An introduction to Aerosol Science
Anthropogenic sources

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Anthropogenic sources

What's Anthropogenic?

mechanical (geological processes, wind-blown dust, sea salt),
biological (pollen, bacteria)

$(NH_4)_2SO_4$,

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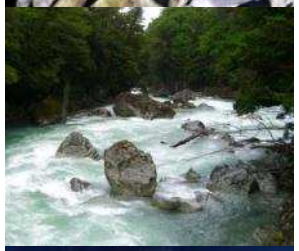

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What's Anthropogenic?

chemical (gas-particle conversion, photochemical reactions, combustion).






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Anthropogenic sources

How much?

Sources	Emission Tg yr^{-1},	Lower limit Tg yr^{-1}	Upper limit Tg yr^{-1}	Column burden mg m^{-2}	Contribution to Optical depth
Natural					
Primary					
Soil dust	1500	100	2000	32.2	0.023
Sea-salt	1300	300	10000	7	0.003
Volcanic dust	33	25	300	0.7	0.001
Biological debris	50	3	150	1.1	0.002
Secondary					
Sulphates	150	85	1100	2.8	0.014
Organics	55	15	200	2.1	0.011
Nitrates	30	15	700	0.5	0.001
Total Natural	3118	543	14450	46.4	0.055
Anthropogenic					
Primary					
Industrial dust	100	10	170	2.1	0.004
Black carbon	20	3	150	0.6	0.006
Secondary					
Sulphates	140	70	375	3.8	0.019
Biomass burning (w/o BC)	90	60	150	3.4	0.017
Nitrates	40	23	65	0.8	0.002
Organic matter	10	5	90	0.4	0.002
Total Anthropogenic	400	171	1000	11.1	0.05
Total	**3518**	**714**	**15450**	**57.5**	**0.105**
Anthropogenic fraction (%)	11	24	6	19	48

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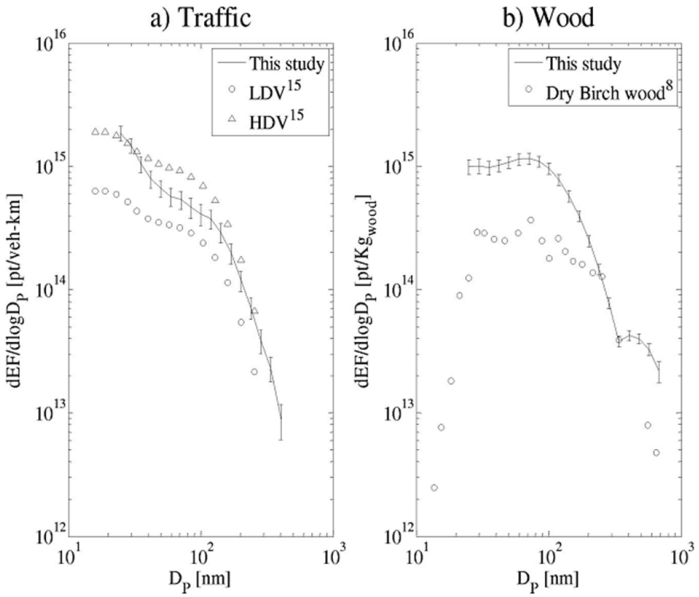
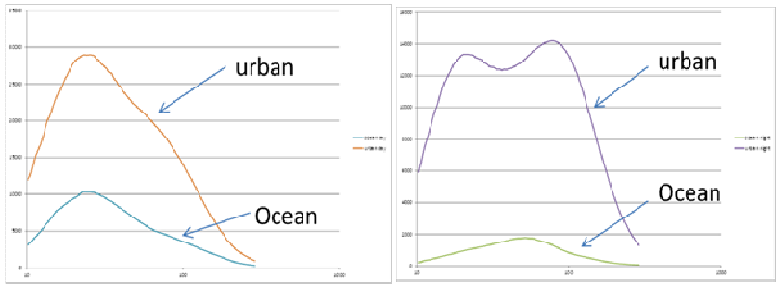
Combustion
Size distributions
Traffic emissions modal peak about 40nm
Woodsmoke modal peaks at about100nm and 500nm

