The NHWC Transmission

February 2018

CONTENTS

Click on hyperlinks located throughout this newsletter for more information.

NHWC 2017-19 Officers and Directors

River Ice and Forecast Uncertainty on the Mississippi River

Laura Diamond, NWS/North Central River Forecast Center

River ice can create problematic conditions that threaten life and property, and can contribute to increased uncertainty when estimating flows and forecasting stages on navigable rivers. Ice jams and ice bite impede and remove water from moving downstream, and cold weather can render observed river gage data unreliable as sensors are impacted or ice creates a shift in the stage/discharge relationship. Modeling river flow becomes increasingly challenging as these phenomena occur; when multiple events are concurrent or extreme weather conditions prolong ice impacts, the level of complexity increases and the uncertainty is further magnified.

Forecast Responsibility and Agency Coordination

The National Weather Service (NWS) North Central River Forecast Center (NCRFC) is responsible for issuing stage and flow forecasts for the Upper Mississippi River Basin. The NCRFC works closely with the United States Army Corps of Engineers (USACE) to exchange data and forecast information, including anticipated regulation strategy of the locks and dams along the Mississippi River above St. Louis, Missouri (Figure 1). Observed data from the United States Geological Survey's (USGS) streamgage network allow flow estimates to be calculated and routed down-stream with increased confidence. The NCRFC incorporates Missouri River forecasts from the Missouri Basin RFC and USACE to produce stage and flow forecasts at St. Louis and downstream through Chester, Illinois—the NCRFC handoff point for forecast flows above the Mississippi confluence with the Ohio River.

Figure 1: Upper Mississippi Basin Lock and Dam Structures

Monitoring and Situational Awareness

Ice production and movement during the winter months are monitored closely throughout the Upper Mississippi drainage. Freeze-up and break-up ice jams are common on many tributaries, and occasionally along the mainstem Mississippi, and the timing and severity of any associated flooding can be hard to predict.

The Corps of Engineers' Cold Regions Research and Engineering Lab (CRREL) maintains a database of freeze-up and break-up ice jam events for many gaged locations with current or historical data, and the NCRFC has used this information to develop ice jam forecasting tools for locations that have a history of ice jam flooding. Risk assessment is based on observed and forecast temperatures, Accumulated Freezing Degree Days (AFDD), and river flow regime (Figure 2).

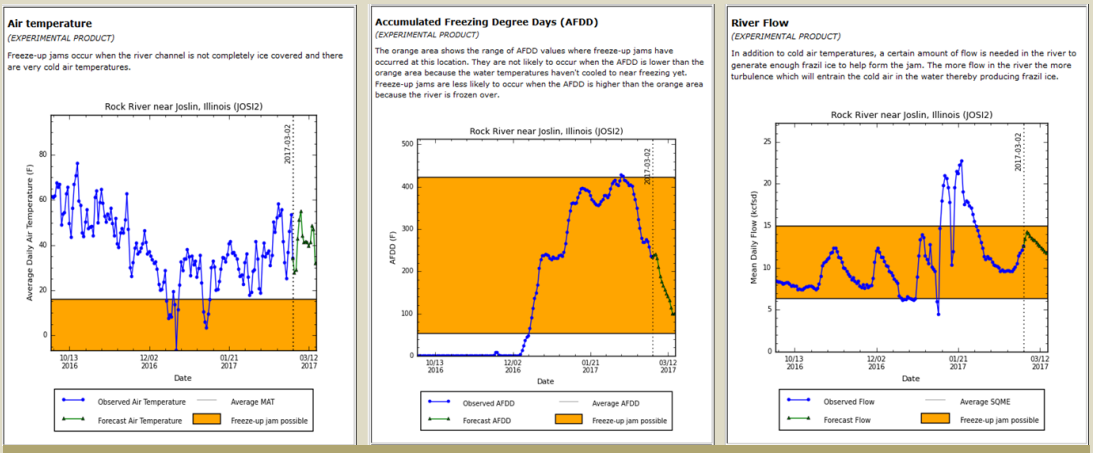


Figure 2: Example Ice Jam Potential for the Rock River at Joslin, Illinois

Sources of Uncertainty

- Observed river gage data are often unreliable when ice is present; stage/discharge relationships are no longer valid and flow must be estimated based on hydrologic/hydraulic model simulations
- Ice bite + breakdown of stage/discharge relationships due to ice = greater uncertainty in accumulated/routed flow volumes
- Freeze-up or break-up ice jams also impede or remove flow from routing downstream

