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3D geological model of the Po Plain subsurface: an example of open geological base data for basin analysis

C. D'Ambrogi, M. Marino, F.C. Molinari, M. Morelli, A. Irace, L. Barale, F. Piana, G. Fioraso, P. Di Manna, and P. Mosca

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PO PLAIN

Main characteristics

DATA

Distribution of input data

METHOD

Stratigraphic scheme and 3D velocity model

3D MODEL

Modeled horizons and faults

USES

How to use the 3D model

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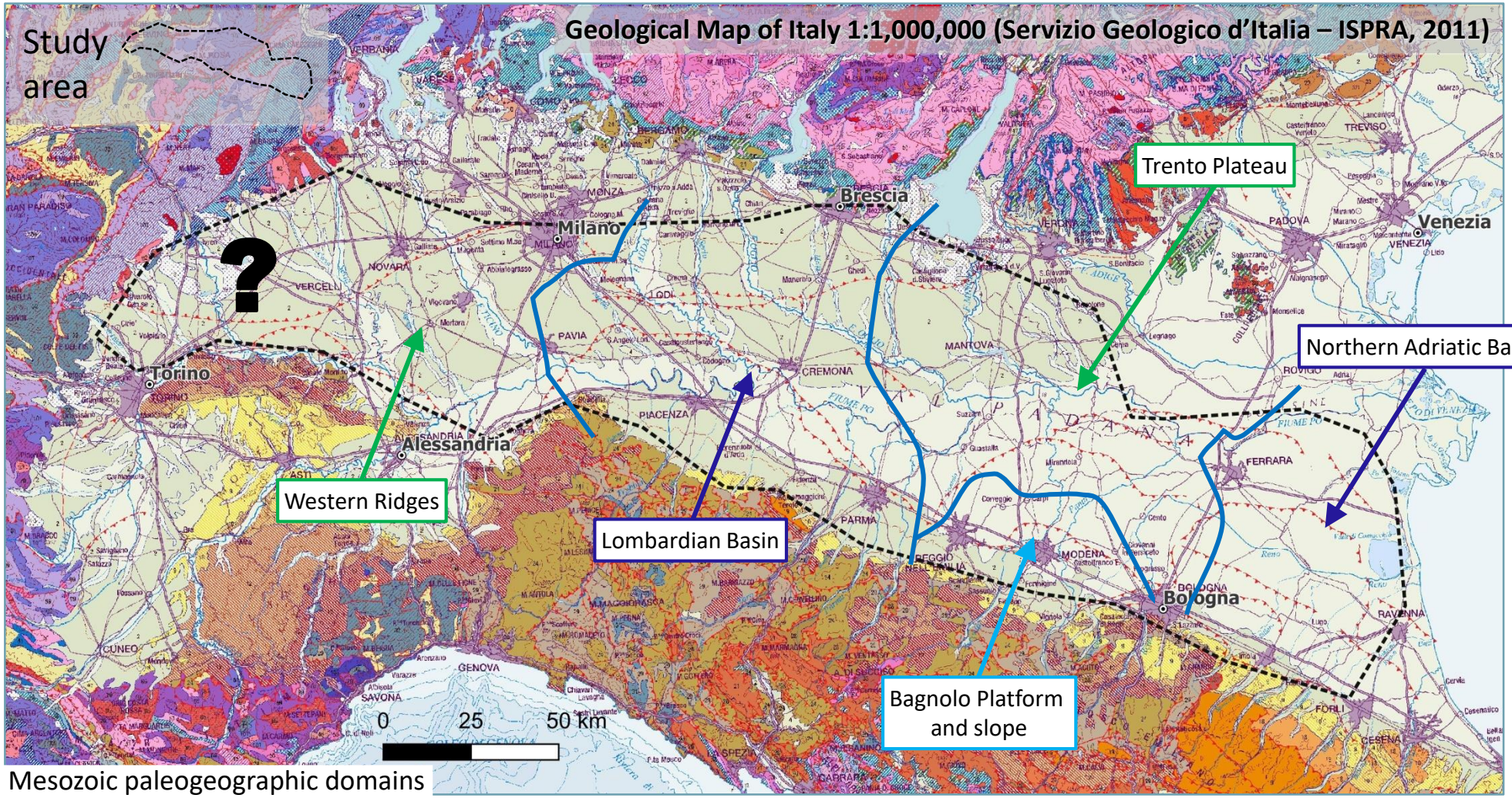
PO PLAIN

Complex buried geological system

- Triassic to Quaternary sedimentary successions with high facies and thickness variability
- mutual interaction of the Western Alps, Southern Alps and Northern Apennines orogenic belts, and related synorogenic basins
- presence of seismogenic faults

Several studies investigated limited chronostratigraphic intervals, specific topics or small areas, also in 3D (**TURRINI** et al, JMPG, 2014; **AMADORI** et al, Bas Res, 2019).



