Topic 2 Annual Meeting 2023

List of Poster

Subtopic 2.1 Warming climates

No	Name	Center	Poster title
1	**Hummels, Rebecca**	**GEOMAR**	**Observations of the boundary currents and AMOC at 11°S - the TRACOS array**
	Abstract:	The upper-ocean circulation of the tropical Atlantic is a complex superposition of thermohaline and wind-driven flows. The zonally and vertically integrated upper-ocean meridional flow is associated with the upper branch of the Atlantic Meridional Overturning Circulation (AMOC) — a major component of the global climate system. In the tropics, the northward AMOC flow is superimposed by the shallower overturning associated with the wind-driven Subtropical cells (STC). At the western boundary, the TRACOS (TRopical Atlantic Circulation & Overturning at 11°S) array consists of tall moorings monitoring the strong western boundary current (WBC) system - more specifically, the North Brazil Undercurrent (NBUC) and the Deep Western Boundary Current (DWBC) as part of the AMOC and STC. Mean transports seem rather stable throughout the observations (between 2000-2004 and 2013 up to date), while long-term changes in water mass properties are detected and related to changes in remote areas. At the eastern side the Angola current is observed since 2013 and shows weak mean circulation, whereas the variability seems dominated by remotely forced waves from the equatorial region. In addition to the boundary observations, the program at 11°S was extended to observe the basin wide circulation with bottom pressures sensors on both sides of the basin. The available data is used to estimate AMOC variability at 11°S on seasonal to interannual time scales. Together with other AMOC arrays, this array has great potential for understanding mechanisms relevant for tropical Atlantic variability, as well as meridional coherence and long-term changes of AMOC variability.	
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2	**Pinho, Tainã Marcos Lima**	**AWI**	**Instability and its interaction with changes in Southern Ocean Circulation**
	Abstract:	Ice-ocean feedbacks in the East Antarctic Ice Sheet (EAIS) lack in-depth understanding and therefore, preclude a robust projection for the sea level rise under ongoing climate warming. It has been shown a progressively ice-mass loss due to current atmospheric and oceanic changes. Importantly, the subsurface temperature is thought to be risen up to 2ºC over the last century toward the present days, which it is in the range of the 2-3°C warming threshold, leading to a partial collapse of the ice sheet. Past warmer-than-present climate intervals offer a distinct opportunity as they have already documented such collapse, which play a key role in enhancing the current prediction basis of future changes in the ice-ocean-climate complex system. Here we present a set of preliminary results from core PS128-2-3 located on the Bungenstock Plateau (69.41°S; 5.58°W; 1868 m water depth). We show for the first time, high-resolution Neogloboquadrina pachyderma sinistral oxygen isotope (d18O) record for the last glacial period, which is remarkably well correlated to the ice core from the Dronning Maud Land (EDML) d18O during the Antarctic Isotope Maxima (AIM) millennial scale events. This indicates that our planktic d18O record is reflecting sea surface temperature and salinity driven by Antarctic air temperature changes. Our N. pachyderma sinistral carbon isotope (d13C) increases during the AIM suggesting either an enhanced primary productivity as also indicated by increases in biogenic opal percentage and/or vigorous air-sea gas exchange, both process are likely related to the presence of open-ocean polynya during warmer/fresher AIM conditions. The distinct high amount of biogenic carbonate during the last glacial period challenge the notion of perennial sea ice coverage at our core site. Our results provide a paramount stratigraphic framework for the Antarctic region. Apart from that, there are ~50 14C radiocarbon dating (MICADAS, AWI, Bremerhaven) as well as ~ 250 Mg/Ca (Mg/Ca paleothermometry laboratory, GEOMAR, Kiel) analysis on N. pachyderma sinistral for the past 70 kyr.	
