CNR | Dipartimento Scienze del Sistema Terra e Tecnologie per l'Ambiente

GRUPPO DI LAVORO PALEOCLIMA

Attività paleoclimatiche e paleoambientali al CNR-DSSTTA

Annual report 2023

Gruppo di Lavoro "Dinamica del Paleoclima"

Per Cambio Climatico si intende la modifica a lungo termine dei parametri climatici della Terra, quali temperatura, precipitazioni, pattern dei venti, estensione della criosfera etc, causata principalmente dalle attività umane. Gli esseri umani sono infatti diventati un agente rilevante di cambiamento globale già a partire dall'inizio del presente interglaciale (Olocene) in alcune regioni, ma è soprattutto dopo la Rivoluzione Industriale che le attività umane, principalmente attraverso le emissioni di gas serra, hanno indiscutibilmente causato il riscaldamento del pianeta, con la temperatura superficiale globale che ha raggiunto 1,1°C sopra i livelli del 1850-1900 nel periodo 2011-2020 (IPCC-AR6 2023). Questo trend di riscaldamento è stato osservato su tutti i continenti e gli oceani, ma risulta più pronunciato in aree particolari come le regioni polari, il Mediterraneo e le zone di alta quota.

Gli effetti del cambiamento climatico sono estesi e influenzano sia i sistemi naturali che quelli umani. Tra questi, si registrano cambiamenti nella composizione di ecosistemi e caratteristiche degli habitat, perdita di biodiversità, innalzamento del livello del mare, desertificazione e aumento della frequenza e dell'intensità degli eventi meteorologici estremi. Le conseguenze includono scarsità di cibo e acqua, rischi per la salute, disagi economici e conflitti sociali. Le comunità vulnerabili, in particolare quelle delle aree costiere o delle regioni aride, sono particolarmente a rischio.

Affrontare il cambiamento climatico richiede sforzi globali per ridurre le emissioni di gas serra, promuovere pratiche di gestione sostenibile del territorio, proteggere e ripristinare gli ecosistemi, e migliorare la resilienza agli impatti climatici. È anche necessario comprendere a fondo come funziona il Sistema Terrestre, esplorando la moltitudine di processi interattivi che ne governano la dinamica a tutte le scale spaziali e temporali, attraverso misurazioni, monitoraggio e modellizzazione.

La paleoclimatologia svolge un ruolo cruciale nella comprensione delle future traiettorie climatiche. Gli archivi naturali provenienti dal record geologico e dei ghiacci conservano infatti nelle loro proprietà fisiche, stratigrafiche e biogeochimiche le condizioni esistenti al momento della loro formazione. Gli stati climatici passati nella storia della Terra coprono un ampio spettro di temperature, pattern di precipitazioni, estensione della criosfera e adattamenti biologici. La loro ricostruzione può fornire un importante riferimento delle condizioni naturali e della variabilità di fondo, aiutando a comprendere le risposte degli habitat e degli ecosistemi a diverse combinazioni di forzanti climatiche ed ambientali, migliorando così la nostra comprensione su come elementi chiave del sistema climatico siano influenzati dai livelli di gas serra, dalla variazione della radiazione solare, dall'estensione dei ghiacci, e così via.

Inoltre, la sfida più attuale della ricerca paleoclimatica è quella di testare i modelli numerici che descrivono il funzionamento del sistema climatico, applicandoli ad intervalli passati e anche al di fuori della gamma di variabilità registrata negli ultimi secoli. Questo può aiutare a prevedere i potenziali impatti di un aumento

del riscaldamento globale e offrire spunti su eventi climatici estremi, meccanismi di soglia e punti critici che potrebbero verificarsi in futuro.

La necessità di avere una visione di lungo periodo sui meccanismi di funzionamento del sistema climatico e sulle risposte del sistema terra, degli ecosistemi e degli ambienti alle variazioni climatiche è riconosciuta a livello internazionale, come testimoniato dai report IPCC a partire dal 2011 e dalla recente call Horizon 2024 "Paleoclimate science for a better understanding of the short- to long-term evolution of the Earth System"

La comunità paleoclimatica presso il CNR-DSSTTA, rappresentata qui dal Gruppo di Lavoro "Dinamica del Paleoclima", è attiva in molteplici aspetti della ricerca paleoclimatica. Le prospettive temporali vanno dal recente passato (ultimi due secoli) fino al passato geologico profondo pre-Cenozoico. Un focus particolare emerge sul periodo Quaternario e sul presente Interglaciale (Holocene).

Vengono utilizzati molteplici approcci disciplinari, con metodologie che abbracciano praticamente tutte le discipline delle Scienze della Terra (geochimica, sedimentologia, mineralogia, geocronologia, stratigrafia, geomorfologia) e coinvolgono la fisica (fisica dell'atmosfera e modellistica numerica); l'oceanografia, le scienze della vita (ecologia, biologia, botanica, chimica organica) e le scienze umane (uso di informazioni da fonti storiche ed archeologiche e ricostruzione dei legami tra clima, ambiente e società del passato). Sono inoltre sviluppati modelli fisici e calibrazioni di proxy attraverso osservazioni moderne (reti di monitoraggio).

Gli obiettivi generali sono:

- Documentare e quantificare la variabilità climatica naturale in termini di ampiezza, tempistiche (inizio, durata, frequenza), sviluppo spaziale (posizione, estensione), impatti (su ambiente ed ecosistemi), nonché le teleconnessioni a livello regionale e globale.
- Descrivere l'evoluzione climatica a breve e lungo termine utilizzando diversi proxy, in particolare per i periodi climatici passati di particolare rilevanza rispetto all'attuale e futuro scenario di cambiamento climatico (ad esempio, interglaciali e deglaciazioni del Quaternario, intervalli di rapido riscaldamento globale come la transizione Eocene-Paleocene, l'Optimum Climatico del Miocene Medio, l'Optimum del Pliocene, ecc.).
- Ricostruire i parametri ecologici e ambientali di base in ambienti incontaminati e sempre più impattati, e la sensibilità degli ecosistemi e degli habitat ai cambiamenti sia naturali che antropici.
- Indagare e calibrare proxy chimici e biologici per ricostruire quantitativamente i parametri climatici ed ambientali del passato.

Il presente rapporto, basato su un'indagine condotta nei diversi Istituti del DSSTTA, ha l'obiettivo di riassumere le attività paleoclimatiche del CNR-DSSTTA per il 2023. Gli istituti con attività in questo ambito sono 8 (ISP, ISMAR, ISAC, IGG, IGAG, IRSA, IRPI, IMAA), e il numero di ricercatori coinvolti è di qualche decina (30-40).

In generale, emerge che gran parte della ricerca paleoclimatica presso il CNR è concentrata su aree climaticamente sensibili (i cosiddetti Hot-spot climatici), come il Mediterraneo, le regioni polari e le zone montane.

Le collaborazioni, sia a livello nazionale che internazionale, sono ben sviluppate, come dimostrato dalla partecipazione a grandi consorzi e progetti scientifici come PRIN, PNRA, PRA in ambito nazionale e ICDP/IODP, ERC, HORIZON in ambito internazionale. La collaborazione con le Università è forte e capillare e include, oltre alla collaborazione a progetti e ricerche, anche il tutoraggio degli studenti, dal livello di laurea

al dottorato, sia l'insegnamento. Anche la collaborazione con gli EPR è ben sviluppata, in particolare con OGS e INGV.
Sono presenti sinergie tra i diversi Istituti, ma la maggior parte delle attività coinvolge singoli ricercatori o piccoli gruppi. Una vasta gamma di attività viene sviluppata grazie a collaborazioni informali e reti di contatti, che spesso portano a una produzione scientifica di alta qualità nonostante la mancanza di finanziamenti dedicati. A questo proposito, degna di nota è la partecipazione di ben 5 istituti (per un totale di oltre 15 ricercatori coinvolti) al progetto INGV "Amused-An integrated, multidisciplinary study of past global climate changes from continental and marine archives in the Mediterranean Region". Questa aggregazione consistente e ed inusuale suggerisce che la rete di ricercatori CNR sia in grado di interagire con profitto in presenza di progetti finanziati e strutturati che coinvolgano vari siti sul territorio nazionale, svolgendo di fatto una funzione di connettivo tra i vari attori coinvolti nella ricerca ed apportando sostanziali contributi in termini sia di competenze che di infrastrutture.
Nel complesso, la produzione scientifica è ampia e variegata, e ben posizionata in termini di indici bibliografici, anche se le pubblicazioni ad accesso aperto sono ancora limitate.

