

# DIMO 1.0.1.0 Manual



# **DIMO 1.0.1.0 Manual**

**A.H. Malinowska  
J.G.M. van der Gref-van Rossum  
G.W.W. Wamelink**

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## ABSTRACT

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DIMO 1.0.1.0 is a plant dispersal model. It simulates plant dispersal in time, given (abiotic) suitability and species-specific characteristics. DIMO comprises three main processes: seed dispersal, seed-bank degradation and germination. The Manual for DIMO 1.0.1.0 consists of instructions on how to install the program, prepare the input data, run the model and uninstall the program.

Keywords: dispersal model, plant, animal, seedbank, wind, germination delay, climate change, habitat suitability

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P.O. Box 47; 6700 AA Wageningen; The Netherlands

Phone: + 31 317 480700; fax: +31 317 419000; e-mail: [info.alterra@wur.nl](mailto:info.alterra@wur.nl)

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# 1 Introduction

DIMO 1.0.1.0 is a plant dispersal model. It simulates plant dispersal in time, given (abiotic) suitability and species-specific characteristics, e.g. different dispersal types, dispersal distances and seed longevity.

DIMO can be used as a stand-alone model, and as part of the model chain SMART/SUMO – MOVE – DIMO.

- ◇ As a stand-alone model, DIMO simulates plant dispersal based on initial plant and seed-bank distribution, an (abiotic) suitability map and species-specific parameters.
- ◇ As part of the model chain, DIMO refines the chance-of-occurrence maps which result from MOVE. In short: MOVE calculates the chance-of-occurrence for a species, based on abiotic conditions, after which DIMO refines these maps by calculating the ability of a plant species to actually colonize a suitable spot. Hence DIMO may set the chance-of-occurrence for a plant species on a suitable location to zero when this location is not (yet) within reach of currently occupied locations. Colonization can either occur from dispersal or from the seed bank.

DIMO comprises three main processes: seed dispersal, seed-bank degradation and germination (fig. 1). These processes are performed after each other, and together form one run year. Species specific parameters required by these processes should be entered in a database. For more background information see Wamelink et al. (in prep) or van der Grefte-van Rossum et al. (in prep).

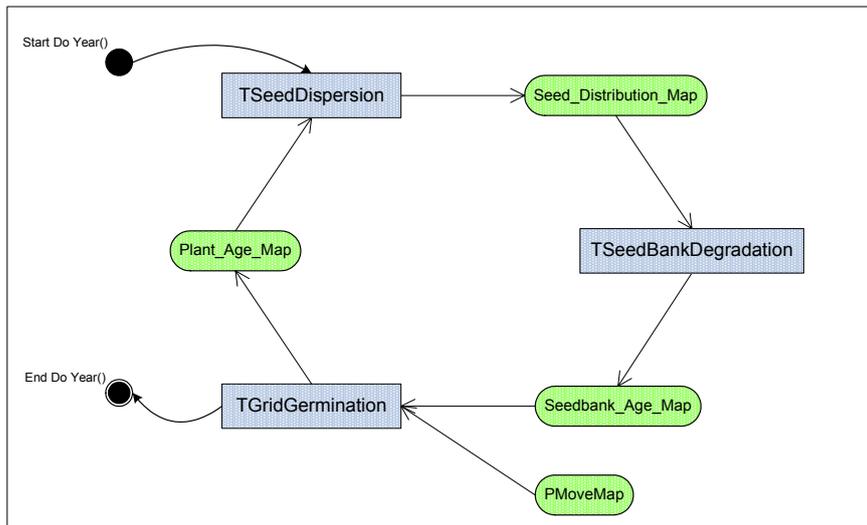


Figure 1. Main processes in DIMO: seed dispersal, seed-bank degradation and germination. Ovals indicate maps, rectangles indicate processes.



## 2 Installation

### 2.1 Installation Wizard

There are three components that have to be installed for running the model:

- ◇ DIMO/IMODS,
- ◇ Firebird database server and
- ◇ Borland Database Engine.

If you have been working already with LARCH or other models that require Borland Database Engine, Firebird and Property Service, you only need to install DIMO itself using the file `setup_DIMO_sec.exe`. In case you do not have any of these components, you should run the full installation with `setup_DIMO_full.exe`. In this case installation of the other two components is a part of the DIMO installation process.

To install the program double click the setup file. The setup wizard will guide you through the installation process. You will be asked where the program should be installed, the default path may be changed (fig. 2).

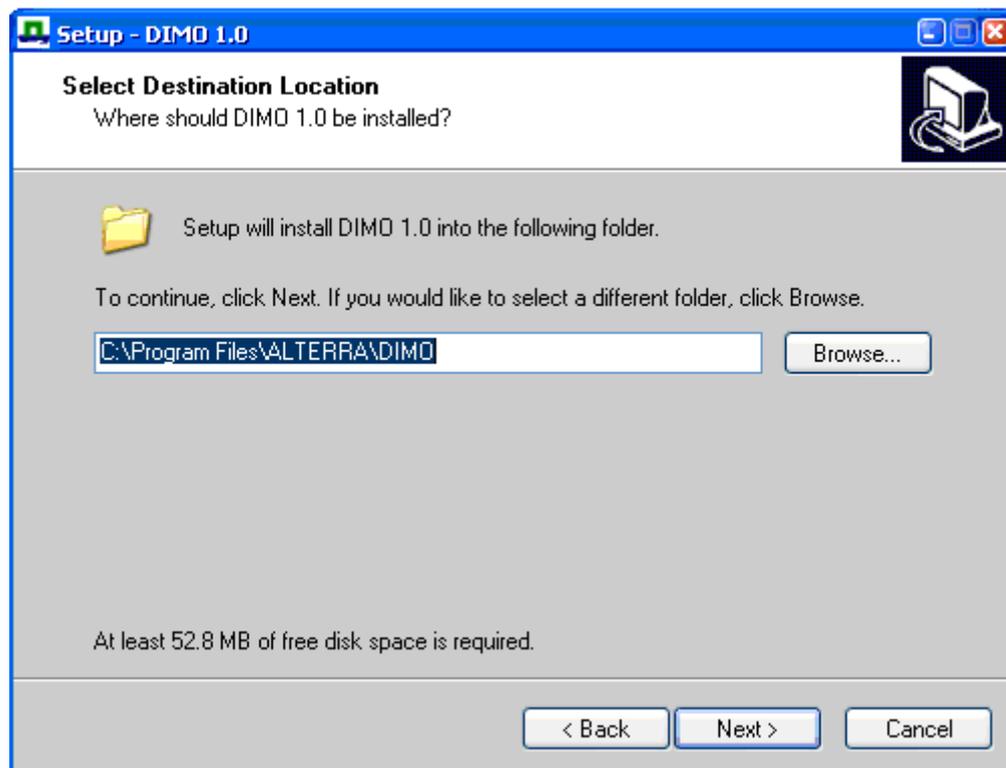


Figure 2. Installation wizard, default path for program installation.