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3	**Soaga, Oluwaseun**	**GEOMAR**	**Variability of Antarctic Intermediate Water composition in the South Atlantic over the last 600,000 years**
	Abstract:	Antarctic Intermediate Water (AAIW) forms an integral part of the global thermohaline circulation as it redistributes heat, salt, CO_2 and nutrients from the Southern Ocean to the nutrient deprived tropics. Although there is clear evidence that the transport and composition of AAIW played a key role in the climate change of the last deglaciation, there are only a few longer records of AAIW variability. Here we reconstruct variations in AAIW water mass sourcing and nutrient content in the South Atlantic using Neodymium (Nd) isotopes and benthic Cd/Ca records complemented by benthic stable carbon isotope (δ13C) data. This study is based on a sediment core from DSDP Site 516 at 1300m water depth from within the modern-day core of the AAIW. The Nd isotope signatures exhibit a glacial-interglacial variability of up to 1.5 εNd units over the last 600 kyr with interglacials characterized by unradiogenic Nd signatures close to modern AAIW while more radiogenic signatures of up to -6.4 prevailed during glacials. This suggests a reduced contribution of unradiogenic northern sourced waters to the Southern Ocean during glacial periods. The δ13C record displays a similar amplitude with another intermediate depth record from the southwest Pacific [1] showing glacial δ13C values as low as 0.55‰. This can be attributed to a reduced ventilation at that depth during glacials. The intermediate depth Cd/Ca record indicates a higher nutrient content during interglacials consistent with other Cd/Ca reconstructions from the Atlantic for the last 55kyr. In addition, we observe a pronounced and steady nutrient decrease of AAIW starting ~270 ka and continuing until the Holocene. This trend is similar to that of the iron content records of DSDP Site 516 and that of Southern Ocean ODP Site 1090 [2] which show an overall increase in glacial Fe supply over the last ~270 kyr. This has likely increased productivity and has impacted the nutrient inventory of AAIW as reflected by Cd/Ca. *[1] Ronge, Tiedemann, Prange, Merkel & Nürnberg (2015), Paleoceanography 30, 23–38. [2] Martínez-Garcia, Rosell-Melé, Jaccard, Geibert, Sigman & Haug (2011), Nature, 476(7360), 312–315.*	
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4	**Treffeisen, Renate**	**AWI**	**Pooling Resources to Investigate and Share Information on Sea Ice – The SEA ICE PORTAL**
	Abstract:	Today, sea ice covers roughly 7% of the ocean. It cools the entire planet, affects ocean currents and offers a habitat for countless species. Due to climate change, sea ice is rapidly disappearing – with consequences for the entire planet. On Sea Ice Portal we share what we know – hot off the press, scientifically sound, and in accessible language. The Sea Ice Portal (www.seaiceportal.de) is an information and data portal on the topic of sea ice and offers essential information on this and many other developments. Since 2023, the joint project of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), the Helmholtz Climate Initiative REKLIM, and the University of Bremen is available in a completely new format – with a more modern interface and new, more accessible content specially targeting users who are newcomers to the topic of sea ice. The portal has undergone a rigorous relaunch according to the newest knowledge of usability, search engine optimization as well as responsiveness on different digital platforms. The Sea Ice Portal was developed within the framework of the Helmholtz Climate Initiative 'Regional Climate Change and Humans' (REKLIM) and as a joint project of the Climate Office at the AWI, the University of Bremen and the AWI – one of the world's leading sea-ice research centres. Researching the sea ice of the Arctic and Antarctic and highlighting its essential role in the Earth system is a substantial scientific undertaking. Accordingly, research institutes from around the globe have joined forces, allowing each to benefit from the strengths of the others. The same applies to knowledge transfer. We pursue research on a public basis for the benefit of all, yet it is equally important that all have access to our findings. Consequently, strong partners from the sea-ice research community have formed an alliance to share information on their findings. Since going online in 2013, the Sea Ice Portal has provided reliable, research-based information, straight from the source: daily updated ice maps based on satellite readings, regular news updates on the latest trends, expedition reports from researchers working directly on the ice, and detailed background articles – e.g. on sea-ice formation and measuring methods –, not to mention a data portal allowing users to directly access raw scientific data and work with it themselves.	
