

Preliminary Data from Special Study at Dinosaur National Monument

Tony Prenni

Derek Day

Kristi Gebhart

ARS

UC Davis

Dinosaur National Monument (DINO)

Expanded Monitoring at DINO late October 2018 to include an air quality web camera (park funded).

Dinosaur National Monument

Webcam **Air Data & Weather** [More Webcams](#)

View from West Entrance | Looking Southwest
Updated 10/08/2019 02:00 PM MDT



Current Air Quality

Ozone (O₃) ?

Good **24 ppb**

Updated 10/08/2019 01:00 PM MDT
Data collected at West Entrance
[See more air data »](#)

Current Weather

Temperature **60 °F**

Precipitation, 1-Hr **0.00 in.**

Wind **SW 3 mph**

Updated 10/08/2019 12:00 PM MDT
Data collected at West Entrance

Standard Metric

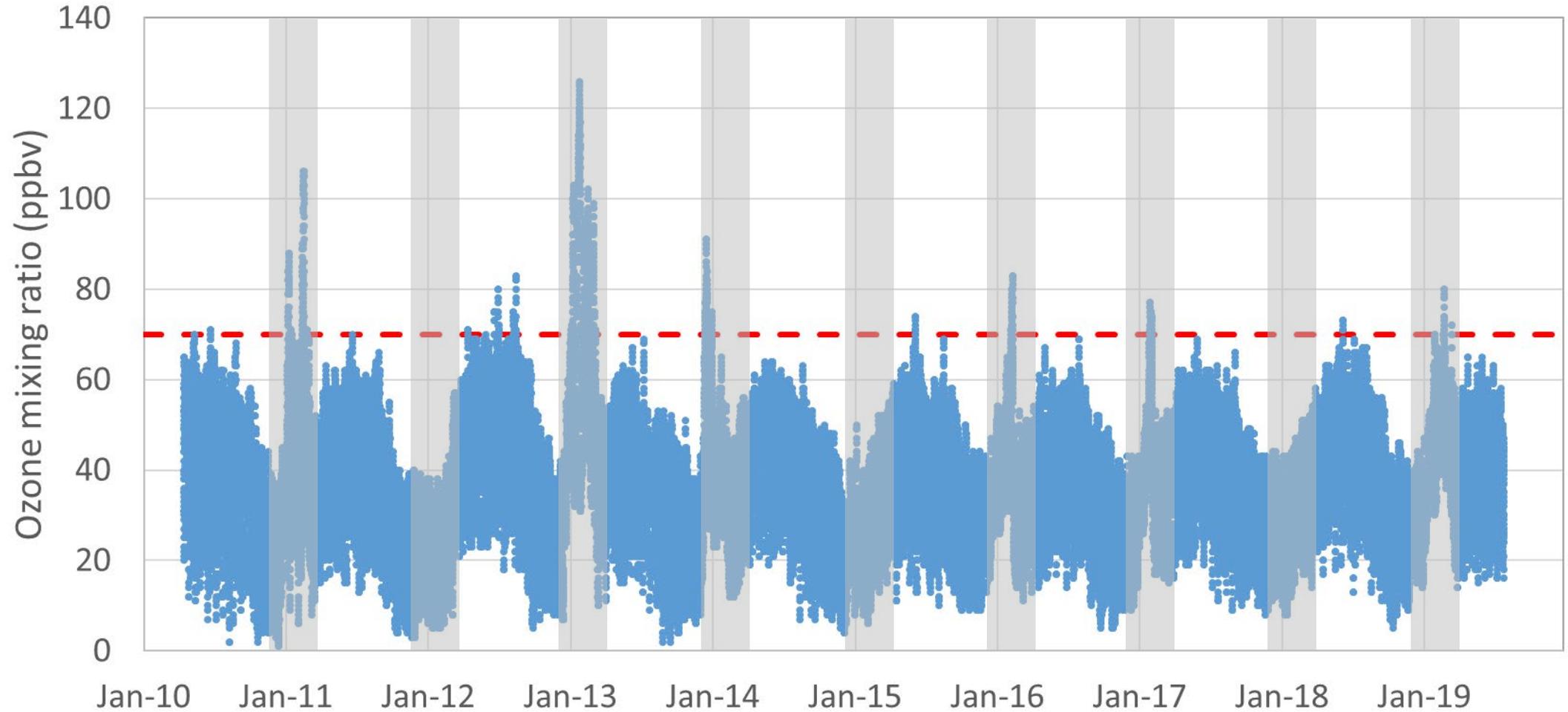
[See more air data »](#)

[Camera](#) [Clear/Hazy](#) [Landmarks](#) [Map It](#) [Archives](#)

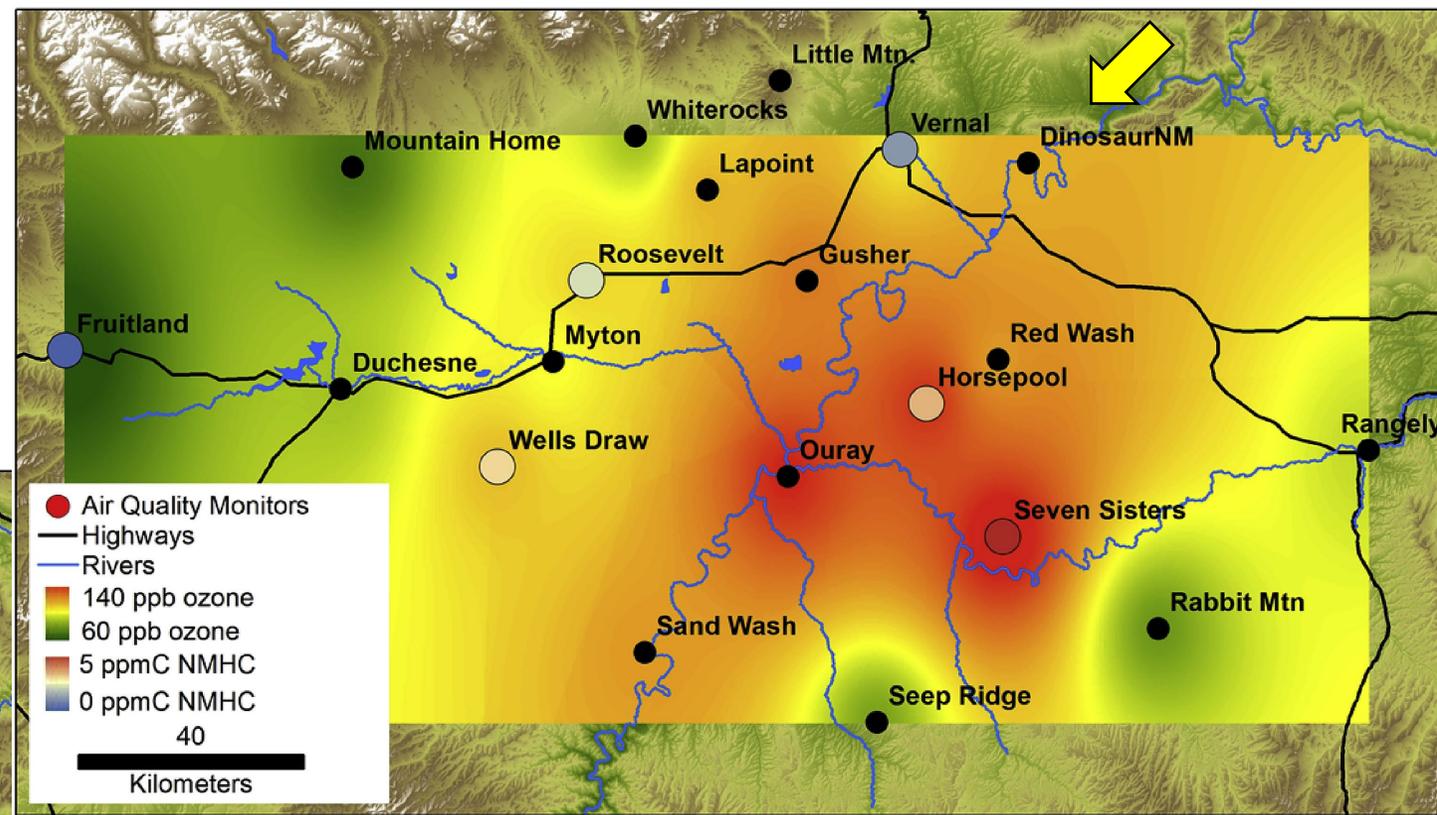


High wintertime ozone at DINO

Dinosaur Ozone Mixing Ratio (8 hr average)

