Sediment Graphs, Importance and Development

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Abstract

Sediment graphs are a graphical presentation of sediment fluxes with respect to time. The sediment graph facilitates hydraulic structural designers, planners and decision makers to have a proper and sound idea about temporal variation as well as the total amount of sediment yield passing from a control point. An effective and compatible design of hydraulic structures and their management can therefore be made using the accurate evaluation of sediment yield obtained through applying sediment graphs. There are several ways viz. continuous sediment sampling, unit sediment graph, conceptual approaches and empirical models to gain sediment graph out of which models based on accessible discharge data as well as watershed physical characteristics can be developed which are more applicable in countries where lack of sediment data exist. In the present paper, an attempt has been therefore made to present some techniques in which sediment graph is developed with an acceptable level of accuracy. The suggested concepts and approaches were ultimately applied for Khanmirza, Amameh and Kassilian watersheds in Iran each bearing different conditions and the corresponding results were also presented in the paper.
Numerical analysis of surface-subsurface mass transfer and residence times at a riffle-pool pair in the Lahn River, Germany

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Abstract

Surface-subsurface exchange at the surface water-riverbed-sediment interface is an ecologically important process, controlling the nutrient supply in the upper riverbed sediments and through this the benthic habitat quality. To investigate the controlling parameters and their influence on mass transfer and residence times, we analyzed the hydraulic exchange at a riffle-pool pair in the River Lahn, Germany. We used HEC-RAS to simulate the surface water flow as a boundary for the subsurface flow and MODFLOW, MODPATH, and MT3DMS to reproduce the transport in the subsurface. Field studies provide the basic data for input to these models.

Hydraulic heads within the interstices, solute transport, and residence times of surface water in the subsurface were simulated. To reproduce spatial and temporal changes in fluvial sediment properties, we determine sediment parameters for different surface water flow rates and distribute the parameters smoothly over the longitudinal profile of the river reach. The sediment parameters are calibrated to fit measured hydraulic heads and tracer throughflow curves from the pool-riffle pair.

The simulations show that although the surface water flow plays an important role for the surface–subsurface, also called hyporheic, exchange at the study site, the influence of the sediment properties on the exchange is larger. About the same percentage of surface water enters the hyporheic zone for each of the different flow conditions. Densely packed sediments reduce the exchange. Anisotropy increases the hyporheic exchange for low and medium surface water flow and has the opposite effect for high flow. Flux weighted residence times were short at low flow and longer at higher flow.
Zonality of anomalous manifestation of suspended sediment yields in river basins on the east of Russian plain

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Abstract

On the basis observation of differences in the amounts of annual suspended sediment yields there are shown its anomalous manifestation. Anomalies are classified as small, large and extreme. The main factors of anomalous manifestation of suspended sediment yields in 16 river basins on the east of Russian plain are determined. The expression of positive anomalies of suspended sediment yields is so much the larger, the lesser the basin, the more southward the zone is situated, and the more intensively the landscape is anthropogenized. And vice versa, the expression of negative anomalies increases northward with less intensive cultivation and larger catchment basin areas.
Effect of the Environmental Parameters on the Distribution of Benthic Foraminifera in the Coastal Area of Ras Al-Khaimah, United Arab Emirates

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Abstract

This contribution describes the relationship between environmental parameters and the abundance of benthic Foraminifera, the ratio of living to dead foraminifera, and the diversity of foraminiferal tests in sediments from the coastal area of Ras Al-Khaimah, United Arab Emirates. The most common foraminifera are the agglutinated types, followed by the porcellaneous foraminifera, while hyaline shells are least common. The principal foraminiferal associations are those of \textit{Penerolips plantus, Quinqueloculina neastrictula}, \textit{Quinqueloculina cooki, Triloculina sp.}, \textit{Ammonia beccarii, Elphidium crispum} and \textit{Texularia sp}. Other Milliolina, Textularina and Rotallina are also noted. Most of the foraminiferal assemblages are consistent with those of normal marine to hypersaline marine environments. Dissolution of calcareous foraminiferal tests is recognized and some samples contain high percentages of blackened foraminifera. The blackened foraminiferal tests observed in the study area could be attributed to the decomposition of organic matter as well as to the effect of pollution. Cluster analysis based on the results of foraminiferal analysis show that the sediment samples can be divided into two groups. These groups correlate with those based on the ternary diagrams which show proportions of the three foraminiferal types (Hyaline, Agglutinated and Porcellaneous) for the total (living & dead) counted foraminiferal species. The two groups correspond to the western and eastern area of the seafloor separated by the Al-Khor opening.
Metals accumulation in the sediments of the offshore area, United Arab Emirates

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Abstract

The present study aims at the quantification and assessment of heavy metal concentrations and pollution in offshore sediments, off Abu Dhabi, Dubai and Sharjah. Thirty-three sediment samples were collected and subjected to grain size analysis, organic carbon and total carbonate determinations, mineralogical analysis and heavy metal (leachable and residual parts) determination. The contents of organic carbon of the study areas vary within a wide range. The maximum is recorded at Dubai and the minimum exists at Abu Dhabi. There is a trend of increasing organic carbon with decreasing grain size. In contrast to organic carbon, carbonate contents in the sediments vary within a narrow range. XRD analysis reveals that carbonate minerals represent about 75\% of the total minerals in the sediments of the three sectors. Generally, the spatial variations in the mineralogy of the sediments could be attributed to differences in their sources and prevailing hydrodynamic conditions. Characterizations of the leachable phases of some metals in the studied sediments show that Fe has the lowest, whereas Ca has the highest percentages of leachable species. Ni, Sr, Mg and Mn (in descending order) have intermediate concentrations. In the present study, Fe is used primarily as a normalizing element and its relationships with other metals (total concentrations) has been investigated. The calculated index of geoaccumulation (Igeo) indicates that Igeo values for different sites are low as they fall into the lowest grades of Igeo. The recorded low values of Igeo for various metals indicate that sediments of the offshore areas as well as those of the creek have a minimum metal pollution accumulation except for those of Ni.
Organic matter mineralisation beneath the Chalk Stream Water Crowfoot (*Ranunculus penicillatus* var. *calcareous*)

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Abstract

In recent years ground-water fed rivers throughout lowland England have exhibited increases in particulate matter loads. The subsequent trapping of particulate matter by aquatic macrophytes and biochemical transformation of the associated organic fraction also requires quantification. This research aimed to quantify and understand the processing of organic matter and subsequent inorganic nitrogen cycling in the sediment trapped beneath macrophyte stands.

*Ranunculus penicillatus* var. *calcareous* is the dominant submerged macrophyte in many unshaded, lowland chalk rivers of the UK. The study investigated the mineralisation of organic matter trapped beneath *Ranunculus* spp. in the River Frome, Dorset (UK), a groundwater-dominated river system. Benthic chambers were developed to withstand high flows and deployed in *Ranunculus* spp. stands, to sample nutrient exchange across the sediment water interface. Water samples were taken every two hours over an eight-hour period from the chambers, and the change in nutrient concentration used to calculate sediment water exchange rates. Sampling was carried out monthly at three sites, over the *Ranunculus* spp. growing season (April-November).

easonal rates of oxygen uptake and nutrient exchange were integrated with respect to time to estimate seasonal integrals. The average rate of uptake was 4.32 mol m⁻² for NO₃⁻ and 9.07 mol m⁻² for O₂, the efflux of NH₄⁺ was 0.67 mol m⁻² and for NO₂⁻ 0.17 mol m⁻², over the growing season. Sediment O₂ uptake suggests ~8% of the deposited organic carbon (115 mol m⁻²) was mineralised, and in turn ~5% of the organic nitrogen (20 mol m⁻²) was released into the water column as NH₄⁺. These calculated rates of exchange indicate that *Ranunculus* spp. stands are intense areas of biogeochemical processing, with important implications for the control of eutrophication in lotic systems.
The dynamics of sediment delivery to streams by soil pipes in rainforest catchments, Malaysia

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Abstract

There is growing evidence of the importance of soil pipe systems in forested humid tropical catchments but their role in sediment and water delivery to streams have rarely been systematically assessed. This paper presents results from an investigation into soil pipe and stream suspended sediment dynamics in small rainforest catchments at Danum Valley in Sabah, Malaysia.

Inputs of sediment to small streams by pipe flow were continuously monitored in two zero-order catchments for 16 months. Data loggers were programmed to record mean turbidity and water depth every fifteen minutes from probes positioned behind 120° v-notch weirs. In one catchment, two pipe flow sites were monitored, and in the other catchment, a pipe and the ephemeral stream into which it feeds were monitored.

