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BSc (Hydrogeology), University of Waterloo, 2010
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DEPARTMENT OF OCEANOGRAPHY

TITLE OF THESIS:	Characterization of Estuarine Particle Dynamics using Optical Properties
TIME/DATE:	2:00 pm, Thursday, November 14, 2019
PLACE:	Room 3107, The Mona Campbell Building, 1459 LeMarchant Street

EXAMINING COMMITTEE:

Dr. W. Rockwell Geyer, Woods Hole Oceanographic Institution (External Examiner)

Dr. Emmanuel Boss, School of Marine Science, University of Maine (Reader)

Dr. Katja Fennel, Department of Oceanography, Dalhousie University (Reader)

Dr. Marlon Lewis, Department of Oceanography, Dalhousie University (Reader)

Dr. Timothy Milligan, Department of Oceanography, Dalhousie University (Reader)

Dr. Paul Hill, Department of Oceanography, Dalhousie University (Supervisor)

DEPARTMENTAL REPRESENTATIVE:	Dr. Keith Thompson, Department of Oceanography, Dalhousie University
CHAIR:	Dr. Nur Zincir-Heywood, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

Estuarine sediment dynamics have a significant economical and ecological importance in environmental management and ecosystems protection. They are influenced by complex physical processes, including river discharge and tide, that circulate and mix estuarine waters. To characterize estuarine particle dynamics, this thesis uses optical properties to understand the spatial and temporal variability of particles properties and distributions in the Columbia River Estuary (CRE). In addition, this thesis also evaluates the utility of remote sensing reflectance for inferring subsurface estuarine processes. In Chapter 2, the optical proxies of suspended particulate mass (SPM) are investigated. The particulate backscattering coefficient is shown to be a reliable proxy for SPM concentration even in stratified parts of the estuary, where the performance of beam attenuation is degraded. In Chapter 3, optical properties are used as proxies to explore variability in sediment mass concentration, size and composition within the CRE, especially in the salinity transition region and in the estuarine turbidity maximum zone. The results demonstrate that optical measurements provide a representation of spatial and temporal variation in particle properties in the CRE that is broadly consistent with the established conceptual model of estuarine particle dynamics. Furthermore, the variation of optical properties in the transition from low- to medium-salinity water (LMW) suggest that particle flocculation transferred mass preferentially from medium-sized particles to large-size particles. Large flocs preferentially incorporated more organic-rich material and some of the newly formed flocs deposited to the seabed. Likely due to the complex variation of particle size and composition, the optical proxies for particle size (beam attenuation exponent γ and backscattering exponent γ_{bb}) are not correlated well with Sauter mean diameter D_s of suspended particles in the LMW. The overall results show that γ_{bb} is a reliable proxy for changes in particle size in a stratified environment. In Chapter 4, longitudinal distributions of remotely sensed reflectance are linked to estuarine dynamics in six estuaries with different dynamics. The results demonstrate that remote sensing observations of ocean color can be utilized to infer subsurface estuarine processes. Satellite ocean color is a potential tool for estuarine classification and riverine monitoring on global scales.