Welcome

Daisy AgroEco-HPM
Århus University, Foulum
15-08-2023

KØBENHAVNS UNIVERSITET

Agenda

- Tha AgroEco-HPM project
- The Daisy/AgroEco-HPM group
- You
- Current work and plans – Maja
- Organization and work groups – Merete
- Discussion
  - Crop calibration, parameterizations and data
  - Tools
  - GeoDaisy
  - New processes
  - Teaching and outreach
- Rounding of and future collaborations

A high-performance data-driven agroecosystem modelling platform for developing agricultural systems with minimum environmental impact:

AgroEco-HPM

The Daisy/AgroEco-HPM group

- Collaboration between PLEN and DIKU

Sune Darkner, Associate Professor, DIKU, Heading AgroEco-HPM

Per Abrahamsen, Research Consultant, PLEN

Merete Styzcen, Affiliated Professor, PLEN

Sarah Niebe Adel, Research Consultant, DIKU

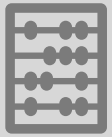
Maja Holbak, Research Consultant, PLEN

Silas Nyboe Ørting, Postdoc, DIKU

Muhammed Adil Rashid, Postdoc, PLEN

Who are you?

Work areas



Experience with Daisy

Specific wishes for today/Daisy

The AgroEco-HPM project

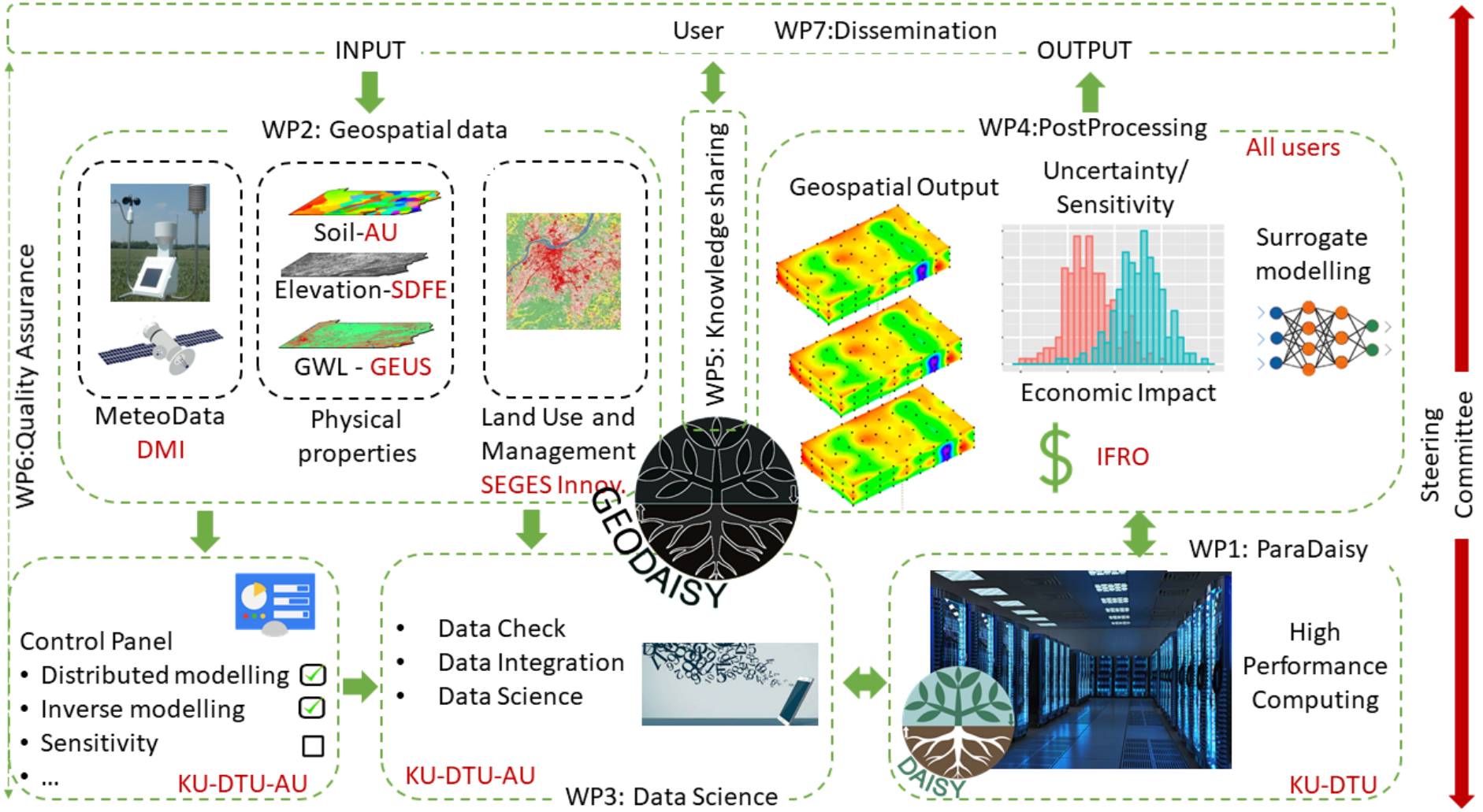


Figure 1: Overview of the suggested GeoDaisy infrastructure. WP1: Implementation of Python library for running parallel Daisy simulations (ParaDaisy). Please note that ParaDaisy is a part of GeoDaisy, WP2: Database extraction, WP3: Access to advanced methods in model simulation, WP4: Post processing, WP5: Knowledge sharing and Gaps, WP6: Quality Assurance, WP7: Dissemination, outreach and teaching.