Mesozoic paleogeographic domains

(after **FANTONI & FRANCIOSI**, Rend Fis Acc Linc, 2010; **RONCHI** et al, Sedim, 2011; **MASETTI** et al, AAPG Bull,2012; **LIVANI** et al, JGR, 2018)

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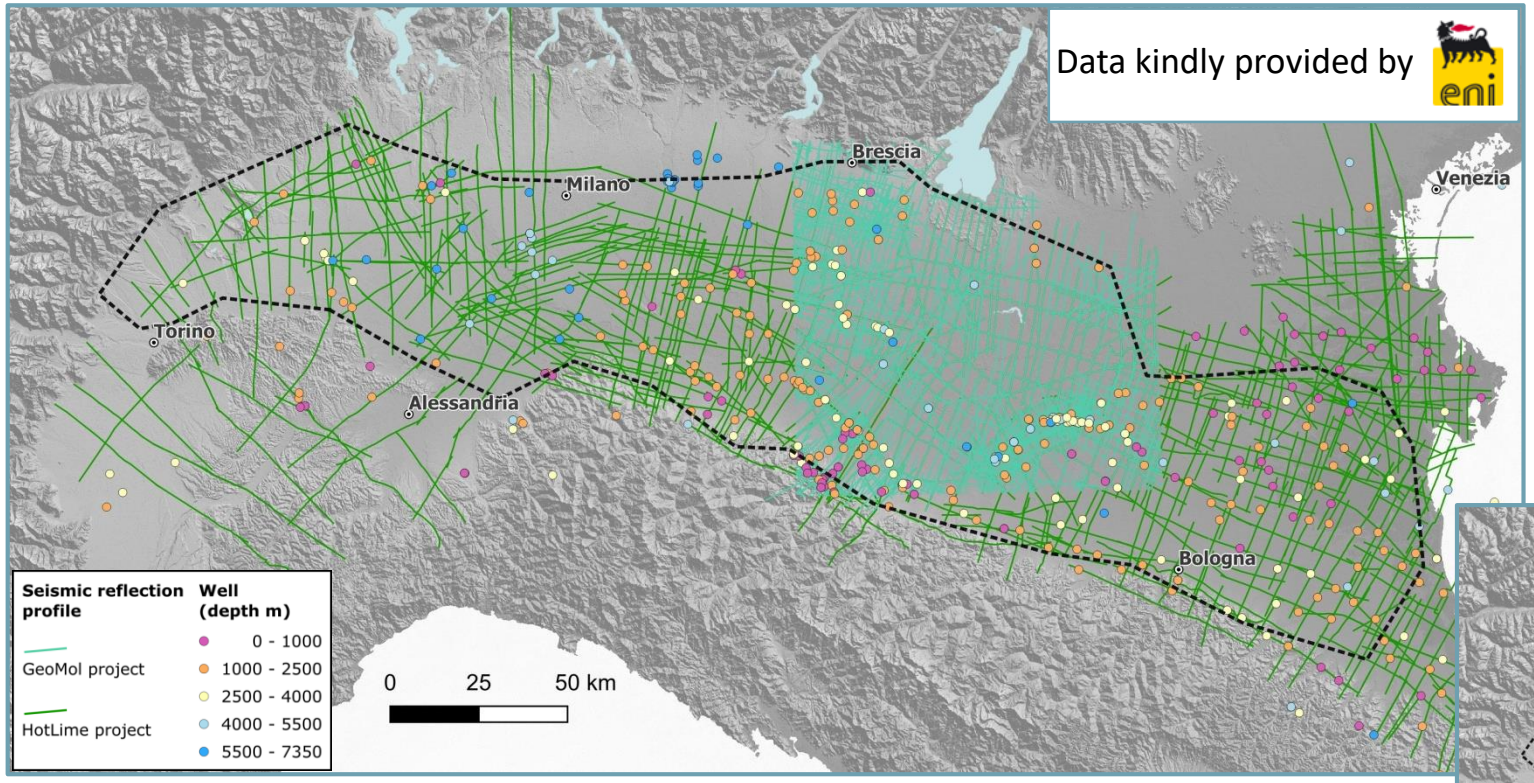
INPUT DATA



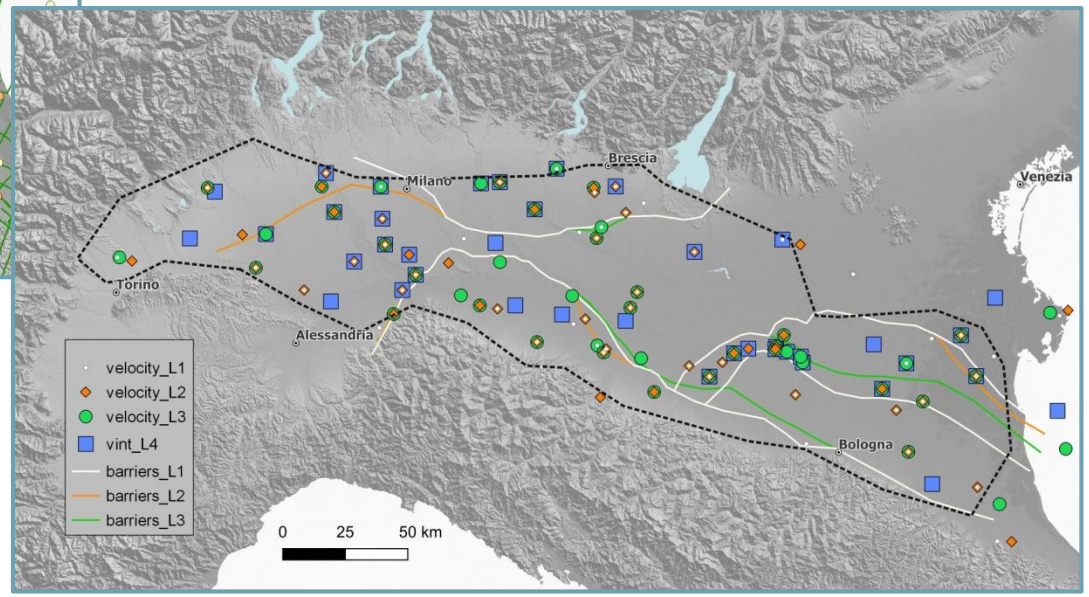
- 26,600 km of seismic reflection profiles interpreted
- > 450 wells analyzed

