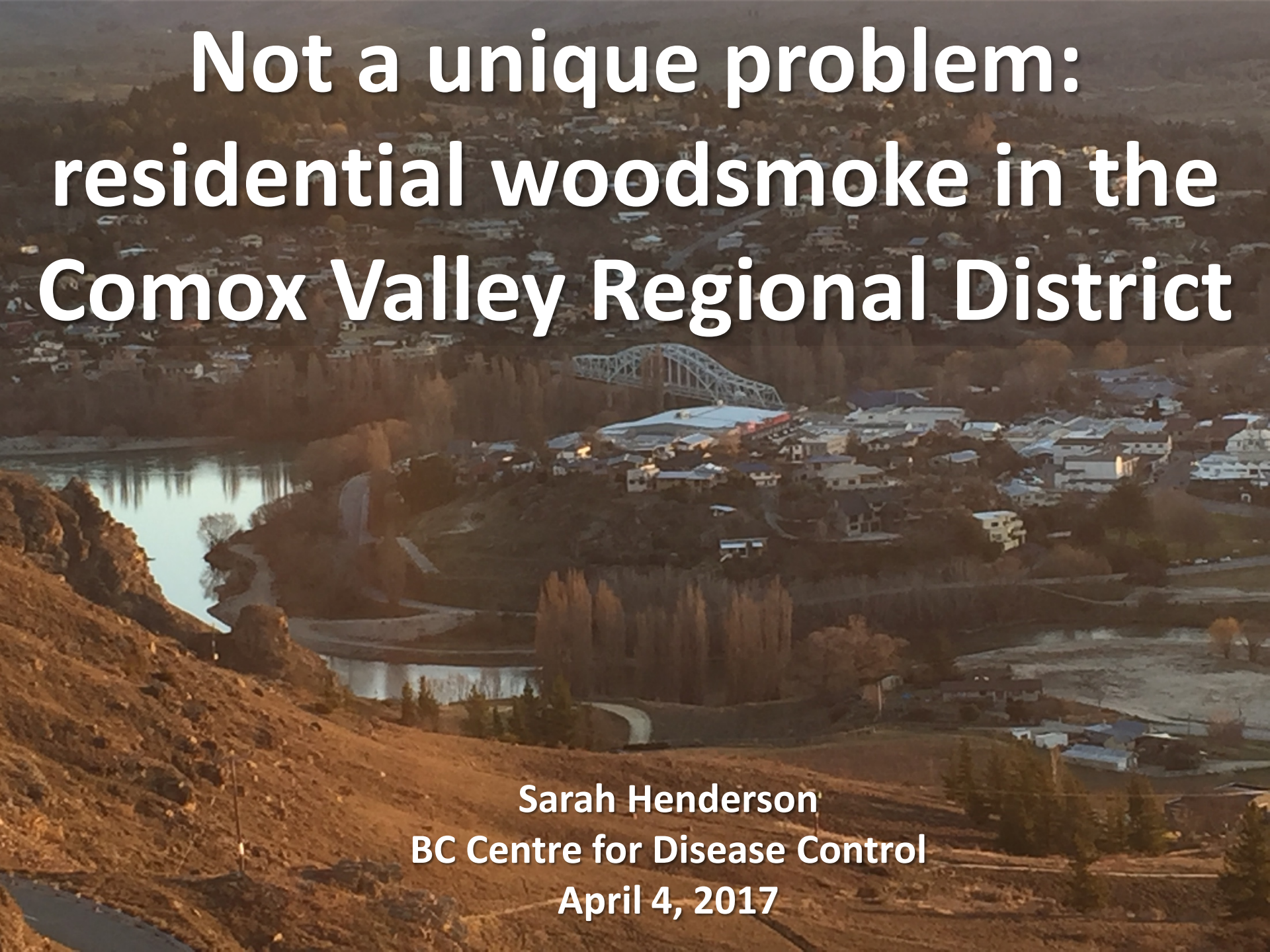
Not a unique problem: residential woodsmoke in the Comox Valley Regional District



Sarah Henderson
BC Centre for Disease Control
April 4, 2017

The Team

Arvind Saraswat, Gavin King, Natalie Suzuki + many others	**BC Ministry of Environment**
Scott Weichenthal	**McGill University**
Michael Brauer, Matthew Wagstaff	**University of British Columbia**
Nina Dobbin	**Health Canada**
Kris Hong	**BC Centre for Disease Control**
Funding	**BC MoE, BC Lung Association, Health Canada**

Outline

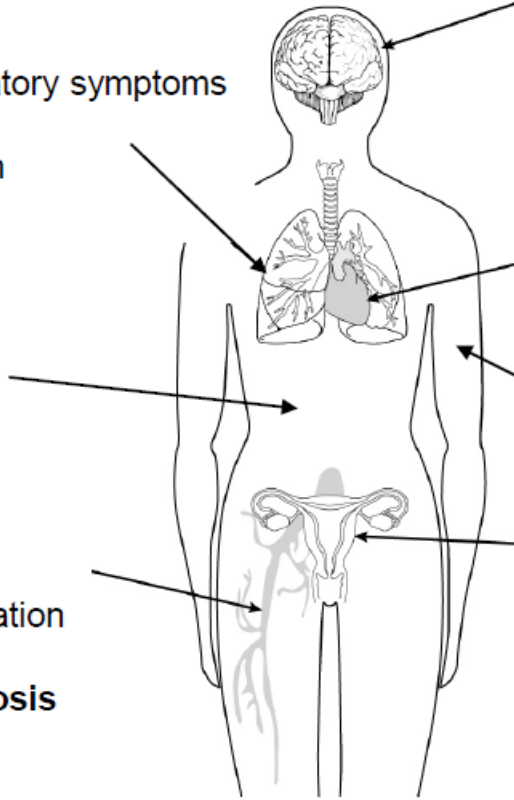
1. Air pollution and health
2. Systematically identifying smoky days in BC communities
    - A. Methods
    - B. Results
3. Mobile monitoring study
    - A. Methods
    - B. Preliminary results

$PM_{2.5}$ affects multiple organs and causes both acute and chronic health effects

- **Respiratory Disease Mortality**
- **Respiratory Disease Morbidity**
- **Lung Cancer**
- **Pneumonia**
- Upper and lower respiratory symptoms
- Airway inflammation
- Decreased lung function
- Decreased lung growth

- Insulin Resistance
- **Type 2 diabetes**
- **Type 1 diabetes**
- Bone metabolism

- **High blood pressure**
- Endothelial dysfunction
- Increased blood coagulation
- Systemic inflammation
- **Deep Venous Thrombosis**



- **Stroke**
- Neurological development
- Mental Health
- **Neurodegenerative diseases**

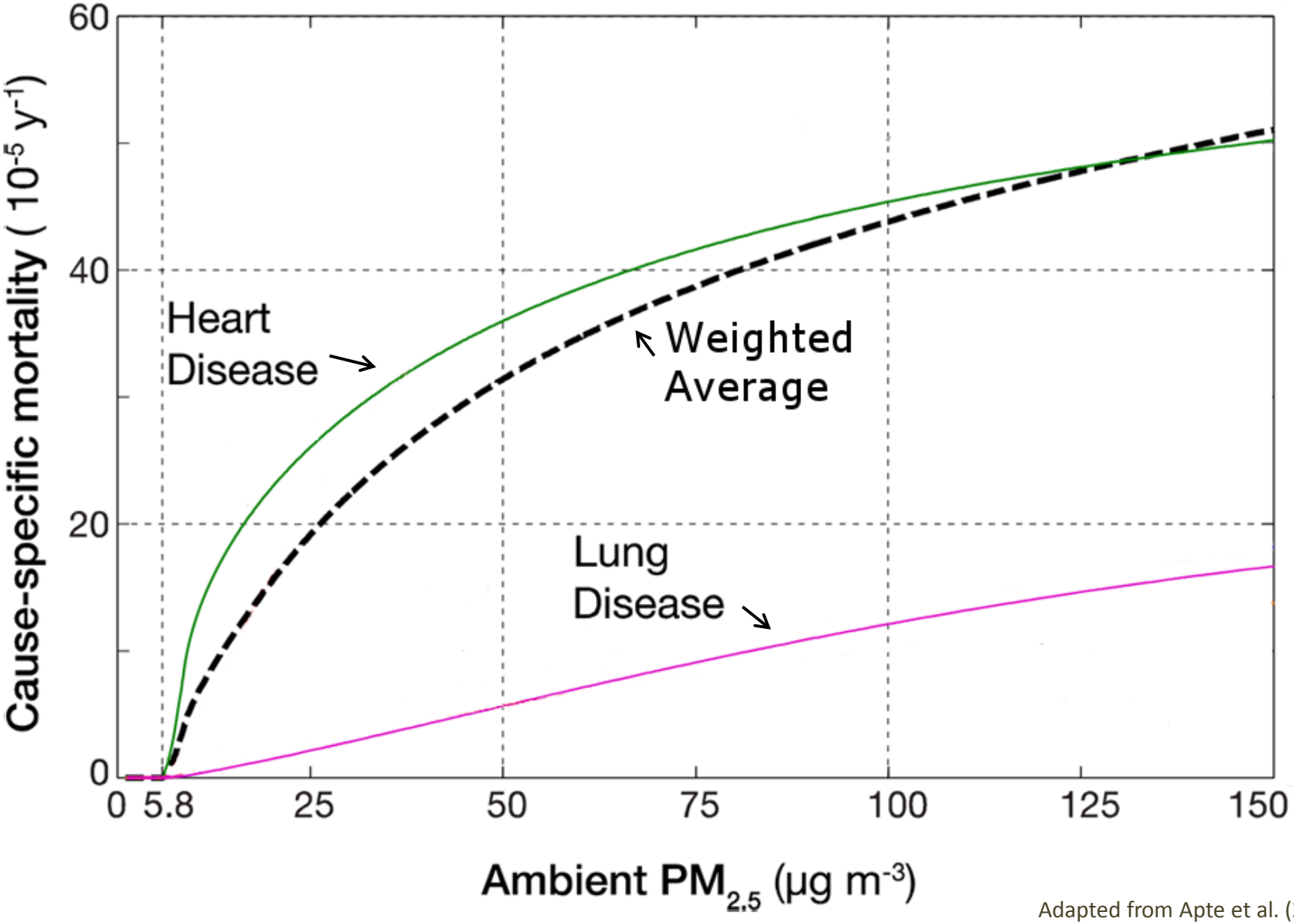
- **Cardiovascular Disease Mortality**
- **Cardiovascular Disease Morbidity**
- **Myocardial Infarction**
- **Arrhythmia**
- **Congestive Heart Failure**
- Changes in Heart Rate Variability
- ST-Segment Depression

- Skin Aging

- **Premature Birth**
- **Decreased Birth Weight**
- Decreased foetal growth
- In uterine growth retardation
- Decreased sperm quality
- Preclampsia

