**SUPPLEMENTARY TABLES**

Supplementary Table 1. List of the 29 vegetation indices used in this study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | MODIS | Landsat-8 | Sentinel-2 | Source |
| Vegetation indices by normalized difference | | | | |
| *Normalized Difference Vegetation Index* |  |  |  | (Rouse et al. 1974) |
| *Normalized Difference Index5* |  |  |  | (Mcnairn and Protz 1993) |
| *Normalized Difference Index7* |  |  |  | (Mcnairn and Protz 1993) |
| *Normalized Difference Tillage Index* |  |  |  | (Van Deventer et al. 1997) |
| *Normalized Difference Senescent Vegetation Index* |  |  |  | (Qi et al. 2002) |
| *Blue normalized difference vegetation index* |  |  |  | (Yang et al. 2004) |
| *Green Normalized Difference Vegetation Index* |  |  |  | (Gitelson, Kaufman, and Merzlyak 1996) |
| *Standardized Normalized Difference Vegetation Index* |  |  |  | (Gowda et al. 2001) |
| *Infrared Percentage Vegetation Index* |  |  |  | (Crippen 1990) |
| *Green Vegetation Index* |  |  |  | (Gitelson et al. 2002) |
| *Green Residue Cover Index* |  |  |  | (Kavoosi et al. 2020) |
| *Blue Residue Cover Index* |  |  |  | (Kavoosi et al. 2020) |
| *Renormalized Difference Vegetation Index* |  |  |  | [Reujean et Breon, 1995] |
| *Modified Simple Ratio* |  |  |  | (Chen 1996) |
| *Chlorophyll detection indices* | | | | |
| *Modified Chlorophyll Absorption in Reflectance Index* |  |  |  | (Daughtry et al. 2000) |
| *Transformed Chlorophyll Absorption in Reflectance Index* |  |  |  | (Haboudane et al. 2002) |
| *Triangular Vegetation Index* |  |  |  | (Broge and Leblanc 2001) |
| *Green Chlorophyll Vegetation Index* |  |  |  | (Gitelson et al. 2003) |
| *Vegetation indices with correction for atmospheric or soil effects* | | | | |
| *Visible Atmospherically Resistant Index* |  |  |  | (Gitelson et al. 2002) |
| *Perpendicular Vegetation Index* |  |  |  | (Richardson and Wiegand 1977) |
| *Soil-Adjusted Vegetation Index* |  |  |  | (Huete 1988) |
| *Optimized Soil-Adjusted Vegetation Index* |  |  |  | (Rondeaux, Steven, and Baret 1996) |
| *Crop Residue Cover* |  |  |  | (Sullivan et al. 2006) |
| *Dead Fuel Index* |  |  |  | (Cao et al. 2010) |
| *Soil Tillage Index* |  |  |  | (Van Deventer et al. 1997) |
| *Vegetation indices by ratio* | | | | |
| *Simple Ratio Index* |  |  |  | (Jordan 1969) |
| *Ratio Vegetation Index2* |  |  |  | (Jordan 1969) |
| *Ratio Vegetation Index3* |  |  |  | (Jordan 1969) |
| *Ration B7/B6* |  |  |  | (Guerschman et al. 2009) |

**Supplementary Table 2: Number of models tested to estimate BH and BT**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BH | | | | BT | | | |
|  | MLS | MML | RF | GBM | MLS | MML | RF | GBM |
| Landsat-8 | 6 | 57 | 42 | 42 | 6 | 57 | 42 | 42 |
| MODIS | 6 | 57 | 42 | 42 | 6 | 57 | 42 | 42 |
| Sentinel-2 | 7 | 120 | 99 | 99 | 8 | 247 | 219 | 219 |
| Total | 19 | 234 | 183 | 183 | 20 | 361 | 303 | 303 |
| 619 models tested for BH | | | | 987 models tested for BT | | | |

