Arctic Navigation

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My presentation:

- Geography and some challenges
- High latitude shipping activity
- Survey and chart quality
- Navigation systems
- Future prospects and climate change
A random snapshot of activity in ice infested waters (from AISSat-1)
Growth in shipping activity demands implementation of new international regimes

- Polar Code
- Mandatory IMO guidelines

Passenger vessels conflict – attraction vs. safety
When technology and humans meet the harsh and remote environment, problems occur.

1912

1989

23.11.2007
Northern Passages – shortcuts between Atlantic and Pacific Waters

Northeast-Passage «Open» since 1991
2011 – a breakthrough for the Northeast passage

17th of July 2012 north of New Siberian Islands
Demanding season extension

This is what you see in the winter time (only 1 month after min. ice coverage)
Radar can be useful to avoid ice ridges.

Close to the North Pole

Ridges can easily be seen

Much ice-clutter close to the ship

Blind sector
Modes of navigation

Positioning / Dynamic Positioning (DP)

…… Different needs and requirements

• Accuracy
• Reliability
• Integrity
• Redundancy
GNSS performance

- **GPS** have no significant latitude limitations
- **GLONASS** more inclined orbits (64.8 vs. 55°). Improves performance at high latitudes.
- Needs augmentation for integrity
- **Galileo og BeiDou** will improve integrity, geometry and add SAR functionality
- Signal strength normally good, but ice on the antenna and auroral activity can reduce performance

Skyplot of GPS and GLONASS at 75°N (24hrs)

GPS-HDOP: 24hrs sailing along the Northeast Passage
Limited DGPS and SBAS coverage

Main research area at N 78°50’

Limit for sat. 120 (15.5°E)

Limit for sat. 126 (25°E)

Polar Circle

Expected coverage of EGNOS satellites
Skyplot from N 71°29’ – E 015°20’

Satellites without EGNOS correction

Satellites with EGNOS correction

EGNOS sat. 124

Kongsberg DPS-132 receiver (GPS L1+L2+SBAS)
DQI – timeplot from the Barents Sea (sat. 124)

Period with correction (DQI > 1).
Number of sat. are low.
HDOP is high

Period without correction (DQI = 1).
Number of sat. are high.
HDOP is low

Software: Kagstrom NMEA-suite / www.kagstrom.no
Skyplot from N 78°49’ – W 004°08’

EGNOS sat. 120 (Elevation is 2.2°)
How to fill the Polar gap?

- More polar RIMS
- Global system coordination
- Polar communication, integrity- and ice data distribution needed
  - Iridium or MEO
  - HEO (Molniya)
All approved compass systems have limitations at high latitudes.

\[ \text{Error} = \frac{v \cdot \cos \phi \cdot 57.3}{901 \cdot \cos \beta + v \cdot \sin \phi} \]

Latitude (\(\beta\)) approaches 90°
- Cos \(\beta\) approaches 0
- Error approaches \(\infty\)

Remember !! Errors will propagate to radar, ECDIS, direction-finders, AIS, SatCom, TV, etc.
Satellite compass – have no latitude limitations (but still not approved by IMO)
Ref. recommendations in IMO guidelines for ships operating in polar waters.
Large and shallow shelf areas. What about the chart quality?

The seachart indicated 300m (Hinlopen, Svalbard)
Information: CAUTIONS

1. The area portrayed by this chart has not been completely surveyed and most of the data are of a reconnaissance nature only. Mariners are warned to exercise extreme caution when navigating in these waters.

2. Numerous uncharted rocks exist off the northern coasts of the South Shetland Islands. Changes of depth are sudden and in these waters give no warning of approaching shoals.

WARNING
The prudent mariner will not rely solely on any single aid to navigation, particularly on floating aids. See paragraph No. 1 of Notice to Mariners No. 1 or Sailing Directions Planning Guides.
Margins between "ingenuous" grounding and disaster are sharp (ref. Exxon Valdez)
A paradox:
Reduced ice coverage can contribute to more ice-navigation
- Cruise / Expeditions
- Oil and gas
- Mining
- Research
- Fishing

Gradual change from thick multi-year ice to thin first-year ice
“Trans Polar Highway “– a future perspective?

Approx. 1000nm shorter

- No depth limitations
- Only international waters

Chinese icebreaker *Xue Long* tested the Trans Polar route over the North Pole (August-Sept.12)

*) Remember – shortest route is rarely the quickest
Obvious need for:

• Better competence
• Stricter regulations (national and international)
• Improved infrastructure and presence

Concluding remarks