FOREShORE ASSESSMENT USING SPACE TECHNOLOGY

Open source integrated dataset of vegetation, waves, water depths, stability, controls/measures

Deliverable No: D.4.7

Open source integrated dataset of vegetation, waves, water depths, stability, controls/measures

Ref.: WP4 - Final

Date: October 2016

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement nº 607131.

Grant Agreement number: **607131** / Project acronym: **FAST**
Project title: **Foreshore Assessment using Space Technology**
Funding Scheme: **Collaborative project** / Project start: **01-01-2014**
Project duration: **48 months** / Project coordination: **Deltares, Delft, the Netherlands**
Project website: **fast-space-project.eu** / **DG Research - FP7 - SPACE - 2013**

Deliverable Title	D.4.7 – Open source integrated dataset of vegetation, waves, water depths, stability, controls/measures
Filename	FAST_D.4.7_IntegratedFieldData_v1.0
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Date	31/10/2016

Dissemination level		
	PU	Public
X	PP	Restricted to other programme participants (including the Commission Services)
	RE	Restricted to a group specified by the consortium (including the Commission Services)
	CO	Confidential, only for members of the consortium (including the Commission Services)

Document Change Record

Authors	Modification	Issue	Date
Iris Möller	Initial draft	0.1	10/10/2016
Ben Evans	Insertion of detail	0.2	17/10/2016
Iris Möller / Ben Evans	Text edits	0.3 - circulation for comment	20/10/2016
Iris Möller / Ben Evans	Accepted edits	0.4 - final formatting	26/10/2016
Iris Möller / Mindert de Vries / Myra van der Meulen	Formatting	1.0 -document for submission	31/10/2016

Content

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Executive summary / Abstract

The objective of the FAST project is to develop a Copernicus downstream Service and software tool (MI-SAFE), combining Sentinel satellite data and in situ data (from eight different foreshore case study areas in four different countries) to integrate the protective role of wetlands in flood risk management strategies. The role of work package 4 (WP4) is to characterise environmental foreshore and floodplain conditions, including water level and wave incidence and dissipation across the foreshore, by direct field measurements in order to link these to remote sensing parameters.

A series of prior deliverables have covered the various ‘batches’ of data that have been uploaded onto the project repository in turn. The data pertain to general site characteristics and repeat photographs, surface reflectance spectra, soil characteristics, surface roughness and stability, elevation and accretion, vegetation characteristics, and hydrodynamics (water depth and waves). The data has all been uploaded onto the project repository and is used to validate the modelling of cross-shore wave dissipation as derived from EO data and to link wetland characteristics to stability and wave energy dissipation. The way in which this data has been collected has previously been explained but, for the sake of completeness and to enable this deliverable to serve as a useful single document for future reference. This deliverable thus summarises the complete set of acquired data that has been uploaded onto the data repository of the project and advises the reader about the methods used and locations of samples, as well as the location of the respective data files within the repository structure.

Scope

EU FAST focuses on the assessment of foreshores, including soil stability parameters (soil type, erodibility, grain size, roughness), vegetation, and foreshore morphology using satellite imagery, as well as wave dissipation across the foreshore to be used in a foreshore assessment tool MI-SAFE. A series of Work Package 5 Deliverables have previously outlined the model needs, potential and limitations of MI-SAFE and examples of the processing workflow for the data within the EU FAST project. This deliverable reports the complete dataset that is now available for all eight case study sites (four from Year 1 and four from Year 2) on the project repository. This now allows WP5 of the FAST project to establish a full validation of the modelled wave dissipation and wetland characteristics and stability from EO information (calibrated through direct field measurements of the soil, vegetation, topographic and hydrodynamic characteristics reported here). In addition to allowing the building of the MI-SAFE tool, this data serves as an illustration of the outputs of the advanced version of the tool that are possible to achieve where field conditions are well defined. As such, it sits at the core of the FAST project.

1. Introduction

This introduction outlines briefly the key remit of the FAST project: The project has arisen from the recognition that vegetated foreshores provide an important ecosystem service as a natural coastal defence feature that attenuates waves, enhances sedimentation and reduces erosion. At present, these key functions are rarely incorporated in safety assessments and levee design, even though it may result in considerable cost reductions for flood risk management. The FAST project aims to develop a Copernicus downstream service, combining Sentinel satellite data and in situ data to integrate the flood defence properties of wetlands with flood risk management strategies. Within the service, Sentinel-1 and Sentinel-2 data will be used to retrieve relevant biophysical parameters, such as the vegetation density and/or biomass of vegetated foreshores. The development of the FAST tool MI-SAFE and associated services and products is the ultimate goal of the project and involves a series of different types of data, from the local to the global (see Figure 1). The most well defined set of data will be that which the project has been gathering at the eight specific case study sites. This data will form the core calibration dataset for the MI-SAFE tool.

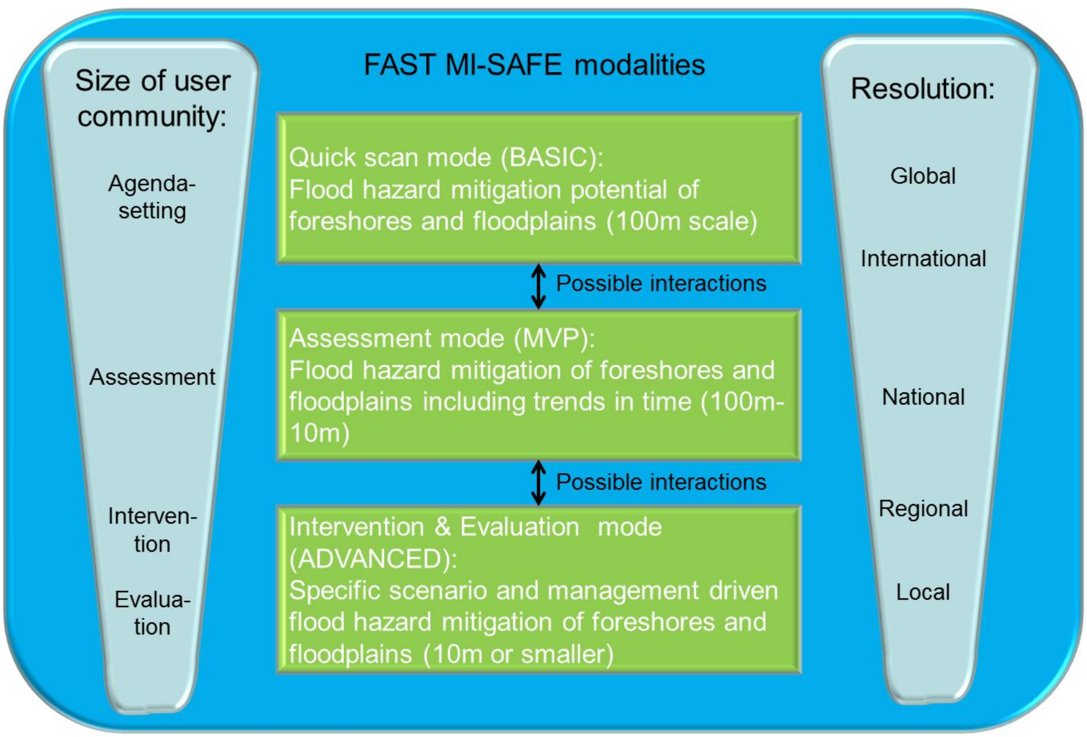

Figure 1 The FAST tool and the different version with their functionality *(source De Vries et al., 2014: EU FAST Deliverable 5.10).*

The field data that is reported in full within this report will enable the linkage between the remotely sensed characteristics of the surface, surface stability, and its coastal protection function to be made. This report describes the methods to collect measurements and the repository folder structure within which the data on particular wetland aspects at each of the study sites is stored. This thus now allows WP5 to draw on this data and for anyone working with this data to have easy access to metadata relating to data acquisition and storage.

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2. Field sampling - locations

The broad locations of all eight field sites located in each of the FAST partner countries and as used broadly for data acquisition between September 2014 and July 2016 are shown in Figure 2.

At each of the field sample sites, a number of plots of 1 m2 were placed in vegetation areas and on the unvegetated foreshore. Five 'transect' plots were located in close vicinity of the transect (i.e. within a distance of 25 m either side of the wave recording transect; these were generally spaced at or more than 30 m apart) – they serve to best characterise the conditions at the wave transect to achieve a linkage between these conditions and the recorded wave dissipation.

The generic field site layout is indicated in Figure 3, but the exact location depended on the local situation (e.g., heterogeneity and size of the sites, diversity of vegetation types and biomass).

Individual field site locations are thus shown in Figures 4 through to 11.

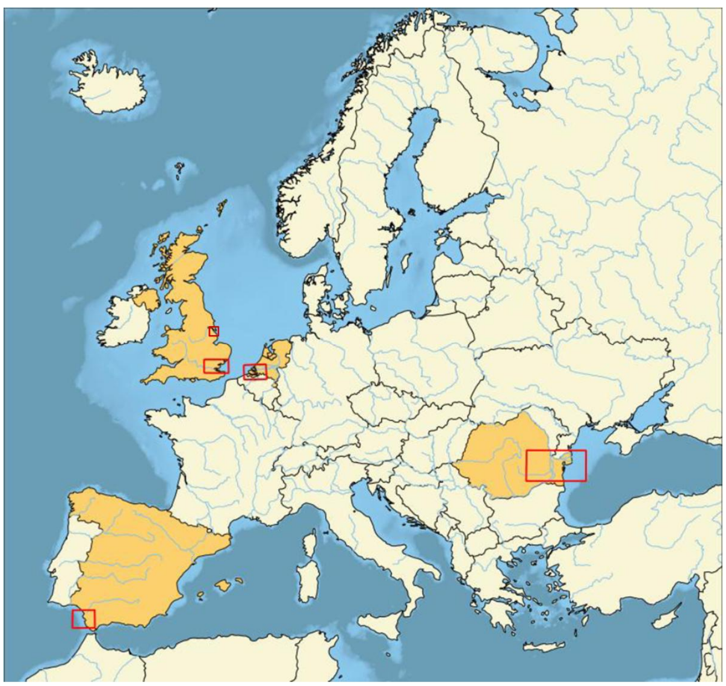

Figure 2. Location of the study sites in Europe (source: Morris, EU FAST proposal), including Tillingham in the UK (most southern UK site, year 2 site UK) and Donna Nook (most northern UK site, year 1 site UK), Paulinaschoor (year 1) and Zuidgors (year 2), Westerschelde, Netherlands, Eastern Cadiz Bay (year 1 and year 2), Cadiz, Spain, and Cape Dolosman, Razelm Lagoon (year 1) and Histria (year 2), Danube delta, Romania.

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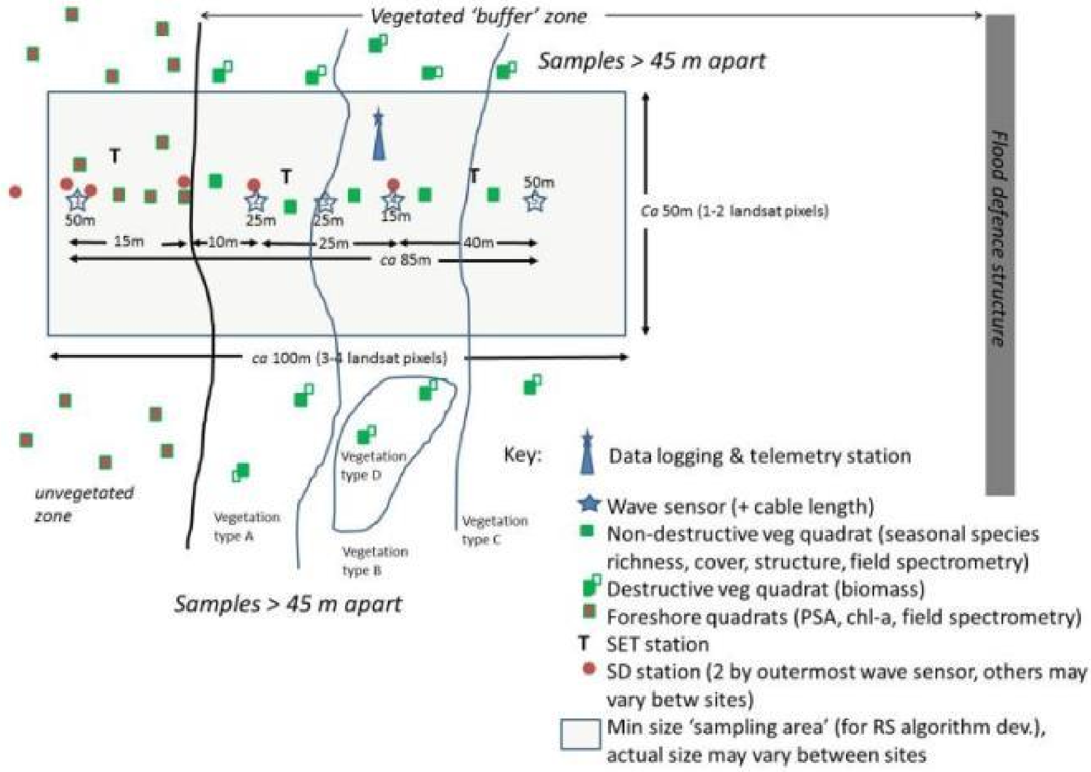

Figure 3: Schematic illustration of field sample layout used within the FAST project. Individual site locations vary from this and geo-referenced information of each sensor location is provided to accompany the wave measurement data uploaded on the FAST data repository.

Two sensors for measuring surface erosion/deposition were deployed next to the three most seaward located wave sensors inside the vegetation of each site, (with the exception of those in Romania and Spain), forming part of the vegetated area's wave sensor array (see Figure 3). A 3rd sedimentation sensor was set up next to the outermost (tidal flat) wave sensor, approx. 15 m on the seaward tidal flat beyond the vegetation edge. A 4th, 5th and a 6th wave sensor were located in relation to the length of the unvegetated seaward tidal flat (Figure 3). The 6th sensor was placed halfway between the vegetation edge and the waterfront. The 4th and 5th were generally equally spaced between the 3rd and the 6th sensor, though note the GPS locations for each sensor in specific cases. Distances from the vegetation edge to the seaward tidal flat were site specific, taking into account the dimensions of the bare tidal flat and the presence of seagrasses and macro-algae, as present, e.g., in the Cadiz Bay sites.

Because of the individual sites peculiarities, any users of the data are referred to the site-specific location information for all measurements (see the next section below).

