

Work Package 1

WP1.1 Characterizing interglacial climates – trends and internal variability

Partners involved: 1, 2, 4, 5, 6, 7, 9 (*lead*), 10, 11, 13, 14, 15, 18 and 20.

WP1.2 Deglacial periods and their impacts on climate during interglacials

Partners involved: 2, 3 (*lead*), 4, 7, 10, 13, 14 and 17.

WP1.3 Integrating climate models and paleoclimatic data

Partners involved: 2, 5, 7, 8, 10 (*lead*), 11, 12, 13, 14 and 20.

Contribution by CEA (partner 14, valerie.masson@lsce.ipsl.fr)

A guideline has been established for the PAST4FUTURE dating strategy.

Task 1.1.1 Model simulations

Tasks 1.1.1.1 Control transient simulations and 1.1.1.2 Evaluation simulations

The experimental design for the snapshot GCM and transient GCM / EMIC simulations is underway. Consultation has been undertaken with the PMIP community and members of WP4 (Eric Wolff) as to the nature of the design, in particular the CO₂ forcing. As a representative example, the following is being proposed for the 130 kyr snapshot simulation:

130 kyr

Orbital parameters: [ecc = 0.038209, obl = 24.241°, peri = 228.32°]

Date of vernal equinox: March 21 at noon

Trace gases: CO₂ = 256 ppm, CH₄ = 518 ppb, N₂O = 238 ppb

Solar constant : 1365 W/m²

Vegetation: Pre-industrial fixed

Ice sheets: Same as PI

Topography and coastlines: Same as PI

For the transient simulations, see this document for the trace gas concentrations:

www.paleo.bris.ac.uk/~ggdjl/pmip

The Bergen group has worked during the spring and early summer of 2010 to develop and prepare the Norwegian Earth System Model (NorESM), to be used for the CMIP5. In the coming months, a base-line multi-century simulation for pre-industrial (0k) climate will be performed and evaluated. Based on this control simulation, further time slice simulations are planned over the next year or so for the other key periods in Past4Future, including 6 kyr BP, 130, 128 and 125 kyr BP.

Task 1.1.1.3 Sensitivity to applied forcings / feedbacks

Task 1.1.1.4 Mechanisms of communication.

Nothing specific to report on these two tasks.

Task 1.1.2 Data

A data spreadsheet has been designed in collaboration with partner 19 (PAGES), which is fully integrable into the Past4Future webpage. This will be sent out to all members of WP1.1 shortly, in order to document the data to be collected and analysed over the course of the project.

Task 1.1.2.1 Latitudinal temperature gradients and ocean circulation

Partner 14 (CEA incl. LSCE) has built a common chronological framework for North Atlantic SST records, Greenland records and Antarctic records for the last interglacial (using EDC3 as a reference age scale) and identified bipolar patterns during the early Holocene and MIS5e Antarctic optimum as well as an abrupt shift in deuterium excess (*Masson-Delmotte et al, PNAS, in press*).

Task 1.1.2.2 Polar amplification

LSCE has conducted high-resolution (~20 year) deuterium measurements on the EDC ice core and is working on the interpretation of the results.

Task 1.1.2.3 Low latitude ITCZ-monsoon shifts

Nothing specific to report on this tasks.

Task 1.2.1 Continuous data records of the Terminations and subsequent climate evolutions

Following the kick-off meeting in Copenhagen, the different teams involved in WP1.2 have initiated work on deglacial periods and their impacts on climate during interglacials. The following actions can be noted for ocean and land data records and for climate modeling:

