WATER INTERFERENCES: DEFINITION, LOCATION, NATURE OF PROCESS AND INDUCED EFFECTS WITH APPLICATIONS IN ROMANIA (II)

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Abstract.- Water Interferences : definition, location, nature of process and induced effects with applications in Romania. In the first part of the paper defines the interference term retention, location and origin of the water that interferes and generates a special category of hazards fluid. Next, have been identified, analyzed and detailed localized, depending on their nature (physical, chemical and mechanical) phenomena and processes underlying this category of hazards fluid and environment effects that induce the different environments in Romania (continental, marine and coastal). Territorial analysis and interference effects they induce in the end allowed the work to delimit affected areas similar to Romania this category waterborne hazards. Regionalization of interference phenomena and processes can be based on several criteria (duration, intensity, frequency and number of types of harmful interference researched area). Based on the latter criterion stated several areas were defined as the number of types of interference and their expressions are identical. Finally, three categories were defined by the number of interferences, regions that affect different (high, medium and low), hence the chance character product: complex, intermediate and low. Of conclusions resulting set theme, originality and the need to study this class of integrated hydrological hazards.

Key words: interferences, physical processes, chemical nature processes, effects

2.3 The mechanical processes

The mechanical processes occur both in continental and in the sea, resulting in land degradation through erosion or accumulation of material transported by rivers. Morphological changes as a result of erosion and accumulation processes are more intense during high waters and floods. Negative

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effects consist in banks degradation, damage or even destruction of hydraulic structures (dams, piers, embankments and so on). Spectacular are the tracks changes in watercourses over quite large distances. In addition to the man-made property damage, erosion carried by rivers has a negative effect, restricting land suitable for crops.

The erosion in the watersheds is carried in three ways: lateral, linear (the longitudinal profile) and complex (in the area).

Lateral erosion does not affect very much the riverbeds where there are established some stabilization works. The average rate of erosion for rivers with non-cohesive banks can reach 10 m / year. Intensity of erosion depends on many factors: geological (nature of the substrate, tectonics), climate (rainfall amount and intensity) relief morphometry (slope, exposition), vegetation coverage. An important role is set on how the mentioned factors are combining. For example, in the Eastern Carpathians, erosion rate is higher in areas with predominance of sedimentary rocks (flysch) and lifting trends (Curvature Carpathians) and where the afforestation is lower. In such areas the average amount of suspended sediment transported by rivers can reach maximum values of 30-45 t / ha.an (Moțoc, 1983).

In hilly lands, areal erosion rate is lower, due to smaller values of surface topographic slope. Differences are imposed by climatic factors and to a lesser extent on the nature of the substrate and relief morphometry. Thus, in the northern Transylvanian Basin (Western Someşean Basin and Almas-Agrij Depression), where the amount of precipitation in 24 hours can exceed 120 mm (Bogdan Octavia, Elena Niculescu, 1999), the average specific sediment runoff values is more than 5 t / ha.an. Nature of the substrate (predominantly non-cohesive sedimentary rocks) and reduced vegetation cover, contribute to those values of average specific runoff silt in suspension.

River bed up-lifting phenomenon can increase the frequency of flooding. The phenomenon is specific for the rivers crossing the west low plains (Someş, Ier, Criş and Timiş Plains) and those with subsidence matter from the Romanian Plain (Titu, Gherghiței Buzăului and Siretului Inferior).

Coastal processes are defined by the advance and retreat of the coastline, which can induce disturbances to the human habitat, transport infrastructure and the port facilities. Coastal erosion affects about 127 km of

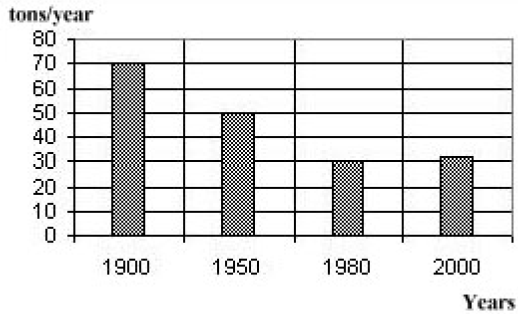

Figure 5. Decrease trend in suspended sediment flow carried by the Danube in Isaccea Section (after Panin, 2004, Babut, 2007)

