Attendee Rules

- ❑ Mute yourself
- ❑ Turn off your camera

2022 Alaska Coastal & Ocean Mapping Summit

2022 Bering Sea Storm Recap Panel

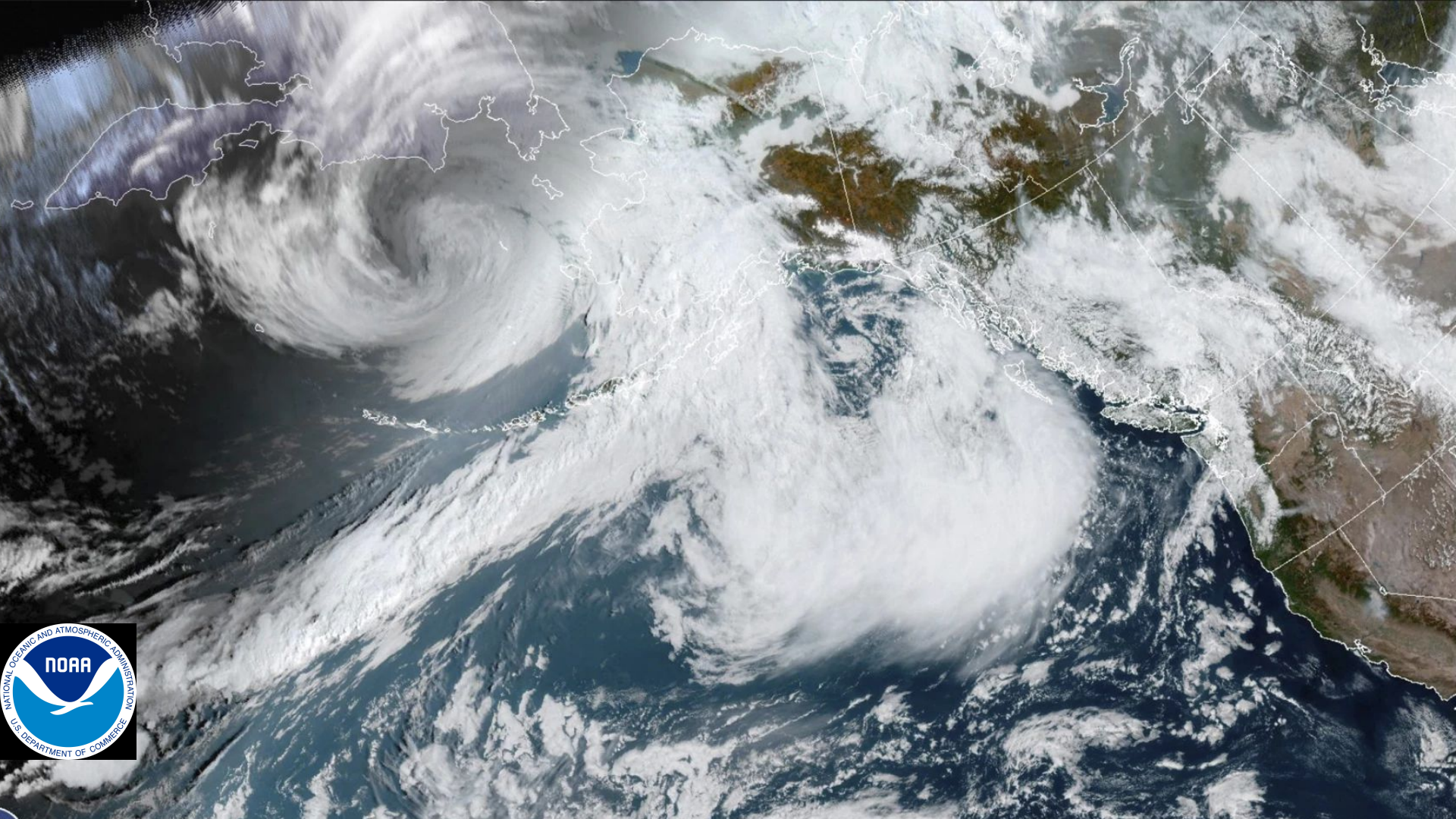
November 16th, 2022

Introduction

Nic Kinsman – Alaska Regional Team, NOAA

Ex-Typhoon Merbok Introduction and Collaborative Data Response

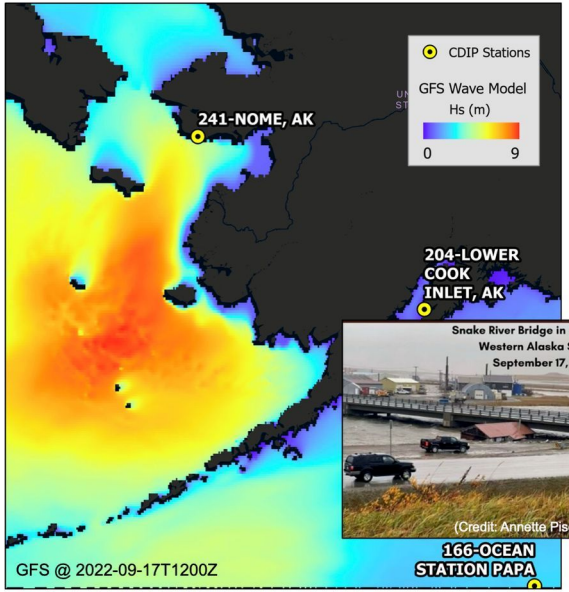
November 17, 2022

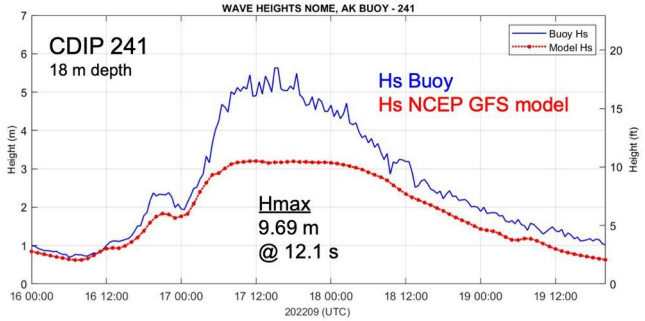

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

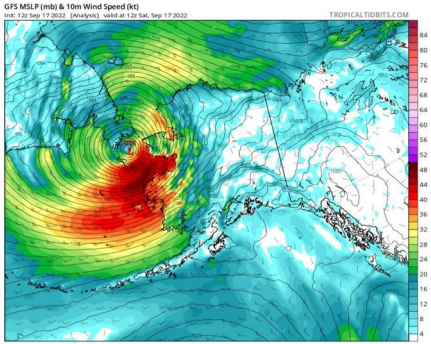
CDIP Wave Observations: **Alaska Storm / Bering Sea**
September 16-19, 2022

CDIP coastal data information program
cdip.ucsd.edu

US Army Corps of Engineers







- Remnants of Typhoon Merbok generated powerful waves and storm surge in the Bering Sea, causing historic severe widespread coastal flooding.
- Waves at CDIP 241 Nome reached a maximum Hs of 5.63 m, with a maximum individual wave of 9.69 m, while the tide exceeded 3 m MLLW, its highest level since 1974.
- Station was established in 2018 and is operated in cooperation with AOOS and the Port of Nome.

Port of Nome Alaska

AOOS Alaska Ocean Observing System

CDIP storm bulletins:
cdip.ucsd.edu/themes/cdip?d2=p12

UC San Diego | Scripps Institution of Oceanography

Major flooding: At what height...

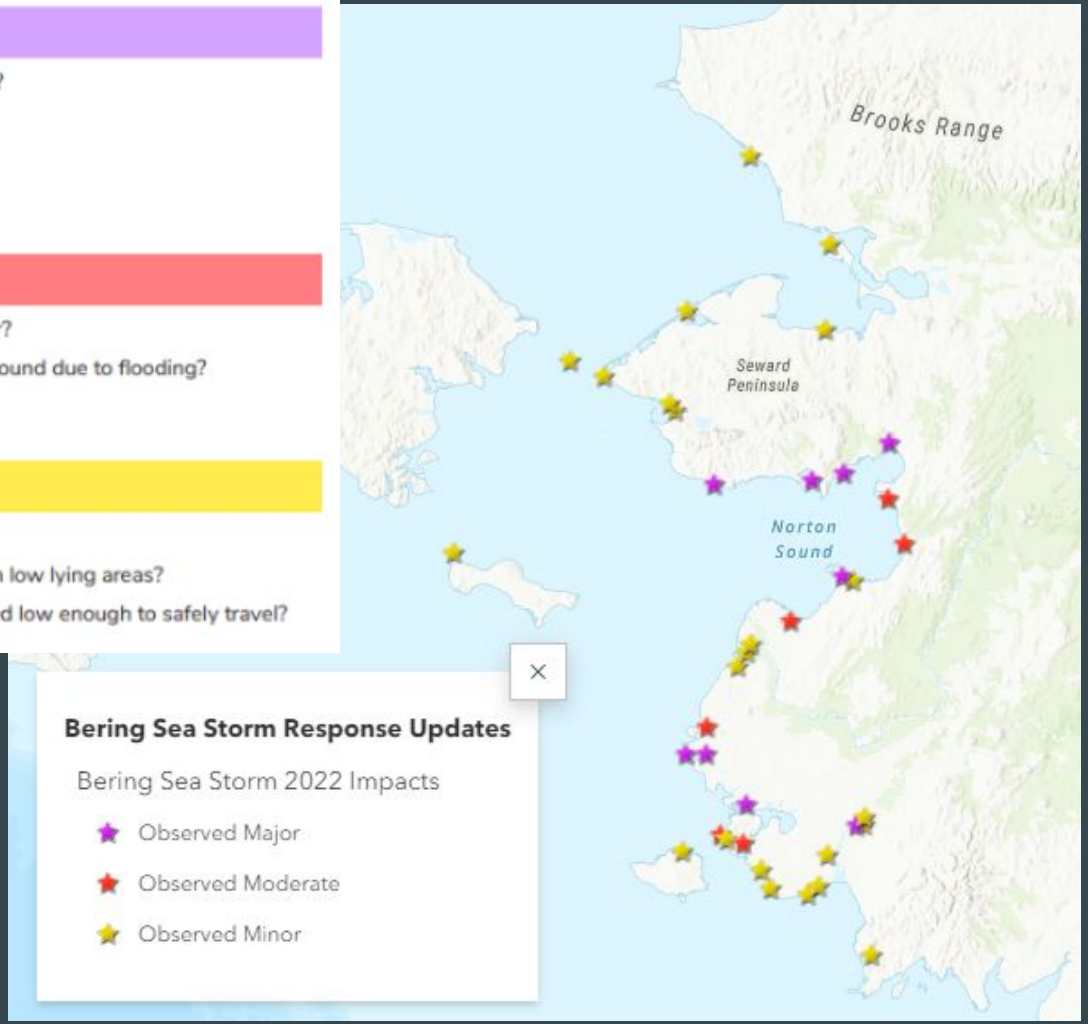
1. Have several buildings been flooded with over 1 foot of water?
2. Have the fuel storage or power generation facilities flooded?
3. Has the airstrip been completely inundated?
4. Has flood water reached the drinking water source?
5. Has flood water reached wastewater facilities?