Pipeflow was found to be an important contributor to stream discharge and sediment loads: a single monitored pipe accounted for approximately 47% of flow and 22% of the sediment budget of the stream into which it feeds over the monitoring period. A dataset comprising 109 storm events of a range of rainstorm magnitudes, intensities and antecedent conditions is analysed. Pipe flow and stream flow discharge and suspended sediment responses to rainfall are rapid and characterised by clockwise hysteresis. Peak pipe flow and stream flow suspended sediment concentrations frequently exceed 1000 mg l⁻¹ and occasionally exceed 3000 mg l⁻¹. Correlation and multiple regression analysis are used to explore the influence of storm rainfall and indices of rainfall intensity and antecedent rainfall on discharge and suspended sediment responses. The influence of temporal changes in the connectivity of pipe segments and episodic collapses and blockages in pipe systems are discussed.
Performance of a flushing event at the run-off river plant Bodendorf in Styria/Austria

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Abstract

The run-off river power station Bodendorf is the head storage of the upstream first series of power stations at the river Mur. The mean annual sedimentation rate for this reservoir is about 40.000 m³. Since 1994 flushings with drawdown are undertaken at regular intervals. An initial channel and groins at the beginning of the reservoir were installed in 2003 for enhancing the efficiency of the flushings. In June 2004 a flushing was carried out which was supervised by the Department of Hydraulic Engineering and Water Resources Management. Echo sounder surveyings before and after the flushing, measurements of suspended sediment concentration, bed load transport and hydraulic gauging were done (1) to determine a sediment balance of the flushing event, (2) to evaluate the effects of the groins and the initial channel and finally (3) to get data for numerical modeling concerning hydraulics and sediment of the flushing events. The purpose of this work, which was performed for the Interreg IIIb Project ALPRESERV (www.alpreserv.org), is an improvement of the flushing management at run-off river plants.
Sediment-water interaction in the hyporheic zone

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Abstract

Remobilized river sediments can obviously be an important source of particle bound nutrients like phosphorus (P). But can river sediments also contribute to nutrient loads in river water during non-erosive discharge?

In order to assess the potential of “stable” sediments in contributing to nutrient loads the Schneckenbach catchment (4 km²) was select as study area. It is situated in the southernmost part of the Black Forest, Germany, a gneiss and granite dominated mountainous area with forest and extensive grassland use. The Schneckenbach is characterized by low suspended sediment (SS) yields and unexpected high P-loads for its land use.

The hypothesis that (re-)solution of sediment-P in the hyporheic zone contributes to river water P-loads implies significant exchange rates between sediment and river water. This experimental study is therefore focusing on interactions (exchange rates) between river and hyporheic water. An approx. 50 m long pool-riffle sequence was investigated in detail with various measurement devices and tracer experiments (Fluorescein).

Five hyporheic probes were installed in this section, each filtered vertically in 3 depth (10, 20, 50 cm) providing water sampling and water temperature measurements. Water temperature was also measured from the rise to the outlet in high temporal an spatial resolution. Discharge was recorded at three gauging stations, where water samplers provided water quality monitoring.

The “paradigm” in P loss modeling of neglecting riverine sinks and sources has to be tested in detail (hyporheic sediment P-solution in this case). The sensitivity of hyporheic habitats and its vital function for self-sustaining lotic ecosystems underpins the importance of studies focusing on surface-subsurface water exchanges.
Assessment and Prediction of Nutrient Loads from a River Basin

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Abstract

Water quality management in developing countries including India, is still confronted with identification, assessment and control of non-point source pollution. Since, majority of nutrient loads are of diffuse origin, an exact understanding of the loading pattern is a prerequisite to reduce their impacts on receiving waters. The present paper describes a methodology for assessment of nutrient loads from the river basin under study. Musi river is one of the tributaries of River Krishna which drains a very large area in the south India. The basin experiences rainfall in one of the three seasons of the year and hence the non-point source contribution is considerable during the rainy season. The rainfall in the non-monsoon period is insignificant. The model consists of three modules for studying the behaviour of pollutants from point sources, non-point sources in urban areas and non-point sources in rural areas. The study attempts to apportion the nutrient loads to the different sources of pollution in the river basin. The predicted loads are in good agreement with observed loads, with a few deviations due to data constraints. At present, nearly all emphasis of pollution abatement in the basin has been placed on the construction of elaborate wastewater treatment plants to control point source pollution. The results emphasize the need for non-point source controls for effective water quality management.
Modelling stream water chemistry using river basin land use characteristics

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Abstract

The influence of land use characteristics on stream water chemistry is well established. In particular, the influence of geology, soils and land cover on the dissolved solids of river water needs to be extensively researched. Specifically river water base cation concentrations primarily reflect the geochemical weathering of the soil mineral horizons and the underlying geology. To predict water quality the small scale, detailed knowledge of the catchments geology, soils and land cover is required, while at regional scale, these characteristics can be aggregated into more general groups. The results of such studies suggest, that it may be possible to use catchments characteristics to explain the water quality of a river with particular reference to conservative dissolved solids reaching the river. The River Krishna and its tributaries drain three important states of South India. The river water plays a very important role in the overall socioeconomic development of Andhra Pradesh. In large river basins monitoring non-point sources pollution is rather difficult and expensive and is subjected to analytical errors. Hence, modeling water quality using land use data of the basin is attempted in the present study. The contribution from non-point sources (runoff from the river basin) is quiet considerable as the river drains various type of land uses. All these sources of pollution are leading to water quality degradation of the river. In this contest, it is necessary to make a detailed study of the water quality of the river, to estimate the level of pollution and also main sources of pollution. The seasonality in river flows and concentrations of dissolved solids is explained with the help of variations in flow patterns that is due to unequal rainfall distribution in the basin over the year. Correlation studies explain the relationships between dissolved solids concentration and land use of the basins. The multiple regression models accounted for significant variation in concentrations for majority of dissolved solids. The predicted concentrations are in good agreement with the observed values. The proposed models can be useful for planning land use controls in integrated water quality management program. As water quality of flowing water is closely linked to the land use in the basin, it is essential to include land use management in future river basin planning. Carefully designed land use studies to identify characterized and quantity of non point sources are essential elements to be emphasized to plan water quality management programme. The results of study indicate relative importance of non point sources pollution in addition to point sources pollution. Further individual classification of sources is suggested with help of a detailed inventory of sources in the river basin.

Key words: Water quality, land use planning, dissolved solids, regression models
Increasing Water Stress Associated with the Sedimentation in the West Flowing Rivers of Kerala

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Abstract

Human impact on the environment leads to sedimentation and creates shortage of reliable water even in heavy rainfall zones. The State of Kerala in India with three times the global average rainfall that gives birth to 44 rivers with number of tributaries faces serious seasonal water shortage, owing to a number of factors such as deforestation in the Western Ghats Mountain where the rivers originate, sand quarrying from riverbeds and watersheds, agricultural practices in riverbanks and construction of dams. Most of the rivers are fast west-flowing through steep slopes and carry considerable sediments during monsoon season. Human impact on rivers plays a significant role in the falling water availability. The input of tremendous sediment load made some of the once perennial rivers have become seasonal in the last few decades. Studies indicate that with the current rate of erosion and sedimentation, six major rivers in the State will disappear in 10 years. The widening and deepening of canals for inland navigation and the proposed highway that divides the State into two may have severe consequences in near future. Issues are likely to worsen with the increasing population through the attempts for more food production and new settlements. Possible changes in rainfall intensity and runoff associated with global anomalies will have added effect on sedimentation. In the present study, a comprehensive study of the factors affecting sedimentation in the west flowing rivers of Kerala in changing climate and environments have been carried out. Sediment discharge data of selected rivers have been analysed. Results warn an increasing stress on reliable water, if the current rate of sedimentation continues. Suggestions for the control of sedimentation and efficient and sustainable management of rivers have been provided, taking into consideration the environmental, social, economic and political situations.
Emerging health issues associated with the water-rock interaction in parts of India

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Abstract

Groundwater forms a major source of drinking water in urban as well as in rural areas. More than 90% of the rural population uses groundwater for domestic purposes. Seventy percent of infectious diseases in rural India are water borne and nearly fifty percent due to diarrhea. Major problems are being faced by the country due to the presence of excess fluoride, arsenic and nitrate in groundwater in certain parts of the country. Fluoride problems are widespread in nine States covering almost the entire country. Nearly 66 million people face the risk of which an estimated 6 million are children. In order to investigate the aspects of water quality and related health problems, the water quality data from nine following States (1) Jammu and Kashmir (J&K), (2) Himachal Pradesh, (3) Rajasthan, (4) Haryana, (5) Bihar, (6) West Bengal, (7) Chattisgarh, (8) Orissa and, (9) Maharashtra, covering almost the entire nation has been collected and analyzed. The surface, subsurface and thermal water sample analysis indicate the fluoride concentration ranging from < 0.2 to 18 ppm in the States of Jammu & Kashmir, < 0.2 to 6.5 ppm in Himachal Pradesh, > 1.5 ppm in Rajasthan, 0.2 to 0.6 in Haryana, 0.35 to 15 ppm in Bihar, on an average 12 ppm in West Bengal, 15 to 20 ppm in Chattisgarh, 8.2 to 13.2 ppm in Orissa and 0.7 to 6.0 in Maharashtra, indicating that except in Haryana, the concentration of fluoride is very high up to 20 ppm.

