Assessment of the sources and distribution of PAN over Northern Eurasia using GEOS-Chem and new measurements from TES

Transport at cold temperatures

PAN

\[ \text{C}_x\text{H}_y \quad \text{NO}_x \]

\text{NO}_x \text{ Source Region}

\[ \text{NO}_x \quad \text{O}_3 \text{ and OH} \]

\text{Remote Atmosphere}

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E. Fischer, V. H. Payne, J. R. Worden, Z. Jiang
TES PAN observations in April show large interannual variability.

Trop. Avg. : average from 800 mbar to tropopause

GEOS-Chem was used to provide a priori profiles for TES retrievals (Payne et al., 2014)

Zhu et al., 2015, submitted to GRL
April 2006 and 2008: More PAN detected but also more observations over Eastern Russia.

TES Special Observations:
More Data
But also a higher % of success!

With Special Observations removed, distributions remain similar. Means are the same.

Zhu et al., 2015, submitted to GRL
Periods of elevated fire activity likely contribute to the observed inter-annual variability.

- Boreal fires contribute to more than 10% of global combustion (Kaiser et al., 2012)
- PAN formed rapidly in boreal fire plumes (Alvarado et al. 2010)
Periods of elevated fire activity likely contribute to the observed inter-annual variability.

- PAN lifetime doubles for every 4°C decrease in temperature.
- Fire region, 700 hPa: April 2006 < 2007, up to 9°C; April 2006 < 2008, up to 4°C.

Zhu et al., 2015, submitted to GRL
A large fraction of detected PAN in northern Eurasia is linked to boreal fires.

**HYPLIT**, 5-day backward trajectories, April 2008

4D: +/- 1° Lat. and Lon., +/- 3 hrs, altitude: 4, 5 and 6 km

-> 81 trajectories for each retrieval

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<th></th>
<th>April 2008</th>
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<td>Fire</td>
<td>57%</td>
<td>Anthro</td>
<td>13%</td>
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<td>Anthro</td>
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<td>Fire &amp; Anthro</td>
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<table>
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<th>April 2006</th>
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<td>36%</td>
<td>Anthro</td>
<td>11%</td>
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<tr>
<td>Anthro</td>
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<td>Fire &amp; Anthro</td>
<td>5%</td>
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*Zhu et al., 2015, submitted to GRL*
Some year-to-year differences in PAN seem poorly represented in the model.

- GEOS-Chem does not capture the 2006 elevated PAN.
Some year-to-year differences in PAN seem poorly represented in the model.

Up to 70% in 2008
Take home:

• Springtime interannual variability in PAN was observed over northern Eurasia.

• A large fraction of detected PAN in this region was due to biomass burning in boreal Russia.

• New satellite observations of PAN from TES provide an opportunity to better understand its sources and distribution.

Thanks!

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PAN is the route for NO\textsubscript{x} to reach the remote troposphere.

\[
\text{PAN (CH}_3\text{C(O)O}_2\text{NO}_2) \quad \text{Transport at cold temperatures} \quad \text{PAN}
\]

\[
\text{NO}_x \quad \text{thermal decomposition} \quad \text{NO}_x \quad \text{HNO}_3
\]

\[
\text{O}_3 \text{ and OH} \quad \text{NO}_x \quad \text{HNO}_3
\]

\text{NO}_x \text{ Source Region} \quad \text{Remote Atmosphere}

Jacob 1998
Some year-to-year differences in PAN seem poorly represented in the model.

- Biomass Burning contributes more than 400 pptv in 2008
- Anthro. contributes ~ 200 pptv in all 5 years