WP overview talks

Modalities:

- ca. 5 minutes per presentation
- Questions explicitly allowed
- Focus on the w's (see whiteboard)

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

CC.1

Hendryk Bockelmann, DKRZ

Federal Ministry of Education and Research
DLR Project Management Agency

WP CC.1 – Model coupling and runtime optimisation

I. improve the model capabilities by:

- Development of a lake model in MPI-ESM, hypotheses testing related to Paleo-lakes
- Coupling between land and ocean biogeochemistry at the transiently changing land-sea interface, hypotheses testing related to fluxes of carbon & nutrients from land to the ocean
- Development of the PICO ice shelf cavity model for transient glacial simulations

WP CC.1 – Model coupling and runtime optimisation

II. improve the model runtime by
    - Adaptation to latest/upcoming HPC-system
    - Establish and widen the approach of component based parallelism

III. setup workflow based on esm-tools including e.g. basic visualisations (and data management?)

⇒ all continued work from phase 1

⇒ bringing all puzzle pieces together into a single model

WP CC.1 – Data in Phase 2

I. Data used/produced in phase 2
   - Transient simulations (covering about 26,000 years) with MPI-ESM-CR => approximately 200TB on disk
   - Input data needed from WG1 and WG2 for tests/simulations

II. Tools adapted/developed in phase 2
   - New/improved components in MPI-ESM and AWI-ESM
   - PICO ice-shelf model

Data statistics (planned): ~200TB output on disk, ~85TB on tape

all none development task can/should be coordinated with WG1/2

WP CC.1 – Plans to Manage Data

Some **condensed** thoughts

- Collaboration/sharing/data reuse should be done in a coordinated way – maybe vie esm-tools
- Unified experiment setup (esm-tools) will allow to prescribe "best" data management
- Unified data access will allow to optimise code/models using real setups (instead of e.g. CMIP style)
- Not only data, also src-code should be managed

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP1.1

Christian Stepanek, AWI

WP1.1 – A SHORT OVERVIEW

- **Goals:** Simulation of full deglaciation with special emphasis on abrupt climate changes and extension into the future following different prescribed scenarios

Main hypotheses to be tested:

- ***H1.1-1:*** State-of-the art ESM's can simulate the last deglaciation including the characteristic spatio-temporal pattern of abrupt climate events
- ***H1.1-2:*** Bi-stability of the AMOC at intermediate states between full glacial and interglacial conditions is consistent with the temporal evolution of deglaciation and millennial-scale climate variability.
- ***H1.1-3:*** The earth system is prone to instabilities in response to rising atmospheric CO_2 concentrations on multi-millennial timescales into the future.

WP1.1 – THE DATA IN PHASE 2

- **Planned experiments:**

- Different realizations of transient runs starting from LGM conditions and extension of selected runs into the future

- => ca. 20,000- 30,000 model years for each AOIGCM

WP1.1 – THE DATA IN PHASE 2

- **Data produced in WP1.1:**
- AWI-ESM-LR: ca. 20 GB per year (all output, monthly data)
  ==> ca. 20 GB x 30,000 years = ca. 600 TB
  (can be reduced if we kick out variables)
- CESM: ca. 3 GB per year (for monthly data) ==> 3 GB x 25,000 years = ca. 75 TB for WP1.3
- MPI-ESM-LR: ca. 11 GB per year (monthly data)
- MPI-ESM-CR: ca. 3 GB per year (monthly data)

WP1.1 – THE DATA IN PHASE 2

- **Do you rely on data/tools produced in other WG's?**
- Collaboration with WG2 regarding carbon cycle

WP1.1 – PLANS TO MANAGE YOUR DATA

Your **condensed** thoughts on

- **Long-term storage:**
- ESGF, PANGAEA according to FAIR data policy
- **Access for externals:**
- Only after publication of results, i.e. most data will be made available at very late stage of phase 2 (or even after)

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP1.2

Clemens Schannwell, MPI-M

WP1.2 – A SHORT OVERVIEW

- Analysis of climate variability during MIS3
  - Interplay of DO-cycles and HEs
    - HEs only occur during DO cold periods
    - DO cycles reaching their maximum amplitudes after HEs
    - AMOC stability
  - Advances in understanding HEs and DO behavior during Phase 1 (e.g. Ziemen et al., 2019; Zhang et al., 2017; Klockmann et al., 2018)
    - No fully coupled simulations with DO cycles and HEs no investigation of interaction between DO cycles with ice sheets or HEs

WP1.2 – A SHORT OVERVIEW

- What went well, what could have gone better?
  - Phase 1: development of coupled model systems - first synchronously coupled simulations are underway for the last deglaciation

WP1.2 – THE DATA IN PHASE 2

- Hypothesis will be tested in collaboration with AWI & MARUM (tuning parameters, parameterizations, freshwater forcing) in asynchronous and synchronous coupled climate-ice sheet simulations
- Produced data in Phase2:
  - Model code to be shared with WG2 for simulations with prognostic carbon cycle
  - Synchronous simulations from 42 ka BP to LGM to be shared with WG3, CC.2

WP1.2 – THE DATA IN PHASE 2

- Data of synchronously coupled model runs will be made publicly available after publication
- MPI-ESM estimated data volume: 2.2 Gb/yr * 22,000 = 48 Tb
- AWI-ESM: 20 GB/yr (mon. mean) => 500-600 TB
- CESM: 3 GB / yr => 75 TB

WP1.2 – PLANS TO MANAGE YOUR DATA

To be decided – WG1 Meeting in May.

