Geothematic open data in Umbria region.

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Abstract

Detailed information about geology, hydrogeology and seismic hazard issues for Umbria region are contained in a spatial database available as open data format (shapefile or KMZ) and distributed under the regional open data portal called Open Data Umbria (http://dati.umbria.it) where 297 datasets have been produced by Umbria Region until now and most of them are made by Geological Survey. Geological Survey of Regione Umbria carried out a 20 years program to produce 276 geological maps at 1:10.000 reference scale with an accurate geological model of the regional surface and providing millions of geological data. The key word is the *characteristic index of the single geologic unit*. *Characteristic index*, shown in percentage, calculates the ratio between the surface of the geologic units compared to their thickness. Thickness value for each geologic unit is intended to be based on rank level and calculated as weighted average of the thickness for each geologic unit.

Standardization of geological data and data availability

Detailed information about geology, hydrogeology and seismic hazard issues for Umbria region are contained in a Geological DataBase (GDB from now on), a spatial database available as open data format (shapefile or KMZ format) and distributed under the regional open data portal called Open Data Umbria (http://dati.umbria.it/dataset/carta-geologica-dell-umbria) where 297 datasets have been produced by Geological Survey of Regione Umbria until now and most of them are made by Geological Survey. Development of standardized regional geologic database took about 2 years since 2010 to manage the huge set of information contained in the 276 former geologic maps, covering the whole territory of Umbria.As a result of migration to GDB, 231 distinct geologic units were found for Umbria Region territory represented by about 47,000 polygon features. The total land area of Umbria 8,475 km ^{2} wide is divided in the GDB into 46,982 different geological areas. Analysis of the information contained in the GDB is preliminary to the creation of more geothematic layers and custom maps led us to define an item describing in a comprehensive way the geological units: the geological representativeness and the Characteristic Index of the single geologic unit. This means evaluating geological units or domains not just for their 2D extent but even in 3 dimensions. Characteristic index, shown in percentage, calculates indeed the ratio between the surface of the geologic units and their thickness. Thickness value for each geologic unit is intended to be based on rank level and calculated as weighted average of the thickness for each geologic unit. Examples are shown in figure 1 and 2, the areas occupied by the alluvial deposits and terraced and those of ancient and very ancient alluvial deposits of Pliocene-Pleistocene age. Figure 1, shows the area occupied by the current and terraced alluvial deposits and those of ancient alluvial deposits of Pliocene-Pleistocene age. In light blue areas occupied by the alluvial deposits and current terraces, which occupy 17.3% of the region, and in yellow the ancient and very ancient alluvial deposits, which occupy 19% of the region. Globally, therefore, the alluvial deposits of different ages occupy 36.3% of the region, far out 1/3 of the entire region. The geological representativeness of current and terraced alluvial deposits is 0.56%, while that of the very old and ancient alluvial deposits is 26%. No doubt These numbers indicate that the alluvial deposits current have a geologic representativeness very different from the more ancient, the former deposits extent is large but its thickness is

pellicular with an approximately 1/45 of the form factor; on the other hand the latter show a little thickness compared to their extent. Figure 2 shows at regional level the situation for merged and reclassified geological units compared to the percentage of total land area, and Figure 3 the geological representativeness of the geological domains for the Umbria Region.

Geological and numerical analysis of the Umbria geothematic open data

a-Potential aquifers

Processing the data contained into GDB led to the Hydrogeological map of the Valle Umbra, where geological units capable to store water and those capable to be possible aquifers are identified. There are many differences between the percentage of the region capable of storing water and the geological representation of units capable of storing water. The situation changes if instead we analyze aquifers within individual geological domains and their geological whose graphic representation of the figure 4 and 5 show significant differences.

