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LIST OF INPUT DATASETS FOR INVEST SDR MODEL:

INPUT 1: DIGITAL ELEVATION MODEL

Description: Raster with elevation values per pixel (meters)

Source: Shuttle Radar Topographical Mission, National Aeronautics and Space Administration, United States

Citation: NASA JPL (2013). NASA Shuttle Radar Topography Mission Global 1 arc second. NASA EOSDIS Land Processes DAAC. https://doi.org/10.5067/MEaSUREs/SRTM/SRTMGL1.003

Year: Multiple years

Coverage: Global

Resolution: 30-meter

Methodology and workflow: Data were downloaded as tiles and then mosaiced using ArcGIS software (Mosaic to New Raster tool). The administrative boundaries for each region were buffered by 40 meters and then used to extract the elevation raster for each of nine administrative boundaries in Solomon Islands (Central, Choiseul, Guadalcanal, Isabel, Makira-Ulawa, Malaita, Rennell-Bellona, Temotu, and Western) in ArcGIS (Buffer and Extract by Mask tools). Data were then reprojected to WGS 84 UTM 57S for model runs. For future country applications, these datasets could be quickly extracted for each country and subregion and made available by SPC on the R2R GeoNode. These data are not updated and

Calibration: While some inherent error is associated with satellite derived elevation models, there is no need for calibration as this is validated and considered the best available global dataset.

INPUT 2: RAINFALL EROSIVITY INDEX

Description: Raster with rainfall erosivity (power of rain to dislodge soil particles) per pixel (MJ mm (ha h yr)$^{-1}$)

Source: European Soil Data Centre (ESDAC), Joint Research Centre

Citation: Panagos P., P. Borrelli, K. Meusburger, B. Yu, A. Klik, K.J. Lim, J.E. Yang, J. Ni, C. Miao, N. Chattopadhyay, S.H. Sadeghi, Z. Hazbavi, M. Zabihi, G.A. Larionov, S.F. Krasnov, A. Garobets, Y. Levi, G. Erpul, C. Birkel, N. Hoyos, V. Naipal, P.T.S. Oliveira, C.A. Bonilla, M. Meddi, W. Nel, H. Dashti, M. Boni, N. Diodato, K. Van Oost, M.A. Nearing, and C. Ballabio. 2017. Global rainfall erosivity assessment based on high-temporal resolution rainfall records. Scientific Reports 7: 4175. DOI: 10.1038/s41598-017-04282-8.

Year: Temporal scale of data vary across the world

Coverage: Global but does not always have full coverage for countries (some gaps for Solomon Islands)

Resolution: 30 arc-seconds (~1 km at the Equator)

Methodology and workflow: Data were downloaded and then reprojected to WGS 84 UTM 57S for model runs. For future country applications, this dataset could be extracted for each country's exclusive economic zone (EEZ) and hosted on the SPC R2R GeoNode.

Calibration: The erosivity layer could be calibrated using rainfall data extrapolated across weather stations. The only available annual rainfall averages were from one source and was for the entire country from 1991-2020 (3039.11 mm). Due to the lack of data being available across multiple weather stations, this dataset was not calibrated.

INPUT 3: SOIL ERODIBILITY

Description: Raster with soil erodibility values per pixel (susceptibility of soil to dislodge/erode) (tons ha h (ha MJ mm) $^{-1}$)

Source: ISRIC Soil Grids 2.0

Citations: Poggio, L., L.M. de Sousa, N.H. Batjes, G.B.M. Heuvelink, B. Kempen, E. Ribeiro, and D. Rossiter. 2021. SoilGrids 2.0: producing soil information for the globe with quantified spatial uncertainty. SOIL, 7, 217–240. https://soil.copernicus.org/articles/7/217/2021/

Stone, R.P. and D. Hilborn. 2012. OMFRA Factsheet 12-051. http://www.omafra.gov.on.ca/english/engineer/facts/12-051.htm

Year: Temporal scale of data vary across the world

Coverage: Global

Resolution: 250 meters

Methodology and workflow: Soil erodibility can be calculated from a variety of methods using soil texture, percent organic matter, soil particle size, permeability class, etc. Raster datasets for the mean sand, silt, clay, and organic matter concentrations were downloaded for the 0-5 cm soil layer from the ISRIC Soil Grids website. Data were downloaded as tiles and each variable was mosaiced to create a country-wide dataset and then reprojected to WGS 84 UTM 57N coordinate system in ArcGIS.

The consultant wrote code in R to calculate soil texture based on the composition of silt, sand, and clay and then produce a raster with soil erodibility values using soil texture and percent organic matter (Stone and Hilborn 2012) (Table 1). The R code to calculate these values could be used to generate country-level soil erodibility data in place of actual field collected data or soil maps. These datasets could be hosted on SPC's R2R GeoNode as a resource for countries.

