



Measurements of Mass and Energy Exchange using Aircraft-based Sensors

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Over the past 30 years, the Canadian Twin Otter research group has operated an aircraft platform for the atmospheric study of the fluxes of greenhouse gases (carbon dioxide, ozone, nitrous oxide and methane) and energy (latent and sensible heat) over a wide range of ecosystems. Using selected examples, we will demonstrate the impact of aircraft-based flux measurements on our understanding of energy and trace gas exchange. In particular, the scientific progress in solving the problem of flux underestimation using the eddy covariance technique will be discussed, and the use of long aircraft transects to quantify the mesoscale flux contribution will be presented. With respect to trace gas exchange, we will show how regional flux measurements of nitrous oxide compared to model estimates have provided some insight on the magnitude of indirect nitrous oxide emissions and will show how aircraft-based flux measurements of methane can be used to verify methane inventory estimates based on animal population. We have used flux measurements over a series of crops to develop an empirical relationship that can be used to estimate the ozone uptake by crops in a region. In closing, we will present a promising new technique that combines spectral analysis of aircraft-based flux measurements and satellite imagery to scale up both greenhouse gas emissions and energy exchange from the local to the regional scale.