b-Seismic hazard

Another geothematic open data made by Geological Survey is the local seismic hazard cartography. Local seismic hazard maps showing part of the territory with morpho-stratigraphic situations producing local amplification of seismic forces generated by earthquakes. Distinct situations were all structured in a geodatabase. Local seismic hazard mapping at 1:10.000 scale started in 1997 with the discovery of the epicentral area of the quake. A total of 265 maps at 1:10.000 were made as a result of seven different cartography project promoted by Geological Survey, from 1997 to 2013.A total of 265 maps were made of local seismic hazard during 7 projects, the last of which was completed in 2013. There have been 13 different distinct situations where local conditions may occur with the greatest impact of earthquakes. It was subsequently made the homogenization of all data and its Geological Data Base which also has been made accessible in open format at http://dati.umbria.it/dataset/carta-di-pericolosita-sismica-locale-dell-umbria . Umbria has been divided in thirteen zones where local conditions, i.e. presence of artificial fills or particular surface topography, may affect the shaking levels and amplify the effects of the earthquake. The total land area of Umbria is 8,475 square kilometers, and it has been classified in 69,675 unique zones each one characterized by particular seismic hazard. Statistics also show that 48 % of Umbria land area is characterized by morphological and stratigraphic conditions affecting the shake while 52 % is not subject to amplification. Population living in area with no amplification is 322,987 accounting for 36.5 % of the total while 561,281 accounting for 63.5 % of the total live in area where amplification of the shake is likely to happen.

Conclusion and perspectives

The use of the representativeness of geological units, as it has been defined here, let us properly assess the impact of the same geological units in the three dimensions. The representativeness of geological units will also be able to assess the incidence of the different geological units in the environmental field and other at different scales.
Currently there are efforts of coordination in the field of geology and geodatabase between Regione Umbria, Emilia-Romagna, Marche and Tuscany, that have led us to define the homogeneous geological-structural scheme of Northern Apennines on account of the hundreds of thousands of information contained in a common GDB. More actions to provide a unique interregional GDB, along with its update, are planned. New geothematic cartography, almost ready, is Geological Map of the Tuscan- Umbrian bedrock. The Regione Umbria has a specific multilingual web portal: "Open Data Umbria" http://dati.umbria.it/".At the end of July 2016, 308 open datasets have been published and distributed under Creative Commons Attribution License (cc-by) to download through the website search functionalities; most of them are geothematic open datasets produced by the Regional Geological Survey.

Figure 1 – Overview of distribution of geological domains in Umbria from Geological Database analysis.

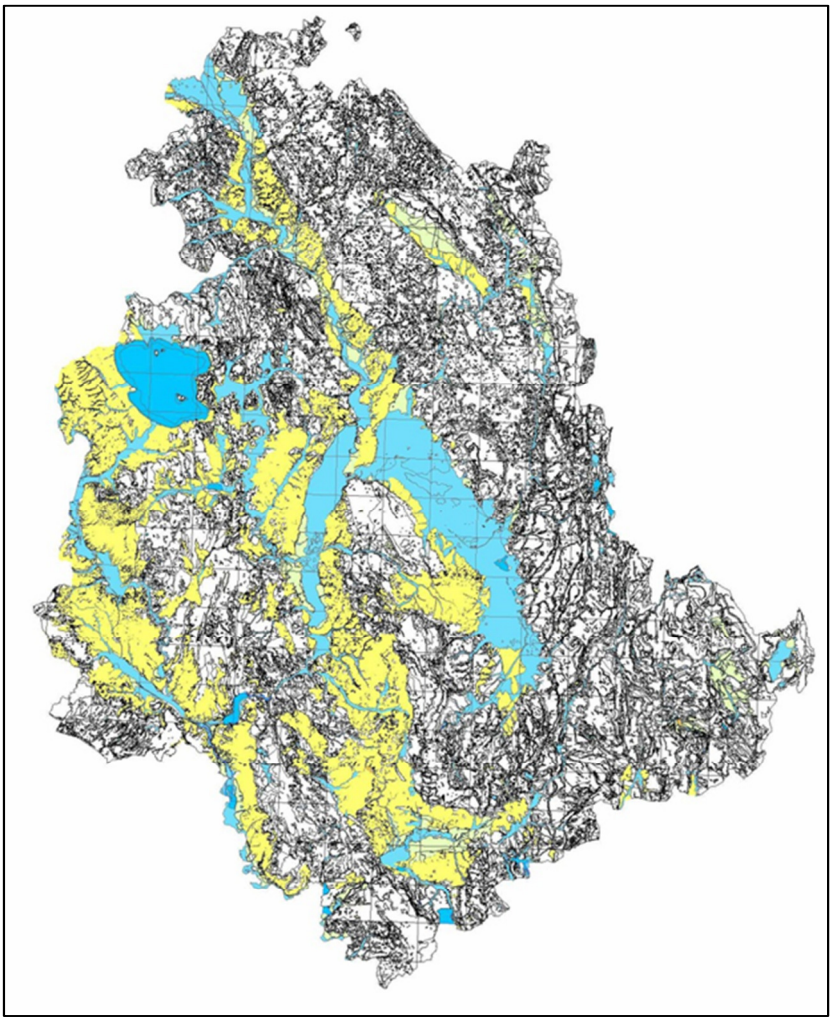


Figure 2 – Chart shows geological domains extent compared to Umbria Region total land area (in percent).

