The Impacts of Wildfire Smoke and the Western Canada BlueSky Wildfire Smoke Forecasting System

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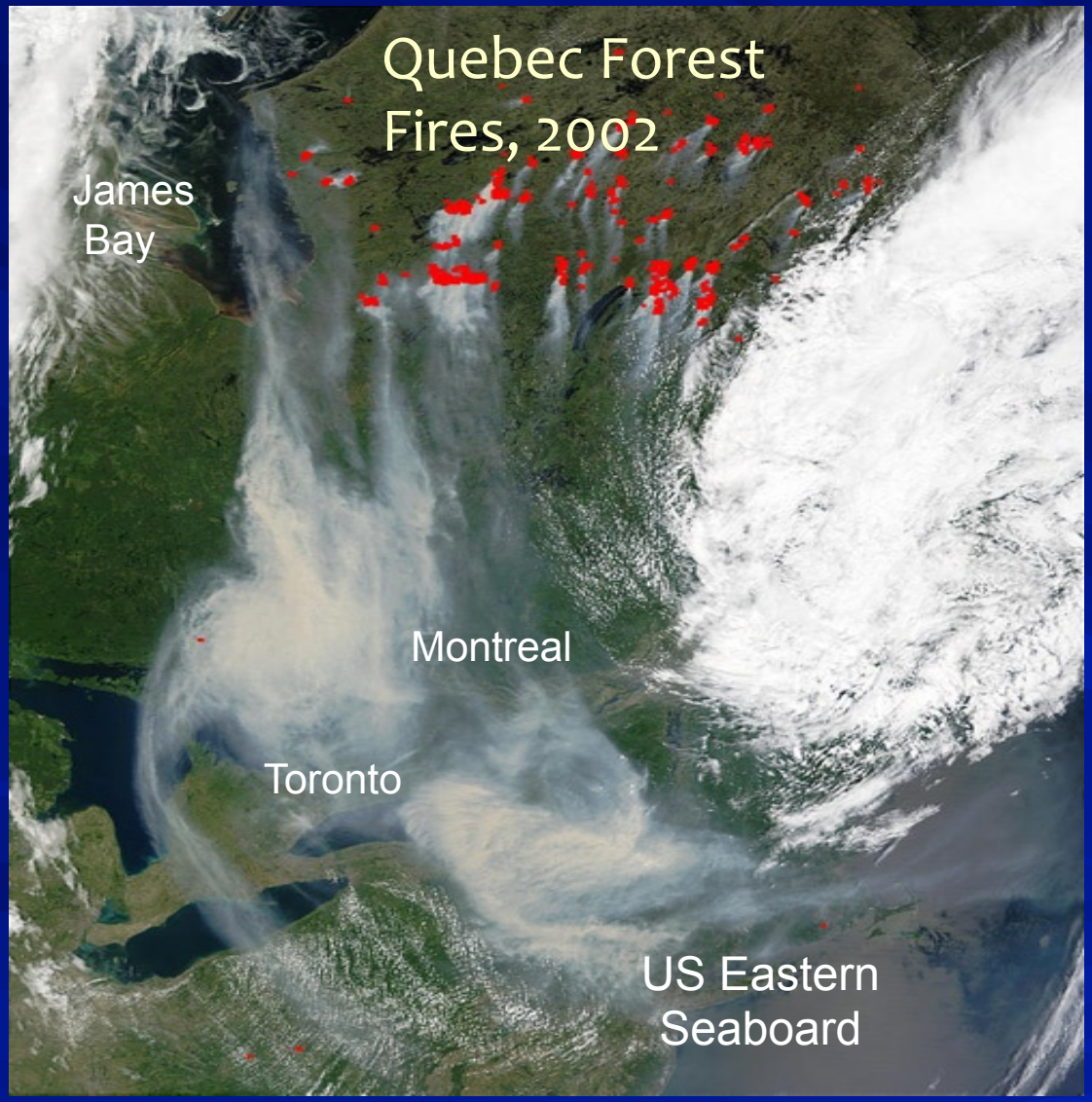
Wildfire smoke can drift for 1000s of km, and impact the lives of millions of people.