- The CEREGE group (Aix-en-Provence) of partner 3 has made initial progress in testing its geochemical tools (*e.g.* elemental profiles by XRF and ICPMS, Mg/Ca and $\delta^{18}\text{O}$ in foraminifera, biomarkers for paleothermometry and river input, U-Th for dating, etc) specifically in the sediments, selected for the P4F project, from the tropical Atlantic, Pacific, and Indian oceans. The next step is to generate paleoclimate records over deglaciation periods.
- The EPOC group (Bordeaux) of partner 3 has made preliminary progress on its work focussed on hydrological (sea-surface) reconstructions (based on dinocyst and foraminifera assemblages) for the last Terminations.
- The LSCE paleoceanography group (Gif-sur-Yvette) of partner 14 has generated climatic records of the last deglaciation in one South Atlantic deep-sea core in collaboration with Luke Skinner (U. of Cambridge; partner 18). The history of deepwater ventilation over the last deglaciation at this site and its impact on atmospheric CO_2 has just been published (*Skinner, Fallon, Waelbroeck, Michel and Barker, Ventilation of the deep Southern Ocean and deglacial CO_2 rise, Science 328:1147-1151, 2010*). Antarctic, Greenland and marine records have been synchronized for Termination II-Last interglacial (*Masson-Delmotte et al, PNAS, in press*).
- The UAB group (Barcelona) of partner 7 has recruited two PhD students to work in the frame of WPs 1, 3 and 4. First Mg/Ca and $\delta^{18}\text{O}$ analyses have been performed at a site in the eastern tropical Pacific, next steps are to increase the resolution across Termination I and the Holocene. Analysis of the high-resolution profiles will start in Fall/Winter 2010. A second core in the westernmost Mediterranean Sea has been sampled at high resolution across Terminations I and II into the Holocene and MIS 5e. Processing of these samples has begun and analysis of Mg/Ca and $\delta^{18}\text{O}$ will commence in Summer 2010.

- The Aarhus group (partner 4) has established good contact with data owners of Eemian palynological series in central Europe and the entering of analogue pollen data into a database has started.
- Partner 17 (AWI) has announced a postdoc position to be filled in September 2011.

Atlantic and Indian Southern Ocean: a total of eight sediment cores has been analysed (diatom-based SST, sea ice reconstruction) and dated. This includes records documenting the past 30 kyr and Termination 2. The records have been correlated with ice core climate records. Three papers will be submitted within the next 6 months.

Pacific Southern Ocean: out of 62 sediment cores recovered in austral summer 2009/10 during ANT-XXVI/2 with RV Polarstern, six cores documenting Termination 1 and 2 at submillennial resolution have been selected. The first two cores have been sampled and preparation for the analysis of diatoms and dinoflagellate cysts (SST, sea ice) and the dating of the cores has been started. First results are expected for winter 2010/11.

Polar North Pacific and Bering Sea: out of 51 sediment cores recovered in northern summer 2009 during SO202-INOPEX with RV Sonne a total of eight cores documenting the last deglacial and the penultimate climate cycle at submillennial to ?annual resolution have been selected. Sample preparation of the microfossil analysis (SST, sea ice) and dating of the cores were started. First results are expected for winter 2010/11.

Task 1.2.2 Rate and magnitude of deglacial sea level variations and carbon cycle changes

Task 1.2.3 Modeling deglacial climate evolution

Nothing reported for these two tasks.

Task 1.3.1 Data assimilation

Task 1.3.1.1 Testing data assimilation approaches

Our first task within Task 1.3.1 is to select a data assimilation technique adequate to studying interglacial climate. The tests are under way and we think that, as planned, we could obtain some results for the end of this year and make our final choice of the method (M1.3.1) for month 18 as planned.

Task 1.3.1.2 Transient simulations with data assimilation

Task not yet started.

Task 1.3.2 Model – data comparison

Task 1.3.2.1 Improving air temperature estimates from ice core isotope data

Task not yet started.

Task 1.3.2.2 Analysis of the causes of changes in aerosols records

Partner 11 (Uni-HB) has finalized time slice simulations for the mid (6 kyr) and early (9 kyr) Holocene as well as for the Last Interglacial (115 kyr and 125 kyr). These experiments have been performed with the low resolution version of CCSM3. The resolution is 3.75° for the atmosphere and approximately 3° for the ocean. A PhD position is currently announced. We expect to fill the position soon. Partner 5 (UNIBE) currently implements and tests the next IPCC version of the

CCSM model (version 4) on their computer facility. The horizontal resolution in this model setup will be approximately 1° for all components. A PhD student will start in October 2010 at the University of Bern (Partner 5).

Task 1.3.2.3 Evaluation of model results

When the results of the new model simulations will be available (WP1.1), this task will start. Some simulations (in particular some time slices) are already available so preliminary analysis should be performed soon.

