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Interactive comment on “Multi-quadric collocation model of horizontal crustal movement” by G. Chen et al.

G. Chen et al.

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We have gratefully received the comments and suggestions and have seriously analyzed its. Then we have amended the manuscript accordingly.

Comment 1:Crustal movement is composed of two parts: rigid rotation, which could be well described by Euler Vector, and local deformation, which is mainly corresponding to local tectonic movement. The local crustal deformation is not stochastic, but obey some physical models. For example, the deformation around an active fault could be well described by the Okada’s half-space elastic dislocation model. In this paper, the local deformation is assumed or simplified as the stochastic signals. How does this assumption affect your method or solution?

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



Interactive
Comment

Response: Thank you for the comment. In this manuscript, we did not look upon the local deformation parameters as random signals, but as non-random variables, and just took into account their random nature. This consideration aimed to take the kernel function of the Multi-quadric function as the covariance function in collocation model in order to reduce the difficulty of determining the random signal covariance function in the collocation model. The kernel function is still a distance function as same as the covariance function, so the effects of this assumption is smaller.

Comment 2: The most important part of this paper is a new interpolation method. How do you convince us that your new method is better than the existing classical ones for the purpose of establishing a horizontal crustal movement model of Chinese Mainland? I suppose you need to do some comparisons and discussions. One strategy to judge which of the methods furnishes the most reliable interpolation to the observed velocity is to predict the velocity at "each" of the 1070 stations using the different methods based on the observed velocities at the other 1069 stations to get the misfit between the observed velocity and the predicted one.

Response: Thank you for the comment. We have done a comparison and discussion by using the observation data derived from the 985 regular observative GPS stations to obtain the different velocity field models, with Multi-quadric collection model, Euler vector model, the collocation method and the multi-quadric function method, and utilizing the data come from the other GPS stations to be as the inspection (for details in the Table 5), in China. The result indicates that the Multi-quadric collection model, proposed in this paper, is more reasonable for the horizontal crustal movement model of Chinese Mainland than the other methods. Meanwhile, the east and north velocity residual of the Multi-quadric collection model, respectively attaining 0.78 mm/y and 0.73 mm/y, are significantly superior to the that of the other methods (for details in Table 5). Furthermore, the external precision in east and north, having remarkable improvements and respectively reaching 1.67 mm/y and 1.45 mm/y, are slightly superior to the that of the other methods (for details see Table 6).

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive
Comment

Comment 3: According to the topic of this paper, It would be better to produce and present a gridded velocity map of Chinese Mainland based on your interpolation method and the observed velocities of the scattered GPS stations.

Response: Thanks a lot for your positive and constructive comment. According to your advice, we add the following parts: "According to the comparative and analysis for the calculation, we have established a $1^{\circ} \times 1^{\circ}$ gridded velocity model (for details see Fig. 1) and a $1^{\circ} \times 1^{\circ}$ velocity field model deducting the Chinese continental crustal deformation background field (for details see Fig. 2). In the Fig.1, the Chinese continental crust has eastward movement as a whole. Meanwhile, the China continental region possesses significantly clockwise rotation, but velocity values exist difference in some parts of China, of the horizontal velocity field, removing the continental movement background in China, in the Fig.2. There has an eastward-southeastward-southwestward movement model with the feature of higher velocity values in the west by 104 longitude degrees in Sichuan-Yunnan region. In the northwest region, the continental crust displays NNW motion model. In the Northeast Plain, there has westward movement. On the contrary, the South China represents SSE motion model with small velocity values relative the others in the China."

