



MAX-PLANCK-INSTITUT
FÜR BIOGEOCHEMIE



Sprint 10



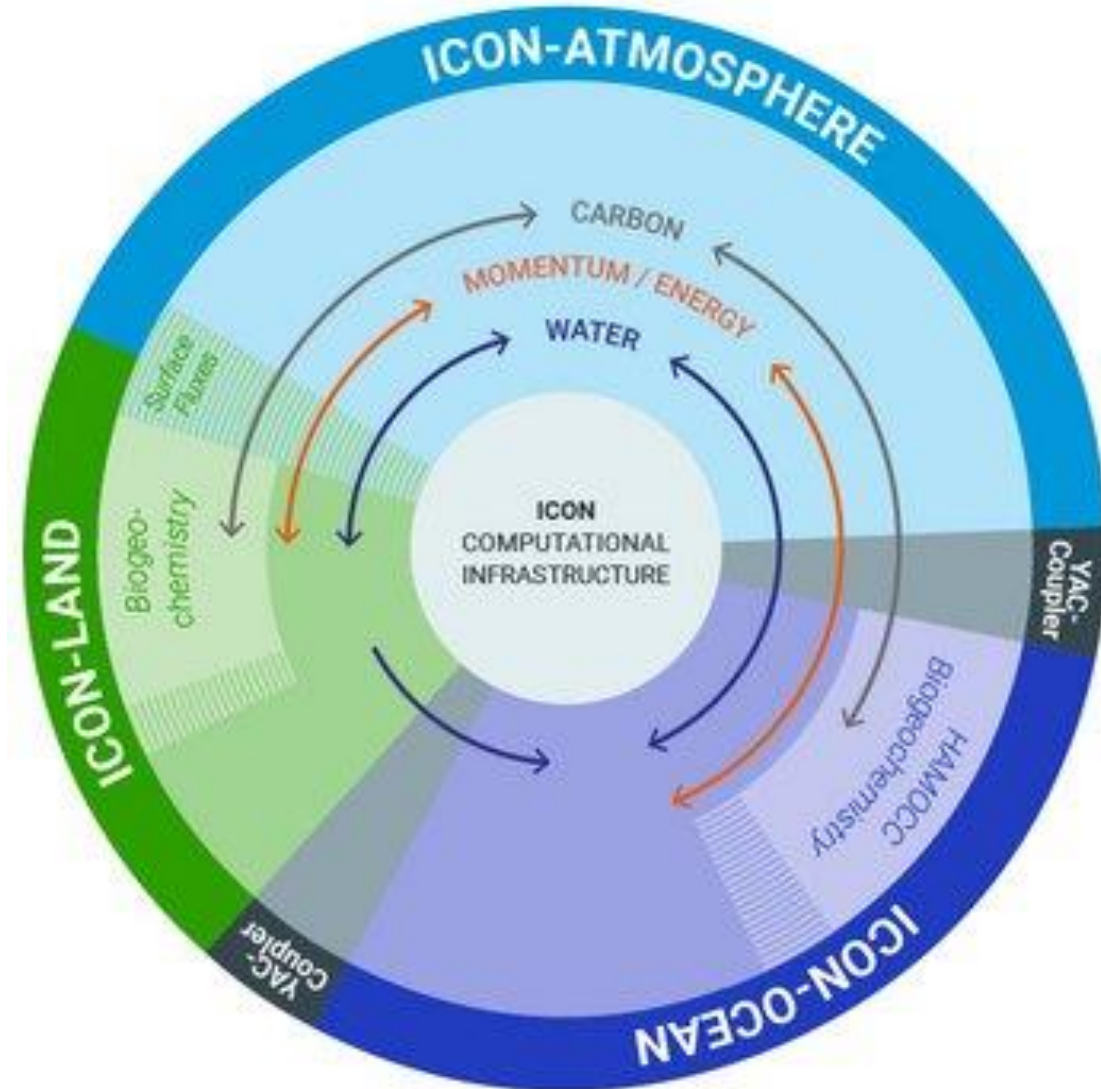
Challenges and results experienced during the IQ sprint



