The Winter Storm Severity Index in 2020

Joshua Kastman
Jim Nelson

Acknowledgments

There is no WSSI without Andy Nash. He is the original creator and developer.

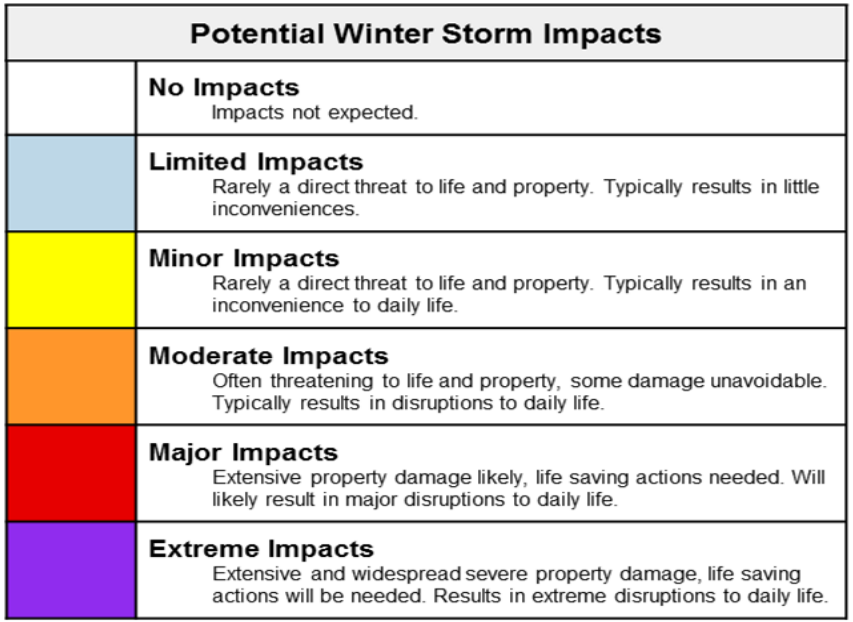
Thank you Andy for your hard work and continued support!

Thank you also to Dan Cobb, Mike Muccilli and the other original developers who laid the foundation for the WSSI.

Thank you to Ian Lee who set up the WSSI VLAB page

Overview

- Goal of the Product
  - Summarize multiple winter weather impacts from a storm into an easily consumable graphic
  - 72 Hour forecast
    - 24 HR breakouts
    - Data comes from the NWS National Digital Forecast Database (NDFD)
    - Updates every 2 hours
- Summary graphic is a composite of the maximum impact from any of the six components



Components:
Snow Amount - Snow Load - Ice Accumulation - Blowing Snow - Ground Blizzard - Flash Freeze

Website: https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php

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Overview - Components

Snow Amount Index:

PURPOSE: This component is designed to highlight areas in which impacts, especially transportation, could become overwhelmed due to either:

- The total amount of snow.
    - 2-Day climatology taken into account
- The rate at which the snow is falling.
- Because we are using 6-hour data impacts from snow amount are much more common

Snow Load Index:

PURPOSE: This component is to highlight areas where the weight of the snow could result in damage to trees and powerlines. In general, the lower the snow-liquid ratio (SLR) is and the greater the total snow accumulation, the higher the index.

Forest type is taken into account (more on that later)

Overview - Components

Blowing Snow Index:

PURPOSE: This component highlights areas where blowing/drifting snow is expected to occur and result in transportation related problems. In general, the blowing snow significance increases as the SLR and winds both increase. Prior blowing snow research indicates that in general it takes just under 20 mph of wind to start to move snow around.

Ground Blizzard Index:

PURPOSE: This component is to highlight areas where pre-existing snow combined with very strong winds results in ground blizzard conditions, which result in a significant impact to transportation.

Land use is taken into account for both of these parameters

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Overview - Components

Flash Freeze Index:

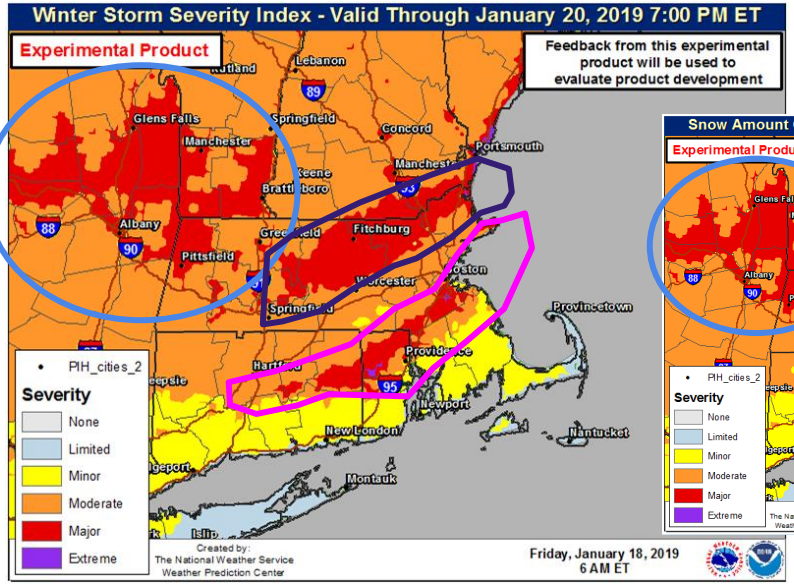
PURPOSE: The component depicts severity primarily to transportation of situations where temperatures rapidly fall below freezing during or just after precipitation.

