

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



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

The National Weather Service
Weather Prediction Center

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

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.

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)



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

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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.

Land use is taken into account for both of these parameters

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.



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

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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.

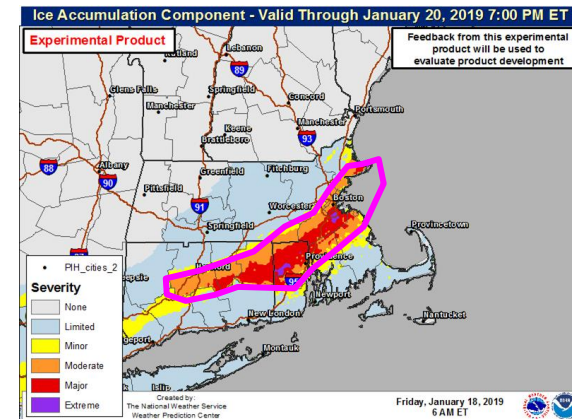
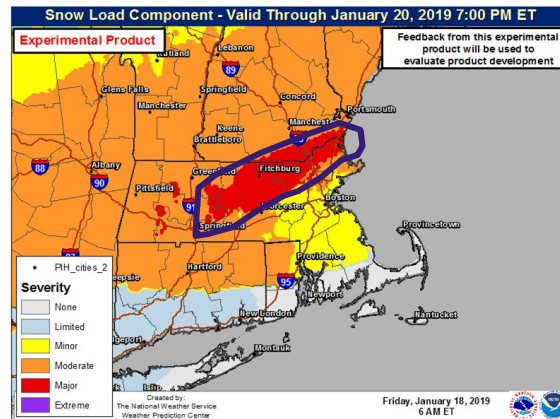
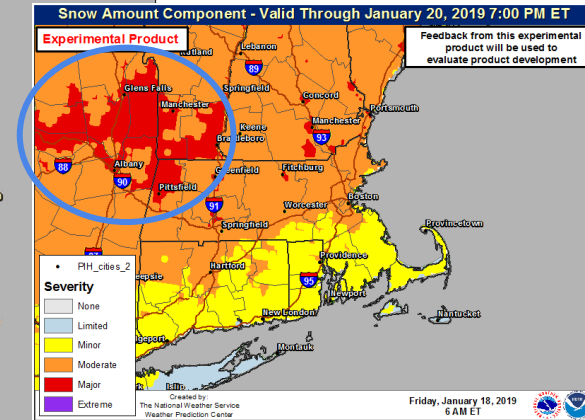
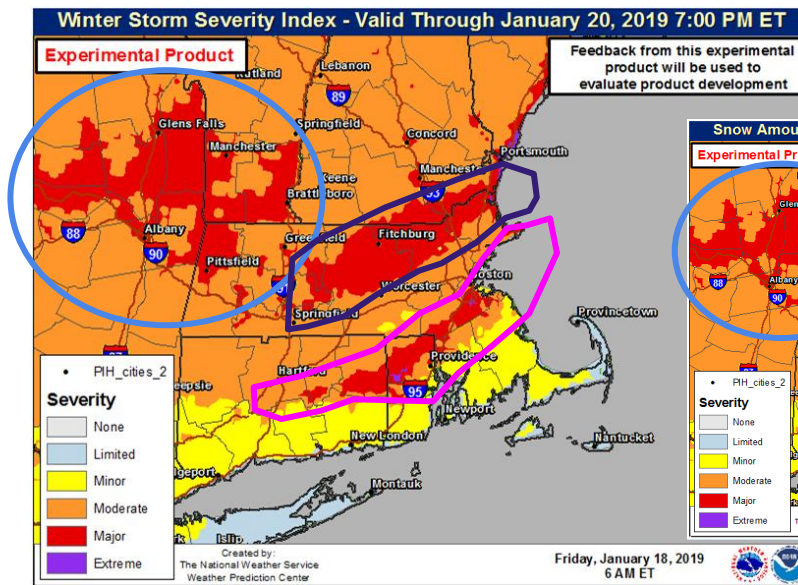


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Weather Prediction Center

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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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

Private Homepage Image Viewers Additional Data Development Document Library Forums Blogs Training Material Team Members

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)

