

African Soil Properties and Nutrients Mapped at 30–m Spatial Resolution using Two-scale Ensemble Machine Learning

Tomislav Hengl^{1,2,*}, Matthew A. E. Miller³, Josip Krizan⁴, Keith D. Shepherd⁵, Andrew Sila⁵, Milan Kilibarda⁶, Ognjen Antonijevic⁶, Luka Glusica⁷, Achim Dobermann⁸, Stephan M. Haefele⁹, Steve P. McGrath⁹, Gifty E. Acquah⁹, Jamie Collinson³, Leandro Parente², Mohammadreza Sheykhmousa², Kazuki Saito¹⁰, Jean-Martial Johnson¹⁰, Jordan Chamberlin¹¹, Francis B. T. Silatsa¹², Martin Yemefack¹², John Wendt¹³, Robert A. MacMillan², Ichsani Wheeler^{1,2}, and Jonathan Crouch³

¹EnvirometriX Ltd, Wageningen, the Netherlands

²OpenGeoHub Foundation, Wageningen, the Netherlands

³Innovative Solutions for Decision Agriculture Ltd (iSDA), Harpenden, United Kingdom

⁴MultiOne Ltd, Zagreb, Croatia

⁵World Agroforestry (ICRAF), Nairobi, Kenya

⁶Department of Geodesy and Geoinformatics, Faculty of Civil Engineering, University of Belgrade, Belgrade, Serbia

⁷GILAB Ltd, Belgrade, Serbia

⁸International Fertilizer Association (IFA), Paris, France

⁹Rothamsted Research, Harpenden, United Kingdom

¹⁰Africa Rice Center (AfricaRice), Bouaké, Côte d'Ivoire

¹¹International Maize and Wheat Improvement Centre (CIMMYT), Nairobi, Kenya

¹²Sustainable Tropical Solutions (STS) Sarl, Yaoundé, Cameroon

¹³International Fertilizer Development Center (IFDC), Muscle Shoals, AL, USA

* Corresponding author e-mail: tom.hengl@envirometrix.net

Supplement Table 1: List of soil and auxiliary variables available from iSDAsoil. The DOI i.e. the data download link is indicated in the first column.

Spatial layer	Extraction / measurement information	Unit	Available depths (cm)	Spatial resolution (m)	Theme	Uncertainty available?	N training samples	Model Accuracy (R-square)	RMSE
Land Cover (2015 - 2019) https://doi.org/10.5281/zenodo.3606295	N/A	%	0	100	Agronomy information	No	N/A	N/A	N/A
Cropland (2015 - 2019) https://doi.org/10.5281/zenodo.3606295	N/A	%	0	100	Agronomy information	No	N/A	N/A	N/A
Slope Angle http://isda-africa.com/isda-soil	N/A	degree	0	30	Physical soil properties and landscape	No	N/A	N/A	N/A
Fertility Capability Classification http://isda-africa.com/isda-soil	N/A	None	0–50	30	Agronomy information	No	N/A	N/A	N/A
USDA Texture Class https://doi.org/10.5281/zenodo.4094615	USDA 12 class system	None	0–20, 0–50	30	Physical soil properties and landscape	No	N/A	N/A	N/A
Clay content https://doi.org/10.5281/zenodo.4085159	Various	%	0–20, 0–50	30	Physical soil properties and landscape	Yes	122,269	0.746	9.6
Bulk density, <2mm fraction https://doi.org/10.5281/zenodo.4087904	Various	g/cc	0–20, 0–50	30	Physical soil properties and landscape	Yes	13,565	0.819	126
Aluminium, extractable https://doi.org/10.5281/zenodo.4087935	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	63,551	0.881*	0.321*
Carbon, total https://doi.org/10.5281/zenodo.4088063	Various	g/kg	0–20, 0–50	30	Soil properties	Yes	50,140	0.794*	0.291*
Calcium, extractable https://doi.org/10.5281/zenodo.4087971	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	144,593	0.840*	0.543*
Effective Cation Exchange Capacity https://doi.org/10.5281/zenodo.4088112	Mehlich-3	cmol(+)/kg	0–20, 0–50	30	Chemical soil properties	Yes	66,380	0.754*	0.417*
Iron, extractable https://doi.org/10.5281/zenodo.4088215	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	57,526	0.817*	0.235*
Potassium, extractable https://doi.org/10.5281/zenodo.4090297	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	139,122	0.773*	0.509*

Magnesium, extractable https://doi.org/10.5281/zenodo.4090373	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	136,681	0.815*	0.497*
Nitrogen, total https://doi.org/10.5281/zenodo.4090385	Measured by Total combustion	g/kg	0–20, 0–50	30	Chemical soil properties	Yes	99,249	0.732*	0.197*
Carbon, organic https://doi.org/10.5281/zenodo.4090926	Various	g/kg	0–20, 0–50	30	Chemical soil properties	Yes	122,457	0.791*	0.369*
Phosphorus, extractable https://doi.org/10.5281/zenodo.4090980	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	53,493	0.486*	0.707*
Sulphur, extractable https://doi.org/10.5281/zenodo.4091141	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	37,530	0.548*	0.384*
Zinc, extractable https://doi.org/10.5281/zenodo.4091170	Mehlich-3	ppm	0–20, 0–50	30	Soil nutrients	Yes	39,344	0.711*	0.375*
pH in H2O https://doi.org/10.5281/zenodo.4073236	1:1 Soil-Water Suspension	–	0–20, 0–50	30	Chemical soil properties	Yes	133,378	0.818	0.459
Sand content https://doi.org/10.5281/zenodo.4094606	Various	%	0–20, 0–50	30	Physical soil properties and landscape	Yes	122,261	0.736	13.7
Silt content https://doi.org/10.5281/zenodo.4094609	Various	%	0–20, 0–50	30	Physical soil properties and landscape	Yes	122,223	0.64	8.92
Stone content https://doi.org/10.5281/zenodo.4091153	Various	%	0–20, 0–50	30	Physical soil properties and landscape	Yes	92,785	0.709*	0.803*
Depth to Bedrock https://doi.org/10.5281/zenodo.4094615	Estimated from soil profile data	cm	0–200	30	Physical soil properties and landscape	Yes	28,054	0.429	41.3

Supplement Table 2: Complete list and description of all covariate layers (file names) used for model fitting.

File_name	Description	Source_URL	Spatial_resolution_native	Spatial_resolution_PSM
clm_precipitation_sm2rain.*_m_1km_s0..0cm_2007..2018_v0.2.tif	Precipitation monthly in mm. Based on the SM2RAIN-ASCAT 2007-2018, GPM (IMERG) 2014–2018 and WorldClim v2, CHELSA rainfall monthly images.	https://doi.org/10.5281/zenodo.2591215	1000	250
clm_precipitation_sm2rain.*_sd_1km_s0..0cm_2007..2018_v0.2.tif	Precipitation monthly sd in mm. Based on the SM2RAIN-ASCAT 2007-2018, GPM (IMERG) 2014–2018 and WorldClim v2, CHELSA rainfall monthly images.	https://doi.org/10.5281/zenodo.2591215	10000	250
clm_*.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	Global horizontal and Diffuse horizontal irradiation [kWh/m2] based on Solargis	https://globalsolaratlas.info/downloads/world	1000	250
dtm_*.usgs.ecotapestry.*_p_250m_s0..0cm_2014_v1.0.tif	USGS Global Ecophysiography landform classification and lithological map	http://rmgsc.cr.usgs.gov/outgoing/ecosystems/Global/	250	250
dtm_floodmap.500y_jrc.hazardmapping_m_250m_s0..0cm_1500..2016_v1.0.tif	Flood hazard map for Europe, 500-year return period	https://data.europa.eu/euodp/en/data/dataset/jrc-floods-floodmapeu_rp500y-tif	1000	250
dtm_water.table.depth_deltares_m_1km_b0..150m_2016_v1.0.tif	Simulated water table depth in metres		1000	250
clm_snow.prob_esacci.*_p_1km_s0..0cm_2000..2016_v1.0.tif	Snow probability monthly. Based on the CCI Land Cover dataset / MOD10A2 product at 500 m for the period 2000–2012.	https://www.esa-landcover-cci.org/?q=node/161	250	250
clm_water.vapor_nasa.eo.*_m_1km_s0..0cm_2000..2017_v1.0.tif	NASA's monthly MODIS Precipitable Water Vapor images (MYDAL2_M_SKY_WV)	http://neo.sci.gsfc.nasa.gov/	10000	250
clm_wind.speed_terraclimate.*_m_5km_s0..0cm_1998..2018_v1.tif	Wind speed based on TerraClimate	https://climate.northwestknowledge.net/TERRACLIMATE/index_directDownloads.php	5000	250
dtm_*.merit.dem_m_250m_s0..0cm_2018_v1.0.tif	Global high-resolution geomorphometry layers - slope, eastness, northness, roughness scale, TWI, MrVBF	http://www.spatial-ecology.net/dokuwiki/doku.php?id=topovar90m	100	250
dtm_*.merit.hydro_m_250m_s0..0cm_2018_v1.0.tif	MERIT Hydro Upstream Drainage Area and Height Above Nearest Drainage	http://hydro.iis.u-tokyo.ac.jp/~yamada/MERIT_Hydro/	100	250
clm_cloud.fraction_earthenv.modis.*_m_1km_s0..0cm_2000..2015_v1.0.tif	MODIS Cloud fraction monthly images	http://www.earthenv.org/cloud	1000	250
lcv_wetlands.cw_upmc.*_p_250m_b0..200cm_2010..2015_v1.0.tif	Multi-source global wetland maps combining surface water imagery	https://doi.org/10.1594/PANGAEA.892657	1000	250

