

Real-time forecast systems for Environmental effects of Dredging activities

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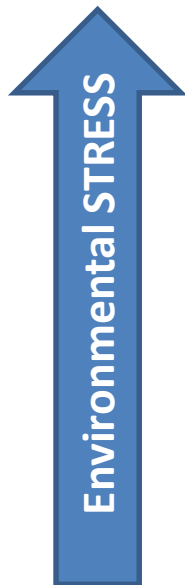
Environmental Scope of Dredging Projects

- Increasing Environmental Awareness
- Int. & Nat. Legislation on Environmental Protection
- Project-Specific Contractual Environmental Objectives for Sensitive Receptors:
 - Ecosystems (eg. Mangroves)
 - Benthic habitats (eg. Coral reefs, Seagrass, ...)
 - Marine and Estuarine Fauna and Flora



Environmental Scope of Dredging Projects

- Env. Objectives are translated to Trigger levels for near-real time measurable (eg. turbidity) parameter with stepwise management actions if breached:

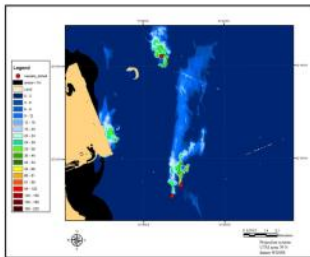


- Trigger level 3: STOP dredging
- Trigger level 2: Operational actions (reduced overflow, move dredging equipm.,...)
- Trigger level 1: Investigate and increased monitoring



Real-Time Data Management Systems

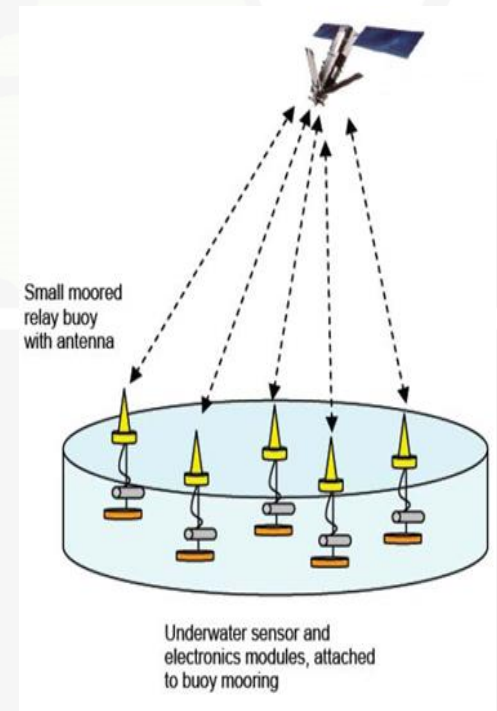
- Quick response times and impact prevention necessitate real-time data gathering
 - Compliance Env. Monitoring at Sensitive Receptor Sites (trigger level checks) with real-time data-exchange.
 - Metocean Conditions (Operationability)
 - Daily Remote Sensing Images



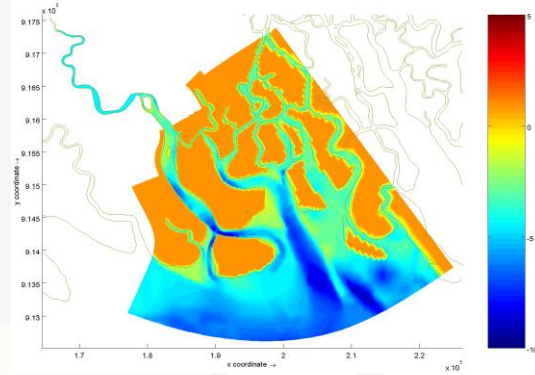
Real-Time Data Management Systems

- Via satellite/radio/3G/WIFI/GSM network instruments at fixed locations send out turbidity data that is QA-QC-ed and checked vs trigger level usually set as an intensity-frequency-duration value:

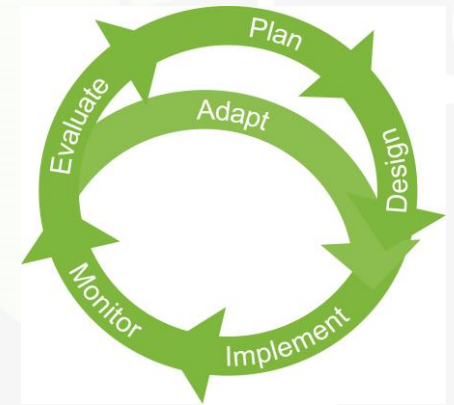
Eg. Daily median turbidity at sensitive area cannot exceed X NTU (intensity) for more than Y days (frequency) in a Z day period (duration)



Sediment Plume Modelling



- Tender Phase – Mobilisation Phase:
 - Sediment plume modelling can explore future impact of dredge execution scenarios:
 - MODEL RUN of EXECUTION SCENARIO
 - EVALUATE MODEL OUTPUT at SENSITIVE RECEPTORS vs TRIGGER LEVELS
 - ACCEPT or REJECT EXECUTION SCENARIO
- Assumptions of Metocean Conditions ('typical' seasonal scenarios), Dredge Execution Methods (soil information, productions).



