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Ice/water classification using dual-polarization C- and L-band synthetic aperture radar images over Fram Strait

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Why do we care about information of sea ice cover?
Outline

1. Study Area
2. Dataset
3. Algorithm
4. Results
5. Outlook
Study Area – Fram Strait

Challenges:
- Sea ice drift
- Incidence angle variations
- Variety of ice regimes

Why using different frequencies?

Penetration depth

⇒ Better information of ice cover
⇒ Increase of temporal resolution

Backscatter dependence on surface roughness
(from "Remote Sensing and Image Interpretation" by T. Lillesand)
## Dataset

<table>
<thead>
<tr>
<th></th>
<th><strong>Alos-2 Palsar-2</strong></th>
<th><strong>Sentinel-1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode</strong></td>
<td>ScanSAR Dual Pol</td>
<td>EW GRDM Dual Pol</td>
</tr>
<tr>
<td><strong>Wavelength</strong></td>
<td>L-band 25 cm</td>
<td>C-band 5.6 cm</td>
</tr>
<tr>
<td><strong>NESZ (design numbers)</strong></td>
<td>-26 dB</td>
<td>-22 dB</td>
</tr>
<tr>
<td><strong># of images</strong></td>
<td>24 =&gt; 12 training/ 12 validation (winter 14/15 15/16)</td>
<td>25 =&gt; 12 training/ 13 validation (winter 15/16)</td>
</tr>
<tr>
<td><strong>Resolution az/rg (pixel size)</strong></td>
<td>95.1 m/77.7 m (40m)</td>
<td>93 m/ 87 m (25 m)</td>
</tr>
</tbody>
</table>
Mapping from features to ice classes

SAR image

Feet-forward Neural Network

Classification

=> Trained with manually defined ROI’s representing the classes
Mapping from features to ice classes

Feet-forward Neural Network

Classification

Autocorrelation

=> Trained with manually defined ROI’s representing the classes
Example for classification 12.10.2015

Copernicus Sentinel data 2015
Alos-2 Palsar-2 ©Jaxa
Validation with icecharts and AMSR-2 data

Agreement:
C-Band: 87%
L-band: 84%

Agreement:
C-Band: 89%
L-band: 86%
Comparison of C-band and L-band
Conclusions

⇒ C-band is more robust for ice/water classification
⇒ L-band outlines thin ice features
⇒ Ice drift plays a role even for short time gaps
⇒ Algorithm needs improvement for areas where texture does not separate ice and water
Thank you for your attention!

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Alos-2 Palsar-2 images were provided by Jaxa under the 4th RA, PI number 1331

Differences in the marginal ice zone

Histogram of L-band cross-polarization training samples

-10^6 dB

-12 -10 -8 -6 -4 -2 0 dB

-10^5

-1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0 0 dB

Ice Water Calm water/Thin ice