ID43- Towed sensors and hydrodynamic model evidence the need to include submarine in coastal lagoons water balance, the Mar Menor example (SE Spain).

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Abstract – The use of radionuclide tracers to determine the submarine groundwater discharges has been used widely but in areas highly anthropized as the Mar Menor surface water tributaries can carry high concentration of Radon, making very difficult to distinguish the radionuclide origin. In this paper a combined approach was applied in the Mar Menor, a towed system was designed to enable the continuous measurement of Radon and Nitrate and a hydrodynamic model was used to establish the influence areas of the surface discharge to the lagoon. The areas were Radon was detected and was out from the area located with the model could be establish as a submarine groundwater discharge point.

Keywords-: Mar Menor, Radionuclide, Submarine water discharge, ROMS

The determination of the different fresh water flux in the Mar Menor coastal lagoon has been studied by different authors, focus mainly on the evaporation and water discharge by the avenues. The submarine fresh water discharge could determined by the use of radionuclide as Radon or Radium but unexpected radionuclide from surface water could overvalue the measurements of submarine water discharge. A combined methodology of towed sensor and hydrodynamic model has been used to distinguish the source of the radionuclide measured.
Two poles was designed to be couple to the ship used. One of the pole was provided with a pump system and the other one with a nitrate sensor (Suna Satlantic) and a YSI Multiparamenter sensor (Conductivity, Temperature, Ph and Oxygen). This system allowed to get continuos measurement and detect small changes in the radionuclide and nitrate values. The hydrodynamic simulations of the lagoon were performed using ROMSAGRIF (Debreu et al., 2011), the ROMS version developed by the Institut de Recherche pour le Développement (IRD) using the AGRIF grid refinement procedure developed at the LJKIMAG (Laboratoire Jean Kuntzmann, Grenoble, France). The Mediterranean Sea grid (150 m resolution) was nested to the Mar Menor grid (40 m) and to the inlets grids (of 5 to 20 m). All nesting grids were bidirectional. The Mediterranean Sea model was forced with sea level fluctuations recorded by a sea level gauge in the Mediterranean Sea (northern part of the study area). The lagoon model was forced with hourly winds recorded at the meteorological station on the northwest coast of the lagoon in the San Javier Airport (run by the Spanish Meteorological Agency –AEMET). Modeling results were validated against Acoustic Doppler Current Profilers (ADCP) (Aquadopp, Nortek) with data recorded at the NW lagoon coast, 500 m to the meteorological station at a 4 m depth. The validation parameters for a 15 days period simulation were: Root Mean Square error (RMS) and correlation coefficient.
Regarding the hydrodynamic validation of the model, sea level data showed the best correlation (r = 0.85, RMS = 1.2 cm). The speed currents recorded by the ADCPs in the lagoon in the days of the surveys were very low (<0.1 m/s) giving a correlation coefficient of 0.70 for current at 2 m above the bottom and 0.72 at 0.5 m above the bottom layer with RMS of 1.1 and 0.1 cm/s respectively. However, higher speed currents showed higher correlation coefficient reproducing correctly the main hydrodynamic patterns.
The model ran for 6 days with all the hydrodynamics forcing in order to let it spin up before the river input was inserted into the model. Then, the hydrodynamic dispersion of the input of 222Rn and 224Ra (Fig. 1) generated by the Rambla into the lagoon (thereafter called "plume") was modeled and compared to the measurements allowing to locate point sources of radionuclides inside the lagoon in areas not attained by the plume during the days of modeling: if such activities could not be explained by the plume, additional sources of radionuclides would be evidenced. The introduction of the tracer in the model started 6 days before the days of sampling, i.e. approximately 1.5 halflife of decay for 222Rn. This decay provided an additional criterion for evidencing the nonRambla origin of measured values, as no more than 25% of the input level of 224Ra and 222Rn was expected to persist at the time of sampling in the oldest parts of the plume.
The model considered mean values for discharge, 222Rn, 224Ra and 223Ra activities of the Rambla, as well as for lagoon activities and Mediterranean Sea activities. The data was provided by the field surveys.

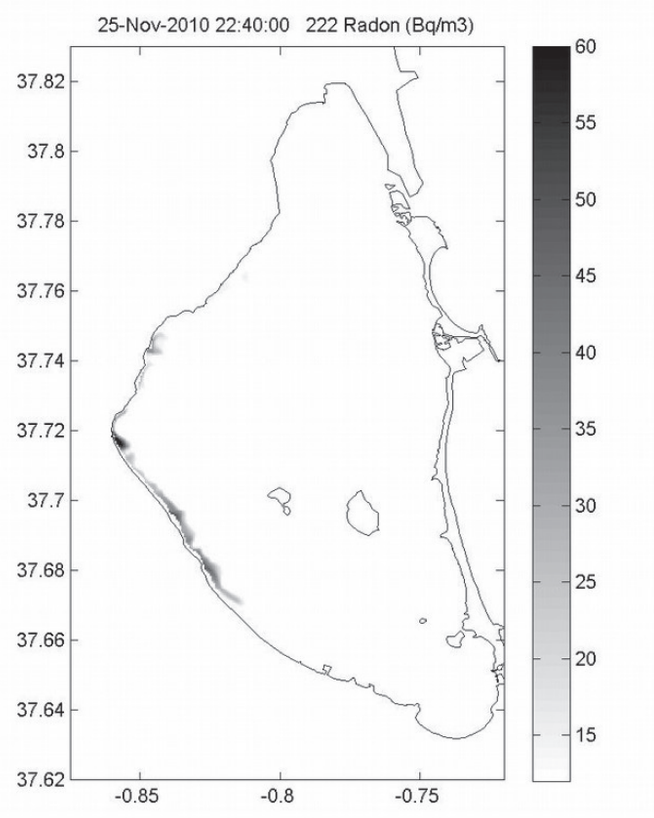

Fig.1. Radon simulaion model out