Supplement of

Updated European hydraulic pedotransfer functions with communicated uncertainties in the predicted variables (euptfv2)

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Figure S1. The scatter plot of the measured versus predicted plant available water content values of the worst and best performing PTF with 90% prediction interval on test datasets. AWC_2: plant available water content based on filed capacity at -100 cm matric potential head (PTF01 vs. PTF03); AWC: plant available water content based on filed capacity at -330 cm matric potential head (PTF01 vs. PTF03); PSD: particle size distribution (sand, 50–2000 μm; silt, 2–50 μm; clay, <2 μm (mass %)); DEPTH_M: mean soil depth (cm); BD: bulk density (g cm\(^{-3}\)); Count: the number of cases in each rectangle.
Table S1. Performance of pedotransfer functions (PTF) by input combination on training and test datasets to predict the plant available water content of the soil (AWC_2) belonging to the -100 cm matric potential head. N: number of samples, RMSE: root mean square error (cm³ cm⁻³), and $R^2$: determination coefficient, TEST_BASIC: samples with measured PSD, DEPTH, OC and BD; TEST_CHEM+: samples with measured PSD, DEPTH, OC, BD, CACO₃, PH_H₂O and CEC. Recommended PTFs are highlighted in bold.

| Name of PTF in euftv2 | Predictor variables | Training set | Test set | Sign. difference² | Recommended PTF |
|-----------------------|---------------------|--------------|----------|-------------------|----------------|
|                       |                     | N   | RMSE | $R^2$ | N   | RMSE | $R^2$ | TEST_BASIC | TEST_CHEM+ |        |
|                       | PSD+DEPTH           | 3528 | 0.062 | 0.446 | 1372 | 0.060 | 0.432 | a          | ab         | PTF01    |
|                       | PSD+DEPTH+OC        | 3208 | 0.055 | 0.540 | 1372 | 0.054 | 0.544 | b          | abcd       | PTF02    |
|                       | PSD+DEPTH+BD        | 3472 | 0.054 | 0.581 | 1372 | 0.053 | 0.552 | b          | abcd       | PTF03    |
|                       | PSD+DEPTH+CACO₃     | 1548 | 0.050 | 0.326 | 274  | 0.055 | 0.219 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+PH_H₂O    | 1849 | 0.058 | 0.463 | 274  | 0.055 | 0.216 | -          | a          | PTF01    |
|                       | PSD+DEPTH+CEC       | 1550 | 0.059 | 0.512 | 274  | 0.060 | 0.050 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+OC+BD     | 3197 | 0.051 | 0.609 | 1372 | 0.051 | 0.588 | b          | abcd       | PTF03    |
|                       | PSD+DEPTH+OC+CACO₃  | 1464 | 0.048 | 0.353 | 274  | 0.053 | 0.257 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+OC+PH_H₂O | 1615 | 0.055 | 0.490 | 274  | 0.053 | 0.270 | -          | ab         | PTF02    |
