FloodNet Annual Workshop 2015
Scientific Program

NSERC Canadian FloodNet 1st Annual General Meeting: DAY 1 Agenda	
Registration and Breakfast D1: 8:00-9:00 AM	**Breakfast and Registration in Toscana BC** • All participants register and enjoy breakfast
D1: 9:00-9:10 AM	**Welcome, Introduction and Network Update** Dr. Paulin Coulibaly, FloodNet Scientific Director
D1: 9:10-9:20 AM	**Welcome Words from FloodNet Board of Directors** Dr. Alain Pietroniro, Chair of FloodNet Board of Directors
SESSION 1a: THEME 1 - FLOOD REGIMES IN CANADA: LEARNING FROM THE PAST AND PREPARING FOR THE FUTURE	
Project 1-1 D.H. Burn D1: 9:30-10:00 AM	**Update of Current Flood and Storm Quantiles** • Project progress and plans for future research (Burn) • Extracting POT data (Ashkar)
Project 1-2 F. Ashkar D1: 10:00-10:30 AM	**Examination of Spatial and Temporal Variation of Extreme Events** • Project progress and plans for future research (Ashkar) • Trends in Canadian flood data (Burn)
D1: 10:30-10:45 AM	**Coffee Break**
SESSION 1b: THEME 1 - FLOOD REGIMES IN CANADA: LEARNING FROM THE PAST AND PREPARING FOR THE FUTURE	
Project 1-3 A. Arain D1: 10:45-11:15 AM	**Analysis and Applicability of Future Extreme Events in Regional and Local Context** • Project overview (Arain) • Update on current progress and some results (Wazneh) • Future plan and discussions (Arain)
Project 1-4 V. Nguyen D1: 11:15-11:45 AM	**Development of New Methods for Updating IDF Curves in Canada** • Update on project progress • Development of software packages for extreme rainfall modeling and IDF curves construction • Plans for future research and collaborative works
Project 1-5 A. Binns D1: 11:45-12:15 AM	**Spatial Changes to Flood Prone Areas in Urban Environments** • Overview of project (background, goal and objectives) (Binns/Guo) • Update on project progress and collaboration (Kokas) • Plan for future research (Binns/Guo)
D1: 12:15-1:15 PM	**Lunch and Network Administration Information** Dr. Kurt C. Kornelsen, FloodNet Manager
SESSION 1c: THEME 1 - FLOOD REGIMES IN CANADA: LEARNING FROM THE PAST AND PREPARING FOR THE FUTURE	

Project 1-6 P. Rasmussen D1: 1:15-1:45 PM	**Development of New Flood Estimation Manual for Canada** • Plans for Flood Estimation Manual (Rasmussen) • Climate change and floods (Rasmussen) • Discrimination between distributions (Ashkar)
SESSION 2a: THEME 2 – QUANTIFYING AND REDUCING THE PREDICTIVE UNCERTAINTY OF FLOODS	
Project 2-1 B. Tolson D1: 1:45-2:15 PM	**Comparison of Ensemble Forecast Methods for Operational Streamflow Forecasting Based on a Single Model** • Update on the project progress and orientation (Tolson)
Project 2-2 F. Anctil D1: 2:15-2:45 PM	**Comparison of Ensemble Forecast Methods for Operational Streamflow Forecasting Based on Multiple Models** • Progress and orientation (Anctil) • Accounting for three sources of uncertainty (Anctil)
D1: 2:45-3:00 PM	**Coffee Break**
SESSION 2b: THEME 2 – QUANTIFYING AND REDUCING THE PREDICTIVE UNCERTAINTY OF FLOODS	
Project 2-4 F. Anctil D1: 3:00-3:30 PM	**Evaluation of Flood Warning Based on Hydraulic Model with Assimilation and Hydrological Ensemble Forecasts** • Update on the project orientation (Anctil)
Project 2-5 A. Tilmant D1: 3:30-4:00 PM	**Real-time Reservoir Operation Based on a Combination of Long-term and Short-term Optimization and Hydrological Ensemble Forecasts** • Update on the project progress and orientation (Tilmant)
SESSION 3: DEVELOPMENT OF CANADIAN ADAPTIVE FLOOD FORECASTING AND EARLY WARNING SYSTEM (CAFFEWS)	
Project 3-1 P. Rasmussen D1: 4:00-4:30 PM	**Evaluation of Flood Forecasting and Warning Systems Across Canada** • Update on project progress and plans (Rasmussen)
Project 3-2 A. Berg D1: 4:30-5:00 PM	**Real-time Spatial Information Evaluation and Processing** • Update on project progress and future plans (Berg) • Agricultural watershed Elora Research (Berg) • SMAP/SMOS Freeze Thaw and Soil Moisture (Berg) • Using GPM and SMAP/SMOS/ASCAT in CaPA (Kornelsen) • Addressing the Issue of Data Limitation (Coulibaly)
Project 3-3 W. Zhuang D1: 5:00-5:30 PM	**Enhanced Information Communication Systems** • Update on project progress and plans (Zhuang and Song)
Project 3-4 P. Coulibaly D1: 5:30-6:00 PM	**Development of Canadian Adaptive Flood Forecasting and Early Warning System (CAFFEWS)** • Update on project progress and future plans (Coulibaly) • OpenDA Toolbox: Data Assimilation (Razavi) • Hydrologic Adapters in Delft-FEWS (Keum)
D1: 6:30-8:30 PM	**Meet and Greet Dinner** All Participants in Toscana C

