

## ***Interactive comment on “A modelling case study of a large-scale cirrus in the tropical tropopause layer” by A. Podglajen et al.***

### **Anonymous Referee #3**

Received and published: 14 December 2015

#### Comments to the Author:

This manuscript details a modeling study of a large-scale TTL cirrus. The authors use the Weather Research and Forecasting (WRF) mesoscale model to simulate an event of horizontally extensive and vertically thin TTL cirrus cloud observed on 27-29 January in the Tropical Eastern Pacific region. Simulations were carried out over a large domain (4000x4000km) covering the Eastern Pacific. They perform simulations with different microphysical parameterizations and different initial/boundary conditions to assess the sensitivity of cirrus properties to cloud physics and dynamics. It is found that dynamics largely controls the location, amplitude and structure of the cirrus cloud while microphysics influences the intensity of the cloud and its vertical position and extent. Overall the content of this study is of interest to readers of Atmospheric Chemistry and

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Physics. The authors made a nice effort to perform various simulations to assess the model sensitivity to cloud microphysics. The paper is generally well written and the methods are reasonably sound. I recommend a few improvements to the presentation before final publications.

General comments:

1) Motivation for this study: In the introduction the authors explain that they focus on this specific cirrus event as it was previously observed and described in Taylor et al. (2011). They should add in the introduction some description of the results of Taylor et al. (2011) so that the readers can understand what were the main results of this study to better justify the focus of this specific cirrus event. There is only one sentence at Line 13 “Taylor et al. (2011) have discussed observations of this cloud” and this sounds rather brief.

2) Section 2.2 provides a description of the parameterizations used in the WRF simulations. For cloud microphysics, the scheme of Thompson et al. (2004) is used but later in the paper other schemes are used for the sensitivity study (WSM5 and Morrison). Please add these schemes to Section 2.2 and a short description of how they handle ice cloud microphysics. The WRF model has many options for cloud microphysics and some justifications for the use of the scheme of Thompson are missing. Also please add when the simulations are initialized in this section. You mentioned that you performed a 4-day integration but not the initial date. It will help the readers understand that your simulations actually cover the full cloud life cycle.

3) Comparison with CALIPSO observations: On Figure 1 do you understand why the WRF simulation does not show the extension of the cirrus cloud beyond 5N? CALIOP shows a rather symmetric cirrus structure that is not seen in the WRF simulation. You later explained that a PV intrusion caused a large-scale uplift and corresponding TTL cooling that is important for the cloud formation. Do you think that extending the northern boundaries of the domain beyond 18N could have helped to improve the represen-

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tation of the cirrus cloud in WRF?

4) You mentioned a large difference of 3K between simulated and analyzed temperature fields in section 2.3. Since TTL water vapor and temperature are important for in-situ cirrus cloud formation and thus for this case event, have you compared the model representation of TTL water vapor and temperature with observations? e.g. water vapor from MLS and temperature from COSMIC since there are very few radiosondes for this region.

5) “We do not look for any further validation of the microphysical properties of the cloud either (such as in cloud supersaturation and ice crystal number), because of the absence of observational data for this case.” Even though you do not have observational data for this specific case, you could use results from other observational studies of cirrus clouds in the Eastern Pacific (e.g. Davis et al. [2010] or Jensen et al. [2013]) to compare qualitatively the properties (ice crystal number concentration, particle size, supersaturation) of this cirrus event. It could help to assess whether this specific cirrus event is representative of cirrus formation in the Eastern Pacific.

6) Lagrangian trajectories and air parcels on Figure 2. Could you add some descriptions of release time and location of the air parcels? On Figure 2, does one point correspond to the center of mass of different points?

7) For the radiative heating rates shown on Figure 8, in addition to the comparison with ERAi radiative heating rates, you could also compare the WRF estimates with Figure 3 of Corti et al. (2006). Of course, the comparison would be only qualitative since you have heating rates from a 4-day simulation while Corti et al. used 6 years of balloon sonde measurements of temperature, ozone, and water vapor profiles from the SHADOZ network and cloud observations to compute mean full sky radiative heating rates in the tropics.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 31089, 2015.

ACPD

15, C10388–C10391,  
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