INTRINSIC VULNERABILITY MAP OF GROUNDWATER BODIES IN THE EMILIA-ROMAGNA APENNINES

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FOREWORD

Following the instructions contained in the implementing provisions of Directives 2000/60/EC (the Water Framework Directive) and 2006/118/EC, the Emilia-Romagna groundwater bodies (GWB) Map was drafted in 2009. For the first time a knowledge framework on regional mountain aquifers was thus outlined and applied to the Management Plans developed by Basin Authorities. It was subsequently requested to undertake a classification of groundwater bodies based on their intrinsic vulnerability.

INTRINSIC VULNERABILITY IN MOUNTAIN AREAS, ASSESMENT AND PROBLEMS.

Over the past decade, the hydrogeology of the regional mountain sector was for the first time systematically studied at the wide area level, thanks to the efforts of the Regional Geological Survey. It is well known that the mountain sector of the Region is to date documented by a much smaller hydrological data quantity than the one referred to the plain, Due to the delay with which regional studies have begun and given the misleading idea of having to do with a "second class" or "unknowable" drinking water supply.

Moreover, the mountain sector, due to geological reasons, suffers from more local variability scenarios fostering the storage of underground water.

All these factors require experts to proceed by successive approximations, when regional scale maps have to be developed.

The definition of intrinsic vulnerability (IV) is the one provided in literature by Civita (1987). This hydrogeological issue is significant when applied for processing information at a scale with a large denominator (ie 1:250.000), thus giving rise to a preliminary regional framework to be compared with the one referring to hydrogeological situation identified at national level.

To reach this result a nonparametric method can only be used for assessing IV as the GNDCI-CNR Method, dating from the late '80s and referred to by the more recent " Linee–guida per la redazione e l'uso delle carte della vulnerabilità degli acquiferi all'inquinamento" (De Maio et al, 2001). In the case study, in fact, a GWB cartography is available which, through the comparison with the 1:10.000 geological database, allows us to trace back (via the prevalence criterion of) to lithology and structural-stratigraphic context of the geological units that compose them, given that they are the most permeable hydrogeological units of the Emilia-Romagna Apennines.

The GNDCI-CNR Method is based on direct comparison between several hydrogeological pre-defined situations, according to the Italian geological setting; six IV classes are obtained, ranging from very low to extremely high degree. The GNDCI-CNR Method application to the Emilia-Romagna Apennines area needs to be duly adjusted, to avoid flattening out the IV classes down to the "medium" or "medium to low" degree, as demonstrated by a previous study experience (Viel, De Nardo and Montaguti, 2003). This adjustment to the local geology has been obtained by applying the "relative IV" concept, by comparing GWB hydrogeological items, starting from a few benchmarks deriving from the Method caption attributions, thus obtaining a preliminary result, as schematized in Figure.

TESTING THE GNDCI-CNR METHOD IMPLEMENTATION

Seizing the opportunity provided by this applied research, a test is underway to implement the IV classification obtained using the GNDCI-CNR Method, with reference to the data available in the Geological Survey data bases. The following factors are considered, through geostatistic methods:

- density of springs, tectonic lineations, drainage, hypogean cavities.
- acclivity classes and the presence of paleosurfaces, with sub-lowland areas where

pedogenesis achieves the utmost development, presence of "stable" wooded areas.

The purpose of these analyses is to identify areas within GWB in which the initial IV value, according to the GNDCI-CNR classification, could reasonably be raised in grade, without neglecting the need to "generalize" the possible zoning, by realistically taking into consideration its applicability for planning purposes. The result that will be obtained is in any case compatible with a 1:100.000 - 1:250.000 scale.

As already shown in previous experiments (Viel et al, 2003) it is possible to outline preliminary integrated aquifer vulnerability maps, matching intrinsic vulnerability maps with land use ones, available in previous regional information systems, serving as point of reference with respect to more detailed analyses, which could be obtained only through (not always available) local census results of centers of danger.

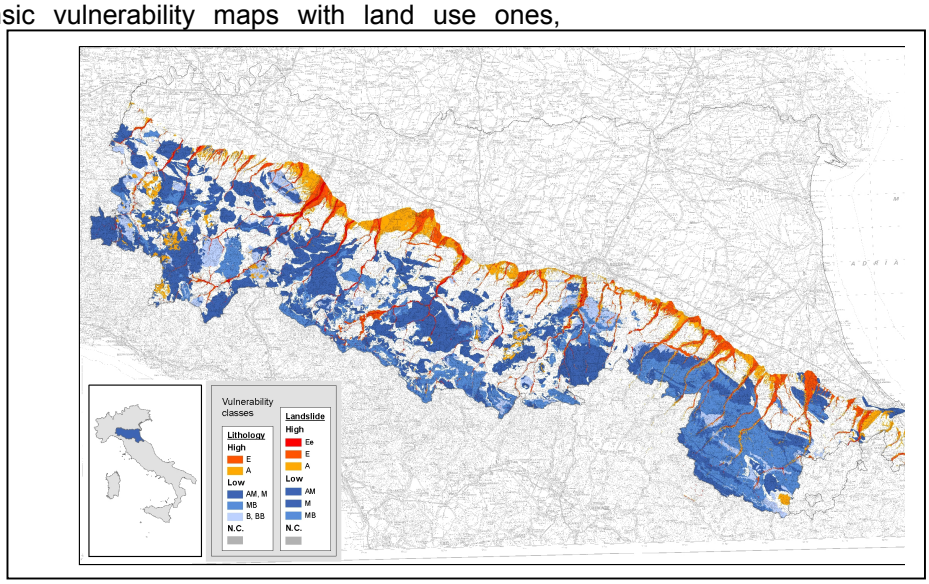

Figure 1 – intrinsic vulnerability map of groundwater bodies in the Emilia-Romagna Apennines, according to the locally adapted GNDCI-CNR Method

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