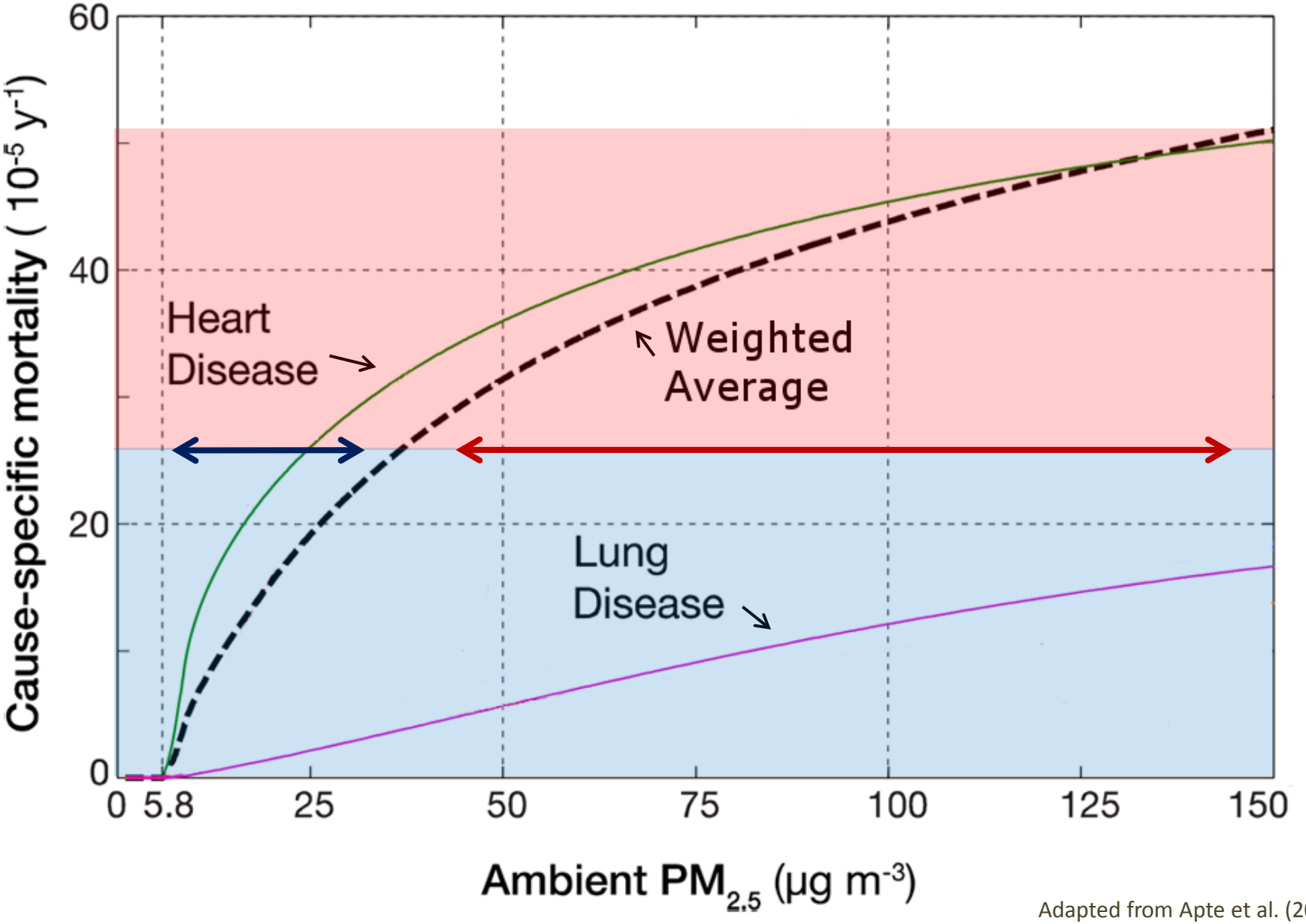
Joint ERS / ATS statement (ERJ 2017)

