2.6 Mean Corrected Precipitation Depths of Hydrological Half-Years

Seasonal comparisons of precipitation depths and precipitation corrections indicate a multitude of regional particularities that are characterised mainly by the climate-induced, varying proportions of mixed precipitation and snow in overall local precipitation. In the extreme northwest of the country and the upper Rhine plain, mixed precipitation and snow together account for less than 10 % of total precipitation; at the higher altitudes of the uplands (Mittelgebirge) and in the Alps they represent over 30 %. A close examination also reveals the influence of the sub-yearly distribution of precipitation depths. The combined action of both factors leads to a number of characteristic differences in the measurement errors of the summer and winter half-years. Figure 1 shows the course of the percentage precipitation measurement error during the year for the western and eastern parts of the north German lowlands (Regions I and III) as well as for the Schwarzwald (Black Forest, Region XI) and the Alps (Region IX). The regional divisions are shown in text accompanying Map 2.5, Figure 2 of the Atlas.

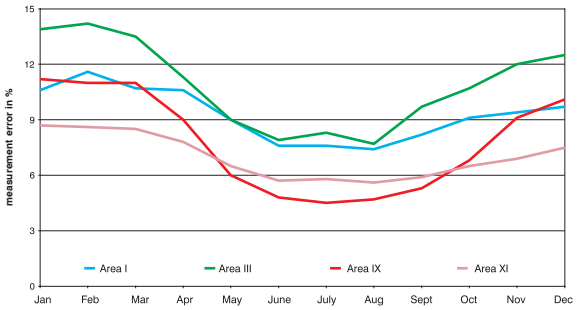

Fig. 1 **Course of the percentage measurement error during the year for selected regions with the same precipitation adjustment correction**

When comparing Regions I and III the major difference appears in winter, with considerably lower errors of measurement in the western lowlands. The low figures clearly result from the much lower proportion of mixed precipitation and snow. A comparison of the Black Forest and the Alps shows stronger annual fluctuations for the Alps, with errors that are higher in winter, lower in summer. They are caused by differences in the annual fluctuation of precipitation depths, especially since the average annual values and the annual proportions of mixed precipitation and snow are largely matched. However, as in the Alps only 40 to 45 % of precipitation falls during the winter half-year while in the Black Forest some 55 % of precipitation falls during the same period, relatively speaking the Alps have a higher proportion of snow with correspondingly higher percentage errors. With heavier summer precipitation, however, those errors are smaller in relative terms. The contrasts between the regions in the north and south also result from different precipitation depths, although the error of measurement has a relatively stronger effect due to the considerably lower precipitation depths in the lowlands. The actual correction values deriving from those contrasts are the difference between the corrected and the uncorrected precipitation depths, and are shown for comparative purposes in Figure 2 and 3.

Table 1 shows a summary of the mean monthly and mean annual values of the precipitation measurement error at various station sites and regions.

Table 1 **Mean monthly and mean annual values of the percentage measurement error for 1961 - 1990, combined regionally into a) exposed, b) slightly sheltered, c) moderately sheltered, and d) well sheltered station sites** (for regional divisions, see Map 2.5, Fig. 2 of the Atlas)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
A	a	22.8	23.6	20.0	16.0	12.0	10.3	10.5	10.3	11.5	13.6	16.2	18.9	14.9
	b	17.3	17.9	15.5	13.6	10.8	9.2	9.4	9.3	10.2	11.2	12.9	14.6	12.3
	c	13.4	13.7	12.6	11.6	9.8	8.4	8.5	8.4	9.1	9.7	10.6	11.6	10.4
	d	9.5	9.6	9.4	9.4	8.5	7.3	7.5	7.3	7.8	7.8	8.0	8.4	8.2
B	a	27.5	29.0	23.6	18.2	12.3	10.3	10.5	10.5	12.1	14.2	19.1	22.7	16.6
	b	20.5	21.5	17.8	15.0	10.9	9.3	9.4	9.5	10.9	11.6	15.0	17.3	13.5
	c	15.2	15.8	14.0	12.4	9.8	8.3	8.6	8.6	9.6	10.2	12.0	13.2	11.1
	d	10.3	10.7	10.0	9.6	8.5	7.3	7.5	7.5	8.2	8.2	8.7	9.2	8.6
C	a	31.6	33.5	26.9	18.3	12.5	10.4	10.8	10.5	12.6	15.5	21.8	26.5	18.2
	b	23.3	24.5	20.3	15.1	11.1	9.8	10.0	9.5	11.5	12.7	16.8	19.8	14.6
	c	17.3	17.9	15.5	12.7	10.1	8.8	9.1	8.5	10.2	11.0	13.3	15.0	12.0
	d	11.5	11.8	10.7	10.0	8.6	7.7	8.0	7.5	8.7	8.8	9.5	10.3	9.3
D	a	31.7	30.5	25.6	18.8	10.4	8.1	7.9	8.2	9.6	13.4	21.3	26.9	15.4
	b	23.0	22.2	19.4	15.0	9.0	7.2	7.1	7.3	8.6	10.6	16.0	19.7	12.2
	c	16.2	15.7	14.3	11.9	8.0	6.5	6.3	6.6	7.7	8.8	12.1	14.4	9.7
	d	10.6	10.2	9.6	8.7	6.7	5.7	5.6	5.8	6.5	6.8	8.3	9.5	7.3