Ice Jam Flooding and Uncertainty

The immediate impact of an ice jam can be flash flooding, creating a threat to life and property. Depending on the type, severity and persistence of an ice jam, the timing and volume of water routed downstream can be greatly impacted. This becomes increasingly problematic as flow estimates are accumulated and if there are multiple events occurring simultaneously.

If the CRREL database includes flow estimates for any historical ice jams at a forecast point location, that information can be used by forecasters to determine a range of shifts to the stage/discharge relationship, based on ice jam type and previously observed stages. In Figure 3 (right), the plotted blue and yellow dots indicate observed stage and flow for historical freeze-up and break-up ice jams on the Rock River at Joslin, Illinois, along with the current USGS rating (green dots). If the risk of an ice jam is high, the forecaster can include a range of stages in a river stage forecast based on the current modeled flow and the difference between the rated stage and observed historical stages within the same flow regime. This is especially useful when there's a risk of significant flooding, and can increase lead time for the issuance of flood warning products.

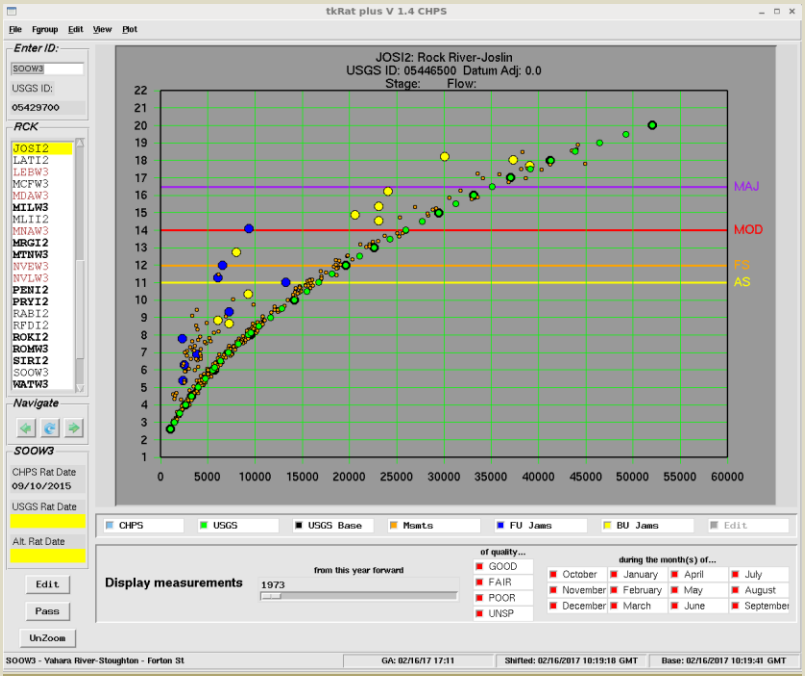


Figure 3: Plot with rating and ice jam events for Joslin, IL. Shifts of 1-6 feet due to ice have been observed.

Ice Bite

Ice bite is another phenomenon that can complicate the modeling and forecast process. Prior to the formation of river ice cover, streamgage data allow a good estimate of flow and there is higher confidence in modeled flows as they are accumulated and routed downstream. Once air temperatures drop and water temperatures are approaching 32° F, a stationary ice cover can form quickly. The

stationary ice cover removes volume from the downstream flow, and river levels can drop rapidly. The reduction in streamflow due to upstream ice formation can have temporary but significant impacts on navigation, municipal water supplies, and power plant operations. The potential impacts to navigation in the middle and lower portions of the Mississippi can be both operationally and economically significant. USACE is required to maintain a 9-foot channel throughout the length of the navigable river and the rapid formation of an ice bite can cause difficulties with barge traffic, pool levels, timing of dredging operations, and any ongoing construction projects. Communication between the NCRFC and USACE districts is crucial during this time.

