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Sedimentary mass flux across the Tien-Shan (central Asia) since Miocene and tectonic setting: a numerical study.

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Despite much progress, many questions remain regarding the potential dynamic coupling between atmospheric and lithospheric processes in the long-term evolution of mountain belts. Recent studies (e.g., Whipple and Meade 2004, Stolar et al. 2006) have reported models that predict a powerful climatic control on orogen evolution and distinct, potentially diagnostic, responses to climatic and tectonic perturbations. We propose to test these hypotheses in a natural system, the Tien Shan mountain belt, using a state-of-the-art numerical model, DOUAR (Braun et al., 2008).
The Tien Shan is the second largest and most active intra-continental range in the world after the Himalayas. This prominent range is flanked by two large sedimentary basins (Junggar and Tarim basins). On the bases of sedimentary, structural and thermochronological studies, many authors have shown that the Tien Shan is a Paleozoic mountain belt that has been reactivated by a change in the India-Asia collision regime during the early Miocene. Since this reactivation, three sedimentation pulses have been identified in the northern (Junggar) and southern (Tarim) basins (15 Myr, 11 Myr and 4 Myr). This orogenic belt therefore experienced changes in tectonic regimes in a varying climate. Moreover, North South cross section across the Tien Shan shows that this belt is highly asymmetric in terms of elevation, basin depth and shape. Using these constraints and testing different climatic/erosion/sedimentation scenarios with the numerical model, we will test the dynamic coupling between climate and tectonics.

Theses test will be performed on a 3D S-line crustal model. Thanks to DOUAR (Braun et al., 2008) we solve the Stokes and Energy equation for the crust using finite element methods. The boundary conditions are chosen to satisfy an Eulerian rotation convergence of 0.45 ± 0.2 °/Myr between 73 and 84°E (1700 km width) around a rotation pole located at 96°E, 45°N. These boundary conditions enable us to vary the convergence velocity from 20 mm/yr to the west side to 6mm/yr in the eastern side of the range. Surface process equations are then solve on a free surface at the top of the crust to investigate the implications of different climatic/erosion/sedimentation scenarios. The model results are, in turn, compared to sedimentological budgets and magneto-stratigraphical data (J. Charreau et al 2006, 2008, 2009).