Desert Research Institute (DRI) cloud condensation nuclei (CCN) spectra

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The 14 PASE C-130 flights (eventually)
Preliminary data

The DRI CCN (Hudson 1989) data (ASCE) provides number concentrations per centimeter cubed normalized to surface pressure; i.e., these are mixing ratios. These are the concentrations of particles that would activate to cloud droplets at supersaturations (S) equal to or less than the value stated at the top of the column. Concentrations are thus cumulative with S. Concentrations then should always decrease (or possibly be identical) as S decreases. Concentrations within S intervals would be the difference between adjacent columns. The last column (lowest S) should include all particles with critical S (S_c) less than S. S_c is a property of each individual particle whereas S represents particle group properties. In any column the concentrations are for all particles with $S_c < S$. In actual fact there is a lower S limit due to the fact that the very lowest S_c particles cannot get into the sample inlet or into the instrument due to their large sizes. However, the concentrations of these unattainable particles is usually trivial compared to those that can be measured.

The particles are individually counted and sized by an optical particle counter (OPC), which measures the supermicrometer sized droplets that the submicrometer particles condense upon in the cloud chamber. The sample aerosol stream is exposed to a series of small increasing supersaturations within the cloud chamber. The sample volume is directly measured with a mass flowmeter and the entire sample volume is measured by the OPC. The measurements are integrated over time intervals of a few seconds with only about a tenth of a second of dead time between each measurement. The size of each individual pulse from each droplet is inversely related to the S_c of the particle upon which the droplet was formed. The electronic pulses from the near forward scattered light of each individual droplet are sorted into 128 voltage channels. A correspondence is made between the channel numbers and S_c by running calibration aerosols of known size and composition, which provides their S_c. Sodium chloride or ammonium sulfate are used for calibration. Calibrations with several different S_c values were done at least once during each flight.

Data are recorded with a time stamp in each row. Time differences between adjacent rows are approximately equal to the integrated time of each measurement. Data gaps are denoted by blank lines. Data gaps are caused by calibrations, cloud penetrations, or malfunctions. Cloud penetrations usually result in high artifact concentrations due to splashing of droplets in the inlet. We attempted to edit these from the data but may have occasionally failed to do so. Therefore, spikes in concentrations should be compared with cloud data to determine if they are splashing artifacts.

Local standard Christmas Island time is used because this is more relevant to aerosol data than universal time. Moreover, this avoids crossing midnight and thus having different dates on the same flights. None of the PASE flights went over local midnight. Christmas Island standard time is 14 hours ahead of GMT time.

There is several seconds of delay for this CCN data because it takes about 30 seconds for the sample to pass through the cloud chamber and another 5 or so seconds to pass through the inlet tubing. Thus the delay is 35 seconds give or take 5 seconds. This may vary by a few seconds during and among flights due to changes in flowrates and time drifts of the computer, which is separate from the aircraft data system.

Hudson, J.G., 1989: An instantaneous CCN spectrometer. *J. Atmos. & Ocean. Techn.,* **6,** 1055-1065.