Courtesy: NASA MODIS Image

Need for Wildfire Smoke Forecasts

Edmonton, mid-day Aug 18th, 2010: Smoke from BC Wildfires
(photo: source unknown)

Wildfire Smoke Main Constituents:

CO_2, CO, NOx, Volatile Organic Compounds, Particulate Matter (PM_{10} and $PM_{2.5}$)

Effects:

Human Health: $PM_{2.5}$ – tiny particles, travel deep into the lungs

Visibility: Aesthetics (haze), Safety (road and aviation)

Wildfire Smoke: Health Effects and Costs

- Increased hospital visits for asthma, chronic obstructive pulmonary disease, upper respiratory infections, general respiratory problems, eye irritation, smoke inhalation [1]
- Greater health impacts for: [1]
  - pre-existing respiratory and cardiovascular disease (i.e. asthma, emphysema)
  - children and elderly

- Health related costs : 2001 Chisholm Alberta fire to smoke exposed population: $6 to 9 million (1 day) [2]
- Increases in mortality risk, hospital admissions, emergency room visits, acute respiratory symptoms

Wildfire Smoke: Socio-Economic Impacts

Courtesy: NASA MODIS Image

Wildfire smoke exposure in Southern California.[3]

Health costs ($9.50/ exposed person/day)

+

Other costs: pain, discomfort, loss of recreational days, wearing masks, staying indoors, running air cleaners, evacuations

Total cost: US $84.42 /exposed person/day [3]

Wildfire Smoke Forecasts: Need

Where will the smoke go? When will the smoke arrive and depart? How bad will it be?

- Public
- Weather Forecasters
- Media
- Health Authorities (Advisories, Public Messages re: Risk Minimization, Evacuation Decisions),
- Health Researchers (Smoke/Health Effects)
- Environmental Agencies (Advisories, Air Quality forecasts),
- Tourism
- Transportation (Road and Aviation Safety),
- Police (Road Safety)

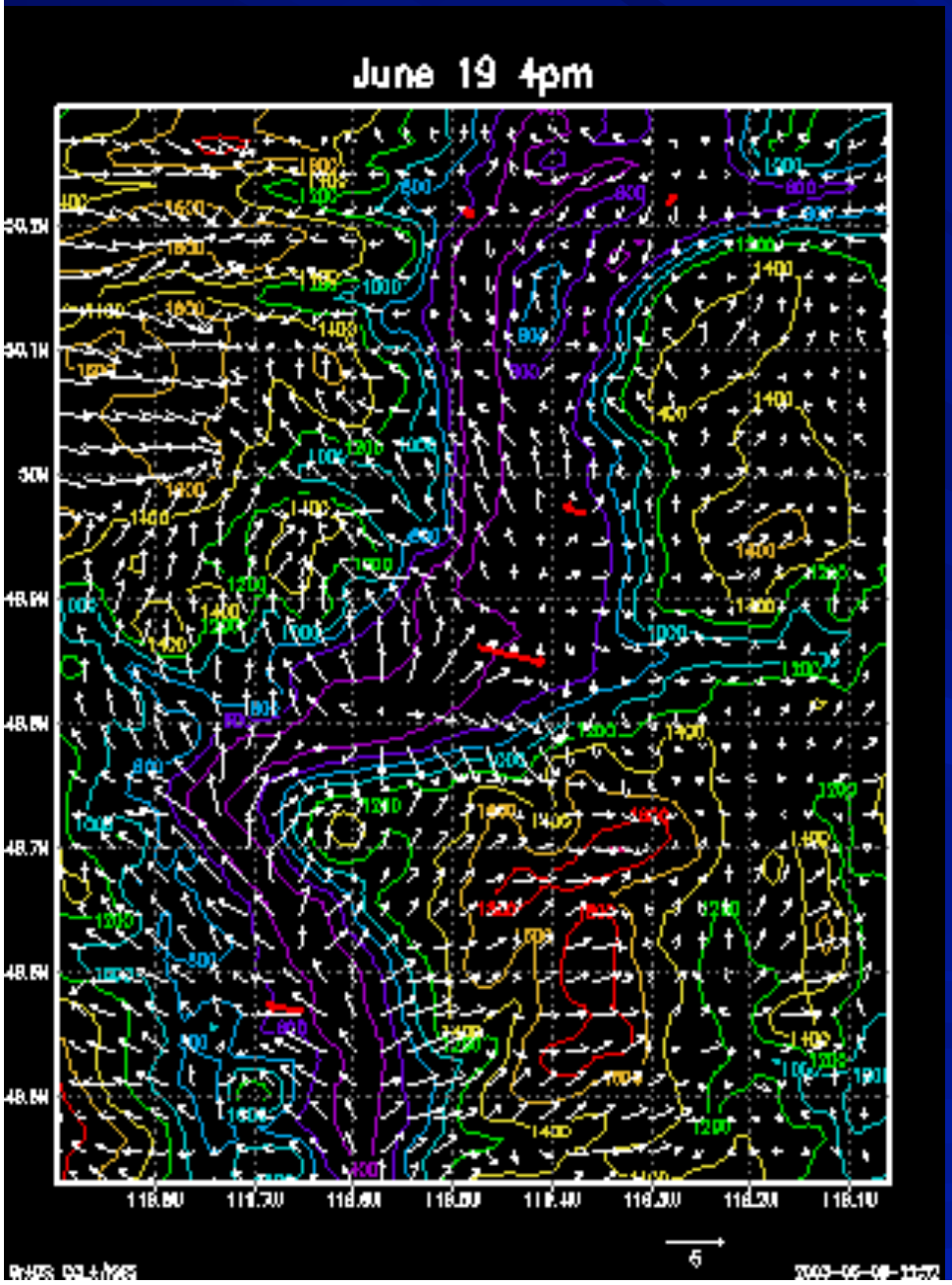
A Tool to Forecast Wildfire Smoke: BlueSky

