IP3 Theme Discussion and Progress 2008

IP3 Scientific Committee and Network

IP3 @ November 2008

- At midpoint of Year 3 of our 4 year network
  - Unique cold regions observations for process understanding and parameterisation are completed.
  - Parameterisation to translate process understanding to model improvements is following an innovative multi-scale, multi-platform strategy.
  - Model development is encouraging and testing using observations is ongoing.
  - Outreach strategy is operational. Outreach is seen as a model for research networks.
  - Information management is developing.

Theme 1 Processes

- 9 Research basins operational and intensively observed, data archiving
- Standard baseline ecophysiological and soil measurements (rating curves)
- Radiative and turbulent transfer to
  - lakes,
  - snow,
  - glaciers
  - permafrost surfaces
- Snowmelt
  - Vegetation interactions – forests, shrubs
  - Variability, snow covered area depletion, upscaling atmospheric interactions
  - glaciers
- Hillslope hydrology
  - Pathways in organic terrain
  - Residence times
  - Hydraulic conductivity
  - Aufeis, snow dammed channel effects
- Frozen ground
  - Frequency distributions
  - Ground thaw
  - Infiltration
  - Over-winter processes……
- Groundwater in Alpine
  - Storage
  - Residence time
- Lake evaporation
  - Advection, energy storage

Theme 2 Parameterisation

- Parameterisation workshop – strategy developed
- Cold Regions Hydrological Model development and testing of parameterisations
  - Fill and spill runoff generation
  - Vegetation – snowmelt, groundthaw energetics
  - spatially variable snow accumulation and incoming radiation on snowmelt hydrology
- Evaluation of spatial aggregation & distribution in models
  - Snow redistribution
  - Snowmelt and snowcovered area depletion
  - Hillslope redistribution of soil moisture
- Basin-scale parameter distributions
- Energy based framework for delineating runoff contributing areas in northern basins

Theme 3 Prediction

- CLASS 3.4 documentation, distribution, deployment
- MESH 1.2 documentation, distribution, workshop
  - testing on basins
  - General solution for near-surface flow providing a drainage function
- GEM-LAM nested modelling from continental-scale to 100 m resolution
- Parameter regionalisation in land surface schemes
- Multiple objective optimization
- Basin segmentation tests for tile atmospheric forcing & initial conditions, tile connectors
- Scaling tests for threshold functions

Basin Themes to Teams (observations, CHRM, MESH)

- Trail Valley Creek – Marsh
- Havikpak Creek – Marsh
- Scotty Creek - Quinton
- Baker Creek - Spence
- Wolf Creek – Pomeroy
- Marmot Creek - Pomeroy
- Polar Bear Pass - Young
- Lake O'Hara - Hayashi
- Reynolds Creek - Link
- Peyto Creek ? Gauge ? Munro
- **TEAM WORKING MEETINGS**
  - **move basin understanding & parameterisations to MESH development & predictions**
- **Modelling Endpoints – User community engagement**
  - **Possible metrics (low flow, peak flow)**

Outreach

- Users/Stakeholders Workshop – Canmore
- Link to WC^2N through joint information and outreach effort
  - Nadine Kapphahn
  - Information Manager
- Water Network Discussion Group
  - DRI, IP3, WC^2N

Information Management

- Archive established
- Information Manager to be hired
- Meta Data
- Field and model data archive
- Model archive
- Visualisation for users
- IP3 glossary
- Final legacy archives
  - EC, NRCAN, Provinces/Territories, NSIDC, CGEO

