Tornadic Events During UNSTABLE

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Objective

Previous U.S. studies identified spatial (40-185 km) and temporal criteria (30 minutes - 3 hours) (Potvin et al., 2010) in which soundings adequately represent a "storm environment". This research will illustrate how targeted soundings can be useful for severe storm prediction in the Canadian Rocky Mountain foothills.

Background

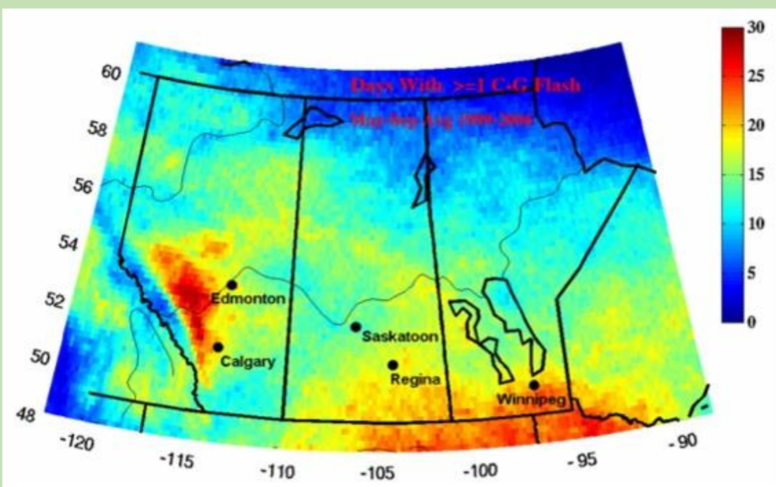

Fig1: (Taylor, 2008) 1999 to 2009 flash density map. © American Meteorological Society. Used with permission.

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment was conducted in the summer of 2008 in the Alberta foothills, a genesis region susceptible to frequent thunderstorm activity.

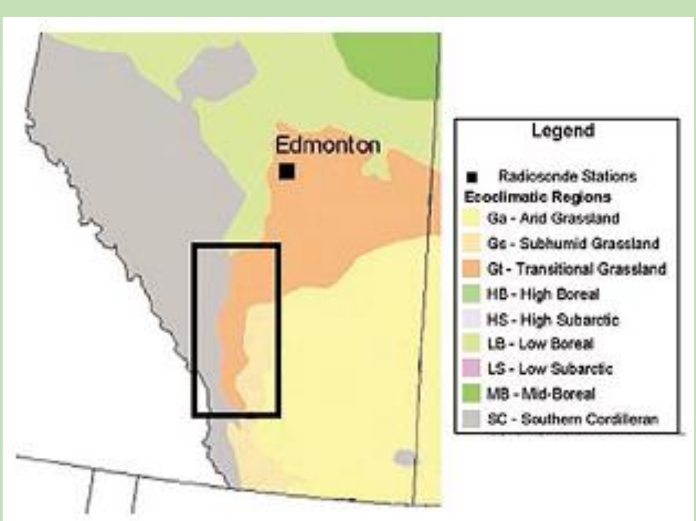

Fig 2: (Taylor et al., 2008) Ecoclimate transition zone. © American Meteorological Society. Used with permission.

Upper air soundings were used in an attempt to characterize boundary layer conditions of different ecoclimate zones and how they influence convective initiation and severe thunderstorm development.

July 7th Synoptic Soundings

An F0 tornado occurred July 7th, 2008 2200 UTC near Calgary, AB. The closest synoptic soundings were Great Falls, MT, TFX (443 km) and Stony Plain, AB, WSE (276 km)

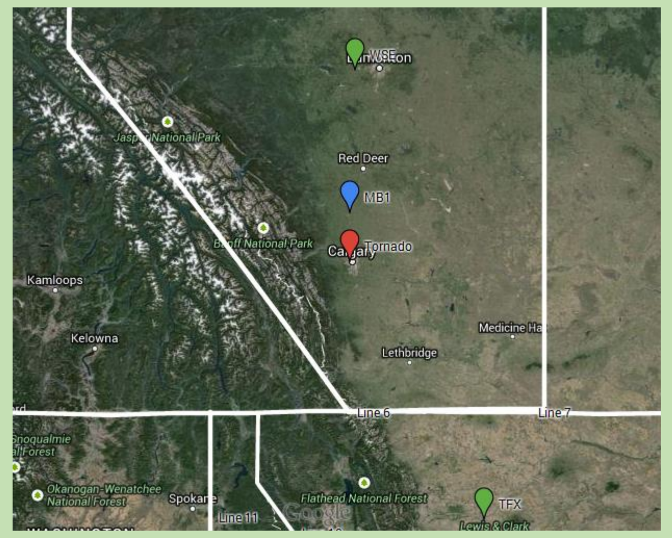

Fig 3: Sounding locations relative to the Calgary tornadic storm. Google map retrieved October, 2014 .

