A13A-03: Relationship between Cloud Base Aerosols and Cloud Droplet Concentrations Derived from Three Years of Airborne Measurements in West Africa, David J Delene, University of North Dakota (delene@aero.und.edu; http://aerosol.atmos.und.edu)

Objective

To better understand precipitation formation, airborne measurements from recent field projects in Mali, West Africa are analyzed to determine if there are any relationships between below cloud base aerosol concentration and above cloud base droplet concentration and size.

2006/2007 Instrumentation



During 2006 and 2007, a Cheyenne II aircraft capable of carrying two During 2008, a King Air 200 aircraft was used for airborne 'PMS probes was used for airborne measurements. The 2-dimensional measurements that has two PMS cans mounted under each wing. The cloud imaging probe (2DC) and Passive Cavity Aerosol Spectrometer aircraft had an Aircraft-Integrated Meteorological Measurement Probe (PCASP) were swapped before flights depending on flight System (AIMMS), 2DC, PCASP, FSSP, Cloud Condensation Nuclei mission, while the Forward Scattering Spectrometer Probe (FSSP) Counter (CCNC), Liquid Water Content (LWC) probe, and a was carried on all flights.







Aircraft flight tracks in Mali. During 2006, a total of 22 flights (34 hours) were conducted between July 24 and August 30. During 2007, a total of 30 flights (82.5 hours) were conducted between July 20 and September 30. During 2008, a total of 9 📙 (GDAS1) data for near cloud base altitudes and PCASP flights (20.1 hours) were conducted between September 22 and October 8.

2008 Instrumentation

Temperature (Temp) probe.

Date	Below Cloud Aerosol (PCASP)			Above Cloud Droplet (FSSP)		
	Start Time	End Time	Conc.	Start Time	End Time	Conc.
[YY/MM/DD]	[HH/MM/SS]	[HH/MM/SS]	[#/cm ³]	[HH/MM/SS]	[HH/MM/SS]	[#/cm ³]
06/08/28	14:30:00	14:35:00	424	14:38:53	14:46:07	365
06/08/29	13:18:21	13:23:20	34	13:27:25	13:32:18	237
07/09/08	18:30:00	18:35:00	162	18:37:06	18:41:01	176
07/09/09	15:15:00	15:21:20	92	15:22:41	15:26:23	96
07/09/14	16:37:30	16:42:40	850	16:44:07	16:44:19	363
08/09/22	16:47:07	16:52:25	207	17:00:30	17:13:59	355
08/09/23	16:03:20	16:09:59	282	17:02:23	17:03:23	457
08/09/25	16:55:00	17:00:39	171	17:01:02	17:08:20	671
08/09/29	16:05:40	16:09:49	141	17:00:20	17:08:20	511
08/10/01	16:38:00	16:42:19	356	17:00:04	17:09:25	711

Mean aerosol concentrations between approximately 0.1 and 3.0 µm measured by a PCASP (500-1000 ft) below cloud base and corresponding cloud droplet mean concentrations between approximately 3.0 and 50 μ m measured by a FSSP (500-1000 ft) above cloud base obtained on aircraft flights in Mali. West Africa.

2006



2007

2008



Hysplit (http://www.arl.noaa.gov/ready) back-trajectories (48 hours) using the NCEP Global Data Assimilation System sampling times given in the above table.





Relationships between above (500-1000 ft) cloud base properties (filtered to include only >50 #/cm³ concentrations 1 Hz FSSP measurements) and below (500-1000 ft) cloud base aerosol concentration for ten aircraft flights in Mali (see table). The 5, 25, 50, 75, and 95 percentiles are given by the box-and-whiskers, while the stars denotes the mean values.

Conclusions

- Three years of airborne aerosol and cloud measurements have been conducted during the rainy season in Mali, West Africa.
- Ten below cloud base aerosol and above cloud base droplet measurement pairs have been found in the three year Mali data set.
 - With the exception of the "smoke" on September 14, 2007, aerosol concentrations to 3.0 µm) are in the range of approximately 100-400 #/cm³ for the ten cases analyzed.
- The cloud droplet concentrations are in the range of approximately 100-800 #/cm³ for the 10 cases analyzed.
- Back-trajectories show no preference for the origin of the below cloud base air mass for the 10 cases analyzed.
- No relationships are evident between the below cloud aerosol concentration and the above cloud droplet parameters of total number concentration, mean droplet diameter, standard deviation of the droplet radius and the relative dispersion (ratio of the droplet spectrum standard deviation to mean droplet radius).

Future Work

- Conduct analysis that uses the cloud nuclei measurements condensation conjunction with the PCASP and FSSP measurements.
- Determine how comparable the SPP200 version of the PCASP used in 2008 is to the standard (old) PCASP.
- Conduct similar analysis using North Dakota and Saudi Arabia data sets and compare results.
- Collect more airborne measurements in upcoming years.