Continuous Real-time Monitoring of Estuarine Environments in Dublin

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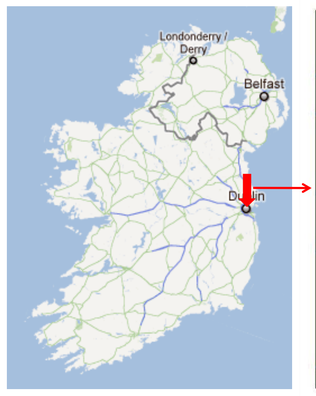
Background.

The growth of population in the coastal areas and the ever increasing density of marine transport translates into an elevated pressure on these water bodies. Effective monitoring is inherently hard to achieve using grab sampling regimes and low frequency sampling. Emerging sensor technologies and high frequency monitoring can provide additional information on the variability of pollutants as well as early detection of special events. As a result, the ability to characterize dynamic and hydrologic properties at adequate temporal and spatial scales has greatly improved. **MESTECH** has deployed two autonomous portable water quality monitoring systems in Dublin Port and Malahide Marina. The systems are ideal for applications where a rapid response is required as they are deployable in under 30 min, and their size and portability allow them to be used to collect data from hard to access or remote locations.

Site Description: Dublin Port

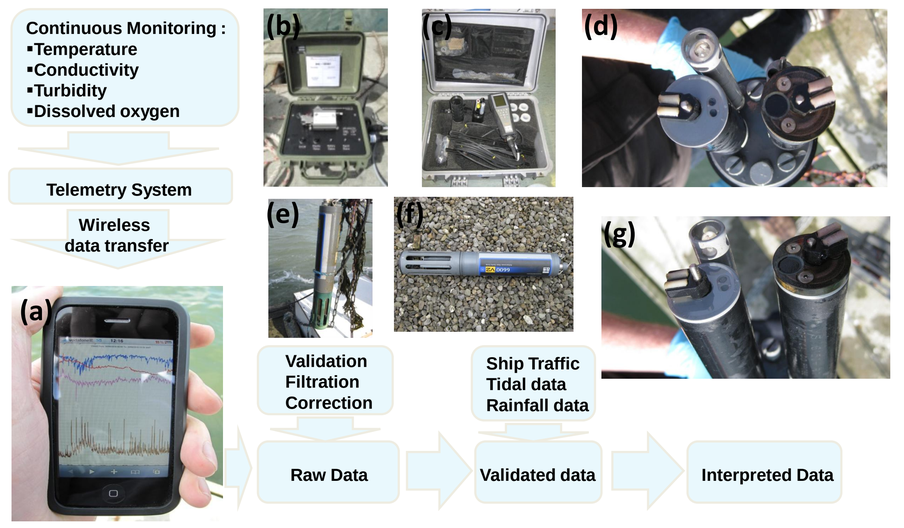
Dublin Port is located on the Lower Liffey Estuary (macro-tidal estuary highly salinity stratified). Constantly changing and dynamic water body (anthropogenic activity, tidal flushing, WWTP discharges, fresh water inflow).



Malahide Marina

Malahide Marina is located on the Estuary of River Broadmeadow. The site is divided by a railway viaduct and host important species of birds and plants.

System. Data Collection Process.



Scheme 1. Data collection, analysis and interpretation, (a)- real time data visualisation in the field using smart phones, (b)- telemetry system, (c)- YSI Pro-Plus hand held sensor used for on-site validation, (d), (e), (f), (g)- YSI 6 series sonde.

Results. Dublin Port

Deployment period (7 months): 1st Oct. 2011-1st May 2012; Frequency of Sampling:15 min; Depth: 2,5 m from the water surface.
Four turbidity events recorded: 1,2,3 were attributed to heavy rainfall and no. 4 was attributed to an increase in primary production (Fig. 1).

Parameter	N	Range	Minimum	Maximum	Mean
Temperature (°C)	20401	11.90	3.20	15.10	8.62
ODO (mg L^{-1})	20401	9.03	5.16	14.19	9.56
Turbidity (NTU)	20401	95.00	0.20	95.20	5.38
Salinity (ppt)	20401	14.05	16.95	31.00	30.35
Total	81604				

Table 1. Data Output from the multi-parameter sonde.