Tra le attività del Gruppo di lavoro, segnaliamo che è in corso la ricognizione dei laboratori in cui sono ospitate facilities analitiche dedicate o potenzialmente utilizzabili per ricerche in ambito paleoclimatico e paleoambientale. Il fine è creare un database virtuale (CRISPY: Coordinated Research Infrastructure for PaleclimatologY), ospitato sul sito del GdL. Tale piattaforma ha gli obiettivi di promuovere la ricerca all'avanguardia, sviluppare tecnologie e metodologie innovative ed incoraggiare la collaborazione tra i singoli ricercatori e tra i diversi gruppi di ricerca che operano nell'ambito (paleo) ambientale e (paleo) climatico. Riteniamo che questo sia un passo fondamentale verso il rafforzamento della competitività del CNR negli ambiti della ricerca internazionale, e che possa rappresentare una nuova ed importante opportunità di sinergia, collaborazione e innovazione tra gli istituti afferenti al DSSTTA.

Al fine di per stimolare una maggiore integrazione tra i ricercatori, e per potenziare il ruolo del CNR come nucleo di connessione ed aggregazione delle realtà coinvolte, il GdL sta inoltre organizzando un evento (programmato per settembre 2024) rivolto alla comunità scientifica di riferimento. Tale evento è stato annunciato durante la Conferenza di Dipartimento svoltasi in data 12/12/2023.

Di seguito si presentano alcuni grafici riassuntivi ed un elenco analitico delle attività, comprendente Progetti, pubblicazioni ed altre attività. Gli ambiti sono divisi tra record marino, terrestre e polare.

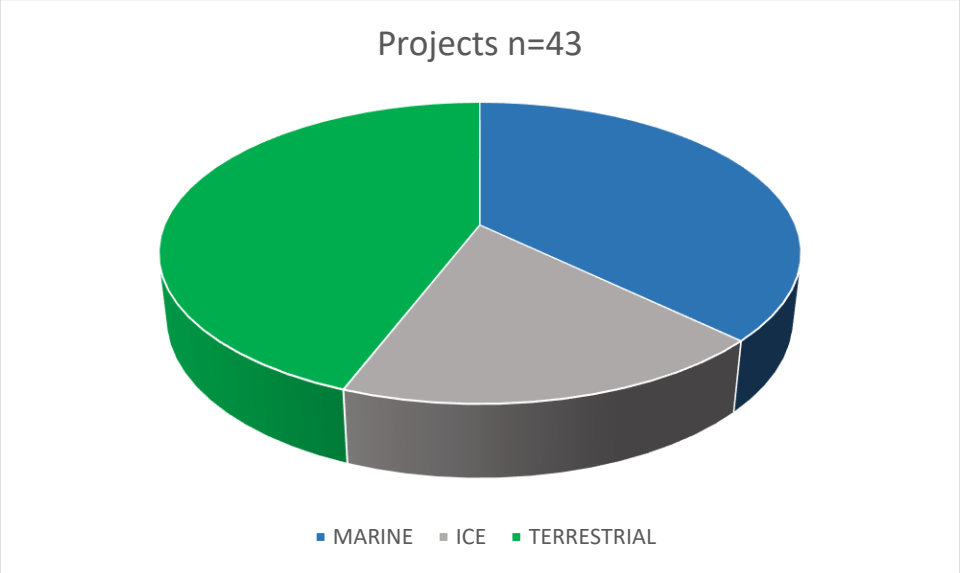

Figura 1: Suddivisione dei progetti censiti nei tre diversi domini (ghiaccio, ambiente marino, ambiente terrestre)

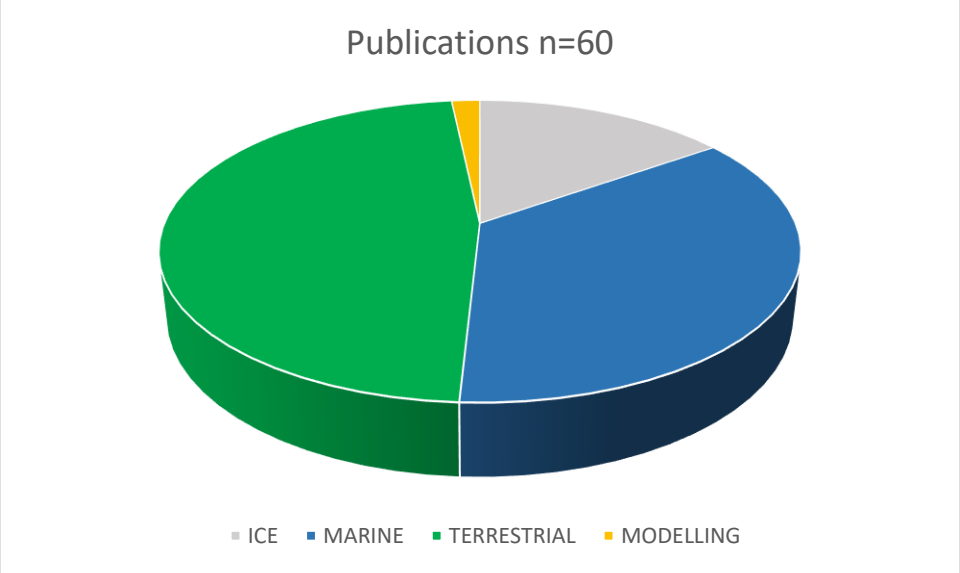

Figura 2: Suddivisione delle pubblicazioni censite nei diversi ambiti (ghiaccio, ambiente marino, ambiente terrestre e modellistica numerica)

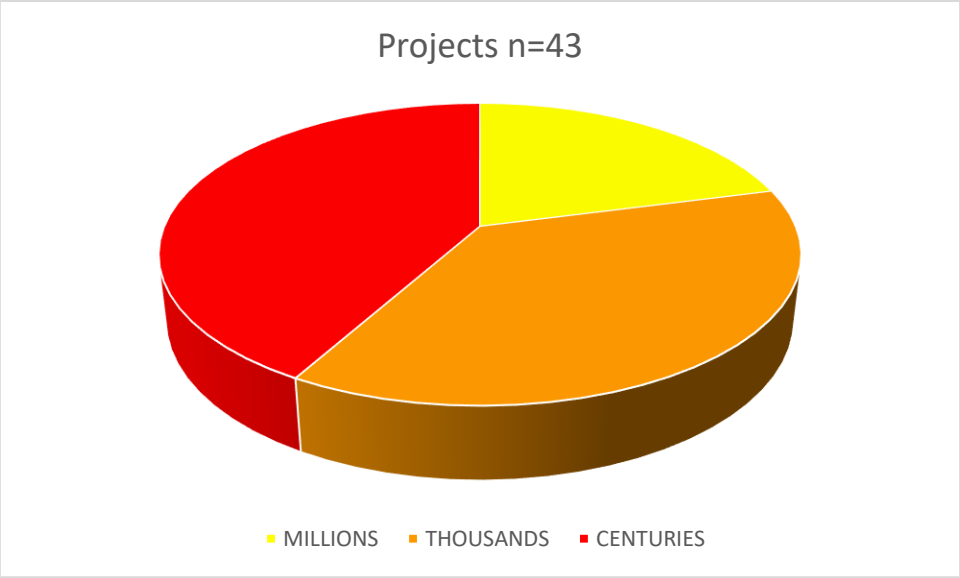

Figura 3: Suddivisione dei progetti censiti nelle diverse prospettive temporali (MILLIONS corrisponde al “deep geological past pre-Quaternario”; THOUSANDS corrisponde al Quaternario; CENTURIES corrisponde all’Olocene ed agli ultimi millenni/secoli

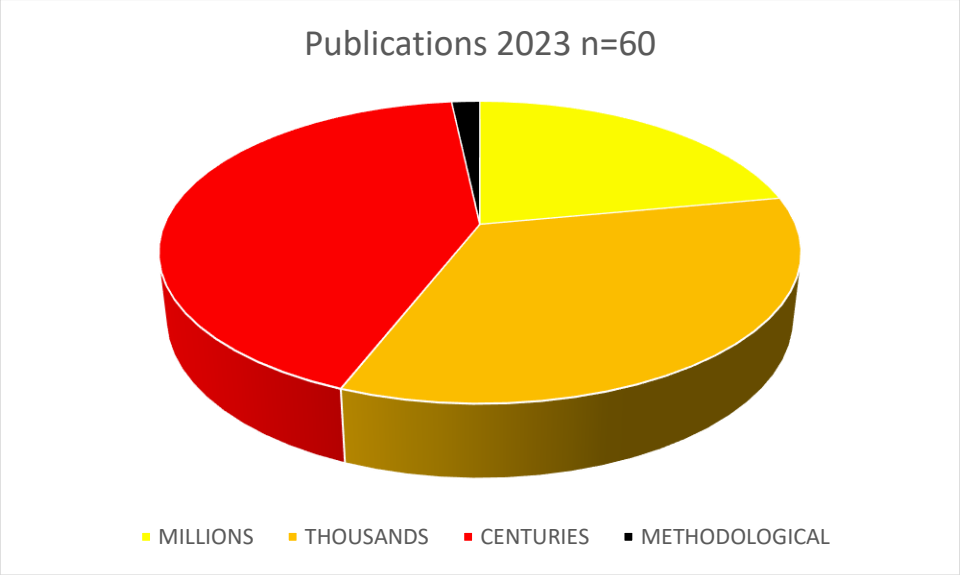

Figura 4: Suddivisione delle pubblicazioni censite nelle diverse prospettive temporali (MILLIONS corrisponde al “deep geological past pre-Quaternario”; THOUSANDS corrisponde al Quaternario; CENTURIES corrisponde all’Olocene ed agli ultimi millenni/secoli

