BasinATLAS-Zambia Attributes (version 1.0)

(click hyperlinked ID to jump to individual information sheet)

ID	Category	Attribute	Source Data	Citation	Column(s)	Count
H01	Hydrology	Natural Discharge	WaterGAP v2.2	Döll et al. 2003	dis_m3_---	x3
H02	Hydrology	Land Surface Runoff	WaterGAP v2.2	Döll et al. 2003	run_mm_---	x13
H03	Hydrology	Inundation Extent	GIEMS-D15	Fluet-Chouinard et al. 2015	inu_pc_---	x6
H04	Hydrology	Limnicity (Percent Lake Area)	HydroLAKES	Messager et al. 2016	lka_pc_---	x2
H09	Hydrology	River Volume	HydroSHEDS & WaterGAP	Lehner & Grill 2013	riv_tc_---	x2
H10	Hydrology	Groundwater Table Depth	Global Groundwater Map	Fan et al. 2013	gwt_cm_---	x1
P01	Physiography	Elevation	EarthEnv-DEM90	Robinson et al. 2014	ele_mt_---	x4
P02	Physiography	Terrain Slope	EarthEnv-DEM90	Robinson et al. 2014	slp_dg_---	x2
P03	Physiography	Stream Gradient	EarthEnv-DEM90	Robinson et al. 2014	sgr_dk_---	x1
C01	Climate	Climate Zones	GEnS	Metzger et al. 2013	clz_cl_---	x1
C02	Climate	Climate Strata	GEnS	Metzger et al. 2013	cls_cl_---	x1
C03	Climate	Air Temperature	WorldClim v1.4	Hijmans et al. 2005	tmp_dc_---	x16
C04	Climate	Precipitation	WorldClim v1.4	Hijmans et al. 2005	pre_mm_---	x14
C05	Climate	Potential Evapotranspiration	Global-PET	Zomer et al. 2008	pet_mm_---	x14
C06	Climate	Actual Evapotranspiration	Global Soil-Water Balance	Trabucco & Zomer 2010	aet_mm_---	x14
C07	Climate	Global Aridity Index	Global Aridity Index	Zomer et al. 2008	ari_ix_---	x2
C08	Climate	Climate Moisture Index	WorldClim & Global-PET	Hijmans et al. 2005	cmi_ix_---	x14
L01	Landcover	Land Cover Classes	GLC2000	Bartholomé & Belward 2005	glc_cl_---	x1
L02	Landcover	Land Cover Extent	GLC2000	Bartholomé & Belward 2005	glc_pc_---	x44
L07	Landcover	Forest Cover Extent	GLC2000	Bartholomé & Belward 2005	for_pc_---	x2
L08	Landcover	Cropland Extent	EarthStat	Ramankutty et al. 2008	crp_pc_---	x2
L09	Landcover	Pasture Extent	EarthStat	Ramankutty et al. 2008	pst_pc_---	x2
L10	Landcover	Irrigated Area Extent (Equipped)	HID v1.0	Siebert et al. 2015	ire_pc_---	x2
L13	Landcover	Protected Area Extent	WDPA	IUCN & UNEP-WCMC 2014	pac_pc_---	x2
L14	Landcover	Terrestrial Biomes	TEOW	Dinerstein et al. 2017	tbi_cl_---	x1
L15	Landcover	Terrestrial Ecoregions	TEOW	Dinerstein et al. 2017	tec_cl_---	x1
L16	Landcover	Freshwater Major Habitat Types	FEOW	Abell et al. 2008	fmh_cl_---	x1
L17	Landcover	Freshwater Ecoregions	FEOW	Abell et al. 2008	fec_cl_---	x1
S01	Soils & Geology	Clay Fraction in Soil	SoilGrids1km	Hengl et al. 2014	cly_pc_---	x2
S02	Soils & Geology	Silt Fraction in Soil	SoilGrids1km	Hengl et al. 2014	slt_pc_---	x2
S03	Soils & Geology	Sand Fraction in Soil	SoilGrids1km	Hengl et al. 2014	snd_pc_---	x2
S04	Soils & Geology	Organic Carbon Content in Soil	SoilGrids1km	Hengl et al. 2014	soc_th_---	x2
S05	Soils & Geology	Soil Water Content	Global Soil-Water Balance	Trabucco & Zomer 2010	swc_pc_---	x14
S07	Soils & Geology	Karst Area Extent	Rock Outcrops v3.0	Williams & Ford 2006	kar_pc_---	x2
S08	Soils & Geology	Soil Erosion	GloSEM v1.2	Borrelli et al. 2017	ero_kh_---	x2
A01	Anthropogenic	Population Count	GPW v4	CIESIN 2016	pop_ct_---	x2
A02	Anthropogenic	Population Density	GPW v4	CIESIN 2016	ppd_pk_---	x2
A03	Anthropogenic	Urban Extent	GHS S-MOD v1.0 (2016)	Pesaresi & Freire 2016	urb_pc_---	x2
A04	Anthropogenic	Nighttime Lights	Nighttime Lights v4	Doll 2008	nli_ix_---	x2
A06	Anthropogenic	Human Footprint	Human Footprint v2	Venter et al. 2016	hft_ix_---	x4
Z01	Zambia	Major Catchments	WRPA Assessment	WWF-Zambia et al. 2019	cat_id_---	x1
Z02	Zambia	Dam Count	WRPA Assessment	WWF-Zambia et al. 2019	dam_ct_---	x1
Z03	Zambia	Waterfall Count	WRPA Assessment	WWF-Zambia et al. 2019	wfa_ct_---	x1
Z04	Zambia	Hotspring Presence	WRPA Assessment	WWF-Zambia et al. 2019	hsp_bi_---	x1
Z05	Zambia	Important Bird Areas	IBA Assessment	Leonard 2005	iba_pc_---	x1
Z06	Zambia	High Amphibian Richness	IUCN Species Data	Darwall et al. 2011	amp_bi_---	x1
Z07	Zambia	High Crab Richness	IUCN Species Data	Darwall et al. 2011	crb_bi_---	x1
Z08	Zambia	High Fish Richness	IUCN Species Data	Darwall et al. 2011	fsh_bi_---	x1
Z09	Zambia	High Mollusc Richness	IUCN Species Data	Darwall et al. 2011	mol_bi_---	x1
Z10	Zambia	High Odonatan Richness	IUCN Species Data	Darwall et al. 2011	odo_bi_---	x1
Z11	Zambia	Aquatic Species Extent	IUCN Red List	IUCN 2018	spc_pc_---	x42
	Total	**Variables: 51**			**Attributes:**	**259**

Category	Hydrology	ID-H01	***>>> Back to Attribute List***

Attribute Natural Discharge

Source data WaterGAP v2.2 (data of 2014)

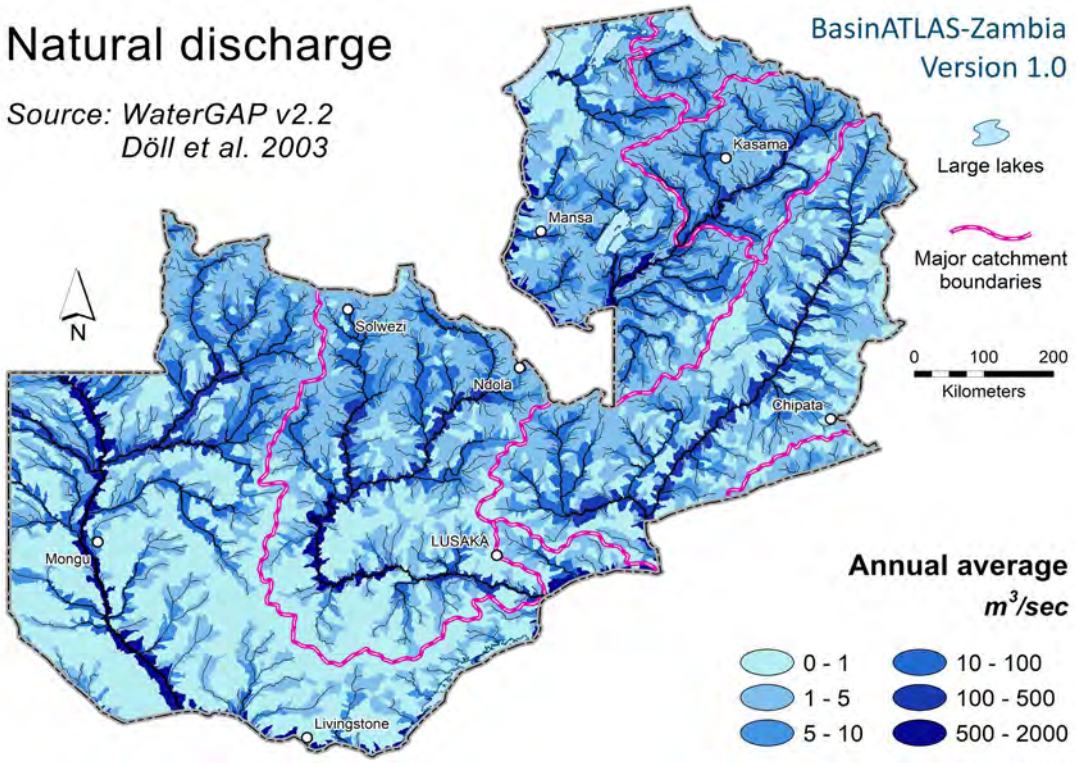
Citation: Döll et al. 2003 ***Native format:*** 15 arc-second grid ***Units:*** cubic meters/second

Column name **dis_m3_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {p} at sub-basin pour point

Dimension {oo}: {yr} annual average | {mn} annual minimum | {mx} annual maximum

Existing suffixes {xoo}: pyr | pmn | pmx



Data description Discharge and runoff estimates for HydroATLAS are based on long-term (1971–2000) average 'naturalized' discharge and runoff values provided by the state-of-the-art global integrated water balance model WaterGAP (Döll et al. 2003, model version 2.2 as of 2014). The WaterGAP data were spatially downscaled from their original 0.5 degree pixel resolution (~50 km at the equator) to the 15 arc-second (~500 m) resolution of the HydroSHEDS river network using geo-statistical techniques (Lehner and Grill 2013). Preliminary tests against approximately 3000 global gauging stations indicate a good overall correlation for the long-term averages, but also reveal larger uncertainties, in particular in the minimum and maximum statistics, for areas that are dominated by snow, glaciers, wetlands, and (semi-)arid conditions.

Reference Döll, P., Kaspar, F., Lehner, B. (2003). A global hydrological model for deriving water availability indicators: model tuning and validation. Journal of Hydrology, 270, 105-134.

Website http://www.watergap.de/

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Additional information Annual minimum and maximum discharges were derived from the 12 long-term average monthly flow values (1971-2000), i.e. they represent the flow of the lowest or highest month within the average year. Monthly mean discharge estimates are only available in RiverATLAS-Zambia but not BasinATLAS-Zambia. Additional reading: Lehner, B., Grill G. (2013). Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. Hydrological Processes, 27(15), 2171-2186.

Category	Hydrology	ID-H02	***>>> Back to Attribute List***

Attribute Land Surface Runoff

Source data WaterGAP v2.2 (data of 2014)

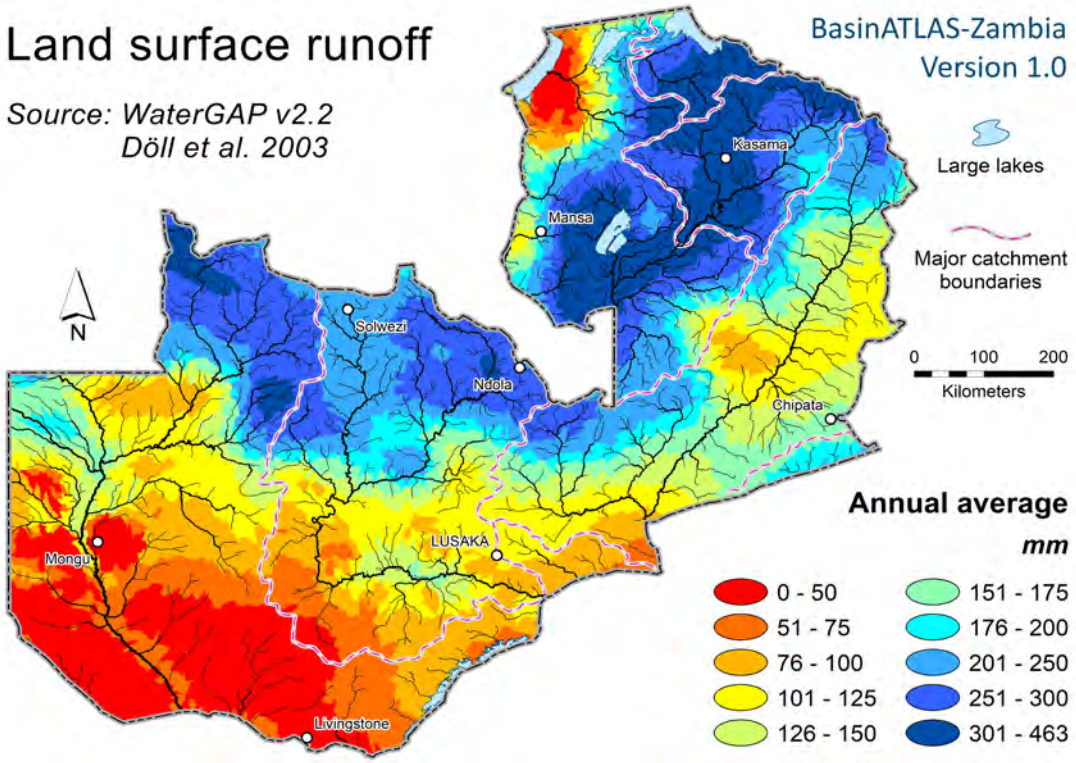
Citation: Döll et al. 2003 ***Native format:*** 15 arc-second grid ***Units:*** millimeters

Column name **run_mm_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {yr} annual average

Existing suffixes {xoo}: syr | s01-s12



Data description Discharge and runoff estimates for HydroATLAS are based on long-term (1971–2000) average 'naturalized' discharge and runoff values provided by the state-of-the-art global integrated water balance model WaterGAP (Döll et al. 2003, model version 2.2 as of 2014). The WaterGAP data were spatially downscaled from their original 0.5 degree pixel resolution (~50 km at the equator) to the 15 arc-second (~500 m) resolution of the HydroSHEDS river network using geo-statistical techniques (Lehner and Grill 2013). Preliminary tests against approximately 3000 global gauging stations indicate a good overall correlation for the long-term averages, but also reveal larger uncertainties for areas that are dominated by snow, glaciers, wetlands, and (semi-)arid conditions.

Reference Döll, P., Kaspar, F., Lehner, B. (2003). A global hydrological model for deriving water availability indicators: model tuning and validation. Journal of Hydrology, 270, 105-134.

Website http://www.watergap.de/

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Additional information Monthly mean runoff estimates are only available in BasinATLAS-Zambia but not RiverATLAS-Zambia. Further reading: Lehner, B., Grill G. (2013). Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. Hydrological Processes, 27(15), 2171-2186. doi: 10.1002/hyp.9740.

Category	Hydrology	ID-H03	***>>> Back to Attribute List***

Attribute Inundation Extent

Source data Global Inundation Extent from Multi-Satellites (GIEMS-D15)

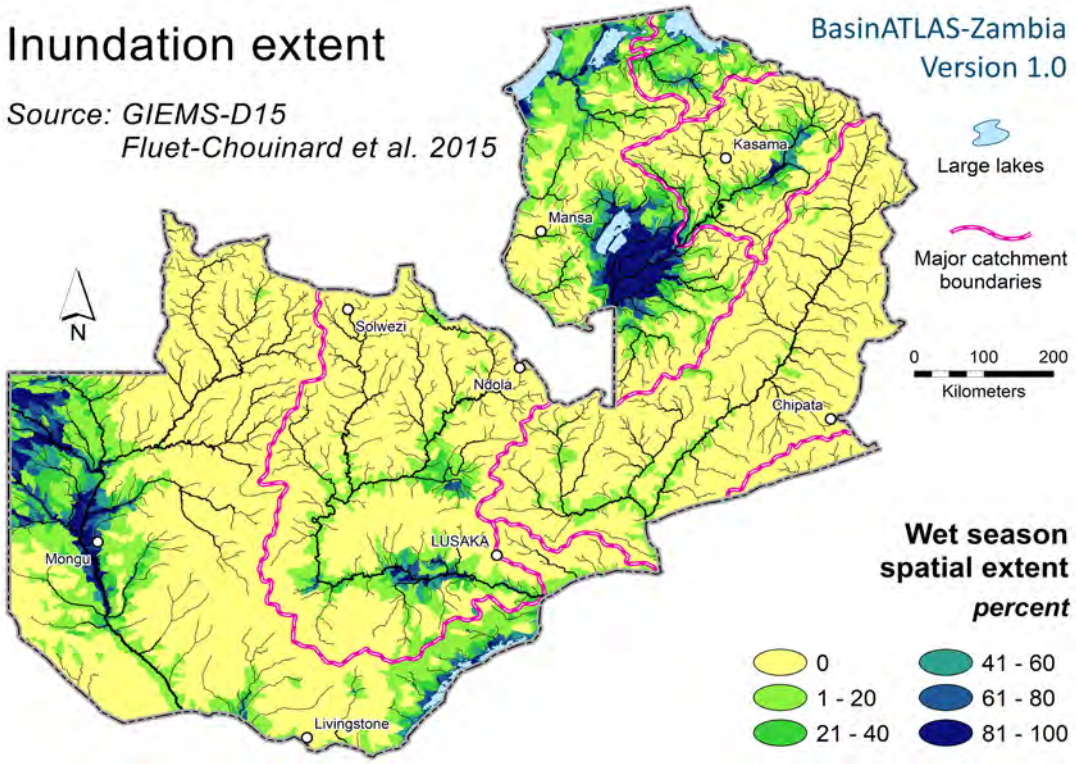
Citation: Fluet-Chouinard et al. 2015 ***Native format:*** 15 arc-second grid ***Units:*** percent cover

Column name **inu_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {mn} annual minimum | {mx} annual maximum | {lt} long-term maximum

Existing suffixes {xoo}: smn | smx | slt | umn | umx | ult



Data description GIEMS-D15 is a high-resolution global inundation map at a pixel size of 15 arc-seconds (approximately 500m at the equator). The map was generated by downscaling inundated area estimates from the Global Inundation Extent from Multi-Satellites (GIEMS, Prigent et al. 2007) for the years 1993-2004, and bias-adjusting them with wetland extents from the Global Lakes and Wetlands Database (GLWD, Lehner and Döll 2004). GIEMS-D15 represents three states of land surface inundation extents: mean annual minimum (permanently inundated), mean annual maximum (seasonally inundated), and long-term maximum (areas affected by extreme flood events).

Reference Fluet-Chouinard, E., Lehner, B., Rebelo, L. M., Papa, F., & Hamilton, S. K. (2015). Development of a global inundation map at high spatial resolution from topographic downscaling of coarse-scale remote sensing data. Remote Sensing of Environment, 158, 348-361.

Website http://www.estellus.fr/index.php?static13/giems-d15

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Additional information Further readings: Prigent, C., Papa, F., Aires, F., Rossow, W.B., Matthews, E. (2007). Global inundation dynamics inferred from multiple satellite observations, 1993-2000. Journal of Geophysical Research, 112(D12107), 1-13. Lehner, B., Döll, P. (2004). Development and validation of a global database of lakes, reservoirs and wetlands. Journal of Hydrology, 296(1), 1-22.

Category	Hydrology	ID-H04	***>>> Back to Attribute List***

Attribute Limnicity (Percent Lake Area)

Source data HydroLAKES

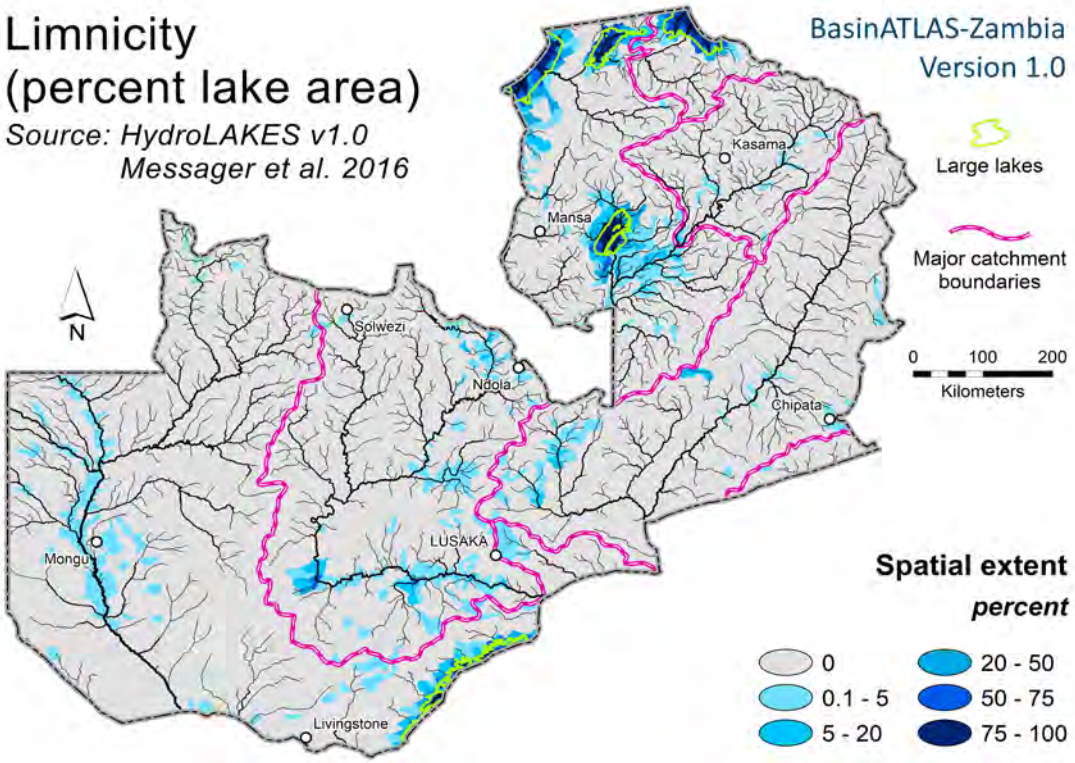
Citation: Messager et al. 2016 ***Native format:*** Polygons ***Units:*** percent cover (x10)

Column name **lka_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description HydroLAKES is a database aiming to provide the shoreline polygons of all global lakes and reservoirs with a surface area of at least 10 ha. Attributes for each of the 1.42 million lakes include estimates of the shoreline length, average depth, water volume and residence time. All lakes are co-registered to the global river network of the HydroSHEDS database via their lake pour points. The volume of most lakes is estimated based on the surrounding terrain information using a geostatistical model. Limnicity is defined as the percent lake area in the given spatial unit.

Reference Messager, M.L., Lehner, B., Grill, G., Nedeva, I., Schmitt, O. (2016). Estimating the volume and age of water stored in global lakes using a geo-statistical approach. Nature Communications, 7, 13603. doi: 10.1038/ncomms13603

Website http://www.hydrosheds.org/page/hydrolakes

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Additional information In the stored data, percent values are multiplied by 10 (i.e. value 10 means 1%).

Category	Hydrology	ID-H09	***>>> Back to Attribute List***

Attribute River Volume

Source data HydroSHEDS and WaterGAP v2.2

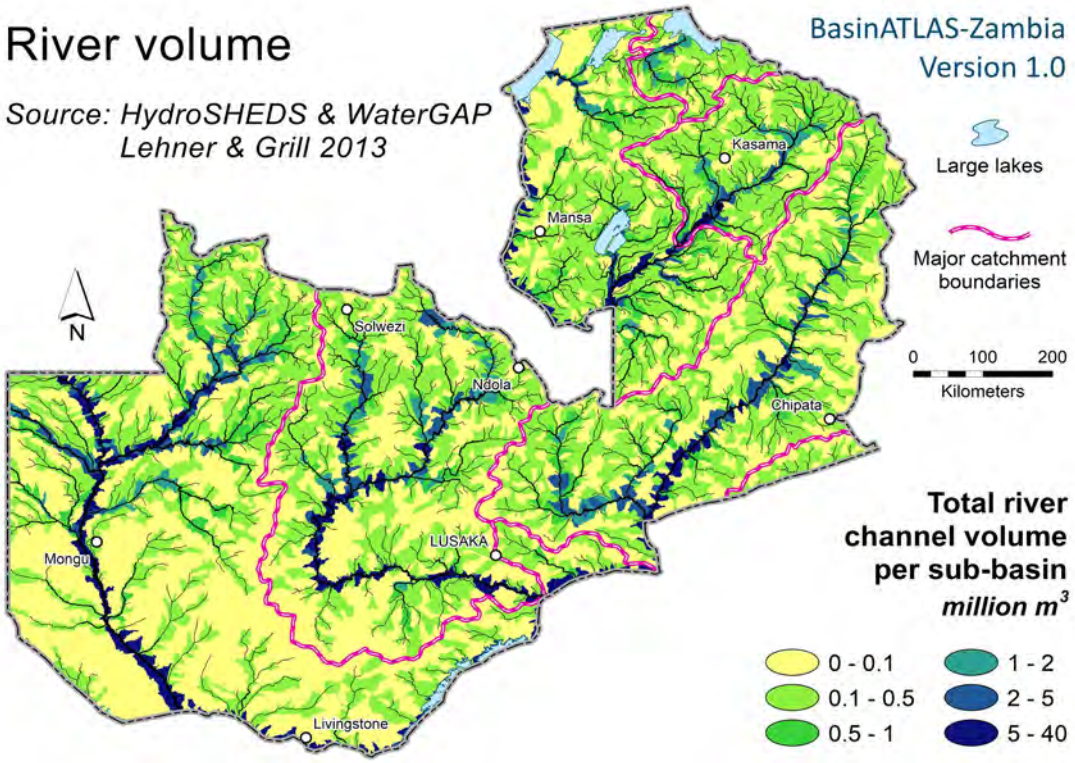
Citation: Lehner & Grill 2013 ***Native format:*** 15 arc-second grid ***Units:*** thousand cubic meters

Column name **riv_tc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {su} sum

Existing suffixes {xoo}: ssu | usu



Data description River volume was calculated using the the HydroSHEDS database at 15 arc-second resolution. HydroSHEDS was derived from high-resolution (3 arc-second) elevation data obtained during NASA's Shuttle Radar Topography Mission (SRTM) in February 2000. Based on global discharge estimates and simple hydraulic geometry laws (Allen et al. 1994), a first-level approximation of the dimensions of channel width and depth was derived for every river reach of the HydroSHEDS database. For discharge, the long-term (1971-2000) monthly maximum was used (see attribute H01) as a proxy to represent bankfull flow. The water volume per river reach was then calculated by multiplying channel width, depth, and length.

