**Project Summary: Up-scaling from leaf to canopy the aerosol-sized particle collection mechanism within a non-uniform canopy medium**

**Intellectual Merit:** Atmospheric aerosol particle concentrations represent one the largest uncertainties in understanding of both historical and possible future climate forcing, and even regional atmospheric chemistry models exhibit considerable discrepancies with in situ observations of particle size distribution and composition in part because of the complexities of particle dynamics, including dry deposition. Given the expansive forest cover and relatively high particle deposition velocities over forests, the role of forested ecosystems in removing aerosol particles is drawing increased attention in a number of scientific disciplines and regulatory agencies. However, significant uncertainties remain due to; (1) difficulties associated with field measurements of particle size resolved fluxes and mean concentrations, (2) lack of detailed and simultaneous measurements of the canopy medium and, more importantly, foliage surface characteristics, and (3) challenges in describing all the main features of the transporting agent (turbulence) within and immediately above the canopy. We propose to address these three key aspects of particle deposition onto forested surfaces using a combined experimental and modeling approach at multiple hierarchical scales (leaf-to-canopy) by exploring:

1. The relative importance of, and correct descriptions of, the foliage collection mechanisms at the leaf scale.
2. Deposition flux partitioning between foliar and non-foliar elements.
3. Up-scaling results from issues [1] and [2] to the entire ecosystem.

We will undertake and analyze canopy scale size-resolved particle fluxes and mean concentration profiles in a diverse array of forested sites (conifers and broadleaf) endowed with ‘idealized’ micrometeorological conditions and in controlled experiments in an environmental chamber. Findings from these experiments will guide the development of new particle collection schemes at the leaf level by accounting for leaf surface properties, turbo- and thermo-phoretic components. Also, how to upscale these results to the canopy level from measurements that can now be acquired from remote sensing platforms (e.g. leaf area density) using multi-level and particle size-resolved canopy turbulence closure models will be explored. The model results will be evaluated at 3 forested sites using size-resolved mean particle concentration profiles and two-level eddy-covariance particle flux systems positioned above the canopy and in the understory.

**Broader Impacts:** Given the importance of atmospheric particles to climate forcing, human health and a plethora of other environmental challenges, there is a need for improvements in process-level understanding of particle dry deposition and for mechanistic descriptions suitable for application in a range of numerical models from earth system models to regional scale air quality models. This project will provide just such insights and model components. To facilitate maximal use of the research products derived from this project, the data sets and the models will be made publically accessible via a project website. The project will provide funding for one Post Doctoral Fellow and one graduate research assistant. Our project will also seek to provide opportunities for those scholars to engage with the broader scientific community via interaction with the BEACHON research team and leaders from our European collaborators. In conjunction with this project, S. Pryor will offer two research opportunities for students within the BSES (Bachelor of Science in Environmental Science, http://www.indiana.edu/~bses/) program to undertake their capstone research experience.