Moderate flooding: At what height...

1. Have several buildings been flooded with up to 1 foot of water?
2. Have people in the lowest area(s) been evacuated to higher ground due to flooding?
3. Has flood water cut off access to larger parts of town?
4. Has flooding closed the airstrip?

Minor flooding: At what height...

1. Has water come into yards, or under elevated buildings?
2. Has flooding reached property (such as vehicles, not homes) in low lying areas?
3. Has flooding reached roads or the airport runway, but remained low enough to safely travel?



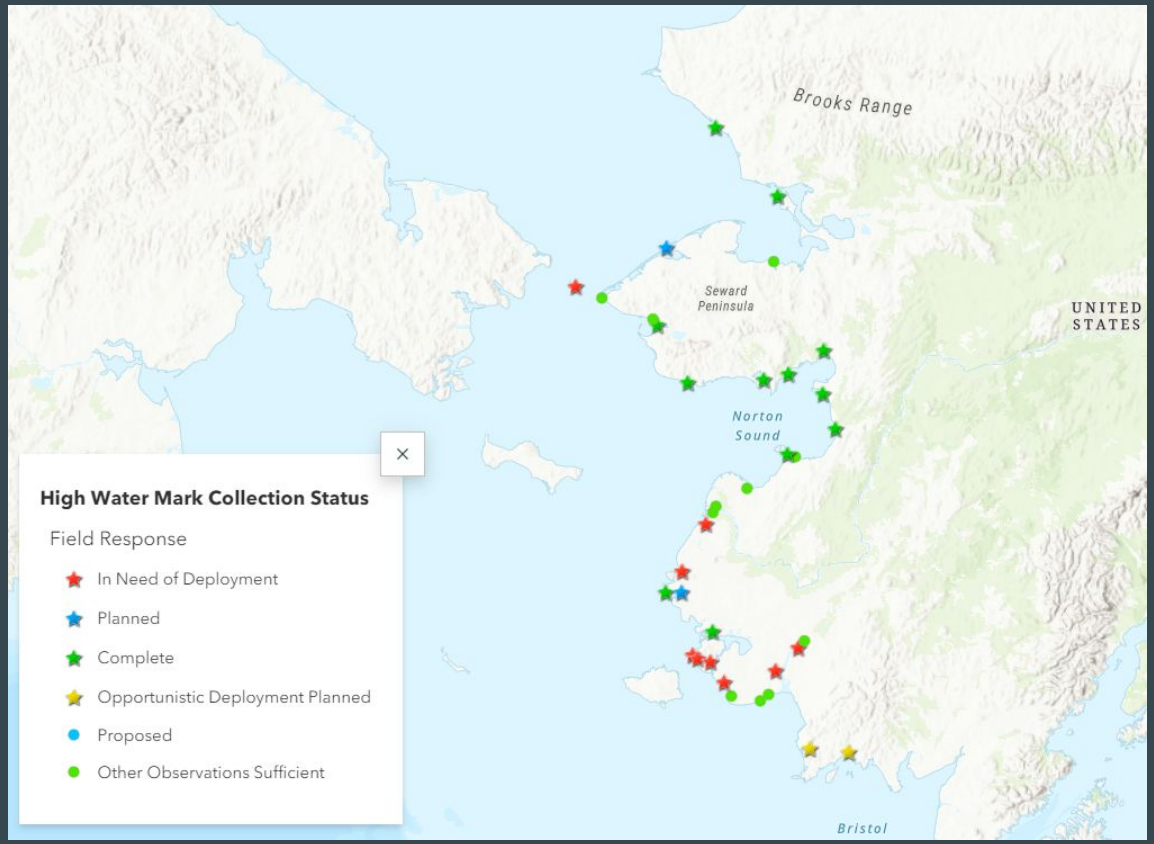

Hooper Bay, AK


Nome, AK


Newtok, AK

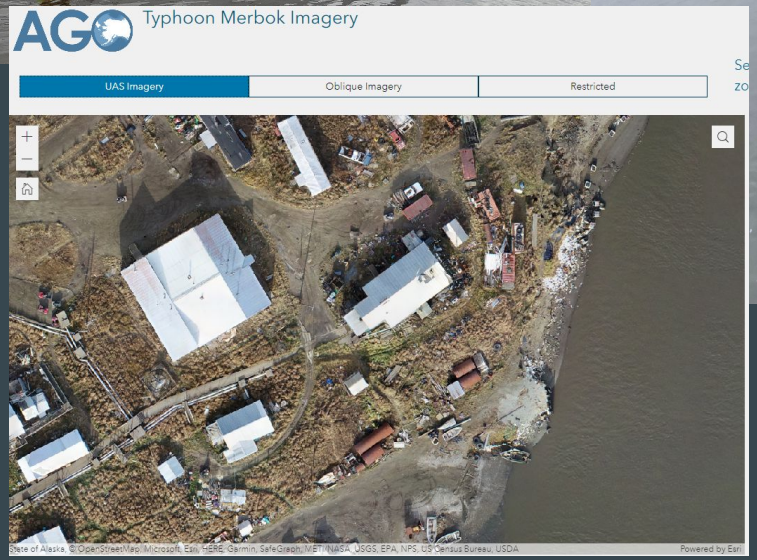
HWMs

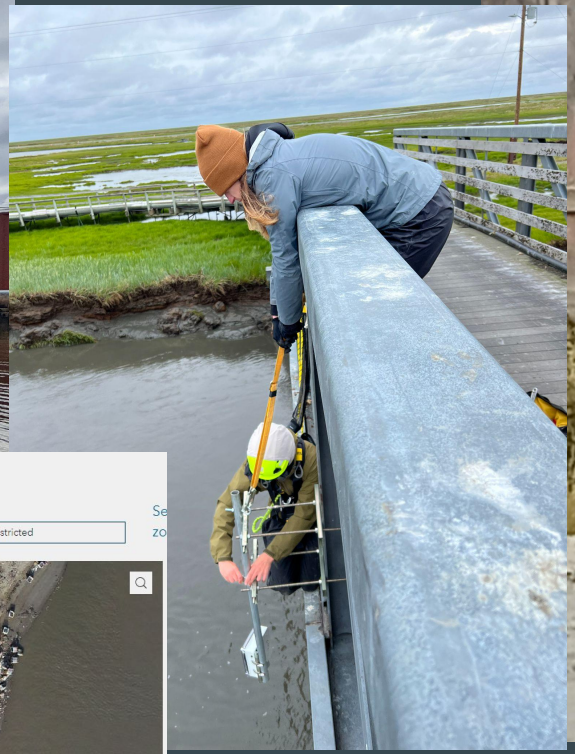
Observed Water Height Through High Water Marks, Water Level Sensors, and Flood Staffs.



High water marks are critical datasets for document the height that water reached in and around communities to understand and map flood extent. More information at: https://pubs.er.usgs.gov/publication/tm3A24

High water mark surveying, DGGS/USGS, Stebbins, AK.





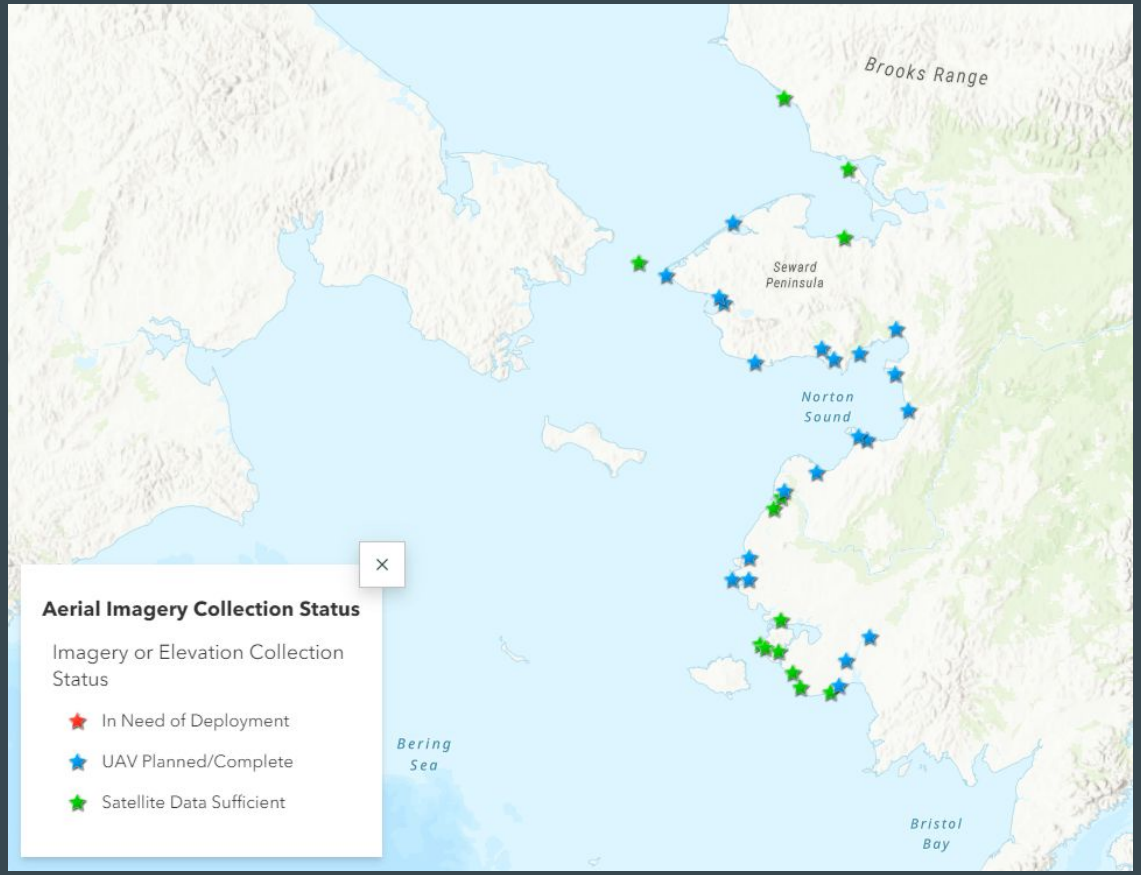
Above: **Water level sensor** installation, DGGS, Kwigillingok, AK.

Left: **UAS survey** UAF, Chevak, AK.

