Value of weather forecast services to the 2010 Olympic and Paralympic Winter Games

Pacific North-West Weather Workshop

29 February, 2008

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Project Rationale

- The Vancouver 2010 Winter Olympics (V10) will be held from 12 -28 February 2010. Given the climatology of the region, it is likely that adverse weather will, in some manner, affect the conduct of the Games.
- Severe winter weather and other adverse weather will affect the scheduling and operation of individual sports.
- It may also create difficult and possibly hazardous conditions for Athletes, spectators and the Games' workforce.
- Will demonstrate how forecasts are used by Operational Olympic decision makers to mitigate the effects of adverse weather conditions, and to demonstrate the value of those forecasts.
- Part of THORPEX societal and economic impacts (SEA) subprogram

Timetable

- Phase 1 (underway) involves assessing the effects of weather types on sporting events and operationally related areas
- transportation
- broadcast
- recording weather forecast-based decisions, and generalizing a decision-making approach from the evidence.
- Estimating the cost/benefit of potential forecast/decision couples.

Phase II: April 08-March 09

- The design, generation and evaluation of forecasts.
- Evaluation of decisions made on the basis of those forecasts.
- A calculation of potential costs and benefits to the Games, were the period of evaluation to be the actual V10 interval.
- This phase will include the Olympic practicum (forecaster training) period of January-March 2009.

Examples – Economic Impacts

- Decisions to alter event timetables or make decisions to mitigate based on weather forecasts have been made at prior Olympics.
- Some economic and social aspects of these decisions include:

- ***Changing schedules affects broadcasters***
  - *Changing the time of the event changes the viewing demographic or numbers – and is potentially costly.*

- ***Events held in better weather are safer****;*
  - *there is a higher likelihood of world record performances in optimal conditions.*

- ***Mobilizing workforce***
  - *coping with adverse weather at the sporting venues is highly dependent on the weather forecast ie. Alpine events may require several hundred in a workforce to deal with snowfalls. If these are unanticipated, it can affect the operation of the venue, the safety and comfort of spectators and cause significant transportation problems.*

Forecasts

- Two kinds of forecasts will be evaluated:
- Short–term (0-48h) subjective (forecaster-produced) forecasts based on the Canadian GEM and derivative LAM models, and
- Longer term (48h-96h) forecasts produced from model data provided by the NAEFS

Environment Canada Participation in T-PARC

T-PARC winter phase:

- Assessment of 3-7 day high-impact weather genesis in NAEFS by operational meteorologists at MSC Pacific Weather Center in Vancouver. (Forecasts produced with and without T-PARC data)
- Verification data: Additional special radiosonde data; Whistler BC, Comox BC, 06/18Z runs added to Port Hardy BC and (maybe) Quilaute WA.
- Microwave Profiling radiometer (Whistler)

Summary of work

- Each phase will require a significant amount of basic research, including:
- Determining what particular sensitivities various and selected 2010 sports and activities have to weather.
- Determining what (if any) decisions are made on the basis of weather forecasts, and;
- Determining the economic consequences of decisions made.
- Generating an estimate of value from forecasts produced both with and without T-PARC winter phase data – enables an estimate of the value of additional data

Findings to date

- Different sports have different thresholds
- Some standard thresholds come from International Sporting Federations
- Others are venue specific and depend to an extent on venue design
- Forecasts of weather crossing threshold do not necessarily result in a decision
- Timing is important
  - Frequent observations; nowcasting
  - Time compression for the event

2010 Sports/Weather Threshold matrix;

Red text = Critical Decision point

Orange text = Significant decision point

Green text = Factor to consider

Sport and Weather	New Snow (24 hours)	Wind	Visibility	Rain	Low Temp	High Temp	Wind Chill
DH,SL,GS	> 30 cm	Constant above 17 m/s or gusts > 17 m/s	< 20 m on the entire course>	15mm in 6 hours or less			
	> 15 cm and < 30 cm	Constant 11 m/s to 17 m/s <	20 m on portions of the course	Mixed precipitation			
	➢5 cm ➢(venue manage ment)	Gusts above 14 m/s but < 17 m/s>	>20m but <50m on whole or part of the course				

2010 Sports/Weather Threshold matrix;
Red text = Critical Decision point
Orange text = Significant decision point
Green text = Factor to consider

