= Quantitative precipitation forecast =

The Quantitative Precipitation Forecast (abbreviated QPF) is the expected amount of melted precipitation accumulated over a specified time period over a specified area . A QPF will be created when precipitation amounts reaching a minimum threshold are expected during the forecast 's valid period . Valid periods of precipitation forecasts are normally synoptic hours such as 0000 , 0600 , 1200 and 1800 GMT . Terrain is considered in QPFs by use of topography or based upon climatological precipitation patterns from observations with fine detail . Starting in the mid @-@ to @-@ late 1990s , QPFs were used within hydrologic forecast models to simulate impact to rivers throughout the United States . Forecast models show significant sensitivity to humidity levels within the planetary boundary layer , or in the lowest levels of the atmosphere , which decreases with height . QPF can be generated on a quantitative , forecasting amounts , or a qualitative , forecasting the probability of a specific amount , basis . Radar imagery forecasting techniques show higher skill than model forecasts within 6 to 7 hours of the time of the radar image . The forecasts can be verified through use of rain gauge measurements , weather radar estimates , or a combination of both . Various skill scores can be determined to measure the value of the rainfall forecast .

= = Use of radar = =

Algorithms exist to forecast rainfall based on short term radar trends , within a matter of hours . Radar imagery forecasting techniques show higher skill than model forecasts within 6 to 7 hours of the time of the radar image .

= = Use of forecast models = =

In the past , the forecaster was responsible for generating the entire weather forecast based upon available observations . Today , meteorologists ' input is generally confined to choosing a model based on various parameters , such as model biases and performance . Using a consensus of forecast models , as well as ensemble members of the various models , can help reduce forecast error . However , regardless how small the average error becomes with any individual system , large errors within any particularly piece of guidance are still possible on any given model run . Professionals are required to interpret the model data into weather forecasts that are understandable to the lay person . Professionals can use knowledge of local effects which may be too small in size to be resolved by the model to add information to the forecast . As an example , terrain is considered in the QPF process by using topography or climatological precipitation patterns from observations with fine detail . Using model guidance and comparing the various forecast fields to climatology , extreme events such as excessive precipitation associated with later flood events lead to better forecasts . While increasing accuracy of forecast models implies that humans may no longer be needed in the forecast process at some point in the future , there is currently still a need for human intervention .

= = = Nowcasting = = =

The forecasting of the precipitation within the next six hours is often referred to as nowcasting . In this time range it is possible to forecast smaller features such as individual showers and thunderstorms with reasonable accuracy , as well as other features too small to be resolved by a computer model . A human given the latest radar , satellite and observational data will be able to make a better analysis of the small scale features present and so will be able to make a more accurate forecast for the following few hours . However , there is now expert systems using those data and mesoscale numerical model to make better extrapolation , including evolution of those features in time .

= = = Ensemble forecasting = = =

The detail that can be given into a forecast decreases with time as these errors increase . There becomes a point when the errors are so large that the forecast has no correlation with the actual state of the atmosphere . Looking at a single forecast model gives no indication of how likely that forecast is to be correct . Ensemble forecasting entails the production of many forecasts in order to reflect the uncertainty in the initial state of the atmosphere (due to errors in the observations and insufficient sampling) . The uncertainty in the forecast can then be assessed by the range of different forecasts produced . Ensemble forecasts are increasingly being used for operational weather forecasting (for example at European Centre for Medium @-@ Range Weather Forecasts (ECMWF) , National Centers for Environmental Prediction (NCEP) , and the Canadian forecasting center) . Ensemble mean forecasts for precipitation have the same problems associated with their use in other fields , as they average out more extreme values , and therefore have limited usefulness for extreme events . In the case of the SREF ensemble mean , used within the United States , this decreasing usefulness starts with values as low as 0 @.@ 50 inches (13 mm) .

= = Probability approach = =

In addition to graphical rainfall forecasts showing quantitative amounts , rainfall forecasts can be made describing the probabilities of certain rainfall amounts being met . This allows the forecaster to assign the degree of uncertainty to the forecast . This technique is considered to be informative , relative to climatology . This method has been used for years within National Weather Service forecasts , as a period 's chance of rain equals the chance that 0 @.@ 01 inches (0 @.@ 25 mm) will fall in any particular spot . In this case , it is known as probability of precipitation . These probabilities can be derived from a deterministic forecast using computer post @-@ processing .

= = Entities which generate rainfall forecasts = =

= = = Australia = = =

The Bureau of Meteorology began a method of forecasting rainfall using a combination , or ensemble , of different forecast models in 2006 . It is termed The Poor Man 's Ensemble (PME) . Its forecasts are more accurate over time than any of the individual models composing the ensemble . The PME is quick to produce , and is available through their Water and the Land page on their website .

= = = Hong Kong = = =

The Hong Kong Observatory generates short term rainstorm warnings for systems which are expected to accumulate a certain amount of rainfall per hour over the next few hours . They use three levels of warning . The amber warning indicates that a rainfall intensity of 30 millimetres (1 @.@ 2 in) per hour is expected . The red warning indicates rainfall amounts of 50 millimetres (2 @.@ 0 in) per hour are anticipated . The black warning indicates that rainfall rates of 70 millimetres (2 @.@ 8 in) are possible .

= = = United States = = =

Within the United States , the Hydrometeorological Prediction Center , River Forecast Centers , and local forecast offices within the National Weather Service create precipitation forecasts for up to five days in the future , forecasting amounts equal to or greater than 0 @.@ 01 inches (0 @.@ 25 mm) . Starting in the mid @-@ to @-@ late 1990s , QPFs were used within hydrologic forecast models to simulate impact of rainfall on river stages .

= = Verification = =

Rainfall forecasts can be verified a number of ways . Rain gauge observations can be gridded into areal averages , which are then compared to the grids for the forecast models . Weather radar estimates can be used outright , or corrected for rain gauge observations .

Several statistical scores can be based on the observed and forecast fields . One , known as a bias , compares the size of the forecast field to the observed field , with the goal of a score of 1 . The threat score involves the intersection of the forecast and observed sets , with a maximum possible verification score of 1 . The probability of detection , or POD , is found by dividing the overlap between the forecast and observed fields by the size of the observed field : the goal here is a score of 1 . The critical success index , or CSI , divides the overlap between the forecast and observed fields by the combined size of the forecast and observed fields : the goal here is a score of 1 . The false alarm rate , or FAR , divides the area of the forecast which does not overlap the observed field by the size of the forecasted area . The goal value in this measure is zero .

With tropical cyclones which impact the United States , the GFS global forecast model performed best in regards to its rainfall forecasts over the last few years , outperforming the NAM and ECMWF forecast models .