Hourly Precipitation Potential Index – a Pragmatic Approach to Communicate Precipitation Timing

97th AMS Annual Meeting

David Ruth and Tabitha Huntemann

NOAA/NWS/Meteorological Development Laboratory
NWS Probability of Precipitation

- Introduced to U.S. Weather Bureau in June 1965 by George Cressman
  - “Improve the usefulness of our forecasts by informing the public of the expected error or the uncertainty that is characteristic of the weather information provided”

- Proposal lists three underlying assumptions:
  1. State of the art supports prediction of precipitation probabilities
  2. Predictions can be made with good reliability
  3. Probability statements can be understood and used by the public after some brief indoctrination on probability statements
PoP in NWS Text Products

- Probability of Precipitation (PoP) in Zone Forecast Product (ZFP) matched to Today, Tonight, Tomorrow periods in local time coordinates.

- PoP in Coded Cities Forecast (CCF) matched to 12-h periods ending at 00z and 12z UTC.

---

TY247-051-058-061-MAZ001-08241-
BERKSHIRE-EASTERN COLUMBIA-EASTERN RENSSELAER-SCHOMARIE-
WESTERN ALBANY-WESTERN GREENE-
400 AM EST SAT DEC 8 2001

---

...WINTER STORM WATCH FOR SATURDAY NIGHT...

...TODAY...PARTLY SUNNY THROUGH EARLY THIS AFTERNOON...THEN BECOMING
MOSTLY CLOUDY. HIGHS IN THE MID 30S. LIGHT EAST WIND.

TODAY...SNOW, SNOW ACCUMULATION 4 TO 6 INCHES. LOWS IN THE UPPER
20S. EAST WIND 10 TO 15 MPH. CHANCE OF SNOW NEAR 100 PERCENT.

SUNDAY...SNOW LIKELY...ENDING IN THE MORNING. PARTLY SUNNY FROM
LATE MORNING ON. TOTAL ACCUMULATION OF 7 OR MORE INCHES POSSIBLE.
HIGHS IN THE MID 30S. NORTH WIND AROUND 15 MPH. CHANCE OF SNOW 70
PERCENT.

SUNDAY NIGHT...CLEAR. LOWS IN THE MID 20S.
MONDAY...SUNNY. HIGHS IN THE LOWER 40S.
MONDAY NIGHT...PARTLY CLOUDY. LOWS IN THE UPPER 20S.
TUESDAY...MOSTLY CLEAR. HIGHS IN THE LOWER 40S.
WEDNESDAY...PARTLY CLOUDY. LOWS IN THE MID 20S AND HIGHS IN THE MID
40S.
THURSDAY...CLOUDY WITH A CHANCE OF RAIN. WINDY. LOWS IN THE UPPER
30S AND HIGHS IN THE LOWER 50S.
FRIDAY...PARTLY CLOUDY WITH A CHANCE OF SNOW SHOWERS. LOWS IN THE
UPPER 20S AND HIGHS IN THE MID 30S.
Local time zones are a challenge for NDFD PoP
NDFD introduces the “Floating PoP”

Floating PoP12 –

- an internal NWS index from which a PoP12 for any 12-hour period can be derived by taking the maximum floating PoP12 value within the desired period
- should be considered as that hour’s contribution to the PoP12, not as a 1-hour PoP, which has different statistical characteristics.
- best stretched over time ranges consistent with other precipitation related elements—ultimately resulting in complete coverage at every hour.
- support the generation of PoP12s in both UTC and LT.

- National Weather Service Instruction 10-506
  October 2003
Floating PoP grids persist

- NWS CONUS Regions each migrate to UTC PoP periods by the end of 2005
- However hourly floating PoPs persist as an internal index to drive hourly NDFD significant weather grids (e.g., chance of rain this morning, rain likely this afternoon)

