

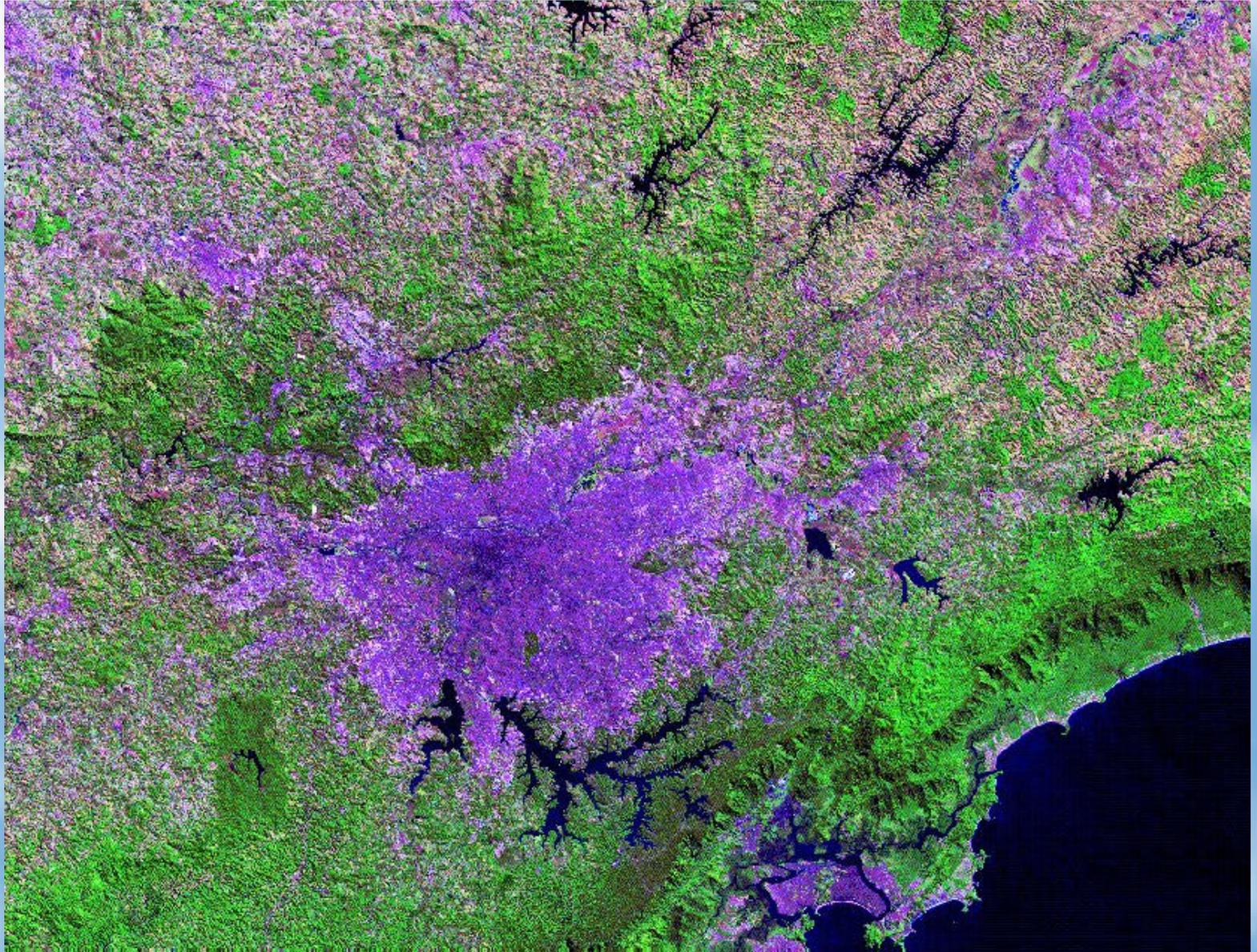
Urban and Biomass Burning contribution to South American aerosols

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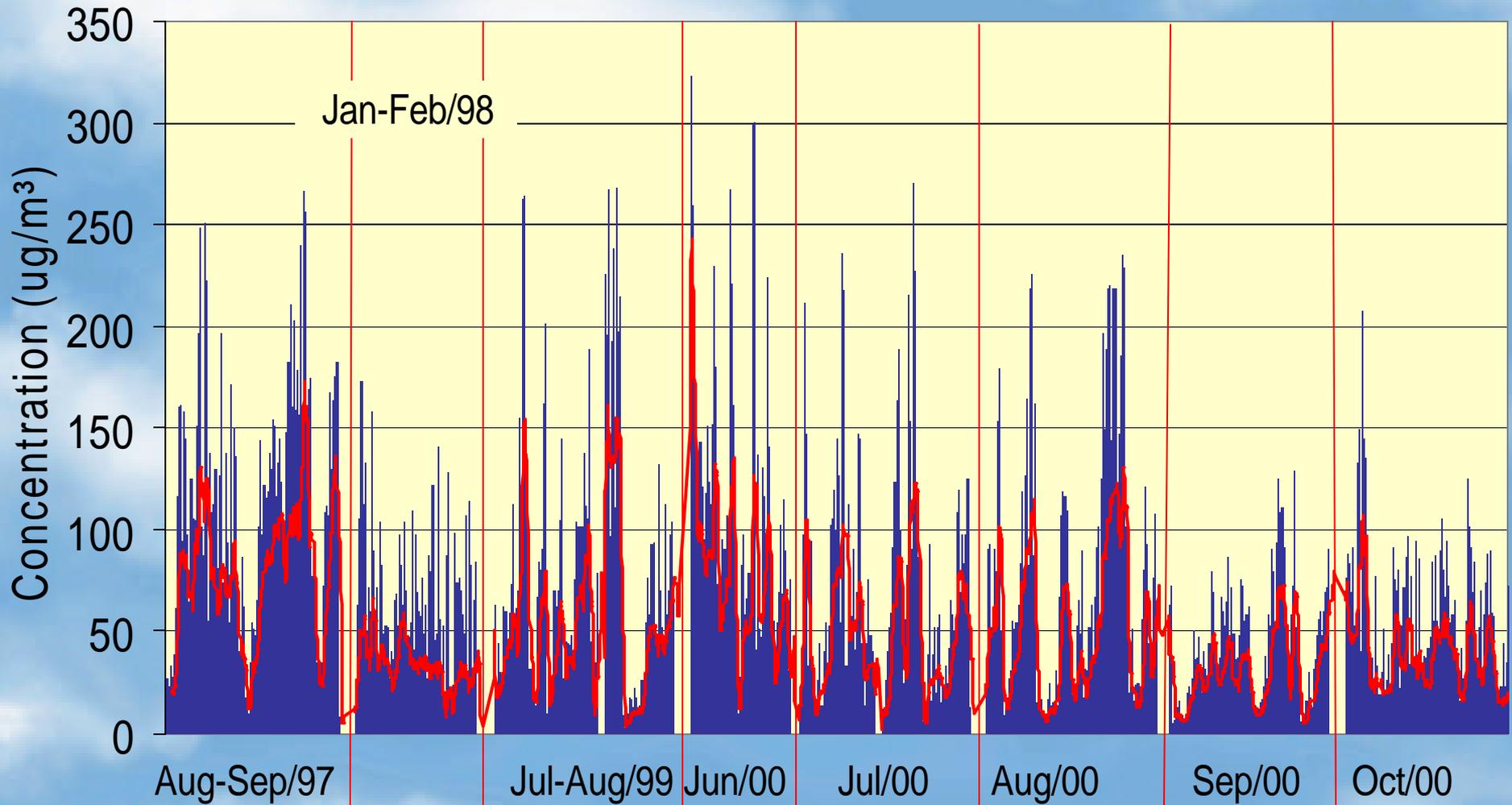
Some important issues

- **Brazil**: 90% hydroelectric power (5% nuclear; 5% coal). All cars runs on gasohol, with 22% ethanol. 34 new natural gas power plants in construction.
- **São Paulo**: 16-18 million people, 36% of Brazil GDP; 6 million autos running on gasohol. Health effects: 35,000 excess deaths per year.
- **Santiago de Chile**: Very high PM_{10} (200-300 $\mu\text{g}/\text{m}^3$) and O_3 levels (120-160 ppb). 40% Chilean GDP. Copper smelters nearby.
- **Amazonia**: 5.5 millions Km^2 , 20 million inhabitants: 90% Urban. Aerosol concentrations: 10 to 600 $\mu\text{g}/\text{m}^3$. Ozone: 10-140 ppb. Deforestation rate: 20-35,000 km^2 per year. 14% of the original area deforested.

