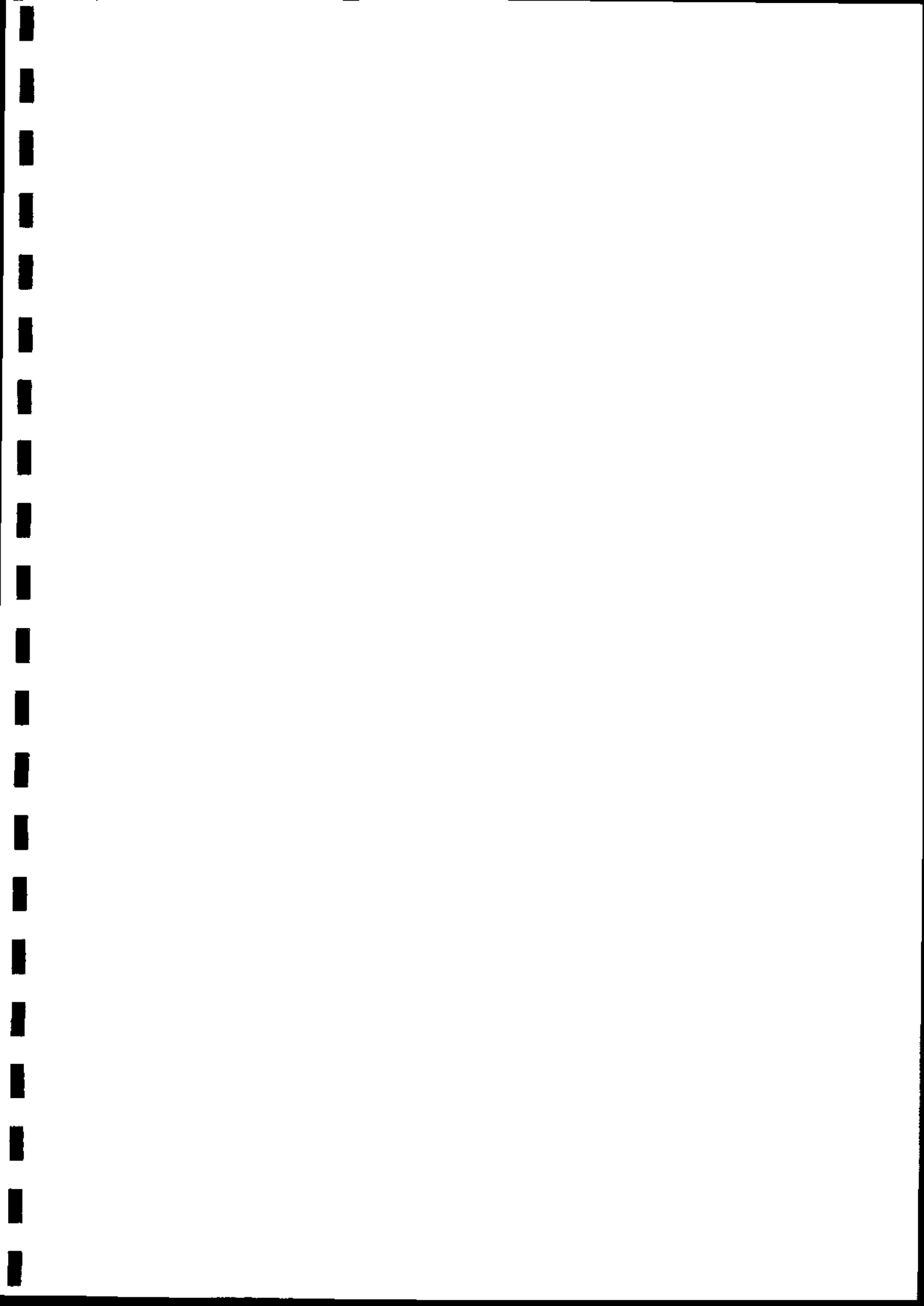


**A canopy compensation point model  
to describe the surface/atmosphere exchange of NH<sub>3</sub>:  
a simple implementation in EXCEL 5.0**

*Mark A. Sutton and Eiko G. Nemitz*

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Institute of Terrestrial Ecology (Edinburgh Research Station)  
Bush Estate, Penicuik, Midlothian  
EH26 0QB, Scotland, UK



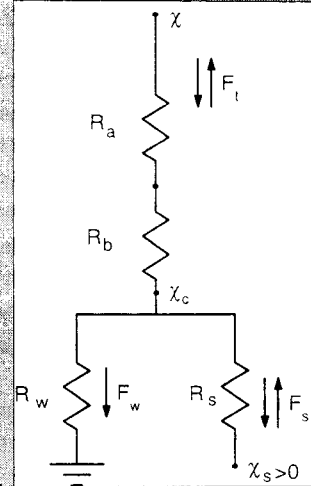
## A canopy compensation point model to describe the surface/atmosphere exchange of NH<sub>3</sub>: a simple implementation in EXCEL 5.0

Mark A. Sutton, Eiko G. Nemitz, Institute of Terrestrial Ecology

The model presented in this spreadsheet describes the surface/atmosphere exchange of NH<sub>3</sub> by a canopy compensation point model. Unlike the simple R<sub>c</sub> model, the canopy compensation point approach accounts for the competition of both the bi-directional exchange through the stomata and the cuticular uptake. The canopy compensation point (X<sub>c</sub>) can be regarded as the net potential for NH<sub>3</sub> exchange at the canopy level. The net flux above the canopy (F<sub>t</sub>) is divided into

- the bi-directional flux through the stomatal resistance (R<sub>s</sub>), F<sub>s</sub>, which represents the transfer with the sub-stomatal cavity and
- the deposition flux to the leaf surface (F<sub>w</sub>) representing the uptake by the cuticle, which is determined by the cuticular resistance (R<sub>w</sub>).

The concentration at the leaf surface is assumed to be zero; hence the second process can only represent deposition. The stomatal exchange, however, is governed by the stomatal compensation point, which is related to the apoplastic NH<sub>4</sub><sup>+</sup> concentration ([NH<sub>4</sub><sup>+</sup>]) and pH through the solubility equilibrium.



In this spreadsheet the model is presented in three different versions. The first two calculate surface parameters from flux measurements, whereas the third approach predicts the net exchange above the canopy (F<sub>t</sub>) from surface parameters:

- 1) Calculate X<sub>s</sub> - interpretative:  
The apoplastic [NH<sub>4</sub><sup>+</sup>] is calculated according to the flux measured and an estimated value of R<sub>w</sub>.
- 2) Calculate R<sub>w</sub> - interpretative:  
Based on independent estimates of [NH<sub>4</sub><sup>+</sup>], the resistance R<sub>w</sub> can be calculated from flux measurements.
- 3) Predict F<sub>t</sub> - predictive:  
If no other uptake/emission paths exist, the net flux above the canopy (F<sub>t</sub>) can be calculated from estimated values of R<sub>w</sub> and measured values of [X<sub>s</sub>].

### Input values required:

The following input values are generally required:

- R<sub>a</sub>(1m)+R<sub>b</sub>: The sum of the aerodynamic resistance at z-d=1m and the laminar boundary layer resistance
- X(1m): The NH<sub>3</sub> concentration at z-d=1m
- T(Z<sub>0</sub>): The temperature in degrees C at the bottom of R<sub>b</sub>, the notional mean height of the surface exchange. This value is used to relate the apoplastic [NH<sub>4</sub><sup>+</sup>] to the equivalent air concentration given by the Henry equilibrium.

For the interpretative use of the model the net exchange of the canopy (F<sub>t</sub>) has to be given as an input. Where necessary R<sub>w</sub> and R<sub>s</sub> can be directly inserted if measured by independent means. Otherwise,

a simple relationship is used to relate  $R_s$  to the solar radiation, which can be given as input or, if not available, can be derived from net radiation measurements.  $R_w$  can be calculated from the relative humidity.

