University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Science

of

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BSc (University of Victoria, 2015)

"Estimating Arctic sea ice melt pond fraction and assessing ice type separability during advanced melt"

Department of Geography

Wednesday, March 21, 2018
1:00 P.M.
David Turpin Building
Room B215

Supervisory Committee:
Dr. Randall Scharien, Department of Geography, University of Victoria (Supervisor)
Dr. Dennis Jelinski, Department of Geography, UVic (Member)

External Examiner:
Dr. Johannes Gemmrich, Department of Physics and Astronomy, UVic

Chair of Oral Examination:
Dr. John Burke, Department of Biochemistry and Microbiology, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies

Abstract

Arctic sea ice is rapidly declining in extent, thickness, volume and age, with the majority of the decline in extent observed at the end of the melt season. Advanced melt is characterized by the formation of melt ponds on the sea ice surface, which have a lower surface albedo (0.2-0.4) than the surrounding ice (0.5-0.7) allowing more shortwave radiation to enter the system. The loss of multiyear ice (MYI) may have a profound impact on the energy balance of the system because melt ponds on first-year ice (FYI) comprise up to 70% of the ice surface during advanced melt, compared to 40% on MYI. Despite the importance of advanced melt to the ocean-sea ice-atmosphere system, advanced melt and the extent to which winter conditions influence it remain poorly understood due to the highly dynamic nature of melt pond formation and evolution, and a lack of reliable observations during this time. In order to establish quantitative links between winter and subsequent advanced melt conditions, and assess the effects of scale and choice of aggregation features on the relationships, three data aggregation approaches at varied spatial scales were used to compare high resolution satellite GeoEye-1 optical images of melt pond covered sea ice to winter airborne laser scanner surface roughness and electromagnetic induction sea ice thickness measurements. The findings indicate that winter sea ice thickness has a strong association with melt pond fraction (fp) for FYI and MYI. FYI winter surface roughness is correlated with fp, whereas for MYI no association with fp was found. Satellite-borne synthetic aperture radar (SAR) data are heavily relied upon for sea ice observation; however, during advanced melt the reliability of observations is reduced. In preparation for the upcoming launch of the RADARSAT Constellation Mission (RCM), the Kolmogorov-Smirnoff (KS) statistical test was used to assess the ability of simulated RCM parameters and grey level co-occurrence matrix (GLCM) derived texture features to discriminate between major ice type during winter and advanced melt, with a focus on advanced melt. RCM parameters with highest discrimination ability in conjunction with optimal GLCM texture features were used as input parameters for the Support Vector Machine (SVM) supervised classifications. The results indicate that steep incidence angle RCM parameters show promise for distinguishing between FYI and MYI during advanced melt with an overall classification accuracy of 77.06%. The addition of GLCM texture parameters improved accuracy to 85.91%. This thesis provides valuable contributions to the growing body of literature on fp parameterization and SAR ice type discrimination during advanced melt.