**Julia Nabel (MPI-BGC), Jan Engel (MPI-BGC), Reiner Schnur (MPI-M),
Sönke Zaehle (MPI-BGC), Sergey Sukov (JSC)**

General information

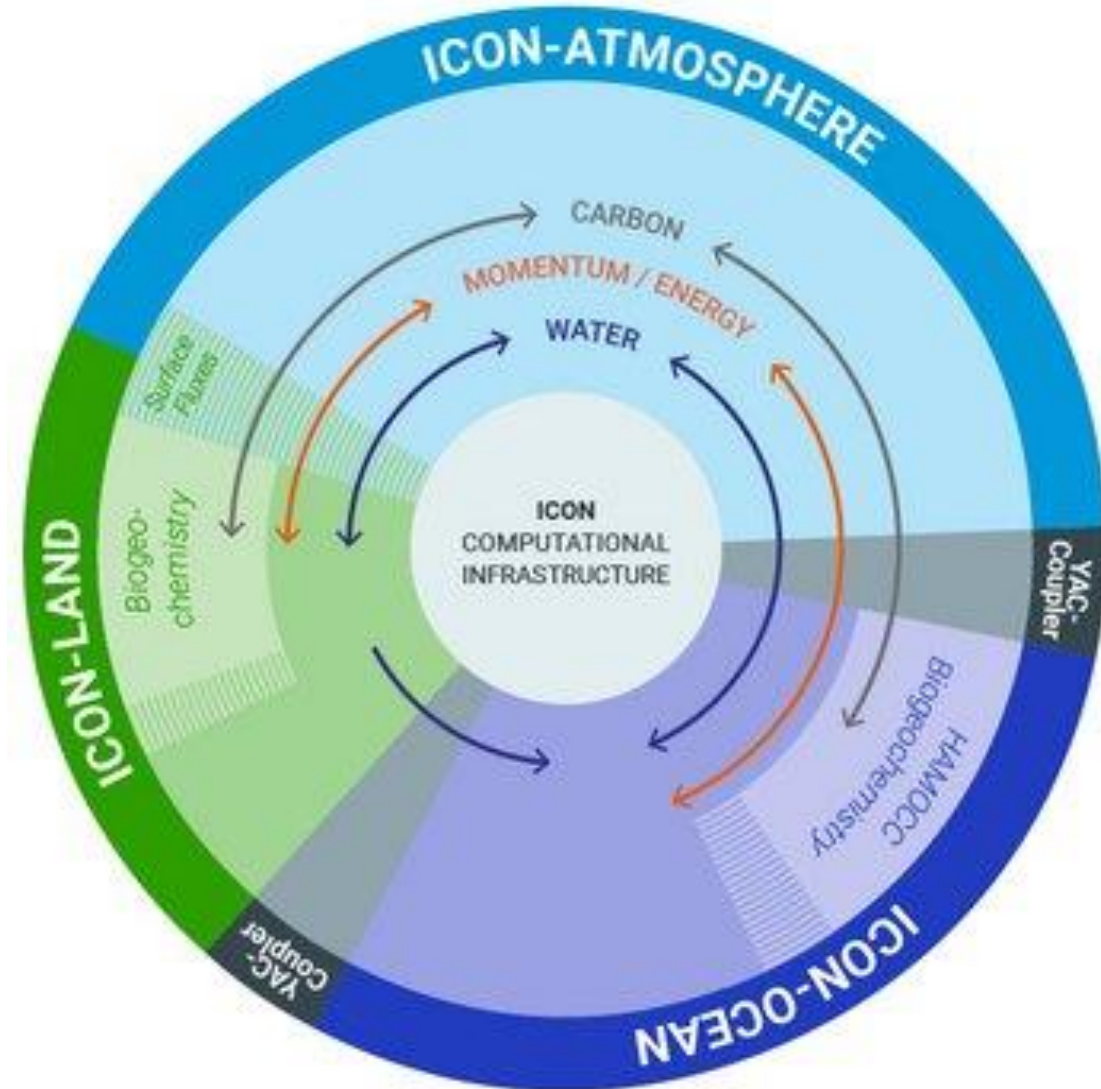
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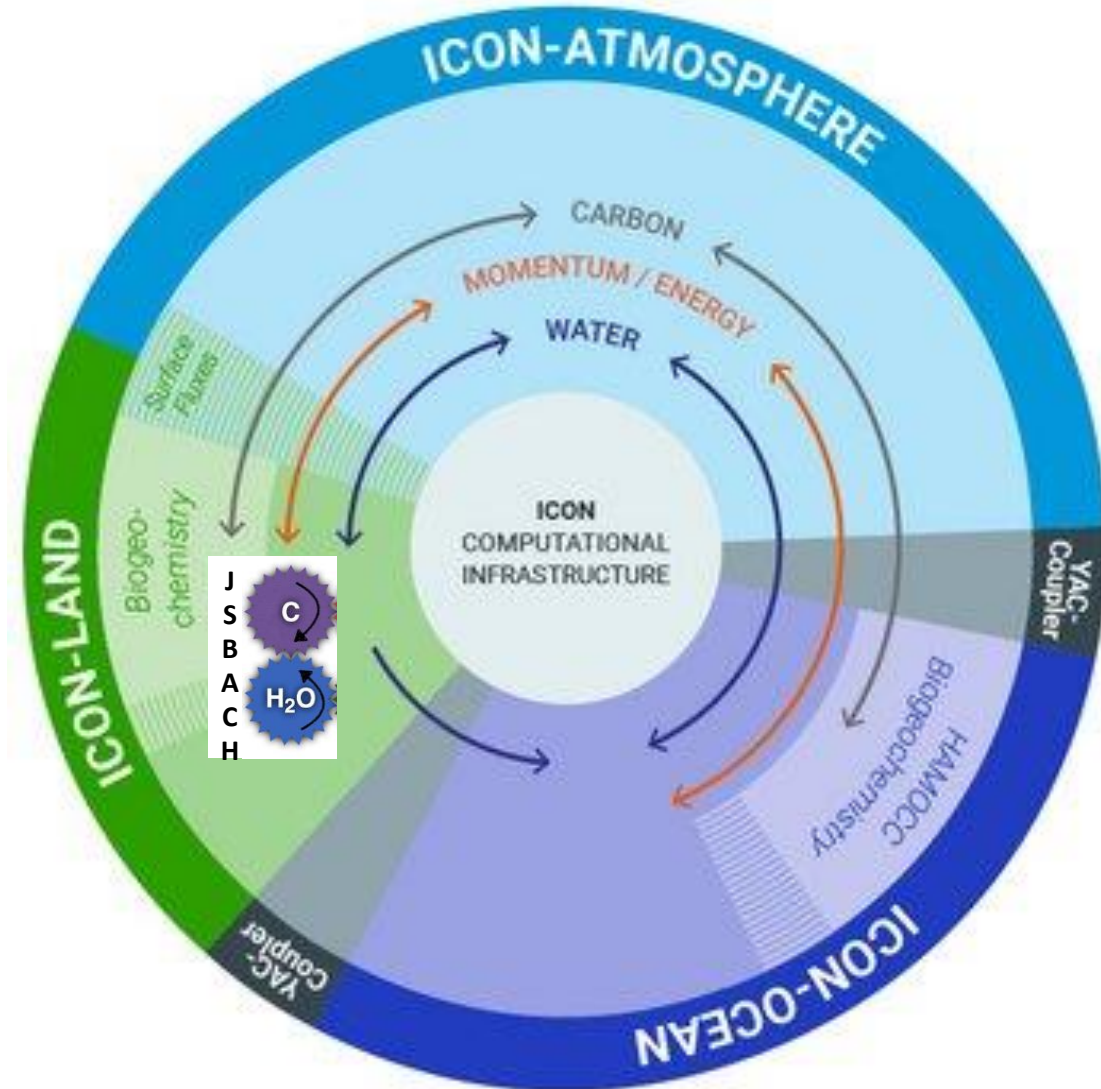


