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The role of meteorological factors in pollution transport and characterization at Halifax, Nova Scotia, during the BORTAS-B field campaign

IWAQFR

Potomac, Maryland

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David Kindred (UK Met Office)

Meteorological Service of Canada

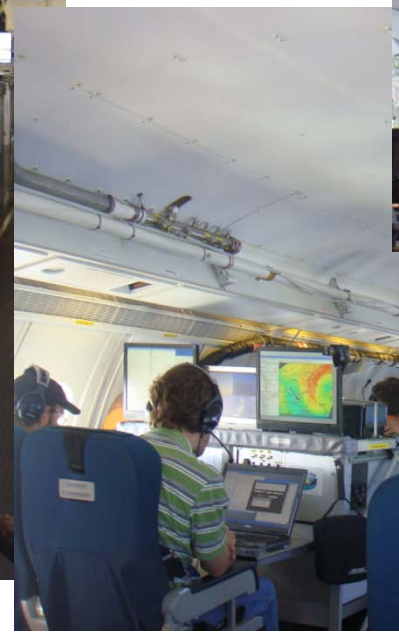
November 29, 2011

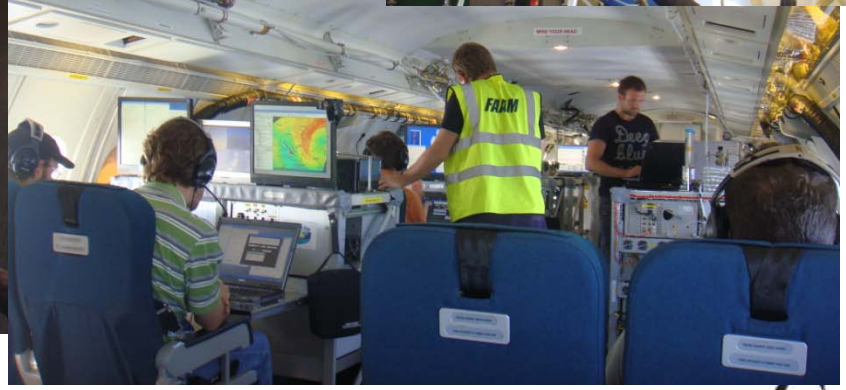
BORTAS

- **Quantifying the impact of BOReal forest fires on Tropospheric oxidants over the Atlantic using Aircraft and Satellites**
  - Objective: to investigate the connection between the composition and the distribution of biomass burning outflow, ozone production and loss within the outflow, and the resulting perturbation to oxidant chemistry in the troposphere.
  - BORTAS-A (summer 2010) consisted of an enhanced ground based air quality monitoring station at Dalhousie University – Dalhousie Ground Station (DGS).
  - BORTAS-B (summer 2011) consisted of the DGS plus a sampling campaign using the UK BAe-146 research aircraft – Facility for Airborne Atmospheric Measurements (FAAM)

FAAM Aircraft

Credit: FAAM





Dalhousie Ground Station

- **Real Time Aerosols:**
  - **Raman Lidar** (λ = 532 nm) including near field to lowest 100m
  - **Nephelometers** “Dust Trak” (PM_1, $PM_{2.5}$, PM_{10}) – estimated mass
  - **Aethelometer** “Magee” - Black Carbon
  - **Aerodynamic Particle Sizer** (TSI APS – 3321) .5-20µm – and estimated mass
  - **Ultra Fine Particle Monitor** (TSI UFP – 3031) 20-500 nm
  - **AOD** – CIMEL **Sun Photometer** – optical depth spectra, fine and coarse mode
  - **AOD** – SPSTAR **Star Photometer** – optical depth spectra, fine and coarse mode

Photo Credit: Peter Klages

Dalhousie Ground Station

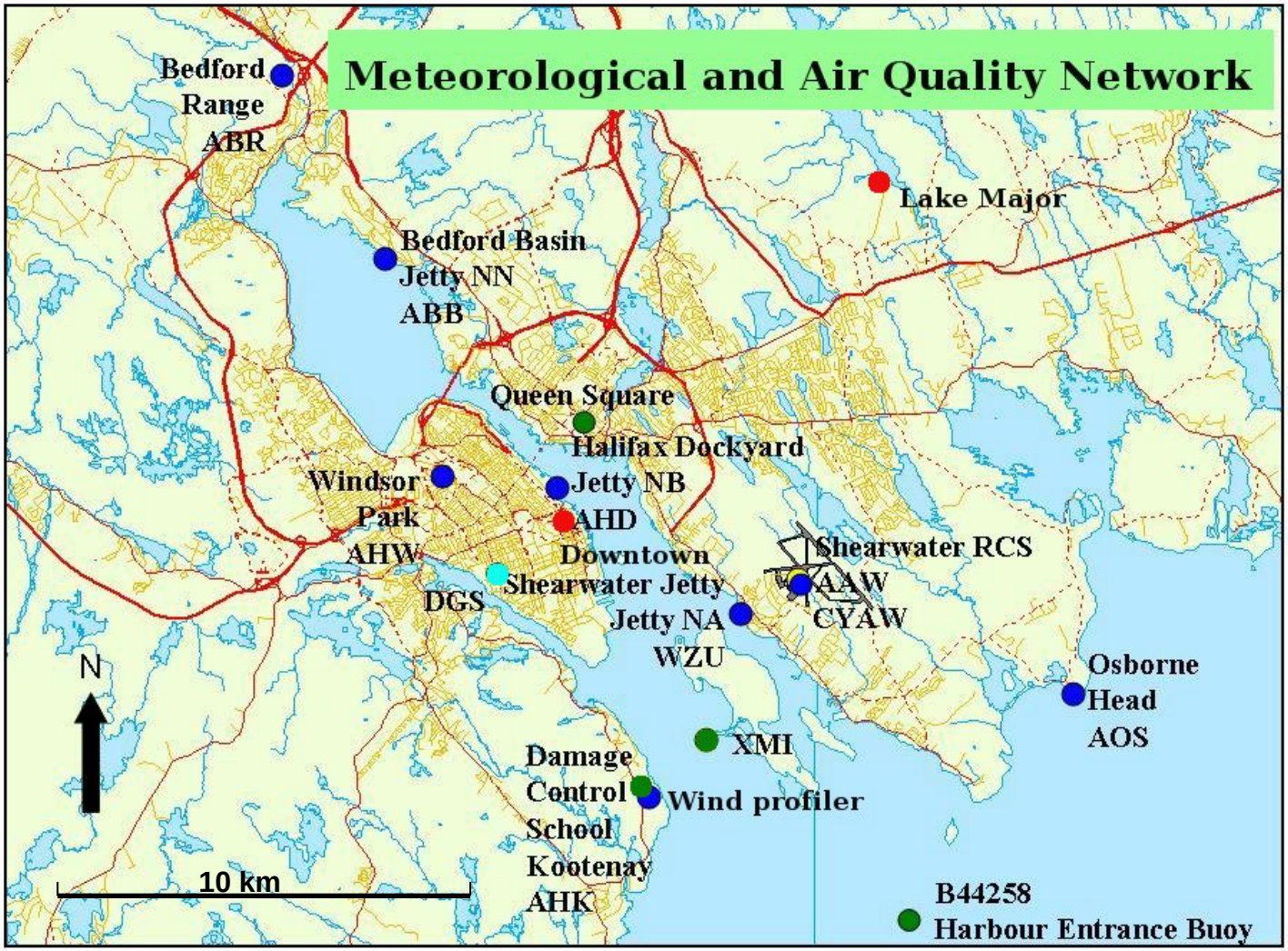
- **Trace Gases:**
  - **PARIS-IR** Column and partial column densities of N_2O, O_3, CH_4
  - Thermo **O_3 Analyzer**
  - **BOMEM DA8 - Fourier Transform IR (FTIR)** – Partial columns - N_2O, O_3, CO, CH_4, Total Columns -C_2H_6, HCN, NO, NO_2

- **Speciation:**
  - **Aerosol Chemical Speciation Monitor (ACSM)** - 40nm – 1μm – NH_4^+, Org, $SO_4^=$, NO_3^-, Cl^- …
  - **Partisol 3035 Chemical Speciation Sampler** (anions, cations, levoglucosan, PAHs, OC/EC)
  - **Partisol 2025- dichot** Fine and coarse mode (mass and metals)
  - **MOUDI – 12 size ranges** - .05-18 μm - $SO_4^=$, NO_3^-, Cl^-, Br^-, Ca, Na, K, Mn

- **Weather:**
  - **Davis Weather** Station - 5 minute values for most variables

