Winter Storm Severity Index (WSSI)

Product Description Document (PDD)
October 2022

Part I - Mission Connection

a. Product Description – The WSSI is created through the use of Geographic Information Systems (GIS) by screening the official National Weather Service (NWS) gridded forecasts from the National Digital Forecast Database (NDFD) for winter weather elements and combining those data with non-meteorological or static information datasets (e.g., climatology, land-use, urban areas). This process creates a graphical depiction of anticipated overall impacts to society due to winter weather. The underlying structure of the WSSI allows it to potentially use other meteorological datasets as inputs (e.g., deterministic or ensemble model output) to create additional guidance products that cover periods beyond those covered by the NDFD. The WSSI provides a classification of the overall expected severity of winter weather (Figure A) using the following terminology: “Minor,” “Moderate,” “Major,” and “Extreme.” The “Winter Weather Area” pertains to areas where winter weather conditions are expected, but are not anticipated to impact daily life (Figure B).

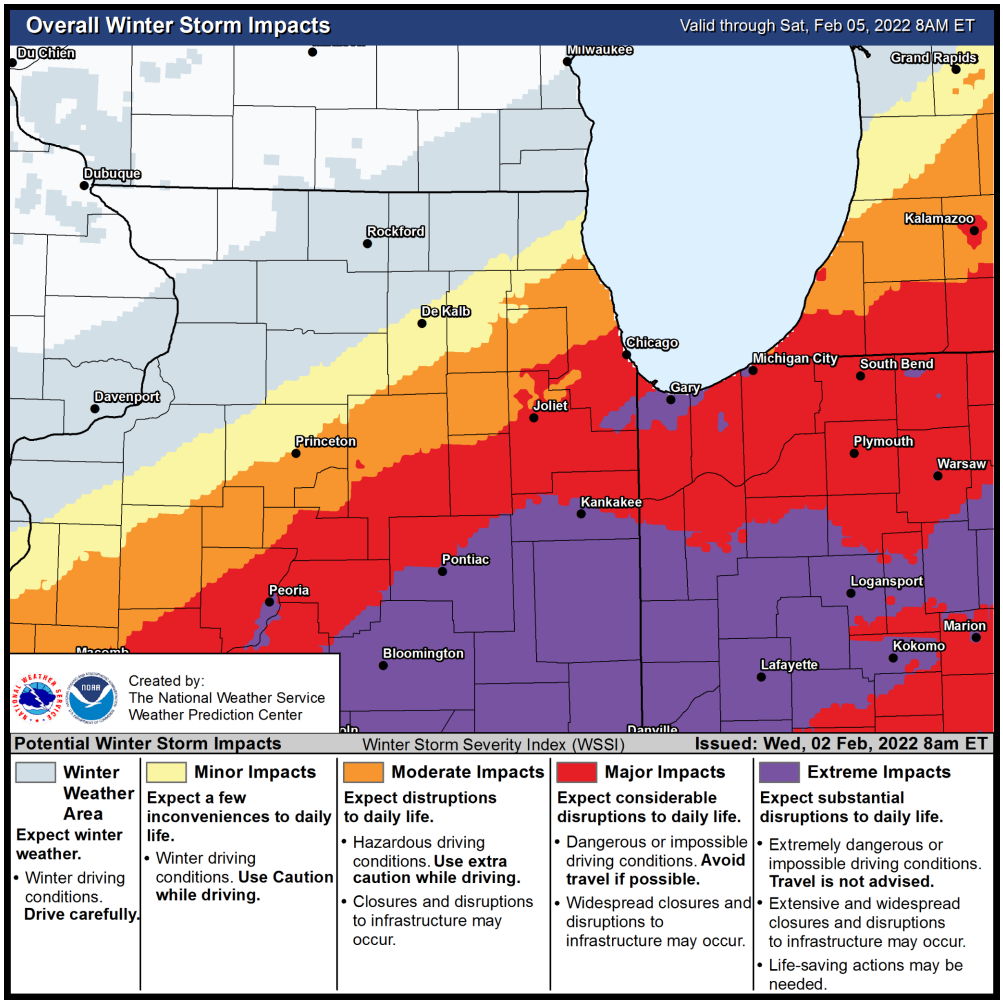

Figure A: Winter Storm Severity Index static image example showing overall impacts from winter hazards from the WFO LOT (Chicago, IL) perspective. Valid 12Z Saturday, February 5, 2022.