Both for the data-assimilation and the model-data comparison, a first step is to make available proxy data. Thus, we started to prepare data sets according to a template sent to all the partners in order to perform a first synthesis of the available proxies. The data sets currently under standardization include sea-ice cover extent (months/year with >50% of concentration), temperature and salinity in winter and summer. The data cover the Holocene and are mainly from the Arctic seas, northern North Atlantic and subpolar seas, Europe, Greenland and Antarctica. In the process of standardization, chronological information are re-evaluated; the reference dinocyst database used for transfer functions is also currently updated with surface samples from the central and western North Pacific (n = 1432 in the updated database); the accuracy of the approaches for the reconstruction of sea-surface conditions is being reassessed. Standardized reconstructions should be available in the forthcoming months for Holocene cores already analysed (n ~ 15).

Work Package 2

WP2.1 Interglacial climate response to catastrophic freshwater forcing
Partners involved: 2, 3, 9, 10, 13 (lead), 14 and 20.

WP2.2 Interglacial climate response to solar and vulcanic forcing
Partners involved: 1, 2, 3, 9, 10, 13 (lead) and 14.

WP2.3 Characterization and analysis of abrupt events and transitions during interglacials
Partners involved: 1, 2, 6 (lead) and 14.

WP2.1 Interglacial climate response to catastrophic freshwater forcing
The following progress has been reported by groups involved.

Partner 13 (VUA):

A first proposal for the experimental design of simulation experiments for the 8.2 kyr event has been submitted to the PMIP3 wiki web-page. All participating modelling groups have been invited to comment on this design. A PhD student (Pepijn Bakker) has been recruited to further set up and perform the planned simulations, starting July 5, 2010.

Partner 20 (GEOTOP):

Recruitments: A postdoc (Bianca Fréchet) is presently working part-time for a standardization of calibrated chronologies in all available deep-sea cores. Two PhD students are working on isotopic tracers (radiogenic isotopes) of source areas of major drainage events through Fram Strait (Jenny Maccali) and Baffin Bay (Quentin Simon). Two others are undertaking investigations on sea-ice and related brine production rates using stable isotopes in planktic foraminifers (*Olivia Gibbs: Baffin Bay; Jéna Zumaque: Labrador Sea, starting September 2010*).

Investigations on cores raised during recent cruises in Fram Strait, the Labrador Sea (off Hudson Strait) and Baffin Bay are in progress. All available cores bearing information on land/ocean conditions during the early Holocene, North of 55°, are revisited with two aims: i) the setting of standard calibrated ¹⁴C-chronologies and ii) the documenting of nebulosity from pollen data. In principle, information about early Holocene paleosalinities is already available for most of these cores in recent literature (see report from WP4.2).

WP2.2 Interglacial climate response to solar and volcanic forcing

The following progress has been reported by groups involved.

Partner 13 (VUA):

Sensitivity experiments have been set up and started (by Cedric Van Meerbeeck, postdoc) to test the sensitivity of the LOVECLIM model to solar forcing. A PhD student (Pepijn Bakker) has been recruited to further set up and perform the simulations planned in WP2.2, starting July 5, 2010.

Partner 3 (CNRS):

The CEREGE group (Aix-en-Provence) has made progress in compiling, correcting and distributing data on solar forcing of climate over the past millenium (*Delaygue and Bard, Clim. Dyn. in press, DOI: 10.1007/s00382-010-0795-1*). The next step is to continue to test the relationship between cosmogenic isotopes and solar activity and to extend the record through time.

Partner 2 (Unifob):

A new climate model simulation of the last 600 years with Bergen Climate Model demonstrate a prominent role of the external solar and volcanic forcings in shaping the multidecadal variations in North Atlantic climate (*Otterå et al. 2010*). The results indicate that volcanoes play a particularly important part in the phasing of the multidecadal variability through their direct influence on tropical sea surface temperatures, the leading mode of Northern Hemisphere atmosphere circulation and the Atlantic thermohaline circulation.

Reference: *Otterå OH, Bentsen M, Drange H, Svo L (2010): External forcing as a metronome for Atlantic multidecadal variability, Nature Geoscience, submitted.*

Partner 4 (AU):

One manuscript on the re-evaluation of previously published proxy records is underway.

WP2.3 Characterization and analysis of abrupt events and transitions dur-

ing interglacials.

The following progress has been reported by groups involved.

Partner 6 (CSIC)

A database of 200 marine cores has been compiled. The cores correspond to Holocene sections in most cases but also cover the MIS 5e interval. These cores are distributed throughout the planet. Data encompass stable isotopes, mineralogy, biomarkers and others. The available ice core records have been added to the database. Continental records involving speleotherms and pollen records from lakes have been collected. Records on loess inputs are also available. More records are still being added to the database. Statistical analysis of the whole database will start in September 2010.

