Arctic Coastal Dynamics

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and the ACD group

*Alfred Wegener Institute
Potsdam (Germany)
OBJECTIVES, GOALS, PRODUCTS

- Rates and Magnitudes of Erosion and Accumulation
- Sediment and Organic Carbon Input from Coastal Erosion
- Arctic Coastal Classification in Digital Form
- Long-term Monitoring at Key Sites
- Focused Research on Critical Processes
- Environmental Forcing Parameters
- Human Interactions
- Empirical Sensitivity Models
Coastal Dynamics as a Function of Environmental Forcing and Coastal Geology/Geocryology

- Wind, storm frequency
- Sea level
- Waves
- Sea ice
- Sediment and organic carbon input
- Marine sediments
- Sedimentology
- Geocryology
- Geochemistry
- Erosion rates
- Onshore permafrost
- Offshore permafrost
- Ground ice
- Thaw consolidation
- Shoreface profile
- Stable unstable
- Bathymetry
- Sedimentology
- Sediment transport
### Coastal Erosion vs. Riverine Sediment Discharge

<table>
<thead>
<tr>
<th></th>
<th>Laptev Sea</th>
<th>Canadian Beaufort Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River Input</strong></td>
<td>24.10</td>
<td>64.45</td>
</tr>
<tr>
<td>($10^6 \text{ t} \cdot \text{a}^{-1}$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Coastal Erosion Input</strong></td>
<td>58.4</td>
<td>5.6</td>
</tr>
<tr>
<td>($10^6 \text{ t} \cdot \text{a}^{-1}$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coastal Erosion Input</strong></td>
<td>0.011</td>
<td>0.005</td>
</tr>
<tr>
<td>($10^6 \text{ t} \cdot \text{a}^{-1} \cdot \text{km}^{-1}$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ratio River/Coastal</strong></td>
<td>0.4</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Rachold, Grigoriev, Are, Solomon, Reimnitz, Kassens and Antonow (2000)
The Sediment Budget of the Laptev Sea During the Last 5 ky

Rachold, Grigoriev and Bauch (2002)
Terrigenous Organic Carbon Input to the Arctic Ocean

= 5 x 10^6 tC y^{-1}
- coastal erosion
- river discharge

Coastal Subdivisions by Arctic Shelf Seas

<table>
<thead>
<tr>
<th>Sector</th>
<th>Shoreline length* (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>Chukchi Sea</td>
</tr>
<tr>
<td>ES</td>
<td>East Siberian Sea</td>
</tr>
<tr>
<td>LS</td>
<td>Laptev Sea</td>
</tr>
<tr>
<td>KS</td>
<td>Kara Sea</td>
</tr>
<tr>
<td>BS</td>
<td>Barents Sea</td>
</tr>
<tr>
<td>GSCA</td>
<td>Greenland Sea/Canadian Archipelago</td>
</tr>
<tr>
<td>CBS</td>
<td>Canadian Beaufort Sea</td>
</tr>
<tr>
<td>USBS</td>
<td>US Beaufort Sea</td>
</tr>
<tr>
<td>total</td>
<td></td>
</tr>
</tbody>
</table>

*based on World Vector Shorelines, excluding islands

- Glaciers
- Unlithified
- Lithified
- 1000m contour
- ACD key sites
Segmentation and Classification Procedure

Grigoriev (2003)

Regional experts

Classification

Geography

Environmental data

GIS layer

Final GIS product

Pangea data manager

Web-based mini-GIS (ArcIMS)

GIS expert

- ice content
- TOC concentration
- dry bulk density
Products and Deliverables

- Electronic newsletters
- ACD web site
  - Circum-Arctic coastal photo collection
  - Metadata for ACD key sites
  - Bibliography of Russian ACD-relevant literature
ACD Products