in the frame of EU-funded projects GeoMol (concluded) and HotLime (ongoing)

HotLime GeoERA

GeoMol Assessing subsurface potentials of the Alpine Foreland Basins for sustainable planning and use of natural resources

> 50 Time-Depth tables used to build the 3D velocity model



- Surface data from Geological Survey of Italy and regional-scale studies (**PIANA** et al, 2017, Jour of Maps)
- Existing 3D geological model (**GEOMOL PROJECT** – www.geomol.eu; **ISPRA,** Rep 234, 2015) and regional subsurface studies (**RER & ENI-AGIP**, 1998; **REG. LOMB & ENI-AGIP**, 2002; **IRACE** et al, 2009)

HotLime GeoERA

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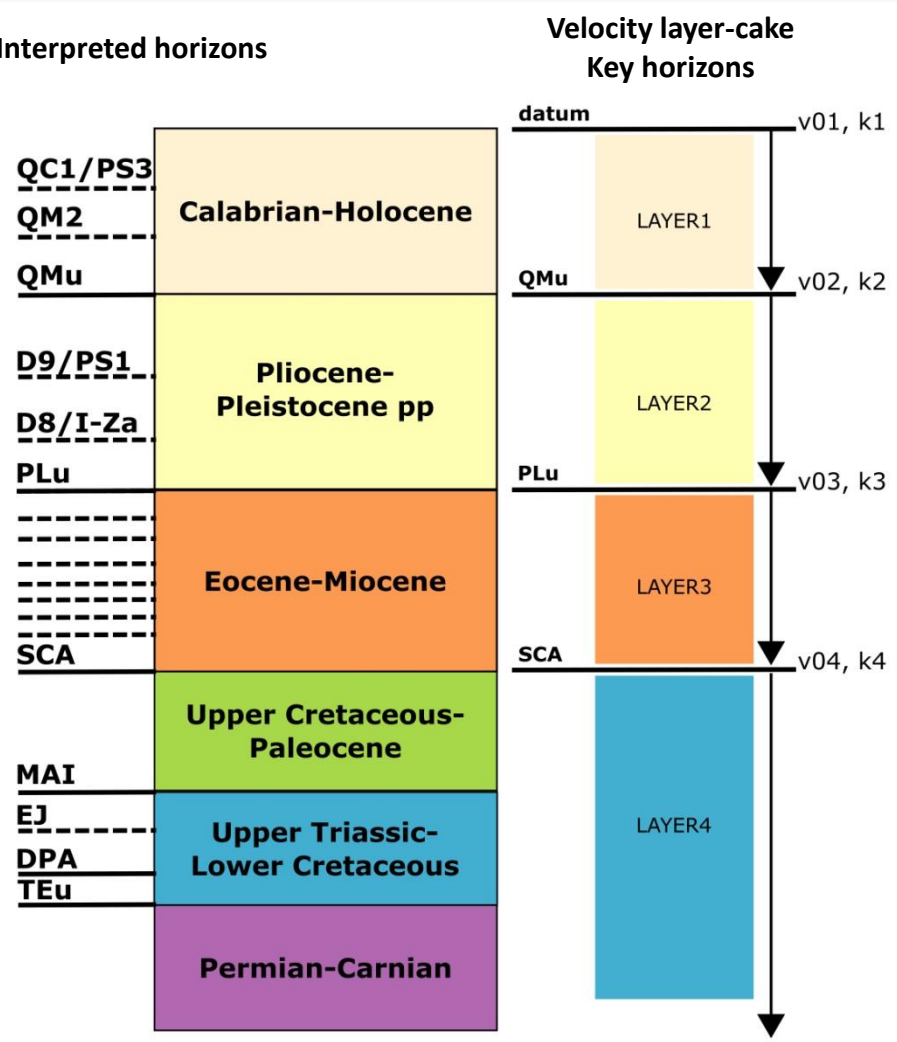
METHOD