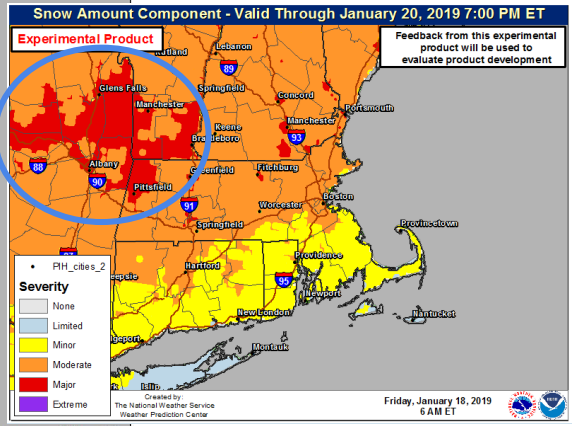
Ice Accumulation Index:

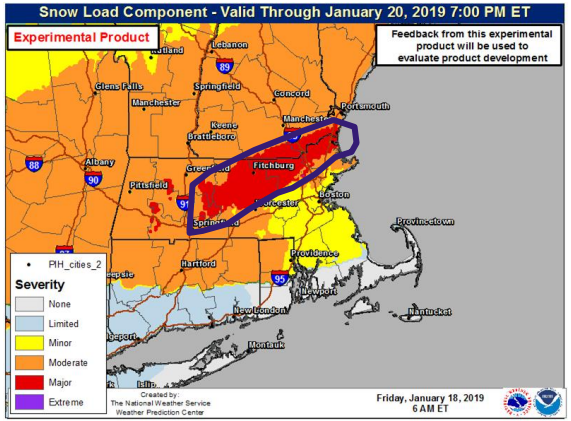
PURPOSE: This component was developed to account for the combined effects of ice accumulation and wind which can produce widespread tree damage, transportation shutdowns and other impacts.

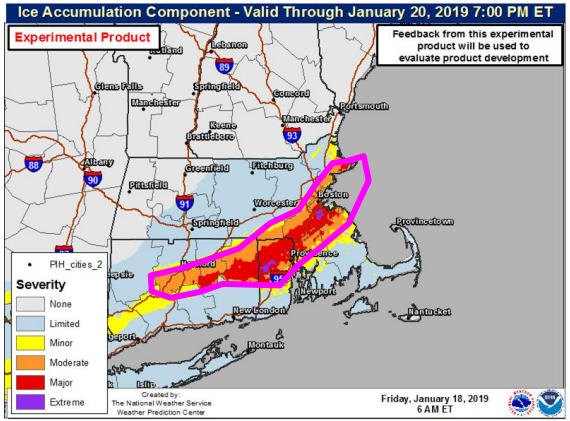
Overview - WSSI Interpretation

Final interpretation: Expect the primary impacts to come from ice accumulations across northern RI northeastward toward Boston, MA. Expect impacts to come from heavy snowfall for VT and NY. There is a major threat for impacts from snow load across central MA through southeast NH.









Colors and Definitions

FROM: → **TO:**

WSSI Descriptor	General Description of Expected Storm Severity Impacts
None	No snow or ice forecast. No potential for ground blizzard conditions
Limited	Small accumulations of snow or ice forecast. Minimal impacts, if any expected. In general, society goes about their normal routine.
Minor	Roughly equated to NWS Advisory Level criteria. Minor disruptions, primarily to those who were not prepared. None to minimal recovery time needed
Moderate	Roughly equated to a NWS Warning Level criteria. Definite Impacts to those with little preparation. Perhaps a day or two of recovery time for snow and/or ice accumulation events.
Major	Significant impacts, even with preparation. Typically several days recovery time for snow and/or ice accumulation events.
Extreme	Historic. Widespread severe impacts. Many days to at least a week of recovery needed for snow and/or ice accumulation events.

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Potential Winter Storm Impacts	
	No Impacts Impacts not expected.
	Limited Impacts Rarely a direct threat to life and property. Typically results in little inconveniences.
	Minor Impacts Rarely a direct threat to life and property. Typically results in an inconvenience to daily life.
	Moderate Impacts Often threatening to life and property, some damage unavoidable. Typically results in disruptions to daily life.
	Major Impacts Extensive property damage likely, life saving actions needed. Will likely result in major disruptions to daily life.
	Extreme Impacts Extensive and widespread severe property damage, life saving actions will be needed. Results in extreme disruptions to daily life.

WSSI Changes for 2019 - Definitions and Colors

- Improvements based upon input from Social Science engagements
  - Participants: Jennifer Sprague (NWS, OPPSD), Danielle Nagele (NWS, OPPSD), Greg Schoor (NWS, AFS), James Nelson (WPC), Joshua Kastman (WPC), Alyssa Cannistraci (WPC), Amanda Wagner (WPC)
- Matched color curve to other NWS Hazards efforts
- Reworked definitions of impacts
  - Removed mentions of watch/warning criteria; focused on impacts to daily life and threat to life and property

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WSSI - VLAB Image Viewer Page

