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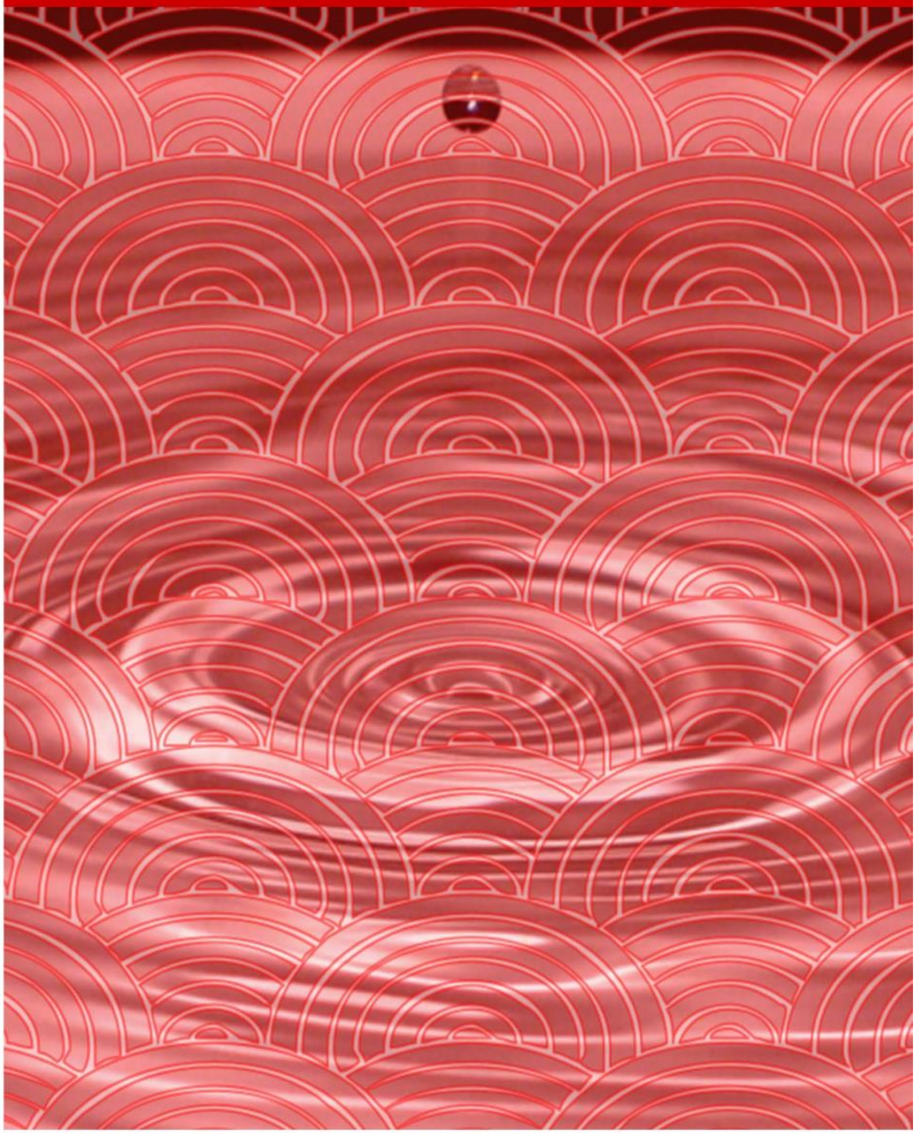

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Center for Risk Studies, Spatial Modelling, Terrestrial and Coastal System Dynamics

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Summary

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The Islet Without Name (Danube River) in summer-autumn season (2015 and 2016)

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Abstract. The Islet Without Name is on the Danube River, located near the Romanian bank, between km 493.3 and km 471.4. Representing one of the most recent fluvial islet on the Danube River, the Islet Without Name began to form in the last 30 years. If, initially, in the sector where the islet is currently located, only a sandy bar emerged in the summer-autumn seasons, now is a permanent landform, covered by forest vegetation. In 2015 and 2016, several field campaigns were carried out to geomorphological changes under certain hydro-meteorological conditions. The results obtained shows the continuous dynamism of this fluvial landform.

Keywords: *Islet Without Name, Danube River, summer-autumn season, field observations*

1. INTRODUCTION

Located near the Romanian bank, between km 493.3 and km 471.4, the Island Without Name is one of the most recent river islets on the Danube River. Like any other fluvial landforms, the size is constantly changing under the influence of water level variations, flow and drainage velocity of water, currents and waves (Munteanu *et al.*, 2009). It presents a specific microrelief. For example, the banks are higher than the central part, where there are small and abandoned lakes (Photo 1).

The Danube's Islands, implicitly, the Islet Without Name, show an important role from the biotic point of view. Danube level variations, the variety of microrelief and climatic conditions allow the installation of a large number of plant species (Munteanu *et al.*, 2009). The Islet Without Name is predominantly covered with willow vegetation (*Salix alba*) and popular species (*Populus alba*, *Populus nigra*).

Also, it is "the home" for many invertebrate and vertebrate species, ensuring feeding, nesting and living conditions for many species of migratory birds (Photo 2), passenger or sedentary. For these reasons, the islet is part of the Natura 2000 Ecological Network and is included in the Special Protection Area (SPA) named ROSPA0090 Ostrovu Lung-Gostinu (area = 2489 ha).

***Photo 1** The Islet Without Name – small depression with lake (August 31, 2015)*

***Photo 2** The Islet Without Name – Cormorants (August 8, 2015)*

2. FROM HISTORICAL MAPS AND SATELLITE IMAGES TO REALITY

Historical data sources, such as old maps analysed in Geographical Information Systems (GIS) represent one of the important resources for identification, localization and change analysis of geographic features. Drawing up a historical evolution of the Danube’s Islands can be achieved from historical maps. But this is not valid for the Islet Without Name, whose recent age allows it to follow its evolution only through new mapping techniques.

Numerous International Earth monitoring and satellite mapping programs have been carried out so far by various governments and institutions. Among the most well-known and accessible to all specialists are: the Landsat satellite program and the Copernicus satellite program. Thus, Landsat and Sentinel 2A satellite images were used in this study.

The information extracted from the satellite images was validated and complemented by data from the field campaigns, carried out in the years 2015 and 2016. There were realized: i) visual observations, which materialized by identifying "in situ" the bed fluvial landforms and obtaining a rich photographic material, and ii) measurements with GPS, which consisted in mapping the water line near the village of Gostinu, Gostinu beach and the Islet Without Name. In 2015, we used a Garmin GPSmap 60CS, a device with an accuracy level of less than 3 m, and in 2016 and 2017 a Trimble Geo7 device was used, the precision of which could reach up to + / – 10 cm.

Photo 3 *GPS devices used in field campaigns*

3. ISLET WITHOUT NAME – PAST AND PRESENT

A careful monitoring of the islet on Landsat satellite imagery from 1990 and 1991, highlights the fact that in the sector where the islet is currently located, temporary fluvial landforms such as a sandy bar (Figure 1) can only be identified in the summer-autumn seasons. Unfortunately, the poor spatial resolution of Landsat's satellite imagery at that time and the lack of images for some years, because of various technical reasons, make it difficult to detect the outline of this islet and the moment when it became a permanent geomorphological landform.

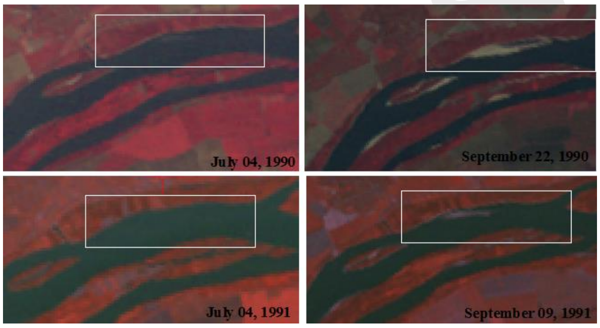

Figure 1 *The white rectangle indicates the sector where The Islet Without Name is located*

At present, the islet has an area of about 0.19 km² and a simple aspect, with a strong elongated shape. In dry years, during summer, as a result of the decrease in Danube’s water level, this islet merges partially with the left bank; so the connection between the islet and the Gostinu beach is made through a strip of sand (Photo 4).

Photo 4 *Strip of sand which link Gostinu beach and the Islet Without Name (September 20, 2015)*

During two years (2015 and 2016), numerous field observations and measurements were carried out in the Danube sector, near Gostinu village, especially on the Islet Without Name. Both in 2015 and in 2016, after a long period of high temperatures and lack of precipitation, the level of the Danube quotas fell sharply. 2015 was a particular year, when Europe, especially its central-eastern part (including the territory of Romania), was hit by a severe drought. The summer of 2015 was characterized by daily temperatures with values of 2 to 3°C higher than the seasonal average, lack of precipitation and much higher evapotranspiration compared to normal limits (Van Lanen *et al.*, 2016). All of these attracted many effects on river transport, hydrological energy, fauna and vegetation, crops, and even human health. In the context of these climatic conditions that persisted for a long time, there was an alarming decrease in hydrological parameters on several Danube sectors, which in turn influenced the riverbed morphology. Between June and September 2015, liquid and solid flows had a general downward trend, with minimum values being recorded in September. On September 10, 2015, the Danube’s flow at the entrance into the country (Baziaş section) was 2300 m^3/s, below September's multiannual average of 3800 m^3/s (INHGA, 2015). At the Giurgiu station, the value of 2400 m^3/s was recorded. On the same day, the suspended solids reached the minimum value (in the course of the year under review) of 7.06 kg/s. The minimum level of Danube water at the Giurgiu hydrological station was also recorded in September: -70 cm. Although not below the historical level of -144 cm, registered in 2003, the decrease of the water level favored the emergence of the riverbed landforms. In Figure 2, it is noticed that the surface of Islet Without Name is larger, merging partly with the Romanian bank at both ends, but retaining a lateral channel filled with water. The width of Gostinu beach was measured in seven cross-sections, set at a distance of about 100 meters each (Figure 2). It is noted that in September 2015 the minimum width was 25 m and was measured along the first profile; As we moved eastwards (downstream), the beach grew, reaching a maximum width of 240 meters.

Unlike in 2015, in September 2016 hydrological parameters did not show such low values, the annual minimum values being recorded in another month. On September 17, 2016, when land measurements were made, the Danube's flow at the entrance into the country (Baziaş section) was of 3200 m3/s, below the 3800 m^3/s multi-annual average of September (INHGA, 2016). At the Giurgiu station, the value of 3520 m^3/s was recorded. On the same day, the water level of the Danube, at the hydrological station Giurgiu, was of 39 cm. In this hydrological context, the Islet Without Name showed significant changes in its surface or appearance (Figure 2), and the width of the beach reached up to 180 m.

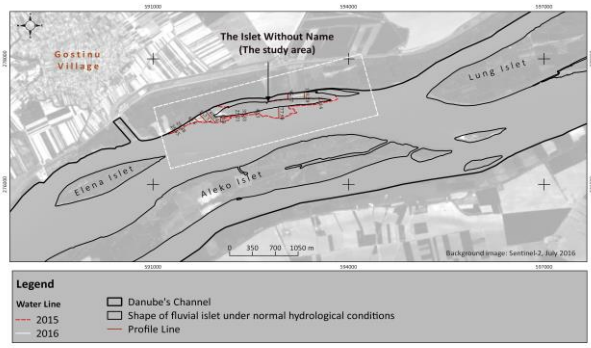

Figure 2 *Changes in the evolution of Islet Without Name (2015-2016)*

4. CONCLUSIONS

Fluvial islets are dynamic geomorphological formations. The shape and the size of Islet Without Name is constantly changing under the influence of hydrological and meteorological conditions. During only two years, large seasonal changes could be oberved on its aspect. This raises our curiosity to continue our observations in the next years and to find a pattern of evolution.

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Validation – a brief introduction

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Abstract. The process validation was developed in the 20th century in order to improve the quality of pharmaceutical products. The validation concept has expanded over the last 50 years from analytical methods used to control pharmaceutical substances to analyses of computerized systems. Validation is nowadays successfully used in most areas. The validation of a method aims to ensure the effectiveness of the method from the point of view of some statistical parameters during each stage of production and not only at the end of the process. By validation, scientific evidence is established that a process is capable of consistently delivering quality products. It is also recognized internationally that validation of a product is required in any production process of a new product.

Keywords: *validation, prospective validation, retrospective validation, simultaneous validation, correlation study*

1. INTRODUCTION

The concept of validation was first proposed in the mid-1970s by two FDA (Food and Drug Administration) officials, Ted Byers and Bud Loftus, in order to improve the quality of pharmaceutical products (Agalloco 1995 quoted in Sarvani *et al*., 2013).

It was proposed as a direct response to the large volume of problems of parental sterility products. The first validation activities focused on the processes involved in making these products, but they spread rapidly across all pharmaceutical production processes (Keyur *et al*., 2014).

The purpose of validation is to test the quality of the system at each stage and not only at the end, as validation activities include checks on production materials, operating procedure, training of the persons involved and monitoring of the system during production (Sarvani *et al*., 2013).

U.S.F.D.A (United States Food and Drug Administration) pioneered the validation process concept, but until September 29, 1978, the definition of the validation process did not appear in any of the U.S.F.D.A. literature, no CGMPs (Current Good Manufacturing Practices) law has spoken about the validation process (Chapman K.G, 1991 quoted in Keyur *et al*., 2014). The validation concept has expanded over the past few years in a wide range of activities, from the methods of analysis used to control the quality of medical substances and drugs to computerized systems, the validation process has become an important and integral part of CGMPs (Kaur *et al*., 2013).

Validation is a method with applicability in various fields: medicine, sales, economics, psychology, chemistry, biology, etc. In fact, the validation concept can be applied in most areas.

Validation of a new or improved method must ensure the integrity and quality of the method in terms of precision, accuracy, detection limit, limit of determination, selectivity, linearity field, and last but not least the transferability of the method (Cardone, 1983; Miller, 1991; Alexandrov 1996).

Process validation can be defined as "establishing documented evidence that provides a high degree of assurance that a certain system of equipments and processes that are consistently linked meet approved specifications and produce products with predetermined quality attributes" (Lakshmana, 2014).

The word validation means "*evaluating validation actions or proving effectiveness*" (www.processvalidation.com). Process validation can be defined as collecting and evaluating data from the product design phase and throughout the process, which establishes by scientific evidence that the process can consistently deliver quality products. (Sarvani *et al.*, 2013).

Table 1 *Definitions of the validation notion (after Keyur et al., 2014)*

Institutions	Definition
European Commission, 1991	Validation – "Act of proving in accordance with GMPs that any ..." process actually leads to expected results (Nash, 1993).
European Commission, 2000	"evidence that this process, operated within established parameters, can perform efficiently and reproducibly to produce a drug substance meeting its predetermined specifications and quality attributes" (Potdar, 2009).
US FDA	"The process validation is the establishment of evidence to ensure a high degree of certainty for a specified process to consistently produce a product that meets its predefined specifications and documented quality characteristics." (FDA, 1998).
ICH	"Process validation represents the means of ensuring and providing supporting documents specifying their design parameters by whom they are capable repeatedly and reliably produce a finished product of the required quality."(ICH, 2011).
WHO	"The documented document proving that any procedure, process, equipment, material, activity or system can lead to the expected result."

Process validation can also be defined as the collection and evaluation of data, from the process design stage, which establishes scientific evidence that a process is capable of consistently delivering quality product. (Keyur *et al.*, 2014).

Validation is an essential part of good manufacturing practices (CGMPs). It is, therefore, an element of the quality assurance programme associated with a particular product or process. The basic principles of quality assurance have as their goal the production of products that are fit for their intended use. (WHO, 2006).

Validation represents the action to verify that any process, procedure, activity, material, system or equipment can achieve the desired results. (Rachna *et al.*, 2012).

Process and systems validation is fundamental to achieving the goal of using a new product. For this purpose, the results of a large number of measurements are analyzed either by the paired t-test or by regression analysis. Regression analysis is the preferred statistical method in such cases because it is less restrictive and provides a greater amount of information, unlike the t-test (Massart *et al.*, 1988; Miller *et al.*, 1988).

From a statistical point of view, validation involves assessing the relationship between one or more predictors using a performance criterion. The fundamental objective is to predict the values of the criterion based on predictor(s) values. Assuming their values are of a quantitative, continuous nature, the most used indicator of validity is the correlation coefficient (Pearson), referred to in this context as the coefficient of validity (Popa, 2011).

Finding a correlation between a predictor (eg, SAR measurements) and a certain criterion (eg, GNSS measurements) is not sufficient to support the conclusion that higher LOS (Line of Sight) values for GNSS measurements are the effect of a higher LOS level for SAR measurements, but only that the two variables tend to vary simultaneously with one another (Popa *et al.*, 2011).

Validation principles can be synthesized in the following words: quality, safety and efficacy in the design *and* building of a product. Quality cannot be adequately assured merely by in-process and finished-product inspection. Each step of a manufacturing process is controlled to assure that the finished product meets all quality attributes. (Keyur *et al.*, 2014; WHO, 2006).

Analyses of the validation concept also appear in the articles Chao and Forbes, 2003; Trubinski, 2003, Ahir *et al*., 2014; Parashar *et al*., 2013; Chaitanya *et al*., 2005; Kathiresan and Kiran, 2005; Varshney *et al*., 2013; Rockville,2010; Dashora and Singh, 2005. These articles present the main features of the process validation in the pharmaceutical industry.

2. TYPES OF VALIDATION

Depending on the type and timing of validation, the following types of validation can be distinguished: prospective or perspective validation, concurrent validation, retroactive or retrospective validation and revalidation (Sarvani *et al*., 2013; Lakshmana, 2014; Keyur *et al*., 2014; Chaitanyakumar, 2005).

Prospective validation represents all the activities performed before the distribution of new products to ensure compliance with the initial (legislative/proposed/etc.) conditions by the product's characteristics. (Sarvani *et al*., 2013; Lakshmana, 2014). Prospective validation is defined in Keyur *et al*., (2014) article as the documented evidence that a system does what it purports to do.

Concurrent validation is issued for establishing documented evidence during actual imputation of the process to show that the process is in a state of control (Sarvani *et al*., 2013).

Retrospective process validation is based on a review of historical manufacturing and testing data, and the analysis of accumulated results from past production to assess the consistency of a process. It is assumed that the composition, procedures and equipment remained unchanged. During retrospective validation results of in-process and final control tests are evaluated. All difficulties and failures recorded are analyzed to determine limits of process parameters and product-related problems. As retrospective validation is not considered to be a quality assurance measure it should not be applied to new processes or products. (Lakshmana, 2014; Keyur *et al*., 2014).

Revalidation is exploratory review of the current performance of the validation effect to confirm the validated status of the facilities, systems, equipments, manufacturing processes and software. Revalidation is necessary for the products that need to be reviewed in time. (Lakshmana, 2014).

3. PROCESS VALDATION STAGES

Process validation involves a series of activities taking place over a lifecycle of the product and process (Keyur *et al*., 2014).

Activities related to validation studies can be classified into three stages: the pre-qualification phase or the qualification phase; process validation phase (Process Qualification phase); continued process verification or validation maintenance phase.

This pre-validation phase or the qualification phase covers all activities related to product research and development, formulation pilot batch studies, transfer of technology to commercial scale batches, establishing stability conditions and storage and handling of in-process and dosage forms, equipment qualification, operational qualification and process capacity. (Sarvani *et al*., 2013).

"It covers all activities relating to product research and development, formulation, pilot batch studies, scale-up studies, transfer of technology to commercial scale batches, establishing stability conditions, storage and handling of in-process and finished dosage forms, equipment qualification, installation qualification, operational qualification, process capability. Also, this is the stage in which the establishment of a strategy for process control is taking place using accumulation knowledge and understanding of the process" (Keyur *et al*., 2014).

During the procedure's validation phase (Process Qualification stage) the process design is evaluated to determine if the process is capable of commercial manufacturing. (Keyur *et al*., 2014).

In this stage it is checked if all established limits of the critical process parameters are valid and if satisfactory products can be produced even under "worst case" conditions. (Sarvani *et al*., 2013).

There are two aspects of process qualification: (Keyur *et al*., 2014)

• Design of facilities and qualification of equipment and utilities. Activities performed to assure proper facility design and that the equipment and utilities are suitable for their intended use and perform properly.

