

**National Digital Forecast Database (NDFD)  
Convective Outlook Hazard Probability Elements  
NWS Product Description  
Document (PDD)  
March 24, 2009**

**Part 1 - Mission Connection**

- a. Product Description – The [National Digital Forecast Database \(NDFD\)](#) contains a seamless mosaic of digital weather forecasts from National Weather Service (NWS) field offices and the National Centers for Environmental Prediction (NCEP). The Storm Prediction Center (SPC) is the NWS' center of expertise for forecasting convection, especially for life-threatening and economically-disruptive weather events such as tornadoes, large hail, and damaging winds.

As of April 30, 2009, the following Convective Outlook Hazard Probability elements prepared by the SPC are now available in the NDFD in operational status:

- Categorical Convective Outlook for today (Day 1), tomorrow (Day 2), and the day following (Day 3)
- Probability of Tornadoes (Day 1)
- Probability of Hail (Day 1)
- Probability of Damaging Thunderstorm Winds (Day 1)
- Probability of Extreme Tornadoes (Day 1)
- Probability of Extreme Hail (Day 1)
- Probability of Extreme Thunderstorm Winds (Day 1)
- Total Probability of Severe Thunderstorms (Day 2 and Day 3)
- Total Probability of Extreme Severe Thunderstorms (Day 2 and Day 3)

All of these elements are currently only available for the contiguous U.S. (CONUS) and the 16 pre-defined NDFD CONUS subsectors.

The Convective Outlook Probabilities are issued for a convective day from 12 UTC to 12 UTC. Day 1 Outlooks are valid from 12 UTC on Day 1 (or, if issued after 12 UTC -- from the issuance time) to 12 UTC on Day 2. The Day 2 products are valid from 12 UTC on Day 2 to 12 UTC on Day 3. The Day 3 products are valid from 12 UTC on Day 3 to 12 UTC on Day 4.

The Categorical Convective Outlook elements specify the perceived level of threat via the descriptive wording: Slight, Moderate, and High Risk. However, these outlooks, do not display the forecaster's expectations of the individual severe weather hazards (large hail, damaging winds, and tornadoes).

The individual probabilistic elements further express forecaster uncertainty of the individual severe weather hazards through the use of probabilities (i.e., percent likelihood of

occurrence). In the Day 1 period, forecaster expectations of large hail, damaging winds, and tornadoes are explicitly conveyed in separate forecasts. By producing forecasts of each hazard individually, users who are sensitive to one particular threat (e.g., car dealers and large hail) can make more informed decisions.

- b. **Purpose** – In support of the mission described in the *National Weather Service Strategic Plan for FY2005 - FY 2020*, "expanded digital services allow communication of forecast information with greater resolution in time and space and facilitates the integration of data in all service program areas." The NDFD is the primary means by which digital information is available to customers and partners. As part of this digital database, Convective Hazard Outlook Probability elements are available in response to growing user needs for planning purposes and critical safety decisions. Future digital datasets will continue to be developed in accordance with growing user needs.
- c. **Audience** - The audience for the Convective Hazard Outlook Probability elements includes large volume users of forecast information, emergency managers, the media, utility companies, the aviation industry, storm spotters, government agencies (including NWS field offices), academia, agricultural interests, and many other groups. They are also for anyone who wishes to decode and explore various potential applications of the NWS convective elements data; or simply view, post, or distribute the graphic images.
- d. **Presentation Format** – As with all NDFD elements, these elements are available in Gridded Binary Data Edition 2 (GRIB2) via file transfer protocol (ftp), eXtensible Markup Language (XML), and web browser. The Convective Hazard Outlook Probability elements are only available for the CONUS and for the 16 pre-defined NDFD CONUS subsectors (see <http://www.weather.gov/ndfd/coverage.htm>).
  1. GRIB2 format at 5 km horizontal grid spacing, via file transfer protocol (ftp): The GRIB2 files can be decoded and converted to other formats, such as shapefiles, netCDF files, etc. A tutorial to download NDFD elements, decode them and generate images is posted online at:

[http://www.weather.gov/ndfd/gis/ndfd\\_tutorial.pdf](http://www.weather.gov/ndfd/gis/ndfd_tutorial.pdf)

These elements are available in GRIB2 from the NWS ftp server (see [http://www.weather.gov/ndfd/anonymous\\_ftp.htm](http://www.weather.gov/ndfd/anonymous_ftp.htm)) for the CONUS and/or for the 16 pre-defined NDFD CONUS subsectors (see <http://www.weather.gov/ndfd/coverage.htm>). A user-defined GRIB2 access method is also available. That service allows the user to input latitude/longitude points for two corners and select a single weather element. The resulting GRIB2 message is built “on-the-fly” and downloaded by the user. For more information about User Defined GRIB2 access, please refer to the Service Description Document at:

[http://products.weather.gov/PDD/User\\_Defined\\_Grib2.pdf](http://products.weather.gov/PDD/User_Defined_Grib2.pdf)

2. Extensible Markup language (XML): Users can request NDFD elements over the Internet using the NDFD XML Simple Object Access Protocol (SOAP) server. The

response to the user request is returned in XML format. For more information, please refer to the NDFD XML Service Description Document online at:

[http://products.weather.gov/PDD/Extensible\\_Markup\\_Language.pdf](http://products.weather.gov/PDD/Extensible_Markup_Language.pdf)

3. Online NDFD graphics: Convective Hazard Outlook Probability images may be accessed from the NWS homepage, [www.weather.gov](http://www.weather.gov), by clicking on the “Graphical Forecasts” tab, or directly at the following URL:

<http://weather.gov/forecasts/graphical/sectors/index.php>

To access these and other NDFD elements, or for further availability and technical information (e.g., temporal and spatial resolutions, forecast projections, and geographic coverage), please visit the following URL:

<http://www.weather.gov/ndfd/technical.htm>

## **Part II - Technical Description**

### **a. Format and Science:**

#### **Day 1**

The most specific Convective Hazard Outlooks are those issued during the Day 1 period. During this period, the SPC produces probabilistic outlooks for each primary severe weather hazard (tornadoes, damaging wind, and large hail) separately. By producing separate forecasts for each hazard, the user is given substantially more information upon which to make decisions than in the categorical (slight, moderate, high) outlook. In addition to the probabilities for separate types of severe weather occurring, a 10% or greater chance of extreme severe weather is also included. Extreme severe weather is defined as tornadoes rated Enhanced Fujita Scale Category 2 (EF2) or greater (see <http://www.spc.noaa.gov/efscale/> for more information on the EF Scale); damaging winds with speeds greater than 65 knots; or hail 2 inches or greater in diameter. If the forecaster believes there is less than a 10% chance of extreme severe weather occurring in the outlook area, the area will not be included in the forecast.

See the section below entitled “Categorical Outlooks” for important information on the conversion of probability information to categorical outlooks.

#### **Day 2 and Day 3**

Probabilistic Hazard Outlooks are issued for the Day 2 and Day 3 periods as well. Since many of the specific details of severe weather forecasting can only be determined hours ahead of time, rather than several days, the severe weather probabilities for the Day 2 and Day 3 outlooks represent the probability of any severe weather hazard (large hail, damaging wind, or tornadoes) occurring (rather than producing individual forecasts for each hazard). Areas where there is a 10% or greater probability of extreme severe weather events (again, defined as 2 inch diameter or larger hail, 65 knot or stronger winds, and EF2 or stronger tornadoes) are also included, when forecast.

## Categorical Outlooks

There are five risk categories in the categorical outlooks:

1. No Significant Thunderstorm, represented by the grid value of zero (0). There is less than a 10% probability of thunderstorms during the valid period in this area.
2. General Thunderstorms, represented by the grid value of two (2). There is a 10% or higher probability of thunderstorms during the valid period.
3. A slight (SLGT) risk represented by the grid value of four (4). This is an area where organized severe thunderstorms are expected, but in small numbers and/or low areal coverage. Depending on the size of the area, approximately 5 to 25 reports of ¾ inch or larger hail, and/or 5 to 25 reports of 50 knot sustained wind speeds, and/or 1 to 5 tornadoes would be possible.
4. A moderate (MDT) risk represented by the grid value of six (6). This is an area with a potential for a greater concentration of severe thunderstorms than the slight risk, and in most situations, greater intensity and areal coverage of severe weather.
5. A high (HIGH) risk represented by the grid value of eight (8). This is an area where a major severe weather outbreak is expected, with a high concentration of severe weather reports and an enhanced likelihood of extreme severe events (i.e., violent tornadoes or very damaging convective wind events occurring across a large area). In a high risk area, the potential exists for 20 or more tornadoes, some possibly EF2 or stronger, or an extreme derecho (for information on derechos, see <http://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm> ) potentially causing widespread wind damage and higher end wind gusts (70 kts) that may result in structural damage.

The slight, moderate, and high categories are used when organized convection with tornadoes, and/or large hail and/or damaging winds are expected. Examples of organized convection include supercells (see <http://www.spc.noaa.gov/faq/tornado/suprcell.htm> ), squall lines (a solid or broken line of thunderstorms or squalls that may extend across several hundred miles), and multi-cell thunderstorm complexes. Pulse type thunderstorms, consisting primarily of solitary brief severe updrafts (often found in weakly sheared environments) are not considered organized. Isolated severe storms with marginal intensities or short durations of severe will likely not be included in a risk area.

Note: A 5% probability for only a tornado threat (mainly associated with tropical systems) can be issued as a SLGT RISK.

## Probability Outlooks

An in depth discussion of probabilities and their meaning is available at <http://www.spc.noaa.gov/products/outlook/probinfo.html>.

Even without a complete understanding of what the probabilities mean, users can directly assess from the data:

- Geographic areas where the various severe weather hazards are expected. These areas may or may not overlap with one another.
- The perceived levels of threat for the severe weather hazards. The higher the probabilities are, the increased threat of that hazard occurring. Refer to the discussion above concerning the probabilities used in the outlooks and especially the range of probabilities used.
- Areas where extreme severe weather is expected.

**b. Product Availability –**

- Day 1 Categorical Outlook , Hail Probability, Damaging Thunderstorm Wind Probability, Tornado Probability, Extreme Hail Probability, Extreme Damaging Wind Probability, and Extreme Tornado Probability products are all issued at 0600 Coordinated Universal Time (UTC), 1300 UTC, 1630 UTC, 2000 UTC, and 0100 UTC.
- Day 2 Categorical Outlook and Day 2 Severe Thunderstorm Probability and Extreme Severe Thunderstorm Probability are issued at 0700 UTC (0600 UTC during Daylight Savings Time) and 1730 UTC.
- Day 3 Categorical Outlook and Day 3 Severe Thunderstorm Probability and Extreme Severe Thunderstorm Probability are issued at 0830 UTC (0730 UTC during Daylight Savings Time).

**c. Additional Information:**

Detailed descriptions of these products are available on the SPC web site. See:

<http://www.spc.noaa.gov/products/outlook/probinfo.html>

For more information on the NDFD, please refer to the NDFD web site at:

<http://www.nws.noaa.gov/ndfd/index.htm>