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METEOROLOGICAL PREPARATIONS FOR THE 2010 WINTER OLYMPIC AND PARALYMPIC GAMES

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1. WEATHER AND 2010

British Columbia was awarded the 2010 Olympic and Paralympic Winter Games in 2004. The overall venue for the 2010 Games will be held in a landscape ranging from coastal plains to complex mountainous terrain. Much of the Olympic area - the region of south-western British Columbia encompassing the lower Fraser river valley and the narrow valley extending from Vancouver to Whistler, is a near-pristine wilderness with a sparse observational and climatologic record. This is especially true for a number of the outdoor Olympic venues.

Environment Canada is providing weather services for 2010; both for sport, under contract to the Vancouver organizing committee for the Games and for the safety and security of the Public during the event.

To meet the meteorological needs of the Olympics, three main initiatives are planned and underway: increasing the density and type of weather observations in the Olympic area, improving forecaster training in the meteorology of complex alpine terrain and introducing operational high resolution NWP model output with downscaled fields at very high resolution. Research activities – both domestic and international - will compliment each initiative.

2. OBSERVATION ENHANCEMENT

The existing weather observing network in the Olympic area has many gaps and may not detect small scale, yet intense, weather systems that could significantly affect public safety and security, and the operation of the Olympic Games. The surface network is therefore being significantly upgraded (Fig. 1).

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Included in the plan are 5 main automatic weather stations at outdoor venues plus a number of supplementary venue observing systems that will be installed as venue construction nears completion over the next one and a half years. A federally funded network of 15-20 automatic weather stations consisting of 11-16 new surface stations plus 4 upgrades to existing observing installations will be completed by the fall of 2007. Sensors not normally employed by the Meteorological Service if Canada (MSC) will be added to the mix, including visibility sensors and Hotplate snow systems.

In addition, three-dimensional sensors including dual polarization Doppler radar and a wind profiler are being acquired, and will be installed in the sea-to-sky corridor (the route between Vancouver and Whistler) by the end of 2007.

The addition of Doppler and wind profiler data to the available suite of observations will contribute to a planned Nowcasting project for 2007-2010 in the Olympic area.

3. FORECASTER TRAINING

The need for meteorologists to have a sound understanding of the meteorology of a complex mountainous region has led to the development, in cooperation with the Cooperative Program for Operational Meteorology, Education and Training (COMET),

of a residency course on the meteorology and forecasting of weather in mountainous environments.

This Mountain Weather Course contains a series of lectures and laboratories led by several academic and operational experts. The next offering of this 1-week course is scheduled for December 2006. Further information can be obtained from Wesley, et. al. *The First MSC/COMET Mountain Weather Course*, at this conference.

In addition to the Mountain Weather Course, forecasters will be employed directly on the Olympic Venues during the January to March period of the winters of 2007-2009. They will produce Olympic style forecasts and gain experience in local meteorology – critical to success at Games' time.

4. NUMERICAL WEATHER PREDICTION

Various inter-related numerical modelling activities are proposed in support of the weather forecasting needs of the Vancouver 2010 Winter Olympics. These include:

- High-resolution numerical modeling;
- Surface modeling;
- Downscaling; and
- Mesoscale ensemble forecasting.

4.1 High-resolution numerical modeling

MSC currently runs a limited-area model (LAM) with a resolution of 2.5 km. The operational regional forecasting model, run at a resolution of 15 km, provides the initial and boundary conditions for the LAM which, in turn, produces 24h forecasts.

By the end of 2008 a new version of the regional model running at 10 km resolution will be introduced. For Olympic forecasting, an improved version of the high resolution LAM for the Vancouver 2010 Winter Olympics will include:

- An improved microphysics scheme;
- an improved surface scheme (including urban parameterization);
- a 2 km resolution grid;
- a 30 to 36 hour leadtime.

Model verification, and the development of winter weather indices based on model output, will be competed prior to the Games. The MSC operational forecasting system, Scribe, will be populated most likely by the regional model rather than the LAM.

4.2 Downscaling and surface modeling

In current operational NWP systems there is a full two-way interaction between the atmospheric component and the surface attributes of the model. However, there is a high cost associated with running the atmospheric component of the coupled system which imposes a limit on the spatial resolution that can cost-effectively be used for simulations.

Recent studies have shown that significant improvements in the forecast of surface air temperature can be achieved by using an "off-line" high resolution surface model. The later is coupled, in a one-way fashion, to the atmospheric forcing provided by a coarser resolution atmospheric model. Because the surface model runs at a fraction of the cost of the upper air model, the spatial resolution of the surface model is mostly limited only by the datasets used in the defining the surface characteristics.

The surface model usually includes a parameterization of natural covers, water, glaciers, sea ice, and snow. At very high resolution (< 500m), a parameterization of urban covers can also be included. Specific rural covers may also be specified, such as those for the outdoor Olympic venues.

For 2010, MSC will drive a high-resolution surface model using, depending on the desired lead time, the high-resolution LAM, or the regional model. This should improve the prediction of all surface variables: surface temperature, snow conditions, low-lever air temperature and humidity, and low-level winds.

4.3 Mesoscale ensemble Forecasting

MSC will participate in a research and development project (RDP) for mesoscale ensemble forecasting (MEF) during the 2008 Beijing summer Olympics. During this period, a 15km resolution 16 member ensemble will be run daily. The initial conditions for the 16 LAM integrations will be provided by either perturbed

integrations of a uniform resolution global model, or by using members of the operational ensemble prediction system (EPS). Given the high computational cost associated with MEF and the nature of the RPD, MSC is unlikely to provide results in real time during the Beijing Olympics.