• Process performance qualification. Part of the planning for stage 2 involves defining performance criteria and deciding what data to collect when, how much data and appropriate analysis of data. Manufacturer must scientifically determine suitable criteria and justify it. Objective measures, where possible.

Continued process verification or validation maintenance requires frequent review of all process related documents, including validation audit reports to assure that there have been no changes, deviations, failures, modifications to the production process and that all stages have been followed, including change control procedures. At this stage the validation team also assures that there have been no changes/deviations that should have resulted in requalification and revalidation. (Sarvani *et al.*, 2013).

A successful validation program depends on the knowledge and understanding and the approach to control manufacturing processes. These include the source of variation, the limitation of the detection of the variation and the attributes susceptible of the variation. (Keyur *et al.*, 2014).

Elements of validation are: (Sarvani *et al.*, 2013):

Design qualification (DQ): It is a documented review of the design, at an appropriate stage of stages in the project, for conformance to operational and regulatory expectations.

Installation qualification (IQ): There are verified all the aspects of a facility, utility or equipment that can affect product quality

Operational qualification (OQ): There are verified all aspects of a facility, utility or equipment that can affect product quality

Performance qualification (PQ): There are verified all aspects of a facility, utility or equipment perform as intended in meeting predetermined acceptance criteria.

From the methodological point of view, the validation analyses start from the structure of the problem, namely from the identification of the general objective, the derived objectives, the identification of the necessary factors in the analysis. A second phase in the process validation consists in the standardization of each factor for their compatibility and then they can be hierarchized according to the importance they represent for the main objective.

4. STATISTICAL PROCESS VALIDATION CONTROL

Statistical process control (SPC) includes, according to Lakshmana *et al.*, (2014): sampling plan, experimental design, variation reduction, process capability analysis, process improvement plans.

SPC will not improve a poorly designed product’s reliability, but can be used as a tool to maintain the consistency of how the product is made.

Sampling must represent the batch under analysis. Statistical quality control criteria as a condition of approval and release of batch must meet its predetermined specifications. (Nash, 2003).

Statistical parameters for use in validation are the following (Zamosteanu *et al.*, 2008):

accuracy; precision: intermediate precision and reproducibility; detection and quantitation limit; linearity and linear range; selectivity and working range.

The linearity of an analysis technique is its ability (within a given range) to obtain test results that are directly proportional to the sum of the sample to be analyzed. To determine whether there is a linear dependence between the two sets of data, calculate the correlation coefficient.

The linearity range is the range between the detection limit and the maximum level of the measured series parameter (concentration, LOS, etc.) of the linearity.

Acceptance criteria: the value of the correlation coefficient should be in the range of 0.990 - 1, which shows that, in the studied range, the dependence between the two elements is linear (Zămosteanu *et al.*, 2008).

The Pearson correlation coefficient is the indicator of the linear relationship between the variables. As a result, the Pearson correlation value decreases when the linear model does not adequately describe the relationship between the two elements (Sackett and Lievens, 2008).

The conditions for calculating the Pearson correlation coefficient are: random sample, distribution variables that do not deviate severely from normal distribution (this is all the more important as the sample is smaller).

To illustrate this problem, linear and curvilinear correlation can be calculated (Popa, 2011).

The interpretation of the validity coefficients without explicit verification of the linearity condition is one of the quite frequent mistakes in the validation studies (Seymour, 1988).

For this purpose, the scatter-plot plot can be used, or specialized procedures can be used to estimate the association of the variables (eg, in SPSS program: Analyze/Regression/Curve Estimation).

In statistical analyses, particular attention must be paid to aberrant values, the presence of which may have unexpected effects on the value of the correlation coefficient. The value of the correlation coefficient is strongly influenced by the existence of pairs of aberrant points. A good alignment of some extreme values can greatly increase the value of the correlation coefficient for two weakly correlated variables, and a good correlation can be "destroyed" by the weak alignment of some extreme values.

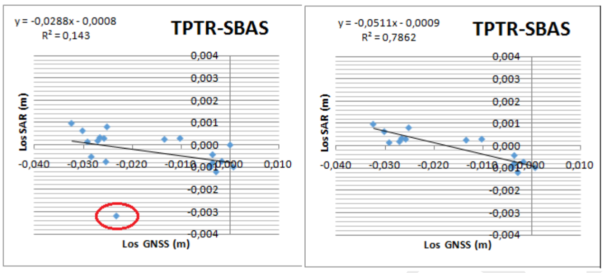

***Figure 1**. The effect of the extreme (bivariate) values on r on the data set representing the LOS values obtained for the TPTR permanent station*

Methods for detecting residual values:

Univariate (via charts with boxes). Everything outside a reference area is a residual value. Bivariate. Points dispersed in a trusted ellipse, 95%; all that is outside the trust ellipse is a residual value.

Multivariate (Mahalanobis D2 distance). The Mahalanobis distance is the distance between a P point and a D distribution. (Mahalanobis, 1936).

5. CONCLUSIONS

Validation refers to the establishment of documented evidence that a process or system can effectively and reproducibly produce a product with identical or similar characteristics. In its short existence, about 50 years, validation has proven its worth in various stages of the manufacturing process, for the preservation, improvement of products and even the use of new methods.

Validation has become a very important research topic when using new products that produce similar results to old ones. Today validation is used in various industries, research, medicine, etc. Also, the validation process is closely related to the development of technology (softwares, computers, tools to collect the data needed).

Validation involves the collection and evaluation of data, throughout process stages, which establishes scientific evidence that a process is capable of consistently delivering quality similar to the one with which the correlation study has been done. The use of validated methods is important for a researcher to demonstrate the qualification and competence of a new product. This implies prospective or perspective validation, concurrent validation, retroactive or retrospective validation and revalidation.

Activities related to validation studies can be classified into three stages: the pre-validation phase; process validation phase and validation maintenance phase, and can be done by statistical process control.

Like any new type of analysis, they also have their limitations. One of them is that validation of a product is directly dependent on obtaining a common element between the validated product and the one used as the reference product. There are also areas where validation must have the same zero point (eg, Geodesy).

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March 4th, 1977 – the year when a new medical specialization appeared

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Abstract. This article represents a short history of how the "operational medicine" appeared in Romania (*the sum of specific activities in the domain of the military emergency medical assistance based on the logistics and specific medical evacuation, according to the goal of the mission and the operational demands*). The operational medical support (OMS) represents the medical specialization derived from the battle technique brought to the civilian level. The repeated sorting of victims at each rescue stage represents the essence of the new medical specialization appeared in March 4th, 1977. At present, this specialization must incorporate the advantages of the space technology.

Key words: operational medical support, repeated sorting, space technology

The natural disaster, the earthquake which affected Romania in March 4th, 1977 at 9:22 p.m. might have caused even more victims, according to the simulation exercises conducted in that period, but especially according to the electronic and medical intervention simulation exercises conducted after the 2000s (Buhoiu, 1977, Steiner, 2004). Measuring 7.2 on the Richter scale and lasting approximately 55 seconds, the earthquake caused about 1570 victims nationally out of which 1400 in Bucharest. The exemplary mobilisation of human and material resources highly diminished the number of the deceased. The state of emergency was established by Order in Council which relied on the army, military firefighters, military athletes, civilians instructed by the Patriotic Guards and … stuntmen*. Whereas after the events of September 11th, 2003 an institution to deal with the medical assistance was founded in the United States – "The National Disaster Medical System (NDMS) – Romania benefitted from a military emergency medical specialisation after the ill-fated day of the earthquake in 1977. At that time, the national army wasn´t involved in operational missions beyond the borders of Romania as a result of the national policy of non-interference in the internal affairs of other countries. The best example of this would be when the Romanian army did not involve itself in the invasion of Czechoslovakia in August 21st, 1968. The real combat experience and especially the humanitarian aid experience were strictly limited to the exercises of "Instruction for the country defense", the extension to the population being insured by the organisations called Patriotic Guards and Civil Defense or the Red Cross (the telling argument would be the participation of Romania in the war from Korea when the Romanian Red Cross built a hospital where there were more than 220 healthcare practitioners to support the Koreans together with the US and China, as Prof. M.D. Corneliu Butnaru states – radiologist during the War in Korea). Nevertheless, the military and civil staff paid a special attention to the training in case of natural hazards, but especially to man-made disasters. We mention the actions at national and international level undertaken by the oil industry

* The director Sergiu Nicolaescu organized the first team of stuntmen in Romania. Those were recruited especially among sportsmen: rugby players, athletes, canoeists, fencers (the sports-clubs belonged to the army or to the Ministry of Internal Affairs). The stuntmen from Buftea were in the first line during the rescue operations of the victims caused by the earthquake in 1977, taking more than 150 people out of the ruins.

workers and the military fire fighters and even of the army during disasters caused by the setting on fire of the derricks, offering medical help to the victims on the spot. Thus, there was a real practical side, and not only trainings, which assessed the correct application of the normative conceptual – organizational plan in the development of the specific activities, leading to generous debates of ideas among soldiers and civilians, especially regarding the medical problems and operational support (MOS) offered to the civilian victims during disasters.

Oil, the "black gold" is indissolubly linked to Romania throughout its history. The first oil distillery in the world was built in Romania, which laid the foundation of the most important industry of the world, and Bucharest was the first city lit up with lamp oil. Moreover, Romania was the first country in the world with oil production officially recorded in the international statistics. "The Science of Petroleum" certifies in 1938 the fact that Romania had been the first country in the world with an oil production of 275 tonnes in 1857. It was followed by the USA in 1859, Italy in 1860, Canada in 1862 and Russia in 1863 (Adevarul, 2015). Under these circumstances, the first oil worker rescue teams were established whose duty was to localise and eliminate the incidents and accidents occurring at the derricks, work places which were extremely dangerous back to those times. Together with the quick development of the oil industry and the modernizing and massive industrialization of Romania between the ´60s and the ´80s, the oil worker´s role of being a rescuer too led to the appearance of the double specialization of certain specialists as rescuers for the first time worldwide. The concept was based on the fact that during the first minutes and/or hours from the occurrence of a disaster, the person on the spot had to help their mates unconditionally, especially if they were trapped together and the rescue was belated. There were many tragic and spectacular at the same time events, reason why the movie "Subteranul" (Underground) is released in 1967, a Romanian movie about a fire breaking out at the oil derrick "Neagra" following a failed research experiment. There were other movies, too, showing rescue oil workers´ interventions in countries from the East (during the years 1970-1989 Romania was an important provider of oil technology), where their professionalism was always appraised. The movie was watched by 1,490,872 people in the cinemas of Romania (the movies also had an educational aim) as attested by the National Centre of Cinematography which drew a statistic of the number of viewers registered for the Romanian movies starting with the date of the premiere till December 31st, 2014. (Centrul National al Cinematografiei, 2014). Nowadays, the disappearance of the specialists in the oil domain and especially of the rescuers had as a result Raed Arafat´s announcement, the coordinator of the Control Department for Emergency Situations that the fire started at some oil derrick "will last long until extinction", announcement made on Digi24 TV channel (2017). "There are very special procedures for this kind of intervention, considering we are talking about foreign rescue teams". Later on, the concept of rescue-professional was introduced in all risky industries, reaching its peak with the subway in Bucharest, where we can find at present rescue departments in the important subway stops. The concept of professional rescuer disappeared after the ´90s together with the destruction of the Romanian educational system. The Army was the only to keep this concept after the 90s and subsequently developed it during the collaboration with the NATO partner armies.

Medical operational support (MOS) represents the sum of specific activities in the domain of the military emergency medical assistance based on the logistics and specific medical evacuation, according to the goal of the mission and the operational demands. This kind of mission is generally oriented to the medical ones, each mission having a humanitarian objective of supporting life, security, logistics and defence. The main element of MOS is the ability of self-support of this kind of special units with special attention to the help given to the operational staff and then to the civilians. The medical staff taking part in MOS was considered more than a provider of primary medical healthcare in emergency, focusing on prevention and the environmental risk. In the case of the army or military firefighters´ actions during man-made disasters such as those happening at the oil derricks, the operational interventions cannot be perfectly framed as planned. The action could last from days to months.

Such teams were made up of a military generalist doctor, a nurse and a couple of soldiers, miners, oil workers or firefighters as emergency medical technicians. These teams were trained in a pre-hospital environment, focusing on the independent way of acting in a well-defined medical structure. MOS concentrated on the military line of medical healthcare at strategic and operational levels within the lines corresponding to the logistic support. The method of offering medical operational support was directed differently according to the type of civil or military foreseen disaster (above ground or underground). Specialised medical help must be permanently offered to the sick and wounded in the process of the rescue actions. The time of the medical intervention was considered decisive for the saving and stabilization of the wounded respectively their survival and healing.

The military rescue system of civilians in natural or man-made disasters was based on the rules stated in the Agreements from Geneva (WHO, 1997), on the model of the six hours or the golden hour. In this period the starting of MOS at the place of disaster, the selection and the medical evacuation didn´t need other procedures or approvals. Nowadays, the Agreements from Geneva which regulate these rescue and emergency healthcare mechanisms stipulate that MOS should insure the wounded´s transport to the specialized healthcare structures (e.g. surgery) within an hour and not later than four hours from the occurrence of a disaster. In case of need (the impossibility of evacuation) this amount of time can be extended with two more hours by providing emergency healthcare or surgery. MOS relied mainly on mobility and availability, insuring the resources, complete recovery, professional authority. The healthcare provided by MOS to the civilians is identical to the one offered on the battlefield. Only the circumstances and priorities at the place of disaster differ (Craciun, 2001).

The repetitive sorting pattern at each stage of the medical rescue chain was one of the key elements of minimizing deaths during the 1977 earthquake in Romania. Sorting based on experience led to the reduction of the deceased number. That year, soldiers, but also technical civil staff (the engineers and workers proved to be much more rigorous than it is believed that they are today) obeying the order given by the MOS responsible chosen on the spot, made the sorting take place under most favourable conditions, even if the resources were much diminished and the emergency healthcare system seemed blocked. While at the place of disaster (where the victim was taken out) there was a primary but experimented type of sorting at the next level (e.g. transport) the victim was reconsidered and a new revaluation was performed in the hospital, the process going on continuously. There were separated sorting and treatment areas to prevent the evacuation of victims made by well-intended people who weren´t part of MOS. The application of military rules during the natural disaster by finding evacuation ways specific to the army made the evacuation be conducted quickly and safely without deceased in the process (there is no information). The registered deaths were only those on the spot of the disaster. The civilians part of MOS as mentioned above, belonged mainly to the construction, industry, and technical domains. For instance, each industrial or agricultural civil unit had organisations such as Patriotic Guards or Civilian Defence which were periodically trained in case of disasters, especially in case of a direct bombing attack. Thus, there were many civilians who had military training not only because of the obligatory military instruction undergone both by boys and girls (later on only for boys) at 18 years, but also by going on with the military instruction as part of the organisations mentioned above. At the moment of the 1977 earthquake, most of the civilians could cooperate with the army, this being the key element of the reduced number of victims. The stuntmen, as particular element of the phenomenon, accomplished successfully numerous actions ordered by the military staff. The evidence given by rescue stuntmen such as Mircea Pascu or Paul Fister are touching. This is what Mircea Pascu declared: ‘I heard some cries and we started digging… as far as the third floor. We crawled under those ceilings, we took the debris away and we found the first survivor from the third floor’ or Paul Fister: ‘The image of those crushed people makes me shiver even today. I saw people´s heads like crushed cigarette ends… I couldn´t even drink the coffee brought by those in the Patriotic Guards anymore, nor the tea from the Red Cross. When you felt that sweet taste, you started thinking of the smell of death immediately. People asked to bury them like Christians… We crossed ourselves and carried them I, by the hands and Tudorica Stavru, by the legs… Today I would do the same. If you´re 73, does it mean that you lack courage?'. This is the article in the online newspaper 'adevarul.ro'. If we also mention that the medical system at that time was subject to a rigour reminding the military one, the sick with TB being monitored like soldiers on duty (in 1989 there were few sick with TB, the disease being eradicated just like many other infectious diseases which re-emerged massively after the ´90s) and the medical mistakes (malpraxis) were punished with jail, we have the image of an extremely rigorous civil action. The emergency military system for civilians (EMSC) with its military medical emergency specialisation for civilians (MMEC) was founded in March 4th, 1977 (Chertic, 1995, Nicolae and Dan, 1995). The present commander of the Central Military Hospital states: 'It was the first important mission to support the population affected by the disaster, when one must be militarized to answer appropriately for the actions to develop well'. (general Florentina Ionita Radu) (Romania Actualitati, 2016).

We can also mention the military instruction imposed to the firefighters to support the above information. After the ´90s, firefighters were transferred to the army as military firefighters, within the Ministry of Internal Affairs. The militarized ambulances belonging to these firefighters represent another argument to support the idea that in emergency case or disaster, the emergency system must be military coordinated.

Paying attention to other events, it is hard to forget the tragic crash of the transplant medical plane in 2014, when misused or basically used technology may have led to the death of some rescuers instead of helping to localise and save them. If the doctor who used the communication technology at the moment of the plane crush had had elementary knowledge of Geography which to corroborate with a military type of thinking (if he had had elementary military instruction) telemedicine and remote sensing would have worked to their advantage (nowadays smart phones can replace a part of applications).

'Many people from different institutions able to interfere in emergency didn´t manage to locate the place of the plane crush hours on end yesterday, even though the survivors called 112 and communicated with the rescue team permanently. The plane wreck and victims were found by a forester after a five-hour search. The pilot Adrian Iovan asked the doctor Zamfir to save him as he was caught in the wreckage. 'I tried to pull him out but I couldn´t. Subsequently (Iovan) became unconscious' the doctor said. Adrian Seceleanu writes in his article "This case proves again the inflation of institutions in Romania and their inability to coordinate at critical moments" (Public Health Emergency, 2017). The opposite example is the case of an Israeli tourist who was perfectly located and saved by the mountain rescuers after using the same type of technology (smart phone) in 2017. The case was mentioned by the local press: "The tourist made the bad decision to follow a shortcut, which represented a real danger. He reached an area difficult to access but finally the mountain rescue team from Arges succeeded in finding and taking him out from that area." (Ziarul financiar, 2014)

The evaluation of victims from the distance in case of lack of MOS and experimented first aid staff using the telemedicine (using the smart phone) has become necessary modernization, not only a desire for the future. Thus, persons without qualification can be used and be guided to collect medical information. However, the MOS system must be revigorated together with the purchase of medical informational technology, remote sensing techniques and telemedicine excluding the business domain and getting into the social environment of rescue in case of disaster. In this case, it would be desirable that the mobile telephony companies should stop imposing taxes on the users and allow free audio-video access to the emergency medical staff, either civil or military (they should only be registered in the telephony company data base as rescue staff). We recently could follow the campaign and struggle for getting permission to transmit a common warning message on the smart phone in case of an earthquake and the opposition of the private companies. The need of a militarily controlled communication line would be one more solution of telemedicine.

The modern exercises such as ‘Cetatea, 2014’ to assess the components of the informational and communication system of our army had as aim dealing with the civilian emergency situations generated by natural disasters. The soldiers, civilians and staff of the Ministry of Internal Affairs collaborated to achieve the technical exercise. The new approaches of MOS prove that the medical support is different for every operation since it needs to be adapted to what happens at the place of disaster no matter the special conditions of the action (e.g. battlefield). As a drop in the number of the medical loss and of the hospitalisation period is aimed at, MOS must be started automatically within the golden hour. The distance of evacuation must be analysed according to the distance of disposing compared to the military medical emergency action area. As shown above, MOS is part of the logistic support system, holding all the execution and management organs of the medical support and their relations. The latest interoperability exercises at NATO level, such as the SARMIS 15 type, show that our professionals in the military and sanitary domains have been highly appreciated for their professionalism and strictness they proved, and demonstrated they are able to apply the best medical practice in case of military or disaster situations. “We have worked with the soldiers and the military medical staff in the allied armies very well and we have proved we are interoperable at NATO standards” as lt.col. dr. Derioiu Daniel, the coordinator of the medical military forces involved in the exercise, mentioned in an interview in 2015 (Armata Romaniei, 2015). The general objectives of certain technical exercises of military medical emergency given to civilians in peacetime in case of natural disasters, represent the training of special structures as to planning, projecting, implementing, managing and insuring the communication/ data processing services as well as the security of the command and control networks to support the military actions directed towards the population in the areas of the natural disasters, as it is mentioned once again by lt. col. dr. Derioiu Daniel (Armata Romaniei, 2015).

