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Sediment Residue Budgeting: An Analysis upon Hydrodynamic Characteristics of the Coastal Environment

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Abstract – Coastal and marine sedimentary archives are sometimes used as indicators of changes in continental sediment production and fluvial sediment transport, but rivers crossing coastal plains may not be efficient conveyors of sediment to the coast. Where this is the case, changes in continental sediment dynamics are not evident at the river mouth. Stream power is typically low and accommodation space high in coastal plain river reaches, resulting in extensive alluvial storage upstream of estuaries and correspondingly low sediment loads at the river mouth. In some cases there is a net loss of sediment in lower coastal plain reaches, so that sediment input from upstream exceeds yield at the river mouth.

Bottom sediments from thirteen transects mainly sampled at depth contours of 30, 100 and 200m along the western continental margin of India, falling in two offshore sectors from Dwaraka to Goa and Cape Comorin to Goa were analysed for calcium carbonate, major elements in silicate fraction, trace and rare earth elements in the bulk fraction, and carbon and nitrogen isotopes in organic matter to understand the provenance of sediments, weathering patterns in the source areas and nature of organic matter.

Yearly transport courses of action of suspended sediments in Beypore estuary a tropical estuary along the south west coast of India-were explored dependent upon time arrangement estimations inside the framework It's watched that the sediment transport was upstream feasting the pre-monsoon period and downstream throughout other seasons. Connection between focus and velocity at tidal frequencies created that the upstream development of sediment was generally achieved by tidal pumping.

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INTRODUCTION

A sediment budget is an accounting of the sources and disposition of sediment as it travels from its point of origin to its eventual exit from a drainage basin. In its full form, a sediment budget accounts for rates and processes of erosion and sediment transport on hills and in channels; for temporary storage of sediment in bars, alluvial fans, and other sites; and for weathering and breakdown of sediments while in transport or storage. Although complete sediment budgets are of scientific interest, they are frequently more detailed than is necessary to address problems encountered in resource management.

The major source locales are geographically and lithologically different, and some disintegration and transport procedures are kept to specific areas. At the sub-catchment scale, litho logical, topographic distinctions, furthermore tectonic characteristics, for example shear zones and blames help spatial varieties in disintegration forms furthermore rates. Anyhow inadequate information exist at the Basin scale to quantify these relationships, despite the fact that some confirmation can be attracted upon to achieve provisional conclusions. It is paramount to connection rates of misfortune from sources, and rates of aggregation in sinks, to courses of action with the goal that dirt preservation furthermore land use acclimatization might be recognized at an fitting spatial scale.

A sediment budget is an offset of the sediment volume entering and leaving a specific area of the coast or an estuary. Sediment budget investigation comprises of the assessment of sediment fluxes, sources and sinks from distinctive techniques that offer ascent to increases and subtractions inside a control volume (e.g. an area of coast or an estuary) so as to addition an improved comprehension of the estuary framework. Control volumes on open coasts relate to areas of a coast which structure sediment units and are regulated by cell limits which either restrain or limit the measure of transport over the unit border. A source increments the amount of material inside the control volume and a sink lessens it and inside the unit there may be focus sources and sinks, for example tidal deltas, and line sources and sinks, for example developments on and off the vacation spot.

Sediment budgets are a method of synthesizing the yields from various accessible investigation and modeling methods. A budget can additionally be ascertained from verifiable information and a dissection of progress, empowering examinations between a comparative budget determined utilizing the yield from computational models. Model yield could be utilized to foresee the imaginable budget as a consequence of some change or advancement in the framework, and is as a rule exhibited as an organization of sources and sinks, or a schematic to represent the trades happening (e.g. as tonnes/tide for the Humber, or volume/annum for Southampton Water, Figure Schematic of the net sediment budget show for the Humber Estuary, UK (Whitehead and Townend, 1994)).

Coastal and marine basins are the ultimate sink for most riverborne sediment, and rivers are the major source of ocean sediment. Coastal and marine sedimentary archives thus represent a potential record of changes in river sediment transport and continental sediment production driven by human impacts, climate change, tectonics, or other environmental changes. This assumes that significant changes in erosion and sediment flux in drainage basins is recorded in sediment delivery to the coast. However, the connection between changes in sediment dynamics within a fluvial system and sediment loads at the river mouth is not always strong or direct.

