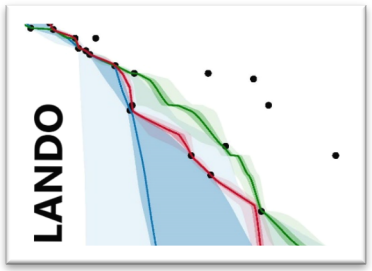
EGU Division Climate: Past, Present & Future
EGU22-8743

Using LANDO as a universal wrapper for applying multiple age-depth modeling systems for sediment records from Arctic lake systems

Gregor Pfalz, B. Diekmann, J.-C. Freytag, L. Syrykh, D. A. Subetto, and B. K. Biskaborn



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The Research Question

How can we reduce the effort to apply all age-depth modelling methods and make results comparable?

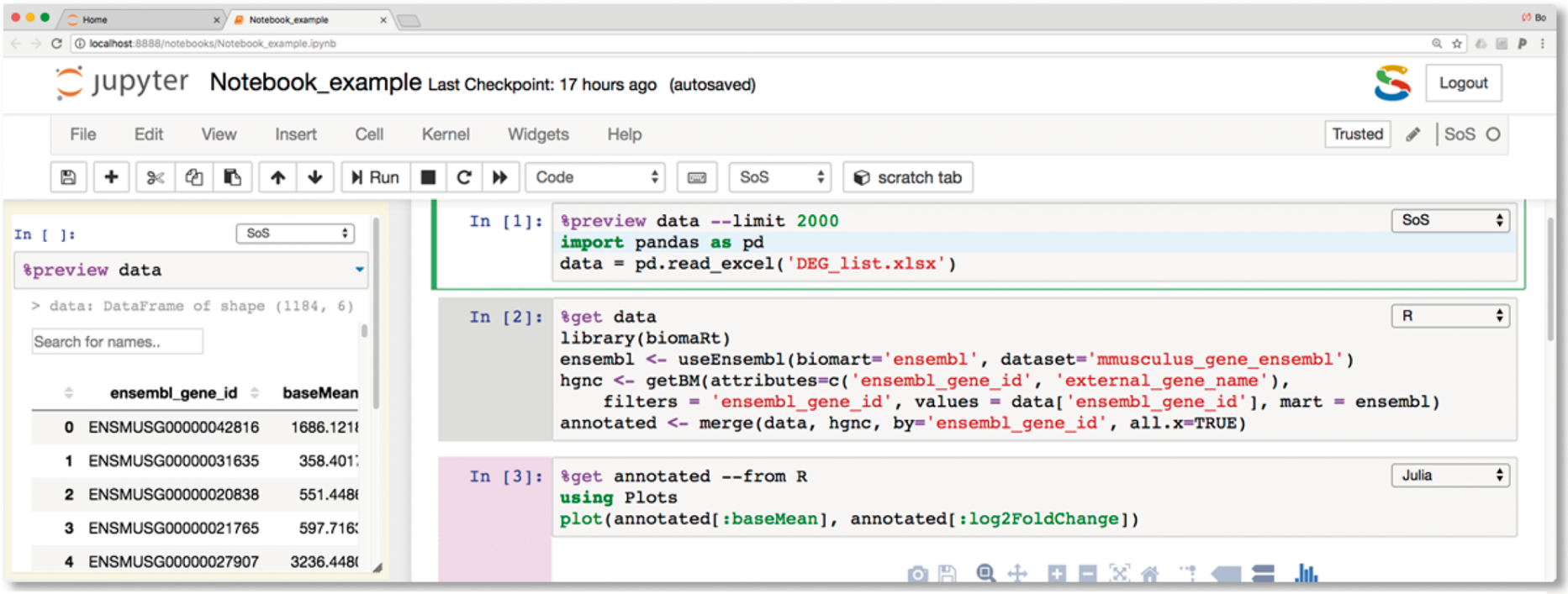
LANDO: Linked **A**ge **A**nd **D**epth M**o**delling

Reference:

Pfalz, G., Diekmann, B., Freytag, J.-C., Syrykh, L., Subetto, D. A., and Biskaborn, B. K.: Improving age–depth relationships by using the LANDO (“Linked age and depth modeling”) model ensemble, Geochronology, 4, 269–295, https://doi.org/10.5194/gchron-4-269-2022, 2022.