The following formulas are used:

$$R_s = c_1 \times (1 + c_2 / \text{solar rad.}) \quad (\text{Hicks et al., 1987})$$

$$R_w = c_3 \times \exp([100 - rh] / c_4) \quad (\text{Sutton and Fowler, 1993})$$

$$\text{solar rad} = (R_n - L_d + \sigma \cdot T^4) / (1 - \rho) \quad (\text{Monteith and Unsworth, 1990})$$

where  $R_n$  is the net radiation,  $L_d$  the downward longwave radiation,  $\sigma$  the Stefan-Boltzman constant,  $T$  the temperature in K and  $\rho$  the reflection coefficient.

$$NH_3(g) = 161,512/T \times 10^{(-4507.11/T)} \times [NH_4^+]/[H^+] \quad (\text{Sutton et al. 1994, transformed})$$

where all concentrations are in mol l<sup>-1</sup>.

The model presented in this spreadsheet is a simplified description of the surface/atmosphere exchange of  $NH_3$ . A more complex approach would have to account for cuticular desorption as well as the variability of apoplastic  $[NH_4^+]$  and pH with changing plant physiology.

This spreadsheet is supplied on the understanding that it or its code is not passed on to third parties without prior permission of the authors.

#### Literature:

- Hicks B.B., Baldocchi D.D., Meyers T.P., Hosker Jr. R.P. and Matt D.R. (1987): A preliminary multiple resistance routine for deriving dry deposition velocities from measured quantities. *Water, Air and Soil Pollution* 36. pp 311-330.
- Monteith J.L. and Unsworth M.H. (1990): *Principles of Environmental Physics*. 2nd edition. Edward Arnold Press. London.
- Sutton M.A., Asman W.A.H. and Schjorring J.K. (1994): Dry deposition of reduced nitrogen. *Tellus* 46B. pp 255-273.
- Sutton M.A., Burkhardt J.K., Guerin D. and Fowler D. (1995): Measurements and modelling of ammonia exchange over arable croplands. In: 'Acid rain research: Do we have enough answers?' (Edts.: G.J. Heij and J.W. Erisman). Elsevier Science.
- Sutton M.A., Burkhardt J.K., Guerin D. and Fowler D. (1996): Development of resistance models to describe measurements of bi-directional ammonia surface-atmosphere exchange. submitted for publication in *Atm. Environ.*
- Sutton M.A. and Fowler D. (1993): A model for inferring bi-directional fluxes of ammonia over plant canopies. In: 'Proceedings of the WMO conference on the measurement and modelling of atmospheric composition changes including pollutant transport. GAW-91'. Sofia, Oct. 1993). WMO, Geneva. pp 179-182.
- Sutton M.A., Fowler D., Hargreaves K.J. and Storeton-West R.L. (1993): Interactions of  $NH_3$  and  $SO_2$  exchange inferred from simultaneous flux measurements over a wheat canopy. In: 'Air pollution research report 47'. (Edts.: J. Slanina, G. Angletti and S. Beilke). Joint workshop CEC/BIATEX of EUROTRAC. May 1993. Aveiro, Portugal.
- Sutton M.A., Schjorring J.K. and Wyers G.P. (1995): Plant-atmosphere exchange of ammonia. *Phil. Trans. R. Soc. Lond.* A351. pp 261-278.









A canopy compensation point model to  
describe the atmosphere/surface exchange of NH<sub>3</sub>:  
a simple implementation in EXCEL 5.0  
- example -

*Mark A. Sutton, Eiko G. Nemitz, Institute of Terrestrial Ecology*

This spreadsheet represents the canopy compensation point model implemented in the file MACEFORM.XLS filled with example data obtained over wheat crop on 19th of May 1992, which have also been used by Sutton et al. (1995, 1996). In order to match the measured data for Ft the intercellular pH was set to 6.8 and the NH<sub>4</sub><sup>+</sup> concentration to 75  $\mu\text{mol l}^{-1}$  (sheet "predict Ft").

The value for [NH<sub>4</sub><sup>+</sup>] had to be modified compared to the value used by Sutton et al. (1995) (100  $\mu\text{mol l}^{-1}$ ), since here a revised formulation of the solubility equilibrium (Sutton et al., 1994) was applied.

The stomatal resistance was parameterised as to fit independent data obtained from measurements of O<sub>3</sub>, which, because of its poor solubility in water, is assumed not to deposit to leaf surfaces. Figure "parameterisation Rs" shows the fit of the parameterisation to the measurement data which was found to be

$$R_s = 3500 \times (1 + 15/\text{solar Rad.})$$

R<sub>s</sub> obtained from the ozone measurements shows lower values at the beginning of the day gradually increasing with time. This is in accordance with the fact that a more accurate parameterisation of the stomatal resistance should include factors like leaf water potential and CO<sub>2</sub> concentration. Consequently, the use of the R<sub>s</sub> values based on the ozone measurements results in a better fit of the predicted to the measured flux than the parameterised values (compare Sutton et al., 1995 to "chart predicted Ft").

R<sub>w</sub> has been parameterised as

$$R_w = 2 \times \exp([100 - r_h]/12)$$

in order to fit the model result. The results are shown on sheet "chart predicted Ft". This parameterisation should be expected to reflect the considerable SO<sub>2</sub> concentration of up to 180  $\mu\text{g m}^{-3}$  at this site (Sutton et al. 1993). In cleaner situations R<sub>w</sub> should therefore be expected to be larger.

The interpretative approach has been implemented on the sheets "calculate [NH<sub>4</sub><sup>+</sup>]" and "calculate R<sub>w</sub>". Here, the measured values of Ft have been used to estimate X<sub>s</sub> (for parameterised R<sub>w</sub>) and R<sub>w</sub> (for fixed [NH<sub>4</sub><sup>+</sup>]), respectively. Bearing in mind that the stomata are closed during night and that for this time R<sub>s</sub> is set to some arbitrary value, [NH<sub>4</sub><sup>+</sup>] can only sensibly be derived for daytime conditions. Hence only values for solar radiation > 100  $\text{W m}^{-2}$  are plotted in figure "chart [NH<sub>4</sub><sup>+</sup>]. Moreover, the values for R<sub>w</sub> become uncertain if R<sub>a</sub>+R<sub>b</sub> is big, i.e. in very stable conditions or at low wind speeds. Therefore, values for R<sub>a</sub>+R<sub>b</sub> > 500  $\text{s m}^{-1}$  have been discarded for figure "chart R<sub>w</sub>".

This spreadsheet is supplied on the understanding that it or its code is not passed on to third parties without prior permission of the authors.

