

Geomorphometric analysis of the scoria cones of the San Francisco Volcanic Field using polar coordinate transformation

EGU2016-1045

X2.423

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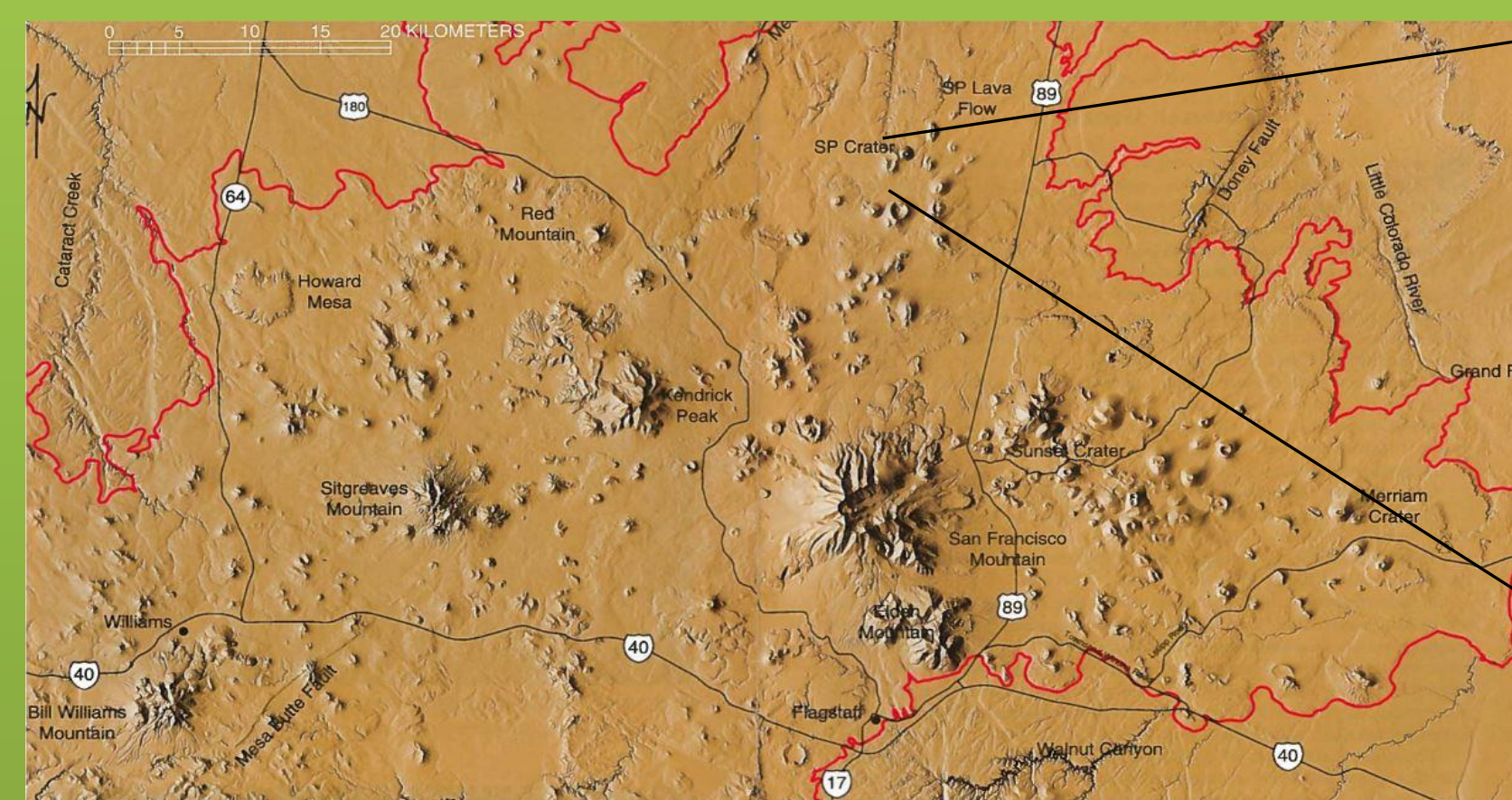


Introduction

Scoria cones are often studied using geomorphometric and traditional GIS methods, e.g. aspect, slope histograms, area, cone height/width ratio. In order to enhance the non-symmetric shape components in contrast to the conical forms, we used a new approach in our research: the polar coordinate transformation (PCT) introduced by Székely & Karátson (2004). With the application of PCT, we can define new derivatives of the morphometric parameters.

