Review of the proposal entitled “Transitioning to operations a novel air quality ensemble design” with ID of 2777584 by Jared A, Lee (PI), Rajesh Kumar (Co-PI), Stefano Alessandrini (Co-I), and Walter Kolczynski and Jeff McQueen (Co-Is)

General comments: This project is proposed to update and evaluate an Air Quality Ensemble Forecasting System (AQEFS) which is currently being developed by another OWAQ-funded project (Award # NA160AR4590116, PI is Rajesh Kumar). The main tasks of this proposal are to update the AQEFS by changing the meteorological driver from a Short-Range Ensemble Forecast (SREF) and Weather Research and Forecasting (WRF) model to the Global Ensemble Forecast System (GEFS) built on the Finite-Volume Cubed-Sphere (FV3) dynamical core and ensure its readiness of transition to operational application through comprehensive evaluations. The proposed work is relevant to NOAA Science Priority AQRF-4. There are two concerns with the proposal. First, the work proposed by this project seems to be not so significant. The SREF-driven AQEFS that this proposal is highly relied on is expected to reach the NOAA Readiness Level (RL)-7 by the end of the existing award (i.e., May 2019) and the RL will be promoted from 7 to 8 through the work proposed by this project. Second, the performance of AQEFS cannot be guaranteed when the meteorological driver is changed from the SREF to the FV3-based GEFS since the horizontal grid-spacing used by the latter is much coarser than that used by the former. Additional uncertainty of air quality predictions is likely to be introduced by the FV3-GEFS with coarse horizontal spacing over the complex terrains such as western US and east coastal regions. Specific comments for each scoring item are provided below.

1. Importance/Relevance and Applicability of Proposed Project to Program Goals: 24 points

Comments: The current operational National Air Quality Forecast Capability (NAQFC) provides only deterministic AQ forecasts for the US and does not quantify the uncertainties associated with meteorological inputs, emissions, and chemistry mechanisms that affect the accuracy of operational forecasts. The proposal is able to identify those uncertainties and uses an Ensemble approach to address those issues. An AQ Ensemble Forecasting System (AQEFS) being developed by another OWAQ-funded project will be further improved through replacing the meteorological driver model from a Short-Range Ensemble (SRE) to one built on the Finite-Volume Cubed Sphere (FV3) dynamic core. The work is important to ensure the AQEFS be ready being transitioned to operation because the NOAA is moving the entire operational model suite to the Unified Forecast System (UFS) FV3 dynamic core meteorological models. In addition, the applicants also propose to use Kalman Filter (KF) method to reduce ensemble raw forecasts. The work is highly relevant to NOAA Air Quality Research and Forecasting (AQRF) Priority 4. The project work team at NCAR has developed a strong collaboration with NCEP/EMC that is helpful to transition the AQEFS to NCEP/EMC for operational pre-implementation test. However, the current AQEFS being developed is expected to reach Readiness Level (RL)-7 by May 2019, the increase of RL (i.e., from RL-7 to RL-8) by this project seems to be small, indicating that development work required by this proposal is not so significant.

1. Technical/Scientific Merits: 25.5 points

In this project, the applicants propose to replace the meteorological driver model of the AQEFS with GEFS; they design a series of simulations to quantify the uncertainties associated with anthropogenic/biogenic emissions, secondary organic aerosol (SOA) formation, and meteorological inputs; they propose to use ensemble down-selection technique to identify 4-6 optimized ensemble members to support operational application. Moreover, a Karman Filter (KF) bias correction approach is proposed to reduce the AQEFS raw forecast biases. Those methods are technically sound and achievable. The proposal provides a clear timetable for milestones and deliverable, a series of evaluation metrices, and a detailed data management plan. However, the horizontal grid-spacing of the FV3-GEFS outputs is coarser than that of SREF (25 km versus 16 km). This may cause additional uncertainties to the NAQFC over complex terrain and coastal regions when the meteorological driver model is changed from SREF to FV3-GEFS. In fact, the current operational NAQFC uses 12-km NMMB outputs and parallel runs use 13-km FV3GFS outputs as meteorological inputs to drive CMAQ. It is difficult to say that the GEFS-driven AQEFS will perform better than the on-going tested FV3GFS/CMAQ since the FV3GFS is running at a fine grid-spacing (about 13km). Meanwhile, the Karman Filter (KF) bias correction approach proposed by this project cannot perform better than the KF Analog Ensemble (KFAN) approach which has been implemented in the operational NAQFC.

The proposal includes a series of statistical metrics for evaluating the model performance and provides a clear schedule for milestones and deliverables. It also includes a Data Management plan as required.

1. Overall Quantifications of Application: 17 points

All the applicants have necessary education, experience, facilities, and resources to complete the project. They have demonstrated an ability to conduct successful research and support R2O transition work.

1. Project Costs: 8.5 points

The requested costs are realistic, reasonable, allowable, and commensurate with the project benefits, deliverable, and time period. The proposal has proposed cost-efficient ways of accomplishing the project.

1. Outreach and Education: 4 points

The proposal has a good plan to share the data, present the results at the AMS and AGU, and submit a peer-reviewed publication, but does not promote the education and field experience of undergraduate and graduate students. No opportunities are developed to share with K-12 educators.