Fire Plumes
FireWork/GEMMACH vs. MISR

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Goals

- Analyze FireWorks plume rise (height) results against MISR (MINX) results
- Find potential issues/bias using MINX software
- Establish benchmark for upcoming comparison with CFFEPS

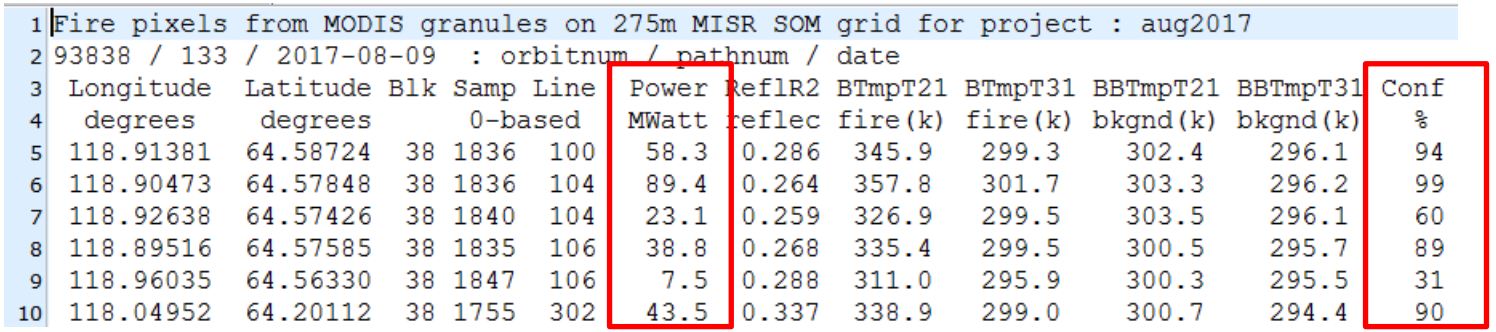
Coverage

- Apr – Oct 2017 (ie. 2017 fire season)
- All of Canada

- Sample Command using preMINX
  - preMINX **-L -142.0 -50.7 42.0 83.0 -d 2017.07.01 2017.07.31** -u elisadong --grandir ./granules

Process

- Download appropriate MISR/MODIS data, FirePixels (preMINX)
- Filter FirePixels by percentile (FRP), then confidence level (P50, C60) to reduce digitizing efforts
- Digitize plumes (MINX4), user selects appropriate bands
- Keep only Fair/Good plumes
- Pass through several functions for analysis and comparison (postMINX, speedAltMINXdemo, binPercentiles, etc)
  - Naming sense is not great



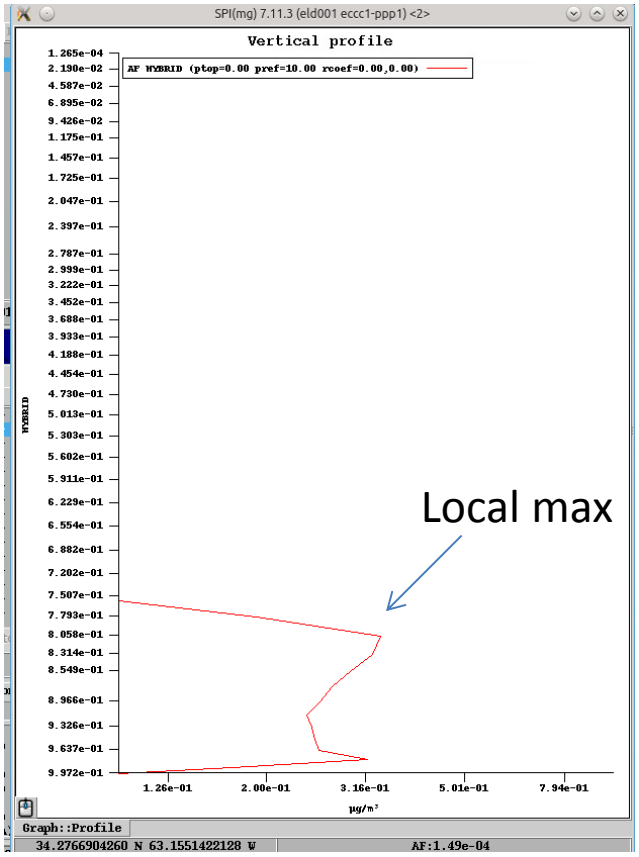
	Longitude	Latitude	Blk	Samp	Line	Power	ReflR2	BTmpT21	BTmpT31	BBTmpT21	BBTmpT31	Conf
	degrees	degrees		0-based		MWatt	reflec	fire(k)	fire(k)	bkgnd(k)	bkgnd(k)	%
5	118.91381	64.58724	38	1836	100	58.3	0.286	345.9	299.3	302.4	296.1	94
6	118.90473	64.57848	38	1836	104	89.4	0.264	357.8	301.7	303.3	296.2	99
7	118.92638	64.57426	38	1840	104	23.1	0.259	326.9	299.5	303.5	296.1	60
8	118.89516	64.57585	38	1835	106	38.8	0.268	335.4	299.5	300.5	295.7	89
9	118.96035	64.56330	38	1847	106	7.5	0.288	311.0	295.9	300.3	295.5	31
10	118.04952	64.20112	38	1755	302	43.5	0.337	338.9	299.0	300.7	294.4	90

