



# Statistiques des précipitations extrêmes des communes belges

Bertem (INS 24009)

1. Niveau de retour estimé pour une durée de précipitations de 10 minutes à 30 jours (lignes) et une période de retour de 2 à 200 années (colonnes). Unités : mm.

| Durée  | Période de retour (années) |       |       |       |       |       |       |       |       |       |       |       |
|--------|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|        | 2                          | 5     | 10    | 15    | 20    | 25    | 30    | 40    | 50    | 75    | 100   | 200   |
| 10 min | 7.5                        | 10.7  | 13.2  | 14.7  | 15.8  | 16.7  | 17.4  | 18.6  | 19.5  | 21.3  | 22.7  | 26.1  |
| 20 min | 10.7                       | 15.3  | 18.7  | 20.9  | 22.4  | 23.6  | 24.7  | 26.3  | 27.7  | 30.2  | 32.1  | 36.9  |
| 30 min | 12.6                       | 18.4  | 22.7  | 25.3  | 27.2  | 28.7  | 30.0  | 32.1  | 33.7  | 36.8  | 39.1  | 45.1  |
| 1 h    | 15.7                       | 21.9  | 26.5  | 29.2  | 31.3  | 32.9  | 34.3  | 36.5  | 38.2  | 41.5  | 44.0  | 50.3  |
| 2 h    | 18.7                       | 25.7  | 30.8  | 34.0  | 36.3  | 38.1  | 39.6  | 42.1  | 44.0  | 47.8  | 50.5  | 57.5  |
| 3 h    | 20.7                       | 28.5  | 34.3  | 37.8  | 40.4  | 42.4  | 44.1  | 46.8  | 49.0  | 53.1  | 56.2  | 63.9  |
| 6 h    | 25.0                       | 33.2  | 39.3  | 43.0  | 45.6  | 47.8  | 49.5  | 52.4  | 54.7  | 59.0  | 62.2  | 70.2  |
| 12 h   | 30.3                       | 40.2  | 47.5  | 51.9  | 55.1  | 57.6  | 59.8  | 63.2  | 65.9  | 71.0  | 74.8  | 84.4  |
| 1 j    | 36.7                       | 48.0  | 56.2  | 61.0  | 64.5  | 67.3  | 69.6  | 73.2  | 76.2  | 81.6  | 85.5  | 95.4  |
| 2 j    | 45.9                       | 59.2  | 68.5  | 74.0  | 77.9  | 81.0  | 83.5  | 87.5  | 90.7  | 96.5  | 100.8 | 111.3 |
| 3 j    | 48.4                       | 62.3  | 72.0  | 77.6  | 81.6  | 84.7  | 87.3  | 91.4  | 94.6  | 100.4 | 104.6 | 115.0 |
| 4 j    | 52.3                       | 67.1  | 77.3  | 83.2  | 87.3  | 90.6  | 93.2  | 97.4  | 100.7 | 106.7 | 111.0 | 121.6 |
| 5 j    | 59.3                       | 75.2  | 86.0  | 92.2  | 96.5  | 99.9  | 102.7 | 107.1 | 110.6 | 116.8 | 121.3 | 132.2 |
| 7 j    | 68.0                       | 85.1  | 96.7  | 103.3 | 107.9 | 111.5 | 114.4 | 119.1 | 122.6 | 129.2 | 133.8 | 145.1 |
| 10 j   | 80.5                       | 99.3  | 111.8 | 118.9 | 123.9 | 127.7 | 130.8 | 135.7 | 139.5 | 146.4 | 151.3 | 163.0 |
| 15 j   | 97.3                       | 119.4 | 133.9 | 142.0 | 147.6 | 151.9 | 155.4 | 161.0 | 165.2 | 172.9 | 178.3 | 191.2 |
| 20 j   | 113.3                      | 138.9 | 155.5 | 164.8 | 171.2 | 176.1 | 180.1 | 186.3 | 191.1 | 199.7 | 205.7 | 220.1 |
| 25 j   | 120.2                      | 147.5 | 165.0 | 174.7 | 181.5 | 186.6 | 190.8 | 197.3 | 202.2 | 211.2 | 217.4 | 232.2 |
| 30 j   | 141.3                      | 170.8 | 189.7 | 200.2 | 207.4 | 212.8 | 217.3 | 224.2 | 229.5 | 238.9 | 245.5 | 261.1 |

2. Niveau de retour estimé et écart-type de l'estimation pour une durée de précipitations de 10 minutes à 30 jours (lignes) et une période de retour de 2 à 200 années (colonnes). Unités : mm.