Sport and Weather	New Snow (24 hours)	Wind	Visibility	Rain	Low Temp	High Temp	Wind Chill
Biathalon		> 8 m/s	< 50 m		< -20C	>0C or sharply rising temp tendency through 0C	<-25C
Snowboard			< 300 m (halfpipe – judges)	Yes or No	< -25C		
Freestyle Aerials and Moguls	Yes or No	> 7 m/s (sustained or gusts)	< 30m aerials <200m Moguls	Yes or No	< -25C		< -25C

2010 Sports/Weather Threshold matrix;
Red text = Critical Decision point
Orange text = Significant decision point
Green text = Factor to consider

Sport and Weather	New Snow (24 hours)	Wind	Visibility	Rain	Low Temp	High Temp	Wind Chill
Ski Jump	Yes or no and how much >30 cm/24h	> 4 m/s sustained, >=3 m/s gust spread, or variability >=60 degrees	< 50 m	Yes or no and how much	< - 20C	> 0C or sharply rising temperature tendency thru 0C.	
		>3 but < 4 m/s sustained, >2 but < 3 m/s gust spread, variability >45 but <60 degrees					
X-Country		Such that blowing snow is produced	<50 m		< - 20C		

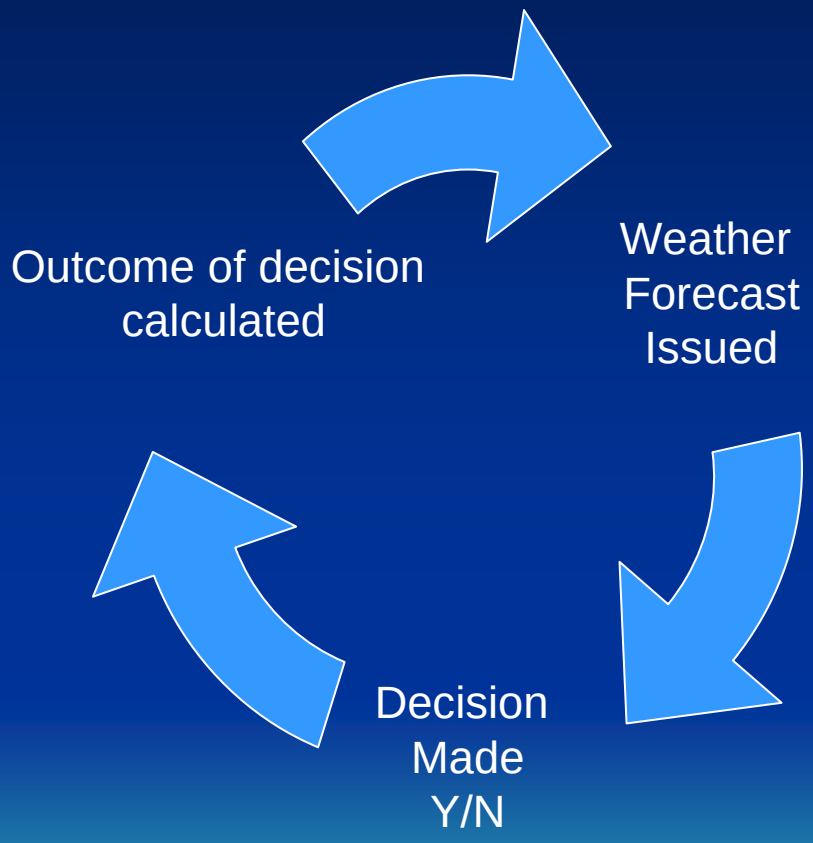
2010 Sports/Weather Threshold matrix;
Red text = Critical Decision point
Orange text = Significant decision point
Green text = Factor to consider

Sport and Weather	New Snow (24 hours)	Wind	Visibility	Rain	Low Temp	High Temp	Wind Chill
Bobsled, Skeleton, Luge	Yes or No	>13 m/s but < 15 m/s		Y or N	Daily mean temp > 4C and RH < 30%	Daily mean temp > 4C and RH < 30%	
Bobsled, Skeleton, Luge	> 15 but < 30 cm/12h	>= 15 m/s					
Bobsled, Skeleton, Luge	>15 cm/6h or >30 cm/12h				T = dewpoint RH > 65%	T = dewpoint RH > 65%	

