**Annex 1. Predicted results of soil waters for the lumped models: Gamma, Exponential-Piston Flow, Dispersion and Linear.**

**Table 1.** Best predicted results for the Gamma model parameters (*τ, α*) and corresponding uncertainty ranges.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τ | α |
| 0/00 | 0/00 | - | 0/00 | 0/00 | weeks | - |
| *Pastures transect* | | |  |  |  |  |  |
| A1 | -6.74 | 3.06 | 0.87 | 1.33 | -0.04 | 3.6(2.9-4.4) | 3.6(2.0-13.4) |
| A2 | -6.72 | 2.46 | 0.73 | 1.72 | 0.07 | 5.5(4.5-6.7) | 1.8(1.2-3.4) |
| A3 | -7.17 | 3.18 | 0.85 | 1.54 | -0.04 | 4.4(3.5-5.5) | 2.0(1.4-8.3) |
| B1 | -6.58 | 3.01 | 0.83 | 1.53 | 0.27 | 4.4(3.6-5.3) | 2.0(1.4-7.0) |
| B2 | -6.88 | 2.71 | 0.80 | 1.53 | 0.15 | 5.0(4.1-6.1) | 1.7(1.2-3.5) |
| B3 | -6.72 | 2.97 | 0.80 | 1.51 | 0.04 | 4.4(3.6-5.4) | 2.1(1.3-5.1) |
| C1 | -6.68 | 3.15 | 0.86 | 1.36 | -0.04 | 3.5(2.7-4.2) | 2.4(1.6-9.0) |
| C2 | -7.19 | 3.11 | 0.88 | 1.19 | -0.14 | 3.7(2.9-4.6) | 2.1(1.2-5.4) |
| C3 | -6.53 | 2.56 | 0.80 | 1.35 | -0.01 | 5.3(4.5-6.4) | 1.9(1.3-3.8) |
| *Forest transect* | |  |  |  |  |  |  |
| D1 | -7.26 | 2.79 | 0.81 | 1.35 | 0.12 | 6.1(5.1-7.5) | 2.4(1.5-4.9) |
| D2 | -7.03 | 2.35 | 0.82 | 1.08 | 0.03 | 7.6(6.6-9.2) | 1.9(1.3-3.2) |
| D3 | -6.82 | 2.40 | 0.82 | 1.16 | -0.02 | 6.7(5.8-7.9) | 1.8(1.2-3.6) |
| E1 | -6.54 | 2.79 | 0.82 | 1.34 | 0.10 | 5.9(5.1-6.8) | 2.9(1.8-7.1) |
| E2 | -6.52 | 2.44 | 0.78 | 1.37 | 0.11 | 7.3(6.4-8.2) | 2.7(1.8-5.6) |
| E3 | -6.43 | 1.97 | 0.79 | 1.16 | 0.02 | 9.4(8.2-10.7) | 2.5(1.8-4.0) |
| F1 | -6.81 | 2.72 | 0.90 | 0.99 | -0.06 | 5.0(4.2-6.1) | 1.9(1.3-4.7) |
| F2 | -6.74 | 2.79 | 0.90 | 0.97 | -0.29 | 4.7(3.8-5.7) | 2.4(1.4-6.4) |
| F3 | -8.50 | 1.87 | 0.69 | 1.41 | -0.41 | 10.2(8.7-12.5) | 1.6(1.2-2.2) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error

