Long-term Time-series of Arctic BrO Derived From UV-VIS Satellite Remote Sensing

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1. Introduction & Motivation
• The Arctic is warming more rapidly than every other region on the planet. This phenomenon is known as Arctic Amplification (Fig. 1) and it’s expected to have drastic ecological consequences.
• Bromine has a crucial role in the atmospheric composition; In higher latitudes, during polar spring, it is released from young sea ice, blowing snow & frost flowers, and through an autocatalytic natural process known as BrO explosion (Fig. 2), it depletes ozone by creating bromine oxides and consequently changes the oxidizing capacity of the atmosphere.
• Our goal is to assess the changes in the halogen atmospheric composition of the Arctic due to Arctic Amplification and link these changes to meteorological drivers & sea ice conditions.

2. BrO Time-series
• In order to study the evolution of BrO over the Arctic, we use UV – VIS satellite remote Sensing instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Platform</th>
<th>Time Period</th>
<th>Footprint</th>
<th>Equatorial Overpass</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERS-2</td>
<td>Envisat</td>
<td>1995 – 2003</td>
<td>320X60 km²</td>
<td>09.30</td>
</tr>
<tr>
<td>GOME</td>
<td>MetOp – A</td>
<td>2002 - 2012</td>
<td>30X30 km²</td>
<td>10.00</td>
</tr>
<tr>
<td>GOME 2A</td>
<td>MetOp – B</td>
<td>2007 - Present</td>
<td>80X40 km²</td>
<td>10.30</td>
</tr>
<tr>
<td>OMI</td>
<td>EOS - Aura</td>
<td>2005 – Present</td>
<td>133X24 km²</td>
<td>13.30</td>
</tr>
<tr>
<td>TROPOMI</td>
<td>Sentinel SP</td>
<td>2017</td>
<td>7X7 km²</td>
<td>13.30</td>
</tr>
</tbody>
</table>

• Spring time monthly mean total BrO VCDs lower in 2008 compared to other years both by SCIAMACHY and GOME-2A.
• We see that BrO explosion events have become more intense (especially after 2013) in the 22 years daily total BrO vertical columns figure.

3. BrO Maps
• Maps provide information not only about the temporal evolution of BrO, but also about the spatial distribution of the BrO.
• We observe changes in the areas where BrO plumes appear in the long run, but also during each year in the monthly total BrO vertical columns below:

4. Conclusions & Outlook
• The annual cycle of total BrO vertical columns increased over the last 22 years
• Possible causes related to arctic amplification (e.g. sea ice extent decrease, higher temperatures)
• We see more BrO explosion events during April rather than March (combination of more solar radiation and young sea ice)
• Also, the areas of the events change, expanding in the last years

Future Work:
• OMI & S5P instruments should be included in our research
• Derive tropospheric BrO from total BrO VCDs
• Link long term time-series of tropospheric BrO to driving parameters of BrO explosion (e.g. sea ice, blowing snow, temperature, wind speed, cyclone frequency, phytoplankton)

5. References & Acknowledgements
4. https://data.giss.nasa.gov/pindexp/

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