Hydrology, Hydropower, and Remote Sensing in Alaska

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High Latitude Proving Ground
Outline

• Motivation: Communities and Physical Infrastructure
• High Latitude Proving Ground Snow Hydrology related activities
• Other Tools in our Toolbox/Ongoing activities related to imagery-based hydrology
Another Flood Season in AK

NWS photo
Susitna Proposal

2.6 million megawatt hours/year
39 mile long reservoir
$5 billion
Bradley Lake: Railbelt Power
Bradley Lake
Two unit 45 MW plant

HYDROELECTRIC PROJECTS in Alaska

The FOUR DAM POOL Power Agency

Terror Lake
Communities Served:
Kodiak and Port Lions
Provider:
Kodiak Electric Association
Facilities:
Two-unit 22.5 MW plant
- 17.4 mile 138 kV line
- 14 mile 42/24.9 kV line
- 2,200 foot tailrace
- discharges into Kichuyak River

Solomon Gulch
Communities Served:
Glennallen & Valdez
Provider:
Copper Valley Electric Association
Facilities:
Two-unit 17 MW plant
- 106 mile transmission line

Tyee Lake
Communities Served:
Wrangell and Petersburg
Provider:
Thomas Bay Power Authority
Facilities:
Two-unit 22.5 MW plant
- 83 mile transmission line

Swan Lake
Communities Served:
Ketchikan Area
Provider:
Ketchikan Public Utilities
Facilities:
Two-unit 22.5 MW plant
- 30 mile transmission line

Planned Swan-Tyee Intertie
Communities To Be Served:
Wrangell, Petersburg, Ketchikan
- with excess 80,000,000 kWh unutilized capacity
Facilities:
Planned 57-mile intertie connecting Swan Lake & Lake Tyee projects
Snotel Network in AK
High Latitude Proving Ground Snow Products: collaboration with AK River Forecast Center
SNOW-17/ SAC-SMA

- **SNOW-17**, snow air temperature index model
- **SACramento Soil Moisture Accounting** model, conceptual water balance model and a frozen ground iteration (Dec 2010), run in lumped mode.
MODIS-driven (normal and regression) snow water equivalent is much larger than SNOW-17 modeled snow water equivalent.

Southern and lower basin unit SWE estimates from SNOW-17 and MODIS exhibit more coherence.
Field Work Spring Snowmelt 2013

• MODIS needs to be verified at the broad scale for quantification of error in snow cover extent through the melt season
• For example, an important question is how does the MODIS data perform in boreal forested regions in comparison to open vegetated sites?
• These questions can not be addressed without a detailed field campaign
Field Work Spring Snowmelt 2013

Capture melt using different types of remote sensors
– Fish eye approach
– Time-lapse photos
– Airborne low level RGB photography (Navion L17, 4 person fixed-wing, 1500 feet AGL)

• Manual sampling through sites in the basin
• Aim to capture a range of forested, tundra and shrub sites for validation of MODIS snow cover extent and melt
CPCRW Snow Surveys
New Collaboration: NOHRSC

• Goals: making more snow and other hydrology products available in Alaska on operational time scales

• Short term: frequent telecons
  – Experimental model evaluation by UAF grad students
  – Get MODSCAG (GOES-R SCA) product flowing to Alaska

• Long term: expand airborne observation program
  – Test and evaluate physically based hydrology models
  – Utilize and improve data assimilation
  – Using NASA LIS and SNODAS in Alaska
Other tools in our Toolbox
In Situ Station Networks
Arctic Transportation Networks: improved monitoring and prediction of blowing snow

ATQASUK

BARROW

Used for in situ studies and validation of models

J. Cherry

WRF model
Example: Seward Peninsula
http://ine.uaf.edu/werc/projects/seward/

Real Time Data pulled over a network of radios and repeaters
Uploaded to Internet at Nome; web services
Archived at UAF

Partnerships: Northwest Campus of UAF in Nome, Anvil City Science Academy (Jr. High), Kawerak Native Corp, National Park Service
Data Management

Imiq Database
Welcome to the ArcticLCC Data Rescue and Inventory of Hydrology-Related data in Arctic Alaska.

Sites are grouped to clusters to show markers which are close together or overlap.
Click on clusters to zoom in.
Airborne Observation and Cal/Val
Platforms: Conventional
Platforms: UAS & Balloons

Photo: Jessica Cherry

Photo: Pat Harman

Photo: NASA

Photo: Vaisala
Integrated Sensor System (‘Tinman’) developed by our group at UAF includes:

- RGB cameras (Nadir and Oblique)
- FLIR cameras
- X-band SAR
- Hyperspectral camera
- Multispectral cameras
Payloads

A meteorological package (T, RH, P)
A cavity-ringdown laser spectrometer for water isotopes
SDSU Water Vapor, Carbon, Methane Flux

Photo: Vaisala  Photo: Phil Yoon  Photo: Picarro
Hydrologic Applications

• Surface Water
• Ground Water
• Water Vapor
• Hydrology and Biogeochemistry
• Snow and Ice Modeling
Surface Waters: Wetlands

Photo: Jessica Cherry
Micro-climatology
Micro-climatology (Thermal IR)
Surface Waters: Lake Freeze Up

Photo: Jessica Cherry
Surface Waters: Lake Freeze Up

Photo: ImSAR
Water Vapor: Isotopes

Deuterium from Aircraft: 27 Aug, 2011

Courtesy David Noone

Data: Jessica Cherry
Hydrology: Snow & Ice Mapping

Photo: Chas Jones

Photo: AKDEC
Future Directions

- Continued Snow Depletion mapping technique development
- Image and hydrology model integration
- Lake and river bathymetry, river velocity
- Migration to more physically-based hydrology models and improved data assimilation
- Develop new products and data integration modules for water resource management tools
Brochure:
educating stakeholders on how to use remote sensing imagery and where to get it

Your contributions are welcome!
Questions?

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