And still, we are disregarding the instrumental errors – at least ±3% in the best series of solar radiation data – and the causes of variability that can be hidden on a series of only 20 years of data. For example, the ones associated with the Global Climatic Change due to the global emissions of CO_2. As a matter of fact, it should be noted that some of the $G_{dm}(0)$ values listed in Table 20.2 for January fall outside this range.

Table 20.3 shows the uncertainty parameters for each month and for the entire year for Madrid, based on data of Reference [16]. It is worth observing that monthly uncertainty is greater in winter than in summer (this is because summer solar radiation is dominated by clear days, essentially governed by the predictable extraterrestrial radiation, while winter solar radiation is strongly influenced by cloudy days, which are governed by random atmospheric phenomena). Besides, uncertainty becomes substantially lower when the whole year is considered (this is because yearly data result from greater aggregates than monthly data, and it is a basic law that the greater the aggregation, the lower the dispersion of the corresponding results). Later on, we will analyse the implications for different PV applications. It should be said that the IES experience in designing PV systems for different locations around the world has led us to believe that the above-described, concerning solar radiation data sources for Madrid, far from being a particular case, is rather representative of a general situation. For example, the December mean daily global horizontal irradiation in New York is $G_{dm}(0) =$ 1.36 kWh/m^2 according to Reference [7], 1.47 kWh/m^2 according to Reference [14], and 1.6 kWh/m^2 according to Reference [15]. The interested reader is encouraged to also consult Reference [18].

It is rather obvious that, whatever the detailed methodology, the PV-system design is essentially a prediction exercise extended over the expected system lifetime. From the previous considerations, it follows that such a prediction exercise is unavoidably associated with a rather large degree of uncertainty. Irrespective of whether good historical data are available and whether more complex models are used, any attempt to overcome such uncertainty is simply wrong. We should insist on that because, unfortunately, many authors often forget it when proposing PV-system design tools. This false sense of predictability and regularity in the solar radiation is, to a certain extent, being boosted by the proliferation of software-based tools, that are able to perform extremely detailed simulations with large sequences of solar radiation data. The great "accuracy" of their calculations tends to confer an impressive "scientific" appearance to these tools, and foster the tendency to believe that their results are superior to others. However, the truth is that such great accuracy is statistically meaningless, and that, much more simple design methodologies can yield results of similar confidence. We should keep this idea in mind all through this chapter.

Table 20.3 Solar radiation parameters for Madrid. Mean G_{dm} and standard deviation values σ are given in kWh/m^2, while $2\sigma/G_{dm}$ is given in %

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean
G_{dm}	1.99	2.64	4.32	5.32	6.28	7.29	7.47	6.62	5.11	3.4	2.16	1.72	4.53
σ	0.31	0.31	0.36	0.39	0.64	0.34	0.31	0.18	0.36	0.39	0.36	0.17	0.08
$2\sigma/G_{dm}$	31	23	17	15	20	9	8	8	14	23	34	20	4