We would like to thank the reviewer for his/her constructive comments. The responses to the referee is formatted as follows:
The original comments are given in black
The author's response is given in red
The changes in manuscript are given in green

Review by Referee #1 (W. Wang):

1st comment:
Page 2 line 24, Sc have a small effect on outgoing longwave radiation. Give some references.

Response:

Two references are added to the manuscript.

The manuscript has been changed as follows:
Stratocumuli strongly reflect incoming solar radiation (Chen et al. 2000) and exert only a small effect on the outgoing longwave radiation. Overall, they exert a strong negative net radiative effect that markedly affects Earth's radiative balance (e.g., Stephens and Greenwald 1991; Hartmann et al. 1992).

Hartmann, D. L., M. E. Ockert-Bell, and M. L. Michelsen, 1992: The effect of cloud type on earth's energy balance—Global analysis. J. Climate, 5, 1281–1304.

Stephens, G. L., and T. J. Greenwald, 1991: Observations of the Earth's radiation budget in relation to atmospheric hydrology. Part II: Cloud effects and cloud feedback. J. Geophys. Res., 96, 15 325–15 340.

2nd comment:
Page 7, line 20 to 23. You estimate dust-cloud radiative effect by using the data where both dust and MSc exist. However, since dust and cloud possibly distribute at different height, dust may have little or ignore effect on clouds (such as your results in Fig. 10). Wang et al. (2010) define dusty clouds (the height difference between dust and cloud less than 50 m) to study dust effects on clouds. The height differences between dust and MSc should also be given here.

Response:

We agree that it would be interesting to separate the analysis to whether the dust is below, at the same height or above the clouds but dust aerosol optical depth (DAOD) from CALIPSO is available only two or three days a month and the DAOD from MACC is not vertically resolved. Dust must not necessarily be at the same height as the clouds to have an effect on clouds. Several studies (e.g. Koch and Del Genio, 2010; Wilcox, 2010; Constantino and Bréon, 2013) have shown that absorbing aerosol, which is above the clouds, can have an influence on the clouds below e.g. Wilcox (2010) estimates SDE where layers identified as cloud features occur predominantly below 1.5 km and features identified as layers of aerosol occur predominantly between 2 km and 4 km. The statistical method used in our study allows assessing the effect of a vertically integrated variable like DAOD on stratocumulus clouds, for example Chen et al. (2014) estimate global aerosol-cloud radiative forcing for marine warm clouds without any assumption for height difference between clouds and aerosols. Most of the dust in summer is indeed above the clouds in the studied region (Fig. 8c and 10c), but for other seasons the opposite was found. Summer is the season when the total radiative effect of dust is largest (Table 2) therefore dust seems to have an influence on the stratocumulus clouds even when it is above them.

The usage of a N_d mediated cloud fraction sensitivity to AI not only suppresses the impact of meteorological covariations on this sensitivity but also to the effect of absorbing aerosol on cloud fraction. We added this to the manuscript:

Figure 10 shows that the sensitivity of cloud fraction to AI is relatively weak. It also shows that this sensitivity is positive (negative) during summer (winter) for most of the study area, which shows that cloud fraction increases (decreases) when AI increases. *Using equation (8) suppresses next to meteorological covariations also part of the effect of absorbing aerosol on cloud fraction i.e. the sensitivity in Figure 10 is a conservative estimate.*

Wang et al. (2010) is a relevant paper to our work, thus this part is added to the introduction part:

Wang et al. (2010) compare dusty and pure cloud properties and radiative forcing over northwestern China (source region) and over the northwestern Pacific (downwind region). Dusty clouds are defined as clouds that extend into a dust plume environment (i.e., dust aerosols observed within 50 m of the cloud), while pure clouds are clouds having no dust aerosols within 500 m around them. They show that dust aerosols change the microphysical characteristics of clouds, reducing the cloud effective particle size and, possibly, cloud optical depth, LWP, and ice water path (IWP). They show that dust aerosols cause an instantaneous net cooling effect in the source and downwind regions respectively.

