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Sensitivity analysis of MOHID-Land model. Calibration and validation of Ulla river watershed.

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Description

This study aims to calibrate and validate the channel flow in Ulla river watershed (Galicia, Spain) using MOHID-Land model considering a sensitivity analysis of some parameters and user's options that can affect model results.

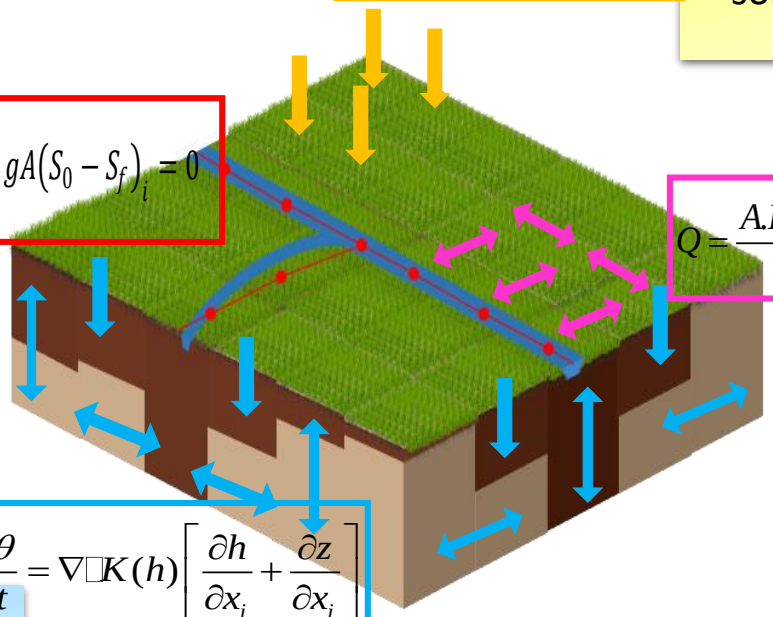
MOHID-Land model

Drainage Network (1D)
(topography, rivers, basin delineation)

$$\frac{\partial Q_i}{\partial t} + v_j \frac{\partial Q}{\partial x_i} + gA\frac{\partial h}{dx_i} - gA\left(S_0 - S_f\right)_i = 0$$

Precipitation variable in time and space

Atmosphere
(precipitation, temperature, solar radiation, wind velocity, relative humidity)



$$Q = \frac{A.R_h^{2/3}\sqrt{\partial H / \partial x}}{n}$$

Runoff (2D)
(surface Manning)

$$\frac{\partial \theta}{\partial t} = \nabla \square K(h)\left[\frac{\partial h}{\partial x_i} + \frac{\partial z}{\partial x_i}\right]$$

Porous Media
(soil hydraulic properties)

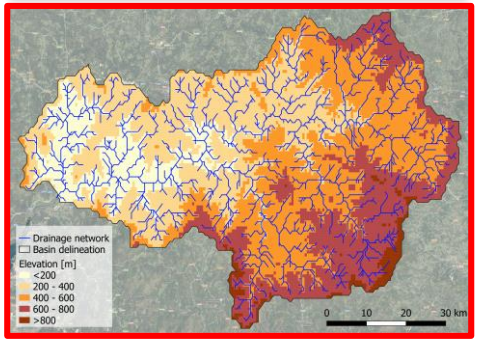
Vegetation (type of vegetation, crop coefficient)

Variable time step

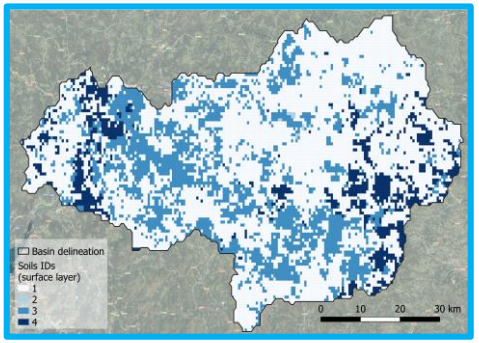
Case study (original set up)

