Environment Canada Environnement Canada

metro vancouver

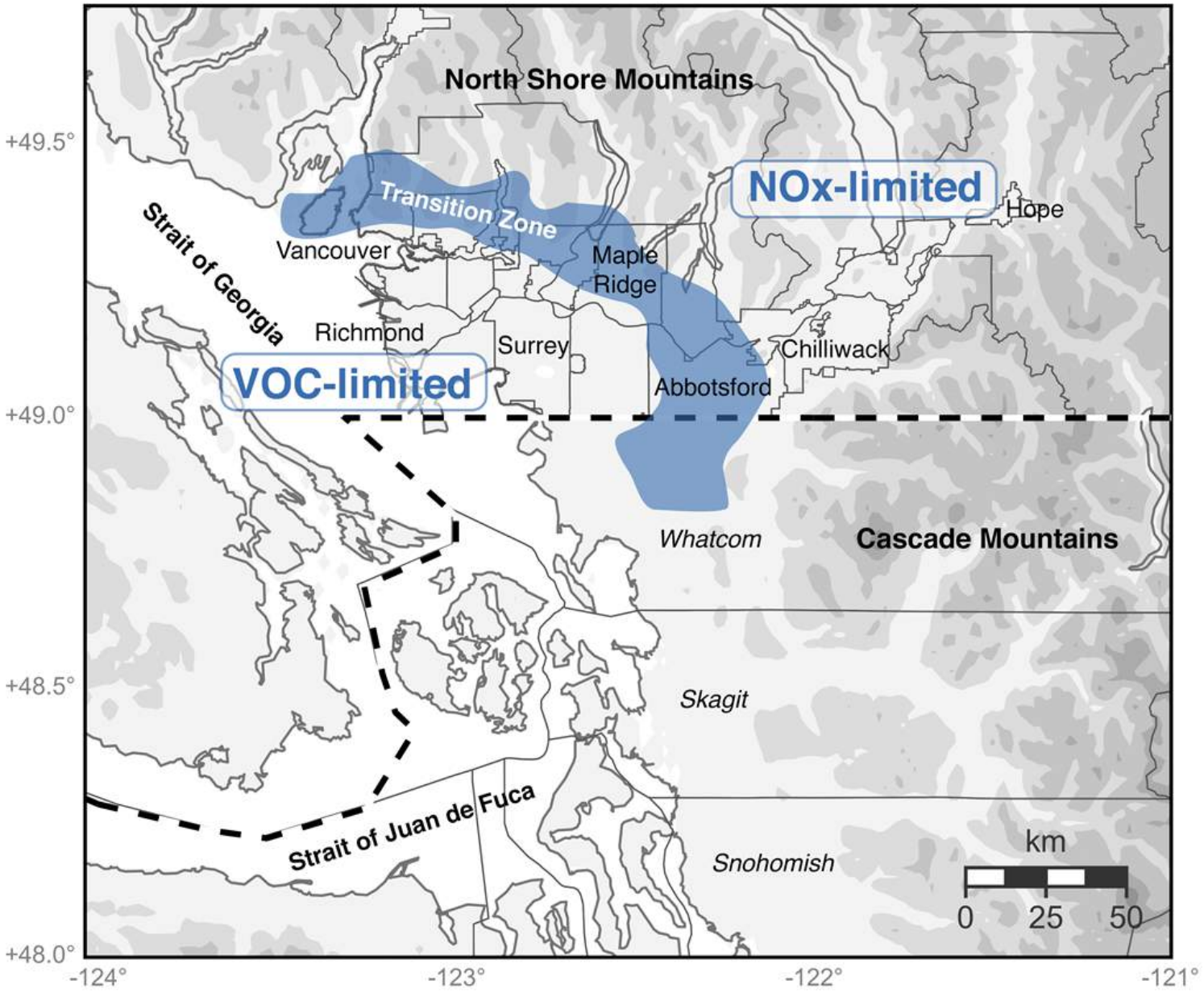
A source-receptor analysis of NO_x emissions in the Lower Fraser Valley

Bruce Ainslie, Annie Seagram, Roxanne Vingarzan

June 26 2015

NW-AirQuest 2015 Annual Meeting

LFV: O_3 episodes VOC/NO_X sensitive regions



Research questions

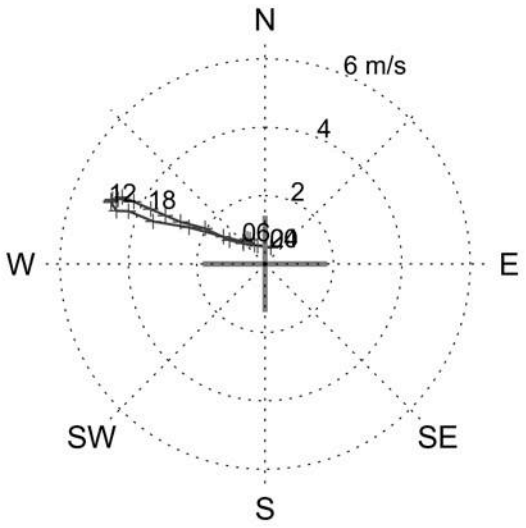
(1) Where could NO_x emissions from the large emission sources in the western part of the LFV travel to?

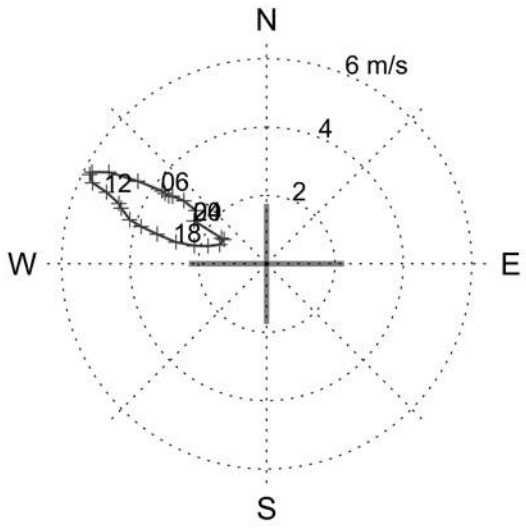
(2) From where could NO_x emissions originate that impacts the eastern (NO_x-limited) LFV?

(3) How sensitive are results from (1) and (2) to meteorological variability?

Meteorological Variability
O_3 episodes Circulation Regimes (CR)

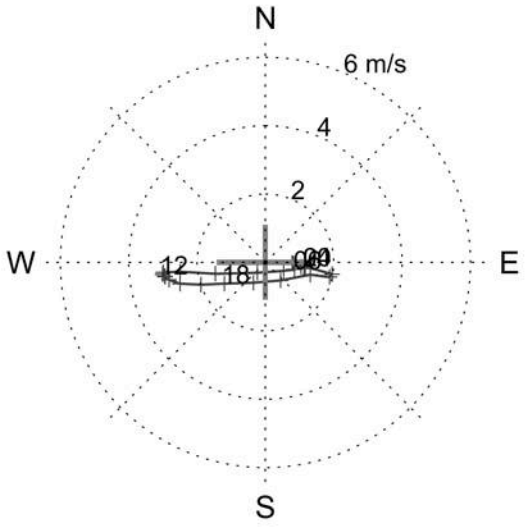
CR I

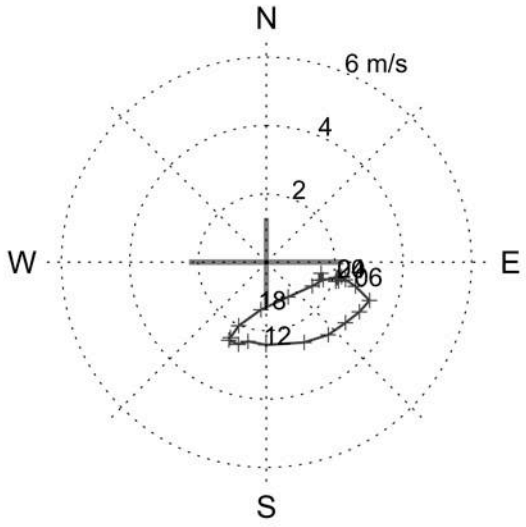




CR II

CR III





CR IV

Statistically-derived daily hodographs valid at YVR for ozone exceedance days (Ainslie & Steyn 2007)

Meteorological Variability
O_3 episodes Circulation Regimes (CR)

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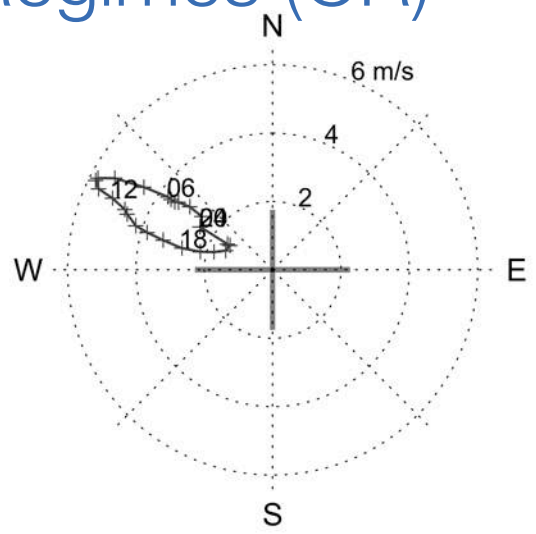

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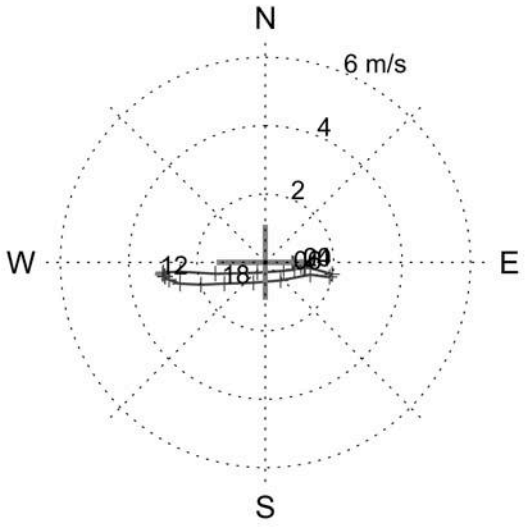
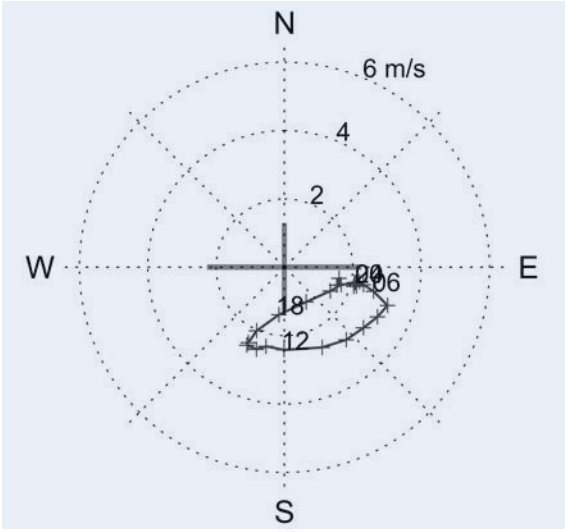


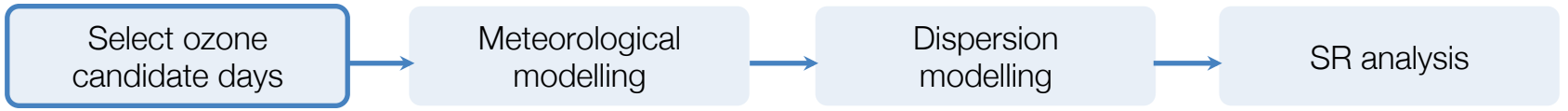


CR IV

Statistically-derived daily hodographs valid at YVR for ozone exceedance days (Ainslie & Steyn 2007)

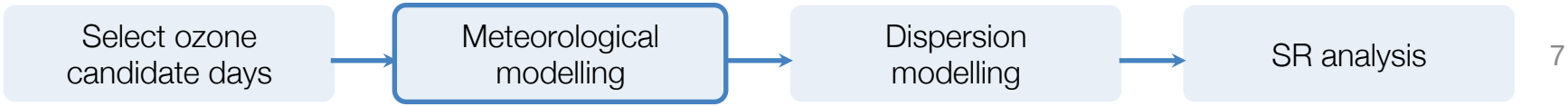
Meteorological Variability: Source receptor days selection

- Select 80 source receptor candidate days
  - Summer (JJAS), [O3]≥ 51 ppb, T≥ 24.7°C, no precipitation
- Each day is classified as one of 4 CRs (20 cases each)



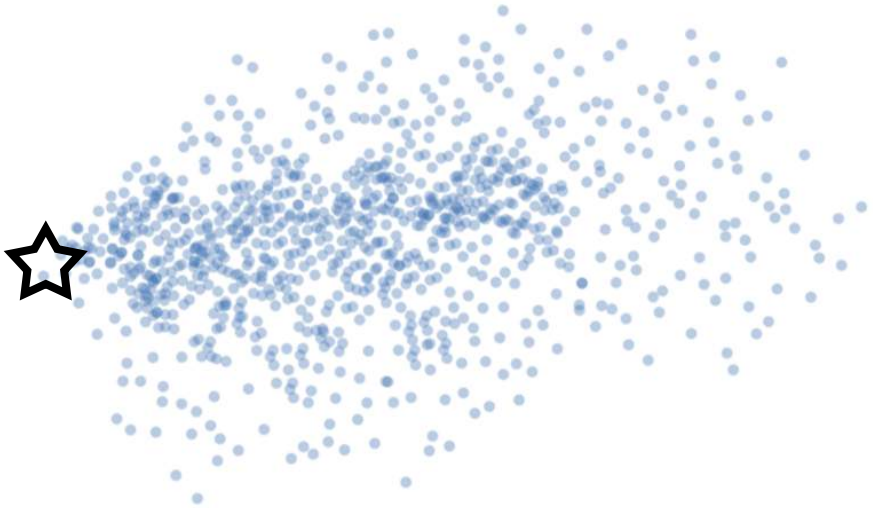
Meteorological Variability: Source receptor days modeling