IP3 Special Issue 2009

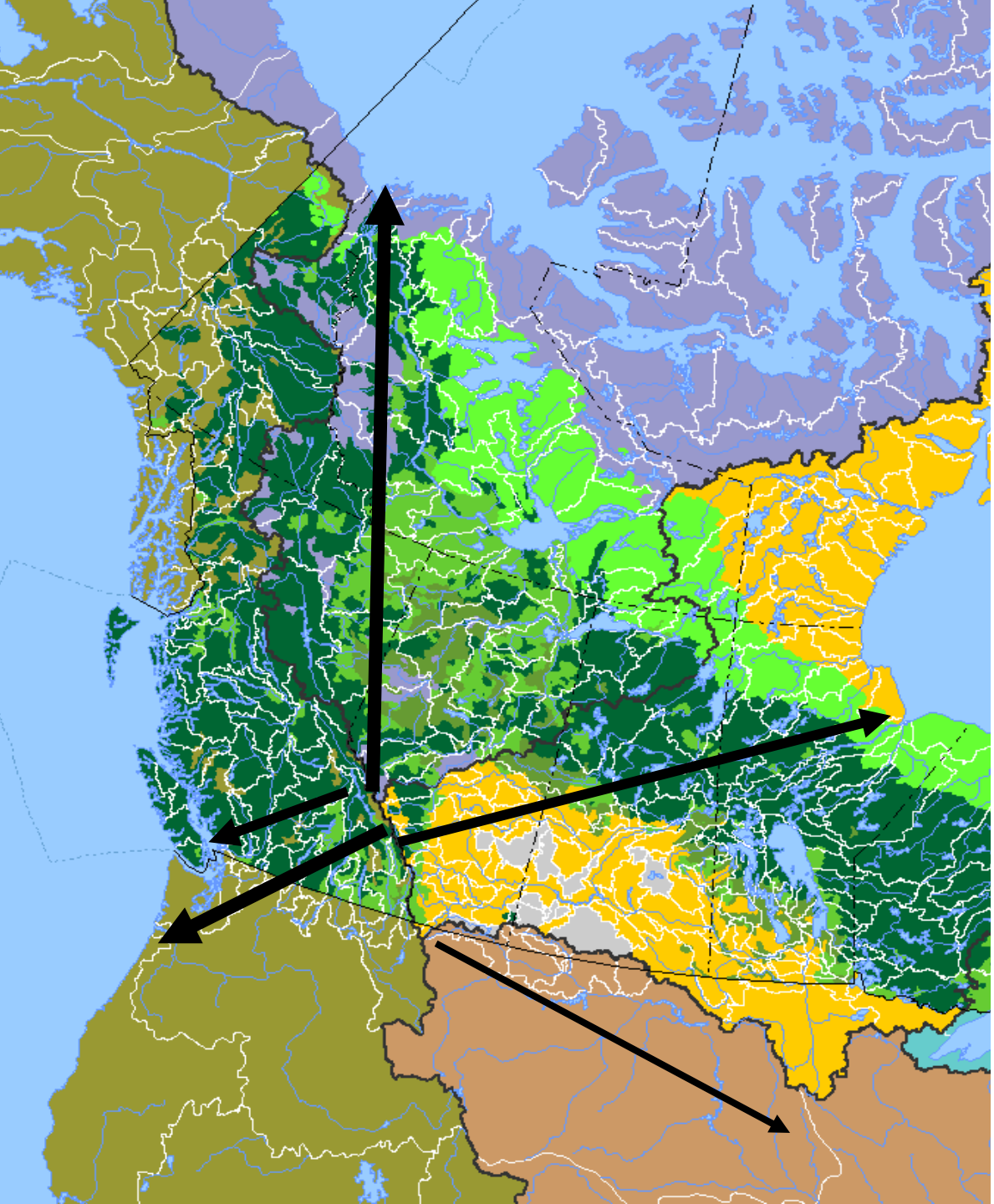
- Mid-term review of our progress
- Hydrology and Earth System Science
  - Contributions to be open from 1 Jan to 1 July 2009
    - Can include presentations at CGU/AGU Toronto etc.
  - ALL Contributions published in HESS Discussions
  - Those that pass review published in HESS and electronically ‘bound’ as special issue

IP3 Legacy Synthesis

- Documented Models: CRHM, CLASS, MESH
- Book? Article(s)? Special Issue(s)?
- Hypertext online document
- Wikip3