Current work and plans

GeoDaisy: A GIS interphase to Daisy linked to relevant databases

Crop calibration, parameterizations and data

ParaDaisy: Making it possible to create, run and output multiple Daisy columns in parallel

Documentation, teaching and outreach

New user interface and output processing

Code quality assurance

Identification of gaps

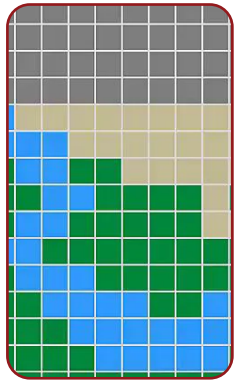
GeoDaisy

- User-friendly graphical interface
- Web-based
- Connected to “live” data
- Quick initial .dai set ups

GeoDaisy - UseCases

A Field

- Field work / Field Management
- Select 1 field: Get a best guess of soil, weather and management
- Get “.dai-files and combine with own measurement



An Area

- Run Daisy for a catchment/municipality/Denmark
- Gis output with for example plant available water, available N or leaching of pesticides.

GeoDaisy – development and dataintigration

- Weather data – DMI (and DCE for N deposition)
- Soil data – AU
- Crop and management – Standard, SEGES, Landbrugsstyrelsen
- Lower boundary – HIP, GEUS, Digitaliseringsstyrelsen

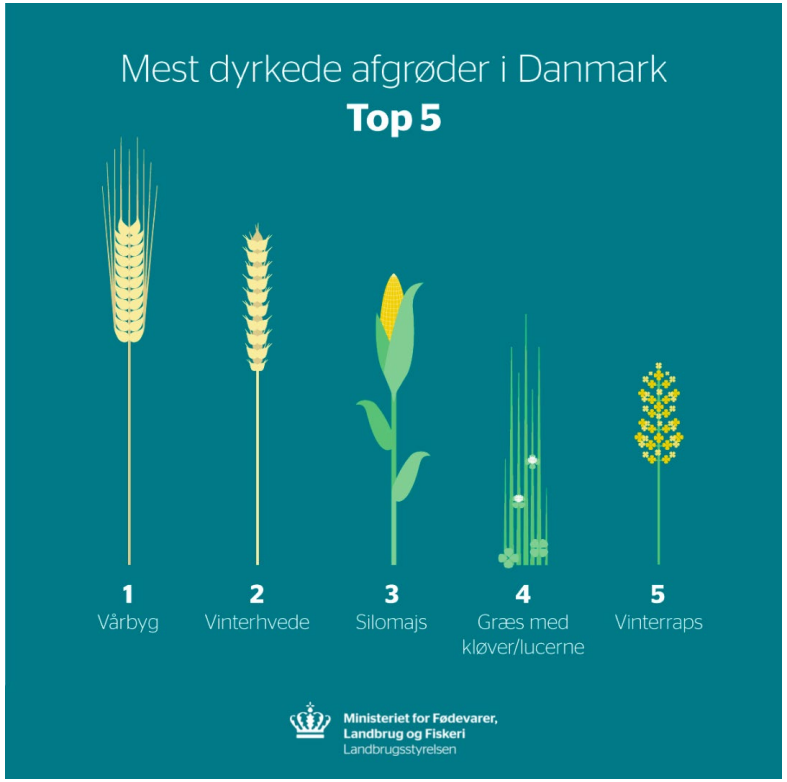
- Outputs: raster gis-layers, plots, datafiles

Datalink – DMI weather data

- For GeoDaisy – but can already be used
- DMI has made weather station data as well as interpolated grid data available through an API.
- The 'dmi-station.py' is a Python script to extract data from the nearest station given a specific location. Which can be used to create a Daisy weather file (.dwf)
- See more: https://daisy.ku.dk/tools-and-guides/dmi-weather-data/

