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Automatic lineament extraction from radar and optical imagery for geological mapping in the Pamir Mountains: a comparative study

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Abstract: Lineament detection and mapping is an important part of structural geological investigations. It is also widely used in other different studies including mineral exploration, hydrogeological and risk assessment. Availability of optical as well as radar remote sensing data such as Landsat and Sentinel with medium and high spatial resolution have proved valuable the utilization of this data for structural lineament mapping through advanced remote sensing techniques. However, the results from these multi-resolution data vary due to their difference in spatial resolution and sensitivity to soil occupation. The accuracy and quality of extracted lineaments depend strongly on the spatial resolution of the imagery. Therefore, the aim of this study was to compare the optical Landsat-8, Sentinel-2A and radar Sentinel-1A satellite data for automatic lineament extraction. The framework of automatic approach includes defining the optimal parameters for automatic lineament extraction with a combination of edge detection and line-linking algorithms and determining suitable bands from optical data suited for lineament mapping in the study area. For result validation, the extracted lineaments are compared against the manually obtained lineaments through the application of directional filtering and edge enhancement as well as to the lineaments digitized from the existing geological maps of the study area. In addition, a digital elevation model (DEM) has been utilized for accuracy assessment followed by the field verification. The obtained results show that the best correlation between automatically extracted lineaments, manual interpretation, and the pre-existing lineament map is achieved from the radar Sentinel-1A images. The tests indicate that the radar data used in this study are more efficient for structural lineaments mapping than the optical imagery.