Status, Current Developments, and Perspectives of ECCC's Operational AQ Forecasting System with Near-Real-Time Wildfire Emissions

Environment and Climate Change Canada | Environnement et Changement climatique Canada

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Abstract

Environment and Climate Change Canada's air quality forecast system with near-realtime wildfire emissions was developed in 2012 and has been run by the Canadian Meteorological Centre Operations division (CMCO) since 2013. Some of the most challenging issues with wildfire pollution modelling concern the treatment of wildfire emission estimates and near-source dispersion within the air quality model. As a consequence, FireWork is undergoing constant development. During the massive Fort McMurray wildfire event in May 2016, for example, different wildfire emission processing approaches and wildfire emissions injection and dispersion schemes within the air quality model were tested. Work on various FireWork components will continue in order to deliver a new operational version of the forecasting system for the 2017 wildfire season. Some of these potential improvements are shown in this poster.

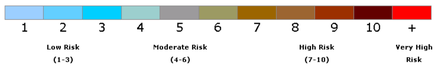
CMCO has also developed different post-processing tools for FireWork that are currently available only to ECCC AQ forecasters and select users. Starting next year, however, some of these products will be available to the general public. Current and future FireWork post-processing products are covered in the poster.

FireWork System

ECCC's Objectives

- Include near-real-time biomass burning emissions into ECCC's operational air quality forecast system. The modified forecasting system that takes these emissions into account is named FireWork
- Forecasts from FireWork can also serve as input for the operational Air Quality Health Index (AQHI*)

***AQHI = (10/10.4)*100*[(exp(0.000871*NO_2)-1) + (exp(0.000537*O_3)-1) + (exp(0.000487*$PM_{2.5}$)-1)]**

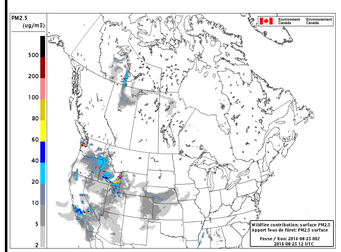


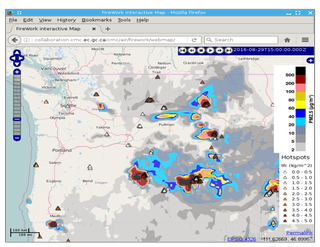
Current FireWork Modelling Strategy

FireWork has the same configuration as RAQDPS, the operational AQ forecast model. The only difference is the inclusion of the NRT wildfire emissions.
- Run twice daily (initiated at 00 UTC and 12 UTC) for 48 hours
- Available at approximately at the same time as the operational model
- **ECCC operational AQ system (April-October) since 2016**

FireWork Products

Different specialized FireWork products are available via:
1) **Government of Canada weather information websites** https://weather.gc.ca/firework
2) **ECCC Geospatial Web Services** http://www.ec.gc.ca/meteo-weather/default.asp?n=C0D9B3D8-1
3) **FireWork password-protected web page** http://collaboration.cmc.ec.gc.ca/cmc/air/firework/





Left: Example of the forecasted wildfire emissions contribution to surface $PM_{2.5}$ concentrations (µg/m^3) valid at 2016-08-25 12UTC forecasted by 2016-08-25 00UTC run.

Right: Examples of the interactive FireWork webmaps showing Total Fuel Consumption (TFC) and the contribution of forecasted wildfire emissions to $PM_{2.5}$ surface concentrations (µg/m^3).

FireWork Status

2013 — **In-house system version run from June to Spetember. FireWork products were available to ECCC forecasters**

