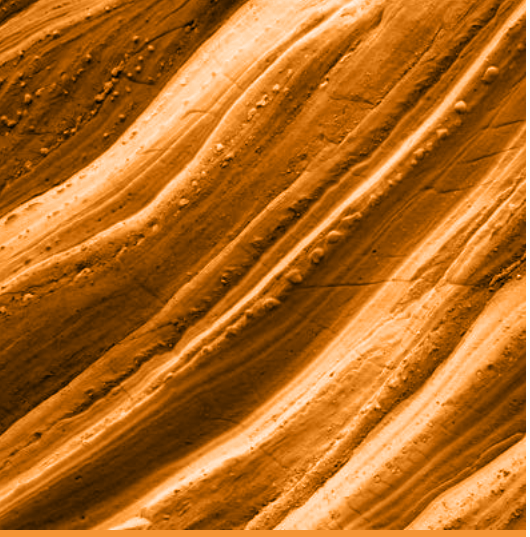
SedNet

Sediment management opportunities to address the climate change challenge

Summary & outcomes

Summary and outcomes of the Joint SedNet-Navigating a Changing Climate Workshop, held on 10th-11th of February 2021

NAVIGATING A CHANGING CLIMATE



Background

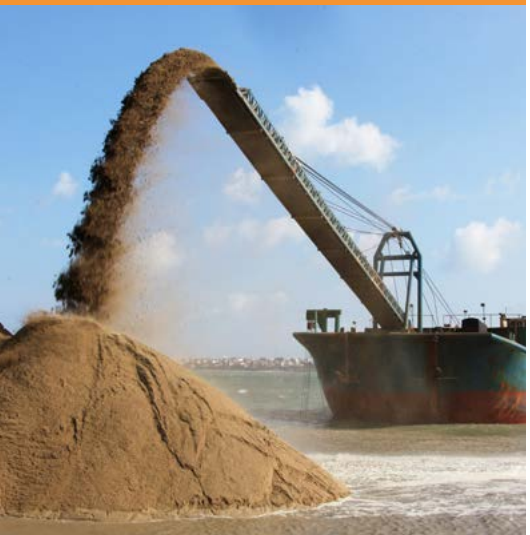
Navigating a Changing Climate and SedNet have collaborated to run a workshop exploring areas of comment interest. The workshop, entitled **'Sediment management opportunities to address the climate change challenge'**, comprised two consecutive half-day sessions. Navigating a Changing Climate is a PIANC-led Global Climate Action initiative under the UNFCCC 'non-state actor' process, set up to promote the sharing of knowledge on how ports and waterborne transport infrastructure can reduce emissions and adapt to climate change (find out more at https://navclimate.pianc.org/). SedNet is the European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management (see https://sednet.org/).

The aim of the workshop was to facilitate knowledge exchange, disseminate good practice, highlight opportunities, and identify gaps in understanding or research needs in relation to:

1. **THE ROLE OF SEDIMENT MANAGEMENT IN CARBON SEQUESTRATION AND STORAGE: OPPORTUNITIES TO CONTRIBUTE TO A NET REDUCTION IN GREENHOUSE GAS EMISSIONS**
2. **SEDIMENTS AND CLIMATE CHANGE ADAPTATION: SEEKING FLEXIBLE AND ADAPTIVE SOLUTIONS TO STRENGTHEN RESILIENCE AND ADAPT PORT AND NAVIGATION INFRASTRUCTURE AND OPERATIONS**
3. **HABITAT ENHANCEMENT AND CREATION, WORKING-WITH-NATURE AND OTHER NATURE-BASED SOLUTIONS**
4. **SEDIMENT MANAGEMENT, CIRCULAR ECONOMY AND THE WASTE HIERARCHY: REDUCE, REUSE, RECYCLE**

The four topics were explored with an emphasis on ports, waterways, dredging and associated infrastructure/activities.

It proved to be an inspiring workshop for sediment practitioners (policy and management) as well as scientists. Pdf-documents of the presentations can be downloaded from www.sednet.org/library.



