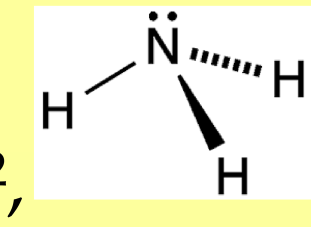
Developing a method to estimate the ammonia loss from fertilized cropland and the part of soil emission recaptured by the canopy, applying field scale bidirectional models and flux measurements.



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Aims: developing a method for

- application of different bidirectional exchange models for different circumstances (day/night, dry/wet foliage, bare soil/vegetation),
- measurement as many as possible parameters avoiding the empirical parameterization, and
- determination of ammonia loss from fertilizers and the amount of soil emission recaptured by wet/dry cuticular ab/adsorption and stomatal uptake.

Photoacoustic measurement of total flux above canopy by the relaxed eddy accumulation method with an open path cell.

By using open path cell, the bias by ad/desorption on walls of sampling units can be avoided.

Soil emission measurement using the PICARRO G2103 and soil chamber.

By direct soil flux measurement the error caused by empirical parameterization (neglecting litter emission, overestimation of ammonium in soil) can be avoided.

Intercomparison of the measured total flux with the soil flux above bare soil.

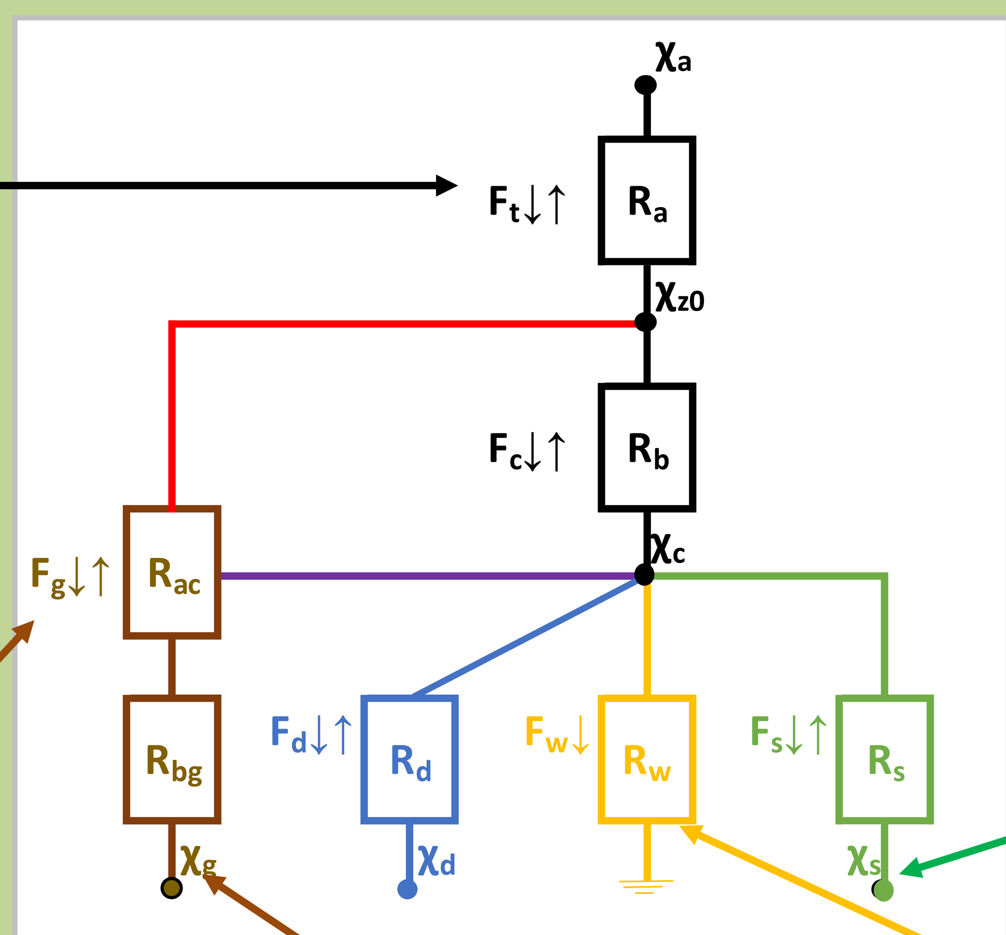
$$F_t = F_g$$

(in case of homogeneous fetch)

After fertilization, direct calculation of the part of ammonia re-captured by the canopy $F_c = F_t - F_g$.