Photo Credit: Peter Klages

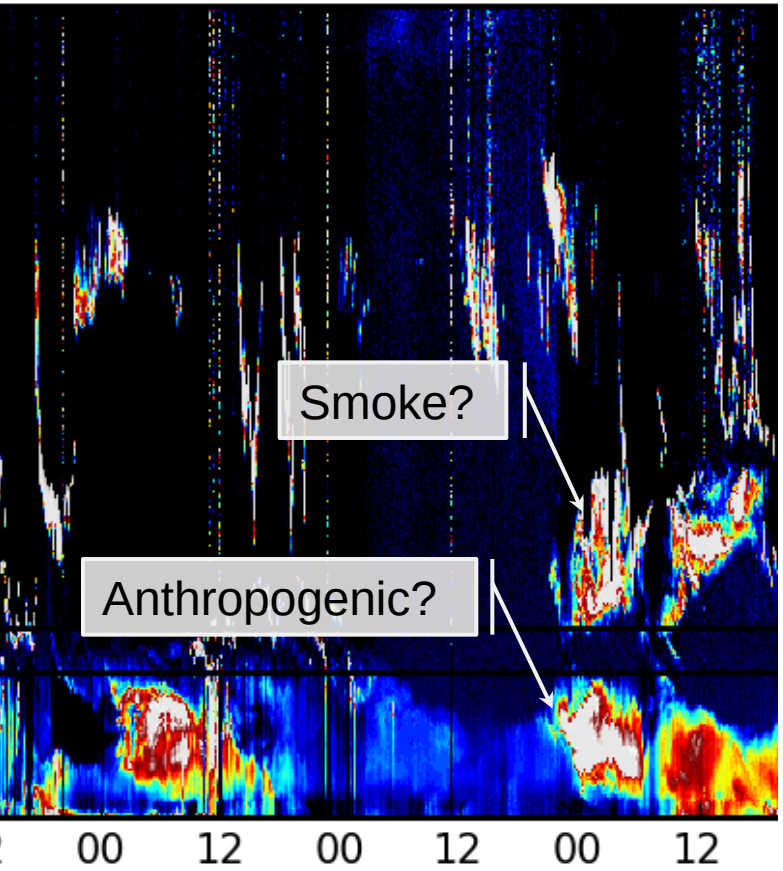
Supplementary Data



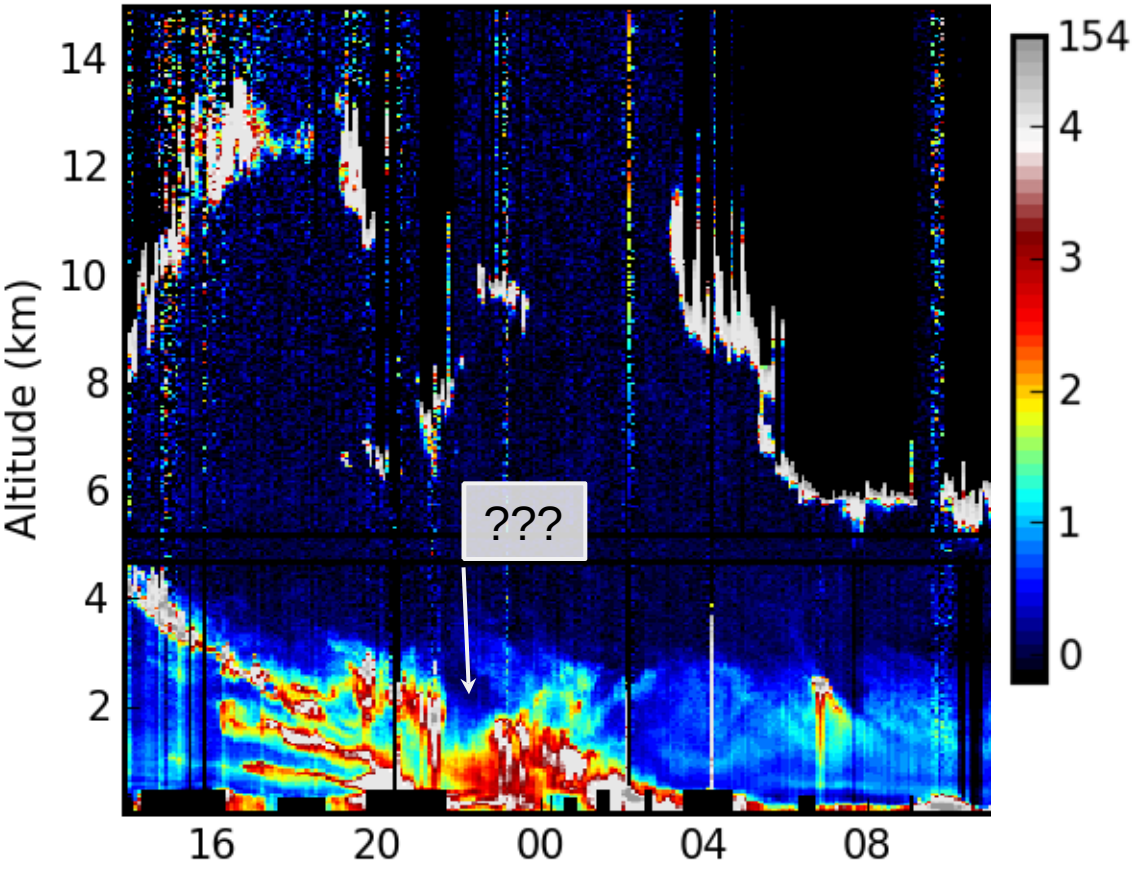
Dalhousie Raman Lidar (DRL)

2011-07-18 ~12 UTC to 2011-07-23 ~11 UTC

532 nm Backscatter Cross-section (/Mm/sr) [Klett]



