Update: VA Cooperative Study #595 Pulmonary Health and Deployment to Southwest Asia and Afghanistan

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Study Objectives

Characterize the impact of deployment-related respirable particulate pollution exposures during OEF, OIF, OND, and continuing operations on current pulmonary health using high-quality, objectively ascertained epidemiologic measures

- Primary objective
  - Assess the association of cumulative exposure to fine particulate matter (particles ≤ 2.5 μm, $PM_{2.5}$) during deployments in Central Asia (Afghanistan and Kyrgyzstan), Southwest Asia (Iraq, Kuwait, Qatar, and United Arab Emirates) and Africa (Djibouti) with current measures of pulmonary function assessed by spirometry (FEV_1)

- Secondary objectives
  - Healthcare-provider diagnosed asthma as an outcome
  - Deployment duration as an exposure

Approach

1. Recruit 5,000 Veterans (at 6 VAMC) with land-based deployments to Afghanistan, Iraq, Kuwait, Djibouti, Qatar, Kyrgyzstan, or the UAE from 10/1/2001 - current

   - Obtain deployment history (link to $PM_{2.5}$); other covariates of exposure (self-reported); assess morbidity (symptoms and asthma); conduct spirometry pre/post BD

2. Create spatial-temporal exposure grid of estimated environmental $PM_{2.5}$ levels during deployment

3. Link exposure grid with an individual's location and duration (spatial-temporal) and sum $PM_{2.5}$ exposures

4. Conduct association analyses to test hypotheses of cumulative deployment-related $PM_{2.5}$ exposure and pulmonary function, and assess secondary outcomes

5. Data collection 5/2018 – 9/2022

Recruitment

- Use DMDC database, update contact information

- Invitation letter/information form to participate in a 3-hour, in-person assessment, $250 incentive

- Three rounds of mailings, 7 phone messages over 17 weeks

- Study visit scheduled after screening
  - No surgery (chest/abdominal/head/neck/brain/eye/ear), MI, pneumothorax in past 3 months
  - No respiratory illness in past 6 weeks
- 8/30/2019: 28% response; 36% if scheduled visits included;
- 26% (1,334) of cohort recruited

Data Collection Modules

Interviewer Administered

- Military history overview
- OEF/OIF/OND dates and locations
  - Each deployment, 10/2001 and later in 7 key countries
- Non-OEF/OIF/OND dates and locations
  - Other active duty military and civilian time after 10/2001
- OEF/OIF/OND exposures
- Non-OEF/OIF/OND military exposures
- Civilian occupational exposures
- Health, smoking, and demographics
- Medication inventory

Self-Completed

- PCL5 (PTSD), GAD-7 (anxiety), PHQ-8 (depression), Combat exposure, PHQ-15 (somatic symptoms), VR-12 (global health)

Assessment of Deployment Location

- Structured interview ascertains deployment histories in chronological order, specific to each base/city location(s)

  - Google Earth map and paper list of 1,274 bases in Afghanistan, Iraq, Kuwait, Djibouti, Qatar, Kyrgyzstan, and the UAE

  - For each deployment, Veteran queried sequentially about:
    - Date he/she arrived in theater (week of month)
    - Where he/she was first located (either a military base or city)
    - Date of next location, one week or more

  - For each deployment, questions repeated to fully characterize deployments including movement among bases

- A geospatial-temporal matrix is created for each participant to reflect time and locations across all deployments

