Here, I have four viewpoints for the authors and the editor to improving this paper.

1. Mineral composition has questions.

   This manuscript adopted the relative volume abundance of minerals deduced from single particle analysis to calculate the mass distribution as a function of particle size for common airborne minerals in Figure 1. The original data is from Table 1 of Kandler et al. (2009) with identified specific mineral phases. In Kandler et al. (2009) used the method in Kandler et al. (2007) to classified the mineral phases, but this method only identified the whole silicate (which could not further classified as illite, kaolinite and chlorite) and Kandler (2009) also written as "All silicates except quartz are sorted into the silicates class, as the different silicate minerals cannot be distinguished from each other reliably by the elemental composition only." in section 4.3.2.1 line 11-14. The content of Table 1 in Kandler (2009) is low quality and unusable. This question directly influence the second challenge mentioned in Page 3501.

2. iron oxides:

   The reported hematite abundances in Table 1 of Kandler et al. (2009) were obtained from the measured content of elemental Fe by EDX, and then each value multiply 20%. Thus, the result is almost similar values (0.5%-0.8%) in different size bins. To my experimental experience, the size of hematite particle is presented as particles less than 10 um. But the iron-rich particles indentified by individual particle analysis actually are the assemble of hematite, goethite, wuitite and so on. These iron-rich particles is the so called "pure crystalline form" and as an external mixture with other minerals. For hematite with nanometer sizes which attached to phyllosilicates is hard to be identified by individual particle analysis, and this attachment is also the external mixing. Because the internal mixing is meaning that "a small particle was coated or partly immersed into a larger particle". Once nano-sized hematite particles attached to phyllosilicates would not effectively change size of silicates. The volume contribution is mainly from the iron-rich particles with micrometer sizes. As mentioned above, the usage of volume fraction of hematite in Fig. 11 of Kandler et al. (2009) is more plausible for calculation in Fig 1 of this manuscript.

The usage of "internal mixture" and "external mixture" in this paper is easy to comprehend as terms for calculating the complex refractive indices for optical properties of mineral mixtures.

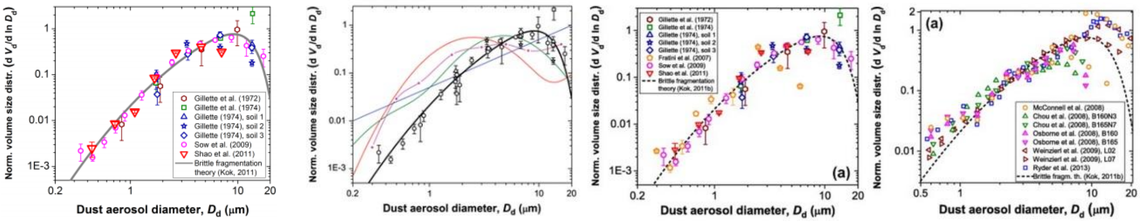
3. settling speed

As mentioned in page 3519 line 1-3, Settling speeds are proportional to mineral density, and the minerals have nearly identical densities except for iron oxides. Quartz has similar density (2.67 g/cm^3) with compare to phyllosilicates (such as Kaolinite with 2.67 g/cm^3), this means that both quartz and kaolinite have almost the same settling speed. Phyllosilicates with flake shape is easy fly in air than quartz, and the difference of morphology will obviously affect the settling speed (Li and Osada, 2007). If possible, the effect of morphologies of different mineral particles on their settling speeds should be taken into account in future works.

4. The core of the paper is built on the brittle fragmentation theory of Kok et al. (2011).

   Once the core collapsed, and this manuscript will be collapsed.

Many models simulate the dust size distribution as a sum of lognormal modes (e.g., Balkanski et al., 2007 and Zhao et al., 2010). This approach is computationally efficient for models using the modal method, but Kok et al., (2011a) concluded that measurements of the dust size distribution at emission and *in situ* near source regions do not generally support the idea that the dust PSD at emission is a sum of a few lognormal modes (Fig. 1 in Kok et al. (2011b), Fig. 3 in Kok et al. (2011a) and Fig. 3 in Mahowald et al. (2013)). This mistake conclusion was conducted by selected measure data and plotted the dots with union color (black) in a Figure, which indicates that the author want to represent the multi-modes distribution with a deformation of Weibull distribution which suitable for size range of 1-12 um. Actually, it is clear that the multi-modes distribution for each single size distribution in the following Figure c and d than a.



(a) (b) (c) (d)

All of above four figures are coped from published papers and books.

