Title: Preliminary Aerosol Data from HIWC 2022

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Data Set Description:

The aerosol data for 12 flights are provided as a preliminary data set. The data were basically acquired through the M300 data acquisition system, whose rate was basically 1 Hz with some exceptions: 1/3 Hz for OPC size spectra, 1/60 Hz for SMPS size spectra. The data of non-acceptable quality are also included in this data set, and such data should be excluded according to the information on data remarks.

The general measurement elements of each flight are included in the following file:
"Part3a_v2_YYMMDD.csv"
YYMMDD means the date of flight. If the M300 data file was interrupted during its acquisition, one alphabetical letter (a, b, …) was added in the last to the file name.

The size spectra of each flight from PCASP and OPC instruments are included in the following files:
"m300_PCASP_conc_cc_YYMMDD.csv", "m300_PCASP_conc_dlogD_YYMMDD.csv"
"m300_OPC_conc_cc_YYMMDD.csv", "m300_OPC_conc_dlogD_YYMMDD.csv"
The unit of size spectra is extracted in two ways: dN (#/scc) or dN/dlogD (#/sL).
The size spectra and house-keeping data from SMPS are included in the following file:
"m300_SMPS_all_YYMMDD.csv"

The OPC raw data of each flight are included in the following file:
"YYMMDDP7.TXT"
It is used for the data status in the Error column.

The CCNC raw data of each flight are included in the following file:
"MERGE_CCN-200_YYMMDD.csv"
It is used for the data analysis for Column-B, since only Column-A data were included in the M300 data. Every time the CCN operation was stopped during a flight, one alphabetical letter (a, b, …) was added in the last to the file name. The data on 220710 were missing due to disk error just before the flight.

The SMPS export data from TSI's Aerosol Instrument Manager (AIM) software are included in the following file:
"SMPS_*****_YYMMDD.txt"
If the SMPS raw data file was interrupted during its acquisition, one alphabetical letter (a, b, …) was added in the last to the file name.

Aerosol sample flow rate was fixed at 0.63(lpm). When exporting data to the file, two flags were selected: multiple charge correction and diffusion correction. Please see the instruction manual of the AIM software in detail.

Instrument Description:

- Passive Cavity Aerosol Spectrometer Probe (PCASP-100X with SPP-200 electronic package): PMS Inc., 0.1-3 μm, 30 size bins.
  max. particle size per channel (um): 0.1, 0.11, 0.12, 0.13, 0.14, 0.15, 0.16, 0.17, 0.18, 0.2, 0.22, 0.24, 0.26, 0.28, 0.3, 0.4, 0.5, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4, 2.6, 2.8, 3

- Scanning Mobility Particle Sizer (SMPS, model 3936L75): TSI Inc., ~0.01-0.4 μm, up scan 45 sec + retrace scan 15 sec.
  midpoint size per channel (nm): 10.6, 10.9, 11.3, 11.8, 12.2, 12.6, 13.1, 13.6, 14.1, 14.6, 15.1, 15.7, 16.3, 16.8, 17.5, 18.1, 18.8, 19.5, 20.2, 20.9, 21.7, 22.5, 23.3, 24.1, 25.0, 25.9, 26.9, 27.9, 28.9, 30.0, 31.1, 32.2, 33.4, 34.6, 35.9, 37.2, 38.5, 40.0, 41.4, 42.9, 44.5, 46.1, 47.8, 49.6, 51.4, 53.3, 55.2, 57.3, 59.4, 61.5, 63.8, 66.1, 68.5, 71.0, 73.7, 76.4, 79.1, 82.0, 85.1, 88.2, 91.4, 94.7, 98.2, 101.8, 105.5, 109.4, 113.4, 117.6, 121.9, 126.3, 131.0, 135.8, 140.7, 145.9, 151.2, 156.8, 162.5, 168.5, 174.7, 181.1, 187.7, 194.6, 201.7, 209.1, 216.7, 224.7, 232.9, 241.4, 250.3, 259.5, 269.0, 278.8, 289.0, 299.6, 310.6, 322.0, 333.8, 346.0, 358.7

