Snow and Lake Hydrology at the Forest/Tundra Transition in the Western Canadian Arctic: Processes, Parameterization, and Modelling

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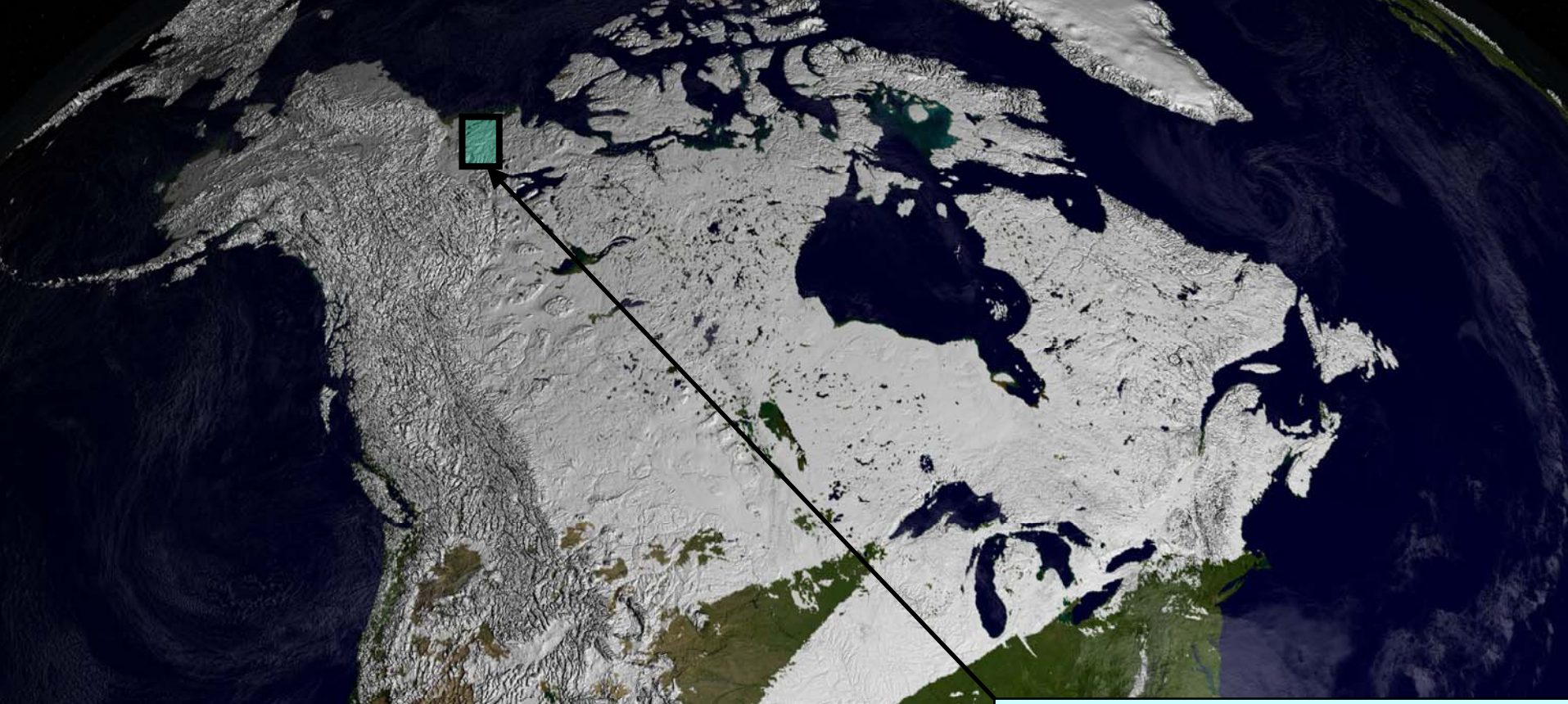
Main Themes of this project

- Will consider:
  - snow accumulation, melt and runoff at a variety of scales
  - the role of lakes in the hydrological cycle
  - understanding processes and developing parameterization
  - a variety of terrain and vegetation types at the northern forest/tundra transition zone, including: forest, shrubs, tundra and lakes
  - use a variety of models. In addition to CRHM, CLASS, and MESH, we use a variety of process models, small scale hydrological models, and snow models.