- BlueSky: a software framework developed by the U.S. Forest Service that links different models to produce wildfire and controlled burn smoke forecasts.

- Canadian Smoke Forecasting Workshop 2007: Informal Partnership (Federal, Provincial, Academia) created to develop a Canadian version of the system.

- Western Canada BlueSky System created: since 2010 – producing wildfire smoke forecasts

Forecast Weather Prediction Model



- MM5 Weather Prediction Model: forecast hourly meteorology up to 48 hours into the future

Wildfire Location, Fuel Consumption

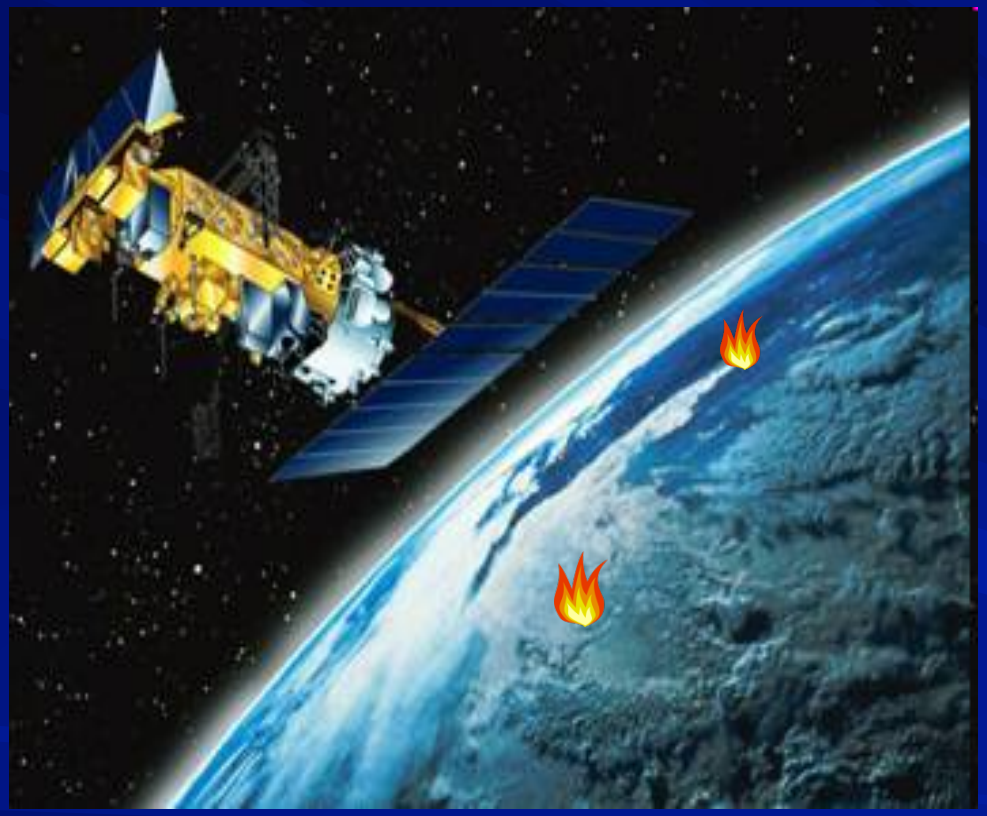
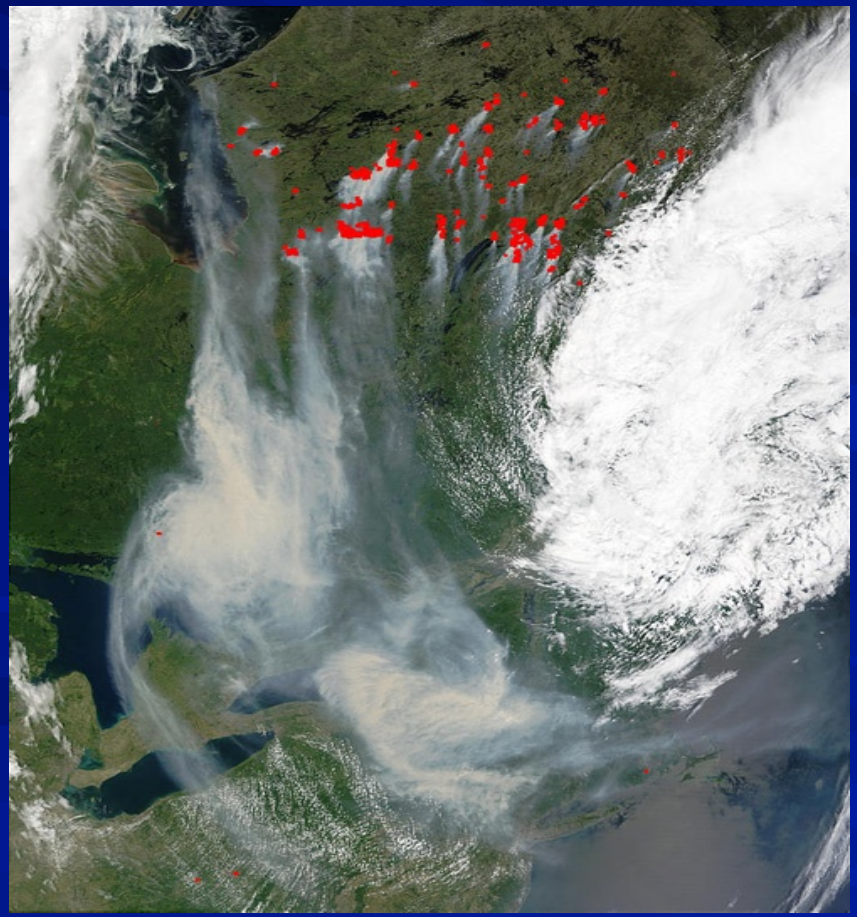