Ill affects of high fluoride content in water are manifested in the form of ‘Endemic fluorosis’ which is an acute public health problem in India. Medical advice recommends the drinking water should not contain more than 1.5 ppm of fluoride (WHO, 1994). Fluoride content above 1.5 ppm in water increases the severity of tooth mottling and induces the prevalence of osteoporosis and collapsed vertebrae.
Sources, sinks and effect of sediment load in fresh water ecosystem of northeastern region of India

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Abstract

The northeastern region of India, having an area of 255090 km², is predominantly hilly. The region receives about 510 km² of water as rainfall, at an annual average of 2450 mm. Two major rivers viz. Brahmaputra and Barak drain 194.4 and 78.1 thousand km² of area with an annual runoff of 537.2 km³ and 59.8 km³, respectively. The fluvial system of the region is in a highly dynamic state due to high gradient. Large scale deforestation combined with heavy rainfall has led to heavy soil and nutrients erosion. Study conducted revealed that prevalence of shifting cultivation in 3869 km², annually, is a major contributor to sediment load. Out of a total soil loss of 601.2 million tonnes from the region, 14.6 %, 15.0 % and 70.4 % are contributed by fresh water runoff from shifting cultivation, other land uses and non-cultivated areas, respectively. Besides, about 685.8, 99.8, 511.1, 22.6, 14.0, 57.1 and 43.0 thousand tonnes of nitrogen, phosphorus, potassium, manganese, zinc, calcium and magnesium, respectively are displaced as sediment load every year. A major part of the soil (51.2 %) and nutrients (48.6 %) find their way to the sea through Brahmaputra and Barak rivers while rest of the sediment load is deposited on river beds, flooded areas, streams, valley land, temporary water storages and lakes and reservoirs. Heavy sediment load through erosion has caused land degradation in hills and silting of river beds and stream in the plains, resulting in floods in about 3760 km², annually. There is immense loss of property, infrastructure and human lives in the region due to floods. Increase in population, urbanization, faulty land use, land tenure system and mismanagement of available water has rendered the whole hydrological system in the region in a fragile state. There is need for awareness programmes, change in land use and enact laws to prevent misuse of water and judicious management of water resources.
Ecological Pollution Stress on Benthic Infauna Macroinfaunal Community at the Mai Po and Inner Deep Bay Ramsar Site in Hong Kong

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Abstract

The Mai Po and Inner Deep Bay wetland is the largest remaining coastal wetland system in Hong Kong, supporting over 380 resident, passage migrant and introduced bird species. It was designated as a Wetland of International Importance under the Ramsar Convention in September 1995. Macroinfaunal community structure and dynamics were investigated at the intertidal mudflat as part of a baseline ecological monitoring programme for the Mai Po and Inner Deep Bay Ramsar Site supported by the Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government. Five stations across the mudflat were sampled quarterly from August 2002 to August 2003. The mean abundance of the benthic infauna ranged from 7,295 to 77,795 individuals m⁻² and the biomass 13.3 to 355.4 g wet wt m⁻². In all 56 infaunal species, mainly detritus feeding polychaetes, oligochaetes, gastropods, bivalves and crustaceans were identified. The infaunal community was characterized by low species diversity (H’ = 0.84-1.84) and high dominance (J = 0.42-0.78) of a few small, pollution-tolerant taxa, with an average individual wet weight of 4.8 mg. Community structure showed significant spatial-temporal variations during the first-year monitoring. Univariate diversity indices, multivariate non-metric multidimensional scaling (MDS) and the graphical method of k-dominance and ABC curves were used to detect possible ecological stress in macroinfaunal community structure in response to the natural and anthropogenic disturbance. A synthesis of various techniques indicated a rank order of ecological stress of the 5 monitoring stations across the mudflat, i.e. B1>C>A=B3>B2. This was neither consistent with distance from the major pollution source of Shenzhen River nor with the measured sediment concentration gradient of pollutants. The polluted situation at the Tai Mei Tsui site C which was the furthest from the Shenzhen River mouth, was not unexpected with regard to organic waste discharge from the nearby pig farms and the influence of the Shan Pui River. We concluded that pollution effects on the mudflat community were a function of different pollution sources (local and non-local), sediment granulometry, typography and hydrodynamic condition. It is crucial for an ecological monitoring programme to identify the interactive effects between the local and non-local pollution sources and the hydrography of monitoring sites.
Sediment remediation in Norway - national status and plans

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Abstract

Several fjords and harbours in Norway have suffered extensive contamination of trace metals as well as organic pollutants due to a long history of industrial activities. As a consequence fish and shellfish at a large number of sites contain levels of contaminants above what is considered recommendable for human consumption. To-day, the most important primary sources of pollutants have been cut and the remaining problem is contaminated soil and sediments.

The Department of the Environment has launched a national remediation plan for contaminated marine sediments. Due to a low rate of natural sediment input to fjords and harbours in Norway, the bottom sediments contain high levels of trace metals and organic components in places where industrial and urban discharges of effluents took place. The primary constituents of concern are dioxins, PCBs, PAHs, TBT, brominated flame retardants and mercury, cadmium and lead.

The levels of contaminants measured in sediments have been compared with a set of national sediment quality criteria. In areas where no local, primary point sources exist, and the level of contaminants in organisms exceed recommended levels with respect to human consumptions, actions plans are made to reduce or eliminate non-point sources (contaminated soil on land or contaminated bottom sediments).

In Norway to-day few sediment remediation projects have been carried out. There is one full scale capping project carried out near a zinc plant (Odda) in 1992 and a few minor capping projects. Monitoring results suggest that the capping has been successful.

Our present recommendation is to avoid dredging and in stead use in situ capping with clean, sandy material. In areas where sediment removal is necessary, like in harbours and navigation channels, we have been considering dredging and underwater disposal in anoxic fjord basins, followed by capping.
Developing a new tracing technique for slurry and particulate transport through grassland catchments

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Abstract

In the UK approximately 90 million tonnes of solid manure and slurry are annually applied to agricultural land. Grassland with ca. 5 million ha comprises more than 50% of this agricultural land. Furthermore, a significant amount of Phosphorous (P) is added in slurry to grassland catchments. Slurry has also been shown to yield particles and colloids to catchment drainage paths. There is particular value in studying particulate and P processes together because P has a strong affinity for attaching to, and being transported with, sediment/colloids. Subsequently transport of such material to rivers may contribute to eutrophication. However, the mechanisms and timing of delivery of this material to headwater streams, and the relationship of such processes to hydrological conditions in catchments, are still relatively unknown.

An interesting new approach with respect to studying particulate transport is the application to slurry of a range of artificially coloured fluorescent tracers. These markers are non-toxic and environmentally benign. Ongoing work in south west England is developing this technique by initially undertaking plot-scale experiments in order to provide proof of concept and optimum sampling strategy prior to future application at the catchment scale. It is hoped that as well as focusing on particulates, the possibility of applying a range of fluorescent colours means that delivery from different fields or different slurry applications can be identified in stream water sampled at the catchment outlet.

In addition to the fluorescent labels, it is known that various forms of organic matter, for example cattle slurry and silage liquor, have different and distinctive natural fluorescent signatures which change over time as the material decomposes. These signals are also being investigated as they may potentially be useful to assess the source of organic material in the stream, but they may also interfere with the fluorescent signal from the applied tracers.
Links between farm management operations, instream sediment processes, and water quality within a grassland catchment in the SW of England

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Abstract

Understanding fine sediment dynamics is seen as a key component in the study of phosphorous (P) and other water quality issues within pastoral grassland farm systems in the south west of England. Investigation of a small (approximately 1 km²) catchment near North Wyke, Devon has provided new insights into links between catchment hydrological events, farm management practices, fine sediment dynamics and associated water quality.

Water Quality sampling took place at weekly, daily and storm event timescales during the eighteen month study period. Discharge, precipitation, turbidity, water temperature and conductivity were monitored using instream probes recording at fifteen minute frequency. A weekly bulk sediment sample was taken from the water column at the catchment outlet using a sediment tube. The farmer kept a diary recording daily farm management activities and stock movements. Typical farm management operations included maize field cutting, installation of new under drainage, slurry spreading, and construction of a slurry storage pit.

Instream water quality and sediment process responses were evident in response to a number of farm management operations. High concentrations of Total P and suspended sediment were observed in low and high flow periods. These were related to one or more of the following factors; (a) disturbance of stream bed sediment following erosion of the upstream end of the channel; (b) slurry applications; and (c) storm event related disturbance of stream bed sediment built up within low flow periods. Storm events caused major changes in sediment and associated water quality dynamics. Particulate P formed a major component of the Total P signal, particularly at instream suspended sediment concentrations over 25 mg l⁻¹.

The results have implications for diffuse pollution management within grassland systems in relation to water quality improvements demanded by the Water Framework Directive over the next decade.
Biogenic matter diagenesis in sediments of the Gulf of Manfredonia, southern Adriatic Sea

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Abstract

In coastal environments, chemical reactions at the sediment-water interface, playing an important role in settling nutrients and oxygen benthic fluxes, account for a closely linkage between pelagic production and the sea floor biogeochemical processes. In this study we examine mechanisms responsible of the recycle of carbon and nutrients at the sediment-water interface to understand the role of sediments to the nutrient mass balances in the Gulf of Manfredonia (southern Adriatic Sea). This shallow gulf, characterized by limited circulation, can be nutrient enriched by the southward Adriatic coastal current coming from the northern basin. This current, connecting northern and southern Adriatic ecosystem regimes, can significantly affect large-scale distribution of biogeochemical properties. Moreover, this gulf is considered a complex area where anthropic pressure is a relevant phenomenon in alteration of marine ecosystem.

