CONTEXT
Human influence on current climate change is now unequivocal. The rate of greenhouse gas (GHG) emissions continues to increase, and climate models and observations show that climate changes are accelerating in response to these emissions. These changes strongly modify the frequency and the intensity of extreme events, such as droughts, heat waves, frost-thaw cycles or extreme precipitation events. Strong rates of GHG emissions can also cause a destabilization of a component of the climate system (e.g. the sudden melt of the Arctic sea ice), a phenomenon referred to as an abrupt change. Today, very few studies have assessed the link between extreme events and cumulative emissions as well as the consequences of abrupt changes on Canadian population and infrastructures.

OBJECTIVES
- Determine the relationship between cumulative GHG emissions and the characteristics of extreme events.
- Assess how the occurrence of abrupt climate changes affects the evolution and the characteristics of extreme events.
- Identify how abrupt changes would affect climate risks at Québec regional scale.

METHODOLOGY
- Identification of climate extreme indicators relevant for Québec and Canada.
- Analysis of an ensemble of Earth System Models simulations with four different emission scenarios to study the relationship between global cumulative emissions and the extreme indicators previously defined.
- Establishment of key abrupt changes in the climate system that might be relevant for Canada and for the elaboration of marginal scenarios from the multi-model ensemble.
- Study of the evolution of extreme events during and after an abrupt change.
- Determination of marginal scenarios including abrupt changes in the ClimEx ensemble and how these abrupt changes affect climate risks at the Québec regional scale.

EXPECTED RESULTS
A catalogue of extreme events and abrupt changes relevant for climate services and adaptation strategies, with a focus on impacts over North America will be developed. A quantified link between the evolution of cumulative emissions and of characteristics of extreme events in different key regions will be determined. Potential major changes in extreme events with the occurrence of an abrupt change at the global scale and for Quebec will be listed. An ensemble of global and regional climate scenarios relevant for policy-makers and users in Quebec will be developed. Finally, three scientific articles in different peer-reviewed journals and presentations in international conferences will be submitted for publication.

BENEFITS FOR ADAPTATION
While the probability of abrupt change is somewhat low, the economic impact of such abrupt change could be staggering. In this context, the occurrence of extreme events plays a significant role in high human and economic losses. Moreover, the characteristics of extreme events may be modified over the twenty-first century, leading to potentially greater damage costs and more people injured. That is why the financial sector and the insurance industry show a growing interest in the modifications of the occurrence of extremes and its numerous impacts on living conditions. The development of new approaches to produce appropriate climate scenarios will most likely be of interest for several economic sectors.