- Share synchronous simulations with WG2, for modeling and analyzing the carbon cycle, and WG3 and CC.2 to compare to proxy data (simulations starting in month 13).
- Choice of repository, data publication, access for externals? - TBD

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP1.3

Marie-Louise Kapsch, MPI-M

Federal Ministry of Education and Research
DLR Project Management Agency

WP1.3 – A SHORT OVERVIEW

- **Goals:** Study the physical processes that led to the last glacial inception during MIS 5 with the fully coupled models (AWI-ESM, MPI-ESM, CESM, CLIMBER-X)
- **Related work from Phase 1:** Development of fully coupled models in WG1

WP1.3 – THE DATA IN PHASE 2

- **Planned experiments:**
- Several sensitivity experiments and transient run from 125 ka – 86 ka with acceleration; estimated 10,000 model years in total
- Non-accelerated simulation (125 ka – 110 ka), i.e. 15,000 model years
- ==> ca. 25,000 model years for each AOIGCM

WP1.3 – THE DATA IN PHASE 2

- **Data produced in WP1.3:**
- CESM ca. 3 GB per year (for monthly data)

  ==> 3 GB x 25,000 years = ca. 75 TB
- AWI-ESM ?
- MPI-ESM ca. 2.2 GB per year (for monthly data) ==> 2.2 GB x 25,000 years = ca. 55 TB
- CLIMBER-X probably negligible in terms of data volume?

WP1.3 – THE DATA IN PHASE 2

- **Do you rely on data/tools produced in other WG's?**
- Collaboration with WG2 regarding carbon cycle
- Ice sheet data from WP3.2-SP5 (Tarasov)

WP1.3 – PLANS TO MANAGE YOUR DATA

Your **condensed** thoughts on

- **Long-term storage:**
- ESGF, PANGAEA
- **Access for externals:**
- Only after publication of results, i.e. most data will be made available at very late stage of phase 2 (or even after)

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP1.4

Meike Bagge, GFZ

Federal Ministry of Education and Research
DLR Project Management Agency

WP1.4 – A SHORT OVERVIEW

Goals of the WP

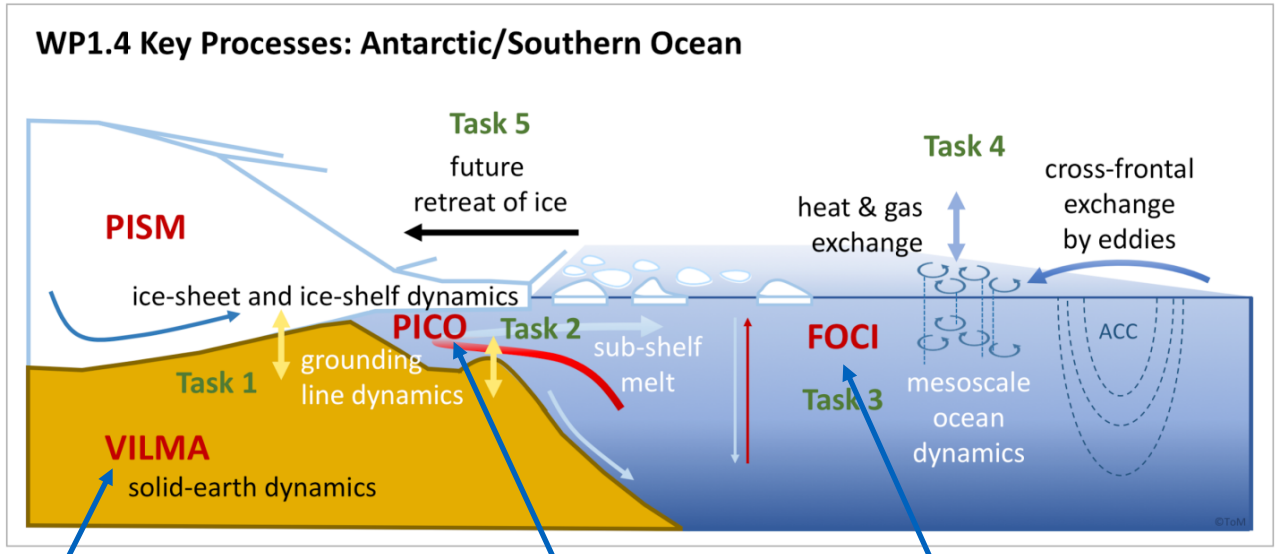
- Investigation of (small-scale) key processes that cannot be resolved in the main GCMs of WG1 with focus on Antarctica and the Southern Ocean
- Development of regional IOSE model including ice-sheet model PISM, ocean model MOM and solid-earth model VILMA, where ice-shelf cavity model PICO acts as main connector
- Development of nested high-resolution Southern Ocean configuration in FOCI climate model

Related work from Phase 1

- All three models VILMA, PICO and FOCI benefit from model development, testing and validation successfully carried out in Phase 1
- Coupling strategy for PICO-VILMA will benefit from VILMA-PISM coupling

What went well, what could have gone better?

