

## How to Interpret a Probability Forecast

The South African Weather Service produces long-term forecasts in terms of probabilities. This is mainly due to the inherent variability of the atmosphere and the lack of understanding of all the components of the climate system. For the case of a three category forecast, there is an equal chance of each of the three categories to occur when no information additional to the climatological records is available. Therefore, the probability for each of the three categories to occur is a  $\frac{1}{3}$  (33.3 %), i.e., likelihoods reflected in the long-term observations. This equal probability forecast of 33.3 % for each category is referred to as a forecast of climatology. In the presence of a climate event, such as an El Niño, the probabilities of the three categories would no longer be equal, i.e., the probability of the below-normal category (dry) would be greater than 33.3%, thus constituting a forecast that is different to a forecast of climatology. The probabilities assigned to the three categories provide both the direction of the forecast relative to climatology, as well as the uncertainty in the forecast.

The forecast probabilities can be interpreted as follows. Say we have a bag with six citrus fruit, consisting of two lemons, two oranges, and two grapefruit. The *two lemons* represent the **below-normal** rainfall category, the *two oranges* the **near-normal** and the *two grapefruit* the **above-normal** rainfall category. To pick one of the fruit from the bag without looking into the bag presents an equal probability for any one of the three fruit groups to be picked. For example, the probability of picking a **lemon** from the bag is 2 out of 6 possible fruit, in other words 33.3 %. The same probability of 33.3 % to be picked blindly also applies to the remaining two fruit groups. If the bag of fruit represents a rainfall season, and if we have no idea whether or not an El Niño or La Niña event might happen or have no skilful model forecasts available, then the same probability as was found for picking fruit blindly applies to each of the three possible rainfall categories. Therefore, without any forecast input, the probability of getting below-normal or near-normal or above-normal rainfall is 33.3 %.

Expecting an El Niño event to reach maturity during the coming summer rainfall season increases the probability of dry (below-normal) conditions to occur over southern Africa.

Knowledge of an impending El Niño event is analogous to replacing *one* of the **grapefruit** (above-normal rainfall) with a **lemon** (below-normal rainfall), which consequently represents the situation where there is a greater chance of below-normal rainfall to occur. The bag of fruit now has *three lemons*, *two oranges*, and only *one grapefruit*. Picking a fruit blindly from the bag produces a 50 % chance (*three* out of six) to pick a lemon, and only a 16.7 % (*one* out of six) to pick a grapefruit. This is the concept on which a probabilistic seasonal forecast is founded. Note that it is not *impossible* to pick an **orange** (near-normal rainfall) or even a **grapefruit** (above-normal rainfall) from the bag. There is simply an increased probability that a **lemon** (below-normal) can be picked. In fact, forecast users should be particularly aware of the non-favoured categories, as these probabilities are never small enough to disregard. Moreover, in order for a “forecast” of a 50 % chance of picking a **lemon** and a 16.7 % chance of picking a **grapefruit** to be considered reliable, picking and replacing fruit a hundred times should produce approximately 50 **lemon** draws and 17 **grapefruit** draws.

Take for example a rainfall forecast over the country that has a 30 % probability of it being a wet season, a 45 % probability of it being a near-normal season, and a 25% probability of it being a dry season. Since the near-normal category is above 33.3 % and the above-normal and below-normal categories are below 33.3 %, this forecast suggests that near-normal rainfall is more likely than usual, and dry and wet conditions less likely than usual. Note the uncertainty implied in the forecast: even though the forecast is in the direction of near-normal rainfall, the probability of near-normal rainfall is only 45 %. Moreover, the probability of below-normal rainfall is still 25 %, implying that in one out of four cases of this climate situation, below-normal rainfall would be expected.