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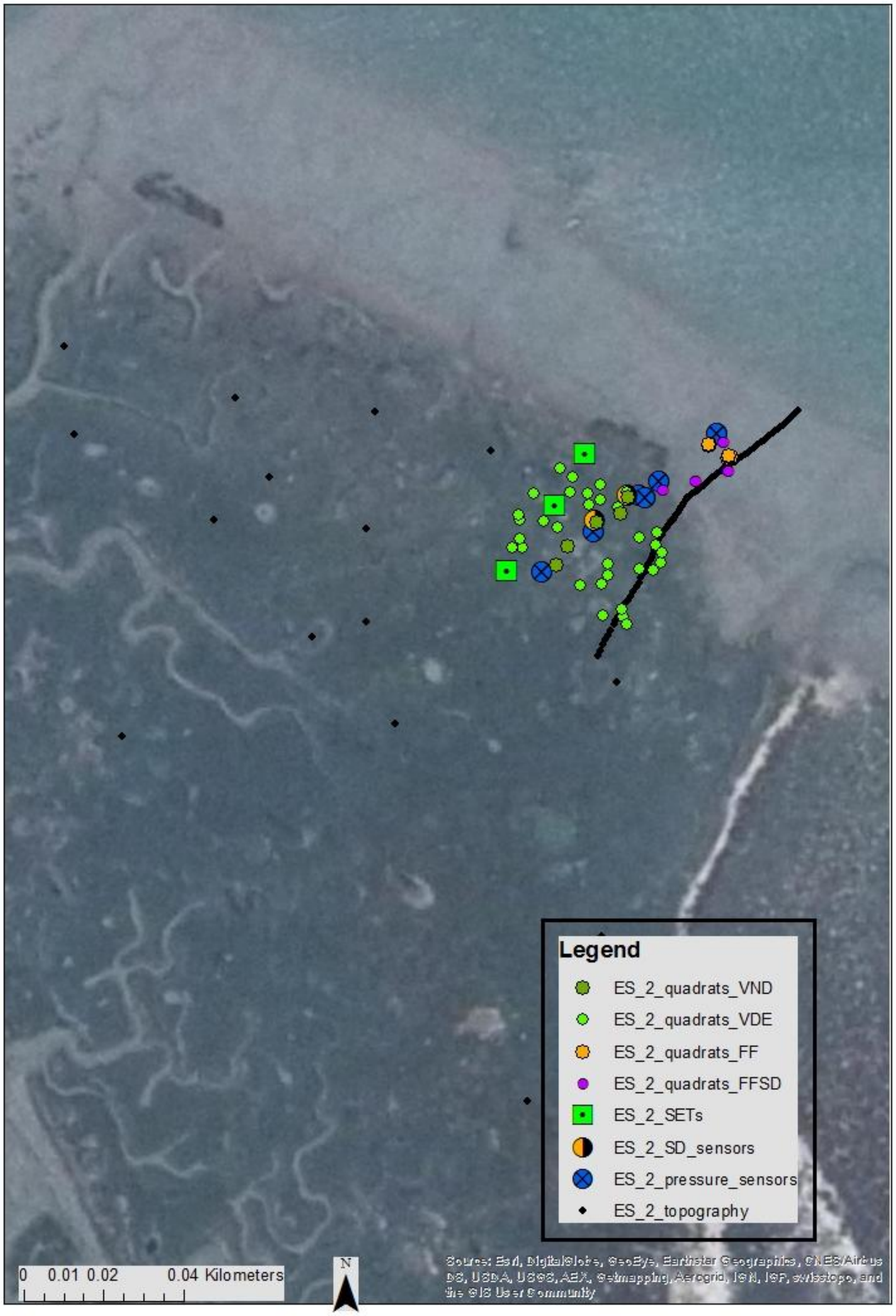

Figure 4: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at ES Y2 site

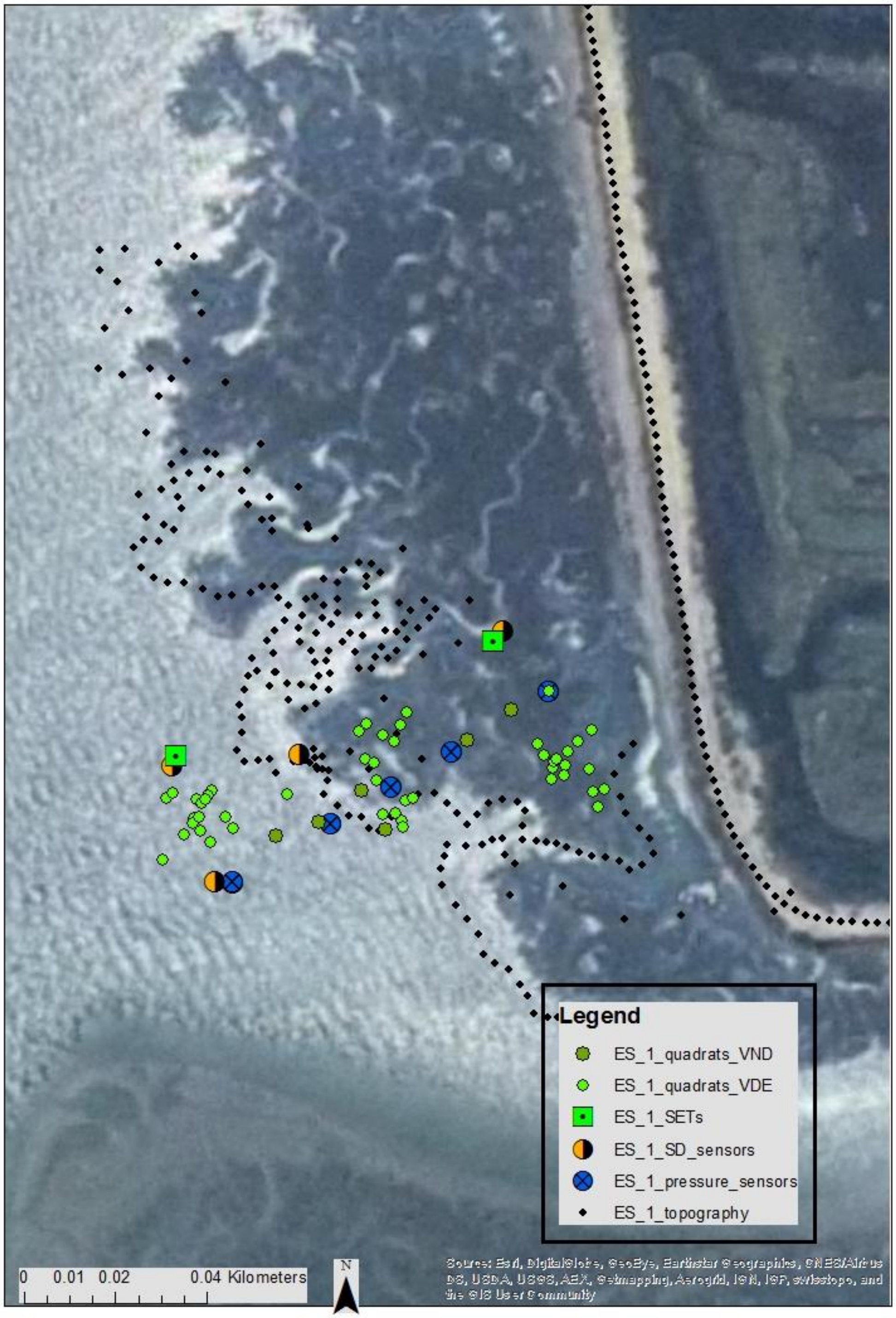

Figure 5: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at ES Y1 site

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Figure 6: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at RO Y2 site

