TSI Nephelometer instrument uncertainty with sub 10*um* scattering coefficient at 550nm (Bsp) for 1 min average time.

Table 1. Instrument noise, drift, and uncertainty factors.

Bsp	Noise	Drift	Calibration	Truncation	STP	Total
1	1.25	0.44	0.08	0.02	0.003	1.33
10	1.56	0.80	0.75	0.22	0.03	1.92
100	3.32	4.40	7.51	2.10	0.34	9.58

Results from Monte Carlo simulation of the error in the kappa and gamma fit parameters stemming from noise in the dry and wet nephelometers and %RH. The %RH range is 45% to 75%. The uncertainty in the nephelometer scattering coefficients is taken from Anderson and Ogren, 1998 and listed in the above table. The uncertainty in %RH was taken as 3% as given by the RH and T sensor manufacturer Vaisala. The mean and median fit values represent the degree of skewness or nonorthogonality of the scatter about the fit line. The fit parameter error is the standard deviation of the residuals about the fit line.

Table 2.0 Mean, median, standard deviation and % error from Monte Carlo simulations

	mean	median	stdev	% kappa
kappa 0.05				
σsp=1	0.092	0.089	0.054	108.64
σsp=10	0.051	0.051	0.005	9.72
σsp=100	0.050	0.050	0.001	2.50
kappa 0.2				
σsp=1	0.250	0.245	0.066	33.12
σsp=10	0.200	0.200	0.007	3.29
σsp=100	0.199	0.199	0.003	1.65
kappa 0.4				
σsp=1	0.456	0.453	0.118	29.47
σsp=10	0.399	0.400	0.009	2.36
σsp=100	0.398	0.398	0.006	1.55
gamma 0.2	mean	median	std dev	% gamma
σsp=1	0.217	0.196	0.315	157.61
σsp=10	0.196	0.196	0.033	16.30
σsp=100	0.197	0.197	0.008	3.78
gamma=0.5				
σsp=1	0.488	0.467	0.319	63.90
σsp=10	0.501	0.501	0.031	6.17
σsp=100	0.500	0.500	0.008	1.51
gamma=0.8				
σsp=1	0.797	0.779	0.298	37.29
σsp=10	0.798	0.798	0.030	3.70
σsp=100	0.800	0.801	0.011	1.39

Calculation of uncertainty in the humidified scattering coefficient from root mean square of the sum of the individual errors in the kappa and gamma equations.

Kappa equation

$$\sigma_w(\mathrm{RH}_w) = \sigma_d(\mathrm{RH}_d)[b + \kappa_{sca}(\frac{\mathrm{RH}_w}{100-\mathrm{RH}_w})]$$ (set b=1 for uncertainty calculation)

$$\frac{\delta\sigma_w}{\sigma_w} = \sqrt{\left(\left(\left(\frac{k \cdot RH}{100-RH}\right)+1\right)\cdot \delta\sigma\, dry\right)^2 + \left(\left(\frac{100 \cdot \sigma\, dry \cdot k}{(100-RH)^2}\right)\cdot \delta\, RH\right)^2 + \left(\left(\frac{\sigma\, dry \cdot RH}{100-RH}\right)\cdot \delta\, k\right)^2}$$

Table 3. Partial derivative values for kappa equation uncertainty at RH=85%

kappa	k=0.4			k=0.2			k=0.05		
σ(dry)	100	10	1	100	10	1	100	10	1
δσ(dry)	31.29	6.27	4.34	20.44	4.10	2.84	12.29	2.46	1.71
δkappa	5.67	0.57	0.68	5.67	0.57	0.68	5.67	0.57	0.68
δRH	53.33	5.33	0.53	26.67	2.67	0.27	6.67	0.67	0.07
total	62.10	8.25	4.43	34.07	4.92	2.93	15.09	2.61	1.84

Gamma Equation

$$\sigma_w(RH_w) = \sigma_d(RH_d)\left[\frac{(1-\frac{RH_w}{100})}{(1-\frac{RH_o}{100})}\right]^{-\gamma}$$

$$\frac{\delta\sigma_w}{\sigma_w} = \sqrt{\left(\left(\left(\frac{1-\frac{RH_w}{100}}{1-\frac{RH_d}{100}}\right)^{-\gamma}\right)\cdot \delta\sigma\, dry\right)^2 + \left(\left(\frac{-1}{100}\cdot \sigma\, dry \cdot \gamma \cdot \left(\left(\frac{1-\frac{RH_w}{100}}{1-\frac{RH_d}{100}}\right)^{-\gamma}\right)(1-\frac{RH_d}{100})^{-1}\cdot \delta\, RH\right)^2 + \left(-\sigma\, dry \cdot \left(\left(\frac{1-\frac{RH_w}{100}}{1-\frac{RH_d}{100}}\right)^{-\gamma}\right)\cdot \ln\left(\left(\frac{1-\frac{RH_w}{100}}{1-\frac{RH_d}{100}}\right)\right)\cdot \delta\gamma\right)^2}$$

Table 4. Partial derivative values for gamma equation uncertainty at RH=85%

gamma	g=0.8			g=0.5			g=0.2		
σ(dry)	100	10	1	100	10	1	100	10	1
δσ(dry)	29.04	5.82	4.03	19.16	3.84	2.66	12.64	2.53	1.75
δgamma	4.62	1.26	1.26	2.86	1.11	1.14	1.62	0.67	0.64
δRH	48.5	4.85	0.49	20.0	2.0	0.2	13.2	1.32	0.13
total	56.7	7.7	4.3	27.8	4.5	2.9	18.3	2.9	1.9