BRAIN-be 2.0
BELGIAN RESEARCH ACTION THROUGH INTERDISCIPLINARY NETWORKS - Phase 2

Annual Network Report

To be filled in for the whole network in French, Dutch or English and sent by the coordinator to: BRAIN-be@belspo.be

Contrat nr: B2/RV/21/PiNS

PiNS

Reporting period: 01/01/2023 – 31/12/2023

The *Annual Network Report* (maximum 15 to 20 pages) is drawn up annually by the coordinator for the entire network and sent by the coordinator to the address BRAIN-be@belspo.be on the dates set in article 4 of annex I to the contract. It presents the state of progress and achievements of the research as well as the forecasts for the following year. This information refers explicitly to the tasks and the project schedule defined in articles 2 and 3 of annex I. It also informs of any modification of the data included in the previous reports – except for the possible changes regarding personnel* - and gives the list of publications and missions carried out during the past year.

This template can be completed in French, Dutch or English.

*Modifications compared to previous reports regarding personnel in charge and at the disposal of the project should be completed by the concerned individual partner in the separate form “Annual Report Personnel” to be downloaded from the website. To be completed conform the instructions given in the Initial Report.

NETWORK

COORDINATOR (PARTNER 1)

1. Michael Fettweis, RBINS

OTHER PARTNERS

2. Name and Institution: …
3. Name and Institution: …
4. Name and Institution: …
5. ……….

AUTHORS OF THIS REPORT

1. Michael Fettweis, RBINS
2. Xavier Desmit, RBINS
3. Duc Tran, RBINS
4. Saumya Silori, RBINS

PROJECT WEBSITE, SOCIAL NETWORKS …

No website will be specifically attributed to the project.

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1. EXECUTIVE SUMMARY of this report

The first year was dedicated to two in situ sampling campaigns in the North Sea (one in spring, one in winter), the generation of remote sensing products, and the analysis of continuous long time series with respect to the sand and mud content of the suspended particulate material (SPM). The measurements and the data analysis have been done in collaboration with international specialists (formalized through subcontracting) from Ifremer (Brest, France), Helmholtz Centre Hereon (Geesthaacht, Germany), Helmholtz Centre GEOMAR for Ocean Research Kiel (Germany) and Qmineral (Belgium).

Quantifying the variability of SPM concentration and composition is a major objective of the project. We have focused on both the organic and mineral composition of the SPM using different techniques. The mineralogy and primary particle size of the SPM samples were analysed using X-ray and laser diffraction, the particulate organic matter (POM) composition was determined by the analysis of POC, PON, chlorophyll-a (Chla), phaeophytine-a and TEP concentrations, and the sand/mud content using the previously defined sediment composition index (SCI) applied to long-term time series of optical and acoustic sensors.

The model of Fettweis et al. (2022) was applied to the in situ and satellite SPM concentrations and the biogeochemistry of suspended particles was used to investigate the transition between coastal and offshore waters in the North Sea. Our results suggest that bathymetry is an important factor controlling the coastal-offshore transition for pelagic particles, but it is not the only one. The results have been summarized and have been published.

The gradual POM enrichment with decreasing SPM concentration, which is typical of cross-shore gradients, has also been investigated on the vertical axis by combining SPM, POC, and Chla data collected from surface and bottom layers at MOW1 station during multiple tidal cycles between 2018 and 2022. The results allow understanding better the phytoplankton production in turbid waters.

We have developed Sediment Composition Index (SCI) functions for a small subset of the existing long-term field data. Such SCI functions have then been applied to the rest of the year in order to predict the sand/mud ratio and the total SPM concentration.

2. ACHIEVED WORK

Detailed description of the achieved work and tasks since the previous report

There are four hypothesis put forward in PiNS

1) The mineral-associated POM fraction of the SPM is entirely determined by the value assigned to the parameter m_{POM} in the semi-empirical diagnostic model proposed by Schartau et al. (2019) and Fettweis et al. (2022). It was previously assumed constant. The first hypothesis of PiNS is that m_{POM} is variable and largely determined by the nature of the mineral particles (especially the amount and types of clay minerals) in the SPM.
2) The second parameter of the above-mentioned model is K_{POM}. The second hypothesis is that K_{POM} is mainly governed by the controlling factors of phytoplankton production, such as the availability of nutrients and light.
3) The transport of SPM is controlled by, amongst other factors, their settling velocity. The third hypothesis is that enhanced vertical fluxes occur at a water depth of about 15-20m, where the mineral and organic content of the SPM is about equal.
4) The presence of mixed sediments in the seabed and/or strong currents and wave conditions may cause sandy material or particle with other erosion characteristics to be resuspended up to the detection volumes of acoustic and optical sensors. If not considered, the SPM concentration output of optical and acoustic sensors will over- or underestimate the SPM concentration and thus also the derived POM proxies. The fourth hypothesis is that a combination of optical and acoustic sensors can identify the sand and mud content of the SPM.

WP 1 – IN SITU MEASUREMENTS OF ORGANIC AND MINERAL PARTICLES

During the past year, two campaigns at sea have been carried out with a focus on the collection of chemical, physical and biological water column parameters along nearshore to offshore transects in the North Sea, the determination of the sand/mud content by deploying a benthic lander (tripod) in the Belgian nearshore (MOW1 station), equipped with acoustic and optic sensors, the mineralogy and particle size of the SPM and the ins situ collections of settling velocity. During the campaigns tidal or half tidal cycles have been sampled in 11 stations in the North Sea (see Figure 1 and Table 1). The analysis of chemical, physical and biological water column parameters is for a great part achieved. Also the mineralogy and primary particle size of the SPM samples (collected with a centrifuge) is available as well as the in situ measurements of particle settling velocity.

Table 1: Overview of the 2023 samples collected during 2 campaigns in 2023 (time is in GMT, S=surface, B=bottom).)