- Meetings for coupling (+)
- Clear definition when which data are required by whom? (-)



TP1 (GFZ / VILMA): The solid earth in palaeo-climate dynamics
Meike Bagge, Volker Klemann

TP2 (PIK / PICO): Ice sheets/shelves interacting with the solid earth and ocean in the Antarctic
Willem Huiskamp, Riccarda Winkelmann

TP3 (Geomar / FOCI): The role of mesoscale eddies in the Southern Ocean
Torge Martin

WP1.4 – THE DATA IN PHASE 2

Data used/produced in Phase2

- Produced: e.g. Ice history, Earth's viscosity structure, relative sea level, land-ocean mask, sea surface height, 3-D ocean temperature & salinity, surface fluxes

Tools adapted/developed in Phase2

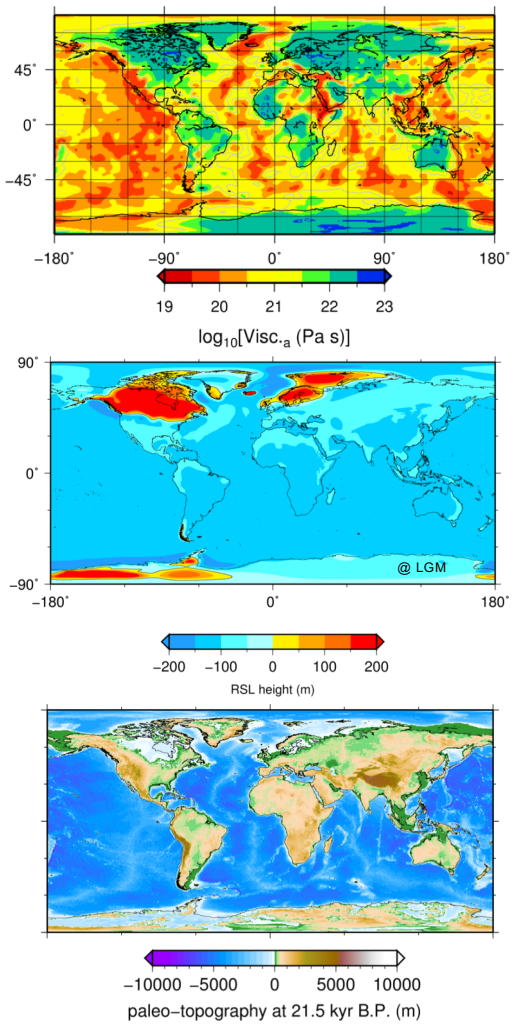
- Coupling performance, strategies
- PISM-VILMA coupling inside AWI ESM Tools
- PISM-PICO-MOM coupling
- FOCI Southern Ocean nest

Do other WP's rely on data from your WP?

- Provide: Earth structure for coupled runs in other WP's

Provide some data statistics

- VILMA output: d/o 170, 256x512, 100 time slices: 1GB (rsl.nc), 1.8 GB (restarts), location on mistral
- PISM-PICO: 380*380*200, 1 GB



WP1.4 – PLANS TO MANAGE YOUR DATA

Methods of collaboration/sharing/data reuse of your WP-data

- Next Cloud (hosted at GFZ) for document sharing (100 GB) in our Verbund or PalMod collaborations
- GFZ's central FTP server (large-data volumes)
- Mistral (sharing data for active Mistral users in PalMod)
- Gitlab / Github for code development

Long-term storage

- Data that belong to publications (e.g. required by AGU journals) can be stored on e.g. GFZ data services website and GEOMAR/Uni Kiel data archive

Data publication

- On demand
- GEOMAR internal development towards a data server with analysis platform

Access for externals

- Open access

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP2.1

Ying Ye, AWI

Federal Ministry of Education and Research
DLR Project Management Agency

WP2.1 – A SHORT OVERVIEW

Goals of the WP

- setting up of biogeochemical simulations with prognostic atmospheric CO2
- for AWI: performing transient simulations during glacial inceptions and abrupt changes during MIS3 with AWI-CM2, and analyzing changes in ocean circulation, C isotopes, Si and Fe cycle as well as the biological pump

- Related work from Phase 1

- coupling of REcoM to the biological sediment model MEDUSA and performing time-slice simulations for PI and LGM
- Implementation of C isotopes (C13 and C14)
- Coupling REcoM with flexible C:N:Si:Fe to FESOM

What went well, what could have gone better?

- Work delayed due to debugging, everything else went well

WP2.1 – THE DATA IN PHASE 2

Data used/produced in Phase2:

- producing transient simulations with prognostic atm. CO_2, ocean physical and biogeochemical variables, concentrations of solutes and solids in sediment and ocean-sediment fluxes
- using prescribed atmospheric input of iron and land weathering fluxes

Tools adapted/developed in Phase2: not planed

Do you rely on data/tools produced in other WP's, do other WP's rely on data from your WP?