Image courtesy NOAA

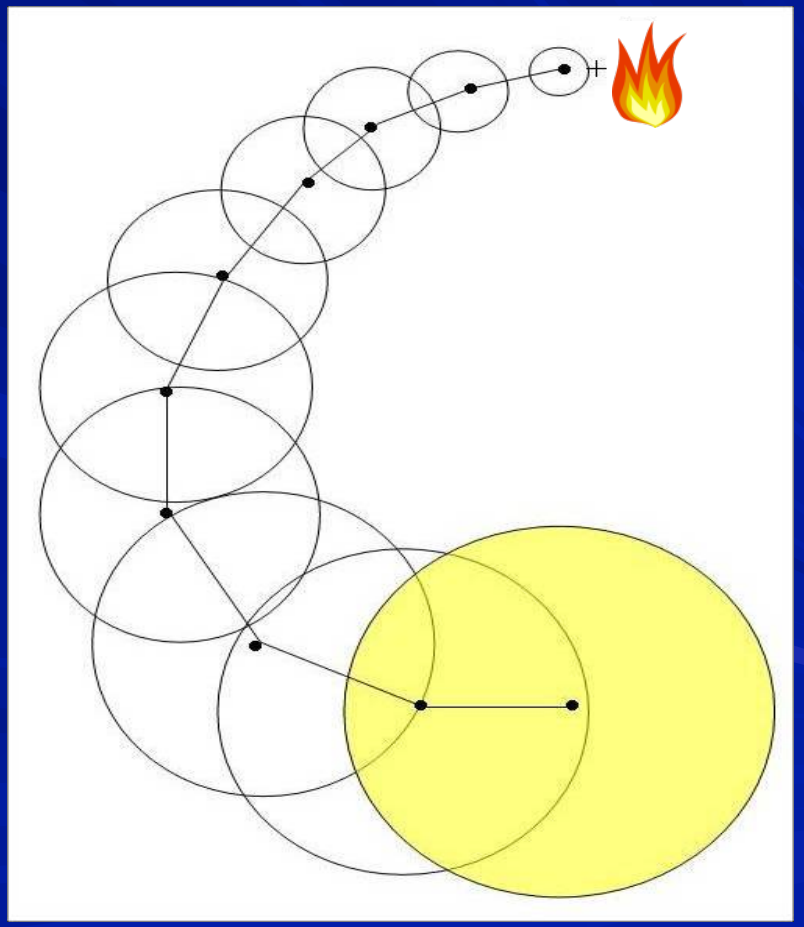
- Canadian Wildland Fire Information System: Natural Resources Canada
- Satellite detects of hotspots (2 x daily) and estimates fuel consumption

Smoke Plume Transport and Dispersion Model

- HYSPLIT Model simulates dispersion and estimates ground–level $PM_{2.5}$ concentrations



Courtesy: NASA MODIS Image



Western Canada BlueSky Framework

Meteorological Forecast Model: University of British Columbia, Vancouver, B.C.