What is SFVF and where to find it?

The study area is the classic cluster of scoria cones at the San Francisco Volcanic Field (SFVF) encompassing roughly 600 scoria cones. Cinder cones are relatively small, symmetrical forms, most of them are basalt cones. Basalt has the lowest viscosity of all common magmas. San Francisco Mountain is the central stratovolcano in the SFVF—which includes Arizona's highest point, Humphreys Peak. The area is well-studied volcanic field (Porter, 1972; Wood, 1980a, b) with evidence of eastward younging trend of the cinder cones (Tanaka et al., 1986, Hooper & Sheridan, 1998).



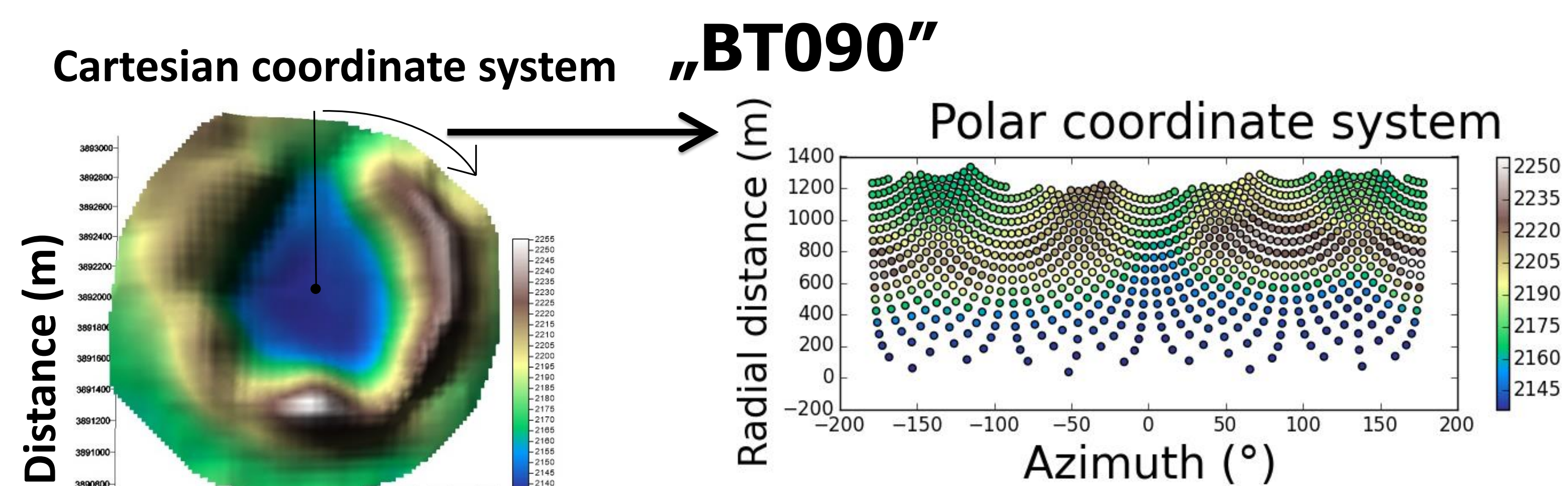
The San Francisco Volcanic Field, Arizona, USA



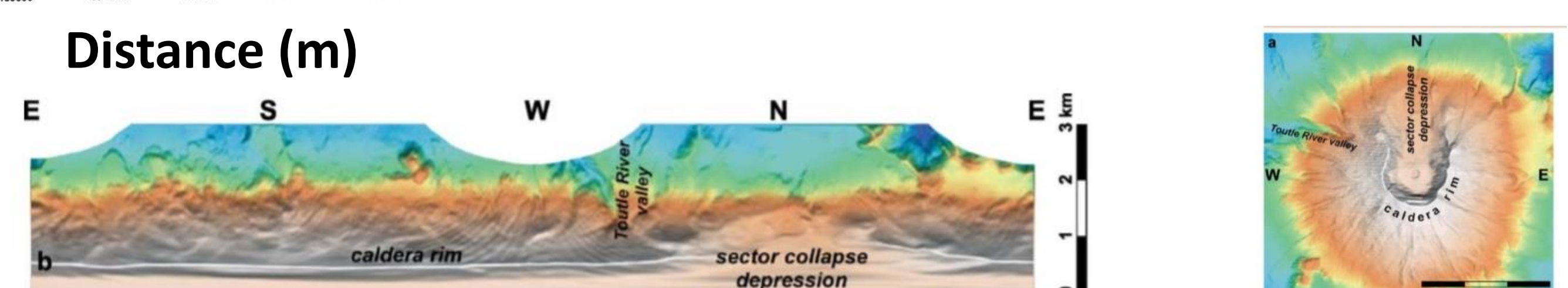
SP Crater is a perfect example of a symmetrical cinder cone with its lava flow.