Romanian seaside shore (57% of its total) being caused mainly by reduced amount of silt carried by the Danube River. The creation of large hydro facilities plants in the catchment area of the Danube, led to a decrease in the period 1900 - 2000, with about 50% of the amount of sediment transported by the river (Fig. 5), with negative consequences for the balance of Romanian coastal sediments. In the 1950 - 1980 periods the annual flow of silt in suspension decreased 1.8 times, respectively from 53 mil.t / year to 30 million tons / year - representing a decrease of approximately 43% - due to large number of new reservoirs created in the entire Danube basin. Another major cause of coastal erosion is the reduced amount of biogenic sand due to decreasing marine biodiversity, namely shellfish populations.

The main causes with local effect are the following ones (Gâştescu, Driga, 2002):

- extension of dykes at the mouth of the Sulina branch, which caused deviation of Chilia silt flow and an increase distance for the Sulina branch discharge point of sediment load;
- Expanding and modernizing works in the port of Midia, Constanța, Mangalia, which generated multiple diversion routes to coastal currents which usually provide material to the sandy beaches of the south coast.

Reducing the amount of sediment along the Danube is accompanied by a change in their granulometry. Thus, the amount of coarse sediment decreased faster than that of fine sediment as coarse sediment was retained in the reservoirs. Decreased intake of sediment brought by the Danube caused strong erosion of beaches located along the Romanian northern coast subunit.

Erosion intensity at sea-shore interface determined on the basis of the measurements recorded in 1980 - 2003 period is as follows:

- In the north part (Sulina-Vadu) was determined the highest withdrawal rate of shoreline with 4-7 m / year for the beach areas with lengths of about 10-15 km (South Sulina - North St. George, Sakhalin Island, Zaton, North Portița - Far Portița, Chituc) (after www.mmediu.roplanuri management, 2007).
- In the southern part of shoreline (Năvodari - Vama Veche), erosion is much reduced in intensity, about 2-3 m / year and is manifested in lower portions of the beach (the center of Mamaia beach, the south of Techirghiol sandbar and Mangalia beach);
- In the shoreline with cliffs (Eforie Nord- Vama Veche) due to lithological constitution of the slope, the erosion intensity is reduced, the highest values being recorded in the following locations: Cap Tuzla, Costineşti and Olimp, with the average rate of withdrawal of 0.5-1.0 m / year.

The most visible shoreline withdrawal are visible onto Eforie and Mamaia Nord beaches, where after 30 years period, there has been a retreat of about 80 m (Photo 1.). Coastal erosion threatens not only the tourism industry during the summer season, but also endangers the safety of housing and quality public activities.


1970 2003

Photo 1. Mamaia beach erosion from the withdrawal of the coastline.

2.4 The dynamic processes

One thermal interference phenomenon is the upwelling process, which involves a movement through wind, of dense, cooler waters and generally richer in nutrients to the ocean surface, replacing the warmer surface waters, poorer in nutrients. Upwelling intensity depends on the wind and seasonal variations and vertical structure of water, changes in seabed bathymetry and current instabilities. In some areas, the upwelling is a seasonal phenomenon which causes periodic increases production of spring flowering similar to coastal waters. Upwelling caused by the wind is generated by the temperature difference between the warm air over land and slightly cooler and denser air and over sea. At temperate latitudes, the contrast has a strong seasonal variability, creating periods of strong upwelling during spring and summer, decreasing or disappearing in winter.

In the Black Sea the most common type of upwelling, is the coast one, which is intimately linked to human activities.

Most recent investigations have revealed coastal upwelling episodes lasting several days, recorded after 2000. Thus, in July 2004, seawater temperature experienced a decrease of about 9 ° C during 3 days, followed later by another rapid cooling of about 10 ° C carried out in 4 days (Mikhailov, Gheorghiță, 2005). Two years later, in early summer, there were three other coastal upwelling phenomena, two moderate, with decreases in sea water temperature of about 3 to 3.5 ° C and an intense one, defined by a decrease of about 5 ° C in 24 hours (from 16.8 º C to 11.9 º C June 5 June 6). In 2007, the phenomenon has manifested for 8 days in May (temperature decrease of about 5 ° C), 6 days in July (temperature decrease of 9.3 ° C) and for 5 days in September (water temperature drop by 8.7 ° C). These values have been highlighted at the Casino's in Mamaia (Mikhailov et all, 2012).

