Table A1 250 samples used to fit the relation equation parameters.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | region | *d* (mm) | *f* (mm) | *θ* (°) | Σ*hij* | Σ*hij*2 |
| 1 | red | 1,400 | 50 | -30 | 162,550 | 10,589,102 |
| 2 | red | 1,700 | 48 | -28 | 80,605 | 4,180,103 |
| 3 | red | 1,800 | 43 | -27 | 48,216 | 2,142,536 |
| 4 | red | 1,400 | 48 | -26 | 159,644 | 10,424,068 |
| 5 | red | 2,000 | 51 | -24 | 53,799 | 2,464,809 |
| 6 | red | 1,400 | 45 | -23 | 130,806 | 8,058,040 |
| 7 | red | 1,900 | 39 | -22 | 33,061 | 1,317,229 |
| 8 | red | 1,900 | 52 | -21 | 69,869 | 3,525,859 |
| 9 | red | 1,700 | 46 | -20 | 73,328 | 3,808,520 |
| 10 | red | 1,500 | 45 | -19 | 103,716 | 6,140,164 |
| 11 | red | 1,600 | 40 | -18 | 58,390 | 2,808,024 |
| 12 | red | 2,000 | 50 | -16 | 54,173 | 2,578,919 |
| 13 | red | 1,900 | 36 | -16 | 25,093 | 926,719 |
| 14 | red | 1,800 | 52 | -14 | 86,995 | 4,875,255 |
| 15 | red | 1,400 | 53 | -13 | 201,377 | 14,996,879 |
| 16 | red | 1,800 | 46 | -12 | 67,329 | 3,392,467 |
| 17 | red | 1,300 | 50 | -11 | 219,488 | 16,557,560 |
| 18 | red | 1,200 | 45 | -9 | 219,348 | 16,463,112 |
| 19 | red | 1,600 | 35 | -7 | 40,643 | 1,777,623 |
| 20 | red | 1,400 | 47 | -7 | 134,934 | 8,474,584 |
| 21 | red | 1,300 | 38 | -6 | 114,659 | 7,010,291 |
| 22 | red | 1,800 | 48 | -4 | 74,366 | 4,003,490 |
| 23 | red | 1,800 | 40 | -2 | 42,470 | 1,850,204 |
| 24 | red | 1,700 | 54 | -1 | 113,256 | 6,937,656 |
| 25 | red | 1,900 | 54 | -1 | 83,460 | 4,672,980 |
| 26 | red | 1,800 | 51 | 0 | 88,433 | 4,935,489 |
| 27 | red | 1,700 | 37 | 2 | 42,656 | 1,913,568 |
| 28 | red | 1,600 | 53 | 3 | 125,865 | 7,862,745 |
| 29 | red | 1,300 | 41 | 5 | 112,943 | 6,913,155 |
| 30 | red | 1,500 | 41 | 5 | 71,107 | 3,687,721 |
| 31 | red | 1,700 | 38 | 7 | 43,520 | 1,936,896 |
| 32 | red | 1,300 | 42 | 8 | 126,145 | 7,873,973 |
| 33 | red | 1,500 | 39 | 8 | 65,486 | 3,378,778 |
| 34 | red | 1,200 | 54 | 11 | 309,723 | 26,242,733 |
| 35 | red | 1,400 | 36 | 12 | 58,076 | 2,875,364 |
| 36 | red | 2,000 | 47 | 12 | 45,013 | 2,042,047 |
| 37 | red | 1,500 | 37 | 14 | 48,436 | 2,182,332 |
| 38 | red | 1,900 | 42 | 14 | 35,061 | 1,430,309 |
| 39 | red | 1,500 | 44 | 17 | 76,726 | 4,055,620 |
| 40 | red | 1,300 | 46 | 18 | 130,249 | 8,178,721 |
| 41 | red | 1,600 | 49 | 18 | 85,280 | 4,716,166 |
| 42 | red | 1,200 | 49 | 20 | 191,189 | 13,586,591 |
| 43 | red | 1,400 | 42 | 21 | 82,323 | 4,507,041 |
| 44 | red | 1,700 | 44 | 22 | 50,960 | 2,414,160 |
| 45 | red | 1,600 | 38 | 23 | 37,886 | 1,616,178 |
| 46 | red | 1,600 | 40 | 24 | 44,483 | 2,004,555 |
| 47 | red | 1,500 | 51 | 25 | 97,619 | 5,557,125 |
| 48 | red | 1,300 | 43 | 27 | 87,174 | 4,764,372 |
| 49 | red | 1,900 | 55 | 29 | 51,504 | 2,341,360 |