The small mountainous drainage basins that provide (relative to their area) a disproportionately large proportion of river sediment yield to the sea (Milliman and Syvitski, 1992; Ludwig and Probst, 1998) may indeed exhibit relatively direct connections between drainage basin sediment dynamics and coastal/marine sediment inputs. In California, for instance, dam construction in small mountainous rivers resulted in a quick and noticeable reduction in sediment supplies to the coast (Willis and Griggs, 2003). However, in some rivers sediment output or accumulation in sedimentary basins has been remarkably consistent despite changes in climate, sea level, vegetation, and human impacts (Summerfield and Hulton, 1994; Gunnell, 1998; Métivier and Gaudemar, 1999; Dearing and Jones, 2003; Phillips, 2003a). In some cases this may be because an overriding control such as relief or tectonic forcing overwhelms variations in climate and other factors, but several authors emphasize the role of alluvial buffering (Métivier and Gaudemar, 1999; Dearing and Jones, 2003; Phillips, 2003a). Alluvial buffering implies that sediment storage and time lags may make the output from some drainage basins slowly or relatively unresponsive to environmental change. This is because alluvial storage during periods of high sediment supply and remobilization when supply is low relative to transport capacity minimize variations in sediment output.

Tropical estuaries offer an excellent opportunity to study the sediment processes in an environment influenced by riverine and marine factors, including sediment input from rivers, mixing of fresh and salt waters under the influence of tides and the prevalent dry and wet seasons. The transport and trapping of sediments are controlled by tidal dynamics, river discharge and particle dynamics throughout the estuarine system. Sediment budget is a quantitative inventory of all the sediment inputs, outputs and storage within the system. Estuarine processes control the distribution and transportation of suspended sediments.

These processes vary in a systematic manner within tidal and weather cycles. During a periodic event many estuaries can carry high-suspended sediment loads and this can drastically change the pattern of sediment transport and dispersion in the system (Nichols, 1977; Perez et al. 2000). The increased suspended sediment into the estuarine ecosystem is causing enormous economic burden by the way of the infrastructures for navigation and flood mitigations (Eyre et al. 1998).

It is therefore necessary to study the processes governing the sediment movement in order to understand contemporary problems in estuarine environment such as reclamation, harbour development and dispersal of pollutants (with an affinity of fine, cohesive sediments) and urbanisation (Van Leussen and Dronkers 1988; Eyre et al. 1998; Wu and Shen 1999). Increased suspended sediment into the estuarine ecosystem is causing enormous economic burden to the society, which necessitate maintaining the water quality and removal of sediment for navigation and flood mitigation purposes.

THEORETICAL BACKGROUND

To construct a sediment budget for a drainage basin, the temporal and spatial variations of transport and storage processes must be integrated. This is done through the solution of three requirements (Swanson et al, 1982), namely:

1) Recognition and quantification of transport processes,

2) Recognition and quantification of storage elements, and

3) Identification of linkages among transport processes and storage elements.

In this study an approach to these requirements is made. Since this study is based on a short-term analysis of a catchment (using some rapid surveying methods and estimates) it is not possible to do exact calculations. Field studies like these are useful in preparation to long-term monitoring programs (Swanson et al, 1982; Reid & Dunne, 1996). In many cases the purpose is to determine the order of magnitude, as is the case in this study and hence an approximate budget gives satisfying results.

To quantify and relate the major processes responsible for the generation and transport of sediment is difficult because the processes are either slow and continuous, like creep, or discreet and both are highly variable in time and space (Dietrich & Dunne, 1978).

In a forested mountainous landscape rapid transport of sediment by landslides and debris flows is of great importance and these processes are also variable in time and space. Other processes that have shown to be important in (wet) forested drainage basins are soil creep, biogenic transport, sheetwash and rainsplash erosion (on unvegetated surfaces, either natural or due to deforestation), and gully erosion (Swanson et al, 1982; Selby, 1993).