Table 1. Soil erodibility values for soil classes based on soil texture and organic matter content.

Soil Texture	Organic Matter Content = 2%	Organic Matter Content < 2%	Organic Matter Content > 2%
Clay	0.029	0.032	0.028
Clay loam	0.040	0.043	0.037
Coarse sandy loam	0.009	0.009	0.009
Fine sand	0.011	0.012	0.008
Fine sandy loam	0.024	0.029	0.022
Heavy clay	0.022	0.025	0.020
Loam	0.040	0.045	0.034
Loamy fine sand	0.014	0.020	0.012
Loamy sand	0.005	0.007	0.005
Loamy very fine sand	0.051	0.058	0.033
Sand	0.003	0.004	0.001
Sandy clay loam	0.026	0.026	0.026
Sandy loam	0.017	0.018	0.016
Silt loam	0.050	0.054	0.049
Silty clay	0.034	0.036	0.034
Silty clay loam	0.042	0.046	0.040
Very fine sand	0.057	0.061	0.049
Very fine sandy loam	0.046	0.054	0.043

Calibration: Soil data collected from the field could be used to validate the ISRIC Soil Grids dataset. However, these data were not readily available for this project. ISRIC Soil Grids does produce uncertainty/confidence levels (10 and 90 percentile) for each of the sand, silt, clay, and organic matter datasets. Upon inspection, these values represented approximately a 3% uncertainty range between each soil particle type and therefore the mean data used to produce this layer is believed to be fairly accurate.

INPUT 4: LAND USE LAND COVER

Description: Raster with a code for land use land cover (LULC)

Source: European Space Agency WorldCover 2020

Citation: Zanaga, D., R. Van De Kerchove, W. De Keersmaecker, N. Souverijns, C. Brockmann, R. Quast, J. Wevers, A. Grosu, A. Paccini, S. Vergnaud, O. Cartus, M. Santoro, S. Fritz, I. Georgieva, M. Lesiv, S. Carter, M. Herold, M., L. Li, N.E. Tsendbazar, F. Ramoino, and O. Arino. 2021. ESA WorldCover 10 m 2020 v100. https://doi.org/10.5281/zenodo.5571936

Year: 2020

Coverage: Global

Resolution: 10 meters

Methodology and workflow: Data were downloaded as tiles, mosaiced in ArcGIS to create a country-level LULC, and then reprojected to WGS 84 UTM 57S for model runs. For future country applications, this dataset could be extracted for each country EEZ and hosted on the SPC R2R GeoNode.

Calibration: The LULC dataset is validated by the European Space Agency and does not need further validation. The consultant did however compare the LULC with Sentinel-2 RGB satellite imagery to verify that the dataset generally matches the satellite imagery it represents.

INPUT 5: WATERSHEDS

Description: Shapefile of watershed boundaries with a field for watershed identifier (ws_id)

Source: Derived from Input 1: Digital Elevation Model

Citation: None

Year: None

Coverage: Region-based

Resolution: Derived from 30-meter elevation model

Methodology and workflow: The DelinateIt software that comes with the InVEST suite of ecosystem service models was used to derive watershed shapefiles for each of the nine regions in the Solomon Islands (Central, Choiseul, Guadalcanal, Isabel, Makira-Ulawa, Malaita, Rennell-Bellona, Temotu, and Western) using the D-infinity algorithm.

Calibration: Watersheds were compared to both stream data downloaded from the Open Street Map project and Sentinel-2 RGB satellite imagery. Watershed boundaries seem to match mapped streams although there is some small error associated with the 30-meter resolution and actual stream paths.

INPUT 6: BIOPHYSICAL TABLE

Description: Table containing cover management (C factor) and support practice (P factor) factors for each land use land cover type.

Source: MODIS satellite derived annual Normalized Difference Vegetation Index (NDVI) composites (https://developers.google.com/earth-engine/datasets/catalog/LANDSAT_LC08_C01_T1_ANNUAL_NDVI)

Citations: Chander, G., B.L. Markham, and D.L. Helder. 2009. Summary of Current Radiometric Calibration Coefficients for Landsat MSS, TM, ETM+, and EO-1 ALI Sensors", Remote Sensing of Environment, 113, 893 – 903, 2009.

Parveen, R. and U. Kumar. 2012. Integrated approach of Universal Soil Loss Equation (USLE) and geographic information system (GIS) for soil loss risk assessment in upper south Koel Basin, Jharkhand. Journal of Geographic Information System 4: 588-596.

