Geophysical Research Abstracts
Vol. 13, EGU2011-374, 2011
EGU General Assembly 2011

A generalization of the log-logistic distribution for the probability of daily precipitation

Roberto Moncho
Fundación para la Investigación del clima, Madrid, Spain (robert@temps.cat)

The daily precipitation in climate models can be used for various environmental studies, but it has a systematic error that is difficult to correct. In most weather stations, daily rainfall is most likely zero, so that the climate probability distribution of the precipitation is very high around the lower rainfall and decreases sharply to high rainfall. For that reason, the commonly used models have problems to fit all daily precipitation (Wilson & Toumi, 2005). The objective of this work is to present and evaluate an alternative model of probability of daily precipitation. Test of the goodness-of-fit was done by comparing the Akaike Information Index (Burnham & Anderson, 2002). In addition, Normalized Mean Absolute Error (NMAE) was compared to all models. The proposed model is a modification of log-logistic distribution according to:

$$\pi(p \geq P) = \frac{1}{1 + \left(\frac{P-P_o}{P_1}\right)^{w+r\left(\frac{P-P_o}{P_1}\right)^w}} \quad (1)$$

where $\pi(p \geq P)$ is the *cumulative probability*, i. e., the probability that a station or group of stations registers a precipitation equal to or higher than P; whilst P_o, P_1, w, and r are positive parameters. The proposed model and commonly used models (Generalized Extreme Value, Generalized Pareto Distribution, Gamma, Gumbel and Weibull) were adjusted for daily precipitation of every month of year, for 52 observatories from Spain. The observed and predicted precipitation were compared for every observatory and month of the year, with which the Normalized Mean Absolute Error (NMAE) was obtained. Every commonly used model showed a total NMAE greater than 1 for the predicted daily precipitation for every observatory, especially for the higher rainfall. However, the modified log-logistic model showed NMAE lower than 0.20 for all values of precipitation and for all stations. In particular, this model showed generally a NMAE between 0.02 and 0.07. Normalized absolute errors for the 12 months were estimated, which showed that the absolute error is similar for all scales of precipitation, except for the minimum measurable value (0.1 mm). In addition, it is found that in general the modified log-logistic model is better, as it shows lower values of Akaike Information Index. For these reasons, the proposed model should be used to characterize and correct the probability distribution of any set of daily precipitation data. This is an important requirement for improving the systematic correction of dynamic and statistical downscaling (Widmann, 2003). This model should also improve calibration of operational weather models and other tools of prediction and analysis of precipitation such as weather radars.

BURNHAM, K. P.; ANDERSON, D. (2002): Model Selection and Multi-Model Inference. Springer-Verlag, NY, ISBN-10: 0387953647

WIDMANN, M.; BRETHERTON, C, S.; SALATHÉ, E. P. (2003): Statistical precipitation downscaling over the northwestern United States using numerically simulated precipitation as a predictor. J Climate 16: 799–816

WILSON, P.S.; TOUMI, R, (2005): A fundamental probability distribution for heavy rainfall. Geophys Res Lett 32: L14812