WSSI Blowing Snow - Valid From Mon, Jun 29, 2020 10 AM ET To Tue, Jun 30, 2020 08 AM ET

Experimental Product

Potential Winter Storm Impacts

No Impacts	Moderate Impacts
Limited Impacts	Major Impacts
Minor Impacts	Extreme Impacts

Monday, June 29, 2020 10 AM ET

Created by the National Weather Service Weather Prediction Center

Feedback from this experimental product will be used to evaluate product development

NAVIGATION MENU

Private Homepage Image Viewers Additional Data
Development Document Library Forums Blogs
Training Material Team Members

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

The screenshot shows the NOAA Virtual Lab (VLAB) interface for the Winter Storm Severity Index (WSSI). The header includes the NOAA logo, the text "VIRTUAL LAB Winter Storm Severity Index", and a "Private" label. A search bar is located in the top right corner. Below the header is a navigation menu with the following items: Private Homepage, Image Viewers, Additional Data (highlighted), Development, Document Library, Forums, Blogs, Training Material, and Team Members.

The main content area is divided into two sections:

- WSSI IMAGE ARCHIVE**: This section prompts the user to "Select a specific day of archived images to view:" and provides a date selection field with a calendar icon and a "Go!" button. Below this, there is a link for the "entire archive listing" and a note stating: "NOTE: for both, need to have wwd login credentials".
- WSSI GIS CONTENT**: This section contains two links: "KMZ files" and "SHP files".

A secondary "NAVIGATION MENU" is located on the right side of the page, containing the same set of navigation items as the main header, with "Additional Data" highlighted.

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

WSSI – Website

The screenshot shows the Weather Prediction Center's WSSI website. At the top, there are logos for NOAA and the Weather Prediction Center, along with navigation links like 'HOME', 'FORECASTS & ANALYSES', and 'SEARCH'. The main heading is 'Experimental Winter Storm Severity Index (WSSI) | Prototype Dynamic Display'. Below this, there's a feedback section and a 'Please provide us your feedback here.' link. The interface includes several tabs for different impact types: 'Overall Impact', 'Snow Amount', 'Snow Load', 'Ice Accumulation', 'Flash Freeze', 'Blowing Snow', and 'Ground Blizzard'. The 'Overall Impact' tab is selected. There are controls for 'Days 1-3', 'Days 1', 'Days 2', and 'Days 3'. A 'Select Zoom Area' dropdown is set to 'CONUS'. A 'Print Map' button is visible. The map shows a color-coded severity index over the United States, with a 'SWITCH BASEMAP' button. To the right of the map is a legend titled 'Potential Winter Storm Impacts' with categories: 'No Impacts', 'Limited Impacts', 'Minor Impacts', 'Moderate Impacts', 'Major Impacts', and 'Extreme Impacts'. At the bottom, there are 'Map Overlays' and a 'Download Latest WSSI in GIS Format:' section with options for 'Download Data in KML' and 'Download Data in SHP'.

- 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

The screenshot shows the Weather Prediction Center's website for the Experimental Winter Storm Severity Index (WSSI). The page features a navigation menu, a title for the 'Experimental Winter Storm Severity Index (WSSI) | Prototype Dynamic Display', and a feedback link. Below this, there are tabs for different impact types: Overall Impact, Snow Amount, Snow Load, Ice Accumulation, Flash Freeze, Blowing Snow, and Ground Blizzard. The 'Overall Impact' tab is selected, showing a map of the United States with a color-coded WSSI overlay. The map is titled 'Winter Storm Outlook - Effective Through FRI March 15, 2019 01:00 AM ET'. To the right of the map is a legend titled 'Potential Winter Storm Impacts' with five categories: No Impacts, Limited Impacts, Minor Impacts, Moderate Impacts, and Major Impacts. Below the map is a 'Map Overlays' section with checkboxes for various geographic boundaries: NWS County Warning Area Boundaries (checked), FEMA Boundaries, State Boundaries (checked), Urban Areas, River Forecast Center Boundaries, Counties Boundaries, NWS Public Forecast Zones, and ARTCC/FIR. A 'Download Latest WSSI in GIS Format' section is also visible at the bottom right.

WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECASTS & ANALYSES ARCHIVES VERIFICATION INTERNATIONAL DEVELOPMENT ABOUT SEARCH

Experimental Winter Storm Severity Index (WSSI) | Prototype Dynamic Display

Feedback from this experimental product will be used to evaluate product development. The WSSI does not depict official warnings, and should always be used in context with official NWS forecasts and warnings. Because this product is experimental, it may not update in a timely fashion. Always check the creation and valid times. For more information, please refer to the following links: [Product/Service Description Document](#), [WSSI Users Guide](#), [Internal Resources Page](#) (NWS Access Only)

Please provide us your feedback [here](#).

Overall Impact Snow Amount Snow Load Ice Accumulation Flash Freeze Blowing Snow Ground Blizzard

Overall Impact: Maximum impact from any of the components.

Days 1-3 Days 1 Days 2 Days 3

Select Zoom Area: CONUS Print Map

Winter Storm Outlook - Effective Through FRI March 15, 2019 01:00 AM ET

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Change image opacity: 100%

Map Overlays

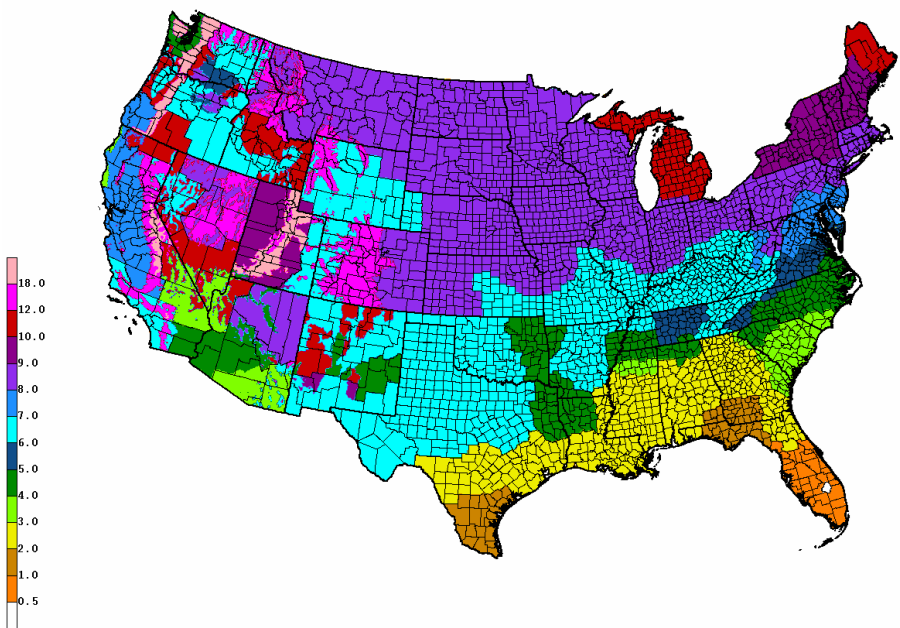
NWS County Warning Area Boundaries <input checked="" type="checkbox"/>	River Forecast Center Boundaries <input type="checkbox"/>
FEMA Boundaries <input type="checkbox"/>	Counties Boundaries <input type="checkbox"/>
State Boundaries <input checked="" type="checkbox"/>	NWS Public Forecast Zones <input type="checkbox"/>
Urban Areas <input type="checkbox"/>	ARTCC/FIR <input type="checkbox"/>