	and groundwater constraints			
clm_lst_mod11a2.*.day_m_1km_s0..0cm_2000..2017_v1.0.tif	MODIS MOD11A2 Land Surface Temperature daytime median value.	https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a2_v006	1000	250
clm_lst_mod11a2.*.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	MODIS MOD11A2 Land Surface Temperature daytime sd value.	https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a2_v007	1000	250
clm_lst_mod11a2.*.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	MODIS MOD11A2 Land Surface Temperature day-night difference.	https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a2_v008	1000	250
lcv_surf.refl.b01_mod09a1.pc*_m_500m_s0..0cm_2001_v1.0.tif	MODIS MOD09A1 Surface Reflectance 8-Day L3 Global 500 m long-term B01 PCs	https://lpdaac.usgs.gov/products/mod09a1v006/	500	250
lcv_surf.refl.b02_mod09a1.pc*_m_500m_s0..0cm_2001_v1.0.tif	MODIS MOD09A1 Surface Reflectance 8-Day L3 Global 500 m long-term B02 PCs	https://lpdaac.usgs.gov/products/mod09a1v006/	500	250
lcv_surf.refl.b05_mod09a1.pc*_m_500m_s0..0cm_2001_v1.0.tif	MODIS MOD09A1 Surface Reflectance 8-Day L3 Global 500 m long-term B05 PCs	https://lpdaac.usgs.gov/products/mod09a1v006/	500	250
lcv_surf.refl.b06_mod09a1.pc*_m_500m_s0..0cm_2001_v1.0.tif	MODIS MOD09A1 Surface Reflectance 8-Day L3 Global 500 m long-term B06 PCs	https://lpdaac.usgs.gov/products/mod09a1v006/	500	250
lcv_surf.refl.b07_mod09a1.pc*_m_500m_s0..0cm_2001_v1.0.tif	MODIS MOD09A1 Surface Reflectance 8-Day L3 Global 500 m long-term B07 PCs	https://lpdaac.usgs.gov/products/mod09a1v006/	500	250
lcv_mangroves_unep.wcmc_p_500m_s0..0cm_2011_v1.0.tif	Status and distribution of mangrove forests of the world using earth observation satellite data (version 1.3, updated by UNEP-WCMC)	https://data.unep-wcmc.org/datasets/4	500	250
veg_fapar_proba.v.*_d_250m_s0..0cm_2014..2017_v1.0.tif	FAPAR median monthly value 2014–2017 based on the Copernicus PROB-V FAPAR product.	https://land.copernicus.eu/global/products/fapar	250	250
veg_fapar_proba.v.*_r_250m_s0..0cm_2014..2017_v1.0.tif	FAPAR IQR monthly value 2014–2017 based on the Copernicus PROB-V FAPAR product.	https://land.copernicus.eu/global/products/fapar	250	250
veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2017_v1.0.tif	FAPAR median annual value 2014–2017 based on the Copernicus PROB-V FAPAR product.	https://land.copernicus.eu/global/products/fapar	250	250
lcv_b02_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 2 – Blue cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b02_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 2 – Blue cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b02_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 2 – Blue cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	10	30

lcv_b02_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 2 – Blue cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 4 – Red cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b04_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 4 – Red cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 4 – Red cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b04_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 4 – Red cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	10	30
lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 8A – Narrow NIR cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b8a_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 8A – Narrow NIR cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 8A – Narrow NIR cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b8a_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 8A – Narrow NIR cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 9 – Water vapour cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	60	30
lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 9 – Water vapour cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	60	30
lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 9 – Water vapour cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	60	30
lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 9 – Water vapour cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	60	30
lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 11 – SWIR cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 11 – SWIR cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 11 – SWIR cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 11 – SWIR cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 12 – SWIR cloud-free mosaick median 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s1_v0.1.tif	Sentinel 2 Band 12 – SWIR cloud-free mosaick IQR 2019 s1	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 12 – SWIR cloud-free mosaick median 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2019.s2_v0.1.tif	Sentinel 2 Band 12 – SWIR cloud-free mosaick IQR 2019 s2	https://registry.opendata.aws/sentinel-2/	20	30
dtm_*_aw3d30.nasadem_m_30m_s0..0cm_2018_v0.1.tif	High-resolution geomorphometry layers - slope, eastness, northness,	https://www.eorc.jaxa.jp/ALOS/en/aw3d30/index.htm	30	30

	openess			
dtm_*_aw3d30.nasadem.100m_m_30m_s0..0cm_2018_v0.1.tif	Geomorphometry layers - slope, eastness, northness, openess, twi, catchemnt area, downscaled from 100 m	https://www.eorc.jaxa.jp/ALOS/en/aw3d30/index.htm	100	30
lcv_water.occurance_jrc.surfacewater_p_30m_b0..200cm_1984..2018_v1.1.tif	Surface water occurrence probability. Based on the Pekel et al. (2016).	https://global-surface-water.appspot.com/	30	30
lcv_landsat.red_wri.forestwatch_m_30m_s0..0cm_*_v1.0.tif	Global Forest Change 2000–2018 v1.6 red band cloud free	http://earthenginepartners.appspot.com/science-2013-global-forest	30	30
lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_*_v1.0.tif	Global Forest Change 2000–2018 v1.6 NIR band cloud free	http://earthenginepartners.appspot.com/science-2013-global-forest	30	30
lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_*_v1.0.tif	Global Forest Change 2000–2018 v1.6 SWIR1 band cloud free	http://earthenginepartners.appspot.com/science-2013-global-forest	30	30
lcv_landsat.swir2_wri.forestwatch_m_30m_s0..0cm_*_v1.0.tif	Global Forest Change 2000–2018 v1.6 SWIR2 band cloud free	http://earthenginepartners.appspot.com/science-2013-global-forest	30	30
veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	ALOS PALSAR HH band from 2007	https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm	20	30
veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	ALOS PALSAR HV band from 2007	https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm	20	30
veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	ALOS PALSAR HH band from 2017	https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm	20	30
veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	ALOS PALSAR HV band from 2017	https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm	20	30
lcv_land.cover_esacc.i4_m_30m_s0..0cm_2016_v1.0.tif	ESA CCI Land Cover (LC) map at 20m over Africa based on 1 year of Sentinel-2A observations	http://2016africallandcover20m.esrin.esa.int/	20	30
lcv_land.cover_esaglc100m.*_p_30m_s0..0cm_2016_v1.0.tif	Global 100m Land Cover maps for 2015	https://land.copernicus.eu/global/content/release-global-100m-land-cover-maps-2015	100	30

Supplement 3: Summary statistics per soil variable with variable importance (Random Forest) and summary model accuracies. Derived from mlr package using the <https://mlr.mlr-org.com/reference/makeStackedLearner.html> function.

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: clay_tot_psa
R-square: 0.746
Fitted values sd: 16.5
RMSE: 9.63

Random forest model:
Call:
stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-75.803	-4.512	-0.178	3.748	82.146

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	4.494652	8.914671	0.504	0.61413
regr.ranger	1.076957	0.003611	298.210	< 2e-16 ***
regr.xgboost	-0.012617	0.004678	-2.697	0.00699 **
regr.cubist	0.030730	0.003930	7.820	5.32e-15 ***
regr.nnet	-0.238376	0.365390	-0.652	0.51415
regr.cvglmnet	-0.044547	0.004379	-10.174	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 9.629 on 122269 degrees of freedom
Multiple R-squared: 0.7458, Adjusted R-squared: 0.7458
F-statistic: 7.175e+04 on 5 and 122269 DF, p-value: < 2.2e-16

Variable importance:

	variable importance
336	hzn_depth 4016546.0
332	lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif 1686145.3
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif 1345905.1
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif 1190567.9
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 669722.1
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif 669571.9
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif 560918.0
37	clm_lst_mod11a2.dec.day_m_1km_s0..0cm_2000..2017_v1.0.tif 512652.5
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif 501181.3
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif 468159.7
276	clm_cloud.fraction_earthenenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif 426687.5
274	clm_cloud.fraction_earthenenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif 426586.6
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif 418043.6

18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	405753.7
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	393397.9
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	392724.8
72	clm_lst_mod11a2.oct.night_m_1km_s0..0cm_2000..2017_v1.0.tif	383326.7
156	clm_bioclim.var_chelsa.10_m_1km_s0..0cm_1979..2013_v1.0.tif	372853.1
185	clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif	369821.6
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	364986.1
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	363420.9
298	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	336227.7
42	clm_lst_mod11a2.feb.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	308694.5
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	302853.6
9	clm_precipitation_sm2rain.feb_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	294082.8
76	clm_lst_mod11a2.sep.night_m_1km_s0..0cm_2000..2017_v1.0.tif	293483.8
13	clm_precipitation_sm2rain.jul_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	291769.8
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	285421.6
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif	283346.6
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	282282.1
287	lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2015_v1.0.tif	280958.3
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	280836.8
58	clm_lst_mod11a2.mar.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	278276.8
308	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	268674.5
279	clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	266859.4
130	veg_fapar_proba.v.jul_u.975_250m_s0..0cm_2014..2019_v1.0.tif	263512.5
267	clm_wind.speed_terraclimate.sep_m_5km_s0..0cm_1998..2018_v1.tif	261704.9
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	254202.7
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	243823.4
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	242089.7
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	241183.5
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	240861.2
333	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	240647.4
29	clm_lst_mod11a2.apr.day_m_1km_s0..0cm_2000..2017_v1.0.tif	239800.7
70	clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	238443.9
34	clm_lst_mod11a2.aug.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	236980.9
62	clm_lst_mod11a2.may.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	234664.6
193	dtm_dvm2_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	234453.0
326	lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	234276.0
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	234120.0

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: db_od

R-square: 0.819

Fitted values sd: 0.269

RMSE: 0.126

Random forest model:

```

Call:
stats::lm(formula = f, data = d)

Residuals:
    Min       1Q   Median       3Q      Max
-1.06778 -0.06450  0.00215  0.06585  0.90016

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.05538    0.04860  -1.140  0.25451
regr.ranger    0.86305    0.01577  54.733 < 2e-16 ***
regr.xgboost   0.15383    0.01651   9.315 < 2e-16 ***
regr.cubist    0.02039    0.01113   1.832  0.06695 .
regr.nnet      0.03465    0.03710   0.934  0.35036
regr.cvglmnet -0.03021    0.01032  -2.927  0.00343 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1263 on 13565 degrees of freedom
Multiple R-squared:  0.8194,    Adjusted R-squared:  0.8193
F-statistic: 1.231e+04 on 5 and 13565 DF,  p-value: < 2.2e-16

Variable importance:

```

	variable	importance
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	173.055853
311	lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	88.203943
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	62.529811
301	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	50.220640
336	hzn_depth	49.436356
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	43.942565
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	38.466574
286	lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2000_v1.0.tif	30.560528
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif	28.298537
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	23.243982
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	14.701368
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	13.918615
3	clm_precipitation_sm2rain.apr.sd.10_10km_s0..0cm_2007..2018_v1.0.tif	13.554058
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	11.872374
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	10.289871
269	clm_cloud.fraction_earthenenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	10.064493
268	clm_cloud.fraction_earthenenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	9.789589
272	clm_cloud.fraction_earthenenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	9.683845
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	8.983756
273	clm_cloud.fraction_earthenenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	8.061213
167	clm_bioclim.var_chelsa.6_m_1km_s0..0cm_1979..2013_v1.0.tif	7.667438

