BlueSky Western Canada Wildfire Smoke Forecasting System Pilot Project

Wildland Fire 2010 Conference
Kitchener-Waterloo, 2010

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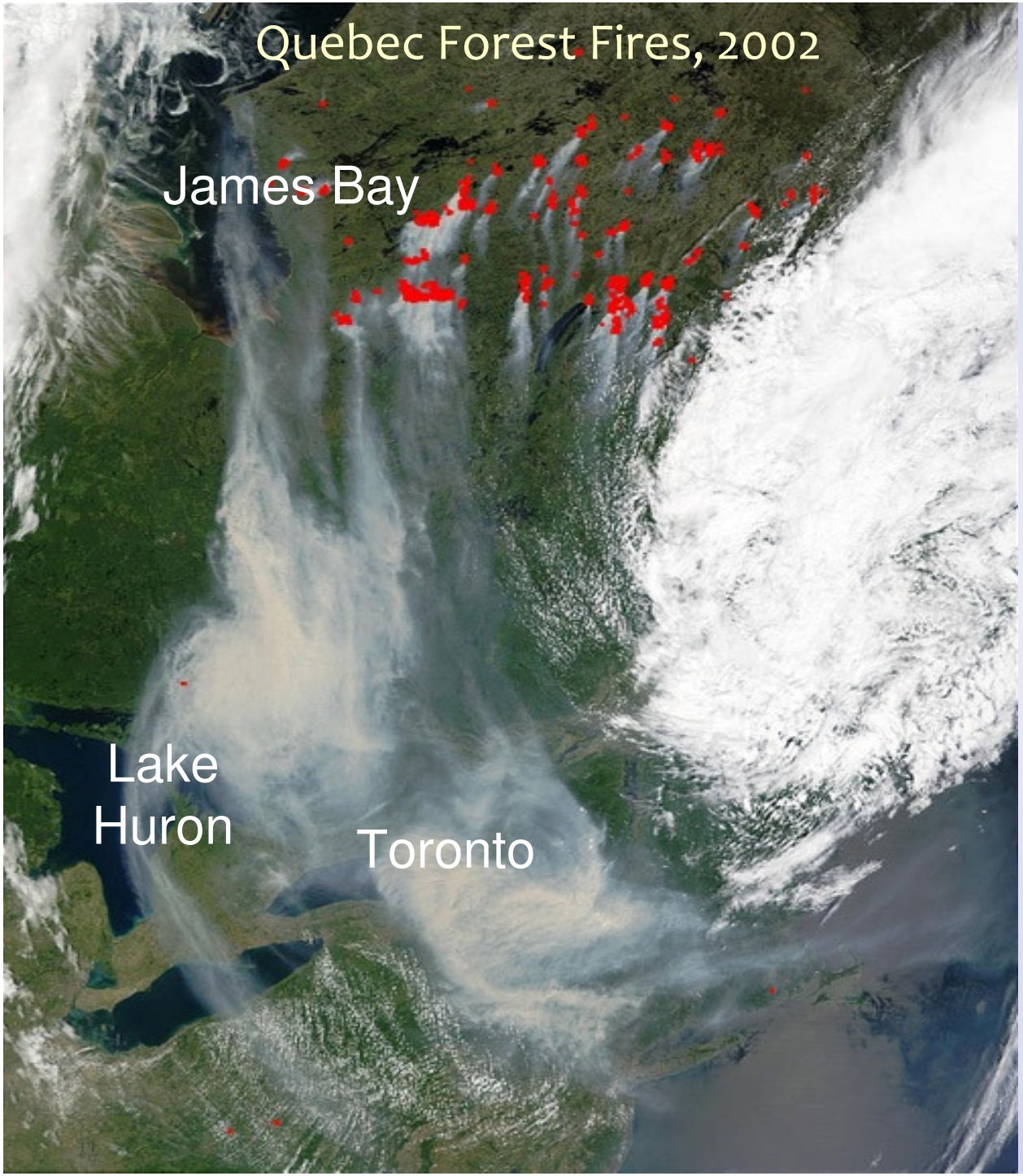

Wildfire Smoke Impacts

Smoke can drift for 1000s of km, and impact activities of millions of people.

There are a variety of agencies which have differing needs with regards to smoke:

- Public safety and health authorities (advisories, evacuations)
- Transportation (visibility)
- Tourism (health, visibility, nuisance)
- Fire management (downstream effects)
- Weather forecasters (trajectories)
- Air Quality Management Agencies (concentrations)
- General public (health, nuisance)

