

Interactive comment on “Idealized WRF model sensitivity simulations of sea breeze types and their effects on offshore windfields” by C. J. Steele et al.

Anonymous Referee #1

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Atmos. Chem. Phys. Discuss.

Title: Idealized WRF model sensitivity simulations of sea breeze types and their effects on offshore windfields

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General comments

This manuscript examined the impact of different types of gradient winds / sea breeze flows on offshore windfields by conducting several idealized Weather Research and

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Forecasting model experiments. In general, this theoretical sea breeze study is of great scientific and environmental interest due to the influence of this mesoscale wind on the offshore wind energy climate (among many other applications: e.g. dynamics of air pollution on coastal areas -air quality-, ship navigation -sailors-, etc.), and particularly because the general absence of research focusing on the characteristics and dynamics of sea breezes offshore. Additionally, the research article introduces new insights concerning the impact of different large-scale synoptic flows (gradient winds) on the behaviour of the marine component of sea breeze cells, which is another novelty because the lack of knowledge in the scientific literature.

As stated above, all these new findings are of great scientific interest in order to get a better knowledge, for instance, about the propagation of sea breezes offshore. Therefore, the results presented are worth of publication, but the paper needs major revision in its present form. To conclude, for the manuscript being published it is strongly recommended to address all the major / minor concerns raised after revision and listed below.

Specific comments

Pages 4-5. While it is clear that there is a general lack of research studying the marine component of sea breezes, a detailed review of studies and findings focussed on this topic is not undertaken – authors just summarized modelling results from Arritt (1989), Finkle (1998) and Savijarvi and Alestalo (1988). I strongly recommend authors to conduct a more detailed review about theoretical and observational studies focussed on the marine component of sea breezes. For instance, a table summarizing results encountered in the literature on the main characteristics (onset, horizontal extension seaward, etc.) of sea breezes offshore should be included. Here is an example of a manuscript dealing with this topic and published recently:

<http://onlinelibrary.wiley.com/doi/10.1002/joc.2362/abstract>

Page. 4. “Originally from nautical origins, the types of sea breeze are known in the

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Northern Hemisphere as:”. Please give here a reference where it was originally described these types of sea breezes.

Page 6. In the Introduction section it is stated that “...it is entirely plausible that the power produced by these wind farms will be modulated by the sea breeze. It is therefore vital to be able to quantify this potential impact on power output”. I agree with the authors that sea breezes offshore can strongly impact on wind power energy around the coast of Britain. However, I am not sure that local / mesoscale flows such as sea breezes are the main circulation influencing offshore wind power in the UK. In addition, authors quoted Simpson (1994) for referring that the most common period for observing sea breezes in UK is during June. I strongly recommend to give some statistics about the characteristics/climatology of sea breezes (occurrence, wind speed, etc.) observed in the southeastern fringe of the British Isles. If sea breezes are not the main wind circulation during the whole year, please rewrite the above statement.

Pages 6-7. The idealized WRF model sensitivity experiments presented in this numerical study have been initialized using vertical observations from sounding data recorded at the Herstmonceux radiosonde station (south east England) on the 3rd June 2006. Previous numerical studies to date used idealized vertical conditions, and therefore applying sounding observations is a strong point of the current manuscript as noted by Crosman and Horel (2010). However, a single sounding for an anticyclonic day dominated by sea breezes over coastal areas in UK is used, which is the major weakness of this study. The direction and strength of prevailing low-level boundary layer winds (large-scale synoptic flows) has been shown to be the most influential factor on sea breeze evolution (Estoque 1962). Since one of the objectives of this manuscript is to test the influence of wind speed and direction of the gradient wind, analyzing three different types of this local wind (pure – large scale flows perpendicular to the coast; corkscrew and backdoor – gradient winds parallel to the coast), it is strongly recommended to choose three vertical profiles representative of each sea breeze type. For the paper being accepted, authors should rerun experiments selecting observed sounding

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data for pure (perpendicular gradient winds), corkscrew and backdoor cases (parallel gradient winds) over the study area.

Page 7. The experiments were initialized for 24 hours, instead of 48 hours. Please discuss in further detail the possible impact of these short simulation time on the findings presented here. It is recommended to rerun the idealized WRF model for 48 hours.

Pages 9-17. In the result section is presented many interesting findings, but please try to summarize all these results in a table in order to help readers to compare these new results with previous studies. I strongly recommend to tabulate all the characteristics of sea breezes (timing, extent, duration and strength, etc.) found for both the single and dual-coast experiments and for the different sea breeze / study cases: baseline, pure, corkscrew and backdoor.

Page 17. Recently Tang (2012) concluded that diurnal variability of Sea Surface Temperature (SST) plays an important role in coastal area weather forecasting for the UK region, particularly for sea fog and sea breezes phenomena. Please if you found that varying SST did not have a significant effect on sea breezes offshore, present and discuss more in depth these results in the manuscript. If not, delete this subsection from the manuscript.

<http://journals.ametsoc.org/doi/abs/10.1175/JAMC-D-11-0253.1?journalCode=apme>

Technical corrections

Page 4. Third paragraph. Please replace “...the primary focus...” with “...the primary focus...”

Page 19. Please replace “Tijim” with “Tijm”.

Page 20. “Cleantech:...” reference is not shown in the main text.

Pages 19-21. Please indicate the access date for the electronic references: e.g. [Accessed 18 June 1997]

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Page 21. Please replace “tokyo” with “Tokyo”

Page 30. Wind hodograph shown in Fig. 7 should have an arrow indicating the daily evolution of the wind speed and direction of sea breezes. The same for Fig. 10.

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