2018 Alaska Section AWRA Annual Conference
Alaska Water Resources: Science, Policy, and Technology

Alaska Pacific University
Atwood Center (Rasmuson Hall)
April 10-12, 2018
Anchorage, AK

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ALASKA DEPARTMENT OF NATURAL RESOURCES

Alaska Section
American Water Resources Association

2018 American Water Resources Association Alaska Section Annual Conference

April 9-12, 2018
Alaska Pacific University
Atwood Building
Anchorage Alaska

Conference Sponsors:

GW Scientific, Michael-Baker International, PDC Engineers, HDR Inc.

AWRA-AK Board and Conference Committee Members:

Robin Beebee, Erica Betts, Dave Brailey, Janet Curran, Michael Lilly, Chandra McGee, Nicole Neuman, Kevin Petrone, Garrett Yager

Alaska Section
American Water Resources Association

AK-AWRA 2018 Conference Schedule

Monday April 9, 2018
Field Trip to Eklutna Dam Removal Site, 10:00 AM - 2:00 PM (email awra.alaska@gmail.com if you would like to attend).
Workshop - Unmanned Aerial Systems (UAS) at Alaska Pacific Univ. 8 - 4:30 PM http://state.awra.org/alaska/ameetings/2018am/uas-workshop.shtml

Tuesday April 10, 2018			
9:00 AM **Registration Opens**			
11:00 AM Keynote Speaker - Brad Meiklejohn, The Conservation Fund and Crane Johnson, NOAA-APRFC **"Eklutna River Dam Removal Project"**			
12:00 PM **LUNCH (provided)**			
Session 1: Water Across Environmental Gradients (Janet Curran)			
1:00 PM	Roman Dial	Alaska Pacific University	Glacier Algae and Meltwater: A Role for Red Carbon in the Cryosphere
1:20 PM	Ryan Toohey	USGS Alaska Climate Science Center	Active layer and water biogeochemical heterogeneities within the Yukon River Basin.
1:40 PM	Jim Munter	J. A. Munter Consulting, Inc	Potential transport of silt through a gravelly aquifer, Sand Lake area, Anchorage, Alaska
2:00 PM **BREAK**			
2:10 PM **Rapid Talks**			
2:30 PM Session 2: Unmanned Aerial Systems Current Applications and Future Needs in Alaska Water Resources (Michael Lilly, GW Scientific)			
Panelists **Eyal Saiet** (UAF-ACUASI) Applying UAS Remote Sensing in Alaska's Cryosphere and Rivers **Jon Zufelt** (HDR Inc) Alaska and Arctic Surface-Water Hydrology and Winter Ice Cover - What have we been doing? What is needed? **Crane Johnson** (NOAA-NWS) River Hydrology and Flood Forecasting, Emergency Management - What is needed? Lessons learned? **Rocky Weber** (ADNR) ADNR Current Applications in UAS technology, What have we been doing? What is needed?			
2:30-3:10 PM **Introductions and Individual Presentations**			
3:10-4:20 PM **Panel Discussion**			
4:20-5:00 PM ***Poster Session***			

Wednesday April 11, 2018

9:00 AM Climate Policy Panel (Erica Betts)

"How does climate policy at the State and Federal level affect water resources in Alaska?"

Panelists

Molly McCammon - Executive Director of the Alaska Ocean Observing System and member of the Governor's Climate Action for Alaska Leadership Team
Hal Shepard - Water Policy Consulting, LLC
Amy Lauren Lovecraft - Interim Director for the Center for Arctic Policy Studies at UAF
Tom Ravens - Professor and Associate Dean of Research Univ Alaska Anchorage

10:30 AM **BREAK**

Session 3: Measurements, Techniques, and Emerging Technologies (Dave Brailey)

10:50 AM	Garrett Yager	Michael-Baker	Real-Time Flood Monitoring in the Colville River Delta, Alaska; Case Study
11:10 AM	Horacio Toniolo	University of Alaska Fairbanks	Estimating bed-load transport along the Sagavanirktok River
11:30 AM	Mark McBroom	Michael-Baker	Adjusting Manning's n Values for Use in Two-Dimensional Hydraulic Models

12:00 PM **LUNCH (provided)**

Session 3 cont: Measurements, Techniques, and Emerging Technologies

1:00 PM	Robin Beebee	USGS	Advances over 20 Years of Assessing Alaska Bridge Hydraulics
1:20 PM	Jeff Conaway	USGS	Remote Sensing of Streamflow in Alaska
1:40 PM	Jacques Annandale	HDR Inc	How 2D Floodplain Modeling is Pushing the Boundaries of Floodplain Regulations

2:00 PM **BREAK**

2:20 PM **Rapid Talks**

Session 4: Climate Change, Hazards, and Extremes (Erica Betts)

2:40 PM	Karen Endres	NOAA-NWS	National Weather Service River Ice Break up Monitoring in Alaska using UAV and Satellite Data
3:00 PM	Janet Curran	USGS	Classifying seasonal patterns in Alaska streamflow provides link to streamflow generating processes
3:20 PM	Joshua Koch	USGS	Changes in stream discharge and chemistry at the Arctic-Boreal Transition related to evapotranspiration and ground thaw
3:40 PM	Michael Lilly	GW Scientific	Factors Influencing Groundwater Flow In Areas of Discontinuous Permafrost