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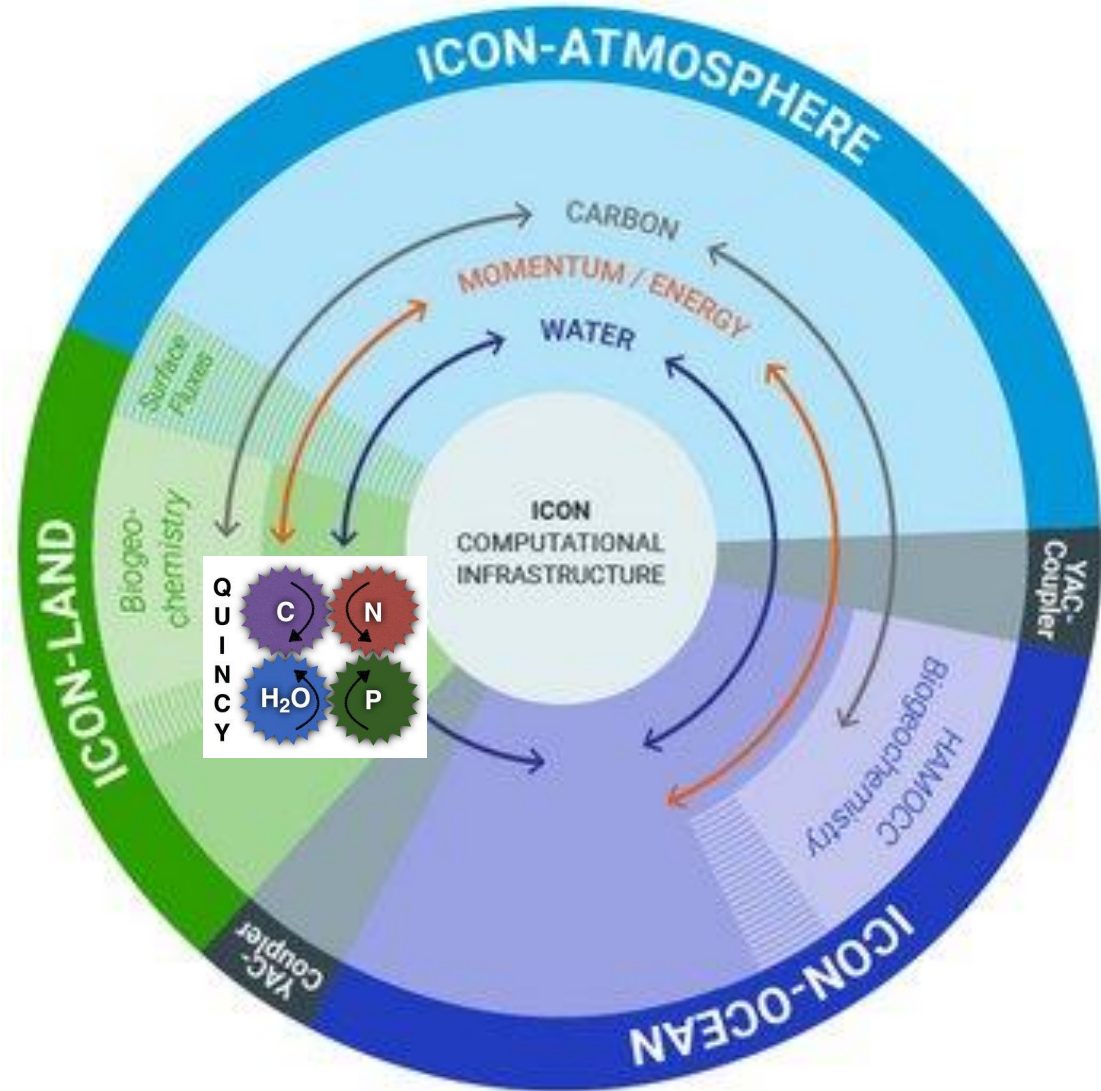
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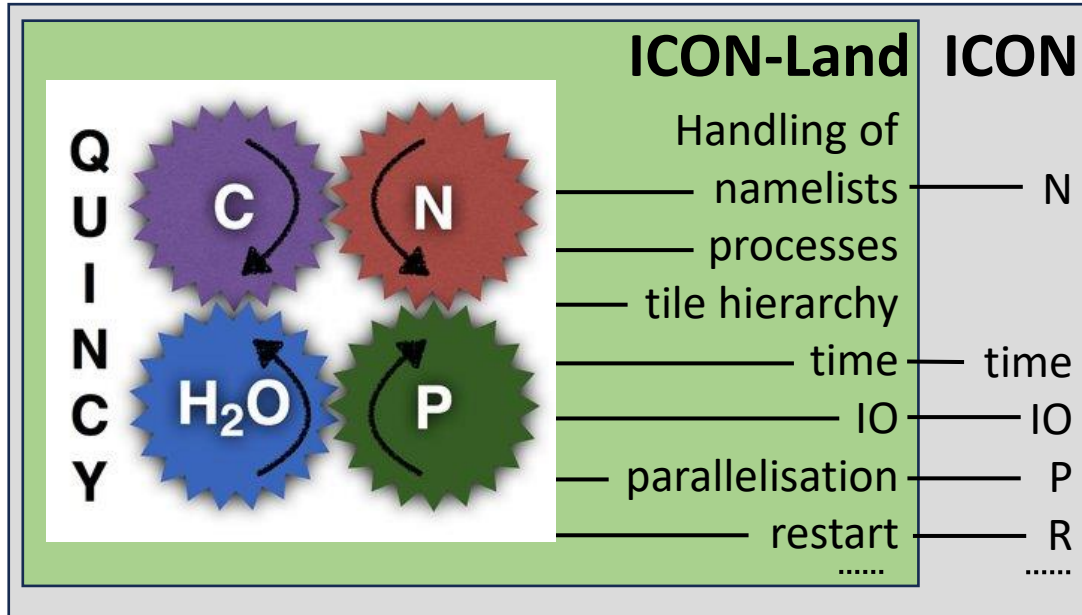