|                       | PSD+DEPTH+OC+CEC    | 1358 | 0.054 | 0.563 | 274  | 0.053 | 0.278 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+BD+CACO₃  | 1545 | 0.044 | 0.470 | 274  | 0.048 | 0.396 | -          | d          | PTF03    |
|                       | PSD+DEPTH+BD+PH_H₂O | 1796 | 0.052 | 0.565 | 274  | 0.048 | 0.406 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+BD+CEC    | 1498 | 0.053 | 0.598 | 274  | 0.048 | 0.398 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+CACO₃+PH_H₂O | 1195 | 0.051 | 0.341 | 274  | 0.052 | 0.284 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+CACO₃+CEC | 726  | 0.050 | 0.286 | 274  | 0.052 | 0.303 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+PH_H₂O+CACO₃ | 1255 | 0.058 | 0.539 | 274  | 0.051 | 0.331 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+OC+BD+CACO₃ | 1464 | 0.044 | 0.465 | 274  | 0.048 | 0.390 | -          | bcd        | PTF03    |
|                       | PSD+DEPTH+OC+BD+PH_H₂O | 1607 | 0.051 | 0.556 | 274  | 0.048 | 0.407 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+OC+BD+CEC | 1349 | 0.052 | 0.593 | 274  | 0.046 | 0.441 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+OC+CACO₃+PH_H₂O | 1130 | 0.050 | 0.367 | 274  | 0.051 | 0.309 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+OC+CACO₃+CEC | 683  | 0.049 | 0.305 | 274  | 0.050 | 0.359 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+OC+PH_H₂O+CACO₃ | 1067 | 0.054 | 0.561 | 274  | 0.049 | 0.367 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+BD+CACO₃+PH_H₂O | 1192 | 0.046 | 0.471 | 274  | 0.049 | 0.375 | -          | bcd        | PTF03    |
|                       | PSD+DEPTH+BD+CACO₃+CEC | 725  | 0.045 | 0.420 | 274  | 0.046 | 0.444 | -          | d          | PTF03    |
|                       | PSD+DEPTH+BD+PH_H₂O+CACO₃ | 1204 | 0.052 | 0.621 | 274  | 0.046 | 0.456 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+BD+PH_H₂O+CEC | 684  | 0.049 | 0.318 | 274  | 0.048 | 0.388 | -          | abcd       | PTF01    |
|                       | PSD+DEPTH+OC+BD+CACO₃+PH_H₂O | 1130 | 0.045 | 0.475 | 274  | 0.049 | 0.367 | -          | abcd       | PTF03    |
|                       | PSD+DEPTH+OC+BD+CACO₃+CEC | 683  | 0.045 | 0.408 | 274  | 0.045 | 0.466 | -          | bcd        | PTF03    |
|                       | PSD+DEPTH+OC+BD+PH_H₂O+CACO₃ | 1059 | 0.052 | 0.603 | 274  | 0.045 | 0.473 | -          | bcd        | PTF03    |
|                       | PSD+DEPTH+OC+BD+PH_H₂O+CEC | 641  | 0.049 | 0.330 | 274  | 0.048 | 0.393 | -          | abcd       | PTF02    |
|                       | PSD+DEPTH+OC+CACO₃+PH_H₂O+CACO₃+CEC | 683 | 0.044 | 0.450 | 274  | 0.045 | 0.480 | -          | cd         | PTF03    |
|                       | PSD+DEPTH+OC+BD+CACO₃+PH_H₂O+CEC | 641 | 0.044 | 0.425 | 274  | 0.045 | 0.471 | -          | cd         | PTF03    |