In the Black Sea coast thermal interference nature is evidenced by higher values of water temperature in the southern tip of the coast, probably caused by the orientation of coastal currents and freshwater input brought by rivers.

2.5. Environmental effects of the water interferences

Water interferences, regardless of their conditions, greatly affect the appearance and development of aquatic fauna and flora. Thus, thermal pollution of rivers has the effect over river water temperature as a result of its use as a coolant in power plants and other industrial facilities. The main effect is the heating of water, although you might see also a sudden cooling, when the water is discharged from a tank or reservoir.

The main effects of heating water are decreasing the amount of oxygen in the water and food chain disruption from the river. Fish species that can better adapt to warmer water prosper at the expense of species that adapts harder, causing an imbalance in the ecosystem. Underwater plants grow more easily in warmer water conditions, but have a lower lifetime and could lead to an increase in algae due to overcrowding. High water temperatures can lead to various dysfunctions in fish's metabolism.

Another phenomenon is thermal shock pollution encountered when starting or stopping power plants with effects for fish fauna near the water outlets.

Chemical processes have a major impact on the development conditions of flora and fauna. The most significant effects are determined by salt intrusions that occur both in continental waters and of the sea (Romanescu, 2003, Gâştescu, Breţcan, 2009). Environmental impact is produced by different sources of pollution that contribute to the development processes of eutrophication and acidification of the aquatic environment. Surface and underground water pollution, is affecting aquatic life from microorganisms to insects, fish, and birds, but also the health of terrestrial animals and plants. Moreover, pollution affects the water uses. Depending on the nature and intensity of pollution the usability can be reduced or canceled to almost any purpose (physiological, hygienic, industrial, recreational and so on). The most serious implication is that over the health of various species of plants and animals living in water or those with indirect contact with it. The pollution of surface water and groundwater has effects also on human health. A large number of diseases can be transmitted through direct contact (bathing, washing, contact with water during various activities).

Eutrophication is a form of pollution observed in continental aquatic ecosystems caused by excessive enriching of waters with nutrients, mainly phosphorus and nitrogen. Unlike the natural process, eutrophication caused by humans is a quick process, which determines the successive and strong changes of aquatic ecosystem conditions, leading to its degradation and diminishing its uses for which it was created: water supply, fisheries, recreation, etc. Eutrophication affects all categories of aquatic ecosystems: rivers, lakes, transitional and coastal waters. However the process is manifested mainly in stagnant or semi-stagnant ecosystems: natural lakes and reservoirs, the Danube Delta and the Black Sea coast. The degree of eutrophication of aquatic ecosystems is expressed mainly by the concentration of nutrients (total nitrogen and total phosphorus), oxygen saturation level and phytoplankton biomass.

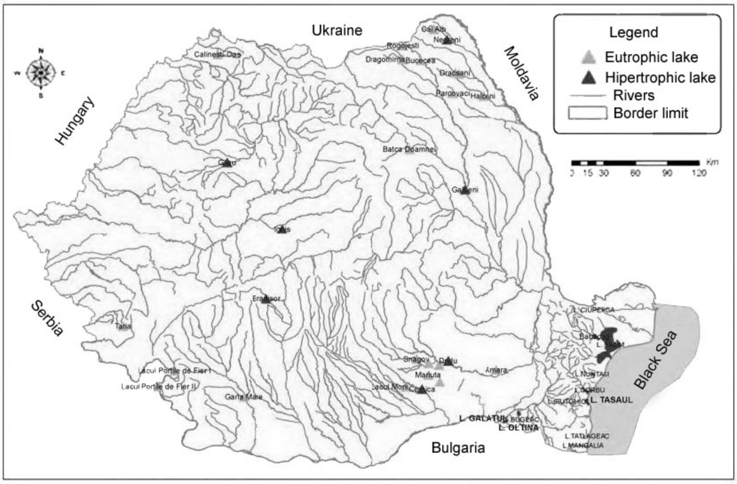

Figure 6. Map of eutrophic and hypertrophic lakes in Romania.

