International Icebreaker Research Operations

Well developed but increasing:
- Surveys
- Autonomous deployments

Developing and Future:
- Drifting stations
- Bases for survey activities
Surveys and autonomous deployments

Surveys for LOS, minerals
Spatial variability in properties

Kronprince Haakon (Norway)
Xuelong (China)
Xuelong II (China)
Aaron (Korea)
Polarstern (German)
Amundsen (Canada)
Oden (Sweden)
Federov (Russian)
Many others.

Survey operations are the most developed international activity, serving to project national interest into the region in addition to science.

Primarily in summer. Increasingly to high latitudes.
Autonomous Deployments

• Increasing demand to fill in situ observing arrays.
  • Canadian and Danish air deployments really filling in networks

• Air deployment will not be possible for many types of desired observations.

• Expect increasing demand for grid-filling in high Arctic
Drifting Camps

- N-ICE 2015 (6 months)
- MOSAiC (13 months)
- Russian “North Pole” camps
- Chinese, Korean, Norwegian, German, Canadian weeks to month camps.

Process understanding and prediction requires long term process studies
Forward Operating Base Model
In the past few days we have set up a station that has been missing so far from Leg 1: the ridge observatory, which we call 'Fort Ridge' as it includes parts of the area initially called the Fortress. It is approximately 100 metres long and 15 to 20 metres wide and located 400 to 500 metres northwest of Polarstern and can be reached by the ROV. The ridge is partly formed by first-year ice on its eastern side, while there might be some older components on the western side. It has likely formed in a deformation event in October 2019, when the first-year ice plate slipped on probably older chunks. In any case, drilling and coring indicates that the ridge is not fully consolidated as it has several soft layers and wet cavities instead of only compact ice. In a common effort, teams Ice, Ocean and Eco installed several instruments, buoys and benthos in and...
An entire year trapped in the Arctic ice
The largest Central Arctic expedition ever

In September 2019 the German research icebreaker Polarstern will depart from Tromsø, Norway and, once it has reached its destination, will spend the next year drifting through the Arctic Ocean, trapped in the ice. A total of 600 people from 17 countries, who will be supplied by other icebreakers and aircraft, will participate in the expedition - and several times that number of researchers will subsequently use the data gathered to take climate and ecosystem research to
The German research icebreaker Polarstern will be at the heart of the expedition.

Surrounding Polarstern, a several-kilometre-wide network of monitoring stations will be set up.

During the expedition, at least three research aircraft will be deployed.

Four icebreakers from Russia, China and Sweden will resupply the expedition with fuel and exchange personnel.

Ice expanse:
- Summer
- Winter

Contact routes:
- Aeroplanes
- Icebreakers

Harbours / Airports:
1. Station Nord, Greenland
2. Longyearbyen, Svalbard
3. Tromso, Norway
## Expedition timeline

**Start:** 20 September 2019  
**End:** 14 October 2020

<table>
<thead>
<tr>
<th>Date</th>
<th>Leg</th>
<th>Duration</th>
<th>Vessel/Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/2019</td>
<td>Leg 1</td>
<td>3 months</td>
<td>Until mid Oct Fedorov</td>
</tr>
<tr>
<td>10/2019</td>
<td>Leg 2</td>
<td>2 months</td>
<td>Mid December Makarov</td>
</tr>
<tr>
<td>11/2019</td>
<td>Leg 3</td>
<td>2 months</td>
<td>Mid February Makarov</td>
</tr>
<tr>
<td>12/2019</td>
<td>Leg 4</td>
<td>2 months</td>
<td>Mid April, Antonov AN-74 =&gt; Ice runway</td>
</tr>
<tr>
<td>1/2020</td>
<td>Leg 5</td>
<td>2 months</td>
<td>Mid June – mid July 2 x Oden</td>
</tr>
<tr>
<td>2/2020</td>
<td>Leg 6</td>
<td>2 months</td>
<td>Mid August, Xuelong or Xuelong II</td>
</tr>
</tbody>
</table>
Drift Statistics
Start point: 85°N/105°E
Drift Statistics
Start point: 85°N/105°E

Drift into Russian waters = bad
Drift Statistics
Start point: 85°N/105°E

Drift out of rescue range = bad
Drift into Russian waters = bad

Thomas Krumpen
Real estate zoning in the Central Arctic

Ice near to the ship is a scarce resource