- Meteorology modelled using GEM-LAM (v. 4.4.0) West
  - horizontal resolution: 2.5 km
  - temporal resolution: 120 s



Dispersion modelling

- CMC's MLDP0 (Modèle Lagrangien de Dispersion de Particules d'ordre *0*)
  - stochastic Lagrangian particle dispersion model



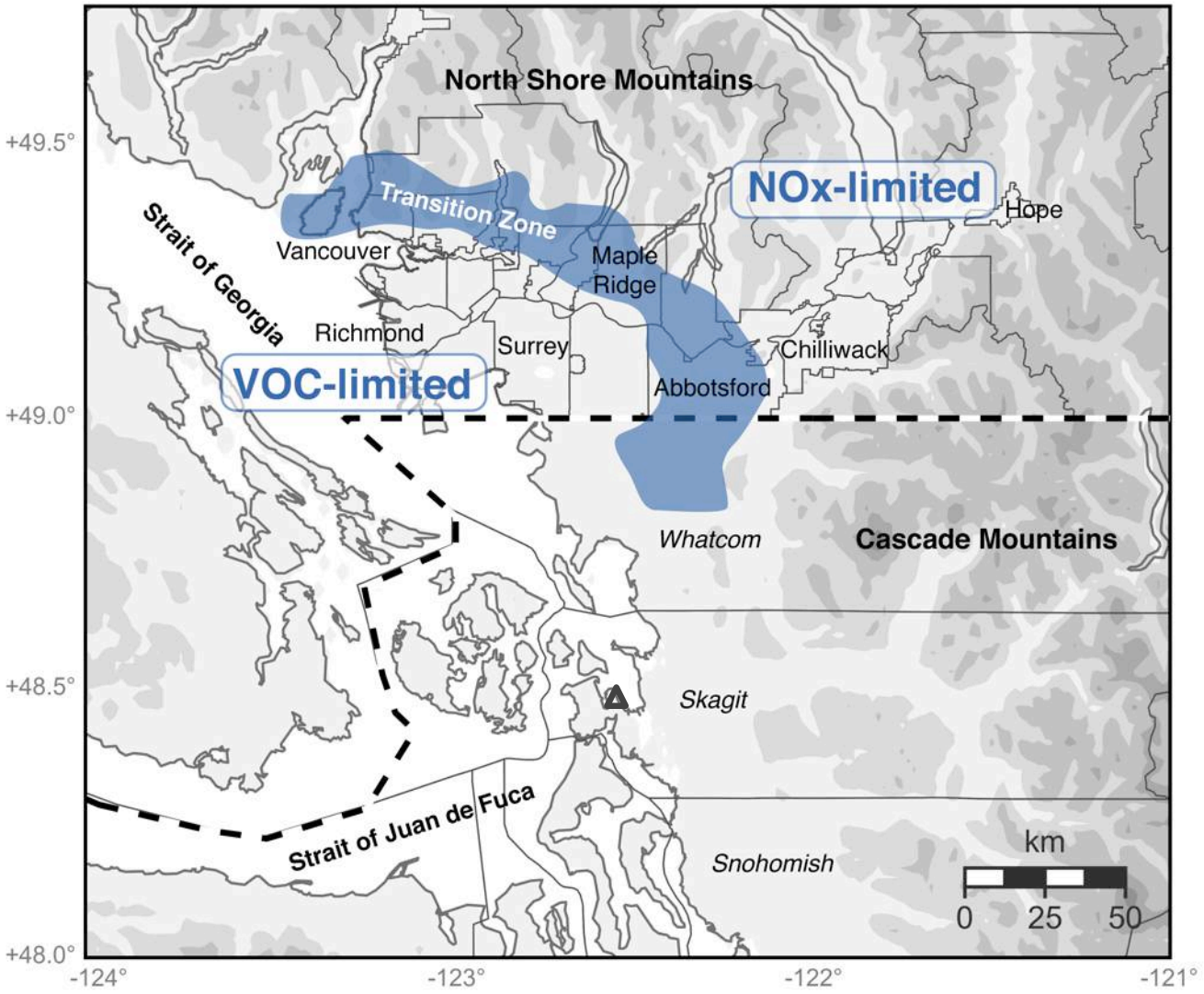
Select ozone candidate days → Meteorological modelling → **Dispersion modelling** → SR analysis

Dispersion modelling

- CMC's MLDP0 (Modèle Lagrangien de Dispersion de Particules d'ordre *0*)
  - stochastic Lagrangian particle dispersion model

- Run with 100,000 inert tracers
  - forward from sources
  - backward from receptors

Dispersion modelling: source & receptor locations



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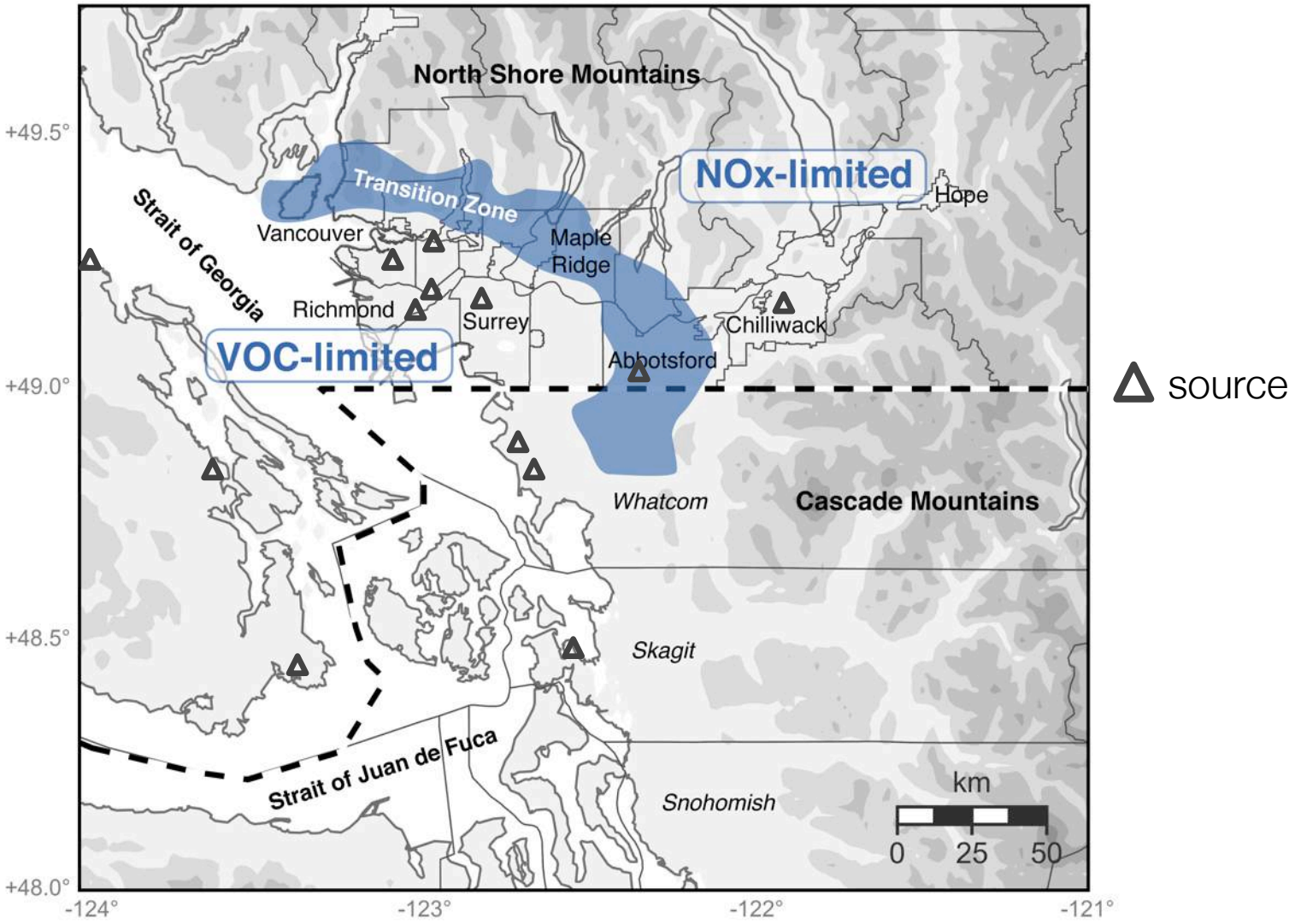

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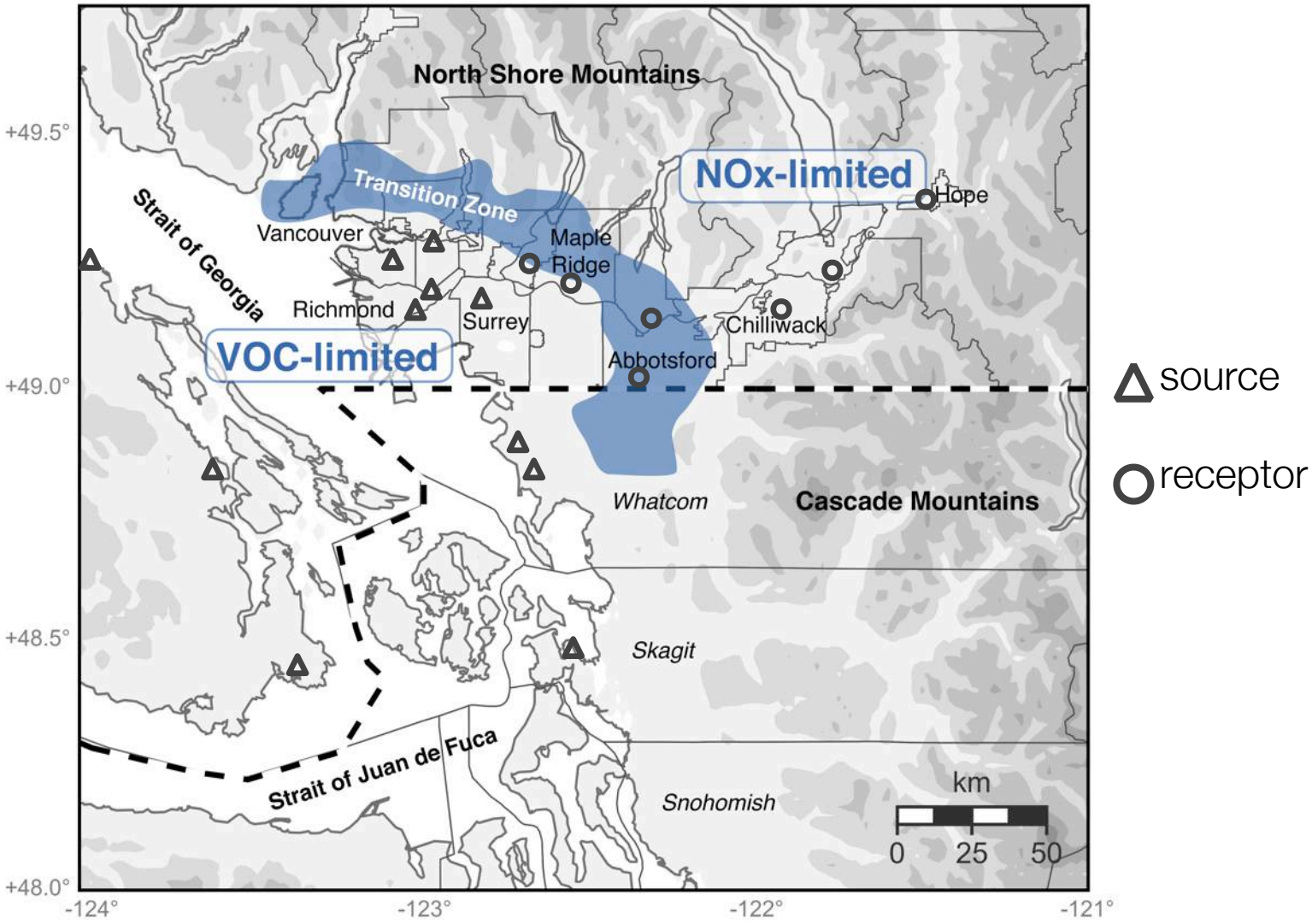
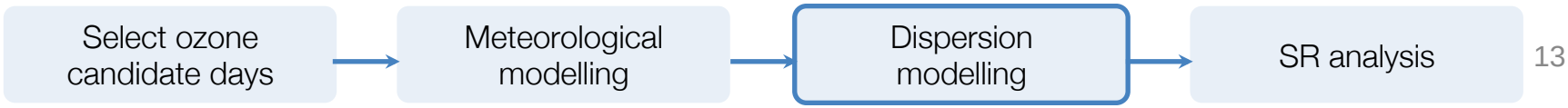


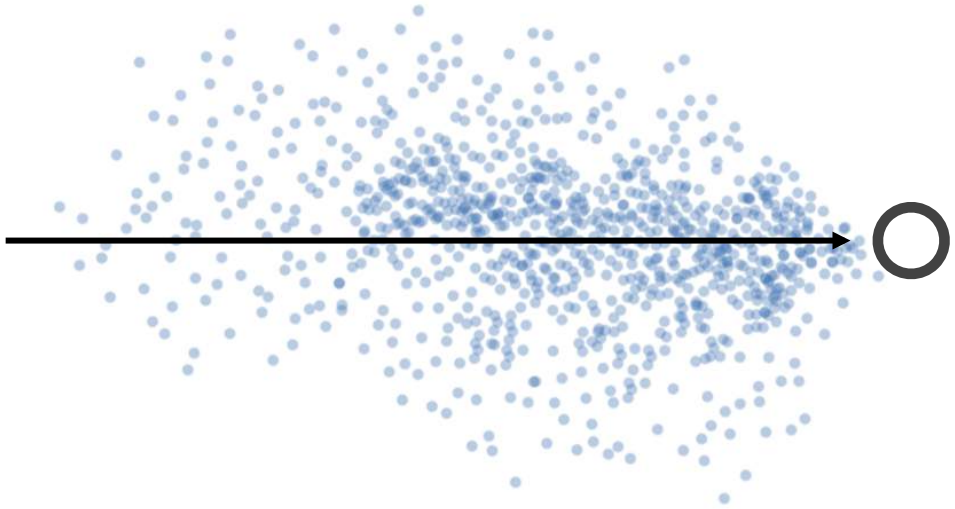
Select ozone candidate days → Meteorological modelling → **Dispersion modelling** → SR analysis

