**Table S2.** Environmental variables used in this study to investigate the most important drivers of the spatio-temporal patterns of water salinity and the most important drivers of salinisation. The correlation among variables (Spearman’s rank correlation coefficient > |0.7|) and the final set of variables used to perform the Random Forest and Generalized Linear Model analyses and the Generalized Linear Mixed-effect Model analyses is also shown.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type and source** | **Code** | **Definition** | **Units** | **Correlated with:**  **(Spatial analysis)** | **Correlated with:**  **(Temporal analysis)** |
| **Topographic**  DEM (IGN; 5 m) | AREA1, 2 | Total catchment area | km2 | ACW | ACW |
| ELE1 | River reach elevation | m | ToOUT | ToOUT |
| ACW | Active channel width | m | AREA | AREA |
| VWI1, 2 | Valley Width Index |  |  |  |
| ToOUT2 | Distance from river reach to river mouth | m | ELE | ELE |
| SINUOSITY1 | River reach sinuosity |  |  |  |
| **Climatic**  SIMPA | MN\_TEM | Mean annual temperature in the draining catchment | ºC | LC\_TEM | - |
| LC\_TEM1 | Mean annual temperature within the adjacent hillslopes | ºC | MN\_TEM, MN\_EP | - |
| MN\_PRE1 | Mean annual precipitation in the draining catchment | mm | LC\_PRE | - |
| LC\_PRE | Mean annual precipitation within the adjacent hillslopes | mm | MN\_PRE, LC\_EI | - |
| MN\_EP | Mean annual potential evapotranspiration in the draining catchment | mm | LC\_TEM, LC\_EP | - |
| LC\_EP1 | Mean annual potential evapotranspiration within the adjacent hillslopes | mm | MN\_EP | - |
| MN\_EI | Mean annual catchment evapotranspiration | mm | LC\_EI | - |
| LC\_EI1 | Mean annual evapotranspiration within the adjacent hillslopes | mm | LC\_PRE, MN\_EI | - |
| **Land uses**  SIOSE | MN\_UHD1, 2 | Area occupied by urban areas in the draining catchment | Parts per unit (º/1) |  |  |
| LC\_UHD1 | Area occupied by urban areas within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_AGR1, 2 | Area occupied by agricultural land in the draining catchment | Parts per unit (º/1) | LC\_AGR | MN\_BLF, MN\_SSH |
| LC\_AGR2 | Area occupied by agricultural land within the adjacent hillslopes | Parts per unit (º/1) | MN\_AGR |  |
| MN\_PAS1, 2 | Area occupied by pasture in the draining catchment | Parts per unit (º/1) |  |  |
| LC\_PAS1 | Area occupied by pasture within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_BLF1 | Area occupied by broadleaf forest in the draining catchment | Parts per unit (º/1) |  | MN\_AGR |
| LC\_BLF1, 2 | Area occupied by broadleaf forest within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_CNF1, 2 | Area occupied by coniferous forest in the draining catchment | Parts per unit (º/1) |  |  |
| LC\_CNF1, 2 | Area occupied by coniferous forest within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_PLT1, 2 | Area occupied by plantations in the draining catchment | Parts per unit (º/1) |  |  |
| LC\_PLT1, 2 | Area occupied by plantations within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_SSH1 | Area occupied by moors, heathland, scrub and shrubs in the draining catchment | Parts per unit (º/1) |  | MN\_AGR |
| LC\_SSH1, 2 | Area occupied moors, heathland, scrub and shrubs within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| **Geologic**  IGME | MN\_calc | Area occupied by calcareous rocks in the draining catchment | Parts per unit (º/1) | MN\_PER, MN\_CON, LC\_CON | MN\_PER, MN\_CON |