1 Fire pixels from MODIS granules on 275m MISR SOM grid for project : aug2017
2 93838 / 133 / 2017-08-09 : orbitnum / pathnum / date

Model Plumes

Determination of Model Plume location/height is dependent on

- Digitized plume location
- Model: FireWork FST – GEMMACH FST
- StartTime: 00, over forecast 24 hours
- Threshold: AF > 0
- Local Max of AF values from model

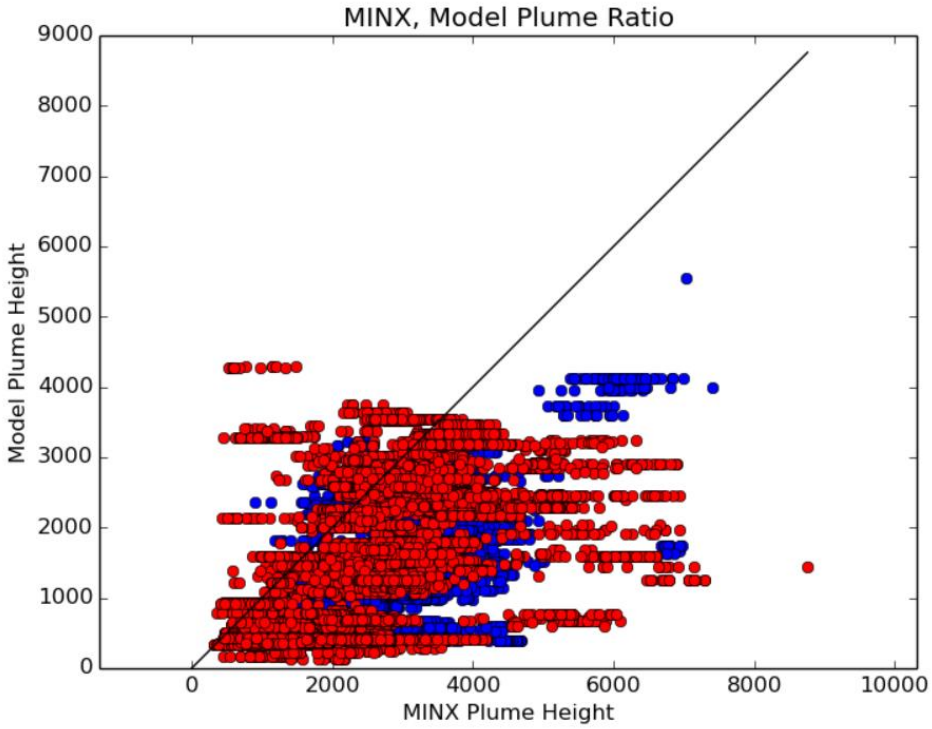


Results (Apr-Oct 2017, P98)