Backward modelling (receptor-oriented)



Backward modelling (receptor-oriented)

- AQ stations
- 1800 → 0600
  (12 h total, 1 h unit release)



[particles]

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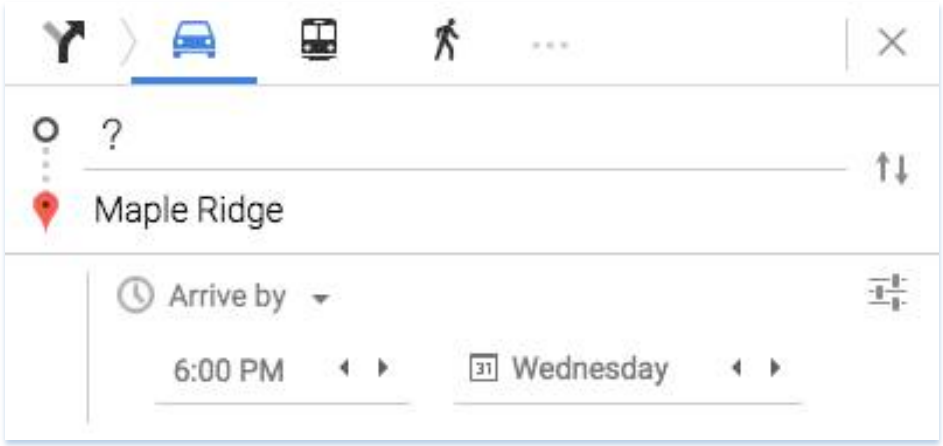

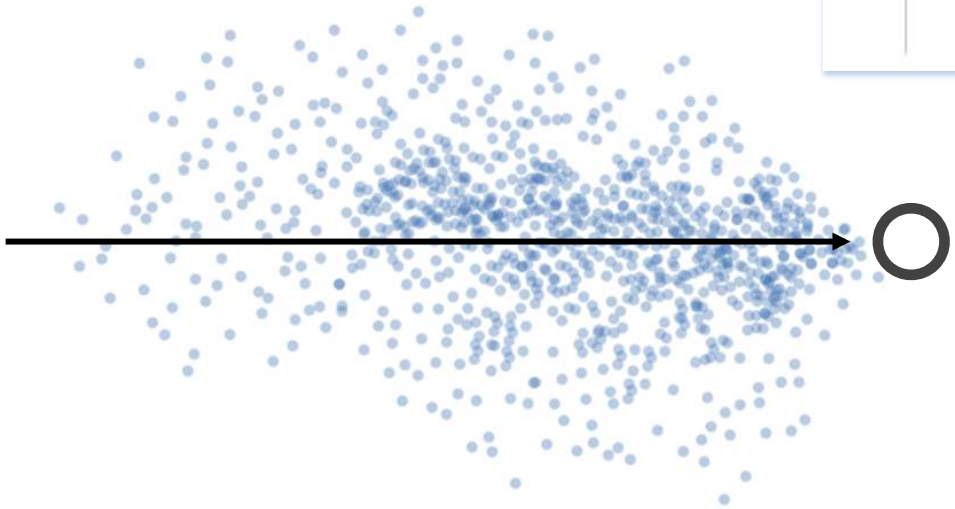

[particles]

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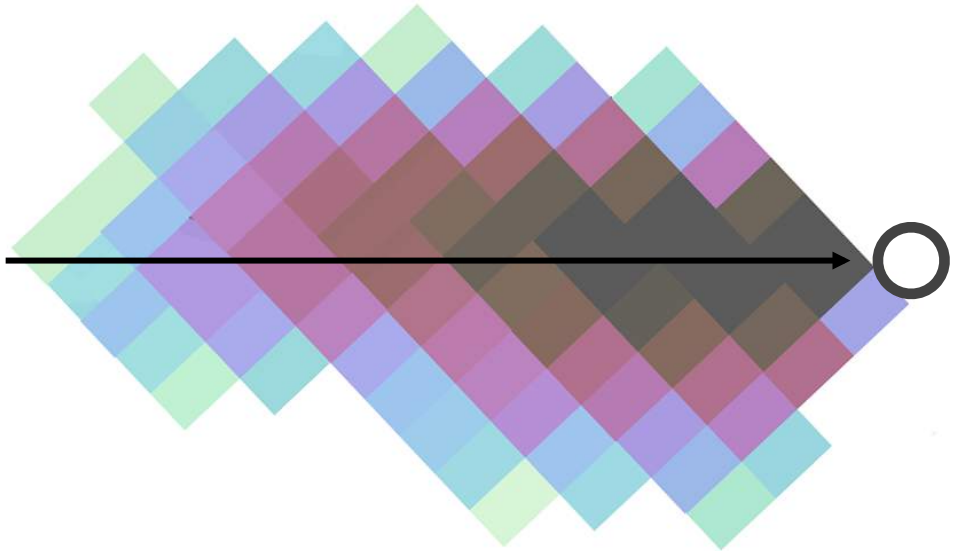

concentration **c** [m^{-3}]
to 500 m agl

Select ozone candidate days → Meteorological modelling → **Dispersion modelling** → SR analysis

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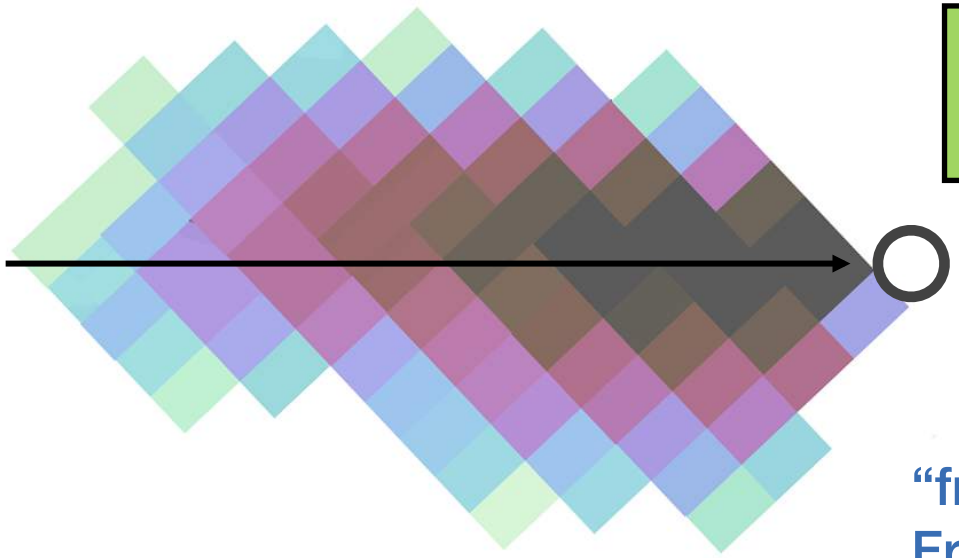
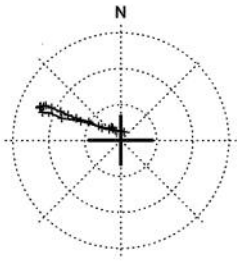


Big matrix of results:
80 days X 12 hrs X 20 sites

~~concentration~~ c [m^{-3}]
to 500 m agl

"fraction of air" – less dilution of mat
From gridcell to receptor
Receptor more sensitive to transport from grid

Select ozone candidate days → Meteorological modelling → Dispersion modelling → SR analysis



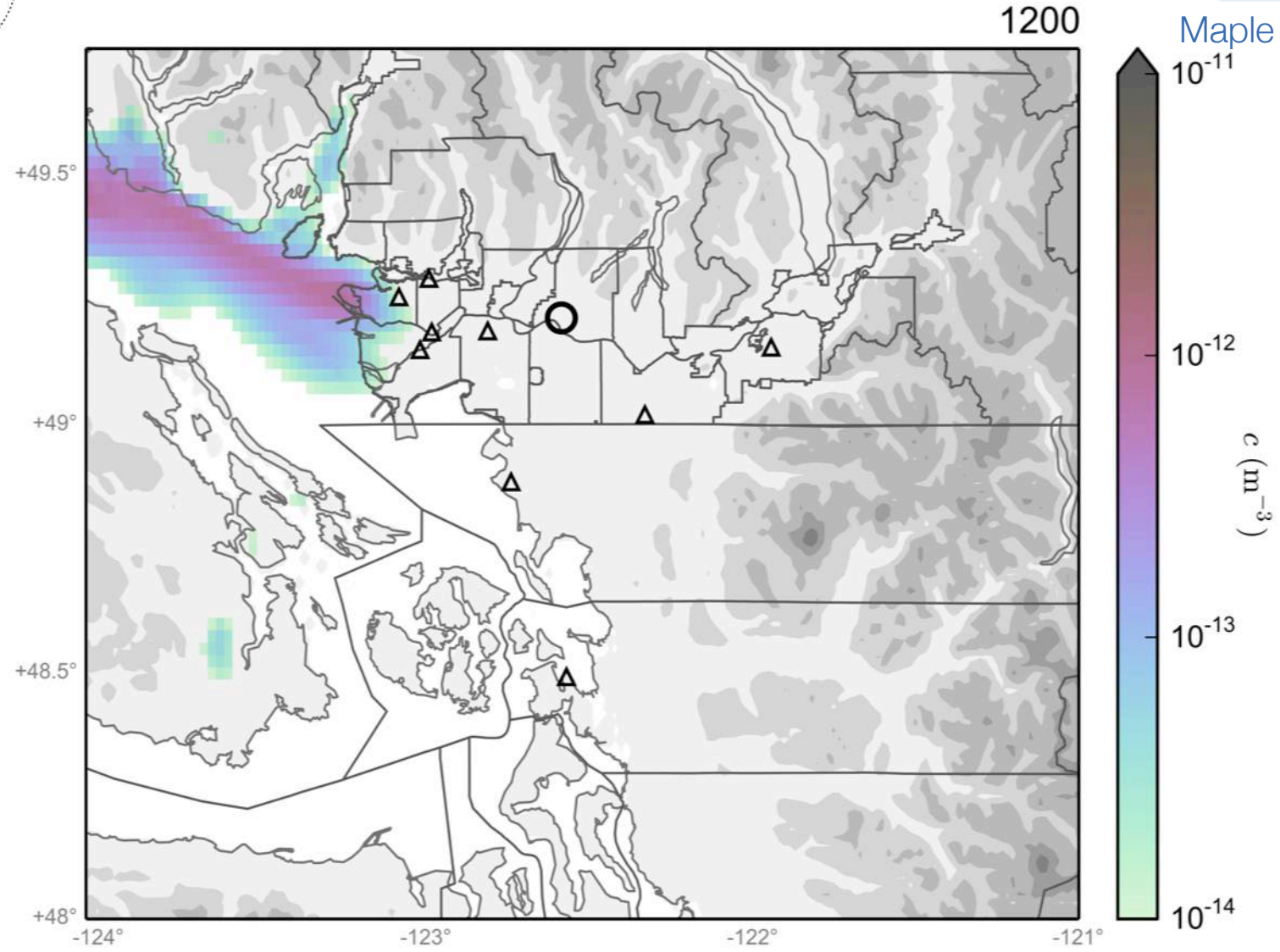
CR I

SR analysis: linear transfer

location

T30

Maple Ridge



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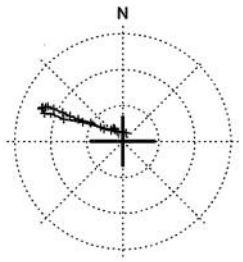

