MEASUREMENT AND MODELLING OF AMMONIA FLUX BETWEEN THE ATMOSPHERE AND A TERRESTRIAL ECOSYSTEM IN HUNGARY

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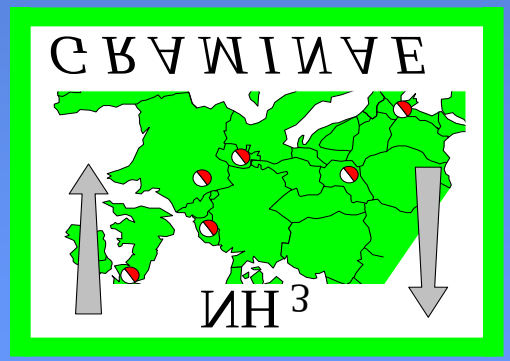
Terrestrial ecosystem

- Hungarian Great Plain
- Püspökladány
- semi-natural grassland
- measurements 2000-2001
- 100 kgN/ha fertilizer for the half sector in May



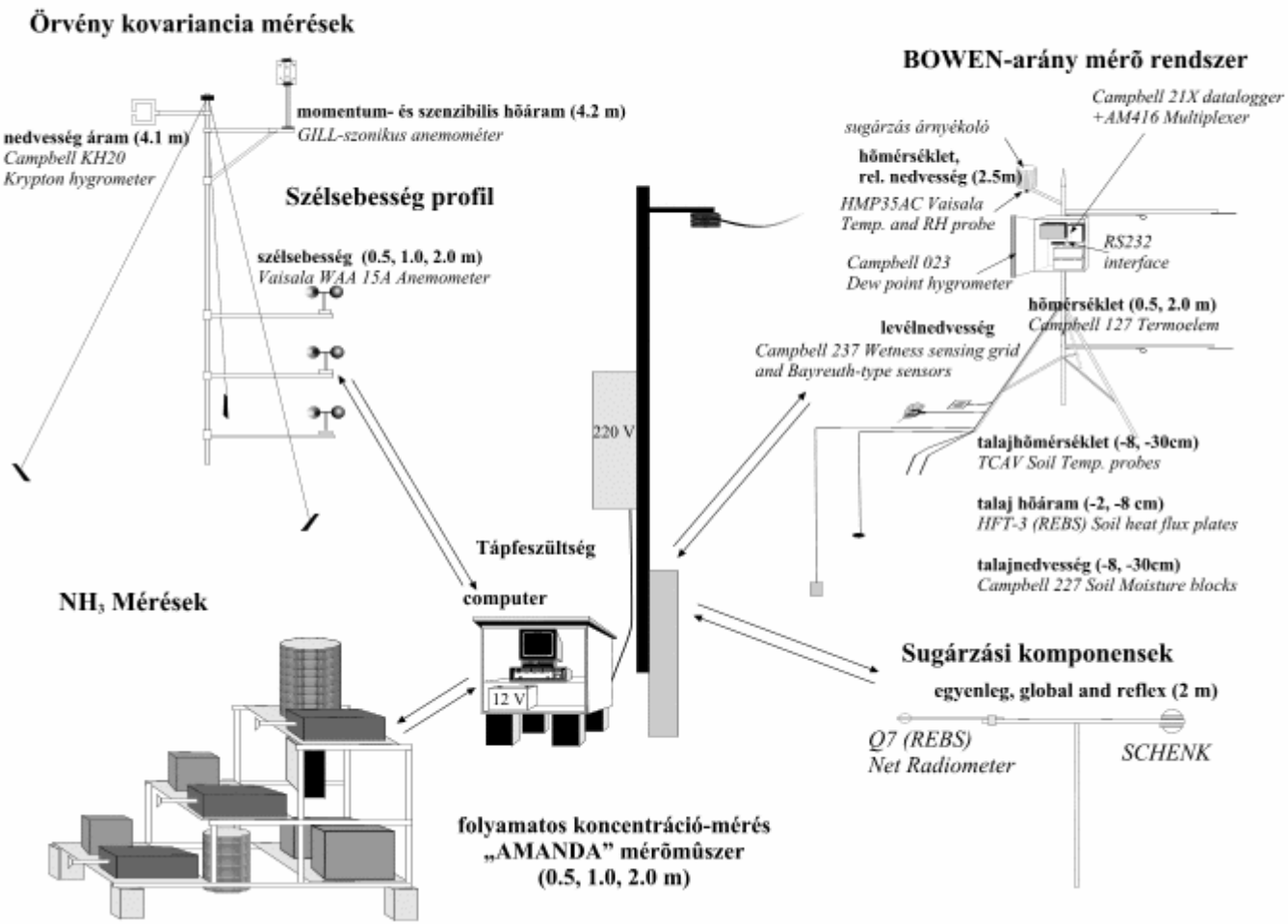
MEASUREMENTS

90 days only

Ammonia gradient measurements

