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MEDFLOOD project: MEDiterranean sea-level change and projection for future FLOODing

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ABSTRACT: MEDFLOOD is a four-year interdisciplinary project recently launched by a team of scientists working in fields concerned with Mediterranean sea-level change. The project has the timely and ambitious aim to build a spatially explicit database of relative sea levels for the Mediterranean and to use this resource to model risk and help project future flooding in and around the Mediterranean basin.

Keywords: Relative sea-level change, Mediterranean flooding, Sea-level index points, Past and future sea levels.

1. INTRODUCTION

It is widely recognized that reconstruction of Holocene relative sea levels (RSLs) is of fundamental importance for understanding Glacio-Isostatic Adjustment (GIA) (and fine-tuning GIA models) as well as to assess coastal vulnerability to sea-level rise (cf. Antonioli et al., 2009). Moreover, Holocene RSL data provide information on vertical land movements, even at the local scale, caused by tectonic and/or volcanic structures. In addition to the 'eustatic' values provided by the IPCC (Lambeck et al., 2011), these are important components of future sea-level projections.

The Mediterranean sea, with its small tidal ranges and relatively low-energy storms (which favour the preservation of sea-level markers along coastlines) has been the theatre of several studies related to field-measures of past sea levels using RSL markers for over four decades (cf. Kershaw and Guo, 2001; Pirazzoli, 2005).

Antonioli et al. (2009) reviewed sea-level markers along the Italian and Istrian (western Slovenian and northwest Croatian) coastlines, and counted 127 studies containing different RSL markers. Other areas where a significant focus on the topic has resulted in a number of studies related to Holocene RSL markers carried out include Greece, Spain and France. The southern part of the basin is characterized by coastal zones where data are lacking or published locally, and are therefore not widely available.

In the Mediterranean, different types of source data have been used to reconstruct RSLs including biological markers (cf. Laborel and Laborel-Deguen, 1994), sedimentological (cf. Dubar and Anthony, 1995), geomorphological (Pirazzoli, 1996) and archaeological (cf. Auriemma and Solinas, 2009; see also Galili and Rosen, 2011 for early Holocene data from the eastern Mediterranean). Much greater amounts of published data exists and such literature, still rapidly growing, has led to the obvious consequence of fragmented information. As such, data are only occasionally reviewed with reference to specific location, but not as a whole, since there has never been a concerted effort to compile this into an organic, yet central database which could then be analysed on a truly 'Mediterranean scale'.

2. AIMS AND OBJECTIVES

The main aim of the MEDFLOOD project, sponsored by INQUA for 2012 and of anticipated duration of four years (2012-2015), is to create a comprehensive, coherent, spatially explicit and updatable database containing Holocene and MIS 5.5 RSL data available in literature for the Mediterranean basin. The database, coupled with considerations on vertical land movements due to tectonics, volcanic and isostatic effects, will create an enhanced platform for evidence-supported projections of future sea level which can in turn be used to supplement coastal-flooding models and maps. The database will be freely accessible and downloadable.

Three subordinate objectives have been identified:

1. Conduct a review of observational RSL evidence across the Mediterranean for MIS 5.5 (132-116 ka) and Post-LGM (18 ka) and compare known field data with model predictions (Lambeck et al., 2011) coupling them with the evaluation of tectonic and volcanic contributions to the displacement of MIS 5.5 markers.
2. Produce a WEB-GIS containing MIS 5.5 and Holocene shorelines, freely accessible by users and fed by input data provided by registered users.