Flood staff photo, Alakanuk Tribe IGAP, Alakanuk, AK.

Imagery

Observed damages, debris, and erosion extent through UAS, fixed-wing, and satellite imagery.



Aerial imagery helps to identify the extent of flooding and erosion in and around communties. These data can be collected by unmanned aerial vehicles, other aircrafts, or satellites. Different platforms result in a different level of resolution of the final images. Multiple types of aerial imagery may be necessary to quantify flood impacts to communities.

Rapid post-storm response activities provide **considerable benefits to residents on multiple timescales**, from directly assisting the response and recovery process, to enhancing models and data that, in turn improve the quality of future NWS watches warnings and advisories

Thanks to the **proactive 'all hands on deck' approach and the opportunistic efforts**, the science, surveying, and mapping community's rapid response to this event will yield more extensive, accurate, and accessible documentation of flooding and erosion when compared to any past coastal flood event of this scale in our State.

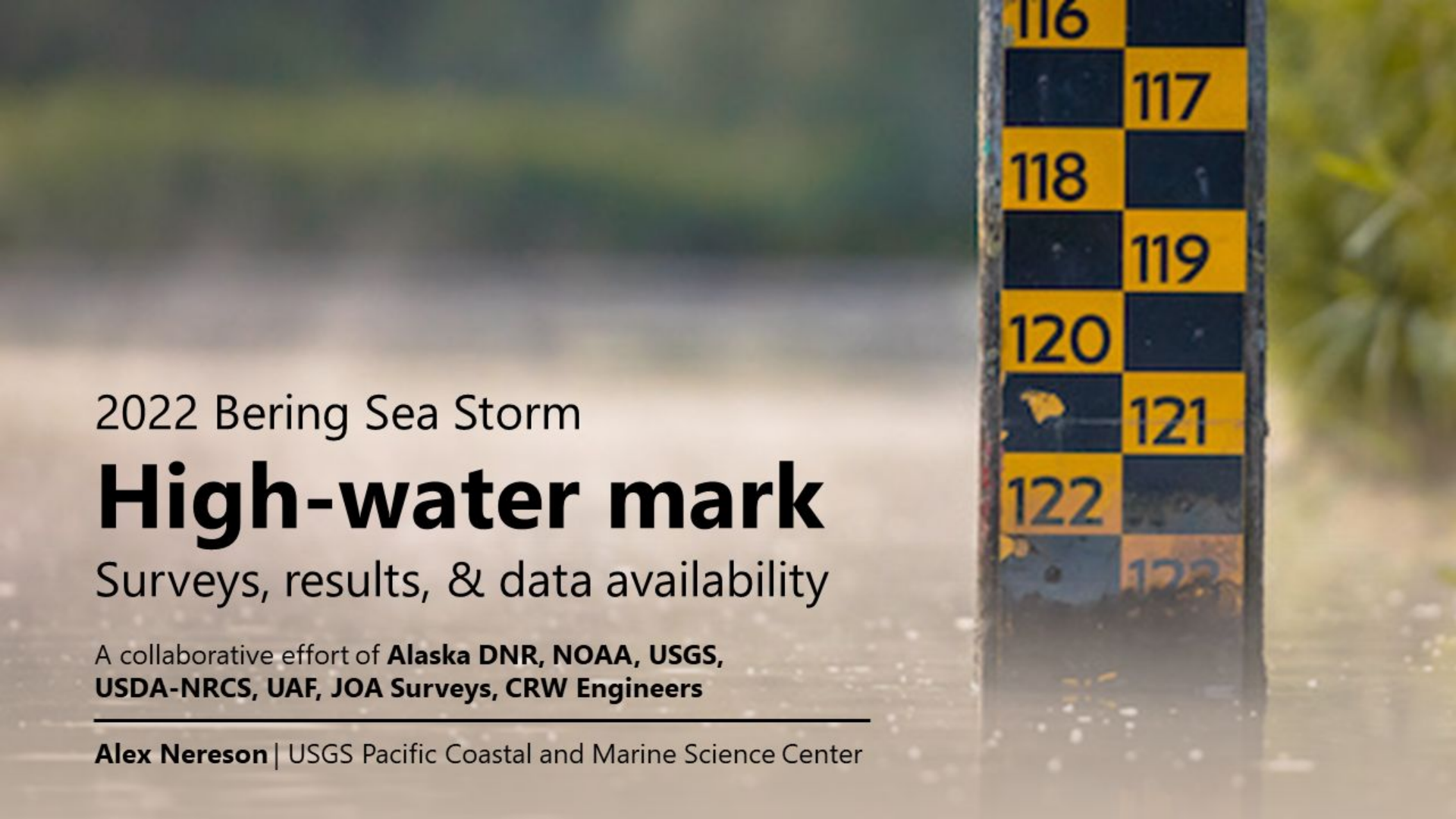
This is a **uniquely Alaskan grassroots response that pulled from known technical capacities regardless of where they reside to best meet the needs of the public**. Beyond those actively collecting data and producing initial products already, numerous additional agency scientists, emergency manager, planners, and partners from many sectors watching along are now readier to contribute and provide follow-on or future support.

End of Presentation

Thank you!

High Water Mark Data

Alex Nereson – Pacific Coastal and Marine Science Center, U.S. Geological Survey



2022 Bering Sea Storm

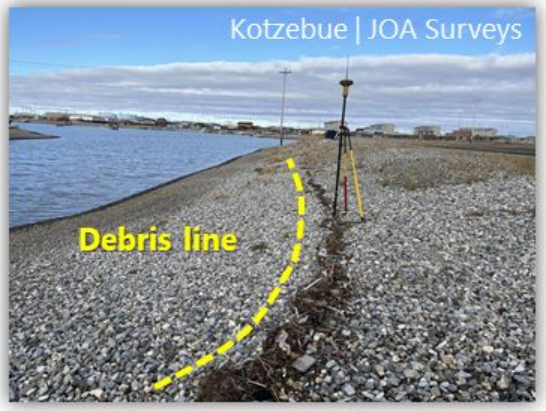
High-water mark

Surveys, results, & data availability

A collaborative effort of **Alaska DNR, NOAA, USGS, USDA-NRCS, UAF, JOA Surveys, CRW Engineers**

Alex Nereson | USGS Pacific Coastal and Marine Science Center

HWMs provide important flooding insights



HWMs = evidence marking
highest elevation of floodwaters

Many common types of HWMs
- **debris lines** most common in Bering Sea Storm

Identifying and preserving HWMs can help:
- Improve understanding
- Communicate risk
- Validate models
- Forecast future events

HWMs are often short-lived

Benson and Dalrymple (1984), Koenig et al (2016)

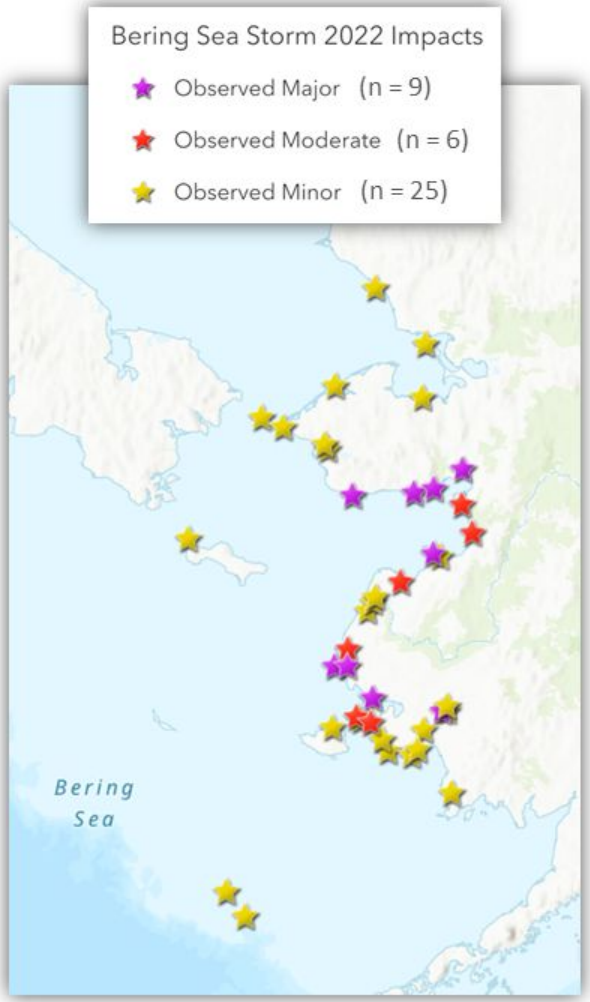
Surveys prioritized by observed impact level and accessibility

- Priority: visit communities with major flood impacts

- Flood impacts compiled from:
  - State Emergency Operations Center
  - in-situ sensors, monitoring equipment
  - community observers
  - social media

- Limited accessibility an important consideration:
  - Flight availability
    - Full flights
    - Return flights not guaranteed
  - Inclement weather

- DMLW contracted with JOA Surveys
- Partners at UAF, USDA-NRCS, and CRW Engineers added more communities, opportunistically



Survey crews deployed rapidly

Sept 16/17: storm impacts AK

Sept 19: Two days later
First State survey crew arrives in Nome

Sept 21: Four days later
First HWM data reported to USGS

Sept 23: Six days later
Eight more communities surveyed

Oct 5: Eighteen days later
Last HWM survey at Unalakleet;
19 total communities surveyed

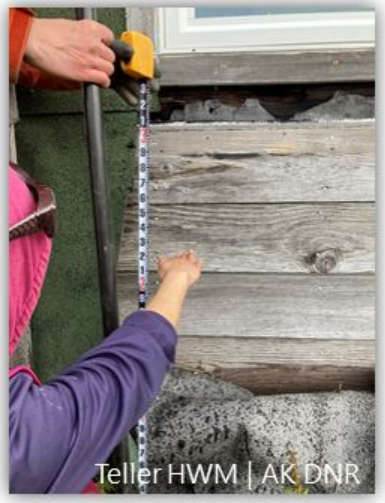
Stebbins tank farm | AK DNR

On the ground

Crews occasionally met with local/state officials: mayors, public works, etc.

Crews were often welcomed and assisted by community residents who:

- Pointed out HWMs
- Shared personal or social media photos
- Relayed flood observations
  - water levels, damage, blocked drainage pathways, etc.


