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Historical storm analysis as an indicator of future flood risk in KZN, RSA

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Floods are a significant contributor to natural disaster related deaths [1]. Detailed flood line mapping can be used to assess flood risk, but the limited coverage (1%) of flood lines in KwaZulu-Natal (KZN) means that flood hazard maps can only cover a fraction of the settled areas in the province. An alternative approach is to interrogate historical rainfall records to identify areas of flood risk as flooding is the result of the duration and intensity of storm systems. These data can be used to reconstruct the spatial patterns of past storms systems [e.g. 2] and can be linked to planetary scale climatic cycles (e.g. El Niño Southern Oscillation - ENSO). Variations in rainfall patterns, rainfall intensities, increased extreme events and periodicity have been attributed to various climatic cycles [e.g. 3].

Using historical rainfall data (1890 – 2000) for KZN [4], daily rainfall maps were gridded in GIS to produce regional storm event (RSE) footprints for recorded flood events. Additional regional storms were identified based on similar parameters to that of the known flood producing regional storms. This resulted in the identification of 228 historical RSEs ranging from localised to extreme flood events.

Results from the analysis of the RSEs allowed for the identification of storm system transit times of (3 – 4 days) and temporal risk periods (January – April). A summed compilation of the spatial distribution of the 228 RSE footprints shows zones of varying counts indicating areas more likely to be affected by flood producing storm systems. Comparison of the historical RSE estimated discharges and annual occurrence counts show that there is a strong correlation between estimated discharge and the Pacific Decadal Oscillation (PDO), while the annual count shows correlation with ENSO. Forward projection of the PDO cycles indicates a probable increase in flood events and flood magnitudes for the period 2011 – 2018 and a significant increase in flood events and magnitude for the period 2030 – 2037.

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