Report as of FY2008 for 2006AK51B: "Investigation of Streamflow Response to Seasonal Snowcover Change in the Yukon River"

Publications

- unclassified:
  - Yang, D., Challenges in understanding arctic hydrology system changes,Asia CliC Workshop, Yokohama, Japan, May 17-19, 2007.
- Articles in Refereed Scientific Journals:
  - Yang, D., Y. Zhao, R. Armstrong, and D. Robinson, 2009: Yukon River Streamflow Response to Seasonal Snowcover Changes, Hydrol. Process. 23,109–121, DOI: 10.1002/7216.
  - Ye, B., D. Yang, Z. Zhang, and D. L. Kane (2009), Variation of hydrological regime with permafrost coverage over Lena Basin in Siberia, J. Geophys. Res., 114, D07102, doi:10.1029/2008JD010537.
- Other Publications:
  - Yang, D., Yukon River Streamflow Response to Seasonal Snowcover Changes, American Water Resource Association Alaska Annual Meeting, Fairbanks, April 3-5, 2007.
  - Yang. D., Streamflow response to seasonal snowcover change over the large northern rivers, American Geophysical Union Fall Meeting, San Francisco, December, 2006.

Report Follows

Summary of activities in 2008

Investigation of Streamflow Response to Seasonal Snowcover Change in Yukon River

PI: Daqing Yang

Focus Category: Snowcover hydrology

Keywords: Discharge, climate, snowcover, and permafrost

Start Date: 1 March 2006; Ending Date: 28 February 2009

1. Background

The Yukon River is one of the largest rivers in the northern regions. It contributes 203 km3 per year freshwater to the Bering Sea. Hydrologic conditions and its changes of the Yukon river significantly affect regional biologic and ecologic systems. Unlike other large northern rivers, Yukon River has received less research attention. The USGS produced a report in 2000 to document the major hydrologic patterns with the basin. Studies found that large parts of southern Canada and Yukon Territories have experienced reduced runoff. Snowcover is one of the critical land memory processes that significantly affect atmosphere, hydrology and ecosystems in the high latitude regions. Snowcover melt and associated floods are the most important hydrologic event of the year in the northern river basins. Studies show that snowmelt has started early over the recent decades in the northern regions of Canada, Alaska and Siberia associated with warming in winter and spring seasons. This change in the melt pattern may indicate a hydrologic regime shift over the high latitudes. Due to insufficient investigation and lack of long-term records, our current understanding of Yukon River hydrology and climate changes, particularly large-scale snowmelt processes and their interaction with climatic change and variation, is incomplete. This limits our capability of documenting past change and predict future change over this largest watershed in Alaska.

We recently applied the weekly snowcover data in large Siberian watersheds (Lena, Yenisei and Ob rivers) and identified a close association of the runoff to snowcover extent changes during the spring melt period. Our initial analyses of snowcover and streamflow data in Alaska also show a strong correlation of monthly runoff with snowcover extent during early summer season. These encouraging results clearly indicate the potential of using the weekly snowcover information to improve snowmelt runoff modeling and prediction in the high latitude regions. This research project continues our effort in the Yukon River with a focus on analyzing basin and sub-basin snowmelt processes.

2. Study Objective

This research uses the weekly AVHRR snowcover extent and SSMI SWE records to study the streamflow hydrology in the Yukon River. The focus of this research is to examine the streamflow response to snowcover extent and mass changes during the spring melt season. The overall objective of this research is to determine the potential of using remotely sensed snowcover information to improve our capability of snowmelt runoff modeling and forecasting over large northern river basins. The major work of this research project includes:

A. *Generation and analysis of weekly snowcover extent, SWE and runoff time-series*
B. *Examination of streamflow response to snowcover extent and SWE changes*
C. *Cross-validation of results*

3. Summary of Activities

In 2007, we focus our effort on examination of streamflow regime and change over the various parts of the basin. We use monthly discharge data at key 4 stations to define normal streamflow conditions, its variation and changes. We found that low flows and low variations in winter over the basin, and high flows and high variations in summer months. Peak flow occurs in June for stations at Eagle, Stevens Village and Pilot, due to snowmelt runoff. For the Nenana river, peak flow occurs in July due to glacier-melt.