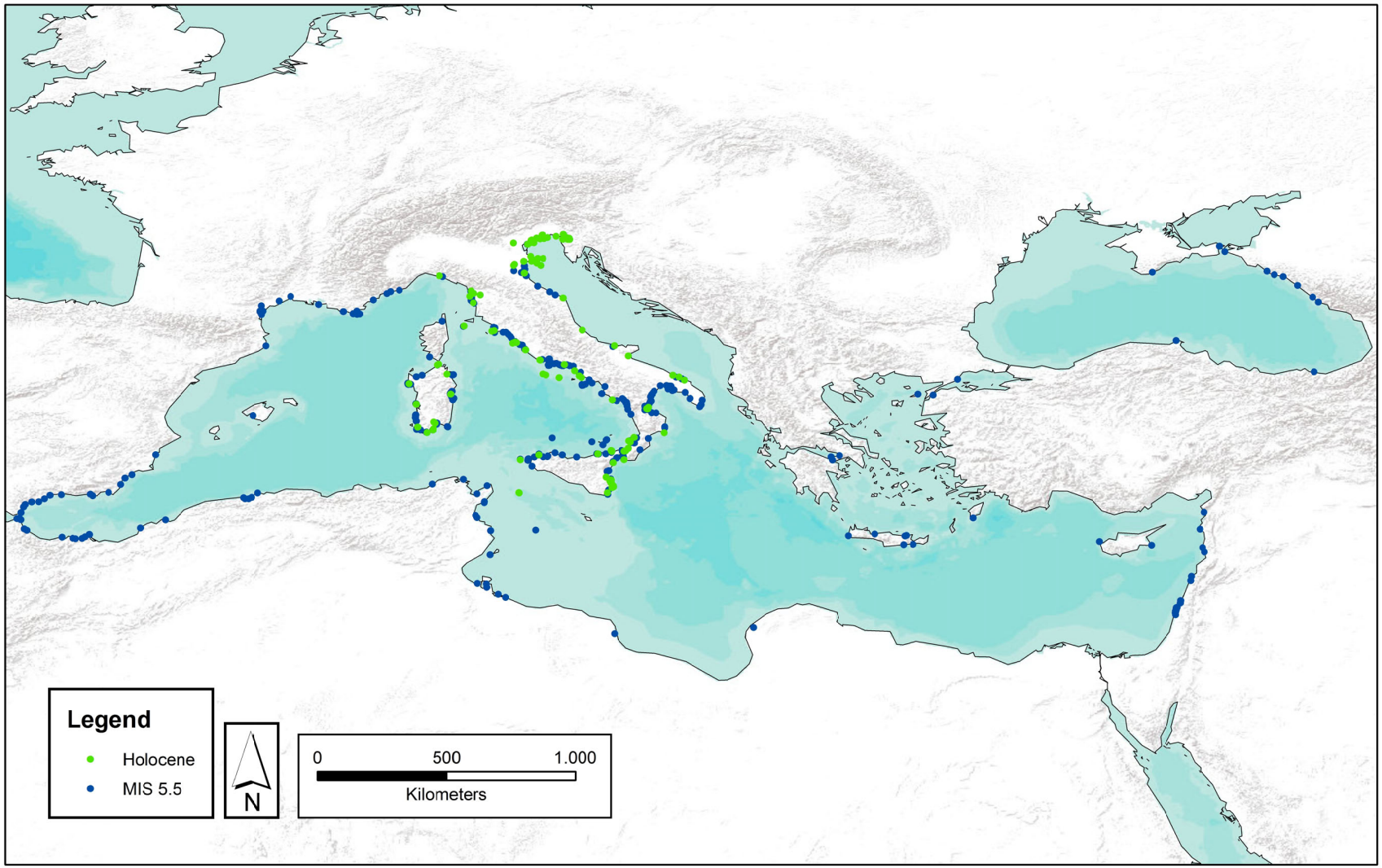

Fig. 1 - Post-LGM (from the additional material in Lambeck et al., 2011) and Last Interglacial (MIS 5.5) (from the additional material in Pedoja et al., 2011 and Ferranti et al., 2006) RSL data published in review papers for the Mediterranean. MEDFLOOD aims to organize under a single structure and expand these datasets. Topography from SRTM data (http://www2.jpl.nasa.gov/srtm/mission.htm).

3. Obtain future sea-level projections and create model flood maps based on the available Digital Terrain Models and on IPCC sea-level scenarios, taking into account isostatic and tectonic effects.

3. ACTIONS

MEDFLOOD was originally designed with the participation of 15 international scientists, experts in different regions of the Mediterranean, or in different fields of study concerned with RSL, including GIA modelling, archaeology, geology or geomorphology, sedimentology and GIS mapping. Four project leaders, who will follow the advancement of the project through its duration, lead this group.

To achieve its goals, actions will be initiated by MEDFLOOD, which can be divided into the following categories.

Networking and dissemination tools

This action is focused at establishing a network of scientists ("the MEDFLOOD team"), coordinated by the four project leaders, who will submit data and cooperate towards the achievement of the project objectives. The team will be updated on the project advancement with a mailing list, and via the website of the project, www.medflood.org. Each year, a workshop will be organised, open to scientists working in a relevant field and willing to participate. Here, ideas and new approaches to the issues of RSL mapping and future sea-level rise projection will be discussed, with particular emphasis on practical solutions to be implemented for MEDFLOOD's success.

Crowdsourcing and Web-GIS construction

The core idea of MEDFLOOD is that the most efficient solution to build large databases is represented by 'crowdsourcing' (a word introduced in 2006 by J. Howe in Wired magazine, [Whitla, 2009] to describe the process of outsourcing an activity to an undefined (and generally large) network of people in the form of an open call.

With this idea, a common structure for submitting RSL data will be established. This will include, but will not be limited to: the type of marker, its elevation and its significance in indicating past sea-level position, and other information relevant for the correct interpretation of the marker (such as tectonic activity in the area). The MEDFLOOD team (and scientists requesting access) will be asked to fill a web form with this information, in order to obtain a standardized database.

The results will be checked for completeness and to avoid duplicate records, and will then be updated into a Web GIS. From here, a user will be able to query and download the data and to see their spatial representation.

Future flooding scenarios

This action is aimed at defining future flooding scenarios, combining corrections for GIA effects across the Mediterranean, tectonic uplift/subsidence estimates from the RSL database, and sea-level rise scenarios from IPCC.

Digital Elevation Models will be sourced and purchased in the second year of project from national cartographic institutes across the Mediterranean, and flooding risk maps will be produced using geospatial statistical analyses. Flooding maps will be obtained using the methodology described in Lambeck et al. (2011), based on the combined observational-computational solutions.

4. ANTICIPATED SCIENTIFIC RESULTS

The various experts within the MEDFLOOD team will interact and share field observations for geology and archaeology and modellers of past glacial changes. This will allow us to provide constraints on past sea levels and, where possible, on estimated future sea-level rise. The key achievements of the projects will be:

- Improved knowledge of MIS 5.5 and Holocene shorelines along the coasts of the Mediterranean;
- Updated glacial-isostatic modelling for the Mediterranean;
- Enhanced understanding of vertical land movements in the Mediterranean;
- The creation of a freely accessible WEB-GIS with MIS 5.5 and Holocene shoreline data;
- The creation of regional sea-level rise projections for 2100 using the available DTMs;
- Collaboration with IPCC for the Mediterranean sea;
- Publication of results in international, peer-reviewed scientific journals and online;
- Dissemination of results to policy makers and managers for planning, land use and hazards related to future sea-level rise.

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