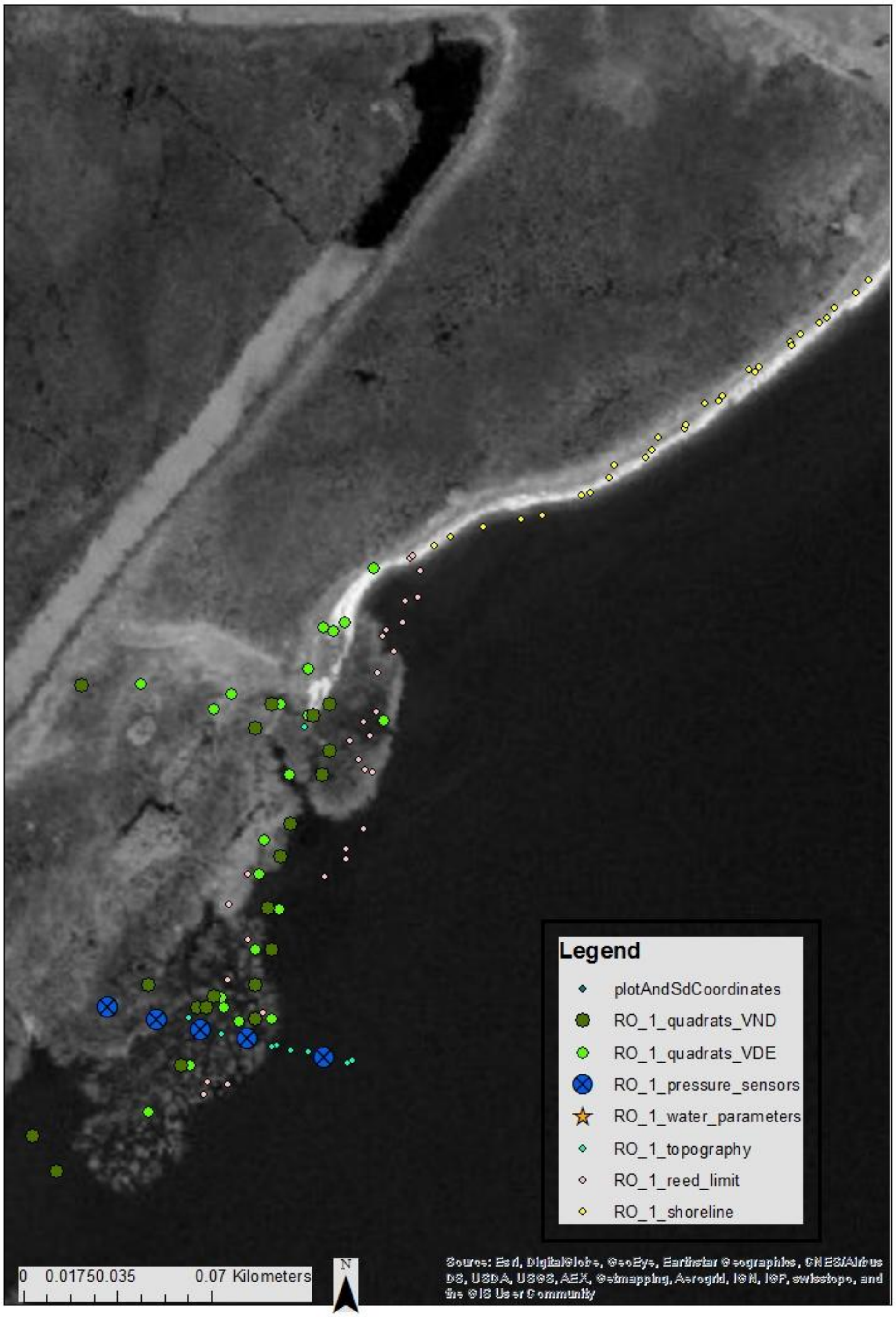

Figure 7: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at RO Y1 site

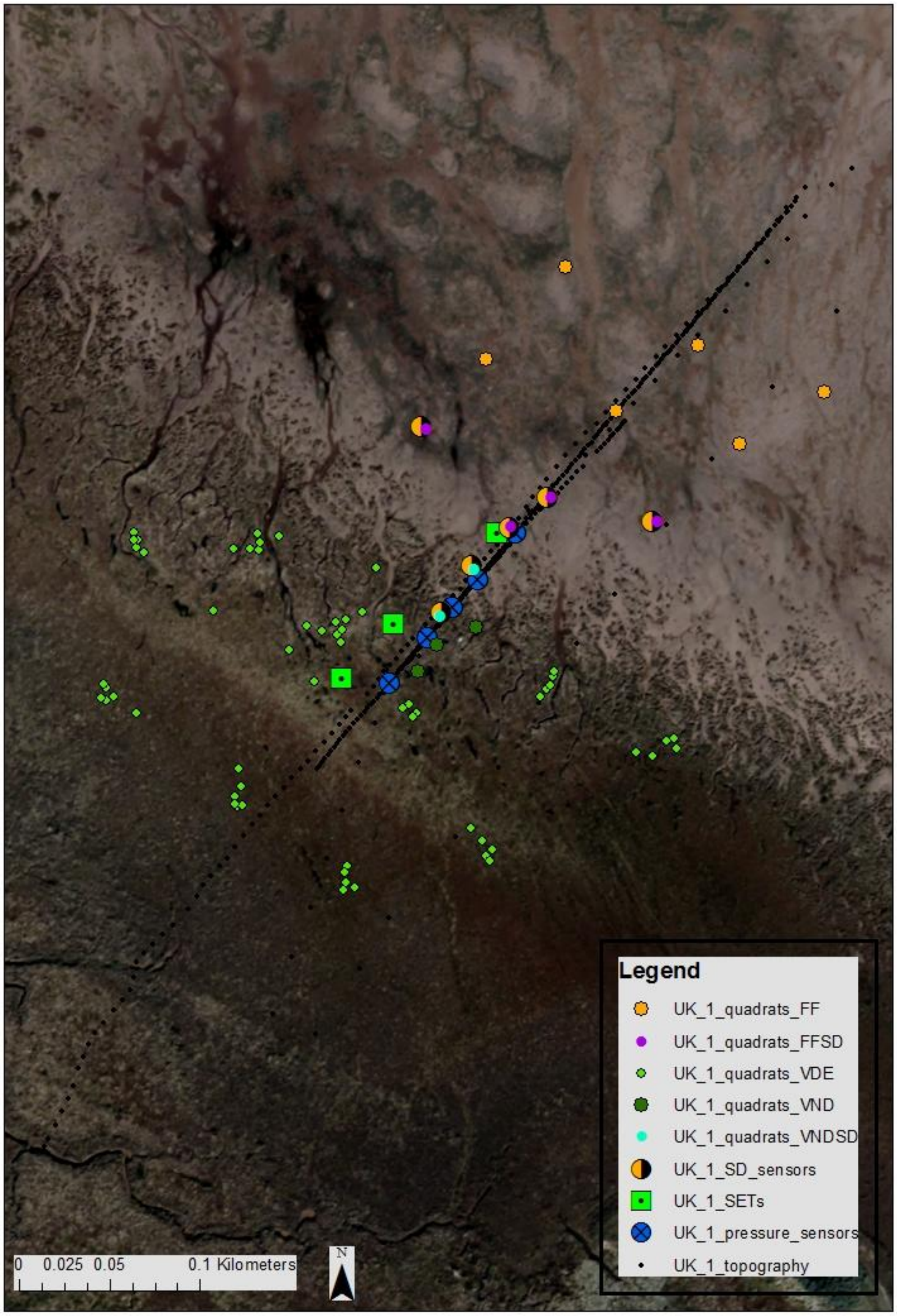

Figure 8: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at UK Y1 site

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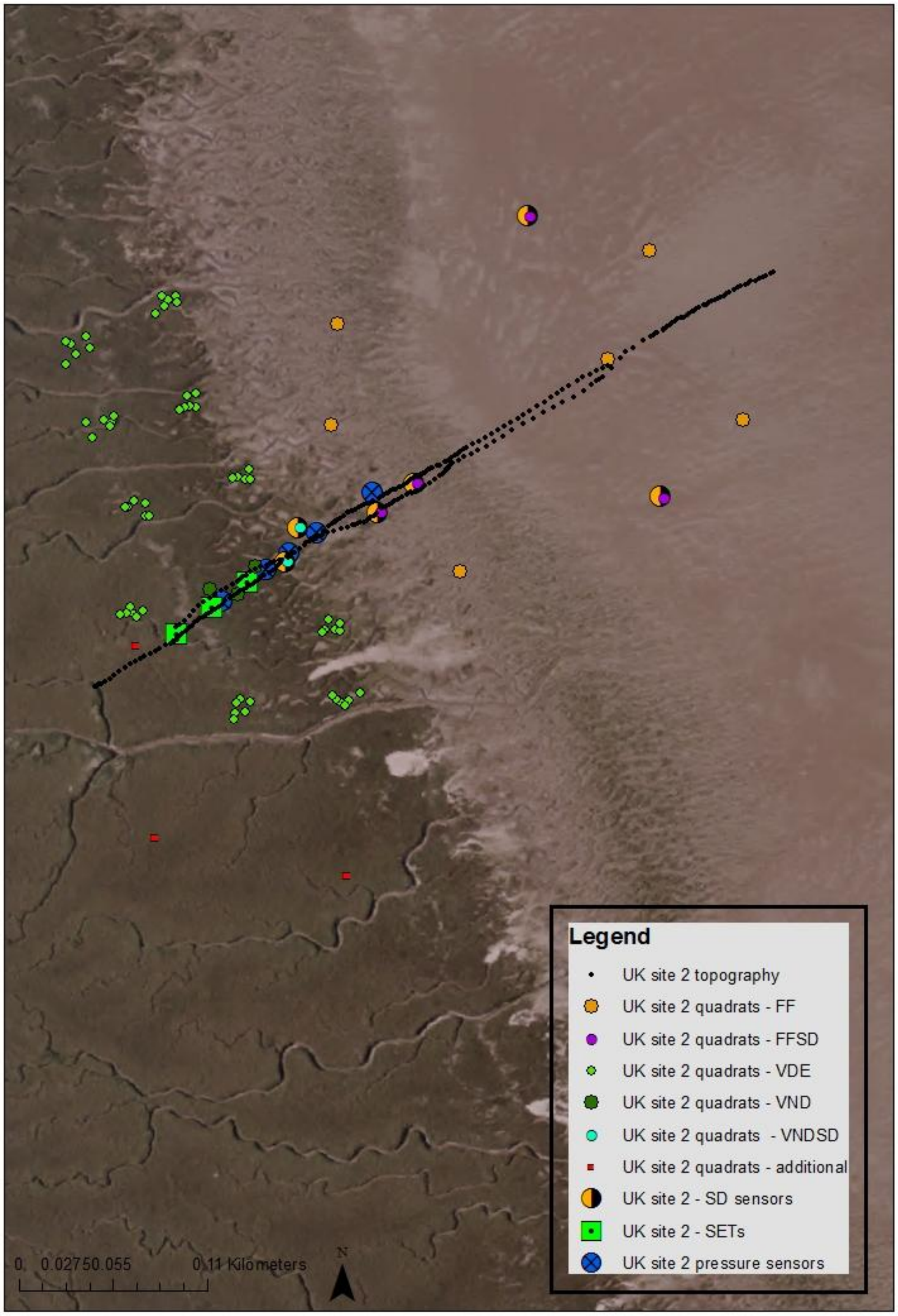

Figure 9: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at UK Y2 site

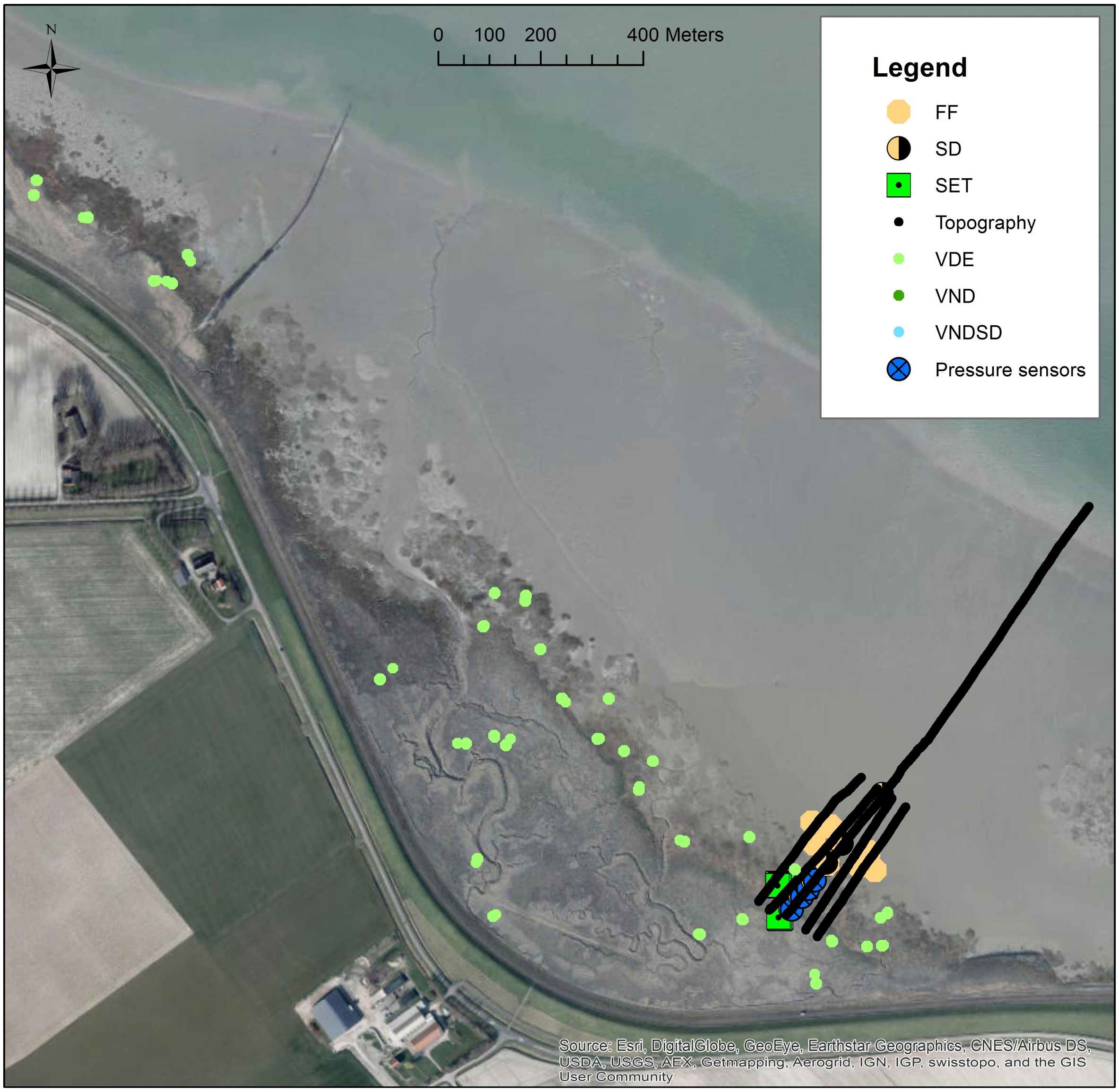

Figure 10: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at NL Y1 site

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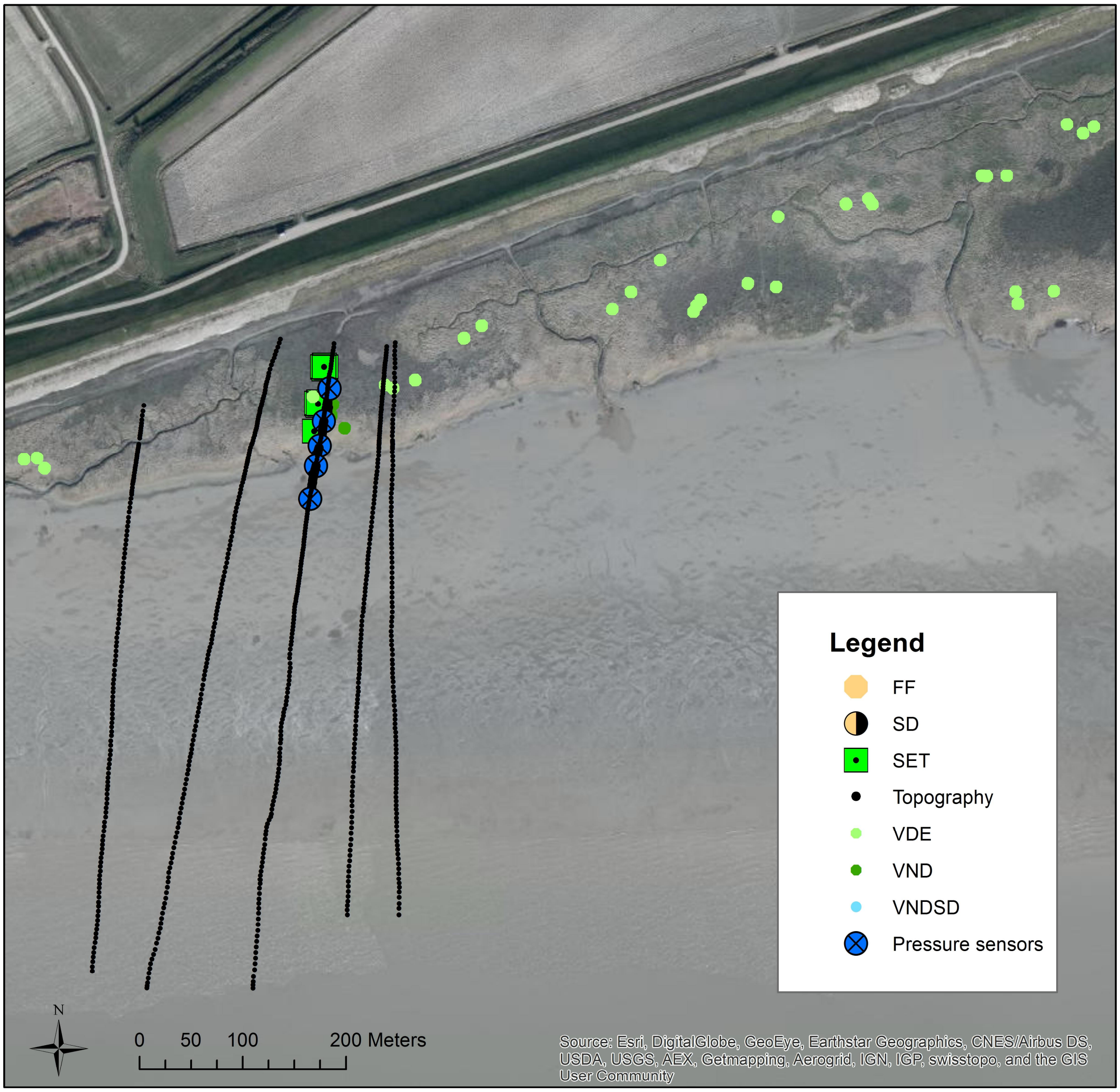

Figure 11: Locations of topographic surveys, monitoring equipment and sampling quadrats deployed at NL Y2 site

3. Data structures and parameter naming conventions

3.1. Overview of project-specific parameters divided into classes

Parameter records are divided into classes based on a grouping of the methods used to measure them and the nature of the characteristics they describe. This deliverable concerns parameters at processing level L0, or dark green as depicted in Figure 12 (light green refers to L1 parameter names).

Figure 12: Schematic of grouping and naming conventions adopted for the parameters measured in the field. Black indicates parameter group, dark green indicates L0 parameter names, light green indicates L1 parameter names.

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3.2. Controlled vocabularies

Where possible, the project has used the most relevant name for parameters available in an existing controlled vocabulary. Where this has been possible, the controlled vocabulary from which the parameter name has been taken is indicated. There were, however, some parameters for which a satisfactory, pre-defined terminology did not appear to be established in any major controlled vocabulary. For these parameters the project has defined its own, project-specific naming conventions

3.2.1. Project-specific controlled vocabulary subsets

Data files for each parameter are provided per site, but the format is standardised across all sites. The files are organised by ParameterGroup and ParameterSubGroup, as described in the "fast_L0b_insitu_parameter_definitions" file located at: https://repos.deltares.nl/repos/FAST/datamanagement/vocab_ranges/fast_L0b_insitu_parameter_definitions.csv

In addition this file provides a description of what the parameter is measuring, the units of measurement, acceptable range of values, the data type and the column of the data files in which the parameter values are to be found. This file also references the vocabulary definitions used for each parameter in column 9 (where appropriate). Where a vocabulary definition reference exists, the relevant vocabularies, as a list of expected values, are provided. The files can be found in the folder:

https://repos.deltares.nl/repos/FAST/datamanagement/vocab_ranges/project_specific_controlled_vocabulary

The vocabulary files supplied are listed below.

	Filepaths (https://repos.deltares.nl/repos/FAST/datamanagement/vocab_ranges/project_specific_controlled_vocabulary/...)
1	fast_vocab_country.csv
2	fast_vocab_crs.csv
3	fast_vocab_datum_geoid_elevation.csv
4	fast_vocab_datum_local_elevation.csv
5	fast_vocab_field_guide_version.csv
6	fast_vocab_general_locations.csv
7	fast_vocab_id_certainty.csv
8	fast_vocab_instrument.csv
9	fast_vocab_methods.csv
10	fast_vocab_orientation.csv
11	fast_vocab_Parameter.csv
12	fast_vocab_ParameterGroup.csv
13	fast_vocab_ParameterSubGroup.csv

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14	fast_vocab_plot_code.csv
15	fast_vocab_site.csv
16	fast_vocab_species_name.csv
17	fast_vocab_staff.csv
18	fast_vocab_time_range.csv
19	fast_vocab_vane_conFigurecsv

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4. Measurement of parameters in the field

Parameters were measured in the field in the order specified in the field sampling guide. The general scheme and order of measurements are indicated below. In the following sections, the field method, the data derived from it, and its locations on the project repository are outlined in order of method number.

