Tables

Simulated Lidar System Specifications	
Component/Parameter	Specification
Laser Power (1064, 532, 355 nm)	10W, 10W, 5W
Laser Repetition Rate	100 Hz
Telescope Diameter	1.5m
Telescope Field of View	130 micro radian
Channel Bandwidths (1064, 532, 355 nm)	30 pm, 30 pm, 20 pm
Total optical efficiencies (molecular, particle)	9.6%, 2.4%
Data Acquisition Technique	Analog
Orbital Altitudes Studied	450 km, 820 km

Table 1. Specifications of the spaceborne lidar system used in the simulation study.

	Yield from 450 km		
A bin is 450 m in the vertical and 80 km in the horizontal	Fraction of bins with extinction >= 0.02 km^{-1} @ 532 nm (i.e. ”qualifying” bin)	Fraction of “qualifying” bins measured with <= 15% uncertainty (3+2 inversions)	Fraction of “qualifying” bins measured with <= 15% uncertainty (3+1 inversions)
Below 3 km	36%	15%	36%
Below 4 km	31%	14%	35%
Below 5 km	27%	14%	35%

Table 2. Yield from an orbital altitude of 450 km. Information is given on what fraction of bins in the GEOS-5 simulations possess sufficient extinction for inversion and then what fraction of those bins are measured with the desired uncertainty.

Yield from 820 km			
A bin is 450 m in the vertical and 80 km in the horizontal	Fraction of bins with extinction >= 0.02 km^{-1} @ 532 nm (i.e. “qualifying” bin)	Fraction of “qualifying” bins measured with <= 15% uncertainty (3+2 inversions)	Fraction of “qualifying” bins measured with <= 15% uncertainty (3+1 inversions)
Below 3 km	36%	3.0%	15%
Below 4 km	31%	3.1%	15%
Below 5 km	27%	2.9%	14%

Table 3. Yield from an orbital altitude of 820 km. Information is given on what fraction of bins in the GEOS-5 simulations possess sufficient extinction for inversion and then what fraction of those bins are measured with the desired uncertainty.

	Comparisons Using GEOS-5 Optical Data for Inversions											
	FINE MODE ($\eta > 0.75$)				MIXTURE ($0.25 < \eta < 0.75$)				COARSE MODE ($\eta < 0.25$)			
	Reg 3b2a	Reg 3b1a 532	LE 3b2a	LE 3b1a 532	Reg 3b2a 532	Reg 3b1a 532	LE 3b2a	LE 3b1a 532	Reg 3b2a	Reg 3b1a 532	LE 3b2a	LE 3b1a 532
R_{eff}	23.2	51.1	26.7	66.1	13.0	22.0	41.4	22.9	54.0	65.1	69.2	68.5
V	12.4	16.7	21.5	31.9	14.5	14.1	41.6	36.1	54.5	67.8	71.4	72.0
S	21.4	39.8	30.1	53.5	11.5	14.4	12.4	19.2	5.7	16.2	9.9	12.7
m_r	0.02	0.02	0.03	0.03	0.13	0.13	0.08	0.08	0.08	0.15	0.09	0.10
m_i	9E-3	8E-3	9E-3	8E-3	2E-3	2E-3	5E-3	4E-3	3E-3	3E-3	4E-3	4E-3
# of data	3378				1851				2383			

Table 4: Comparison of GEOS-5 aerosol microphysical data and inversions of microphysical data using different sets of GEOS-5 optical data and both regularization and linear estimation inversion techniques. The values shown come from evaluation of the root-mean-square and fractional metrics that are defined in eqs. 1 and 2 in the text. In the column headings the type of retrieval scheme used is indicated (regularization or linear estimation) as well as the combination of optical input data. 3b2a means that the full 3ß+2α optical input data have been used, while 3b1a532 indicates that only 1 extinction value was used and it was at 532 nm.