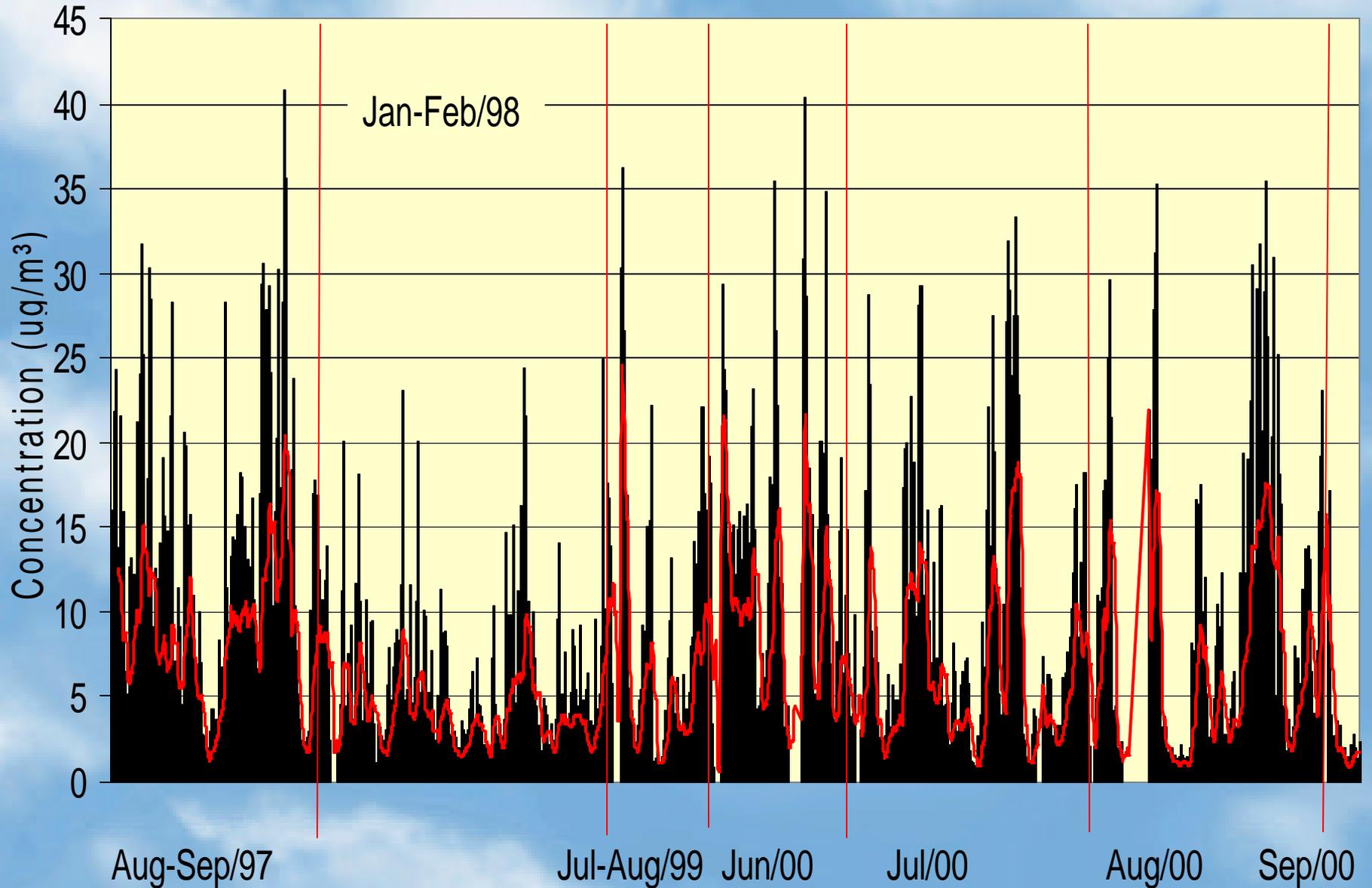
São Paulo metropolitan area



TEOM PM₁₀ aerosol concentrations

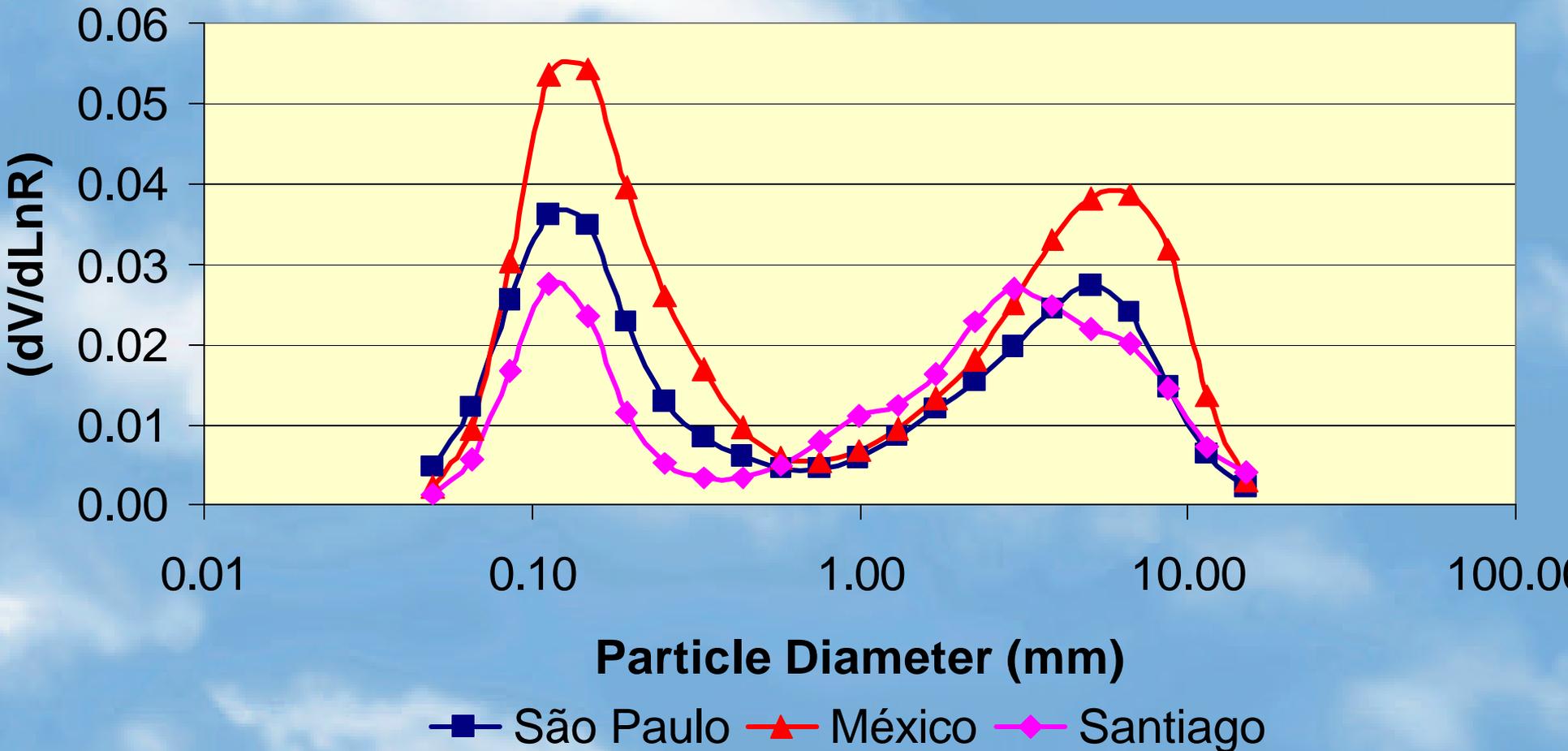


São Paulo equivalent black carbon aethalometer PM_{2.5}



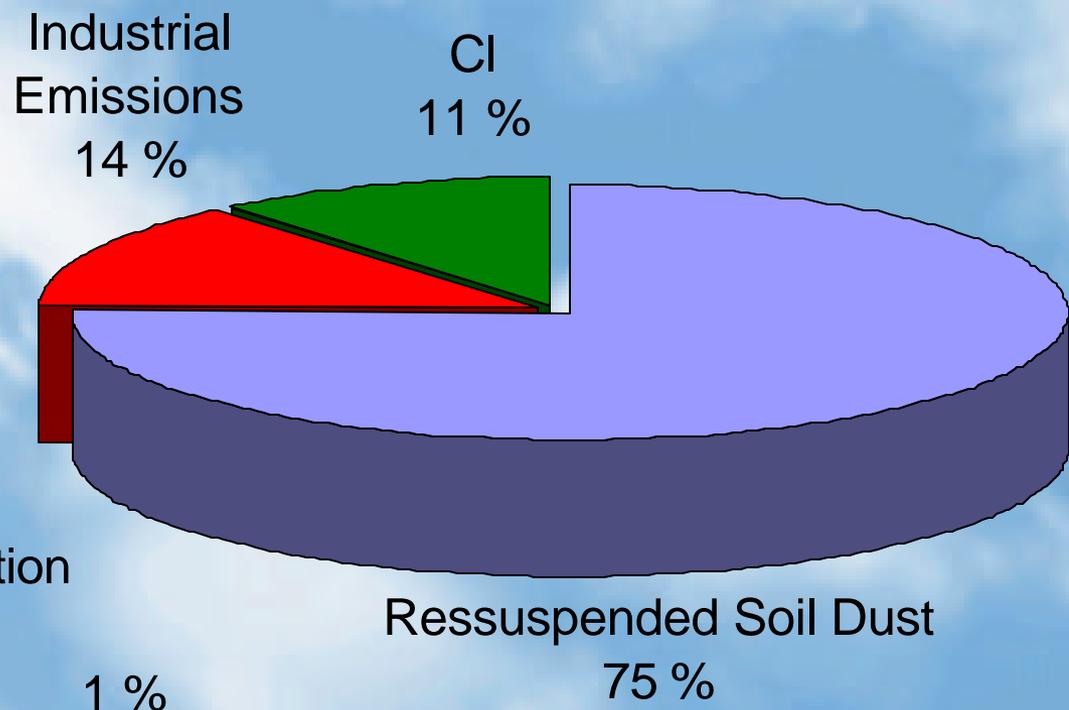
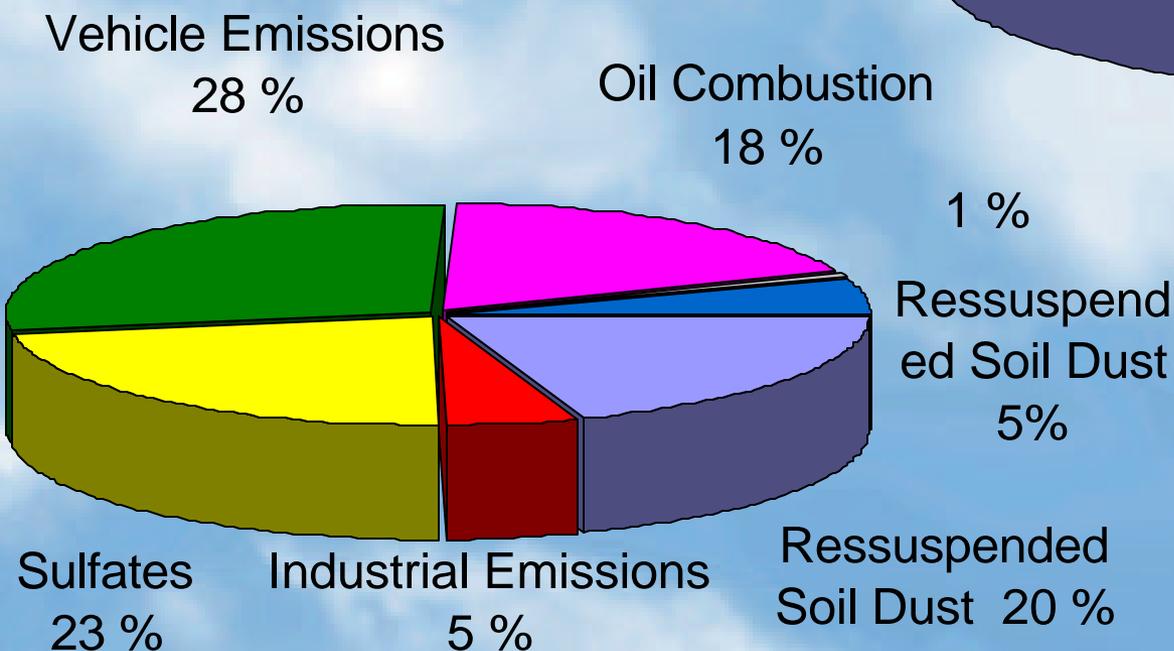
AERONET Size Distribution

Size Distributions - AERONET



São Paulo quantitative aerosol source apportionment

Coarse Mode
($2.5 < d_p < 10 \mu\text{m}$)

