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Holistic aerosol evaluation using synthesized aerosol aircraft measurements

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Despite ongoing efforts there are still large uncertainties in aerosol concentrations and loadings across many commonly used GCMs. This in turn leads to large uncertainties in the contributions of the direct and indirect aerosol forcing on climate. However, constraining these fields using earth observation data, although providing global coverage, is problematic for many reasons, including the large uncertainties in retrieving aerosol loadings. Additionally, the inability to retrieve aerosols in or around cloudy scenes leads to further sampling biases (Gryspeerdt 2015). Many in-situ studies have used regional datasets to attempt to evaluate the model uncertainties, but these are unable to provide an assessment of the models ability to represent aerosols properties on a global scale.

Within the Global Aerosol Synthesis and Science Project (GASSP) we have assembled the largest collection of quality controlled, in-situ aircraft observations ever synthesized to a consistent format. This provides a global set of in-situ measurements of Cloud Condensation Nuclei (CCN) and Black Carbon (BC), amongst others.

In particular, the large number of vertical profiles provided by this aircraft data allows us to investigate the vertical structure of aerosols across a wide range of regions and environments. These vertical distributions are particularly valuable when investigating the dominant processes above or below clouds where remote sensing data is not available. Here we present initial process-based assessments of the BC lifetimes and vertical distributions of CCN in the HadGEM-UKCA and ECHAM-HAM models using this data. We use point-by-point based comparisons to avoid the sampling issues associated with comparing spatio-temporal aggregations.