The reform of the military medical system started by col. dr. Eremie Adrian in the Medical Department of the Ministry of National Defence has as aim new conceptions of medical insurance of the army in peacetime and/or during war. There must be short-term and very short-term projects (a natural disaster cannot be announced), starting with centralizing the effects and medical services at global civil and military level to make them interoperable and obeying to an only command (Top de Arges, 2017, Craciun, 2001).

Let´s not forget that Romania took part in UN PKOs after the ´90s: UN observation mission in Irak-Kuweit (UNIKOM) April 1991 – October 2003, 10 military observers (MilObs); UN observation mission in Somalia (UNISOM-II), March 1993 – March 1995, a military field hospital (236 staff members); UN examination mission in Angola (UNAVEM – III), May1991 – June 1997, 36 general staff officers and military policemen, an infantry battalion (751 soldiers) and a military field hospital (110 staff members); UN observation mission in Angola (MONUA), August 1997 – February 1999, an infantry subunit (156 soldiers); UN mission in Bosnia and Herzegovina (UNMIBH), 1995 – December 2005, 10 MilObs; UN Interim Administration mission in Kosovo (UNMIK), launched in July 1999, 1 MilObs; UN observation mission in DR Kongo (MONUC) launched in November 1999 – Romania started its participation with 5 liaison officers. From July 1st, 2010, the UN observation mission was transformed into UN stabilisation mission in DR Kongo (MONUSCO). At present, Romania is taking part with 22 MilObs; UN observation in Cote d´Ivoire (UNOCI), launched in April 2004, 6 MilObs; UN mission in South Soudan (UNMISS) launched in July 9th, 2011, 6 MilObs; ONU mission in Libia (UNMIL) launched in September 19th, 2003, 2 MilObs; UN assistance mission in Afghanistan (UNAMA) launched in 2002, 2 MilObs.

The first participation of the Romanian Army in a conflict area was with medical teams. A field hospital was sent to provide medical assistance in the first war in the Gulf, Gen. Dr. Ion Dragusin´s special activity as a commander of the field hospitals with 236 staff members at UNOSOM II and UNAVEM III with 110 staff members, coordinated by the Manager of the Medical Department – at that time – gen. Dr. Petru Chertic, raised the management of the MOS medical operations given to civilians at international levels (in 1995 he lays the foundations of the Congress of the Balkan Committees of Military Medicine, BCMM, having as partners his Greek and Turkish counterparts). At this moment BCMM hold specialists belonging to the military medicine services from Albania, Bulgaria, Greece, Romania, Serbia and Turkey. The scientific collaboration which is promoted brings its essential contribution to the increase of the visibility of the military medical activity in the Balkan area. "The two field hospitals treated numerous civilians caught in the war and even assisted births, thus our hospitals being ranked as ROL1 – ROL 4", as gen. Florentina Ionita Radu, the commander of the Central Military Hospital states (WHO, 1997). The reputation of the Romanian medical staff got to the UN General Secretary. Gen. Dragusin remembers "when Boutros Boutros Ghali visited the UN troops in Somalia, he organized his press conference in the Romanian hospital in the airport". Gen. Dragusin went back to the battlefield in 1995, when he commanded another Romanian field hospital in Angola. (Stiri TVR, 2013)

At this point some question rises. If, at present, the Romanian military doctors are perfectly inter-operable with the NATO soldiers, will they be able to rise to the level of those in the year 1977? If yes, then the civilians have been trained with military rigour and have first aid and sorting knowledge just like the ones trained within the Patriotic Guards in the old system. Moreover, do we still have a "Codex alimentarium" which today stipulates an easily obtainable Mediterranean diet to eliminate or correct the changes occurring in the metabolic syndrome and reduce the cardio-vascular risk as side effects in natural disasters? And which are the standards of the psychiatric emergency in case of disaster nowadays?

For example, in the US, "The National Disasters Medical System" (NDMS) is based on the former soldiers who are veterans. In fact, NDMS is a federal half militarized organism under governmental control and coordinated by the Department of Public Health (HHS) and the Department of Defence (DOD), Citizen Safety (DHA) and Veteran Affairs (VA). The organisation is made up of independent teams such as the Disaster Medical Assistance Team, the Coordinating and Response during Civil Accidents Team, Medical and Surgical Response Team, the Operational Team for Decease Response, the Federal Coordination Centre, the Centre for Victim Identification and the Veterinarian Incident Response Team. This organization has been reorganized many times and, at present it deals with incidents from pandemic and climatic disasters. There are also direct collaborations with governmental and local institutions and organisations, such as the Administration for Children and Family (ACF), Substance Abuse and Mental Health Services Administration (SAMNSA), National Centre for Medical Assistance (CMAS) and Centre for Disease Control and Prevention (CDC). (Romania actualitati, 2016)

In the civil area, the Romanian reform started with the partnership between the Department for Emergency Situations and the company Qualitance, in which certain applications of the mobile multifunctional telephony are addressed to the resident doctors specializing in emergency medicine, hoping that these applications will help them achieve and monitor the medical activities and procedures more rapidly. Moreover, the application is expected to facilitate the collaboration between doctors and their guides by simplifying the assessment and validation mechanism. "This new mobile application helps 500 doctors making their activity easier and more efficient and it also helps the patients since the doctors have more time available to treat them. As a result, the reporting and validation mobile application supports the DSU commitment of coming closer to the doctor´s and patient´s needs and the partnership with Qualitance is one more step in the right direction", dr. Raed Arafat said (Ziarul financiar, 2014).

When will the telemedicine technology and the DSU mobile applications have the same objectives as those from the Ministry of National Defence, facilitating the interoperability between civil and military doctors?

Unfortunately, these days the emergency military medicine for civilians is called “operational medicine″. This naming could be explained by the fact that we need to forget that once there was an operational medical department. We leave the linguists decide if medicine is “operational” or the services can be “operational″. Another idea would be that the “operational medicine” is the one focusing on the latest technical and informatic research with operational systems, algorithms, and medical decision based on theories of analytic mathematics in close relationship with medical ethics to strictly coordinate such a system. The logistic elements found in the army can be transferred to medicine for predictions and quick and real diagnosis, for efficient and quality operations to the highest degree. Such analysis was realised on the disaster in Japan in March 11th, 2011, when, after the earthquake the devastating effect was the one produced by the tidal waves and the radioactive leakage of the destroyed nuclear plant (Stiri TVR, 2013).

Foundations, such as Whitaker, established in 1998, deal with this of phenomena, reason why we understand that any reference to the “operational” medicine before 1998 are odd. All is left is the operational medical support offered by the emergency military services offered to the civilians as basic definition of this concept which appeared in Romania in March 4th, 1977. Anyway, in our opinion the emergency services must consider the new technic discoveries, such as telemedicine and the rational use of digital telephony which, correctly applied (by qualified persons in data transmission and not by simple “smart phones” users) can logarithmically decrease the number of victims in case of disasters.

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Potential of InSAR monitoring for seismic areas in Romanian

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Abstract. National Institute of Earth Physics operates one of the densest real-time regional networks in Eastern Europe for monitoring seismic activity, counting 130 real time seismic station and 22 permanent GNSS stations. The network serves for early warning applications, research studies regarding seismic sources and internal Earth structure, as well as crustal deformation monitoring. In areas that make the object of detailed studies for crustal deformation, additional periodic GNSS stations are installed in monthly surveying campaigns, increasing the coverage of the network.

The current study focuses on two regions of interest, Izvoarele-Galați and Black Sea coast, monitored with 9 and 4 GNSS reference points respectively. The Izvoarele-Galați represents an interesting research site because of recent abnormal seismic behaviour, while the Black Sea coast is integrated in a project for a regional early-warning system for marine geohazards. Satellite synthetic aperture radar interferometry is proposed as a complementary monitoring technique that can offer insights regarding surface deformation in addition to information offered by classic techniques such as GNSS and optical levelling.

Keywords: *InSAR, earthquake, Permanent Scatterer, Dobrogea, Galați*

1. INTRODUCTION

Since the launch of the European Remote Sensing (ERS) 1 satellite in 1991, radar remote sensing has become very popular in studies that are based on surface displacement and deformation monitoring. Although relatively new in comparison to classic monitoring techniques such as optical levelling or GNSS, InSAR (Interferometric Synthetic Aperture Radar) has been preferred in many studies instead of classic techniques due to the possibility to cover large areas in a short amount of time and at lower costs, accessibility to remote areas and offering a high density of measured points with comparable accuracy results.

InSAR has been used in various studies, from earthquake epicentre or fault slip identification and modelling (Massonnet *et al.*, 1993; Fialko *et al.*, 2005, Wright *et al.*, 2001), geological or tectonic subsidence and uplift monitoring in built-up areas (Cigna *et al.*, 2011; Armaş *et al.*, 2017), identification of subsidence due to underground constructions or gas extraction (Perissin *et al.*, 2011) or slow developing landslides monitoring (Ye *et al.*, 2004).

Satellite InSAR is based on pairing two SAR satellite images acquired at different times over the same area and in the same geometry in order to obtain interferograms. Interferograms contain information regarding phase variation of the signal in the line of sight (LOS) of the sensor between two different acquisition in the same geometry.

First time when InSAR was used for depicting earthquake related surface deformation was in 1993, when Massonnet *et al.*, 1993 studied a 6.9 magnitude and 1.09 depth earthquake that took place in Landers, California. By processing two satellite images taken by ERS-1 before and after the event, the scientists depicted 0.6 m displacements kilometres away from the epicentre. Since then, InSAR has contributed to increasing substantially the number of modelled earthquakes, from only 15 before 1993 to 30 in the last 25 years. However, all the earthquakes that were studied with the help of InSAR techniques have occurred at a maximum depth of 30 km, therefore being considered shallow-depth earthquakes.

The first studies involving satellite InSAR were analysing single pairs of images to determine changes that occurred in an area between two acquisition dates, usualy before and after an event took place. Ferretti *et al.*, 1999 and Berardino *et al*. 2002 have proposed algorithms for multi-temporal InSAR techniques, like Permanent Scatterer (PS) and Small BAseline Subset (SBAS) InSAR in order to monitor fine displacements of the earth surface. These techniques improve the results precision from centimetres to millimetres. Ferretti *et al.*, 1999 proposed a multi-temporal approach that allows exploiting sets of multiple interferograms selected from large image sequences acquired over longer periods of times for the same area. A single SAR satellite image from the actual sensors can cover areas of 10 000 km^2 or wider with a frequency of a few days (6 days for Sentinel-1A and B). Therefore, data about phenomena can be obtained before, during, and after their occurrence, resulting in monitoring time series.

The technique proposed is the Permanent Scatterer technique (PS). The PS was used and improved for a multitude of applications that required displacement times series monitoring. The basic principle of the PS technique is that radar sensors can observe ground surface objects whose reflectance remains coherent in time, backscattering radar radiation for as long as their displacements are smaller than half the wavelength of the signal. The objects that are reflective to microwaves are mainly represented by objects from the built-up areas, such as buildings, infrastructure, poles or bridges, or open rocks from natural sites.

The advantage of studying very small displacement rates from multiple acquisition has been exploited for approaching earthquakes by studying possible earthquake precursors depicted as low magnitude surface deformations. Earthquake precursors can consist of unusual surface movement patters, such as atypical subsidence or uplift phenomena in areas near the earthquake epicenter (Moro *et al*., 2017). Starting with 3 years before the earthquake that occurred in L'Aquilla, Italy, a subsidence of 15 mm/yr has been found above quaternary basins in the proximity of the epicentre. After the earthquake, the same surface was characterized by a continuous uplift of 12 mm/yr.

In the current paper, we present the results obtained after processing Sentinel-1A data using the PS technique for monitoring two areas of interest for their seimsic behaviour, the Izvoarele-Galați area and the Black Sea coast, in an attempt to identify fine surface movements that characterize the surface of the study sites and can be used for seismic and geological interpretations.

2. STUDY AREA

One of the important objectives of the National Institute for Earth Physics (NIEP) is to detect and locate in the shortest all seimsic events (anthropic, natural) occurences. The information can be used in an early warning system addressed to authorities, emergency situation personel and the wide public. Part of the monitoring network that has been developed by the NIEP is represented by the Romanian high resolution GNSS / GPS (Global Navigation Satellite System / Global Positioning System) networks designed for monitoring crustal movements, started in 2001 when the first permanent station was installed in Lacauti.

Although the seismic hazard in Romania is dominated mainly by intermediat-depth seismicity characteristic to the Vrancea zone, there are also areas where shallow-depth earthquakes occur and have been offered a particular interest in time.

- *Izvoarele-Galați area*

Starting in September 2013, a swarm of more than 500 earthquakes occurred over an interval of 3 months in an area found 30 km from Galați, in the South-Eastern foredeep. A swarm is represented by a multitude of low magnitude earthquakes. Earthquake swarms occur also in other areas of Romania, such as the Carpathian Bend or the Sinaia region However, the 0.1-4 magnitude earthquakes on the Richter scale that occurred in the Izvoarele-Galați area were considered atypical due to their longer duration and higher intensity in comparison to other areas.

The area was investigated by specialists from many different fields, like geologists, surveyors and earth physicists, in an attempt to find an explanation for the surface movement patterns (Năstase *et al.*, 2016; Ioane *et al.*, 2015). The Negrea village area where the seismic swarm emerged and the Izvoarele village where the effects of earthquakes are amplified are differentiated. The hypothesis is that some local effects in the Izvoarele area might influence the surface behaviour. The local effects have been classified as terrain conditions and geological conditions.

According to the geology experts, the Izvoarele - Slobozia Conachi localties from the Galați area are located over predominantly unconsolidated (sand and gravel) deposits (Micu, 2017). One interpretation of the earthquake swarm is based on mechanical suffusion processes that cause changes in the surface area and precede the event (geological conditions). Another hypothesis for the causes that may influence the magnitude and duration the earthquakes was anthropic intervention: the extraction of gas and oil for more than 30 years in the area. Due to exploitation on the three domes of the Petrolum Structure Independence platform on which the localities are found, the land can suffer differential compaction (terrain conditions).

Immediately after the events, NIEP has installed portable seismic GNSS equipment to mark GNSS reference points. Six GNSS reference points were added to the already existing 3 permanent monitoring stations found in the area. The purpose of GNSS monitoring was determining crustal deformation rates and displacement directions close to the affected areas [11].

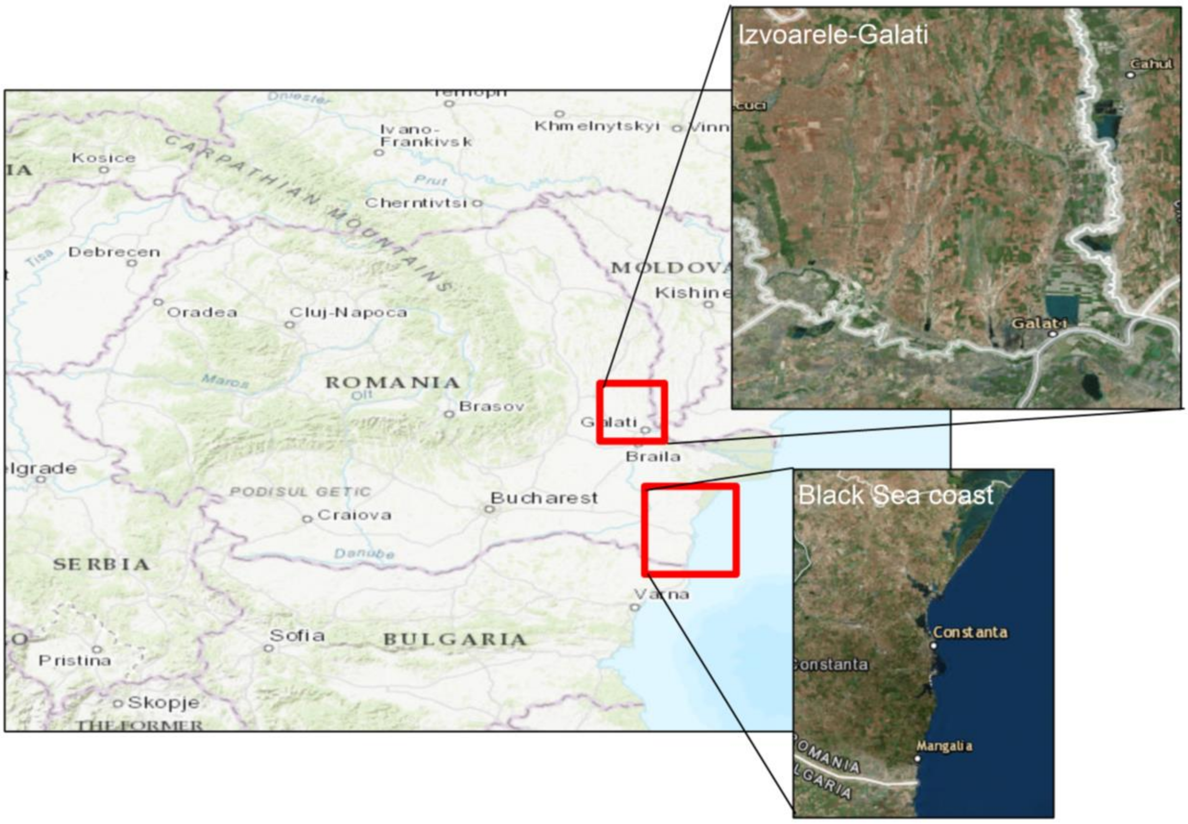

Figure 1 *Localization of Izvoarele-Galați and Black Sea coast study areas in Romania*

• *Black Sea coast*

The seismic hazards in the area of Dobrogea are characterized by shallow earthquakes (0-10 km) (Bala *et al.*, 2013). The foci of shallow earthquakes can be divided into three areas (western part of North Dobrogea, east of Tulcea and the SE of Central and NW of South Dobrogea), with the seismic hazard derived from shallow earthquakes being higher in South Dobrogea, controlled by the events in the Shabla region. Besides the crustal movement on the Black Sea Coast, the Black Sea area is also liable to tsunamis generation. Although the last tsunami that was observed in the Shabla region was dated on 31st of March, 1901, statistics show that more than 20 tsunamis have been observed in the past in the area. The oldest recorded tsunami that has been recorded on the Romanian shore is dated back in year 104. The shallow depth of the earthquakes in the area, of around 15 km below the sea, can result in tsunami waves of 5 m height and material losses.

The NIEP are studying extreme marine events and catalogue marine geohazards. The main purpose of establishing a monitoring network on the Black Sea coast was create an early warning system for marine hazards in the Black Sea. In this respect, NIEP has developed a coastal network for marine seismicity, by installing seismic stations, Sea Level Sensors, Radar and Pressure sensors, Meteorological and GNSS stations at every site in the coastal area of the Black Sea. The GNSS stations of interest are installed in Constanța, Mangalia and Sulina localities.

3. METHODOLOGY

One of the most recent SAR satellites are Sentinel-1A and Sentinel-1B, launched by the European Space Agency in 2014 and 2016 respectively. The signal wavelength of the Sentinel-1 satellites is approximately 5.6 cm (C-band). The individual temporal resolution of each satellite is of 11 days. Because it is recommended to use images from a single satellite for interferometry studies, and due to its longer acquisition time, we have chosen to process and analyse the Sentinel-1A data. The Sentinel-1A images were made available by the European Space Agency for free (ESA) through the Copernicus program, and were downloaded from https://scihub.copernicus.eu/dhus after creating an account.

The first sensing time of the Sentinel-1A images is dated back in 2014, exactly after the events in the Galați area occurred. Images were downloaded and processed using the PS routine implemented in Sarscape v. 5.2 software provided by SARMAP.

In the Black Sea area, the GNSS permanent stations and reference points are found in built-up areas. The satellite images were processed for Constanța, Mangalia and Sulina cities for the 2015-2017 – time interval. A number of 54 Sentinel-1A on descending orbit were processed for Galați area for the interval between 06.03.2015-10.08.2017 [Fig. 2]. For Constanța and Sulina, 29 images in descending orbit sensed between 13.05.2015 and 23.09.2017 were downloaded and processed [Fig. 3]. For comparison with Mangalia 1 and 2 permanent stations, 27 images in descending orbit were acquired [Fig. 4].