NSERC Canadian FloodNet 1st Annual General Meeting: DAY 2 Agenda	
Breakfast D2: 8:00-9:00 AM	**Breakfast in Toscana B**
SESSION 4: THEME 4 – RISK ANALYSIS OF PHYSICAL, SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF FLOODS	
Project 4-1 M. Xenopoulos D2: 9:00-9:30 AM	**Role of Floods on Aquatic Ecosystem Condition** • Relationships between sediment and nutrient concentration and river discharge (D'Amario and co-authors). • Ecological and biogeochemical changes following experimental flooding (Xenopoulos and co-authors)
Project 4-2 A. Elshorbagy D2: 9:30-10:00 AM	**Modelling-based Integrated Assessment on Flood Impacts on Urban and Rural Water Resources Systems** • Progress on model development for Prairie watersheds (Hossain/Elshorbagy)
Project 4-3 A. Elshorbagy D2: 10:00-10:15 AM	**Flood Risk Analysis and its Utility for Management Decisions** • Plan for future research to develop flood risk analysis framework (Elshorbagy)
Project 4-4 J. Eyles D2: 10:15-10:30 AM	**Assessing and Planning for the Socio-Economic Effects of Floods** • Plan for future research to develop socio-economic flood risk indicators (Yiannakoulias)
D2: 10:30-10:45 AM	**Coffee Break**
Working Group Meetings D2: 10:45-12:15 AM	**Working Group Meetings** Working Group 2 & 3 (Themes 2 & 3) – Toscana Foyer BC Working Group 1 (Theme 1) – York Room Working Group 4 (Theme 4) – MacKenzie Room
D2: 12:15-1:15 PM	**Lunch in Toscana B**
SESSION 5: FLOODNET POSTERS FOR ALL THEMES	
D2: 1:15-2:15 PM	**Poster Session and Meetings** All Themes Poster Session – Toscana B Board of Directors Meeting – York Room Partner Advisory Committee Meeting – MacKenzie Room
D2: 2:15-2:30 PM	**Coffee Break – Toscana Foyer BC**
D2: 2:30-4:30 PM	**DHI FEWS Workshop** DHI Flood Forecasting Workshop (Delaney) – Toscana B Board of Directors Meeting (Continued) – York Room

FloodNet Poster and Oral Session Abstracts

Project 1-1: Update of current flood and storm quantiles
Dr. Donald H. Burn, University of Waterloo

Floods are arguably the most common natural disaster with considerable social, economic and environmental consequences. Damages from floods can include property loss, destruction of infrastructure, loss of life, social and economic disruption from evacuations, and environmental degradation. This component of FloodNet explores ways to better estimate the probability of occurrence of extreme events. The research will provide updated estimates for flood and extreme rainfall quantiles for many locations across Canada as well as a unified procedure for applying frequency analysis that reflects the diversity of hydrologic and meteorological conditions in Canada. The research adopts a regional (pooled) approach to frequency analysis. Important aspects of the pooled approach will be presented and future plans will be discussed.