**Table 2.** Best predicted results for the Exponential Piston flow model parameters (*τ, η*) and corresponding uncertainty ranges.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τ | η |
| 0/00 | 0/00 | - | 0/00 | 0/00 | weeks | - |
| *Pastures transect* | | |  |  |  |  |  |
| A1 | -6.88 | 3.00 | 0.86 | 1.38 | -0.18 | 3.7(2.9-4.8) | 1.40(1.28-1.59) |
| A2 | -6.91 | 2.53 | 0.73 | 1.71 | -0.12 | 5.7(4.7-7.2) | 1.26(1.18-1.34) |
| A3 | -7.31 | 3.23 | 0.84 | 1.57 | -0.18 | 4.5(3.5-5.7) | 1.33(1.21-1.48) |
| B1 | -6.99 | 3.11 | 0.84 | 1.49 | -0.14 | 5.1(4.0-6.3) | 1.33(1.24-1.43) |
| B2 | -7.14 | 2.82 | 0.80 | 1.51 | -0.10 | 5.5(4.4-6.9) | 1.28(1.20-1.36) |
| B3 | -6.82 | 2.94 | 0.80 | 1.52 | -0.05 | 4.7(3.8-6.0) | 1.30(1.21-1.40) |
| C1 | -6.75 | 3.15 | 0.86 | 1.38 | -0.10 | 3.7(2.9-4.7) | 1.40(1.29-1.57) |
| C2 | -7.15 | 3.09 | 0.88 | 1.18 | -0.09 | 3.8(3.0-5.0) | 1.36(1.25-1.51) |
| C3 | -6.59 | 2.54 | 0.80 | 1.36 | -0.08 | 5.5(4.5-6.9) | 1.25(1.17-1.33) |
| *Forest transect* | |  |  |  |  |  |  |
| D1 | -7.40 | 2.79 | 0.83 | 1.28 | -0.02 | 7.0(5.6-8.6) | 1.44(1.33-1.56) |
| D2 | -7.06 | 2.36 | 0.82 | 1.11 | 0.00 | 8.5(7.2-10.2) | 1.32(1.26-1.39) |
| D3 | -6.84 | 2.36 | 0.81 | 1.19 | -0.05 | 7.2(6.0-8.9) | 1.18(1.12-1.23) |
| E1 | -6.67 | 2.75 | 0.82 | 1.34 | -0.03 | 6.6(5.5-8.1) | 1.47(1.37-1.63) |
| E2 | -6.69 | 2.38 | 0.77 | 1.40 | -0.07 | 8.2(6.9-9.8) | 1.37(1.29-1.46) |
| E3 | -6.54 | 1.99 | 0.78 | 1.21 | -0.09 | 10.3(8.9-12.1) | 1.45(1.32-1.58) |
| F1 | -6.88 | 2.73 | 0.90 | 0.97 | -0.13 | 5.2(4.2-6.6) | 1.27(1.19-1.36) |
| F2 | -6.61 | 2.65 | 0.91 | 0.95 | -0.16 | 4.8(3.8-6.1) | 1.25(1.16-1.37) |
| F3 | -8.14 | 2.02 | 0.74 | 1.30 | -0.05 | 9.6(8.4-11.7) | 1.37(1.22-1.47) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error

**Table 3.** Best predicted results for the Dispersion model parameters (*τ, Dp*) and corresponding uncertainty ranges.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τ | Dp |
| 0/00 | 0/00 | - | 0/00 | 0/00 | weeks | - |
| *Pastures transect* | | |  |  |  |  |  |
| A1 | -6.77 | 3.10 | 0.86 | 1.33 | -0.07 | 3.6(3.1-4.7) | 0.13(0.07-0.53) |
| A2 | -6.63 | 2.45 | 0.72 | 1.76 | 0.16 | 5.7(4.7-7.8) | 0.33(0.22-0.99) |
| A3 | -7.15 | 3.23 | 0.84 | 1.59 | -0.02 | 4.5(3.6-6.1) | 0.22(0.11-0.97) |
| B1 | -6.56 | 3.08 | 0.82 | 1.55 | 0.29 | 4.6(3.8-5.8) | 0.21(0.11-0.78) |
| B2 | -6.79 | 2.77 | 0.79 | 1.57 | 0.24 | 5.1(4.3-7.2) | 0.31(0.21-1.06) |
| B3 | -6.64 | 2.94 | 0.80 | 1.52 | 0.12 | 4.5(3.8-6.5) | 0.28(0.17-0.87) |
| C1 | -6.61 | 3.17 | 0.86 | 1.37 | 0.03 | 3.5(2.9-5.1) | 0.19(0.10-0.85) |
| C2 | -7.00 | 3.06 | 0.88 | 1.19 | 0.06 | 3.7(3.2-5.8) | 0.29(0.17-0.97) |
| C3 | -6.46 | 2.53 | 0.79 | 1.38 | 0.06 | 5.5(4.7-7.5) | 0.32(0.20-0.84) |
| *Forest transect* | |  |  |  |  |  |  |
| D1 | -7.24 | 2.68 | 0.83 | 1.28 | 0.14 | 6.7(5.7-9.2) | 0.31(0.18-0.64) |
| D2 | -6.99 | 2.33 | 0.82 | 1.08 | 0.07 | 8.4(7.2-11.7) | 0.34(0.23-0.76) |
| D3 | -6.77 | 2.40 | 0.81 | 1.19 | 0.03 | 7.2(6.2-10.0) | 0.32(0.19-0.82) |
| E1 | -6.55 | 2.75 | 0.82 | 1.33 | 0.10 | 6.3(5.4-7.8) | 0.21(0.12-0.46) |
| E2 | -6.51 | 2.45 | 0.77 | 1.39 | 0.11 | 7.6(6.8-9.4) | 0.20(0.13-0.43) |
| E3 | -6.41 | 2.00 | 0.78 | 1.19 | 0.03 | 9.8(8.7-11.8) | 0.22(0.15-0.39) |
| F1 | -6.72 | 2.72 | 0.90 | 1.00 | 0.04 | 5.2(4.3-7.1) | 0.29(0.18-0.83) |
| F2 | -6.66 | 2.73 | 0.91 | 0.95 | -0.21 | 4.8(3.9-6.7) | 0.29(0.15-0.73) |
| F3 | -8.49 | 1.90 | 0.70 | 1.39 | -0.40 | 11.6(9.8-14.6) | 0.41(0.29-0.75) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error