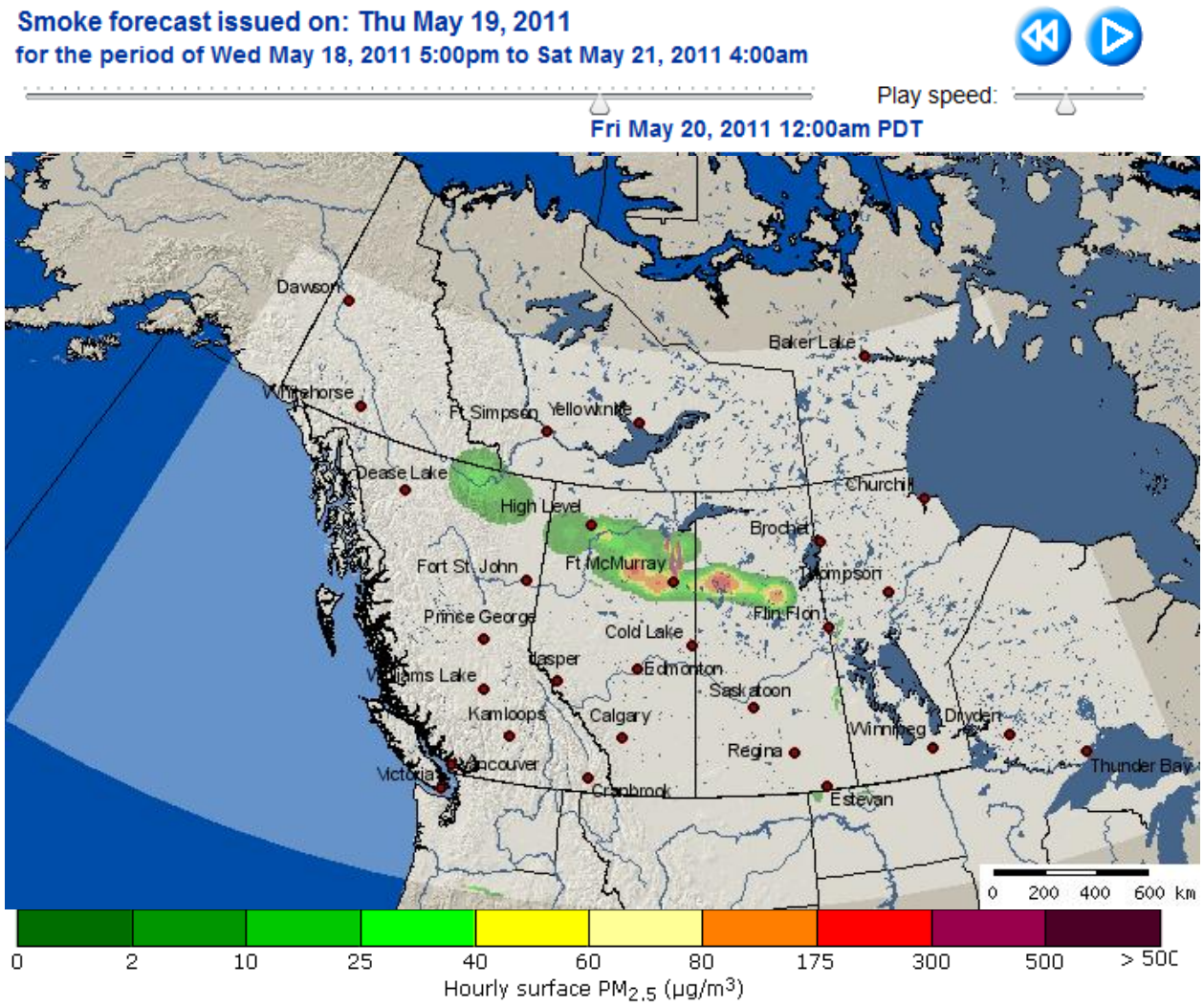
Wildfire Location and Fuel Consumption: Northern Forestry Research Centre, Edmonton, Alberta

SmokeTransport/Dispersion and BlueSky Framework: University of BC - produces smoke forecast 2x/day

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

BlueSky Website: Animations of Forecast Smoke

(Hourly Surface $PM_{2.5}$)