Reference Lehner, B., Grill G. (2013). Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. Hydrological Processes, 27(15), 2171-2186. doi: 10.1002/hyp.9740.

Website http://www.hydrosheds.org/

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Additional information Further reading: Allen, P.M., Arnold, J.C., Byars, B.W. (1994). Downstream channel geometry for use in planning-level models. JAWRA Journal of the American Water Resources Association, 30, 663-671. doi:10.1111/j.1752-1688.1994.tb03321.x

Category	Hydrology	ID-H10	***>>> Back to Attribute List***

Attribute Groundwater Table Depth

Source data Global Groundwater Map

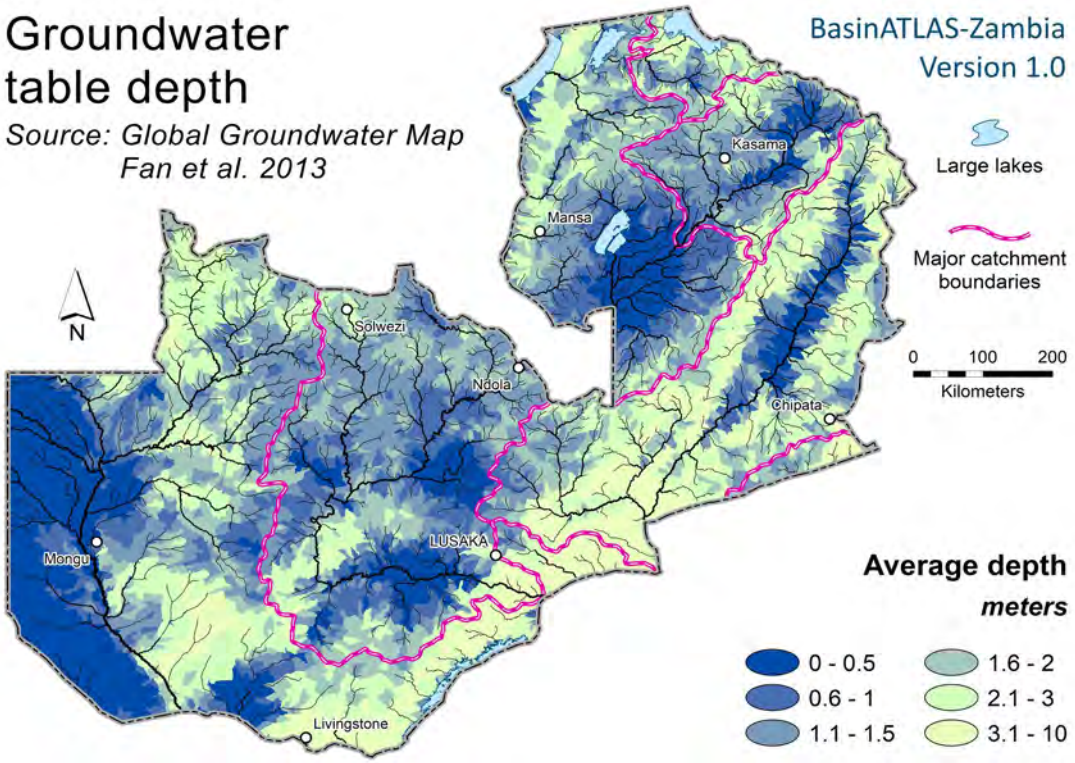
Citation: Fan et al. 2013 ***Native format:*** 30 arc-second grid ***Units:*** centimeters

Column name **gwt_cm_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav



Data description Fan et al. (2013) compiled global observations of water table depth from government archives and literature (including years 1927-2009), and then filled in data gaps and infered patterns and processes using a groundwater model forced by modern climate, terrain, and sea level. Patterns in water table depth explain patterns in wetlands at the global scale and vegetation gradients at regional and local scales. Overall, shallow groundwater influences 22 to 32% of global land area, including ~15% as groundwater-fed surface water features and 7 to 17% of the water table or its capillary fringe within plant rooting depths.

Reference Fan, Y., Li, H., & Miguez-Macho, G. (2013). Global patterns of groundwater table depth. Science, 339(6122), 940-943.

Website http://science.sciencemag.org/content/339/6122/940

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Additional information None

Category	Physiography	ID-P01	***>>> Back to Attribute List***

Attribute Elevation

Source data EarthEnv-DEM90

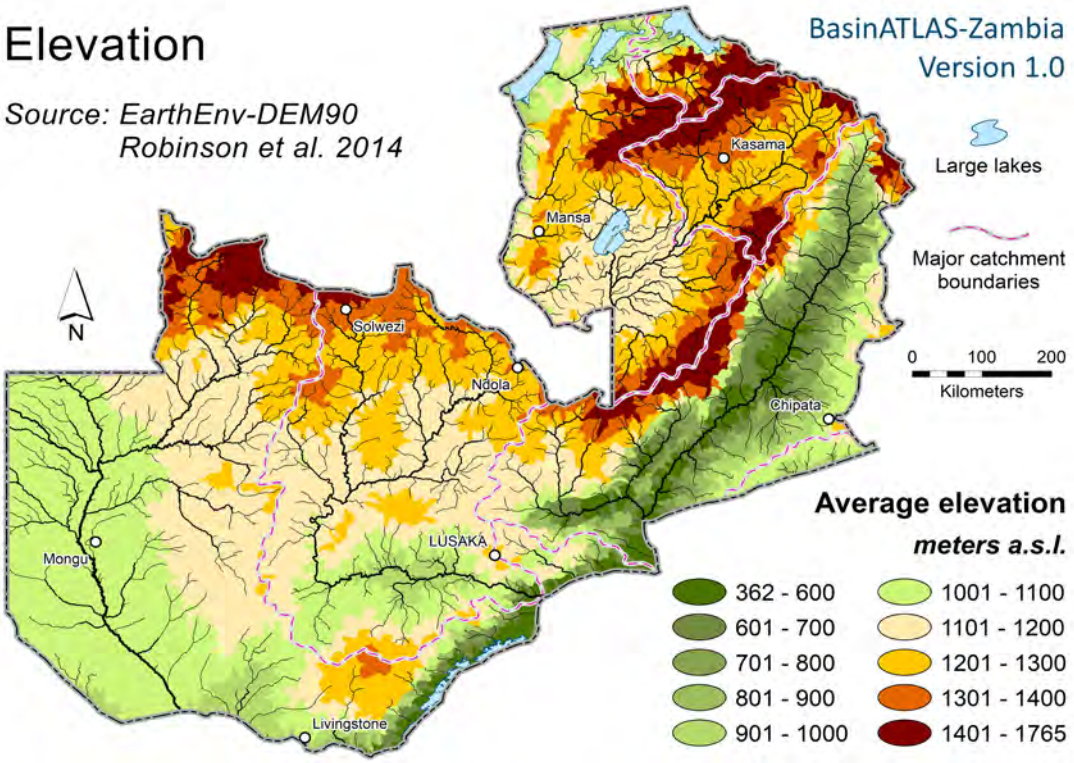
Citation: Robinson et al. 2014 ***Native format:*** 3 arc-second grid ***Units:*** meters a.s.l.

Column name **ele_mt_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average | {mn} minimum | {mx} maximum

Existing suffixes {xoo}: sav | smn | smx | uav



Data description

EarthEnv-DEM90 is a digital elevation model that provides elevation values for a pixel resolution of 3 arc-seconds (approximately 90m at the equator). It is derived from CGIAR-CSI SRTM v4.1 and ASTER GDEM v2 data products representing conditions of 2000-2010. These data have been processed and merged to provide a continuous coverage between 60˚S and 83˚N. For inclusion in HydroATLAS, the original values were first aggregated into a 15 arc-second resolution using the 'mean' statistic.

Reference

Robinson, N., Regetz, J., Guralnick, R.P. (2014). EarthEnv-DEM90: A nearly-global, void-free, multi-scale smoothed, 90m digital elevation model from fused ASTER and SRTM data. ISPRS Journal of Photogrammetry and Remote Sensing, 87, 57-67. doi: 10.1016/j.isprsjprs.2013.11.002.

Website http://www.earthenv.org/DEM

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Additional information None

Category	Physiography	ID-P02	***>>> Back to Attribute List***

Attribute Terrain Slope

Source data EarthEnv-DEM90

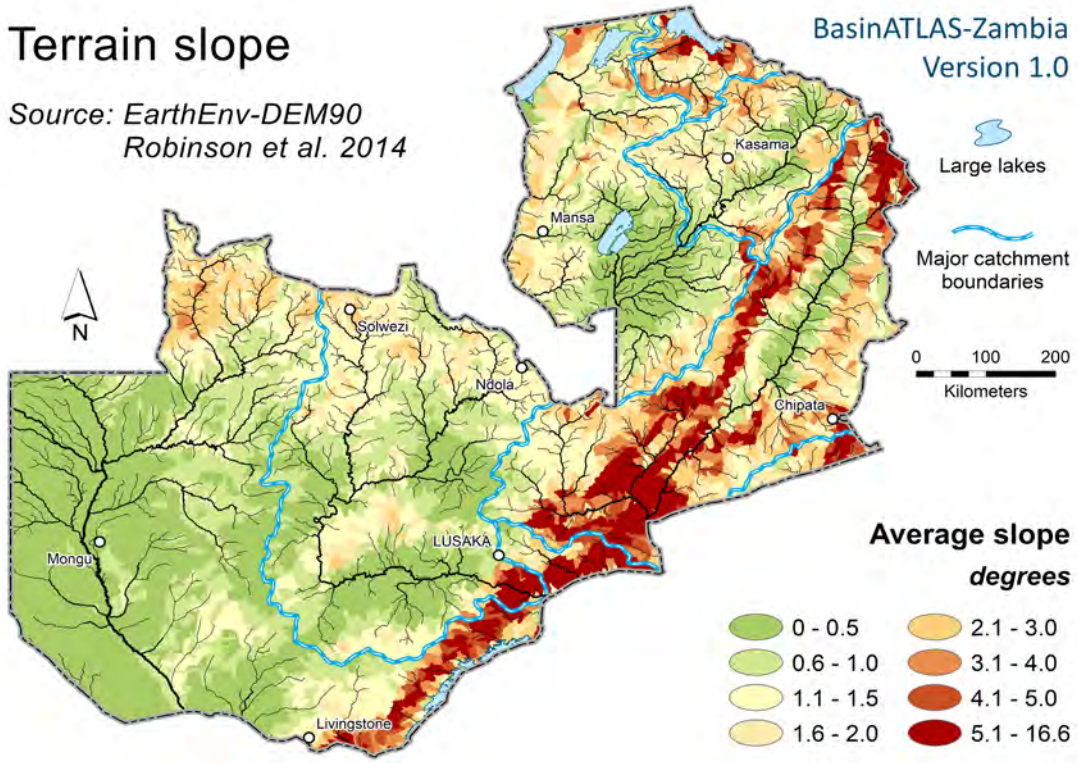
Citation: Robinson et al. 2014 ***Native format:*** 3 arc-second grid ***Units:*** degrees (x10)

Column name **slp_dg_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description	EarthEnv-DEM90 is a digital elevation model that provides elevation values for a pixel resolution of 3 arc-seconds (approximately 90m at the equator). It is derived from CGIAR-CSI SRTM v4.1 and ASTER GDEM v2 data products, representing conditions of 2000-2010. These data have been processed and merged to provide a continuous coverage between 60˚S and 83˚N. Slope values were computed at 3 arc-second resolution based on Horn's method with latitudinal corrections for the distortion in the XY spacing of geographic coordinates by approximating the geodesic distance between cell centers. For inclusion in HydroATLAS, the high-resolution results were first aggregated into a 15 arc-second resolution using the 'mean' statistic.
Reference	Robinson, N., Regetz, J., Guralnick, R.P. (2014). EarthEnv-DEM90: A nearly-global, void-free, multi-scale smoothed, 90m digital elevation model from fused ASTER and SRTM data. ISPRS Journal of Photogrammetry and Remote Sensing, 87, 57-67. doi: 10.1016/j.isprsjprs.2013.11.002.
Website	http://www.earthenv.org/DEM
License	Creative Commons CC-BY 4.0
Additional information	In the stored data, degree values are multiplied by 10 (i.e. value 10 means 1 degree). NoData values (-9999) were assigned to all of Greenland because calculated slopes were not within reasonable ranges due to substantial outliers in DEM over the Greenland ice sheet.

Category	Physiography	ID-P03	***>>> Back to Attribute List***

Attribute Stream Gradient

Source data EarthEnv-DEM90

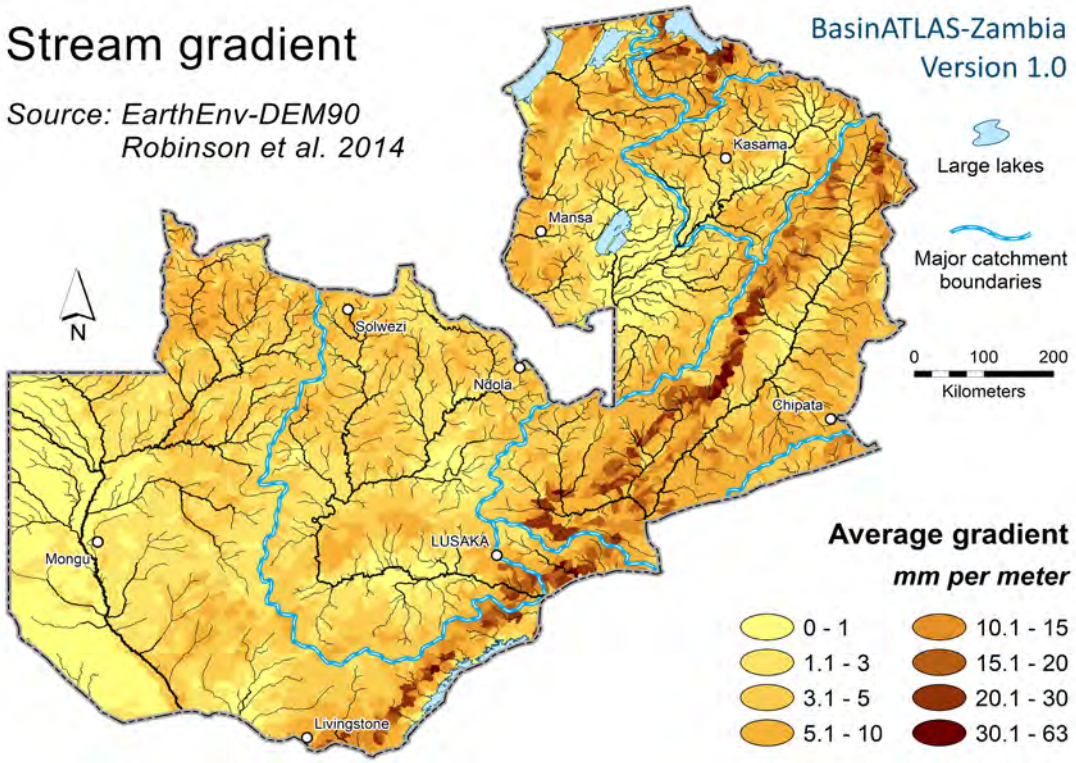
Citation: Robinson et al. 2014 ***Native format:*** 3 arc-second grid ***Units:*** decimeters per km

Column name **sgr_dk_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav



Data description EarthEnv-DEM90 is a digital elevation model that provides elevation values for a pixel resolution of 3 arc-seconds (approximately 90m at the equator). It is derived from CGIAR-CSI SRTM v4.1 and ASTER GDEM v2 data products. These data have been processed and merged to provide a continuous coverage between 60˚S and 83˚N. Stream gradients were computed after removing single pixel sinks by lifting them to the minimum elevation of their eight surrounding pixels. The 3 arc-second pixels were then aggregated to 15 arc-second resolution using the 'minimum' statistic (to preserve the valley bottom height within the larger pixel). Finally, the stream gradient was calculated as the ratio between the elevation drop within the river reach (i.e. the difference between min. and max. elevation along the reach) and the length of the reach.

Reference Robinson, N., Regetz, J., Guralnick, R.P. (2014). EarthEnv-DEM90: A nearly-global, void-free, multi-scale smoothed, 90m digital elevation model from fused ASTER and SRTM data. ISPRS Journal of Photogrammetry and Remote Sensing, 87, 57-67. doi: 10.1016/j.isprsjprs.2013.11.002.

Website http://www.earthenv.org/DEM

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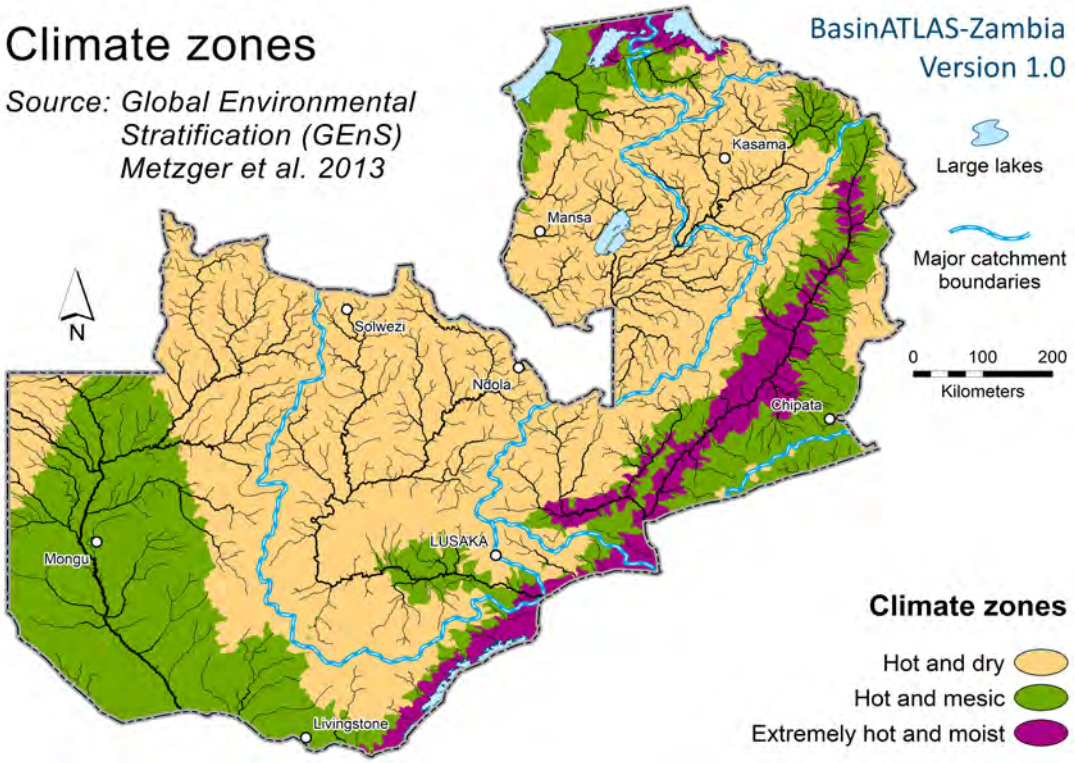
Additional information NoData values (-9999) were assigned to all of Greenland because calculated stream gradients were not within reasonable ranges due to substantial outliers in DEM over the Greenland ice sheet.

Category	Climate	ID-C01	***>>> Back to Attribute List***
Attribute	**Climate Zones**		
Source data	Global Environmental Stratification (GEnS)		
Citation:	Metzger et al. 2013	***Native format:*** Polygons	***Units:*** classes (18)
Column name	**clz_cl_{xoo}**	*(for syntax options of suffix {xoo} see next lines)*	
Spatial extent {x}:	{s} in sub-basin		
Dimension {oo}:	{mj} spatial majority		
Existing suffixes {xoo}:	smj		



Data description	The Global Environmental Stratification (GEnS) is a statistically derived global bioclimate classification (representative of the year 2000) that provides a global spatial framework for the integration and analysis of ecological and environmental data. The dataset used statistical analysis to distinguish 125 environmental strata based on 42 variables. To facilitate accessibility, these strata were aggregated into 18 environmental zones.
Reference	Metzger, M.J., Bunce, R.G., Jongman, R.H., Sayre, R., Trabucco, A., Zomer, R. (2013). A high-resolution bioclimate map of the world: a unifying framework for global biodiversity research and monitoring. Global Ecology and Biogeography, 22(5), 630-638.
Website	https://edinburgh-innovations.ed.ac.uk/project/bioclimate-world-map
License	Creative Commons CC-BY 4.0
Additional information	For class names see file HydroATLAS_v10_Legends.xlsx.

Category	Climate	ID-C02	***>>> Back to Attribute List***

Attribute Climate Strata

Source data Global Environmental Stratification (GEnS)

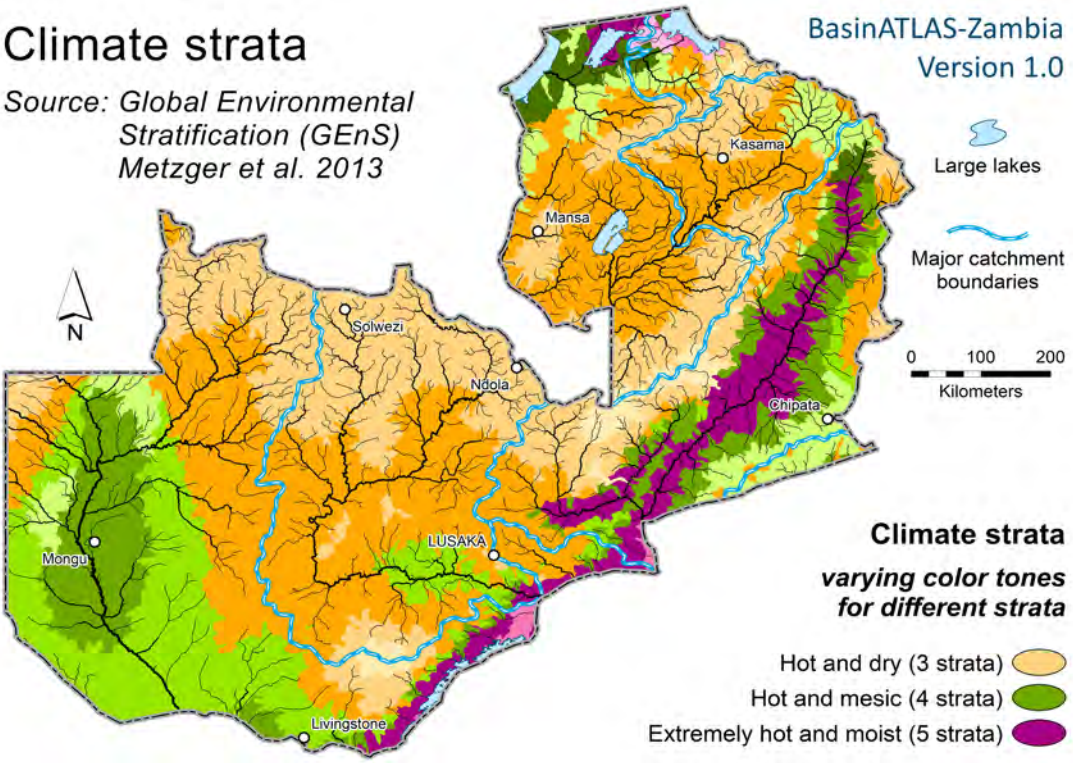
Citation: Metzger et al. 2013 ***Native format:*** Polygons ***Units:*** classes (125)

Column name **cls_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description The Global Environmental Stratification (GEnS) is a statistically derived global bioclimate classification (representative of the year 2000) that provides a global spatial framework for the integration and analysis of ecological and environmental data. The dataset used statistical analysis to distinguish 125 environmental strata based on 42 variables. To facilitate accessibility, these strata were aggregated into 18 environmental zones.

Reference Metzger, M.J., Bunce, R.G., Jongman, R.H., Sayre, R., Trabucco, A., Zomer, R. (2013). A high-resolution bioclimate map of the world: a unifying framework for global biodiversity research and monitoring. Global Ecology and Biogeography, 22(5), 630-638.

Website https://edinburgh-innovations.ed.ac.uk/project/bioclimate-world-map

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Additional information For class names see file HydroATLAS_v10_Legends.xlsx.

