Interreg North Sea

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How to use drone monitoring for NbS?

Evaluation of pilot experiences for upscaling & mainstreaming approaches

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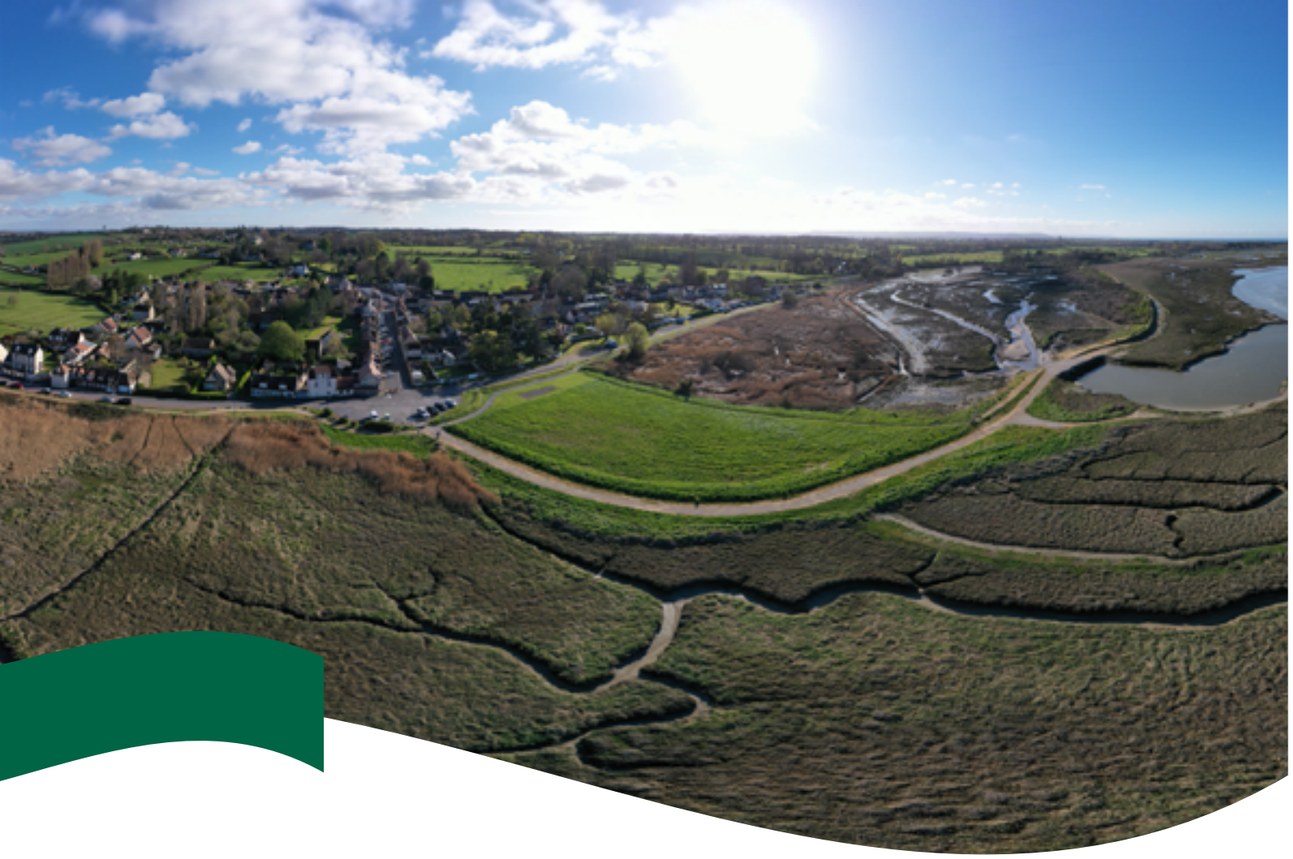
This two-pager summarises the pilot experiences from MANABAS Coast in overcoming the barriers to upscaling and mainstreaming NbS in coastal regions. These barriers can exist in three systems: social, natural and governance. The results of the NbS pilots (WP2) have been reflected upon in How To group meetings. From this reflection, several key points of good practice emerge for other coastal managers/ professionals to upscale or mainstream NbS. It also provides input for the regional or national upscaling and mainstreaming strategies of NbS, linked to our project partners' pilot areas.



Question at hand

Drone technology is a powerful tool for mainstreaming the monitoring of Nature-based Solutions (NbS). Drone imagery serves various objectives, such as monitoring saltmarshes, Natura 2000 areas and coastal nourishments, making it applicable to many of the MANABAS Coast pilot sites. Beyond the defined monitoring objectives, drone data can play a crucial role in showcasing results and convincing authorities and the public of the successes of NbS.

