An Overview of the 2014 Spring River Ice Breakup across Alaska and Utilization of the Suomi NPP VIIRS River Ice and Flooding Areal Extent Products

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Introduction

Polar orbiting satellites have been critical in the Alaska's National Weather Service (NWS) operations due to the limited observation network. Specifically, Suomi NPP VIIRS satellite imagery has become extremely beneficial in observing a variety of high impact events with information critical to the Weather Forecast Office (WFO) and River Forecast Center (RFC) operations.

In May 2013 during river ice breakup, the VIIRS false-color and reflectance imagery was extremely helpful in identification of river flooding due to ice jams along the Yukon River. An ice jam formed along Bishop Rock downstream of village of Galena (Figure 1A) on the Yukon River. On May 26, 2013 waters rose 6.5 ft. above flood stage for a 3 day period with historic record flooding that devastated the village.

This event prompted the development of the river ice and flood detection products derived from Suomi NPP VIIRS satellite imagery (Figure 1B-C) by the Joint Polar Satellite System (JPSS) Proving Ground and Risk Reduction in conjunction with George Maddison University (GMU) and the City College of Ney York (CCNY).

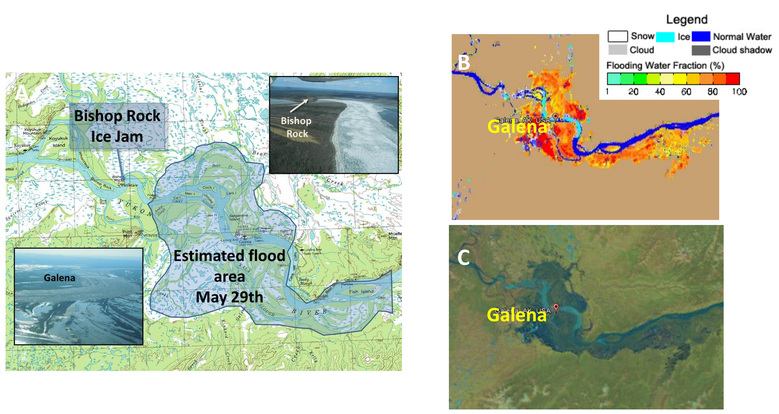

Figure 1. A) West Interior AK map of Yukon River ice jam at Galena. **B)** River Ice and Flood detection products on May 29, 2013 at 1330 UTC. **C)** Suomi NPP VIIRS false-color satellite imagery at same time.

New Products created using Suomi NPP VIIRS imagery

River Ice Product from CCNY: Provides information on ice on major rivers using the 375 m spatial resolution.

- Daily maps with water, cloud, ice, and mixture of water and ice classifications corresponding to RGB color composite generated.
- Technique clusters pixels within an area and uses frequency distribution of the reflectance values at the VIS, near IR, and shortwave IR satellite bands.

Flood detection product from GMU: Primarily used for the ice jams and snow-melting flood forecast and monitoring.

- Series of algorithms varying from water detection, cloud shadow removal, water fraction retrieval, flood determination, and integration of water fraction and DEM for high resolution water map generation.

Case Events Examined

Product Examined	Date(s)	Flooding Type	River	Comments
Flood Detection	May 2013	Ice Jam	Yukon	Galena– West Interior AK (Fig 1)
River Ice Product	April 28-29, 2014		Yukon	Eagle – East Interior AK (Fig 2)
Flood Detection	May 5-9, 2014	Ice Jam	Yukon	Circle – East Interior AK (Fig 3)
Flood Detection	June 2-4, 2014	Ice Jam	Colville	Colville – North Slope AK (Fig 4)
Flood Detection	July 2-4, 2014	Convection	Chena	North Pole – Central Interior AK (Fig 5 and 6)
Flood Detection	June 18-22, 2014	Convection	Salcha	Salcha – Central Interior AK (not shown)

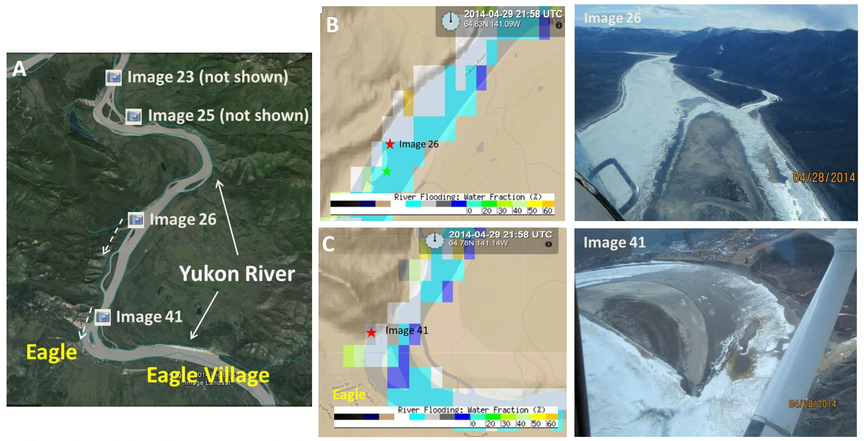

Figure 2. A) Yukon River map near Eagle with dashed arrows identifying the direction photo was taken. **B)** River Ice product on April 29, 2014 at 2158 UTC with corresponding visual image of Yukon River condition (AK River Watch Program). **C)** Same as in B, but for location near Eagle.