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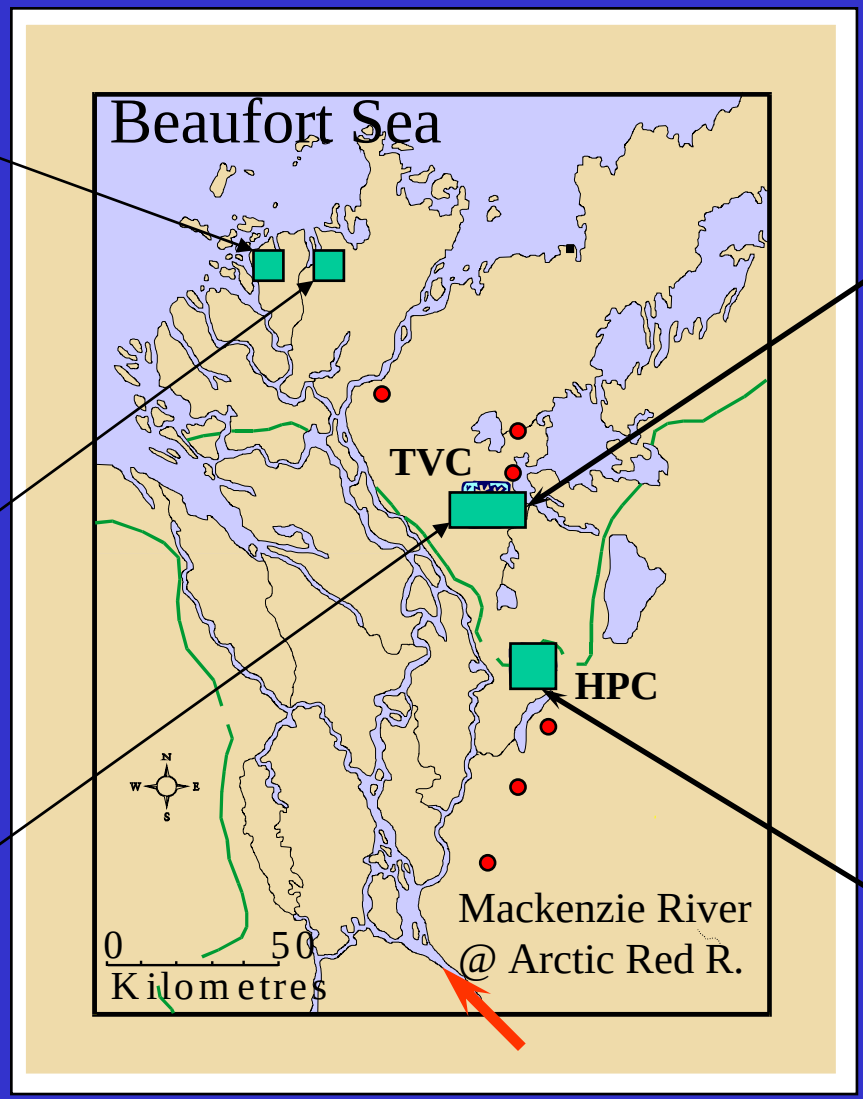
Long term observation sites that contribute to: a variety of Environment Canada programs including ongoing studies related to the proposed MGP project; CCAF; a previous CFCAS project; and MAGS for example