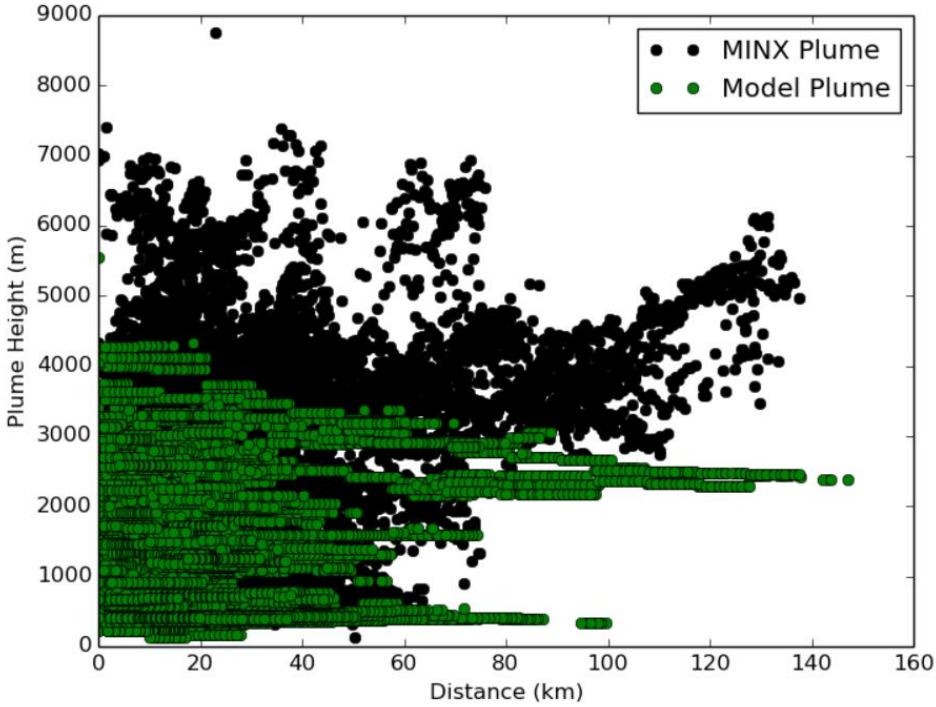
Plumes Processed	**203**
Number of Valid Pairs	**9971**
Number of Dropped Pairs	**10273**
Minimum FRP (MWatts)	243.95
MINX Plume Max	8759
Model Plume Max	5541.54541
MINX Plume Min	322
Model Plume Min	124.6417236
MINX Plume Mean	2806.447397
Model Plume Mean	1562.115637
RMSD	1684.2709
Pearson Correlation Coefficient, pValue	0.485868138710415, 0
R Squared, pValue	0.236067848213927, 0, 'y = 0.398811854941x + 442.87114428'
Mean Absolute Percent Error	50.1600712
Mean Percentage Error	40.52520558