The Backbone

ScriptOfScript notebook



Peng, Bo et al. (2018). SoS notebook: An interactive multi-language data analysis environment. *Bioinformatics*, *34*(21), 3768–3770. https://doi.org/10.1093/bioinformatics/bty405

The Backbone

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SoS notebook

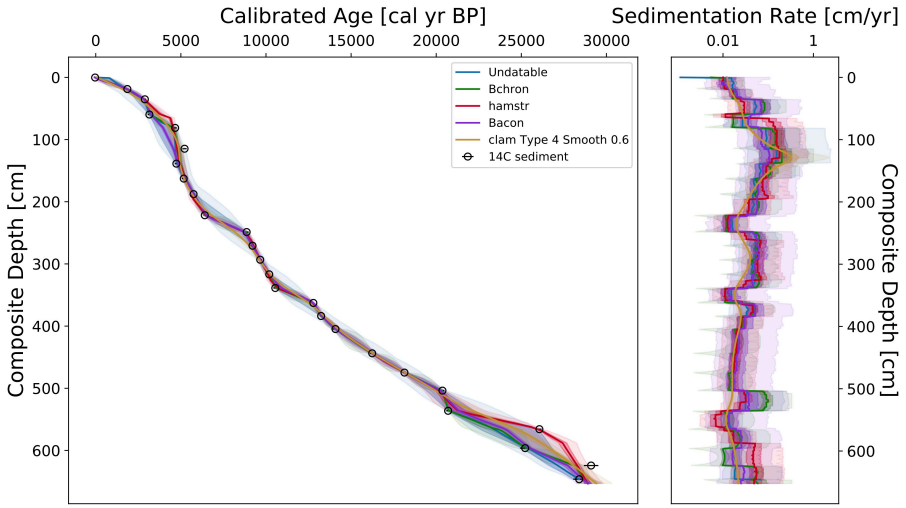
Undatable

Bchron

hamstr

Bacon

clam



The Components

Input & Preparation | Execution & Result Aggregation

- Input via spreadsheet or PostgreSQL database – must follow predetermined format of necessary attributes
- LANDO automatically sets calibration curve based on selected material category – users can change to different calibration curve (IntCal20, Marine20, SHCal20)

- LANDO can approximate the reservoir effect from existing radiocarbon data by using hamstr package
- LANDO automatically prepares dataset for each modeling software

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Execution & Result Aggregation

- LANDO executes multiple sediment cores in parallel using R and Python parallelization libraries
- LANDO uses default setting of every modeling software, which users can adapt parameters before modeling process

- LANDO calculates 1σ and 2σ age ranges and sedimentation rates for every modeling software from 10,000 converged age estimates

The Use Cases

1st use case - continuously deposited sequence:

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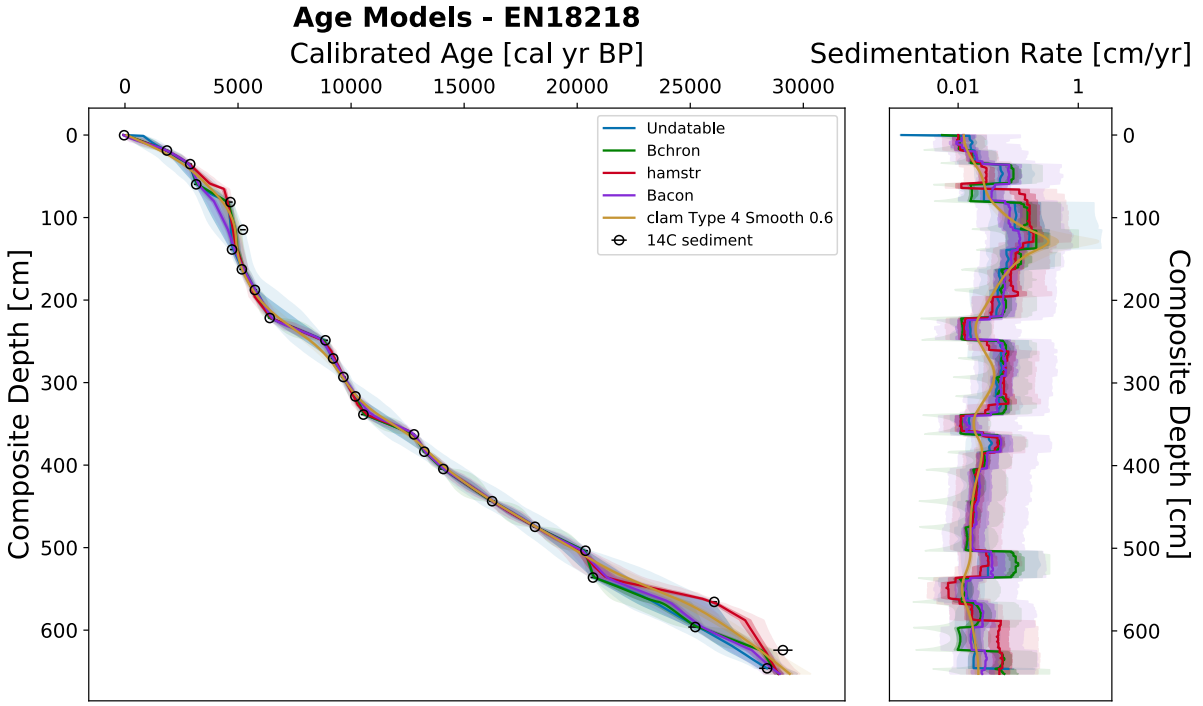
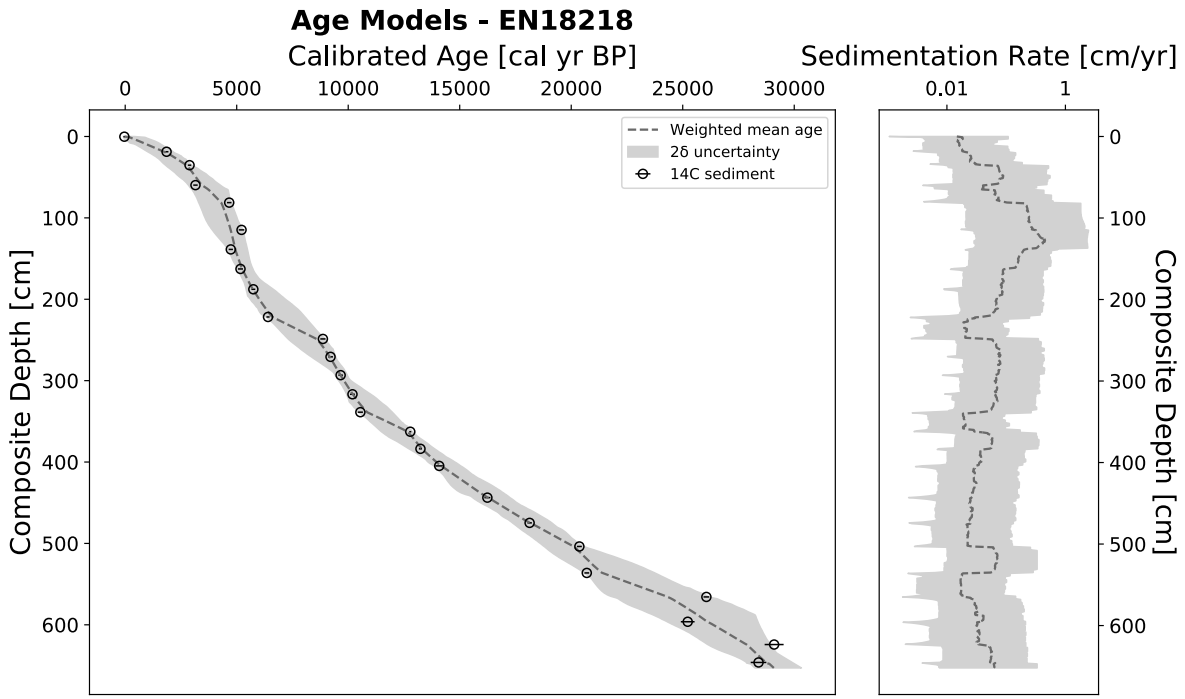