- Data produced in WP1 (AWI-ESM physics) and in WP2.2 (land carbon fluxes)

Provide some data statistics

- volume estimated for different resolution: up to 20GB storage/year (Rechenzeitantrag)

WP2.1 – PLANS TO MANAGE YOUR DATA

Your **condensed** thoughts on

- Methods of collaboration/sharing/data reuse of your WP-data (both in- and outside of PalMod)
- large-data volumes
- Long-term storage (data selection, choice of repository)
- Data publication?
- Access for externals?

- standardizing model output (variables, units and format) for comparison within WP
- Data exchange within PalMod?
- maintaining access for externals like PMIP or in PANGEA for data publication

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP2.2

Janine Börker, Uni Hamburg

Federal Ministry of Education and Research
DLR Project Management Agency

WP2.2 – A SHORT OVERVIEW

Focus: feedbacks between climate and terrestrial biogeochemical processes + CO_2 changes

- SP1: Vegetation and carbon dynamics
- SP2: Carbon dynamics CLIMBER-X
- SP3: Weathering on exposed shelves

- Productive cooperation with WG3 (vegetation)

WP2.2 – THE DATA IN PHASE 2

- SP1: mainly analyzing long-term simulations produced in WG1 and WG2.3 + short sensitivity experiments
- cooperation with WG3

- SP3: Compile data about sediment characteristics of the continental shelves → global continental shelves map (lithological, geophysical, geochemical)
- cooperation with WG3?

WP2.2 – PLANS TO MANAGE YOUR DATA

- Is there a direct way to share data on Mistral with project partners not working on Mistral?
- (final) simulations and data should be stored on a platform that everyone within Palmod can access!

WP2.2 – PLANS TO MANAGE YOUR DATA

- A complete picture of for example grain size distribution might be used as a base for hydrogeological models on the shelves
- Ideally, upload the final map database to a public repository like for example PANGAEA

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP2.3

Thomas Kleinen, MPI-M

WP2.3 – A SHORT OVERVIEW

- AIM: Simulating the methane cycle for a complete glacial cycle
- 2 Parts: **MPI-C** (Mainz) – development of simplified representation of methane atmospheric chemistry, to be integrated in MPI-ESM

  MPI-M – methane emission processes, model integration, MPI-ESM experiments
- First phase rather successful, only transient deglaciation exp. to be redone
- Climate history full of surprises – Sahara too green in MPI-ESM, leads to major emissions at early / mid-Holocene

WP2.3 – THE DATA IN PHASE 2

- Planned for phase 2: Transient experiments deglaciation, glacial inception, MIS3
- Tools: MPI-ESM & EMAC – extensions developed in phase 1
- We rely on WG1 for physical climate, CC for model acceleration
- 1 paper published, 1 paper nearly finished, 1 paper in prep.
- Transient experiment MPI-ESM: 6TB of model output (GRIB, T31GR30, monthly output, 25 ka)
- Time-slice experiment EMAC: 400GB (T63L95, 30 years, netcdf)
- So far everything on /work, some experiments archived

WP2.3 – PLANS TO MANAGE YOUR DATA

- Collaboration *within* Palmod – so far mainly with shared access to /work – works well, but relies on good communication
- Likely a waste of space
- Many open questions with sharing results:
  - Format? Variables? Full output is ~250 GB/Millennium – 6TB for deglaciation in *GRIB* format – netcdf likely 4x as large
  - CMOR? As implemented for CMIP6, it's an implementation nightmare (2-3 scientific programmers for 1 year+)
- Missing: Way to find out who has what available – no problem for us, as we tend to be the first, but hinders collaboration

WP2.3 – PLANS TO MANAGE YOUR DATA (2)

- External access *required* by BMBF
- Dedicated server? Hosted by DKRZ?
- Tape storage / Backup?
- How do users *find* what is there?

