

The Grassmind Model Extension

Description of Usage in CANDY

Introduction

With the GRASSMIND model the CANDY model can simulate populations of plant species instead of single crops in the field management.

This document describes the details to use the GRASSMIND (Taubert 2014) model.

The combination of CANDY and GRASSMIND is still on a test level and is to be improved in some details to make the usage easier.

Requirements

Using the GRASSMIND model requires the additional file forgrassmind.dll in the same program directory as the CANDY.exe.

Furthermore several GRASSMIND specific parameter tables have to exist in the database:

GRASSMIND_PAR:	parameters of all selectable species
GRASSMIND_POPLIST:	definition of all populations usable for the field management
GRM_CROP:	composition of the populations with abundance of single species

Description of use

All populations in GRASSMIND_POPLIST need to be added as well to the table CDYPFLAN with the same *item_ix* and *name*. Further obligatory attributes in CDYPFLAN are: *art=-1*, *modell='GRASSMIND'* and *n_gehalt=1*.

The litter from a GRASSMIND population has still fixed properties and is to be defined in CDYOPSPA. The database demo_grm.mdb contains the record with *item_ix*=900 that is linked to the litter attributes (green, straw, root) in GRASSMIND_POPLIST and should not be changed with the current GRASSMIND version (Figure 1, red box).

The usage of GRASSMIND requires the definition of a certain plant population (Figure 1). Replace the "?" in the edit field with a new population name and add single species together with their abundance (as weights) in the data grid. The properties of existing populations can be changed after selection from the pop down menu. The litter quality of the population is up to now restricted to the grassmind_litter record in the CDYOPSPA table.

CANDY - user interface	MT DATABASE - Parameters
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ Datapath: D:Ldateri.dejzii./XESk.dy.gm.dyn ?	General parameters Actions Soil Profiles Crop-Parm Grassland + 1877 Grassland DM-Parm Fertilizers Properties ResultDiplects T_model SBA parameters ACCESS-DATABASE
Plot Selection	define new Litter (root) grassmind_inter 💌
Parameters	
Check <u>R</u> esult Tables	Name abundance art_id alias ▲ ▶ vitual species light 12 3 viti
Climate Data	vitus species user 12 3 van vitus species valer 12 1 vava
SQL - module	virtual species nitrogen 12 2 vsni
	Festuca pratensis 12 0 fest
Change Database	
Change Data P <u>r</u> ovider	
system database	
Provider-Microard-Lief OLEB 4.0. Uare ID-Adda Data Source-O'Adarn Adelphi X-55-odygm.dgm/cdygm/cdygm. Mode Scale Ores Note: 	H H + - A V X C check species parameters End
2015 Version: 3.20.15.91 //	

Figure 1: Activate the [GrassMind] sheet within the CANDY parameters (blue boxes) to edit the properties of a population with different species.

Properties of single species can be checked or edited after clicking [check species parameters] in the form shown in Figure 2.

species parametrisation	check mode		×
virtual species light	name •	? Create new	
Geometry Overlap factor Allocation rate to shoot Height-Wildth-Ratio correction factor shoot Max. height [cm] SLA [cm²/g]	1 0.54 2 0.002 120 176	Recruitment and Establishment Seed Biomass (g odm) 0.0018 Germination rate 0.3 Days to Emergence [d] 14 min. Age for Start of Recruitment [y] 0.055 min. height of seedlings [cm] 3	Growth Max. Grossphotosynthese [µmol/µ ² /s] 25 Slope Light-Response-Curve [µmol/µmol] 0.06 Light-Extinction-Coefficient 0.4 light transmission coefficient 0.1 maintenance respiration rate [/d] 0.02 growth respiration factor 0.25
Shoot-Root-Ratio Specific Root Length [cm/g] Rooting Depth ~ Shoot Bioma Intercept Exponent		Competition Water-Use-Effidency [g ODM/kg H20] 4 Nitrogen-Use-Effidency [g ODM/kg N] 350000 C:N ratio of shoot 23.5 symbiotische Stickstofffixierung	Mortality Seeding mortality [/y] 30 Annual Basic mortality [/y] 0.02 Bi-Annual Leaf life span [d] 100 Perennial V Root life span [d] 709
			dose

Figure 2: Parameterisation of single species

If a population with all species is properly defined it can be activated like any other crop with a sowing action in the management data (Figure 3). The input of a yield is not required - the value in this field has no meaning for the simulation.