AMANDA 3-channel wet denuder system 2000-2001
H=0.5-1.0-2.0 m

Mérõrendszer



Calculation of ammonia flux by gradient method (Sutton et al., 2000 Agric For Meteorol 105)

Sutton et al., 2000: $F = -u_* \chi_*$

u_* friction velocity χ_* dynamic concentration

$$\chi(z-d) = \frac{\chi_*}{k}\left[\ln\left(\frac{z-d}{z_0}\right) - \psi_H\left(\frac{z-d}{L}\right)\right] + \chi(z_0)$$

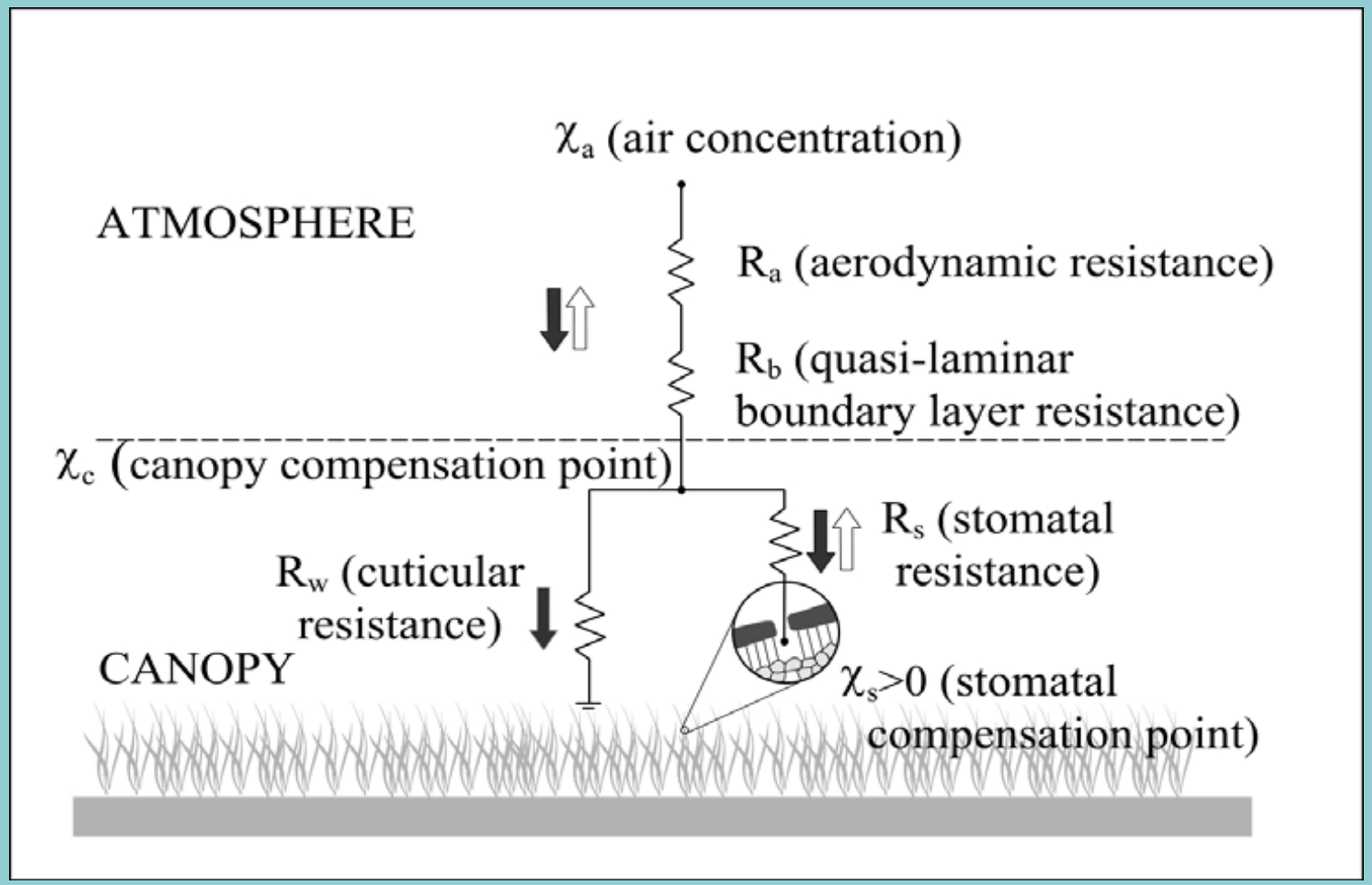
χ(z–d) ammonia concentration at the height z

