Atmos. Chem. Phys. Discuss., 12, C10383–C10386, 2012
www.atmos-chem-phys-discuss.net/12/C10383/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A comparative study of the response of non-drizzling stratocumulus to meteorological and aerosol perturbations" *by* J. L. Petters et al.

Anonymous Referee #2

Received and published: 10 December 2012

The paper "A comparative study of the response of non-drizzling stratocumulus to meteorological and aerosol perturbations" aims to investigate the impacts of meteorological variations and changes in aerosol state on non-drizzling stratocumulus. The paper first describes a large eddy simulation (LES) of non-drizzling coastal stratocumulus based on flight observations, and then compares the impacts on the simulated non-drizzling stratocumulus from aerosol variations with those from meteorological variations through the use of three groups of sensitivity tests. This study finds that the realistic variations of meteorological conditions and solar radiative heating can lead to substantial changes in cloud properties times larger than those changes caused by the realistic aerosol variations. This study is well organized and complete but could be benefited by addressing the major and minor comments noted below.

Major comments:

1. Since you mentioned the simulations might be resolution dependent, have you tried different resolutions to make sure the model output won't change too much when the resolution is higher than the current setting? Furthermore, if you increase the spatial and temporal resolution, will the main results (e.g. Fig 11-12, Table 6) still be similar as the current results?

2. The paper specifies the large-scale subsidence and initial condition for best match to observations (Table 1, 3), and argues that the base case simulation without the sub-grid scheme (NODIFF in your paper) matches better to the observations (pp27123 L19-20). When you tune the initial condition and large scale forcing to match the observations, which one (DIFF or NODIFF) is the testing case? Because the shape of LWC distribution from DIFF looks closer to observation (Fig 4 a-c), is it possible that you can tune the initial condition and large scale forcing to let DIFF match better?

3. According to section 6, both meteorological and aerosol perturbations impact the cloud layer through changing cloud top entrainment rate (Table 4 and section 6.4). Recent direct numerical simulations (DNS) of the cloud top interface indicated that the small eddies and molecular processes near the cloud top play a key role in regulating the entrainment rate (Mellado 2010, J. Fluid Mech.). Traditional LES, however, is unlikely able to represent such small scale processes. Therefore, the cloud top mixing processes are largely simplified in LES and cloud top entrainment might not be simply overestimated as the paper discussed (pp 27132, L 16-18). You may explain more or prove that the comparison in this study is very solid.

Minor comments:

Abstract:

pp27112 L2-11: The key research methods could be more detailed.

ACPD

12, C10383–C10386, 2012

pp27112 L9: “LES” should be spelled out at its first occurrence.

pp27112 L12-15: “those responses found due to similar changes in aerosol state.” I don’t quite understand “similar changes”. Does it mean the similar magnitudes of the changes? Or the similar relative changes in aerosol state?

Introduction:

pp27115 L21-23: The sentence is a bit misleading. Section 2-4 are model configuration, observation, and comparison. You may either modify the sentence, or reorganize section 2-4 to be observation, model configuration, and comparison.

pp27115 L26 - pp27116 L4: These sentences already appear in section 7 and need to be removed.

Section 3

pp27118 L23-24: Can you roughly estimate how the cloud layer changed by checking the profiles taken at the beginning and the end of the flight mission?

Section 5

pp27124 L4-10: the vertical resolution of the ERA-Interim dataset is not high enough to resolve the strong inversion at the top of stratocumulus layer. Furthermore, the ERA-Interim dataset tends to underestimate the boundary layer depth near the coastal region. Both issues can affect the estimates of qt and theta jumps.

pp27126 L5-6: During VOCALS, the Twin Otter observed Nd ranged between 80 and 400 cm$-$3(Zheng et al., 2011, ACP).

Section 7

pp27141 L25-26: The mean value (Table 6) in this study is much smaller than in other studies (Lu and Seinfeld, 2005; Hill et al., 2009). Can you explain what physical processes might contribute to the large value of standard deviation?

ACPD

12, C10383–C10386, 2012

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Section 8

pp27142-143: Many symbols, such as DIFF, NODIFF, τ, SW CRF, have been defined in previous chapters.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 27111, 2012.

ACPD

12, C10383–C10386, 2012

Interactive Comment