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Global Hydrologic Soil Groups (HYSOGs250m) for Curve Number-Based Runoff Modeling

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Summary

This dataset - HYSOGs250m - represents a globally consistent, gridded dataset of hydrologic soil groups (HSGs) with a geographical resolution of 1/480 decimal degrees, corresponding to a projected resolution of approximately 250-m. These data were developed to support USDA-based curve-number runoff modeling at regional and continental scales. Classification of HSGs was derived from soil texture classes and depth to bedrock provided by the Food and Agriculture Organization soilGrids250m system.

There is one data file of global hydrologic soil groups (HSGs) at 250-m resolution in GeoTIFF format provided with this dataset. The R script used to generate the dataset is included as a companion file.

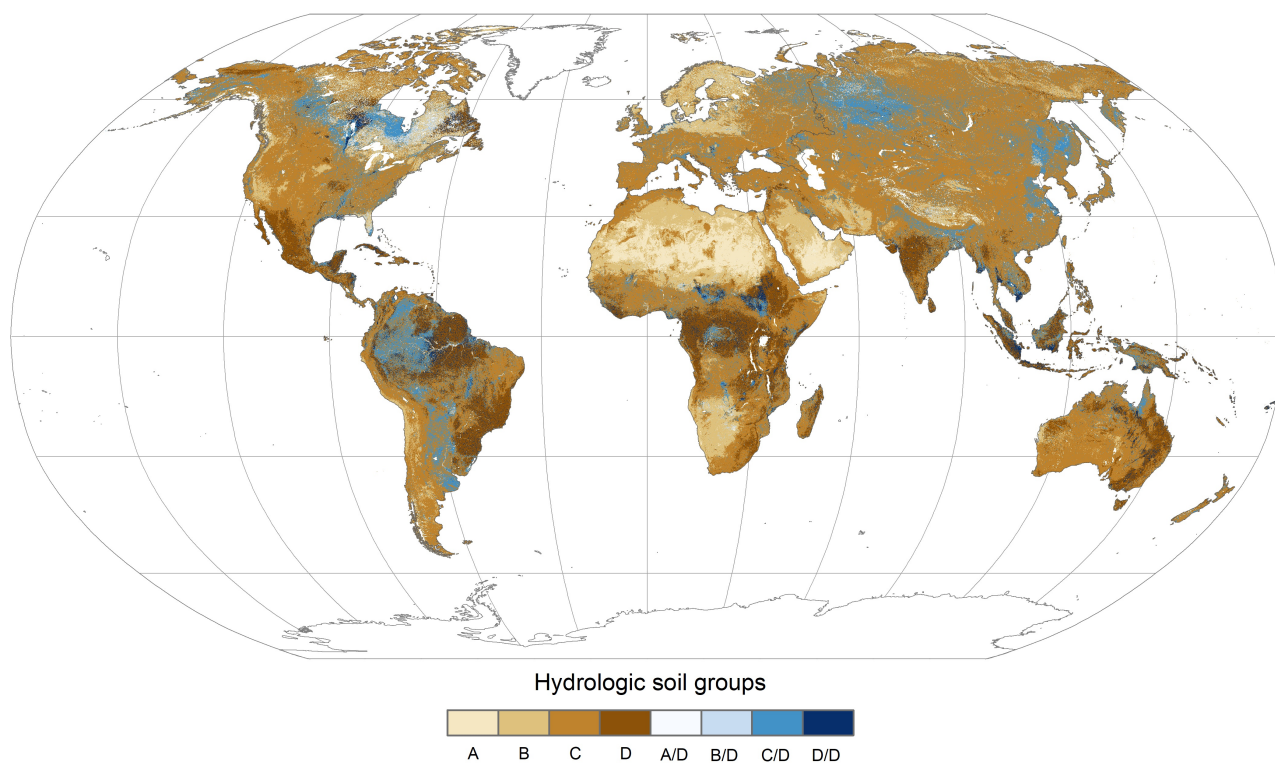


Figure 1. Global distribution of hydrologic soil groups at 250-m spatial resolution. Hydrologic soil groups A, B, C, and D correspond to low, moderately low, moderately high, and high runoff potential, respectively. Wet soils are assigned a dual HSG (e.g., HSG A/D) and have high runoff potential due to the presence of a water table within 60 cm of the surface. A less restrictive group can be assigned if these soils are drained (e.g., HSG-A).

