Brunsweiller Creek, Oct 2020 WI photo Kyle Magyera

# Fall 2020 RRT5 S&T Welcome!

- **Lt Rachel Pryor for Mike Doig (NOAA SSC)**
- **John Nelson on detail for Lindy Nelson's position (DOI Regional Environmental Officer)**
- **Jordan Stout (Senior SSC) replacing NRT S&T for Steve Lehmann (retired)**

# Agenda

- ISB In situ burning (Scott Binko/Eric Pohl)
- Nonfloating oil related reports and research (Scott)
- Shoreline cleaner (Scott/Jon Gulch)
- Containment points mapping (Jon Gulch)
- Fate/transport tools (Faith/Rachel Pryor)
- Ice research/forecasting (Faith/Scott)
- Other updates (all)

# Science & Technology Subcommittee Updates

- **ISB**
  - USCG R&D ISB Reports – Mobile, AL (Sep 2019)
    - Final Report – Expected (Sep 2020)
    - Air Monitoring Report (Feb 2022)
  - Multi-Partner Research Initiatives – Offshore CA (DFO, NOAA, EPA, BSEE – Summer 2021)
  - Crossover w/ Planning Subcommittee
    - Develop toolbox for ISB Proposals – RRT5 Website
    - Continue to identify knowledge gaps – state specifics

# Freshwater In-Situ Burn (ISB) Research

47041

**Mission Need:** Improve ISB knowledge base to supplement oil spill response options.

## Objectives

- Evaluate best practices for operational use of ISB in multiple environments, including fresh water and areas with vegetation.
- Develop methods to conduct ISB smoke-plume monitoring that improve sampling accuracy and responder safety.
- Provide reference guidance for Federal On Scene Coordinator and Regional Response Team use.

## Notes

- Multiple funding sources including Oil Spill Liability Trust Fund and Great Lakes Restoration Initiative.
- Partner with academia and national labs to ensure result visibility and access.

| | |
|---|---|
| **Sponsor:** EPA Great Lakes Nat'l Program Office, CG-MER | **Stakeholder(s):** CG-721, NSF, EPA, BSEE, D9, RRT5 |
| **RDC Research Lead:** LT Liz Murphy | **CG-926 Domain Lead:** Ms. Karin Messenger |
| **Anticipated Transition:** Knowledge Product *Influence Tactics, Techniques, & Procedures* | |

## Project Timeline / Key Milestones

| | | |
|---|---|---|
| **Project Start:** 1 Oct 18 | | |
| Mesoscale Freshwater Burns Complete | 19 Jul 19 ✓ | |
| Large-scale Freshwater Burns Complete | 25 Oct 19 ✓ | |
| Remote Air Monitoring Market Research Complete | Aug 20 | |
| Freshwater In-Situ Burn (Report) | Aug 20 | ★ |
| Remote Air Monitoring Process Framework Complete | Oct 20 | |
| Test Plan for Remote Air Monitoring Complete | Jan 21 | |
| Air Monitoring During ISB – Event 1 Complete | Mar 21 | |
| Air Monitoring During ISB – Event 2 Complete | Jul 21 | |
| Remote Air Monitoring Technology Evaluation (Report) | Feb 22 | ★ |
| **Project Completion:** Feb 22 | | |

# Science & Technology Subcommittee Updates

- **Non-Floating Oil Reports & USCG R&D Research**
  - Underwater Sediment Sampling Research (Jan 2017)
  - Testing of Oil Sands Products Recovery in Freshwater (Apr 2018)
  - Mitigation of Oil Moving Along the Waterway Bottom (Nov 2019)
  - Oil Sands Products Spill Response (August 2020)
  - Behavior of Diluted Bitumen in Freshwater (TBD 2021 - 2022)

# Behavior of Diluted Bitumen (Dilbit) in Fresh Water

2021-20

**Mission Need:** Better decision-making guidance for response to dilbit spills in fresh water.

## Objectives

- Provide the U.S. Coast Guard (CG) Federal On-Scene Coordinators with decision–making guidance as they relate to the fate and transport of dilbit in the freshwater environment.
- Study the behavior (density and weathering) and response tools of dilbit spills in the freshwater environment.