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

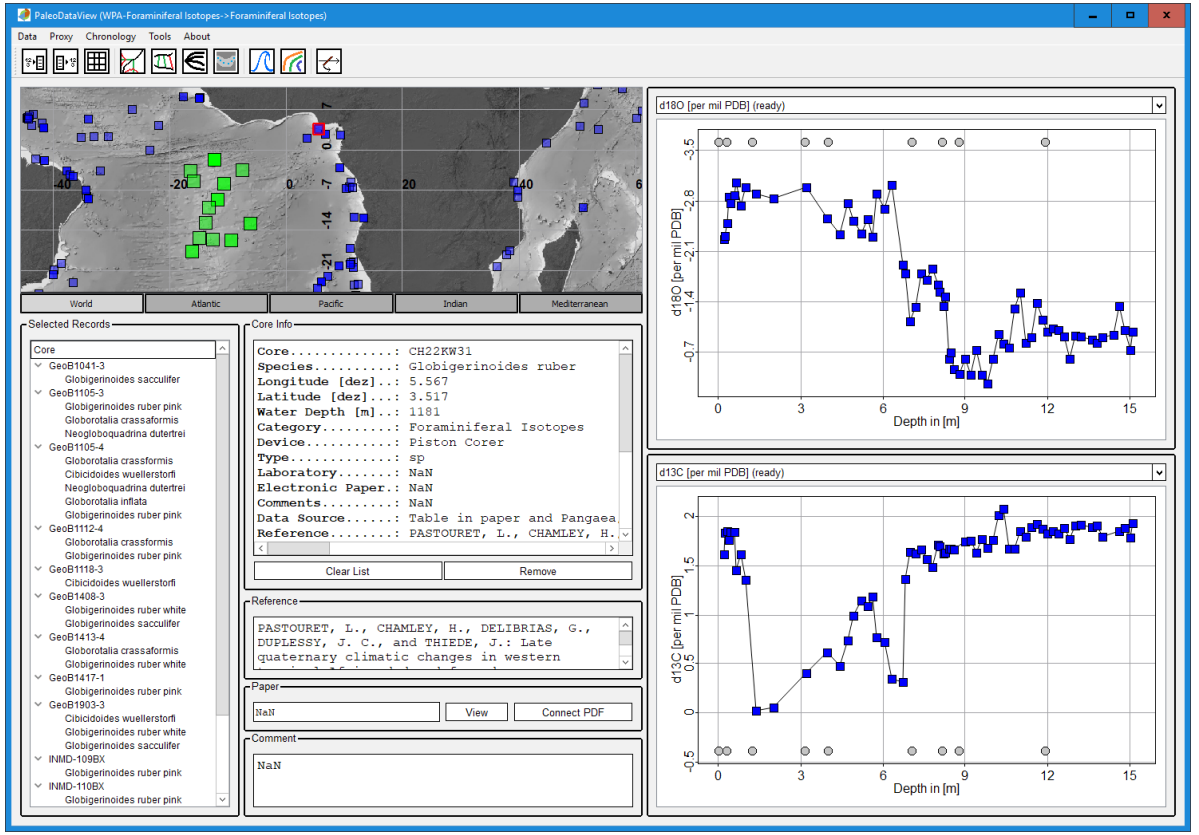
WP3.1

Michael Langner, MARUM

Federal Ministry of Education and Research
DLR Project Management Agency

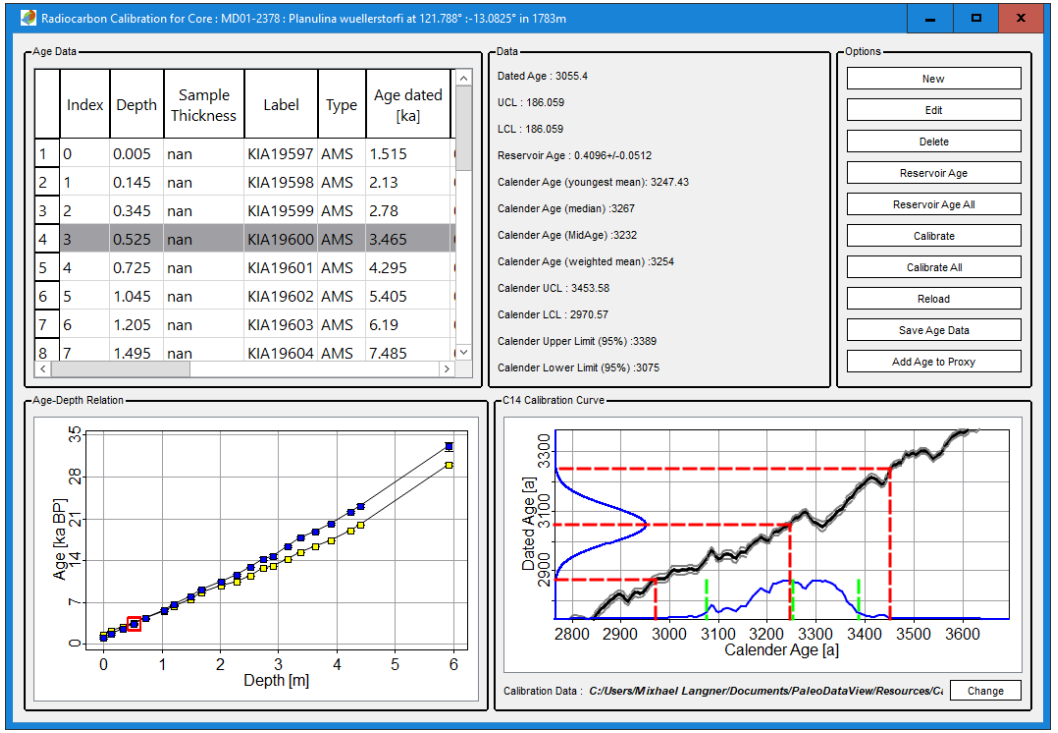
WP3.1 – PaleoDataView (M.Langner/S.Mulitza)

- Proxy-Toolbox for :
  - Homogenization of data
  - Visualization
  - Age modeling
  - Creation of data products
- Paper: Climate of The Past (Dec ´19)
- Download:
  - https://www.marum.de/Stefan-Mulitza/PaleoDataView.html



