A Norwegian Satellite for Space-based Observations of AIS in the High North

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Norwegian High North viewed from 600km

Can the maritime activity in this area be monitored by an AIS satellite?
AIS Features

• VHF based reporting system operating at ~162MHz

• Broadcasting vessel information inside line of sight limited SOTDMA cells
  – This enables global reuse of the two AIS frequency channels
  – but becomes a troublesome feature for detection in space
  – because several vessels can transmit in the very same TDMA timeslot
  – thereby causing loss of AIS messages in space

• Two main groups of AIS messages
  – Dynamic messages every 2 – 10 sec (of prime interest)
  – Static messages every 6 min
Large Number of Vessels within FoV

< 500 moving vessels in the High North

~7000 “disturbing” vessels within FoV

From 600km altitude
Global AIS Vessel Distribution Map

Based on NOAA ICOADS updated by aircraft observations
~52000 moving vessels globally
Satellite Model

Satellite body 20x20x20cm, AIS antenna length 46cm
AIS Signal Power (dBm) at 600 km Altitude

Horizontal dipole with Faraday & Polarization
Global AIS Detection Probability Map

Daily detection probability for 1 satellite in a 600km polar orbit

The Norwegian High North
Daily Observations Map

Number of daily observations at >95% detection probability for 1 satellite in a 600km polar orbit

The Norwegian High North
AISSat-1 Demonstration Satellite

20x20x20cm body, 85cm tall, 75cm wide

Platform built by the Space Flight Laboratory at UTIAS, Canada
AIS Sensor built by the Kongsberg Group, Norway
AIS Sensor Concept

- 2-channel maritime VHF receiver
- Prototype consumes < 2W

Courtesy Kongsberg Group
AIS Sensor Prototype

Courtesy Kongsberg Group
AISSat-1 Platform

20x20x20cm
5.5 W power
6.5 kg

Courtesy UTIAS/SFL
AISSat-1 Internal Layout

- AIS Sensor
- System trays
- 3 Momentum wheels

Courtesy UTIAS/SFL
AISSat-1 Launch Configuration

AISSat-1 will be launched with antennas fully deployed

Courtesy UTIAS/SFL
AIS Data Dissemination to Authorities

• Focus will be on the Dynamic AIS messages (types 1, 2 and 3)

• AIS data will be distributed as:
  – NMEA ”Comment Block” for observation time (green)
  – NMEA AIS sentence (blue)

• Example:
  – \texttt{\textbackslash 1G1:2345,c:1203089309*03\textbackslash \!AIVDM,1,1,,A,13u\textbackslash \textbackslash 08=V,0*34<CR/LF>
AISSat-1 Project Group

- Forsvarets forskningsinstitutt (FFI) Management & MCC
- Norwegian Space Centre (NSC) Financial support
- Kongsberg Group AIS sensor/Ground station
- Space Flight Laboratory (UTIAS/SFL) Satellite platform & Launch
AISSat-1 Observation of the High North
Thank you for listening

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