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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Large-eddy simulation of radiation fog: Part 1: Impact of dynamics on microphysics" *by* Marie Mazoyer et al.

Anonymous Referee #1

Received and published: 20 November 2016

Review of paper:

Large-eddy simulation of radiation fog: Part 1: Impact of dynamics on microphysics

By Mazoyer, Lac, Thouron, Bergot, Masson & Musson-Genon

Submitted to Atmospheric Chemistry & Physics

Manuscript: acp-2016-900

Recommended disposition: The manuscript requires major revisions before publication in Atmospheric Chemistry and Physics.

General comments:

The manuscript presents results from various LES of a radiation fog event observed at

a complex site. The simulations were aimed at identifying the main dynamical factors affecting the simulated life cycle of the fog layer, including its microstructure. The research is an original contribution toward a more complete understanding of the complex interactions shaping the evolution of a fog layer, as well as the identification of possible improvements of numerical models necessary for more accurate fog forecasts. The work is also a good example of how carefully crafted simulations can provide some insights into specific features often present in observations taken at complex sites. The discussion is comprehensive and generally well-structured, with major findings clearly emphasized. Some parts of the discussion could be shortened to further improve the clarity of the overall presentation. It is the opinion if this reviewer that major revisions are however needed before the manuscript can be accepted for publication.

More specifically:

1. First and foremost the written English is not of sufficient quality, which provides for a difficult read of the manuscript. It appears that the text was not put through a basic grammar check that most text editors have available. I highly encourage the authors to have the text revised by an English speaker to ensure appropriate terminology and sentence construction. There are also numerous opportunities to make the text more concise and clearer.

2. As this is a central aspect of this study, the parameterization of fogwater deposition on the tree canopy should be more clearly described and justified. In particular, the use of a drag term on momentum and TKE to represent the impact of a tree barrier on the flow and associated turbulence, while the use of a parameterization of fog water deposition which is entirely independent of the flow and turbulent characteristics (i.e. constant deposition velocity) may appear as incompatible. Hence, the chosen formulation should be more clearly justified and contrasted against the work of von Glasow and Bott (1999).

Specific comments:

1. Throughout the text, replace “trees barrier” by “tree barrier” or by “barrier of trees”.

2. Use of past tense to describe some aspects of the simulations throughout the paper is awkward. You may have performed the simulations in the past, but their characteristics remain true now. Please revise your use of the past tense throughout the manuscript.

3. Throughout the manuscript, replace “ponctual” by “point”.

4. Abtsract line 2: Revise with “during the ParisFog”

5. Abstract line 3: Please specify which aspect of “dynamics” you are referring to. Boundary layer?

6. Abstract line 5: deposition of what? Please specify for greater clarity.

7. Abstract line 7: We should read “as in observations” rather than “like in the observation”.

8. Abstract last sentence: I would suggest re-wording as: . . .“necessary to accurately represent the fog life cycle at very high resolution” for a clearer statement.

9. Introduction line 18: How do you define "local dynamics"? and why do you not seem to include turbulence in that category?

10. Introduction line 19: Please rewrite with “understanding of fog processes” rather than “fog processes understanding”.

11. Introduction, line 20: Sentence is without a verb.

12. Introduction, line 22: measurements (please use plural).

13. Introduction, line 22: “and set liquid water content”: ? I do not understand. Please revise.

14. Page 2, line 5: use “as shown by Nakanishi”

15. Page 2, line 6: Here, need to add "to study some aspects of the characteristics of a fog layer". Nakanishi was not the first to use LES in general, as you seem to imply.

16. Page 2, line 8: “a turbulence scheme”

17. Page 2, line 11: Use of “stripes” is not appropriate. Maybe use "banded structures" and specify in which field(s) theses structures are observed.

18. Page 2, line 14: Replace “move” by “relocate”.

19. Page 2, line 18: the word “Hence” is superfluous.

20. Page 2, line 26: The use of “allowing to represent” is not proper. Change to "allowing the representation of"

21. Page 2, line 30: replace “it” by “values”

22. Page 3, lines 3-4, sentence beginning with “Sensitivity tests will. . .”: This has been said already. Please remove sentence.

23. Page 3, line 5: Replace “sophisticated microphysics” by “sophisticated microphysical parameterizarion scheme" to be more precise.