1 PSD: particle size distribution (sand, 50–2000 μm; silt, 2–50 μm; clay, <2 μm (mass %)); DEPTH: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO₃: calcium carbonate content (mass %); PH_H₂O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).

2 Different letters indicate significant differences at the 0.05 level between the accuracy of the methods based on the squared error; for example performance indicated with the letter c is significantly better than the one noted with letters b and a.
Table S2. Performance of pedotransfer functions (PTF) by input combination on training and test datasets to predict the plant available water content of the soil (AWC) belonging to the -330 cm matric potential head. N: number of samples, RMSE: root mean square error (cm³ cm⁻³), and $R^2$: determination coefficient, TEST_BASIC: samples with measured PSD, DEPTH, OC and BD; TEST_CHEM+: samples with measured PSD, DEPTH, OC, BD, CACO3, PH_H2O and CEC. Recommended PTFs are highlighted in bold.

| Name of PTF in | Predictor variables¹ | Training set | Test set | Sign. difference² | Recommended PTF |
|----------------|-----------------------|--------------|----------|-------------------|----------------|
| PTF01          | PSD+DEPTH             | 1863 0.042 0.312 | 705 0.048 0.196 | a a PTF01        |                |
| PTF02          | PSD+DEPTH+OC          | 1650 0.041 0.337 | 705 0.045 0.288 | ab a PTF01       |                |
| PTF03          | PSD+DEPTH+BD          | 1849 0.040 0.374 | 705 0.045 0.285 | ab a PTF01       | PTF03          |
| PTF04          | PSD+DEPTH+CACO3       | 1531 0.040 0.366 | 279 0.050 0.199 | - a PTF01        |                |
| PTF05          | PSD+DEPTH+PH_H2O      | 1245 0.042 0.344 | 279 0.048 0.238 | - a PTF01        |                |
| PTF06          | PSD+DEPTH+CACO3+BD    | 1092 0.041 0.356 | 279 0.053 0.078 | - a PTF01        |                |
| PTF07          | PSD+DEPTH+OC+BD       | 1645 0.040 0.381 | 705 0.043 0.337 | b a PTF03        | PTF03          |
| PTF08          | PSD+DEPTH+OC+CACO3    | 1336 0.041 0.345 | 279 0.049 0.219 | - a PTF01        |                |
| PTF09          | PSD+DEPTH+OC+PH_H2O   | 1074 0.042 0.345 | 279 0.048 0.242 | - a PTF01        |                |
| PTF10          | PSD+DEPTH+OC+CACO3+BD | 998 0.039 0.413 | 279 0.051 0.147 | - a PTF01        |                |
| PTF11          | PSD+DEPTH+BD+CACO3    | 1522 0.038 0.428 | 279 0.048 0.258 | - a PTF01        |                |
| PTF12          | PSD+DEPTH+BD+PH_H2O   | 1236 0.039 0.429 | 279 0.047 0.287 | - a PTF01        |                |
| PTF13          | PSD+DEPTH+BD+CACO3+BD | 1088 0.038 0.429 | 279 0.049 0.231 | - a PTF01        |                |
| PTF14          | PSD+DEPTH+CACO3+BD    | 1230 0.041 0.376 | 279 0.047 0.263 | - a PTF01        |                |
| PTF15          | PSD+DEPTH+CACO3+BD+CEC| 791 0.041 0.366 | 279 0.049 0.214 | - a PTF01        |                |
| PTF16          | PSD+DEPTH+PH_H2O+CEC  | 739 0.042 0.321 | 279 0.048 0.237 | - a PTF01        |                |
| PTF17          | PSD+DEPTH+OC+BD+CACO3 | 1334 0.039 0.399 | 279 0.048 0.262 | - a PTF03        |                |
| PTF18          | PSD+DEPTH+OC+BD+PH_H2O| 1072 0.040 0.393 | 279 0.047 0.293 | - a PTF03        |                |
| PTF19          | PSD+DEPTH+OC+CACO3+BD | 995 0.038 0.432 | 279 0.049 0.223 | - a PTF03        |                |
| PTF20          | PSD+DEPTH+OC+CACO3+PH_H2O | 1059 0.042 0.362 | 279 0.047 0.289 | - a PTF01        |                |
| PTF21          | PSD+DEPTH+OC+CACO3+CEC| 707 0.041 0.358 | 279 0.049 0.229 | - a PTF01        |                |
| PTF22          | PSD+DEPTH+OC+PH_H2O+CEC| 660 0.041 0.339 | 279 0.048 0.253 | - a PTF01        |                |
| PTF23          | PSD+DEPTH+BD+CACO3+PH_H2O | 1221 0.039 0.442 | 279 0.047 0.267 | - a PTF01        |                |
| PTF24          | PSD+DEPTH+BD+CACO3+CEC| 788 0.039 0.405 | 279 0.047 0.269 | - a PTF01        |                |
| PTF25          | PSD+DEPTH+BD+PH_H2O+CEC| 736 0.039 0.402 | 279 0.046 0.307 | - a PTF01        |                |
| PTF26          | PSD+DEPTH+CACO3+PH_H2O+CEC| 732 0.040 0.405 | 279 0.048 0.254 | - a PTF03        |                |
| PTF27          | PSD+DEPTH+OC+BD+CACO3+PH_H2O | 1057 0.040 0.415 | 279 0.046 0.312 | - a PTF03        |                |
| PTF28          | PSD+DEPTH+OC+BD+CACO3+CEC| 705 0.040 0.383 | 279 0.047 0.277 | - a PTF03        |                |
| PTF29          | PSD+DEPTH+OC+BD+CACO3+PH_H2O | 658 0.040 0.385 | 279 0.046 0.315 | - a PTF03        |                |
| PTF30          | PSD+DEPTH+OC+CACO3+PH_H2O+CEC| 653 0.040 0.395 | 279 0.047 0.274 | - a PTF01        |                |
| PTF31          | PSD+DEPTH+OC+CACO3+PH_H2O+CEC| 729 0.039 0.431 | 279 0.047 0.290 | - a PTF01        |                |
| PTF32          | PSD+DEPTH+OC+BD+CACO3+PH_H2O+CEC| 651 0.039 0.403 | 279 0.046 0.307 | - a PTF03        |                |