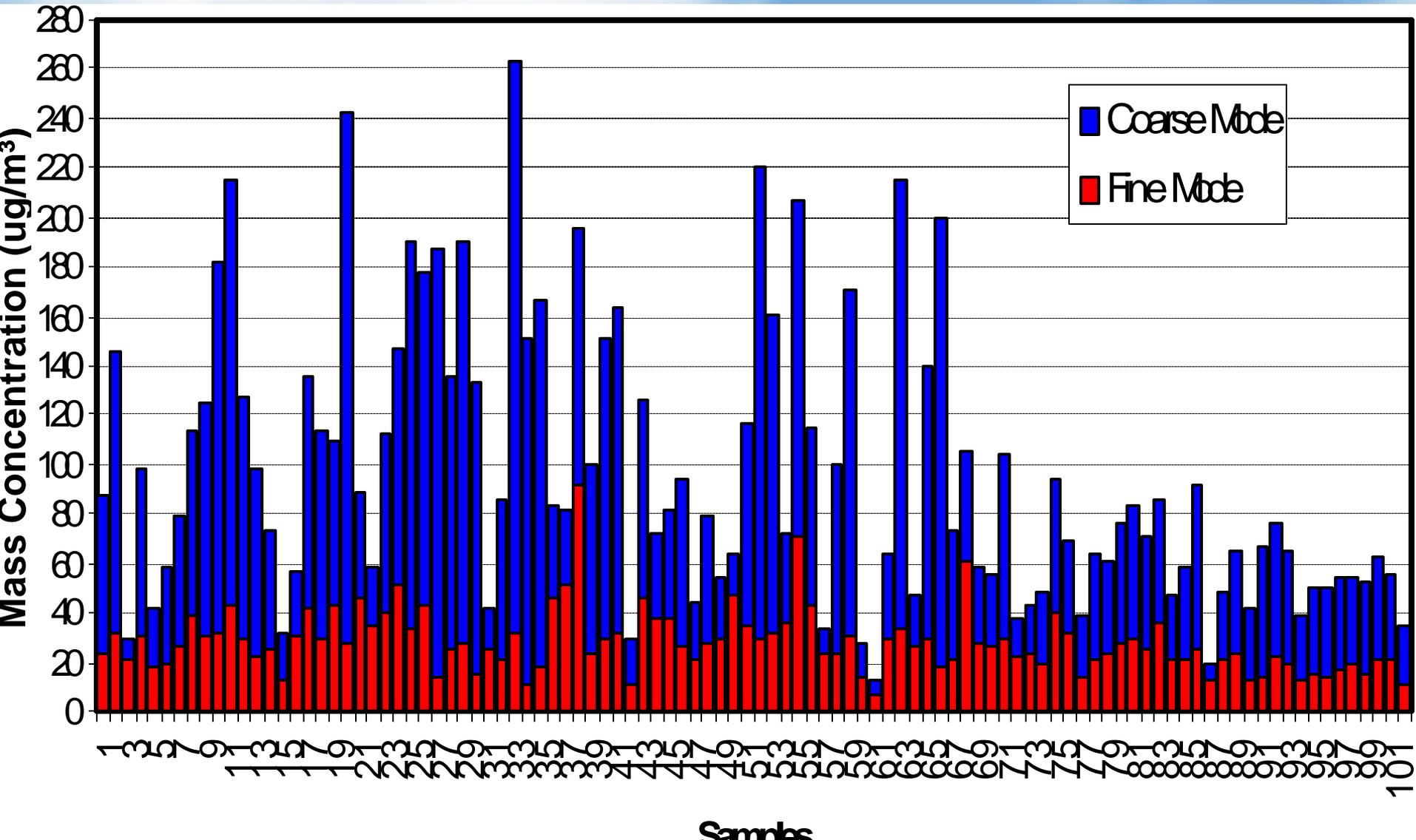


PM_{2.5}

Santiago de Chile: Dry, strong and shallow inversions, Andes nearby.

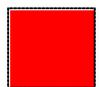
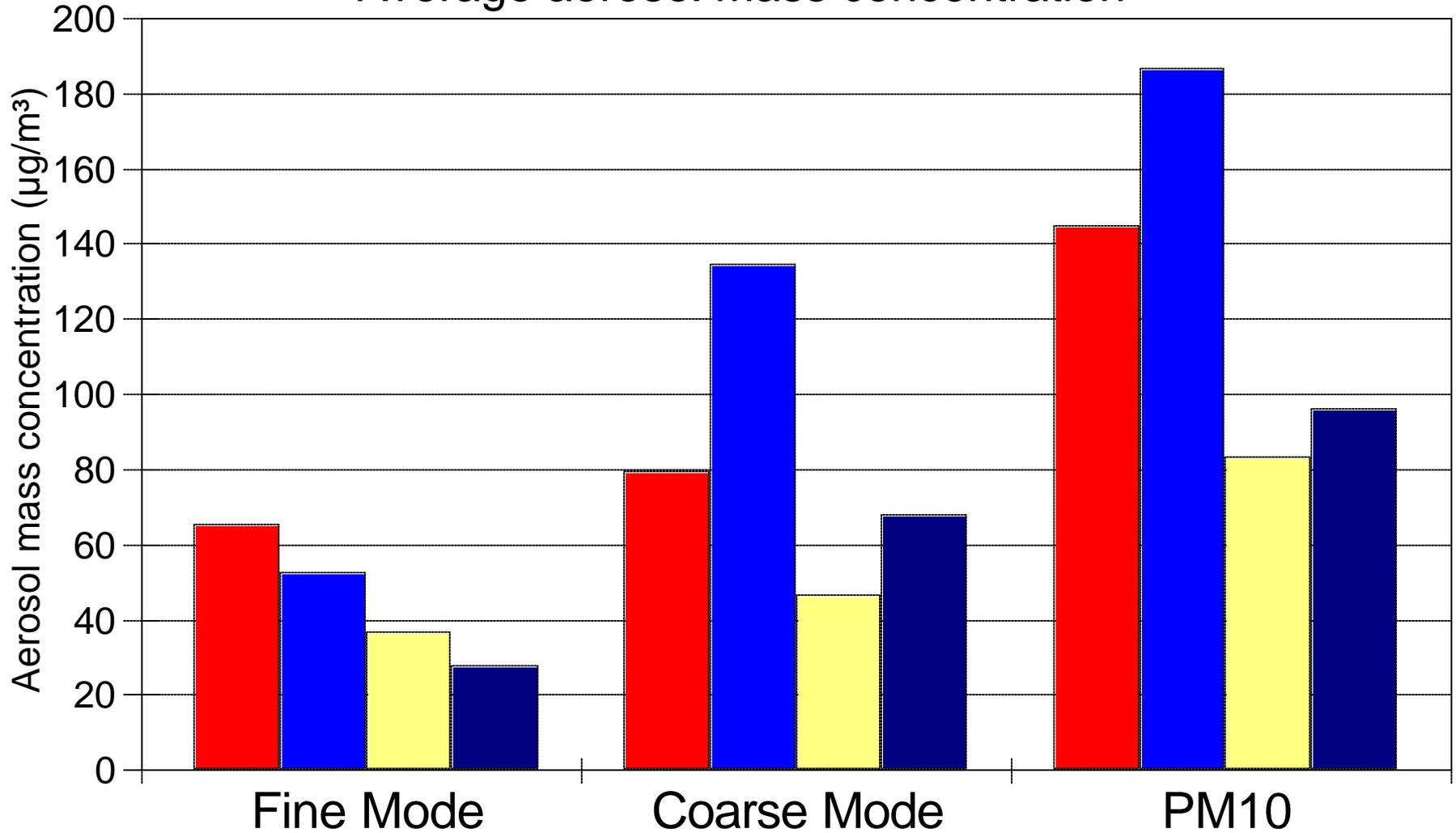


Santiago de Chile: PM₁₀ dominated by coarse aerosol



Santiago de Chile 1999 Aerosol Study

Average aerosol mass concentration



La Florida



Pudahuel

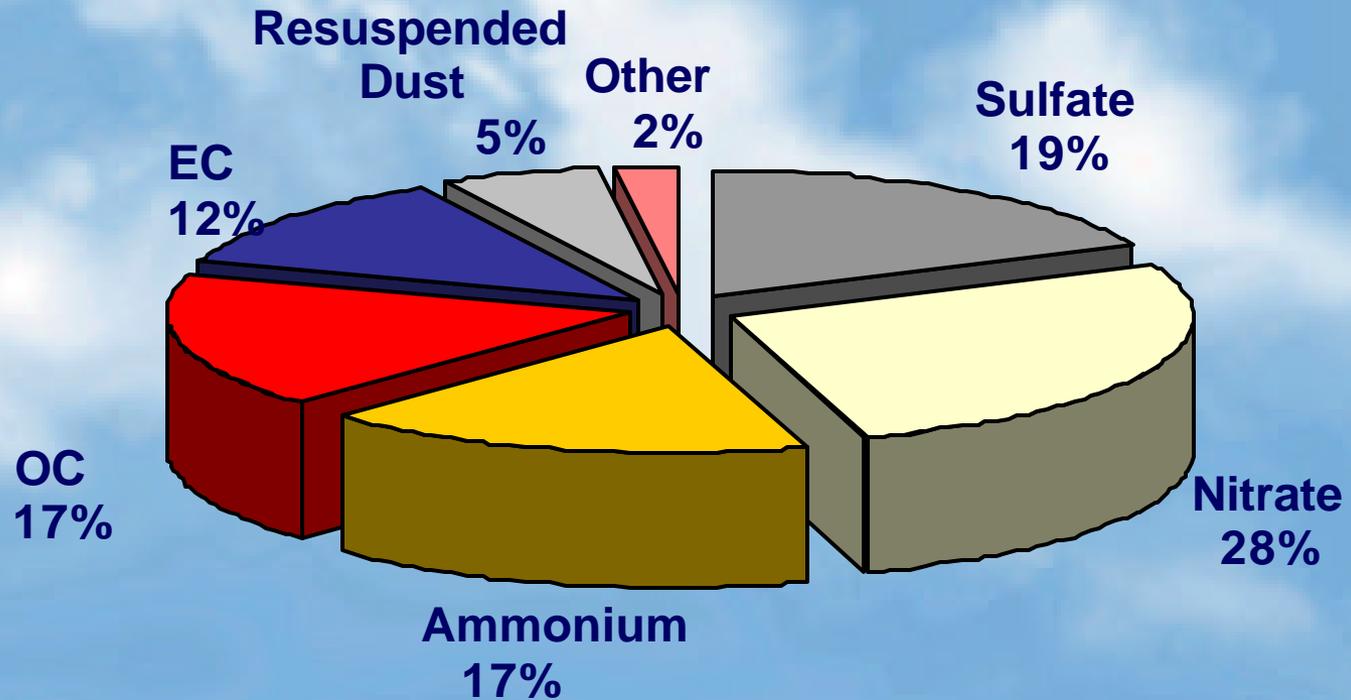


Las Condes



O'Higgins

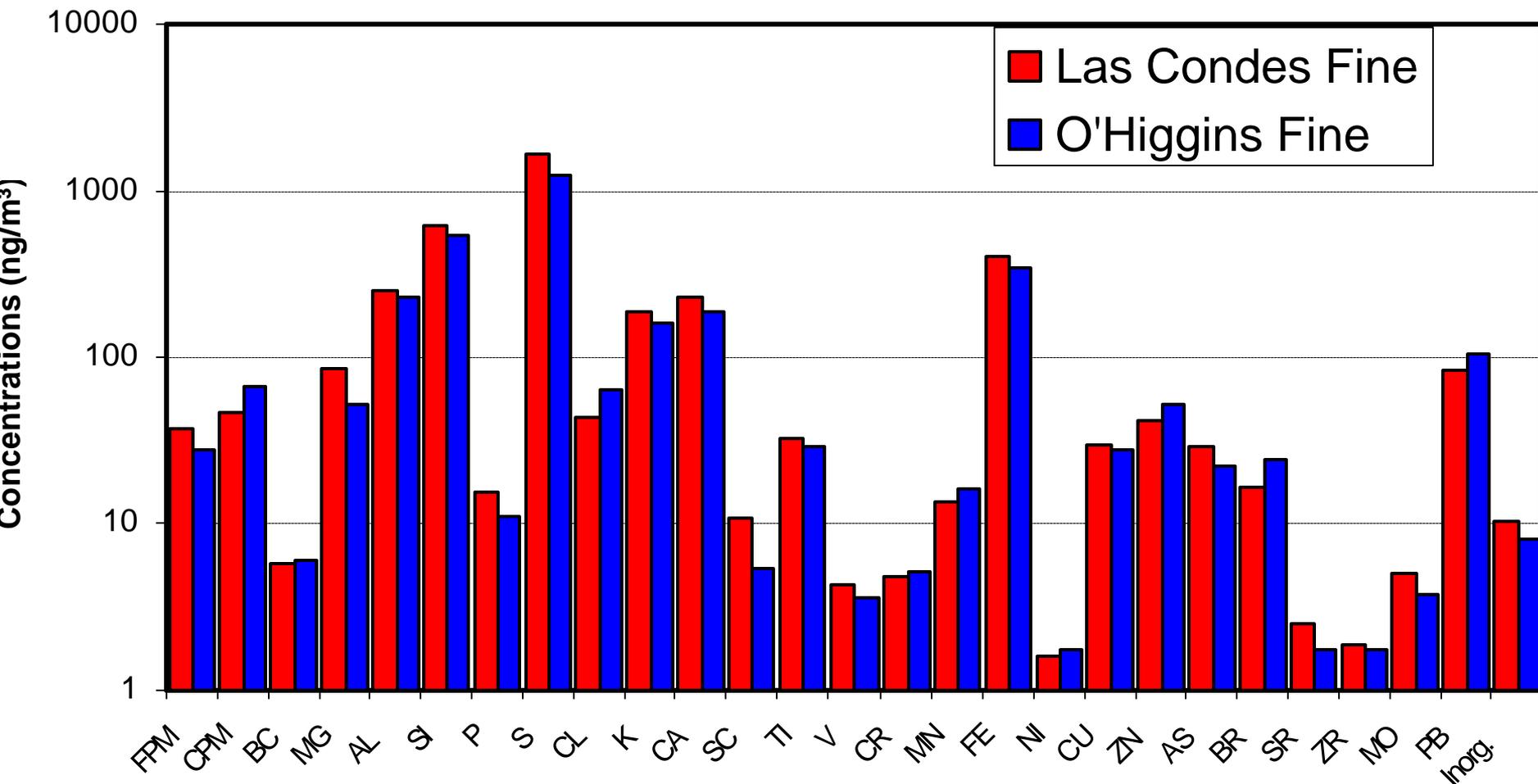
Chemical Composition of PM_{2.5} Santiago, winter 1998