1. ONGOING PROJECTS

1.1. Paleoclimatic-environmental archives

1.1.1. Ice records

Project	Brief description	Time scale	CNR-Institute	Partner
PNRA18_00037 "Magma-Ice interaction: late Miocene ice thickness and eruption tempo in northern Victoria Land"	Reconstruction of the ice cover evolution by means of glacial volcanology, igneous petrology and geochronology, coupled with investigations of the effects of variable ice load on the eruptibility and composition of magma from shallow crustal chambers	Miocene	IGG	UniPI UniPG INGV
FISR ICE MEMORY An International Salvage Program	Sampling and analysis of ice cores from different climatic environments and geomorphological analyses of glacial and periglacial environments. The objective is the paleoclimatic reconstruction of the chemical, isotopic, and biological composition of the atmosphere in regions differing in both latitude and altitude, as well as the recognition of glacial and periglacial stratigraphy in the following regions: a) Arctic (Holtedahlfonna Glacier, Svalbard Islands), b) Mediterranean (Grotta del Gelo in Mount Etna), c) Alpine (Colle del Lys Glacier on Monte Rosa), and d) Apennine (Calderone Glacier, Gran Sasso d'Italia).	Last 2000 yr	ISP	NPI CNRS INGV UniPD UniVE
PRA – SENTINEL - The impact of sea ice diSappearance on highEr North aTlantic clImate and atmospheric bromiNe and mErcury cycLes	The aims of this project are to use water stable isotopes as a fingerprint of air mass sources, climate model simulations and atmospheric re-analysis to evaluate the climate impact of sea ice disappearance on two Arctic basins, namely the Barents Sea and the Fram Strait regions, and to evaluate how bromine sea ice chemistry effects atmospheric mercury deposition rates and atmospheric ozone lifetimes in Svalbard and the east Greenland region.	Last 1000 yr	ISP	ISAC ENEA UniVE
PNRA - EAIIST2	Analyse the samples and the data collected during the East Antarctic International Ice sheet traverse, recover the automatic station left in the field, and disseminate the results of the research.	Last 1000 yr	ISP	ENEA UniRM3 UniVE UniFI
Beyond EPICA Oldest Ice Core: 1,5 Myr of greenhouse gas – climate feedbacks - 'Beyond EPICA' (H2020 #815384)	Retrieve a continuous ice core to bedrock in Antarctica, covering the climate history of the Mid Pleistocene Transition and beyond, where glacial/interglacial cycles changed from a 40,000 to a 100,000 yr cyclicity. Derive first high-resolution climate records	Last 1.5 My	ISP	AWI BAS IPEV ENEA CNRS UU NPI

	over the time interval older than 700 kyr. Use the new climate records to constraint the cause of the MPT and long-term carbon cycle-climate feedbacks			SU UniBERN UCPH ULB UniVE UGA CEA
Southern East Dome Ice core project	Ice Core Drilling and the Related Observations at SE-Dome site, southeastern Greenland Ice Sheet for retrive an high temporal resolution climate record	Last 250 yr	ISP	ISP Hokkaido
DEEPICE	An innovative training network for a new generation of 15 early-stage researchers in instrumentation, ice core analysis, statistic tools and glaciological and climatic modelling	100yr to 1.5 Myr	ISP	AWI BAS CNRS UU LU UniBERN (CH) UCPH ULB UniVe
CLIMADA Project - Stratigrafia integrata di proxies pollinici e sedimentari della carota di ghiaccio estratta al Pian di Neve (Ghiacciaio dell'Adamello)	Multiproxy analysis of the 224 m long ice core (ADA 270) recovered in 2021 from Pian di Neve (summit plateau of the Adamello Glacier, ca. 3200 m asl) aimed at reconstructing age, depositional features, past climates and environments recorded in the ice sequence.	Late Holocene	IGAG	UniMI Bicocca

1.1.2. Marine records

Project	**Brief description**	**Time scale**	**CNR-Institute**	**Partner**
ECORD-IODP-The Oceanic Anoxic Event 3 (Coniacian-Santonian): paleoceanographic changes and plankton response	Study of IODP cores to Verify the influence of OAE3 on the planktonic community, compare the changes in the distribution of planktonic organisms observed in the Equatorial Atlantic Ocean with those from southern high latitudes	Cretaceous	IGG	
INGV-AMUSED "An integrated, multidisciplinary study of past global climate changes from continental and marine archives in the Mediterranean region	The project aims to reconstruct the climatic variability in the central Mediterranean region during the mid-late Quaternary, with a focus on the Holocene, integrating paleoclimatic multi-proxy records acquired from different marine and terrestrial paleoenvironmental archives. ALSO TERRESTRIAL RECORD	Pleistocene-Holocene	IGG ISMAR IGAG IRPI ISP	INGV UniPG UniPD UniVE UniPA
KURADGROUP "Upper Cretaceous Radiolarian Group"	Taxonomic revision of Late Cretaceous radiolarian biostratigraphy	Cretaceous	IGG	UniLausanne (CH) ZRC-SAZU (SLO)

				UniEhime (Japan) UniBelgrado (SRB) UniWellington (NZ)
Intergrated nannoplancton and radiolarian biostratigraphy at the J/K boundary	Improving and integrating the nannoplancton and radiolarian biostratigraphy at the J/K boundary	Jurassic	IGG	UniMIStatale UniNiigata (Japan) UniNanjing (Cina)
DISGELI Drone-based acquISition and modelling of morpho-stratigraphic data alonG the TErra Nova Bay (Victoria Land, AntarctIca) coastline (PNRA19_00107	Using innovative technologies, the DISGELI project aims to collect morphobathymetric, morpho-topographic and stratigraphic data along the coasts of Terra Nova Bay (Victoria Land, Antarctica) for most of the ice-free summer season, with the mainpurposes of : i) reconstruct the temporal passages of the retreat of the land line along the marine valleys and local glaciers after the last glacial maximum (LGM); ii) chronologically constrain the deglaciation processes along the coast; and iii) reconstruct the relative sea level changes during the Holocene in better detail than achieved so far	Late Holocene	ISMAR ISP	UniBO UniPI UniBA UniFI Museo Nazionale dell'Antartide TS
Recent environmental changes in the North Atlantic revealed by cold-water coral geochemistry and implications for the Arctic warming (ICE-CORALS)	The ICE-CORALS project aims to address some of the fundamental knowledge gaps of the decadal and centennial variability in the northward transport of warm subtropical waters to the Arctic region, and expand our mechanistic understanding of the link between the northward ocean heat transport (OHT), the Atlantic meridional overturning circulation (AMOC) and Subpolar Gyre (SPG) dynamics. In particular, the project will provide robust and precisely-dated records of the mid-depth hydrography at decadal to centennial timescale for the last ca. 500-600 years, including seawater temperature, full carbonate chemistry, nutrient content and water mass circulation and ventilation, using the geochemistry of cold-water corals (CWC) and numerical modelling.	Last 500-600 years	ISP	UniPD
Contrasting present and last interglacial (c.125,000 years ago) tropical climates and sea level using novel proxy reconstructions from corals of the Seaflower Reserve (Colombia)	The geochemical analyses (trace elements, boron isotopes) of unique fossil coral core samples from San Andres and Providence Islands in Colombia will enable novel sub-seasonal reconstructions of climate and environmental change from a still unconstrained region over long periods during the Last Interglacial.	Late Pleistocene	ISP	Columbia University (USA) Universidad Nacional de Colombia, LSCE
Multidisciplinary study of enigmatic mounds in the East Antarctica offshore	The overarching goal of MYSTERO is to investigate the origin, the function mechanisms and the environmental conditions of the submarine reliefs of	Holocene	ISP ISMAR	OGS UniNA SZN

