43rd NATIONAL CONFERENCE

GRUPPO NAZIONALE DI GEOFISICA DELLA TERRA SOLIDA
NATIONAL GROUP FOR SOLID EARTH GEOPHYSICS

11 -14 FEBRUARY, BOLOGNA

BELMELORO CAMPUS, VIA ANDREATTA 8

TOPIC 1 - SEISMICITY, VOLCANOES, DATA AND MODELS

Session 1.1: Earthquakes, Active Faults and Seismogenic Processes: from Field Surveys to Laboratory Experiments

Convenors of the session:

Paolo Galli (DPC) - Angela Saraò (OGS) - Stefano Solarino (INGV) - Simone Bello (UniCH)

Session 1.2: The role of geofluids in earthquakes, volcanoes and geothermal fields

Convenors of the session:

Mimmo Palano (UniPa) - Francesca Forni (UniMI) - Luigi Passarelli (INGV-BO)

Session 1.3: Physical models for the Solid Earth and integration between modeling and data of different nature

Convenors of the session:

Anna Maria Marotta (UniMI) - Carla Braitenberg (UniTS) - Massimo Nespoli (UniBO) - Barbara Orecchio (UniME)

TOPIC 2 - DISASTER RISK ANALYSIS AND REDUCTION

Session 2.1: Earthquake and tsunami hazard: different return periods, different conceptual schemes and models in a continuum spectrum of time

Convenors of the session:

Daniela Di Bucci (DPC) - Dario Albarello (UniSI) - Bruno Pace (UniCH)

Session 2.2: Science and technology to support earthquake prevention and preparedness

Convenors of the session:

Mauro Dolce (UniNA) - Sara Sgobba (INGV) - Maria Polese (UniNA)

Session 2.3: Risk Communication

Convenors of the session:

Serena Tagliacozzo (IRPPS, CNR) - Valentina Rizzoli (CORIS, Sapienza University of Rome)

TOPIC 3 - APPLIED GEOPHYSICS FOR ENERGY, ENVIRONMENT AND NEW TECHNOLOGIES

Session 3.1: Energy Transition and Resources

Convenors of the session:

Vincenzo Lipari (OGS) - Paolo Mazzuchelli (ARESYS) - Erika Barison (OGS)

Session 3.2: Near Surface Geophysics

Convenors of the session:

Chiara Colombero (Polito) - Emanuele Forte (UniTS) - Michele Cercato (Uniroma)

Session 3.3: Theoretical and Methodological Development in Applied Geophysics

Convenors of the session:

Andrea Tognarelli (UniPI) - Luca Masnaghetti (SLB) - Gianluca Fiandaca (UniMI)

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OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

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SEZIONE ITALIANA

Investigating the interseismic coupling degree of the northern Apennines external Arc in Emilia Romagna region, (northern Italy).

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The Emilia Romagna region, hosts part of the outermost sector of the northern Apennines. This domain is affected by a contractional stress dynamic results from the westward subduction of the Adriatic lithosphere and its flexural retreat. This process leads the formation of a thrusts and fold belt system, migrating toward east and north-east (Malinverno and Ryan, 1986; Fig. 1 a - b). The above-mentioned regional dynamics, determine a shortening deformation pattern, in the interseismic period, probably accommodated by various faults hidden below the Po-Plain, which represents the nowadays foredeep of the northern Apennines.

In this work, we apply a kinematic Block Modeling approach (McCaffrey, 2002), to investigate which faults, striking across the Po Plain, is actively accommodating the recognized geodetic velocity field. We use several GNSS data (Serpelloni et al., 2022), and exploit all the available fault parameters (e.g., position, strike, dip angle and locking depth) from previous studies and database, to verify the role of major fault segments in the complex seismotectonic framework in which they are located. Our solution shows that the outermost sector of the Northern Apennines is characterized by contractional slip rates, at most equal to 1.5 mm/yr (dip-slip component), that reproduce the observed velocity field in the long-term (Fig. 2 a). Our model includes the Mirandola fault and Ferrara thrusts System, these two faults have been widely studied during the last years because of their capability of generating high magnitude earthquakes. An example is the 2012 seismic sequence, characterized by two mainshocks that occurred on 20 May (Mw ~ 6) and 29 May (Mw ~ 5.8), (Lavecchia et al., 2012; Fig. 1 b).