$$L = \frac{u_*^2}{k\beta T_*}$$

$$\beta = g / \Theta$$

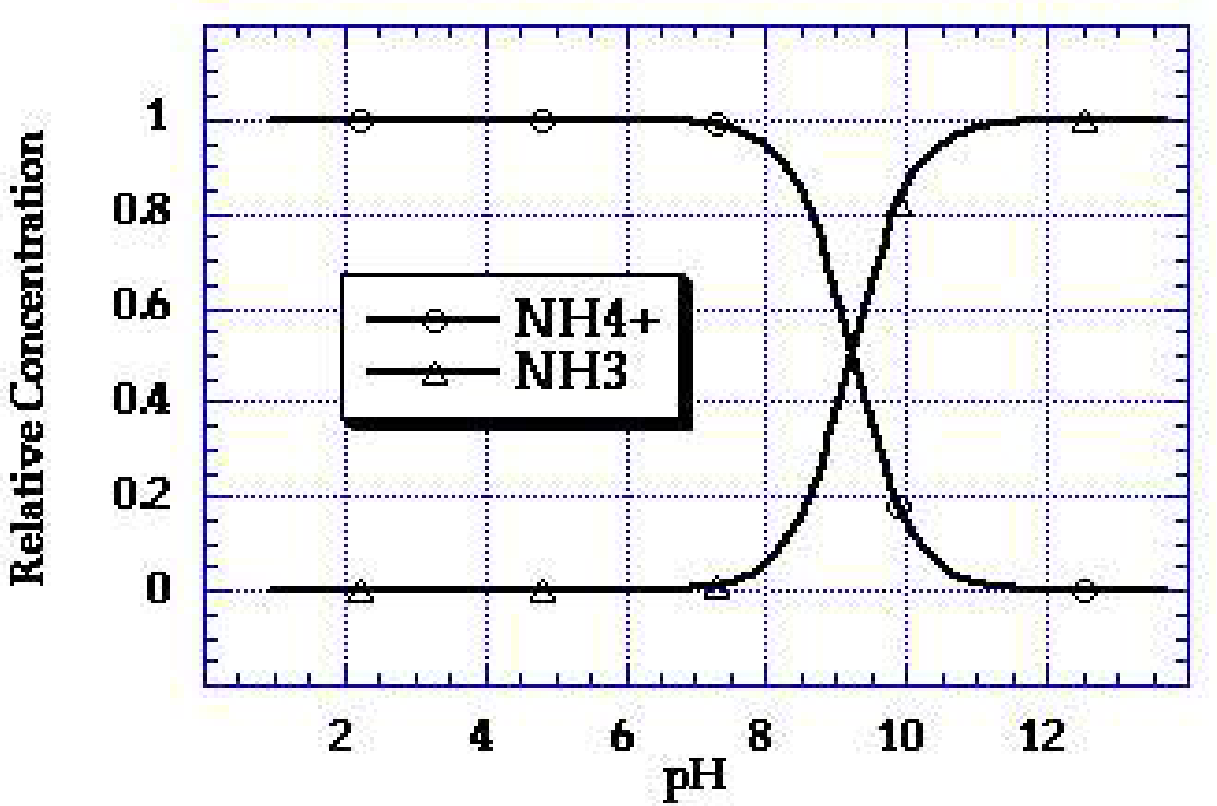
MODELLING

Single layer modelling
(Nemitz et al. 2000, Agric For Meteorol 105)



Is there soil efflux of ammonia?

pH of the soil in the upper layer 6-7



$$F_t = F_s + F_w$$

$$F_s\,(\mathrm{ng\,m^{-2}\,s^{-1}}) = 1000\frac{\chi_s - \chi_c}{r_s}$$

$$F_w\,(\mathrm{ng\,m^{-2}\,s^{-1}}) = 1000\frac{\chi_c}{r_w}.$$

