MODELING OF SCATTERING ENHANCEMENT FACTOR FROM GROUND-BASED INSTRUMENTS IN CHIBA, JAPAN

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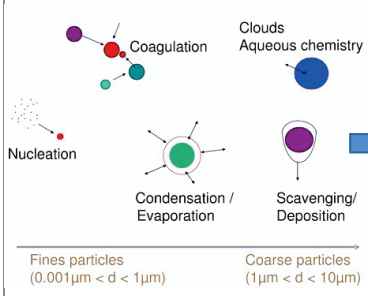
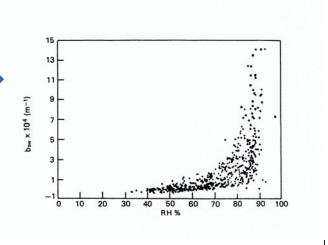
Aerosol growth: Optical properties vs RH



http://cerea.enpc.fr/en/mphase.html

Effect of relative humidity on the scattering of visible light by liquid sulfate aerosols, as measured by extinction coefficient (Malm, 1992)



http://www.spc.noaa.gov/publications/corfidi/haze.html

Outline

- Objective
- Theory
- Instruments
- Methodology
- Result
- Conclusion

Aerosol growth: Optical properties vs RH

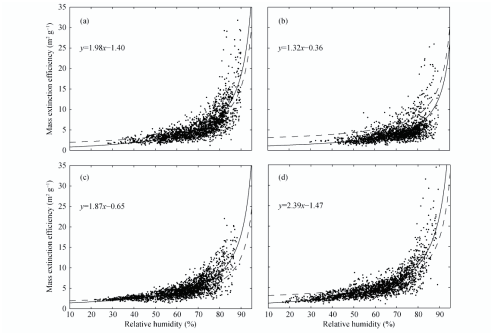


Figure 2 . MEE as a function of RH in (a) spring, (b) summer, (c) autumn, and (d) winter in Hong Kong. The scattered points are for Hong Kong. The solid lines are fitted functions as shown in the figures. The dashed lines are for Beijing (as in Fig. 1).

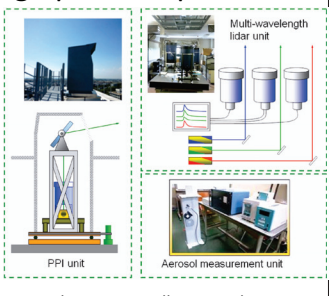
Li Cheng-Cai, He Xiu, Deng Zhao-Ze, Alexis Kai-Hon Lau & Li Ying (2013) Dependence of Mixed Aerosol Light Scattering Extinction on Relative Humidity in Beijing and Hong Kong, Atmospheric and Oceanic Science Letters, 6:2, 117-121

Objective

- to model annual trend of *f*(*RH*) in Chiba for the purpose of investigating optical response of aerosols with *RH*

Motivation

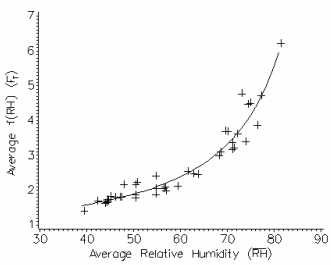
- To **use** the ground instruments (nephelometer, aethalometer, optical particle counter, weather monitor) to **calibrate** multiwavelength lidar data.



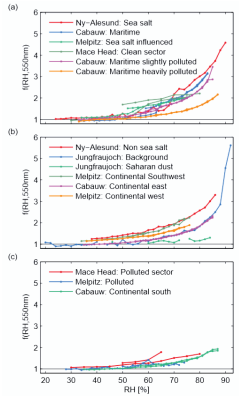
Atmospheric Data Collection Lidar (ADCL), (Kuze, 2012)

Scattering enhancement factor:

$$f(RH,\lambda) = \frac{\sigma(RH,\lambda)}{\sigma(RH_{dry},\lambda)}$$



http://vista.cira.colostate.edu/improve/tools/reconbext/reconbext.htm



Zieger, P., et. al.(2013): Effects of relative humidity on aerosol light scattering: results from different European sites.

