

Andy Ridgwell (andy@seao2.org)

A Hitchhikers Guide to Earth system & marine ecological modelling



key papers

[Watson and Lovelock \[1983\]](#)

got data?

GEO111 -- week 01:

historical ice-core μCO_2 record data;
Phanerozoic μCO_2 proxy data;
[OLD] Historical global temperature data;
Observed global mean temperature anomaly data;
Observed Riverside temperature trend data;

[OLD] marine sediment d180 data;

[OLD] USGS earthquake data; 2D model grid data.

GEO111 -- week 02:

monthly global gridded temperature data: jan, feb, mar, apr, may, jun, jly, aug, sep, oct, nov, dec.
continental outline files: 'k', lon, lat, start, end;

GEO111 -- week 04:

μCO_2 data -- simple format;
 μCO_2 data -- complex format;
 μCO_2 data -- Excel format;
model netCDF file -- 2D;
model netCDF file -- 3D;
global Earth surface topography data;
ice-core CO_2 data.

GEO111 -- week 05:

monthly ocean temperature data: jan, feb, mar, apr, may, jun, jly, aug, sep, oct, nov, dec.

GEO111 -- week 10:

complete App: zip-file.

GEO111: Numerical Techniques for Geosciences (2019/20)

- [GEO111 course guide](#) *to-date* (including syllabus and course overview, weekly learning goals and lab exercises, micro-assessments).
- The [GEO111 course text](#) [in revision].
- MATLAB 'Getting Started Guide'.

GE290: Introduction to Earth system modelling(2019/20)

- [GE290 course guide](#) *to-date* (including syllabus and course overview).
- The [GE290 course text](#) (the 'muffin manual!') [in revision].
- [domino.ucr.edu](#) cluster usage rules and account configuration instructions.

GEO111: Numerical Techniques for Geosciences (2018/19) [OLD]

- [GEO111 course guide](#) to-date (including syllabus and course overview, weekly learning goals and lab exercises, micro-assessments).
- Current revision of the [GEO111 course text](#).
- MATLAB 'Getting Started Guide'.
- micro-assessment #6 files: [m-file](#); [etheridge_etal_1996.txt](#); [model_grid.txt](#); [data_caco3.dat](#).

GEO157: An Introduction to Geographical Information Science (2017/18) [OLD]

- Course [Syllabus and Introduction](#)
- Current course [TIMETABLE](#).
- Course material (by week number):
 - (01) [lecture #1](#), plus Lab presentation
 - (02) [lecture #2](#), Problem set #1
 - (03) [preamble ... and lecture #3 \(part I\) ... AND ... lecture #3 \(part II\)](#).
 - (04)
 - (05) [preamble](#) (misc info and problem set discussion); [slides](#) on relational algebra and a relational table example.
 - (06) [preamble](#); paper presentation instructions; example publication data bank.
 - (07) paper presentation running order.
- Final project [INSTRUCTIONS](#).

GEO111: Numerical Techniques for Geosciences (2017/18) [OLD]

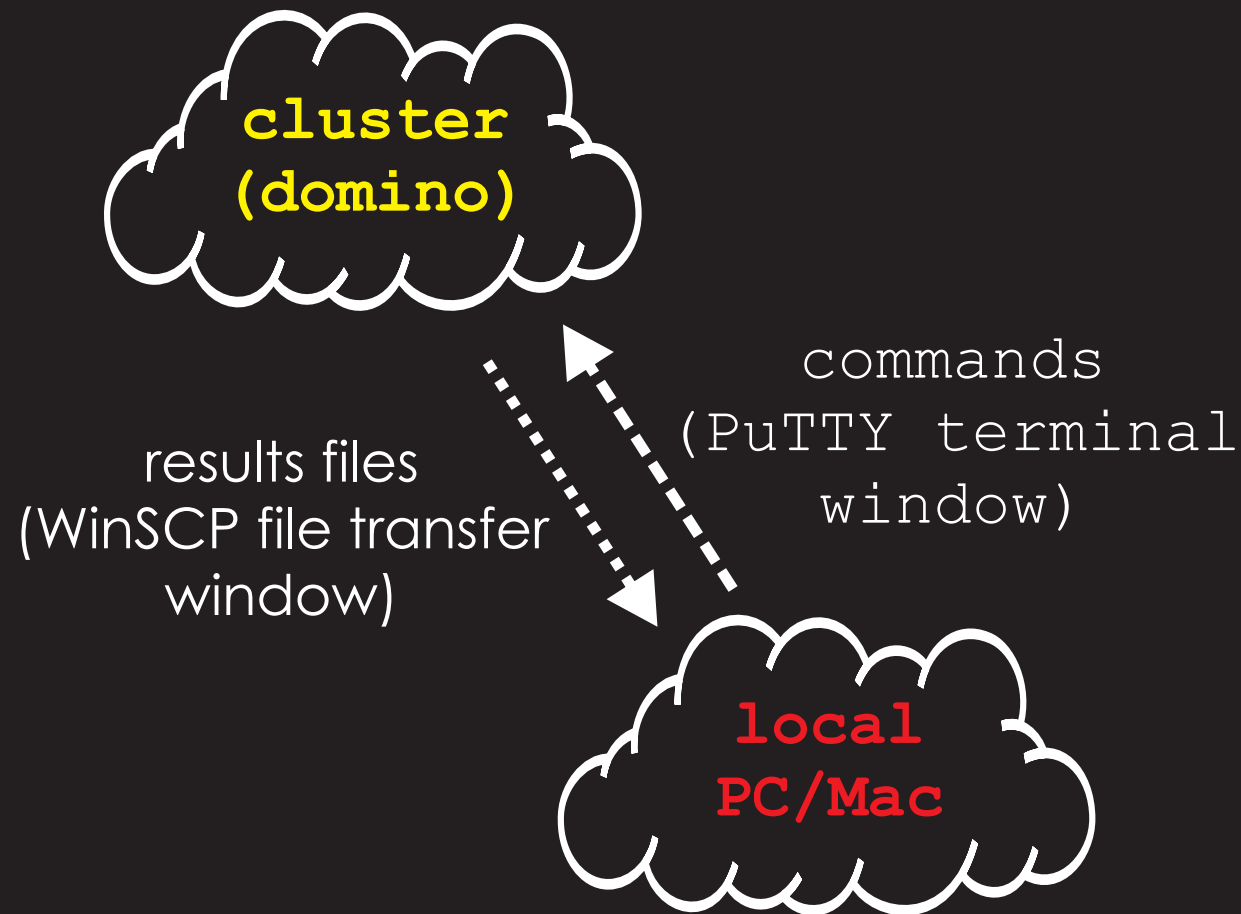
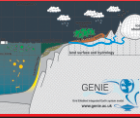
- [GEO111 course guide](#) to-date (inc. weekly learning goals and lab exercises, micro-assessments).
- [GEO111 course text](#) to-date (also old (2016/17) complete course text for reference).
- MATLAB 'Getting Started Guide'.

GEO111: Numerical Techniques for Geosciences (2016/17) [OLD]

- [GEO111 course text](#) [!!!OLD_(2015/16)_DRAFT!!!] (just FYI)
- [GEO111 course outline](#)
- MATLAB 'Getting Started Guide'
- Weekly learning goals and lab exercises + relevant course text chapter
 - (01) [lab #1](#), chapter #2.
 - (02) [lab #2a](#), [lab #2b](#), chapter #3.
 - (03) [lab #3a](#), [lab #3b](#), chapter #3a.
 - (04) [lab #4](#). [chanter #3b](#). [chanter #5](#). [chanter #6](#).



Start (/stop) model experiments
Edit (configuration) files
(**SciTE**/other editor)
Visualize results (**Panoply**)

