Extreme precipitation statistics for Amsterdam Airport Schiphol

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One of the objects of the project Climatology and Climate Scenarios for Hotspot Schiphol (project HSMS02) in the program Knowledge for Climate (Kennis voor Klimaat) is the analysis of extreme precipitation at Amsterdam Airport Schiphol. In this summary results are presented for several durations and return periods, which can be used for operational and hydrological use at the airport. The results are based on the scientific reports WR2009-01 (included) and STOWA 2004 26.

Table 1.Precipitation amounts (mm) for several durations and return times for Amsterdam Airport Schiphol.

SCHIPHOL														
	minutes				*hours*					*days*				
	5	*15*	*30*	*60*	*2*	*4*	*6*	*8*	*12*	*1*	*2*	*4*	*7*	*10*
10 times per year	-	3	4	5	7	9	11	12	13	16	21	-	-	-
5 times per year	-	4	6	7	10	12	14	15	17	23	28	-	-	-
2 times per year	4	6	8	10	13	16	19	20	23	30	38	49	63	73
once per year	5	9	11	14	17	21	23	24	27	36	44	56	71	86
once per 2 years	7	11	14	18	21	25	27	29	32	42	52	65	82	98
once per 5 years	9	15	19	23	26	31	34	36	40	51	63	77	95	113
once per 10 years	11	18	23	27	31	36	39	41	46	58	70	86	106	123
once per 20 years	12	21	27	32	36	41	45	47	52	66	79	96	116	134
once per 50 years	15	26	32	38	42	49	53	56	61	77	91	108	129	146
once per 100 years	17	29	37	43	48	55	59	62	68	85	99	118	137	154

By the end of 2004 a renewed statistical analysis of extreme precipitation for durations between four and nine days was presented. This analysis was based on hourly precipitation observations of KNMI-station De Bilt between 1906 and 2003. A study of daily precipitation values of ten other stations in the same report led to the conclusion that for obtaining local statistics of extreme precipitation for durations of 24 hours and more the statistics of the Bilt should be corrected. An in depth study of regional differences in extreme precipitation statistics was recommended, but in the meantime the use of a correction factor equal to the ratio of the average yearly precipitation amounts (fig. 1) at the desired location and at De Bilt was suggested.

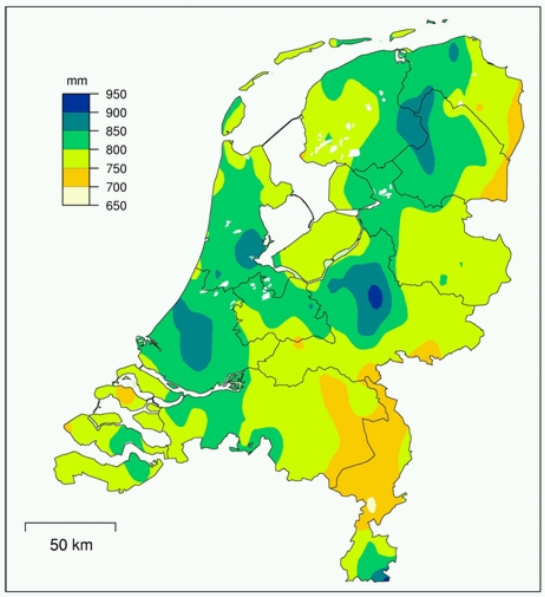

Figure 1. Average annual precipitation (1971-2000).

Repeated occurrences of flooding in the coastal region of The Netherlands after the presentation of the report led to the discussion whether extreme precipitation occurred more often than the corrected statistics of De Bilt would suggest. Several studies on the occurrences of flooding in the coastal zone showed that the statistics of The Bilt should be corrected with a higher factor than was assumed on the basis of the ratio of average yearly amounts.

