Upper Green Winter Ozone Study (UGWOS) 2011 & 2012

Air Quality Division/Monitoring Section
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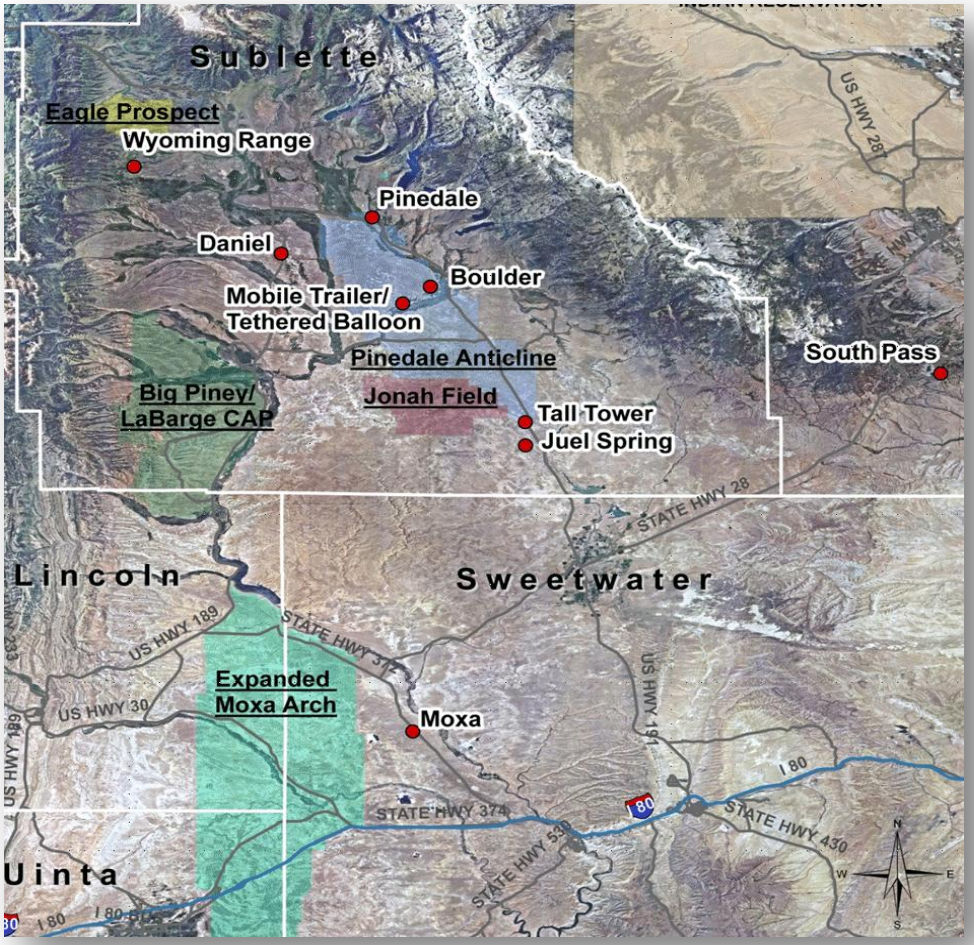
PAWG Meeting
May 22, 2012