## Notes

- Supported by Great Lakes Restoration Initiative and Oil Spill Liability Trust Fund resources.
- Leverage CG Research and Development Center Project 4705: Oil Sands Products Spill Response.
- Collaborate with the International Institute for Sustainable Development's Experimental Lakes Area and U.S. Department of Energy labs.

**Sponsor:** CG-MER, CG D9

**Stakeholder(s):** EPA Great Lakes Nat'l Program Office/Pollution Response Office, LANT-54, NOAA

**RDC Research Lead:** Benedette Adewale, PhD

**CG-926 Domain Lead:** Ms. Karin Messenger

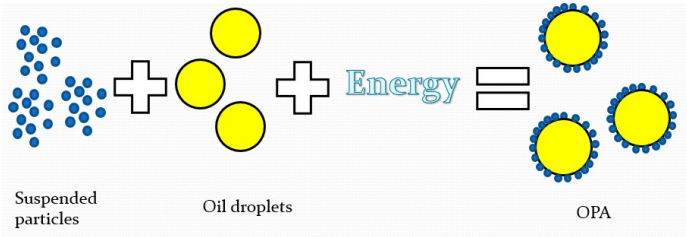
**Anticipated Transition:** Knowledge Product
*Influence Tactics, techniques & Procedures*

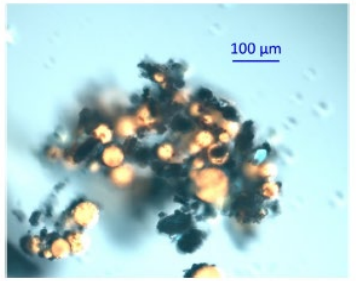
## Project Timeline / Key Milestones

| | | |
|---|---|---|
| **Project Start:** Oct 20 | | |
| Literature Review Complete | Jan 21 | |
| Literature Review Report: Dilbit in the Environment | Feb 21 | ★ |
| Dilbit Test Plan Complete | Apr 21 | |
| CRREL Dilbit Weathering Warm Weather Test Complete | Jun 21 | |
| CRREL Dilbit Weathering Cold Weather Test Complete | Nov 21 | |
| Dilbit Oil Analysis Complete | Jan 22 | |
| Behavior of Bitumen in Freshwater (Report) | May 22 | ★ |
| **Project Completion:** May 22 | | |

# EPA RARE Grant Studies Oil Particle Aggregates

- EPA Quick Reference Guide on Oil-Particle Aggregates (review stage)
- Research Brief “Formation, Transport, and Breakup of Submerged Oil-Particle Aggregates in Great Lakes Riverine Environments” (approval stage)
- Rapid Response Oil-Particle Aggregate Formation, transport, and fate model – Jones and Garcia 2018 J., Environ Eng 144(12).