Plume Heights

Model by MINX plume height

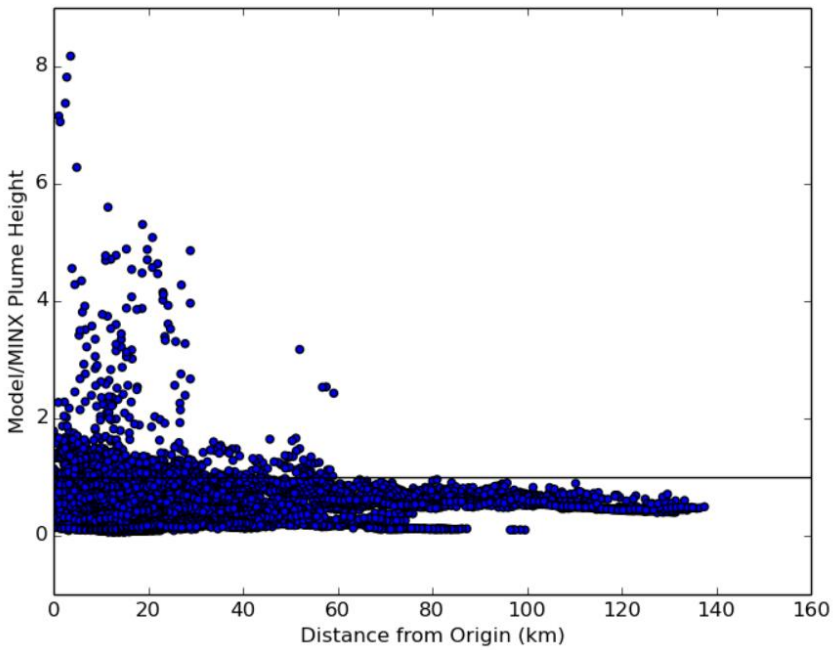


Plume Height by Distance

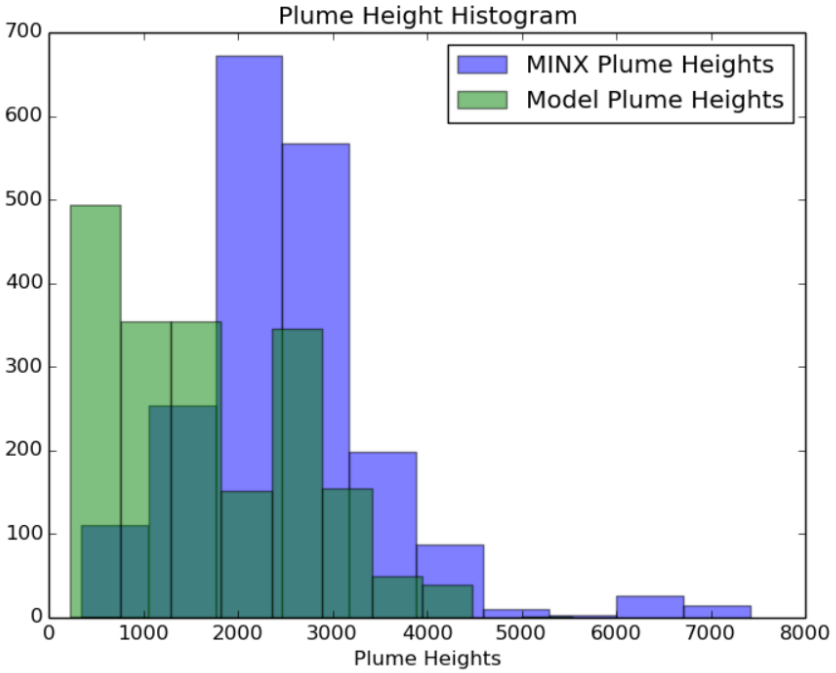


Plume Heights by Distance

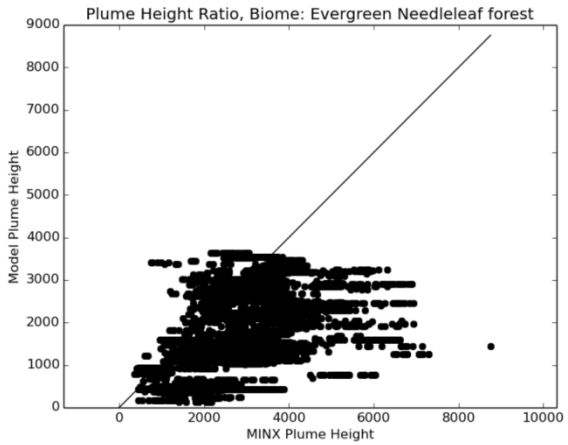
Model/MINX Ratio

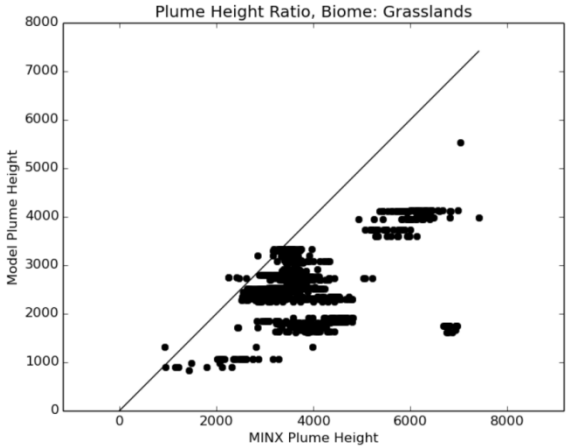


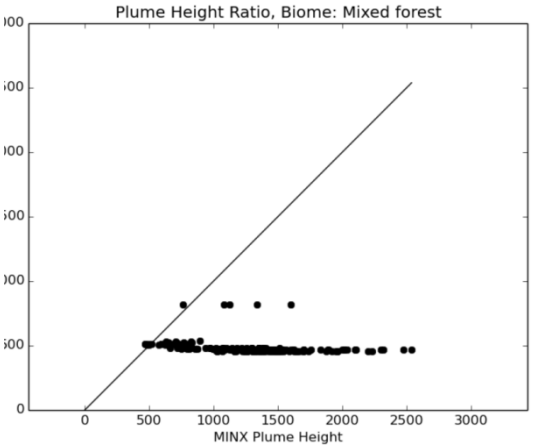
Plume Heights (0-10km)