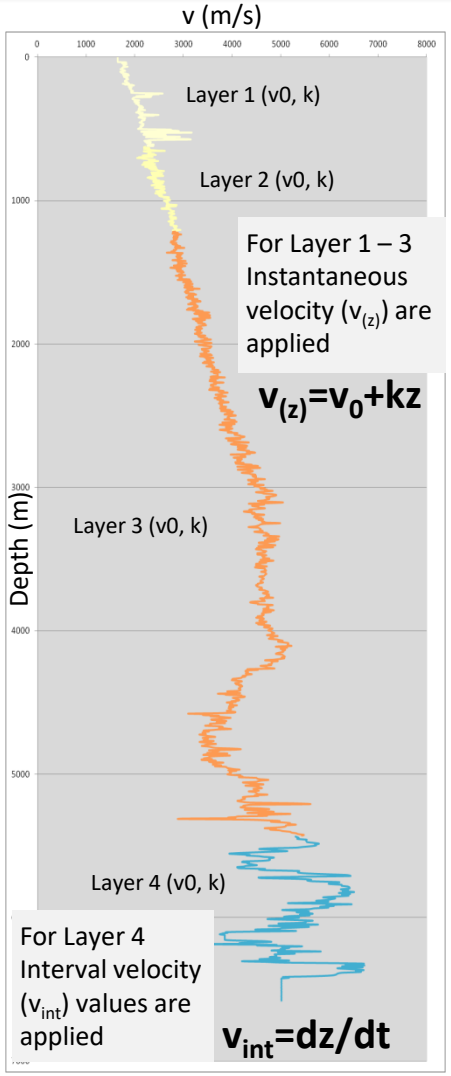
3D geological model → 3D velocity model

- Horizons have been defined according to regional stratigraphic studies and geological maps (**Irace** et al, 2009; **ISPRA,** Rep 234, 2015; **Rossi**, JMPG, 2017; **Piana** et al, 2017, Jour of Maps; **Amadori** et al, Bas Res, 2019; **Ghielmi** et al, Geol Insub, 2019).
- The integrated analysis of surface and subsurface data allows for better interpreting and correlating the key horizons. For the first time the 3D geological modeling of the area have been approached as a whole.
- The defined horizons describe major sedimentary and structural events.

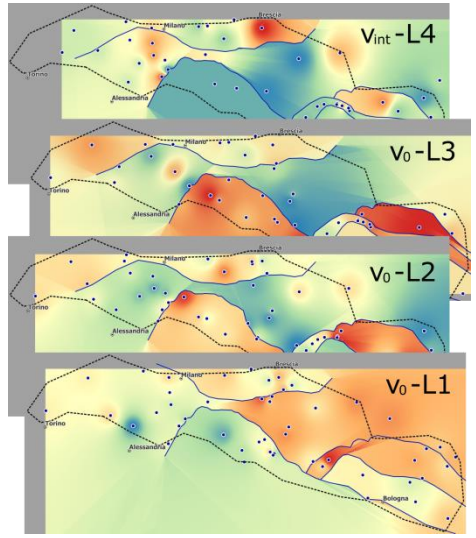


major — discontinuous

CODEu unco
CODE top



- The whole 3D geological model in time is depth-converted using **Vel-IO 3D** tool and method proposed by **Maesano & D'Ambrogi** (Comp & Geosc, 2016)



Maps of v value variations from **Vel-IO 3D**

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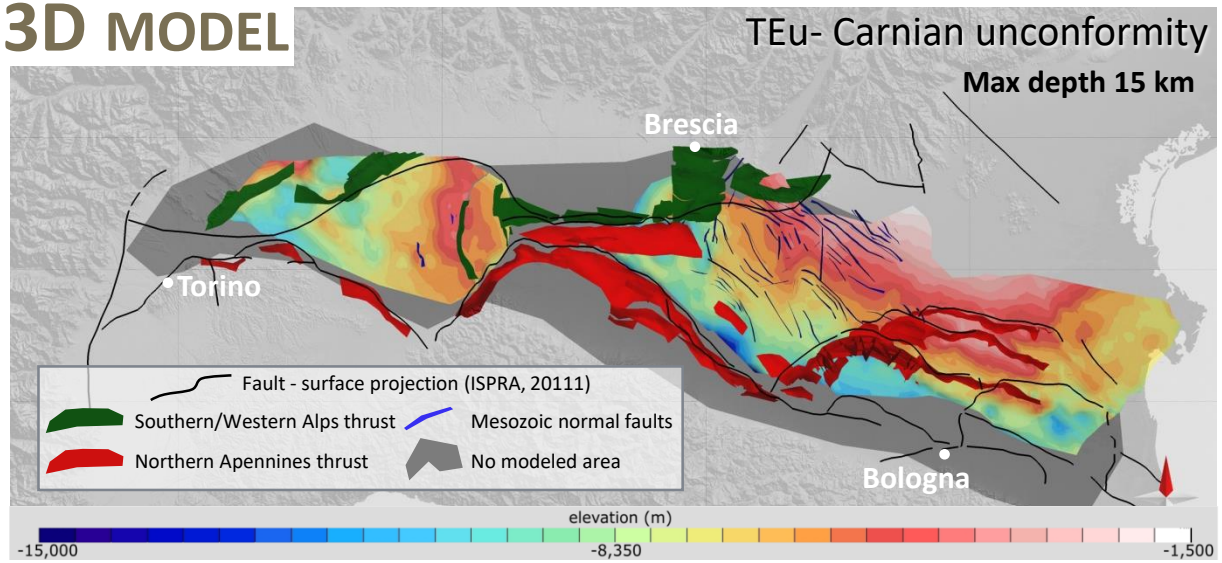
3D MODEL

