



# Chemical characterisation of water-soluble ions in atmospheric particulate matter on the east coast of Peninsular Malaysia

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**Abstract.** Air quality on the east coast of Peninsular Malaysia is influenced by local anthropogenic and biogenic emissions as well as marine air masses from the South China Sea and aged emissions transported from highly polluted East Asian regions during the winter monsoon season. An atmospheric observation tower has been constructed on this coastline at the Bachok Marine Research Station. Daily PM<sub>2.5</sub> samples were collected from the top of the observation tower over a 3-week period, and ion chromatography was used to make time-resolved measurements of major atmospheric ions present in aerosol. SO<sub>4</sub><sup>2-</sup> was found to be the most dominant ion present and on average made up 66% of the total ion content. Predictions of aerosol pH were made using the ISORROPIA II thermodynamic model, and it was estimated that the aerosol was highly acidic, with pH values ranging from -0.97 to 1.12. A clear difference in aerosol composition was found between continental air masses originating from industrialised regions of East Asia and marine air masses predominantly influenced by the South China Sea. For example, elevated SO<sub>4</sub><sup>2-</sup> concentrations and increased Cl<sup>-</sup> depletion were observed when continental air masses that had passed over highly industrialised regions of East Asia arrived at the measurement site. Correlation analyses of the ionic species and assessment of ratios between different

ions provided an insight into common sources and formation pathways of key atmospheric ions, such as SO<sub>4</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup> and C<sub>2</sub>O<sub>4</sub><sup>2-</sup>. To our knowledge, time-resolved measurements of water-soluble ions in PM<sub>2.5</sub> are virtually non-existent in rural locations on the east coast of Peninsular Malaysia. Overall this dataset contributes towards a better understanding of atmospheric composition in the Maritime Continent, a region of the tropics that is vulnerable to the effects of poor air quality, largely as a result of rapid industrialisation in East Asia.

## 1 Introduction

The tropical Maritime Continent, a region in Southeast Asia between 10° S–20° N and 90–150° E, is a complex distribution of islands and peninsulas and incorporates countries such as Malaysia, Indonesia, the Philippines and Papua New Guinea (Neale and Slingo, 2003). It lies within a tropical warm pool that extends eastwards from the Indian Ocean to the Western Pacific and is home to some of the warmest ocean temperatures in the world. Tropical regions such as the Maritime Continent are of central importance for the chemistry–climate system (Carpenter et al., 2010). For example, high photochemical activity in these regions means