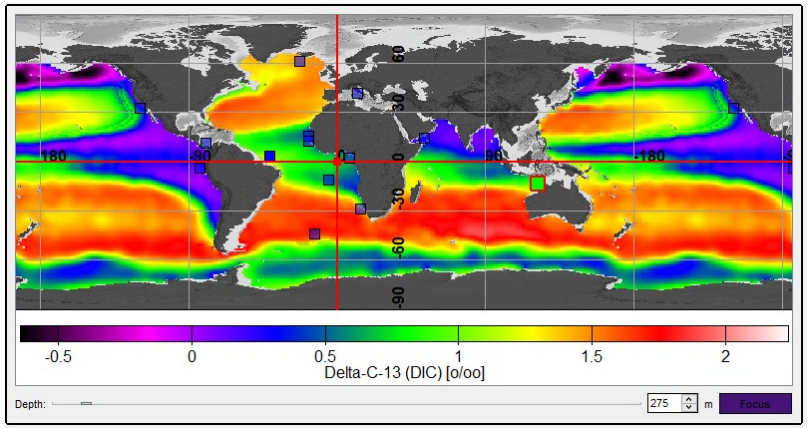
WP3.1 – A SHORT OVERVIEW

- Current Status
  - Tools for Data exploration (map based / inventory tables / filters)
  - Import via Excel, ASCII, and PANGAEA files
  - All data (including plots and tables) can be exported
  - Age modeling via tuning / AMS calibration / BACON
  - Atlas Hydrography
  - Visualization and comparison of proxy data
  - First simple data products
- Database:
  - NetCDF based binaries (data and meta in one file)
  - Inventory system for quick overviews
  - NetCDF proxy or age files can be added / removed simply by using Windows explorer



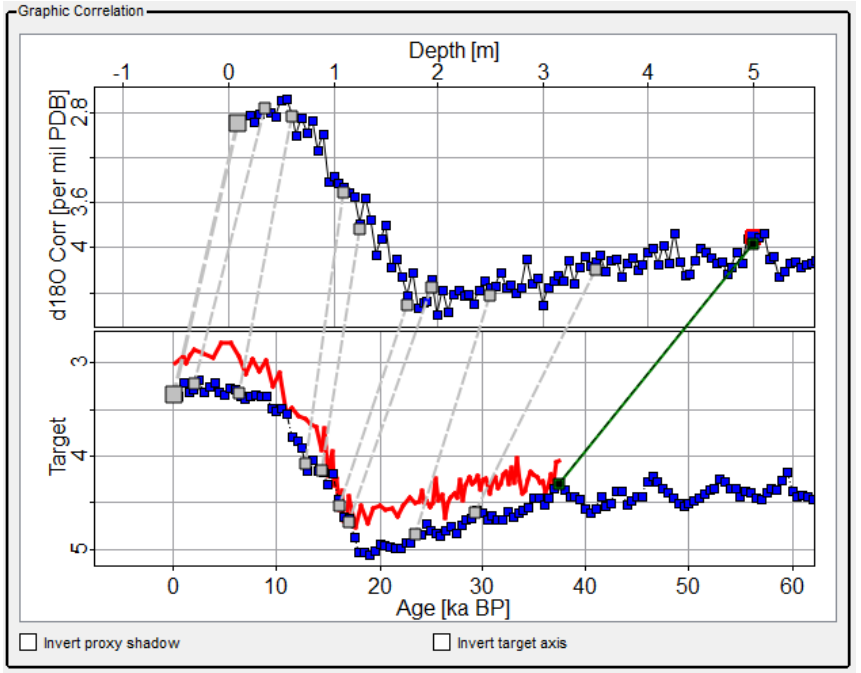
WP3.1 – PALEODATAVIEW IN PHASE 2

- WP 3.1-8: Adapt the stratigraphic tools in PDV (M9)
  - Currently adding Dynamic Time Warping(DTW)
- WP 3.1-9: Implement the DIVA interpolation method (M18)
  - Necessary for map-like data products
- WP 3.1-10: Calculation of volume-weighted δ13C(DIC), δ18O(seawater) and temperature records for the mean ocean and specific ocean basins (M27)
  - Requires data currently prepared by Stefan Mulitza based on PANGAEA and NOAA files
- WP 3.1-11: Create an interactive 4-d visualization of time dependent changes in globally distributed marine proxies (M36)
  - A tool to explore and visualize the produced data products



WP3.1 – AVAILABILITY

- The current version of the software is available via the MARUM website
  - Installers are available for Windows and MacOS (64bit only)
  - It is open access (source code is installed alongside the software)
- Data
  - Currently only a small test data set is included
  - Lukas Jonkers published his own data set recently (https://doi.org/10.5194/essd-2019-223, in review, 2020)
  - Bigger data sets will be published in the future



PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP3.2

Arne Ramisch, GFZ

Federal Ministry of Education and Research
DLR Project Management Agency

WP 3.2 – A SHORT OVERVIEW

Overarching Goal

Quantitative and qualitative **climate reconstructions** from terrestrial records for **model-data comparison**

TP 1	**Achim Brauer**, GFZ	*Synchronization of lake proxies from varved sediment*
	Lev Tarasov, MUN	*Refinement and expansion of ice sheet calibration to full glacial cycle and Termination II with joint calibration of Earth model*
TP 2	**Ulrike Herzschuh**, AWI	*Stable-states, trajectories and variability of terrestrial vegetation*
	Bernhard Diekmann, AWI	*Comparison of lake sediment δ18O proxy data to isotope-enabled PalMod model outputs*