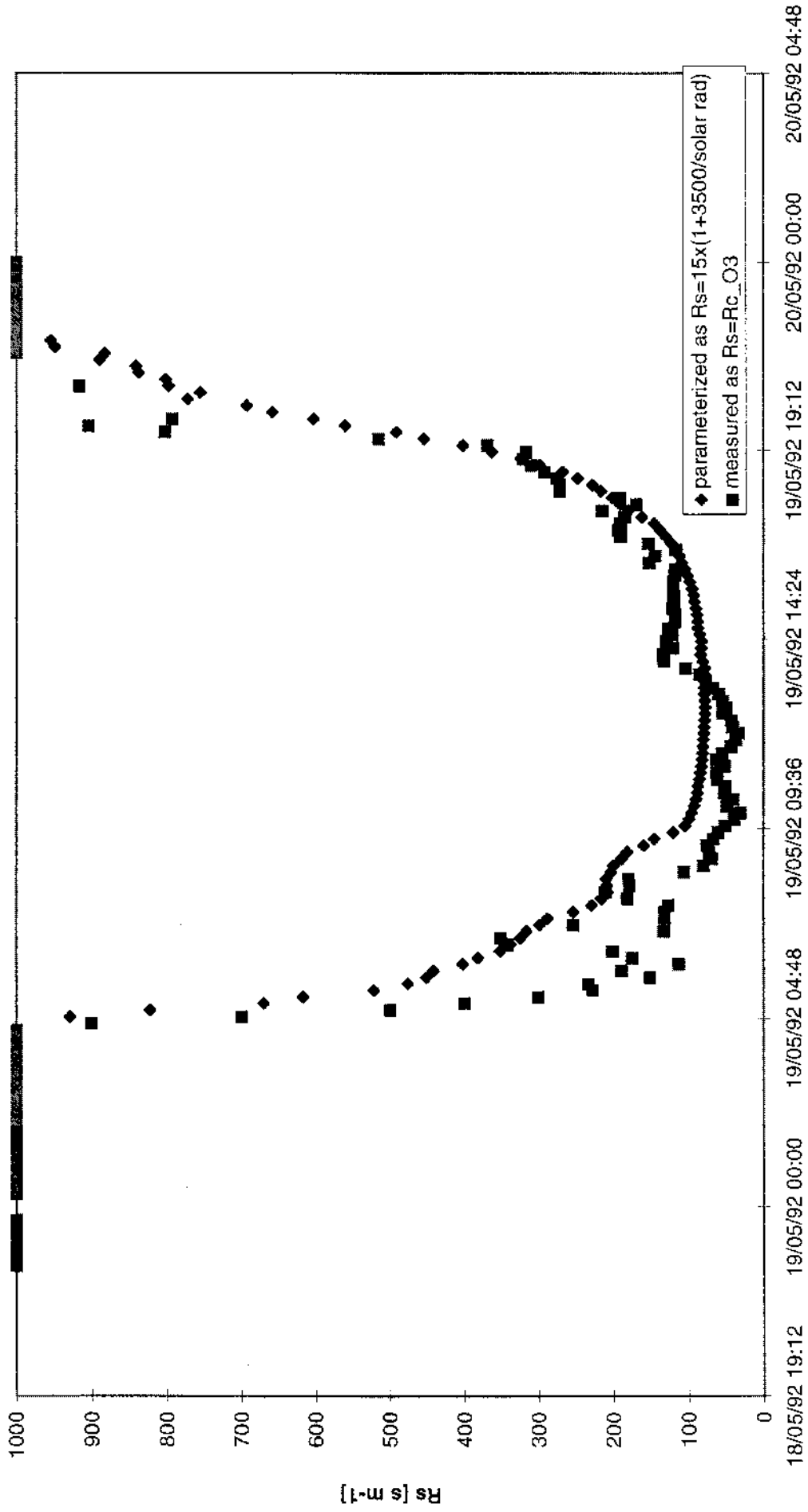
**Literature:**

Hicks B.B., Baldocchi D.D., Meyers T.P., Hosker Jr. R.P. and Matt D.R. (1987): A preliminary multiple resistance routine for deriving dry deposition velocities from measured quantities. Water, Air and Soil Pollution 36. pp 311-330.



- Monteith J.L. and Unsworth M.H. (1990): Principles of Environmental Physics. 2nd edition. Edward Arnold Press. London.
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- Sutton M.A., Burkhardt J.K., Guerin D. and Fowler D. (1995): Measurements and modelling of ammonia exchange over arable croplands. In: 'Acid rain research: Do we have enough answers?' (Edts.: G.J. Heij and J.W. Erisman). Elsevier Science.
- Sutton M.A., Burkhardt J.K., Guerin D. and Fowler D. (1996): Development of resistance models to describe measurements of bi-directional ammonia surface-atmosphere exchange. submitted for publication in *Atm. Environ.*
- Sutton M.A. and Fowler D. (1993): A model for inferring bi-directional fluxes of ammonia over plant canopies. In: 'Proceedings of the WMO conference on the measurement and modelling of atmospheric composition changes including pollutant transport. GAW-91'. Sofia, Oct. 1993). WMO, Geneva. pp 179-182.
- Sutton M.A., Fowler D., Hargreaves K.J. and Storeton-West R.L. (1993): Interactions of NH<sub>3</sub> and SO<sub>2</sub> exchange inferred from simultaneous flux measurements over a wheat canopy. In: 'Air pollution research report 47'. (Edts.: J. Stanina, G. Angletti and S. Beilke). Joint workshop CEC/BIATEX of EUROTRAC. May 1993. Aveiro, Portugal.
- Sutton M.A., Schjorring J.K. and Wyers G.P. (1995): Plant-atmosphere exchange of ammonia. *Phil. Trans. R. Soc. Lond.* A351. pp 261-278.

