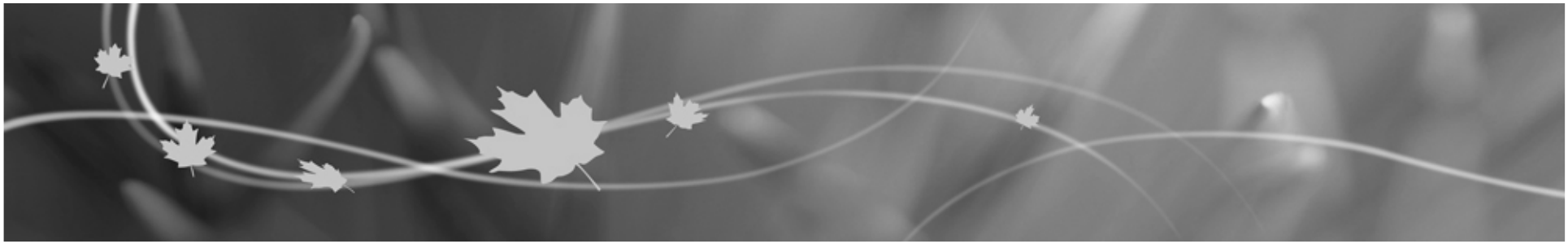
Environment Canada Environnement Canada

Canada



C-Band dual polarimetric observations of snow events in southern Canada.

S. Boodoo[1] , D. Hudak[1] , N. Donaldson[1] , M. Leduc[1] , L. Bliven[2]

[1]Environment Canada, 4905 Dufferin St.,Downsview, Ontario, Canada, M3H-5T4.
[2]NASA Goddard Space Flight Center, Greenbelt, Maryland USA.

ERAD 2012 7th European Conference on Radar in Meteorology and Hydrology. June 25-29 2012 Toulouse, France.

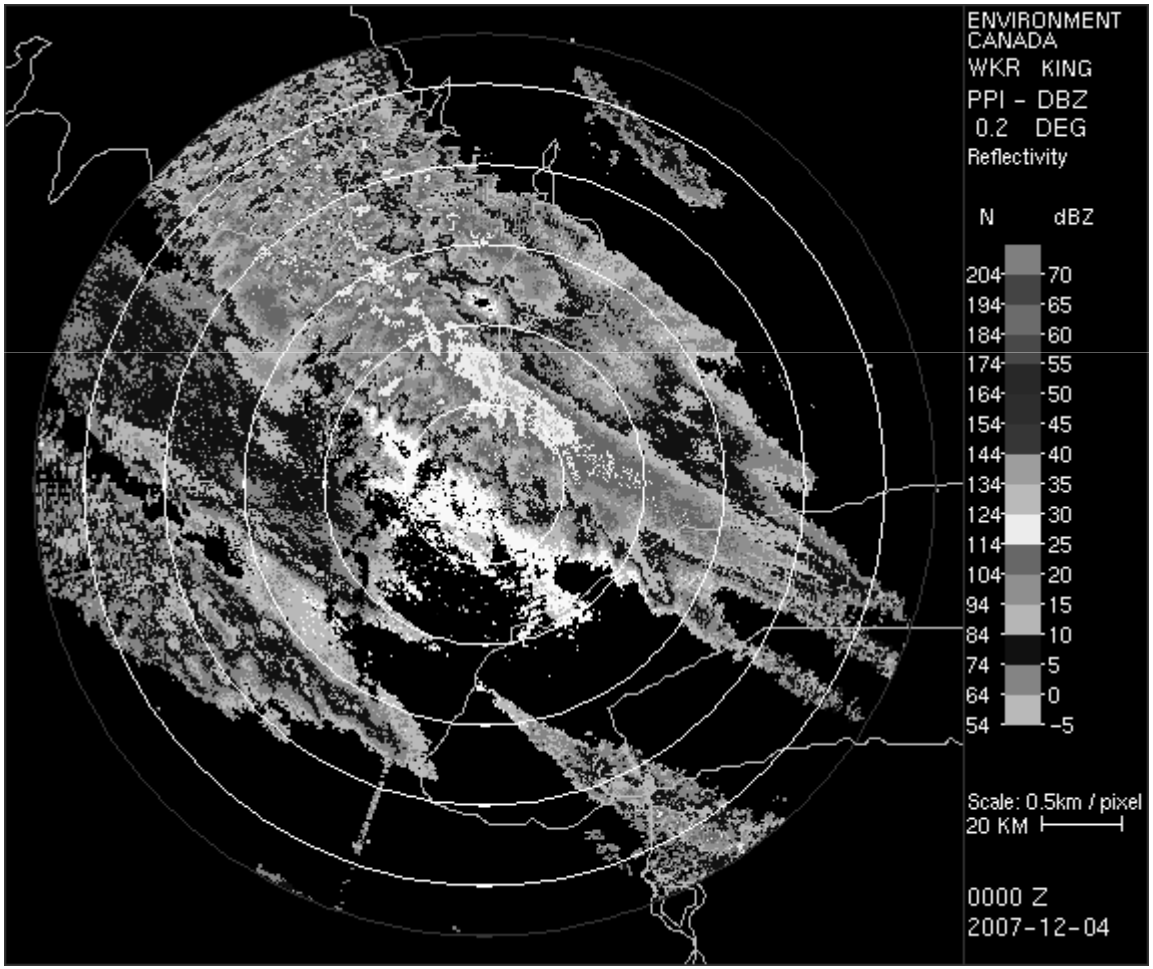
Snowfall generally of two types: synoptic and lake effect.

