

Prof. Urs Neumeier
Institut des sciences de la mer (ISMER)
Université du Québec à Rimouski (UQAR)
310 allée des Ursulines
Rimouski QC G5L 6J5, Canada



M.Sc. scholarship in oceanography (marine geology)

Topic: Flooding of dykes and salt-marsh erosion in the Kamouraska region

General context

The low-lying coastal areas of the Kamouraska region are characterised by wide coastal marshes, which in the 19th and 20th centuries led to the construction of dykes to protect and reclaim new, highly productive agricultural land. Today, nearly 35 km of dykes protect around 15 km² of farmland, as well as the A20 motorway, the R132 highway and several villages. These dykes are now under threat from rising sea levels, an increase in the frequency of winter storms due to the reduction in sea ice cover, and the erosion of coastal marshes that can be observed throughout the St Lawrence Estuary.

The Kamouraska Regional County Municipality, the Union of Quebec Municipalities, the École de technologie supérieure (ETS) and the Institut des sciences de la mer (ISMER) have developed a research project to anticipate risks, assess the performance of sea defences and guide adaptation strategies. This project, funded by the Fonds de recherche du Québec, is divided into two parts. ISMER is leading the first on field observations and the analysis and interpretation of oceanographic measurements. ETS is leading the second on hydrodynamic modelling of coastal flooding. Two high-risk areas will be studied: Rivière-Ouelle and Saint-Denis-De La Bouteillerie.

Objectives

The main objectives of this M.Sc. project are to characterise the local coastal geomorphology, including the dykes, and to determine the critical climatic parameters for coastal flooding and erosion based on records of water levels, waves and currents. This will enable to estimate the future evolution of at-risk areas. It will also generate scenarios for the hydrodynamic modelling team.

Method

The geomorphological characterisation of the sea defences, the intertidal zones in front of them and the low-lying land behind them will be carried out using DGPS-RTK topographic surveys. These surveys will be repeated over time along the eroding marsh-scarp. They will be supplemented on the seaward side by single-beam bathymetric surveys and on the landward side by existing LiDAR data, which will be validated by DGPS-RTK measurements. The associated topographical features will be analysed, and the intertidal vegetation will be mapped to assess its influence on water flow and its wave-attenuation capacity.

New data (water level, waves, currents) will be recorded over a two-year period (excluding winter) to document the conditions responsible for the flooding. Waves will be recorded at 10-m depth and in the middle of the intertidal zone using ADCPs (AWAC-AST 1 MHz and Aquadopp 2 MHz). Water levels

will be monitored using tide gauges (RBRduet T.D|tide16) installed at four or five points along the coast, particularly near the sea defences, as well as in the Ouelle River. These data will be supplemented by data from the tide gauge stations at Saint-Jean-de-la-Rive and Saint-François-de-l'Île-d'Orléans (DFO) to analyse harmonic components and storm surges. Hydrological databases for the Ouelle River and the St Lawrence River in Quebec City will be incorporated into the statistical analysis of flooding at the river mouths. Projections for relative sea-level rise for 2050 and 2080 will be estimated using the Canadian Extreme Water Levels Adaptation Tool.

The new wave data will be combined with existing datasets from the upper and lower St Lawrence Estuary in order to estimate the return periods of extreme events using statistical distributions (generalised Pareto, Weibull, Gumbel). Finally, joint waves – water level probabilities will be calculated to define extreme water-level scenarios associated with different return periods, and to assess the flooding probability for the various sectors at risk.

Funding

A 25 000 \$/year scholarship is available for 2 years.

Admissibility criterias

- **Fluent in French** (classes are in French)
- Meet the basic entry requirements for the M.Sc. in Oceanography at UQAR (<http://www.uqar.ca/etudes/etudier-a-l-uqar/programmes-d-etudes/3615>);
- B.Sc. in geology, geography, physics, civil engineering, or another branch of the natural sciences;
- Interest for fieldwork in coastal environment;
- Experience in computer-based data analysis (ArcGIS and/or programming with Matlab or a similar language);
- Proficiency in written and spoken English.

To apply

Send to Professor Urs Neumeier (urs_neumeier@uqar.ca) a application, which must include:

- Motivation letter;
- Curriculum vitae;
- Academic transcripts for all university years;
- Names and contact information of two references.

The selection process for candidates begins immediately and will continue until a candidate has been recruited. The successful candidate will be required to enrol full-time on the M.Sc programme in Oceanography at UQAR.