Category	Climate	ID-C03	***>>> Back to Attribute List***

Attribute Air Temperature

Source data WorldClim v1.4

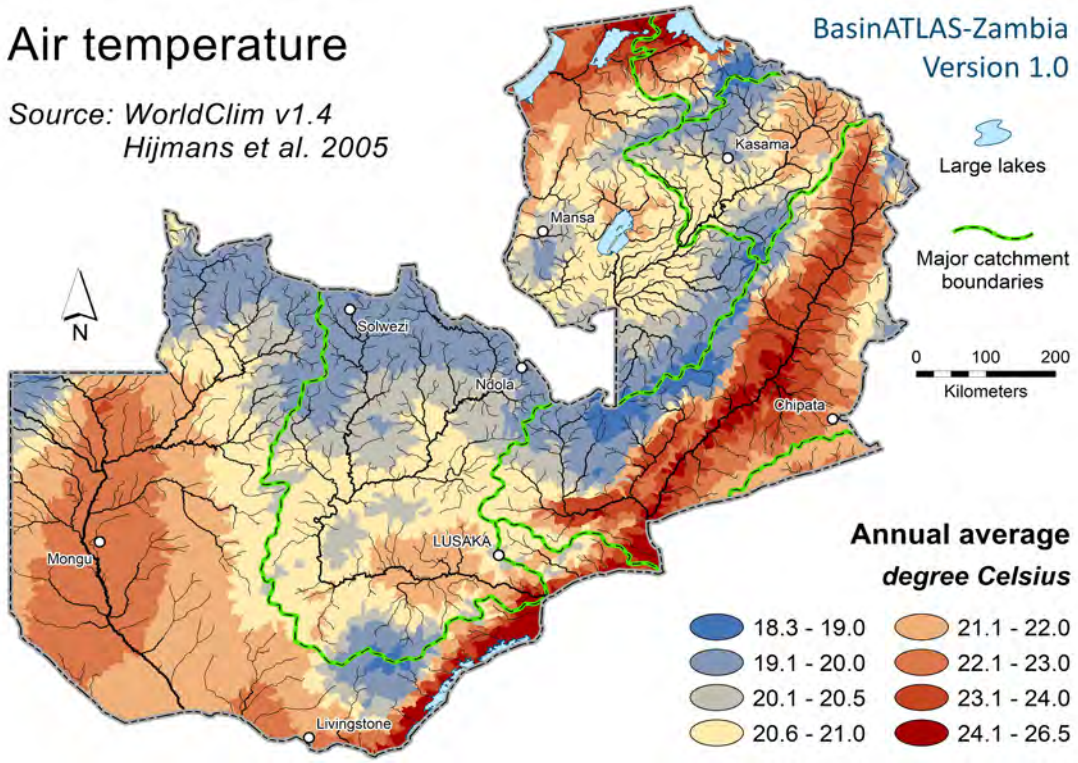
Citation: Hijmans et al. 2005 ***Native format:*** 30 arc-second grid ***Units:*** degrees Celsius (x10)

Column name **tmp_dc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {mn} annual minimum | {mx} annual maximum | {01-12} monthly average

Existing suffixes {xoo}: syr | smn | smx | s01-s12 | uyr



Data description

WorldClim is a database of interpolated global climate surfaces (excluding Antarctica) at a spatial resolution of 30 arc-seconds. Input data for the generation of WorldClim were gathered from a variety of sources (~70,000 stations) and, where possible, were restricted to records from 1950 to 2000. WorldClim applied the thin-plate smoothing spline algorithm implemented in the ANUSPLIN package for interpolation, using latitude, longitude, and elevation as independent variables. The climate elements included in HydroATLAS are mean monthly and annual precipitation; and mean, minimum, and maximum monthly and annual temperature.

Reference

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G., Jarvis, A. (2005). Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology, 25(15), 1965-1978.

Website http://worldclim.org/

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Additional information

In the stored data, degree values were multiplied by 10 (i.e. value 10 means 1 degree Celsius). Annual minimum and maximum temperatures were derived from the 12 long-term average monthly temperature values, i.e. they represent the temperature of the lowest or highest month within the average year.

Category	Climate	ID-C04	***>>> Back to Attribute List***

Attribute Precipitation

Source data WorldClim v1.4

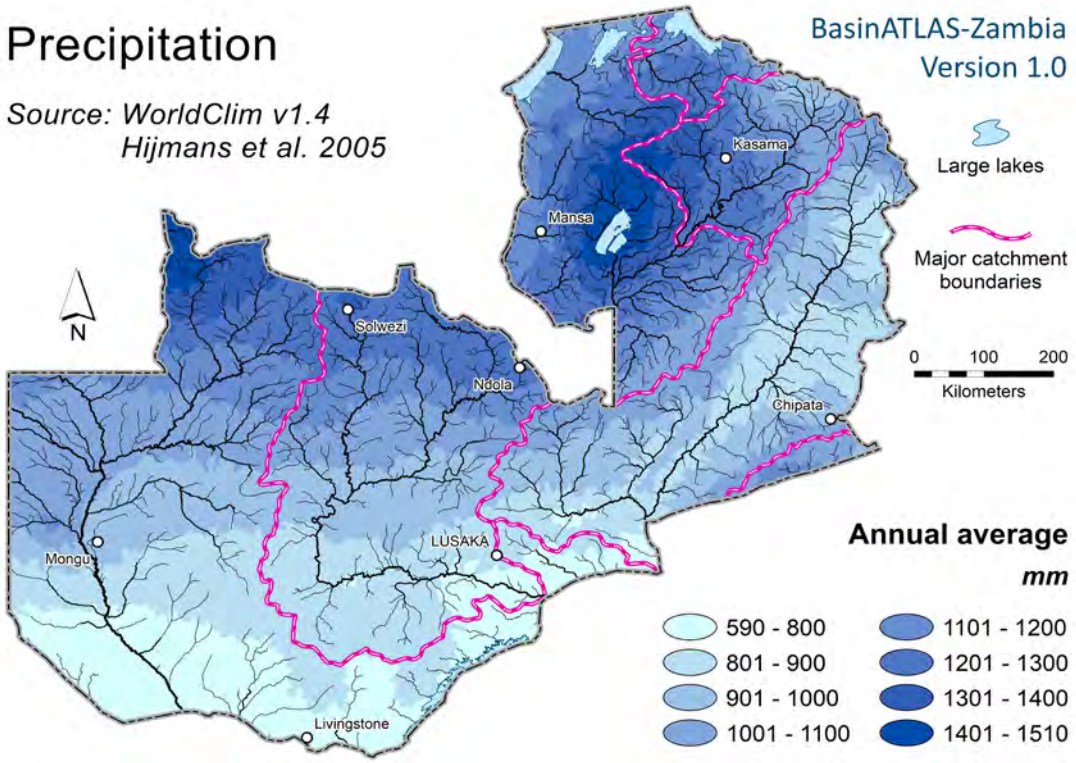
Citation: Hijmans et al. 2005 ***Native format:*** 30 arc-second grid ***Units:*** millimeters

Column name **pre_mm_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {01-12} monthly average

Existing suffixes {xoo}: syr | s01-s12 | uyr



Data description WorldClim is a database of interpolated global climate surfaces (excluding Antarctica) at a spatial resolution of 30 arc-seconds. Input data for the generation of WorldClim were gathered from a variety of sources (~70,000 stations) and, where possible, were restricted to records from 1950 to 2000. WorldClim applied the thin-plate smoothing spline algorithm implemented in the ANUSPLIN package for interpolation, using latitude, longitude, and elevation as independent variables. The climate elements included in HydroATLAS are mean monthly and annual precipitation; and mean, minimum, and maximum monthly and annual temperature.

Reference Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G., Jarvis, A. (2005). Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology, 25(15), 1965-1978.

Website http://worldclim.org/

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Additional information None

Category	Climate	ID-C05	***>>> Back to Attribute List***

Attribute Potential Evapotranspiration

Source data Global-PET v1

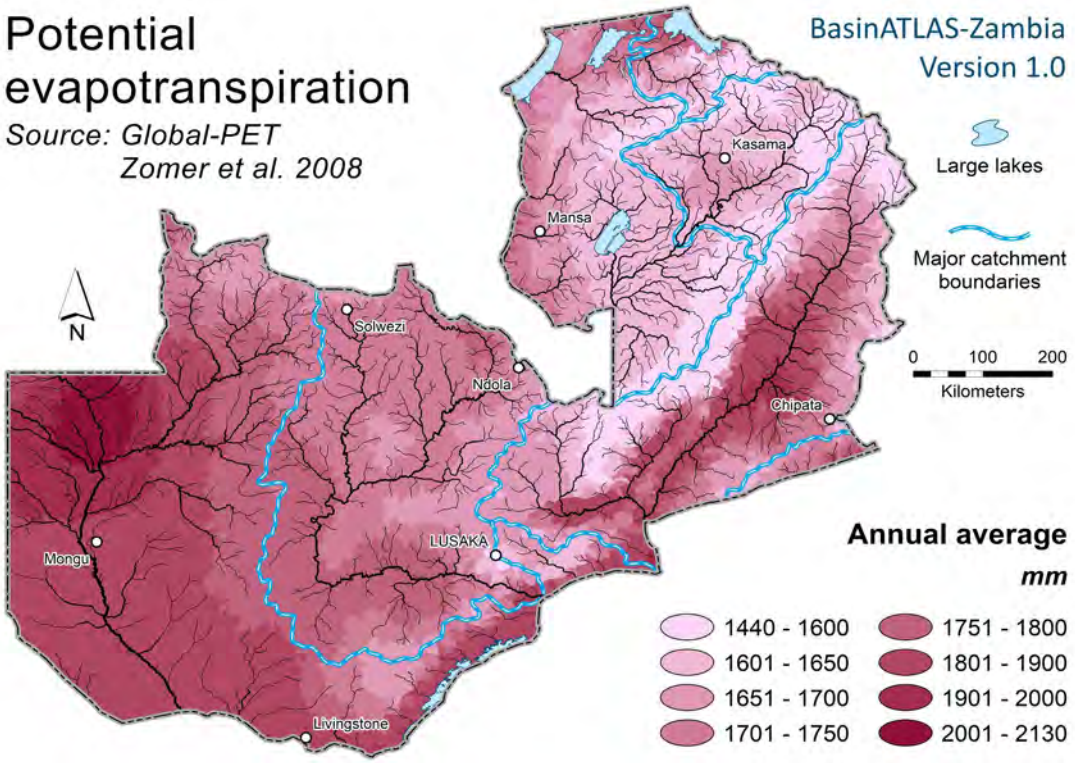
Citation: Zomer et al. 2008 ***Native format:*** 30 arc-second grid ***Units:*** millimeters

Column name **pet_mm_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {01-12} monthly average

Existing suffixes {xoo}: syr | s01-s12 | uyr



Data description

Global Potential Evapotranspiration (Global-PET) is modeled using data from WorldClim as input parameters. WorldClim is insufficient to fully parameterize physical radiation-based PET equations; however, it can be used to parameterize simpler temperature-based PET equations. Based on the results of comparative validations for South America and Africa, the Hargreaves model was chosen as the most suitable to model PET globally.

Reference

Zomer, R.J., Trabucco, A., Bossio, D.A., van Straaten, O., Verchot, L.V. (2008). Climate change mitigation: A spatial analysis of global land suitability for clean development mechanism afforestation and reforestation. Agriculture, Ecosystems & Environment, 126(1), 67-80.

Website https://cgiarcsi.community/data/global-aridity-and-pet-database

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Additional information

Additional required citation: Trabucco, A., Zomer, R.J., Bossio, D.A., van Straaten, O., Verchot, L.V. (2008). Climate change mitigation through afforestation/reforestation: A global analysis of hydrologic impacts with four case studies. Agriculture, Ecosystems and Environment, 126, 81-97.

Category	Climate	ID-C06	***>>> Back to Attribute List***

Attribute Actual Evapotranspiration

Source data Global High-Resolution Soil-Water Balance

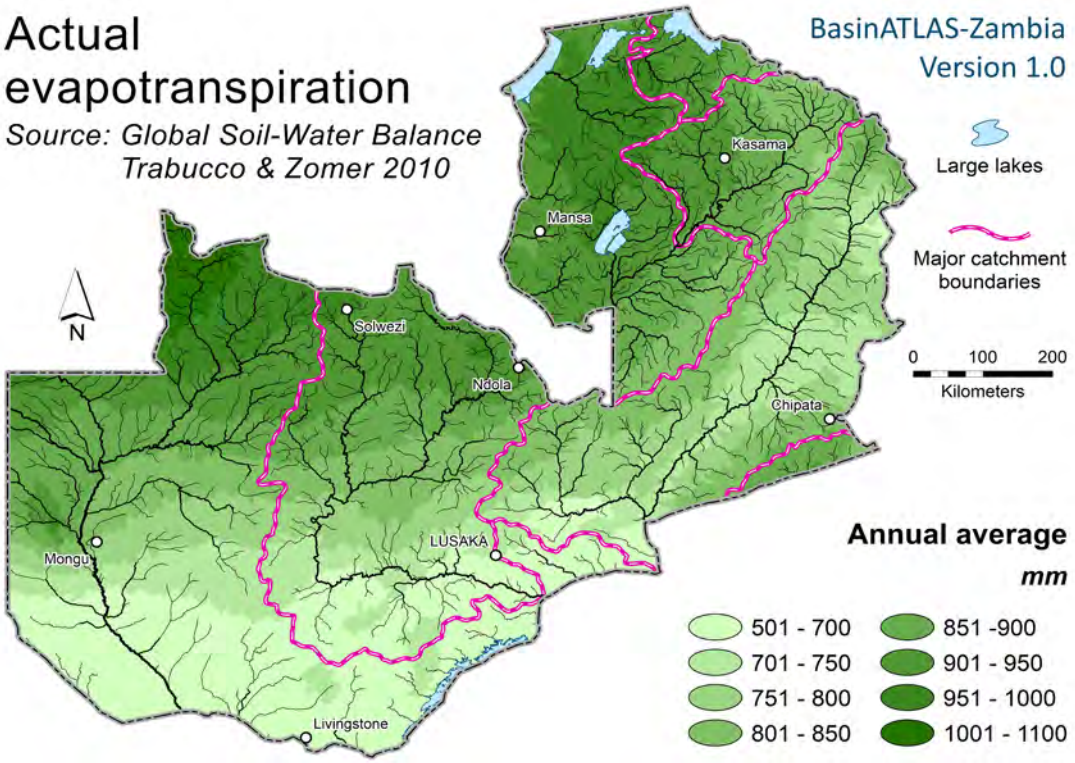
Citation: Trabucco & Zomer 2010 ***Native format:*** 30 arc-second grid ***Units:*** millimeters

Column name **aet_mm_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {01-12} monthly average

Existing suffixes {xoo}: syr | s01-s12 | uyr



Data description Global Actual Evapotranspiration (Global-AET) is provided as part of the Global High-Resolution Soil-Water Balance dataset which contains gridded estimates of actual evapotranspiration and soil water deficit. The dataset defines the monthly fraction of soil water content available for evapotranspiration processes (as a percentage of the maximum soil water content). It is therefore a measure of soil stress, and equal to the soil water stress coefficient as a percentage. This dataset utilizes the WorldClim and Global-PET databases as primary input. The results highlight specifically the climatic influence on hydrological dimensions that regulate vegetation suitability.

Reference Trabucco, A., Zomer, R.J. (2010). Global soil water balance geospatial database. CGIAR Consortium for Spatial Information. Available from the CGIAR-CSI GeoPortal at https://cgiarcsi.community.

Website https://cgiarcsi.community/data/global-high-resolution-soil-water-balance

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Additional information None

Category	Climate	ID-C07	***>>> Back to Attribute List***

Attribute Global Aridity Index

Source data Global Aridity Index v1

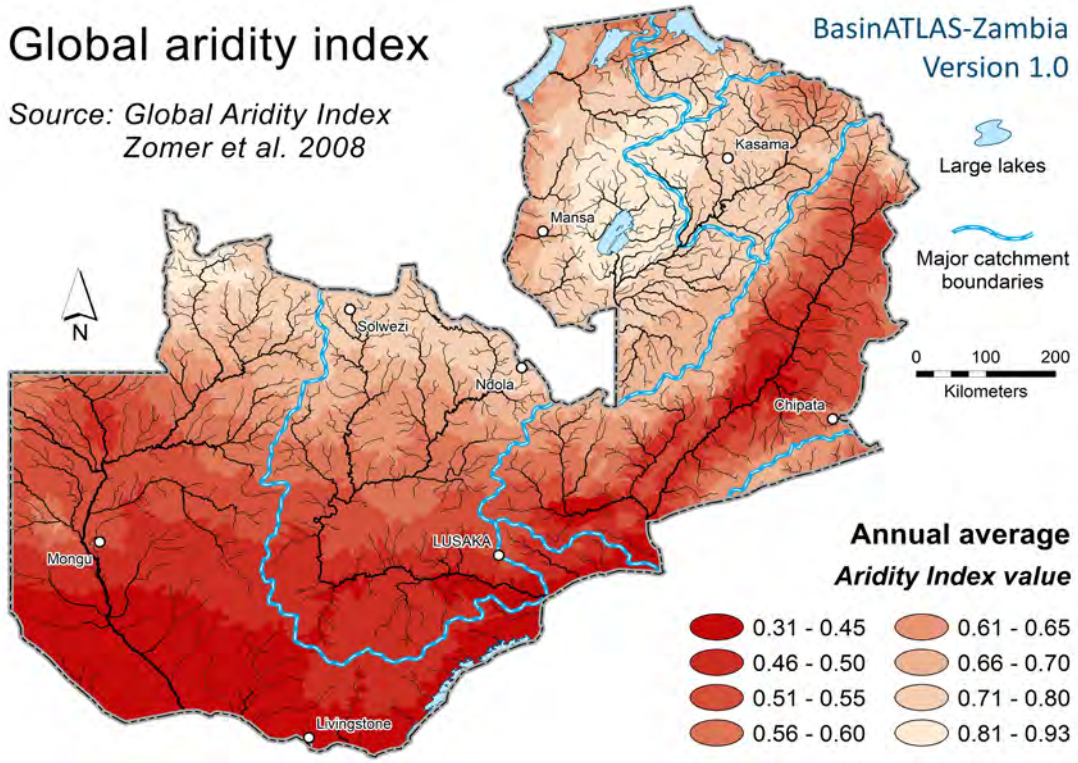
Citation: Zomer et al. 2008 ***Native format:*** 30 arc-second grid ***Units:*** index value (x100)

Column name **ari_ix_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description	The Global Aridity Index (Global-Aridity) is modeled using data from WorldClim as input parameters. Aridity is usually expressed as a generalized function of precipitation, temperature, and/or potential evapotranspiration (PET). For this global aridity index, it was calculated as mean annual precipitation over mean annual PET, i.e. rainfall over vegetation water demand (aggregated on an annual basis). Under this formulation, the aridity index values increase with more humid conditions, and decrease with more arid conditions. An aridity index value of 0 represents areas of no preciptiation, a value of 1 represent areas where precipitation equals PET, and a value >1 represents areas where precipitation exceeds PET. Note that maximum values were capped at 100.
Reference	Zomer, R.J., Trabucco, A., Bossio, D.A., van Straaten, O., Verchot, L.V. (2008). Climate change mitigation: A spatial analysis of global land suitability for clean development mechanism afforestation and reforestation. Agriculture, Ecosystems & Environment, 126(1), 67-80.
Website	https://cgiarcsi.community/data/global-aridity-and-pet-database
License	Original: Free for non-commercial use -- HydroATLAS: Creative Commons CC-BY 4.0
Additional information	In the stored data, index values are multiplied by 100 (i.e. value 100 means 1). Additional required citation: Trabucco, A., Zomer, R.J., Bossio, D.A., van Straaten, O., Verchot, L.V. (2008). Climate change mitigation through afforestation/reforestation: A global analysis of hydrologic impacts with four case studies. Agriculture, Ecosystems and Environment, 126, 81-97.

Category	Climate	ID-C08	***>>> Back to Attribute List***

Attribute Climate Moisture Index

Source data WorldClim v1.4 and Global-PET v1

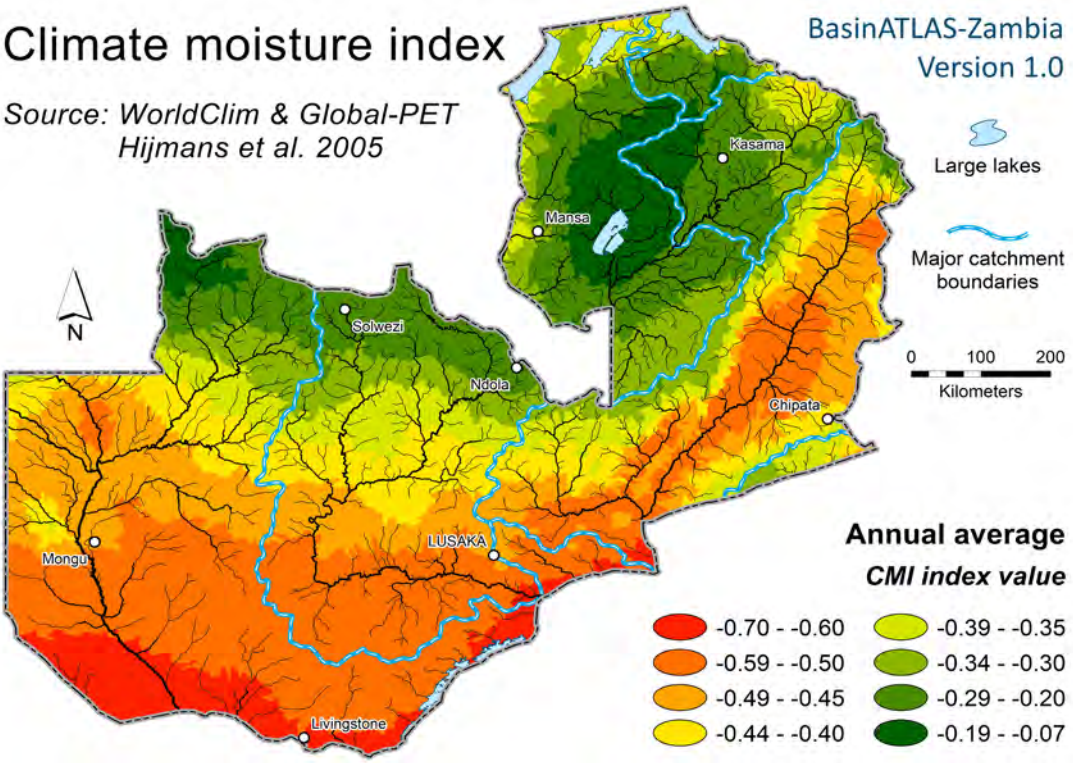
Citation: Hijmans et al. 2005 ***Native format:*** 30 arc-second grids ***Units:*** index value (x100)

Column name **cmi_ix_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {01-12} monthly average

Existing suffixes {xoo}: syr | s01-s12 | uyr



Data description The Climate Moisture Index (CMI) was derived from the annual precipitation (P) and potential evapotranspiration (PET) datasets as provided by the WorldClim v1.4 (Hijmans et al. 2005) and Global-PET v1 (Zomer et al. 2008) databases, respectively. The CMI was calculated using the equations presented in Willmott and Feddema (1992, see Website link below): [CMI = (P / PET) - 1 when P < PET] or [CMI = 1 - (PET / P) when P >= PET]. The resulting values range from -1 to 1.

Reference Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G., Jarvis, A. (2005). Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology, 25(15), 1965-1978.

Website http://climate.geog.udel.edu/~climate/publication_html/Pdf/WF_ProfGeog_92.pdf

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Additional information In the stored data, index values are multiplied by 100 (i.e. value 100 means 1). Additional required citation: Zomer, R.J., Trabucco, A., Bossio, D.A., van Straaten, O., Verchot, L.V. (2008). Climate change mitigation: A spatial analysis of global land suitability for clean development mechanism afforestation and reforestation. Agriculture, Ecosystems & Environment, 126(1), 67-80.

Category	Landcover	ID-L01	***>>> Back to Attribute List***

Attribute Land Cover Classes

Source data GLC2000

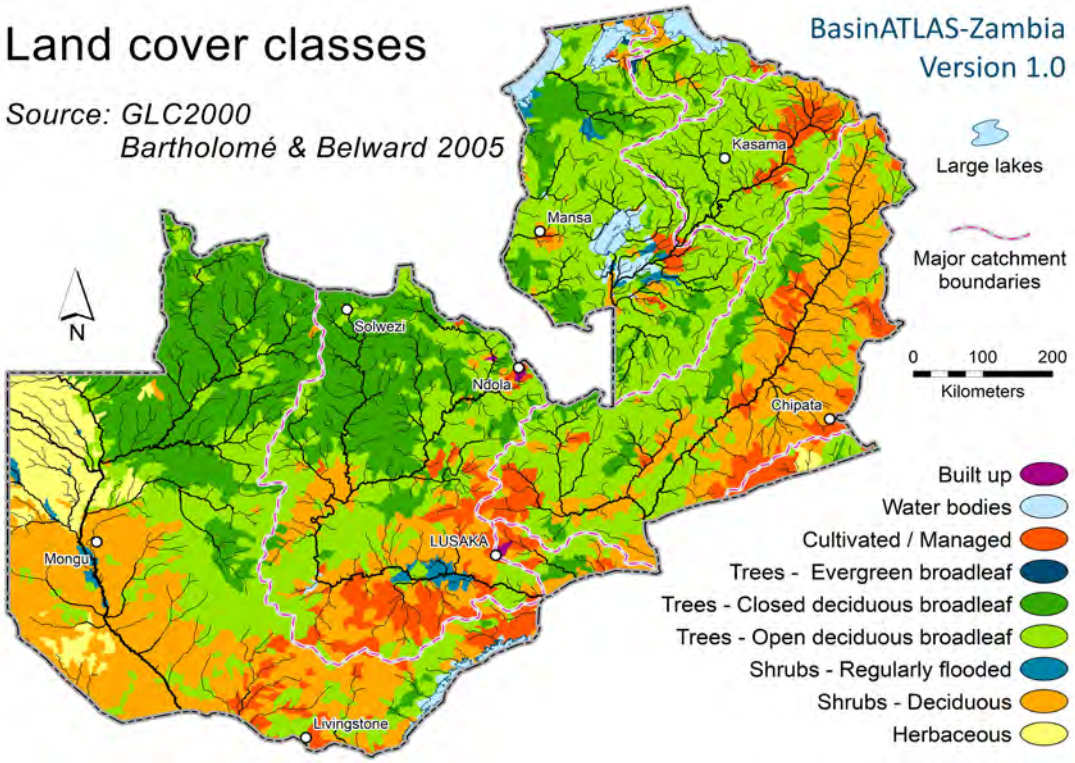
Citation: Bartholomé & Belward 2005 ***Native format:*** 30 arc-second grid ***Units:*** classes (22)

Column name **glc_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description The GLC2000 (Global Land Cover in the year 2000) database distinguishes 22 land cover classes and was produced by an international partnership of 30 research groups coordinated by the European Commission's Joint Research Centre. Land cover maps were based on daily data from the SPOT vegetation sensor (VEGA 2000 dataset: a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite) and other Earth observing sensors. The general objective was to provide a harmonized land cover database over the whole globe for the year 2000. The year 2000 is considered as a reference year for environmental assessment in relation to various activities, in particular the United Nation's Ecosystem-related International Conventions.