4:00-4:30 PM ***Poster Session***

Thursday April 12, 2018			
9:00 AM Plenary Talk - Becci Anderson USGS NHD Program **"USGS National Hydrography Mapping-Where Are We Now and Where Are We Going?"**			
Session 5: Information Resources (Garrett Yager)			
10:00 AM	Jessica Cherry	NOAA-NWS	Use of Satellite Tools to Assess 2018 Tetlin Road Flooding
10:20 AM **BREAK**			
10:40 AM **Rapid Talks**			
Session 6: Water Resource Development, Management, Conservation and Policy (Jessica Cherry)			
11:00 AM	Ann Marie Larquier	ADFG	Protecting Fish and Wildlife Habitat: Alaska's Instream Flow Reservations Program
11:20 AM	Jim Munter	J. A. Munter Consulting, Inc	Proposed improvements to the regulation of aquifer tests in Alaska
11:40 AM	Kevin Petrone	ADNR	Where Can You Float a Boat? Relating Flow and Basin Characteristics to Assess Navigability in Alaska
12:00 PM	**AWRA-AK Membership meeting (Lunch provided)**		
Session 6 cont: Water Resource Development, Management, Conservation and Policy			
1:00 PM	Hal Shepard	Water Policy Consulting, LLC	Environmental Justice and Alaska Native Tribal Water Policy
1:20 PM	Mark McBroom	Michael-Baker	Predicting In-Stream Habitat Improvements with 2D Hydraulic Modeling: A Case Study
1:40 PM	**Closing Remarks and Feedback**		
2:45–5:00 PM **Interagency Hydrology Committee for Alaska (IHCA)** USGS Conference Room, 1st Floor Glenn Olds Hall (across street from Alaska Pacific Univ. campus)			

Poster Presentations ***(posters can be mounted on first day and remain for entire conference)***		
Kelsey Dean	Univ. of Alaska Fairbanks	Snowmelt flooding trends in the North Slope of Alaska Kuparuk Watershed
Celine van Breukelen	NOAA-NWS	Observing Precipitation for Hydrologic Modeling and Flood Prediction: an Analysis of Methods
Karenth Dworsky	USGS	Assessment of channel change through repeat cross section surveys and real-time monitoring at bridge crossings in Alaska
Crane Johnson	NOAA-NWS	Glacial Dammed Lake Monitoring Techniques
Janelle Sharp	UAF, NANA Regional Corporation	Methane Seep Mechanism for a Northwest Alaska Lake

2018 American Water Resources Association Alaska Section Annual Conference

Conference Abstracts

Keynote Presentation

Eklutna River Dam Removal Project

Meiklejohn, Brad, The Conservation Fund

The Conservation Fund launched the effort to remove the Lower Eklutna River Dam in 2015. Built in 1929 as the first major power supply for Anchorage, the 70’ tall concrete arch dam was abandoned in 1955 and has since remained an orphan, unmaintained facility. The removal of the Eklutna dam is the most ambitious watershed restoration project ever undertaken in Alaska. In partnership with the Eklutna Native Corporation, the project has advanced faster than any major dam removal previously attempted in the nation, and is on track for completion in Fall 2017. The talk, and the subsequent field trip, will look at the complexities and challenges of this dramatic project.

Plenary Presentation

USGS National Hydrography Mapping - Where Are We Now and Where Are We Going?

Anderson, Becci. USGS

The USGS manages multiple, complementary hydrography datasets for the inland waters of the United States - the National Hydrography Dataset (NHD), Watershed Boundary Dataset (WBD), and elevation-hydrography integrated NHDPlus High Resolution (NHDPlus HR). This presentation will give an update on the status of these datasets for Alaska and the Nation, and will also discuss what's new with data acquisition via elehydro methods, improving data stewardship through the Markup Application, enhancing dataset utility with the VisibilityFilter, and the growth of intelligent water data applications as a part of the National Hydrography Infrastructure.

How 2D Floodplain Modeling is Pushing the Boundaries of Floodplain Regulations

Annandale, Jacques; Forest, Mark; Zufelt, Jon. HDR inc.

Over the last couple of years, the USACE has developed a robust, publicly available, 2-dimensional hydraulic modeling software update for the Hydrologic Engineering Center River Analysis System (HEC-RAS) software, which has improved floodplain mapping capabilities for the engineering and science communities. The advancements in hydraulic analysis and remote data sensor resolution has allowed communities to re-evaluate and update flood maps in the National Flood Insurance Program (NFIP). These advancements in technology have begun to challenge the regulatory standards that protect a community and the development occurring within that community’s floodplain. The adoption of a regulatory Floodway (44 CFR 60.3(d)), has historically been considered a higher level of regulation and perceived protection. While the advancement and broad use of 2D hydraulic modeling provides improved delineation of flooded areas, it has also shown that the temporal impacts of development may still put a community and developers at risk. This presentation, will provide a case study exploring development scenarios in a 44 CFR 60.3(d) regulated river, the consequences of the development as represented by 2D hydraulic modeling, and the questions and concerns that FEMA NFIP regulations will have to address in the near future.