$$r_s = r_{s,\min}\left(1 + \frac{b_s}{R_G}\right)$$

$$r_w = \min(r_{w,\max}, r_{w,\min}\exp\left[b_w(e_s - e)\right])$$

$$\chi_c = \frac{\chi_s r_w(r_a + r_b) + \chi_a r_w r_s}{r_w r_s + (r_a + r_b)r_w + (r_a + r_b)r_s}$$

$$r_a = \frac{u}{u_*^2}, \quad \text{if } L > 0$$

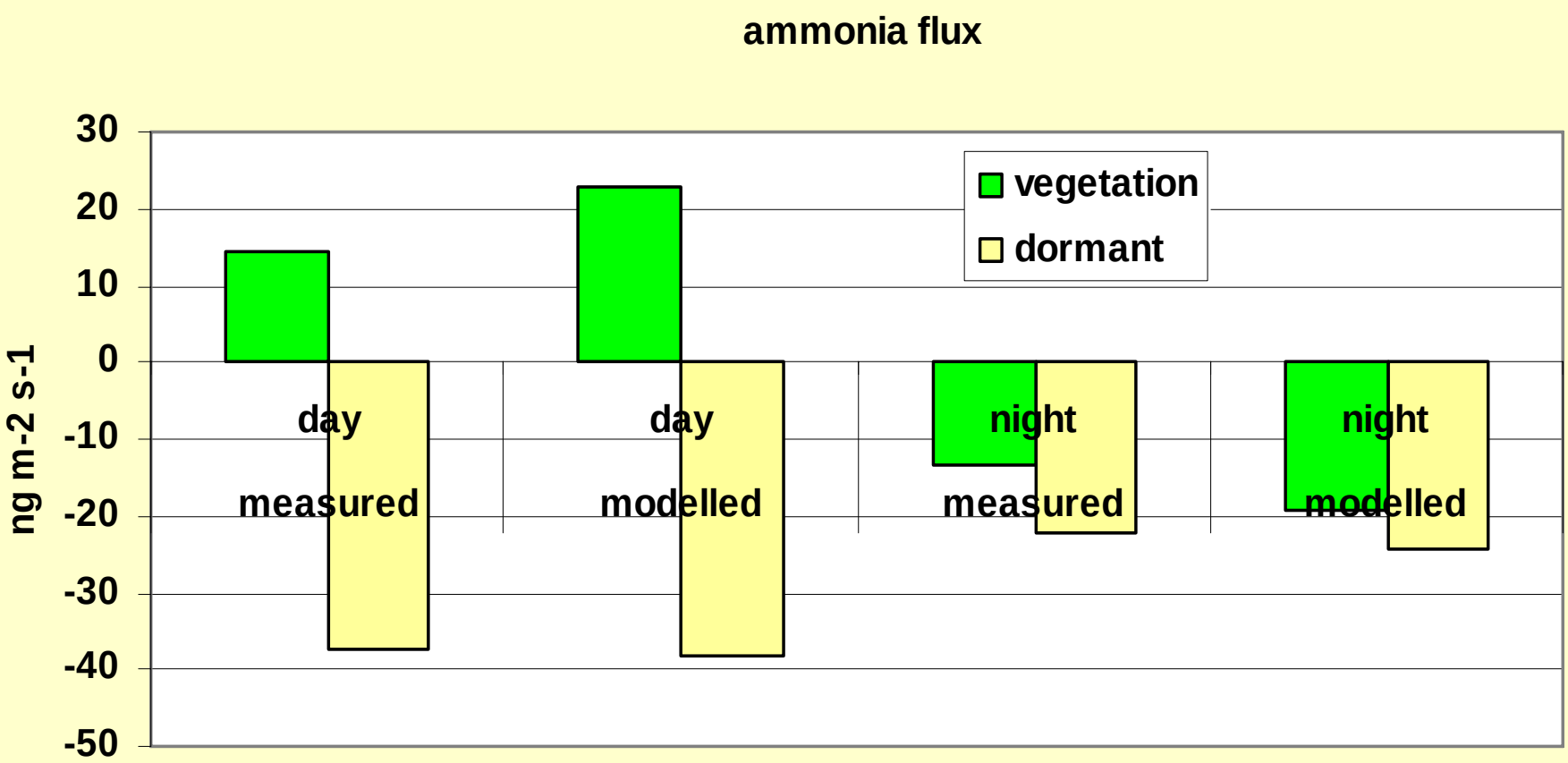
$$\chi_s = \frac{161500}{T}\exp\left(-10378T^{-1}\right)\Gamma_s$$

