**The relationships between biotic uniqueness and environmental uniqueness are context dependent across drainage basins worldwide**

Henna Snåre1,2, Jorge García-Girón1,3, Janne Alahuhta1, Luis Mauricio Bini4, Pál Boda5, Núria Bonada6,7, Leandro S. Brasil8, Marcos Callisto9, Diego M. P. Castro9, Kai Chen10, Zoltán Csabai11,48, Thibault Datry12, Sami Domisch13, Jaime R. García-Marquez13, Mathieu Floury13,14, Nikolai Friberg15,16,17, Brian A. Gill18, Juan David González-Trujillo19, Emma Göthe20, Peter Haase21,22, Neusa Hamada23, Matthew J. Hill24, Jan Hjort1, Leandro Juen25, Jonathan F. Jupke26, Ana Paula Justino de Faria25, Zhengfei Li27, Raphael Ligeiro25, Marden S. Linares9, Ana Luiza-Andrade28, Diego R. Macedo31, Kate L. Mathers29, Andres Mellado-Diaz32, Djuradj Milosevic45, Nabor Moya30, N. LeRoy Poff46,47, Robert J. Rolls49, Fabio O. Roque33,34, Victor S. Saito35, Leonard Sandin36, Ralf B. Schäfer26, Alberto Scotti37,38, Tadeu Siqueira39, Renato Tavares Martins23,41, Francisco Valente-Neto42, Beixin Wang43, Jun Wang44, Zhicai Xie27 & Jani Heino1

## Supplementary Information 3 S1. Classification of land use types

## S1. Classification of land use types.

**Table S1.** Land use classification.

|  |  |
| --- | --- |
| Land use classification | Land use categories included |
| 1. Bare areas | Bare areas  Consolidated bare areas  Unconsolidated bare areas |
| 2. Sparse vegetation | Sparse vegetation (tree, shrub, herbaceous cover) (<15%)  Sparse tree (<15%)  Sparse shrub (<15%)  Sparse herbaceous cover (<15%)  Lichens and mosses |
| 3. Urban | Urban areas |
| 4. Open water | Water bodies |
| 5. Ice/snow | Permanent snow and ice |
| 6. Agriculture | Cropland, rainfed,  Cropland, rainfed, herbaceous cover  Cropland, rainfed, tree or shrub cover  Cropland, irrigated or post-flooding  Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)  Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%) |
| 7. Forest | Tree cover, broadleaved, evergreen, closed to open (>15%)  Tree cover, broadleaved, deciduous, closed to open (>15%)  Tree cover, broadleaved, deciduous, closed (>40%)  Tree cover, broadleaved, deciduous, open (15-40%)  Tree cover, needleleaved, evergreen, closed to open (>15%)  Tree cover, needleleaved, evergreen, closed (>40%)  Tree cover, needleleaved, evergreen, open (15-40%)  Tree cover, needleleaved, deciduous, closed to open (>15%)  Tree cover, needleleaved, deciduous, closed (>40%)  Tree cover, needleleaved, deciduous, open (15-40%)  Tree cover, mixed leaf type (broadleaved and needleleaved)  Mosaic tree and shrub (>50%) / herbaceous cover (<50%) |