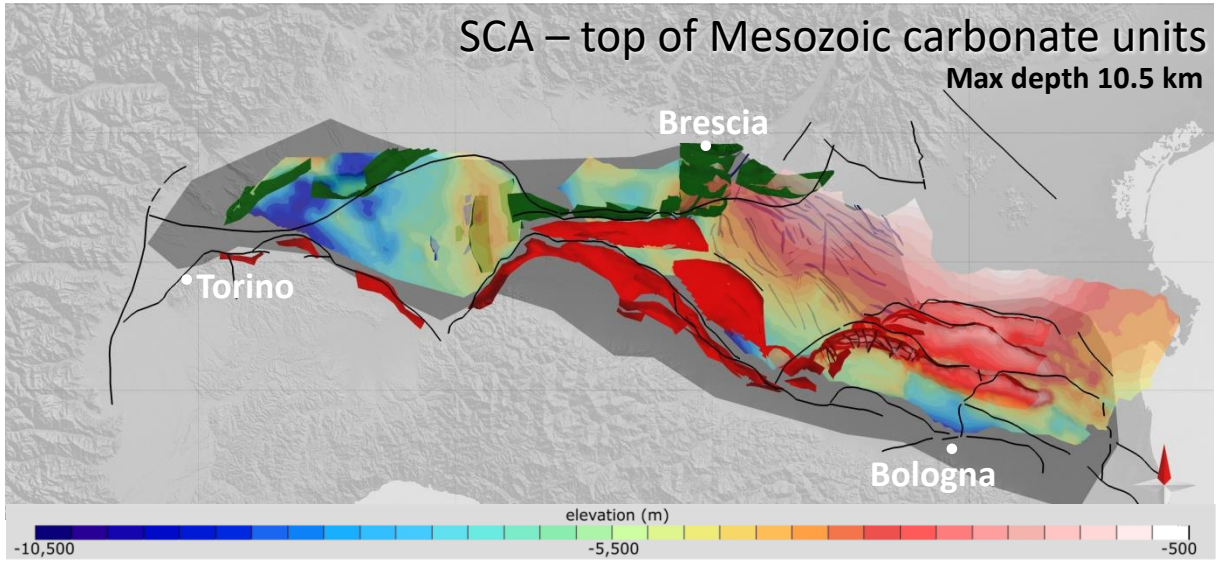
TEu- Carnian unconformity

Max depth 15 km



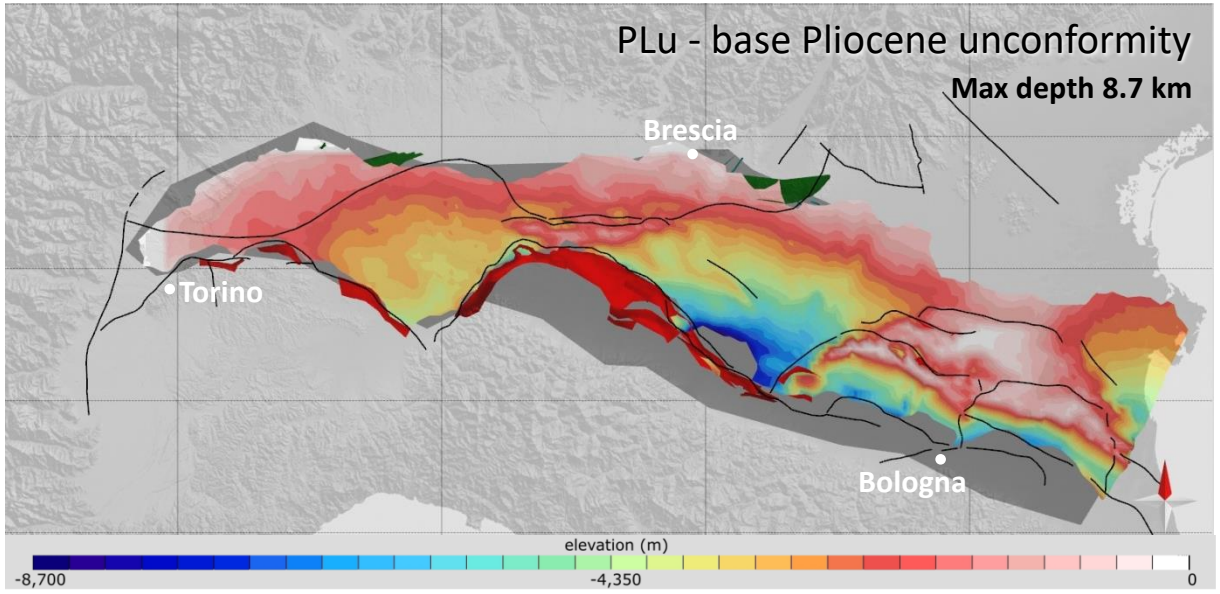
SCA – top of Mesozoic carbonate units

Max depth 10.5 km



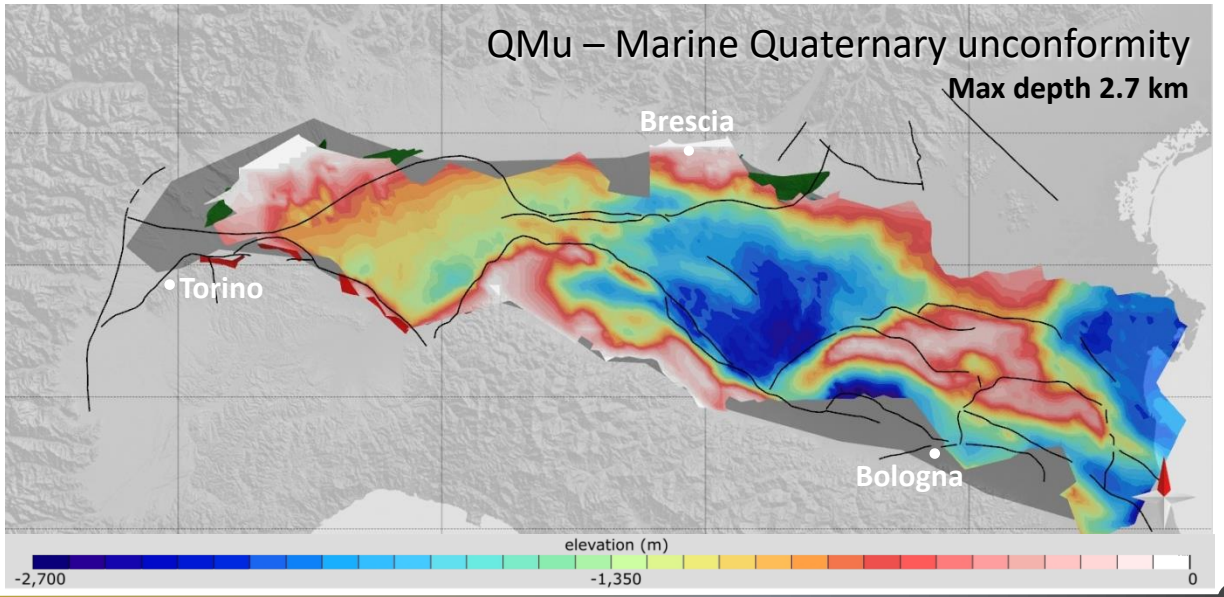
PLu - base Pliocene unconformity

Max depth 8.7 km



QMu – Marine Quaternary unconformity

Max depth 2.7 km



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3D MODEL

The **3D GEOLOGICAL MODEL OF THE PO PLAIN SUBSURFACE**
is the first attempt to provide a general-purpose, comprehensive and accessible 3D model of the general framework of the entire Po Plain subsurface, extended from Piemonte to Emilia-Romagna Region - Adriatic coastline, including:

- the distribution and geometry of the main Triassic to Quaternary sedimentary bodies;