Citation

Ross, C.W., L. Prihodko, J.Y. Anchang, S.S. Kumar, W. Ji, and N.P. Hanan. 2018. Global Hydrologic Soil Groups (HYSOGs250m) for Curve Number-Based Runoff Modeling. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1566>

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1. Dataset Overview

Hydrologic soil groups (HSGs) are a fundamental component of the USDA curve number (CN) method for estimation of rainfall runoff; yet these data are not readily available in a format or spatial resolution suitable for regional to global scale modeling applications. We developed a globally consistent gridded dataset defining HSGs to fill this gap. The resulting data product—HYSOGs250m—represents rainfall runoff potential at 250-m spatial resolution. The four standard classes—A, B, C, and D—correspond to soils with low, moderately low, moderately high, and high runoff potential, respectively. Wet soils have high runoff potential (regardless of texture) due to the presence of a groundwater table within 60 cm of the surface. These soils receive are assigned dual HSGs, as a less restrictive class group can be assigned (according to texture or KS) if they can be adequately drained.

Related Publication:

Ross, C.W., L. Prihodko, J. Anchang, S. Kumar, W. Ji, and N.P. Hanan. 2018. HYSOGs250m, global gridded hydrologic soil groups for curve-number-based runoff modeling. *Scientific Data* 5, 180091. <https://doi.org/10.1038/sdata.2018.91>

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2. Data Characteristics

Spatial Coverage: Global

Spatial Resolution: 1/480 decimal degrees (~250 m)

Temporal Coverage: These data are modeled to represent contemporary soil runoff potential. For completeness, the data were given a date range of 1900 to 2015.

Temporal Resolution: One-time estimates

Study Area: (All latitude and longitude given in decimal degrees.)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Global	-180	179.999	83.999	-56

Data File Information:

There is one data file of global HSGs at 250 m resolution in GeoTIFF format provided with this dataset.

Spatial Data Properties: Raster file - HYSOGs250m.tif

Spatial Representation Type: Raster

Pixel Depth: 8 bit
Pixel Type: byte
Number of Bands: 1
Band Information: Global Hydrological Soil Groups
Raster Format: GeoTIFF
No Data Value: 255
Scale Factor: none
Offset: none

Number Columns: 172,800
Column Resolution: 0.002083333 degree
Number Rows: 67,200
Row Resolution: 0.002083333 degree

Extent in the items coordinate system
North: 83.99972222222222
South: -56
West: -180
East: 179.9997222222222

xll corner: -180
yll corner: -56
Cell Geometry: area
Point in Pixel: center

Pixel values	Description
1	HSG-A: low runoff potential (>90% sand and <10% clay)
2	HSG-B: moderately low runoff potential (50-90% sand and 10-20% clay)
3	HSG-C: moderately high runoff potential (<50% sand and 20-40% clay)
4	HSG-D: high runoff potential (<50% sand and >40% clay)
11	HSG-A/D: high runoff potential unless drained (>90% sand and <10% clay)

12	HSG-B/D: high runoff potential unless drained (<50% sand and 10-20% clay)
13	HSG-C/D: high runoff potential unless drained (<50% sand and 20-40% clay)
14	HSG-D/D: high runoff potential unless drained (<50% sand and >40% clay)

Companion File:

The HSG classification was performed in R. The script (*HYSOGs250m_SciDat.R*) is included as a companion file.

3. Application and Derivation

These data were developed to support CN-based runoff modeling for ecological and hydrological models at regional to global scales. Other potential applications include flood risk assessment, and as a covariate for biogeographical analysis of vegetation distributions and dynamics.

4. Quality Assessment

HYSOGs250m was derived from USDA-based soil texture classes, depth to bedrock, and depth to groundwater table. Soil texture and bedrock depth predictions were obtained from the FAO soilGrids250m system. (Hengl et al., 2017). Groundwater table depth was obtained from Fan et al (2013). A brief description of the technical validation of the texture classes and depth to bedrock predictions are discussed in Ross et al. (2018). However, end-users are referred to the respective publications for a detailed description of modeling and uncertainty assessments of the soilGrids and groundwater table data.