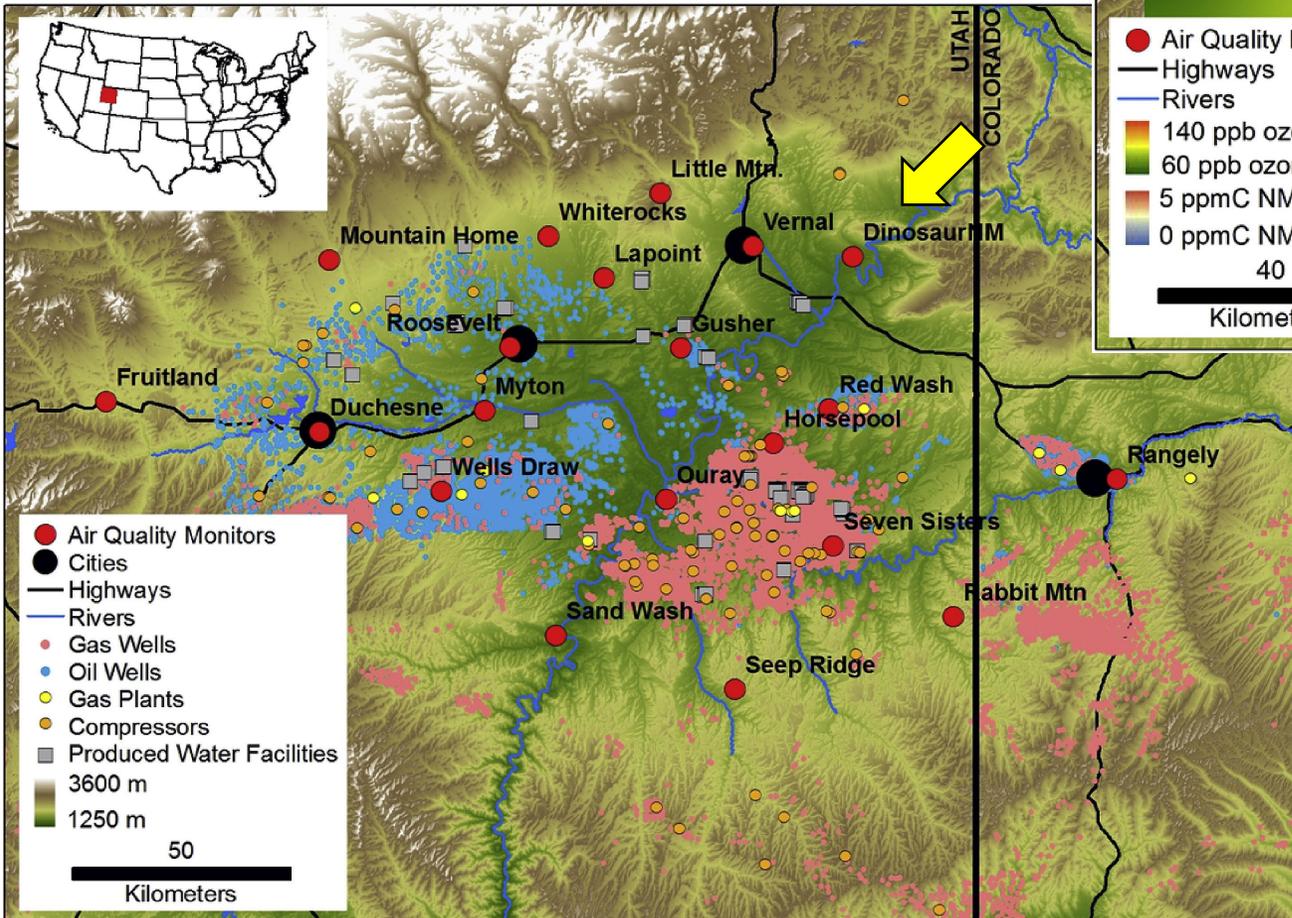


Wintertime inversions promote ozone exceedances



Ozone mixing ratios during inversion

Figures from Lyman et al., 2015

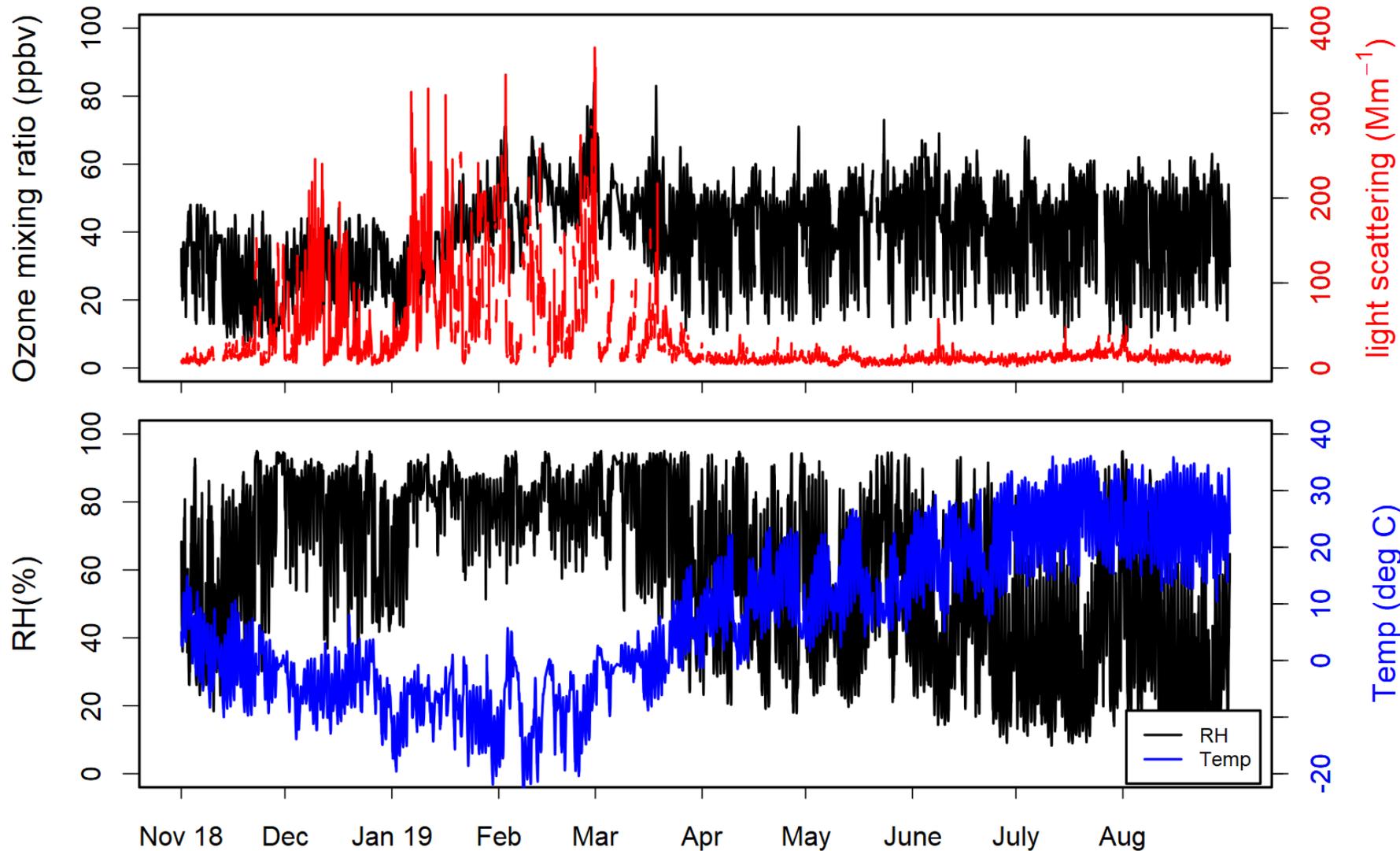


Park staff expressed concern regarding wintertime haze

- Expanded Monitoring
 - IMPROVE
 - Nephelometer
- Intended for winter 2018-2019.
