IT ISSN 0391 - 9838

Bollettino del Comitato Glaciologico Italiano - ser. 3

GEOGRAFIA FISICA e DINAMICA QUATERNARIA

An international Journal published under the auspices of the
Rivista internazionale pubblicata sotto gli auspici di

Associazione Italiana di Geografia Fisica e Geomorfologia
and (e) Consiglio Nazionale delle Ricerche (CNR)

recognized by the (*riconosciuta da*)

International Association of Geomorphologists (IAG)

volume 44 (2)
2021

COMITATO GLACIOLOGICO ITALIANO - TORINO
2021

GEOGRAFIA FISICA E DINAMICA QUATERNARIA

A journal published by the Comitato Glaciologico Italiano, under the auspices of the Associazione Italiana di Geografia Fisica e Geomorfologia and the Consiglio Nazionale delle Ricerche of Italy. Founded in 1978, it is the continuation of the «Bollettino del Comitato Glaciologico Italiano». It publishes original papers, short communications, news and book reviews of Physical Geography, Glaciology, Geomorphology and Quaternary Geology. The journal furthermore publishes the annual reports on italian glaciers, the official transactions of the Comitato Glaciologico Italiano and the Newsletters of the Intemational Association of Geomorphologists. Special issues, named «Geografia Fisica e Dinamica Quaternaria - Supplementi», collecting papers on specific themes, proceedings of meetings or symposia, regional studies, are also published, starting from 1988. The language of the journal is English, but papers can be written in other main scientific languages.

Rivista edita dal Comitato Glaciologico Italiano, sotto gli auspici dell'Associazione Italiana di Geografia Fisica e Geomorfologia e del Consiglio Nazionale delle Ricerche. Fondata nel 1978, è la continuazione del «Bollettino del Comitato Glaciologico Italiano». La rivista pubblica memorie e note originali, recensioni, corrispondenze e notiziari di Geografia Fisica, Glaciologia, Geomorfologia e Geologia del Quaternario, oltre agli Atti ufficiali del C.G.I., le Newsletters della I.A.G. e le relazioni delle campagne glaciologiche annuali. Dal 1988 vengono pubblicati anche volumi tematici, che raccolgono lavori su argomenti specifici, atti di congressi e simposi, monografie regionali sotto la denominazione «Geografia Fisica e Dinamica Quaternaria - Supplementi». La lingua usata dalla rivista è l'Inglese, ma gli articoli possono essere scritti anche nelle altre principali lingue scientifiche.

Indexed/Abstracted in: Bibliography & Index of Geology (GeoRef); GeoArchive (Geosystem); GEOBASE (Elsevier); *Geographical Abstract*: *Physical Geography* (Elsevier); GeoRef; Geotitles (Geosystem); Hydrotitles and Hydrology Infobase (Geosystem); Referativnyi Zhurnal.
Geografia Fisica e Dinamica Quaternaria has been included in the Thomson ISI database beginning with volume 30 (1) 2007 and now appears in the Web of Science, including the Science Citation Index Expanded (SCIE), as well as the ISI Alerting Services.

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Printed with the financial support from (pubblicazione realizzata con il contributo finanziario di):

– Comitato Glaciologico Italiano
– Associazione Italiana di Geografia Fisica e Geomorfologia
– Ministero dell'Istruzione, Università e Ricerca
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Comitato Glaciologico Italiano
President (*Presidente*) M. Frezzotti

Geogr. Fis. Dinam. Quat.
44 (2021). 123-137, 6 figg., 3 tabb.

DOI 10.4461/ GFDQ.2021.44.10

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OPEN ACCESS DATA REPOSITORY OF LATE-PLEISTOCENE AND HOLOCENE PALEO-SHORELINES ALONG THE ANTARCTIC PENINSULA AND SOUTH SHETLAND ISLANDS COASTS

ABSTRACT: ZINGARO M., BARONI C., CAPOLONGO D., MASTRONUZZI G., SALVATORE M.C., SCICCHITANO G. & VACCHI M., *Open access data repository of Late-Pleistocene and Holocene paleo-shorelines along the Antarctic Peninsula and South Shetland Islands coasts.* (IT ISSN 0391-9838, 2021).

An improved understanding of the chronology of Antarctic ice sheet deglaciation since the Last Glacial Maximum (LGM) represents a fundamental tool to better define the origin of past and future meltwater influx in the global oceans. Relict shorelines and other evidence of past Relative Sea Level (RSL) evolution were widely used to understand past ice sheet history and to improve predictions of climate-controlled sea level evolution. In the last decades, RSL data in the Antarctic region have been mostly produced using a wide range of geomorphic evidence such as beach and marine deposits, marine terraces and isolation basins. However, the lack of a geographic common framework that includes data derived from different sources, limits the accessibility to the information. Here we present a new cartographic approach to create an open access geodatabase of the postglacial paleo-shorelines by using a standard collecting pattern. Cartographic Antarctica Repository (CAR) includes RSL data along the coasts of the Antarctic Peninsula and South Shetland Islands. Results show the advantages to use CAR for integrating data and supporting spatial analyses, by representing an easy and usable tool for the improvement of shoreline evolution definition and the planning of Antarctic coast investigations. CAR is dynamic repository project that will be further expanded on other Antarctic regions too, integrating fully into the wide reference context of the free access Antarctic datasets.

KEY WORDS: Antarctica, Post-glacial, Paleo-shorelines, Cartographic Repository, Open access.

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This work contributes to the PNRA (Italian National Antarctic Programme) Project SealData (PNRA18_00175, PI Matteo Vacchi; responsibles of local operative units: M. Vacchi, Pisa and G. Mastronuzzi, Bari) funded by the MUR (Italian Ministry of Research).

RIASSUNTO: ZINGARO M., BARONI C., CAPOLONGO D., MASTRONUZZI G., SALVATORE M.C., SCICCHITANO G. & VACCHI M., *Dataset ad accesso libero delle paleo linee di costa del Pleistocene superiore e dell'Olocene lungo la Penisola Antartica e sulle Isole Shetland Meridionali.* (IT ISSN 0391-9838, 2021).

Una dettagliata conoscenza della progressiva fusione del sistema glaciale antartico a partire dall'ultimo massimo glaciale rappresenta uno strumento fondamentale per meglio definire il contributo passato e futuro delle calotte antartiche alle variazioni globali del livello del mare. Morfologie costiere relitte e altre evidenze di paleo stazionamento del livello marino sono state ampiamente utilizzate per comprendere l'evoluzione delle calotte glaciali e meglio stimare l'evoluzione del rapporto tra la variazione climatica e il livello del mare. Negli ultimi decenni, i dati delle variazioni relative del livello del mare nella regione antartica sono stati ottenuti utilizzando un'ampia varietà di informazioni derivate dall'analisi di evidenze geomorfologiche, quali depositi di spiaggia e marini, terrazzi marini e bacini progressivamente isolati dal mare aperto. Tuttavia, la mancanza di un sistema di riferimento geografico comune e di un modello descrittivo omogeneo attraverso i quali aggregare dati derivati da fonti diverse, limita fortemente l'accessibilità alle informazioni. In questo lavoro presentiamo un innovativo approccio cartografico che utilizza un modello standard di catalogazione per creare un geodatabase ad accesso libero delle paleo-linee di costa post-glaciali. Il *Cartographic Antarctica Repository* (CAR) include dati noti del livello del mare relativo, raccolti lungo le coste della Penisola Antartica e delle Isole Shetland Meridionali. I risultati mostrano i vantaggi dell'utilizzo di CAR per integrare varie tipologie di dati e supportare le analisi spaziali, rappresentando uno strumento semplice e utile per una migliore descrizione dell'evoluzione costiera e per la pianificazione delle indagini lungo la costa antartica. CAR si presenta come un progetto dinamico di archiviazione dei dati potenzialmente estendibile anche ad altre regioni antartiche, andando così a collocarsi nell'ampio contesto di riferimento dei dataset ad accesso libero dell'Antartide.