Advances over 20 Years of Assessing Alaska Bridge Hydraulics

Beebee, Robin A. U.S. Geological Survey

Streambed scour, the removal of sediment from around bridge foundations during floods, is the primary cause of bridge failures in the United States. The Federal Highway Administration requires that each State Department of Transportation assess every bridge for scour vulnerability, regardless of bridge ownership. In Alaska, the U.S. Geological Survey partners with the Alaska Department of Transportation and Public Facilities (ADOT&PF) to assess scour potential during floods. The USGS and ADOT&PF are nearing the close of a 20-plus-year project to assess scour at over 400 bridges, and have used an evolving variety of both field and modeling techniques. This presentation will discuss the evolution of Alaskan scour assessments and special cases where two-dimensional modeling and the availability of additional field data have improved our ability to evaluate flood hydraulics and thus scour potential at Alaskan bridges. In years past, two-dimensional models were used only for bridges over large rivers where the cost of reconstruction justified additional modeling effort. Now, with the increasing availability of lidar and faster processers, 2-dimensional modeling does not necessarily require greater effort than one-dimensional models on smaller streams and rivers. In particular, braided channels or those with low floodplains are common in Alaska, and two-dimensional models show significant advantages in distributing flow between channels. Two dimensional modeling also allows for the computation of flow angles, which are particularly important in determining pier and abutment scour potential. Two cases where both 1-dimensional and 2-dimensional models were used to assess scour are Bridge 1713 on the the Little Susitna River and Bridge 1199 on the South Fork Anchor River. On the Little Susitna River, the 2-dimensional model started upstream of a flow split and distributed flow between channels of the river, whereas the user had to choose a flow distribution for the 1-dimensional model. In the case of Bridge 1199, the 2-dimensional model computed angled flow through the bridge from a channel confluence upstream of the bridge, resulting in an increase in water surface elevation and pressure flow for the same discharge.

Use of Satellite Tools to Assess 2018 Tetlin Road Flooding

Cherry, Jessica E. NOAA/NWS APRFC

Late in July, 2017, the National Weather Service got word that the road to the Village of Tetlin, near Tok, was flooded and impassable. With help from local observers, the Fairbanks Civil Air Patrol, and satellite imagery, the Alaska Pacific River Forecast Center was able to determine the source of the flood water as a breach in the Tanana River. Last summer, the upstream watersheds--the Nabesna and Chisana Rivers—were anomalously warm and wet. Rain and snowmelt contributed to high water on the Tanana, which eroded a narrow, natural levy between the river and an historic floodplain. Eventually, that water crossed the Tetlin Road and disrupted travel to village residents and commercial use, well into mid-August. This presentation will discuss the details of what happened, the factors contributing to impacts, gauge data and its limitations, and the variety of satellite products, aerial photos, and GIS layers we employed to understand this event.

Remote Sensing of Streamflow in Alaska

Conaway, Jeffrey S., USGS, Nelson, Jonathon M., USGS, Legleiter, Carl J., USGS, Bjerklie, David M., USGS, Jones, John W., USGS, Eggleston, Jack, USGS

Remote Sensing of Streamflow in Alaska
The USGS is investigating techniques for measuring streamflow from a variety of platforms. This effort focuses on Alaska because remote sensing methods offer the potential to augment the limited streamflow gaging network and improve the safety of those tasked with measuring streamflow in remote areas. Continued advances in sensors deployed on satellites, aircraft, and unmanned aerial systems (UAS), as well as progress in image processing methods, will move remote sensing of streamflow from research to operations. The USGS has computed discharge estimates for the Yukon and Tanana Rivers based on channel widths determined from Landsat imagery, water-surface elevations from the Jason-2 satellite's radar altimeter, and flow resistance equations. This application is limited to large rivers and constrained by the frequency of observations, but also offers the ability to compute historical flows from the 40-year Landsat image archive. Thermal and hyperspectral cameras have been tested from bridges and from a helicopter. Thermal infrared images resolve features at the surface of flowing water that arise from turbulent mixing. Image time series acquired by thermal cameras can be processed with particle image velocimetry (PIV) software to compute surface velocities based on the displacement of thermal features advected with the flow. In clear flowing streams, hyperspectral data f can be used to characterize the strong relationship between depth and reflectance and thus map river bathymetry. This information on channel geometry can then be combined with flow velocities obtained by thermal PIV to estimate discharge. Spectrally-based estimation of water depth from passive optical images is only feasible in relatively shallow, clear-flowing rivers, however. Discharges calculated with thermal PIV were within 15 percent of conventional discharge measurements from streamgages when combined with depths measured in the field or estimated from hyperspectral data acquired from bridges and within 40 percent when the depth information was derived from thermal data based on an empirical relationship between flow turbulence and water depth. UAS are used to obtain high-resolution imagery from which digital elevation models can be produced and used as input to hydraulic models. Helicopter based measurements will be collected in 2018 on six rivers across Alaska and satellite data from two of these sites will also be used to estimate discharge.

