

# The science of 'probability of precipitation'



The Met Office is a world leader in forecast accuracy, but due to the chaotic nature of weather there are unavoidable limitations to what we can predict. However, we can calculate the confidence in a weather forecast to give people a clear picture of any uncertainties.

This is particularly relevant when it comes to *precipitation* (usually rain, but also including drizzle, sleet, snow, hail, etc) because it can often vary a lot from place to place - especially when it falls as showers. This makes it difficult to be precise about whether precipitation will fall, and if so how much. To try and convey the uncertainty better, we have introduced a new element to the forecast, the *Probability of Precipitation (PoP)*.

Here we explain what this part of the forecast means and how we produce it.

## **What does the Probability of Precipitation (PoP) forecast on the website mean?**

PoP is given in the 5-day forecasts for specific locations (there are now 5000 locations to choose from around the UK). Each line of the table in the forecast represents a 3-hour period of the day, and the Precipitation Probability is given as a percentage (%) to the nearest 10% - which indicates how likely it is that any precipitation will fall during that 3-hour period at the selected location. More precisely, by "any precipitation" we mean at least 0.1mm, which is about the smallest amount that we can measure. Note that this does not mean the probability that it will be raining, snowing, hailing etc for the whole of the 3-hour period, only the probability that some precipitation will fall during that period.

So what does a PoP of 10% mean? This means that there is a 1 in 10 chance that precipitation will fall during this period. Another way of looking at this probability is that there is a 9 in 10 chance that it will stay dry. Similarly, a PoP of 80% means an 8 in 10 chance that precipitation will fall, and only a 2 in 10 chance that it will remain dry.

You can learn more about the precipitation risk by looking at the PoP alongside the weather symbol for the same period. This will indicate what type of precipitation is most likely (drizzle, rain, snow, showers etc) and how heavy it might be. The symbol represents the most likely weather during the 3-hour period, so you may sometimes find that the symbol indicates no precipitation, but the PoP gives a low amount, say 20%, indicating that although it is most likely that it will be dry, there is still some risk.

## **Why don't we just give our best guess of wet or dry?**

Often people want to make a decision, such as whether to put out their washing to dry, and would like us to give a simple yes or no. However, this is often a simplification of the complexities of the forecast and may not be accurate. By giving PoP we give a more honest opinion of the risk and allow you to make a decision depending on how much it matters to you. For example, if you are just hanging out your sheets that you need next week you might take the risk at 40% probability of precipitation, whereas if you are drying your best shirt that you need for an important dinner this evening then you might not hang it out at more than 10% probability. PoP allows you to make the decisions that matter to you.

### **How do we create the Probability of Precipitation?**

A weather forecast is an estimate of the future state of the atmosphere. It's created by observing the current state of the atmosphere and using a computer model to calculate how it may change over time. As the atmosphere is a chaotic system, small approximations in the way observations are analysed can lead to large errors in a weather forecast. We can't create perfect weather forecasts because we can never observe every detail of the atmosphere as it changes hour by hour and day by day.

To estimate the uncertainty in the forecast we use what are known as ['ensemble forecasts'](#). Here, we run our computer model many times from slightly different starting conditions. Initial differences are tiny so each run is equally likely to be correct, but the chaotic nature of the atmosphere means the forecasts can be quite different. On some days the model runs may be similar, which gives us a high level of confidence in the weather forecast; on other days, the model runs can differ radically so we have to be more cautious.

### **How do we know if a probability forecast is accurate?**

A single probability forecast is never right or wrong. We can only measure how good our probability forecasts are by looking at a large number of them over time. We do this by grouping together, for example, all of the 10% probability forecasts and checking that those weather events actually took place on one in 10 occasions as predicted.