Exposure–Response Relationship Between $PM_{2.5}$ and Mortality



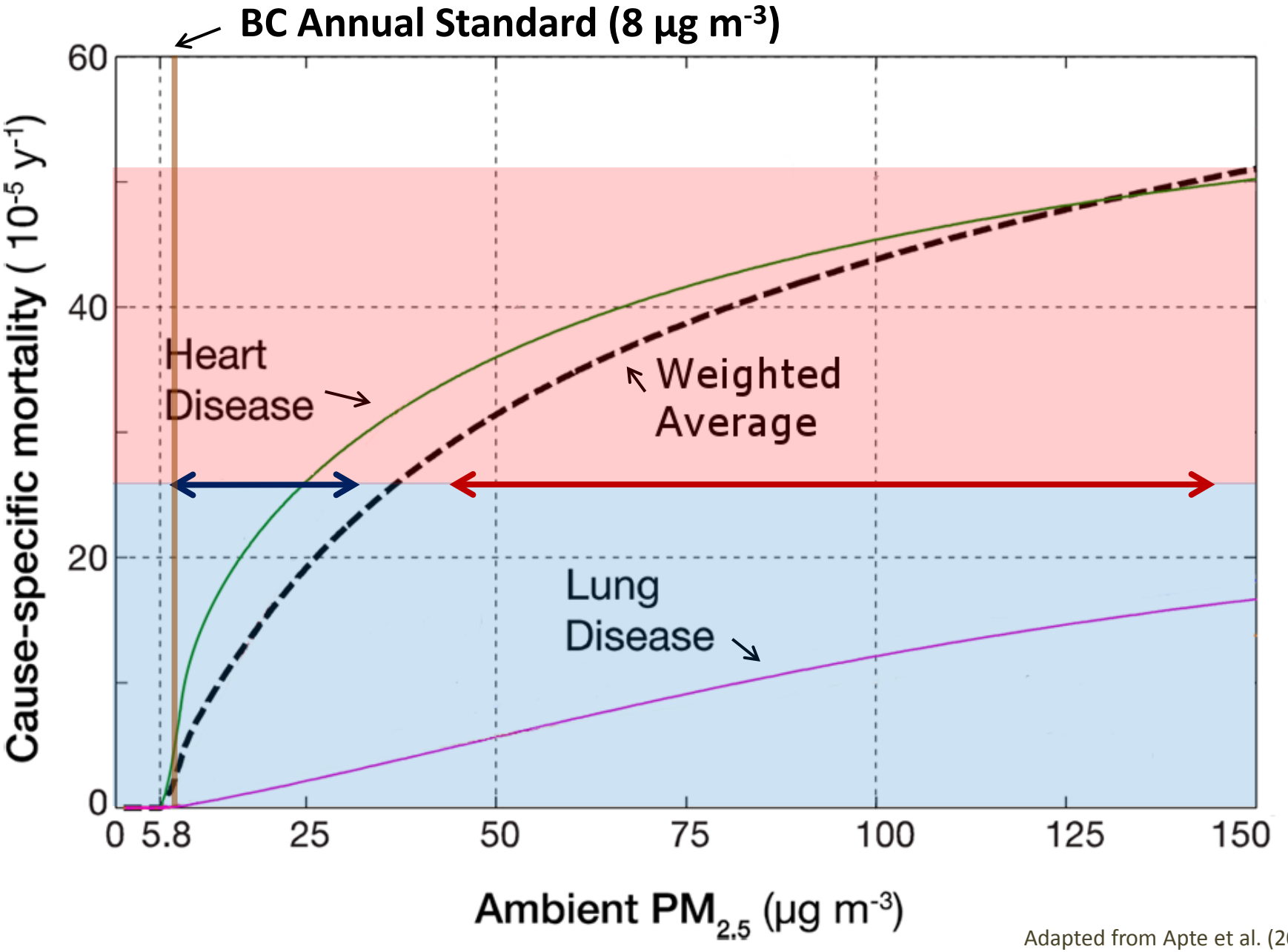
Adapted from Apte et al. (2015) ES&T

Exposure–Response Relationship Between $PM_{2.5}$ and Mortality



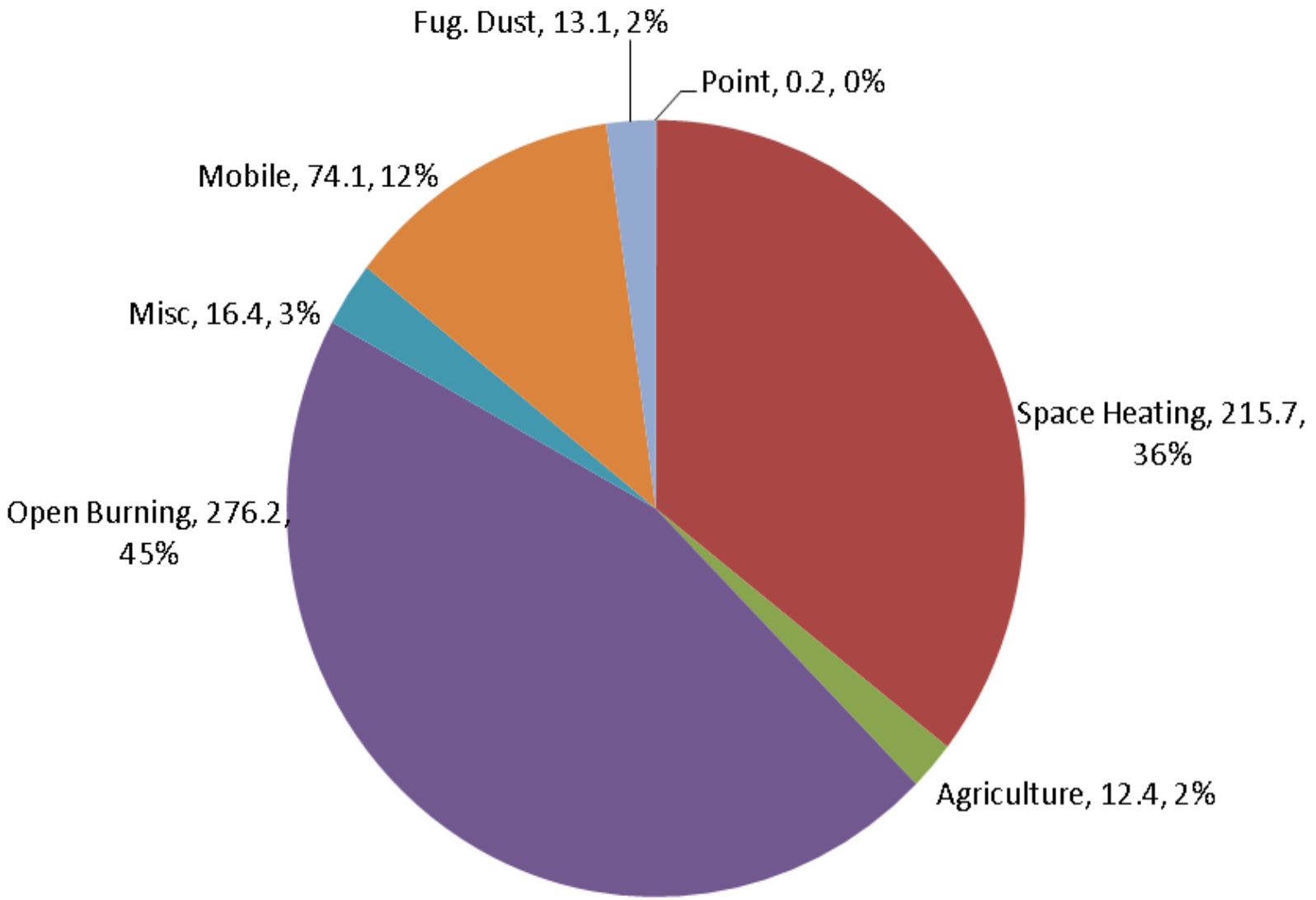
Adapted from Apte et al. (2015) ES&T

Exposure–Response Relationship Between $PM_{2.5}$ and Mortality

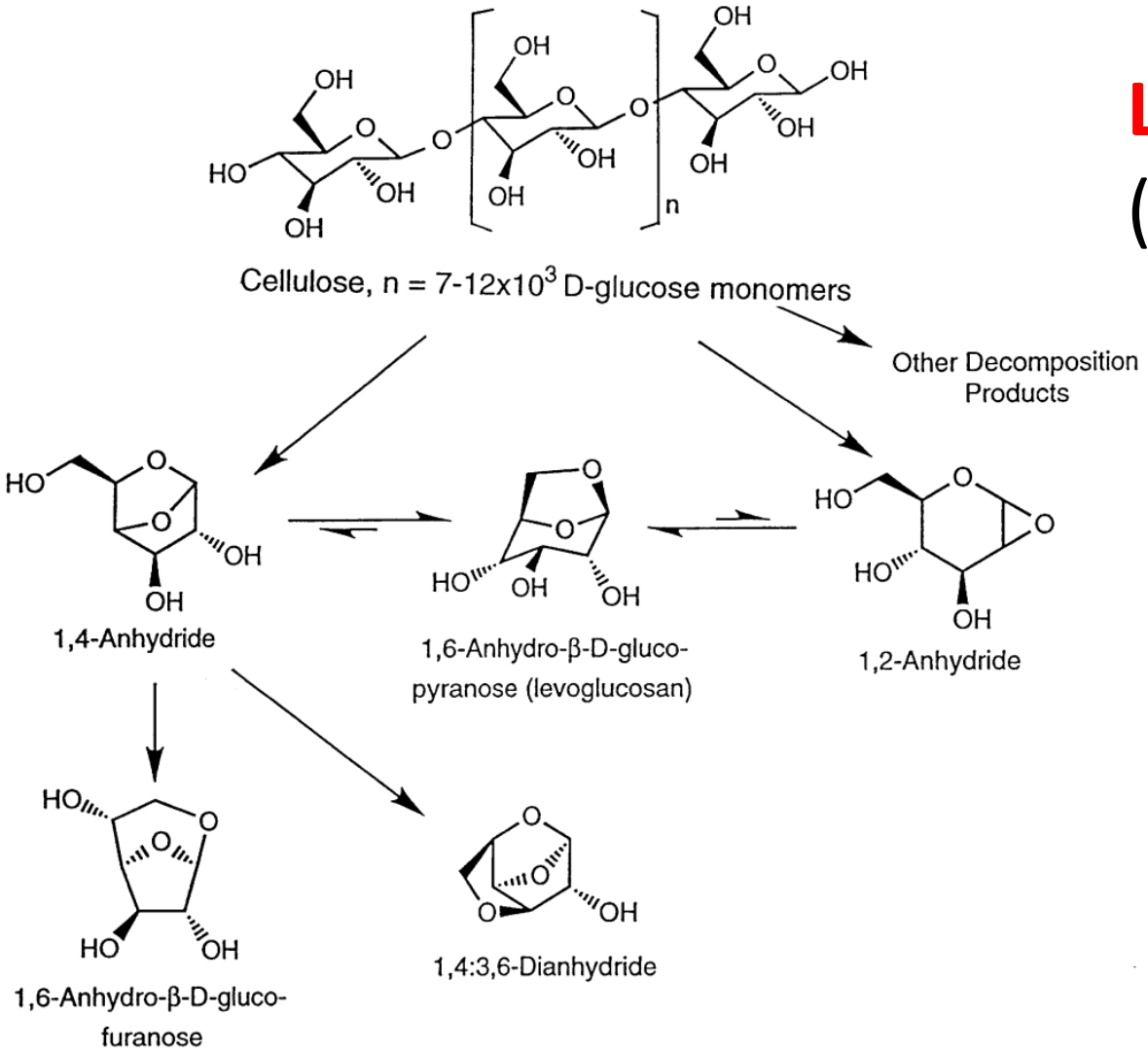


Adapted from Apte et al. (2015) ES&T

Comox Valley Emissions Inventory For PM2.5 (TPY) Base Year 2015



Establishing Empirical Evidence for Woodsmoke Pollution



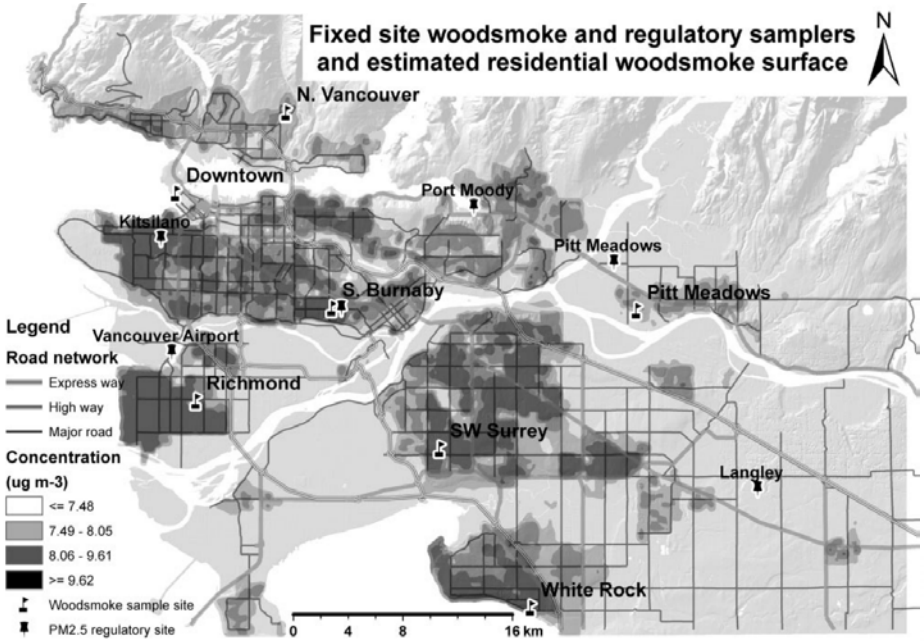
Levoglucosan

(the gold standard)

- Requires special study
- Fixed samplers for at least 24 hours
- Expensive lab analysis

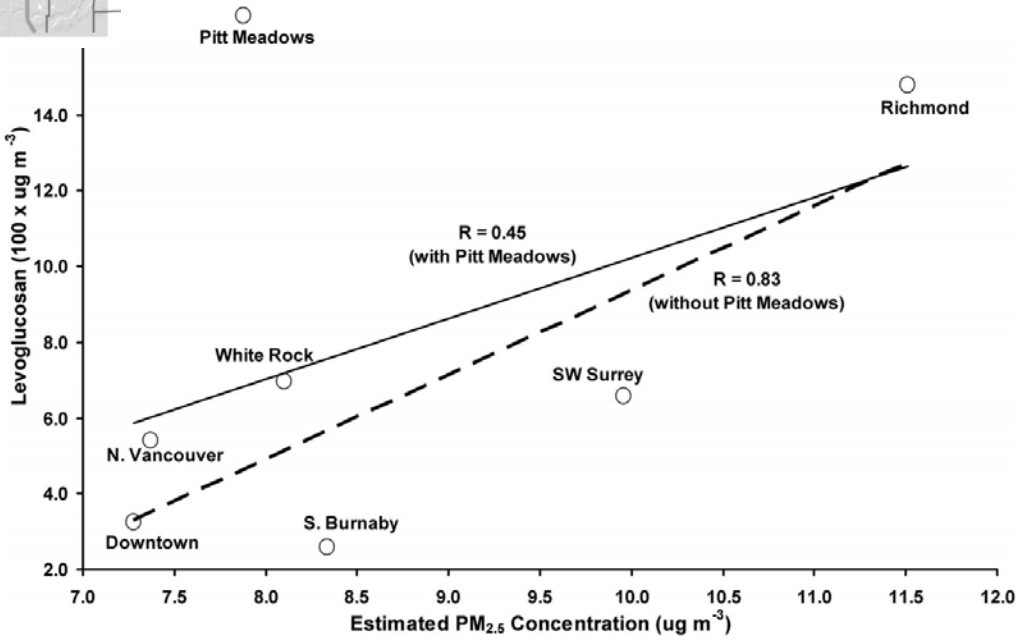
Simoneit et al (1999), Atmospheric Environment, 33(2)

Establishing Empirical Evidence for Woodsmoke Pollution



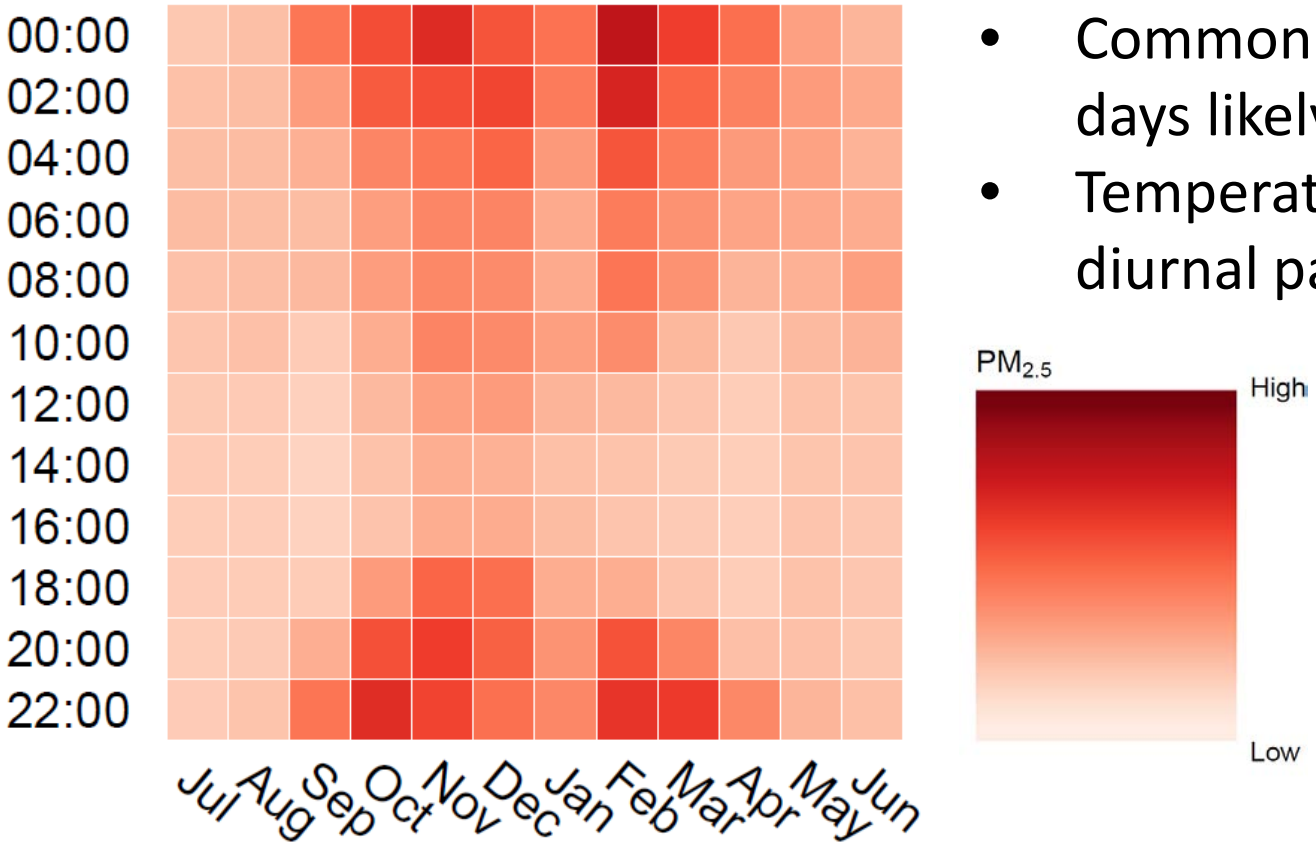
Mobile monitoring

- Requires special study
- Requires continuous reading instrument
- Allows spatial characterization



Su et al (2007), JAWMA, 57

Establishing Empirical Evidence for Woodsmoke Pollution



Routine monitoring data

- No special study required
- Common features of smoky days likely identifiable
- Temperature, variability, diurnal patterns

Given that:

1) Woodsmoke sampling is too expensive to conduct in all affected communities

AND

2) Communities want evidence to inform local policy

Question:

Can we use routinely collected $PM_{2.5}$ and temperature data to assess woodsmoke impacts in BC communities?