Upper Green Winter Ozone Study 2011

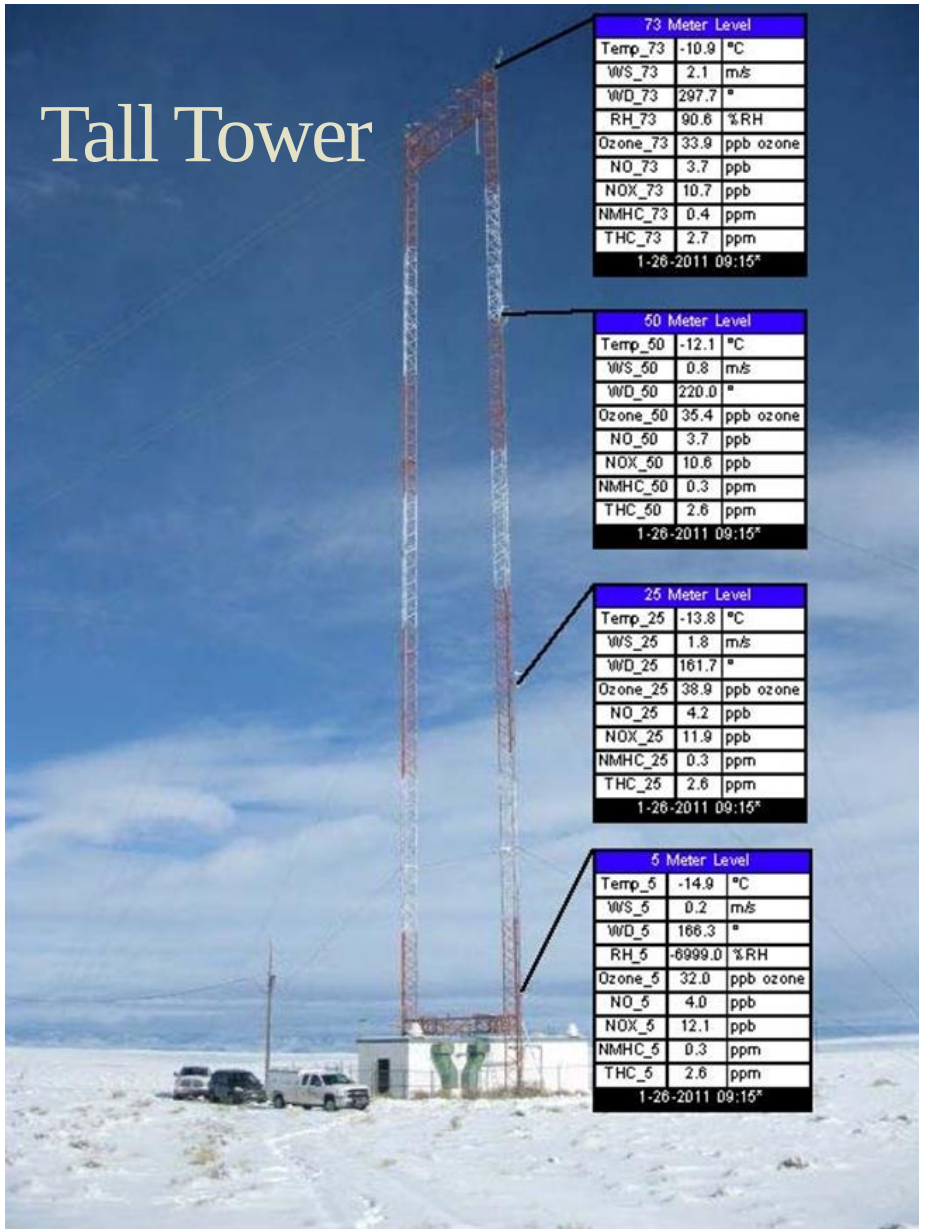
- Focus on vertical distribution of precursors
- Contractors: MSI; T&B Systems; U of Houston; Environ
- Operation between Jan. 15 - March 31, 2011
- Balloons were deployed during Intensive Operational Periods (IOPs); rest of equipment was continuous