**Table 4.** Best predicted results for the Linear Model parameter (*τ*)and corresponding uncertainty ranges.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τ |
| 0/00 | 0/00 | - | 0/00 | 0/00 | weeks |
| *Pastures transect* | | |  |  |  |  |
| A1 | -6.85 | 3.06 | 0.86 | 1.37 | -0.15 | 3.5(2.8-4.5) |
| A2 | -6.87 | 2.63 | 0.73 | 1.72 | -0.08 | 5.4(4.5-6.2) |
| A3 | -7.32 | 3.30 | 0.86 | 1.46 | -0.19 | 4.4(3.5-5.2) |
| B1 | -6.89 | 3.19 | 0.83 | 1.52 | -0.04 | 4.3(3.3-4.9) |
| B2 | -7.03 | 3.02 | 0.78 | 1.57 | 0.00 | 4.4(3.8-5.2) |
| B3 | -6.77 | 3.03 | 0.79 | 1.54 | 0.00 | 4.4(3.4-4.9) |
| C1 | -6.72 | 3.17 | 0.84 | 1.44 | -0.07 | 3.5(2.5-4.1) |
| C2 | -7.10 | 3.16 | 0.87 | 1.27 | -0.04 | 3.5(2.9-4.5) |
| C3 | -6.54 | 2.71 | 0.80 | 1.36 | -0.02 | 4.9(4.4-5.9) |
| *Forest transect* | |  |  |  |  |  |
| D1 | -7.31 | 2.91 | 0.76 | 1.50 | 0.07 | 5.4(4.8-6.2) |
| D2 | -6.97 | 2.56 | 0.78 | 1.19 | 0.09 | 6.6(5.9-7.1) |
| D3 | -6.74 | 2.61 | 0.80 | 1.22 | 0.05 | 6.0(4.9-6.6) |
| E1 | -6.65 | 2.84 | 0.80 | 1.41 | 0.00 | 5.4(4.8-6.1) |
| E2 | -6.64 | 2.55 | 0.78 | 1.37 | -0.01 | 6.4(5.8-7.1) |
| E3 | -6.48 | 2.14 | 0.76 | 1.24 | -0.04 | 8.1(7.3-9.2) |
| F1 | -6.79 | 2.90 | 0.89 | 1.05 | -0.03 | 4.5(4.0-5.5) |
| F2 | -6.52 | 2.79 | 0.89 | 1.03 | -0.08 | 4.6(3.9-5.6) |
| F3 | -8.42 | 2.37 | 0.64 | 1.51 | -0.33 | 7.2(7.1-8.2) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error

**Annex 2. Predicted results of stream, creek and spring waters for the lumped models Gamma and Two Parallel Linear Reservoirs.**