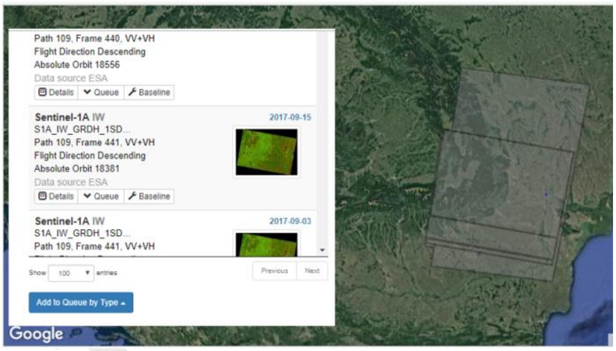

Figure 2 *Extent of the Sentinel-1A images for Izvoarele-Galați area*

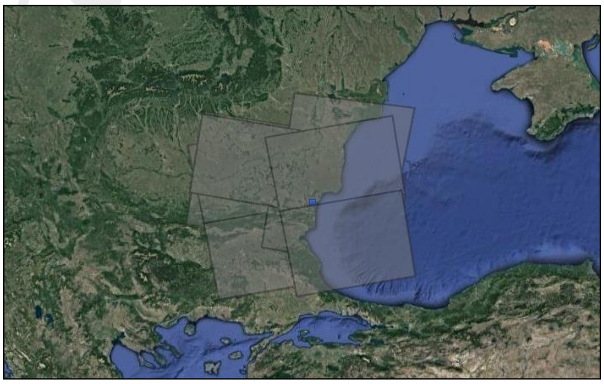

Figure 3 *Extent of the Sentinel-1A images for Constanța and Sulina*

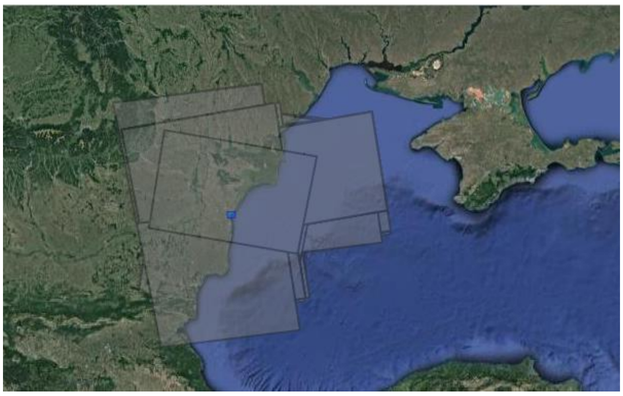

Figure 4 *Extent of the Sentinel-1A images for Mangalia*

The main objects that are identified using the PS processing algorithm are man-made objects, such as buildings and infrastructure. In the Galați-Izvoarele area, some of the GNSS reference points were installed outside the built-up areas, therefore, couldn't be compared to PS results.

Firstly, the PS algorithm identifies the permanent reflector candidates by selecting those with higher amplitude dispersion values. Height errors are then eliminated using an external digital elevation model (DEM), the Shuttle Radar Topography Mission (SRTM) (90 m resolution and 16 m vertical accuracy) in this case. The atmospheric errors were eliminated using a low pass and a high pass filter for spatial and temporal corrections. In the end, the annual displacement rates as well as displacement values were calculated for all existent permanent scatterers and displayed as discrete points showing cumulated displacement values and velocity rates.

Between 2015 and 2017, the Sentinel-1A satellite acquired images of the Galați area every 11 days, summing up to a number of approximately 70 images. From these images, 54 images containing the study area and ranging from 06.03.2015 until 10.08.2017 were selected for surface motion monitoring. In order to diminish the influence of the atmosphere, images that were acquired during heavy precipitations, earth snow cover, overcast or foggy weather conditions, were eliminated before

The resulted points, corresponding to each coherent point identified, were georeferenced in the WGS 84 system and displayed as a deformation map of the studied areas.

The movement tendencies of each GNSS point was compared to the movement patterns depicted for points found within 50 m from each GNSS station. In the Izvoarele-Galați area, besides the already existing three permanent stations, and additional 6 stations were installed and measured periodically between 2014 and 2015, when three surveying campaigns were conducted in the area. After 2015, the surveying campaigns continued at random time intervals, whenever traveling in the study area was possible.

In Constanța, Mangalia and Sulina, there are installed 1, 2 and 1 permanent stations respectively in the built up areas. For each monitored point, a displacement tendency and displacement rate value were depicted. In Fig. 5, the vertical surface movements resulted for the period between 2013 and 2017 are represented as vectors. The movement tendencies for the GNSS point stations in the study area were interpreted as uplift or subsidence.

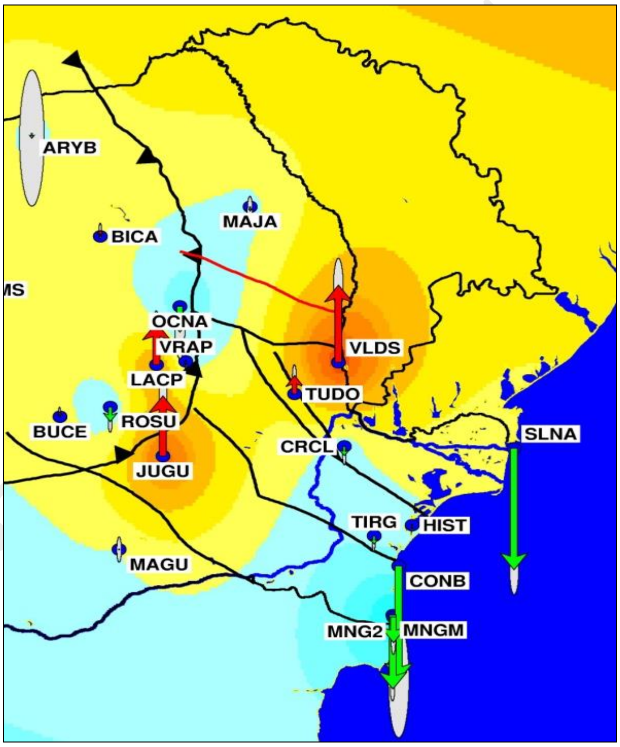

Figure 5 *GNSS derived vectors for the study areas*

4. RESULTS

For the Izvoarele-Galați study area, we have obtained 176887 points with velocity values ranging from -28 mm/yr to 20 mm/yr with an accuracy of ±0.5 mm. Velocity values characterizing the Galați area have a normal distribution, with a higher frequency of the values between -3.0 mm and +3.0 mm [Fig. 6].

The southern part of the study area is characterized by an uplift pattern with velocity values between 0.6 mm/yr up to 5 mm/yr, resulting in a cumulated displacement value of +14 mm in 2 years. The high uplift values are high especially along the Siret river terrace, which is bordering the study area. The velocity and displacement values are higher than the average displacement rates that are characterizing the area.

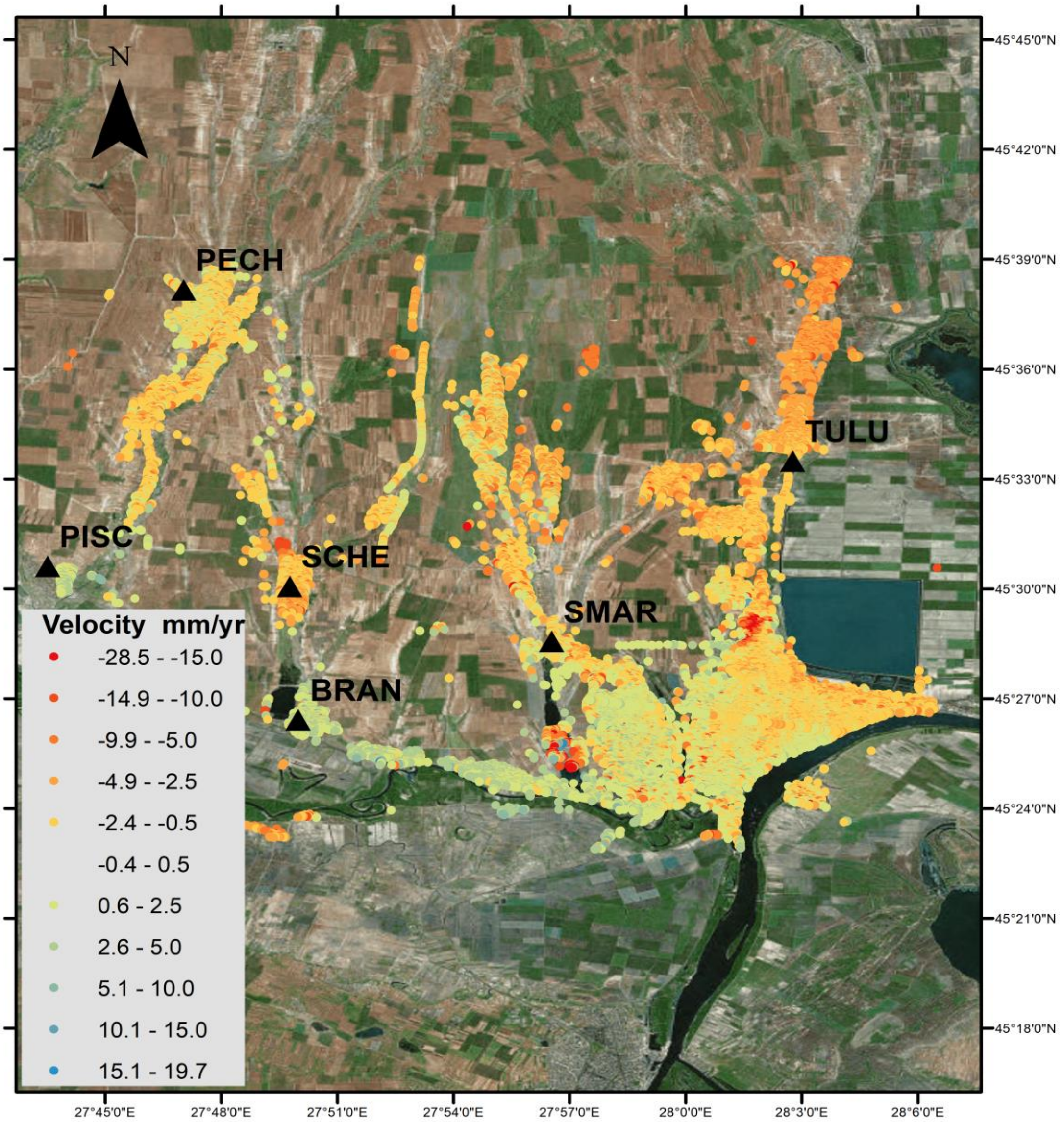

Figure 6 *Deformation map obtained for the Galați-Izvoarele area*

An interesting pattern of local very high subsidence values was obtained for 3 areas in the study area, found on the gas and petroleum extraction platform. These localized subsidence regions are of the order of hundreds of square meters. Their average velocity values range from -5mm/yr to -10 mm/yr, reaching cumulated displacement values of around -30 mm in two years [Fig. 7]. Due to their limited area and very high displacement values, these affected areas can be considered as compaction sites caused by human intervention during extraction activities.

On the Black Sea coast, we have obtained 184 067 points for Constanța, 67803 points in Mangalia and 16798 points in Sulina. The average velocity values range from -24 mm/yr to 24 mm/yr for Constanța [Fig. 8], and smaller intervals for Mangalia and Sulina, between -19 mm/yr and 13 mm/yr [Fig. 9, 10]. The surface movement evolution depicted for Constanța shows mainly stability, affected also by noise. In Mangalia, besides the general surface movement patterns that show stability, we have obtained also a strip of subsiding points along the road that links the northern part of the locality to the southern part. This motorway is subsiding with more than 5 mm/yr, its points reaching on average -15 mm cumulated displacement values in two years.

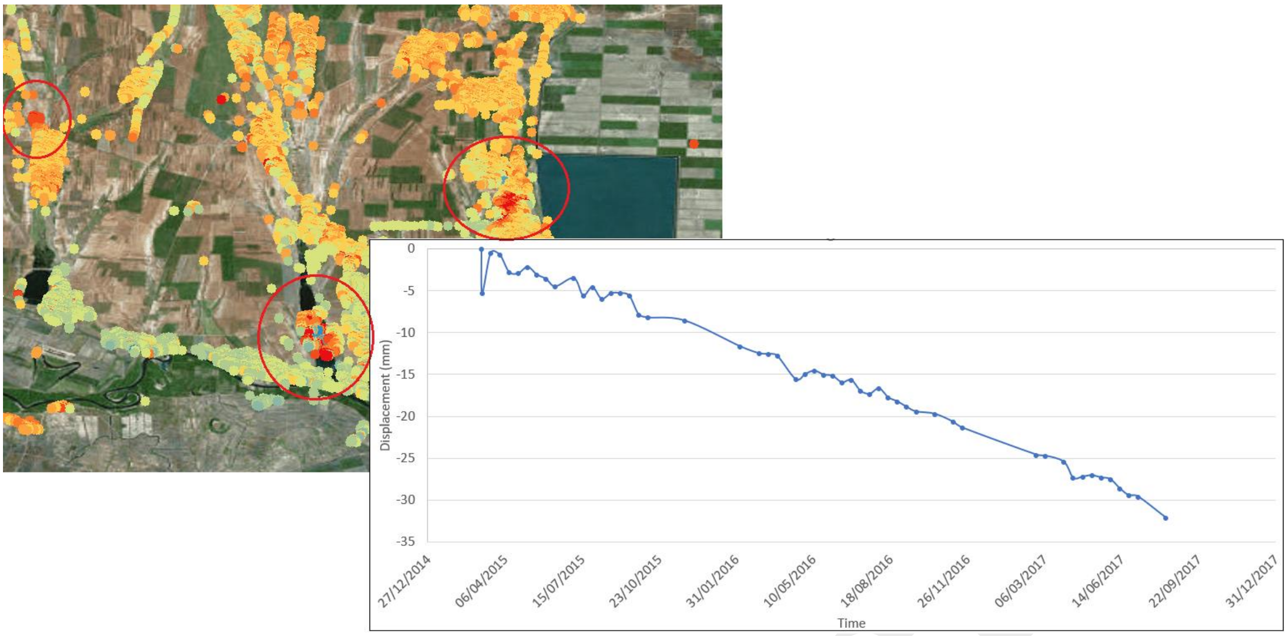

***Figure 7** Compaction zones in Galați and Izvoarele characterized by cumulated displacements of -35 mm/yr*

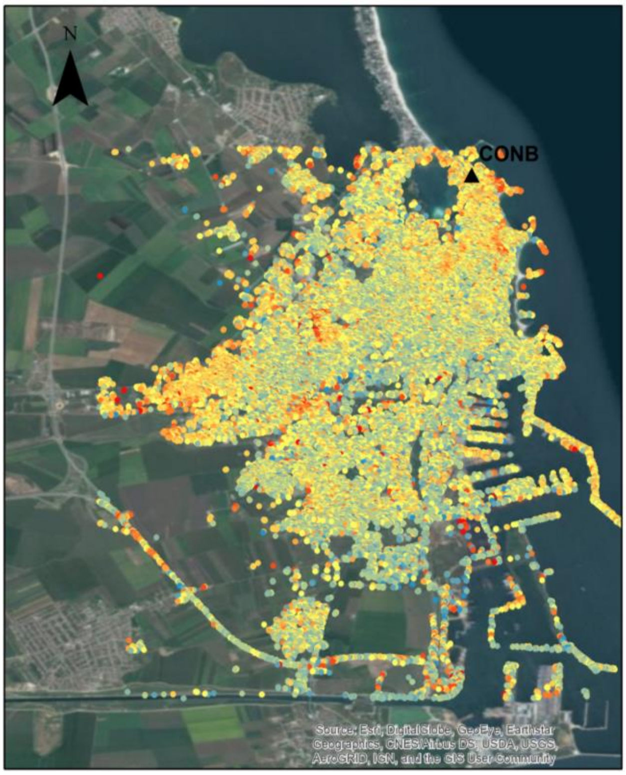

***Figure 8** Deformation map obtained for Constanța*

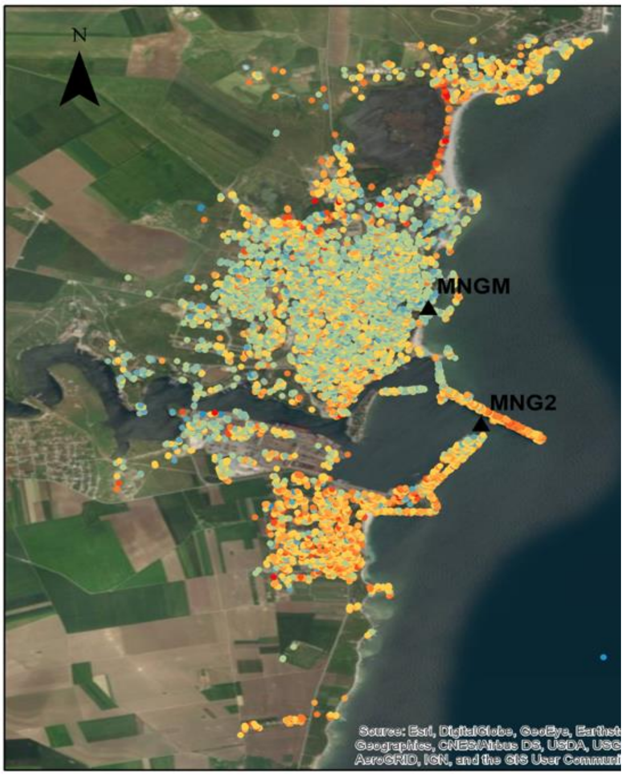

***Figure 9** Deformation map obtained for Mangalia*

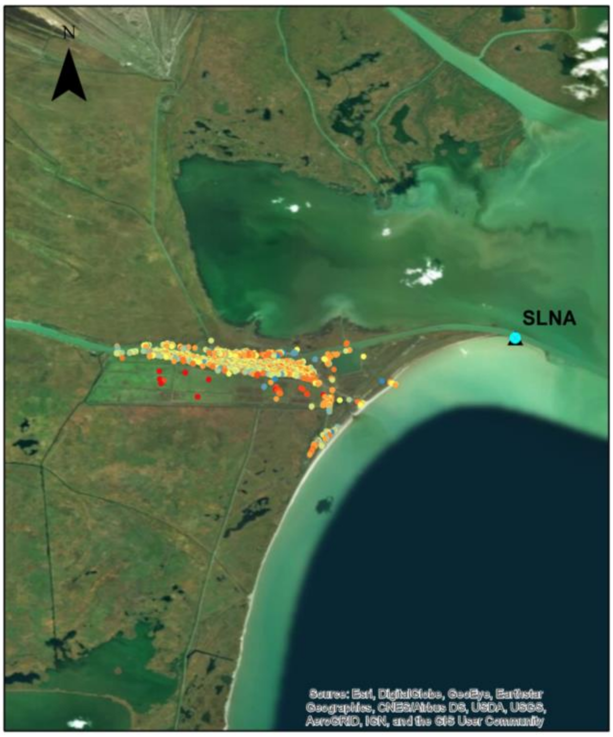

Figure 10 *Deformation map obtained for Sulina*

Table 2 *Comparison between GNSS derived displacement tendency and PS-InSAR results*

GNSS station	Displacement tendency		Correspondence
	GNSS	***InSAR***	
PECH	Uplift	Uplift	Yes
TULU	Uplift	Subsidence	No
PISC	Subsidence	Uplift	No
SCHE	Subsidence	Subsidence	Yes
SMAR	Subsidence	Subsidence	Yes
BRAN	Uplift	Uplift	Yes
SLNA	Subsidence	Subsidence	Yes
CONB	Subsidence	Subsidence	Yes
MNGM	Subsidence	Stability	No
MNG2	Subsidence	Stability	No

5. CONCLUSION

The main scope of our research was obtaining preliminary results from multitemporal InSAR techniques, such as PS processing of Sentinel-1A data. The areas of interest were represented by Galați-Izvoarele and Black Sea coast, which are both interesting sites from the point of view of seismic behaviour.