| 8. Forested wetlands | Tree cover, flooded, fresh or brakish water  Tree cover, flooded, saline water |
| 9. Non-forested wetlands | Shrub or herbaceous cover, flooded, fresh/saline/brakish water |
| 10. Grassland, shrubland | Mosaic herbaceous cover (>50%) / tree and shrub (<50%)  Grassland  Shrubland  Evergreen shrubland  Deciduous shrubland |

**Supplementary Information 3 S2. Variation in environmental factors used in the calculation of local contribution to environmental heterogeneity (LCEH) values.**

Table S2. Variation in pH, soil organic carbon (SOC), nitrogen, elevation, upstream basin area (UPSb area), annual precipitation (ppt), annual evapotranspiration (aet), atmospheric maximum (max temp) and minimum temperature (min temp) used in the calculation of local contribution to environmental heterogeneity (LCEHSoil, LCEHPosition, and LCEHClimate) values.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **LCEHSoil** | | | **LCEHPosition** | | **LCEHClimate** | | | |
| **Drainage basin** | **pH** | **SOC** | **Nitrogen** | **Elevation** | **UPSb area** | **ppt** | **aet** | **max temp** | **min temp** |
| **Acará** | 4.62 (4.4–4.8) | 332.62 (283.95–396.4) | 311.45 (253–362.75) | 19 (4–41) | 7.66 (0.1–38.11) | 2396.19 (2335.37–2440.3) | 1111.28 (1100.67–1124.7) | 32.6 (32.54–32.78) | 20.96 (20.83–21.1) |
| **Aidge** | 5.93 (5.35–6.45) | 855.26 (724.64–990.98) | 786.94 (661.51–1003.53) | 856 (204–1803) | 1337.43 (30.34–7167.39) | 741.46 (436.03–1316.47) | 489.16 (355.6–562.8) | 22.06 (12.75–27.9) | -6.17 (-12.46–-3.14) |
| **Ain** | 6.17 (5.93–6.45) | 995.57 (605.41–1180.31) | 804.16 (527–1038.81) | 397 (227–809) | 247.73 (0.05–842.3) | 1153.22 (966.6–1271.97) | 674.84 (648.87–695.7) | 25.17 (22.74–27.26) | -1.54 (-2.98–-0.74) |
| **Aude** | 6.73 (5.86–7.5) | 713.42 (355.83–1319.8) | 465.75 (271.67–697.79) | 320 (10–1625) | 423.05 (0.06–4825.3) | 762.13 (552.87–1257.93) | 647.23 (522.63–748.07) | 26.83 (17.99–29.42) | 1.37 (-3.37–3.61) |
| **Betione** | 5.92 (5.79–6.2) | 253.25 (222.25–342.23) | 214.99 (183.15–273.83) | 260 (139–344) | 21.5 (0.2–145.86) | 1295.61 (1286.53–1304.67) | 1080.83 (1071.87–1086.33) | 32.54 (32.12–33.1) | 13.77 (13.39–14.24) |
| **Bükkösdi-víz** | 5.83 (5.45–6.39) | 459.76 (426.75–500.24) | 618.07 (578.43–681.57) | 183 (145–253) | 5.76 (0.32–18.63) | 660.04 (648.47–679.6) | 587.63 (577.37–600.13) | 27.3 (26.84–27.69) | -2.76 (-2.78–-2.7) |
