It must be stressed that, whatever the detailed methodology, PV-system sizing relies on future prediction (the expected system lifetime) based on past observations of the solar radiation. Basic statistical laws imply that such prediction exercises are unavoidably associated with a degree of uncertainty, as mentioned before. This implies a basic limit of accuracy for PV sizing. We will try to clarify this aspect with an example.

We will suppose that 20 years of daily irradiation data measured in a certain location with a great level of accuracy are available. We will call them the "historical sequence". This allows us first, to establish the statistical characteristics of the radiation (mean value, standard deviation, etc.); and, second, to make detailed simulations of a PV system's behaviour over these particular years. Thus, we can map with high precision the reliability associated with different system sizes, for this particular historical sequence. As a simulation exercise, the accuracy of the result is limited only by the precision of the initial measurements, which have been assumed to be very good. However, when using such a sequence for sizing a future system, another limitation arises simply because the solar radiation in the future will not exactly repeat the same pattern as in the past. In fact, it is extremely unlikely in terms of daily sequences. All that can be expected is that the future solar radiation sequence will keep some statistical properties whose validity is known to be general, which opens the door for the generation of a vast collection of hypothetical solar radiation sequences with the same occurrence probability as the historical one. Then, a different reliability map can be associated with each of these radiation sequences, by means of the above-mentioned simulation exercise. Obviously, the similarity between the different maps can be understood as a measure of the uncertainty associated with the prediction. Figure 20.24 shows the result of superimposing such maps. The example is for Madrid, generating different solar radiation sequences following the above-mentioned Aguiar's method [37]. It is clear that precautions must be taken with predictions for $LLP < 10^{-2}$. For example, for $LLP = 10^{-3}$ and $C_S = 3$, we can find C_A values from 1.1 to 1.5. Other authors [70, 77] have presented similar results. We must conclude that the validity of PV-sizing methodologies is generally restricted to the range $1 > LLP > 10^{-2}$, that is, to solar coverage below 99%. Beyond this limit, sizing results are statistically of doubtful quality, although unfortunately, they are often found in the literature and in simulation software tools marketed today.

It must be stressed that this basic uncertainty cannot be overcome either by reducing the simulation time-step (hourly instead of daily values) or by incorporating more complex models of the elements of the PV systems (non-linear $I-V$ models of PV generators, battery efficiency dependence with *SOC* etc.). In fact, the reduction of the considered simulation period can only worsen the situation. It can be shown that the validity of sizing results based only on the *TMY* (avoiding the generation of large-radiation sequences) is restricted to the range $1 > LLP > 10^{-1}$, independent of any other consideration [78]. Appropriately, Marion and Urban [18], when presenting USA *TMY* s, advises "... *Because they represent typical rather than extreme conditions, they are not suited for designing systems to meet the worst-case conditions occurring at a location*".

On the other hand, such basic uncertainty can help to explain why the result of the different PV-sizing methods can be inconsistent; and also why the accuracy gains associated with the consideration of second-order effects when modelling the PV system are likely to be insignificant. In other words, such modelling can be useful for studying some PV-system features (optimal number of solar cell per module, optimal charge regulation