The deformation maps describing the areas show displacement rate values between -28 mm/yr and 20 mm/yr for Galați, between -24 mm/yr to 24 mm/yr in Constanța, and smaller interval ranges for Sulina and Mangalia.

The general subsidence pattern in Izvoarele Galați could be explained by a tectonic subsidence that is characterizing the whole study area. The subsidence along the riverbed of Siret could be attributed to the continuous deposition of sand and gravel sediments. The localized high subsidence values are associated to human interaction which is causing differential land compaction through gas and petroleum extractions.

Besides the subsiding motorway in Mangalia, the coastal localities are characterized by stability patterns and seasonality.

In what concerns the comparison against the GNSS results, not all the compared movement patterns were characterized by a good agreement. The main reason that we considered was the difference in time table between the GNSS and InSAR acquisitions. There were also GNSS reference points that were not compared to PS results because they were installed outside the built-up area, and no permanent reflectors were depicted in their proximity.

Although the deformation map obtained for the current study was linked to both geological and human interaction in the area, we consider that the results require a more thorough investigation from a geological perspective. Due to the suggestive patterns that we identified in the deformation maps, that could not be depicted through GNSS monitoring, InSAR proves to be a valuable monitoring tool that can bring additional information and complete discrete GNSS data.

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The hydrological regime of the Prahova River along Carpathian and Subcarpathian stretch

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Abstract. The objective of this study is to analyze the hydrological regime of the Prahova River along its Carpathian and Subcarpathian stretches. The study reach has a length of 56 km and is situated between the Prahova River source and the downstream confluence with its main left tributary, the Doftana River. The description of the hydrological regime of the Prahova River is based on the statistical analysis of the climatic and hydrological data recorded at the meteorological stations and hydrometric stations in the area of interest. In order to understand the hydrological regime of the Prahova River, we focused on the following aspects: (1) sources of supply, (2) climatic factors (temperature regime, precipitation regime), (3) the mean flow, (4) the maximum flow (floods), (5) the sediment discharge and (6) the thermal and freezing regime of the Prahova River. The importance of this study lies in the need to know the hydrological regime that plays a leading role in the study of the morphodynamics of the Prahova River channel.

Key words: hydrological regime, statistical analysis, climatic factors, mean flow, floods, sediment discharge, hydrological nivo-pluvial regime.

1. INTRODUCTION

The hydrological regime sums up the set of hydrological characteristics of a watercourse and the way they vary (Musy, 2005). The definitions given by most authors indicate that the hydrological regime represents the daily, annual seasonal and multi-annual variations of liquid and solid flow rates, temperatures, chemistry, bedland processes (Lăzărescu and Panait., 1957; Musy, 2005; Zăvoianu, 2006; Ioana-Toroimac, 2009).

The variations of these parameters take place according to the factors that determine and condition the runoff formation: climatic factors (temperature and precipitation regime), geological characteristics, morphological characteristics, vegetation, soils and land use in the drainage basin. In addition to the natural factors mentioned above, an increasingly important role in the modification, sometimes even radical, of the hydrological regime of the watercourses is the anthropic factor (Zăvoianu, 2006, Jora *et al.*, 2010).

The hydrological regime plays a pivotal role in the study of the river bed morphodynamics. Liquid and solid leakages are the factors that dramatically influence the time and space dynamics of the Prahova River bed. The liquid flow controls the size of the river bed while the sediment discharge is responsible for its stability or instability (Canciu, 2008). Also, besides the characteristics of river channel and rock in which the river bed may incise, the liquid and solid flows are the variables that have a determining role in the shape of the longitudinal profile.

2. STUDY AREA

The Prahova River headwaters is in the Clabucetele Predealului Mountains, in the Predeal step area, at an altitude of 1100 m; it is a second order tributary of the Danube River and the first order tributary of the Ialomita River, the hydrographic basin having the shape of an amphitheater with an area of 3740 km^2. The Prahova River basin has a large asymmetry with the left side occupying 88% of the total area of the basin (Pișota and Zaharia, 1994).

The Prahova River drains the territory of the counties of Brasov, Prahova and Ilfov along 193 km length, after which it flows into the Ialomita River at Dridu locality, downstream Adâncata settlement. As paved relief units, after springs from Predeal step, the Prahova River crosses the Carpathian chain, representing the geographical limit between the Southern Carpathians and the Eastern Carpathians. Then it continues its course through the Curvature Subcarpathians with a general NNV-SSE direction of flow, and enters the Romanian Plain. The study area covers the mountain and Subcarpathian areas over a distance of 56 km along the river (Fig. 1).

From a geological point of view, the mountain sector of the Prahova River falls into the flish area. The Subcarpathian stretch extends to the north, in the Carpathian flish area, and to the south, in the structural area defined as the molasses area, which corresponds to the foredeep (Armaş *et al*., 2003).

Regarding the relief, the Carpathian stretch of the Prahova River is characterized by a transversal corridor with reaches in which the valley is narrow (the sector between Predeal and Azuga or between Sinaia and Posada localities), but it also spreads in certain areas (e.g. the depression basin where the Bușteni, Poiana Tapului, and Predeal resorts are located). The Subcarpathian reach is characterized by a large valley with a meadow and a system of 4-5 terraces.

From a pedological point of view, the districambosols, eutricambosols, luvosols, prepodzols, podzols and rocks predominate in the mountain sector. In the Subcarpathian area, eutricambosols, luvosols, preluvosols, erodosols, lithosols, faeosomes are encountered.

As far as the anthropic impact is concerned, it is well known that the mountain and Subcarpathic sectors of the Prahova River are to a large extent influenced by man-made activities, and are characterized by a high morphodynamic vulnerability (bank erosion and collapse, incision) (Armaş *et. al*., 2013, Gogoaşe Nistoran *et. al*., 2018).

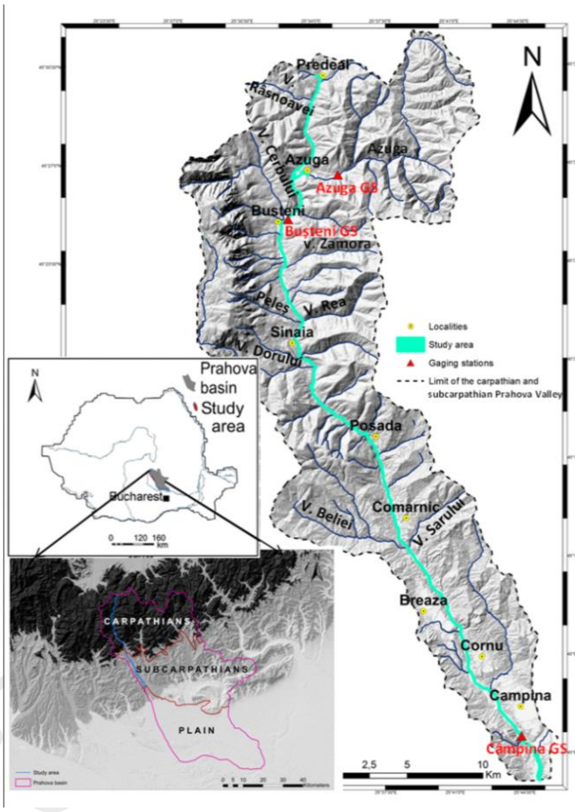


Fig. 1 *Location of study area*

3. DATA AND METHODS

The research was based on the use of climatic and hydrological data. The analyzed climatic data consist of chronological series of: air temperature, water temperature, daily rainfall, thickness of snow layer, thickness of ice layer. The data covers the period 1961-2012 and were recorded at the Predeal, Omu mountain peak, Sinaia and Câmpina meteorological stations. Climate data was provided by the National Meteorological Agency. Among the hydrological data used, we include: daily mean liquid flows, sediment flow rates, rating curves, daily mean water elevations, catastrophic (historic) floods, other hydrometric data measured at the gaging stations cross-section (velocity, top width, depth, wetted perimeter, hydraulic radius, water surface slope). All these data come from the Azuga, Poiana Țapului / Buşteni and Câmpina gaging stations (GS), covering the period 1960-2012, and were provided by the Water Directorate Buzău-Ialomiţa, Prahova Water Management System (S.G.A. Prahova, in Romanian).

In order to meet the objectives of this study, the above data were analyzed by statistical methods.

4. THE TRIBUTARIES OF THE PRAHOVA RIVER

Along the 56-kilometer-long study stretch, Prahova collects the flows of several tributaries. In the mountainous reach, the left bank tributaries, which drain the Clabucetele Predealului and Baiului Mountains are: Valea Puriştoicei or Poliștoaca, Azuga River, Valea Fetei, Valea Zamora, Valea Şipa, Valea Rea, Valea Câinelui. In the Sinaia-Posada Gorge, the Prahova River receives along the left bank many torrents, of which the most important are: Valea Bogdan, Valea Razoarelor, Valea Floreiului and Valea Batrâioarei.

In the Carpathian reach, the right bank tributaries draining the Bucegi massif are: Valea Rîșnoavei, Valea Cerbului, Valea Albă, Valea Jepilor, Valea Urlătoarelor, Valea Peleșului, Valea Zgarburei, Valea Izvorului / Dorului. In the Sinaia-Posada Gorge, the Prahova River receives on the right side numerous torrents, of which the most important are: Valea Largă, Valea Dracului, Valea Dogariei, Valea Măgarului.

In the Subcarpathian reach, Prahova receives only two more tributaries on the left side: Valea Sarului and Câmpinița. Because of the lithological conditions and complex structures, these valleys are characterized by intense torrential processes and landslides bringing a significant solid flow. In the Subcarpathian area, Prahova River receives on the right one single tributary, Valea Beliei.

5. SUPPLY SOURCES

Following the origin of the supply sources, the Prahova River has superficial or surface supply and underground feeding. Surface feeding is represented by precipitations that fall in liquid or snow form, and groundwater is represented by water table. Nedelcu (2010) states that, at the level of the Prahova drainage basin, rainwater sources account for 70-87% of the volume of the annual runoff, while the underground sources represent 13-27%.

Referring only to the studied area, in the mountain sector of the Prahova River predominates the snow supply, where the thick snow layer stagnates on the valleys from November to March-April and may even continue to remain throughout the warm season in the shady areas (Mihai *et al*., 2016). Along the Subcarpathian reach the rain supply is predominant.

6. CLIMATE FACTORS (TEMPERATURE AND PRECIPITATION REGIMES)

In the process of runoff, climatic factors have a decisive influence on water reserves, both through the intake of rainwater and due to the losses caused by evapotranspiration.

The temperature regime – was registered at four meteorological (weather) stations: the lowest average temperatures recorded in January at Predeal are -4.9°C, at Sinaia are -5.4^{0}C, at Câmpina -1.8^{0}C, and only at the Omu mountain peak, due to the high altitude, the lowest average temperature is recorded in February at -10.6^{0}C. In the hot season, the air temperature has positive values and the highest thermal average values are registered in July at Predeal 14.4^{0}C, in Sinaia 12.5^{0}C, at Câmpina 19.3^{0}C and at the Omu mountain peak station, the highest thermal average occurs in August, being 5.5 °C. In spring and autumn, the thermal average values remain predominantly negative in the high mountain areas while in the intramontane corridors with depressions and basins, the thermal average values lyes between 10-12^{0}C. In conclusion, in the studied area, the thermal regime is characterized by a peak in July (Predeal, Sinaia, Câmpina stations) and August (Omu mountain peak station), and by a minimum in January (Predeal, Sinaia, Câmpina stations) and February (Omu mountain peak station).

The Rainfall regime. Rainfall was measured by precipitation gage at the Azuga (971 m altitude) and Bușteni (875 m altitude) gaging stations, in the Carpathians and at the Câmpina (378 m altitude) gaging station, located in the Subcarpathians.

Monthly average precipitation recorded for the year 2009 (considered a hydrologically normal year), as shown in the graph in Fig. 2, show a maximum in the warm season, namely in June, July and August. The highest values were registered in July at Azuga 16 mm, in Bușteni - 11 mm and in Câmpina - 7 mm. The minimum values occur during the cold season (December, January and February) due to the predominance of the anti-cyclonic regime (Azuga 5 mm, Bușteni 4 mm and Campina 3 mm). Analyzing these data, we can see that rainfall values gradually decrease from the Carpathian area (Azuga and Bușteni) to the Subcarpathian area (Câmpina).

The pluviometric regime is characterized by two maxima:

- The first maximum rainfall occurs during the warm season (June and July): at Azuga 83 mm (July 2009), at Bușteni 61 mm (July 2009) and at Campina 42 mm (July 2009).
- The second pluviometric maximum is low and is recorded in October and November: Azuga 26 mm (October 2009), Bușteni 43 mm (October 2009) and Câmpina 33 mm (July 2009).

The pluviometric regime also has two minimums: a minimum is produced in the winter (January / February) and the second minimum is recorded in autumn.

7. MEAN FLOW AND VARIATIONS

Average flow is the most important indicator of water resources in rivers and is expressed by several parameters:

7.1. Mean multiannual flow (Q_0, m^3/s) is a parameter resulting from the arithmetic mean of daily flows over a period of years. The mean multiannual flow rates are small in the Prahova mountain sector (GS Azuga: 1.84 m^3/s, Poiana Țapului / Bușteni: 4.14 m^3/s) and as the river enters the Subcarpathians, the values increase due to the intake of liquid flow coming from tributaries (GS Câmpina – 8.04 m^3/s) (Fig. 3).

If the average daily flows are listed in decreasing ordered, from highest to lowest, and if each value is assigned a probability of exceedance (p%) per year (1-100), Q(p), or its analogous – the duration curve, Q(t), in days of a year is obtained (Fig. 4).

From this curve it may be seen that the annual flow has a probability of exceedance, p% = 38%, corresponding to a return / recurrence period, T = 1/p% of 2.6 years, i.e. the flow that is statistically repeated every 2.6 years. Otherwise, statistically, for 139 days in an average hydrological year, the flow rate in the river channel is higher than the annual flow rate, while for the remaining 226 days, the flow rate falls below this value (Gogoașe Nistoran, 2018).

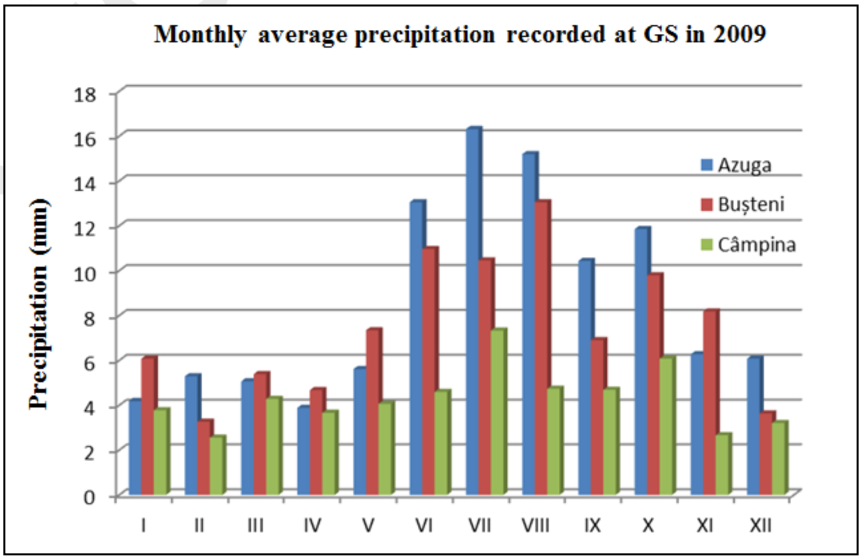


Fig. 2. *Monthly average precipitation recorded at the three gaging stations in 2009*

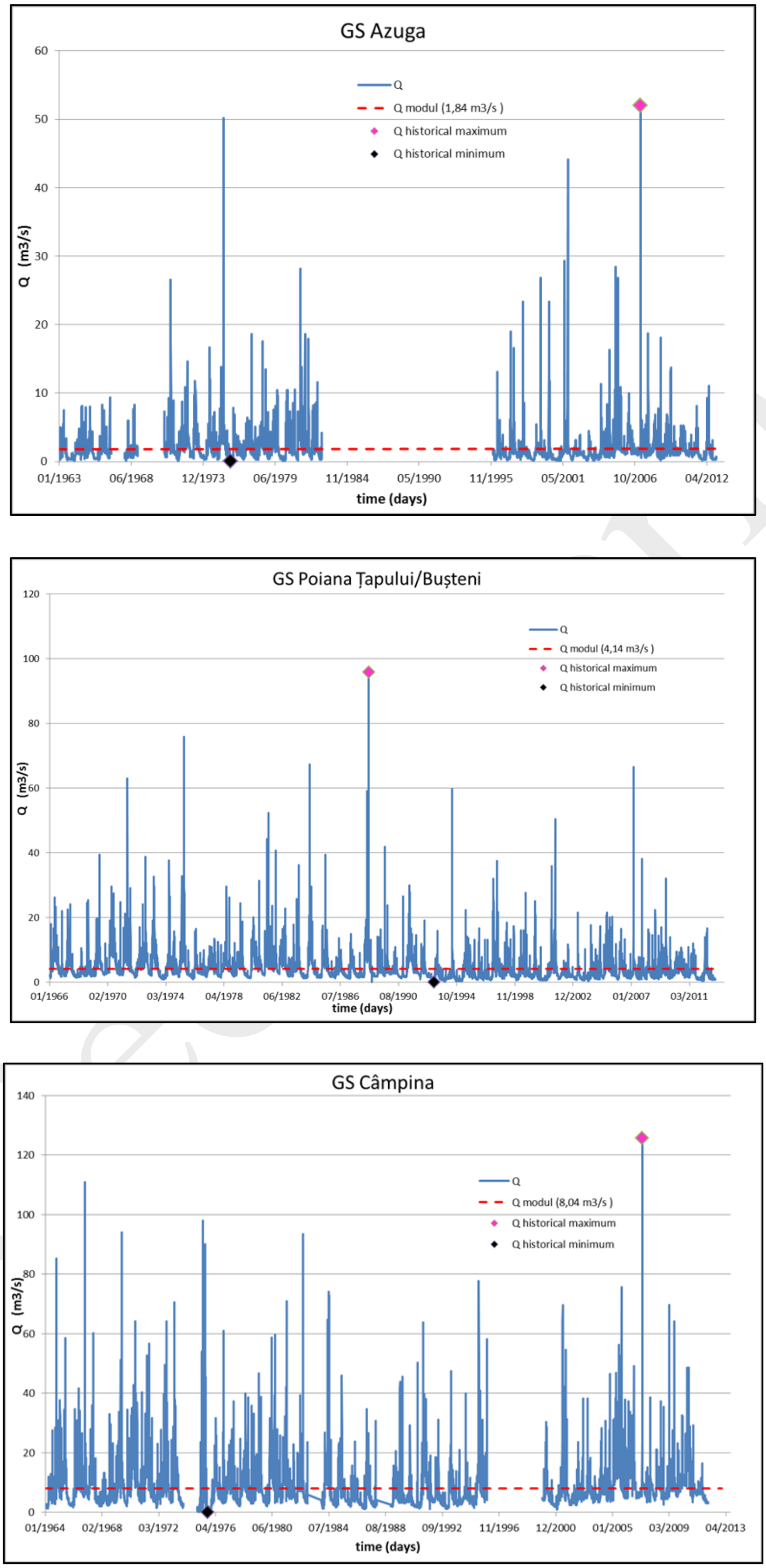


Fig. 3. Hydrograph of daily mean flows, Q (t) recorded at the three GS along Prahova River (1963-2012)

