Methodology for studying exchanges between salt marshes and coastal marine waters

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Abstract

The salt marshes of the Mont St. Michel bay represent a complex system in continuous change, mostly due to the frequent exchanges with the coastal waters through tidal processes. In such ecosystems, water is an important element insofar as it represents the common vector of flows between and among several ecosystem compartments. The purpose of the approach discussed here is to estimate the volume of water coming in and out and to determine the variations of the water quality according to time and nutrients concentrations. The estimation of the water fluxes is dependent on the channel calibration downstream of the watershed. Among the different methods examined, the continuous integrals calibration appears as the best one because the water level changes very quickly.

Up to now, estimations of nutrients exchanges in wetlands have been based on rigorously regular field sampling, in consideration of the fact that exchanges occurred mainly during annual spring tides or during spring tides of each cycle of the year. According to our results, it seems that every tide, and portion of a tide, of a monthly and seasonal cycle has some importance and variability, which suggests that all parts of a tide should be considered in estimations of exchanges between wetlands and coastal waters.

Introduction

As part of the EEC program ‘Comparative Studies on Salt Marsh Processes’, we developed a study schedule about the factors governing the salt marsh transformations in a coastal saltmarsh on the Atlantic coast. The studied area is a system in a permanent state of change, because there are many internal and external exchanges occurring over a variety of spatial and temporal scales. Such a system can be defined as a site colonized by different vegetation units, arranged according to a specific zonation, with the whole joined within and between the coastal zone through a channel network. Thus, the marsh is sometimes completely submerged by the sea. It is also evident that three essential compartments are involved in the salt marsh exchanges: water, vegetation and soil. In spite of the importance of vegetation and soil, it appears that water, which may be considered as common to the different compartments, corresponds to the fundamental explanatory element for the transformations occurring in the marsh.

In the present study, we developed a method for studying this water compartment for qualitative and quantitative aspects. The tides coming in and out represent a nutrient supply, but may also export the diverse productions of the marsh. According to the studies approaching such problems, we noticed that a great majority only refer to the spring tides of
the year or to those of some tidal cycles (Valiela et al. 1984, Koch et al. 1992). However, the importance and the nature of the exchanges do not only depend upon seasons (Nixon 1980, Dame 1986), but also upon the tidal amplitude and chronological location of the tide in the studied tidal cycle.

Fig. 1. Location of the study area.

Fig. 2. An aerial view of the watershed studied.