Then click 'OK' and 'Next' throughout the installation. In the full installation process Firebird database server (fig. 3 left) and Borland Database Engine (fig. 3 right) installation will start automatically.

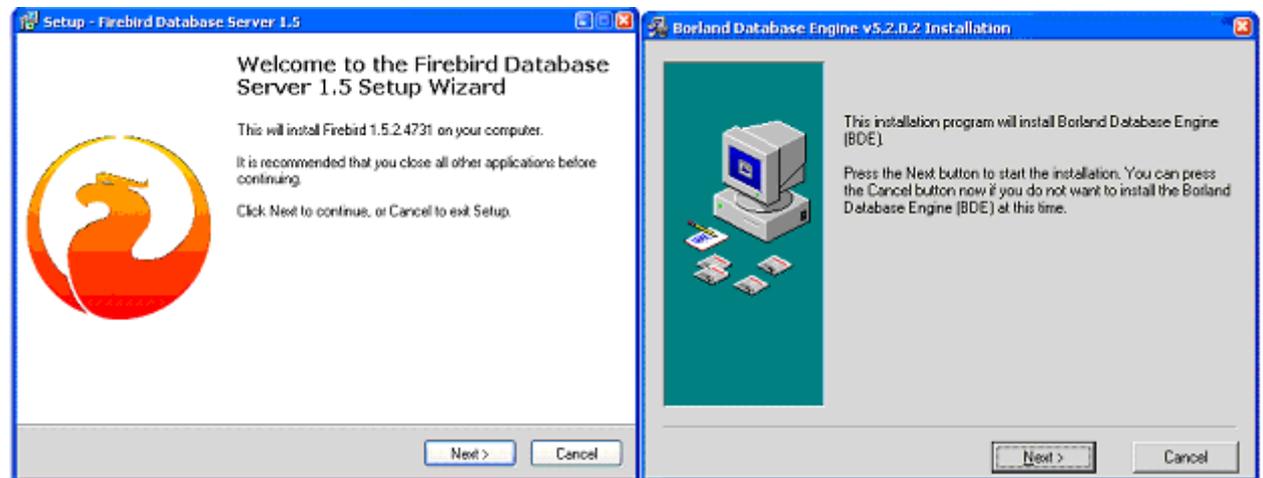


Figure 3. Other DIMO components: Firebird database server (left) and Borland Database Engine (right).

## 2.2 BDE configuration

During the full installation, after Borland Database Engine is installed, the BDE Admin window pops up (fig. 4). Then you have to:

- select the tab 'Configuration'
- select Drivers \ Native \ dBase
- change 'LEVEL' to '4'
- change 'LANGDRIVER' to 'dBase ENU cp437'
- save changes by clicking 'Apply' button (the blue arrow pointing right, fig. 5)
- close the window

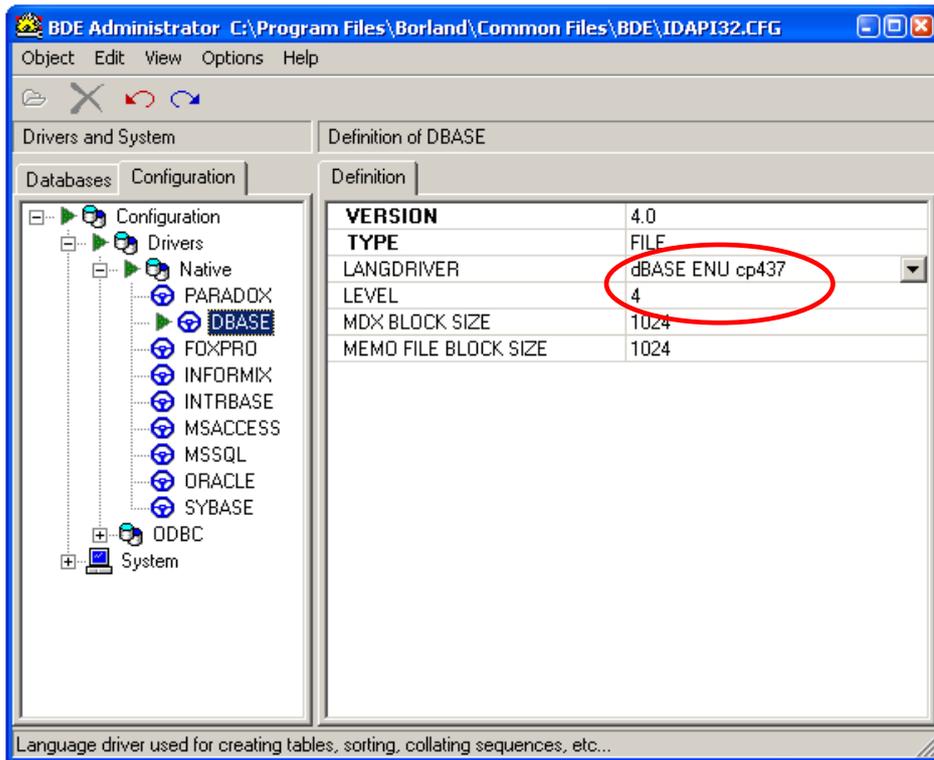


Figure 4. BDE Admin window, necessary changes are indicated in red.