(MYSTERO – PNRA_0000063	subcircular shape (mounds) identified between 400 and 1200 m in the Western Ross Sea (Antarctica).			
PermAfroSt Thawing: what Happened to the largest tErrestrial cArbon pool during lasT deglaciation? Acronym: PAST-HEAT	The last deglaciation is a warming phase following the Last Glacial Maximum (21ky ago). Models suggest that, during this transition, permafrost thawing exerted a positive feedback on climate change by releasing CO2/CH4 into the atmosphere. Processes and timing of carbon release remain, however, elusive. PAST-HEAT will examine the behavior of permafrost during last deglaciation to improve our knowledge on the post-glacial carbon cycle and elucidate how Arctic soils will response to climate change	Late Pleistocene	ISP ISMAR	OGS
CoolinG oveR thE VicToria LAnd (GRETA): resolving the Ross Sea response to continental climate change during the last two millennia (PNRA19)	GRETA investigates the ocean response to a cooling event recorded over the Victoria Land (ca 1.3-1.9 ky CE). Specifically, we will reconstruct the sea ice dynamics (shelf sea ice and fast ice) and water mass properties (sea surface temperature, water mass circulation, upwelling) in the Ross Sea during this abrupt cooling event using marine sediment archives of the last 2ky.	Last 2000 yr	ISP ISMAR	OGS UniPI UniTS AWI UniPlymouth
Edisto inlet Diatom laminations Sequences Through the Holocene (EDISTHO) – (PNRA18)	The EDISTHO project focus on sediment cores collected inside the Edisto Inlet (Cape Hallett, Western Ross Sea, Antarctica). The aim is to investigate the glaciological and oceanic processes in the Edisto Inlet and their connection with the Ross Sea continental shelf as well as to link them to local, regional and global climatic changes and glacial dynamics.	Last 2000 yr	ISP ISMAR	UniPI UniMA UniNA OGS
The Po-Adriatic source-to-sink system: from modern sedimentary processes to millennial-scale stratigraphic architecture. PASS (PRIN)	The PASS project aims at establishing a framework in which different disciplines integrates high-resolution sequence stratigraphy, sediment provenance and a quantitative assessment of modern sedimentary processes. The goal is to quantitatively assess sediment fluxes across a ~1,000 km long, source-to-sink system by applying a multiscale sequence-stratigraphic method to the chronologically well-constrained post-glacial succession of the Po-Adriatic system	Late Quaternary	ISMAR ISP	UniBO
Refining the sequence stratigraphic model through high-resolution onshore-offshore correlation (ON/OFF): The late Quaternary succession of the Po-Adriatic system	ON/OFF targets a comprehensive basin-scale analysis of the key stratigraphic units, by innovatively examining the hierarchy of depositional hiatuses and condensed horizons on well-constrained millennial to centennial time scales. Through the application of a multiscale sequence-stratigraphic method (from systems tract to parasequence and bedset) and integration of sedimentology, seismic stratigraphy,	Late Quaternary	ISMAR	UniBO Indiana University

	paleoecology and bulk-sediment geochemistry, the proposed research project aims at developing a coherent picture that integrates the sedimentary response of alluvial, coastal and shallow-marine depositional systems to short-lived eustatic and climatic events.			
Mesozoic carbonate platforms as valuable archive of local and global changes	Integrated Stratigraphy (sedimentology, biostratigraphy, cyclostratigraphy, sequence stratigraphy, chemostratigraphy, palynology) and high-resolution correlations of Cretaceous shallow-water carbonate platform successions in order to reconstruct palaeoenvironmental perturbations and short-to-long-term palaeoclimatic/palaeoceanographic changes.	Aptian-Cenomanian	ISMAR	UniNA UniBA State Authority for Mining, Energy and Geology (DE)
CLimate forcing On Adriatic SEa deoxygenation: A multi-archive Reconstruction of Sapropel S1 (CLOSER) (PRIN PNRR)	CLOSER tackles regional aspects of the Mediterranean system by leveraging the large-scale expression of the youngest sapropel event (Sapropel S1, 10-6 ka) to unravel the link between the regional Adriatic climate and Mediterranean processes. CLOSER investigates the climate-ocean coupling with an unprecedented level of high-resolution, multi-proxy, and multi-archive approach, by combining the analysis of continental deposits, speleothems, ice cores, and marine records.	Late Quaternary	ISMAR ISP IGG	UniBO UniSapienza
PPT – PRIN 2022 **Climatic impact on terrestrial and marine realms of the eastern Mediterranean at the Plio-Pleistocene transition**	This project proposes a multidisciplinary investigation of marine and continental sedimentary successions accumulated at the PPT and aims to understand the efforts of climatic impact on terrestrial and marine realms of the eastern Mediterranean.	**Plio-Pleistocene transition**	IRPI	UniSI UniSapienza UniPD
BIOVERTICES (BIOdiversity of VERTebrates In the CEnozoic Sea):	New approaches and research tools for unveiling the paleoecology, stratigraphy, taphonomy and evolutionary diversity of the Eo–Miocene marine vertebrates of the Pisco Basin Fossil-Lagerstätte (southern Peru) and their relationships to global and regional environmental changes	**Eocene medio-Miocene Inferiore**	IMAA	UniMORE UniPI UniTO UniCAM UniMIBicocca
OCEANS – impacts Of a Cidification on past biodivErsity: insights from mAriNe vertebrate	Approccio multi-proxies rivolto a materiale a cavallo di tre grandi estinzioni: Ordoviciano/Siluriano, Permiano/Triassico e Triassico Superiore. Dopo aver eliminato ogni imprinting diagenetico, si verificherà se e cosa cambia nella cristallochimica della bioapatite prima e dopo una estinzione.	Ordoviciano /Siluriano, Permiano/Triassico	IMAA	UniMORE uniPD

1.1.3 Terrestrial and lake records

Project	Brief description	Time scale	CNR-Institute	Partner
Australian Research Council, Discovery Project "New insights on the forcing of Quaternary ice-age terminations"	This project investigates the period 1.0 to 1.4 Ma ,when Earth's climate last experienced a major step change. It combines information from an exceptional archive of cave deposits and ocean sediments to precisely determine the timing of ice-age cycles.	Early Pleistocene	IGG	UniMelbourne (AU) UniCambridge (UK)
PRIN 2022 ": TErrestrial And Marginal System in a hot world (TEAMS).	Study of the continental and marginal-marine Cenomanian environments of the Southern Morocco between climate extreme and regional tectonics	Late Cretaceous	IGG	UniFI UniPD
Bilateral project MOES Albania/CNR AL.C.h.E.Mi.S.T. (Albanian Caves as archives of past Environments and climate: Exploring their potential for Scientific research and Touristic development)	Sampling and geochemical and geochronological study of speleothems from selected Albanian caves, to reconstruct late Quaternary paleoenvironment and climate	Late Quaternary	IGG	INGV UniPI
Transformations of the terrestrial ecosystems during the Carnian Pluvial Episode: high-resolution study of non-marine successions from the northern and southern hemispheres	Biostratigraphic study of terrestrial sequences from the Carnian Pluvial episode	Triassic	IGG	China University of Geosciences
ICDP-DOVE (Drilling Overdeepened Alpine Valleys) step 1 master cores - Biostratigraphy of long Quaternary sedimentary records from the northern side of the Alps	This project aims at generating new knowledge on the Quaternary history of overdeepened Alpine valleys through biostratigraphic analysis of terrestrial proxies on relevant long cores drilled in Switzerland, Germany and Italy for the ICDP-DOVE project.	Last 2.5 Ma	IGAG IGG	UniBern (CH) UniFreiburg (DE)
MUR-FISR "S-P-HERITAGE - Lezioni per il futuro dal patrimonio culturale del passato: quattrocentomila anni di risposta delle popolazioni umane alle variazioni del livello del mare e ai cambiamenti climatici nel Mediterraneo Nord-Occidentale	Geomorphological, biostratigraphic, geoarcheological and geochemical study of coastal sites in the Ligurian Sea, to investigate: the magnitude and timing of past sea level changes, the past vulnerability to global warming of coastal ecosystem biodiversity; the response of past human communities to environmental changes caused by coastline modifications.	Middle-Late Pleistocene-Holocene	IGG	UniPI UniMIStatale
PROMETHEUS - Paleofire RecOnstruction from MEditerranean speleoTHEms USing trace organic	Mediterranean paleofire reconstruction from speleothems, integrating multiple linear and polycyclic hydrocarbon records with $\delta^{18}O$-$\delta^{13}C$ time series, to interpret the fire signal and the vegetation record together with climate information,	**Holocene**	ISP	UniPI