Method No	Parameter – in measurement order	Sep	Nov	Jan	Mar	May	Jul	Vegetated foreshore quadrats			Fronting foreshore quadrats		Appr ox
								VNDSD (N=2)	VND (N=3)	VDE (N=10)	FFSD (N=4)	FF (N=6)	
1*	dGPS survey (incl. transect & all quadrats)	Yes	RO only	RO only	RO only	RO only	Yes	Yes	Yes	Yes	Yes	Yes	
2*	Repeat photo of site	Yes	Yes	Yes	Yes	Yes	Yes						
3*	Wave array mainten	Yes	Yes	Yes	Yes	Yes	Yes						
4*	Download/clean SD sensors (**not RO**)	Yes	Yes	Yes	Yes	Yes	Yes						
5	Verify quad position	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2
6	Top-down photo	Yes		Yes		Yes		Yes	Yes	Yes	Yes	Yes	3
7	Reflectance Spec	Yes		Yes		Yes		Yes	Yes	Yes	Yes	Yes	10
8	Species richness	Yes		Yes		Yes		Yes	Yes	Yes			10
9	Vegetation cover	Yes		Yes		Yes		Yes	Yes	Yes			10
10	Plant H, d, spacing	Yes		Yes		Yes		Yes	Yes	Yes			10
11	Disc height (for biomass) (**not RO**)	Yes		Yes		Yes		Yes	Yes	Yes			10
12	Projected Area Photo (**not RO**)	Yes		Yes		Yes		Yes	Yes	Yes			20
13	Surface roughness (**not RO**)	Yes		Yes		Yes					Yes	Yes	15
14	Particle size (ALL), total organic matter (ALL), bulk density	Yes	Yes (SD onlynot RO)	Yes	Yes (SD onlynot RO)	Yes	Yes (SD onlynot RO)	Yes			Yes	Yes (SepJ anMay only)	15
15	Sediment samples for Chl-a **(not RO)**	Yes	Yes (SD onlynot RO)	Yes	Yes (SD onlynot RO)	Yes	Yes (SD onlynot RO)	Yes			Yes	Yes (SepJ anMay only)	10
16*	Water Chl-a (**RO only**)		Yes		Yes		Yes						5
17*	Secci (**RO only**)		Yes		Yes		Yes						5
18	Shear vane (**not RO**)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes		5
19	Erosion pin (**not RO**)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes		5
20	Plant Biomass Harvest	Yes		Yes		Yes				Yes			15
21*	SET readings	Yes											

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5. Site-based measurements

5.1. dGPS survey (including cross-shore transect & all quadrats)

The dGPS surveys were carried out in September/October once per year at each site (bi-monthly in Romania) to record the location (in WGS84 coordinates) and elevation (relative to mean sea level) of all quadrats (mark at least two corners across the diagonal of the 1 x 1 m quadrat), pressure sensors, SETs, accretion markers, and SD sensors. In addition, detailed topography of the foreshore and floodplain is recorded at least up to the furthest SD-sensor over the area of the monitoring transect (i.e. approximately 80 m in the cross-shore and 40-50 m in the long-shore direction), with individual spot heights (up to 50) to characterise adjacent topographic features, if required. Surface elevation along a shore-normal transect was also determined by dGPS from the highest tide / flood level to be expected with a return period of *ca* 50 years to the lowest tide level (MLW) or to 1 m water depth, whichever is practical. Elevation was recorded to an accuracy of ±20mm every 20m or more frequently whenever there is a break in slope, and the location of each survey point recorded in WGS84. Information on local datum and adjustments to mean sea level is provided in the meta-data.

dGPS data pertaining to the locations of sampling for all other parameters are contained in one file per site. Where more than one file is provided, this is referred to as 'dGPS_Core'. This file should contain location data for all unique plot codes found in the data files for other parameters. Geolocation data can be matched to other parameter measurements based on *plot_code* alone for measurements that are taken at the same location during every sampling campaign, or by *plot_code* and *timestamp.ISO8601* for information recorded at different locations throughout the year, such as the destructive vegetation quadrats. Where additional information is available extra files may be included that describe the cross-shore topography as a 'transect', or where transect information and other additional geolocation data are included the additional file is termed 'ancillary'.

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/geo_positioning/FAST_NL_Pau_dGPS_2014-2015.csv theNetherlands/site2Zuidgors/insitu/geo_positioning/FAST_NL_2_dgpsTransect.csv theNetherlands/site2Zuidgors/insitu/geo_positioning/FAST_NL_2_dGPS_Core.csv
Romania	*Data to be re-formatted prior to addition to repository*
Spain	Spain/ES1_CadizBay/insitu/geo_positioning/FAST_ES_1_dgps_2014-2015.csv Spain/ES2_CadizBay/insitu/geo_positioning/FAST_ES_2_dgps_2015-2016.csv
United Kingdom	UK/site1/insitu/geo_positioning/FAST_UK_1_dGPS_Core_2014-2016.csv UK/site1/insitu/geo_positioning/FAST_UK_1_dGPS_Ancillary_2014-2016.csv UK/site2/in_situ/geo_positioning/FAST_UK_2_dGPS_Core_2015-2016.csv UK/site2/in_situ/geo_positioning/FAST_UK_2_dGPS_Ancillary_2015-2016.csv

5.2. Repeat photo of site

A series of photos of the whole site were taken from a fixed location. The exact camera location coordinates (WGS84) and compass direction of photograph were recorded together with the photograph(s). Photographs are provided in the following locations:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/site2Zuidgors/insitu/photographs/repeat_site_pictures theNetherlands/Site1Paulina/insitu/photographs/allPictures
Romania	Romania/Site1/in_situ/photographs Romania/Site2/in_situ/photographs
Spain	Spain/ES1_CadizBay/insitu/site_description/data/repeat-photo Spain/ES2_CadizBay/insitu/photographs/repeat-photo
United Kingdom	UK/site2/in_situ/photographs UK/site1/in_situ/photographs

5.3. Download and clean SD sensors

SD-sensors, developed in-house by NIOZ, use of an array of optical cells to detect the height of the sediment. Details of the instruments are provided in Hu et al. 2015. SD-sensors were inserted on the tidal flat and within the vegetated wetland margin at the sites in the UK and the NL, and in the saltmarsh in ES, where sediment surface and inundation conditions allowed appropriate measurements to be obtained. An instruction video on use of the SD sensors can be found at https://www.youtube.com/watch?v=c0-QiQkSzsQ&list=PLf1lPygSvdgswSCuVfQh-Dq0ms4uQuHpP&index=4. The sensors were kept clean from fouling by growth of marine organisms or sedimentary deposits stuck to the side, and batteries and storage card were regularly checked. Data derived from the SD sensors is stored in raw hexadecimal files.

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/site2Zuidgors/insitu/sediment_dynamics/sd_sensors
Spain*	Spain/ES1_CadizBay/insitu/sediment_dynamics/data/SD_sensors Spain/ES2_CadizBay/insitu/sediment_dynamics/data
United Kingdom	UK/site1/insitu/sediment_dynamics/sd_sensors UK/site2/insitu/sediment_dynamics/sd_sensors

*Note: SD sensors at the Spanish site failed due to transmission / data saving problems; data recovering is being looked into.

5.4. Top-down photo

In addition to the measures described below a vertical digital photograph of the area (in which a 1 x 1 m quadrat frame needs to be clearly visible) was taken from a standard height of 2m above the surface prior to any sampling at the sites in the UK, the NL, and Spain, where access was possible. At the field sites in Romania, the height of the reed vegetation made this technique unusable. The following information was generally recorded with each photograph:

- Quadrat reference (label)
- Date and time (including zone)
- Weather (cloud octants, max daily temperature, precipation in mm, wind speed in Beaufort, wind direction, and approximate description of weather prior to acquisition (e.g., dry or wet, calm or stormy period etc).

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Each plot was marked with a clear label for identification and this label was used to archive all spectral and bio-physical measurements obtained in the field.

For the fronting foreshore quadrats (FFSD and FF in the table above), the following were also recorded when the photo was taken:

- cover (%) and species of seagrass
- cover (%) and species of macroalgae/seaweeds
- density and state and type of microphytobenthos (diatom biofilms etc)
- sediment type (gravel, sand, or mud; low or high organic matter content, shells etc) and state (compaction, water etc)
- any other peculiarities that may have determined the color and topography of the plot

The photos, identified by the string "TDQ" present within the filename, are located in the following folders

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/photographs/allPictures theNetherlands/site2Zuidgors/insitu/photographs/top_down
Romania	NA - no top-down photos possible
Spain	Spain/ES1_CadizBay/insitu/site_description/data/top-down-photo Spain/ES2_CadizBay/insitu/photographs/top-down-photo
United Kingdom	UK/site1/in_situ/photographs/TDQ UK/site2/in_situ/photographs/TDQ

5.5. Reflectance spectrum (not Romania)

Field reflectance measurements were made using a hyperspectral radiometer, so that reflectances can be converted to the wavelengths/band settings of the selected satellite images. Radiometer instruments recorded at least in the visible and NIR range (ca 400-1000 nm). The spectrometer measurements were taken at a standardised height (depending on the FOV of the sensor) above the canopy. TRIOS Ramses (FOV 7 degrees) was held at 2 m above the surface using an arm construction, measuring a ground diameter of 24.5 cm. This worked for all sites, except for high reed, where a higher sensor elevation was required and only few spectra could be obtained due to access restrictions. Solar reflected upwelling radiance from the vegetation or sediment was measured at nadir and, subsequently, upwelling radiance was measured at nadir from a reference white standard panel (either Spectralon or polysterene panel), under the same illumination conditions to enable conversion of radiance to surface reflectance in post-processing. For some sites, such as Cadiz Bay, a 20% standard was more appropriate. The reference panel was much bigger than the field of view held closer to the sensor if needed. The reference panel was kept level. Edge effects were kept minimal (e.g., no poles or grid marks measured); the field of view was well within the plot. The measurement position was changed to account for changes in solar azimuth angle; the operator standing perpendicular to the solar plane, but without casting any shadow on

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the plot. Measurements were aimed for clear sky conditions (direct sunlight) and at mid-day (between 10h and 15h) but this was not always possible; measurements in winter may be suboptimal due to low sun angles. Bright objects and bright clothes nearby were avoided. A minimum of three replicate measurements (spatial sub measurements) for each set of ground/reference was collected at each quadrat. For TRIOS Ramses, 5 measurements were done in a dice 5 structure to cover the plot. Note:

- Label of each measurement referring to plot number. The same label was used for ground/reference pairs, but consistently 's' for surface and a 'r' for reference readings was added in the label
- The height of the sensor was noted
- Date and time (including zone) was noted
- Weather and sky conditions (including cloud octants) were noted

Please see Appendix of the Field protocol (Deliverable 3.4) for further details. As spectroradiometers have different fields of view, the follow sensor heights were used:

- NIOZ TRIOS Ramses: 7 degrees FOV, sensor height 200 cm above the surface
- UCA: 22 degrees FOV: sensor height 64 cm above the surface
- UCAM: variable FOV, preferably with 8 degrees FOV sensor height 179 cm above the surface (or 26 degrees FOV with sensor height ca 54 cm above the surface), consistently.

In order to verify atmospheric conditions, semi-invariant targets were preferably measured during the field campaigns. These consisted of large areas in which features do not change over time, such as dry tarmac, dry sand etc.

The radiometers from the respective institutes were cross-calibrated and the effects of settings (e.g., sensor height depending on FOV) were evaluated at a spectrometry workshop at the Field Spectroscopy Facility in the UK in June 2015 (see Deliverable D4.2).

Reflectance spectra data are presented in a series of files per study site. These include files identified as "Eref", containing the reference spectra, those identified with "HCRF", containing the hemispherical-conical reflectance factors calculated based on the target spectrum and the associated reference and calibration data. Files identified as "Lsamp" contain the unprocessed target data. Each of these may be supplied with an associated metadata file containing instrument parameter information, geolocation data and so forth for each spectrum acquisition. The files available depend on the instrument that was used so are not all available in every location. The contents of the metadata files vary depending on instrument. Where the dataset contained erroneous "target" acquisitions taken from the reference panel, or other known problems occurred during acquisition, the dataset has been filtered to remove these records. Where filtered data are reported, the filename has the identifier "_filtered" appended. A further general "instrument metadata" file may be provided containing general information about the instrument being used not contained in the

The files provided are as follows:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/ground_based_spectrometry/FAST_NL_1_HCRF_2014-2015.csv theNetherlands/site2Zuidgors/insitu/ground_based_spectrometry/FAST_NL_2_HCRF_2015-2016.csv
Romania	Romania/Site1/in_situ/ground_based_spectrometry/FAST_RO_1_HCRF_2014-2015.csv
Spain	Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_Eref_2014-2015.csv Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_Eref-metadata_2014-2015.csv Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_HCRF_2014-2015.csv Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_HCRF-metadata_2014-2015.csv Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_Lsamp_2014-2015.csv Spain/ES1_CadizBay/insitu/ground_based_spectrometry/FAST_ES_1_Lsamp-metadata_2014-2015.csv FAST/Spain/ES1_CadizBay/insitu/ground_based_spectrometry/metadata_OceanOpticsUSB2000-USB2G14742.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_Eref_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_Eref-metadata_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_HCRF_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_HCRF-metadata_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_Lsamp_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/FAST_ES_2_Lsamp-metadata_2015-2016.csv Spain/ES2_CadizBay/insitu/ground_based_spectrometry/metadata_OceanOpticsUSB2000-USB2G14742.csv
United Kingdom	UK/site1/insitu/ground_based_spectrometry/FAST_UK_1_Eref_2014-2015.csv UK/site1/insitu/ground_based_spectrometry/FAST_UK_1_HCRF_2014-2015.csv UK/site1/insitu/ground_based_spectrometry/FAST_UK_1_HCRF-metadata_2014-2015.csv UK/site1/insitu/ground_based_spectrometry/FAST_UK_1_Lsamp_2014-2015.csv UK/site2/in_situ/ground_based_spectrometry/FAST_UK_2_Eref_2015-2016_filtered.csv UK/site2/in_situ/ground_based_spectrometry/FAST_UK_2_HCRF_2015-2016_filtered.csv UK/site2/in_situ/ground_based_spectrometry/FAST_UK_2_HCRF-metadata_2015-2016_filtered.csv UK/site2/in_situ/ground_based_spectrometry/FAST_UK_2_Lsamp_2015-2016_filtered.csv

5.6. Species richness and vegetation community

All individual species present in the quadrat are listed. The number of individuals from each species present as well as the total number of species present was recorded. A note of the broad vegetation community type may also be included in these observations.

Species richness is reported in files providing the per-quadrat, per species percentage ground cover. Species richness and community measures are L1 parameters and are therefore not calculated at L0. The files provided are:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_spp_cover_2014-2015.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_spp_richness.csv
Romania	Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_spp_cover_2014-2015.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_species_richness_2015-2016.csv
Spain	Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_spp_cover_2014-2015.csv Spain/ES2_CadizBay/insitu/vegetation_properties/FAST_ES_2_spp_cover_2015-2016.csv
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_spp_richness_2014-2015.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_spp_richness_2015-2016.csv

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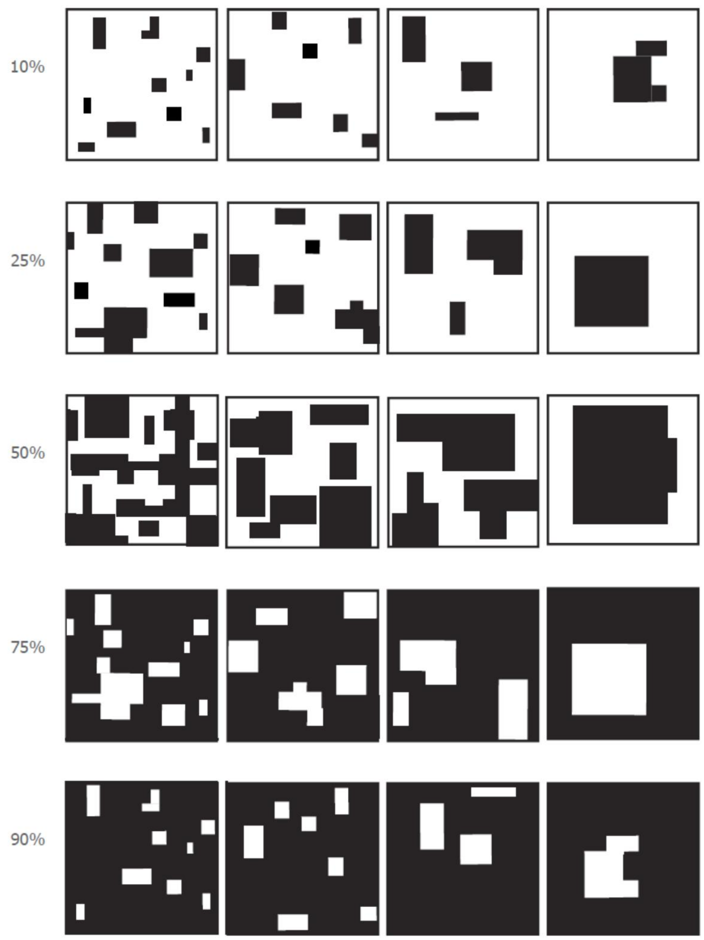
5.7. Vegetation cover

Total vegetation cover (all species together) of the plot was estimated as percentage (see chart below), based on visual assessment of each quadrat. The chart was used to guide the observer and a set of repeat readings should be done by different people to establish operator variance. Generally, the same person did the estimations over time for each site. Cross-calibration among partners was done at joined field surveys (e.g., prior to annual meetings), checked with photos. In the analysis phase, the data can be converted to classes (e.g., DOMIN scale). For each plot, an estimate of patchiness was also made for total density: homogeneous, intermediate or aggregated/clumped (see Figure 13)



.

