the future of THE ITALIAN GEOSCIENCES of the future (M) Marine sediment cores: archive of the Mediterranean Basin. A tool for Holocene climatic and environmental studies

Alberico I.⁽¹⁾, Ferraro L.⁽¹⁾, Lirer F. ⁽¹⁾, Anzalone E.⁽¹⁾, Vallefuoco M.⁽¹⁾, Bonomo S.⁽¹⁾, Cascella A.⁽²⁾, Petrosino P.⁽³⁾, Insinga D.D.⁽¹⁾, Barra R.⁽⁴⁾ & Marsella E.⁽¹⁾

(1) Istituto per l'Ambiente Marino Costiero - CNR, Napoli
 (2) Istituto Nazionale di Geofisica e Vulcanologia, Pisa
 (3) Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse - Università degli Studi di Napoli Federico II, Napoli
 (4) Associazione Comitato Ev-K2-CNR, Bergamo

Natural archives as tree rings, ice cores, sediment cores, which take into account diatoms, foraminifera, microbiota, pollen and charcoal, represent valuable resources to recover quantitative information on past regional climates and to define new high-resolution climatic reconstructions for the last millennium (IPCC,2013 and reference therein). In this framework, the NextData project defines the implementation of an infrastructure able to retrieve, store and share climatic data from mountain sites and the Mediterranean Basin (**figure A**). This area is a natural laboratory for study landscaping processes and monitor the past climatic oscillations, thanks to its semi-enclosed configuration and to its location, transitional between North Africa, situated within the arid zone of the subtropical high, and Central and Northern Europe, affected by the westerly air flows (e.g. Corte-Real et al. 1995; Xoplaki 2002; Lionello et al. 2006 and references therein).



This Basin occupies an area of about 2.5 million km², the seascape is mainly modeled by neotectonic processes and fluviosedimentary systems. The continental shelf is narrow in the western basin, but extends to over 50 km, off the Ebro and Rhône Rivers mainly due to the progradation of deltaic systems (Fig. A). The continental shelf is also wide off the north of Tunisia as well, but here, it is because of a structural control. Bathyal plains occupy large areas in the western Mediterranean Basin, located between the Balearic Islands, north of Africa and Sardinia with depths reaching 2,800 m, and in the Tyrrhenian basin with depths of up to 3,430 m (Amblas et al., 2004). The continental shelves in the eastern basin are narrow off Peloponnese, Crete, and Turkey, while, they are well developed in the areas directly subjected to deposition from the Nile River delta, and in the Adriatic Sea, where large portions are shallower than 100 m. Basin floors are deeper, but smaller than in the western basin. Maximum depths are up to 4,200 m in the Ionian Abyssal Plain and 3,200 m in the Herodotus Abyssal Plain (Amblas et al., 2004).

Straits: (A) Gibraltar, (B) Sicily, (C) Otranto, (D) Messina (E) Kithira-Crete, (F) Crete-Karpathos, (G) Karpathos-Rodos. Numbers 1-5 indicate zones characterized by a wide continental shelf: (1) off Ebro River, (2) off Rhône River, (3) Tunisia continental shelf, (4) off Nile River, (5) Adriatic Sea.



The analysis of marine data infrastructures, which manage data of in situ and remote observations of the seas (Geo-Seas, 2014; ICSU World Data, 2014; NOAA, 2014), highlighted that the online data of marine sediment cores are mainly descriptive information rather than quantitative analysis results (e.g. stable isotope data, planktonic foraminifera quantitative data, etc.) and only few of them are typified by references to scientific works. The goal of the NextData archive is to list the type of useful proxies which record the Holocene climatic changes and share them with scientific community. At this aim a conceptual and a logical model were defined in order to publish the metadata on SHARE Geonetwork (http://geonetwork-evk2cnr.org/webapp/, last connection: December 2013) and the quantitative data on WDB-Paleo (https://github.com/wdb/wdb, last connection: January 2014). The entity relationship diagram is illustrated in figure B.

For the study area we collected data from 8,000 sites. The percentage of each information type listed in the right side of Entity relation diagram, calculated as rate between the count of single data type and the total sites, highlighted that excluding the ocean/sea information that is known for all the cores and the data source holder for the 58%, other information is available for less than 40% of sites.

This information published as metadata of marine sediment cores were linked together by using the parent/child relation (scheme C). Figure D reports an example of the metadata structure published on SHARE Geonetwork while the following maps illustrate the spatial distribution of sites in accordance with the structure reported in the scheme C.



inside the green box. Entities recording quantitative data are shown inside the red box. Entities recording quantitative data derived from scientific literature are shown in the blue box.

