<u>Response to Reviewer # 1's comments</u>

1. ***Comment:*** *Generally, the paper is well-written and the methodology is clearly presented. However, there are major concerns with regard to the contribution of the paper: Firstly, application of the model is quite limited. Nutrient loadings have been a major concern in agricultural and environmental engineering because of human use of fertilizers. On the other hand, for undeveloped basins, water quality is usually quite good and nutrient loading is not a problem. Given that the model can only be applied to undeveloped basins, it is concluded that the paper tries to but actually fails to address the important issue of nutrient loadings. To make it a solid contribution, the paper should develop a model for river basins subject to human interferences.*

   Response: Thanks for this comment. This is a good point and requires clarification. We should have written it more clearly. HCDN stations are undeveloped watersheds from hydrology perspective with streamflow from the station being not influenced by upstream storage or groundwater pumping. This is needed from the perspective linking weather to streamflow. Otherwise, the flows will be controlled due to operational guidelines of the reservoir and we will not be relate it to the weather information.

   To substantiate this point, we have added the percentage area under agriculture in Table 1 based on the National Land Use Classification Data (NLCD) data of 2001. From Table 1, we can see the distribution with seven, six and five watersheds having 20%-30%, 10%-20% and 0%-10% of area under agriculture respectively. Thus, the watersheds are not completely undeveloped without any agricultural activity.

   We have revised the manuscript based on the above response.

2. ***Comment:*** *Secondly, the simple combination of two models doesn't present a novel contribution. The model for nutrient loading forecast is based on the k-NN model and the LOADEST model, which are classical models and have been applied to many cases. To make the model combination a solid contribution, the paper should exploit the models and derive some new understandings, e.g., structural relationships between daily streamflow and nutrient loading.*

   Response: To address this, we have added Figure 9 that quantifies the role of different predictors, 3-day average streamflow prior to forecasting day and 1-day ahead precipitation forecasts, on the overall skill in forecasting TN loadings for all the 18 sites in the Southeast. Figure 9 clearly indicates that the combination of both 3-day average streamflow and 1-day ahead precipitation forecasts as predictors result in improved correlation and reduced RMSE in estimating daily TN loadings at all the sites. Comparing the skill obtained from 3-day average streamflow and forecasted precipitation, we infer that for most of the watersheds, the skill obtained using streamflow alone is better than that of the skill obtained using forecasted precipitation alone. But, including both predictors result in overall improvement.

We have included details related to this under discussion.

3. ***Comment:*** *Thirdly, besides daily streamflow, nutrient storage in the river basin is another key determinant of nutrient loading. This paper didn't consider this issue in nutrient loading forecast. Notably, the statistical models k-NN and LOADEST are based on historical samples, and the underlying assumption is "stationarity". However, nutrient storage can vary with time and is greatly affected by human interferences. How to consider this kind of non-stationarity in the statistical model?*

Response: This comment has two parts: First, the issue of nutrient storage in the river reach. Though instream loadings primarily depend on streamflow and precipitation variability during the season, antecedent moisture/flow conditions also play a critical role in influencing the nutrient loadings from the watershed (Vecchia 2003, Alexander and Smith 2006). Our hypothesis is that by considering 3-day average streamflow prior to the forecasting day accounts for the storage in the river. Increased streamflow indicates increased streamflow storage conditions in the basin, which could potentially increase nutrient storage in the river. This is further validated by our plot added (Figure 9). From Figure 9, storage in the river reach explain higher variability in the observed nutrients as opposed to the skill obtained using the forecasted precipitation alone.

With regard to the second question on "non-stationarity", Oh and Sankarasubramanian (2012) clearly show that there is no trend in the observed TN nutrients in the WQN data over the 18 stations. Given that the basins are from the HCDN basins, the streamflow is also not influenced by upstream storage or pumping with no exhibited time trend. Thus, the LOADEST model is appropriate for the time period that we have considered. Thus, the presented modeling framework is applicable for the selected stations and for the evaluation period.

However, developing a model for basin experiencing significant land use changes due to human influences require additional information. For instance, if the basin experiences significant urbanization, then it is natural to expect the point TN loadings from waste water treatment (WWT) plants to influence the downstream loadings and concentration. Under such situation, we need to know the discharges from the WWT plants to develop the model.

On the other hand, for a basin experiencing significant changes in agricultural land use, it may be important to know the area under cultivation for each year so that it could be considered as an additional predictor. To substantiate this point, we investigated relating (Figure 10) the nutrient forecast ability to the percentage of area under agriculture provided in Table 1. Based on that, we infer that as the percentage area under agriculture increases the skill in forecasting nutrients. This indicates that as the nutrient storage in the basin increases, the transport induced by the streamflow increases resulting in improved skill in forecasting the nutrients. Any non-stationarity in the predictand could be explained if the appropriate time-varying predictor is identified.   Information from remote sensing satellites that quantify the Chlorophyll concentration could be also be considered as nutrient storage in the river reach and water bodies.

To our knowledge, this is the first study that evaluates the ability to forecast nutrients based on actual streamflow forecasts. It is beyond the scope of this study to consider basins experiencing significant human interferences. However, we have added the above points in the discussion for forecasting TN for basins experiencing significant human interferences.

Thanks for the detailed comments!