Reference Bartholomé, E., Belward, A.S. (2005). GLC2000: a new approach to global land cover mapping from Earth observation data. International Journal of Remote Sensing, 26(9), 1959-1977.

Website https://forobs.jrc.ec.europa.eu/products/glc2000/glc2000.php

License Creative Commons CC-BY 4.0

Additional information For class names see file HydroATLAS_v10_Legends.xlsx.

Category	Landcover	ID-L02	***>>> Back to Attribute List***

Attribute Land Cover Extent

Source data GLC2000

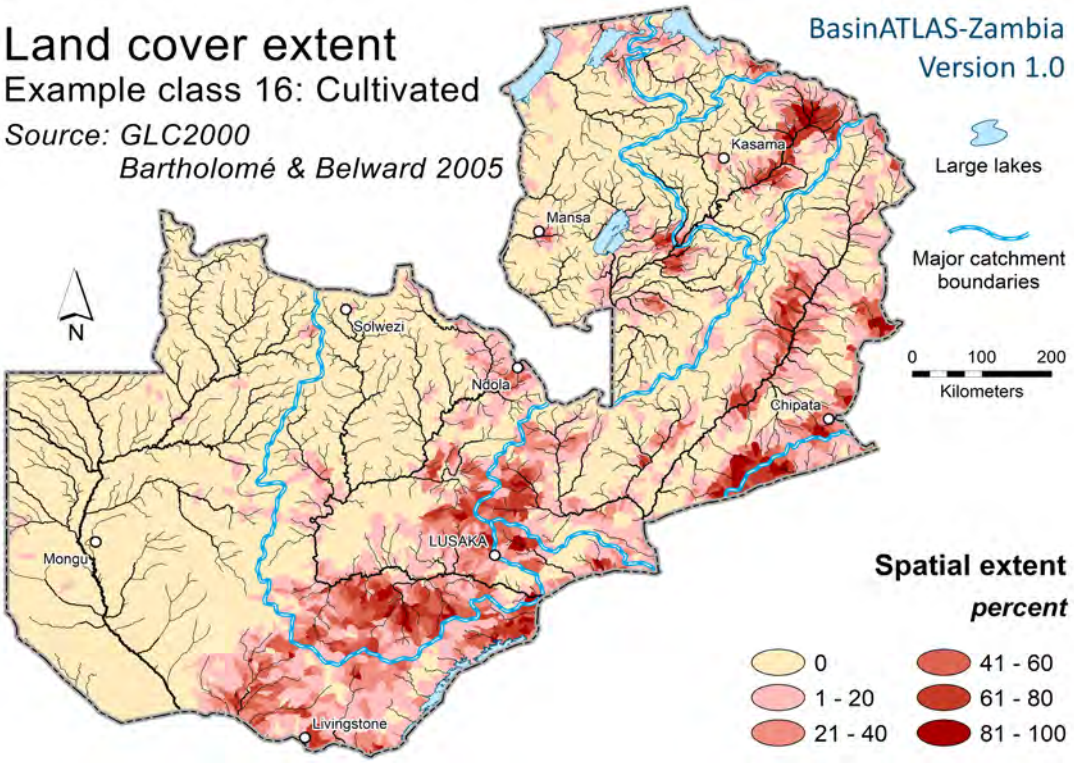
Citation: Bartholomé & Belward 2005 ***Native format:*** 30 arc-second grid ***Units:*** percent cover

Column name **glc_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {01-22} spatial extent (%) by class

Existing suffixes {xoo}: s01-s22 | u01-u22



Data description The GLC2000 (Global Land Cover in the year 2000) database distinguishes 22 land cover classes and was produced by an international partnership of 30 research groups coordinated by the European Commission's Joint Research Centre. Land cover maps were based on daily data from the SPOT vegetation sensor (VEGA 2000 dataset: a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite) and other Earth observing sensors. The general objective was to provide a harmonized land cover database over the whole globe for the year 2000. The year 2000 is considered as a reference year for environmental assessment in relation to various activities, in particular the United Nation's Ecosystem-related International Conventions.

Reference Bartholomé, E., Belward, A.S. (2005). GLC2000: a new approach to global land cover mapping from Earth observation data. International Journal of Remote Sensing, 26(9), 1959-1977.

Website https://forobs.jrc.ec.europa.eu/products/glc2000/glc2000.php

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Additional information For class names see file HydroATLAS_v10_Legends.xlsx. All forest classes combined (1-8) are also available as an additional attribute of Forest Cover Extent (see L07).

Category	Landcover	ID-L07	***>>> Back to Attribute List***

Attribute Forest Cover Extent

Source data GLC2000

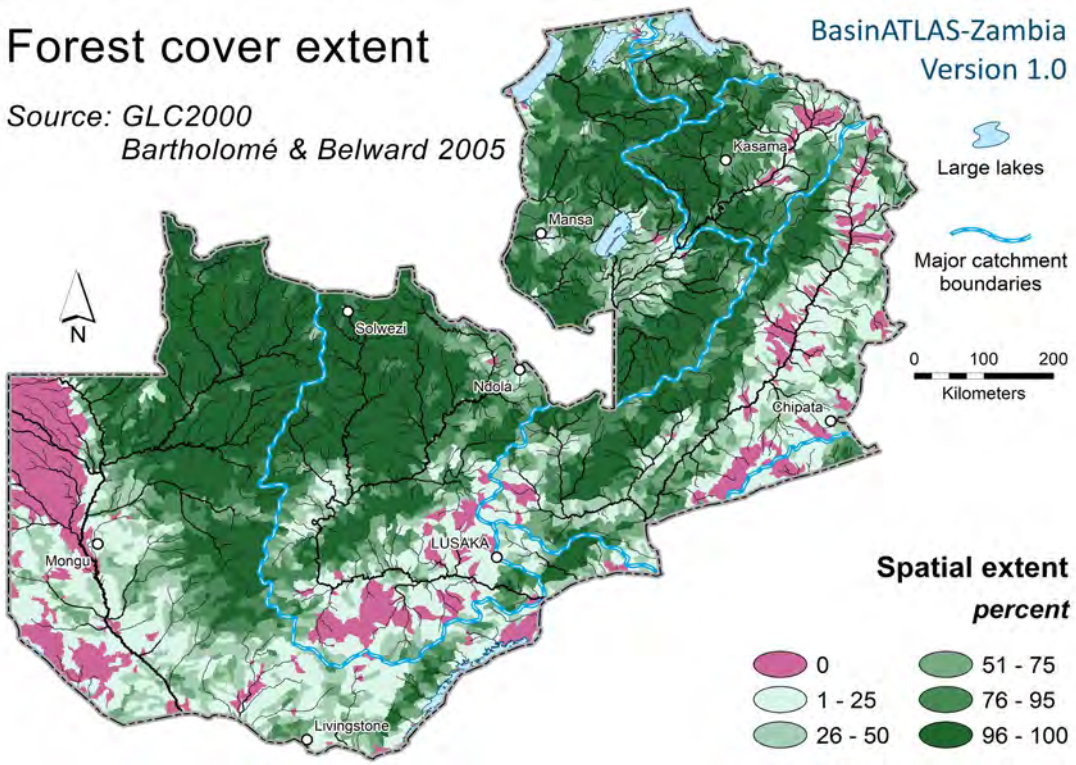
Citation: Bartholomé & Belward 2005 ***Native format:*** 30 arc-second grid ***Units:*** percent cover

Column name **for_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description Forest cover was taken from the GLC2000 land cover map (see L01) by combining classes 1 to 8. GLC2000 was produced by an international partnership of 30 research groups coordinated by the European Commission's Joint Research Centre. Land cover maps were based on daily data from the SPOT vegetation sensor (VEGA 2000 dataset: a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite) and other Earth observing sensors. The general objective was to provide a harmonized land cover database over the whole globe for the year 2000. The year 2000 is considered as a reference year for environmental assessment in relation to various activities, in particular the United Nation's Ecosystem-related International Conventions.

Reference Bartholomé, E., Belward, A.S. (2005). GLC2000: a new approach to global land cover mapping from Earth observation data. International Journal of Remote Sensing, 26(9), 1959-1977.

Website https://forobs.jrc.ec.europa.eu/products/glc2000/glc2000.php

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Additional information None

Category	Landcover	ID-L08	***>>> Back to Attribute List***

Attribute Cropland Extent

Source data EarthStat

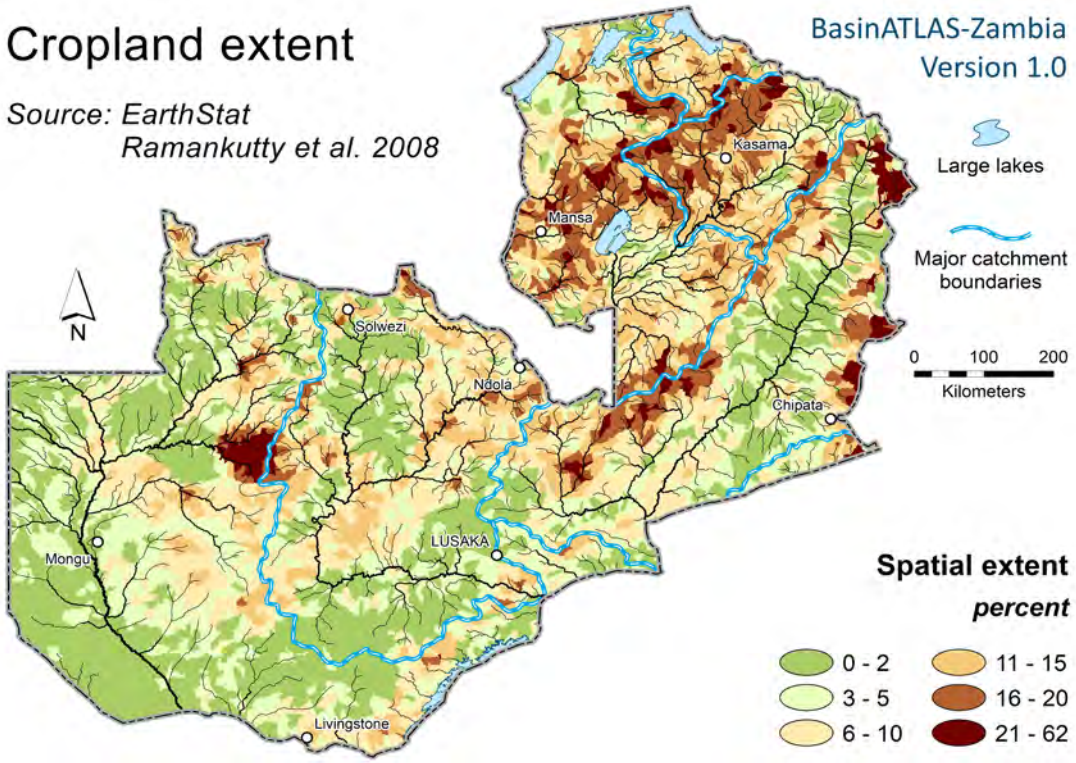
Citation: Ramankutty et al. 2008 ***Native format:*** 5 arc-min grid ***Units:*** percent cover

Column name **crp_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description EarthStat provides a global data set of croplands and pastures circa 2000 by combining agricultural inventory data and satellite-derived land cover data. The agricultural inventory data was used to train a land cover classification dataset obtained by merging two different satellite-derived products (Boston University's MODIS-derived land cover product and the GLC2000 data set). According to EarthStat data, there were 15 million km2 of cropland (12% of the Earth's ice-free land surface) and 28 million km2 of pasture (22%) in the year 2000.

Reference Ramankutty, N., Evan, A.T., Monfreda, C., Foley, J.A. (2008). Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycles, 22(1), 1-19.

Website http://www.earthstat.org/cropland-pasture-area-2000/

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Additional information None

Category	Landcover	ID-L09	***>>> Back to Attribute List***

Attribute Pasture Extent

Source data EarthStat

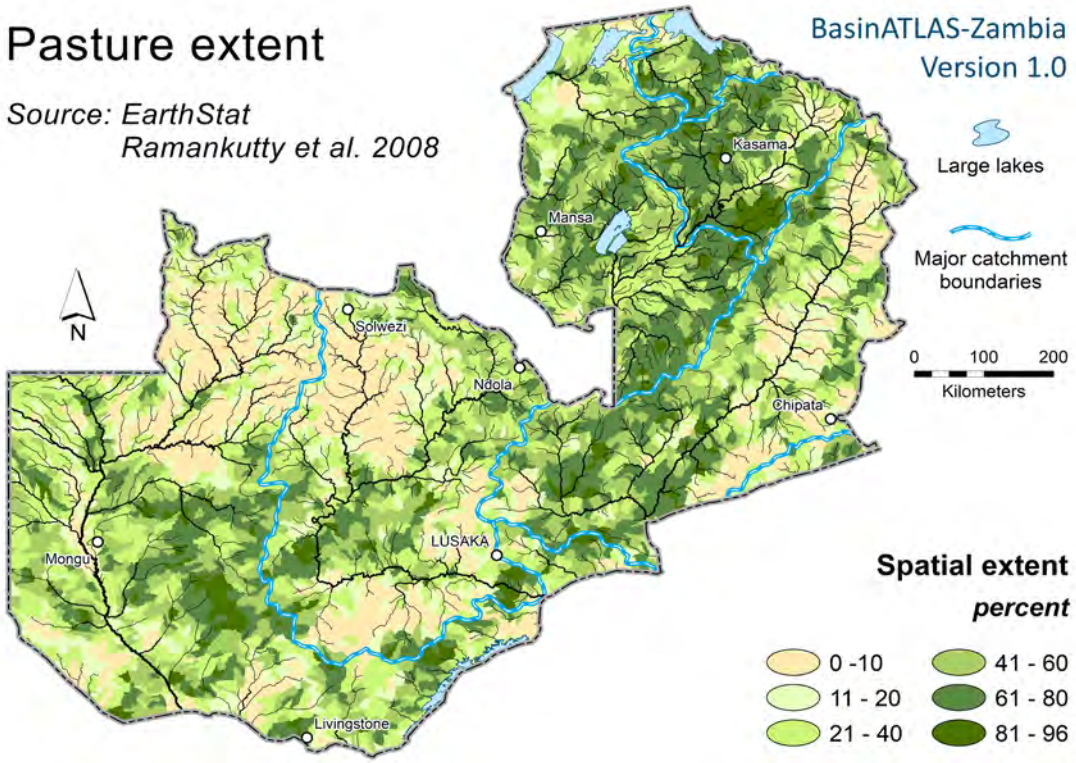
Citation: Ramankutty et al. 2008 ***Native format:*** 5 arc-min grid ***Units:*** percent cover

Column name **pst_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description EarthStat provides a global data set of croplands and pastures circa 2000 by combining agricultural inventory data and satellite-derived land cover data. The agricultural inventory data was used to train a land cover classification dataset obtained by merging two different satellite-derived products (Boston University's MODIS-derived land cover product and the GLC2000 data set). According to EarthStat data, there were 15 million km2 of cropland (12% of the Earth's ice-free land surface) and 28 million km2 of pasture (22%) in the year 2000.

Reference Ramankutty, N., Evan, A.T., Monfreda, C., Foley, J.A. (2008). Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycles, 22(1), 1-19.

Website http://www.earthstat.org/cropland-pasture-area-2000/

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Additional information None

Category	Landcover	ID-L10	***>>> Back to Attribute List***

Attribute Irrigated Area Extent (Equipped)

Source data Historical Irrigation Dataset (HID) v1.0

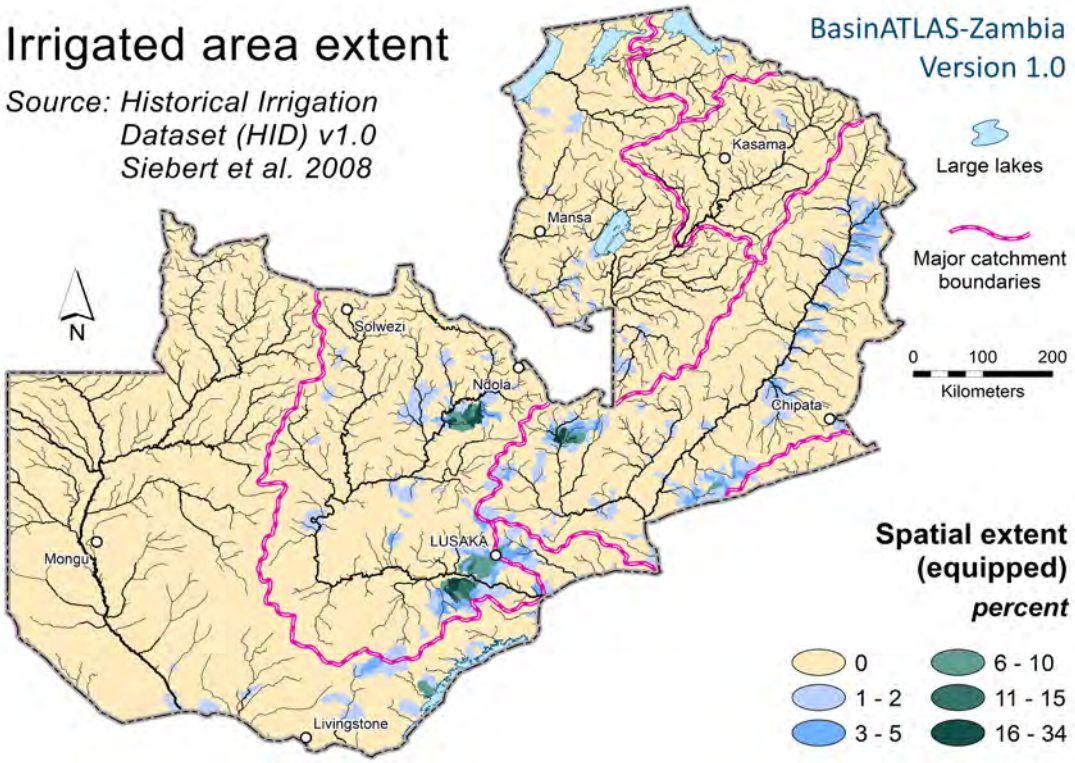
Citation: Siebert et al. 2015 ***Native format:*** 5 arc-min grid ***Units:*** percent cover

Column name **ire_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description The HID (Historical Irrigation Dataset) depicts the extent of area equipped for irrigation (AEI) for 1900 to 2005 in 5 arc-minute resolution. The authors collected subnational irrigation statistics for this period from various sources and found that the global extent of AEI increased from 63 million ha (Mha) in 1900 to 111 Mha in 1950 and 306 Mha in 2005. They developed eight gridded versions of time series of AEI by combining subnational irrigation statistics with different data sets on the historical extent of cropland and pasture. Different rules were applied to maximize consistency of the gridded products to subnational irrigation statistics or to historical cropland and pasture data sets. HydroATLAS includes results for the year 2005.

Reference Siebert, S., Kummu, M., Porkka, M., Döll, P., Ramankutty, N., Scanlon, B.R. (2015). A global data set of the extent of irrigated land from 1900 to 2005. Hydrology and Earth System Science, 19, 1521-1545. doi:10.5194/hess-19-1521-2015

Website https://doi.org/10.13019/M20599

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Additional information HydroATLAS uses the AEI_EARTHSTAT_IR_2005 version of available HID grids which maximizes consistency with subnational irrigation statistics (based on discussions in Siebert et al. 2015).

Category	Landcover	ID-L13	***>>> Back to Attribute List***

Attribute Protected Area Extent

Source data World Database on Protected Areas (WDPA)

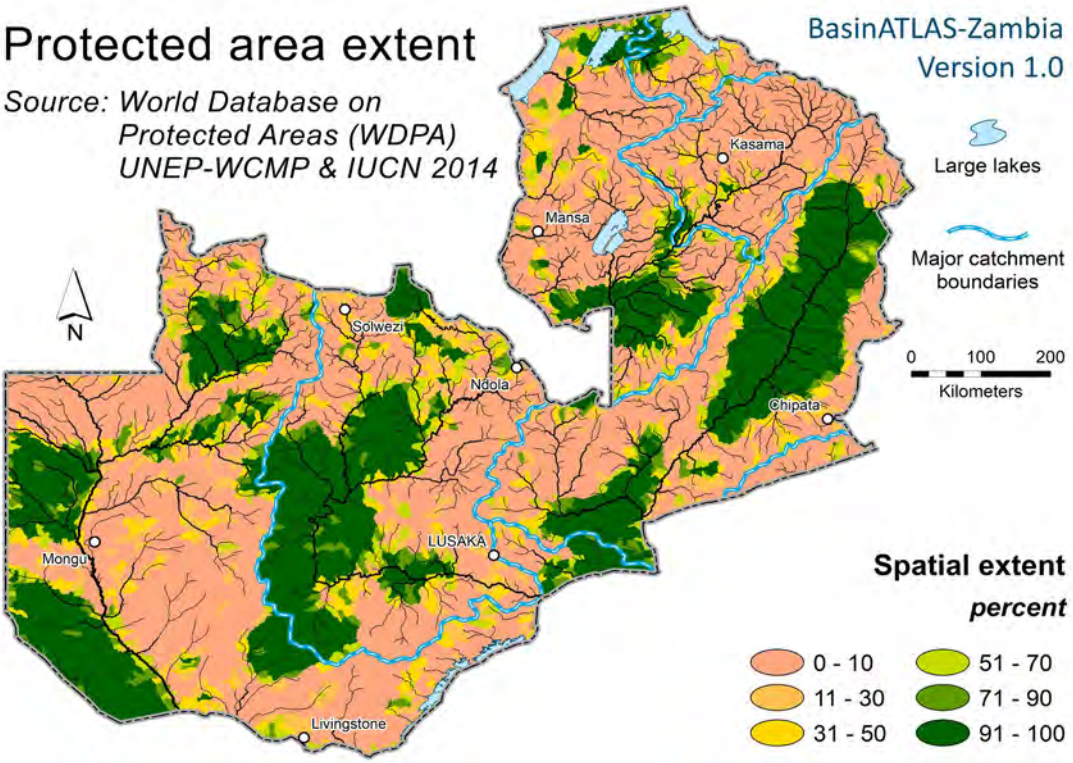
Citation: IUCN & UNEP-WCMC 2014 ***Native format:*** Polygons & points ***Units:*** percent cover

Column name **pac_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description The World Database on Protected Areas (WDPA) is the most comprehensive global database of marine and terrestrial protected areas. It is a joint effort between IUCN and UNEP, managed by UNEP-WCMC, to compile protected area information for all countries in the world from governments and other authoritative organizations. HydroATLAS includes all nationally designated PAs (DESIG TYPE = “national”; STATUS = “designated”) of all IUCN categories (IUCN CAT = “I-VI,” “not reported,” or “not assigned”) from the October 2014 version of WDPA (160,000 polygons representing 19.2 million km2). In cases where PA sites were only given as point data (17,000 points representing 1.1 million km2), their spatial extent was approximated as a circle with a size representing the reported area.

Reference UNEP-WCMC and IUCN (UN Environment World Conservation Monitoring Centre and International Union for Conservation of Nature) (2014). The World Database on Protected Areas (WDPA). UNEP-WCMC and IUCN, Cambridge, UK. Available at: www.protectedplanet.net.

Website https://www.protectedplanet.net/

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Additional information The World Database on Protected Areas (WDPA) is updated on a regular basis and the latest version is available at https://www.protectedplanet.net/.

