RamWass Project Number 037081

Integrated decision support system for risk assessment and management of the water-sediment-soil system at river basin scale in fluvial ecosystems

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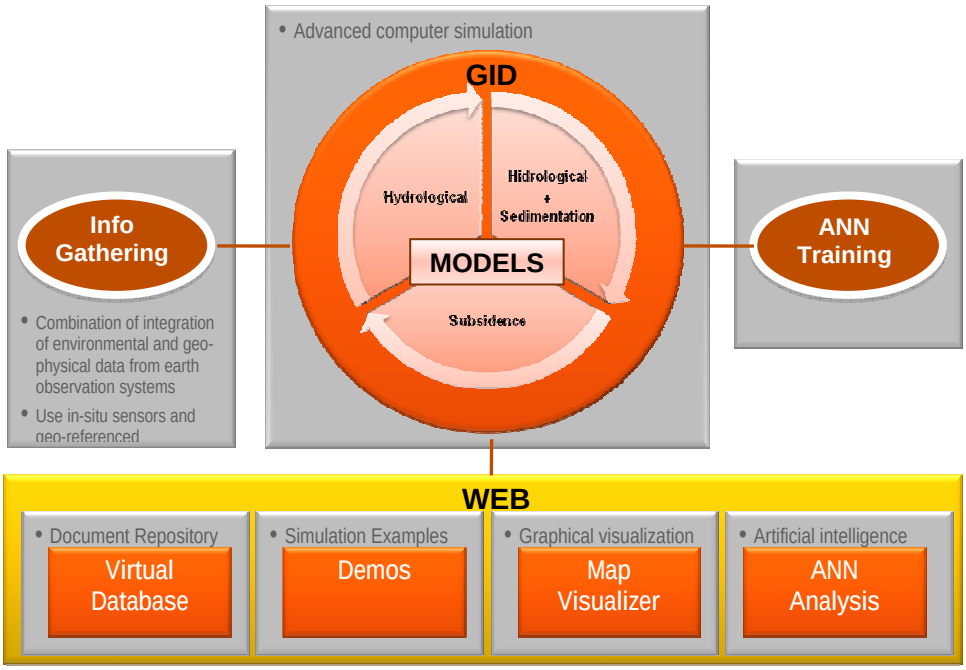
Publishable Executive Summary

Project Objectives

Global change and human activities can exert severe impacts on the ecology of aquatic and wetland ecosystems adjacent to a river basin area, influencing in some cases the life of many human beings. The devastating impacts of recent severe contamination accidents in relevant fluvial ecosystems (such as the Aznalcóllar mine dam failure and spill in the Doñana marshes adjacent to the Guadalquivir river estuary in Spain on 1998) have sparked interest in the water-sediment-soil modeling in fluvial ecosystems worldwide.

There is a need for efficient methods and tools to assist public administrators and emergency services in the risk assessment of the water-sediment-soil (WASS) system in fluvial ecosystems and in the management of different prevention, mitigation and remediation scenarios. Modern day satellite information on the land surface properties and meteo processes, combined with on-site information from state of the art sensors, are the basis for regional-scale environmental modelling. As part of the current modelling effort, maps of the hydrologic properties of the soils of the region can be developed using databases populated with data from on-site sensors. Such maps can be used with process-based models of the land surface to provide information to decision makers regarding the hydrodynamics of the ecosystems, the erosion and compaction levels, the filter and transport functions of soils, the water quality and the overall ecological impact of hazards. This information is crucial for the design of efficient prevention, mitigation and remediation scenarios.

The objective of the project is to develop and validate a new decision support system (DSS) for the risk assessment and management for the prevention and/or reduction of the negative impacts caused by human activities on the water/sediment/soil system at river basin scale in fluvial ecosystems. The DSS will combine and integrate environmental and geo-physical data from earth observation systems, on-site sensors and geo-referenced information, advanced computer simulation and artificial intelligence tools for generating knowledge contributing to the assessment of the ecological impact and the design of effective response actions maximising the integrity and safety of the ecosystem and human life.



Following the successful integration of the RamWass DSS, a crucial activity of the project will be the in-depth calibration, validation and assessment of the performance, scalability and effectiveness of the DSS in its application to three relevant fluvial ecosystems adjacent to important river basins in Europe:

- The marsh area of Doñana in Spain

- The biosphere reserve Elbe Riverland in the lower part of the Elbe river valley in Germany
- The marshland and lagoons of the Po river delta in Italy.