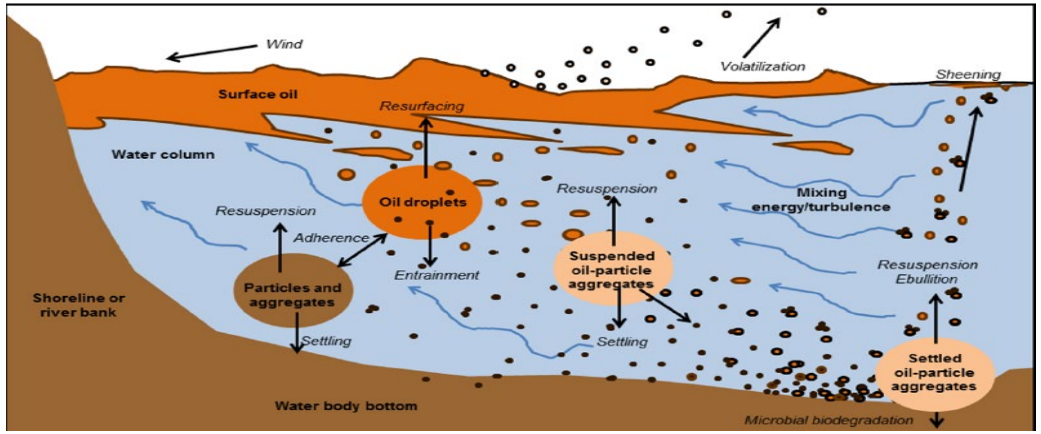





**Figure 23**: A crescent shaped solid-type OPA

*Waterman and Garcia (2015)*

# Science & Technology Subcommittee Updates

- **Shoreline Cleaner Protocol**
  - RRT5 Shoreline Cleaner Test & Evaluation Protocol (2002)
  - RRT5 Incident Specific RRT Checklist
  - WLEAC Shoreline Cleaner SOP (Draft 2014)
    - https://response.epa.gov/site/site_profile.aspx?site_id=1922

- **ICCOPR – R&T Plan**
  - **https://www.dco.uscg.mil/ICCOPR/**

# Containment points mapping (Jon)

# Fate/Transport tools (Faith/Rachel)

- Fate and transport tools/models – Inland Riverine Oil Spill (IROS) CDI group – call 10/22 1:00 CT to summarize results of June 2020 meeting – discuss river tools technique sheet?

https://my.usgs.gov/confluence/display/cdi/IROS+-+Inland+Riverine+Oil+Spill+Collaboration+Area

- NOAA modeling update

# Rapid Riverine Spill Fate/Transport Tools – 2020

| Tool/Model | Component | Application | Geospatial resolution | Extent | River Flows | How to use | Limitations | Contact |
|---|---|---|---|---|---|---|---|---|
| Streamstats TOT | Water, dissolved chemical | Front and trailing edge | NHD reaches | National | User defined | Web-based, public domain, anyone can use but training advised | No floating oil, no dams/impoundments | USGS |
| GNOME | Oil | Front, trailing edge, dispersion, toxicity, weathering, vertical mixing, tactics | Detailed bathy | Local | User defined | Run by experts | Needs detailed bathy | NOAA OR&R |
| ICWater | Water, dissolved chemical | Front and trailing, weathering, mixing | NHD reaches | Local | Average flows | Run by experts | Need access and training | Consultant EPA |
| OilMapLand and Simap | Oil | Front and trailing, weathering, mixing | NHD reaches | Local | Average flows | Run by experts | Proprietary software | Consultants, industry? |
| FluOil | Oil, OPA | Front and trailing edge | HEC-RAS cross sections | Local | User defined | Public domain, anyone can use, training advised | Need channel geometry data but usually available from flood mapping | USGS |
| 1DHydroOPA | Oil-OPA formation | OPA formation, transport, deposition | Simple to complex channel geom | Local | User defined | Run by experts | Need water depth | USGS/Univ of IL |
| CWMS | Water | Decision-making for federal water management facilities | Includes reservoirs | National | Realtime | Only USACE | Linkage to spill community? | USACE |

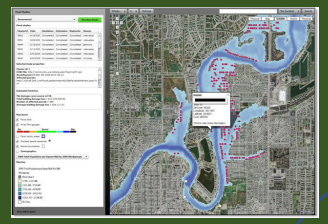
Table 10. Summary of oil spill models and applications.