TERMINI CHIAVE: Antartide, Post-glaciale, Paleo linee di costa, Archivio cartografico, Accesso libero.

INTRODUCTION

Relative Sea Level (RSL) history since the Last Glacial Maximum (LGM) in Antarctica could provide constraints for timing ice sheet deglaciation, modelling glacial-isostatic adjustment and quantifying past and future meltwater con-

tribution to global sea level rise (Whitehouse & *alii*, 2012; Church & *alii*, 2013). The transition from glacial to postglacial climatic conditions caused ice thickness changes determining the unloading of ice, the consequent transfer of land ice mass into global oceans and the isostatic response of the solid Earth. Then, the interplay of eustatic and glacio-isostatic adjustment (GIA) along with tectonic and other local factors controlled the variability in the RSL histories (Burbank & Anderson, 2011; Khan & *alii*, 2015; Roy & Peltier, 2015). Paleo-shorelines and other morphological evidences of the sea-level still-stands such as marine deposits or isolation basins, were widely used to reconstruct the RSL history in formerly glaciated areas (Baroni & Hall, 2004; Bentley & *alii*, 2005; Hall, 2010; Vacchi & *alii*, 2018). The occurrence of ice-free land condition in large portions of some Antarctica regions, such as the Antarctic Peninsula (AP) in the north-west of the continent, and South Shetland Islands (SSI) archipelago in the maritime sub-Antarctic, makes particularly favourable the preservation and the investigation of beaches, marine platforms and other exposed and raised features (Fretwell & *alii*, 2010; Simms & *alii*, 2011; Simkins, Simms & DeWitt, 2013). In fact, over the past decades several studies have collected RSL data along the coasts of AP and SSI, which currently are regions proving to be particularly sensitive to the effects of climate change such as rapid warming, alterations in ocean currents, collapse of ice shelves, ice mass loss. As the processes that cause these phenomena are accelerating, AP and SSI are considered key regions for an improved understanding of climatic-driven sea level evolution since LGM (Bentley & *alii*, 2011; Roberts & *alii*, 2011; Mulvaney & *alii*, 2012; Hodgson & *alii*, 2013; Oliva & *alii*, 2016). Different methodologies have been applied to produce RSL data in this area: (i) radiocarbon dating of the transition between brackish-marine and freshwater facies from sediment cores in isolation basins; (ii) Optically Stimulated Luminescence (OSL) dating of beach ridges from underside surface of cobbles in beach deposits; (iii) radiocarbon dating of samples collected on beach surface, within beach deposits or in cliff section; (iv) relative chronology of the processes that shape the morphologies through the geomorphological and the stratigraphic analysis and mapping of glacial, coastal and marine landforms and deposits. All these data are useful to produce geomorphological cartography and well-constrained RSL curves. However, the lack of a geographic and descriptive common system that includes data derived from different sources limits the accessibility, the integration and the full exploitation of information. Thus, we developed an easy-to-access tool for managing and combining all RLS data in a common geographic reference system and by a common descriptive method.

We thus developed a Cartographic Antarctica Repository (CAR) of postglacial paleo-shorelines based on a new approach that applies a uniform pattern – i.e., a single storing model for various data typologies, able to describe heterogeneous data by a homogeneous method – to collect available RSL data in AP and SSI regions (fig. 1) as to realize a geodatabase useful for interacting the information, providing mapping environment and supporting the spatial analyses. The free accessibility of CAR through a free and open source Geographical Information System (GIS) platform makes it a valuable instrument to share data and to improve the definition of shoreline evolution, as demonstrated by other free access data-repositories, such as World Atlas of Last Interglacial Shorelines-WALIS (Rovere & *alii*, 2020) and global atlas of HOLocene SEA levels-HOLSEA (Khan & *alii*, 2019). Moreover, an increasingly large Antarctica database community is evolving towards a widespread online availability of the scientific data as shown by dataset experiences such as Antarctica ICEsheet Evolution DATabase-AntICEdat (Briggs & Tarasov, 2012), Reference Elevation model of Antarctica-REMA (Howat & *alii*, 2019), Quantarctica (Matsuoka & *alii*, 2021), Scientific Committee on Antarctic Research Antarctic Digital Database-SCAR ADD (British Antarctic Survey Mapping Team, 2021) and others listed in table 1, which provides a brief overview of the available resources. This list does not pretend to include all the Antarctic datasets made until now, but only wants to offer a general reference context, in which CAR is inserted, useful for carry out researches in Antarctica.

CAR IMPLEMENTATION

Setting and implementation of CAR is based on the following five steps.

Step 1. Overall screening of the scientific literature (i.e., peer-reviewed papers and survey reports) available on the web in order to acquire information about RSL data in AP and SSI.

Step 2. Detection of the different RSL data typologies (i.e., samples on/within beaches, transition layers from sediment cores in isolation basins, raised marine and glacial features e.g. platforms, beaches, cliffs, rock glaciers) and the various methodologies applied in investigations (e.g., geomorphological and stratigraphic analysis, OSL dating, radiocarbon dating, uranium-thorium dating) in order to determine data inclusion and arrangement criteria. It should be specified that all information from literature was preserved as much as possible to keep data authenticity without any form of manipulation or result interpretation.

Step 3. Recognition of six typologies of RSL indicators (i.e., potential markers of the past sea-level position) through the previous analysis of the geomorphologic, stratigraphic and biological coastal data known from literature: marine conglomerates, rock glaciers, platforms, beaches, cliffs and isolation basins. During this phase, RSL data were sorted and classified in categories representative of RSL indicators.

Step 4. Geodatabase design with the definition of database management system and the data format. A GIS project was set and a relational database was created and stored in a geopackage file aiming to produce an easily accessible, shareable and constantly updated repository (Rigaux & *alii*, 2002; Arctur & Zeiler, 2004; Huang, 2017).

QGIS® software (http://qgis.org) and Open Geospatial Consortium Encoding Standard-OGC® GeoPackage database container (http://www.geopackage.org/spec) were used.