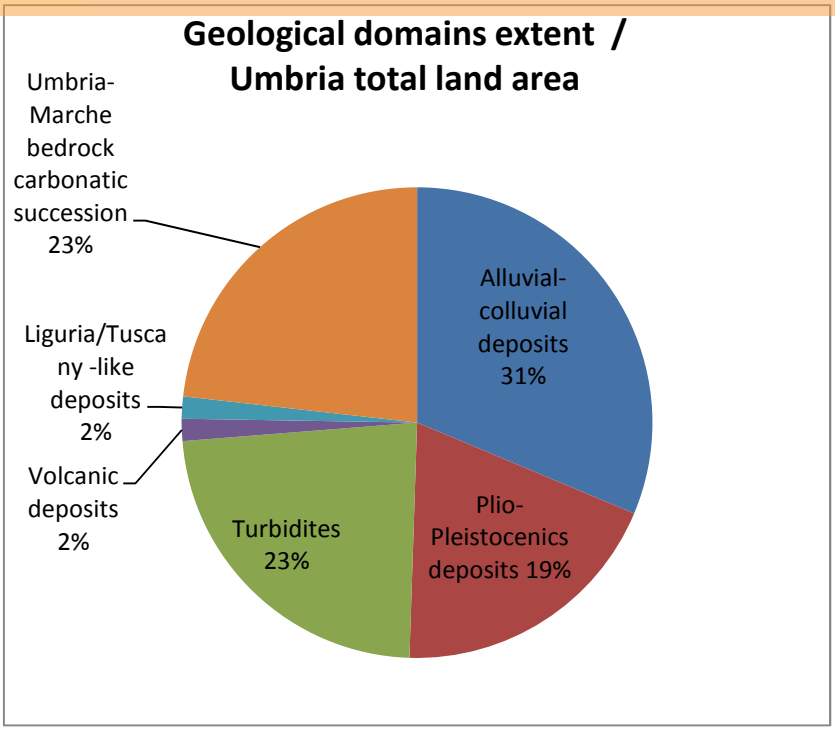


Figure 3 - Representativeness of the single geologic domain and its Characteristic Index.