Compounds (PRIN 2022 PNRR_P20224E2HB)	identifying environmental and climatic drivers of change in fire regimes in each specific context.			
Laboratory Tests of Pyrogenic Organic Compounds in Australian Stalagmites as a Novel, High-Resolution Paleofire Proxy (NSF-DEB-2147186)	Field activity for measurements of polycyclic aromatic hydrocarbons in percolation water of cave KNI-51 in northwestern Australia before and after a prescribed fire; analysis of stalagmite and soil samples, plant material and comparison of data with satellite data.	**Last 1000 yr**	ISP	Cornell College (USA)
Impact of centennial to millennial scale climate variability and fires on vegetation and sedimentation: a high-resolution approach from a lake record	Microbotanical and geochemical proxies from the Lake Fimon record provide information on the response of terrestrial and freshwater ecosystems to climate variability and fires pervading the last glaciation.	Late Pleistocene (MIS 4 - 3)	IGAG	UniBO UniFE Uni Brno (CZ), Czech Academy of Sciences
PRIN PNRR 2022 "TrAcking Long-term declIne of forest biodiVErsity in Italy to support conservation actions (ALIVE)"	Through a detailed survey of the pollen records available for the Italian Peninsula, the Project ALIVE aims to identify spatio-temporal dynamics of tree and shrub populations during the last 6000 years, to define rate, geographic extent, and trends of range losses of species belonging to different bioclimatic belts. New data on the modern pollen deposition from mosses/lichens/litter will be collected to calibrate past pollen records and to connect the information from past and present ecosystems.	Holocene (last 6 ka)	IGAG	UniSapienza
Progetto "Creatori di paesaggio: la relazione tra natura e umanità nel Parco Nazionale dello Stelvio. Una ricerca di storia ambientale".	Ricostruire pratiche di gestione delle risorse naturali alle medie ed alte quote nelle vali trentine del Parco dello Stelvio attraverso l'individuazione di indicatori ecologici e paleoecologici; definire la dimensione temporale, lo sviluppo e le modalità con cui esse nel corso dei millenni sono state attuate sul territorio; ricostruire l'evoluzione delle dinamiche e dei fattori naturali e antropici che hanno portato alla formazione dei paesaggi bio-culturali attuali	Holocene	IGAG	MUSE Trento
"Per una storia ambientale del Parco Nazionale dello Stelvio. Strumenti e metodi di ricerca interdisciplinare e multidisciplinare sulla storia dell'interazione uomo/animali/ambiente/ paesaggio dall'anno Mille al tempo presente".	Ricognizione e campionamento esplorativo del contenuto paleobiologico di archivi naturali stratigrafici e antropogenici nel settore lombardo del Parco dello Stelvio. Analisi microbotanica, macrobotanica e analisi di parametri ambientali co-registrati nei materiali studiati a scopo di ricostruzione di serie stratigrafiche nonché di monitoraggio e di calibrazione.	Holocene	IGAG	ERSAF Parco dello Stelvio UniBG UniBO UniInsubria Soprintendenza Archeologica Lombardia Fondazione AEM - A2A, comune di Valdidentro

PRIN 2022 - Consolidating the radiocarbon calibration over the 12-40 ka interval using paired ^{14}C and $^{40}Ar/^{39}Ar$ dating of Mediterranean tephra (COMET)	COMET aims at improving the calibration curve for the radiocarbon the most common and powerful geochronometer of the Earth's and human history for the last 55 kyr. This goal will be achieved by acquiring 40Ar/39A and 14C paired ages and correlating, via geochemical data, several proximal and distal tephra, sourced by Neapolitan volcanoes (Italy) during the 12-40 ka interval.	Late Pleistocene-Holocene	IGAG	UniPG UniParis-Saclay, LSCE INGV UniBA
Timing and dynamic of the Glacial Termination IX	The project aims to provide a contribution to the knowledge on the role played by the orbital forcing and other factors driving the Pleistocene Glacial Termination (T-#). The goal is to reconstruct, at high temporal resolution, the quantitative temperature variation through the T-IX (ca. 805-790 ka), by means geochemical and geochronological analyses of the lacustrine sediments, spanning the 810-770 ka interval, hosted in the Sulmona Basin (central Italy).	Pleistocene	IGAG IGG	UnMelbourne UniPI, UniParis-Saclay (FR)
Climatic variability In central Italy before the Middle-Pleistocene Transition: the succession of the L'Aquila Basin	The project aims to reconstruct the paleoenvironmental and paleoclimatic history from the late Lower Pleistocene lacustrine succession of the San Nicandro Formation (AQ) hosted in L'Aquila Basin, central Italy, through a multy-proxy approach that integrates, sedimentological, micropaleontological, tephrochronological, bio-geochemical and magnetostratigraphical investigations.	Pleistocene	IGAG ISMAR IGG	UniRM3 UniPI UniFI UniParis-Saclay (FR) INGV
VARIIG: Intra-interglacial variability: are warmer periods climatically more unstable?	Variability of the Atlantic Meridional Overturning Circulation during the warm interglacial MIS 9c and cool intergalcials MIS 7-ac and 7e	Pleistocene	IGAG	UCLondon (UK) UniPI UniSapienza
TIMLIGS - Timing of the last interglacial relative sea level highstand	High-precision chronology and magnitude of the relative sea level variability along the Tyrrhenian cast during the Last Interglacial (129-115 ka)	130-100 ka	IGAG	UniPI, UniRoma-2, INGV
Biochemical responses of lakes to rapid climate transitions across space and time: insights from novel high-resolution analyses of sediments from Europe and Northern China	Anthropogenic environmental change has put unprecedented pressure on ecosystems across the world and contributed in a synergistic way to global spread of anoxia in freshwater with multiple negative effects on biodiversity, water resources and quality. The project aims to build a comprehensive view of the thermal-chemical stratification of a lake, its primary productivity, organic matter from examples in the past is essential to understand anoxia events in freshwater systems today and in the future.	Holocene/ Late Pleistocene	IRSA	UniBern, UniGdansk (PL) GFZ Helmholtz Centre Potsdam (DE) UniMainz (DE) ELSA cores University of Science and Technology of China
PRIN Using ancient environmental DNA to	The WFD requires member states of the UE to ensure that the ecological quality of water	Anthropocene	IRSA	UniSapienza

assess VOlcanic LAkes REference condition, biodiversity and long term ecological response to climate variability and anthropic pressure (VOLARE)	bodies is maintained or brought back to conditions close to those of an undisturbed body of water (reference condition). For the Italian volcanic lakes, this definition involves a difficulty, as there are no similar environments free from anthropogenic pressure and the methods used to define the ecological quality of the lakes are expensive (phytoplankton community evaluation and algal species determination require monthly samplings and specialised personnel). This project aims to provide a solution to this problem with coordinated actions based on traditional paleolimnological methods and ecological surveys together with the analysis of environmental DNA (eDNA) extracted from volcanic lake sediments from central and southern Italy:			UniBASILICATA

1.1.4 Others (modelling, cartography..)

Project	**Brief description**	**Time scale**	**CNR-Institute**	**Partner**
Geological Mapping project (CARG) - Geological map of Italy at the scale 1:50.000- in progress	Sheets 177 Tortona & 195 Novi Ligure	Permian to Quaternary	IGG	UniTO
	Sheet 087 Palmanova e 061 Borgo Valsugana	Permian to Quaternary	IGG	UniPD
	Sheet 121 Brescia	Mesozoic to Quaternary	IGAG	UniMi Statale Museo di Scienze di Brescia
ISMAR-ISPRA collaboration agreement for CARG (Geological map of Italy at the scale 1:50,000) biostratigraphic analyses by the Geological Survey of Italy	Sheet 131 Camerino and 370 Guardiagrele	Cretaceous to Quaternary	ISMAR	ISPRA

1.2. <u>Methodological development</u>

Title	**Brief description**	**CNR-Institute**	**Partner**
CFA – FLC – MS/MS system	A new Continuous Flow Analysis (CFA) system coupled with Fast Liquid Chromatography – tandem Mass Spectrometry (FLC-MS/MS) has been recently developed for determining organic markers in ice cores.	**ISP**	UniVE IMAU

2. MEETING AND WORKSHOP ORGANIZATION

Title, date, location	Brief description	CNR-Institute	Partner
Beyond EPICA Science Consortia Meeting and DEEPICE meeting	The Science Consortia Meeting of Beyond EPICA project was held on 20th-22nd March 2023 in hybrid mode, at the Istituto Veneto di Scienze Lettere ed Arti, in Venice (Italy) and online through Zoom platform	ISP	AWI, BAS, IPEV, ENEA, CNRS, UU, NPI, SU, UBERN, UCPH, ULB, UNIVE, UGA, CEA, UiB……..and more
PAIGE Chronologies for Polar Paleoclimate Archives – Mestre, April 2023	The international collaborative project called PAIGE (Chronologies for Polar Paleoclimate Archives - Italian-German Partnership) is funded by the Helmholtz Association and aims to strengthen collaborative research between the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) and the Italian Institute of Polar Sciences of the National Research Council of Italy (ISP-CNR). The project's key theme revolves around the ambitious goal of linking chronologies for paleoclimate archives from ice cores and sediment cores	ISP	AWI
ICDP worpshop MEME, Gioia de Marsi (AQ) 24-27 October 2013	The Fucino sedimentary succession; the longest and continuous terrestrial archive in the **ME**diterranean area recording the last five **M**illion years of the **E**arth system history (**MEME**)	IGAG	UniPI UniSapienza, UniCH-PE INGV UniCologne (DE) UCLondon UniCambridge (UK) Uni Sacly Paris LSCE Paris (FR) NSB Munich (DE)
FT1 pre congress field trip at FORAMS 2023 congress "Shallow water Cretaceous to Paleogene successions in NE Italy: the Carso Region" 2 days: June 2023, 23rd and 24th	This pre-congress field trip in the behalf of the congress FORAMS 2023 aims to unravel some key places in the surroundings of Trieste (NE Italy) including rock strata rich in larger Foraminifera as well as Recent depositional environments where benthic Foraminifera can be found as a living constituent.	ISMAR	UniTS