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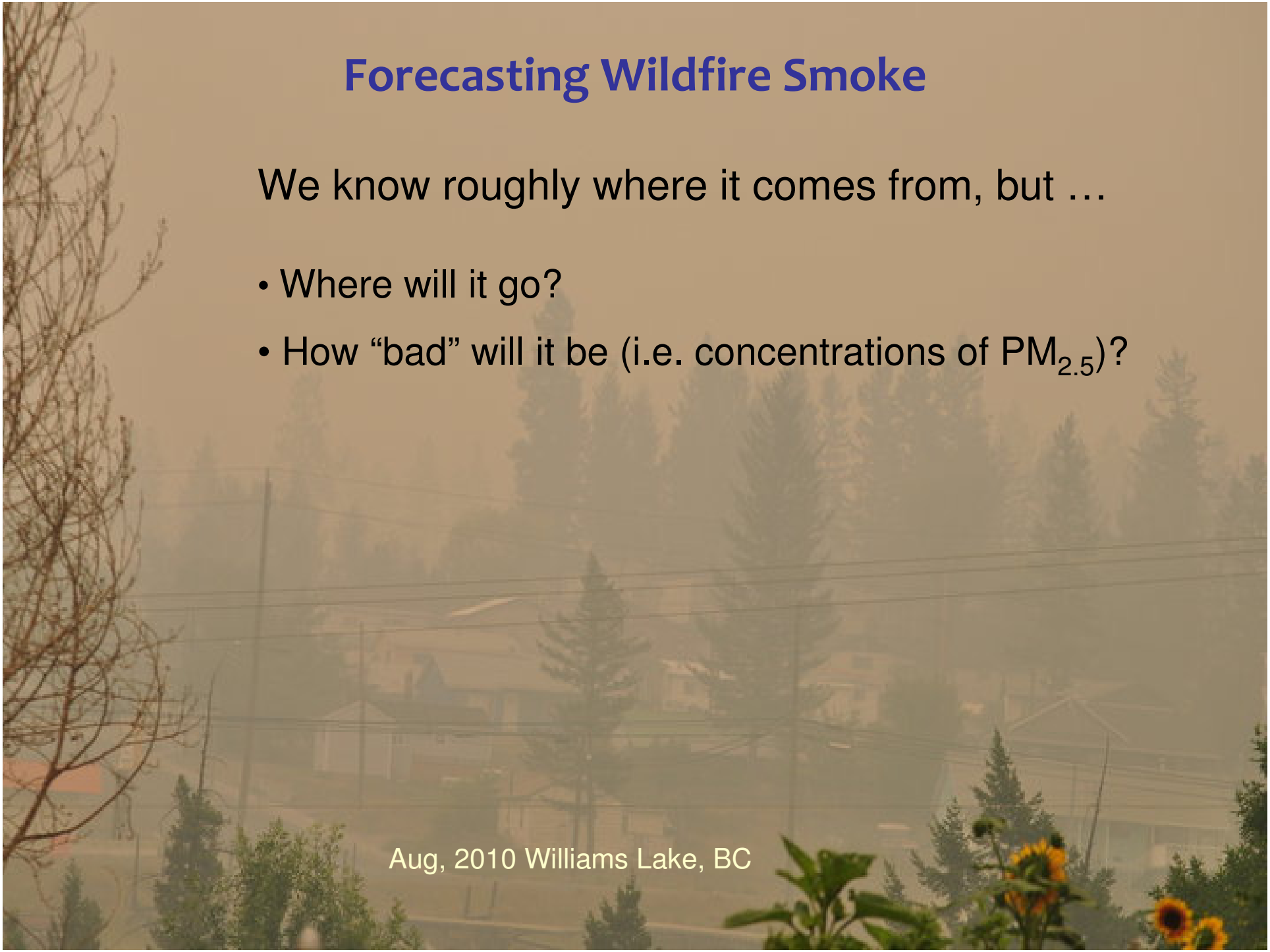
Forecasting Wildfire Smoke

We know roughly where it comes from, but …

- Where will it go?
- How "bad" will it be (i.e. concentrations of $PM_{2.5}$)?



Smoke Forecasting System BC/Alberta: Origin and Development

Brew-Sky, BlueSky-Eh?

- Early Alberta wildfire smoke modelling (2005)
- Wildfire Smoke Workshop, Edmonton (2007)
  - Idea: Use existing US Forest Service BlueSky Framework
  - Modular – Canadian parts swapped in
  - Multi-Agency pilot project to test feasibility

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Partners

A subset of the twelve partners, which include several Canadian federal, provincial and US agencies

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Alberta
Freedom To Create. Spirit To Achieve.

