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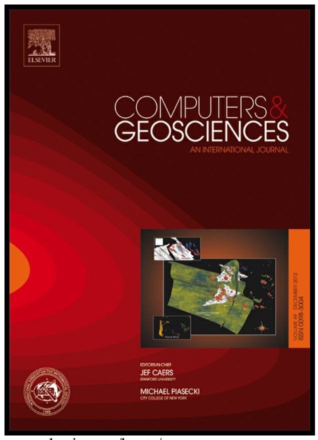

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Spatially adaptive probabilistic computation of a sub-kilometre resolution lightning climatology for New Zealand

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Abstract

Lightning is a key component of the Earth's atmosphere and climate systems, and there is a potential positive feedback between a warming climate and increased lightning activity. In the biosphere, lightning is important as the main natural ignition source for wildfires and because of its contribution to the nitrogen cycle. Therefore, it is important to develop lightning climatologies to characterise and monitor lightning activity. While traditional methods for constructing lightning climatologies are suitable for examining lightning's influence on atmospheric processes, they are less well suited for examining questions about biosphere-lightning interactions. For example, examining the interaction between lightning and wildfires requires linking atmospheric processes to finer scale terrestrial processes and patterns. Most wildfires ignited by lightning are less than one hectare in size, and so require lightning climatologies at a comparable spatial resolution. However, such high resolution lightning climatologies cannot be derived using the traditional cell-count methodology. Here we present a novel geocomputational approach for analysing lightning data at high spatial resolutions. Our approach is based on probabilistic computational methods and is capable of producing a sub-kilometre lightning climatology that honours the spatial accuracy of the strike locations and is adaptive to underlying spatial patterns. We demonstrate our methods by applying them to the mid-latitude oceanic landmass of New Zealand, an area with geographic conditions that are under-represented in existing lightning climatologies. Our resulting lightning climatology has unparalleled spatial resolution, and the spatial and temporal patterns we observe in it are consistent with other continental and tropical lightning climatologies. To encourage further use and development of our probabilistic approach, we provide Python scripts that demonstrate the method alongside our resulting New Zealand lightning climatology.

Keywords: Getis-Ord; GIS; Python; spatial autocorrelation; smoothing; wildfire