3. PUBLICATIONS (2023)

References	Topic	Time Scale	Institute
Amorosi, A., Bruno, L., Caldara, M., Campo, B., Cau, S., De Santis, V., C. Pellegrini, Vaiani, S. C. (2023). Late Quaternary sedimentary record of estuarine incised-valley filling and interfluve flooding: The Manfredonia paleovalley system (southern Italy). Marine and Petroleum Geology, 147,105975.	Marine Record	Late Pleistocene	ISMAR
Atti S, Rantala MV, Lami A, et al (2023) Impacts of anthropogenic pressures on underwater light conditions and diatom functional group distributions in mountain lakes. J Paleolimnol 70:57–76. https://doi.org/10.1007/s10933-023-00283-y	Terrestrial Record	Anthropocene	IRSA
Badino F., Pini R., Ravazzi C., Chytry' M., Bertuletti P., Bortolini E., Dudova L., Peresani M., Romandini M., Benazzi S. (2023) - High-resolution ecosystem changes pacing the millennial climate variability at the Middle to Upper Paleolithic transition in NE-Italy. Scientific Reports, 13: 12478.	Terrestrial record	Late Pleistocene	IGAG
Balestrieri, M. L., Olivetti, V., Chew, D., Zurli, L., Zattin, M., Drakou, F., ... & Perotti, M. (2023). Recurrent E-W oscillations of the ice flow confluence of the East and West Antarctic ice sheets in the central Ross Sea, Antarctica, from the Middle Miocene to the present day. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 111885	Ice Record	Miocene to present	IGG
Brandano, M., Cornacchia, I., Di Bella, L., & Marianelli, D. (2023). The Bolognano Fm in the south-eastern sectors of Majella and correlation with the north-western domain. RENDICONTI ONLINE DELLA SOCIETÀ GEOLOGICA ITALIANA, 59, 112-118.	Marine Record	Miocene	IGAG IGG
Burgay, F., Fernández, R. P., Segato, D., Turetta, C., Blaszczak-Boxe, C. S., Rhodes, R. H., Scarchilli, C., Ciardini, V., Barbante, C., Saiz-Lopez, A., and Spolaor, A.: 200-year ice core bromine reconstruction at Dome C (Antarctica): observational and modelling results, The Cryosphere, 17, 391–405, https://doi.org/10.5194/tc-17-391-2023, 2023.	Ice Record	Last 200 yr	ISP
Burgdorf, A-M, Brönnimann S., Adamson, G., Amano, T., Aono, Y., Barriopedro, D., Bullon, T., Camenisch, C., Camuffo, D., Daux, V., del Rosario Prieto, M., Dobrovolny, P., Gallego, D., Garcia-Herrera, R., Gergis, J., Grab, S., Hannaford, M. J., Holopainen, J., Kelso, C., Kern, Z., Kiss, A., Lin Kuan-Hui, E., Loader, N. J., Mozny, M., Nash, D., Nicholson, S. E., Pfister, C., Rodrigo, F. S., Rutishauser, T., Sharma, S., Takacs, K., Vargas, E. T., Vega, I.. 2023. DOCU-CLIM: A global documentary climate dataset for climate reconstructions. *Scientific Data*, 10, 402. DOI: 10.1038/s41597-023-02303-y	Terrestrial record methodology	Last 600 yr	ISAC
Camuffo, D. 2023. The Gondola: a boat to respond to the history and the morpho-dynamics of the Venice Lagoon. Méditerranée – Revue géographique des pays méditerranéens, 1-77. DOI: 10.4000/mediterranee.14364	Marine record methodology	Last 1000 yr	ISAC

Camuffo, D. 2023. The Treatise on Waters by Cornaro (1560) and a quantitative assessment of the historical sea surges 'Acqua Alta' in Venice. *Climatic Change*, 176:18, 1-20 DOI: 10.1007/s10584-023-03492-6	Marine record methodology	Last 1000 yr	ISAC
Camuffo, D.; della Valle, A.; Becherini, F. 2023. Instrumental and Observational Problems of the Earliest Temperature Records in Italy: A Methodology for Data Recovery and Correction. Climate, 11, 178. DOI 10.3390/cli11090178	Terrestrial record methodology	Last 400 yr	ISAC ISP
Camuffo, D.; della Valle, A.; Becherini, F., 2023: Tre serie meteorologiche storiche: Firenze, Bologna e Padova. *Quaderni di Storia della Fisica*, 30, 3-21 DOI: 10.1393/qsf/i2023-10118-4	Terrestrial record methodology	Last 400 yr	ISAC ISP
Canesi, M., Douville, E., Montagna, P. et al. Differences in carbonate chemistry up-regulation of long-lived reef-building corals. Sci Rep 13, 11589 (2023). https://doi.org/10.1038/s41598-023-37598-9	Marine record	Last 100 years	ISP
Carrer, M., Dibona, R., Prendin, A.L., Brunetti, M. 2023. Recent waning snowpack in the Alps is unprecedented in the last six centuries, Nature Climate Change, 13(2), pp. 155–160	Terrestrial record	Last 600 yr	ISAC
Cavalcante, F., Perri, F., Belviso, C., Lettino, A., Prosser, G., La Bruna, V. and Agosta, F., 2023. Clayey sediments analysis as a useful tool to assessing the geodynamic evolution of fold-and-thrust belts: The case study of the Monte Alpi area (southern Apennines, Italy). Marine and Petroleum Geology,151, p.106204.	Marine Record	Upper Messinian	IMAA
Cerrato, R., Salvatore, M.C., Carrer, M., Brunetti, M., Baroni, C. 2023. Blue intensity of Swiss stone pine as a high-frequency temperature proxy in the Alps, European Journal of Forest Research, 142(4), pp. 933–948	Terrestrial record methodology	Last 200 yr	ISAC IGG
Chimani, B., Bochníček, O., Brunetti, M., Ganekind M, Holec J., Izsàk B., Lakatos M., Perčec Tadic M., Manara Manara ., Maugeri M., Šťastný P., Szentes, O., Zardi, D. 2023. International Journal of Climatology, 43(15), pp. 7381–7411	terrestrial record	Last 200 yr	ISAC
Coletti, G., Bosio, G., Collareta, A., Bialik, O. M., Regattieri, E., Cornacchia, I., Insacco, G. & Buckeridge, J. (2023). Barnacle-rich facies as a tool for palaeoenvironmental reconstructions. Palaeogeography, Palaeoclimatology, Palaeoecology, 111914.	Marine Record	Pliocene	IGG
Columbu, A., Zhornyak, L. V., Zanchetta, G., Drysdale, R. N., Hellstrom, J. C., Isola, I., Regattieri, E., Fallick, A. E. (2023). A mid-Holocene stalagmite multiproxy record from southern Siberia (Krasnoyarsk, Russia) linked to the Siberian High patterns. Quaternary Science Reviews, 320, 108355.	Terrestrial Record	Holocene	IGG
Consorti, L., Fabbi, S., Cipriani, A., & Pampaloni, M.L., 2023. Benthic foraminiferal bioevents through the Italian geological sheet N. 377 "Trasacco" (CARG Project) (2023). In Papazzoni, C., & Petrizzo, M.R. (Eds.) Forams 2023, Abstracts with Program, Grzybowski Foundation Special Publication No. 27, 75	Marine Record	Cretaceous to Quaternary	ISMAR

Consorti, L., Krizova B., Cardelli S., Bagherpour B., Franceschi M., Bonini L., & Frijia G (2023). New insights on the benthic Foraminifera at the Cenomanian-Turonian boundary (OAE2) aftermath and the role of the genus *Rotorbinella* Bandy through the Late Cretaceous. In Papazzoni, C., & Petrizzo, M.R. (Eds.) Forams 2023, Abstracts with Program, Grzybowski Foundation Special Publication No. 27, 76.	Marine Record	Late Cretaceous	ISMAR
De Santis, V., Scardino, G., Scicchitano, G., Meschis, M., Montagna, P., Pons-Branchu, E., et al. (2023) Middle-late Pleistocene chronology of palaeoshorelines and uplift history in the low-rising to stable Apulian foreland: overprinting and reoccupation. Geomorphology, 421,108530.	Marine record	Late Pleistocene	ISP
Del Gobbo C., Colucci R.R., Monegato G., Žebre M., Giorgi F. (2023). Atmosphere–cryosphere interactions during the last phase of the Last Glacial Maximum (21 ka) in the European Alps. Climate of the Past, 19, 1805–1823	Terrestrial record	Late Pleistocene	IGG
della Valle, A., Camuffo, D., Becherini F, Zanini V., 2023. Recovering, correcting, and reconstructing precipitation data affected by gaps and irregular readings: The Padua series from 1812 to 1864. Climatic Change 176:9, 1-20 DOI: 10.1007/s10584-023-03485-5	terrestrial record/ methodology	Last 200 yr	ISAC ISP
Di Roberto A, Re G, Scateni B, Petrelli M, Tesi T, Capotondi L, Morigi C, Galli G, Colizza E, Melis R, Torricella F. Cryptotephras in the marine sediment record of the Edisto Inlet, Ross Sea: Implications for the volcanology and tephrochronology of northern Victoria Land, Antarctica. Quaternary Science Advances. 2023 Apr 1;10:100079.	Marine sediments	Holocene	ISMAR ISP
Fabbi, S., Cipriani, A., & Consorti, L., (2023). Stratigraphy and tectonic evolution of a portion of the Simbruini-Ernici Mountains (Central Apennines - Italy): review and new data from detailed geological mapping. Geological Field Trips and Maps 15(2.3):1-40	Marine Record	Cretaceous to Quaternary	ISMAR
Ferretti, A., Corradini, C., Fakir, S., Malferrari, D. and Medici, L., 2023. To be or not to be a conodont. The controversial story of Pseudooneotodus and Eurytholia. Marine Micropaleontology,182, p.102258.	Marine Record	Paleozoic	IMAA
Fontana V., Furlanetto G., Bertuletti P., Brunetti M., Zerbe S., Pini R. (2023) - Plant distribution and modern pollen deposition across an elevation eco-gradient: the lesson learnt from a case-study in the Italian Alps. The Holocene, 33(3): 281-295.	Terrestrial record	Holocene	IGAG
Forouzande, S.K., Hadi, M., Vahidinia, M., Consorti, L., Salahi, A., Mahmudy Gharaie, M.H., & Ozcan E. (2023)- Biostratigraphy of larger foraminifera from the Middle Eocene Jahrum-Pabdeh formations (Zagros region, SW Iran) and their correlation with the planktonic foraminiferal zones. Micropaleontology 69(4):487-514	Marine Record	Eocene	ISMAR