Three criteria to be classified as a smoky day:

1. **Mean daily temperature ≤ X**

AND

2. Standard deviation (SD) of 1-hour $PM_{2.5}$ concentrations ≥ Y

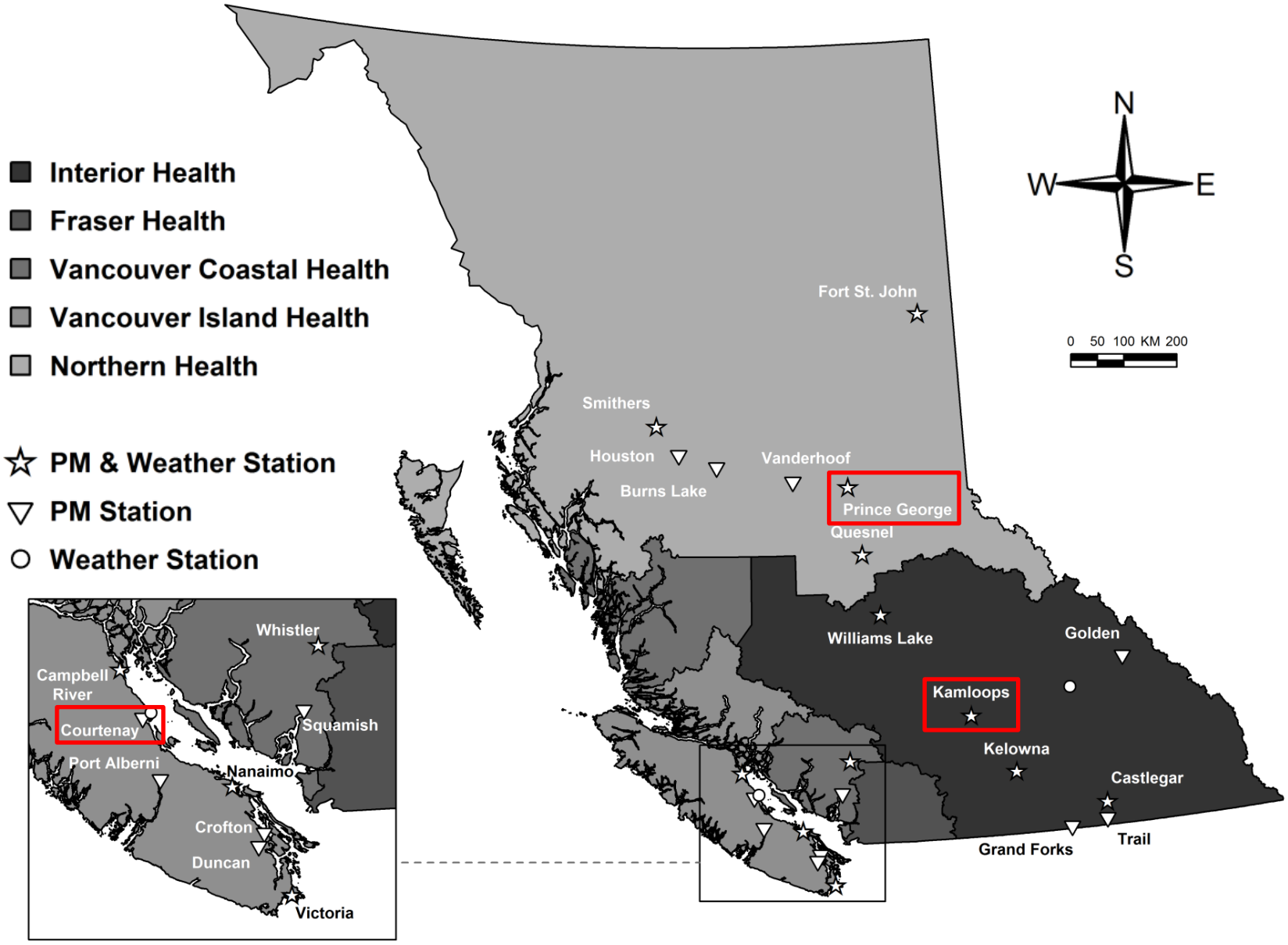
AND

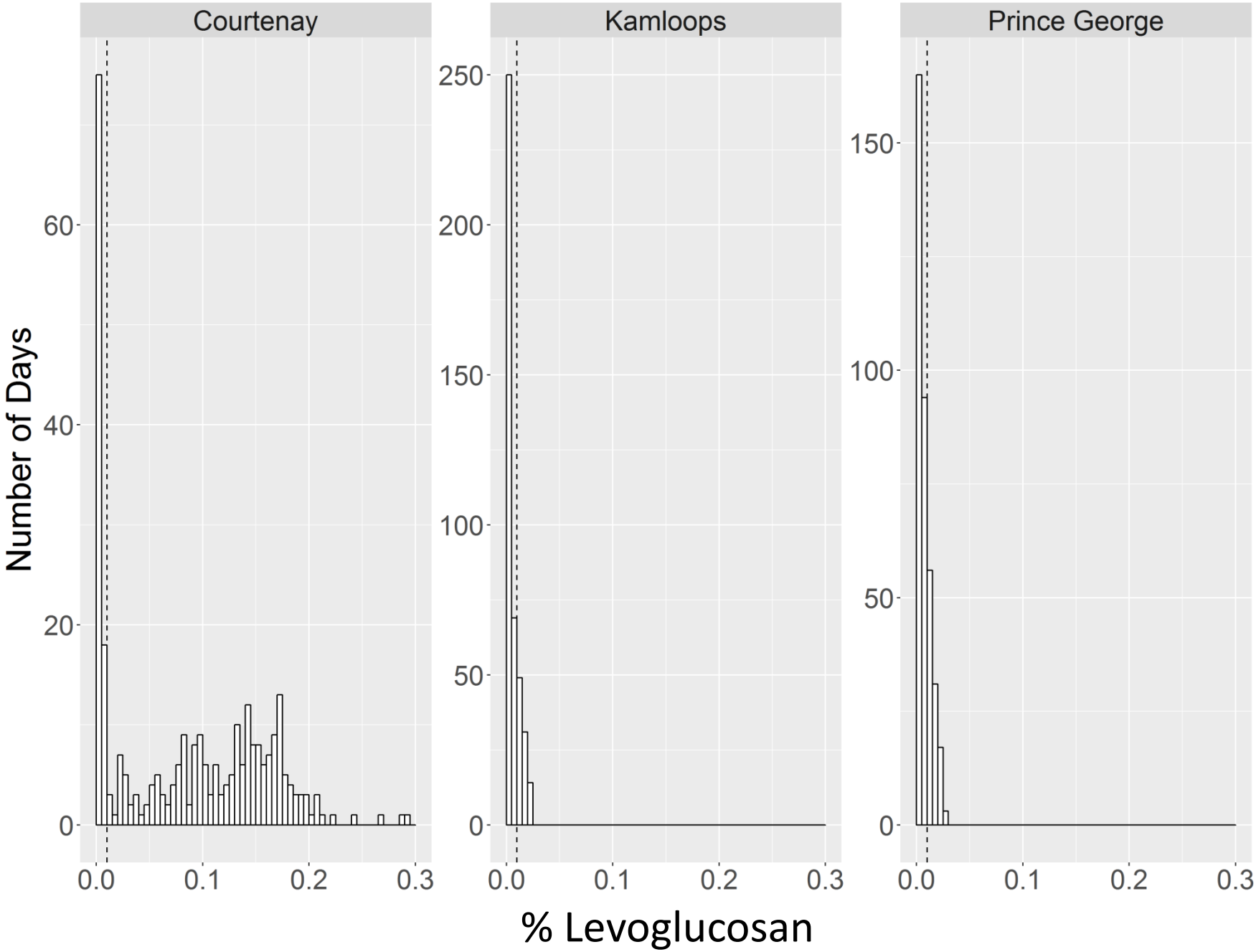
3. Daytime to Nighttime $PM_{2.5}$ Ratio ≤ Z

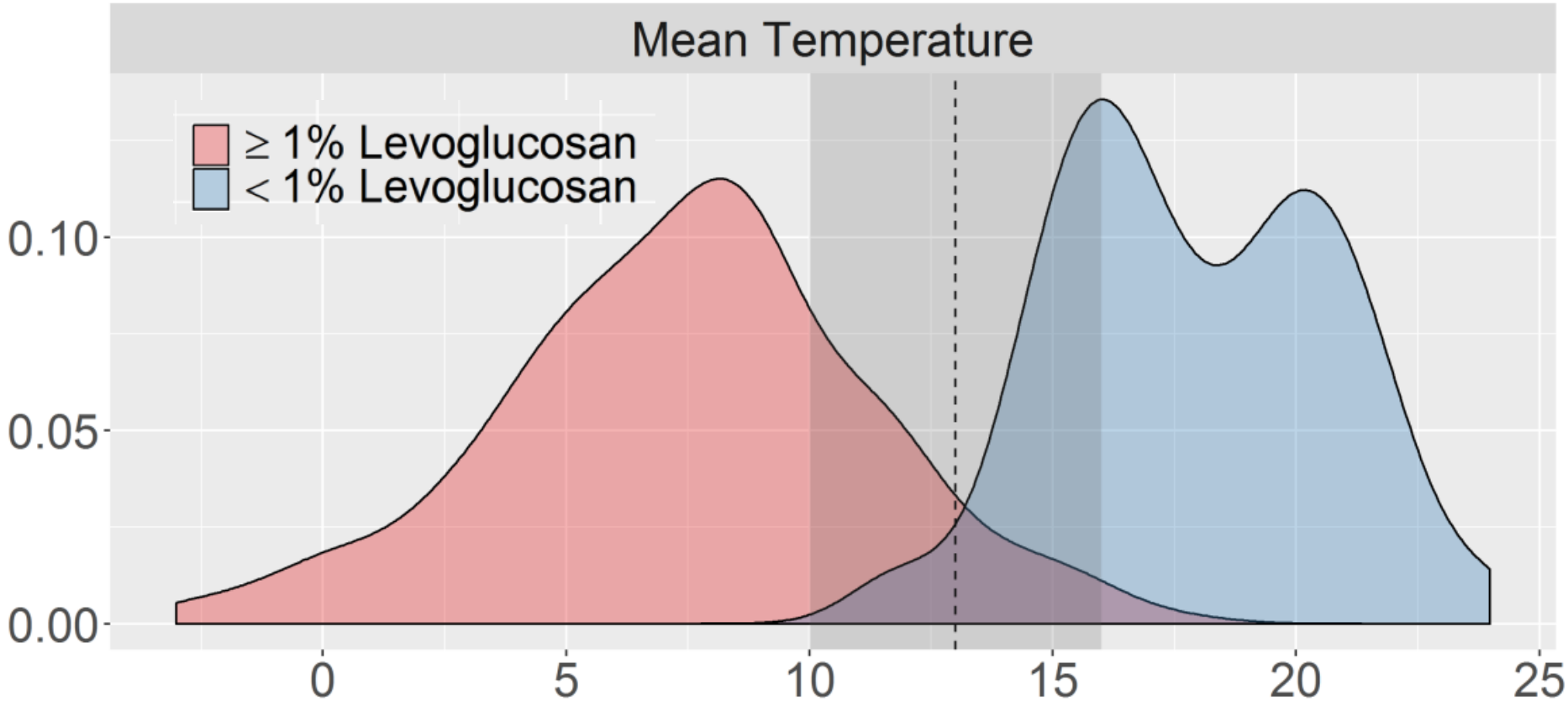
What are the ideal values for the X, Y, and Z?

