Aerosol indirect effect of the 'wrong' sign

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Anthropogenic aerosols are estimated to have canceled a significant portion of the greenhouse gas warming over the last century. The largest contribution to this cooling comes from the aerosol indirect effect, by which anthropogenic aerosols cause clouds to reflect more solar radiation than otherwise. This is largely due to a general reduction in cloud droplet size, leading to a larger cloud albedo ('albedo effect') and a reduced release of precipitation ('lifetime effect'). We will present results from ongoing investigations, highlighting some aspects of the aerosol indirect effect that deviate from this traditional view.

In the polar regions, where insolation is weak and the clouds are thin, the aerosol indirect effect may be strongly influenced by changes in the trapping of thermal infrared radiation by the clouds [1]. Such effects are usually ignored in considerations of the aerosol indirect effect. Through a set of simulations with CAM-Oslo, taking into account observed properties of Arctic clouds, we seek to evaluate the potential significance of such a longwave indirect effect.

In another set of simulations, we focus on the ability of some aerosols to act as ice nuclei (IN). Recently developed parameterizations of the ice nucleating capabilities of mineral dust and black carbon are used [2], together with a new treatment of the Bergeron-Findeisen effect (B-F effect [3]). Adding ice nuclei to a cloud consisting of supercooled water droplets stimulates their freezing, and this, in turn, enhances the release of precipitation, due to rapid growth of the ice crystals via the B-F effect. Therefore, the cloud lifetime effect is reversed, tending to cancel the cloud albedo effect. Preliminary results from simulations with a new parameterization of biogenic aerosols (pollen and bacteria) as ice nuclei [4] will also be presented.

[1] Garrett & Zhao (2006) *Nature*, **440**, 787-789. [2] Storelvmo *et al.* (2008) *JAS*, **65**, 3214-3230. [3] Storelvmo *et al*. (2008) *ERL*, **3**, 045001. [4] Chen *et al.* (2008) *ACP*, **8**, 7431-7449.

Hf isotope composition of high heat producing felsic and mafic rock from Mount Painter, South Australia

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Mesoproterozoic felsic and mafic igneous rocks of the Mount Painter Province, South Australia contain high heat production values (average heat production values of 4.6 and 19.6 μWm^{-3} for mafic and felsic rocks respectively). In particular, microgranular enclaves and their host, the Yerila Granite, have average heat production values of 97 and 57 μWm^{-3} respectively. They are enriched in trace elements (e.g. U, Th, Rb, Zr, Nb, Y, Ce and REE and deleted Sr), and are classified as A2-type granites suggesting an anorogenic setting. The mafic-felsic bimodal magmatic activity occurred from 1620 to 1480 Ma.

Zircons from volcanic, granitic and mafic rocks, and microgranular enclaves were dated using LA-ICPMS and their Hf-isotope compostion measured using MC-ICPMS. The $^{176}Hf/^{177}Hf$ ratios calculated at their crystallisation ages vary between 0.28136 and 0.282161, and εHf_t values range between -12.9 and 12.8, with a weighted mean of 0.73. Sixty percent of εHf values are positive, the majority of these being from microgranular enclaves and mafic dykes, suggesting a juvenile source. However, negative εHf value are also found reflecting an old crustal component in their source. Zircons from this study are likely derived from the mixing of a juvenile source with an old crustal source.