14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	7.381931
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	7.167184
28	clm_lst_mod11a2.annual.night_m_1km_s0..0cm_2000..2017_v1.0.tif	6.899234
69	clm_lst_mod11a2.oct.day_m_1km_s0..0cm_2000..2017_v1.0.tif	6.897999
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif	6.877684
17	clm_precipitation_sm2rain.mar_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	6.829219
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	6.753470
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	6.717086
36	clm_lst_mod11a2.aug.night_m_1km_s0..0cm_2000..2017_v1.0.tif	6.150320
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	6.029270
280	clm_cloud.fraction_earthenv.modis.sep_p_1km_s0..0cm_2000..2015_v1.0.tif	5.882436
27	clm_lst_mod11a2.annual.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	5.759884
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	5.529642
60	clm_lst_mod11a2.mar.night_m_1km_s0..0cm_2000..2017_v1.0.tif	5.518799
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	5.290183
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif	5.257706
175	af_lithology_X9	5.240793
192	dtm_dvm2_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	5.157378
55	clm_lst_mod11a2.jun.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	4.874207
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	4.848989
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	4.823740
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	4.754339
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	4.649781
328	lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	4.546480
91	lcv_surf.refl.b05_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	4.486198
16	clm_precipitation_sm2rain.mar_m_1km_s0..0cm_2007..2018_v0.2.tif	4.430792
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	4.305822
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	4.303449
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	4.220544

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: dbr

R-square: 0.429

Fitted values sd: 37.5

RMSE: 43.3

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-249.840	-0.724	2.667	12.198	242.184

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	650.69680	638.91097	1.018	0.3085
regr.ranger	0.85465	0.01640	52.128	< 2e-16 ***
regr.xgboost	0.13640	0.01874	7.280	3.43e-13 ***
regr.cubist	0.11993	0.01211	9.903	< 2e-16 ***
regr.nnet	-2.89697	2.78062	-1.042	0.2975
regr.cvglmnet	-0.04644	0.01536	-3.024	0.0025 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 43.26 on 28054 degrees of freedom
Multiple R-squared: 0.429, Adjusted R-squared: 0.4289
F-statistic: 4216 on 5 and 28054 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif	1625434.4
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	1595999.6
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	1452172.3
108	veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2019_v1.0.tif	1270840.8
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	1098804.1
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif	1095576.0
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	1082679.9
272	clm_cloud.fraction_earthenenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	1034668.1
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	1027417.3
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	1021259.8
266	clm_wind.speed_terraclimate.oct_m_5km_s0..0cm_1998..2018_v1.tif	1018394.5
262	clm_wind.speed_terraclimate.jun_m_5km_s0..0cm_1998..2018_v1.tif	1013247.0
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	976202.4
36	clm_lst_mod11a2.aug.night_m_1km_s0..0cm_2000..2017_v1.0.tif	975607.1
271	clm_cloud.fraction_earthenenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	963765.6
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	945470.1
147	veg_fapar_proba.v.oct_d_250m_s0..0cm_2014..2019_v1.0.tif	918678.7
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	888139.6
151	veg_fapar_proba.v.sep_d_250m_s0..0cm_2014..2019_v1.0.tif	886679.3
273	clm_cloud.fraction_earthenenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	856595.1
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	835007.3
275	clm_cloud.fraction_earthenenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	834660.3
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	818492.8
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	794544.7
124	veg_fapar_proba.v.jan_d_250m_s0..0cm_2014..2019_v1.0.tif	792837.5
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	747307.1
131	veg_fapar_proba.v.jun_d_250m_s0..0cm_2014..2019_v1.0.tif	697004.2
192	dtm_dvm2_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	675968.6
260	clm_wind.speed_terraclimate.jan_m_5km_s0..0cm_1998..2018_v1.tif	669228.5

```

279 clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif 668248.3
269 clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif 662771.0
14      clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif 631001.7
89      lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 626569.5
270 clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif 623979.1
61      clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif 623073.5
256      clm_wind.speed_terraclimate.apr_m_5km_s0..0cm_1998..2018_v1.tif 613790.4
263      clm_wind.speed_terraclimate.mar_m_5km_s0..0cm_1998..2018_v1.tif 609655.3
120      veg_fapar_proba.v.feb_d_250m_s0..0cm_2014..2019_v1.0.tif 609362.3
325      dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif 609128.9
75      clm_lst_mod11a2.sep.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif 607180.4
185      clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif 606570.0
42      clm_lst_mod11a2.feb.day_sd_1km_s0..0cm_2000..2017_v1.0.tif 601597.1
148      veg_fapar_proba.v.oct_l.025_250m_s0..0cm_2014..2019_v1.0.tif 599634.2
157      clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif 592305.8
109      veg_fapar_proba.v.apr_d_250m_s0..0cm_2014..2019_v1.0.tif 585096.2
23      clm_precipitation_sm2rain.oct_sd.10_10km_s0..0cm_2007..2018_v1.0.tif 580821.3
4      clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif 560969.5
265      clm_wind.speed_terraclimate.nov_m_5km_s0..0cm_1998..2018_v1.tif 560530.1
95      lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 558936.2
224      dtm_northness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif 555155.0

```

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.al_mehlich3

R-square: 0.881

Fitted values sd: 0.872

RMSE: 0.321

Random forest model:

Call:

```
stats::lm(formula = f, data = d)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-5.7042	-0.1036	0.0059	0.1189	3.3777

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.675492	2.771906	-0.244	0.807
regr.ranger	0.879567	0.005464	160.969	<2e-16 ***
regr.xgboost	0.071537	0.005813	12.306	<2e-16 ***
regr.cubist	0.150157	0.004553	32.979	<2e-16 ***
regr.nnet	0.087603	0.431261	0.203	0.839
regr.cvglmnet	-0.084440	0.003182	-26.534	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3208 on 63551 degrees of freedom

Multiple R-squared: 0.8808, Adjusted R-squared: 0.8808

F-statistic: 9.391e+04 on 5 and 63551 DF, p-value: < 2.2e-16

Variable importance:

		variable importance
336	hzn_depth	13418.5825
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	1571.9326
256	clm_wind.speed_terraclimate.apr_m_5km_s0..0cm_1998..2018_v1.tif	1230.9573
18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	1000.2514
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	937.1489
264	clm_wind.speed_terraclimate.may_m_5km_s0..0cm_1998..2018_v1.tif	881.4959
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	867.0038
257	clm_wind.speed_terraclimate.aug_m_5km_s0..0cm_1998..2018_v1.tif	846.6338
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	683.9056
56	clm_lst_mod11a2.jun.night_m_1km_s0..0cm_2000..2017_v1.0.tif	649.7619
16	clm_precipitation_sm2rain.mar_m_1km_s0..0cm_2007..2018_v0.2.tif	626.1463
167	clm_bioclim.var_chelsa.6_m_1km_s0..0cm_1979..2013_v1.0.tif	623.9146
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	619.9115
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	570.6529
266	clm_wind.speed_terraclimate.oct_m_5km_s0..0cm_1998..2018_v1.tif	536.3592
156	clm_bioclim.var_chelsa.10_m_1km_s0..0cm_1979..2013_v1.0.tif	509.8736
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	498.8553
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	495.6036
260	clm_wind.speed_terraclimate.jan_m_5km_s0..0cm_1998..2018_v1.tif	492.4013
49	clm_lst_mod11a2.jul.day_m_1km_s0..0cm_2000..2017_v1.0.tif	463.4539
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	462.5531
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif	441.9174
72	clm_lst_mod11a2.oct.night_m_1km_s0..0cm_2000..2017_v1.0.tif	434.6131
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	418.7509
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	415.5855
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	409.0120
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	399.9598
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	385.7886
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif	384.5702
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	381.4038
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	375.0136
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	368.3472
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	367.8038
273	clm_cloud.fraction_earthenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	362.4353
52	clm_lst_mod11a2.jul.night_m_1km_s0..0cm_2000..2017_v1.0.tif	358.6965
61	clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif	343.3633
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif	334.2879

276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	332.7767
259	clm_wind.speed_terraclimate.feb_m_5km_s0..0cm_1998..2018_v1.tif	330.3643
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	323.2967
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif	319.7172
155	clm_bioclim.var_chelsa.1_m_1km_s0..0cm_1979..2013_v1.0.tif	306.0843
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	300.7234
265	clm_wind.speed_terraclimate.nov_m_5km_s0..0cm_1998..2018_v1.tif	292.0814
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	290.4675
85	lcv_surf.refl.b02_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	287.7645
270	clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif	285.8978
7	clm_precipitation_sm2rain.dec_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	282.9229
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	272.3740
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	271.9390

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.ca_mehlich3

R-square: 0.84

Fitted values sd: 1.24

RMSE: 0.543

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-6.0376	-0.2577	0.0076	0.2756	5.3825

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.737959	3.850998	1.490	0.136
regr.ranger	1.054018	0.003175	331.978	< 2e-16 ***
regr.xgboost	-0.030930	0.003939	-7.853	4.1e-15 ***
regr.cubist	0.061829	0.003561	17.364	< 2e-16 ***
regr.nnet	-0.855297	0.561006	-1.525	0.127
regr.cvglmnet	-0.065040	0.003225	-20.166	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5428 on 144593 degrees of freedom

Multiple R-squared: 0.8403, Adjusted R-squared: 0.8402

F-statistic: 1.521e+05 on 5 and 144593 DF, p-value: < 2.2e-16

Variable importance:

		variable	importance
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif		25629.557
336		hzn_depth	15475.129
136	veg_fapar_proba.v.mar_1.025_250m_s0..0cm_2014..2019_v1.0.tif		12867.069
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		11012.360
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif		9706.161
62	clm_lst_mod11a2.may.day_sd_1km_s0..0cm_2000..2017_v1.0.tif		9286.497
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif		8707.913
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif		6540.222
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif		4443.386
58	clm_lst_mod11a2.mar.day_sd_1km_s0..0cm_2000..2017_v1.0.tif		3945.553
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif		3827.796
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif		3652.756
121	veg_fapar_proba.v.feb_1.025_250m_s0..0cm_2014..2019_v1.0.tif		3485.488
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif		3031.816
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif		2890.768
55	clm_lst_mod11a2.jun.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		2800.209
12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif		2694.930
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif		2638.236
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif		2467.229
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif		2393.608
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif		2346.238
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif		2279.393
135	veg_fapar_proba.v.mar_d_250m_s0..0cm_2014..2019_v1.0.tif		2138.859
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif		1903.479
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif		1857.197
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif		1846.464
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif		1783.455
275	clm_cloud.fraction_earthenenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif		1778.113
278	clm_cloud.fraction_earthenenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif		1753.762
45	clm_lst_mod11a2.jan.day_m_1km_s0..0cm_2000..2017_v1.0.tif		1493.797
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif		1484.762
298	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif		1482.038
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif		1445.098
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif		1340.312
320	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif		1310.983
269	clm_cloud.fraction_earthenenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif		1306.876
90	lcv_surf.refl.b05_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif		1306.185
279	clm_cloud.fraction_earthenenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif		1292.117
204	dtm_twi_merit.dem_m_2km_s0..0cm_2017_v1.0.tif		1274.419
75	clm_lst_mod11a2.sep.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		1263.827
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif		1256.875
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif		1248.525
216	dtm_dev.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif		1245.920
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif		1245.698
268	clm_cloud.fraction_earthenenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif		1244.454

203	dtm_twi_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	1234.857
259	clm_wind.speed_terraclimate.feb_m_5km_s0..0cm_1998..2018_v1.tif	1234.189
51	clm_lst_mod11a2.jul.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1223.667
69	clm_lst_mod11a2.oct.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1206.937
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	1201.371

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.c_tot
R-square: 0.794
Fitted values sd: 0.571
RMSE: 0.291

Random forest model:
Call:
stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-2.70312	-0.16714	-0.00549	0.15691	3.01116

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.025841	0.032713	0.790	0.429570
regr.ranger	0.902240	0.008462	106.619	< 2e-16 ***
regr.xgboost	0.066535	0.008145	8.169	3.18e-16 ***
regr.cubist	0.145730	0.006927	21.039	< 2e-16 ***
regr.nnet	-0.048957	0.013466	-3.636	0.000278 ***
regr.cvglmnet	-0.075212	0.005556	-13.537	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.291 on 50140 degrees of freedom
Multiple R-squared: 0.7938, Adjusted R-squared: 0.7938
F-statistic: 3.861e+04 on 5 and 50140 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
301	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	1529.37519
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	1332.97927
336	hzn_depth	1067.10077
286	lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2000_v1.0.tif	927.23617
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	877.53084
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	563.68050
261	clm_wind.speed_terraclimate.jul_m_5km_s0..0cm_1998..2018_v1.tif	419.49978

95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	404.49441
274	clm_cloud.fraction_earthenenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif	378.58867
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	338.85521
18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	328.63451
27	clm_lst_mod11a2.annual.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	312.28715
334	lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_2015_v1.0.tif	293.18473
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	283.37199
276	clm_cloud.fraction_earthenenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	259.93640
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	257.11119
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	244.43550
204	dtm_twi_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	240.34002
328	lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	220.24873
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	217.36030
72	clm_lst_mod11a2.oct.night_m_1km_s0..0cm_2000..2017_v1.0.tif	210.13389
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	190.70229
61	clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif	187.23391
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	179.33366
269	clm_cloud.fraction_earthenenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	162.88049
185	clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif	151.38205
16	clm_precipitation_sm2rain.mar_m_1km_s0..0cm_2007..2018_v0.2.tif	148.96814
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif	147.08369
44	clm_lst_mod11a2.feb.night_m_1km_s0..0cm_2000..2017_v1.0.tif	138.29304
320	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	137.23427
319	lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	134.05703
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	133.09698
53	clm_lst_mod11a2.jun.day_m_1km_s0..0cm_2000..2017_v1.0.tif	132.39539
235	dtm_vrm_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	131.96077
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	129.11108
330	lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	121.26827
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	118.03946
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	117.43699
273	clm_cloud.fraction_earthenenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	113.74181
49	clm_lst_mod11a2.jul.day_m_1km_s0..0cm_2000..2017_v1.0.tif	112.89753
260	clm_wind.speed_terraclimate.jan_m_5km_s0..0cm_1998..2018_v1.tif	107.82618
167	clm_bioclim.var_chelsa.6_m_1km_s0..0cm_1979..2013_v1.0.tif	105.85939
71	clm_lst_mod11a2.oct.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	104.07157
142	veg_fapar_proba.v.may_u.975_250m_s0..0cm_2014..2019_v1.0.tif	103.11904
91	lcv_surf.refl.b05_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	101.13754
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	99.54664
324	dtm_saga.twi_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	99.02696
112	veg_fapar_proba.v.apr_u.975_250m_s0..0cm_2014..2019_v1.0.tif	97.38614
285	lcv_landsat.red_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	97.29888
66	clm_lst_mod11a2.nov.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	95.00835

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.ecec.f
R-square: 0.754
Fitted values sd: 0.729
RMSE: 0.417

Random forest model:
Call:
stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-3.2877	-0.1888	0.0097	0.2023	3.1494

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.807991	1.806781	1.554	0.1202
regr.ranger	1.046105	0.004845	215.911	< 2e-16 ***
regr.xgboost	-0.016558	0.005912	-2.801	0.0051 **
regr.cubist	0.031843	0.005063	6.289	3.21e-10 ***
regr.nnet	-1.142820	0.713071	-1.603	0.1090
regr.cvglmnet	-0.027630	0.005607	-4.928	8.34e-07 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4166 on 66380 degrees of freedom
Multiple R-squared: 0.7538, Adjusted R-squared: 0.7538
F-statistic: 4.065e+04 on 5 and 66380 DF, p-value: < 2.2e-16

Variable importance:

	variable importance
336	hzn_depth 2942.4846
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 1793.2962
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif 1236.6638
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif 960.4174
183	af_lithology_X19 941.4197
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif 896.4531
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif 669.6200
273	clm_cloud.fraction_earthenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif 626.1853
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif 550.5576
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 496.8094
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif 470.9722
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif 466.6186
40	clm_lst_mod11a2.dec.night_m_1km_s0..0cm_2000..2017_v1.0.tif 447.8735
262	clm_wind.speed_terraclimate.jun_m_5km_s0..0cm_1998..2018_v1.tif 443.6185
274	clm_cloud.fraction_earthenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif 442.9051

24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	421.2403
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	419.7370
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	409.7946
320	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	404.2286
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	373.1247
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	361.7942
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	358.2872
141	veg_fapar_proba.v.may_r_250m_s0..0cm_2014..2019_v1.0.tif	356.5329
53	clm_lst_mod11a2.jun.day_m_1km_s0..0cm_2000..2017_v1.0.tif	355.9928
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	351.8851
50	clm_lst_mod11a2.jul.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	344.7256
12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif	344.6858
257	clm_wind.speed_terraclimate.aug_m_5km_s0..0cm_1998..2018_v1.tif	329.6783
56	clm_lst_mod11a2.jun.night_m_1km_s0..0cm_2000..2017_v1.0.tif	328.7805
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	327.6904
48	clm_lst_mod11a2.jan.night_m_1km_s0..0cm_2000..2017_v1.0.tif	324.0546
71	clm_lst_mod11a2.oct.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	313.1764
279	clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	302.3604
298	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	302.2950
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	301.6377
26	clm_lst_mod11a2.annual.day_m_1km_s0..0cm_2000..2017_v1.0.tif	298.1593
280	clm_cloud.fraction_earthenv.modis.sep_p_1km_s0..0cm_2000..2015_v1.0.tif	297.2237
309	lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_2000_v1.0.tif	293.0423
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	291.2268
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	287.2366
74	clm_lst_mod11a2.sep.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	286.0513
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	281.2668
62	clm_lst_mod11a2.may.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	281.0670
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	280.9722
190	dtm_dvm_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	280.0835
256	clm_wind.speed_terraclimate.apr_m_5km_s0..0cm_1998..2018_v1.tif	275.7936
137	veg_fapar_proba.v.mar_r_250m_s0..0cm_2014..2019_v1.0.tif	274.6347
45	clm_lst_mod11a2.jan.day_m_1km_s0..0cm_2000..2017_v1.0.tif	273.4807
90	lcv_surf.refl.b05_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	271.0436
191	dtm_dvm_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	268.0071

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.fe_mehlich3

R-square: 0.817

Fitted values sd: 0.497

RMSE: 0.235

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-4.0165	-0.1312	-0.0082	0.1238	2.5077

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	3.913522	1.869721	2.093	0.036344 *
regr.ranger	0.856893	0.007912	108.306	< 2e-16 ***
regr.xgboost	0.027856	0.007738	3.600	0.000318 ***
regr.cubist	0.146095	0.007230	20.207	< 2e-16 ***
regr.nnet	-0.879348	0.402810	-2.183	0.029037 *
regr.cvglmnet	0.005610	0.004470	1.255	0.209415

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2349 on 57526 degrees of freedom

Multiple R-squared: 0.8173, Adjusted R-squared: 0.8173

F-statistic: 5.148e+04 on 5 and 57526 DF, p-value: < 2.2e-16

Variable importance:

	variable importance
336	hzn_depth 4211.56365
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif 751.76482
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif 504.21235
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif 376.24932
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif 358.44514
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 310.04292
162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif 256.75292
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif 247.92123
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif 246.86960
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif 202.62456
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif 201.88177
75	clm_lst_mod11a2.sep.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif 189.18492
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 188.38100
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 180.13546
185	clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif 174.75047
148	veg_fapar_proba.v.oct_1.025_250m_s0..0cm_2014..2019_v1.0.tif 164.16878
132	veg_fapar_proba.v.jun_1.025_250m_s0..0cm_2014..2019_v1.0.tif 162.79290
263	clm_wind.speed_terraclimate.mar_m_5km_s0..0cm_1998..2018_v1.tif 161.41109
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif 158.69588
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif 153.83944
15	clm_precipitation_sm2rain.jun_sd.10_10km_s0..0cm_2007..2018_v1.0.tif 148.38200
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif 132.38091
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif 129.85375

322	lcv Landsat.SWIR2.WRI.ForestWatch_m_30m_s0..0cm_2018_v1.0.tif	129.46999
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	127.10799
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	126.44015
67	clm_lst_mod11a2.nov.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	125.22611
323	dtm_openn_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	124.85134
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	123.93251
267	clm_wind.speed_terraclimate.sep_m_5km_s0..0cm_1998..2018_v1.tif	113.74646
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	111.80516
56	clm_lst_mod11a2.jun.night_m_1km_s0..0cm_2000..2017_v1.0.tif	108.09862
11	clm_precipitation_sm2rain.jan_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	105.14812
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	104.95026
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	100.91802
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	97.16541
29	clm_lst_mod11a2.apr.day_m_1km_s0..0cm_2000..2017_v1.0.tif	94.70764
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	94.19590
12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif	92.08210
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	91.45380
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	90.41915
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	88.14494
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	87.37166
258	clm_wind.speed_terraclimate.dec_m_5km_s0..0cm_1998..2018_v1.tif	84.74383
136	veg_fapar_proba.v.mar_l.025_250m_s0..0cm_2014..2019_v1.0.tif	83.73858
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	83.16436
265	clm_wind.speed_terraclimate.nov_m_5km_s0..0cm_1998..2018_v1.tif	81.71888
51	clm_lst_mod11a2.jul.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	80.83370
3	clm_precipitation_sm2rain.apr_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	80.65716
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	78.85146

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.k_mehlich3

R-square: 0.773

Fitted values sd: 0.938

RMSE: 0.509

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-4.3088	-0.2648	-0.0037	0.2639	6.8136

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	10.907726	6.134422	1.778	0.0754 .