Download Latest WSSI in GIS Format:
Download Data in KML
Download Data in SHP

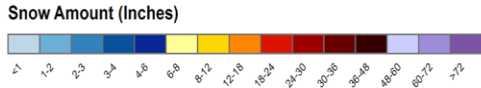
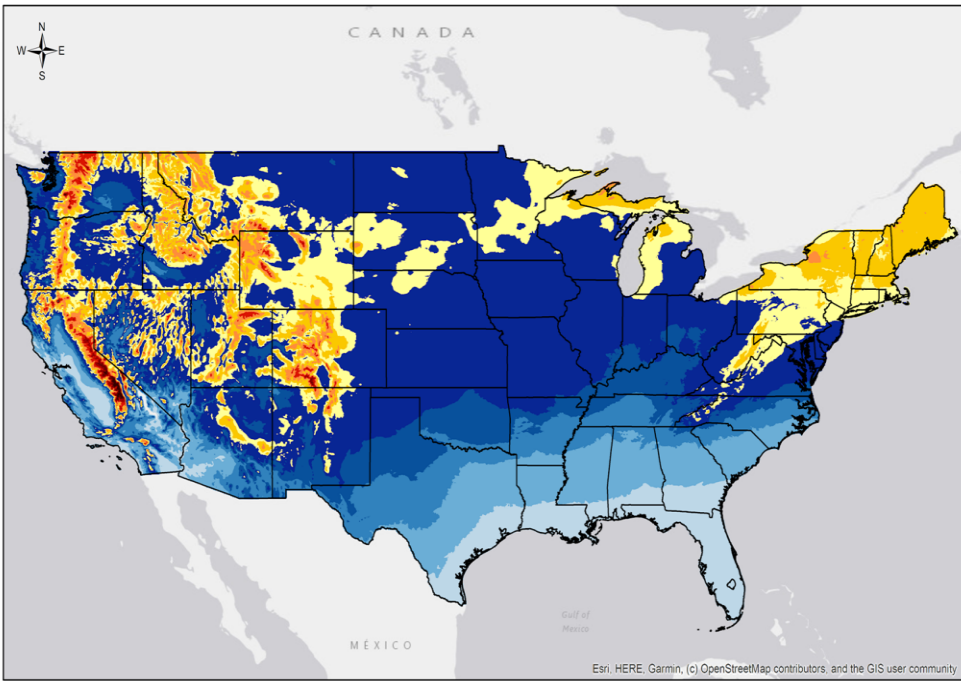
WSSI Changes for 2019 - Snow Climatology Update

- 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



24-HR WINTER STORM WARNING SNOWFALL 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.

2019-20 Survey Results

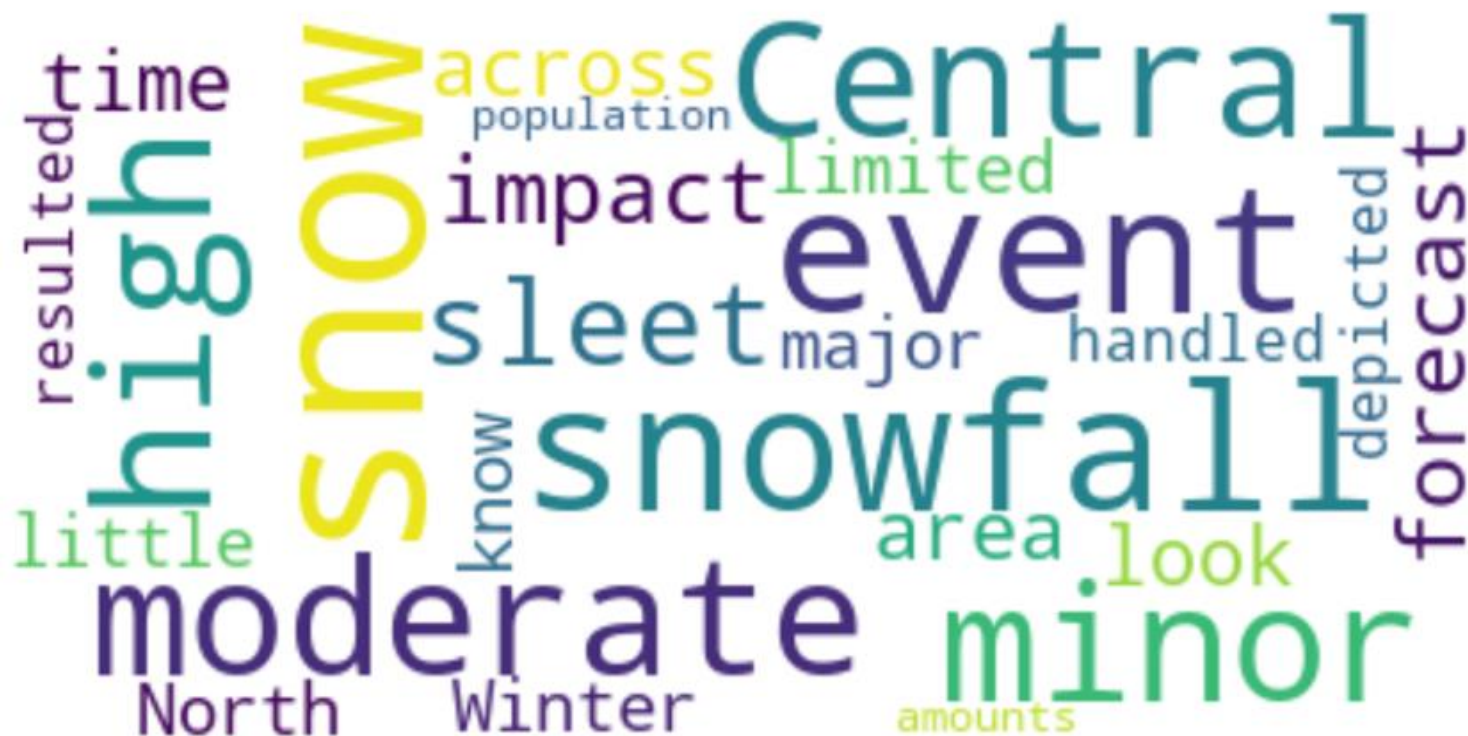
- Public Survey 76 Responses
 - Less than last year (150)
 - Less snow in the east
 - Pandemic could have eaten into March/April responses
 - Generally very positive (81% favorable)
- NWS Internal Survey 29 Responses
 - Event Specific
 - Focused on time of day / commutes
 - Lots of model discussion in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