Eutrophic lakes:Călineşti-Oaş, Dragomirna, Rogojeşti, Bucecea, Cal Alb, Tăria, Dragşani, Pârcovaci, Hâlceni, Bâtca Doamnei, Porțile de Fier I şi II, Gârla Mare, Lacul Morii, Măriuța, Snagov, Amara

Hypertrophic lakes:Negreni, Gilău, Ighiş, Gârleni, Cernica, Dridu, Nuntaşi, Corbu, Brădişor, Siutghiol, Tatlageac, Taşaul, Mangalia, Oltina, Gălățui, Bugeac

At national level a number of 114 natural lakes and reservoirs, are monitored in respect with eutrophication phenomenon, of which 41 are affected by eutrophication, 23 lakes (20.2%) falling within the eutrophic category and 18 (15.8%) in the hypertrophic category (Fig. 6).

The most active eutrophication processes occur mainly in the north-western and western part of Black Sea and is manifested by increased phytoplankton biomass, reduced number of species, the development of algal bloom episodes, reduced amount of dissolved oxygen up to anoxic phase. The most intense period of eutrophication took place between 1970 and 1995, followed by a latent phase of the effects mentioned above. Lately algal bloom episodes decreased in frequency and intensity of expression. In 2003, were only reported some numerical increases in abundance for a few phytoplankton species. Invasion of beaches from green algae proliferation in recent years has resulted in the emergence of real "carpets" of green algae that creates a compact layer, unaesthetic in terms of tourism, with potential consequences for coastal-marine attraction (Photo 2).

Incidence of algal bloom in recent years in the tourist resorts on the Black Sea coast:
July 2005 - Mamaia, Eforie, 2 Mai
June 2006 - Olimp, Venus, 2 Mai
June 2007 - Eforie Sud, Costineşti, Olimp, Venus, Mangalia, Vama Veche
July 2008 - Mamaia
July 2009 - Năvodari, Constanța
June 2010 – Mamaia, Constanța
June 2011 - Mamaia
July 2011 - Mamaia, Eforie Sud

Photo 2. Green algae overgrowth of the Black Sea.

According to river basin management plans, coastal sector was defined by a series of specific processes: spatial restriction of marine macro algae: Phyllophora and Cystosteira, simplifying of benthic fauna, the occurrence of algal bloom with high frequency and persistence, reducing of photic zone and occurrence of hypoxic conditions, even anoxic ones at the sediment-water interface (Vădineanu, 2004).

An increase of eutrophication process was determined by intake of nutrients brought by the Danube River, which contributed to further development of algal mass (Table 4).In terms of numbers, between 1981 - 1990 there were 46 algal bloom produced by 15 species of planktonic algae, of which 12 reached the highest densities known to date on the Romanian seaside. A very frequent and severe Environmental effect is defined by the acidification process of aquatic units. An extreme manifestation of this process can led to fish mortality. Thus, a decline below 6 pH units will converge to the extinction of some components of ecosystems: fishes lose their food sources, reaching mineral deficits, with physical debility consequences, bone decalcification, infertility. Also, lowering the pH leads to reduced oxygen, growth of anaerobic bacteria, biodiversity loss, thriving of filamentous algae and macrophytes etc.

3. Regionalization of interference phenomena and processes

On national level we have completed a thematic map of areal distribution of different water interferences, classified by genetic nature of its occurrence (Fig. 7).