Category	Landcover	ID-L14	***>>> Back to Attribute List***

Attribute Terrestrial Biomes

Source data Terrestrial Ecoregions of the World (TEOW)

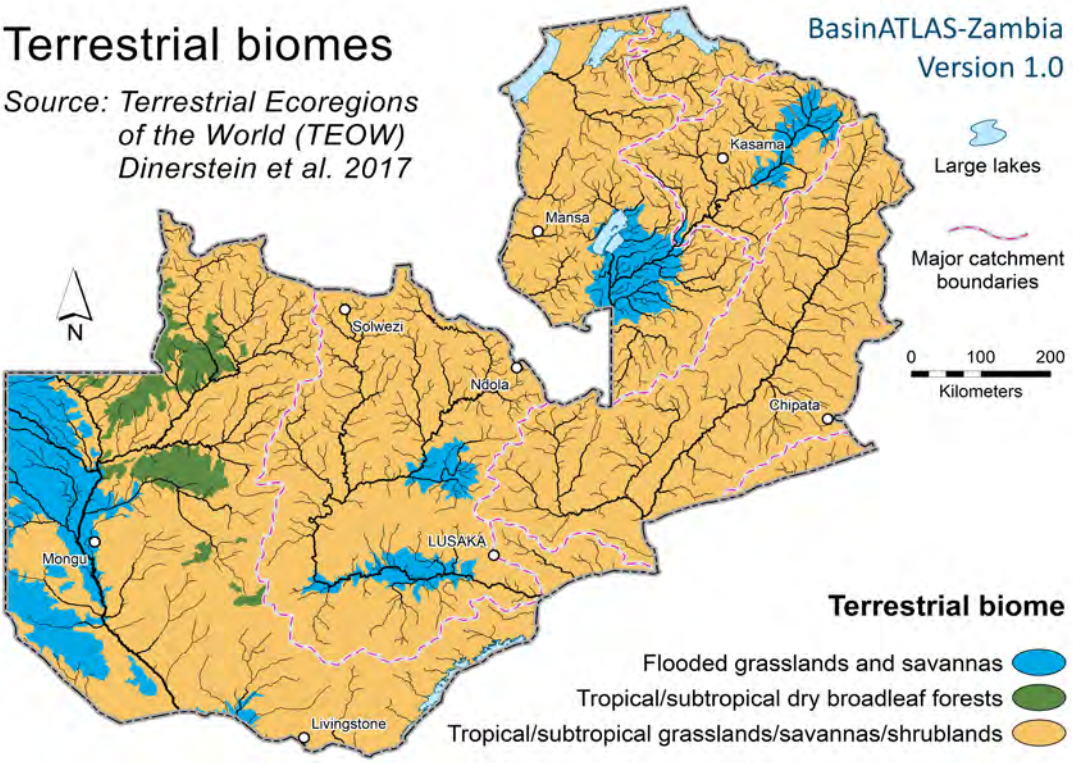
Citation: Dinerstein et al. 2017 ***Native format:*** Polygons ***Units:*** classes (14)

Column name **tbi_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description Terrestrial Ecoregions of the World (TEOW) is a biogeographic regionalization that defines ecoregions and biomes as relatively large units of land or water containing a distinct assemblage of natural communities sharing a large majority of species, dynamics, and environmental conditions of the Earth's terrestrial biodiversity. Globally, there are 846 distinct terrestrial ecoregions, classified into 14 different biomes such as forests, grasslands, or deserts. Note that this version included in HydroATLAS is an updated version from the original TEOW database (Olson et al. 2001).

Reference Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N. D., Wikramanayake, E., ... & Hansen, M. (2017). An ecoregion-based approach to protecting half the terrestrial realm. BioScience, 67(6), 534-545. doi:10.1093/biosci/bix014

Website https://ecoregions2017.appspot.com/

License Creative Commons CC-BY 4.0

Additional information For legend see file HydroATLAS_v10_Legends.xlsx. This is an updated version of the original TEOW map: Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V.N., Underwood, E.C., ... & Kassem, K.R. (2001). Terrestrial ecoregions of the world: a new map of life on Earth. BioScience, 51(11), 933-938. Note that 'noData' areas on original map, including some large lakes, were allocated to the nearest biome or ecoregion.

Category	Landcover	ID-L15	***>>> Back to Attribute List***

Attribute Terrestrial Ecoregions

Source data Terrestrial Ecoregions of the World (TEOW)

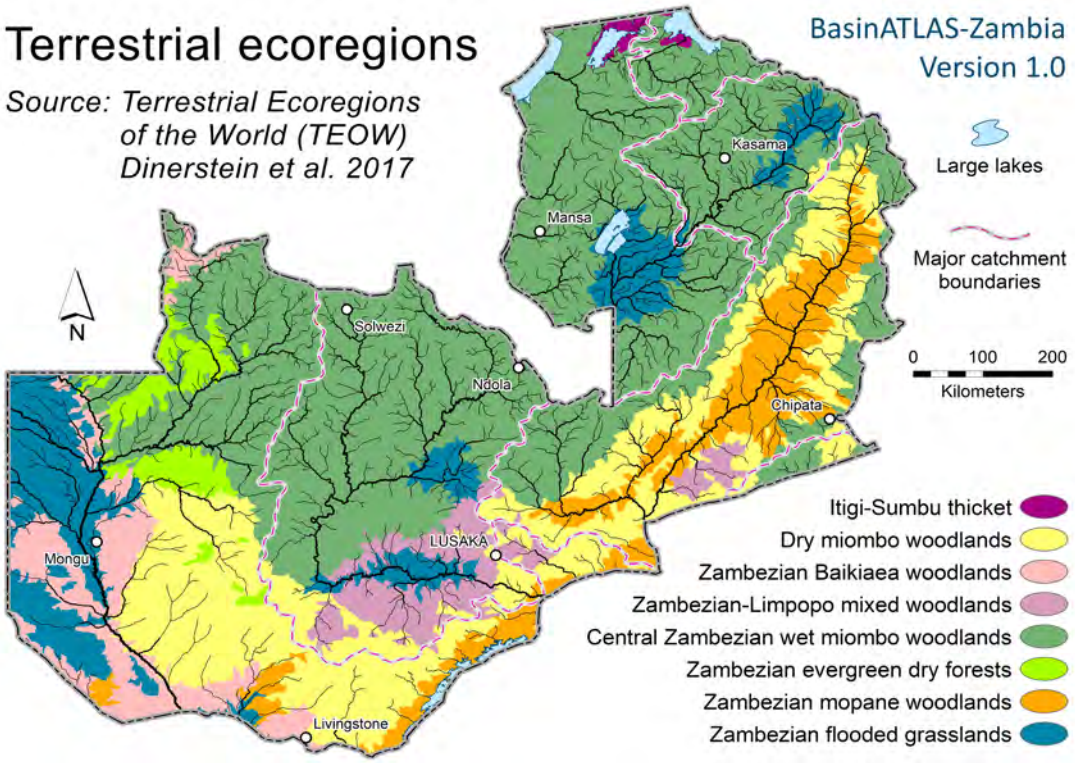
Citation: Dinerstein et al. 2017 ***Native format:*** Polygons ***Units:*** classes (846)

Column name **tec_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description Terrestrial Ecoregions of the World (TEOW) is a biogeographic regionalization that defines ecoregions and biomes as relatively large units of land or water containing a distinct assemblage of natural communities sharing a large majority of species, dynamics, and environmental conditions of the Earth's terrestrial biodiversity. Globally, there are 846 distinct terrestrial ecoregions, classified into 14 different biomes such as forests, grasslands, or deserts. Note that this version included in HydroATLAS is an updated version from the original TEOW database (Olson et al. 2001).

Reference Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N. D., Wikramanayake, E., ... & Hansen, M. (2017). An ecoregion-based approach to protecting half the terrestrial realm. BioScience, 67(6), 534-545. doi:10.1093/biosci/bix014

Website https://ecoregions2017.appspot.com/

License Creative Commons CC-BY 4.0

Additional information For legend see file HydroATLAS_v10_Legends.xlsx. This is an updated version of the original TEOW map: Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V.N., Underwood, E.C., ... & Kassem, K.R. (2001). Terrestrial ecoregions of the world: a new map of life on Earth. BioScience, 51(11), 933-938. Note that 'noData' areas on original map, including some large lakes, were allocated to the nearest biome or ecoregion.

Category	Landcover	ID-L16	***>>> Back to Attribute List***

Attribute Freshwater Major Habitat Types

Source data Freshwater Ecoregions of the World (FEOW)

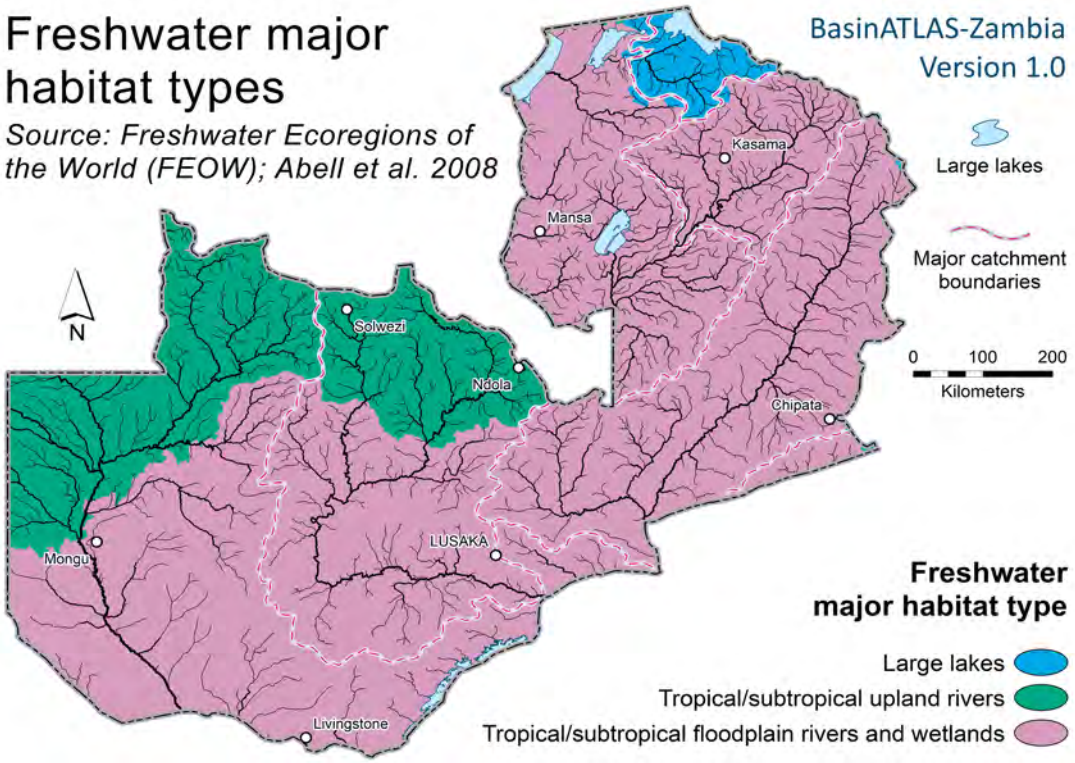
Citation: Abell et al. 2008 ***Native format:*** Polygons ***Units:*** classes (13)

Column name **fmh_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description

The Freshwater Ecoregion of the World (FEOW) dataset by World Wildlife Fund (WWF) and The Nature Conservancy (TNC) contains vector data on the biogeographic regionalization of Earth's freshwater biodiversity based on regional expert knowledge. Biodiversity and threat data were used to distinguish a total of 426 freshwater ecoregions globally which were classified into 13 major habitat types. HydroATLAS uses a slightly updated version with some revised major habitat assignments; this version also includes some additional oceanic islands (which do not represent individual ecoregions and are flagged by ID numbers above 900) bringing the total number of classes to 448.

Reference

Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., … & Wikramanayake, E. (2008). Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation. BioScience, 58(5), 403-414.

Website https://www.feow.org/download

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Additional information

For legend see file HydroATLAS_v10_Legends.xlsx.

Category	Landcover	ID-L17	***>>> Back to Attribute List***

Attribute Freshwater Ecoregions

Source data Freshwater Ecoregions of the World (FEOW)

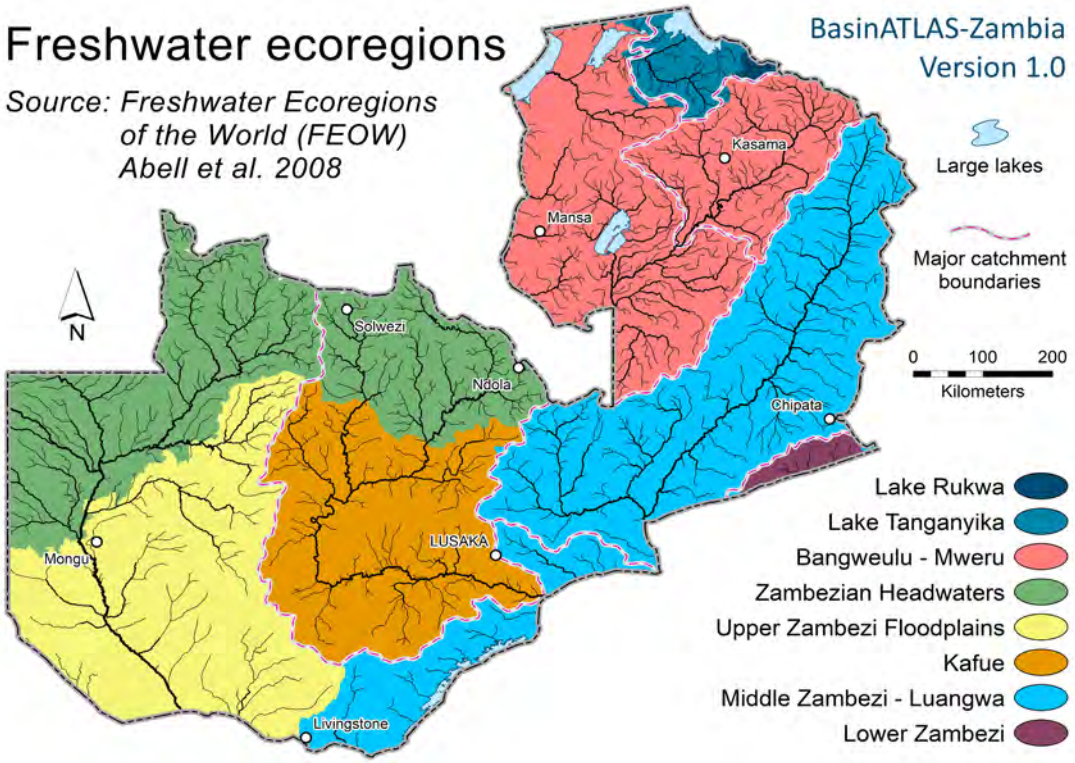
Citation: Abell et al. 2008 ***Native format:*** Polygons ***Units:*** classes (426)

Column name **fec_cl_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {mj} spatial majority

Existing suffixes {xoo}: smj



Data description	The Freshwater Ecoregion of the World (FEOW) dataset by World Wildlife Fund (WWF) and The Nature Conservancy (TNC) contains vector data on the biogeographic regionalization of Earth's freshwater biodiversity based on regional expert knowledge. Biodiversity and threat data were used to distinguish a total of 426 freshwater ecoregions globally which were classified into 13 major habitat types. HydroATLAS uses a slightly updated version with some revised major habitat assignments; this version also includes some additional oceanic islands (which do not represent individual ecoregions and are flagged by ID numbers above 900) bringing the total number of classes to 448.
Reference	Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., … & Wikramanayake, E. (2008). Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation. BioScience, 58(5), 403-414.
Website	https://www.feow.org/download
License	Original: Free for non-commercial use -- HydroATLAS: Creative Commons CC-BY 4.0
Additional information	For legend see file HydroATLAS_v10_Legends.xlsx.

Category	Soils & Geology	ID-S01	***>>> Back to Attribute List***

Attribute Clay Fraction in Soil

Source data SoilGrids1km

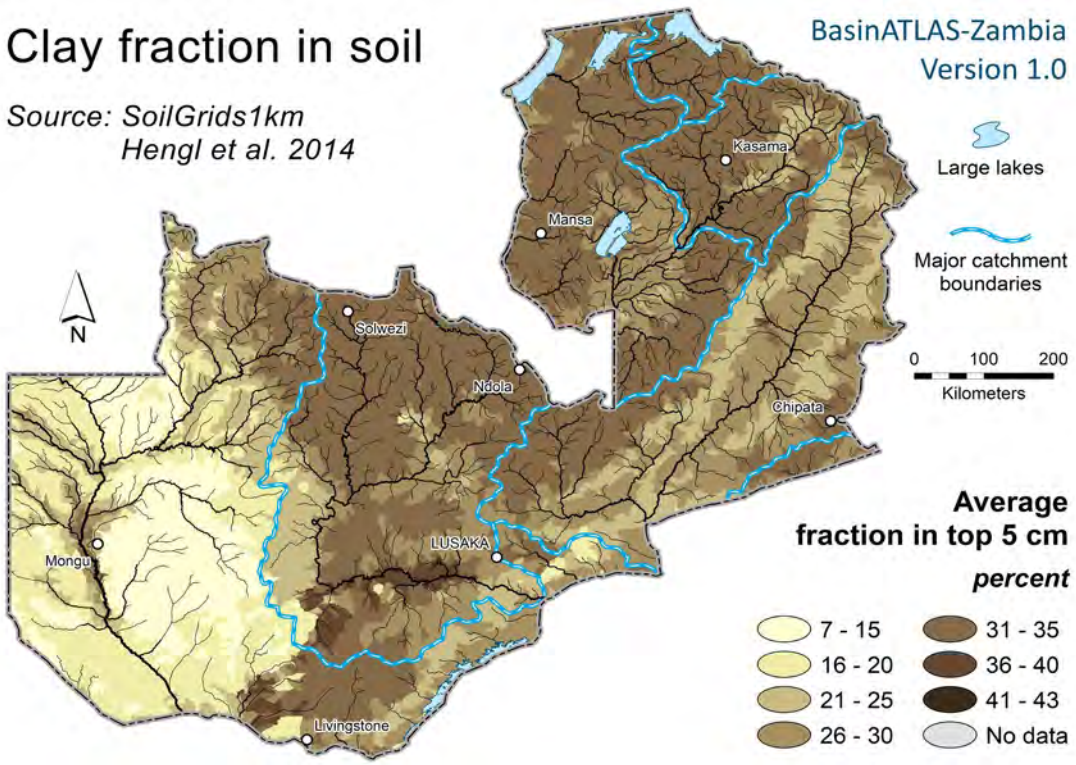
Citation: Hengl et al. 2014 ***Native format:*** 30 arc-second grid ***Units:*** percent

Column name **cly_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description SoilGrids1km contains spatial predictions for a selection of soil properties (at six standard depths) including sand, silt and clay fractions as well as soil organic carbon stocks. Predictions are based on global spatial prediction models which were fitted, per soil variable, using a compilation of major international soil profile databases (~110,000 soil profiles), and a selection of ~75 global environmental covariates representing soil forming factors. HydroATLAS provides data for the 0-5 cm top soil layer.

Reference Hengl, T., de Jesus, J.M., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J., Walsh, M., Gonzalez, M.R. (2014). SoilGrids1km—global soil information based on automated mapping. PLoS ONE, 9(8), e105992. doi:10.1371/journal.pone.0105992

Website http://isric.org/explore/soilgrids

License Open Data Commons Open Database License (ODbL v1.0)

Additional information Original grid contains NoData pixels (mostly in deserts and within open water surfaces such as lakes) which were excluded from average calculations. Value -9999 indicates that there is no data for the entire spatial unit.

Category	Soils & Geology	ID-S02	***>>> Back to Attribute List***

Attribute Silt Fraction in Soil

Source data SoilGrids1km

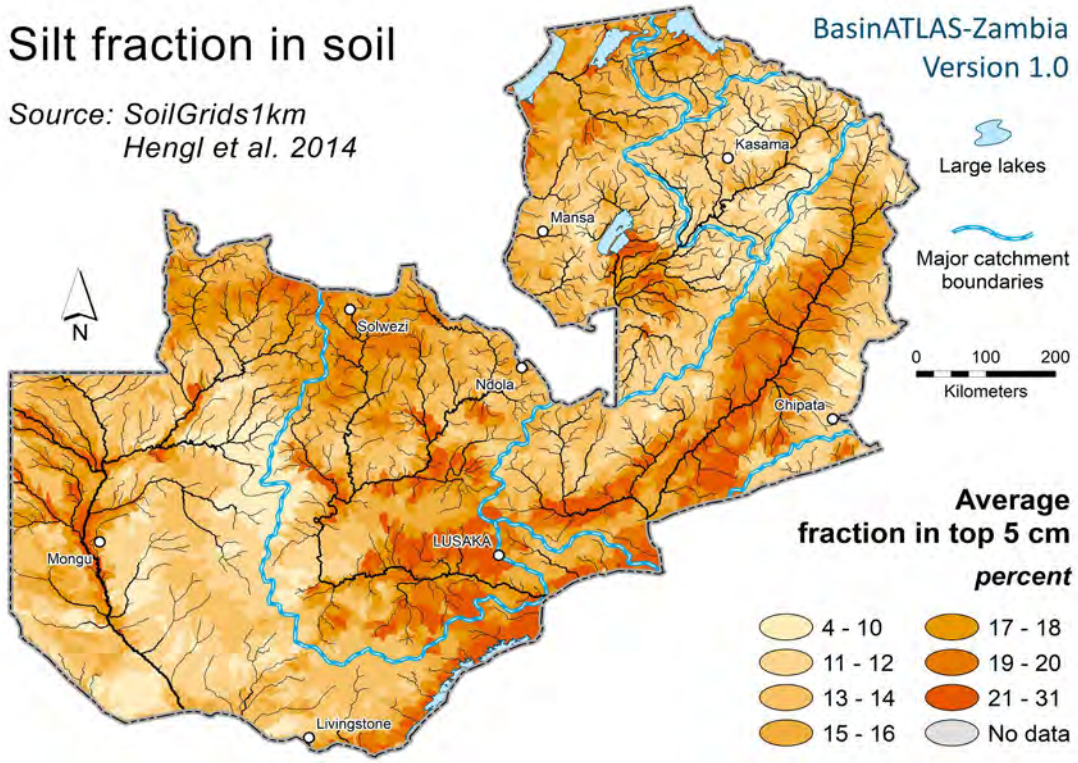
Citation: Hengl et al. 2014 ***Native format:*** 30 arc-second grid ***Units:*** percent

Column name **slt_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description SoilGrids1km contains spatial predictions for a selection of soil properties (at six standard depths) including sand, silt and clay fractions as well as soil organic carbon stocks. Predictions are based on global spatial prediction models which were fitted, per soil variable, using a compilation of major international soil profile databases (~110,000 soil profiles), and a selection of ~75 global environmental covariates representing soil forming factors. HydroATLAS provides data for the 0-5 cm top soil layer.

Reference Hengl, T., de Jesus, J.M., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J., Walsh, M., Gonzalez, M.R. (2014). SoilGrids1km—global soil information based on automated mapping. PLoS ONE, 9(8), e105992. doi:10.1371/journal.pone.0105992

Website http://isric.org/explore/soilgrids

License Open Data Commons Open Database License (ODbL v1.0)

Additional information Original grid contains NoData pixels (mostly in deserts and within open water surfaces such as lakes) which were excluded from average calculations. Value -9999 indicates that there is no data for the entire spatial unit.

Category	Soils & Geology	ID-S03	***>>> Back to Attribute List***

Attribute Sand Fraction in Soil

Source data SoilGrids1km

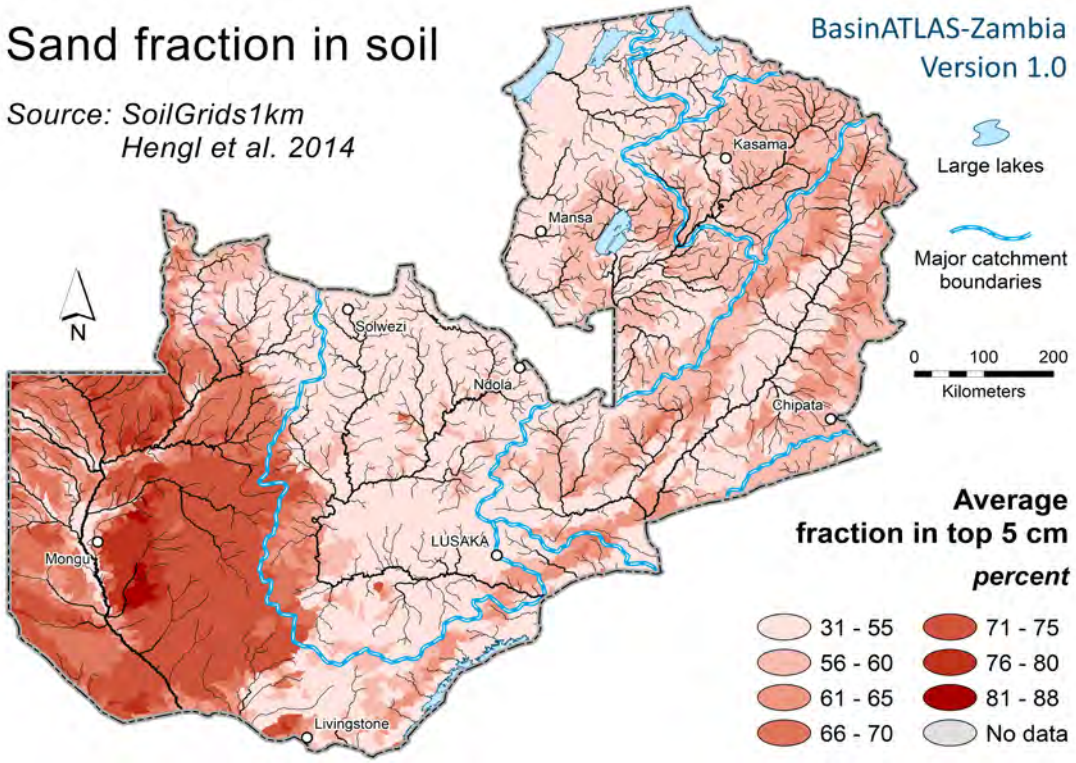
Citation: Hengl et al. 2014 ***Native format:*** 30 arc-second grid ***Units:*** percent

Column name **snd_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description SoilGrids1km contains spatial predictions for a selection of soil properties (at six standard depths) including sand, silt and clay fractions as well as soil organic carbon stocks. Predictions are based on global spatial prediction models which were fitted, per soil variable, using a compilation of major international soil profile databases (~110,000 soil profiles), and a selection of ~75 global environmental covariates representing soil forming factors. HydroATLAS provides data for the 0-5 cm top soil layer.