Teller HWM | AK DNR


Unalakleet HWM | NOA Surveys


Hooper Bay | AK DNR


Newtok HWM | AK DNR

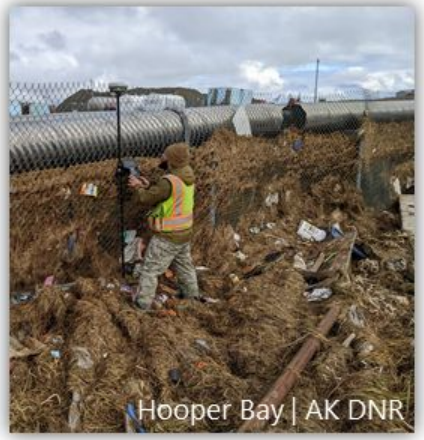
HWM data collection methods and results

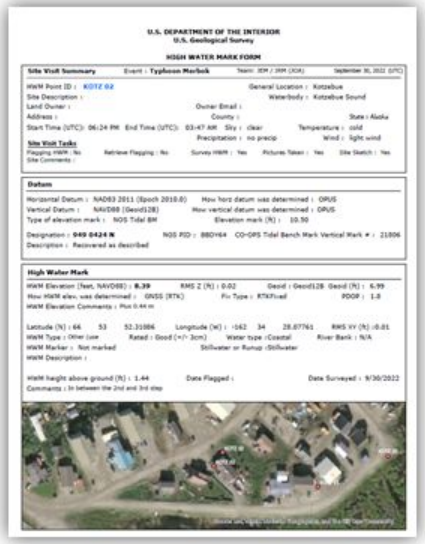
Collection methods

- Static or RTK GNSS (+ tape measure)
- Observations were recorded in photos, spreadsheets, USGS HWM forms
- All observations submitted to USGS for quality checks and database entry

Summary as of 11/9/2022

- 19 communities (1,200+ km apart)
- 430 HWMs





U.S. DEPARTMENT OF THE INTERIOR
U.S. Geological Survey

HIGH WATER MARK FORM

Site Visit Summary — Event : Typhoon Merbok

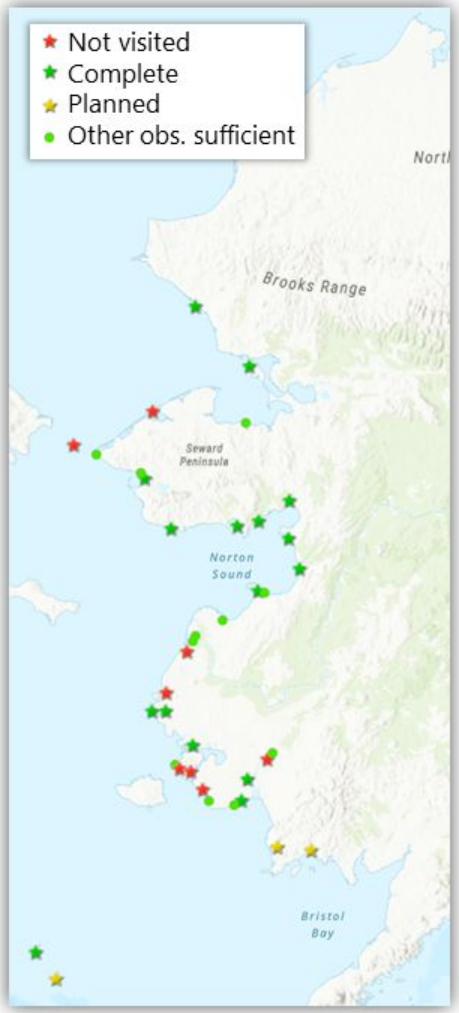
HWM Point ID : KOTZ 02 — General Location : Kotzebue
Site Description : — Waterbody : Kotzebue Sound
Land Owner : — Owner Email :
Address : — County : — State : Alaska
Start Time (UTC): 06:24 PM End Time (UTC): 03:47 AM — Sky : clear — Temperature : cold
Precipitation : no precip — Wind : light wind
Site Visit Tasks
Flagging HWM : No — Retrieve Flagging : No — Survey HWM : Yes — Pictures Taken : Yes — Site Sketch : Yes
Site Comments :

Datum

Horizontal Datum : NAD83 2011 (Epoch 2010.0) — How horz datum was determined : OPUS
Vertical Datum : NAVD88 (Geoid12B) — How vertical datum was determined : OPUS
Type of elevation mark : NOS Tidal BM — Elevation mark (ft) : 10.50
Designation : 949 0424 N — NOS PID : BBDY64 — CO-OPS Tidal Bench Mark Vertical Mark # : 21806
Description : Recovered as described

High Water Mark

HWM Elevation (feet, NAVD88) : 8.39 — RMS Z (ft) : 0.02 — Geoid : Geoid12B Geoid (ft) : 6.99
How HWM elev. was determined : GNSS (RTK) — Fix Type : RTKFixed — PDOP : 1.8
HWM Elevation Comments : Plus 0.44 m
Latitude (N) : 64 53 52.31886 — Longitude (W) : -162 34 28.87761 — RMS VY (ft) :0.01
HWM Type : Other (see — Rated : Good (+/- 3cm) — Water type :Coastal — River Bank : N/A
HWM Marker : Not marked — Stillwater or Runup :Stillwater
HWM Description :
HWM height above ground (ft) : 1.44 — Date Flagged : — Date Surveyed : 9/30/2022
Comments : In between the 2nd and 3rd step

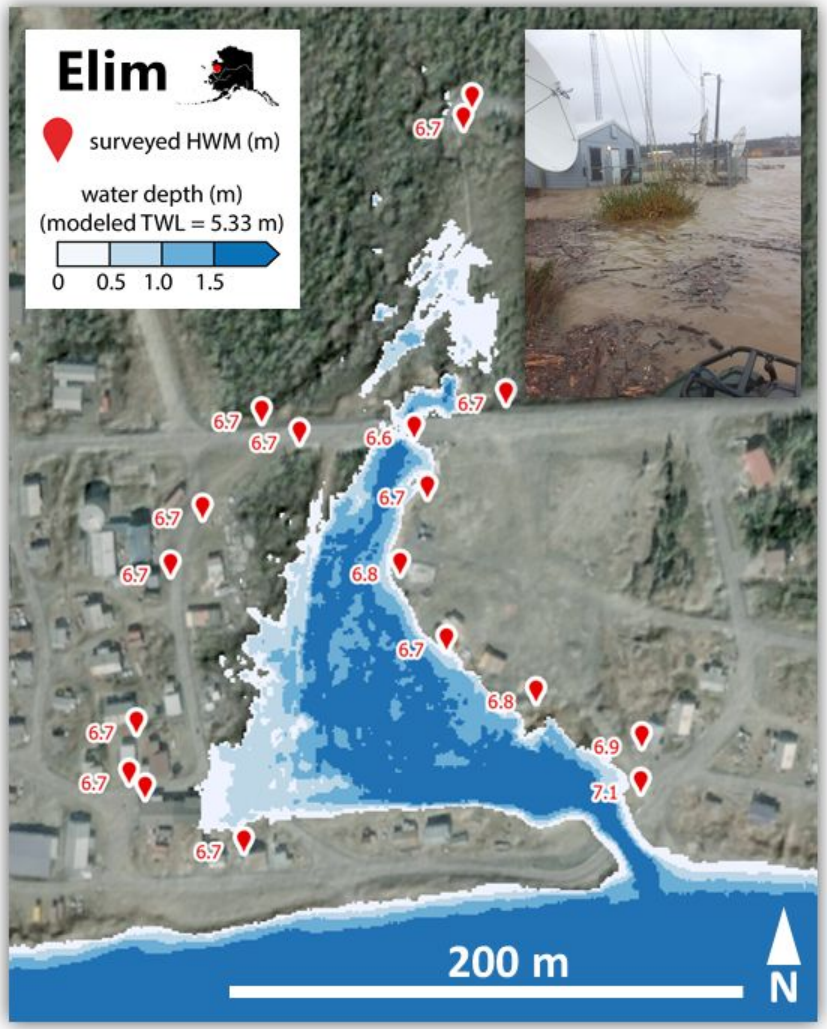


Preliminary HWM results

Community	HWM Count	Avg HWM Elev ft MHHW
Elim	18	16.8
Koyuk	14	16
Nome	46	15.4
Shaktoolik	71	14.5
Golovin	36	12.6
Unalakleet	23	11.8
Stebbins	17	10.9
Hooper Bay	52	9.3
Kivalina	6	7.8
Teller	82	5.5
Kotzebue	23	4.4
Goodnews Bay	10	3.9
North Hotham Inlet	11	3.6
Newtok	21	1.4

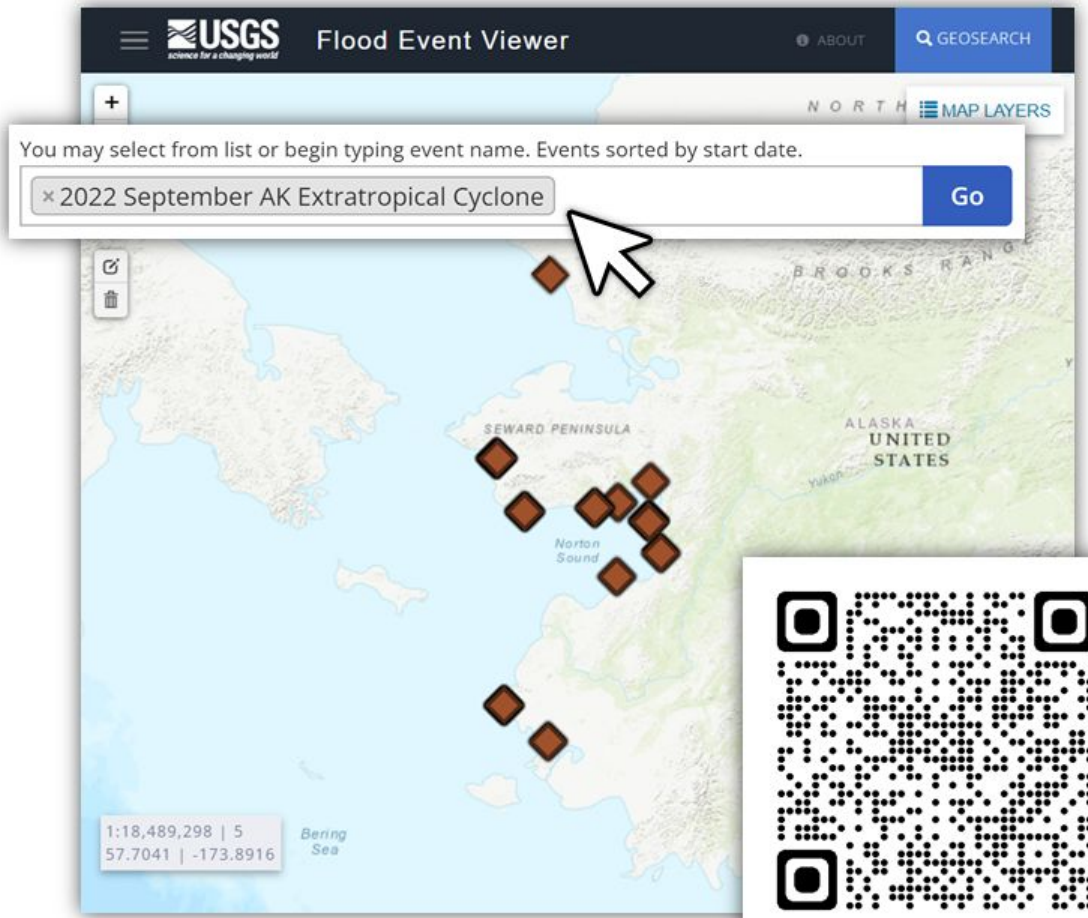
Higher water marks

Still pending: Chevak, St. Paul, Kongiganak, Tuntutuliak, Tununak



HWMs available in Flood Event Viewer

stn.wim.usgs.gov/FEV



All HWM data is publicly available through the FEV under the event called: "**2022 September AK Extratropical Cyclone**"