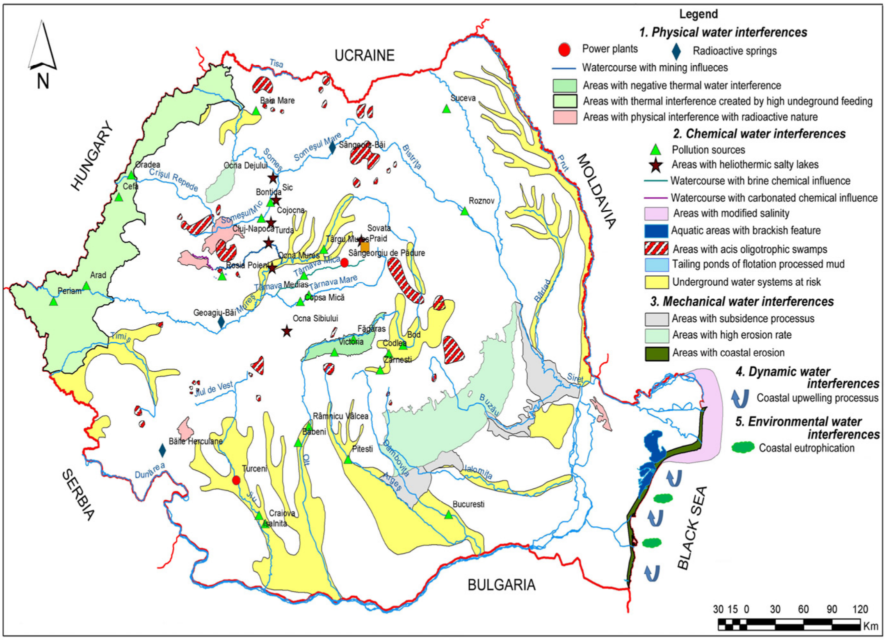

Figure 7. Spatial distribution of water interferences phenomenon in Romania.

Territorial analysis of water interferences and their effects allows delineation of some areas that are affected similarly (Fig. 10). Criteria by which you can define areas with similar interference phenomena and processes are duration, intensity and frequency of the number of types of interference that affect the researched space. In this respect, on a national scale we have identified three regions which grouped a variable number of water interferences.

1. Regions affected by a large number of water interferences. These areas are dominated by chemical and mechanical processes with a wide range of forms. The following territories are included in this category: Sub-Carpathians, the peripheral areas of Transylvanian Basin, Apuseni Mountains and the Black Sea. Significant disturbances marked the environmental components: high land erosion and chlorination of surface and groundwater , respectively carbonation (Apuseni Mountains).

2. Regions affected by an average number of water interferences. These areas include lands outside the Carpathian arch. Thus, most of the Moldavian Plateau (Moldavian Plain, Bârlad Plateau) and the Romanian Plain, are effected by natural chemical interferences (salinity and sulphatization) or anthropogenic ones(wastewater pollution). In contrast, Western Hills and Plains meet the physical nature interference (heat) and mechanical ones (moderate erosion in the hills and the subsidence or river bed up-lifting in the plains).

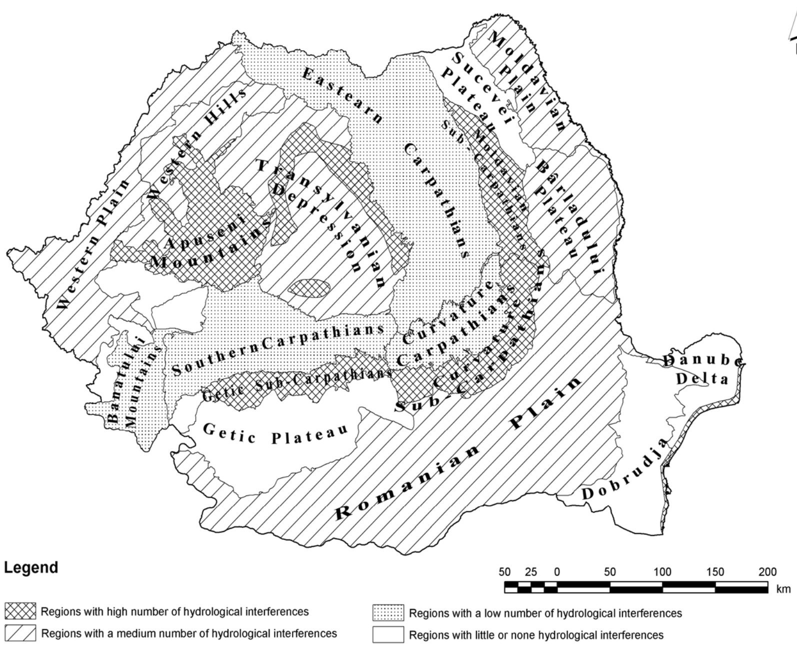

Figure 8. Regionalization of water interferences phenomenon in Romania.

3.Regions affected by a few water interferences. In the corresponding regions associated with Eastern and Southern Carpathians the physical and mechanical phenomena and processes are predominating.

4. Conclusions

Interference is a category of water hazards less analyzed in the scientific literature.

Processes that occur after the interference can be physical, chemical, mechanical dynamic and environmental. Identify the location and nature of processes induced by water interferences is essential in developing plans for preventing and combating waterborne hazards.

Water interference is a special category of hazard characterized by complex environment with multiple implications. Environmental effects induced by water interference are felt in the continental area, especially in the coastal space.

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