Reference Hengl, T., de Jesus, J.M., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J., Walsh, M., Gonzalez, M.R. (2014). SoilGrids1km—global soil information based on automated mapping. PLoS ONE, 9(8), e105992. doi:10.1371/journal.pone.0105992

Website http://isric.org/explore/soilgrids

License Open Data Commons Open Database License (ODbL v1.0)

Additional information Original grid contains NoData pixels (mostly in deserts and within open water surfaces such as lakes) which were excluded from average calculations. Value -9999 indicates that there is no data for the entire spatial unit.

Category	Soils & Geology	ID-S04	***>>> Back to Attribute List***

Attribute Organic Carbon Content in Soil

Source data SoilGrids1km

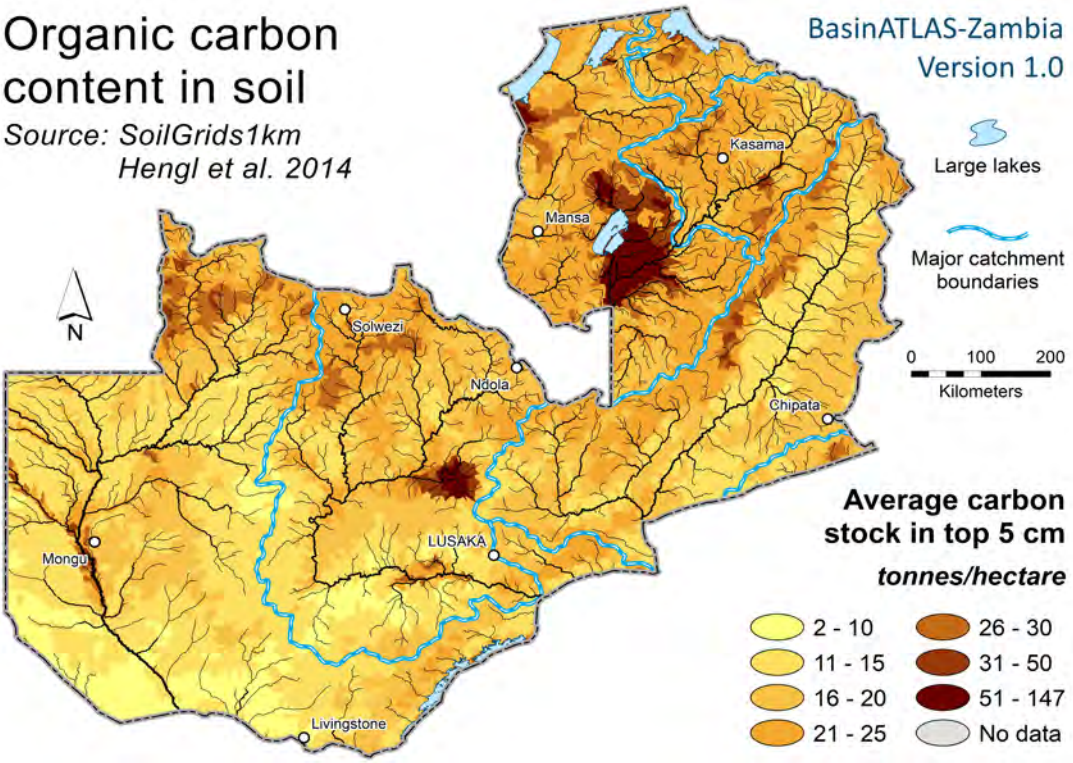
Citation: Hengl et al. 2014 ***Native format:*** 30 arc-second grid ***Units:*** tonnes/hectare

Column name **soc_th_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description SoilGrids1km contains spatial predictions for a selection of soil properties (at six standard depths) including sand, silt and clay fractions as well as soil organic carbon stocks. Predictions are based on global spatial prediction models which were fitted, per soil variable, using a compilation of major international soil profile databases (~110,000 soil profiles), and a selection of ~75 global environmental covariates representing soil forming factors. HydroATLAS provides data for the 0-5 cm top soil layer.

Reference Hengl, T., de Jesus, J.M., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J., Walsh, M., Gonzalez, M.R. (2014). SoilGrids1km—global soil information based on automated mapping. PLoS ONE, 9(8), e105992. doi:10.1371/journal.pone.0105992

Website http://isric.org/explore/soilgrids

License Open Data Commons Open Database License (ODbL v1.0)

Additional information Original grid contains NoData pixels (mostly in deserts and within open water surfaces such as lakes) which were excluded from average calculations. Value -9999 indicates that there is no data for the entire spatial unit.

Category	Soils & Geology	ID-S05	***>>> Back to Attribute List***

Attribute Soil Water Content

Source data Global High-Resolution Soil-Water Balance

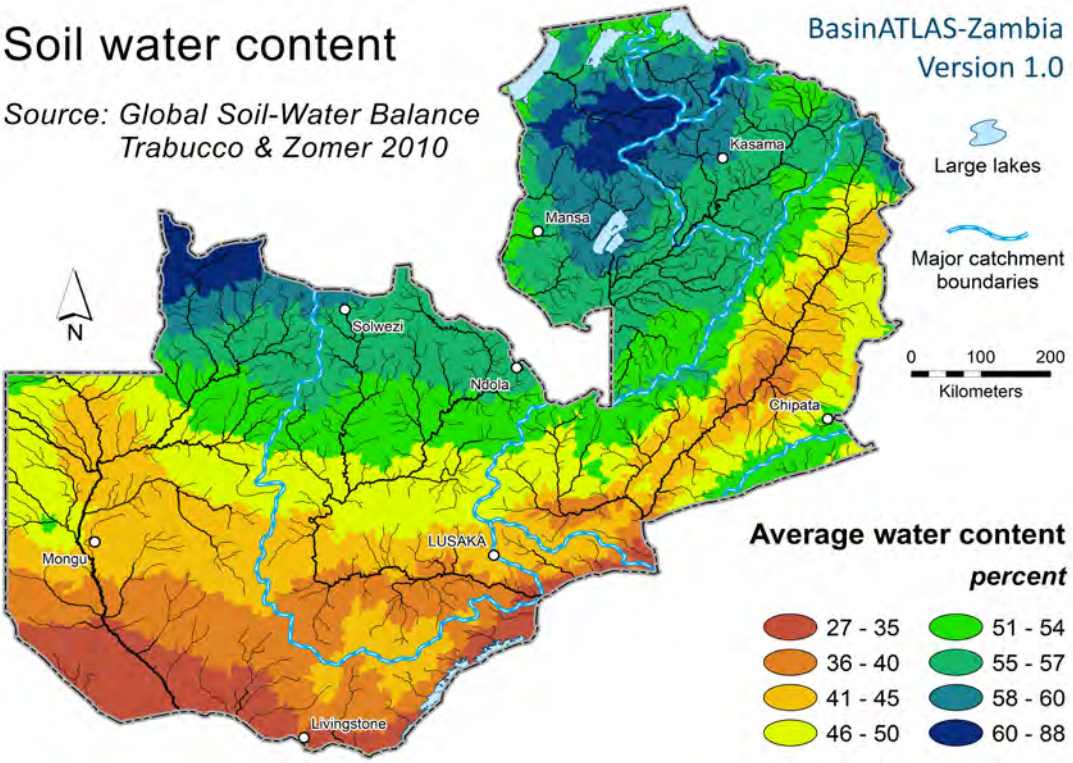
Citation: Trabucco & Zomer 2010 ***Native format:*** 30 arc-second grid ***Units:*** percent

Column name **swc_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {yr} annual average | {01-12} monthly average

Existing suffixes {xoo}: syr | s01-s12 | uyr



Data description Soil water content is provided as part of the Global High-Resolution Soil-Water Balance dataset which contains gridded estimates of actual evapotranspiration and soil water deficit. The dataset defines the monthly fraction of soil water content available for evapotranspiration processes (as a percentage of the maximum soil water content). It is therefore a measure of soil stress, and equal to the soil water stress coefficient as a percentage. This dataset utilizes the WorldClim and Global-PET databases as primary input. The results highlight specifically the climatic influence on hydrological dimensions that regulate vegetation suitability.

Reference Trabucco, A., Zomer, R.J. (2010). Global soil water balance geospatial database. CGIAR Consortium for Spatial Information. Available from the CGIAR-CSI GeoPortal at https://cgiarcsi.community.

Website https://cgiarcsi.community/data/global-high-resolution-soil-water-balance

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Additional information None

Category	Soils & Geology	ID-S07	***>>> Back to Attribute List***

Attribute Karst Area Extent

Source data World Map of Carbonate Rock Outcrops v3.0

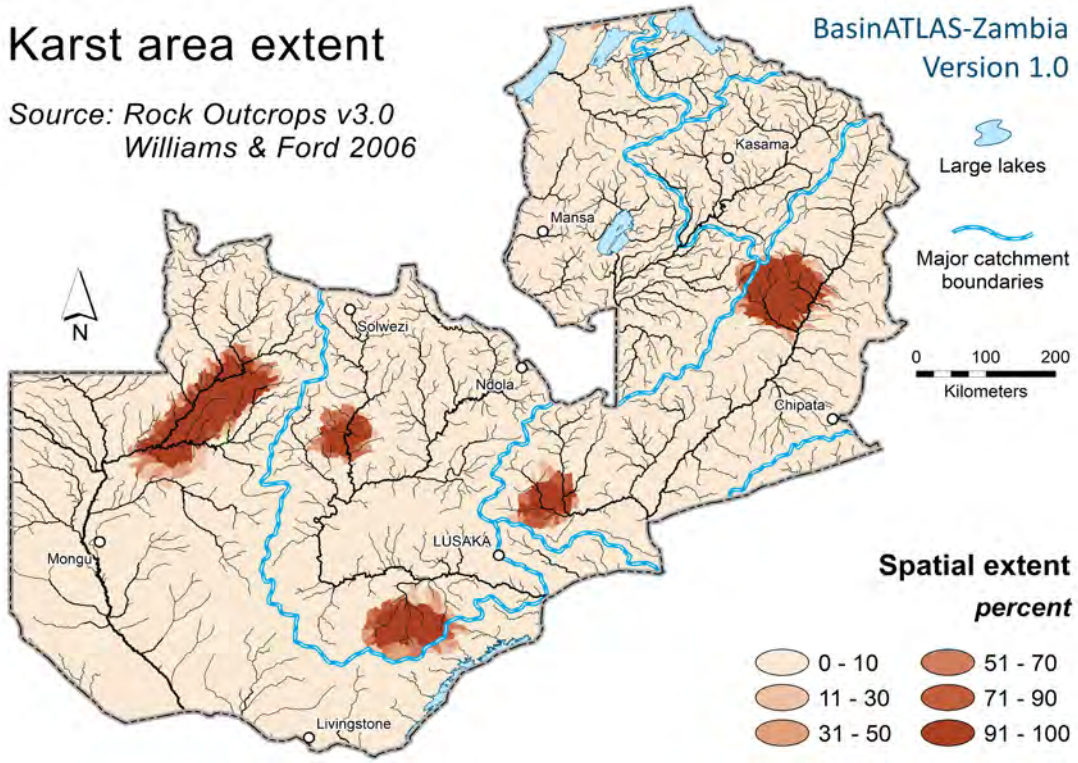
Citation: Williams & Ford 2006 ***Native format:*** Polygons ***Units:*** percent cover

Column name **kar_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse | use



Data description The World Map of Carbonate Rock Outcrops represents an upper limit of the area of exposed karst terrain. Extensive karstified carbonate rock also exists in subcrop, but is not mapped in this product. Version 3.0 of the dataset attempts to differentiate those areas where carbonate rocks are relatively pure and continuous from those where they are abundant but discontinuous or impure. The map was assembled using a multitude of sources within a GIS environment.

Reference Williams, P.W., Ford, D.C. (2006). Global distribution of carbonate rocks. Zeitschrift für Geomorphologie, Supplementary Issue, 147, 1-2.

Website http://www.fos.auckland.ac.nz/our_research/karst/

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Additional information Alternative reference: Ford D., Williams P. (2007). Karst Hydrogeology and Geomorphology. 2nd ed. West Sussex, England: John Wiley & Sons Ltd.

Category	Soils & Geology	ID-S08	***>>> Back to Attribute List***

Attribute Soil Erosion

Source data RUSLE-based Global Soil Erosion Modelling platform (GloSEM) v1.2

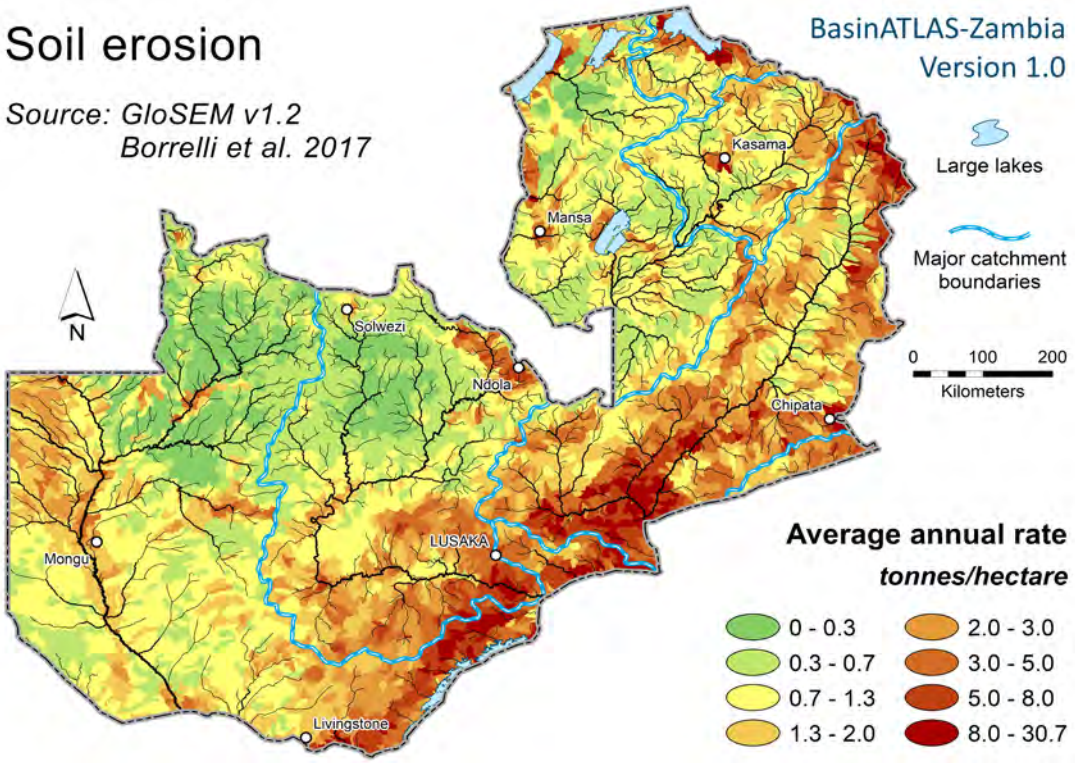
Citation: Borrelli et al. 2017 ***Native format:*** 250-m grid ***Units:*** kg/hectare per year

Column name **ero_kh_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description GloSEM erosion estimates were produced with a high resolution (250 × 250 m) global potential soil erosion model, using a combination of remote sensing, GIS modelling and census data. The long-term annual soil erosion rates were estimated using an improved large-scale version of the Revised Universal Soil Loss Equation (RUSLE) model. RUSLE belongs to the so-called detachment-limited model types where the soil erosion (expressed as a mass of soil lost per unit area and time) due to inter-rill and rill erosion processes is given by the multiplication of six contributing factors. Consistent with the predictive capacity of the model, soil displacement due to processes such as gullying and tillage erosion is not estimated.

Reference Borrelli, P., Robinson, D.A., Fleischer, L.R., Lugato, E., Ballabio, C., Alewell, C., Meusburger, K., Modugno, S., Schütt, B., Ferro, V., Bagarello, V., Van Oost, K., Montanarella, L., Panagos, P. (2017). An assessment of the global impact of 21st century land use change on soil erosion. Nature Communication, 8, 2013.

Website https://doi.org/10.1038/s41467-017-02142-7

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Additional information GloSEM was developed for the reference years 2001 and 2012 to assess the 21st century human-induced soil erosion by water erosion at a global scale. HydroATLAS provides data for the year 2012. Original GloSEM erosion grid contains NoData pixels (mostly in deserts and within open water surfaces such as lakes) which were set to zero for HydroATLAS calculations.

Category	Anthropogenic	ID-A01	***>>> Back to Attribute List***

Attribute Population Count

Source data Gridded Population of the World (GPW) v4

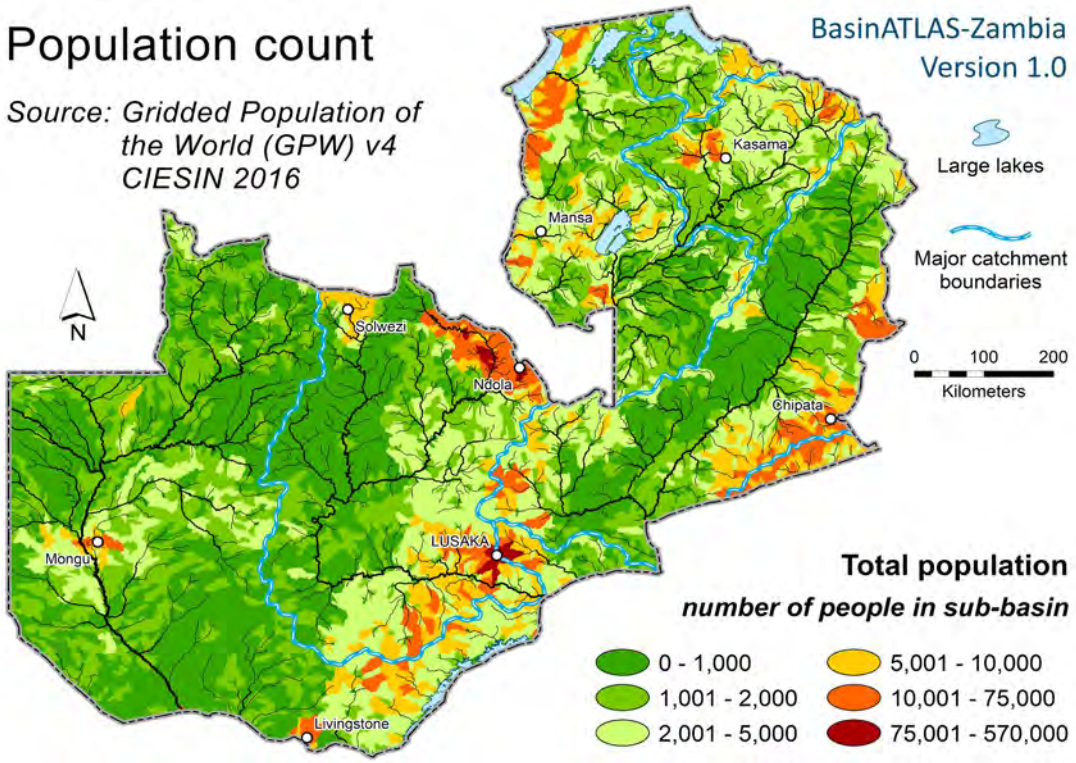
Citation: CIESIN 2016 ***Native format:*** 30 arc-second grid ***Units:*** count (thousands)

Column name **pop_ct_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {su} sum

Existing suffixes {xoo}: ssu | usu



Data description The Gridded Population of the World (GPW) database provides the distribution of humans (counts and densities) on a continuous global surface. For version 4 of GPW, population input data were collected at the most detailed spatial resolution available from the results of the 2010 round of censuses, which occurred between 2005 and 2014. The input data were available for the years 2000, 2005, 2010, and were extrapolated to produce population estimates for 2015, and 2020. HydroATLAS provides data for the year 2010.

Reference CIESIN (Center for International Earth Science Information Network at Columbia University) (2016). Gridded Population of the World, Version 4 (GPWv4): Population Count. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4X63JVC. Accessed 23 May 2017.

Website https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-count-rev11

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Additional information People count is stored in thousands of people. Original grid contains NoData pixels which were set to zero for HydroATLAS calculations (i.e. no population). To avoid underestimation along the global coastline due to misalignment of landmasks, any population numbers that were located outside of the HydroATLAS landmask were allocated to the nearest land pixel (within a maximum distance of 20 km).

Category	Anthropogenic	ID-A02	***>>> Back to Attribute List***

Attribute Population Density

Source data Gridded Population of the World (GPW) v4

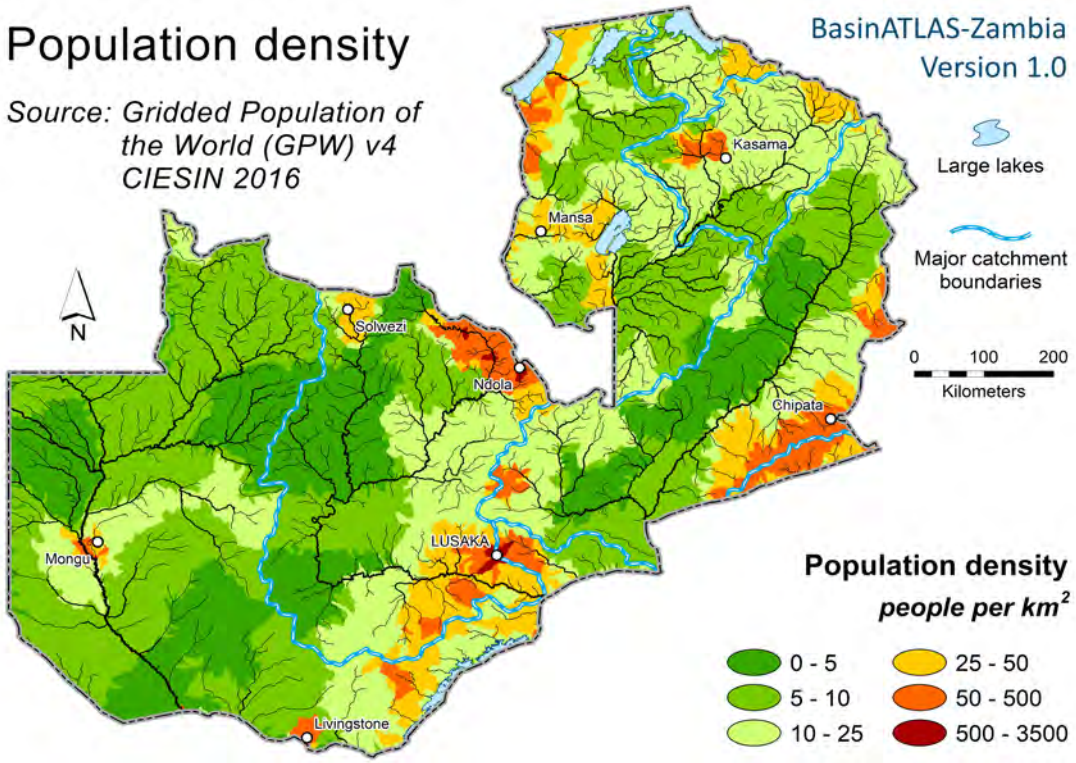
Citation: CIESIN 2016 ***Native format:*** 30 arc-second grid ***Units:*** people per km²

Column name **ppd_pk_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description The Gridded Population of the World (GPW) database provides the distribution of humans (counts and densities) on a continuous global surface. For version 4 of GPW, population input data were collected at the most detailed spatial resolution available from the results of the 2010 round of censuses, which occurred between 2005 and 2014. The input data were available for the years 2000, 2005, 2010, and were extrapolated to produce population estimates for 2015, and 2020. HydroATLAS provides data for the year 2010.

Reference CIESIN (Center for International Earth Science Information Network at Columbia University) (2016). Gridded Population of the World, Version 4 (GPWv4): Population Density. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4X63JVC. Accessed 24 May 2017.

Website https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-density-rev11

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Additional information All 'noData' areas on the original grid were replaced with zero values (i.e. no population). To avoid underestimation along the global coastline due to misalignment of landmasks, any population numbers that were located outside of the HydroATLAS landmask were allocated to the nearest land pixel (within a maximum distance of 20 km).