VLab Home Page

VIRTUAL LAB
Winter Storm Severity Index Private

Search

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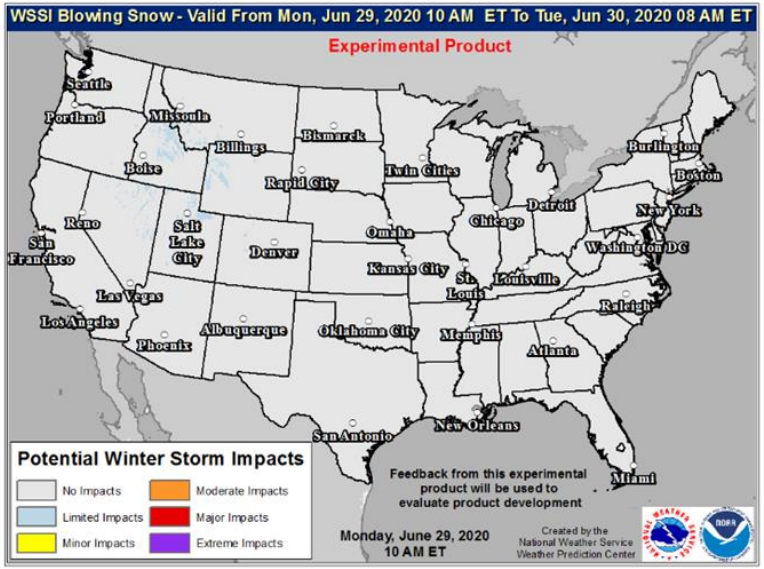
DAY 1-3 CONUS WSSI LOOPS

When looking at images, Day 1 graphics should be valid for:
Mon Jun 29 2020 12:34:51 GMT-0400 (Eastern Daylight Time)
When looking at images, Day 2 graphics should be valid for:
Tue Jun 30 2020 12:34:51 GMT-0400 (Eastern Daylight Time)
When looking at images, Day 3 graphics should be valid for:
Wed Jul 01 2020 12:34:51 GMT-0400 (Eastern Daylight Time)



NAVIGATION MENU

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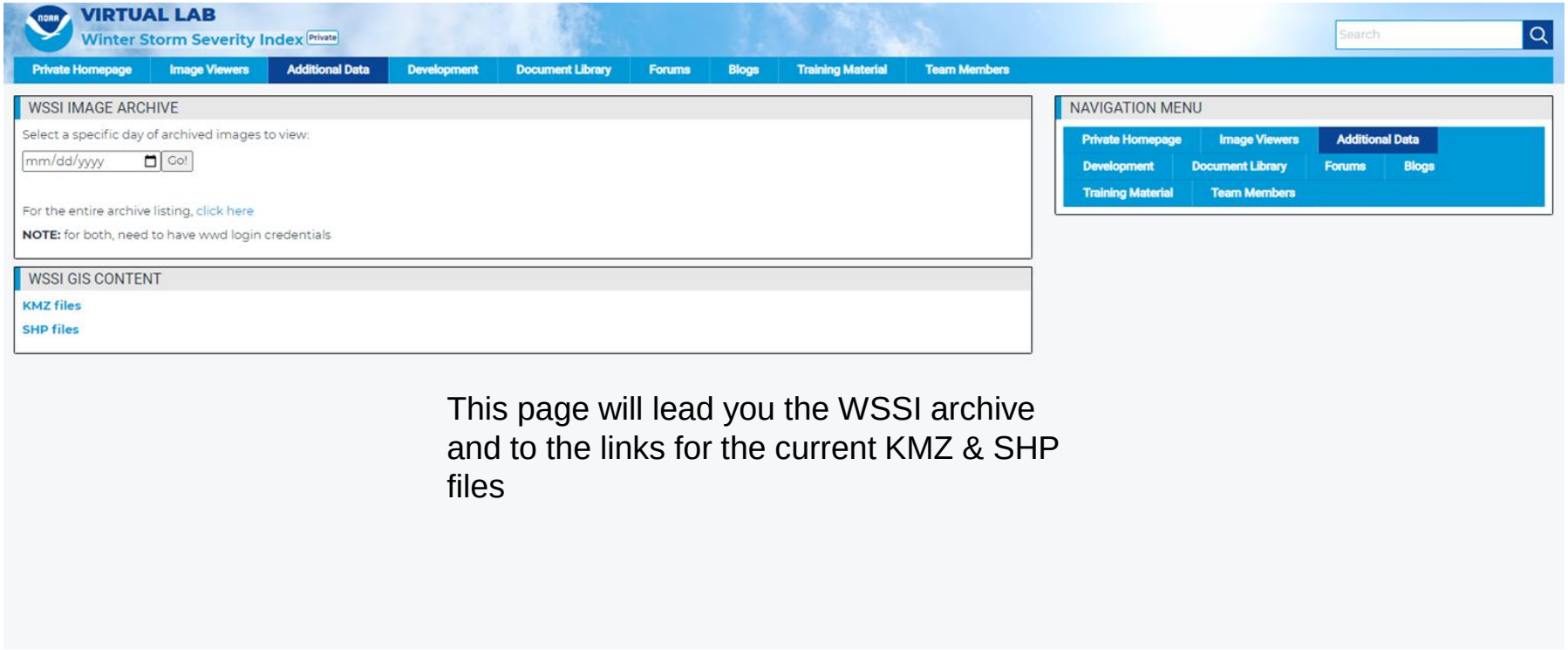
WSSI WFO-CENTRIC GRAPHICS

Click the button to open the dropdown menu, and use the input field to search for a specific WFO.