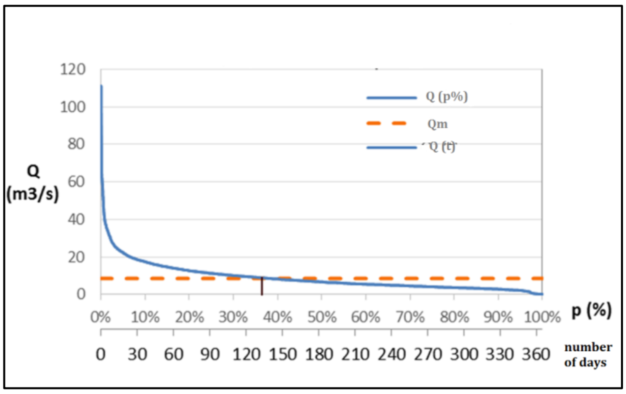


***Fig. 4**. Duration / probability curve of exceeding the mean daily flows at GS Câmpina*

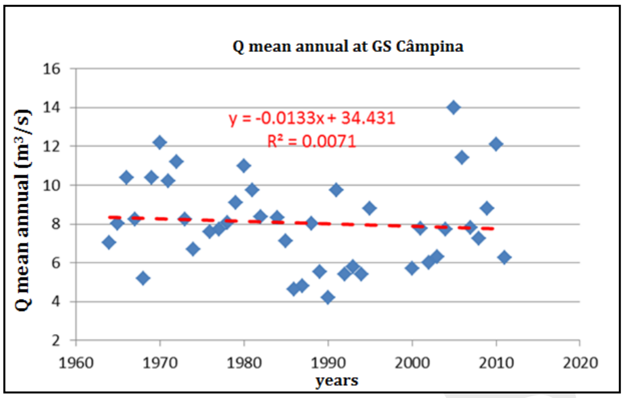


***Fig. 5**. Multiannual variation of mean annual flows at GS Câmpina*

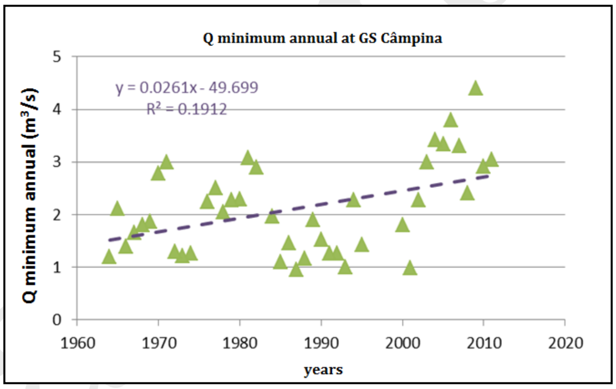


***Fig. 6**. Multiannual variation of minimum annual flows at GS Câmpina*

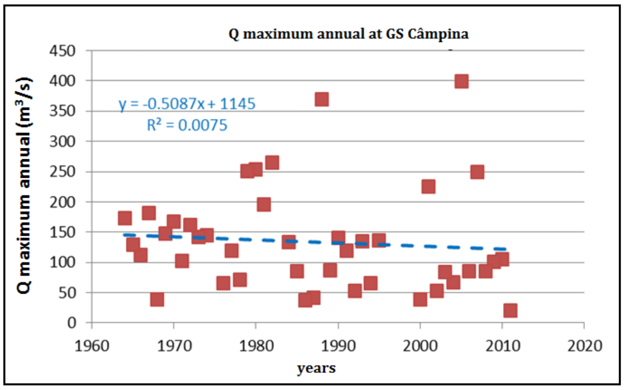


***Fig. 7**. Multiannual variation of maximum annual flows at GS Câmpina*

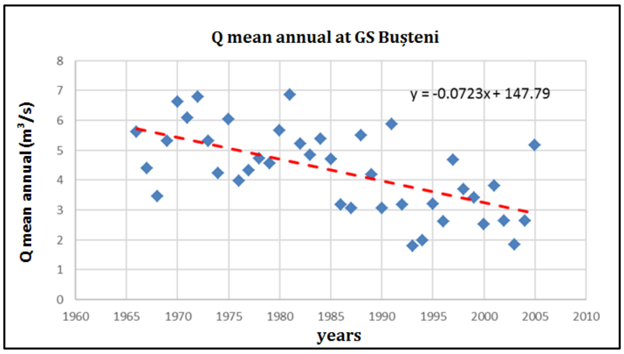


***Fig. 8**. Multiannual variation of mean annual flows at GS Bușteni*

7.2. Mean specific flow (q_0, l/s/km²) is the parameter that shows the amount of water drained per second and unit area. In the studied area, the highest values are recorded in the mountain area, respectively at GS Azuga of 23.93 l/s/km² and GS Poiana Țapului / Bușteni of 23.78 l/s/km² and decrease in the Subcarpathians reaching at GS Câmpina 16.67 l/s/km².

7.3. The flow extremes result from the hydrographs of the recorded flows at the gaging stations located in the studied area (represented in the Fig. 3). Analyzing these hydrographs one can make the following observations: at GS Azuga, the maximum historical flow rate is 52 m³/s, produced on 23 March 2007, and the minimum historical flow is 0,04 m³/s recorded at January 17, 1976; the maximum historical flow rate at Poiana Țapului / Bușteni GS is 95.9 m³/s registered on July 17, 1988 and the minimum historical flow is 0.068 m³/s on March 2, 1993. At Câmpina GS the maximum flow rate of 125.64 m³/s was recorded on March 23, 2007, and the historical minimum flow was 0.044 m³/s, on September 26, 1975.

7.4. The interannual variation of the mean, minimum and maximum average annual flows. From Figures 5, 6 and 7 it can be seen that at the Câmpina GS, the mean and maximum annual flows decreased slightly during 1964-2012, while the minimum annual flow has increased over the same period of time. At Poiana Țapului / Bușteni GS however, all these three annual flow values show a decreasing trend (Figures 8, 9 and 10).

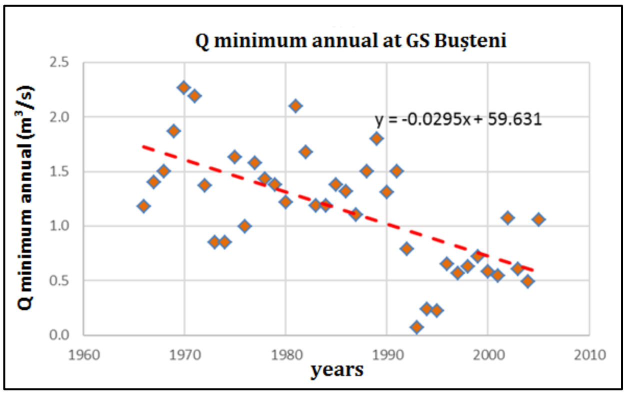


Fig. 9. Multiannual variation of minimum annual flows at GS Câmpina

7.5. Monthly and seasonal variations of flows recorded at gaging stations must be correlated with the temperature and precipitation regimes. Analyzing the graph in Fig. 11, one can see that the mean monthly flow reaches the first maximum during spring months (March-April) due to the increase in temperatures causing snow melting (Azuga of 3.65 m^3/s, Buşteni of 6.31 m^3/s, and Câmpina of 12.2 m^3/s), and a second maximum in the summer months (July-August), due to torrential rain from this season (Azuga of 3,.08 m^3/s, Buşteni of 6.12 m^3/s, Câmpina of 13.7 m^3/s).

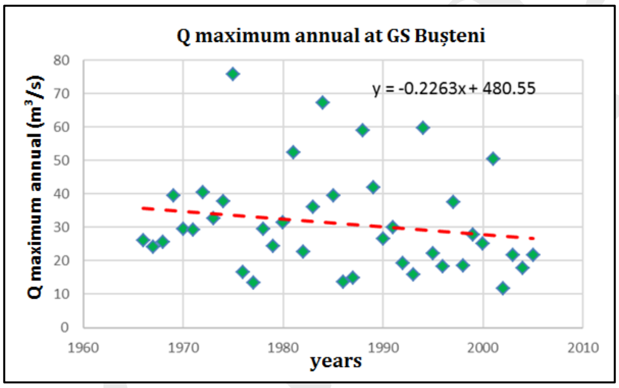
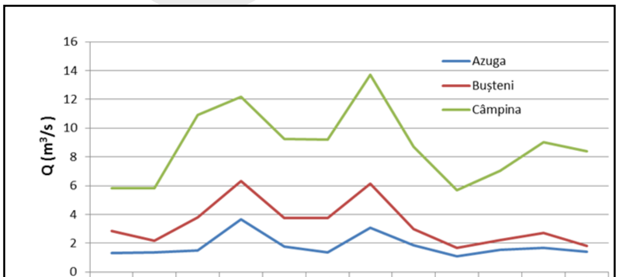


Fig. 10. Multiannual variation of maximum annual flows at GS Câmpina



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Azuga	1.32	1.35	1.5	3.65	1.79	1.35	3.08	1.86	1.11	1.53	1.7	1.41
Buşteni	2.86	2.18	3.81	6.31	3.73	3.74	6.12	2.97	1.7	2.23	2.73	1.8
Câmpina	5.83	5.83	10.9	12.2	9.24	9.21	13.7	8.71	5.68	7.02	9.01	8.4

Fig. 11. Variations in monthly mean flows recorded at gaging stations in 2009

Minimum mean monthly flow rates are recorded during winter months (January-February) when the temperatures are very low and the precipitations fall in the form of snow (Azuga of 1.32 m^3/s, Buşteni of 2.18 m^3/s, Câmpina of 5.83 m^3/s). A second minimum is recorded during autumn in September (Azuga of 1.11 m^3/s, Buşteni of 1.7 m^3/s, Câmpina of 5.68 m^3/s).

7.6. The floods – are extreme hydrological phenomena that are characterized by sudden increases (bursts) in the level and flow of a watercourse due to torrential rains and/or snow melting. The floods may occur at any time of the year, but generally correspond to the spring months (March and April) caused by spring rains and snow melting, but occur also during the rainy years.

The most important floods that occurred on the Prahova River are:

➢ The floods in 2007 – at all three gaging stations in the studied area; floods occurred in 2007 between March 18-31 and October 19-30. The March 2007 flood occurred due to the heavy rainfall experienced during this period. Rain gages installed at the stations recorded on March 23 maximum precipitations of 120 mm at Azuga, 105 mm at Buşteni and 30 mm at Câmpina. Under such rain conditions, on March 23, peak flows of 81.5 m^3/s were registered along Prahova River at Azuga GS, of 102 m^3/s at Buşteni GS and of 250 m^3/s at Câmpina GS. The October 2007 floods were less intense and raingages recorded the highest rainfall this month on the 23rd, respectively 55 mm at Azuga, 51 mm at Buşteni and 26 mm in Câmpina. The peak flows recorded on the Prahova River on October 23 were: 25.4 m^3/s GS Azuga, 55.2 m^3/s GS Buşteni, 57.2 m^3/s GS Câmpina. In Fig. 12 are the floods that occurred at GS Buşteni in 2007.

➢ The floods in 2005; it is well known that in 2005 Romania was affected by high-intensity meteorological phenomena, which caused at least 50% of the normal rainfall to be exceeded. During this year, on the Prahova River, intense precipitation caused floods in May, July, August and September, when maximum flows reached historic values. In May, the rain gages recorded the maximum precipitation on the 7th, respectively: at the Predeal weather station there were of 51.2 mm, at the Omu mountain peak station of 64.4 mm, at

Sinaia of 64.4 mm and at Câmpina of 16.2 mm. These climatic conditions led to a peak flow of 147 m^3/s at Câmpina GS. In July 2005, rainfall was higher than in May with a peak flow rate at Câmpina GS of 399 m^3/s, which is considered historic for this gaging station. High intensity floods also occurred in September, when on 19 and 20, the sum of the precipitations was 157.4 mm in Predeal, 43.6 mm at the Omu mountain peak, 194 mm at Sinaia and 226 mm at Câmpina.

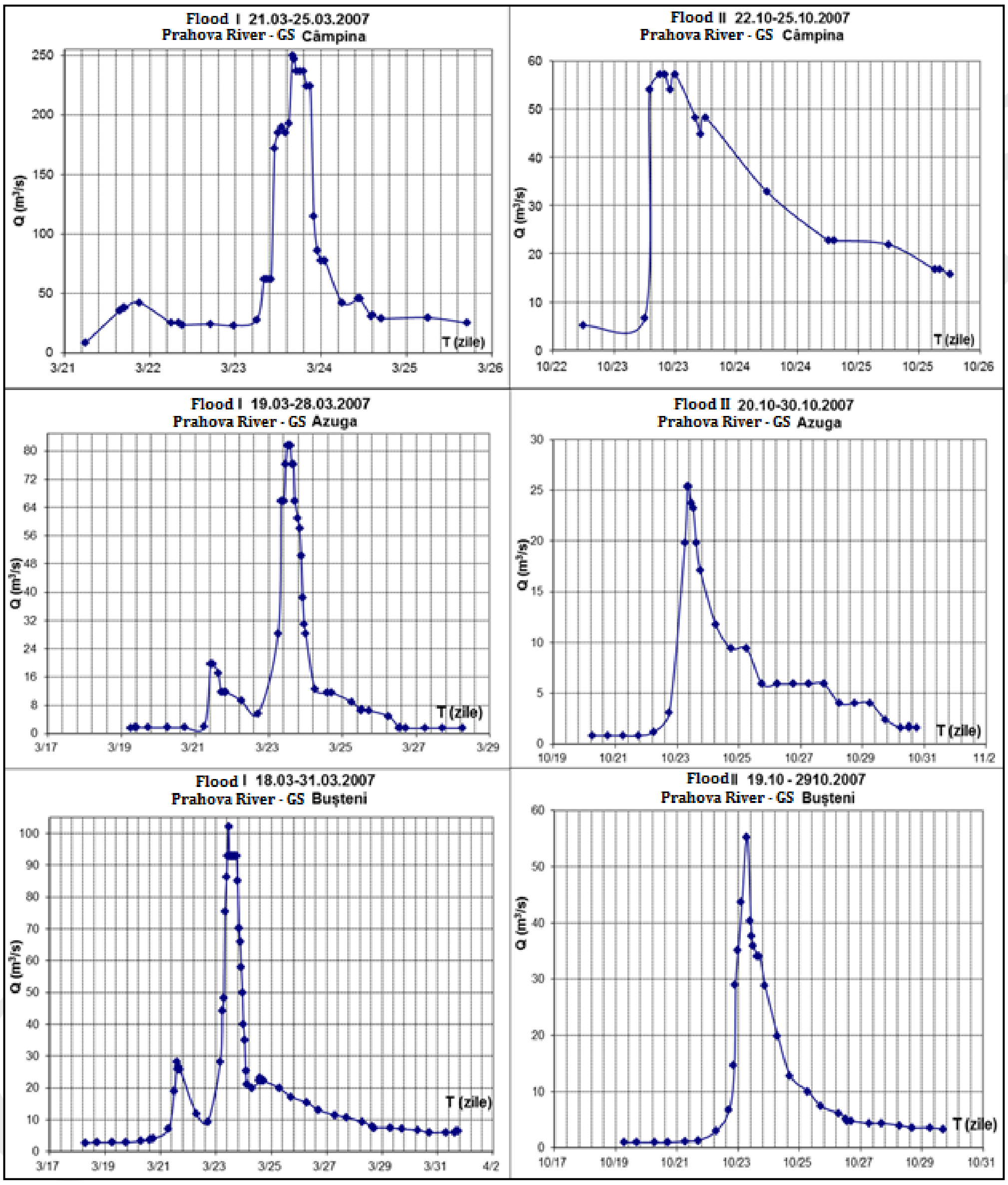


***Fig. 12**. The floods registered at gaging stations in 2007*

- Major floods occurred in 2001 when a peak flow rate of 92 m^3/s was registered at Azuga GS, of 123 m^3/s at Bușteni GS and of 110 m^3/s at Câmpina GS. During the period 1960-2000, the most important floods occurred in 1975 when the raingages recorded on the 1st and 2nd of June 179 mm at Predeal weather station, 95 mm at the Omu mountain peak station, 157 mm at Sinaia and 144 mm at Câmpina stations. These abundant precipitations led to a peak flow rate in the river channel of 135 m^3/s at Poiana Țapului GS and of 340 m^3/s at Câmpina GS.

In Europe's mountainous areas, the duration of floods has decreased and their intensity has increased over the last decades, with a fast character (flash flood) (Alfieri et. al, 2016, Hall, 2014). In the study area this is mainly due to deforestation (vegetation delaying precipitation water runoff along slopes) and to the increase in paved (impervious) areas, which concentrates precipitation into the river channel much faster.

8. THE SEDIMENT DISCHARGE

From the point of view of the source, the total sediment flow transported by a stream represents the sum of the upstream river contribution and the riverbed contribution due to the effect of entraining the particles from the river bed into the stream water (Chanson, 2004, Graf, 1996). Consequently, the contribution and transport of sediment load into a river stream (which for the Carpathian reach can consist of sand, gravel, boulders, etc.) depends on the character of the sediments (size, density, nature, hardness, shape, granulometry, cohesion) and at the same time on climatic, hydrological, geological, morphological, and topographical features of all its upstream tributaries, as well as of the river itself along the study sector (Anderson *et al*., 1996).

From the point of view of the mode of transport, total load may be suspended or bedload solid discharge. The first consists of finer particles transported by the water stream and the second of coarser particles moved only at higher flow rates, specific to high water periods or floods.

The two types of sediment load are measured with different instruments and quantified with distinct formulas. Since dragging is very difficult to measure, especially on gravel beds, we will only refer to suspended load (flow).

Taking into account all the above-mentioned parameters, which underlie the formation and suspension of sediments, one can state that in the mountain reach of the Prahova River, characterized by low flows, compact rocks with high erosion resistance and high degree of afforestation, average suspended load has very low values. At the exit of the Prahova River from the Posada Gorge, the rocks are less cemented or even unconsolidated, being very friable and the soils have a loamy texture. Therefore, downstream this area there is a significant increase in the suspended flow. This is why systematic measurements of suspended load are only performed at the Campina GS, although in the studied area there are three gaging stations, as stated before (Fig. 1).

The interannual variations of the maximum and minimum annual suspended load have the same decreasing trend as the annual average values (Figures 13-15), since they are dependent on the corresponding values of the liquid flow rate (which also decrease). This may be due to: (i) the upstream Sinaia hydroelectric arrangements with small dams, (ii) river and tributaries hydrotechnical works to protect banks and riverbed of erosion, with concrete weirs, sills and stilling basins and (iii) aggregate extractions, especially in the existing gravel pits along the analyzed river stretch.

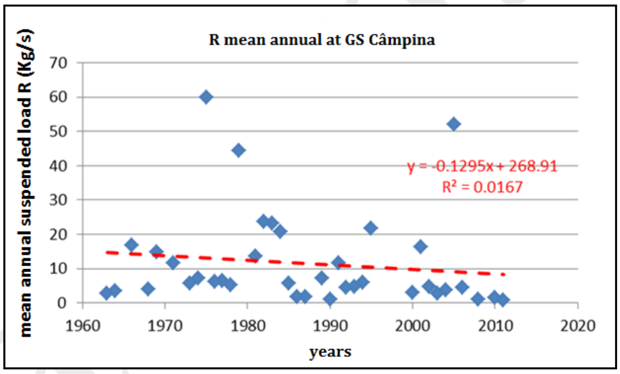


Fig. 13. *Multiannual variation of the mean annual suspended load at Câmpina GS*

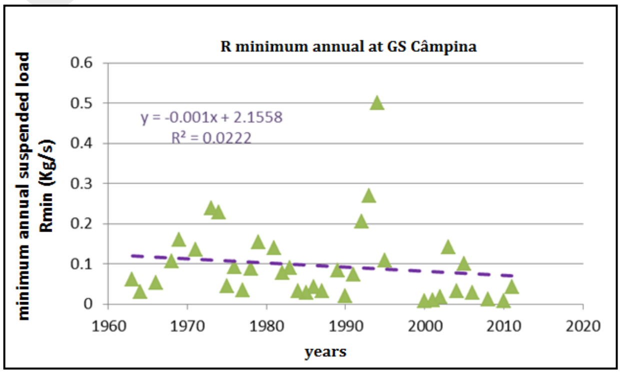


Fig. 14. *Multiannual variation of the minimum annual suspended at Câmpina GS*

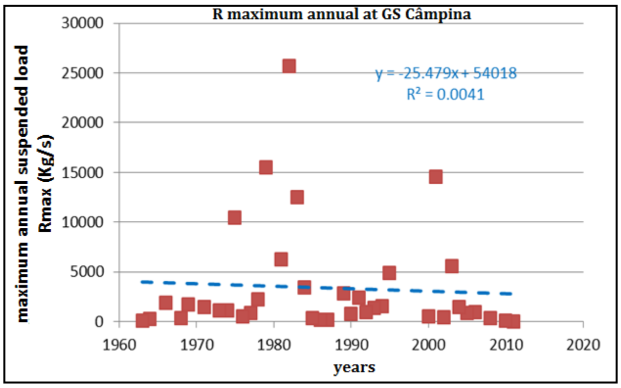


Fig. 15. *Multiannual variation of the maximum annual suspended at Câmpina GS*

9. THERMAL AND FREEZING REGIME

The Prahova River water temperature varies from one reach to another, and this variation is closely related to the air temperature of the relief unit that the river crosses, the water dynamics, etc. Increasing altitude determines the decrease of the air temperature according to a vertical thermal gradient of 1°C/100 m which in turn influences the decrease of the water temperature. This assertion is supported by the records made at the three gaging stations in the studied area as follows: at the Câmpina GS (378 m altitude) the annual average is 9.8^{0}C, at the Buşteni GS (at an altitude of 875 m) the annual thermal average is 5.9^{0}C and at the Azuga GS (located at the altitude of 971 m) annual thermal is 3.4^{0}C.