Category	Anthropogenic	ID-A03	***>>> Back to Attribute List***

Attribute Urban Extent

Source data Global Human Settlement (GHS) Settlement Model v1.0 (2016)

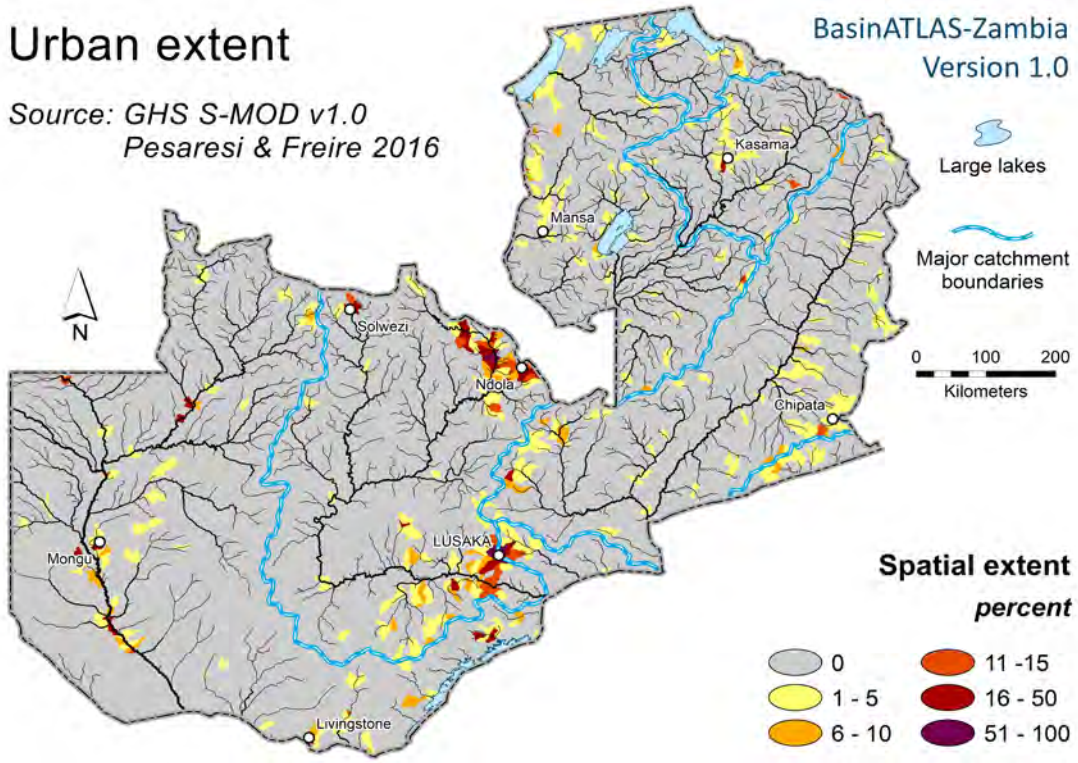
Citation: Pesaresi & Freire 2016 ***Native format:*** 1-km grid ***Units:*** percent cover

Column name **urb_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {c} in reach catchment | {u} in total watershed upstream of reach pour point

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: cse | use



Data description The Global Human Settlement (GHS) framework produces global spatial information about the human presence on the planet over time. This achieved in the form of built-up maps, population density maps and settlement maps. This information is generated with evidence-based analytics and knowledge using new spatial data mining technologies. The framework uses heterogeneous data including global archives of fine-scale satellite imagery, census data, and volunteered geographic information. The data is processed fully automatically and generates analytics and knowledge reporting objectively and systematically about the presence of population and built-up infrastructures.

Reference Pesaresi, M., Freire, S. (2016). GHS Settlement grid following the REGIO model 2014 in application to GHSL Landsat and CIESIN GPW v4-multitemporal (1975-1990-2000-2015). European Commission, Joint Research Centre (JRC). PID: http://data.europa.eu/89h/jrc-ghsl-ghs_smod_pop_globe_r2016a

Website https://ghsl.jrc.ec.europa.eu/

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Additional information HydroATLAS uses the settlement model grid (GHS-SMOD) for the year 2015 (dataset name: GHS_SMOD_POP2015_GLOBE_R2016A_54009_1k). Codes 0 (unpopulated) and 1 (rural areas) were classified as rural; and codes 2 (low density clusters) and 3 (high density clusters) were classified as urban.

Category	Anthropogenic	ID-A04	***>>> Back to Attribute List***

Attribute Nighttime Lights

Source data DMSP-OLS Nighttime Lights v4

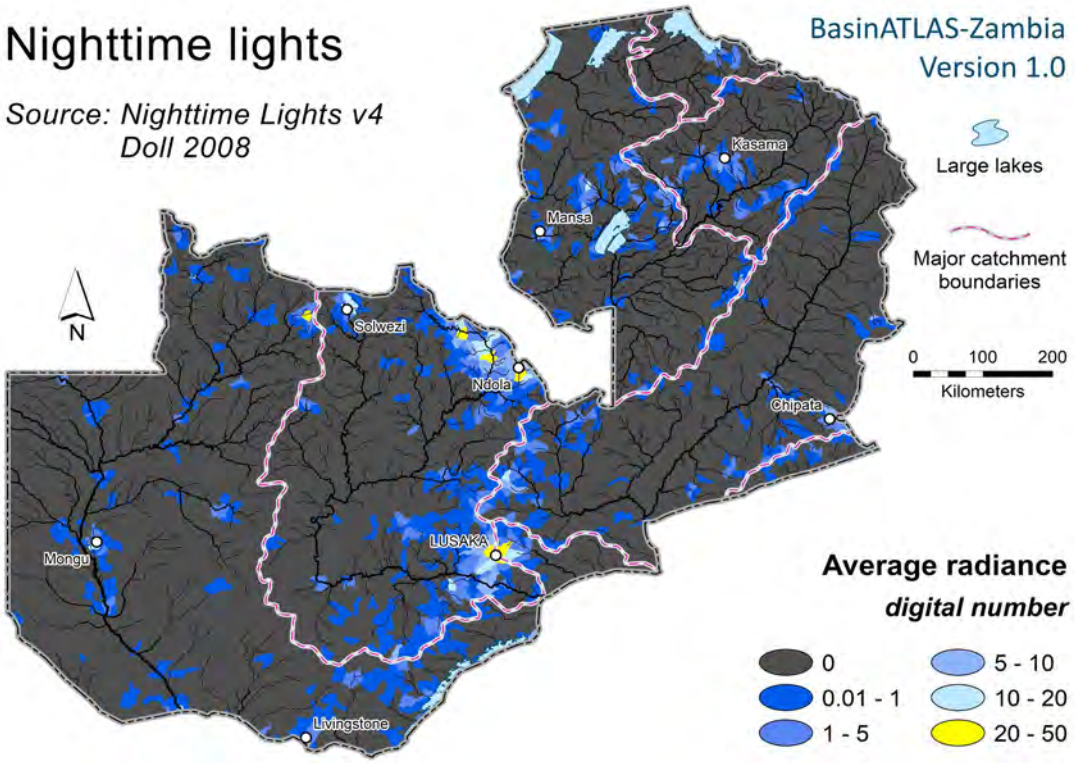
Citation: Doll 2008 ***Native format:*** 30 arc-second grid ***Units:*** index value (x100)

Column name **nli_ix_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {av} average

Existing suffixes {xoo}: sav | uav



Data description The Nighttime Lights dataset represents light visible at night generated by human activity, including settlements, gas flaring, or agricultural fires. The data was produced using cloud-free composites from archived remote sensing imagery from the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) at a spatial resolution of 30 arc-seconds. The values represent the product of the average visible band digital number of cloud-free light detections and the percent frequency of light detection. The inclusion of the percent frequency of detection term normalizes the resulting digital values for variations in the persistence of lighting. For instance, the value for a light only detected half the time is discounted by 50%. HydroATLAS provides Nighttime Lights data for 2008.

Reference Doll, C.N. (2008). CIESIN thematic guide to night-time light remote sensing and its applications. Center for International Earth Science Information Network of Columbia University, Palisades, NY.

Website http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html#AXP

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Additional information In the stored data, index values ('digital numbers' ranging from 0 to 63) were multiplied by 100 (i.e. value 100 means 1).

Category	Anthropogenic	ID-A06	***>>> Back to Attribute List***

Attribute Human Footprint

Source data Global Human Footprint v2

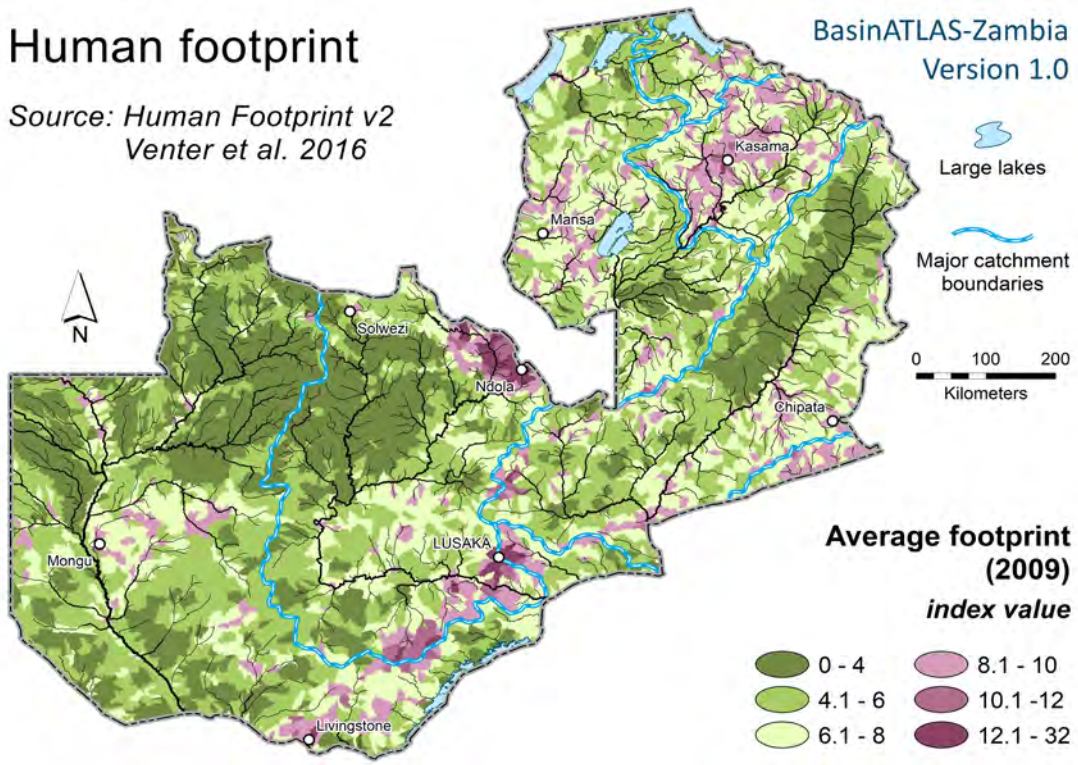
Citation: Venter et al. 2016 ***Native format:*** 30 arc-second grid ***Units:*** index value (x10)

Column name **hft_ix_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin | {u} in total watershed upstream of sub-basin pour point

Dimension {oo}: {93} year 1993 | {09} year 2009

Existing suffixes {xoo}: s93 | u93 | s09 | u09



Data description The Human Footprint represents the relative human influence in every biome on the land's surface, expressed as a percentage. Remotely-sensed and bottom-up survey information were compiled on eight variables measuring the direct and indirect human pressures on the environment globally in 1993 and 2009. This represents not only the most current information of its type, but also the first temporally-consistent set of Human Footprint maps. Data on human pressures were acquired or developed for: 1) built environments, 2) population density, 3) electric infrastructure, 4) crop lands, 5) pasture lands, 6) roads, 7) railways, and 8) navigable waterways. Pressures were then overlaid to create the standardized Human Footprint maps for all non-Antarctic land areas.

Reference Venter, O., Sanderson, E.W., Magrach, A., Allan, J.R., Beher, J., Jones, K.R., Possingham, H.P., Laurance, W.F., Wood, P., Fekete, B.M., Levy, M.A., Watson, J.E. 2016. Global terrestrial human footprint maps for 1993 and 2009. Scientific Data, 3,160067. https://doi.org/10.1038/sdata.2016.67.

Website https://doi.org/10.1038/sdata.2016.67

Additional information In the stored data, index values (range 0 to 50) were multiplied by 10 (i.e. value 10 means 1). HydroATLAS provides data for both the years 1993 ('93' in column name) and 2009 ('09' in column name).

Category	Zambia	ID-Z01	***>>> Back to Attribute List***

Attribute Major Catchments

Source data Water Resource Protection Area (WRPA) Assessment 2019

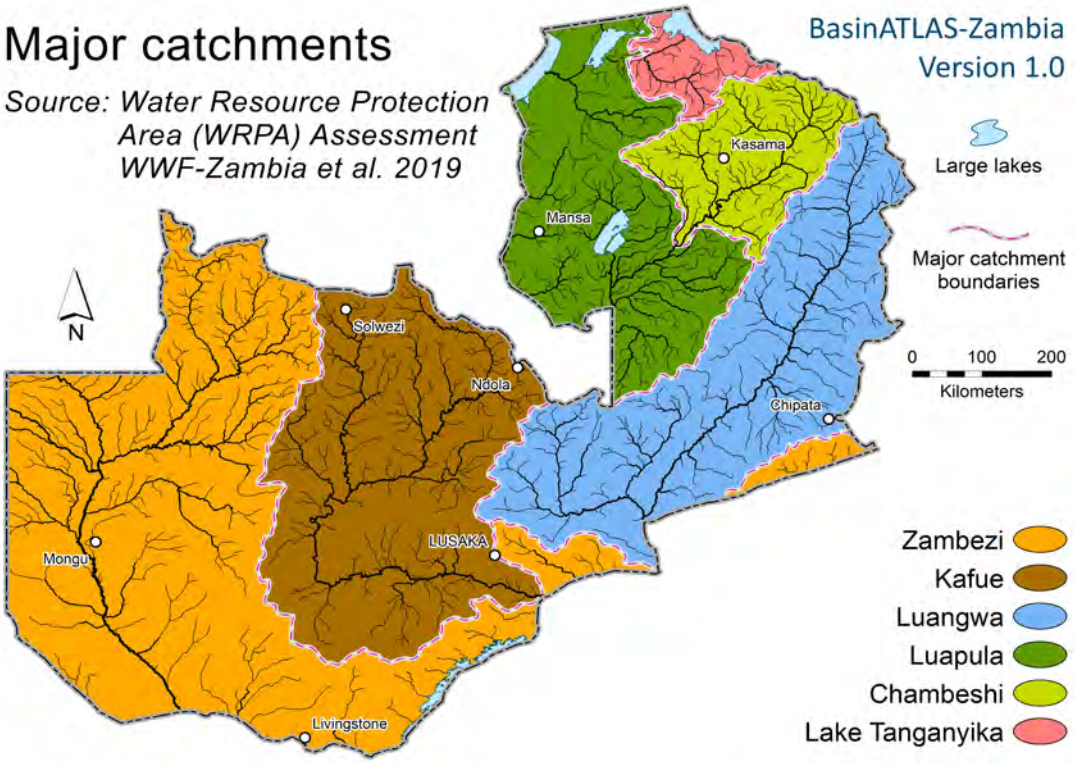
Citation: WWF-Zambia et al. 2019 ***Native format:*** Polygons ***Units:*** ID number

Column name **cat_id_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description There are six major catchments in Zambia, as defined by WARMA: Zambezi, Kafue, Luangwa, Luapula, Chambeshi and Tanganyika. This information was compiled as part of the Water Resource Protection Area (WRPA) assessment conducted by World Wide Fund for Nature (WWF) Zambia and the Zambian Water Resources Management Authority (WARMA) (WWF-Zambia et al. 2019). Original information was provided by WARMA.

Reference WWF-Zambia, WARMA, Lehner, B., Grill, G. (2019). Identification of Water Resource Protection Areas (WRPAs) for Zambia. Final Technical Report by B. Lehner and G. Grill. World Wide Fund for Nature (WWF) Zambia and Water Resources Management Authority (WARMA), Lusaka, Zambia. 59 pp.

Website http://www.warma.org.zm/catchments-zambia/

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Additional information For catchment names see file HydroATLAS_Zambia_v10_Legends.xlsx.

Category	Zambia	ID-Z02	***>>> Back to Attribute List***

Attribute Dam Count

Source data Water Resource Protection Area (WRPA) Assessment 2019

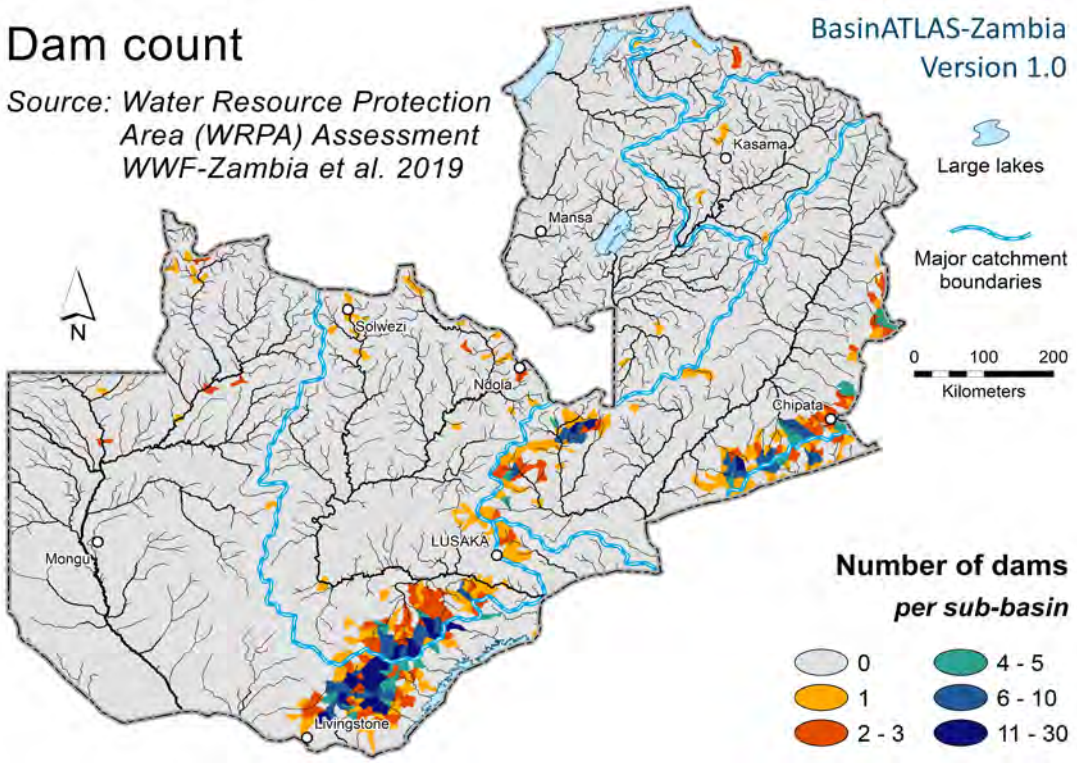
Citation: WWF-Zambia et al. 2019 ***Native format:*** Point locations ***Units:*** count

Column name **dam_ct_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {su} sum

Existing suffixes {xoo}: ssu



Data description The number of dams in each sub-basin or reach catchment was compiled as part of the Water Resource Protection Area (WRPA) assessment conducted by World Wide Fund for Nature (WWF) Zambia and the Zambian Water Resources Management Authority (WARMA) (WWF-Zambia et al. 2019). Original information was provided by WWF-Zambia, WARMA, or other Zambian agencies and stakeholders.

Reference WWF-Zambia, WARMA, Lehner, B., Grill, G. (2019). Identification of Water Resource Protection Areas (WRPAs) for Zambia. Final Technical Report by B. Lehner and G. Grill. World Wide Fund for Nature (WWF) Zambia and Water Resources Management Authority (WARMA), Lusaka, Zambia. 59 pp.

Website https://wrpa-zambia.weebly.com/

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Additional information Note that this information may not be comprehensive.

Category	Zambia	ID-Z03	***>>> Back to Attribute List***

Attribute Waterfall Count

Source data Water Resource Protection Area (WRPA) Assessment 2019

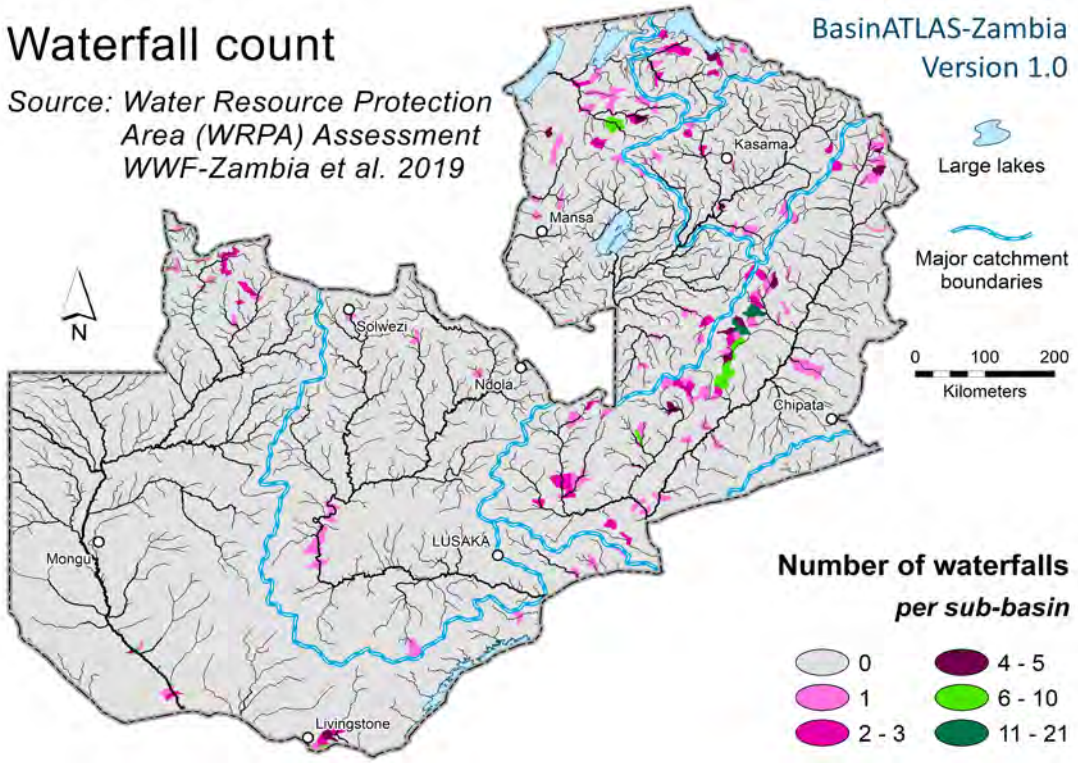
Citation: WWF-Zambia et al. 2019 ***Native format:*** Point locations ***Units:*** count

Column name **wfa_ct_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {su} sum

Existing suffixes {xoo}: ssu



Data description The number of waterfalls in each sub-basin or reach catchment was compiled as part of the Water Resource Protection Area (WRPA) assessment conducted by World Wide Fund for Nature (WWF) Zambia and the Zambian Water Resources Management Authority (WARMA) (WWF-Zambia et al. 2019). Original information was provided by WWF-Zambia, WARMA, or other Zambian agencies and stakeholders.

Reference WWF-Zambia, WARMA, Lehner, B., Grill, G. (2019). Identification of Water Resource Protection Areas (WRPAs) for Zambia. Final Technical Report by B. Lehner and G. Grill. World Wide Fund for Nature (WWF) Zambia and Water Resources Management Authority (WARMA), Lusaka, Zambia. 59 pp.

Website https://wrpa-zambia.weebly.com/

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Additional information Note that this information may not be comprehensive.

Category	Zambia	ID-Z04	***>>> Back to Attribute List***

Attribute Hotspring Presence

Source data Water Resource Protection Area (WRPA) Assessment 2019

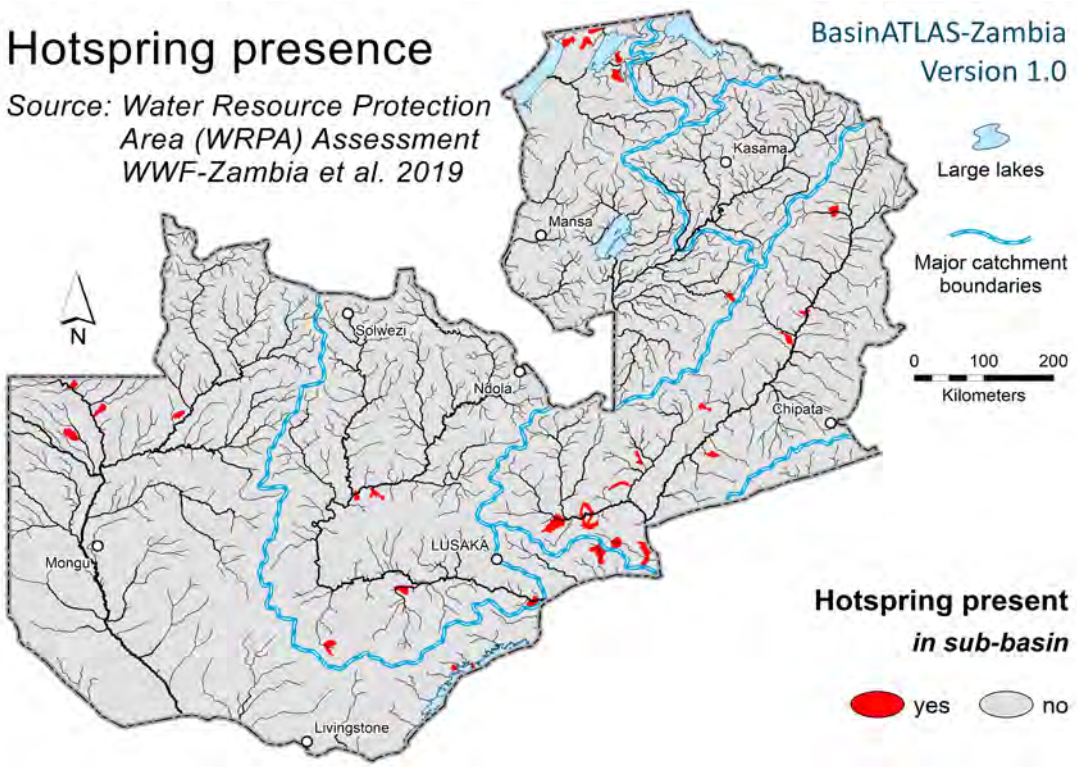
Citation: WWF-Zambia et al. 2019 ***Native format:*** Point locations ***Units:*** binary (1/0 = yes/no)

Column name **hsp_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description The presence of hotsprings (yes/no) in each sub-basin or reach catchment was compiled as part of the Water Resource Protection Area (WRPA) assessment conducted by World Wide Fund for Nature (WWF) Zambia and the Zambian Water Resources Management Authority (WARMA) (WWF-Zambia et al. 2019). Original information was provided by WWF-Zambia, WARMA, or other Zambian agencies and stakeholders.