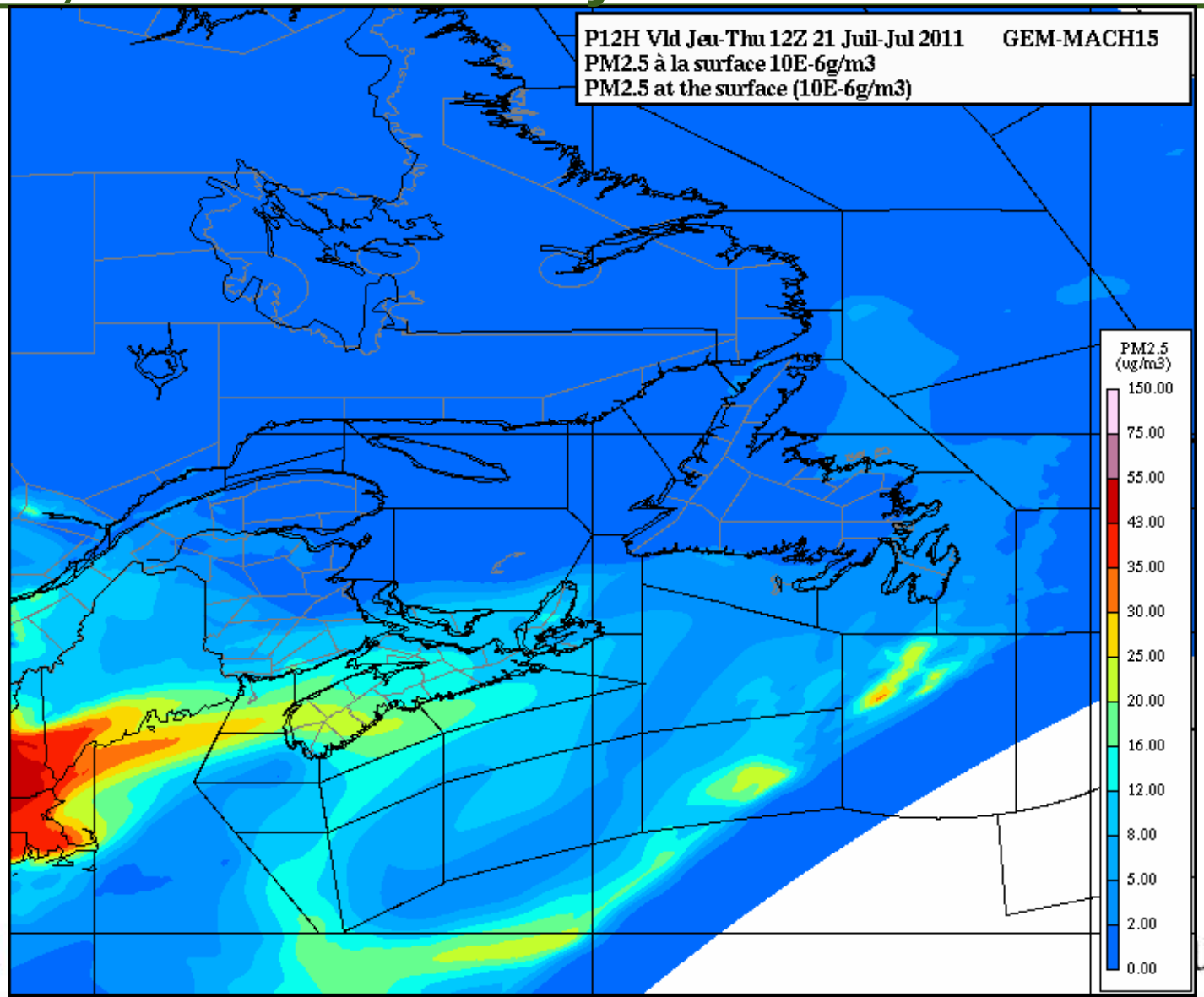
Time (UTC) on 18-21 July 2011



Time (UTC) on 22-23 July 2011

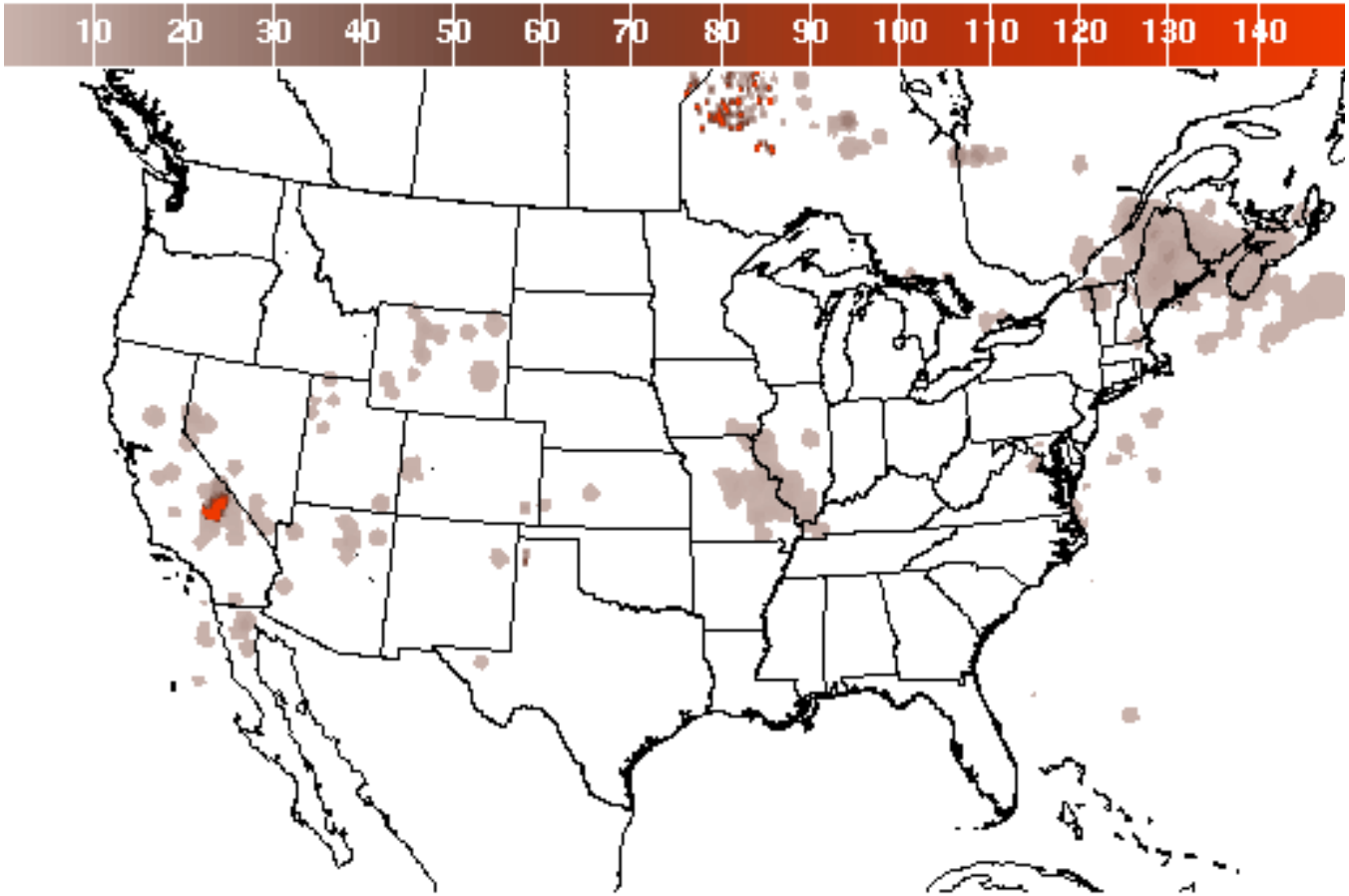
GEM-MACH15 Surface PM2.5

July 20, 00Z run – for July 21 12Z



NOAA Smoke Model

July 20, 06Z run – for July 21 12Z



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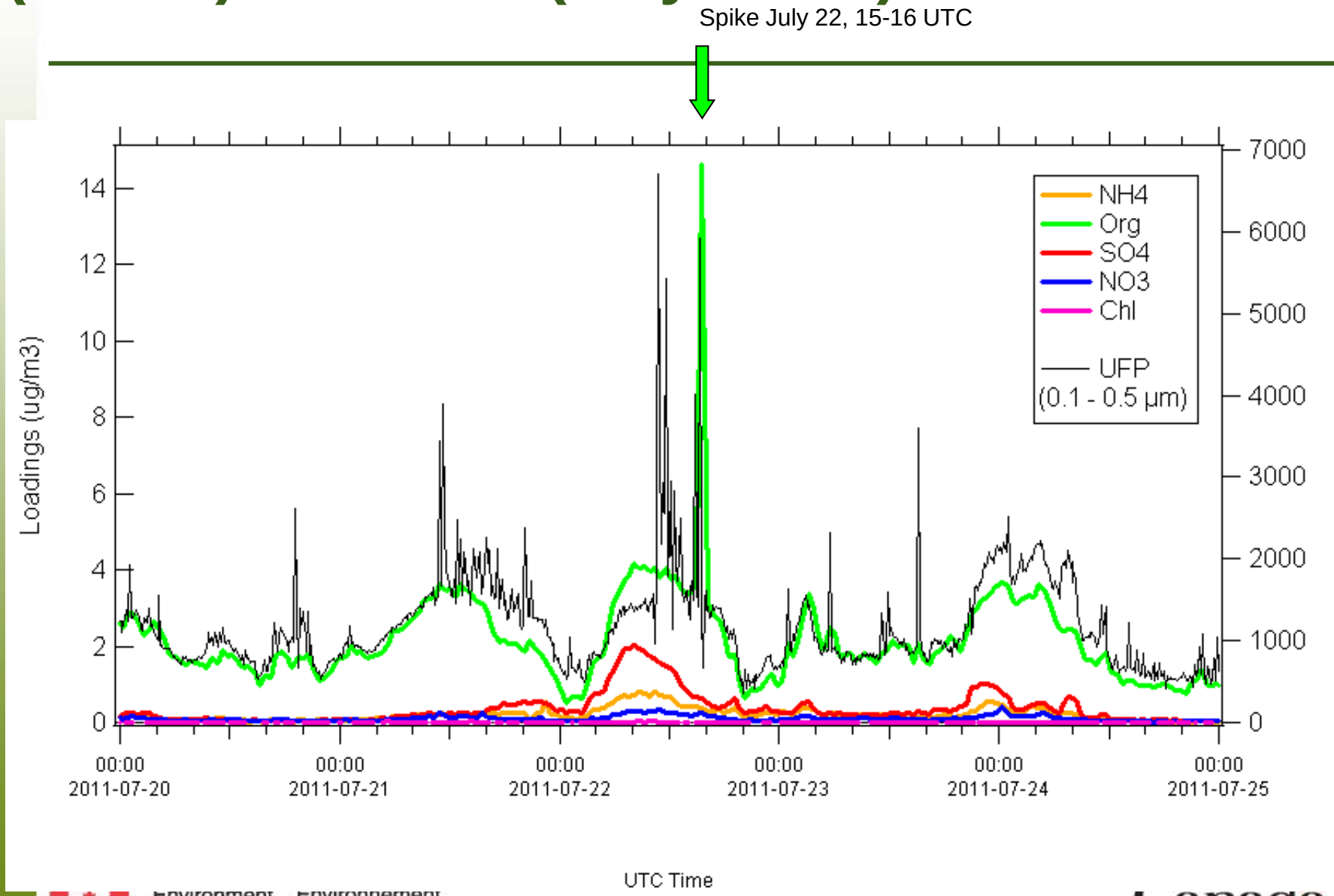
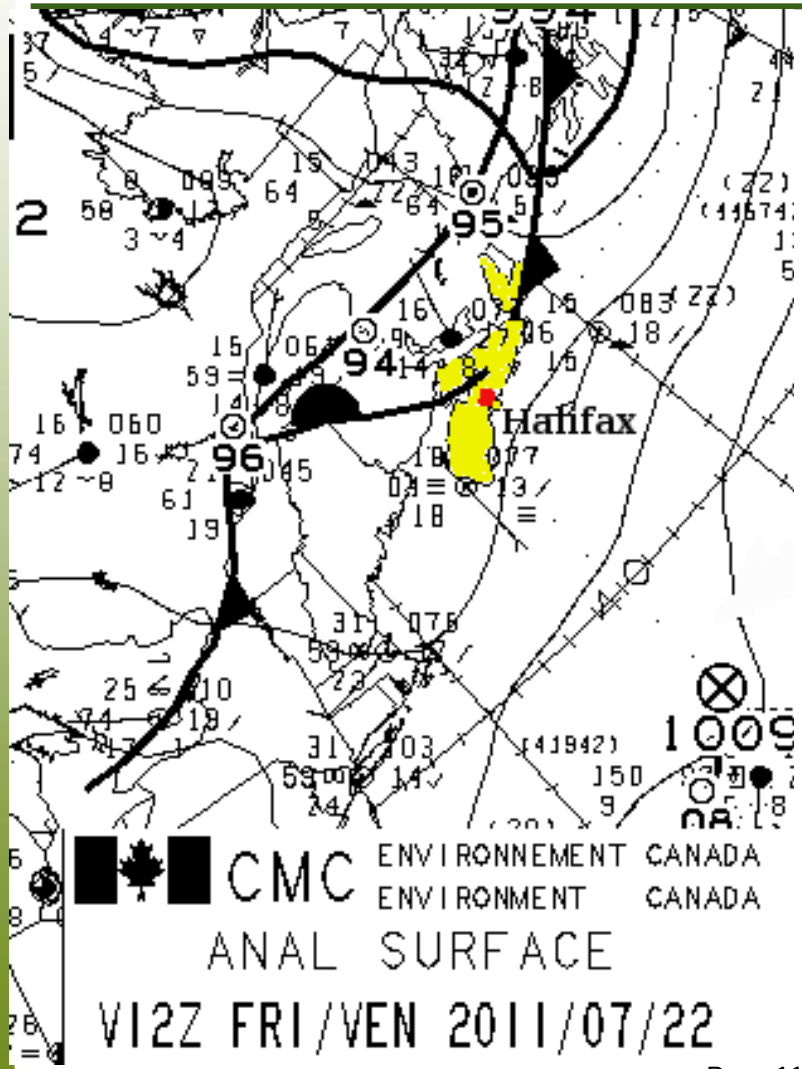
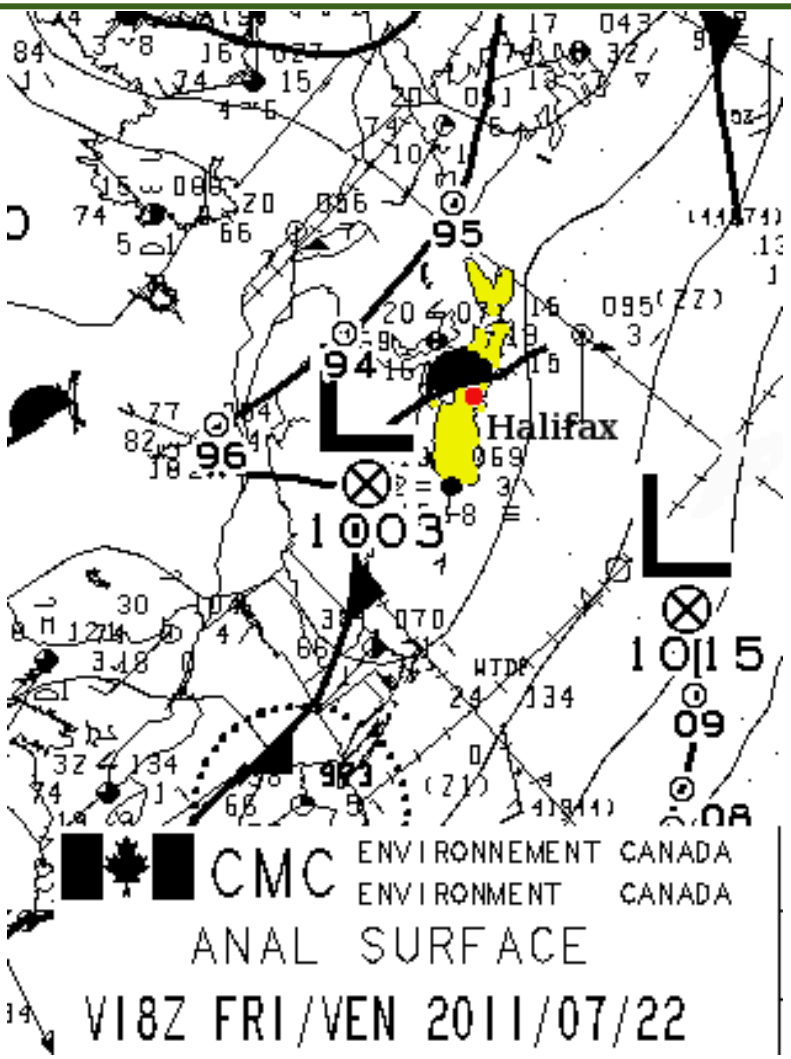
Aerosol Chemical Speciation Monitor (ACSM) with UFP (July 20-24)