The study sites were placed in region characterized by high sedimentation rate, where the northern Adriatic inputs and local river inflows are relevant. Benthic chamber fluxes were measured and pore waters samples was analyzed in two stations, (inside and in offshore boundary of the gulf) during two oceanographic cruises carried out during October 2002 and March 2003. Pore water profiles suggest oxic and suboxic degradation of organic matter more intense in late summer, due to higher input of fresh organic matter and higher temperature of water column, hence microbial activity. In the same season, benthic flux measurements show higher fluxes of organic matter degradation products, especially in offshore site, supporting a higher remineralization rates. In both seasons, diagenetic processes in the inner station progress in a thinner layer than the outer site due to lower organic matter input to this site. Finally, a comparison between benthic chambers and pore water fluxes was useful to indicate which transport processes operate a relevant role in solute exchange rates at the sediment water interface.
Geochemistry and particle size of surface sediments from the Gulf of Manfredonia (southern Adriatic Sea)

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Abstract

Sedimentological and geochemical (major and trace elements) distribution patterns can be useful tools to understand hydrodynamical processes and to estimate the role of sediments as the sink or source of organic and inorganic compounds. Grain size distribution, major and trace element distribution, and contamination levels in sediments of the Gulf of Manfredonia, were determined on 76 surficial samples collected by a box corer during an extensive biogeochemical survey carried out during September 2002-March 2003. This shallow gulf (max depth 40 m), located in the western part of the southern Adriatic Sea and characterized by limited circulation, is considered a complex area, presently not well studied, where anthropogenic pressure plays an important role in pollution phenomena and alteration of the marine ecosystem.

The range of variation in element concentrations in sediments appears related to the presence of different sediment types: fine grained sediments tend to retain relatively high metal contents while coarser fractions, principally related to bioclastic material, appear associated with high contents of CaO, Zr, Zn, Cu, Rb. In addition, patterns of metal concentrations reflect the hydrodynamic characteristics of the gulf and the mixing between the sediments supplied by Ofanto, the main river in this area, and the Nord Western Adriatic current inputs. Finally, to evaluate the source and to assess whether the concentrations are at background or contaminated levels, the metal concentrations were normalized as ratios with Al, as grain-size proxy and this element not anthropogenically altered (Sinex and Wright, 1988; Balls et al., 1997). Enrichment factors (EF) (Ackerman, 1980) have been calculated. The EF method evidences that pollution status in the gulf is generally close to background values than on the index/factor used and it suggests that anomalies mineral concentrations of some metals are mainly linked with accumulation and adsorption processes of these elements in biogenic deposits.


Impacts of Water Injection Dredging on Water Quality and Ecotoxicity in Limehouse Basin, Thames Estuary, UK

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Abstract

British Waterways are currently proposing the increased use of water injection dredging (WID) in the UK’s inland waterways and marinas. Jets of water are injected under low pressure directly into bottom sediment creating a turbulent water-sediment mixture. This mixture acts as a fluid and suspended sediment particles are able to flow under the influence of gravity and this determines ultimate transport distance. Many of these sediments are highly contaminated and little is known of the effects of contaminant release on water quality or the risks to biota living in both the sediment and the water column.

Sediment cores were collected from Limehouse Basin, a proposed WID site in SE England and current sediment toxicity was assessed using a number of techniques. Comparison of metal data to US ERM/ERL sediment quality guidelines indicates intermediate levels of toxicity while, calculation of acid volatile sulphide/simultaneously extracted metal ratios under estimates the potential toxicity to sediment dwelling organisms. In contrast, porewater ammonia concentrations are in excess of all published ecotoxicological guidelines and indicate serious risk to biota. Therefore there is considerable discrepancy between techniques currently used to assess sediment quality.

Re-suspension experiments were used to mimic the effects of WID on overlying water quality and ecotoxicity tests were carried out on elutriates using Daphnia magna to examine the impacts on biota. Concentrations of a range of metals in the elutriates predict that adverse biological effects would be observed during WID, however only 10 % of the elutriate samples caused an adverse effect on Daphnia. Limehouse Basin is a complex aquatic environment, receiving both fresh and saline waters, resulting in a slightly brackish environment. However, the sediments have high porewater chloride concentrations reminiscent of previously higher tidal inputs. Therefore choice of indicator organism in such brackish or estuarine environments is problematic and must be resolved.
Study of sediments of the Upper Reaches of River Ganga: its Geo-environmental implication

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Abstract

The aquatic sediments act as a ‘Sink’ for a large number of contaminants present in water. They sorb many heavy toxic metals, nutrients and pollutants on their surface by ion exchange, adsorption and/or complexation. However, the sedimentary contaminants may pass over to water due to change in the physico-chemical conditions of the aquatic milieu. The River ‘Ganga’ is one of the important rivers of the world. Its water has been regarded as a ‘nectar’ due to possessing ‘extra-ordinary’ properties in comparison to water of the other rivers. However, in the recent years pollution load in this river has been enhanced and is beyond its self-purification capacity of the river because the river has been used as a convenient conduit for the disposal of the huge amount of wastes generated by the industrial processes and for sewage disposal along with toxic, hazardous materials and the sedimentary contaminants. Studies carried out in the river ecosystem reveal that sediments of the river are heavily enriched in heavy metals i.e Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn and Hg. It is pertinent to establish the threshold value of the heavy metals in the sediments by assessing the heavy metals budget in the upper reaches sediment in order to delineate the pollution status of the aquatic milieu of the river ecosystem. These threshold values may be taken as a tolerance level of heavy metals in the river sediments like those of heavy metals in water. Usually, the average shale value (TUREKIAN and WEDDEPOHL, 1961, in FORSTNER and MULLER, 1973) and World Surface Rock (WSR), the average lithology subjected to weathering in the hydrosphere (MARTIN and MEYBECK, 1979) have been taken for the comparative study. As the River Ganga has a high rate of chemical weathering, so the Indian average sediments will differ from that of WSR markedly in mobile and reactive elements. Besides, the average shale value, which is taken for comparative study of the Ganga sediments may not refer to the level of toxicity.

Keeping this in view, an attempt has been made to establish the threshold value for the toxic heavy metals in the sediments of Ganga ecosystem by assessing the metal concentration in sediments of the Upper Reaches of the river and its spatial behavior vis-à-vis texture, mineralogical behavior and organic matter content. It may be mentioned that from origin to plains near Hardwar, courses of the river passes through nominally settled rural areas and forests, allowing retention of pristine quality.
The role of alluvial sediments in surface water filtering

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Abstract

The source of water supply for Cacak and Krusevac are formed in alluvial sediments of the South and West Morava. Hydraulic connection between surface river water and ground water in alluvium does not exist because of riverbed clogging. Surface water injection in alluvial sediments is necessary in order to increase production of source capacity. Physical and chemical water filtering has been done in this way. Decreasing of some parameters in water (Fe, Mn, NO₃, NO₂) after infiltration and filtration through the natural medium is noticed. Levels of decreasing some parameters are from 10 % to 30 % in depending on concentration of river water. This paper deals with the source of water supply in Cacak.
Natural tracers in karst terrains

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Abstract

In the region of eastern Serbia there is a typical occurrence of thermal water springs in river valleys that cross massive limestone. While observing and exploring the thermal spring “Banjica” near Knjazevac, we uncovered a karst aquifer under pressure. The basic aquifer is a karstified triassic limestone. This fissure system was partially filled with magnetite sand. Magnetite sand was deposited with surface water as a product of the ultrabasic rocks’ decay. This natural tracer pointed to the feed zone of the karst aquifer 40 km distant from the spring in the area of the massive ultramafic rock Zaglavak.
The boron migration in the water of paleolandslides Sremski Karlovci

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Abstract

On the paleolandslide of the Danube-type in the Sremski Karlovci there exist captured wells and artesian wells of different depth depending of location of water outflow there have been differences in water quality. Aquifers are pliocenic sands in the body of the landslide and turbidity in the back- ing. Waters from these aquifers have the characteristic amount of ammonia, iron, manganese and boron. On the captured water shells (on the top of the landslide) values are lower than the maximum allowance of concentrations for drinking water or little bit over. On the artesian wells (at the bottom of landslide) values of these parameters are considerably over the maximum allowed concentrations.
On dynamics of bedforms in natural streams:
implications for exchange processes between surface
and interstitial waters and benthic biota

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Abstract

Alluvium in natural streams is often composed to bedforms of various scales on account of flows’
spatial heterogeneity. The beforms presence promotes two specific mechanisms of exchange be-
tween surface and interstitial waters, namely, pumping and turnover. Pumping is driven by pressure
difference on sides of bedforms, and turnover is an entrapment of water by shifting grains manifested
in bedforms propagation. Contrary to mountain rivers with coarse sediments and high ratios of rough-
ness elements submergence where the total budget of exchanging waters is dominated by pumping,
the exchange processes in lowland rivers are mainly controlled by turnover. These mechanisms con-
trol delivery of oxygen and nutrients for diverse arrays of aquatic flora and fauna colonizing intersti-
tial spaces. Determination of turnover rates is therefore an important problem in biological studies
seeking for quantitative explanation of spatial compositions of benthic organisms.