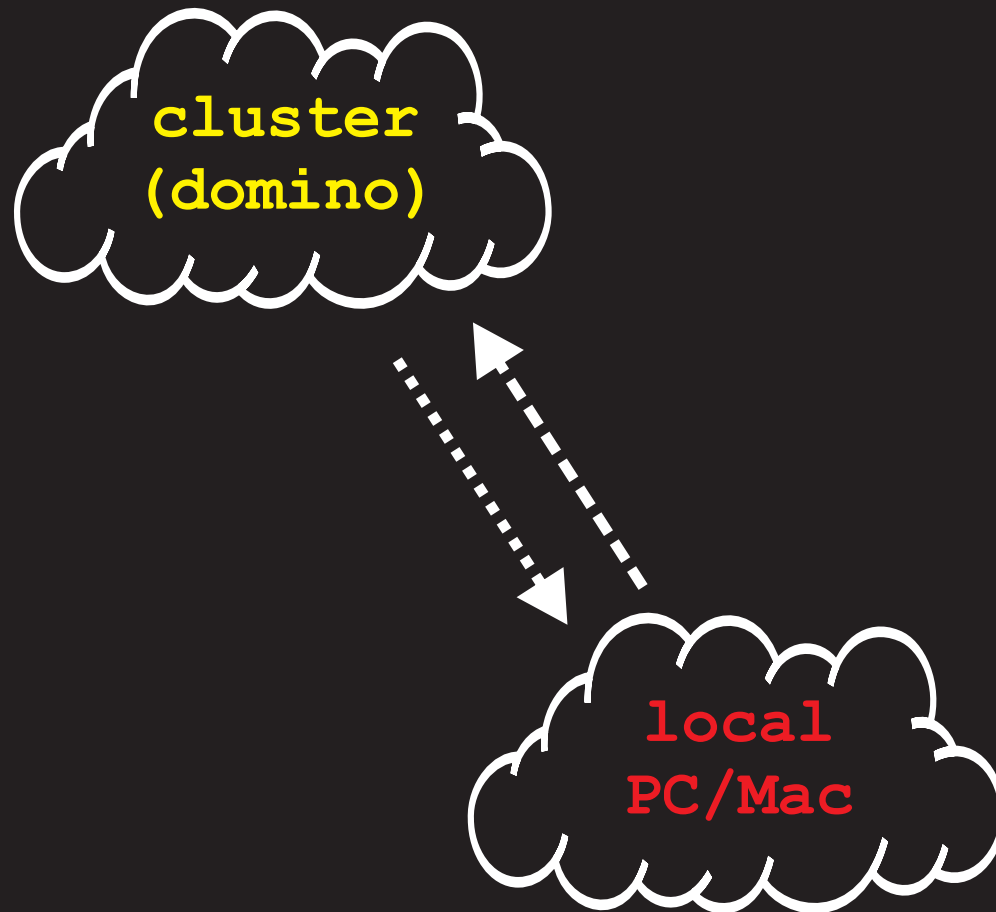


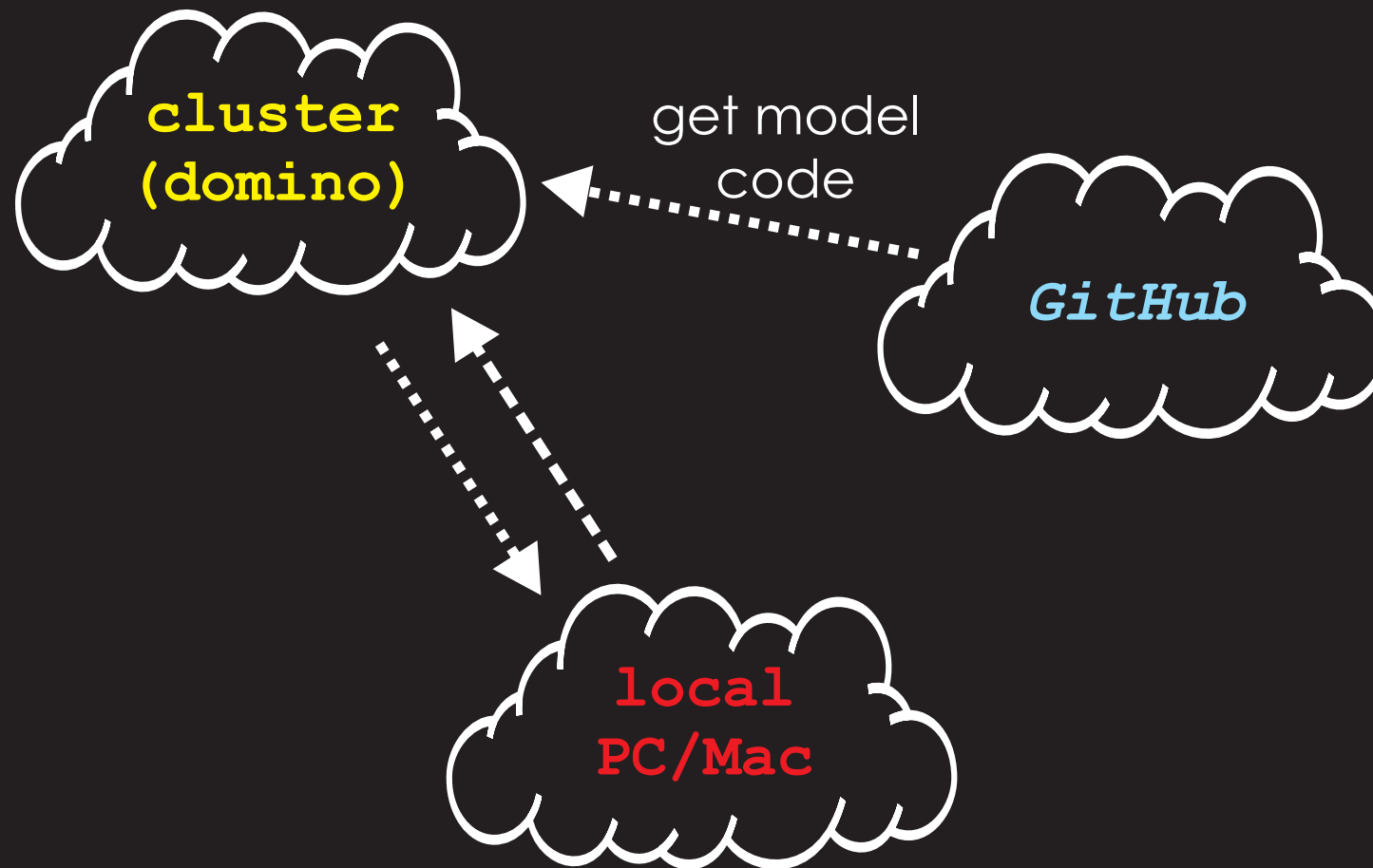
Works in groups of 2s / 3s

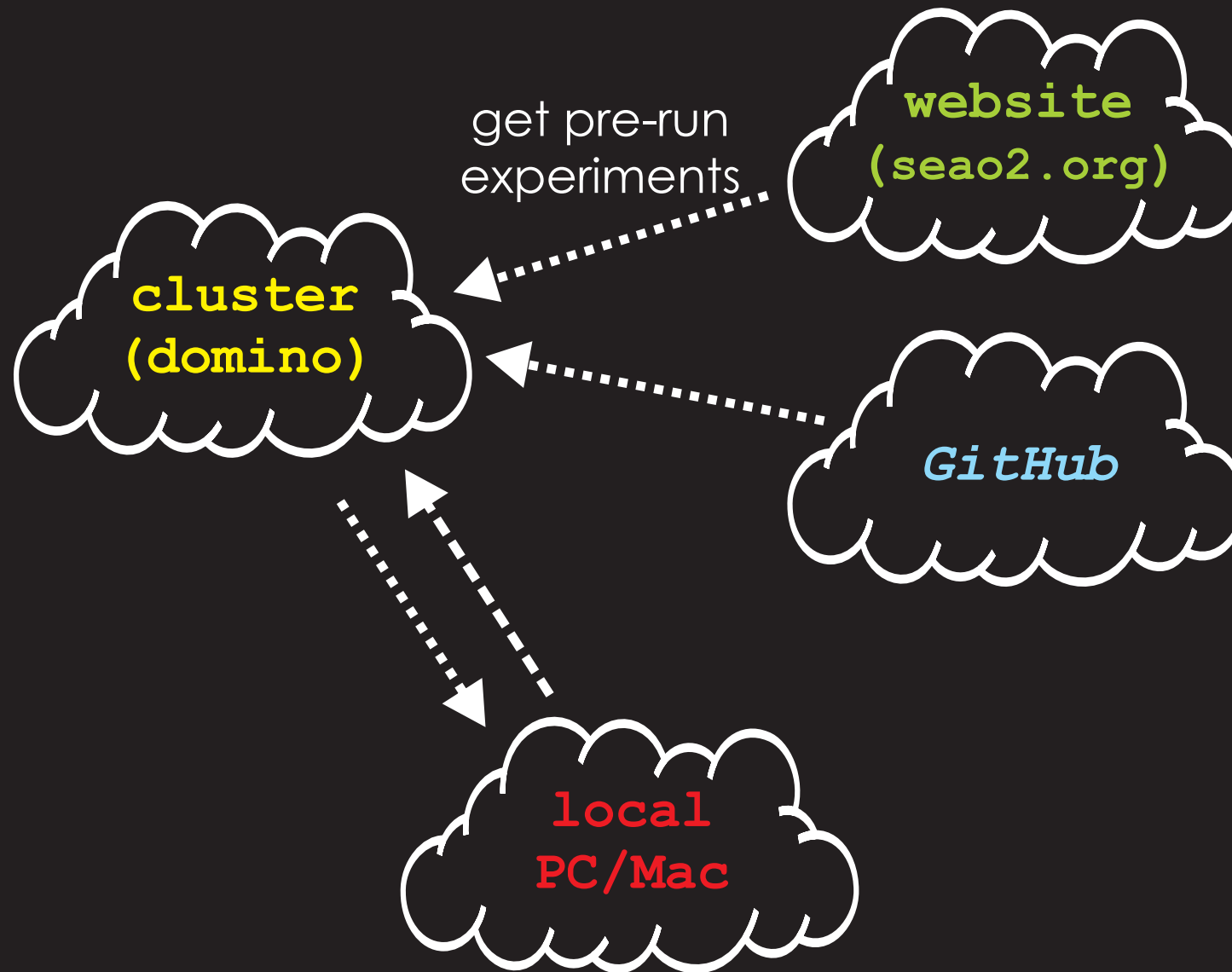
domino cluster account names:

muffin_11, muffin_12, muffin_13,
... muffin_19

Password: *****(the same for all)