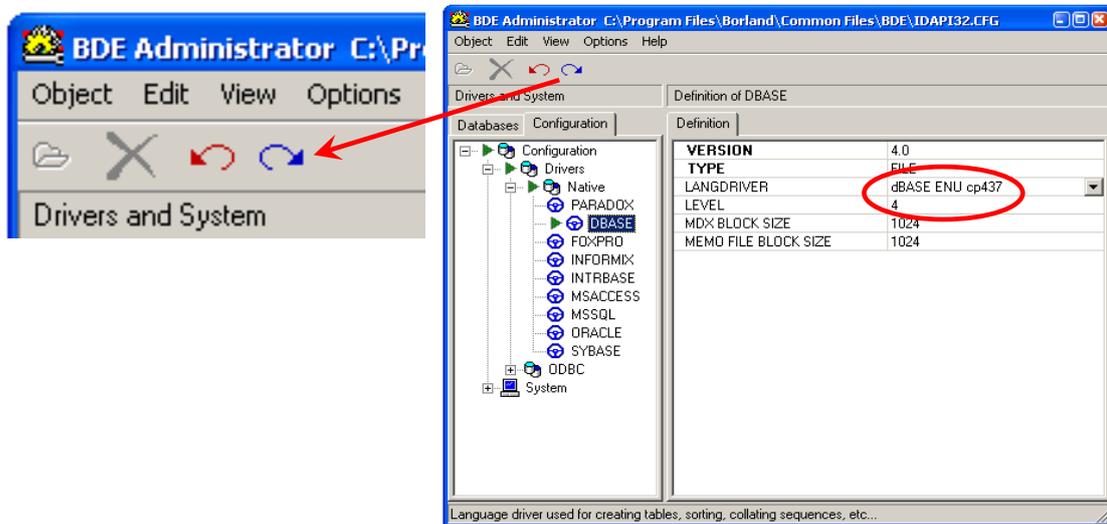


Figure 5. BDE Admin window, 'Apply' button.

If, for any reason, this window does not show, go to `C:\Program Files\Common Files\Borland Shared\BDE` and open the file `bdeadmin.exe`.

Next, continue the installation. During setup a sample project will be installed in `C:\Program Files\ALTERRA\DIMO\Examples`. After the installation is completed, you will have to restart your computer.

## 2.3 Regional Options

After DIMO is installed, make sure that the decimal separator is set to a point and the digit grouping symbol is a comma. To check it, go to (fig. 6):

- Start \ Settings \ Control Panel \ Regional and Language Options
- tab Regional Options \ 'Customize...'
- tab Numbers

Set Decimal symbol to '.'

Set Digit grouping symbol to ','

Click 'OK'

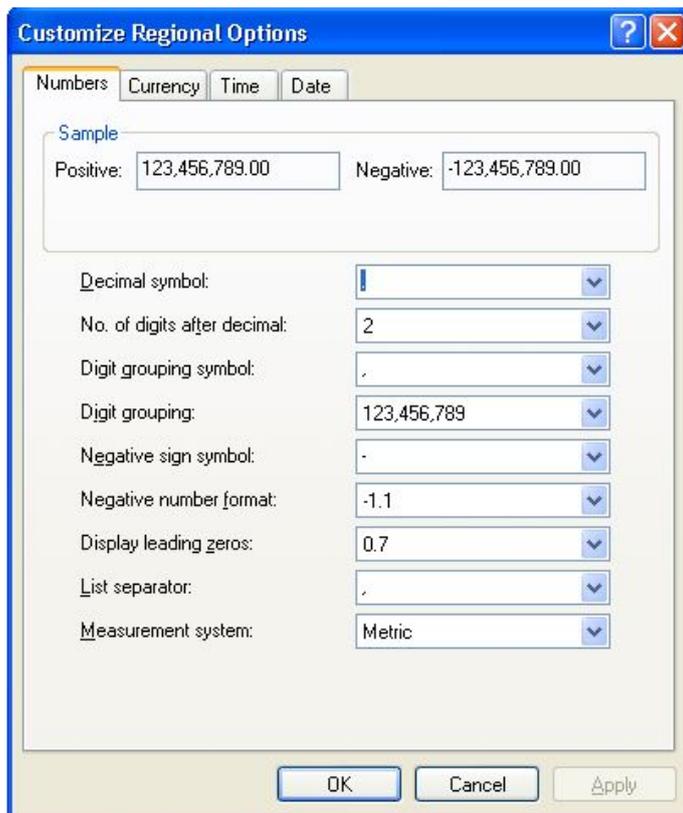


Figure 6. Regional options window.

## 2.4 Program check

To check if the program is installed correctly, run example.mds, installed default in C:\Program Files\ALTERRA\DIMO\Examples (unless you changed the path during the installation process).

### 3 Data preparation

#### 3.1 Database - New project

In order to prepare the data for a model run go to:

- Start \ Programs \ DIMO \ Property Data

To create a new project you have to fill out a minimum of 1 project data set and 1 plant set.

Select: Project \ New (fig. 7)

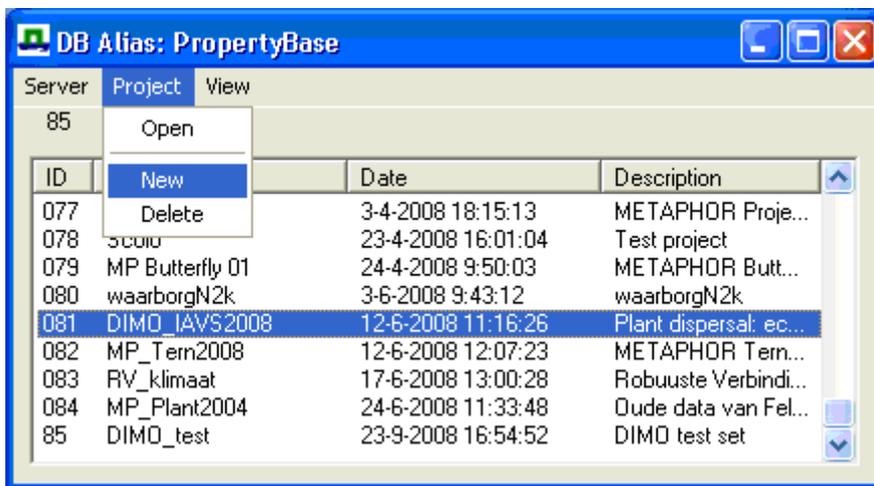


Figure 7. PropertyBase of DIMO.