Classifying seasonal patterns in Alaska streamflow provides link to streamflow generating processes

Curran, Janet H. U.S. Geological Survey; Biles, Frances U.S. Forest Service

The pattern of streamflow variability over the year, commonly visualized as the shape of the annual hydrograph, is a fundamental characteristic of stream hydrology that reflects underlying streamflow generating processes. Identifying patterns of seasonal flow thus differentiates streams by streamflow generating process, which can facilitate an understanding of potential streamflow changes with variability in climate. Seasonal streamflow patterns for 176 Alaska streams having at least 10 years of peak streamflow data and 5 years of daily streamflow data were classified using cluster analysis of long-term mean monthly flow normalized by long-term mean annual flow. A hierarchical arrangement of as many as 12 subgroups collapsed to three major groups that captured the primary patterns of annual hydrographs in Alaska: a bimodal spring/fall to dominantly fall high flow group, a dominantly spring high flow group, and a dominantly summer high flow group, corresponding to streams where high flow is dominated by a mix of snowmelt and rainfall or rainfall, snowmelt, and high-elevation snow or glacier meltwater runoff, respectively. The subgroups further divide these major groups into groups having similar timing of high and low-flow periods, length of high-flow season, and relative dominance of the various streamflow generating processes. Although the subgroups are statistically viable, the strength of group membership is weak for some streams, suggesting that groups and subgroups form a continuum rather than mutually exclusive groups. This facilitates analysis of changes in streamflow with variability in climate, in that shifts along this continuum may be possible with changes in climate. This classification of Alaska streams by annual hydrograph is intended to provide a platform for analysis of a broad range of hydrologic topics, including planned development of prediction of hydrograph shape for ungaged streams and comparison of relative magnitude and trends in peak streamflows grouped by streamflow generating processes.

Snowmelt flooding trends in the North Slope of Alaska Kuparuk Watershed

Dean, Kelsey University of Alaska Fairbanks; Stuefer, Svetlana Assistant Professor University of Alaska Fairbanks

The IPCC Report (2014) and the Arctic Climate Impact Assessment (2005) project in the next decades continued reduction in snow covered days and changes in the seasonal timing of snowmelt. Changes to snow cover affect the timing and magnitude of snowmelt runoff as well as associated flooding, which has direct impacts for Arctic Alaska. Snowmelt spring floods are the largest hydrologic event of the year in Arctic Alaska river systems. Though problems exist (sparse observational network and short periods of hydrometeorological records) with quantifying trends in snow accumulation and predicting risk of snowmelt floods for northern Alaska, several monitoring programs in the Kuparuk watershed have been operating long enough to generate 30-yr climate records sufficient for statistical analysis. Long-term climate and streamflow data collected by the University of Alaska Fairbanks at the Water and Environmental Research Center and other agencies were used to quantify trends in snowcover and snowmelt floods in the Kuparuk watershed. Variables including air temperature, peak discharge, and precipitation were used to analyze trends and identify extreme years in snowmelt flooding. Further investigation into the identified years will include the application of the Snowmelt Runoff Model (SRM) developed by Martinec. SRM has been used across the world and in a large number of states in the United States. Testing SRM in the Kuparuk watershed will provide insights and set of recommendations for improved snowmelt runoff forecasting and hydrologic modeling across Arctic Alaska.

Glacier Algae and Meltwater: A Role for Red Carbon in the Cryosphere

Dial, Roman, Alaska Pacific University

Net solar radiation controls melt in almost all snow and ice covered environments, so any reduction in albedo on glacier surfaces potentially increases meltwater there. Specialized microbes inhabit glaciers and ice fields across Alaska, and like all organisms, they cannot metabolize water in its solid form. Theoretical and correlative studies document a substantial reduction of albedo by these microbes both on ice and on snow, implicating their role in glacier melt. If glacial microbiomes are limited by liquid water, and the albedo-reducing properties of individual cells enhance melt rates, then natural selection should favor those microbes that melt ice and snow crystals most efficiently. Here we show natural selection likely favors a red color on snow and a purple color on ice based on instantaneous radiative forcing and we present results of the first replicated, controlled field experiment to both quantify the impact of microbes on snowmelt in "red-snow" communities and demonstrate their water-limitation. Using remote sensing of the Harding Icefield as an example of the extent of snow-algae's spatial distribution shows microbes can increase snowmelt over 20% by volume, a percentage likely to increase as the climate warms and particulate pollution intensifies.

