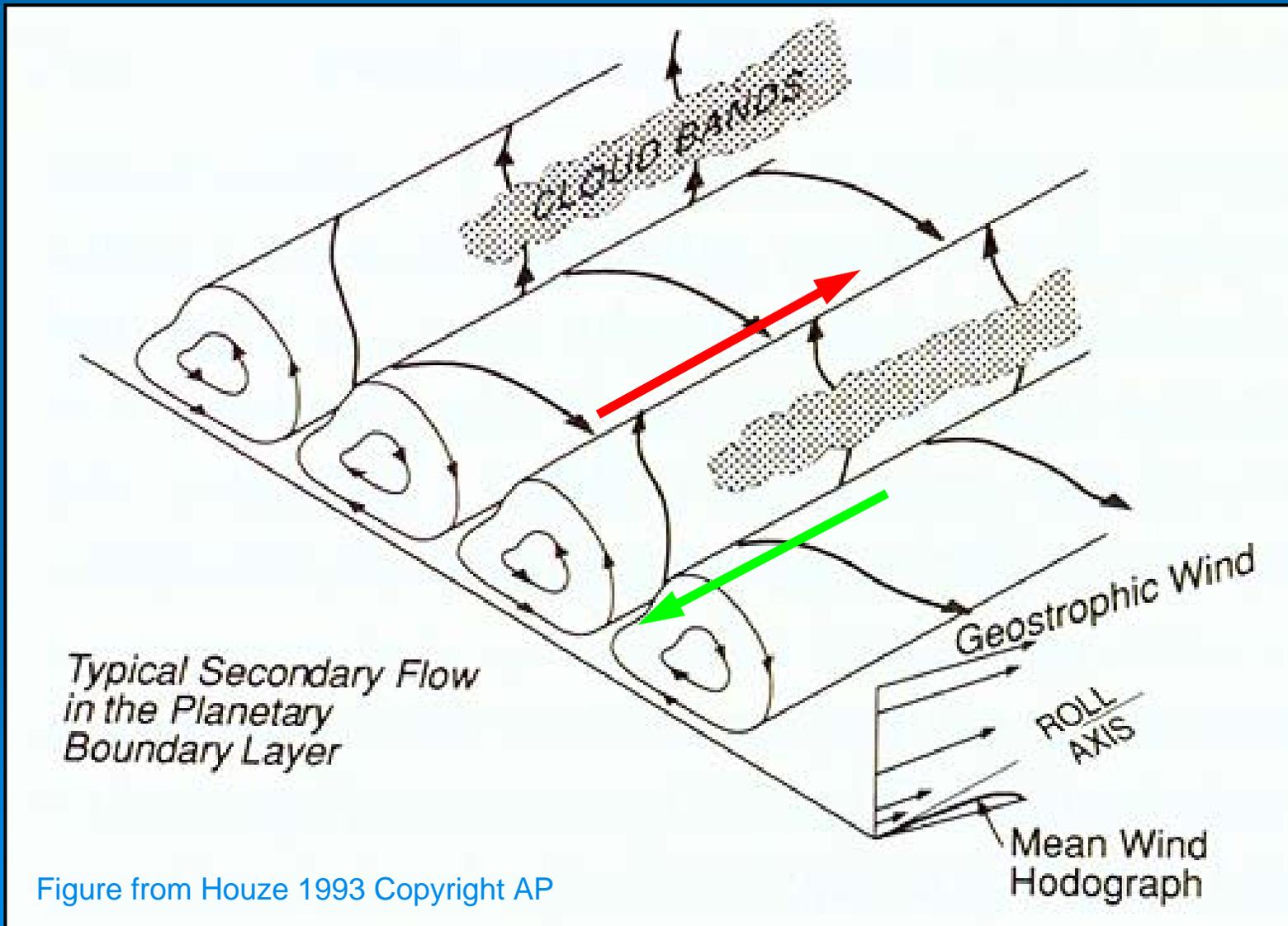