	Comparisons Using Simulated Lidar Data for Inversions																			
	Case A: η > 0.75 (Fine Mode Predominance)																			
	Uncertainties 0-15 %				Uncertainties 15-20 %				Uncertainties 20-30 %				Uncertainties 30-40 %				Uncertainties 40-50 %			
	Reg 3b2a	Reg. 3b1a 532	LE 3b2a	LE 3b1 a532	Reg 3b2a	Reg. 3b1a 532	LE 3b2a	LE 3b1a 532	Reg 3b2a	Reg. 3b1a 532	LE 3b2a	LE 3b1a 532	Reg 3b2a	Reg. 3b1a 532	LE 3b2a	LE 3b1a 532	Reg 3b2a	Reg. 3b1a 532	LE 3b2a	LE 3b1a 532
R_{eff}	48.6	59.3	44.9	73.3	51.2	53.2	45.6	64.9	54.4	55.2	49.7	67.2	53.2	56.4	47.3	68.3	48.9	59.8	43.1	61.2
V	16.2	18.4	22.1	30.5	16.7	17.7	21.5	28.4	19.6	19.4	23.5	28.4	17.7	17.6	21.2	26.2	16.5	17.3	20.1	25.3
S	34.3	39.3	35.3	52.3	33.7	37.3	35.0	49.3	37.0	38.7	34.5	48.9	35.5	37.0	32.0	47.2	36.0	35.9	28.2	43.4
m_r	0.03	0.03	0.04	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.04	0.05	0.03
m_i	9E-3	8E-3	8E-3	8E-3	8E-3	8E-3	8E-3	7E-3	8E-3	8E-3	7E-3	7E-3	8E-3	8E-3	8E-3	8E-3	7E-3	7E-3	7E-3	7E-3
	Case B: 0.25 < η < 0.75 (Mixture)																			
	Uncertainties 0-15 %				Uncertainties 15-20 %				Uncertainties 20-30 %				Uncertainties 30-40 %				Uncertainties 40-50 %			
	Reg.	Reg. 3b1a 532	LE	LE 3b1 a532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532
R_{eff}	40.5	22.6	52.1	23.0	42.4	24.4	52.3	24.8	44.4	24.2	54.2	25.6	52.0	28.2	58.2	25.4	52.1	33.1	57.8	25.8
V	28.1	19.9	52.5	40.1	30.7	22.0	52.0	39.7	32.1	22.6	53.7	40.7	37.0	23.5	57.2	44.0	36.6	28.8	56.5	39.8
S	43.6	22.1	16.0	26.2	46.7	23.4	17.0	27.3	49.7	23.8	17.4	27.6	60.0	24.9	19.1	29.5	67.8	25.6	21.9	28.8
m_r	0.11	0.13	0.08	0.08	0.11	0.13	0.08	0.08	0.10	0.12	0.08	0.08	0.11	0.13	0.09	0.08	0.11	0.12	0.09	0.08
m_i	2E-3	2E-3	5E-3	4E-3	2E-3	2E-3	5E-3	4E-3	3E-3	2E-3	5E-3	4E-3	2E-3	2E-3	5E-3	4E-3	2E-3	2E-3	5E-3	4E-3
	Case C: η < 0.25 (Coarse Mode Predominance)																			
	Uncertainties 0-15 %				Uncertainties 15-20 %				Uncertainties 20-30 %				Uncertainties 30-40 %				Uncertainties 40-50 %			
	Reg.	Reg. 3b1a 532	LE	LE 3b1 a532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532	Reg.	Reg. 3b1a 532	LE	LE 3b1a 532
R_{eff}	58.2	65.6	70.0	68.4	59.2	65.8	70.2	68.1	55.9	64.8	70.3	69.2	55.3	65.1	70.8	70.2	49.1	67.6	70.9	72.1
V	60.7	68.3	71.7	71.8	61.2	67.2	71.5	71.2	57.6	67.5	71.3	72.5	56.7	69.3	72.5	74.7	50.9	72.1	71.1	77.5
S	14.7	21.8	14.4	17.8	14.9	20.2	14.0	16.3	15.2	21.1	14.9	17.7	12.5	21.3	13.1	19.0	12.0	22.1	11.5	20.5
m_r	0.14	0.15	0.11	0.11	0.14	0.15	0.11	0.11	0.15	0.15	0.11	0.11	0.15	0.15	0.11	0.12	0.12	0.23	0.12	0.22
m_i	4E-3	3E-3	3E-3	3E-3	4E-3	3E-3	4E-3	3E-3	4E-3	3E-3	4E-3	3E-3	5E-3	4E-3	4E-3	4E-3	5E-3	4E-3	4E-3	4E-3

Table 5: Comparison of microphysical inversions based on simulated lidar data. The values shown come from evaluation of the root-mean-square and fractional metrics that are defined in eqs. 1 and 2 in the text. Cases are separated into fine, mixture and coarse mode cases. Different retrieval schemes are tested as are varying amounts of random uncertainty in the input optical data.

Color coding scheme used in Tables 4 and 5			
	Green	Yellow	Red
Effective Radius	0-25%	25-40%	>40%
Volume Concentration	0-20%	20-35%	>35%
Surface Area Concentration	0-25%	25-40%	>40%
Real Part Refractive Index	0.01-0.02	0.03-0.05	>0.06
Imaginary Part Refractive Index	<0.002	0.003-0.009	>0.01

Table 6. Color coding scheme used for Tables 4 and 5. Green indicates values fully consistent with the desired uncertainties expressed in the ACE draft report, yellow indicates marginal consistency, while red indicates uncertainties inconsistent with desired uncertainties.