### Parameterisation of Rs by comparison to Rs\_O3



Prediction of the net flux above canopy from measurements of [Xs] and estimates of Rs, Rw:																					
Date/Time	compulsary input values:		further input values:		interim results calculated from further input values or given as input parameters:		results:														
	Ra(m)+Rb	X(1m)	T(Zo')	(NH4+)	apoplasmic pH	r.H(Zo')	net radiation [W m-2]	Rs [µg m-3]	Rw [µg m-3]	Rs	Rw	Rs	Rw	Xs	Xc	Fs	Fw	Ft	Rs	Ft	for comparison: from C3: measured [µg m-3]
18/05/92 22:00	88.36760766	0.55963	11.00689	75	6.8	78.23949	-45.18	10	5265	12.26222	0.106343	-5.65466	-5.4832	0.629236	0.069339	0.112115	-2.5611	-2.44898	828.23	-1.93396	
18/05/92 22:10	194.0381744	0.90474	10.87918	75	6.8	79.20477	-44.595	10	5265	11.31448	0.112115	-2.5611	-2.44898	0.619266	0.028978	0.112115	-2.4857	-2.37502	1078.08	-1.3674	
18/05/92 22:20	161.3580678	0.410615	10.90953	75	6.8	79.38363	-43.89	10	5265	11.14708	0.112115	-2.4857	-2.37502	0.620953	0.027708	0.112115	-2.4857	-2.37502	2006.294	-1.13375	
18/05/92 22:30	1958.467387	0.39395	10.34504	75	6.8	80.35806	-42.645	10	5265	10.27769	0.109398	-0.30895	-0.19955	0.579157	0.003175	0.109398	-0.30895	-0.19955	1000	-0.0842	
18/05/92 22:40	1875.161327	0.450568	10.2036	75	6.8	80.35806	-41.4	10	5265	10.27769	0.109398	-0.30895	-0.19955	0.569954	0.003554	0.109398	-0.34577	-0.23838	1000	-0.0962	
18/05/92 22:50	1851.445309	0.446996	9.631199	75	6.8	80.42485	-40.455	10	5265	10.20064	0.10245	-0.34199	-0.23954	0.642895	0.003495	0.10245	-0.34199	-0.23954	1000	-0.11505	
18/05/92 23:00	315398.9268	0.408317	-2.84426	75	6.8	80.42485	-39.51	10	5265	10.22064	0.1019295	-0.02059	-0.00129	0.101798	0.000211	0.1019295	-0.02059	-0.00129	1000	-0.00768	
18/05/92 23:10	13660.57556	0.485813	7.605143	75	6.8	79.35574	-37.405	10	5265	11.17302	0.07468	-0.11294	-0.03547	0.40913	0.001262	0.07468	-0.11294	-0.03547	1000	-0.02976	
18/05/92 23:20	1851.568206	0.643668	9.471304	75	6.8	79.35574	-35.3	10	5265	11.17302	0.07468	-0.11294	-0.03547	0.518784	0.004924	0.07468	-0.11294	-0.03547	1000	-0.18138	
18/05/92 23:30	882.450223	0.680644	9.714307	75	6.8	80.91404	-33.27	10	5265	11.17302	0.07468	-0.11294	-0.03547	0.534995	0.008709	0.126098	-0.98753	-0.76144	1000	-0.40797	
18/05/92 23:40	201.038771	0.565434	9.470536	75	6.8	82.14733	-31.24	10	5265	13.63787	0.364576	0.854004	-0.44072	0.518733	0.024936	0.127775	-2.81631	-2.68853	1000	-0.205169	
18/05/92 23:50	190.8733065	0.463024	9.590082	75	6.8	83.01933	-29.57	10	5265	16.66199	0.165884	0.233434	-0.76144	0.527226	0.02041	0.160087	-2.47897	-2.31869	1110.206	-1.66593	
19/05/92 00:00	284.2131826	0.471142	9.640657	75	6.8	82.57559	-27.9	10	5265	19.1077	0.262583	0.543589	-0.44072	0.530001	0.015295	0.186313	-1.79021	-1.60389	1026.23	-1.95423	
19/05/92 00:10	162.3381883	0.481377	9.728414	75	6.8	83.25613	-26.69	10	5265	21.26396	0.266396	0.845689	-0.44072	0.535903	0.023368	0.206337	-2.90446	-2.69813	1000	-0.75463	
19/05/92 00:20	432.6418555	0.460792	9.688521	75	6.8	82.24068	-25.48	10	5265	22.56946	0.241152	0.785393	-0.44072	0.533212	0.011091	0.223019	-1.26245	-1.03943	1000	-0.43177	
19/05/92 00:30	301.8268989	0.462818	9.820161	75	6.8	83.70792	-24.755	10	5265	23.38895	0.267164	0.774277	-0.44072	0.54214	0.013971	0.243664	-1.79703	-1.55337	1000	-1.14791	
19/05/92 00:40	450.6044216	0.539541	9.819821	75	6.8	83.31821	-24.03	10	5265	25.32891	0.28773	0.830899	-0.44072	0.542123	0.012395	0.253734	-1.54334	-1.2897	1000	-0.88243	
19/05/92 00:50	2370.578046	0.880399	9.266608	75	6.8	82.44746	-22.905	10	5265	23.10807	0.2286934	0.633304	-0.44072	0.505524	0.005078	0.218828	-0.98807	-0.36924	1000	-0.31217	
19/05/92 01:00	1792.37969	1.477691	9.352141	75	6.8	82.44746	-21.78	10	5265	25.13695	0.2103567	0.633304	-0.44072	0.511025	0.009135	0.23959	-1.05792	-0.81933	1000	-0.58843	
19/05/92 01:10	1184.879079	1.393325	9.181686	75	6.8	82.70934	-20.9	10	5265	25.928	0.2099396	0.448894	-0.44072	0.500118	0.011873	0.239355	-1.40526	-1.1659	1000	-0.6186	
19/05/92 01:20	1214.230988	0.705131	9.281899	75	6.8	82.20009	-19.82	10	5265	26.51471	0.1856155	0.448894	-0.44072	0.506504	0.00713	0.289037	-0.84388	-0.57485	1000	-0.28372	
19/05/92 01:30	1630.566354	0.590028	9.666494	75	6.8	82.20009	-17.495	10	5265	26.16512	0.2021498	0.815167	-0.44072	0.46847	0.005182	0.229182	-0.89786	-0.35888	1000	-0.16399	
19/05/92 01:40	2050.873556	0.617461	8.576219	75	6.8	82.20009	-16.17	10	5265	27.29105	0.1998708	0.815167	-0.44072	0.468323	0.004716	0.236449	-0.53522	-0.29877	1000	-0.12755	
19/05/92 01:50	443.4319031	0.567316	8.369146	75	6.8	83.2088	-15.225	10	5265	27.159	0.1948274	0.104494	-0.44072	0.468323	0.004716	0.236449	-1.47774	-1.25237	1000	-0.70265	
19/05/92 02:00	1159.811215	0.424957	8.667745	75	6.8	82.74367	-14.28	10	5265	30.3487	0.1744893	0.104494	-0.44072	0.468546	0.005295	0.285494	-0.62734	-0.36184	1000	-0.18697	
19/05/92 02:10	1251.650577	0.414422	8.202525	75	6.8	82.84484	-13.785	10	5265	27.93212	0.1944556	0.494426	-0.44072	0.441595	0.004739	0.230565	-0.5579	-0.32731	1000	-0.11996	
19/05/92 02:20	1075.453064	0.339934	8.57758	75	6.8	82.84484	-13.29	10	5265	31.04027	0.1706351	0.494426	-0.44072	0.468203	0.004927	0.228571	-0.58007	-0.3115	1000	-0.14614	
19/05/92 02:30	1517.108498	0.371246	8.311771	75	6.8	82.1372	-13.17	10	5265	29.4479	0.179781	0.861477	-0.44072	0.447788	0.004329	0.246687	-0.48852	-0.24185	1000	-0.09887	
19/05/92 02:40	4235.22889	0.479806	-2.0812	75	6.8	81.30899	-13.015	10	5265	28.37457	0.165248	0.861477	-0.44072	0.437217	0.004489	0.23178	-0.51179	-0.32001	1000	-0.10971	
19/05/92 03:00	181296.6378	0.639353	-11.7726	75	6.8	81.30899	-12.98	10	5265	18.94876	0.10299	0.394676	-0.44072	0.028363	0.005313	0.021639	-0.03296	-0.01132	1000	-0.00592	
19/05/92 03:10	303842.1683	0.581913	-15.0308	75	6.8	81.02299	-12.8	10	5265	9.723688	0.10299	0.394676	-0.44072	0.0174	5.07E-05	0.003295	-0.00521	-0.00192	1000	0.002326	
19/05/92 03:20	850.6374.854	0.774877	-128.439	75	6.8	81.02299	-12.82	10	5265	9.723688	0.10299	0.394676	-0.44072	6.42E-07	8.74E-07	0.003295	-0.00521	-0.00192	1000	0.000121	
19/05/92 03:30	8991.793686	0.845435	5.092891	75	6.8	82.89253	-11.78	10	5265	10.47121	0.0281745	0.602834	-0.44072	0.295669	0.001542	0.026049	-0.17919	-0.1207	1000	0.047413	
19/05/92 03:40	5180.870971	0.492435	6.11393	75	6.8	82.49253	-10.435	10	5265	18.07753	0.291815	0.802834	-0.44072	0.0174	5.07E-05	0.003295	-0.00521	-0.00192	1000	0.002326	
19/05/92 03:50	2095.459995	0.55925	0.458151	75	6.8	82.19271	-10.45	10	5265	10.589	0.291815	0.802834	-0.44072	6.42E-07	8.74E-07	0.003295	-0.00521	-0.00192	1000	0.000121	
19/05/92 04:00	2051.08336	0.842168	6.420586	75	6.8	82.19271	-9.93	10	5265	21.35095	0.2472505	0.820586	-0.44072	0.295669	0.001542	0.026049	-0.17919	-0.1207	1000	0.047413	
19/05/92 04:10	2259.989939	0.7401	6.815917	75	6.8	83.61789	-7.943	10	5265	26.48999	0.198688	0.733282	-0.44072	0.159853	0.0005	0.030266	-0.06674	-0.02847	1000	0.049929	
19/05/92 04:20	1534.593038	0.680082	7.176415	75	6.8	83.61789	-6.966	10	5265	31.40509	0.1686703	0.733282	-0.44072	0.389723	0.005219	0.226486	-0.66825	-0.43977	1000	0.049929	
19/05/92 04:30	1539.803913	0.754097	7.500497	75	6.8	85.04204	-1.9875	10	5265	38.68545	0.172.501	0.855272	-0.44072	0.40368	0.005401	0.290122	-0.77635	-0.48623	1000	-0.29275	
19/05/92 04:40	6150.431421	0.48995	6.381716	75	6.8	85.04204	-1.981	10	5265	36.57837	0.1450275	0.959272	-0.44072	0.34954	0.002217	0.239487	-0.91872	-0.70794	900	-0.04297	
19/05/92 04:50	1523.208687	1.18876	8.381014	75	6.8	82.96034	8.1255	10	5265	57.42789	0.29219	0.855347	-0.44072	0.450607	0.010296	0.473965	-1.24754	-0.77367	700	-0.38286	

