Observing Atmospheric Fluxes with UAS (*miniFlux*)

Duration: 24 months (06/07/2018 – 06/07/2020)

Principal Investigators:
Dr. Gijs de Boer
Cooperative Institute for Research in Environmental Sciences
University of Colorado – Boulder / NOAA Physical Sciences Division
Dr. Janet Intrieri
U.S. Department of Commerce
NOAA / Physical Sciences Division

The University of Alaska SeaHunter UAS takes off from Ugnu-Kuparuk Airport in Alaska, equipped with the NOAA miniFlux sensor (under the nose) to make measurements of atmospheric state and turbulence over the Beaufort Sea during the SODA field campaign.

Understanding the transfer of heat and momentum between different layers of the atmosphere and the underlying surface is critical for improving our weather and climate forecasts. Typically, measurements of Earth system energy dynamics – such as temperature, humidity, winds and turbulence – are made by surface stations, buoys or ships, which provide a single observation at one altitude rather than capturing the vertical structure and variability of these measurements.

Scientists at NOAA's Physical Sciences Division (PSD) and the University of Colorado's (CU) Cooperative Institute for Research in Environmental Sciences (CIRES) are working to develop, test, calibrate and deploy the compact, lightweight (1.2 lbs) *miniFlux* sensor system. This miniaturized instrument, which is supported by NOAA's UAS Program Office, can reliably collect these measurements from unmanned aircraft systems (UAS). Deploying this lightweight package on UAS over difficult-to-sample regions of the Earth can provide perspectives on these important processes in ways not previously possible.

Initial development and testing work by NOAA PSD and CIRES, working closely with the University of Colorado's Integrated Remote and In Situ Sensing (IRISS) program,

has largely focused on laboratory testing and field evaluation. A prototype system has been deployed on several different campaigns involving NOAA, including the 2018-2019 Stratified Ocean Dynamics of the Arctic (SODA) project, and the ongoing Arctic Heat campaign. Both of these studies aim to better understand energy exchange in the Arctic environment, and the consequences for Arctic sea ice and ocean circulation. Data collected during these campaigns has been instrumental in furthering the development of the *miniFlux* sensor suite and helping to prepare it for future operational deployments.

miniFlux, as deployed on a NOAA Twin Otter aircraft while flying over northern Alaska.

In addition to having significant influence on the lifecycle of sea and land ice, turbulent transfer of heat and momentum also plays a significant role in the formation of clouds and precipitation. The *miniFlux* sensor provides new perspectives on this transport and will be deployed in key environments, including the tropics (as part of the Atlantic Tradewind Ocean–Atmosphere Mesoscale Interaction Campaign, ATOMIC) and central Arctic ocean (as part of the Multidisciplinary drifting Observatory for the Study of Arctic Climate, MOSAiC), over the coming year. Data from these field deployments will help scientists by providing valuable input to improve weather and climate models in areas where they have been shown to struggle. Such improved predictive capabilities help to support public safety through better forecasts for marine transportation and commerce activities, and for understanding of the evolution of clouds in response to an evolving Earth system.