Atmosphere: ERA5 from ECWMF[1]

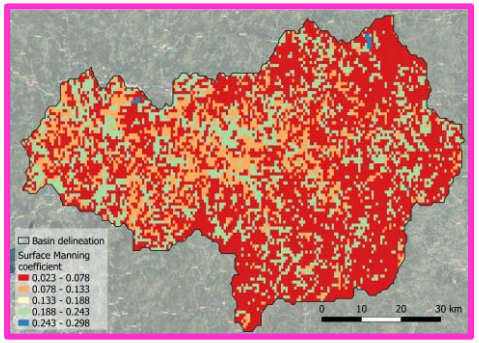
Drainage network: EU-DEM (30 m resolution) [2]



Porous Media: European Soil Hydraulic Database[3]

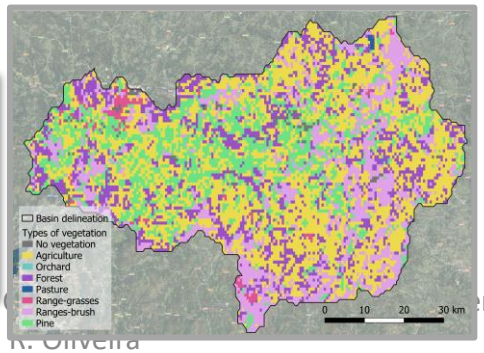


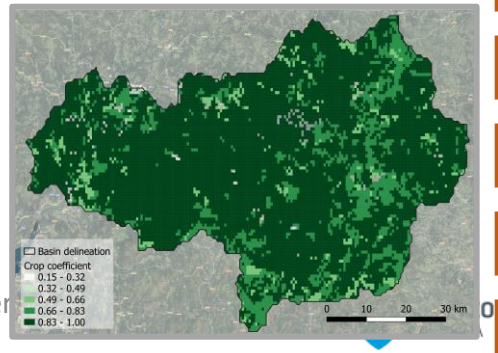
Runoff: deducted from Corine Land Cover (2012) [4]



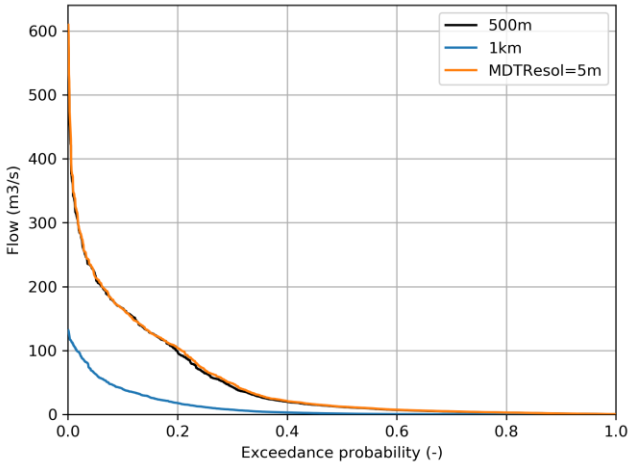
Grid resolution: 500m

Vegetation: deducted from Corine Land Cover (2012) [4]





Sensitivity analysis

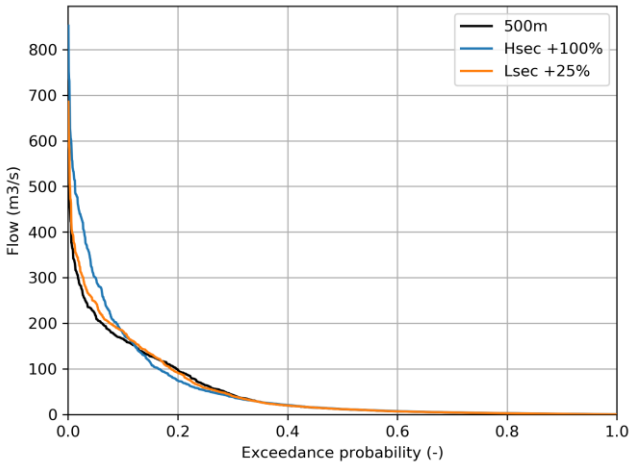


Impact of a grid resolution of 1 km and a source MDT with 5 m resolution.