Trend analyses show that for the Eagle Station, negative trends of 17,235 ft^3/s - 34,875 ft^3/s in June, July, and August have confidence below 90%; the positive trends of 12 ft^3/s -8,763 ft^3/s in May, September, and October have confidence below 85%; the changes in other months are from 886 ft^3/s -3,081 ft^3/s, with confidence below 80%. For the Stevens Village Station, negative trends of 6810 ft^3/s-40,632 ft^3/s in June and August have confidence below 80%; the decrease of 35,174 ft^3/s in July has confidence over 90%; the increase of 70,265 ft^3/s in May and the increase of 23,325 ft^3/s have confidence below 80%. Small changes in other months have confidence below 80%. For the Nenana station, the increase of 4,594 ft^3/s in October has confidence over 90%; the increase of 2,938 ft^3/s-4,844 ft^3/s in May, June, and September has confidence below 80%. Small changes in other months are not statistically significant. For the Pilot Station near the basin outlet, the increase of 177,000 ft^3/s in May is obvious and confident at 97%; increase of 4,586 ft^3/s in April is significant over 85%; the small decreases (7502 ft^3/s-12,184 ft^3/s) in January, February, and December are significant around 85%.

Our effort continues to examine daily flow patterns and changes over the Yukon basin. We will also study the basin temperature and precipitation patters and their relations with streamflow.