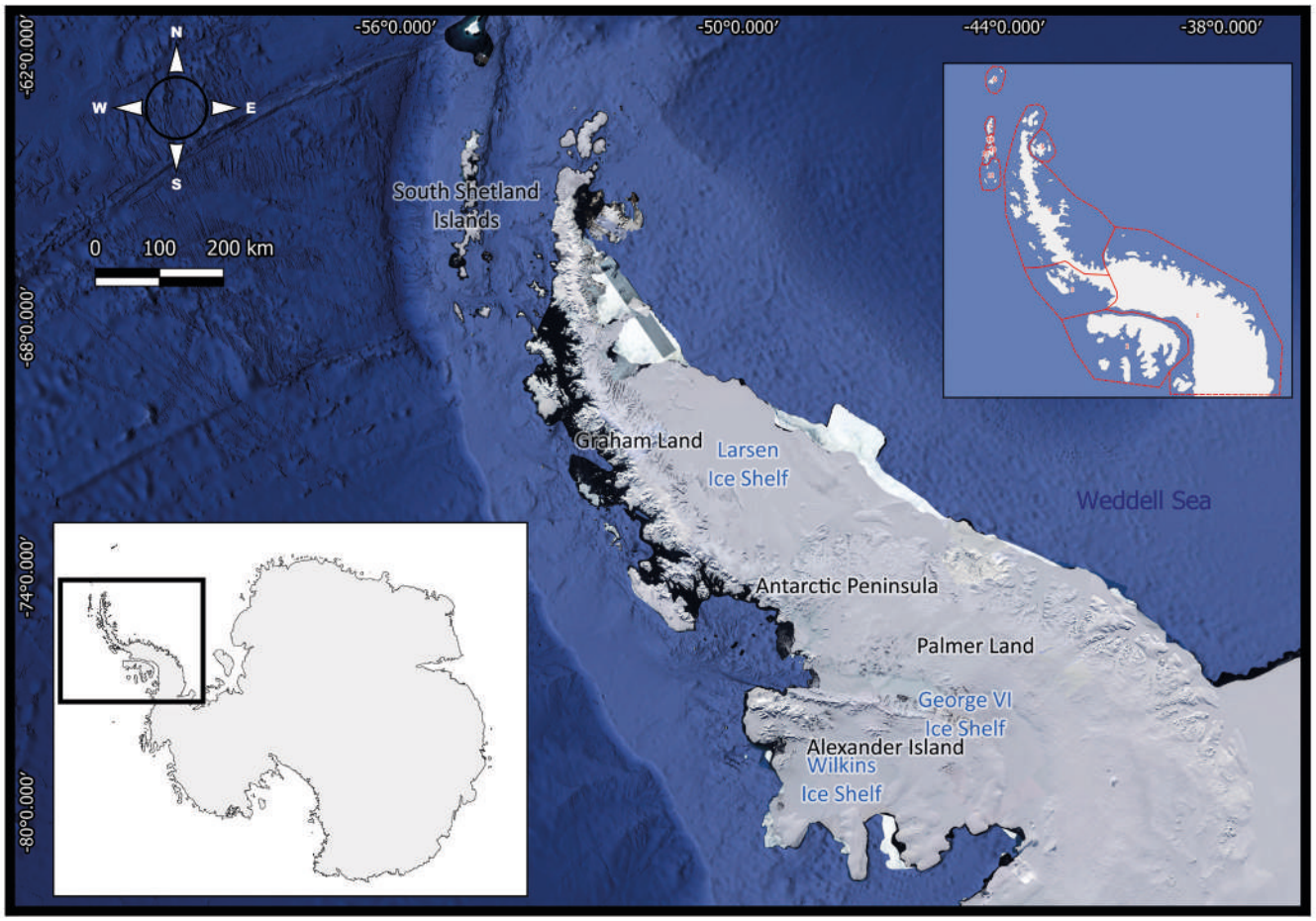


FIG. 1 - Regions of interest in Cartographic Antarctica Repository-CAR: Antarctic Peninsula and South Shetland Islands. Top box: sub-regions and corresponding numeric code in CAR. Base maps: Google Satellite and layers of ADD and Overview place name in Quantarctica (Matsuoka & *alii*, 2021).

Three spatial layers with corresponding attributes tables, i.e. *CAR1*, *CAR2*, *CAR3*, and two one-to-many (1:N) relationship tables, i.e. *CAR2_levels* and *CAR3_layers* connected to *CAR2* and *CAR3* respectively, were used to collect and describe different RSL data derived from literature (fig. 2). In particular, *CAR1* contains data derived from marine conglomerates, rock glaciers, platforms and samples on beach surface. *CAR2* contains data derived from samples buried in beach deposits or collected in sections along the cliffs; *CAR2_levels* relation table includes information about the stratigraphy of the sites implemented in *CAR2*, so that many samples from excavation levels, if available, can be recorded for the same site. *CAR3* contains data derived from sediment cores in isolation basins; *CAR3_layers* relation table includes information about transition layers between marine and freshwater phase of isolation basins implemented in *CAR3*. This flexible database architecture allowed us to insert the various typologies of data in a common geographic system (WGS84/Antarctic Polar Stereographic, EPSG code: 3031) applying a descriptive and analytical standard approach that proved to be suitable to include heterogeneous data.

Each RSL data was associated to a site located through geographical information, i.e. latitude and longitude, provided by the authors of the article from which the data was extracted, or determined through cartographic indications (geomorphological sketchs, maps, etc.) found in the article. Each site is a record of the point vectors (*CAR1*, *CAR2*, *CAR3*, respectively orange, yellow and blue points, see figs. 2, 3) identified by an integer in ascending numerical order starting from 1 in *CAR1*, 1001 in *CAR2*, 2001 in *CAR3*, in order to distinguish the numerical series of the layers (see FID in table 1). This id field represents the primary key to relate *CAR2* and *CAR3* (i.e. parent layers) to *CAR2_levels* and *CAR3_layers* (i.e. child layers) respectively, through site field (i.e. external key). Fields of attribute tables and relationship tables with corresponding descriptions are listed in table 1. Community-standard used for publishing and archiving RSL information was attempted to apply to define data fields. As CAR multi-levels and relational database, its three layers vary in number, position and name of the fields that can be common, unique or alternative (see fig. 2 and table 2).

Graphic interface of CAR shows a map of AP and SSI with RSL data represented by points (lozenge shaped) whose colour marks CAR layers; a pop-up window displays integrated information associated to each site (figs. 3, 4).