DATA

- **Low level PPI scans Z, Z_{DR}, ρ_{HV} and K_{DP} at 10 minute cycles.**
- **0.25km range resolution, 0.5^{o} azimuthal resolution.**
- **Ground instrumentation located at Centre for Atmospheric Research (CARE) 34 km 331^{o} from radar for meteorological observations.**
- **Precipitation Occurrence Sensor System (POSS) provided rate reference and type at CARE.**

Lake effect systems(Z - animation).

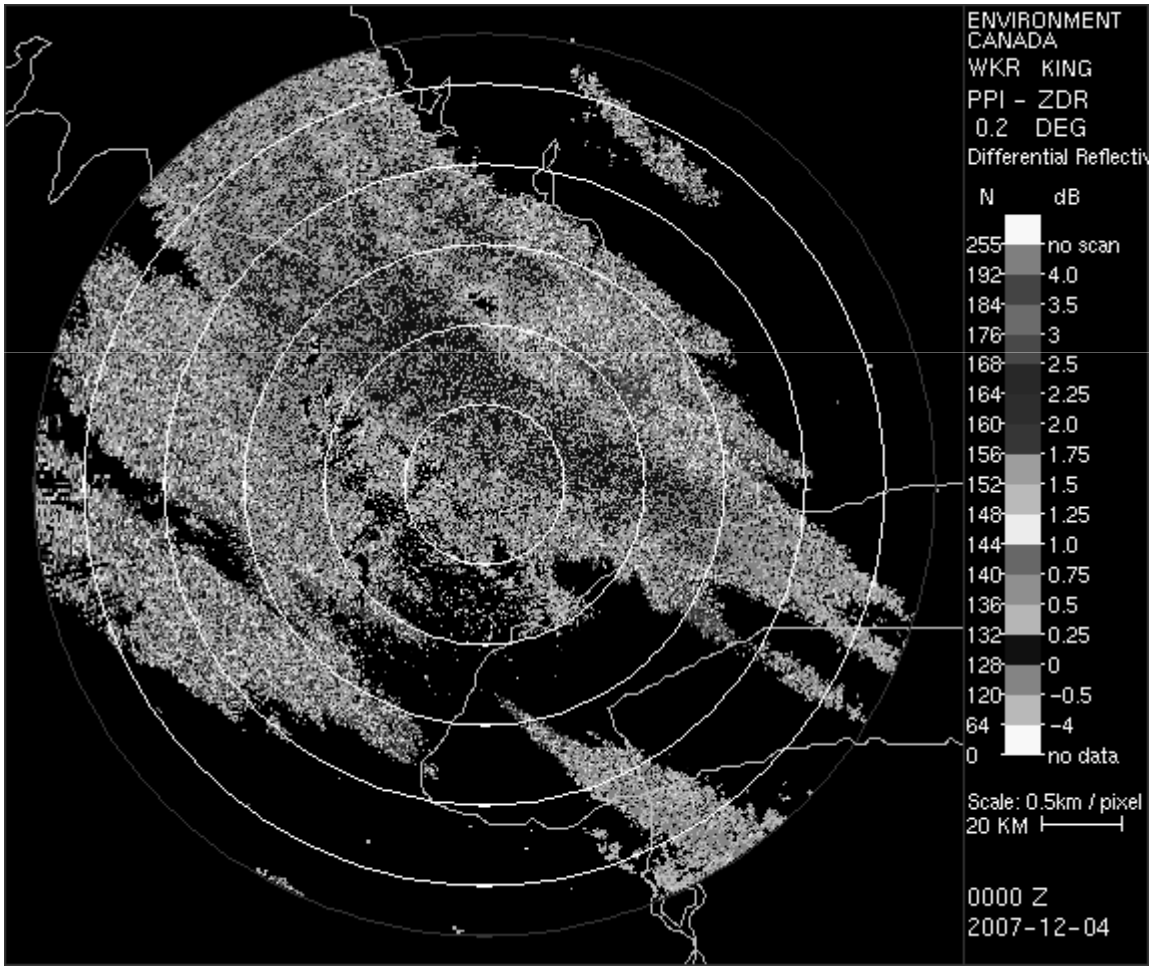
- Lake effect off Georgian Bay and Lake Huron.



