Supplement of Atmos. Chem. Phys., 16, 9321–9348, 2016
http://www.atmos-chem-phys.net/16/9321/2016/
doi:10.5194/acp-16-9321-2016-supplement

Atmospheric Chemistry and Physics Open Access EGU

Supplement of

Multiple new-particle growth pathways observed at the US DOE Southern Great Plains field site

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Supplementary Information

S1 Growth Rate Methods

Three methods were employed for determining a range of possible growth rates from the SMPS data. The first method, referred to here as the leading-edge method, is adapted from Lehtipalo et al. (2014) and finds the time at which the binned aerosol distribution between 10-20 nm reaches one-half of its maximum concentration for each bin. A linear fit between the bins' median diameter and the associated times determines the growth rate. The second method, referred to here as the D_p-mode method, tracks the change in diameter of the maximum concentration of the aerosol size distribution between 10-20 nm; a linear fit between peak diameters and the associated times determines the growth rate. When plotted against the size distribution (Figures S1-S3), it is seen that the leading-edge and D_p-mode methods do not tend to track the growing size distribution for every days. For this reason, we have included a third method, which we call the visual method, in which we have made a linear growth-rate estimate between 10-20 nm for each day based upon visual inspection of the size distribution.

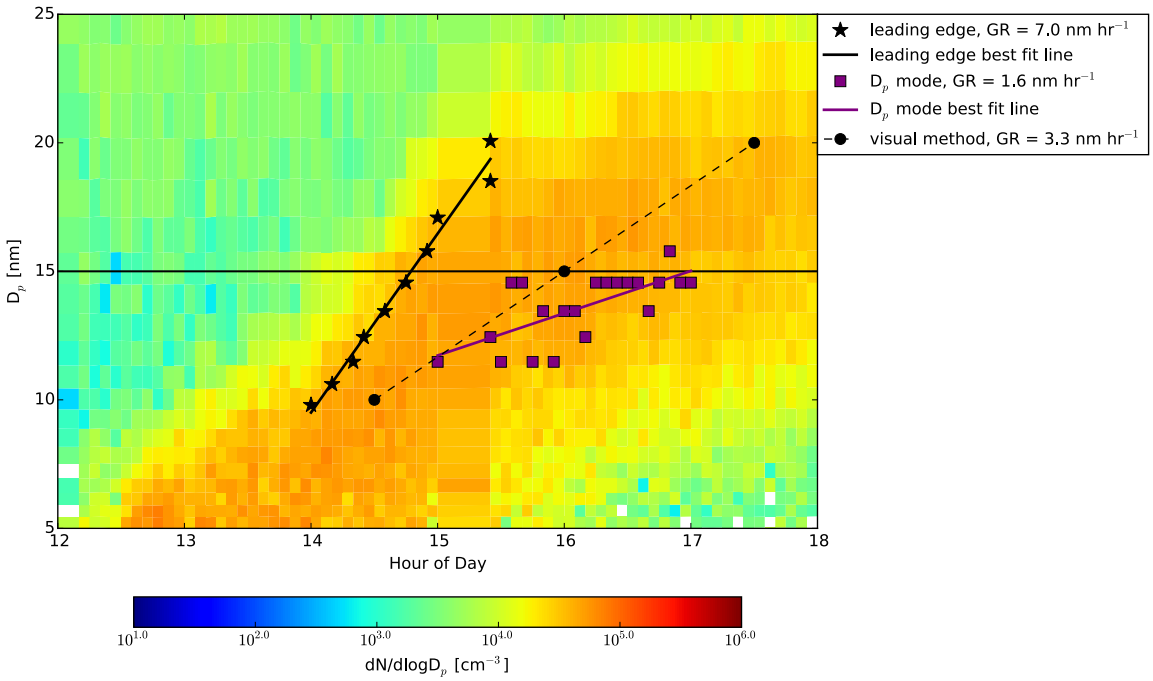

Figure S1. The results of the three growth rate calculations for April 19, 2013. The x-axis represents CDT time. The line at 15 nm D_p is to guide the eye.