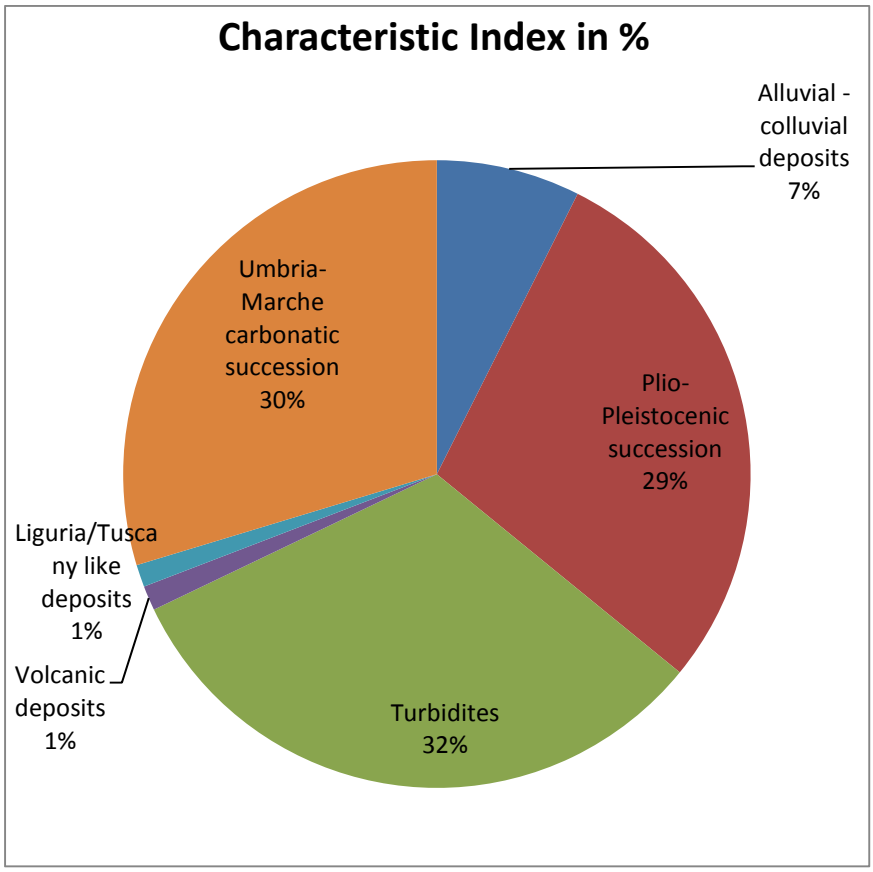


Figure 4 – Chart showing an analysis from Geological Database: aquifers area compared to total land area of Umbria, shown in percent.

