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Interactive comment on "Dry deposition fluxes and deposition velocities of seven trace metal species at five sites in Central Taiwan – a summary of surrogate surface measurements and a comparison with model estimation" *by* L. Zhang et al.

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We greatly appreciate all the comments which helped us to improve the paper. We have addressed all the comments carefully as detailed below.

We conducted t-tests for every pair of the sites and for every metal species using annual data of concentration, flux and deposition velocity to enhance the discussions related to Table 1. Site-differences in terms of significance were added in the revised

paper.

We also conducted t-tests for seasonal variations. P-values between the two seasons with the highest and the lowest seasonal means were generated and related discussions were added in the revised paper.

We added standard deviations in Figures 2, 4, S1 and S2 and used the information for discussing the variability in the revised paper.

We added p-values for regressions in Figures 3, 5 and S3 and used the information to enhance the discussion on correlation.

We addressed all specific and technical comments.

Regarding Section 3.3: The reviewer is right in that 'the flux was calculated with measured concentration', and yes, they should be related. However, we did not know how good flux and concentration should be related; in other words, how much percentage of the variations in fluxes should be explained by the variations in concentrations (the rest of the variations was from Vd). This section, by correlating the modeled fluxes and the measured concentrations, gave us a rough idea of the percentages of variations in fluxes that were expected to be explained by the variations in concentrations. Such information provided support to the hypothesis made in Section 2.5, that is, the weak or no correlation between measured flux and concentration was likely caused by uncertainties, not reflecting the realities.

Regarding the proposed 'universal' model: We added three paragraphs in Section 4 and changed this section from 'Conclusions' to 'Conclusions and Discussions'. We think that using limited field data to develop a 'universal' model would have too many limitations; such a model is likely not universally applicable. Instead, we proposed a different approach of developing such a model as described below.

The best approach of developing such empirical models would be to use one (or ensemble of) size resolved models to conduct a large set of sensitivity tests to identify key

parameters that need to be included in the empirical models. Key parameters likely include surface roughness length, leaf are index, friction velocity, surface-layer stability (Monin-Obukou length), etc. An additional land-use dependent empirical constant is also likely needed since the particle collection efficiencies by different landscapes are different. Typical land types should include 'broadleaf trees', needleleaf trees', 'agricultural/grass lands', bare soil, water, and urban. Residential areas (e.g., suburban) can be weighted from a combination of urban, trees and grasslands. Field flux data collected at various locations can then be used to validate the empirical models developed from the simplification of existing more sophisticated models.

It is also recommended that the empirical models should not be 'particle-species' dependant (to avoid developing too many models); instead, it should be for certain particle size ranges, e.g., PM2.5, PM2.5-10 and PM10+. Very small particle (e.g., 0.001 to 1.0 micro meter), although having large deposition velocities and high number concentrations, generally have low mass concentrations and thus are not important to the total dry deposition budget. If empirical models were developed for the three modes (PM2.5, PM2.5-10 and PM10+), dry deposition of any particle species can be simply estimated as long as its mass fraction in these size ranges are known or can be reasonably assumed (such as using the information reviewed in Section 3.1 of this study).

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 32847, 2011.