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

UBC

Environment Canada | Environnement Canada

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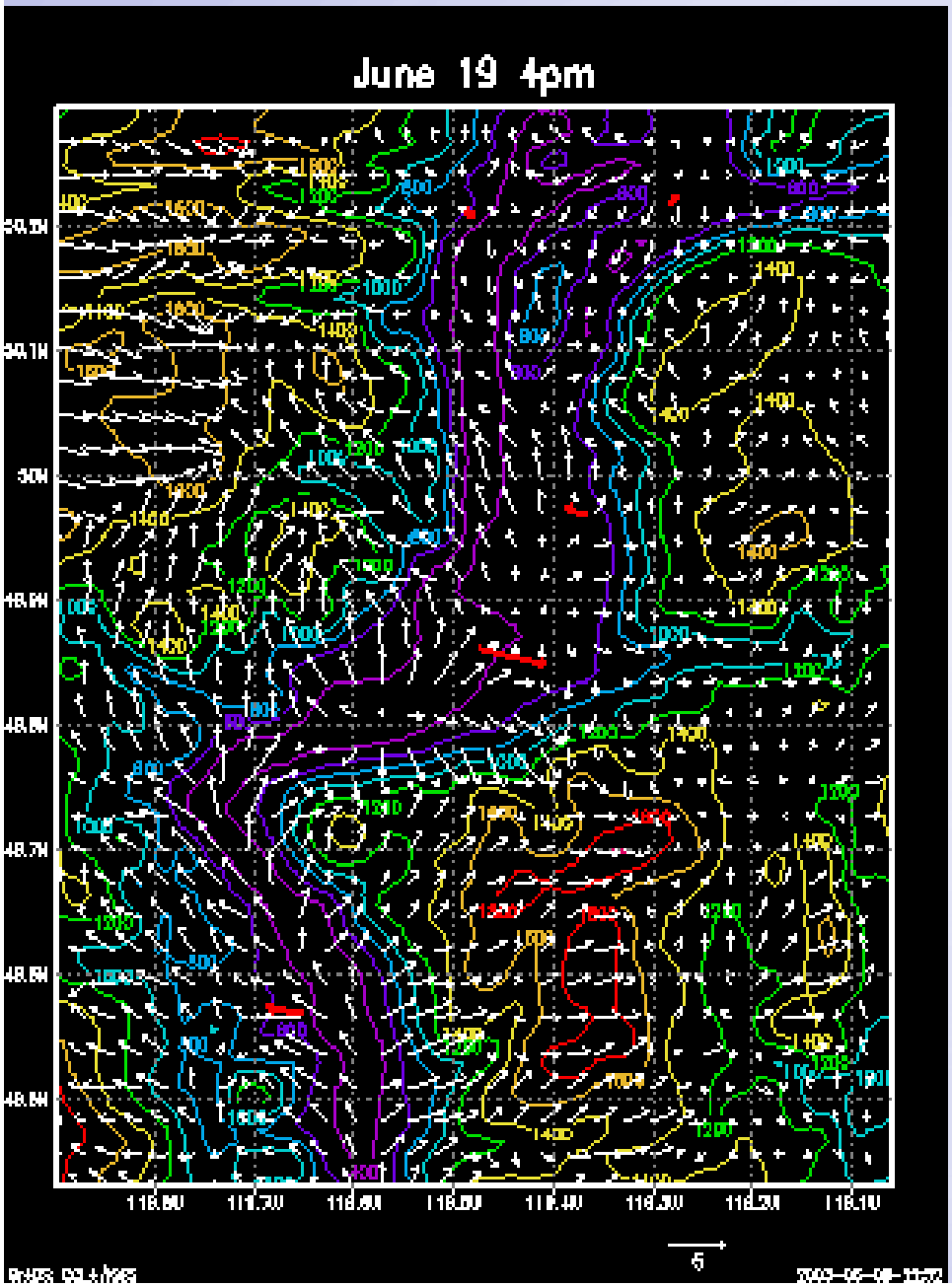
Forecasting Smoke from Wildfires: What is Needed?



Forecast Meteorology

- University of British Columbia: Dept of Earth and Ocean Sciences
- Weather Prediction Model: MM5 produces forecast hourly meteorology up to 48 hours into the future, for a 4 km grid across BC and Alberta

Example: Forecast Wind Direction Okanagan Valley

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Forecasting Smoke from Wildfires: What is Needed?
(cont'd)