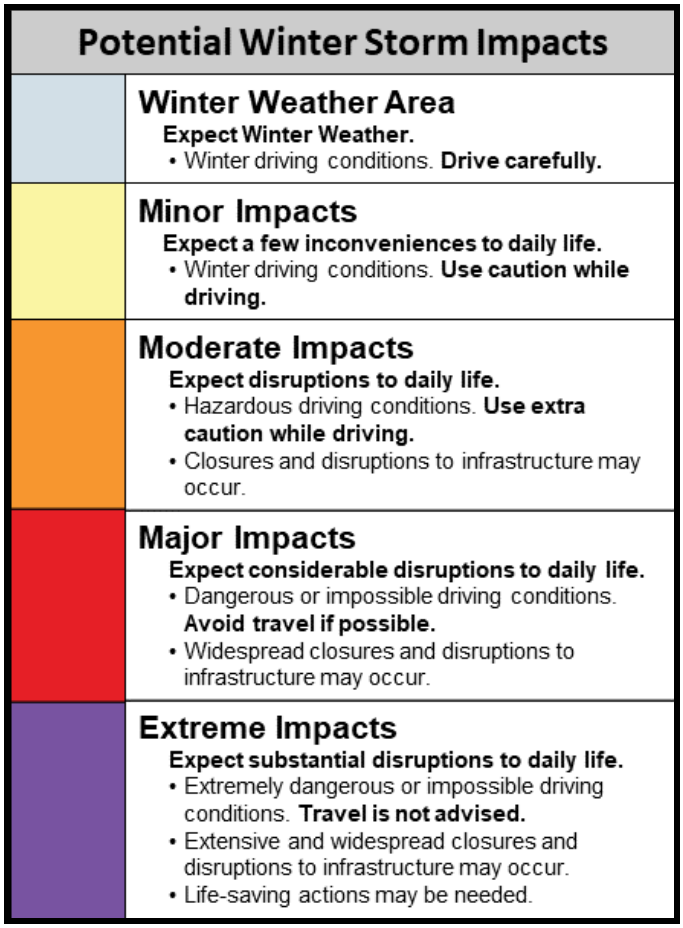

Figure B: Winter Storm Severity Index impact definitions.

b. Purpose – The WSSI has been developed to have a two-fold focus. The first is for use as a tool to assist NWS operational forecasters in maintaining situational awareness of the possible significance of weather-related impacts based upon the current official forecasts. The second is to enhance communication to external partners, media and the general public of the expected severity of potential societal impacts due to expected winter hazards and their distribution.

c. Audience – The WSSI is intended for operational use by 116 NWS Weather Forecast Offices (WFOs) and Weather Prediction Center (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 116 WFOs on individual websites along with one national viewer that encompasses the Contiguous United States (CONUS) (Figure C). These pages depict local and national views of the WSSI. These webpages are updated every two hours at approximately 0100 Coordinated Universal Time (UTC), 0300 UTC, 0500 UTC, etc. The publicly-shared output is available as static images, for both CONUS and WFO perspectives, and in GIS format (KMZ, SHP, REST Service). The links to the GIS formats are available on the WSSI homepage. Participating WFOs will include links to the WSSI on their

local web pages.