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Subtopic 2.2 Variability and extremes

No	Name	Center	Poster title
5	**Bayr, Tobias**	**GEOMAR**	**Equatorial cold SST bias hampers a realistic simulation of ENSO dynamics and asymmetry in Climate Models**
	Abstract:	Common problems in state-of-the-art climate models are the underestimation of important properties of El Niño/Southern Oscillation (ENSO), like the asymmetry between El Nino and La Nina. Based on simulations from the Kiel Climate Model (KCM) and the 5th and 6th phase of Coupled Model Intercomparison Project (CMIP5 & CMIP6), we investigate how well ENSO dynamics are simulated and found a crucial role of the two atmospheric feedbacks operating in ENSO: the positive, i.e. amplifying wind-SST feedback and the negative, i.e. damping heat flux-SST feedback. Here we analyze the ocean–atmosphere coupling over the equatorial Pacific in case of underestimated ENSO atmospheric feedbacks (EAF): While models featuring realistic atmospheric feedbacks simulate ENSO dynamics close to observations, models with underestimated EAF exhibit fundamental biases in ENSO dynamics. In models with too weak feedbacks, ENSO is not predominantly wind-driven as observed; instead ENSO is driven significantly by a positive shortwave radiation feedback. Thus, although these models simulate ENSO, which in terms of simple indices is consistent with observations, it originates from very different dynamics. The equatorial Pacific cold SST bias can explain a large part of the biased ENSO dynamics: One the one hand, it causes a too westward position of the rising branch of the Pacific Walker Circulation by up to 30°, which weakens the wind feedback and causes the positive shortwave feedback due to cloud biases. On the other hand, due to a too high convective threshold it hampers the southward migration of the Intertropical Convergence Zone onto the equator during El Nino events. This in turn leads to fewer strong EP El Niño events, which causes the underestimated ENSO asymmetry in climate models, as ENSO asymmetry is dominated by strong EP El Ninos. Our results suggest that a broad continuum of ENSO dynamics exists in the climate models and that simulated ENSO dynamics would strongly benefit from a reduced equatorial Pacific cold SST bias.	
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6	**Bischof, Sabine**	**GEOMAR**	**The role of the North Atlantic for heat wave characteristics in Europe**
	Abstract:	European heat waves have become more frequent recently. To improve the predictability of such extreme events, it is important to understand their driving mechanisms better. Earlier case studies hint at a connection between North Atlantic (NA) sea surface temperatures (SSTs) and the occurrence of European heat waves. However, the role of the ocean in shaping heat waves is not fully understood. We investigate the effect of the cold subpolar NA 2018 SST pattern on European heat waves using two 100-year long AMIP-like model experiments: 1) employing daily 2018 SSTs as observed and 2) applying a novel approach to remove the negative NA SST anomaly from the forcing. Comparing these experiments shows that cold subpolar NA SSTs can increase heat wave duration and magnitude downstream over the European continent. This effect is connected to an enhancement of the simulated summer wave pattern of meridional winds over the North Atlantic European sector.	
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7	**Dilmahamod, Fehmi**	**GEOMAR**	**(Sub)-mesoscale dynamics in the Labrador Sea**
	Abstract:	Ocean dynamics at the (sub)-mesoscale play a fundamental role in the upper ocean, influencing physical, biological, and chemical processes. They are integral to the turbulent kinetic energy cascade and dissipation, contributing to the variability of upper ocean stratification and guiding carbon and oxygen uptake – from processes to long term changes. In-situ high-resolution sampling (MVP, uCTD, drifters, and gliders) combined with higher-resolution satellite data (SWOT and Sentinels) offer an unprecedented view of fine-scale dynamical processes in the Labrador Sea. Drifter pairs deployed during a RV Meteor cruise (M184) in August-September 2022 were used to estimate relative dispersion associated with different regimes (boundary current and mesoscale). Additionally, two ocean gliders surveyed the peripheries of an Irminger Ring, revealing coexisting mesoscale structures like fronts and filaments. These findings enhance our understanding of ocean complexity, its impact on global processes, and the significance of (sub)-mesoscale phenomena.	