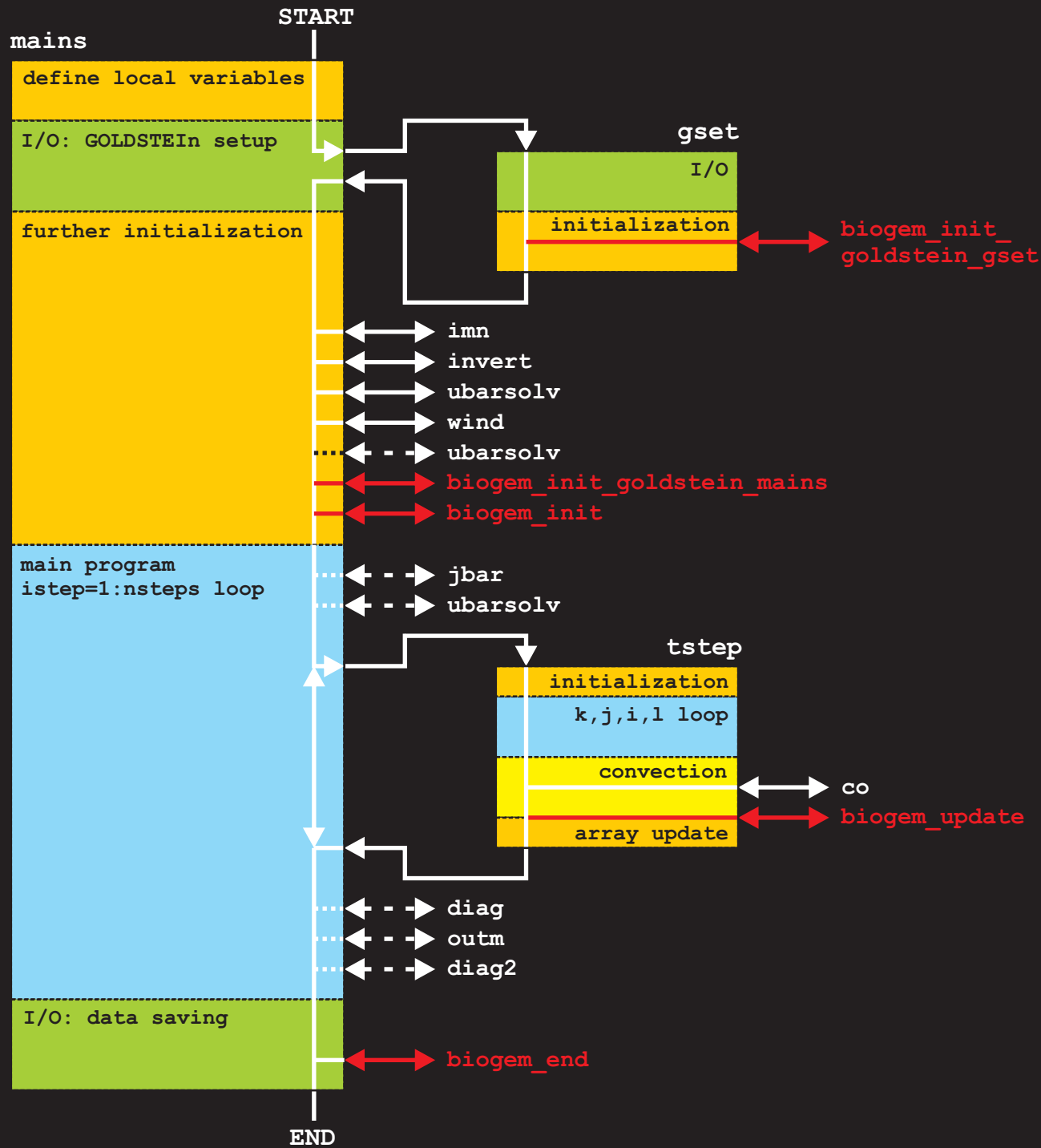




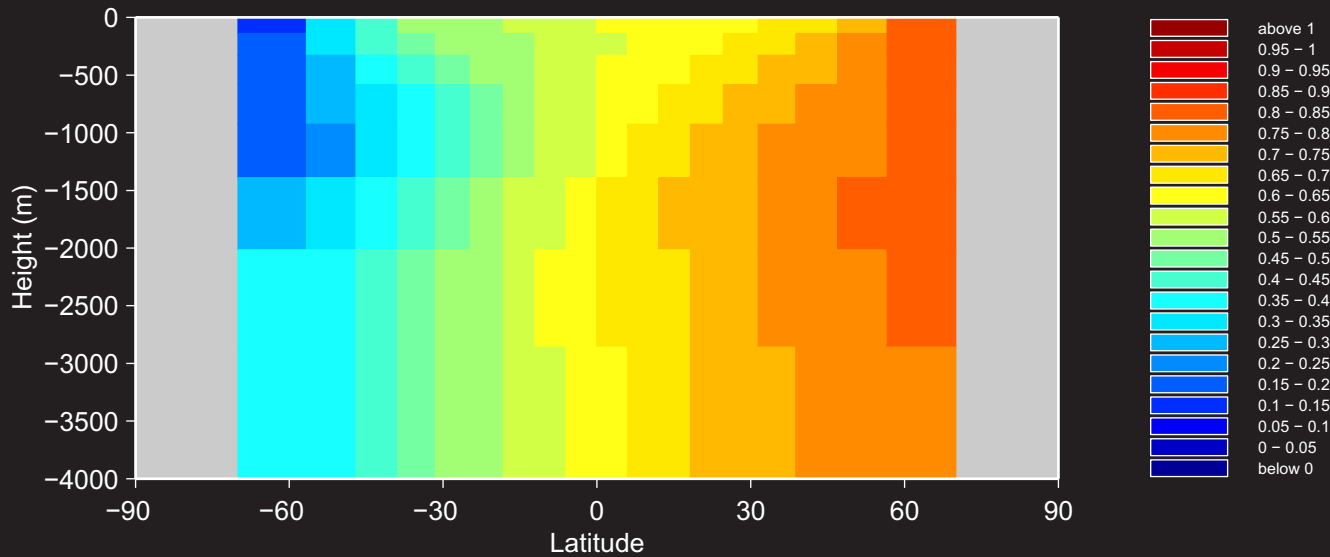
[unnamed] – Just 2 science modules ...
a (3D) ocean circulation model and an
ocean (-atmosphere) biogeochemistry
model.

f77 mains.f with a mix of f77
(GOLDTSEIn) and f90 (BIOGEM).



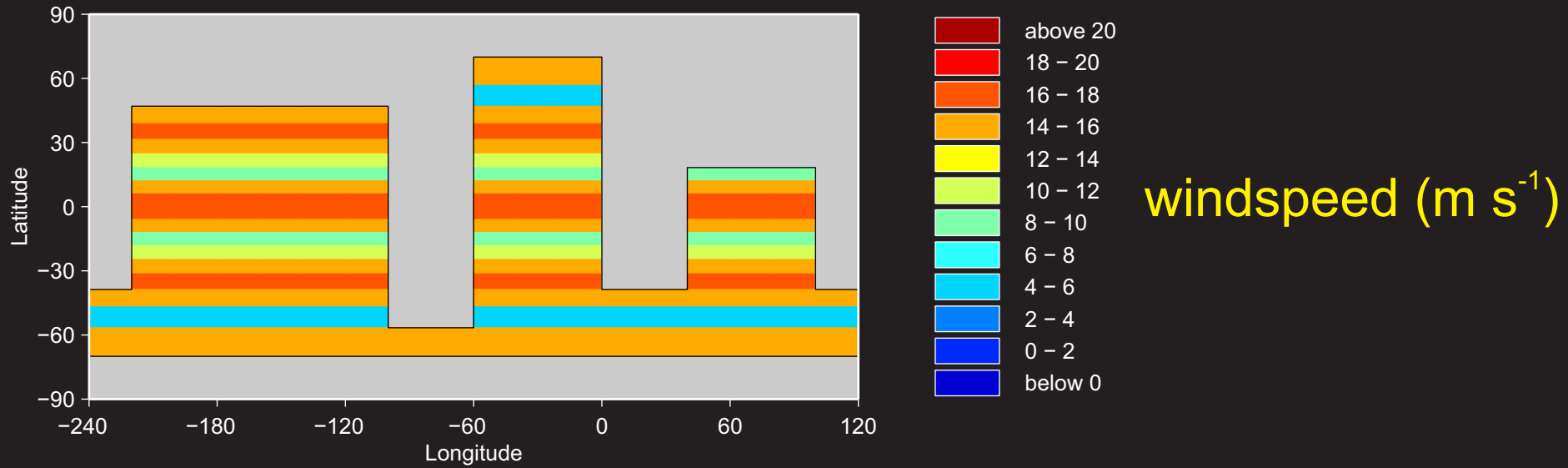


First steps in coupled model development – numerical tracers of ocean circulation.

