World-wide HYPE is under continuous development. Please be aware of which version you refer to.

World-wide HYPE version: 1.3.5

HYPE model version: HYPE 5.6.3

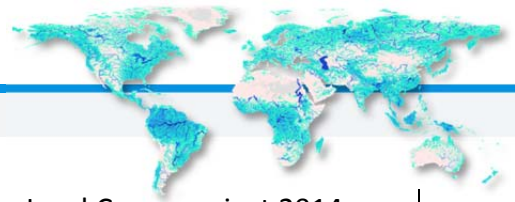
Geographical domain: All continents except Antarctica

Model purpose

The model calculates water volume and fluxes over large geographical areas, which encompass many river basins, cross regional and international boundaries, and a number of different geophysical and climatic zones. Each river basin cover numerous coupled catchments and has thus a relatively high spatial resolution, although most basins are ungauged. The model produce water variables for the past, present and future and the results have been used in climate change impact assessments and scientific research. The results from the model are shared under license the Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

Table 1. Data sources and characteristics

Characteristic/ Data type	Info/Name	Provider/Reference
Total area (km2)	135 million	-
Resolution (km2)	1000	
Number of subbasins	131 407	Tailored by SMHI from topography
Topography and routing	GWD-LR v1.2 [3arcsec] -Flow direction -Upstream area -River width	Yamazaki et al., 2014
	SRTM - Digital Elevation Database [3 arcsec}	U.S. Geological Survey
	HYDRO1K [30 arcsec]	U.S. Geological Survey
	Greenland Ice Mapping Project, GIMP[90m]	Howat et al, 2015
	IMO basin polygons	Veðurstofu Íslanda, 2016
	Non- contributing Drainage areas AAFC Watersheds project - 2013	Government Canada
Waterbodies	Global Lakes & Wetland Database, GLWD	Lehner & Döll, 2004
	Global reservoir and Dam Database, GRanD v1.1	Lehner et al. 2011
	ESA CCI waterbodies [150m] v4.0	ESA Climate Change Initiative -



		Land Cover project 2014
	GWD-LR v1.2	Yamazaki et al, 2014
LakeDepths	Global Lake Data base v2	Kourzeneva, 2009
Forcing Data	Hydro-GFD 2.0	Berg et al., 2018
Land cover, irrigation and crop type	ESA CCI Land Cover, epoch 2010, v 1.6.1 [300m]	ESA Climate Change Initiative - Land Cover project 2014
	MIRCA2000	Arendt et al., 2015
	Global Map of Irrigation Areas, GMIA	Seibert et al., 2013
	Randolph Glacier Inventory, RGI v 5.0	Arendt et al., 2015
	Greenland Glacier Inventory	Rastner et al, 2012
Discharge and catchment area	Global Runoff Data Base, GRDB	The Global Runoff Data Centre, GRDC
	European Water Archive, EWA	The Global Runoff Data Centre, GRDC
	R-ArcticNet v 4.0	University of New Hampshire, UNH
	RIVDIS v1.1	Vörösmarty et al., 1998
	USGS-NWIS, national data	U.S. Geological Survey
	HYDAT, national data	WSC (Water Survey of Canada)
	Chinese Hydrology Data Project, CHDP	Henck et al., 2011
	Spain, national data	Spanish authorities
	RESEAU HYDRO, Congo	CICOS (International Commission for Congo-Ubangui-Sangha Basin)
	WISKI	SMHI
	ds553.2 Russian River Data	Byron Bodo, 2000
Catchment area	SIEREM	Boyer et al., 2006
	La Plata basin regional data	CLARIS-project
	CWC handbook	Central Water Commission, CWC

Hydrologic Reference Stations, national data	BOM (Bureau of Meteorology)
Red Hidrometrica SNHN 2013	Servicio Nacional de Hidrgrafía Naval
Estacoes Fluviometrica	ANA (Agencia Nacional de Aguas)
Red Hidrometrica	DGA (Direccion General de Aguas)
Catalogo Nacional de Estaciones de Monitoreo Ambiental	IDEAM (Instituto de Hidrologia, Meteorologia y Estudios Ambientales)
Estaciones Hidrologicas	Instituto Nacional de Meteorologia e Hidrologia
Peru, national data	SENAMHI (Servicio Nacional de Meteorologia e Hidologia del Peru)
Venezuela, national data	IGVSB (Instituto Geográfico de Venezuela Simon Bolivar)
Conabio 2008	Instituto Mexicano de Tecnología del Agua/CONABIO
Niger HYCOS	ABN
South Africa, national data	Department Water & Sanitation, Republic of South Africa
Mauritsius, national data	Mauritsius Ministry of Energy and Public Utilities

Calibration and validation

The calibration objective in the large scale applications is not to provide an optimal model for a specific region, but rather to identify a model that achieves best possible performance averaged across many gauged basins at all scales.

Global parameter values (for e.g. precipitation, landuse, evaporation, river routing, lake dynamics, floodplains) were estimated using a step-wise multi-basin approach for groups of parameters and aimed at finding robust values also valid for ungauged basins. Catchments were selected globally to represent each process calibrated and the estimated parameters were then applied wherever relevant, world-wide.

Before the step-wise procedure, the global PET parameter values were fixed using the MODIS global evapotranspiration product and then time-series from 5338 gauges of river flow across the globe (with >10 years of observations) were used for model calibration and evaluation (half for calibration and half for independent validation). The calibration period was 1981-2012 proceeded by 15 years of initialization and different metrics were used depending on the character of the parameter (e.g. volume error for precipitation and PET parameters, correlation coefficient when timing was of importance, Kling-Gupta Efficiency (KGE) if both water volume and timing was required.

This first attempt to calibrate World-wide HYPE resulted in an average monthly KGE=0.4.

The World-wide HYPE (WWH) model shows large variation in model performance, spatially and between various flow signatures. It should be used with caution especially in dry regions. However, there are good potential for model improvements and the calibration cycle will be repeated. For the next version, there will be special focus on water balance, soil storage and hydrological features such as lakes, reservoirs, glaciers and floodplains.

More information
To explore data, buy water services, attend courses, use the HYPE open source code and see showcases, please check our website:
http://hypeweb.smhi.se/

Contact
For further information, please contact us through our website:
http://hypeweb.smhi.se/contact-us/

Reference
Arheimer, B., Pimentel, R., Isberg, K., Crochemore, L., Andersson, J. C. M., Hasan, A., and Pineda, L.: Global catchment modelling using World-Wide HYPE (WWH), open data and stepwise parameter estimation, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-111, in review, 2019.