Com DATABASE - plot selection				- • ×
Y:\Gruppen\bophy\Projecgrassmind\demo_grm.mdb Go grami	Basic-Info	Management	Experimental Values	
😟 🖶 files	10: test	\checkmark	crops 🗹 min.frt. 🗹 org.am. 🗹 tillage	🗸 irrigtn. 🖌 pest.am. 🖌 grazing
i plots □10: test	DATE	ACTION	SUBJECT	INTENSITY UNIT
trgmf	▶ 11.02.2000	(sowing)	Blumenwiese	0 dt/ha
	16.04.2000	mineral N fertilizer	calcium ammonium nitrate	125 kgN/ha
	Manageme • Insert F 11.02.200	Record Oven	write Record (sowing)	*
		Subject	Blumenwiese	•
		yield goal	0 dt/ha N-uptake (kg/l	ha)= 0
End	pri	nt	delete record	insert

Figure 3: Integration of a GRASSMIND population in the management data

The result assessment for the single species requires a special preparation: please add the key 'debug' with the value 'xlsgrm' in the registry of candy switches (this is recommended only for experienced windows users).

a 🔒 candy	10 CIPS	REG_DWORD	0x000000
switches	ab debug	REG_SZ	xlsgrm

Figure 4: Registry record required to get an EXCEL output for all species

Now CANDY will fill an EXCEL sheet during the simulation run with selected properties of the species within a population: coverage, dry matter, rooting depth and plant height.

Attention, please wait until the simulation run is finished before using the created EXCEL sheet.