# Modelling Approach for Satellite-Derived PM$_{2.5}$ from NASA MAIAC
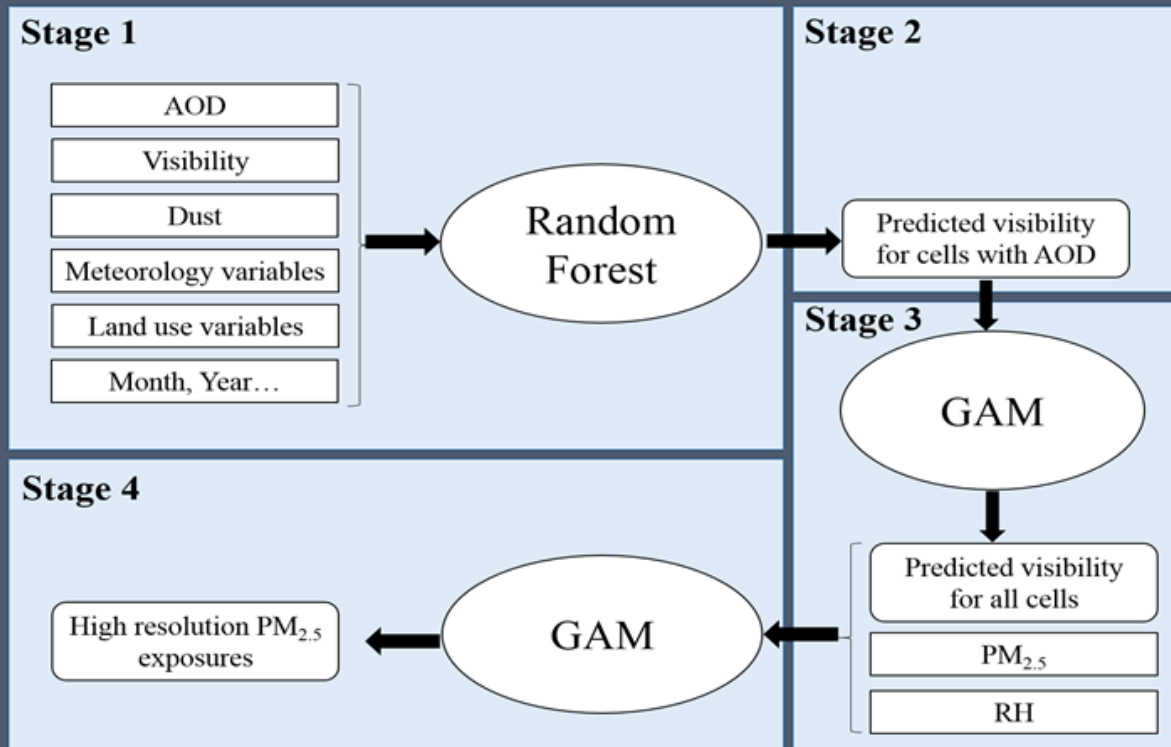
- AOD, visibility (US Air Force), and surface PM$_{2.5}$ to generate 1x1 km PM$_{2.5}$ modelled over the entire study period.

- PM$_{2.5}$ sites in Kuwait – US Embassy, HSPH sites

Pilot: Use of visibility measurements to predict $PM_{2.5}$ exposures in Southwest Asia and Afghanistan

Masri et al. *JAWMA.* 2017; 67: 86-96

- Matched daily $PM_{2.5}$ and average daily visibility at 3 sites in Kuwait 2004-2005
  - 648 daily $PM_{2.5}$ values
  - Visibility data included Kuwait International and Camp Udairi

- $PM_{2.5} = \alpha + \beta_1 (1/\text{visibility}) + \beta_2 (\text{relative humidity})^2$

- 10-fold cross-validation analysis where 90% of data used to predict remaining 10%

- 3-month (seasonal) $PM_{2.5}$ observed and predicted comparison
  - $R^2 = 0.84$ and mean relative error of -4.5%