- NW flows off Georgian Bay and Lake Huron often develops after a synoptic low passage.
- Related to wind speed, vertical wind shear, and lake shape.
- Dependant on temperature difference between 850mb and lake surface. T_{diff} >13^{o}C.
- Single or Multiple bands, parallel to long lake axis, or wind parallel rolls across the short lake axis.

Lake effect systems(Z_{DR} - animation).

- Lake effect off Georgian Bay and Lake Huron.



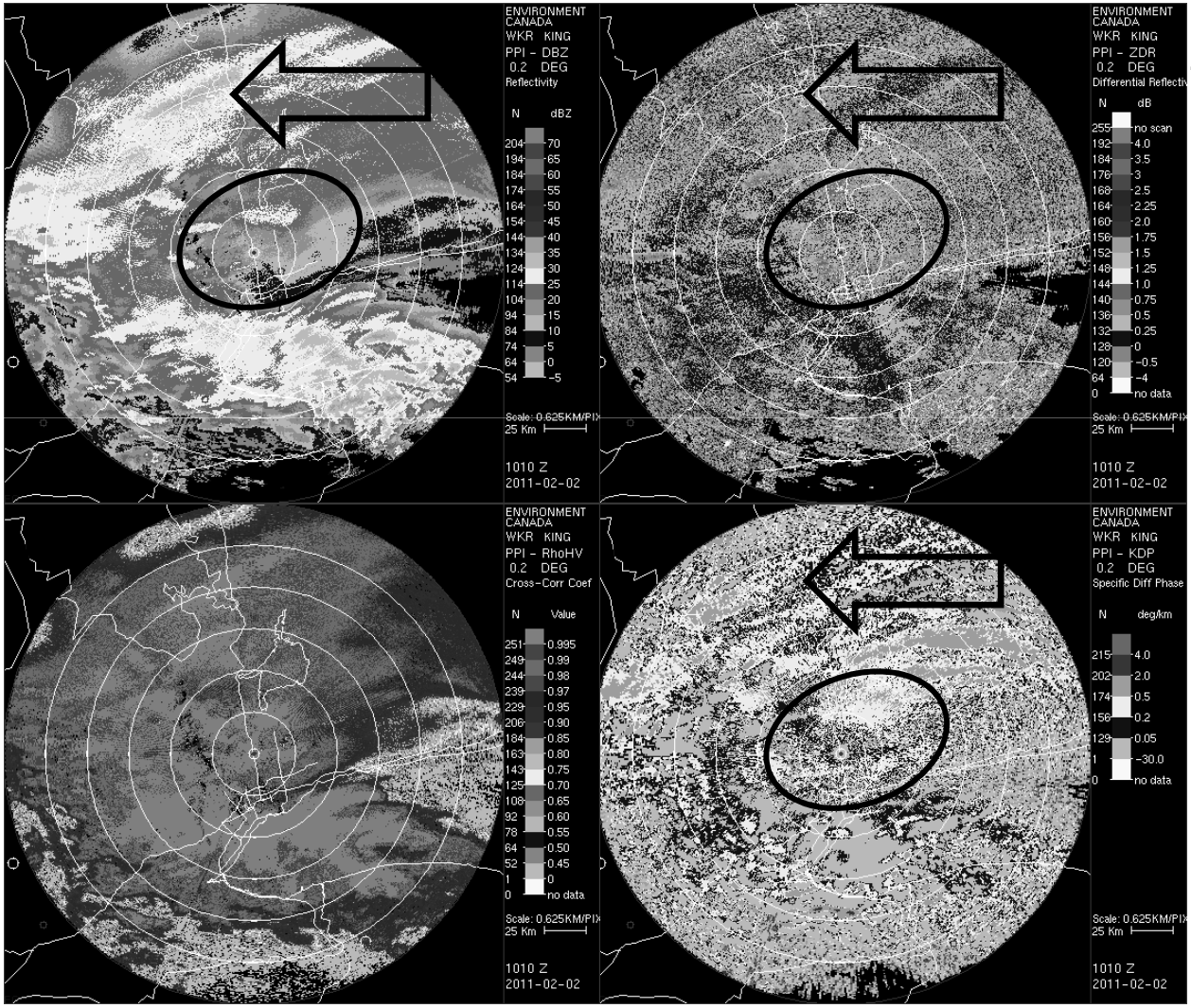
Polarimetric characteristics for specific examples.

1) Synoptic event Feb 02, 2011. 1010UTC.

2) Lake effect off Georgian Bay, Jan 18, 2012. 12UTC.

3) Lake effect off Lake Ontario, Feb. 12 2008. 15UTC.

1) 0.2º PPI's of Z, Z_{DR}, ρ_{HV} and K_{DP}.



