Developing Macroscale Indicators for Estuarine Morphology: The Case of the Scheldt Estuary

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ABSTRACT

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A set of quantitative parameters is derived for the morphological characterization of estuaries. This is the first part of a long-term project aiming at the ecological characterization of tidal environments, which should provide practical tools for the management of such systems. The parameters apply to the macroscale, that is, the scale of the estuarine cross-section, including channels and adjacent intertidal areas. They are derived from recent theoretical models for estuarine morphology, as well as data from the tide-dominated Scheldt estuary. The set of parameters is believed to be universally representative, although this needs to be supported by further research, including data from other estuaries. The analysis suggests that morphodynamic equilibria do not form a continuum but manifest themselves as discrete steps. For each step, there is a straightforward relation between the extension of the intertidal areas and the other parameters. For the Scheldt estuary, large width-to-depth changes are necessary to jump from one equilibrium state to the other.

ADDITIONAL INDEX WORDS: *Morphodynamics, equilibrium, tidal.*

INTRODUCTION

An estuary can be morphologically altered in such a way that the local biology is negatively affected, even though water and sediment are both clean. For management purposes, it is thus important to be able to measure also the morphological quality of a water system, which would allow quantifying the level of damage caused by physical changes exclusively and establish acceptability limits.

Chemical pollution is easily quantifiable and many standards are currently available. On the contrary, the morphological deterioration is still difficult to quantify. Chemical pollution often has visible and direct effects on water and organisms, while the effects of morphological changes are slow and not immediately visible. They can manifest themselves after a long period, in the form of alterations in the typical succession stages of salt marshes or as erosion of banks and intertidal areas. For this reason, men have first concentrated their efforts in identifying and treating chemical pollution and, only at a later stage, have realized the importance of recognizing and treating morphological deterioration.

The aim of the present analysis is to provide a morphological characterization tool at a macroscale level, through the definition of a set of parameters able to identify different morphological situations. This is the first step of a long-term project that should finally result in an ecomorphological characterization of the estuarine systems. The purpose is that of being able to measure the morphological quality, providing graphs or tables based on easily assessable parameters, where threshold lines separate different morphological typologies that are related to well-defined ecological environments. The selected quantitative indicators should become a useful support for decisions in the management of estuaries.

The macroscale has been selected as the most suitable scale for this study because all the morphological elements that are important for decision makers can be taken into account. They are intertidal areas, channels, and islands, to be considered in a common context and not as single entities. Thus, the morphological quality of macroscale estuarine sections is here linked to the presence and to the characteristics of intertidal areas, islands, and channels.

The parameters to be used as morphological indicators have been selected on the basis of their role in the morphological evolution, their range of variation within the estuary, and the feasibility of their measurement. The set of parameters is believed to be universally representative, although it