19/05/92 05:00	1575.540537	1.030377	8.294151	75	6.8	82.99034	14.27	64.96854	823.0834	8.253347	0.446784	0.010053	0.530604	-1.218	-0.6874	500	-0.52419
19/05/92 05:10	145.3532203	0.596372	9.485231	75	6.8	86.81171	19.775	80.05833	670.7964	5.166375	0.520355	0.024163	0.799706	4.67693	3.93722	400	-2.93724
19/05/92 05:20	234.452889	0.523995	9.48251	75	6.8	85.66238	25.28	87.12008	517.6185	6.605803	0.519519	0.007127	0.829482	-1.09255	-0.26307	300	-0.15054
19/05/92 05:30	158.959725	0.603212	10.40868	75	6.8	92.18411	33.13	103.5042	522.2256	3.89818	0.583604	0.019874	1.080241	-5.12867	-4.04843	227.8942	2.8194
19/05/92 05:40	101.7105935	0.551267	10.41044	75	6.8	92.28909	40.98	113.7109	472.6974	3.802745	0.583983	0.024172	1.174247	-6.95655	-5.1823	233.6254	4.8708
19/05/92 05:50	111.3605988	0.533121	10.96846	75	6.8	95.08163	43.135	120.2881	401.9226	3.019225	0.582919	0.024177	1.34704	-6.82619	-4.62573	151.2466	-3.7434
19/05/92 06:00	83.84648009	0.316022	10.96214	75	6.8	94.78371	45.29	123.0241	441.7465	3.088971	0.825725	0.016347	1.361742	-4.95819	-3.58845	189.2194	-3.54559
19/05/92 06:10	66.47901776	0.086553	11.73323	75	6.8	95.47378	50.85	136.4748	402.5259	2.915863	0.868882	0.008359	1.690532	-2.86584	-1.17821	112.7741	0.862478
19/05/92 06:20	76.5535341	0.08731	11.77984	75	6.8	95.66234	58.41	143.013	382.0994	2.87088	0.765002	0.007987	2.16423	-2.82661	-1.03448	175.197	0.97498
19/05/92 06:30	82.00696843	0.082255	12.63218	75	6.8	95.84343	61.705	155.7232	352.1367	2.601777	0.750092	0.008482	2.24377	-3.09107	-0.85669	201.1358	-0.18289
19/05/92 06:40	53.73565318	0.054517	12.57907	75	6.8	96.20453	67	162.2348	388.8051	2.744054	0.799397	0.008182	2.24377	3.09107	-0.85669	341.2116	-0.46822
19/05/92 06:50	59.22687384	0.038327	12.93475	75	6.8	N/A	70.85	169.4234	324.8745	N/A	0.799397	N/A	N/A	N/A	N/A	351.1514	0.097013
19/05/92 07:00	66.47901776	0.040506	12.9074	75	6.8	97.35563	74.3	173.9751	298.7185	2.493062	0.796706	0.007681	2.493062	3.08076	-0.58989	132.9116	-0.15192
19/05/92 07:10	59.22687384	0.031377	13.44574	75	6.8	98.11558	79.8	184.8471	211.8073	2.340073	0.851395	0.007414	2.825503	3.16842	-0.34592	253.8492	-0.17003
19/05/92 07:20	56.05687597	0.018488	13.43138	75	6.8	97.86776	85.3	191.8834	288.6037	2.388903	0.849789	0.007428	2.918747	3.10922	-0.19047	132.0311	0.148625
19/05/92 07:30	40.39427007	0.006692	13.82405	75	6.8	98.41945	104.65	219.7674	253.889	2.281561	0.892149	0.007985	3.482476	3.49998	-0.01751	132.1257	0.699002
19/05/92 07:40	53.84007187	0.00594	13.82405	75	6.8	98.67526	124	244.871	228.3986	2.233438	0.891736	0.008494	3.850252	-3.803	0.04725	126.954	0.638043
19/05/92 07:50	56.26453685	-0.0148	14.67629	75	6.8	98.78168	131.75	280.895	218.2304	2.213717	0.896983	0.009397	4.532136	4.33623	0.196809	161.8888	0.827316
19/05/92 08:00	52.4441868	-0.00643	14.72866	75	6.8	98.64634	139.5	271.3278	208.4929	2.238828	0.995914	0.009891	4.729284	4.41809	0.31119	211.065	0.995788
19/05/92 08:10	40.35046882	-0.00738	14.87827	75	6.8	99.33262	138.4	270.9514	208.7617	2.114381	1.014211	0.009274	4.813802	-4.3861	0.4277	178.721	1.260755
19/05/92 08:20	52.84679936	-0.01027	14.9109	75	6.8	99.81073	137.3	269.7525	209.8228	2.065942	1.018244	0.009184	4.813802	-4.4456	0.368086	179.8664	0.937629
19/05/92 08:30	54.98556134	-0.01184	15.56139	75	6.8	98.87036	140.8	278.693	203.2442	2.19742	1.100713	0.010875	5.367799	-4.94919	0.418613	106.2003	0.992777
19/05/92 08:40	50.66194627	-0.01717	16.15252	75	6.8	100.2522	154.65	301.0834	189.3703	1.962812	1.183408	0.011058	5.442079	-4.95064	0.491439	79.66109	0.967221
19/05/92 08:50	51.40847285	-0.01746	16.15252	75	6.8	100.3502	165	314.5304	181.9155	1.942469	1.183516	0.011482	6.442748	5.91088	0.531867	68.75063	1.046574
19/05/92 09:00	52.08764516	N/A	17.27734	75	6.8	99.49291	194.9	361.4251	160.2593	2.086327	1.354525	N/A	N/A	N/A	N/A	75.3592	N/A
19/05/92 09:10	49.22101268	N/A	17.31439	75	6.8	99.36027	224.8	400.5237	146.0764	2.105156	1.360541	N/A	N/A	N/A	N/A	66.43525	N/A
19/05/92 09:20	48.14560207	N/A	19.23041	75	6.8	97.84832	290	499.0932	120.1908	2.192775	1.706196	N/A	N/A	N/A	N/A	60.41736	N/A
19/05/92 09:30	45.04501787	N/A	19.35401	75	6.8	97.63463	355.2	584.7528	104.7816	2.435766	1.73929	N/A	N/A	N/A	N/A	51.04852	N/A