3rd Comment:
The dust-cloud radiative effect could be either positive or negative by method 1 during Winter, Spring and Fall, but the RF is negative during Summer from the results in Table 2. Since the sign of RF is affected by the height of dust (Huang et al., 2014), the vertical profile of dust in spring and autumn should also be given and discussed.

The manuscript has been modified (both in the text and abstract) as follows:
Since the sign of the dust-cloud radiative effect is affected by the height of dust (Huang et al., 2014), to investigate the role of the SDE over the region, we look at the vertical

profile of Saharan dust from CALIPSO. Figure 8 shows that during winter, most of the dust burden resides between 0-1 km. In contrast, during spring there are two peaks in Saharan dust: one peak is within the marine boundary layer (between 0-1km), and the rest resides above the boundary layer., with the peak above boundary layer being smaller than that within the boundary layer. During summer, similar to spring, there are two peaks, but most of dust resides above the boundary layer. During fall the amount of dust is less than in other seasons and most of dust burden resides between 0-1 km, with some dust between 1-4 km. The horizontal solid and dashed red lines in Figure 8 are average CERES MSc cloud top heights ± one-sigma respectively for each season. The average cloud top heights in summer and spring are lowest with 1.9±0.4 km respectively 2.0±0.4 km, and highest in winter and fall with 2.2±0.3 km as shown in Figure 9. CALIPSO shows that 88.3% ±8.5% of dust resides below 1.5 km in winter. During summer, however, there are two peaks, with 35.6% ±13% below 1.5 km and 44.4% ±9.2% between 2 and 4 km.

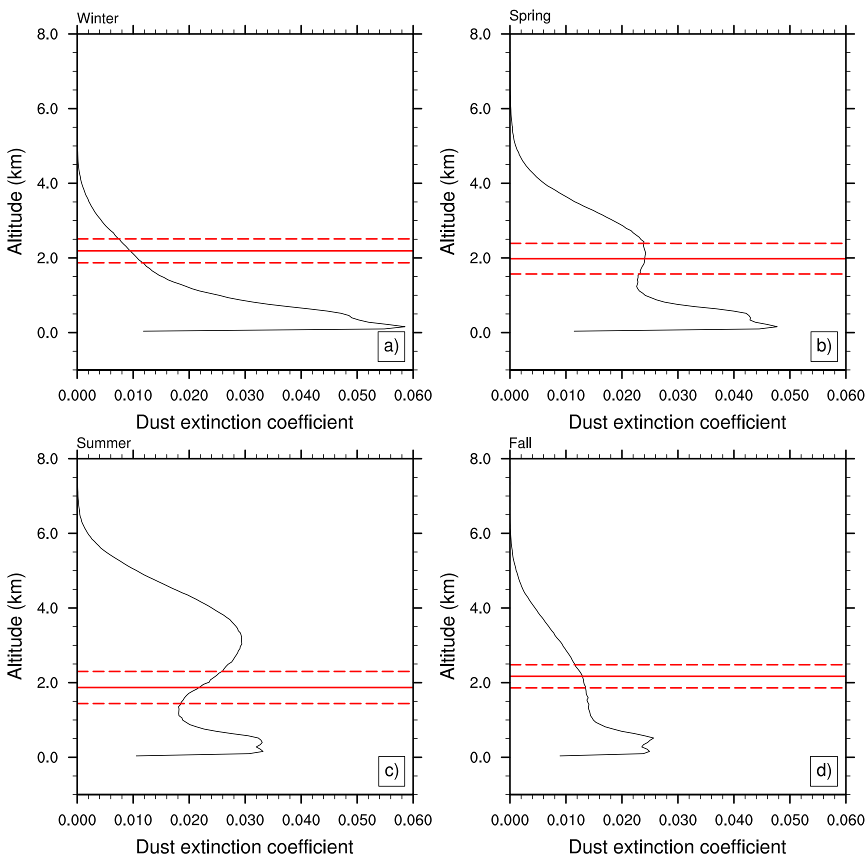

Figure 8. Vertical profile of dust from CALIPSO in (a) winter, (b) spring, (c) summer, (d) fall. Solid and dashed red lines show CERES MSc cloud top height ± one-sigma respectively for each season.

