Evaluation of MAGIC Sea Ice Classifier on 61 Dual-polarization RADARSAT-2 Scenes

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Motivation

• Automated ice classification has many benefits:
  » Very high detail (pixel level)
  » Process large data sets (especially important for future)
  » Consistency (no inter-operator bias)
  » Automated analysis for typical scenes - leaves complex scenes and validation to experts

• MAGIC sea ice classifier is new and complex and requires validation
MAGIC System (MAp Guided Ice Classification)

- Software for developing, testing, sharing, and using image processing algorithms
- Accessible GUI interface for complex algorithms
- Primarily developed for sea ice
- This study used the MAGIC system to evaluate one of its main algorithms: IRGS+SVM sea ice classifier
MAGIC Algorithm: IRGS+SVM

• (Leigh et al. 2014)
• Combination of classifiers
• Takes RS-2 scene as input
• Returns binary ice-water labelled scene

\[ E = \sum_{i \in R} [V_G(x_i) + V_S(x_i)] + \sum_{\langle i,j \rangle \xi} V_E(x_i, x_j) \]
IRGS (Iterative Region Growing using Semantics)

• Initially developed for sea ice (Yu and Clausi, 2008)
• Classification with arbitrary labels
• Spatial context - Region based
• Merges based on Gaussian statistics and edge strength
• Only HV pol
SVM (Support Vector Machine)

• Provides ice-water labels
• Models non-linear nature of ice vs water discrimination boundary
• 28 features, primarily texture from HH and HV pols
• Leave-one-out training/testing
Data Set

- 61 scenes
- RADARSAT-2 scanSAR Wide
- 10,000 by 10,000 pixels at 50m resolution
- Dual pol HH, HV
- HH has strong incidence angle effects
- April 2010 – Nov 2011
Location
Ground Truth

- Created manually using MAGIC PEF (Performance Evaluation Framework)
- Reference expert ice charts when available
Results

• Overall accuracy: 95.8%
• Classification speed: ~22 min per scene
• Over 90% of scenes are over 90% accurate
Sample Result

- $[HH]$ $[HV]$ [ground truth] [result]
- Wind-roughened water
- Dark ice response
- Accuracy: 95.9%
Conclusion

• MAGIC maintains high accuracy (>95%) through challenging circumstances:
  » New data set
  » Wind-roughened water
  » Incidence angle
  » Across seasons and years

• Under consideration by CIS for operational purposes
Thank You

Questions?