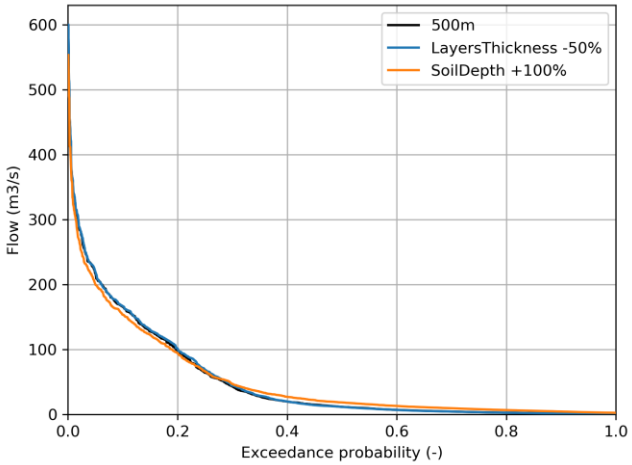
	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
1 km	0.03	0.29	1.51	14.77	70.45
DTM=5 m	0.97	4.07	13.05	78.57	244.44

Impact of change cross-sections geometry (height – H and width – W).

	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
Hsec +100%	1.16	4.15	1304	67.42	336.44
Wsec +25%	0.93	3.91	12.59	74.78	268.08



Sensitivity analysis

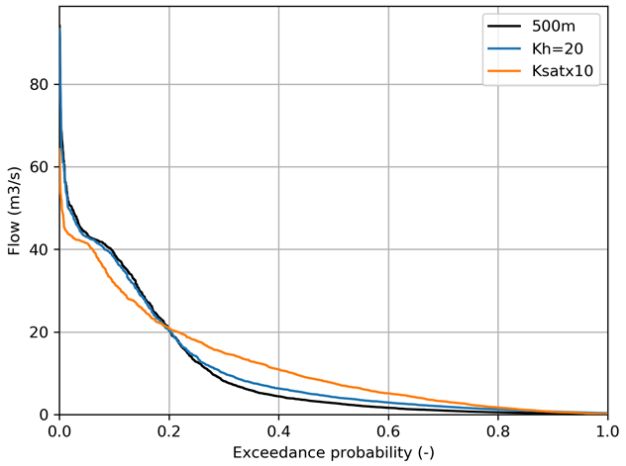


Impact of soil geometry with decreasing of layers thickness (LayThick) (maintaining soil depth) and increasing of soil depth.

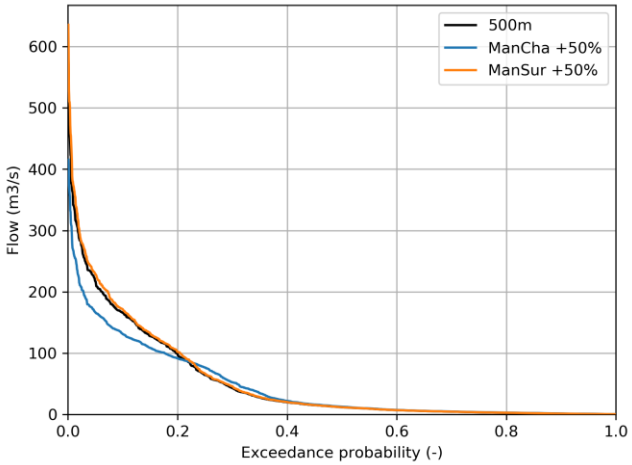
	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
LayThick -50%	1.09	3.76	12.12	78.09	242.66
SoilDepth +100%	3.46	8.35	19.03	75.44	225.73

Impact of increasing vertical (Ksat) hydraulic conductivity and horizontal (Kh) hydraulic conductivity.