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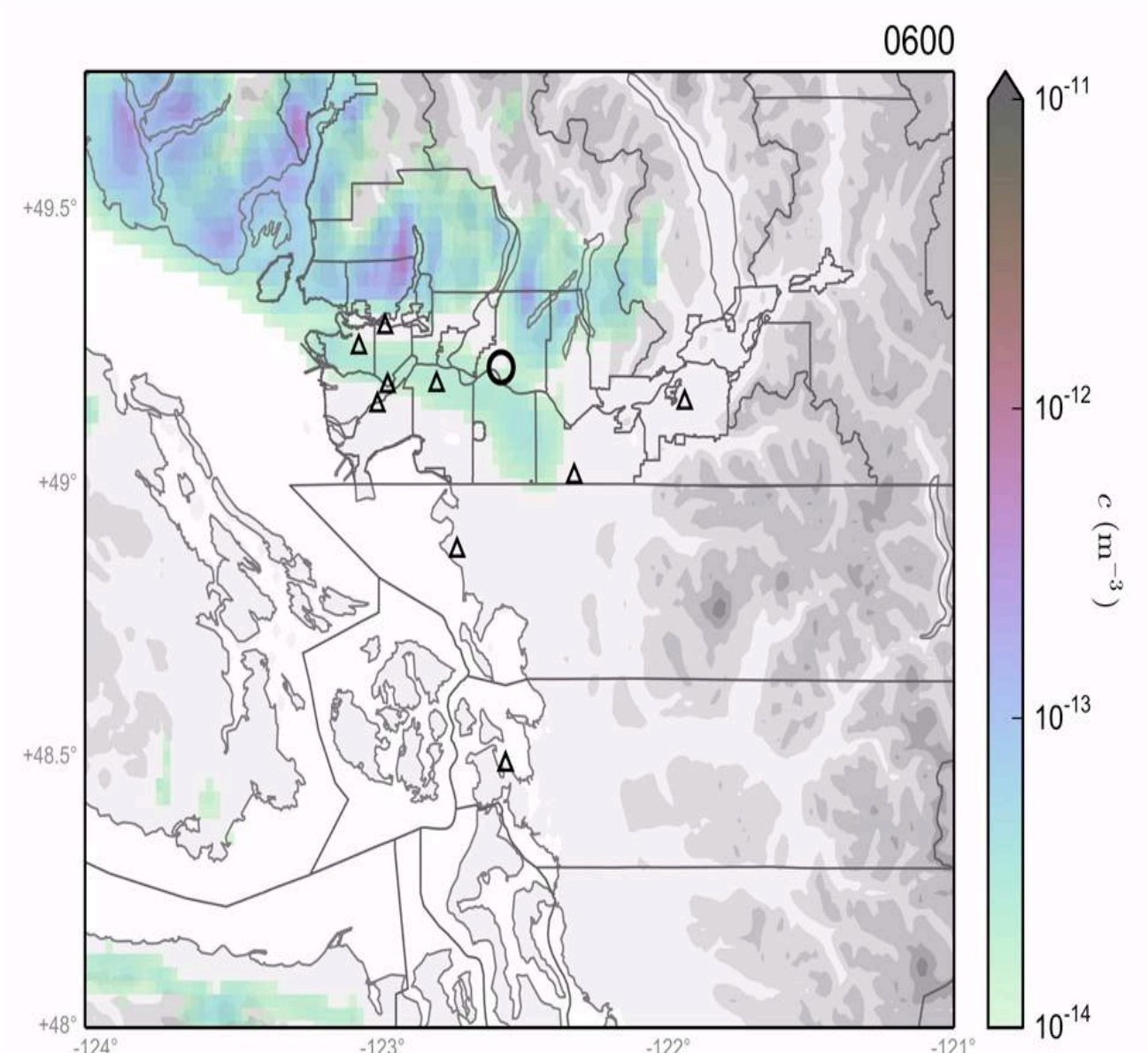
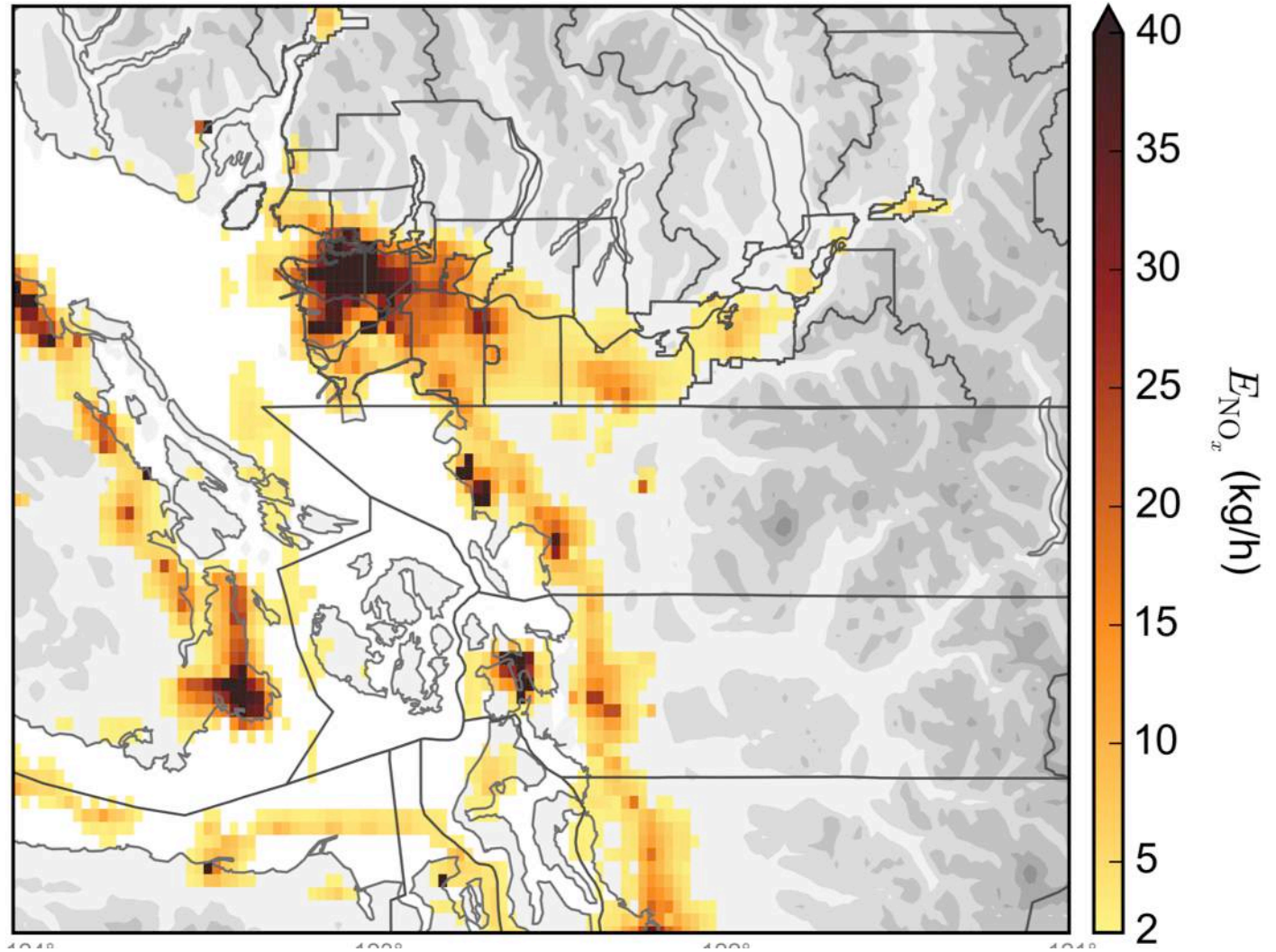


*

Total NO_x emissions



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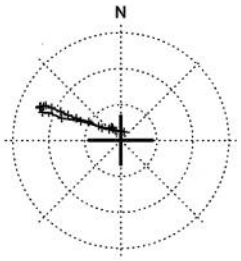

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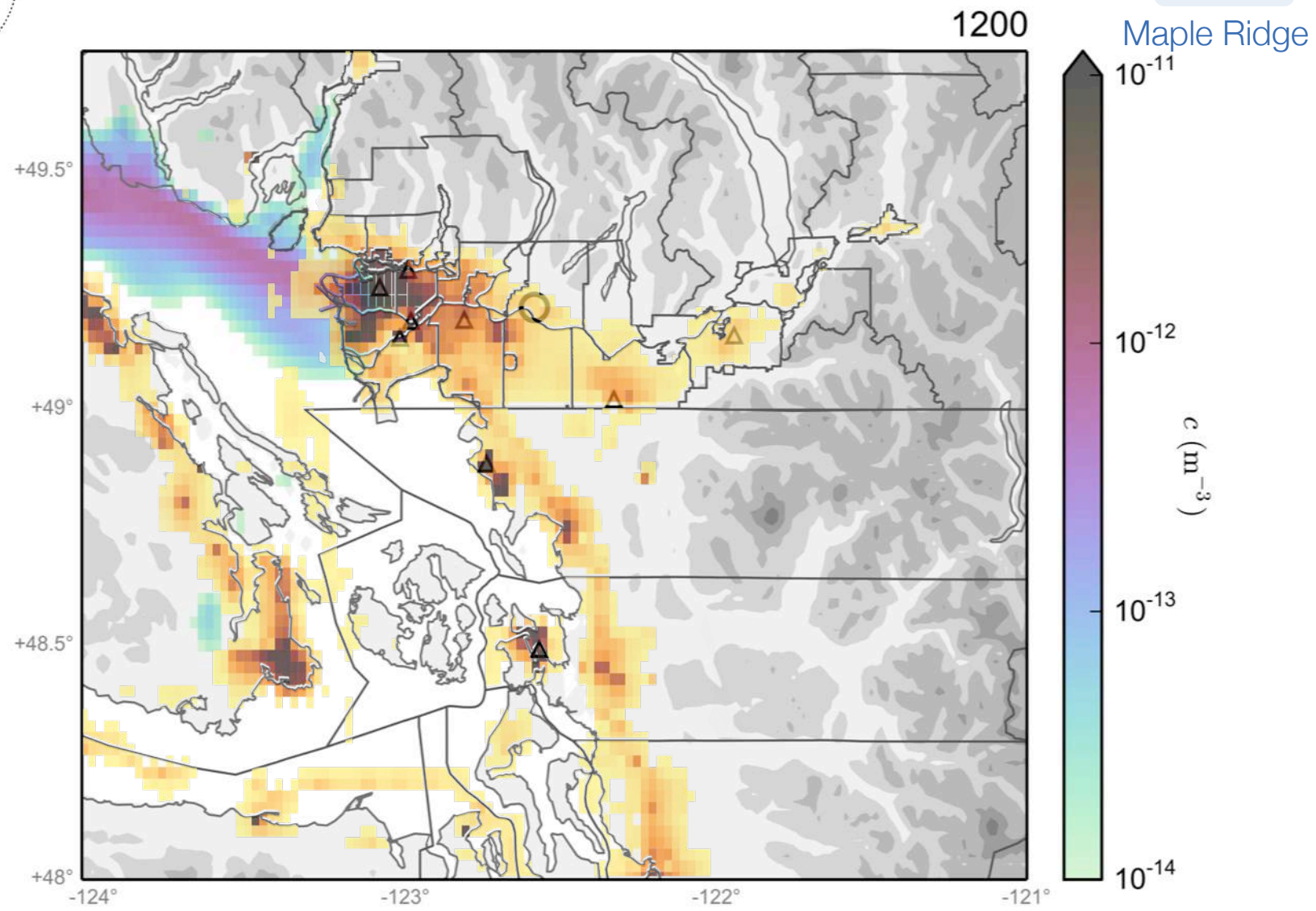

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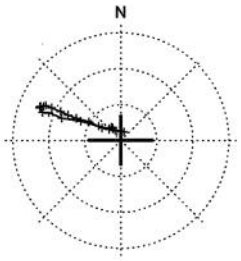

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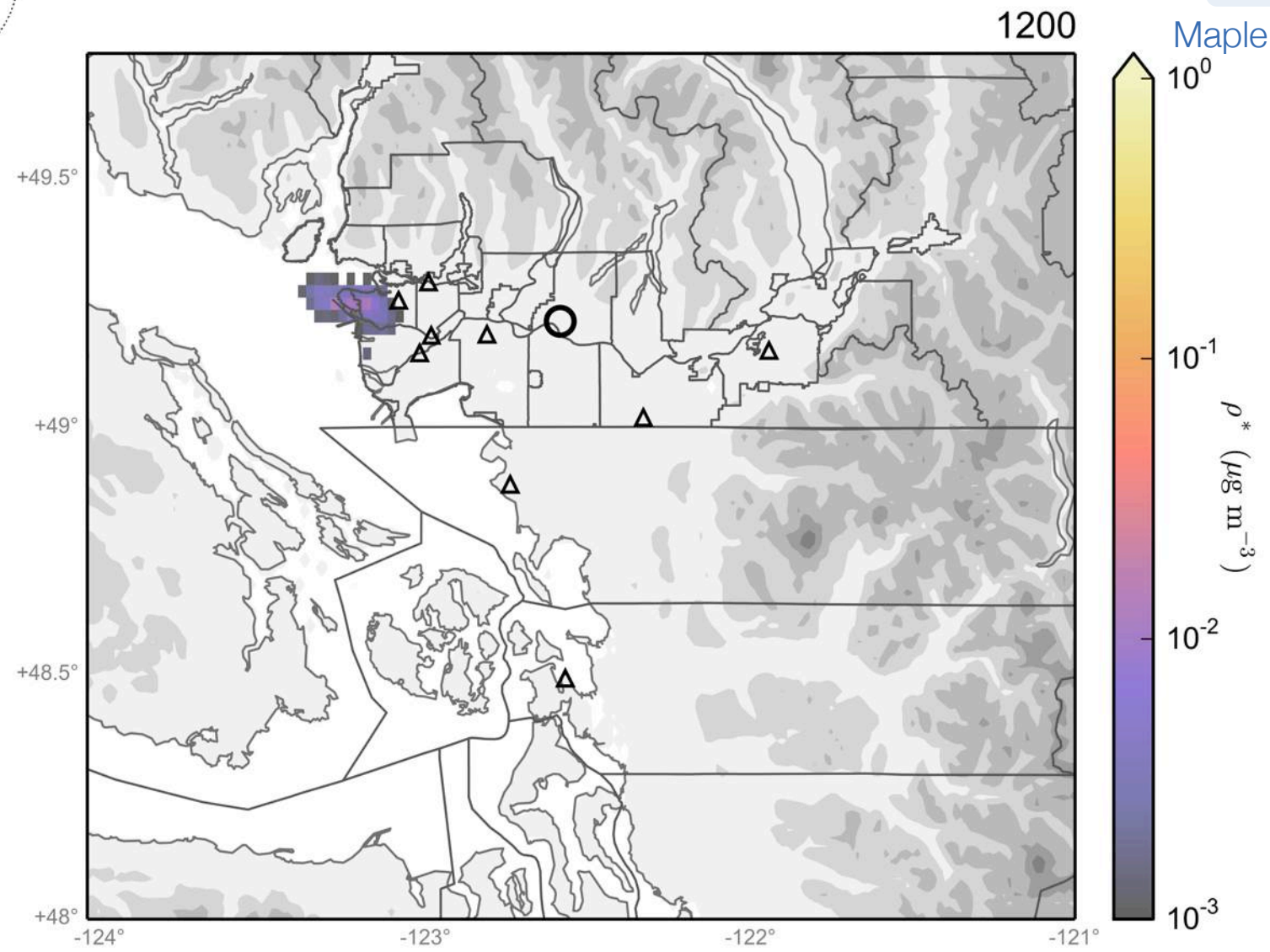

