OVIDIUS UNIVERSITY OF CONSTANTA

HABILITATION THESIS

Contributions to hydrological modelling

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Abstract

Dear reader,

This paper is an overview of my entire research and expertise in hydrology over the past 20 years.

First of all, I would like to thank my professors from the former Polytechnic Institute of Iasi, especially Professor Eftimie Nitescu and Professor Corneliu Cismaru. They understood, maybe before me, that I am not made for the life on a construction site. They allowed me to knock on the doors of research when they suggested a subject in the field of applied hydrology for my doctoral studies (in 1990). My beginnings on this path have not been spared from doubts and hesitations, so the start occurred much later, in 1995. At that time I was already assistant professor and I was honoured when professor Dumitru Ion Arsenie accepted the proposal to coordinate my doctoral thesis.

The scholarship obtained from TEMPUS offered me the possibility to continue my studies. In this context, I began with professor Radu Drobot (UTCB) and PhD Pierre Chevallier (IRD Montpellier, at that moment) and his team, a work in the field of hydrological modelling.

In 1998, I began my doctoral studies, in a co-tutelage program financed by the World Bank Program, with Pierre Chevallier. Through his way of being, tenacious and rigorous in everything he does, he gave me his enthusiasm, the love for this profession and he opened me the door of a new world to me. Even though we do not see each other or talk much, I am sure I can always count on his advice.

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How can I describe all my activities in a few words? It is important to note that the research activity in Romanian universities is conducted in parallel with an intense teaching activity. For this reason, being almost impossible to keep a single research direction, I also worked on the integration of hydrology within land reclamation project research. So, I thought to divide my 20 years of research activity in periods, in function of the main research directions. This has led to three main periods:

1993-2002 – a hydrological modelling period; mainly focused on the surface flow study and modelling on small catchments. The project “Studies on solid and liquid flow on small watershed equipped with land reclamation works”, obtained in 1993, is my first research grant. The aim of

this project was to model the surface flow in order to find the parameters which influenced it. In this context, I had the chance to continue my research work within the project entitled “HAPEX Sahel” (Hydrological and Atmospheric Pilot EXperimental in the Sahel) in a research team of IRD Montpellier (France). The objective of my post-graduate thesis “Global or semi-distributed approach of surface runoff modelling in the semi-arid zone (experience Hapex-Sahel, Niger)” completes the comprehension of the hydrological functioning of the environment (mare Wankama) by a simple global or semi-distributed model. I obtained my PhD Diploma within the World Bank Program „Postgraduate Academic Studies and Doctoral Thesis in the Field of Water Resources” at University II of Montpellier (France).

My research study presented 2 original aspects at that time: (i) it detailed the mechanisms of the hydrological cycle applied on a small catchment in the Sub Carpathians by means of two main categories of processes: evapotranspiration and water transfer in the vadose zones; (ii) it presented two original applications of hydrological spatial modelling, starting from the detailed description of the catchment by a geographic informational system.

2002-2010 – a “self-discovery” period; my goal in this period was interrelated with the processes of collecting data, analysis and modelling. From this point of view, this period is divided in two sub-periods: (i) one related to the development of a physical model able to follow the water flow in porous media in steady or unsteady conditions (ii) one related to the study of the climate change impact.

(i) The experience accumulated during the doctoral period offered me the possibility to prepare a research grant proposal whose main objective was to establish an experimental equation of water movement in the heavy soils. The results of this project were published in several scientific papers but the most important result is that it made a contribution to the completion of the doctoral thesis of Mr. C. Buta in 2010.

(ii) Starting with 2007, a systematic study of precipitation, streamflow and temperature evolution in Dobrogea area has been performed. The knowledge of the temperature, precipitation and streamflow evolution is necessary in all the water resources activities (including land reclamation) from the assessment and design, to the exploitation and management of water resources. The main objective of this study is to increase the knowledge in the field of hydrological time series analysis in order to understand the impact of climate changes on water cycle components. Part of the results of this study are included in the project: “Mathematical modelling of rainfall in Dobrogea area" directed by Associate Professor, PhD, Barbulescu A., spanning the period 2007-2010 and published on http://www.math-modelling.ro/, or different scientific papers published in different journals or conference proceedings.

2010-2014 – again hydrology principally focused on extremes: floods and droughts. Two project are important for this period: SciNetNatHazPrev (A Scientific Network for Earthquake, Landslide and Flood Hazard Prevention) and ECOMAGIS (Implementation of a complex geographic Information System for Ecosystem-based Management, through integrated monitoring and assessment of the biocenosis status and its evolution trends in the fast changing environment of the Romanian coastal zone of the Black Sea).

The SciNetNatHazPrev project is implemented under the Black Sea Basin Joint Operational Program funded by the European Union and national funds of the six participating countries including Romania. According to the objective of this project my role is: (i) to provide an overview regarding the methodological approaches for flood hazard assessment at regional and local scales, (ii) evaluation of existing flood hazard assessment models in terms of scientific soundness, data demands and credibility of the results (iii) flood hazard assessment on local scale. The results of the research activity are presented in project scientific reports, in the book I edited in IGI Global publishing house entitled "Extreme Weather and Impacts of Climate Change on Water Resources in Dobrogea Region", and at the Second International Conference on Natural and Anthropic Risks - ICNAR 2014, Bacau.

My long-term research plan is to continue the research activity I began in the past years related to the remote sensing technique used in water resources. Our goal is to create an innovative and operational tool for drought early warning. In this respect, our research team developed a software based on the grid technique which will allows us to use the computational power of a Grid cluster and, hence, to distribute the computational effort and to minimize the processing time of the satellite images. This computer software is in a development stage and it is used for several applications in order to evaluate different drought indexes such as NDVI (Normalized Differences Vegetation Index), LST (Land Surface Temperature), LE (Land Emissivity), VI (Vegetation Index).