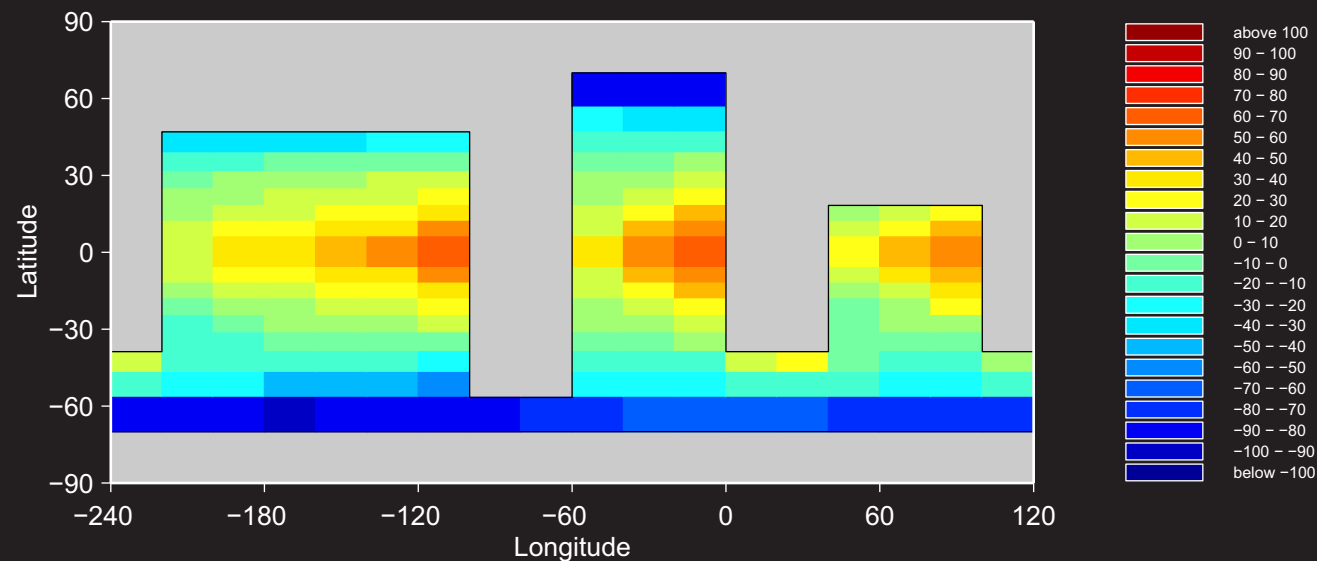
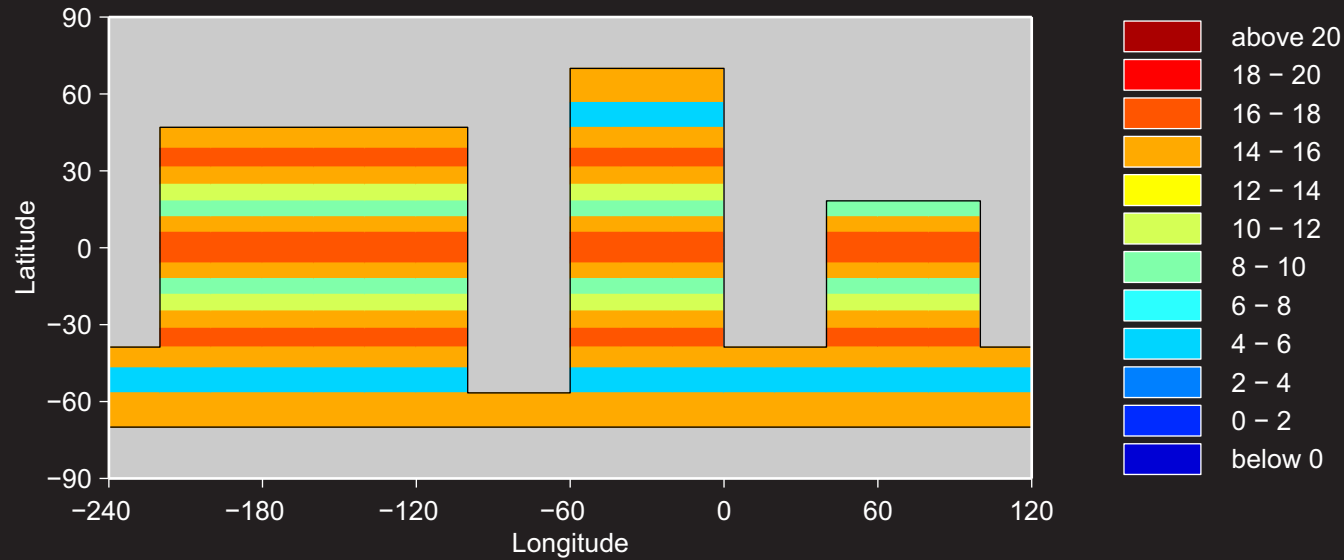


(Some things have not changed much in >10 years ... MATLAB plotting ...)

Add air-sea gas transfer ...



... and an **abiotic** carbon cycle.

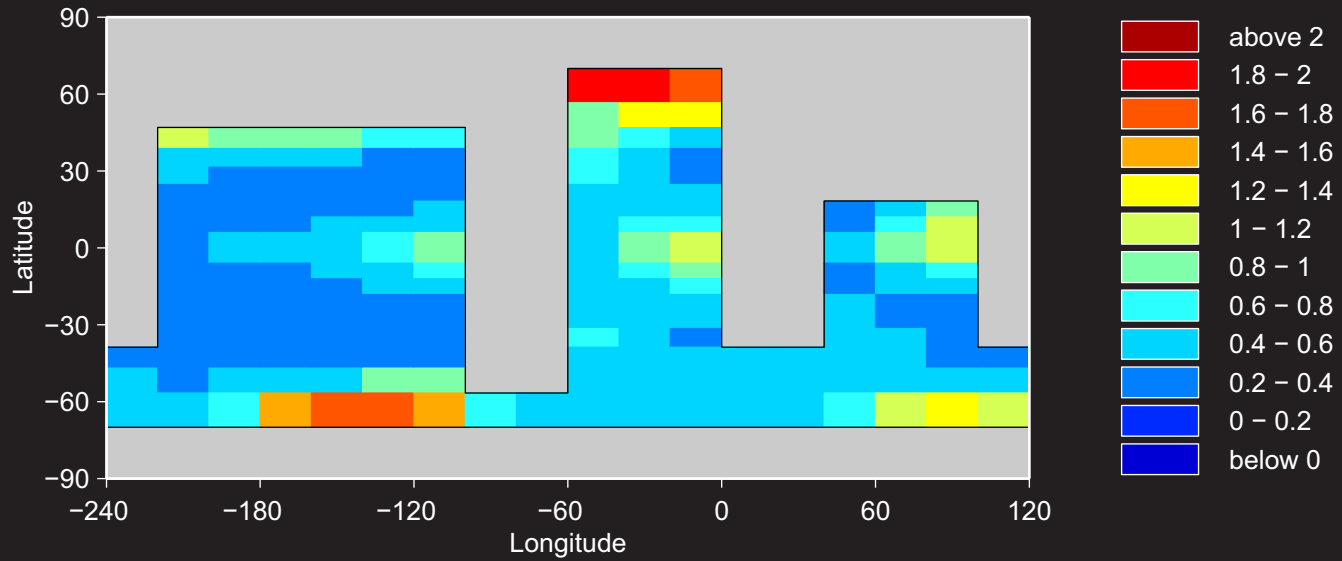


windspeed (m s⁻¹)

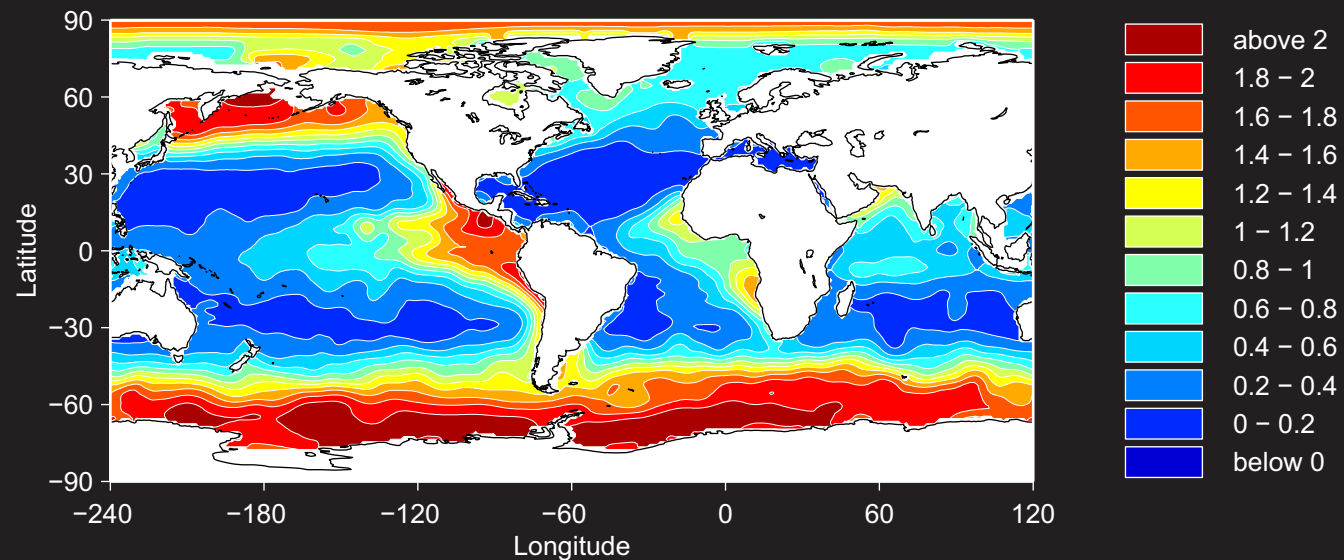
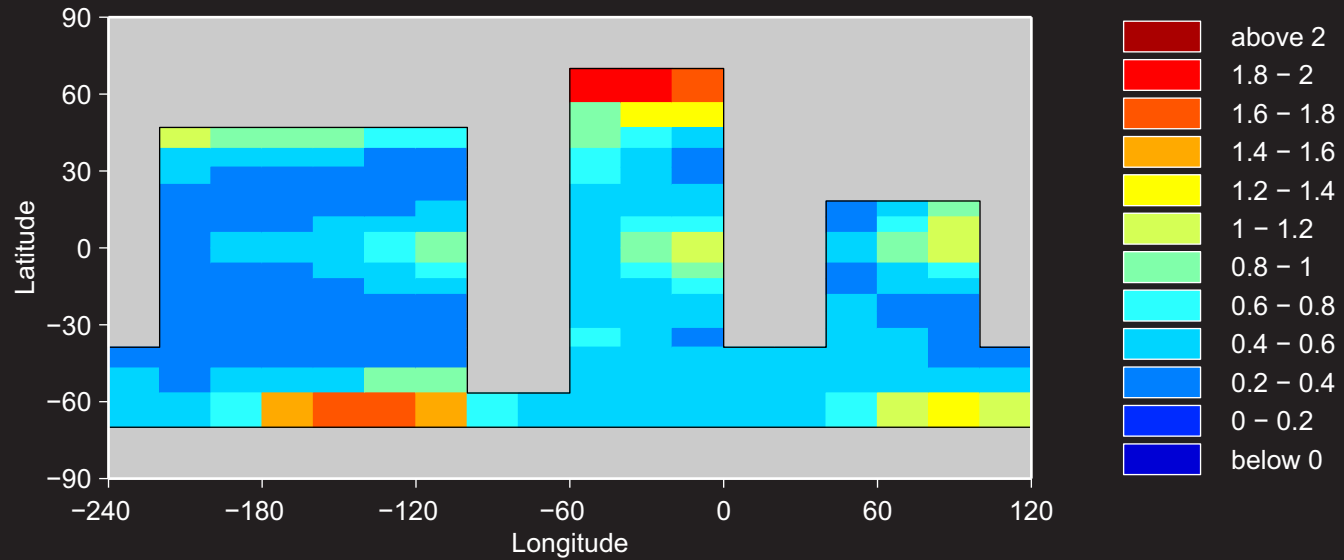