Computes five age-depth models with 1σ or 2σ range for one lake



Computes combined age-depth model for one lake

The Use Cases

2nd use case - inconsistent sequence:

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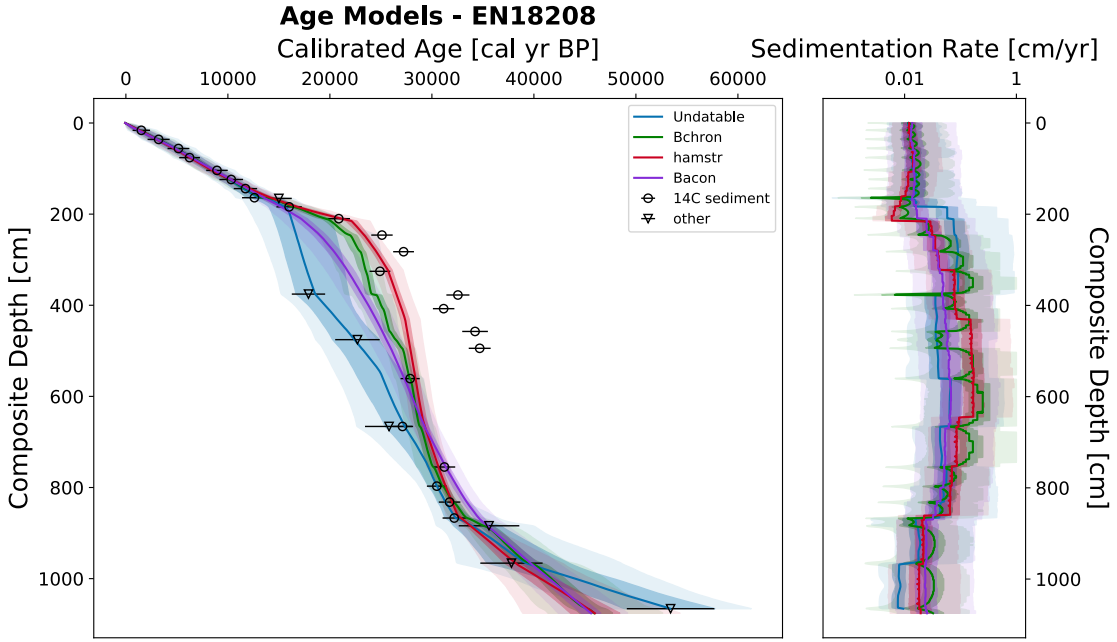
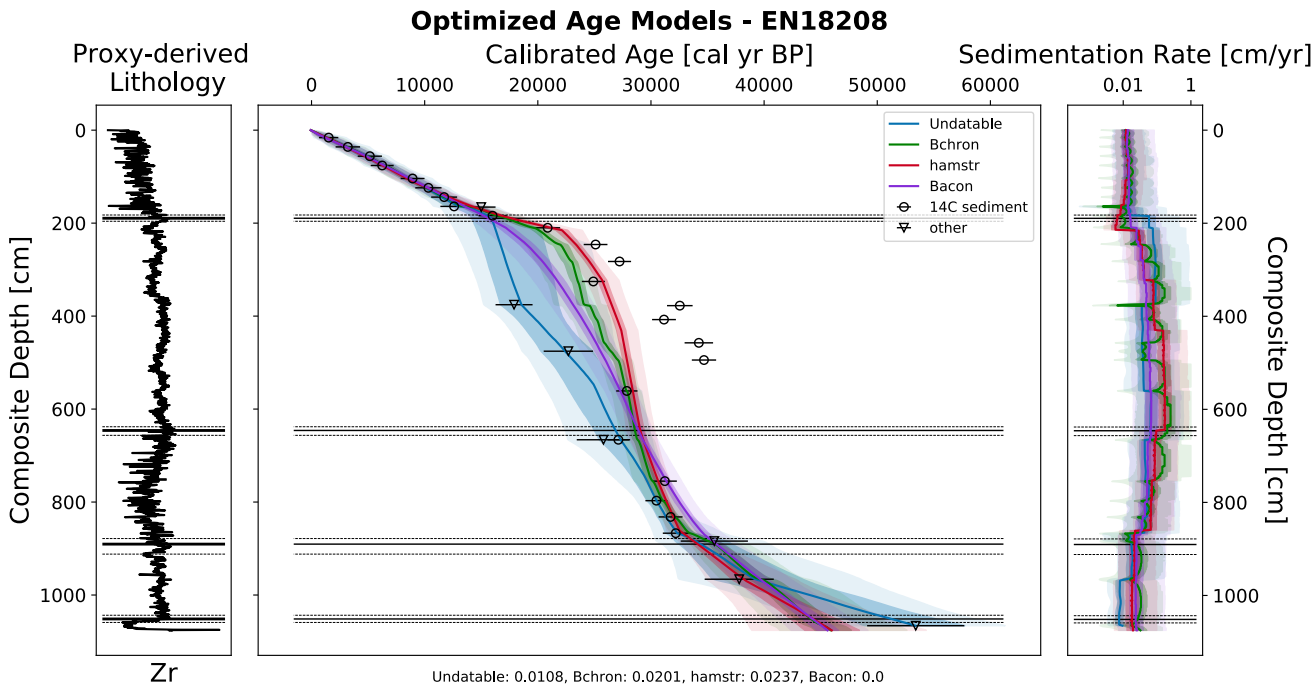


