



# Summer Ozone Variations in Barrow, Alaska: Initial Verification of CESM Surface Ozone by NOAA Observations

Anna Yudina, Irina Petropavlovskih, Audra McClure-Begley,  
Simone Tilmes, Louisa Emmons, Paul Novelli, and Anne  
Jefferson



# Introduction

What characterizes the Arctic air quality over time?

- Surface Ozone
- Greenhouse Gases
- Biomass Burning
  - Fires are a source of pollutants

How important are these contributing factors to the Arctic summer atmosphere?

# International Arctic Systems for Observing the Atmosphere (IASOA) Stations



# Observational Data

## NOAA's Barrow Data Sets:

- Ozone (PI's McClure-Begley, Petropavlovskih)
- Wind directions and speeds (Christy Schultz)
- CO data (Paul Novelli)
- Aerosol data (Anne Jefferson)

Source: <https://www.esrl.noaa.gov/gmd/obop/brw/>



Ozone  
Barrow, Alaska, United States

Select Plot Type

Time Series

Parameter

Ozone (O<sub>3</sub>)

Data Type

Surface Ozone

Data Frequency

Monthly Averages

Time Span

- All - a graph of all available data
- Current - this year's data
- Last year - previous full year of data
- Some - a subset of the available data

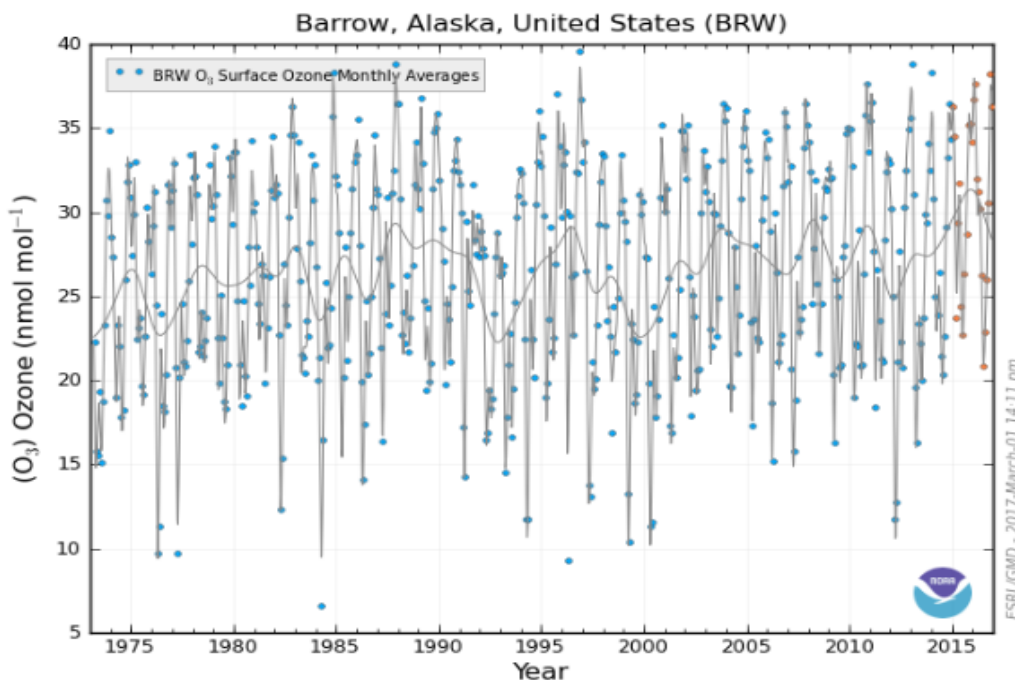
Start Year: 1973

End Year: 2016

Submit

OR

• [Save this dataset for later plotting](#)



[PDF Version](#)

[Download Data](#)

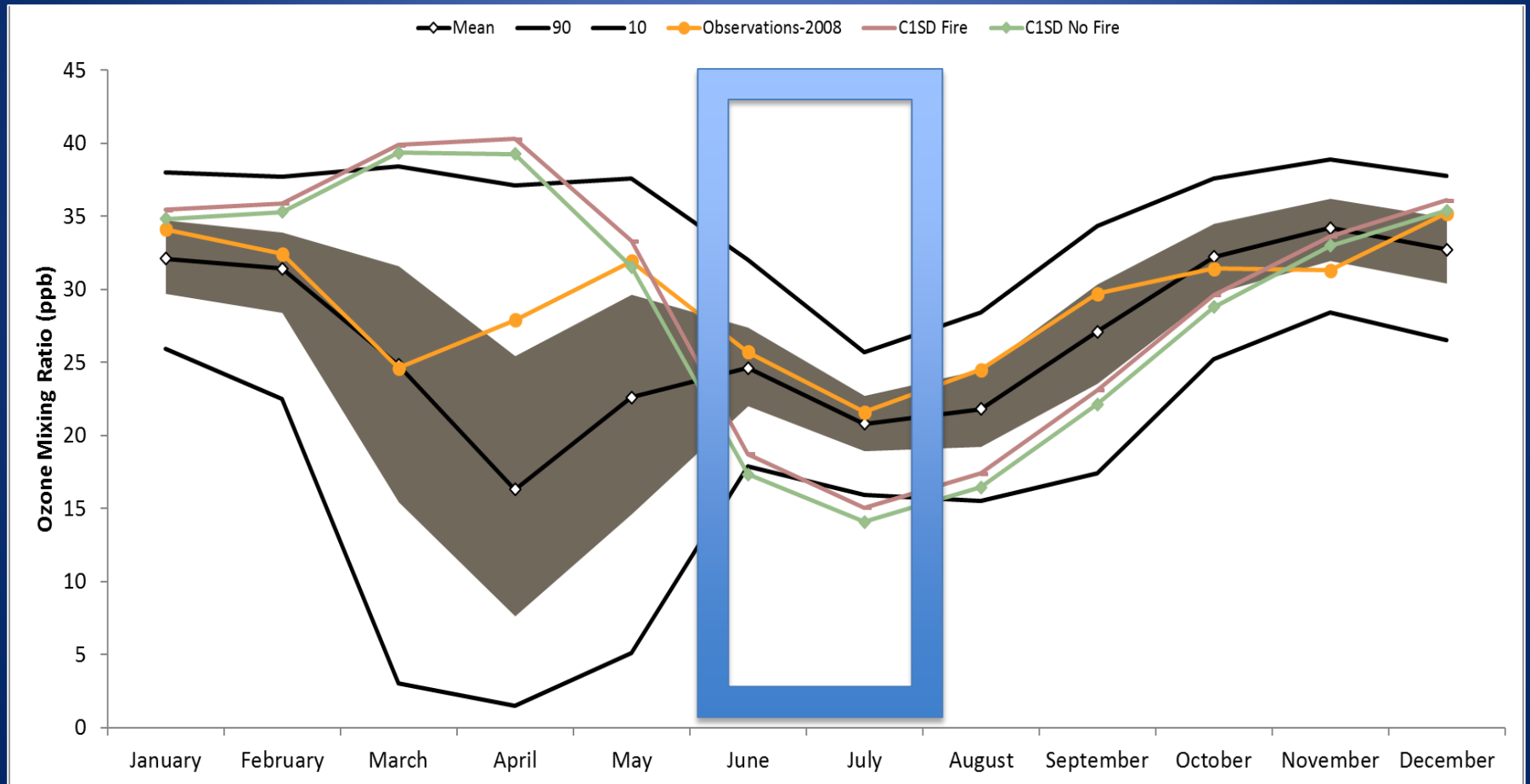
Data Disclaimer: Data displayed in **blue** represent surface ozone measurements that have undergone thorough quality checks and are available from GMD and WDCGG. Data displayed in **orange** are PRELIMINARY data-this Preliminary data includes the most up-to-date data. Preliminary data has not been subjected to the NOAA/ESRL Global Monitoring division quality control and assurance procedures. Therefore, there exists the potential for these data to be modified at the discretion of NOAA/ESRL/GMD. These data will be released for limited public use as preliminary data and users should exercise extreme caution when using this data.