To simplify the quantification of a sediment budget, it is necessary to estimate the relative importance of these types of hillslope-transport processes and their distribution within the basin (Swanson et al, 1982). The today's planet wide yearly misfortune of space limit because of sedimentation is now higher than the build of limit by the development of new repositories for watering system, drinking water and hydropower. Therefore the feasible utilization of the repositories is not ensured in enduring. On account of profound and long repositories the sedimentation rate is much beneath the planet mean esteem. By the by the sedimentation debilitates likewise these repositories, since turbidity flows are sporadically transporting expansive volumes of sediments down to the dam. There the focused stores are preventing the protected operation of the outlet structures as admissions and bottom outlets.

After just 30 to 40 years of operation, sedimentation has turned into a genuine issue in numerous repositories placed even in catchment ranges with direct surface disintegration as in the Alps. The specified turbidity momentums are regularly the figuring out methodology for the transport and testimony of the sediments in such repositories. These underwater torrential slides with a high suspended-sediment fixation take after the thalweg of the lake to the deepest range close to the dam, where the sediments can influence the operation of the bottom outlet and the force admission. To control the sedimentation inside the repository, the impacts of snags, screens, water streams and bubble draperies on the turbidity ebb and flow were researched with physical investigations and numerical reproductions.

The examinations indicated that turbidity momentums could be affected adequately by fittingly planned productive measures.

On account of this study a sediment budget is developed for current conditions, taking into account the outcomes of two months of examination. The conditions (atmosphere and vegetation) are thought to be steady over the long run (i.e. the most recent 100 years) and the territory is in surmised consistent state.

A SEDIMENT BUDGET

A sediment budget for a river catchment is usually presented as rates of sediment production from source soils and bedrock, specified by process (e.g. sheet and rill erosion, gullying, landsliding, channel erosion and glacial processes); rates of deposition in sinks, specified by landform or landscape element (e.g. colluvium, alluvial fan, floodplain, channel bed/bars); and finally the rate of loss from the catchment, usually called the yield. The sources and sinks ideally should be spatially defined.

The soil, sediment and rocks of the catchment are most simply divided into three categories for the purpose of budgeting: the Peninsular (or Shield) to the south of the catchment; the Himalaya; and the Plain including the delta. Estimates of the output from the soils and rocks of the Peninsular consist mainly of calculations using the Universal Soil Loss Equation (USLE) and some results of sheet and rill erosion rate measurement. There are also a few estimates of gully erosion rate, and transport rates of sediment in some rivers are also known. Estimates are also available for sheet and rill erosion on the Plain and for the Indian part of the Himalaya, and for landslide erosion rates, and river sediment flows in the Himalaya and on the Plain.

The various estimates of losses from sources and of sediment transport have been previously used to infer which sources are eroding fastest, the location of these sources, where the largest flows occur, and, by correlation and deduction, the respective roles of natural processes and land use in the fluxes of sediments. But there has not been a systematic attempt to identify either the major components of a basin-wide budget, or which component is adequately quantified and thereby define where additional data are required.

The sources in the Ganga Basin lose material by sheet and rill erosion, channel processes (including glacier lake-burst floods, GLOFs, and landslide lake-burst floods, LLFs), gullying, landslides and other mass movements, glacial erosion, and aeolian processes. The sinks gain material by: settling of fines from water and, in the case of dust, from the atmosphere; cessation of bedload flow in channels; deposition on hillslopes by landslides; glacial deposition; and by density currents on the Bengal Fan.

LITERATURE REVIEW

As already mentioned sediment budgeting studies are lacking in the Indian scenario. But such studies are available for some coastal locations of the world. Depending on the objective of the study, sediment budgets are constructed with different time frames. Sediment budget on geological time scales has been attempted (Belknap and Kraff, 1985; Oxford et al., 1996; Riggs et al., 1998; Schwab et al., 2000) to bring out the influence of natural forces on the geomorphology of the beach systems. Studies on a historical time frame (several hundred years) are undertaken to unravel the influence of large-scale human activities like dam, jetty and seawall construction on changes in beach systems (Hess and Harris, 1987; Fitz Gerald et al., 1989; List et al., 1991; Pilkey and Dixen, 1996; Cooper and Nevas, 2004). Contemporary (annualdecadal) time scale studies based on sediment budget are planned to bring out the influence of human activities such as dredging, dredge spoil disposal, beach replenishment, sand mining etc. (Pilky et al., 1989; Fenster and Dolan, 1994; Hill et al., 2004).

