Monitoring permafrost degradation in Siberia using microwave remote sensing

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Introduction

**CO₂ concentration in the atmosphere**

**CO₂ concentration**

**Latitude**

**Year**
Figure SPM.6. Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. Temperatures are relative to the period 1980-1999. {Figure 3.2}
Natural disasters by global warming

- Forest fire
- Drought (Plant growth)
- Permafrost degradation
- Flood
Objectives

(i) to monitor permafrost degradation using microwave remote sensing

(ii) to understand what happened as a result of permafrost degradation in the far north of Siberia
Alazeya river
Length: 1590 km
Basin: 64700 km²
Discharge: 320 m³/s
Meteorological data

(a) Annual mean air temperature

\[ y = 0.0455x - 101.38 \]

(b) Monthly mean air temperature

2007
Permafrost degradation process

Active layer
Permafrost
Ice wedge
Water from ice wedge melting

Ice wedge
Soil water content: 80%

by Semen Gotovtsev
ALOS/PALSAR

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fine</th>
<th>ScanSAR</th>
<th>Polarimetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Frequency</td>
<td>1270 MHz (L-band)</td>
<td>14MHz</td>
<td>14MHz</td>
</tr>
<tr>
<td>Chirp Bandwidth</td>
<td>28MHz</td>
<td>14MHz</td>
<td>14MHz, 28MHz</td>
</tr>
<tr>
<td>Polarization</td>
<td>HH or VV</td>
<td>HH+HV or VV+VH</td>
<td>HH or VV</td>
</tr>
<tr>
<td>Incident angle</td>
<td>8 to 60deg.</td>
<td>8 to 60deg.</td>
<td>18 to 43deg.</td>
</tr>
<tr>
<td>Range Resolution</td>
<td>7 to 44m</td>
<td>14 to 88m</td>
<td>100m</td>
</tr>
<tr>
<td>Observation Swath</td>
<td>40 to 70km</td>
<td>40 to 70km</td>
<td>250 to 350km</td>
</tr>
</tbody>
</table>
Detection of water area using ALOS/PALSAR

Water area accounts for more than 20%.
Interannual changes in flood

Light blue area is flooded in 2007.

Dark blue area is flooded in 2007 and 2008.

by Semen Gotovtsev

by Mekheda Alexander
Interannual changes in flood damage

Light blue area is flooded in 2007.
Dark blue area is flooded in 2007 and 2008.
Interannual changes in flood damage

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Interannual changes in flood damage

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by Dr. S. Gotovtsev@MPI
Interannual changes in flood damage

Light blue area is flooded in 2007.
Dark blue area is flooded in 2007 and 2008.
Interannual changes in flood damage

Very long duration time for two years

Long duration time for one year

No flood occurrence

Andryushkino

Argahtah

Svatai 30 km
Conclusion

- Permafrost degradation occurred in 2007 at the far north of Siberia, because air temperature in 2007 drastically increased.

- Melting water of ice wedge caused flood.

- Duration time of flood was different by location. Around Andryushkino, flood continued for 2 years, because landscape is almost flat without slope.

- Therefore, the local people suffered flood for a long time.
Thank you
Спасибо