Select WFO

This button will take you to the WFO WSSI page

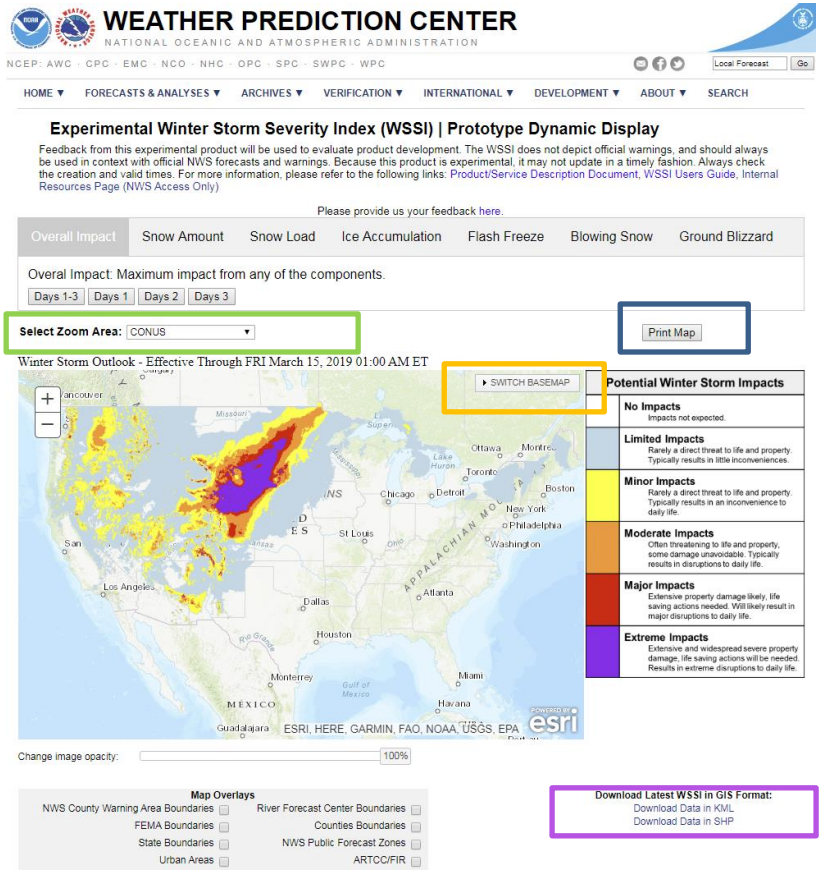
WSSI - VLAB Page



This page will lead you the WSSI archive and to the links for the current KMZ & SHP files

WSSI – Website

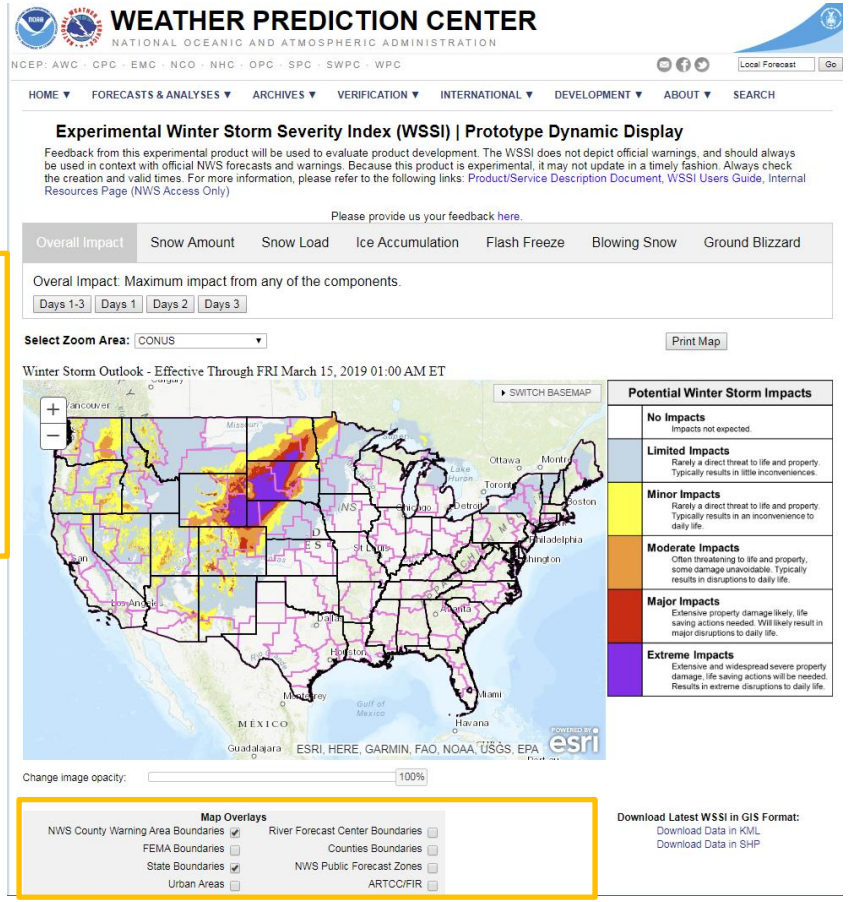
- Clickable tabs
  - Loads WSSI components upon click
  - Day Period tabs
- Revised definitions
- Zoom to WFO
  - Dropdown Box
- Print Image button
  - Creates a PDF of the map with your specifications
- Variety of basemaps
  - Switch Basemap dropdown button
- Links to GIS Data



WSSI – Website

- Map overlay options
  - Toggled via checkbox
- CWA
- FEMA
- State
- RFC
- Counties