19/05/92 09:40	50.17261236	N/A	20.4247	75	6.8	99.43519	377.3	621.3898	99.48803	2.27857	1.965567	N/A	N/A	N/A	N/A	38.89266	N/A
19/05/92 10:00	51.53639415	N/A	20.4474	75	6.8	99.50183	399.4	650.2603	95.7369	2.265982	1.970764	N/A	N/A	N/A	N/A	31.15909	N/A
19/05/92 10:10	37.68605555	N/A	21.24968	75	6.8	84.60812	415.8	677.564	92.48345	2.13617	2.164134	N/A	N/A	N/A	N/A	48.725	N/A
19/05/92 10:20	44.27558235	N/A	21.31993	75	6.8	84.78578	432.2	699.3909	90.06522	2.106421	2.164134	N/A	N/A	N/A	N/A	40.47703	N/A
19/05/92 10:30	43.38303212	N/A	22.30872	75	6.8	84.78578	432.2	699.3909	90.06522	2.106421	2.164134	N/A	N/A	N/A	N/A	40.47703	N/A
19/05/92 10:40	45.80795103	N/A	22.31361	75	6.8	78.71875	445.7	724.4347	87.4703	11.7841	2.446809	N/A	N/A	N/A	N/A	51.79668	N/A
19/05/92 10:50	46.57887208	N/A	23.27353	75	6.8	78.25061	456.6	745.919	85.38287	14.46062	2.446809	N/A	N/A	N/A	N/A	51.13355	N/A
19/05/92 11:00	44.10771323	0.153008	23.10048	75	6.8	78.25061	456.6	745.919	85.38287	14.46062	2.734231	N/A	N/A	N/A	N/A	61.52489	N/A
19/05/92 11:10	42.86317837	0.14769	24.06184	75	6.8	74.1014	474.45	775.1712	82.72598	17.31198	2.680446	0.341007	27.78685	-23.5244	4.262268	62.23229	13.19545
19/05/92 11:20	47.16629837	0.140839	24.11467	75	6.8	74.18075	481.4	784.6073	81.91245	17.19728	2.982272	0.42514	31.03137	-24.5584	6.472839	51.73225	11.78944
19/05/92 11:30	40.08013018	0.19882	24.87418	75	6.8	73.01998	484.25	794.2078	81.10362	18.95338	3.010493	0.434019	31.45324	-25.2376	6.215606	62.88806	10.89033
19/05/92 11:40	43.56195343	0.266023	24.91792	75	6.8	73.08856	487.1	798.2501	80.78886	18.85595	3.282164	0.504841	34.24783	-26.8201	7.627743	54.38737	10.24247
19/05/92 11:50	43.56195343	0.496623	25.58622	75	6.8	71.69553	490.2	807.5064	80.01497	21.15432	3.282164	0.504841	34.24783	-26.8201	7.627743	42.86668	10.68523
19/05/92 12:00	43.10228484	0.07431	25.49491	75	6.8	71.70015	493.3	810.8156	79.74962	21.14636	3.557711	0.675318	36.02318	-31.9231	4.100075	36.92296	11.32484
19/05/92 12:10	44.20984106	1.542787	26.18455	75	6.8	70.97001	495.35	819.1135	79.09388	22.47296	3.521197	0.835635	38.67492	-39.5167	5.84181	33.34156	-0.69122
19/05/92 12:20	42.41026809	1.542787	26.18455	75	6.8	70.97001	495.35	819.1135	79.09388	22.47296	3.817108	0.954637	36.19087	-42.4794	-6.28848	41.01925	-0.978
19/05/92 12:30	38.10857128	1.72711	26.37315	75	6.8	69.73061	503	830.3336	78.2276	24.91816	3.805916	1.049045	34.94042	-46.5825	-11.642	42.60717	-0.78
19/05/92 12:40	39.30760212	1.92387	26.42097	75	6.8	69.73952	508.6	837.9849	77.65029	24.69664	3.887464	1.200361	34.94981	-48.1721	-13.8223	53.78786	-11.0517
19/05/92 12:50	37.41539936	2.280272	26.78232	75	6.8	69.22553	499.5	829.0334	78.32575	25.98934	3.909399	1.264339	34.04314	-50.8015	-16.7584	49.59606	-13.8244
19/05/92 13:00	36.50453299	2.623601	26.77688	75	6.8	69.20794	490.4	817.1704	79.24609	26.02747	4.070067	1.448063	33.47519	-55.7176	-22.2424	54.54685	-22.0668
19/05/92 13:10	34.20459116	3.460339	27.25093	75	6.8	67.94844	492.45	823.6086	78.74386	26.90586	4.067498	1.563117	31.55021	-60.8249	-28.4747	59.63356	-25.6359
19/05/92 13:20	34.23193172	27.21346	27.21346	75	6.8	67.94844	492.45	823.6086	78.74386	26.90586	4.288973	2.033608	28.64178	-70.354	-41.7123	67.27487	-24.2924
19/05/92 13:30	35.30319423	27.39016	27.39016	75	6.8	63.37425	494.75	825.9736	78.56135	28.89783	4.271175	N/A	N/A	N/A	N/A	76.66646	76.66646
19/05/92 13:40	34.15684787	27.4103	27.4103	75	6.8	63.37016	495	828.2197	78.38896	42.33584	4.367526	N/A	N/A	N/A	N/A	85.03766	85.03766
19/05/92 13:50	36.7077395	27.4098	27.4098	75	6.8	60.147	471.25	797.3475	80.84331	55.38087	4.367526	N/A	N/A	N/A	N/A	103.7244	103.7244
19/05/92 14:00	39.27829641	27.45253	27.45253	75	6.8	60.14837	447.5	766.8452	83.46232	55.37435	4.367526	N/A	N/A	N/A	N/A	133.2254	133.2254
19/05/92 14:10	37.39718708	27.69368	27.69368	75	6.8	58.09157	451.5	773.9718	82.63193	85.72742	4.506162	N/A	N/A	N/A	N/A	130.7295	130.7295
19/05/92 14:20	37.41546622	2.847632	27.7007	75	6.8	58.09384	455.5	779.2228	82.37482	85.71499	4.509682	2.19854	28.52865	32.8622	4.33239	120.1059	120.1059
19/05/92 14:30	35.41802203	2.826394	27.68903	75													

