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Multilevel methods for Poisson-like equations on the sphere using highly non-uniform meshes

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Numerical models of electron transport in 3D include a scattering term that, in the Fokker-Planck limit, converges to a diffusion operator on the surface of the unit sphere. Motivated by this example, we have implemented a finite-element discretization scheme and a multilevel solver for Poisson-like PDEs on the sphere. We approximate the sphere by a piecewise-triangular surface, and the triangular faces of the approximating surface play the role of the finite elements. We are interested in the problems where the source function (nearly) has a point singularity and, thus, we use highly nonuniform meshes. Our multilevel solver is a version of the Fast Adaptive Composite Grid (FAC) method. We study numerically both the discretization accuracy and the multilevel solver performance.