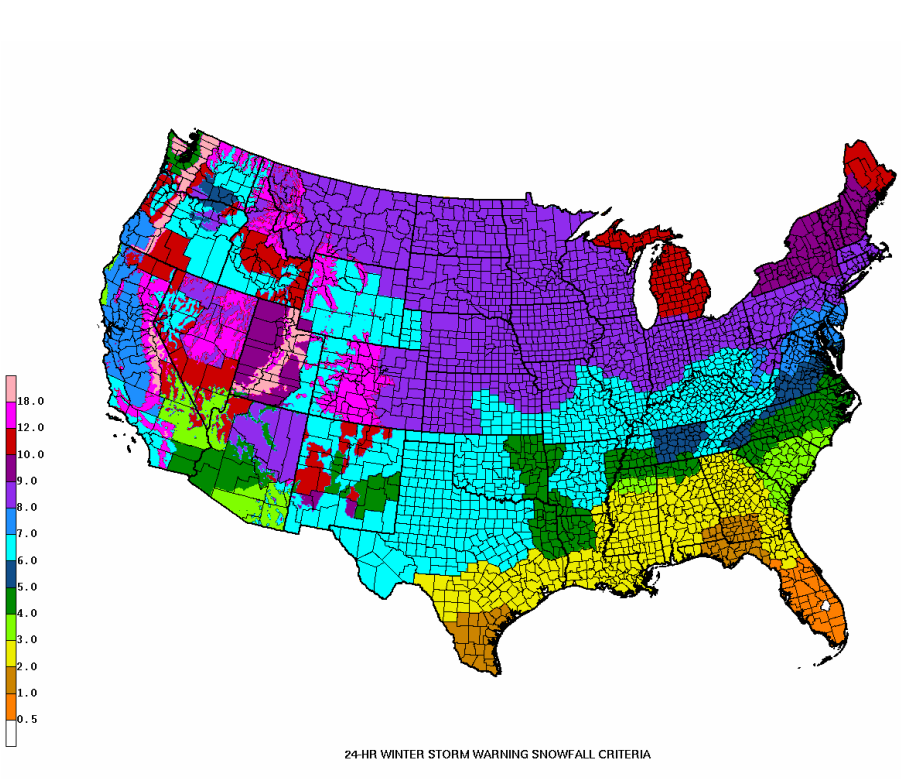
- Public Forecast Zones
- ARTCC
- Metro Areas

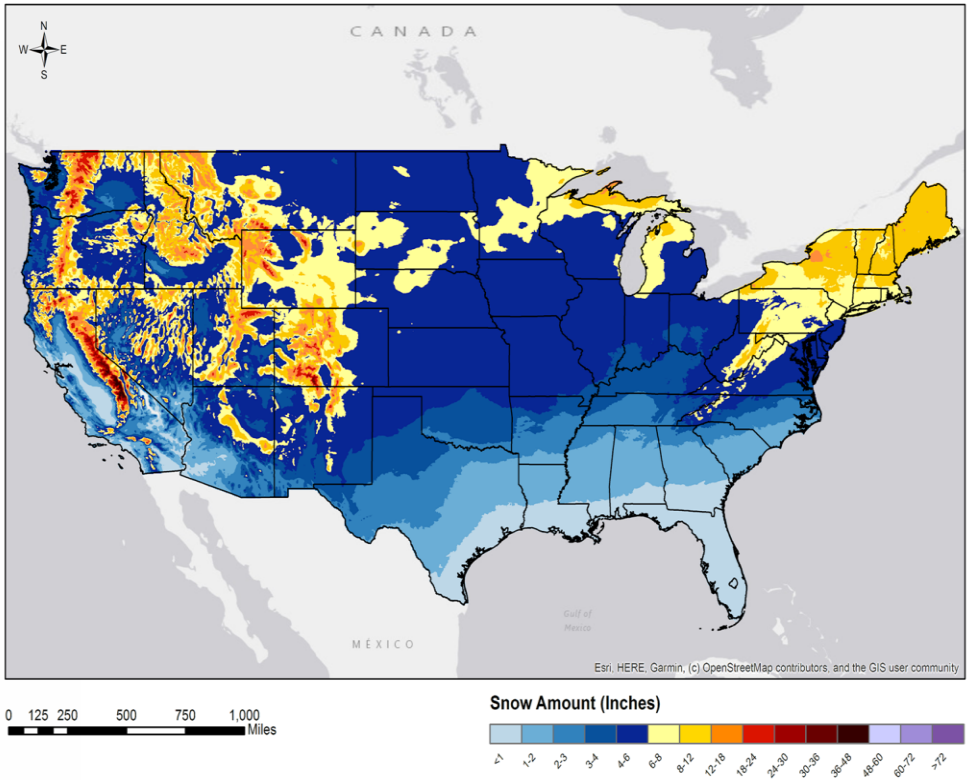


WSSI Changes for 2019 - Snow Climatology Update

- More quality control
  - Station must have at least 30 years of data
  - This reduced number of stations and increased influence of 1st order stations
    - ~ 3900 Stations
- Average of Max plus Mean 2-Day snowfall
  - Increased correlation to moderate and minor thresholds
  - Reduced minor threshold particularly in snowy regions
    - Response to feedback from NWS WFOs of minor being too hard to achieve
- Empirical Bayesian Kriging Regression (EBKR) included River Forecast Center (RFC) boundaries
  - Same regression variables used (Annual Snow, Elevation & Latitude)
- Improved EBKR results by grouping stations by RFC
  - Model weighted stations more within the same RFC
  - Improved results where different regions had similar statistics