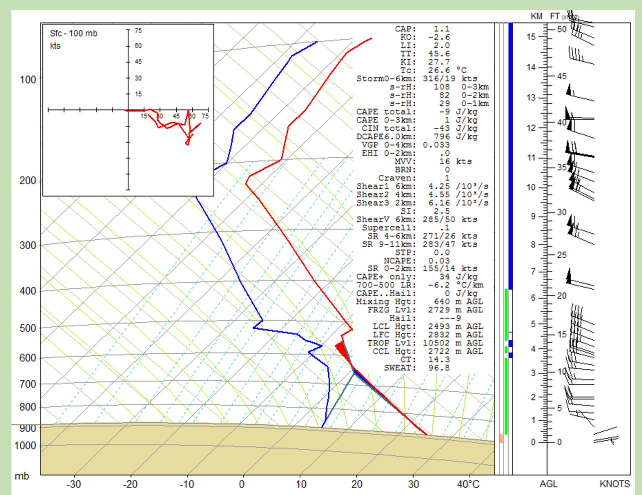

Fig 4: July 8th, 2008 0000 UTC Great Falls (TFX) sounding.

The 0000 UTC TFX sounding exhibited a mid-level (subsidence) capping inversion and a very dry boundary layer resulting in low SBCAPE values of 34 J kg^{-1}. Low-level winds were backed to weak easterly which is an upslope direction favorable for moist parcel lift. Tornadic potential was low with 0-1 km SRH values of 29 m^2 s^{-2} and 0-6 km shear of 19 kt and high LCL of 2500 m AGL.

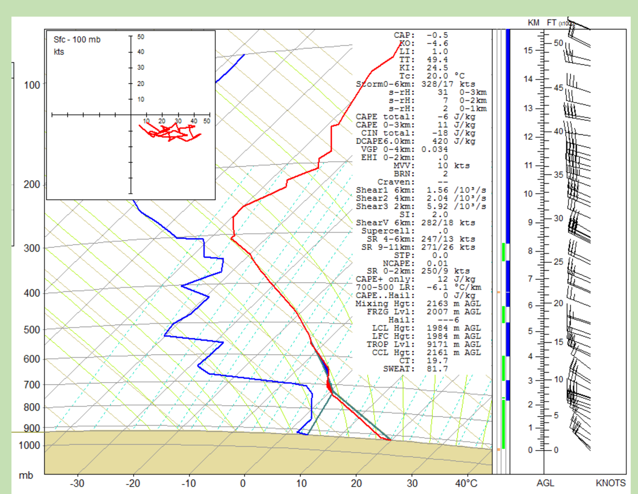

Fig 5: July 8th, 2008 0000 UTC Stony Plain (WSE) sounding.

At 0000 UTC WSE indicated unidirectional northwest winds. Combined with dry low levels producing nil CAPE values, this sounding would be indicative of no convective initiation.

July 15th Synoptic Soundings

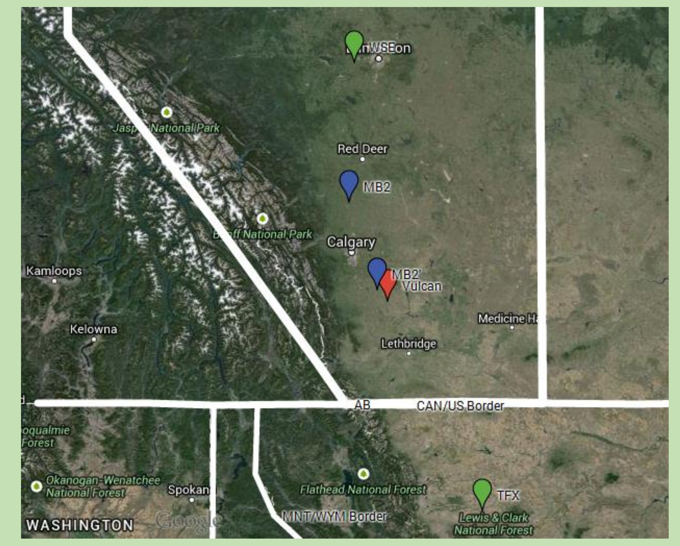

Fig 6: Sounding locations relative to the Vulcan tornadic storm. Google map retrieved October, 2014 .