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8	Kearney, Rebecca	GFZ	Important findings from the TephroMed project: The cryptotephras of the ICDP Dead Sea deep core during the last 130kya
	Abstract:	The eastern Mediterranean region experienced large hydroclimatic shifts throughout the last glacial-interglacial period (130-30kya). The region is located between the contrasting humid Mediterranean climate and the Saharo-Arabian desert belt. Important lake sediment archives allow reconstruction of past changes in precipitation regimes using multiple proxy datasets. The Dead Sea (Israel) ICDP DSDDP record is an important palaeoenvironmental archive that provides detailed insight into the environmental characteristics and timing of these climatic changes. This record has undergone extensive palaeoenvironmental and climatic reconstructions (e.g. stable oxygen isotopes, pollen) and has been dated through absolute and relative methods (e.g., radiocarbon, U-Th-dating, wiggle-matching). However, large chronological uncertainties have prevented detailed insight into the regional climatic (a)synchronies with other palaeoclimatic records in the region (e.g. Lake Van, eastern Anatolia). The application of cryptotephra (non-visible volcanic ash), is a powerful chronological tool to refine age uncertainty and correlate palaeoclimatic records, particularly over long distances. Previous investigations on the Dead Sea record have found important cryptotephra layers within the sediment (e.g., the early Holocene S1 tephra), allowing the integration of palaeoenvironmental data. Based on this work, we now present the important Dead Sea cryptotephra findings that are part of TephroMed project. Our cryptotephra studies focused on sections that may contain glass shards from important eruptions originating from volcanic sources in the Mediterranean region. Major, minor and trace element volcanic glass chemistry (Electron microprobe analysis and LA-ICP-MS), with the use of statistical methods, have revealed cryptotephra layers derived from numerous volcanic sources in the Mediterranean. These include Central Anatolia and Eastern Anatolia, Hellenic Arc, and the Phlegraean Fields. The identification of cryptotephra in the Dead Sea has greatly extended the tephrostratigraphic framework of the region of disparate volcanic areas. Using tephra layers, correlations have now been made to other important palaeoenvironmental sites (Lake Van) and archaeological records in the region, including into the Levant and Arabia. This has provided insight into the time transgressive nature of climatic shifts throughout this period.	
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9	**Koungue, Rodrigue Anicet Imbol**	**GEOMAR**	**Drivers and impact of the 2021 extreme warm event in the tropical Angolan upwelling system**
	Abstract: Contact:	Between April and August 2021, high interannual sea surface temperature anomalies of more than 1.5◦C were recorded along the coasts of Angola and Namibia. This extreme coastal warm event has reached its peak amplitude in June 2021 in the Angola Benguela Area during the major upwelling season in tropical Angolan upwelling system. Analyses have revealed that the warm event was forced by a combination of local and remote forcing. In April 2020, a local warming was triggered around the Angola Benguela front (~15◦S -17◦S) by local positive anomalies of near coastal wind-stress curl leading to downwelling anomalies through Ekman dynamics and by anomalously weak winds. Moreover, between May and August 2021, downwelling coastal trapped waves (CTWs) were observed along the African coast. Those coastal trapped waves might have partly emanated from the downwelling equatorial Kelvin waves (EKW) triggered by the reflection of downwelling Rossby waves at the Brazilian coast. Additional forcing of downwelling EKW comes from the westerly wind anomalies observed in the western or central equatorial Atlantic in early May 2021. Along the southwest African coast, extra forcing for the downwelling CTWs likely resulted from an observed weakening of the prevailing coastal southerly winds along north of 10◦S between in early 2021. Moreover, a heat budget analysis reveals a contribution of meridional heat advection to the near-surface warming during the early stages of the warm event. A substantial reduction of net primary production in the Southern Angola and Angola Benguela front regions was observed during the extreme warm event. rimbol@geomar.de	
10	**Zeller, Mathias**	**GEOMAR**	**Southern Ocean warm bias and mesoscale dynamics as drivers of different ocean mean state dynamics**
	Abstract:	While past research has shown that a realistic representation of the Southern Ocean (SO) in climate models is critical for reliable global climate projections, state-of-the-art climate models are still facing severe biases in the high-latitude Southern Hemisphere leading to different mean states of the SO. Using a fully coupled global climate model, we here investigate the effect of a 0.5◦, 1◦ and 1.6◦C warmer than today SO on i) the spin-up behaviour of a high-resolution simulation branched off a coarse-resolution SO and ii) the equilibrium state for various relevant dynamical quantities in this region. Our results show that the SO state at the time of initialising a high-resolution simulation is critical for the evolution of dynamical quantities during the spin-up phase. Depending on the	

		initial magnitude of the SO heat content the hydrography and circulation develop in different ways and eventually also result in distinct equilibrium states. Initialisation from a strongly warm-biased simulation can result in a severe disruption of the dynamical system shedding doubt on the results of any subsequent analysis of the model output. For low-resolution simulations, we further find that in a steady state a warmer SO comes along with a temperature-driven reduction of the meridional density gradient across the 45◦-65◦S latitude band due to a disproportionately stronger warming on its southern flank. The reduced density gradient results in a weaker Antarctic circumpolar current and is accompanied by weaker Weddell and Ross gyres and a stronger Agulhas current. The increased SO heat content as a consequence of higher ocean temperatures is dominated by a particularly strong increase of the Weddell gyre heat content. In a second set of experiments with an increased ocean resolution south of 28◦S, we further examine the role of resolved mesoscale dynamics in setting the modelled SO mean state under different initial conditions. Our results show that all high-resolution experiments strive for a cooler SO mean state than their low-resolution counterparts. The SO cooling effect is predominantly related to a strongly reduced heat content of the Weddell gyre. When initialized from a warm-biased control simulation, the high resolution SO loses most of its excess heat via deep convection to the atmosphere. The lower temperatures, in particular at high latitudes, invoke a steeper mean isopycnal slope across the Antarctic circumpolar current inducing higher current speeds. At the same time, the strength and size of both the Weddell and Ross gyres in the high-resolution simulations are reduced under cooler conditions. The strength of the Agulhas current strongly increases when mesoscale dynamics is resolved. As for the low-resolution experiments, the Agulhas current is even stronger the warmer the SO is.