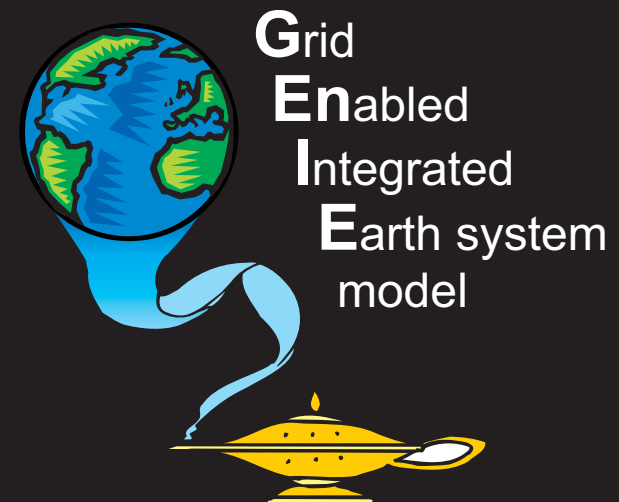
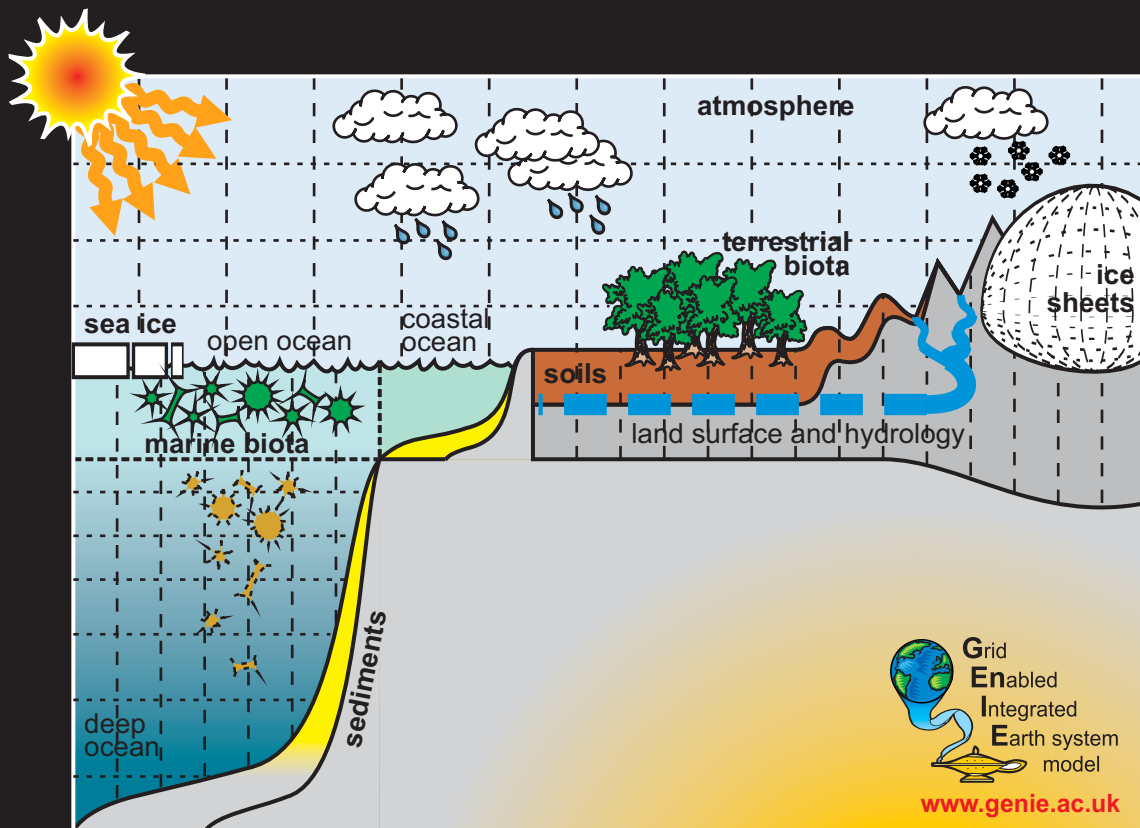
air-sea $\Delta p\text{CO}_2$ (μatm)

A **biotic** carbon cycle!



A **biotic** carbon cycle!
And challenges of model-data analysis.