The question at hand is 'How are the different NbS pilots in the MANABAS Coast project approaching drone monitoring, and what can they learn from each other?'

Main findings

Several of the partners within the MANABAS Coast project are using drone monitoring for many purposes in their pilots regarding mudflats, saltmarshes, sandy coasts, dunes and revetments. There is a need for diverse types of monitoring to get a comprehensive overview of the NbS study areas.

While some partners are just starting out (e.g. have recently obtained a new drone), others already have longer time series of data available. The longer time series allows for demonstrating and evaluating the evolution of the pilot sites.

The topic of drone monitoring is closely related to other techniques, such as remote sensing, terrestrial photography (e.g. CoastSnap) and topo-bathymetric monitoring, which are also used in several pilots. Drone monitoring is usually added to the NbS monitoring plan because it allows for the acquisition of high resolution data for the pilot site. Cost-efficiencies of techniques and sensors differ, so there is often a tradeoff (e.g. LiDAR is usually more expensive than photogrammetry).

The partners are interested in learning about the different applications and elevate their use of drone technology to the latest developments. Because of the technical challenges, it is recommended to work with a professional team for executing the drone monitoring and processing the raw data. A short line of communication between the technicians and the researchers is important.

Experiences and lessons learned

Within the MANABAS Coast pilots, drone monitoring is used for many different applications:

Elevation monitoring:

- Several pilots (FR, BE, NL, DE, DK, SE) have been using drone photogrammetry as a tool to obtain detailed elevation data to perform morphological and geotechnical monitoring.
- NL (Sand engine) is using LiDAR mounted on a drone for their elevation monitoring. Other partners have LiDAR data available from airplane LiDAR, used to cover the entire coastline. DK is also using Red LiDAR to derive Digital Terrain Models (DTM) and Digital Surface Models (DSM) in order to track nourishments subaerial and for dike inspections.
- Green LiDAR bathymetry is a technique that uses a green wavelength laser to penetrate water, allowing it to measure underwater topography. Several partners (BE, DK) have experimented with the technique. The results were variable, but can compare to multibeam surveys in clear waters. Because of its specific potential for mapping shallow waters and the intertidal zone, the method is gaining importance for mapping coastal areas.

Changes in the coastline

- SE is using photogrammetry orthomosaics combined with LiDAR for monitoring changes in the coastline over time (e.g. retreat caused by climate change). The higher resolution and precision allow for detection of small-scale erosion and for the penetration of vegetation.
- BE and DE are using the data for storm surge impact evaluation and coastal protection measures.

Ecology

- DE and FR use drone monitoring as a support tool in the monitoring of vegetation and wildlife (mostly birds)
- Spectral indices such as the Normalized Difference Vegetation Index (NDVI) are used to improve visibility of particular features of vegetation.
- DE has developed techniques for mapping and counting breeding birds using flights with a time gap (bird staying on the same location indicates breeding). FR is using infrared scanning for bird counting on-site.
- FR and SE are using drone data for monitoring areal growth of certain species such as mussels and eelgrass. FR is also using the data to monitor the disappearance of former supratidal terrestrial vegetation (from arborescent to herbaceous strata)
- DE, NL (HZ) and BE are monitoring the renaturization and development of saltmarshes in connection with soil extraction and coastal realignment.
- Additionally, most pilots are interested in vegetation mapping to address deviations in the elevation data due to vegetation (e.g. marram grass). This could be possible with AI-Methods.

Inspections of constructions

- DK, DE and NL (HHNK) are using drone photogrammetry for inspections on the construction conditions, such as groynes, dykes and revetments.
- NL (HHNK) is using outlier detection to identify missing individual revetment elements.

Landscape monitoring and documentation

- Most pilots value the drone data as a reference archive for documenting the past status of an area. For example, the disappearance of former supratidal terrestrial vegetation in the case of a coastal realignment.
- Time-lapse animations are commonly used for showing an evolution, either with the orthophoto's or the Digital Elevation Models (DEM).
- Orthophotos are ideal for GIS-analyses, but oblique photos and videos are often preferred for illustration. Many of the pilots use drone data to create explanatory visualisations.
- FR is ahead in using panoramic photographs and virtual reality, whereas BE and others are using oblique drone movies to visualise their pilot in the online communications.

Checklist for coastal managers and professionals

Table 1: Checklist for practitioners: drone monitoring.

