EXPLORING FUTURE CLIMATE EFFECTS ON WESTERN US AIR QUALITY

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INTRODUCTION
Air quality regulations have reduced emissions of air pollutants in the US, but previous studies suggest that the future air quality might be degraded by climate change (Chen et al., 2009; Gonzalez-Abraham et al., 2015; Nolte et al., 2018). Those studies were typically based on computationally expensive 3D Eulerian chemical transport models (CTMs). To study how future air quality at a local scale will be influenced by global factors in an efficient way, we have developed a Lagrangian air quality modeling framework, called HYSSPLIT-MOSAIC (H-M). It consists of HYSSPLIT, an air trajectory model developed by NOAA (Stein et al., 2015), and MOSAIC, a gas and aerosol chemistry and dynamics model developed at PNNL (Zaveri et al., 2008).

METHOD AND DATA
To simulate future air quality in H-M at specific locations, we applied HYSSPLIT cluster analysis to generate representative back trajectories for each site using historical NAM meteorology data. Next, we employed 4-km gridded statistically downscaled climate data (e.g., MACA, Abatzoglou & Brown, 2012) from 20 CMIP5 GCMs for two future climate scenarios (RCP4.5 and RCP8.5). The present-day and future anthropogenic and biogenic emissions along each trajectory were from U.S. EPA (Nolte et al., 2018). The initial and boundary conditions are from the ModelE2-TOMAS global model. (See Figure 2)

RESULTS
We evaluated the historical simulations of July from 1995-2005 at two AQ5 sites of Seattle and Sacramento. Because the historical MACA data are close among GCMs, so we chose one GCM for historical period. Note that median values are used to describe the changes in this study.

For future runs, we chose two GCMs from MACA for each AQ5 site. The simulations of Salt Lake City and Boise were run for January to represent the winter months conditions. Seattle and Sacramento were run for July to represent the summertime conditions.

CONCLUSION AND FUTURE PLANS
Our 2050s future O3 shows 5-20 ppb increase in the median value in all cases but the changes in PM2.5 depends on sites and scenarios.

- Air quality is very similar in the all future runs used here, but using two GCMs adds 1% variation of PM2.5 and 3% of PM2.5, and using two RCPs adds 1% variation of O3 and 5% of PM2.5.
- The biogenic emissions vary with meteorology, but it is not included in this study yet. We plan to run MEGAN biogenic emission model with MACA meteorology in order to better estimate the influence of future meteorology on air quality.