Workshop programme

After a welcome and introduction by Marc Eisma, Port of Rotterdam Authority/SedNet Chairman, The Netherlands, and Jan Brooke, UK, Chair NavClimate and Chair PIANC Climate Change Task Group, the following four topics were addressed:

SESSION 1

Role of sediment management in carbon sequestration and storage: opportunities to contribute to a net reduction in greenhouse gas emissions

Moderator Jos Brils, Deltares, SedNet Steer group, The Netherlands

Sediments and their associated aquatic habitats play a vital role in sequestering and storing carbon. Understanding these critical natural processes can help sediment scientists, dredging managers, port and waterway operators and others identify win-win opportunities, for example related to sustainable dredged material management. This session provided an introduction to carbon sequestration in sediment; discussed some practical experiences of how sediments can be used in this context (Blue Carbon); and explored related issues such as water quality and the use of riverine and marine sediments on land.

Presentations:

- Carbon sequestration in sediments (by Mike Clare, National Oceanography Centre, UK)
- Blue Carbon: possibilities, challenges and perspectives for dredging and sediment management (by Erik van Eekelen, EuDA, Belgium, and Van Oord and ECOSHAPE, The Netherlands)
- Beneficial use of river sediments as topsoil for passive carbon capture and storage during land restoration and energy crop production (by Richard Lord, University of Strathclyde, UK)
- Restoration measures in shallow lakes: how improvement of water quality has the added benefit of reducing greenhouse gas emissions (by Wouter van der Star, Deltares, The Netherlands)

SESSION 2

Sediments and climate change adaptation: seeking flexible and adaptive solutions to strengthen resilience and adapt port and navigation infrastructure and operations

Moderator Katherine Cronin, Deltares, SedNet Steer group, The Netherlands

The resilience of port and navigation infrastructure is often intertwined with the resilience of the natural environment. Climate change will impact on both. Many ports and waterways will need to invest in strengthening the resilience of their infrastructure and operations to ensure business continuity, particularly in the face of more frequent and/or severe extreme events. Coastal and riverside towns, cities and local communities face similar challenges so there are common lessons to be learned. The inherent uncertainties in projections for rates of change in parameters such as rainfall, storms, wind and waves mean that flexible and adaptive solutions will offer the best way forward. Sediments can play a crucial role here, not only in relation to physical infrastructure solutions, but also understanding and managing morphological processes.

Presentations:

- Increasing the resilience of ports by using locally dredged sediments – a pilot application in the Port of Rotterdam (by Arjan Wijdeveld, Deltares, The Netherlands)
- An innovative technology to combine navigability and sustainability in port infrastructure (by Marco Pellegrini, University of Bologna, Italy)
- Nature-based remediation as a solution for heavy metal pollution in stream sediments to safeguard floodplains (by Froukje Kuijk, OVAM, Belgium)
- Sustainable and Resilient Coastal Cities - SARCC (by William Coulet, Exo Environmental Ltd., UK)
- Water depth forecasting for the purpose of navigation improvements – importance of accounting for river bed morphodynamics (by Rolien van der Mark, Deltares, The Netherlands)

SESSION 3

Habitat enhancement and creation, Working-with-Nature and other nature-based solutions

Moderator Jos Brils, Deltares, SedNet Steer group, The Netherlands

Nature-based solutions are moving rapidly up the international climate change agenda as a potentially cost-effective win-win solution to help address both the climate and ecological crises. At the same time, nature-based solutions are important to the achievement of national and international environmental protection objectives, some of which will become increasingly difficult to achieve due to climate change impacts on natural as well as built environments. This session highlighted these important climate-environment inter-relationships. It explored both ecological protection imperatives and practical experiences, highlighting the critical role of sediments and sediment management in the effective and sustainable delivery of nature-based solutions.

Presentations:

- Sediment in EU environmental policies (by Jeanne Boughaba, European Commission DG Environment, WFD team, Belgium)
- Beneficial Sediment Use and Nature-Based Solutions: opportunities for sustainable and circular developments (by Luca Sittoni, ECOSHAPE & Deltares, The Netherlands)
- Effective Defensive Mechanisms of Coastal Sediment Regeneration against the rising Sea Level (by Henry Odunsi, Earth Info Services, Nigeria)
- Peel Ports: Strategy for Beneficial use of dredged sediment (by Lisa Reilly, Peel Ports Group, UK)
- Technological Advances in Saltmarsh Restoration (by William Coulet, Exo Environmental Ltd., UK)