Circum-Arctic Coastal Photo Collection

http://www.awi-potsdam.de/ww-pot/geo/acd.html
### Key Site Metadata

<table>
<thead>
<tr>
<th>DATE PREPARED</th>
<th>22 January 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>COASTAL SECTION NAME</td>
<td>Mørre-Sale</td>
</tr>
<tr>
<td>TYPE SITE</td>
<td>Key</td>
</tr>
<tr>
<td>COUNTRY</td>
<td>Russia</td>
</tr>
<tr>
<td>REGION</td>
<td>West Siberia</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>69.70</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>66.50</td>
</tr>
<tr>
<td>SECTION LENGTH (km)</td>
<td>4.5</td>
</tr>
<tr>
<td>OBSERVATION PERIOD</td>
<td>1978-2000</td>
</tr>
<tr>
<td>OBSERVATION FREQUENCY</td>
<td>1 to 5</td>
</tr>
<tr>
<td>ONSHORE METHODS</td>
<td>GPS, observation of 60 coastal sections</td>
</tr>
<tr>
<td>OFFSHORE METHODS</td>
<td>bathymetry (2000, VNIIOceangeologia, St.Petersburg)</td>
</tr>
<tr>
<td>REMOTE SENSING</td>
<td>Video (1991)</td>
</tr>
<tr>
<td>CLIFF HEIGHT (m)</td>
<td>10 to 30</td>
</tr>
<tr>
<td>CLIFF ANGLE</td>
<td>&gt;60</td>
</tr>
<tr>
<td>LOCAL RELIEF (m)</td>
<td>2 to 30 m (tundra plain)</td>
</tr>
<tr>
<td>OFFSHORE SLOPE</td>
<td></td>
</tr>
<tr>
<td>GEOLOGY</td>
<td>onshore: sand and clay; offshore: sand</td>
</tr>
<tr>
<td>GEOCRYOLOGY</td>
<td>ice-content 0.1 – 0.6, massive ice, ice-wedge, tabular ground ice</td>
</tr>
<tr>
<td>DOMINANT SITE VEGETATION</td>
<td>typical tundra vegetation (moss, lichen, grassy vegetation)</td>
</tr>
<tr>
<td>CLIMATE MEANS</td>
<td>daily data available since 1961 for air temperature and snow cover</td>
</tr>
<tr>
<td>OCEANOGRAPHIC CONDITIONS</td>
<td>daily data available since 1989 for frequency of storms and wave height</td>
</tr>
<tr>
<td>ACCESSIBILITY</td>
<td>helicopter</td>
</tr>
<tr>
<td>LOCATION OF CLOSEST CLIMATE STATION</td>
<td>Mørre-Sale, identical with key site</td>
</tr>
<tr>
<td>CONTACT:</td>
<td>Alexandr Vasiliev, Earth Cryosphere Institute SB RAS, 30/6 Vavilov str.117982 Moscow, Russia. E-mail <a href="mailto:emelnikov@mru-net.ru">emelnikov@mru-net.ru</a>, fax 7-095-135-6582</td>
</tr>
<tr>
<td>RELEVANT PUBLICATION</td>
<td>Yu. Shar, A. Vasiliev et al. 1984</td>
</tr>
<tr>
<td>SKETCH-PHOTO</td>
<td>Some photos and video (1991), about 10 min.</td>
</tr>
<tr>
<td>OTHER COMMENTS</td>
<td></td>
</tr>
</tbody>
</table>

**DATE PREPARED**: 2 November 2000

**COASTAL SECTION NAME**: North Head

**TYPE SITE**: Key

**COUNTRY**: Canada

**REGION**: Mackenzie Delta

**LATITUDE**: 69.715312

**LONGITUDE**: -134.48779

**SECTION LENGTH (km)**: 2.38

**OBSERVATION PERIOD**: 13 years

**OBSERVATION FREQUENCY**: 1 to 5

**ONSHORE METHODS**: theodolite, RTK_DGPS

**OFFSHORE METHODS**: Echosounding 200

**REMOTE SENSING**: Air Photo SPOT Radarsat

**CLIFF HEIGHT (m)**: 5 to 30

**CLIFF ANGLE**: >70 to 10 degrees

**LOCAL RELIEF (m)**: 25 m

**OFFSHORE SLOPE**: 0.00001

**GEOLOGY**: Predominantly fine sand with thin veneer of diamict. Sand overlies mud

**GEOCRYOLOGY**: Massive ice and ice wedges in tundra, ice wedges in drained lake basins

**DOMINANT SITE VEGETATION**: Typical tundra vegetation (moss, lichen, grassy vegetation)

**CLIMATE MEANS**: Available before 1961 for air temperature, since 1959 for snow cover

**OCEANOGRAPHIC CONDITIONS**: Available

**ACCESSIBILITY**: Helicopter

**LOCATION OF CLOSEST CLIMATE STATION**: Pelly Island 17 km Tuktoyaktuk

**CONTACT**: S. Solomon - Geological Survey of Canada (solomon@nrcan.gc.ca)

**RELEVANT PUBLICATION**: Dallimore et al. 1996...

**SKETCH-PHOTO**: Spot Image with 1997 survey available. Grid is 2 km UTM NAD83. Other comments?

**OTHER COMMENTS**: Long-term mean retreat: 1-2 m/a, short-term retreat (from storms):
ARCTIC COASTAL DYNAMICS Bibliography