Average mass = 35.97 mg/m³

Santiago: High As, S, Pb, Cu, Soil dust

Santiago 1999 fine mode aerosol average elemental concentrations

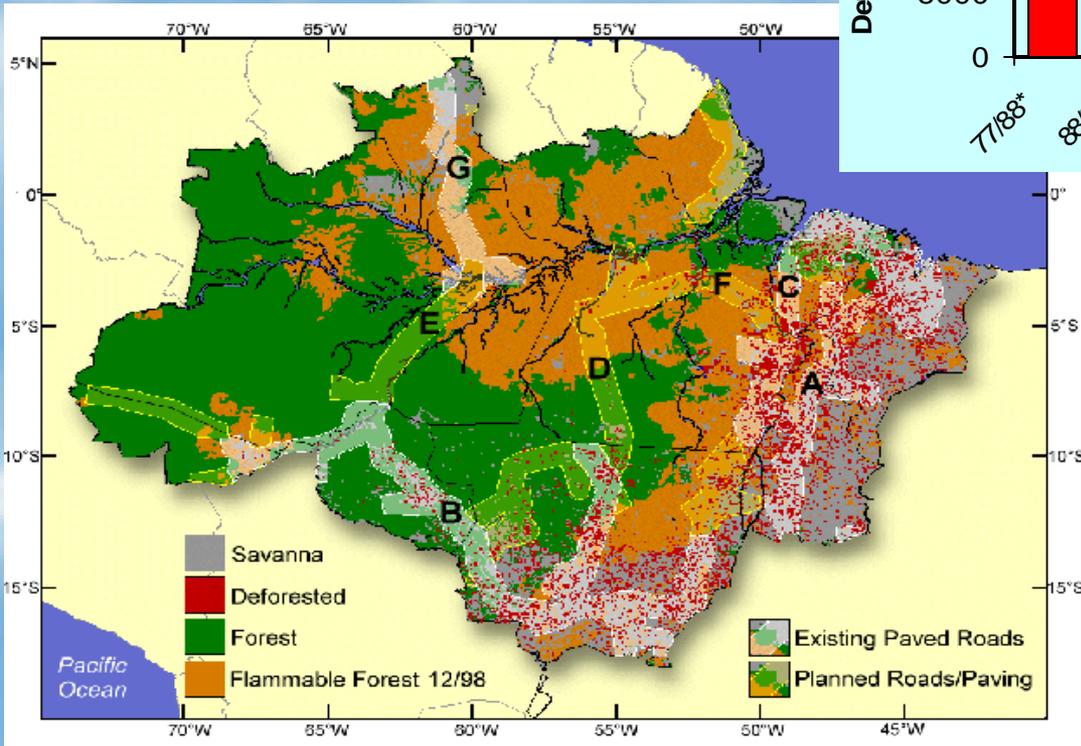
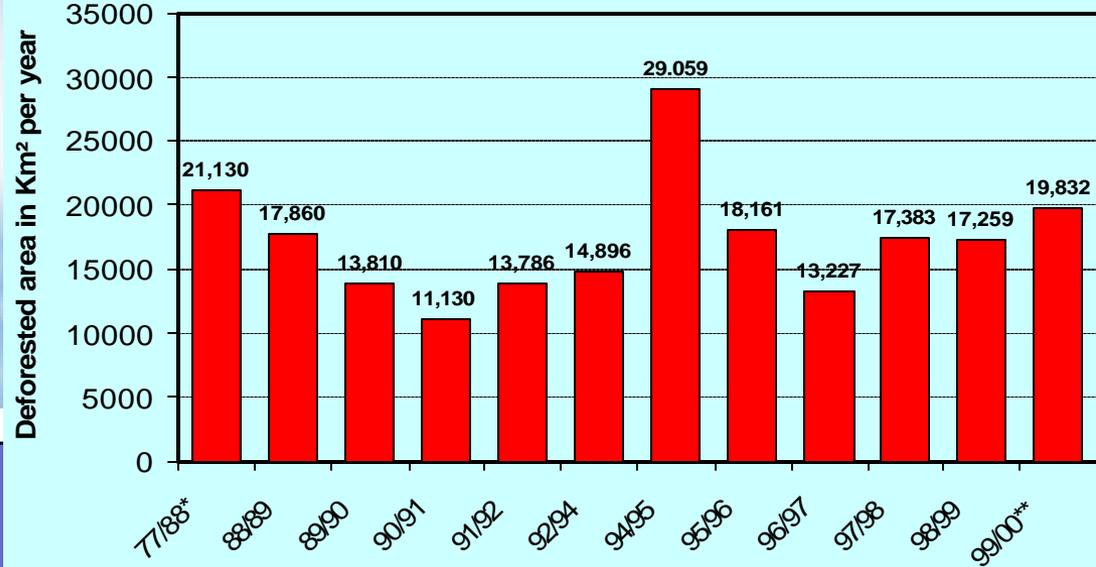




Deforestation rates in Amazonia

Total land use change area: 14% of the 5.5 million Km²

Amazonia deforestation in km² per year 1977-2000



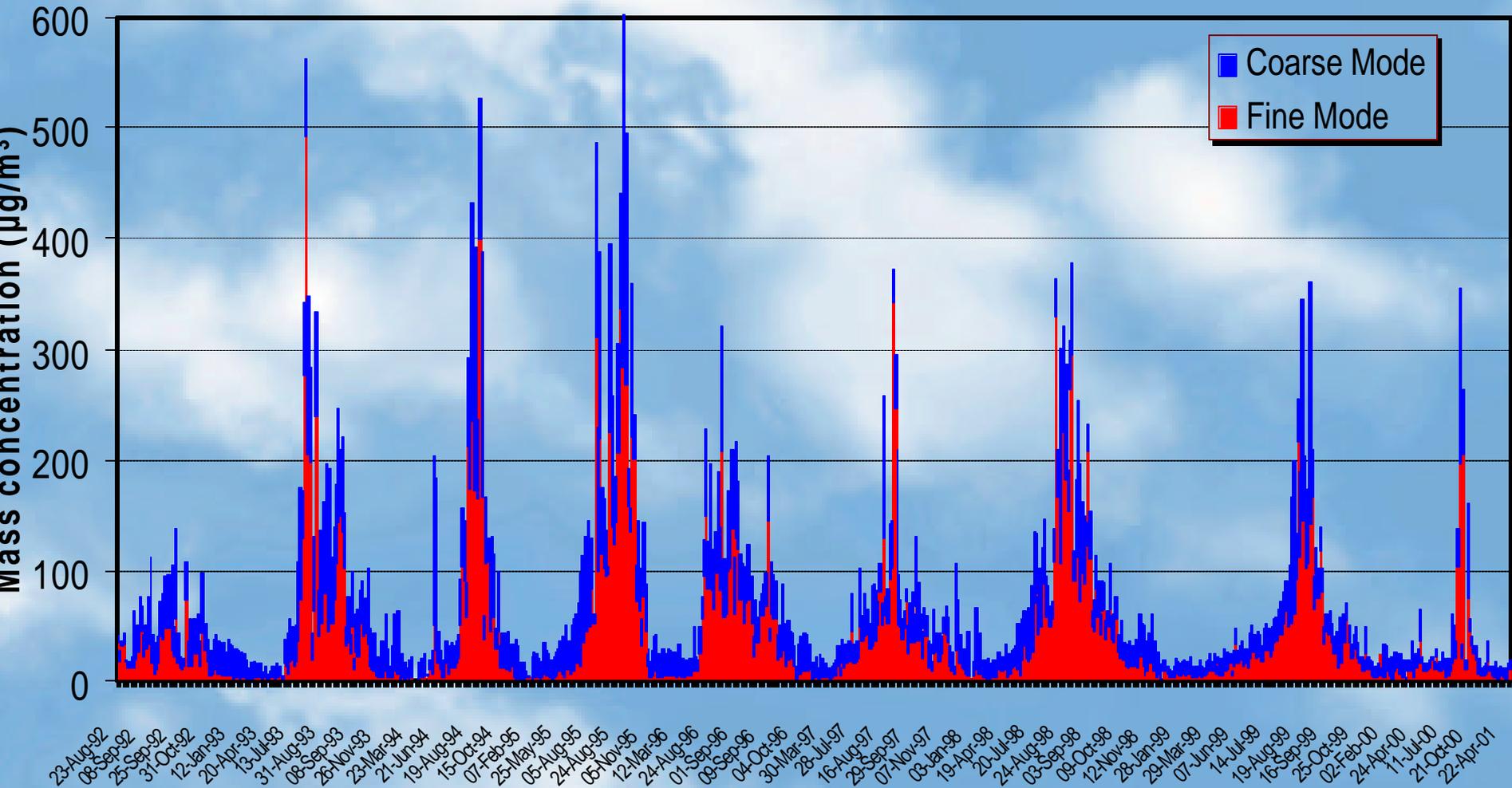
INPE data



Aerosol Concentrations in Amazonia

Aerosol Concentrations in Amazonia changes from very low values of 5-12 $\mu\text{g}/\text{m}^3$ to very high 500 $\mu\text{g}/\text{m}^3$ in areas affected by biomass burning