Temuco, Chile



Olivares et al 2005

Takapuna, Auckland



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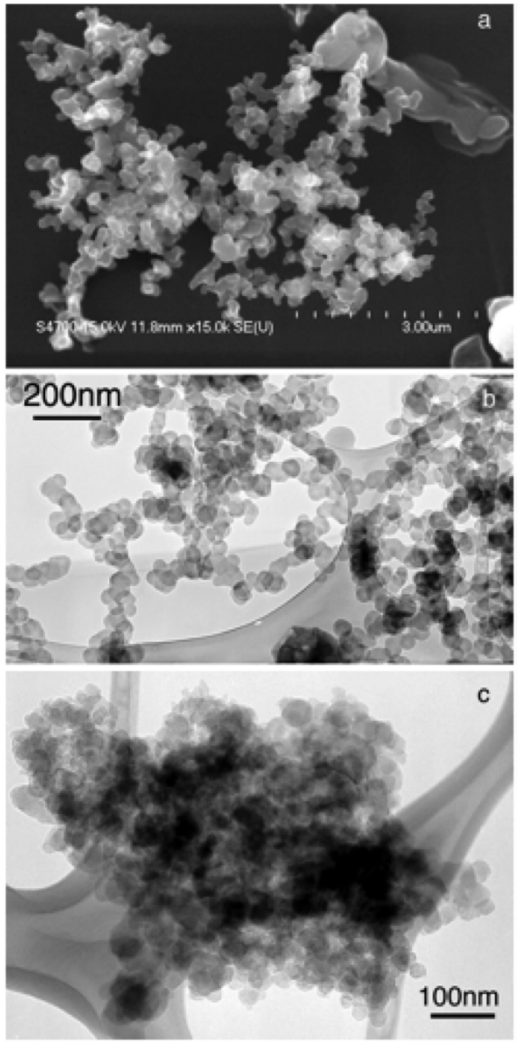
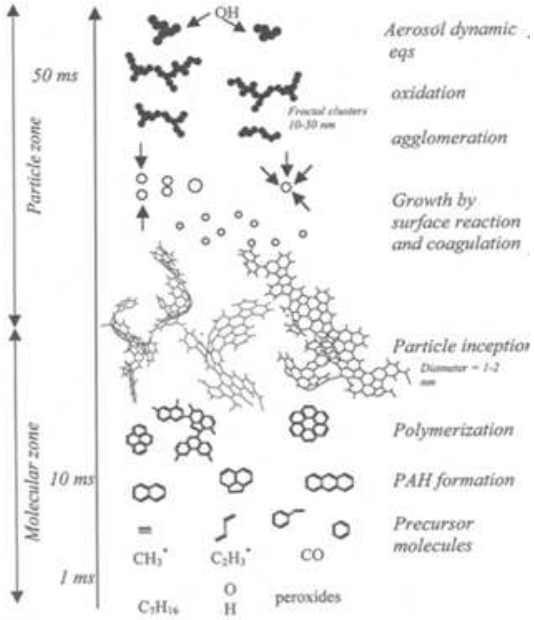
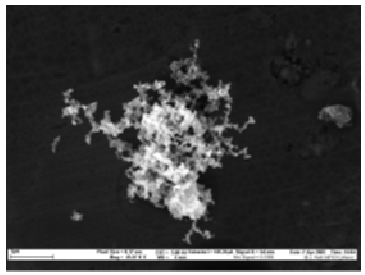
Black carbon aggregates