<table>
<thead>
<tr>
<th>Floating PoP12</th>
<th>Expression of Uncertainty</th>
<th>Equivalent Areal Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 percent</td>
<td>Isolated or Few</td>
<td></td>
</tr>
<tr>
<td>20 percent</td>
<td>Slight Chance</td>
<td>Widely Scattered</td>
</tr>
<tr>
<td>30, 40, 50 percent</td>
<td>Chance</td>
<td>Scattered</td>
</tr>
<tr>
<td>60, 70 percent</td>
<td>Likely</td>
<td>Numerous or none used</td>
</tr>
<tr>
<td>80, 90, 100 percent</td>
<td>none used</td>
<td>Occasional, Periods of, or none used</td>
</tr>
</tbody>
</table>
Floating PoP becomes PPI - internal no more

- WFOs begin posting floating PoP meteograms and images to the web under the name “Precipitation Potential Index”
- NWS partners soon complain that hourly PPI grids shown on the web are not available to them via NDFD.
NWS introduces PPI to NDFD experimentally

- Providing hourly PPI via NDFD enables users to make near-term decisions based on finer temporal resolution precipitation information than 12-hour Probability of Precipitation.
On July 7, 2015, the NWS implemented changes to the icons depicted on all of its point-forecast pages. Changes include 6-hour increments for rapidly-changing weather via "dual-icons" that portray experimental PPI values.
**Pragmatic PPI vs Scientific PoP01**

- Should PPI be made operational?
- Should we do a PoP01 instead?

<table>
<thead>
<tr>
<th>Hourly Precipitation Potential Index (PPI)</th>
<th>1-h Probability of Precipitation (PoP01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult to produce and verify objectively</td>
<td>Easy to produce and verify objectively</td>
</tr>
<tr>
<td>Difficult to explain scientifically</td>
<td>Easy to explain scientifically</td>
</tr>
<tr>
<td>PoP12 can be derived from hourly PPIs</td>
<td>PoP12 cannot be derived from PoP01s</td>
</tr>
<tr>
<td>Forecasts only edit one probability element</td>
<td>Forecasts edit multiple probability elements</td>
</tr>
<tr>
<td>Users need only understand one probability scale</td>
<td>Users need understand multiple probability scales</td>
</tr>
</tbody>
</table>
Can reliable PoP12s be derived from PoP01?

- Assuming independent events:
  \[ \text{PoP12} = (\text{PoP06}_1 + \text{PoP06}_2) - (\text{PoP06}_1 \times \text{PoP06}_2) \]

- Assuming dependent events:
  \[ \text{PoP12} = \text{Max(} \text{PoP06}_1 , \text{PoP06}_2) \]

- In reality, 0 < PoP correlation < 1, changing hour to hour, day to day, and gridpoint to gridpoint.

<table>
<thead>
<tr>
<th>Period</th>
<th>R</th>
<th>7pm</th>
<th>8pm</th>
<th>9pm</th>
<th>10pm</th>
<th>11pm</th>
<th>12pm</th>
<th>1am</th>
<th>2am</th>
<th>3am</th>
<th>4am</th>
<th>5am</th>
<th>6am</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoP01</td>
<td></td>
<td>60%</td>
<td>55%</td>
<td>39%</td>
<td>36%</td>
<td>35%</td>
<td>28%</td>
<td>27%</td>
<td>25%</td>
<td>20%</td>
<td>19%</td>
<td>18%</td>
<td>09%</td>
</tr>
<tr>
<td>PoP03</td>
<td>R = 0</td>
<td></td>
<td></td>
<td></td>
<td>89%</td>
<td></td>
<td></td>
<td>70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PoP06</td>
<td>R = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PoP12</td>
<td>R = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PoP12</td>
<td>R = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Can reliable PoP12s be derived from PoP01?
If not, can we just call our PPI a PoP01?
My Forecast

- PPI will remain experimentally available in NDFD.
- PPI guidance consistent with PoP12 will be provided by the National Blend of Models (NBM) version 3 beginning June 2017.
- Reliable PoP01 guidance will become available in NBM v4 in 2018.
- Forecasters will increasingly transition away from editing grids to providing Impact-based Decision Support Services.
- PoP01 will be added to NDFD, eventually replacing PPI.
Sunday 1/15/17 02z thru Monday 1/16/17 12z

NDFD PPI

NBM v3 PPI

NDFD PoP12

NBM v3 PoP12