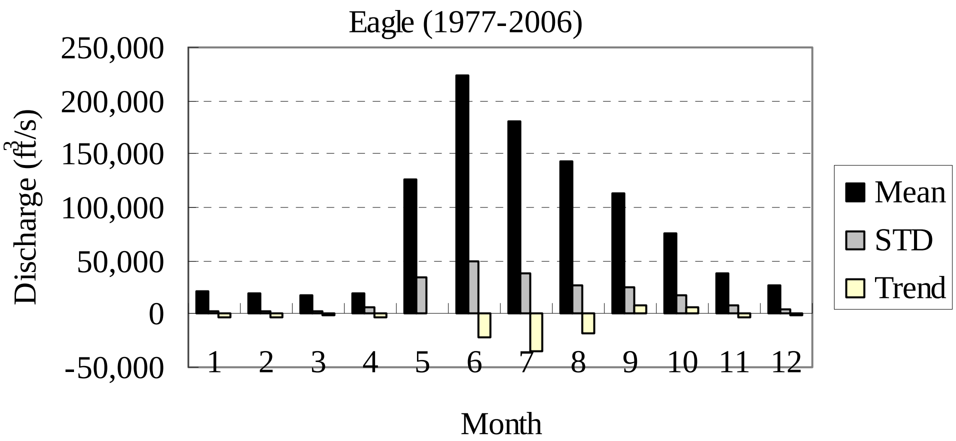

Fig.1 Mean monthly discharge, STD, and trend at Eagle Station

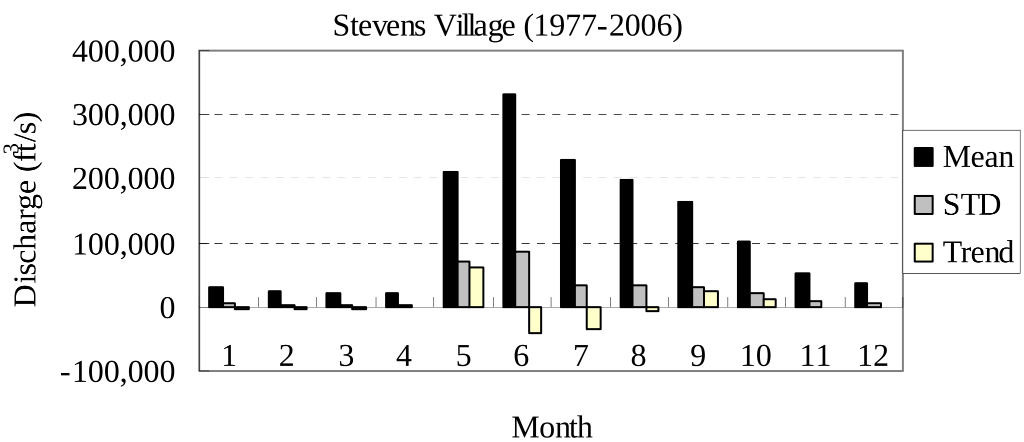

Fig.2 Mean monthly discharge, STD, and trend at Stevens Village Station

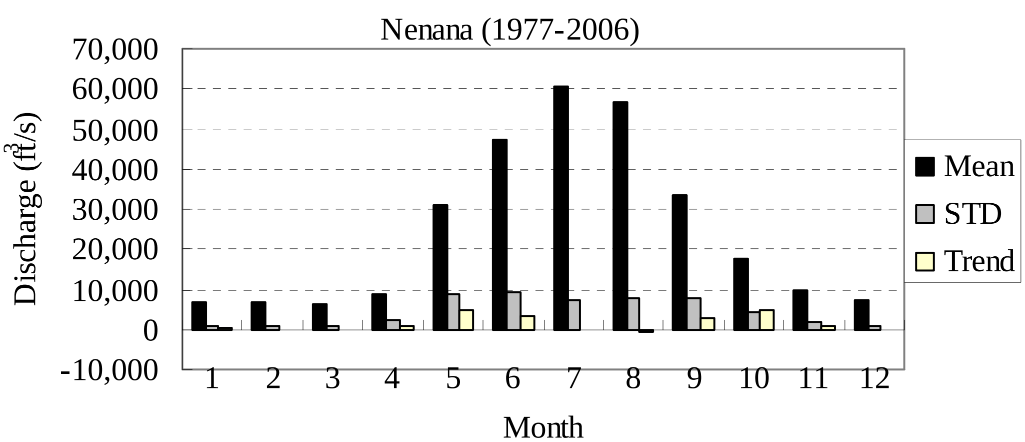

Fig.3 Mean monthly discharge, STD, and trend at Nenana Station

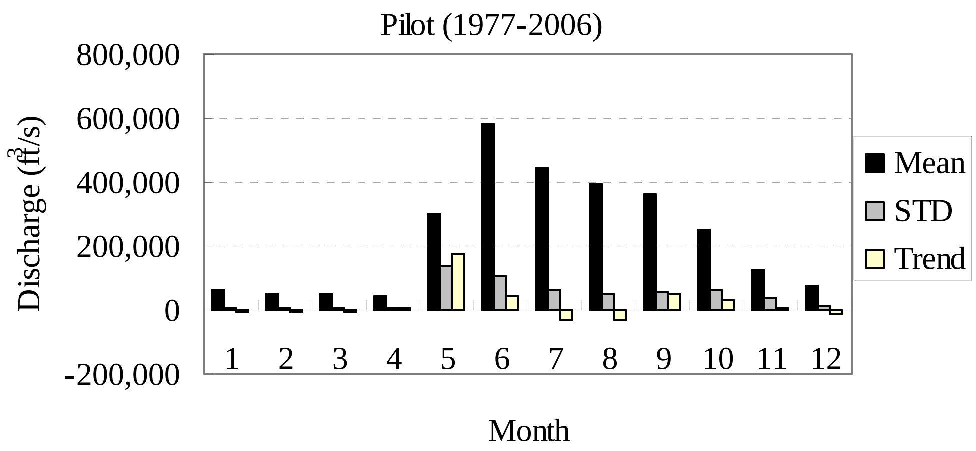

Fig. 4 Mean monthly discharge, STD, and trend at the Pilot Station