Kok (2011b) proposed a theory for the size distribution of emitted dust aerosols that assumes that most dust emission is the result of fragmentation of soil dust aggregates by impacting saltators. As also noted by Gill et al. (2006), stressed dry soil aggregates are known to fail as brittle materials (Braunack et al., 1979, Lee and Ingles, 1968, Perfect and Kay, 1995 and Zobeck et al., 1999). Therefore, Kok (2011b) hypothesized that the impact energy of a saltating particle shatters aggregates of dust particles in soils in much the same way that glass shatters upon a sufficiently energetic impact. Since the patterns in which cracks are created and eventually merge in brittle materials is *scale-invariant* (Astrom, 2006), and thus does not require detailed knowledge of the strength of interparticle bonds in the dust aggregate, this hypothesis produced a relatively straightforward expression for the size distribution of emitted dust aerosols. Specifically, Kok (2011b) derived

$$\frac{dV_d}{d\ln D_d} = \frac{D_d}{c_v}\left[1+\mathrm{erf}\left(\frac{\ln(D_d/\overline{D_s})}{\sqrt{2}\ln\sigma_s}\right)\right]\exp\left[-\left(\frac{D_d}{\lambda}\right)^3\right] \qquad (1)$$

where V_d is the normalized volume of dust aerosols with size D_d, c_v = 12.62 μm is a normalization constant, and $\sigma_s \approx$ 3.0 and $\overline{D_s}$ $\approx$ 3.4 μm are the geometric standard deviation and median diameter by volume of the log-normal distribution of a typical arid soil size distribution in the < 20 μm size range. The parameter λ denotes the propagation distance of side branches of cracks created in the dust aggregate by a fragmenting impact, and Kok (2011b) obtained λ = 12 $\pm$ 1 μm using least-square fitting to dust PSD measurements.

Formula (1) of this manuscript is $\dfrac{dV}{d\ln D} = \dfrac{D}{c_v}u(D)\exp\left[-\left(\dfrac{D}{\lambda}\right)^3\right]$, (2a)

To our knowledge, the probability density function of the three-parameter Weibull distribution is given by

$$f(D_d) = \frac{k}{\lambda}\left(\frac{D_d}{\lambda}\right)^{k-1} \exp\left[-\left(\frac{D_d}{\lambda}\right)^{k}\right] \tag{2}$$

A higher similarity is presented between (2a) and (2).

I will detail introduce them as following:

Several phenomenological models have been proposed for the homogeneous fragmentation of solid (non-porous) materials. Depending upon the assumptions made, the resulting fsd 's may conform to a log-normal distribution (Epstein, 1947), a Rosin–Rammler distribution (Bennett, 1936; Gilvarry, 1961), or a Gates-Gaudin–Schuhmann (power-law) distribution (Griffith, 1943; Turcotte, 1986). While it is possible to successfully parameterize soil fsd 's using all three of these models (Perfect et al., 1993b), such efforts are fundamentally flawed.

Fragmentation is a process whereby a coherent body breaks apart into smaller pieces or fragments as a result of externally applied stresses. Soils are formed by weathering of geological parent material. The weathering results in a fragmentation of the initial solid rock or sediment. Soil fragmentation occurs naturally as a result of wetting/drying and freezing/thawing cycles (Edwards, 1991; Grant et al., 1995). However, the major cause of fragmentation in most agricultural soils is anthropogenic, i.e. primary and secondary tillage. The fine particles (PM20) are easy to attach to larger particles and form aggregates (Note that this aggregate is heterogeneous due to different mineral composition of particles). The salating with impact will disperse the aggregate (the progress that fragmentation of heterogeneous aggregate), but at the same time, the larger particle will further fractal fragment to more homogenous particles (which equal to the former wetting/drying and freezing/thawing cycles). Thus, the dust emission progress should be the assemble of muti-modes of fractal fragmentation distributions.So both log-normal distribution and power-law distribution (contain Weibull distribution) could be used to fit the size distribution of emitted dust particles, and the distribution of Kok (2011b) is just a asymmetric curve for size range of 1-12um.

It has been recognized that the products of fragmentation in nature can often be described with fractal concepts. For different types of objects, a power-law relation between the number and size of objects has been proposed (Mandelbrot, 1982; Matsushita, 1985; Turcotte, 1986)

$$N(r > R) = CR^{-D_f} \tag{3}$$

where $N(r > R)$ is the number of objects per unit volume having a radius r larger than R, C is a constant of proportionality, and D_f is the fractal dimension. $0 \le D_f < 3$ (Brown et al., 1995). The volume-based or mass-based power-law form is expressed as (Rosin and Rammler, 1933; Turcotte, 1986; Wohletz et al., 1989; Tyler and Whetcarft, 1992; Zobeck et al., 2003)

$$\frac{V(r > R)}{V_T} = \left(\frac{R}{R_u}\right)^{v} \tag{4}$$

where $V(r > R)$ is the volume of soil particles with a radius less than R, V_T is the total volume of particles with radius less than the upper size limit for fractal behavior R_u (which is the side crack propagation length λ in Kok et al. (2011a)), ν is a power-law exponent. The power-law relation given in Eq. (32) has also a lower limit R_l of validity (Turcotte, 1992; Bittelli et al., 1999).Taking the derivatives of Eq. (31) and (32) with respect to the radius R yields, respectively,

$$\frac{dN}{dR} \propto R^{-D_f-1} \text{ and } \frac{dV}{dR} \propto R^{\nu-1} \qquad (5)$$