Galli G, Morigi C, Melis R, Di Roberto A, Tesi T, Torricella F, Langone L, Giordano P, Colizza E, Capotondi L, Gallerani A. Paleoenvironmental changes related to the variations of the sea-ice cover during the Late Holocene in an Antarctic fjord (Edisto Inlet, Ross Sea) inferred by foraminiferal association. Journal of Micropalaeontology. 2023 Sep 13;42(2):95-115.	Marine sediments	Holocene	ISMAR ISP
Hadi, M., Forouzande, S.K., Consorti, L., Parandavar, M., & Vahidinia M. (2023) - Extending the stratigraphic range of Nummulites bormidiensis Tellini in the Neo-Tethys (Zagros basin, SW Iran) through biometry and calcareous nannofossil biostratigraphy. Micropaleontology 69(4):515-532	Marine Record	Oligocene	ISMAR
Hönisch et al. (2024). Toward a Cenozoic history of atmospheric CO2. Science, 382, 6675	Marine record	Cenozoic	ISP
Incarbona A., Bonomo S., Cacho S., Lirer F., Margaritelli G., Pecoraro D., Ziveri P.. Solar forcing for nutricline depth variability inferred by coccoliths in the pre-industrial northwestern Mediterranean. Global and Planetary Change, 224, 104102	Marine record	Pre Industrial	IRPI
Ivy-Ochs S., Monegato G., Reitner J.M. (2023). The Alps: glacial landforms during deglaciation (18.9 to 14.6 ka). In: Palacios D., Hughes P.D., García Ruiz J.M., de Andrés N. (Eds.) European Glacial Landscapes: Last Deglaciation, Elsevier, Amsterdam, 175-183.	Terrestrial record	Late Pleistocene	IGG
Ivy-Ochs S., Monegato G., Reitner J.M. (2023). The Alps: glacial landforms from the Bølling-Allerød Interstadial. In: Palacios D., Hughes P.D., García Ruiz J.M., de Andrés N. (Eds.) European Glacial Landscapes: Last Deglaciation, Elsevier, Amsterdam, 355-360.	Terrestrial record	Late Pleistocene	IGG
Le Roy M., Ivy-Ochs S., Nicolussi K., Monegato G., Reitner J.M., Colucci R.R., Ribolini A., Spagnolo M., Stoffel M. (2023). Holocene glacier variations in the Alps. In: Palacios D., Hughes P.D., Jomelli V., Tanarro L.M. (Eds.) European Glacial Landscapes: The Holocene, Elsevier, Amsterdam, 367-418.	Terrestrial record	Late Pleistocene	IGG
Leicher, N., Giaccio, B., Pereira, A., Nomade, S., Monaco, L., Mannella, G., ... & Wagner, B. (2023). Central Mediterranean tephrochronology between 313 and 366 ka: New insights from the Fucino palaeolake sediment succession. *Boreas*, *52*(2), 240-271.	Terresrial record	Pleistocene	IGAG
Macrì, P., Smedile, A., Minelli, L., Siravo, G., Caricchi, C., Scateni, B., ... & Giaccio, B. (2023). Setting the basis for a high-resolution record of the late Quaternary to present climate variability from Castiglione maar, central Italy: First results from AMUSED project. *Quaternary International*, *671*, 1-14.	Terrestrial record	Pleistocene	IGAG
Maffezzoli, N., Cook, E., van der Bilt, W. G. M., Støren, E. N., Festi, D., Muthreich, F., Seddon, A. W. R., Burgay, F., Baccolo, G., Mygind, A. R. F., Petersen, T., Spolaor, A., Vascon, S., Pelillo, M., Ferretti, P., dos Reis, R. S., Simões, J. C., Ronen, Y., Delmonte, B., Viccaro, M., Steffensen, J. P., Dahl-Jensen, D., Nisancioglu, K. H., and Barbante, C.: Detection of ice core	Ice Record	ALL (methods development)	ISP

particles via deep neural networks, The Cryosphere, 17, 539–565, https://doi.org/10.5194/tc-17-539-2023, 2023.			
Mancin, N; Guastella, R; Carlton, JT; Caruso, A; Cobianchi, M; Evans, J; Capotondi, L; Langone, L; Marchini, A. 2023. The chronicles of a small invader: the canal, the core and the tsunami. Biological Invasions, 25 (4): 1265-1283. https://doi.org/10.1007/s10530-022-02979-0	Marine Record	Holocene	ISMAR
Mazzini, I., Cronin, T. M., Gawthorpe, R. L., Collier, R. E. L., De Gelder, G., Golub, A. R., ... & Shillington, D. J. (2023). A new deglacial climate and sea-level record from 20 to 8 ka from IODP381 site M0080, Alkyonides Gulf, eastern Mediterranean. *Quaternary Science Reviews*, *313*, 108192.	Marine record	Late Pleistocene-Holocene	IGAG
Monegato G., Gianotti F., Ivy-Ochs S., Reitner J.M., Scardia G., Akçar N. (2023). The Early and Middle Pleistocene glaciations in the Alps. Alpine and Mediterranean Quaternary, 36/2, 127-148.	Terrestrial record	Late Pleistocene	IGG
Nogarotto A, Noormets R, Chauhan T, Mollenhauer G, Hefter J, Grotheer H, Belt ST, Colleoni F, Muschitiello F, Capotondi L, Pellegrini C. Coastal permafrost was massively eroded during the Bølling-Allerød warm period. Communications Earth & Environment. 2023 Oct 3;4(1):350.	Marine sediments	Late Pleistocene-Holocene	ISP ISMAR
Olivetti, V., Balestrieri, M. L., Chew, D., Zurli, L., Zattin, M., Pace, D., ... & Perotti, M. (2023). Ice volume variations and provenance trends in the Oligocene-early Miocene glaciomarine sediments of the Central Ross Sea, Antarctica (DSDP Site 270). Global and Planetary Change, 221, 104042.	Ice Record	Oligocene-Miocene	IGG
Parth, S., Ankit, Y., Rigterink, S., Mazzini, I., Russell, J., Anoop, A., & Waldmann, N. (2023). Investigating the impact of climate change on the lake ecosystem during the late Holocene using a sedimentary record from the southern Arabian Desert, Yemen. *Science of the Total Environment*, *901*, 165835.	Terrestrial record	Holocene	IGAG
Pavoni, M., Boaga, J., Carrera, A., Urbini, S., de Blasi, F., & Gabrieli, J. (2023). Combining Ground Penetrating Radar and Frequency Domain Electromagnetic Surveys to Characterize the Structure of the Calderone Glacieret (Gran Sasso d'Italia, Italy). Remote Sensing, 15(10). https://doi.org/10.3390/rs15102615	Ice Record	Last 150 yr	ISP
Queiroz Alves E, Wong W, Hefter J, Grotheer H, Tesi T, Gentz T, Zonneveld K, Mollenhauer G. Deglacial export of pre-aged terrigenous carbon to the Bay of Biscay. Climate of the Past. 2023 Mar 7;2023:1-21.	Marine sediments	Late Pleistocene-Holocene	ISP
Razum, I., Ilijanić, N., Petrelli, M., Pawlowsky-Glahn, V., Miko, S., Moska, P., & Giaccio, B. (2023). Statistically coherent approach involving log-ratio transformation of geochemical data enabled tephra correlations of two late Pleistocene tephra from the eastern Adriatic shelf. *Quaternary Geochronology*, *74*, 101416.	Transitional record	Late Pleistocene	IGAG

