Long Time Integrations of a Convective PDE on the Sphere by RBF Collocation

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As was shown recently by Flyer and Wright, radial basis function (RBF) discretization offers a very interesting alternative to other types of spectral methods for solving convection-dominated PDEs on a sphere. When using this RBF approach, there are two main choices that have to be made: (i) which type of radial function to use, and (ii) what value to choose for its shape parameter (making it vary from very peaked to entirely flat). We have obtained test results for a wide choice of radial functions throughout the complete range for the shape parameter. It transpires that that high accuracy can be maintained also over very long time integrations, corresponding to many thousands of revolutions.

The recently discovered numerical algorithm RBF-QR, which made the computations possible in cases of nearly flat basis functions, also offers a proof that the flat basis limit is equivalent to collocation with spherical harmonics. This limit is often not the optimal shape parameter choice. Another advantage with the RBF approach is that it can combine spectral accuracy with local node refinement.