Fill out project information (fig. 8)

- Project Name
- Description

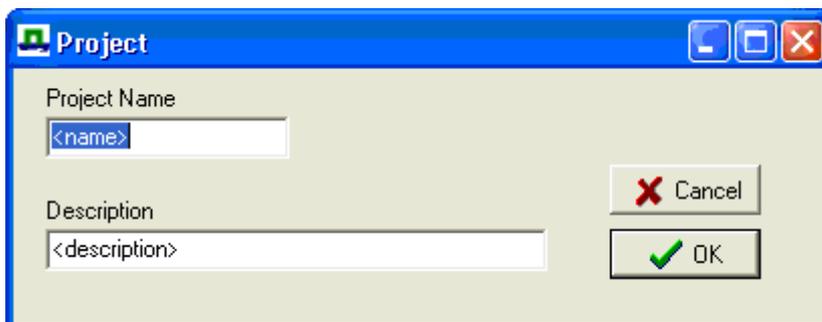


Figure 8. Creating a new project.

Click 'OK'. The new Project window pops up.

### 3.1.1 Project data set

Each project has a project data set, where the general information about the project is stored.

Select Property Set \ New \ Project Data (fig. 9)

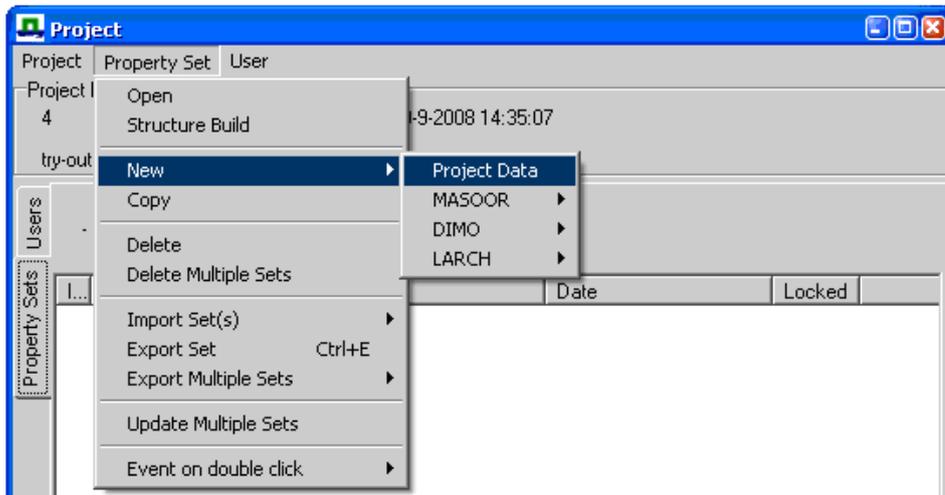


Figure 9. Entering new project data.

Fill out the Project Data set (fig. 10)

- Select Model: select DIMO
- Fill out all the boxes according to your project
- Choose an interface language from the drop-down menu (currently only English available)

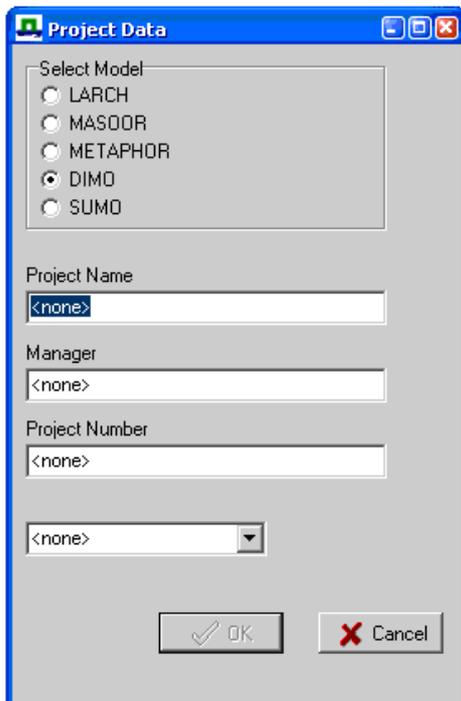


Figure 10. Project Data set

Click: 'OK'

By double clicking the data set 'ProjectData' in the 'Project' window you can edit these data (fig. 11). In the 'Species' tab, you can add all species you use in your project (fig. 12). For addition of the species parameters see 3.2.

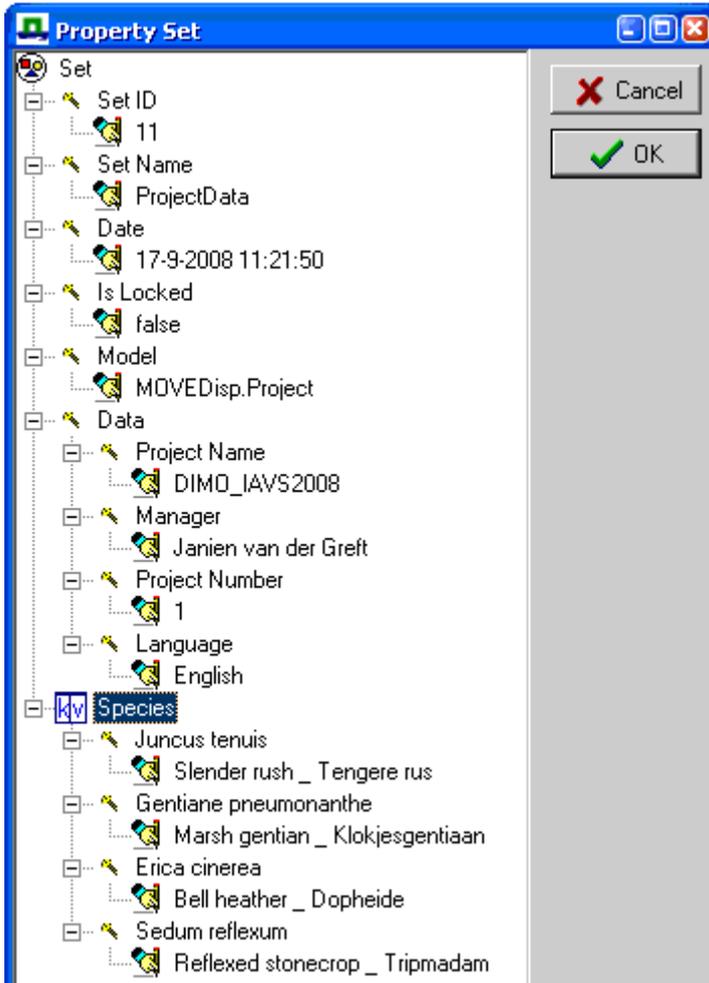


Figure 11. Property window of Project Set

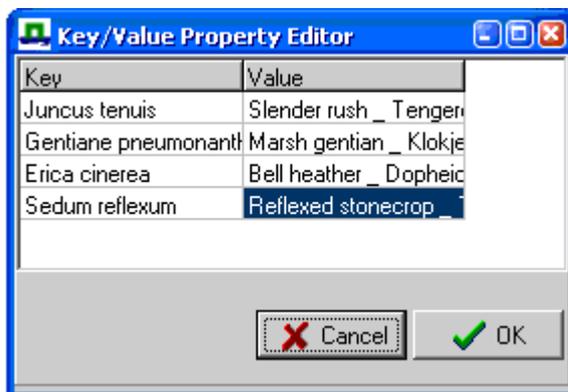


Figure 12. Editing species key/value

### 3.2 Database - Plant species set

For every species in the model a separate species set has to be created.