A: areas I and IV (up to 700 m above sea level)
B: areas II, VI and VII (up to 700 m a.s.l.)
C: areas III and V (up to 700 m a.s.l.)
D: areas VIII und IX (up to 1000 m a.s.l.)

Map Structures

A direct comparison of the hydrological half-years (Maps A and B on Map Sheet 2.6) indicates regionally less variable fluctuations during the summer half-year and stronger fluctuations during the winter half-year for corrected precipitation depths also; although the summer half-year shows higher precipitation depths overall. Throughout northeast Germany, those depths come to between 300 and 400 mm, as in some smaller regions too, such as the Marshes in Hessen and the central Main area. In the lee of the Harz Mountains and in parts of the Thüringer Becken (Thuringian basin), values of < 300 mm also appear. Lower regions get 400 to 500 mm in summer precipitation and most of the uplands get 500 to 700 mm. Only the Alps and the Black Forest have significantly higher values. The average for all grid points of 459 mm yields an increase of 34 mm or 8 % in comparison with the uncorrected precipitation depths.

During the winter half-year precipitation depths at lower altitudes mainly lie between 200 and 500 mm, with the lowest values being found throughout the northeast and the Hessisches Ried (Hessian Marshes). The entire area in the lee of the Harz Mountains, the Thuringian basin, the Oder fault, and parts of Lausitz and the Hessian Marshes all have precipitation depths that are < 200 mm. In contrast, the uplands and the Alps stand out more, with values of 800 to over 1000 mm, than in summer. On average during the winter half-year the corrected precipitation depths of 400 mm are 40 mm or 11 % over the uncorrected values.

The distribution of correction values (Map C, Figs. 2 and 3) should also be evaluated similarly to the precipitation depths. For large areas of Germany those values fall between 20 and 40 mm, and do not deviate very much for most of the upland regions either, with 40 to 60 mm. Only some peaks and the high Alps altitudes have higher values, with up to 90 mm. During the winter half-year the correction values are slightly higher overall, with noticeable stronger fluctuations in the lowlands extending from 20 to 60 mm and the lowest values again appearing in those regions that have been mentioned several times already. The low mountains stand out somewhat more with 50 to 80 mm, while still higher correction values remain limited to the peaks of those uplands and the Alps.

Fig. 2 **Mean correction values of summer precipitation depths for 1961–1990 in mm**

Based on detailed knowledge of the different precipitation conditions during the summer and winter half-years, wider-range studies of seasonal precipitation regimes can be carried out, as illustrated by several examples of precipitation types in the text accompanying Maps 2.3 and 2.4 of the Atlas. To provide a foundation for doing so, the average percentage share of summer precipitation in annual precipitation has been calculated (Map D on Map Sheet 2.6).

Attention should be focused primarily on the following results: summer precipitation that represents less than 50 % of annual precipitation occurs only in most of low-mountain regions and near several small rises, as in the Münsterland and the Lüneburger Heide (Lüneburg Heath). Such precipitation can be classified into the low mountain range or winter precipitation type, and sometimes also remains below 45 % at higher altitudes. That does not apply to the Erzgebirge (Erz Mountains) and Schwäbische Alb (Swabian Alps), parts of the Fränkische Alb (Franconian Alps), and the Bayerischer Wald (Bavarian Forest). Those, like large parts of Germany, have a proportion of summer precipitation that lies between 50 and 55 %, which matches Summer Precipitation Type I. Particular attention should be paid to those regions with over 55 % summer precipitation. First, they often coincide with the driest areas, and second, they include the Alps and their foothills as far as the area north of the Danube valley. The reasons for that are probably very diverse. In the drier regions the convectional summer precipitation depths predominate, under the influence of the continental climate; in addition, this is a particular disadvantage in terms of water resources, since the greater part of what is already a limited amount of precipitation is consumed by high summer evaporation. In alpine regions, however, the causes should be sought primarily in the barrier effect that reaches far into the north and the high-intensity, rising-air precipitation it induces in summer. In the foothills of the Alps, especially, over 60 % of precipitation falls in the summer half-year, which characterises Summer Precipitation Type II.

Fig. 3 **Mean correction values of winter precipitation depths for 1961–1990 in mm**