| 50 | red | 1,800 | 36 | 30 | 17,871 | 585,149 |
| 51 | yellow | 1,400 | 50 | -30 | 8,435 | 399,873 |
| 52 | yellow | 1,700 | 48 | -28 | 4,389 | 158,361 |
| 53 | yellow | 1,800 | 43 | -27 | 3,615 | 88,495 |
| 54 | yellow | 1,400 | 48 | -26 | 9,187 | 416,255 |
| 55 | yellow | 2,000 | 51 | -24 | 2,556 | 101,904 |
| 56 | yellow | 1,400 | 45 | -23 | 6,432 | 330,988 |
| 57 | yellow | 1,900 | 39 | -22 | 2,480 | 56,000 |
| 58 | yellow | 1,900 | 52 | -21 | 3,990 | 147,630 |
| 59 | yellow | 1,700 | 46 | -20 | 4,859 | 165,277 |
| 60 | yellow | 1,500 | 45 | -19 | 8,528 | 253,760 |
| 61 | yellow | 1,600 | 40 | -18 | 3,465 | 115,115 |
| 62 | yellow | 2,000 | 50 | -16 | 3,555 | 114,295 |
| 63 | yellow | 1,900 | 36 | -16 | 1,959 | 39,569 |
| 64 | yellow | 1,800 | 52 | -14 | 6,282 | 221,970 |
| 65 | yellow | 1,400 | 53 | -13 | 14,285 | 639,155 |
| 66 | yellow | 1,800 | 46 | -12 | 3,927 | 142,233 |
| 67 | yellow | 1,300 | 50 | -11 | 11,448 | 715,500 |
| 68 | yellow | 1,200 | 45 | -9 | 8,925 | 692,951 |
| 69 | yellow | 1,600 | 35 | -7 | 3,150 | 78,450 |
| 70 | yellow | 1,400 | 47 | -7 | 3,219 | 385,341 |
| 71 | yellow | 1,300 | 38 | -6 | 5,912 | 312,748 |
| 72 | yellow | 1,800 | 48 | -4 | 5,476 | 177,970 |
| 73 | yellow | 1,800 | 40 | -2 | 1,922 | 80,724 |
| 74 | yellow | 1,700 | 54 | -1 | 7,334 | 317,764 |
| 75 | yellow | 1,900 | 54 | -1 | 6,084 | 216,996 |
| 76 | yellow | 1,800 | 51 | 0 | 3,987 | 223,453 |
| 77 | yellow | 1,700 | 37 | 2 | 3,844 | 92,256 |
| 78 | yellow | 1,600 | 53 | 3 | 5,330 | 385,370 |
| 79 | yellow | 1,300 | 41 | 5 | 7,568 | 321,640 |
| 80 | yellow | 1,500 | 41 | 5 | 3,483 | 176,371 |
| 81 | yellow | 1,700 | 38 | 7 | 2,560 | 93,696 |
| 82 | yellow | 1,300 | 42 | 8 | 3,986 | 396,764 |
| 83 | yellow | 1,500 | 39 | 8 | 5,994 | 170,718 |
| 84 | yellow | 1,200 | 54 | 11 | 13,273 | 1,306,485 |
| 85 | yellow | 1,400 | 36 | 12 | 5,855 | 158,875 |
| 86 | yellow | 2,000 | 47 | 12 | 4,208 | 101,296 |
| 87 | yellow | 1,500 | 37 | 14 | 2,246 | 106,220 |
| 88 | yellow | 1,900 | 42 | 14 | 1,410 | 68,670 |
| 89 | yellow | 1,500 | 44 | 17 | 4,558 | 212,856 |
| 90 | yellow | 1,300 | 46 | 18 | 6,909 | 444,479 |
| 91 | yellow | 1,600 | 49 | 18 | 6,336 | 247,704 |
| 92 | yellow | 1,200 | 49 | 20 | 8,589 | 726,575 |
| 93 | yellow | 1,400 | 42 | 21 | 7,875 | 243,755 |
| 94 | yellow | 1,700 | 44 | 22 | 5,830 | 135,372 |
| 95 | yellow | 1,600 | 38 | 23 | 3,465 | 86,295 |
| 96 | yellow | 1,600 | 40 | 24 | 4,396 | 105,544 |
| 97 | yellow | 1,500 | 51 | 25 | 6,306 | 296,566 |
| 98 | yellow | 1,300 | 43 | 27 | 6,406 | 269,634 |
| 99 | yellow | 1,900 | 55 | 29 | 3,763 | 125,021 |
| 100 | yellow | 1,800 | 36 | 30 | 1,787 | 31,743 |
| 101 | green | 1,400 | 50 | -30 | 154,707 | 9,884,683 |
| 102 | green | 1,700 | 48 | -28 | 76,501 | 3,902,865 |