Monthly PM$_{2.5}$ predictions for 104 sites based on visibility in Southwest Asia and Afghanistan 2000-2012
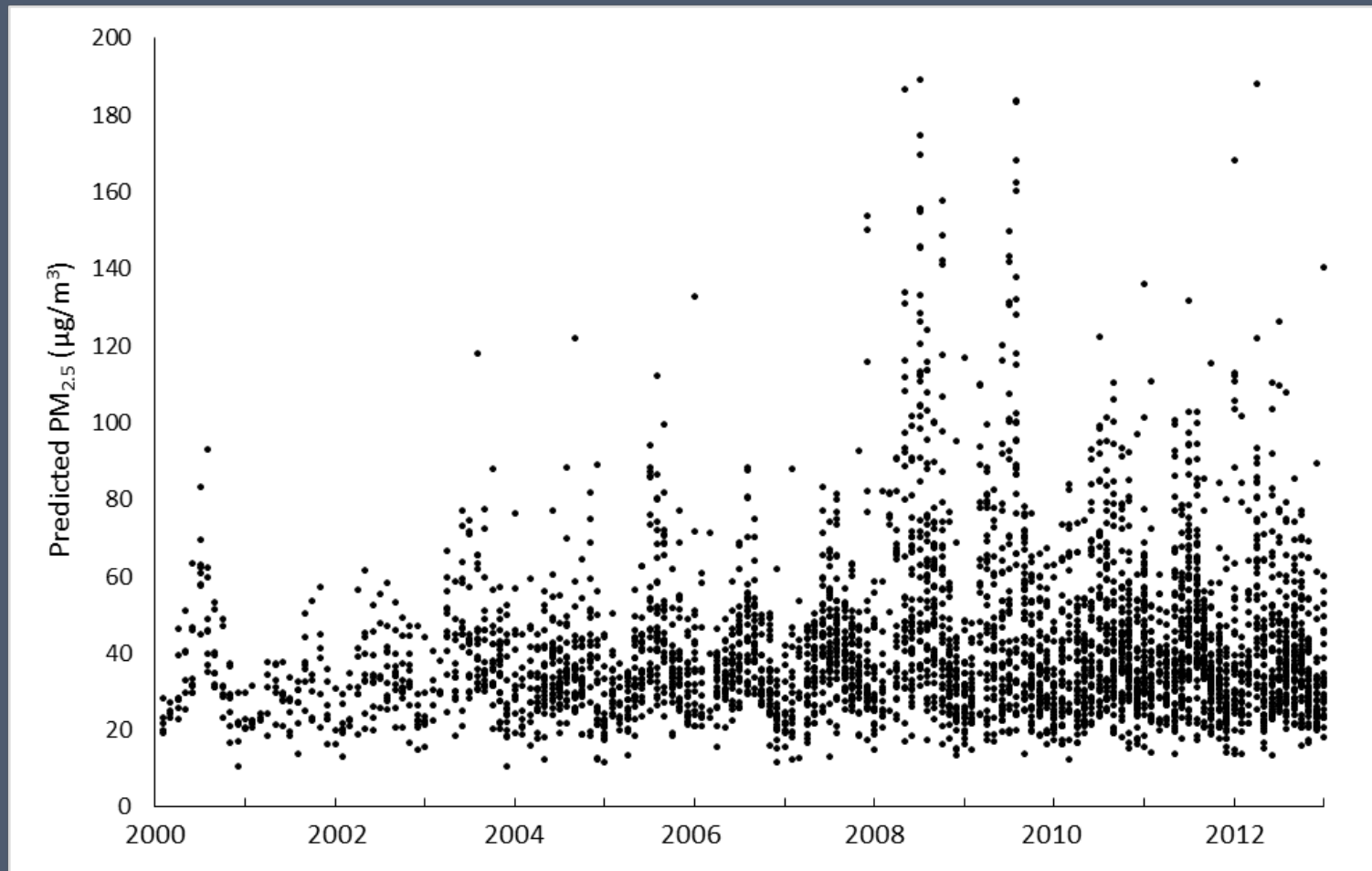
Association Analyses

- Participant geospatial-temporal matrices are linked with weekly $PM_{2.5}$ geospatial-temporal matrices

- Participant specific time/location based $PM_{2.5}$ is calculated ($\mu g/m^3$ – weeks at each location)

- Information is summed to produce cumulative $PM_{2.5}$ exposure over all deployments

- Regression analyses used to estimate the association between cumulative $PM_{2.5}$ with current FEV_1 and secondary outcomes

Burn Pit-Related Exposures

- Questionnaire to identify more highly exposed persons
  - Work at burn pit
  - Smoke coming into living area or work area
  - Exercise near burn pit

- Location-specific burn pit related $PM_{2.5}$
  - Identify locations of and assess duration of burn pit exposures
  - Examine MODIS fire and VIIRS active fire in proximity to base locations

- Self-report and satellite sensing-derived data will be used as alternative exposure measures

VA Merit Review Ancillary Study

- 320 non-smokers/< 10 pack-years, in SHADE , with and without respiratory symptoms for additional assessment
  - Inspiratory and expiratory CT scans
    - %-emphysema, gas trapping, small airway disease
  - Inflammatory and COPD-related biomarkers
  - T cell immune response
  - Lung volumes, diffusion
  - Impulse oscillometry and lung clearance index.
  - IgE, CBC with differential

- Assess associations with symptoms and deployment $PM_{2.5}$
- Determine characteristics that cluster together and with cumulative exposure