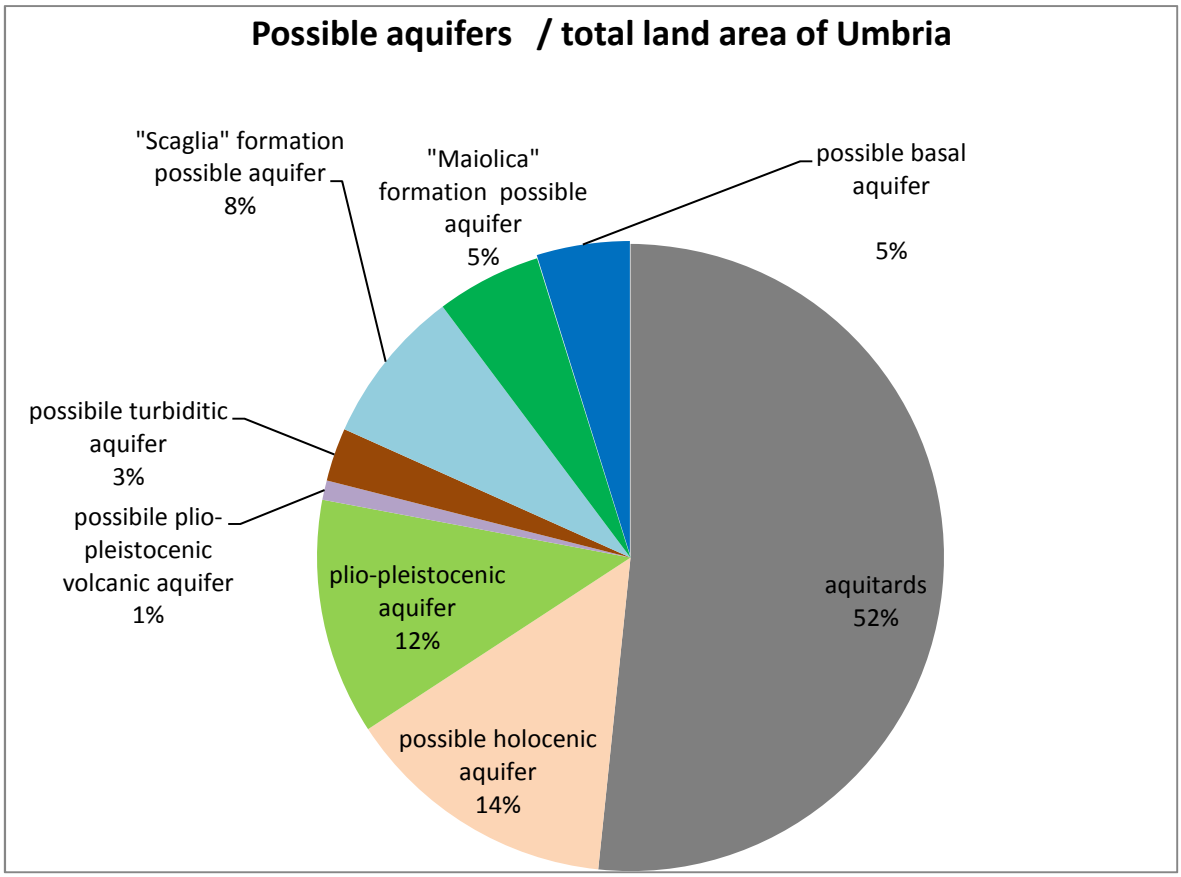
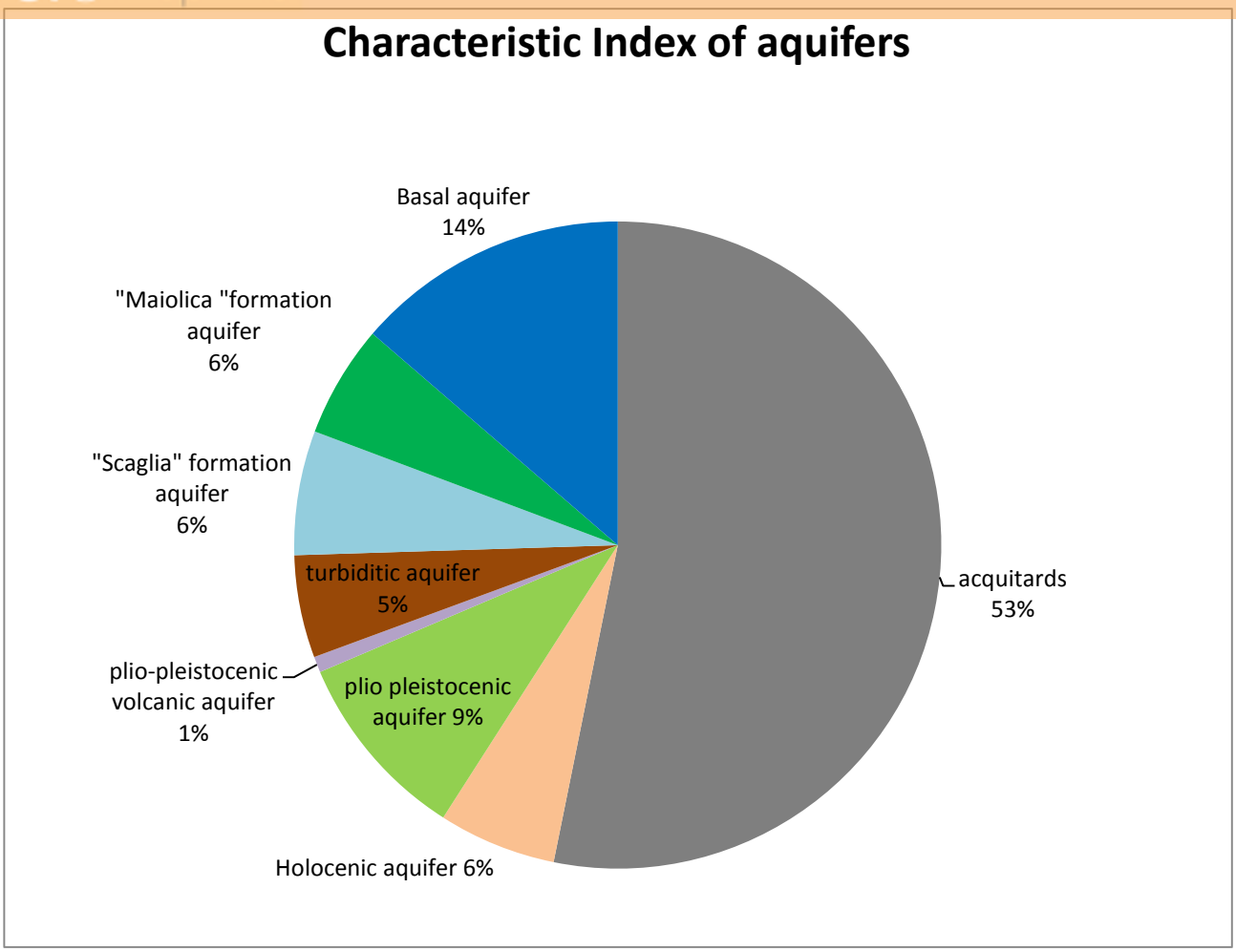


Figure 5 – Representativeness of single aquifer and its Characteristic Index.



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