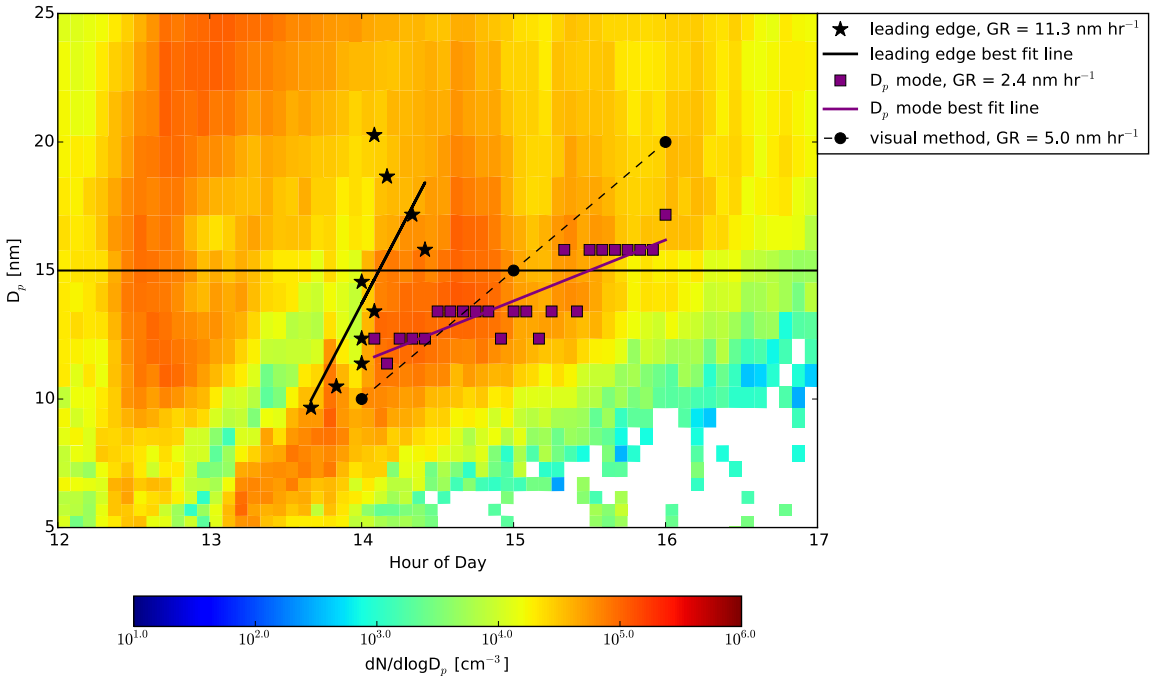

Figure S2. The results of the three growth rate calculations for May 9, 2013. The x-axis represents CDT time. The line at 15 nm D_p is to guide the eye.