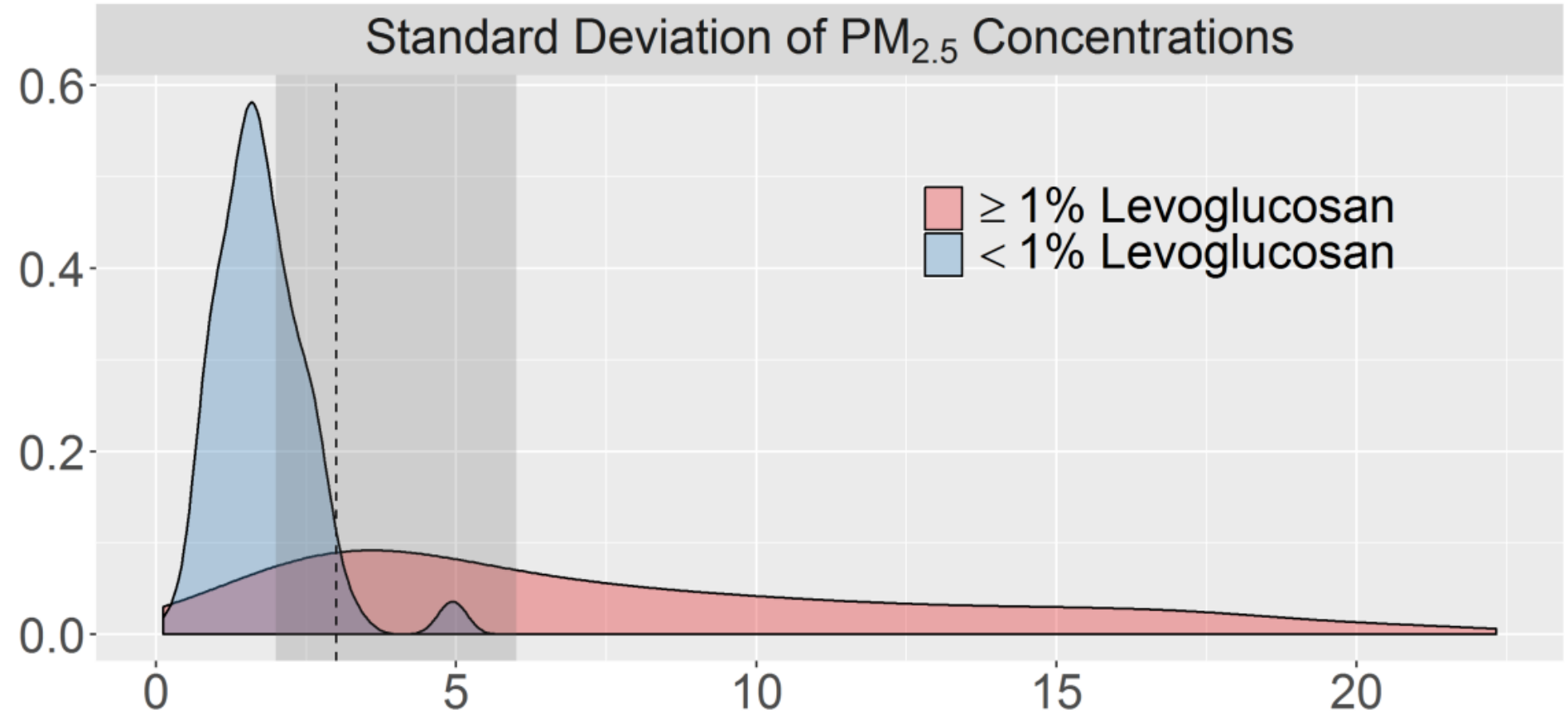
Optimize thresholds based on levoglucosan data

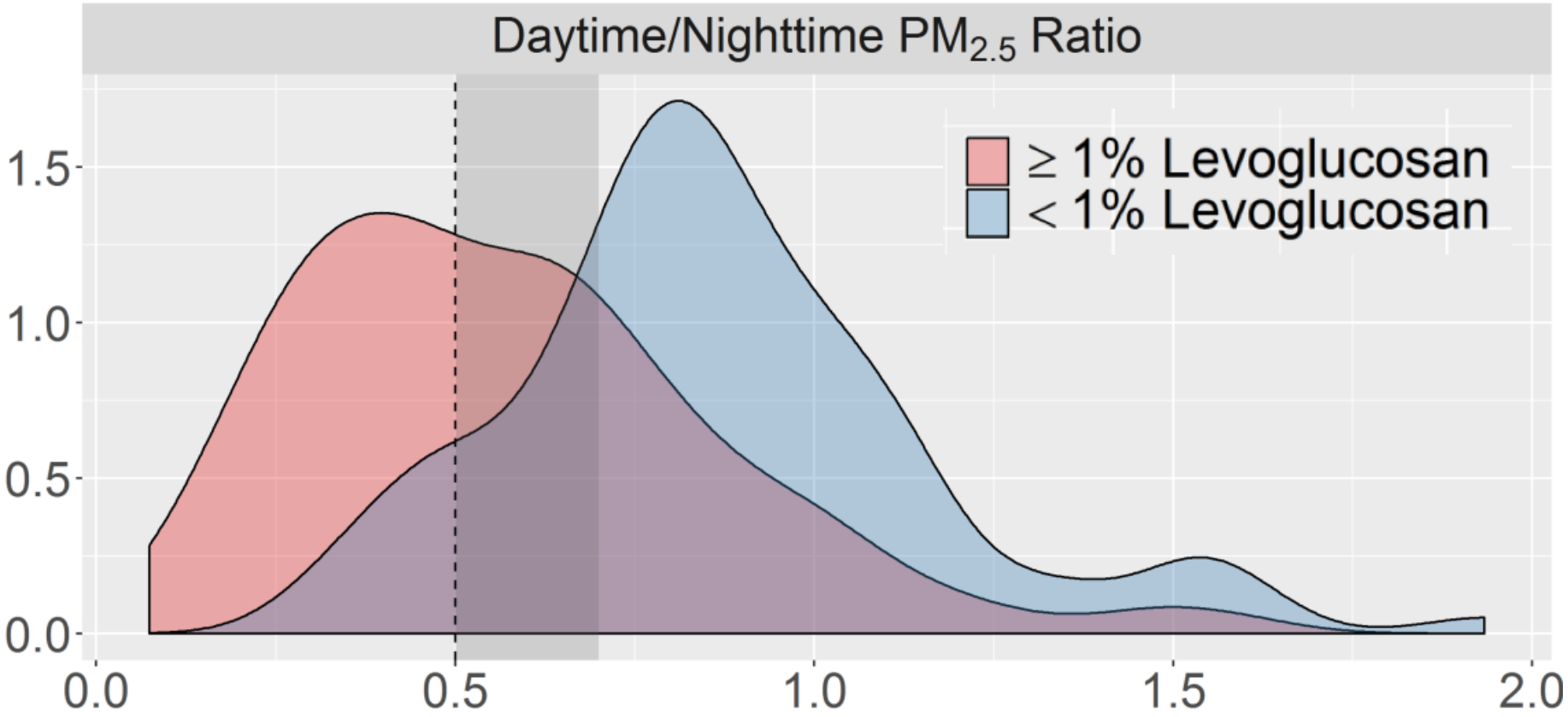
What Data Do We Have to Work With?



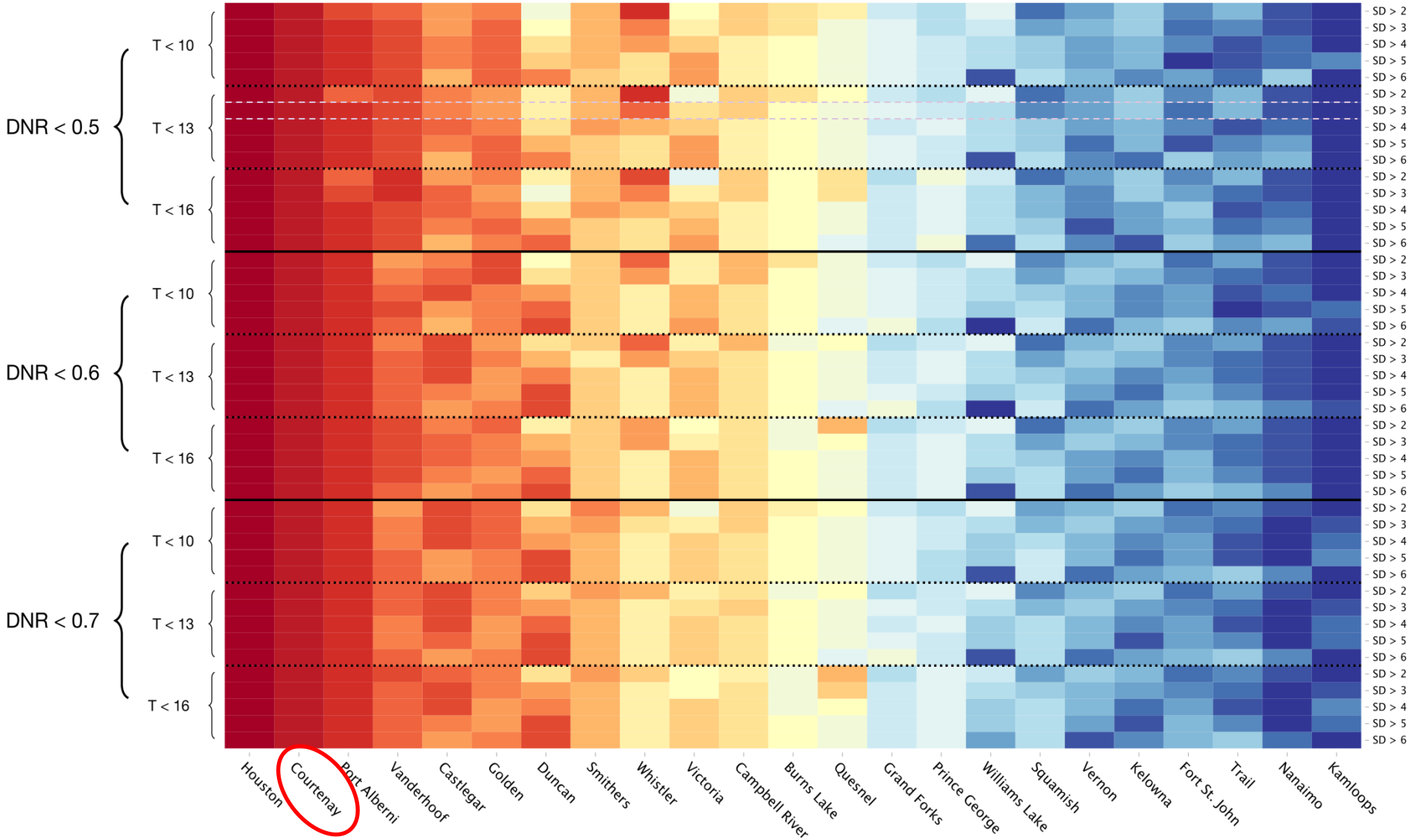

Courtenay
Kamloops
Prince George
Number of Days
% Levoglucosan
0
20
40
60
50
100
150
200
250
0.0
0.1
0.2
0.3

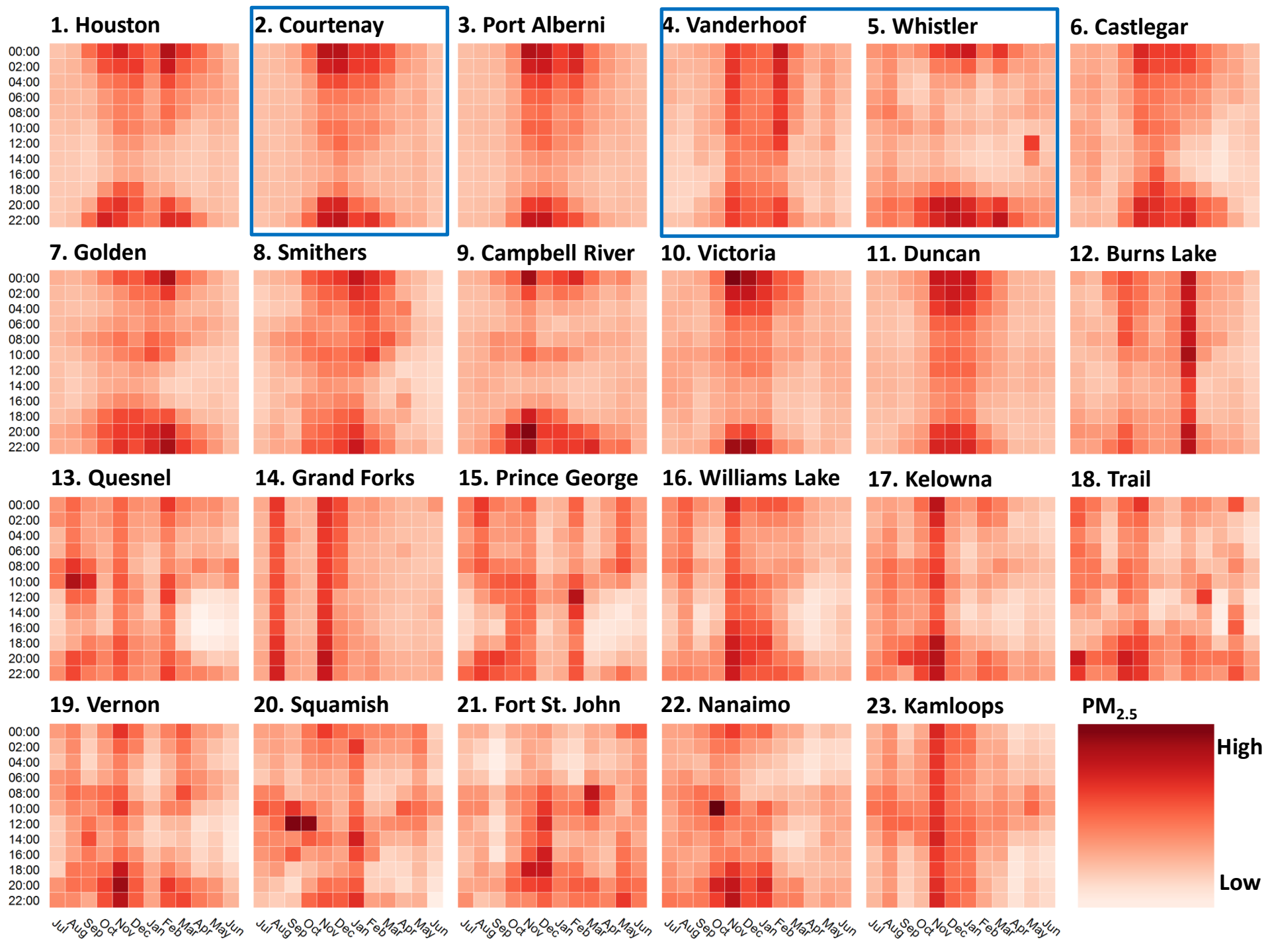

Mean Temperature
≥ 1% Levoglucosan
< 1% Levoglucosan
0.10
0.05
0.00
0
5
10
15
20
25


