Geo-Mar Lett (2012) 32:85–87
DOI 10.1007/s00367-012-0279-x

INTRODUCTION

Contributions from Particles in Europe (PiE) 2010, Villefranche-sur-Mer, France: an introduction

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Received: 17 January 2012 / Accepted: 27 January 2012 / Published online: 1 March 2012

Abstract This special issue of Geo-Marine Letters presents selected contributions from the international conference Particles in Europe (PiE) 2010 organized by Sequoia Scientific, Inc., and the Laboratoire d'Océanographie de Villefranche (LOV) on 15–17 November 2010 in Villefranche-sur-Mer, France, and guest-edited by Ole Mikkelsen, Malik Chami and David Doxaran. PiE was initiated in 2008, in order to promote and further our understanding of the importance of suspended particulate matter (SPM) for a very wide range of processes in the aquatic environment—from optics and acoustics, over sediment transport, to the global carbon balance. The papers in this special issue are in particular concerned with the interaction between SPM and water optical properties, as well as how to use optical proxy measurements to understand SPM processes. The next PiE conference is scheduled for 17–19 October 2012 in Barcelona, Spain.

Preamble

The international conference Particles in Europe (PiE) 2010 was held on 15–17 November 2010 in Villefranche-sur-Mer, France, organized by Sequoia Scientific, Inc., and the Laboratoire d'Océanographie de Villefranche (LOV). Eight peer-reviewed papers have been selected for inclusion in this special issue of Geo-Marine Letters, guest-edited by Ole Mikkelsen, Malik Chami and David Doxaran.

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In one way or the other, these contributions all deal with the measurement and understanding of suspended particulate matter (SPM) dynamics in coastal and inland waters, or with the influence of SPM on water optical properties. Several of these papers demonstrate the advantage of using optical proxy measurements of SPM: it allows for a significant increase in the amount of data related to SPM properties such as concentration, size, and organic content. In turn, this enables better studies of suspended sediment transport processes in order to gain knowledge on the dynamics and export of suspended matter from land into the coastal ocean, and further into the deep sea. The remainder of the papers is more concerned with the actual influence of SPM on water optical properties. In more than one case, their findings demonstrate the limitations of the optical proxy measurements. This is a topic of great importance for those actually using optical proxies to understand SPM processes. A synthesis of the focus of the papers found in this special issue is given below.

Synthesis

Lorthiois et al. (2012) employed in situ bio-optical and ocean color remote sensing measurements to evaluate SPM dynamics in the Rhone River plume discharging into the Mediterranean Sea. They demonstrate that the remotely sensed particulate optical backscattering coefficient can serve as a robust proxy for SPM in the Rhone plume and, furthermore, that the SPM load is constrained largely within the upper 5 m of the water column during flood events. These findings can help improving predictions of SPM transport rates as well as the fate of SPM based on sediment transport models.

Lefebvre et al. (2012), working in an estuary of the Red River delta in northern Vietnam, assessed the seasonal floc size distributions of cohesive particles in an attempt to better understand the regional estuarine suspended sediment transport patterns. In the wet season, high turbulence levels associated with increased freshwater flow lead to the break-up of flocs and sediment export seawards. In the dry season, floc breakup is strongly reduced and flocs settle faster; in combination with tidal pumping, this causes siltation in the shipping lanes.

Fettweis et al. (2012) recorded the size distributions of suspended particulate matter in bottom waters during storms in the Belgian nearshore sector of the southern North Sea. Particle size distributions (PSDs) were classified in terms of subtidal alongshore flow, by means of entropy analyses. The PSDs during storms with a NE-directed alongshore subtidal current are typically unimodal and characterized by mainly granular material (silt, sand) resuspended from the seabed. During storms with a SW-directed alongshore subtidal current, by contrast, the PSDs mainly comprise flocculated material. Together with data on SPM concentrations, the authors found that storm winds blowing from the NE cause the formation of a highly concentrated, near-bottom mud suspension layer that armors the sand bed.

Working in roughly the same geographical region, Rivier et al. (2012) present a study from the English Channel concerned with measuring and understanding the seasonal variability of surface water turbidity, an important aspect in terms of biological productivity. For this purpose, it is necessary to be able to tease apart those pools of suspended particulate matter that are composed of algae-related and non-algal particles. Using data from the MODIS and MERIS ocean color remote sensing platforms, the authors developed a statistical model to evaluate how tides, waves, and flocculation processes influence seasonal regional trends in surface water turbidity. Model predictions of surface concentrations of non-algal suspended particulate matter are good, reaching coefficients of determination of about 70% for certain sectors of the English Channel.

The ultimate fate of suspended particles is their deposition in the course of settling. In doing so, they commonly act as export agents for carbon. Consequently, flocculation processes and settling of suspended particles has long been recognized as an important part of the global carbon cycle (De La Rocha et al. 2008). In this special issue, Bressac et al. (2012) present a mesocosm study aimed at improving our understanding of the processes involved in the settling of particulate organic matter aggregated with Saharan dust particles. They used optical proxy measurements to distinguish organic-rich particle assemblages from inorganic ones, and tracked the formation and settling of flocs through the water column. They demonstrate that particle export is driven partly by organic–mineral aggregate formation in the surface layer, in turn controlled by the amount of organic matter and resulting in settling speeds of aggregates reaching 86 m/day.

Bowers and Braithwaite (2012) report evidence that the reflectance of a turbid water body is better correlated with the cross-sectional area than with the mass concentration of SPM. A key implication of their findings is that, in order to interpret satellite data in terms of mass concentration, it is necessary to establish site-specific relationships between the particle cross-sectional area and mass. This is not straightforward—the authors report considerable variation in the former parameter for particles of a given size and mass in western UK coastal waters.

In his paper focusing on the modeling of coral reef SPM optical properties based on the FDTD (finite difference time domain) approach, Hedley (2012) demonstrates differences between scattering from particles of equivalent volume but variable shapes. Computation of the angular scattering from non-spherical particles—such as sediment particles—assuming that they are spheres can lead to large errors in estimates of attenuation as well as scattering coefficients. This is potentially a concern for all involved in deriving proxy parameters for particle characteristics based on remote sensing as well as other optical instrumentation.

Finally, Kopelevich (2012) provides a selective review of work done in Russia over the last 3–4 decades on the application of optical properties for studying SPM parameters such as volume and mass concentration, as well as optical parameters such as the volume scattering function. Many of the results in his paper are here presented for the first time in English.

Acknowledgements We heartily thank all authors, as well as numerous peer-reviewers and colleagues for their efforts in improving the quality of contributions to this special issue.

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