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

97th AMS Annual Meeting

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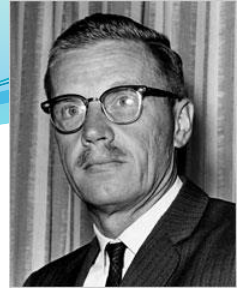
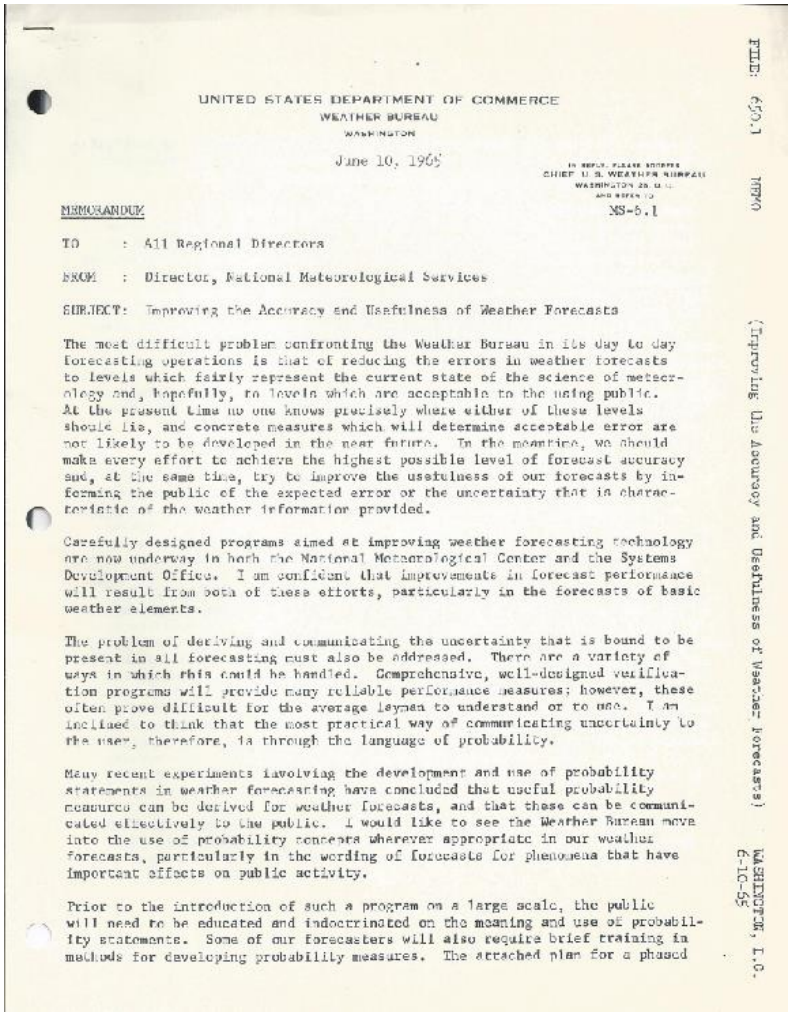


NWS Probability of Precipitation

- 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



UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
WASHINGTON

June 10, 1965

MEMORANDUM MS-5.1

TO : All Regional Directors

FROM : Director, National Meteorological Services

SUBJECT: Improving the Accuracy and Usefulness of Weather Forecasts

The most difficult problem confronting the Weather Bureau in its day to day forecasting operations is that of reducing the errors in weather forecasts to levels which fairly represent the current state of the science of meteorology and, hopefully, to levels which are acceptable to the using public. At the present time no one knows precisely where either of these levels should lie, and concrete measures which will determine acceptable error are not likely to be developed in the near future. In the meantime, we should make every effort to achieve the highest possible level of forecast accuracy and, at the same time, try to 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.

Carefully designed programs aimed at improving weather forecasting technology are now underway in both the National Meteorological Center and the Systems Development Office. I am confident that improvements in forecast performance will result from both of these efforts, particularly in the forecasts of basic weather elements.