Existing Field Sites - Inuvik, NWT area



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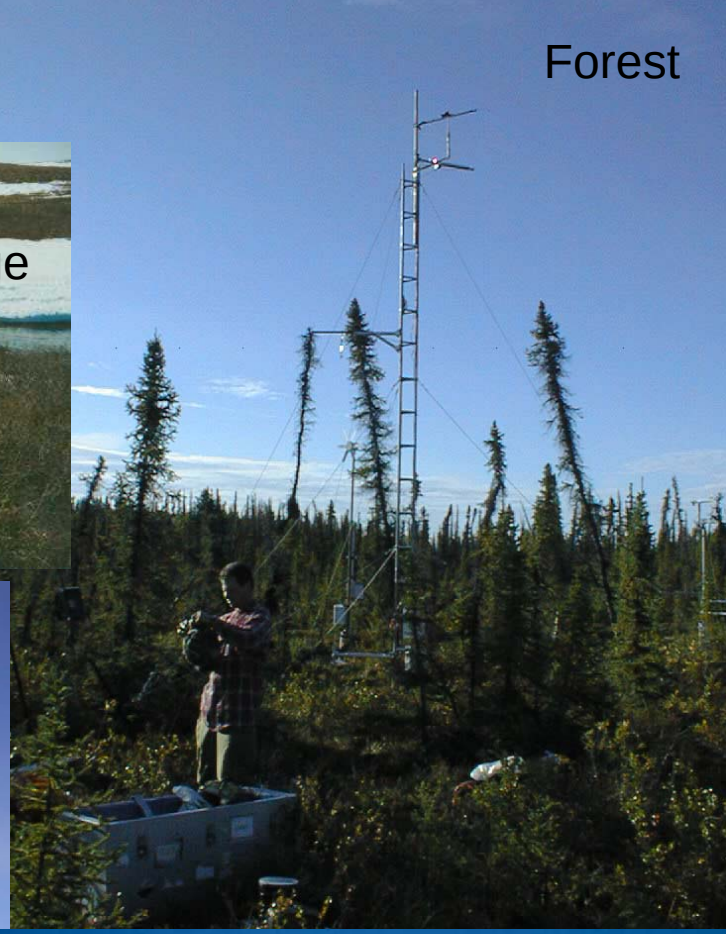
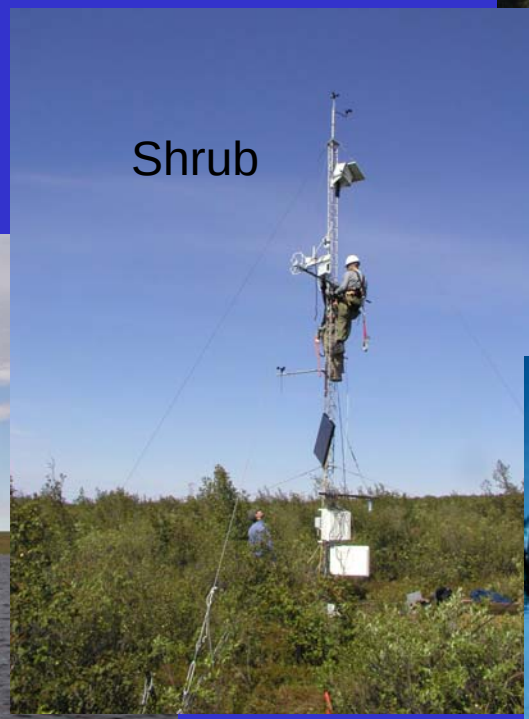
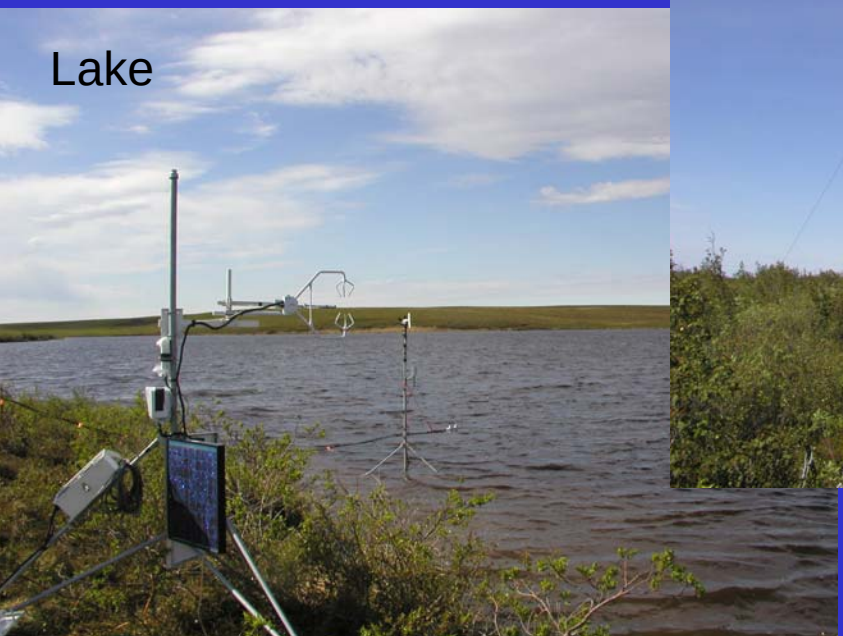
"Standard" hydrological research observations