For incremental particle numbers and volumes, we have

$$R^3 dN \propto dV \qquad (6)$$

Substituting Eq. (5) in to (6) gives (Turcotte, 1992; Bittelli et al., 1999)

$$R^{-D_f-1} \propto R^{-3} R^{\nu-1} \qquad (7)$$

from which it follows that (Tyler and Whetcarft, 1992)

$$D_f = 3 - \nu \qquad (8)$$

Experiments show that, the distribution at larger sizes becomes exponential as a result of a Poisson process, which introduces a large-scale cutoff (A˚stro¨ m et al., 2004) and the resulting large-size cutoff can be approximately described by the product of the power law (Eq. (**33**)) with an exponential function in terms of the fractal dimension (Turcotte, 1986; Bittelli et al., 1999)

$$\frac{dN}{dR} \propto R^{-D_f-1} \exp\left[-\left(\frac{R}{R_0}\right)^{D_f}\right] \text{ and } \frac{dV}{dR} \propto R^{2-D_f} \exp\left[-\left(\frac{R}{R_0}\right)^{D_f}\right], \qquad (9)$$

Once we follow the assumption in Kok et al. (2011a) that the production of aerosols of size R is proportional to the volume fraction of soil particles with size $R_s \le R$,

$$\frac{dN}{dR} \propto \int_0^R P(R_s) dR_s , \qquad (10)$$

where $P(R_s)$ is the size distribution of soil particles in the form of log-normal distribution or Weibull distribution. As the distribution of fully disaggregated soil particles is usually described as a log-normal distribution

$$P(R_s) = \frac{1}{\sqrt{2\pi}\,\ln(\sigma_s)} \exp\left[-\frac{\ln^2(R_s/\bar{R}_s)}{2\ln^2(\sigma_s)}\right], \qquad (11)$$

where $\bar{R}_s$ is the median size by volume, and σ_s is the geometric standard deviation.

The cumulative distribution functions for log-normal distribution and Weibull distribution are expressed as

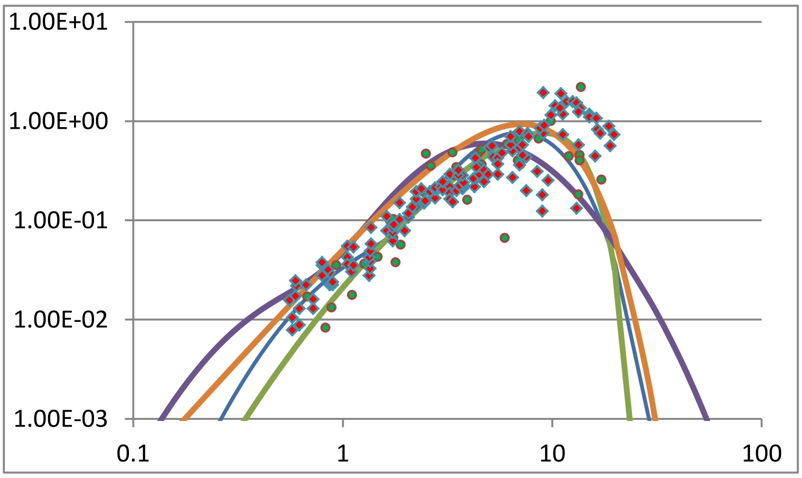
$$F(R_s) = \frac{1}{2} + \frac{1}{2} erf\left(\frac{\ln(R / \bar{R}_s)}{\sqrt{2}\ \ln(\sigma_s)}\right) \quad \text{and} \quad F(R_s) = 1 - \exp\left(-\frac{R}{R_u}\right)^k \tag{12}$$

we got that

$$\frac{dV_d}{d \ln D_d} = \frac{D_d}{c_v}\left[1 + \mathrm{erf}\left(\frac{\ln(D_d / \overline{D_s})}{\sqrt{2}\ \ln \sigma_s}\right)\right]\exp\left[-\left(\frac{D_d}{\lambda}\right)^3\right] \tag{13}$$

$$\frac{dV_d}{d \ln D_d} = R^{2-D_f}\frac{D_d}{c_v}\left[1 - \exp\left(-\frac{R}{R_u}\right)^k\right]\exp\left[-\left(\frac{R}{R_0}\right)^{D_f}\right], \tag{14}$$

Recently, some researchers (Zobeck et al., 2003; Hwang 2004; Zhao et al. 2008; Zhao et al. 2011; Zhap et al., 2012) have proved that the PSD of soils with silt contents ranging from about 0 to 82% followed [estimated value from Fig. 2 of Hwang et al. (2004)] a Weibull (1951) curve distribution.



In the above figure, green line is the curve of kok's distribution, the cure with orange color is a single Weibull distribution, and the blue line Weibull distribution with two modes. The purple line is Weibull distributions with different ratios between two modes which compare to the blue curve.