Scatter age determination data leads to disagreeing models



Using independent proxy data indicating lithological changes help us to select models which represent these changes

Hollaway, M. J., Henrys, P. A., Killick, R., Leeson, A., and Watkins, J.: Evaluating the ability of numerical models to capture important shifts in environmental time series: A fuzzy change point approach, Environmental Modeling Software, 139, 104993, https://doi.org/10.1016/j.envsoft.2021.104993, 2021.

The Use Cases

2nd use case - inconsistent sequence:

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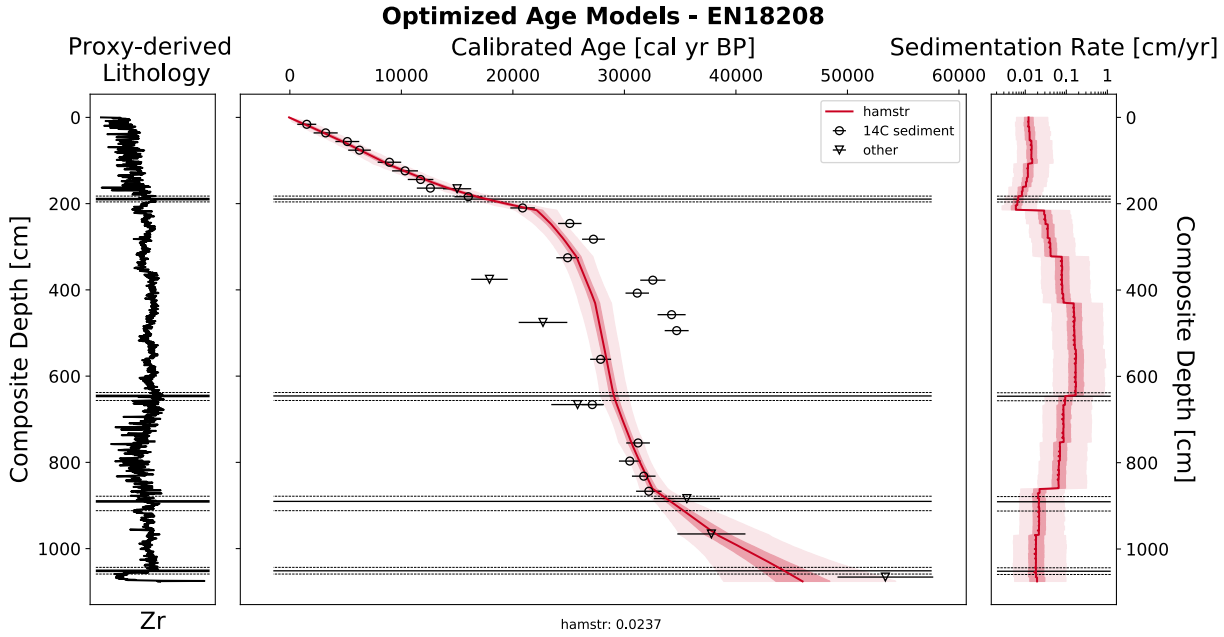
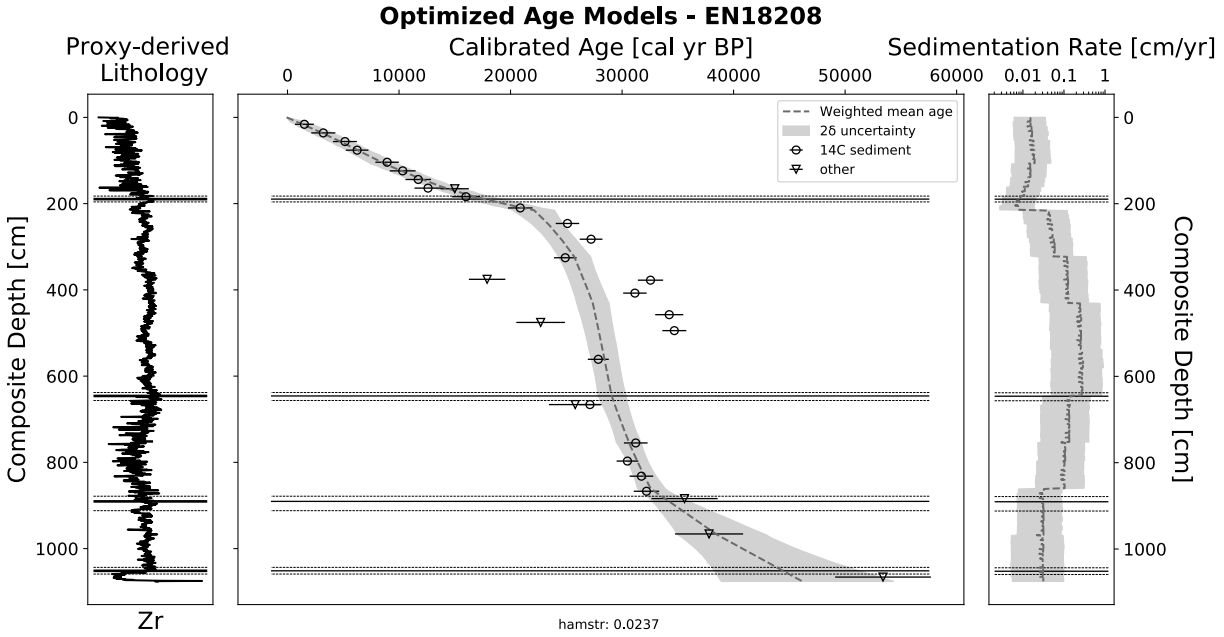