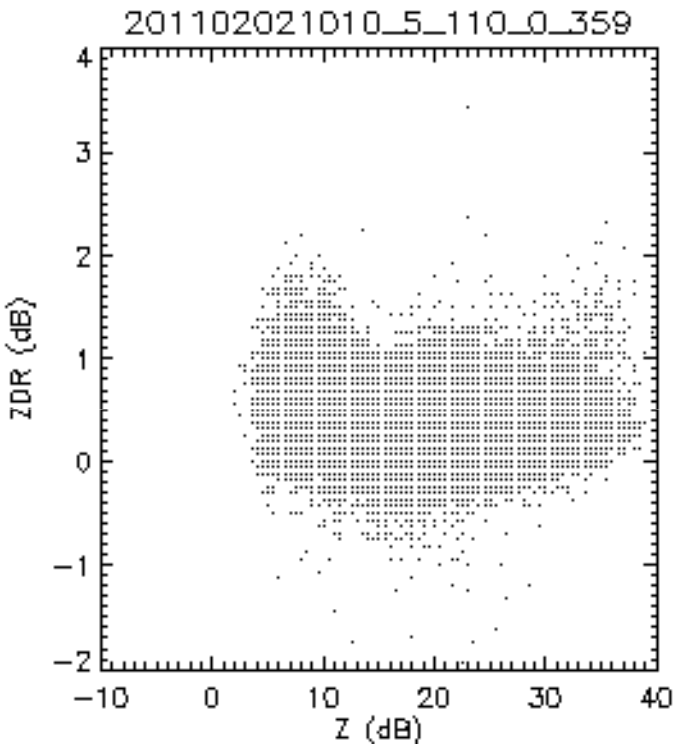
1010Z Feb. 02 2012

2 regions of storm

1) High Z, low Z_{DR}, low K_{DP}..

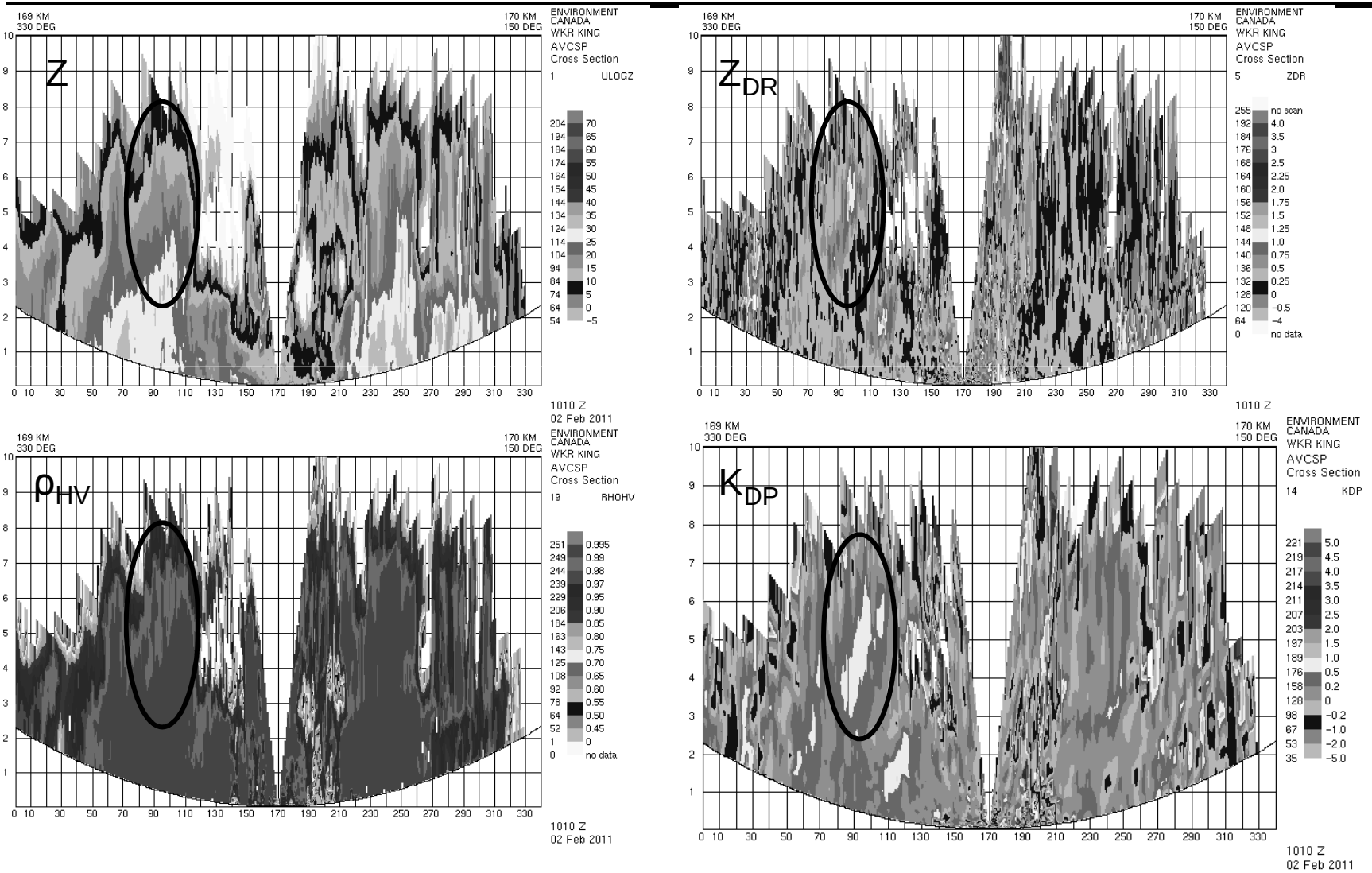
2) Low Z, high Z_{DR}, high K_{DP}.