Assessment of channel change through repeat cross section surveys and real-time monitoring at bridge crossings in Alaska

Dworsky, Karenth L. USGS; Conaway, Jeffery, S. USGS

The U.S. Geological Survey (USGS) has been cooperating with Alaska Department of Transportation and Public Facilities (ADOT&PF) since 1993 to provide hydraulic assessments of scour for bridges throughout Alaska (Heinrichs and others, 2001; Conaway, 2004; Conaway and Schauer, 2012; Beebee and Schauer, 2015; Beebee and others, 2017). The purpose of the program is to evaluate, monitor, and study streambed scour at bridges in Alaska; this includes surveying streambed elevations at regular intervals, and monitoring real-time bed elevation changes. Over the duration of the scour program (1993-2017), repeat cross sections have been surveyed along the lengths of 67 bridges, and real-time elevation data have been collected at 23 bridge piers. Channel soundings are depth-from-bridge measurements on either the upstream or downstream side of a bridge. Flow, depth and velocity dictated whether streambed elevations were measured using either USGS sounding weights on cable reels, weighted measuring tapes, or acoustic Doppler current profilers (ADCP). The soundings were conducted on an annual basis at most sites. In addition to annual soundings, channel soundings were made during floods or periods of scour. Results illustrate that general scour can be uniform or non-uniform across the channel. The magnitude and distribution of scour across the channel is influenced by several factors that include streambed sediment type, degree of channel contraction at the bridge crossing, influence of instream structures, and bridge pier location and alignment. The data garnered from the repeat soundings can be used to identify long term aggradation or degradation of the streambed, as well as seasonal changes in streambed elevations. Sonar data were collected at a subset of these bridges where scour was of particular concern. Streambed elevations were collected at half-hour intervals during the open-water period using a fixed, pier-mounted single-beam sonar. Sonar data illustrated local scour and fill throughout the open-water season and at shorter time scales (hours to days) at some scour-critical bridges, while at others very little streambed change was seen.

National Weather Service River Ice Break up Monitorin in Alaska using UAV and Satellite Data

Endres, Karen NWS Fairbanks; Ed Plumb NWS Fairbanks

Ice jam events have frequently produced the most extreme and dangerous flood events on record, resulting in millions of dollars in associated damages. Ice-related flood events are highly variable and difficult to evaluate, especially with respect to likelihood of site-specific re-occurrence and statistical frequency. Our ability to forecast such events remains quite limited. The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy.

In support of this NWS mission, the NWS in Alaska has operational observing programs that are unique within the NWS and consist of a team of citizen observers that provide year round information throughout the State of Alaska, a small low cost river stage gage developed to supplement a sparse network of stream gaging stations, satellite coverage with individualized processing and UAV flights. Small multi-agency teams follow the breakup front as it advances downstream past many small Alaska communities primarily on the Yukon and Kuskokwim Rivers collecting data on the ground and from the sky. Primary data sources for River Watch include:

- Direct aerial reconnaissance
- Pilot reports
- Local observer reports
- River gage information
- Satellite Data
- UAV Flights
- Winter ice and snow monitoring

Will it melt smoothly and go downstream, or will one of the ice dams form, abruptly causing water and ice overrun roads, properties and cause flooding? The NWS Alaska River Watch program is developing and implementing innovative tools help answer that question. In 2017 River Watch partnered with ACUASI program to utilize unmanned aircraft systems to provide new tools for river breakup monitoring. The region is also on the fore front of developing satellite image processing tools for river ice detection. The challenges and research tools used in this massive yearly undertaking are presented along with future direction of the program

Glacial Dammed Lake Monitoring Techniques

Johnson, Crane Alaska Pacific River Forecast Center; Pierce, Jamie United States Geologic Survey; Jacobs, Aaron National Weather Service Juneau

In the summer of 2011 an unusual flooding event called a Jökulhlaup or Glacier dammed lake outburst flood (GLOF) took place on the Mendenhall River system from Suicide Basin. A Jökulhlaup is an Icelandic term for a glacial outburst flood. They occur when a lake fed by glacial meltwater breaches its dam and drains catastrophically. This was the first significant Jökulhlaup on the Mendenhall River since the United States Geologic Survey (USGS) gage was installed in 1966. Since 2011, Jökulhlaups have contributed to five out of the last seven peak annual events on the Mendenhall River and three of the top six peak events for the period of record. In 2016, the USGS, City and Borough of Juneau and University of Alaska Southeast installed near real-time monitoring equipment in Suicide Basin to measure the rising and falling water levels associated with filling and release of the subglacial lake that forms periodically throughout the summer. Initially, water levels were monitored using traditional pressure sensing equipment. Monitoring the water levels in Suicide Basin is challenging due to the extreme changes in water levels and difficult gage siting conditions. In the summer of 2016, a remote camera system was installed and then in the summer of 2017 the USGS with assistance from the National Weather Service, installed an oblique laser distance sensor. The camera and laser provide supplemental information and proved to be valuable tools for monitoring of the glacier during the 2017 season. The NWS developed an algorithm to extract qualitative elevation information from the daily images of the Suicide Basin glacier. Data derived from the images are then compared to the hourly information provided by the oblique laser.

Protecting Fish and Wildlife Habitat: Alaska's Instream Flow Reservations Program

Klein, Joe; Larquier, Ann Marie; Keith, Kevin; Ellis, Leah (Alaska Department of Fish and Game)

The Alaska Department of Fish and Game's Instream Flow Reservations Program is tasked with protecting aquatic resources by quantifying streamflow and acquiring water rights (Reservations of Water) for the purpose of sustaining Alaska's fish and wildlife resources. Since the program's inception in 1986, thousands of miles of fish habitat have been protected on more than 300 rivers and several lakes. ADF&G's Anchorage office is currently operating streamgaging networks in four watersheds: Lower Susitna River, Matanuska River, Nushagak River, and Chester Creek. An overview of the existing and anticipated instream flow reservations, as well as current hydrologic data collection efforts to support these reservations, will be presented.