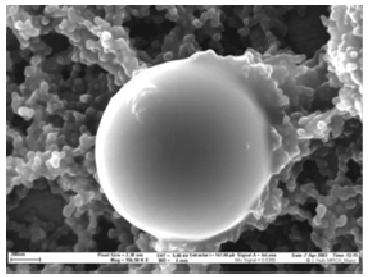




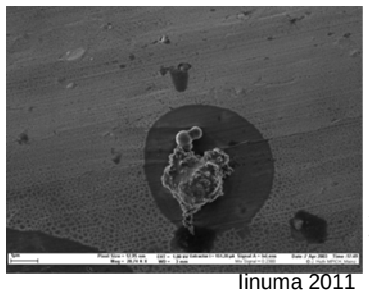
woodsmoke



Agglomerate



Tar ball



Agglomerate with halo

Iinuma 2011

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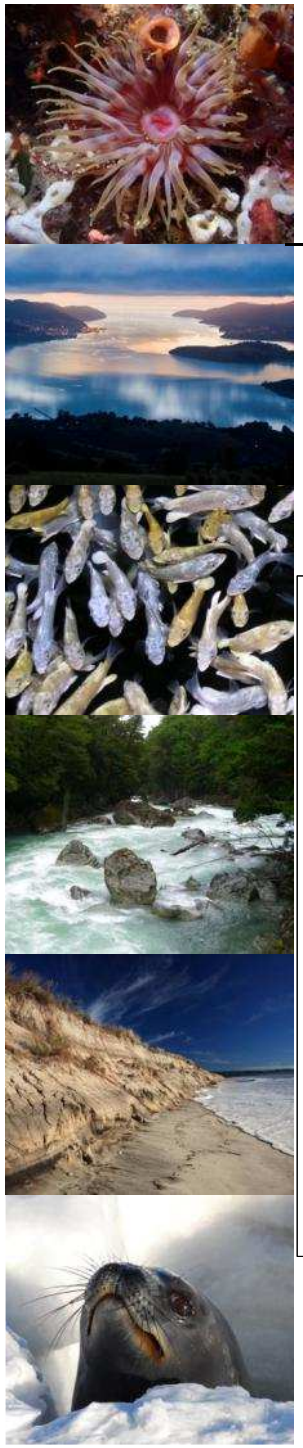

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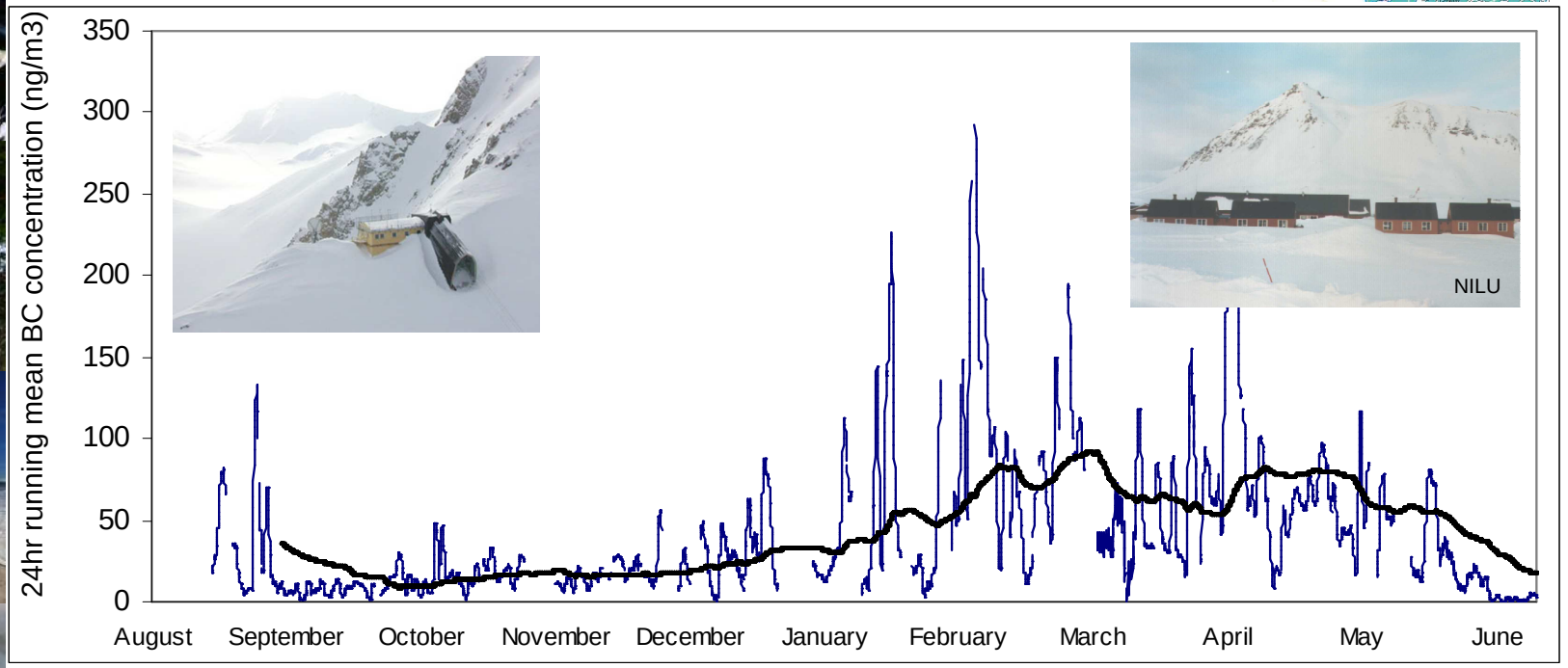
Black Carbon at Zeppelin Mountain