Z – Z_{DR} scatter-plot (Synoptic).

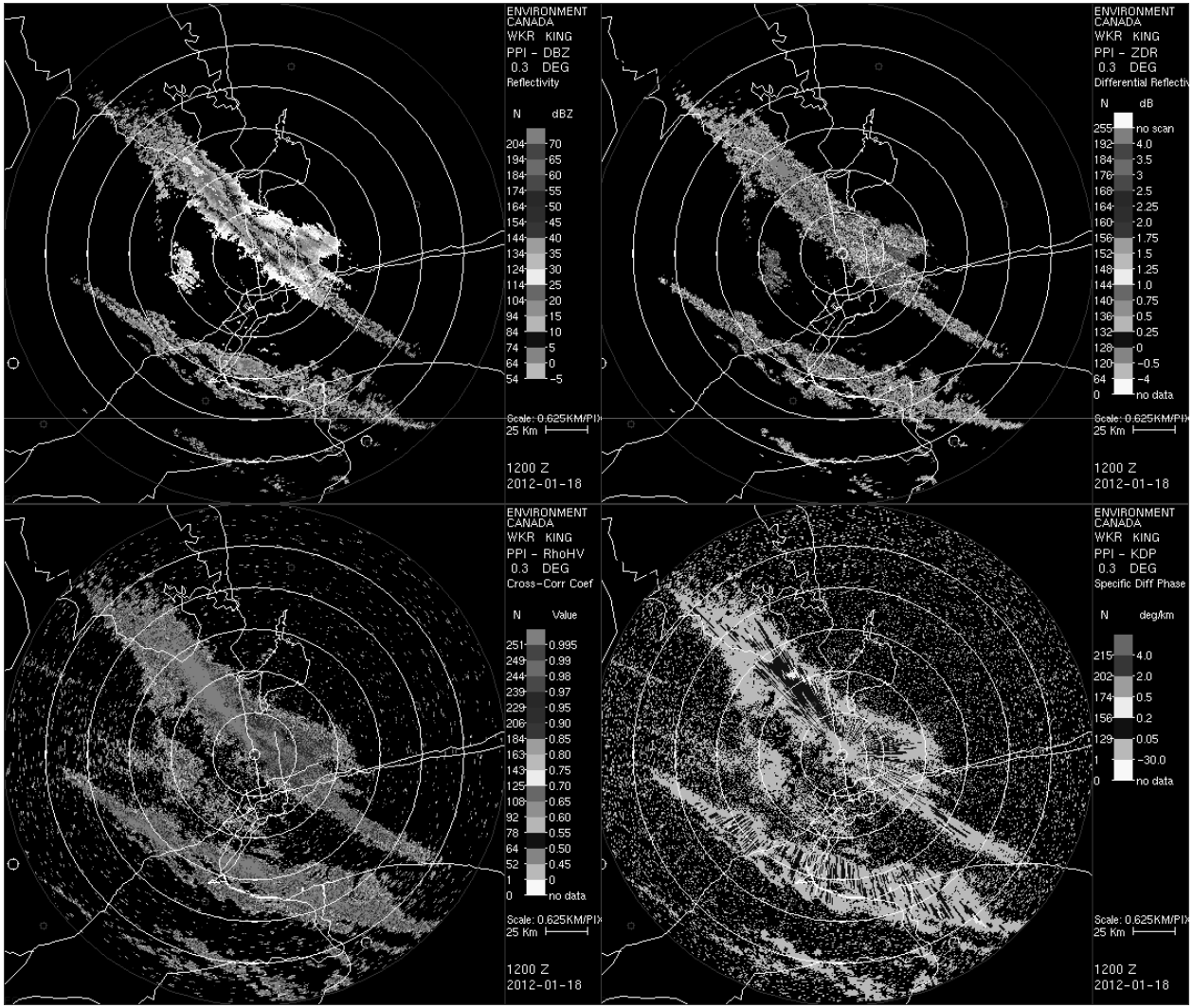


Z ranges from 0-40 dBZ but Z_{DR} remains relatively independent of Z.

Arbitrary cross-sections of Z, Z_{DR}, ρ_{HV} and K_{DP}.