Figure 13: Chart to aid with visual assessment of vegetation cover. Source: http://www.vvpcmn.org/2010/03/percentage-cover-guide-weed-cover/…Note that both percentage cover and patchiness are depicted (ranging from patchy to aggregated).

Vegetation cover is reported in the same spreadsheets as species richness (presence/cover) information. For each quadrat a value for "bare_ground" is provided as a percentage. Total

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vegetation cover is computed at L1 as 100 minus the percentage of bare_ground per quadrat. The files provided are therefore the same as above:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_spp_cover_2014-2015.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_spp_richness.csv
Romania	Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_spp_cover_2014-2015.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_species_richness_2015-2016.csv
Spain	Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_spp_cover_2014-2015.csv Spain/ES2_CadizBay/insitu/vegetation_properties/FAST_ES_2_spp_cover_2015-2016.csv
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_spp_richness_2014-2015.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_spp_richness_2015-2016.csv

5.8. Plant height, diameter and stem spacing

Stand height was measured at 10 randomly selected locations within each quadrat by the use of the disc method for biomass estimates (Sutherland (2008)) The height of the first contact with the vegetation canopy was recorded to give a 'plant height' reading. In Romania, the height of 10 stems was determined after harvesting for biomass.

For complex, shrubby canopies it was not possible or meaningful to measure stem spacing and diameter, however, in largely monospecific stands of, for example, reeds or Spartina these measures were taken. Stem spacing was measured by counting the number of stems in a sub-set of the quadrat (typically a 20cm x 20cm area in salt marsh vegetation and 50cm x 50cm in reeds). Stem diameter was measured for a representative sample of 20 individuals in salt marsh vegetation and 10 individuals in reed using Vernier callipers to measure stems at a fixed height of above the substrate surface.

Height, diameter and stem spacing are reported per quadrat in separate spreadsheets for each site. In some locations additional measurements of individual stem mass were recorded, these are also reported. The files provided are:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_stem_density_2014-2015.csv theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_stem_diameter_2014-2015.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_stem_density.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_stem_diameter.csv
Romania	Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_stem_density_2014-2015.csv Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_stem_diameter_2014-2015.csv Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_stem_height_2014-2015.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_stem_density_2015-2016.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_stem_diameter_2015-2016.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_stem_height_2015-2016.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_stem_mass_2015-2016.csv
Spain	Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_stem_density_2014-2015.csv Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_stem_diameter_2014-2015.csv Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_stem_height_2014-2015.csv Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_stem_mass_2014-2015.csv
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_stem_density_2014-2015.csv UK/site1/insitu/vegetation_properties/FAST_UK_1_stem_diameter_2014-2015.csv UK/site1/insitu/vegetation_properties/FAST_UK_1_stem_height_2014-2015.csv

	UK/site2/in_situ/vegetation_properties/FAST_UK_2_stem_density_2015-2016.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_stem_diameter_2015-2016.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_stem_height_2015-2016.csv

5.9. Disc height (for biomass) (not Romania)

A graduated pole with a polystrene disc lowered over it to contact the vegetation was used to measure stand height. A disc diameter of 20 cm and a weight of 20 grams was used (van der Graaf et al. 2002). The disc was 2cm thick. Measurements were taken at five positions in each plot (1m* 1m), in a dice five pattern. Two variables were recorded, the maximum vegetation height and the height at which the disc's weight is fully supported by the vegetation. These measurements were corrected for the thickness of the disk.

Disc height is reported per quadrat for each site, excluding those in Romania. The files are as follows:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_biomass_2014-2015.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_drop_disc.csv
Romania	Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_spp_cover_2014-2015.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_species_richness_2015-2016.csv
Spain	Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_drop_disc_2014-2015.csv Spain/ES2_CadizBay/insitu/vegetation_properties/FAST_ES_2_drop_disc_2015-2016.csv
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_drop_disc_2014-2015.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_drop_disc_2015-2016.csv

5.10. Projected area (photo method) (not Romania)

For each quadrat a side-on photograph was taken using the same model of camera at all sites through a 20cm by 60cm section of vegetation against a red background (see Figure 14). The photographs were subsequently classified and analysed to calculate projected area and structural parameters. The method required a photoframe (ensuring identical camera-vegetation-backboard geometries in all photgraphs at all locations) and a calibrated digital camera with discrete focal lengths. Due to the size of the vegetation, this method is not feasible in Romania. Efforts were made when taking photographs to avoid shadowing or glare effects from sunlight as these complicate the subsequent classification.

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Figure 14: Example of an acceptable photograph (left) and rectified, cropped and classified image ready for analysis (right); note the lack of shading and reflection from the back board. It is just possible to see points along the bottom of the red back board, although one at the right hand side would be ideal. It is acceptable to manually move vegetation away from the edges to provide this view as the sides of the back board should include a metre rule (not pictured) and are therefore cropped out of the image before analysis.

At L0, the raw photographs are delivered, identified by the string "PAP" within the filename, and are located in the following folders:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/photographs/allPictures theNetherlands/site2Zuidgors/insitu/photographs/projected_area
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/site_description/data/canopy-projected-photo Spain/ES2_CadizBay/insitu/photographs/canopy-projected-photo
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_drop_disc_2014-2015.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_drop_disc_2015-2016.csv

5.11. Surface Roughness (not Romania)

On the unvegetated foreshore, surface roughness was measured by placing a ca 1 m by 0.5 m gridded board (with a grid spacing of ca 5 cm marked in pencil), as provided by NIOZ, horizontally into the ground and photographing the side-view (ideally with the same camera as used for the projected-area and top-down photographs above, set to the highest possible resolution) (see Figure 15). Three photographs were taken per quadrat per campaign with orientation and location being randomly selected. The board was inserted into the sediment so that the entire bottom edge was submerged, and the board was both level and vertical. Again, care was taken to avoid glare and shading effects that might complicate subsequent classification. In the next processing level, the photographs are to be scaled based on the grid marks, and information on the microtopographical profile will be extracted.

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Figure 15: Example of a photograph with a properly clean (and thus white) roughness board.

Roughness board photos are delivered at L0, and identified by the string "RBP" within the filename. They are located in the following folders:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/photographs/Roughness_board theNetherlands/site2Zuidgors/insitu/photographs/roughness_board
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/site_description/data/surface_roughness_photo Spain/ES2_CadizBay/insitu/photographs/surface_roughness_photo
United Kingdom	UK/site1/insitu/photographs/Roughness_board UK/site2/in_situ/photographs/RBP

5.12. Grain size, total organic matter and bulk density samples

Plastic syringes marked at 20cc (3cm depth) were used to collect three replicates of sediment samples at each quadrat site on the unvegetated foreshore and at quadrats associated with the SD sensors (see Figure 16). Three random samples were taken per quadrat and pooled. Samples were taken by pushing the syringe gently into the sediment, while simultaneously pulling the plunger, so that the sediment did not get compacted.

In the laboratory, Bulk density was determined by weighing the samples before and after drying.

Particle size was determined for the NL, ES and UK sites using a Malvern Laser Particle Sizer in the University of Cambridge, Department of Geography laboratories and the protocol described at https://repos.deltares.nl/repos/FAST/Documents/UCAM_Lab_Protocols/University of Cambridge LPSA protocol.docx. Romanian samples were analysed for particle size within GeoEcomar.

Similarly, NL, ES and UK samples were analysed in the Cambridge laboratory using the protocol detailed at https://repos.deltares.nl/repos/FAST/Documents/UCAM_Lab_Protocols/University of Cambridge LOI protocol.docx, by loss on ignition to determine total organic content (TOC), among other measures. Romanian samples were analysed for TOC by GeoEcomar.

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NB: Bulk density was determined differently at the Romanian sites and was collected during mid-summer only, due to under-water sampling: a core was extracted and then sub-sampled for a known volume to get bulk density.

Figure 16: Sediment sampling with the big syringe, sides of the plunger should be level with top of the red tape to sample the right volume, as shown here.

Particle size data are reported in one sheet per site detailing the percentage content by size fraction. Total organic content and bulk density are both reported in a second sheet per site. The method of analysis necessarily differed between Romania and the other three countries. Details of the method employed in Romania are documented at:

Romania/Site1/in_situ/sediment_properties/Bulk density_method.doc

and

Romania/Site1/in_situ/sediment_properties/Grain_size_method.doc.

The data files are located in the following directories:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/sediment_properties/FAST_NL_1_LOI_BD_2014-2015.xlsx theNetherlands/Site1Paulina/insitu/sediment_properties/FAST_NL_1_LPSA_2014-2015.xlsx theNetherlands/site2Zuidgors/insitu/sediment_properties/FAST_NL_2_LOI_BD.xlsx theNetherlands/site2Zuidgors/insitu/sediment_properties/FAST_NL_2_LPSA.xlsx
Romania	Romania/Site1/in_situ/sediment_properties/FAST_RO_1_BD_2014-2015.csv Romania/Site1/in_situ/sediment_properties/FAST_RO_1_PSA_2014-2015.csv *Year 2 data to be reformatted in due course and added at:* *Romania/Site1/in_situ/sediment_properties/FAST_RO_2_BD_2015-2016.csv* *Romania/Site1/in_situ/sediment_properties/FAST_RO_2_PSA_2015-2016.csv*
Spain	Spain/ES1_CadizBay/insitu/sediment_properties/FAST_ES_1_LOI_BD_2014-2015.xlsx Spain/ES1_CadizBay/insitu/sediment_properties/FAST_ES_1_LPSA_2014-2015.xlsx Spain/ES2_CadizBay/insitu/sediment_properties/FAST_ES_2_LOI_BD_2015-2016.xlsx Spain/ES2_CadizBay/insitu/sediment_properties/FAST_ES_2_LPSA_2015-2016.xlsx
United Kingdom	UK/site1/insitu/sediment_properties/bulk_density/FAST_UK_1_LPSA_2014-2015.xlsx UK/site1/insitu/sediment_properties/bulk_density/FAST_UK_1_LOI_BD_2014-2015.xlsx UK/site2/insitu/sediment_properties/FAST_UK_2_LPSA.xlsx UK/site2/in_situ/sediment_properties/FAST_UK_2_LOI_BD.xlsx

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5.13. Sediment sample for Chl-a (not Romania)

Six chlorophyll-a samples per quadrat were collected of the upper 1 cm, using a small syringe. These 6 samples per plot were pooled. Samples are taken at the SD sensors and at the foreshore plots. Chlorophyll-a samples were kept cool and dark until returned to the laboratory of the respective countries where they were deep frozen (preferably at -80 degrees), and then shipped to the NIOZ laboratory, where they were stored at -80 degrees. They were freeze-dried (at -20 deg C), in the dark and returned to the -80 deg C freezer for storage prior to further analysis in the NIOZ laboratory. Samples were homogeneized and weighed, pigments were extracted using 90% aceton, and chlorophyll was determined using spectrophotometric methods. Sediment samples were not collected for Chl-a in Romania.

Data files are in the following locations:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/sediment_properties/FAST_NL_1_Chla_L0.xlsx theNetherlands/site2Zuidgors/insitu/sediment_properties/FAST_NL_2_Chla_L0.xlsx
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/sediment_properties/FAST_SP_1_Chla_L0.xlsx Spain/ES2_CadizBay/insitu/sediment_properties/FAST_SP_2_Chla_L0.xlsx
United Kingdom	UK/site1/insitu/sediment_properties/chla/FAST_UK_1_Chla_L0.xlsx UK/site2/in_situ/sediment_properties/FAST_UK_2_Chla_L0.xlsx

5.14. Water samples for suspended sediment and Chl-a (Romania only)

Between 10 and 20 water samples were taken in the Romanian site per campaign. The samples were handled following the standard GeoEcoMar method.

Data are reported for Chl-a, suspended sediment and organic content in separate spreadsheets in the following locations:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	NA
Romania	Romania/Site1/in_situ/water_properties/FAST_RO_1_chla_2014-2015.csv Romania/Site1/in_situ/water_properties/FAST_RO_1_SS_2014-2015.csv Romania/Site1/in_situ/water_properties/FAST_RO_1_TOC_2014-2015.csv Romania/Site2/in_situ/water_properties/FAST_RO_2_chla_2015-2016.csv Romania/Site2/in_situ/water_properties/FAST_RO_2_SS_2015-2016.csv Romania/Site2/in_situ/water_properties/FAST_RO_2_TOC_2015-2016.csv
Spain	NA
United Kingdom	NA

5.15. Secchi disk readings (Romania only)

At each sampling site, a Secchi disk was used to measure the light attenuation in the water at the time of water sampling. The method works if total water depth is much greater than the Secchi disk

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depth. The Secchi disk used was a white metal disk of 30 cm diameter (marine waters style) with a measuring tape attached. Readings were taken from the shaded side of the boat. The disk was lowered in the water and the depth at which it disappeared recorded. Secchi disk readings were taken between late morning to early afternoon (sun overhead).

Data files are in the following location:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	NA
Romania	https://repos.deltares.nl/repos/FAST/Romania/Site1/in_situ/water_properties/FAST_RO_1_Secchi_depth_2014-2015.csv https://repos.deltares.nl/repos/FAST/Romania/Site2/in_situ/water_properties/FAST_RO_2_Secchi_depth_2015-2016.csv *Year 2 Secchi disk data requires reformatting – to be added in due course to same directory*
Spain	NA
United Kingdom	NA

5.16. Shear vane (not Romania)

A shear vane was provided by NIOZ for each country. The head of the instrument was pushed into the sediment, so that the ribs on the surface of the head were fully in the sediment (i.e., the flat surface of the head touched the top of the sediment). The shear vane was then turned until the head of the instrument started to turn. The indicator arrow indicated an integrative value of the strength / erodability of the sediment. Three shear vane measurements were taken at each unvegetated quadrat, and the vegetated quadrats associated with SD sensors. The raw readings can be converted to measurements of the shear strength of the sediment, taking account of the head used, by application of the calibrations determined at NIOZ.

Shear vane readings are reported as raw readings from the instrument at L0 in individual files per site. Their locations are as follows:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/sediment_properties/FAST_NL_1_shear_vane.csv theNetherlands/site2Zuidgors/insitu/sediment_properties/FAST_NL_2_shear_vane.csv
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/sediment_properties/FAST_ES_1_shear_vane_2014-2015.csv Spain/ES2_CadizBay/insitu/sediment_properties/FAST_ES_2_shear_vane_2015-2016.csv
United Kingdom	UK/site1/insitu/sediment_properties/strength/FAST_UK_1_shear_vane_2014-2015.xlsx UK/site2/in_situ/sediment_properties/FAST_UK_2_shear_vane_2015-2016.csv

5.17. Erosion pins (not Romania)

The erosion pin is a very thin metal rod with a height marker on top, and a ring around the pin. The pin was pushed into the sediment until the marker was at a fixed height above the sediment (i.e., 100 mm), and with a metal ring placed around the pin on top of the soil surface (T0 of a

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measurement). Pins The height of the marker was chosen in such way that it was close to the sediment but was never buried by the sediment between deployment and harvesting.