Partner 2 (Unifob)

Two PhD students are actively working on sediment cores from North Atlantic sediment drifts. Isotopic and trace metal reconstructions of multidecadal-centennial scale climate and hydrographic reconstructions are proceeding for both the Holocene and MIS5e simultaneously. Distinct events and transitions have already been identified in the North Atlantic records and are now being analyzed in greater detail and resolution. Assemblage and isotopic records are also being produced at core sites monitoring the Nordic Seas inflows.

Partner 4 (AU)

One manuscript on the Atlantic Multidecadal Oscillation is underway.

Work Package 3**WP3.1 The carbon cycle**

Partners involved: 1, 2, 3, 4, 5, 6, 7, 9, 12 (lead), 14 and 16.

WP3.2 CH₄ and N₂O cycle

Partners involved: 1 (lead), 3, 5, 12 and 16.

Summary

WP3 is going well through the initial project phase. The project personnel, with a few exceptions, is already hired and the work is mostly proceeding as planned. There are not yet milestones or deliverables to report (the first deliverable in WP3 is allocated to month 18). A WP3 workshop on interglacial carbon cycle modelling is planned on 27-28 October in Hamburg.

Contribution by UCPH (Partner 1, WP3.2 lead, blunier@gfy.ku.dk)

Work at UCPH for WP3 is evolving as planned. We hired Theo Jenk as a PostDoc responsible for $\delta^{13}\text{C}$ of CO_2 measurements on Greenland ice cores. The UCPH extraction and measurement system for $\delta^{13}\text{C}$ of CO_2 measurements is operational. It has been tested on NEEM firn air. The results are consistent to measurements from partner laboratories within the NEEM deep drilling project. The next step involves measurements on ice, which will be performed in the next months.

In collaboration with partner 3 CNRS and partner 5 UNIBE, UCPH set up a system for high-resolution CH₄ measurements along the currently drilled NEEM ice core in Greenland (*milestone M3.2.1 reached*). Three systems are connected in series (two optical, one traditional gas chromatography) and should provide an unsurpassed profile of the CH₄ concentration of the past. Measurements of the YD (Younger Dryas period) and the last transition are very promising and show features not observed with discontinuous measurements. The measurements continue throughout this field season and are to be continued next year when stage MIS5e will be measured in the field.

An off-line combustion oven was built to calibrate $\delta^{13}\text{C}$ and δD of CH₄ for isotopic measurements.

UCPH contributed to a publication on high resolution δD of CH₄ data over Dansgaard-Oeschger events 7 and 8 (*Bock et al., Science, in press*).

Contribution by Unifob (Partner 2, ulysses@uib.no)

Unifob submitted a manuscript to Science (*Olsen and Ninnemann, Large ¹³C Gradients in the Pre-Industrial North Atlantic Revealed. Submitted.*) as our WP3.1, task 3.1.1, bullet #6 contribution to establish the ocean distribution of carbon isotopes corrected for Suess effects in the North Atlantic for improved proxy and model evaluation.

Contribution by CNRS (Partner 3, chappellaz@lgge.obs.ujf-grenoble.fr)

CNRS is involved, together with UCPH and UNIBE in producing new high-resolution constraints on CO₂, $\delta^{13}\text{CO}_2$ and CH₄ changes during the last two interglacials, as well as during the previous Terminations and following inception.

Over the last six months, partner 3 has contributed to improve our knowledge of the CO₂ history during the Termination leading to MIS5e. It confirms that the CO₂ increase took place in two main steps, with a slow and gradual increase over ~12 kyr followed by a rapid jump of 11 ppmv within 300 years. CO₂ reached a maximum at 289 ± 3 ppmv during the first ~700 years of the last interglacial, significantly higher than during pre-industrial times. The concomitant evolution of $\delta^{13}\text{CO}_2$ has also been determined, showing in particular that CO₂ was on average more depleted in ¹³C during the penultimate Termination than during the last one. Both profiles are now in press (*Lourantou et al., Quaternary Science Reviews, 2010*).

CNRS has worked together with UCPH and UNIBE to set up a new experimental system for high-resolution CH₄ and N₂O measurements along the newly drilled NEEM ice core in Greenland (*milestone M3.2.1 reached*). Based on the combination of new optical detectors and gas chromatography, the system should provide an unsurpassed profile of at least CH₄, covering the early Holocene and hopefully back to MIS5e if the corresponding ice is reached during the current drilling season.