The problem of deriving and communicating the uncertainty that is bound to be present in all forecasting must also be addressed. There are a variety of ways in which this could be handled. Comprehensive, well-designed verification programs will provide many reliable performance measures; however, these often prove difficult for the average layman to understand or to use. I am inclined to think that the most practical way of communicating uncertainty to the user, therefore, is through the language of probability.

Many recent experiments involving the development and use of probability statements in weather forecasting have concluded that useful probability measures can be derived for weather forecasts, and that these can be communicated effectively to the public. I would like to see the Weather Bureau move into the use of probability concepts wherever appropriate in our weather forecasts, particularly in the wording of forecasts for phenomena that have important effects on public activity.

Prior to the introduction of such a program on a large scale, the public will need to be educated and indoctrinated on the meaning and use of probability statements. Some of our forecasters will also require brief training in methods for developing probability measures. The attached plan for a phased

FILE: 650.1 MEMO (Improving the Accuracy and Usefulness of Weather Forecasts) WASHINGTON, D.C. 6-10-65

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.

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NYZ047-051-054-058-061-MAZ001-082241-
BERKSHIRE-EASTERN COLUMBIA-EASTERN RENSSELAER-SCHOHARIE-
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.
.TONIGHT...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.
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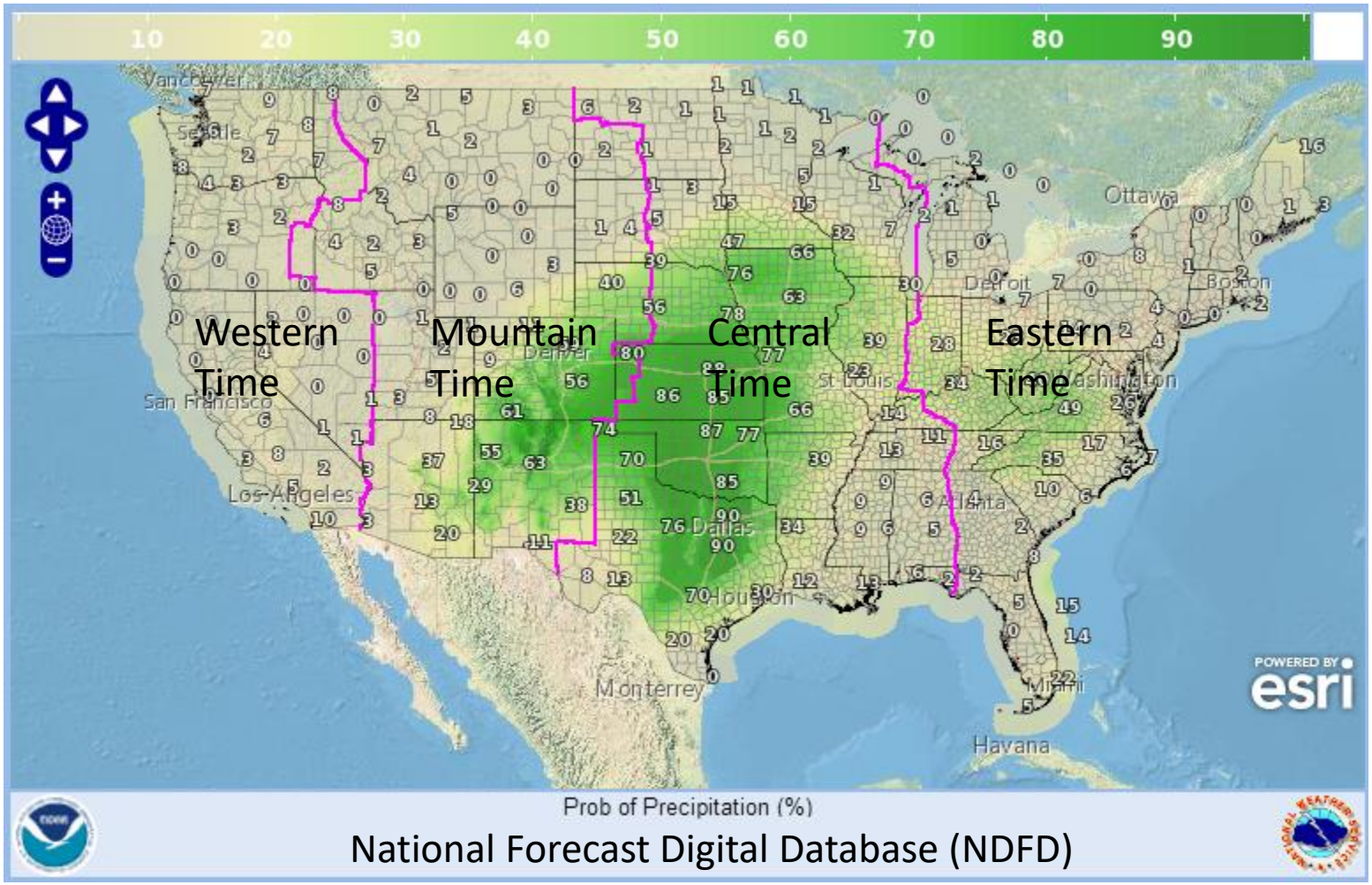
Local time zones are challenge for NDFD PoP