Quantification of sediment sources, be that as it may, remains a major challenge in building a sediment budget for a huge waterway basin (Brown et al., 2009; Wilkinson et al., 2009). A couple of sediment budget studies completed for substantial stream basins have reflected upon these challenges, incorporating Parker (1988), Kesel et al. (1992), Holmes Jr. (1997), Rondeau et al. (2000), Wasson (2003), Shi and Zhang (2005), Garzanti et al. (2006) Wang et al. (2007), and Xu (2008). Case in point, the arrangement of every day sediment stations gives an extraordinary database for the Missouri River where simultaneous records are accessible subsequent to 1940s. Indeed, with this great quality information, nonetheless, characteristic variability furnishes considerable questionable matter as far as the sediment budget (Parker, 1988). This requires consideration regarding conceiving rearranged systems, models or method of evaluating disintegration and sediment yield in substantial waste basins.

Sanil Kumar et al. (2002) figured the long shore sediment transport rate In Nagapattinam coast utilizing CERC recipe and discovered that the normal yearly horrible transport was 0.448 million m3 and the normal net transport (towards south) was 0.098 million rrr'. Sanil Kumar et al. (2006) concentrated on the coastal methods along the Indian coastline utilizing measured information on waves and flows. They figured that the horrible sediment transport rate was in the vicinity of 1 million m3/year along south Kerala and south Orissa coasts.

Christiansen et al. (2004) developed an aggregate sediment budget for the Skallingen boundary spit (South Wadden, Denmark) and utilized the same to make the relative imperativeness of sediment transport courses of action included in restraint relocation. The creators watched solid bury yearly varieties in the enduring budget, making assessment of boundary conduct dependent upon transient estimations dubious.

Kelley et al. (2005) formed sand budget at land, verifiable and contemporary time scales for Saco Bay (Maine, USA) sunny shore framework by assessing the past and present sand-transport pathways, fluxes and reservoir volumes. Dark and Healy (1983) talked about numerous systems to gauge the pathways of sediment transport.

CONCLUSION

Effective construction and interpretation of sediment budgets requires a sound understanding of erosion and sedimentation processes, experience in field mapping and in the measurement and analysis techniques to be used, and above all, good professional judgment. Each area represents its own difficulties and opportunities, so analysts must have a strong enough background in geomorphology and hydrology to take advantage of the peculiarities of the area to be evaluated, and they must be creative and open-minded in their approach.

Construction of sediment budgets is more difficult in some areas than others. At sites where sediment input is dominated by large, infrequent events, rates must be evaluated using as long a period of record as possible. In such cases, land use may cause small changes in process frequencies which can strongly affect long-term sediment yields, but which may not be observable over the time frame available for analysis.

The part of fluvial sediment transport limit, in any case, has been underappreciated. Incline regulated diminishments in transport limit are broadly distinguished where waterways rise onto coastal fields. In a few cases incline regulated decreases in stream force happen in the easier coastal plain arrives at – in the Trinity River illustration, stream force diminishes by a request of extent or more in this zone. This diminishment in transport limit comes to be considerably more affirmed as tidal and coastal backwater impacts increment downstream.

Sediment budget analysis proved very useful to quickly determine the relative importance of all processes acting in the sub catchments, and to indicate crucial areas for debris flow initiation. Only a partial sediment budget could be constructed due to the fact that some processes could not be quantified (size or frequency), although the order-of magnitude of debris flows was estimated. A more extensive monitoring plan may well yield all data required for a complete budget.

A dissection of the extent recurrence qualities of sediment transport in the basin uncovers a pattern of transporting generally sediment throughout great occasions. The rate of sediment transported at high releases diminishes downstream. The sediment release histograms uncover an assortment of structures and an extensive variety of viable releases. The adequate releases for tributaries go from 1.5-2.0 to 5.5-6.0 times the normal release, and diminish downstream. The primary Indus River, nonetheless, shows a steady viable release in the reach of 2.5-3.0 times the normal release.

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