Standard Deviation of $PM_{2.5}$ Concentrations
0.6
0.4
0.2
0.0
0
5
10
15
20
≥ 1% Levoglucosan
< 1% Levoglucosan


Daytime/Nighttime $PM_{2.5}$ Ratio
≥ 1% Levoglucosan
< 1% Levoglucosan
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0

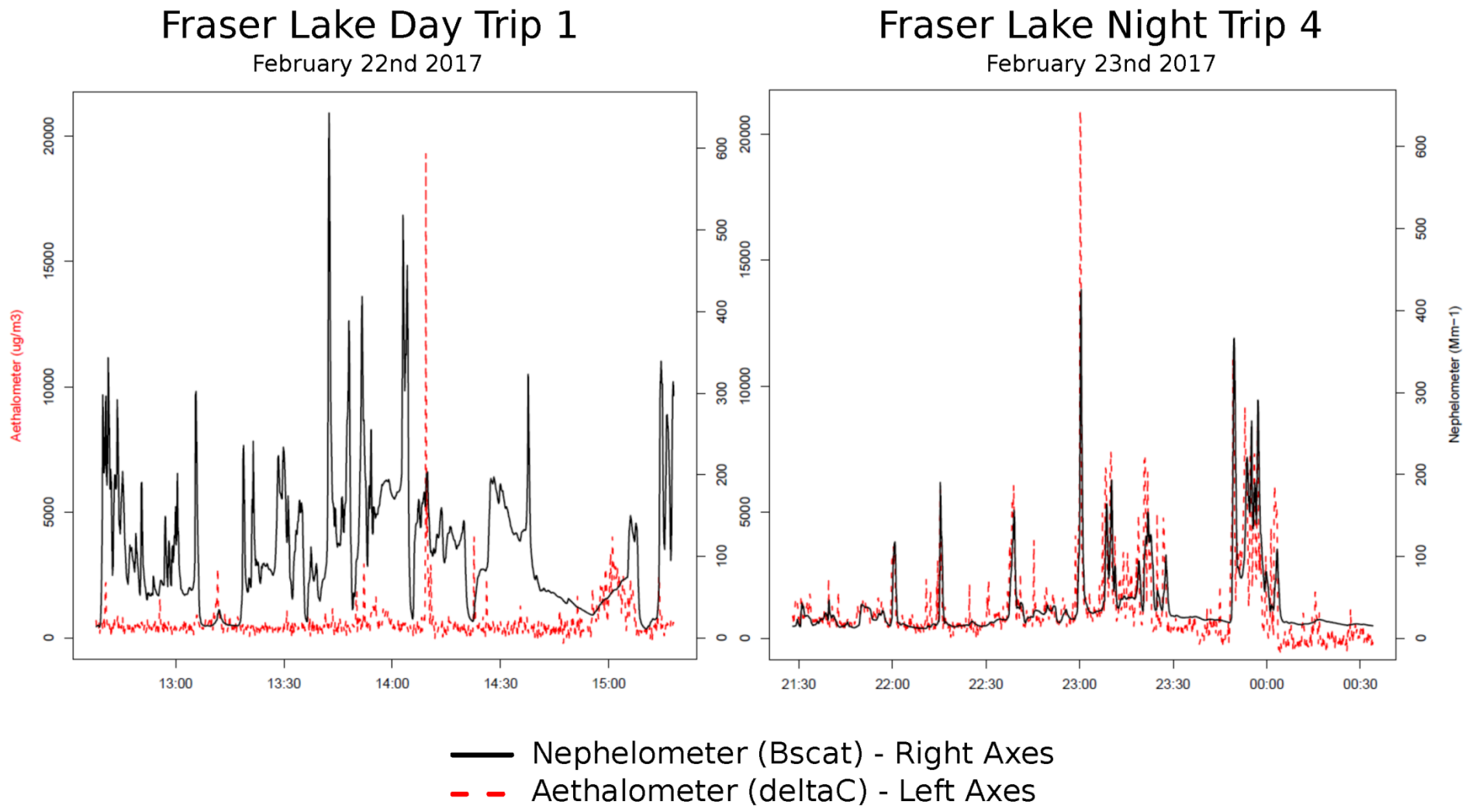
Communities Ranked by Smokiness by Criteria Combinations



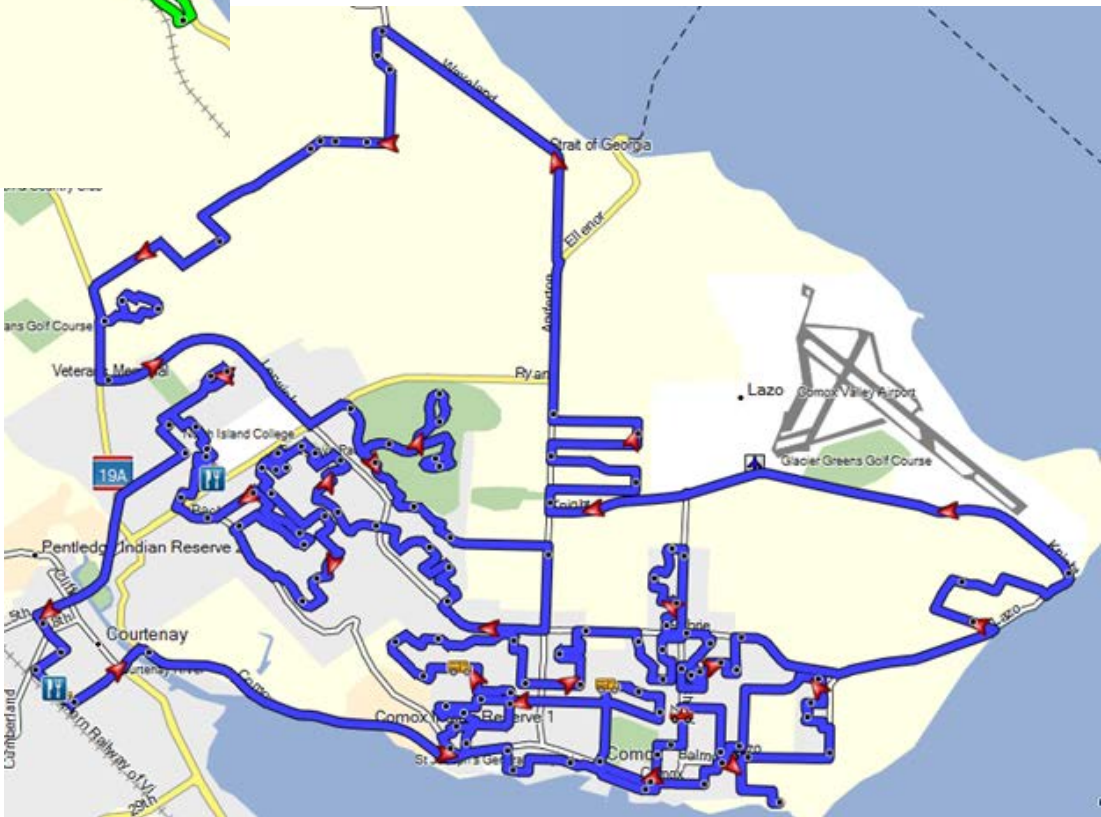

1. Houston
2. Courtenay
3. Port Alberni
4. Vanderhoof
5. Whistler
6. Castlegar
7. Golden
8. Smithers
9. Campbell River
10. Victoria
11. Duncan
12. Burns Lake
13. Quesnel
14. Grand Forks
15. Prince George
16. Williams Lake
17. Kelowna
18. Trail
19. Vernon
20. Squamish
21. Fort St. John
22. Nanaimo
23. Kamloops
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
PM2.5
High
Low

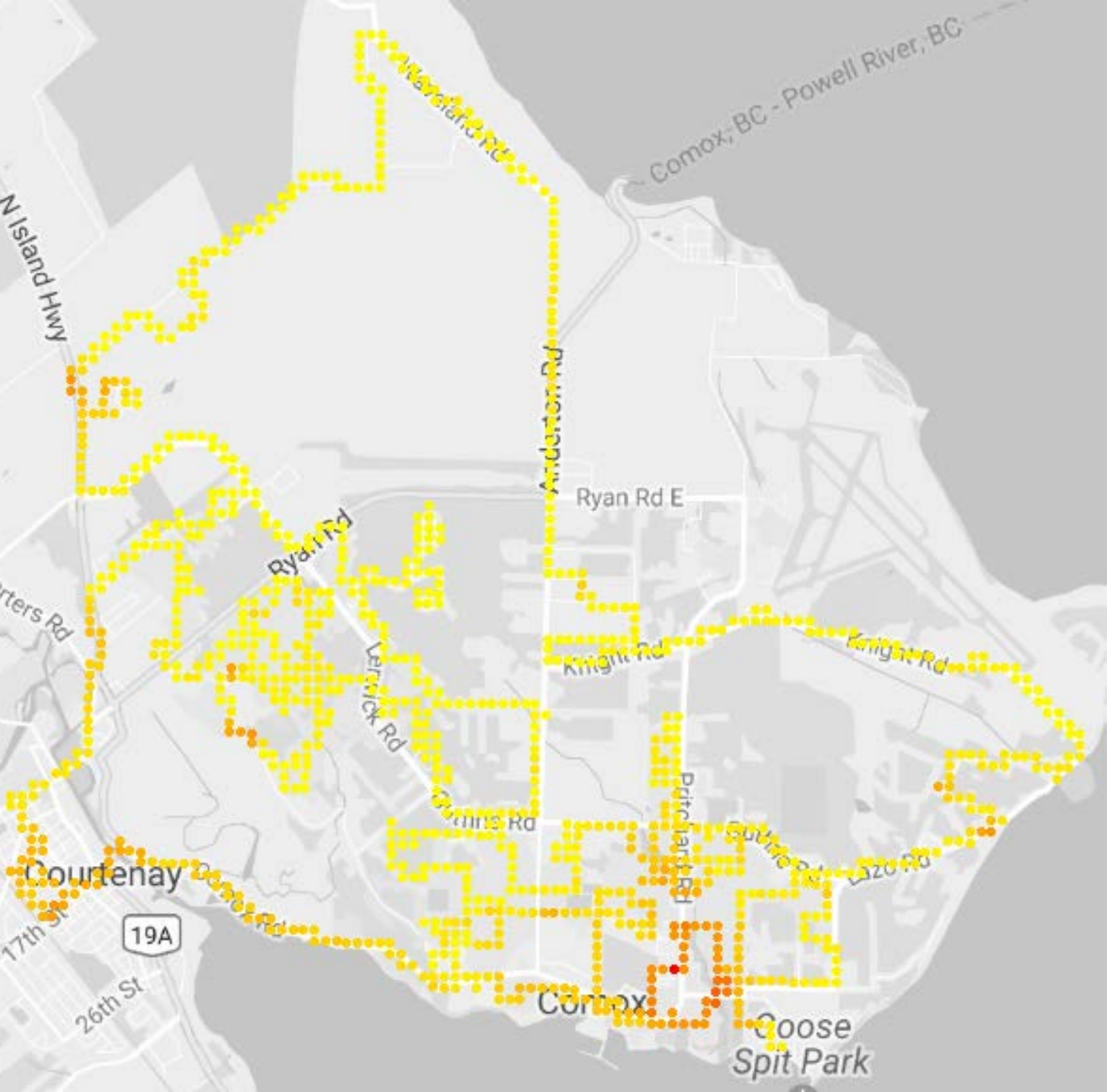
Nephelometer vs. multi-channel aethelometer