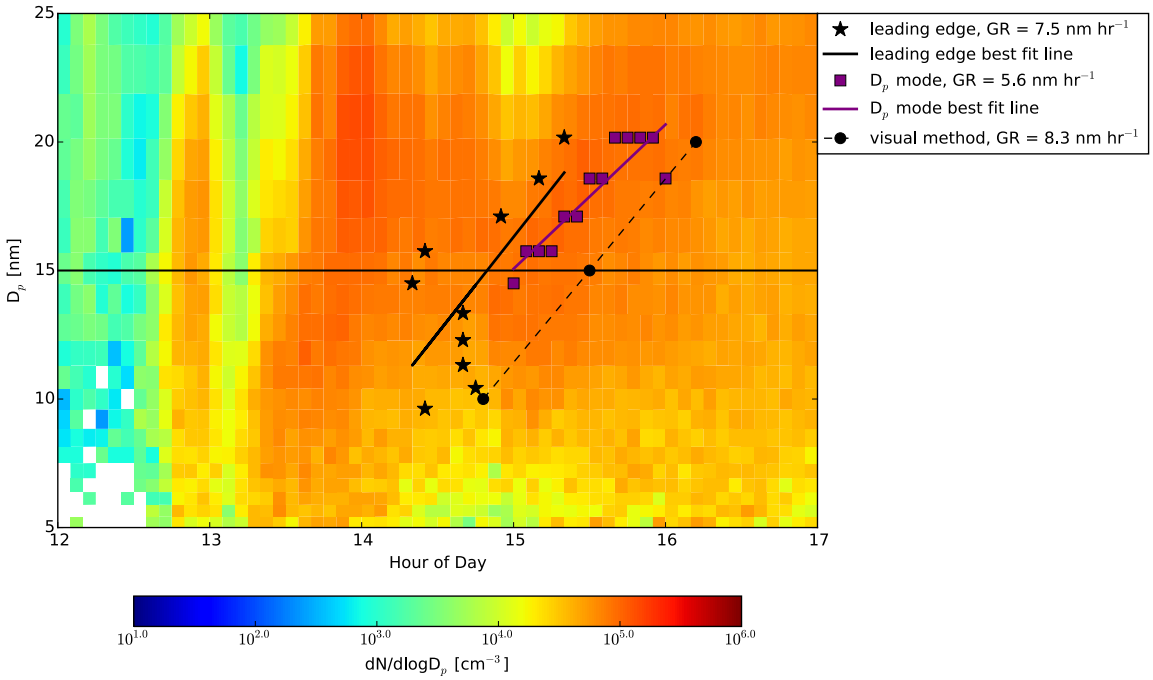

Figure S3. The results of the three growth rate calculations for May 11, 2013. The x-axis represents CDT time. The line at 15 nm D_p is to guide the eye.

S2 MABNAG-predicted Ion Dissociations

Table S1. Breakdown of the percent dissociations of H_2SO_4 to HSO_4^{-1} to HSO_4^{-1} and SO_4^{-2} ; the organic acid (malonic or oxalic) to its first and second dissociation products; NH_3 to NH_4^+; and the amine (DMA or TMA) to its dissociation product for the model output of April 19, 2013. In MABNAG, sulfuric acid is assumed to dissociate completely.

Case	HSO_4^{-1}	SO_4^{-2}	Org. Acid	Org. $Acid^{-1}$	Org. $Acid^{-2}$	NH_3	NH_4^+	Amine	$Amine^+$
MAL/1ox/DMA_L	0.01	0.99	0.49	0.029	0.48	8.6E-09	1	3.1E-10	1
MAL/10ox/DMA_L	**0.01**	**0.99**	**0.49**	**0.029**	**0.48**	**8.6E-09**	**1**	**3.1E-10**	**1**
MAL/100ox/DMA_L	0.011	0.99	0.5	0.028	0.47	8.3E-09	1	3E-10	1
MAL/1ox/TMA_L	0.018	0.98	0.64	0.027	0.33	6.3E-09	1	2.3E-09	1
MAL/10ox/TMA_L	0.018	0.98	0.64	0.027	0.33	6.3E-09	1	2.3E-09	1
MAL/100ox/TMA_L	0.018	0.98	0.64	0.027	0.33	6.2E-09	1	2.3E-09	1
MAL/1ox/TMA_T	0.013	0.99	0.55	0.028	0.42	7.6E-09	1	2.8E-09	1
MAL/10ox/TMA_T	0.013	0.99	0.55	0.028	0.42	7.6E-09	1	2.8E-09	1
MAL/100ox/TMA_T	0.013	0.99	0.56	0.028	0.41	7.4E-09	1	2.7E-09	1
OX/1ox/DMA_L	0.016	0.98	0.071	0.1	0.83	4.2E-09	1	1.5E-10	1
OX/10ox/DMA_L	0.01	0.99	0.028	0.066	0.91	8.6E-09	1	3.2E-10	1
OX/100ox/DMA_L	0.01	0.99	0.028	0.066	0.91	8.5E-09	1	3.1E-10	1
OX/1ox/TMA_L	0.024	0.98	0.1	0.11	0.78	3.6E-09	1	1.4E-09	1
OX/10ox/TMA_L	0.025	0.97	0.11	0.12	0.77	3.1E-09	1	1.3E-09	1
OX/100ox/TMA_L	0.018	0.98	0.05	0.086	0.86	6.3E-09	1	2.3E-09	1
OX/1ox/TMA_T	0.019	0.98	0.085	0.11	0.81	3.9E-09	1	1.5E-09	1
OX/10ox/TMA_T	0.013	0.99	0.035	0.074	0.89	7.6E-09	1	2.8E-09	1
OX/100ox/TMA_T	0.013	0.99	0.035	0.074	0.89	7.5E-09	1	2.8E-09	1
MAL_LoVP/1ox/DMA_L	0.011	0.99	0.5	0.028	0.47	8.3E-09	1	3E-10	1
MAL_LoVP/10ox/DMA_L	0.011	0.99	0.51	0.028	0.46	8.1E-09	1	2.9E-10	1
MAL_LoVP/100ox/DMA_L	0.011	0.99	0.56	0.028	0.41	6.9E-09	1	2.3E-10	1
MAL_LoVP/1ox/TMA_L	0.018	0.98	0.64	0.027	0.33	6.2E-09	1	2.3E-09	1