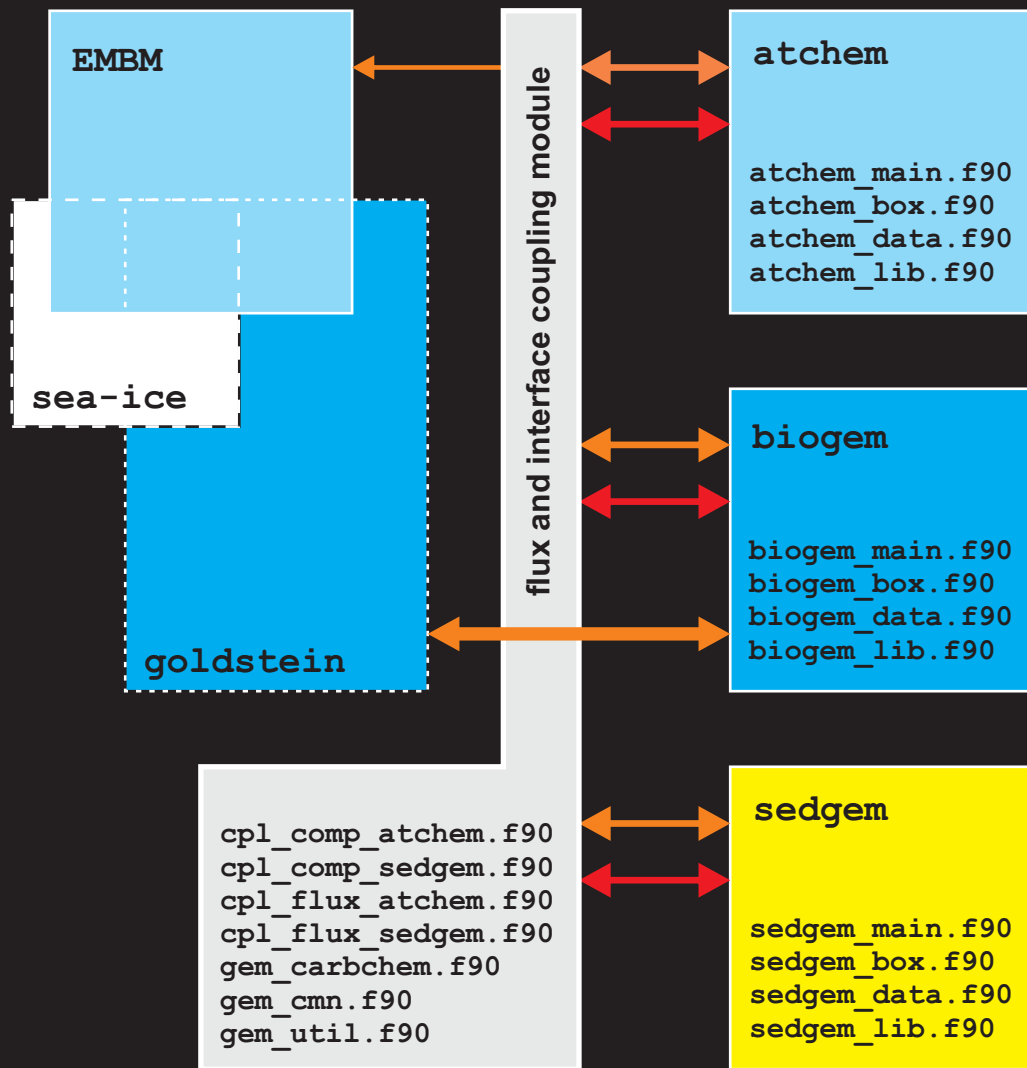




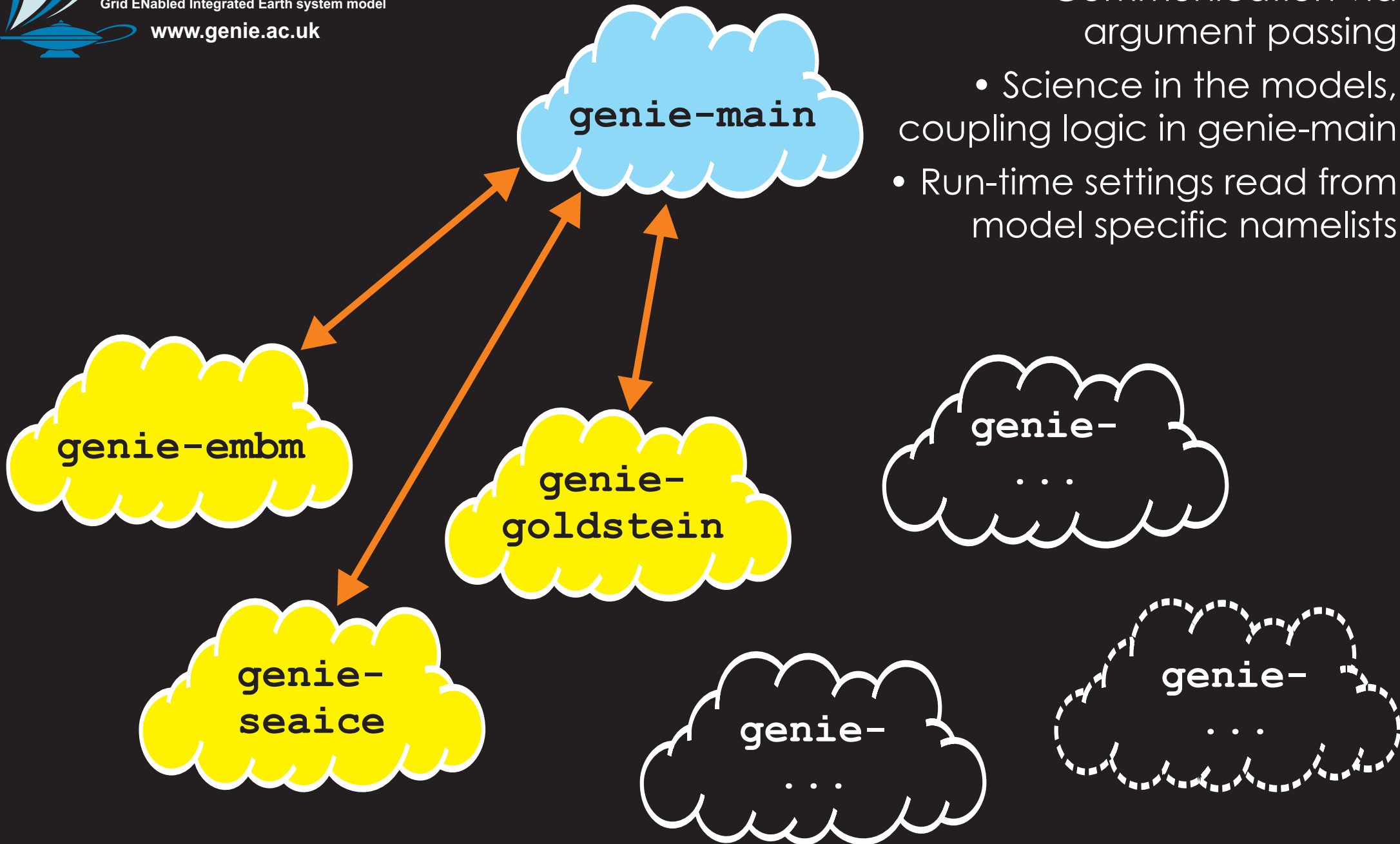


Grid ENabled Integrated Earth system model

www.genie.ac.uk

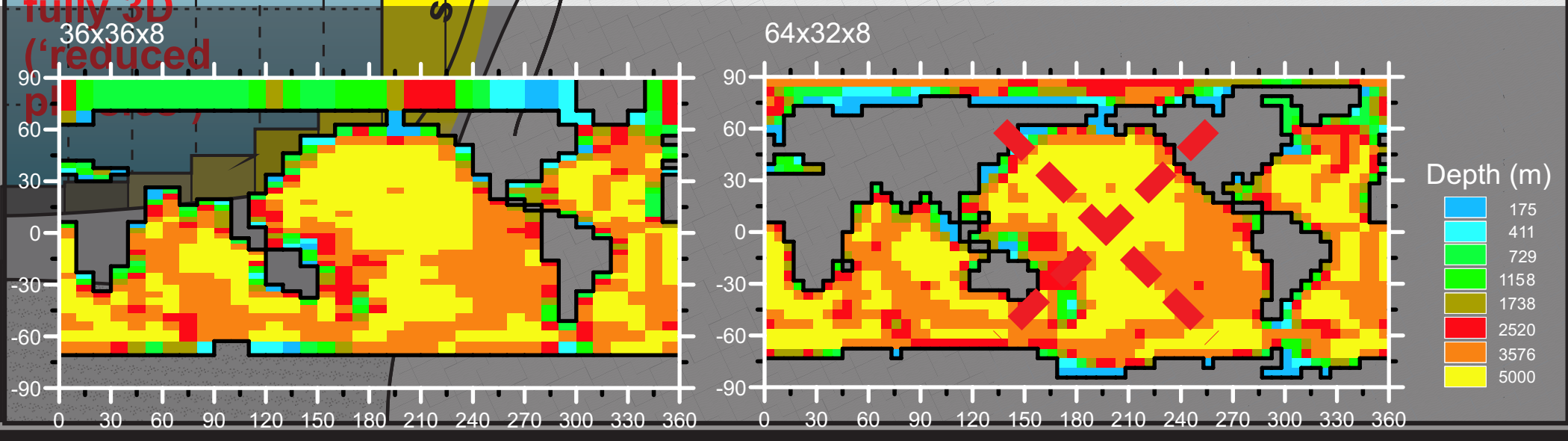
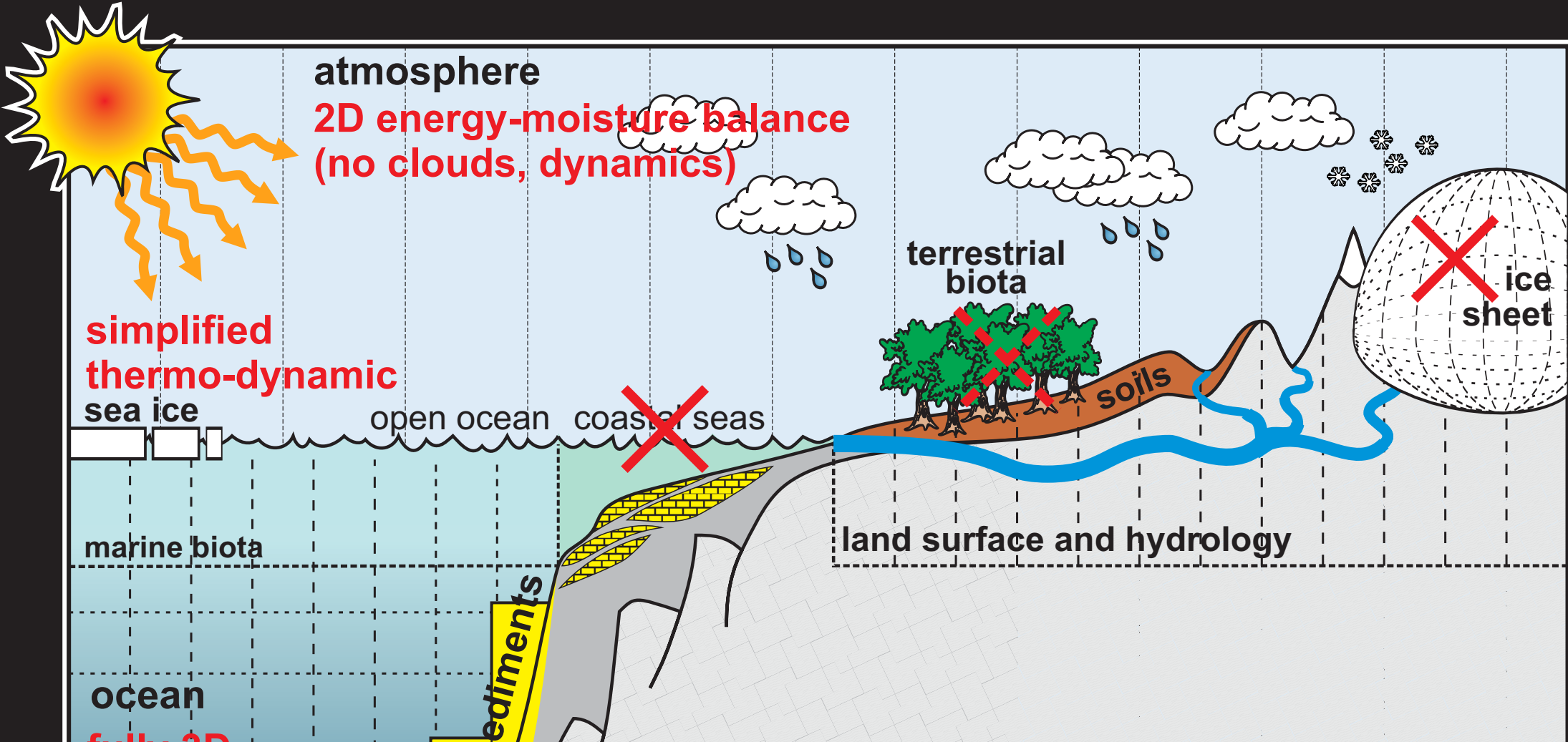