Method of PCT

The digitized points in the original, Cartesian coordinate system can be characterized by X and Y coordinates (m). After the transformation, the same points can be represented by a radial distance (m) and azimuth (°) values.



Example:

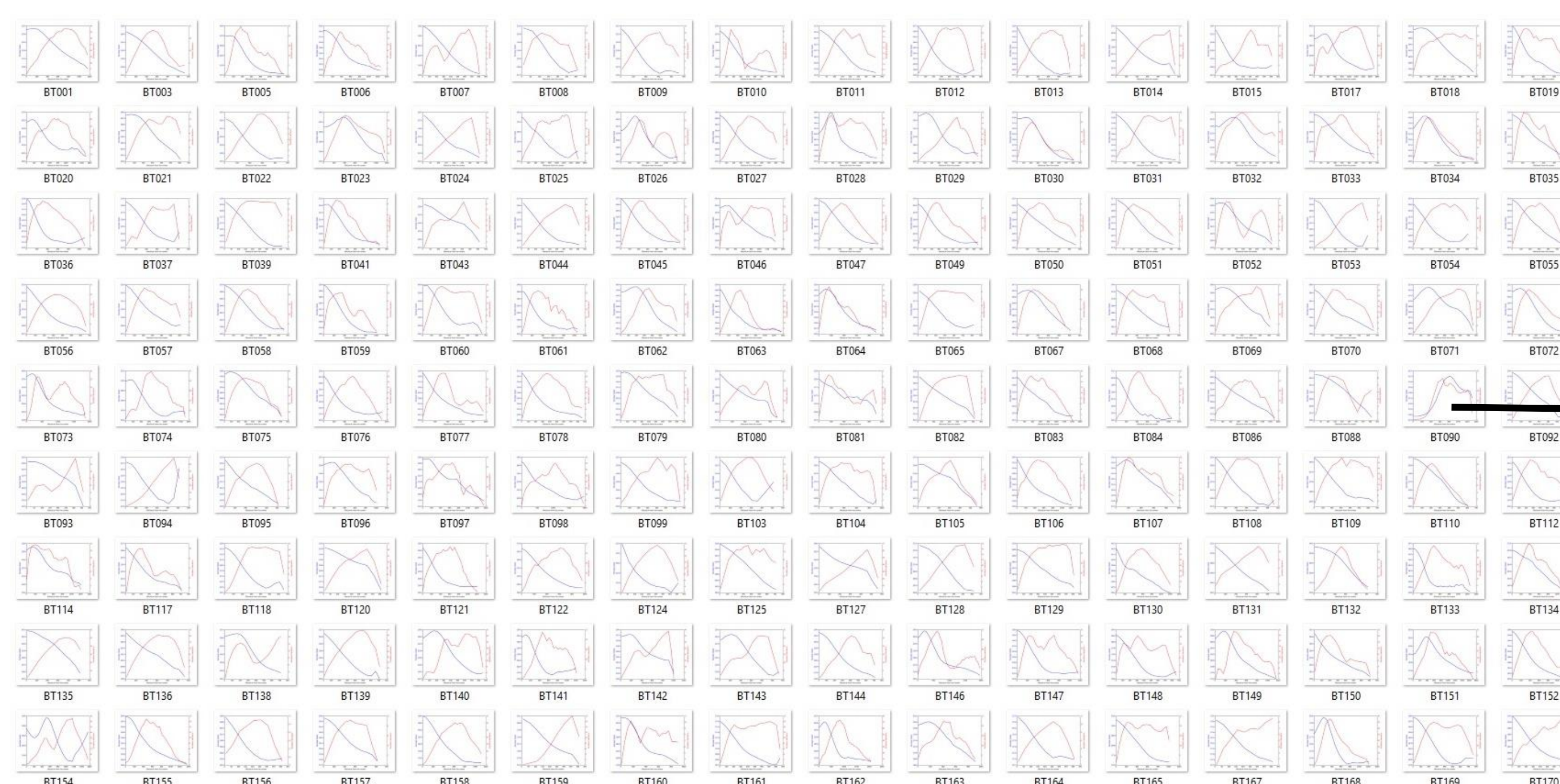
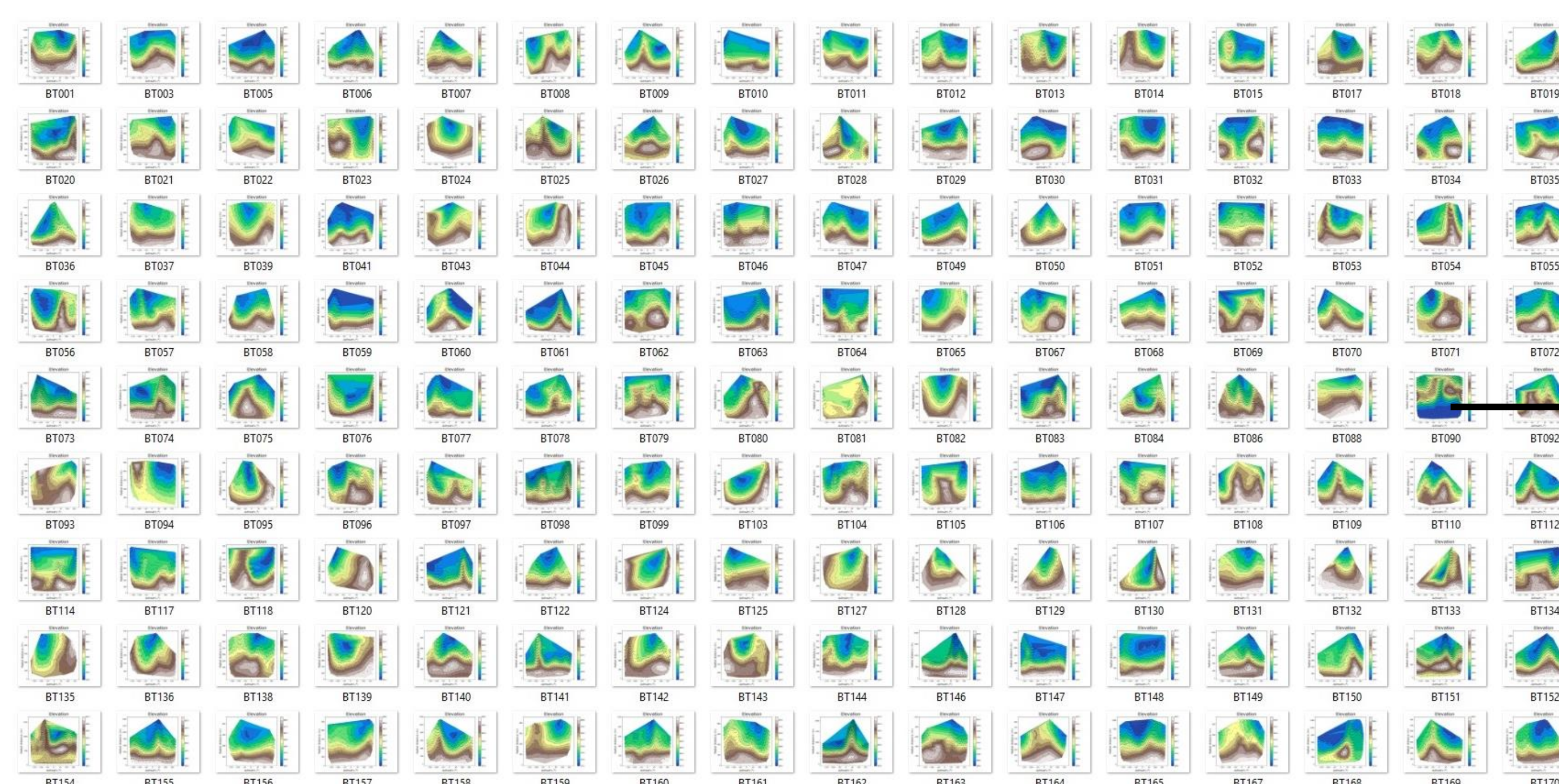
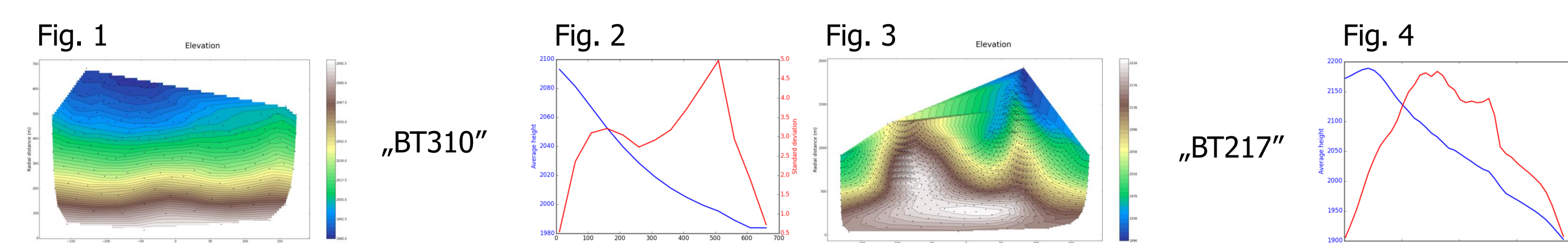


