Response

We thank both reviewers for their constructive and helpful comments.

We will first address the main point made by the reviewers, followed by responses to the individual points and some general revision notes.

Both reviewers point out that a modified simulation design is required to investigate how stratocumulus properties would respond to a long-term change in wind speed, and that the current design does not address this question. We agree. The answers and insights we give were obtained by analysis of the short time scale response, and are only a stepping stone for understanding the long-term response of stratocumulus clouds to changes in wind speed. The following changes were made in the manuscript:

Abstract

How do~~might~~ marine stratocumulus clouds and their radiative properties respond to ~~future~~ changes in large scale wind speed?"

"We present an investigation of the dynamical response of non-precipitating, overcast marine stratocumulus clouds to different wind speeds over the course of a diurnal cycle, all else equal."

Introduction

"The simulations are hence a suitable framework for identifying and characterizing the mechanisms by which the stratocumulus-topped marine boundary layer responds over a diurnal cycle to different wind speeds, all else equal. However, they do not represent a stratocumulus-topped marine boundary layer in a future climate at different wind speeds, which would require initial and boundary conditions that are consistent with the chosen climate and wind speeds."

We have added passages to the introduction to highlight the contrast between this study, which focuses on the response of the stratocumulus cloud deck over a diurnal cycle, and works that investigate the steady state response of stratocumulus clouds to climate change parameters (Schubert et al, 1979; Jones et al., 2014; van der Dussen et al., 2015; …).

Conclusions

"We have investigated the response of non-precipitating, overcast marine stratocumulus clouds to changes in large scale wind speed over the course of a diurnal cycle, all else equal."

"Owing to identical initial and boundary conditions, the simulations are suited to identify and characterize the mechanisms by which the stratocumulus-topped marine boundary layer responds on the time scale of a diurnal cycle to different wind speeds. "

We have added the following paragraph at the end of the conclusions section:

"On longer (climatic) time scales, wind speed may act differently on the CRE than in the course of one diurnal cycle. We hypothesize that on longer time scales, a higher wind speed would also render the nighttime, non-precipitating, stratocumulus-topped boundary layer more decoupled, and less decoupled at

lower wind speed. During daytime, the effect of wind speed on decoupling on longer time scales will depend on whether production of turbulence in the sub-cloud layer by shear from large scale wind supports or suppresses vertical moisture transport from the surface to cloud base. The response may depend on local conditions. Key questions are how future changes in large scale wind speed will modify cloud properties and the CRE on longer time scales, and how their effect compares to the effect of changes in sea surface temperature, atmospheric moisture, CO_2 content, subsidence strength, and inversion stability."

Response to reviewer 2

p. 28405 line 26: 'misses the observed cloud water' instead of 'misses the observations' would be better.

Corrected.

p. 29407 line 20 It would be clearer if 'identical' was replaced with 'otherwise identical' and if 'from the latter' were 'from L-,0,+'

Corrected.

Figures 1,3,4,6,and C1: The subfigure letters should be closer to the boxes that they are labeling.

The distance between panel labels and the left plot border could indeed be reduced in panels where the vertical axis label is short, such as Fig. C1a. However, in panels where more information is given in the vertical axis label, the distance needs to be sufficiently large (e.g. Fig. C4b). Using a variable distance for the panel label in the individual panels would result in an uneven viewing experience. We have set the distance to accommodate the longest (widest) vertical axis label.

Given the caveat that this is only a simulation of specific transient case in a specific region, could you make any statements or comments in the last paragraph of the conclusions about the sensitivity of CRE to winds peed shown here? Is the amplitude of the CRE response significant?

We cannot provide a quantitative assessment of the relevance of wind speed effects on the CRE on climatic time scales and put them in relation to the role of other changes in the system in the present work. However, we have added aparagraph at the end of the conclusions section to address this point (see introduction above).

p. 28406 Discussion in last paragraph: Including sedimentation of cloud droplets (but not precipitation droplets) might allow a more realistic aspect ratio to be used by reducing mixing at the inversion. This is just a suggestion for potential future follow on simulations.

Cloud droplet sedimentation is accounted for in the two-moment bin-emulating cloud microphysics scheme we use, and is enabled in the simulations (however, it is disabled in the the spin-up runs). We have added a sentence in the text to clarify this (cloud droplet sedimendation and collision coalescence are accounted for in the simulations).

We hypothesize that the reason why an anisotropic aspect ratio gives better results than a more isotropic one is the isotropic sub-grid TKE scheme of the WRF model. An isotropic sub-grid TKE scheme used on an isotropic grid may not capture anisotropicity of turbulence in the inversion layer. An anisotropic grid may compensate for this. This would also imply that an anisotropic sub-grid TKE scheme (provided it correctly captures anisotropicity of turbulence in the inversion layer) may be better suited to reproduce observations when using an isotropic grid. However, on an isotropic grid, the simulations in our work would be more expensive by a factor of ~ 100, unless the anisotropic sub-grid TKE scheme would allow using a coarser vertical resolution. Using an isotropic sub-grid TKE scheme with an anisotropic grid, with an aspect ratio that reproduces observations has therefore the benefit of producing realistic results at acceptable computational cost, although requiring a specific choice of aspect ratio.

Technical corrections

p. 28938 line 15 should be ’additional’

Corrected.

p. 28399 line 23 should be ’Atlantic’

Corrected.

p. 28411 line 17 ’lead’ should be ’led’

Corrected.

p. 28431 line 18 should be ’transport’ and probably better to use ’stronger’ instead of ’faster’

Corrected (with other occurrences of “tranport”).

p. 28432 lines 4/5 should refer to figure C1, not C2

Corrected.

General revision notes

In the revised version, wording has been improved in a number of locations. Together with the changes requested by the reviewers, these changes are highlighted in the revised version by blue (new text) and gray (removed text).

Values in Table 3 of the revised version give the top-of-atmosphere (TOA) total (short-wave + longwave) cloud radiative effect, while the top-of-domain total (short-wave + longwave) cloud radiative effect was given in the original version.