| Model | Description | Applications |
|---|---|---|
| **FVCOM** | Coastal ocean hydrodynamic model that uses variable density grids from higher resolution near shore and in channels; simulates oil as particles. | Operational model currently being used in Great Lakes by NOAA to replace Princeton Ocean Model; recent Straits simulations by Schwab and Anderson. |
| **Lagrangian Model** | Two-layer model that represents advection, dispersion, evaporation and dissolution. | Developed in 1980s for application to Lake St. Clair. |
| **ROSS3** | Next generation model building on prior Lagrangian model with more processes. | Developed in 1990s for St. Clair River and Lake St. Clair; includes ice. |
| **ROSS2 and MICROSS2** | Simpler models than ROSS3, with lower resolution grids. | Applied to Upper St. Lawrence River for spill hindcasting, and Ohio-Monongahela-Allegheny River System in early 1990s. |
| **GNOME** | Operational NOAA spill trajectory model; simulates 2-D Eulerian/Lagrangian movement. | Used in Great Lakes and coastal ocean during spill response for projecting spill movement. |
| **ADIOS® System** | Set of tools developed for NOAA; focus is on weathering up to five days, using a database of over 1000 crude oil and refined product types. | Requires only limited field data because of large database; applied rapidly in many spill responses. |
| **OILTRANS** | Similar in formulations to the ROSS2 and ROSS3 models, but it operates on fully 3-D grids. | Applied to Celtic Sea spill in 2009 near the coast of Ireland. |
| **MEDSLIK** | Well-documented 3-D model that predicts the fate and weathering of oil spills in marine systems. | Applied operationally in the Mediterranean Sea. |
| **SIMAP** | Estimates the three-dimensional trajectory, fate, and biological exposure and effects of oil spills. | Applied to Deepwater Horizon spill response and natural resources damage assessment. |
| **Ecotoxicological and food web models: AQUATOX, PETROTOX, CATS-5 GBMBS, QWASI, FISHRAND** | More recently developed models include the application of probabilistic, spatially explicit, and dynamic bioaccumulation formulations, but only simple food chains have been simulated. | These models are primarily used in research and contaminated sediment cleanup applications. Their use in guiding operational response or early recovery following oil spills has been limited. |

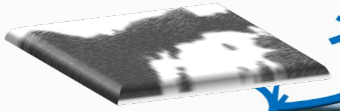
p. 61, LimnoTech, 2018[2]

# Linking rapid tools and models for spill response in the Great Lakes Region

Real-time flood inundation mapping



Wind forecasts
IMAAC plume modeling

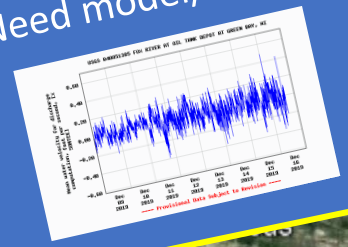


USGS Streamstats (https://streamstats.usgs.gov/ss/
- Flow statistics
- Flowpath navigation – NHDPlus, NHDHiRes
- Time of Travel (Jobson Eq)
- Q ungaged realtime estimate (in progress)

ICWater
- Flowpath navigation -- NHDPlus
- V and Q average
- Travel and chemical dispersion

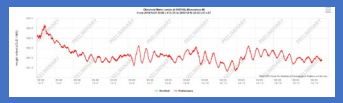
National Water Model
- River forecasts linked to NHDPlus river segments

Seiche/surge zone
- USGS index velocity and stage
- Need model/tool

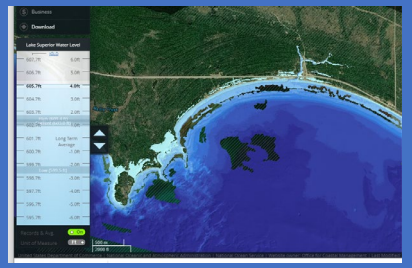


NOAA GLERL Great Lakes Forecasting System https://www.glerl.noaa.gov/res/Programs/ipemf/GLCFS_nextgen.html

NOAA GNOME tools, IJC table
- 2D, lake, large rivers, harbors



NOAA CO-OPS https://tidesandcurrents.noaa.gov/
6 minute water level data
Record of seiche/surge



NOAA GLERL Lake level viewer https://coast.noaa.gov/llv/#/lake/superior
- Coastal inundation manually linked to lake level

# What is Available and When: Real-time Flood Inundation Mapping Products

**PHASE 1A** — ONGOING OPERATIONS (MODELING, LIBRARY BUILDING, SCENARIO DEVELOPMENT, HISTORICAL FLOODS)

**PHASE 1B** — ESCALATION OF THREAT

**PHASE 1C** — CREDIBLE THREAT

**PHASE 2A** — EVENT

**PHASE 2B** — RESPONSE

**Civil Applications Committee Global Fiducials Library (GFL)**
(https://gfl.usgs.gov/)
The GFL archive is dedicated to ensuring that images of environmentally significant sites around the world are collected, maintained, and made available to scientists and policy makers in support of scientific investigations into global dynamic systems and change.