19/05/92 14:40	45.56725764	2.974653	21.68931	75	6.8	57.79324	414.9	726.4041	87.27382	67.69152	4.503962	2.436231	23.80704	36.8425	-12.0354	126.4173	-9.99502
19/05/92 14:50	41.4696288	3.08585	21.94242	75	6.8	58.22086	409.95	722.0087	87.13088	65.0231	4.632586	2.498985	24.31473	36.4456	-14.1309	117.6502	-2.318
19/05/92 15:00	47.8132761	3.15292	27.95347	75	6.8	58.22372	405	715.6583	86.3658	65.00759	4.638286	2.487231	24.34477	39.2866	-13.9158	117.23	-25.2549
19/05/92 15:10	47.285437	3.163611	27.90411	75	6.8	58.20033	392.5	599.1678	90.08929	65.13442	4.612905	2.481207	23.66206	38.0936	-14.4316	121.7738	-22.3665
19/05/92 15:20	46.37298889	3.204196	27.11166	75	6.8	58.20074	380.2	883.1244	91.86427	65.13222	4.616775	2.476844	23.2974	41.7305	-19.4233	119.4233	-22.4661
19/05/92 15:30	46.7190972	3.49673	28.10548	75	6.8	57.54964	370.15	671.684	93.18409	68.76377	4.71937	2.688087	21.80328	39.0916	-17.2853	119.6857	-30.6864
19/05/92 15:40	54.0020958	3.741331	28.0963	75	6.8	57.55102	360.1	658.5059	94.72594	68.75586	4.712467	2.728962	20.94046	39.8992	-18.7487	120.8515	-24.9881
19/05/92 15:50	49.38714784	3.912771	27.8987	75	6.8	56.39063	342.4	693.778	97.83658	76.73661	4.600485	2.890774	17.47518	38.1668	-20.6936	120.3616	-26.7226
19/05/92 16:00	58.59603968	3.906927	27.8878	75	6.8	56.39227	324.7	610.9385	100.9474	75.72625	4.603513	2.794569	17.91977	36.9034	-18.9837	117.9162	-23.7849
19/05/92 16:10	49.55123749	3.674835	27.29261	75	6.8	55.87174	306.6	582.8354	105.0763	79.08393	4.309085	2.719972	15.12352	34.3937	-19.2702	117.4088	-20.7253
19/05/92 16:20	42.73828666	3.401323	27.3207	75	6.8	55.85608	288.9	599.9171	108.7806	79.12077	4.352233	2.839141	15.48522	33.3432	-17.8156	152.449	-29.0177
19/05/92 16:30	53.10335464	3.333984	27.39206	75	6.8	55.78623	274.25	541.2816	110.7692	78.64887	4.352233	2.521258	16.35005	31.6547	-15.3048	144.3389	-19.9124
19/05/92 16:40	52.15138552	3.389599	27.39387	75	6.8	55.78346	259.6	522.27	115.5227	79.65399	4.352233	2.505477	15.69097	31.8948	-16.2036	116.5054	-22.9162
19/05/92 16:50	57.94437507	3.29186	26.80426	75	6.8	57.37681	236.15	487.1947	122.9903	89.78133	4.090707	2.285987	14.77766	32.484	-17.7044	153.5874	-21.9592
19/05/92 17:00	62.78002508	3.405121	26.79659	75	6.8	57.38253	212.7	456.6798	129.9603	89.72805	4.076581	2.254904	14.01717	32.3386	-18.3214	190.4175	-26.2791
19/05/92 17:10	65.03294383	3.848374	26.34549	75	6.8	59.34906	193.05	427.5823	137.7834	59.18832	3.875402	2.208524	12.69782	37.3135	-25.2157	193.1876	-28.8795
19/05/92 17:20	63.32288329	3.458865	26.36355	75	6.8	59.34828	173.4	402.2057	145.5302	59.18225	3.863274	2.054192	12.5884	34.7037	-22.1353	190.7205	-24.0441
19/05/92 17:30	90.04775551	3.626437	25.47892	75	6.8	62.50667	143.65	358.5983	162.2241	45.4945	3.514841	1.549761	12.11337	34.0648	-21.9514	184.7255	-18.3044
19/05/92 17:40	77.80187221	3.081486	25.48741	75	6.8	62.502	113.9	318.0295	180.079	45.51222	3.518241	1.464741	11.40318	32.1835	-20.7803	214.8257	-14.3238
19/05/92 17:50	90.1016491	3.383168	25.1234	75	6.8	64.64103	101.1	298.557	190.8466	38.08147	3.316241	1.29876	10.89609	34.0523	-23.1562	169.0106	-14.0062
19/05/92 18:00	110.7730948	3.61786	25.10628	75	6.8	64.63883	88.3	281.7984	201.3034	38.10433	3.369892	1.227857	10.64063	32.2183	-21.5775	191.0578	-20.5952
19/05/92 18:10	120.0554891	2.803112	24.33923	75	6.8	67.56834	76.54	260.7097	216.3734	29.83906	3.095531	0.810387	10.56111	27.1595	-16.5984	271.4601	-10.8934
19/05/92 18:20	118.1358809	2.598694	24.5314	75	6.8	67.56273	64.78	246.7093	227.8011	29.89203	3.153825	0.771049	10.4599	25.828	-15.3991	271.4601	-10.8934
19/05/92 18:30	294.6864082	2.455385	23.92979	75	6.8	69.99382	51.96	223.4552	247.8612	24.37734	2.947226	0.4174	10.20862	17.1223	-6.91568	274.8986	-4.54825
19/05/92 18:40	71.44781278	2.683932	23.78187	75	6.8	69.99382	39.14	207.673	267.8012	23.9811	2.898155	0.807574	7.806463	33.8165	-26.01	291.8541	-26.8797
19/05/92 18:50	54.4868293	2.724236	23.70542	75	6.8	66.66908	28.07	190.5706	298.0712	32.16002	2.691969	1.001714	5.907909	34.2076	-28.8997	303.5387	-29.6378
19/05/92 19:00	48.68934245	2.805524	22.56846	75	6.8	66.66574	13	169.7778	324.2278	32.16886	2.732704	1.32249	4.958205	35.1959	-30.2607	320.4418	-28.6586
19/05/92 19:10	56.66047097	2.402084	22.56846	75	6.8	67.41358	1.91	150.7589	363.2428	30.22539	2.732704	0.923833	4.475168	30.2607	-26.0896	316.4276	-9.4842
19/05/92 19:20	45.2474524	2.802236	22.5794	75	6.8	67.41358	-9.18	137.0351	401.8728	30.22539	2.524439	1.8253	3.33914	39.1358	-35.7966	368.4503	-29.2568
19/05/92 19:30	46.10724998	2.770362	21.78292	75	6.8	68.1133	-17.095	119.4568	454.4895	28.51335	2.305055	1.105101	2.640222	38.7573	-36.1171	515.9245	-27.8181
19/05/92 19:40	57.56522028	2.205895	21.92198	75	6.8	68.09302	-25.01	110.1536	491.8073	28.51335	2.305055	0.791641	3.149141	27.717	-24.5679	802.901	-9.97656
19/05/92 19:50	59.76817791	2.116813	20.9584	75	6.8	69.66533	-30.065	96.28811	560.3497	28.51335	2.089966	0.71478	2.453979	28.5295	-26.0755	904.5354	-16.4837
19/05/92 20:00	49.2516983	2.240577	20.90099	75	6.8	69.66533	-35.12	89.33083	602.7027	25.01559	2.077777	0.79014	1.336437	31.5859	-23.4495	792.8202	-21.3076
19/05/92 20:10	51.67850908	2.657649	20.30398	75	6.8	69.66533	-37.68	81.5557	658.7328	25.01559	1.931957	0.99811	1.578556	35.6263	-34.0478	1048.672	-25.3757
19/05/92 20:20	47.97308965	3.831746	20.20169	75	6.8	69.59127	-37.68	89.59127	772.218	25.19875	1.914738	1.392075	1.054774	40.0135	-38.9587	1090.125	-49.4336
19/05/92 20:30	71.87453839	3.658518	19.05346	75	6.8	68.8163	-40.24	77.48544	895.216	25.19875	1.706932	0.448938	1.054774	40.0135	-38.9587	1042.656	-31.7993
19/05/92 20:40	83.65833037	2.948474	19.22367	75	6.8	71.44631	-39.7	69.33274	772.218	21.45228	1.600141	0.907988	1.369263	37.9672	-26.5978	916.9528	-19.218
19/05/92 20:50	58.46677666	2.926684	18.67163	75	6.8	73.53458	-39.5	67.05601	797.8276	18.1487	1.588123	0.536704	1.31121	29.714	-28.4028	1401.619	-21.2611
19/05/92 21:00	82.68167477	2.09301	18.61989	75	6.8	73.59182	-39.5	66.72019	801.8688	18.06234	1.495452	0.359707	1.3496	19.7477	-18.3881	1395.193	-13.4639
19/05/92 21:10	57.88451779	1.916078	18.18035	75	6.8	73.69571	-39.31	63.80677	837.9688	17.06063	1.394755	0.420795	1.094884	21.7193	-20.6246	1674.045	-11.1389
19/05/92 21:20	84.92585765	1.922178	18.10735	75	6.8	73.4907	-39.12	63.51767	841.5417	18.21519	1.387975	0.170022	1.379045	8.2829	-6.90386	1940.001	-15.4053
19/05/92 21:30	77.38924083	2.024138	17.52227	75	6.8	72.75043	-38.945	60.47094	883.1856	20.52693	1.261212	0.10211	1.221029	5.49185	-4.27083	1000	-2.9458
19/05/92 21:40	284.7473602	2.135877	17.48148	75	6.8	72.05697	-37.97	60.01934	889.719	19.37424	1.223676	0.097745	1.179443	3.28511	-4.10566	1000	-1.5273
19/05/92 21:50	414.4810414	1.872286	16.66175	75	6.8	73.24432	-36.83	56.19281	948.2832	18.59303	1.099125	0.028274	1.024182	-1.72132	-0.69714	1000	-1.80202
19/05/92 22:00	373.1263793	1.629676	16.43039	75	6.8	73.30811	-35.69	55.87311	954.5691	18.49446	1.033672	0.040669	1.067903	2.47597	-1.40807	1000	-0.44631
19/05/92 22:10	1001.28014	1.490557	15.79677	75	6.8	74.73169	-35.15	52.05728	1023.505	16.42557	1.033672	0.033898	0.98223	1.84646	-0.86423	1000	-0.28913
19/05/92 22:20	1782.655453	1.271028	15.54089	75	6.8	74.73169	-34.61	50.92423	1045.569	16.19576	1.033672	0.033898	0.98223	1.84646	-0.86423	1000	-0.28913
19/05/92 22:30	109.723937	1.493032	15.07593	75	6.8	73.5035	-34.01	50.32116	1058.299	18.19576	1.033672	0.033898	0.98223	1.84646	-0.86423	1000	-0.28913
19/05/92 22:40	109.723937	1.493032	15.07593	75	6.8	74.2886	-33.41	49.21414	1081.787	17.04342	1.033672	0.033898	0.98223	1.84646	-0.86423	1000	-0.28913
19/05/92 22:50	1782.655453	1.271028	15.54089	75	6.8	71.74854	-33.44	47.4145	1035.914								