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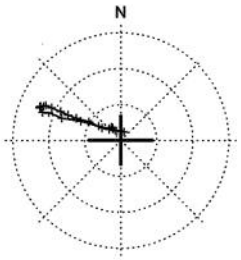


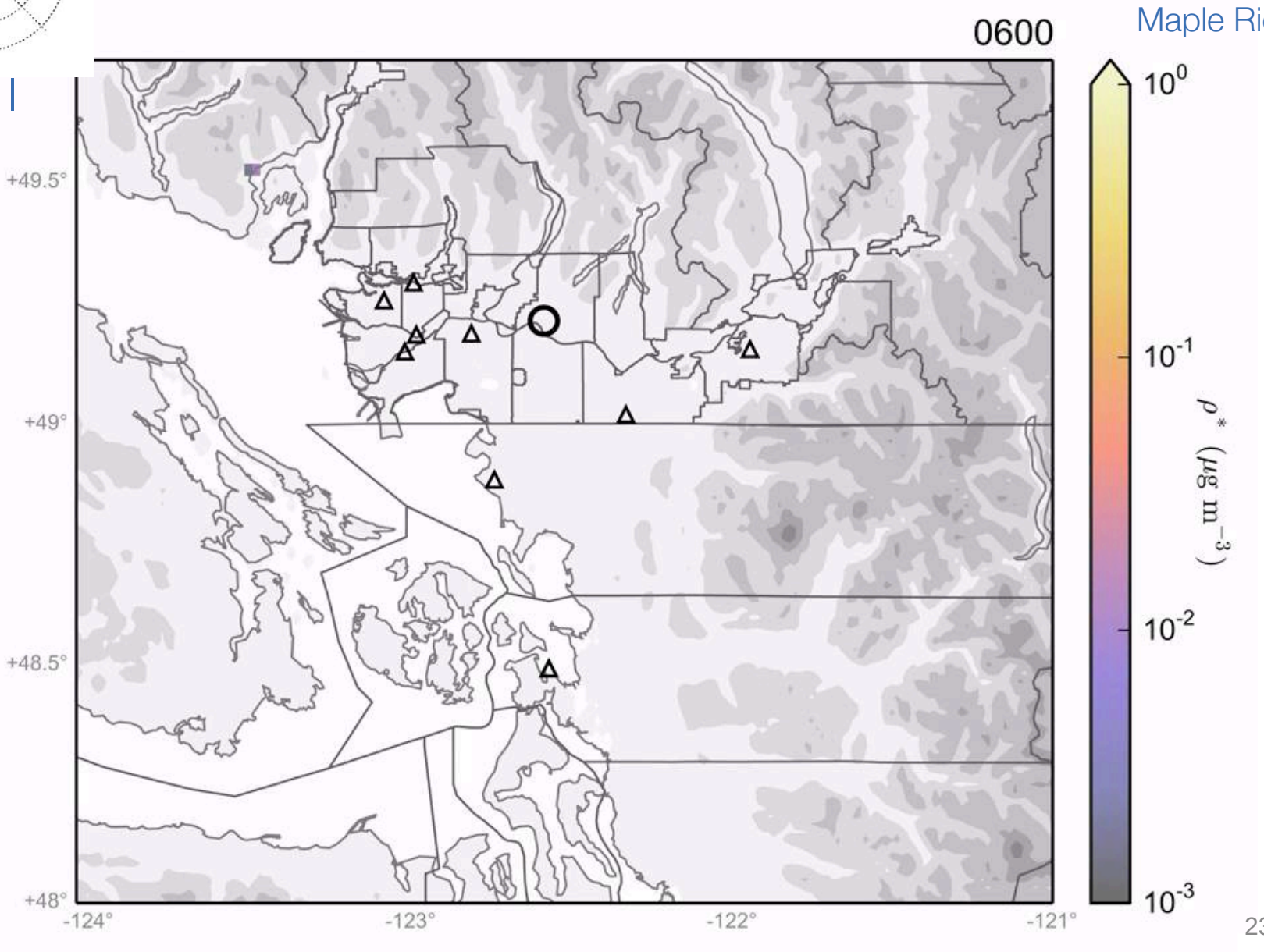
location

T30

Maple Ridge

SR analysis: linear transfer

CR I



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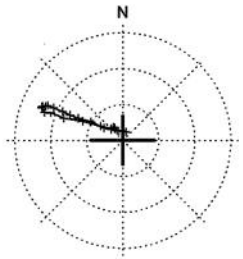


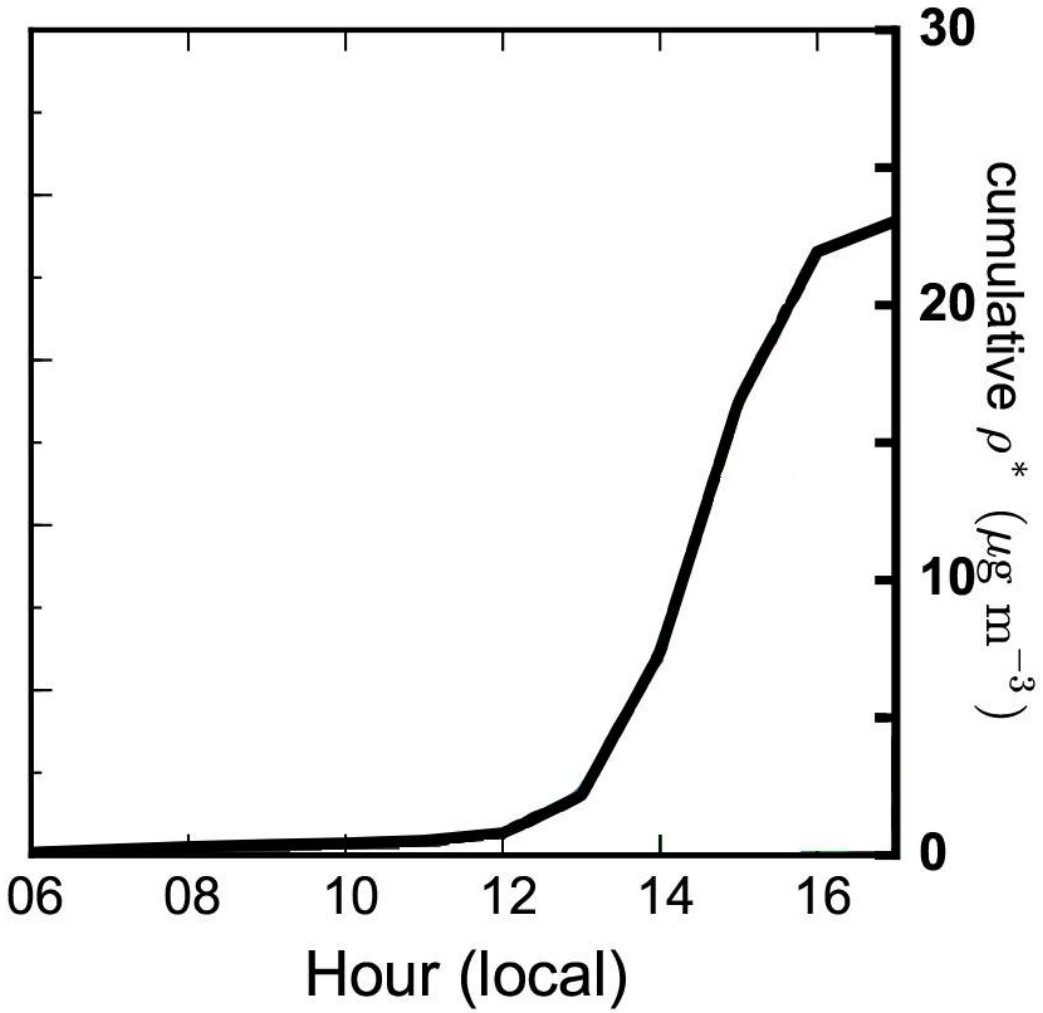
CR I

SR analysis: Total contributions

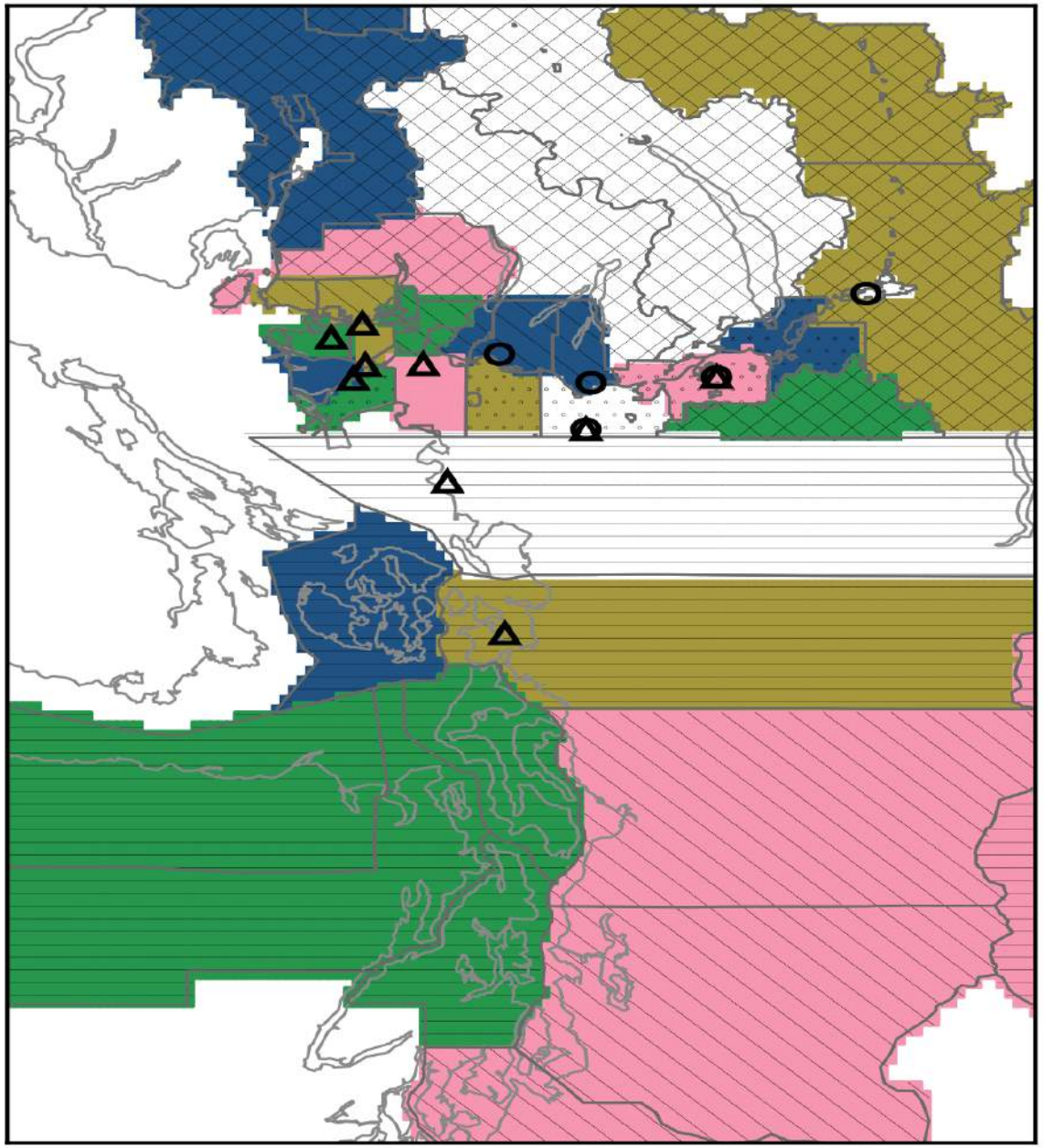
location

T30

Maple Ridge

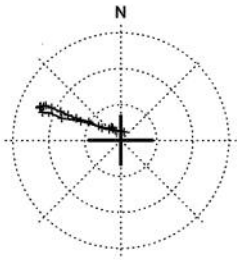


Source Apportionment: Masked Municipality Areas



- Abbotsford
- Burnaby
- Delta
- FV Central
- FV East
- FV North
- FV West
- Fraser Valley E
- Greater Vancouver A
- Hope
- Langley
- MV NE *
- North Shore
- Richmond
- San Juan
- Skagit
- Squamish-Lillooet-Whistler
- Surrey
- Tri-Cities
- Vancouver
- WA East
- WA South
- WA West
- Whatcom
- Unclassified