 - Extended to spring 2020
- Monitoring Data
 - Ozone
 - Met
 - Webcam

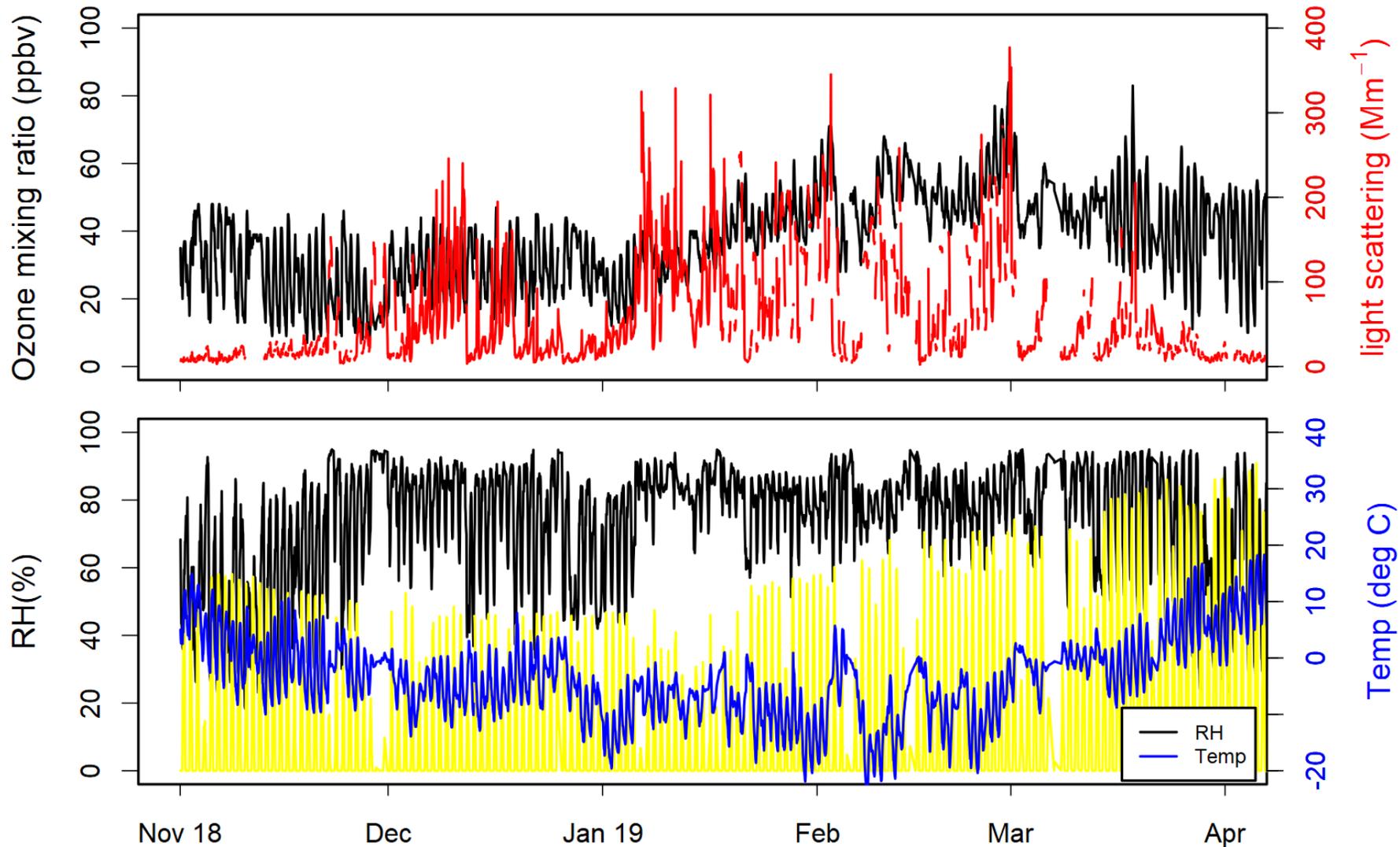


Timeline of the entire study

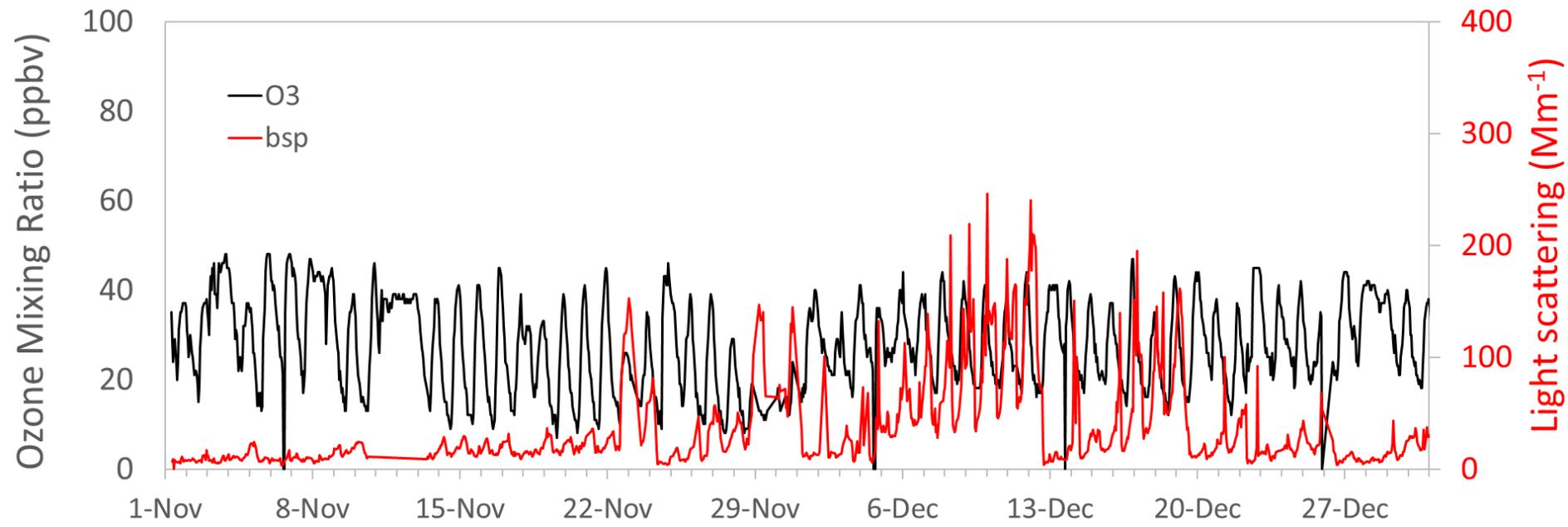


- Elevated light scattering December – March, periods with low temperature and high RH.
- Corresponds to same time period as elevated ozone.
- Very little scattering April – November