Select Property Set \ New \ DIMO \ Plant species (fig. 13)

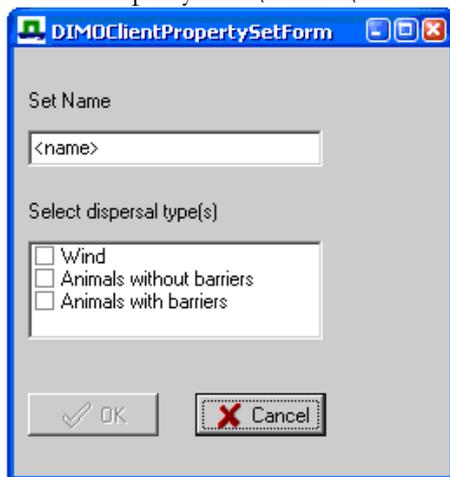


Figure 13. Entering new species in the project

Fill out the plant data

- Name
- Types of dispersal (will be reflected in species set)

Click: 'OK'

Each plant species property set contains species-specific parameters necessary for DIMO (fig. 14). By double clicking on a parameter value you can edit it.

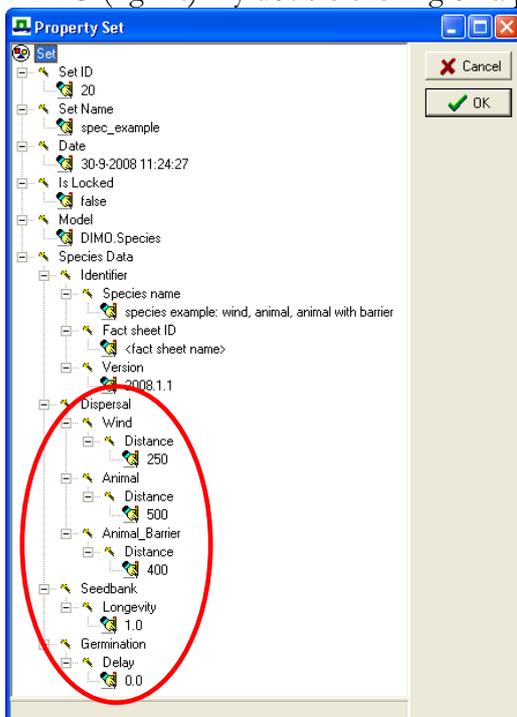


Figure 14. Plant species set. Shown in the red oval are the species-specific parameters necessary for DIMO.

### 3.2.1 Dispersal

The first process in the DIMO run year is the actual dispersal process. Starting with a user-given plant-age map (see 3.3), the dispersal is calculated. The dispersal depends on the occurrence of the plant species, the dispersal type and distance of the plant species and the age of first flowering. The result of the dispersal process is a seed-distribution map.

DIMO can currently use 3 different dispersal processes, or dispersal types, either separate, or in all possible combinations:

- Wind: fixed distance, without barriers;
- Animal: fixed distance, without barriers;
- Animal\_Barrier: fixed distance with barrier compartments.

Parameters for dispersal types are found in the database under:

- 'Dispersal -> Wind -> Distance';
- 'Dispersal -> Animal -> Distance';
- 'Dispersal -> Animal\_Barrier -> Distance'.

All the dispersal distances are in meters/year. For dispersal distance the 99 percentile of the long distance dispersal can be taken.

Age of first flowering: this option is not yet fully implemented. A work-around is to enter the value of this parameter to the germination delay. This parameter is found in the database under 'Germination -> Delay'. For further description: see Seed-bank degradation (3.2.2).

### 3.2.2 Seed-bank degradation

The second process in the DIMO run year is the seed bank degradation process. The seed-distribution map of the dispersal process is integrated in the user-provided seed-bank-age map, and aging of the seeds is calculated by reducing the remaining seed longevity. The result of the seed-bank-degradation process is a refreshed seed-bank-life map.

For this process the parameter seed longevity is used: the number of years a seed can survive in the seed bank. In the database: 'Seedbank -> Longevity', in years (integer values). Its constraints are:

- seed longevity in years > germination delay in years;
- seed longevity > 0, else no seeds will germinate.

### 3.2.3 Germination

The third process in the DIMO run year is the seed germination process which is combined with plant ageing. Seed germination requires active seeds and a suitable

location. Ageing occurs on all cells (newly) occupied by plants. The result of the germination plus ageing process is a refreshed plant-age map.

Seed germination in a cell can occur when seeds are available which have finished the germination delay process (seeds are produced and not dormant anymore) and the cell habitat is suitable. Habitat suitability is read from the user-given suitability map. For LARCH-type suitability maps, an additional suitability restriction can be formed by maximum biomass in grassland habitats.

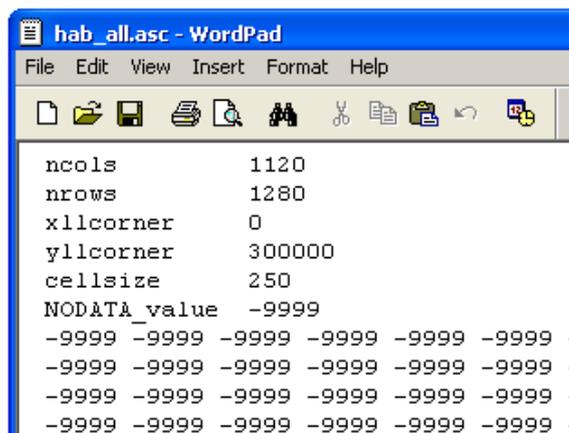
The plant ageing process sets plant age = 1 year in newly occupied cells and plant age +1 in cells with existing plants.