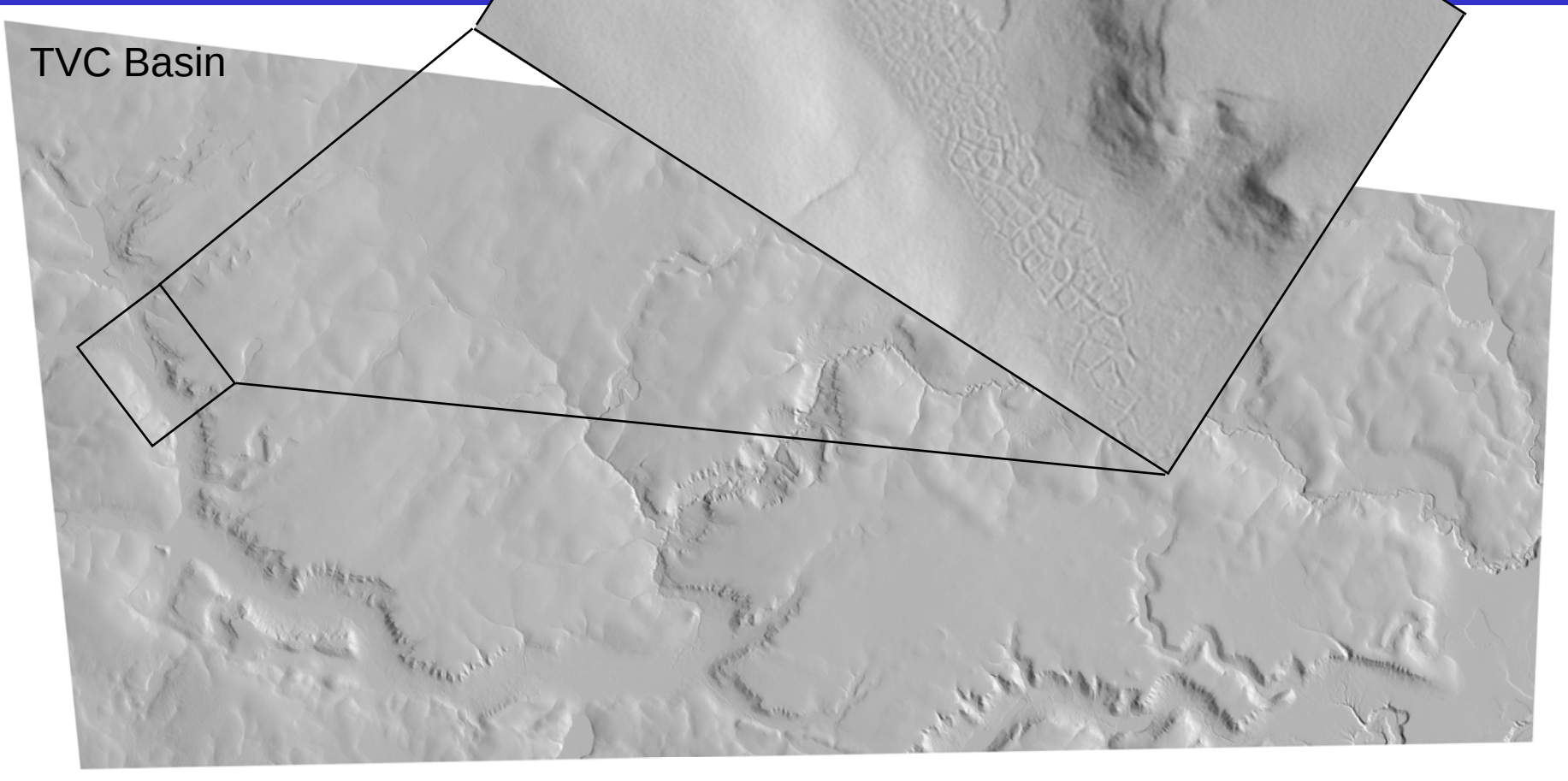




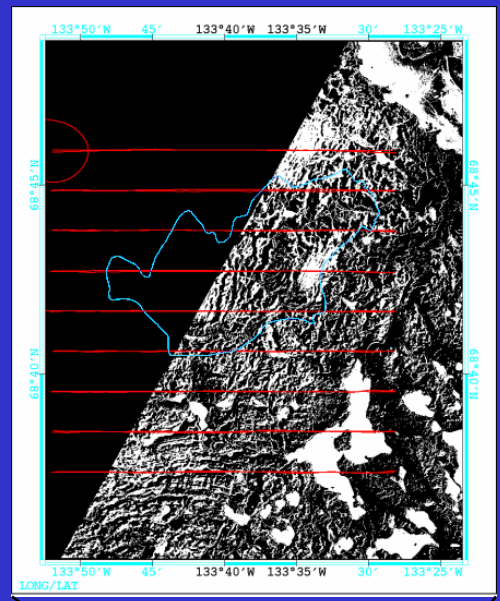
LiDAR Data

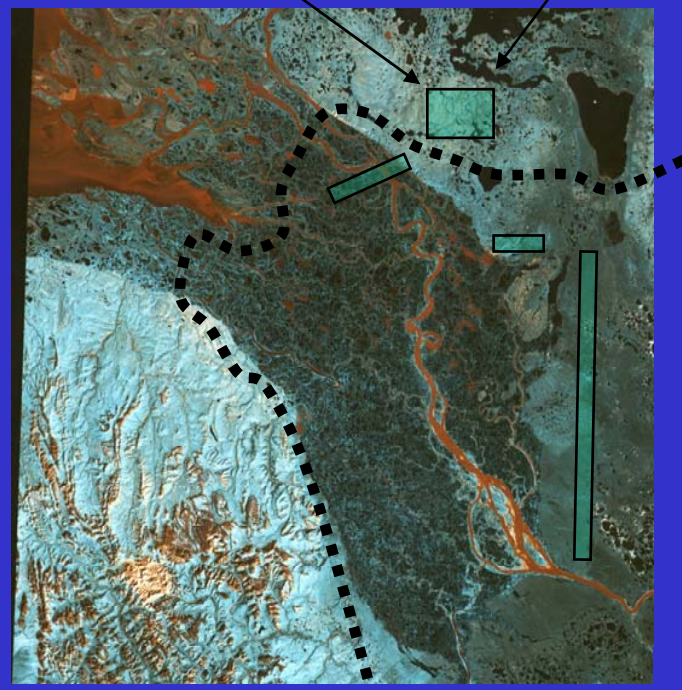
-Data available for:
- HPC
- TVC
- Drained like site
- Denis Lagoon

Data includes:
- DEM
- Vegetation height
- at 2 m x 2m grids



NRC Twin Otter Aircraft





- aircraft eddy correlation measurements provide an estimate of basin average measurement of spatial variability at a 2 km resolution

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MACKENZIE MAGS ÉTUDE GEWEX STUDY

This combination of data sets helps us understand how to scale upwards from a point to a region

- ***Larger Scale***
  - 20 km: aircraft flux measurements
  - **2 km**: aircraft flux measurements