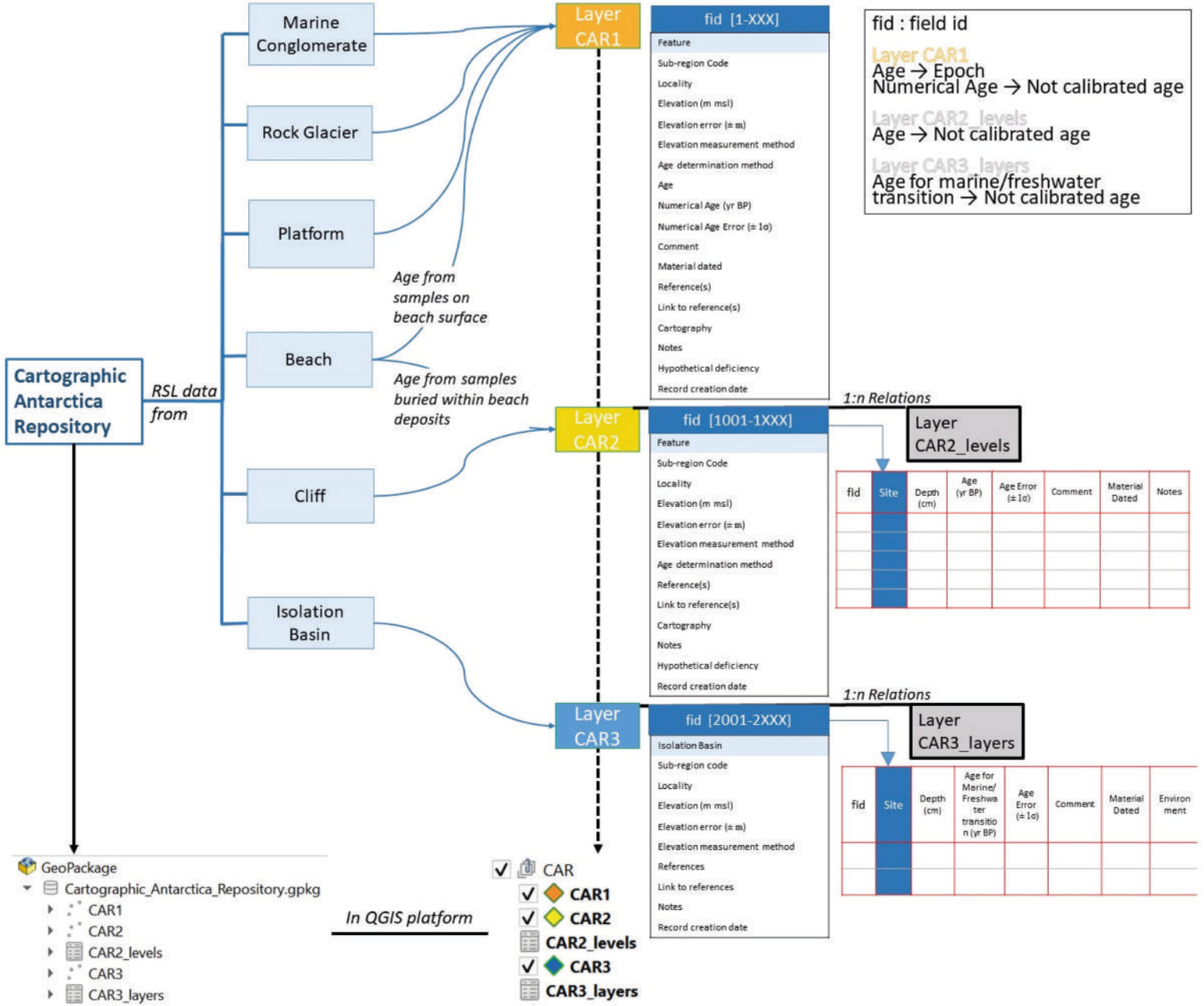


FIG. 2 - Flow chart of CAR geodatabase with RSL indicators, spatial layers (*CAR1*-orange, *CAR2*-yellow, *CAR3*-blue) and connected relationship tables (*CAR2_levels* and *CAR3_layers*).

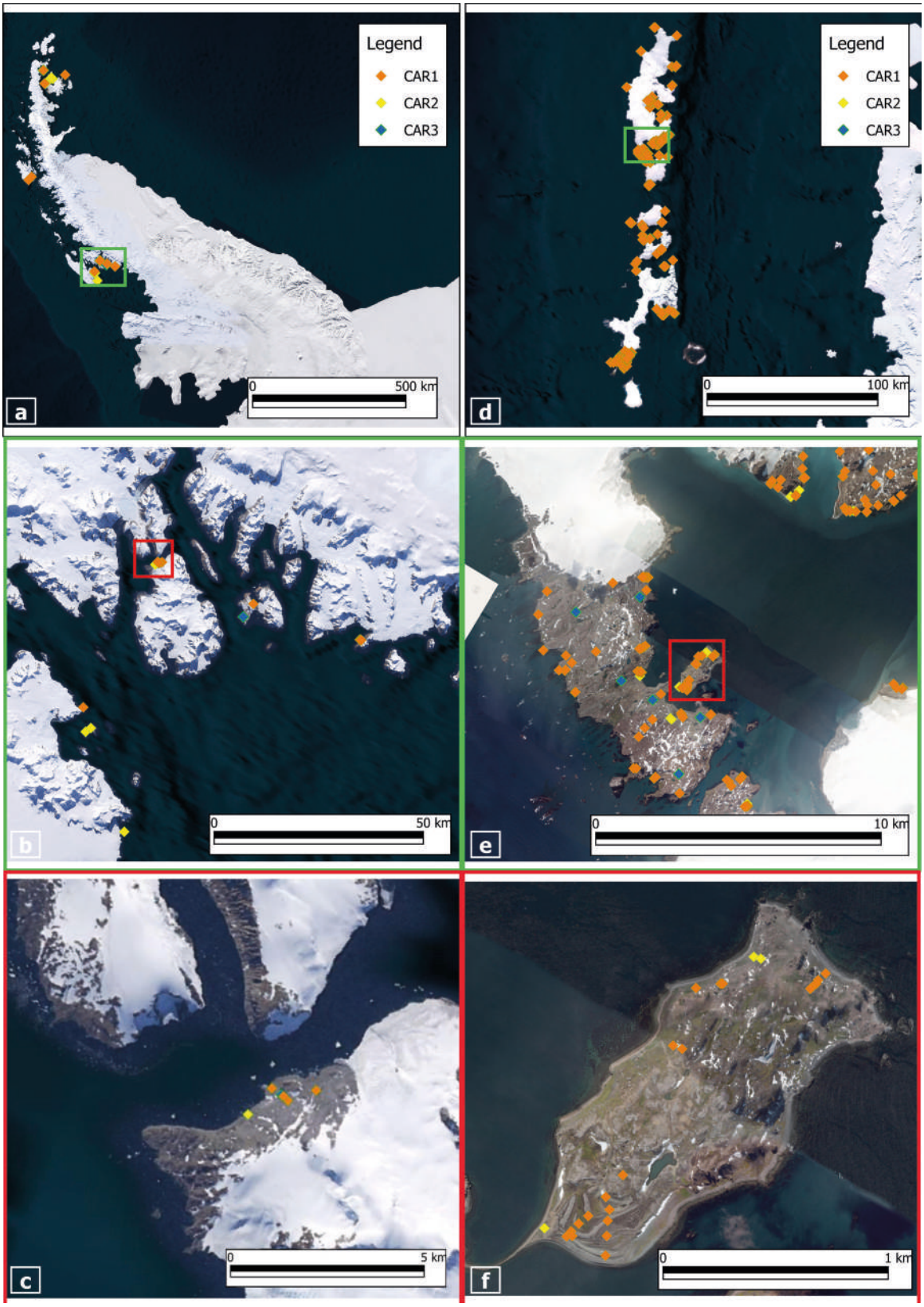


FIG. 3 - Screenshots of CAR map at various scales with orange, yellow and blue lozenge shaped points corresponding to *CAR1*, *CAR2* and *CAR3* respectively. Base map: Google Satellite. (**a**) Antarctica Peninsula. (**b**) Marguerite Bay, area corresponding to green square in a. (**c**) Pourquoi Pas Island, area corresponding to red square in b. (**d**) South Shetland Island. (**e**) Fildes Peninsula, Maxwell Bay, area corresponding to green square in d. (**f**) Ardley Island, corresponding to red square in e.