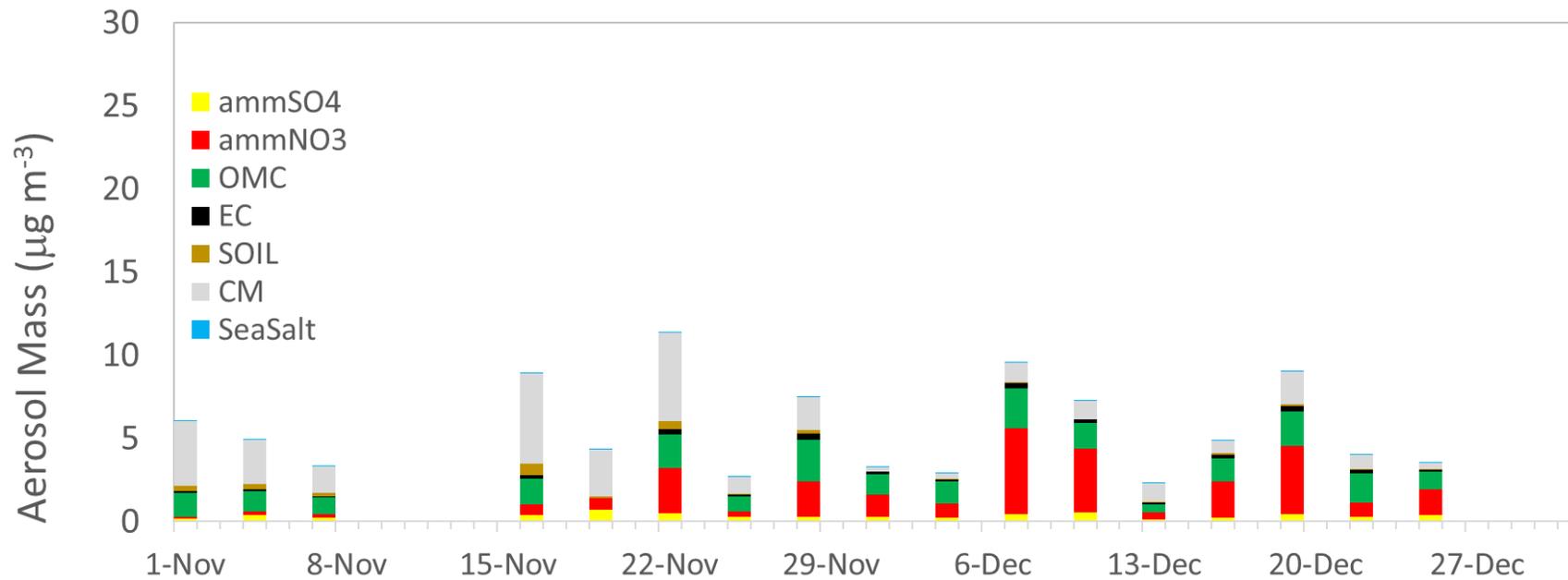
Winter period



- Gradually increasing ozone in January/February, corresponding to increasing solar, and generally low wind speeds (not shown).
- Persistent snow cover throughout this time period.
- Light scattering elevated Dec-March.
- Total of 39 hours Ozone ≥ 70 ppbv

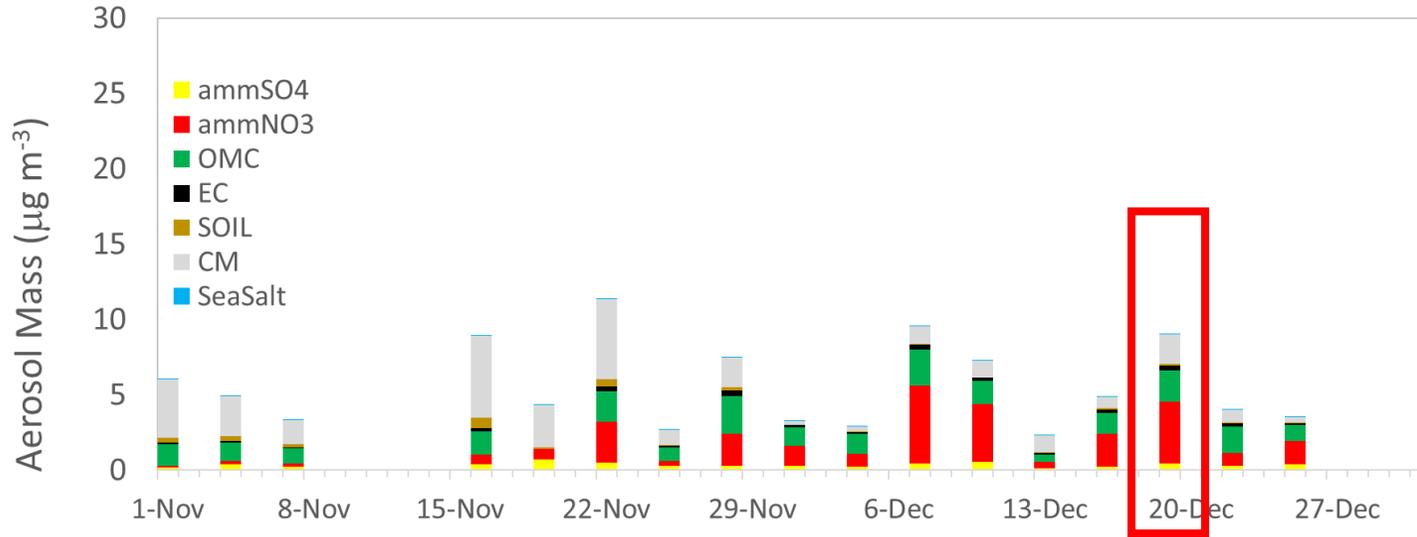


November-December, 2018



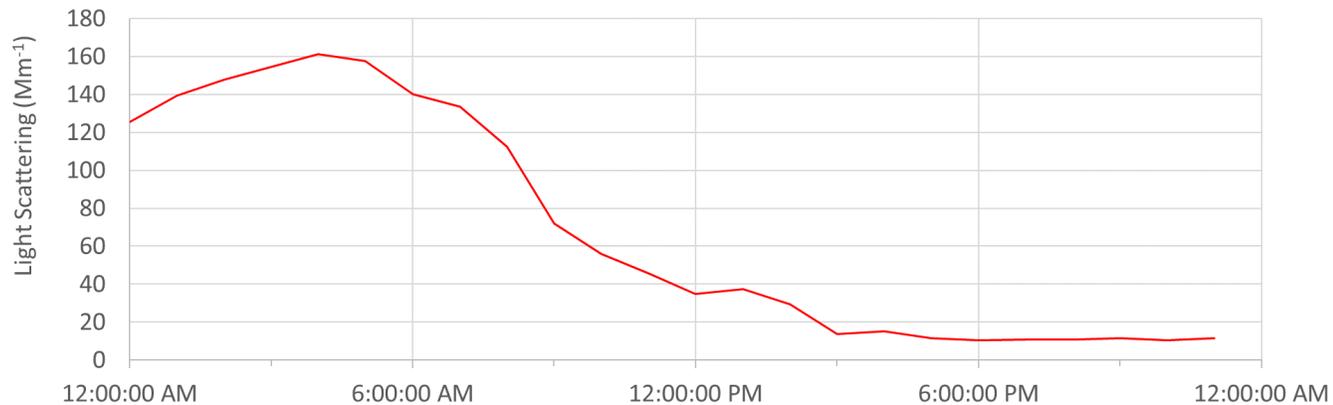
- Relatively low ozone.
- Scattering increases, with an increased contribution from ammonium nitrate.