Changes in stream discharge and chemistry at the Arctic-Boreal Transition related to evapotranspiration and ground thaw

Koch, Josh; USGS, Carey, M; O'Donnell, J; Records, M; Sjoberg, Y; Zimmerman, C

The Arctic-Boreal transition zone of Alaska is experiencing rapid change related to warming, vegetation expansion, and permafrost thaw. These processes may alter stream discharge and nutrient regimes of watersheds as streams lose water to evapotranspiration or infiltration into thawed soils. We monitored 15 streams draining catchments in the western Brooks Range and considered how gradients in mean annual ground temperature (MAGT) and ground ice impacted discharge, evapotranspiration, infiltration, and stream chemistry. Whereas we would expect all headwater streams to gain water, we observed that some streams in warmer, ice-poor catchments were losing water at rates up to 50% of their total discharge per kilometer of stream reach. Warmer catchments also had lower runoff ratios across the season and for individual storms. Diel discharge indicated that evapotranspiration accounts for some of the water loss, and the remainder is likely due to infiltration into increasingly thawed ground. Because inflows contained solutes including nutrients, the loss of inflows related to ground thaw, coupled with warmer stream temperatures may alter aquatic food webs. Based on relationships between temperature, chlorophyll-a, and fish growth, continued warming will likely lead to increased productivity, but warm streams may be at risk of desiccation due to the increased evapotranspiration and infiltration. Strong relationships between MAGT and hydrologic parameters also allow us to predict how cold streams will change in the future. These findings have direct implications for streamflow, lotic habitat, and food webs, and for predicting changes to water resources and ecosystems in a warming Arctic.

Factors Influencing Groundwater Flow in Areas of Discontinuous Permafrost

Lilly, Michael R., GW Scientific, Barnes, David, University of Alaska Fairbanks; Garber-Slaght, Robbin, Cold Climate Housing Research Center; Sosebee, Conor, Cold Climate Housing Research Center

Discontinuous permafrost can significantly impact groundwater levels and flow conditions. Permafrost masses within groundwater aquifer systems and saturated formations are characterized as ice rich and are effectively zones of no permeability. Within regional groundwater aquifers, discontinuous aquifers can reduce the effective cross-sectional areas available for groundwater flow, resulting in localized changes in horizontal and vertical flow characteristics. Changing climate conditions may slowly change the shape of discontinuous permafrost and result in changing precipitation. Man-made activities may also change groundwater conditions in areas of discontinuous permafrost. Some examples, common in developed areas, include changing land surface drainage features (ditches, retention ponds), surface barriers to infiltration (paved roads, building, parking lots), winter snow storage piles, water supply wells and injection wells, land clearing and agricultural activities, construction of roads and buildings that freeze the subsurface to help maintain permafrost conditions.

Depending on the collective effects of these factors, groundwater levels and flow may change over time. Evaluations of changing groundwater level and flow conditions need to consider any of these, or other potential factors, when evaluating changing groundwater systems. The Cold Climate Housing Research Center is located on the University of Alaska Fairbanks campus. The area of the facility is characterized by discontinuous permafrost. The area has winter snow storage dumps, water supply and reinjection wells, and a history of local research agriculture fields, road and railroad transportation corridors, runoff retention features and buildings. Groundwater conditions have been observed to have changed from prior conditions. This presentation will focus on identifying the factors that should be considered in future groundwater monitoring activities and information that should be collected to evaluate all of the potential factors that may impact groundwater flow conditions.

Adjusting Manning's n Values for Use in Two-Dimensional Hydraulic Models

McBroom, Mark. Michael Baker International; Friend, Andrew. Michael Baker International

The empirically derived Manning's n coefficient was developed to account for energy losses associated with resistance to flow. In one-dimensional (1D) models, Manning's n values are used, in part, to account for the effects of channel sinuosity and meandering. In fact, Cowan and Chow suggested that Manning's n values should be increased by as much as 30% to account for increased meander. In two-dimensional (2D) models lateral flow and more complex flow paths are inherently accounted for in the model's calculations suggesting that assigned Manning's n values should be lower than for 1D models when modeling the same reach. However, guidance documents for 2D models, such as HEC-RAS and SRH-2D, do not specify adjusting Manning's n values to account for increased numerical resolution.

To more accurately assess how Manning's n values should be adjusted for use in 2D models, we have performed comparative studies of several different streams using both 1D (HEC-RAS) and 2D (HEC-RAS and SRH-2D) models. The results of this comparison yield preliminary recommendations for adjusting Manning's n values within 2D models, based on the degree of sinuosity and flowpath complexity, as well as the modeling software being used. The goal of this presentation is to increase awareness and initiate a dialog around the need for more accurate resistance coefficients specific to 2D surface water models.