Project 1-1: Extracting peaks-over-threshold (POT) data from daily stream flow data.
Dr. Fahim Ashkar, Université de Moncton

A computer program (using R) will be presented and discussed to extract peaks-over-threshold (POT) data from daily stream flow data. The user needs to fix how many flood events are desired on the average per year (e.g., 1.5 or 3 or ...) and the program automatically extracts these events along with their characteristics such as duration, volume and intensity. The program also allows the separation of flood events by a user-defined minimum duration (in days) in order to fulfill the requirement of statistical Independence between successive flood events.

Project 1-1: Update of current flood quantiles in Canada
Shabnam Mostofi Zadeh, University of Waterloo

Extreme hydrological events such as floods can have a profound effect on human health, safety, infrastructure and environment. It is hence essential to accurately estimate the probability of exceedance of these extreme events to design appropriate infrastructure. Flood frequency analysis relates the magnitude of extreme events to their frequency of occurrence. In Canada, there is no up to date national standard for flood frequency analysis. This project will explore ways to better estimate the probability of occurrence of flood events. The objective of this research is to characterize the current flood regimes for selected locations in Canada and provide updated estimates of extreme events.

Project 1-1: Exploration of spatial and temporal scaling of regions for rainfall Intensity Duration Frequency curve estimation
Zhe (Emma) Yang, University of Waterloo

Intensity–duration–frequency (IDF) curves are widely used to provide the basic information of rainfall event magnitudes for the design of civil infrastructure. Pooled (regional) frequency analysis is an attractive approach to the estimation of IDF design events to overcome the effects of inadequate rainfall data at a site of interest. To obtain accurate quantile estimation of rainfall events, the proposed research aims to find the effective pooling group size and length of record for the homogeneous group. In the context of improved pooling approach, which includes the effects from topographic and climatic features, a new sampling method will be proposed to enhance the pooling group by gathering an unbiased population for the fitted distribution. Variance reduction methods and machine learning techniques will be used to reduce the confidence intervals and search for the effective sample size in Monte Carlo simulation. Based on the effective sample obtained, the effective length of data record will be calculated using the characteristics of its binomial distribution, during which the non-stationary factors will be considered. Techniques for applying this system for the accurate estimation of IDF curves in an ungauged area will be explored.

Project 1-2: Improving the accuracy of confidence intervals for flood quantiles
Dr. Fahim Ashkar, Université de Moncton

Fitting frequency distributions to flood or extreme rainfall data allows the calculation of quantile estimates. To assess the magnitude of the statistical error involved in the estimation, it is common practice to calculate Confidence Intervals for quantiles (CIQs). Large-sample theory, which assumes that the quantile estimators are normally distributed, is the standard approach currently used to construct such CIQs. We will show that this approach can lead to very inaccurate results for quantiles in the right-tail of a fitted distribution to hydrological data. This is especially true for distributions used in the POT approach to flood or extreme rainfall analysis such as the generalized Pareto distribution. We therefore will propose a methodology to improve the accuracy of CIQs based on improving the fit of the normal distribution to quantile estimators under sample sizes typically to be expected in the FloodNet project.

Project 1-2: Nonstationary analysis of annual maximum streamflow of Canada
Xuezhi Tan, University of Alberta

Both natural climate change and anthropogenic impacts may cause nonstationarities in hydrological extremes. In this study, long-term annual maximum streamflow (AMS) records from 145 stations over Canada were used to investigate the nonstationary characteristics of AMS, which include abrupt changes and monotonic temporal trends. Nonparameteric Pettitt test was applied to detect abrupt changes, while temporal monotonic trend analysis in AMS series was conducted using the nonparameteric Mann-Kendall and Spearman tests, and parametric Pearson test. Nonstationary frequency analysis of the AMS series was done using a group of non-stationary probability distributions. The nonstationary characteristics of Canadian AMS were further investigated in terms of the Hurst exponent (H) which represents the long-term persistence (LTP) of streamflow data. Our results indicate that for Canadian AMS data, abrupt changes are detected more frequently than monotonic trends, partly because many rivers began to be regulated in the 20th Century. Drainage basins which have experienced significant land-use changes are more likely to show temporal trends in AMS, compared to pristine basins with stable land-use conditions. The nonstationary characteristics of AMS were accounted for by fitting the data with probability distributions with time-varying parameters. Large H found in almost 2/3 of the Canadian AMS dataset indicates strong LTP, which may partly represent the presence of long-term memories in many Canadian river basins. Further, H values of AMS data are positively correlated with the basin area of Canadian rivers. It seems that nonstationary frequency analysis, instead of the traditional, stationary hydrologic frequency analysis should be employed in future.