In terms of manpower, partner 3 is currently getting applications for a PhD run under a European ITN project, who will work on the $\delta^{13}\text{CO}_2$ signal, including the

development of a new optical detector. The search for a PAST4FUTURE postdoc on the same topic is underway.

Contribution by AU (Partner 4, mss@geo.au.dk)

Nothing to report.

Contribution by UNIBE (Partner 5, joos@climate.unibe.ch, hubertus.fischer@climate.unibe.ch)

Work at UNIBE for WP3 is evolving as planned. Raphael Roth has been hired as a Past4Future PhD student. Several manuscripts have been published or submitted and different results presented at three conferences.

WP3.1:

UNIBE has carried out a set of transient simulations over the past 11 kyr with its terrestrial model to investigate the impact of Holocene land use and land use change on atmospheric CO₂ and results have been written up for the peer-reviewed literature (*Stocker et al. 2010*). We show that suggested upward revisions of Holocene land use reconstructions imply a smaller contemporary terrestrial carbon sink and that early agricultural activities did only marginally contribute to the late Holocene CO₂ rise of 20 ppm measured on ice cores. Simulated CO₂ change remains small even in scenarios where average land use per person is unrealistically increased by a factor of 4 to 8 above published estimates. Our results are not compatible with the hypothesis that humans are responsible for the late Holocene CO₂ increase and that anthropogenic land use prevented a new ice age.

In addition, CO₂ and δ¹³CO₂ records from Antarctica ice cores are provided to WP3.1 by UNIBE. CO₂ concentrations for the Holocene have been published previously but have been complemented by high-precision δ¹³CO₂ data in a recent publication. This indicates that the long-term re-equilibration of the marine carbonate system is mainly responsible for the CO₂ trend in the second half of the Holocene. Similar high-resolution CO₂ and δ¹³CO₂ records are currently obtained on the EPICA Dome C ice core for MIS5.5.

WP3.2:

UNIBE is analyzing the sensitivity of boreal CH₄ emissions for different model parameters and input data. The model has been forced with the climate output from GCM freshwater experiments to mimic the reduction in the Atlantic Meridional Overturning Circulation at the 8.2 kyr event. Modelled reduction compares well with reconstructed CH₄ changes for a constant atmospheric lifetime.

Recently, high-resolution δ¹³CH₄ and δD(CH₄) data over the Holocene and the last glacial / interglacial termination have been published outside of P4F: *Fischer, H., Behrens, M., Bock, M., Richter, U., Schmitt, J., Loulergue, L., Chappellaz, J., Spahni, R., Blunier, T., Leuenberger, M., and Stocker, T. F. (2008). Changing boreal methane sources and constant biomass burning during the last termination. Nature 452, 864-867;* *Sowers, T. (2010). Atmospheric methane isotope records covering the Holocene period. Quaternary Science Reviews 29, 213-221;*

Sowers, T. (2006). Late Quaternary atmospheric CH₄ isotope record suggests marine clathrates are stable. *Science* 311, 838-840.

– and complemented in a recent publication by $\delta D(CH_4)$ data during rapid climate variations during the last glacial. Coarse-resolution records of the methane isotopic composition during MIS5.5 are planned within the next year.

Forthcoming publication:

Bock, M., Schmitt, J., Möller, L., Spahni, R., Blunier, T., and Fischer, H. (2010). Hydrogen isotopes preclude clathrate CH₄ emissions at the onset of Dansgaard-Oeschger events. *Science*, in press.

Contribution by CSIC (Partner 6)

Nothing received.

Contribution by UAB (Partner 7, Rainer.Zahn@uab.cat)

Nothing specific for WP3 to report.

Contribution by BRIS (Partner 9)

Nothing received.

Contribution by MPG (Partner 12, WP3.1 lead, victor.brovkin@zmaw.de)

Work at MPG for WP3 is evolving as planned. Tim Brücher was hired as a Post-Doc from 1st April 2010. He started to extract and analyze data from two existing integrations of full complexity model (ECHAM5/JSBACH/MPIOM) of the Last Interglacial (Eemian snapshot, app. 1000 yrs) and a transient run from 6 kyr BP to present (*Fischer and Jungclaus, Climate of The Past, 2010*). The focus of current analysis is mainly on the carbon storage and on climate dynamics in tropics. Simulated burned land area fraction will be compared to the charcoal data (*Power et al., Clim Dyn, 2008*) and data on levoglucosan collected by partner 16 (IDPA-CNR).

