ENSEMBLE PREDICTION OF MEGA-NOURISMENT MORPHODYNAMIC EVOLUTION

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INTRODUCTION

Mega-nourishment is an innovative soft coastal protection method (Stive et al., 2013) which was applied for first time in 2011 in the Netherlands (Figure 1).

Figure 1 - The "Sand Engine", as this project was named, in July 2011 (adopted from de Schipper et al., 2014).

Although conventional nourishments are considerably smaller in size, and designed to maintain their sediment volume to the specific site of their application for as long as possible, mega-nourishments are expected to redistribute via the local hydrodynamic forcing their massive volume along a beach, and provide coastal protection at regional scale.

PURPOSE OF THIS STUDY

Since mega-nourishment constitutes a new technology, adequate experience in accurate long-term predictions of its morphodynamic evolution under various conditions has not been achieved yet (Luijendijk et al., 2017). This is because the involved coastal processes have not been investigated to a satisfactory degree. The current study aims at further understanding the spreading mechanism of mega-nourishment via a new modelling technique. The solution to the one-line model that was applied was calibrated and validated in the period 2011-2016 where seabed and wave measurements are available. Then, a prediction of the morphodynamic evolution of Sand Engine was attempted up to the target year 2031, namely twenty years after its construction, and in the end of its life cycle.

METHODOLOGY

Wave data and detailed bi-monthly surveys of the mega-nourishment (Sand Engine) in the Netherlands were used. Initially, an ARMA stochastic model was applied for extending the existing three wave time-series in the time period 2011-2016, with respect to wave height, period and direction respectively, up to the target year 2031. The extended three time-series that were produced preserved not only the statistical characteristics of the corresponding original time-series, but also the correlation between them. The ARMA stochastic model ran 50 times, and subsequently, the produced wave time-series were used as input-data to the new time-varying semi-analytical solution, which describes the morphodynamic evolution of a mega-nourishment.

RESULTS

A detailed discussion over the morphodynamic response of a mega-nourishment to various hydrodynamic conditions will be provided and further insight to the factors that dominate the evolution in time of a mega-nourishment will be gained. Preliminary results of the evaluated semi-analytical solution for a parabolically shaped beach nourishment are presented in Figure 2:

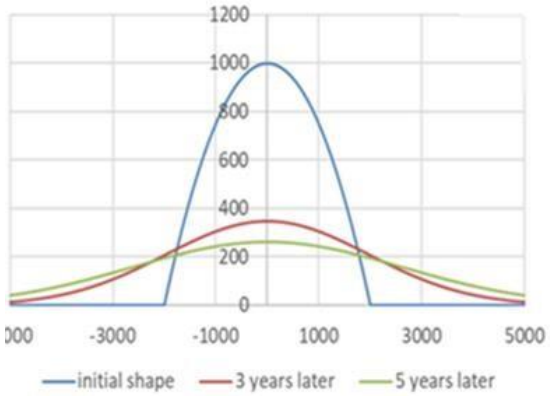

Figure 2

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