2. robust quantitative evaluation with a cross-validation procedure balancing accuracy and performances;
3. qualitative evaluation of the spatial patterns of the maps to include information about matching with well recognised pedo-landscape features;
4. quantification and mapping of the spatial uncertainty to provide users with a measure for and warning for users of the products.

As such, it describes a next step into global modelling and mapping of soil properties, explicitly highlighting the importance of quantitative and qualitative evaluation and uncertainty communication. The actual use of SoilGrids 2.0 in global and wide-area regional applications, where soil properties are important model inputs, will be the real test of its applicability and usefulness.

Appendix A: Environmental covariates

Over 400 geographic layers were available as environmental covariates for this work. These are chosen for their presumed relation to the major soil forming factors.

Table A1. Covariate sets and sources.

Weather and climate
- Temperature and precipitation from the Climatologies at high resolution for the Earth's land surface areas (CHELSEA) dataset (Karger et al., 2016) - Snowfall from ESA's CCI Land Cover dataset (Bontemps et al., 2013) - Cloud cover by EarthEnv (Wilson and Jetz, 2016) - Temperature and water vapour from NASA's MODIS products (Wan, 2006) - Precipitation, solar radiation, temperature, water vapour, wind speed plus various indexes from the WorldClim version 2 climate data series (Fick and Hijmans, 2017)
Ecology and ecosystems
- Bioclimatic zones in the Global Ecophysiography product by the USGS Geosciences and Environmental Change Science Center (GECSC) (Dinerstein et al., 2017)
Geology
- Average soil and sedimentary-deposit thickness by the Distributed Active Archive Centre (DAAC) (Pelletier et al., 2016). - Rock types by the USGS Geosciences and Environmental Change Science Center (GECSC), based on the Global Lithological Map database v1.1 (Hartmann and Moosdorf, 2012)
Land use and land cover
- 2010 land cover classes from ESA's CCI Land Cover (Bontemps et al., 2013) - Bare ground and tree cover from the USGU Global Land Cover dataset (Hansen et al., 2013) - 2010 land cover classes from the NGCC's GLobeLand30 product (Chen et al., 2015)
Elevation and morphology
- Land surface elevation from the EarthEnv-DEM90 dataset (Robinson et al., 2014) - Land surface elevation and various morphology indexes from the WorldGrids dataset (Reuter and Hengl, 2012) - Land form classes in the Global Ecophysiography product by the USGS Geosciences and Environmental Change Science Center (GECSC) (Sayre et al., 2014)
Core satellite outputs
- Bands 3, 4, 5 and 7 from Landsat (Zanter, 2019) - Middle- and near-infrared bands from MODIS (Savtchenko et al., 2004)
Vegetation indexes
- NDVI from Landsat (Zanter, 2019) - EVI and NPP from MODIS (Savtchenko et al., 2004)
Hydrography
- Global Inundation Extent from Multi-Satellites (GIEMS) dataset by Estellus (Fluet-Chouinard et al., 2015) - Extent of glaciers, surface water change and occurrence probability by the JRC (Pekel et al., 2016) - Global water table depth (Fan et al., 2013)

Appendix B: Bioclimatic regions

Table B1 summarises the number of observations per property for each bioclimatic region. An interactive map of the regions is available at http://ecoregions2017.appspot.com/ (last access: 20 May 2021).

Table B1. Number of observations per property for each bioclimatic region. See Table 1 for abbreviations.

Biome	CEC	CFVO	N	pH	SOC	STF
Tropical and subtropical moist broadleaf forests	4185	2117	8378	12 872	11 901	11 651
Tropical and subtropical dry broadleaf forests	558	205	1370	3264	2724	3051
Tropical and subtropical coniferous forests	59	30	54	1336	878	1331
Temperate broadleaf and mixed forests	12 585	29 708	24 711	56 569	49 727	61 822
Temperate conifer forests	6058	6417	5812	7597	9490	9834
Boreal forests/taiga	1443	3210	4834	4140	6819	5358
Tropical and subtropical grasslands, savannas and shrublands	8391	8259	20 181	27 633	24 951	23 135
Temperate grasslands, savannas and shrublands	13 442	9885	9812	23 654	24 421	25 416
Flooded grasslands and savannas	246	124	503	754	818	798
Montane grasslands and shrublands	479	1865	1073	1386	3994	3568
Tundra	312	199	466	548	807	695
Mediterranean forests, woodlands and scrub	1747	5951	8034	9126	12 532	11 428
Deserts and Xeric shrublands	3342	3412	3224	8994	8163	9862
Mangroves	88	26	165	264	437	250

Code and data availability. The code underpinning the SoilGrids 2.0 workflow is available under the GPL3 license at https://git.wur.nl/isric/soilgrids/soilgrids (last access: 21 May 2021). SoilGrids predictions themselves are available to the public under the Creative Commons CC-BY 4.0 licence, facilitating their widespread use. They may be obtained as world mosaics in the Virtual Raster Tile (VRT) format from https://files.isric.org/soilgrids/latest/ (last access: 21 May 2021). The Web Coverage Service (WCS; https://maps.isric.org, last access: 21 May 2021) facilitates automated access, e.g. from computer programmes or modelling frameworks. A set of notebooks (https://git.wur.nl/isric/soilgrids/soilgrids.notebooks, last access: 21 May 2021) was developed with examples for the use of the WCS. A new web-based portal (https://soilgrids.org/, last access: 21 May 2021) was also developed with this release, providing users with a light and swift means to visualise and explore the new predictions, making the best of state-of-the-art technologies for the web. A ReST API in beta stage is also available at https://rest.soilgrids.org/ (last access: 21 May 2021).

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