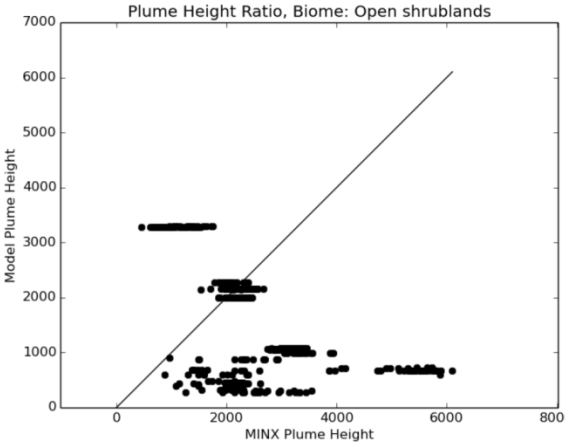


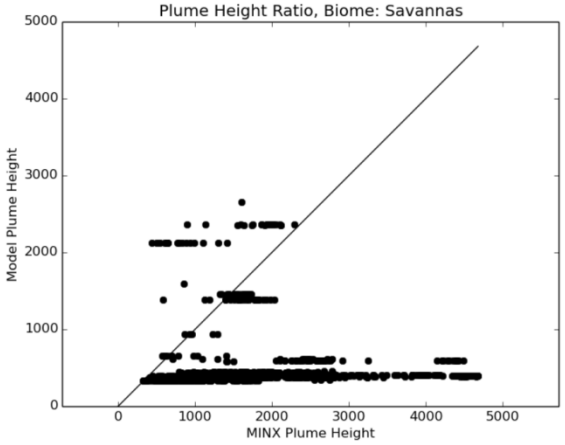
Breakdown by Biome

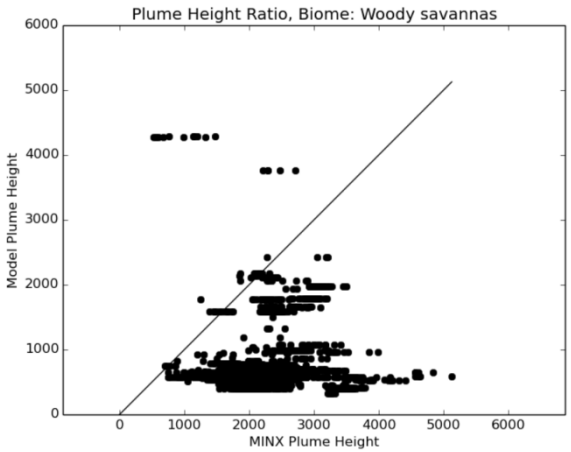












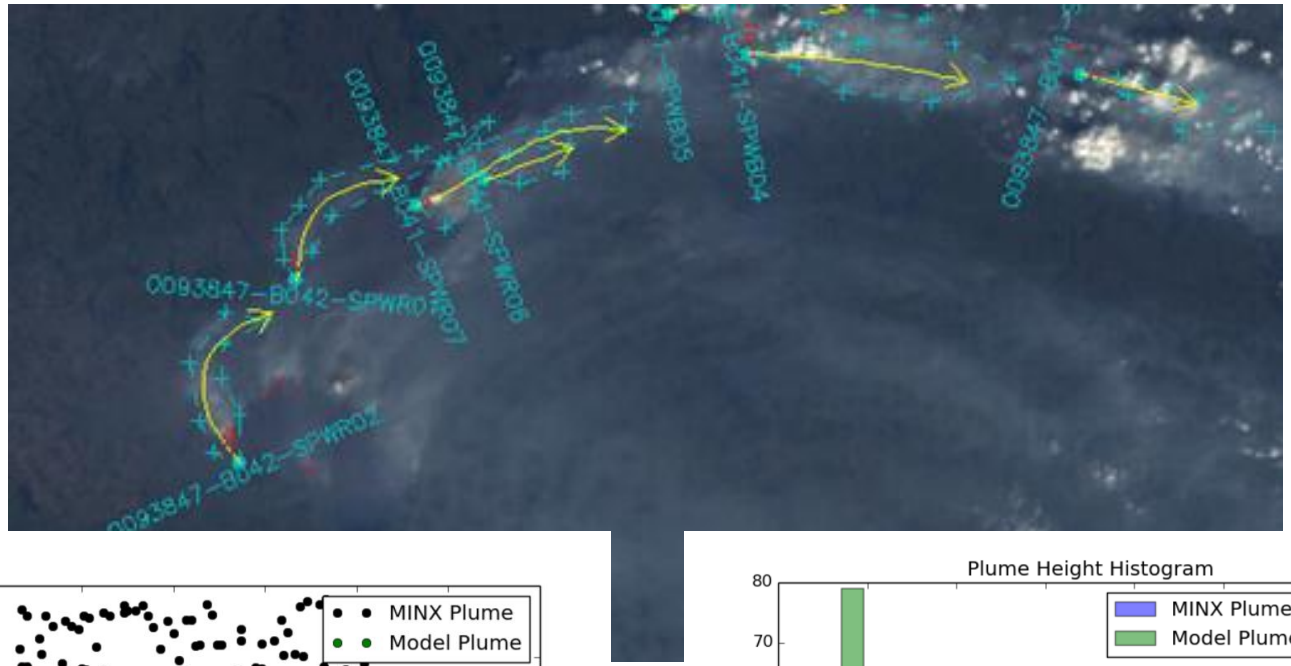
MINX Caveats

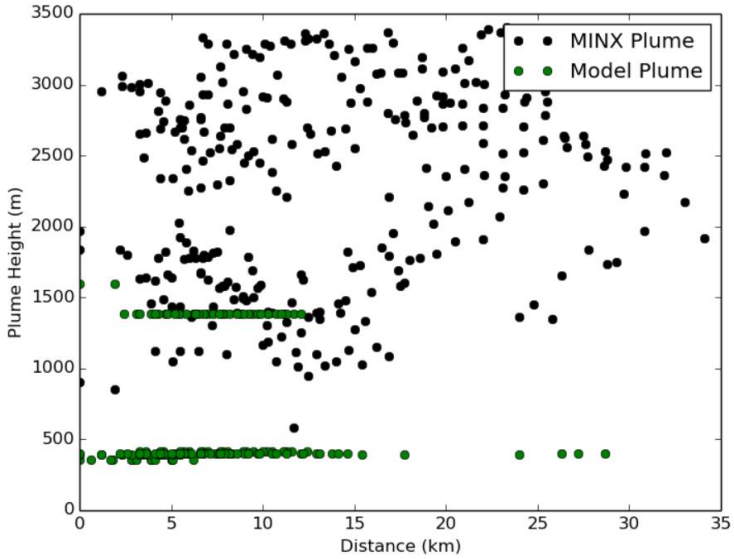
- Using filtered height, other ‘heights’ available
- User selection of red/blue band (affects resolution)