| **Pará** | 4.51 (4.41–4.69) | 358.02 (284.63–607) | 283.7 (236.67–337.19) | 5 (1–13) | 11.06 (0.06–62.42) | 2203.72 (2049.1–2391.7) | 1108.92 (1083.47–1162.1) | 32.64 (32.39–33.11) | 21.04 (20.94–21.3) |
| **Chinsui** | 5.79 (5.34–6.35) | 448.27 (379.6–513.96) | 377.95 (354.33–402) | 558 (209–1546) | 3150.95 (0.16–16950.74) | 1015.95 (945.03–1065.7) | 814.34 (733.3–829.2) | 30.19 (25.2–31.92) | 3.75 (-0.49–5.88) |
| **Chipiriri** | 5.36 (5.3–5.68) | 722.31 (693–756) | 504.3 (453.46–540) | 229 (211–250) | 254.11 (0.05–5020.22) | 4051.51 (3922.7–4157.17) | 1331.36 (1328.67–1335.03) | 32.24 (31.53–32.48) | 15.29 (15.22–15.4) |
| **Croton** | 4.95 (4.65–5.5) | 2233.69 (1291–2860.11) | 1549.57 (1366.67–1665.93) | 127 (66–236) | 19.76 (0.02–102.11) | 1244.52 (1204.97–1270.17) | 750.9 (725.57–771.63) | 28.58 (27.46–28.93) | -7.76 (-8.43–-6.9) |
| **Dalälven** | 4.66 (4.53–4.79) | 1790.27 (1617.44–2114.62) | 828.24 (733.33–976.56) | 299 (138–525) | 3.51 (0.34–25.66) | 688.26 (612.37–833.5) | 387.99 (342.47–416.6) | 20.55 (18.5–21.75) | -10.39 (-13.25–-8.32) |
| **Doubs** | 5.99 (5.42–6.61) | 867.45 (490.59–1123.53) | 686.94 (512.7–859.84) | 329 (181–910) | 787.87 (0.27–4796.35) | 1102.46 (919.7–1394.67) | 621.19 (561.07–665.3) | 24.82 (20.48–26.26) | -1.42 (-3.99–-0.36) |
| **Durance** | 7.03 (6.34–7.61) | 752.12 (527.1–1097.26) | 496.21 (339.39–617.9) | 501 (268–831) | 1720.55 (0.04–9338.82) | 744.96 (650.47–866.67) | 560.7 (540.7–578.6) | 27.69 (25.35–29.29) | -1.05 (-2.95–0.82) |
| **Elbe** | 6.17 (5.32–6.89) | 654.78 (578.06–772.35) | 759.85 (584.75–874.95) | 122 (17–338) | 11362.24 (0.08–125833.03) | 586.71 (501.9–756.73) | 502.31 (468.7–536.43) | 23.91 (21.79–24.66) | -2.03 (-2.87–-1.23) |
| **Fromoso** | 5.67 (5.53–5.76) | 283.53 (205.91–377.7) | 226.55 (199.01–277.82) | 329 (200–510) | 82 (0.62–1259.08) | 1342.39 (1326.83–1356.63) | 1112.41 (1100.97–1123.5) | 31.98 (30.92–32.57) | 12.9 (12.27–13.33) |
| **Capim** | 4.5 (4.36–4.63) | 305 (281.32–327.2) | 252.72 (233.87–291.88) | 89 (58–107) | 15.28 (0.01–236.62) | 2089.1 (1980.9–2185.93) | 1084.94 (1075.27–1092.8) | 32.83 (32.68–33.01) | 20.85 (20.52–21.51) |
| **Gurupi** | 4.83 (4.51–5.15) | 289.73 (243–341.33) | 239.58 (180.67–301.33) | 117 (68–174) | 5.01 (0.09–52.01) | 1893.31 (1764.53–2012.07) | 1088.19 (1065.7–1113.23) | 32.57 (32.23–33.11) | 20.33 (20.11–20.59) |
| **Hanjiang** | 6.28 (5.93–6.7) | 475.49 (329–665.4) | 427.73 (278.73–537.21) | 790 (168–1459) | 214.66 (0.03–1267.25) | 832.73 (759.8–1018.97) | 696.05 (644.1–784.8) | 26.82 (23.52–32.53) | -3.47 (-5.45–-1) |