Due to the complex seismotectonic history of the studied domain, we discretise the northern Apennines external Arc by means of a Triangular Dislocation Elements (TDEs) mesh and resolve the variability of the slip-deficit rate pattern on fault planes. (Fig. 2 a) According to Meade and Loveless (2009), we calculate the interseismic coupling degree as the ratio of the slip deficit rate and the

long term slip rate, derived from the relative motion of the bounding blocks (Fig 2 b). We therefore investigate each fraction of coupling increment to discern portions of fault planes characterized by a complex behaviour (i.e., aseismic creep vs. elastic responses). Finaly, we detect at least three locked asperities, with which we propose a set of possible rupture scenarios and calculate the amount of seismic moment rate that the Emilia Romagna region is accumulating. The obtained seismic moment accumulation rate (M0i, 3.21 x 10^{16} Nm/yr) is higher than the rate of the released seismic moment (M0, 2.2 x 10^{16} Nm/yr) in the last ~35 years (from earthquakes database of Latorre et al., 2023). Finally, according to our calculation, the difference between M0i and M0, define the total amount of seismic moment rate that this region is accumulating, equal to 1.01 x 10^{16} Nm/yr. Assuming that all this energy is released elastically (the worst condition), it would be the equivalent of an earthquake of Mw ~ 4.4, each year.

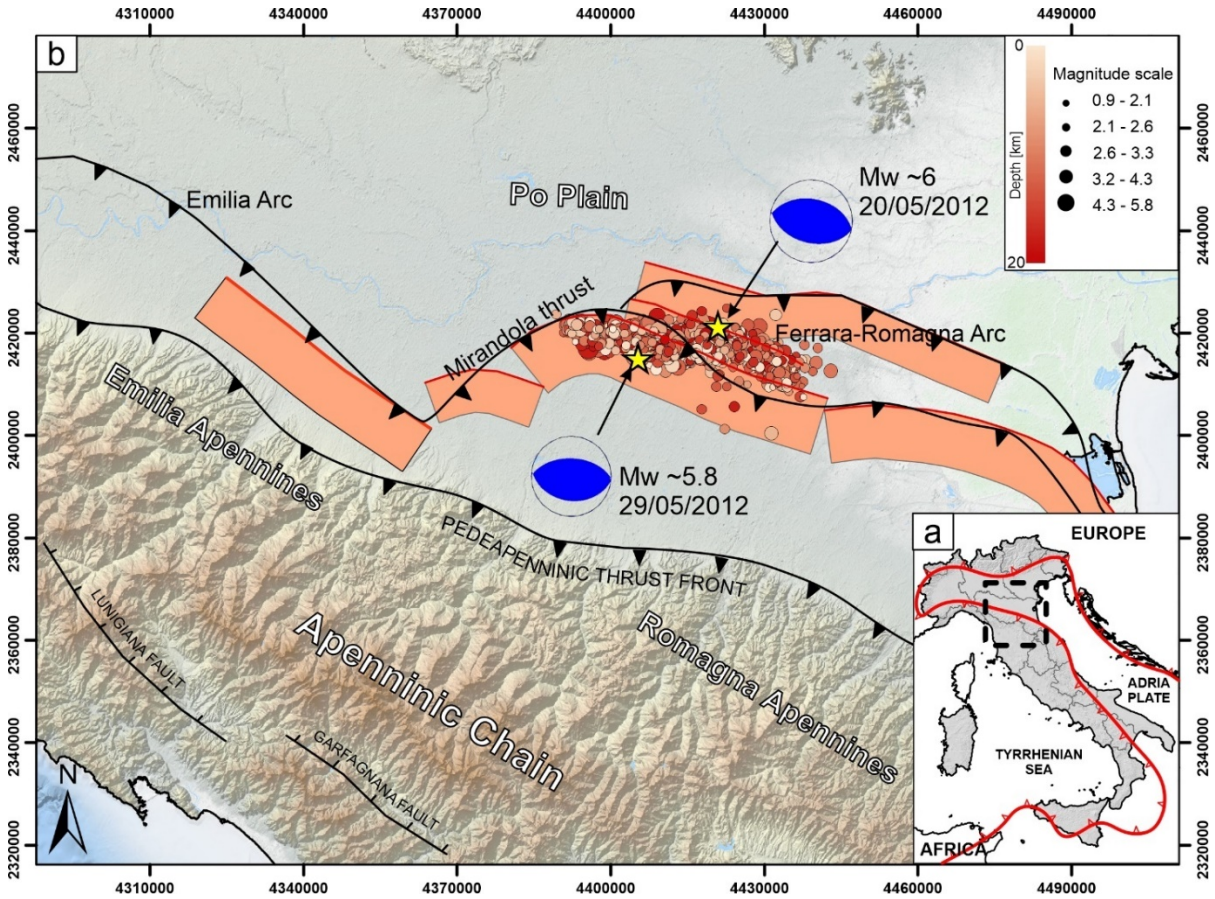

Fig. 1 – a) Europe-Africa relative convergence in the context of the Central mediterranean area, (red line represent the front of the collisional domain. – b) Simplified seismotectonic map of the Emilia region (modified after: Toscani et al., 2009; Martelli et al., 2017). Seismogenic sources in orange are from DISS (Database of individual Seismogenic Sources). The microseismicity associated to the 2012 seismic event is from La Torre et al., 2023 (CLASS Database). Focal mechanisms of the May 2012 mainshocks are from INGV (https://terremoti.ingv.it/en). Digital Elevation Model from emodnet (https://emodnet.ec.europa.eu/).