**Table 1.** Best predicted results for the Gamma model parameters (*τ, α*) and corresponding uncertainty ranges.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τ | α |
| 0/00 | 0/00 | - | 0/00 | 0/00 | yr | - |
| *Stream* |  |  |  |  |  |  |  |
| PL | -8.16 | 0.42 | 0.61 | 0.34 | 0.0909 | 2.2(1.6-3.2) | 0.62(0.55-0.71) |
| SF | -8.03 | 0.43 | 0.62 | 0.34 | 0.0836 | 2.0(1.5-3.1) | 0.63(0.56-0.72) |
| *Streamwater tributaries* | | |  |  |  |  |  |
| FH | -8.21 | 0.42 | 0.58 | 0.36 | 0.0765 | 1.8(1.5-2.9) | 0.71(0.60-0.78) |
| QZ | -8.35 | 0.36 | 0.58 | 0.31 | 0.0596 | 2.7(2.0-3.9) | 0.63(0.57-0.72) |
| QN | -8.21 | 0.40 | 0.64 | 0.30 | 0.0681 | 2.1(1.6-3.2) | 0.66(0.58-0.75) |
| QR | -7.86 | 0.16 | 0.45 | 0.35 | 0.0915 | 3.5(2.6-4.4) | 0.60(0.56-0.67) |
| QP | -8.04 | 0.26 | 0.54 | 0.23 | 0.0240 | 4.3(3.3-5.4) | 0.65(0.62-0.73) |
| QM | -7.74 | 0.44 | 0.60 | 0.37 | 0.0706 | 2.5(1.8-3.7) | 0.57(0.51-0.64) |
| QC | -7.57 | 0.24 | 0.53 | 0.21 | 0.0508 | 4.5(3.7-5.4) | 0.68(0.64-0.74) |
| *Creeks* |  |  |  |  |  |  |  |
| TP | -7.63 | 0.20 | 0.45 | 0.18 | 0.0249 | 5.5(4.8-5.9) | 0.68(0.64-0.73) |
| Q3 | -7.66 | 0.45 | 0.68 | 0.30 | 0.0126 | 1.7(1.3-2.8) | 0.65(0.55-0.74) |
| *Springs* |  |  |  |  |  |  |  |
| PLS | -7.94 | 0.43 | 0.69 | 0.28 | 0.0945 | 2.6(1.9-3.7) | 0.58(0.53-0.66) |
| SFS | -7.57 | 0.23 | 0.56 | 0.19 | 0.0432 | 3.9(3.0-4.9) | 0.74(0.68-0.81) |
| QRS | -7.78 | 0.09 | 0.25 | 0.14 | 0.0146 | 6.0(5.3-6.5) | 0.94(0.91-1.00) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error

**Table 2.** Best predicted results for the Two Parallel Reservoir model parameters (*τs, φ*) and corresponding uncertainty ranges. A fixed range from 4 to 4.5 weeks was maintained for *f* in all cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Mean |  | NSE | RMSE | Bias | τs | φ |
| 0/00 | 0/00 | - | 0/00 | 0/00 | yr | - |
| *Stream* |  |  |  |  |  |  |  |
| PL | -8.24 | 0.44 | 0.66 | 0.32 | 0.0176 | 2.5(1.9-5.6) | 0.622(0.554-0.706) |
| SF | -8.10 | 0.44 | 0.64 | 0.33 | 0.0117 | 2.1(1.6-4.3) | 0.631(0.555-0.721) |
| *Streamwater tributaries* | | |  |  |  |  |  |
| FH | -8.24 | 0.43 | 0.60 | 0.34 | 0.0383 | 2.0(1.5-3.1) | 0.708(0.605-0.782) |
| QZ | -8.41 | 0.37 | 0.60 | 0.30 | 0.0000 | 2.5(1.9-4.7) | 0.632(0.570-0.717) |
| QN | -8.27 | 0.41 | 0.67 | 0.29 | 0.0141 | 2.2(1.6-3.6) | 0.660(0.582-0.749) |
| QR | -7.93 | 0.23 | 0.52 | 0.33 | 0.0280 | 4.6(3.1-7.0) | 0.603(0.562-0.672) |
| QP | -8.09 | 0.24 | 0.54 | 0.23 | -0.0207 | 3.6(2.8-6.5) | 0.653(0.620-0.728) |
| QM | -7.84 | 0.48 | 0.63 | 0.36 | -0.0307 | 2.7(2.1-8.3) | 0.565(0.506-0.636) |
| QC | -7.60 | 0.23 | 0.59 | 0.19 | 0.0183 | 5.2(3.8-6.8) | 0.685(0.642-0.741) |
| *Creeks* |  |  |  |  |  |  |  |
| TP | -7.65 | 0.17 | 0.51 | 0.17 | 0.0054 | 7.0(5.7-7.8) | 0.680(0.642-0.726) |
| Q3 | -7.71 | 0.43 | 0.67 | 0.31 | -0.0428 | 1.7(1.3-2.7) | 0.648(0.554-0.742) |
| *Springs* |  |  |  |  |  |  |  |
| PLS | -8.04 | 0.44 | 0.78 | 0.24 | -0.0045 | 4.0(2.6-8.0) | 0.581(0.526-0.659) |
| SFS | -7.58 | 0.23 | 0.59 | 0.19 | 0.0255 | 3.6(2.8-5.2) | 0.735(0.684-0.813) |
| QRS | -7.79 | 0.09 | 0.25 | 0.14 | 0.0119 | 6.1(5.3-6.6) | 0.945(0.911-0.997) |

σ= standard deviation, NSE = Nash-Sutcliffe Efficiency, RMSE = Root Mean Square Error