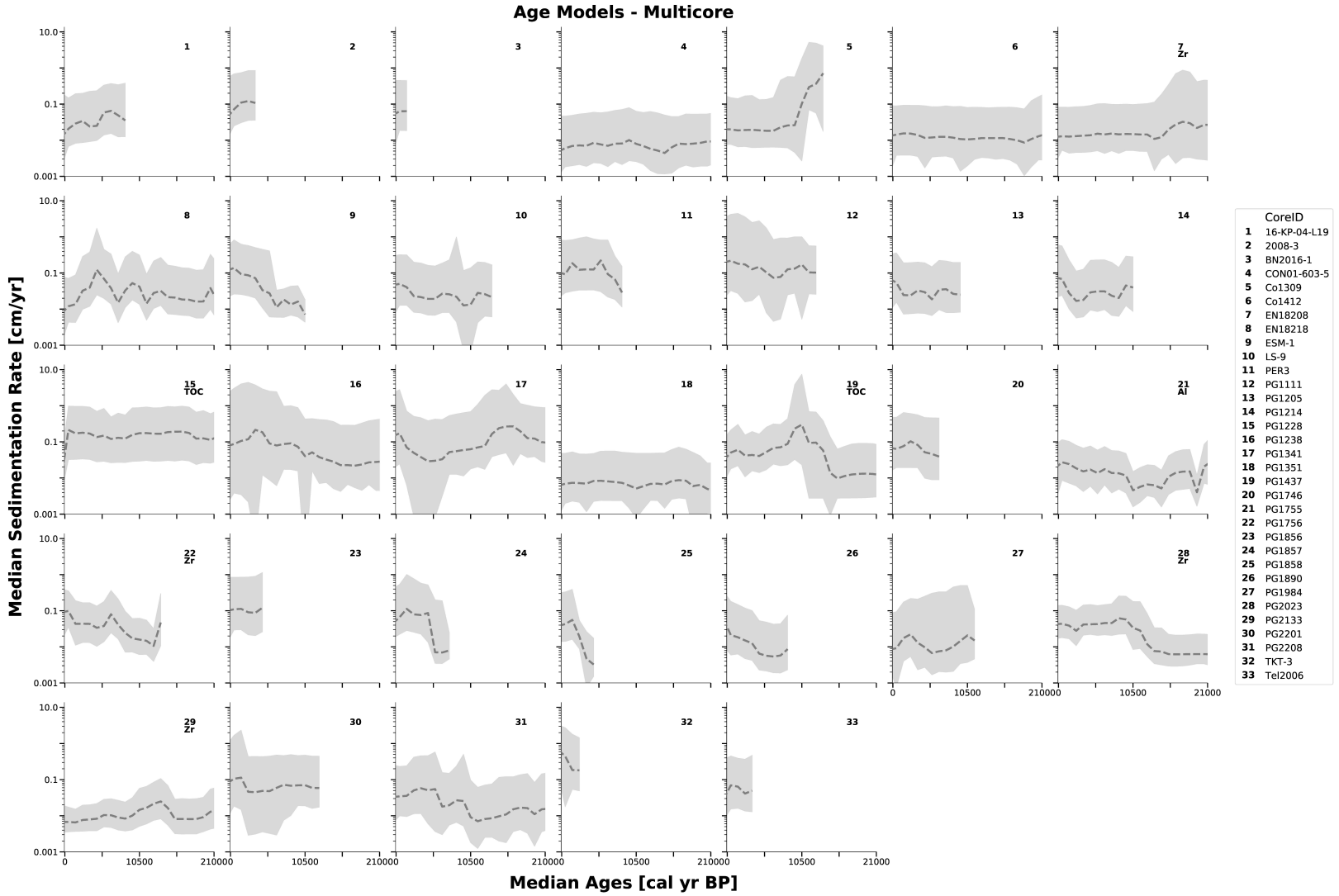
Models over a certain threshold represent more likely age-depth models without removing dating points



Combined model takes 2-sigma uncertainty from models into account

The Use Cases

3rd use case - multiple sediment cores:



The Additional Feature

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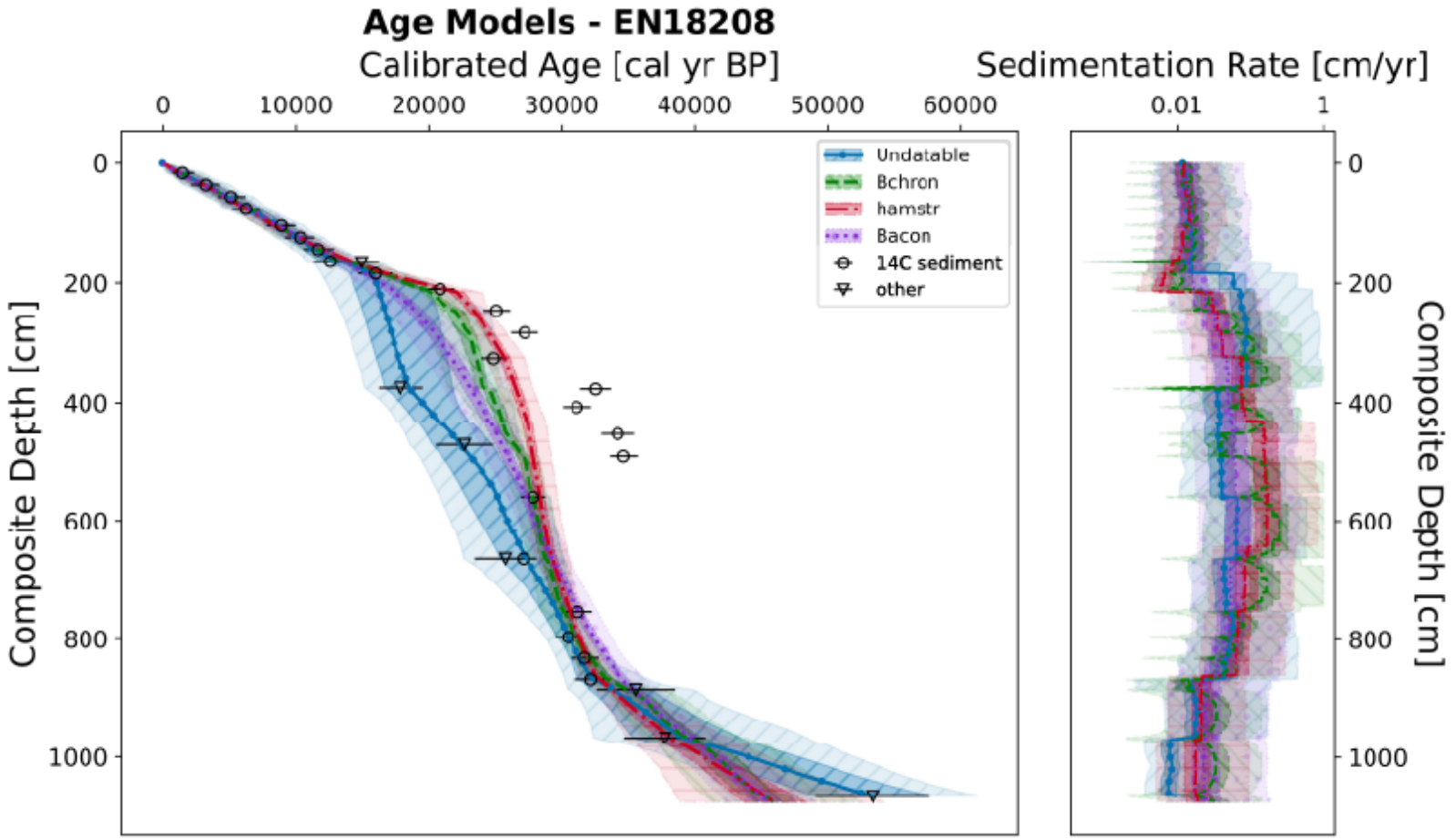
- For people with color visual deficiency, LANDO creates color-blind friendly output



On GitHub

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https://github.com/GPawi/LANDO

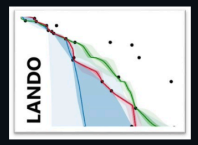
@ClimateCompathy

README.md

LANDO: Linked age-depth modeling

DOI 10.5281/zenodo.6353852

About the project



LANDO links the most commonly used age-depth modeling software in one multi-language Jupyter Notebook, known as *SoS notebook* (Peng et al., 2018). Due to its design, the notebook uses four Jupyter kernels: Python, R, Octave, and MATLAB. We implemented the following modeling systems in **LANDO**:

* *Bacon* (Blaauw and Christen, 2011),
* *Bchron* (Haslett and Parnell, 2008; Parnell et al., 2008),
* *clam* (Blaauw, 2010),
* *hamstr* (Dolman, 2021),
* *Undatable* (Lougheed and Obrochta, 2019).

Furthermore, **LANDO** uses the fuzzy changepoint method by Holloway et al. (2021) to evaluate the performance of modeling systems to represent lithological change based on independent proxy data. **LANDO** can run models for single or multiple sediment cores.

Getting started

Reference:

Pfalz, G., Diekmann, B., Freytag, J.-C., Syrykh, L., Subetto, D. A., and Biskaborn, B. K.: *Improving age–depth relationships by using the LANDO (“Linked age and depth modeling”) model ensemble*, Geochronology, 4, 269–295, https://doi.org/10.5194/gchron-4-269-2022, 2022.