Comment 4: The English expression of this article need to have substantial improvement, as the meaning of some sentences is difficult to understand. Some corrections: P.3360 +L.15 : the precision in the north and east directions was 1.25 and 0.80mm/yr, respectively.[the precision in the north and east components was 1.25 and 0.80mm/yr, respectively.] P.3360 +L.23 : from measured points has been the focus of much research at home and abroad, and it has produced a lot of research literature [from measured points has been the focus of a lot of researches all over the world] P.3362 +L.22 : where n and u are the station quantity and estimated parameter numbers [where n and u are the station number and estimated parameter number, respectively.] P.3363 +L.5: where U_e denotes the easterly component of the ground station's horizontal velocity in a topocentric coordinate system, and U_n represents the northerly component.[where

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Interactive
Comment

Ue and Un denotes the east and north components of the horizontal velocity of ground stations, respectively, in a topocentric coordinate system] P.3364 +L.13:different physical applications spend a lot of energy in determining the covariance [different physical applications take a lot of effort in determining the covariance] P.3366 +L.18:inverted double curved surface, positive three surface, and inverted three surface.[inverted double curved surface, positive thrice curved surface, and inverted thrice curved surface.] P.3367 +L.22: the Crustal Movement Observation Network Engineering [the Crustal Movement Observation Network project] P.3368 +L.2: (29 consecutive observation stations and 56 irregular observation basis points) [(29 continuous observation stations and 56 campaign-mode observation stations] P.3368+L.20:We use inverted and positive, double curved, two, and three surfaces to obtain[We use inverted and positive, double curved, twice (?) and thrice curved surfaces to obtain] P.3369 there are a lot of "three surfaces" which should be thrice curved surface, I suppose!

Response: According to your comments, we have revised them. Meanwhile, all of "three surfaces" and "two surfaces" have been revised as "thrice curved surface" and "twice curved surface", respectively.

Please also note the supplement to this comment:

<http://www.solid-earth-discuss.net/7/C2054/2016/sed-7-C2054-2016-supplement.pdf>

Interactive comment on Solid Earth Discuss., 7, 3359, 2015.