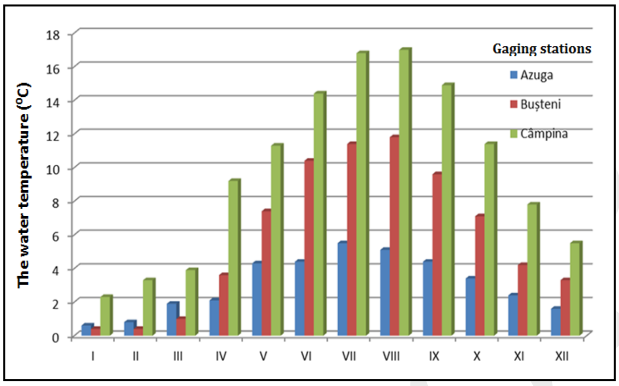


Fig. 16*. Monthly average water temperatures recorded at the three gaging stations in 2009*

Regarding the variation of the Prahova River water temperature regime during one year, we can see an increase in the average monthly temperature beginning with the snow melting in April and reaching a peak in July and August (Figure 16).

10. CONCLUSIONS

The present paper highlights new results that are in line with the previous literature.

Analysing the climatic and hydrological data, the hydrological regime of the Prahova River is characterized by high waters during the spring months (March-April), due to the increase of the temperatures causing snow melting and low waters during the winter months (January-February), when temperatures are very low and water is stored in the snow layer. A second maximum, which is much lower, occurs in some years in July-August due to torrential rains, and in other years at the end of autumn. The second minimum takes place in early autumn, in September. Thus, we can conclude that ***the Prahova River has a nivo-pluvial hydrological regime.***

Interannual variations of mean, minimum and maximum annual flows over a period of about 50 years show a decreasing trend at Poiana Țapului / Busteni GS and Campina GS, with the exception of minimum annual average flow at Campina, which shows an unusual rising trend. While for the first GS a sudden fall in average flow values starting with 1993 might be explaind by the upstream location changing from Poiana Tapului to Bușteni, the overall interannual decreasing trend of annual flow values for both GSs may only be explained at this time scale, as either being due to climate change or to consumer-related anthropogenic impact in the Prahova River Valley area, which has the highest population density in the country.

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Organisation type and whistleblowing arrangements

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Abstract. Hidden vulnerabilities are exposed by stressors. These stressors can be natural (flood, earthquake, heat-wave, etc.) or man-made (earthquake, flood, economic crisis, pathogen development, storage tank explosion, etc.). If the system they impact is riddled with vulnerabilities it will collapse. If a building is poorly built, because of say poor corporate ethics on the part of the contractor or corruption allowing lax observation of codes, it will collapse whether because of a natural earthquake or a man-made landslide. Whistleblowing can reveal these hidden vulnerabilities, but it also potentially manifests differently across different types of organisations, so we therefore encourage research in Romania to compare whistleblowing arrangements across the various organizational sectors.

Keywords: *disaster, whistleblowing, organisations, ethics, organisational sector*

1. INTRODUCTION

Whistleblowing can reveal the hidden vulnerabilities which facilitate disasters. This article examines some of the research that focuses on the organisational perspective concerning whistleblowing and its usefulness for both organisations and the societies they operate in.

From an organisational communication perspective, information that is perceived as destructive or negative is less likely to be transmitted to upper management. Knowledge of clear and proper channels for reporting unethical behaviour within an organization may enhance internal rather than external whistleblowing (King, 1999). Internal disclosure is preferred by organisations because it limits bad publicity and lowers the chances of regulations impacting their activities. Whether this varies depending on the organization type is something research in Romania has not dealt with.

2. ORGANISATIONS AND WHISTLEBLOWING ARRANGEMENTS

Companies will have a natural tendency to externalise costs. There are two major forces opposing this process: regulations and the company's desire to project an image of ethical business practices. We now focus on the latter. Business reputation is a good motivator for companies to appear to act ethically (De Castro *et al*, 2006). Whistleblowing can be seen as a power struggle between social actors, specifically the wrongdoer, the whistleblower, the recipient and the organisations' management. Ben-Yehuda (2001, pp. 79 in Uys, 2008) describes how the same action is interpreted in different ways by the actors involved:

"The organization sees whistle-blowing as betraying of the interests of the organization, violating the rules of hierarchy, bypassing authority, squealing, damaging the reputation of the organization, acting in a hostile manner toward the organization, poisoning the atmosphere, and supplanting cooperation with suspicion. Whistle-blowers, on the other hand, tend to justify their activities in such terms as doing one's job, being faithful to the community, revealing the truth, and doing something that is in the best interests of the organization" (Uys, 2008: 79).

The action of whistleblowing is characterised by ethical tensions between the needs of organisations and the needs of society. But values as part of ethical systems guide action. The medical sector, especially patient care, has long-standing ethical systems in place which serve values that can be used to guide action. Other industries may not have developed values systems and whistleblowers need to find other justifications (Johnson, 2004).

One way of solving this is if the organisation indicates that it values the behaviour and provides internal channels that are an indication that the behaviour is seen as loyal (Near and Miceli, 1996). Re-conceptualising organisational loyalty as rational loyalty is another, perhaps more elegant, solution to this dilemma. Essentially rational loyalty is a loyalty that the organization and the member share for the organisations' explicit, legitimate set of mission statement, goals, value statement and code of conduct (Vandekerckhove, 2006). So, if organizational loyalty means being loyal to its values and norms (which are validated by the society it operates in because they are public), then observing wrongdoing would compel the employee to blow the whistle (Uys, 2008).

Organisations are interested in promoting silence. The whistleblower is seen as someone who violates organisational boundaries by representing "outside" moral values on "the inside". Key to this overlap is that identity is negotiated as opposed to fixed. An employee is also a citizen, a member of a family or of a community or cultural groups. This divided-self initiates hidden strategies at various levels of consciousness which means silence and whistleblowing are not the only two options (Teo and Caspersz, 2011).

Behaviour is regulated by co-workers not only by management, so it appears that the employees internalise regulations and regulate their own behaviour in terms of constant surveillance. The more he/she used dissenting discourse (jokes, gossip, codes, and sarcasm) to regulate the behaviours of others, the more it became apparent that the discourse can be used to modify his/her behaviour. This way power can be viewed as a relation (Teo and Caspersz, 2011). Every individual has the power to act ethically. The challenge is to find the effective means of exercising it.

3. SCENARIOS

To help researchers and managers gauge the potential harm to come from hidden vulnerabilities coming to the surface it is useful to use scenario planning (Schoemaker, 1995). Scenarios include relevant, plausible and unexpected situations and problems. Each scenario is unlikely, yet possible and uncomfortable. They help policy-makers anticipate hidden vulnerabilities and limits in organisations and methods. When identified in advance, these vulnerabilities can be better managed than during an emergency. In similar fashion, Business continuity plans with "PREsponse protocols" help deal with operational problems and deliver measurable future value-added.

Well-designed wargames allow the players flexibility and the freedom to adapt the simulated organisations. These adaptations are then stress tested by the scenario as it plays out. The game move much faster than real-life so one has the opportunity to observe years of decisions and simulated effects in the space of a day.

Military scenario planning typically follows the following steps: 1) Decide on the key question to be answered by the analysis, 2) Set the time and scope of the analysis, 3) Identify major stakeholders, 4) Map basic trends and driving forces, 5)Find key uncertainties, 6) Check for the possibility to group the linked forces, 7) Identify the extremes, 8) Define the scenarios, 9) Write out the scenarios, 10) Assess the scenarios, 11) Identify research needs, 12) Develop quantitative methods, 13) Converge towards decision scenarios.

In the past, scenario analysis in business organizations would follow current trends-lines carried into the future. These lacked demographics or qualitative differences across social aspects or conditions. Though useful these fail to consider qualitative social changes and the combined effect of a multitude of factors. Complex interactions are key here, as opposed to for example fault tree analysis where one may discount factors in isolation. When instead we explore the factors together we find that certain combinations can reverberate across the system and magnify to the point where this resonance can be disastrous.

For scenarios, knowledge is divided in two domains. That which we think we know. And that which we think we don't know. The first domain is mostly made up of trends which rely on past information to make prediction about the future. Some assumptions, such as those about demographics or next quarter's GDP, are quite safe to make. The second domain is populated by unknowns such as the outcomes of elections or the appearance of new technologies. When devising a scenario, the known blends with the unknown in a limited number of views of the future that encompass a multitude of possibilities. As the scenario unfolds this cone of uncertainty narrows.

These are some of limitations of scenario planning. First there is the inherent subjectivity that goes into the design. The second relates to how the game is carried out in the organisation (team composition, facilitator, etc.) and to where its focus lies (long v. short term, incremental v. paradigm shifting, etc.). There is also little that can be done to prevent political derailing, limited imagination or agenda control when running the scenario in an organisation. The third limitation is that weak integration with other planning arrangements. Dealing with multiple futures is not something all organisations are capable of. Plans and budgets follow one view of the future and are adjusted with variance analysis, renegotiations and rolling budgets. Major incidents will overcome these approaches and paralyse most organisation, their plans and budgets now rendered useless.

4. CHALLENGES

Simply having a procedure will have almost no impact on conduct and encouraging internal disclosures needs substantial top management support (Schmidt, 2005). Organisations that support whistleblowing and where there is value congruence between managers and whistleblowers seem to have more whistleblowers. Relatively non-bureaucratic, high performing organizations have higher rates of whistleblowing (Near and Miceli, 1996). Feldman and Lobel (2008) found that if the organization emphasizes its internal compliance systems and the voice of employees, this will have a positive effect on the willingness of a person to report unlawful behaviour within the organization and the opposite effect on external whistleblowing. However, there is somewhat of a paradox here because the organisations that support whistleblowing are generally the ones that benefit the least from it because they were open to start with (Lewis, 2006). On the other hand, the ones that oppose it are the ones that suspect the power struggle between them and society would be won by the latter should this one have the indicting information protected by the organisation.

5. CONCLUSION

One characteristic of the organisations that is easy to record and could enhance the picture resulting from further studies is the sector to which the organisations belong. Hersh (2002) has found no significant differences between organisations depending on their sector (specifically, the study looked at nursing compared to the army). Generally, organisations are categorised in to three sectors: the governmental, public or first sector; the business, private or second sector; and the non-governmental, non-profit or third sector (Defourny *et al*, 2001). We therefore encourage research in Romania to compare whistleblowing arrangements across the various sectors.

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Erasmus+ in Cologne. TH Cologne

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Abstract. "TH Cologne" is the second article of the series "Erasmus+ in Cologne" and is intended mainly for students and researchers of the Faculty of Geography of the University of Bucharest, who want to take part in an Erasmus+ scholarship. It covers advice and relevant information regarding TH Cologne, the enrolment procedures before and after the stay and presents viable modules and study programmes for Erasmus+ geographers that can be attended at the Institute for Rescue Engineering and Civil Protection and at ITT.

Keywords: *Erasmus+, TH Cologne, International Student, Rescue Engineering, ITT*

1. THE UNIVERSITY

Founded 1971, TH Cologne is a higher education institution located in Cologne, Germany. It was established as a fusion of well-known former institutions, including the Cologne College of Higher Education for Business, the State Engineering Schools for Mechanical Construction Engineering, the German Insurance Academy, the Cologne College of Higher Education for Social Work, the old College of Higher Education for Librarianship and Documentation, the Cologne Craft Schools, the Gummersbach Campus and the Cologne State College of Higher Education for Photography. New chairs were added later such as Design, Restoration and Conservation and the Institute for Technology and Resources Management in the Tropics and Subtropics (TH Cologne, 2018a).

44 years after its foundation, in September 2015, the university became *TH Köln - Technology, Arts, Sciences*. TH Cologne along with 6 other universities is part of the strategic alliance UAS7, that consists of the seven leading German Universities of Applied Sciences (UAS7). Having more than 25 000 students (TH Cologne, 2018b), TH Cologne is the largest university of applied sciences in Germany.

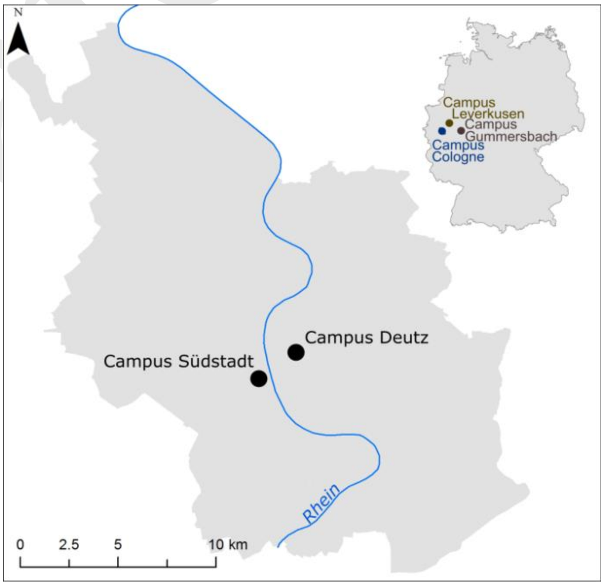

Figure 1 *The location of the 4 campuses in Germany (upper right) and in Cologne (left)*

TH Cologne offers 90 degree programmes (full-time, career integrated or part-time), while the students of the university originate in more than 110 different countries. The institution comprises 420 professors and 1200 staff employees. The research at TH Cologne mainly focuses on future-related topics such as energy supply, health and food safety, climate and demographic change, since they collaborate with 290 international institutions of higher education. The European Commission certified TH Cologne with the quality seal "HR Excellence in Research", meeting international standards in the area of human resources development. TH Cologne's campuses (Figure 1) are located in Cologne (2 campuses), Gummersbach and Leverkusen (TH Cologne, 2018c).

TH Cologne comprises 11 faculties and one standalone institute as follows:

- Applied Social Sciences;
- Cultural Sciences;
- Business, Economics and Law;
- Architecture;
- Civil Engineering and Environmental Technology;
- Information, Media and Electrical Engineering;
- Automotive Systems and Production;
- Process engineering, Energy and Mechanical Systems;
- Information and Communication Sciences;
- Computer Science and Engineering Sciences
- Applied Natural Sciences;
- Institute for Technology and Resources Management in the Tropics and Subtropics.

2. THE ENROLMENT PROCEDURES

After arrival in Cologne, you have to reach the International Office. There are three International Offices: two in Cologne (one in Campus Südstadt, one in Campus Deutz) and one in Gummersbach. Applying for an Erasmus+ Programme at the TH Cologne on behalf of the Faculty of Geography of the University of Bucharest means that all your activities regarding academic matters will take place in the Campus Deutz. The campus can be reached by bus (line 153) or by light rail/*Stadtbahn* (line 1, 5 or 9) - *Deutz Technische Hochschule* station.

The main building of Campus Deutz is divided into four wings: North (N), South (S), West (W) and Ost/*East* (O), the interior walls of each wing being painted accordingly. The purpose of different colours for each of the wings is locating easier a specific room. Each room name starts with Z for *Zimmer* (the German word for "room"), followed by one of the four regions (N, S, W or O), the floor number and the room number. For instance, ZN 4-5 stays for the room located in the northern wing, in the fourth floor whose number is 5; ZO 3-11 is the room number 11 located in the eastern wing, in the third floor. The remaining buildings from the campus have different functions such as canteen and cafeteria, library or other facilities (Figure 2).

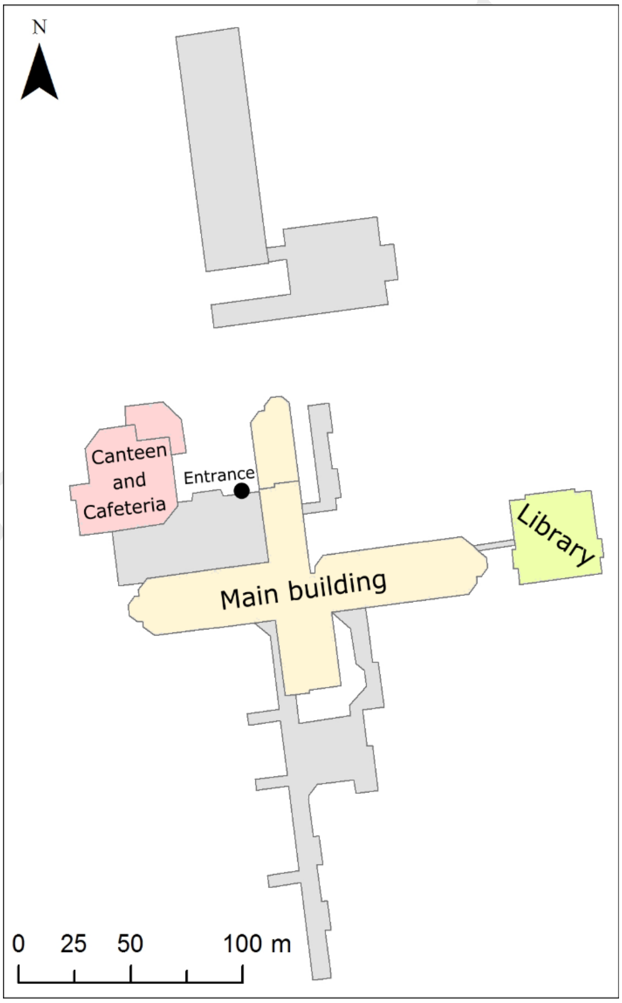

Figure 2 *Campus Deutz and its main buildings*

The International Office is in the room ZN 2-4 on the second floor. It is important to mention that the main entrance of the university is located on the second floor, and not on the ground floor as usual. The required documents for the enrolment are: the letter of admission, a confirmation from a German statutory health insurance provider and one passport-size picture (the medical insurance you have brought – European Health Insurance Card or a private health insurance – serves as a proof to be exempt from a German statutory health insurance provider). There are two main statutory health insurance companies that offer you a confirmation from a German statutory health insurance: AOK or Techniker Krankenkasse (TH Cologne, 2018e).

The fee for each semester is approximately €260. This covers the semester ticket and different contributions. Payment by cash is not possible, but only by card. The fee must be paid before the start of the semester. The academic calendar with all the semester dates, including the lecture periods and the semester breaks can be found online at *www.th-koeln.de/en/academics/semester-dates_11444.php*. The calendar is updated until 2024.

As an Erasmus+ student, you also have to provide two signed documents from your home university: *confirmation of arrival/departure form* and the *learning agreement*. The *confirmation of arrival/departure form* must be signed by the International Office with your arrival date, while the Learning Agreement must be signed by your coordinator from TH Cologne. Both must be then sent via email to the International Office from the University of Bucharest. These documents are to be provided to the International Office from Romania after you return.

Once you are enroled, you will receive on the same day a certificate of enrolment useful for different authorities in Cologne and a preliminary travel ticket within the VRS grid.

After the semester fee is paid, you will receive your student ID card by mail. Also, called MultiCa, the ID card covers as follows: the access to library, cashless payment in the student cafeterias and canteens, semester ticket within the VRS grid (Cologne and surroundings). The semester ticket for the whole state North Rhine-Westphalia can be generated online at *www.asta.th-koeln.de/semesterticket* after you receive your MultiCa. This has to be printed and will be your proof once you travel in North Rhine-Westphalia outside the VRS grid. The Deutz canteen (Mensa) and cafeteria are located in the same campus. Please note that the canteen is open only for 3 hours a day around the noon, while the cafeteria has longer opening hours. Your MultiCa allows you to eat at every canteen of higher education institution from Cologne.