Mount St. Helens, after the eruption

Székely & Karátson (2004)

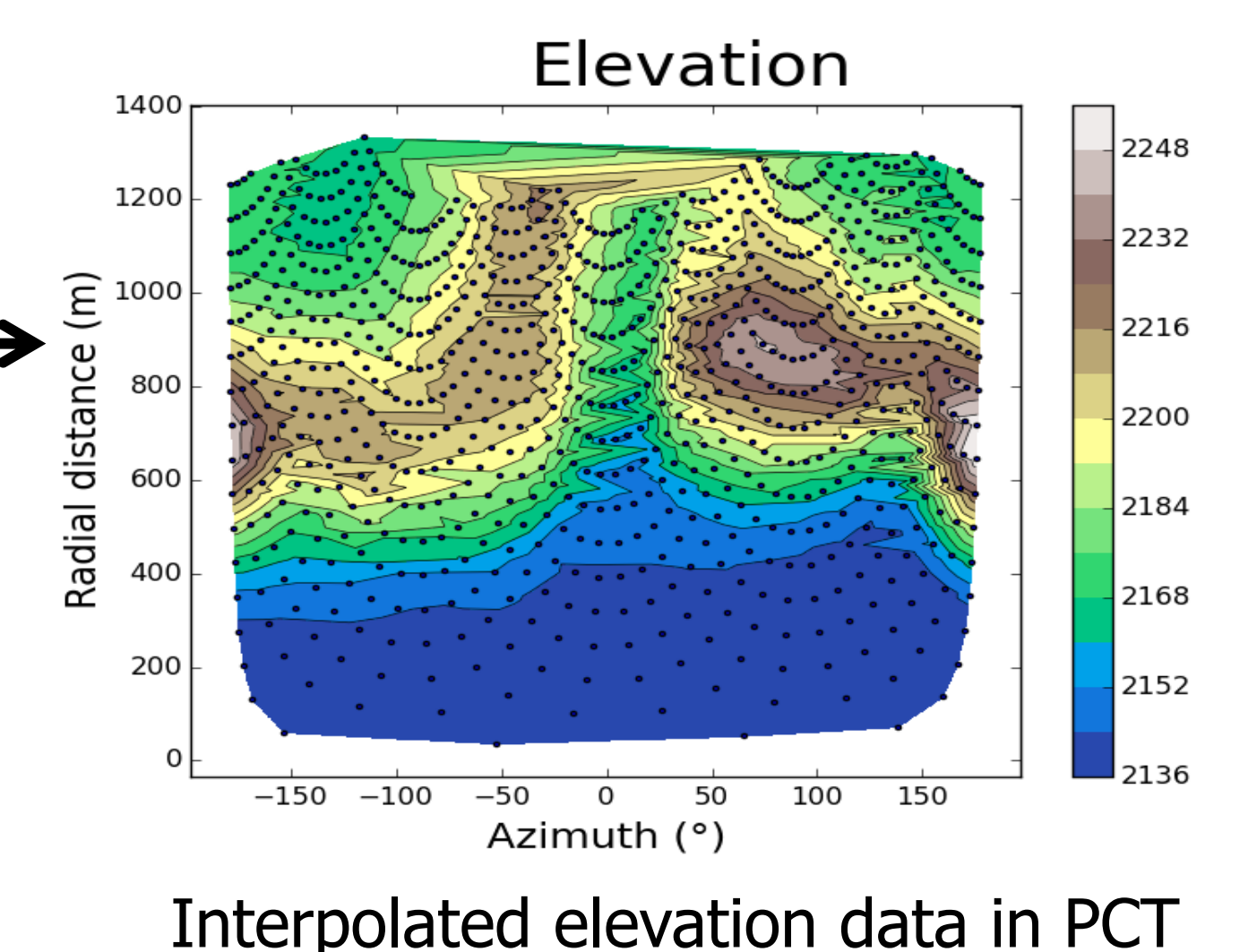
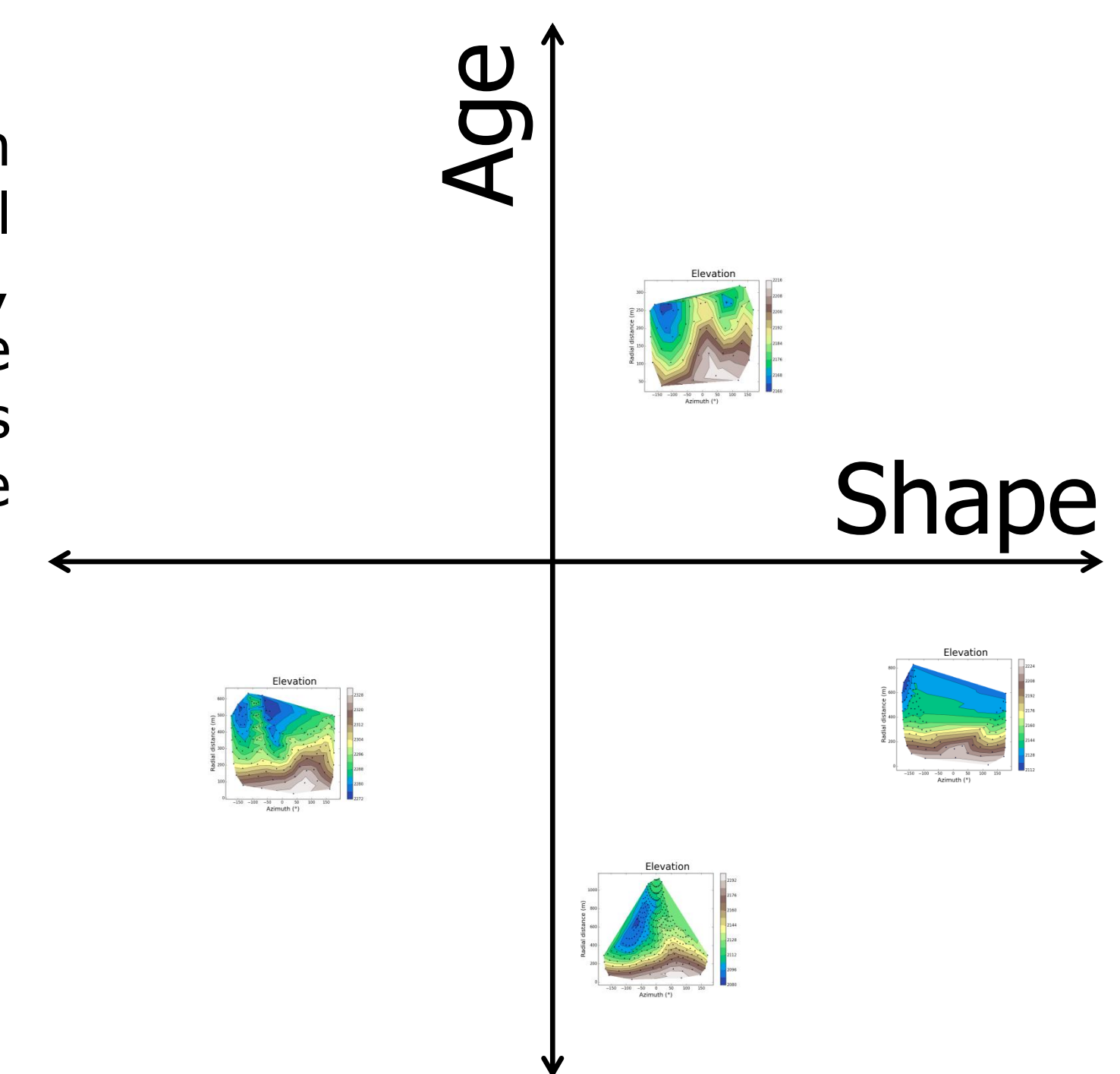
Conclusion