BASH, Python



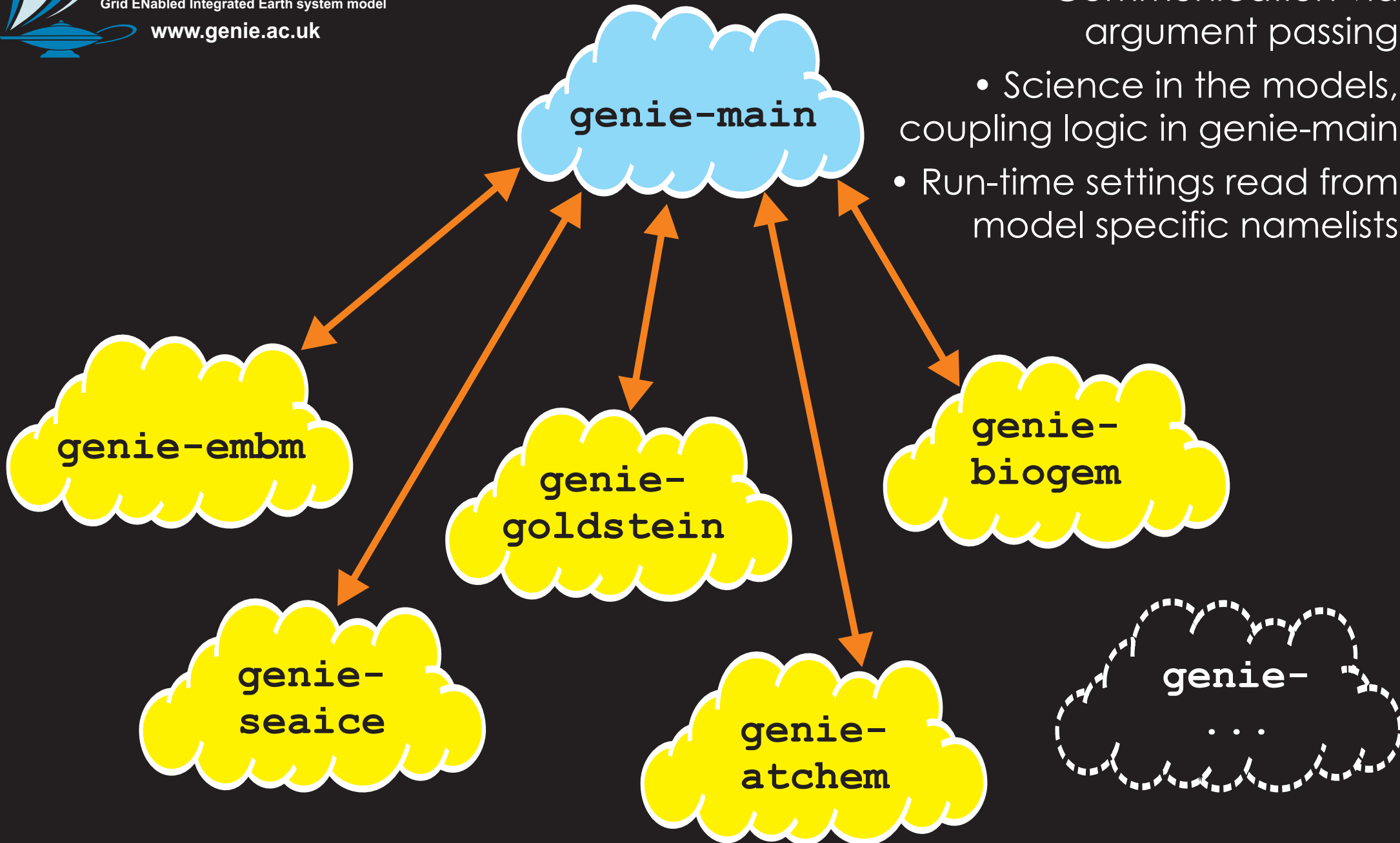
Modular, Hierarchical

- Communication via argument passing
- Science in the models, coupling logic in genie-main
- Run-time settings read from model specific namelists

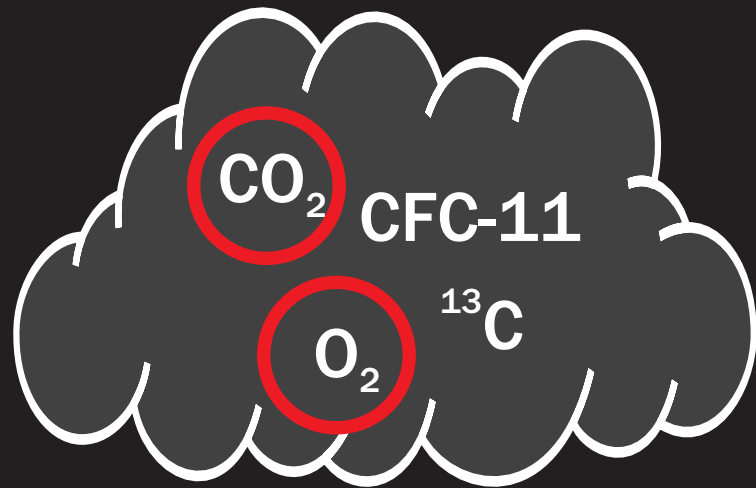


Modular, Hierarchical

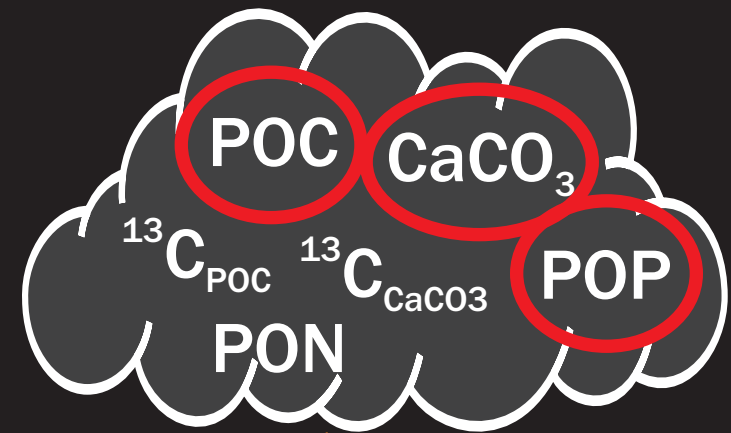
- Communication via argument passing
- Science in the models, coupling logic in genie-main
- Run-time settings read from model specific namelists



atmospheric tracers (gases)



biogeochemistry
solid tracers (particulates)