This study presents some results of field experiments on sand waves dynamics and the structure of
overlying turbulent flow. Accurate measurements with multi-sensor echo-sounding system and acoustic
Doppler velocity meters were performed in two lowland rivers: Spree (Germany), and Embarras
(USA). The investigated two river reaches pertain to approximately the same range of bedload mate-
rial, but differ by the relative submergence of roughness elements. Turnover rates were estimated
directly from the time-series of river bed elevations and indicated an agreement with available semi-
theoretical approaches. Comparison of double space and time averaged profiles of turbulence statis-
tics measured over sand waves and scaled with the averaged shear velocities indicated the rule of
relative submergence of roughness elements. The consequences for composition of benthic organ-
isms are discussed and illustrated by results of complimentary biological surveys.
Spatial patterns of macrophyte abundance and their correspondence to the patterns of bedload transport and morphology in the Spree River

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Abstract

Although freshwater macrophytes colonizing small lowland rivers produce considerable biomass - a source of fine particulate organic material utilized by invertebrates, their role in ecosystems is mainly associated with the effect on river flow, transport of sediments, and habitats of aquatic life. This study examines the spatial patterns of *Sagittaria Sagittifolia* and temporal changes in the patterns of its abundance during the vegetation period in a representative river reach of lowland river Spree in Germany. A detailed field survey of riverbed morphology and spatial patterns of riverbed material composition accompanied by macrophyte mapping allowed us to exploring the relationship between the observed patterns of macrophyte abundance and riverbed morphology and bedload transport.

A semi-theoretical model of river flow structure incorporating the effect of vegetation and the mobility of riverbed material was used to interpret observed spatial patterns. This model is based on the theory of mixing layers and was parameterized using the results of comprehensive field measurement. The study shows that macro-forms of the river bed are very important for macrophyte colonies. Reduced depth and deeper layer of the fine sediments at the alternate bars’ crests provide favorable conditions for the initiation of plants growths. In contrast, the enhanced depth and active sediment transport in the pools adjacent to bars precluded macrophyte development. Additionally, the consequences of macrophyte growth on the structure of micro-forms of riverbed relief are discussed. It was observed that when the plants reach maximum abundance they substantially modify the bedforms by substituting oblique transverse dunes with longitudinal drop-shaped forms.
Development and evaluation of Rare Earth Element (REE) labelled clays as fine sediment transport tracers in the marine environment

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Abstract

There is an urgent need from the marine regulatory authorities, ports and harbour authorities as well as academics to develop a field methodology to accurately measure transport pathways of the <63 mm sediment fraction in coastal and estuarine environments. Techniques such as sediment trend analysis and sediment tracing using fluorescent sands are well established for the silt and sand fraction but are unsuitable for clay sediments due to their cohesive nature. Geochemically labelled clays have been used as fine sediment tracers in freshwater environments with some success, although little is known about their chemical or physical behaviour once released to saline environments.

In this work, common clay minerals (kaolinite, vermiculite, phlogopite and muscovite) and bentonite have been used as the base aggregates for the sorption of REEs (lanthanum and samarium) to produce geochemical sediment tracers. The tracer element signal must be detectable after considerable dilution and dispersion in the marine environment and in preliminary experiments a labelled bentonite retained 43000 mg g⁻¹ La reduced to 36000 mg g⁻¹ La after washing in seawater. This element signal can be detected by routinely available ICP techniques and suggests that REE labelled clay minerals may prove to be suitable sediment tracers and require further investigation. In saline environments, the tracer elements may be exchanged with competing cations, thus the extent of REE desorption when exposed to fresh and marine conditions has been investigated over a range of salinities and for a number of clay minerals, these data will also be presented. Additionally, ICP-MS will be used to gain new insights into the fractionation of REEs during desorption from clay mineral surfaces in saline environments.
Organotin compounds and Cd, Pb, Ni, Cr, Cu and Zn in the sediments of the Ljubljanica River

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Abstract

The investigation was carried out on the extent of pollution with organotin compounds (OTC) and selected metals in the sediments of the Ljubljanica River. Sampling was performed in dark glass containers at five locations at the river source Močilnik, boating area Podpeč, boating club Livada, Ljubljanica in the center of the Ljubljan at Fužine, and at river mouth before Ljubljanica enters the Sava River.

For the analysis of OTCs extraction with acetic acid was applied while derivatization was performed with sodium tetraethyl borate. Ethylated OTC species were extracted into isoctane and their concentrations determined by GC-MS and GC-PFPD. The latter technique was applied at “Jožef Stefan” Institute and University of Pau, to compare the analytical performances of two laboratories. The accuracy of the analytical procedure was checked by the analysis of standard reference material PACS 2 (marine sediment). Good agreement of results between certified and determined values was obtained for butyltin compounds. Good agreement between results was also obtained for OTCs analyzed by GC-MS and GC-PFPD. GC-PFPD results agreed as well between two laboratories. Metals in sediments were determined by FAAS or ETAAS techniques after microwave assisted digestion of samples, using mixture of nitric, hydrochloric and hydrofluoric acids. The accuracy of the analytical procedure was checked by the analysis of standard reference material CRM 320 (river sediment). Good agreement of results between certified and determined values was obtained. Normalization procedure to Fe was applied in order to estimate the anthropogenic inputs of metals in sediments.

Data indicate that the extent of pollution with OTC in the Ljubljanica River is low. Only butyltin compounds were determined in concentrations about 50 ng g⁻¹ at Podpeč and Livada boating area, most probably due to the use of tributyltin based antifouling agents.

Normalization data indicate that Cd at sampling sites analysed does not represent anthropogenic inputs. Data from the normalization procedure further indicate that Cr arises from anthropogenic activities at Podpeč and Fužine. At Fužine the anthropogenic inputs of Pb and Cu are also observed, while Ni, Cu and Zn arise from the anthropogenic activities in sediments at the river mouth.
Levels of organotin compounds and selected metals in the Slovenian marine environment

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Abstract

The extent of pollution with organotin compounds (OTC) and the content of Cd, Pb, Ni, Cu, Zn, Cr, Mn, V and Co were investigated in sediments and mussels from the Slovenian costal area. Sampling was performed in marina Portorož, dockyard Izola, non exposed area of the bay Mesečev zaliv and in mariculture Sečovlje. Mussel samples were taken in summer and winter time. For the analysis of OTCs extraction with methanol in HCl was applied while derivatization was performed with sodium tetraethyl borate. Ethylated OTC species were extracted into iso-octane and their concentrations determined by GC-MS. The accuracies of the analytical procedures were checked by the analysis of standard reference materials CRM 477 (mussel tissue) and PACS 2 (marine sediment). Good agreements of results between certified and determined values were obtained for butyltin compounds. Metals in mussels and sediments were determined by FAAS or ETAAS techniques after microwave assisted digestion of samples. For the digestion of mussels nitric acid was used while sediment samples were digested in the mixture of nitric, hydrochloric and hydrofluoric acids. The accuracies of the analytical procedures were checked by the analysis of standard reference materials SRM 2976 (mussel tissue) and CRM 320 (river sediment). Good agreements of results between certified and determined values were obtained. Normalization procedure to Fe was applied in order to estimate the anthropogenic inputs of metals in sediments.

The analyses of OTCs in sediments at non exposed areas indicate low extent of pollution with OTCs, while in marina and in dockyard moderate extent of pollution was observed. The analyses of mussels exhibit higher extent of pollution with tributyltin (TBT) and its degradation products in winter than in summer. At the sampling sites investigated phenyltin species were not detected. Similarly, the analysis of metals in sediments exhibit elevated concentrations in marina and dockyard. Data from the normalization procedure indicate anthropogenic inputs of Cu, Zn, Pb and Cr in marina Portorož and of Mn and Cr in dockyard Izola. Mussels as accumulators of elemental pollutants in general exhibit higher metal contents in marina Portorož and dockyard Izola.
A Nero-Based Sediment Estimation Compared with Depth Averaged Formula

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Abstract

The vital importance of sediment in river engineering and its broad deficiencies on hydraulic structures reveals the necessity of research and more investigations on estimating sediment discharge. There are many economical and technical limitations have effects in measuring sediment discharge, this in turn makes empirical methods active. Developing causes practical formula development. Many factors that affect sediment transport phenomena with the existence of little accuracy of practical formula, while knowing that, Computational Intelligent (CI) especially Neural Networks (NNs) have an extensive usage in engineering, the idea of estimating sediment using NNs becomes emergent. In this paper, two multi-layer perceptron (MLP) with Marquardt- Levenberg training algorithm are designed to predict sediment discharge. The results of simulation are compared with the van Rijn’s formula. The inputs of the first designed NN are: flow parameters’ like velocity, hydraulic radius, depth, channel slope, viscosity of water and sediment parameters including: median size, standard deviation, while in the second designed network depth averaged parameters plus depth and slope of the flow are used as input data. Furthermore in the latter case the input data are classified according to the bed form shape. This makes the accuracy of the NN high.
Diatom-induced Si pulses to the sediment surface in a eutrophic lake and implications for the release of P

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Abstract

Large pulses of inorganic Si may competitively displace P from adsorption sites at the sediment surface through the ligand exchange mechanism, and consequently large-scale sedimentation and dissolution of diatom blooms may accelerate the internal loading of P in water ecosystems. This process and the factors influencing it are so far imperfectly known and have mainly been studied by simple empirical Si-P interaction models in which the Si pulses used were derived from discrete measurements of inorganic Si and diatom biomass fluctuations in the water column. In order to validate the assumptions used in these models and improve them, this study estimated potential Si pulses to the sediment surface from four sets of measured variables (dissolved Si in the water column, diatoms in the water column, trapped diatoms and trapped biogenic Si) in two basins of a eutrophic lake in Southern Finland over a period of four years. Comparing the results to each other showed that although the trapped diatoms produced the best results (smallest deviation from the average), the more easily obtainable data from the water column also gave reasonable estimates, and the model calculations based on such data can be considered valid.
Influence of bacterial activity on early diagenetic processes in the Authie Estuary (Northern France)

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Abstract

Early diagenesis processes are closely bound to the bacterial activity. Oxygen is first consumed before other oxidants such as nitrates, manganese and iron oxhydroxides and sulfates. These latter are reduced into sulfides, which play a key role for the cycle of a large number of metal pollutants. For that reason, in this study, particular attention has been paid on the S element behaviour.