¹PSD: particle size distribution (sand, 50–2000 μm; silt, 2–50 μm; clay, <2 μm (mass %)); DEPTH: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).

²Different letters indicate significant differences at the 0.05 level between the accuracy of the methods based on the squared error; for example performance indicated with the letter c is significantly better than the one noted with letters b and a.
Table S3. Normalized root mean square error (NRMSE) of the point predictions by soil hydraulic properties computed on the test datasets in cm$^3$ cm$^{-3}$ for water retention and log$_{10}$ (cm day$^{-1}$) for saturated hydraulic conductivity. In case of PTF01, 02, 03 and 07 TEST_BASIC set was used for the analysis, for the rest of the PTFs TEST_CHEM+ set was considered.

| Name of PTF in euptf2 | Predictor variables$^1$ | NRMSE in test sets$^2$ |
|------------------------|-------------------------|------------------------|
|                        |                         | THS        | FC_2         | FC          | WP          | AWC_2       | AWC         | KS          |
| PTF01                  | PSD+DEPTH_M             | 0.104      | 0.090        | 0.082       | 0.105       | 0.126       | 0.140       | 0.17        |
| PTF02                  | PSD+DEPTH_M+OC          | 0.086      | 0.083        | 0.076       | 0.102       | 0.112       | 0.132       | 0.14        |
| PTF03                  | PSD+DEPTH_M+BD          | 0.048      | 0.079        | 0.074       | 0.100       | 0.111       | 0.132       | 0.17        |
| PTF04                  | PSD+DEPTH_M+CACO3       | 0.191      | 0.107        | 0.113       | 0.122       | 0.164       | 0.145       | 0.19        |
| PTF05                  | PSD+DEPTH_M+PH_H2O      | 0.176      | 0.112        | 0.114       | 0.126       | 0.164       | 0.142       | 0.19        |
| PTF06                  | PSD+DEPTH_M+CEC         | 0.191      | 0.107        | 0.107       | 0.118       | 0.181       | 0.156       | 0.19        |
| PTF07                  | PSD+DEPTH_M+OC+BD       | 0.047      | 0.075        | 0.073       | 0.097       | 0.107       | 0.127       | 0.14        |
| PTF08                  | PSD+DEPTH_M+OC+CACO3    | 0.184      | 0.097        | 0.109       | 0.117       | 0.160       | 0.143       | 0.19        |
| PTF09                  | PSD+DEPTH_M+OC+PH_H2O   | 0.167      | 0.095        | 0.107       | 0.119       | 0.158       | 0.141       | 0.18        |
| PTF10                  | PSD+DEPTH_M+OC+CEC      | 0.172      | 0.098        | 0.108       | 0.116       | 0.158       | 0.150       | 0.18        |
| PTF11                  | PSD+DEPTH_M+BD+CACO3    | 0.072      | 0.091        | 0.105       | 0.115       | 0.144       | 0.140       | 0.19        |
| PTF12                  | PSD+DEPTH_M+BD+PH_H2O   | 0.069      | 0.086        | 0.103       | 0.117       | 0.143       | 0.137       | 0.19        |
| PTF13                  | PSD+DEPTH_M+BD+CEC      | 0.070      | 0.091        | 0.100       | 0.115       | 0.144       | 0.142       | 0.19        |
| PTF14                  | PSD+DEPTH_M+CACO3+PH_H2O | 0.168     | 0.101       | 0.109       | 0.121       | 0.157       | 0.139       | 0.19        |
| PTF15                  | PSD+DEPTH_M+CACO3+CEC   | 0.179      | 0.102        | 0.106       | 0.113       | 0.155       | 0.144       | 0.19        |