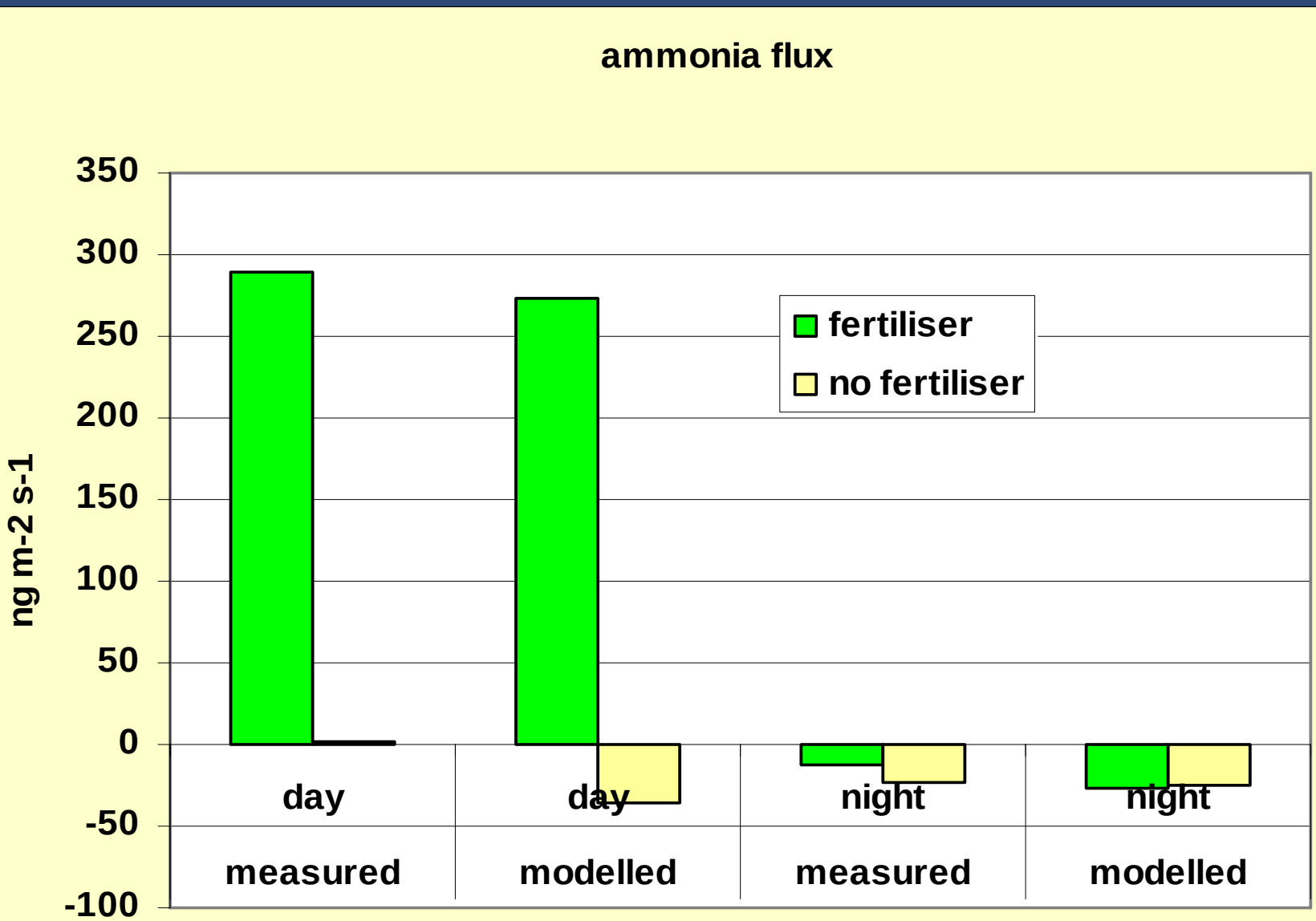
$$r_a = \frac{u}{u_*^2} - \frac{\Psi_H - \Psi_M}{k u_*}, \quad \text{if } L < 0$$

