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From Navier Stokes to Maxwell: A look at the fluid-gravity duality in the context of the double copy. NIKHIL MONGA, CYNTHIA KEELER, TUCKER MANTON, Arizona State University, Physics Department — Work done by Bredberg et. al. 2011 showed that for certain algebraically special metrics it was possible to obtain the incompressible Navier Stokes equations. They show that satisfying Einstein's equations for these metrics is equivalent to obtaining the incompressible Navier Stokes equations. Monteiro et. al. 2014 showed that for metrics which can be written in the Kerr-Schild form, i.e. $g_{\mu\nu} = \eta_{\mu\nu} + \phi k_\mu k_\nu$, for $k^2 = 0$, one can identify ϕk_μ with Maxwell fields on the flat background. We extend the fluid-gravity picture by combining these ideas, in particular by using the Weyl double copy (Luna et. al. 2018). We observe for algebraically special type D spacetimes, the Maxwell field strength tensor is proportional to the vorticity of the fluid. In the limit that we produce only magnetic fields, we observe that the Maxwell fields A_μ are proportional to the velocity fields of the fluid. Further we show that the surface integral of the Poynting vector of our single copy gauge fields is equivalent to the enstrophy of the fluid modulo a constant. This proportionality constant depends upon the gauge choice we make. These parallels are strongly suggestive of a fluid-gauge duality for such metrics.

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