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Gábor Szatmári Spatio-temporal modelling of soil organic carbon stock for the support of national level assessment of land degradation neutrality in Hungary

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### Highlights

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- Indicators and spatial assessment of Land Degradation Neutrality (LDN)
- Soil organic carbon (SOC) stock mapping in Hungary
- Spatio-temporal modelling of soil organic carbon stock (SOC)
- SOC changes vs. land use/land cover (LU/LC) changes
- SOC changes attributed to land use/land cover (LU/LC) changes



Land degradation neutrality (LDN) aims to achieve no net loss of land-based natural capital, compared with the baseline.



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Indicator 15.3.1 Proportion of land that is degraded over total land area The minimum set of indicators recommended for tracking progress towards LDN against a baseline are:

- land cover,
- land productivity (metric: net primary productivity) and
- carbon stocks above and below ground (metric: soil organic carbon).



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## Soil organic carbon (SOC) stock mapping in Hungary

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#### 1<sup>st</sup>: In the frame of Global Soil **Organic Carbon Map initiative**





#### For details see: EGU2020-7095

Altitude (meter



Szatmári G, Pásztor L: Comparison of various uncertainty modelling approaches based on geostatistics and machine learning algorithms. GEODERMA, 337: 1329-1340 (2019)



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## Soil organic carbon (SOC) stock mapping in Hungary

2<sup>nd</sup>: Based on GSOC@hu (QRF) with some modifications ( 500 m -> 100 m; two dates: 1992 & 2010)



Szatmári G, Pirkó B, Koós S, Laborczi A, Bakacsi Zs, Szabó J., Pásztor L.: Spatio-temporal assessment of topsoil organic carbon stock change in Hungary. SOIL & TILLAGE RESEARCH, 195 (2019)



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## Spatio-temporal modelling of soil organic carbon stock





Change of soil organic carbon stocks between the years 1992 and 2010 and its significance according to the elaborated scheme

increasing

increasing tendency

decreasing tendence

decreasing

Scheme for assessing the soil organic carbon stock temporal change based on the 90% prediction intervals, (a) decreasing, (b) decreasing tendency, (c) no change, (d) increasing tendency and (e) increasing. (blue and red circles are the spatial predictions for the years 1992 and 2010, respectively; blue and red whiskers are the corresponding 90% prediction intervals.

Szatmári G, Pirkó B, Koós S, Laborczi A, Bakacsi Zs, Szabó J., Pásztor L.: Spatio-temporal assessment of topsoil organic carbon stock change in Hungary. SOIL & TILLAGE RESEARCH, 195 (2019)



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# Spatio-temporal modelling of soil organic carbon stock

## SOC changes vs. LU/LC changes



Szatmári G, Pirkó B, Koós S, Laborczi A, Bakacsi Zs, Szabó J., Pásztor L.: Spatio-temporal assessment of topsoil organic carbon stock change in Hungary. SOIL & TILLAGE RESEARCH, 195 (2019)



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## SOC changes attributed to LU/LC changes

Reporting manual for the 2017-2018 UNCCD reporting process



United Nations Convention to Combat Desertification

#### SO1-3 Trends in carbon stocks above and below ground

Soil organic carbon stocks

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Quantitative data National level estimates of the soil organic carbon (SOC) stock in topsoil (0-30 cm) within each land cover type (in tonnes per hectare).

Default data are derived from the SoilGrids database of the ISRIC — World Soil Information

and they can b	e amended as a	appropriate.						
	Soil organic carbon stock in topsoil (t/ha)							
Year	Tree-covered areas	Grassland	Cropland	Wetland	Artificial surfaces	Other Land		
2000	96,1	78,5	77,2	119,6	69,9	92,6		
2001	96,1	78,5	77,2	119,6	69,9	92,6		
2002	96,1	78,5	77,2	119,6	69,7	92,6		
2003	96,1	78,5	77,2	119,5	69,6	92,6		
2004	96,1	78,5	77,2	119,5	69,4	92,6		
2005	96,1	78,5	77,2	119,5	69,2	92,6		
2006	96,1	78,5	77,2	119,5	69	92,6		
2007	96,1	78,4	77,2	119,5	68,9	92,6		
2008	96,1	78,4	77,1	119,5	68,7	92,6		
2009	96,1	78,4	77,1	119,4	68,5	92,6		
2010	96,1	78,4	77,1	119,4	68,3	92,6		
2011	96,1	78,4	77,1	119,4	68,1	92,6		
2012	96,1	78,4	77,1	119,4	67,9	92,6		
2013	96,1	78,4	77,1	119,4	67,7	92,6		
2014	96,1	78,4	77,1	119,4	67,6	92,6		
2015	96,1	78,4	77	119,4	67,4	92,6		

Estimates of change of organic carbon stock in soil due to land conversion to a new land cover type