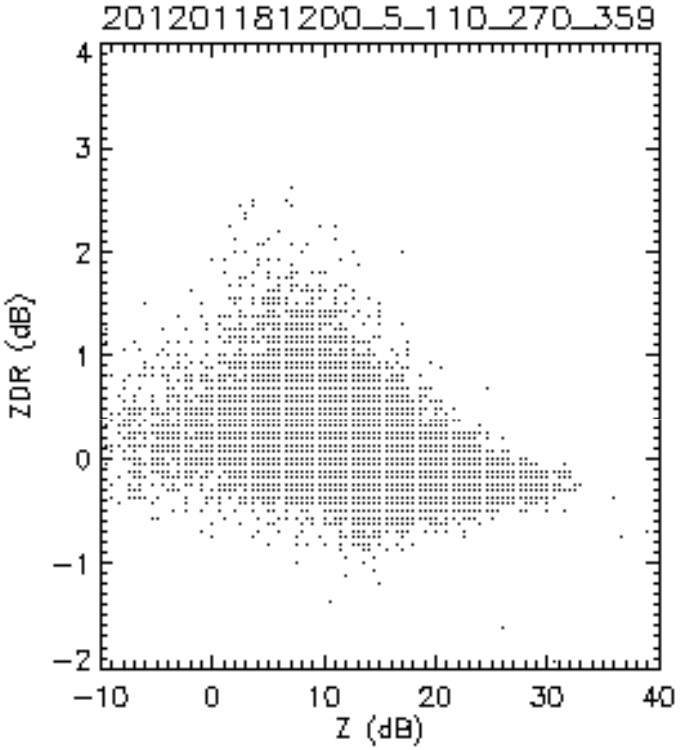


2) 0.3º PPI's of Z, Z_{DR}, ρ_{HV} and K_{DP} 18 Jan. 2012 12UTC.



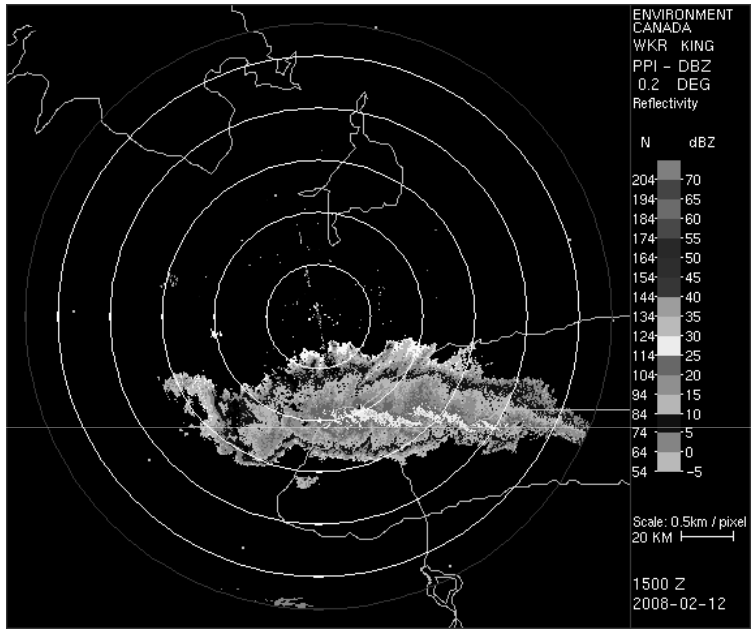
- Highest reflectivity is at the middle of the band.
- Corresponds with low Z_{DR}.
- Bands parallel to wind and long axis of lake.
- Bands can extend to over 80km inland.

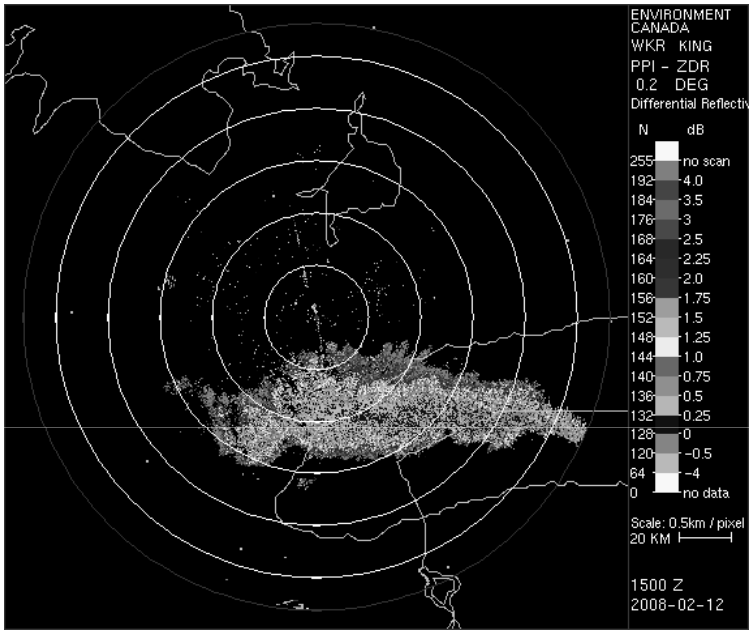
Z – Z_{DR} scatter-plot (Lake effect off Georgian Bay).



