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Compatible finite elements for numerical weather prediction

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Compatible finite element methods have two aspects that make them exciting for use in dynamical cores. The first is that they extend the linear wave propagation of C grid methods (steady geostrophic modes, lack of spurious pressure modes, absence of spurious inertial oscillation modes) to non-affine grids such as the cubed sphere, whilst allowing flexibility to alter pressure/velocity degree-of-freedom ratios (to eradicate spurious inertia-gravity wave oscillations) and increase the order of consistency on arbitrary grids. The second is that they have a natural framework for incorporating conservation of energy and enstrophy (or appropriate dissipation of these at the small scale, with correct energy transfers between kinetic and potential energy). I will survey both of these, and report recent work on bringing these methods closer to operational use, considering efficient implicit solvers, upwinding methods and coupling with moisture parameterisations.

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Session Classification: Moderator: Michail Diamantakis (ECMWF)