Alta Floresta Aerosol Mass Concentration 1992-2001

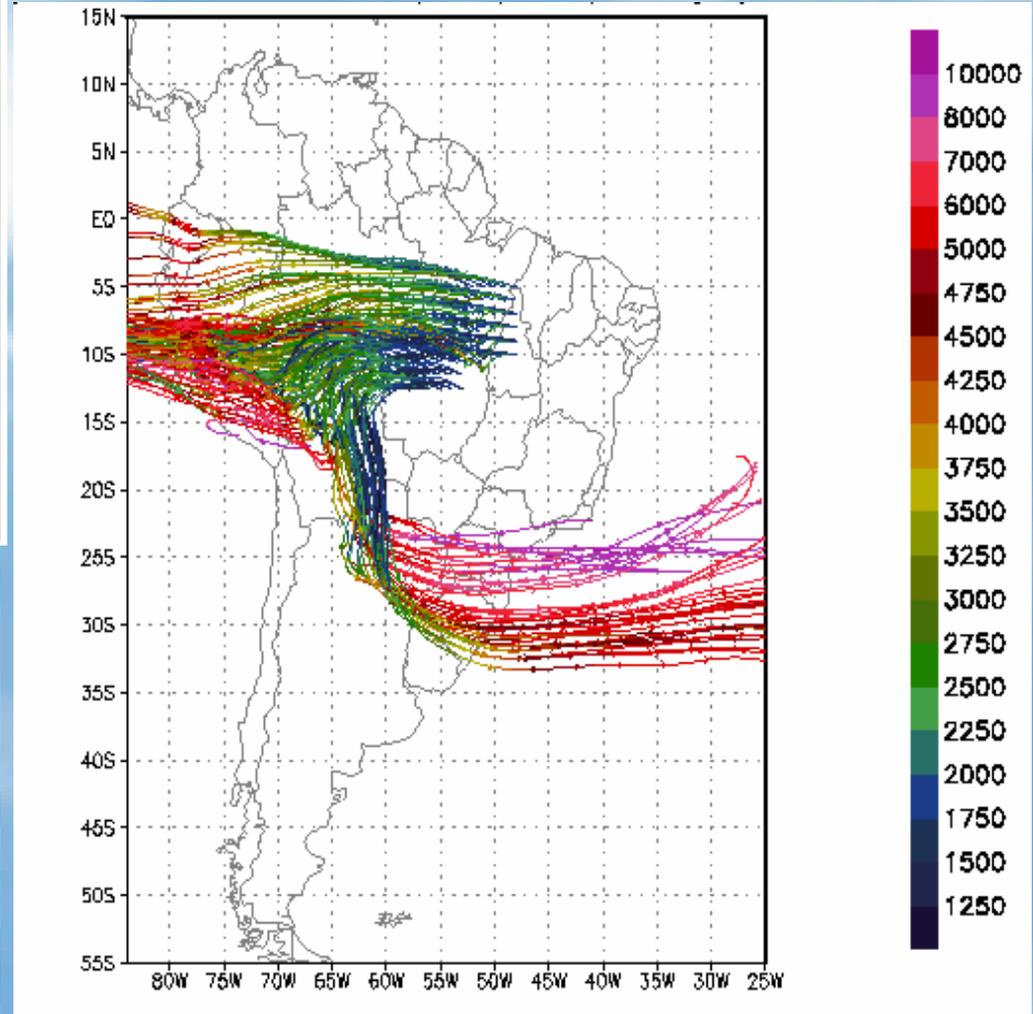
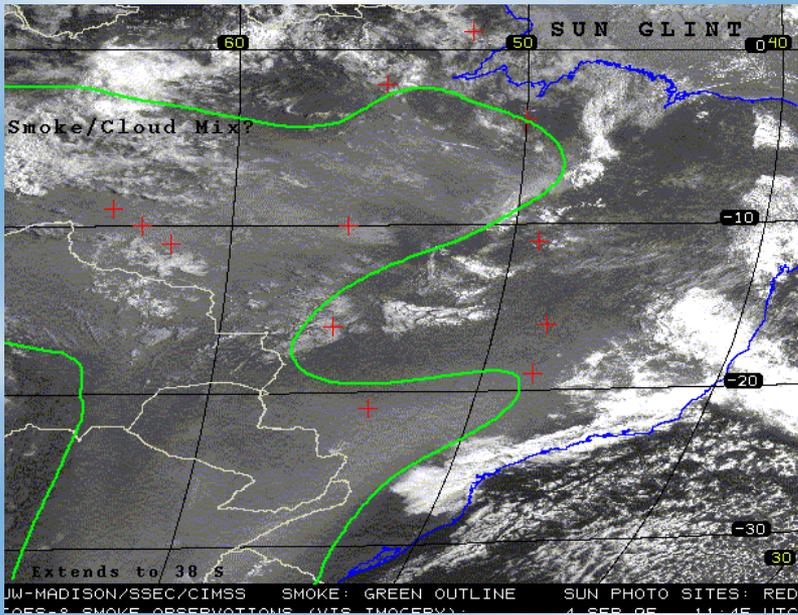
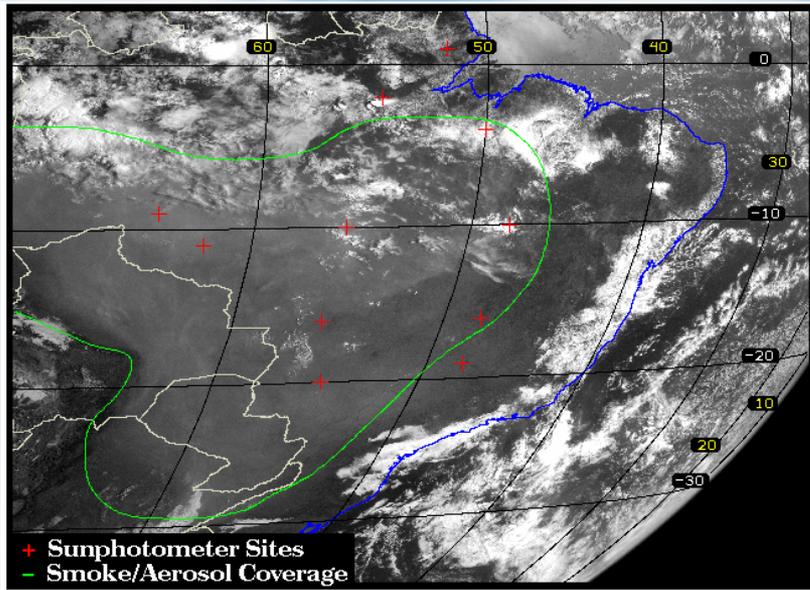




Biomass burning plume covers millions of km²

Biomass burning trajectories

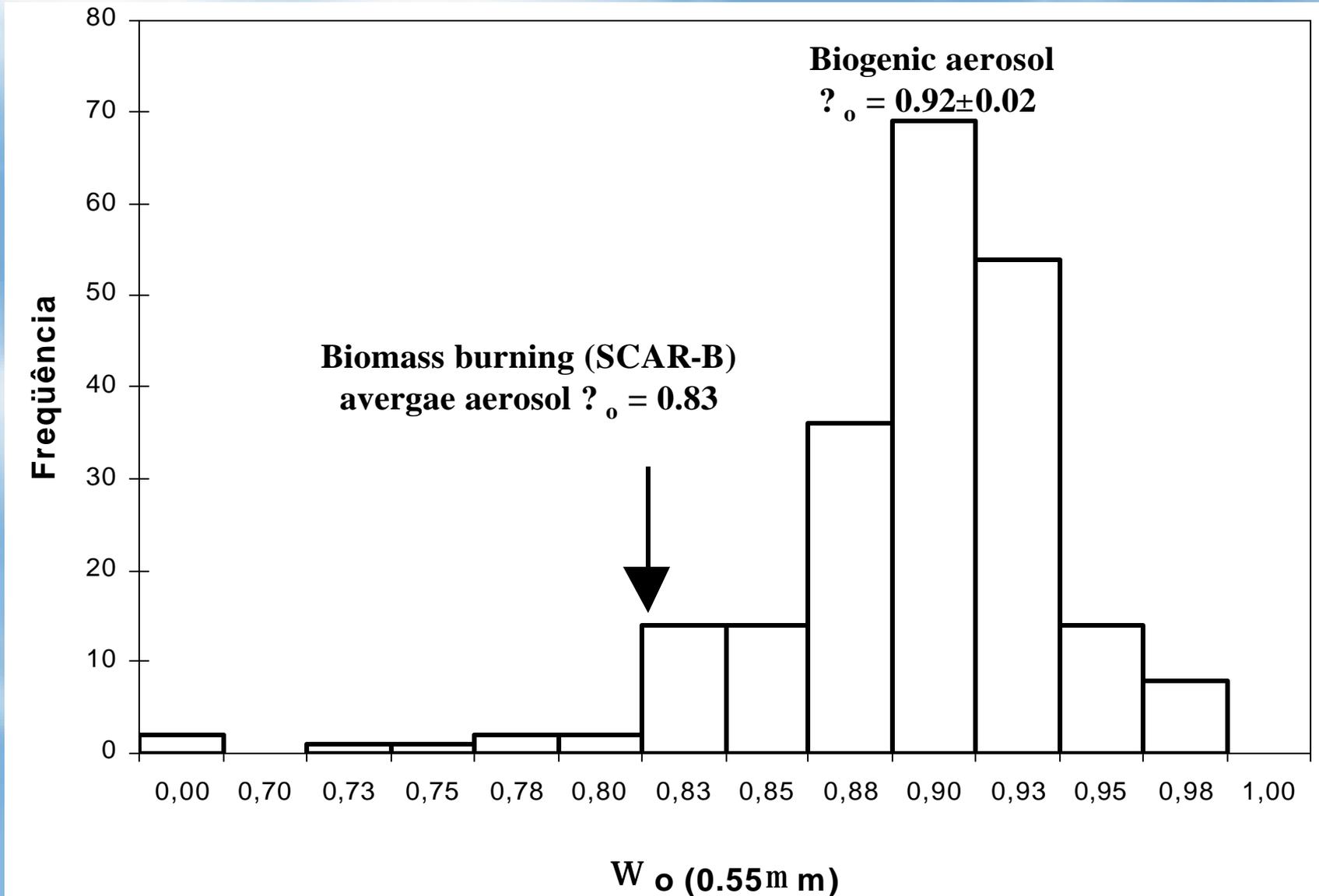
Altitude (m)





But Not Only Smoke and Dust Absorbs Light...

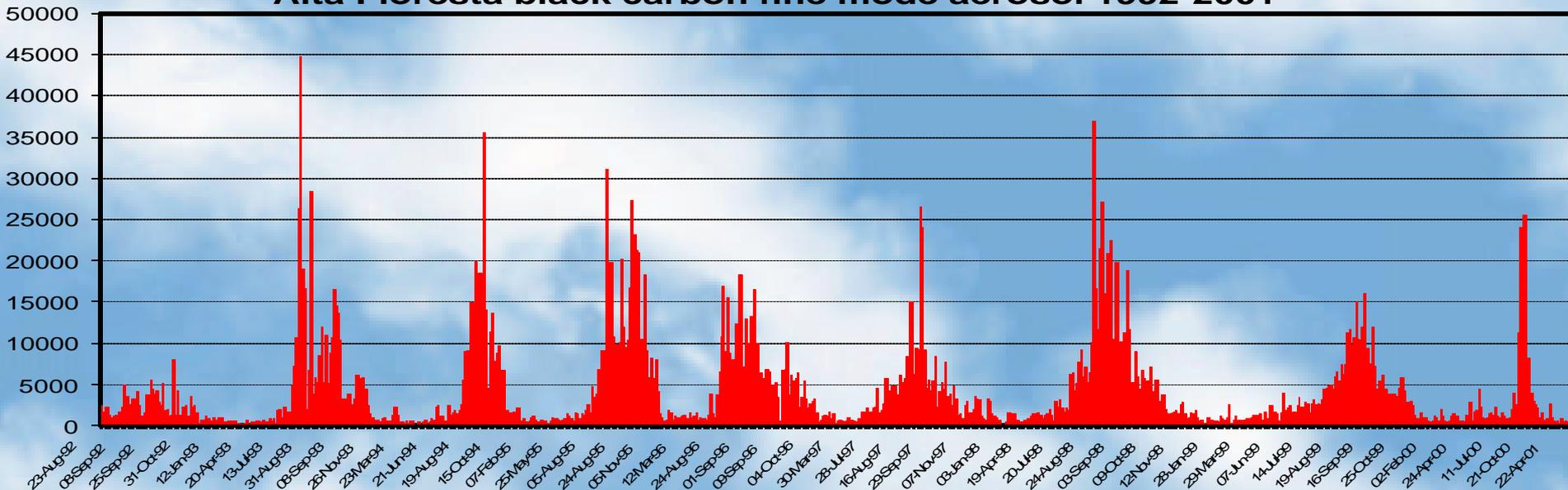
Histogram of τ_o values obtained in the wet season in the Amazon (Balbina), at $\lambda = 0.55 \text{ mm}$.