**Risk Mapping, Assessment and Planning (Risk MAP)**
(https://www.fema.gov/risk-mapping-assessment-and-planning-risk-map)
Tailored to each community, the FEMA Risk Mapping, Assessment, and Planning (Risk MAP) program integrates information and assessment tools to help communities and individuals identify and understand their risks before a flood occurs.

**Earth Science Data and Information System (ESDIS) Distributed Active Archive Centers (DAACs)**
(https://earthdata.nasa.gov/eosdis/daacs)
EOSDIS DAACs process, archive, document, and distribute data from NASA's past and current Earth-observing satellites and field measurement programs.

**Coastal Hazards System**
(https://chswebtool.erdc.dren.mil/)
The Coastal Hazards System (CHS) provides probabilistic coastal hazards assessment (PCHA) results and statistics based on high-resolution numerical modeling of coastal storms.

**Coastal Storm Modeling System** (CSTORM-MS)
(https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476697/coastal-storm-modeling-system/)
The Coastal Storm Modeling System (CSTORM-MS) is a comprehensive system of highly skilled and highly resolved models used to simulate coastal storms and accurately assess risk to coastal communities.

**Corps Water Management System** (CWMS)
(https://www.hec.usace.army.mil/cwms/cwms.aspx)
The Corps Water Management System (CWMS) is the automated information system used to evaluate and model watersheds.

**National Inventory of Dams** (https://nid.sec.usace.army.mil/ords/f?p=105:1::::::)
The National Inventory of Dams contains data collected in late-2018 on more than 90,000 dams nation-wide.

**National Agricultural Statistics Service (NASS) Disaster Analysis**
(https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis/index.php)
NASS can now monitor agricultural disasters in near real-time and provide quantitative assessments using remotely sensed data and geospatial techniques. This website provides disaster assessments in geospatial data format, reports, and metadata (as available).

**Cropscape-Cropland Data Layer (CDL)**
(https://nassgeodata.gmu.edu/CropScape/)
The purpose of the Cropland Data Layer Program is to use satellite imagery to provide acreage estimates for major commodities and to produce digital, crop-specific, categorized geo-referenced output products.

**Dynamic Surface Water Extent Model**
(https://www.usgs.gov/land-resources/nli/landsat/landsat-dynamic-surface-water-extent?qt-science_support_page_related_con=0#qt-science_support_page_related_con )
The Dynamic Surface Water Extent product provides raster layers that represent surface water inundation per-pixel in Landsat 4-8 data.

**Earth Resources Observations and Science (EROS) Center**
(https://www.usgs.gov/centers/eros)
The USGS EROS Center studies land changes, produces land change data products, operates the Landsat satellite program with NASA, and maintains images of the Earth's land surface.

**USGS Flood Inundation Mapper (FIM)**
(https://fim.wim.usgs.gov/fim/)
The FIM Mapper allows users to explore the full set of inundation maps that shows where flooding would occur given a selected stream condition.

## COMING SOON

**Real-Time, Event Driven Flood Inundation Mapping based on the National Water Model**
This model will offer more coverage and better alignment with the USGS High-Water Marks than the traditional route and replace method.