Besides the student ID card, you will receive your personalized campus ID by mail (note that it will be sent in two separate letters due to security reasons). The campus ID is your personal identification number and allows you to use the campus ID center, *PSSO*, *ILIAS*, your personal TH Cologne email address and the Wi-Fi service. The campus ID center can be accessed only via intranet or through VPN and is a page where you can administer your campus ID. PSSO (the Online Examination and Student Services) offers you the possibility to organize all your academic matters online and can be accessed at *https://psso.th-koeln.de*. In *PSSO* you can register or withdraw from your exams, generate certificates related to your study and even transcript of records. *ILIAS* (The Integrated Learning, Information and Work Cooperation System) is an online e-learning platform implemented in the whole Germany. On ILIAS lecturers have the opportunity to upload didactic material, communicate important updates, while students join for courses, get in touch with others and even upload their reports and papers (ILIAS, 2018). You can reach out ILIAS for TH Cologne at *https://ilias.th-koeln.de/*.

If you do not have a place of residence yet, you can ask the International Office to deliver these documents to them, on the *Betzdorfer Str. 2, 50679 Cologne* – that is also the official address of the Deutz campus of TH Cologne.

In case you seek technical help, the Campus IT department (*http://www.campus-it.th-koeln.de/*) provides IT services such as setting up your CampusID or the WiFi connection or acquiring several software licenses that are free for students.

If your stay in Germany is longer than three months, your new place of residence has to be registered at a registration office in Cologne in the first week. There are five main registration offices in Cologne. If you want to avoid the long queues, be sure to make an appointment online. More information about the location and the schedule can be found online at *www.stadt-koeln.de*. Registering your place of residence requires a valid passport and a *Wohnungsgeberbescheinigung* (signed confirmation from your landlord). If you live in a student dormitory, the signed confirmation can be provided by KSTW (Kölner Studierendenwerk/Cologne state-run non-profit organization for student affairs).

After the successful registration with the city of Cologne, it is recommended to open an account at a German bank. The payment of your rent and your fees require a German bank account. In order to open the account, you need a valid passport/ID, a certificate of enrolment at TH Cologne and the certificate of registration obtained from the registration office.

You can sign up for the *KARIBU* – buddy programme (a programme organized by students for new and international students at TH Cologne). Through this programme you can receive support from students, participate in different cultural events and free-time activities. The programme can be accessed at *www.th-koeln.de/karibu*.

The university library (*https://www.th-koeln.de/Hochschulbibliothek*) includes several books and journals in hard copy and e-resources. Besides the library located in the campus Deutz, there are three libraries in the other campuses of TH Cologne that you are allowed to enter. It is also possible to download books or articles in digital form on your personal computer while being connected to the intranet or to the VPN.

In addition to this, you can also sign up for the *Sprachtandem* programme, a language partnership programme that helps you to learn a new language by teaching your partner another language. More information about the programme can be found at *www.th-koeln.de/sprachtandem*.

If you still have time left and are interested in a job, the Career Service offers personal advice on career planning and informs you regarding possible long- and short-term jobs in Cologne and in the surroundings.

3. STUDY PROGRAMMES FOR ERASMUS+ GEOGRAPHERS

If you are a geographer, there are 2 possible opportunities to study at TH Cologne: at the Faculty 09 or at ITT.

A. Faculty 09

The faculty of Process Engineering, Energy and Mechanical Systems (Faculty 09) comprises 5 institutes:

- Institute of Chemical Process Engineering and Plant Design
- Cologne Institute of Construction Machinery and Agricultural Engineering
- Institute of Rescue Engineering and Civil Protection
- Institute of Product Development and Engineering Design
- Institute of Applied Materials

The Institute of Rescue Engineering and Civil Protection focuses on prevention and operative emergency response. The offered disciplines in civil protection and security are related to:

a. Operative Civil Protection (including Rescue Services, Catastrophe Protection and Technical Aid)

b. Preventive Civil Protection (with Environment and Civil Protection, Fire Protection and Management System)

c. Safety Technology (comprising Machine Safety, Plant and Process Safety, Worker Protection)

The disciplines in risk and crisis management are covered here through teaching and research as an interdependence between natural, technical and anthropogenic hazards and social vulnerability and critical infrastructure as follows (TH Cologne, 2018d):

- Civil protection and security
- Development cooperation
- Interdisciplinary
- Infrastructure criticality
- Natural & man-made hazards
- Risk analysis, risk communication, risk management, risk governance
- Vulnerability and resilience

The Rescue Engineering Bachelor's programme combines engineering and knowledge for the development of effective concepts concerning hazard control and prevention. The programme comprises two branches: Rescue Engineering (RIW) and Fire Protection Engineering (BIW). The Rescue Engineering Master's programme helps the students obtaining a specialized skill set, contributing to innovative concepts not only in hazard control and prevention, but also in safety engineering (Table 1).

***Table 1** Rescue Engineering Bachelor's and Master's Programmes*

Programme	Certificate	Study duration	Study language
Rescue Engineering (Bachelor's Programme)	TH Köln Bachelor of Engineering (B.Eng.)	7 sem.	German
Rescue Engineering (Master's Programme)	TH Köln Master of Science (M.Sc.)	3 sem.	

Concerning the Rescue Engineering Bachelor's Programme there are nine relevant modules for geographers that can be attended at the Faculty 09, as shown in *Table 2*.

***Table 2** Relevant Bachelor modules for geographers*

Module Semester ECTS credits	*Main contents*
Introduction to rescue and fire protection engineering, risk management *1st 5 ECTS*	Basic understanding of rescue engineering; Similarities and differences of fire safety and risk management specializations; Interdisciplinary overview of local, national and international actors; Types of emergencies, crises, disasters and escalation levels.
Methods of risk analysis *2nd 5 ECTS*	Common methods and procedures of risk analysis and risk assessments; Characteristic features, advantages and disadvantages of the methods; Acquisition and evaluation of empirical, statistical, temporal and spatial data; Projects: selection and application of appropriate procedures and methods for specific questions.
Natural hazards and risks *4th 5 ECTS*	Exogenous and endogenous processes and natural conditions as a basis for natural hazards; Characteristics of historical and recent natural hazards; Methods for measuring hazards, effects, risks; Complex, dynamic and social-ecological feedback systems.
Human and technical hazards and risks *4th 5 ECTS*	System basics of technical and human systems; CBRN hazards, cyberattacks, infrastructure failures; Measurement and observation methods; Humanitarian crises and conflicts.
Critical infrastructures and civil protection *6th 5 ECTS*	Fundamentals of infrastructures and civil protection; Description and analysis of critical infrastructures sectors; Safety goals definitions and concepts in Germany and at international level; State security, strategies, criticality and vulnerability concepts
Logistics and management systems *6th 5 ECTS*	Basics of logistics; Logistics in the rescue service and in emergency management; Conceptual design of logistics systems; Civil protection logistics.
Risk and crisis communication *6th or 7th 5 ECTS*	Risk communication in risk and crisis management (ISO 31010); Risk perception and crisis response; Stakeholder analysis; Social evaluation and participation.
Security systems in international comparison *6th or 7th 5 ECTS*	State and social structures; Security systems in Europe and worldwide; Cooperation in the European Union and cross-border security; Risks and potential hazards.
Programmes and methods in security research *6th or 7th 5 ECTS*	Research of national security research strategies and programs of relevant authorities and NGOs; Advanced methods in risk and crisis assessment; State and international security strategies; Comparison of current activities and priorities in security research.

The Rescue Engineering Master's Programme consists of three modules relevant for geographers as shown in *Table 3*.

***Table 3** Relevant Master modules for geographers*

Module Semester, ECTS credits	*Main contents*
Humanitarian aid and international development cooperation *2nd 5 ECTS*	Humanitarian aid and development cooperation actors; Classic and actual solution approaches; Impact orientation and sustainability; Vulnerability and resilience.
Analyses of networked critical infrastructure	Interdependencies and resilience of KRITIS; Criticality, vulnerability and risk analysis of critical infrastructures by sector; Geographic information systems,

2nd *5 ECTS*	satellite remote sensing data, statistical evaluation methods; Risk governance and risk management approaches.
Risk and crisis management *2nd* *5 ECTS*	Goals, structure and challenges of risk management systems; Internal and external risk factors; Methods of risk analysis and assessment; Strategies and framework for dealing with risks.

Each module part of the Rescue Engineering study programme includes at least one lecture and one seminar/exercise per week. The lectures are held by a lecturer, whereas the seminars or exercises are held either by the same lecturer or by a different one. These takes usually place in a big room, where the projection of the content followed to be presented is projected. Most lecturers use interactive PowerPoint presentations and once every 3-4 weeks an expert from a state institution is invited to hold a presentation on a specific topic related to the module. During the presentation and afterwards students have the opportunity to discuss about the topic, to ask questions and even to find out more about that institution and a possible career there. The concepts and theory discussed during the lectures are put in practice through the seminars or exercises, where students can get used to the topics.

There are mainly three different ways to evaluate the performance of the students: taking an exam (*Klausur*), writing a report/project or both. The exams are planned for the exam session, while the deadline of the projects is usually the last lecture session of the semester. In modules with a final exam the aim of the exercises/seminars is to better understand the content discussed and to prepare for the final exam. In modules with assessments such as projects or reports the aim of the seminars is to build the teams (projects are usually carried out in teams), to choose the title of the projects and to get acquainted with the general terms of reference needed to be followed. The progress of the project status will be monitored throughout the remaining sessions during the semester.

B. ITT

The Institute for Technology and Resources Management in the Tropics and Subtropics (ITT) is part of TH Cologne and aims to better solve the complex issues related to environmental problems (ITT, 2018). ITT is offering programmes at postgraduate level, providing not only teaching and research, but also cooperating with major organizations worldwide.

ITT is offering three main study programmes and two similar ones with focus on other regions of the world. The duration of each study programme is 4 semesters (Table 4).

Table 4 *Master's programmes at ITT*

Programme	Certificate	Structure (semesters)
Renewable Energy Management	TH Köln Master of Science	**1st 2nd** and **4th**: Germany **3rd**: Germany/exchange semester Study language: *English*
Natural Resources Management		
Integrated Water Resources Management, International		
Environment and Resources Management	Double Degree Master of Science	**1st 2nd** and **4th**: Mexico **3rd**: Germany/exchange semester Study language: *English* and *Spanish*
Integrated Water Resources Management, MENA	Joint Degree Master of Science	**1st 2nd** and **4th**: Germany **3rd**: Jordan Study language: *English*

At ITT, there are two types of lectures: lectures and laboratories. Similar to the Rescue Engineering study programmes, lecturers use interactive PowerPoint presentations and once per month a specialist or a researcher from a different scientific or state institution will hold a presentation on a specific topic. The laboratory sessions take place in the computer laboratories, where students are instructed and learn how to use new methods, tools and software programs in accordance with the required topic. The performance of the students is being measured through reports or exams. Reports usually include an additional presentation of the topic a couple of weeks before the final deadline, when students receive feedback. Some reports require applying the knowledge gathered in the laboratory sessions, knowledge such as Geographic Information Systems or remote sensing.

As a full-time student, there must be attended Core modules, Methods and Tools modules and specific modules depending on each master programme. Erasmus+ students can attend any module they like (Table 5). The complete contents can be found at http://curriculum.itt.th-koeln.de/.

Table 5 *Curriculum at ITT*

Programme	*Module* *(Semester, ECTS credits)*
Core Modules	• Management of Natural Resources Systems *(Winter, 5 ECTS)* • Natural Resources Economics and Governance *(Winter, 5 ECTS)* • Project and Business Management *(Summer and Winter, 5 ECTS)* • International Cooperation and Development *(Summer, 5 ECTS)* • Project I *(Winter, 5 ECTS)* • Project II *(Summer, 5 ECTS)* • Project III *(Winter, 5 ECTS)* • Master Thesis Preparation *(Winter, 5 ECTS)* • Master Thesis and Colloquium *(Winter, 25 ECTS - Master Thesis, 5 ECTS - Colloquium)*
Methods and Tools	• Scientific Work and Research Methods *(Winter, 5 ECTS)* • Geographic Information Systems and Remote Sensing *(Winter, 5 ECTS)* • Statistics *(Winter, 5 ECTS)* • Eco-Balancing and Decision Support Systems *(Summer, 5 ECTS)* • Empirical Social Research Methods *(Summer, 5 ECTS)* • Environmental Monitoring *(Summer, 5 ECTS)* • Economic Evaluation Methods *(Winter, 5 ECTS)* • Environmental Assessment *(Winter, 5 ECTS)* • Entrepreneurship *(Winter, 5 ECTS)*
Renewable Energy Management	• Energy Resources and Energy Systems *(Winter, 5 ECTS)* • Bioenergy and Geothermal Energy *(Winter, 5 ECTS)* • Energy Economics and Markets *(Summer, 5 ECTS)* • Energy Efficiency and Environment *(Summer, 5 ECTS)* • Photovoltaic and Solar Thermal Systems *(Summer, 5 ECTS)* • Energy Policy, Legislation and Management *(Winter, 5 ECTS)* • Wind Energy and Hydro Power *(Winter, 5 ECTS)* • Decentralized Energy Systems Planning *(Winter, 5 ECTS)*
Natural Resources Management	• Land Use Systems and the Environment *(Winter, 5 ECTS)* • Soil Management *(Summer, 5 ECTS)* • Farming Systems Economics *(Summer, 5 ECTS)* • Ecosystem Management and Conservation *(Summer, 5 ECTS)* • Public Services and Housing Provision *(Summer, 5 ECTS)* • Ecological and Social Risks *(Winter, 5 ECTS)* • Food Security *(Winter, 5 ECTS)* • Resources Efficient Buildings and Quarters *(Summer, 5 ECTS)* • Urban, Regional and Community-Based Management *(Winter, 5 ECTS)* • Water Energy Food Security Nexus *(Winter, 5 ECTS)*
Integrated Water Resources Management	• Water Resources Management *(Winter, 5 ECTS)* • Hydrology *(Summer, 5 ECTS)* • Hydraulic Structures *(Summer, 5 ECTS)* • Water and Agriculture *(Summer, 5 ECTS)* • Water Economics and Governance *(Summer, 5 ECTS)* • Watershed Management *(Summer, 5 ECTS)* • Sanitation and Public Health *(Winter, 5 ECTS)* • Flood Management *(Winter, 5 ECTS)* • Water Scarcity and Drought *(Winter, 5 ECTS)* • Water Supply *(Winter, 5 ECTS)* • Water System Analysis *(Summer, 5 ECTS)*

In the end, Table 6 reveals the main differences of day-to-day activities and study structures at the Faculty09, at ITT and at the University of Bucharest.

Table 6 *TH Cologne, ITT and UNIBUC – comparison*

Parameter	*Rescue Engineering (TH Cologne)*	*ITT (TH Cologne)*	*Faculty of Geography (University of Bucharest)*
Lecture duration	90 minutes	150 minutes	100 minutes
Break duration	30 minutes	10 minutes	20 minutes

Lunch break	13:00-14:00	13:05-14:05	No
Lecture types	-Lecture -Exercise -Seminar	-Lecture -Laboratory	-Lecture -Seminar
Bachelor duration	7 sem.	N/A	6 sem.
Master duration	3 sem.	4 sem.	4 sem.

Exchange students have the chance to take part in language courses for free: *www.th-koeln.de/internationales/sprachlernzentrum_9102.php*). The language center (Sprachlernzentrum) provides German, English, French, Italian and Spanish courses. The only requirements are to be enroled at TH Cologne and to submit a valid language certificate prior to your registration. If you do not hold a language certificate, you can take part in a language placement test and depending on your result, you will be assigned to the suitable language level.

4. AFTER YOUR STAY

Before leaving, complete following tasks:

1. Attend the OLS+ language assessment test according to *https://erasmusplusols.eu*.
2. Close your German bank account
3. Deregistration at the registration office
4. Hand over the keys from your apartment/dormitory room to the landlord
5. Get your certificate of arrival/departure signed
6. Complete all remaining steps in the mobility online platform for exchange students (*https://www.th-koeln.de/mobility*).

After your return to Bucharest, you must hand in following documents to the International Office:

1. Signed Learning Agreement for Studies
2. Changes to Learning Agreement for Studies
3. Transcript of records
4. Signed Certificate of Arrival/Departure
5. Boarding tickets or any other travel tickets related to your trip from Romania to Cologne
6. A survey concerning the performed academic activities during your stay
7. An additional sheet you must fill in, necessary to receive the last tranche of your grant

If you are convinced and want to take part in the programme, we invite you to read our last article. In the next article - Life in Cologne - you will find out more about the student life in Cologne and how to make your Erasmus+ experience memorable.

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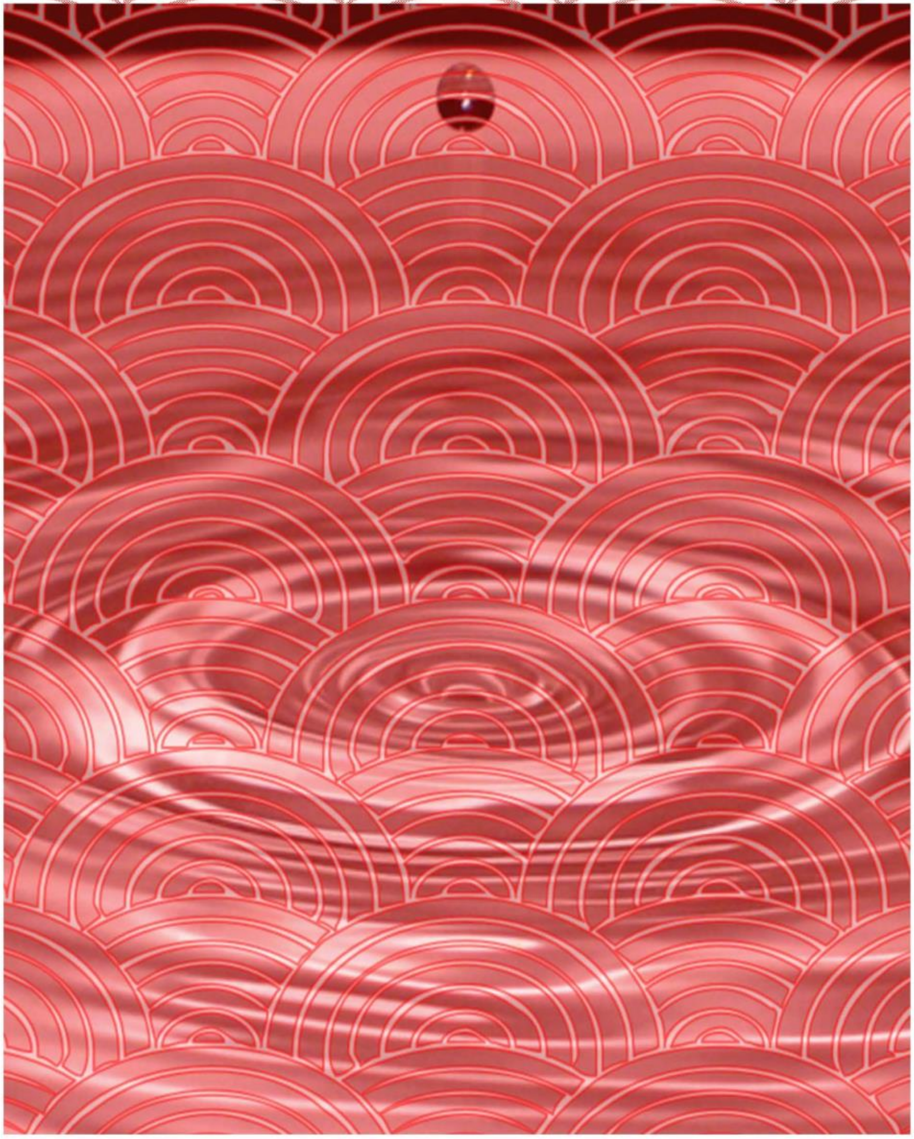

"Science is the millennial endeavor to identify the underlying patterns that form our world and explains the interconnectedness of the natural and social systems."

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