Location

CHIBA UNIVERSITY AND JMA STATION

CHIBA UNIVERSITY

Methodology

Visibility measurements from JMA → **Extinction coefficients** for visibility <20km

Extract absorption coefficient @ 550nm from aethalometer data → **SUBTRACT**

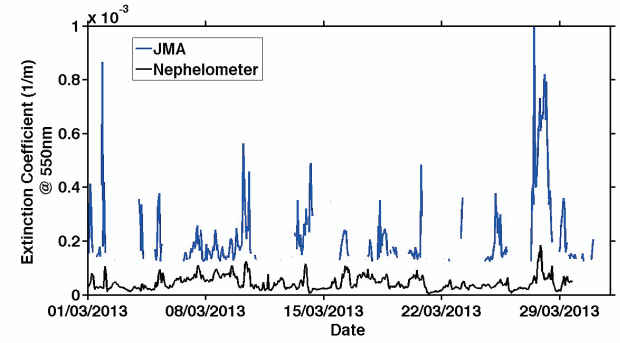
Use monthly average dry RH(<35%) scattering coefficient from nephelometer as **reference** scattering coefficient

f(RH) @ 532nm

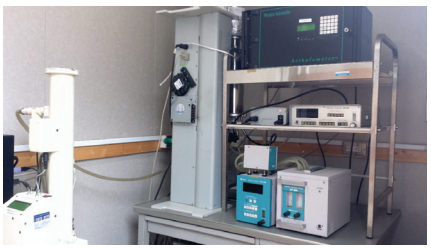
Instruments

- Visibility meter
  - Located ~3km from CEReS.
- Nephelometer
  - TSI 3563; wavelengths: 450, 550 and 700nm
- Aethalometer
  - Magee AE31; wavelengths: 370, 470, 520, 590, 660, 880 and 950nm
- Optical Particle Counters (OPC)
  - Rion KC-22B and KC-01D
- Weather monitor (WM)
  - Pressure, Wind direction, Wind speed, RH, Temperature, Rain rate

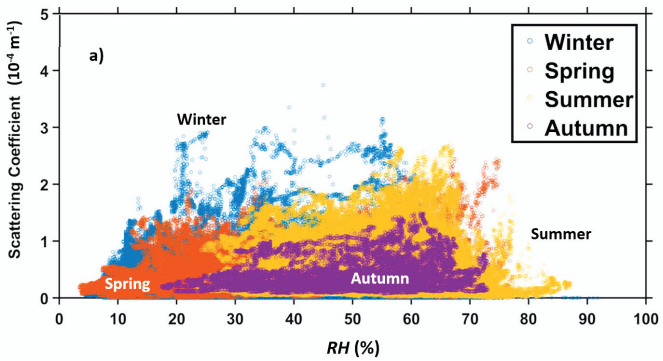
Extinction coefficients (JMA vs nephelometer)



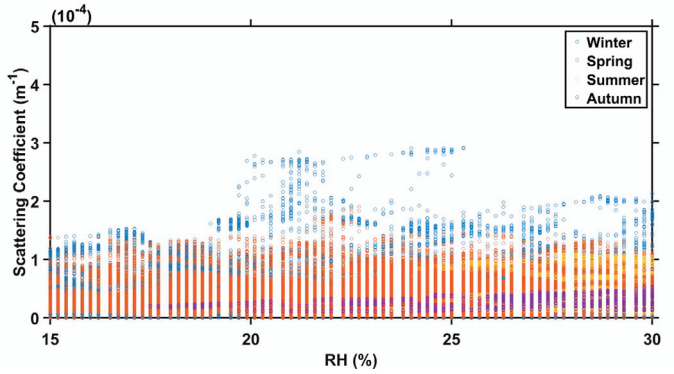
Ground Instruments



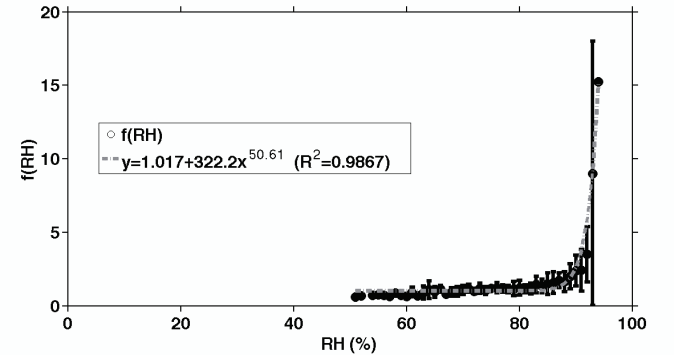
Nephelometer-based Scattering Coefficients



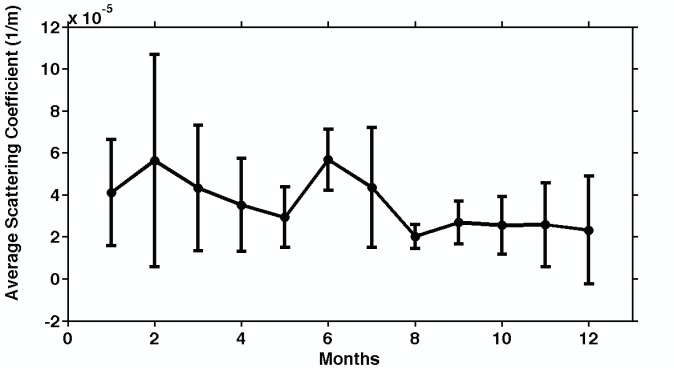
Nephelometer-based Scattering Coefficients