Project 1-3: Analysis and applicability of future extreme events in regional and local context: An overview of Project 1.3 and initial work being done

Dr. M. Altaf Arain, McMaster University

Project 1.3 focuses on to investigate the limitations and applicability of various indices to describe and characterize extreme weather events, in particular precipitation events at local scales. It also strives to explore the applicability of extreme weather indices for predicted future climatic conditions at local scales in selected regions across Canada.

Currently the historic trends and applicability of various extreme weather indices are begin explored in the Hamilton region using observed, gridded and regional and global climate model data sets. Initial results from this analysis will be presented in one oral and one poster presentation.

Project 1-3: Historical spatial and temporal climate trends for Hamilton region

Dr. Hussein Wazneh, McMaster University

Extreme events have serious impacts on communities and vulnerable populations. In recent years many indices have been developed to describe and characterize extreme weather. However, the limitation and the applicability of these indices have not been evaluated at regional and local scales. In this study, a suite of indices derived from daily temperature and precipitation data, has computed and analyzed for the Hamilton region. Seasonal and annual indices for the period 1951 to 2011 are gridded to explore the historic spatial and temporal variability of climate trends. Trends in the gridded fields are computed and tested for statistical significance. Results showed that over the historical period, the two temperature indices; number of Frost days (FD) and percentage of days when minimum temperature less than10th percentile (TN10p) had a decreasing trend. However, for the precipitation indices, total precipitation in winter, spring and summer had an increasing trend.

Project 1-3: Development of future Intensity-Duration-Frequency curves using local and regional scale methods

Marc D'Allesandro, McMaster University

Currently Intensity-Duration-Frequency (IDF) curves are formulated based on historical rainfall data, which excludes the notion of climate change. Therefore, finding the most fundamental approaches to update IDF curves that accounts for climate change is essential, or else municipalities face the risk of infrastructure failure. The objective of this study is to apply local and regional scale methods to update IDF statistics and to generate an ensemble of IDF curves for selected stations in Southern Ontario. Rainfall intensities will be compared for all 2 to 100 year return-periods for event durations ranging from 15 minutes to 24 hours.

Project 1-3: Hamilton Climate Change Trends and Uncertainty Analysis
Dr. Tara Razavi, McMaster University

Project 1-4: Development of IDF Curves for Different Sites in Canada
Dr. Van-Thanh-Van Nguyen, McGill University
The presentation will provide a summary of current research progress in the development of IDF relations for different sites in Canada.

Project 1-4: Development of IDF Curves for Different Sites in Canada
Huy-Truong Nguyen, McGill University
The presentation will provide a summary of current research progress in the development of IDF relations for different sites in Canada.

Project 1-4: Development of IDF Curves for Different Sites in Canada
Dr. Myeong-Ho Yeo, McGill University
The presentation will provide a summary of current research progress in the development of IDF relations for different sites in Canada.

Project 1-4: Possible Impact of climate change to Future Storms of Alberta
Dr. Thian Yew Gan, University of Alberta
Under climate change impact, warming likely means that extreme storms are expected to occur more frequently and in greater severity, resulting in municipal Intensity-Duration-Frequency (IDF) curves with higher intensities and shorter return periods. Two regional climate models, MM5 (Pennsylvania State University/National Center for Atmospheric Research RCM), and WRF (Weather Research Forecasting) model of NCAR, were set up in a three-domain framework to simulate future summer (May to August) precipitation of Alberta and Northwest Territory of Canada. MM5 was forced with climate data of four global climate models for the baseline period of 1971-2000 and 2011-2100 based on the Special Report on Emission Scenarios A2, A1B, and B1 of IPCC (2007). Due to the bias of MM5's simulations, a quantile-quantile bias correction method and a regional frequency analysis was applied to derive grid-based IDF curves for Alberta. Future IDF curves show a wide range of increased intensities especially storms of short durations. WRF was forced also with climate data of several GCMs for the baseline, 2050s and 2080s based on the RCP 4.5 and RCP 8.5 climate scenarios of IPCC (2013). Projected upward shift in intensities of future storms essentially mean a decrease in the return periods of future storms of similar intensity and storm durations. Under potential impact of climate change, the risk of flooding in Alberta and other parts of Canada is expected to increase.