24. Page 3, line 6: Replace “taking into account” by “while accounting for".

25. Page 3, line 6: We should read “such as forests”

26. Page 3, line 14: winter of

27. Page 3, line 20: wind does not flow from a "side", rather from a direction. Also, "this side" implies that information about wind direction has been provided to the reader, which wasn’t. Please revise your sentence(s).

28. Page 3, line 21: It is mentioned that the reader should refer to the study by Stolaki for a description of the instrumentation, yet the the entire next paragraph is devoted to just that. Please revise your text.

29. Page 3, line 23: Get rid of “At the surface”. 30m is not "at the surface" in this context.

30. Page 3, line 31: We should read “Aerosol particle measurements”, not “particles measurements”

31. Page 3, line 33: What type of profiler? I suppose it is a microwave profiler. Please be more precise with your statement.

32. Page 4, line 5: 1000 UTC “on the following morning”? Please be more precise.

33. Page 4, line 9: I am not clear as to why fog events were not classified as stratus lowering. 150m for initial cloud formation does seem high to be a radiation fog. Please explain.

34. Page 4, line 12: Replace “according to” by “following”

35. Page 4, line 14: Use of “moistening” could lead to confusion. Is "moistening" referring to an increase in *relative* humidity (due to cooling) or increase in absolute humidity (water vapor content)? Please be more precise.

36. Page 4, line 19: Not sure I understand the meaning of “temperature convergence” in this context.

37. Page 5, line 2: “fog droplet microphysics” is awkward wording in this context. Perhaps “fog microstructure” is more appropriate?

38. Page 5, line 5: “leaded” is not proper English.

39. Page 5, line 6: LWC and Nc decreased at 3m but visibility remained constant? Please explain.

40. Page 5, line 15: Can you be more precise in your description. Nut sure that "between" means in the context of a size distribution.

41. Page 5, line 29: “at the instrumental site”

42. Page 6, line 1: By “It” you mean “The drag approach”? Please be more precise.

43. Page 6, line 5: “a combination of the product” is confusing. A product already is a "combination" of terms. Simply say that it is a product of the fraction of vegetation with LAI and a weighting function. I would suggest that you show an equation for greater clarity and since it is a central aspect of your study.

44. Page 6, line 7: The vertical profile of what exactly? Please be more precise in you statement.

45. Page 6, line 7: “atlantic broad leaved trees”: Where does that information included and how? Again, please be more precise in your statement. Perhaps refer to the equation that will show how Af is expressed.

46. Page 6, line 11: Aren’t "activated CCN" droplets? Please clarify the difference between Nc and Nccn.

47. Page 7, line 16: How is droplet concentration and cloud mixing ratio taken into account in LW and SW calculations? Just provide appropriate references.

48. Page 8, line 2: I think here you rather mean that the **reduction** in visibility is underestimated. Please revise your statements.

49. Page 8, lines 8 and 9: .Variables are not transported. Perhaps simply write "momentum is advected"

50. Page 8, line 11: Awkward use of past tense.

51. Page 8, sentence on line 17-18: 1) soil moisture not moistening 2) Used the same point measurements to initialize soil variables across the entire domain? Please justify this approach.

52. Page 8, line 30, sentence with “good degree of confidence”: This is not clearly justified. Please more directly and clearly address the possible shortcomings or impact of using this on your results. You should convince the reader that this mismatch does

not adversely affect your results.

53. Page 9, lines 3-4, “good degree of confidence” : Compared to surface observations? Please be more precise with your statement.

54. Page 9, statement on lines 5-6: making some assumption of ergodicity here? Taking time averages of point observations to compare to area-averaged simulated fields? Please describe more clearly the assumptions you are making and justify.

55. Page 10, line 22: What does “reducing the spectrum” mean? I do not know what a reduction in the spectrum mean.

56. Page 10, line 24: “leaded” is not proper English

57. Page 10, line 24: Awkward use of “weakness”. Maybe replace by "underestimated"

58. Page 10, line 24: What do you mean by ”surface cloud water amount by sedimentation”? Do you mean to say "amount of water deposited on the surface by sedimentation"?

59. Page 10, last sentence: Maybe an important point here about usefulness of more sophisticated formulations of visibility diagnostics for models. Your simulation results indicated that a simpler formulation based solely on LMC is adequate given the difficulty in simulating Nc. Perhaps this finding could be expanded upon here.