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Subtopic 2.3 Sea level change

No	Name	Center	Poster title
11	**Bagge, Meike**	**GFZ**	**Solid Earth component for coupled climate models**
	Abstract:	In times of global warming, the understanding of key processes in ice-sheet melting and sea-level change is of major relevance. Glacial isostatic adjustment (GIA) – the viscoelastic response of the solid Earth to surface loading – is a key feedback mechanism for bedrock deformation, sea level, grounding-line position, ice-sheet elevation and its stability and hence the solid Earth provides an essential contribution to global climate models. Hereby, the deformational solid Earth feedback depends on the Earth structure parametrization. Observational data as seismic tomography reveals large global and regional Earth structure contrasts that should be considered in global climate models. Within the German Climate Model Initiative PalMod we implemented the – generally in climate models neglected – solid Earth component. In GIA standalone and coupled ice sheet–solid Earth models we investigated the effect of different Earth structure parametrizations on the solid Earth response and the stability of the Antarctic Ice Sheet during the last deglaciation. We developed geodynamically constrained 3D Earth structures for the model input as well as data sets and validation methods to constrain the model output with observations on paleo geological sea-level and present-day geodetic uplift rates.	
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12	**Hassanibesheli, Forough**	**GFZ**	**Downscaling Satellite Gravimetry Using Generative Adversarial Network**
	Abstract:	Our Helmholtz Research Topic 2 Ocean and Cryosphere in Climate involves contributions from the Global Geodetic Observing System (GGOS) in terms of satellite altimetry (Subtopic 3 Sea Level Change) for the observation of the sea level, an essential climate variable, or sea surface height, an essential ocean variable. For the altimetry measurements to work precisely, a precise orbit determination is required. Given the precise orbit, altimetry allows for the connection of the physical sea surface height to the high-precise geometric global terrestrial reference frame: ITRF (International Terrestrial Reference Frame). Without the geometric reference, the space geodetic technique altimetry would not work. Hence, the ITRF is mentioned in Topic 2 as an	

		important Deliverable in Subtopic 2.4 Advanced Research Methodologies. In our poster, we review the fundamental principles of the ITRF focusing on its role and importance for the quantification of the sea surface height in space and time. The required quality is part of the discussion as well. We also highlight the work done at Section 1.1 Space Geodetic Techniques and Section 1.2 Global Geomonitoring and Gravity Field of GFZ in support of the ITRF determination. From a geodetic point of view, ITRF is the most important global reference frame. It is applied as the metric basis for the quantification of a variety of geophysical effects well beyond topic 2. Nevertheless, the requirements of the quality of ITRF for the determination of the sea surface height are very tight, perhaps the tightest. In this respect, the question is whether the ITRF delivers the quality that supports the demand. Based on our point of view, the current ITRS realization is not accurate enough. Currently, three different product types are available for the global terrestrial reference frame: ITRF2020, DTRF2020, and JTRF2020. All three products are computed based on identical input data, i.e. intra-technique combined time series from the space geodetic techniques GNSS, VLBI; SLR, and DORIS as well as local tie measurements. The three products, however, show significant differences. Current research on ITRF is concerned with the utilization of other ties, e.g. tropospheric ties, clock ties, space ties, such as the planned GENESIS mission of ESA, and on the expected improvements due to next generation GNSS. The current state of research will be described shortly as well.	