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Interactive
Comment

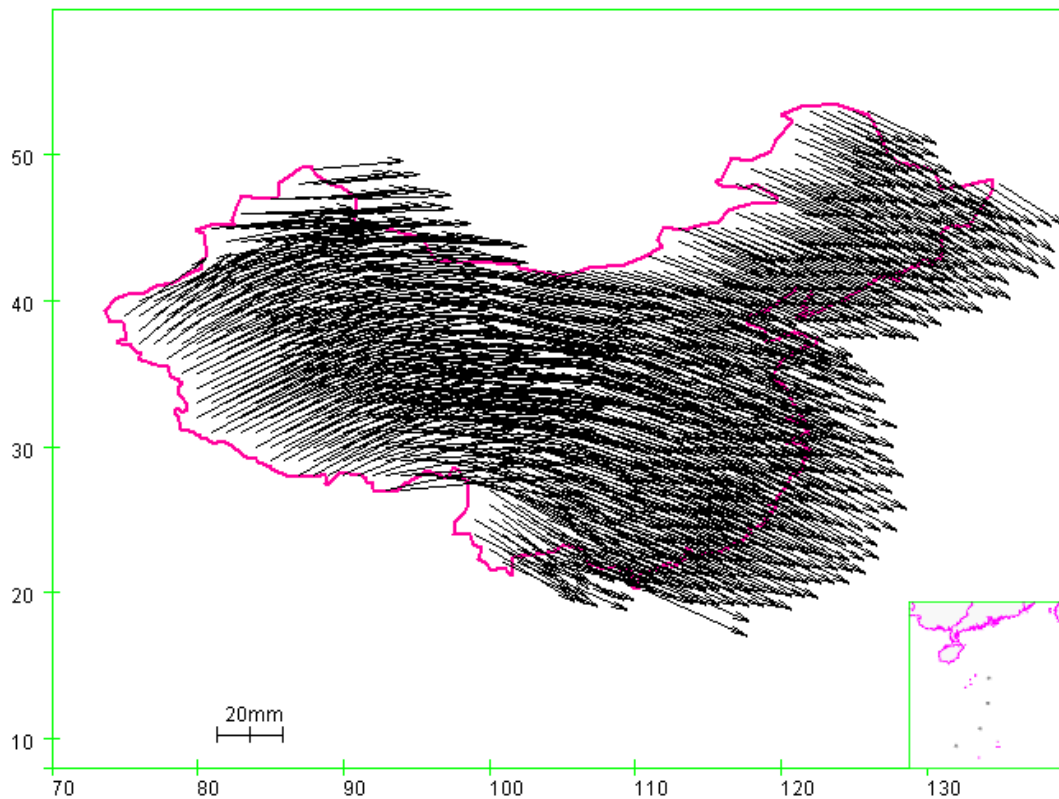


Fig. 1. $1^\circ \times 1^\circ$ Velocity Field Model

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Interactive Discussion

Discussion Paper



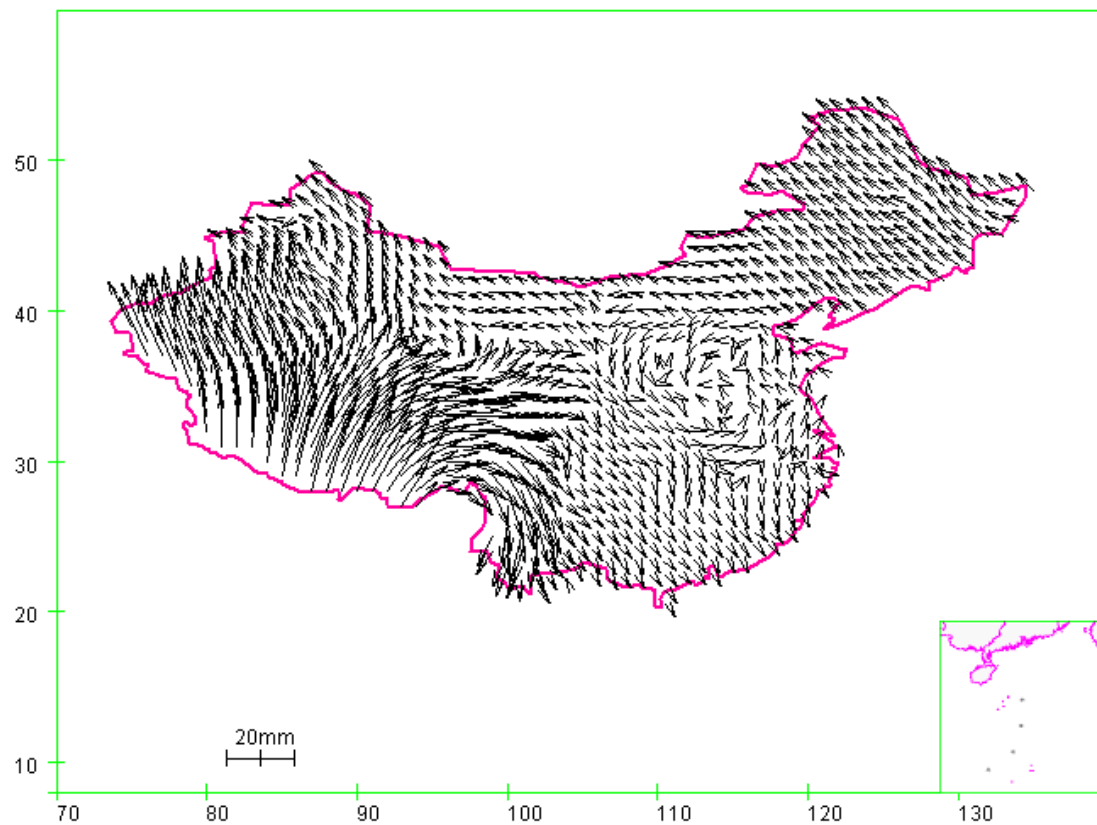
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Fig. 2. $1^{\circ} \times 1^{\circ}$ Velocity Field Model deducing the Chinese continental crustal deformation background field

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