December, 2018 haze event



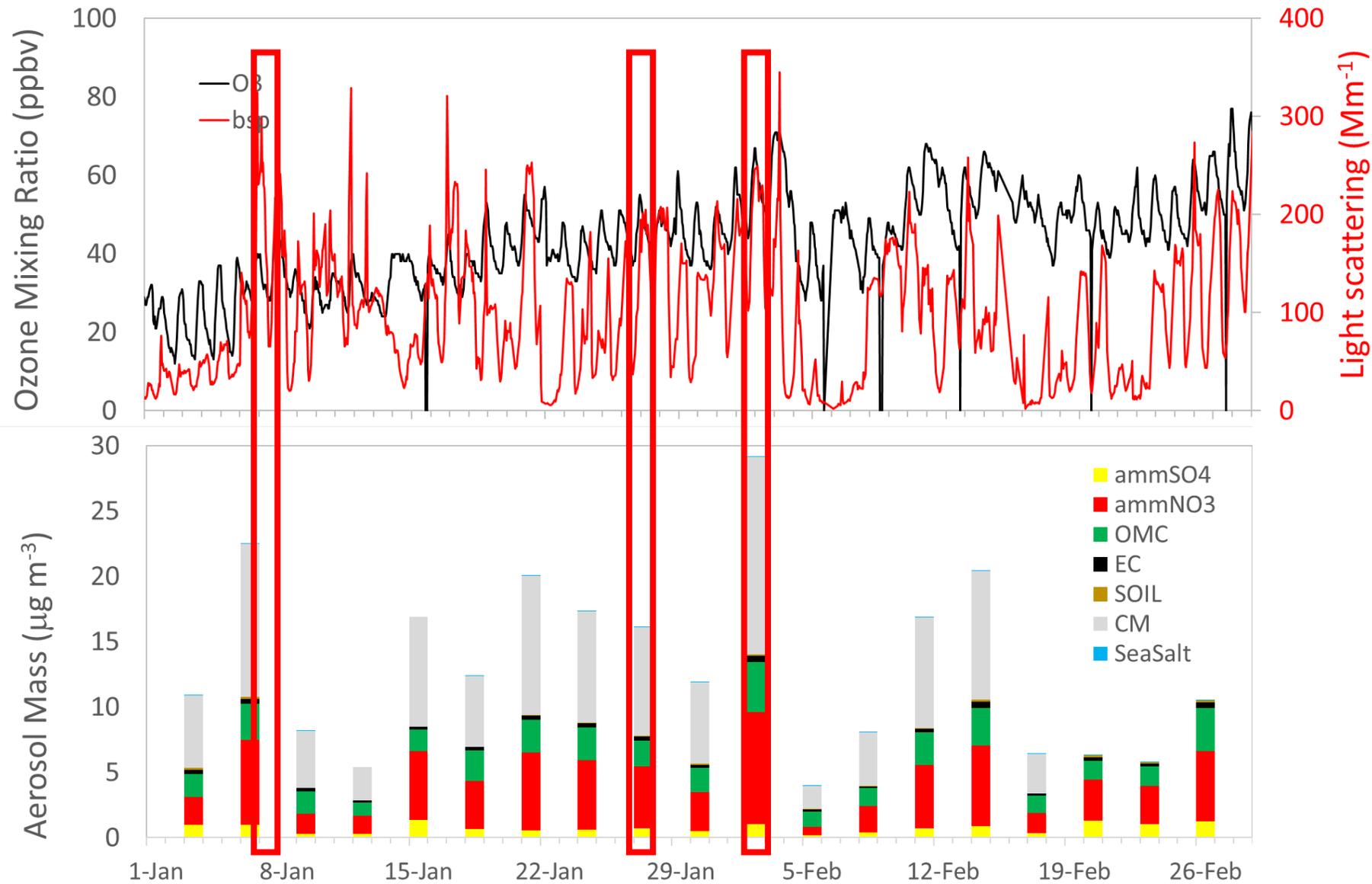
- Relatively high RH (not shown), with greater contribution from ammonium nitrate.
- December 19 had early morning scattering peak.

December 22 Light Scattering



December 22, 8 AM

January-February measurements



Elevated ozone (two exceedances).

Elevated scattering throughout this period.

Elevated ammonium nitrate; contributions from CM.

Winds (not shown) are low throughout the high ozone/bsp periods.