Predicting In-Stream Habitat Improvements with 2D Hydraulic Modeling: A Case Study from the North St. Vrain.

McBroom,, Mark, Michael Baker International.

Improving in-stream habitat is a desirable end condition for stream restoration activities, but quantifying a design's potential benefit to in-stream habitat is not a part of most stream restoration budgets. In this talk we'll discuss how to co-opt the stream restoration design process to extract actionable information on in-stream habitat improvement. This presentation will discuss how to piggy back on the tasks of surveying, surface creation, H&H, and analysis to generate the inputs of an in-stream habitat model. We'll discuss useful tools and workflow, what can reasonably be expected from different levels of effort, and the limitations of modeling habitat. Flood recovery efforts on the North St. Vrain outside of Lyons, CO provides a case study of this process. As part of the restoration design, two-dimensional surface water hydraulic modeling provided detailed analysis of current and future flooding impacts and hydraulic conditions in the project area. In addition to geomorphic and flood risk considerations, the modeling effort enabled a quantitative prediction of improved in-stream habitat and insights into how to improve the design from a biological perspective.

Potential transport of silt through a gravelly aquifer, Sand Lake area, Anchorage, Alaska

Munter, Jim J. A. Munter Consulting, Inc

Observations of unusual sediment occurrences and disappearances in a well closely coincident with two major turbidity events in a gravel-pit pond approximately 830 feet away prompted evaluation of whether the events may be related through plausible groundwater flow processes. The two events were separated by about 25 years. A literature review of particulate transport in groundwater, site-specific subsurface geological mapping, aquifer testing, and tritium analysis, all indicate that transport of silt-sized particulate matter to the well through a gravel and sand aquifer is plausible. A more complete summary of findings (last modified August 24, 2017) can be found at: http://communitycouncils.org/servlet/viewfolder?id=10655.

Proposed improvements to the regulation of aquifer tests in Alaska

Munter, Jim J. A. Munter Consulting, Inc

Aquifer testing relies on significantly stressing an aquifer by pumping a well for a relatively brief period of time while water levels are observed to draw down and recover. Impacts to streams, other wells, or contaminant plumes are transient and rare. Regardless, significant administrative resources and long lead times are required to regulate this activity in conformance with the Alaska Water Use Act. The existing system is widely recognized to be dysfunctional because it allocates scarce state resources to a relatively low-value regulatory process, likely does not result in acquisition of more or higher-quality data, and creates risk and costs to the orderly development and use of the groundwater resources of the State. This paper reviews the State's interests and proposes alternatives including whole or partial exemption, on-line registration, or issuance of a general permit to improve the regulation of aquifer testing in Alaska. Since 1964, when the Alaska Water Use Act was first passed, Alaskans have had ample opportunity to evaluate its strengths and weaknesses, and minor revisions are warranted.

Where Can You Float a Boat? Relating Flow and Basin Characteristics to Assess Navigability in Alaska

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Stream size and flow regime are important factors affecting navigation (i.e. boat passage) for recreation, travel, and commerce on Alaskan waterways. Focusing on the Yukon River basin, we examined the hydrologic characteristics of the open water season (May-September) for all USGS gages (54 total) with a daily flow record. We found a significant relationship between basin size and the median open water season flow across the entire range of USGS gaging sites (1.1 to 318,300 square miles) as well as smaller basin area bins (e.g. <35,000, <3000, <1200, and <120 square miles). Further, we applied the Strahler stream order classification system to the National Hydrography Dataset (NHD) within the Yukon River basin to obtain a Strahler stream order for all stream segments. All mainstem Yukon River sites are stream order 9, major tributaries are stream order 7-8 (Porcupine, Tanana, Koyukuk, Chandalar, Fortymile), medium basins are stream order 5-7 (Chisana, Melozitna, Salcha, Nenana, Anvik, MF Koyukuk, Kandik, Nation, Chena), and smaller basins are stream order 4-5 (Goodpaster, Teklanika, Hess, Jim, Mosquito Fork, Little Chena, Tolovana). This basin-wide approach provides a useful guide that can be combined with boating experience and site-specific conditions such as channel slope, substrate, thalweg depth and width to determine stream and river navigability throughout Alaska. We will provide some examples of navigable river segments from recent float trips in the Yukon basin.

Methane Seep Mechanism for a Northwest Alaska Lake

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Methane (CH4) is a potent greenhouse gas that accumulates in subsurface hydrocarbon reservoirs. For Arctic areas, layers may also be overlain with impermeable permafrost which is thought to form a secondary ‘cryosphere cap’, inhibiting emission of the gas to the atmosphere. When this cap is penetrated, either by a fault or due to thawing of the permafrost from a lake above, methane can escape from the secondary trap. We present results of our investigation of a large ebullition (bubbling) gas seep in northwest Alaska. Our work includes characterization of the geologic and cryosphere systems underlying the lake and mechanisms involved in gas emission from the lake.