Please contact Audra McClure-Begley for questions or concerns, as well as most recent data.  
audra.mcclure@noaa.gov 303-497-6823

# Model: Community Earth System Model (CCMI C1SD ) Tilmes et. al. (2015)

- Used 'nudged' SD version with MERRA winds
- Included runs that had fire and no fire emissions that were provided by Louisa Emmons
- Horizontal Resolution: 1.9 deg by 2.5 deg
- No ice bromine chemistry (spring depletion not captured)

# Barrow, Alaska Climatology (1973-2015), CCM1-C1SD Model, and Observations (Monthly Mean 2008)

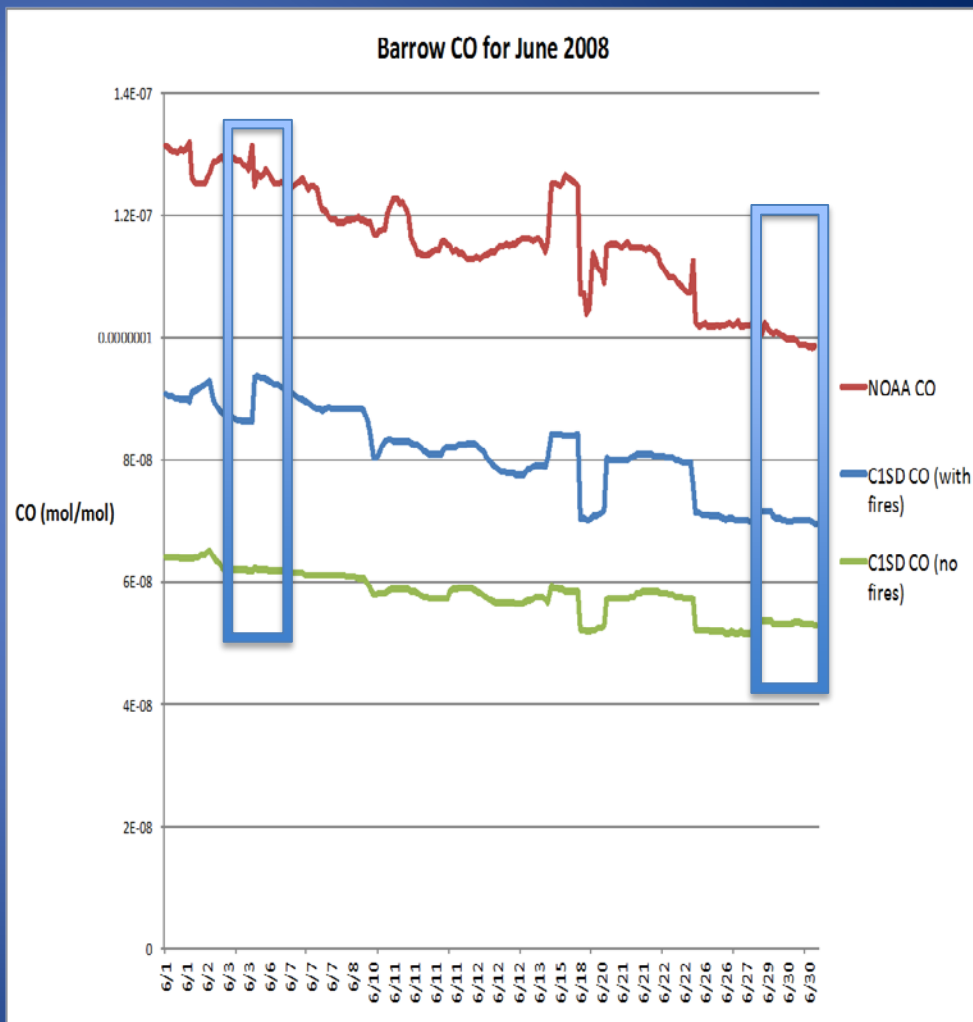


# Carbon Monoxide (CO) Analysis

- CO is an indicator of pollution and fires
- Can assist in the explain of ozone variation

## Two Case Studies:

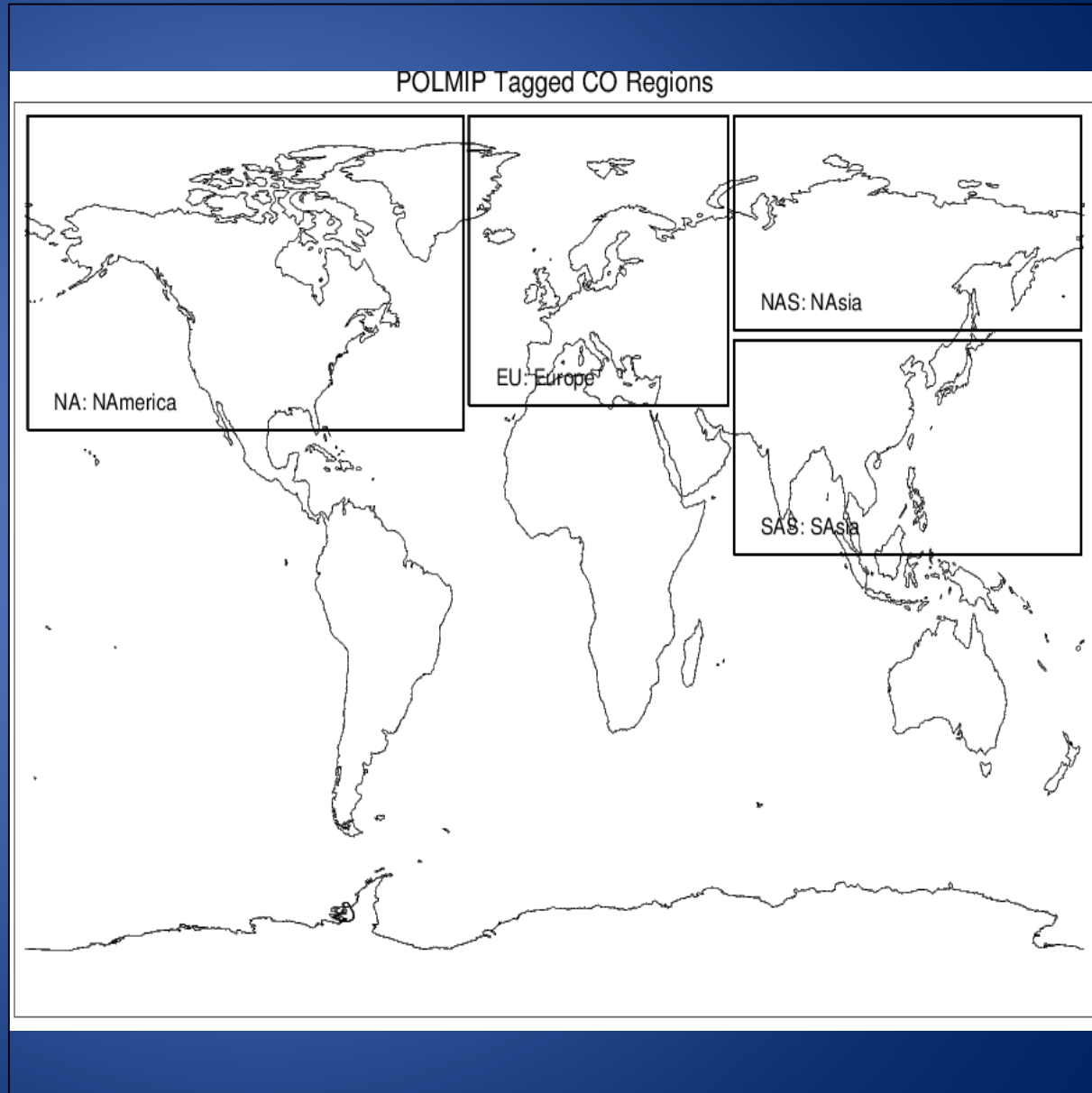
- June 3, 2008 (fire episode)
- June 28, 2008 (no major fire or pollution episodes)