Regattieri, E., Forti, L., Drysdale, R. N., Mannella, G., Hellstrom, J. C., Conati Barbaro, C., Morandi Bonacossi, D., & Zerboni, A. (2023). Neolithic hydroclimatic change and water resources exploitation in the Fertile Crescent. Scientific Reports, 13(1), 45	Terrestrial Record	Holocene	IGG
Rettig L., Monegato G., Spagnolo M., Hajdas I., Mozzi P. (2023). The Equilibrium Line Altitude of isolated glaciers during the Last Glacial Maximum – New insights from the geomorphological record of the Monte Cavallo Group (south-eastern European Alps). CATENA, 107187	Terrestrial Record	Late Pleistocene	IGG
Rolfo, M. F., Bini, M., Di Mario, F., Ferracci, A., Giaccio, B., Hsun-Ming, H., ... & Zanchetta, G. (2023). Neanderthal bones collected by hyena at Grotta Guattari, central Italy, 66–65 ka: U/Th chronology and paleoenvironmental setting. *Quaternary Science Reviews*, *311*, 108132.	Terrestrial record	Late Pleistocene	IGAG
Segato, D., Saiz-Lopez, A., Mahajan, A.S. et al. Arctic mercury flux increased through the Last Glacial Termination with a warming climate. Nat. Geosci. 16, 439–445 (2023). https://doi.org/10.1038/s41561-023-01172-9	Ice Record	Late Pleistocene-Holocene	ISP
Serafini G., Maxwell E.E., Cobianchi M., Borghi L, Papazzoni C.A., Roghi G. & Giusberti L., 2023, Dead, discovered, copied and forgotten: history and description of the first discovered ichthyosaur from the Upper Jurassic of Italy. Italian Journal of Geoscience, Volume: 142 (2023) f.1, Pages: 131-148.	Terrestrial record	Jurassic	IGG
Shi, X., Werner, M., Yang, H., D'Agostino, R., Liu, J., Yang, C., & Lohmann, G. (2023). Unraveling the complexities of Last Glacial Maximum climate: the role of individual boundary conditions and forcings. Climate of the Past Discussions, 2023, 1-25.	Modelling	Late Pleistocene	ISAC
Smellie J.S., Rocchi S., Di Vincenzo G. (2023). Controlling influence of water and ice on eruptive style and edifice construction in the Mount Melbourne Volcanic Field (northern Victoria Land, Antarctica). Frontiers in Earth Sciences, 10:1061515, https://doi.org/10.3389/feart.2022.1061515	Ice Record	Pleistocene	IGG
Smith A.J., Ito E., Burls N., Clarke L., Donders T., Hatfield R., Kuehn S., Koutsodendris A., Lowenstein T., McGee D., Molnar p., Prokopenko A., Snell K., Valero Garcés B., Werne J., Zeeden C. and the Pliowest Working Consortium (2023) - Workshop report: Pliowest - drilling Pliocene lakes in western North America. Scientific Drilling 32: 61-72.	Terrestrial records	Pliocene	IGAG
Soares L., Jenny J.P.,, Desgué-Itier o. et al. A crisis of lake hypoxia in the Anthropocene: The long-term effects of climate and nutrients, 07 November 2023, PREPRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-3234938/v1]	Anthropocene	Terrestrial Record	IRSA

Spagnesi, A., Barbaro, E., Feltracco, M., De Blasi, F., Zannoni, D., Dreossi, G., Petteni, A., Notø, H., Lodi, R., Gabrieli, J., Holzinger, R., Gambaro, A., & Barbante, C. (2023). An upgraded CFA – FLC – MS/MS system for the semi-continuous detection of levoglucosan in ice cores. Talanta, 265. https://doi.org/10.1016/j.talanta.2023.124799	Ice Record	Last 100 yr	ISP
Spagnesi, A., Bohleber, P., Barbaro, E., Feltracco, M., De Blasi, F., Dreossi, G., Stocker-Waldhuber, M., Festi, D., Gabrieli, J., Gambaro, A., Fischer, A., & Barbante, C. (2023). Preservation of chemical and isotopic signatures within the Weißseespitze millennial old ice cap (Eastern Alps), despite the ongoing ice loss. Frontiers in Earth Science, 11. https://doi.org/10.3389/feart.2023.1322411	Ice Record	Last 1500 yr	ISP
Stefanini, C.; Becherini, F.; della Valle, A.; Rech, F.; Zecchini, F.; Camuffo, D. 2023 Homogeneity Assessment and Correction Methodology for the 1980–2022 Daily Temperature Series in Padua, Italy. Climat, 11, 244. DOI 10.3390/cli11120244	terrestrial record/ methodology	Last 300 yr	ISAC ISP
Susini, D., Vignola, C., Goffredo, R., Totten, D. M., Masi, A., Smedile, A., ... & Mazzini, I. (2023). Holocene palaeoenvironmental and human settlement evolution in the southern margin of the Salpi lagoon, Tavoliere coastal plain (Apulia, Southern Italy). *Quaternary International*, *655*, 37-54.	Terrestrial RECORD	Holocene	IGAG
Vallé F., Nowak H., Kustatscher E., Erkens S., Roghi G., Morelli C., Krainer K., Preto N., Hartkopf-Fröder C., 2023, Reconstructing Kungurian (Cisuralian, Permian) terrestrial environments within a megacaldera in the Southern Alps (N-Italy) using lithofacies analysis, palynology and stable carbon isotopes. Rivista Italiana di Paleontologia e Stratigrafia (Research in Paleontology and Stratigraphy) vol. 129(1): 1-24.	Terrestrial record	Permian	IGG

4. Ph.D MENTORING, DISSEMINATION

4.1 Ongoing Ph.D thesis

Project	Candidate	Time scale	CNR-Institute	Partner
GAIA – Great Acceleration In Antarctica	Giulia Genuzio	150 yr	ISP	UNIVE
Climate regime shift on Svalbard: a case study for understanding the effects of future climate change in the mid latitudes	Enrico Biscaro	1000 yr	ISP	UNIVE
Climatological and Glaciological Implication in the Western Italia Alps from the study of the LyS Glacier icecore Archive	Elia Gipponi	150 yr	ISP	UNIVE

Investigation of the Antarctic ozone hole's influence on mercury and halogens' snow geochemical cycles in the framework of the East Antarctic International Ice Sheet Traverse (EAIIST)	Giuditta Celli	200 yr	ISP	UNIVE
Understanding feedback to climate during the last deglaciation: reconstructions from multiproxy multi-site case studies in the Ross sea	Chiara Pambianco	Late Pleistocene	ISP	UNIVE
Biomass burning derivates in Antarctica's snow and firn: a two-decadal levoglucosan, mannosan and galactosan record	João GOMES ILHA	2000 yr	ISP	UNIVE
Technological Innovation for Exploring a new method to measure stable water isotopes on ice cores	Mbemba CONTEH	1.5 Myr	ISP	
Improvements and application of the laser techniques LA-ICP-MS for high resolution non-destructive elemental analyses on ice cores	Piers Michael Larkman	1.5 Myr	ISP	UNIVE, CNRS, AWI
A snowpack module for modelling chemical exchanges (mercury, iodine, bromine) at the snow-air interface in climate model	Veronica Amoruso	100 yr	ISP	UNIVE
Understanding land-ocean connections and coastal sea ice dynamics in polar regions during the last 30ky through a combination of marine and terrestrial biomarkers	Alessio Nogarotto	Late Pleistocene	ISP	UNIVE
The Oi-1 and Mi-1 events: insights from shallow and deep carbonate successions of the central and western Mediterranean	Diego Marianelli	Millions of years	IGAG	UNI SAPIENZA
Unveiling timing and dynamic of Marine Isotope Stage 11c interglacial: a high-resolution pollen record from Fucino Basin, central Italy	Pablo Vera Polo	Pleistocene	IGAG	UNI SAPIENZA
Reconstruction of Late Pleistocene East Antarctic ice sheet behavior through stratigraphic analysis of marine sediment cores from Ross Sea, Antarctica.	Giulia Giorgetti	Late Pleistocene	ISMAR	UNIPI
Stratigraphic and structural evolution of the Pliocene-Quaternary Italian continental margins	Giulia Lisi	Pliocene-Quaternary	ISMAR	UNIMI
Analisi dei cambiamenti climatici nell'area del Mediterraneo Centrale negli ultimi 2000 anni	Haidra Saleh	Last 2k	IRPI	UNIPG

4.4 Third mission

Title	Type	Brief description	CNR-Institute	Partner
GOOD NIGHT,GLACIERS	Multimedia and physical display	GOOD NIGHT, GLACIERS showcases the beauty, risks, and secrets of glaciers. lt documents missions and core samplings and reveals how glaciers have changed over the past decades. The exhibition alternates between photos, videos, real sounds, and scientific data, depicting ajourney from the dark calm of the unchanged night to the harsh light of increasingly warmer days, influenced by human actions.	ISP	Lagazuoi EXPO Dolomiti, UniVE, Fondazione Ca' Foscari di Venezia