SINERGEA - Real-time forecasting system for managing floods, bathing water quality and wastewater energy consumption

Luís M DAVID[1], Anabela OLIVEIRA[2], Marta RODRIGUES[3], André B FORTUNATO[4], João ROGEIRO[5], João BARREIRO[6], Filipa FERREIRA[7], José S. MATOS[8], Flávio SANTOS[9], Ramiro NEVES[10], António MARTINS[11]; Osvaldo SILVA[12]; Alexandre ATAÍDE[13]; Nuno SILVA[14], Joaquim FREIRE[15], Alexandra CRAVO[16], António SOARES[17], Hugo RODRIGUES[18], Paulo B AZEVEDO[19]

[1,2,3,4,5] Laboratório Nacional de Engenharia Civil, Portugal, ldavid@lnec.pt
[6,7,8] CERIS, Instituto Superior Técnico da Universidade de Lisboa, Portugal, joao.barreiro@tecnico.ulisboa.pt
[9,10] MARETEC, Instituto Superior Técnico da Universidade de Lisboa, Portugal, flavio.t.santos@tecnico.ulisboa.pt
[11,12,13,14,15] Águas do Algarve S.A., Portugal, antonio.m.martins@adp.pt
[16] CIMA, Universidade do Algarve, Portugal, acravo@ualg.pt
[17,18] Siemens, S.A., Portugal, antoniom.soares@siemens.com
[19] Município de Albufeira, Portugal, paulo.azevedo@cm-albufeira.pt

ABSTRACT

1. Introduction

Coastal cities face growing challenges from flooding, sea water quality and energy sustainability, which increasingly require an intelligent, real-time management. Urban drainage infrastructures often require pumping stations (PS) in low-lying areas, which transport to the wastewater treatment plant (WWTP) all waters likely to pollute downstream beaches, including rainfall-derived infiltration inflows and stormwater from small rain events. During the bathing season, decentralized management measures, including nature-based solutions, can be used to retain stormwater and promote its transport to the WWTP after the rainy event. However, the growth in pumped and treated flows increases energy consumption. In addition, real-time tools are required to support the assessment and prediction of the quality of bathing waters, to assess the possible need to prohibit beach water usage. During heavy rainfall events, decentralized management systems can also contribute to mitigate downstream flooding. Nevertheless, this requires the operation of the entire system to be different from that used to protect bathing water.

2. The SINERGEA IT infrastructure

Within the SINERGEA Project, an intelligent platform was developed and is being demonstrated to support the management of flooding emergencies and bathing water contamination, and the efficient use of energy consumed by sanitation infrastructures. This system integrates real-time information provided by different entities, including monitoring networks, infrastructure operation data and a forecasting framework. The forecasting system includes several models covering all relevant water compartments: atmospheric, rivers and streams, urban stormwater and wastewater infrastructure, and receiving coastal water bodies.

The SINERGEA system uses the XHQ platform (eXtended HeadQuarters), which is an Enterprise Operations Intelligence software developed by Siemens. It aggregates, integrates, analyses and displays information from various sources, including personalized products in real time, based on the available information. The intelligent forecasting system that simulates in real time the water quantity and quality and energy consumption is based on LNEC's generic forecast framework WIFF (Fortunato et al., 2017).

Figure 1 shows the input and output variables between the models used for modelling and forecasting discharges in coastal waters. The meteorological modelling uses the WRF model, applied with a 1 km grid resolution for the case study region (Albufeira, south coast of Portugal). Urban drainage modelling uses the MOHID Land model (www.mohid.com) loosely coupled with the SWMM model (US EPA). A deterministic model of energy consumption in pumping and treatment plants was developed and data-driven approaches that suit the objectives of the case study and the monitored data will be investigated. The modelling of hydrodynamics and water quality in the receiving body is performed with the SCHISM modelling system (ccrm.vims.edu/schismweb) in 3D mode, taking into account the interactions between baroclinic flow and short-period waves, and simulating hydrodynamics and faecal contamination (Rodrigues et al., 2011). The

intelligent system uses a database of indicators for flooding, bathing water and energy issues, based on a wide combination of scenarios and management alternatives.