Version 1.0 - 7 January 2003

This bibliography of Russian literature has been compiled for "Arctic Coastal Dynamics (ACD)"; which is a project of the International Arctic Sciences Committee (IASC) and the International Permafrost Association (IPA). The references are listed in alphabetical order and for each article regional coverage and main topic are given in separate fields. The original contributors of the references are indicated: O - Stanislav Ogorodov (Moscow State University), S - Irina Streletskaya (Moscow State University), P - Yury Pavlidis (Shirshov Institute of Oceanology RAS, Moscow), N - Nikolaev (VNIIOkeangeologia, St. Petersburg), Sh - Andrei Sher (Severtsov Institute of Ecology and Evolution RAS, Moscow).

contatc:
Feliks Are, St. Petersburg State University of Means of Communications, Russia (but@peterlink.ru)
George Cherkashov, VNIIOkeangeologia, St. Petersburg, Russia (cherkashov@vniio.ru)
Volker Rachold, Alfred Wegener Institut for Polar and Marine Research, Potsdam, Germany (vrachold@awi-potsdam.de)

additional information:
http://www.awi-potsdam.de/www-pot/geo/acd.html

<table>
<thead>
<tr>
<th>Reference</th>
<th>Region (Sea): if no region - general</th>
<th>Main topic: if general ideas - theory</th>
<th>Additional topic</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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http://www.awi-potsdam.de/www-pot/geo/acd.html
Products and Deliverables

ACD contribution to the CD-ROM „Circumpolar Active Layer Permafrost System“

Segmentation and classification at PANGAEA web site (coming soon)

Publications

• Workshop reports
• Proceedings of the „8th International Conference on Permafrost“
• Other ACD-relevant publications

Electronic newsletters

ACD Web site

• Circum-Arctic coastal photo collection
• Metadata for ACD key sites
• Bibliography of Russian ACD-relevant literature

Metadata for ACD key sites

Bibliography of Russian ACD-relevant literature
<table>
<thead>
<tr>
<th>Year</th>
<th>Report Title</th>
<th>Location</th>
<th>Authors</th>
</tr>
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<tbody>
<tr>
<td>2002</td>
<td>Arctic Coastal Dynamics</td>
<td>Potsdam (Germany) 26-30 November 2001</td>
<td>Volker Rachold, Jerry Brown and Steve Solomon</td>
</tr>
<tr>
<td>2003</td>
<td>Arctic Coastal Dynamics</td>
<td>Oslo (Norway), 2-5 December 2002</td>
<td>Volker Rachold, Jerry Brown, Steve Solomon and Johan Ludvig Sollid</td>
</tr>
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</table>
Coordination

- International Permafrost Association (IPA)
- Arctic Climate Impact Assessment (ACIA)
- Land-Ocean Interactions in the Russian Arctic (LOIRA)
- IGBP-LOICZ (Land-Ocean Interactions in the coastal zone)
- Global Terrestrial Observation Systems (G-TOS)
  - Global Terrestrial Network Permafrost (GTNP)
  - new coastal initiative
- Circum-Arctic Environmental Observatories Network (CEON)
- Land-Shelf Interactions (LSI)
Achievements in 2003

Field work
- Annual measurements at key sites
- Detailed sampling of transects to study the fate of organic carbon

Segmentation and classification
- To be completed by the end of 2003

Publications
- Special issue of international journal (in preparation)

Conference presentations
- ELOISE European Land-Ocean Interaction Studies (Gdansk, Poland, March 2003)
- ASSW (Kiruna, Sweden, April 2003)
- EGU/AGU (Nice, France, April 2003)
- Annual Geocryology Conference (Pushchino, Russia, May 2003)
- 8th International Conference on Permafrost (Zürich, Switzerland, July 2003)
- ICAM Arctic Margins Meeting (Halifax, Canada, October 2003)
- SEARCH Open Science Meeting (Seattle, USA, October 2003)

Next ACD workshop
- To be organized in St. Petersburg (November 2003)
- Expand the scope of ACD to cover human aspects and the impact of coastal dynamics on habitats and species
Acknowledgements

Financial support by the following organizations is highly appreciated:

- International Arctic Sciences Committee (IASC)
- International Permafrost Association (IPA)
- Canadian Department of Foreign Affairs and International Trade (DFAIT): Canada-Germany agreement
- INTAS (International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union): project numbers INTAS Open Call 2001-2329 and INTAS Open Call 2001-2332
- International Arctic Research Center (IARC): grant “Analysis of Coastal Meteorological and Oceanographic Forcing in the Arctic Basin”