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

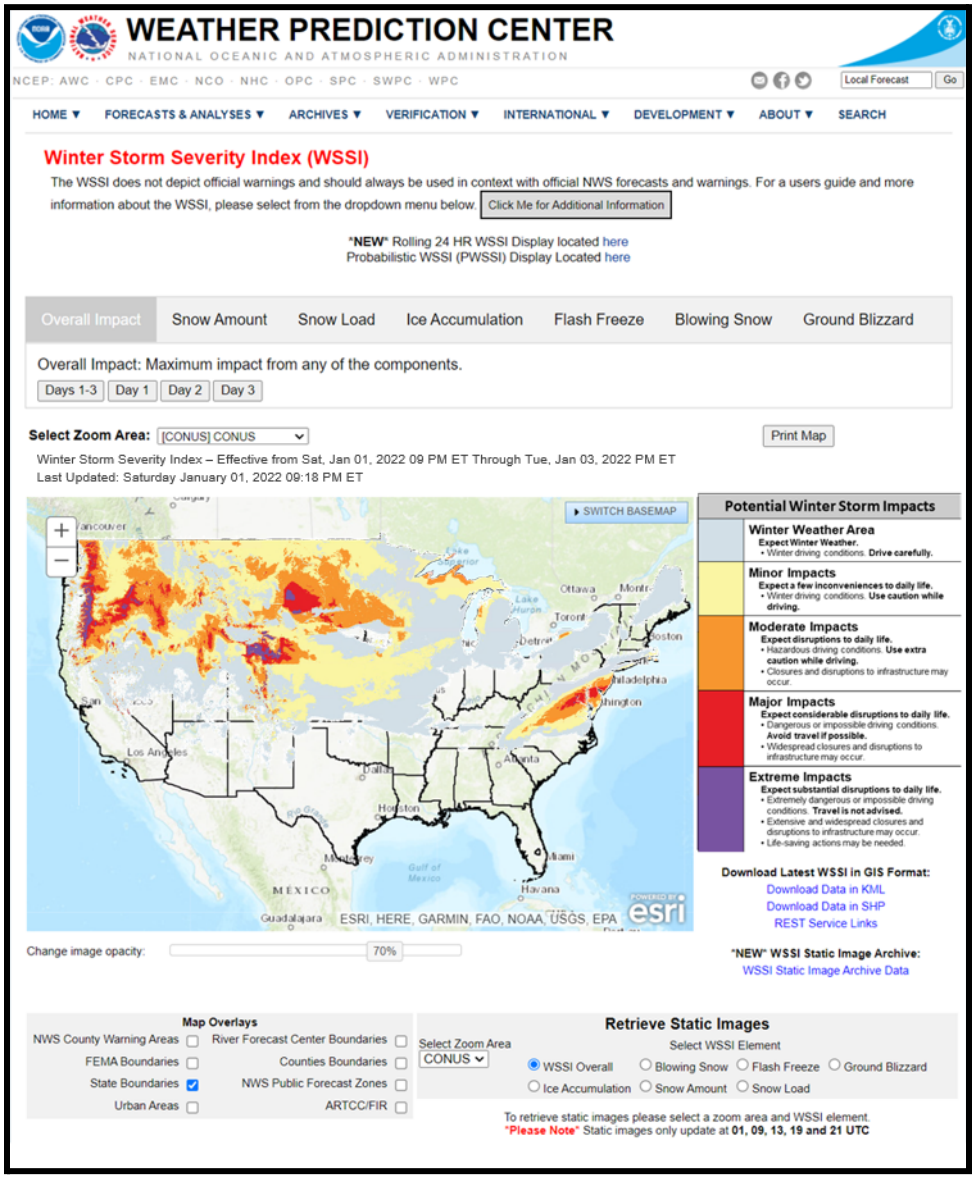

Figure C: Winter Storm Severity Index website homepage.

Comments or questions regarding the WSSI can be addressed to:

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NOTE:
NWS has implemented the WSSI to provide the public with a tool that attempts to convey the complexities and hazards associated with winter storms as they relate to potential societal impacts. NWS acknowledges contributions to the field of ice impact forecast graphics made by Sidney Sperry (Oklahoma Association of Electric Cooperatives) and Steven Piltz (NWS) in the development of the "Sperry-Piltz Ice Accumulation Index" or SPIA® Index.

Part II – Technical Description

a. Format and Science Basis – The WSSI output consists of graphical image files (.png), and GIS files (.shp, .kmz, REST Service) though the core calculations are done in a GIS environment. The following datasets are used or derived as part of calculating the WSSI.

Official NWS Forecast datasets from NDFD of:
- 6-hour snow accumulation
- 6-hour ice accumulation
- 6-hour precipitation accumulation (Quantitative Precipitation Forecasts)
- Wind speed (hourly time steps)
- Temperature (hourly time steps)

Additional derived forecast parameters from other official NWS NDFD fields:
- Total snowfall
- Total ice accumulation
- Maximum wind speed within each 6-hour period
- 6-hourly snowfall accumulation rate
- 6-hourly snow-liquid ratio
- Average snow-liquid ratio

Daily National Snow Analyses is obtained from the NWS National Operational Hydrologic Remote Sensing Center (NOHRSC) which includes:
- Snow depth
- Snowpack temperature
- Snow water equivalent

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

The WSSI consists of a series of component algorithms, each of which use meteorological and non-meteorological data to model predicted severity of specific characteristics of winter weather. Each of the components produce a 0 to 5 output scale value that equates to the potential severity based on the winter weather hazards (0 = no winter weather, 1 = winter weather area, 2 = minor, 3 = moderate, 4 = major, and 5 = extreme). The final WSSI value is the maximum value from all the sub-components. The 4 impact levels are given the following descriptors: Minor, Moderate, Major, and Extreme. In addition to the impact levels, Winter Weather Area is also shown to depict the extent of the winter weather conditions.

The specific sub-components are:

- Snow Load Index
    - Indicates potential infrastructure impacts 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.
- 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.
- Ice Accumulation
    - Indicates potential infrastructure impacts (e.g. roads/bridges) due to combined effects and severity of ice and wind. Designated urban areas are also weighted a little more than non-urban areas. Please note that not all NWS offices provide ice accumulation information into the NDFD. In those areas, the ice accumulation is not calculated.
- 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.
- Flash Freeze Index
    - Indicates the potential impacts of flash freezing (temperatures starting above freezing and quickly dropping below freezing) during or after precipitation events.
- Ground Blizzard
    - Indicates the potential travel-related impacts of strong winds interacting with pre-existing snow cover. This is the only sub-component that does not require snow to be forecast in order for calculations to be made. The NOHRSC snow cover data along with forecast winds are used to model the ground blizzard.

Adjustments are made based upon the land cover type. For example, heavily forested areas will have a lower ground blizzard severity than the same conditions occurring across open areas.

These raw and calculated forecast values are then used for a series of additional calculations to compute individual WSSI components which are then categorized internally on a 0 to 5 scale. The final WSSI value is the maximum from among all components for each grid point at the native 2.5 km NDFD resolution.

b. Availability – The WSSI products will be available via a CONUS and WFO-centric view at 116 selected WFOs. This product has A CONUS wide archive going back until 2019. Archived forecasts older than 30 days are available upon request (email joshua.kastman@noaa.gov for request). A rolling 30 archive of WSSI forecasts are available at: https://ftp.wpc.ncep.noaa.gov/WSSI_Archive/