Despite independence of latitude, other second-order factors can affect the observed correlations, leading to a certain site dependence. For example, at very high latitudes, perennial snow cover could significantly increase diffuse radiation caused by multiple reflections between the ground and cloud cover. Also, atmospheric humidity tends to increase scattering, in relative terms. Hence, for a given clearness index, locations with low humidity will tend to have the lowest diffuse radiation content. Because of that, and because radiation data are still being accumulated and revised, new correlations are continuously enlarging the available literature. A recent study [22], devoted to the development of solar radiation models for the Mediterranean area, has found about 250 different correlations in the literature. The same study, extended to more than 150 000 pairs of data from eleven different stations of the European network, has proposed the following expression

$$\begin{aligned} F_{\mathrm{Dd}} &= 0.952 \text{ for } K_{\mathrm{Td}} \leq 0.13 \\ F_{\mathrm{Dd}} &= 0.868 + 1.335K_{\mathrm{Td}} - 5.782{K_{\mathrm{Td}}}^2 + 3.721{K_{\mathrm{Td}}}^3 \\ &\qquad \text{for } 0.13 < K_{\mathrm{Td}} \leq 0.8 \\ F_{\mathrm{Dd}} &= 0.141 \text{ for } K_{\mathrm{Td}} > 0.8 \end{aligned} \tag{20.20}$$

Local correlations that are derived from the data of only one site can also be found. As an example, Macagnan [16] proposed the following for Madrid

$$\begin{aligned} F_{\mathrm{Dd}} &= 0.942 \text{ for } K_{\mathrm{Td}} \leq 0.18 \\ F_{\mathrm{Dd}} &= 0.974 + 0.326K_{\mathrm{Td}} - 3.896{K_{\mathrm{Td}}}^2 + 2.661{K_{\mathrm{Td}}}^3 \\ &\qquad \text{for } 0.18 < K_{\mathrm{Td}} \leq 0.79 \\ F_{\mathrm{Dd}} &= 0.115 \text{ for } K_{\mathrm{Td}} > 0.79 \end{aligned} \tag{20.21}$$

Such diversity of correlations can again perplex our hypothetical questioner, who would ask, “What correlation should I use?” Hence, it is worth to study further the implications of using one or the other.

On the one hand, it should be remembered that the uncertainty associated with the variability of observed individual data, as described in the previous section for global radiation, also applies here. The cluster of (F_{Dd}, K_{Td}) points in Figure 20.12 reveals that, for a given K_{Td}, very different F_{Dd} values can be found in reality. For example, the observed range for $K_{\mathrm{Td}} = 0.5$ is $0.1 \leq F_{\mathrm{Td}} \leq 0.7$, that is ±75% around the mean value. In more strict terms, a measure of the dispersion of expected observations around the prediction derived from a particular correlation, is given by the so-called Root Mean Square Error, or Standard Error of Estimate, s_{e}. As with the standard deviation, $\pm 2s_{\mathrm{e}}$ is the interval, around the predicted value, for 95% confidence. In general, s_{e} are larger than 25%, which means that, regardless of the selected correlation, we would nearly always expect real values of diffuse irradiation for individual days falling between ±50% of the predictions. It is also interesting to observe that the dispersion associated with individual days (Figure 20.12) is significantly larger than the dispersion associated with monthly means (Figure 20.11).

On the other hand, when long-term performance predictions are concerned – which is the standard case on PV design – the implications of using different correlations are in