Location	Start	End	Tripod	Number of samples		
				Water	Settling velocity	Centrifuge
Scenes	26/03 15h00	27/03 03h00	-	9 S + 9 B	2	1
BS1	27/03 11h00	27/03 23h00	-	9 S + 9 B	2	1
W Gabbard	28/03 20h45	29/03 07h00	-	7 S + 7 B	1	1
Sizewell	29/03 16h00	30/03 04h00	-	9 S + 9 B	2	1
Doggerbank	30/03 17h30	30/03 19h30	-	2 S + 2 B	1	1
Helgoland	31/03 12h30	01/04 00h30	-	9 S + 9 B	2	1
HB2	02/04 01h30	02/03 13h30	-	9 S + 9 B	2	1
HB1	03/04 22h00	03/04 04h00	-	5 S + 5 B	1	1
W05	04/04 17h30	04/04 23h30	-	5 S + 5 B	1	1
W08	05/05 15h30	05/05 21h00	-	4 S + 4 B	1	1
MOW1	06/04 06h45	06/04 19h00	06/04 - 21/04	9 S + 9 B	2	1
Scene	06/12 11h30	06/12 23h00	-	9 S + 9 B	2	1
W Gabbard	07/12 14h15	07/12 20h00	-	5 S + 5 B	2	1
Sizewell	08/12 05h00	08/12 17h00	-	9 S + 9 B	2	1
Doggerbank	09/12 06h00	09/12 08h00	-	2 S + 2 B	1	1
HB2	10/12 07h00	10/12 19h00	-	9 S + 9 B	2	1
HB1	11/12 01h00	11/12 13h00	-	9 S + 9 B	2	1
Helgoland	11/12 19h00	12/12 01h00	-	5 S + 5 B	2	1
MOW1	13/12 09h00	13/12 21h00	05/12 - 14/12	9 S + 9 B	2	1
W05	14/12 16h30	14/12 22h30	-	5 S + 5 B	2	1
W08	15/12 18h20	16/12 00h30	-	4 S + 4 B	2	1

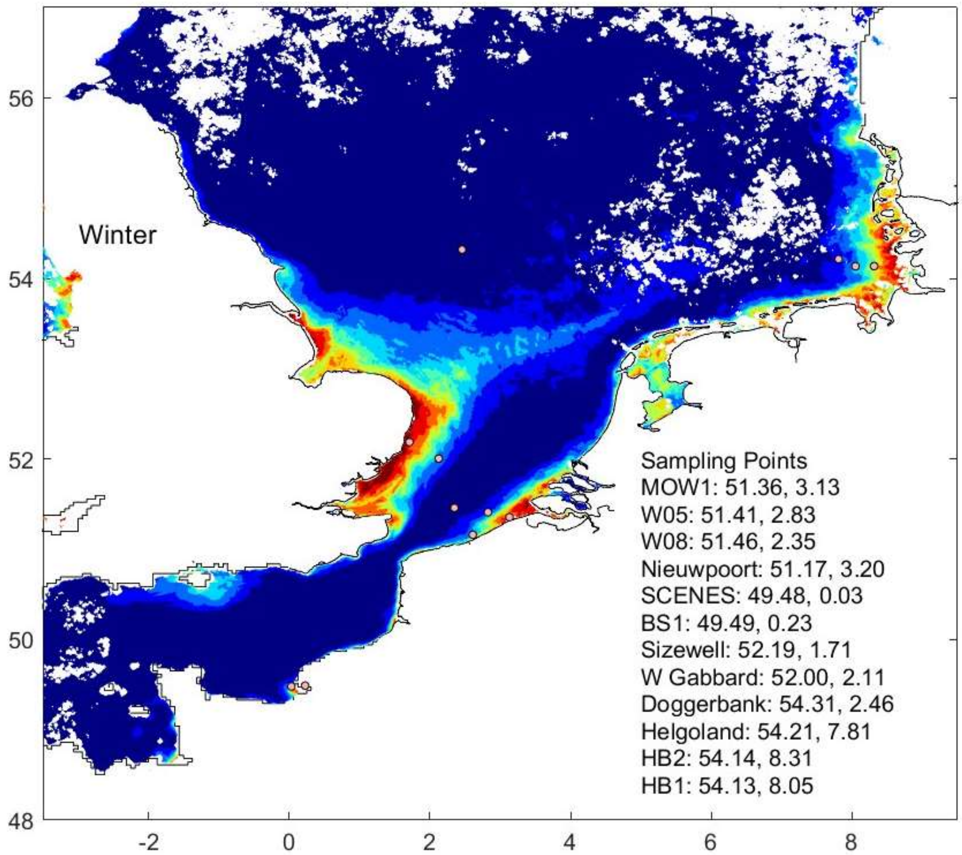

Figure 1: Sampling stations (BS1 was only sampled in spring 2023).

Sand/mud content of the SPM

The sand/mud content of long-term and continuous time series derived from an Acoustic Doppler Velocimeter (ADV) backscatter sensors and the SPM concentration from an optical backscatter sensor (OBS) from the Belgian nearshore area (station MOW1) has been calculated. Data at MOW1 consists of hourly water samples, particle size distributions, turbidity, hydrodynamic conditions and Chla concentration for the year 2013 during 125 tidal cycles, providing one of the most comprehensive field datasets in the North Sea. Figure 2 shows three steps in applying the Sediment Composition Index method (see Pearson et al. 2021; Tran et al. 2021) to obtain SPM concentration from raw signals of OBS and ADV. First, the data was divided into 20 bins, i.e., 0-100, corresponding to the ratio of sand/mud in suspension and OBS and ADV signals (Figure 2 left). Second, the relationship between SCI and bins was plotted (Figure 2 right) to obtain mathematical functions for each mooring during 2013. Last, the raw data of OBS and ADV from different moorings were applied to the functions derived in the previous step to compute the SPMC of the year 2013 and potentially of any other years at the same station.