In the germination process the parameter Germination delay is used: the number of years a seed should minimally remain in the seed bank (dormancy) before germination is possible. In the database: 'Germination -> Delay', in years (integer values). Its constraints are:

- seed longevity in years > germination delay in years;
- germination delay >= 0.

### 3.3 Input maps

The next step is to prepare input maps. DIMO works with ascii or binary grids (\*.asc or \*.flt). The header in each map file has to be the same, i.e. maps have to have the same size, resolution and other parameters. 'No data' should be preferably set at -9999 (fig. 15).



```
ncols      1120
nrows      1280
xllcorner   0
yllcorner  300000
cellsize    250
NODATA_value -9999
-9999 -9999 -9999 -9999 -9999 -9999 -
-9999 -9999 -9999 -9999 -9999 -9999 -
-9999 -9999 -9999 -9999 -9999 -9999 -
-9999 -9999 -9999 -9999 -9999 -9999 -
```

Figure 15. Example of a map header.

To run the model, the following maps are required:

- ◇ Plant age map: map with initial plant occurrence. Cell values represent the number of years the species has occupied the cell consecutively till the initial year. Cells without plants may have value = 0 or -9999, cells with plants have an integer value >0.

- ◇ Seed-bank-life map: map with initial seed-bank life. Cell values represent the number of years seeds have left to germinate in that cell. Cells with no seeds left may have value = 0 or -9999, cells with a seed bank have an integer value >0.
- ◇ Habitat suitability map: map which indicates the suitability for a plant species to germinate and to grow. Cell values should be either 0 (not suitable) or >0 (suitable). Note: all real values > 0 are considered suitable.
- ◇ Barrier map (only with the 'Animal\_Barrier' dispersal option). A barrier map consists of 'barrier compartments': connected cells with the same value.

To create a barrier map:

1. take/create an appropriate vector barrier map (fig. 16 left)
2. convert this vector barrier map into a barrier compartment grid (when in doubt, consult your GIS-specialist) (fig. 16 right)

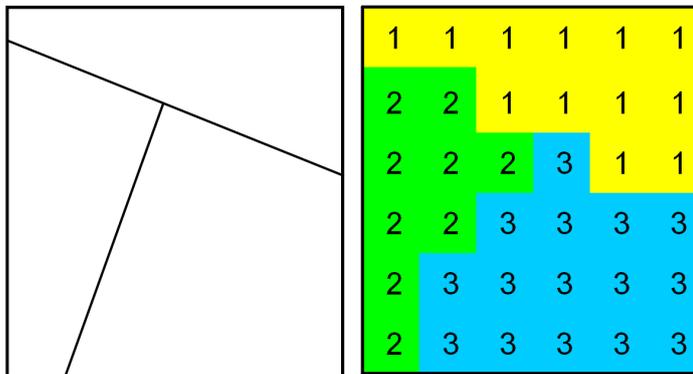


Figure 16. Example of a vector barrier map (left) converted to a barrier compartment grid (right).

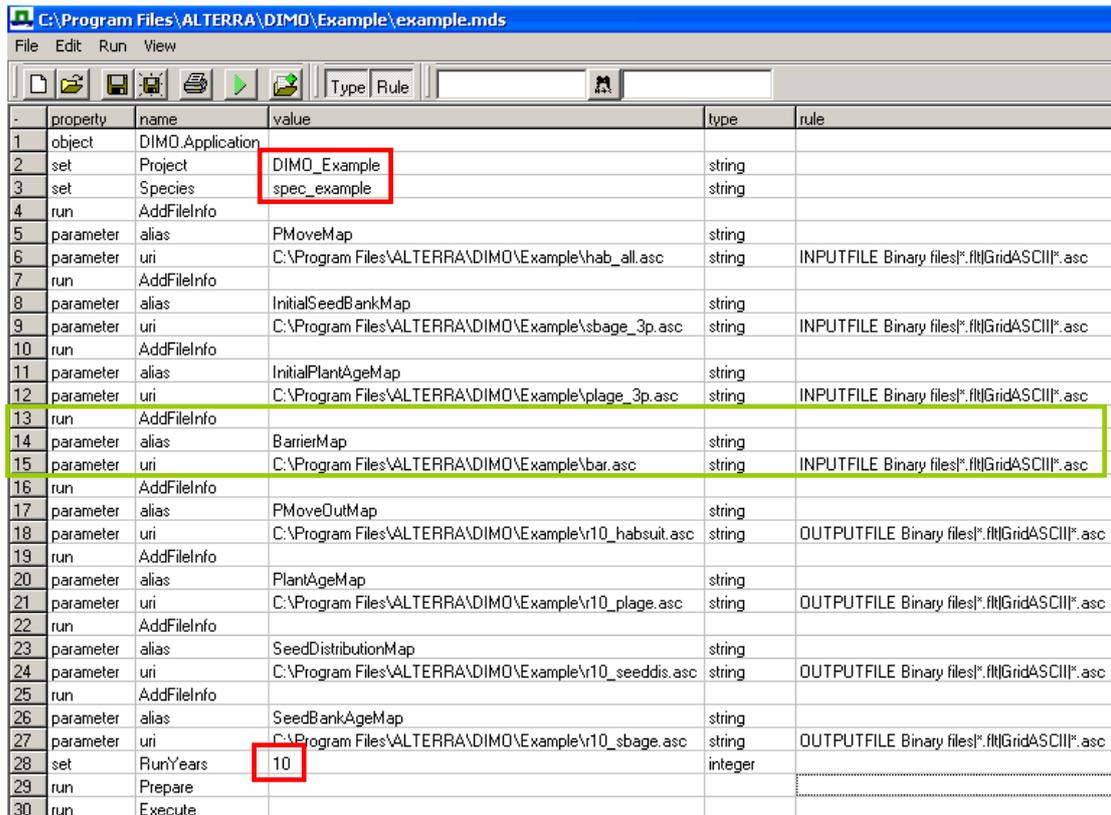
Grid cells with the same values do not contain barriers, so seeds can be dispersed by animals. Grid cells with different values contain barriers between them and animals cannot disperse seeds to grids with different values.



## 4 Running the model

### 4.1 IMODS

After all your data is ready, to run the model you have to create an .mds file (fig. 17). The easiest way to do it is to copy example.mds and create a new file based on this one.