Every two months (bi-monthly), the erosion pins were harvested (T1 measurement), (1) by measuring the distance from the marker to the soil surface, and (2) by measuring the distance from the marker to the ring buried into the sediment. After measurement, pins were redeployed in undisturbed locations nearby. Three pins were deployed per SD-sensor location. When harvesting pins, a note was made of any phenomena that might have influenced the reading (i.e. scour, biofouling, detritus).

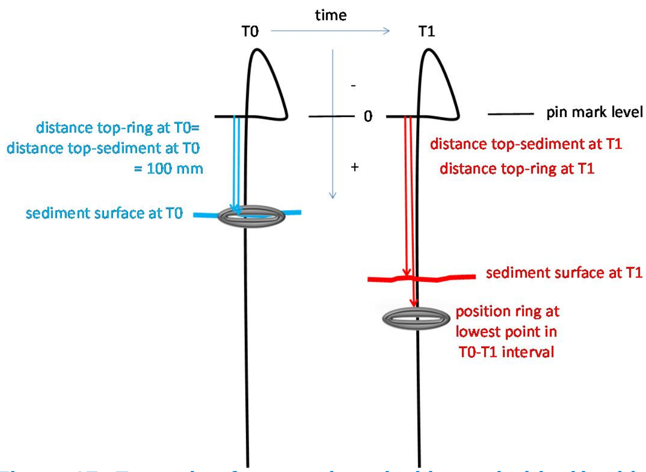

Figure 17: Example of an erosion pin (drawn in black) with readings at T0 and T1. Both distance top-ring and distance top-sediment are measured at each date. Note the sign of the distance measurement (positive towards ring). From the differences at T0 and T1, maximal erosion and net deposition/erosion is calculated.

Erosion pin data are presented as raw measurements between the reference point on the pin and the substrate surface or that of the marker ring. They are reported in individual files per site.

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/sediment_dynamics/FAST_NL_1_erosion_pin.csv theNetherlands/site2Zuidgors/insitu/sediment_dynamics/FAST_NL_2_erosion_pin.csv
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/sediment_dynamics/FAST_ES_1_erosion_pin_2014-2015.csv Spain/ES2_CadizBay/insitu/sediment_dynamics/FAST_ES_2_erosion_pin_2015-2016.csv
United Kingdom	UK/site1/insitu/sediment_dynamics/erosion_pins/FAST_UK_1_erosion_pin_2014-2015.xlsx UK/site2/in_situ/sediment_dynamics/FAST_UK_2_erosion_pin_2015-2016.csv

5.18. Plant biomass

Before removing the photoframe, the vegetation in the aperture was harvested. This was done by cutting with scissors/knife at ground level and carefully collecting, bagging and labelling all samples. If the photographic method had not been employed, vegetation from the equivalent area of the quadrat (i.e. 20cm x 60 cm) was sampled. Samples were subsequently returned to the laboratory, weighed and dried to constant mass at 65 degrees C (this usually takes 48 hours), before being re-

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weighed. This destructive sampling was the last method used at each quadrat to which it applied. In Romania, a sub-sample of 10 stems was harvested from the quadrat instead of using the photo frame area for harvesting

Plant biomass is reported in one file per site:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/vegetation_properties/FAST_NL_1_biomass_2014-2015.csv theNetherlands/site2Zuidgors/insitu/vegetation_properties/FAST_NL_2_biomass.csv
Romania	Romania/Site1/in_situ/vegetation_properties/FAST_RO_1_stem_mass_2014-2015.csv Romania/Site2/in_situ/vegetation_properties/FAST_RO_2_biomass_2015-2016.csv
Spain	Spain/ES1_CadizBay/insitu/vegetation_properties/FAST_ES_1_biomass_2014-2015.csv Spain/ES2_CadizBay/insitu/vegetation_properties/FAST_ES_2_biomass_2015-2016.csv
United Kingdom	UK/site1/insitu/vegetation_properties/FAST_UK_1_biomass_2014-2015.csv UK/site2/in_situ/vegetation_properties/FAST_UK_2_biomass_2015-2016.csv

5.19. SET readings (not Romania)

Surface elevation change was recorded at the three SET stations per site at the start and end of Year 1 (site 1) and Year 2 (site 1 and 2). Readings in Spain and the UK were taken with the rod-SET of UCam. Readings in the NL were taken either using the UCAM equipment or, for the Y1 SET that was previously installed, using the equipment previously used to monitor that location.

For each site, the readings from the SET instrument ("pins") and the depths of the marker horizons ("cores") are reported independently.

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/sediment_dynamics/FAST_NL_1_set_cores.csv theNetherlands/Site1Paulina/insitu/sediment_dynamics/FAST_NL_1_set_pins.csv
Romania	NA
Spain	Spain/ES1_CadizBay/insitu/sediment_dynamics/FAST_ES_1_set_pins_2014-2015.csv Spain/ES1_CadizBay/insitu/sediment_dynamics/FAST_ES_1_set_cores_2014-2015.csv Spain/ES2_CadizBay/insitu/sediment_dynamics/FAST_ES_2_set_pins_2015-2016.csv Spain/ES2_CadizBay/insitu/sediment_dynamics/FAST_ES_2_set_cores_2015-2016.csv
United Kingdom	UK/site1/insitu/sediment_dynamics/rod_set/FAST_UK_1_set_pins_2014-2015.csv UK/site1/insitu/sediment_dynamics/rod_set/FAST_UK_1_set_cores_2014-2015.csv UK/site2/in_situ/sediment_dynamics/FAST_UK_2_set_cores_2015-2016.xlsx UK/site2/in_situ/sediment_dynamics/FAST_UK_2_set_pins_2015-2016.xlsx

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6. Waves and water depth

Water level fluctuations were recorded using high frequency (4 Hz) dynamic water pressure measurements to resolve even small (2 Hz frequency) waves through the use of bed-mounted pressure sensors (see left of Figure 18). To allow for meteorologically induced variations in tidal high water level timing, the high-frequency wave recording was inundation-triggered and controlled by a data logging system (see Figure 18). For this purpose, water level averages were recorded at 5 minute intervals and, when the water level difference between successive water levels was less than a given threshold (indicating that levels are no longer rising), a high frequency wave record of 17 minute length was triggered. For each inundation event all five sensors recorded simultaneously. The Romanian field sites (Jurilovca (Razelm) and Histria (Sinoe)) experienced continuous inundation, albeit with varying water levels, such that data acquisition at these sites varied from that at the UK, NL, and Spanish sites in that wave records were triggered every 8 hours (three times per day).Further at the Dutch sites, additional information on wave exposure of the foreshore to waves during the full tidal cycle was thought to be potentially important for tidal flat stability. To yield data on this exposure level, wave records were obtained for the full tidal cycle (i.e. high frequency pressure was recorded at the outermost sensor over a series of successive 17 minute-long intervals during inundation, ensuring that one 17-minute long wave record was obtained at high water as at all other sites, together with all sensors along the transect). Data was stored on data loggers and downloaded regularly by a mobile phone telemetry system (see antenna on top of the data logging station in Figure 18), with the exception of Spain, Cádiz Bay, where manual downloads were sufficient due to easy access and due to the manual deployment/recovery of the wave sensors before/after each deployment at the year 1 site. Pressure records acquired in this way were processed into wave spectra and summary wave statistics (L1) by the University of Cambridge, using tried and tested programming routines (Möller et al. 1996).

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Figure 18: (left) Bed-mounted pressure sensor (see arrow) with buried cable connection to (right) telemetered data logging system at the Year 2 site in Cadiz Bay, ES.

Records are stored in the format produced by the dataloggers (documented in Deliverable D4.6). Separate files are provided containing the event-based record from which wave parameters are derived ("Burst4Hz"), an open-air offset check file ("ExposedCheck"), a file recording the reading at PT1 every five minutes ("test5min"), a file with five-minute average readings for PT1 when submerged ("AvgLvl") and a battery voltage record ("BattV_6h"). For Romania, where the installation was non-tidal, only the "Burst4Hz" and "BattV_6h" files were recorded as the principal purpose of the other data are to identify the timing of high tide to trigger a recording event. Sensor-specific calibration files are also provided for each site:

Country	Filepaths (https://repos.deltares.nl/repos/FAST/...)
Netherlands	theNetherlands/Site1Paulina/insitu/pressure_sensors/rawdata_complete_year1/CR1000_Netherlands_Remote_AvgLvl.dat theNetherlands/Site1Paulina/insitu/pressure_sensors/rawdata_complete_year1/CR1000_Netherlands_Remote_BattV_6h.dat theNetherlands/Site1Paulina/insitu/pressure_sensors/rawdata_complete_year1/CR1000_Netherlands_Remote_Burst4Hz.dat theNetherlands/Site1Paulina/insitu/pressure_sensors/rawdata_complete_year1/CR1000_Netherlands_Remote_ExposedCheck.dat theNetherlands/Site1Paulina/insitu/pressure_sensors/rawdata_complete_year1/CR1000_Netherlands_Remote_test5min.dat theNetherlands/Site1Paulina/insitu/pressure_sensors/NL_Paulina_calibdata.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/CR1000_NL_Z_Remote_AvgLvl.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/CR1000_NL_Z_Remote_BattV_6h.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/CR1000_NL_Z_Remote_Burst4Hz.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/CR1000_NL_Z_Remote_ExposedCheck.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/CR1000_NL_Z_Remote_test5min.dat theNetherlands/site2Zuidgors/insitu/pressure_sensors/NL_Zuidgors_calibdata.txt
Romania	Romania/Site1/in_situ/pressure_sensors/rawdata_complete_year1/CR1000_RO_CD_Remote_BattV_6h.dat Romania/Site1/in_situ/pressure_sensors/rawdata_complete_year1/CR1000_RO_CD_Remote_Burst4Hz.dat Romania/Site1/in_situ/pressure_sensors/RO_CD_Calibdata.txt Romania/Site2/in_situ/pressure_sensors/rawdata/CR1000_RO_HS_Remote_BattV_6h.dat Romania/Site2/in_situ/pressure_sensors/rawdata/CR1000_RO_HS_Remote_Burst4Hz.dat Romania/Site2/in_situ/pressure_sensors/rawdata/RO_HS_Calibdata.txt
Spain	Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/CR1000_AvgLvl.dat Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/CR1000_BattV_6h.dat Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/CR1000_Burst4Hz.dat Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/CR1000_ExposedCheck.dat Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/CR1000_test5min.dat Spain/ES1_CadizBay/insitu/hydrodynamics/data/pressure_sensors/ES_CB_Calibdata.txt Spain/ES2_CadizBay/insitu/hydrodynamics/raw/CR1000_ES_Y2_Remote_AvgLvl.dat

	Spain/ES2_CadizBay/insitu/hydrodynamics/raw/CR1000_ES_Y2_Remote_BattV_6h.dat Spain/ES2_CadizBay/insitu/hydrodynamics/raw/CR1000_ES_Y2_Remote_Burst4Hz.dat Spain/ES2_CadizBay/insitu/hydrodynamics/raw/CR1000_ES_Y2_Remote_ExposedCheck.dat Spain/ES2_CadizBay/insitu/hydrodynamics/raw/CR1000_ES_Y2_Remote_test5min.dat Spain/ES2_CadizBay/insitu/hydrodynamics/raw/ES_Y2_Calibdata.txt
United Kingdom	UK/site1/insitu/pressure_sensors/rawdata/rawdata_complete_year1/CR1000_UK_DN_Remote_AvgLvl.dat UK/site1/insitu/pressure_sensors/rawdata/rawdata_complete_year1/CR1000_UK_DN_Remote_BattV_6h.dat UK/site1/insitu/pressure_sensors/rawdata/rawdata_complete_year1/CR1000_UK_DN_Remote_Burst4Hz.dat UK/site1/insitu/pressure_sensors/rawdata/rawdata_complete_year1/CR1000_UK_DN_Remote_ExposedCheck.dat UK/site1/insitu/pressure_sensors/rawdata/rawdata_complete_year1/CR1000_UK_DN_Remote_test5min.dat UK/site1/insitu/pressure_sensors/calibration_dat/UK_DN_Calibdata.txt UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_AvgLvl.dat UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_BattV_6h.dat UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_Burst4Hz.dat UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_ExposedCheck.dat UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_LTburst1.dat UK/site2/in_situ/hydrodynamics/CR1000_UK_TF_Remote_test5min.dat UK/site2/in_situ/hydrodynamics/TF_calibdata.txt

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7. Known deviations from the stated protocol

It was not always possible to follow the field protocol exactly. Any deviations are noted in the tables below. One table is provided per country, containing detail on deviations from the field protocol for both sites within that country.

7.1. Deviations - Netherlands

Method No	Parameter – in measurement order	Deviations from protocol
1*	dGPS survey (incl. transect & all quadrats)	None
2*	Repeat photo of site	Pictures taken at plot positions, in every wind direction. Pictures only to be used as promotion material, not likely usefull data.
3*	Wave array mainten	None
4*	Download/clean SD sensors (**not RO**)	No full time coverage due to technical problems and battery issues. Deployment timestamps are in sd datafiles, times recorded as Amsterdam summer time rather than GMT. Files have been renamed, to match dgps codes, original files also available on server.
5	Verify quad position	Y1: Destructive plots set up to be representative of the entire area rather than only the transect to support remote sensing. Hence destructive plots cannot be assumed to all be similar (check vegetation cover before use). 4 measurements missing in January, measurement locations similar between October and January (see dgps measurements). Y2: no deviations
6	Top-down photo	Weather conditions not recorded - to be taken from local meta data. Algal cover not recorded.

7	Reflectance Spec	Measurements from 2m height, to approach 20cm diameter, as discussed at calibration meeting (see calibration meeting report).
		Y2: due to a malfunction of the measurement device some measurements are recorded with a wrong date. All measurements in 2016-05 have an offset:
		`(2016, 05, 27, 09, 51, 30) (YYYY, MM, dd, mm, HH, ss)`
		`Was recorded as:`
		`(2000, 01, 13, 05, 31, 30) (YYYY, MM, dd, mm, HH, ss)`
		This was corrected in the L1 dataset, but not in the raw L0 data.

8	Species richness	Percentage cover recorded instead of individual numbers
9	Vegetation cover	Combined with species richness
10	Plant H, d, spacing	Height: not regularly recorded with ruler, only with drop disk. Diameter: dominant species (with the highest cover) in plot measured, unless noted otherwise in notes. On two occasions only 19 stems measured. Spacing: Some plots skipped due dead-organic matter (removing it destroyed the fragile vegetation), listed in notes.