To start preparations of long-term simulations of intermediate complexity models with integrated carbon cycle, we initiated a WP3 workshop on interglacial carbon cycle modeling at MPI-M in Hamburg on 27-28 October 2010. The main goal of the workshop is to establish a common protocol on non-equilibrium initial setup for transient carbon cycle simulations through interglacials, which needs to be harmonized among the models. Contributions from the data community are welcome, especially in terms of quantitative proxies useful for constraining the carbon cycle dynamics at the onset of interglacials.

Contribution by CEA (Partner 14)

Nothing received.

Contribution by IDPA-CNR (Partner 16, barbante@unive.it)

The researchers at IDPA-CNR have two main deliverables for the Past4Future program which include: D3.1.4 “Production and synthesis of high resolution records of iron and other bioactive trace elements from ice cores of the northern hemisphere” (Month 36) and D3.2.3 which states that we will provide high reso-

lution biomass burning (levoglucosan) data for the present and previous interglacial by Month 30.

We have made considerable progress on D3.2.3 and have calibrated levoglucosan as a proxy for past biomass burning with other known proxies such as oxalate in both Greenland and Antarctic ice cores. We have produced a high-resolution (decadal) record of past biomass burning from the Kilimanjaro ice core for the past ~4000 years. Kilimanjaro is an important location because of savanna fires are the largest producer (~60%) of carbon in biomass burning. We have hired a PhD student (September 2010) who will measure past biomass burning recorded in the Holocene and past glacial transition in Greenland (NEEM) and Antarctic (EPICA Dome C) ice cores. We have also hired a Post-Doc (January 2011) who will produce high-resolution records of iron and other bioactive trace elements from the NEEM ice core.

Work Package 4

WP4.1 Synthesis of sea level and ice sheets

Partners involved: 1, 3, 4, 8 (lead), 9, 14 and 22.

WP4.2 Sea ice and its link to climate changes

Partners involved: 2, 3, 4 (lead), 8, 10, 17, 20 and 21.

WP4.3 Quantifying and modeling ocean circulation variability and impacts during warm climates

Partners involved: 2 (lead), 4, 7, 10, 11, 14, 17 and 20.

Note: in some cases, the studentships/staff and science progress associated with a partner is actually allocated to several sub-WPs, and may not be specific to the one where it is listed. We will try to better understand the actual allocation in the next report.

WP4.1 Synthesis of sea level and ice sheets

Deliverables and milestones

All deliverables and milestones are in the distance (earliest is month 36).

Recruitment and personnel

Partner 3 (CNRS): Postponed the recruitment of the post-doc until after 2010.

Partner 8 (NERC-BAS): Has interviewed for a joint NERC/EU post-doc, but is suffering administrative problems. EU part of post-doc not due to start until 2012.

Partner 9 (BRIS): Have just put out the advert and the job will start in November.

Science progress

Partner 3 (CNRS; Ritz, Charbit) has tested the sensitivity of our Greenland ice sheet model to the atmospheric fields used to force it. The objective is, before doing Eemian experiments, to improve the downscaling methods and eventually to reject some of the GCMs because they perform not well enough to force the

Greenland ice sheet model with an absolute approach (could be OK with a perturbation method). Near-term plans are to finalize the sensitivity study mentioned above (*paper in preparation, Aurélien Quiquet et al.*), work on the ice sheet model with re-inclusion of semi-Lagrangian tracers (same as in *L'homme et al. 2004*), work on the Antarctic ice sheet model on the spinup issues (same as for ice2sea) and on grounding line treatment (schoofing).

Partner 3 (CNRS; Bard, Deschamps, CEREGE group (Aix-en-Provence)) has made initial progress in testing its geochronological tools (*e.g.* U-Th, ¹⁴C and mineralogy) specifically in aragonitic sediments and corals selected for the P4F project. The next step is to date samples and estimate durations of interglacials and deglacial transitions.

Partner 8 (NERC-BAS) is undertaking model development work relevant to Past4Future under ice2sea and NERC funding.