Year: 2020

Coverage: Global

Resolution: Derived from 250 meters

Methodology and workflow: The Natural Capital Project provides a database of C and P factor values from various studies around the world. Unfortunately, C and P factors for the Solomon Islands and general Pacific Islands region were absent from both the database and scientific literature. Substituting NDVI, a measure of vegetation greenness derived from infrared red and red light bandwidths, has been proposed as an alternative method for calculating the C factor since vegetation cover and NDVI are generally correlated (Parveen and Kumar 2012). Considering that NDVI is also highly correlated with precipitation, the consultant used the annual average NDVI for the entire year of 2020 to best represent vegetation cover throughout both dry and wet seasons.

Google Earth Engine was used to extract the mean annual NDVI for each LULC class specifically found within each of the nine regions. The following formula was used to transform NDVI to C factor ($=e^{(-2*((NDVI)/(1-NDVI))}$) (Parveen and Kumar 2012). Since P factor values were not available for the project sites and general farming practices are unknown, a default value of 1.0 was used for all LULC classes.

Calibration: Computed C factor values are presented below (Table 2). There was no available data to calibrate P factor values but C factor values appear acceptable for the LULC classes.

Table 2. Cover management (C) factor for land use land cover types for nine regions in the Solomon Islands.

LULC Code	LULC	Central	Choiseul	Guadalcanal	Isabel	Makira-Ulawa	Malaita	Rennell-Bellona	Temotu	Western
10	Tree Cover	0.17	0.18	0.18	0.11	0.21	0.07	0.07	0.13	0.38
20	Shrubland	0.42	0.13	0.18	0.17	0.14	0.03	0.03	0.40	0.37
30	Grassland	0.18	0.15	0.11	0.21	0.08	0.02	0.10	0.14	0.40
40	Cropland	0.23	0.24	0.10	0.22	0.21	0.30	0.27	0.54	0.49
50	Built-up	0.41	0.23	0.26	0.25	0.10	0.14	0.08	0.27	0.48
60	Bare and sparse vegetation	0.28	0.10	0.20	0.31	0.13	0.23	0.23	0.32	0.54
80	Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	Herba-ceous Wetland	0.42	0.34	0.15	0.36	0.22	0.20	0.51	0.37	0.56
95	Mangroves	0.41	0.04	0.16	0.19	0.26	0.14	0.14	0.10	0.52

INPUT 7: THRESHOLD FLOW ACCUMULATION

Description: Threshold for delineating waterways which will not have sediment export or retention

Source: InVEST User's Guide

Citation: Sharp, R., J. Douglass, S. Wolny, K. Arkema, J. Bernhardt, W. Bierbower, N. Chaumont, D. Denu, D. Fisher, K. Glowinski, R. Griffin, G. Guannel, A. Guerry, J. Johnson, P. Hamel, C. Kennedy, C.K. Kim, M. Lacayo, E. Lonsdorf, L. Mandle, L. Rogers, J. Silver, J. Toft, G. Verutes, A.L. Vogl, S. Wood and K. Wyatt. 2020, InVEST 3.9.2 User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Methodology and workflow: A default value of 1,000 was used as a preliminary threshold flow accumulation value. The resulting stream rasters were validated by visually comparing the flow accumulation raster and RGB Sentinel-2 satellite imagery. A stream layer from the Open Street Map project was also used to extract the mean and 80th percentile values from the flow accumulation raster, although this method did not provide any relevant information since there was some misalignment with the stream layer and 30-meter DEM derived layers. A final threshold accumulation value of 1,000 was used for model runs since the resulting values were indicative of the waterways seen in the satellite imagery.

INPUT 8: DRAINAGES (OPTIONAL)

This input allows the user to indicate drainage systems that may interrupt the flow path of sediment transport. This input was not used in model runs.

INPUTS 9 THROUGH 12: MODEL PARAMETERS

Description: Parameters for calibrating SDR model

Source: InVEST User's Guide

Citation: Sharp, R., J. Douglass, S. Wolny, K. Arkema, J. Bernhardt, W. Bierbower, N. Chaumont, D. Denu, D. Fisher, K. Glowinski, R. Griffin, G. Guannel, A. Guerry, J. Johnson, P. Hamel, C. Kennedy, C.K. Kim, M. Lacayo, E. Lonsdorf, L. Mandle, L. Rogers, J. Silver, J. Toft, G. Verutes, A.L. Vogl, S. Wood and K. Wyatt. 2020, InVEST 3.9.2 User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Methodology and workflow: Due to lack of sediment data collected from field studies, model defaults values suggested in the InVEST User's Guide were used. If field data were available, the model parameters could be altered to ensure model outputs are in accordance with the sediment data recorded at field sites.

Borselli k Parameter: 2

Borselli IC0 Parameter: 0.5

Max SDR Value: 0.8

Max L Value: 150

Calibration: These parameters are typically adjusted after model runs by comparing outputs and sedimentation data collected at stream gauges or outlets. Sedimentation data was not available to calibrate these values so the default values were used.