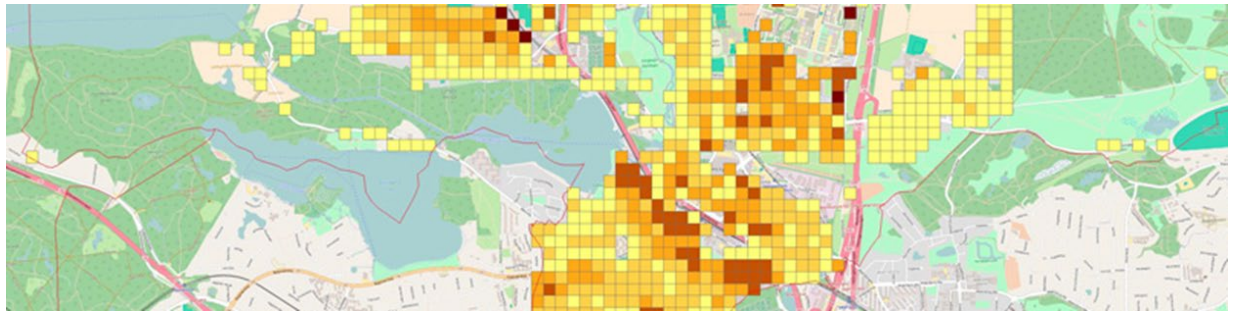
Crop Calibrations

- DK crops – update standards

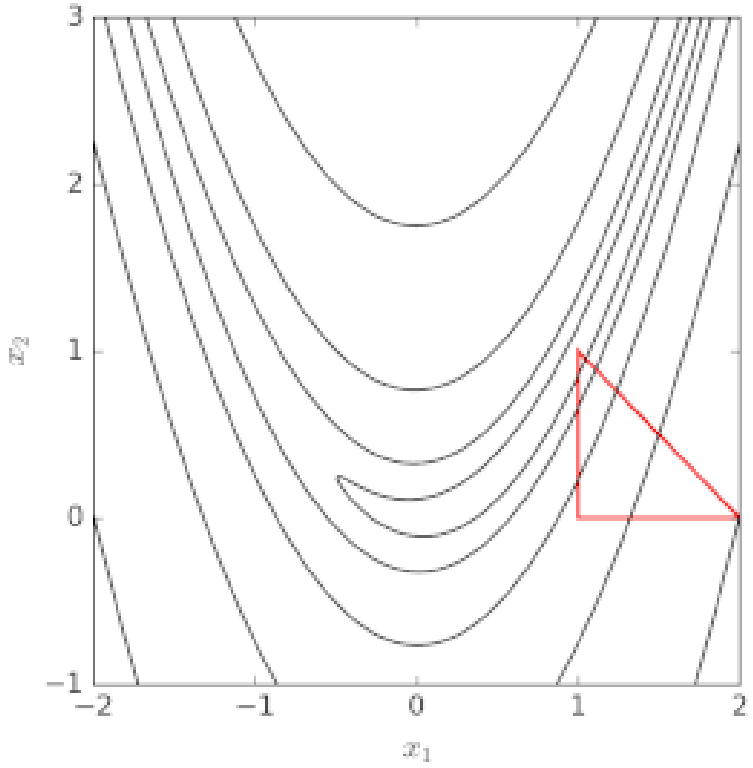


- Crop calibration for field data
  - AgMIP
  - Automatic calibration procedure
  - Which crops?
- Field experiment data
  - Sharing data for calibration and testing
  - Sharing parameterizations
- Collaborations and contribution
  - What would it take?
  - How to distribute?