- the position and geometry of > 150 faults, both Mesozoic extensional faults and Paleogene to Neogene thrusts.

It summarizes and integrates the knowledge deriving from surface and subsurface geology studies in the region.

The supra-regional **3D GEOLOGICAL MODEL OF THE PO PLAIN SUSBURFACE** constitutes a powerful tool, as it represents:

1. an improvement of the knowledge on the still controversial geological reconstructions of the Po Basin
2. the starting point for several thematic applications, such as the development of wide-scale geothermal, seismotectonic, and hydrogeological models.

Free Accessibility
(June 2021)

Map Viewer GeoERA INFORMATION PLATFORM

WMS – Web Map Service

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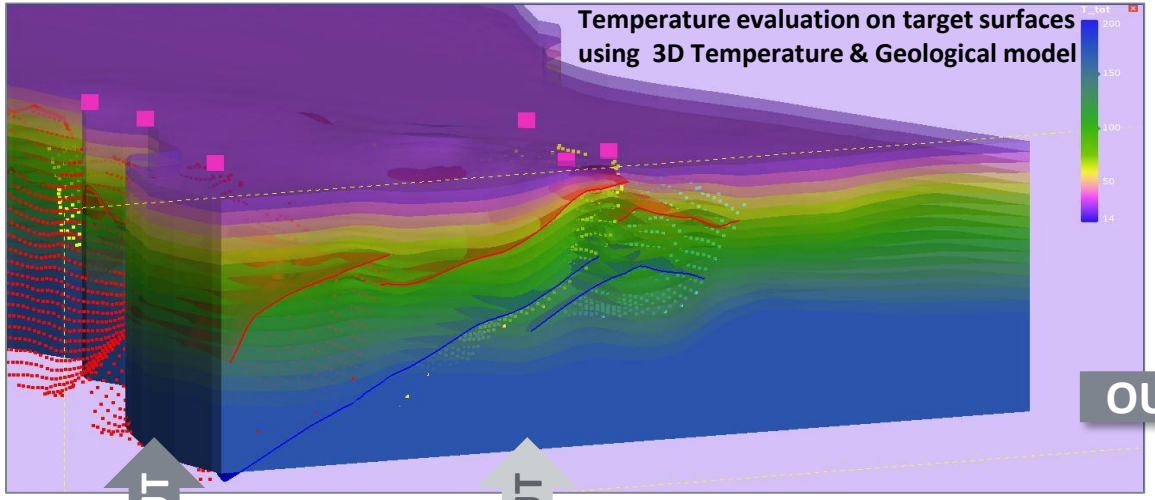
USES