Project 1-4: Risk of Exceeding Extreme Design Storm Events under Possible Impact of Climate Change
Dr. Chun-Chao Kuo, University of Alberta

Project 1-5: Spatial Changes to Flood Prone Areas in Urban Environments (in Session 1b)
Dr. Andrew Binns, University of Guelph & Western University

This presentation provides a progress report and update on Project 1-5 (spatial changes to flood prone areas in urban environments). The goal of this project is to predict spatial changes to flood prone areas in urban environments as a result of changing environmental and hydrological factors. In particular, this project seeks to assess the effect of intensifying urban development (changes in land use and modification to fluvial systems) on spatial changes to flood prone lands by simulating historical and future scenarios. Case studies in Toronto, Hamilton and Edmonton will be investigated To date, work on this project has begun to examine historical flooding occurring along portions of Black Creek in Toronto in collaboration with partners at the Toronto and Region Conservation Authority. Future work on this project will explore flooding at sites in Hamilton and Edmonton. This project will produce a greater understanding of the relationship between flooding and land-use in urban environments. Results will aim to provide improved guidance for future urban development and will assist in the planning and development of flood mitigation measures, including more effective stormwater management measures.

Project 1-6: Discriminating between two competitive flood frequency models
Dr. Fahim Ashkar, Université de Moncton

In performing frequency analysis on an observed flood or extreme rainfall dataset, a common approach is to fit several competitive frequency models to the data and then exclude those that do not provide adequate fit. In the final analysis, the user is often faced with having to choose between a specific pair of competitive models. We will propose some practical methods for discriminating between two competitive frequency models. Among the discrimination methods to be compared: one is based on the Anderson-Darling goodness-of-fit (GoF) statistic, another on the ratio of maximized likelihood, and the third on a transformation to normality followed by application of the Shapiro-Wilk GoF statistic. This last discrimination method will be shown to display some practical advantages for sample sizes to be expected in the FloodNet project.

Project 2-1: Preliminary hydrologic model development for FLOODNET basins
Dr. Bryan Tolson, University of Waterloo

Preliminary hydrologic model results will be overviewed in multiple research basins. Model calibration results and spatial discretization strategies will be presented. Future ensemble forecasting plans will be outlined.

Project 2-1: Hydrologic model of the Madawaska River Basin
Hongli Liu, University of Waterloo

Project 2-2: Post-processing of Canadian ensemble meteorological forecasts by exploiting the recent reforecasting product over a 32-day forecast horizon.
Dr. Mabrouk Abaza, Université Laval

Biases and dispersion errors of Canadian ensemble meteorological forecasts need to be addressed, namely through a statistical post-processing of the output data. The Bayesian Model

Averaging (BMA), which is a statistical post-processing method for ensemble forecasts that can lead to calibrated probabilistic forecast data for weather quantities at individual sites, was chosen to post-process the 20-member Canadian meteorological product. Eighteen years of CMC ensemble reforecasts, which contain 4 nonexchangeable members and extends up to 32 days, will be used in the BMA process. Comparison will be performed between the raw ensemble outputs and the BMA corrected ones. The corrected meteorological forecasts (precipitation and temperature) will thus be integrated into thae hydrological model to verify if it improves or not the hydrological forecasts.

Project 2-2: Combining three tools to decipher the main sources of uncertainty in hydrometeorology.

Antione Thiboult, Université Laval

Hydrological ensemble prediction systems offer the possibility to dynamically assess forecast uncertainty. An ensemble may be issued wherever the uncertainty is situated along the meteorological chain. We commonly identify three main sources of uncertainty: meteorological forcing, hydrological initial conditions, and structural uncertainty. Among others, meteorological ensemble prediction systems, data assimilation and multimodel approach are tools that proved to be efficient to decipher these uncertainties respectively.