Land conversion		Net area change	Soil d	(2000 - 2015)				
From	То	km²	Initial SOC stock (t/ha)	Final SOC stock (t/ha)	Initial SOC stock total	Final SOC stock total	SOC stock change (t)	
Cropland	Artificial 星	1.534	69	51,3	10.562.319	7.848.936	-2.713.383	1
Tree-cov 🗸	Croplanc	178	84,1	76,1	1.500.714	1.358.307	-142.407	
Grasslan	Artificial 🗗	36	68,9	51,3	247.518	184.176	-63.342	
Tree-cov 🗸	Artificial 星	30	85,2	65,8	252.216	194.913	-57.303	
Add row								

#### ESA Climate Change Initiative Land Cover Dataset [CCI-LC] v2.0.7, ISRIC SoilGrids 250m



#### SOC(1992)@hu & CLC changes

	Soil organic carbon stock in topsoil (t/ha)							
Year	Tree-covered areas	Grassland	Cropland	Wetland	Artificial surfaces	Other Land		
2000	41,1	49,5	50,5	62,4	11,6	53,3		
2001	41,1	49,4	50,5	62,5	11,6	53,3		
2002	41,1	49,4	50,6	62,5	11,6	53,3		
2003	41,1	49,3	50,6	62,6	11,6	53,3		
2004	41,2	49,3	50,6	62,7	11,6	53,3		
2005	41,2	49,2	50,7	62,8	11,6	53,3		
2006	41,2	49,1	50,7	62,8	11,6	53,3		
2007	41,2	49,1	50,7	62,9	11,6	53,2		
2008	41,2	49	50,8	63	11,6	53,2		
2009	41,2	49	50,8	63,1	11,6	53,2		
2010	41,2	48,9	50,9	63,2	11,6	53,2		
2011	41,2	48,9	50,9	63,2	11,6	53,2		
2012	41,3	48,8	50,9	63,3	11,6	53,2		
2013	41,3	48,7	51	63,4	11,6	53,2		
2014	41,3	48,7	51	63,5	11,6	53,2		
2015	41,3	48,6	51	63,6	11,6	53,2		



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# SOC changes attributed to LU/LC changes



Corine Land Cover Change maps were used to derive the GSOC estimations for the base year (2000) as well as for the target year (2012) from the original SOC map (representing 1992). SOC change was estimated by the difference of the two predictions.

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Land conversion		Net area change	Soil o	(2000 - 2015)				
 From	То	km²	Initial SOC stock (t/ha)	Final SOC stock (t/ha)	Initial SOC stock total	Final SOC stock total	SOC stock change (t)	
Tree-cov 🔽	Tree-cov	6,62	22,6	22,6	14.961	14.961	0	啬
Grasslan	Tree-cov	961,65	39,17	39,17	3.766.361	3.766.361	0	窗
Cropland	Tree-cov	104,54	30,58	35,29	319.684	368.898	49.214	盲
Wetland 🛃	Tree-cov	0,28	44,61	44,61	1.249	1.249	0	窗
Artificial 🔽	Tree-cov	1,03	2,66	4,31	274	444	170	<b></b>
Tree-cov 🔽	Grasslan	1.422,06	38,24	38,24	5.437.421	5.437.421	0	盲
Grasslan	Grasslan	171,57	44,07	44,07	756.177	756.177	0	窗
Cropland	Grasslan	1.044,04	42,37	48,84	4.424.107	5.099.198	675.091	窗
Wetland 🗸	Grasslan	1,45	47,69	47,69	6.915	6.915	0	<b></b>
Artificial 🔽	Grasslan	20,93	24,03	38,67	50.295	80.942	30.647	窗
Tree-cov 🔽	Cropland	2,81	44,47	38,99	12.496	10.955	-1.541	窗
Grasslan	Cropland	321,25	52,85	46,46	1.697.744	1.492.668	-205.076	盲
Cropland	Cropland	560,29	38,36	38,36	2.149.172	2.149.172	0	啬
Wetland 🗸	Cropland	0,36	85,08	70,31	3.063	2.531	-532	Ē
Artificial 💽	Cropland	1,25	27,6	44,34	3.450	5.543	2.093	盲
Grasslan	Wetland 🚽	4,9	20,25	20,25	9.922	9.922	0	啬
Tree-cov 🔽	Artificial 🔽	10,67	16,47	1,44	17.570	1.537	-16.033	Ē
Grasslan	Artificial 🛃	46,54	16,55	1,51	77.022	7.044	-69.978	啬
Cropland	Artificial 🔽	191,09	14,92	1,34	285.115	25.698	-259.417	Ē
Wetland 🗸	Artificial 🔽	1,56	28,55	2,67	4.454	417	-4.037	Ē
Artificial 🔽	Artificial 🔽	49,42	10,05	10,05	49.665	49.665	0	Ē
Add row								

water bodies & settlements



#### TAKE HOME MESSAGE

- Spatial assessment of LDN SO1-3 (trends in carbon stocks above and below ground) supposes the availability of proper DSM products;
- SOC stock map compiled using local (at most regional; as opposed to global) data can provide more accurate estimates at national level;
- Spatial information on LC/LU changes can and should be used in SOC mapping and monitoring;
- We recommend applying the SOC stock map of 1992 as baseline to track and assess SOC stock change in Hungary.



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THANK YOU FOR YOUR ATTENTION