Ice Bite—What is it?

- An ice cover on the river hasn't formed yet
- River water temperature is approaching 32°F
- An extreme cold snap occurs over the course of a few days
- Cold temperatures rapidly generate a stationary ice cover on the river
- Stationary ice reduces the flow volume that is routed downstream, and river levels can drop rapidly
- An ice bite can have temporary but significant impacts on navigation, municipal water supplies, and power plant operations

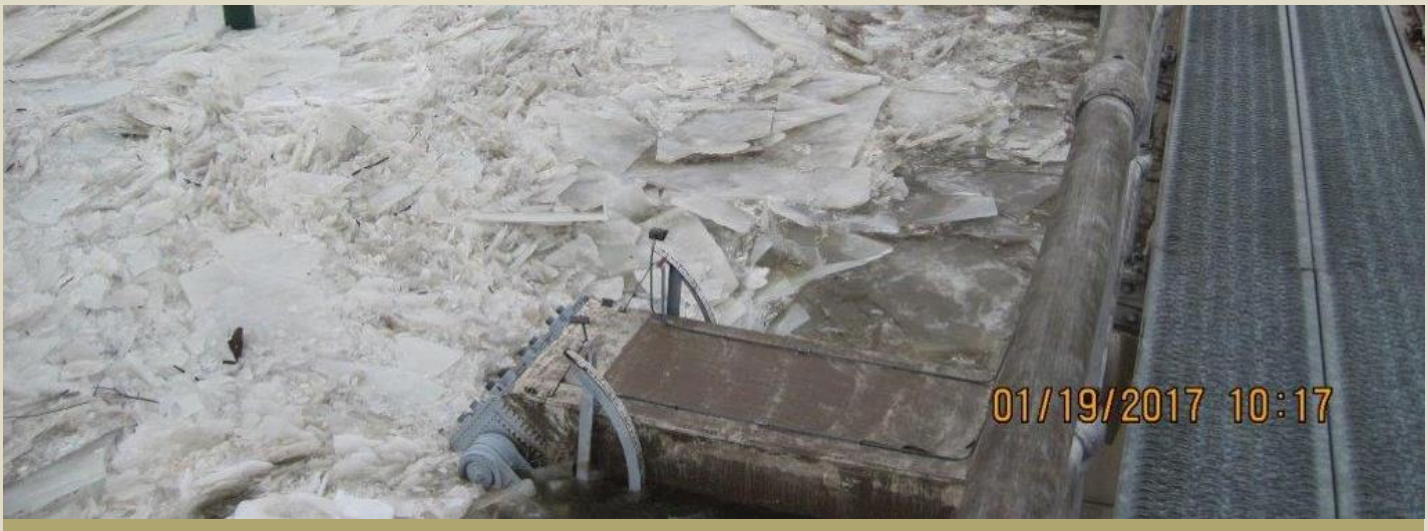
Extreme Uncertainty: The Winter of 2016-17

The winter of 2016-17 saw extreme ice production and movement in the upper Mississippi River drainage, with multiple rounds of freeze-up and break-up ice jams that caused significant tributary flooding in multiple states across the upper Midwest. A late December rainfall event and subsequent thaw moved significant volumes of river ice and runoff in to the mainstem Mississippi River along the Iowa/Illinois border. Another cold snap in January generated additional ice and locked much of the ice from upstream in place within the lock and dam system between Dubuque and Keokuk, Iowa, leading to major flooding and significant forecasting challenges within the reach.

Every phenomenon discussed previously contributed to last winter's forecasting challenges, and the complexity of the event caused prolonged uncertainty in flow estimates. An additional level of complexity was added when an ice jam breakup at Lock and Dam 19 released a flood wave, once temperatures finally moderated!

Large chunks of flushed ice are refrozen in place at Lock and Dam 18; photo credit USACE, Rock Island District

St. Louis was experiencing critical low flow levels due to the ice upstream; stages were within a day of dropping below the 9-foot navigation channel requirement when the pulse of water that was released from the ice jam brake-up at Lock and Dam 19 arrived downstream.