WSSI Moderate Criteria Vs 24 HR NWS Winter Warning Criteria





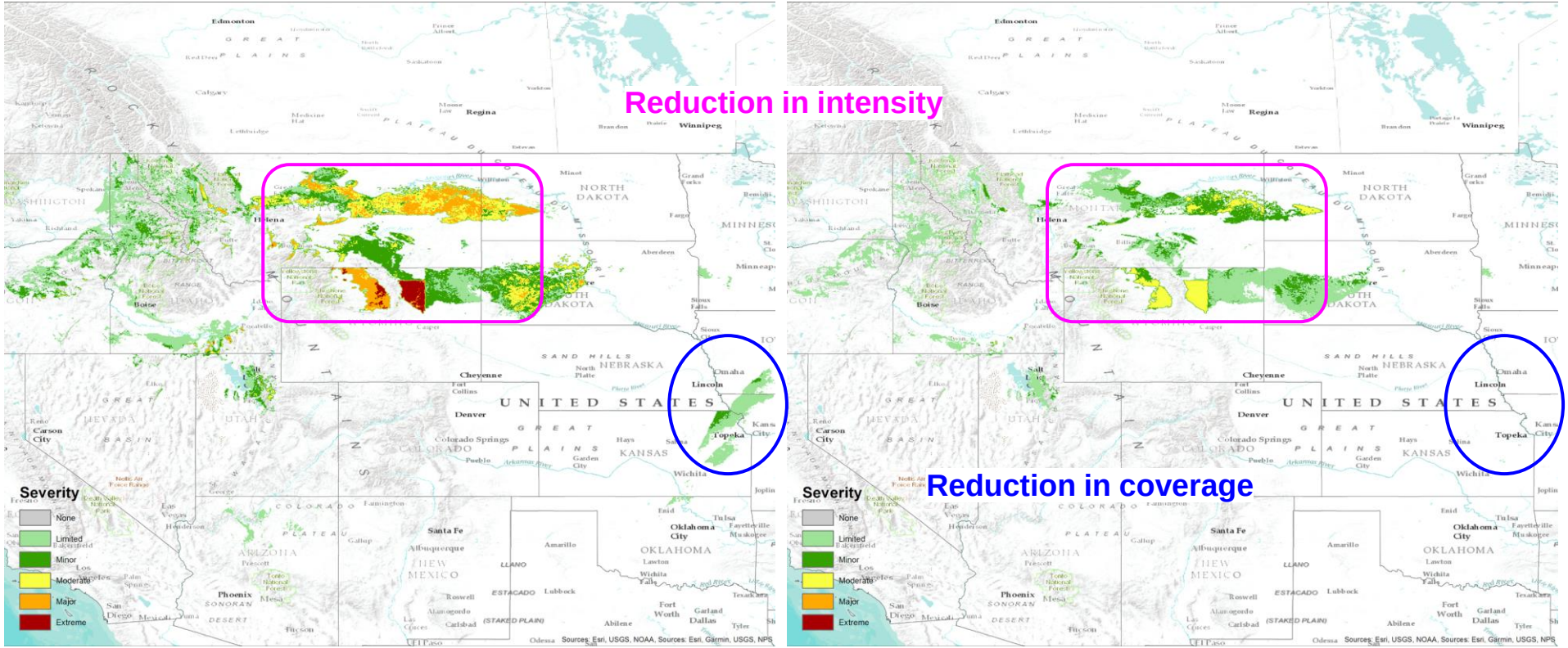
Modified WSSI Flash Freeze Component

- A three hour average temperature change will be used this upcoming season as opposed to hourly temperature changes.
- This will effectively cap the Flash Freeze impact. While extreme will be possible, it will take a highly unusual scenario to generate an extreme Flash Freeze.
- This will mitigate problems when rapidly rising temperatures are followed by a quick, steep drop of temperatures within a six hour QPF block.
- The proposed modification will not fix QPF temporal resolution issues.

WSSI Changes for 2019 - Flash Freeze

30 December 2018 Original Method

30 December 2018 Proposed Method



2019-20 Survey Results

- Public Survey 76 Responses
  - Less than last year (150)
  - Less snow in the east
  - Pandemic could have eaten into March/April responses
  - Generally very positive (81% favorable)
- NWS Internal Survey 29 Responses
  - Event Specific
  - Focused on time of day / commutes
  - Lots of model discussion in responses

2019-20 Survey Results - NWS Survey Word Cloud

Website: https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php

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2019-20 Survey Results - Public Survey Word Cloud

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2019-20 Use & Visibility

- Amazon Use
  - Lead intelligence Analyst reached out for an explainer
  - Reported they use it daily for decision making at shipping and distributions centers
- Washington Post's Capital Weather Gang wrote a positive article on the WSSI
- Weather Channel also wrote an article on the W
- Pivotal Weather now has the tool on its website
- TV station use
  - KMLs are being use to create graphics

Website: https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php

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WSSI - Overview Version 2.0

- Implemented October 4th, 2019
- 72hr Summary and Components Graphics
- CONUS, FEMA, States, and CWA Basemaps
- **24hr Breakout Summary and Components Graphics**
- KML and Shapefiles (CONUS)
- Flash Freeze Update
- Updated Snow Climatology from WSSI Prototype

- Average of Max plus Mean 2-Day snowfall
  - Increased correlation to moderate and minor thresholds
  - Reduced minor threshold particularly in snowy regions
    - Response to feedback from NWS WFOS of minor being too hard to achieve

