Hydrol. Earth Syst. Sci. Discuss., 9, C1569–C1572, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C1569/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Factors affecting the runoff coefficient" *by* G. Del Giudice et al.

G. Del Giudice et al.

roberta.padulano@unina.it

Received and published: 20 May 2012

RESPONSE TO THE REFEREES

We agree with Referee #1 that the present manuscript deals with practical hydrology, so addressing to those who work in the environmental field. Indeed our aim was to provide a methodology for assessing the runoff coefficient to be utilized for flood protection work design. Nevertheless, we believe that science can be referred to as "technical" as long as it yields, more or less directly, tangible results. The Authors regret that the aim of their work proved to be quite obscure, maybe that is being due to a different philosophy of approach to hydrological problems; thus, they are going to sketch a general scheme of the manuscript, in an attempt to clarify the purpose and structure of their work. Every technician, in the design of a flood protection work in a river basin, finds himself dealing with the problem of determining the probability distribution of annual maximum flood peak discharges. This is not an easy issue, because of the numerous questions that need to be answered: 1. What is the function that fits the probability distribution in the best way? 2. Which is the variance to be considered in the model? 3. Which is the scale factor to be considered in the model? The first question is methodological; the answer depends on the specific models typically applied in the operating areas, so that a technician already knows which model is to be adopted, among numerous possibilities (lognormal, Gumbel, Pearson). Scientifically speaking there's a lot to be said, but this particular choice is not the object of the manuscript. As Referee #2 correctly assumes, in Italy, even though technicians aren't imposed any specific probability model, technical regulations (DPRCM 29/09/1998) suggest adopting the VAPI criteria about statistical inference arranged by CNR (Research National Council), which is now a standard model for hydrological applications, and whose scale factor, that is the index flood, is the mean of annual maximum flood peak discharges. For the determination of the variance for the annual maximum flood peak discharges, hydrological similarity criteria are now fully widespread (Penta, Rasulo & Rossi, 1972; Rossi & Versace, 1982; Cunnane, 1988; Hosking e Wallis, 1997); references are quite dated because this issue can be considered substantially solved. The variance value to be considered in an ungauged river section stems from a large-scale regional study, usually commissioned by the numerous Italian Watershed Authorities. Thus, that value is already known for technicians who work in ungauged watersheds, and any deviation from it should be fully justified. As already stated above, this isn't the object of the paper. Since the trend of the growth factor kT depends on the above mentioned choices, the kT values for each return period T are available too, for the technicians working in ungauged river sections. The main parameter that technicians need to compute is the scale factor for their specific ungauged section, and this issue is precisely the purpose of the manuscript. The mean of the probability distribution of the annual maximum flood peak discharges was considered as the scale factor. We believe that comparable results would have been obtained if any other similar parameter had been

HESSD
9, C1569–C1572, 2012

adopted, given an overall uncertainty concerning the data, which do not stem from a deterministic process. This was perhaps not sufficiently highlighted in the manuscript. In order to compute the scale factor for an ungauged river section, simple lumped conceptual rainfall-runoff transformation models are generally used, where the watershed extent, rainfall, morphology and average permeability can be taken into account; the latter is usually expressed by a runoff coefficient phi. Runoff generation is a complex phenomenon, consequently rainfall-runoff models can be very complex too; a technician needs to quantify all the involved parameters in order to apply the chosen model, so that the more a model is complex, the more its parameters are difficult to calibrate, the more results will end up being uncertain. Thus, simpler models should be preferred, where the few involved parameters have been extensively calibrated. Since some phi values can be obtained from tables, which provide concise values for specific cases with few experimental basis and without taking into account the climatic effects, the Authors' purpose was to carry a general analysis, based on all the gauged river sections available in Southern Peninsular Italy. The total number of gauged river sections (=50) may be considered small for statistical applications but they represent all available regional information. Indeed, using the above mentioned tables could lead to even greater uncertainties, as it should have been better explained in the manuscript. Thus, the "observed runoff coefficient" is the parameter that, placed into the chosen rainfall-runoff model equation, enables the estimation of a mean discharge value which is exactly equal to the mean of the recorded data of annual maximum flood peak discharges for the gauged river section. Indeed, only thanks to the analysis of the mean discharges within a watershed one can assess which part of their variability is due to soil permeability and which part depends on the watershed extent, rainfall and morphology. The Authors are aware that a so computed observed runoff coefficient is a function of the chosen model, but they believe that similar results would have been obtained with any other model. The Authors didn't discuss this, whereas they decided to adopt the most used model in Italy, that is the kinematic one, with a similarly widespread expression for the time of concentration. After computing the observed phi, representing the permeability of the available gauged watersheds, the existence of a relation with some watershed features (geology and land use first) was investigated in order to estimate the phi values for ungauged watersheds. The reliability of the proposed method can be expressed by an error E, that is the difference between the observed and the estimated phi values for the gauged watersheds. The paper shows that watershed permeability deeply depends on climatology, so that the latter cannot be neglected in the analysis. The Lang Factor was chosen to account for the climate effects, even if it is quite dated, because it is one of the easiest indexes a technician can compute, simultaneously having proved to be highly representative of the effects of climate on permeability. Nevertheless, as the Referee #2 suggests, other indexes could be studied, like the Budyko index. Of course, as for all the empirical models, the influence of every parameter must be limited to the experimental range, or extrapolated within a short distance. The Authors would also like to address one of the Referee #1's comments about other advanced geomorphologic methods (GIUH, WFIUH) and the SCS-CN method itself; hopefully, it will be clearer now that the manuscript purpose is not the reconstruction of the flood wave, but an estimate of the mean of the probability distribution of annual maximum flood peak discharges. Hadn't it been so, the Authors would have certainly adopted more complex and complete methods.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4919, 2012.