

## ICON.NL

### COASTLINE OBSERVATORY TO EXAMINE COASTAL DYNAMICS IN RESPONSE TO NATURAL FORCING AND HUMAN INTERVENTIONS

S.G.J. Aarninkhof<sup>1,\*</sup>, M.A. de Schipper<sup>1</sup>, A.P. Luijendijk<sup>1,2</sup>, B.G. Ruessink<sup>3</sup>, M.F.P. Bierkens<sup>3</sup>, K.M. Wijnberg<sup>4</sup>, J.A. Roelvink<sup>1,5</sup>, J. Limpens<sup>6</sup>, M.B. Baptist<sup>6,7</sup>, M. Riksen<sup>6</sup>, T.J. Bouma<sup>8</sup>, S. de Vries<sup>1</sup>, A.H.J.M. Reniers<sup>1</sup>, S.J.H.M. Hulscher<sup>4</sup>, A. Wijdeveld<sup>2</sup>, A. van Dongeren<sup>2</sup>, C. van Gelder-Maas<sup>9</sup>, Q. Lodder<sup>9</sup>, A.J.F. van der Spek<sup>2</sup>

<sup>1</sup> Delft University of Technology, <sup>2</sup> Deltares, <sup>3</sup> Utrecht University, <sup>4</sup> University of Twente, <sup>5</sup> IHE Delft, <sup>6</sup> Wageningen UR, <sup>7</sup> Wageningen Marine Research, <sup>8</sup> NIOZ, <sup>9</sup> Rijkswaterstaat

\* s.g.j.aarninkhof@tudelft.nl

Climate change and rising population pressure are driving increasing risk for coastal domains worldwide, and especially for low-lying deltas. Yet, our knowledge base to manage or mitigate these challenges lags behind. Modern-day sustainable coastal design concepts (e.g. ‘Building with Nature’) demand fundamental insight into the complex interplay of hydrodynamic, morphological and ecological processes. In the past, improved understanding was mostly based on laboratory experiments or dedicated theoretical research on isolated processes. However, field observations have revealed that the coastal system behaves as a nonlinear dynamic system with emergent behaviour of unknown predictability for many processes. To cater for these new paradigms, Dutch coastal scientists are in urgent need of a world-class, natural coastline observatory to ensure continuous, long-term and high-resolution monitoring of coastal processes.

We therefore propose the establishment of a facility named ICON.NL, the first node in an envisioned International Coastline Observatories Network (ICON). The objective of ICON.NL is to establish a truly multidisciplinary data corpus, which will inspire and enable internationally outstanding coastal research, fundamental as well as applied, by the entire Dutch coastal science community and their international partners. To that end, we envision an innovative, interconnected data-collection scheme that fuses together, for the first time ever, i) remote-sensing instruments (including optical and infrared cameras, X-band radar, drones, and laser altimetry); ii) *in situ* instrumentation (to measure offshore wave forcing, to yield ground-truth bathymetry/topography estimates and to map the marine and terrestrial ecosystems); and iii) a mature modelling system (to produce time-varying, dynamically consistent maps of the important coastal bio-geophysical variables).

ICON.NL will be based at the Delfland Coast with core observations focused on the internationally well-known Sand Engine experiment. As part of this initiative, a man-made sandy peninsula was built to ensure long-term coastal safety and to promote nature development, science and recreation. The combination of the unique site and ambitious facility design enables a new avenue in coastal science and a leap in interdisciplinary research. ICON.NL will allow field experimentation to advance our understanding in fundamental science topics such as unsteady currents and circulation, sediment transport near the beach, emergent morphological patterns, wave breaking/turbulence and storm/recovery cycles. It will also serve as home to interdisciplinary work that crosses the sea-land interface, which has always been difficult or impossible to perform in traditional labs. The open-source data corpus from ICON.NL will form a growing resource that can be the research spearhead for Dutch coastal scientists and will focus the eyes of the world on the Dutch coast.

The proposed facility is supported by the full Dutch coastal science community (united in the Netherlands Centre for Coastal Research, NCK), aligns with the strategic agendas of industry and government and is well embedded in international research frameworks. In all, ICON.NL and the research that it facilitates will be a crucial step toward sustainable Coastal Engineering and Management to meet societal challenges in a changing climate.