MAL_LoVP/10ox/TMA_L	0.018	0.98	0.65	0.027	0.32	6.1E-09	1	2.3E-09	1
MAL_LoVP/100ox/TMA_L	0.018	0.98	0.68	0.026	0.3	5.6E-09	1	1.9E-09	1
MAL_LoVP/1ox/TMA_T	0.013	0.99	0.56	0.028	0.41	7.4E-09	1	2.7E-09	1
MAL_LoVP/10ox/TMA_T	0.013	0.99	0.57	0.028	0.4	7.2E-09	1	2.7E-09	1
MAL_LoVP/100ox/TMA_T	0.013	0.99	0.61	0.027	0.37	6.3E-09	1	2.2E-09	1
OX_LoVP/1ox/DMA_L	0.01	0.99	0.028	0.066	0.91	8.5E-09	1	3.1E-10	1
OX_LoVP/10ox/DMA_L	0.01	0.99	0.028	0.067	0.9	8.4E-09	1	3.1E-10	1
OX_LoVP/100ox/DMA_L	0.011	0.99	0.031	0.07	0.9	7.7E-09	1	2.8E-10	1
OX_LoVP/1ox/TMA_L	0.018	0.98	0.05	0.086	0.86	6.3E-09	1	2.3E-09	1
OX_LoVP/10ox/TMA_L	0.018	0.98	0.05	0.086	0.86	6.2E-09	1	2.3E-09	1
OX_LoVP/100ox/TMA_L	0.019	0.98	0.053	0.089	0.86	5.9E-09	1	2.2E-09	1
OX_LoVP/1ox/TMA_T	0.013	0.99	0.035	0.074	0.89	7.5E-09	1	2.8E-09	1
OX_LoVP/10ox/TMA_T	0.013	0.99	0.036	0.074	0.89	7.5E-09	1	2.8E-09	1
OX_LoVP/100ox/TMA_T	0.013	0.99	0.039	0.077	0.88	6.9E-09	1	2.6E-09	1

Table S2. Breakdown of the percent dissociations of H_2SO_4 to HSO_4^{-1} to HSO_4^{-1} and SO_4^{-2} ; the organic acid (malonic or oxalic) to its first and second dissociation products; NH_3 to NH_4^+; and the amine (DMA or TMA) to its dissociation product for the model output of May 9, 2013. In MABNAG, sulfuric acid is assumed to dissociate completely

Case	HSO_4^{-1}	SO_4^{-2}	Org Acid	Org. $Acid^{-1}$	Org. $Acid^{-2}$	NH_3	NH_4^+	Amine	$Amine^+$
MAL/1ox/DMA_L	0.032	0.97	0.78	0.035	0.18	3.3E-09	1	1.4E-10	1
MAL/10ox/DMA_L	**0.031**	**0.97**	**0.78**	**0.035**	**0.19**	**3.3E-09**	**1**	**1.4E-10**	**1**
MAL/100ox/DMA_L	0.028	0.97	0.77	0.035	0.19	3.7E-09	1	1.4E-10	1
MAL/1ox/TMA_L	0.062	0.94	0.88	0.026	0.092	2.2E-09	1	1.2E-09	1
MAL/10ox/TMA_L	0.061	0.94	0.88	0.025	0.092	2.2E-09	1	1.2E-09	1
MAL/100ox/TMA_L	0.055	0.95	0.88	0.025	0.097	2.5E-09	1	1.0E-09	1
MAL/1ox/TMA_T	0.035	0.97	0.8	0.034	0.17	3.1E-09	1	1.6E-09	1
MAL/10ox/TMA_T	0.035	0.97	0.8	0.033	0.17	3.1E-09	1	1.6E-09	1
MAL/100ox/TMA_T	0.031	0.97	0.79	0.033	0.18	3.5E-09	1	1.4E-09	1
OX/1ox/DMA_L	0.032	0.97	0.13	0.16	0.71	3.2E-09	1	1.4E-10	1
OX/10ox/DMA_L	0.032	0.97	0.13	0.16	0.71	3.2E-09	1	1.4E-10	1
OX/100ox/DMA_L	0.032	0.97	0.13	0.16	0.71	3.2E-09	1	1.4E-10	1
OX/1ox/TMA_L	0.062	0.94	0.24	0.19	0.57	2.2E-09	1	1.2E-09	1
OX/10ox/TMA_L	0.062	0.94	0.24	0.19	0.57	2.2E-09	1	1.2E-09	1
OX/100ox/TMA_L	0.062	0.94	0.24	0.2	0.57	2.2E-09	1	1.2E-09	1
OX/1ox/TMA_T	0.035	0.97	0.14	0.17	0.69	3.0E-09	1	1.6E-09	1
OX/10ox/TMA_T	0.035	0.97	0.14	0.17	0.69	3.0E-09	1	1.6E-09	1
OX/100ox/TMA_T	0.035	0.97	0.14	0.17	0.69	3.1E-09	1	1.6E-09	1
MAL_LoVP/1ox/DMA_L	0.03	0.97	0.78	0.034	0.19	3.5E-09	1	1.4E-10	1
MAL_LoVP/10ox/DMA_L	0.027	0.97	0.76	0.035	0.2	4.0E-09	1	1.4E-10	1
MAL_LoVP/100ox/DMA_L	0.016	0.98	0.71	0.04	0.25	5.4E-09	1	1.6E-10	1
MAL_LoVP/1ox/TMA_L	0.057	0.94	0.88	0.025	0.094	2.4E-09	1	1.1E-09	1
MAL_LoVP/10ox/TMA_L	0.051	0.95	0.87	0.026	0.1	2.7E-09	1	9.9E-10	1
MAL_LoVP/100ox/TMA_L	0.025	0.98	0.81	0.037	0.16	4.5E-09	1	9.7E-10	1