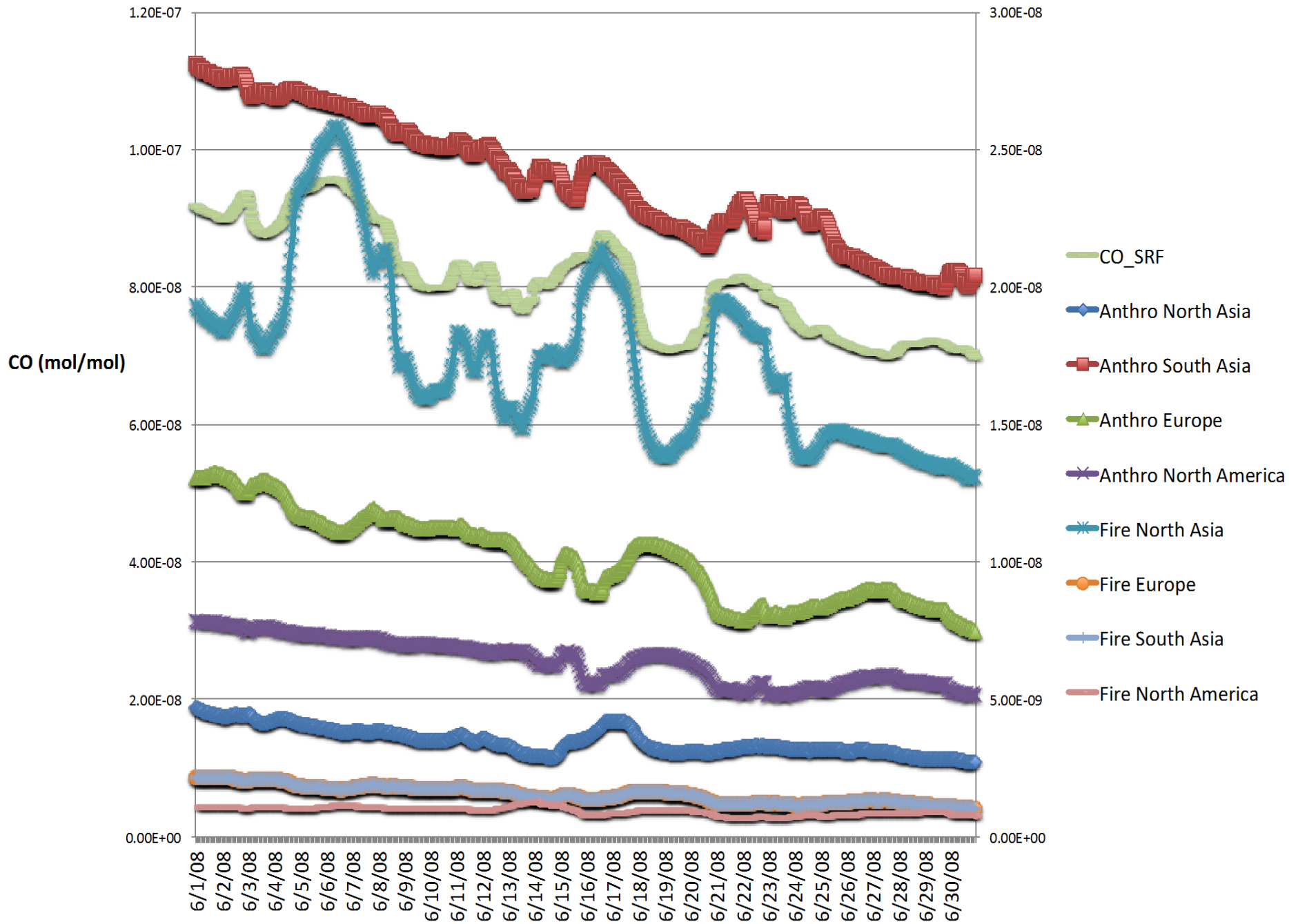


# Overview of CO Tagged Tracers (Emmons et al., 2012, GMD)

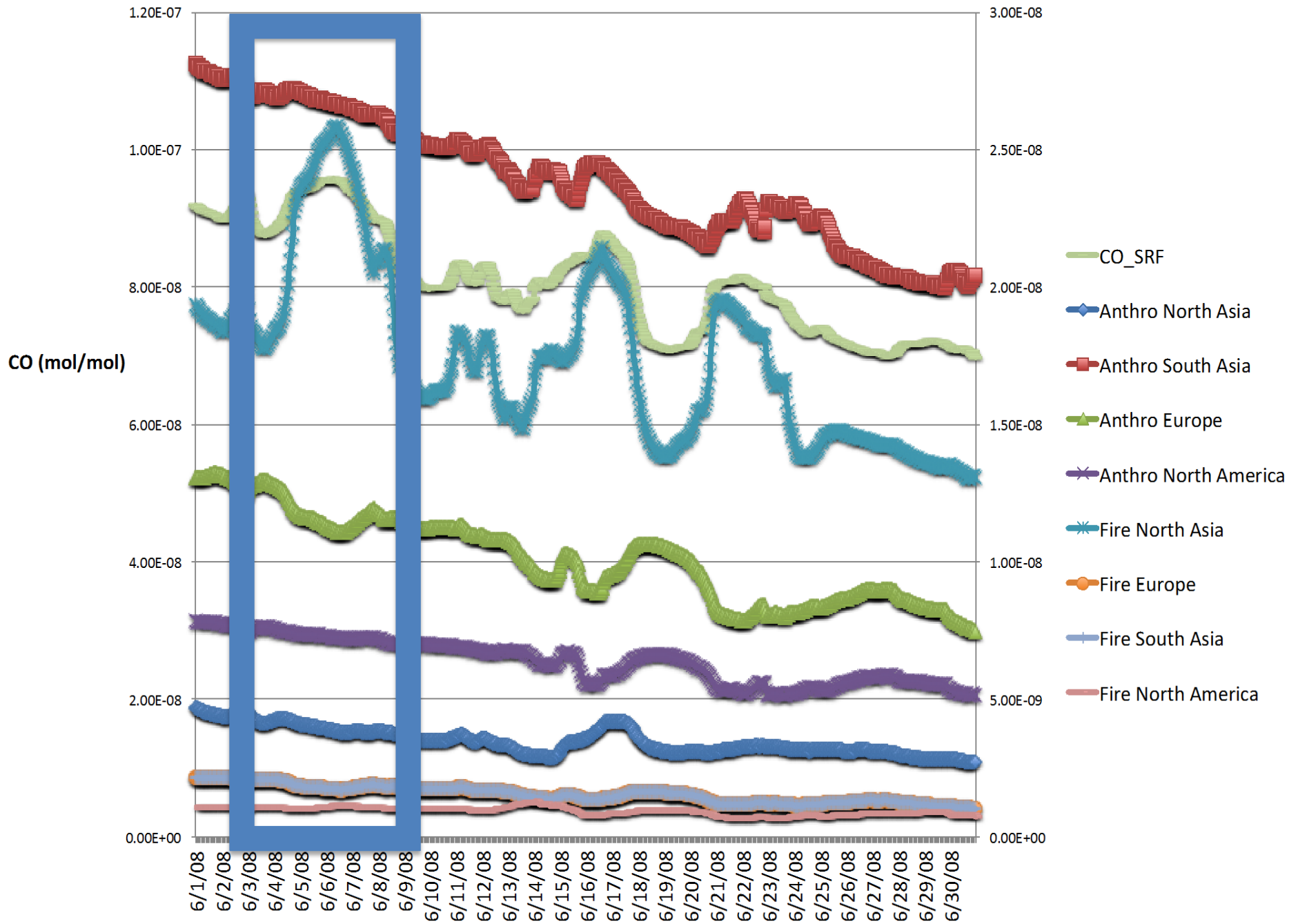
- Simulate CO that come from various sources
- Simulation is typically linear and allows for the tracers to be 'tagged' to a source
- Each region has two tracers: Fire and Anthropogenic
- Doesn't account all of the contributing factors