Upper Green Winter Ozone Study 2011



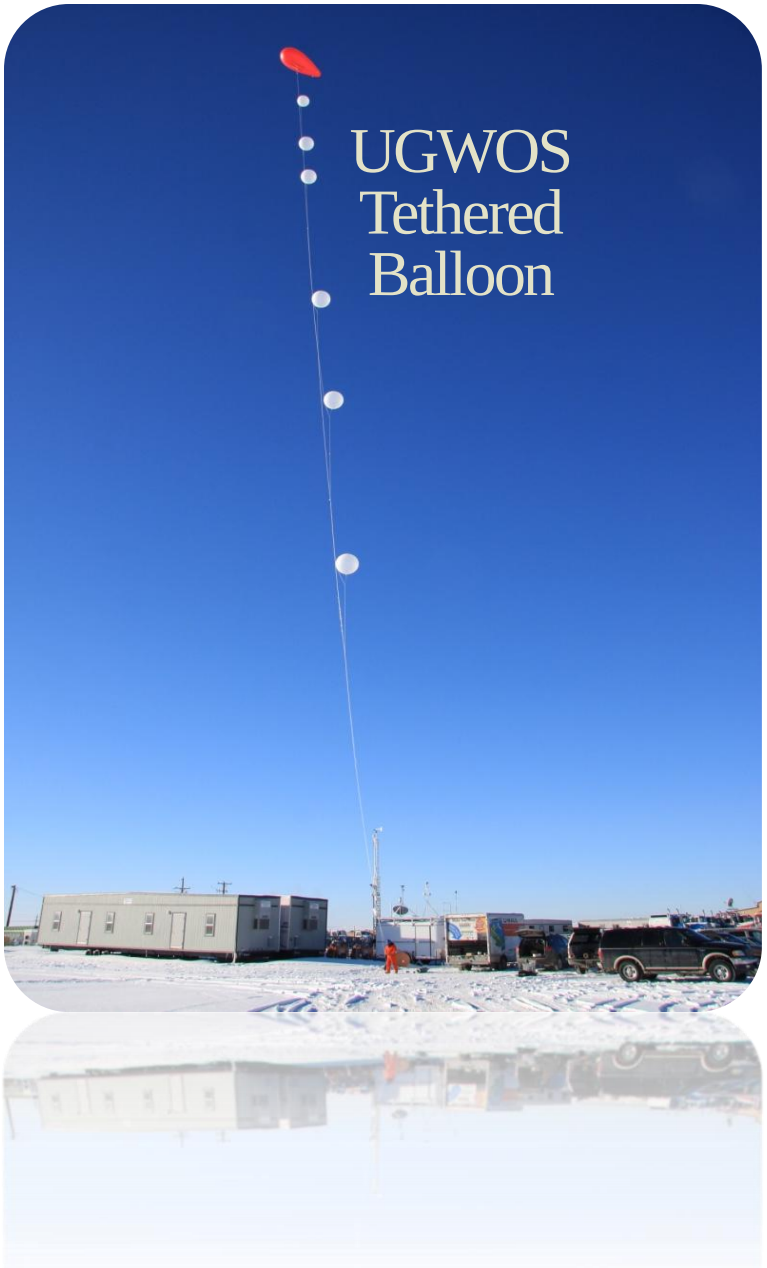
Upper Green Winter Ozone Study 2011

- Tall Tower: 4 Levels – 73m, 50m, 25m, 5m (Continuous)
- Each level: WS/WD, Temp, RH, Ozone, Oxides of Nitrogen, THC/TNMHC
- Met: 15-minute averages
- AQ: 5 sample readings per hour (every 12 minutes)



Upper Green Winter Ozone Study 2011

- Only during IOP's
- Four measurement heights: 4, 33, 67, and 100 meters
- Measurements: Ozone, Oxides of Nitrogen, THC/TNMHC, Temp, RH
- 5 sample readings per hour (every 12 minutes)