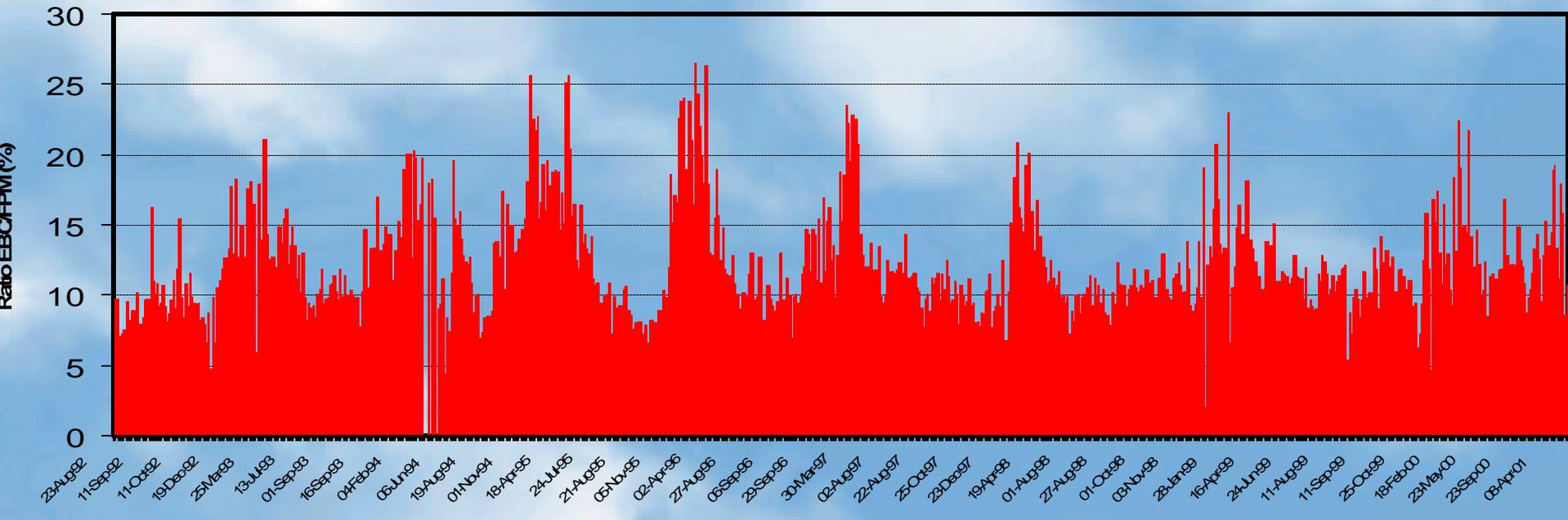


Equivalent black carbon concentration and ratio to FPM

Alta Floresta black carbon fine mode aerosol 1992-2001

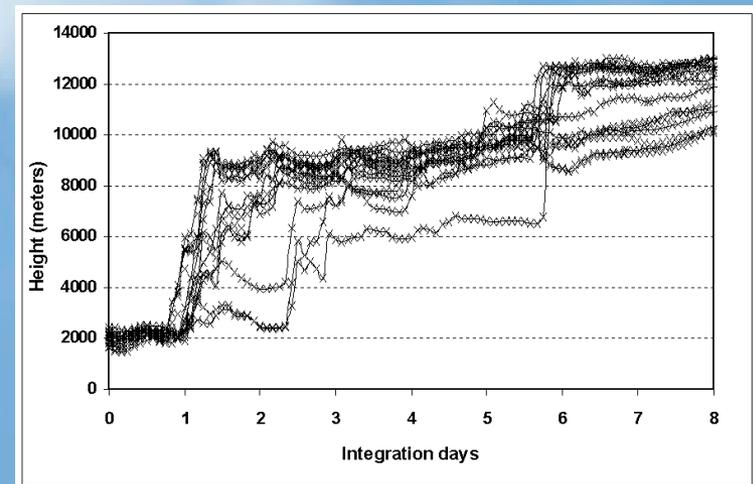
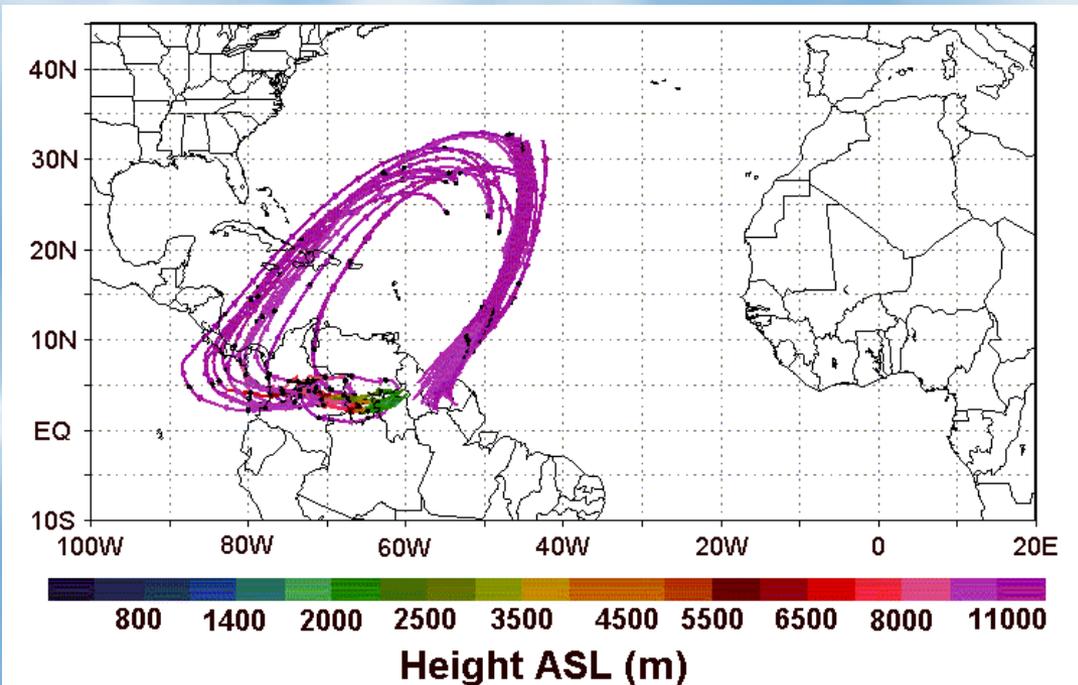
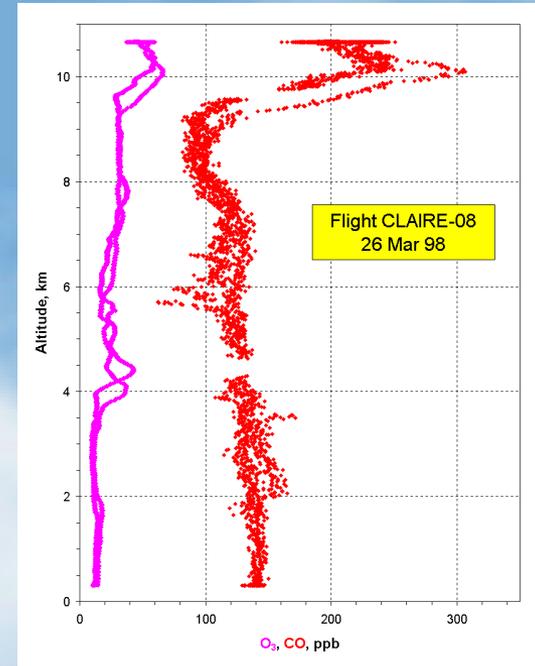


Alta Floresta ratio black carbon to fine mode aerosol 1992-2001



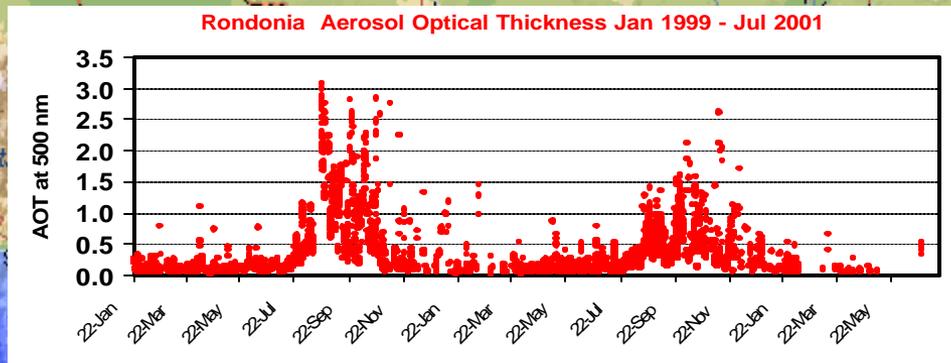
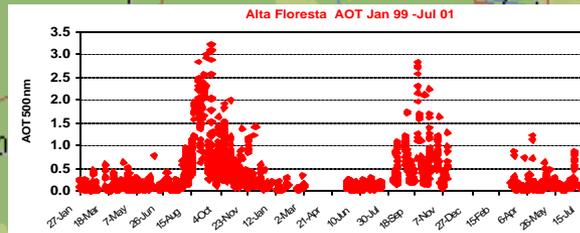
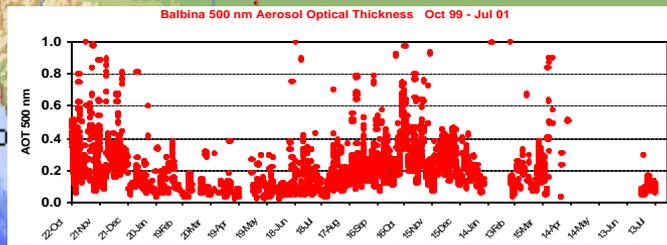
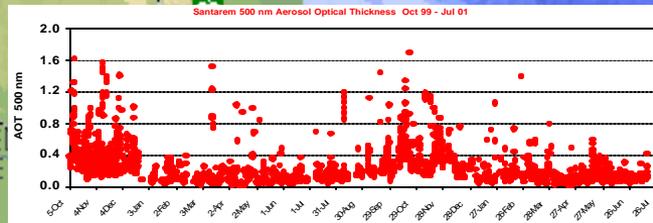
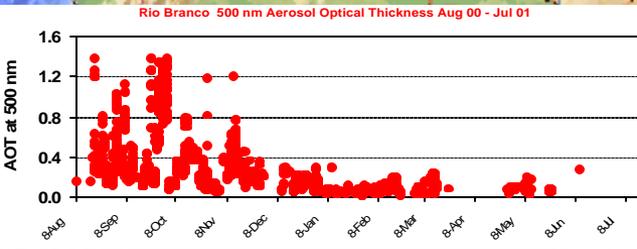