- Optical Particle Counter (OPC, model KC-01E): RION Inc., 0.3-5 μm, 5 size bins.
  measured size range in each channel: $d \geq 0.3$um, $d \geq 0.5$um, $d \geq 1$um, $d \geq 2$um, $5 \leq d < 8$um

- CCN Counter (CCNC, model CCN-200): DMT Inc., SSw = 0.5% (fix) for Column-A, SSw = 0.1% (11min), 0.2% (4min), and 1.0% (5min) cyclically for Column-B. Details are found in Roberts and Nenes (2005). The Inlet Pressure Controller was installed to maintain a constant pressure in the CCNC.

Data Collection and Processing:

During the period of 5-Jul-2022 to 1-Aug-2022 the FAA/NASA/Nagoya-U HIWC-2022 flight campaign collected data during 12 flights over 12 different days. The NASA DC-8 aircraft was instrumented with a variety of aerosol measuring instruments that included the PCASP, SMPS, OPC, and CCNC. The data were basically acquired and recorded through the M300 DAS. The text data were extracted through the M300 DAS.

Data Format:

The csv data are in comma-delimited text format. Data elements and format in each csv file are listed according to the following ASCII output table configuration files (as M300 data style and format):

- "Part3a_22jul_v2.asc":
  DateTime, M300Time, Lat(deg), Lon(deg), GPSAlt(m), PresAlt(ft), RadarAlt(ft), TAS(m/s), Heading(deg), Pitch(deg), Roll(deg), SideSlip(deg), AmbTemp(C), DewPoint(C), StaticPres(hPa), DynamicPres(hPa), CabinPres(hPa), WindSpd(m/s), WindDir(deg), Theta(K), Thetae(K), MixingRatio(kg/kg), AbsoluteHumi(g/m3), RHw(%), RHi(%), P/1013*293/(T+273), Exhaust_Flow(slpm), Bypass_Flow(slpm),

Inlet_IKF, OPC_SampleFlow(slpm), OPC_TotalFlow(slpm), CCN_SampleFlow(ccpm), CCN_SheathFlow(ccpm), InletCntlPres(hPa), FlowRate_Imp#1[TEM](slpm), FlowRate_Imp#2[SW](slpm), FlowRate_MF(slpm), CCN_AbsPres(hPa), CCN_SampleTemp(C), SPP200_SampleFlow(scc/s), SPP200_SheathFlow(scc/s), Class_SheathFlow(lpm), Class_AbsPres(hPa), Class_SheathTemp(C), Class_ImpactFlow(lpm), SMPSTotConc(#/cc), PCASPTotConc(#/scc), OPCTotConc(#/scc), CCNTotConc(#/cc), CCNTotConc_c(#/cc), CCNTotConc_c2(#/scc), CDPTotConc(#/cc) , PIPTotConc(#/cc), IKP(g/m^3), NoseTWC(g/m^3), NoseLWC(g/m^3)

- "PCASP_conc_cc.asc":
  DateTime, M300Time, [PcaspMidSizes(um)](1), [PcaspMidSizes(um)](2), [PcaspMidSizes(um)](3), ……, [PcaspMidSizes(um)](29), [PcaspMidSizes(um)](30), [PCASP.Conc(#/scc)](1), [PCASP.Conc(#/scc)](2), [PCASP.Conc(#/scc)](3), ……, [PCASP.Conc(#/scc)](29), [PCASP.Conc(#/scc)](30)

- "PCASP_conc_dlogD.asc":
  DateTime, M300Time, [PcaspMidSizes(um)](1), [PcaspMidSizes(um)](2), [PcaspMidSizes(um)](3), ……, [PcaspMidSizes(um)](29), [PcaspMidSizes(um)](30), [PCASP.Conc(#/dlogD/sL)](1), [PCASP.Conc(#/dlogD/sL)](2), [PCASP.Conc(#/dlogD/sL)](3), ……, [PCASP.Conc(#/dlogD/sL)](29), [PCASP.Conc(#/dlogD/sL)](30), PcaspSmplFlowRate(scc/s), PcaspShthFlowRate(scc/s), InternalTemp(C), PcaspRange, LaserReference(v)