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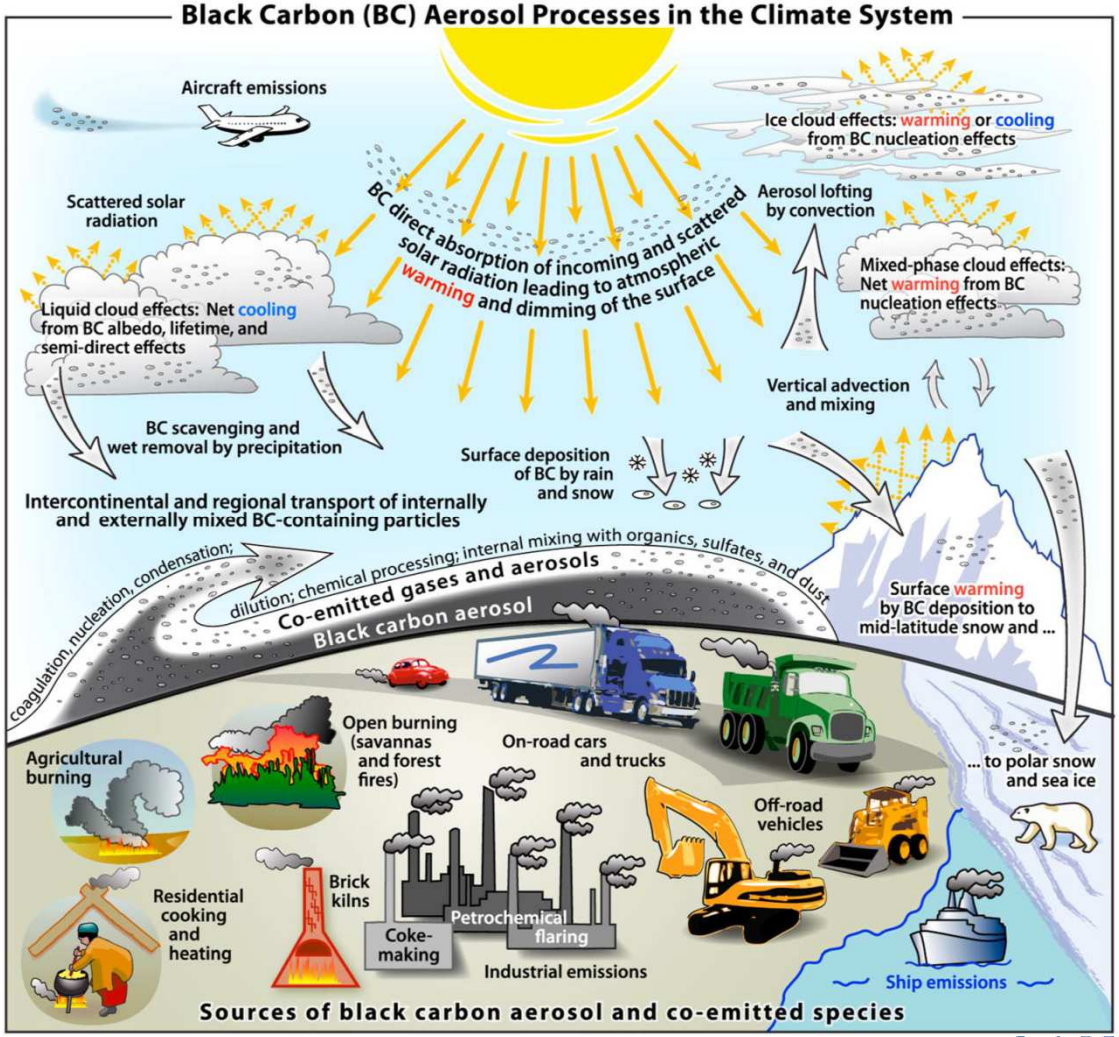

