AQRP Monthly Technical Report

PROJECT TITLE	Sources and Properties of Atmospheric Aerosol in Texas: DISCOVER-AQ Measurements and Validation	**PROJECT #**	14-005
PROJECT PARTICIPANTS	Sarah Brooks and Ping Yang	**DATE SUBMITTED**	5/8/2014
REPORTING PERIOD	**From:** April 1, 2015 **To:** April 30, 2015	**REPORT #**	Choose an item.

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task

Accomplishments for this month include processing of the CASPOL data and generation of optical signatures for each of the time periods identified in the previous month.

Preliminary Analysis

Data is available for a limited number of days in which satellite overpasses occurred during clear sky conditions in which the CASPOL was operation. The MODIS cases and Aqua MODIS cases found collected during overpasses in clear sky conditions are shown in Tables 1 and 2 below.

Table 1. CASPOL-MODIS on Terra Comparison

		Terra AOD		Characteristics derived from MODIS	
Date, 2013	CASPOL optical signature classification	50 km	100 km	absorptivity	size distribution
6-Sep	ship	0.262	0.382	medium	broad distribution
8-Sep	ocean	0.278	0.22	medium	broad distribution
13-Sep	urban	0.312	0.295	medium	broad distribution
22-Sep	ocean	0.098	0.042	week	peak between 0.3um and 1.5um
25-Sep	ocean	0.152	0.113	medium	peak between 0.3um and 1.5um
26-Sep	ocean	0.133	0.116	medium	broad distribution

Table 2. CASPOL-MODIS on Aqua Comparison.

Date, 2013	CASPOL optical signature classification	Aqua AOD		Characteristics derived from MODIS	
		50 km	100 km	Absorptivity	Particle Size Distribution
13-Sep	urban	0.312	0.295	medium	broad distribution
22-Sep	ocean	0.098	0.042	weak	peak between 0.3um and
25-Sep	ocean	0.152	0.113	medium	peak between 0.3um and
26-Sep	ocean	0.133	0.116	medium	broad distribution

Data Collected

In addition to CASPOL in-situ data, we will use the following:
-- 3-km AOD retrievals from the Terra and Aqua MODIS Collection 6 (See above.)

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

No problems were identified this month.

Goals and Anticipated Issues for the Succeeding Reporting Period

Evaluation of whether the optical signature results for each of the satellite overpass periods can be classified as Ship Channel, Urban, or Ocean/Transported aerosol. Evaluation of whether or not variations in CASPOL data (the best measurement of changes in surface level aerosol concentration and characteristics) are detected in the satellite measurements. In the cases of differences, we will look to other data for insight. In particular, the AERONET data may prove to be very useful in determine the type of surface aerosol conditions which can be observed from satellite and those which cannot.

Also, compare the MODIS-derived size distributions to the CASPOL measured size distributions.

Detailed Analysis of the Progress of the Task Order to Date

CASPOL-MODIS Comparisons

A number of studies have focused on the validations of MODIS AOD retrievals since the first-generation MODIS aerosol algorithm [*Chu et al.*, 2002; *Remer et al.*, 2005]. However, to the best of our knowledge, no study has validated MODIS AOD retrievals and aerosol type settings simultaneously. In our study, we compared the MODIS AOD and aerosol type assumptions to AERONET AOD and CASPOL aerosol typing in Houston urban area during the 2nd intensive DISCOVER-AQ campaign. The field campaign lasted from Sep. 5 to Oct. 1 in 2013 on the

Moody Tower located at 29.7176° N and 95.3414° W. The CASPOL was operated on the Moody Tower during that time.

In addition to comparisons with CASPOL, MODIS data will be compared to aerosol optical depth (AOD) measurements provided by AERONET (AErosol RObotic NETwork). In the Houston-Galveston area, AOD retrievals were available during the field campaign at two AERONET sites—Univ_of_Houston and UH_Coastal_Center, the locations of which are 29.7176° N and 95.3419° W and 29.7178° N and 95.0428° W, respectively. We therefore picked the AOD retrievals from the closest AERONET site, which is the Univ_of_Houston site on the Moody Tower. Then, we used AOD retrievals from this site to validate the 3-km AOD retrievals from the Terra and Aqua MODIS Collection 6 [*Levy et al.*, 2013], which is the latest version of the MODIS aerosol product. The Univ_of_Houston site AOD retrievals are available at 1640 nm, 1020 nm, 870 nm, 675 nm, 500 nm, 440 nm, 380nm, and 340 nm. We interpolated the AOD retrievals at 675 nm and 500 nm in a logarithmic manner to 550 nm, which is the wavelength of MODIS AOD retrievals.

In the Houston-Galveston area, urban aerosols, oceanic/transported aerosols, and aerosols from the Houston Ship Channel show distinct backscatter intensity and depolarization ratio features from the CASPOL measurements. The depolarization ratios of oceanic aerosol particles are significantly higher than urban and ship channel aerosol particles. The depolarization ratios of almost all the urban aerosol particles are below 0.1. Compared to the urban aerosols, a considerable portion of HSC aerosol particles show lower backscatter intensities but higher depolarization ratios [*Orcutt et al.*, 2015 in preparation]. Consequently, as long as enough aerosol particles have been sampled by CASPOL, the dominant type of this group of aerosols may be inferred from the CASPOL backscatter measurements. We therefore typed each group of aerosol particles based on their ensemble backscatter characteristic from the CASPOL measurements 4 hours before and after the satellite overpassing time. A large number of particles can be collected during the 8 hours, allowing for the generation of a reliable CASPOL optical signature plot.

In agreement with the previous study, *Orcutt et al.* [2015] show significantly lower OC-to-EC ratios of the Ship Channel aerosol cases than those of the urban aerosol cases, suggesting Ship Channel aerosols are more absorptive than urban aerosols as inferred by CASPOL. Additionally, oceanic aerosols are less absorptive than continental aerosols. As a result, among the three CASPOL inferred aerosol types, Ship Channel aerosols are strongly absorptive; urban aerosols are moderately absorptive; oceanic aerosols are weakly absorptive.

CASPOL-CALIPSO Comparisons
On this project, CASPOL data will also be compared to the CALIPSO remote sensing data, once the MODIS comparisons are finalized.

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