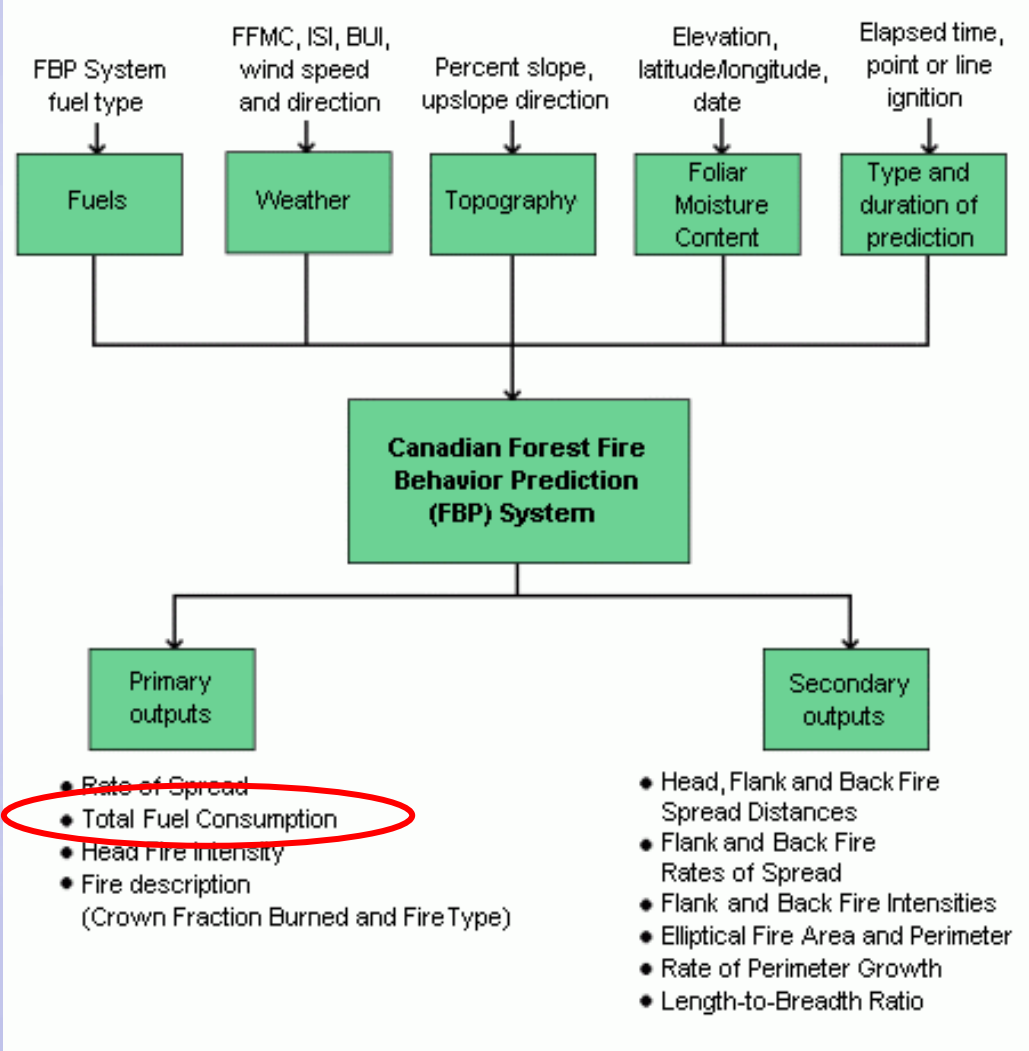
Wildfire Location, Fuel Consumption

Image courtesy NOAA

- NOAA satellites: *identify & locate* active fires (hotspots) daily using Moderate Resolution Imaging Spectroradiometer (MODIS) and Advanced Very High Resolution Radiometer (AVHRR) instruments
- Canadian Wildland Fire Information System (CWFIS) downloads hotspot data and estimates fire attributes for each hotspot using the Fire Behaviour Prediction (FBP) system

Forecasting Smoke from Wildfires: What is Needed?
(cont'd)

Plume / $PM_{2.5}$ Modelling



- Canadian Forest Fire Behavior Prediction (FBP) System estimates fuel consumption
- future: CanFIRE
- USFS: Fire Emission Production Simulator (FEPS) – estimates plume and $PM_{2.5}$ emissions

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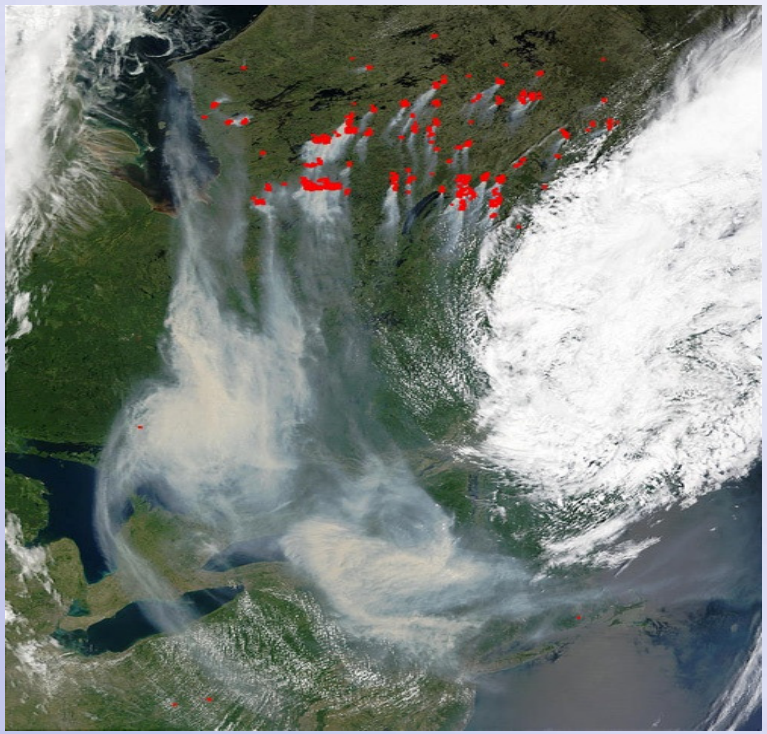
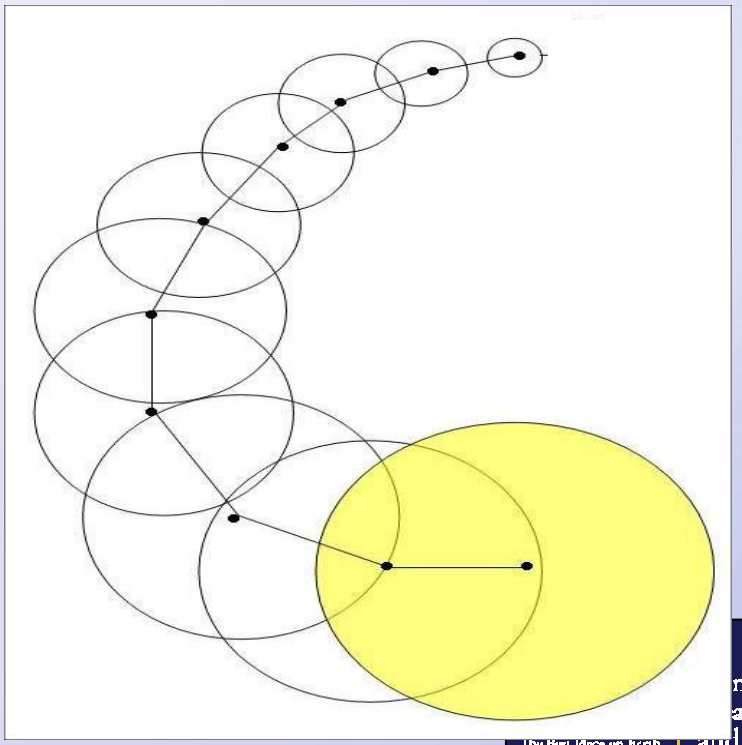
Forecasting Smoke from Wildfires: What is Needed?
(cont'd)

Smoke Plume Transport and Dispersion Model

- NOAA Air Resources Laboratory HYSPLIT Model
- Estimates ground–level $PM_{2.5}$ concentrations with puffs
- Mixing height, stability, topography, vertical motions included





Forecasting Smoke from Wildfires: What is Needed?
(cont'd)

BlueSky Framework to Link the Pieces

- BlueSky Framework Software with Computer Hardware provided by the US Forest Service
- Installed and Operated at UBC

BlueSky Framework: Fitting it Together

Hourly Meteorological Forecast: MM5 Weather Forecast Model: University of BC in Vancouver, B.C.