Mobile Instruments Comparison



Sampling conducted every night for two weeks on one of two routes





Single Night, Comox Route

deltaC

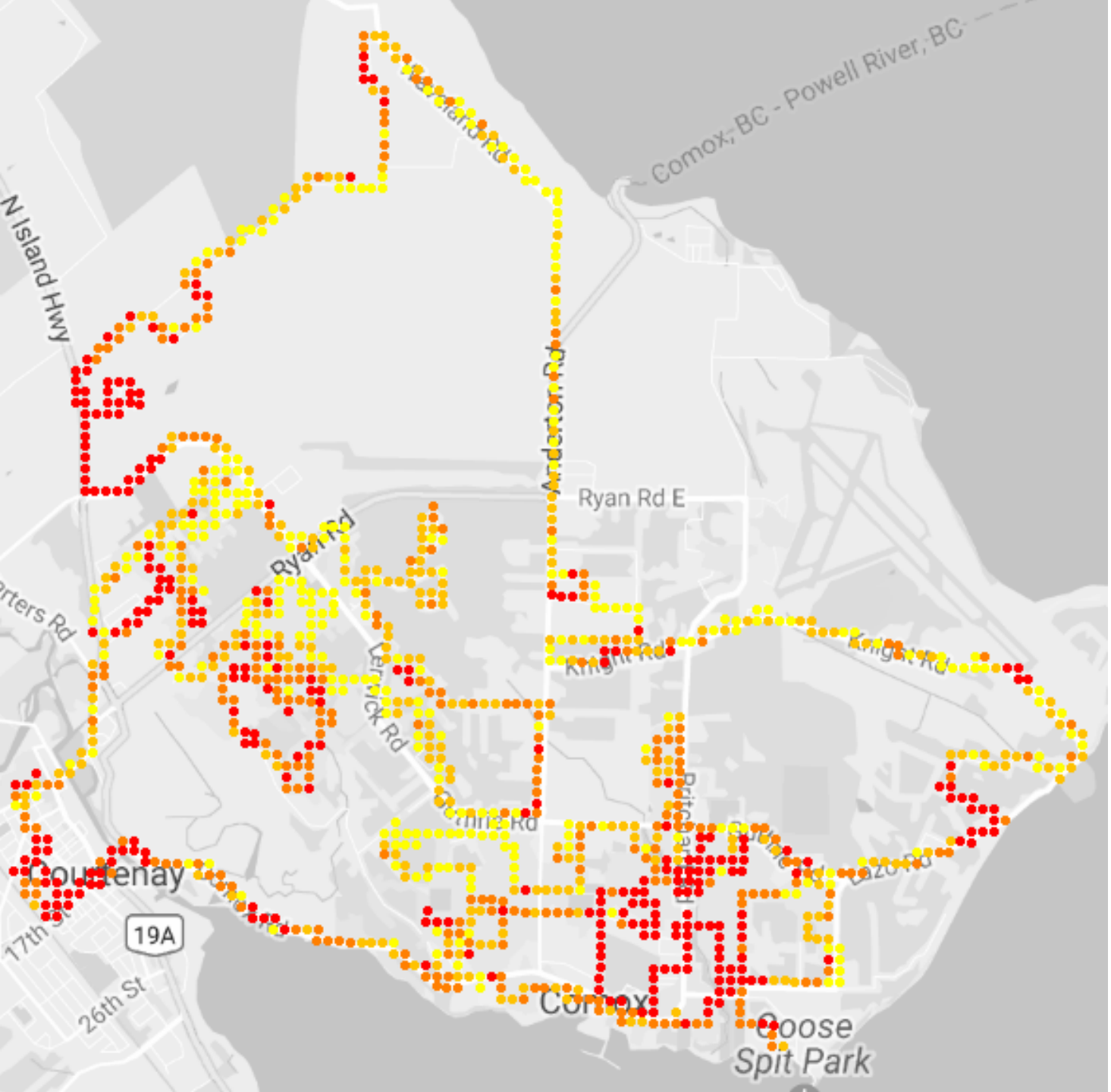
5

4

3

2

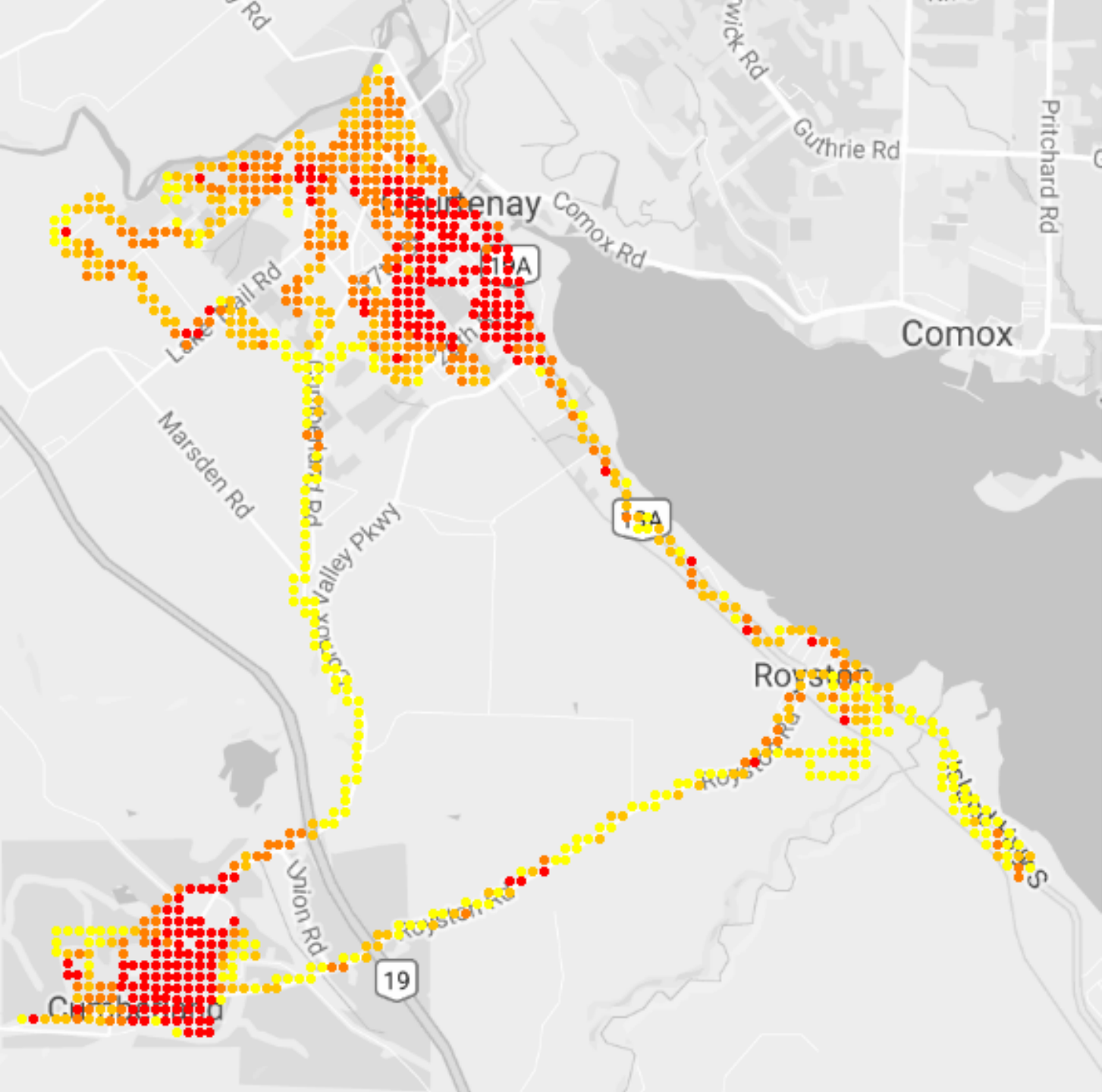
1



Nighttime Mean, Comox Route

deltaC Quantile

- 1
- 2
- 3
- 4



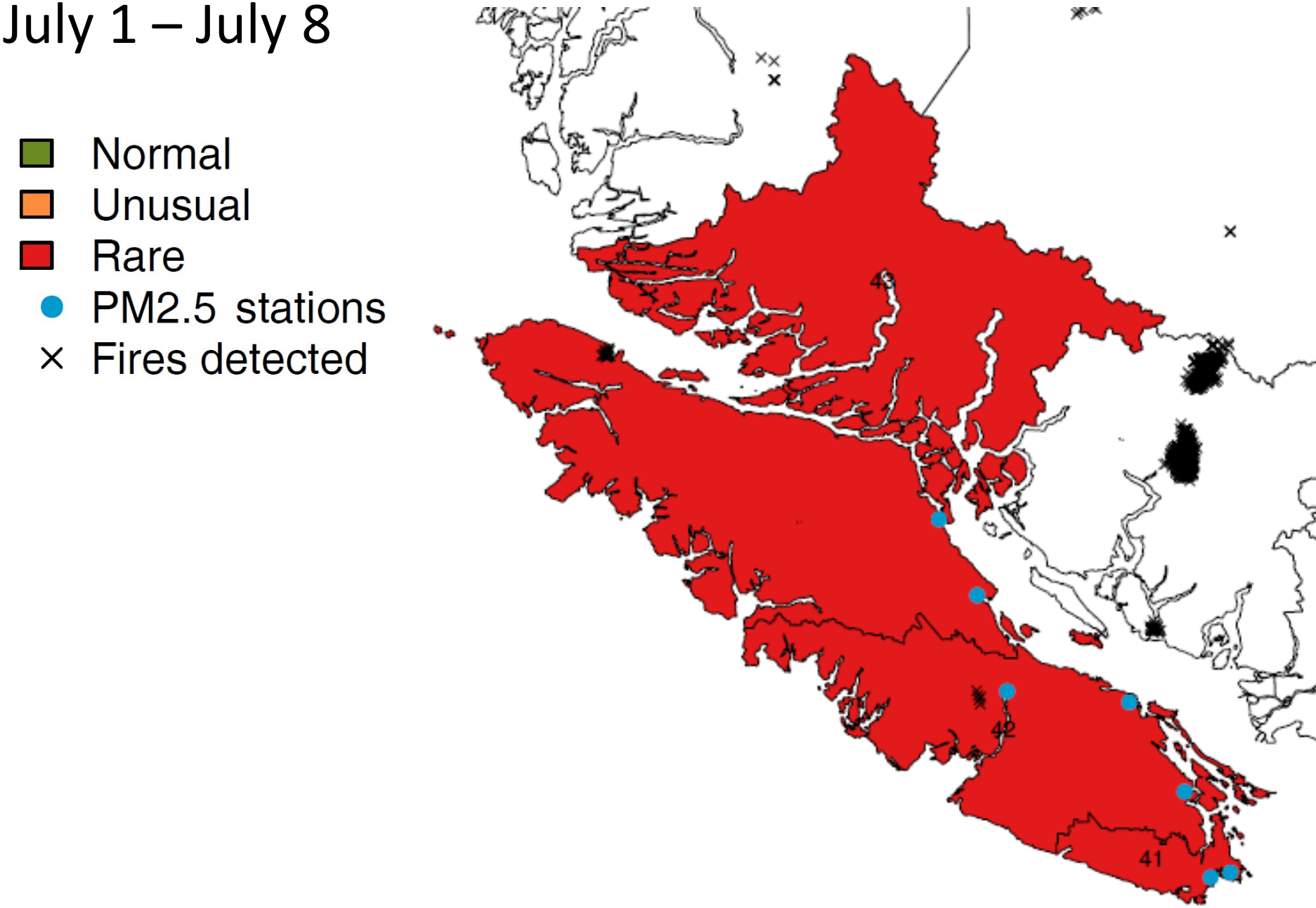