ParaDaisy – usecases

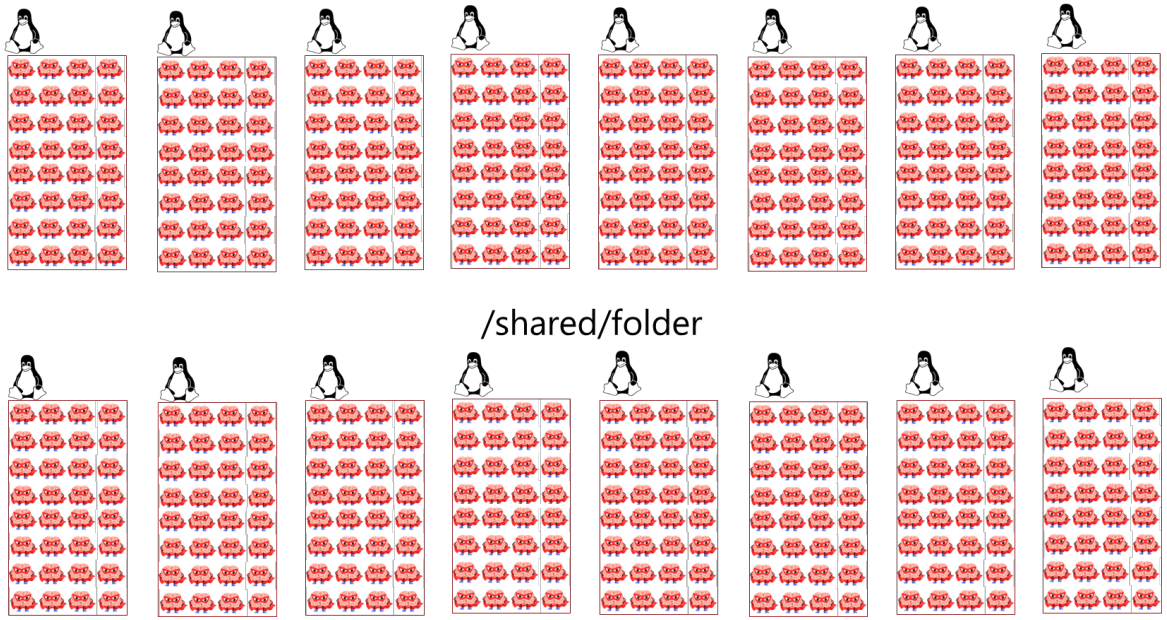


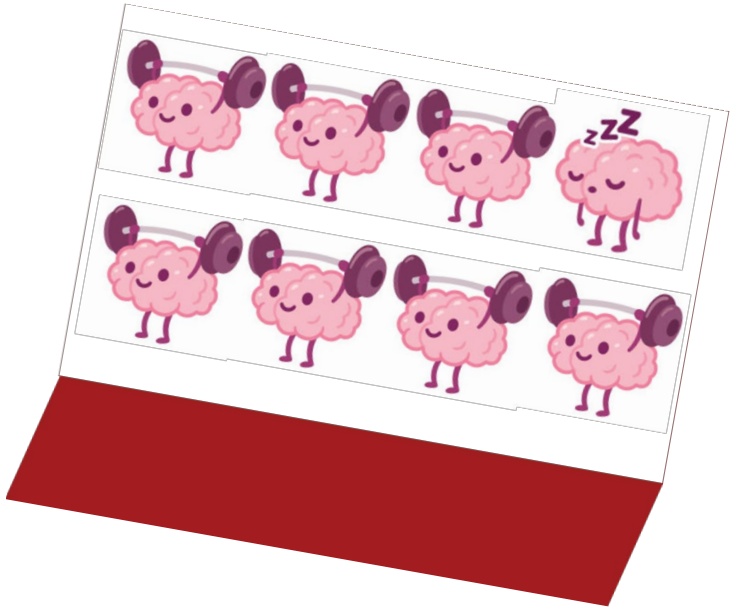
- GeoDaisy
  - Run 1 Daisy per square
  - Communication through GW
    - Indirect coupling
    - MIKE SHE
- Scenario analysis
- Uncertainty and sensitivity analysis
- Inverse modelling



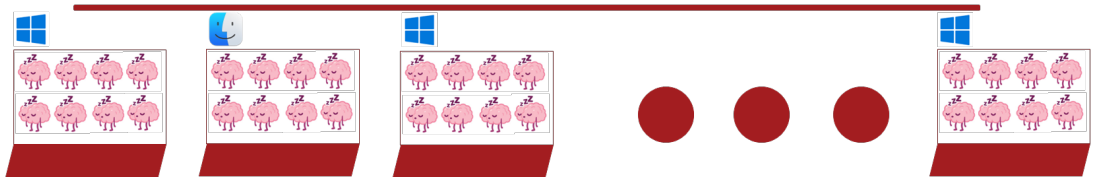
ParaDaisy – implemented in Daisy 6.35 / 6.36

- SPAWN – Run Daisy in parallel, e.g. use all cores at the same time, on own computer, network or supercomputer
- NWAPS – Compile outputs in csv-files





N:\NETWORK\DRIVE



The "spawn" program, setup example

```
(defprogram common Daisy
  (time 2998 1 1)
  (activate_output (after 3000 1 1))
  (stop 3100 1 1)
  (output Yield "Water usage 4-7" "Water usage 5-7"
          ("Field water" (when yearly))
          ("Field nitrogen" (when yearly))
          ("Soil nitrogen" (when yearly) (to -1 [m]))
          harvest
          ("Carbon Balance" (when yearly))))

(defprogram PRESENT-CONTROL-SB common
  "Scenario PRESENT-CONTROL-SB"
  (weather PRESENT) (column CONTROL) (manager SB))

(defprogram PRESENT-CONTROL-WW common
  "Scenario PRESENT-CONTROL-WW"
  (weather PRESENT) (column CONTROL) (manager WW))
```

```
(defprogram all spawn
  (program PRESENT-CONTROL-SB
           PRESENT-CONTROL-WW
           PRESENT-CONTROL-SBI
           PRESENT-CONTROL-WWI
           PRESENT-BIO60-SB
           PRESENT-BIO60-WW
           PRESENT-BIO70-SB
           PRESENT-BIO70-WW
           PRESENT-BIO80-SB
           PRESENT-BIO80-WW
```

```
(defprogram both batch
  (run all
       (nwaps (scenario Climate Soil Crop))))

;;(run PRESENT-CONTROL-SB)
(run both)
```