On the other hand, fatty acids (FA) in environmental ecosystems are known to be biochemical markers which give some information on organic matter origin. Some of them are typically synthetized by some category of organisms. Polyunsaturated FA are for instance specific of planktonic algae, long chain saturated FA (> 24 C atoms) are specific of the higher plants and ramified FA with 17 and 15 C atoms are specific of bacteria.

This preliminary study is focused on the connection between the variations of fatty acids and those of some main geochemical parameters bound to early diagenetic processes. All experiments were carried out on an unpolluted muddy area in the Authie estuary (in northern France). For that purpose, three sediment cores have been sampled in September and November 2003, and in May 2004.

First results indicate clearly good relations between ramified FA variations and the concentration of sulfides in porewaters. Moreover, the degradation of algae at the surface of the sediments is well pointed out by the decrease of polyunsaturated FA. These variations are also compared with those of other geochemical parameters such as Eh, dissolved iron (II) and manganese (II).
Quantification of denitrification rates in sediments of the Solina reseroar

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Abstract

Seasonal variations of denitrification rates \(D_{\text{tot}}\) were determined in bottom sediments of the Solina Reservoir in southeastern Poland. The isotope pairing technique measured on a combined gas chromatograph – isotope ratio mass spectrometer (IRMS Delta PLUS on line with GC/III) was used to obtain sedimentary denitrification rates in order to distinguish the denitrification of \(\text{NO}_3^-\) diffusing from the overlying water \(D_u\) from the coupled nitrification – denitrification within sediments \(D_s\). Denitrification rates were measured on intact sediment cores collected at four littoral and four profundal sites in reservoir. Littoral denitrification rates ranged from about 3 mmol N\(_2\)/m\(^2\)h to 163 mmol N\(_2\)/m\(^2\)h (in temperature from 6 to 24 °C), and resembled the values reported for eutrophic reservoirs. Denitrification rates in profundal sediments where the temperature of overlying water changed from 8 to 10 °C were lower and ranged between about 6 and 32 mmol N\(_2\)/m\(^2\)h. Litoral denitrification rates were positively related to the temperature, content of organic matter in the sediment, and nitrate concentration in overlying water.

Denitrification of nitrate from the water column was only significant in high temperature, reaching up to 90 % of \(D_{\text{tot}}\). In contrast, nitrification was the major source of \(\text{NO}_3^-\) for denitrification in low temperatures – maximum contribution to the overall process was 76%. Coupled nitrification - denitrification was stimulated by an increase in oxygen concentration in the overlying water whilst contribution of the denitrification of nitrate supplied from water column in overall process increased with increasing \(\text{NO}_3^-\) concentration in water.
Impact of an intermittently sediment sink on the bottom morphology of a floodplain river (Mulde River, Germany)

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Abstract

The Mulde river, a meandering floodplain river and one of the large tributaries of Elbe river in Germany (width 40 – 70 m, MQ = 64 m$^3$s$^{-1}$) is well suitable for investigations on fluvial geomorphology, since human interference on the river and its floodplain have been and still are comparably limited along large reaches. Beyond this, an artificial lake came into existence (Mulde reservoir) acting as a sediment sink since 1975 when an abandoned open-cast mining pit was flooded by an unreversed diversion of the river. Down cutting of the channel bed, destabilization of banks, and armouring of the channel bottom are processes that were presumed to occur downstream of the reservoir due to the solid load deficit. However, there was so far no unequivocal evidence for those phenomena. The focus of the work presented in this contribution lies on flood related changes of the bottom morphology taking into account channel morphometry, associated bank activity and bedload transport.

Hydrographic surveys have been performed during the course of floods up to almost bank full stages along reaches of app. four km length upstream and downstream of the Mulde reservoir each. Results are expressed as water depth below water surface. Bank activity was surveyed and mapped, and bed material samples were taken. Additionally, systematic geodetic surveys at low discharges were evaluated.

At any stage, mean and minimum water depth values are generally lower at the upstream reach than downstream of the Mulde reservoir. This proves down cutting of the river downstream most certainly caused by the solid load deficit.

Standard deviation (STD) values of water depths along longitudinal surveys are taken as an indicator for bottom undulations between ripples and pools. Flood related change of bottom undulations is much more pronounced under conditions of sufficient solid load supply than under disturbed conditions (downstream of the Mulde reservoir) with generally higher values downstream. Downstream morphology thus exhibits features of a flood bottom morphology which is sustained even during low stages. There is no evidence for bottom armour downstream. It is hypothesized that form roughness as expressed by the STD of water depths in combination with the altered hydraulic geometry by generally higher water depths balance the loss of the solid load during.

Asymmetry of cross sections is significantly higher along the upstream reach than downstream and there is no armouring of the downstream channel bottom. Since active banks are more frequent along the upstream reach bedload transport seems to be an important control for bank changes via asymmetry of cross sections. Further evaluations are underway.
Using DC electrical resistivity to investigate saltwater/freshwater intrusion in the Haiphong coastal plain, Vietnam

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Abstract

By over pumping groundwater along the coastal plain, Haiphong port city faces the seawater intrusion into the aquifer. The saltwater/freshwater interface is an ideal object for investigating using the geo-electrical method. Using 200 VES stations in 1988 and geo-electric and hydro-chemical surveys in 4/2004 along Haiphong coastal plain, the geo-electric and chemical properties of the Q_{sal} aquifer were investigated. The conductivity, salinity and total chemical composition of the pore-water of the aquifer in 30 wells were obtained. The bulk resistivity and depth of the aquifer were also obtained by inversion of the VES curves and 2D electrical imaging profiles.

The empirical relation between pore-water resistivity and the bulk resistivity of the aquifer was set up based on the modified Archie’s law. The regression equation between pore-water resistivity and total chemical composition of the aquifer was also formulated. The maps of pore-water resistivity and total chemical composition at the past (1988) was computed based on this formula. The result shows the distribution of the salt-water intrusion. These maps of the periods of 1988 and 2004 are a useful index to monitor and evaluate the temporal variation and possible spreading of the saltwater invasion.
The composition of authigenic iron compounds and its contribution to fluvial suspended sediment concentrations and fluxes in the Nete Basin, Belgium

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Abstract

Fluvial suspended sediment comes from a combination of detrital (e.g., from mechanical erosion), biogenic (e.g., organic matter), and/or authigenic (e.g., chemical precipitates) sources. Many chemical precipitates in fluvial systems form when reduced groundwater seeps into well-oxygenated rivers. In the Nete Basin (Flanders, Belgium), there are indications that the chemical precipitates derived from groundwater-associated Fe (II) seeping into the overlying water essentially control the composition and concentration of locally-derived suspended sediment. To evaluate the relative importance of chemical precipitates to both the concentration and loads of suspended sediment, modeled-derived concentrations were compared with those determined from actual samples.

Model calibration requires a measure of the baseflow flux of groundwater-associated Fe (II). Therefore, dissolved Fe (II) concentrations from upstream areas were measured and multiplied by the annual baseflow. In turn, annual baseflow was estimated using the NAM hydrologic model (a lumped, conceptual, rainfall-runoff model, simulating overland, interflow, and baseflow components). The model-derived Fe (II) flux estimates were subsequently converted to suspended sediment fluxes, and compared to actual fluxes. After fine tuning, the results from the mathematical model indicate that authigenic suspended sediment may constitute around 70 % of the total sediment load in the basin. In an attempt to verify the assumptions made in the mathematical model, the physical and chemical composition of locally-derived suspended sediment is being examined with different analytical techniques (such as XRF and Mössbauer spectrometry).
Incorporating the effects of particle size and organic matter enrichment and depletion, when using environmental radionuclides as sediment tracers

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Abstract

Environmental radionuclides are being increasingly used for tracing sediment mobilization, transport and storage in fluvial systems. They have proved particularly useful for fingerprinting sediment sources, for documenting rates of erosion and deposition and for establishing catchment sediment budgets. However, the enrichment and depletion effects commonly associated with erosion and deposition processes, and which influence the grain size and organic matter content of soils and sediments, frequently introduce uncertainties into the interpretation of tracer behaviour. As a result there is a need to develop improved procedures for taking account of particle size and organic matter enrichment and depletion effects when using environmental radionuclides as sediment tracers. This contribution reports the results of an experimental investigation aimed at developing simple numerical procedures for correcting for the effects of particle size and organic matter enrichment and depletion in sediment fingerprinting investigations and when using Cs-137 measurements for assessing soil redistribution.
Changes in the metal content of bed sediment along a river-lake-estuary system in a rehabilitated post-industrial landscape