| **Iijoki** | 4.72 (4.6–4.82) | 2163.02 (2016.64–2605.93) | 1058.11 (1014.97–1149.29) | 219 (159–282) | 6.25 (0.03–16.34) | 678.12 (653.37–696.53) | 335.87 (323.5–352.33) | 20.01 (19.58–20.46) | -16.24 (-17.19–-15.1) |
| **Isère** | 5.99 (5.66–6.42) | 1166.29 (1016.12–1311.57) | 729.41 (631.13–888.15) | 850 (353–1314) | 321.9 (0.53–990.7) | 1118.54 (931.6–1394.57) | 562.41 (466.4–635.3) | 22.33 (18–27.01) | -4.68 (-6.35–-2.01) |
| **Kinzing** | 5.71 (4.95–6.5) | 705.5 (482.36–960.33) | 557.9 (493.74–603.49) | 162 (101–519) | 356.13 (0.06–1053.87) | 843.26 (689.33–1153.7) | 557.48 (545.87–577.43) | 24.52 (22.34–25.48) | -1.88 (-3.7–-1.17) |
| **Kouta** | 4.61 (4.5–4.7) | 2110.67 (1902.47–2294) | 888.46 (760.38–979) | 216 (159–284) | 17.37 (0.03–208.75) | 586.28 (578.23–595.17) | 310.26 (308.73–313.13) | 19.16 (19–19.29) | -18.31 (-18.79–-17.93) |
| **Mekong** | 5.29 (5.05–6.26) | 445.78 (375.5–629.36) | 343.83 (298.35–470.25) | 754 (515–1202) | 7735.68 (0.01–145435.1) | 1635.11 (1536.37–1789) | 1056.99 (1013–1108.87) | 30.3 (27.6–32.59) | 9.04 (6.6–11.2) |
| Napo | 5.31 (5.06–5.62) | 1591.02 (1211.65–1868.93) | 946.35 (682.81–1164.45) | 2921 (1701–3993) | 99.85 (1.17–483.89) | 1269.44 (909.7–1831.63) | 715.04 (625.97–881) | 14.88 (10.53–22.28) | 4.55 (1.48–9.63) |
| **Araguari** | 5.24 (5.17–5.31) | 319.45 (212.21–482.26) | 187.31 (151.12–236.83) | 901 (840–967) | 11 (1.34–50.78) | 1609.46 (1581.93–1656.33) | 877.42 (866.57–891.17) | 27.63 (27.17–28.09) | 10.92 (10.36–11.36) |
| **Orinoco** | 5.12 (4.8–5.56) | 851 (385.82–1231.27) | 498.79 (301.67–751.57) | 1363 (204–3337) | 19.1 (0.39–89.73) | 2929.27 (1572.9–4113.9) | 1086.68 (842.1–1212.7) | 25.55 (12.82–35.35) | 14.53 (3.87–22.85) |
| **Paranapanema** | 4.92 (4.65–5.16) | 557.39 (374.23–702) | 362.61 (286.32–452.2) | 765 (638–977) | 6.03 (0.2–56.28) | 1476.5 (1309.7–1823.6) | 877.8 (861.6–913.8) | 26.25 (24.61–27.38) | 8.13 (7.2–8.84) |
| **Qiantang** | 5.67 (5.38–6.11) | 313.34 (179.51–590.32) | 277.91 (178.8–418.33) | 85 (35–210) | 82.88 (0.13–1261.34) | 1501.54 (1404.6–1657.53) | 956.9 (924.83–970.2) | 33.25 (30.79–33.84) | 1.92 (-0.25–2.69) |
| **Rhine** | 5.65 (5.03–7.06) | 810.65 (462.48–1119.54) | 659.86 (586.78–722.93) | 200 (148–342) | 34.93 (0.08–282.44) | 766.91 (618.07–940.7) | 520.89 (476.3–580.37) | 24.24 (23–25.67) | -1.53 (-2.17–-1) |
| **Amazon** | 4.38 (4.01–4.91) | 308.18 (285.82–373.66) | 240.56 (209.5–262.77) | 72 (17–123) | 32.56 (0.43–242.11) | 1855.71 (1753.17–1934.93) | 1004.9 (991.3–1022) | 32.45 (32.19–32.81) | 20.31 (19.97–21.03) |
