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Is the Himalayan Arc Really Perfect?

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The India-Eurasia collision Himalayan plate boundary is one of the most active orogens on the earth and is considered to form a near perfect circular arc between longitudes 77.2ºE and 92.1ºE with a radius of 1696±55 km and centre at 42.4±2.1ºN; 91.6 ±1.6ºE. The continuity of this arc has been used to laterally project and extrapolate geological cross-sections and geophysical data along the length of the Himalayan belt. For example, the INDEPTH Himalayan hinterland geometry has been used as the representative Himalayan hinterland geometry in many parts of the Himalayan belt. Continuity of the arc has also been used to compute representative convergence rate of ~ 20 mm/yr along the arc from Global Positioning System (GPS) based geodetic measurements and used to compute Himalayan seismic hazard estimates. Is this realistic over different space and time scales? The Himalayan Mountain front exhibits sinuosity with amplitudes of the order of 10s of kilometers resulting in well-defined salients and recesses pointing to lateral variations in the deformation kinematics of the Himalayan wedge over geological time. The sinuosity of the front causes a variation in the number of thrusts south of the Main Boundary Thrust, making the definition of the Siwalik on Quaternary, Main Frontal Thrust non-unique along the length of the Himalayan front. The presence of transverse zones in the Himalayas also supports variation in deformation kinematics along its length. Variations in the earthquake epicenter and hypocentre distribution patterns in the Himalayan belt point to lateral variation in deformation kinematics over more recent timescales. GPS based convergence rates also exhibit significant variability along the length of the Himalayan arc ranging from about ~10 mm/yr to ~20 mm/yr. Given this, continuity of the Himalayan arc through different space and time scales is not a realistic assumption. The Himalayan plate boundary is segmented like the fingers of the hand instead and each finger is mechanically distinct from its neighbour and separated from them by transverse zones, lateral or oblique ramps. Consequently, the Himalayan convergence is likely to be discontinuous with abrupt changes across transverse zones. A non-continuous Himalayan plate boundary and lateral variation in the deformation kinematics evident from the available geologic, geophysical and seismological data implies that it is meaningless to project data and geometry of structures laterally from one part of the Himalayas to another, especially across known transverse zones. Complete transects across the Himalayan mountain belt must be made to understand the deformation kinematics in the Himalayas better.