```

regr.ranger      1.004487    0.003878 259.026    <2e-16 ***
regr.xgboost     -0.004081    0.004739  -0.861    0.3892
regr.cubist      0.084556    0.004346  19.454    <2e-16 ***
regr.nnet        -2.205286    1.228586  -1.795    0.0727 .
regr.cvglmnet    -0.064510    0.003933 -16.401    <2e-16 ***

```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5092 on 139122 degrees of freedom

Multiple R-squared: 0.7725, Adjusted R-squared: 0.7725

F-statistic: 9.451e+04 on 5 and 139122 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
336	hzn_depth	10227.3215
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	10018.9636
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	8704.8286
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	6659.1114
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	5875.7950
272	clm_cloud.fraction_earthenenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	2928.5415
51	clm_lst_mod11a2.jul.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	2737.4136
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	2663.4097
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	2481.9534
46	clm_lst_mod11a2.jan.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	2453.6357
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif	1983.4801
273	clm_cloud.fraction_earthenenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	1929.7810
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1921.4043
64	clm_lst_mod11a2.may.night_m_1km_s0..0cm_2000..2017_v1.0.tif	1814.1560
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	1768.5479
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	1720.0973
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	1718.0333
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1709.1744
271	clm_cloud.fraction_earthenenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	1560.8609
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	1557.2605
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1480.3266
266	clm_wind.speed_terraclimate.oct_m_5km_s0..0cm_1998..2018_v1.tif	1402.1554
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	1389.0582
185	clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif	1344.7656
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1297.0359
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1296.6207
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif	1259.5051
278	clm_cloud.fraction_earthenenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif	1235.1713
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	1222.5705
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	1192.1016
274	clm_cloud.fraction_earthenenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif	1178.0660

162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif	1139.1934
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	1101.3717
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1097.1118
3	clm_precipitation_sm2rain.apr_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1054.9025
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	1049.9744
258	clm_wind.speed_terraclimate.dec_m_5km_s0..0cm_1998..2018_v1.tif	1039.3554
110	veg_fapar_proba.v.apr_l.025_250m_s0..0cm_2014..2019_v1.0.tif	1003.1885
5	clm_precipitation_sm2rain.aug_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	995.1651
257	clm_wind.speed_terraclimate.aug_m_5km_s0..0cm_1998..2018_v1.tif	993.6640
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	962.4582
136	veg_fapar_proba.v.mar_l.025_250m_s0..0cm_2014..2019_v1.0.tif	948.6746
270	clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif	940.9086
113	veg_fapar_proba.v.aug_d_250m_s0..0cm_2014..2019_v1.0.tif	888.3852
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	846.8952
53	clm_lst_mod11a2.jun.day_m_1km_s0..0cm_2000..2017_v1.0.tif	843.2879
74	clm_lst_mod11a2.sep.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	835.6056
149	veg_fapar_proba.v.oct_r_250m_s0..0cm_2014..2019_v1.0.tif	833.4164
18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	805.4782
265	clm_wind.speed_terraclimate.nov_m_5km_s0..0cm_1998..2018_v1.tif	792.1192

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.mg_mehlich3

R-square: 0.815

Fitted values sd: 1.05

RMSE: 0.498

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.8775	-0.2312	0.0028	0.2465	3.7400

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.034349	0.051219	-0.671	0.5025
regr.ranger	1.034217	0.003263	316.950	<2e-16 ***
regr.xgboost	-0.008057	0.003854	-2.091	0.0366 *
regr.cubist	0.073223	0.003649	20.067	<2e-16 ***
regr.nnet	-0.017388	0.009528	-1.825	0.0680 .
regr.cvglmnet	-0.075566	0.003402	-22.213	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4979 on 136681 degrees of freedom
Multiple R-squared: 0.8152, Adjusted R-squared: 0.8152
F-statistic: 1.206e+05 on 5 and 136681 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	11658.0891
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	10809.6652
272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	9517.4497
336	hzn_depth	9356.2670
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	8421.4743
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	3063.8104
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	2752.7731
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	2646.6504
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	2621.2727
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	2569.9765
37	clm_lst_mod11a2.dec.day_m_1km_s0..0cm_2000..2017_v1.0.tif	2567.4405
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	2286.1967
125	veg_fapar_proba.v.jan_l.025_250m_s0..0cm_2014..2019_v1.0.tif	2132.7690
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	2001.6765
264	clm_wind.speed_terraclimate.may_m_5km_s0..0cm_1998..2018_v1.tif	1922.4882
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	1847.0113
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1834.8276
18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	1756.2352
210	dtm_vbf_merit.dem_m_500m_s0..0cm_2017_v1.0.tif	1705.8147
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	1684.7982
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	1656.0278
256	clm_wind.speed_terraclimate.apr_m_5km_s0..0cm_1998..2018_v1.tif	1545.6106
110	veg_fapar_proba.v.apr_l.025_250m_s0..0cm_2014..2019_v1.0.tif	1539.1636
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1525.1769
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	1444.3785
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	1415.8759
257	clm_wind.speed_terraclimate.aug_m_5km_s0..0cm_1998..2018_v1.tif	1401.6521
49	clm_lst_mod11a2.jul.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1401.0751
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1384.8821
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1379.8090
259	clm_wind.speed_terraclimate.feb_m_5km_s0..0cm_1998..2018_v1.tif	1335.2672
26	clm_lst_mod11a2.annual.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1316.1492
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif	1200.6009
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	1181.9259
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif	1162.6065
263	clm_wind.speed_terraclimate.mar_m_5km_s0..0cm_1998..2018_v1.tif	1146.3949
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	1145.6780
300	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	1135.2428
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1122.1417

286	lcv Landsat.SWIR1_WRI.ForestWatch_m_30m_s0..0cm_2000_v1.0.tif	1122.1017
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	1096.7862
66	clm_lst_mod11a2.nov.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1081.7642
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	1079.2317
266	clm_wind.speed_terraclimate.oct_m_5km_s0..0cm_1998..2018_v1.tif	1040.0766
108	veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2019_v1.0.tif	1015.6935
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	990.2735
34	clm_lst_mod11a2.aug.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	969.9446
135	veg_fapar_proba.v.mar_d_250m_s0..0cm_2014..2019_v1.0.tif	968.3554
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	965.1066
111	veg_fapar_proba.v.apr_r_250m_s0..0cm_2014..2019_v1.0.tif	962.7918

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.n_tot_ncs

R-square: 0.732

Fitted values sd: 0.326

RMSE: 0.197

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-1.87298	-0.09584	-0.00985	0.07613	3.14728

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.267429	0.493235	0.542	0.588
regr.ranger	1.128208	0.005766	195.669	< 2e-16 ***
regr.xgboost	-0.048780	0.006108	-7.987	1.4e-15 ***
regr.cubist	0.143954	0.004424	32.539	< 2e-16 ***
regr.nnet	-0.482261	0.797938	-0.604	0.546
regr.cvglmnet	-0.170889	0.004955	-34.489	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1972 on 99249 degrees of freedom

Multiple R-squared: 0.7319, Adjusted R-squared: 0.7319

F-statistic: 5.419e+04 on 5 and 99249 DF, p-value: < 2.2e-16

Variable importance:

	variable importance
336	hzn_depth 2148.70938

227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	864.35073
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	539.88155
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	237.76542
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	236.14521
301	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	224.39376
235	dtm_vrm_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	218.06073
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	187.84097
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	169.72542
61	clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif	164.43068
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	147.98790
286	lcv_landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2000_v1.0.tif	147.26162
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	139.63193
18	clm_precipitation_sm2rain.may_m_1km_s0..0cm_2007..2018_v0.2.tif	133.40604
68	clm_lst_mod11a2.nov.night_m_1km_s0..0cm_2000..2017_v1.0.tif	121.11814
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	111.78102
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	109.69198
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	107.32010
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif	107.14063
162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif	105.83956
37	clm_lst_mod11a2.dec.day_m_1km_s0..0cm_2000..2017_v1.0.tif	104.37362
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	97.85928
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	97.23733
142	veg_fapar_proba.v.may_u.975_250m_s0..0cm_2014..2019_v1.0.tif	92.20478
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	89.18928
209	dtm_vbf_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	87.64995
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	86.56225
320	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	85.65804
270	clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif	84.07678
29	clm_lst_mod11a2.apr.day_m_1km_s0..0cm_2000..2017_v1.0.tif	83.38562
332	lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	82.88817
139	veg_fapar_proba.v.may_d_250m_s0..0cm_2014..2019_v1.0.tif	82.13841
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	79.65647
44	clm_lst_mod11a2.feb.night_m_1km_s0..0cm_2000..2017_v1.0.tif	79.35033
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	78.93093
58	clm_lst_mod11a2.mar.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	78.82087
276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	78.61886
204	dtm_twi_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	77.71265
66	clm_lst_mod11a2.nov.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	77.57004
272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	77.43724
273	clm_cloud.fraction_earthenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	77.37877
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	76.43363
67	clm_lst_mod11a2.nov.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	74.87560
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	73.29149
210	dtm_vbf_merit.dem_m_500m_s0..0cm_2017_v1.0.tif	73.17131
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	72.92421
42	clm_lst_mod11a2.feb.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	72.82393

12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif	70.72952
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif	70.18299
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	69.01352

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.oc
R-square: 0.791
Fitted values sd: 0.716
RMSE: 0.369

Random forest model:
Call:
stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-3.1517	-0.1900	-0.0060	0.1793	4.2621

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.821657	0.794000	2.294	0.0218 *