SESSION 4

Sediment management, circular economy and the waste hierarchy: reduce, reuse, recycle

Moderator Katherine Cronin, Deltares, SedNet Steer group, The Netherlands

The climate crisis and the ecological crisis are closely interlinked. But the COVID-19 pandemic has highlighted that societies are also vulnerable, and without a thriving economy, it is sometimes difficult to deliver the measures needed to redress the balance. Those responsible for sediment management have an important role to play in achieving this balance, enabling the continuation of essential economic activities whilst on the other as achieving the ecological balance between on the one hand retaining sediment in the natural system and on the other ensuring that contaminants do not compromise aquatic life and ecosystem functioning. In the context of the waste hierarchy (e.g. reduce the need for extraction of virgin aggregate); reuse (e.g. shift perceptions of sediment from a waste to a resource); recycle (e.g. optimising sediment placement), sediment managers have an important role to play within the circular economy concept.

Presentations:

- Sediment treatment in Hamburg as part of a circular economy (by Henrich Röper, Hamburg Port Authority, SedNet steer group, Germany)
- Assessing circularity of inland dredging activities: a new tool for the Dutch Water Authorities to pave the way towards a circular economy of dredge sediments (by Eldert Besseling, NETICS - The Sediment Engineers, The Netherlands)
- GEOWALL® technology as the key for unlocking the value of dredged sediments by reuse in civil structures and infrastructure (by Hugo Ekkelenkamp, NETICS - The Sediment Engineers, The Netherlands)
- A Pilot Study for the Nature-based Conditioning of Dredged Urban Canal Sediments and their Beneficial Reuse (by Keith Torrance, University of Strathclyde, UK)
- Towards a generalized circular use of salty dredged sediments: the Desalination of Slurries for Delta Protection project (by Maria Barciela Rial, HAN University of Applied Sciences, The Netherlands)

Results from the panel discussion

The four workshop sessions concluded with a panel discussion and an interactive session with the audience to determine:

- Key climate change-related challenges for sediment managers;
- Key opportunities for sediment management to contribute to addressing the climate change challenge;
- Key topics for further research and development.

In the tables below the challenges, opportunities and research needs as identified by the workshop participants during panel discussions and during the online Mentimeter questionnaire are summarized and categorized into the four workshop themes.

Eight climate change *challenges* for sediment managers as identified by workshop participants

	GENERIC CHALLENGE	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
1	**Attaining net zero** from sediment management activities	Need to take into account the complete greenhouse gas footprint of sediment management activities • Dredging and placement generates emissions due to sediment disturbance (methane/CO2) i.e. the release of stored organic carbon • Important to understand the long-term fate of stored carbon if sediment is disturbed • Ripening/drying sediments for re-use generates emissions; also when using sand for concrete (need to find an alternative 'sustainable concrete')	SS, RI, NBS, CE
		Delivering CO2 reductions reliably and cost-effectively remains a key challenge	SS, RI, CE
		Developing ways to minimise climate change impacts is crucial for sustainability	SS, RI, NBS
2	Dealing with **climate change consequences**, including uncertainties	Climate change uncertainties compound the lack of predictability in natural systems; small changes can affect the sediment balance; the past is no longer a reliable guide to the future • Need to develop improved understanding of process changes and risks due to climate change in order to reduce the uncertainties needed for sediment management decisions and related infrastructure design • Climate change is leading to changes in sediment fluxes e.g. changes in severity and frequency of extreme events (floods, drought, wind) • A wide variety of natural and anthropogenic factors contribute/lead to (cumulative) system degradation	RI, NBS, CE
		Issues with data availability and knowledge gaps; some are specific to the changing climate, others are compounded by climate change uncertainty; for example • Links between climate models and sediment load • Climate change impacts on sediment morpho-dynamics • Understanding of sediment-ecological relationships • Challenges of measuring and monitoring of long-term trends when there is additional climate change complexity and more extreme events	SS, RI, NBS, CE
		Need to develop new, risk-based standards for infrastructure design to push the boundaries on innovative solutions	RI, NBS, CE

* **SS = Sequestration / Storage** **RI = Resilient Infrastructure** **NBS = Nature-Based Solutions** **CE = Circular Economy**

