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 national-wide determin

 The ensemble approach is an effective and feasible way to investigate the impact of various uncertainties on air quality forecasts. As compared to its wide use in weather and climate forecasts, the ensemble approach hasn’t been applied to operational forecast by the National Air Quality Forecast Capability (NAQFC) and related studies are relatively scarce. In this project, the applicants propose to improve the Air Quality Ensemble Forecast System (AQEFS) being developed by changing the meteorological driver model(s) from the Short-Range Ensemble Forecast (SREF) and Weather Research Forecast (WRF) mode-based framework to the Global Ensemble Forecasting System (GEFS) built on the Finite-Volume Cubed-Sphere (FV3) dynamic core. The updated AQEFS with the FV3-GEFS is expected to account for uncertainties of meteorological inputs, emission, and atmospheric chemistry that affect air quality forecasts. This update is necessary since the SREF is planned for decommissioning in 2021 and the NOAA entire operational modeling suite is moving to FV3. The applicants also propose to use Kalman Filter (KF) method to reduce ensemble members 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, there are three major concerns with this proposal. First, the current NAQRC provides 12-km forecast. However, the horizontal resolution of FV3-GEFS is coarser than that of SREF (25km vs. 16km), which may introduce additional uncertainty to air quality forecast over the complex terrain such as western US as well as coastal regions. Second, the SREF-based AQEFS that this proposal starts with, will be at the NOAA Readiness Level (RL)-7 when the on-going OWAQ-funded project is completed, i.e. May 2019. The AQEFS updated with FV3-GEFS will reach the NOAA RL-8 through this project. The small increase of RL (i.e., from RL-7 to RL-8) implies that development work required by this proposal is not so significant. Third, the KF Analog Ensemble (KFAN) bias correction approach has been implemented into the NAQFC and the method should be applicable to the AQEFS. I do not think that the KF bias correction approach will perform better than the KFAN.

1. Technical/Scientific Merits: 25 points

In this project, the AQEFS will be revisited by creating the CMAQ ensemble refined with a series of combinations of emissions perturbations, secondary organic aerosol (SOA) perturbations, and individual members of FV3-GEFS. The ensemble down-selection technique will be utilized to identify 4-6 optimized ensemble members to support operational AQEFS. Moreover, a KF bias correction approach is proposed to reduce the AQEFS forecast bias. 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, as mentioned above, the horizonal grid-spacing of the FV3-GEFS outputs is coarser than that of SREF (25 km versus 16 km). This may cause additional uncertainties of regional air quality forecasts over complex terrain and coastal regions when the meteorological driver model is changed from SREF to FV3-GEFS. It is difficult to say that the GEFS-driven AQEFS will perform better than the on-going teste FV3GFS/CMAQ since the FV3GFS is running at a fine grid-spacing (about 13km). Moreover, the KF bias correction approach proposed by this project cannot be better than KFAN being used in the operational NAQFC. Overall the methods don’t enough novelty.

1. Overall Quantifications of Application: 18 points

All the applicants have necessary education, experience of developing, testing and evaluating the AQEFS. The project can be accomplished through the effective collaborative arrangement and partnership.

1. Project Costs: 9 points

The requested costs are realistic, reasonable, allowable, and commensurate with the project benefits, deliverable, and time period.

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.