Network Completion

- March 2009 – Users/Stakeholders Workshop (joint with WC^2N)
- Fall 2009 –network workshop (joint with WC^2N)
- May 2010 CGU-CMOS Ottawa scientific session
- June 2010 end of investigator spending, accounts closed
- Sept 2010 reports due
- Final report preparation, approval Oct-Nov 2010
- Network completed Dec 2010.
  - Secretariat dissolved, main account closed, data archive secured



Canadian Rockies are the Hydrological Apex of North America

Monitoring and Predicting Western Water and Weather

- ***Rocky Mountain Hydrometeorological Observatory***

- **Focussed Experiment Area to couple key issues**
  - **Mountain snow and glacier dynamics (western cordillera)**
  - **Downstream drought and water supply (intermountain interior and northern plains)**
  - **International Waters**

- **Coordinated, integrated observations**
  - **Surface water, groundwater, snow & ice**
  - **Remote sensing**
  - **Research basins**

- **Regional Data Assimilation & Prediction**
- **Information Portal**
- **Information Interpretation**

- **Workshop 8-10 December 2010, Canmore Alberta**
- **http://www.usask.ca/hydrology/mpwww**

IP3 Follow-on Activity?

- Proven link between high altitude and high latitude hydrology, meteorology and climate – international interest
- International linkages, CliC, GEWEX, GEO
- National linkages, glaciers, prairies, coast?
- Approach: hydrology, cryospheric science, atmospheric science, water resources

What to do?

CREW

Canadian Cordilleran & Cold Regions Energy and Water Experiment

(Strawman Concept, kick away!)

CREW:
Canadian Cordilleran & Cold Regions Energy & Water Experiment

- Advance our understanding and prediction of water and energy cycles in the western mountains and adjacent cold regions of Canada
- Improve our ability to assess change and predictive uncertainty in mountain and cold regions headwaters that arise from changing climate and land use
- *Ultimately* – contribute to the assessment of the long term sustainability of western and northern water resources

CREW Themes

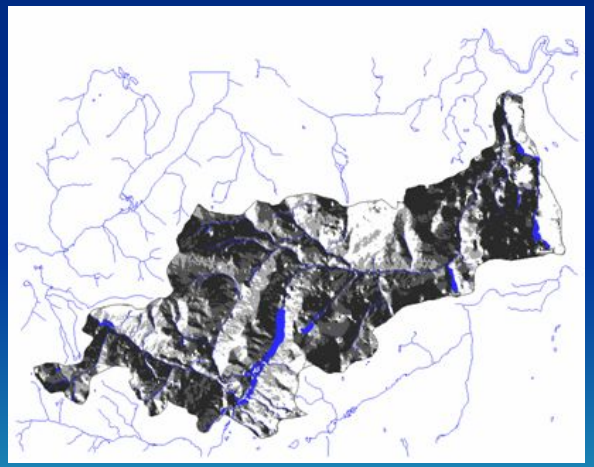
- Understanding Processes:
  - improve understanding of processes and interactions
- Describing and Scaling Processes:
  - Develop improved numerical descriptions
- Improving Models
  - Improve comprehensive models to reduce predictive uncertainty.
- Predicting Impacts:
  - Predict impacts of changing climate and land use on water and climate with reduced uncertainty
- Applying Knowledge:
  - Demonstrate water resource applications and improved forecast accuracy with collaborators

Understanding Processes

- Better understand the effect of complex environments on hydrological and atmospheric energy and water transfer processes.
  - Persistently non-steady state land surface systems – advective landscapes
  - Radiative, latent and sensible heat fluxes and atmospheric flow over complex terrain – mountain landscapes
  - Poorly defined drainages – glaciated landscapes
  - Orographic and inversion effects on winds and precipitation
- Better understand the effect of phase change on processes
  - Mountain precipitation phase and elevational effect
  - Mountain snowmelt variability
  - Rain on snow events
  - Glacier effects on atmospheric exchange, melt and runoff
  - Infiltration and runoff generation over frozen ground hillslopes
- Will require improved observational methodologies to deal with heterogeneity