National Forecast Digital Database (NDFD)

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

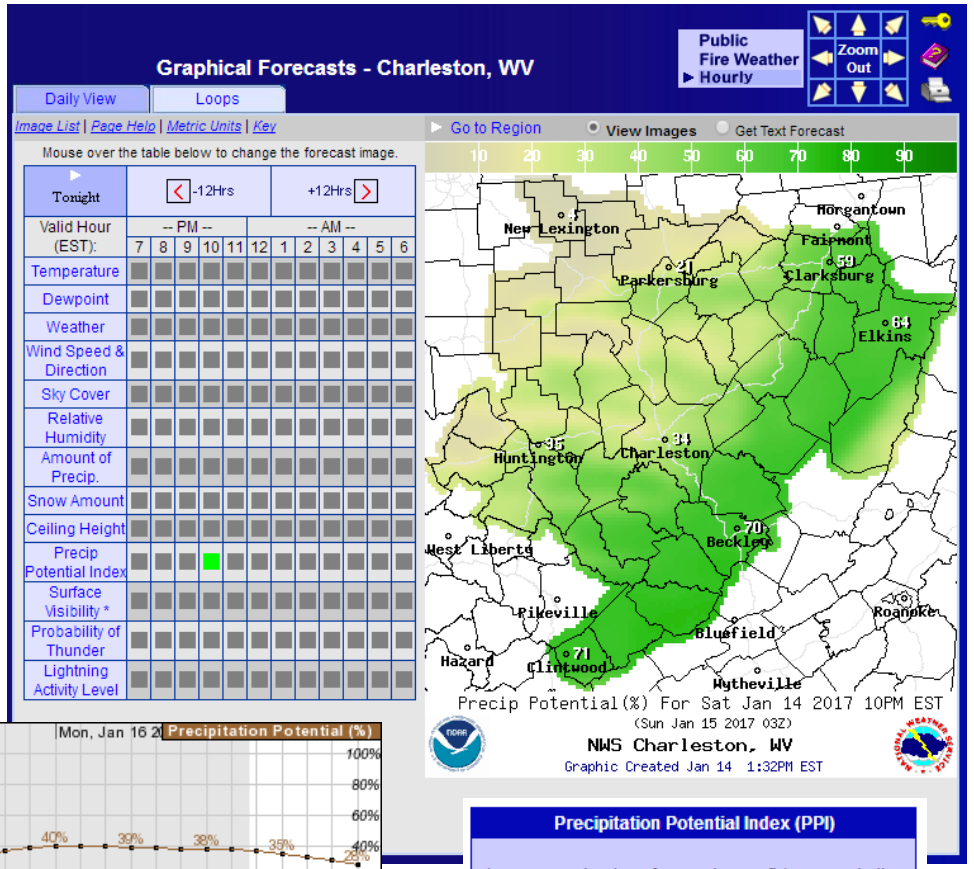
Floating PoP grids persist

- 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)