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WP 3.2 – THE DATA IN PHASE 2

Class I – Time series reconstructions

Data and Tools

Time series of proxy records, mainly tabular format (.csv, .xls or .xlsx), also .json

Proxy system models (e.g. from inverse modelling)

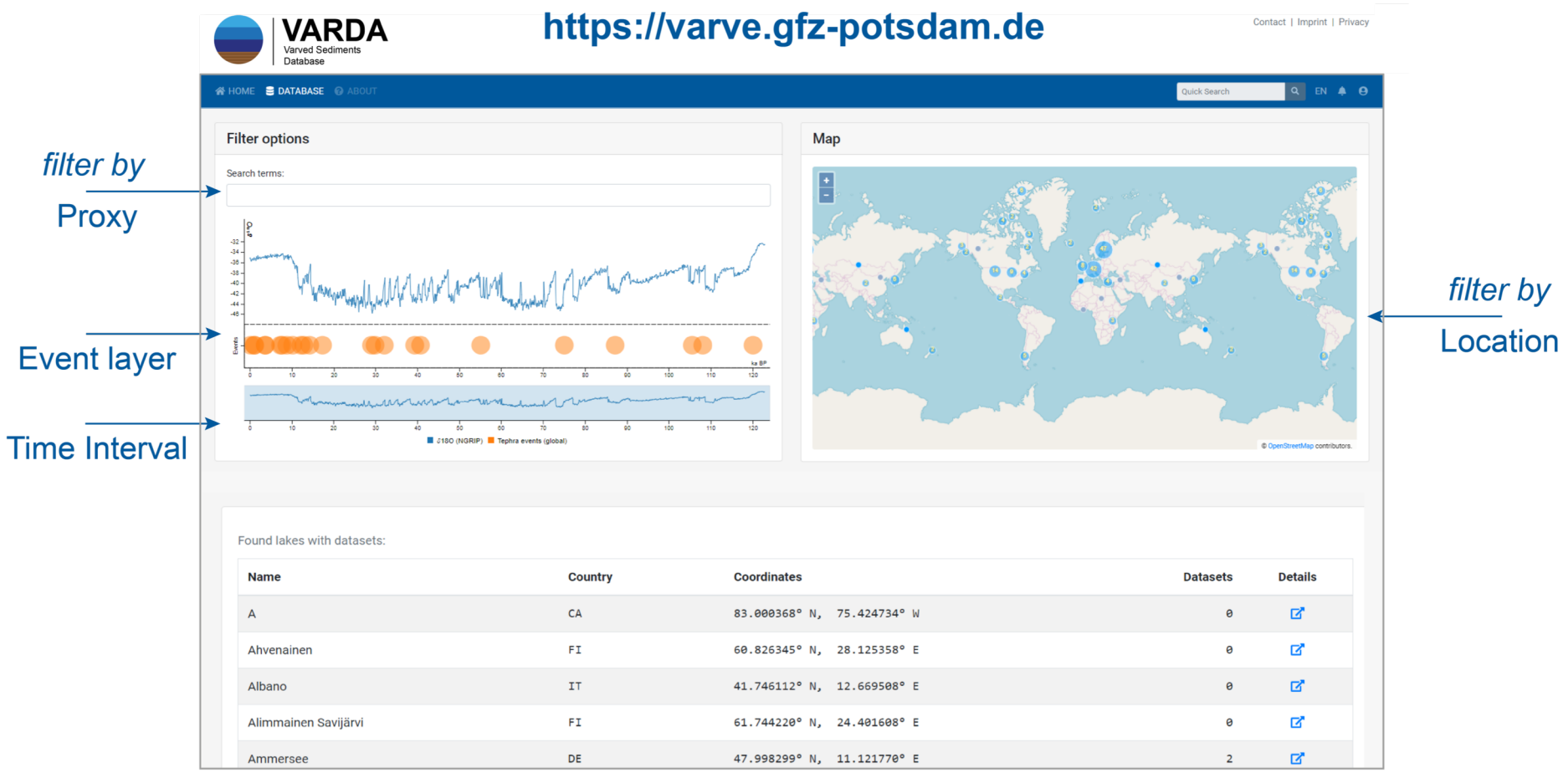
Required Input:

Isotope-enabled PALMOD model outputs (WG1), error estimation in sedimentation models (WP3.2 SP3)

Data statistics:

Not exceeding 10 GB in total, available at GFZ Data Services and Pangaea

WP 3.2 – THE DATA IN PHASE 2



WP 3.2 – THE DATA IN PHASE 2

Class II – Spatiotemporal reconstructions

Data and Tools

Global ice/topo chronologies (@ 20-25 km grid resolution)

Updated ice sheet constraint databases (RSL, Rdot, cosmo ages, etc.)