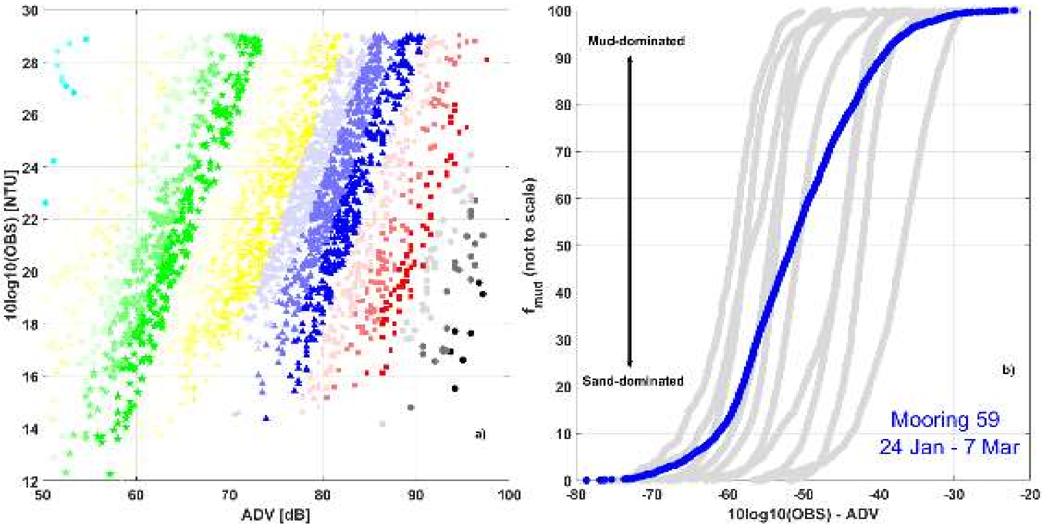

Figure 2. Left: field data illustrates a log-linear relationship between raw OBS and ADV signals of different bins. Right: data from each mooring was divided into 20 bins to derive a mathematical function, describing ratio of sand/mud in suspension as a function of raw OBS and ADV signals.

Mineralogy and particle size of the SPM and the sediments

SPM samples (using a centrifuge connected to the sea water pump of the RV Belgica) have been taken at each location and have been analyzed for the bulk and the clay mineralogical composition (Figure 3) and the primary particle size distribution (Figure 4).

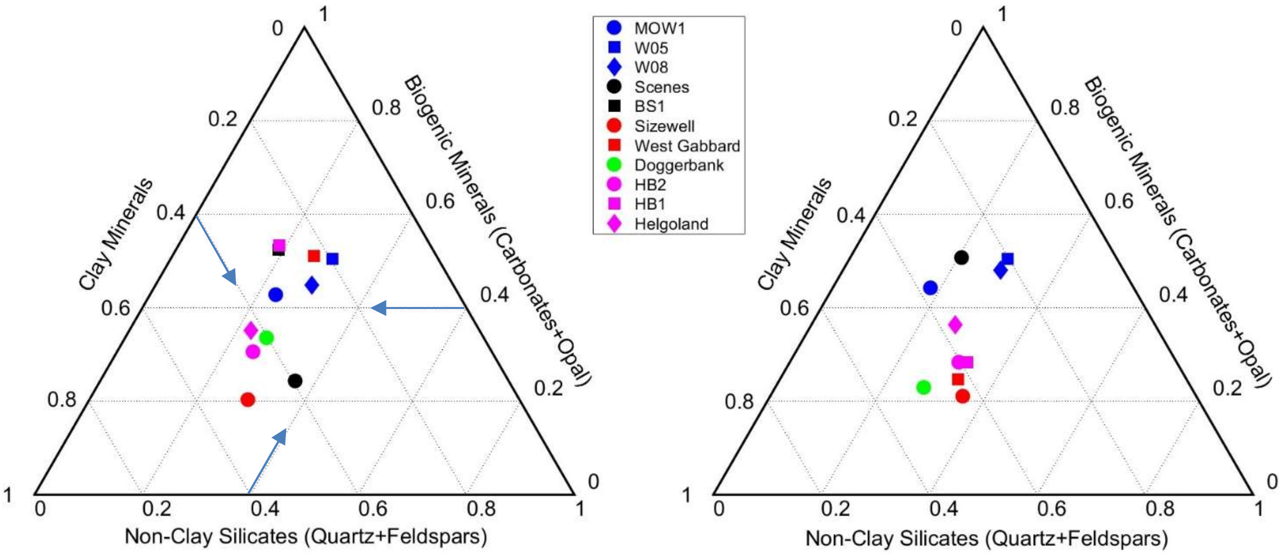

Figure 3: Mineralogical composition of the SPM for the spring (left) and the winter (right) campaign 2023.

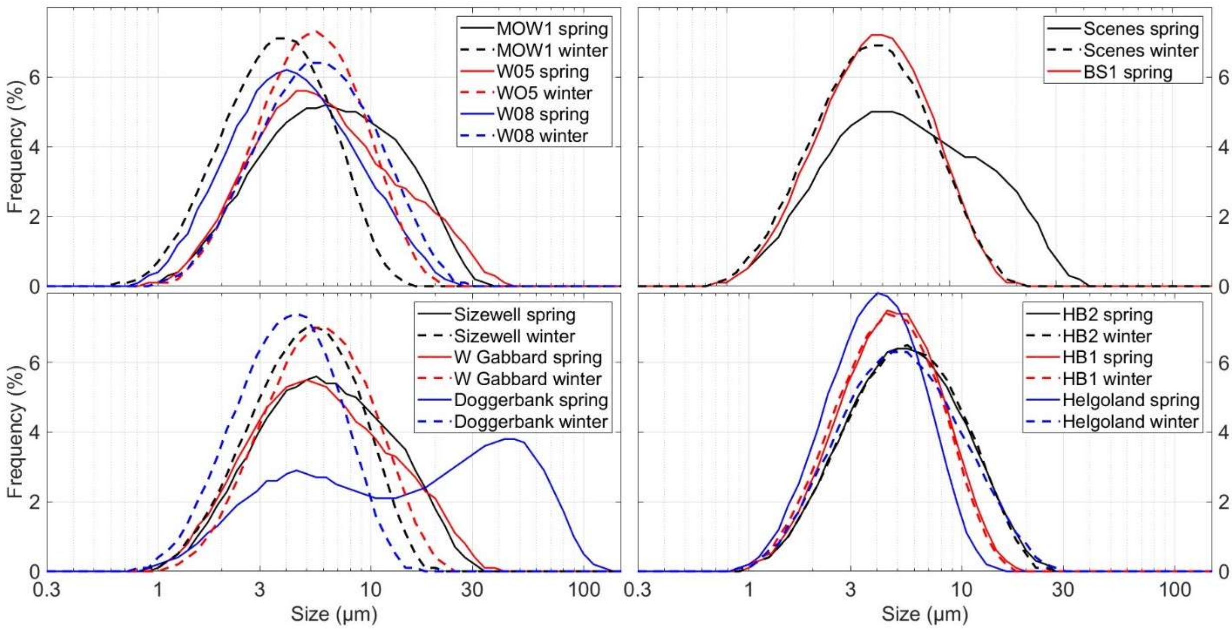

Figure 4: Primary particle size distribution of the SPM for the spring and the winter campaign 2023.

