

Interactive comment on “Fast sulfur dioxide measurements correlated with cloud concentration nuclei spectra in the marine boundary layer” by D. C. Thornton et al.

Anonymous Referee #1

Received and published: 14 July 2011

General comments:

Thornton et al. report simultaneous measurements of SO₂, CN and CCN concentrations from flights during the RICO field campaign. They investigated the relationship between SO₂ and CCN, in an effort to examine the role of SO₂ on cloud formation.

The paper addresses relevant scientific questions within the scope of ACP, and presents high quality and potentially useful data. However, the interpretation of the data and conclusions were hard to discern in the manuscript.

My impression is that it was difficult to learn much about the impact of SO₂ on cloud formation from these measurements. This makes the manuscript often confusing and

C6385

at times hard to read. Based on the correlation plots of CCN and SO₂ (Figure 8), I thought they were going to say that the two are related. But they end by saying that they don't understand the relationship, and more measurements and modeling are needed. What are the implications of Figure 8? This linear correlation is also mentioned in the abstract, but what does it tell us? The authors end by saying that more measurements and modeling are needed. Based on the experience of this project, specifically what kind of measurements and modeling are needed to examine this question? I am unsure what I am supposed to learn from this paper.

Specific comments:

Abstract: “Accumulation mode aerosols were a factor of two greater. . .” What was greater? Their number concentration?

1 Introduction: Replace “which were observed visually on occasions but more often than not” with “which were occasionally observed visually”.

3 Observations: Define “cold pool event”.

3.2 CN What is “CONCN”? Second to last paragraph: Refer to a figure here. Figure 3? Last paragraph: Elaborate on what makes this remarkable.

3.3 PCASP What is “CONCP”?

3.4 CCN Use the word “supersaturation” rather than “S”. The last sentence of the second paragraph doesn't make sense to me.

4 Discussion I don't consider SO₂ itself highly soluble ($H = 1.23 \text{ M atm}^{-1}$). Of course, its effective Henry's law constant will depend on cloud pH, which was apparently not measured. The apparent high solubility of SO₂ is likely due to rapid oxidation of SO₂ to sulfate in cloud droplets. Line 291: “SO₂ conversion to sulfate”. How? By SO₂ + OH? Line 297-298 is not a complete sentence. Insert “is” before “in”?