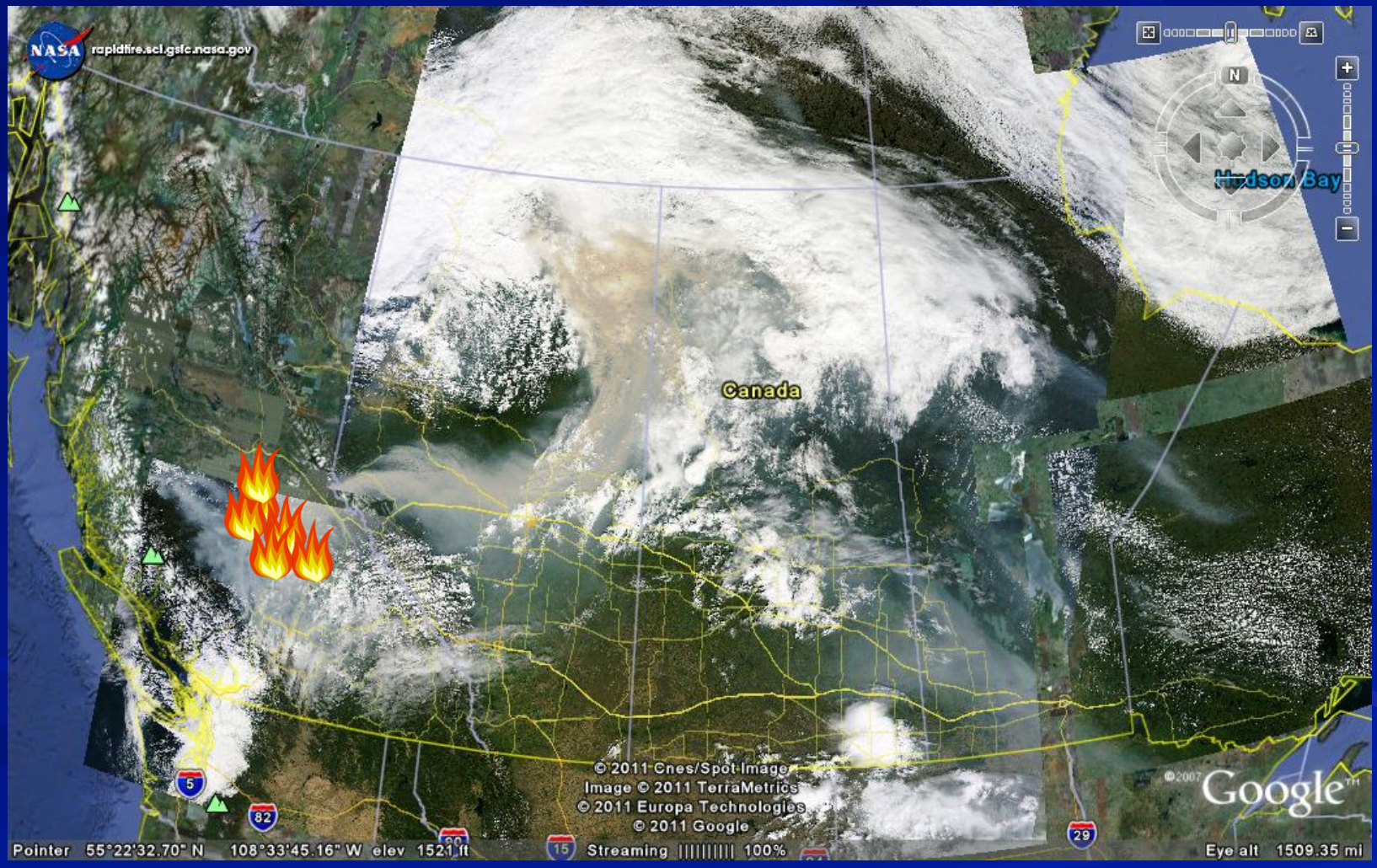
One intense fire day in Aug 2010: 40,000 hits