Bond et al 2013

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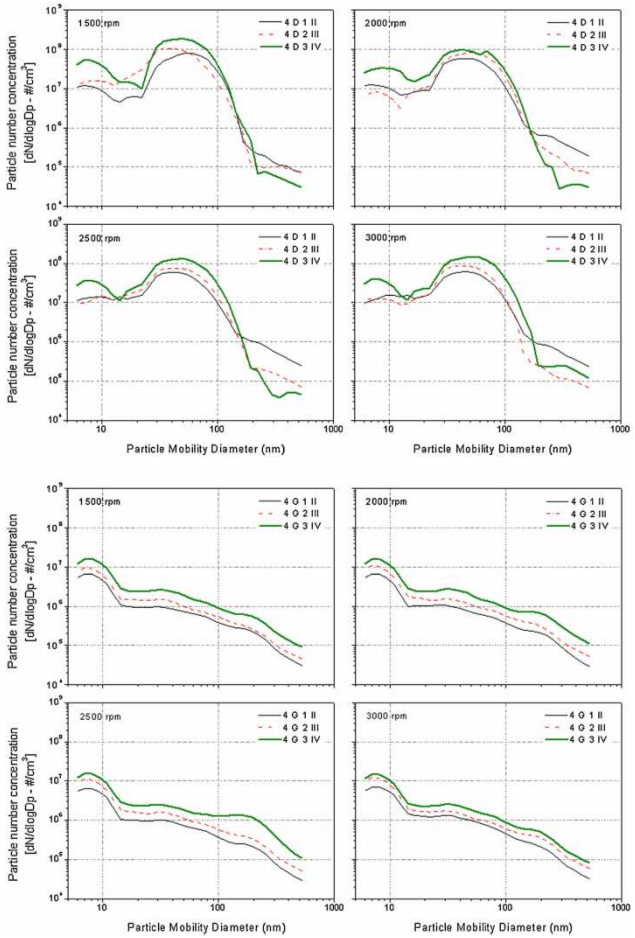
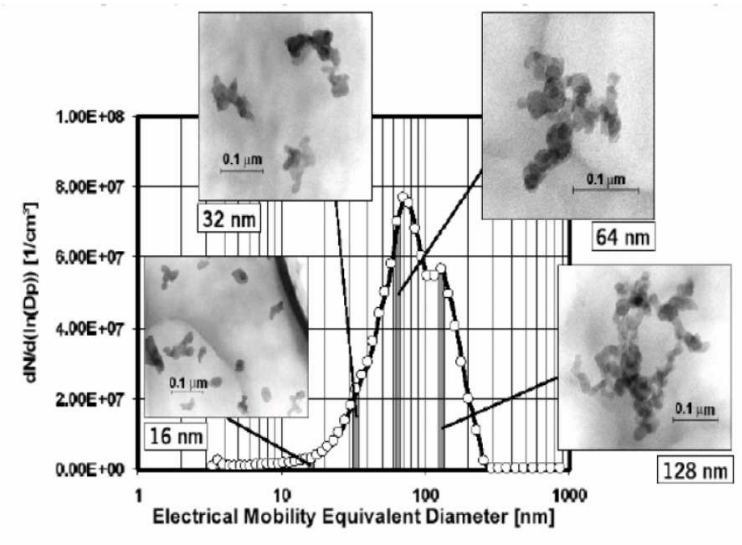
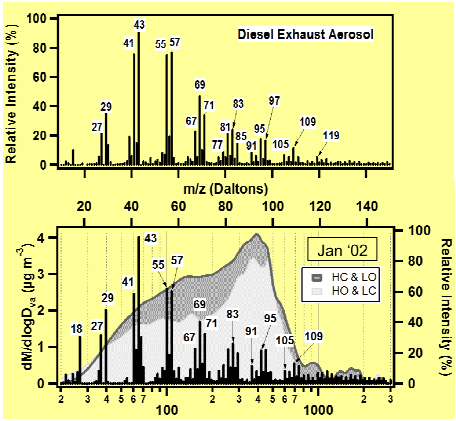
Petrol vs Diesel