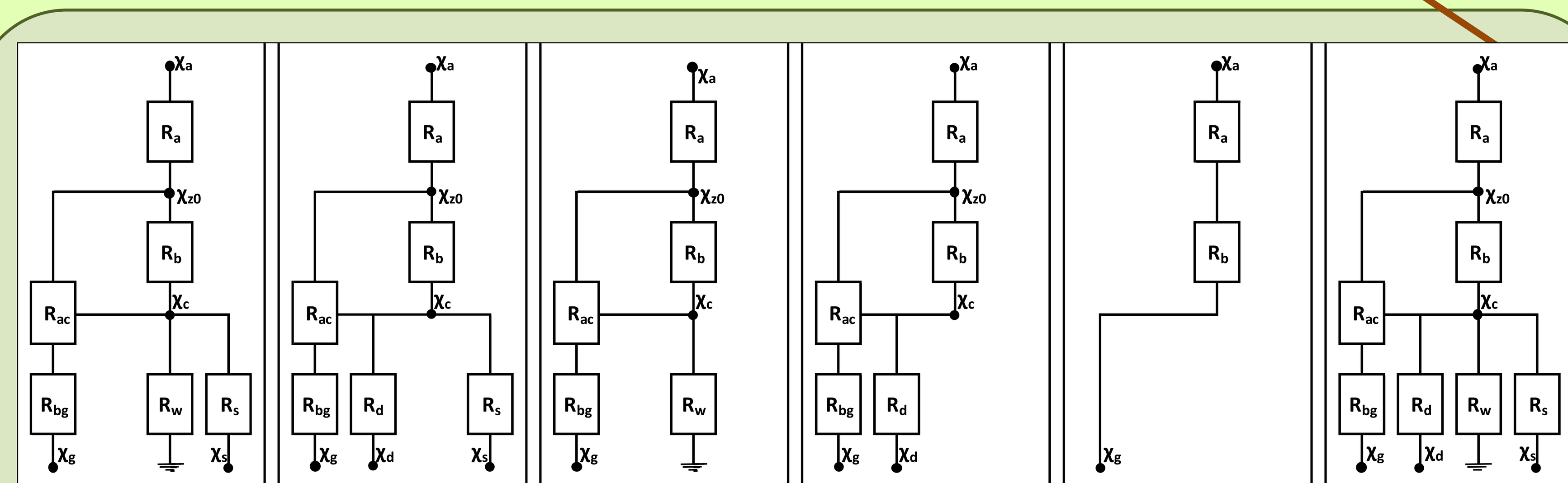
Day: $F_c = F_s + F_d$ (dew, guttation)
Day: $F_c = F_s + F_w$ (dry leaves)
Night: $F_c = F_d$ (dew, guttation)
Night: $F_c = F_w$ (dry leaves)

Possible pathways for ammonia in the fertilized soil-plant-atmosphere system. Combination of bidirectional exchange models (Nemitz et al., 2000; Burkhardt et al., 2009; Zhang et al., 2010).



F_c canopy flux
F_g measured soil-litter flux
F_s stomatal flux
F_t measured total flux
F_w deposition flux to cuticula
R_a aerodynamic resistance
R_{ac} aerodynamic resistance above soil
R_b resistance of quasi laminar layer
R_{bg} boundary layer resistance above soil
R_d wet cuticular resistance
R_s stomatal resistance
R_w cuticular resistance for deposition
χ_a measured concentration above canopy
χ_c canopy compensation point concentration
χ_d compensation point concentration, wet leaf
χ_g soil-litter compensation point concentration
χ_s stomatal compensation point concentration
χ_{z0} concentration at z_0

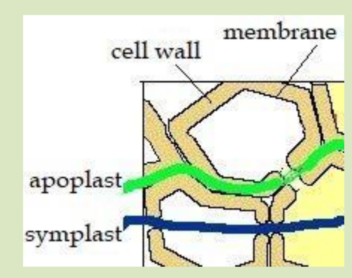
all cases
soil exchange
stomatal exchange (day)
foliar recapture of soil emission
soil emission without foliar uptake
absorption by dew, drops on cuticula
deposition on dry cuticula



$I_p > 0$, LW < 1	$I_p > 0$, LW = 1	$I_p = 0$, LW < 1	$I_p = 0$, LW = 1	$I_p \geq 0$, LW ≥ 0	$I_p \geq 0$, LW ≥ 1
daytime, dry cuticula	daytime, drops on cuticula	night-time, dry cuticula	night-time, drops on cuticula	no vegetation, bare soil	all pathways

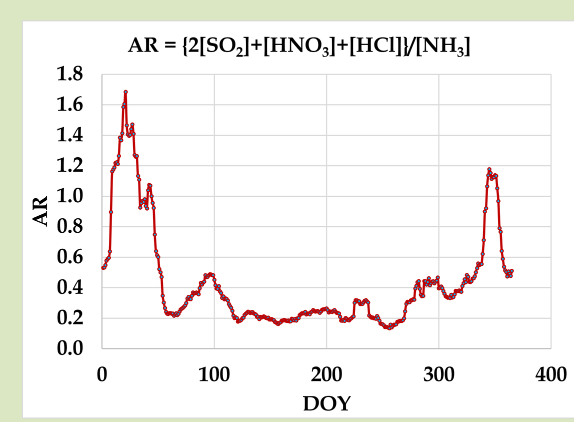
Application of different models for different circumstances.
I_p: photosynthetically active radiation, *LW*: leaf wetness (fractional 0-1).

Stomatal compensation point concentration (χ_s) depends on the emission potential of apoplast Γ=[NH_4^+]/[H^+].



Bioassay measurements to avoid the bias caused by use of bulk tissue [NH_4^+]/[H^+] ratio instead of apoplastic concentrations, which determine the emission potential.

R_w strongly depends on the ratio of acid/base compounds (AR index).



Using daily concentration data from the database of background air pollution monitoring stations.

Comparison the measured and empirically calculated soil flux from soil bulk [NH_4^+].

Prevents the bias by using bulk soil [NH_4^+] while:

1) neglecting litter emission (underestimation) and
2) part of soil [NH_4^+] in solid phase does not play role in liquid-air equilibrium (overestimation).

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