An F1 tornado occurred July 15th, 2008 2300 UTC near Vulcan, AB. The closest synoptic soundings were Great Falls, MT, TFX (355 km) and Stony Plain, AB, WSE (351 km)

The 0000 UTC TFX sounding, exhibited a very dry boundary layer only producing 2 J kg^{-1} SBCAPE with strong 0-6 km speed shear of 42 kt, although unidirectional from the west with weak low-level winds. 0-1 km SRH 2 m^2 s^{-2} and high LCLs of 3000 m AGL were also not indicative of convective or tornadic potential

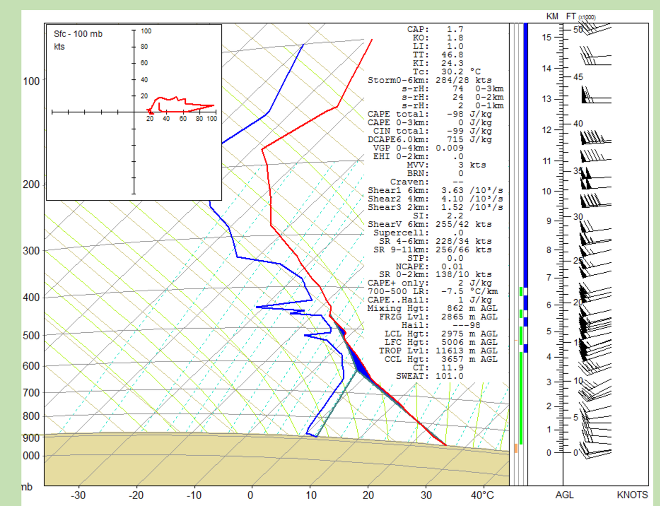

Fig 7: July 16th, 2008 0000 UTC Great Falls (TFX) sounding.

At 0000 UTC WSE indicated backed southeasterly low-level winds, and favorable SBCAPE values of 655 J kg^{-1} with the LCL and LFC at 1250 m AGL although dry low-levels. Low 0-6 km shear of 4 kt, 0-1 km SRH 19 m^2 s^{-2} were not indicative of tornadic potential.

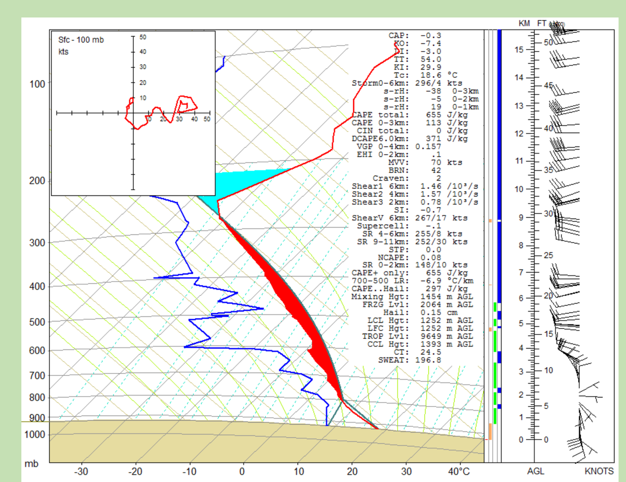

Fig 8: July 16th, 2008 0000 UTC Stony Plain (WSE) sounding.

