

JAMC-D-17-0231 Submission Review

Evaluation of Modeled Lake Breezes Using Breezes Using an Enhanced Observational Network in Southern Ontario: Case Studies by Armin Dehghan et al.

General comments:

This manuscript aims to evaluate the ability of Canadian Global Environmental Multiscale Model (GEM) predicting the lake breezes generated by Lake Ontario and assess the impact of model resolutions on the lake-breeze predictions in the Greater Toronto Area (GTA). The authors presented a series of comparisons of different resolutions of GEM simulations (i.e., 2.5km, 1.0 km and 0.25km) with mesoscale analysis, lidar and surface observational data. The results showed that the GEM was successful to predict the lake-breezes for the two events, and increasing model resolution improved the predictions of lake-breeze location, updraft density, and depth. To me, it is a mystery that the GEM was running with a 250m horizontal resolution (see more comments below). Given the large impact of lake breezes on the local weather and air quality near the lakeshores, the study with high resolution numerical model is worthwhile. However, the evaluation and analyses were mainly limited to the selected sites along the cross-section of L1B to A2T. The evaluations with more observational sites will be helpful. The authors should be able to provide statistical evaluations on the GEM simulations (e.g., 2-m air temperature and 10-m winds) with all the available observational data for these two lake-breeze cases. The manuscript is recommended with major revisions by addressing the following specific comments.

Specific comments

- 1) The GEM is a global model but was run for the three nested domains with a highest horizontal resolution of 0.25 km for the innermost domain. This is extremely challenging. It is nearly impossible to run a regional model with a horizontal resolution of 250m in terms of stability of numerical solution of partial differential equations that all the numerical weather prediction models rely on. What version of the GEM did you use in this study? What special treatments did you take in order to run a global model at a 250m resolution which is suitable for Large-Eddy Simulations (LESs)? Please highlight the detailed information (e.g., treatment and configurations) which are very important and useful for the readers.
- 2) Accurate simulation of lake surface temperature is important to predict the lake breezes. Did the authors use any lake model for the lake-breeze predictions?
- 3) As pointed out in the manuscript on Lines 118-119, 53 automated surface weather stations were added to the existing network. How many surface observational sites were there available during the 2015 Pan/Parapan American Games? It will be very helpful if all the observational data are included into the verifications of the GEM predictions during these two lake-breeze cases?
- 4) There is nothing wrong with the UTC usage in the manuscript. However, this is very inconvenience for the users who are not familiar with the local time in the GTA. Lake-breeze is a local circulation phenomenon with strong diurnal variation. Local time is much easier for readers to know when the

lake breezes started and when they ended. UTC really does not matter. It is strongly recommend using local time rather than UTC for all the analyses and plots.

- 5) In several places (e.g., L640, L174-176), the authors mentioned the temperature and dew points at 5 m AGL. To my knowledge, no any measurements were taken and no models generated air temperature output at this height.
- 6) Lines 103-105: Although this study was not focused on the measurements, I believe that some readers are still interested in how the horizontal winds (wind speed and wind direction) and vertical velocity were derived from the lidar measurements.
- 7) Lines 134-142: How were the winds (horizontal or vertical or both?) derived from the Doppler radar measurements? What are the major differences between Doppler lidar and Doppler radar data since the authors mentioned both in this section?
- 8) L139-142: What is the “other mesoscale boundaries”? How can we distinguish the lake-breeze fronts from other mesoscale boundaries?
- 9) L158-159: What are the differences between the thermal and humidity roughness lengths? How they can be used to improve the flux simulations?
- 10) L168: Were satellite images from GOES13 used for the analyses in this study?
- 11) L169-173: It is better to provide a brief description of the criteria of lake-breeze identification.
- 12) L237-238: Are there any more evidences to support this statement?
- 13) Figures 17-20: Why did the authors only present the results at the two sites for the July 15th case?