| 103 | green | 1,800 | 43 | -27 | 44,522 | 1,954,376 |
| 104 | green | 1,400 | 48 | -26 | 149,720 | 9,741,874 |
| 105 | green | 2,000 | 51 | -24 | 49,532 | 2,224,036 |
| 106 | green | 1,400 | 45 | -23 | 124,754 | 7,601,986 |
| 107 | green | 1,900 | 39 | -22 | 30,323 | 1,186,705 |
| 108 | green | 1,900 | 52 | -21 | 63,931 | 3,173,197 |
| 109 | green | 1,700 | 46 | -20 | 67,834 | 3,459,164 |
| 110 | green | 1,500 | 45 | -19 | 97,976 | 5,727,878 |
| 111 | green | 1,600 | 40 | -18 | 54,798 | 2,613,874 |
| 112 | green | 2,000 | 50 | -16 | 50,052 | 2,337,852 |
| 113 | green | 1,900 | 36 | -16 | 21,776 | 788,330 |
| 114 | green | 1,800 | 52 | -14 | 81,623 | 4,513,097 |
| 115 | green | 1,400 | 53 | -13 | 191,937 | 13,938,121 |
| 116 | green | 1,800 | 46 | -12 | 60,966 | 3,023,378 |
| 117 | green | 1,300 | 50 | -11 | 212,375 | 15,832,779 |
| 118 | green | 1,200 | 45 | -9 | 207,473 | 15,373,761 |
| 119 | green | 1,600 | 35 | -7 | 36,754 | 1,585,154 |
| 120 | green | 1,400 | 47 | -7 | 126,924 | 7,944,864 |
| 121 | green | 1,300 | 38 | -6 | 108,337 | 6,565,477 |
| 122 | green | 1,800 | 48 | -4 | 69,582 | 3,692,154 |
| 123 | green | 1,800 | 40 | -2 | 40,051 | 1,730,625 |
| 124 | green | 1,700 | 54 | -1 | 109,542 | 6,691,682 |
| 125 | green | 1,900 | 54 | -1 | 78,488 | 4,341,874 |
| 126 | green | 1,800 | 51 | 0 | 83,614 | 4,600,764 |
| 127 | green | 1,700 | 37 | 2 | 40,607 | 1,816,845 |
| 128 | green | 1,600 | 53 | 3 | 118,831 | 7,343,085 |
| 129 | green | 1,300 | 41 | 5 | 105,973 | 6,414,833 |
| 130 | green | 1,500 | 41 | 5 | 66,746 | 3,420,590 |
| 131 | green | 1,700 | 38 | 7 | 40,362 | 1,772,084 |
| 132 | green | 1,300 | 42 | 8 | 120,709 | 7,442,485 |
| 133 | green | 1,500 | 39 | 8 | 63,353 | 3,262,161 |
| 134 | green | 1,200 | 54 | 11 | 299,380 | 25,141,824 |
| 135 | green | 1,400 | 36 | 12 | 56,909 | 2,871,565 |
| 136 | green | 2,000 | 47 | 12 | 43,284 | 1,951,876 |
| 137 | green | 1,500 | 37 | 14 | 47,147 | 2,124,217 |
| 138 | green | 1,900 | 42 | 14 | 34,225 | 1,392,955 |
| 139 | green | 1,500 | 44 | 17 | 74,510 | 3,933,444 |
| 140 | green | 1,300 | 46 | 18 | 127,843 | 8,024,699 |
| 141 | green | 1,600 | 49 | 18 | 83,083 | 4,582,619 |
| 142 | green | 1,200 | 49 | 20 | 189,469 | 13,480,515 |
| 143 | green | 1,400 | 42 | 21 | 78,552 | 4,300,836 |
| 144 | green | 1,700 | 44 | 22 | 48,723 | 2,320,505 |
| 145 | green | 1,600 | 38 | 23 | 35,661 | 1,503,763 |
| 146 | green | 1,600 | 40 | 24 | 41,309 | 1,801,141 |
| 147 | green | 1,500 | 51 | 25 | 93,224 | 5,216,632 |
| 148 | green | 1,300 | 43 | 27 | 86,421 | 4,785,139 |
| 149 | green | 1,900 | 55 | 29 | 51,987 | 2,409,621 |
| 150 | green | 1,800 | 36 | 30 | 16,937 | 548,351 |
| 151 | blue | 1,400 | 50 | -30 | -102,657 | 5,303,079 |
| 152 | blue | 1,700 | 48 | -28 | -57,854 | 2,468,672 |