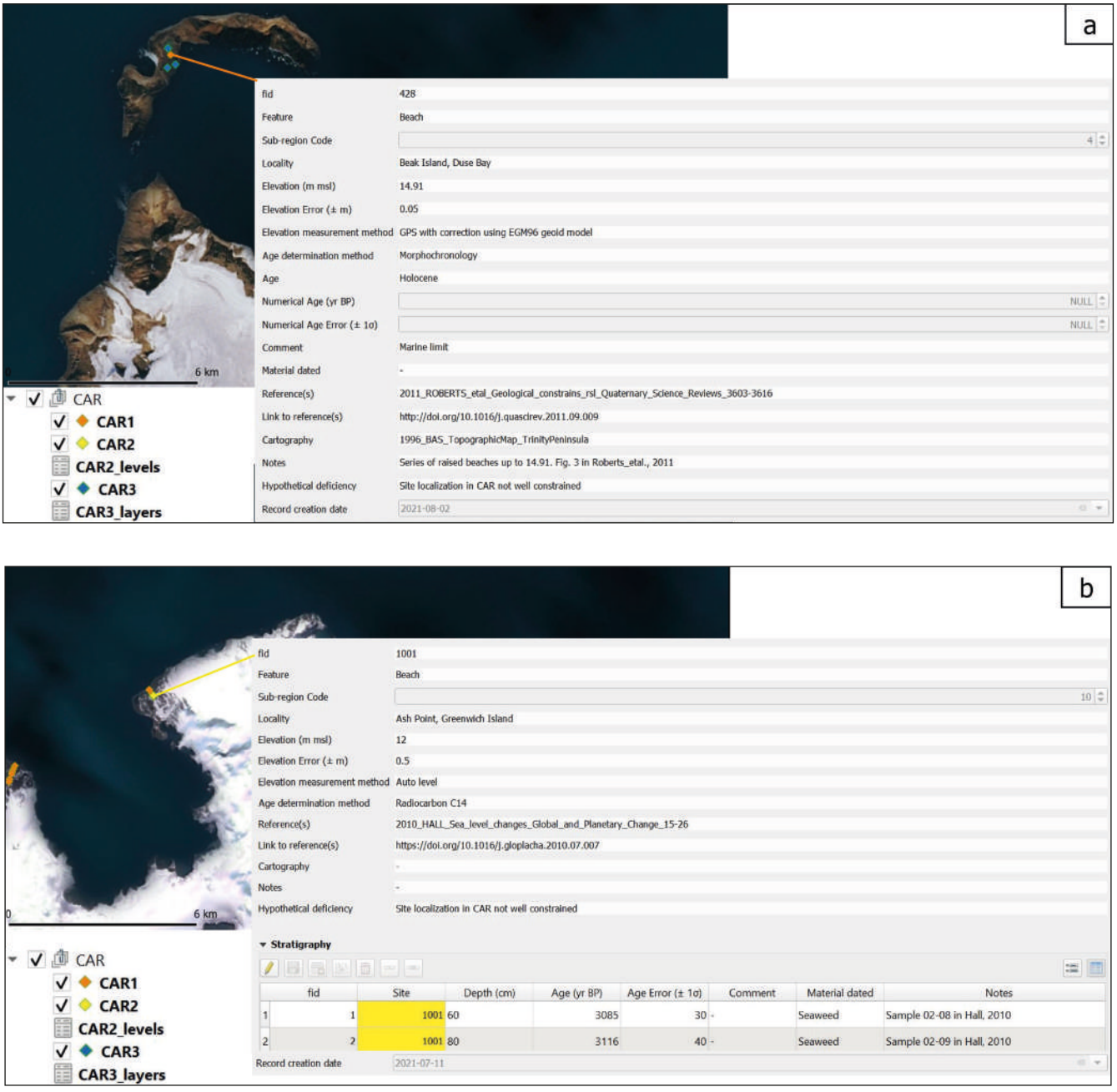


FIG. 4 - Pop-up windows with integrated information for sites in *CAR1* (**a**), *CAR2* (**b**) and *CAR3* (**c**). Base map: Bing Satellite.

Step five. Implementation and update of CAR. An initial collection of about 640 records was obtained (table 3) by implementing RSL data from literature (see references in paragraph 5). However, this phase should be considered in progress as implementation of data is subject to integrations and improvements to increasingly conform the database to data flow and research requirements.

It should be stated that sometimes RSL data could not be implemented in CAR because of the lack of primary information such as elevation above mean sea level (msl) of the site as well as in Fretwell & *alii* (2010) where the elevation of the paleo-beaches is measured above the present-day beaches position.

CAR DATASET AND POTENTIAL APPLICATIONS

Changes in RSL data since LGM are particularly useful in key regions such as Antarctic Peninsula and South Shetland Islands to reconstruct processes as ice sheet deglaciation and meltwater influx to past and future global sea level rise (Cofaigh & *alii*, 2014). Thus, the collection

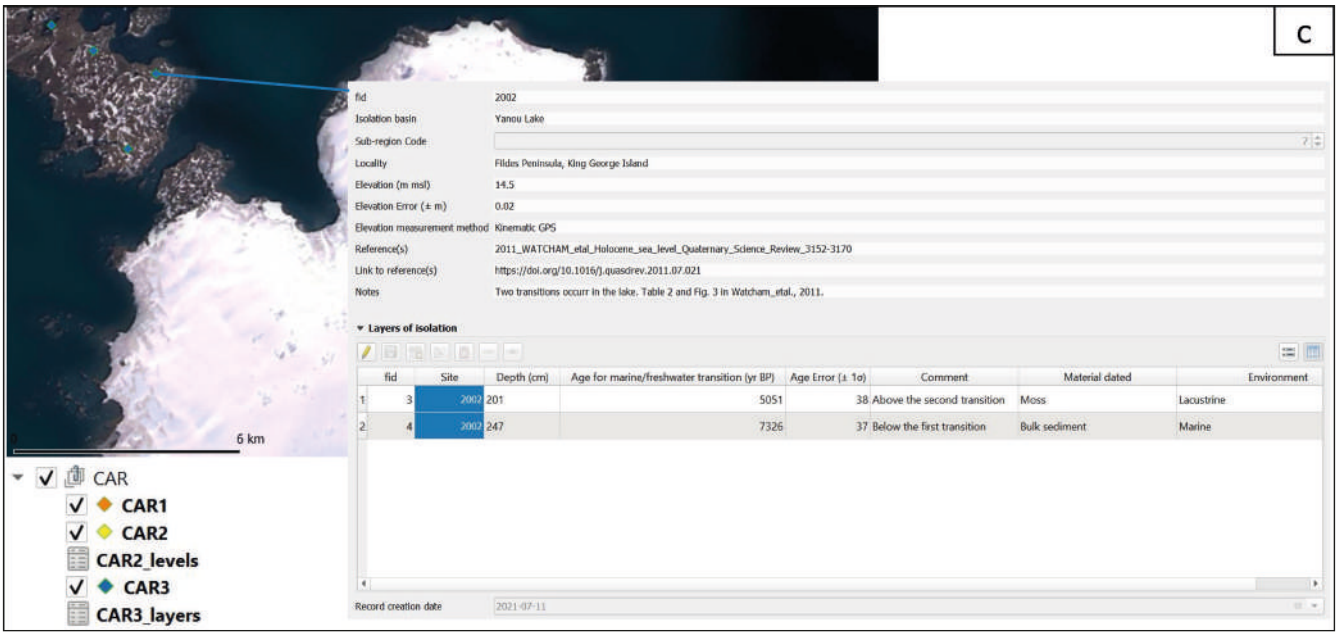


FIG. 4 - Pop-up windows with integrated information for sites in *CAR1* (**a**), *CAR2* (**b**) and *CAR3* (**c**). Base map: Bing Satellite.

of various available paleo-shorelines data in a geodatabase becomes functional to (i) create an easy access to the data, (ii) connect and integrate information and (iii) support the spatial analyses. The Cartographic Antarctica Repository is based on a new approach that satisfies these requirements, as preliminary results seem to demonstrate:

(i) Through QGIS platform and a relational database, CAR allows the open access to 640 records of RSL data collocated in seven sub-regions of the area corresponding to AP and SSI (figs. 1, 3). The composition of three layers (*CAR1*, *CAR2* and *CAR3*) comprises data from marine conglomerates, rock glaciers, platforms, beaches, cliffs and isolation basins, storing the main information and the relative references derived from various methodologies by a standardized pattern that makes more usable the description and the collection of heterogeneous data.

