



SINTACS PROCEDURE AS A TOOL FOR THE EVALUATION OF THE INTRINSIC VULNERABILITY OF AN AQUIFER

The SINTACS procedure (Civita, 1994; Civita & De Maio, 1997) was proposed in studies of aquifers vulnerability provided by the "Gruppo Nazionale Difesa Catastrofi Idrogeologiche, CNR" (*National Group of Defense from Hydrogeological Disasters, CNR*). It is a parametric system with scores and weight which takes into account 7 parameters in order to evaluate the intrinsic vulnerability of an aquifer: the depth to the groundwater table, the effective infiltration, the unsaturated zone attenuation capacity, the soil attenuation capacity, the hydrogeological characteristics of the aquifer, the hydraulic conductivity and the topographical slope.

A range of points from 1 to 10 is assigned to each parameter according to the lithological, morphological, hydraulic, natural and biological characteristics of the area and of the rocky aquifers involved.

The final intrinsic vulnerability, the index SINTACS, is the sum of the scores of the seven parameters and is obtained by superposition of the seven thematic maps, in which a score (multiplied by the weight assigned to each input parameter) is assigned to each areal element:

$$\text{index SINTACS} = S_o r S_{o_w} + I_r I_w + N_r N_w + T_r T_w + A_r A_w + C_r C_w + S_r S_w$$

where

S_o = soggiacenza (*depth to groundwater table*)

I = infiltrazione efficace (*effective infiltration*)

N = non saturo (*unsaturated zone attenuation capacity*)

T = tipologia della copertura (*soil attenuation capacity*)

A = acquifero (*hydrogeological characteristics of the aquifer*)

C = conducibilità idraulica (*hydraulic conductivity*)

S = superficie topografica (*topographical slope*)

r = score

w = weight associated to each parameter

The study area is divided into square areal elements of predetermined size, according to a regular grid. Scores are assigned to each areal element by processing with the use of specific software. This software automatically processes the final map of the intrinsic vulnerability with a subdivision into six vulnerability classes: very high, high, high, medium, low and very low.

The map of the depth to groundwater table is obtained from the topographical map depending on the thickness of the unsaturated zone.

The parameter effective infiltration highlights the deep dragging of pollutants and their dilution at first in the unsaturated zone, then in the saturated one. It depends on the effective rainfall and the surface hydrological conditions, which are merged to obtain the index of infiltration, which is in turn determined by the surface lithology.

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As in general the soils have thicknesses equal to or greater than one meter, the average annual value of infiltration can be calculated by multiplying the value of the effective precipitation (P) for the coefficient of infiltration potential (X). The textural classes proposed by SINTACS to define the values of the coefficients of potential infiltration ($0 < X < 0.55$) are the same as proposed for the soil attenuation capacity.

The unsaturated zone attenuation capacity (effect of self-purification) highlights the chemical and physical processes that occur in the unsaturated zone and is a tool for the evaluation of self-purification and pollution mitigation explicated by unsaturated horizons. It is processed by assigning to each cell the values proposed by SINTACS protocol according to the hydrogeological complexes. These are recognized by using the lithological map of the first 15 m of the subsoil and the lithostratigraphic sections.

Pedological maps can be considered and use in order to develop the soil attenuation capacity (type of cover) map and define the extent of surface reduction of pollutant.

The hydrogeological characteristics of the aquifer depend on the degree of primary and secondary porosity, the litho-mineralogical composition and the permeability of the aquifer.

The hydraulic conductivity represents the groundwater capacity of moving in the saturated zone and gives informations on the speed with which a contaminant can reach the point of delivery.

REFERENCES:

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