- Pan and zoom to HWMs
- Read site descriptions
- View photos

HWMs available in Flood Event Viewer

stn.wim.usgs.gov/FEV

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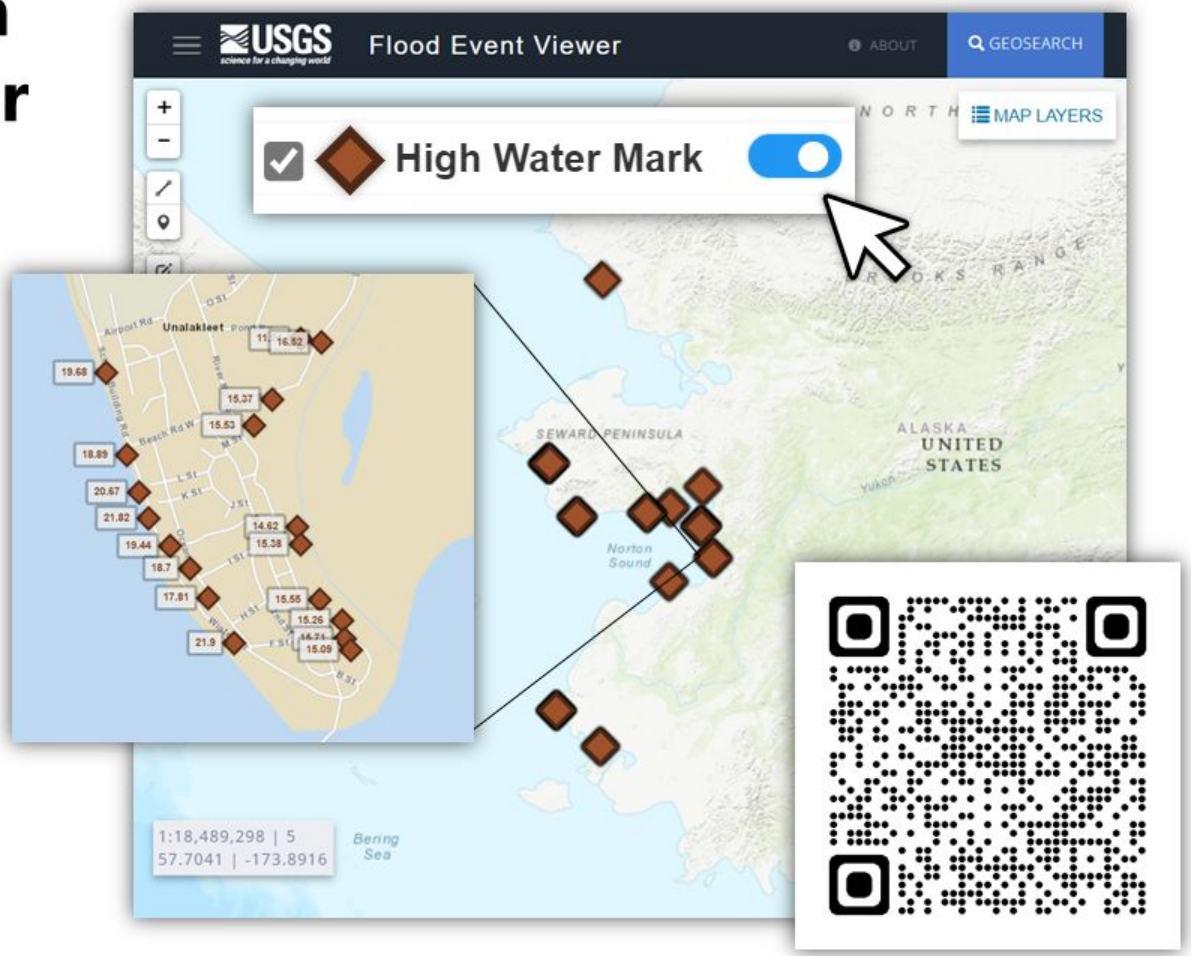

HWMs available in Flood Event Viewer

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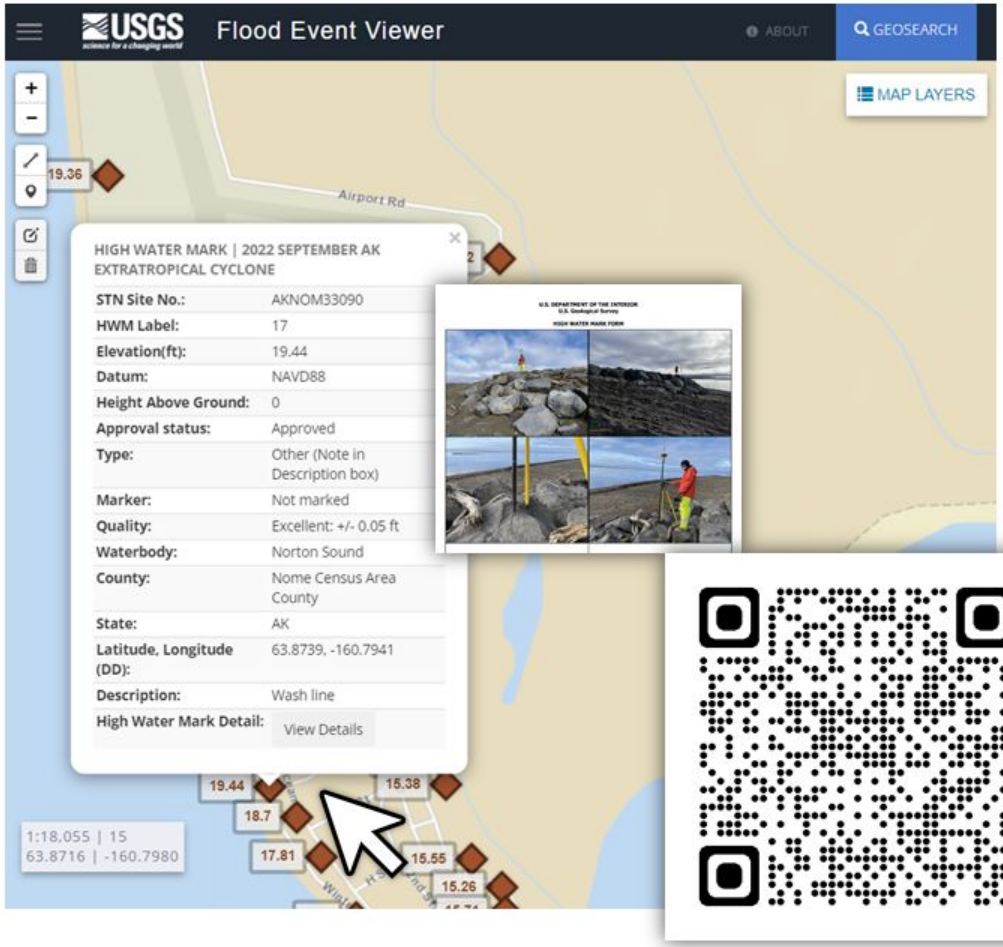
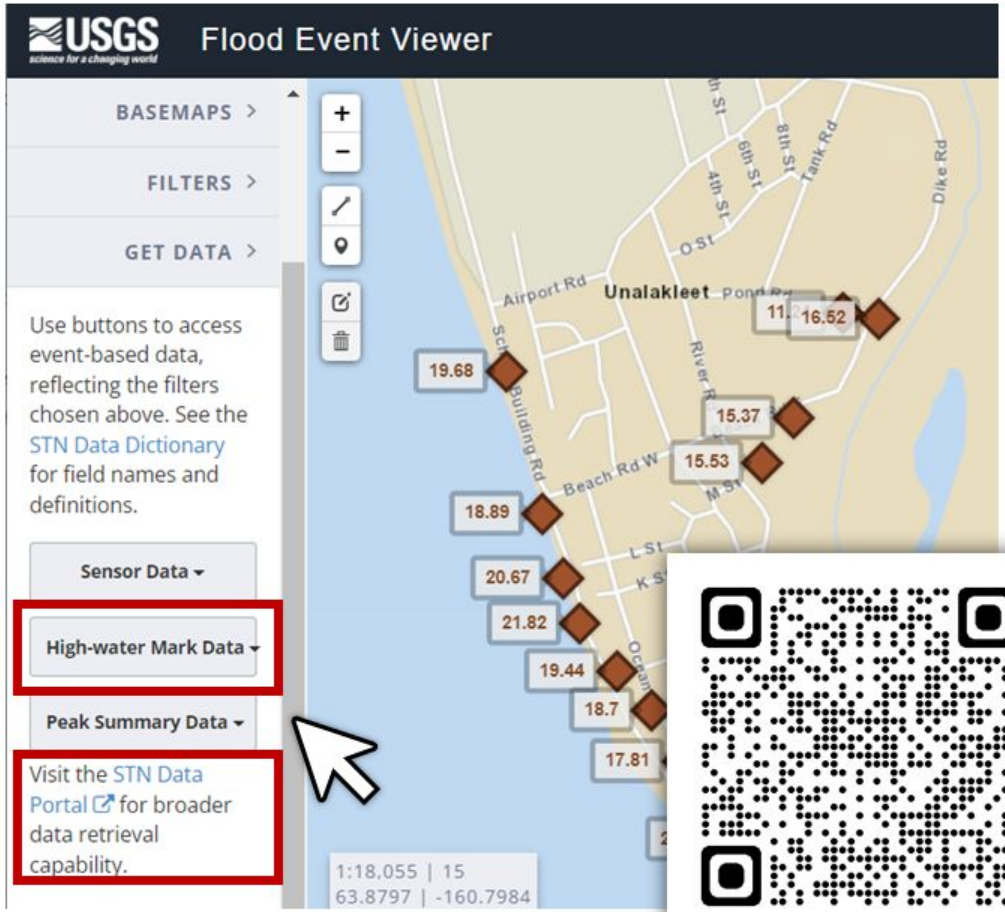