Doñana marshes

Elbe riverland

Po delta

RamWass Consortium

RamWass brings together 8 partners from Spain, Germany and Italy that gather the maximum complementarity of skills for the achievement of project objectives:

CIMNE Centre Internacional de Mètodes Numèrics en Enginyeria
Research organisation in Barcelona, Spain, devoted to the development and application of numerical methods to a wide class of problems in engineering and applied sciences.

UPC Universitat Politècnica de Catalunya
One of the largest technical Universities in Spain. It is represented by the Department of Hydraulic, Maritime and Environmental Engineering (DEHMA), which provides quality teaching and carries out high-level research in the field of water and environmental engineering.

CHG Confederación Hidrográfica del Guadalquivir
Entity responsible in front of the Spanish Government for the matters concerning water management in the Guadalquivir river and in the Doñana National Park.

LUH Leibniz Universität Hannover
Technical university in Germany with wide experience in the development and application of computational methods in civil and geotechnical engineering.

ULG Universität Lüneburg
Technical university in Germany with long-term experience in the fields of environmental informatics, hydrology, environmental management and soil science.

ABRE Biosphärenreservat Niedersächsische Elbtalaue
Entity responsible for legal regulations concerning nature conservation and sustainable regional development in the UNESCO Biosphere Reserve of Elbe Riverlands in Lower Saxony.

CISM International Centre for Mechanical Sciences
Italian non-profit organisation that favours the exchange and application of the most advanced knowledge in the mechanical sciences and related fields. The Centre carries out research in the field of computational methods in applied sciences and informatics.

STAR STAR Engineering
STAR is a young SME that deals with geotechnical problems, in particular related to

environmental aspects. It has specialised in the management and engineering services of the Venice lagoon and the Po river delta.

Coordinator contact details

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Third Year Achievements

The objectives and the achievements of the RamWass project for the last semester can be summarised as follows:

- **Validation of computer codes for hazard simulation.** Partners have finished the validation of the computer simulation codes implemented during the previous periods
  - UPC has completed the validation of the upgrades done to CARPA, their hydraulic simulation model. This validation has focused on the wind action – it is an important factor in the hydraulic modelling of Doñana marshes, since the wind stress on free surfaces can produce large displacements –, the infiltration and evaporation losses, and the modelling of rainfall inflows. The results of the numerical simulations have been validated by comparison with the on-site data and remote sensing images.
  - LUH has finished the validation of the depth-averaged two-dimensional model for calculating sediment transport in channels. The key problem in the Elbe basin is that frequent high waters have resuspended high amounts of sediments and transported them to inundation areas, thus leading to contamination of large areas with toxic compounds like heavy metals and persistent organic pollutants. The validation has focused on the simulation of water discharge, water level and pollution transport in a lower middle river section of the Elbe river.
  - CISM has validated the upgrades done to PLASCON3D, their geomechanical finite element simulation code, which deal with elastic and elastic-plastic analysis of subsidence at regional scale. The Italian partners have reconstructed the Po Delta stratigraphy and have collected the main geotechnical data, and PLASCON3D has been successfully calibrated against both elastic compaction and subsidence analyses.

- **Enhancement of RamWass DSS** – On the basis of the validation results obtained by partners, only minor enhancements have been identified to be done in the RamWass DSS. The enhancements have mainly focused on the virtual database, called RamWipedia, that had already been set up in the previous year. The virtual database can be accessed through the project website or using the link http://www.ramwass.net/wiki/. In the last semester partners have completed the information related to the three test sites (e.g. information on

the area, the available data, the regulations, etc.). Moreover, during the RamWass project, German partners have developed a case-based reasoning approach in collaboration with Volgograd State Technical University to support decision-making in the Elbe riverland.

- **Elaboration of guidelines for risk management in fluvial ecosystems** – The experience gained in the development and validation of the RamWass DSS has been used to establish a set of pre-standardisation rules and recommendations for risk assessment of hazards in fluvial ecosystems. These guidelines provide an overview on hazards in fluvial ecosystems and the related prevention, mitigation and remediation measures. The document describes the basic components of RamWass DSS such as the digital terrain models, core models, GiD, soil contamination prediction formulas, the Artificial Neural Network, or the Case-based Reasoning module. The guidelines explain moreover the strategy for updating the different RamWass DSS databases and describe how to develop the modules in the future.

- **Dissemination activities** – During the last project months, partners have published several press releases, have participated in different conferences and have submitted publications and posters, where the results of the RamWass project have been presented to a wide spectrum of audiences. Moreover, partners have periodically updated the project website (http://www.ramwass.net), since it is the source of the most up-to-date te information about the project. It links to the RamWipedia and the document manager area for partners, and gives users free access to the RamWass DSS and to demos on the simulations in the three test sites.