Nighttime Mean, Courtenay Route

deltaC Quantile

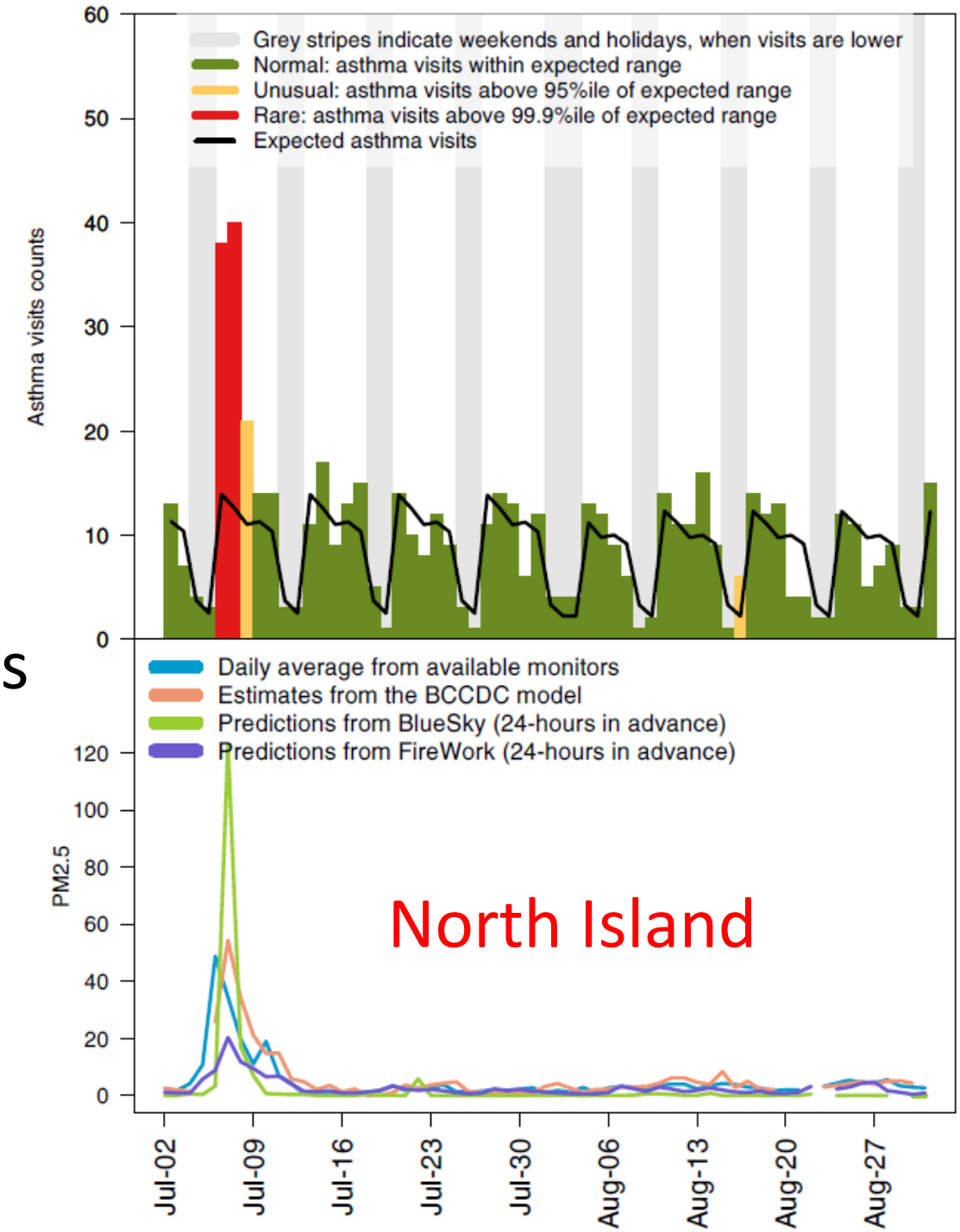
- 1
- 2
- 3
- 4

Thank you!

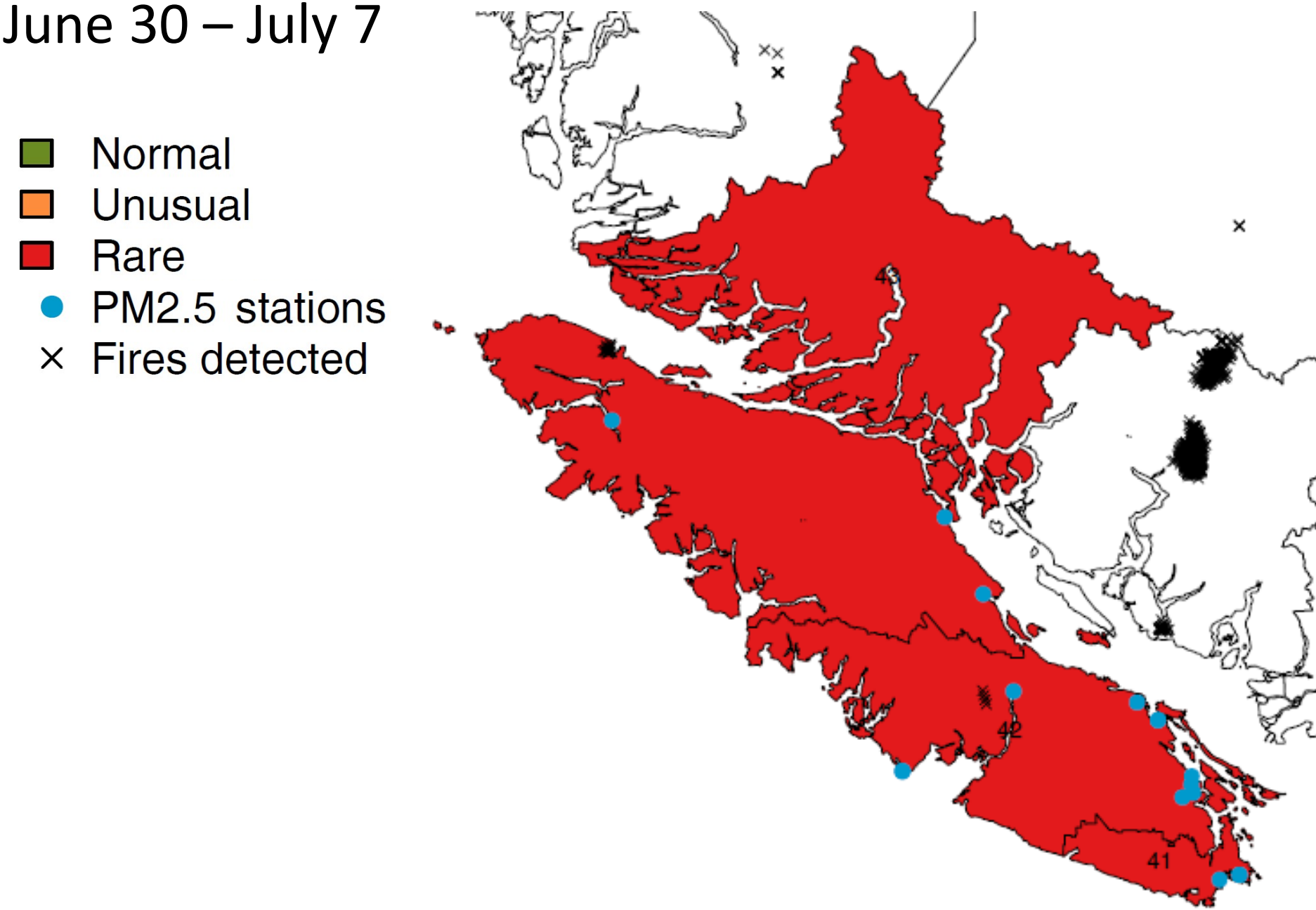
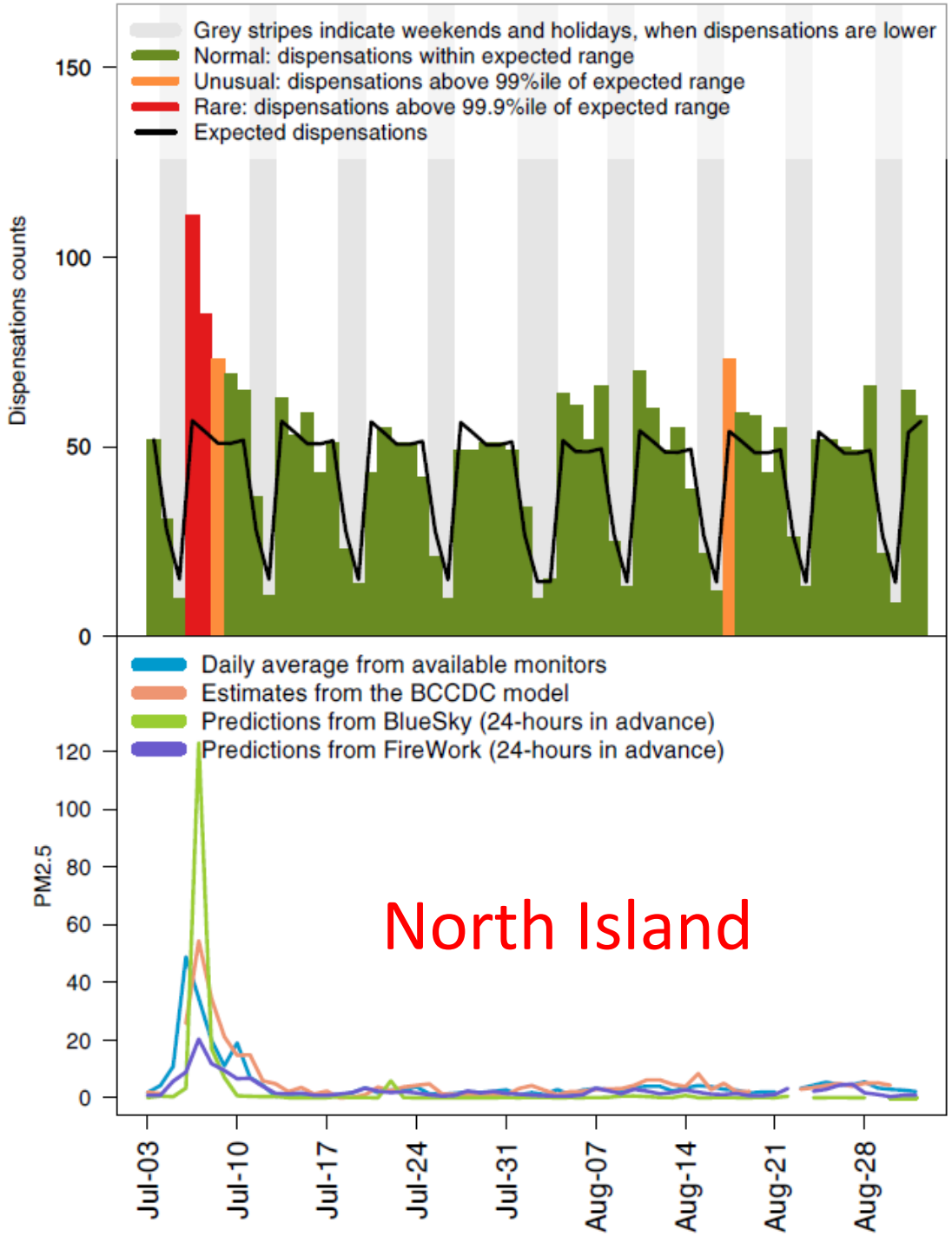
Asthma MSP Billings within 5 days
July 1 – July 8



Asthma Visit MSP Billings within 5 days



Salbutamol Dispensations
June 30 – July 7



Salbutamol Dispensations