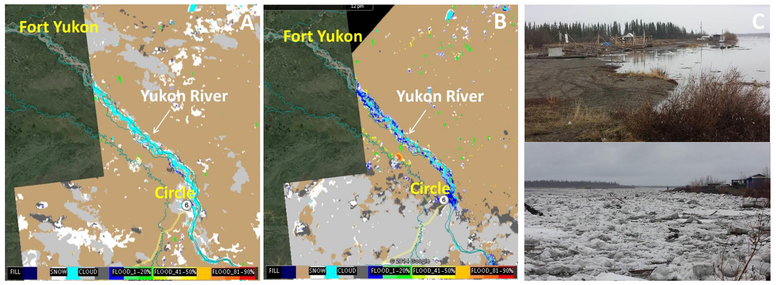

Figure 3. A) Flood detection product on May 4, 2014 at 1846Z. **B)** Same as A, but on May 4, 2014 at 2021Z. **C)** Images of rising waters increasing across Fort Yukon on May 6-7, 2014 with minor flooding.

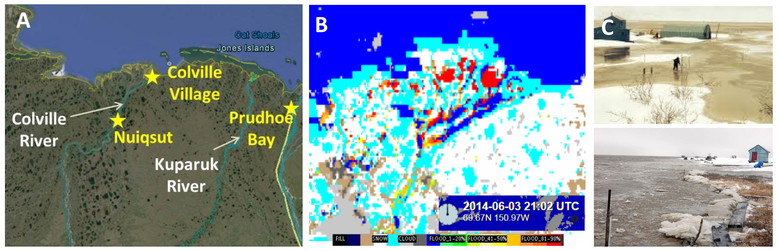

Figure 4. A) Northern Alaska map of Colville River draining into Beaufort Sea. **B)** Flood detection product on June 3, 2014 at 2102 UTC. **C)** Flooded images of Colville Village on June 1, 2014.

Summary

There was limited opportunities to evaluate the new river ice and flood detection products due to a relatively quiet spring breakup season. However, the few events available did show benefits in utilization of the new products.

In addition, there were other benefits to using the products during the record precipitation in the summer convective season and breakup of sea ice, with some limitations.

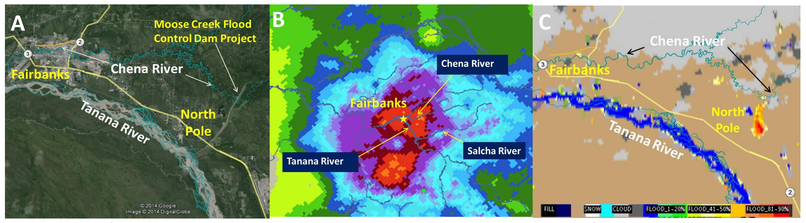

Figure 5. A) Interior Alaska map of Moose Creek Flood Control Dam Project. **B)** Storm total precipitation between July 1 -3, 2014 ending 1200 UTC. **C)** Flood detection product on July 4, 2014 at 21:20 UTC.

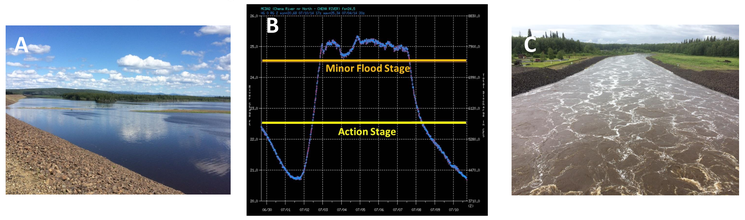

Figure 6. A) Chena River east of Moose Creek Flood Control Dam. **B)** Moose Creek Dam (MCDA2) hydrography at Chena River on July 2-9, 2014. **C)** Downstream view of Chena River from Moose Creek Dam.

Future Work

The Alaska RFC and Fairbanks WFO continue to work closely with the JPSS Risk Reduction Project which include GMU and CCNY in effort to provide useable and valuable product that will help in hazardous warning forecast operations. Some significant areas for improvement across Alaska include:

- Cloud shadow issues and solar zenith angle
- Temporal consistency in analysis for river ice and flood detection
- Potential ability to include other polar orbiting satellite imagery from the MODIS instruments with a proof of concept from Suomi NPP VIIRS

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