regr.ranger	1.047507	0.005146	203.571	<2e-16 ***
regr.xgboost	-0.005943	0.005340	-1.113	0.2657
regr.cubist	0.052084	0.004884	10.664	<2e-16 ***
regr.nnet	-0.867384	0.359213	-2.415	0.0158 *
regr.cvglmnet	-0.050157	0.003863	-12.984	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3687 on 122457 degrees of freedom
Multiple R-squared: 0.7906, Adjusted R-squared: 0.7906
F-statistic: 9.248e+04 on 5 and 122457 DF, p-value: < 2.2e-16

Variable importance:

	variable importance
336	hzn_depth 20255.8035
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif 6102.3811
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif 2270.1690
72	clm_lst_mod11a2.oct.night_m_1km_s0..0cm_2000..2017_v1.0.tif 1796.4102
56	clm_lst_mod11a2.jun.night_m_1km_s0..0cm_2000..2017_v1.0.tif 1766.8975
68	clm_lst_mod11a2.nov.night_m_1km_s0..0cm_2000..2017_v1.0.tif 1003.6975
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif 921.8340
301	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif 838.3108
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif 773.4460

97	lcv_surf.refl.b06_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	763.6430
48	clm_lst_mod11a2.jan.night_m_1km_s0..0cm_2000..2017_v1.0.tif	747.2118
311	lcv Landsat.swir1_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	741.4477
332	lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	719.6563
328	lcv_b04_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	704.4746
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	672.9509
64	clm_lst_mod11a2.may.night_m_1km_s0..0cm_2000..2017_v1.0.tif	631.9388
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	627.1609
134	veg_fapar_proba.v.jun_u.975_250m_s0..0cm_2014..2019_v1.0.tif	566.6067
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	558.9450
204	dtm_twi_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	552.8697
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	552.2587
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	548.4602
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	526.1304
16	clm_precipitation_sm2rain.mar_m_1km_s0..0cm_2007..2018_v0.2.tif	520.9192
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif	508.4019
69	clm_lst_mod11a2.oct.day_m_1km_s0..0cm_2000..2017_v1.0.tif	489.0852
300	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	467.1103
91	lcv_surf.refl.b05_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	464.2171
108	veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2019_v1.0.tif	442.6062
86	lcv_surf.refl.b02_mod09a1.pc4_m_500m_s0..0cm_2001_v1.0.tif	440.9818
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	438.5319
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	436.9871
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	433.6595
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif	426.0610
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	424.6914
284	lcv Landsat.red_wri.forestwatch_m_30m_s0..0cm_2000_v1.0.tif	417.5280
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	407.3196
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	398.0410
310	lcv Landsat.red_wri.forestwatch_m_30m_s0..0cm_2015_v1.0.tif	385.1587
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	382.1089
270	clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif	374.2499
21	clm_precipitation_sm2rain.nov_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	373.2142
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	363.0467
119	veg_fapar_proba.v.dec_u.975_250m_s0..0cm_2014..2019_v1.0.tif	360.5461
77	lcv_surf.refl.b01_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	357.9015
26	clm_lst_mod11a2.annual.day_m_1km_s0..0cm_2000..2017_v1.0.tif	355.8623
274	clm_cloud.fraction_earthenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif	355.3579
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	349.3912
47	clm_lst_mod11a2.jan.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	346.4775
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	333.8883

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.p_mehlich3

R-square: 0.486

Fitted values sd: 0.687

RMSE: 0.707

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-3.2892	-0.3942	-0.0637	0.2614	4.9466

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	3.378801	3.143200	1.075	0.282
regr.ranger	0.861655	0.011099	77.631	< 2e-16 ***
regr.xgboost	0.066139	0.013091	5.052	4.38e-07 ***
regr.cubist	0.157674	0.008886	17.744	< 2e-16 ***
regr.nnet	-1.649621	1.442240	-1.144	0.253
regr.cvglmnet	0.013628	0.010407	1.310	0.190

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7066 on 53493 degrees of freedom

Multiple R-squared: 0.486, Adjusted R-squared: 0.486

F-statistic: 1.012e+04 on 5 and 53493 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	2864.4507
336	hzn_depth	1302.1635
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1050.8439
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	972.4168
160	clm_bioclim.var_chelsa.14_m_1km_s0..0cm_1979..2013_v1.0.tif	892.9976
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	884.0819
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	775.3970
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	718.7164
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	682.3064
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif	550.2259
85	lcv_surf.refl.b02_mod09a1.pc3_m_500m_s0..0cm_2001_v1.0.tif	550.1456
277	clm_cloud.fraction_earthenenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	542.4723
274	clm_cloud.fraction_earthenenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif	530.8185
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	497.0550
283	lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	487.3369
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	439.1131
329	lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	436.5929

184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	431.1487
27	clm_lst_mod11a2.annual.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	415.0181
4	clm_precipitation_sm2rain.aug_m_1km_s0..0cm_2007..2018_v0.2.tif	388.7653
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	388.5768
333	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	388.0191
321	lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	387.2811
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif	380.3644
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	376.1103
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	375.9394
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	374.3861
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	369.5684
281	veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	368.8913
129	veg_fapar_proba.v.jul_r_250m_s0..0cm_2014..2019_v1.0.tif	364.5444
114	veg_fapar_proba.v.aug_l.025_250m_s0..0cm_2014..2019_v1.0.tif	363.7978
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	361.3844
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	360.1045
34	clm_lst_mod11a2.aug.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	357.4737
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	354.1600
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	351.1124
331	dtm_uplocal_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	350.8357
192	dtm_dvm2_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	350.3820
80	lcv_surf.refl.b01_mod09a1.pc4_m_500m_s0..0cm_2001_v1.0.tif	344.6165
272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	341.1547
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	335.4151
288	dtm_devmean_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	334.3574
53	clm_lst_mod11a2.jun.day_m_1km_s0..0cm_2000..2017_v1.0.tif	332.1994
300	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	328.5600
231	dtm_tcurv_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	327.6651
327	lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	327.3327
313	dtm_devmean2_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	326.0274
273	clm_cloud.fraction_earthenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	324.3382
191	dtm_dvm_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	321.2799
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	317.4992

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.s_mehlich3

R-square: 0.548

Fitted values sd: 0.423

RMSE: 0.384

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-2.5729	-0.2102	-0.0264	0.1694	5.0049

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.459208	4.154229	0.351	0.725
regr.ranger	0.937179	0.016167	57.967	< 2e-16 ***
regr.xgboost	0.002587	0.016252	0.159	0.874
regr.cubist	0.145396	0.010890	13.351	< 2e-16 ***
regr.nnet	-0.672062	1.796642	-0.374	0.708
regr.cvglmnet	-0.045157	0.011256	-4.012	6.04e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3841 on 37530 degrees of freedom

Multiple R-squared: 0.5481, Adjusted R-squared: 0.548

F-statistic: 9103 on 5 and 37530 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	690.66815
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	474.21199
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	353.13511
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	352.87391
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	331.16664
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	234.17556
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	185.07246
167	clm_bioclim.var_chelsa.6_m_1km_s0..0cm_1979..2013_v1.0.tif	177.99550
280	clm_cloud.fraction_earthenenv.modis.sep_p_1km_s0..0cm_2000..2015_v1.0.tif	166.11337
37	clm_lst_mod11a2.dec.day_m_1km_s0..0cm_2000..2017_v1.0.tif	151.83940
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	142.39826
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	123.53111
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif	121.78029
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif	115.49266
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	110.30792
279	clm_cloud.fraction_earthenenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	110.24695
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif	109.55527
270	clm_cloud.fraction_earthenenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif	107.29977
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif	103.19180
120	veg_fapar_proba.v.feb_d_250m_s0..0cm_2014..2019_v1.0.tif	102.56230
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif	101.60913
89	lcv_surf.refl.b05.mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	100.50936
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	100.31714
320	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	98.50520
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	98.37292

16	clm_precipitation_sm2rain.mar_m_1km_s0..0cm_2007..2018_v0.2.tif	98.29067
21	clm_precipitation_sm2rain.nov_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	96.40140
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	93.77023
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	92.84808
20	clm_precipitation_sm2rain.nov_m_1km_s0..0cm_2007..2018_v0.2.tif	89.47828
155	clm_bioclim.var_chelsa.1_m_1km_s0..0cm_1979..2013_v1.0.tif	85.37452
62	clm_lst_mod11a2.may.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	85.11217
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	82.96540
162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif	81.74435
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	79.49712
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	79.38138
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif	78.13930
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif	77.44151
327	lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	76.81885
58	clm_lst_mod11a2.mar.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	76.76216
330	lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	76.69275
71	clm_lst_mod11a2.oct.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	76.45822
51	clm_lst_mod11a2.jul.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	74.97020
258	clm_wind.speed_terraclimate.dec_m_5km_s0..0cm_1998..2018_v1.tif	74.82602
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	74.30399
123	veg_fapar_proba.v.feb_u.975_250m_s0..0cm_2014..2019_v1.0.tif	73.50763
9	clm_precipitation_sm2rain.feb_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	72.74588
160	clm_bioclim.var_chelsa.14_m_1km_s0..0cm_1979..2013_v1.0.tif	72.71787
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	72.38706
281	veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	71.51745

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.wpg2

R-square: 0.709

Fitted values sd: 1.25

RMSE: 0.803

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-4.0555	-0.3113	-0.0222	0.2378	4.5794

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.008606	1.361982	-0.006	0.995
regr.ranger	0.972265	0.004443	218.854	< 2e-16 ***
regr.xgboost	0.034649	0.006404	5.411	6.3e-08 ***