-	property	name	value	type	rule
1	object	DIMO_Application			
2	set	Project	DIMO_Example	string	
3	set	Species	spec_example	string	
4	run	AddFileInfo			
5	parameter	alias	PMoveMap	string	
6	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\vhav_all.asc	string	INPUTFILE Binary files*.fltGridASCII*.asc
7	run	AddFileInfo			
8	parameter	alias	InitialSeedBankMap	string	
9	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\sbage_3p.asc	string	INPUTFILE Binary files*.fltGridASCII*.asc
10	run	AddFileInfo			
11	parameter	alias	InitialPlantAgeMap	string	
12	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\plage_3p.asc	string	INPUTFILE Binary files*.fltGridASCII*.asc
13	run	AddFileInfo			
14	parameter	alias	BarrierMap	string	
15	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\bar.asc	string	INPUTFILE Binary files*.fltGridASCII*.asc
16	run	AddFileInfo			
17	parameter	alias	PMoveOutMap	string	
18	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\r10_habsuit.asc	string	OUTPUTFILE Binary files*.fltGridASCII*.asc
19	run	AddFileInfo			
20	parameter	alias	PlantAgeMap	string	
21	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\r10_plage.asc	string	OUTPUTFILE Binary files*.fltGridASCII*.asc
22	run	AddFileInfo			
23	parameter	alias	SeedDistributionMap	string	
24	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\r10_seeddis.asc	string	OUTPUTFILE Binary files*.fltGridASCII*.asc
25	run	AddFileInfo			
26	parameter	alias	SeedBankAgeMap	string	
27	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\r10_sbage.asc	string	OUTPUTFILE Binary files*.fltGridASCII*.asc
28	set	RunYears	10	integer	
29	run	Prepare			
30	run	Execute			

Figure 17. IMODS window. Data indicated in green is optional (only with the 'Animal\_Barrier' dispersal option)

In lines 2 and 3 write the name of the project and the name of the species you want to run. In lines 6, 9, 12, 15 you have to specify the path and name of the input maps. In lines 18, 21, 24, 27 you have to specify the path and name of the output maps that will be created by the model. File names can contain only 13 characters (excluding extension). If you want your output maps to be placed in a new folder, you have to create this folder first. In line 28 you can specify the running time of the model (in whole years). Parameter aliases usually have self-explaining names, except for habitat suitability map, which is called PMoveMap (fig. 18).

-	property	name	value	type	rule
1	object	DIMO.Application			
2	set	Project	DIMO_Example	string	
3	set	Species	spec_example	string	
4	run	AddFileInfo			
5	parameter	alias	PMoveMap	string	
6	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\hab_all.asc	string	INPUTFILE Binary files!\nGridASCII".asc
7	run	AddFileInfo			

Figure 18. IMODS window, PMoveMap encircled in red is the map of suitable habitat.

If the suitable habitat or barriers changes over time, run time can be split and a new suitability map or barrier map can be loaded (fig. 19).

-	property	name	value	type	rule
1	object	DIMO.Application			
2	set	Project	DIMO_Example	string	
3	set	Species	spec_example	string	
4	run	AddFileInfo			
5	parameter	alias	PMoveMap	string	
6	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\hab_1.asc	string	INPUTFILE Binary files!\nGridASCII".asc
7	run	AddFileInfo			
8	parameter	alias	InitialSeedBankMap	string	
9	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\sbage_3p.asc	string	INPUTFILE Binary files!\nGridASCII".asc
10	run	AddFileInfo			
11	parameter	alias	InitialPlantAgeMap	string	
12	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\plage_3p.asc	string	INPUTFILE Binary files!\nGridASCII".asc
13	run	AddFileInfo			
14	parameter	alias	BarrierMap	string	
15	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\bar1.asc	string	INPUTFILE Binary files!\nGridASCII".asc
16	run	AddFileInfo			
17	parameter	alias	PMoveOutMap	string	
18	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_habsuit.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
19	run	AddFileInfo			
20	parameter	alias	PlantAgeMap	string	
21	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_plage.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
22	run	AddFileInfo			
23	parameter	alias	SeedDistributionMap	string	
24	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_seeddis.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
25	run	AddFileInfo			
26	parameter	alias	SeedBankAgeMap	string	
27	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_sbage.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
28	set	RunYears	10	integer	
29	run	Prepare			
30	run	Execute			
31	run	AddFileInfo			
32	parameter	alias	PMoveMap	string	
33	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\hab_2.asc	string	INPUTFILE Binary files!\nGridASCII".asc
34	run	AddFileInfo			
35	parameter	alias	InitialSeedBankMap	string	
36	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_sbage.asc	string	INPUTFILE Binary files!\nGridASCII".asc
37	run	AddFileInfo			
38	parameter	alias	InitialPlantAgeMap	string	
39	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v10_plage.asc	string	INPUTFILE Binary files!\nGridASCII".asc
40	run	AddFileInfo			
41	parameter	alias	BarrierMap	string	
42	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\bar2.asc	string	INPUTFILE Binary files!\nGridASCII".asc
43	run	AddFileInfo			
44	parameter	alias	PMoveOutMap	string	
45	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v20_habsuit.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
46	run	AddFileInfo			
47	parameter	alias	PlantAgeMap	string	
48	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v20_plage.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
49	run	AddFileInfo			
50	parameter	alias	SeedDistributionMap	string	
51	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v20_seeddis.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
52	run	AddFileInfo			
53	parameter	alias	SeedBankAgeMap	string	
54	parameter	uri	C:\Program Files\ALTERRA\DIMO\Example\v20_sbage.asc	string	OUTPUTFILE Binary files!\nGridASCII".asc
55	set	RunYears	10	integer	
56	run	Prepare			
57	run	Execute			

Figure 19. IMODS window. Maps that can be changed are indicated in red. Output from the first run used as input for the second run is indicated in green.

To prepare such a file, copy lines 4-30 and paste them below, with the name of new suitability or barrier map. The output maps from first run are the input maps for the second run. By double clicking on the path field, the file browser window opens, where you browse to the file. The editing of \*.mds files can be done in any text editor (fig. 20).

