Aerosol impact on the stratiform cloud and light precipitation in mid-Korean peninsula

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Many observational and numerical studies have indicated that land cover and aerosol effect modify cloud property, precipitation, and further weather pattern over and downwind of urban region. Because these effects have occurred in the urban region together, it is important to understand each effect over and downwind of urban region. Eun *et al*. (2011) showed increasing trend of precipitation amount and frequency downwind of Seoul Metropolitan Area (SMA) from 1972 to 2007, for particularly light precipitation (less than 1 mm per day) and westerly condition only. It implies the possible influences of land cover change and aerosol on the precipitation in the downwind region of SMA. Based on observed results, we selected golden case (10 February 2009) to investigate the impact of aerosol on light precipitation using the Weather Research & Forecasting (WRFV3.2) model. The sensitivity run sets up 1,000 #/cm^3 for the initial number concentration of cloud condensation nuclei (CCN) at SMA, but the background uses 100 #/cm^3.

The results show that mean horizontal wind from surface to 850 hPa have easterly wind and approximately 5~6 m/s. Cloud thickness is about 500 m, and locates within 2 km. Also the results of cloud properties indicates that the enhanced CCN at SMA is associated with smaller effective radius (re; μm) and more cloud droplet number concentration (Nc; #/cm^3) over and downwind of urban region than control run. Especially after 3-hour, change of re and Nc was distributed much more widely downwind of urban region. On the other hand, precipitation amount appears to widely increase in the downstream region of SMA. In the near future, further sensitivity tests need to be conducted for combined effect of land cover and aerosol effect on the light precipitation.

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Reconciling seawater Mg/Ca reconstruction with foraminifera geochemistry

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Virtually all Paleogene seawater Mg/Ca (Mg/Ca_{sw}) proxy data suggests values 2-4 times lower than the present day. Despite this, the majority of studies utilising foraminifera Mg/Ca (Mg/Ca_{test}) as a palaeothermometer during this period have argued for ratios around twice as high as the proxy evidence suggests. This is because the use of lower Mg/Ca_{sw} values resulted in unrealistically high palaeotemperature estimates. It has now been shown that this inconsistency is the result of an incorrectly assumed linear relationship between Mg/Ca_{sw} and Mg/Ca_{test}, as detailed in Evans & Müller [2012].

In order to empirically show that this theory is applicable to foraminifera, we have produced the first combined Mg/Ca-temperature and Mg/Ca_{sw}-Mg/Ca_{test} calibrations for the same species, derived from both cultured and field-sampled *Operculina ammonoides*, a shallow-dwelling large benthic foraminifera. We apply these calibrations to Eocene samples from Java and the southern UK; *O. ammonoides* is the closest living relative of the abundant Paleogene *Nummulites*. We utilise laser-ablation ICPMS as a highly spatially resolved analytical technique capable of identifying newly precipitated calcite in cultured material (via a [Ba] spike), and less well-preserved areas of fossil calcite through the simultaneous analysis of proxy and diagenesis-identifying trace elements.

The consistency between our field and culture Mg/Ca-temperature calibration suggests secondary controls on Mg incorporation are less problematic for large benthic foraminifera in comparison to planktic species. Our Mg/Ca_{test}-Mg/Ca_{sw} calibration confirms the power relationship described by studies based on other foraminifera.

By placing reasonable constraints on palaeotemperature, our calibrations enable us to demonstrate for the first time that foraminifera-derived data imply Mg/Ca_{sw} in excellent agreement with other proxy evidence.

[1] Evans & Müller, 2012, *Paleoceanography*, **27**, PA4205.

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