MAL_LoVP/1ox/TMA_T	0.033	0.97	0.8	0.033	0.17	3.3E-09	1	1.5E-09	1
MAL_LoVP/10ox/TMA_T	0.029	0.97	0.78	0.034	0.18	3.8E-09	1	1.3E-09	1
MAL_LoVP/100ox/TMA_T	0.017	0.98	0.73	0.04	0.23	5.2E-09	1	1.2E-09	1
OX_LoVP/1ox/DMA_L	0.032	0.97	0.13	0.16	0.71	3.2E-09	1	1.4E-10	1
OX_LoVP/10ox/DMA_L	0.032	0.97	0.13	0.16	0.71	3.2E-09	1	1.4E-10	1
OX_LoVP/100ox/DMA_L	0.029	0.97	0.12	0.16	0.71	3.3E-09	1	1.3E-10	1
OX_LoVP/1ox/TMA_L	0.062	0.94	0.24	0.2	0.57	2.2E-09	1	1.2E-09	1
OX_LoVP/10ox/TMA_L	0.062	0.94	0.23	0.2	0.57	2.2E-09	1	1.2E-09	1
OX_LoVP/100ox/TMA_L	0.058	0.94	0.23	0.2	0.58	2.3E-09	1	1.1E-09	1
OX_LoVP/1ox/TMA_T	0.035	0.97	0.14	0.17	0.69	3.0E-09	1	1.6E-09	1
OX_LoVP/10ox/TMA_T	0.035	0.97	0.14	0.17	0.69	3.1E-09	1	1.6E-09	1
OX_LoVP/100ox/TMA_T	0.032	0.97	0.14	0.17	0.69	3.1E-09	1	1.4E-09	1

Table S3. Breakdown of the percent dissociations of H_2SO_4 to HSO_4^{-1} to HSO_4^{-1} and SO_4^{-2} ; the organic acid (malonic or oxalic) to its first and second dissociation products; NH_3 to NH_4^+; and the amine (DMA or TMA) to its dissociation product for the model output of May 11, 2013. In MABNAG, sulfuric acid is assumed to dissociate completely.