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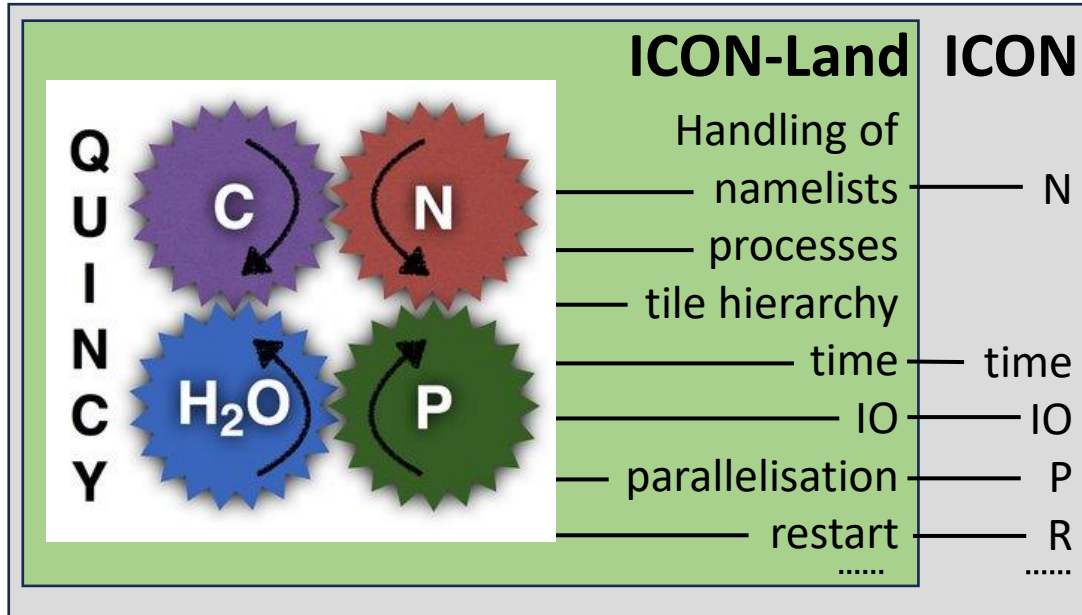
Quincy: a biosphere model, coupling the land ecosystem cycles of carbon, nitrogen, phosphorus, water and energy.
An alternative to JSBACH in ICON-Land (IQ).