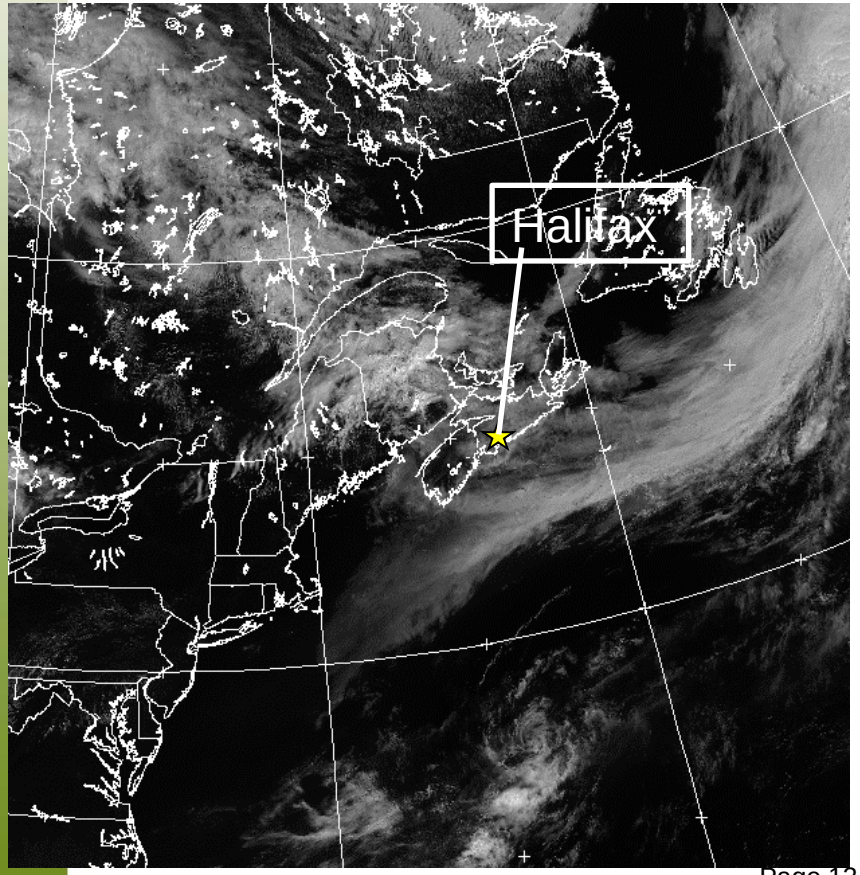
Surface synoptic maps 22 July 2011



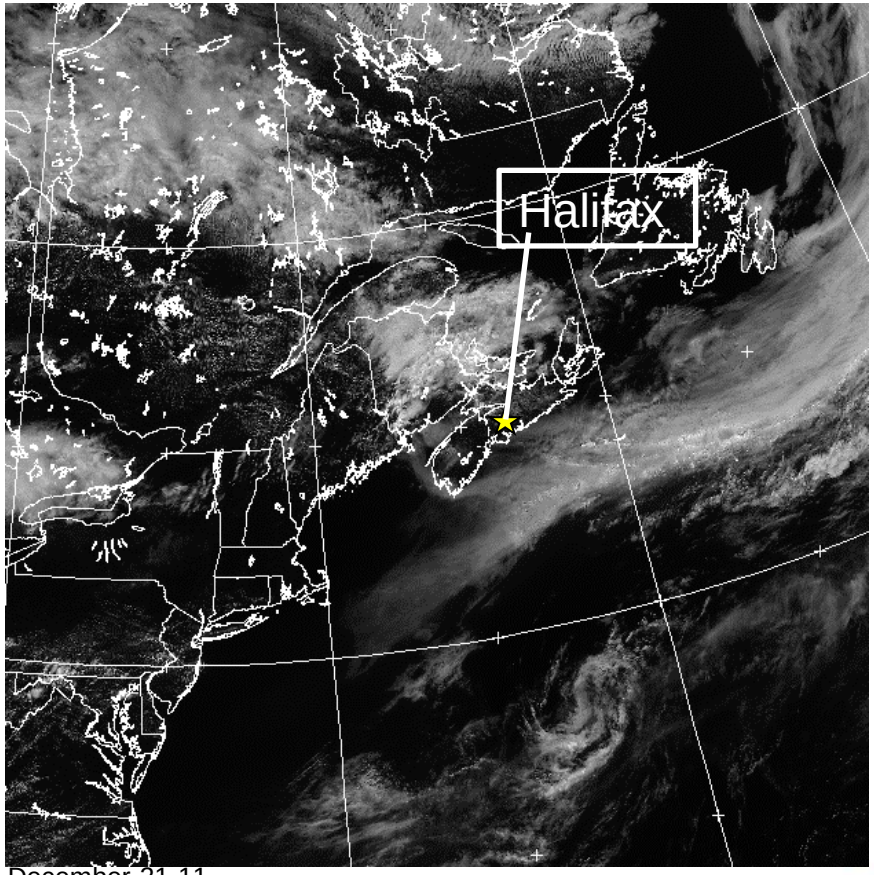


GOES 12 visible imagery

20110722 1445Z



20110722 1745Z



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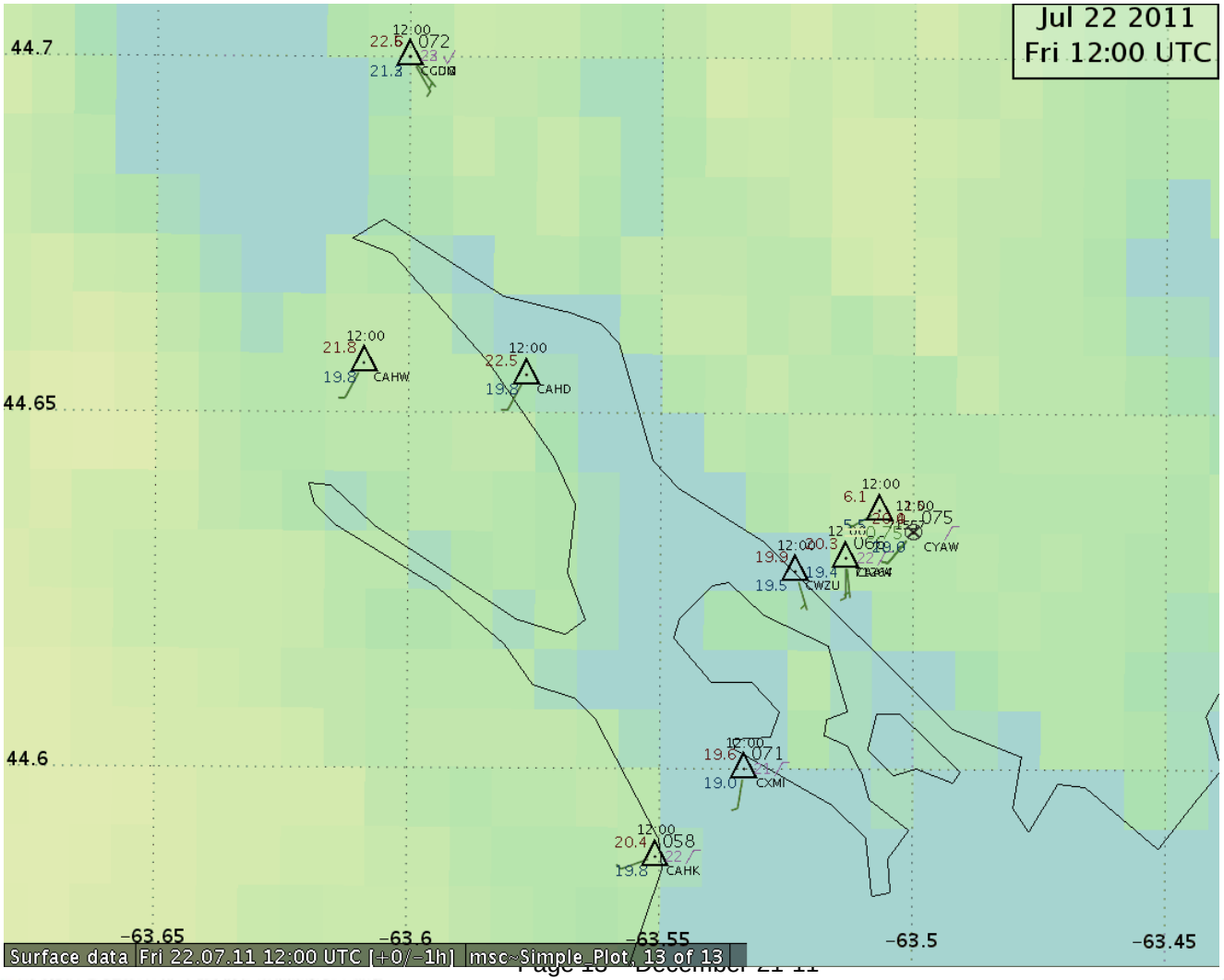
HRM Mesonet reports