| Durée  | Période de retour (années) |       |       |       |       |       |       |       |       |       |       |       |
|--------|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|        | 2                          | 5     | 10    | 15    | 20    | 25    | 30    | 40    | 50    | 75    | 100   | 200   |
| 10 min | 7.5                        | 10.7  | 13.2  | 14.7  | 15.8  | 16.7  | 17.4  | 18.6  | 19.5  | 21.3  | 22.7  | 26.1  |
|        | 0.2                        | 0.3   | 0.5   | 0.7   | 0.8   | 0.9   | 1.0   | 1.2   | 1.3   | 1.7   | 1.9   | 2.6   |
| 20 min | 10.7                       | 15.3  | 18.7  | 20.9  | 22.4  | 23.6  | 24.7  | 26.3  | 27.7  | 30.2  | 32.1  | 36.9  |
|        | 0.3                        | 0.5   | 0.8   | 0.9   | 1.1   | 1.2   | 1.4   | 1.6   | 1.8   | 2.2   | 2.5   | 3.4   |
| 30 min | 12.6                       | 18.4  | 22.7  | 25.3  | 27.2  | 28.7  | 30.0  | 32.1  | 33.7  | 36.8  | 39.1  | 45.1  |
|        | 0.4                        | 0.6   | 0.9   | 1.1   | 1.3   | 1.4   | 1.5   | 1.7   | 1.9   | 2.3   | 2.6   | 3.4   |
| 1 h    | 15.7                       | 21.9  | 26.5  | 29.2  | 31.3  | 32.9  | 34.3  | 36.5  | 38.2  | 41.5  | 44.0  | 50.3  |
|        | 0.5                        | 0.8   | 1.1   | 1.4   | 1.6   | 1.8   | 2.0   | 2.3   | 2.5   | 3.0   | 3.4   | 4.6   |
| 2 h    | 18.7                       | 25.7  | 30.8  | 34.0  | 36.3  | 38.1  | 39.6  | 42.1  | 44.0  | 47.8  | 50.5  | 57.5  |
|        | 0.6                        | 0.9   | 1.3   | 1.6   | 1.8   | 2.0   | 2.2   | 2.6   | 2.8   | 3.4   | 3.9   | 5.2   |
| 3 h    | 20.7                       | 28.5  | 34.3  | 37.8  | 40.4  | 42.4  | 44.1  | 46.8  | 49.0  | 53.1  | 56.2  | 63.9  |
|        | 0.7                        | 1.0   | 1.4   | 1.6   | 1.9   | 2.1   | 2.3   | 2.6   | 2.8   | 3.4   | 3.8   | 5.0   |
| 6 h    | 25.0                       | 33.2  | 39.3  | 43.0  | 45.6  | 47.8  | 49.5  | 52.4  | 54.7  | 59.0  | 62.2  | 70.2  |
|        | 0.8                        | 1.1   | 1.5   | 1.8   | 2.1   | 2.4   | 2.6   | 3.0   | 3.4   | 4.1   | 4.7   | 6.4   |
| 12 h   | 30.3                       | 40.2  | 47.5  | 51.9  | 55.1  | 57.6  | 59.8  | 63.2  | 65.9  | 71.0  | 74.8  | 84.4  |
|        | 1.1                        | 1.5   | 2.0   | 2.4   | 2.8   | 3.1   | 3.4   | 3.9   | 4.4   | 5.3   | 6.1   | 8.3   |
| 1 j    | 36.7                       | 48.0  | 56.2  | 61.0  | 64.5  | 67.3  | 69.6  | 73.2  | 76.2  | 81.6  | 85.5  | 95.4  |
|        | 1.2                        | 1.5   | 1.9   | 2.1   | 2.4   | 2.6   | 2.7   | 3.0   | 3.3   | 3.8   | 4.2   | 5.3   |
| 2 j    | 45.9                       | 59.2  | 68.5  | 74.0  | 77.9  | 81.0  | 83.5  | 87.5  | 90.7  | 96.5  | 100.8 | 111.3 |
|        | 1.9                        | 2.5   | 3.2   | 3.7   | 4.1   | 4.5   | 4.8   | 5.3   | 5.8   | 6.7   | 7.4   | 9.2   |
| 3 j    | 48.4                       | 62.3  | 72.0  | 77.6  | 81.6  | 84.7  | 87.3  | 91.4  | 94.6  | 100.4 | 104.6 | 115.0 |
|        | 2.3                        | 3.0   | 3.7   | 4.3   | 4.7   | 5.1   | 5.4   | 5.9   | 6.3   | 7.2   | 7.8   | 9.6   |
| 4 j    | 52.3                       | 67.1  | 77.3  | 83.2  | 87.3  | 90.6  | 93.2  | 97.4  | 100.7 | 106.7 | 111.0 | 121.6 |
|        | 2.6                        | 3.3   | 3.9   | 4.3   | 4.7   | 4.9   | 5.2   | 5.6   | 6.0   | 6.7   | 7.2   | 8.6   |
| 5 j    | 59.3                       | 75.2  | 86.0  | 92.2  | 96.5  | 99.9  | 102.7 | 107.1 | 110.6 | 116.8 | 121.3 | 132.2 |
|        | 3.0                        | 3.7   | 4.3   | 4.7   | 5.0   | 5.3   | 5.5   | 5.9   | 6.2   | 6.8   | 7.3   | 8.7   |
| 7 j    | 68.0                       | 85.1  | 96.7  | 103.3 | 107.9 | 111.5 | 114.4 | 119.1 | 122.6 | 129.2 | 133.8 | 145.1 |
|        | 3.6                        | 4.3   | 4.9   | 5.3   | 5.6   | 5.8   | 6.0   | 6.4   | 6.7   | 7.2   | 7.7   | 8.9   |
| 10 j   | 80.5                       | 99.3  | 111.8 | 118.9 | 123.9 | 127.7 | 130.8 | 135.7 | 139.5 | 146.4 | 151.3 | 163.0 |
|        | 4.4                        | 5.5   | 6.2   | 6.7   | 7.1   | 7.4   | 7.6   | 8.0   | 8.3   | 9.0   | 9.5   | 10.7  |
| 15 j   | 97.3                       | 119.4 | 133.9 | 142.0 | 147.6 | 151.9 | 155.4 | 161.0 | 165.2 | 172.9 | 178.3 | 191.2 |
|        | 5.4                        | 6.6   | 7.4   | 7.8   | 8.1   | 8.4   | 8.6   | 8.9   | 9.1   | 9.6   | 10.0  | 10.8  |
| 20 j   | 113.3                      | 138.9 | 155.5 | 164.8 | 171.2 | 176.1 | 180.1 | 186.3 | 191.1 | 199.7 | 205.7 | 220.1 |
|        | 6.4                        | 7.9   | 8.8   | 9.4   | 9.8   | 10.1  | 10.4  | 10.8  | 11.1  | 11.7  | 12.2  | 13.4  |
| 25 j   | 120.2                      | 147.5 | 165.0 | 174.7 | 181.5 | 186.6 | 190.8 | 197.3 | 202.2 | 211.2 | 217.4 | 232.2 |
|        | 7.1                        | 8.8   | 10.0  | 10.7  | 11.3  | 11.7  | 12.1  | 12.7  | 13.1  | 14.1  | 14.8  | 16.6  |
| 30 j   | 141.3                      | 170.8 | 189.7 | 200.2 | 207.4 | 212.8 | 217.3 | 224.2 | 229.5 | 238.9 | 245.5 | 261.1 |
|        | 7.9                        | 9.7   | 11.1  | 12.0  | 12.7  | 13.2  | 13.7  | 14.5  | 15.1  | 16.3  | 17.2  | 19.7  |