Upper Green Winter Ozone Study 2011

Soundings measure temperature, humidity, and ozone in vertical structure

Mini-SODAR to measure winds in vertical structure

Upper Green Winter Ozone Study 2011

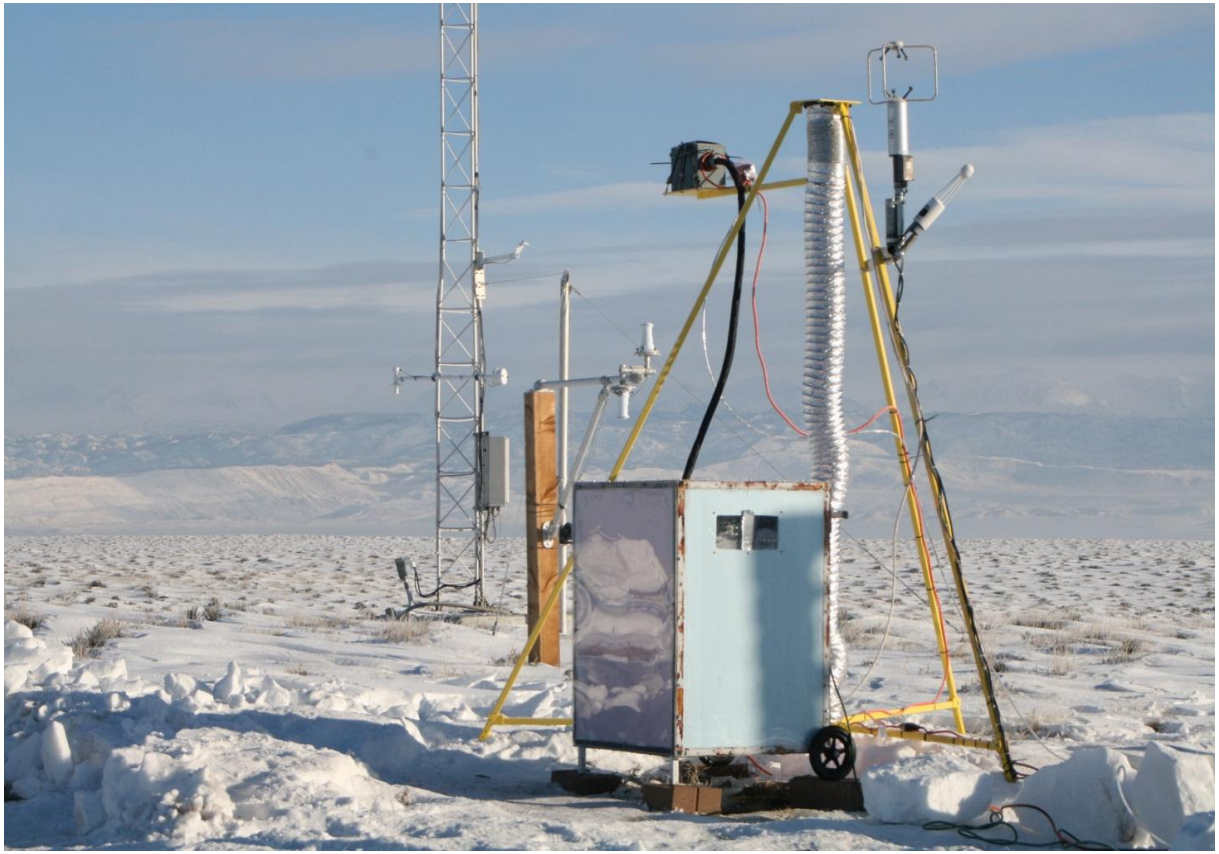
- HONO
- Speciated VOC and PM
- NOy

UGWOS Boulder Complex

Upper Green Winter Ozone Study 2011

- Precursor monitoring
- Continuous
- Samples at ground and 2 m
- Sample for 15 min. each

HONO/HCHO at Boulder



Upper Green Winter Ozone Study 2011

Intensive Operational Periods

UGWOS 2011 Jan 15-Mar 31, 2011						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	IOP # 1	2	3	4	5
6	7	8	9	IOP # 2	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Upper Green Winter Ozone Study 2011

IOP #1 : February 28 – March 2

- Abundant snow cover
- Surface temps in the negative single digits °C during the days and negative 20's °C at night resulting in strong surface inversions
- Surface winds averaging 2-3 mps

Upper Green Winter Ozone Study 2011

IOP #2 : March 9 – March 12

- Abundant snow cover
- Surface temps mostly below freezing…Night time lows between -5 and -15 °C
- Surface winds breezy at times late on the 10th and early on the 11th otherwise averaging 2-3 mps

UGWOS 2011
Summary of Observations

- Extensive snow cover and periods of light winds produced high O3 in Feb-Mar 2011
- Several high O3 days well captured by IOPs
- Presence of snow pack is extremely important and compensated for weak high pressure in 2011
- UGWOS 2011 occurred during a very active storm season which kept high pressure periods infrequent, weak and transient
- With weak high pressure at best during both IOP's the flow aloft was generally westerly
- This westerly flow may have helped inversions strengthen and deepen over the Upper Green River Basin by providing warming/descending flow off the Wyoming Range Mountains

UGWOS 2011
Summary of Observations

- Shallow inversion, low mixing height critical for high ozone episodes
- Trapping of precursors at base of elevated inversions common
- No evidence of ozone carryover aloft in tethered balloon or tall tower data
  - Consistent with aircraft data from previous (2008) study
  - Maximum balloon and tower heights limit observations
- VOC concentrations highest at surface, NOx concentrations highest somewhat above the surface

UGWOS 2011
Summary of Observations

- Transport of ozone-laden air mass occurred frequently to the Wyoming Range site
- This transport of ozone is associated with deep inversions/SE flow that can extend to higher elevations on edge of basin
- Other than ozonesonde measurements vertical structure of pollutants > 100 meters not well understood

UGWOS 2011
Summary of Observations

- TNMHC/NOx ratio higher near the surface during the morning
  - In balloon data: appears to be due primarily to higher NOx in aloft stable layer
  - In Tall Tower data: appears to be associated with low level NMHC source
  - No NOx plumes in aloft stable layer at Tall Tower
    - Observations limited by 73 m max height
- Correlation between ozone and NMHC concentrations frequently noted in afternoon/evening when NMHC < 6 ppm

Upper Green Winter Ozone Study 2012

- Continued ozone, NO_x, meteorological, and camera operations at current sites
- Mini-SODAR operations and height analysis
- Snow sticks at four sites
- Continued true NO_2 operations at Boulder
- 25 speciated VOC samples at Boulder, Big Piney, Juel Springs
- Added NO_y sampling at Boulder
- Added Jonah monitoring: ozone, NO_x, met., speciated VOC samples

UGWOS 2012
Preliminary Ozone Data

- Values have not gone through the data validation process yet but all stations passed independent quality assurance audits
- January 1 – March 31, 2012
  - 8-hour daily max ozone: 0 days > 75 ppb (NAAQS)
  - 1-hour daily max ozone: 11 days > 60 ppb < 70 ppb
    7 days > 70 ppb < 80 ppb

- Ozone Action Days
  - March 4 and March 5
  - Weather forecast was verified with observed meteorological conditions but elevated ozone above the level of the NAAQS was not observed.

Questions?