Role of Tropical Convection in Long Range Transport





Aerosol Optical Thickness in Amazonia





Aerosols and radiation in Amazonia

Instantaneous shortfall of 150-350 w/m²

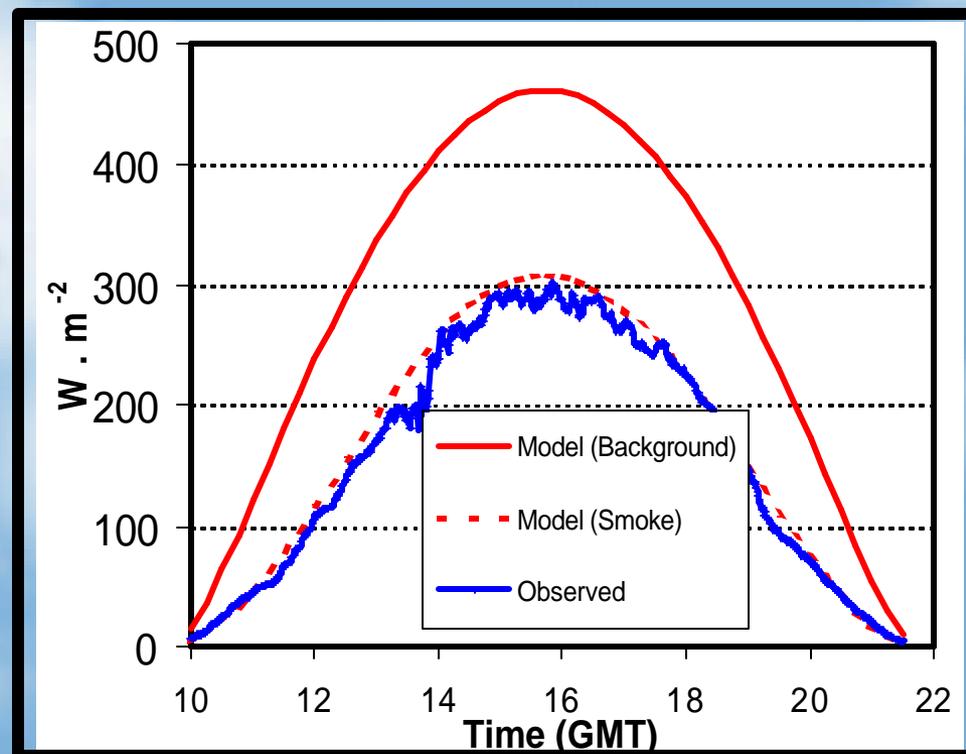
Photosynthetic Active Radiation

Fraction of total irradiance and energy shortfall

AOT (500 nm)	Fraction of background		Shortfall (W/m ²)	
	Amazonia avg.	África avg.	Amazonia avg.	África avg.
0.5	0.91	0.87	81	121
1.0	0.84	0.78	145	210
2.0	0.72	0.63	254	353
3.0	0.63	-	337	-

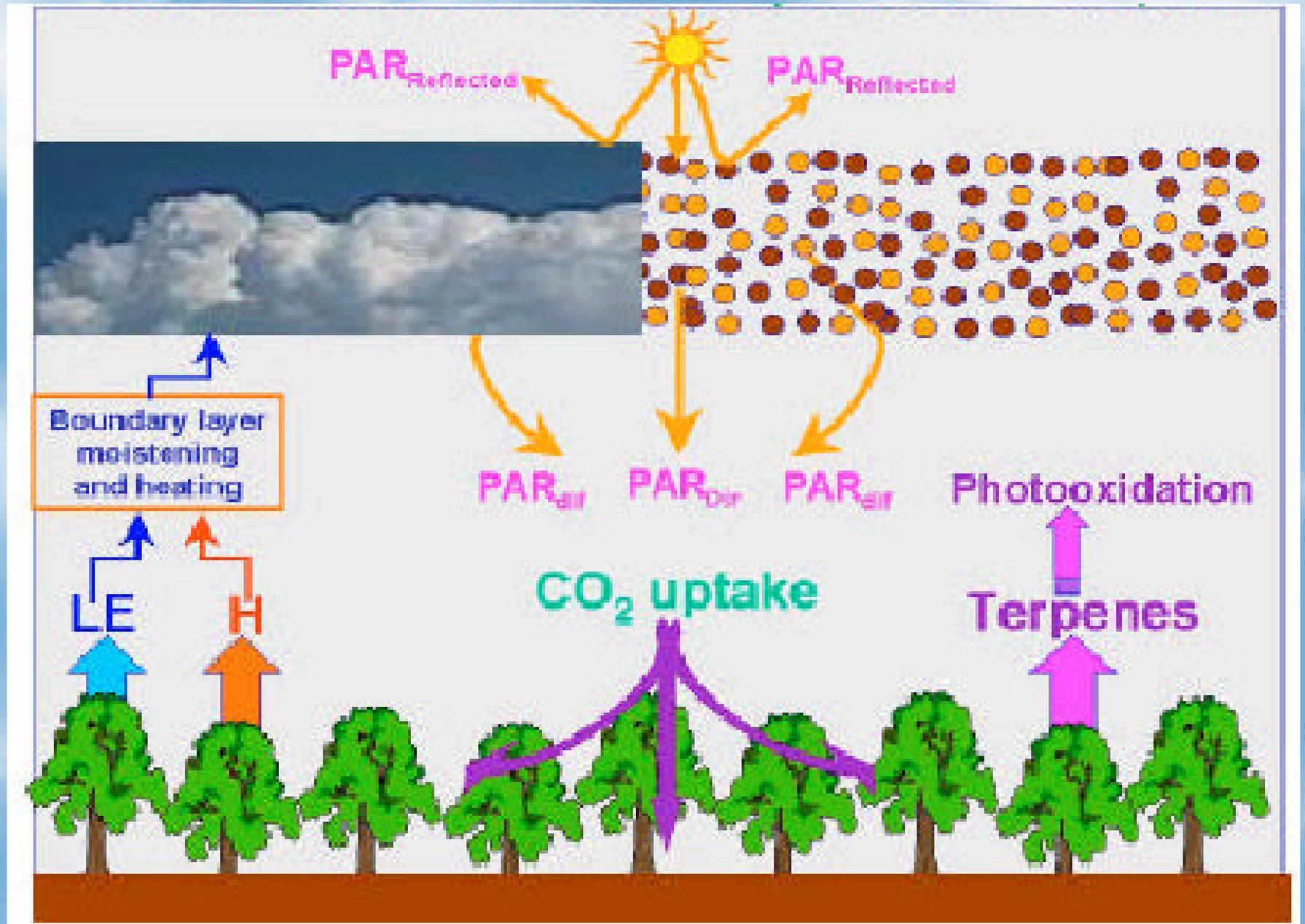
Single Scattering albedo w_0

	Alta Floresta	Rondonia	Zambia
w_0	0.86 ± 0.04	0.87 ± 0.03	0.79 ± 0.03



PAR modelling and measurements in Alta Floresta, 04/09/1999. Red line: no aerosols. Dashed line modelled with AERONET measurements.

Cloud-aerosol-mediated feedback loop on forest carbon uptake





←
Clear day

Visibility ~ ??? km

$N_{CN} \sim 500 \text{ cm}^{-3}$

$CCN \sim 50\text{-}200 \text{ cm}^{-3}$

$BC \sim 0.1\text{-}0.2 \mu\text{g m}^{-3}$



Smoke day

Visibility ~ 800 m

$N_{CN} \sim 10,000 \text{ cm}^{-3}$

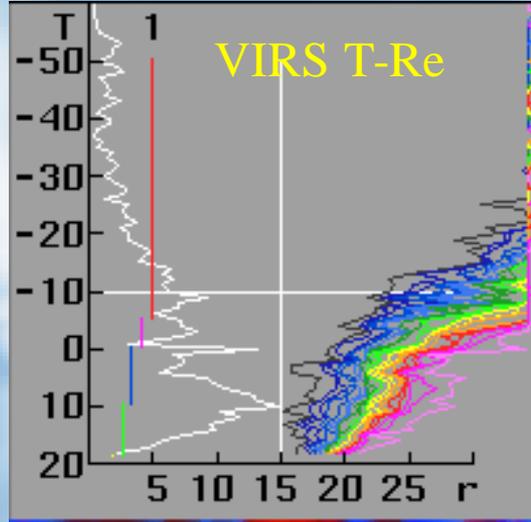
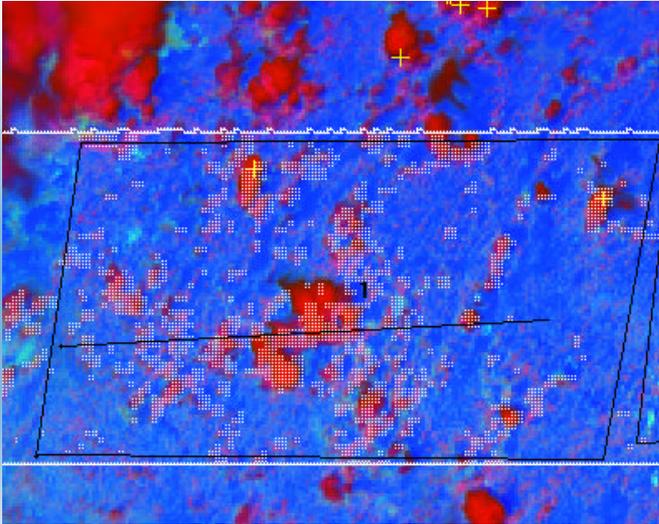
$CCN \sim 3,000\text{-}6,000 \text{ cm}^{-3}$

$BC \sim 7\text{-}20 \mu\text{g m}^{-3}$



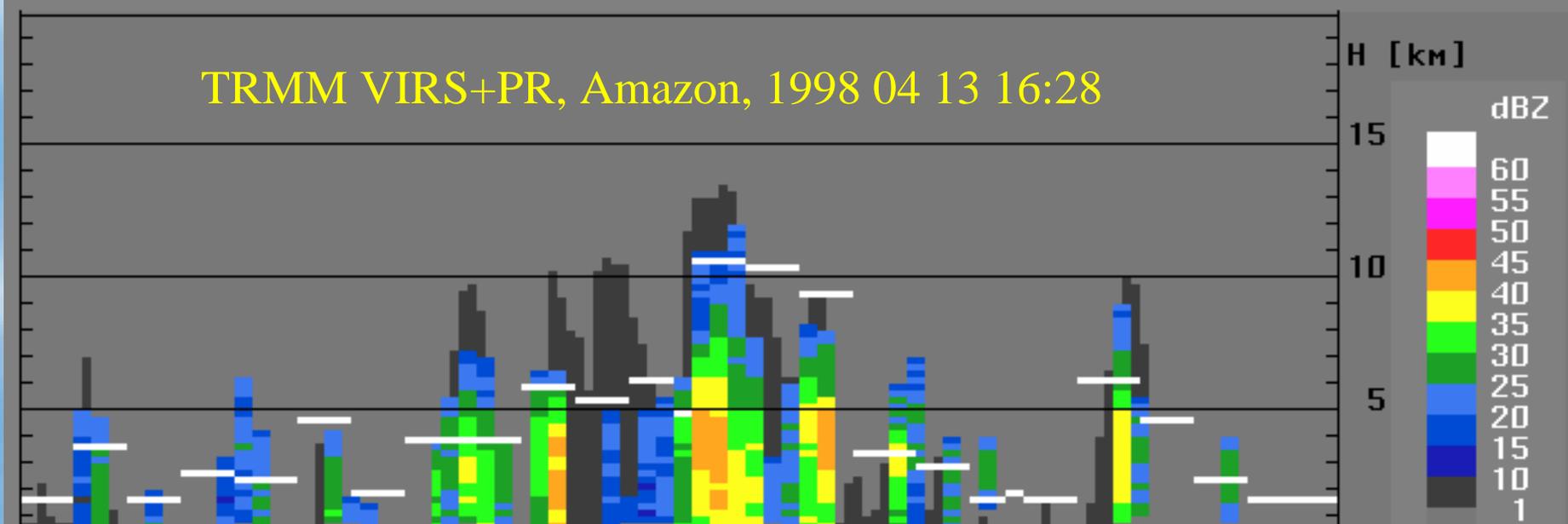
The Green Ocean: Maritime clouds over Amazonia