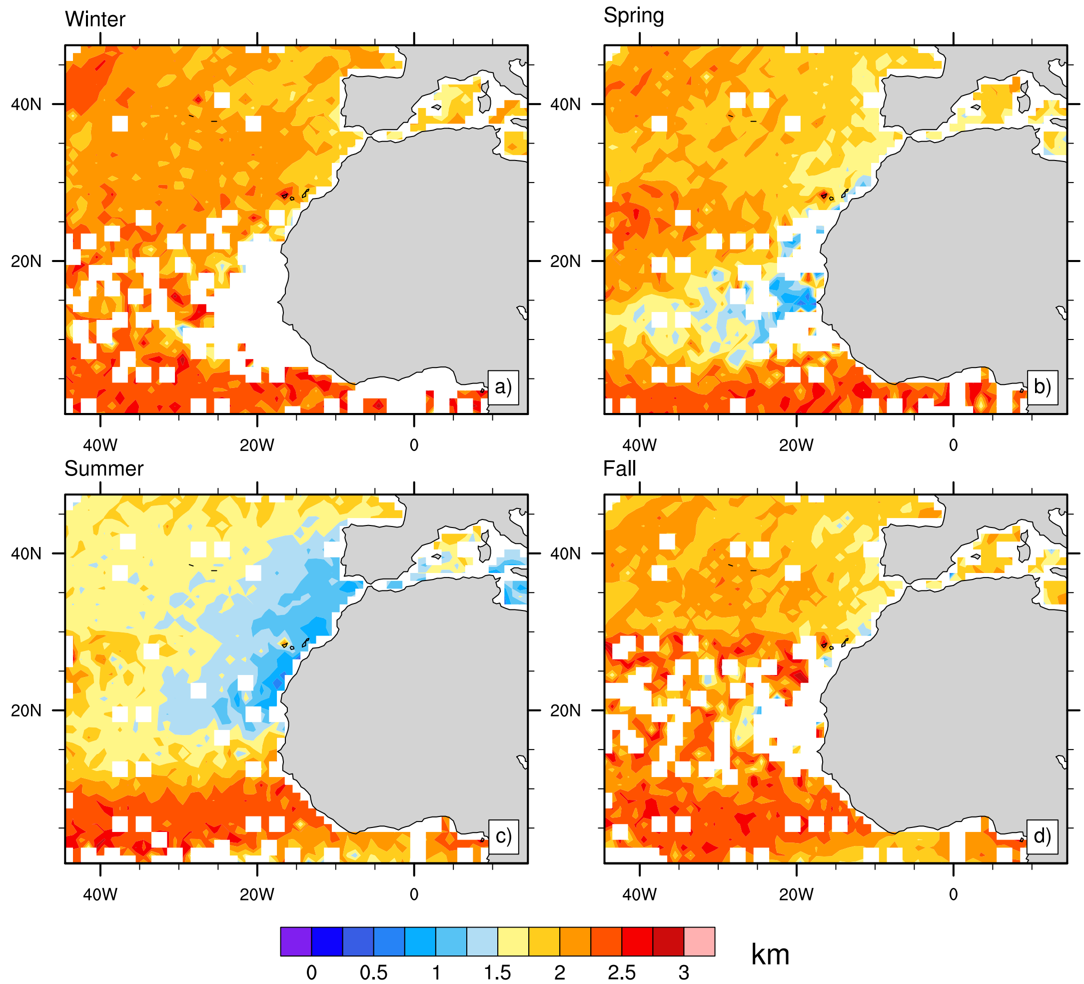

Figure 9. Marine stratocumulus clouds top height from CERES in (a) winter, (b) spring, (c) summer, (d) fall.

Figure 10 shows that 61.8% ±12.6 of the dust resides above MSc during the summer; only 11.9% ±10.8 resides above MSc during the winter. In spring (fall) 35% ±19.8 (31.2% ±15.9) of the dust resides above MSc.