**Flood Inundation Surface Typology (FIST) Model for Rapid Flood Mapping**
This model can rapidly fuse terrain derived information with imagery, hydrologic models, high water marks, or ground observations to produce flood inundation and depth grid estimates, filling a niche not covered by

## FORECAST

**Storm Surge Prediction Available** — COASTAL

### Surge Forecast Maps

**Tropical Cyclone Storm Surge Probabilities (P-Surge 2.0)**
(https://www.nhc.noaa.gov/surge/psurge.php)
The Tropical Cyclone Storm Surge Probabilities graphics show the overall chances that the specified storm surge height will occur at each individual location on the map during the forecast period indicated.

**Extratropical Surge and Tide Operational Forecast System (ESTOFS)**
(Atlantic: https://ocean.weather.gov/estofs/estofs_surge_info.php; Pacific: https://ocean.weather.gov/estofs/estofs_pacific_surge_info.php)
ESTOFS delivers predictions of (1) combined surge and tide, (2) astronomical tides, and (3) sub-tidal water level (the isolated surge).

**Rainfall Prediction Available** — RIVERINE

### Hydro Forecast Maps

**Pre-Event Depth Grids based on Forecasts**
Using NOAA's Advanced Hydrologic Prediction Service (AHPS), FEMA generates an automated depth grid script tool that uses predicted instead of observed water levels.

**Streamflow Prediction Tool (Outside Continental United States (OCONUS) only)**
(https://streamflow-prediction-tool.readthedocs.io/en/latest/index.html)
The Streamflow Prediction Tool provides 15-day streamflow predicted estimates by using the European Center for Medium Range Weather Forecasts (ecmwf.int) runoff predictions routed with the RAPID (rapid-hub.org) program.

**Advanced Hydrologic Prediction Service (AHPS) Flood Inundation Mapping**
(https://water.weather.gov/ahps/inundation.php)
AHPS categories convey flood severity and risk based on the potential impact to property and public safety.

**Hydrodynamic Models**
(https://nauticalcharts.noaa.gov/learn/hydrodynamic-model-development.html)
NOAA's National Ocean Service develops and tests hydrodynamic modeling applications for use in operational systems and products (e.g., tide models and tidal datum products used in NOAA's VDatum vertical datum transformation software and storm surge models to provide combined tide and storm-induced surge guidance for coastal water levels and inundation).

## HISTORICAL FLOOD DOCUMENTATION

## DOCUMENTATION

### Flood Documentation

**Cyclone Global Navigation Satellite System (CYGNSS) Satellite Inundation Estimates**
(http://clasp-research.engin.umich.edu/missions/cygnss/)
In addition to measuring tropical cyclone activity, CYGNSS has begun estimating river widths, which may lead to better monitoring of stream flow and prediction of flooding on a global scale.

**Dartmouth Flood Observatory (DFO)**
(http://floodobservatory.colorado.edu/)
The DFO provides space-based measurement, mapping, and modeling of surface water. (Note: In general, the DFO website may have more accurate products as experts have been involved in building the flood extent maps using available data and are thus able to edit out errors. The NASA website will have more timely products, as they are generated and posted automatically within several hours of satellite overpass, but they have not been manually examined or edited for errors.)

**European Copernicus Sentinel-1 Synthetic Aperture Radar (SAR)**
(https://sentinel.esa.int/web/sentinel/missions/sentinel-1)
The SENTINEL missions support emergency management by providing timely, continuous, and independent data on a near-real-time basis.

**Advanced Rapid Imaging and Analysis (ARIA) Program**
(https://aria.jpl.nasa.gov/)
The ARIA Program generates imaging products in near real-time that can improve situational awareness for disaster response.

**NASA Earth Science Disasters Team**
(https://maps.disasters.nasa.gov/arcgis/apps/sites/#/home/pages/floods)
NASA's fleet of Earth observing satellites can provide a wealth of information during and after flooding occurs.

**Near Real-Time Global Flood Mapping**
(https://floodmap.modaps.eosdis.nasa.gov/)
NASA's Near Real-time Global Flood Mapping provides routine global mapping of likely flood water using available satellite data resources. (Note: In general, the DFO website may have more accurate products as experts have been involved in building the flood extent maps using available data and are thus able to edit out errors. The NASA website will have more timely products, as they are generated and posted automatically within several hours of satellite overpass, but they have not been manually examined or edited for errors.)