KMZ files for Viewing in Google Earth are Available

Qualitative Evaluation: Satellite Image Comparisons

Aug 19th Multiple Fires in BC

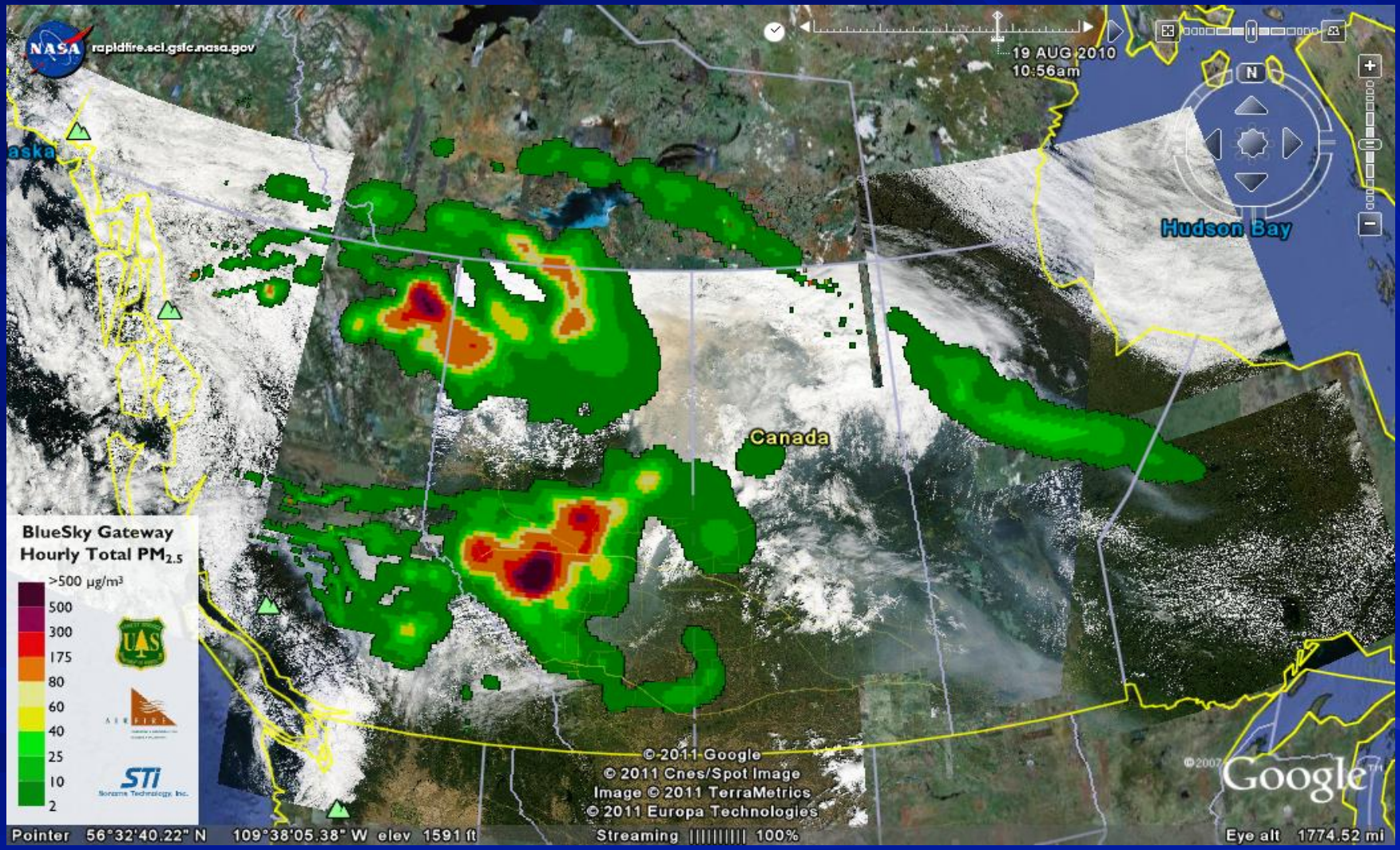
Edmonton, Alberta



MODIS image (courtesy of NASA) superimposed on Google Earth Image

Qualitative Evaluation: Satellite Image Comparison

BlueSky Forecast: Time Corresponds to Image Time



MODIS image (courtesy of NASA) superimposed on Google Earth Image

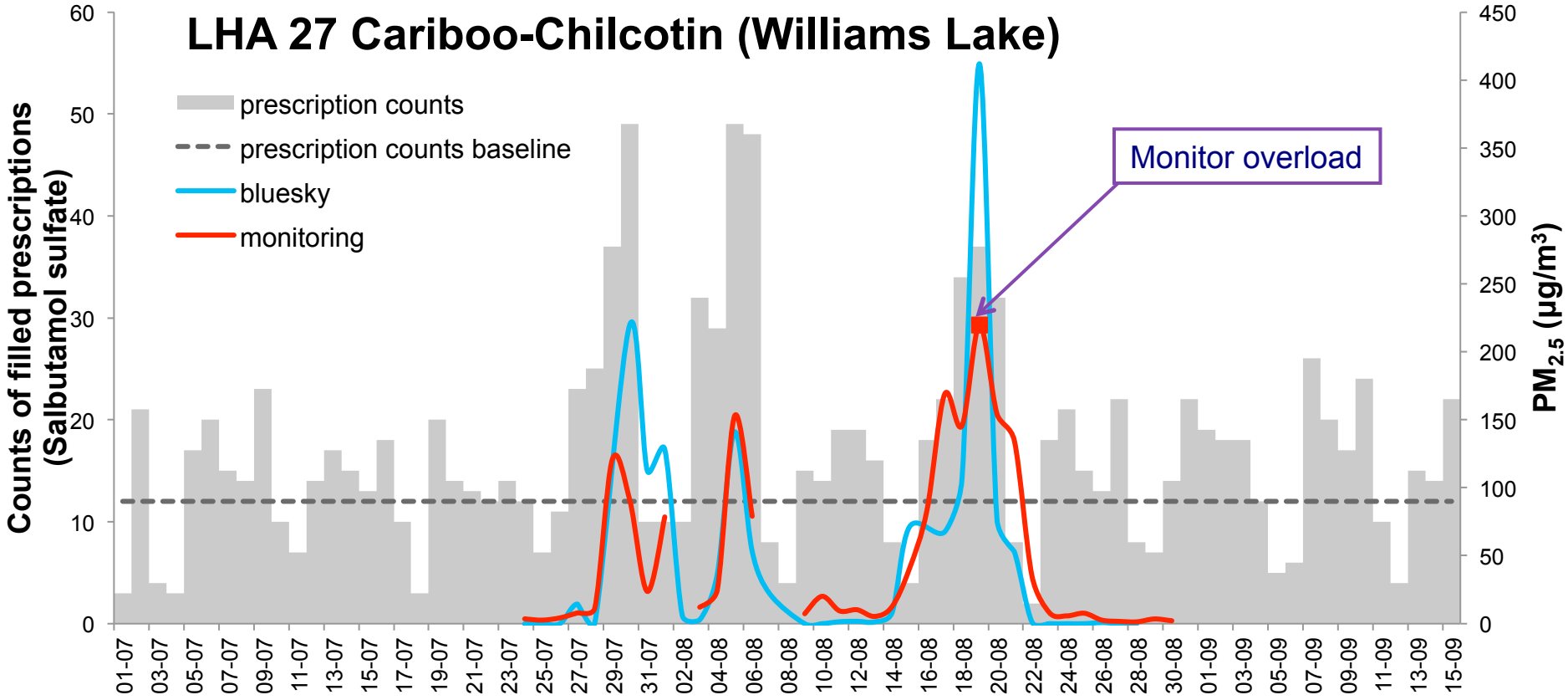
How Good are the Forecasts?

- Research Tool: forecasts considered to be experimental.
- Challenge: Predict timing, location, and magnitude of smoke given uncertainties in wild fire source, weather forecasts and smoke dispersion
- Forecast patterns of smoke impacted areas generally consistent with actual smoke dispersion pattern.
- Comparisons to ground-level measures of $PM_{2.5}$ concentrations indicate that forecast concentrations can have big misses in timing, location, magnitude – can't expect precision all the time.
- Technical development underway - should improve accuracy.

Wildfire Smoke (Observed, Forecast) and Health Outcome Association: J Yao UBC[4] :

Pharmaceutical data

Filled prescriptions of Salbutamol Sulfate (Asthma Medication)



Further Developments and Plans

- Several technical improvements underway
- BlueSky Playground (a tool for Prescribed Burns)
- System originally intended to be a pilot – to feed the creation of a National wildfire smoke forecasting system by Environment Canada.
- National system is under development – completion date and availability uncertain..2013?
- Will continue to improve Western Canada BlueSky and seek operational funding from partners for next wildfire season ($25 K)

Summary and Final Points