	GENERIC CHALLENGE	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
3	Reconciling **sustainability** and adaptation needs with ongoing human activities	Human activities can disturb/release carbon stored in sediments	SS
		Climate change is exacerbating degradation (e.g. large-scale bed erosion) impacting human uses such as navigation	RI
		Ecosystems will change as the climate changes; solutions need to be adaptive Inherent conflicts between restoring nature and supporting human activities e.g. • Restoring natural sediment flows is an aspiration, but a return to undisturbed conditions is often not practicable because of human demands and use of space and resources • Delivering adaptation at the same time as achieving good water body status, including in physically modified water bodies, can be challenging	RI, NBS
		Tackling cumulative environmental degradation should be a priority; requires development of integrated approaches involving all users	SS, RI, NBS, CE
4	Tackling **perceptions** and scaling up	Reliability/justifying nature-based solutions for infrastructure: • Scaling up to deliver large scale restorations • Perception of beneficial use as expensive and/or difficult • Many excellent pilots but evidence is needed to justify new solutions, prove longevity, sustainability • Inter-organisational barriers need breaking down; improved understand of others' perspectives to facilitate upscaling • Making the business case is essential • Recognise sediment as a resource; include life cycle assessments • Be flexible and look to the future; things will change; innovation will happen	SS, NBS, RI, CE
		Need more technical guidance; consider combinations of solutions; embrace differences	SS, NBS, RI, CE
		Perceptions of sediment quality remain a challenge; need site-specific Environmental Quality Standards?	NBS, RI, CE
5	Facilitating **dialogue**, changing entrenched current practice	Communicate the sense of urgency to address climate challenges and need for change	SS, RI, NBS, CE
		Vital importance of effective stakeholder engagement, including for business case • Engage to identify win-wins and discuss/resolve possible objections or conflicts • Gaining acceptance of disruptive approaches • Different entities manage the sediment source and the destination/ recipient; build new relationships	SS, RI, NBS, CE

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	GENERIC CHALLENGE	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
6	Developing specific **technical know-how**	Further research/innovation and development is needed on: • Engineering options for contaminated sediment • Site specific environmental quality standards • New and emerging contaminants (pharmaceuticals, plastics) are being recognised in water; will affect sediments	CE, RI
		Specific technical challenges • Forecasting non-linear responses in carbon/pollutant flux • Determining burial fate/variability • Enhancing habitats (e.g. saltmarsh) in sediment-impoverished environments • Find ways to use fine sediments; develop new equipment • Opportunities for use of nutrients, gases, etc. in sludges/sediments • Re-naturing sediment streams where climate change compounds cumulative ongoing ecosystem degradation	SS, RI, NBS, CC
		Technical work on metrics/credits needed	RI, NBS, CE
7	Addressing **legal and regulatory** issues	Existing carbon neutrality policy focus is insufficient	SS, RI, CE
		Sediment re-use in nature involves regulatory, environmental quality standards and legal challenges • Policy needs to keep up with the science (metrics/credits, adaptive management) • Ecosystem services need to be properly acknowledged in legislative, regulatory and financing criteria • Need risk-based approaches enshrined in legislation; address disconnect between dynamic/uncertain infrastructure needs and static regulations • Challenge to convince regulators that innovative practices control risks in longer term • Tackle inter-organisational barriers • Tragedy of the commons: who pollutes vs. who bears cost of contaminated sediments	NBS, RI, CE
8	Availability of **finance**	Priority is developing effective strategies to get markets working • Net zero goals (e.g. via carbon credits) can help shape future financial frameworks • Create market demand linked to circular economy e.g. re-use products	SS, RI, NBS, CE
		Urgent need for infrastructure strengthening but often limited budgets	RI, NBS

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Eight climate change *opportunities* for sediment managers as identified by workshop participants