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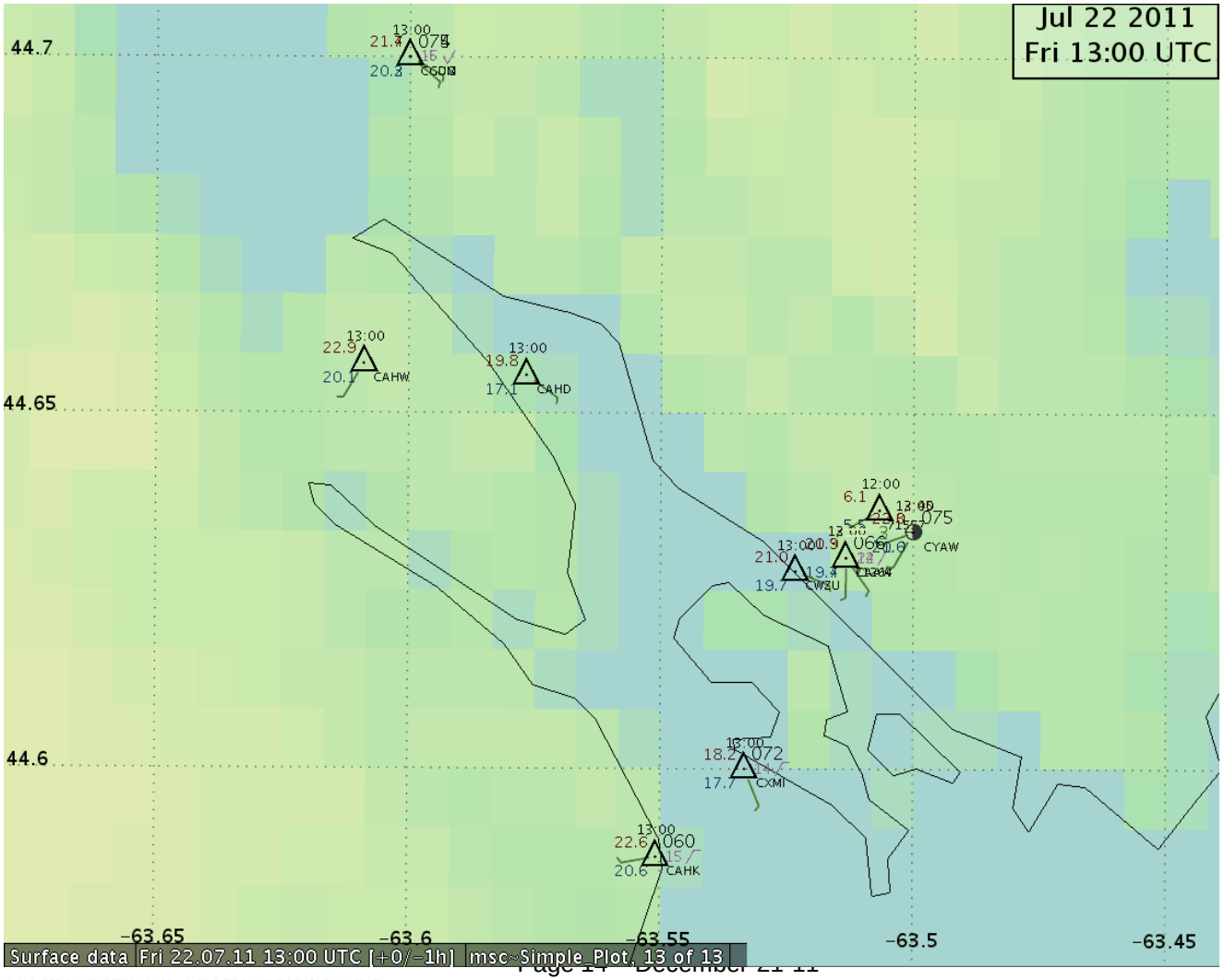
HRM Mesonet reports



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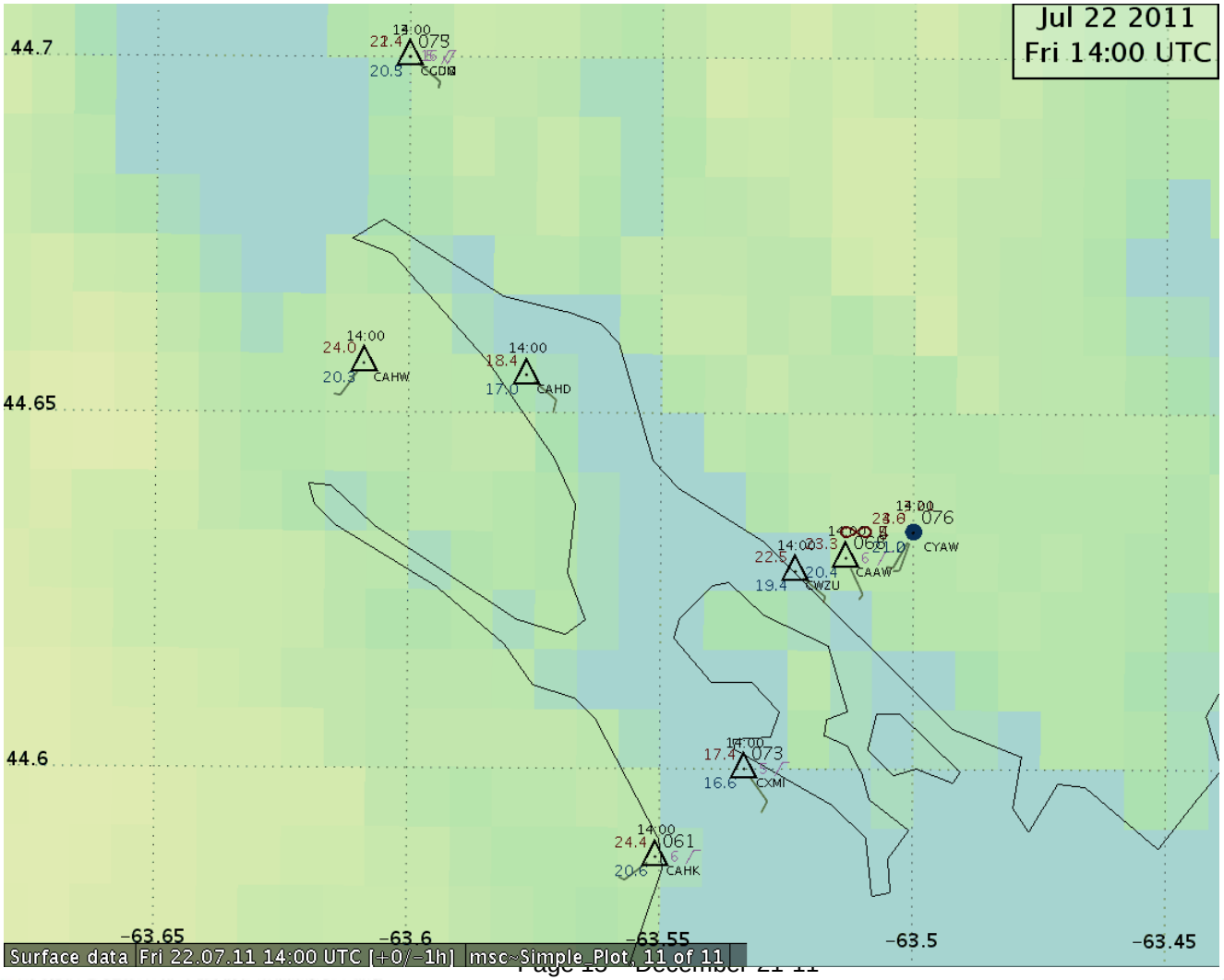
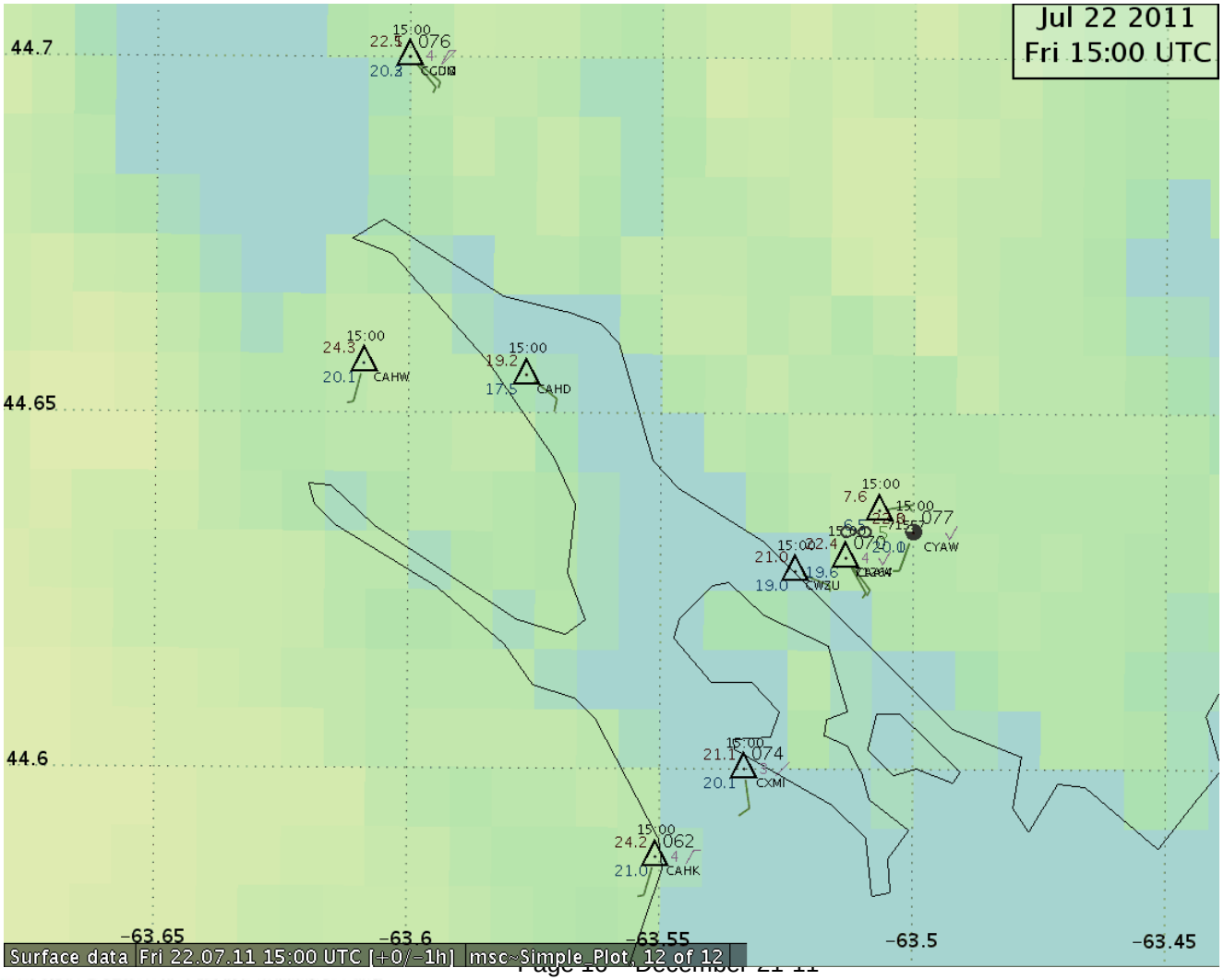