Z ranges from 0-30 dBZ. Z_{DR} ranges from -0.5-2.0dB and increases for lower Z. Very narrow range of Z_{DR} at core of band.

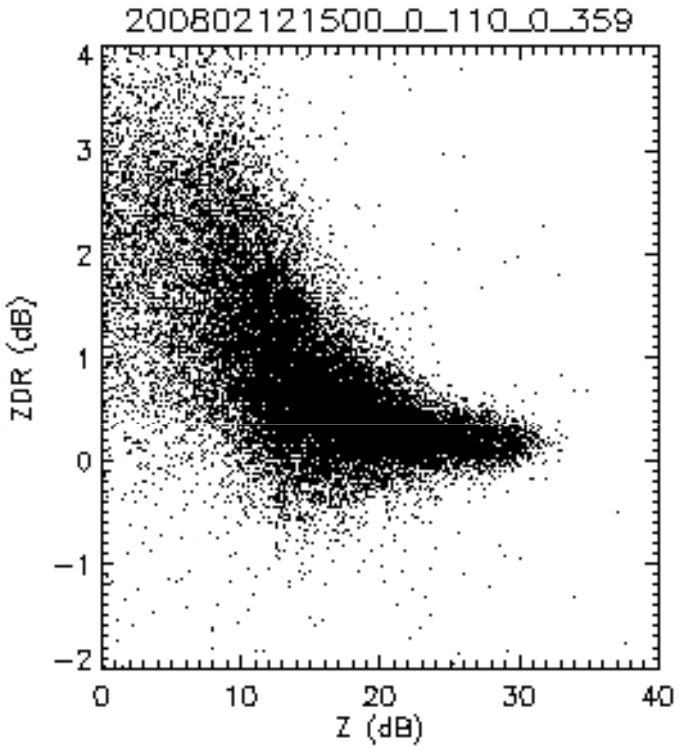
3) Lake effect example off Lake Ontario Feb. 12 2008 15UTC.





- Artic high north of lake.
- Shallow convection due to capping subsidence inversion.
- Surface temperature was ~-10^{o}C.
- Band is wider compared to previous case.

Z – Z_{DR} scatter-plot (Lake effect off Lake Ontario).



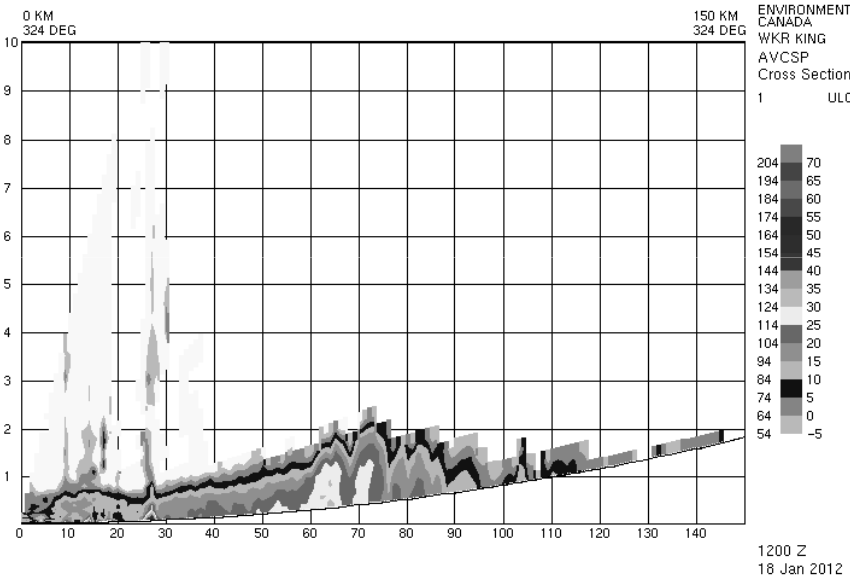
Large distribution of particles with varying shapes and sizes.

Systematic inverse relation between Z and Z_{DR}.

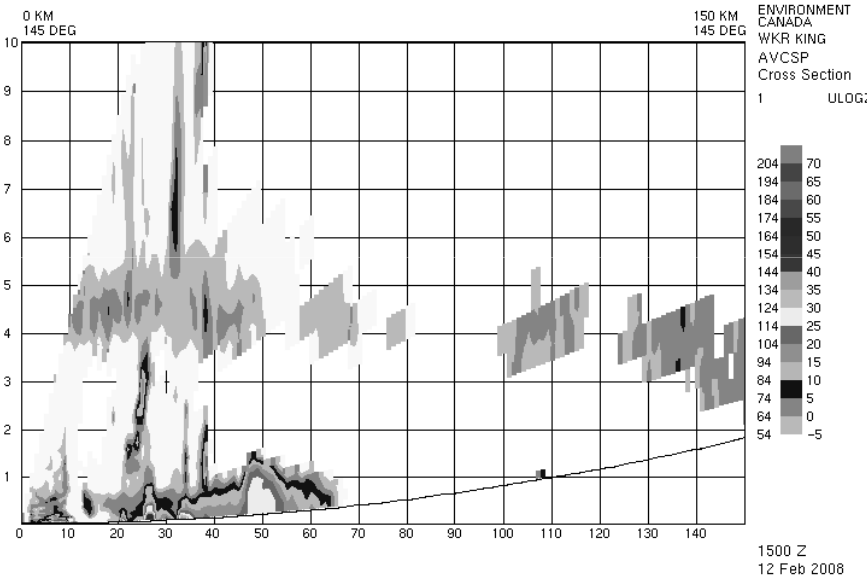
Arbitrary cross-sections of Z.

