An Examination of Winter Precipitation at Cypress Mountain, BC, during SNOW-V10

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1) Introduction

The mountainous coastal region of British Columbia experiences substantial amounts of precipitation (Figure 1), especially during the winter months, due to the prevalence of moist, onshore flows. At low altitudes, much of this occurs as rain, but snowfall becomes more dominant with increasing elevations. Quantifying the precipitation between frozen and liquid states is difficult, due to the region's complex circulation. An examination of data obtained during the SNOW-V10 field campaign (to assist with the 2010 Winter Olympic Games) from Cypress Mountain, located just north of Vancouver (Figure 2), is performed to analyze the occurrence and assess driving mechanisms of precipitation quantity, rate, and type.

Figure 1. Mean Annual Precipitation for British Columbia Lower Mainland. The oval signifies the location of Cypress Mountain. (Source: Oke and Hay, 1998)

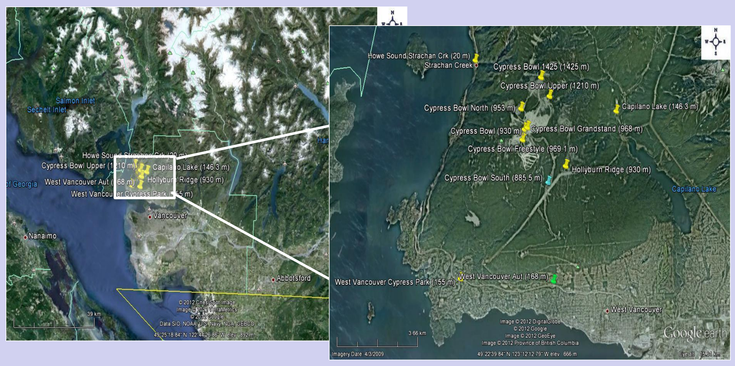

Figure 2. Cypress Mountain Area and Locations of Meteorological Stations. (Source: Google Earth)

2) Data

These analyses will be carried out through examination of the following meteorological data: temperature, relative humidity, wind speed and direction, precipitation type, rate, and accumulation, as well as radar imagery. Data availability is shown in Figure 3.

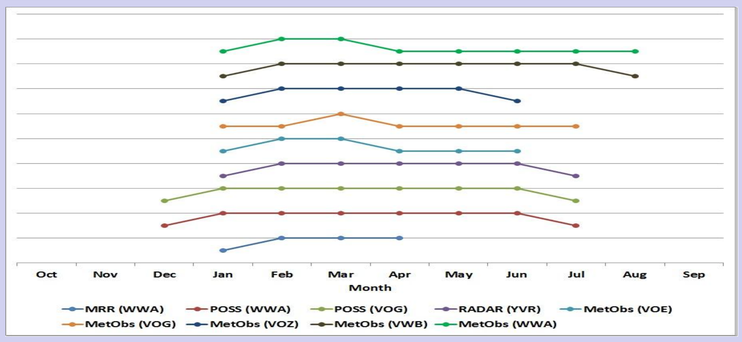

Figure 3. Duration of Record for Meteorological Information from October 2009 to September 2010. Dots off the line and on the line represent partial data and full data for each month, respectively.

3) Study Area

The BC Lower Mainland is subject to:
- atmospheric rivers and other large-scale circulation patterns favouring moist air advection from the Pacific Ocean, particularly during the boreal winter (Neiman *et al*., 2008).
- mean monthly (during the winter months) and mean annual precipitation exceeding 100 mm and 1000 mm, respectively, for Vancouver (Oke and Hay, 1998).
- significantly higher precipitation amounts (> ~2500 mm annually) over most of Cypress Mountain (el. ~1500 m), due to its higher elevation (Oke and Hay, 1998). The mountain acts as a barrier which promotes orographic lift and, therefore, significantly greater condensation. During the winter months, a considerable portion of this precipitation falls as snow.

4) Results

Two sites have detailed meteorological records for the duration of SNOW-V10: West Vancouver (WWA, el. 168 m, blue on Figure 1) and Cypress Bowl South (VOG, el. 885.5 m, red on Figure 1).

Figures 4 to 6 show meteorological data for March 11, 2010. Figure 4 shows WWA and VOG temperatures, precipitation rates, and precipitation types. Figure 5 displays WWA and VOG temperatures, wind speed, and wind direction. Figure 6 shows Micro-Rain Radar data over WWA for fall velocity and reflectivity.

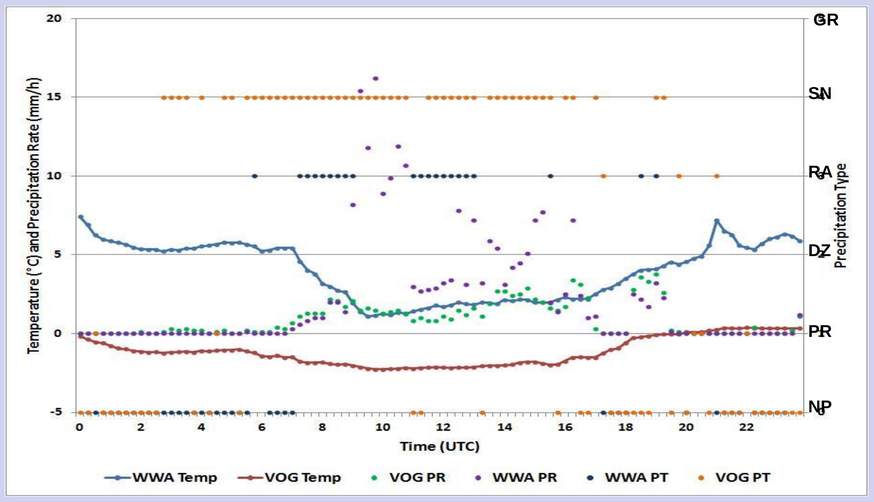

Figure 4. 15-Minute Temperature, Precipitation Rate, and Precipitation Type for West Vancouver and Cypress Bowl South for March 11, 2010.