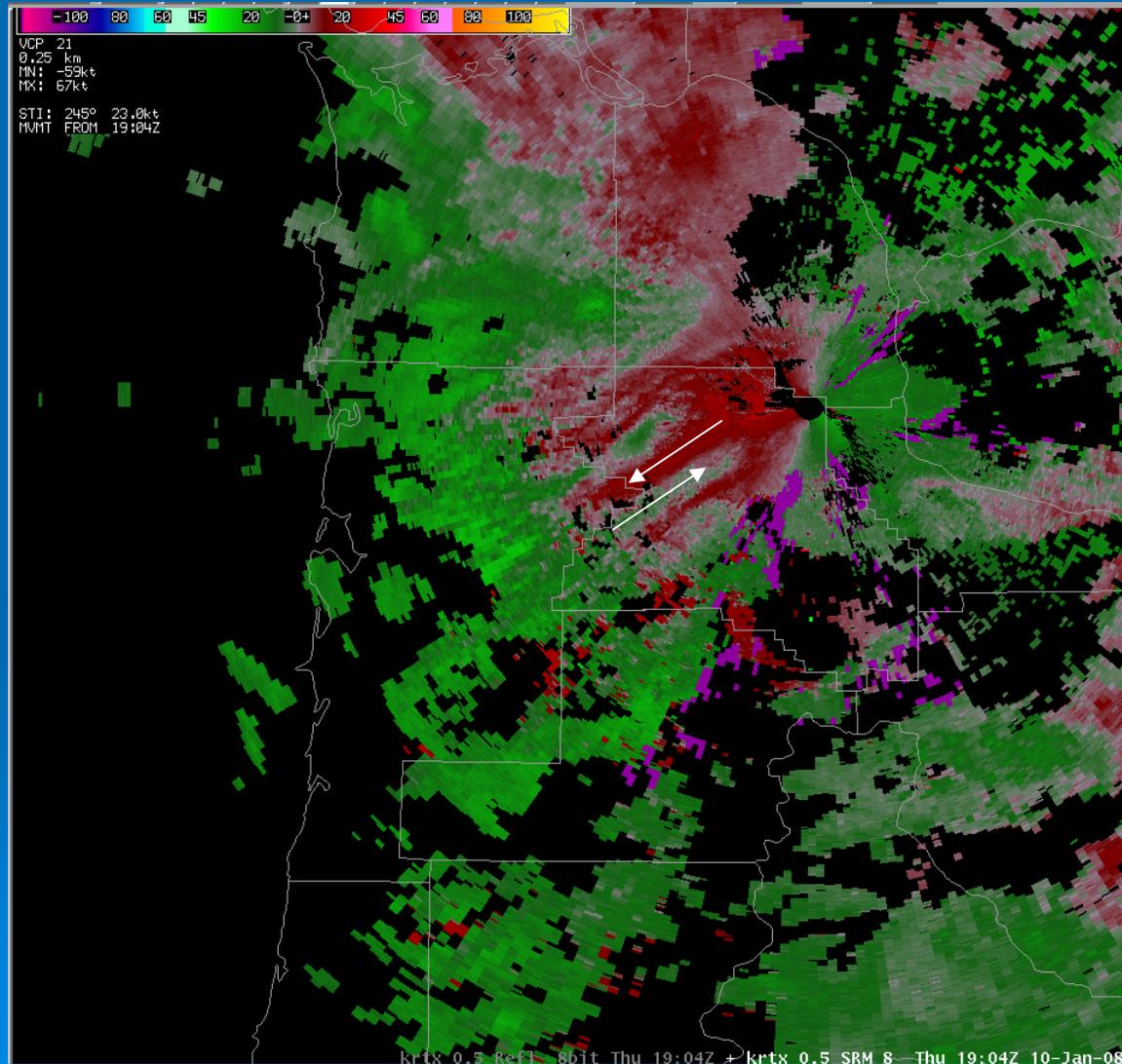