Supplementary Table 3. Optimization parameters used with random forest

|  |  |  |
| --- | --- | --- |
| Parameters | Definitions | Typical default values |
| mtry | Number of features to use at each split | 1 to 10 |
| ntree | Number of trees to grow | 1 to 25 |
| nodesize | Minimum number of observations in a terminal node | 1 to 5 |

Supplementary Table 4. Optimization parameters used with Gradient Bosting Machines

|  |  |  |
| --- | --- | --- |
| Parameters | Definitions | Value tested |
| ntree | Total number of trees | 50,100,200 |
| Interaction.depth | Maximum depth of variable interactions | 1,3,6 |
| shrinkage | Learning rate | 0.0001, 0.01, 0.1 |
| n.minobsinnode | Minimum number of observations in the trees terminal nodes | 3,5,10 |

Supplementary Table 5. Simple linear models for the assessment of the herbaceous biomass during the dry-season developed by Jacques et *al.* (2014) and in this study, both using the STI index based on MODIS and the best model using Sentinel-2 images.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model equation | Sensor | RMSE (kg‧DM/ha) | R2 | RRMSE (%) | Reference |
|  | MODIS | 280 | 0.66 | **44** | Jacques et *al.* (2014) |
|  | MODIS | 555 | 0.42 | **39** | Model of this study |
|  | Sentinel-2 | 378 | 0.74 | **26** | Best model of this study to estimate BH |

Supplementary Table 6. Performance of MLS, MML, RF and GBM models with Landsat-8

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Landsat-8 | | R2 | RMSE | RRMSE | INDICES |
| MLS | BH | 0,37 | 569 | 40 | NDI5 |
| BT | 0,39 | 825 | 45 | VIgreen |
| MML | BH | 0,62 | 437 | 30 | NDI5 CRC DFI TCARI |
| BT | 0,77 | 526 | 26 | NDI5 TCARI DFI SRI |
| RF | BH | 0,63 | 476 | 33 | NDI5 BRCI DFI |
| BT | 0,63 | 683 | 34 | NDI5 TCARI VIgreen DFI |
| GBM | BH | 0,68 | 450 | 31 | VARI, BRCI DFI |
| BT | 0,63 | 622 | 31 | NDI5,TCARI DFI SRI |

Supplementary Table 7. Performance of MLS, MML, RF and GBM models with MODIS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| MODIS | | R2 | RMSE | RRMSE | INDICES |
| MLS | BH | 0,42 | 575 | 40 | DFI |
| BT | 0,51 | 923 | 46 | NDI5 |
| MML | BH | 0,65 | 414 | 29 | NDI5, DFI, TCARI |
| BT | 0,69 | 551 | 27 | RVI2, NDI5, DFI, TCARI |
| RF | BH | 0,57 | 482 | 34 | NDI5, VIgreen, DFI, TCARI |
| BT | 0,64 | 694 | 35 | NDI5, TCARI, DFI, RVI3 |
| GBM | BH | 0,55 | 469 | 33 | NDI5, VIgreen, DFI, TCARI |
| BT | 0,69 | 605 | 30 | TCARI, DFI, CRC, RVI3 |

**Supplementary Table 8.** Performance of MLS, MML, RF and GBM models with Sentinel-2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sentinel-2 | | R2 | RMSE | RRMSE | INDICES |
| MLS | BH | 0,43 | 567 | 39 | NDI5 |
| BT | 0,36 | 901 | 45 | NDI5 |
| MML | BH | 0,74 | 378 | 26 | NDI5, GRCI, SRI, DFI, TCARI |
| BT | 0,78 | 496 | 25 | NDI5, DFI, SRI, TCARI, GRCI, RVI3 |
| RF | BH | 0,45 | 544 | 38 | NDI5, SRI, GRCI, DFI, RVI3 |
| BT | 0,53 | 816 | 41 | NDI5, RVI2, DFI, SRI, TCARI, GRCI |
| GBM | BH | 0,53 | 476 | 33 | NDI5, GRCI, DFI, RVI3, TCARI |
| BT | 0,57 | 712 | 35 | NDI5, SRI, TCARI |

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