ATOM CO AND AEROSOLS IN THE CONTEXT OF INTERANNUAL VARIABILITY: A SATELLITE VIEW

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INTRODUCTION

• CO and aerosols show interannual variability (IAV)
  • Consider temporal representativeness of ATom
• Did ATom occur during “typical” years, or anomalous ones?
• Satellite observations can show how the ATom period compares with previous years
• We will consider the 4 ATom deployments in relationship to IAV
**APPROACH**

- Satellite data for CO & aerosols:
  - MOPITTv7 TIR column and 700 hPa CO data
  - MLS 215 mb CO
  - MODIS Aqua Aerosol Optical Thickness (AOT), ocean only

- Average satellite data over regions (black boxes) crossed by ATom

- Average GFEDv4 biomass burning CO emissions over relevant burning regions (red boxes)
HOW DOES CO & AEROSOL VARY BY YEAR?

**Oct. CO**

- **a. Tropical Atlantic**
  - Highly correlated
  - MOPITT (700 hPa)
  - MLS (215 hPa)

- **b. Northern Atlantic**

- **c. Alaska**

- **d. New Zealand**
  - Significantly correlated

- **e. Eastern Pacific**

- **f. Central Tropical Pacific**

**Oct. MODIS AOT**

- **a. Tropical Atlantic**
  - Significant correlation w/ CO column

- **b. Northern Atlantic**

- **c. Alaska**

- **d. New Zealand**

- **e. Eastern Pacific**

- **f. Central Tropical Pacific**
AUG. 2016 VERSUS OTHER AUGUSTS

What if the order of the deployments was switched?

a. MOPITT CO column

Modest IAV

2016 below average but within the range for most regions

b. GFED4 CO emissions

What if the order of the deployments was switched?

c. MOPITT CO at 700 hPa

2016 below average but within the range for most regions

d. MLS CO at 215 hPa
FEB. 2017 VERSUS OTHER FEBRUARYS

a. MOPITT CO column

b. GFED4 CO emissions

2016 would have been very different

More IAV

2016 would have been very different
OCT. 2017 VERSUS OTHER OCTOBERS

a. MOPITT CO column

b. GFED4 CO emissions

c. MOPITT CO at 700 hPa

d. MLS CO at 215 hPa
MAY 2018 VERSUS OTHER MAYS

(a) MOPITT CO column

(b) GFED4 CO emissions

(c) MOPITT CO at 700 hPa

(d) MLS CO at 215 hPa

2018 on the low end
WHY ARE 2016-2018 ON THE LOW SIDE OF THE CO RECORD?

- Is CO getting lower in general?
- MOPITT CO appears to be decreasing over time
- Worden et al. (2013) reported significant negative trends in CO
- Is the decrease real?
LETS REMOVE THE TREND FROM THE VARIABILITY

Feb., original timeseries

Feb., de-trended timeseries

Removing trend shrinks inter-quartile range

2018 more average with trend removed
IAV IN MODIS AEROSOL OPTICAL THICKNESS

AOT on the low side for most regions in May and Aug. (Atom-4 & -1), high side in Oct. (ATom-3)
## SIGNIFICANT CORRELATIONS WITH BIOMASS BURNING EMISSIONS

Correlation between regional CO & BB from other regions

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<tr>
<td>Feb. (A2)</td>
<td>NH Africa</td>
<td>NH Africa</td>
<td></td>
<td>NH Africa Amazon</td>
<td>NH Africa NH Africa Amazon ENSO (MEI)</td>
<td>NH Africa Amazon</td>
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<td>May (A4)</td>
<td>Siberia</td>
<td>Siberia</td>
<td>Siberia</td>
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<td>Driven by negative trend, correlation insignificant if trend removed</td>
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<td>Aug. (A1)</td>
<td>NH Africa SH Africa</td>
<td>Siberia</td>
<td>Siberia</td>
<td>SH Africa NH Africa Indonesia</td>
<td>Amazon</td>
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<td>Oct. (A3)</td>
<td>Siberia Amazon</td>
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MOPITT column
MOPITT 700 hPa
MLS 215 hPa
SUMMARY

• MOPITT, MLS, and MODIS show IAV in CO and aerosols over regions sampled during ATom

• CO during ATom was below average for most regions and seasons

• AOT above average during ATom-3 & over the Tropical Atlantic, mostly below average for other deployments/regions

• CO variability correlates with Siberian, African and S. American biomass burning for several regions and seasons