January 7, 2019, 13:45

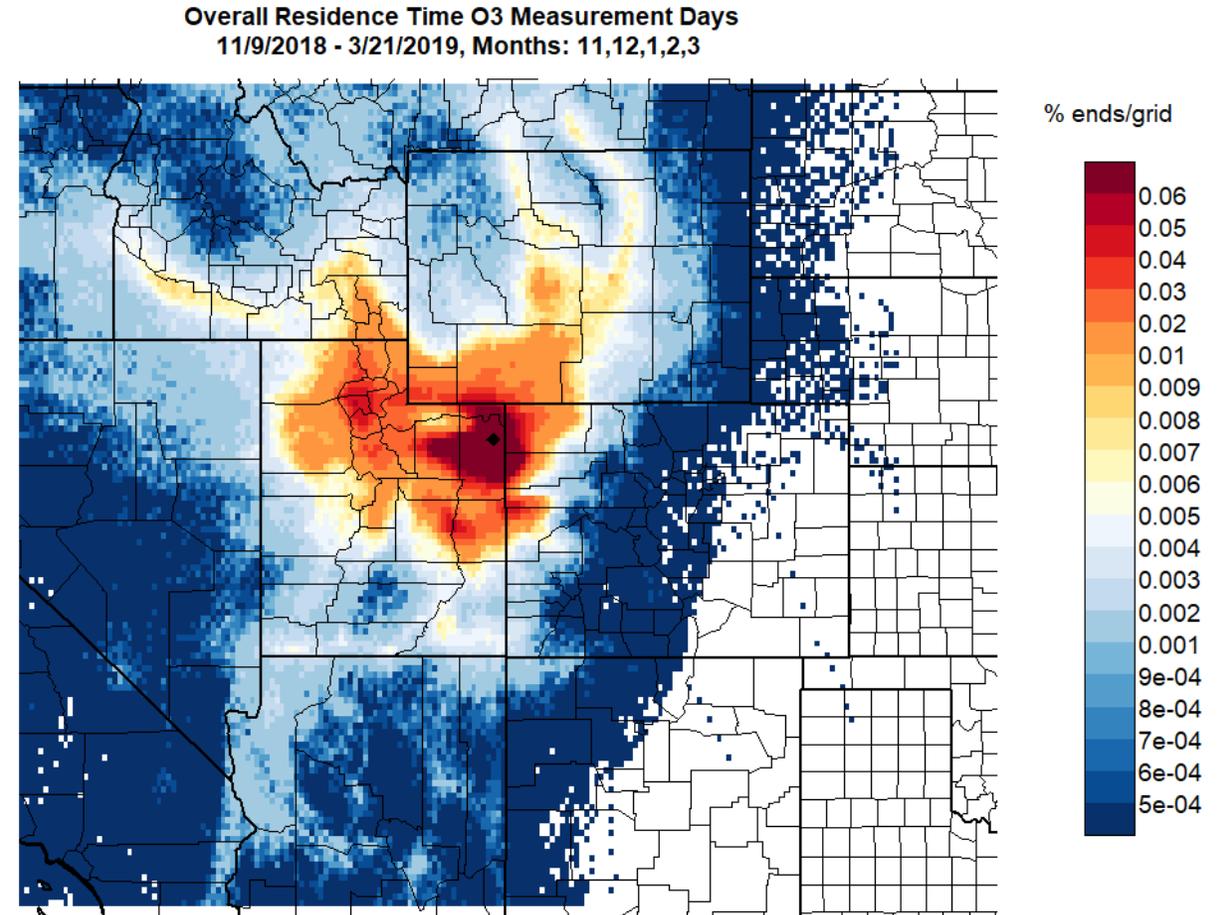


January 27, 2019, 14:45
IMPROVE Sampling Day



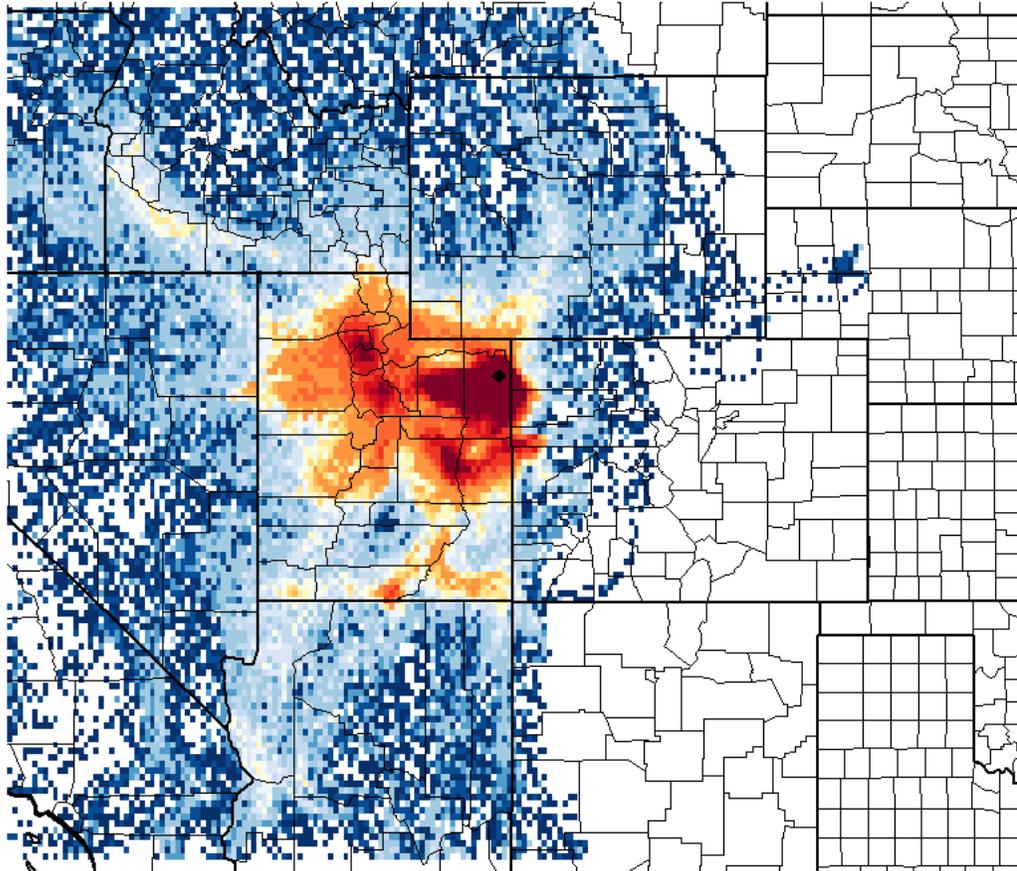
February 2, 2019
IMPROVE sampling day.

Where did air mass come from during the study?

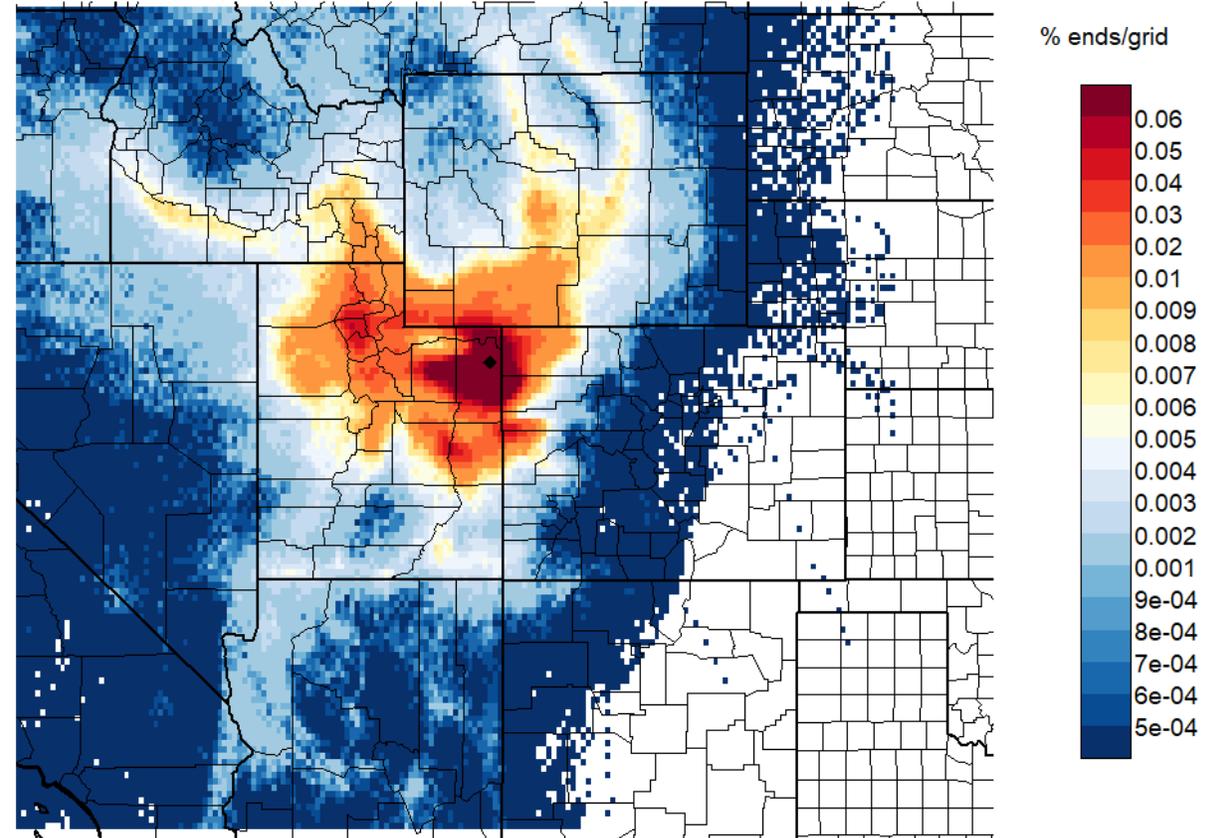


Where did air mass come from during the study?