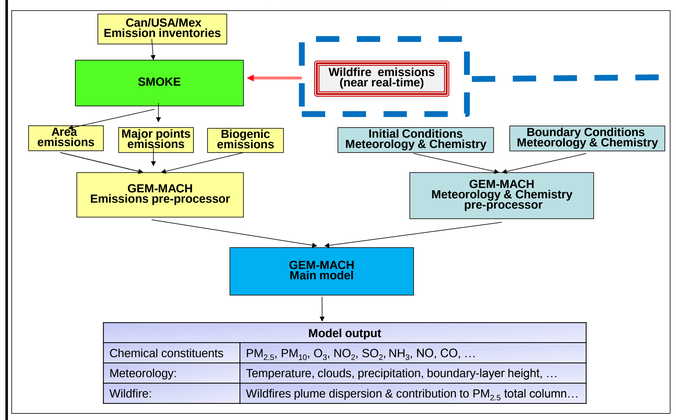
2014 — **Experimental status**

2015 — **Objective Analysis fo $PM_{2.5}$ and PM_{10} added to system**

2016 — **FireWork becomes ECCC operational AQ system**

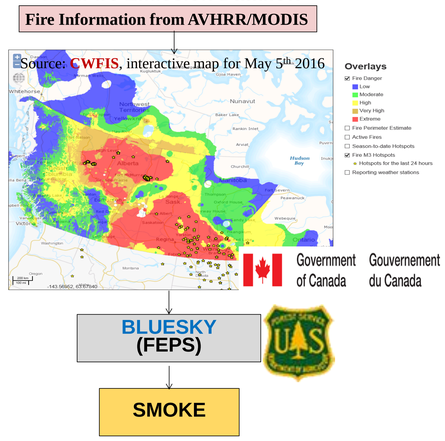
FireWork Modelling Framework Description