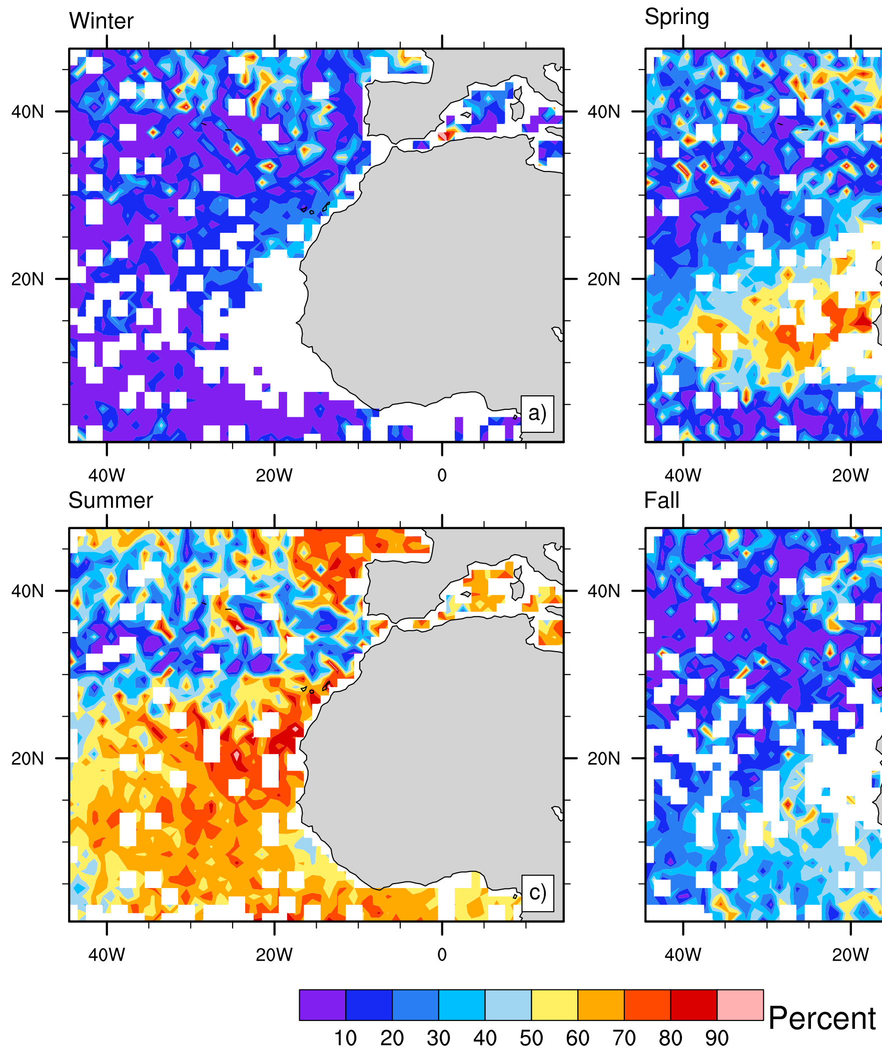

Figure 10. Amount of dust (%) above marine stratocumulus clouds in (a) winter, (b) spring, (c) summer, (d) fall

4th Comment:

Fig. 10. The authors conclude SDE is the dominant effect. However, the results in Fig.10 which also represents the semi-direct effect of dust is not really obvious. The authors should give the significance degree for Fig 10.

The manuscript is modified as follows:

Using Eq. 8 to calculate the sensitivity of cloud fraction to a relative change in aerosol index leads to a non-linear distribution, thus the statistical significance of the Eq. 8 is evaluated using a bootstrap test. Using eq. (8) (i.e. only cloud fraction changes mediated by N_d) the effect of absorbing aerosol on meteorology and subsequently cloud cover is suppressed (i.e. a part of the SDE).