Agarwal et al 2015





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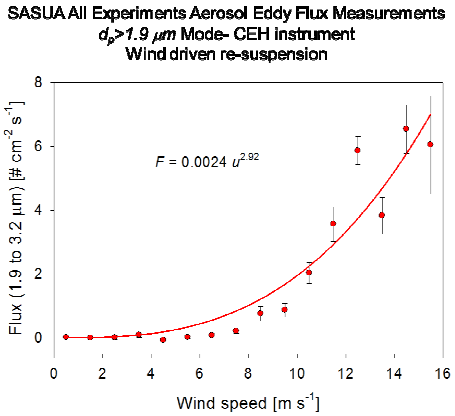
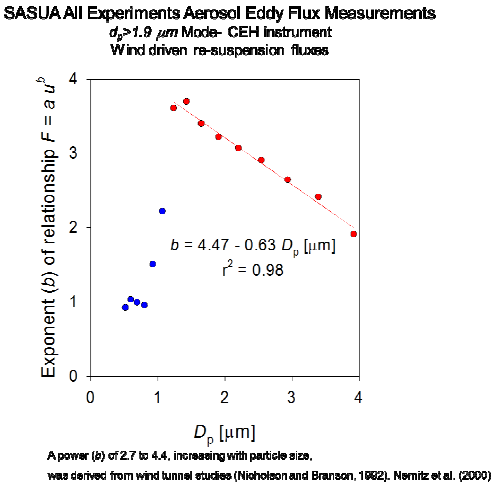
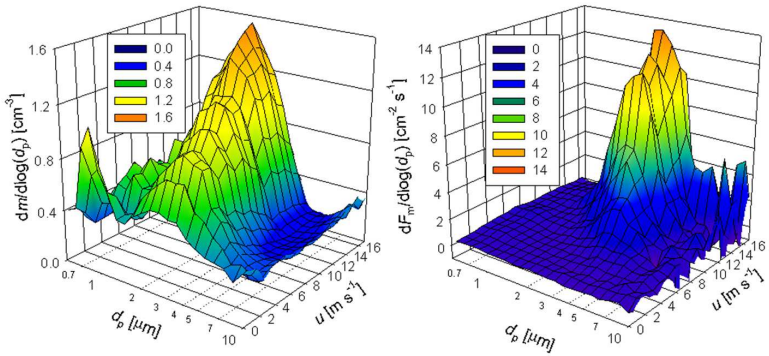
Urban mechanical sources