  - **100 m**: tower based flux measurements
  - **Point**: measurements of micromet, snow accumulation and melt
- ***Smaller Scale***

Experience with a variety of models used to upscale and to test parameterizations

- ***Larger Scale***
  - CRCM
  - MESH
  - CLASS
  - CRHM
  - TOPOFLOW
  - SNOWMODEL
  - "Pohl" model (collection of radiation, wind, advection, melt models)
  - **Process models**
- ***Smaller Scale***

Snow Processes and Parameterizations

Will build upon work by our research group to consider:

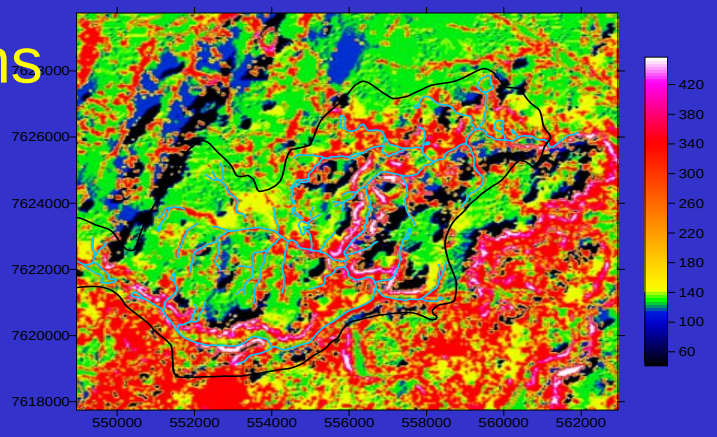
- Spatial variability in
  - snow accumulation
  - turbulent fluxes
  - incident radiation
  - advection
  - snowmelt
  - change in SWE and factional area