Floating PoP12	Expression of Uncertainty	Equivalent Areal Qualifier
10 percent		Isolated or Few
20 percent	Slight Chance	Widely Scattered
30, 40, 50 percent	Chance	Scattered
60, 70 percent	Likely	Numerous or none used
80, 90, 100 percent	none used	Occasional, Periods of, or none used

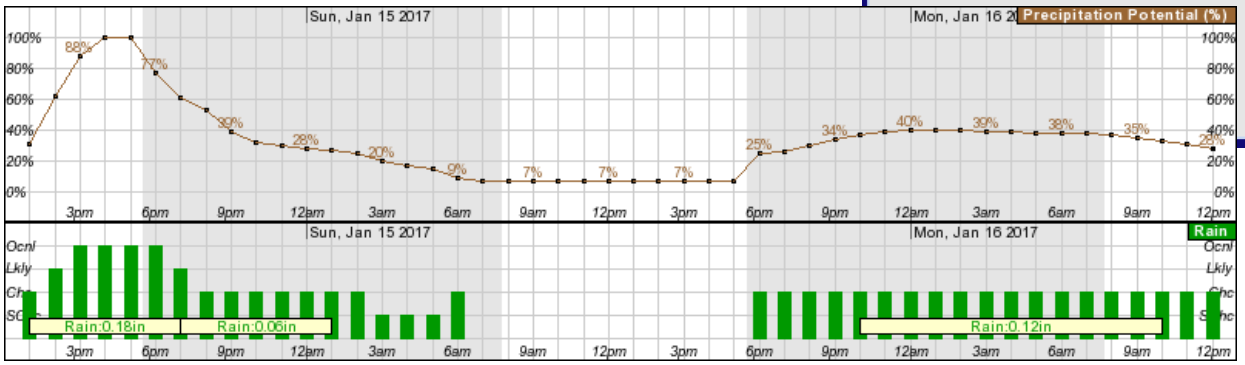
Floating PoP becomes PPI - internal no more

- 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.



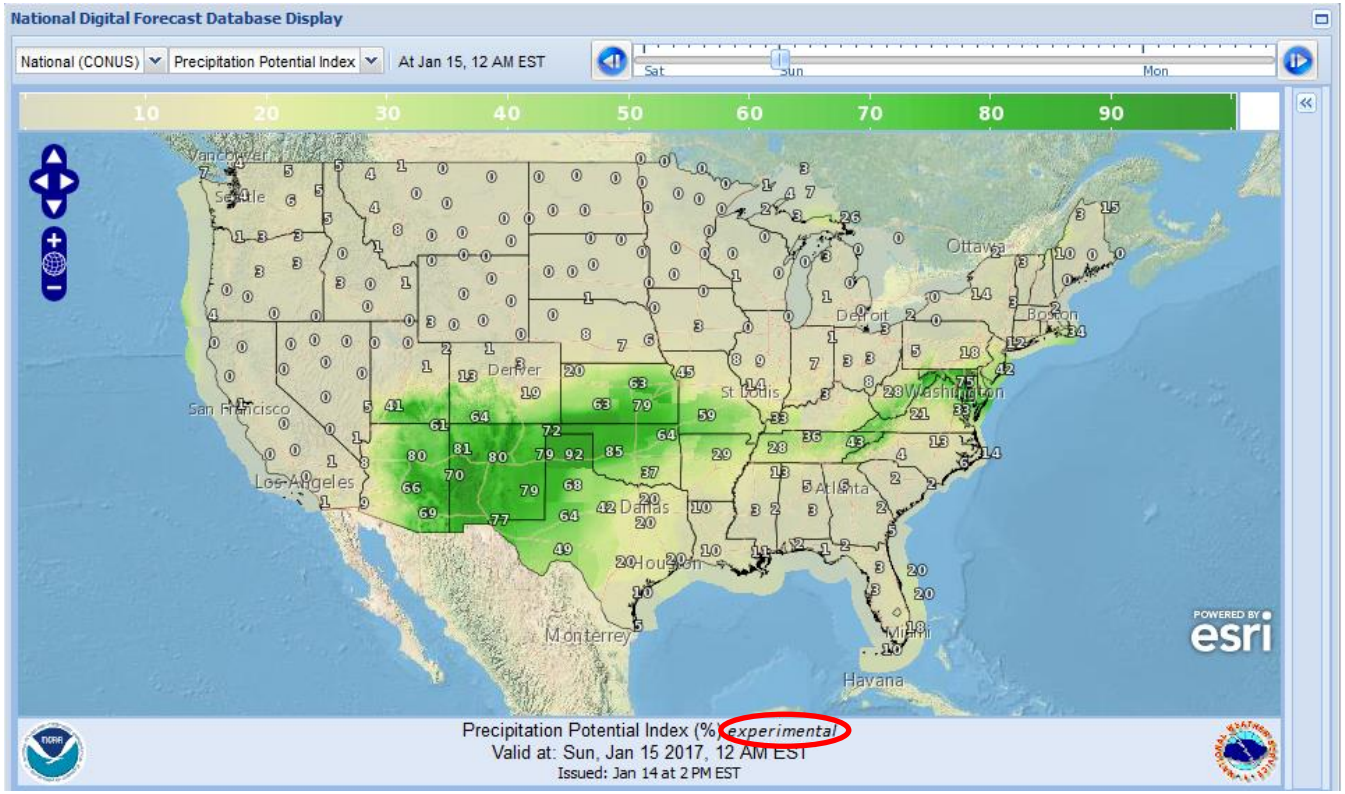
Precipitation Potential Index (PPI)