Significant changes in the mineralogy are found between spring and winter for the stations Scene, West Gabbard and HB1. Also the Belgian stations have undergo changes in the composition when compared to older data (Adriaens et al., 2018). The reason for these changes are unclear. The primary particle sizes are generally unimodal with a median size of about 4µm, except in spring when bimodality is present. This secondary mode is most pronounced in the offshore stations (Doggerbank), but is also visible in the nearshore stations. It is probably related to the bloom of phytoplankton and the size of diatom skeletons and is supported by a higher content of Opal (diatom shells are made of Opal).

WP 2 - MODEL REFINEMENT, VALIDATION AND DATA ANALYSIS

The tasks in this WP are based on the in situ data collected. Concerning task 2.1, the conclusion is so far (we still miss a campaign) that the mineralogy is sufficiently similar in the sampling stations and within the sampled seasons to use a constant m_{POM} parameter for the whole North Sea. For tasks 2.2 and 2.3 the data are collected, but the analysis has not yet started.

WP 3 - REMOTE SENSING AND SENSOR SPM CONCENTRATION DATA

The transition zone between nearshore and offshore

Pelagic particles follow different biogeochemical transformations along the coastal-offshore transect. Their dynamics of sedimentation and resuspension is different at the coast and offshore due to changes in bathymetry (and thus in turbulence), in particle quality, and in biological activity (affecting the composition of particles).

Identifying the mechanisms that contribute to the variability of SPM concentrations in coastal areas is important but difficult, especially due to the complexity of physical and biogeochemical interactions involved. Our study addresses this complexity and investigates changes in the horizontal spread and composition of particles, focusing on cross-coastal gradients in the southern North Sea and the English Channel. A semi-empirical model is applied on in situ data of SPM and its organic fraction to resolve the relationship between organic and inorganic suspended particles. The derived equations are applied onto remote sensing products of SPM concentration (Sentinel-3), which provide monthly synoptic maps of POM concentrations (here, particulate organic nitrogen) at the surface together with their labile and less reactive fractions. Comparing these fractions of particulate organic matter reveals their characteristic features along the coastal-offshore gradient, with an area of increased settling rate for particles generally observed between 5 and 30 km from the coast. We identify this area as the transition zone between coastal and offshore waters with respect to particle dynamics. Presumably, in that area, the turbulence range and particle composition favour particle settling, while hydrodynamic processes tend to transport particles of the seabed back towards the coast. Bathymetry plays an important role in controlling the range of turbulent dissipation energy values in the water column, and we observe that the transition zone in the southern North Sea is generally confined to water depths below 20 m. Seasonal variations in suspended particle dynamics are linked to biological processes enhancing particle flocculation, which do not affect the location of the transition zone (see Figure 5).

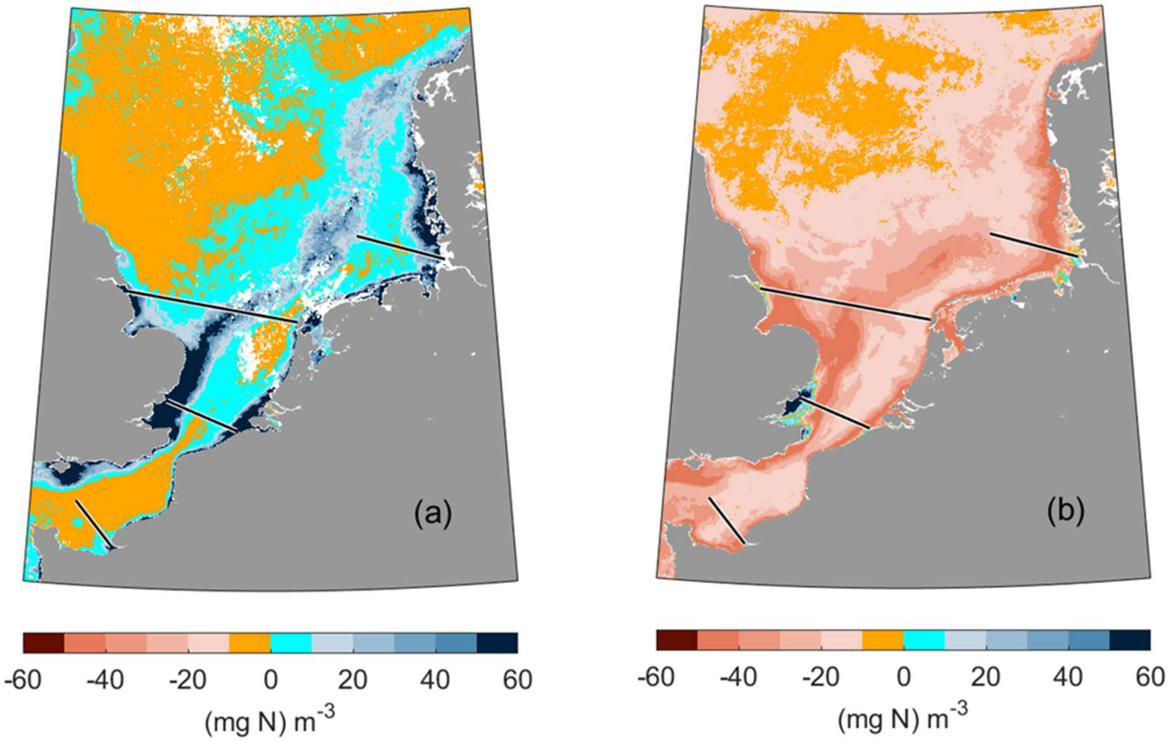

Figure 5: Surface ΔPON (PON_m-PON_f) concentration [(mg N) m^{-3}] in 2020, January (a) and April (b).