WP4.2 Sea ice and its link to climate changes

Deliverables and milestones

Milestone M4.2.1, "Database of existing proxy data for sea ice" is due in April 2011 (month 16). Several partners are working on compiling existing sea ice data for the Holocene and last interglacial; most progress has been made on the Holocene, but literature search is taking place for both periods. In addition to Holocene data compilation, Partner 20 (GEOTOP) is currently working on the "modern" sea-ice data to use as reference for reconstructions. We feel that a workshop will be needed to compile all the data into the database required for the deliverable. WP4.2 will strive to coordinate data compilation with WP1.3 and WP4.3 undertaking similar exercises on different aspects of data.

Recruitment and personnel

Partner 3 (CNRS) is seeking funding for a PhD-student to work on the last millennium; data produced through other projects (ANR, ESF) will be injected in P4F.

Partner 4 (AU) has announced a studentship (application deadline August 2010, partly funded by Past4Future). One PhD-student (Sofia Ribero) at the University of Copenhagen and two postdocs (Camilla Snowman Andresen and Francisca Staines-Urias) at GEUS are funded by other sources but will contribute data.

Partner 8 (NERC-BAS) has someone funded by another project trawling the literature for last interglacial sea ice (and climate). Our other WP4.2 work starts only in a year's time.

Partner 17 (AWI): A post doc position will be filled in September 2010.

Partner 20 (GEOTOP) has a postdoc (Bianca Fréchet) working part-time on the data compilation. By September 2010, we are planning to hire a PhD-student (Jéna Zumaque).

Partner 21 (ECNU) will have one PhDstudent (Longbin Sha, funded by other sources) to contribute data.

Science progress

Partner 3 (CNRS; Crosta) is sieving the literature, and devising the analytical strategy for the cores listed in P4F. Analysis of Holocene cores from the Antarctic Peninsula is underway.

Partner 4 (AU) has generated a new record (~ 5 kyr) of sea-surface conditions and sea ice cover and iceberg production in Vaigat Sound just north of Jacobs-havn Isbrae based on dinoflagellate cysts and IRD (*paper by Andresen et al. will be published in 'The Holocene'*). Future plans: Further proxy records will be studied.

Partner 17 (AWI) has been working on 8 sediment cores from the Atlantic and Indian Southern Ocean (SO); 6 (of 62) cores recovered in austral summer 2009/10 from the Pacific SO have been selected (covering two climatic cycles); 8 (of 51) cores recovered in summer 2009 from the polar North Pacific and Bering Sea have been selected.

Partner 20 (GEOTOP) is completing a compilation of Holocene reconstructions based on dinocysts; currently working on "modern" sea-ice data to use as reference for reconstructions.

Partner 21 (ECNU) is expanding the existing diatom database for quantitative reconstruction to include also data from the Labrador Sea region. Diatom analysis of core DA06139G will start after October 2010; the plan is to finish counting by summer 2011, resulting in reconstruction of sea ice changes off Jakobshavn Isbrae during the last 7000 years.

Other partners have not yet started on WP4.2.

WP4.3 Quantifying and modeling ocean circulation variability and impacts during warm climates

Deliverables and milestones

Deliverable D4.3.1, "Database of existing proxy data for THC for present and past interglacials", is due in December 2010. A small workshop together with WP4.2 would be a good way to initiate the work. Partner 2 (Kleiven) will distribute work tasks within the WP4.3. We are each experts from various areas in the world and, with the newly hired in place, most partners should be able to pitch

in. The amount of data for the last interglacial is trivial, but for the Holocene it is quite complicated and we should draw upon recent syntheses papers and compilations.

Recruitment and personnel

Partner 2 (Unifob): Two in-kind 4-year PhD students are recruited.

Partner 4 (AU): One PhD starts in July (in-kind funding) and one PhD student will be recruited soon (partly P4F funding).

Partner 7 (UAB): Two PhD students were recruited in March and May 2010.

Partner 10 (UCL): One PhD student starts August 2010, one more to be recruited autumn 2010.

Partner 11 (Uni-HB): A post-doc (H. Johnstone) will be hired.

Partner 14 (CEA): No hires.

Partner 17 (AWI): A post doc position will be filled in September 2010.

Partner 20 (GEOTOP): No hires.

Science progress

Partner 2 (Unifob) has initiated work on Holocene and MIS5e cores from drift sites in the North Atlantic capturing the eastern and western overflows. Cores in the inflow regions (Nordic Seas) are investigated to find a site with an expanded MIS5e.