Ice locked in place at Lock & Dam 18 on Jan 19, 2017. A 6-foot shift and backwater due to ice caused major flooding in the Burlington, Iowa area. Photo credit: USACE, Rock Island District

SAVE THE DATE!!!

June 17-20, 2019

The NHWC13th Biennial Training Conference & Exposition

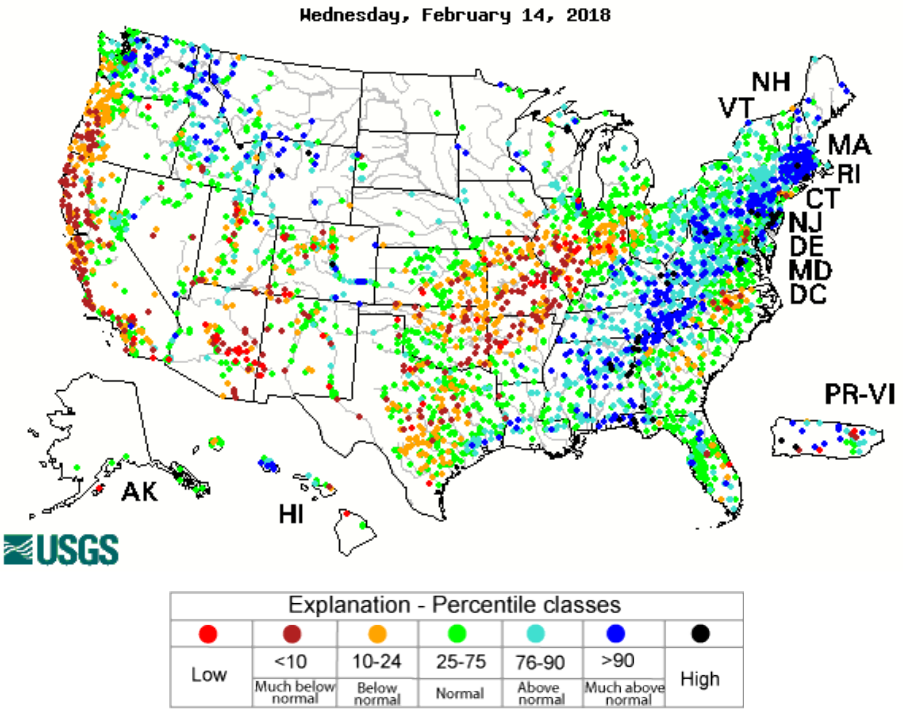
Louisville, Kentucky

Big News! The Galt House in Louisville, Kentucky will serve as the host hotel for the 2019 NHWC Conference on June 17-20, 2019.

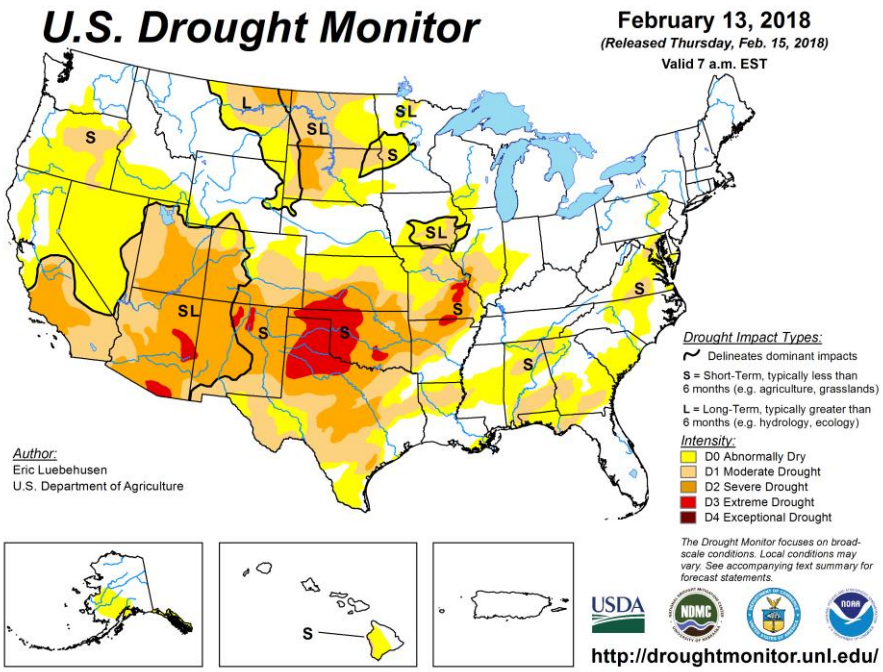
We're currently looking for some enthusiastic folks to join our 2019 Conference Planning Committee. If you're interested, please email our Committee Chairman, Brad Heilwagen, at nhwc2019conference@hydrologicwarning.org before February 23, 2019.