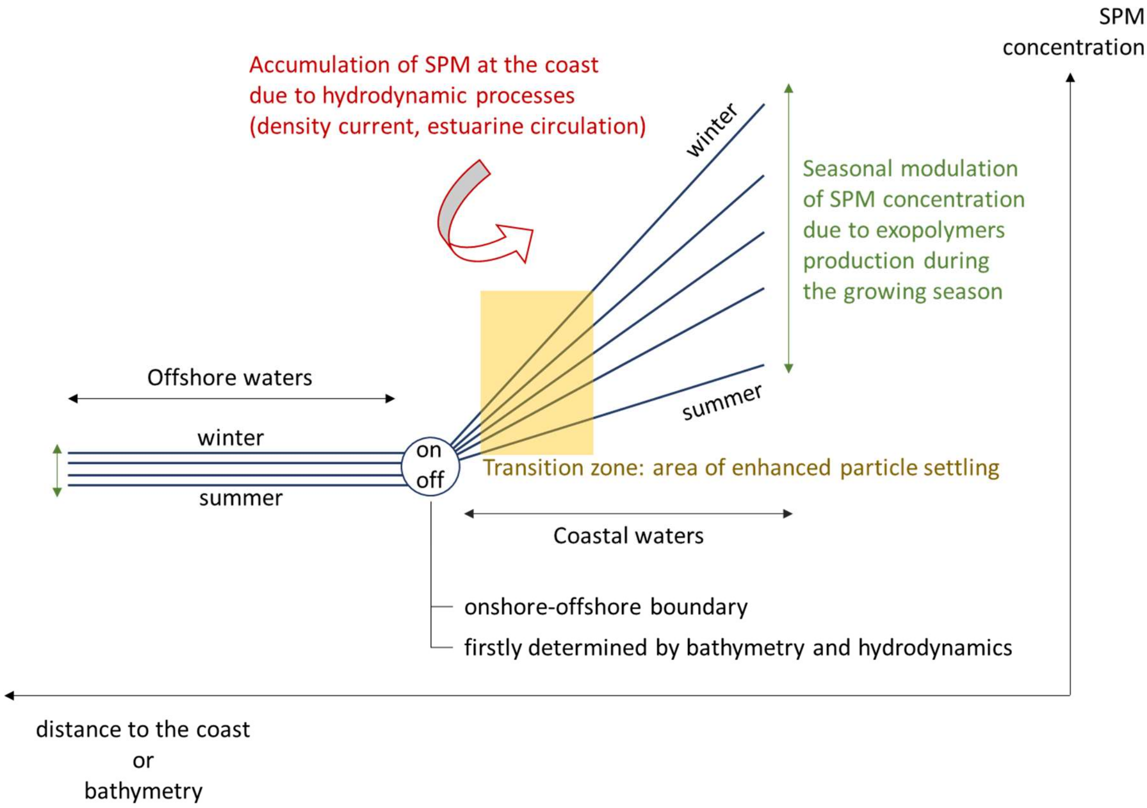

Figure 6: Graphical summary of particle dynamics along the coastal-offshore gradient.

Our results and hypotheses can be found in Desmit et al. (2014) and are summarized in Figure 6. An idealized coastal-offshore gradient of SPM concentration is shown with high, declining concentrations at the coast and lower, more stable concentrations offshore. In both areas, the seasonal phytoplankton bloom and subsequent increase in fresh TEP cause SPM concentration to decrease in spring and summer due to enhanced flocculation. Just before the limit between coastal and offshore waters, there is a transition zone where SPM is subject to a sink, particularly in April. This may be the result of particle settling inducing a vertical gradient of SPM concentration coupled with hydrodynamic processes inducing onshore currents at the bottom of the water column. Such process would accumulate particles at the coast, maintaining the strong coastal-offshore gradient in spite of continuous water mixing. If this hypothesis is verified, it may have strong consequences for particle and carbon budgets in coastal zones.

WP 4 – SYNTHESIS AND TRANSDISCIPLINARY ANALYSIS

The in-situ measurements have been combined with the model-derived proxies of fresh and mineral-associated POC, PON and TEP concentrations; and with the Chl*a* data to elaborate the seasonal variability in floc size and SPM composition and concentration and the mutual interactions between SPM and phytoplankton. Further, we have investigated under which environmental conditions (water clarity) fresh POM is formed and degraded over time, and how this controls the interaction and the sinking of aggregates of phytoplankton and SPM.