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11	Disc height (for biomass) (**not RO**)	Drop from canopy +1m not carried out. 5 replicates for every plot.
12	Projected Area Photo (**not RO**)	None
13	Surface roughness (**not RO**)	Surface roughness at sd positions incomplete. FF plots are complete.
14	Particle size (ALL), total organic matter (ALL), bulk density	When establishing water content no correction was carried out for the weight of sampling tubes in the L0 data. Their average weights (in gram, n=10) are: Tube: 6.26916 ±0.033342 Cap: 3.57947 ±0.014329 Each sample consisted of material in two tubes+caps hence the soil weight can by calculated by substracting 19.69726 from either wet or dry weight. (note: this does not affect the calculated water content itself, as this affects both dry and wet weight equally).
15	Sediment samples for Chl-a **(not RO)**	None
16*	Water Chl-a (**RO only**)	OK. Two samples from year 2 missing; all seasons analysed.
17*	Secci (**RO only**)	N/A
18	Shear vane (**not RO**)	Not possible in vegetated plots, roots produced huge variation in measurements.
19	Erosion pin (**not RO**)	None
20	Plant Biomass Harvest	Y1: representative area outside of plot used to preserve plot for future measurements. Y2: no deviations Note: species separated in biomass measurements, use total for analyses.
21*	SET readings	Initial measurements Y1 late hence Y1 data only covers a few months, was re-measured at the end of Y2. Y2 deployment of 2/3 on schedule, 1 late due to material setback (for SET1 deployment, feldspar and initial measurement was late). Final measurement postponed as much as possible, but Y2 data covers less than a year.

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7.2. Deviations - Romania

Method No	Parameter – in measurement order	Deviations from protocol
1*	dGPS survey (incl. transect & all quadrats)	No sampling in winter (December to March)
2*	Repeat photo of site	No sampling in winter (December to March)
3*	Wave array mainten	No sampling in winter (December to March)
4*	Download/clean SD sensors (**not RO**)	Instruments installed on alternative sites (test)
5	Verify quad position	No sampling in winter (December to March)
6	Top-down photo	Not possible, only repeated side photos of the site
7	Reflectance Spec	
8	Species richness	No sampling in winter (December to March). Monospecific site
9	Vegetation cover	No sampling in winter (December to March). Monospecific site
10	Plant H, d, spacing	No sampling in winter (December to March). Only 10 replicates per quadrat, monospecific site
11	Disc height (for biomass) (**not RO**)	NA
12	Projected Area Photo (**not RO**)	NA
13	Surface roughness (**not RO**)	NA
14	Particle size (ALL), total organic matter (ALL), bulk density	No sampling in winter https://repos.deltares.nl/repos/FAST/Romania/Site1/in_situ/sediment_properties/Bulk density_method.doc https://repos.deltares.nl/repos/FAST/Romania/Site1/in_situ/sediment_properties/Grain_size_method.doc
15	Sediment samples for Chl-a **(not RO)**	NA
16 *	Water Chl-a (**RO only**)	No sampling in winter (December to March) https://repos.deltares.nl/repos/FAST/Romania/Site1/in_situ/water_properties/Method/Water parameters_method.doc
17 *	Secci (**RO only**)	No sampling in winter (December to March) https://repos.deltares.nl/repos/FAST/Romania/Site1/in_situ/water_properties/Method/Water parameters_method.doc
18	Shear vane (**not RO**)	
19	Erosion pin (**not RO**)	NA
20	Plant Biomass Harvest	No sampling in winter (December to March). Only 10 stems harvested by quadrat, monospecific site
21 *	SET readings	NA

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7.3. Deviations - Spain

Method No	Parameter – in measurement order	Deviations from protocol
1*	dGPS survey (incl. transect & all quadrats)	The very difficult working conditions on the tidal flats in Cadiz Bay (very deep fluid mud) combined with intermitent equipment failures meant cross-shore transects were poorly covered. We collected more elevations on higher marsh areas and conducted a UAV flight at ES_2 (data in process).
2*	Repeat photo of site	We collected panoramic photos from approx. same position regularily through year, direction was not recorded.
3*	Wave array mainten	Maintenance was carried about 3 times per year.
4*	Download/clean SD sensors (**not RO**)	This was poorly implemented. We had regular problems downloading the data, a clear record of cleaning, movement was not kept. sensors completely failed at ES_2.
5	Verify quad position	Only new positions were collected, previous positions were not repeated.
6	Top-down photo	OK. Sometimes different cameras were used. 6 photos presently missing (VND - Spring)
7	Reflectance Spec	OK. No recording of metadata (csky conditions ect.), however maybe able to use associated photos.
8	Species richness	OK, although very rare species probably negelected.
9	Vegetation cover	OK. Recorded estimates per major spp.
10	Plant H, d, spacing	Height of canopy, was collected by eye and later using disc_drop method. No d or spacing for shrubby species (ES_2)
11	Disc height (for biomass) (**not RO**)	Collected more info than needed in year 1 and reduced this in year 2. Method was an enormous hassle, especially when windy.
12	Projected Area Photo (**not RO**)	OK. In hindsight orientation and shadow removal from images could be improved. 6 photos presently missing (VND - Spring)
13	Surface roughness (**not RO**)	We did our best in the difficult muddy conditions… Some images of the roughness board taken at lower resolution.
14	Particle size (ALL), total organic matter (ALL), bulk density	OK. We also collected an intensive dataset for a student project at ES_1; data to be added.
15	Sediment samples for Chl-a **(not RO)**	OK (summer/winter)
16*	Water Chl-a (**RO only**)	
17*	Secci (**RO only**)	
18	Shear vane (**not RO**)	OK
19	Erosion pin (**not RO**)	This method began to fail at ES_2 and was abondoned; the pins vibrated creating a visible hole in the highly cohesive sediment of the foreshore plots.
20	Plant Biomass Harvest	OK. We also took individual 'shoot'/'branch' FW, DW and surface area. Plants scans and -shoot-specific biomass in process.
21*	SET readings	OK. revisiting the sites revealed some deviations in terms of the standard orientation (i.e., N, E, ect) these are noted. Limited sucsee finding marker horizons; highly active region (fiddler crabs, humans).

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7.4. Deviatons - United Kingdom

Method No	Parameter – in measurement order	Deviations from protocol
1*	dGPS survey (incl. transect & all quadrats)	None
2*	Repeat photo of site	Not taken at every visit, camera location not always recorded - incomplete dataset
3*	Wave array mainten	None - except 6-month revisit time in 2016 for UK site 1, year 2. No problematic fouling found.
4*	Download/clean SD sensors (**not RO**)	None. SD sensors downloaded in situ, except May and July 2016, UK site 2 where they were downloaded in the lab and redeployed.
5	Verify quad position	None
6	Top-down photo	Weather conditions not recorded - to be taken from local met data. Algal cover to be determined from photographs, sediment type from LPSA
7	Reflectance Spec	Semi-invariant features not regularly recorded
8	Species richness	Percentage cover recorded instead of individual numbers
9	Vegetation cover	None
10	Plant H, d, spacing	H for all quadrats, d and spacing only for Spartina where present in quadrat
11	Disc height (for biomass) (**not RO**)	Drop from canopy+1m not carried out
12	Projected Area Photo (**not RO**)	None
13	Surface roughness (**not RO**)	Only carried out at UK site 2 for quadrats beyond deep ridge-runnel transition as scale of features greater than height of board - 5 foreshore quadrats instead of 10.
14	Particle size (ALL), total organic matter (ALL), bulk density	No BD for UK site 2 - lab error
15	Sediment samples for Chl-a **(not RO)**	One sample known to be missing; all seasons analysed
16*	Water Chl-a (**RO only**)	N/A
17*	Secci (**RO only**)	N/A
18	Shear vane (**not RO**)	UK site 1, some readings exceed 10 so may need further calibration to determine shear strength.
19	Erosion pin (**not RO**)	Some deleterious fouling and scour around pins and loss of some washers means that UK site 2 data is only ca. 90% complete
20	Plant Biomass Harvest	Wet mass not recorded for early UK site 1 samples and two later Site 2 samples
21*	SET readings	Complete, except in cases where marker horizons not able to be found by coring in six attempts (principally UK site 1 SET 1)

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8. Summary of data delivered at Level-0

The tables below are updated versions from previous deliverables, now reflecting the extent of the entire, finalised dataset being delivered here.

8.1. Update from data delivered in D4.10

Topographic / Elevation Measurement	UK – year 1 site		NL – year 1 site		Spain – year 1 site		Romania – year 1 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Repeat photo of whole site	20/10/2014 17/11/2014 12/01/2015 15/03/2015 13/07/2015 12/10/2015	1 1 1 1 1 1	15/10/2014 27/01/2015 20/03/2015	6 11 11	08/05/15 19/05/15 02/07/15 16/07/15	1 1 1 1	29/08/2014 30/09/2014 22/11/2014 13/05/2015 20/07/2015	1 1 1 1 1
dGPS position / elevation of quadrats	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	25 10 10 10 10 10 10	07/04/2014 24/10/2014 9/12/2014 14-08-15	5 44 6 5	10/08/14 25/11/14 15/02/15 09/04/15 20/07/15	11 18 17 12 12	29/08/2014 29/09/2014 22/11/2014 20/07/2015	35 46 13 25
Top-down photo	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	25 25 25 25 25 25 25	23/09/2014 24/09/2014 27/01/2015 08/05/2015 21/05/2015 09/08/2015	6 18* 11 8 7 10			Repeated photo of the whole site only on the shore side, due to health and safety restrictions	
Cross-shore topographic profiles	28/08/2014 12/05/2015 13/07/2015	1 1 1	07/04/2014 14-08-15	1 1	29/10/14 25/11/14	225 436	29/08/2014	1
Surface Roughness Photo* (not RO)	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	10 10 10 10 10 10 10	17/10/2014 29/01/2015 26/05/2015	18 18 18	05/02/15 20/04/15 16/07/15	8 7 6	Not available	
SD sensor first deployed	12/01/2015	6	08/04/2014 09/12/2014 06/03/2015	4 7 7	05/02/15	6	Not available	
(*please note: For the NL,: N = 18 means 6 stations with 3 reps each, for the UK, N = 10 means 10 stations)								

Topographic / Elevation Measurement	UK – year 1 site		NL – year 1 site		Spain – year 1 site		Romania – year 1 site	
	Dates	N	Dates	N	Dates	N	Dates	N
SD sensor downloads	15/03/2015 12/05/2015 14/07/2015	6 6 6	01/08/2014 27/01/2015 05/03/2015 15/03/2015 07/05/2015 26/05/2015 09/06/2015 25/07/2015	4 1 6 7 7 7 7 7	01/04/15 19/05/15 16/07/15	6 6 6	Not available	
Erosion pin first deployed	13/01/2015	8	09/12/2014	21	22/01/15 05/02/15	6 12	Not available	
Subsequent erosion pin readings/re-deployment	15/03/2015 12/05/2015 13/07/2015 12/10/2015	8 8 8 8	30/01/2015 20/03/2015 21/05/2015 30/07/2015	21 21 21 21	07/04/15 20/04/15 19/05/15 20/05/15 21/05/15 16/07/15 20/07/15	12 6 6 6 6 6 12	Not available	
Accretion horizon first deployed	28/08/2014	12	08/04/2014	2	08/10/14 09/10/14 29/10/14	1 1 1	Not available	
Subsequent accretion readings	17/11/2014 07/03/2015 14/07/2015	12 12 12	10/04/2015 01/09/2015 21/10/2016	12 12 12	17/09/15	3	Not available	
SET first deployed	28/08/2014	3	08/04/2014	2	08/10/14 09/10/14 29/10/14	1 1 1	Not available	
Subsequent SET reading dates	17/11/2014 07/03/2015 14/07/2015	3 3 3	05/03/2015 10/04/2015 01/09/2015 21/10/2016	1 2 2 3	17/09/15	3	Not available	

Topographic / Elevation Measurement	UK – year 2 site		NL – year 2 site		Spain – year 2 site		Romania – year 2 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Repeat photo of whole site	21/10/2015 18/12/2015 18/01/2016 11/05/2016	1 1 1 1	28/09/2015 23/11/2015 18/01/2016 17/05/2016	15 15 15 15	28/10/15 26/11/15 27/11/15 25/02/16 07/04/16 22/04/16 23/05/16	1 1 1 1 1 1	23/07/2015 19/11/2015 10/03/2016 13/05/2016	1 1 1 1
dGPS position / elevation of quadrats	02/03/2016 11/05/2016 12/05/2016 13/05/2016 11/07/2016	69 10 14 6 10	02/09/2015 21/01/2016 17/05/2016	18 10 10	26/01/16	30	22/07/2015 17/02/2016 10/03/2016 13/05/2016 01/07/2016	43 2 1 34 45
Top-down photo	21/10/2015 18/12/2015 18/01/2016 02/03/2016 26/05/2016 11/07/2016	25 25 25 25 35 25	20/10/2015 18/01/2016 17/05/2016	15 15 15	26/11/15 27/11/15 27/01/16 08/04/16 23/05/16	2 1 5 4 6	Repeated photo of the whole site only on the shore side, due to health and safety restrictions	
Cross-shore topographic profiles	02/03/2016 13/07/2016	153 147	02/09/2015 26/07/2016	1 1	26/01/16	91	22/07/2015 01/07/2016	1 1
Surface Roughness Photo (not RO)	21/10/2015 18/12/2015 18/01/2016 02/03/2016 11/07/2016	10 5 5 5 5	07/10/2015 21/01/2016 18/05/2016	18 33 33	27/11/15 27/01/16 08/04/16 23/05/16	3 5 4 6	Not available	
SD sensor first deployed	22/10/2015	6	24/09/2015	7	26/11/15 27/11/15 10/02/16	4 1 1	Not available	
SD sensor downloads	18/12/2015 19/01/2016 02/03/2016 22/05/2016 11/07/2016	6 6 6 6 6	23/11/2015 21/01/2016 18/05/2016 13/10/2016	7 7 7 7	27/01/16 23/05/16	5 6	Not available	
Erosion pin first deployed	21/10/2015	8	07/10/2015	21	26/11/15 27/11/15	3 12	Not available	
Subsequent erosion pin readings/re-deployment	18/12/2015 18/01/2016 02/03/2016 26/05/2016 11/07/2016	8 8 8 8 6	23/11/2015 20/01/2016 22/03/2016 18/05/2016 19/07/2016	21 21 21 21 21	27/01/16 08/04/16 23/05/16	15 6 6	Not available	
Accretion horizon first deployed	21/09/2012	12	02/09/2015 21/01/2016	8 4	10/11/15	3	Not available	
Subsequent accretion readings	18/12/2015 13/07/2016	12 12	20/10/2016	12			Not available	
SET first deployed	21/09/2012	3	02/09/2015 21/01/2016	2 1	10/11/15	3	Not available	
Subsequent SET reading dates	18/12/2015 13/07/2016	3 3	20/10/2016	3			Not available	

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 607131.