# Surface CO and CO Tracers for Barrow in June 2008

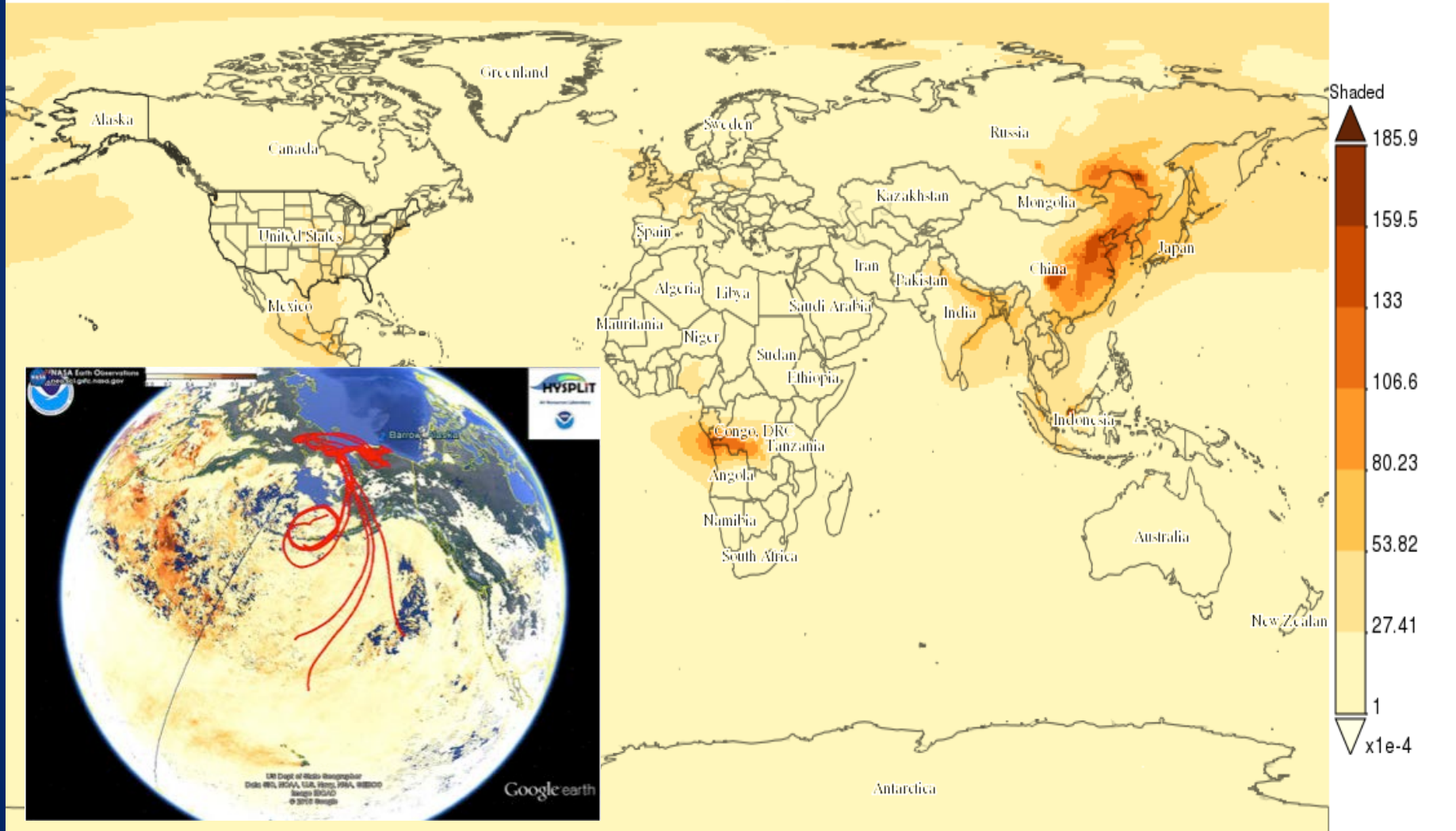


# Surface CO and CO Tracers for Barrow in June 2008

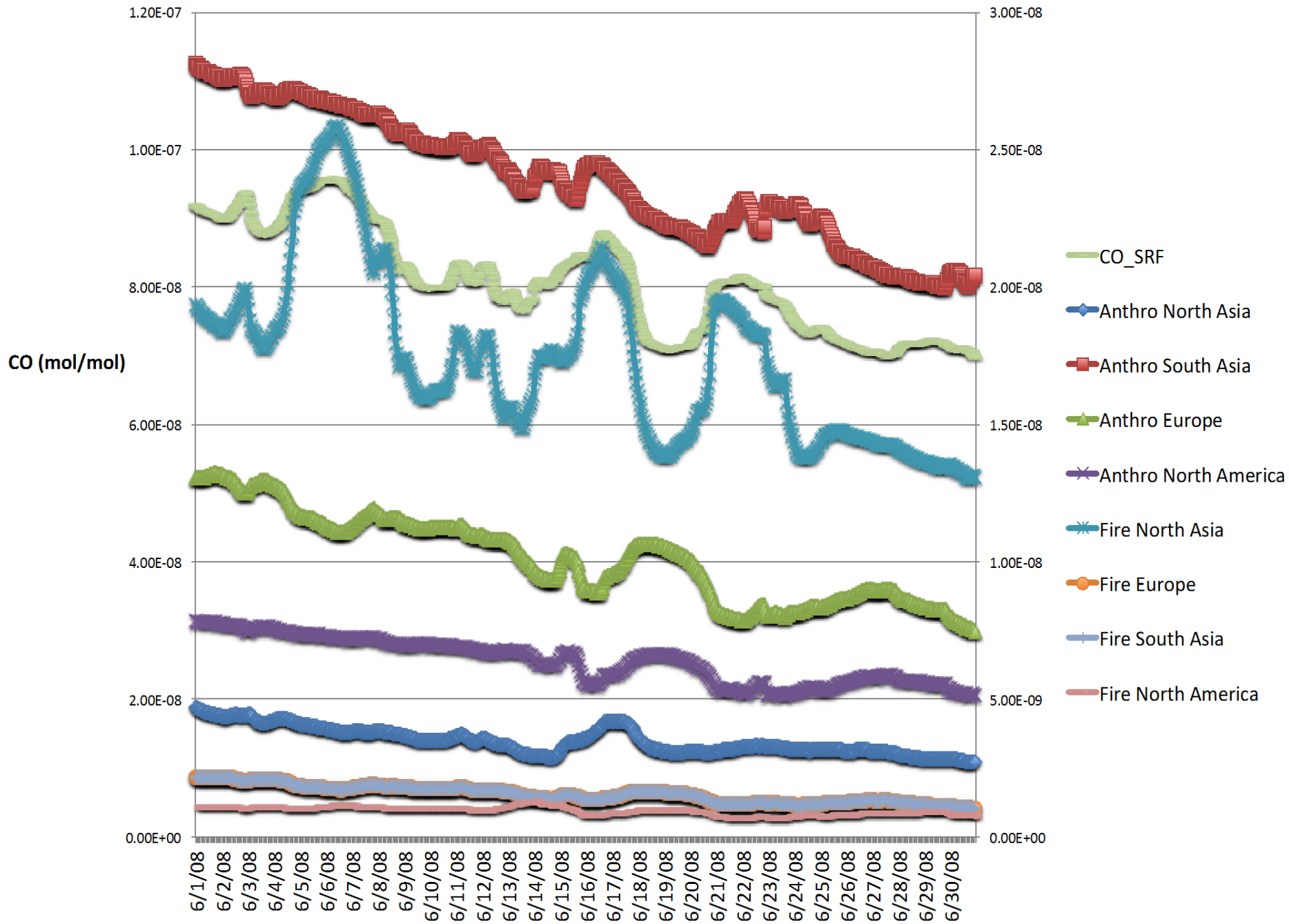