- "OPC_conc_cc.asc":
  DateTime, M300Time, [OpcMidSizes(um)](1), [OpcMidSizes(um)](2), [OpcMidSizes(um)](3), [OpcMidSizes(um)](4), [OpcMidSizes(um)](5), [OPC.Conc(#/scc)](1), [OPC.Conc(#/scc)](2), [OPC.Conc(#/scc)](3), [OPC.Conc(#/scc)](4), [OPC.Conc(#/scc)](5)

- "OPC_conc_dlogD.asc":
  DateTime, M300Time, [OpcMidSizes(um)](1), [OpcMidSizes(um)](2), [OpcMidSizes(um)](3), [OpcMidSizes(um)](4), [OpcMidSizes(um)](5), [OPC.Conc(#/dlogD/sL)](1), [OPC.Conc(#/dlogD/sL)](2), [OPC.Conc(#/dlogD/sL)](3), [OPC.Conc(#/dlogD/sL)](4), [OPC.Conc(#/dlogD/sL)](5), OpcDeltaP(hPa), OpcSmplFlowRate(slpm), OpcTotFlowRate(slpm)

- "SMPS_all.asc"
  DateTime, M300Time, ClassSize(nm), ClassDmaVolts(v), ClassSheathFlow(1pm), ClassBypassFlow(1pm), ClassAbsPress(hPa), ClassSheathTemp(C), ClassCabTemp(C), ClassImpactFlow(1pm), ClassElecMobil(cm^2/v), ClassVoltMode, ClassFlowMode, ClassSheathStat, ClassBypassStat, ClassHighVStat, ClassImpactDelP(cmH_2O), ClassDmaModel, ClassGasType, ClassImpactType, ClassActPartDia(nm), ClassAdjMinDia(nm), ClassAdjMaxDia(nm), ClassSizeDelayed(nm), ClassSizeDelta(nm), PreviousSize(nm), UpDnFlag, UpDnFlag2, DnScanStartFlag, SmpsScanState, StartVolts(v), EndVolts(v), ScanTime(sec), ResetTime(sec), ResetTimeNeg(sec), Exponent, TimeInc(sec), CommandVolts(v), CurrentScanTime(sec), ScaledVoltsOut(v), CpcCount(#), Cpc1secCount(#/sec), DisplayConc(#/cc), SMPSNumberConc(#/cc), TotalSMPSNumberConc(#/cc), [CPCArray2(#/L)](1), [CPCArray2(#/L)](2), [CPCArray2(#/L)](3), ……, [CPCArray2(#/L)](59), [CPCArray2(#/L)](60)

The time was provided as UTC from network data (NASA M300) and from MRI M300.
The M300 formula table file ("fml.300") is also provided since an equation of each element can be followed.

The OPC raw data (YYMMDDP7.TXT):
There is a 2-line header at the beginning of each file.
The title of each column is at the fourth line in the following order:
Date, Time, 0.3um (#), 0.5um (#), 1um (#), 2um (#), 5um (#), Alarm, Error
The columns in five size bins shows raw counts. The column of Alarm is blank.
Meaning of typical error messages:

HIGH CONCE : Sample air with high particle number concentration (> 100,000 particles/L) has been drawn into the unit.
FLOW ALERT : Flow rate is between -3 and -5% or +3 and +5% of rated value.
FLOW ERROR : Flow rate is different from rated value by more than ±5%.
NAK Err : Particle counter response problem.

The Time was provided as UTC from the instrument PC.