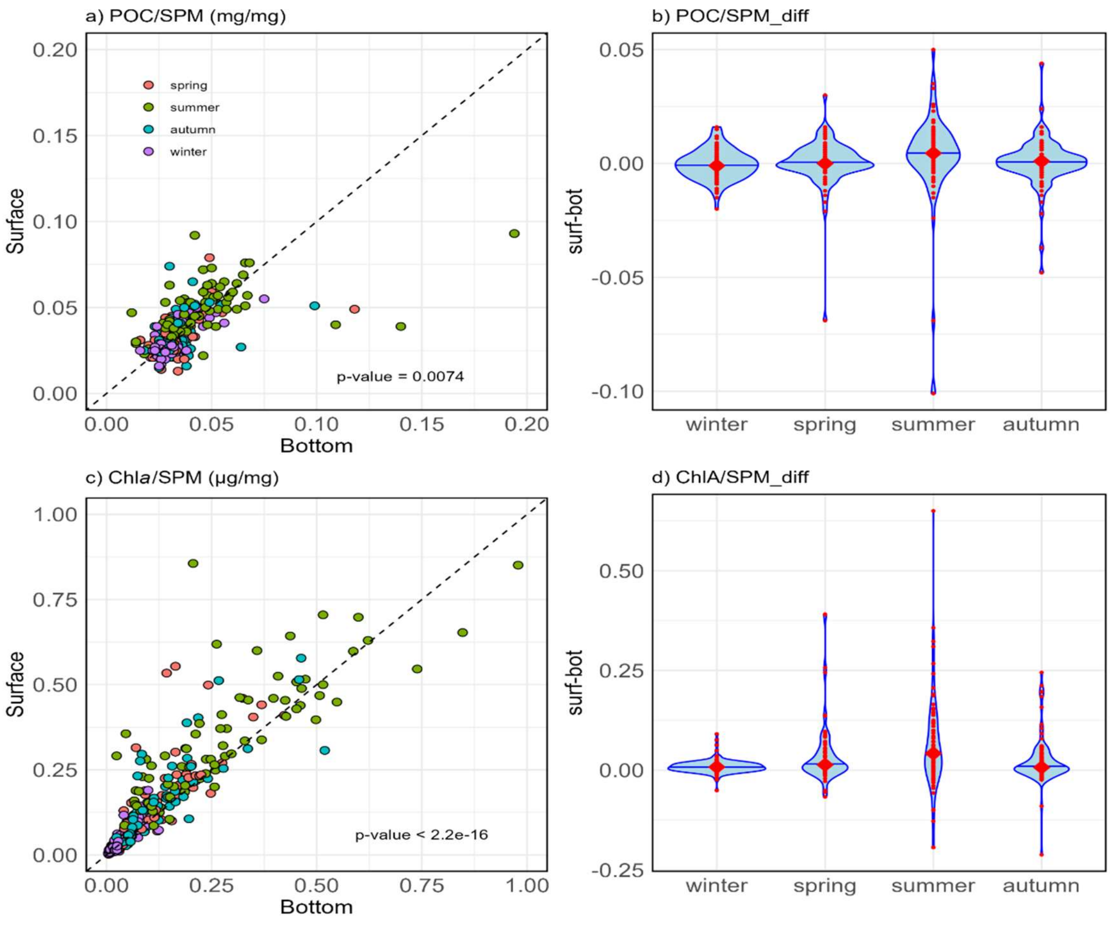

Figure 7: (a) Scatter plot comparing surface and bottom POC:SPM. (b) Violin plot showing the difference between surface and bottom POC:SPM ratios. (c) Scatter plot comparing surface and bottom Chla:SPM ratios. (d) Violin plot showing the difference between surface and bottom Chla:SPM (µg/mg) ratios. The black dashed line in the scatter plots represents the 1:1 line. In the violin plots the blue horizontal line, bigger red point, and smaller red points indicate median, mean, and the data points respectively.

Interaction between phytoplankton and mineral particles in a turbid well-mixed area

The gradual increase in the POC content of SPM along a horizontal cross-shore gradient from high-turbidity to low-turbidity waters is a characteristic feature of coastal SPM dynamics. Here, we investigate whether this gradual POM enrichment is also evident on the vertical in a turbid, shallow, well-mixed water column (station MOW1), where variation in hydrodynamic forcing and phytoplankton production is likely to differ markedly from the cross-shore transects.

Combining SPM, POC, and Chl*a* data collected from surface and bottom layers at MOW1 during multiple tidal cycles, we observe relatively higher POC and Chl*a* contents in surface waters, beginning in spring (Figure 7). This increase in Chl*a* concentration at the surface is associated with a weak correlation between Chl*a* and SPM in spring, which contrasts with winter conditions, when the correlation is significantly higher. Monthly vertical profiles of SPM, constructed using optical backscattering sensor (OBS) data, and Chl*a* profiles from water sample data indicate that at least a significant amount of phytoplankton is floc-attached and that free phytoplankton type predominates only during the growing period. These findings suggest that, similar to the horizontal gradients in POM content of SPM, differential settling amongst various components of SPM contributes to the compositional gradient within the vertical water column. These results imply that free phytoplankton cells may be able to prolong residence in the photic depths, particularly advantageous during the early stages of phytoplankton blooms when SPM concentrations remain high (Figure 8).

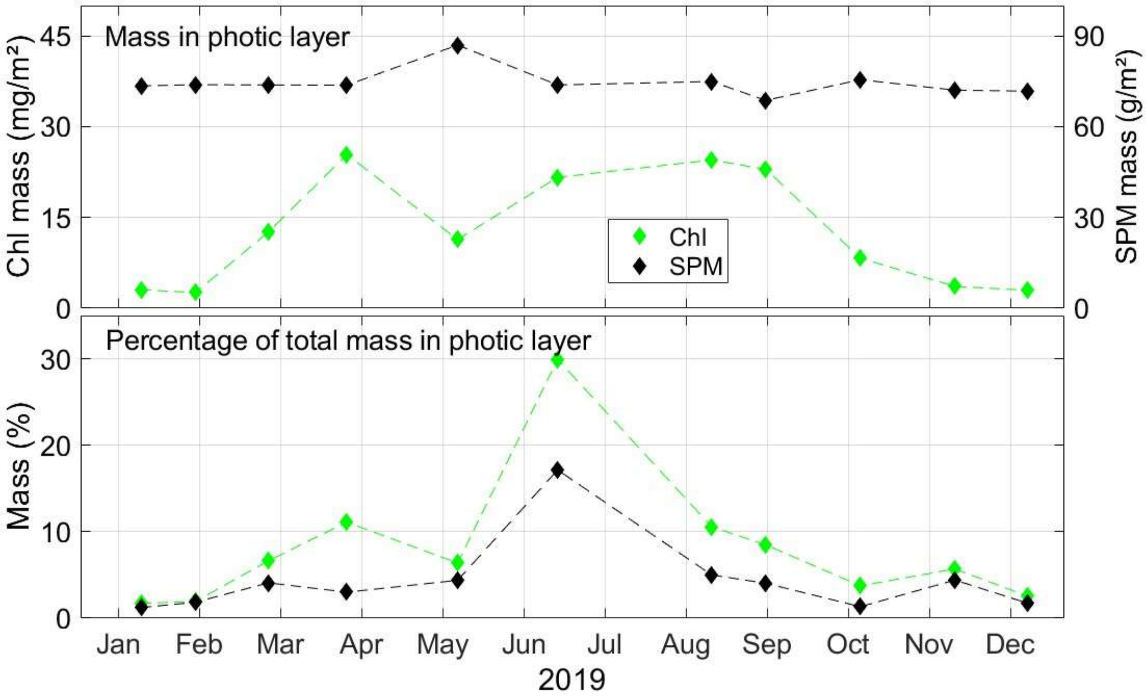

Figure 8: (a) Mass of Chla and SPM integrated over the photic layer per tide and unit area. (b) Percentage of Chla and SPM in the photic layer with respect to their total mass available for resuspension during a tide.