# Verification for June 3, 2008

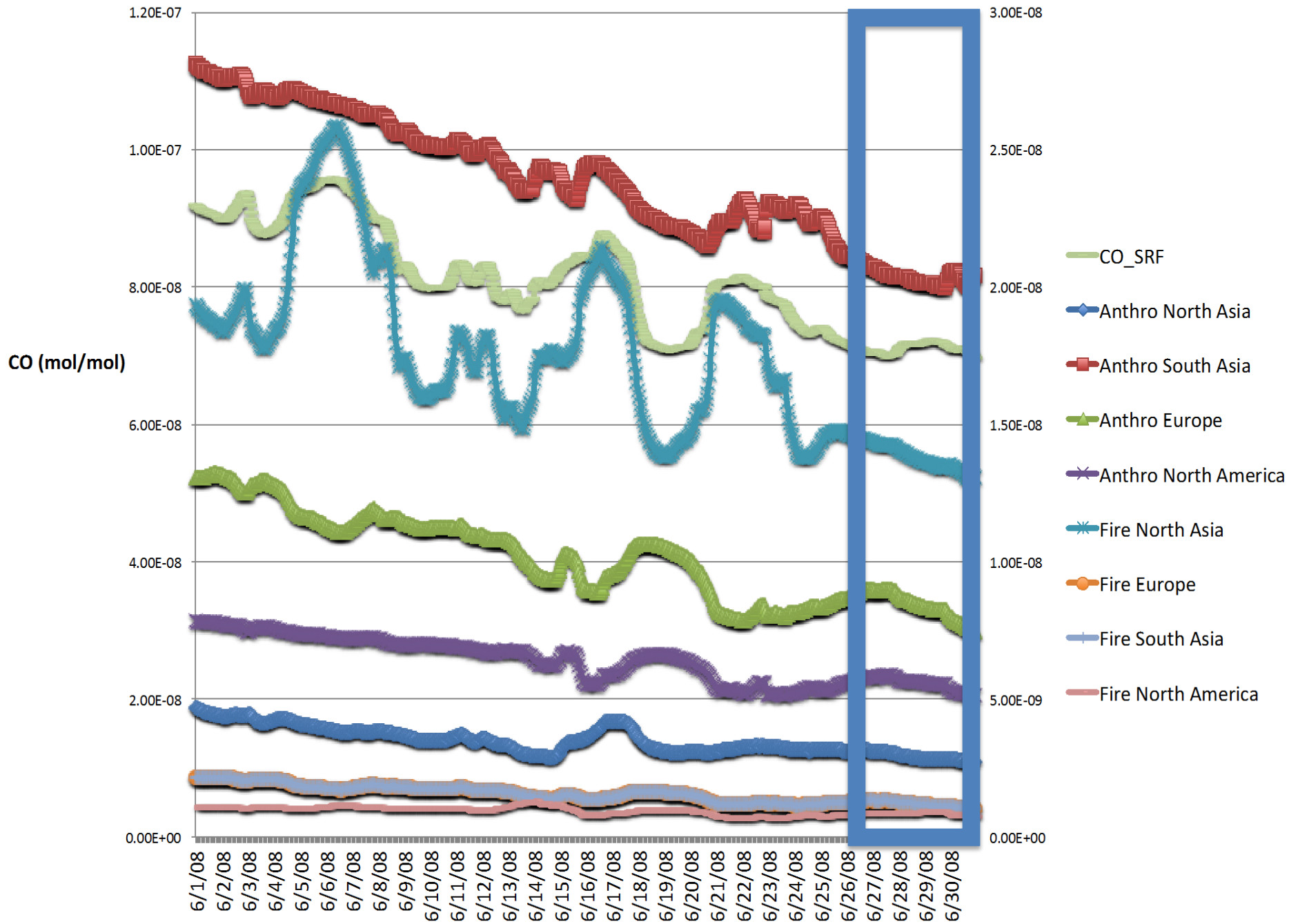
Time Averaged Map of Black Carbon Scattering AOT 550 nm monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] over 2008-May