3. Intervalle de confiance à 95% de la période de retour estimée pour une durée de précipitations de 10 minutes à 30 jours (lignes) et une période de retour de 2 à 200 années (colonnes). Unités : mm.

| Durée  | Période de retour (années) |       |       |       |       |       |       |       |       |       |       |       |
|--------|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|        | 2                          | 5     | 10    | 15    | 20    | 25    | 30    | 40    | 50    | 75    | 100   | 200   |
| 10 min | 7.1                        | 10.1  | 12.2  | 13.4  | 14.2  | 14.9  | 15.4  | 16.2  | 16.9  | 18.1  | 18.9  | 20.9  |
|        | 7.9                        | 11.4  | 14.2  | 16.0  | 17.4  | 18.5  | 19.4  | 20.9  | 22.2  | 24.6  | 26.4  | 31.3  |
| 20 min | 10.0                       | 14.2  | 17.3  | 19.0  | 20.2  | 21.2  | 22.0  | 23.2  | 24.2  | 25.9  | 27.2  | 30.2  |
|        | 11.3                       | 16.3  | 20.2  | 22.7  | 24.6  | 26.1  | 27.3  | 29.4  | 31.2  | 34.5  | 37.0  | 43.6  |
| 30 min | 11.8                       | 17.1  | 20.9  | 23.1  | 24.7  | 26.0  | 27.0  | 28.6  | 29.9  | 32.3  | 34.1  | 38.4  |
|        | 13.5                       | 19.6  | 24.4  | 27.4  | 29.7  | 31.5  | 33.0  | 35.5  | 37.5  | 41.3  | 44.2  | 51.7  |
| 1 h    | 14.8                       | 20.3  | 24.3  | 26.5  | 28.1  | 29.4  | 30.4  | 32.0  | 33.3  | 35.6  | 37.3  | 41.2  |
|        | 16.6                       | 23.4  | 28.6  | 32.0  | 34.4  | 36.4  | 38.1  | 40.9  | 43.2  | 47.5  | 50.7  | 59.3  |
| 2 h    | 17.6                       | 23.9  | 28.3  | 30.9  | 32.7  | 34.1  | 35.2  | 37.1  | 38.5  | 41.1  | 42.9  | 47.3  |
|        | 19.8                       | 27.5  | 33.4  | 37.1  | 39.9  | 42.1  | 44.0  | 47.1  | 49.6  | 54.4  | 58.1  | 67.6  |
| 3 h    | 19.4                       | 26.6  | 31.6  | 34.6  | 36.7  | 38.3  | 39.7  | 41.8  | 43.5  | 46.6  | 48.8  | 54.2  |
|        | 22.1                       | 30.5  | 37.0  | 41.0  | 44.0  | 46.5  | 48.5  | 51.9  | 54.6  | 59.7  | 63.6  | 73.7  |
| 6 h    | 23.4                       | 31.1  | 36.4  | 39.4  | 41.5  | 43.1  | 44.4  | 46.5  | 48.0  | 50.9  | 52.9  | 57.6  |
|        | 26.6                       | 35.4  | 42.2  | 46.6  | 49.8  | 52.5  | 54.7  | 58.4  | 61.3  | 67.1  | 71.4  | 82.8  |
| 12 h   | 28.1                       | 37.3  | 43.6  | 47.2  | 49.6  | 51.5  | 53.1  | 55.5  | 57.3  | 60.6  | 62.8  | 68.2  |
|        | 32.5                       | 43.1  | 51.4  | 56.6  | 60.6  | 63.7  | 66.4  | 70.9  | 74.5  | 81.5  | 86.7  | 100.6 |
| 1 j    | 34.3                       | 45.0  | 52.5  | 56.8  | 59.9  | 62.3  | 64.2  | 67.3  | 69.7  | 74.1  | 77.3  | 85.0  |
