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From Source to Sink: Quantification of mass transfer from mountain ranges to active sedimentary basins in the Danube basin – Black Sea system

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The erosion of rocks in mountainous source areas, transport via drainage (river) networks and deposition in subsiding sinks, as well as the response to tectonic stress changes are an expression of the complex interaction between deep Earth and near-surface processes. Regional-scale integrated assessment of an entire hydrographic basin corridor, addressing interactions between active mountain uplift processes, through drainage networks to former and/or active sedimentary basins, has never been attempted before. In particular, incorporation of long term and deep lithospheric processes into the study of natural hazards is entirely novel. The challenge lies in demonstrating the quantitative links between lithosphere dynamics, neotectonics, surface and climatic processes, through the development of numerical models, making use of datasets that cover different aspects of these phenomena at a range of scales.

The Danube River Basin - Black Sea area represents a unique natural laboratory for studying the interplay between lithosphere and surface processes, source-sink relationships, and the impact of global change. The densely populated Danube River Basin is threatened by landslides, flooding and earthquakes. Human activities contribute to these risks at local, regional and transnational scales. Water, air and soil pollution cause serious deterioration of the Black Sea sink environment. Corrections to the Danube greatly enhanced flooding risk. Recurring major flooding disasters reflect a significant disturbance of the source-sink balance. Process-oriented studies improve understanding of what determines the present-day situation and causes changes in the sediment supply to basins, and thus form the base for developing defence strate-

gies. An integrated and strategic management of interdisciplinary research activities is needed for the mitigation of natural hazards and sustainable development of natural resources.

Changes in source areas due to past and active tectonics control the transport and deposition of sediments in adjacent sinks. This pertains particularly to the Carpathians, where great variations in lithospheric structure have led to pronounced weaknesses and the localisation of strain in adjacent basins. In the Carpathians- Pannonian system significant Quaternary vertical movements cause increased seismicity, landscape and slope instabilities, rapid drainage system changes and the development of late stage hydrocarbon traps. Late stage structural inversion of post-orogenic basins in the Carpathians-Dinarides - Pannonian domain involves large differential vertical movements at regional and local scales. This process is associated with significant changes in recent lithosphere dynamics, tectonic topography and climate variations. In intra-Carpathian basins, the key research objective is to relate river dynamics and active land-forming processes to changes in tectonic topography. Understanding these changes permits us to project geotrends into a reliable human scale.

The drainage network of the Danube river system and its transition zone to the active sink area of the Black Sea responds rapidly to changes in the upper reaches of the source-sink system. As active processes provide the key link to the sedimentary balance of this system, these are influenced by the inherited memory from the Carpathians collision time, rapid sea-level changes, basin filling patterns and climatic instability. For the active sink system, the Black Sea, a multidisciplinary and integrated approach links crustal-scale tectonics and climatic processes to its high-resolution shallow sedimentary record in a set of basin evolutionary models. The aim is to gain an understanding of active basins dynamics in the face of a rapidly changing carrier system, controlling sediment supply and forcing processes, and to separate climatic from neotectonic effects.

These processes will be linked by an integrated modelling approach, in order to establish reliable links between lithosphere dynamics, neotectonics, surface and climatic processes and to develop quantitative models covering different scales and aspects of the Source-Sink sedimentary balance. Understanding the entire system balance will equip large-scale modellers for the first time with tools to analyse the higher resolution system components.