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WSSI - Collaboration

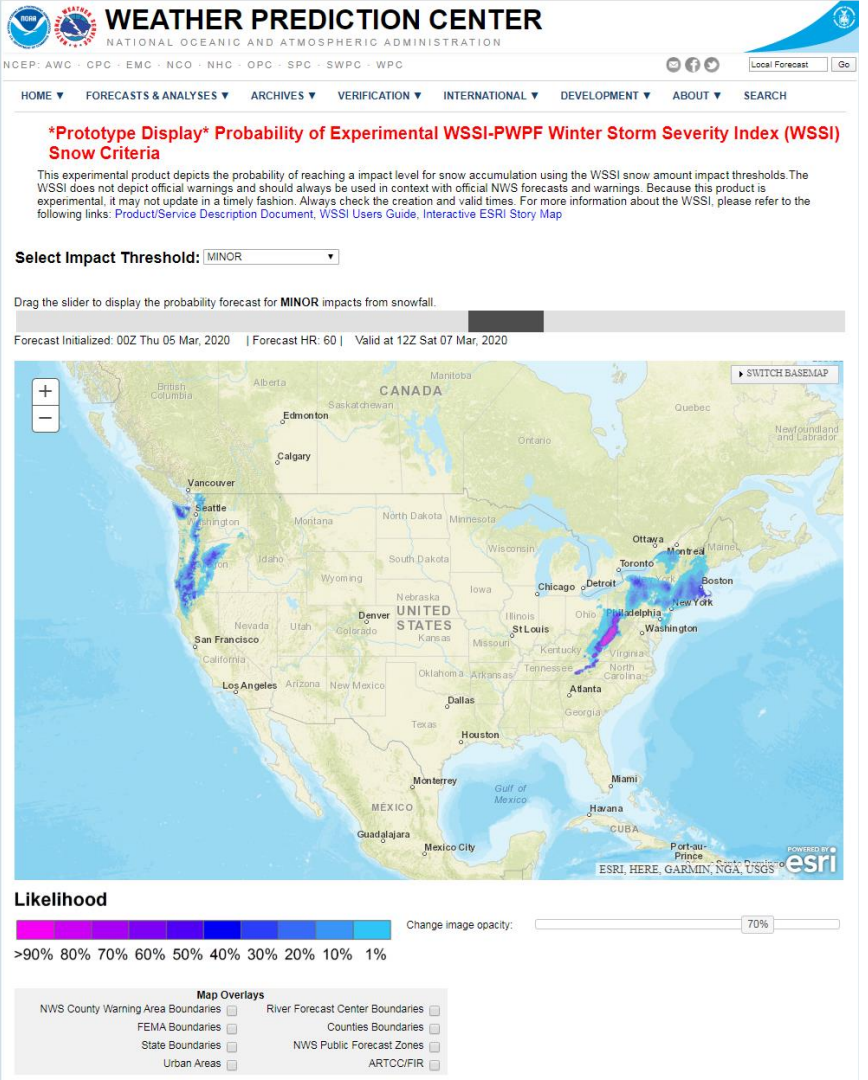
- Active NWS WSSI Team
  - WFO and regional representation
- Great Feedback from NWS Offices and Regions in the Last Year
  - Lead directly to improvements
- Training Materials
  - Training development planned with WDTD this summer

WSSI Version 3.0

- 72hr Summary and Components Graphics
- CONUS, FEMA, States, and CWA Basemaps
- 24hr Breakout Summary and Components Graphics
- KML and Shapefiles (CONUS)
- Updated Snow Climatology from WSSI Prototype
- Flash Freeze Update
- Rolling 24hr Summary and Components Graphics (6hr cadence)
  - In development
- Extend WSSI to Day 5
  - In development using NBM deterministic forecast
- ArcGIS Online Service
  - Internal services created by IDP in April (link)

Probabilistic WSSI

- Probability of Exceeding WSSI Snow Amount Criteria
  - Web page launched Feb. 2020.
  - Used WSSI Snow Climatology Thresholds & WPC PWPF
- More Probabilistic Components will be developed