Required Input:

Ice proximal (terrestrial + marine) climate constraints

Data statistics:

120 to 0 ka, 50km resolution ice mask + topography chronology (uncompressed) : 2.0 Gb

Not exceeding 10 GB in total

WP 3.2 – PLANS TO MANAGE YOUR DATA

Data sharing

No common strategy yet, data mainly shared for cooperation within PalMod

Public access after publication, VARDA (varved lake synthesis) already publicly available

Long term storage

Storage at data repositories preferred (Pangaea or GFZ data service)

Large data volumes

Interactive servers to extract relevant fields and timeslices

Big issue: how to know what is available at any now within Palmod? Orgmode document (data desacriptors, directory pathnames)? Data curator?

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

WP3.3

Martin Werner, AWI

Federal Ministry of Education and Research
DLR Project Management Agency

WP3.3 – A SHORT OVERVIEW

- Goals of the WP:
  - quantitative and process-oriented model-data comparison, **focus on water isotopes** (inc. power-spectrum) & foraminiferal abundances
  - performing & analyzing **transient simulations** with CESM & AWI-ESM
- Related work from Phase 1
  - development of water isotope diagnostics, porting of CESM including water isotope module to HLRN
  - developing methods for model-data comparison and data assimilation
- What went well, what could have gone better?
  - CESM with water isotopes became available late during PalMod phase 1

WP3.3 – THE DATA IN PHASE 2

- Data used/produced in Phase2
  - **used:** boundary files and optimized model parameters for simulations with a fully-coupled configuration (from WG1); paleo-data synthesis to evaluate model results (from WG3)
  - **produced:** Simulated atmospheric (oxygen isotopes in humidity, precipitation) and ocean (oxygen isotopes in seawater) fields for three time periods (deglaciation, inception, MIS3) from CESM and AWI-ESM
- Tools adapted/developed in Phase2
  - diagnostics for comparing model results to planktic and benthic foraminiferal isotope ratios as well as for terrestrial records (e.g. speleothems)
  - expressions for power-spectrum of proxy error

WP3.3 – THE DATA IN PHASE 2

- Do you rely on data/tools produced in other WP's, do other WP's rely on data from your WP?
  - simulation setup and restart files of WG1 simulations
  - paleo-data synthesis of WG3 for model evaluation and power spectrum of water isotopes
- Provide some data statistics
  - applied DKRZ resources for AWI-ESM for 2020:
    ca. 8,000 simulation years / 180,000Nh / 260 TB disk space / 160 TB tape space
  - similar resources needed for 2021 and 2022
  - similar resources needed for CESM (run on HLRN4)

WP3.3 – PLANS TO MANAGE YOUR DATA

- Condensed **thoughts**
  - internal and cross-WP data sharing:
    strong collaboration within WP3.3, as well as with WG3 and WP1.x
  - public sharing: Use an existing data publisher such as Github+Zenodo, PANGAEA or ESGF for distributing code and selected model output
  - use WDCC (World Data Centre for Climate) for long-term archiving of model output
  - standardize model output (e.g. by CMORizing)
  - use standardized compressing/archiving format (tar.gz) for large-data volumes

PAL MOD GERMAN CLIMATE MODELING INITIATIVE

CC.2

Oliver Bothe, HZG

WP.CC.2 – A SHORT OVERVIEW

- Goals of the WP

  Data-Management, Model-Data-Comparison-Tools, Volcanic forcing, simulations

- Related work from Phase 1

  Hamburg Workshop 2018,

  WG3 work on uncertainty and reconstruction tests

- What went well, what could have gone better?

  well: ...

  worse: data-access, access to tools

WP.CC.2 – THE DATA IN PHASE 2

- Data: used: Data-Management requires information on data used in all WPs
  produced: DMP, longterm-handles for simulations, synthesis of data-syntheses, volcanic activity & radiative forcing time series extending < 100 ka
- Tools: adapted: Ice cores and tephra records -> compilation of a combined data base
  developed: Data-Model-Comparison-Toolbox, workflows for model data standardisation
- Rely on: all of the other groups, need Metadata information early
  Produce for: hopefully all of the other groups
- Statistics (volume, location, access possibilities, already published?, …)
  simulations: unclear for simulations within CC.2, possibly 1PB at DKRZ onetime, 15PB at DKRZ for 10 years, publication via ESGF, not yet published (as from Proposal)
  paleo data: negligible, DKRZ and Repository outside, ideally multiple access channels including from the command line, partially already published if we count PalMod I

WP.CC.2 – PLANS TO MANAGE YOUR DATA

Your **condensed** thoughts on

- Methods of collaboration/sharing/data reuse of your WP-data (both in- and outside of PalMod)
  - access channels provided by us, most data provided by other WPs
  - in our view all open to in- and outside (license CC-BY 4.0)
  - as early as possible
- large-data volumes
  - is cloud possible?
- Long-term storage (data selection, choice of repository)
  - simulations via ESGF at DKRZ, data preservation at World Data Center for Climate (WDCC)
  - paleo-data on very long term repository, NOAA, Pangaea, or … OSF, Figshare, WDCC?
- Data publication?
  - simulations: ?
  - data: DOI enough, additional quality check?, peer review?
- Access for externals
  - over repositories or ESGF

WP.CC.2 – PLANS TO MANAGE YOUR DATA

We make sure this does not happen...