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13	**Shihora, Linus**	**GFZ**	**Inferring North Atlantic Deep Water Transports from Ocean Bottom Pressure at the Western Boundary**
	Abstract:	Dedicated satellite gravity missions operated jointly by NASA and its German partners DLR and GFZ allow for the precise mapping of large-scale surface mass changes on planet Earth. Initiated with the GRACE mission launched in the year 2002, the record is currently being extended by GRACE-FO in operation since 2018. Over the oceans, the GRACE/GRACE-FO data is dominated by signatures of ocean tides, barotropic wind- and pressure-driven variations, and barystatic sea-level rise. Ocean bottom pressure variations from baroclinic processes associated with, e.g., the southward transport of North Atlantic Deep Water (NADW) are much weaker and it remains to be demonstrated that such signals can indeed be detected from space. Based on five decades of data from the high-resolution ocean model VIKING20X of the North Atlantic (Biastoch et al., 2021), we will outline the dynamical relations that allow to infer NADW transport variations using ocean bottom pressure changes from a	

		narrow strpi at the western continental slope of the North Atlantic between depths of 1000 and 3000 m as proposed earlier by Bingham and Hughes (2008). Our assessment will be complemented with model data-sets from ECCO2 and also CMIP6 high-resolution model experiments in order to robustly quantify the signals that can be expected in either the combined GRACE/GRACE-FO record that spans already over more than two decades, or alternatively in observations from the future gravity missions GRACE-C (to be launched in 2028) and NGGM/MAGIC (planned for 2032), which are expected to provide an even higher accuracy and spatial resolution. *Biastoch, A., Schwarzkopf, F. U., Getzlaff, K., Rühs, S., Martin, T., Scheinert, M., Böning, C. W. (2021). Regional Imprints of Changes in the Atlantic Meridional Overturning Circulation in the Eddy-rich Ocean Model VIKING20X. Ocean Science Discussions, [preprint]. Retrieved from https://os.copernicus.org/preprints/os-2021-37* *Bingham, R. J., & Hughes, C. W. (2008). Determining North Atlantic meridional transport variability from pressure on the western boundary: A model investigation. J. Geophys. Res., 113(9), 1–16. https://doi.org/10.1029/2007JC004679*
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14	**Zeising, Ole**	**AWI**	**Observing ice–ocean interaction – Extreme melting of 79°N Glacier, Greenland**
	Abstract:	The 79° North Glacier in Greenland is experiencing significant changes in the last decades. Due to extreme melt rates, the ice has thinned significantly in vicinity of the grounding line where a large subglacial channel has formed since 2010. We attribute these changes to warm ocean currents and an increased subglacial discharge from surface melt. However, basal melting has decreased since 2018, indicating colder water inflow into the cavity below the glacier.	
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Subtopic 2.4 Advanced research methodologies for tomorrow

No	Name	Center	Poster title
15	**Dallmayr, Remy**	**AWI**	**A cryocell for 2D-imaging of impurities by LA-ICP-MS in large ice-cores**
	Abstract:	The success of the “Oldest Ice Challenge” – the investigation of the Mid-Pleistocene Transition (MPT) in an Antarctic ice core – crucially depends on extracting paleoclimatic information from highly thinned deep ice, with misinterpretation by post-depositional signal alteration carefully avoided. The state-of-the-art 2D imaging with laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) can provide key insights in this regard, but is currently limited to ice samples smaller than 10cm. We present here a prototype of large cryocell able to accommodate samples up to 55cm long. Such technical development will ultimately enable a fast 2D analysis, and thus the overview of impurity content and localization in entire ice core segments.	