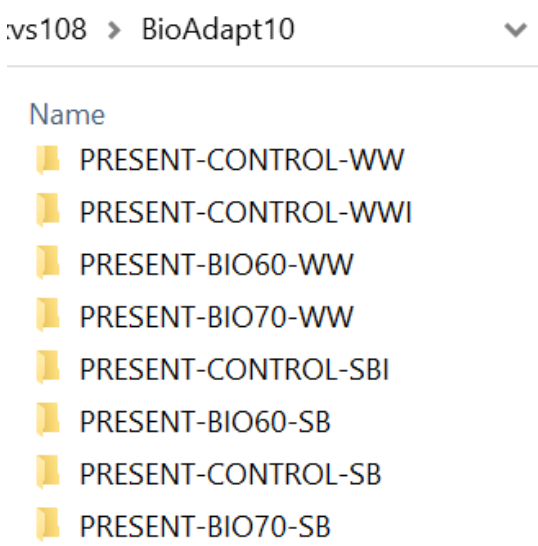
The "spawn" program, running

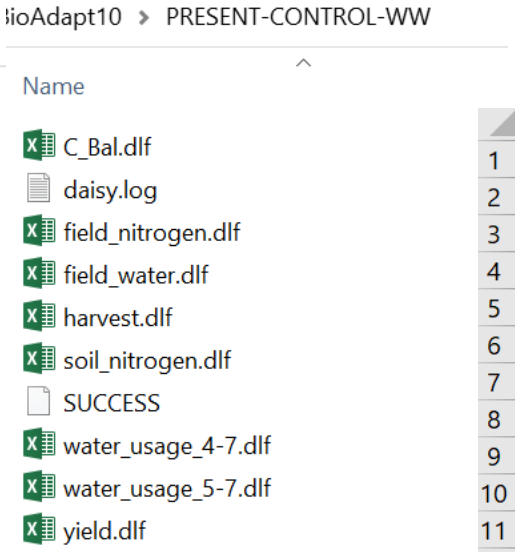
```
Daisy crop/soil simulation version 6.35. (Apr 21 2023)
Copyright 1996 - 2016 Per Abrahamsen, Søren Hansen and KU.
Storing 'daisy.log' in '/home/xvs108/BioAdapt10'
Program started Mon May  1 10:37:07 2023, 2 seconds ago.
* both[0]: all
** program: all run
Executable '/home/xvs108/daisy/objn/daisy'
Spawning at most 8 programs in parallel
Initial spawn
*** PRESENT-CONTROL-SB
Spawning 'PRESENT-CONTROL-SB'
*** PRESENT-CONTROL-WW
Spawning 'PRESENT-CONTROL-WW'
*** PRESENT-CONTROL-SBI
Spawning 'PRESENT-CONTROL-SBI'
*** PRESENT-CONTROL-WWI
Spawning 'PRESENT-CONTROL-WWI'
*** PRESENT-BIO60-SB
Spawning 'PRESENT-BIO60-SB'
*** PRESENT-BIO60-WW
Spawning 'PRESENT-BIO60-WW'
*** PRESENT-BIO70-SB
Spawning 'PRESENT-BIO70-SB'
*** PRESENT-BIO70-WW
Spawning 'PRESENT-BIO70-WW'
Running...
'PRESENT-CONTROL-WWI' finished sucessfully
*** PRESENT-BIO80-SB
Spawning 'PRESENT-BIO80-SB'
'PRESENT-CONTROL-WW' finished sucessfully
*** PRESENT-BIO80-WW
```

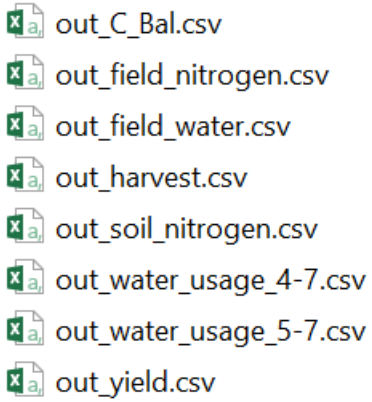
This allows multiple computers!

1. Create directory
   a) If this fails, skip program
2. Spawn program in directory
   a) But don't wait for it to finish
3. Repeat 1 & 2 until you have "n" programs running
   a) By default, n is number of cores on your computer
4. When a program is finished, start another if there are any left
5. Wait for all programs to finish

The spawn and nwaps program, results







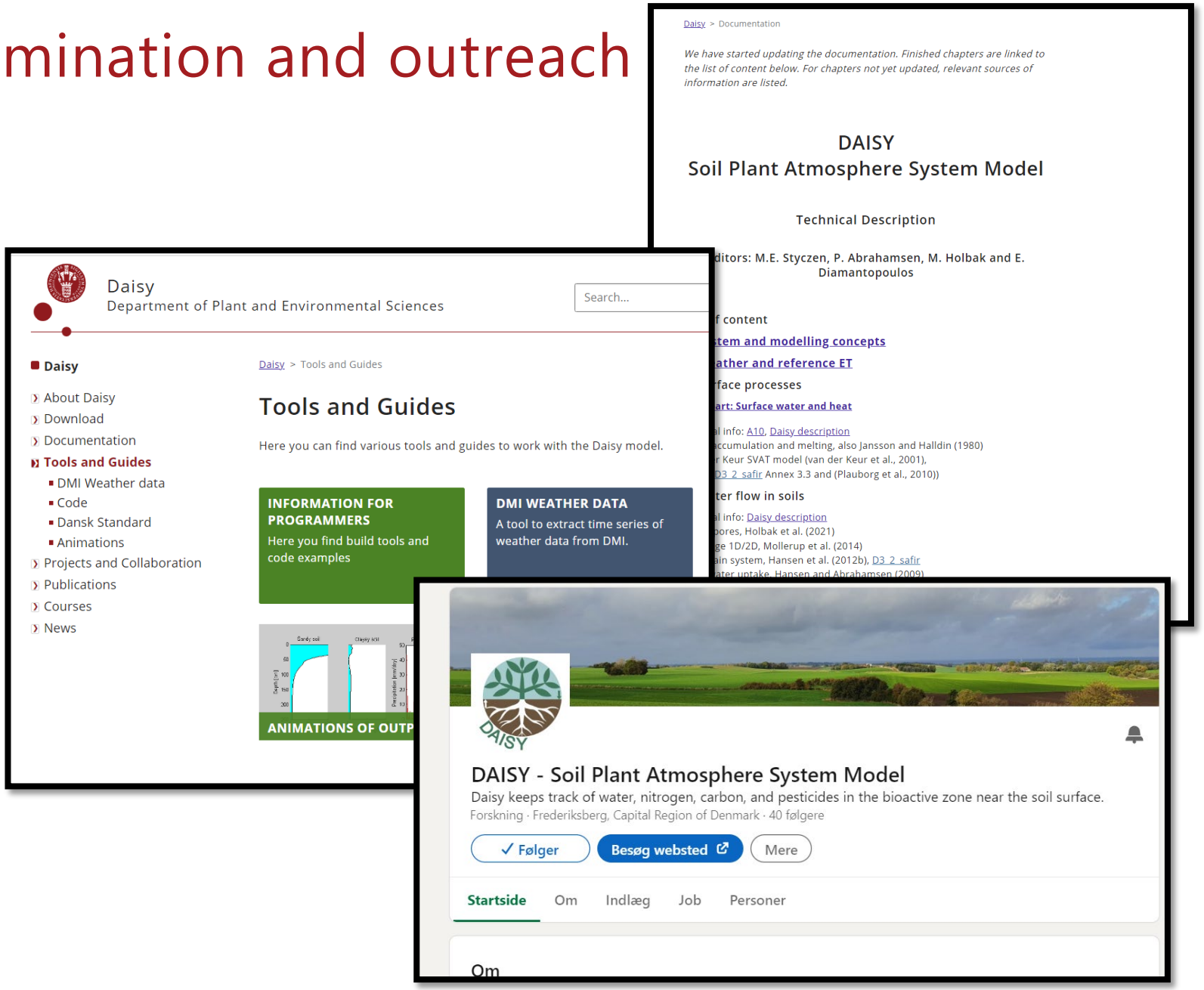

```
(nwaps (scenario Climate Soil Crop))
```