References

Adriaens R, Zeelmaekers E, Fettweis M, Vanlierde E, Vanlede J, Stassen P, Elsen J, Środoń J, Vandenberghe N. 2018. Quantitative clay mineralogy as provenance indicator for recent muds in the southern North Sea. Marine Geology, 398, 48-58. doi:10.1016/j.margeo.2017.12.011

Desmit X, Schartau M, Terseleer N, Van der Zande D, Riethmüller R, Fettweis M. 2024. The transition between coastal and offshore areas in the North Sea unraveled by the suspended particle composition. Science of the Total Environment 915, 169966. doi:10.1016/j.scitotenv.2024.169966

Fettweis M, Schartau M, Desmit X, Lee BJ, Terseleer N, Van der Zande D, Parmentier K, Riethmüller R. 2022. Organic matter composition of biomineral flocs and its influence on suspended particulate matter dynamics along a nearshore to offshore transect. Journal of Geophysical Research Biogeosciences, 126, e2021JG006332. doi:10.1029/2021JG006332

Pearson S, Verney R, Prooijen B, Tran D, Hendriks E, Jacquet M, Wang Z. 2021. Characterizing the composition of sand and mud suspensions in coastal and estuarine environments using combined optical and acoustic measurements. Journal of Geophysical Research Ocean. 126(7), e2021JC017354.

Schartau M, Riethmüller R, Flöser G, van Beusekom JEE, Krasemann H, Hofmeister R, Wirtz K. 2019. On the separation between inorganic and organic fractions of suspended matter in a marine coastal environment. Progress in Oceanography. 171, 231–250. https://doi.org/10.1016/j.pocean.2018.12.011.

Tran D, Pearson SG, Jacquet M, Verney R. 2021. Investigating suspended particulate matters from multi-wavelength optical and multi-frequency acoustic measurements. vEGU 2021.

3. INTERMEDIARY RESULTS

Detailed description of the deliverables completed since the previous report

Deliverable: D 1.1.1 – In situ collection of the water column chemical and physical properties.
Data during 2 campaigns have been collected.

Deliverable: D 1.1.2 – Laboratory analysis of the samples. A consistent and extensive dataset of these properties at relevant time and spatial scales (2022-2023) will be generated.
The sample for the first two campaigns have been analysed.

Deliverable: D 1.1.3 – In situ data set of SPM particle images
Particle images have been collected, analysis is still ongoing

Deliverable D.1.2.1 - The sensor-based time series of SPM concentration and the sand-mud content of them.
The SCI has been applied to SPM concentration time series at station MOW1.

Deliverable D.1.3.1 – Detailed mineralogical composition of the samples that will allow testing the hypothesis is that m_{POM} depends on the nature of the mineral particles.
Bulk and clay mineralogy, grain size and TOC content have been analysed on the centrifuge samples (see Table 1)

Deliverable D.1.4.1 – Dataset of settling velocity and lateral particle advection along the coast to offshore gradient.
The in situ of settling velocity data has been collected during two campaigns (see Table 1)

Deliverable D.2.1.1 – The validity of hypotheses 1 and 2 will be tested.
Hypothesis 1 has been validated.

Deliverable D.2.2.1 – A model will be available that has been confirmed and can be applied to the North Sea and the English Channel.
A partially validated model has been applied to the North Sea and English Channel data on satellite derived SPM concentration

Deliverable D.2.3.1 – Estimated settling velocities in the North Sea as an additional dataset to D.1.4.
Existing in-situ particle size data for the analysis of settling velocities have been gathered in stations W05, W08 and MOW1.

Deliverable D.3.1.1 - SPM concentration data from 2016 onward of the North Sea and the English Channel.
During the first year we have focused on long-term and continuous SPM concentration data from the year 2013 at the station MOW1 (southern North Sea).

Deliverable D.3.1.2 - New map products from satellite images.
The validated semi empirical model has been applied to the remote sensing SPM concentration data to generate maps of POM proxies as upgraded secondary data products. The temporal and spatial changes of these POM data have been analysed according to seasonal variability.

Deliverable D.4.1.2 A peer reviewed transdisciplinary publication on the spatial and temporal variability and the fluxes of fresh and mineral associated POM in the North Sea and the English Channel.
see Desmit et al. (2024)

4. PRELIMINARY CONCLUSIONS AND RECOMMANDATIONS

Two RV Belgica campaigns have been carried out, one in spring 2023 and one in winter 2023. A third one is planned during summer 2024. Most of the planned samples have been taken and most of them are analysed; some of the sensor data still need further treatment. They constitute a unique and global (on the scale of the North Sea) dataset along land-ocean transition zones in the North Sea.
The research activities have been focused on existing datasets of the Belgian part of the North Sea, partially validated with the new data. Coastal areas with elevated SPMC, and with strong alongshore, weak cross-shore currents, and horizontal salinity gradients, feature a coastal-offshore transition zone that can be identified based on temporal and compositional changes of the particles. Cross-shore and seasonal variabilities dominate the particle dynamics, suggesting that basin morphology (bathymetry) and biological activity mainly control the processes at play.

We have shown that the vertical enrichment of POM at the surface follows the same processes as along the horizontal cross-shore gradient, i.e. differential settling of mineral vs organic rich particles, which is a fundamental property of SPM in turbid areas. Additionally, the seasonal variation in the composition of SPM between surface and bottom waters, peaking in summer, corresponds to notable differences in the quality of POM at these depths.