Daily Wildfire Location and Fuel Consumption: Canadian Wildland Fire Information System: Northern Forestry Research Centre in Edmonton, Alberta

HYSPLIT and BlueSky Framework: Framework links pieces and produces smoke transport and dispersion forecast (UBC)

Web Output: Animations of forecast hourly ground-level concentrations of $PM_{2.5}$ for BC/Alberta at www.bcairquality/bluesky/

Total Partner Cost (past 3 years): 95K
Result: Priceless

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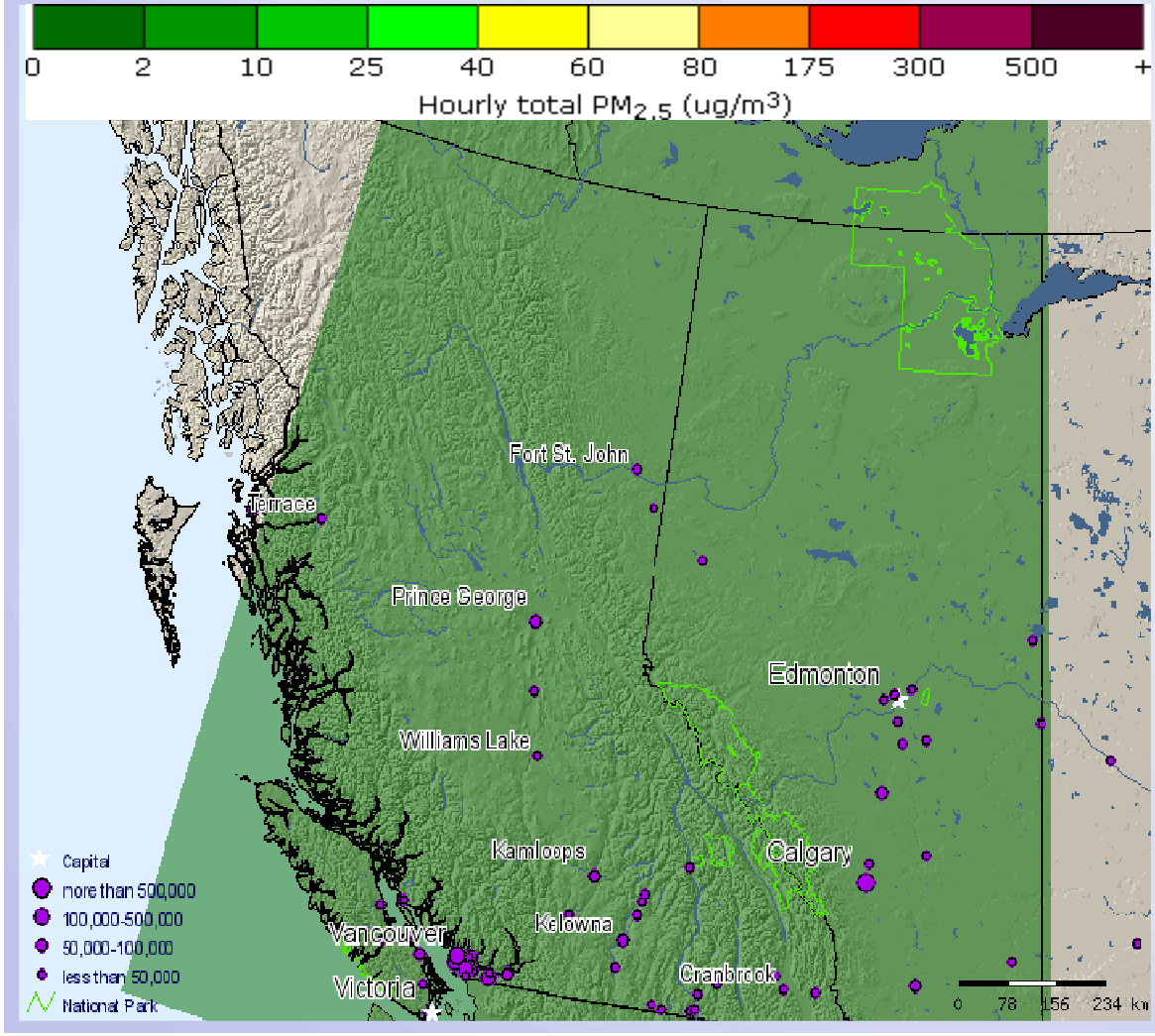
Output Display via Website

Forecast hourly ***Ground Level*** $PM_{2.5}$ concentrations up to 48 hours into the future
(*www.bcairquality.ca/bluesky*)