	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
1	Capitalise on sediment's **carbon storage** properties	Manage/optimise sediment's ability to trap and store carbon: • Protect and manage existing carbon stores • Retain and store carbon in relocated or recycled sediments • Implement (natural) blue carbon or human-managed carbon sequestration initiatives • Enhance/extend storage in biomass/vegetated sediments • Link sediments and landscape management • Account for storage and incorporate in NBS decision making at system level	SS, RI, NBS, CE
		Measure and predict blue carbon influence on the carbon resource	SS, CE
		Promote recognition that actions (to reduce emissions, sequester or store carbon) do 'count'	SS, RI, NBS, CE
2	Save costs and **reduce** transport **emissions**	Actively seek the right solution in the right place at the right time • (Re)use sediments in-situ or locally to reduce emissions associated with transport (e.g. of dredged material) • Reduce impacts of (maintenance) dredging; contribute to more sustainable ports	RI, NBS, CE
		Recognise and draw attention to co-benefits (e.g. for pooled funding opportunities)	SS, RI, NBS, CE
3	Apply **improved knowledge** and monitoring abilities to support adaptive management	Capitalise on e.g. Internet of Things; real time and remote monitoring	SS, RI, NBS, CE
		Use improved system understanding to help avoid unnecessary costs e.g. application of dynamic navigation width and depth (based on real time information)	RI, NBS, CE
		Specific technical opportunities • Monitor and assess carbon implications of sediment management (as already done for contaminants) • Improve desalinisation techniques to improve options for re-use of marine sediments	SS, RI, NBS, CE
		Accept/work with change; don't fight it	SS, RI, NBS, CE
		Recognise importance of timescales (30 years minimum for sustainability?)	SS, RI, NBS, CE

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	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
4	Contribute to achievement of UN **Sustainable Development Goals** (SDG)	Raise profile of sediment management linkages with SDGs. Use sediments to: • combat climate change and its impacts (SDG 13) • build resilient infrastructure (SDG 9) • reduce human pressures on land and water environments (SDG 13, 14)	SS, RI, NBS, CE
		Acknowledge role of sediments including blue carbon in achievement of Paris Agreement Nationally Determined Contributions (NDCs) (subject to understanding long term fate)	SS, NBS
5	Apply **nature-based solutions** (NBS) for societal/infrastructure resilience and nature co-benefits	Apply NBS at systems level; keep sediments in the system to strengthen resilience of ecosystem and infrastructure • Restore sediment regime to increase ecosystem resilience (resist extreme events, regulate water quality, reduce flood risk) but ensure ecological balance/avoid developing mono-functional ecosystems • Realise joint benefits of safeguarding nature areas and managing flood risk: contribute to improved resilience of infrastructure and society • Use sediments beneficially in soft sediment coastal environments and, solidified, for eco-reefs, etc. • Sediment nourishment options • Explore beneficial use in riverine (not only coastal) environments • Role of sediment management to address desertification	SS, RI, NBS, CE
		Develop/support climate adaptive infrastructure • Deliver multi-function infrastructure for next generation of construction and renewal	RI, NBS
6	Take advantage of **green recovery** initiatives	Capitalise on national (governmental) and international push to develop green, sustainable, circular or nature-based solutions • Take opportunity to review and revise policies, plans, standards, environmental quality standards to incorporate sustainable sediment management • Embed sediment management considerations in strategic planning e.g. river basin management plans • Incorporate sediment re-use in buildings, transport infrastructure, etc.	SS, RI, NBS, CE
		Ensure emissions are properly costed into sediment management decision making to drive incentives to innovate, capitalise on NBS and carbon storage options	SS, RI, NBS, CE

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	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
7	Continue to support **technological innovation**	Recognise that sediments are very amenable to circular economy thinking	RI, NBS, CE
		Promote circular use of sediments for infrastructure/nature-based solutions (e.g. to sea level rise)	RI, NBS, CE
		Develop new sediment management solutions • Solidification for greening grey infrastructure; re-use stabilised sediments to reduce economic and ecological costs of building materials • Promote dynamic depth/SMART infrastructure • Improve/apply bioremediation • Develop sediment pumping systems	SS, RI, NBS, CE
8	Embrace **stakeholder engagement** to identify and deliver win-wins	Identify innovative and multi-functional win-win solutions	SS, RI, NBS, CE
		Important to avoid unintended consequences	SS, RI, NBS, CE
		Link to business case and possible co-financing	SS, RI, NBS, CE
		Improve trans-national cooperation; cross-sectoral integration	SS, RI, NBS, CE

Key topics for further research and development, as identified by workshop participants