Low cloud top height, warm rain, little lightning, efficient precipitation mechanism



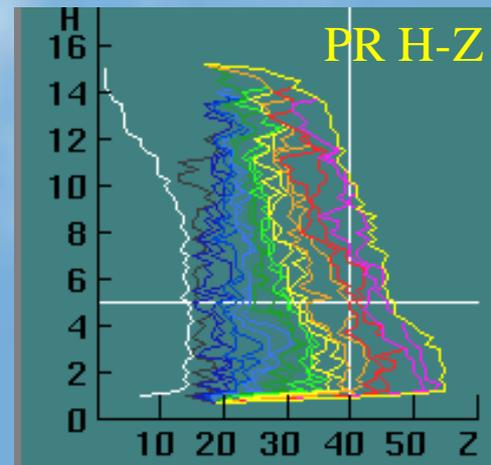
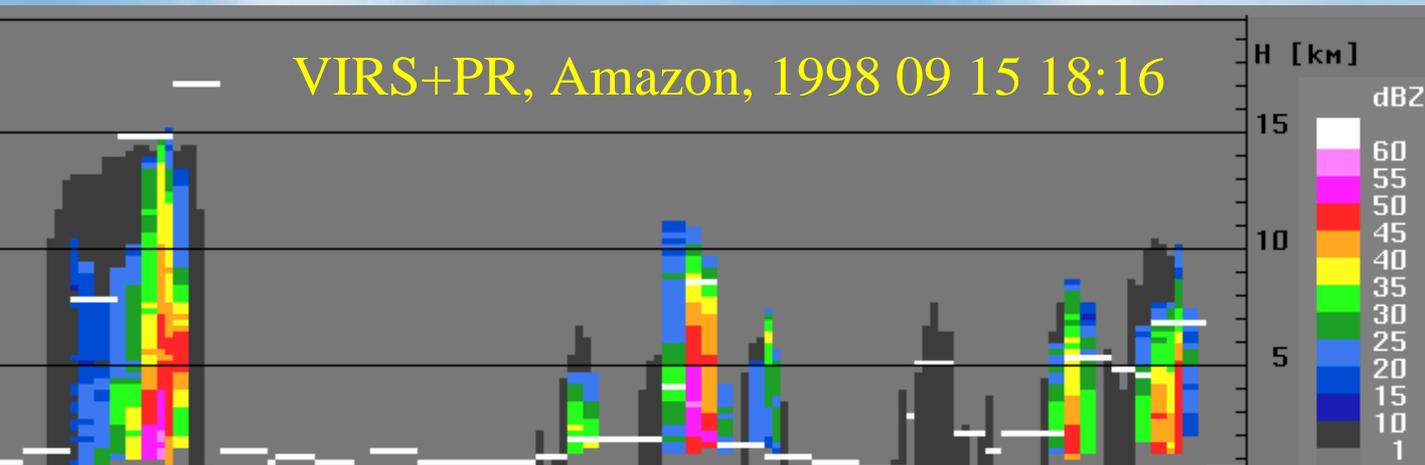
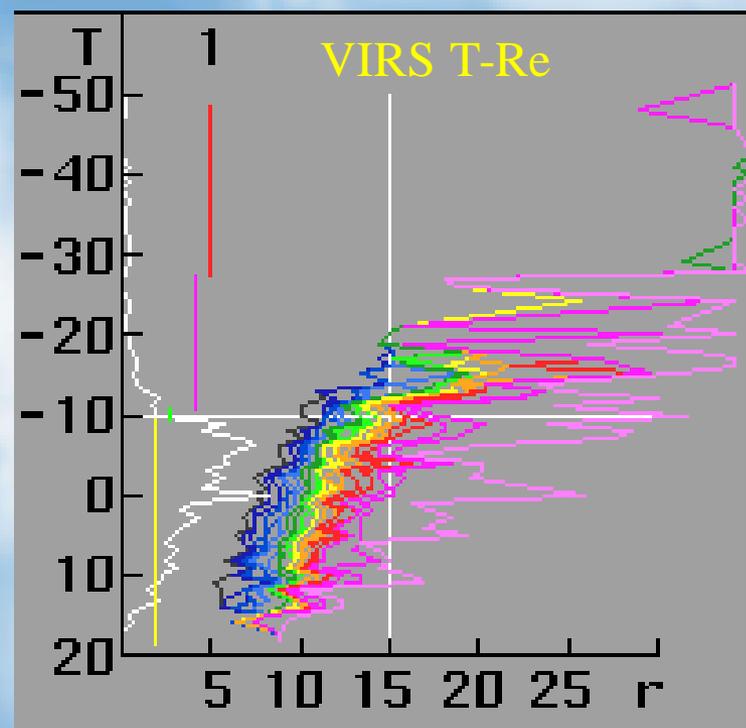
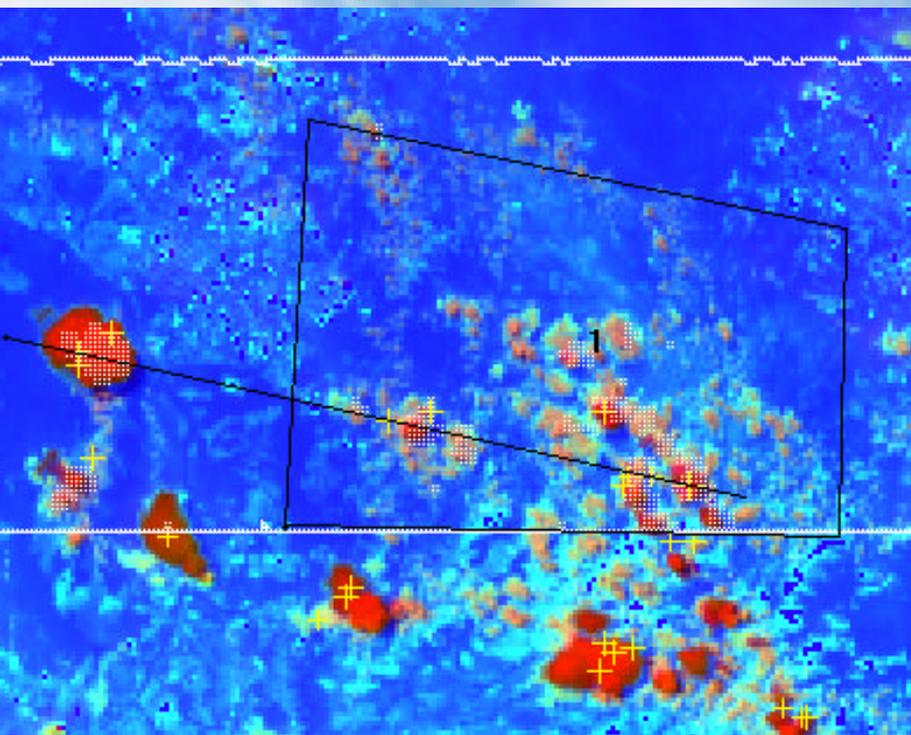
(Danny Rosenfeld)

TRMM VIRS+PR, Amazon, 1998 04 13 16:28





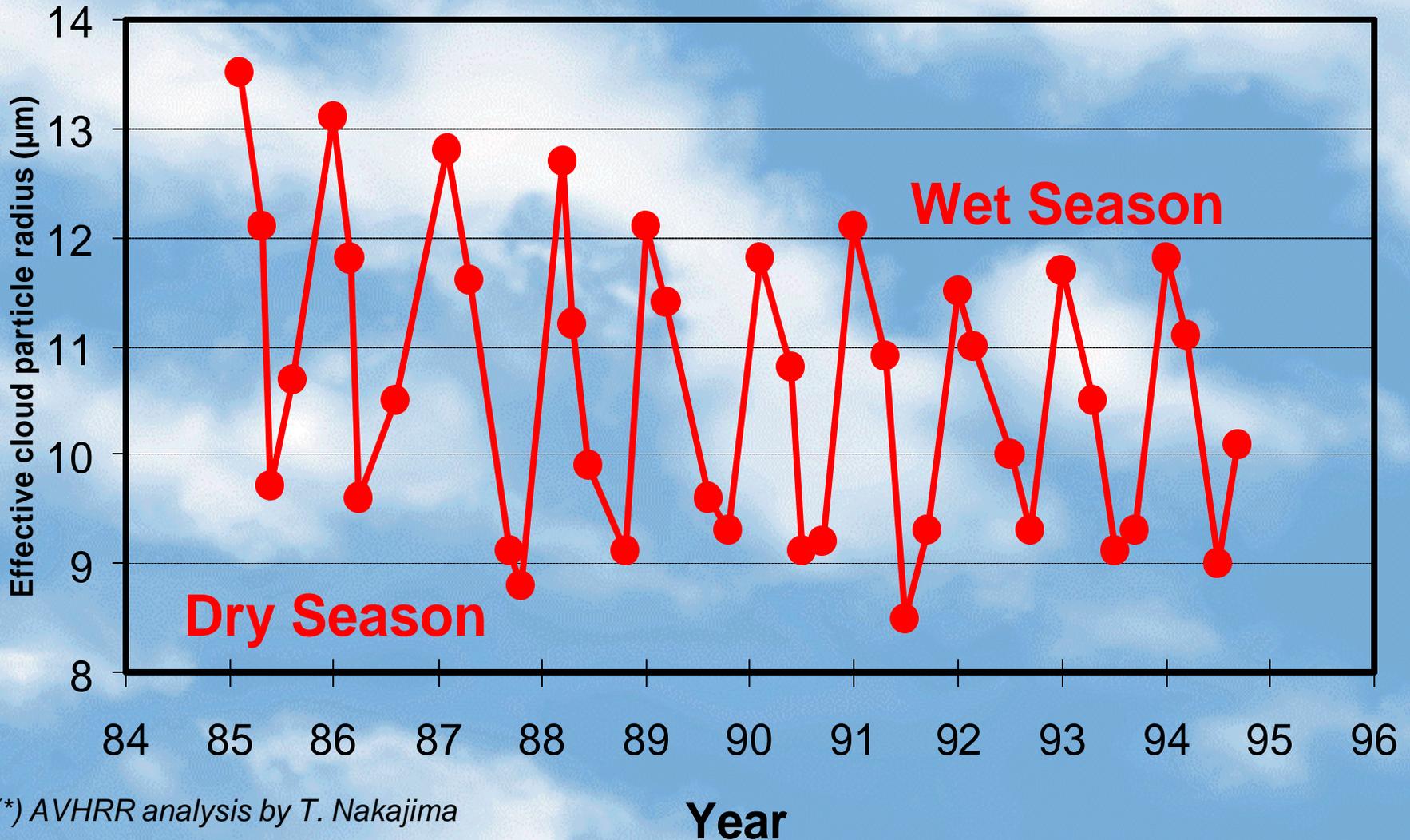
Amazon Basin Dry Season Cloud Structure





Are cloud properties changing in Amazonia because of the occupation process?

Amazon Basin cloud effective radius (*)



(*) AVHRR analysis by T. Nakajima