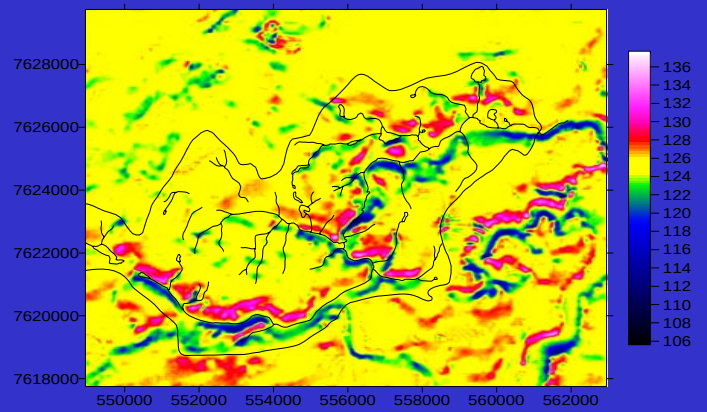
- include aircraft flux data for validation

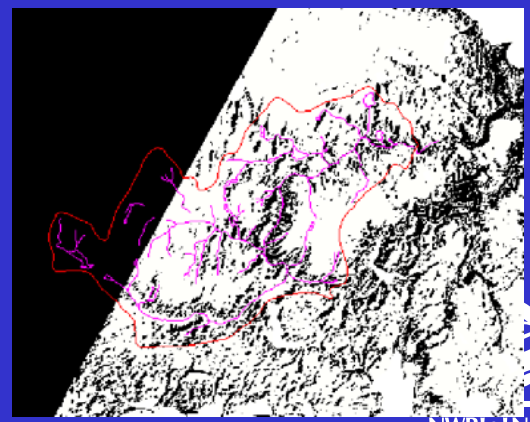
- utilize Lidar DEM and vegetation data

- include multiple years of data

- improved incorporation of the role of shrubs using ongoing work with Murray Mackay using observations and CLASS







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Lake Processes and Parmeterization

Will consider:

- lake ice
- open water evaporation
- energy and water balance
- runoff into/out of lake
- will work with Murray Mackay to test lake model
- will work with Raoul Granger to consider lake evaporation
- consider effects of sub-grid lakes on regional fluxes