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

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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



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

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2019-2020 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



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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



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

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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](#))



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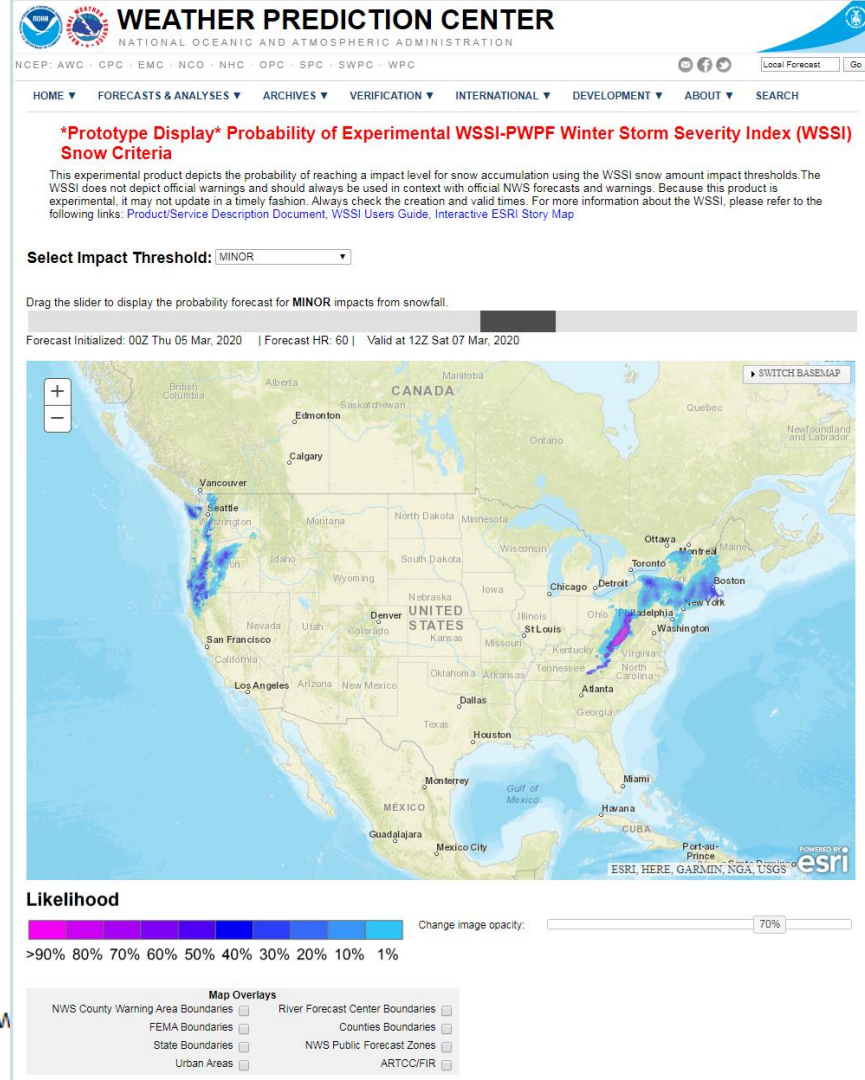
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Probabilistic WSSI