**Flood Maps from NOAA Operational Weather Satellites**
(https://www.ssec.wisc.edu/flood-map-demo/)
NOAA provides experimental flood products based on satellite imagery that show flood areal extent and that can be used for situational awareness.

**USGS Flood Information**
(https://www.usgs.gov/mission-areas/water-resources/science/usgs-flood-information?qt-science_center_objects=0#qt-science_center_objects)
This webpage includes links to the collection of USGS flood data, including products to help Federal, State, and local agencies, decision makers, and the public before, during, and after a flood.

**Hazard Data Distribution System (HDDSExplorer)**
The HDDSExplorer is an event-based interface that provides a single point-of-entry for access to remotely sensed imagery and other geospatial datasets as they become available during a response, including data from public domain sources.

**USGS Flood Inundation Mapper (FIM)**
(https://fim.wim.usgs.gov/fim/)
The FIM Mapper allows users to explore the full set of inundation maps that shows where flooding would occur given a selected stream condition.

### High-Water Mark + Mapping

**Post-Event Depth Grids**
FEMA generates post-event depth grids based on measured/observed data; damage assessments are made from depth grids, both of which are validated with satellite imagery.

**Americas Strategic Analysis & Crisis Support**
NGA collects LIDAR over major urban areas in the U.S. and generates unclassified products to provide information to FEMA within 24-48 hours for flood studies.

**Post-Event Evaluations**
NIST is in the process of developing post-disaster survey techniques that will allow for more representative data collection in which state of the art engineering and social science survey techniques are employed that will generate data and subsequently findings that can be combined

**USGS Flood Information**
(https://www.usgs.gov/mission-areas/water-resources/science/usgs-flood-information?qt-science_center_objects=0#qt-science_center_objects)
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## COMING SOON

**Machine Learning/Artificial Intelligence and Flood**

SCIENCE FOR DISASTER REDUCTION | DECEMBER 2019

# Ice forecasting, Sentinel-1 mapping, and applications

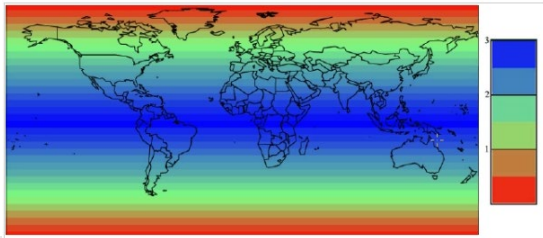
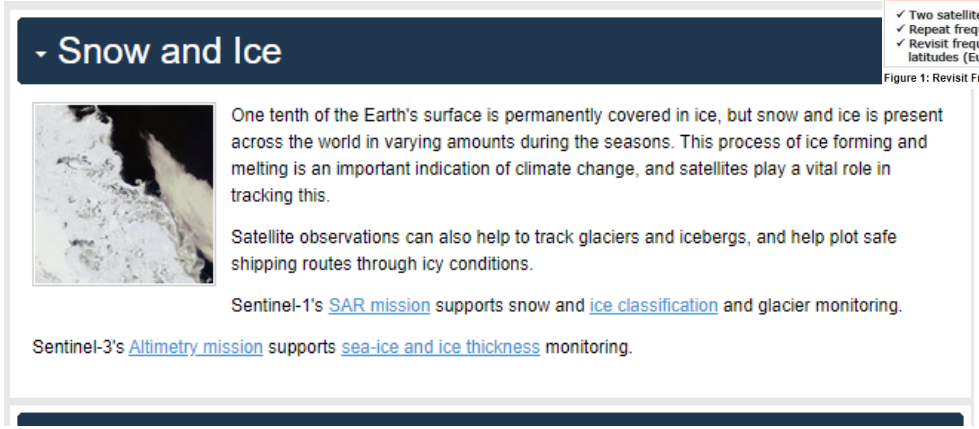