# Surface CO and CO Tracers for Barrow in June 2008

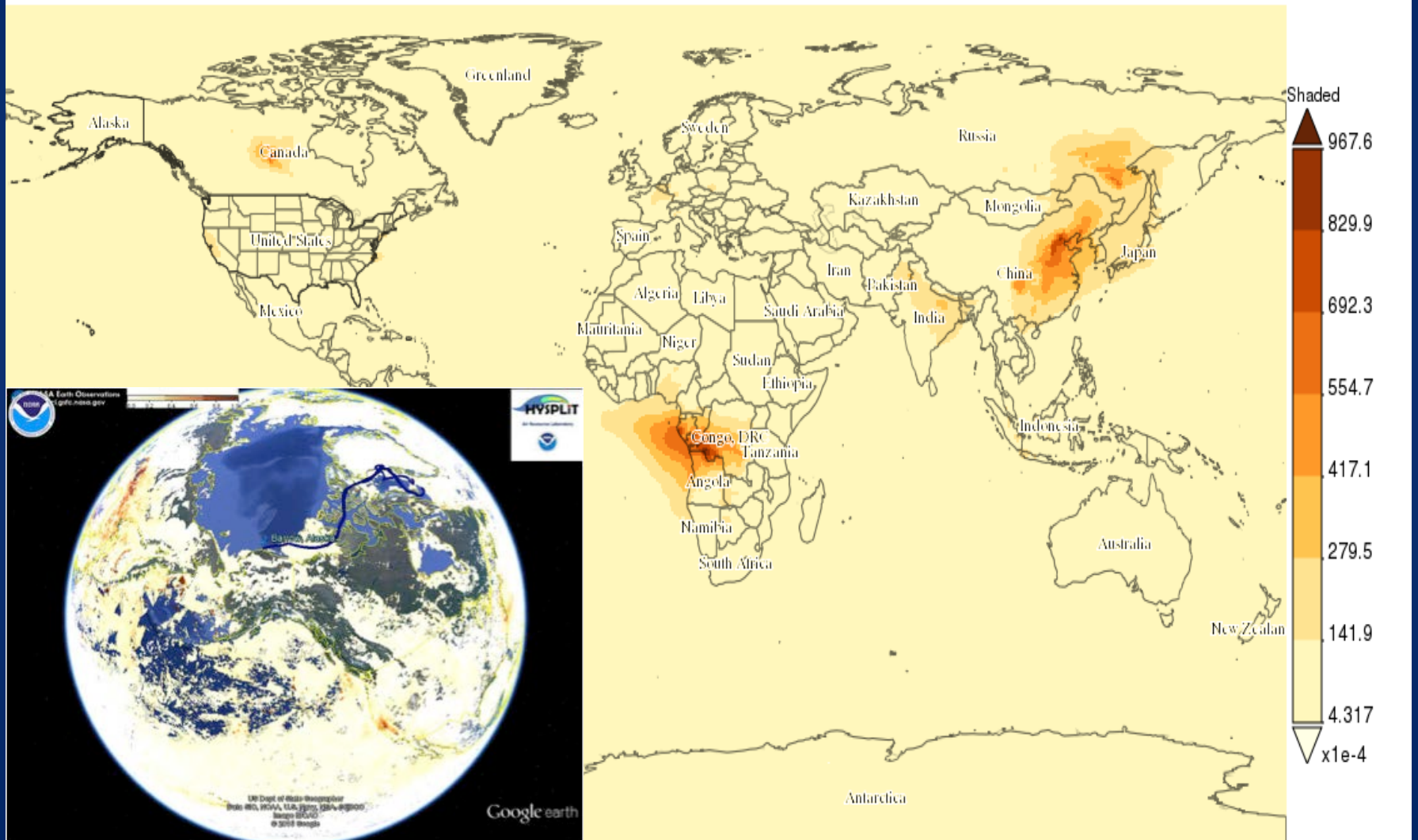


# Surface CO and CO Tracers for Barrow in June 2008

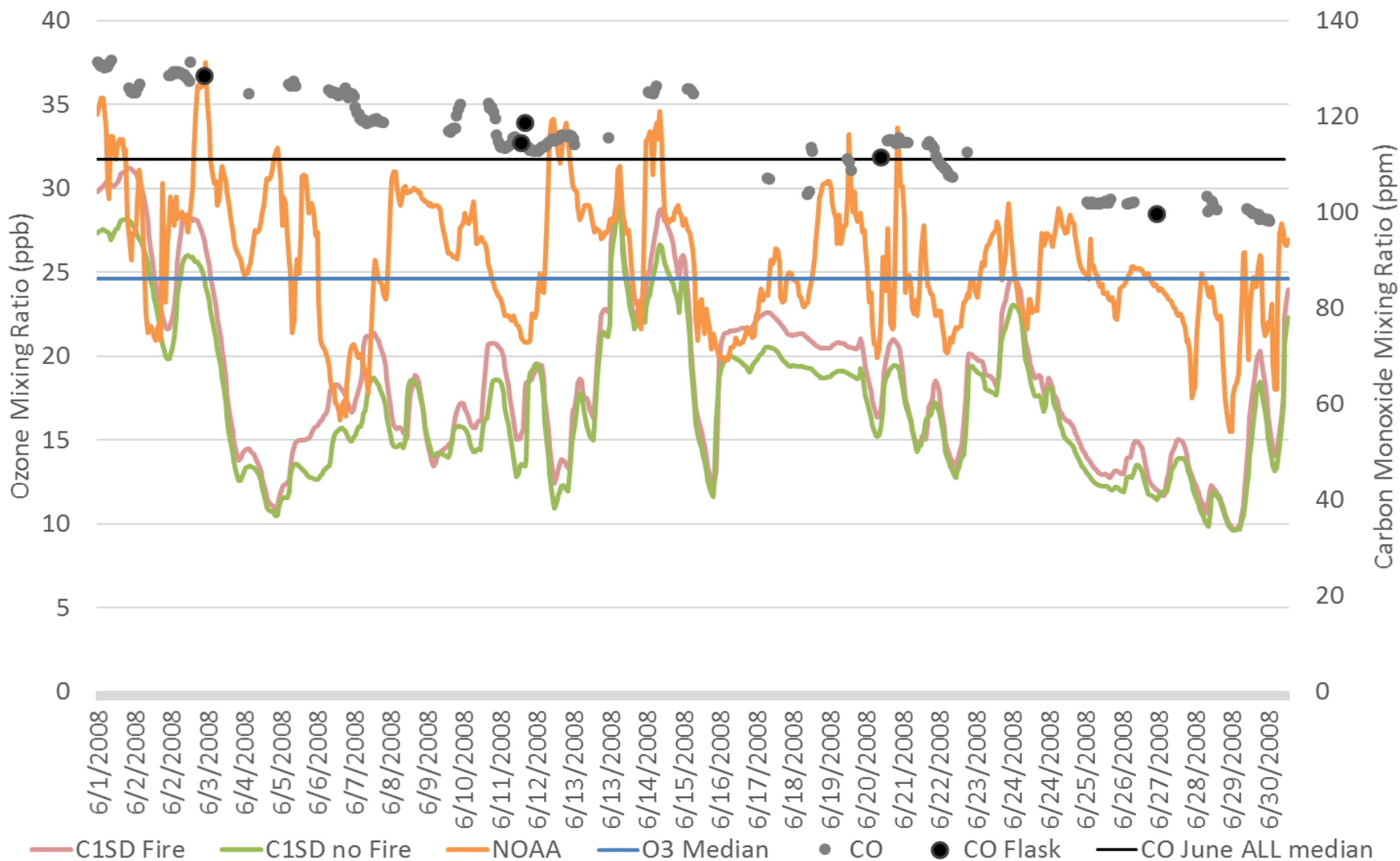


# Verification for June 28, 2008

Time Averaged Map of Black Carbon Extinction AOT 550 nm monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] over 2008-Jun