Reference WWF-Zambia, WARMA, Lehner, B., Grill, G. (2019). Identification of Water Resource Protection Areas (WRPAs) for Zambia. Final Technical Report by B. Lehner and G. Grill. World Wide Fund for Nature (WWF) Zambia and Water Resources Management Authority (WARMA), Lusaka, Zambia. 59 pp.

Website https://wrpa-zambia.weebly.com/

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Additional information Note that this information may not be comprehensive and the actual location of hotsprings may not be spatially precise.

Category	Zambia	ID-Z05	***>>> Back to Attribute List***

Attribute Important Bird Areas

Source data BirdLife Zambia Important Bird Area (IBA) Assessment

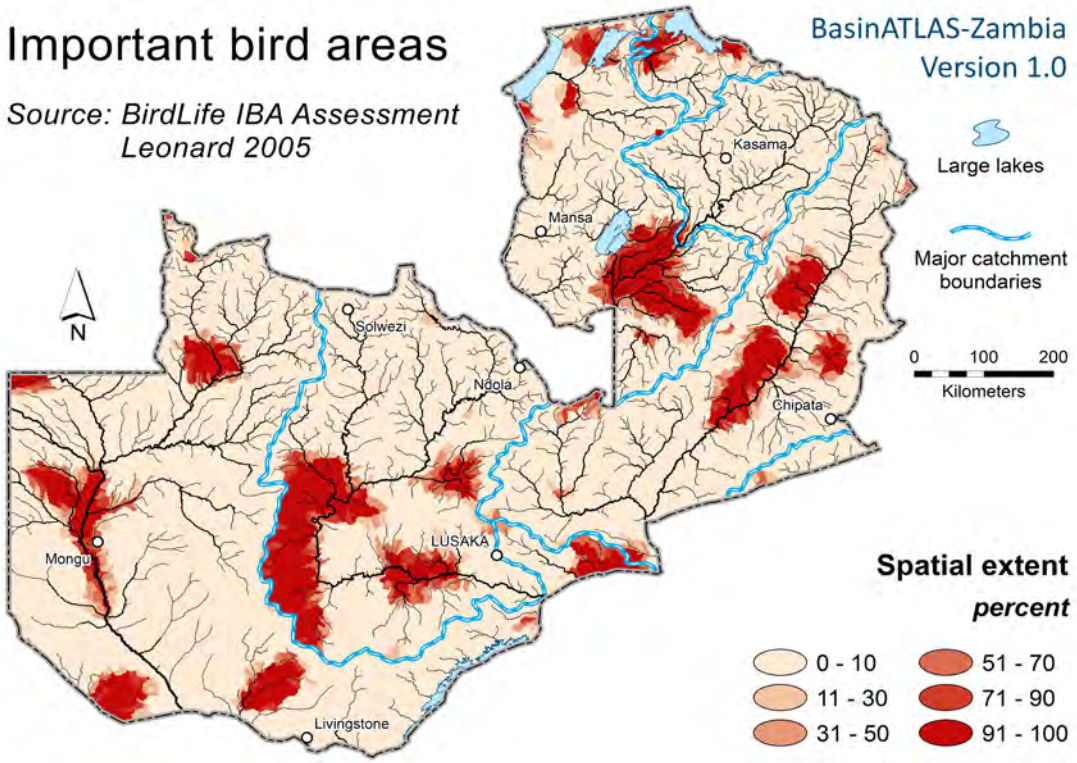
Citation: Leonard 2005 ***Native format:*** Polygons ***Units:*** percent cover

Column name **iba_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {se} spatial extent (%)

Existing suffixes {xoo}: sse



Data description Important bird areas (IBAs) were identified and provided by Birdlife Zambia (Leonard 2005). Implicit in this coverage are confirmed occurrences of Zambian aquatic-dependent species.

Reference Leonard, P. (2005): Important Bird Areas in Zambia. Zambian Ornithological Society and BirdLife International, 218 pp. ISBN-10: 9982811010.

Website https://www.birdwatchzambia.org/

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Additional information None

Category	Zambia	ID-Z06	***>>> Back to Attribute List***

Attribute High Amphibian Richness

Source data IUCN Freshwater Species Data and Key Biodiversity Areas (KBAs)

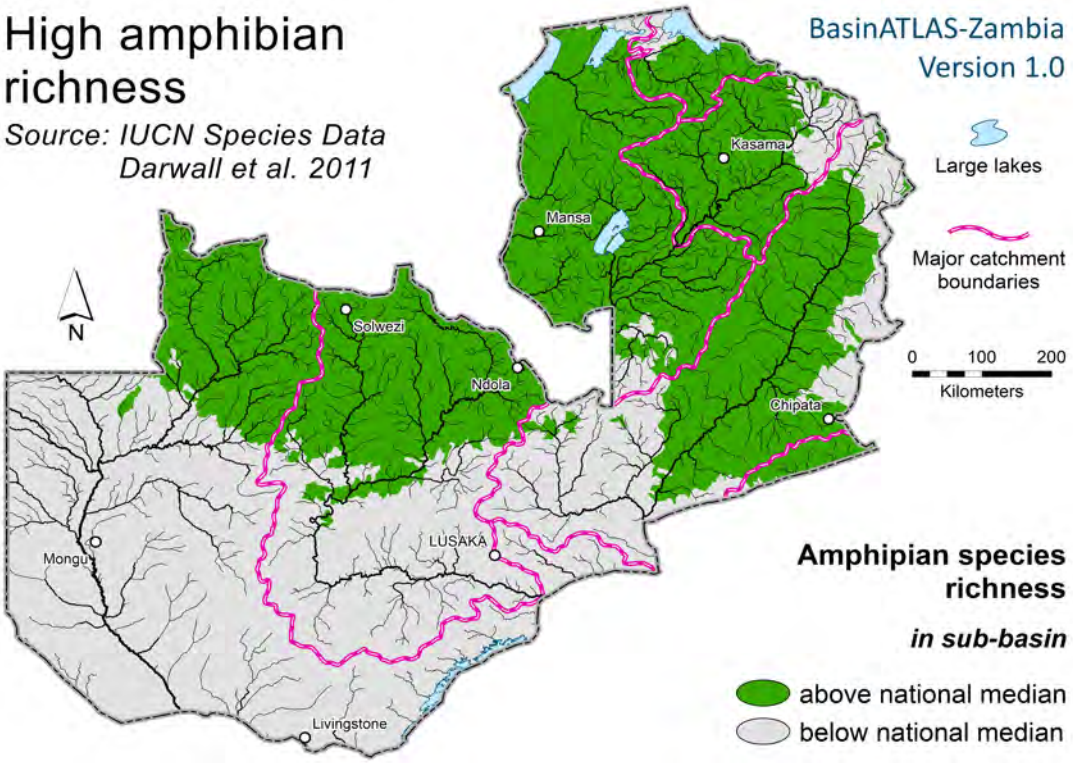
Citation: Darwall et al. 2011 ***Native format:*** Polygons ***Units:*** binary (1/0)

Column name **amp_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description A species richness index (number of species per sub-basin) was derived for all amphibian species listed by IUCN; and all sub-basins or reach catchments were flagged (value 1) which showed a species richness above the national median. Species distribution data were mostly provided by the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011). Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland.

Website https://portals.iucn.org/library/sites/library/files/documents/RL-6-001.pdf

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Additional information None

Category	Zambia	ID-Z07	***>>> Back to Attribute List***

Attribute High Crab Richness

Source data IUCN Freshwater Species Data and Key Biodiversity Areas (KBAs)

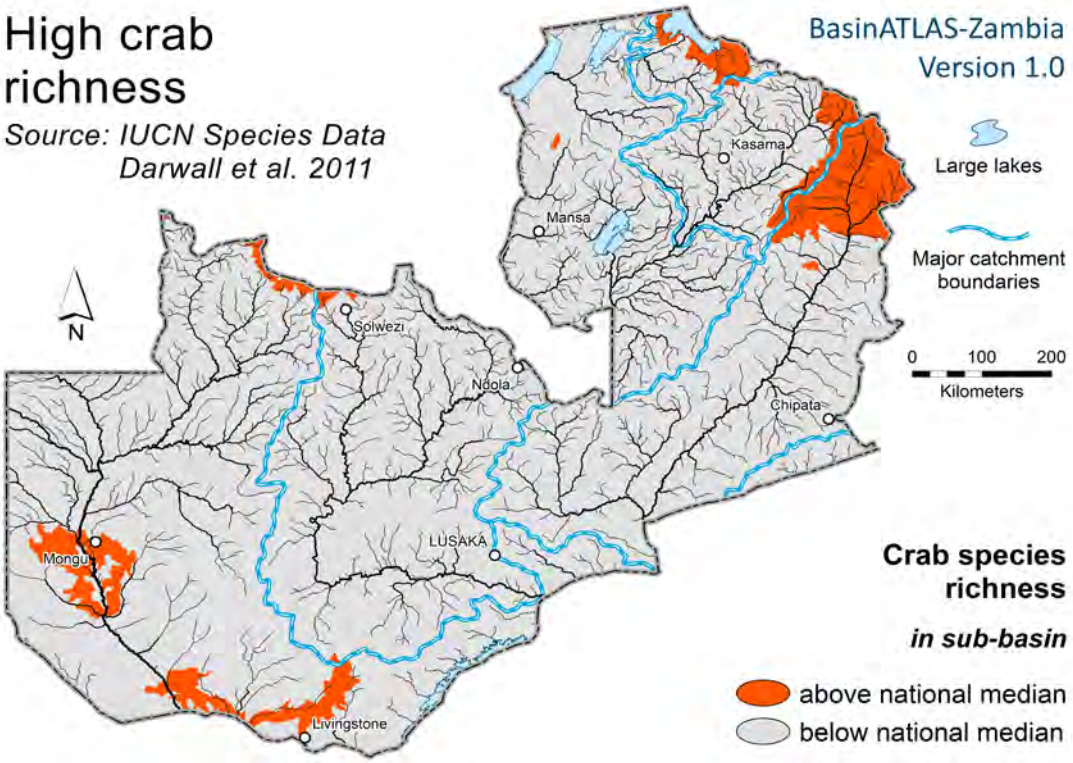
Citation: Darwall et al. 2011 ***Native format:*** Polygons ***Units:*** binary (1/0)

Column name **crb_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description A species richness index (number of species per sub-basin) was derived for all crab species listed by IUCN; and all sub-basins or reach catchments were flagged (value 1) which showed a species richness above the national median. Species distribution data were mostly provided by the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011). Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland.

Website https://portals.iucn.org/library/sites/library/files/documents/RL-6-001.pdf

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Additional information None

Category	Zambia	ID-Z08	***>>> Back to Attribute List***

Attribute High Fish Richness

Source data IUCN Freshwater Species Data and Key Biodiversity Areas (KBAs)

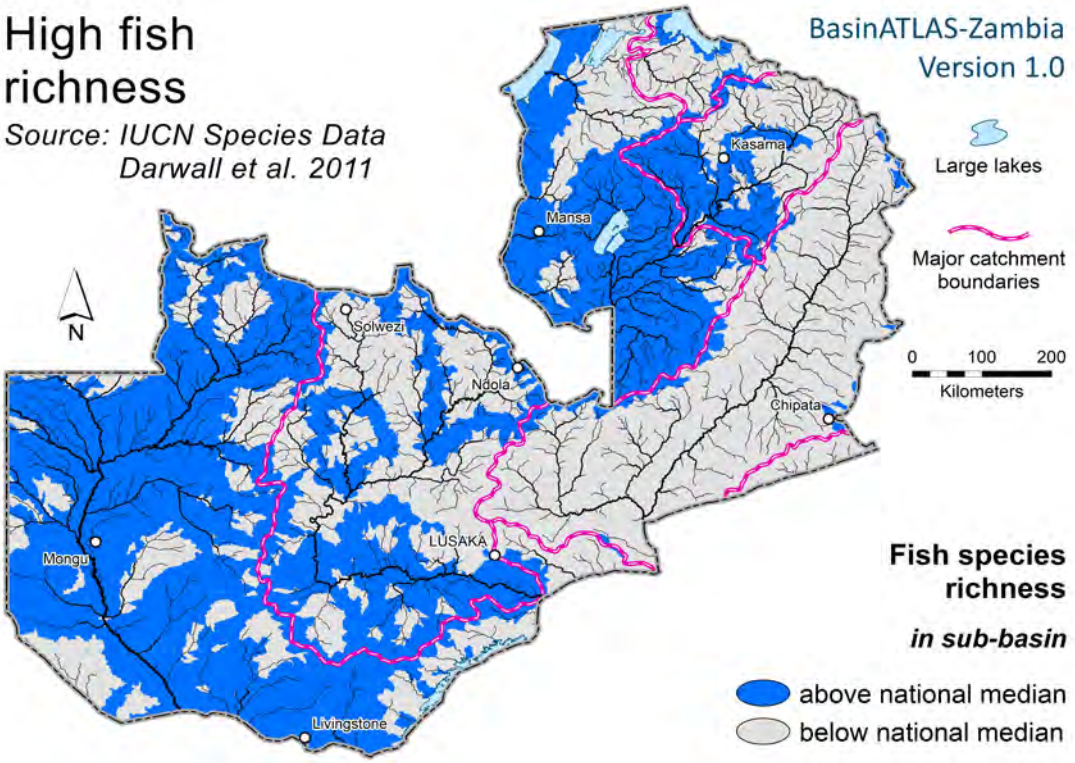
Citation: Darwall et al. 2011 ***Native format:*** Polygons ***Units:*** binary (1/0)

Column name **fsh_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description A species richness index (number of species per sub-basin) was derived for all fish species listed by IUCN; and all sub-basins or reach catchments were flagged (value 1) which showed a species richness above the national median. Species distribution data were mostly provided by the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011). Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland.

Website https://portals.iucn.org/library/sites/library/files/documents/RL-6-001.pdf

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Additional information None

Category	Zambia	ID-Z09	***>>> Back to Attribute List***

Attribute High Mollusc Richness

Source data IUCN Freshwater Species Data and Key Biodiversity Areas (KBAs)

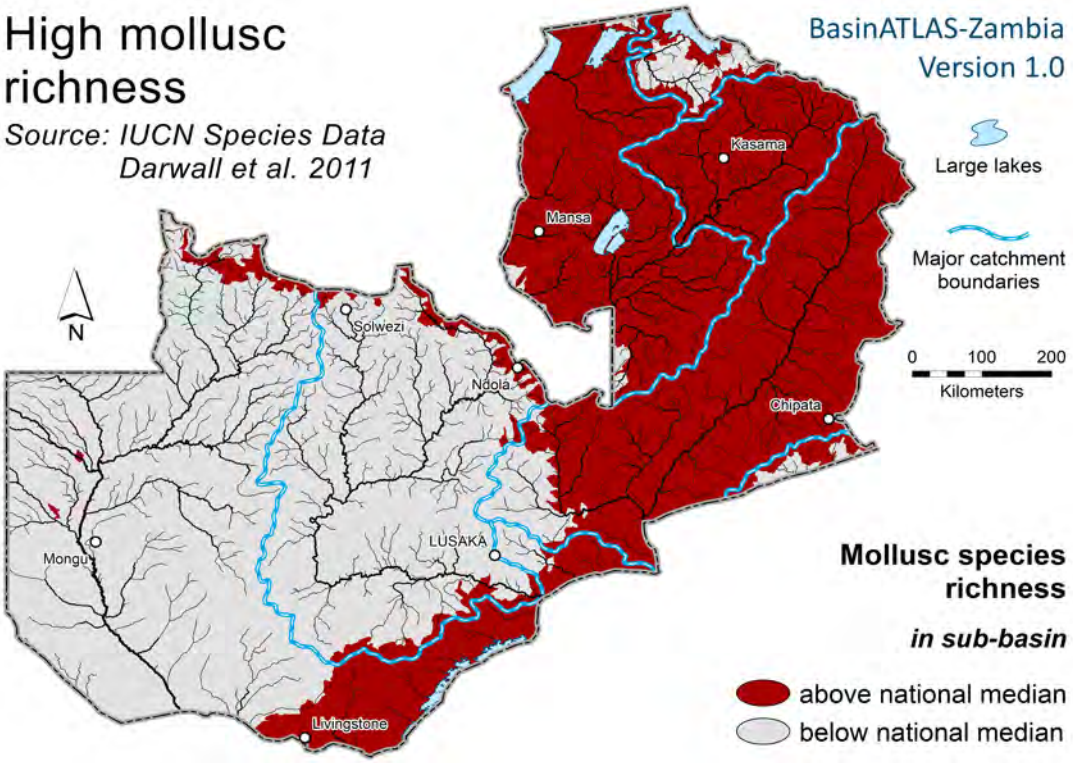
Citation: Darwall et al. 2011 ***Native format:*** Polygons ***Units:*** binary (1/0)

Column name **mol_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description A species richness index (number of species per sub-basin) was derived for all mollusc species listed by IUCN; and all sub-basins or reach catchments were flagged (value 1) which showed a species richness above the national median. Species distribution data were mostly provided by the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011). Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland.

Website https://portals.iucn.org/library/sites/library/files/documents/RL-6-001.pdf

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Additional information None

Category	Zambia	ID-Z10	***>>> Back to Attribute List***

Attribute High Odonatan Richness

Source data IUCN Freshwater Species Data and Key Biodiversity Areas (KBAs)

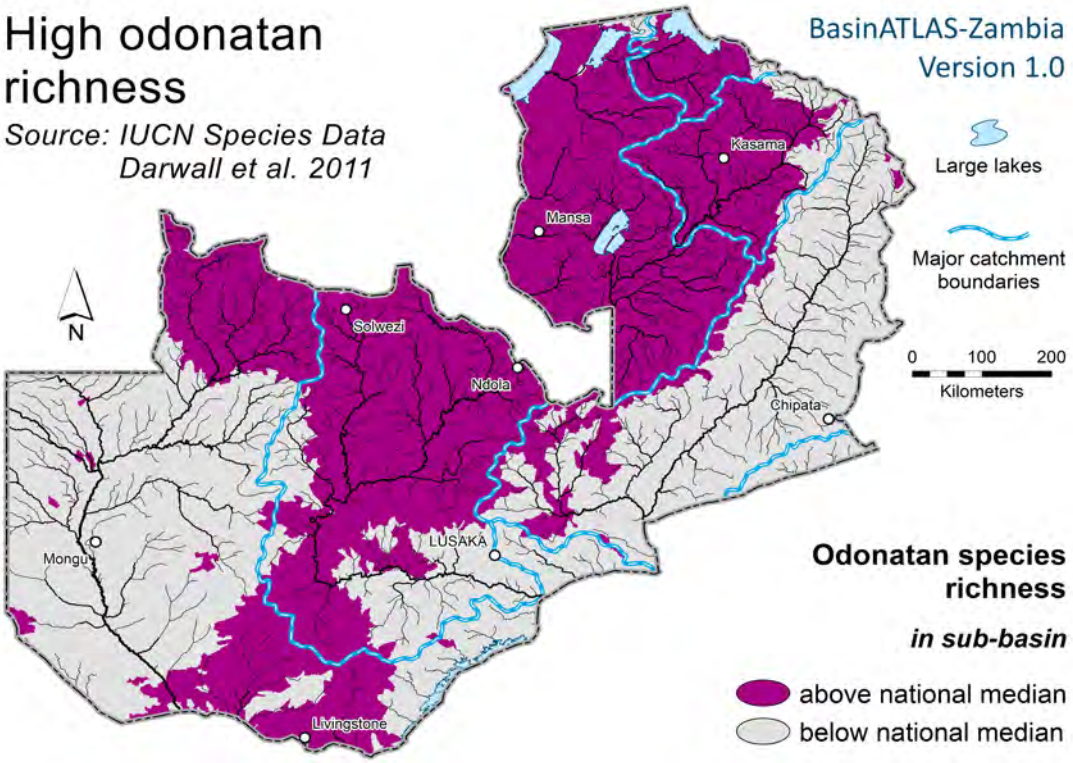
Citation: Darwall et al. 2011 ***Native format:*** Polygons ***Units:*** binary (1/0)

Column name **odo_bi_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {va} value

Existing suffixes {xoo}: sva



Data description A species richness index (number of species per sub-basin) was derived for all odonatan species listed by IUCN; and all sub-basins or reach catchments were flagged (value 1) which showed a species richness above the national median. Species distribution data were mostly provided by the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011). Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland.

Website https://portals.iucn.org/library/sites/library/files/documents/RL-6-001.pdf

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Additional information None

Category	Zambia	ID-Z11	***>>> Back to Attribute List***

Attribute Aquatic Species Extent

Source data IUCN Red List and Key Biodiversity Areas (KBAs)

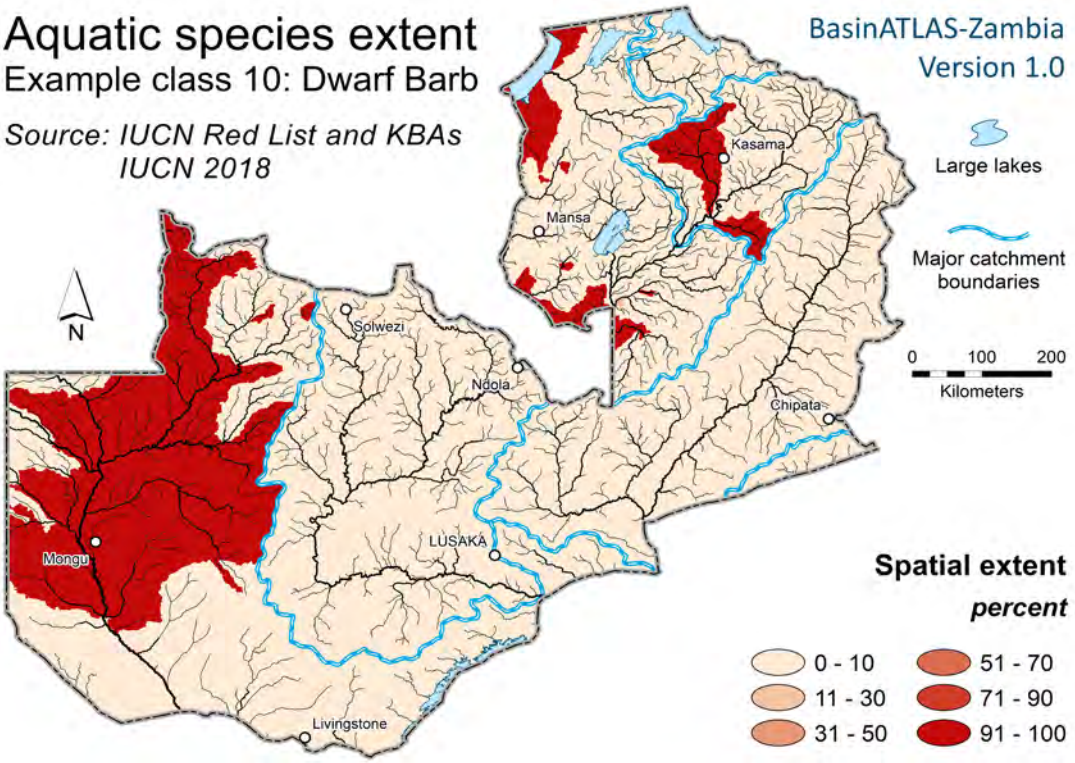
Citation: IUCN 2018 ***Native format:*** Polygons ***Units:*** percent cover

Column name **spc_pc_{xoo}** *(for syntax options of suffix {xoo} see next lines)*

Spatial extent {x}: {s} in sub-basin

Dimension {oo}: {01-42} spatial extent (%) by species

Existing suffixes {xoo}: s01-s42



Data description Distribution data for a total of 42 species were provided by the IUCN Red List, the IUCN African freshwater species assessment for fish, molluscs, amphibians and odonata (Darwall et al. 2011), and were supplemented by species distribution models developed by Trainor et al. (2017). Threatened and range-restricted species were included as separate layers as per the IUCN Key Biodiversity (KBA) methodology. Species distribution information was also provided or verified by SAIAB and/or the Zambian Department of Fisheries.

Reference IUCN (2018). The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org. Downloaded on 22 November 2018.

Website http://www.iucnredlist.org

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Additional information For species names see file HydroATLAS_Zambia_v10_Legends.xlsx. Additional citations: Darwall, W.R.T., Smith, K.G., Allen, D.J., Holland, R.A., Harrison, I.J., Brooks, E.G.E. (eds.) (2011). The Diversity of Life in African Freshwaters: Under Water, Under Threat. An analysis of the status and distribution of freshwater species throughout mainland Africa. IUCN, Cambridge, United Kingdom and Gland, Switzerland. Trainor, A., Slamudaala, V.M., Gondwe, F., Matongo, M. & Shitima, E.M. (2017). Promoting Smart Growth: balancing development needs with nature and people - methods for conservation priority mapping. The Nature Conservancy. 34 pp.