Figure 1: Revisit Frequency for S-1A and S-1B in Days per Revisit




Journal of *Marine Science and Engineering*

MDPI

*Article*

**Ice Forecasting in the Next-Generation Great Lakes Operational Forecast System (GLOFS)**

**Eric J. Anderson [1,*], Ayumi Fujisaki-Manome [2,3], James Kessler [3], Gregory A. Lang [1], Philip Y. Chu [1], John G.W. Kelley [4], Yi Chen [4] and Jia Wang [1]**

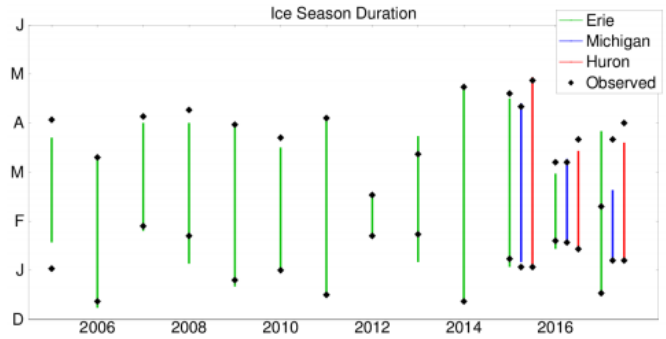
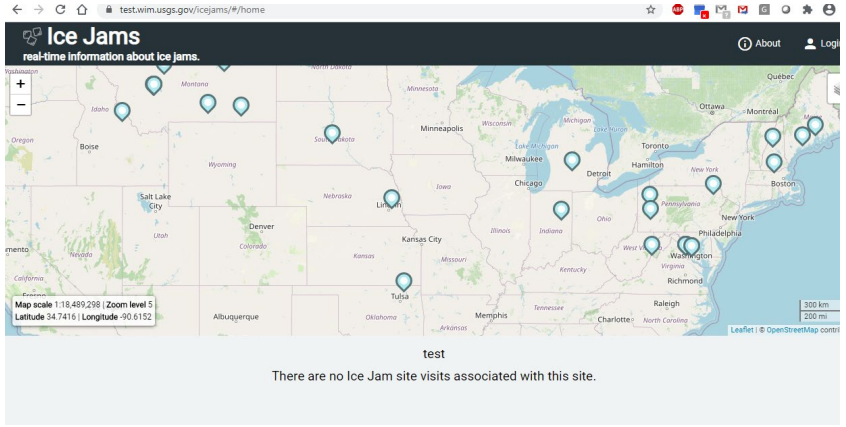



**Figure 10.** Modeled vs observed ice season duration for all simulated years. The duration is defined as the period of time between ice onset (first day lake-wide extent exceeds 10%) and ice-off (last day extent exceeds 10%). The y-axis shows the length and timing of the ice season by month.




Velocity msmts under ice at USGS gages

# Other topics/checkin

- Canada DFO Multi-partner Research Initiative (MPRI) and NOAA OR&R ERD Response Oil Assay Workgroups – ideal oil database, consistent lab protocols for oil properties, metadata
  - Working Group #1 – what should be in the database?
  - Working Group #2 – Oil property composition, response lab oil assay protocols
- UAS applications – EPA policy update, UAS taskforce, Emergency management information technology (EMIT) workgroup
- Air monitoring/mapping – [NEW- Airnow (fire and smoke), Purpleair PM2.5 sensors, USGS gages link? (Faith)
- High water levels/inundation mapping (Midland flood general meeting)
  - Pin2Flood
  - 3Dep Lidar Point cloud public data set
  - Any benefits, needs for more linkage between river and coastal flooding, coastal erosion? Hurricane examples?
- PFAS (general meeting)
- USGS gages – velocity/stage relations, NAVD88 water surface, rapid deployment gages, sensors, surface velocity metrics from cameras
- New issues? Things we should be doing more indepth between fall and spring meeting remotely?