at low winds fines go up as coarse go down – low dispersion

As wind goes up fines disperse whereas coarse are re-suspended

MASS flux peaks at ~ 3 microns regardless of wind speed

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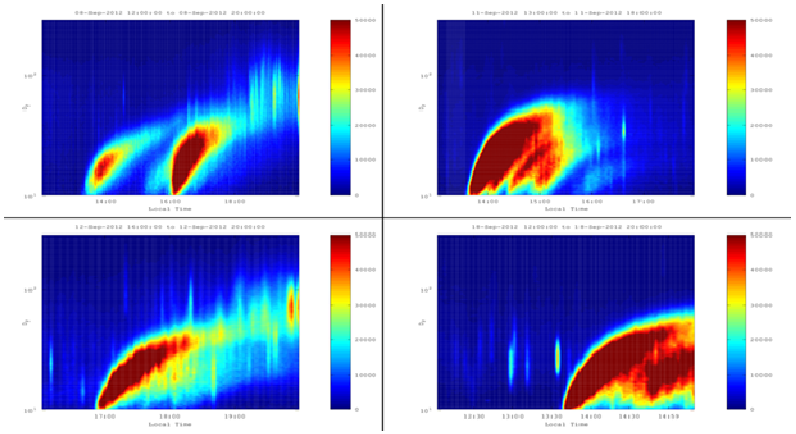
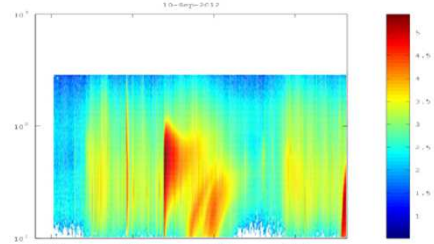
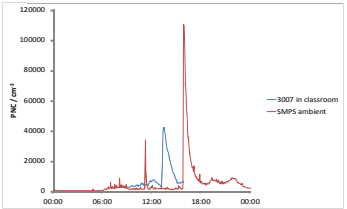
Nucleation as an urban source

Aerosol formation events at Mt Eden School (Urban background)







largest and most sudden event - Mt Eden School, 10th September 2012

strong westerly wind, showers

PNC increased by factor of 65 in 3 minutes

VERY low concentrations before the event

indoor events NOT coinciding with outdoor events

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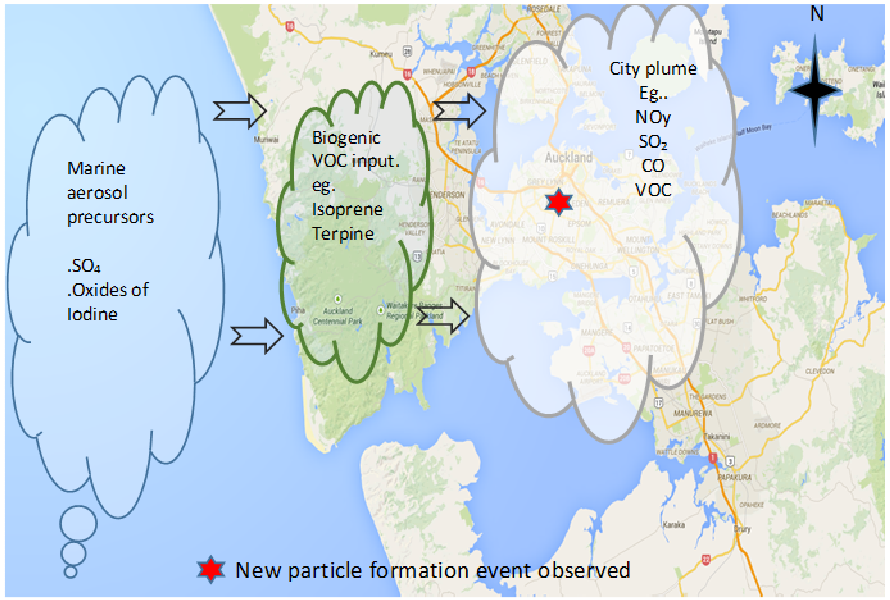

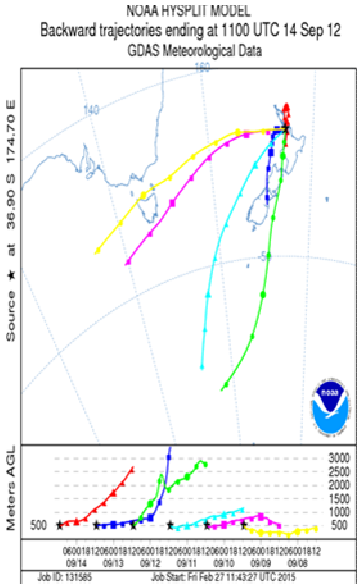

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The End

The view from Zeppelin Mountain

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