Example forecast

- issued 0800, Aug 2nd
- valid from 1700, Aug 1 to 0400, Aug 4

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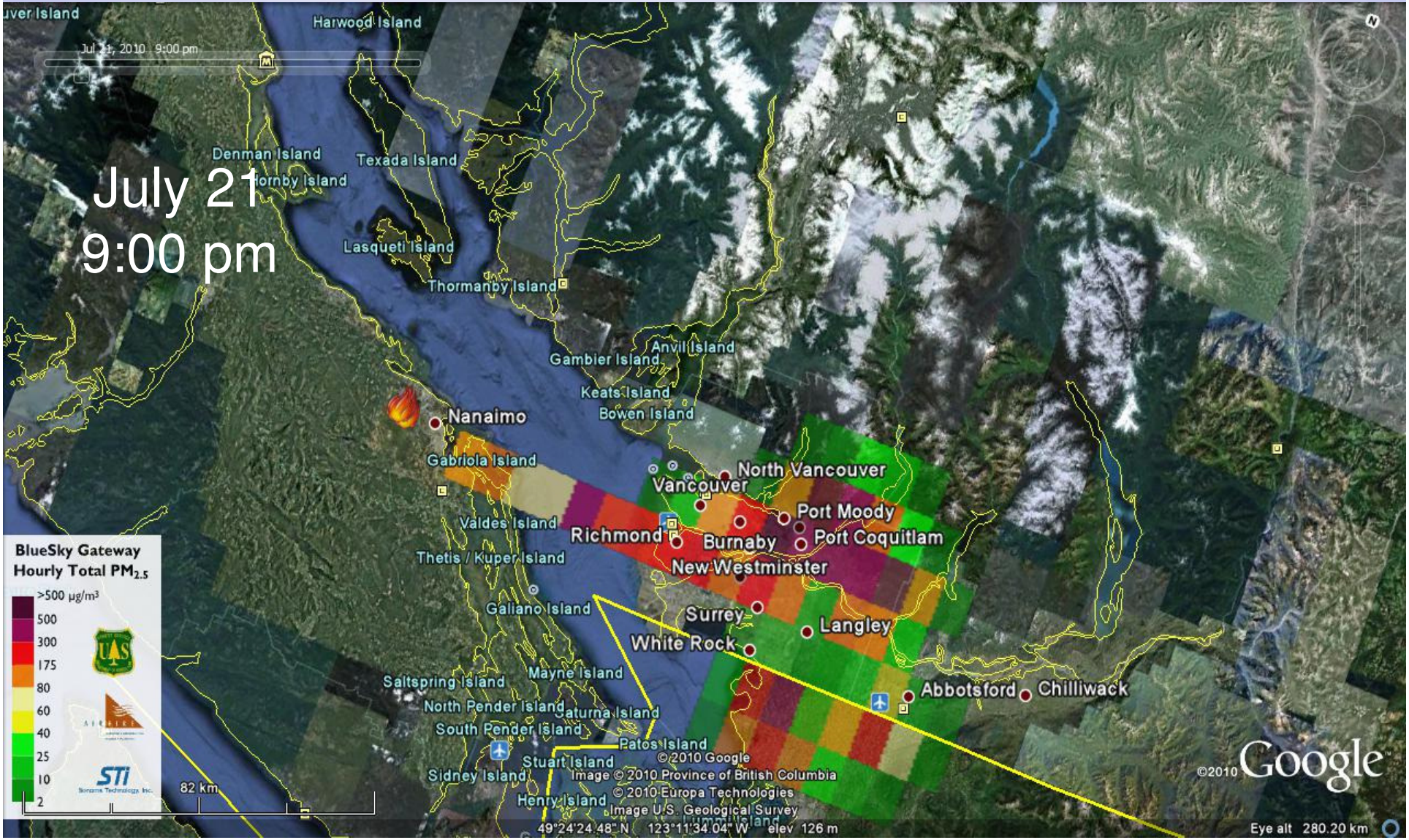
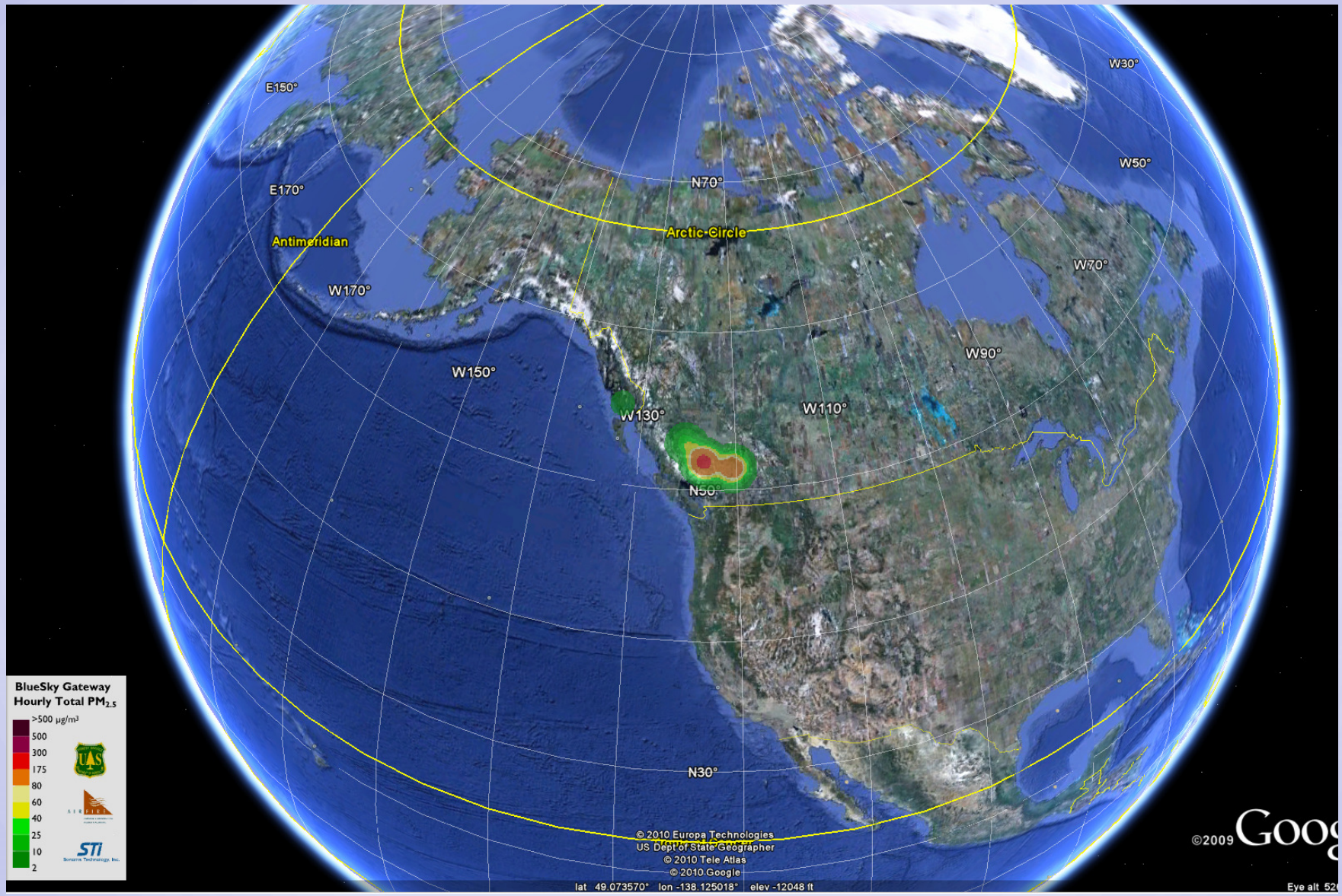
Output Display