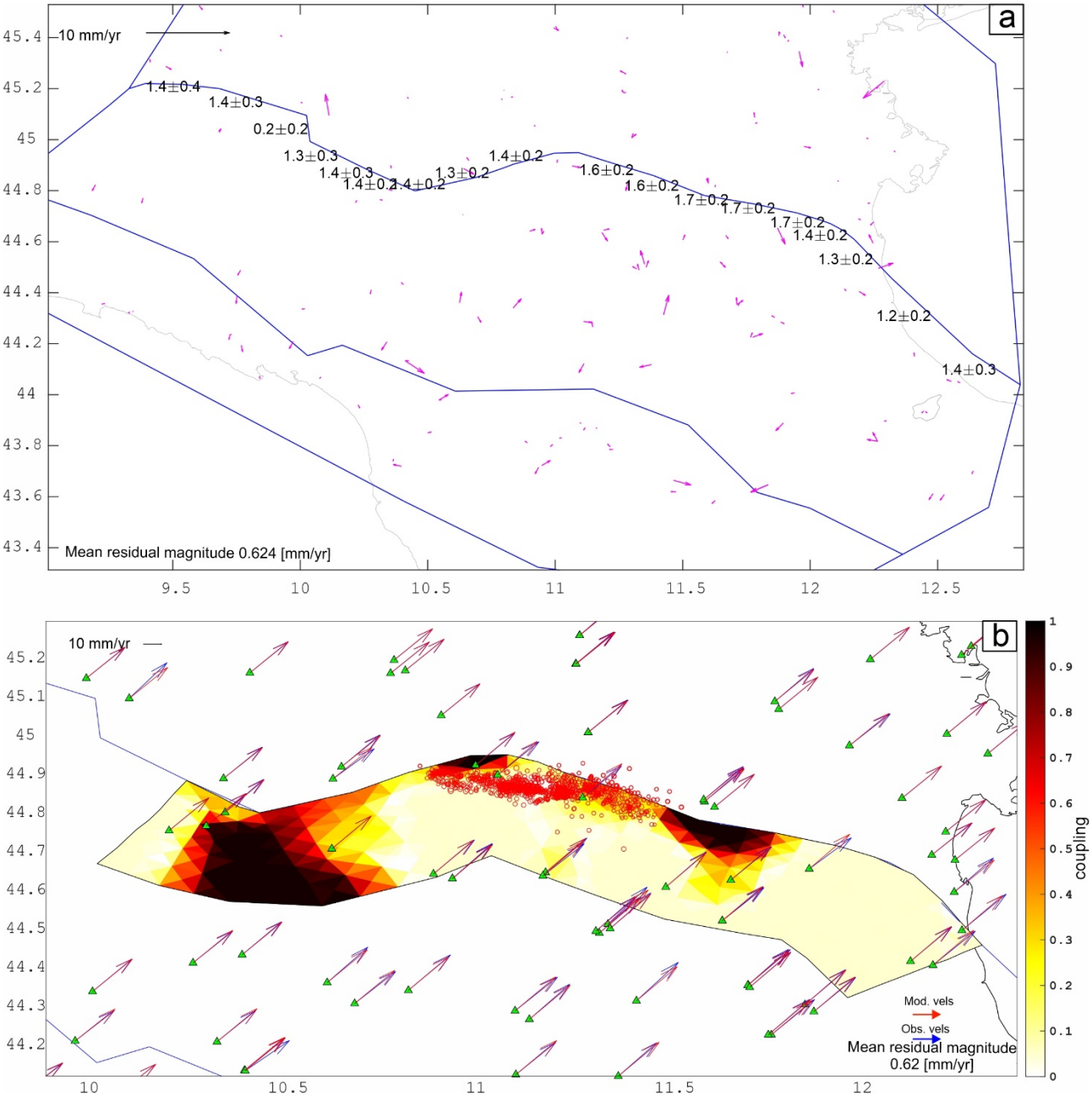

Fig. 2 – a) *long-term slip rate values (dip slip components) of the northern Apennines external Arc. – b) view of the triangular patches mesh coloured as function of the interseismic coupling distribution, red circles indicate the instrumental seismicity from CLASS database (La Torre et al., 2023), blue and red arrows indicate the observed and the modelled velocity field respectively, green triangles are the permanent GNSS stations of Serpelloni et al., 2022 (in ITRF 2014 reference frame).*

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