() v) ~ (v)	- ∥≂							Mapp	el - Micr	rosoft Exce									
Datei St	art	Einfüge	n Seit	tenlayout	Form	eln D	aten	Überprüfe	en An	nsicht	Entwickle	rtools	Acrobat				۵	3 - 0	7
Einfügen	Ŧ	Calibri		* 11 ·	A A	= =	- »	-	Stand			ngte Form abelle fori	atierung • matieren •		nfügen 🝷 schen 🍷	Σ - -	27	Suchen	
- v		F K	<u>u</u> - []	- 🏻	• <u>A</u> •	EE	≣ ≇	# e	,00 4	.00 •,0	🚽 Zelle	nformatvo	rlagen *	🗒 Fo	rmat *			 Auswähl 	
vischenablag	e 154		Schrifta	art	Fai	Au	usrichtung		🖬 Za	hi G	F	ormatvoria	gen	Z	ellen		Bearbe	iten	
J46		(•	f_{x}															
- A	В	С	D	E	F	G	Н	1	J	K	L	M	N	0	P	Q	R	S	
			vsli_cover			vsli_height				vswa_heig					fest_cover			fest_height	¢
09.05.200	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10.05.200	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12.05.2002	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13.05.200	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
14.05.200	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15.05.200;	4	0.00299	0.04574	40.6001	9.19315	0.03053	0.04561	40.4262	18.3625	0.03048	0.04561	40.4262	9.18127	0.03048	0.04561	40.4262	9.18127	0.03048	
16.05.200;	4	0.00314	0.04797	43.5875	9.38953	0.03126	0.04772	43.2451	18.7345	0.03118	0.04764	43.1464	9.36078	0.03115	0.04764	43.1464	9.36078	0.03115	
17.05.200;	4	0.00335	0.04903	45.032	9.47978	0.03161	0.04924	45.3199	18.9961	0.03167	0.04861	44.4498	9.44266	0.03147	0.04861	44.4498	9.44266	0.03147	
18.05.200;	4		0.04948	45.6259	9.51478	0.03175	0.05019	46.6239	19.1543	0.03198	0.04901	44.9787	9.47388	0.0316	0.04901	44.9787	9.47388	0.0316	
19.05.200;	4	0.00352	0.0506	47.1769	9.60879	0.03211	0.05124	48.0717	19.3269	0.03231	0.05003	46.3769	9.55935	0.03192	0.05003	46.3769	9.55935	0.03192	
20.05.200	4		0.05138	48.2564	9.67214	0.03235	0.05196	49.0765	19.443	0.03254	0.05074	47.3473	9.61681	0.03215	0.05074	47.3473	9.61681	0.03215	
21.05.200;	4	0.00371	0.05167	48.6382	9.6926	0.03244	0.05223	49.4338	19.4804	0.03262	0.05099	47.6877	9.63506	0.03223	0.05099	47.6877	9.63506	0.03223	
22.05.200	4	0.00373	0.05189	48.9303 49.0194	9.70756 9.71027	0.03251	0.05252 0.05262	49.8251 49.9554	19.5217 19.5318	0.03271	0.05119	47.9472 48.0251	9.64829 9.65041	0.03229	0.05119	47.9472 48.0251	9.64829 9.65041	0.03229	
23.05.200	4	0.00375	0.05136	49.2813	9.72334	0.03254	0.05262	43.3554	19.5579	0.03274	0.05126	48.2588	3.65041	0.03232	0.05126	48.2588	3.65041	0.03232	
25.05.200	4		0.05246	49.6835	9.74472	0.03269	0.05311	50.6149	19.5991	0.03289	0.05171	48.6178	9.68115	0.03246	0.05171	48.6178	9.68115	0.03246	
26.05.200	4	0.0038	0.05309	50.5677	9.79444	0.03289	0.05382	51,6079	19,7098	0.03311	0.05228	49.407	9,726	0.03263	0.05228	49.407	9,726	0.03263	
27.05.200	4		0.05481	53.0397	9.93497	0.03342	0.05542	53,9148	19.9682	0.0336	0.05383	51.6158	9.85358	0.03312	0.05383	51.6158	9.85358	0.03312	
28.05.200	4	0.00403	0.05723	56.5813	10.1295	0.03415	0.05765	57.2077	20.3262	0.03427	0.05601	54.7692	10.0303	0.03378	0.05601	54.7692	10.0303	0.03378	
29.05.200	4	0.00429	0.05966	60.2162	10.3205	0.03486	0.0599	60.5696	20.6769	0.03493	0.05819	57.9897	10.2035	0.03443	0.05819	57.9897	10.2035	0.03443	
30.05.200	4		0.06267	64.8312	10.5522	0.03573	0.06267	64.8142	21.1019	0.03573	0.06088	62.0555	10.4133	0.03522	0.06088	62.0555	10.4133	0.03522	
31.05.200;	4	0.00487	0.06616	70.3217	10.8137	0.03671	0.06586	69.8319	21.5805	0.03663	0.06398	66.8624	10.6497	0.0361	0.06398	66.8624	10.6497	0.0361	
01.06.200;	4		0.06989	76.347	11.0846	0.03773	0.06926	75.3014	22.0757	0.03756	0.06728	72.103	10.8943	0.03702	0.06728	72.103	10.8943	0.03702	
02.06.200	4	0.00567	0.07275	81.0672	11.2859	0.0385	0.07185	79.5563	22.4422	0.03826	0.0698	76.1802	11.0753	0.03771	0.0698	76.1802	11.0753	0.03771	
03.06.200	4	0.006	0.0744	83.8316 84.4545	11.3986 11.4212	0.03893	0.07334	82.0368 82.6516	22.6469 22.6923	0.03865	0.07126	78.5581 79.0921	11.1764 11.1965	0.0381	0.07126	78.5581 79.0921	11.1764 11.1965	0.0381	
04.06.200	4	0.00619	0.07479	84.4545	11.5065	0.03903	0.07373	82.6516	22.6323	0.03876	0.0716	79.0921	11.2727	0.03819	0.0716	80.9435	11.2727	0.03819	
05.06.200	4		0.11786	124,568	10.4201	0.03537	0.07436	122.94	20.7874	0.03945	0.10088	106.702	10.5133	0.03885	0.07272	106,702	10.5133	0.03885	
07.06.200	4	0.00885	0.1208	129.348	10.5308	0.04033	0.12027	128.048	21.0445	0.03997	0.10325	110.543	10.6194	0.03935	0.10325	110.543	10.6194	0.03935	
08.06.200	4	0.00918	0.12399	134,419	10.6541	0.04083	0.12318	132.646	21.2697	0.04042	0.10572	114,472	10.7318	0.0398	0.10572	114.472	10.7318	0.0398	
08.06.200	4	0.00951	0.12675	138.858	10.759	0.04126	0.12569	136.662	21.4611	0.04081	0.10785	117.899	10.8271	0.04018	0.10785	117.899	10.8271	0.04018	
10.06.200;	4	0.0098	0.12832	141.38	10.8162	0.0415	0.12712	138.931	21.565	0.04103	0.10906	119.839	10.8789	0.0404	0.10906	119.839	10.8789	0.0404	
A P P Ta	abelle	1 / Tabe	elle2 / Ta	abelle3 🏒	87/						I 4				Ш				
reit 🔚																70 % (-) —		-(+)

Figure 5: Example of an EXCEL output

Literature

Taubert, F. (2014). Modelling and Analysing the Structure and Dynamics of Speciesrich Grasslands and Forests, Dissertation, University of Osnabrück. (https://www.ufz.de/export/data/global/56771_ufz-phddiss_05_2014_.pdf)