Lake effect of Georgian Bay 18 Jan. 2012 12UTC.
Lake effect of Lake Ontario Feb. 12 2008 15UTC.

Georgian Bay 18 Jan. 2012 12UTC.



Lake Ontario Feb. 12 2008 15UTC

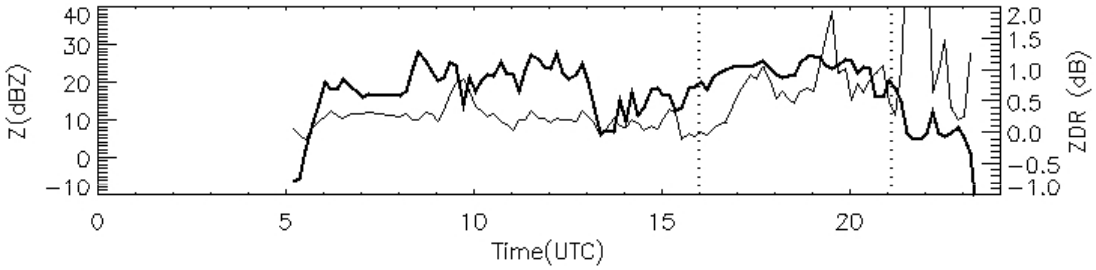


Z, Z_{DR} time series at point location.

Synoptic and Lake effect.

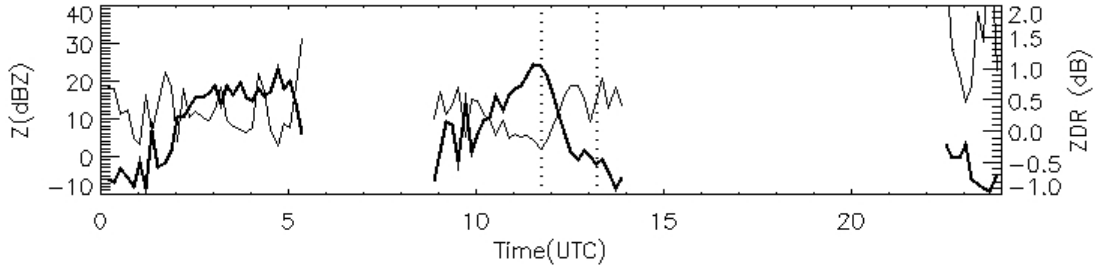
Series from 0.2º elevation PPI of Z and ZDR. 3x3 range/azimuth window averages over CARE.

Synoptic Feb. 02 2011.



- Z ranged from 10-30dBZ.
- Z_{DR} ranged from 0-1dB.
- From around 2100Z, low moved out of area, winds shifted to NW, lake effect flurries started.

Lake effect off Georgian Bay 18 Jan. 2012.



- Band was 20km wide.
- Changes in wind direction changes intensity over CARE.
- Z ranges from -10-20dBZ.
- Z_{DR} from 0-1dB.
- Inverse relationship with Z and Z_{DR} 10-14Z.

Summary.

• Synoptic and lake effect are main winter systems over the Great Lakes region of Canada.

Lake effect systems:- 1) Northwest flows off Georgian Bay and Lake Huron.
2) Easterly flows off Lake Ontario.

• Z and Z_{DR} differences between synoptic and lake effect systems.
Synoptic :- Z is mostly independent of Z_{DR}.
Lake effect :- Systematic inverse relation between Z and Z_{DR}.

• Differences between lake effect systems:-
Squalls off Lake Ontario - elliptical in shape
- short extent inland.
Squalls from NW flows - narrower, multi-banded
- extends far inland.
Both are relatively shallow ~1-3km in vertical extent.

• POSS provided insights on particle types to characterize the radar observables for the events.

Future work.

- Further investigate the POSS modal output, and the precipitation rates. Use this information as reference for developing radar snow-rate algorithm suited to the event type.
- With recent GPM Cold-season Precipitation Experiment (GCPEx) (http://pmm.nasa.gov/GCPEx) at CARE, use the supplemental ground information from particle video imager (PVI), Parsivel, 2DVD disdrometer and manual gauge readings of event snow water equivalent accumulation, to support the development of such multi-parameter snowfall estimation algorithms for differing snow types.

Merci / Thank You!