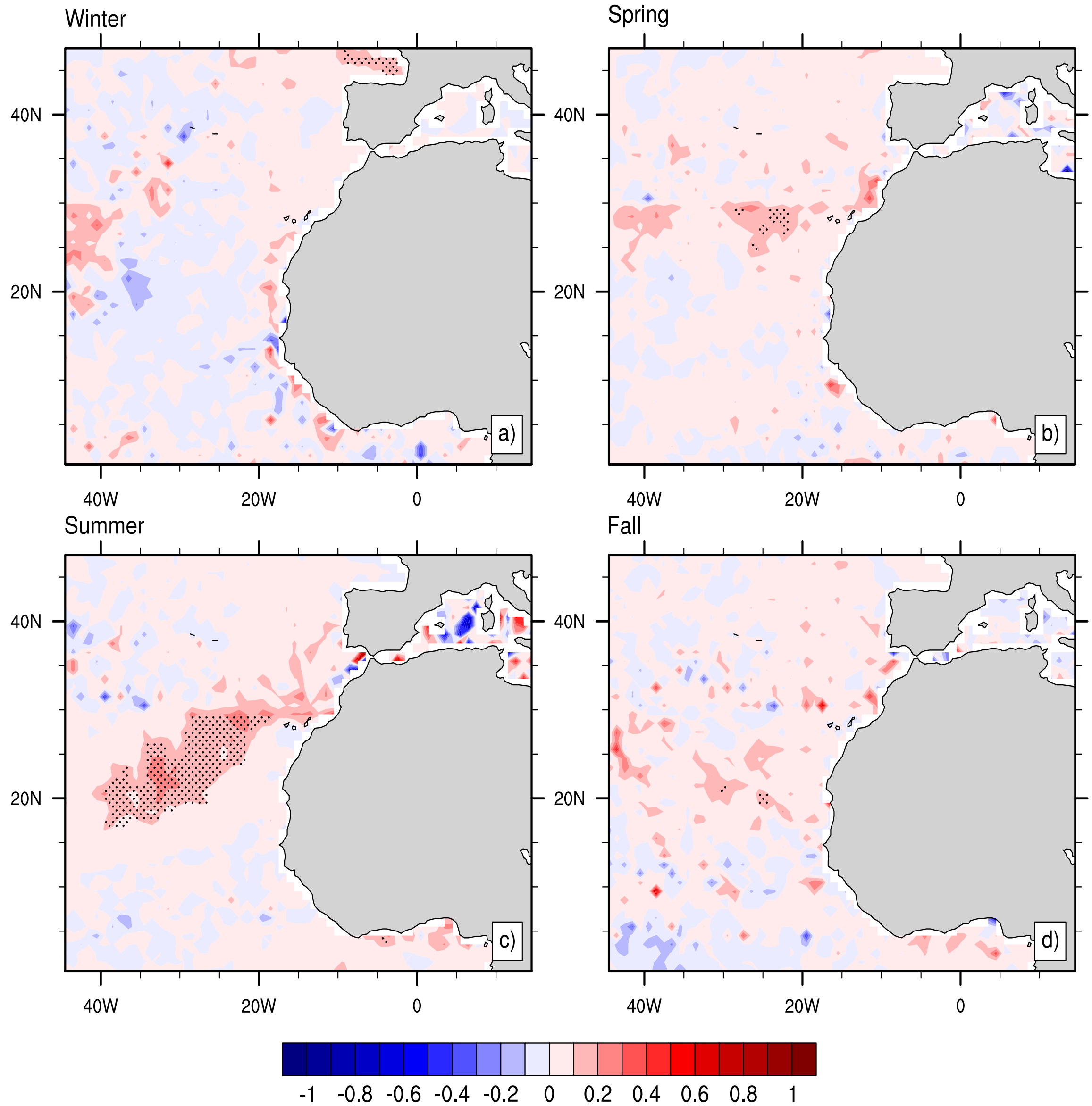

Figure 11. The sensitivity of cloud fraction to a relative change in aerosol index for (a) winter, (b) spring, (c) summer, (d) fall. Dots represent the significance at the 95% confidence level.