	A	B	C	D	E	F	G	H	I	J	K
1	Climate	Soil	Crop	year	month	mday	hour	DM [Mg/ha]	N [kg/ha]	total DM [Mg/ha]	total N [kg/ha]
2	PRESENT	CONTROL	WW	3001	1	1	0	3.69687	83.5225	7.424	133.193
3	PRESENT	CONTROL	WW	3002	1	1	0	5.84917	116.07	11.4764	174.768
4	PRESENT	CONTROL	WW	3003	1	1	0	7.32204	124.952	13.802	179.14
5	PRESENT	CONTROL	WW	3004	1	1	0	6.80891	119.082	12.6638	170.309
6	PRESENT	CONTROL	WW	3005	1	1	0	4.47722	94.1787	9.61436	153.077
7	PRESENT	CONTROL	WW	3006	1	1	0	7.97009	145.826	13.4007	196.494
8	PRESENT	CONTROL	WW	3007	1	1	0	5.53567	106.692	11.6091	167.268
9	PRESENT	CONTROL	WW	3008	1	1	0	5.96103	112.254	11.9686	170.559
10	PRESENT	CONTROL	WW	3009	1	1	0	3.34227	69.2849	8.56559	130.245
11	PRESENT	CONTROL	WW	3010	1	1	0	9.66991	143.964	16.6971	191.844
12	PRESENT	RZ	SB	3001	1	1	0	3.53964	74.2077	6.16842	104.481
13	PRESENT	RZ	SB	3002	1	1	0	6.3455	102.467	9.78978	131.754
14	PRESENT	RZ	SB	3003	1	1	0	7.26118	93.9249	10.3629	116.61
15	PRESENT	RZ	SB	3004	1	1	0	7.10142	91.8134	10.2007	114.58
16	PRESENT	RZ	SB	3005	1	1	0	5.39128	87.433	8.6414	115.534
17	PRESENT	RZ	SB	3006	1	1	0	7.58732	98.6353	10.9909	123.486
18	PRESENT	RZ	SB	3007	1	1	0	6.7221	98.5149	9.89205	122.639
19	PRESENT	RZ	SB	3008	1	1	0	6.43722	88.9393	9.28518	110.014
20	PRESENT	RZ	SB	3009	1	1	0	3.88625	74.0629	6.90504	104.539
21	PRESENT	RZ	SB	3010	1	1	0	7.57062	102.652	10.8273	127.484

See more: https://daisy.ku.dk/news/lunch-meetings/spawn_nwaps.pdf

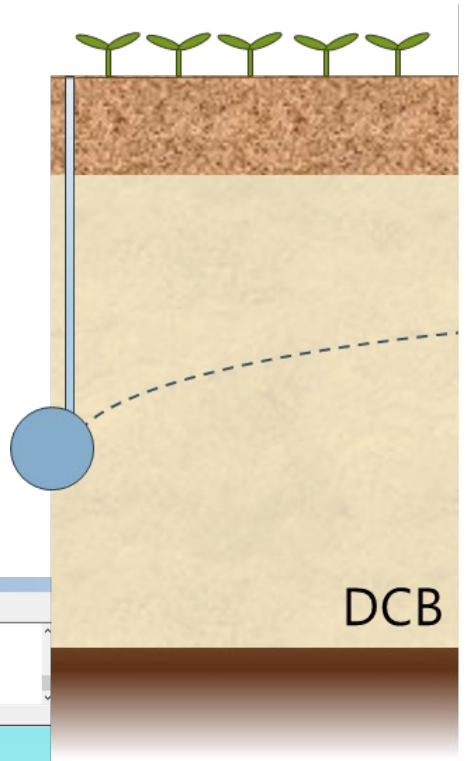
Documentation, Dissemination and outreach