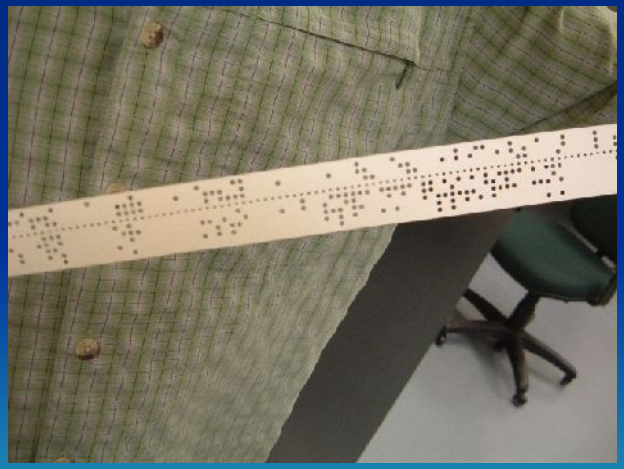
Describing and Scaling Processes

- Develop process descriptions that are appropriate to time and space scale of application – e.g. precipitation, runoff, streamflow, evaporation, convergence
- Transfer parameters across scales – developing parameter sets appropriate to the time and space scale of application – e.g. hydraulic conductivity.
- Aggregate process descriptions – finding appropriate scales, contributing areas, flux footprints and methods for aggregation



Improving Models

- Develop a suite of scale-appropriate modelling strategies for applications from small to larger scales.
- Develop coupled hydrological-land surface models that have appropriate water redistribution schemes and contributing area estimation techniques for cordilleran and cold regions applications at resolution scales from 5 to 10 km^2 .
- Develop models that require little or no calibration from streamflow records.
- Develop spatially nested surface-atmosphere-climate models that relate large scale influences to small scale impacts and account for surface feedbacks in complex terrain



Predicting Impacts

- Quantify and reduce the predictive uncertainty in meteorological, climatological and hydrological forecasts.
- Predict the impacts of changes to land use on water and energy cycling
- Predict the impacts of climate variability on water and energy cycling.
- *Predict water and energy cycles with minimal streamflow information*

Applying Knowledge

- Demonstrate water resource applications with user groups:
  - Small basins
  - Large basins
  - Ensemble forecasting
- Develop improved water forecasts for assessments of ecosystem health, human health, energy development & transport, agricultural use, communities
- Improve mountain weather forecasts for
  - recreation (ski areas, avalanche, hiking, boating),
  - transportation,
  - flood forecasting

Methodologies

- Research basins: intensive point and areal observations of processes at scales less than 200 km^2. Located on transects N-S through Cordillera and E-W through North.
- Observatories for hydrometeorological observations using research basins nested within larger basin networks.
- Remote sensing (satellite, airborne, ground-based): integrate into basin experiments & scaling exercises, data assimilation, model initialization and operation.
- Explicit model development strategy for rapidly incorporating scale appropriate algorithms and structure into models
- 2-way nested modelling strategy using a 'model coupler' between hydrological/LSS & GEM/CRCM/CGCM. Smaller scale models inform and parameterize larger scale, larger scale set boundary conditions for prediction
- Dynamic and statistical downscaling and upscaling from RCM down and from point scale up to climate
- Predictive uncertainty assessments for climate and water resource predictive uncertainty, use and compare research basins
- Demonstrations of water resource and weather predictions with user groups.

Challenge and Excitement

- Challenge: heterogeneous climate, terrain, vegetation, drainage; small spatial scales for both atmosphere and hydrology; large scale impacts; cold regions phenomena; non-steady state.

- Excitement: The Challenge and applying our skills to one of Canada's most critical hydrometeorological problems.

Discussion

NSERC Strategic Networks Grant LOI Due 15 June 2009
IF SUCCESSFUL, Application June 2010
IF SUCCESSFUL, Start April 2011

- How to Bridge to CFCAS Networks?
- Can we avoid being the Avro Arrow of water and cryosphere prediction?
- Comments