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Abstract

Over 250 years of non-ferrous metal smelting in the Lower Swansea Valley left metal-rich slag across the Tawe valley floor and aerial metal pollution over the wider landscape. Reclamation since 1965 included: (1) partial removal of valley-bottom waste and flattening and capping the rest with topsoil, (2) culverting watercourses and creation of two flood relief lakes and (3) leaving the aerially polluted landscape to regenerate naturally or planting it with conifers. Recent work indicates that metals continue to be mobilized and leached into the hydrological system, whereupon interaction with particulates occurs. This paper assesses (1) downstream change in geochemical and magnetic properties of bed sediment; (2) heavy metal storage in lakes along the Nant-y-Fendrod tributary, in the lower Tawe behind the Tawe Barrage and at its mouth; and (3) temporal changes in metal transport indicated by lacustrine and estuarine sediment cores. Total metal concentrations in surface bed sediment remain high but vary greatly along the system. In the upper, ‘aerial-pollution zone’ of the Fendrod catchment Zn, Cu, Pb and Cd increase from 781, 128, 163 and 6.6 mg/kg above to 892, 207, 212 and 7.2 mg/kg respectively within the first lake. Farther downstream, Cu and Pb rise sharply and Zn and Cd more progressively as the stream passes through the ‘capped metal-rich waste zone’; Zn, Cu, Pb and Cd reach 12853, 595, 871 and 155 mg/kg respectively. The second lake acts as a metal sink, with Zn and Cd reaching 22671 and 229 mg/kg respectively. Levels of all four metals fall 35-56 % below its outlet. Substantial differences in metal concentrations with depth in both lacustrine and estuarine deposits are interpreted to reflect (a) industrial decline and (b) alternating periods of landscape disturbance and stability with reclamation and redevelopment. Implications for reclamation methods and post-reclamation management (especially dredging policy) are considered.
Carbonate weathering and HCO$_3^-$ fluxes from temperate carbonate-rich landscapes, Michigan (USA) and Slovenia

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Abstract

Of the common minerals comprising rock and soils, only calcite and dolomite can maintain equilibrium on human timescales as atmospheric CO$_2$ increases from anthropogenic influences. Furthermore, carbonate solubility in physically open weathering environments is proportional to soil PCO$_2$; so carbonate-weathering intensities should be affected by land use and soil thickness, linking closely the rates of organic matter transformation and carbonate weathering reactions. To understand the landscape level controls on this system, we are investigating surface water geochemistry and mineral weathering fluxes from the glaciated Midcontinent (Michigan) of the US and from alpine/valley/karst regions of Slovenia. The Michigan watersheds discharge into the Great Lakes, while Slovenia’s Sava River, an arm of the Danube River, drains into the Black Sea. Carbonate saturation-state, fluxes and CO$_2$ dynamics were determined from geochemical analyses of river and shallow groundwaters, along with discharge data from river gauges.

Hydrogeochemical settings of Michigan and Slovenia differ significantly in terms of their climate, discharge, land use, tectonic history, and age of bedrock carbonates. Slovenian soil thicknesses range from 0 cm on mountainous slopes to >70 cm in valleys. Michigan soils are typically 1-3 meters deep, controlled by geologic age rather than slope. Michigan and Slovenian groundwaters are Ca-Mg-HCO$_3^-$ waters and < 2x saturated for calcite and near equilibrium for dolomite at PCO$_2$ values up to 20x atmospheric values. In Michigan, groundwater Mg$^{2+}$/Ca$^{2+}$ mole ratios are between 0.4-0.7, suggesting that calcite and dolomite dissolution are roughly equal in importance. Waters draining endmember (calcite or dolomite) lithologies are observed in Slovenian groundwaters with Mg$^{2+}$/Ca$^{2+}$ values from 0.25-1.0. Geochemically similar to groundwater, surface waters have lower PCO$_2$ values and many are supersaturated for calcite. Michigan rivers have HCO$_3^-$ values from 1.5-6 meq/l, while Sava River values are >5 meq/l. The Sava drainage-area-normalized HCO$_3^-$ fluxes are nearly 7-15 times higher than the world average (~10 meq HCO$_3^-$/km$^2$-s) and 2-5 times higher than Michigan values.
Combined Al- and CaCO$_3$-treatment for controlling of internal phosphorus loading from sediments of a stratified eutrophic lake

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Abstract

A new combination of hypolimnetic Al- and CaCO$_3$-treatments has been applied for restoration of Lake Tiefwarensee (Mecklenburg-Vorpommern, Germany), a dimictic eutrophicated hardwater lake. At the end of the last century the lakes internal phosphorus loading was about twice as the external loading. From 2001 to 2003 approximately 100 g Al$^{3+}$ m$^{-2}$ sediment surface as Na-aluminate and 115 g Ca$^{2+}$ m$^{-2}$ as suspended Ca(OH)$_2$ were added to the hypolimnion by deep-water aeration technology. As a result a sediment boundary layer of about 6 cm arised during three years where TP concentrations at the sediment surface increased from 2 g kg$^{-1}$ dw to 7 g kg$^{-1}$ dw, whereas the SRP concentration in the sediment pore water decreased from 5 mg L$^{-1}$ to less than 0.05 mg L$^{-1}$. The ratio of added Al to P (Al:Al-P) ranged from 5 to 20 by weight during the application. The P-release from the sediments was drastically reduced. Decreased SRP- and TP-concentrations in the whole water column and especially in the euphotic zone followed circulation periods in late autumn and early spring. The trophic conditions shifted from highly eutrophic to mesotrophic state.
Sorption of selected endocrine disruptors on sediments from major rivers of China

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Abstract

The sorption behaviors of three endocrine disruptors (bisphenol A (BPA), 17\textalpha-estradiol (E2), and 17\textalpha-ethynylestradiol (EE2)) on sediments collected from five major rivers of China were investigated using bath techniques. Samples were taken from the middle reaches of the Yangtze River and the Yellow River, and the lower reaches of the Pearl River, Haihe River, and Liaohe River, respectively. Particular attention was paid to the effects of natural mineral and organic components of sediments on sorption of BPA, E2, and EE2. The results show that the order of sorption (E2$>$EE2$>$BPA) corresponds with log$K_{oc}$ values for the compounds (3.1-4.0, 3.7-3.9, 3.3 respectively). The sorption of a single solute to sediments displays varying extents of a nonlinear isotherm, which may be altered by other solutes in multiple-solute systems. The sediments which adsorbed the highest quantities of BPA, E2, and EE2 have higher total organic carbon and greater proportion of clay, and sediments of the Yellow River adsorbed the least BPA, E2, and EE2 due to their lowest organic and highest carbonate contents. The observed sorption behaviors indicate that dissolved organic matter of the sediments were considerable different. Moreover, Fourier Transform Infrared (FTIR) examination, which provides structure and composition information on humic substances of sediments, suggests that not only the contents but also the characteristics of the sediment organic matters influence the sorption behaviors. After thermal oxidation of the sediments, decreasing sorption of the selected endocrine disruptors was observed. In addition, the grain size and sediment concentration also have significant effects on the sorption.
Impact of artificial drainage systems to matter and nutrient yield in the Swiss Jura Mountains

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Abstract

The Länenbach catchment (2.6 km$^2$) is characterized by low to moderate soil-phosphorus (P) availability. Nevertheless P export to surface aquatic systems is explicitly high, due to particle-adsorbed P input caused by land use, artificial subsurface drainage and natural processes. Objective of the study is the assessment of varying human impacts within subcatchments and the identification of source areas. Correlations between precipitation, discharge, suspended sediment (SS) and P explain transport mechanisms and pathways. Simple GIS analyses of subsurface drainage systems, land use and management as well as soils and topography are carried out to link yields with catchment properties. The study was examined at catchment and sub-catchment scale in the period of March 2002 to December 2004. Two hydrological different subcatchments have been chosen to study pathways of Molybdate Reactive P (MRP), Total Dissolved P (TDP), Total P (TP), discharge and SS. A monitoring program consisting of three stage gauges in combination with water samplers enabled to calculate SS and P yields for storm event runoff at the outlet of two subcatchments as well as the entire catchment. Additionally fortnightly bucket samples were collected during baseflow conditions. Concentrations of MRP and TDP vary spatially and temporally with levels being highest at subsurface drainage inlets (Wei\textsuperscript{s}heidinger et al., in press). Analyses illustrate high SS and TP concentrations and yield during storm events. Apart from channel processes subsurface drainage systems cause a major contribution of SS and TP to the budget of the entire catchment.
Biological engineering of flows and fine sediments by macrophytes and suspension feeders in the Frome and Piddle Catchments, Dorset (UK)

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Abstract

Macrophyte-dominated chalk rivers are recognised as a priority habitat under the UK Biodiversity Action Plan. Their sensitive management requires improved understanding of the complex interactions between sediments, river flows and biota, in particular how the biota engineer their environment. This paper examines the significance of bioengineering by Ranunculus spp (water crowfoot) and its associated suspension-feeding blackly larvae for five contrasting reaches in the Frome and Piddle catchments, Dorset (UK). The study (2003-4) focused on the trapping, storage and modification of fine sediment. Monthly data on sediment accumulations within Ranunculus stands were related to continuous flow and turbidity data, samples of suspended sediment, the magnitude and timing of in-stream macrophyte cover and the magnitude of flow modification by vegetation. Sediment samples were characterised in terms of their absolute and effective particle sizes and organic matter content. Temporal changes in faecal pellet numbers in the suspended and deposited sediment samples were also related to suspension feeder activity, which is linked to life cycle timing, river temperature, flow and macrophyte growth.