Since we estimate that a prototype of the EPS will have to be available for evaluation and training by local forecasters in Vancouver by 2007, the product delivered for the Beijing will most probably be the one provided for the Vancouver Winter Olympics

5.0 NOWCASTING AND FORECAST DEMONSTRATION PROJECT

A Nowcasting project is planned for the sea-to-sky corridor that will endeavour to use a variety of data sources, data integration and management techniques, and forecast production methodologies to improve very short range (0-3h) forecast of ambient weather in the Olympic area. Nowcasting observations will be used in routine nowcast and short range forecast production in the Olympic area. In addition, MSC is planning to host a World Weather Research Program (WWRP) Forecast Demonstration Project and possibly a Research Development Project as part of this effort. These will operate both prior to and during the Olympic period. Additional observing instrumentation planned for nowcasting and FDP purposes are illustrated in Figure 2.

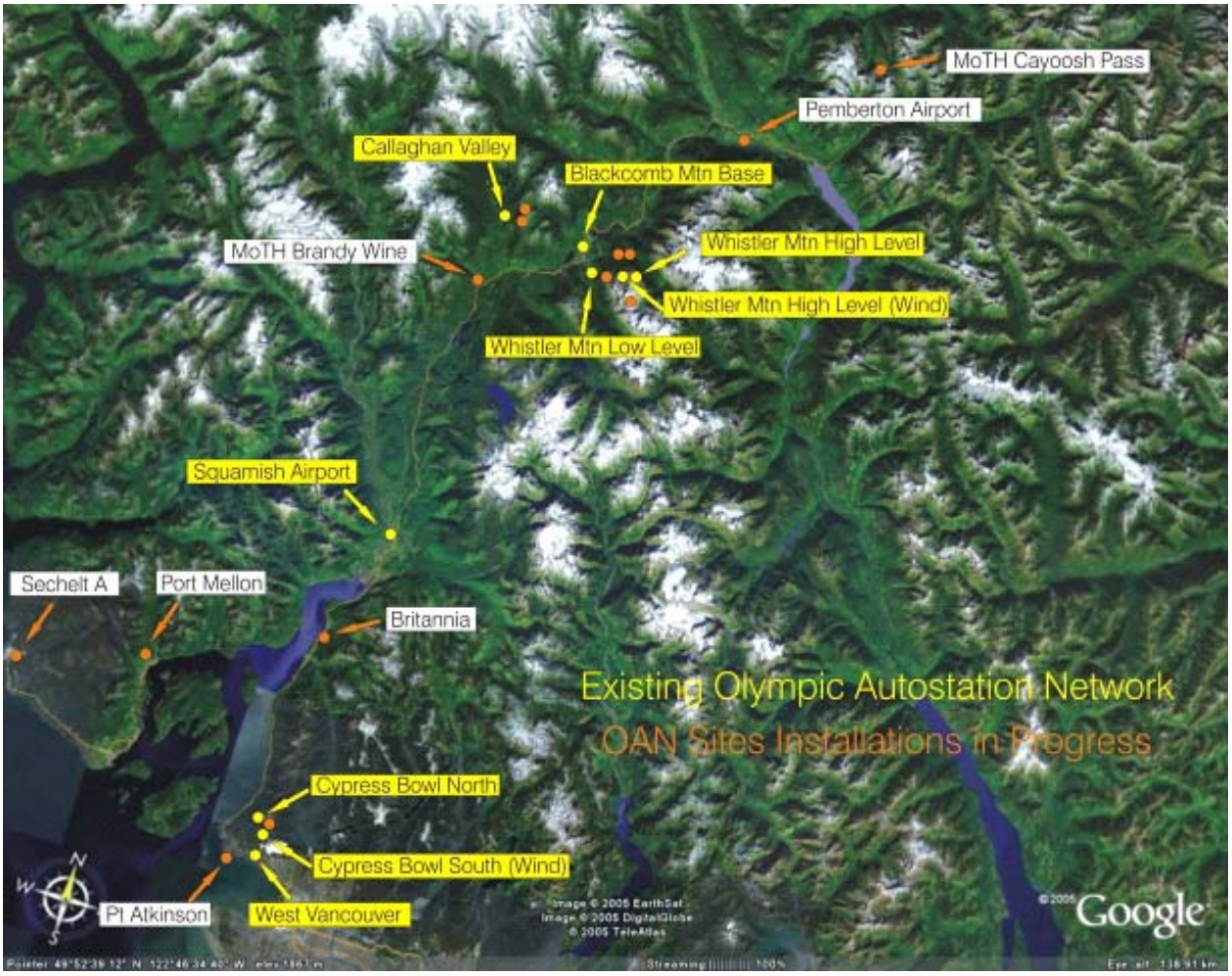

Figure 1. Installed and planned surface observing systems

Figure 2: Additional observing systems for operations, Nowcasting and FDP purposes. WP: Wind Profiler (includes RASS); HP: Hot Plate Snow/precipitation sensor; MRR: Microwave Rain Radar; POSS: precipitation- type sensor; GeoNOR: rain Gauge; Fog/VIS: visibility sensors; CASA: potential small footprint radars from the Center for Collaborative Adaptive Sensing of the Atmosphere; X Dop POL: X-band dual polarization Doppler weather radar.