(ii) Spatial layers, attributes tables and relationship tables create a common geographic and integrated information system in which each RSL data is identifiable, traceable and connectable as to distinguish features and fields through different database levels on one side, and to link data through relations and combined lists on the other side (fig. 4). In this way, CAR represents a helpful tool to extract data through queries and filters in order to acquire information, derive graphs and visualize complementary data. Fig. 5 shows graphs of RSL data in SSI plotted in elevation and age expressed both in years before present and in epochs, so that diverse chronological estimations (resulted from radiometric dating of samples, stratigraphic sequences, assumptions on geomorphological processes) can be inspected for a first RSL changes analysis in this region. CAR can be considered an innovative archive than the other similar ones (Briggs & Tarasov, 2012; Khan & *alii*, 2019; Rovere & *alii*, 2020) for including different RSL data typologies.

(iii) A coherent geodatabase as CAR constitutes a suitable environment for observing and mapping spatial variability of RSL data. Fig. 6 describes the spatial distribution of beaches and platforms in different elevation ranges in SSI by contributing to provide elements for shoreline evolution definition in this region. The integration and the completeness of information in a geodatabase represent the main characteristics for applying geographical analyses and trying data interpretation.

CAR is an innovative project based on a new GIS approach, experimented in AP and SSI regions, potentially developable in other Antarctic regions. CAR supplies a usable reference framework for RSL data in Antarctica, as expressed by the brief report in table 3. This summary describes and compares amount of records – until now implemented – for the main data fields by acquiring information useful to evaluate the statistical population in relation to RSL indicators, methods applied and characteristics detected by studies in literature. Scarcity or poor quality and/or low accuracy of data can be determined in order to identify areas needing in-depth investigations. At the same time, areas with high quality data can be highlighted to constrain processes of RSL changes at regional scales. Therefore, CAR could represent a high potential tool for evaluating spatial and temporal coverage of data in AP and SSI and planning future researches about post-LGM history of coastal areas.

As geodatabase built on QGIS platform, CAR can be overlapped with other public access datasets by supplementing information about Antarctic coast, enlarging the Antarctic database community and increasing end-user collectivity (table 1). Furthermore, if available as web-GIS, CAR could further contribute to free sharing and visualizing Antarctic RSL data.

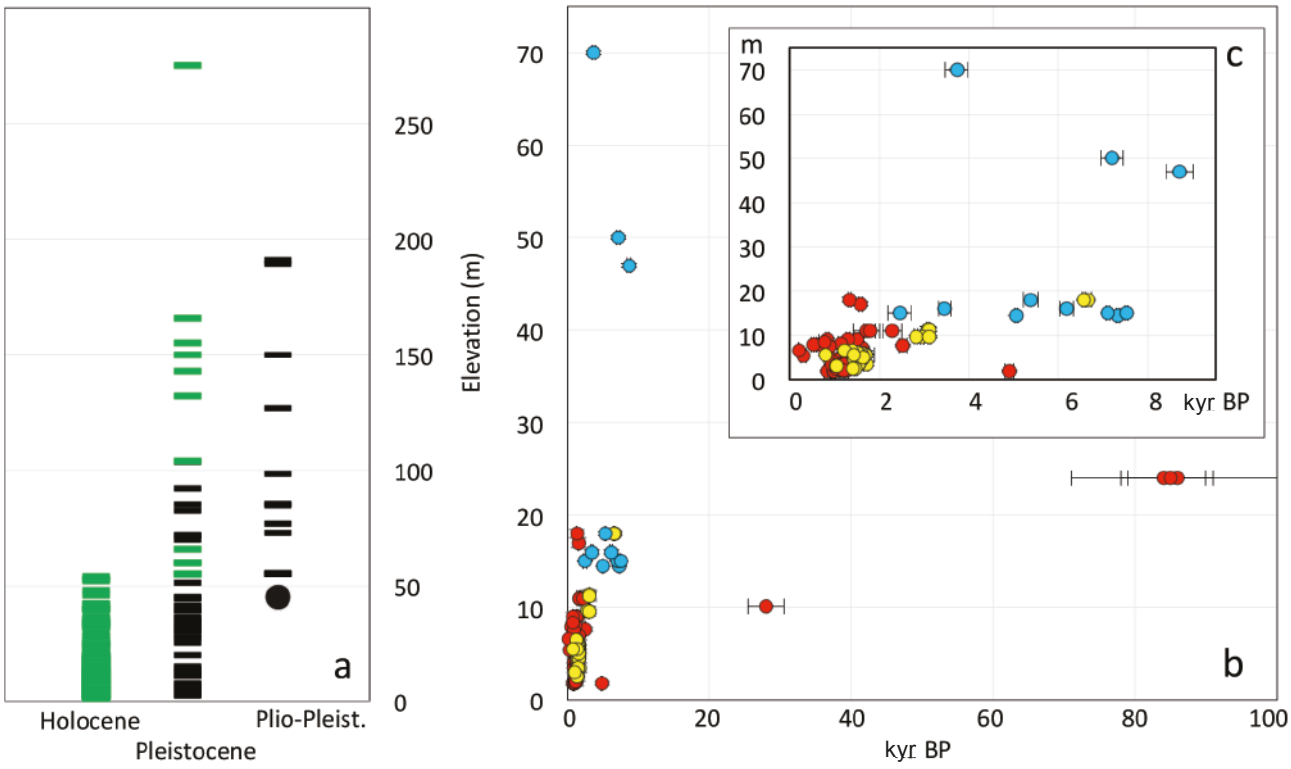


FIG. 5 - Example of graphs obtained querying and extracting RSL data from CAR relatively to South Shetland Islands. (a) Plot of the elevation of RSL data (m msl) subdivided for ages; green horizontal lines are beach deposits; black horizontal lines are marine platforms and black circles are marine conglomerates. (b) RSL data plotted as change in sea level relative to present msl against calibrated age (1-sigma error bars); red circles: CAR1; yellow circles: CAR2; cyan circles: CAR3. (c) Same as 'b' but restricted for last 10 kyr.