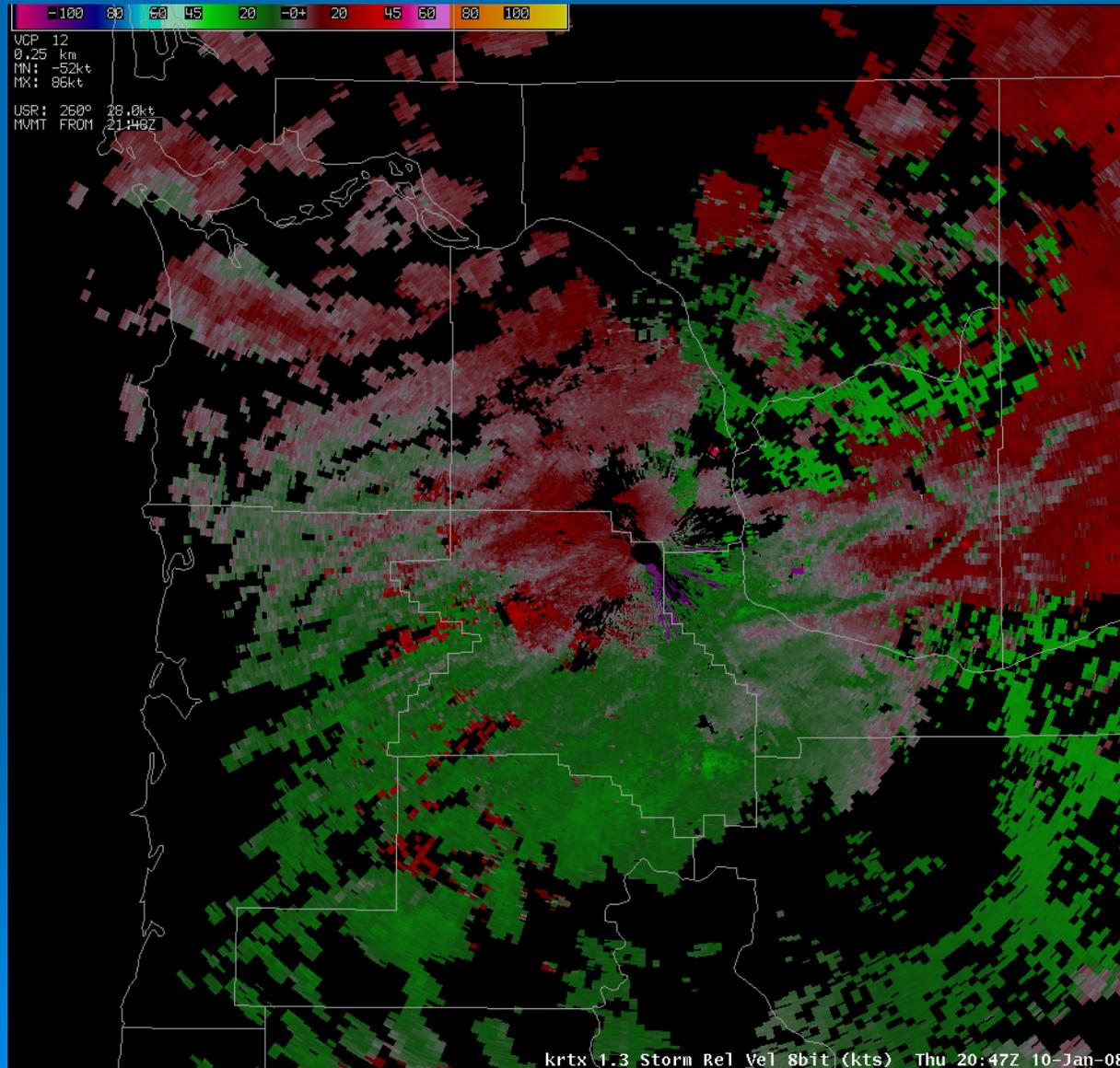