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ICON-A		ICON-Land Standalone driver	
JSBACH	QUINCY	JSBACH	QUINCY
CPU & GPU		CPU only	CPU only

Planned schedule

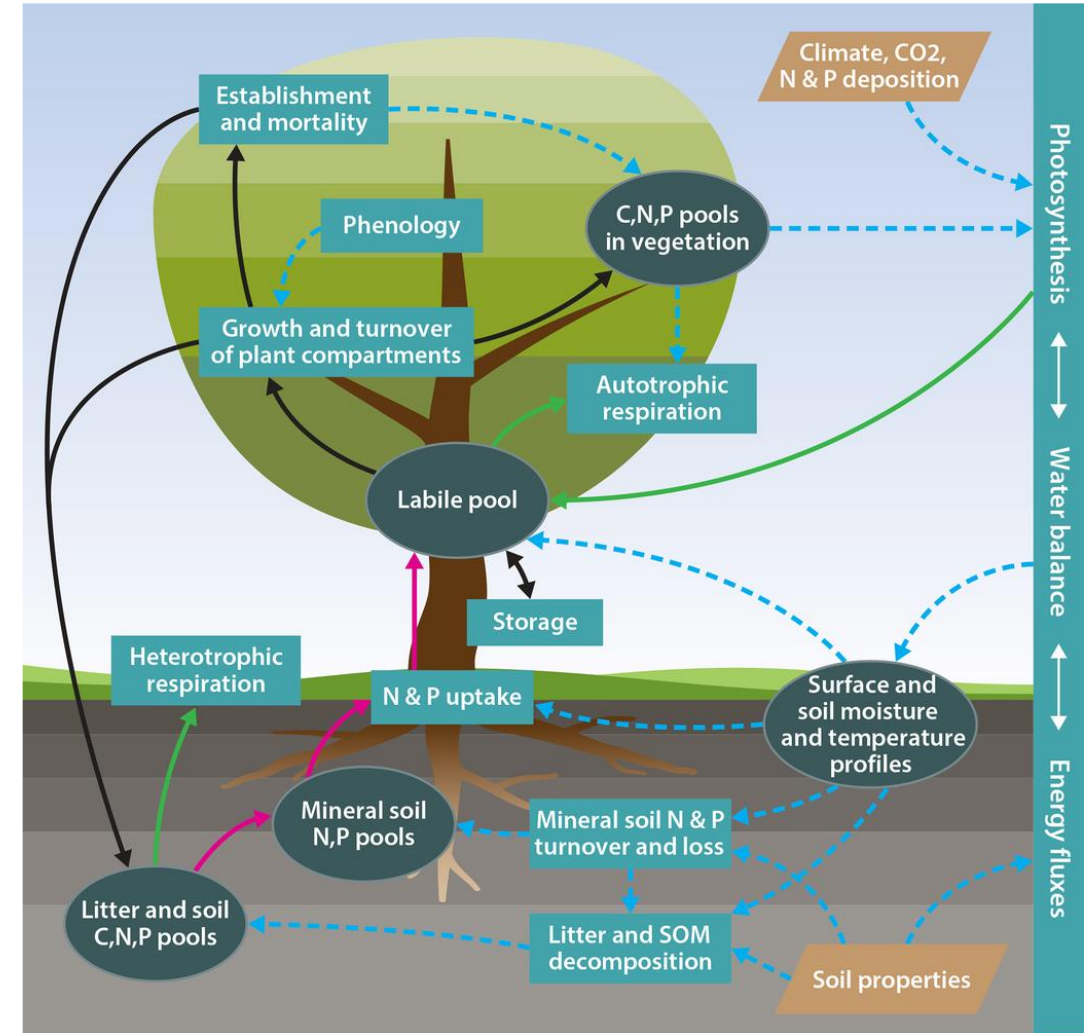


Task Nr.	Task	Duration
1	Getting to know the code	2 weeks
2	Port ICON-Land standalone driver to GPU using JSBACH scientific routines	1 month
3		
4		
5		
6		