High Concentration Residence Time bsp
11/19/2018 - 3/19/2019, Months: 11,12,1,2,3

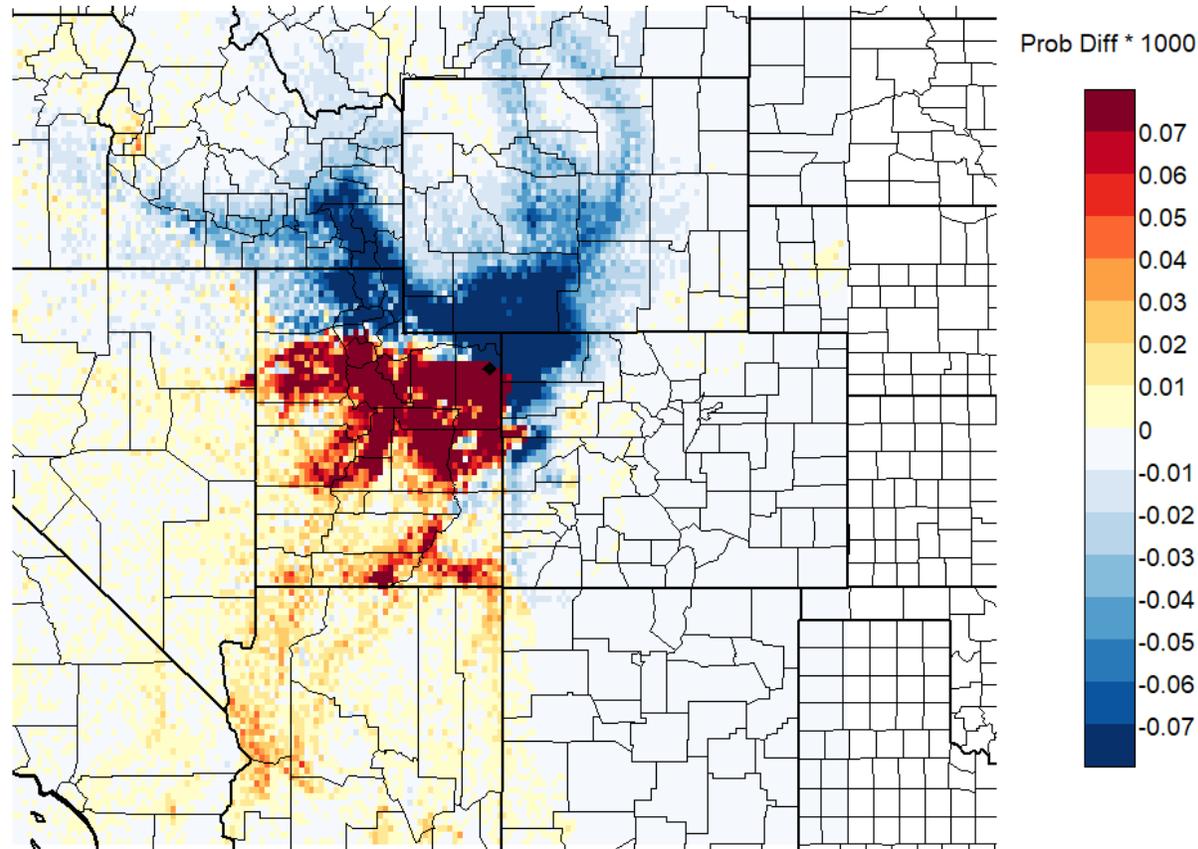


Overall Residence Time O3 Measurement Days
11/9/2018 - 3/21/2019, Months: 11,12,1,2,3



High Concentration Residence Time (HRT) - Overall Residence Time (ORT): Light Scattering

DINO bsp High Concentration Differential Probability
11/1/2018 - 3/21/2019, Months: 11,12,1,2,3



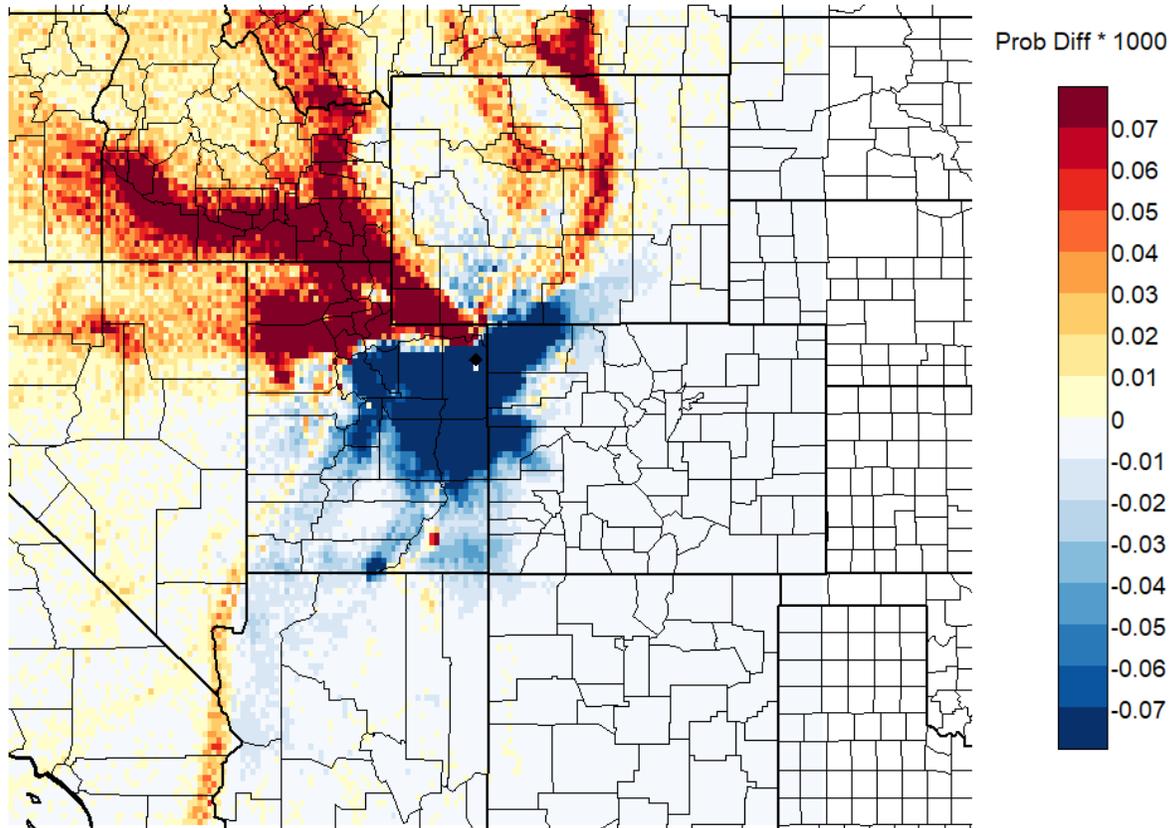
Warm colors: *More likely* to come from these areas.

Cool colors: *Less likely* to come from these areas.

During **high scattering days**, air comes from **south and west** of the park, near the oil and gas activity.