- Terrain offset (1 pixel = hundreds of meters)
- Topography effects (depressions, valleys)
- Thin aerosols
- Bright clouds (high albedos)
- Fire Pixel masking, bowtie effect
- Satellite pass time (10:30am)

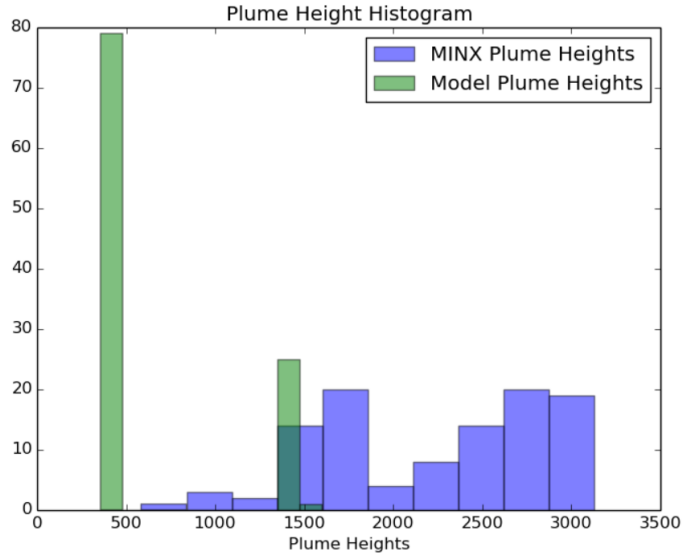
Model Caveats

- Low Resolution Grid
- Using Nearest Neighbour
- Other methods of determining plume height exist