HRM Mesonet reports



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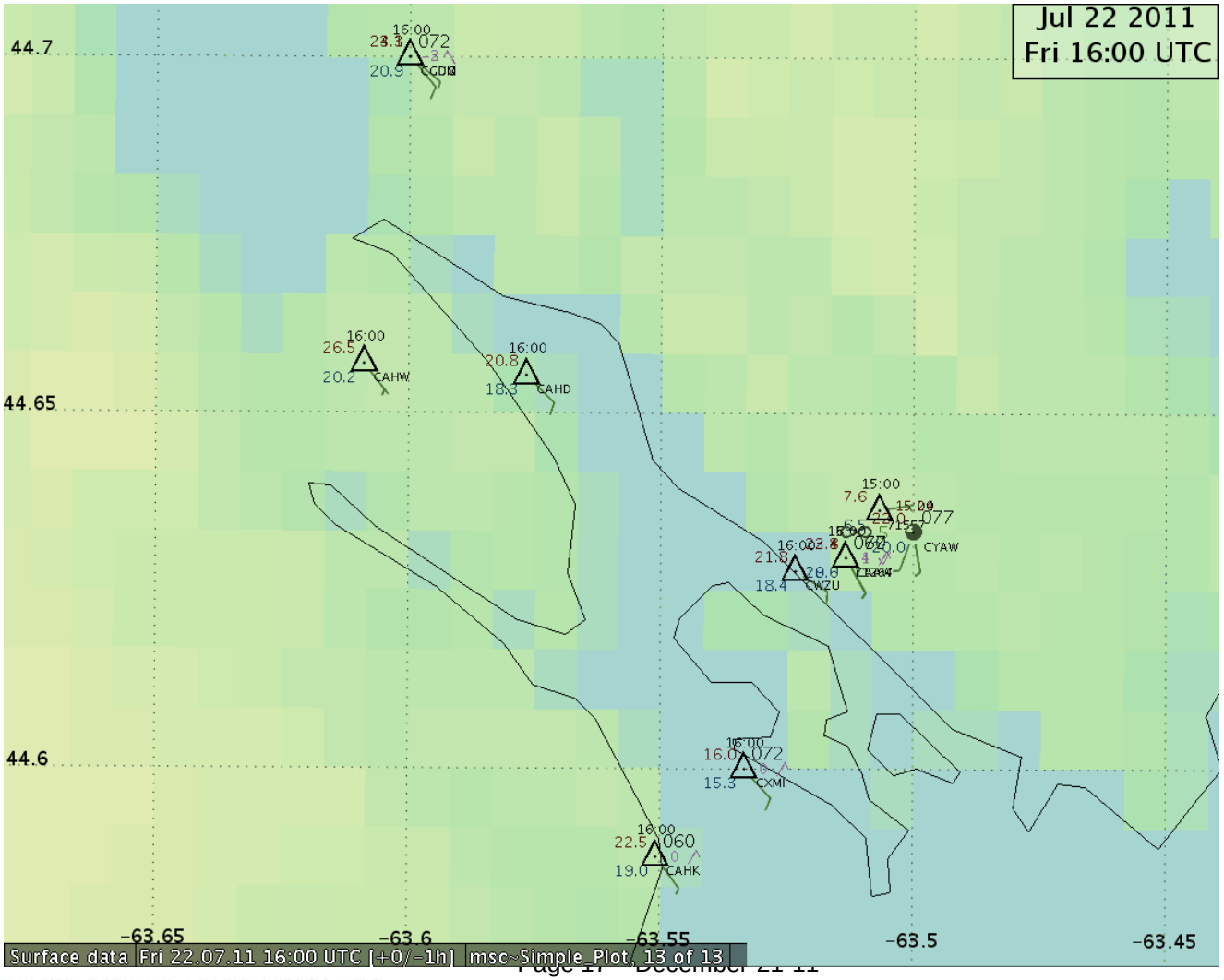

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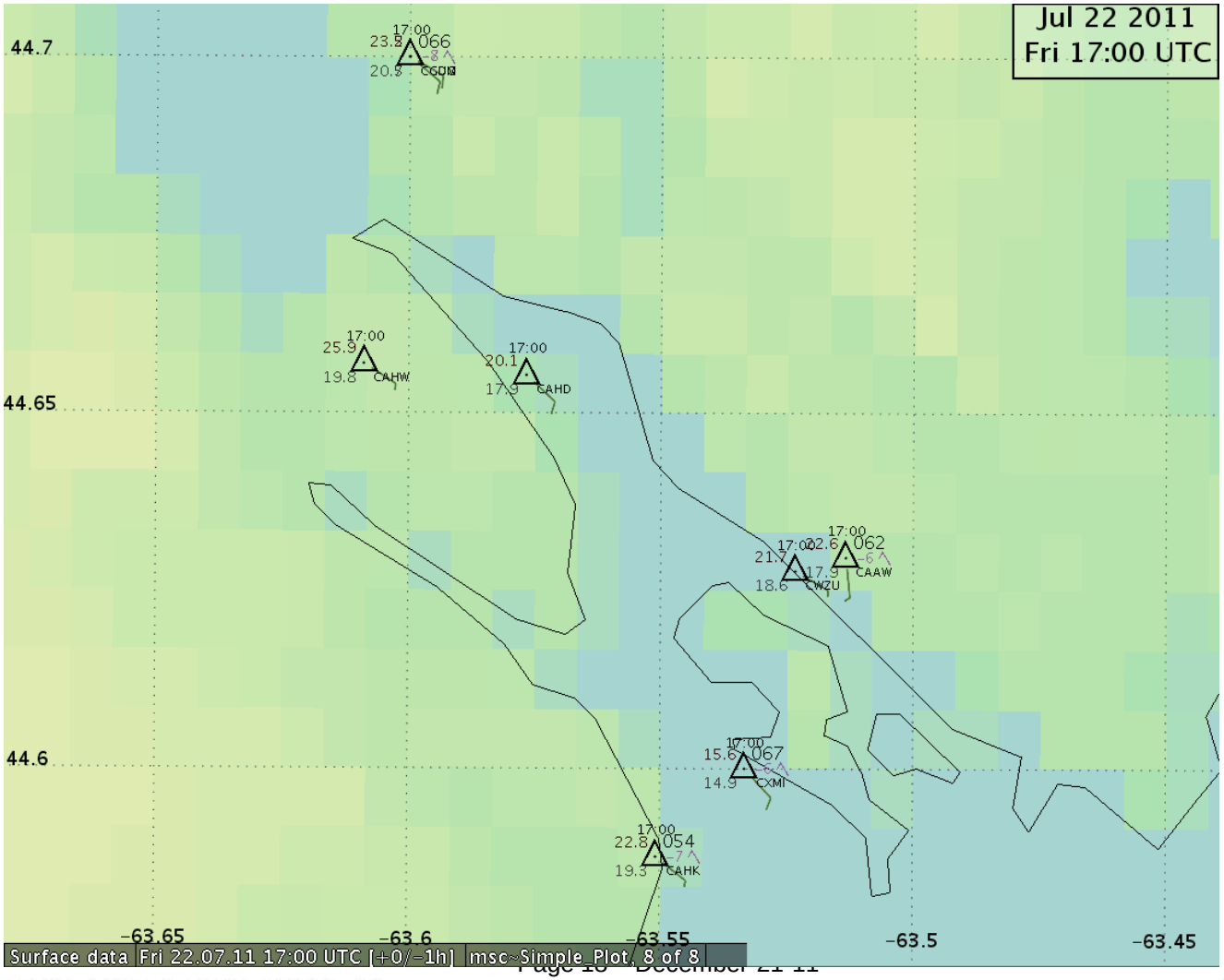

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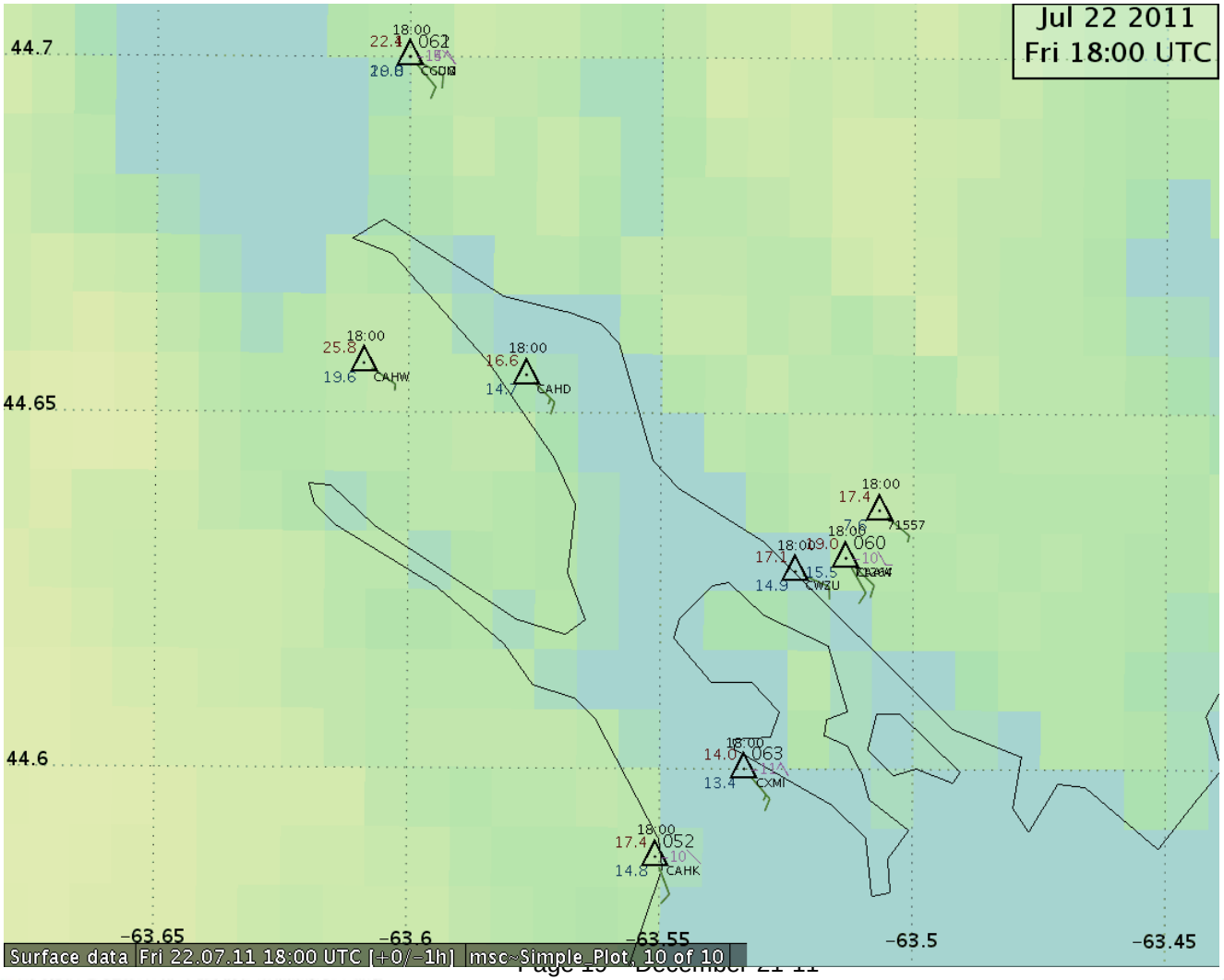