| 153 | blue | 1,800 | 43 | -27 | -33,597 | 1,172,815 |
| 154 | blue | 1,400 | 48 | -26 | -106,681 | 5,656,073 |
| 155 | blue | 2,000 | 51 | -24 | -44,388 | 1,756,330 |
| 156 | blue | 1,400 | 45 | -23 | -93,036 | 4,815,092 |
| 157 | blue | 1,900 | 39 | -22 | -23,404 | 748,504 |
| 158 | blue | 1,900 | 52 | -21 | -52,834 | 2,262,734 |
| 159 | blue | 1,700 | 46 | -20 | -55,358 | 2,368,484 |
| 160 | blue | 1,500 | 45 | -19 | -71,075 | 3,261,657 |
| 161 | blue | 1,600 | 40 | -18 | -44,396 | 1,795,978 |
| 162 | blue | 2,000 | 50 | -16 | -43,304 | 1,712,568 |
| 163 | blue | 1,900 | 36 | -16 | -18,415 | 545,625 |
| 164 | blue | 1,800 | 52 | -14 | -66,256 | 3,063,950 |
| 165 | blue | 1,400 | 53 | -13 | -145,351 | 8,675,671 |
| 166 | blue | 1,800 | 46 | -12 | -53,853 | 2,348,337 |
| 167 | blue | 1,300 | 50 | -11 | -168,714 | 10,828,554 |
| 168 | blue | 1,200 | 45 | -9 | -172,314 | 11,222,518 |
| 169 | blue | 1,600 | 35 | -7 | -32,606 | 1,185,034 |
| 170 | blue | 1,400 | 47 | -7 | -120,754 | 7,173,422 |
| 171 | blue | 1,300 | 38 | -6 | -94,529 | 5,016,327 |
| 172 | blue | 1,800 | 48 | -4 | -63,068 | 2,854,808 |
| 173 | blue | 1,800 | 40 | -2 | -38,563 | 1,532,483 |
| 174 | blue | 1,700 | 54 | -1 | -99,544 | 5,338,930 |
| 175 | blue | 1,900 | 54 | -1 | -71,370 | 3,399,552 |
| 176 | blue | 1,800 | 51 | 0 | -78,980 | 3,947,940 |
| 177 | blue | 1,700 | 37 | 2 | -34,720 | 1,294,560 |
| 178 | blue | 1,600 | 53 | 3 | -115,495 | 6,669,109 |
| 179 | blue | 1,300 | 41 | 5 | -100,980 | 5,483,940 |
| 180 | blue | 1,500 | 41 | 5 | -64,578 | 3,053,602 |
| 181 | blue | 1,700 | 38 | 7 | -41,730 | 1,667,868 |
| 182 | blue | 1,300 | 42 | 8 | -125,729 | 7,491,157 |
| 183 | blue | 1,500 | 39 | 8 | -59,926 | 2,660,570 |
| 184 | blue | 1,200 | 54 | 11 | -321,420 | 25,924,938 |
| 185 | blue | 1,400 | 36 | 12 | -55,256 | 2,387,940 |
| 186 | blue | 2,000 | 47 | 12 | -41,750 | 1,628,474 |
| 187 | blue | 1,500 | 37 | 14 | -51,653 | 2,235,141 |
| 188 | blue | 1,900 | 42 | 14 | -37,324 | 1,448,816 |
| 189 | blue | 1,500 | 44 | 17 | -80,817 | 4,043,735 |
| 190 | blue | 1,300 | 46 | 18 | -145,588 | 8,898,310 |
| 191 | blue | 1,600 | 49 | 18 | -87,325 | 4,397,211 |
| 192 | blue | 1,200 | 49 | 20 | -223,108 | 15,729,846 |
| 193 | blue | 1,400 | 42 | 21 | -85,303 | 4,205,447 |
| 194 | blue | 1,700 | 44 | 22 | -49,212 | 1,982,160 |
| 195 | blue | 1,600 | 38 | 23 | -39,269 | 1,476,077 |
| 196 | blue | 1,600 | 40 | 24 | -43,392 | 1,666,094 |
| 197 | blue | 1,500 | 51 | 25 | -110,518 | 5,974,634 |
| 198 | blue | 1,300 | 43 | 27 | -103,850 | 5,448,728 |
| 199 | blue | 1,900 | 55 | 29 | -57,038 | 2,458,298 |
| 200 | blue | 1,800 | 36 | 30 | -19,225 | 550,275 |
| 201 | purple | 1,400 | 50 | -30 | -100,636 | 5,296,916 |
| 202 | purple | 1,700 | 48 | -28 | -53,766 | 2,296,292 |