Information regarding registration, sponsorship & exhibitor opportunities, tours, golf, and more will be posted to our website as it becomes available.

Hydrologic Conditions in the United States
Through February 13, 2018



Latest stream flow conditions in the United States. (courtesy USGS)



Latest drought conditions in the United States.
(courtesy National Drought Mitigation Center)

March Newsletter Articles Focus:

Hydrology

The NHWC is requesting articles that focus on hydrology - the science behind the work we do. Please consider preparing a short article about new methods, research, or discoveries in hydrology or a recent significant hydrologic event.

Submit your article to:

editor@hydrologicwarning.org

March 8th is the deadline for inclusion in the March issue.

Future Newsletter Articles Focus

To give you more time to prepare articles, below is the article focus schedule for the next four months:

Mar - Hydrology
Apr - Hazard Communication & Public Awareness
May - Modeling/Analysis
Jun - Data Collection

NHWC Calendar

June 17-20, 2019 – The NHWC 13th Biennial Training Conference and Exposition, Louisville, Kentucky

General Interest Calendar

March 29, 2018 – Southwest Extreme Precipitation Symposium (SWEPSYM), Scripps Seaside Forum, Scripps Institution of Oceanography, California

April 17-20, 2018 – The ALERT User's Group Training Conference and Exposition, Ventura, California

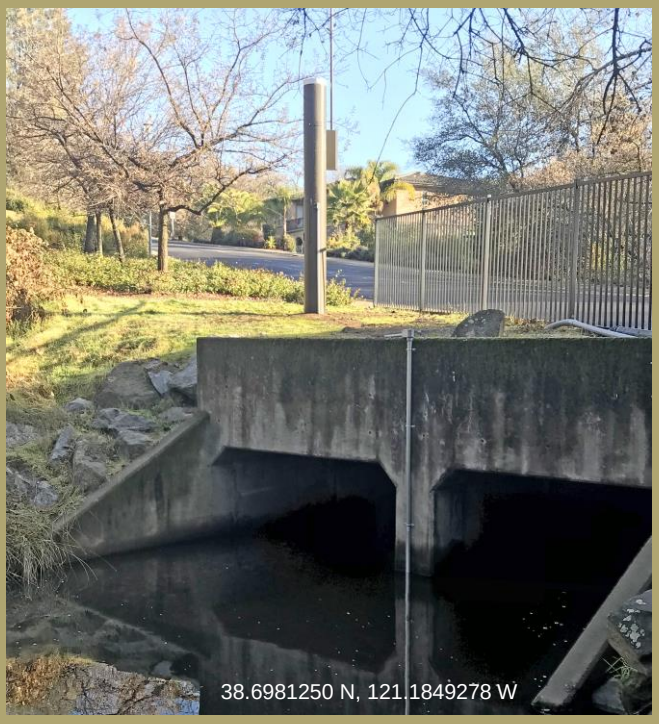
June 4-7, 2018 – 2018 ASCE Environment and Water Resources Institute International Congress, Minneapolis, Minnesota

June 17-21, 2018 – ASFPM 2018 Annual Conference, Phoenix, Arizona

(See the event calendar on the NHWC website for more information.)

Parting Shot

New Folsom, California ALERT2 Station



This ALERT2 rain/ stream station was installed December 2017 on Hinkle Creek at Oak Avenue in Folsom, California.

Real-time data from this station and others in the system can be accessed at:

https://folsom.onerain.com/home.php

Photo by **David Curtis**, WEST Consultants