Probabilistic Winter Storm Severity Index (WSSI-P)
Product Description Document (PDD)
September 2023

Part I - Mission Connection

A. Product Description – The Probabilistic WSSI (WSSI-P) for Days 1-7 is a graphical depiction (Figure A) created through the use of Geographic Information Systems (GIS) by using the Probabilistic Winter Precipitation Forecast (PWPF) gridded information from the Weather Prediction Center (WPC) for winter weather elements and combining those data with non-meteorological or static information datasets (e.g., climatology, land-use, urban areas). The WSSI-P provides a classification of the likelihood of potential societal impacts due to expected winter hazards and their distribution using the following terminology: “minor,” “moderate,” “major,” and “extreme.”

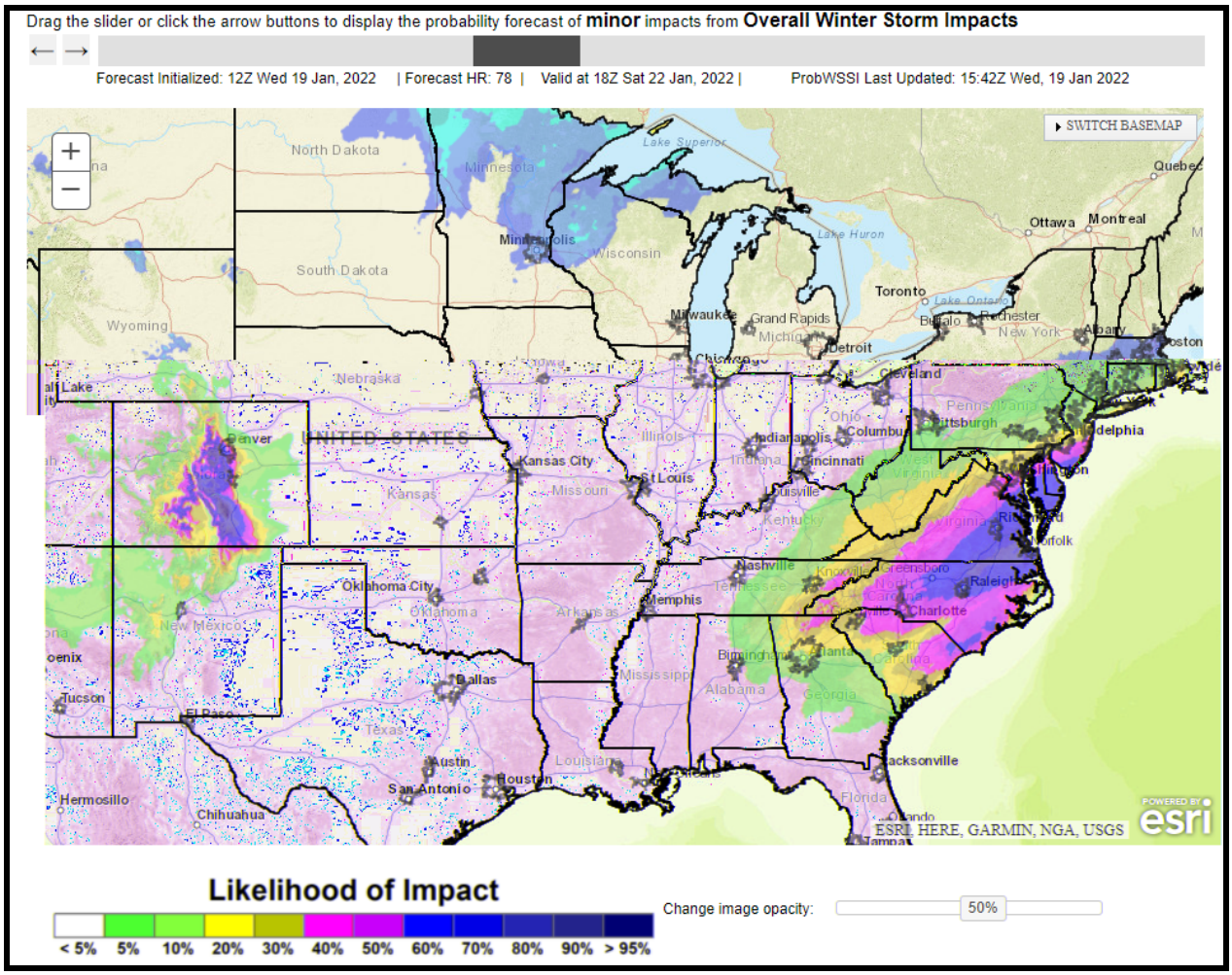

Figure A: Probabilistic Winter Storm Severity Index showing the likelihood of minor overall

impacts from winter hazards. Valid 18Z Saturday, January 22, 2022.

B. Purpose – The Probabilistic WSSI has been developed with two main purposes:

1. Serve as a tool to assist NWS operational forecasters in maintaining situational awareness regarding the possible significance of winter weather-related impacts based upon the PWPF input, thus informing the winter watch/warning decision process.

2. Enhance communication with external partners, media, and the general public of the likelihood of potential societal impacts due to expected winter hazards and their geographical and temporal distributions.

