Background
- Arctic frozen soils store twice as much carbon\(^1\) (C) as is currently in atmosphere
- Climate-warming induced permafrost thaw will release C into the aquatic system
- During lateral transport, C is processed + generates greenhouse gases\(^2\) (GHG)
  - The flux of greenhouse gases will depend on the biodegradability of aquatic C

Synthesis Product
- We target dissolved organic C (DOC) rather than particulate OC as (i) Arctic rivers transport
  ~ 35 Tg DOC annually\(^3\) (ca. 10x DOC) and (ii) DOC is more readily available for biological processing\(^4\).
- We compiled available literature and conducted a meta-analysis of soil and water lability experiments.

Literature
- 13 available studies (refs. 5-17)
  - Located in Arctic Ocean watershed or nearby
  - Soil leachates, streams, lakes and rivers
  - Analysis of DOC lability through DOC loss or CO\(_2\) evasion

Circum-Arctic experiment
- We performed a large-scale experiment to assess the validity of comparing historic datasets in a meta-
  analyses of differing methods. We used standardized protocols to assess effects of different methods
  used in previous studies (see methods)
- Spatial: 2 streams/3 rivers/3 soil core leachates (Alaska, Russia, Canada)
- Temporal: late Spring, Summer and Fall 2013

First experimental results (i)

<table>
<thead>
<tr>
<th>Experimental type</th>
<th>Incubation T(°C)</th>
<th>Incubation time (days)</th>
<th>Soil leachates</th>
<th>Aquatic core leachates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>5.0</td>
<td>0-1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Aquatic</td>
<td>17.5°C</td>
<td>17</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

- The method diversity in literature is huge. Most common: 17.5°C incubation T, 0.7μm filter size, addition of inoculum, incubation time 14-40days.
- All "no permafrost" data are in S-Canda (Mackenzie watershed)

First experimental results (ii)

<table>
<thead>
<tr>
<th>Core 1</th>
<th>Core 2</th>
<th>Core 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water table 24cm &amp; 23cm</td>
<td>Water table 23cm &amp; 23cm</td>
<td>Water table 2cm &amp; 2cm</td>
</tr>
<tr>
<td>- core + incubation &amp; core length 26cm</td>
<td>- core + incubation &amp; core length 26cm</td>
<td>- only core &amp; core length 25cm</td>
</tr>
</tbody>
</table>

- Core 1 (active plant growth): higher %BDOC than other cores and increasing %BDOC in fall/w spring
- Soil leachates have higher %BDOC (14-48%, mean±stddev 28±9%) than streams/rivers (2-26%, 10±10%)  
- More results coming soon for Siberia (summer incubations), and Alaska/Canada (spring/fall incubations)

Conclusions
- Meta-analyses of 13 available papers with n=426 data points (soil: 127, aquatic 299) show a huge method diversity. Most frequent parameters used: incubation T 17.5°C, filter size 0.7μm filter size, inoculum addition, incubation time 14-40d.
- Soil DOC tends to become more labile during the growing season (Spring through Fall) while aquatic DOC seems to become less labile.
- We observe a general decrease in DOC lability from land to streams, large streams, and small rivers. Large rivers (watersheds >500,000km\(^2\)) have a relative high lability, potentially affected by a sampling bias towards the fresher.

References:  

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