CONCLUSIONS

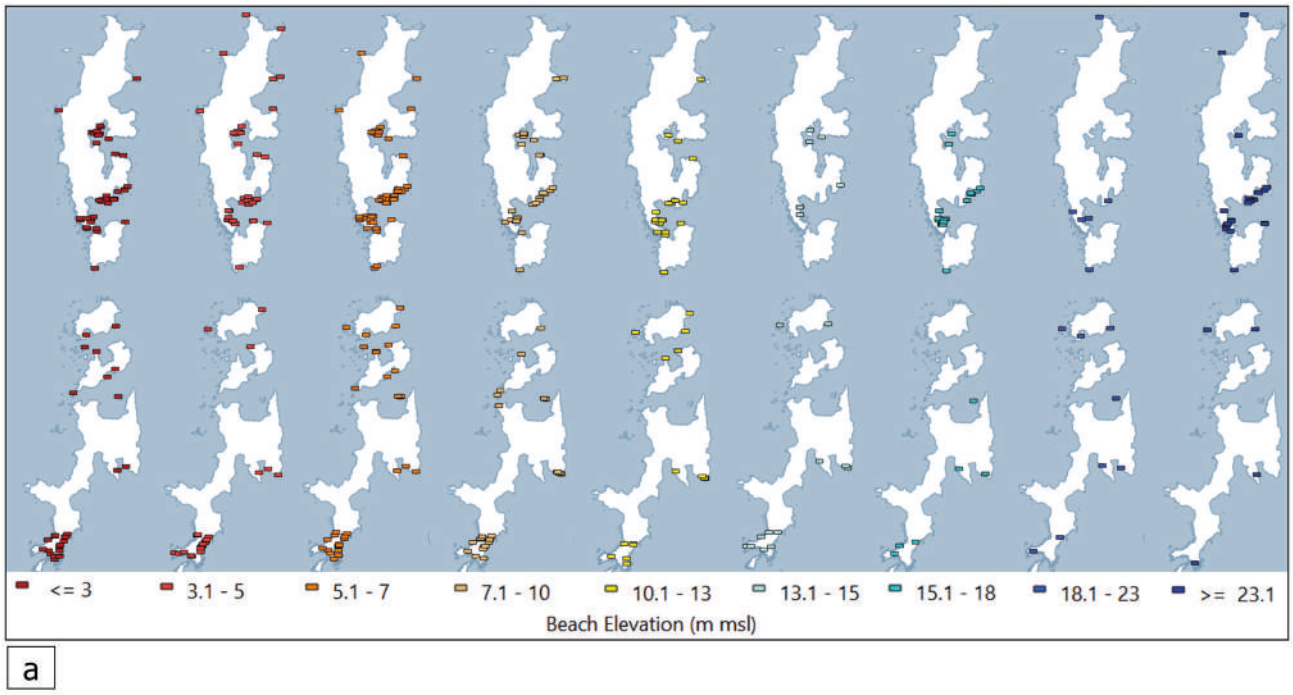
The potentiality of RSL changes data derived from researches in Antarctica strongly depends on the need to access, observe, import, explore and share all various typologies of published data. The new CAR is proposed as a solution to the absence of an open common collection system that includes heterogeneous RSL data.

However, there are two main limits of CAR. First, the localization of most of sites in CAR is not well constrained because of the lack of the geographic coordinates from literature. This drawback, however, represents a necessary effort made by the authors to create a database that collects the greatest possible number of data known from the studies applied so far. Secondly, CAR archives most of available RSL data in AP and SSI, not considering remaining coastal regions of Antarctica.

Then the architecture and the implementation of CAR must be considered evolving in relation to new data acquisition.

SUPPLEMENTARY MATERIAL

The Cartographic Antarctica Repository (CAR) associated with this article (including QGIS project and access instructions) can be found in the online version, at: http://gfdq.glaciologia.it/044_2_02_2021/.



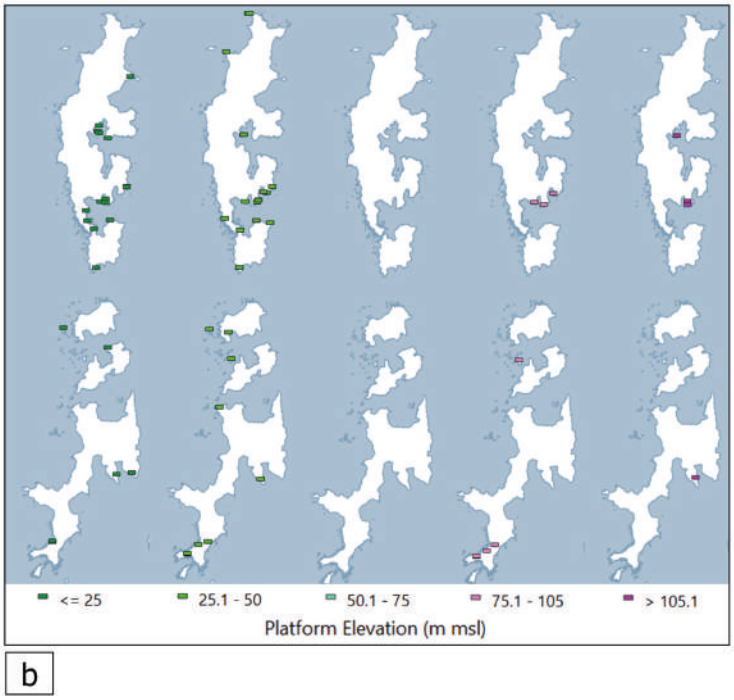


FIG. 6. Example of query executed on CAR for spatial distribution in different elevation ranges of beaches (**a**) and platforms (**b**) in South Shetland Islands. Base map: layer of ADD in Quantarctica (Matsuoka & *alii*, 2021).

TABLE 1 - Synthetic list of Antarctica datasets with corresponding definition and reference.
BAS = British Antarctic Survey;
EMODnet = European Marine Observation and Data Network;
RSL = Relative Sea Level;
SCAR = Scientific Committee on Antarctic Research;
SCOR = Scientific Committee on Oceanic Research.

Dataset	Definition	Reference	Web resources
	Mapping & Topography		
Quantarctica*	Collection of Antarctic geographical datasets (basemaps, satellite imagery, terrain models, and scientific data of physical and biological sciences, environmental management, and social science).	Matsuoka & *alii*, 2021	https://www.npolar.no/quantarctica/
Reference Elevation model of Antarctica-REMA	Digital Elevation Model (DEM) at a resolution of less than 10 m.	Howat & *alii*, 2019	https://www.pgc.umn.edu/data/rema/
SCAR Antarctic Digital Database	Compilation of topographic data (coastline, rock outcrop, contours, lakes, moraine, streams, seamask).	Burton-Johnson & *alii*, 2016	https://www.add.scar.org/
SCAR MAP Catalogue	Digital catalogue of maps and graphs of Antarctica.	SCAR Geographic Information Committee -SCAGI	https://data.aad.gov.au/aadc/mapcat/
International Bathymetric Chart of the Southern Ocean-IBCSO	Bathymetric data at an extent south of 60° S at a scale of 1:7,000,000.	Arndt & *alii*, 2013	https://www.scar.org/science/ibcso/resources/
	Geology, Geomorphology & Geophysics		
SCAR Biogeographic Atlas of the Southern Ocean	Synthesis of relevant environmental factors: depth and gradient of the seafloor, geomorphic features, bottom sediments, locations of potential shelf refugia during the last glaciation, sea ice extent and seasonality, physical oceanographic processes, distribution of nutrients and oxygen at the sea surface and through the water column.	Post & *alii* 2014	https://www.biodiversity.aq/atlas/
GeoMAP	Synthesis of existing published and unpublished mapping of the geology of Antarctica in a single geodatabase at a regional scale.	Cox & *alii*, 2019	https://data.gns.cri.nz/ata_geomap/index.html?content=/mapservice/Content/antarctica/Download.html
Met-READER	Database of monthly mean surface and upper air climatological data derived from the in-situ meteorological observations made at Antarctic stations.	SCAR	https://legacy.bas.ac.uk/met/READER/
Antarctic Seismic Data Library System-SDLS	Database of multichannel seismic-reflection data collected south of 60° S.	SCAR	https://sdls.ogs.trieste.it/cache/index.jsp
Antarctic Digital Magnetic Anomaly Map-ADMAP	Database of magnetic anomaly data collected over the past 50 years.	Golynsky & *alii*, 2018	http://admap.kopri.re.kr/