The structure of the plant was shown to determine the meso-habitat conditions through the modification of flows causing sediment retention within and scouring around the plant; and the extent of this engineering varied according to inter-reach structural differences in the Ranunculus stands. Engineering by Ranunculus also determined the seasonal availability of micro-habitat conditions suitable for filter feeders and hence the extent of their influence on fine sediment modification through faecal pellet production. Both the meso-habitat and micro-habitat conditions were spatially heterogeneous within and between reaches and varied temporally through the growing season as a consequence of macrophyte engineering. Consequently, at the catchment scale such bioengineering will affect the sediment and nutrient dynamics through the spatio-temporal variability in both the trapping and release of fine sediments and faecal pellets.
Influence of a “soil erosion control project” on inflows and inflowing sediment runoffs at the Three Gorges Reservoir

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Abstract

The Three Gorges Reservoir has already been put into operation, starting impoundment to the water level of 135 m before the dam. The present status of soil and water losses above the reservoir and the factors affecting inflowing sediment runoffs have been described. The changes in the characteristics of inflows and inflowing sediment runoffs since the program of soil and water conservation in the Upper Changjiang River Basin was implemented in 1989 have been analyzed on the basis of runoff and sediment data at control stations on the main stem of Changjiang River and its major tributaries. The benefits of the soil and water conservation program have been preliminarily evaluated. The inflows and inflowing sediment runoffs have decreased and inflowing sediment distribution has varied at Cuntan and Yichang, which stems mainly from the decrease in inflows and inflowing sediment runoffs on the Jialingjiang River. Countermeasures to mitigate sediment runoffs into the reservoir have also been explored in this paper.
Interactions between phthalate esters and copper in their sorption process on Yellow River sediments

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Abstract

Effects of aqueous common cations, such as Na⁺, K⁺, Ca²⁺ and Mg²⁺, on the sorption of organic pollutants in water-sediment systems have been extensively studied in the past decades. However, the mechanism on interactions between heavy metals and organic chemicals accompanied with sorption to sediments is still not clear. Heavy metals are more harmful and more liable to adhere to particulates than common cations, thus more attention should be paid to their effects on sorption of organic chemicals. In this paper, batch sorption experiments were conducted for copper and phthalate esters on sediments sampled from Tong Guan and San Men Xia in the middle reach of the Yellow River. Copper is one of the most frequently detected heavy metals in the river and phthalate esters are the most popular organic pollutants. Tested phthalate esters include diethyl phthalate (DEP), di-n-butyl phthalate (DBP), di-(2-ethylhexyl) phthalate (DEHP) and di-n-octyl phthalate (DOP), ranging from moderately to highly hydrophobic. The results show that the sorption of copper and phthalate esters are both weakened due to their complexation via dissolved organic matter (DOM), and the complexation strength is dependent on the phthalate hydrophobicity. Effects of minerals on the interaction process were also studied. The complexation of copper with DOM and phthalate esters was well described by the MINTEQA2 chemical equilibrium model.

Abstract
Experimental Study on Bed form Dimensions in Compound Open Channels

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Abstract

In order to investigate the effect of compound channel flow on the resistance to flow and bed form characteristics over a loose bed, a series of tests were carried out in two scenarios: isolated inbank flow tests as simple channel experiments and tests with asymmetric compound channel, using a non-tilting flume under uniform flow condition. The flume was filled with a 200 mm thickness of uniform quartz sand having a median size of 0.88 mm. Measurements of hydraulic head, flow discharge, mean velocity, shear stress, length and height of the bed forms were determined at three positions along the channel. The results showed that the condition of flow has a direct effect on the length of bed forms but it is not so for the height. In the case of overbank flow, the bedform steepness results indicate an approximately constant figure for all flow discharges with scatters. However, in the case of simple channel, the above parameter increases with flow discharge. Also, the overbank flow conditions showed that wave length increased to a value of 30 % when compared with simple channel flow tests. Observation on relative roughness of bed form showed a constant figure with some scatters under overbank flow conditions. Overbank friction factor results indicate a general reduction with dimensionless bed form index. Furthermore, some non-dimensional equations were obtained for predicting shear stress, length and height of bed form in compound channels.
Particle-associated metallic contaminants transfer in a river displaying polluted sediment: use of environmental radionuclides

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Abstract

Urban watercourses are potential hazards because of their poor water quality and contaminated sediments. Fate and transport of metallic compounds depend on both chemical and physical processes which occur in aquatic systems. Physical disturbances at water-sediment interface, induced by natural or anthropogenic events, can result in resuspension of contaminated sediments and in remobilisation of metals from sediment into water column. In aquatic ecosystems, metallic pollutants are largely particle-associated and their fate depends on particle dynamics.

Use of environmental radionuclides ²³⁴Th, ²¹⁰Pb, ²¹⁰Po, ¹³⁷Cs, and ¹³⁷Be, allows us to quantify dynamical processes of particulate material at different time-scales. They are widely used in identifying and modeling particulate transfer processes in various aquatic media.

This study focuses on sediment-associated metal contamination and its transport dynamics in a highly urbanized and canalized shallow river: the Scarpe River, North of France. Six sampling sites of sediment cores and water have been selected between two locks 6.5 km apart.

According to ¹³⁷Cs activities versus depth in sediment cores, mean sedimentation rate is around 0.4 g.cm⁻².year⁻¹. This deposition rate coupled with low hydrodynamics favored the entrapment of metallic pollutants over past twenty years of industrial and urban activities. Chemical analysis show high amounts of Zn, Pb and Cd in deep as in superficial layers of sediment: 2300, 340, 176 mg.kg⁻¹ respectively at the most heavily superficial contaminated sampling sites. In the water column, concentrations of Zn, Pb and Cd in dissolved fraction reach 30, 2.5 and 1.0 mg.L⁻¹ respectively, and 2400, 390 and 194 mg.kg⁻¹ in suspended material.

Activity disequilibria ²¹⁰Po/²¹⁰Pb and ²³⁴Th/²³⁰U and activity of ¹³⁷Be coupled with metals analysis in samples of water, superficial and suspended material will give kinetic information on sedimentary processes affecting the release and transfer of metallic contaminants on a shorter time-scale.
Suspended sediment dynamics in a Mediterranean mountain catchment over the last five decades: assessing the role of large floods

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Abstract

The Ladonas River (1047 km\textsuperscript{2}) drains the high mountains of the northern Peloponnese (Greece) and is a major tributary of the Alfios River (3600 km\textsuperscript{2}). The Ladonas reservoir (575 m) was impounded in 1955 and provides a unique record of suspended sediment flux in this steepland Mediterranean environment. Reliable long-term records of water and sediment flux are extremely rare for Mediterranean mountain catchments and the Ladonas reservoir sediments constitute an important archive of catchment dynamics and environmental change for the second half of the 20\textsuperscript{th} Century. Bathymetric survey has established the volume of sediment accumulation in the reservoir and its spatial variability. However, this approach is not capable of identifying detailed temporal changes in sediment inputs that may be related to land use change, extreme hydrological events or other factors. We present the results of an integrated analysis of both fine sediment provenance (based on quantitative sediment fingerprinting) and sedimentation history based on a finely resolved chronology using Cs-137 and unsupported Pb-210. Data from three sediment cores show that the bulk of the sedimentation in the reservoir can be related to a few discrete large flood events. These events convey sediments from catchment sources that are not significant during lower magnitude flood events. This paper outlines our approach and critically evaluates its utility for elucidating the behaviour of such catchment sediment systems over timescales of several decades. Our results have important implications for the management of such systems and for the widespread practice of presenting mean annual sedimentation rates from traditional (coarse resolution) bathymetric surveys.
Geochemistry of inorganic iodine in the Rogoznica Lake

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Abstract

Iodine is the most abundant redox-sensitive and biophilic minor element in seawater. In contrast to open-ocean and stream aquatic systems, in small and semi-closed marine sub-environments the intensity of interactions between iodine system, biota and sediment is altered. Rogoznica Lake is a small, eutrophicated saline lake. Due to high productivity, restricted water exchange and specific mixing regime, sulphides bearing anoxic conditions are common in deeper layers and iodine speciation is additionally affected by redox reactions with reducible sulphur species and allochthonous organic matter. The concentrations of both inorganic and organic iodine species in the lake water were always higher than in the surrounding seawater, and seasonal pattern has been confirmed.

In this study iodine speciation was investigated in water column and sediment pore water of the Rogoznica Lake in order to explain high concentrations of iodide in the water column bellow the chemocline during stratification periods (up to 2.3 µmol L⁻¹). Sediment cores were sampled at different depths with aim to catch different redox conditions (oxic-anoxic) in the overlying water.

Pore water sub-samples contained only reduced chemical form of iodine due to anoxic conditions within sediment. Based on concentration gradients in the pore water and at the sediment-water interface, the fluxes of dissolved iodide were calculated. In addition to iodate reduction which takes place at the interface of oxic water layer-anoxic sediment and plays important role in speciation of iodine, diffusion of iodide from sediment is among most important factors that control concentration level of iodine in the entire water column.
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