Environmenal Justice and Alaska Native Tribal Water Policy

Shepherd , Hal Water Policy Consulting, LLC

Of the over 500 federally recognized tribes in the United States, 229 of them are in Alaska. When Alaska became the 50th state a mere 50 years ago, therefore, a hasty development of laws occurred to address the inevitable, clash between the Alaska Native and western European cultures. For better or worse nowhere are the results of successes and failures of the development of environmental justice principals more transparent than in Alaska and this is especially true in the area of tribal water and subsistence interests.

Water is not only vital for life, it is also essential to a functioning economy. Water, therefore, often plays a role in the preservation of environmental justice because the health of all communities —small or large, wealthy or in need— depends on adequate infrastructure that can reliably deliver safe drinking water and provide clean wastewater and stormwater management. Environmental justice principals are also visible in Alaska because a higher percentage of the food supply of tribal communities located within the state comes from a subsistence lifestyle that relies on healthy fresh water fish and wildlife habitat, streams, lakes, coastal areas and rivers.

As a result, Alaska Native village communities (Villages) are disproportionately impacted by toxic substances, lowered instream flows, stream bank erosion and temperature increases resulting from industrial development activities and climate change. This presentation will focus on barriers to environmental justice in relation to the water and subsistence resource interests of Alaska Native Tribal governments and what can done to better implement environmental justice policies in the state.

Estimating bed-load transport along the Sagavanirktok River

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The estimation of bed-sediment transport in rivers, through direct measurements, is complex due to the phenomenon's intermittency. In addition, the systematic collection of bed sediment is impractical because the fieldwork must be performed under active sediment transport conditions. The logistical tasks to gain access to the river are further complicated when the sampling sites are located in remote, hard-to-reach areas. The use of trenches in these cases allows for estimating the average bed-sediment transport rates. The presentation will describe the work being done by a research group from the University of Alaska Fairbanks along the Sagavanirktok River.

Active layer and water biogeochemical heterogeneities within the Yukon River Basin.

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The Yukon River Basin (YRB), underlain by discontinuous permafrost, has experienced a warming climate over the last century that has altered air temperature, precipitation, and permafrost. A collaborative effort between the Yukon River Inter-Tribal Watershed Council (YRITWC) and the United States Geological Survey (USGS), the Indigenous Observation Network (ION) has developed two projects that focus on water quality and permafrost research. Data gathered as part of these community-based research programs over the past decade have contributed to the global understanding of climate change through the Arctic Observing Networks and the Circumpolar Active Layer Monitoring Network and ultimately its impacts on Alaska Native Villages. Combined with historical data from the USGS, the ION database now covers over 30 years of historical water quality data in key locations. Trend analysis of this database suggests increased active layer expansion, weathering and sulfide oxidation due to permafrost degradation throughout the YRB. Changing geochemistry of the YRB may have important implications for the carbon cycle, aquatic ecosystems, and contaminant transport. With predicted environmental changes, the efforts of ION will become critical to assess, mitigate and adapt to changing local environments.

Observing Precipitation for Hydrologic Modeling and Flood Prediction: an Analysis of Methods

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How much precipitation fell and when? What gage data is available? What about precipitation in under- or non-gaged areas? These are essential questions for hydrologists and meteorologists who are tasked with flood forecasting. This study seeks to evaluate the accuracy of using model data to augment or replace gage based precipitation estimates in the state of Alaska.

The National Weather Service's (NWS) National Water Model (NWM) has been implemented in the continental United States. It is a fundamental leap forward and a paradigm shift in flood forecasting for the NWS - it is the difference between ~8300 point gages simulated on a 6-hour time step to a continuous, gridded model for streamflow run on an hourly time step over the entire continental United States.

The next step in the implementation of the NWM is expanding it to include the state of Alaska.
The single most important driver for this advanced model is accurate and timely observed precipitation data, which is challenging in Alaska due to the sparse density of radar and observed data.

To bridge the gap and create accurate precipitation estimates, this study evaluates whether model data could be used to augment or replace gage-based precipitation estimates. The Regional Deterministic Precipitation Analysis (RDPA), was tested to approximate quantitative precipitation estimates. This models was compared to an observed grid created from gage data and climatology and were evaluated for skill in recognition of precipitation type, event timing, quantity and location. Model comparison focused primarily on snow events during the winter of 2016-2017 between 58 and 65 degrees N.

Real-Time Flood Monitoring in the Colville River Delta, Alaska; Case Study

Yager, Garrett C. Michael Baker International

Real-Time Flood Monitoring in the Colville River Delta, Alaska provides instantaneous flood information to hydrologists and oil and gas operations managers. The system was developed to reduce helicopter activity and decrease the lag time for data distribution. The system is comprised of a network of water level sensors, pier scour systems, cameras, and telemetry equipment. Data is collected by onsite dataloggers which transmit the data to a host computer. Information is accessed through a project website by field crews, senior hydrology advisors, and operations management for prompt and well-informed decision making. System alarms trigger emails and text messages to activate a response plan when stage or pier scour exceeds set levels at specific locations. Remote cameras are used to monitor ice jam formations and releases and allow hydrologists to remotely collect measurements for correcting water level sensor data. Results from the first year revealed immediate reductions in helicopter activity, ability for continuous monitoring, and a more efficient use of resources for hydrology teams.

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