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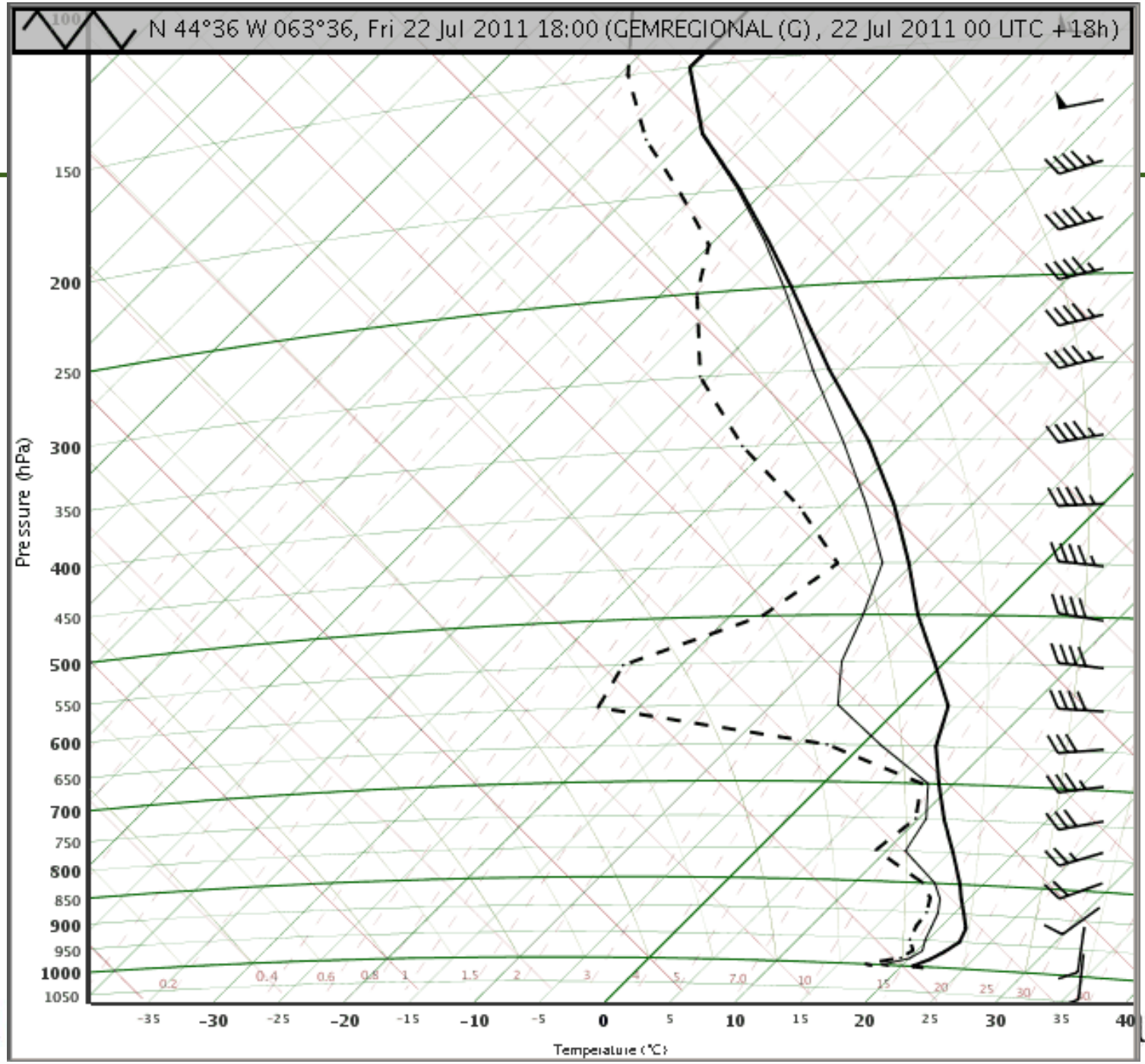
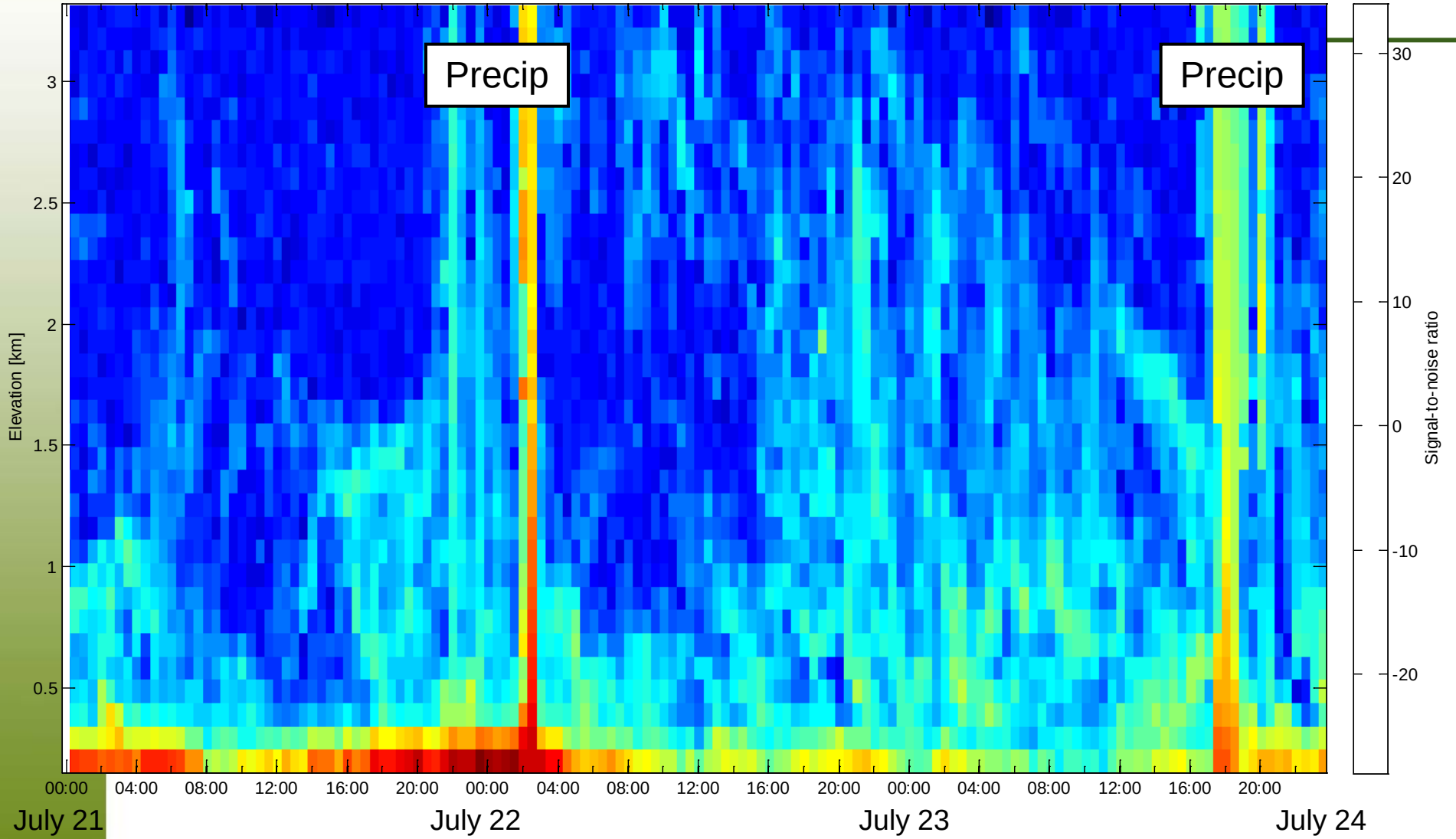

N 44°36 W 063°36, Fri 22 Jul 2011 18:00 (GEMREGIONAL (G), 22 Jul 2011 00 UTC +18h)
Pressure (hPa)
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Temperature (°C)