FireWork Dataflow

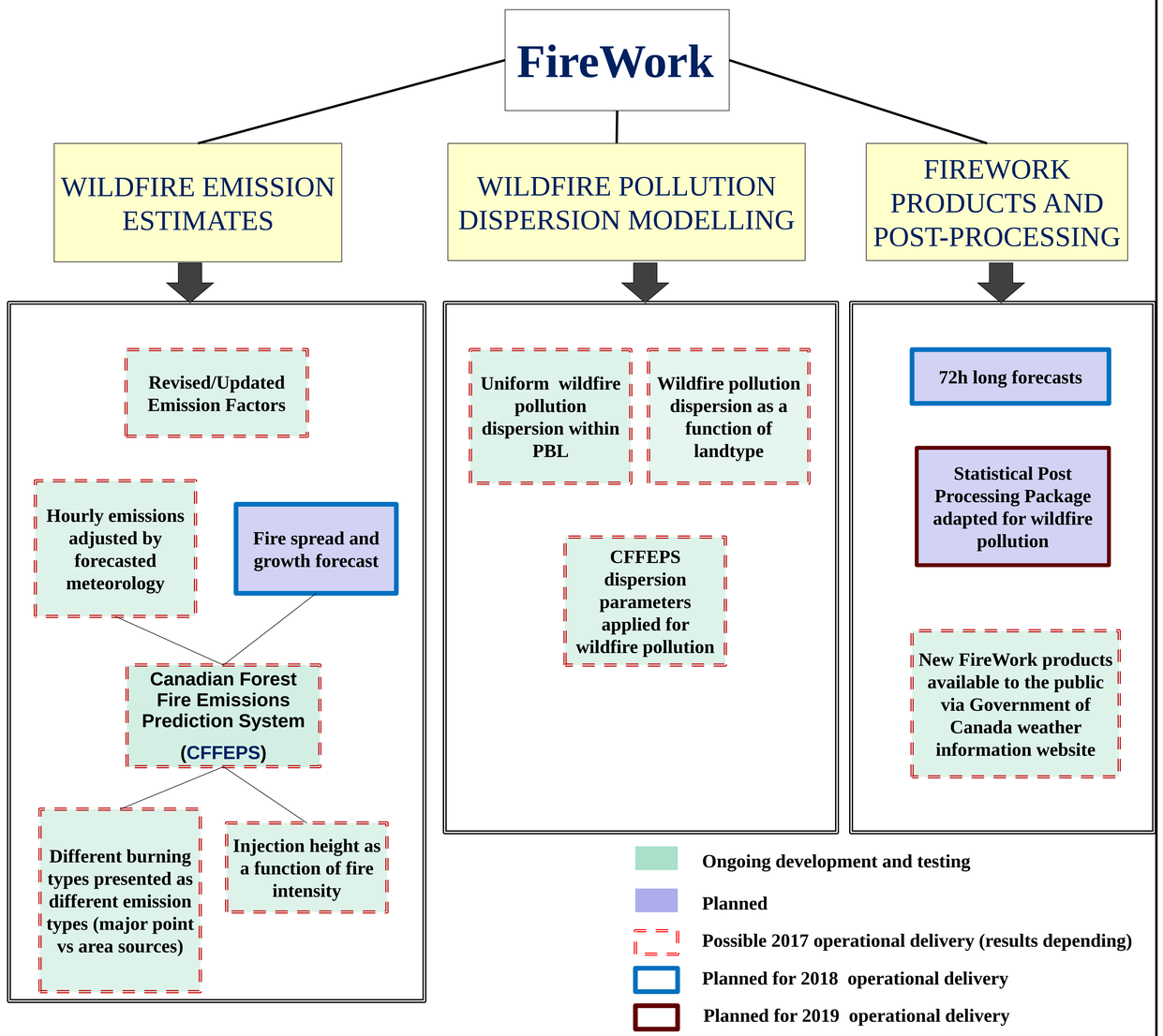


Model output	
Chemical constituents	$PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, NH_3, NO, CO, …
Meteorology:	Temperature, clouds, precipitation, boundary-layer height, …
Wildfire:	Wildfires plume dispersion & contribution to $PM_{2.5}$ total column…

WildFire Emission Dataflow

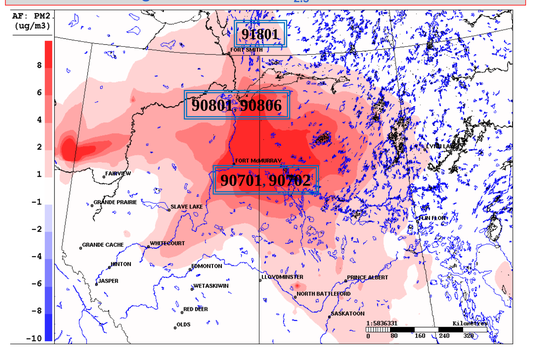


FireWork Ongoing and Planned Developments

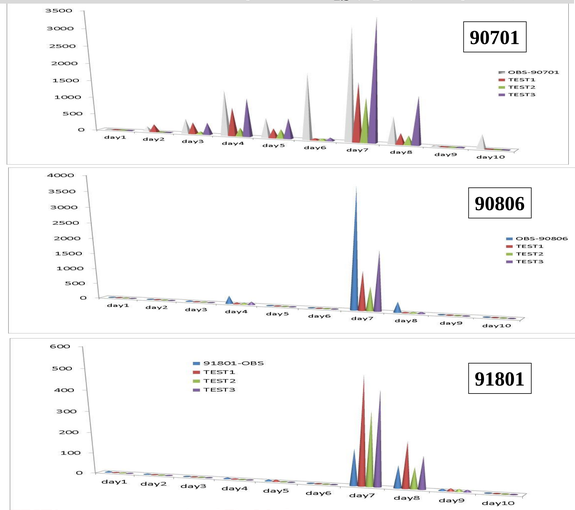


Test Results for the 2016 Fort McMurray Wildfire Event

Forecasted wildfire emissions contribution (May 2016) to average summertime $PM_{2.5}$ concentrations

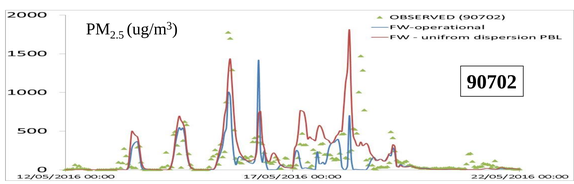


Foreacted and observed daily max $PM_{2.5}$ (ug/m^3) –May 1-10, 2016



TEST1 – current, operational FireWork
TEST2 –FireWork with updated emission rates
TEST3 –FireWork with CFFEPS plume-rise parameters and emissions

Test with uniform wildfire pollution dispersion within PBL



Conclusions

FireWork has been under constant development since 2013. Based on the results from current testing, major updates are planned for the 2017 wildfire season to
a) wildfire emission estimates;
b) wildfire pollution dispersion modelling; and
c) FireWork products.

Some other system improvements like forecast length and statistical post processing are planned for 2018 and/or 2019.

ECCC will continue to upgrade the FireWork system in collaboration with Canadian and international partners.