Vancouver
Burnaby
Richmond
Pitt Meadows
Surrey
Maple Ridge



SR analysis: Total contributions

location

T30

Maple Ridge

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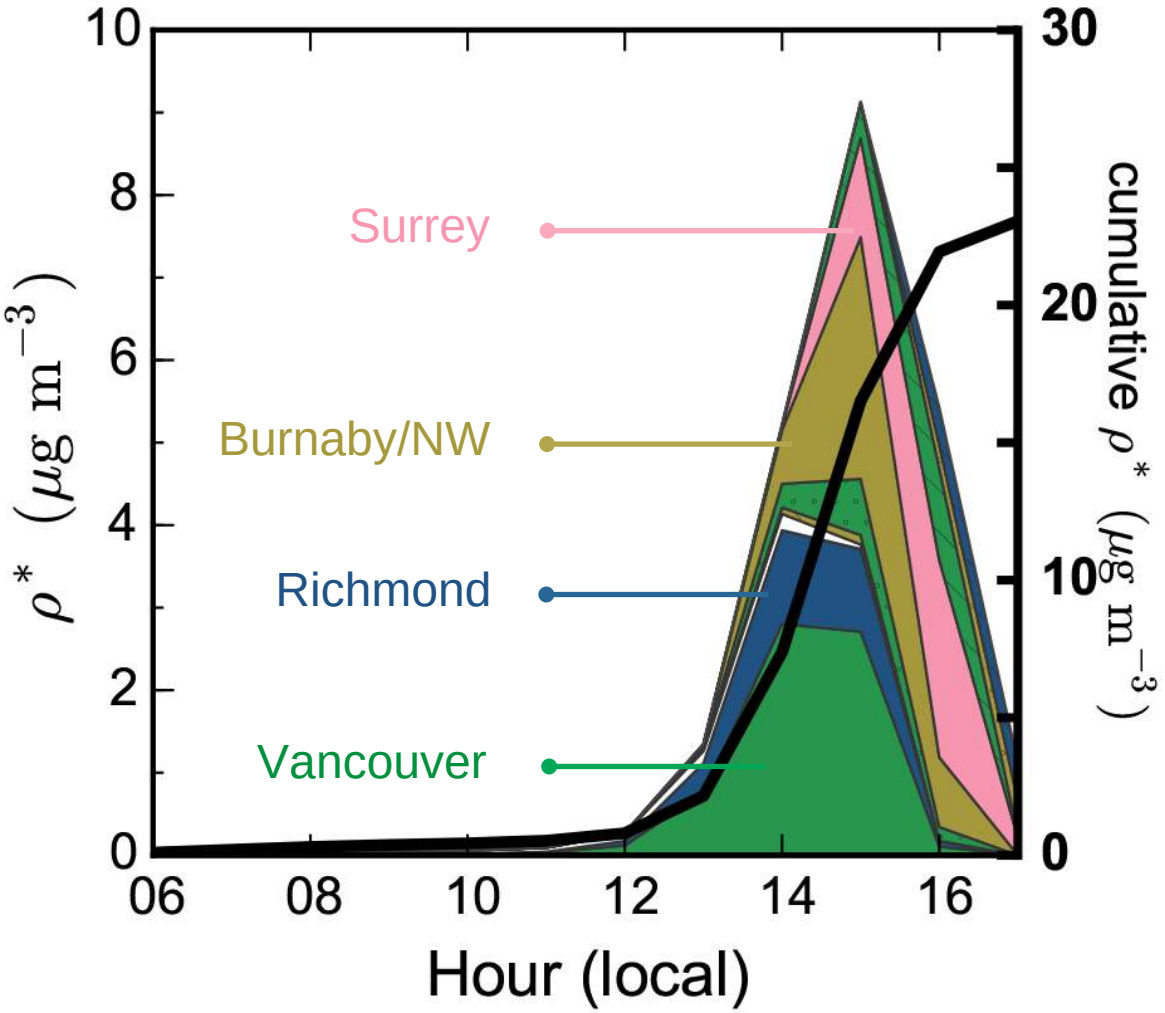

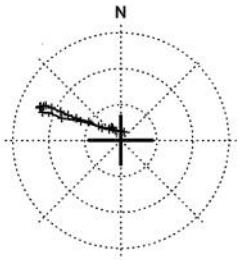

SR analysis: Total contributions

location

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Maple Ridge

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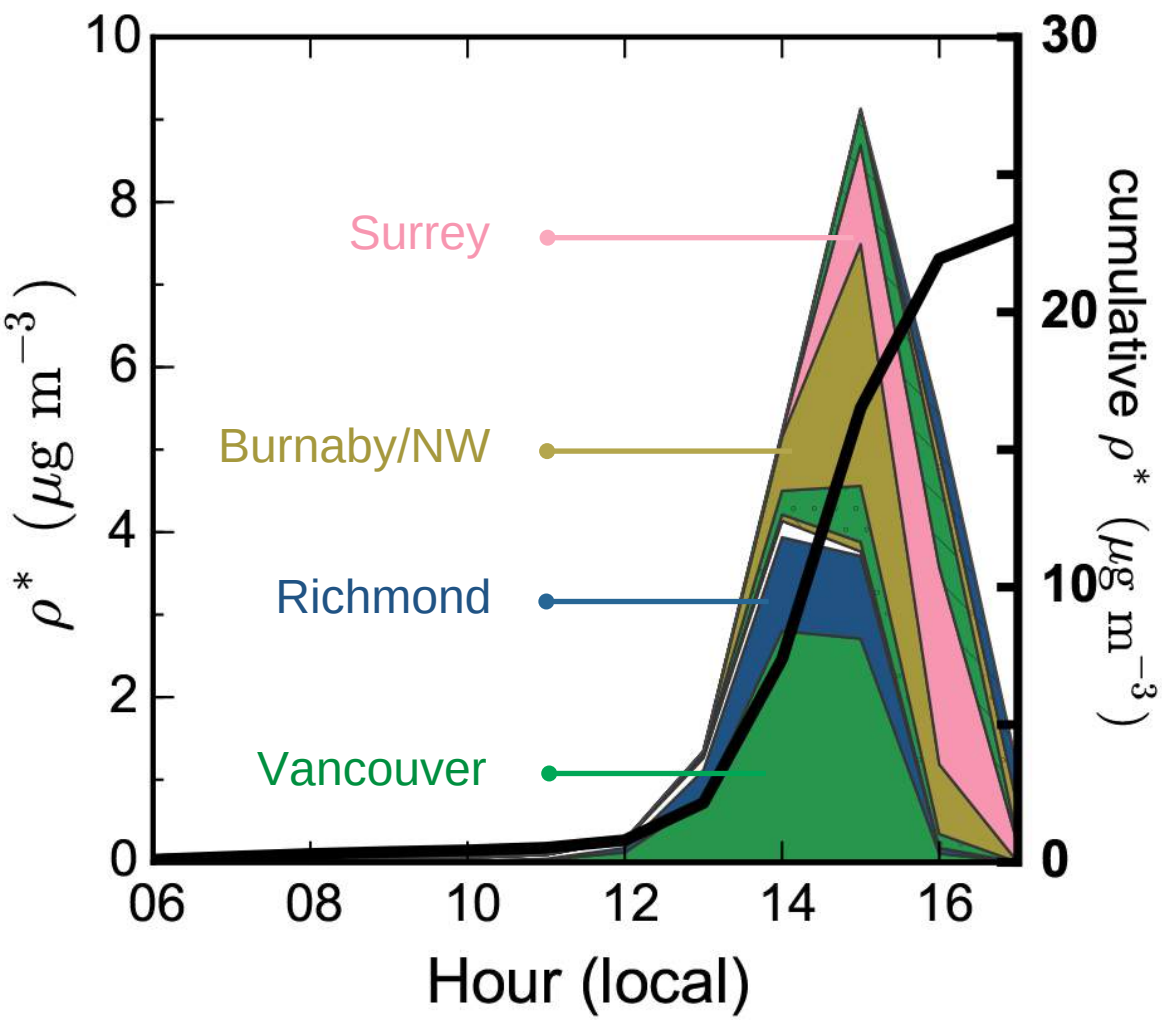
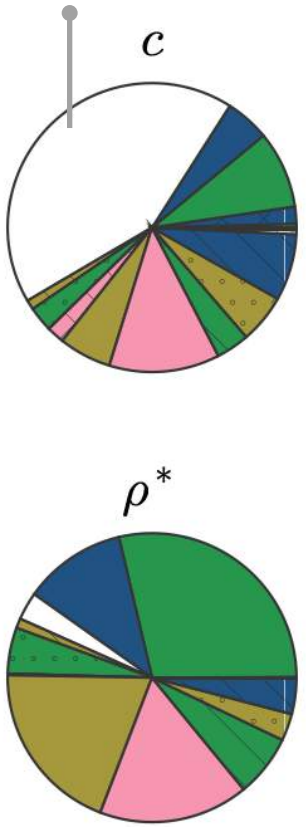
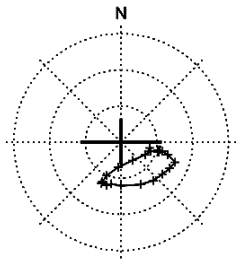