| 203 | purple | 1,800 | 43 | -27 | -31,381 | 1,100,995 |
| 204 | purple | 1,400 | 48 | -26 | -99,680 | 5,221,108 |
| 205 | purple | 2,000 | 51 | -24 | -39,224 | 1,552,184 |
| 206 | purple | 1,400 | 45 | -23 | -89,889 | 4,653,241 |
| 207 | purple | 1,900 | 39 | -22 | -21,649 | 678,283 |
| 208 | purple | 1,900 | 52 | -21 | -50,837 | 2,175,233 |
| 209 | purple | 1,700 | 46 | -20 | -49,840 | 2,106,718 |
| 210 | purple | 1,500 | 45 | -19 | -67,943 | 3,142,705 |
| 211 | purple | 1,600 | 40 | -18 | -41,202 | 1,636,362 |
| 212 | purple | 2,000 | 50 | -16 | -40,165 | 1,593,673 |
| 213 | purple | 1,900 | 36 | -16 | -17,160 | 501,800 |
| 214 | purple | 1,800 | 52 | -14 | -64,528 | 2,988,946 |
| 215 | purple | 1,400 | 53 | -13 | -143,285 | 8,740,671 |
| 216 | purple | 1,800 | 46 | -12 | -51,131 | 2,217,621 |
| 217 | purple | 1,300 | 50 | -11 | -164,113 | 10,583,755 |
| 218 | purple | 1,200 | 45 | -9 | -165,838 | 10,842,122 |
| 219 | purple | 1,600 | 35 | -7 | -31,001 | 1,136,249 |
| 220 | purple | 1,400 | 47 | -7 | -114,516 | 6,692,538 |
| 221 | purple | 1,300 | 38 | -6 | -89,368 | 4,689,642 |
| 222 | purple | 1,800 | 48 | -4 | -59,071 | 2,694,403 |
| 223 | purple | 1,800 | 40 | -2 | -38,356 | 1,526,328 |
| 224 | purple | 1,700 | 54 | -1 | -96,475 | 5,178,125 |
| 225 | purple | 1,900 | 54 | -1 | -68,061 | 3,248,109 |
| 226 | purple | 1,800 | 51 | 0 | -75,207 | 3,774,645 |
| 227 | purple | 1,700 | 37 | 2 | -33,635 | 1,254,105 |
| 228 | purple | 1,600 | 53 | 3 | -115,148 | 6,646,816 |
| 229 | purple | 1,300 | 41 | 5 | -97,739 | 5,248,623 |
| 230 | purple | 1,500 | 41 | 5 | -63,452 | 3,012,166 |
| 231 | purple | 1,700 | 38 | 7 | -40,020 | 1,614,776 |
| 232 | purple | 1,300 | 42 | 8 | -122,110 | 7,313,614 |
| 233 | purple | 1,500 | 39 | 8 | -55,968 | 2,502,072 |
| 234 | purple | 1,200 | 54 | 11 | -313,158 | 25,359,922 |
| 235 | purple | 1,400 | 36 | 12 | -51,192 | 2,161,944 |
| 236 | purple | 2,000 | 47 | 12 | -38,461 | 1,491,975 |
| 237 | purple | 1,500 | 37 | 14 | -47,244 | 2,030,138 |
| 238 | purple | 1,900 | 42 | 14 | -34,959 | 1,338,839 |
| 239 | purple | 1,500 | 44 | 17 | -77,774 | 3,867,138 |
| 240 | purple | 1,300 | 46 | 18 | -139,892 | 8,464,696 |
| 241 | purple | 1,600 | 49 | 18 | -82,309 | 4,121,903 |
| 242 | purple | 1,200 | 49 | 20 | -218,613 | 15,349,769 |
| 243 | purple | 1,400 | 42 | 21 | -79,924 | 3,873,560 |
| 244 | purple | 1,700 | 44 | 22 | -46,735 | 1,861,705 |
| 245 | purple | 1,600 | 38 | 23 | -35,955 | 1,340,645 |
| 246 | purple | 1,600 | 40 | 24 | -42,526 | 1,679,062 |
| 247 | purple | 1,500 | 51 | 25 | -103,869 | 5,582,255 |
| 248 | purple | 1,300 | 43 | 27 | -99,396 | 5,158,934 |
| 249 | purple | 1,900 | 55 | 29 | -53,468 | 2,236,366 |
| 250 | purple | 1,800 | 36 | 30 | -17,280 | 489,998 |