Regional groundwater balance and submarine karstic springs. Examples in South-eastern France.

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The submarine spring of Mortola (Menton). Photo. A. Rosenfeld

PRESENTATION

Achieving an hydrogeological balance is difficult in coastal karstic areas due to the presence of important submarine springs. Many examples are known in Southeastern France and the absence of data does not make it possible to realize a satisfactory groundwater balance. Moreover, the mixing between sea and fresh water complicates the evaluation of the annual discharge.

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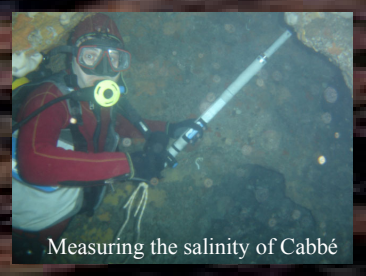
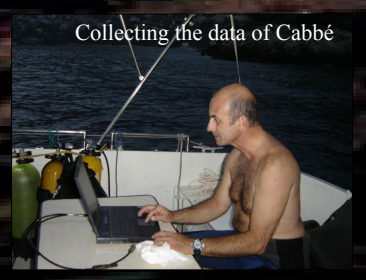
CTD sea probe


The submarine spring of Cabbé


Measuring the salinity of Cabbé


Collecting the data of Cabbé

WATER FRAMEWORK DIRECTIVE

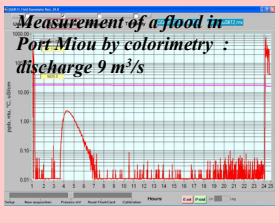
Excerpt of the Official Journal of the European Communities - 22.12.2000
Annexe II
2. Groundwaters
2.1. Initial characterisation
Member States shall carry out an initial characterisation of all groundwater bodies to assess their uses and the degree to which they are at risk of failing to meet the objectives for each groundwater body under Article 4…..

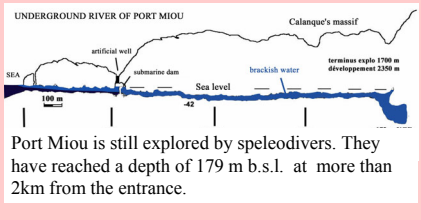
CONCLUSION

An important work of detection and monitoring of coastal and submarine springs should be done in Italy, France, Spain, Malta, Slovenia, Romania, Bulgaria, Greece, Cyprus to characterize the European coastal karstic aquifers in view to comply with the European Water Framework Directive before 2015.

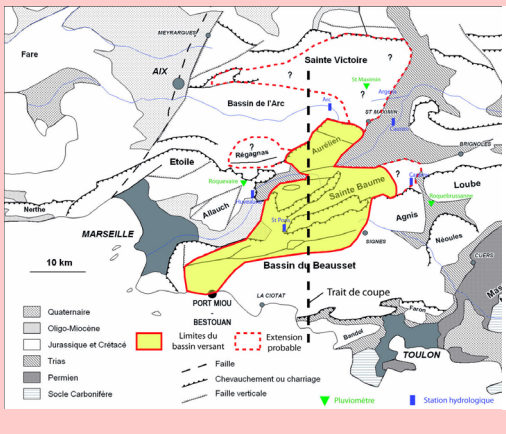
SPRING OF PORT MIOU 2 to 5 m^3/s

The group of springs of Port Miou-Bestouan (Marseille-Cassis, France) whose average flow is between 2 to 5 m^3/s, is the largest freshwater outlet between the Rhône and the Argens but it is not included in the french network of hydrological data. It is fed by a badly known aquifer that extends in the Basse Provence area (Gilli, 2001). This area is considered as a dry one but the values of rainfall and evapotranspiration do not explain the dryness. The absence of springs, or a too small discharge of the outlets, for several karstic units, tends to prove that only a part of the infiltrated water feeds the continental springs while the other part reaches a deep aquifer that is drained towards the sea. Data on discharge, temperature and salinity was collected in Port Miou. The correlation with rainfall gave indications to extend the basin up to 500 km^2 or more (Cavalera, 2007).