HWMs available in Flood Event Viewer

stn.wim.usgs.gov/FEV

HWMs can be **downloaded** from underlying database: Short Term Network (STN)

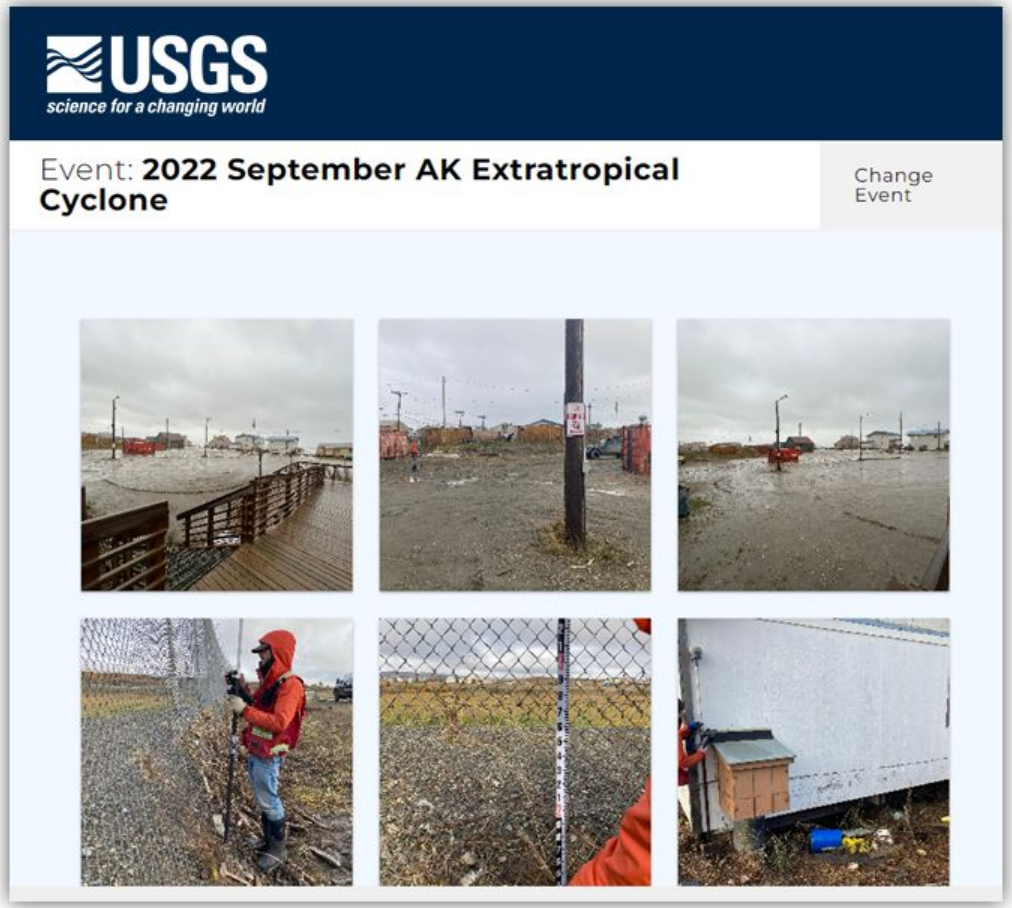
- **Quick download** all HWMs as CSV
- **STN Data Portal** for filter options



HWM photos available separately

HWM photos can be viewed and downloaded here:

test.wim.usgs.gov/STNPhotos



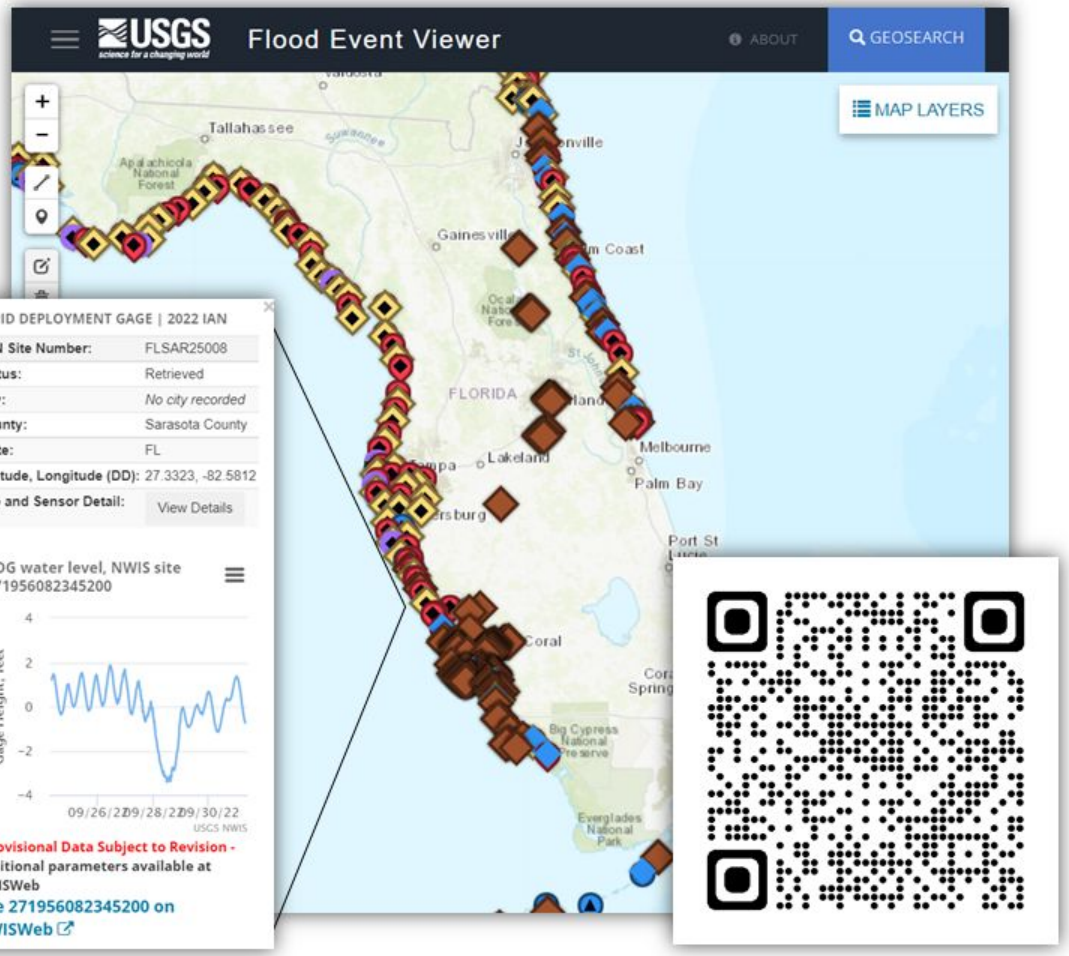
USGS STN database & Flood Event Viewer

stn.wim.usgs.gov/FEV

First use of STN/FEV in Alaska!

Other example: Hurricane Ian

- Hundreds of sensors deployed and/or linked to event
- Real-time data can be streamed through-out event
- HWMs can be measured and entered (brown diamonds)






Questions?

Alex Nereson anereson@usgs.gov
Jaci Overbeck jacquelyn.overbeck@noaa.gov

Credit to all our partners:
Alaska DNR, NOAA, USGS, USDA-NRCS, UAF, JOA Surveys, CRW Engineers

End of Presentation

Thank you!

Imagery Services

Andrew Herbst – Alaska Division of Geological and Geophysical Surveys

Imagery Support

Andrew Herbst

Alaska Geospatial Office, State of Alaska

USGS IPA Detailee

Imagery and Elevation Portal Manager

Co-Chair, AGC Imagery and Elevation Technical Working Group

USGS
science for a changing world

AGO

SITREP

Monday, September 19, 2022
Communities Affected: >30
Demand for Imagery: Very High

- The interagency response to Ex-Typhoon Merbok spurs immediate demand for remotely sensed data covering affected communities
- Field crews from UAF, DOT, and others enroute with UAS-mounted cameras and survey equipment
- 36 separate taskings ordered for SkySat

AGO Imagery Server

Specs
- 15 PB storage capacity
- Located at UAF
- Configured for ArcGIS Enterprise with ImageServer
- Public file server

Action Plan

1. Design and document submission procedure, distribute to response team
2. Code ingestion models in preparation for first batch of data
3. Draft front-end product (web map) to provide access to all services created for the response

After One Week

UAS ortho-imagery available for:

- Unalakleet
- Shaktoolik
- Kotlik
- Golovin
- Emmonak

Workflow:

1. Collectors submit data to our AWS bucket using our instructions, including vital metadata in their file names
2. Our python scripts pull in image files, mosaic them, and integrate metadata pulled from the file name
3. Services are published in a web map and sent out to mailing list

After Two Weeks

- UAS ortho coverage for 10 communities
  - Source: UAF IARC and ACGL
- 36 communities with SkySat imagery
- Over 150GBs of data added to the portal

International Arctic Research Center

UNIVERSITY OF ALASKA FAIRBANKS
ACGL
ARCTIC COASTAL GEOSCIENCE LAB

planet.

gis.data.alaska.gov/pages/imagery

State of Alaska
Open Data Geoportal

Home Imagery Elevation Partnerships Alaska Geospatial Council Get Involved Terms

Elim (UAF IARC)	UAS Imagery	10/14/2022
Hooper Bay (UAF IARC)	UAS Imagery	10/06/2022
Chevak (UAF ACGL)	UAS Imagery	10/05/2022
Shaktooklik	SkySat Imagery	9/24/2022
St. Michael	SkySat Imagery	10/05/2022

Typhoon Merbok Imagery

View Imagery

Typhoon Merbok Imagery

UAS Imagery | Oblique Imagery | Restricted

Select a community to zoom the map.

