Element-based Galerkin Methods in Geophysical Fluid Dynamics Modeling

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In this talk, I will present the role that element-based Galerkin (EBG) methods have had in GFD but more specifically in atmospheric modeling. I will describe the experiences of my group and collaborators to remedy the identified weaknesses and emphasize the strengths. Among EBG methods, I will describe not only spectral element and discontinuous Galerkin methods, but also flux differencing which invariably must include a discussion on kinetic-energy-preserving and entropy-stable methods. I will also touch on the time-integration strategies required for constructing efficient solutions for global, regional, and Large-Eddy-Simulation (LES) modeling and will show results for these regimes. I will briefly discuss the future of these methods in regards to the changing landscape in high-performance computing and discuss our experience with using neural networks to represent LES processes in GFD models.. This talk is motivated by my group and collaborators' research in building operational weather prediction models as well as advancing the field for application in climate, space weather, and ocean dynamics. A list of publications on these topics can be found at: `https://frankgiraldo.wixsite.com/mysite/` publications.