```

regr.cubist      0.069589    0.005229   13.308   < 2e-16 ***
regr.nnet       -0.012756    0.796535   -0.016    0.987
regr.cvglmnet   -0.056645    0.005509  -10.283   < 2e-16 ***

```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8032 on 92785 degrees of freedom

Multiple R-squared: 0.7092, Adjusted R-squared: 0.7092

F-statistic: 4.525e+04 on 5 and 92785 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
124	veg_fapar_proba.v.jan_d_250m_s0..0cm_2014..2019_v1.0.tif	17444.120
336	hzn_depth	17211.898
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif	7541.375
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif	6102.419
162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif	5954.180
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	5196.589
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	2772.433
126	veg_fapar_proba.v.jan_u.975_250m_s0..0cm_2014..2019_v1.0.tif	2462.278
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	2323.912
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif	2100.172
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	1976.042
29	clm_lst_mod11a2.apr.day_m_1km_s0..0cm_2000..2017_v1.0.tif	1969.533
155	clm_bioclim.var_chelsa.1_m_1km_s0..0cm_1979..2013_v1.0.tif	1936.928
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	1875.351
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif	1715.364
210	dtm_vbf_merit.dem_m_500m_s0..0cm_2017_v1.0.tif	1650.927
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	1582.444
288	dtm_devmean_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	1573.769
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	1566.203
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1528.746
274	clm_cloud.fraction_earthenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif	1499.375
21	clm_precipitation_sm2rain.nov_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1452.154
191	dtm_dvm_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	1442.747
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	1415.957
326	lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	1415.025
297	lcv_b04_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	1404.104
325	dtm_vertical.depth_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	1403.599
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	1367.738
71	clm_lst_mod11a2.oct.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1335.743
190	dtm_dvm_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	1332.501
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	1311.222
74	clm_lst_mod11a2.sep.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1299.263
70	clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1273.064

229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1258.946
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1243.709
30	clm_lst_mod11a2.apr.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	1235.846
218	dtm_dvm_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	1227.213
156	clm_bioclim.var_chelsa.10_m_1km_s0..0cm_1979..2013_v1.0.tif	1214.948
15	clm_precipitation_sm2rain.jun_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1212.291
321	lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	1201.329
90	lcv_surf.refl.b05_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	1176.983
298	lcv_b09_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	1166.598
212	dtm_aspect.sine_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1161.763
302	lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	1161.589
327	lcv_b8a_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	1144.972
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	1136.767
323	dtm_openn_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	1136.469
228	dtm_rough.scale_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	1130.037
282	veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	1113.694
333	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	1112.093

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: log.zn_mehlich3

R-square: 0.711

Fitted values sd: 0.588

RMSE: 0.375

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-2.1382	-0.2038	-0.0274	0.1632	3.6353

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.836394	1.555108	1.181	0.23766
regr.ranger	0.823144	0.013982	58.871	< 2e-16 ***
regr.xgboost	0.037861	0.013644	2.775	0.00552 **
regr.cubist	0.169653	0.010091	16.813	< 2e-16 ***
regr.nnet	-1.511745	1.244933	-1.214	0.22463
regr.cvglmnet	0.009770	0.008046	1.214	0.22467

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3747 on 39344 degrees of freedom

Multiple R-squared: 0.7109, Adjusted R-squared: 0.7109

F-statistic: 1.935e+04 on 5 and 39344 DF, p-value: < 2.2e-16

Variable importance:

		variable importance
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	1771.70604
8	clm_precipitation_sm2rain.feb_m_1km_s0..0cm_2007..2018_v0.2.tif	1324.59725
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	901.72362
227	dtm_rough.magnitude_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	812.88909
90	lcv_surf.refl.b05_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif	611.32862
336	hzn_depth	497.79455
108	veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2019_v1.0.tif	425.47394
61	clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif	422.05961
128	veg_fapar_proba.v.jul_l.025_250m_s0..0cm_2014..2019_v1.0.tif	404.78892
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	375.14352
12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif	288.80837
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	282.79413
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif	268.26853
136	veg_fapar_proba.v.mar_l.025_250m_s0..0cm_2014..2019_v1.0.tif	253.28066
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	243.96324
156	clm_bioclim.var_chelsa.10_m_1km_s0..0cm_1979..2013_v1.0.tif	239.29262
22	clm_precipitation_sm2rain.oct_m_1km_s0..0cm_2007..2018_v0.2.tif	220.35555
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	209.76486
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif	207.31070
70	clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	172.40199
210	dtm_vbf_merit.dem_m_500m_s0..0cm_2017_v1.0.tif	171.10056
125	veg_fapar_proba.v.jan_l.025_250m_s0..0cm_2014..2019_v1.0.tif	164.79150
118	veg_fapar_proba.v.dec_l.025_250m_s0..0cm_2014..2019_v1.0.tif	160.65066
25	clm_precipitation_sm2rain.sep_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	147.10143
147	veg_fapar_proba.v.oct_d_250m_s0..0cm_2014..2019_v1.0.tif	141.45931
151	veg_fapar_proba.v.sep_d_250m_s0..0cm_2014..2019_v1.0.tif	133.64483
148	veg_fapar_proba.v.oct_l.025_250m_s0..0cm_2014..2019_v1.0.tif	133.28296
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	129.91862
315	dtm_slope_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	128.96582
33	clm_lst_mod11a2.aug.day_m_1km_s0..0cm_2000..2017_v1.0.tif	124.47058
6	clm_precipitation_sm2rain.dec_m_1km_s0..0cm_2007..2018_v0.2.tif	119.47122
283	lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	116.98678
9	clm_precipitation_sm2rain.feb_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	116.80245
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	110.28752
130	veg_fapar_proba.v.jul_u.975_250m_s0..0cm_2014..2019_v1.0.tif	98.38020
131	veg_fapar_proba.v.jun_d_250m_s0..0cm_2014..2019_v1.0.tif	97.81026
55	clm_lst_mod11a2.jun.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	96.57759
15	clm_precipitation_sm2rain.jun_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	94.32784
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif	93.99688
276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	93.33088
279	clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	93.15406

46	clm_lst_mod11a2.jan.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	91.74179
17	clm_precipitation_sm2rain.mar_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	89.32569
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	89.21204
329	lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	88.49155
74	clm_lst_mod11a2.sep.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	87.35524
306	lcv_b8a_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	87.07720
11	clm_precipitation_sm2rain.jan_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	84.71854
333	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	84.42120
56	clm_lst_mod11a2.jun.night_m_1km_s0..0cm_2000..2017_v1.0.tif	82.64769

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: ph_h2o
R-square: 0.818
Fitted values sd: 0.972
RMSE: 0.459

Random forest model:
Call:
stats::lm(formula = f, data = d)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.5939	-0.2328	-0.0066	0.2222	4.7477

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.113440	1.164473	0.956	0.338986
regr.ranger	1.032918	0.003138	329.116	< 2e-16 ***
regr.xgboost	-0.014201	0.004185	-3.393	0.000691 ***
regr.cubist	0.049667	0.003709	13.392	< 2e-16 ***
regr.nnet	-0.188570	0.188214	-1.002	0.316398
regr.cvglmnet	-0.059763	0.003636	-16.438	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4591 on 133378 degrees of freedom
Multiple R-squared: 0.8176, Adjusted R-squared: 0.8176
F-statistic: 1.195e+05 on 5 and 133378 DF, p-value: < 2.2e-16

Variable importance:

		variable importance
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	19293.9099
27	clm_lst_mod11a2.annual.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	10304.5321
26	clm_lst_mod11a2.annual.day_m_1km_s0..0cm_2000..2017_v1.0.tif	8024.7428

336		hzn_depth	7534.0473
45	clm_lst_mod11a2.jan.day_m_1km_s0..0cm_2000..2017_v1.0.tif		7269.1869
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif		3521.1232
57	clm_lst_mod11a2.mar.day_m_1km_s0..0cm_2000..2017_v1.0.tif		2959.6055
41	clm_lst_mod11a2.feb.day_m_1km_s0..0cm_2000..2017_v1.0.tif		2388.6211
185	clm_direct.irradiation_solar.atlas.kwhm2.10_m_1km_s0..0cm_2016_v1.tif		2312.8365
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif		1843.7390
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif		1760.6048
13	clm_precipitation_sm2rain.jul_sd.10_10km_s0..0cm_2007..2018_v1.0.tif		1729.2683
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif		1515.3343
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif		1505.6802
148	veg_fapar_proba.v.oct.1.025_250m_s0..0cm_2014..2019_v1.0.tif		1303.4942
270	clm_cloud.fraction_earthenv.modis.aug_p_1km_s0..0cm_2000..2015_v1.0.tif		1293.9230
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		1287.9794
272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif		1278.4984
89	lcv_surf.refl.b05_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif		1277.7427
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif		1198.5653
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		1156.0320
29	clm_lst_mod11a2.apr.day_m_1km_s0..0cm_2000..2017_v1.0.tif		1149.6378
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif		1122.3751
75	clm_lst_mod11a2.sep.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		1095.5760