TVC Lake


Denis Lagoon

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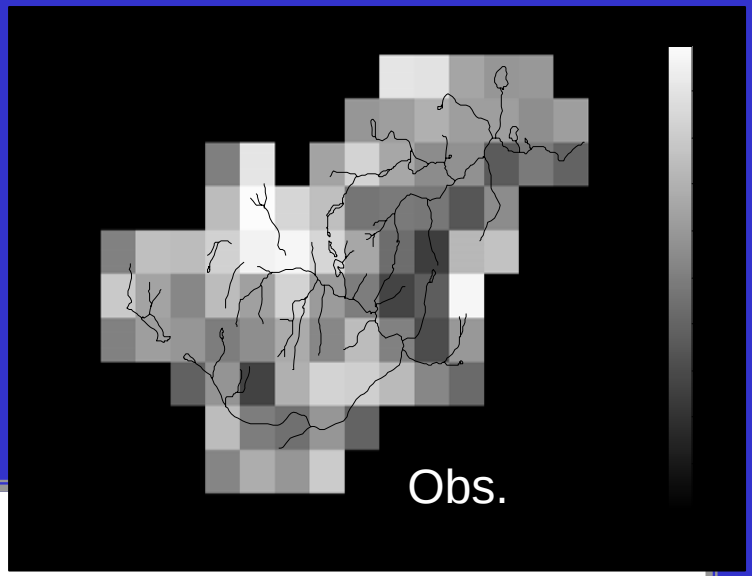
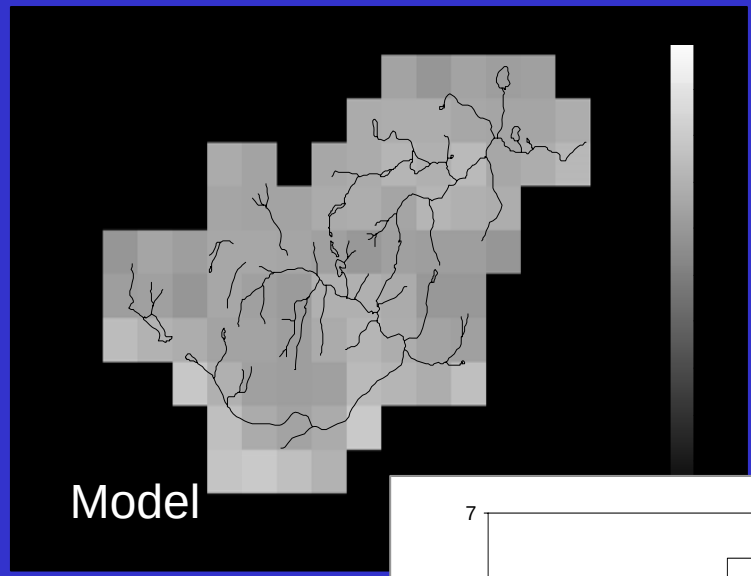
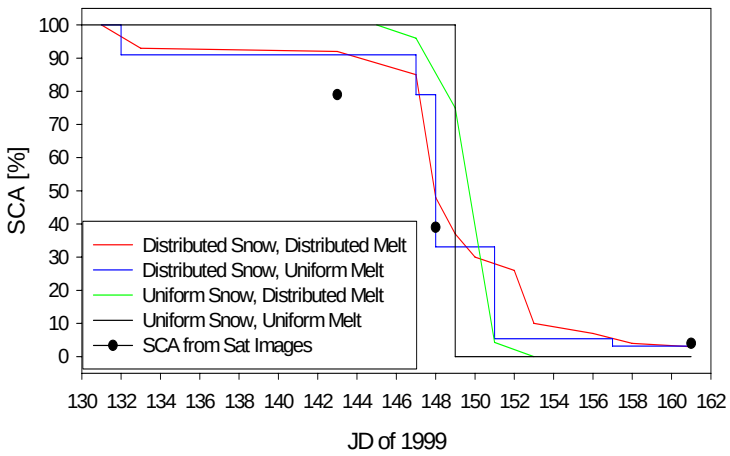
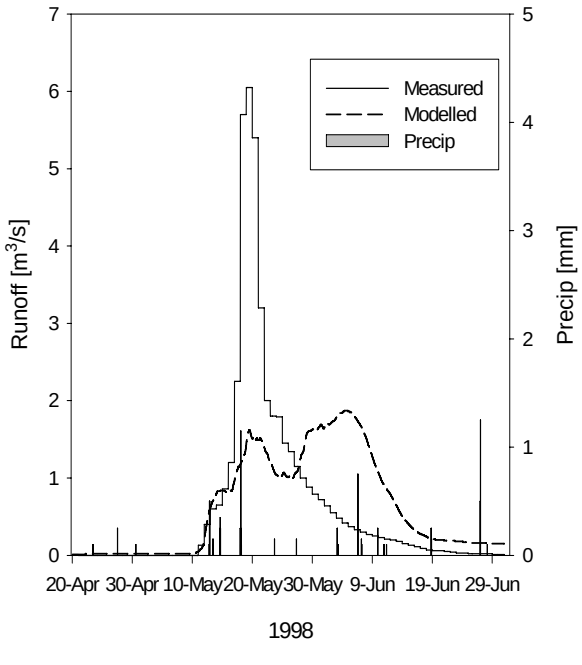
Hydrological Model Testing