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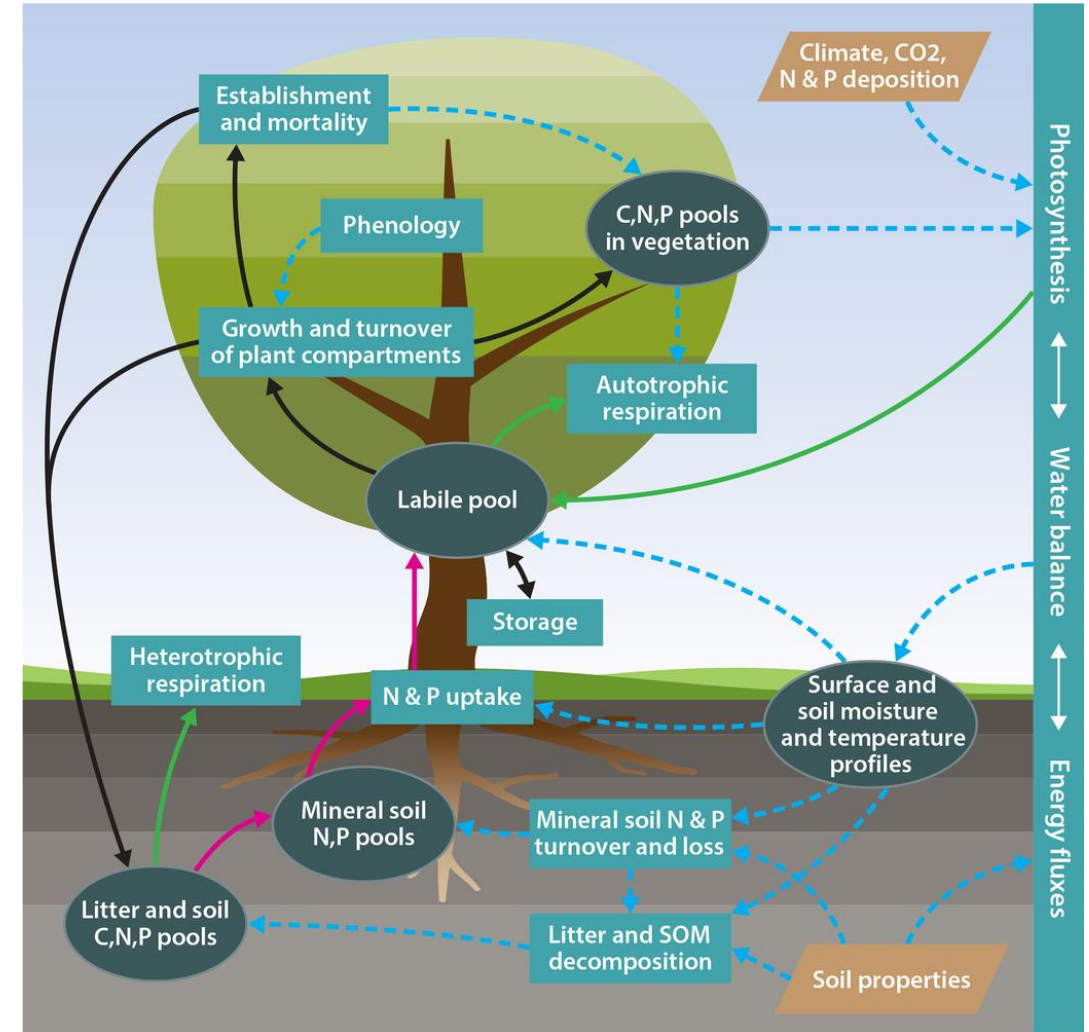
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Thum et al. (2019)