Google Earth Format Available

Smoke location and *Ground Level* $PM_{2.5}$ concentrations for each hour up to 48 hours into the future





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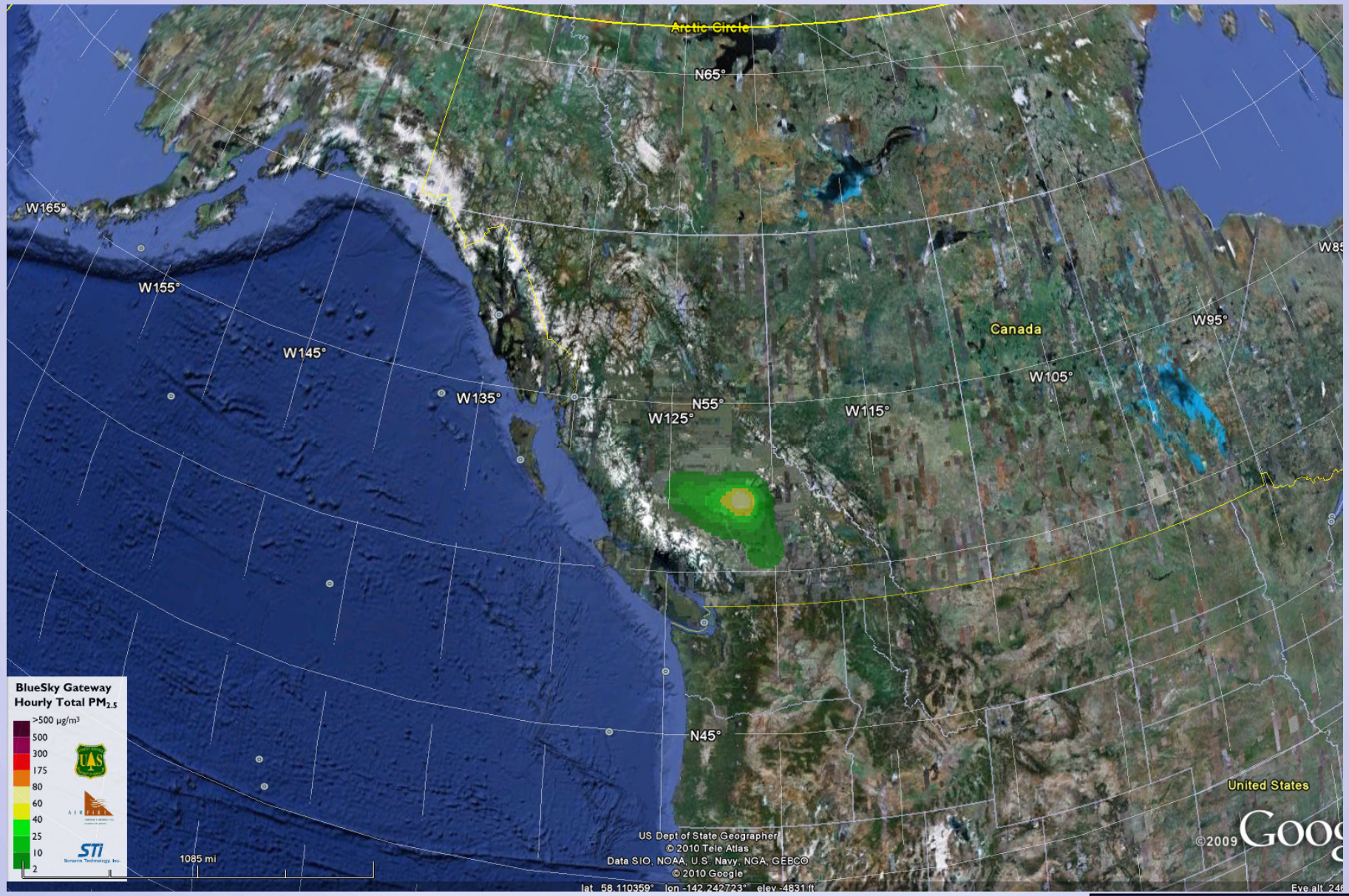