The CCNC raw data (MERGE_CCN-200_YYMMDD.csv):
The title of each column is at the first line in the following order:

Time, Current SS A (%), Temps Stabilized A, Delta T A (degC), T1 Set A (degC), T1 Read A (degC), T2 Set A (degC), T2 Read A (degC), T3 Set A (degC), T3 Read A (degC), Nafion Set A (degC), T Nafion A (degC), Inlet Set A (degC), T Inlet A (degC), OPC Set A (degC), T OPC A (degC), T Sample A (degC), Sample Flow A (ccpm), Sheath Flow A (ccpm), Sample Pressure A (hPa), Laser Current A (mA), Overflow A (counts/sec), Baseline Mon A (volts), 1st Stage Mon A (volts), Bin # A, Bin 1 A (counts/sec, the same unit up to Bin 20), Bin 2 A, Bin 3 A, Bin 4 A, Bin 5 A, Bin 6 A, Bin 7 A, Bin 8 A, Bin 9 A, Bin 10 A, Bin 11 A, Bin 12 A, Bin 13 A, Bin 14 A, Bin 15 A, Bin 16 A, Bin 17 A, Bin 18 A, Bin 19 A, Bin 20 A, CCN Number Conc A (#/cc), Valve Set A (volts), Current SS B, Temps Stabilized B, Delta T B, T1 Set B, T1 Read B, T2 Set B, T2 Read B, T3 Set B, T3 Read B, Nafion Set B, Nafion Read B, Inlet Set B, T Inlet B, OPC Set B, T OPC B, T Sample B, Sample Flow B, Sheath Flow B, Sample Pressure B, Laser Current B, Overflow B, Baseline Mon. B, 1st Stage Mon. B, Bin # B, Bin 1 B (count/sec), Bin 2 B, Bin 3 B, Bin 4 B, Bin 5 B, Bin 6 B, Bin 7 B, Bin 8 B, Bin 9 B, Bin 10 B, Bin 11 B, Bin 12 B, Bin 13 B, Bin 14 B, Bin 15 B, Bin 16 B, Bin 17 B, Bin 18 B, Bin 19 B, Bin 20 B, CCN Number Conc B, Valve Set B, Alarm Sum

The Time was provided as UTC from the instrument PC.

Data Remarks: This is preliminary data set. The number concentrations of particles from SMPS and CCNC should be corrected according to the method in the appendix. The data of non-acceptable quality (unusable) can be identified according to the note in the appendix.

References:

- Roberts, G. C., and A. Nenes, 2005: A continuous-flow streamwise thermal-gradient CCN chamber for atmospheric measurements. *Aerosol Sci. Technol.*, **39**, 206–221.
- TSI Inc., 2006: Aerosol Instrument Manager software for scanning mobility particle sizer (SMPS) spectrometer, *User's manual*, P/N 1930038, Rev. G.

Appendix:

The correction methods of SMPS sample flow rate and of CCNC water supersaturation (SSw) under low air pressure conditions are provided in the document "Correction_methods_SMPS&CCNC_v230522.docx".

The time periods of data of non-acceptable quality (unusable) are as follows.

All aerosol instruments (CCNC, SMPS, OPC, PCASP): the data are unusable during cloud penetrations (Whether or not DC-8 is flying through clouds can be determined from IKP, ICD, CDP, 2D-S, and PIP data)

CCNC: time periods when the data are usable are limited due to air leakage in water flow lines (see the lists in "HIWC2022_CCNC_UsableTimePeriod.xlsx").

SMPS: the data are unusable during the time periods of communication errors between the sensor and control PC and during the time periods of dry out of butanol in CPC (see the lists in "HIWC2022_SMPS_UnusableTimePeriod.xlsx").

OPC: the data are unusable during the time periods of communication errors between the sensor and control PC. “NAK Err” in the ninth column of YYMMDDP7.TXT indicates the occurrence of the response error.
PCASP: the data are unusable during ascent and descent except for Flight #10 (Underestimation/Overestimation of aerosol concentrations due to air-tight canister). The data are also unusable during EM interference due to aviation communication when PCASP concentrations shows unrealistically high concentrations. PCASP data greater than SMPS concentration 1 minute before cannot be used.
PCASP data that are several times greater than the number concentrations of the preceding and following time periods are not usable.

On request

For specified time periods, CCN, SMPS, OPC and PCASP data with QC will be available on request. Analysis results of aerosol samples collected by EM impactor, SW impactor and membrane filter will be available on request. Please consult with the PI for proper data use.