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# Variogram analysis of stable oxygen isotope composition of daily precipitation over the British Isles

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Water stable isotopes are important natural tracers in the hydrological cycle on global, regional and local scales. Daily precipitation water samples were collected from ∼70 sites over the British Isles on the 23rd, 24th, and 25th January, 2012 [1]. Samples were collected as part of a pilot study for the British Isotopes in Rainfall Project, a community engagement initiative, in collaboration with volunteer weather observers and the UK Met Office.

Spatial correlation structure of daily precipitation stable oxygen isotope composition ($\delta$18OP) has been explored by variogram analysis [2]. Since the variograms from the raw data suggested a pronounced trend, owing to the spatial trend discussed in the original study [1], a second order polynomial trend was removed from the raw $\delta$18OP data and variograms were calculated on the residuals. Directional experimental semivariograms were calculated (steps: 10º, tolerance: 30º) and aggregated into variogram surface plots to explore the spatial dependence structure of daily $\delta$18OP.

Each daily data set produced distinct variogram plots.
-A well expressed anisotropic structure can be seen for Jan 23. The lowest and highest variance was observed in the SW-NE and NNE-SSW direction, respectively. Meteorological observations showed that the majority of the atmospheric flow was SW on this day, so the direction of low variance seems to reflect this flow direction, while the maximum variance might reflect the moisture variance near the elongation of the frontal system.
-A less characteristic but still expressed anisotropic structure was found for Jan 24 when a warm front passed the British Isles perpendicular to the east coast, leading to a characteristic east–west $\delta$18OP gradient suggestive of progressive rainout. The low variance central zone has a ∼100 km radius which might correspond well to the width of the warm front zone. Although, the axis of minimum variance was similarly SW-NE, the zone of maximum variance was broader and practically perpendicular to it. In this case, however, directions of the axes appear misaligned with the flow direction.
-We could not observe similar characteristic patterns in the last variogram calculated from the Jan 25 data set.
These preliminary results suggest that variogram analysis is a promising approach to link $\delta$18OP patterns to atmospheric processes.

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References

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