- 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

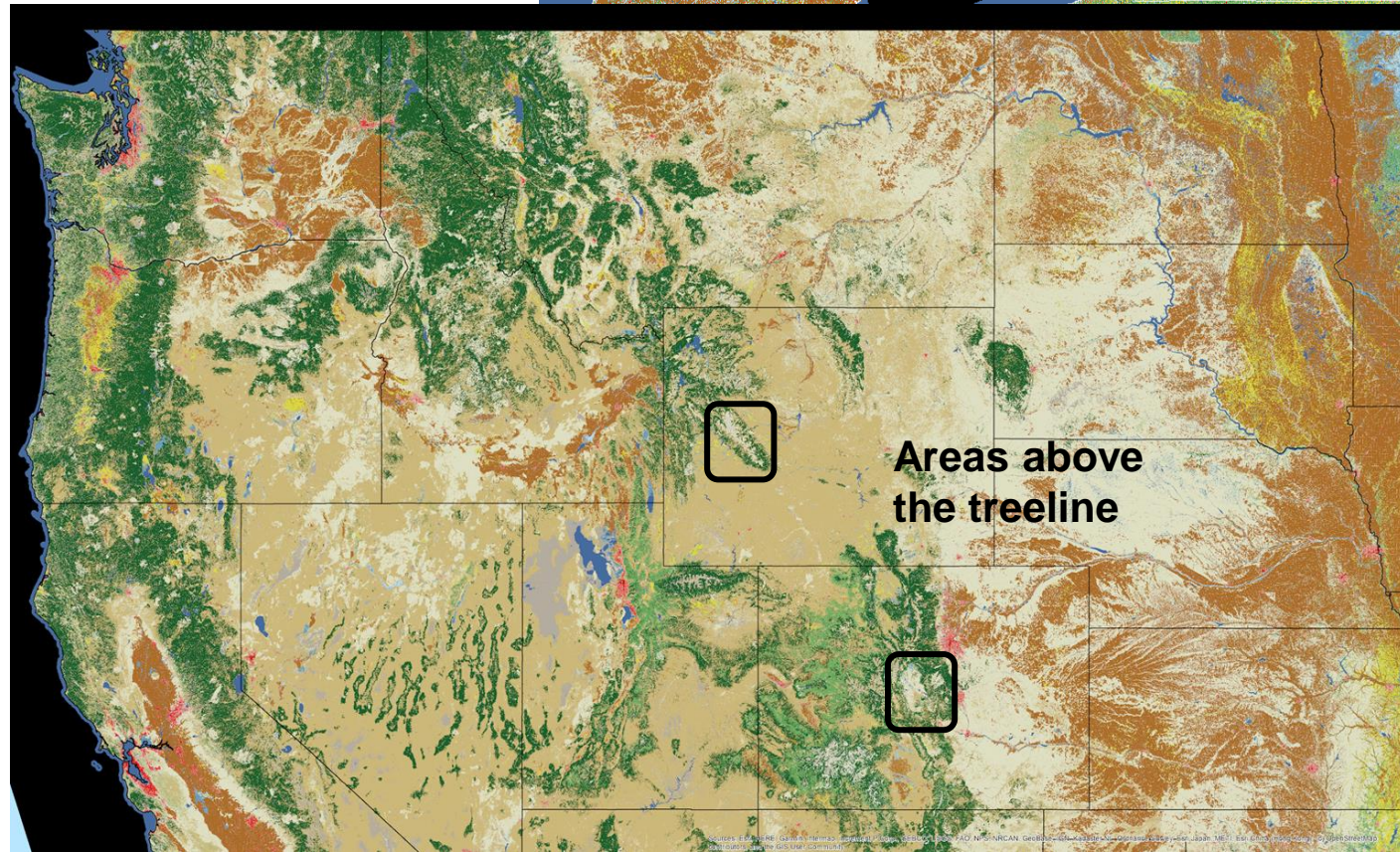
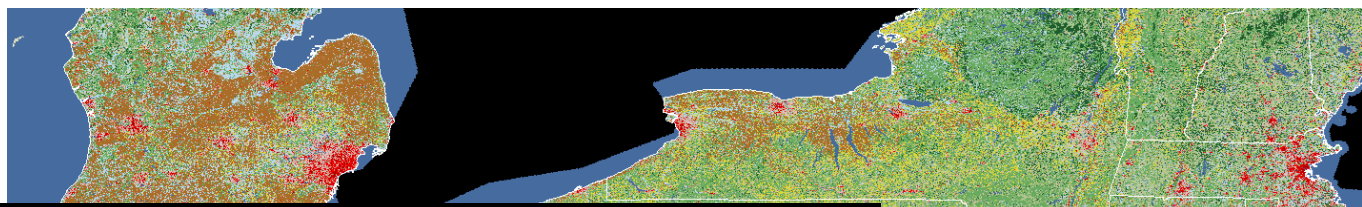
- Fully probabilistic WSSI using PMPF model members in development
 - Method 1:
 - Each member will have its own WSSI forecast
 - Probabilistic output for each component
 - Forecast out to day 3.5
 - Method 2:
 - Joint probability method
 - Probability of raw components calculated
 - Snow Amount, Ice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