Marine Science			
Antarctic Tide Gauge Database	Tidal harmonic coefficients (amplitude and phase) for ocean surface height (tide-induced height perturbation relative to the seabed) at many coastal, ocean and ice shelf locations around Antarctica.	Howard & *alii*, 2020	https://www.esr.org/data-products/antarctic_tg_database/atg-data/
Antarctic & Southern Ocean	Collection of geophysical and oceanographic data acquired with ship-mounted sensors during expeditions of the US Antarctic Program research vessels R/V NB Palmer and LM Gould, some geoscience data sets from the Antarctic continent and other science party data submitted by scientists.	Marine Geoscience Data System-MGDS	https://www.marine-geo.org/collections/#!/collection/USAP#-summary
SCAR Southern Ocean Continuous Plankton Recorder-SO-CPR	Map of the spatial-temporal patterns of plankton biodiversity.	Australian Antarctic Data Center	https://data.aad.gov.au/aadc/cpr/index.cfm
Southern Ocean REference Antarctic Data for Environmental Research-SOR	Portal for links to oceanographic data in South Ocean.	John Turner-BAS, SCAR	https://legacy.bas.ac.uk/met/SCAR_ssg_ps/OceanREADER/index.html
Southern Ocean Observing System-SOOS	Access portal to various observing platforms (tide gauge, plankton, sea ice, sea surface temperature etc.).	SCAR, SCOR, EMODnet	https://www.soos.aq/data/soos-map
Glaciology			
Antarctica ICE sheet DATabase-AntICEdat	RSL indicators, past ice sheet thickness from elevation (ELEV) markers, and ice sheet extent (EXT) from grounding line retreat and open marine conditions data.	Briggs & Tarasov, 2012	https://www.sciencedirect.com/science/article/pii/S0277379112004921#tbl2
Global Land Ice Measurements from Space-GLIMS	Database of glacier outlines from around the world and information about glaciers that includes the metadata on how those outlines were derived.	Kargel & *alii*, 2014	https://www.glims.org/maps/glims
MEaSUREs InSAR-Based Antarctica Ice Velocity Map	High-resolution, digital mosaic of ice motion in Antarctica assembled from multiple satellite interferometric synthetic-aperture radar data.	Rignot & *alii*, 2011	https://faculty.sites.uci.edu/erignot/measures-insar-based-antarctica-ice-velocity-map/
Antarctic Surface Accumulation and Ice Discharge-ASAID	Dataset of grounding line and hydrostatic line locations for the Antarctic coastline and islands around Antarctica.	Bindschadler & *alii* 2011	https://nsidc.org/data/nsidc-0489
SCAR International Iceberg Database	Database of iceberg position in Antarctica classified in size categories.	Orheim & *alii*, 2021	https://data.npolar.no/dataset/e4b9a604-1b64-4890-9f21-56b5589807c4
ICE-READER	Database of ice core records collected from across the Antarctic continent.	International Trans-Antarctic Science Expedition-ITASE, SCAR	http://www.icereader.org/icereader/index.jsp

* Some datasets cited in the table are included in *Quantarctica*, as well as many other Antarctic datasets not cited in the table such as Regional Atmospheric Climate Model-RACMO, Landsat Image Mosaic of Antarctica-LIMA, MODIS, BEDMAP2, ALBMAP, Ice core database and many others (please refer to Matsuoka & *alii*, 2021 for relative references).

TABLE 2 - List of CAR fields with corresponding description. Example of field values is relative to a record of *CAR1*: it has not values in DEPTH and SITE fields.

Data Field	Description	Example of field value
FID	An integer in ascending numerical order.	409
FEATURE	Feature corresponding to RSL indicator.	Beach
SUB-REGION CODE	An integer that identifies the sub-region in which the site is located: the area corresponding to AP and SSI was divided in twelve sub-regions defined by geographic, topographic and toponymic criteria. See top box in fig. 1.	7
LOCALITY	Geographic/toponymic name of site locality and reference places (peninsula, island and bay).	C. Escondida, Fildes Peninsula, King George Island
ELEVATION (m msl)	Elevation of the site in metres above mean sea level.	4
ELEVATION ERROR (± m)	Elevation accuracy expressed in metres, corresponding to the potential error associated with measurement uncertainties.	0.5
ELEVATION MEASUREMENT METHOD	Method applied to measure the elevation of the site.	Auto Level
AGE DETERMINATION METHOD	Method applied to determine the age of the site.	Radiocarbon C14
AGE *	Age in epochs.	-
NUMERICAL AGE (yr BP) *, †	Age in years Before Present, not calibrated.	1309
NUMERICAL AGE ERROR (± 1σ) *, †	Age 1-sigma error.	46
COMMENT *	Age details (minimum, maximum, etc.)	Minimum Age
MATERIAL DATED *	Material sampled for age determination.	Whalebone
DEPTH (cm)	Depth of levels/layers from which sample derived, in centimetres. Only in *CAR2_levels* and *CAR3_layers*.	-
SITE	FID of the site whose record (from stratigraphic level, transition layer) refers (primary key field to connect *CAR2* to *CAR2_levels*, and *CAR3* to *CAR3_layers*). Only in relationship tables.	-
REFERENCE(S)	Year, Authors, Title (keywords), Journal (including the Pages) of the article/report in which the site is published.	2010_HALL_Sea_level_changes_Global_and_Planetary_Change_15-26
LINK TO REFERENCE(S)	Web link to the publication(s).	https://doi.org/10.1016/j.gloplacha.2010.07.007
CARTOGRAPHY	Year, Authors and Thematic of some published maps in which the area of the site is represented.	2012_Serrano&LopezMartinez_GeomorphologicalMapFildesPeninsula&ArdleyIsland
NOTES	Site number and description details marked in the article/report.	Sample (on beach surface) 01-72 in Hall, 2010
HYPOTHETICAL DEFICIENCY	Potential failing aspects (declared in the article/report or found in CAR implementation) that could affect the record reliability.	Site localization in CAR not well constrained
RECORD CREATION DATE	Date of record creation in CAR.	2021-08-02

* Fields alternatively filled depending on data typology.
† Numerical Age is AGE (yr BP) in CAR2 and AGE FOR MARINE/FRESHWATER TRANSITION (yr BP) in CAR3. Numerical Age Error is AGE ERROR (± 1σ) in CAR2 and CAR3.

TABLE 3 - Report of records according to the main data fields in first version of CAR. Note that: (i) records are distributed in seven of twelve sub-regions shown in fig. 1 (top box) in an elevation range of 0 - 275 meters above mean sea level; (ii) most of RSL data derive from beach surface/deposits; (iii) elevation measurement through level instrument is the most widely applied method; (iv) records with chronological estimations expressed both in years and epochs are included, with a prevalence of the latter; (v) not well constrained site localization is the deficiency most frequently found in records storing.

Records in CAR	640
Sub-regions with records	7
Records by marine conglomerate as RSL indicator	9
Records by rock glacier as RSL indicator	9
Records by platform as RSL indicator	72
Records by beach as RSL indicator	518
Records by cliff as RSL indicator	12
Records by isolation basin as RSL indicator	20
Minimum elevation (m msl)	0
Maximum elevation (m msl)	275
Records by aneroid barometer as elevation measurement method	19
Records by level/levelling as elevation measurement method	497
Records by GPS as elevation measurement method	47
Records with unknown elevation measurement method	77
Records with age in epochs	454
Records with age in years	182
Records without age	4
Most popular hypothetical deficiency	**Site localization in CAR is not well constrained**

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(Ms. received 06 May 2022, accepted 01 June 2022)