Is a means to show forecaster confidence as to the location of precipitation at each hour across the forecast area.



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.



New Forecast-at-a-Glance icons

- On July 7, 2015, the NWS implemented changes to the icons depicted on all of its point-forecast pages.

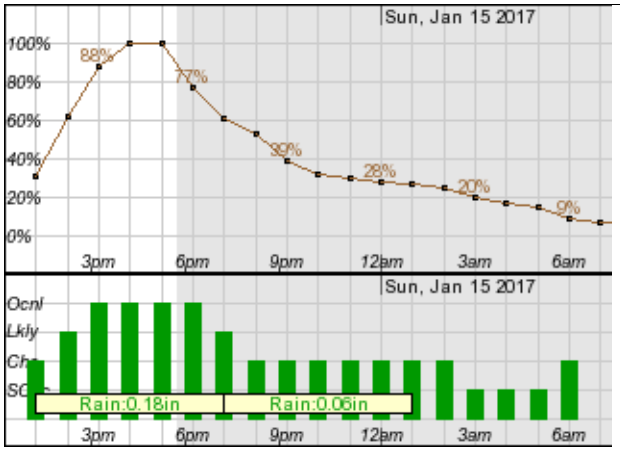
- Changes include 6-hour increments for rapidly-changing weather via "dual-icons" that portray experimental PPI values.

Pragmatic PPI vs Scientific PoP01

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

Hourly Precipitation Potential Index (PPI)	1-h Probability of Precipitation (PoP01)
Difficult to produce and verify objectively	Easy to produce and verify objectively
Difficult to explain scientifically	Easy to explain scientifically
PoP12 can be derived from hourly PPIs	PoP12 cannot be derived from PoP01s
Forecasters only edit one probability element	Forecasters edit multiple probability elements
Users need only understand one probability scale	Users need understand multiple probability scales

Can reliable PoP12s be derived from PoP01?



- Assuming independent events:

  $PoP12 = (PoP06_1 + PoP06_2) – (PoP06_1 * PoP06_2)$

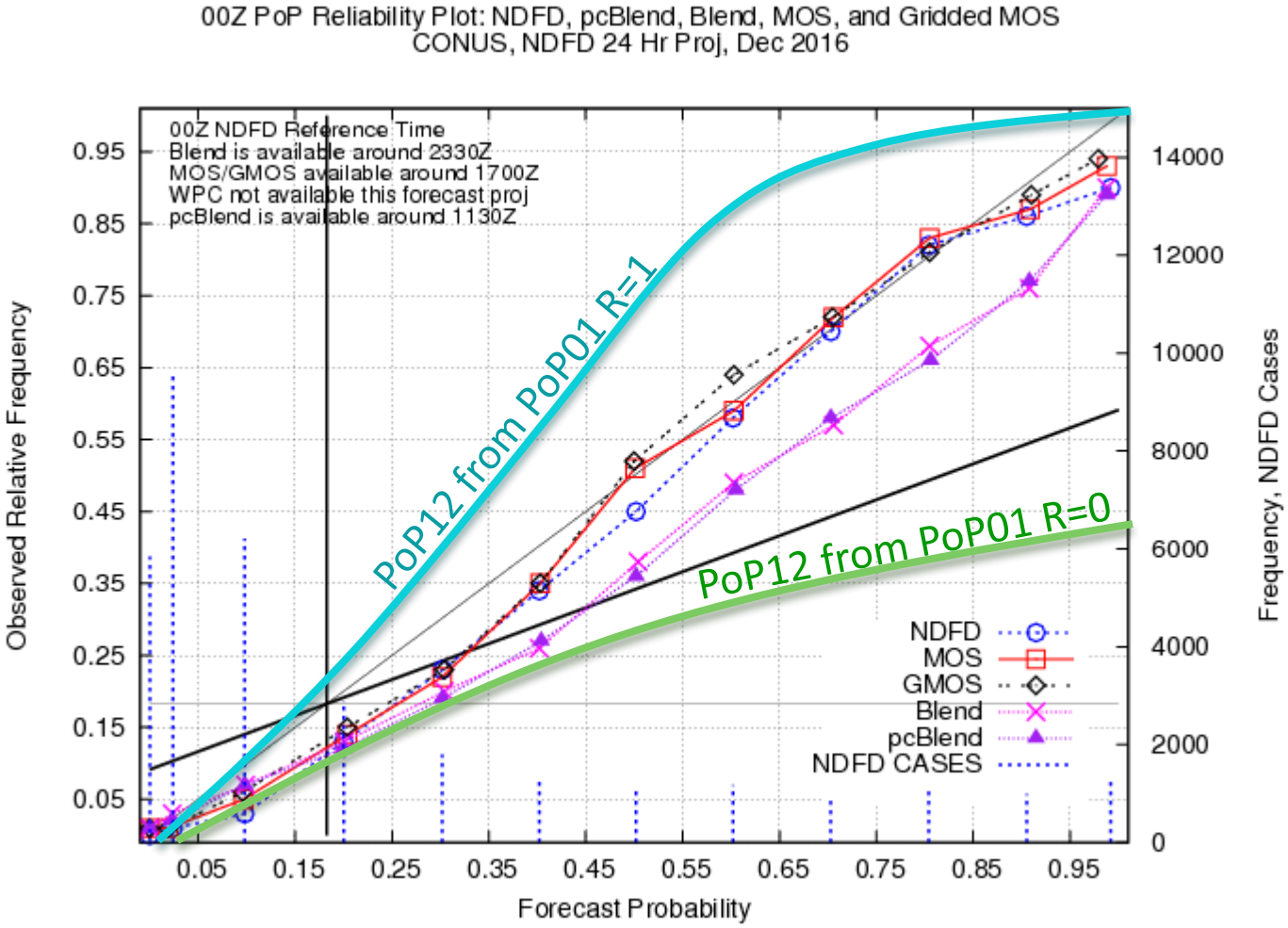
- Assuming dependent events:

  $PoP12 = Max(PoP06_1 , PoP06_2)$

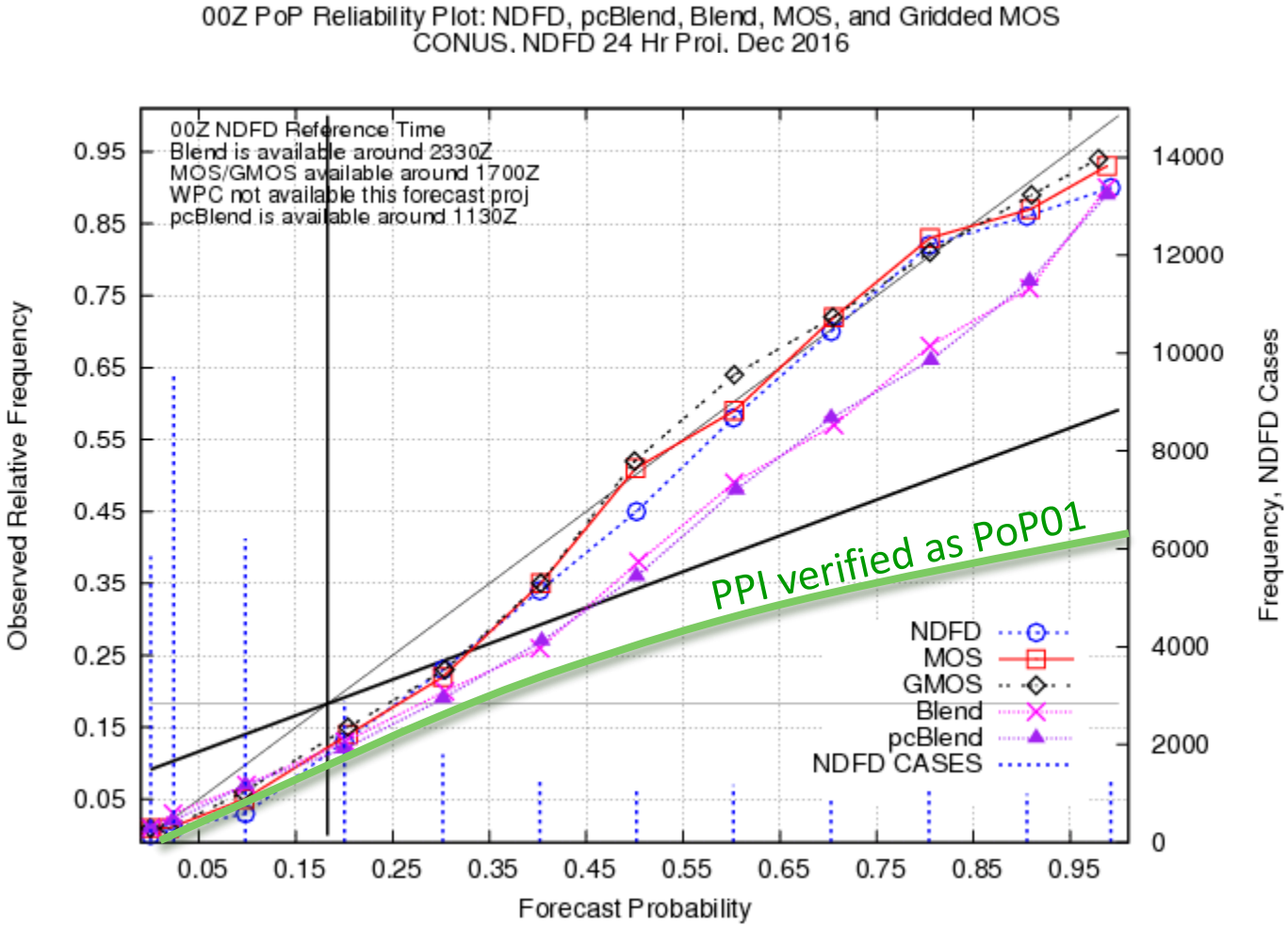
- In reality, 0 < PoP correlation < 1, changing hour to hour, day to day, and gridpoint to gridpoint

Period	R	7pm	8pm	9pm	10pm	11pm	12pm	1am	2am	3am	4am	5am	6am
PoP01		60%	55%	39%	36%	35%	28%	27%	25%	20%	19%	18%	09%
PoP03	R = 0	-------	-------	89%	-------	-------	70%	-------	-------	56%	-------	-------	40%
PoP06	R = 0	-------	-------	-------	-------	-------	97%	-------	-------	-------	-------	-------	74%
PoP12	R = 0	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	99%
PoP12	R = 1	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	60%

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