

Interactive comment on “The climate penalty for clean fossil fuel combustion” by W. Junkermann et al.

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The study shows that cleaning the SO₂ emissions actually increased the production rate of CCN, in contrast to the expected outcome. This is a very interesting and important observation that has implications to redistribution of precipitation and to the Earth energy budget as noted by the authors. I recommend publishing this paper in ACP after addressing the comments below.

Page 24568 line 26: Please provide additional background for the readers and explain what a flue gas is and why it would enhance the aerosol nucleation rate.

Page 24571 line 13: Aerosols scatter light starting from 100 nm. So please provide also the change in concentrations of aerosols of that size, and not only for 300 nm.

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Page 24571 line 16: The authors assume here that the nucleated aerosols can grow indefinitely at a rate of 8 nm h⁻¹. But this has obviously to be limited at some point by the sulfur availability. Please discuss the amounts of available sulfur and the extent that it might be a limiting factor in the size that the aerosols can eventually reach. How does this change in the various studied locations?

Page 24572 line 12: Same comment as for Page 24571 line 13.

Page 24574 line 3: Is the 12,000 km only for the highways or for all the automobile traffic in Germany?

Page 24578 line 9: The light rain that might be reduced is not necessarily steady. It can come also from shallow convective clouds, in which addition of CCN would prevent rain.

Page 24578 line 13: The authors discuss here the possibilities of redistribution of precipitation, having more dry conditions and floods. The reference of Rosenfeld et al. (2008) would be appropriate here. Also, CCN have been shown mostly to suppress or redistribute orographic precipitation. This has been shown by a number of observational and simulation studies.

Minor comments of technical nature:

Figure 4 panel B: Please explain the colors and expand the vertical scale.

Page 24569 line 19: A missing (for the reference.

Page 245709 lines 8-9: A missing () for the reference.

References:

Rosenfeld D., U. Lohmann, G.B. Raga, C.D. O'Dowd, M. Kulmala, S. Fuzzi, A. Reissell, M.O. Andreae, 2008: Flood or Drought: How Do Aerosols Affect Precipitation? *Science*, 321, 1309-1313.

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