	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
Kh = 20 (instead of 10)	1.16	4.15	13.04	67.42	336.44
Ksat x10	1.92	11.02	31.47	76.5	175.93



Sensitivity analysis

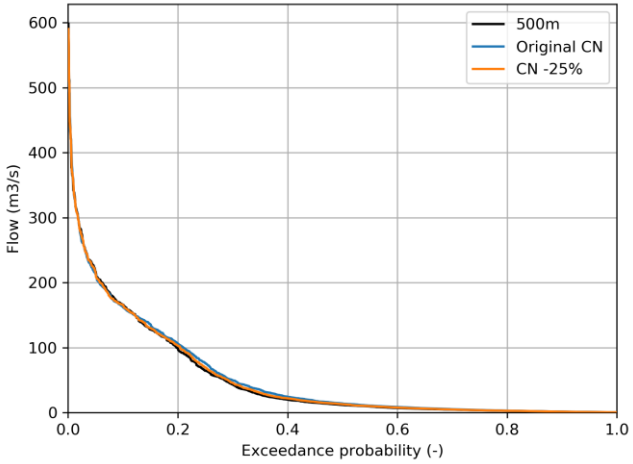


Impact of channel (ManCha) and surface (ManSur) Manning coefficient value.

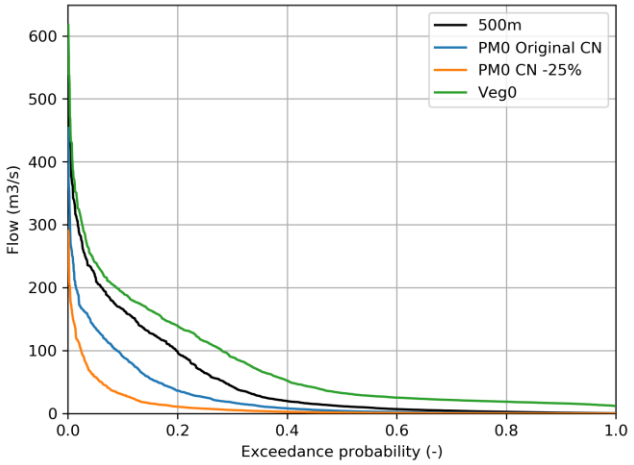
	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
ManCha +50%	0.98	4.05	13.31	73.32	186.74
ManSur +50%	0.89	3.83	12.56	77.96	254.78

Impact of using Curve Number (CN) method instead of Richard's equation.

	Q_{mean} [m^3/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
CN	0.82	4.37	14.84	81.89	238.21
CN -25%	0.84	4.04	13.51	78.2	239.28