| PTF16                  | PSD+DEPTH_M+PH_H2O+CEC  | 0.183      | 0.098        | 0.104       | 0.115       | 0.152       | 0.142       | 0.19        |
| PTF17                  | PSD+DEPTH_M+OC+BD+CACO3 | 0.070      | 0.089        | 0.102       | 0.111       | 0.145       | 0.139       | 0.18        |
| PTF18                  | PSD+DEPTH_M+OC+BD+PH_H2O | 0.070    | 0.083        | 0.103       | 0.116       | 0.143       | 0.136       | 0.18        |
| PTF19                  | PSD+DEPTH_M+OC+BD+CEC   | 0.070      | 0.087        | 0.099       | 0.113       | 0.139       | 0.143       | 0.18        |
| PTF20                  | PSD+DEPTH_M+OC+CACO3+PH_H2O | 0.166    | 0.105       | 0.107       | 0.114       | 0.154       | 0.137       | 0.18        |
| PTF21                  | PSD+DEPTH_M+OC+CACO3+CEC | 0.171     | 0.090        | 0.104       | 0.108       | 0.149       | 0.142       | 0.18        |
| PTF22                  | PSD+DEPTH_M+OC+PH_H2O+CEC | 0.166    | 0.089       | 0.102       | 0.111       | 0.148       | 0.140       | 0.18        |
| PTF23                  | PSD+DEPTH_M+BD+CACO3+PH_H2O | 0.071    | 0.089       | 0.104       | 0.116       | 0.147       | 0.139       | 0.18        |
| PTF24                  | PSD+DEPTH_M+BD+CACO3+CEC | 0.071    | 0.085       | 0.099       | 0.110       | 0.138       | 0.139       | 0.19        |
| PTF25                  | PSD+DEPTH_M+BD+PH_H2O+CEC | 0.067    | 0.084       | 0.100       | 0.112       | 0.137       | 0.135       | 0.19        |
| PTF26                  | PSD+DEPTH_M+CACO3+PH_H2O+CEC | 0.163   | 0.094       | 0.103       | 0.111       | 0.145       | 0.140       | 0.18        |
| PTF27                  | PSD+DEPTH_M+OC+BD+CACO3+PH_H2O | 0.072   | 0.086       | 0.101       | 0.111       | 0.148       | 0.135       | 0.18        |
| PTF28                  | PSD+DEPTH_M+OC+BD+CACO3+CEC | 0.070    | 0.082       | 0.098       | 0.106       | 0.136       | 0.138       | 0.18        |
| PTF29                  | PSD+DEPTH_M+OC+BD+PH_H2O+CEC | 0.068   | 0.083       | 0.095       | 0.109       | 0.135       | 0.134       | 0.18        |
| PTF30                  | PSD+DEPTH_M+OC+CACO3+PH_H2O+CEC | 0.162  | 0.100       | 0.101       | 0.108       | 0.145       | 0.138       | 0.17        |
| PTF31                  | PSD+DEPTH_M+BD+CACO3+PH_H2O+CEC | 0.070   | 0.081       | 0.097       | 0.108       | 0.134       | 0.137       | 0.18        |
| PTF32                  | PSD+DEPTH_M+OC+BD+CACO3+PH_H2O+CEC | 0.069  | 0.079       | 0.097       | 0.107       | 0.135       | 0.135       | 0.18        |

$^1$PSD: particle size distribution (sand, 50–2000 µm; silt, 2–50 µm; clay, <2 µm (mass %)); DEPTH: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).

$^2$THS: saturated water content (pF 0); FC_2: water content at -100 cm matric potential head (pF 2.0); FC: water content at -330 cm matric potential head (pF 2.5); AWC_2: plant available water content based on FC_2; AWC: plant available water content based on FC; WP: water content at wilting point (pF 4.2); KS: saturated hydraulic conductivity.
Figure S2. Root mean square error (RMSE) of the pedotransfer functions derived to predict water content at saturation (THS) computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).