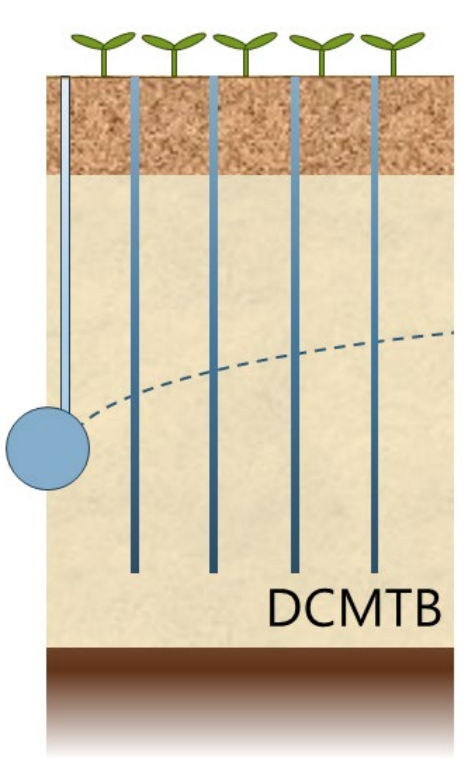
- Technical Description
- User manual
- Newsletter
- Lunch-meetings
- LinkedIN: https://www.linkedin.com/company/daisy-soil-plant-atmosphere-system-model
- Conference
- Daisy forum

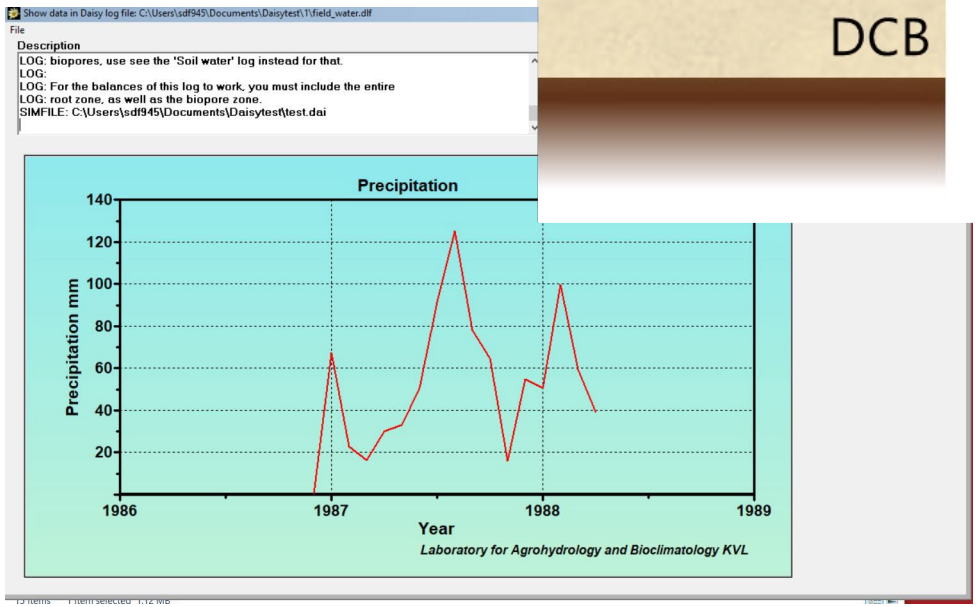


Teaching and interface

- Video tutorials
  - How to instal
  - Setting up your first .dai-file
  - Seeing outputs
- Online course
- User manual
- Interface
- Output-processing







Identification of gaps

Tools	
Automatic calibration, sensitivity and inverse modelling	
Crop parameterizations	
Interface	
Outputs-processing	
Process-description	New root model; Gas-transport
Documentation/Teaching	Video tutorials; Guides; Courses