Unclassified





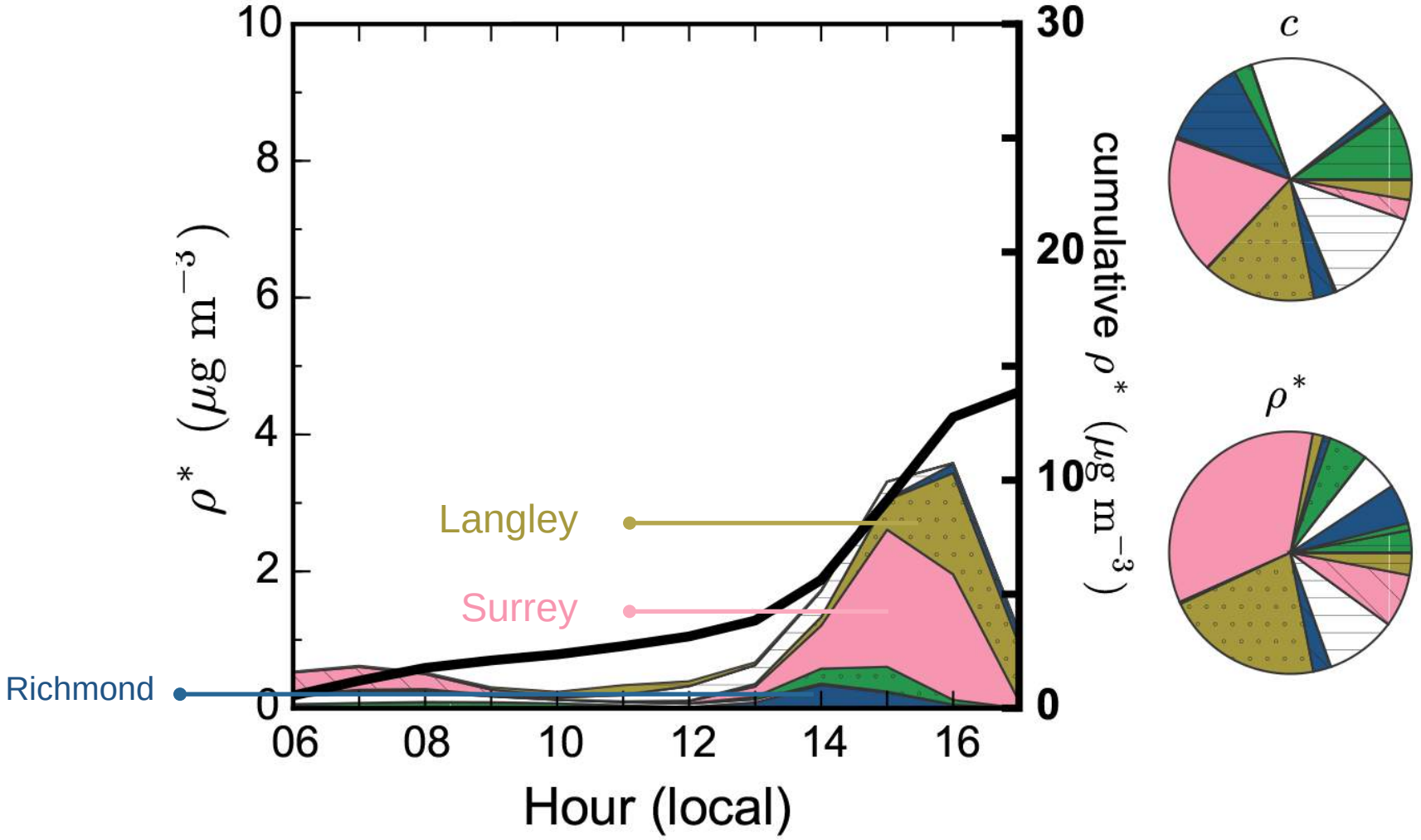
CR IV

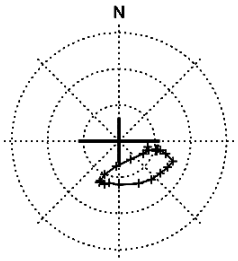
SR analysis: Total contributions

location

T30

Maple Ridge





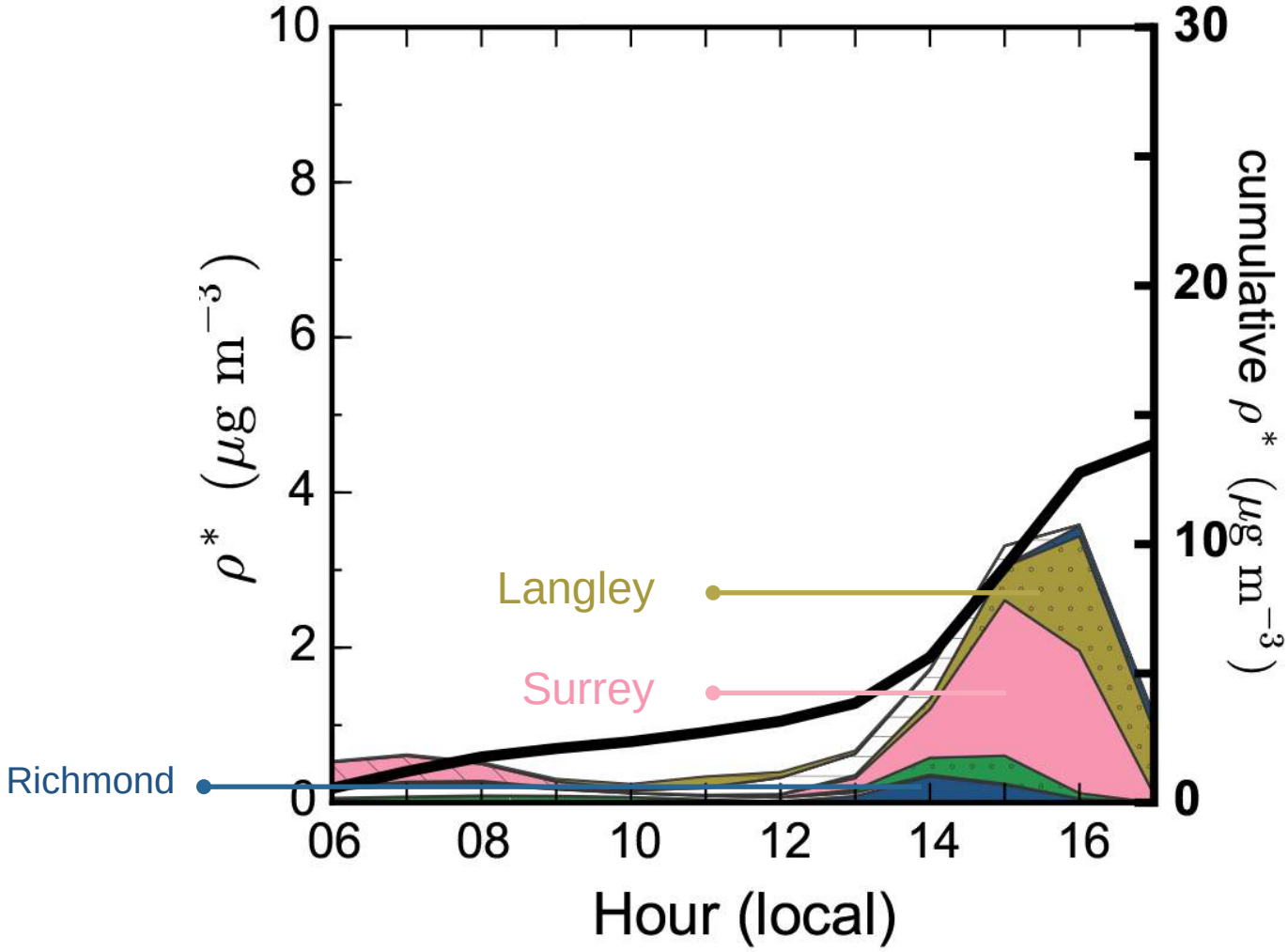
CR IV

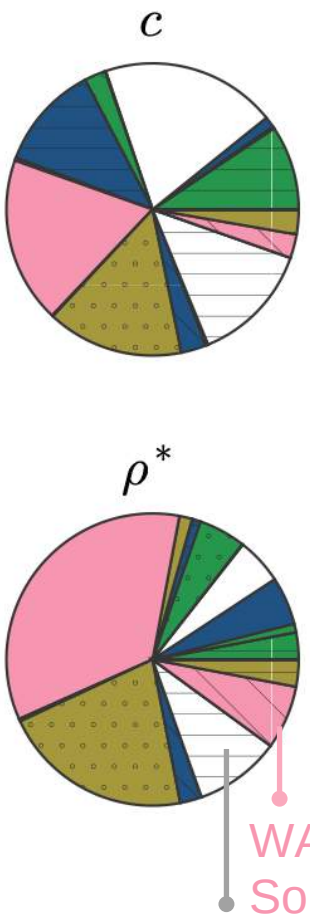
SR analysis: Total contributions

location

T30

Maple Ridge



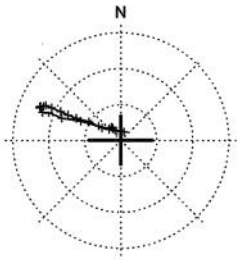


location

T30

Maple Ridge

SR analysis: Source contributions



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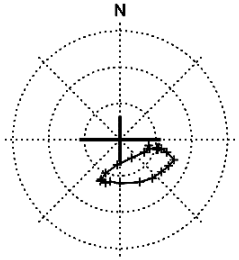

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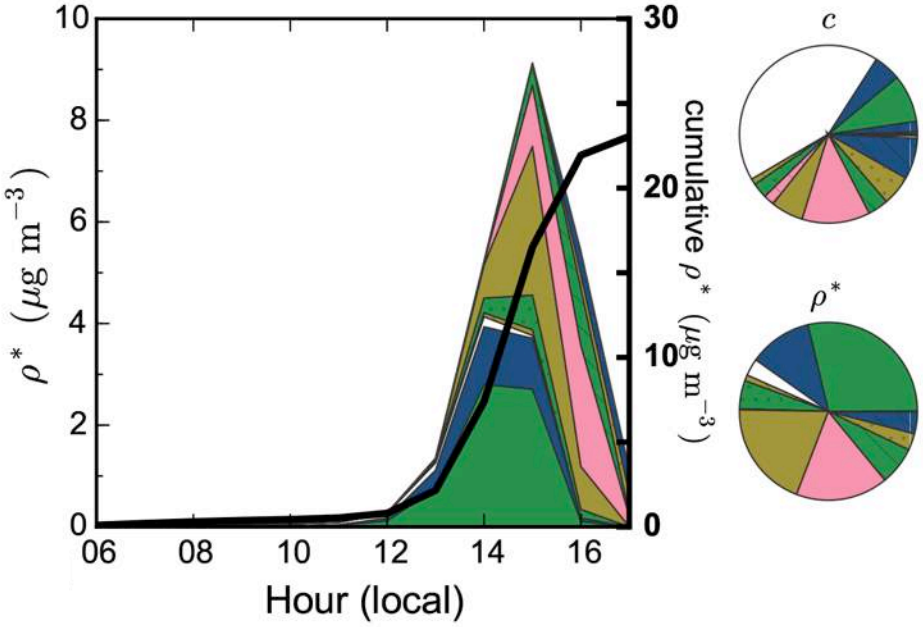
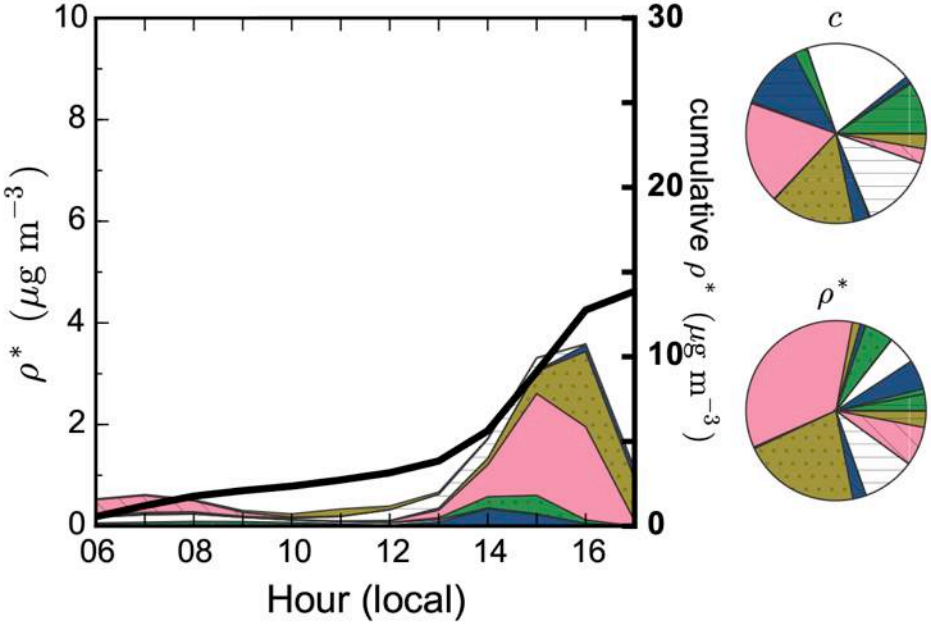


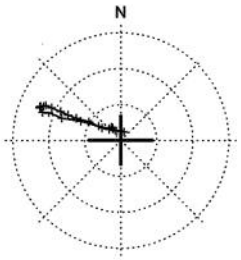


location

T12

Chilliwack

SR analysis: Source contributions



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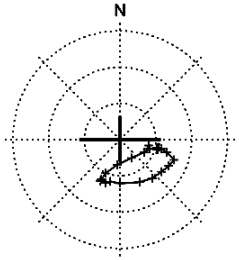
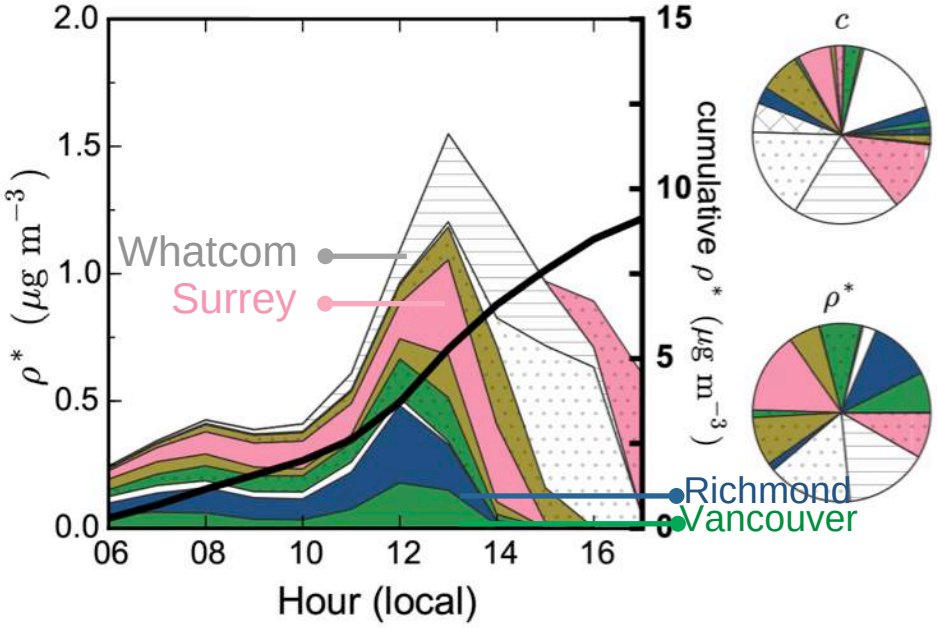
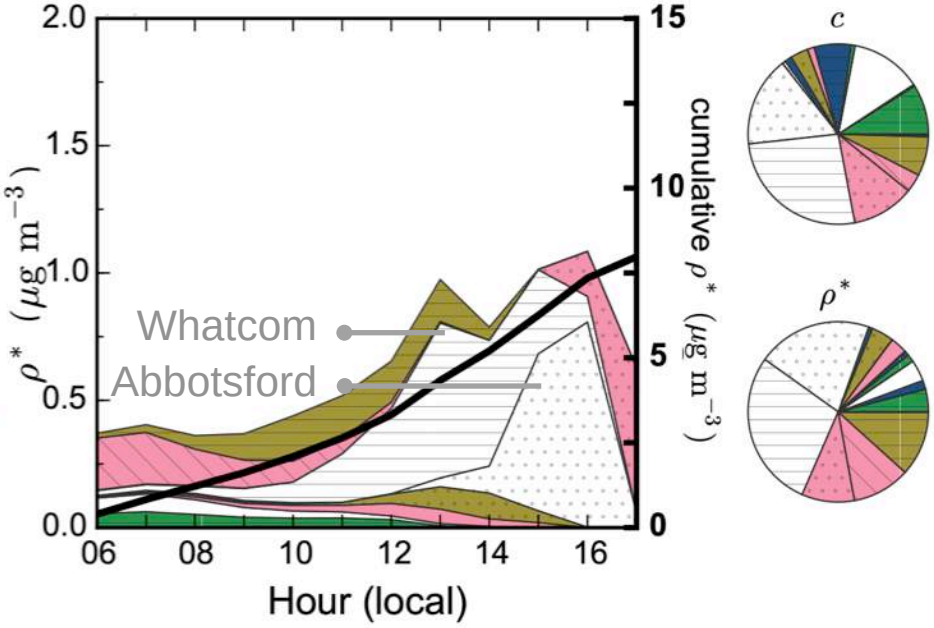


CR IV





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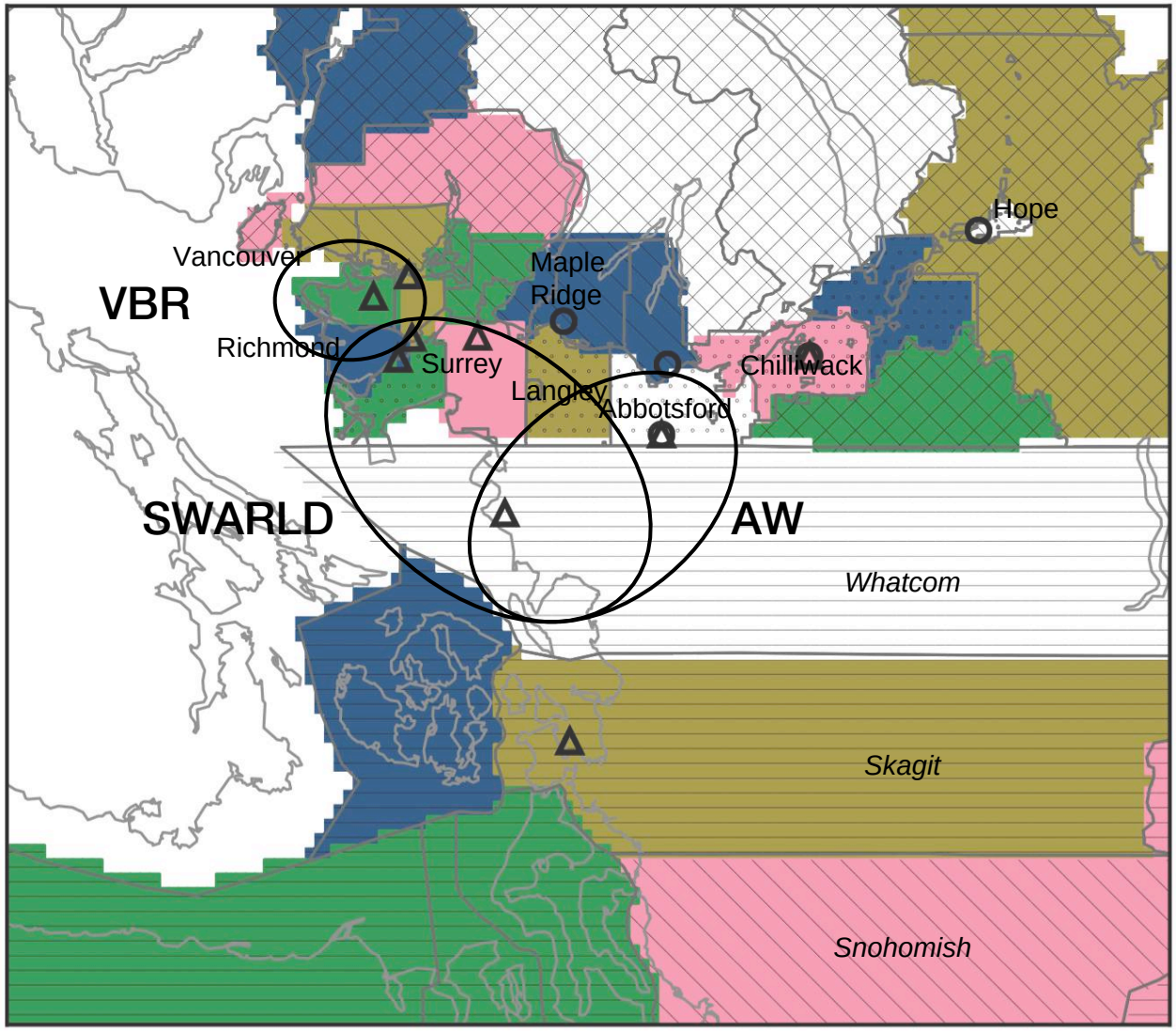