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16	**Grotheer, Hendrik**	**AWI**	**Untargeted mapping of polar organic compounds in suspended particulate organic matter off Cape Blanc, NW Africa**
	Abstract:	Well-known biomarkers provide important chemotaxonomic information on biological communities and carbon fluxes in different environmental settings. However, the focus on the known can be laborious, time-consuming and informative, yet unknown, compounds may be overlooked. To overcome these limitations, we applied an untargeted approach to examine organic molecules detected by HPLC-MS in suspended particulate matter (SPM). Samples from six stations along a transect from organic-rich shelf waters to the oligotrophic North Atlantic were analyzed. The untargeted approach detected 93,134 compounds. The majority cannot be identified and may have been neglected by traditional HPLC-MS data processing routines. Principal component analysis (PCA) revealed three distinct molecular assemblages across the investigated transect: a) shallow near-shore; b) intermediate; and 3) deep-offshore. Paired with environmental data and isotopic variations (D14C and d13C) of the bulk C species (DOC, POC, DIC), untargeted lipid characterization will significantly improve our understanding of the fate of OM on its journey through the water column, from primary production to burial in sediments.	
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17	Heinkelmann, Robert	GFZ	ITRF – the metric basis for quantification of sea level change and contributions from GFZ
	Abstract:	Our Helmholtz Research Topic 2 Ocean and Cryosphere in Climate involves contributions from the Global Geodetic Observing System (GGOS) in terms of satellite altimetry (Subtopic 3 Sea Level Change) for the observation of the sea level, an essential climate variable, or sea surface height, an essential ocean variable. For the altimetry measurements to work precisely, a precise orbit determination is required. Given the precise orbit, altimetry allows for the connection of the physical sea surface height to the high-precise geometric global terrestrial reference frame: ITRF (International Terrestrial Reference Frame). Without the geometric reference, the space geodetic technique altimetry would not work. Hence, the ITRF is mentioned in Topic 2 as an important Deliverable in Subtopic 2.4 Advanced Research Methodologies. In our poster, we review the fundamental principles of the ITRF focusing on its role and importance for the quantification of the sea surface height in space and time. The required quality is part of the discussion as well. We also highlight the work done at Section 1.1 Space Geodetic Techniques and Section 1.2 Global Geomonitoring and Gravity Field of GFZ in support of the ITRF determination. From a geodetic point of view, ITRF is the most important global reference frame. It is applied as the metric basis for the quantification of a variety of geophysical effects well beyond topic 2. Nevertheless, the requirements of the quality of ITRF for the determination of the sea surface height are very tight, perhaps the tightest. In this respect, the question is whether the ITRF delivers the quality that supports the demand. Based on our point of view, the current ITRS realization is not accurate enough. Currently, three different product types are available for the global terrestrial reference frame: ITRF2020, DTRF2020, and JTRF2020. All three products are computed based on identical input data, i.e. intra-technique combined time series from the space geodetic techniques GNSS, VLBI; SLR, and DORIS as well as local tie measurements. The three products, however, show significant differences. Current research on ITRF is concerned with the utilization of other ties, e.g. tropospheric ties, clock ties, space ties, such as the planned GENESIS mission of ESA, and on the expected improvements due to next generation GNSS. The current state of research will be described shortly as well.	
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18	**Kattein, Laura**	**AWI**	**Ramped pyrolysis-oxidation-14CO2: A versatile method to elucidate organic carbon reactivity in sediments**
	Abstract:	Marine and sedimentary organic matter (OM) is a highly heterogenous and complex mixture of different compounds, with individual chemical characteristics, including molecular composition, age, and reactivity. Deciphering this information could provide valuable tools in the understanding of organic carbon (OC) cycling pathways as well as sequestration and remineralization, processes that have a direct influence on the atmospheric carbon budget. Isolating individual components of OM is, however, a sophisticated task, and information like compound reactivity is difficult to quantify. Ramped pyrolysis-oxidation (RPO) has been established as a novel method to separate fractions of OM components based on their thermochemical stability. The sample is subjected to a steady temperature ramp, leading to the thermal decomposition of the components and the formation of volatile pyrolysis products, which are subsequently oxidized to CO2. Trapping CO2 of individual fractions enables analytical investigations (including 14C quantification) of the OC contained within. Here we present the planned setup and functionality of an RPO system optimized for the operation in conjunction with a self-constructed molecular sieve trap system and the subsequent measurement with AWI's Mini CArbon DAting System (MICADAS). In addition, we show the initial results of bulk 14C analyses of sediments sampled on the East Antarctic continental slope and in the fjords of South Georgia island, which will form the basis of two different studies, where the novel RPO technique will be applied.	