| LC\_calc1, 2 | Area occupied by calcareous rocks within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_cong | Area occupied by conglomerate rocks in the draining catchment | Parts per unit (º/1) | MN\_HAR | MN\_HAR |
| LC\_cong1, 2 | Area occupied by conglomerate rocks within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_sdim1, 2 | Area occupied by sedimentary rocks in the draining catchment | Parts per unit (º/1) | LC\_sdim |  |
| LC\_sdim2 | Area occupied by sedimentary rocks within the adjacent hillslopes | Parts per unit (º/1) | MN\_sdim | LC\_HAR |
| MN\_slic1, 2 | Area occupied by siliceous rocks in the draining catchment | Parts per unit (º/1) |  |  |
| LC\_slic1, 2 | Area occupied by siliceous rocks within the adjacent hillslopes | Parts per unit (º/1) |  |  |
| MN\_HAR1, 2 | Average rock hardness in the draining catchment | 1-5 | MN\_cong | MN\_cong |
| LC\_HAR1 | Average rock hardness within the adjacent hillslopes | 1-5 |  | LC\_sdim |
| MN\_CON1, 2 | Average rock conductivity in the draining catchment | 1-5 | MN\_calc, MN\_PER, LC\_CON | MN\_calc, MN\_PER |
| LC\_CON2 | Average rock conductivity within the adjacent hillslopes | 1-5 | MN\_calc, MN\_CON |  |
| MN\_PER | Average rock permeability in the draining catchment | 1-5 | MN\_calc, MN\_CON | MN\_calc, MN\_CON |
| LC\_PER1, 2 | Average rock permeability within the adjacent hillslopes | 1-5 |  |  |
| **Anthropic pressures**  Hydrographic confederations and water agencies | A\_DAR1, 2 | Distance to the nearest weir upstream. Limitation of 5000 m. | m |  |  |
| P\_DAR1 | Distance to the nearest dam upstream. Limitation of 5000 m. | m |  |  |
| V\_DAR1, 2 | Distance to the nearest effluent discharge upstream. Limitation of 5000 m. | m |  |  |
| **Temporal**  SAICA network | WL | Daily average water level | m | - | WL\_Max5, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min20, WL\_Min40 |
| WL\_Max5 | Maximum water level for the 5 previous days | m | - | WL, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min20, WL\_Min40 |
| WL\_Max10 | Maximum water level for the 10 previous days | m | - | WL, WL\_Max5, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min20, WL\_Min40, WL\_SD10 |
| WL\_Max20 | Maximum water level for the 20 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min20, WL\_Min40, WL\_SD20 |
| WL\_Max40 | Maximum water level for the 40 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max20, WL\_Min5, WL\_Min10, WL\_Min20, WL\_Min40, WL\_SD40 |
| WL\_Min5 | Minimum water level for the 5 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min10, WL\_Min20, WL\_Min40 |
| WL\_Min10 | Minimum water level for the 10 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min20, WL\_Min40 |
| WL\_Min20 | Minimum water level for the 20 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min40 |
| WL\_Min402 | Minimum water level for the 40 previous days | m | - | WL, WL\_Max5, WL\_Max10, WL\_Max20, WL\_Max40, WL\_Min5, WL\_Min10, WL\_Min20 |
| WL\_SD52 | Water level standard deviation for the 5 previous days | m | - | WL\_CV5, WL\_SD10, WL\_SD20, WL\_SD40 |
| WL\_SD10 | Water level standard deviation for the 10 previous days | m | - | WL\_CV10, WL\_SD5, WL\_SD20, WL\_SD40, WL\_Max10 |
| WL\_SD20 | Water level standard deviation for the 20 previous days | m | - | WL\_CV20, WL\_SD5, WL\_SD10, WL\_SD40, WL\_Max20 |
| WL\_SD40 | Water level standard deviation for the 40 previous days | m | - | WL\_SD5, WL\_SD10, WL\_SD20, WL\_Max40 |
| WL\_CV5 | Water level coefficient of variation for the 5 previous days | m | - | WL\_CV10, WL\_CV20, WL\_CV40, WL\_SD5 |