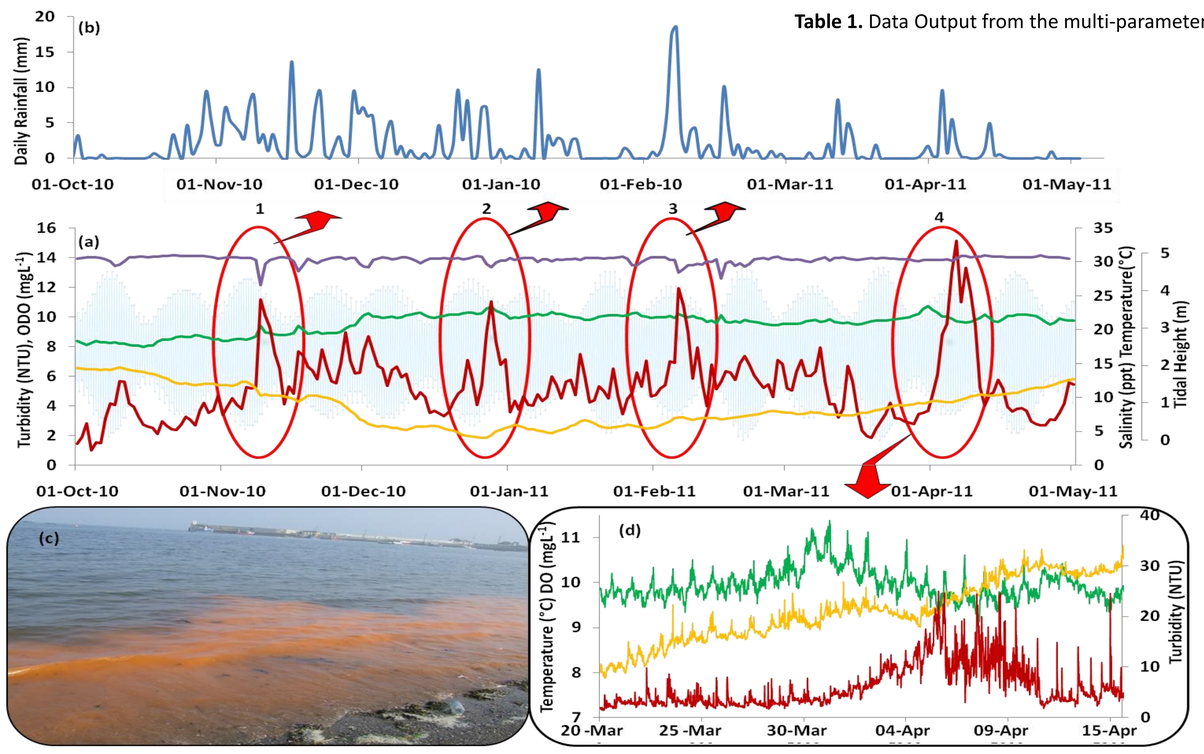


Fig 1. Averaged data set for the seven months deployment period and major events in this period.
(a) Plot of daily averages : —Turbidity (NTU), —ODO (mgL^{-1}), —Salinity (ppt) , —Temperature (°C) and —Tidal Height (m). (b) —Daily rainfall.
(c) Picture taken by the Skerries Coast Guard on 19th of April showing an algal bloom.
(d) Time series of DO, temperature and turbidity raw data from the 20th of March until 15th of April.

Turbidity and Ship Traffic in Dublin Port

Ferries coming in and out of Dublin Port have a pronounced effect on turbidity readings by resuspending river bed material and creating an artificial vertical mixing of the water body (Fig. 3).
Higher amounts of sediments are resuspended by the arriving ships due to the turnover procedure (Fig. 2).

Fig 2. Explanation for the different effects on turbidity of the arriving and departing ferries.

Fig 3. The impact of P&O ferries activity in Dublin port on the turbidity readings small time. The arrival and departure times of P&O ferries and the turbidity readings for 3 different days.

Results. Malahide Estuary

Deployment period (3 months): 1st March 2012-1st June 2012;
Frequency of Sampling:15 min; Depth: 2,5 m from the water surface.
It was found that for the duration of the deployment tidal cycle had a pronounced effect on all the measured parameters.

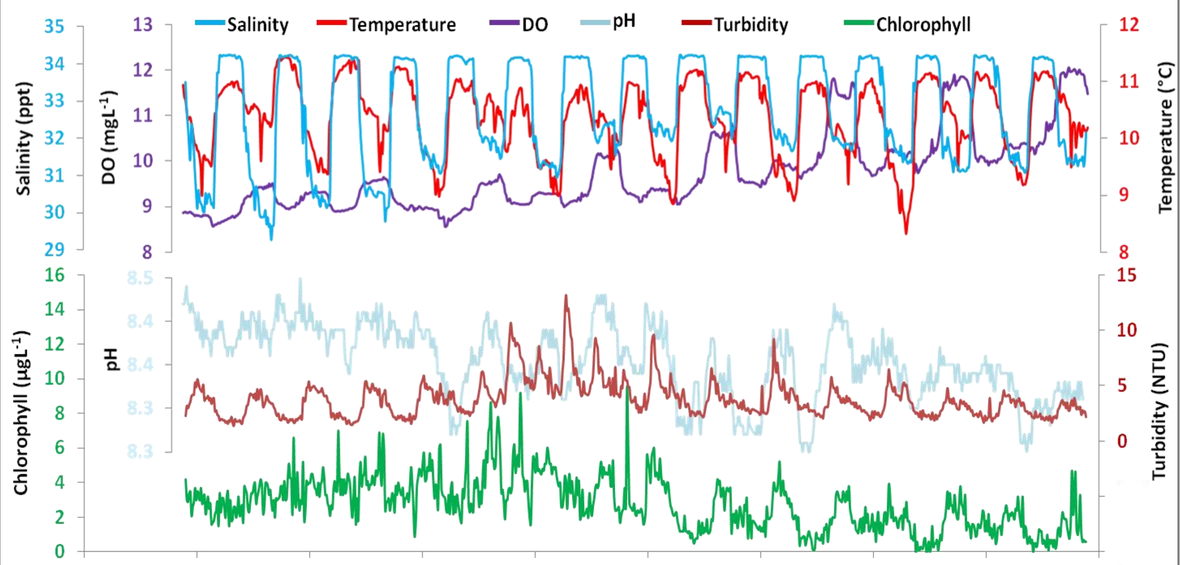


Fig 4. Sample data collected from the YSI sonde from the 20th of March 2012 until the 28th of March 2012.

Summary of findings

In a constantly changing environment influenced by so many factors continuous monitoring has overcome the limitations of grab sampling regimes.
Ship traffic within Dublin Port has a pronounced effect not only on the daily turbidity readings but also on the entire averaged turbidity data set (same pattern, Fig. 5, Fig. 2).
Continuous monitoring should be employed for exploratory purposes in such challenging environments as it has the potential to be used as a decision support tool to aid in the development of future effective monitoring programs.

Fig 5. Average turbidity values for the entire data set at each sampling time during the course of 24 hours; ⊢⊣Time periods for the arrival of the ferries over the deployment period.

Acknowledgements

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