The current operational deterministic WSSI is based upon National Digital Forecast Database (NDFD) single value forecasts. Informed by ensemble information, the WSSI-P allows for detailing the likelihood of potential impacts (i.e., "what is my chance of reaching a moderate impact?"). The WSSI-P output will convey a range of possibilities of impacts enabling enhanced preparedness and decision making as they pertain to winter weather.

C. Audience – The WSSI-P is intended for use by 116 NWS WFOs in the contiguous U.S. (CONUS) and by WPC staff as an enhancement to decision support services, as well as for use and evaluation by NWS partners, the media and the general public.

D. Presentation Format – The graphics are available for the CONUS. The page depicts local and national views of the WSSI-P which includes disclaimers appropriate for products under NWS policy. The webpage is updated at approximately 0200 Coordinated Universal Time (UTC), 0500 UTC, 1400 UTC and 1700 UTC. The publicly-shared output is also available in GIS format (KMZ, SHP, REST Service).

The website is listed below:

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

E. Feedback Method –

Comments or questions regarding the WSSI-P can be addressed to:

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Part II – Technical Description

a. Format and Science Basis – The WSSI-P output is via GIS display, though the core calculations are done in a Linux environment. The following datasets are used as part of calculating the WSSI-P.

WPC's Winter Storm Ensemble (WSE) Elements consisting of:

- 6-hour snow accumulation
- 6-hour ice accumulation
- 6-hour precipitation accumulation (Quantitative Precipitation Forecasts)
- 6-hour Max Wind gust
- 6-hour Temperature
- Total snowfall
- Total ice accumulation
- Maximum wind gust within each 6-hour period
- 6-hourly snowfall accumulation rate
- 6-hourly snow-liquid ratio
- Average snow-liquid ratio

Non-forecast datasets include:

- Urban area designation
- Land-use designations
- National Oceanic and Atmospheric Administration (NOAA)/National Centers for Environmental Information (NCEI) gridded annual snowfall climatology
- Snow Loading climatological data*
- Ice accumulation climatological data*

*Source data https://asce7hazardtool.online used with permission from the American Society of Civil Engineers (ASCE).

The current deterministic operational WSSI consists of a series of sub-component algorithms, each of which use meteorological and non-meteorological data to model predicted severity of specific characteristics of winter weather. Each of the sub-components produce a 1 to 4 output scale value that equates to the potential severity based on the winter weather hazards. The final WSSI value is the maximum value from all the sub-components. The 4 levels are given the following descriptors: Minor, Moderate, Major, and Extreme.

The WSSI-P uses an ensemble of meteorological data as input into the sub-component algorithms to arrive at a range of severity scenarios for each sub-component. The ensemble of severity levels is used to generate a probability of reaching each impact severity level of the sub-components. This probability of reaching a severity level for each sub-component will be displayed on the web page. **A WSSI-P value for each constituent is calculated for each WSE member; probabilities are defined as a percentage of available members that yield a given WSSI-P outcome.**

The specific WSSI-P sub-components are defined as:

- Snow Rate Index
    - Indicates potential impacts due to snowfall rate. Designated urban areas are also weighted 25% more than non-urban areas. Forecast is available for 168 hours.

- Snow Load Index
    - Indicates potential infrastructure impacts (e.g., downed trees/power lines) due to the weight of the snow. This index accounts for the land cover type. For example, more forested and urban areas will show increased severity versus the same snow conditions in grasslands. Forecast is available for 168 hours.

- Snow Amount Index
    - Indicates potential impacts due to the total amount of snow or the snow accumulation rate. This index also normalizes for climatology, such that regions of the country that experience, on average, less snowfall will show a higher level of severity for the same amount of snow that is forecast across a region that experiences more snowfall on average. Designated urban areas are also weighted a little more than non-urban areas. Forecast is available for 168 hours.

- Ice Accumulation
    - Indicates potential infrastructure impacts (e.g., downed trees/power lines, roads/bridges) due to combined effects and severity of ice and wind. Designated urban areas are also weighted 25% more than non-urban areas. Note that not all NWS offices provide ice accumulation information into the NDFD. In those areas, the ice accumulation is not calculated. Forecast is available for 168 hours.

- Blowing Snow Index
    - Indicates the potential disruption due to blowing and drifting snow. This index accounts for land use type. For example, more densely forested areas will show less blowing snow than open grassland areas. Forecast is available for 168 hours.

These calculated forecast values are then used for a series of additional calculations to

compute individual WSSI-P components for each member of the WSE that are categorized internally on a 1 to 4 scale. The membership will be used to produce a probabilistic likelihood of exceeding “minor”, “moderate”, “major”, “extreme”. There will be overall max probabilities for each impact level based upon the probability among all WSSI-P components for each grid point at a 5km resolution.

For more information about the WSSI-P, please see the user guide.

b. Availability -- The WSSI-P products will be available at approximately 0200 Coordinated Universal Time (UTC), 0500 UTC, 1400 UTC and 1700 UTC. Data will be available on the web page and in GIS formats (shp, kmz and REST services).

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