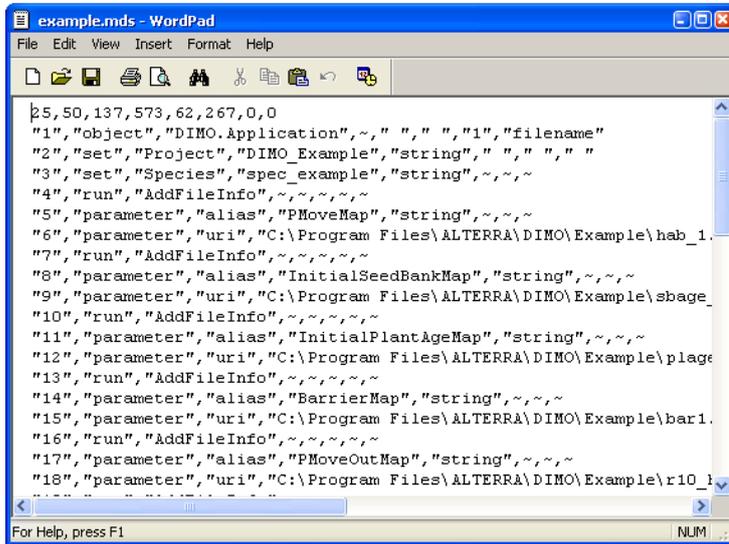


Figure 20. Text editor with \*.mds file.

To run the model, press 'Run the model' button of IMODS (fig. 21). More information can be found in the IMODS User Guide (Start \ Programs \ DIMO \ User Guide).

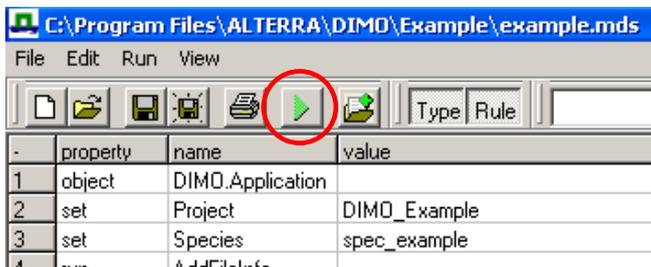


Figure 21. Run the model' button.

The results are maps that can be further inspected with the help of GIS software.

- ◇ Plant-age map: resulting plant-age map after the whole run.
- ◇ Seed-bank-life map: resulting seed-bank life map after the whole run.
- ◇ Suitability map: the 'corrected' initial suitability map, containing only the suitable areas which could be reached by the dispersing plant. Note; always the initial suitability of the current run is taken for the next calculations.
- ◇ Seed-distribution map: a map showing the seed 'rain' from the last year.

## 4.2 Troubleshooting

If you get an error message after trying to run the model (in the \*.mds window), check the following:

- ◇ are all the path names correct (spelling, missing or extra spaces, non-existing folders etc.)?
- ◇ are there extensions (.asc) after the file name in the input and output paths?
- ◇ are the header data of the input maps the same (ncols, nrecs, xllcorner, yllcorner, cellsize, NODATA\_value)?

For more assistance contact Janien van der Grefte ([janien.vandergreft@wur.nl](mailto:janien.vandergreft@wur.nl)) or Wieger Wamelink ([wieger.wamelink@wur.nl](mailto:wieger.wamelink@wur.nl)).

## 5 Program Uninstall

To uninstall the program go to:

Start \ Settings \ Control Panel \ Add or Remove Programs.

Remove all three components of the program (fig. 22). If you want to upgrade DIMO or if your other programs use Firebird database server and Borland Database Engine, uninstall only DIMO.

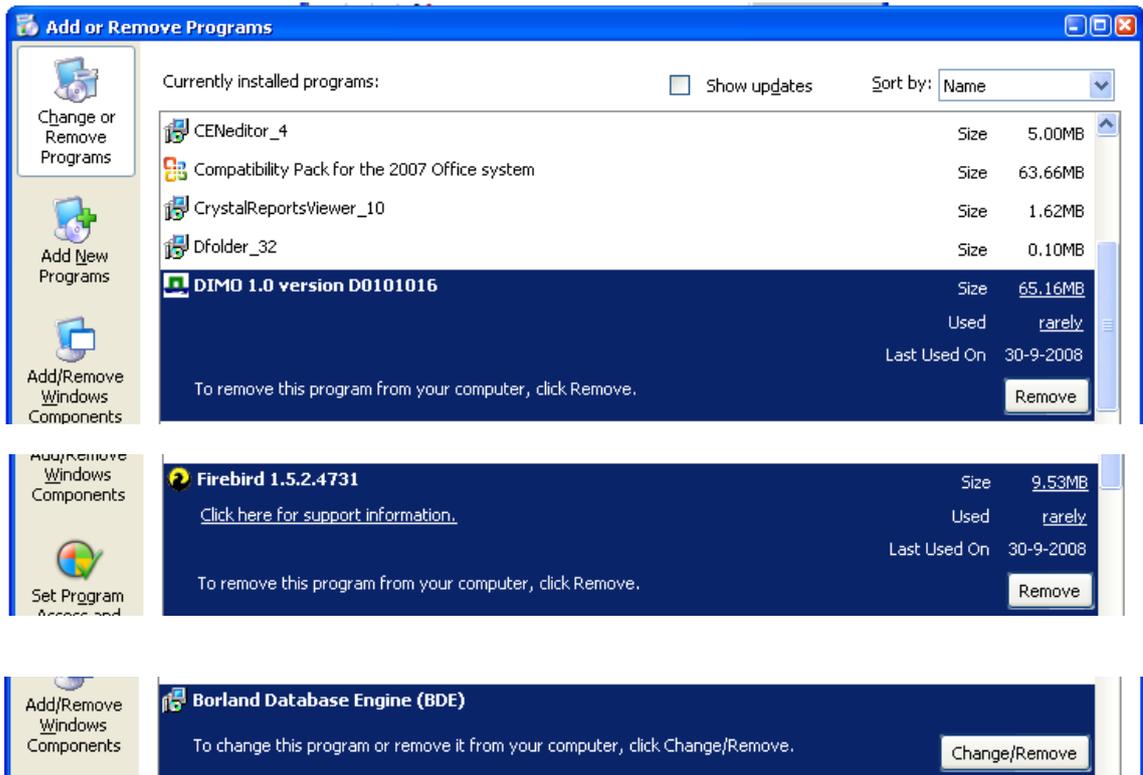


Figure 22. Program uninstall