| **Saône** | 5.97 (5.4–6.4) | 752.56 (441.5–1064.42) | 665.67 (618.5–735.11) | 231 (189–426) | 335.73 (0.12–1875.15) | 995.72 (866.73–1154.83) | 603.97 (570.3–639.03) | 25.33 (23.43–25.7) | -1.15 (-2.63–-0.62) |
| **Paranaíba** | 5.47 (5.35–5.57) | 206.64 (178.11–235.52) | 152.73 (132.32–170.62) | 475 (405–602) | 30.59 (0.2–79.5) | 1501.22 (1427.97–1573.37) | 934.63 (920.1–951.7) | 31.15 (30.53–31.76) | 13.39 (12.59–14.12) |
| **Segura** | 7.39 (6.58–7.9) | 371.2 (188–673.88) | 297.21 (180.99–466.14) | 536 (7–1160) | 2068.11 (0.04–10849.55) | 372.2 (284.1–547.9) | 344.75 (269.83–473.2) | 32.76 (30.55–33.93) | 1.72 (-2.95–6.22) |
| **Southern Morava** | 6.3 (5.98–6.75) | 582.88 (373.33–805.05) | 577 (365.5–835.67) | 401 (150–1264) | 1296.98 (0.07–13885) | 655.96 (613.8–815.03) | 558.1 (545.17–598.33) | 26.95 (22.23–29.23) | -3.73 (-6.11–-2.45) |
| **South Platte** | 5.64 (5–6.49) | 851.54 (566.71–1110.91) | 575.93 (387.69–870) | 2630 (1557–3411) | 39.84 (0.19–279.21) | 525.08 (383.83–693.33) | 410.79 (361.17–446.1) | 23.06 (16.93–31.56) | -11.85 (-15.07–-7.46) |
| **Teno** | 5.1 (4.92–5.24) | 2056.57 (1888.5–2202.13) | 1022.67 (903.23–1140.82) | 125 (46–214) | 13.9 (0.03–62.41) | 446.09 (418.23–487.2) | 259.53 (253.93–270.57) | 17.19 (16.39–18.09) | -18.84 (-20.96–-16.14) |
| **São Francisco** | 5.45 (5.3–5.56) | 213.77 (177.17–269.01) | 161.18 (147.87–185.77) | 674 (577–822) | 38.93 (0.41–165.37) | 1280.92 (1154.13–1445) | 852.38 (814.9–892.9) | 29.69 (28.76–30.24) | 10.63 (9.99–11.46) |
| **Grande River** | 5.34 (5.27–5.41) | 247.01 (199.53–348.93) | 175.99 (157.31–203.43) | 614 (522–730) | 17.84 (0.09–85.12) | 1576.89 (1531.47–1621.07) | 912.01 (875.53–944.07) | 29.34 (28.14–30.43) | 12.05 (11.48–12.46) |
| **Wei** | 6.71 (6.01–7.71) | 476.44 (157.33–775.58) | 337.49 (127–501.99) | 760 (368–1278) | 102.03 (0.12–344.71) | 684.37 (627.4–767.47) | 602.2 (571.87–624.5) | 28.04 (22.51–31.79) | -5.31 (-6.64–-3.96) |
| **Yarlung Tsangbo** | 6.29 (5.54–7.06) | 743.23 (429.96–1020.47) | 508.99 (359.44–658.45) | 2019 (594–4201) | 25160.37 (0.08–240523.61) | 1181.29 (445.3–2069.33) | 736.89 (349.47–958.7) | 22.52 (11.27–29.51) | -5.05 (-20.2–3.45) |
| **Yuqu** | 6.42 (5.98–6.68) | 686.85 (620.67–885.56) | 534.61 (516.39–606.5) | 3554 (2400–4365) | 2649.4 (0.02–8598.43) | 665.55 (593.3–788.87) | 528.53 (426.87–654.03) | 16.24 (13.38–19.5) | -12.61 (-18.63–-6.89) |
| **Thur** | 5.8 (5.32–6.05) | 985.94 (596–1193.43) | 917.01 (836.5–966.24) | 630 (500–775) | 42.49 (0.1–110.04) | 1263 (1113.07–1363) | 637.29 (631.57–643.13) | 22.71 (21.9–23.76) | -3.24 (-3.4–-3.1) |