WindDrift: Engineered Real Time Adaptive Platform for Atmospheric and Marine Sensing

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Sensing of the Tropopause and Marine Boundary Layer (MBL) is limited by cost and operational constraints of conventional fixed monitoring systems. WindDrift is a dual-modality Lagrangian sensing platform consisting of a superpressurized balloon payload for tropopause observation and a surface drifter for the MBL. Both modules use Weak Signal Propagation Reporting (WSPR) radio telemetry to eliminate communication infrastructure costs. Development progressed from subsystem benchtesting to full-scale deployments, with accuracy, power, and RF performance validated at each stage. 11 flights and 7 marine launches were conducted. The longest tropopause flight completed a triple circumnavigation, lasting over two months at an altitude of 10,500m. Across 5 flights, 2000+ hours of telemetry were received. Collected data supported vertical and horizontal atmospheric profiling, including cloud layer identification, contrail persistence, and atmospheric stability analysis. Flights over Eastern Europe also indicated GNSS suppression in regions of electronic warfare, making WindDrift useful for passive monitoring. The MBL module was validated on Lake Ontario, where telemetry, sensors, and an antenna self-deployment system operated successfully through freezing conditions, strong winds, and ice. Measured parameters such as air and water temperature, UV, ALS, speed, and turbidity were validated against reference datasets within 3% accuracy. Through a full scale marine launch, the platform survived 50km/h+ winds, thunderstorms, and extreme rain. WindDrift also supports ionospheric propagation studies, informing MUF forecasting and HF communications reliability. With a coupled system cost of $100, WindDrift shows that research-grade, adaptable sensing is achievable at an accessible cost.

Awards Won:

Third Award of $1,200

Association of Old Crows Educational Foundation: 2nd Place