Supplemental Soundings

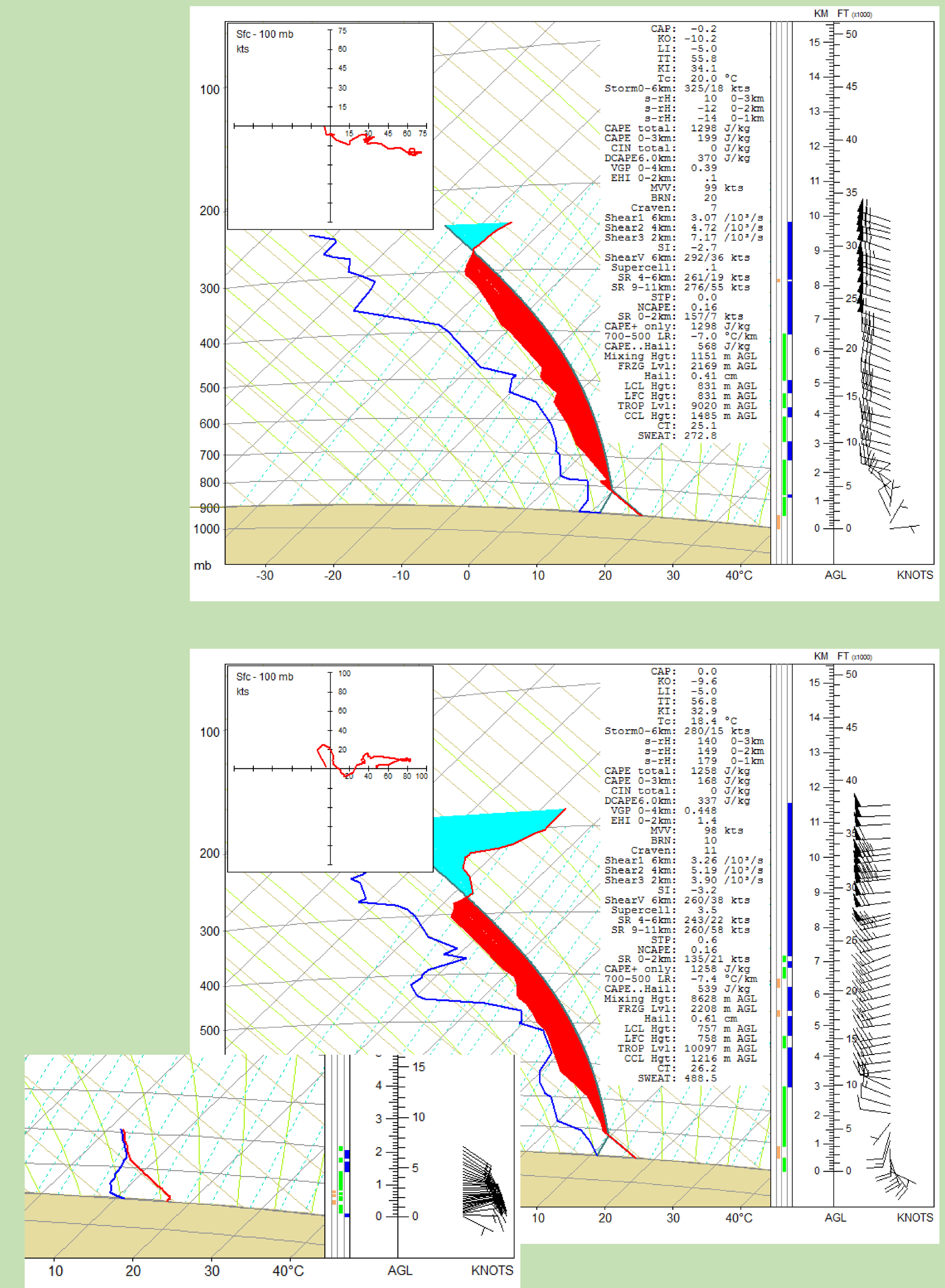

Fig 9: MB1 sounding at 2238 UTC on July 7 (top) and MB2 1200 UTC modified sounding on July 15, 2008 (bottom), 71 and 160 km away from the respective tornadic storms. Inset MB2' 2200 UTC sounding 30 km away from the tornadic storm.

The UNSTABLE soundings, 70/160 (30) km away from the tornadic storms, displayed deeper and stronger easterly low-level winds, conducive to moist, upslope flow. This easterly low-level flow also provides veering winds necessary for tornadic development. Targeted soundings also exhibited favorable 1298/1200 J kg^{-1} SBCAPE and low LFCs/LCLs 833/745 m AGL. July 15th measured 0-1 km SRH 179 m^2 s^{-2} indicative of tornadic potential. However, weak 0-6 km shear of 17/15 kt,

Conclusion

Supplemental soundings better represented the pre and near storm environment by giving a more accurate measurement of large CAPE and backed low-level winds, more indicative of supercell potential.

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