In the framework of the project "Van Neerslag tot Schade", which was a part of the research program "Leven met water", KNMI has conducted a comprehensive study of regional differences in the statistics of extreme precipitation in The Netherlands. The project was coordinated by "HKV Lijn in water" and partly financed by STOWA, the province of South-Holland and the "Verbond voor Verzekeraars". The study is based on daily precipitation observations of 141 stations between 1951 and 2005. These stations were selected from the KNMI daily rainfall observation network on the basis of homogeneity tests on the yearly number of exceedances of certain rainfall amounts in the data series of each station. From these series yearly maxima for durations of 1, 2, 4, 8 and 9 days were calculated. Maximum likelihood estimates of the location parameter and the dispersion coefficient per station and duration were derived by fitting a Generalized Extreme Value (GEV) distribution to the corresponding yearly maxima in a similar way as was done during the earlier mentioned analysis of the precipitation data of station De Bilt. The shape parameter in both fitting procedures varied according to a predetermined equation with the duration, but was spatially kept constant.

The three parameters of the GEV distribution for each of the 141 rainfall stations describe the local behaviour of extreme precipitation. The variation over the country in these parameters determines the regional differences in the extreme precipitation statistics. The hypothesis that the various local estimates for a certain parameter are all equal against the anti hypothesis that not all differences are equal should be tested to exclude coincidence. The differences are called significant, if the anti hypothesis is not rejected. Normally this kind of test is based on the assumption that the local series of yearly maxima are independent. In general this assumption does not hold for precipitation, since precipitation also effects neighbouring places in a certain pattern. The covariance between rainfall stations is involved in the calculation of the test statistic to account for this dependency. With some alterations this test can also be used in regression analysis to show the significance of a relationship between several statistical parameters as will be discussed in the next paragraphs.

The variances and covariances for the various durations are calculated from 1000 bootstrap samples and these values are used to compose covariance matrices, which are used to calculate the various test statistics. The test statistics for the dispersion coefficient for the various durations did neither show a significant relationship with average yearly precipitation amount, a significant difference between coastal and inland stations nor significant differences between stations for durations of one, four and nine days. As a consequence the dispersion coefficient per duration over the whole of the Netherlands is assumed to be constant.

The test statistic for the location parameter showed significant differences between stations for all durations. A linear relationship between the location parameter and the average yearly amount of precipitation appears to be significant for all durations, but a constant ratio between both statistics does not describe this relationship sufficiently. Although a linear relationship is significant, the variance of the remaining deviations stays high. The relationship with a parameter, which summarizes the location parameter for all durations, seems to be more effective to describe the regional differences in extreme precipitation statistics. This relationship is summarized in figure 2 and used to compose table 1.

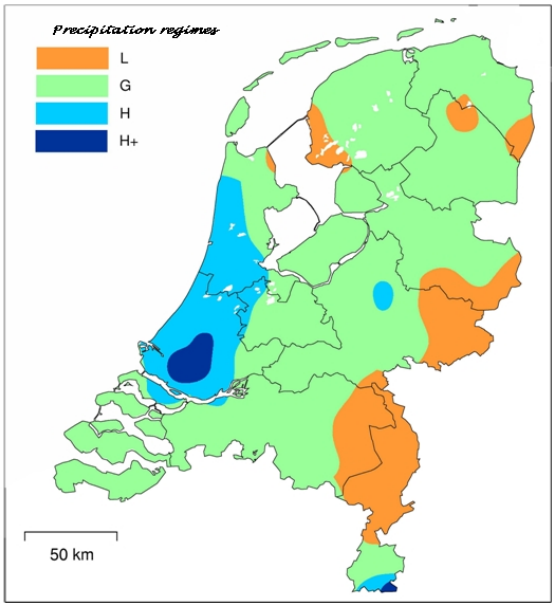

Figure 2. Four different precipitation regimes in the Netherlands, each with its own extreme value statistics

Further reading:
Regionale verschillen in extreme neerslag, T.A. Buishand, R. Jilderda en J.B. Wijngaard, WR2009-01 KNMI.