The numerical values of all proxies established for sites C90 and C836 (CARG project), C90-1m (VECTOR project), and the C5, C5_2_SW104, C6_SW104, C13_SW104,ND2, ND5, ND6, ND9, ND10, ND11, ND13 (NEXTDATA project) and shown in the red box of **figure B**, were recorded into the WDBPALEO.



Chains Sa
Chains Sa
Strait of Sicily
Extern Modifiermans Sa
Scheme Cl
<p

Only 600 out of all the sites were published in scientific papers; about 33% studied the planktonic foraminifera, 28% the stable isotopic data and the benthonic foraminifera, while the calcareous nannoplankton, dinoflagellate and AMS ¹⁴C proxies reach a percentage lower than 15.

The geographical distribution of planktonic foraminifera, stable isotopic data and AMS ¹⁴C encompass the whole Mediterranean Basin, but displays a higher density around the coastline of the Italian peninsula than in other areas. Calcareous nannoplankton pollen and tephra layers have a higher concentration in the Eastern Mediterranean Basin.







The planktonic foraminifera and calcareous nannoplankton species, recognized in the sampled levels of marine sediment cores, were reported below as an example of the data recorded in WDBPALEO.

id_sample	id_nanno	section	Sample level	top	bottom	Emiliania huxleyi	Small Gephyrocapsa	Small Placoliths
IAM00A080	C5_A001	F	99-100	246	247	0	0	99.00
1444004000		с	00 00	21E	216	65 72	2 1 2 2	27 56

IAM00A08 Id	_sample	id_planc	section		top	bottom	Globigerina	a Globig	erinita inoto	Globig
IAM00A080	C5_A005	F	93-94	240	241	0	0		99.00	
IAM00A080	C5_A004	F	94-95	241	242	50.29	0.29		43.19	
IAM00A080	C5_A003	F	96-97	243	244	52.92	0.92		44	

IAM00A080	C5_A139	F	99-100	246	247	80	23	
IAM00A080	C5_A140	F	97-98	244	245	11	9	
IAM00A080	C5_A141	F	96-97	243	244	78	19	
IAM00A080	C5_A142	F	94-95	241	242	18	3	
IAM00A080	C5_A143	F	93-94	240	241	101	16	
IAM00A080	C5_A144	F	91-92	238	239	70	14	
IAM00A080	C5_A145	F	90-91	237	238	34	5	





We recovered detailed information relating to the AMS ¹⁴C and to tephra layers from scientific literature, as reported in **figure E**, because of their key role to evaluate the synchrony/diachrony of the climatic changes in the Mediterranean and as a constraint for age modelling of marine sequences. Moreover, a map of the AMS ¹⁴C data distribution shows that about 80 sites contain samples aged 10-2 ky and about 40 sites contain samples of the last 2 ky.

Id reference	ld author	Author	Year		jour	nal - report		Tephra layers
200	7	Calanchi and Dinelli	2008	Journal o 177, 81-9	f Volcanology 15.	and Geotherm	al Research,	x
ld reference	Id site							
200	1014005071					2.0		
200	ISIVIOUFU71	Id site	Tephra code	Eruption code	Eruption name	Calendar Age (ka BP)	¹⁴ C age	Depth of tep layers in cor (cm)
200	ISMOUFU71	Id site	Tephra code TM4	Eruption code AV	Eruption name Avellino	Calendar Age (ka BP) 3.6-4.2	¹⁴ C age 3.548±129	Depth of tep layers in cor (cm) 170-160
Figu		Id site ISM00F071 ISM00F071	Tephra code TM4 TM5	Eruption code AV AMS	Eruption name Avellino Agnano Monte Spina	Calendar Age (ka BP) 3.6-4.2 4.1±100	¹⁴ C age 3.548±129	Depth of tep layers in cor (cm) 170-160 210-200

CONCLUSION

Within the context of climatic changes and of the role played by antrophic pressure, the NextData project, based on the concept that the past represents a guide for the future, has among its aims the assessment of climate during the Holocene and in particular of last 2,000 years. To achieve this goal, a database of marine sediment sites for the Mediterranean Sea and the North Atlantic Ocean close to the Strait of Gibraltar was implemented. The database presented in this work records: a) the metadata concerning the description of cruise and cores realized in the study area, b) the references of scientific papers related to the investigated time frame, c) the results of quantitative analysis of benthic_foraminifera, planktonic_foraminifera, pollen, diatoms, dinoflagellates, calcareous nannoplankton, and the magnetic susceptibility, stable isotopes, radionuclides values of cores recovered within the CARG, VECTOR and the NextData projects. Despite the paucity of the studied sites, these provide significant information to assess the state of knowledge. The PaleoWDB database supplies a tool and an invitation for the scientific community to share quantitative data facilitating the comparison and integration of information.