- Wildfire smoke can affect the lives of millions of people with attendant social, health, economic impacts.
- Forecasting wildfire smoke needed by a wide variety of interests
- Western Canada BlueSky produces forecasts of hourly surface $PM_{2.5}$ concentrations due to wildfire smoke up to 48 hours into the future (www.bcairquality.ca/bluesky/)
- Forecast smoke patterns show consistency with actual smoke impacted areas – but there can be large misses in timing, location and magnitude of $PM_{2.5}$ concentrations.

Summary and Final Points

- On-going development to improve speed and accuracy
- Massive project: possible through support from partners (Key: Alberta Environment and Sustainable Resource Development, BC Ministry of Environment, Natural Resources Canada)
- Will continue to improve the system and seek operational funding for 2013 – will re-evaluate when the National system is a reality.
- Need another Canadian Smoke Forecasting Conference (last one was 5 years ago).

Partners and Acknowledgements

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- B Crumb: Manitoba Health

References

1. Barn, P. 2010 Forest Fires: Impacts on Air Quality and Health. CIPHI NB Annual Conference. http://ccnse.ca/sites/default/files/CIPHI_NB_2010_Forest_Fires_Air_Quality.pdf Accessed Aug 26, 2012
2. Rittmaster, R., Adamowicz W.L., Amiro, B. and Pelletier, R.T. 2006 Economic analysis of health effects from forest fires. Can. J. For. Res. **36:** 868-877
3. Richardson, L.A., Champ, P.A., Loomis, J.B. 2011 The hidden cost of wildfires: Economic valuation of health effects of wildfire smoke exposure in Southern California. J. Forest Econ. **18:** 14-35
4. Yao, J. 2012. Evaluation of the BlueSky Smoke Forecasting System and its Utility for Public Health Protection in B.C. Canadian Smoke Newsletter 2012 Edition