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Crustal block structure by GPS data using neural network in the Northern Tien Shan

A. Kostuk and D. Carmenate
Research Station of Russian Academy of Science in Bishkek city, Kyrgyzstan (a_d_kostuk@mail.ru, +996-312-611459)

For over ten years regular GPS measurements have been carried out by Research Station RAS in the Central Asia. The results of these measurements have not only proved the conclusion that the Earth's crust meridional compression equals in total about 17 mm/year from the Tarim massif to the Kazakh shield, but have also allowed estimating deformation behavior in the region. As is known, deformation behavior of continental crust is an actively discussed issue. On the one hand, the Earth's crust is presented as a set of microplates (blocks) and deformation here is a result of shifting along the blocks boundaries, on the other hand, lithospheric deformation is distributed by volume and meets the rheological model of nonlinear viscous fluid.
This work represents an attempt to detect the block structure of the surface of the Northern Tien Shan using GPS velocity fields. As a significant difference from analogous works, appears the vector field clustering with the help of neural network used as a classifier by many criteria that allows dividing input space into areas and using of all three components of GPS velocity. In this case, we use such a feature of neural networks as self-organization. Among the mechanisms of self-organization there are two main classes: self-organization based on the Hebb associative rule and the mechanism of neuronal competition based on the generalized Kohonen rule. In this case, we use an approach of self-organizing networks in which we take neuronal competition as an algorithm for their training. As a rule, these are single-layer networks where each neuron is connected to all components of m-dimensional input vector.
GPS vectors of the Central Asian velocity field located within the territory of the Northern Tien Shan were used as input patterns. Measurements at GPS sites were fulfilled in 36 hour-long sessions by double-frequency receivers Trimble and Topcon. In so doing, measurement discreteness equaled 30 seconds; the data were processed by GAMIT\GLOBK programs. An overall period of measurements lasted from 1995 to 2005. Those GPS vectors were admitted to processing that had an estimated error no more than 1 mm per year for each of the three components.
In general, an obtained cluster structure reflecting the block structure of the Earth's crust of the Northern Tien Shan is proved by the location of active faults. Certainly, the structure analysis of GPS velocity field is a rather complicated task that yet does not have a definite solution; however, obtained results indicate the possibility of using of neural networks for solving such a problem.