Reviewer #1:

This study focuses on balloon measurements carried out from the Tibetan plateau to understand the microphysical processes involved in aerosol formation and growth in the Upper Troposphere and Lower Stratosphere during the Summer Asian Monsoon. The authors use the COBALD backscatter sonde together with the Cryogenic Frost Point Hygrometer to understand how humidity affects the size of aerosols. In addition, they use Mie calculations to interpret those measurements. Overall, the paper is short, to the point, well written and follow a logical path with clear figures and consistent interpretation. I would recommend the publication of this manuscript in ACP after the following points are corrected :

- P1-L27 replace "a balloon.." by "the balloon.."

R: Done.

- P1-L28 add "COBALD sensor"

R: We rewrote the sentence as '*using the balloon-borne, lightweight Compact Optical Backscatter AerosoL Detector (COBALD) instruments above Linzhi***' according to the comments from the two reviewers..**

- P2L20: Park et al. [2007] should not be quoted here but rather after "large scale circulation.."

R: Done.

- P3L6. Frey et al. [2011] talk about the West African Monsoon and the Asian Monsoon.
Do you think it's relevant here ?

R: We agreed with reviewer's concerns and rewrote this and related sentence earlier as '*Sources and formation mechanism of aerosols in the UTLS, especially over the tropics, have been studied over the past decades. New particle formation events can occur at very low temperatures accompanied by the outflow of convective systems, as observed in the West African Monsoon [Frey et al., 2011]***'. Here we merely give a brief overview about the studies for the UTLS.**

- P7L7. Are you sure that the Kelud eruption did not impact those balloon measurements?

R: We appreciate the reviewer's suggestions (also from Reviewer #2) and add the corresponding discussion about the Kelud eruption.

'On February 13, 2014 the Mt. Kelud (8°S, 112°E) in Indonesia erupted, with a volcanic plume located near 18-21 km within the tropical stratosphere, which was detected 11 days after the eruption by the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) [Vernier et al, 2016]. Stratospheric aerosols were perturbed significantly by the Kelud volcanic plumes, especially the fresh ash plume in the southern hemisphere [Vernier et al, 2016; Sakai et al., 2016], The Kelud volcanic eruption might have negligible influence on the observed aerosols in the ATAL, since the ATAL began to form about four months after the Kelud eruption when the volcanic materials in the troposphere might have vanished. On the other hand, CALIOP data analysis also showed that sulfate components from the Kelud volcanic eruption, peaking at an higher altitude with a longer residence time compared with the volcanic ashes, influenced aerosol optical depth (AOD) between 20°N and 20°S 18-25 km considerably three months after the eruption [Vernier et al, 2016]. It is

*likely that sulfate aerosols from the Kelud eruption contributed to stratospheric background aerosols above the ATAL and even in the Junge layer at slightly higher latitude, as indicated by our COBALD measurements'***.**

- Fig.1. I would rather differentiate in this plot: the Junge Layer, the stratospheric aerosol layer peaking in the mid stratosphere and the ATAL which is limited to the Upper Tropospheric and Lower Stratospheric region.

R: We appreciate the reviewer's suggestions and add the corresponding statement about the enhanced aerosol layer from COBALD measurement in the first paragraph of Sect. 3.

"The enhanced aerosol layer from COBALD measurement is a mixture of ATAL and the on-setting Junge Layer due to the signal above 50 hPa stemming from the Junge Layer but the maximum occurring in ATAL".

- Fig.2. Here, it's important to define the lower size boundary that cannot be observed by COBALD due to the lack of scattering efficiency of small aerosols. I would say that 30-40 nm is probably the limit.

R: We agreed with reviewer's concerns and added the corresponding statement and a new table about the lower size boundary of COBALD measurement.

"The signal to noise ratio at the blue channel with respect to the molecular Rayleigh backscatter at tropopause conditions (taken 100 hPa and 210 K) is 220. Given the molecular backscatter coefficient of 4.4e^{-7} (sr^{-1}m^{-1}) for 455 nm, this corresponds to a backscatter coefficient minimum detection limit of 2e^{-9} (sr^{-1}m^{-1}), which is holding in general over the entire profile. To define an aerosol size limit, typical aerosol dumber densities need to be assumed: 10 cm^{-3} for stratospheric background and 100 cm^{-3} for the ATAL. The aerosol backscatter coefficients of different aerosol mode radius for the typical aerosol dumber densities are calculated by Mie theory and listed in Table 1. The results confirm that the particles with 100 nm radius are well detected under background conditions, which mainly contribute to the particulate backscatter ratio of approx. 0.01 and is always present. With increasing particle number density, the particles with 30 nm radius start to contribute to the particulate backscatter ratio (> 2e^{-9} sr^{-1}m^{-1}). Therefore, the lower size boundary that cannot be observed by COBALD due to the lack of scattering efficiency of small aerosols can be defined as 30 nm.

Table 1 The aerosol backscatter coefficients of different aerosol mode radius for the typical aerosol dumber densities.

Mode Radius (nm)	10	30	100
β_a@10 cm^{-3} (sr^{-1} m^{-1})	1e^{-12}	3e^{-10}	2e^{-8}
β_a@100 cm^{-3} (sr^{-1} m^{-1})	1e^{-11}	3e^{-9}	2e-^{7}

"

- Fig.3 was also explored in Vernier et al., 2015 (Fig.3) using the same technique. I think it's important to make sure that data plotted here are not in the stratosphere and should remain below 19 km. The upper pressure limit (50 hPa) includes stratospheric data and I believe that the points in black where CI is between 4-6 and RHi below 40 % could be in the stratosphere. It would be interesting to color the points according to their heights.

R: We agreed with reviewer's concerns and replotted Fig 3b by coloring the points according to the height of particles.

More generally, the authors should remain the reader than the conclusions drawn from this paper are only based on 3 balloon flights so that general conclusions should be established with caution.

R: The reviewer's comments are very valuable. We added a sentence about the conclusions drawn from only 7 balloon flights.

"It must be borne in mind that the conclusions drawn from this study are only based on 7 balloon flights so that general conclusions should be established with caution".