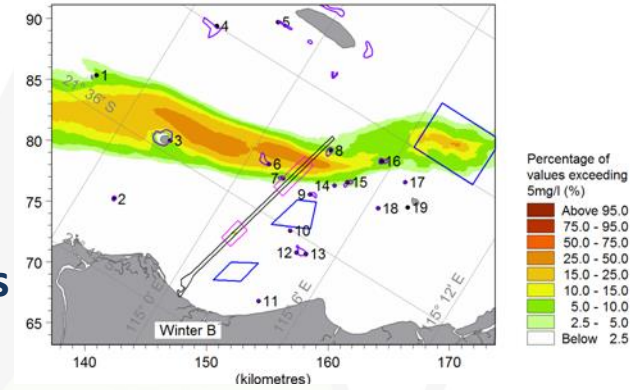
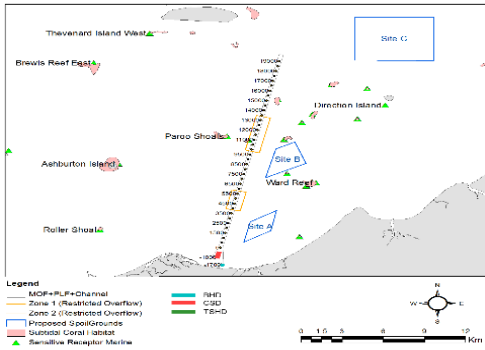
Operational Forecasting Systems

- In situ real-time **monitoring** between dredge works and receptors for fast intervention (forecast: a few hours)
- Early Warning Monitoring System: fixed stations to be moved with dredging works.
- If wanted: internal trigger levels can be set up

Operational Forecasting Systems

- Real time forecasting modelling for evaluation of scenarios and execution methods – Steering Dredging Works to avoid stoppage (forecast: 3-7 days)
- Improve forecasting with measurement data: Hindcasting = validation of model and improving forecasting abilities with in-situ measurements and available data

= Pro-active Adaptive Management eg.
EcoPAM



**SEDIMENT
PLUME
MODEL**

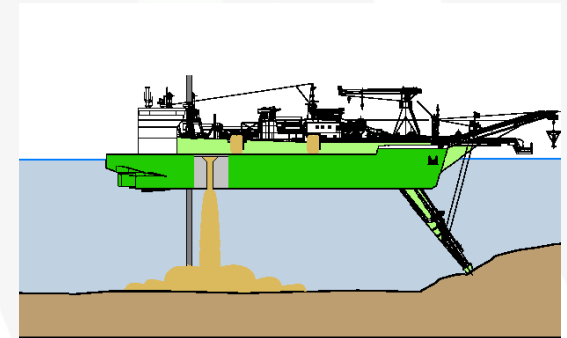
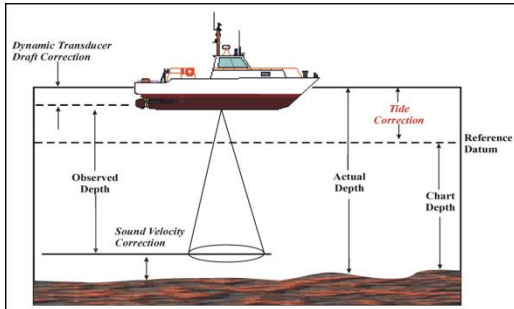
**EVALUATE vs
TRIGGER
LEVEL**

ADAPT

**MEASUREMENT
DATA**

**DREDGING
SCENARIO**

**DREDGE &
MONITOR**



Operational Forecasting Systems

- Integration of monitoring and modelling for operational forecasting systems together with
 - Automated processes for trigger level calculations
 - Remote Sensing images for validation and dredging process observation (plume dimensions)
 - Hindcast for model validation, dredge process-learning.
 - In the past REACTIVE mgmt, now Pro-ACTIVE!



Conclusion – Future of OFS

- Very useful operational tool for dredging projects with increased environmental compliance
- Pro-active instead of Reactive management
- Tool for adaptive management, learning about environmental impact
- Future: Smart modelling (Machine Learning)

Questions?

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