Figure from Houze 1993 Copyright AP

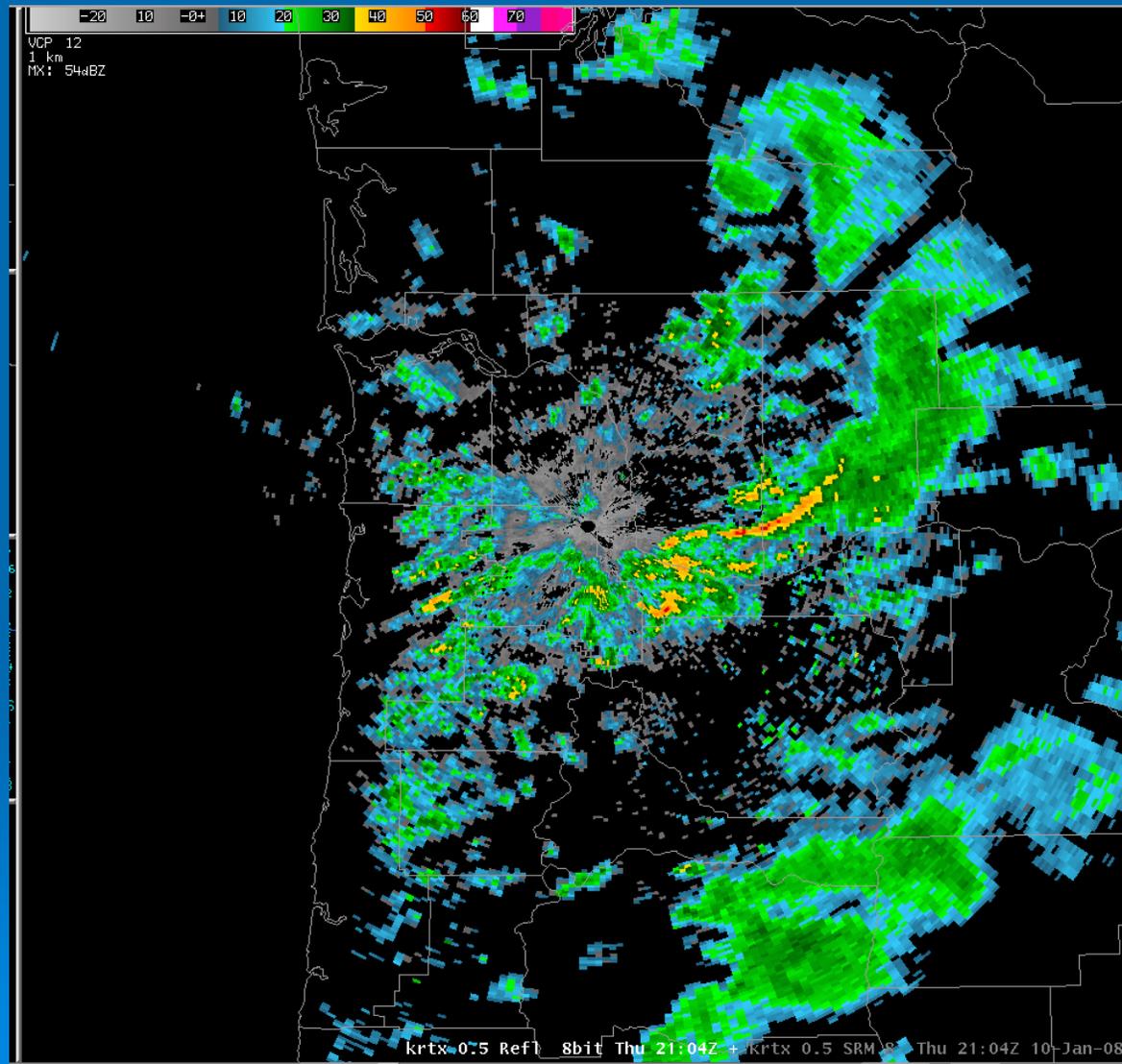
Radar Signature of HCR



Convective Rolls in Velocity Loop



Reflectivity Signature of HCRs



Summary

- A Number of Factors Combined to Produce Tornadic Supercell
 - Strong Upper Level Vorticity Max Moved Across Area with Preexisting Shear
 - Surface Temp and Dewpoint Key to Destabilizing Air Mass
 - Cell Moved Across Coast Range and West Hills then Over Clark County Plain
 - HCRs Present in Pre-Storm Convective Boundary Layer

Conclusions

- You Can't Be Too Vigilant
- You Can't Be Too Lucky



References

- Houze, R. A., 1993: *Cloud Dynamics*. Academic Press.
- Conceptual HCR images, COMET

Questions?



It's QUESTION TIME !!