Steps	Description
1	Regulatory compliance • Airports • Military areas • Visitor safety / crowd control • Privacy (eg. GDPR) • Drone usage should comply with EU drone regulations (safety) • Breeding season restrictions
2	Timing • Tidal window • Preference for spring ebb tide • Position of the sun (lighting and shading) • Weather conditions • Seasonal variations
3	Drone specifications • What sensors are used? (photogrammetry, multispectral, IR, LiDAR,...) • Wind and weather proofing • Battery range
4	Data processing • Which software to use • Metadata • Storage of data

Future directions

- Several pilots are interested in learning more about aerial Green LiDAR bathymetry as an alternative for the time-intensive bathymetric monitoring that is currently executed by survey vessels. By innovating (e.g. green and red LiDAR), we can get better data and, hence, more knowledge to continually improve NbS implementations.

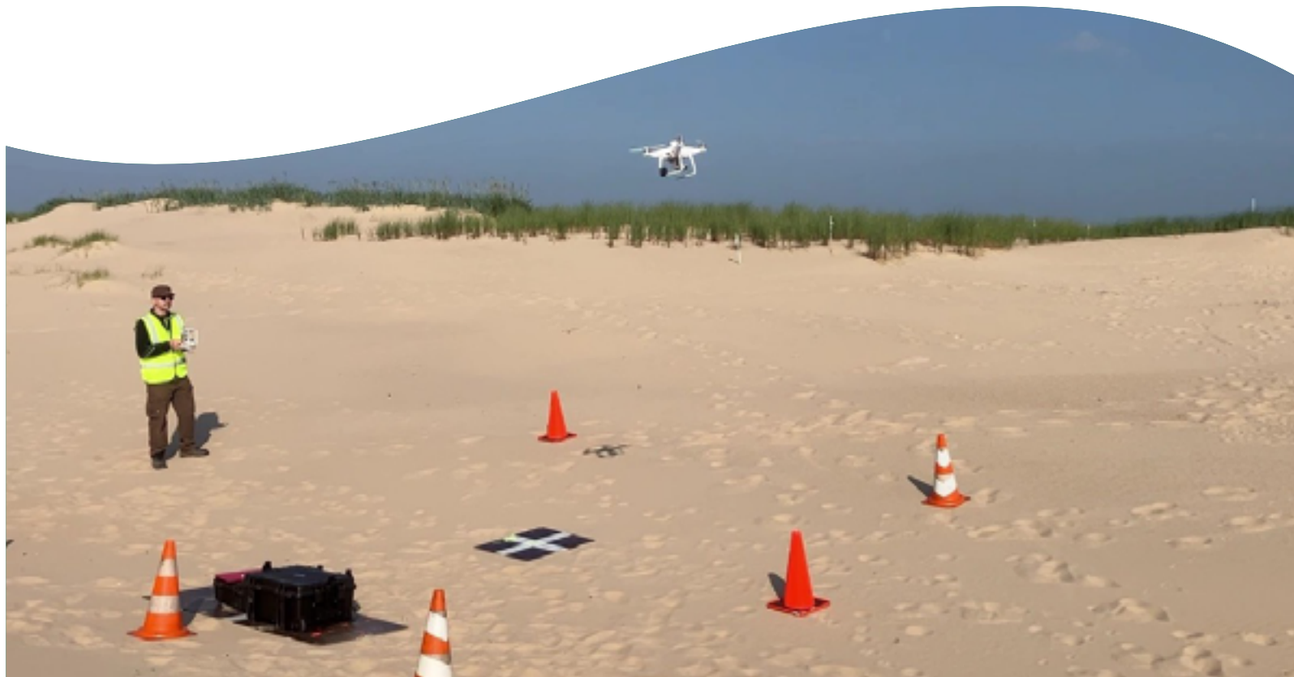
- Many pilots are still developing pathways to store and structure the acquired information. It can be a challenge to figure out which formats are suitable and there is also a need to combine diverse types of monitoring to get a full overview.

- There is lot of value in derived products that can be generated, such as erosion lines, differential analysis, etc. The use of neural networks and other AI technologies is only in its infancy and has great potential for the coming future.

- There is also interest in integrated platforms such as digital twins and the integration of different sources of data, including from citizen science (e.g. CoastSnap)

- New possibilities with newer/better drone technology: multispectral data, larger coverage, higher resolution, etc.

- The ongoing monitoring programs are both a result of, and a requirement for NbS mainstreaming. Drone data is an asset in the promotion of NbS.



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