The knowledge about these individual techniques is getting broader and many individual applications can be found in the literature. Even though they improve upon traditional forecasting, they frequently fail to issue reliable hydrological forecast as all sources of uncertainty are not tackled. Therefore, an improvement can be obtained in combining them, to provide a more comprehensive, specific, and cohesive handling of errors. Moreover, using these techniques separately or in combination allows to issue better forecasts, to diagnose the contribution of each technique accounts and to untangle sources of uncertainty.

This study evaluates performance in terms of accuracy and reliability of an ensemble composed of 20 lumped hydrological models chosen for their structural and conceptual diversity. The multimodel ensemble is coupled with the ECMWF probabilistic meteorological weather forecast and tested on more than 2 years of 10-day ahead forecasts and 20 catchments under important nival influence while the Ensemble Kalman filter is used to reinitialize state variables prior to the forecasting step.

Results show that even if the multimodel ensemble, the meteorological ensemble, and the data assimilation are efficient, they do not individually allow to issue a reliable and accurate predictive distribution for all lead times. However, their actions are complementary and by combining them, it is possible to issue a forecast that is accurate and nearly reliable. The EnKF contributes largely to the required ensemble spread but fails to maintain it and needs to be supported by a multimodel approach and meteorological ensemble forcing. Finally, the different tools, and the EnKF in particular, need to be set accordingly to the tools they are combined with to ensure that the uncertainty is deciphered correctly.

Project 2-5: Real-time reservoir operation based on a combination of long-term and short-term optimization and hydrological ensemble forecasts.

Dr. Amaury Tilmant, Université Laval

Traditional stochastic optimization techniques are not computationally amenable methods for solving large-scale reservoir operation problems subject to hydrological ensemble forecasts (H-EPS). Most attempts found in the literature have adopted simplifications and/or case studies that are not representative of the real conditions faced by operators in Canada. Recent advances in the field of stochastic programming offer new opportunities in terms of modelling details, particularly with respect to the size of the system and to the treatment of hydrologic uncertainty. We propose a solution strategy based on the construction of a locally accurate approximation of the objective function instead of an exhaustive representation over the entire state-space. This approximate solution strategy is particularly attractive here because the use of frequently updated H-EPS implies that there is no need to explore the entire state space but only the most relevant subset considering the initial status of the system and the forecasts.

Project 3-2: Estimating root-zone moisture by assimilating near-surface soil moisture data from SMAP datasets

Dr. Kim Huong Hoang, McMaster University

Microwave remote sensing becomes a useful tool for near-surface soil moisture estimation based on the contrast in dielectric properties between dry soil and water derived from backscatter data. However, the variation in backscattering is influenced by topography, surface roughness and vegetation, which makes the tasks of estimating soil moisture accurately more difficult. The spatio-temporal resolution of the remote sensing data is also a drawback for near-surface soil moisture retrieval.

In the case of flood prediction and flood forecasting application, this research focuses on decreasing the drawback previously mentioned, while also improving the near-surface soil moisture accurately in order to obtain the estimated root-zone soil moisture accurately.

The Soil Moisture Active Passive (SMAP) data will be used for near-surface soil moisture retrieval. As for the root-zone soil moisture estimation, an adapted method will be applied to Hamilton-Halton watershed.

Project 3-3: Enhanced Information Communication Systems

Dr. Wei Song, University of New Brunswick

In this presentation, we will introduce the work progress of Project 3-3 in the past year. In particular, we will highlight some interesting wireless communication approaches we proposed to collect and disseminate data efficiently and reliably. These include a novel channel access scheme for a multihop wireless sensor network, an opportunistic cooperation strategy for a wireless ad hoc network, and a social-aware data dissemination approach with the mobile social network. More details of our work will also be found in our posters presented in this workshop.