Measurement of a flood in Port Miou by colorimetry : discharge 9 m^3/s

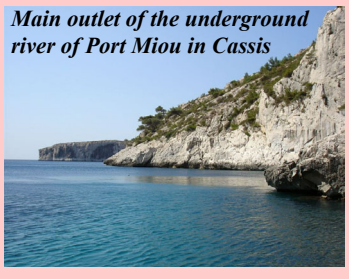


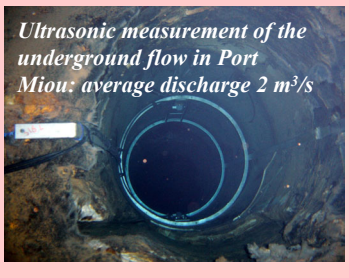
Port Miou is still explored by speleodivers. They have reached a depth of 179 m b.s.l. at more than 2km from the entrance.



Using different methods (geology, geography, paleogeography, speleology, bathymetry, hydrometry,….) made it possible to estimate the size of the basin of Port Miou. Due to its extension and to the submarine position of the outlets, dye tests are difficult to realize.

A regional balance shows a deficit of water for several limestone units while Port Miou shows a surplus.


Main outlet of the underground river of Port Miou in Cassis


Ultrasonic measurement of the underground flow in Port Miou: average discharge 2 m^3/s

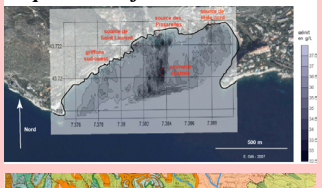

Measurement of the discharge in Port Miou

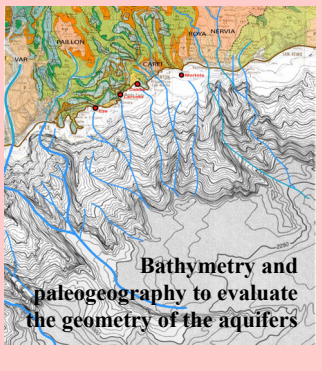
SPRINGS OF ALPES MARITIMES 0.7 to 1 m^3/s

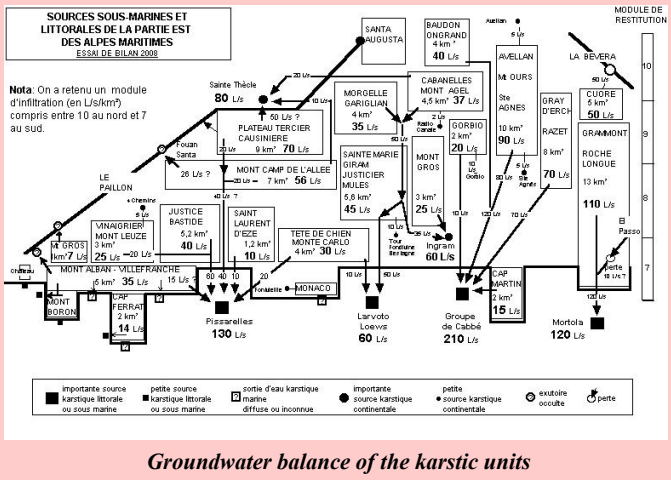
A same problem exists between Nice and Menton (Gilli, 2003) where several karstic springs have been studied for water supply. Their average annual discharge is 600 L/s. A global approach using different methods have been done to evaluate the importance of these emergences and to define the extension of their water basins (fig. 1). Dye tests, monitoring of springs, maps of surface salinity, bathymetric and palaeogeography analysis where conducted to define a more accurate ground water balance of this area (Mangan et al, 2007).


Dye test to estimate the size of the basin

Salinity map to estimate the importance of the outlets







Groundwater balance of the karstic units between Nice and Menton (France).

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