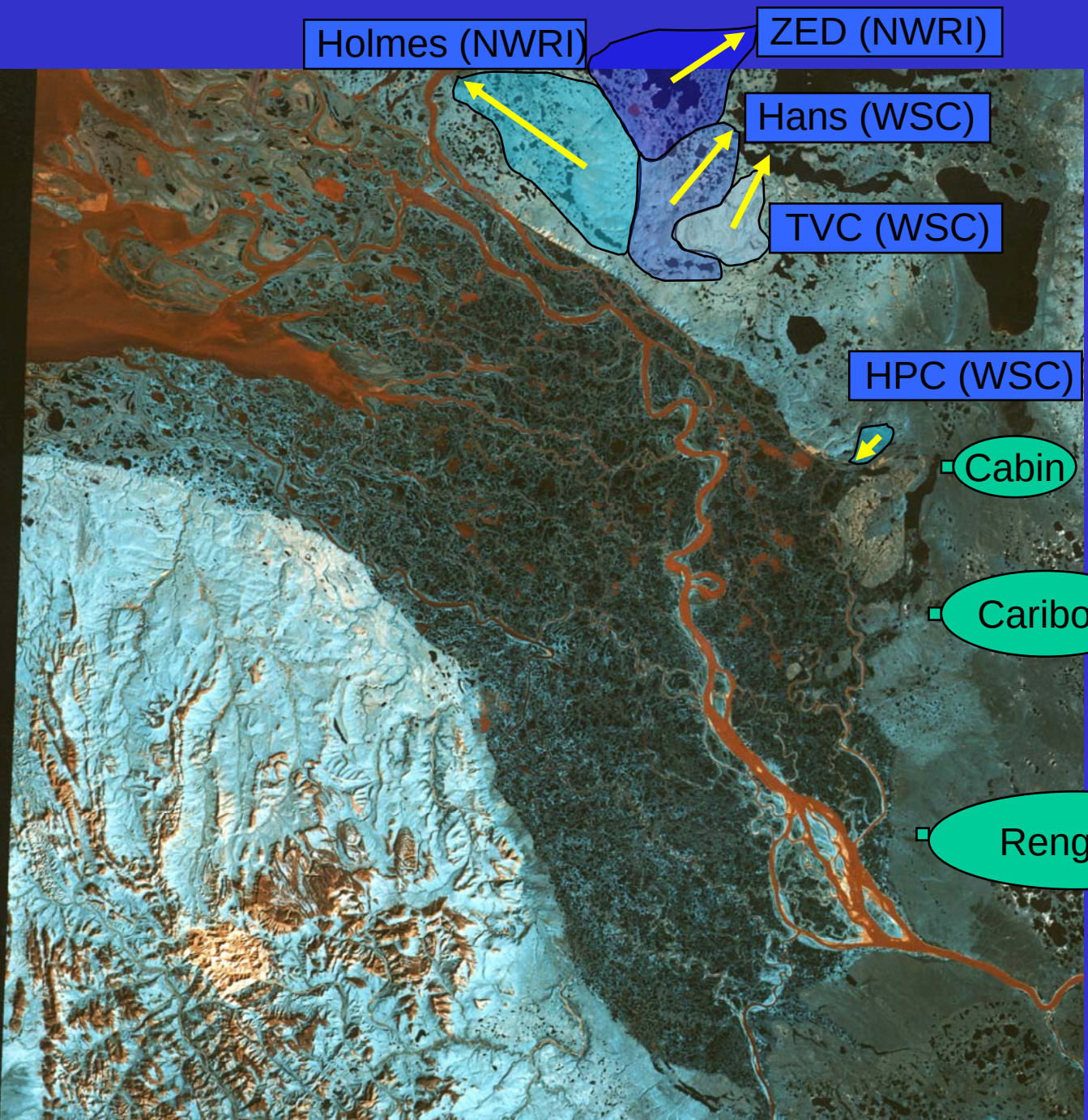








Discharge Stations



Larger scale River: Anderson River (WSC) to the East of the delta

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Schedule, milestones, and deliverables

- Year 1
  - T1: install and upgrade hydrometeorological network in research basins **(completed)**
  - T1: begin analysis of MAGS turbulent flux data **(tower data ongoing, aircraft data delayed until appropriate student found)**
  - T2: setup CRHM at test basins
  - T2: assess existing parameterizations mass and energy **(ongoing with comparison to CLASS with M. Mackay**
  - T2: Assessment of MAGS aircraft for use in regional fluxes **(ongoing, but delayed due to reduced funding)**

- Year 2
  - T1: field sites operational
  - T1: ongoing analysis of radiation and turbulent transfer data from lake and snow experiments
  - T1: new and developing descriptions – CHRM
  - T2: evaluate MESH to mass and energy
  - T2: develop improved snow, melt parameterizations

Issues

- Recruiting 2 Ph.D. students to work on this project
- Aircraft flux data
  - Budget reduction has affected this aspect of the project
  - Discussions with Murray Mackay on how best to proceed

Why?

- Training of next generation of hydrologists

- Environment Canada
  - We require improved predictive models
  - For variety of major impact studies
    - Providing science required for EC to carry out the impact assessment and licensing of the proposed Mackenzie Gas Project

- EC realizes that we must work in collaboration with our university colleagues to develop improved predictive methods