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A new Drunken Sailor perspective and Spontaneously Singular Control approach for Lagrangian particles (buoyancy-controlled balloons) in highly stratified turbulence THOMAS BEWLEY, UCSD, PAOLO LUCHINI, UNISA, GIANLUCA MENEGHELLO, MIT — We will discuss recent progress in an ambitious project proposing a low-cost balloon observation system for sustained (in time), broadly distributed (in space), in-situ (between 1-8km altitude), real-time (from data acquisition to NCAR within 20 minutes) measurement of hurricane development. The high density (in space & time) of measurements from such a robotic sensor vehicle swarm (100 or more vehicles persisting for 5 days) will be invaluable in improving our ability to estimate and forecast such extreme and dangerous atmospheric events. Recent work has focused on a decentralized strategy for rejecting small-scale disturbances of the sensor balloons (acting as Lagrangian tracers in the horizontal directions) that arise due to unresolved turbulent flowfield fluctuations with a concomitant ω^{-2} spectrum. This is done by modeling the balloon velocities (note: NOT positions) with a statistical random walk away from those planned by the coordinating MPC formulation. Implementing a realistic control penalty, $< |u| >$, in this setting gives a curious (and, practically implementable!) Spontaneously Singular Control strategy (on-off); this strategy is ultimately to be combined in a hierarchical setting with centralized MPC coordination of the large-scale balloon trajectories.

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