| WL\_CV102 | Water level coefficient of variation for the 10 previous days | m | - | WL\_CV5, WL\_CV20, WL\_CV40, WL\_SD10 |
| WL\_CV20 | Water level coefficient of variation for the 20 previous days | m | - | WL\_CV5, WL\_CV10, WL\_CV40, WL\_SD20 |
| WL\_CV40 | Water level coefficient of variation for the 40 previous days | m | - | WL\_CV5, WL\_CV10, WL\_CV20 |
| T2 | Daily average water temperature | ºC | - |  |
| T\_Max5 | Maximum water temperature for the 5 previous days | ºC | - | T\_Max10, T\_Max20 |
| T\_Max10 | Maximum water temperature for the 10 previous days | ºC | - | T\_SD10, T\_Max5, T\_Max20 |
| T\_Max20 | Maximum water temperature for the 20 previous days | ºC | - | T\_SD20, T\_Max5, T\_Max10 |
| T\_Max402 | Maximum water temperature for the 40 previous days | ºC | - | T\_SD40 |
| T\_Min52 | Minimum water temperature for the 5 previous days | ºC | - | T\_Min10, T\_Min20 |
| T\_Min10 | Minimum water temperature for the 10 previous days | ºC | - | T\_CV40, T\_Min5, T\_Min20, T\_Min40 |
| T\_Min20 | Minimum water temperature for the 20 previous days | ºC | - | T\_CV40, T\_Min5, T\_Min10, T\_Min40 |
| T\_Min40 | Minimum water temperature for the 40 previous days | ºC | - | T\_CV40, T\_Min10, T\_Min20 |
| T\_SD5 | Water temperature standard deviation for the 5 previous days | ºC | - | T\_CV5 |
| T\_SD102 | Water temperature standard deviation for the 10 previous days | ºC | - | T\_CV10, T\_CV20, T\_SD20, T\_Max10 |
| T\_SD20 | Water temperature standard deviation for the 20 previous days | ºC | - | T\_CV20, T\_SD10, T\_SD40, T\_Max20 |
| T\_SD40 | Water temperature standard deviation for the 40 previous days | ºC | - | T\_CV40, T\_SD20, T\_Max40 |
| T\_CV5 | Water temperature coefficient of variation for the 5 previous days | ºC | - | T\_SD5 |
| T\_CV10 | Water temperature coefficient of variation for the 10 previous days | ºC | - | T\_CV20, T\_SD10 |
| T\_CV20 | Water temperature coefficient of variation for the 20 previous days | ºC | - | T\_CV10, T\_CV40, T\_SD10, T\_SD20, |
| T\_CV40 | Water temperature coefficient of variation for the 40 previous days | ºC | - | T\_CV20, T\_SD40, T\_Min10, T\_Min20, T\_Min40 |
| pH2 | Daily average pH |  | - | pH\_Max5, pH\_Max10, pH\_Max20, pH\_Min5, pH\_Min10, pH\_Min20, pH\_Min40 |
| pH\_Max5 | Maximum pH for the 5 previous days |  | - | pH, pH\_Max10, pH\_Max20, pH\_Max40, pH\_Min5 |
| pH\_Max10 | Maximum pH for the 10 previous days |  | - | pH, pH\_Max5, pH\_Max20, pH\_Max40 |
| pH\_Max20 | Maximum pH for the 20 previous days |  | - | pH, pH\_Max5, pH\_Max10, pH\_Max40 |
| pH\_Max40 | Maximum pH for the 40 previous days |  | - | pH\_Max5, pH\_Max10, pH\_Max20 |
| pH\_Min5 | Minimum pH for the 5 previous days |  | - | pH, pH\_Max5, pH\_Min10, pH\_Min20, pH\_Min40 |
| pH\_Min10 | Minimum pH for the 10 previous days |  | - | pH, pH\_Min5, pH\_Min20, pH\_Min40 |
| pH\_Min20 | Minimum pH for the 20 previous days |  | - | pH, pH\_Min5, pH\_Min10, pH\_Min40 |
| pH\_Min40 | Minimum pH for the 40 previous days |  | - | pH, pH\_Min5, pH\_Min10, pH\_Min20 |
| pH\_SD5 | pH standard deviation for the 5 previous days |  | - | pH\_CV5, pH\_CV10, pH\_CV20, pH\_SD10, pH\_20 |
| pH\_SD10 | pH standard deviation for the 10 previous days |  | - | pH\_CV5, pH\_CV10, pH\_CV20, pH\_CV40, pH\_SD5, pH\_SD20, pH\_SD40 |
| pH\_SD20 | pH standard deviation for the 20 previous days |  | - | pH\_CV5, pH\_CV10, pH\_CV20, pH\_CV40, pH\_SD5, pH\_SD10, pH\_SD40 |