Figure S3. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) water content at saturation (THS) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).
Figure S4. Root mean square error (RMSE) of the pedotransfer functions derived to predict water content at -100 cm matric potential head (FC_2) computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).

Figure S5. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) water content at -100 cm matric potential head (FC_2) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).
**Figure S6.** Root mean square error (RMSE) of the pedotransfer functions derived to predict water content at -330 cm matric potential head (FC) computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).

**Figure S7.** Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) water content at -330 cm matric potential head (FC) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).
Figure S8. Root mean square error (RMSE) of the pedotransfer functions derived to predict water content at wilting point (WP) computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).

Figure S9. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) water content at wilting point (WP) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).
Figure S10. Root mean square error (RMSE) of the pedotransfer functions derived to predict plant available water content (AWC_2) considering field capacity at -100 m UPC potential head (FC_2), computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %); USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).

Figure S11. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+) plant available water content (AWC_2) considering field capacity at -100 m UPC potential head (FC_2) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %); USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).
**Figure S12.** Root mean square error (RMSE) of the pedotransfer functions derived to predict plant available water content (AWC) considering field capacity at -330 matric potential head (FC), computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).

| Input parameters of the PTF | RMSE (cm\(^{3}\) cm\(^{-3}\)) |
|-----------------------------|-------------------------------|
| USSAND+USSILT+USCLAY+DEPTH_M+OC+CEC | 279 |
| USSAND+USSILT+USCLAY+DEPTH_M+OC+CACO3 | 279 |
| USSAND+USSILT+USCLAY+DEPTH_M+OC+PH_H2O | 279 |
| USSAND+USSILT+USCLAY+DEPTH_M+OC+BD+PH_H2O | 279 |

**Figure S13.** Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) plant available water content (AWC) considering field capacity at -330 matric potential head (FC) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm\(^{-3}\)); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg\(^{-1}\)).
Figure S14. Root mean square error (RMSE) of the pedotransfer functions derived to predict saturated hydraulic conductivity (KS), computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %); USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).

Figure S15. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) saturated hydraulic conductivity (KS) for selected pedotransfer functions, computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm⁻³); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg⁻¹).
Figure S16. Root mean square error (RMSE) of the pedotransfer functions derived to predict parameters of the van Genuchten model for the description of the moisture retention curve (MRC), computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).

Figure S17. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) water retention values (MRC) computed based on the parameters of the van Genuchten model, computed on TEST_BASIC and TEST_CHEM+ set. Predicted values of those PTFs are shown which use the most often available predictor variables. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).
Figure S18. Mean error of the pedotransfer functions derived to predict parameters of the van Genuchten model for the description of the moisture retention curve, computed on TEST_BASIC (N = 1591) (A) and TEST_CHEM+ (N = 288) (B) sets by matric potential head values.
Figure S19. Root mean square error (RMSE) of the pedotransfer functions derived to predict parameters of the Mualem-van Genuchten model for the description of the hydraulic conductivity curve (HCC), computed on TEST_BASIC and TEST_CHEM+ set. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).

Figure S20. Density plot of observed (OBS) and predicted median (PSD+DEPTH_M+*) hydraulic conductivity values (HCC) computed based on the parameters of the Mualem-van Genuchten model, computed on TEST_BASIC and TEST_CHEM+ set. Predicted values of those PTFs are shown which use the most often available predictor variables. USSAND: sand (50–2000 μm) content (mass %); USSILT: silt (2–50 μm) content (mass %), USCLAY: clay (<2 μm) content (mass %); DEPTH_M: mean soil depth (cm); OC: organic carbon content (mass %); BD: bulk density (g cm$^{-3}$); CACO3: calcium carbonate content (mass %); PH_H2O: pH in water (-); CEC: cation exchange capacity (cmol (+) kg$^{-1}$).
Figure S21. Mean error of the pedotransfer functions derived to predict parameters of the Mualem-van Genuchten model for the description of the hydraulic conductivity curve, computed on TEST_BASIC (N = 176) (A) and TEST_CHEM+ (N = 57) (B) sets by matric potential head values.