Kuo, T.-H., M. Murakami, T. Tajiri, and N. Orikasa, 2019: Cloud condensation nuclei and immersion freezing abilities of Al_2O_3 and Fe_2O_3 particles measured with the Meteorological Research Institute's cloud simulation chamber. *J. Meteor. Soc. Japan*, **97**, 597-614.
https://doi.org/10.2151/jmsj.2019-032

Plain Language Summary: Surrogates of ambient aluminum oxide and iron oxide particles, which have been observed frequently and in high concentrations in the atmosphere and are thought to influence aerosol–cloud interactions, were investigated for their physico-chemical properties such as their size distribution and abilities to act as CCN and INPs, using the Meteorological Research Institute's (MRI) cloud simulation chamber and an array of aerosol instruments.

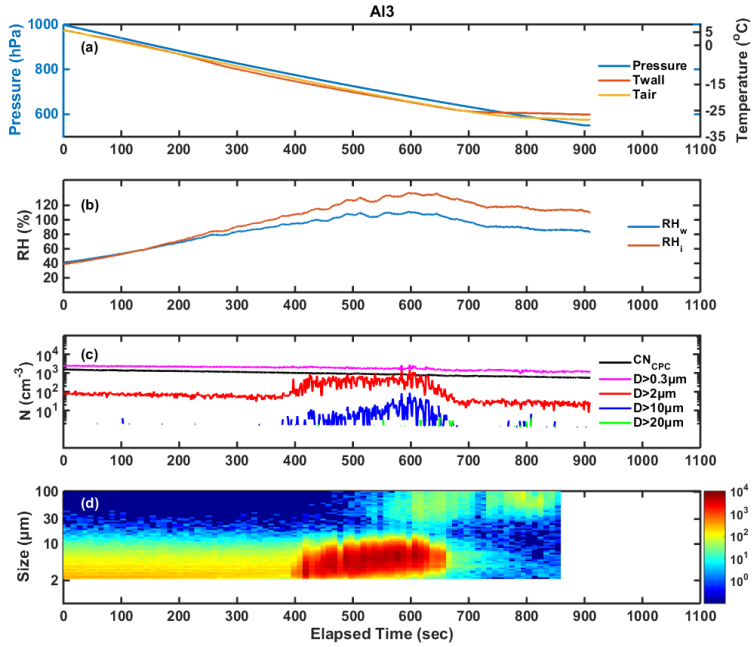

Figure 1. Time series of various parameters collected during the adiabatic expansion experiment using Al_2O_3 particles: (a) Air pressure (blue curve, hPa), wall temperature (brown curve, °C), and air temperature (yellow curve, °C); (b) Relative humidity with respect to water (blue curve, %) and ice (brown curve, %); (c) CN number concentrations (cm^{-3}) measured with the CPC (black curve) and number concentrations (cm^{-3}) of particles larger than 0.3 μm (magenta curve), larger than 2 μm (red curve), larger than 10 μm (blue curve), and larger than 20 μm (light green curve) measured with the CAS; and (d) Aerosol size distributions (color scale, d*N*/dlog*D*, cm^{-3}) measured with the Welas OPC.

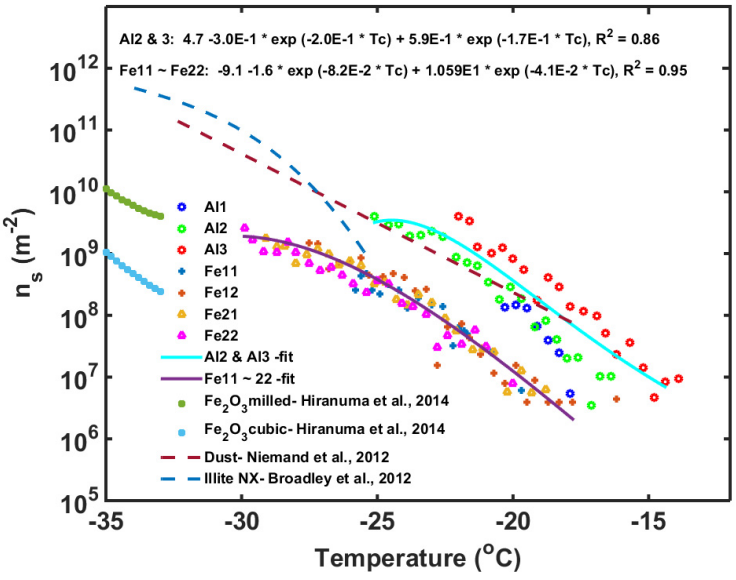

Figure 2. INAS densities of Al_2O_3 and Fe_2O_3 particles obtained from the MRI cloud chamber experiments. Reference INAS densities are included for immersion freezing nucleation of Fe_2O_3 (Hiranuma et al. 2014), dust (Niemand et al. 2012), and illite (Broadley et al. 2012).

- Hygroscopicity parameter (κ-value) of Al_2O_3 and Fe_2O_3 particles ranged from 0.01 to 0.03.
- In the cloud simulation chamber experiments, Al_2O_3 and Fe_2O_3 particles continuously nucleated ice crystals via immersion freezing at temperatures below −14°C and −20°C, respectively.
- INAS density of Al_2O_3 was 4×10^9 m^{-2} at −23°C and was one or more orders of magnitude greater than that of Fe_2O_3. INAS densities of both metal oxides were comparable to those of surrogates of mineral dust and other atmospheric INPs.
- Simultaneous CFDC-type INC measurements showed considerably smaller INAS densities for both metal oxides, suggesting that only a portion of the ice nucleation sites can be activated in the CFDC-type INC when their nucleation rate is low.