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19	**Lausecker, Marleen**	**AWI**	**Towards dating marine sediments using 26Al**
	Abstract:	The cosmogenic radionuclide 26Al might be used to date different climate archives. However, variable terrestrial 27Al input and scavenging rates lead to highly variable dissolved Al contents in the water column and little is known about the resulting patterns of dissolved 26Al/27Al which may affect its applicability as a dating tool. We will present the authigenic 26Al/27Al of globally distributed marine core-top sediments, assess the spatial variability of 26Al/27Al in the ocean and discuss the implications for dating of marine sediments.	
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20	**Loftfield, Julia**	**AWI**	**10Be as synchronization tool in marine sediments**
	Abstract: Contact:	The cosmogenic radionuclide 10Be may be used as a dating tool in various climate archives. Its production rate is inversely related to the Earth's magnetic field strength and solar activity and recorded in climate archives globally. In this project we aim to use the authigenic 10Be/9Be ratio to improve the age models of marine sediment cores. We are testing the possibilities and constraints of the method using samples from different oceanographic and sedimentary settings covering the Laschamps geomagnetic field minimum when the atmospheric production rate of 10Be has roughly doubled. As this method requires a high sample resolution we developed a cheap sample preparation protocol for the purification of authigenic 10Be from marine sediments with a high sample throughput. We will present this protocol, as well as the first 10Be/9Be data from an Arctic sediment core. julia.loftfield@awi.de	
21	**Röschel, Lina**	**RIFS**	**Governance of ocean-based negative emissions technologies**
	Abstract:	The model pathways of the Intergovernmental Panel for Climate Change (IPCC) for the timely achievement of global climate targets, especially the target of limiting global warming to 1.5°C compared to pre-industrial levels, suggest the need for safeguarding and enhancing the global carbon sink. Experts argue that the deployment of so-called negative emissions technologies for large-scale carbon dioxide removal holds potential for keeping the temperature in line with limits set by the Paris Agreement. Ocean-based negative emissions technologies (ONETs) intend to enhance carbon sequestration and storage in the ocean, e.g., by changing the ocean's physical or biogeochemical properties. But in addition to these intended effects, ONETs may also cause unintentional impacts on the ocean's condition and on related coastal and marine ecosystem services that are relevant for the attainment of a range of global policy goals. Our research links potential direct and indirect, intentional and unintentional impacts of eight ONETs on the marine environment to the regulations and policy goals of international environmental agreements of the current global ocean governance regime. We outline a direct, implicit and indirect governance framework of ONETs. Hereby, a broader perspective of the concept of (global) ocean governance is adopted to outline a wider network that goes beyond the explicit regulation of ONETs within the realm of ocean governance. This first-order assessment derives gaps and challenges in the existing governance framework, as well as needs and opportunities for comprehensive governance of the technologies. It is determined that while the inclusion of ONETs in the global climate strategy may be deemed necessary for reaching net zero emission targets in the future, a range of potential trade-offs with	

		other policy goals may need to be considered or dealt with when deploying ONETS for climate mitigation. Further, foresight-oriented and adaptive governance mechanisms appear imperative to bridge gaps resulting from extensive uncertainties and unknowns linked to ONET deployment in a changing ocean and. The identified ONET governance framework reiterates current challenges in ocean governance, for instance related to fragmentation, but also represents an opportunity for a synergistic and integrated approach to future governance.	
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22	**Zhang, Zhouling**	**GEOMAR**	**Tracing TEIs Sources and Water Mass Mixing in the South Pacific Ocean Using Neodymium Isotopes and Rare Earth Elements**
	Abstract:	The South Pacific Ocean (SPO) is one of the least studied ocean regions. Here we present results of radiogenic neodymium isotope (εNd) and rare earth elements (REEs) from a recent GEOTRACES cruise GP21 (Feb.- Apr., 2022), along a zonal section (26-33°S) from the Chilean shelf to the South Fiji Basin. Based on our results, we characterize dominant water masses and reveal various sources of trace elements and their isotopes (TEIs) to the SPO from volcanic inputs, continental particles, and oceanic crust (hydrothermalism). Our findings help to further develop and reliably apply radiogenic Nd isotopes as proxies for past ocean circulation.	
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