Organizations and workgroups

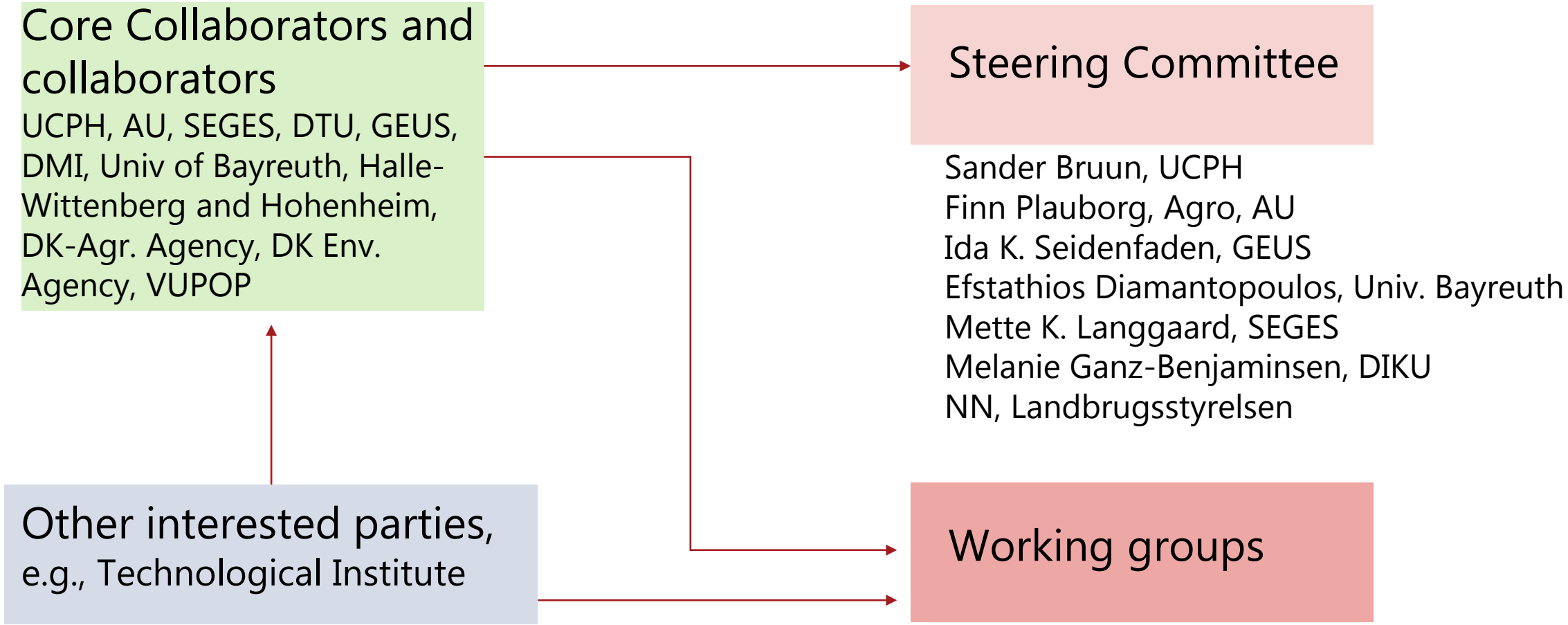


Table 1: Gantt chart (Milestones in green; Deliverables in red text; Allocated time in yellow, Presentation in orange lines |). Work group letters are explained below.

Sub-Project / Tasks		2023				2024				2025				2026				2027			
No.	**Title**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
WP0	**Project management**																				
T0.1	Recruitment of AC-TAPs and Project Manager	0.1																			
T0.2	Steering Committee-Meetings				0.2				0.2				0.2				0.2 0.1				0.2 0.2
T0.3	Subgroup activities and meetings.																				
WP1	**Implementation of ParaDaisy**																				
T1.1	Define and document input format			1.1																	
T1.2	Define and document Output format			1.2																	
T1.3	Write and document main ParaDaisy tool									1.3		1.1									
T1.4	Maintenance and links WP2-5-tools																		1.2		
WP2	**Database extraction**																				
	Attached work groups				a																
T2.1	Weather (DMI)				2.1																
T2.2	Soil, groundwater, and other static information							2.2	2.1												
T2.3	Management data										2.3	2.2									
T.2.4	Other databases, as per decision																				
WP3	**Access to advanced methods in model simulation**																				
	Attached work groups		b,c		3.1		3.2		d				3.3								
T3.1	Inverse modelling																				
T3.2	Sensitivity analysis, uncertainty assessment, viz									3.1		3.2									
T3.3	Data assimilation and forecasting																3.3				
WP4	**Post processing**																				
	Attached work groups						c,e				f										
T4.1	Code for generating GIS-files								4.1												
T4.2	Code for statistical analyses on output												4.2	4.1							
T4.3	Code examples for use of machine learning/AI on simulated and measured data																	4.3			4.2
WP5	**Knowledge sharing and gaps**																				
	Attached work groups		g																		
T5.1	Identify major gaps					5.1							5.2								
T5.2	Improve descriptions														5.3						
T5.3	Collect best practices																	5.4			5.1
WP6	**Integration and user study**																				
T6.1	Select framework				6.1																
T6.2	Set up test environment																6.1				
T6.3	User study of GeoDaisy																6.2				6.2
W7	**Dissemination, outreach and teaching**																				
	Attached work groups											h									
T7.1	Project dissemination		7.1		7.2				7.2				7.2				7.2				7.2
T7.2	Define and implement example cases													7.3				7.4			7.2
T7.3	Task completion presentations and workshops												7.1								7.1
T7.4	Develop an-line teaching platform				7.5								7.6								7.3

Working groups already indicated in the text: a) Working group analyzing the need for links to additional databases (national and international), b) Working group on inverse modelling methods., c) Working group on sensitivity and uncertainty assessment methods to include, d) Working group on data assimilation and forecast issues, e) Working group on statistical methods required for output analysis – may be a continuation of c, f) Working group on AI methods and software to link to, and definition of code examples to supply, g) A series of working groups, as the work will be divided in topics (soil, weather data resolution, quality and routines, specific crops, organic matter turn-over, etc.), h) Working group on definition of example cases.

a) Need for additional databases
b) Inverse modelling methods
c) Sensitivity and uncertainty assessment methods
d) Data assimilation and forecast issues
e) Statistical methods for output analysis
f) AI methods and software to link to and code examples to share,
g) Several relevant issues (soil, weater data resolution, quality and routines, specific crops, org.matter etc)
h) Definition of example cases.

Discussion points

Crop calibration – data and automatization tools	Tools	GeoDaisy	New process implementations	Teaching /Outreach
• Automatization tools • Sharing data • Sharing parameterizations • How to?	• Optimization • Interface • Output-processing • ParaDaisy	• Data connections • Use cases • Point • Areas	• New root model • Gastransport • ?	• Video tutorial • Online course • User manual • Conference • Lunch meetings • Newsletter • LindkedIn • How to stay I contact / Collaborate?

Rounding off and future collaborations