Evaluating the role of forages and grasslands on flood and drought resiliency with advanced simulation technology.

Presented at: Agricultural Institute of Canada's 2017 Conference Winnipeg, MB, AP 24-26

Growing Forward 2 Canada





The *HydroGeoSphere* Simulation Platform





- 20+ years of development at U.
 Waterloo and U. Laval
- Simulation of the entire terrestrial water cycle
- Utilizes state of the art HPC and 'big data'





HGS Simulation Methodology



Finite Element Analysis HGS Prairie Pothole Example



Agricultural Applications











Water management and smart watersheds



Assiniboine River Basin (~154,000 km²)



Association





Perennial Grass vs. Annual Crop – Root Structure







Image from landinstitute.org



Preliminary Landcover Sensitivity Tests

1. Scenario 1 (flow_out_woodlands)

Irregular channel with meanders and dense growth woody debris (logs),

Overbank with n=0.5 and stream channel n = 0.06



3. Scenario 3: (flow_out_original):

Minimal cover with overbank n=0.3 and stream channel = 0.03





2. Scenarios 2 (flow out grasslands):

Short grass Prairie with overbank n = 0.1 and stream channel n = 0.05





Preliminary Landcover Test Results







-flow out original

Flow_out_woodlands
Flow_out_grasslands



Model Construction - Key Datasets

Climate and weather, surficial geology, bedrock geology, soil, landcover, terrain elevation, river and stream geometry, surface water operations (dams and diversions)



Model Constuction – Spatial Resolution





- 7 layers with 276,041 nodes per layer (~1.9 M total)
- Maximum nodal spacing of 1500 m
- Target nodal spacing along rivers is 250 m





Model Construction - Subsurface Structure





Simulation Output - Land-Surface



Associat

Dynamic representation of:

- Standing water depth
- Depth to groundwater
- Evapotranspiration rates
- Infiltration rates
- Soil moisture levels

30 year monthly average soil moisture levels - simulated





Simulation Output - Surface Water



Dynamic representation of:

- Surface water flow rates at any point along river and stream network
- Anthropogenic influences such as dam and diversion operation

30 year monthly average surface water flow rates for month of April





Simulation Output – Surface Water Flow Rates



Applications for Assiniboine R. Basin Model



Immediate goal

• Quantify the role of perennial grass and forage landcover on flood and drought resiliency across the basin

Future opportunities

- Quantification of Ecosystem Goods and Services value associated with alternative and natural land cover
- Climate change impacts and mitigation strategies
- Drainage impacts on basin hydrology
- Water quality and nutrient fate and transport
- •
- and others