$$\Gamma_s = \frac{[\mathrm{NH_4^+}]_{ap}}{[\mathrm{H^+}]_{ap}}$$

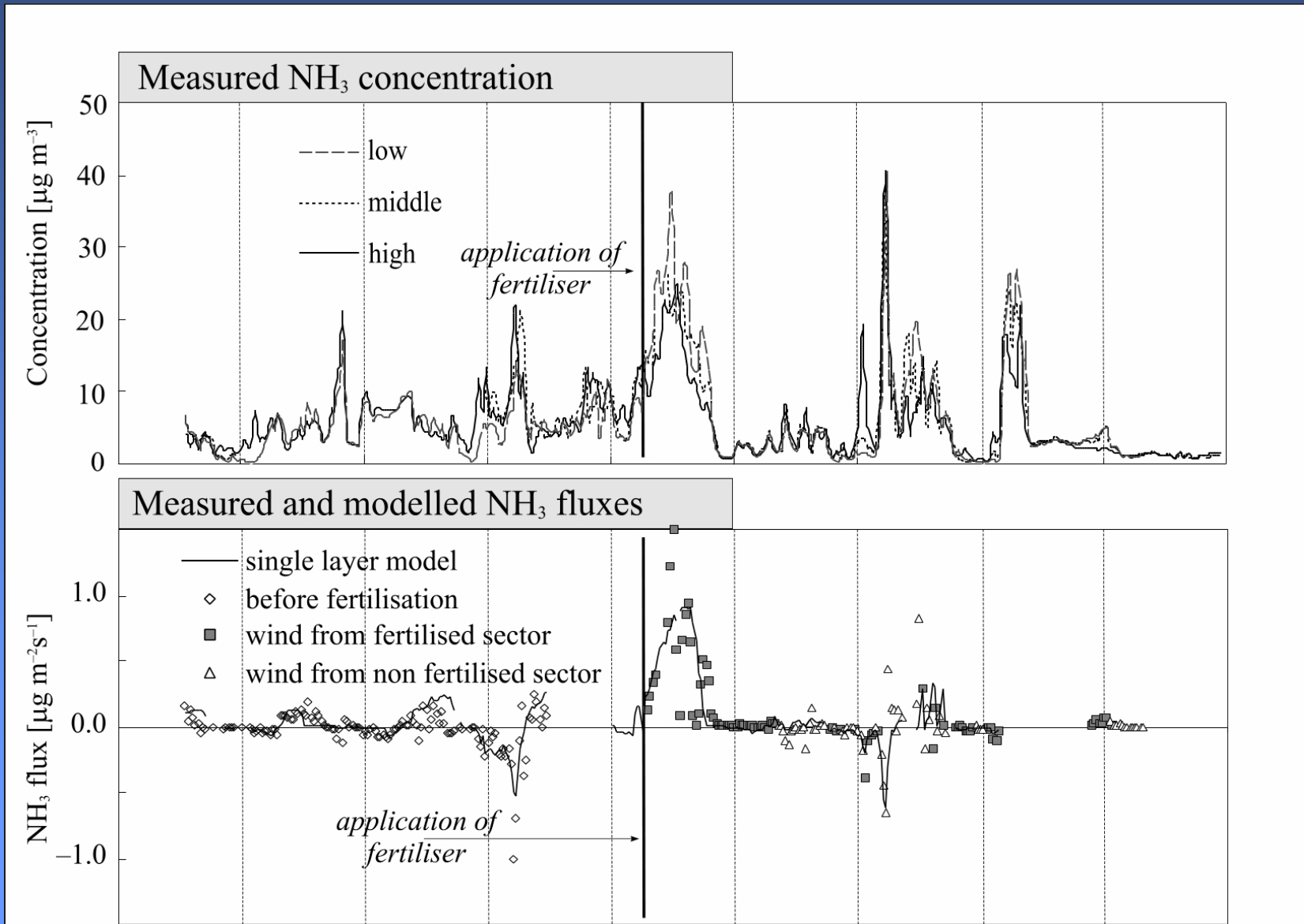
$$r_b = \frac{1.45 Re^{0.24} Sc^{0.8}}{u_*}$$

Difficulties with estimation of some input parameters (e.g. with Γ)
Change till the best fit


ammonia flux
ng m-2 s-1
30
20
10
0
-10
-20
-30
-40
-50
vegetation
dormant
day
measured
day
modelled
night
measured
night
modelled


ammonia flux
ng m-2 s-1
350
300
250
200
150
100
50
0
-50
-100
fertiliser
no fertiliser
day
day
night
night
measured
modelled
measured
modelled

Comparison of modelled and measured fluxes 14-22 May, 2001



Deposition of other N-compounds

N-compound	wet deposition	dry deposition	total (wet+dry)
	g N m^{-2} yr^{-1}	g N m^{-2} yr^{-1}	g N m^{-2} yr^{-1}
NH_4^+-N	0.26	0.05	0.31
HNO_3-N		0.32	0.32
NO_3^--N	0.21	0.08	0.29
NO_2-N		0.00	0.00
total	0.47	0.45	0.92

N-balance

Total N-deposition without ammonia	0.92	g N/m^2yr
Ammonia		
Weak emission in vegetation period:	0.037	g N/m^2
Deposition in dormant season:	0.50	g N/m^2
Net yearly deposition of ammonia:	0.46	g N/m^2yr
Total N-deposition with ammonia	1.38	g N/m^2yr

Conclusions

- Ammonia plays key role in N-budget (1/3)
- Net deposition when stomata closed (dormant, night)
- Net emission when stomata open (vegetation season, daytime)
- Relatively good correlation between measured and modelled fluxes, but…
- After fertilizer large emission during dayime, for 2 weeks (EF=1.3%) (more stomatal than soil emission)

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Measurement of ammonia exchange over grassland in the Hungarian Great Plain

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