Project 3-3: Energy Efficient Medium Access Control for D2D Communications
Kamal Rahimi Malekshan, University of Waterloo

Efficient radio spectrum utilization and low energy consumption in mobile devices are essential in developing next generation wireless networks. This work presents a new medium access control (MAC) mechanism to enhance spectrum efficiency and reduce energy consumption in a wireless ad hoc network. A set of coordinator nodes, distributed in the network area, periodically schedule contention-free time slots for all data transmissions/receptions in the network, based on transmission requests from source nodes. Adjacent coordinators exchange scheduling information to effectively increase spatial spectrum reuse and avoid transmission collisions. Moreover, the proposed MAC scheme allows a node to put its radio interface into a sleep mode when it is not transmitting/receiving a packet, in order to reduce energy consumption. Simulation results demonstrate that the proposed scheme achieves substantially higher throughput and has significantly lower energy consumption in comparison with existing schemes.

Project 3-3: Social-Aware Energy-Efficient Data Dissemination with D2D Communications
Yiming Zhao, University of New Brunswick

Recently, data dissemination in wireless networks has gained increasingly attention because of its application value in a wide range of applications such as disaster alert and event notification. Meanwhile, device-to-device (D2D) communication has appeared as an energy efficient approach for communication among mobile terminals. In this work, we propose a novel social-aware data dissemination approach using D2D communication underlaying cellular networks. Our approach can effectively reduce the total energy consumption of mobile terminals and decrease the completion time of data dissemination.

Project 3-3: Cooperative Communication in Wireless Device-to-Device Networks
Yong Zhou, University of Waterloo

Wireless device-to-device networks have been attracting more and more attentions in recent years from both academia and industry, because of their low deployment costs and broad applications. Due to the scarcity of the radio spectrum, enabling concurrent cooperative transmissions can achieve both spatial frequency reuse gain and spatial diversity gain to enhance spectrum utilization. The concurrent cooperative transmissions redistribute the interference over the network. Accurate characterization of interference is a fundamental step towards understanding the performance of cooperative communication. In this presentation, we evaluate the effectiveness of cooperative communication from a perspective of overall network performance, while taking into account the interference redistribution due to relay transmissions.

Project 3-4: Hydrologic Adapters in Delft-FEWS
Dr. Jongho Keum, McMaster University

Flood Forecasting and Early Warning System (FEWS) is an open platform that handles several modules designed for customizing hydrologic forecasting. One of the major benefits of FEWS platform is that FEWS itself does not include any hydrologic or hydraulic models, but is capable of connecting various external models using adapters. The roles of adapters can be summarized in 5 basic steps: (1) export input data from FEWS, (2) convert the input data for an external model, (3) execute the external model, (4) convert the model output to FEWS format, and (5) import the output to FEWS.

Project 3-4: Hybrid Ensemble Bayesian Flood Forecasting System
Shasha Han, McMaster University

In the past few decades, floods have been seen as one of the most common and largely distributed natural disasters in the world. If floods can be predicted accurately in advance, their negative impacts could be minimized. In terms of uncertainty quantification, the Bayesian forecasting system (BFS) is an ideal theoretic framework for probabilistic flood forecasting. Therefore the proposed research aims to develop a hybrid ensemble Bayesian forecasting system (HEBFS) based on the existing Bayesian theory and algorithms to generate an ensemble of probabilistic flood forecasts through multi-model combination, as well as implement the HEBFS in the Humber River watershed and compare forecast results with existing forecasting model. The HEBFS aims to assimilate various sources of information and is expected to further improve flood forecast accuracy, and in the meantime, extend the forecast lead time.

Project 4-1: Ecological and biogeochemical changes following experimental flooding (a review of the whole ecosystem experiments at the Experimental Lakes Area)
Dr. Marguerite Xenopoulos, Trent University

For this first FloodNet meeting we are presenting our proposed research to improve our understanding of flooding events on ecological responses in aquatic systems. We propose to do this in two ways: 1) an empirical approach which links solute concentrations and river discharge and 2) an experimental approach using extensive datasets on two whole ecosystem flooding experiments from the Experimental Lakes Area. Sediment and nutrient concentration–discharge relationships have been widely used to better understand the processes that control water quality and flooding events are typically expected to increase the loading of solutes in aquatic environments. Here we will examine concentration–discharge relationships for two solutes, total phosphorus and total suspended sediments from a handful of rivers in Manitoba and Ontario with a focus on the peak flow (the maximum water level reached during a high flow event). The relationship between water discharge and suspended sediment concentrations as well as total phosphorus will be characterized with landscape parameters and contrasted with both local and inter-annual time scales using available datasets from our partners (AAFC, Manitoba Water Stewardship, Ontario Conservation Authorities and Ontario Ministry of the Environment). For the flooding experiments at the ELA, several catchments were flooded experimentally in the 1990s. Using the experimental dataset we can quantify the changes in carbon and nutrient fluxes before, during and after flooding.