276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif		1047.5214
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif		1029.2173
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		1026.8175
274	clm_cloud.fraction_earthenv.modis.jul_p_1km_s0..0cm_2000..2015_v1.0.tif		1004.9678
53	clm_lst_mod11a2.jun.day_m_1km_s0..0cm_2000..2017_v1.0.tif		987.4694
84	lcv_surf.refl.b02_mod09a1.pc2_m_500m_s0..0cm_2001_v1.0.tif		935.8682
277	clm_cloud.fraction_earthenv.modis.may_p_1km_s0..0cm_2000..2015_v1.0.tif		857.5225
192	dtm_dvm2_merit.dem_m_1km_s0..0cm_2017_v1.0.tif		840.9972
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif		836.2909
73	clm_lst_mod11a2.sep.day_m_1km_s0..0cm_2000..2017_v1.0.tif		834.8211
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		825.5137
71	clm_lst_mod11a2.oct.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		815.3191
24	clm_precipitation_sm2rain.sep_m_1km_s0..0cm_2007..2018_v0.2.tif		800.2364
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif		773.9541
290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif		766.6710
108	veg_fapar_proba.v.annual_d_250m_s0..0cm_2014..2019_v1.0.tif		766.0450
191	dtm_dvm_merit.dem_m_2km_s0..0cm_2017_v1.0.tif		762.4431
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif		755.9078
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif		737.9077
61	clm_lst_mod11a2.may.day_m_1km_s0..0cm_2000..2017_v1.0.tif		723.3509
203	dtm_twi_merit.dem_m_1km_s0..0cm_2017_v1.0.tif		720.0467
94	lcv_surf.refl.b05_mod09a1.pc6_m_500m_s0..0cm_2001_v1.0.tif		710.1720
308	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif		673.5901
263	clm_wind.speed_terraclimate.mar_m_5km_s0..0cm_1998..2018_v1.tif		671.0222
288	dtm_devmean_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif		665.8133

70 clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif 665.1251

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: sand_tot_psa

R-square: 0.736

Fitted values sd: 22.8

RMSE: 13.7

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-80.626	-5.321	0.221	6.071	88.686

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	6.687471	24.022001	0.278	0.780714
regr.ranger	1.060521	0.003503	302.742	< 2e-16 ***
regr.xgboost	-0.018718	0.004910	-3.812	0.000138 ***
regr.cubist	0.031749	0.003922	8.096	5.73e-16 ***
regr.nnet	-0.161127	0.422746	-0.381	0.703098
regr.cvglmnet	-0.028217	0.004462	-6.323	2.57e-10 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13.65 on 122261 degrees of freedom

Multiple R-squared: 0.736, Adjusted R-squared: 0.736

F-statistic: 6.818e+04 on 5 and 122261 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
336	hzn_depth	6407706.1
95	lcv_surf.refl.b06_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	2452003.6
301	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	1801324.0
68	clm_lst_mod11a2.nov.night_m_1km_s0..0cm_2000..2017_v1.0.tif	1739631.6
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	1523461.8
19	clm_precipitation_sm2rain.may_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1389146.1
31	clm_lst_mod11a2.apr.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	1219948.1
276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	1203760.6
13	clm_precipitation_sm2rain.jul_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	1186606.8
208	dtm_vbf_merit.dem_m_1km_s0..0cm_2017_v1.0.tif	1153595.5
303	lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	1126239.4

272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	1045192.0
332	lcv_b12_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s22_v0.1.tif	990174.3
168	clm_bioclim.var_chelsa.7_m_1km_s0..0cm_1979..2013_v1.0.tif	981311.5
156	clm_bioclim.var_chelsa.10_m_1km_s0..0cm_1979..2013_v1.0.tif	843897.5
166	clm_bioclim.var_chelsa.5_m_1km_s0..0cm_1979..2013_v1.0.tif	820636.7
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	759930.7
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	717446.0
14	clm_precipitation_sm2rain.jun_m_1km_s0..0cm_2007..2018_v0.2.tif	698575.9
279	clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	688402.1
12	clm_precipitation_sm2rain.jul_m_1km_s0..0cm_2007..2018_v0.2.tif	671624.1
273	clm_cloud.fraction_earthenv.modis.jan_p_1km_s0..0cm_2000..2015_v1.0.tif	670523.5
83	lcv_surf.refl.b02_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	654835.0
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	647023.1
46	clm_lst_mod11a2.jan.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	641065.2
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	640350.0
269	clm_cloud.fraction_earthenv.modis.apr_p_1km_s0..0cm_2000..2015_v1.0.tif	638630.1
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	629429.0
167	clm_bioclim.var_chelsa.6_m_1km_s0..0cm_1979..2013_v1.0.tif	626345.3
161	clm_bioclim.var_chelsa.16_m_1km_s0..0cm_1979..2013_v1.0.tif	611934.9
111	veg_fapar_proba.v.apr_r_250m_s0..0cm_2014..2019_v1.0.tif	607170.9
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	605217.5
308	veg_f02dar.hv_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	595912.8
42	clm_lst_mod11a2.feb.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	593624.5
321	lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	587246.8
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	582629.6
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	580752.9
162	clm_bioclim.var_chelsa.17_m_1km_s0..0cm_1979..2013_v1.0.tif	570026.0
304	lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	565524.8
34	clm_lst_mod11a2.aug.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	561365.5
281	veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2007_v1.0.tif	554162.5
51	clm_lst_mod11a2.jul.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	553083.1
35	clm_lst_mod11a2.aug.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	548436.9
184	clm_diffuse.irradiation_solar.atlas.kwhm2.100_m_1km_s0..0cm_2016_v1.tif	546090.2
23	clm_precipitation_sm2rain.oct_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	542121.6
62	clm_lst_mod11a2.may.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	541941.6
70	clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	538653.4
75	clm_lst_mod11a2.sep.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	537783.6
50	clm_lst_mod11a2.jul.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	528742.9
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	516653.4

Results of ensemble model fitting 'ranger', 'xgboost', 'glmnet', 'deepnet':

Variable: silt_tot_psa
R-square: 0.64
Fitted values sd: 11.9
RMSE: 8.92

Random forest model:

Call:

stats::lm(formula = f, data = d)

Residuals:

Min	1Q	Median	3Q	Max
-63.746	-3.631	-0.526	2.630	72.486

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-35.876865	36.887592	-0.973	0.331
regr.ranger	0.948111	0.003874	244.733	< 2e-16 ***
regr.xgboost	0.062717	0.005506	11.391	< 2e-16 ***
regr.cubist	0.025705	0.004747	5.415	6.14e-08 ***
regr.nnet	1.902142	1.968248	0.966	0.334
regr.cvglmnet	-0.028579	0.005799	-4.928	8.32e-07 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 8.915 on 122223 degrees of freedom

Multiple R-squared: 0.6399, Adjusted R-squared: 0.6399

F-statistic: 4.344e+04 on 5 and 122223 DF, p-value: < 2.2e-16

Variable importance:

	variable	importance
336	hzn_depth	2342544.8
43	clm_lst_mod11a2.feb.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	820982.0
59	clm_lst_mod11a2.mar.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	655784.3
165	clm_bioclim.var_chelsa.4_m_1km_s0..0cm_1979..2013_v1.0.tif	620131.8
13	clm_precipitation_sm2rain.jul_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	509345.4
272	clm_cloud.fraction_earthenv.modis.feb_p_1km_s0..0cm_2000..2015_v1.0.tif	413336.9
275	clm_cloud.fraction_earthenv.modis.jun_p_1km_s0..0cm_2000..2015_v1.0.tif	411241.5
210	dtm_vbf_merit.dem_m_500m_s0..0cm_2017_v1.0.tif	276745.3
10	clm_precipitation_sm2rain.jan_m_1km_s0..0cm_2007..2018_v0.2.tif	257836.1
164	clm_bioclim.var_chelsa.3_m_1km_s0..0cm_1979..2013_v1.0.tif	251798.7
288	dtm_devmean_aw3d30.nasadem.100m_m_30m_s0..0cm_2017_v0.1.tif	249054.8
300	lcv_b11_sentinel.s2l2a_d_30m_s0..0cm_2018..2019.s12_v0.1.tif	240499.0
191	dtm_dvm_merit.dem_m_2km_s0..0cm_2017_v1.0.tif	228981.3
278	clm_cloud.fraction_earthenv.modis.nov_p_1km_s0..0cm_2000..2015_v1.0.tif	227571.1
157	clm_bioclim.var_chelsa.11_m_1km_s0..0cm_1979..2013_v1.0.tif	221997.4
268	clm_cloud.fraction_earthenv.modis.annual_m_1km_s0..0cm_2000..2015_v1.0.tif	211767.8
65	clm_lst_mod11a2.nov.day_m_1km_s0..0cm_2000..2017_v1.0.tif	210742.7
282	veg_f02dar.hh_alos.palsar_m_30m_s0..0cm_2017_v1.0.tif	210502.5
276	clm_cloud.fraction_earthenv.modis.mar_p_1km_s0..0cm_2000..2015_v1.0.tif	202306.2

290	dtm_elevation_aw3d30.nasadem_m_30m_s0..0cm_2017_v0.1.tif	200230.6
101	lcv_surf.refl.b07_mod09a1.pc1_m_500m_s0..0cm_2001_v1.0.tif	195400.5
280	clm_cloud.fraction_earthenv.modis.sep_p_1km_s0..0cm_2000..2015_v1.0.tif	195161.4
2	clm_precipitation_sm2rain.apr_m_1km_s0..0cm_2007..2018_v0.2.tif	194027.2
279	clm_cloud.fraction_earthenv.modis.oct_p_1km_s0..0cm_2000..2015_v1.0.tif	193326.5
326	lcv_b11_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	192737.0
15	clm_precipitation_sm2rain.jun_sd.10_10km_s0..0cm_2007..2018_v1.0.tif	186500.0
297	lcv_b04_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s22_v0.1.tif	185644.1
163	clm_bioclim.var_chelsa.2_m_1km_s0..0cm_1979..2013_v1.0.tif	182643.1
329	lcv_b12_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	180803.5
271	clm_cloud.fraction_earthenv.modis.dec_p_1km_s0..0cm_2000..2015_v1.0.tif	179439.2
54	clm_lst_mod11a2.jun.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	178766.8
221	dtm_elevation_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	176816.7
63	clm_lst_mod11a2.may.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	173548.9
1	clm_precipitation_sm2rain.annual_m_1km_s0..0cm_2007..2018_v0.2.tif	173546.6
299	lcv_b09_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	170634.3
229	dtm_roughness_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	170129.3
34	clm_lst_mod11a2.aug.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	169657.3
159	clm_bioclim.var_chelsa.13_m_1km_s0..0cm_1979..2013_v1.0.tif	169453.2
38	clm_lst_mod11a2.dec.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	168707.5
160	clm_bioclim.var_chelsa.14_m_1km_s0..0cm_1979..2013_v1.0.tif	167783.0
219	dtm_dvm2_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	167168.9
70	clm_lst_mod11a2.oct.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	166110.9
234	dtm_vbf_merit.dem_m_250m_s0..0cm_2017_v1.0.tif	165551.1
50	clm_lst_mod11a2.jul.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	163821.2
58	clm_lst_mod11a2.mar.day_sd_1km_s0..0cm_2000..2017_v1.0.tif	163745.8
39	clm_lst_mod11a2.dec.daynight_m_1km_s0..0cm_2000..2017_v1.0.tif	161704.0
213	dtm_convergence_merit.dem_m_250m_s0..0cm_2018_v1.0.tif	160570.2
318	lcv_b02_sentinel.s2l2a_iqr_30m_s0..0cm_2018..2019.s12_v0.1.tif	158744.4
283	lcv_landsat.nir_wri.forestwatch_m_30m_s0..0cm_2018_v1.0.tif	158553.2
158	clm_bioclim.var_chelsa.12_m_1km_s0..0cm_1979..2013_v1.0.tif	158014.4