Low Concentration Residence Time (LRT) - Overall Residence Time (ORT): Light Scattering

DINO bsp Low Concentration Differential Probability
11/1/2018 - 3/21/2019, Months: 11,12,1,2



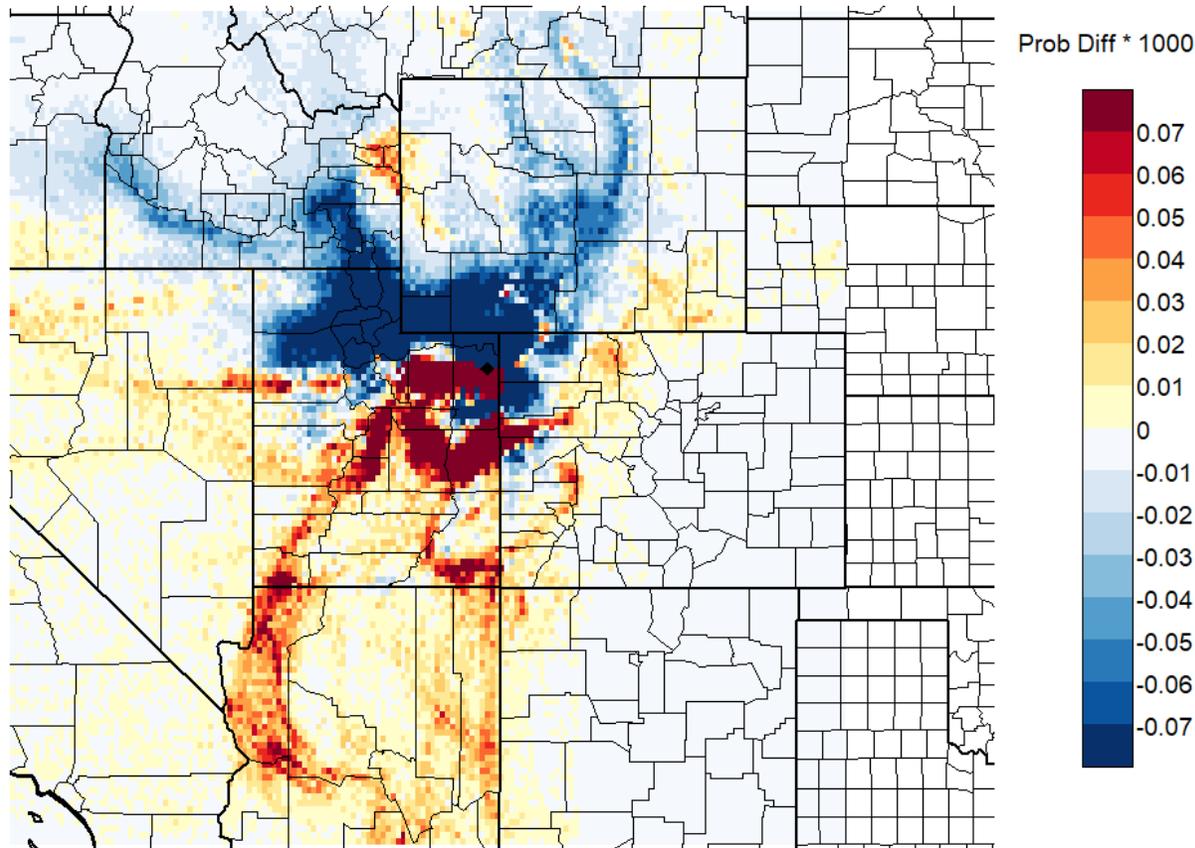
Warm colors: *More likely* to come from these areas.

Cool colors: *Less likely* to come from these areas.

During **low scattering days**, air comes from **northwest** of the park.

High Concentration Residence Time (HRT) - Overall Residence Time (ORT): Ozone

DINO O3 High Concentration Differential Probability
11/9/2018 - 3/21/2019, Months: 1,2,3



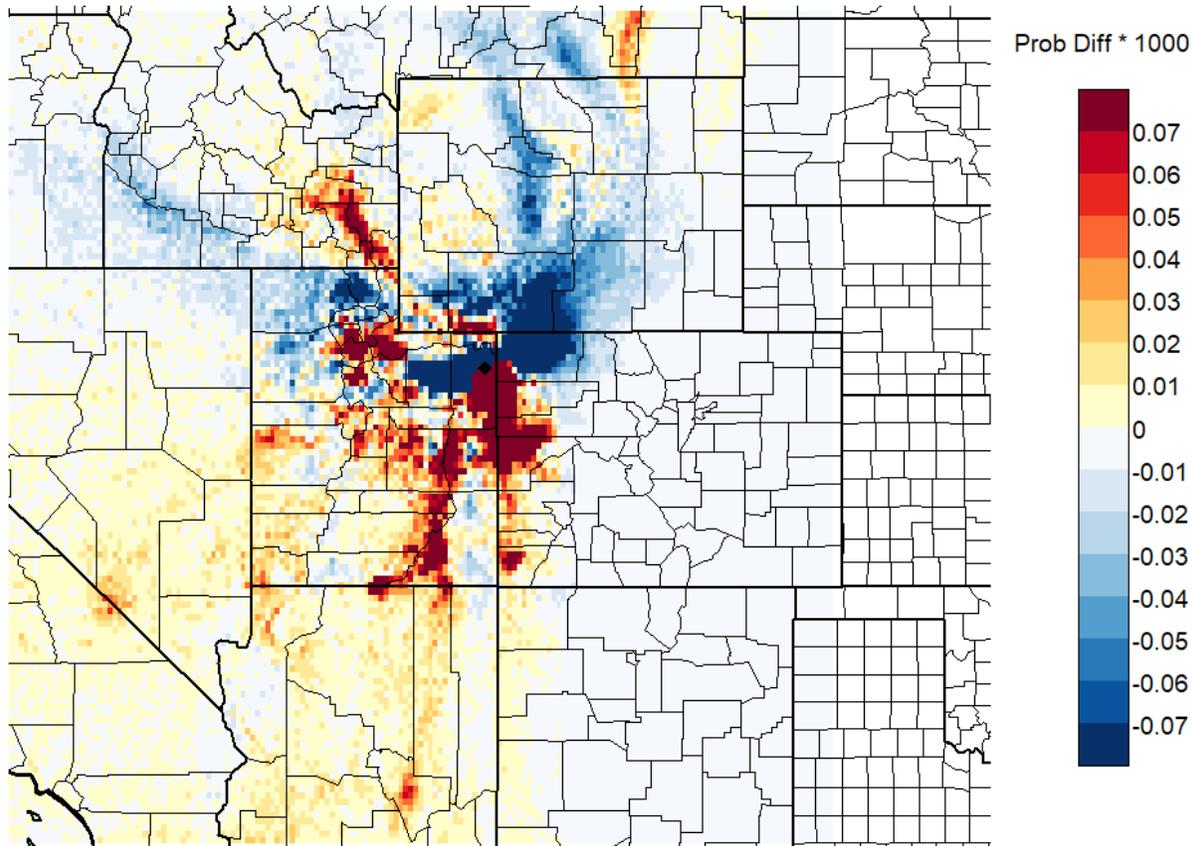
Warm colors: *More likely* to come from these areas.

Cool colors: *Less likely* to come from these areas.

During **high ozone days**, air comes from **west and south** of the park.

Low Concentration Residence Time (LRT) - Overall Residence Time (ORT): Ozone

DINO O3 Low Concentration Differential Probability
11/9/2018 - 3/21/2019, Months: 11,12,1,2



Warm colors: *More likely* to come from these areas.

Cool colors: *Less likely* to come from these areas.

During **low ozone days**, air comes from **south** of the park.

Summary

- Pilot study at Dinosaur National Monument indicates wintertime haze, often coincident with periods of high ozone.
- IMPROVE suggests ammonium nitrate and coarse mass as primary contributors to haze.
- Will collect data for at least another winter. Also planning to analyze cations.
- Could potentially add some tracer measurements next winter.
- There is a potential upcoming field study (2021?) focused on wintertime haze in the west (AQUARIUS).
- Site may become permanent protocol site.