### Ozone and Carbon Monoxide, Barrow Alaska: June 2008





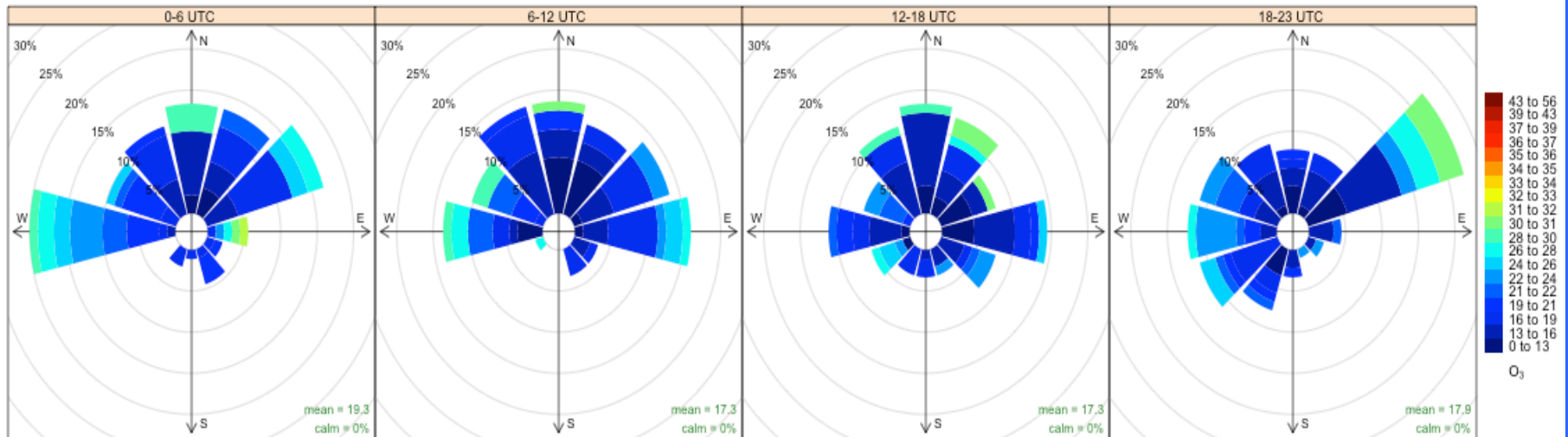
# Future Research

- Conducting similar analysis for other years
- Examining other arctic stations (Summit)
- Looking at other greenhouse gases ( $\text{NO}_2$  and  $\text{CO}_2$ )

# Wind Rose Diagrams

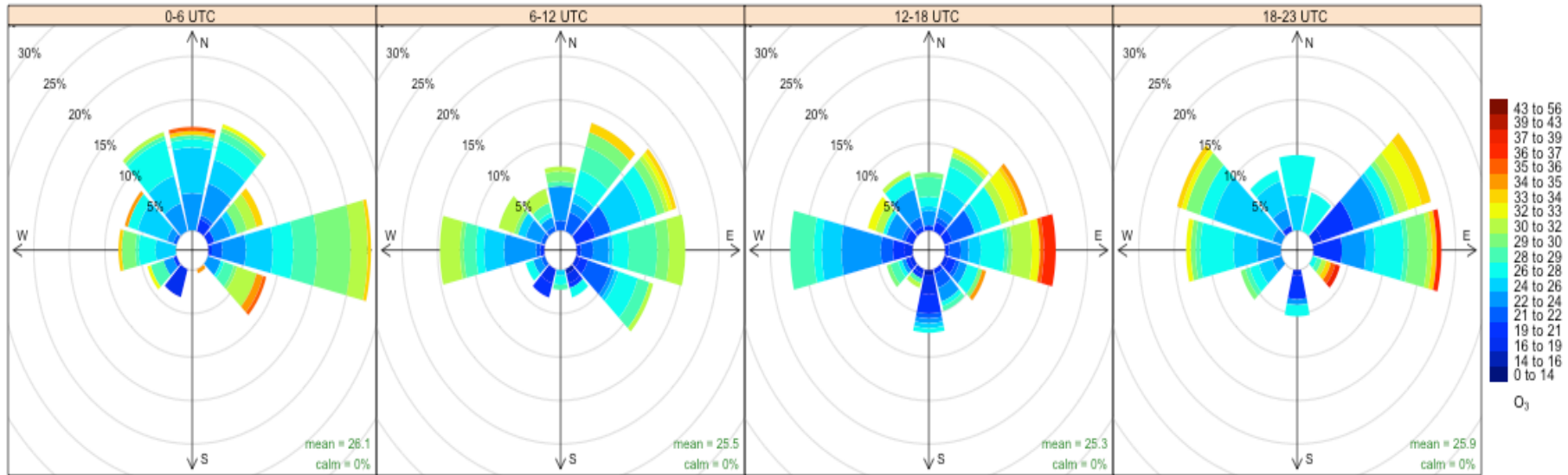
- Comparing CCMI C1SD model runs (with and without fires) to NOAA Observations
- Wind direction and ozone levels for the month of June in 2008
- Generated with R

CCMI C1SD Model For Barrow (062008 [202.5E & 71.5N])



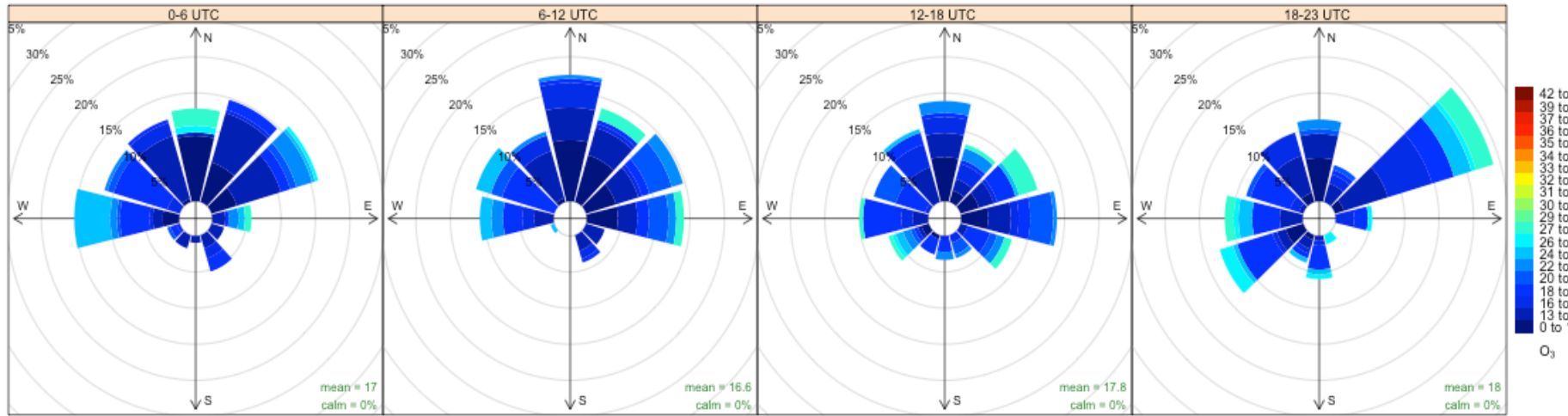
Ozone Mixing Ratio [PPB]