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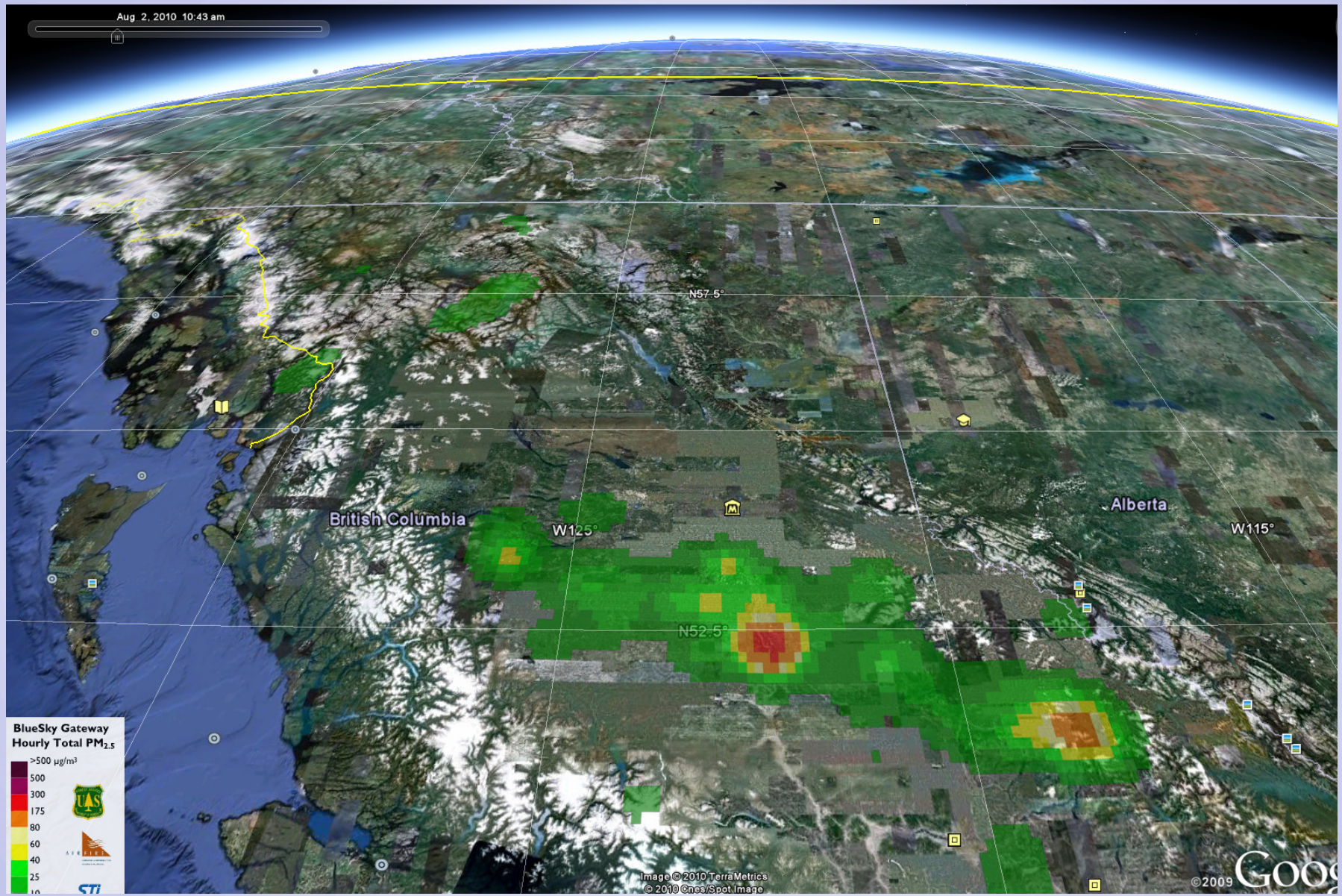

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System Testing, Evaluation and Application

- Stress testing - August 2009 (an extreme wildfire period):
  - System can handle hundreds of fires
  - Based on a qualitative evaluation using satellite data, reasonable forecasts produced, not perfect
- System operational August 2010 (extreme wildfire activity in BC Interior):
  - Produced daily forecasts reliably
  - Over ***60,000 hits*** on BlueSky website in August
  - Informed decisions for air quality alerts and evacuations by BC Health Authorities

Caveats

Output is experimental. Partners are learning from this fire season's experience.

- Clouds or thick smoke will obscure hotspot detection
- $PM_{2.5}$ concentrations should be interpreted as relative levels of concentrations, rather than as absolute values
- Smoke from outside BC/AB not accounted for
- Smoke from previous hours/days is not fully accounted for
- Odd bull's eye patterns appear and disappear in HYSPLIT output
- Fires only emit smoke for the first 12-24 hours. That smoke is then dispersed for the remaining portion of the forecast

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BlueSky Partner Parallel Work

- David Lavoue of DL Modeling and Research: incorporation of smoke into EC's GEM-MACH combined met-chemistry model, with potential benefit to Canadian BlueSky effort
- 2nd Wildfire Smoke Workshop under discussion (Victoria in 2011?) – stay tuned

Summary and Final Points

- A Canadian operational wildfire smoke forecasting system as a tool to inform decision-making is feasible through partner funding and cooperation
- High interest and need
- Evaluation underway and system enhancements are planned (funding dependant)
- Interest from Manitoba and Saskatchewan...expansion is feasible – new partners are welcome
- Full article on BlueSky will appear in upcoming fall/winter edition of the Canadian Smoke Newsletter (al.pankratz@ec.gc.ca)

Our Partners and Acknowledgements

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