60. Page 11, line 15: “allows to decompose formally” is awkward. Maybe change to "serves as a basis for decomposing"

61. Page 11, line 19: “consecutively to the flow”, you rather mean "related to the flow perturbations"?

62. Page 12, line 10, use of “rc” I believe you used "LWC" before. You should remain consistent throughout the paper.

63. Page 13, line 8: drawning? Please revise

64. Page 13, sentence on lines 10-11 is unclear. Please revise.

65. Page 13, line 31: statement with “even if measurements” is unclear. You mean "...probably overestimated, although this cannot be confirmed as measurements ..."

66. Page 14, sentence on lines 24-25 is confusing. Please revise.

67. Page 16, line 5: “removed fully deposition” should be replaced by “removed deposition altogether” for proper wording.

68. Page 16, line 18, LWP was largely overestimated. Where? At the surface? If so, how is LWC at surface positively correlated to the depth of the fog layer? Please provide a clearer explanation.

69. Page 16, line 21: Is DE5 based on deposition on a grassy surface only, or is deposition over the entire tree canopy considered as well? In the context of this section, this text is not clear. Please clarify.

70. Page 16, line 21: Why not use a value of 8 cm s-1, the upper bound suggested by Katata?

71. Page 16, line 22: Replace “diminution” by “reduction”.

72. Page 16, line 29: Replace “the remove of” by “neglecting” for proper wording.

73. Page 17, line 26: I do not think “preformation” is a word. Maybe you mean “initial formation”?

74. Page 17, line 27: A DSD does not "move". Maybe "characterized by higher concentrations of larger droplets"

75. Page 17, line 30: “dilutes” is not properly used here. You rather mean “decreases” or “diminishes”.

76. Page 17, line 30: Also this reduced effect impacts which field(s) in particular. Please clarify.

77. Page 17, line 32, “fog slightly deeper”: Please revise as "a slightly deeper fog layer"

78. Page 18, lines 26-27: I do not understand the statement “diverged on the fog life cycle in the same way”. Please revise your statement.

79. Page 18, lines 27-28: Not a very clear statement. Please revise. And be more explicit about what you mean by "dynamical conditions".

80. Page 19, line 10, “as the wind overcame this obstacle”: Awkward formulation. Maybe “and associated perturbed mean flow and turbulence conditions” would be a clearer statement.

81. Page 19, line 17: replace “meeting” with “encountering” or “reaching”.

82. Page 19, line 17: use of the expression “dynamical gradients” is not specific enough. Do you mean “wind shear” in particular?

83. Page 19, line 18, “became well-marked”: This is awkward wording. Do you mean "became prominent"?

84. Page 19, line 23,”homogeneous”. Where? Throughout the fog layer? At the top of the layer? Please be more precise in your statement.

85. Page 19, line 24: “evolved” rather than “involved”?

86. Page 19, line 29: “damaging the visibility diagnostic” is awkward wording. Maybe “worsening visibility diagnostics”?

87. Page 19, line 31: “The removal of the deposition process” is awkward wording. Maybe replace “The removal of” by “Neglecting”.

88. Page 20, line 4, “Endly”: You mean “Finally” or “Lastly”?

89. Page 20, lines 4-5: The use of “reduce much more the number concentration” is awkward. Change to "reduce the overestimated droplet number concentration" for a more precise statement.

90. Page 20, line 8: In what way “simulations remain very challenging”? Please explain.

91. Page 20, line 12: I suggest you replace “cannot be neglected anymore” by “should not be neglected”

92. Page 20, line 20: We should read “dewfall” instead of “dewfal”

93. Page 20, line 23: Change “no one” to “none” for appropriate wording.

94. Page 20, line 23: Change “to reproduce correctly” to “in correctly reproducing”

95. Page 39: The citation of Hammer is not accurate. That paper has now been fully published and the citation should now indicate : Atmos. Chem. Phys., 14, 10517-10533, doi:10.5194/acp-14-10517-2014

96. The formatting of citations is inconsistent throughout the References section. In particular, the names of journals sometimes uses capital letters (as should be) and sometimes not. Please revise.

Note: Only the most important text corrections have been suggested. A much greater number of possible corrections have been omitted due to time constraints for the reviewer. I strongly recommend that the text be reviewed by someone with a higher proficiency in English.

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