3D GEOLOGICAL MODEL OF THE PO PLAIN SUBSURFACE is a basic input for

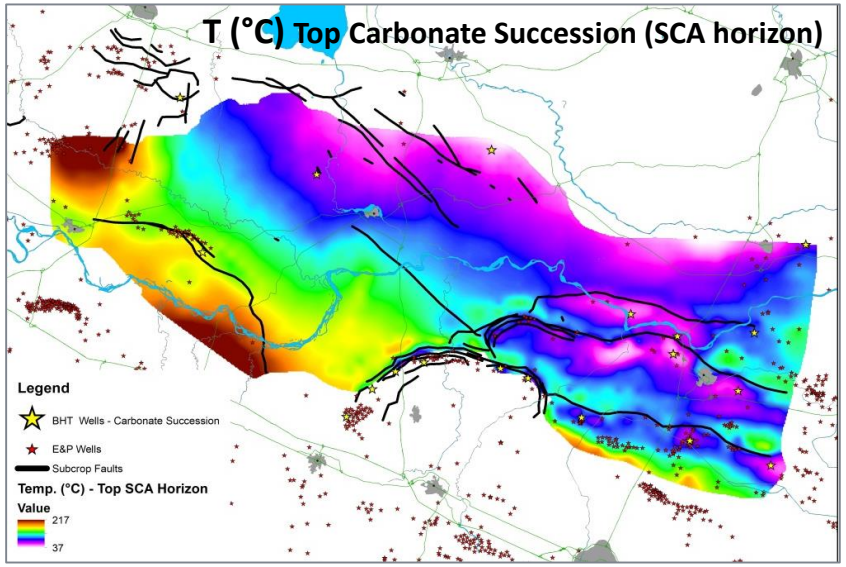


- **3D Temperature Model**
  Analytical a-priori model

Results of HotLime GeoERA

OUTPUT

Thematic Maps
Data analysis in ArcGIS



INPUT

Geological Model
[x,y,z points]

INPUT

T (°C) [x,y,z points]

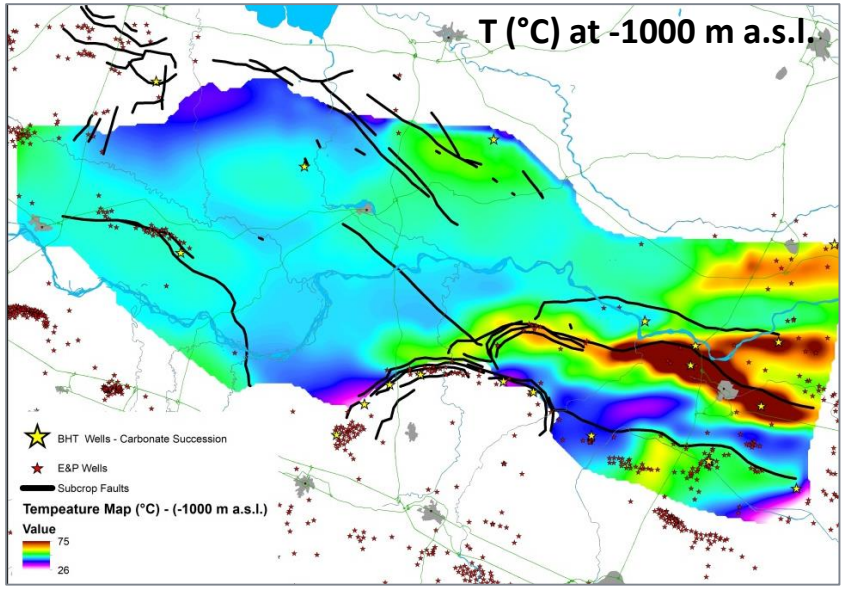
Data analysis in GIS

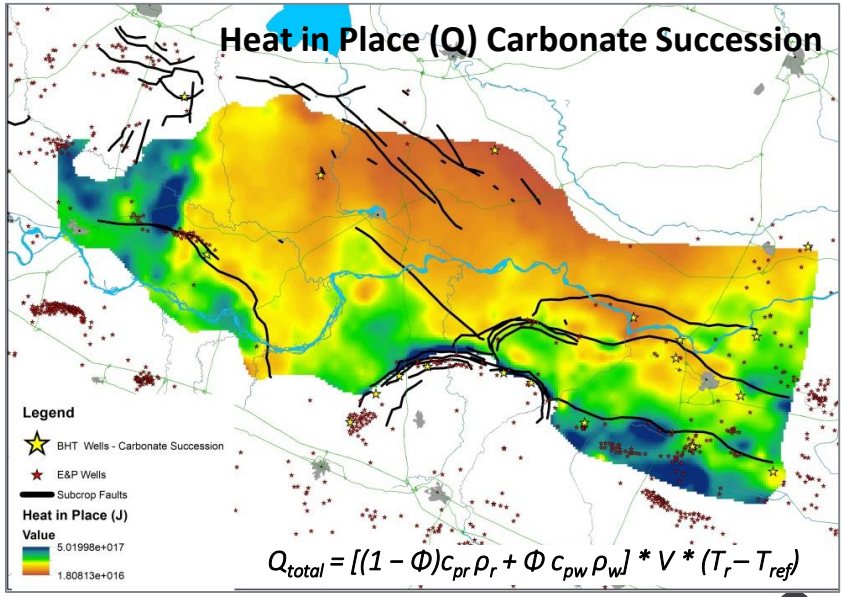
Temperature evaluation
Geothermal Gradient (K0 - Siliciclastic succession)
Geothermal Gradient (K1 - Carbonate succession)