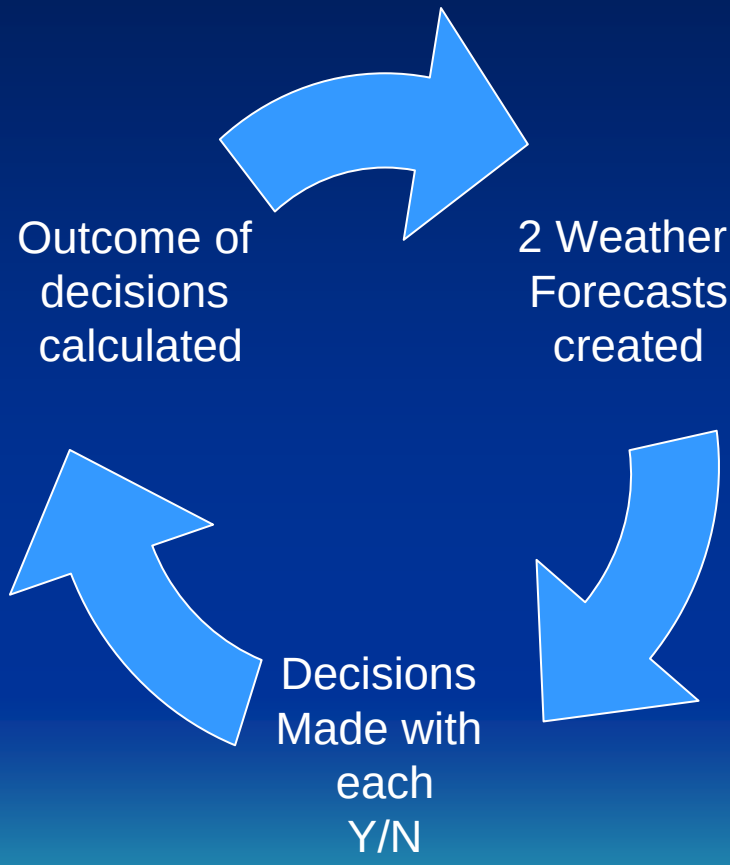
2010 Sports/Weather Threshold matrix;
Red text = Critical Decision point
Orange text = Significant decision point
Green text = Factor to consider

Sport and Weather	New Snow (24 hours)	Wind	Visibility	Rain	Low Temp and humidity	High Temp	Wind Chill
Indoor Ice	Yes or No (duration of precipitation)			Yes or No (duration of precipitation)		Rapidly rising temperature trend (>10C/24h)	

Cost benefit calculus



Forecast value calculus



Anecdotes

- February 9-10; Men's and Women's world cup freestyle and moguls event, Cypress Resort
- Day 1 – Forecast vis to decline below threshold during event (Men’s moguls)
- Forecast correct
- Competition cancelled after 40/48 competitors completed

Anecdotes

- February 9-10; Men's and Women's world cup freestyle and moguls event, Cypress Resort
- Day 2 of competition– Forecast vis to improve above threshold by 2 pm.
- Organizers postponed cancellation and scheduled event (Women’s aerials trials) to begin at 2pm – a 3 hour delay…further delays not possible due daylight limitations
- Venue cleared at 2:15. Event was completed.
- Medal awarded on the basis of trials results

Participants

- Principal investigators:
- Tracy Parker (economist PYR)
- Roger McNeill (economist PYR)
- Ian Okabe (PYR Science Division)
- Chris Doyle (Chief Meteorologist, V10).
- Forecast generation:
- NCEP (Winter Phase T-PARC)
- Trevor Smith
- 2010 Practicum forecasters
- Olympics Information:
- V10 Sports Division Managers
- Transportation Division
- Workforce
- Broadcast

References

- Parsons, David. SCIENTIFIC PROGRAM OVERVIEW, THORPEX PACIFIC-ASIAN REGIONAL CAMPAIGN (T-PARC) http://www.ucar.edu/na-thorpex/tparc/SPO_PARC_revised.pdf
- T. KEENAN, P. JOE, et. al. THE SYDNEY 2000 WORLD-WEATHER RESEARCH PROGRAMME FORECAST DEMONSTRATION PROJECT. Overview and Current Status. Bulletin of the American Meteorological Society. Aug 2003, p. 1041, pp 1049-1051.