5. FUTURE PROSPECTS AND PLANNING

Overview of the foreseen activities and planning for the next reporting period, taking into account the current state of the work and the intermediary results

WP1 Sampling and analysis

A last measuring campaign is foreseen in summer 2024.

WP2 Model refinement, validation and data analysis

Data analysis will focus on the task 2.3, i.e. settling velocity calculations.

WP4. Synthesis and transdisciplinary analysis

A transdisciplinary publication (together with the international subcontractors) on the dynamics and interactions of suspended mineral and organic particles will be submitted

6. FOLLOW-UP COMMITTEE

Date(s) of the meeting(s) and overview of the concrete contributions of the follow-up committee

Some members of the Follow-up Committee are regularly consulted through meetings online. A workshop with the follow-up committee and international experts has been organized in Brussels on 4-6 October 2023.

7. VALORISATION ACTIVITIES

7.1. PUBLICATIONS

Desmit X, Schartau M, Terseleer N, Van der Zande D, Riethmüller R, Fettweis M. 2024. The transition between coastal and offshore areas in the North Sea unraveled by the suspended particle composition. *Science of the Total Environment* 915, 169966. doi:10.1016/j.scitotenv.2024.169966

Silori S, Desmit X, Schartau M, Terseleer N, Riethmüller R, Fettweis M. Interaction of phytoplankton and mineral particles in a turbid coastal zone: How important is water clarity? (in prep.)

7.2. PARTICIPATION/ORGANISATION OF SEMINARS (NATIONAL/INTERNATIONAL)

Oral presentations, posters… and/or organisation of workshops, conferences, etc.

Organisation of a workshop

Workshop on "Pelagic Particle Dynamics in Coastal Systems", 4-6 October 2023, Brussels (Belgium), Organizing Committee: Desmit X, Fettweis M, De Rijcke M, Sabbe K, Terseleer N.

Oral presentations (presenting author is underlined)

<u>Fettweis M</u>, et al. 2023. Organic matter composition of biomineral flocs and its influence on suspended particulate matter dynamics along a nearshore to offshore transect. Workshop on Pelagic Particle Dynamics, 4-6 October, Brussels.

<u>Desmit X</u>, Schartau M, Terseleer N, Van der Zande D, Riethmüller R, Fettweis M. 2023. The transition between coastal and offshore waters unraveled by suspended particle composition. Workshop on Pelagic Particle Dynamics, 4-6

October, Brussels.

Silori S, Fettweis M, Desmit X, Lee BJ, Riethmüller R, Schartau M. 2023. Vertical profiles of Chlorophyll and SPM at seasonal and tidal scales in a turbid, well-mixed coastal zone. Workshop on Pelagic Particle Dynamics, 4-6 October, Brussels.

Tran D, Desmit X, Verney R, Fettweis M. 2023. Application of sediment composition index to predict suspended particulate matter concentration in the North Sea. 2023. Workshop on Pelagic Particle Dynamics, 4-6 October, Brussels.

Fettweis M, Delhaye L, Lee BJ, Riethmüller R, Schartau M, Silori S, Desmit X. 2023. Vertical variations of suspended particle composition reflect particle dynamics. INTERCOH, 18-22 September, Inha University, Incheon (Korea).

Tran D, Desmit X, Verney R, Fettweis M. 2023. Application of sediment composition index to predict suspended particulate matter concentration in the North Sea. INTERCOH, 18-22 September, Inha University, Incheon (Korea).

Schartau M, Fettweis M, Desmit X, Terseleer N, Riethmüller R. 2023. From brown to blue water: Unraveling spatio-temporal variations in organic matter composition of suspended particulate matter. ASLO Aquatic Sciences Meeting, 4–9 June, Palma de Mallorca (Spain).

7.3. SUPPORT TO DECISION MAKING (IF APPLICABLE)

none

7.4. OTHER

none

8. ENCOUNTERED PROBLEMS AND SOLUTIONS

Encountered problems/obstacles, implemented and/or considered solutions, if any.

In the PiNS contract four RV Belgica campaigns were foreseen during the first year (each season). This was not possible and only two campaigns (spring and winter) could be organized. Due to budgetary limitations (inflation) the fourth campaign was canceled (autumn). Remains to be executed is the summer campaign (foreseen in July 2024), this is crucial for the outcome of the project.

A problem arose in June 2024, which will affect the future of the project: the cancellation of all RV Belgica campaigns in 2024 and thus also of our July 2024 campaign. The probability is very high that even in 2025 no summer campaign will be possible. A cancellation of this basic scientific tool for a project that was funded in the in the framework of the specific call for the new RV Belgica, is a major event that will affect the outcome of the project significantly. Besides this, it may also affect our reputation as researchers and also the reputation of Belspo on an international level, see the international partners (subcontractors) that are involved in the project.

9. POSSIBLE MODIFICATIONS COMPARED TO THE PREVIOUS REPORT

COMPOSITION OF THE FOLLOW-UP COMMITTEE

Name, first name: ENGEL, Anja
Title, function: Prof., Researcher
Institution: GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany
Phone: +49 431 600 1510
E-mail: aengel@geomar.de

Name, first name: NEUKERMANS, Griet
Title, function: Prof., Researcher
Institution: UGent, Department of Biology, Marine Optics and Remote Sensing, France
Phone: +32 (0)9 264 85 16
E-mail: griet.neukermans@ugent.be
Name, first name: LEE, Byung Joon
Title, function: Prof., Researcher
Institution: Kyungpook National University, South Korea
Phone: +82 10 3126 0252
E-mail: bjlee@knu.ac.kr
Name, first name: SCHARTAU, Markus
Title, function: Prof., Researcher
Institution: GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany
Phone: +49 431 600 4212
E-mail: mschartau@geomar.de
Name, first name: VERNEY, Romaric
Title, function: Prof., Researcher
Institution: IFREMER, Dynamics of Ecosystems Research Unit, France
Phone: +33 2 29 00 85 33
E-mail: romaric.verney@ifremer.fr

10. REMARKS and SUGGESTIONS

Concerning for example: the coordination, the use or valorisation of the results, personnel change …

no remarks