Contribution ID: **493** Type: **Oral Presentation**

Quantification of Heterogeneity of Spatially Averaged Generalized sub-Gaussian Random Fields

Monday, 30 May 2022 17:05 (15 minutes)

While Gaussian models have been used to describe spatial heterogeneity of hydro-geological attributes, the Generalized sub-Gaussian (GSG) model introduced by Riva et al. (2015) has been shown to be able to capture heavy tailed marginal distributions and simultaneous leptokurtic scaling of increment distributions of a broad range of hydrogeological variables. In this context, it can be noted that the main statistics characterizing the spatial heterogeneity of a given system attribute such as, e.g., permeability, depend on observation scale. A key parameter of the GSG model is a length scale which is proportional to the size of the volume associated with observations and can be characterized through standard inverse approaches. Here, we investigate the dependence of observation scale of the parameters of the GSG model, with specific focus on the way uncertainty propagates across random fields associated with diverse observation scales. We do so by analytically deriving expressions according to which the variance of a (two- or three-dimensional) GSG random field varies as a function of the degree of spatial averaging. Our formulations enable one to estimate the level of heterogeneity (as quantified through the variance) at a given scale, as a result of averaging from a reference scale. Our analytical findings show that the level of heterogeneity in GSG fields (a Gaussian distribution being a special case thereof) is highest at the finest scale and decays towards zero as we increase the spatial averaging volume. As expected, the field becomes homogeneous at the limit of complete spatial averaging. Our model for variance propagation across averaging scales allows efficient estimation of residual heterogeneity retained at larger length scales, thus being of interest when formulating coarse grained hydro-geological flow models. The model is first verified through comparison with results achieved through a Monte-Carlo numerical analysis and it is then applied to a comprehensive dataset composed of more than 2000 air permeability data collected at various observation scales on the surface of a block of Massilon Sandstone sample.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

Country

United Kingdom

References

Riva, M., Neuman, S. P., & Guadagnini, A. (2015). New scaling model for variables and increments with heavy-tailed distributions. Water Resources Research, 51(6), 4623-4634.

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Unsure

Primary author: HARRISON, Matthew (University of Warwick)

Co-authors: Dr MOUSAVI NEZHAD, Mohaddeseh (Associate Professor); Dr HUDSON, Thomas (University of Warwick); GUADAGNINI, Alberto (Politecnico di Milano); RIVA, Monica (Politecnico di Milano)

Presenter: HARRISON, Matthew (University of Warwick)

Session Classification: MS14

Track Classification: (MS14) Uncertainty Quantification in Porous Media