**DroughtCat service**

**Goal**

Offer model predictions regarding the current-day and recent trends in water status of forest soils and main tree species over Catalonia (NE Spain). Uses a soil water balance model on forest plots of the Spanish National Forest Inventory (De Cáceres *et al.* 2015). Intended to complement monitoring programs of observed drought-related forest decay in the same area (DEBOSCAT) (Chaparro *et al.* 2016).

**Soil water balance variables**

The following variables are stored every day:

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable name** | **Definition** | **Units** | **Display** |
| PET | Penman’s potential evapotranspiration | mm/day | Yes |
| Precipitation | Precipitation | mm/day | No |
| NetPrec | NetPrecipitation | mm/day | No |
| Runoff | Surface (overland) runoff | mm/day | No |
| DeepDrainage | Deep drainage to groundwater | mm/day | No |
| LAI | Leaf area index (including all woody species) | m2/m2 | Yes |
| Eplant | Plant transpiration | mm/day | Yes |
| Esoil | Soil evaporation | mm/day | No |
| Theta | Average soil moisture relative to field capacity. | [0-1] | Yes |

**Tree drought stress variables**

For each forest plot, the daily drought stress for every species present is calculated by averaging daily drought stress of plant cohorts of the species, using leaf area index values as weights. The following species are tracked in terms of their daily drought stress:

|  |  |  |
| --- | --- | --- |
| **Variable** | **Definition** | **Units** |
| PinusHalepensis | Drought stress for *Pinus halepensis* | [0,1] |
| PinusNigra | Drought stress for *Pinus nigra* | [0,1] |
| PinusSylvestris | Drought stress for *Pinus sylvestris* | [0,1] |
| PinusUncinata | Drought stress for *Pinus uncinata* | [0,1] |
| PinusPinea | Drought stress for *Pinus pinea* | [0,1] |
| PinusPinaster | Drought stress for *Pinus pinaster* | [0,1] |
| QuercusIlex | Drought stress for *Quercus ilex* | [0,1] |
| QuercusSuber | Drought stress for *Quercus suber* | [0,1] |
| QuercusHumilis | Drought stress for *Quercus humilis* | [0,1] |
| QuercusFaginea | Drought stress for *Quercus faginea* | [0,1] |
| FagusSylvatica | Drought stress for *Fagus sylvatica* | [0,1] |
| Overall | Average drought stress across all woody plants | [0,1] |

**Mapping**

Variable maps (1 km resolution) are created by interpolation with a spatial kernel (radius 3 km). Displayed areas are limited to forested areas according to the Third Spanish Forest Map (MFE50). Species-specific drought stress maps (1 km resolution) are created by interpolation with a spatial kernel (radius 3 km). Displayed areas are limited to the distribution of the species according to the Third Spanish Forest Map (MFE50).

**Trends**

|  |  |  |
| --- | --- | --- |
| **Temporal resolution** | **How far into past?** | **Update** |
| Daily | Last 365 days | Daily |
| Monthly | Last 36 months | Every first day of month |
| Yearly | Since service started | Every first day of year |

**Scripts**

*Preliminaries\_0\_InitSpatialForesPoints.R* – Initializes forest plot data (trees, shrubs, soil properties) from Forest inventory (IFN3) data and soil layers.

*Preliminaries\_1\_InitRootSystems.R* – Initializes root system distribution and soil depth using estimates derived from optimization under the eco-hydrological equilibrium hypothesis (Cabon et al. in prep.).

*Preliminaries\_2\_InitInputObjects.R* – Creates input for soil water balance model for each plots. Soil and plant state variables are stored in “/Rdata/Plots”.

*Preliminaries\_3\_InitPlotYearTrends.R* – Initializes one-year plot trends (missing values for all days). One-year trends are stored in “/Rdata/PlotYearTrends”.

*Day\_0\_MeteorologyInterpolation.R* – Interpolates daily weather over forest plot locations from weather station data.

*Day\_1\_SWB.R* – Calls soil water balance function in medfate to update soil and plant water status. Soil and plant state variables are stored in “/Rdata/Plots”. Results of daily soil water balance are stored in “/Rdata/DailySWB”.

*Day\_2\_DaySWBMaps.R* – Extracts soil water balance status from daily results and shapes it in form of spatial points data frame. Results are stored in “/Rdata/SpatialPointSWBMaps”.

*Day\_3\_UpdatePlotSWBYearTrends.R* – Extracts soil water balance status from daily results to update plot-wise tables that store daily trends for one year. One-year trends are stored in “/Rdata/PlotSWBYearTrends”.

*Day\_4\_DayDroughtStressMaps.R* – Extracts species drought stress from daily results and shapes it in form of spatial points data frame. Results are stored in “/Rdata/SpatialPointDroughtStressMaps”.

*Day\_5\_UpdatePlotDroughtStressYearTrends.R* – Extracts species drought stress from daily results to update plot-wise tables that store daily trends for one year. One-year trends are stored in “/Rdata/PlotDroughtStressYearTrends”.

*Day\_Master.R* – Calls the routine to download AEMET daily weather and, after that, calls Day\_0 to Day\_3 functions to perform simulations and process results for the current day.

*RecoverDays\_Master.R* – Used to simulate daily water balance and/or process results when, for any reason, Day\_Master.R has not been successfully completed in programmed tasks. Also used to reshape past outputs to current display formats.

**References**

1.De Cáceres, M., Martínez-Vilalta, J., Coll, L., Llorens, P., Casals, P., Poyatos, R., *et al.* (2015). Coupling a water balance model with forest inventory data to predict drought stress: the role of forest structural changes vs. climate changes. *Agric. For. Meteorol.*, 213, 77–90

2.Chaparro, D., Vayreda, J., Vall-llossera, M., Banque, M., Piles, M., Camps, A., *et al.* (2016). The Role of Climatic Anomalies and Soil Moisture in the Decline of Drought-Prone Forests. *IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens.*, 10, 503–514