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Optimal Hurricanes Part I: Motivation and Theory

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The determination of how strong a hurricane can become is, to us, a fundamental geophysical vortex dynamics problem. For simplicity, we consider the simplest formulation of the maximum hurricane intensity problem. We assume an axisymmetric "cloud resolving" geometry with a prescribed sea surface temperature (infinite heat bath) and "standard" bulk aerodynamic transfers of heat and momentum between the underlying ocean and atmosphere. After giving a brief overview of known attempts to solve this problem, we will show that at cloud resolving scales even this simple problem has new surprises to teach us. At sufficiently high resolution, simulated hurricanes are much more intense than any known consistent theory can predict. We will explain how this 'superintensity' comes about and will discuss the observational evidence that supports our numerical findings.