	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
1	Capitalise on sediment's **carbon storage** properties	Long-term observation/measurement/analysis:	
		• C sequestration in sediments	SS
		• In-situ organic C content in sediment	SS
		• C dynamics in beneficial reuse options	SS, CE
		Modelling:	
		• C sequestration in coastal sediments in different habitats (environments)	SS
		Management:	
		• Combining sediment management with organic C storage	SS, NBS, CE
		• The role sediment management in relation to the Global Carbon Market	SS, CE
2	Save costs and **reduce** (transport) **emissions**	• Dredging and impact on greenhouse gas emissions and C-Sequestration	SS, CE
3	Apply **improved knowledge** and monitoring abilities to support adaptive management	• Connecting technological and ecological solutions with governance	RI, NBS, CE
4	Contribute to achievement of UN **Sustainable Development Goals**	• Natural Capital Accounting	SS, NBS, CE
		• Quantification of the effects of sediment management practices on ecosystem services provision	NBS, CE
5	Apply **nature-based solutions** (NBS) for societal/infrastructure resilience and nature co-benefits	• Apply and test NBS in coastal highly energetic coasts	NBS
		• NBS for sustainable sediment management in river areas (we have learnt they work in coastal areas, let's dive more into rivers)	NBS
		• Sediment management geared to protect or enhance biodiversity	NBS
		• Harmonisation of standards and codes of practice to support practitioners to plan for and design NBSs	NBS

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	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
6	Take advantage of **green recovery** initiatives	• Erosion prevention, pollution prevention, restoring aquatic ecosystems	RI, CE
7	Continue to support **technological innovation**	Amendments to sediment:	
		• Use of sustainable concrete to reduce the need for sand extraction	RI, CE
		• Longer term performance of sediment-amended products, particularly contaminant leaching and volatilization	RI, CE
		• Green Cements and binders for sediment stabilization	RI, CE
		• Comprehensive performance standards for various infrastructure applications of stabilized sediment for beneficial reuse options: beyond permeability/strength (this adds to engineers' confidence in beneficial use)	RI, CE
		• Amplified sequestration of CO2 in stabilized sediment and/or use of low CO2 additives (low CO2 cement, non-cement products)	SS, RI, CE
		• Sediment treatment and resulting behaviour, technology needed and ways to move forward legally	RI
		Management:	
		• Offshore dredging and impact on C sequestration	SS, RI
		• Combining sediment management with organic C storage	SS, RI, NBS, CE
		• Beneficial reuse options and their business case: defining added value (as much as possible)	RI, CE
		• Beneficial reuse options for sediment accumulated at dams	RI, CE
8	Embrace **stakeholder engagement** to identify and deliver win-wins	• Beneficial reuse options	RI, NBS, CE
		• Connecting technological solutions end ecology with governance	SS, RI, NBS, CE
		• Harmonisation of standards and codes of practice to support practitioners to plan for and design NBSs	SS, RI, NBS, CE
		• Management of sediment influx from further upstream from the coast, for example in delta's or rivers	RI, CE

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	GENERIC OPPORTUNITY	SPECIFIC COMMENTS AND EXAMPLES	CATEGORY*
9	**Improve understanding** from micro to entire systems scale and/or **cross-cutting**	(Long-term) observation/measurement/analysis:	
		• C sequestration in sediments	SS, NBS
		• Soil-sediment balance	CE
		• Sediment budgets (including sources and sinks) in estuaries	CE
		• From sediment to soil and vice versa: how does the behaviour change (including contaminant emissions)	CE
		Modelling:	
		• Sediment fluxes in global hydrological models	CE
		• Sediment accumulation in reservoirs	RI, CE
		Management:	
		• Incentivize agriculture along river basins to increase sediment load	RI, NBS, CE
		• A way to deal with large amounts of methane trapped under ice barriers	SS
		• Hard to put name on one topic. Interested in cross cutting issues and framing	SS, RI, NBS, CE
		• Management of sediment influx from further upstream from the coast, for example in delta's or rivers	NBS, CE
		• Quantification of the effects of sediment management practices on ecosystem services provision	RI, NBS, CE

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NAVIGATING A CHANGING CLIMATE

Further information/ contact:

For further information about NavClimate and SedNet see the websites:
https://navclimate.pianc.org and https://sednet.org

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