Sort

- Chevak
- Elim
- Emmonak
- Golovin
- Hooper Bay
- Kotlik
- Saint Paul
- Shaktoolik
- Unalakleet

1

Post Storm

- Another TB+ of pre and post storm imagery and LiDAR to ingest
- Refine our processes to optimize response times
- Integrate lessons learned into longer term projects

Thank You

Data Access and Uses

Jaci Overbeck – Office for Coastal Management, NOAA

Ex-Typhoon Merbok Data Summary, Access, and Use

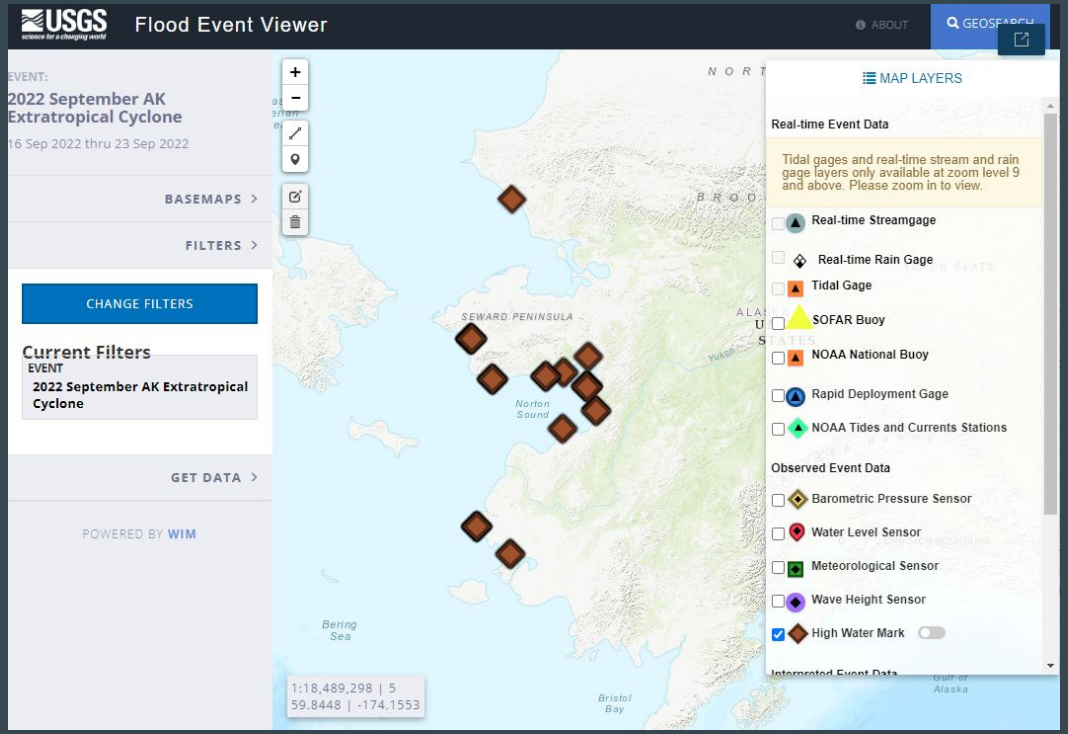
November 17, 2022

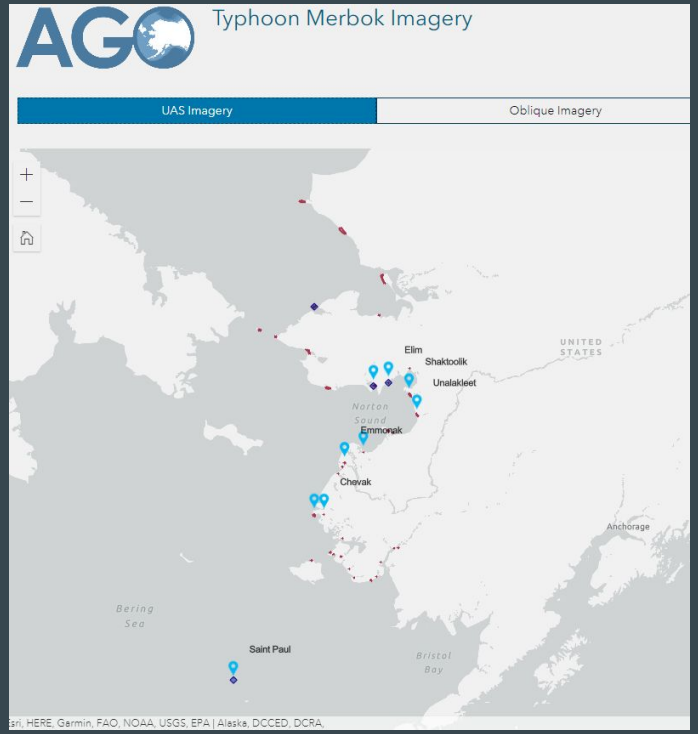
Data Access

Accessing data in a one stop shop, ArcGIS story map.

https://arcg.is/1umjSH0

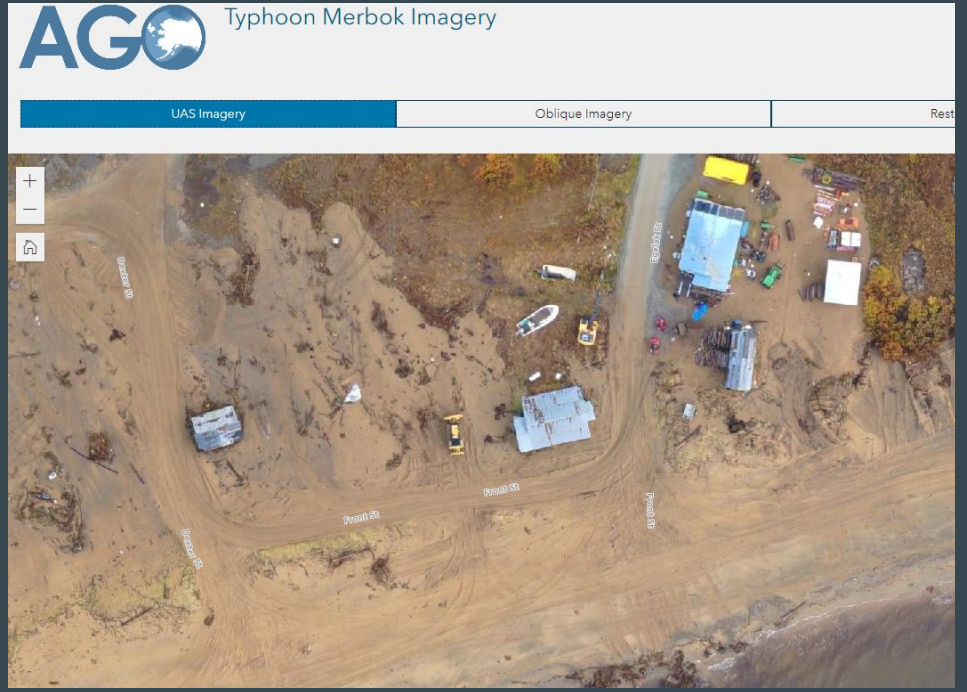
Data Access

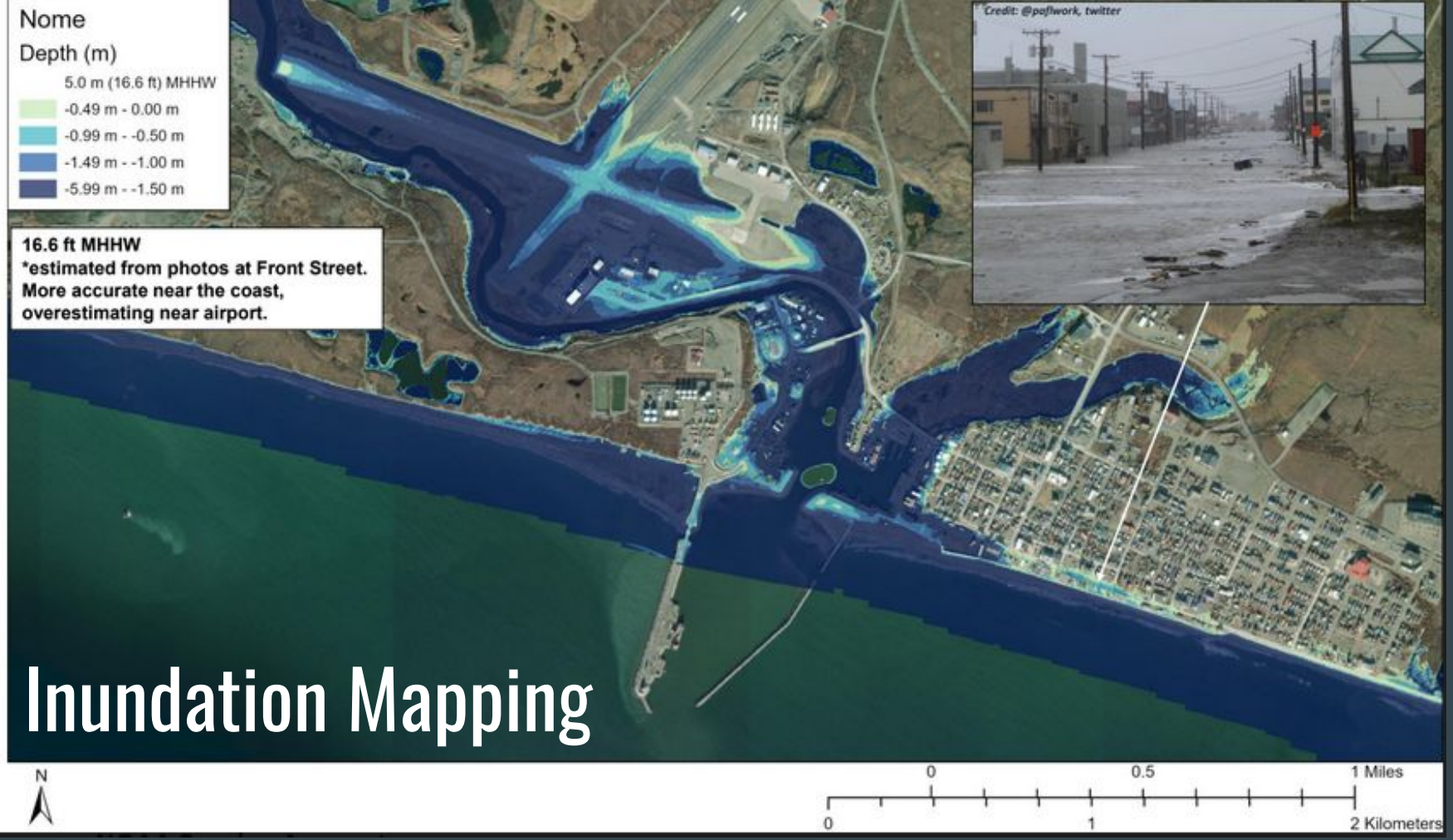

USGS
Flood Event Viewer
ABOUT
GEOSEARCH
EVENT:
2022 September AK Extratropical Cyclone
16 Sep 2022 thru 23 Sep 2022
BASEMAPS
FILTERS
CHANGE FILTERS
Current Filters
EVENT
2022 September AK Extratropical Cyclone
GET DATA
POWERED BY WIM
MAP LAYERS
Real-time Event Data
Tidal gages and real-time stream and rain gage layers only available at zoom level 9 and above. Please zoom in to view.
Real-time Streamgage
Real-time Rain Gage
Tidal Gage
SOFAR Buoy
NOAA National Buoy
Rapid Deployment Gage
NOAA Tides and Currents Stations
Observed Event Data
Barometric Pressure Sensor
Water Level Sensor
Meteorological Sensor
Wave Height Sensor
High Water Mark
SEWARD PENINSULA
Norton Sound
Bering Sea
Bristol Bay
1:18,489,298 | 5
59.8448 | -174.1553


AGO
Typhoon Merbok Imagery
UAS Imagery
Oblique Imagery
Elim
Shaktoolik
Unalakleet
Emmonak
Chevak
Anchorage
Saint Paul
Norton Sound
Bering Sea
Bristol Bay
UNITED STATES
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA | Alaska, DCCED, DCRA,

Data Use

- Immediate emergency response and recovery.
- FEMA damage assessments.
  - Access to grant funding for recovery.
  - Access to grant funding for mitigation.
- Updated flood modeling.
- Inundation mapping.
- Checks on forecasts of erosion projections.
- Community flood assessments.
- Community planning.
- Assess gaps in monitoring and emergency response procedures - after action assessments.