Barrow NOAA Observations (062008 [203.39E & 71.323N])



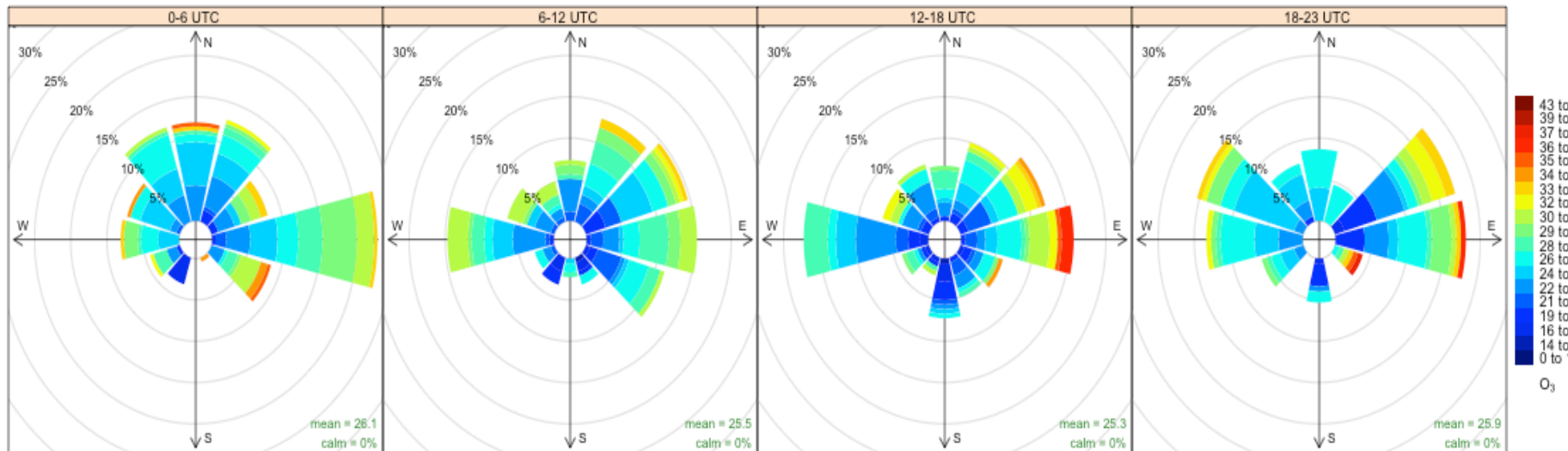
Ozone Mixing Ratio [PPB]

CCMI C1SD (No Fire) for Barrow (062008 [202.5E & 71.5N])

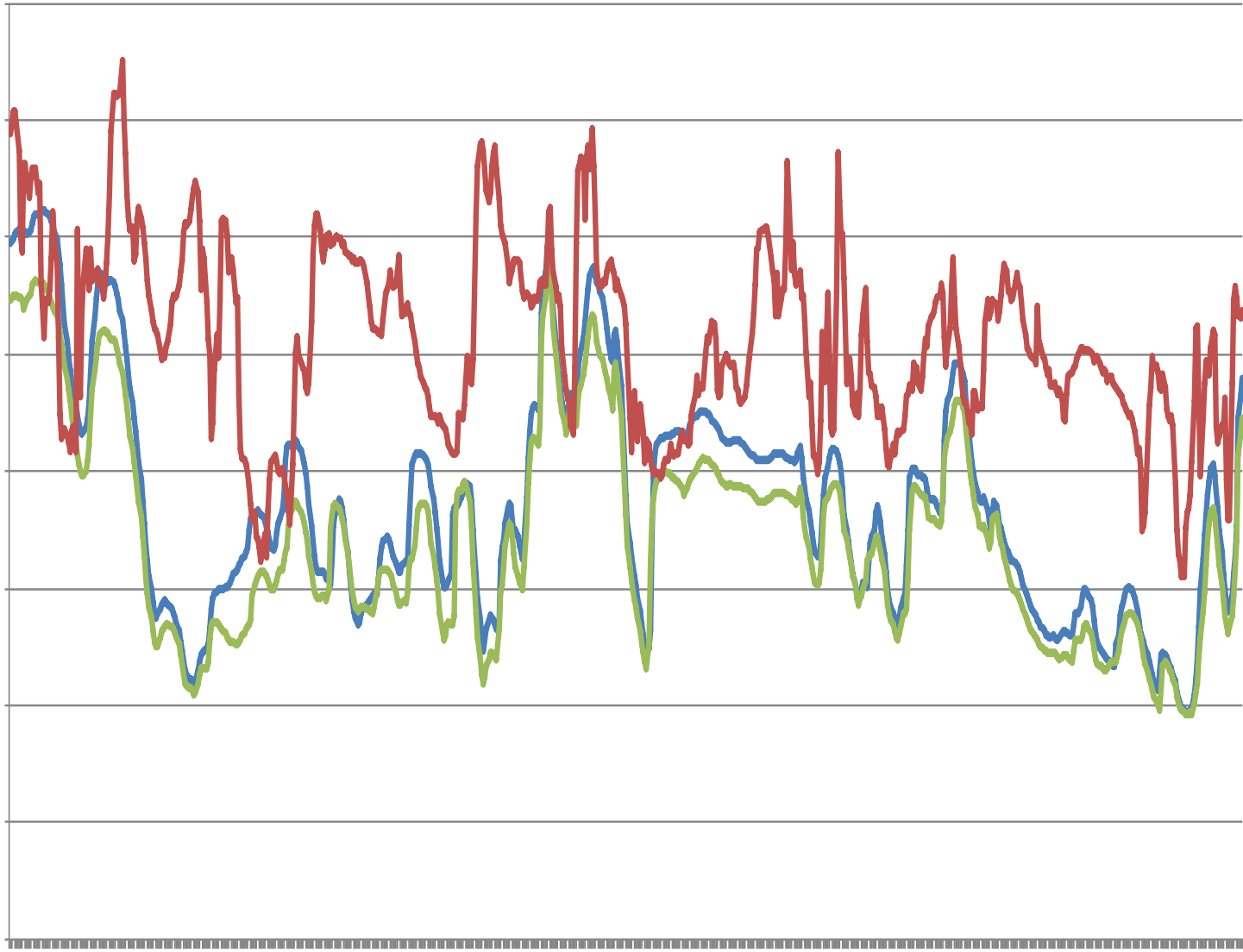


Ozone Mixing Ratio [PPB]

Barrow NOAA Observations (062008 [203.39E & 71.323N])



Ozone Mixing Ratio [PPB]



— NOAA  
Observations

fires)