SNR for Wind Profiler



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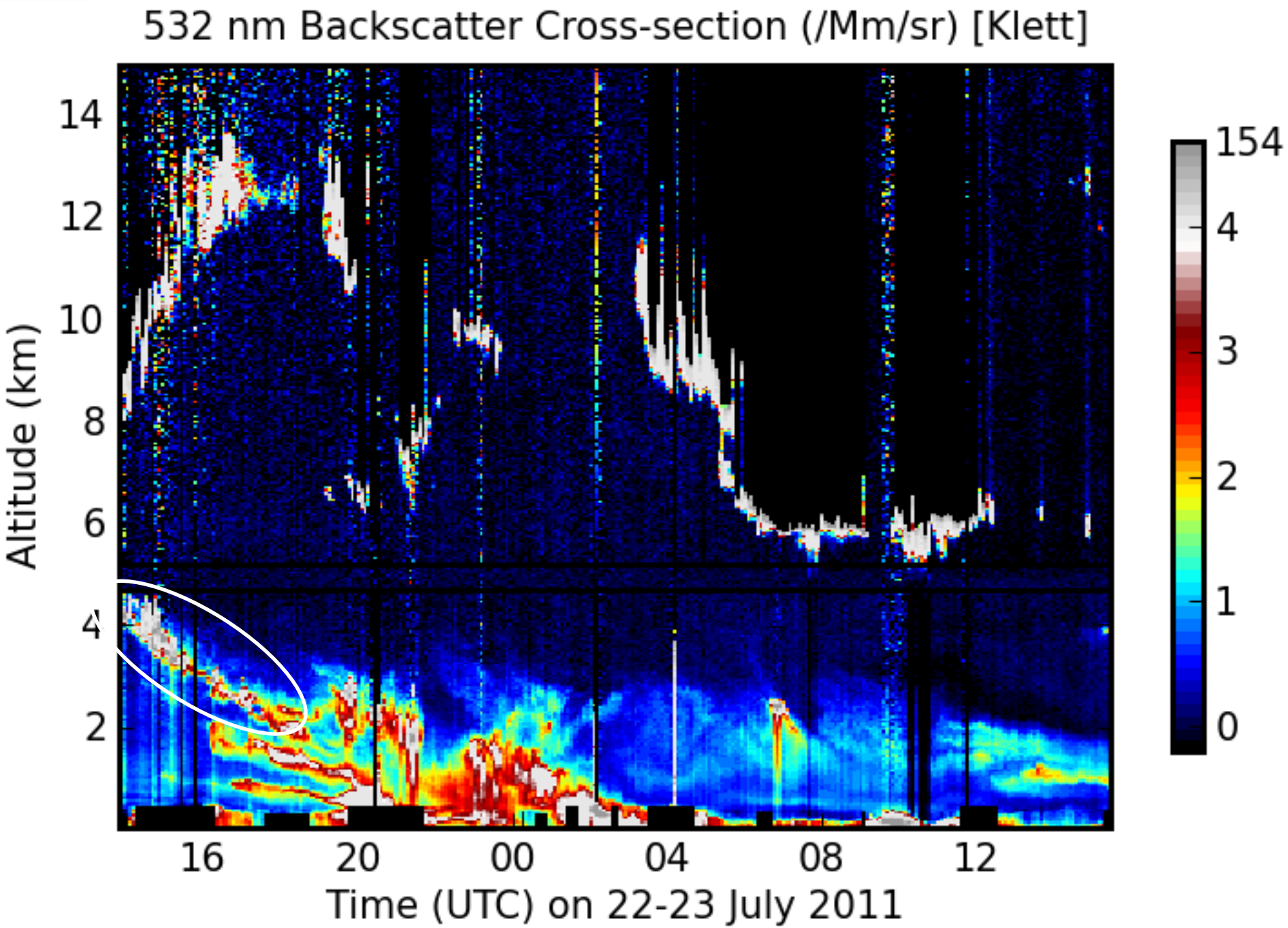
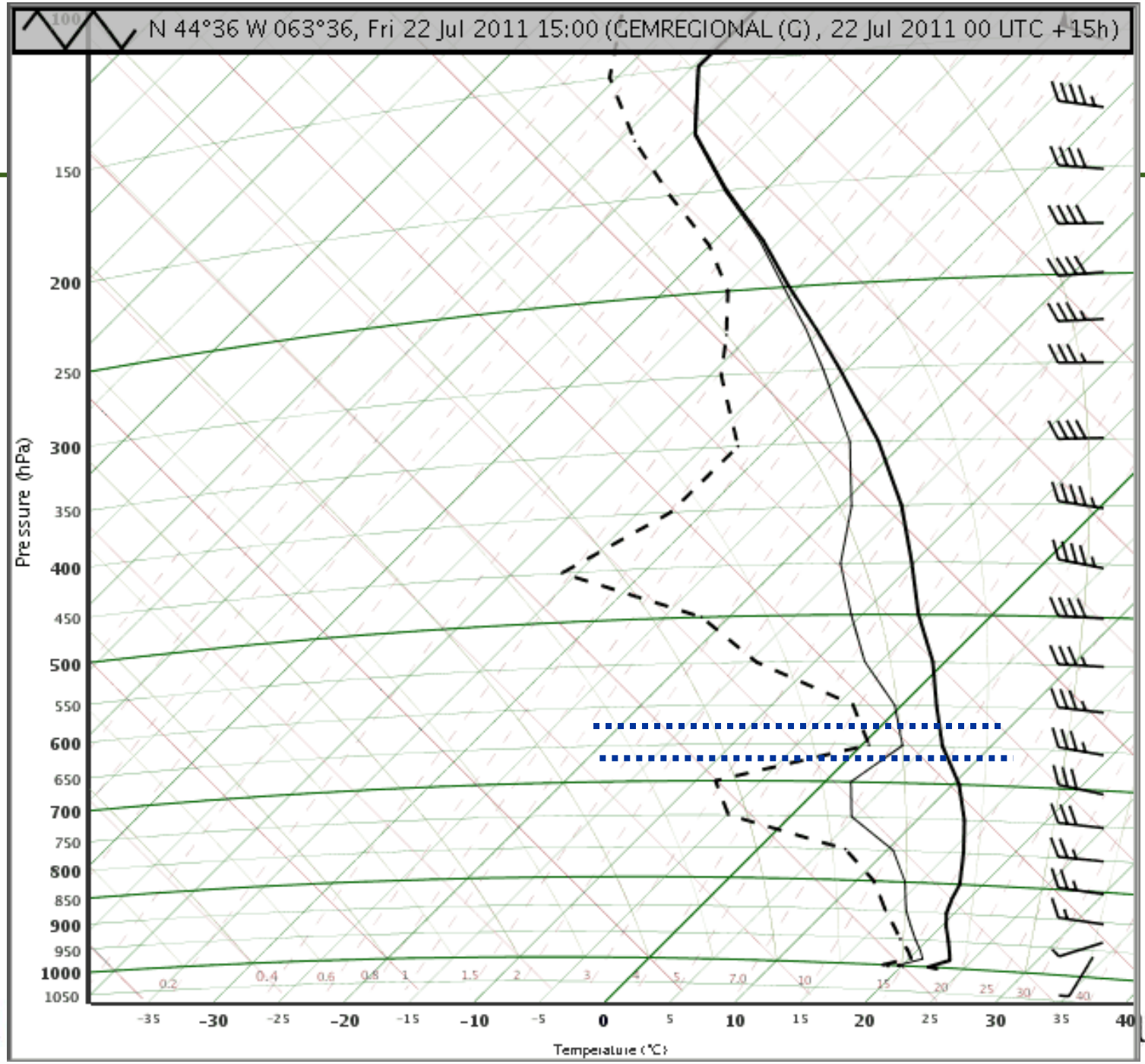

532 nm Backscatter Cross-section (/Mm/sr) [Klett]
Altitude (km)
14
12
10
8
6
4
2
16
20
00
04
08
12
Time (UTC) on 22-23 July 2011
154
4
3
2
1
0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Pressure (hPa)
100
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950
1000
1050
0.2
0.4
0.6
0.8
1
1.5
2
3
4
5
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15
20
25
30
40
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-30
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-15
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-5
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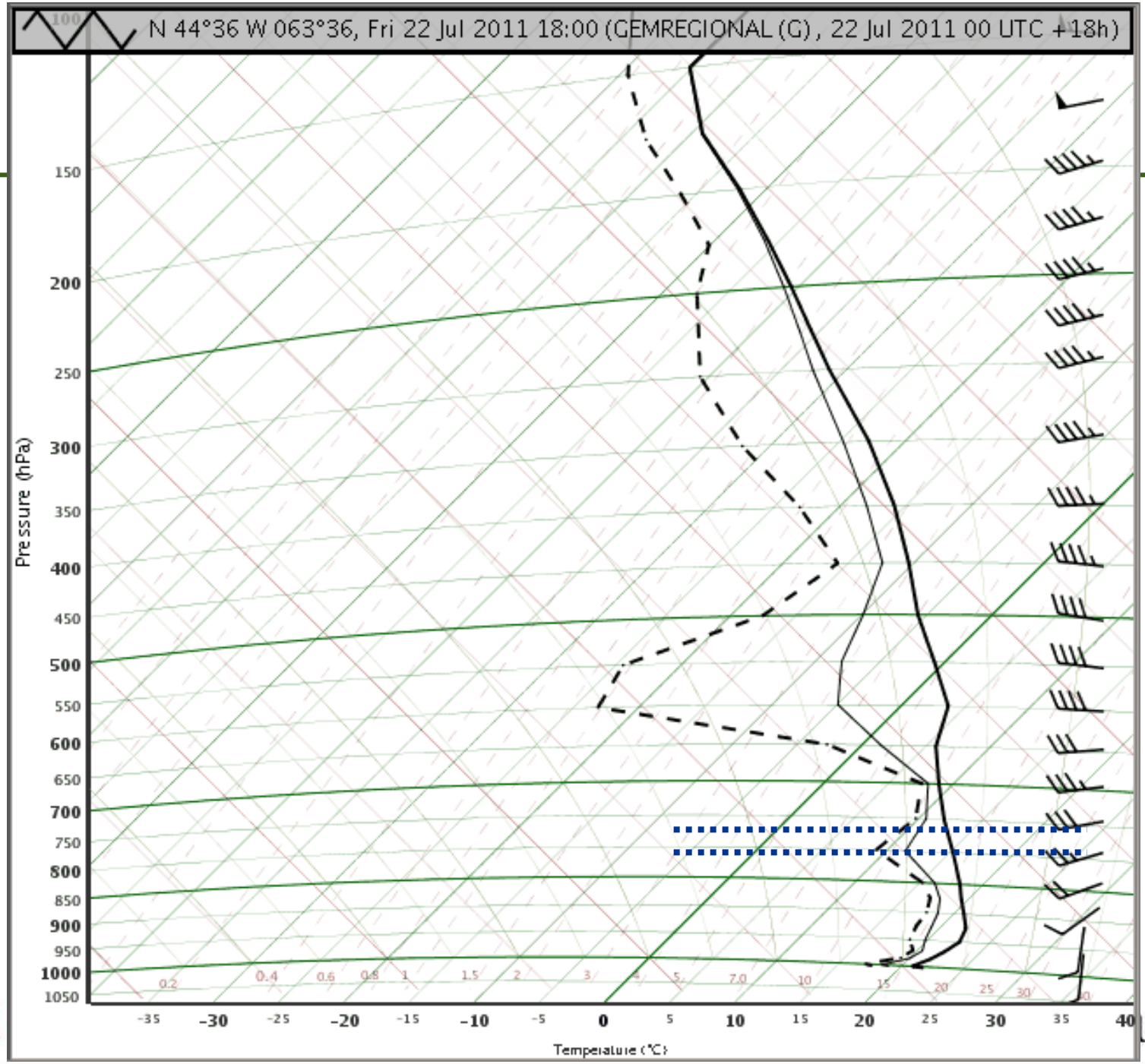
20
25
30
35
40
Temperature (°C)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Pressure (hPa)
100
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1000
1050
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Temperature (°C)

Further Work

- Aircraft data and filter speciation data still being processed.
- Data needs to be QC'd.
- Collaboration with DISCOVER-AQ.

- A careful assessment of mesoscale/microscale meteorology will be important for interpreting the event.

Acknowledgements

Co-authors:
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Dave Kindred (UK Met Office)

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Environment Canada:
Serge Desjardins, Kevin Nicholson, Steve Beauchamp, Grant Burton, Kimberley Forsythe (Summer student)

Nova Scotia Environment:
Fran DiCesare, Barb Bryden

Website for the DGS data:
(NOTE: Not all data are QC'd)
http://aolab.phys.dal.ca/data/archive/halifax_2011/