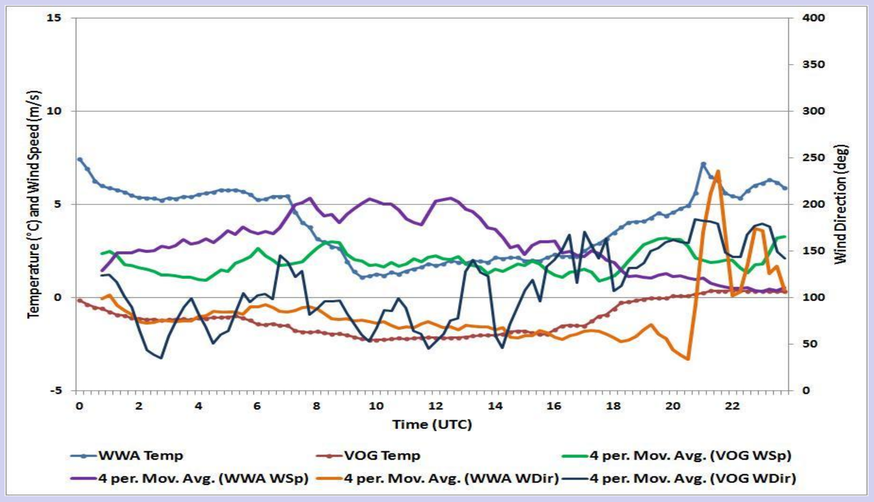

Figure 5. 15-Minute Temperature, Wind Speed, and Wind Direction for West Vancouver and Cypress Bowl South for March 11, 2010.

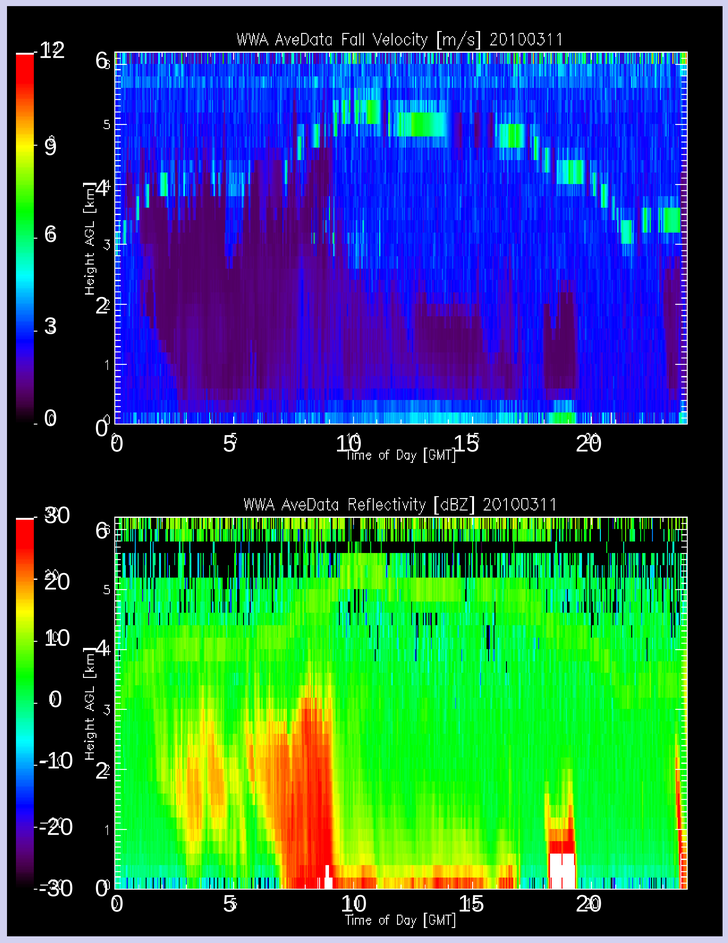

Figure 6. Micro-Rain Radar (MRR) Detection of Fall Velocity (top, in m/s) and Reflectivity (bottom, in dBZ) of Particles for March 11, 2010 over West Vancouver. Height in km AGL is the ordinate and time of day in UTC is the abscissa.

5) Conclusions

Preliminary conclusions for January-April, 2010, over Cypress Mountain are:
- Precipitation up to 1500 mm was observed, but varied by as much as a factor of two.
- Precipitation events often lasted 6-10 h, with embedded heavier precipitation rates occurring for 15-30 min and up to 2-3 h.
- Altitude differences and upslope processes contributed to whether rain or snow fell.
- Moisture advection at low levels was a prime reason for precipitation accumulation and its alteration led to diversity of amount, rate, and type.

6) References

- Neiman, P.J. *et al*. 2008. *J. of Hydromet*, 9, 22-47. DOI: 10.1175/2007JHM855.1.
- Oke, T. and Hay, J. 1998. *The Climate of Vancouver*, BC Geographical Series, No. 50. UBC, 84 pp.

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