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

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30 M Land Use Classification

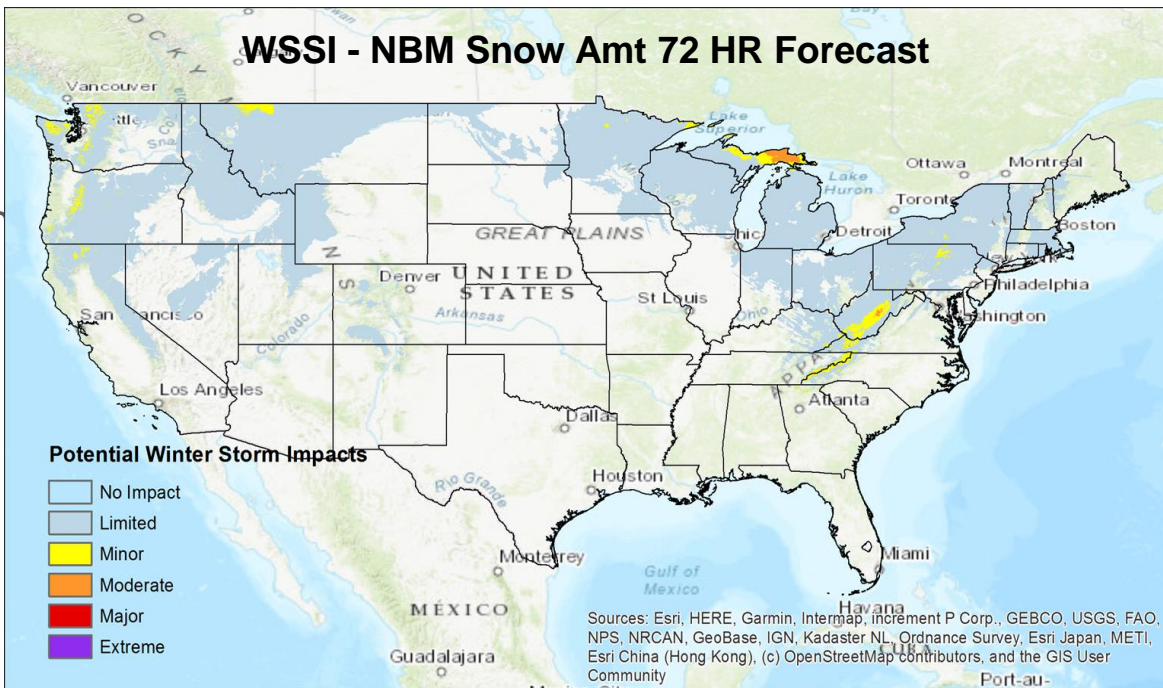


**Areas above
the treeline**

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



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

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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)



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

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Thank You!!!

Comments or Questions?



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