Project 4-1: Relationships between sediment and nutrient concentration and river discharge

Sarah D'Amario, Trent University

For this first FloodNet meeting we are presenting our proposed research to improve our understanding of flooding events on ecological responses in aquatic systems. We propose to do this in two ways: 1) an empirical approach which links solute concentrations and river discharge and 2) an experimental approach using extensive datasets on two whole ecosystem flooding experiments from the Experimental Lakes Area. Sediment and nutrient concentration–discharge relationships have been widely used to better understand the processes that control water quality and flooding events are typically expected to increase the loading of solutes in aquatic environments. Here we will examine concentration–discharge relationships for two solutes, total phosphorus and total suspended sediments from a handful of rivers in Manitoba and Ontario with a focus on the peak flow (the maximum water level reached during a high flow event). The relationship between water discharge and suspended sediment concentrations as well as total phosphorus will be characterized with landscape parameters and contrasted with both local and inter-annual time scales using available datasets from our partners (AAFC, Manitoba Water Stewardship, Ontario Conservation Authorities and Ontario Ministry of the Environment). For the flooding experiments at the ELA, several catchments were flooded experimentally in the 1990s. Using the experimental dataset we can quantify the changes in carbon and nutrient fluxes before, during and after flooding.

Project 4-2: Representation of a Canadian Prairie Watershed using physically based model and system dynamics approach.

Dr. Amin Elshorbagy, University of Saskatchewan

This study of project 4-2 aims at modeling floods in the Canadian Prairies. The Qu'Appelle River Basin (QRB) in the southeast of Saskatchewan is selected as a typical watershed representing the challenging prairie hydrology. Unique topography with dynamic hydrological contributing area is the main reason for complex hydrological connectivity in the Canadian prairie region. Thousands of small depressions are one of the main features in the prairies. Glacier originated depressions or prairie potholes are responsible for non-contributing drainage areas. The dynamic relationship between contributing drainage area, soil moisture, precipitation, and runoff makes commonly used watershed models ineffective in the prairies. Also the existence of water management in the form of a series of controlled lakes and reservoirs creates a complex hydrological feedbacks and artificial storage within the watershed. Other common features, such as long winters, snowmelt runoff events, less prominent baseflow, high seasonal and annual streamflow variability, climatic variability, windblown snow transport, and high evaporation rate in summer are also present in the QRB.

In this study, a hybrid modeling approach using a physically based hydrological model and a System Dynamics (SD) model is proposed to represent the unique prairie hydrology. MESH is used as a physically based environmental modeling system, which is a combination of Canadian Land Surface Scheme (CLaSS) and WATFLOOD. MESH model is used for developing a simulation model for the natural hydrological processes, and SD is used to simulate the water management portion, aiming at combining both in an integrated approach. MESH model was recently modified using the PDMROF algorithm, to replace WATROF, for prairie runoff generation. Unfortunately, this algorithm assumes no interflow or base flow in the watershed. The PDMROF assumption is valid for watersheds with high annual flow, but this assumption is less accurate for low runoff producing watersheds; e.g. sub-basins of QRB. Therefore, a new algorithm that combines PDMROF surface flow generation algorithm with WATROF algorithm’s interflow and baseflow generation algorithm is developed. The Results shows improvement of the modified PDMROF algorithm over original PDMROF algorithm. The future steps include finalizing the SD component, integrating MESH and the SD in one hybrid modeling approach, and simulating flood scenarios of the watershed.

Project 4-2: Representation of a Canadian Prairie Watershed using physically based model and system dynamics approach

Md Kamrul Hussein, University of Saskatchewan

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Dr. Raja Bharath, University of Saskatchewan

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