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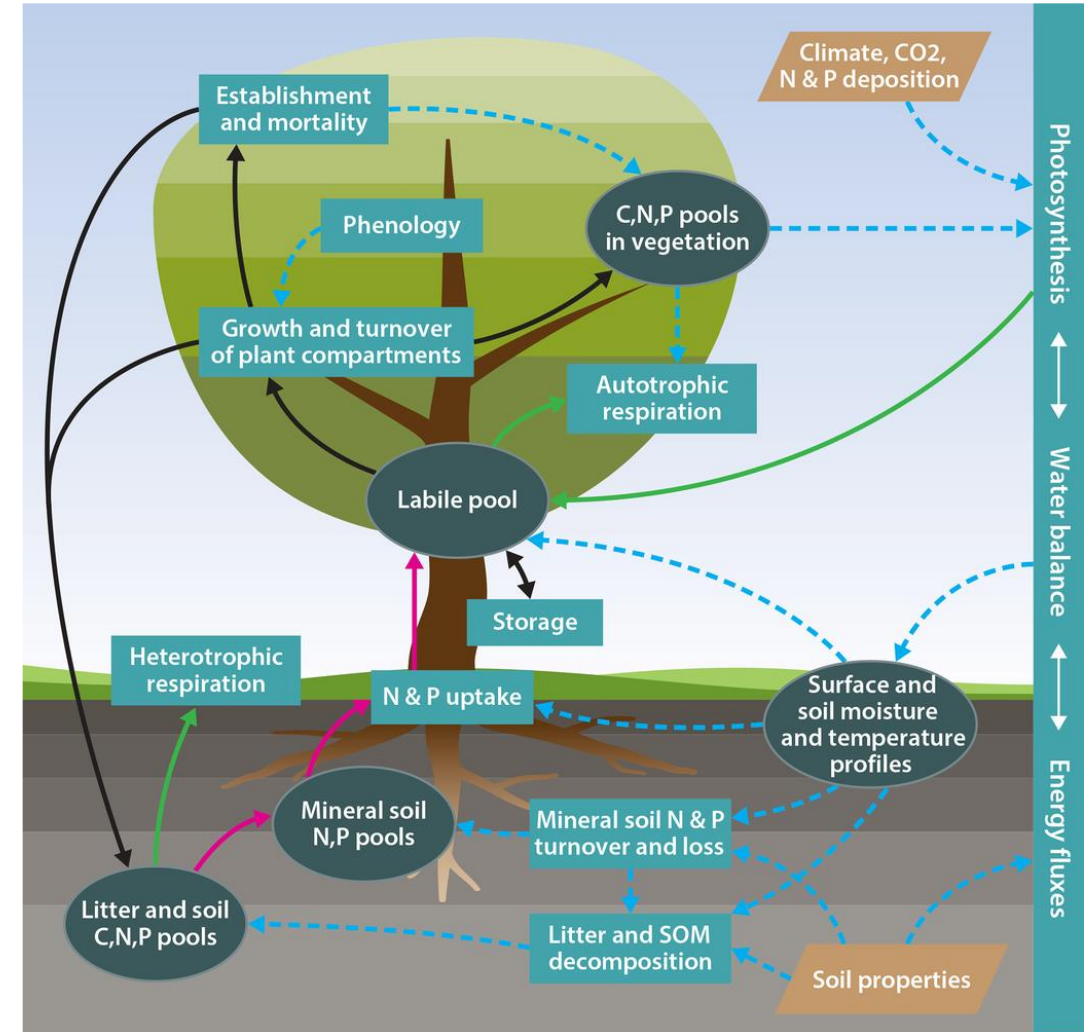
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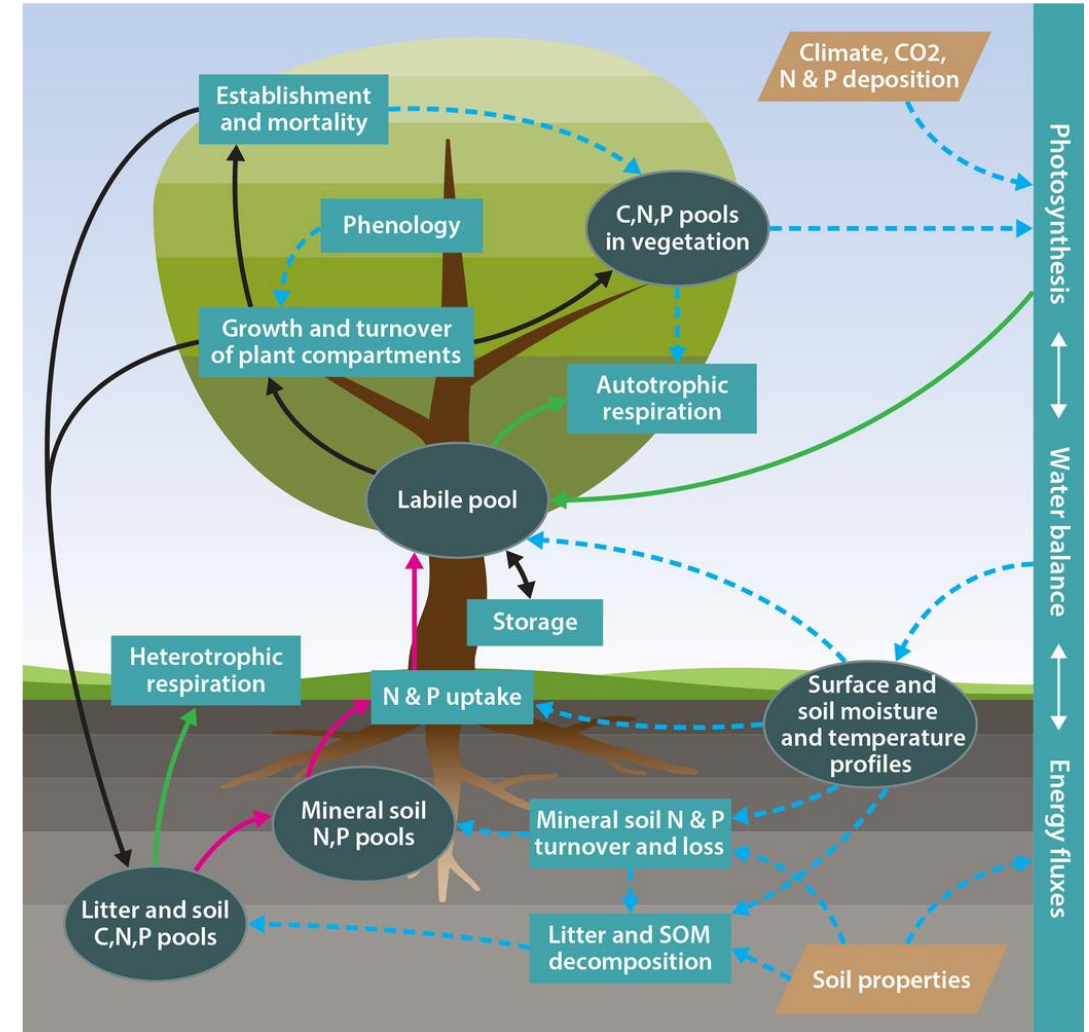
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Thum et al. (2019)