With the help of PCT, average elevation and standard deviation (calculated and shown in Python) we can compare the shape of the cones. Symmetric ones represent roughly parallel contour lines (Fig. 1) with polyconic form and low standard deviation (Fig. 2). In contrast, asymmetric cones' elevation (Fig. 3) strongly depend on azimuth values. These usually have craters (eroded or regular), so the standard deviation is more significant (Fig. 4). Our plan is to place the cones in a graph with shape-age axes, in order that in the future we can tell the age of a cone from its shape.



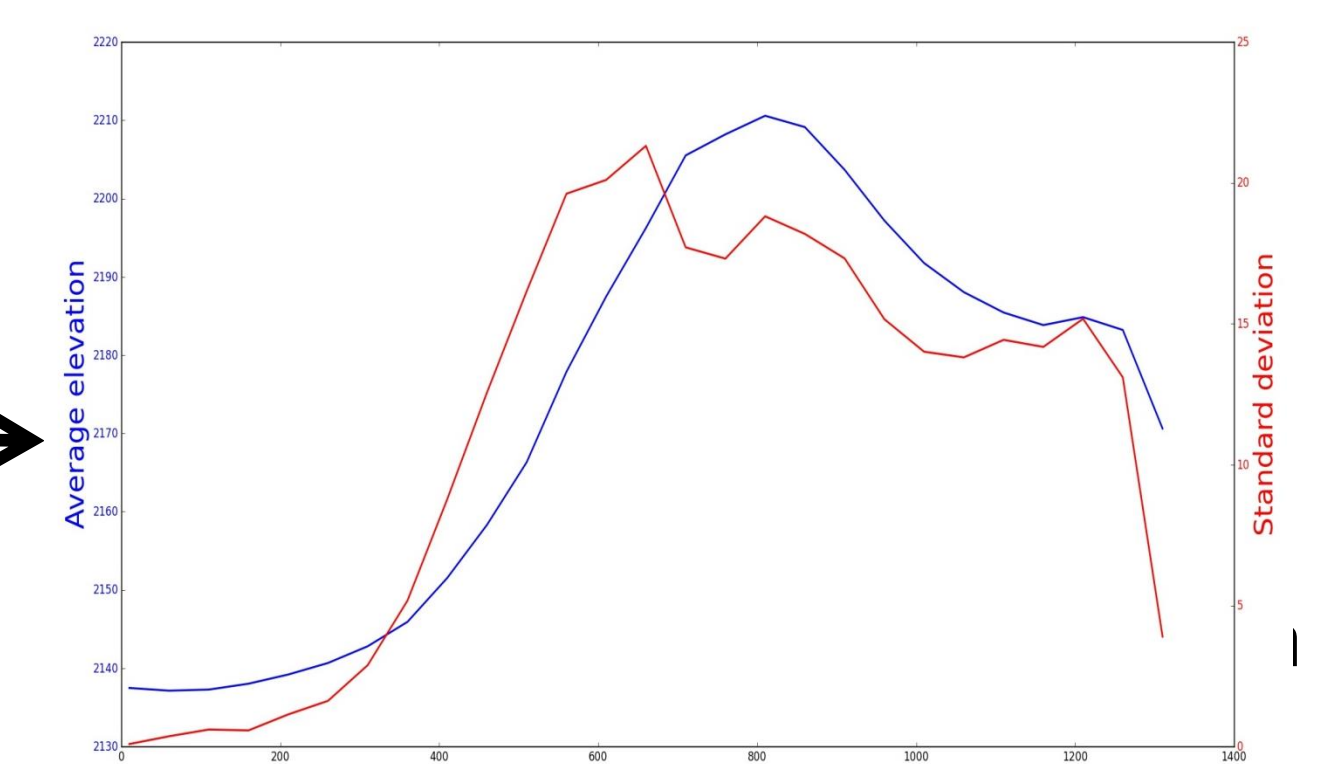
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Interpolated elevation data in PCT

„BT090”



Average elevation and standard deviation data