| pH\_SD40 | pH standard deviation for the 40 previous days |  | - | pH\_CV10, pH\_CV20, pH\_CV40, pH\_SD10, pH\_SD20 |
| pH\_CV5 | pH coefficient of variation for the 5 previous days |  | - | pH\_CV10, pH\_CV20, pH\_SD5, pH\_SD10, pH\_SD20 |
| pH\_CV10 | pH coefficient of variation for the 10 previous days |  | - | pH\_CV5, pH\_CV20, pH\_CV40, pH\_SD5, pH\_SD10, pH\_SD20, pH\_SD40 |
| pH\_CV20 | pH coefficient of variation for the 20 previous days |  | - | pH\_CV5, pH\_CV10, pH\_CV40, pH\_SD5, pH\_SD10, pH\_SD20, pH\_SD40 |
| pH\_CV40 | pH coefficient of variation for the 40 previous days |  | - | pH\_CV10, pH\_CV20, pH\_SD10, pH\_SD20, pH\_SD40 |
| DO2 | Daily average dissolved oxygen concentration | mg/L | - | DO\_Max5, DO\_Min5, DO\_Min10, DO\_Min20 |
| DO\_Max5 | Maximum dissolved oxygen concentration for the 5 previous days | mg/L | - | DO, DO\_Max10, DO\_Max20, DO\_Max40 |
| DO\_Max10 | Maximum dissolved oxygen concentration for the 10 previous days | mg/L | - | DO\_Max5, DO\_Max20, DO\_Max40 |
| DO\_Max20 | Maximum dissolved oxygen concentration for the 20 previous days | mg/L | - | DO\_Max5, DO\_Max10, DO\_Max40 |
| DO\_Max40 | Maximum dissolved oxygen concentration for the 40 previous days | mg/L | - | DO\_Max5, DO\_Max10, DO\_Max20 |
| DO\_Min5 | Minimum dissolved oxygen concentration for the 5 previous days | mg/L | - | DO, DO\_Min10, DO\_Min20, DO\_Min40, DO\_CV5, DO\_CV10, DO\_CV20 |
| DO\_Min10 | Minimum dissolved oxygen concentration for the 10 previous days | mg/L | - | DO, DO\_Min5, DO\_Min20, DO\_Min40, DO\_CV5, DO\_CV10, DO\_CV20, DO\_CV40 |
| DO\_Min20 | Minimum dissolved oxygen concentration for the 20 previous days | mg/L | - | DO, DO\_Min5, DO\_Min10, DO\_Min40, DO\_CV5, DO\_CV10, DO\_CV20, DO\_CV40 |
| DO\_Min402 | Minimum dissolved oxygen concentration for the 40 previous days | mg/L | - | DO\_Min5, DO\_Min10, DO\_Min20, DO\_CV5, DO\_CV10, DO\_CV20, DO\_CV40 |
| DO\_SD5 | Dissolved oxygen concentration standard deviation for the 5 previous days | mg/L | - | DO\_CV5, DO\_SD10, DO\_SD20 |
| DO\_SD102 | Dissolved oxygen concentration standard deviation for the 10 previous days | mg/L | - | DO\_CV5, DO\_CV10, DO\_CV20, DO\_SD5, DO\_SD20, DO\_SD40 |
| DO\_SD20 | Dissolved oxygen concentration standard deviation for the 20 previous days | mg/L | - | DO\_CV5, DO\_CV10, DO\_CV20, DO\_SD5, DO\_SD10, DO\_SD40 |
| DO\_SD40 | Dissolved oxygen concentration standard deviation for the 40 previous days | mg/L | - | DO\_CV40, DO\_SD10, DO\_SD20 |
| DO\_CV5 | Dissolved oxygen concentration coefficient of variation for the 5 previous days | mg/L | - | DO\_CV10, DO\_CV20, DO\_CV40, DO\_SD5, DO\_SD10, DO\_SD20, DO\_Min5, DO\_Min10, DO\_Min20, DO\_Min40 |
| DO\_CV10 | Dissolved oxygen concentration coefficient of variation for the 10 previous days | mg/L | - | DO\_CV5, DO\_CV20, DO\_CV40, DO\_SD10, DO\_SD20, DO\_Min5, DO\_Min10, DO\_Min20, DO\_Min40 |
| DO\_CV20 | Dissolved oxygen concentration coefficient of variation for the 20 previous days | mg/L | - | DO\_CV5, DO\_CV10, DO\_CV40, DO\_SD10, DO\_SD20, DO\_Min5, DO\_Min10, DO\_Min20, DO\_Min40 |
| DO\_CV40 | Dissolved oxygen concentration coefficient of variation for the 40 previous days | mg/L | - | DO\_CV5, DO\_CV10, DO\_CV20, DO\_SD40, DO\_Min10, DO\_Min20, DO\_Min40 |

\*\* 1 = Variables selected for spatial Random Forest model and Generalised Linear Model performed to identifyenvironmental factors that enhance salinisation ; 2 = Variables selected for temporal Generalised Linear Mixed-effect Model; - = Variables not considered in spatial or temporal analyses.