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1	Getting to know the code	2 weeks
2	Port ICON-Land standalone driver to GPU using JSBACH scientific routines	1 month
3	Port canopy mode (biogeophysics)	2.5 months
4	Port plant mode (+ vegetation biogeochemistry and dynamics)	1 month
5	Port land mode routines (+ simple soil biogeochemistry)	1 month
6	Investigate portability of complex soil model	If time permits



Thum et al. (2019)

Realised schedule



Task Nr.	Task	Duration
1 + 2	Getting to know the code Port ICON-Land standalone driver to GPU using JSBACH scientific routines	3 months
3	Preliminary port of canopy mode (biogeophysics)	3 months



Complexity of the ICON infrastructure

- If you are new to ICON
 - getting to know such a complicated code requires much longer than 2 weeks
 - also for a technically very skilled RSE



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➤ Importance of natESM project

- Long compiling times
- Long queueing times

Results



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Porting the ICON-Land standalone driver			CPU & GPU	

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	JSBACH	QUINCY	JSBACH	QUINCY (biogeophysics)
Initial status	CPU & GPU		CPU only	CPU only
Porting the ICON-Land standalone driver			CPU & GPU	
Preliminary port of QUINCY (biogeophysics)				CPU & GPU



Support for subsequent porting of further QUINCY routines

- QUINCY porting guide:

https://www.nat-esm.de/services/support-through-sprints/documentation/quincy_porting_guide.pdf



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- Port stepwise - routine by routine:
 - prepare code to run on GPU
 - replace vectorised code with do-loops and if clauses
 - care for derived types
 - use data synchronisation directives to allow running on GPUs
 - while still calculating not yet ported routines on CPU
- Assert equal results of the GPU+CPU simulation with a 'pure' CPU simulation



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- Data comparison module:

https://www.nat-esm.de/services/support-through-sprints/documentation/mo_acc_util_guide.pdf

... during the meantime



Continued the port of the biogeophysical routines

- ported still missing scientific routines of the CANOPY mode
- bringing the code into full compliance with the ICON OpenACC style and implementation guide

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- ported still missing scientific routines of the CANOPY mode
- bringing the code into full compliance with the ICON OpenACC style and implementation guide
- merged into the official ICON-MPIM repository
- ... including QUINCY CANOPY as ICON-MPIM buildbot test on levante GPUs

Outlook



- Finish merge of QUINCY and JSBACH physics
 - getting rid of remaining QUINCY physics routines only running on CPU
 - and thereby of data synchronisation directives
- With the fully ported code: assessing the performance
 - with a test case large enough to fully load the GPUs (R2B6)!

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- Porting scientific routines for other modes (PLANT and LAND)?
- Investigating portability of the complex soil model?
 - Whats next? C++ and Kokos?

THANK YOU

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References

Thum et al. (2019): A new model of the coupled carbon, nitrogen, and phosphorus cycles in the terrestrial biosphere (QUINCY 861 v1.0; revision 1996), *Geosci. Model Dev.*, 12, 4781-4802, [10.5194/gmd-12-4781-2019](https://doi.org/10.5194/gmd-12-4781-2019).