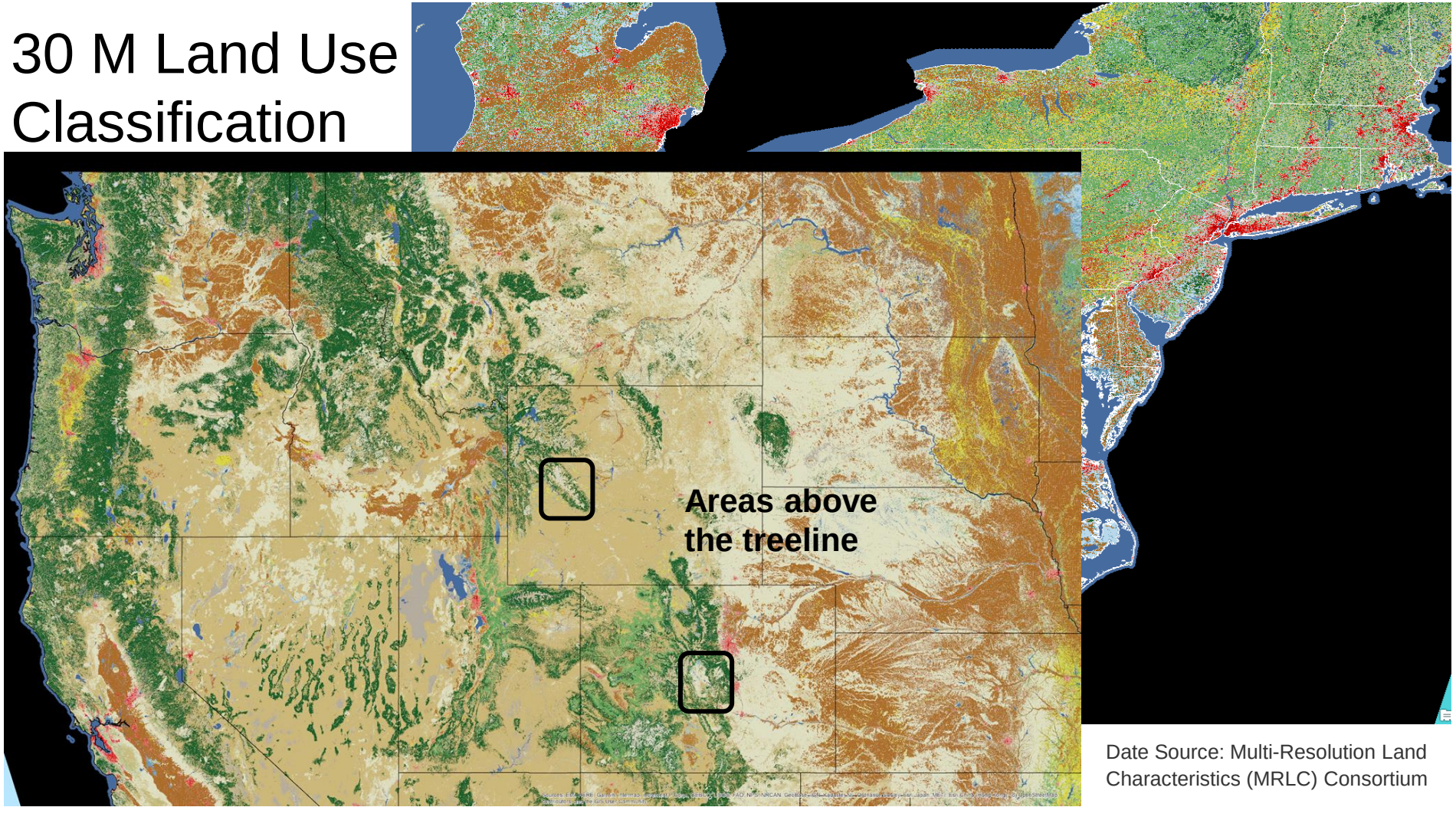


Website: https://www.wpc.ncep.noaa.gov/w

Probabilistic WSSI - All Component

- Fully probabilistic WSSI using PWPF model members in development
  - Method 1:
    - Each member will have its own WSSI forecast
    - Probabilistic output for each component
    - Forecast out to day 3.5
  - Method 2:
    - Joint probability method
    - Probability of raw components calculated
      - Snow Amount, Ice amount, QPF amount, Wind Speed, Temperature
- Currently Developing Method 1

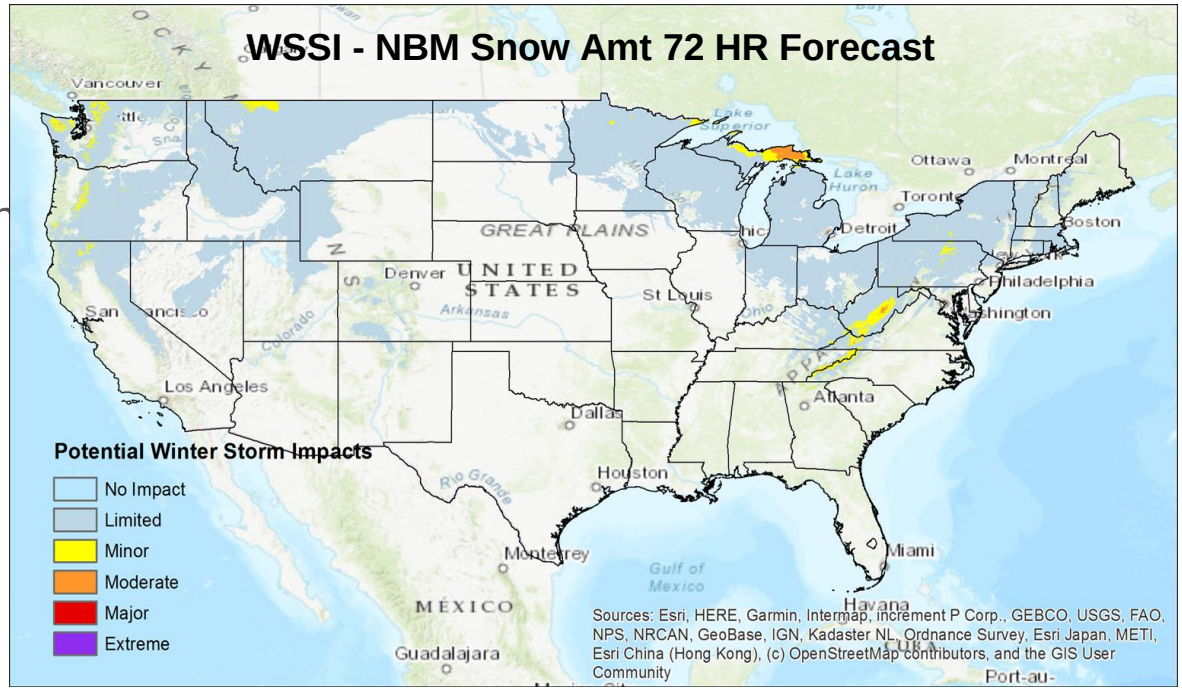
30 M Land Use Classification



Date Source: Multi-Resolution Land Characteristics (MRLC) Consortium

WSSI - Model Generated Output

- Deterministic NBM WSSI
  - Proof of concept
- Higher Temporal Resolution
  - Time of day impacts
  - Hourly Snow Rates
- Collaboration Opportunities
- Possible to expand out to day 7
- Could pair with GWHO



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NCEP Summer Intern and Summer Projects

- One summer student (Chris Long of Penn State)
- Projects
  - URMA/RTMA Reanalysis of key cases from last two seasons
  - Yearly Counting Stats
  - Improvements to WSSI website
    - Static Images
    - Improved Archive
    - CWA tracker (number of each component and severity)

Thank You!!!

Comments or Questions?

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