solubility coefficient
Schmidt number

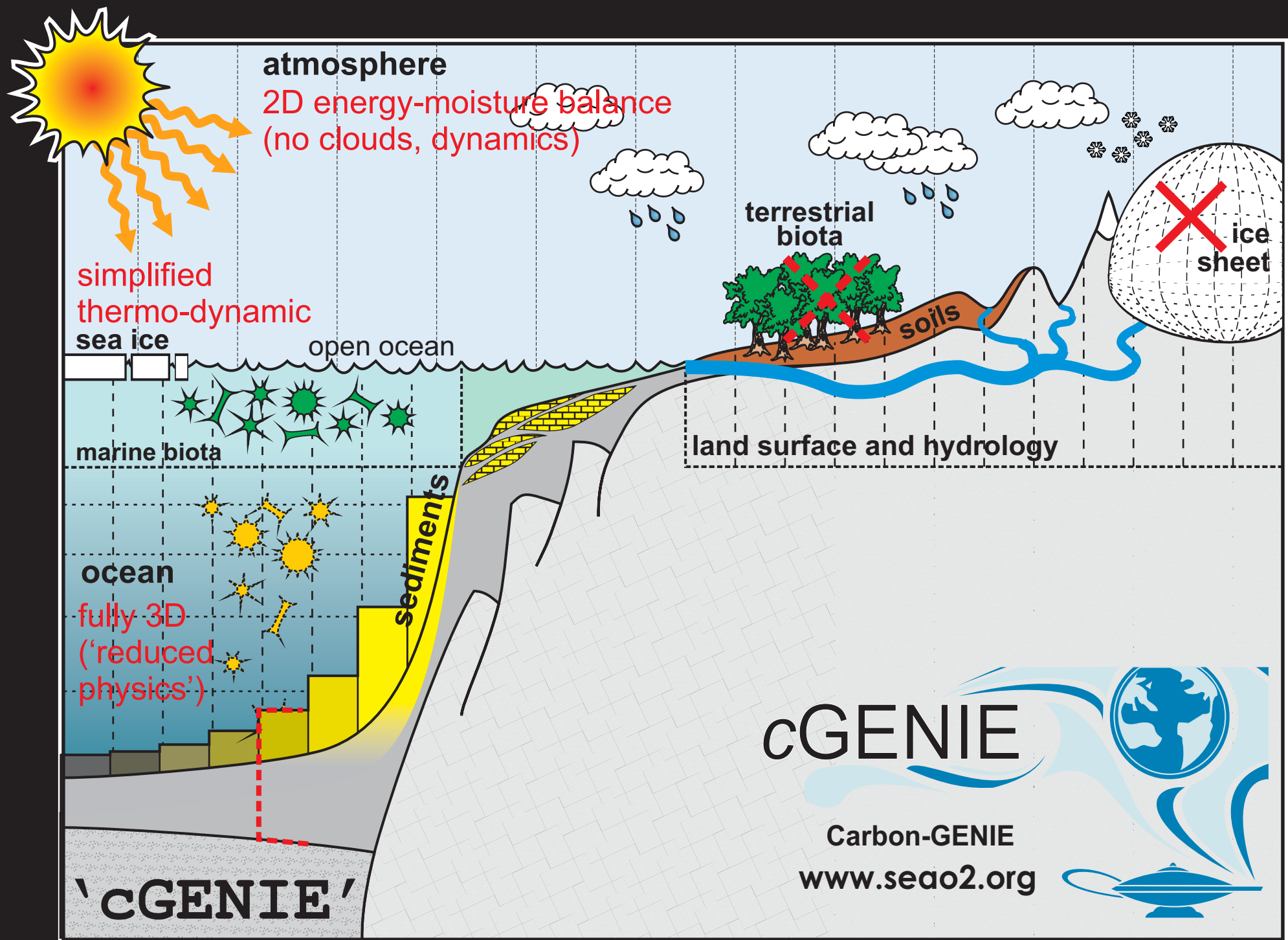
PRE-DEFINED
RELATIONSHIPS

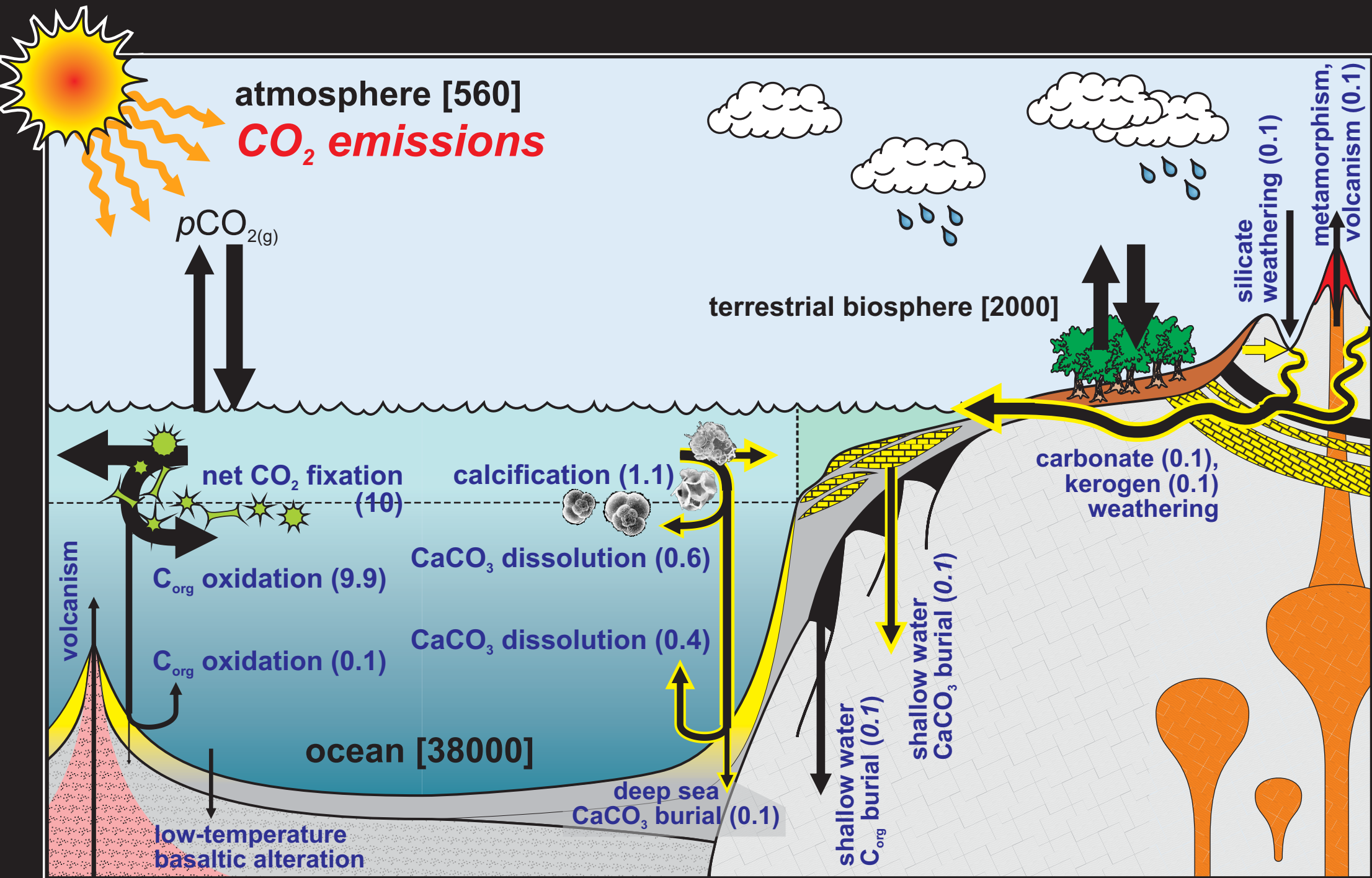
e.g., Redfield ratios



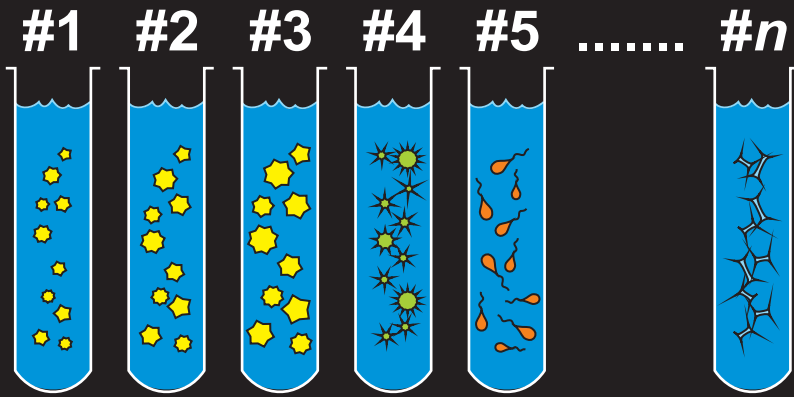
dissolved tracers



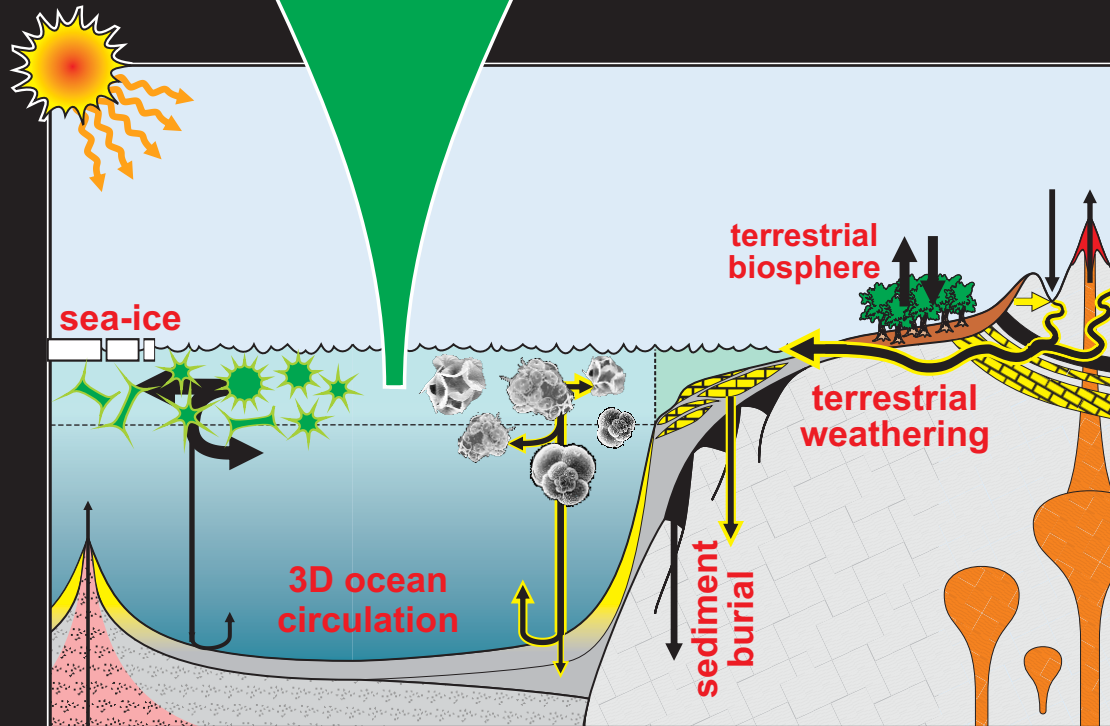






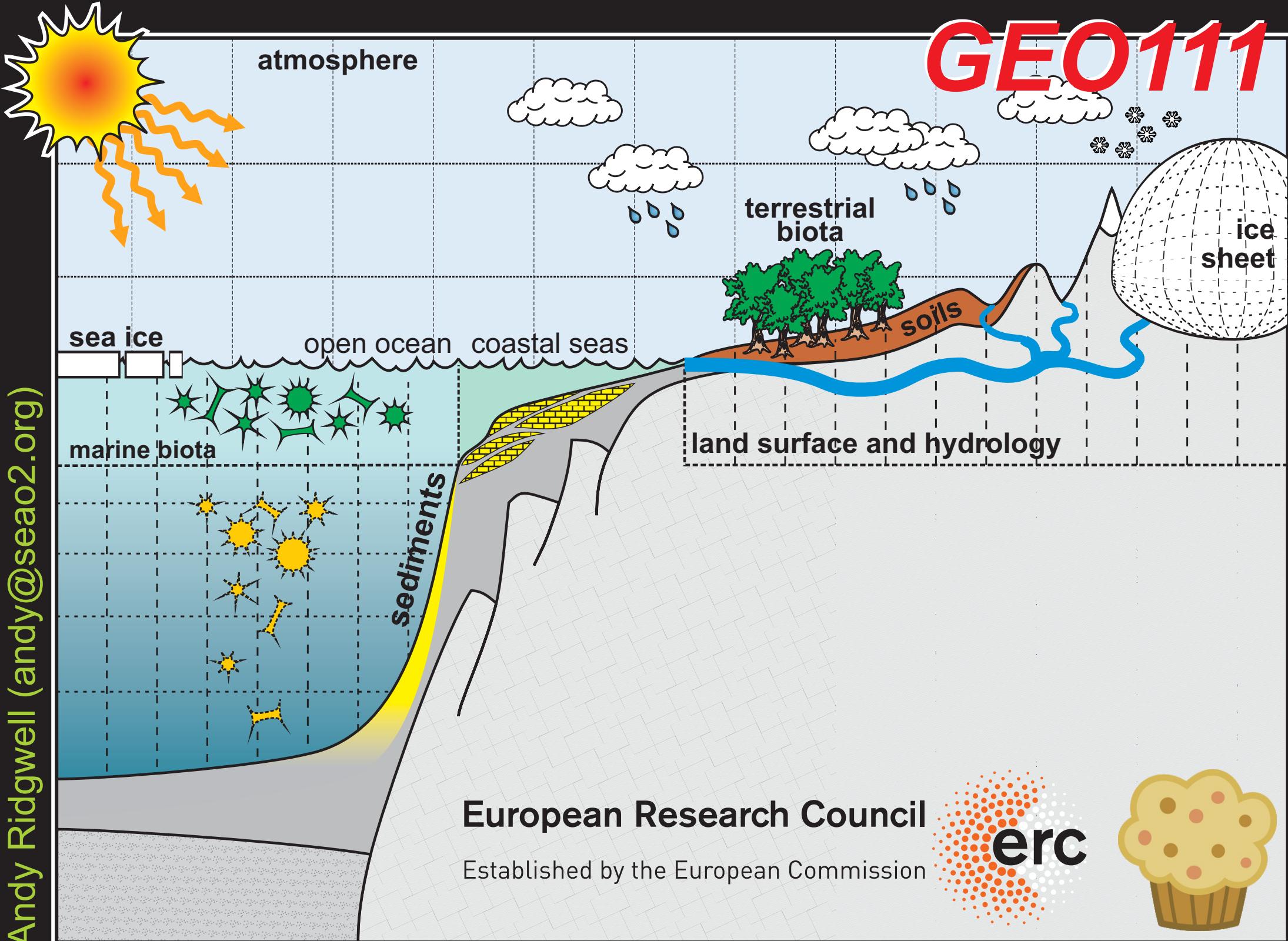


ECOGEM





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European Research Council

Established by the European Commission