Inundation Mapping

Flood Assessments

COASTAL FLOOD IMPACT ASSESSMENTS FOR ALASKA COMMUNITIES

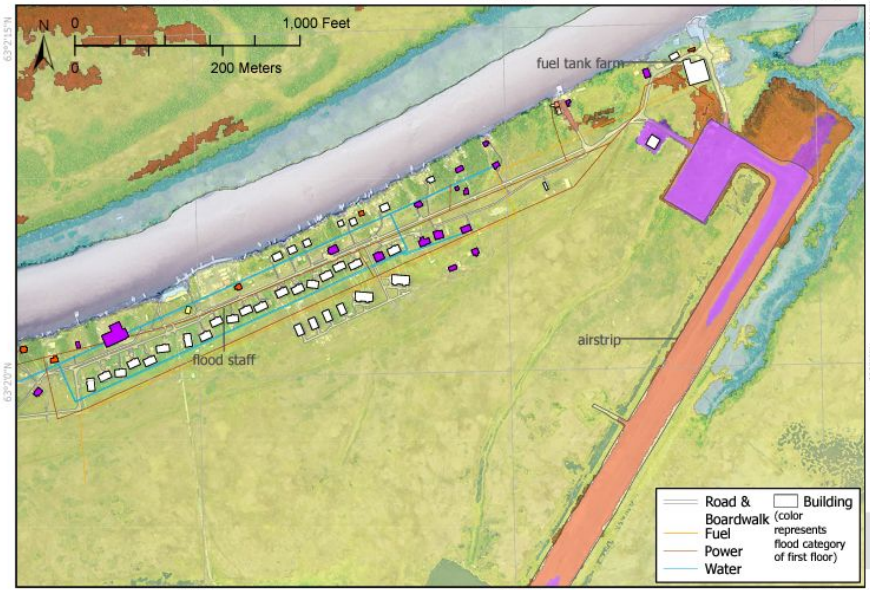
Richard M. Buzard, Jacquelyn R. Overbeck, Jonathan Chriest, Karen L. Endres, and Edward W. Plumb

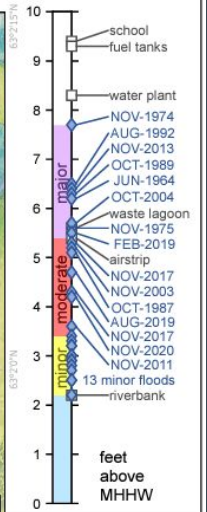
Hooper Bay residents identify the flood height of the November 1974 storm. Source: U.S. Army Corps of Engineers Flood Information Papers, photo taken by community member of Hooper Bay.

Published by
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
2021

Coastal Flood Impact Map
Kotlik, Alaska

REPORT OF INVESTIGATION 2021-1C
Buzard and others, 2021
KOTLIK, SHEET 3 OF 3





To calculate height above
MLLW: add 3.2 ft
NAVD88: add 6.3 ft

Projection: NAD 1983 2011 UTM Zone 3N
Orthoimagery available from elevation.alaska.gov
Houses or infrastructure may have moved since DCRA linework was completed

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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website: dggs.alaska.gov

Major Flooding is defined to have extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary.

Moderate Flooding is defined to have some inundation of structures and roads near the water. Some evacuations of people and/or transfer of property to higher elevations may be necessary.

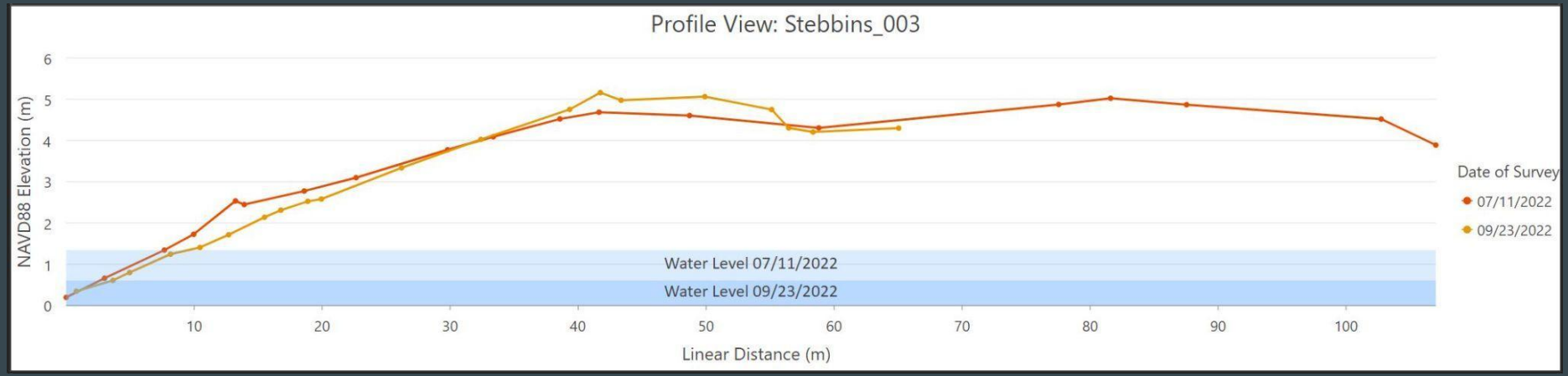
Minor Flooding is defined to have minimal or no property damage, but possibly some public threat.

This work was funded by Bureau of Indian Affairs Tribal Resilience Program through a collaborative project with the Native Village of Bill Moore's Slough.

Quantifying Erosion

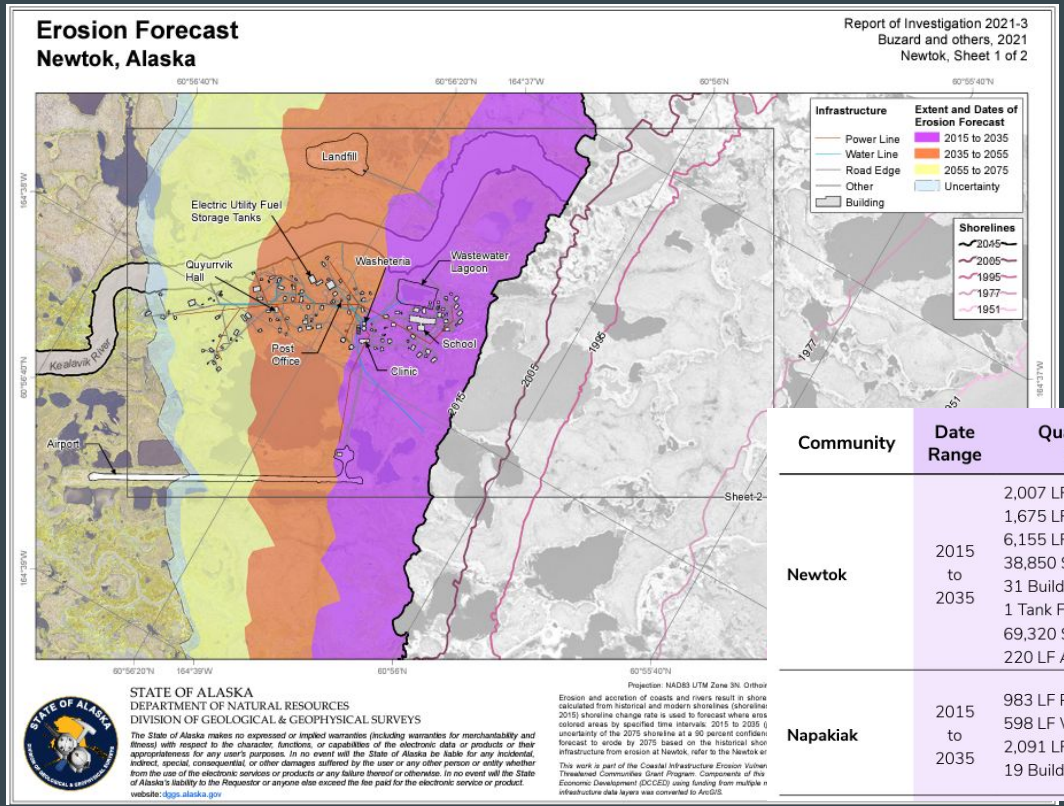
Stebbins

Quantifying Erosion



Stebbins

Checking Erosion Forecasts



Community	Date Range	Quantity of Exposed Infrastructure	Date Range	Quantity of Exposed Infrastructure	Date Range	Quantity of Exposed Infrastructure
Newtok	2015 to 2035	2,007 LF Power Line 1,675 LF Water Line 6,155 LF Road & Boardwalk 38,850 SF Barge Landing 31 Buildings 1 Tank Facility 69,320 SF Wastewater Lagoon 220 LF Airport	2035 to 2055	3,373 LF Power Line 1,854 LF Water Line 10,892 LF Road & Boardwalk 3,480 SF Barge Landing 44 Buildings 1 Tank Facility 730 LF Airport	2055 to 2075	1,191 LF Power Line 254 LF Water Line 1,347 LF Road & Boardwalk 9 Buildings 1 Tank Facility 520 LF Airport
Napakiak	2015 to 2035	983 LF Power Line 598 LF Water Line 2,091 LF Road 19 Buildings	2035 to 2055	1,117 LF Power Line 288 LF Water Line 3,088 LF Road 25 Buildings 145,240 SF Landfill	2055 to 2075	1,222 LF Power Line 2,377 LF Road Line 19 Buildings 1 Tank Facility

Continued Collection

- Efforts are still ongoing.
- Make sure high water marks are marked through winter.
- Additional community observations and outreach welcome!

POCs:
jacquelyn.overbeck@noaa.gov and
leslie.jones2@alaska.gov

Figure 1: Durable high water mark in Circle placed by USGS on 5/15/09, surveyed by USACE on 5/22/09. Note that the silt line has disappeared at the time of the USACE survey. Without the nail and flagging, this point would not have been surveyed.

Thanks to all those who have contributed to these efforts and to the communities for working with various entities during this very difficult time.

End of Presentation

Thank you!

Lunch Break