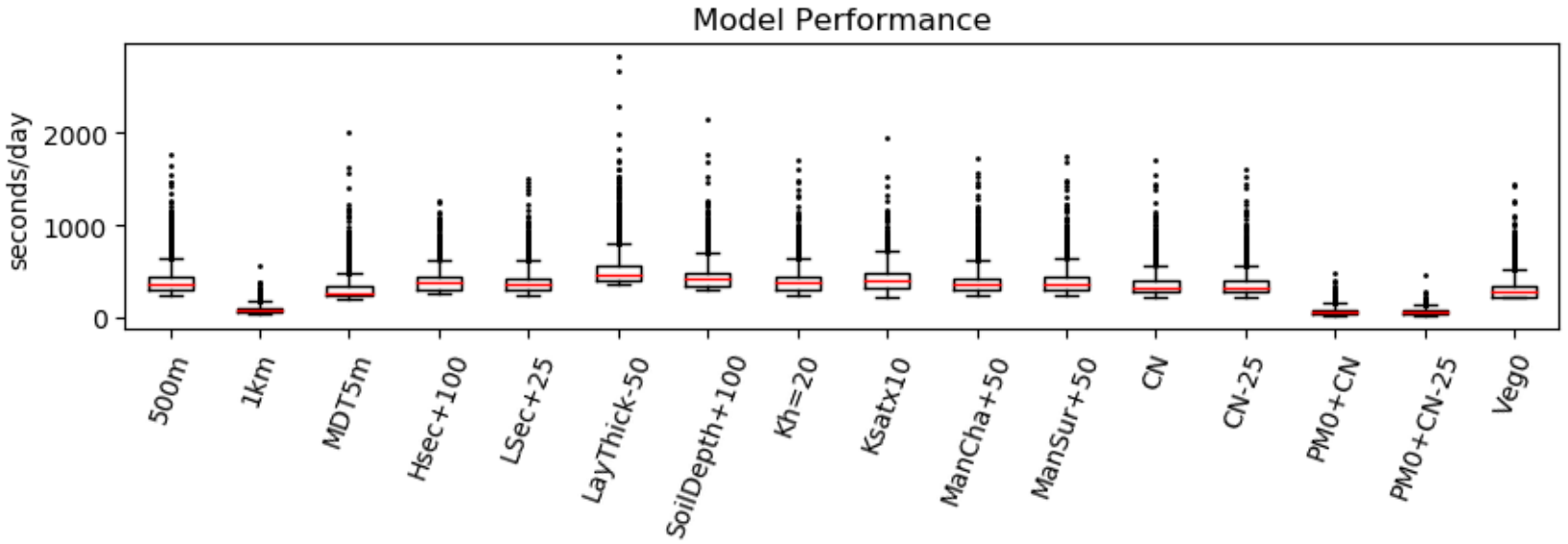


Sensitivity analysis

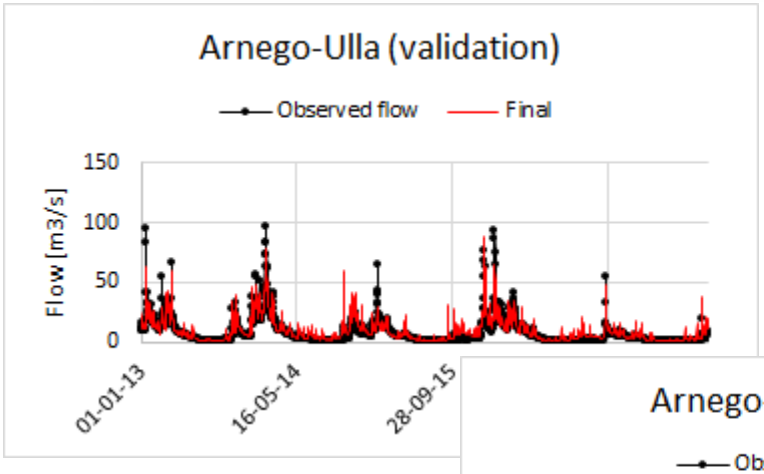


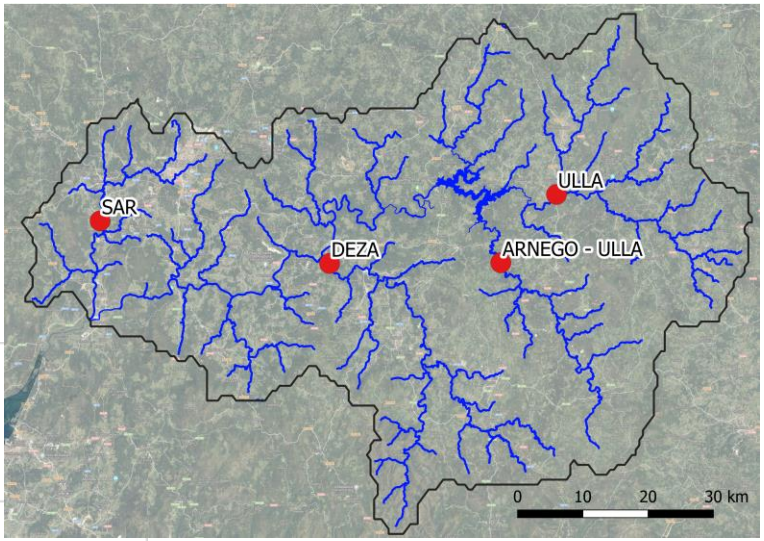
Impact of deactivation of porous media processes using Curve Number method (PM0 + CN) and deactivation of vegetation processes (Veg0).

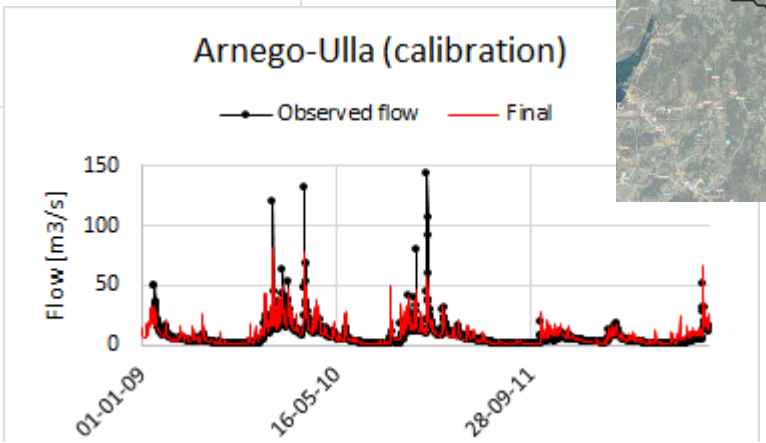
	Q_{mean} [m³/s]				
%Exceedence	**0-10**	**10-40**	**40-60**	**60-90**	**90-100**
500 m	0.89	3.82	12.45	75.69	241.25
PM0 + CN	0.13	1.10	4.63	32.57	152.43
PM0 + CN -25%	0.03	0.38	1.66	10.01	75.89
Veg0	14.52	20.39	34.94	116.56	269.1



Calibration and validation







Stations	Calibration				Validation			
	NSE	PBIAS	R^2	RMSE	NSE	PBIAS	R^2	RMSE
Sar	0.53	114.63	0.50	5.68	0.64	27.39	0.73	6.10
Ulla	-0.03	-2.84	0.56	20.18	0.17	0.32	0.17	42.48
Arnego-Ulla	-0.14	-12.29	0.70	5.99	0.76	-16.82	0.78	5.46
Deza	0.20	25.57	0.66	24.46	0.09	30.71	0.10	78.41

Acknowledgement

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References

1. Copernicus Climate Change Service (C3S) (2017): ERA5: Fifth generation of ECMWF atmospheric reanalysis of the global climate. Copernicus Climate Change Service Climate Data Store (CDS), https://cds.climate.copernicus.eu/cdsapp#!/home (last access on 19/12/2019).
2. Copernicus Land Monitoring Service – EU-DEM (2017), https://www.eea.europa.eu/data-and-maps/data/copernicus-land-monitoring-service-eu-dem (last access on 12/12/2019).
3. Tóth B., Weynants M., Pásztor L., Hengl T., 2017. 3D soil hydraulic database of Europe at 250 m resolution. Hydrological Processes. 2017;31:2662–2666. https://doi.org/10.1002/hyp.11203.
4. Copernicus Land Monitoring Service, 2019. Corine Land Cover 2012, https://land.copernicus.eu/paneuropean/corine-land-cover/clc-2012 (last accessed on 03/07/2018).