

# Non-linear methods for estimation of interrelationship between two scalar fields: multifield gradient measure and Jacobi sets.

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We consider a problem of estimation of relationship between scalar fields for a multifield data set.

Evaluation techniques using computation of correlation matrix for fields give a global result and therefore are non-informative. As a satisfactory alternative, gradient comparison measure can be used [Nagaraj, 2011].

Another alternative is Jacobi sets, which are the sets of critical points of the restrictions of one function to the intersection of level sets of the other functions [Huettenberger, 2015].

We present the results of a numerical experiment for the case of multifield containing two fields: geopotential height on isobaric level 300 hPa and total ozone column in the Northern hemisphere in January 2005, when intensive solar proton events were observed. Estimation of relationship by gradient measure indicates strengthening interaction between fields at 18<sup>th</sup> and 20<sup>th</sup> of January. However, note that gradient measure value depends on gradient vectors length, so such strengthening may be related with magnitude change of gradient fields. Jacobi sets computation gives more reasonable estimate: relation between fields weakens during solar proton events; paths on Jacobi set between critical points of total ozone field become longer.

In this work we also give physical explanations of obtained results.

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