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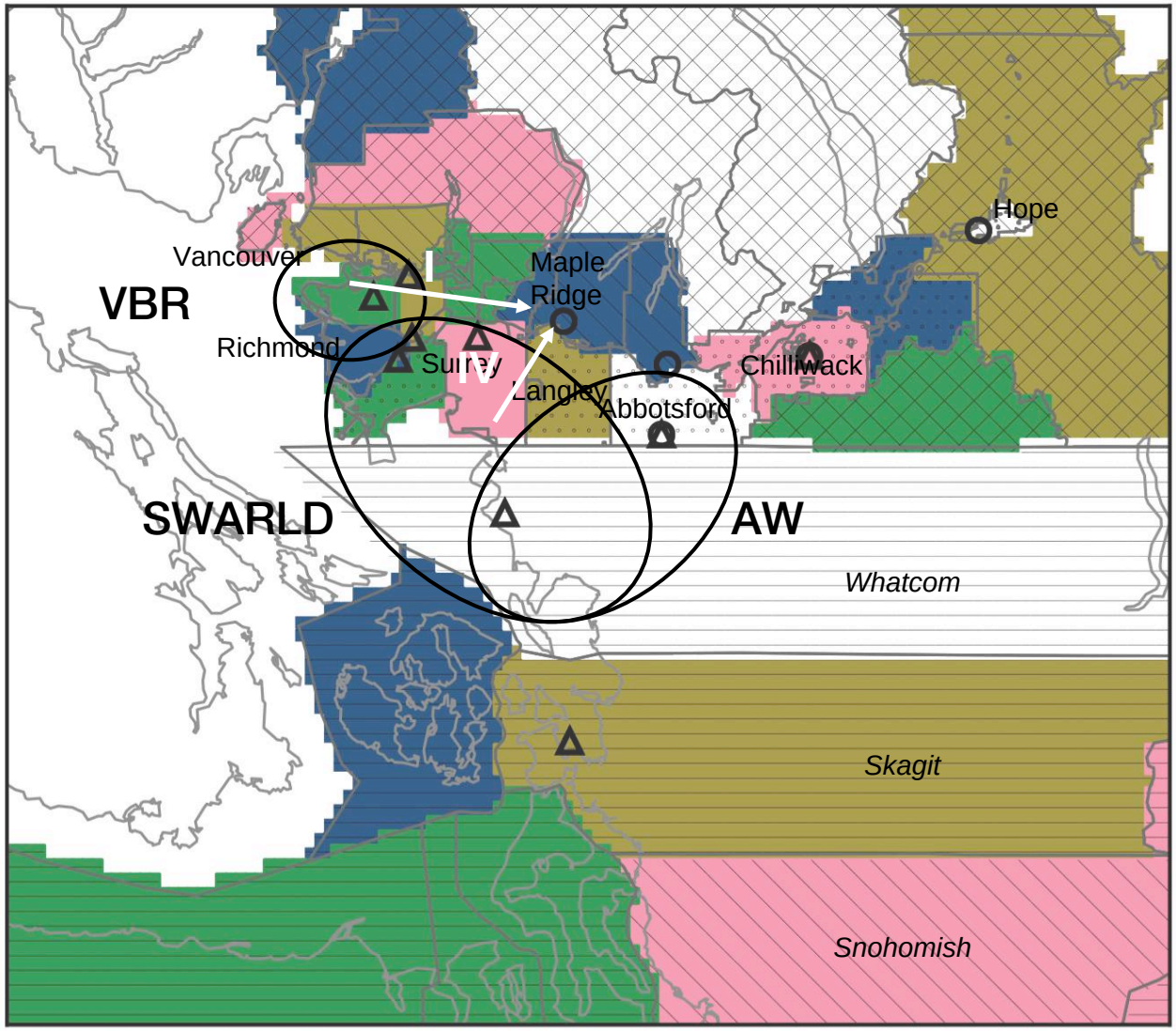

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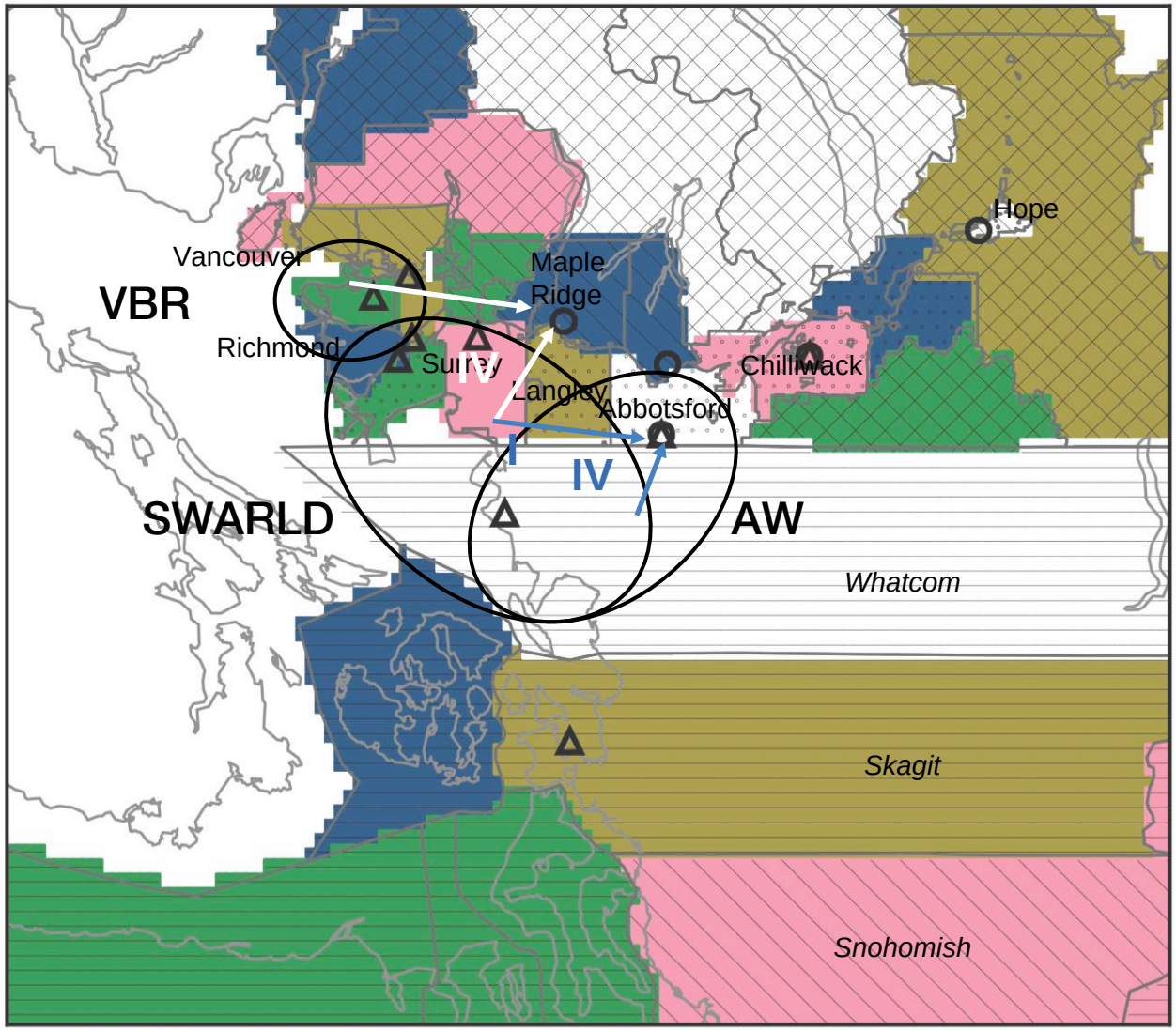

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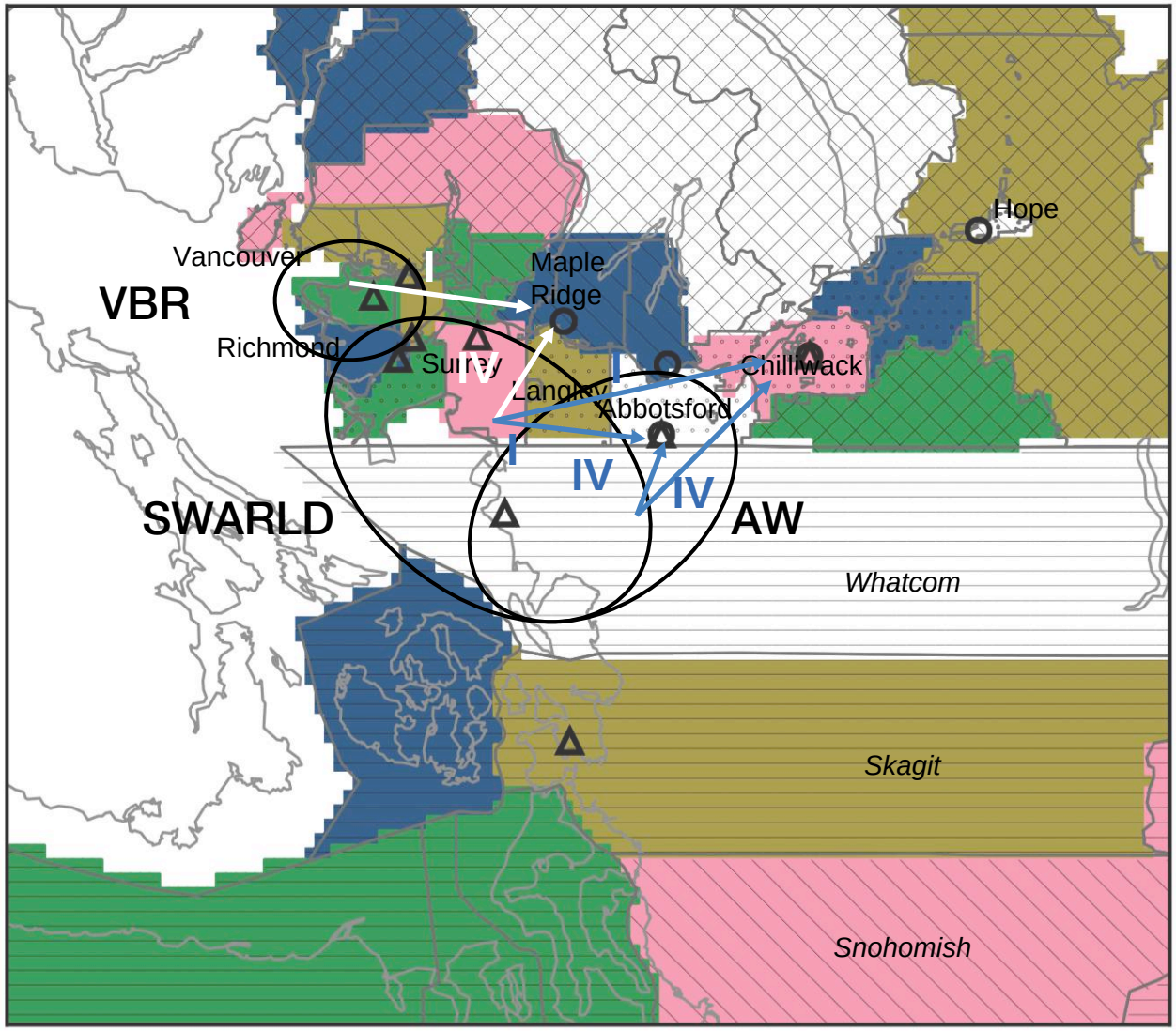

Conclusions

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  - Circulation Regime

Conclusions

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  - time of day
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- VBR emissions do not significantly impact the far Eastern LFV
- SWARLD area is a potential source region for both the eastern LFV (T12) and central valley locations (T45, T30)
- Importance of US sources under CR IV conditions

Questions?

Annie Seagram aseagram@eos.ubc.ca
Bruce Ainslie Bruce.Ainslie@ec.gc.ca
Roxanne Vingarzan Roxanne.Vingarzan@ec.gc.ca