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Multiridge and ScalFun for the volcanic deformation: estimation of sources geometrical parameters.

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Since the development of the remote sensing technologies, a big amount of data is available and so its exploitation, in the last years, becomes a crucial task. The volcanic phenomena are nowadays monitored by the detection of physical and chemical parameters. Generally, the changes of geometrical and physical parameters of magmatic reservoirs induce an anomaly in the observed ground deformation field. Currently, the most employed methods to retrieve the source parameters are essentially based on the optimization/inversion procedures, although they do not guarantee to have a single solution.
In this scenario, we propose a new modeling strategy, already validated for the case of spherical sources modeling (Castaldo et al., 2018). This approach allows the estimation of the source parameters, responsible of the ground deformation field, recorded by DInSAR technique, via Multiridge and ScalFun methods. The method provide univocal information about source geometrical parameters and it is particularly suitable in the volcanic context. Specifically, the Multiridge method detects the depth and the location of the source, while the ScalFun method gives information about the source shape.
To do this, we firstly verify if the observed ground deformation field satisfy the requirements of Laplace equation (Blakely, 1996) in order to apply the above mentioned methodology. Then, we apply the proposed methods on the modelled ground deformation field by considering several model settings. In particular, by using Multiridge and ScalFun, the geometric features of the active source, such as the position and source type, can be easily detected independently from (i) other physical features of the source (such as the pressure variation), (ii) physical-elastic parameters of the medium (such as the shear modulus and the Poisson ratio), and (iii) a low signal-to-noise ratio.
In conclusion, since the proposed modeling approach does not depend on the physical model parameters, we need to apply a subsequent procedure to fully interpret the ground deformation measurements. So, we highlight that the source parameters estimated with Multiridge and ScalFun methods, depth to the center, horizontal position and source-type, represent relevant information to constrain the entire interpretation procedure.