Grant Agreement number: **607131**
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8.2. Update from data delivered in D4.4

Parameter – in measurement order collected in vegetated foreshore quadrats (N = 15)	UK – year 1 site		NL – year 1 site		Spain – year 1 site		Romania – year 1 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Top-down photo	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	24/09/2014 15/10/2014 27/01/2015 08/05/2015 21/05/2015	11* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Repeated photo of the whole site only on the shore side, due to health and safety restrictions	
Species richness	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	17/09/2014 15/10/2015 27/01/2015 08/05/2015 21/05/2015	6* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	29/08/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015	15 3 5 5 15
Vegetation cover	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	17/09/2014 15/10/2015 27/01/2015 08/05/2015 21/05/2015	6* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Not available	
Plant H, d, spacing	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	24/09/2014 15/10/2015 27/01/2015 21/05/2015 22/05/2015	6* 11* 11 14 1	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	29/08/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015	15 3 5 5 15
Disc height (for biomass) (not RO)	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	17/09/2014 23/09/2014 15/10/2014 27/01/2015 08/05/2015 21/05/2015	5* 1* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Not available	
Projected Area Photo (not RO)	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	24/09/2014 15/10/2014 27/01/2015 08/05/2015 21/05/2015 27/05/2015	6* 11* 11 8 7 2	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Not available	
Biomass harvest (n=10)	29/10/2014 17/11/2014 13/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	5 10 10 10 10 10 10	13/10/2014 27/01/2015 21/05/2015 22/05/2015	6* 6* 8 2	25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2015 25/01/2015 05/02/2015	2 3 1 7 2 1 9	29/08/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015	5 3 5 5 5

Parameter – in measurement order collected in vegetated foreshore quadrats (N = 15)	UK – year 1 site		NL – year 1 site		Spain – year 1 site		Romania – year 1 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Top-down photo	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	24/09/2014 15/10/2014 27/01/2015 08/05/2015 21/05/2015	11* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Repeated photo of the whole site only on the shore side, due to health and safety restrictions	
Species richness	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	17/09/2014 15/10/2015 27/01/2015 08/05/2015 21/05/2015	6* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	29/08/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015	15 3 5 5 15
Plant scans	Not available		Not available		25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2015 25/01/2015 05/02/2015	2 3 1 7 2 1 9	Not available	

Parameter – in measurement order collected in vegetated foreshore quadrats (N = 15)	UK – year 2 site		NL – year 2 site		Spain – year 2 site		Romania – year 2 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Verify quad position	02/03/2016 11/05/2016 12/05/2016 13/05/2016 11/07/2016	69 10 14 6 10	02/09/2015 21/01/2016 17/05/2016	18 20 10	26/01/2016	130	23/07/2015 16/09/2015 11/03/2016 13/05/2016 01/07/2016	15 15 5 5 5
Top-down photo	21/10/2015 18/12/2015 18/01/2016 02/03/2016 19/05/2016 11/07/2016	15 15 15 15 35 15	10/08/2015 12/08/2015 28/09/2015 18/01/2016 17/05/2016	14 1 15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	Not available	
Species richness	21/10/2015 18/12/2015 18/01/2016 02/03/2016 11/05/2015 14/05/2016 11/07/2016	15 15 15 15 15 20 15	10/08/2015 12/08/2015 28/09/2015 18/01/2016 17/05/2016	14 1 15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	23/07/2015 16/09/2015 11/03/2016 13/05/2016 01/07/2016	15 15 10 10 10
Vegetation cover	21/10/2015 18/12/2015 18/01/2016 02/03/2016 11/05/2015 14/05/2016 11/07/2016	15 15 15 15 15 20 15	10/08/2015 12/08/2015 28/09/2015 18/01/2016 17/05/2016	14 1 15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	Not available	
Plant H, d, spacing	21/10/2015 18/12/2015 18/01/2016 02/03/2016 11/05/2015 14/05/2016 11/07/2016	15 15 15 15 15 20 15	28/09/2015 18/01/2016 17/05/2016	15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	23/07/2015 16/09/2015 11/03/2016 13/05/2016 01/07/2016	15 15 10 10 10

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 607131.

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Parameter – in measurement order collected in vegetated foreshore quadrats (N = 15)	UK – year 1 site		NL – year 1 site		Spain – year 1 site		Romania – year 1 site	
	Dates	N	Dates	N	Dates	N	Dates	N
Top-down photo	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	24/09/2014 15/10/2014 27/01/2015 08/05/2015 21/05/2015	11* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	Repeated photo of the whole site only on the shore side, due to health and safety restrictions	
Species richness	20/10/2014 17/11/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015	15 15 15 15 15 15 15	17/09/2014 15/10/2015 27/01/2015 08/05/2015 21/05/2015	6* 11* 11 8 7	24/11/2014 25/11/2014 02/12/2014 04/12/2014 05/12/2014 21/01/2014 25/01/2015 05/02/2015	1 4 4 3 6 2 4 12	29/08/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015	15 3 5 5 15
Disc height (for biomass) (not RO)	21/10/2015 18/12/2015 18/01/2016 02/03/2016 11/05/2015 14/05/2016 11/07/2016	15 15 15 15 15 20 15	28/09/2015 18/01/2016 17/05/2016	15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	Not available	
Projected Area Photo (not RO)	21/10/2015 18/12/2015 18/01/2016 02/03/2016 19/05/2015 11/07/2016	15 15 15 15 35 15	12/08/2015 10/10/2015 19/01/2016 17/05/2016	16 15 15 15	28/10/2015 26/11/2015 26/01/2016 25/02/2016 31/03/2016 07/04/2016 22/04/2016	8 6 8 6 3 5 6	Not available	
Biomass harvest (n=10)	21/10/2015 18/12/2015 18/01/2016 02/03/2016 19/05/2015 11/07/2016	10 10 10 10 30 10	28/09/2015 19/01/2016 19/05/2016	10 10 10	28/10/15 26/11/15 26/01/16 25/02/16 31/03/16 07/04/16	4 4 4 4 3 5	23/07/2015 16/09/2015 11/03/2016 13/05/2016 01/07/2016	5 5 5 5 5
Plant scans	Not available		Not available		28/10/15 26/11/15 26/01/16 25/02/16 31/03/16 07/04/16	4 4 4 4 3 5	Not available	

8.3. Update from data delivered in D4.2

	UK		NL		Spain		Romania	
	Dates	N	Dates	N	Dates	N	Dates	N
Field spectra - Y1	2014-10-20 2014-10-27 2015-11-17 2015-01-12 2015-03-15 2015-05-13 2015-07-14	25 86 125 27 125 125 125	2014-09-18 2014-09-23 2014-10-15 2014-10-17 2015-01-29 2015-05-07 2015-05-11 2015-05-21 2015-05-27 2015-07-30	88 30 25 29 71 15 40 101 10 45	2014-10-20 2014-10-27 2014-11-17 2014-11-18 2015-01-12 2015-01-13 2015-03-15 2015-03-16 2015-05-12 2015-05-13	78 28 101 51 78 51 77 50 12 126	2015-04-29	19

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					2015-07-14	126
Field spectra - Y2	2015-10-12 2015-10-23 2015-12-17 2016-01-18 2016-03-03 2016-05-11 2016-07-11	125 125 125 125 125 225 125	2015-10-02 2015-10-05 2016-01-19 2016-01-21 2016-05-19	139 50 119 10 140	2015-10-12 2015-10-13 2015-10-23 2015-12-17 2016-01-18 2016-03-03 2016-05-11 2016-05-12 2016-05-13	76 50 128 126 127 128 42 155 30

8.4. Update from data delivered in D4.9

Parameter – in measurement order collected in vegetated and foreshore quadrats (N = 15)	UK		NL		Spain		Romania	
	Dates	N	Dates	N	Dates	N	Dates	N
dGPS survey (incl. transect & all quadrats)	20/10/2014 27/10/2014 12/01/2015 15/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 02/03/2016 13/07/2016	25 86 27 10 52 104 10 216 168	07/04/2014 24/10/2014 9/12/2014 YEAR 2: 9-6-2015 2-9-2015 21-01-16 17/05/2016	135 44 6 5 18 20 10	2014-10-29 2014-11-25 2015-02-05 YEAR 2: 2016-01-26	18 18 16 129	29/08/2014 29/09/2014 22/11/2014 20/07/2015 YEAR 2: 22/07/2015 17/02/2016 10/03/2016 13/05/2016 01/07/2016	35 46 13 25 32 2 1 34 45
Repeat photo of site	20/10/2014 18/11/2014 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2015 18/12/2015 18/01/2016 11/05/2016	1 1 1 1 1 1 1 1 1 1	15/10/2014 27/01/2015 20-03-15 YEAR 2: 28-09-15 23-11-15 18-01-16 17/05/2016	6 11 11 15 15 21 15	05/2/2015 YEAR 2: 28/10/2015 26/11/2015 26/01/2016 25/02/2016	2 1 1 1 1	29/08/2014 30/09/2014 22/11/2014 YEAR 2: 23/07/2015 19/11/2015 10/03/2016 13/05/2016	1 1 1 1 1 1 1
Surface roughness (not RO)	27/10/2014 18/11/2014 13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 18/12/2015 02/03/2016 11/07/2016	10 10 10 10 10 10 10 10 6 5	05/11/2014 29/01/2015 YEAR 2: 26-05-15 21-01-16 18-05-2016	6 6 18 33 33	05/2/2015 20/04/2015 16/7/2015 YEAR 2: 27/11/2015 26/01/2016	2 2 2 3 3	Not deployed because of permanent submergence	

Particle size (ALL), total organic matter (ALL), bulk density	28/10/2014 18/11/2014 13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2016 18/12/2016 18/01/2016 02/03/2016 11/05/2016 11/07/2016	6 12 12 12 12 12 12 12 12 12 12 12 12	16/10/2014 29/01/2015 19/03/2015 19-05-15 29-07-15 YEAR 2: 29-09-15 23-11-15 20-01-16 22-03-16 18-05-2016 19-07-2016	24 24 24 28 28 28 28 28 28 28 28	05/2/2015 16/07/2015 20/07/2015 YEAR 2: 26/01/2016	12 12 6 15	29/08/2014 30/09/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015 YEAR 2: 23/07/2015 03/09/2015 11/03/2016 13/05/2016 01/07/2016	15 6 5 3 5 5 6 3 4 5 5
Sediment samples for Chl-a (not RO)	28/10/2014 18/11/2014 13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2016 18/12/2016 18/01/2016 02/03/2016 11/05/2016 11/07/2016	6 12 12 12 12 12 12 12 12 12 12 12 12	16/10/2014 29/01/2015 19-03-15 19-05-15 29-07-15 YEAR 2: 29-09-15 23-11-15 21-01-16 22-03-16 18-05-2016 19-07-2016	24 24 24 28 28 18 11 11 11 11 11	05/2/2015 16/07/2015 20/07/2015 YEAR 2: 26/01/2016	12 12 6 15	Not deployed because of permanent submergence	
Water Chl-a (RO only)							30/09/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015 YEAR 2: 23/07/2015 03/09/2015 10/03/2016 13/05/2016 01/07/2016	10 10 3 5 5 4 5 5 5 5
Secci (RO only)							30/09/2014 20/11/2014 15/03/2015 13/05/2015 20/07/2015 YEAR 2: 23/07/2015 03/093015 19/11/2015 10/03/2016 13/05/2016 01/07/2016	3 2 3 5 5 4 3 3 3 5 5

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Shear vane (not RO)	28/10/2014 18/11/2014 13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2016 18/12/2016 18/01/2016 02/03/2016 11/05/2016 11/07/2016	6 6 6 15 12 12 12 12 12 12 6 12 12	09-12-14 30-01-15 20-03-15 21-05-15 30-07-15 YEAR 2: 07-10-15 23-11-15 20-01-16 23-03-16 18-05-2016 19-07-2016	9 27 27 27 27 54 33 33 33 33 33	05/2/2015 19/02/2015 8/4/2015 20/04/2015 16/7/2015 20/72015 YEAR 2: 27/11/2015 26/01/2016	2 4 24 12 12 24 5 5	Not deployed because of permanent submergence	
Erosion pin (not RO)	28/10/2014 18/11/2014 13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2016 18/12/2016 18/01/2016 02/03/2016 11/05/2016 11/07/2016	B 8 8 8 8 8 8 B 8 8 8 8 6	09-12-14 30-01-15 20-03-15 26-05-15 30-07-15 05-10-15 YEAR 2: 07-10-15 23-11-15 20-01-16 23-03-16 18-05-2016 19-07-2016	B 21 21 21 21 9 21 21 21 21 33 33	05/2/2015 8/4/2015 20/04/2015 16/7/2015 20/72015 YEAR 2: 27/11/2015 26/01/2016	B 12 6 12 6 5 5	Not deployed because of permanent submergence	
SD sensors	13/01/2015 16/03/2015 12/05/2015 13/07/2015 12/10/2015 YEAR 2: 21/10/2016 18/12/2016 18/01/2016 02/03/2016 11/05/2016 11/07/2016	B 6 6 6 6 B 6 6 6 6 6	08/04/2014 01/08/2014 09/12/2014 01-09-15 YEAR 2: 24-09-15 13-10-2016	B 5 B XB B 7XE	05/2/2015 19/5/2015 20/7/2015 YEAR 2: 26/01/2016	B 6 4 5	Not deployed because of permanent submergence	
SET readings	18/11/2015 07/03/2016 YEAR 2: 18/12/2015 13/07/2016	3 3 3 3	05-03-15 10-04-15 01-09-15 21-10-2016 YEAR 2: 02-09-15 21-01-16 20-10-2016	1 2 2 3 2 1 3	08/10/2015 09/10/2015 29/10/2015 YEAR 2: 10/11/2015	2 1 3 3	Not deployed because of permanent submergence	
Suspended Sediment (RO only)							30/09/2014 20/11/2014 15/03/2015 20/07/2015 YEAR 2: 23/07/2015 03/09/2015 19/11/2015 10/03/2016 13/05/2016 01/07/2016	5 5 3 6 6 5 5 5 4 5 5

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement nº 607131.

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9. References

Cahoon, D. R., Lynch, J. C., Hensel, P., Boumans, R., Perez, B. C., Segura, B., & Jr., and J. W. D. (2002). High-precision measurements of wetland sediment elevation. I. Recent improvements to the sedimentation--erosion table. *Journal of Sedimentary Research*, *72*(5), 730–733.

Hu, Z., W. Lenting, D. van der Wal, T.J. Bouma (2015). Continuous monitoring bed-level dynamics on an intertidal flat: Introducing novel, stand-alone high-resolution SED-sensors. Geomorphology 245: 223-230. http://dx.doi.org/10.1016/j.geomorph.2015.05.027

Möller, I., Kudella, M., Rupprecht, F., Spencer, T., Paul, M., van Wesenbeeck, B.K., Wolters, G., Jensen, K., Bouma, T.J., Miranda-Lange, M., Schimmels, S. 2014. Wave attenuation over coastal salt marshes under storm surge conditions. *Nature Geoscience*, 7, 727–731. doi:10.1038/ngeo2251

Möller, I. 2006 Quantifying saltmarsh vegetation and its effect on wave height dissipation: results from a UK East coast saltmarsh. *Journal of Estuarine, Coastal, and Shelf Sciences*, 69(3-4), 337-351

Möller, I., Spencer, T., French, J.R., Leggett, D.J., Dixon, M. 1999 Wave transformation over salt marshes: A field and numerical modelling study from North Norfolk, England. *Estuarine, Coastal and Shelf Science* 49, 411-426

Moeller, I., Spencer, T., and French, J.R. 1996 Wind wave attenuation over saltmarsh surfaces: Preliminary results from Norfolk, England. *Journal of Coastal Research* 12(4), 1009-1016

Van der Graaf, A.J., Bos, D., Loonen, M.J.J.E., Engelmoer, M. and Drent, R.H. 2002. Short-term and long-term facilitation of goose grazing by livestock in the Dutch Wadden Sea area. Journal of coastal conservation 8: 179-188

Webb, E. L., Friess, D. A., Krauss, K. W., Cahoon, D. R., Guntenspergen, G. R., & Phelps, J. (2013). A global standard for monitoring coastal wetland vulnerability to accelerated sea-level rise. Nature Climate Change, 3(5), 458–465. http://doi.org/10.1038/nclimate1756

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Grant Agreement number: **607131**

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