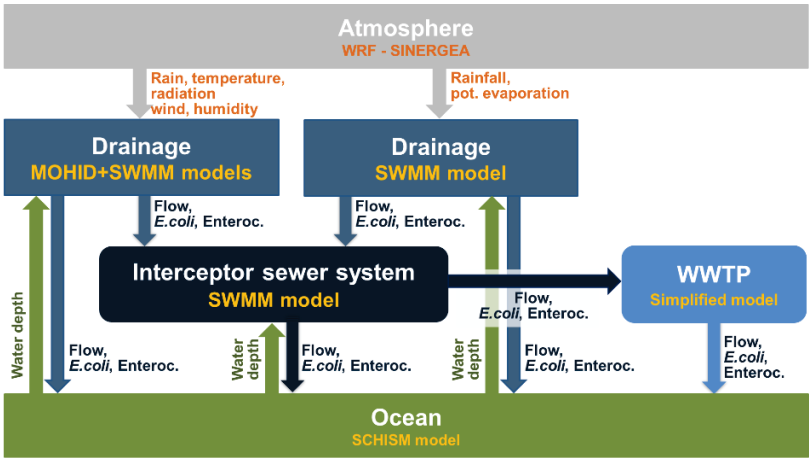
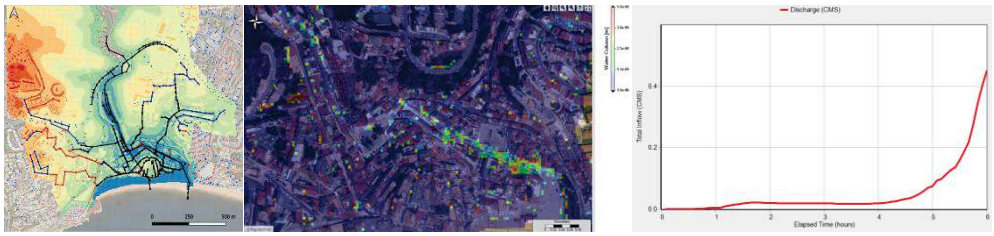


Fig. 1. Input and output variables between models for modelling and predicting the quality of water discharged into the receiving water body.

3. Case study results

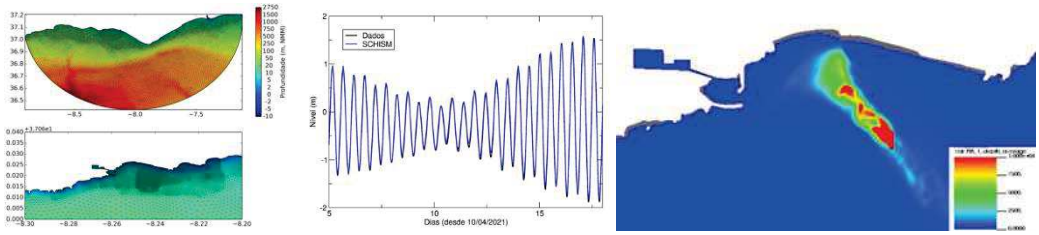
The SINERGEA system is being demonstrated on the city of Albufeira, Portugal, and its coastal neighbourhood. The stream and the separate sewer networks are managed by the municipality, the interceptor sewer system and the WWTP are managed by a wastewater utility, and the coastal bathing water by the National Water Authority. The interceptor sewer system has 10 pumping stations and serves various coastal urban-tourist developments. Figure 2 illustrates some results.

Flooding



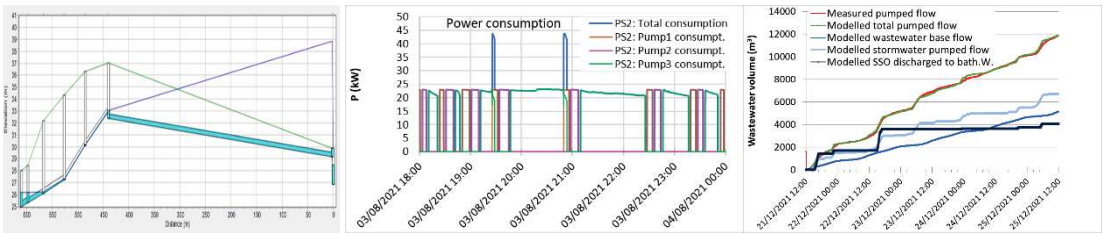
1D/2D model domain and infrastructures (left); Ex. of results for water depth (middle) and outlet discharge.

Bathing water quality



Coastal zone model: horizontal grid and bathymetry, water levels validation, and example of an emergency scenario.

Energy and sanitary sewer overflows



Examples of modelled energy line, power consumption, and calibration of pumped and SSO flows at a pumping stat.

Fig. 2. Case study models and results for the three components studied: flooding, bathing water quality and energy.

Acknowledgements

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