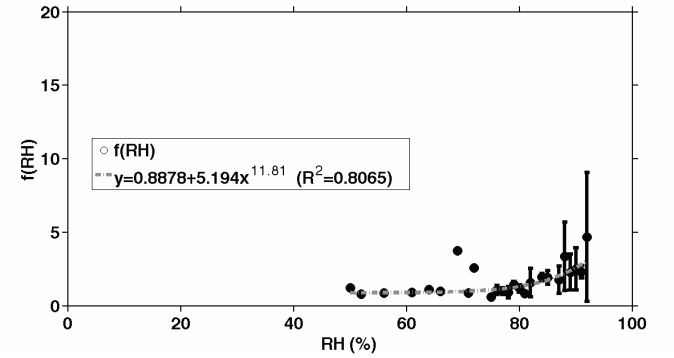
f(RH) for July 2014



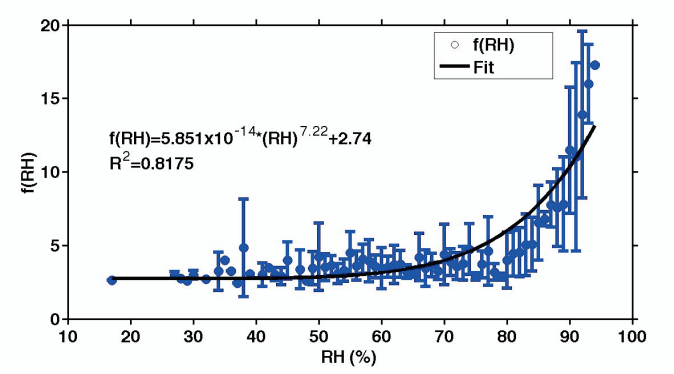
Average Scattering Coefficients (15%<RH<30%) @ 550nm



f(RH) for September 2014

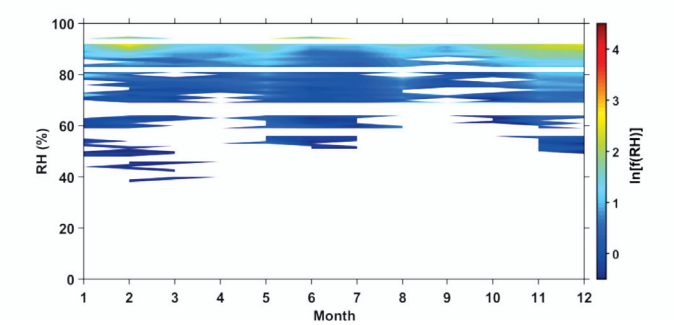


March 2013 f(RH)



	Fitting parameters			
Months	*a*	*b*	*c*	R^2
Jan	14.02	15.12	0.8755	0.91
Feb	55.14	20.16	0.9114	0.94
Mar	8.969	12.11	0.7063	0.92
Apr	6.205	10.11	0.8968	0.91
May	17.77	16.05	1.532	0.94
Jun	19.53	23.58	0.9089	0.93
Jul	322.2	50.61	1.017	0.99
Aug	263.6	49.59	2.156	0.94
Sep	5.194	11.81	0.8879	0.81
Oct	26.23	17.07	0.6793	0.92
Nov	26.17	13.44	1.306	0.96
Dec	22.47	11.92	1.053	0.95

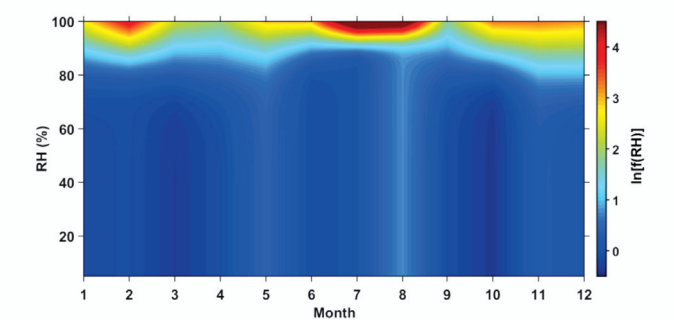
Measured f(RH) 2014



Acknowledgement

- This work was carried out by the joint research program of CEReS, Chiba University (2014-2015)

Modeled f(RH) 2014



Conclusions

- Modeling of *f*(*RH*) values **illustrates and gives insights** on the monthly variation of aerosol optical response to changing *RH* in the year 2014
- The modeled varations are consistent with previously observed measurements
- Monthly trends of modeled *f*(*RH*) can elucidate information on scattering coefficients when used to calibrate lidar-derived optical properties