|        | 39.1                       | 51.0  | 59.9  | 65.2  | 69.2  | 72.3  | 74.9  | 79.2  | 82.6  | 89.0  | 93.8  | 105.9 |
| 2 j    | 42.2                       | 54.3  | 62.2  | 66.7  | 69.8  | 72.1  | 74.0  | 77.0  | 79.3  | 83.4  | 86.3  | 93.1  |
|        | 49.5                       | 64.1  | 74.8  | 81.3  | 86.0  | 89.8  | 92.9  | 98.0  | 102.0 | 109.6 | 115.2 | 129.4 |
| 3 j    | 43.9                       | 56.5  | 64.7  | 69.2  | 72.4  | 74.8  | 76.8  | 79.8  | 82.2  | 86.4  | 89.3  | 96.2  |
|        | 52.8                       | 68.2  | 79.4  | 86.0  | 90.8  | 94.7  | 97.8  | 102.9 | 107.0 | 114.5 | 120.0 | 133.9 |
| 4 j    | 47.2                       | 60.8  | 69.7  | 74.7  | 78.2  | 80.9  | 83.0  | 86.4  | 89.0  | 93.7  | 96.9  | 104.6 |
|        | 57.4                       | 73.5  | 84.9  | 91.6  | 96.4  | 100.2 | 103.4 | 108.4 | 112.4 | 119.8 | 125.1 | 138.5 |
| 5 j    | 53.5                       | 68.0  | 77.6  | 83.0  | 86.7  | 89.6  | 91.9  | 95.6  | 98.4  | 103.4 | 106.9 | 115.3 |
|        | 65.1                       | 82.4  | 94.4  | 101.4 | 106.4 | 110.3 | 113.5 | 118.7 | 122.7 | 130.3 | 135.7 | 149.2 |
| 7 j    | 61.0                       | 76.7  | 87.1  | 93.0  | 97.0  | 100.1 | 102.6 | 106.5 | 109.6 | 115.0 | 118.8 | 127.7 |
|        | 74.9                       | 93.5  | 106.3 | 113.6 | 118.8 | 122.9 | 126.2 | 131.6 | 135.7 | 143.4 | 148.9 | 162.5 |
| 10 j   | 71.8                       | 88.6  | 99.6  | 105.7 | 110.0 | 113.3 | 115.9 | 120.0 | 123.1 | 128.8 | 132.7 | 141.9 |
|        | 89.1                       | 110.0 | 124.1 | 132.1 | 137.8 | 142.2 | 145.8 | 151.4 | 155.9 | 164.0 | 169.8 | 184.0 |
| 15 j   | 86.7                       | 106.5 | 119.4 | 126.6 | 131.7 | 135.5 | 138.7 | 143.5 | 147.3 | 154.0 | 158.8 | 170.0 |
|        | 108.0                      | 132.3 | 148.3 | 157.3 | 163.5 | 168.3 | 172.2 | 178.4 | 183.1 | 191.7 | 197.8 | 212.4 |
| 20 j   | 100.8                      | 123.5 | 138.2 | 146.4 | 152.0 | 156.3 | 159.8 | 165.2 | 169.3 | 176.7 | 181.8 | 193.9 |
|        | 125.9                      | 154.4 | 172.9 | 183.2 | 190.4 | 195.9 | 200.4 | 207.5 | 212.9 | 222.7 | 229.6 | 246.3 |
| 25 j   | 106.2                      | 130.2 | 145.4 | 153.7 | 159.4 | 163.7 | 167.1 | 172.4 | 176.5 | 183.6 | 188.5 | 199.7 |
|        | 134.2                      | 164.7 | 184.6 | 195.7 | 203.5 | 209.5 | 214.4 | 222.1 | 228.0 | 238.7 | 246.3 | 264.7 |
| 30 j   | 125.7                      | 151.9 | 168.0 | 176.7 | 182.5 | 186.9 | 190.5 | 195.8 | 199.9 | 206.9 | 211.7 | 222.6 |
|        | 156.8                      | 189.8 | 211.4 | 223.6 | 232.2 | 238.7 | 244.1 | 252.5 | 259.1 | 270.9 | 279.3 | 299.7 |

