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Applying New 3D Jet Core Visualisation Techniques to the Study of Extreme Cyclones

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Wide-ranging scientific advances are making real-time use of 3D visualisation in meteorology increasingly attractive. Improved computer technology, mainly derived from the gaming industry, and encapsulated in modern-day graphics cards, now allows for transparency, fly through, re-orientation and animation of complex 3D model atmosphere scenes in real time. Meanwhile one can adapt relatively recent mathematical techniques to represent the salient atmospheric features (e.g. cyclones, jet cores, trough lines, fronts) as points, strings or surfaces in 3D space. These algorithms compress large volumes of synoptically relevant gridded data into a very compact yet meaningful form, and likewise dramatically reduce obscuration of other aspects of interest. Together these advances can allow researchers (and indeed forecasters) to quickly establish a clear 3D picture of the key features of the model atmosphere, and their evolution in time. For some aspects one can even visualise the 4D behaviour of multiple ensemble members.

This presentation will illustrate how the above developments are brought together in the open-source, interactive 3D meteorological visualisation tool “Met.3D” (http://met3d.wavestoweather.de/), showing in particular how a new algorithm for identifying jet cores in 3D as “strings” performs in this environment. The jet core algorithm extends and adapts 2D jet core mathematics to 3D. It derives from a momentum-based definition of a jet core line; the algorithm will be described.

Cases of extreme extra-tropical cyclones will be used to illustrate applications, and the benefits of 3D versus 2D visualisation. These show in a clearer way than hitherto the dynamical links between extreme cyclogenesis events and “vertically stacked” jet cores. The plots can also provide helpful pointers to the mechanisms of downward momentum transfer in sting jet regions. There will also be an illustration of how jet stream core ‘bundles’ can be derived from the 51-member ECMWF ensemble and portrayed in a meaningful way.