

Contents

1	Introduction	1
1.1	Atmospheric aerosols	1
1.2	Secondary organic aerosol	2
1.3	Aerosol climate interactions	4
1.4	Focus of this work	4
2	Theory	7
2.1	Hygroscopicity of aerosol particles	7
2.2	Koehler theory	8
2.2.1	General application	8
2.2.2	Parametrization of the Koehler theory	9
2.3	UNIFAC model	14
3	Experimental Set-up	17
3.1	Particle size selection and size measurement	17
3.2	HTDMA	18
3.2.1	Set-up	18
3.2.2	Calibration	19
3.2.3	Measurement errors	19
3.3	CCN-Counter	20
3.3.1	Working principle	20
3.3.2	Set-up	21
3.3.3	Calibration	23
3.3.4	Correction for multiple charged particles	25
3.3.5	Measurement errors	27
3.4	Measurements of the chemical compositions of aerosol particles . .	28
3.4.1	HR-Tof-AMS	28
3.4.2	APCI-MS	28
3.5	Chambers	29
3.5.1	The SAPHIR-chamber	29
3.5.2	The Juelich Plant Atmosphere Chamber	32
4	Results	35
4.1	CCN-C data	35
4.1.1	SAPHIR data	35
4.1.2	JPAC data	37
4.2	HTDMA data	39
4.2.1	SAPHIR data	39

4.2.2	JPAC data	45
4.2.3	Measurement errors	50
5	Discussion	53
5.1	Closure between the sub- and super-saturated regime	53
5.1.1	Comparing CCN-C and HTDMA data	53
5.1.2	Solute entities in solution	56
5.1.3	Surface tension of the solution	56
5.1.4	Deducing M_s from κ	57
5.2	UNIFAC model calculations	58
5.2.1	a_w dependence of κ and ϕ	58
5.2.2	UNIFAC calculations with surrogates for SOA compounds	59
5.2.3	Fitting the measurement data	62
5.2.4	Prediction of CCN activation	66
5.3	Influence of the experiment conditions on the properties of the formed SOA	69
5.3.1	Oxidant to VOC ratio	70
5.3.2	Chemical composition of the gas-phase precursors	73
5.4	Aging of SOA	73
5.4.1	Discussion of the general trends in the BMT experiments .	73
5.4.2	Implications of the α -pinene experiments	76
5.5	Transfer to JPAC data	77
5.5.1	Influence of the oxidation pathway	77
5.5.2	Chemical composition	79
6	Summary and Conclusions	81
A	Recorded CCN-C and HTDMA data	91
A.1	CCN-C data	91
A.1.1	BMT- and α -pinene experiments in SAPHIR	92
A.1.2	JPAC experiments	98
A.2	Hygroscopic growth data	107
A.2.1	BMT- and α -pinene experiments in SAPHIR	107
A.2.2	JPAC experiments	115
A.3	$\phi(a_w)$ curves from HTDMA measurements	124
A.4	Primary OH production	129
B	Acknowledgments	131
C	List of Publications	133
D	Erklärung	135