Aircraft and Tethered Balloon Measurements in the Uinta Basin in Winter 2013


Seven Flights on January 31, February 1, 2, 4, 5, 6, and 7
Continuous measurements of O₃, CH₄, CO, CO₂, NO₂, T, RH
12 Flask samples per flight measuring ~50 constituents including several VOCs

Tethered Balloon Ozonesondes from 3 sites with multiple profiles (~350)
Ozone in the Unita Basin of Utah in Winter 2012 and 2013

What is the role of snow cover?
- Produces strong temperature inversions giving a shallow, confined boundary layer.
- High albedo of the surface essentially doubles the UV available for photochemistry.
- Heterogeneous chemistry on snow surfaces?
What is Unique About the Unita Basin of Utah?

- Confined topography
- Intense oil and gas exploration and extraction
- Active oil and gas processing facilities
- Persistent winter snow cover!
Ozone in the Unita Basin of Utah in Winter 2012 and 2013

Tethered ozonesonde at Fantasy Canyon

Ozone profiles through the day at Ouray on February 5, 2013

Ozone across the basin on Feb. 2
Increase of ozone amount and vertical extent with time.
End of an event (Jan. 29) and the beginning of the next event (Jan. 31)
Ozone across the basin on Jan. 31, Feb. 1, 2, and 5

January 31
February 1
February 2
February 5
O$_3$, CH$_4$, CO, and NO$_2$ below 1650 masl on Feb. 2
O₃, CH₄, NO₂ and CO time series on Feb. 2

Red

Green

Blue

Alt

O₃

CH₄

NO₂

CO
Correlation of $O_3$ with CH$_4$, CO, NO$_2$, and CO$_2$ on Feb. 2

Methane

Carbon Monoxide

Carbon Dioxide

Nitrogen Dioxide
Correlation of O$_3$ with CH$_4$ and with CO on Feb. 1, 2, 4, 5, 6

February 1

February 2

February 4

February 5

February 6

Methane

Methane

Methane

Methane

CO

CO
Correlation of $O_3$ with $CH_4$ and CO with $CH_4$ on Feb. 2

Aircraft flask samples.

- Ozone (ppb) vs. Methane (ppb)
- Methane (ppb) vs. Altitude (masl)
- Methane (ppb) vs. Carbon Monoxide (ppb)
- Propane (ppb) vs. Methane (ppm)
- CO (ppb) vs. Methane (ppm)
- Benzene (ppb) vs. Methane (ppm)
Conclusions

• The tethered sonde and aircraft data provide an unparalleled set of data for understanding the vertical and spatial characteristics of winter high ozone events in the Uinta Basin of Utah.

• There is a continued buildup in ozone through a high ozone episode that is seen across the basin which fills the layer to the top of the shallow boundary layer.

• There is a strong correlation between methane and ozone through the basin. Ozone is also correlated with CO.

• The levels of methane and hydrocarbons are extremely high.

• The aircraft data identify the precursor emission hot spot in the gas field but high ozone is seen well away from this source.