Case	HSO_4^{-1}	SO_4^{-2}	Org Acid	Org. $Acid^{-1}$	Org. $Acid^{-2}$	NH_3	NH_4^+	Amine	$Amine^+$
MAL/1ox/DMA_L	0.026	0.97	0.78	0.026	0.19	3.9E-09	1	1.8E-10	1
MAL/10ox/DMA_L	**0.026**	**0.97**	**0.78**	**0.026**	**0.19**	**3.9E-09**	**1**	**1.8E-10**	**1**
MAL/100ox/DMA_L	0.027	0.97	0.78	0.026	0.19	4.1E-09	1	1.8E-10	1
MAL/1ox/TMA_L	0.039	0.96	0.84	0.023	0.13	3.2E-09	1	2.1E-09	1
MAL/10ox/TMA_L	0.039	0.96	0.84	0.023	0.13	3.2E-09	1	2.1E-09	1
MAL/100ox/TMA_L	0.04	0.96	0.84	0.022	0.13	3.3E-09	1	2.0E-09	1
MAL/1ox/TMA_T	0.033	0.97	0.82	0.024	0.16	3.5E-09	1	2.3E-09	1
MAL/10ox/TMA_T	0.033	0.97	0.82	0.024	0.16	3.5E-09	1	2.3E-09	1
MAL/100ox/TMA_T	0.033	0.97	0.82	0.024	0.16	3.6E-09	1	2.2E-09	1
OX/1ox/DMA_L	0.033	0.97	0.15	0.14	0.71	3.3E-09	1	1.4E-10	1
OX/10ox/DMA_L	0.026	0.97	0.1	0.13	0.77	3.9E-09	1	1.8E-10	1
OX/100ox/DMA_L	0.026	0.97	0.1	0.13	0.77	3.9E-09	1	1.8E-10	1
OX/1ox/TMA_L	0.046	0.95	0.19	0.16	0.66	2.8E-09	1	1.6E-09	1
OX/10ox/TMA_L	0.039	0.96	0.14	0.15	0.71	3.2E-09	1	2.2E-09	1
OX/100ox/TMA_L	0.04	0.96	0.15	0.15	0.71	3.2E-09	1	2.2E-09	1
OX/1ox/TMA_T	0.041	0.96	0.17	0.15	0.68	3.0E-09	1	1.6E-09	1
OX/10ox/TMA_T	0.033	0.97	0.13	0.14	0.73	3.5E-09	1	2.3E-09	1
OX/100ox/TMA_T	0.033	0.97	0.13	0.14	0.73	3.5E-09	1	2.3E-09	1
MAL_LoVP/1ox/DMA_L	0.026	0.97	0.78	0.026	0.19	4.0E-09	1	1.8E-10	1
MAL_LoVP/10ox/DMA_L	0.027	0.97	0.78	0.026	0.19	4.1E-09	1	1.7E-10	1
MAL_LoVP/100ox/DMA_L	0.017	0.98	0.75	0.024	0.22	6.2E-09	1	1.6E-10	1
MAL_LoVP/1ox/TMA_L	0.04	0.96	0.84	0.022	0.13	3.3E-09	1	2.1E-09	1
MAL_LoVP/10ox/TMA_L	0.04	0.96	0.84	0.022	0.13	3.4E-09	1	1.9E-09	1
MAL_LoVP/100ox/TMA_L	0.028	0.97	0.82	0.021	0.16	5.2E-09	1	1.1E-09	1

MAL_LoVP/1ox/TMA_T	0.033	0.97	0.82	0.024	0.16	3.6E-09	1	2.2E-09	1
MAL_LoVP/10ox/TMA_T	0.034	0.97	0.82	0.024	0.16	3.7E-09	1	2.1E-09	1
MAL_LoVP/100ox/TMA_T	0.022	0.98	0.79	0.022	0.19	5.7E-09	1	1.1E-09	1
OX_LoVP/1ox/DMA_L	0.026	0.97	0.1	0.13	0.77	3.9E-09	1	1.8E-10	1
OX_LoVP/10ox/DMA_L	0.026	0.97	0.1	0.13	0.77	3.9E-09	1	1.8E-10	1
OX_LoVP/100ox/DMA_L	0.028	0.97	0.1	0.13	0.77	3.9E-09	1	1.8E-10	1
OX_LoVP/1ox/TMA_L	0.039	0.96	0.14	0.15	0.71	3.2E-09	1	2.2E-09	1
OX_LoVP/10ox/TMA_L	0.04	0.96	0.15	0.15	0.71	3.2E-09	1	2.2E-09	1
OX_LoVP/100ox/TMA_L	0.042	0.96	0.15	0.15	0.71	3.2E-09	1	2.1E-09	1
OX_LoVP/1ox/TMA_T	0.033	0.97	0.13	0.14	0.73	3.5E-09	1	2.3E-09	1
OX_LoVP/10ox/TMA_T	0.033	0.97	0.13	0.14	0.73	3.5E-09	1	2.3E-09	1
OX_LoVP/100ox/TMA_T	0.035	0.97	0.13	0.14	0.73	3.4E-09	1	2.3E-09	1