Partner 4 (AU) will initiate the work on tropical paleoceanography in August 2010 and initiate the work on sea surface conditions in the North Atlantic and Labrador Sea in the fall of 2010. Will also start compiling metadata on all available partner 4 records.

Partner 7 (UAB) has been performed the first Mg/Ca and oxygen isotope analyses from a site in the eastern tropical Pacific, next steps are to increase the resolution across Termination I/Holocene. Analysis of the high-resolution profiles will start in Fall/Winter 2010. A second core in the westernmost Mediterranean Sea has been sampled at high resolution across Terminations I and II into the Holocene and MIS5e. Processing of these samples has begun and analysis of Mg/Ca and $\delta^{18}O$ will commence in Summer 2010.

Partner 10 (UCL) will initiate work within WP4 later this year.

Partner 11 (Uni-HB) is finishing a high-resolution planktonic Mg/Ca record for eastern Atlantic site Geob9501 for the past ~3200 years.

Partner 14 (CEA; the LSCE group in collaboration with partner 18, (CAM; Skinner) has generated dated sea surface temperature (SST) and benthic isotopic records over the last 30 kyr in a South Atlantic deep-sea core. The history of deep-water ventilation has been reconstructed at this site and is published in *Science* (Skinner *et al.*, 2010), whilst the THC circulation is inferred from a suite of cores spanning the same time interval (Waelbroeck *et al.* submitted). Reconstruction of

surface and deepwater properties are underway at the same site over the last interglacial and comparisons will be done with cores from the south Indian Sea.

Partner 17 (AWI): see core selection under WP4.2.

Work Package 5

WP5.1 Integration of results

Partners involved: 1 (lead), 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 and 22.

WP5.2 Training and education

Partners involved: 1, 4 (lead) and 19.

WP5.3 Stakeholders review

Partner involved: 1 (lead).

WP5.4 External communication

Partners involved: 1, 4 and 19 (lead).

WP5.5 Final delivery

Partners involved: 1 (lead) and 19.

WP5.1 Integration of results

Deliverables and milestones

D5.1.1 “Guidelines for dating and synchronization”

A document has been prepared and is ready to be placed on the P4F website.

D5.1.2 “Instructions for use of databases”

A document is under construction. Because the databases, relevant for the P4F project, span from collected data to model output it has been suggested that the usually used databases should be reserved for data and that the P4F website should include a facility where data produced under the P4F project are listed in a metadatabase with links to the web locations where the original data are available.

M5.1.1 “First annual meeting on strategy for the work packages”

The meeting was held in connection to the first Open Forum and a few modifications were suggested.

Recruitment and personnel

No personal has been recruited directly under this WP.

Science progress

The integration of results will first happen later in the project. At this first stage of the project, focus has been on coordination of the procedure to obtain results so they can be integrated during later stages in the project.

WP5.2 Training and education

Deliverables and milestones

D5.2.1 “Website with climate courses”. This was accomplished ultimo April 2010 and the climate course roster will be maintained throughout the project period through input to partner 4 (AU).

D5.2.2 “PhD-, MSc- and BSc-theses work”. Started primo 2010 and will be kept updated through input to partner 4 (AU) throughout the project period.

M5.2.1 “Creating a network of climate courses”

Recruitment and personnel

No personal has been recruited under this WP

Science progress

The progress of establishing a network for young researchers through climate courses is seen as an important part of the integration of the project.

WP5.3 Stakeholders review**Deliverables and milestones**

D5.3.1 “Questionnaire to stakeholders”. Work for this deliverable is in progress.

M5.3.1 “Identification of the group of stakeholders”. Milestone reached in April.

Recruitment and personnel

No personal has been recruited under this WP

Science progress

Partner 1 (UCPH) is preparing the stakeholder questionnaire.

WP5.4 External communication**Deliverables and milestones**

M5.4.1 “Establishing a P4F website”. This milestone was reached in March-April 2010. past4future.eu was created by partner 19 (PAGES) who is also hosting and maintaining the website.

Recruitment and personnel

Partner 19 (PAGES) has hired a part-time webmaster (Wartenburger).

Science progress

The contents of the website is updated and new (meta)databases are being added.

Primo May, partner 19 (PAGES) produced and printed a Past4Future pamphlet (www.past4future.eu/documents/project/Past4Future_flyer.pdf). For a complete list of produced external communication for P4F, please see www.past4future.eu/resources

WP5.5 Final delivery

Nothing to report.