BHT temperature analysis & analytical/empirical correction

The dataset

Bottom Hole Temperature from E&P well profiles
40 data - siliciclastic succession
19 data - carbonate succession





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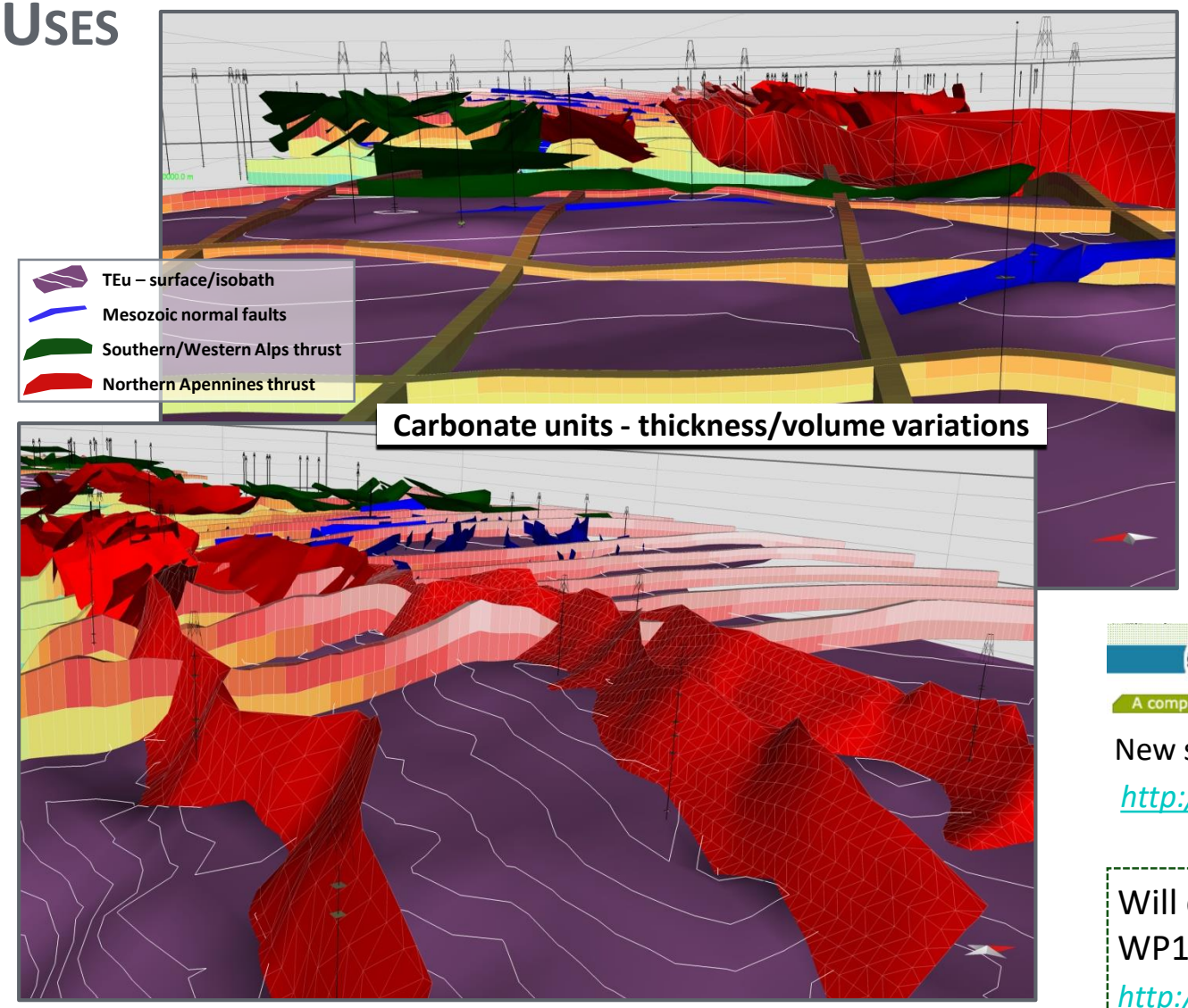
USES



3D GEOLOGICAL MODEL OF THE PO PLAIN SUBSURFACE
is a basic input

- to define the average depths and thicknesses of the aquifers and aquitards, and the depth of the fresh-salt interface

GeoERA RESOURCE GROUNDWATER

Resources of groundwater harmonized at cross-border and pan- European scale

HIKE GeoERA GEO-ENERGY

European Fault Data Base

Hazard and Impact Knowledge for Europe

- to provide 3D fault's geometries and characteristics

Istituto Nazionale di Geofisica e Vulcanologia
Database of Individual Seismogenic Sources
DISS version 3
A compilation of potential sources for earthquakes larger than M 5.5 in Italy and surrounding areas

New seismogenic sources and reshaping (e.g. geometry, depht) of existing ones

http://diss.rm.ingv.it/diss/

Will contribute to **EPOS**
WP15 *Geological Information and Modeling*
http://www.ics-c.epos-eu.org/

EPOS EUROPEANPLATEOBSERVINGSYSTEM

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