#### 4. Estimation des coefficients de Montana.

Formule de Montana : intensité[mm/h] =  $a \cdot \text{durée}[\text{min}]^{-b}$  pour une plage de durées

$a_1, b_1$  : durées < 25 min

$a_2, b_2$  : durées entre 25 min et 6000 min (= 100 h)

$a_3, b_3$  : durées > 6000 min (= 100 h)

| Période de retour (années) | $a_1$ | $b_1$  | $a_2$  | $b_2$  | $a_3$ | $b_3$  |
|----------------------------|-------|--------|--------|--------|-------|--------|
| 2                          | 131.0 | 0.4662 | 305.1  | 0.7288 | 54.4  | 0.5306 |
| 5                          | 189.5 | 0.4695 | 468.2  | 0.7505 | 84.9  | 0.5543 |
| 10                         | 231.9 | 0.4684 | 598.6  | 0.7630 | 112.4 | 0.5707 |
| 15                         | 257.2 | 0.4670 | 681.3  | 0.7696 | 131.1 | 0.5801 |
| 20                         | 275.6 | 0.4657 | 743.5  | 0.7741 | 145.8 | 0.5868 |
| 25                         | 290.1 | 0.4647 | 794.0  | 0.7774 | 158.1 | 0.5919 |
| 30                         | 302.2 | 0.4637 | 836.8  | 0.7802 | 168.8 | 0.5961 |
| 40                         | 321.5 | 0.4621 | 907.3  | 0.7844 | 186.9 | 0.6028 |
| 50                         | 336.9 | 0.4608 | 964.7  | 0.7876 | 202.1 | 0.6079 |
| 75                         | 365.5 | 0.4582 | 1075.4 | 0.7934 | 232.4 | 0.6173 |
| 100                        | 386.5 | 0.4562 | 1159.3 | 0.7974 | 256.4 | 0.6240 |
| 200                        | 439.4 | 0.4511 | 1381.8 | 0.8070 | 323.5 | 0.6401 |

## Références

Van de Vyver, H. (2012). Spatial regression models for extreme precipitation in Belgium, *Water Resour. Res.*, 48, W09549, doi :10.1029/2011WR011707.

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