Case Study

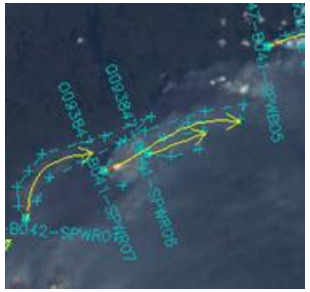

0093847-B042-SPWR07
0093847-B042-SPWR02

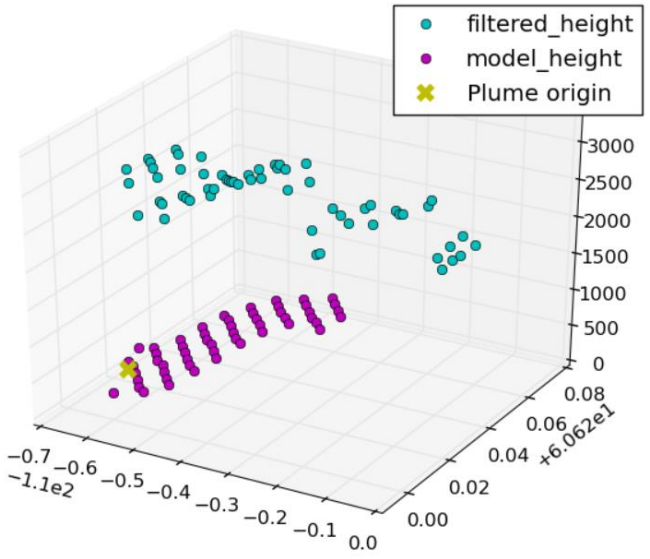

MINX Plume
Model Plume
Plume Height (m)
Distance (km)
0
500
1000
1500
2000
2500
3000
3500
0
5
10
15
20
25
30
35


Plume Height Histogram
MINX Plume Heights
Model Plume Heights
Plume Heights
0
10
20
30
40
50
60
70
80
0
500
1000
1500
2000
2500
3000
3500

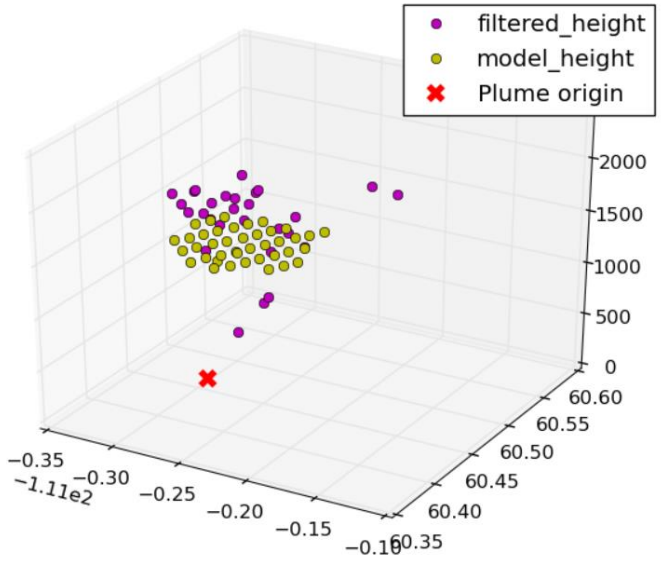
Case Study – 2 Plumes

O093847-B041-SPWR07





O093847-B042-SPWR02



In Progress/Future Goals

- Different model (CFFEPS)
- Comparison of CFFEPS to FireWork (monthly comparisons may also be useful)
- Consider different model plume height retrieval methods (10% of max PM2.5, CO levels, etc)
- Incorporate CALIOP data to validate MINX results (really long-term goal)

Link to results

- https://hpfx.science.gc.ca/~eld001/MINXResults/FW-GM_start00/