ABSTRACT OF THE THESIS

Assessment of Population Exposures to Airborne Allergenic Pollen in the US from 1994 To 2010

By Kun Mei

Thesis Director:

Professor Panos G. Georgopoulos

Airborne allergenic pollen is a main cause of Allergic Airway Disease (AAD), which affects 5%-30% of the population in industrialized countries. Furthermore, allergenic pollen has been reported to act synergistically with common air pollutants, such as ozone and particular matter, to exacerbate allergy symptoms. Studies of population exposures to allergenic pollen will help to provide useful information for the scientific community to aid allergy sufferers.

In the present study, a probabilistic exposure modeling system has been developed using Monte Carlo methods to simulate exposures of the general population in the United States (US) to airborne allergenic pollen. Simulations were conducted by sampling randomly from distributions of outdoor and indoor allergenic pollen concentrations and distributions of activity data for the general US population. These activity data include time spent indoors and outdoors, inhalation rates, exposed skin area, hand-to-mouth touch frequency, etc. Distributions of airborne allergenic

pollen concentrations from representative trees, weeds and grass in nine climate regions in contiguous US were developed from observed airborne pollen counts collected at the American Academy of Allergy Asthma and Immunology (AAAAI) monitoring stations. US demographic data were used to generate the distributions of activities stratified by age and gender in the corresponding climate regions.

The mean and standard deviation of "virtual individual" daily inhalation intakes from 1994 to 2000 in the contiguous US (CONUS) were 74±193 (mean±1std.) pollen grains/day for ragweed (*Ambrosia*), 213±687 pollen grains/day for mugwort (*Artemisia*), 146±616 pollen grains/day for birch (*Betula*), 72±237 pollen grains/day for grasses (*Gramineae*), and 401±1312 pollen grains/day for oak (*Quercus*), during their respective pollen periods. The mean and standard deviation of daily "virtual individual" daily inhalation intakes from 2003 to 2010 in the CONUS were 162±540 pollen grains/day for ragweed (Ambrosia), 121±284 pollen grains/day for mugwort (Artemisia), 163±780 pollen grains/day for birch (Betula), 114±368 pollen grains/day for grasses (Gramineae), and 667±1974 pollen grains/day for oak (Quercus), during their respective pollen periods.

Global sensitivity analysis of the simulations, based on Morris' design, was used to investigate sensitivity and interaction effects of the daily intakes of allergenic pollen to the model parameters and inputs.

Exposure estimates were sensitive to parameters such as indoor ventilation rate, density of pollen, removal coefficient of pollen on the skin and efficiency of adherence to skin. The inhalation route contributes 140 times higher pollen exposure levels than the dermal contact route and 157 times higher pollen exposure levels than the unintentional ingestion route for subjects of the general population.