5. Data Acquisition, Materials, and Methods

Overview

HSGs were derived from texture classes as reported in Table 1 and described in the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) National Engineering Handbook (USDA, 2009). The resulting data product—HYSOGs250m—represents general soil runoff potential suitable for regional, continental, and global scale analyses and is available in a gridded format at a spatial resolution of 250 m (Fig. 1).

- HSG-A has the lowest runoff potential (typically contains more than 90% sand and less than 10% clay),
- HSG-B has moderately low runoff potential (typically contains between 10 to 20% clay and 50 to 90% sand),
- HSG-C has moderately high runoff potential (typically contains between 20 to 40% clay and less than 50% sand), and
- HSG-D has the highest runoff potential (typically contains more than 40% clay and less than 50% sand).

Methods

We classified HSGs from USDA-based soil texture classes, depth to bedrock, and depth to water table as specified in the NEH (NRCS, 2009). Soil texture to 1 m depth was represented with FAO soilGrids250m texture classes at six depths: 0, 5, 15, 30, 60, and 100 cm. The soilGrids were stacked into a multi band raster (textStack) using the raster::stack function. For the purpose of this analysis, we refer to individual grid cells (~ 250-m x 250-m) in the raster stack (1 m depth) as soil pedons. Each grid cell in the raster stack (or pedon) was re-classified into one of four HSGs (hsgStack) according to USDA specifications. This allowed us to infer the water transmissivity of each layer in the profile from the stacked texture classes. Note that integers 1, 2, 3, and 4 were used to represent HSGs A, B, C, and D, respectively. The raster::max function was then used to determine the largest value of each grid cell in the raster stack, allowing us to infer the most restrictive layer in the pedon. This value (maxHSG) was used to assign HSGs for each pixel in the stack, thus representing soil runoff potential for each pedon. Shallow soils (bedrock within 50 cm of the surface) were re-classified to HSG-D (maxHSGR). Dual HSGs were assigned to pedons with shallow water tables (< 60 cm from the surface) using the depth to groundwater table dataset. Integers 11, 12, 13, and 14 were used to denote dual HSGs A/D, B/D, C/D, and D/D in the dataset.

All computations were performed with the R open source environment for statistical computing and functions from the raster package.

Input Data Availability

Instructions on how to access the Food and Agriculture Organization (FAO) soilGrids250m meta-data, texture classes, and depth to bedrock are described in Hengl et al. (2017). Access to the groundwater table depth16 and associated meta-data are available from Deltares (<https://www.deltares.nl/en/projects/glowasis-providing-access-water-scarcity-data/>)

Table 1. Classification scheme used to develop hydrologic soil groups (HSGs).

HSG	Soil texture class ¹	Runoff potential	soilGrids250m texture class value
A	Sand	Low	12
B	Sandy loam, Loamy sand	Moderately low	9, 11
C	Clay loam, Silty clay loam, Sandy clay loam, Loam, Silty loam, Silt	Moderately high	4, 5, 6, 7, 8, 10
D	Clay, Silty clay, Sandy clay	High	1, 2, 3
A/D	Sand	High	12

B/D	Sandy loam, Loamy sand	High	9, 11
C/D	Clay loam, Silty clay loam, Sandy clay loam, Loam, Silty loam, Silt	High	4, 5, 6, 7, 8, 10
D/D	Clay, Silty clay, Sandy clay	High	1, 2, 3

¹Soil texture classes that typically comprise hydrologic soil groups (HSGs) (USDA, 2009).

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[Global Hydrologic Soil Groups \(HYSOGs250m\) for Curve Number-Based Runoff Modeling](#)

Contact for Data Center Access Information:

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- Telephone: +1 (865) 241-3952

7. References

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Ross, C.W., L. Prihodko, J. Anchang, S. Kumar, W. Ji, and N.P. Hanan. 2018. HYSOGs250m, global gridded hydrologic soil groups for curve-number-based runoff modeling. *Scientific Data* 5, 180091. <https://doi.org/10.1038/sdata.2018.91>



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