### Model prediction and measured values for Ft - parameterised Rs -

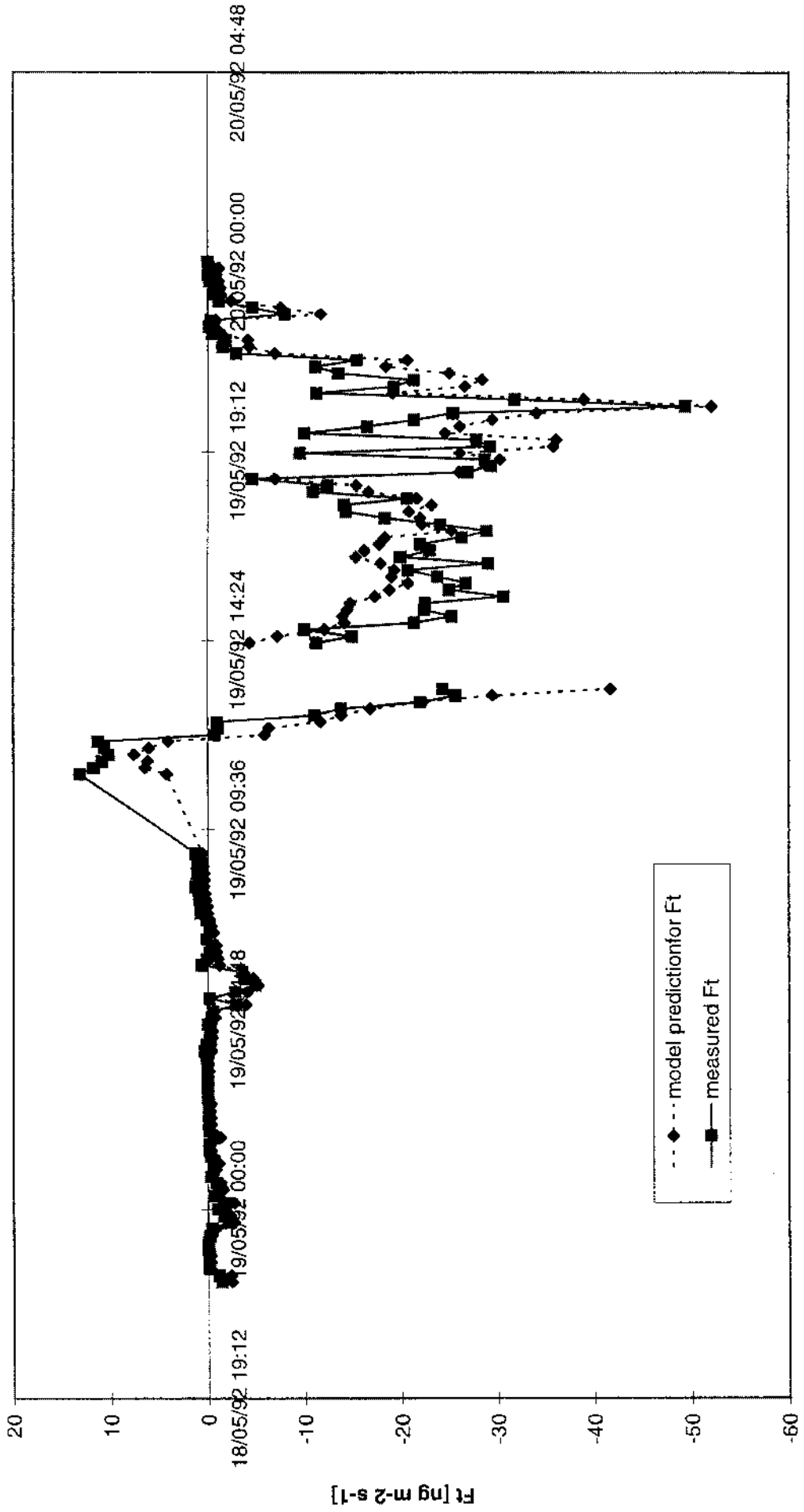
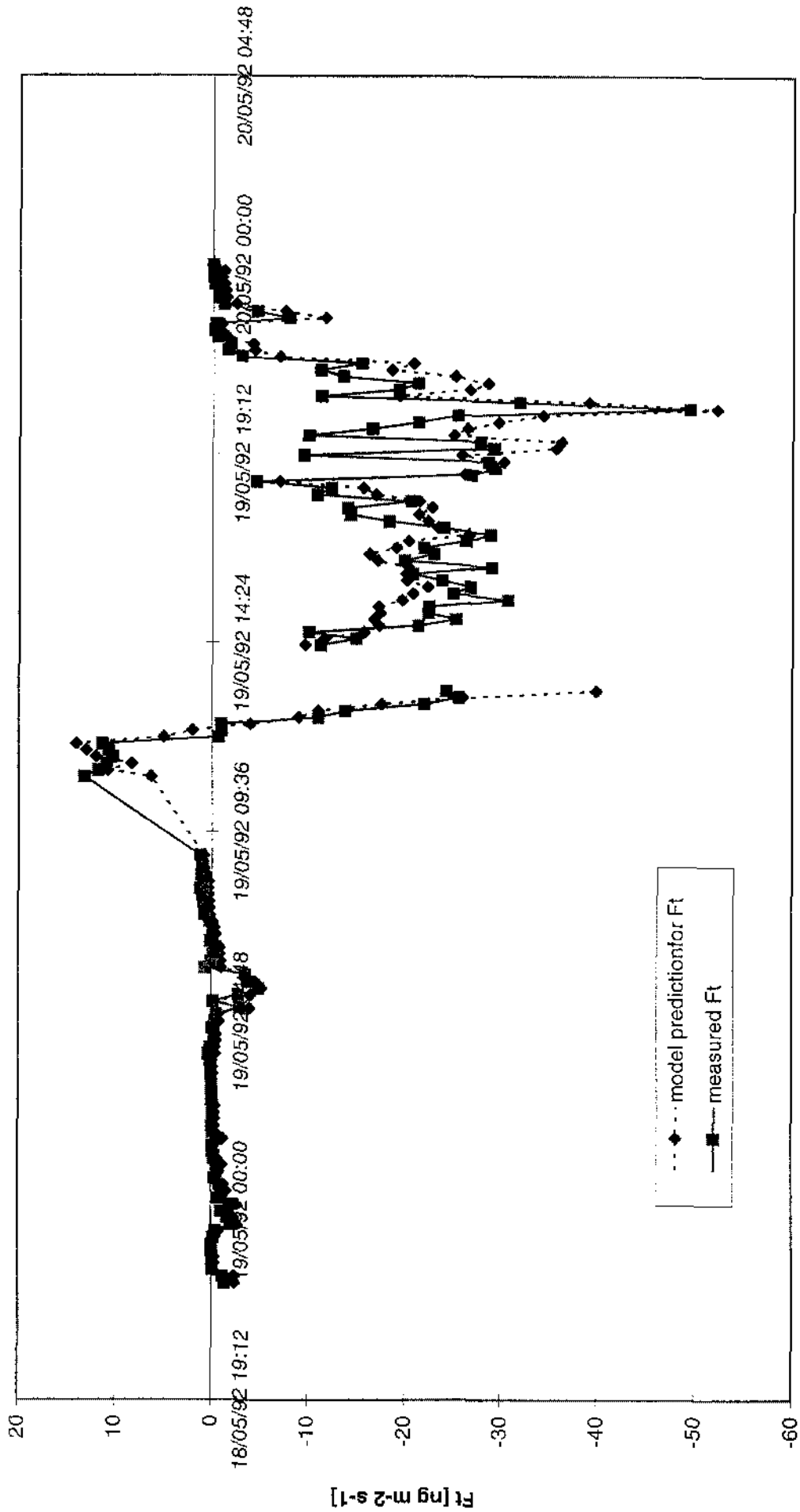


chart predicted Ft

### Model prediction and measured values for Ft

- measured Rs -



Calculation of the stomatal compensation point and the apoplastic [NH4+] from flux measurements:															
Date/Time	Ra[fm]+Rb [s m-1]	F [mg m-2 s-1]	X(fm) [μg m-3]	T(Zo) [deg C]	apoplastic pH	net radiation [W m-2]	h, H(Zo) [%]	input values:	solar radiation [W m-2]	Rs [s m-1]	Rw [s m-1]	results:			
								further input values:				Xc [μg m-3]	Fs [mg m-2 s-1]	Fw [mg m-2 s-1]	Xs [μmol l-1]
18/05/92 22:00	88.3678077	-1.9339562	0.55963	11.00889	6.8	78.23949	-45.18	10	5285	12.26222	0.398731	29.76769	-31.7016	157.1151	
18/05/92 22:10	194.038174	-1.3674026	0.504174	10.87918	6.8	79.20477	-44.595	10	5285	11.31448	0.238846	19.74232	-21.1037	104.1822	
18/05/92 22:20	161.358066	-1.1337461	0.410615	10.90093	6.8	79.36363	-43.89	10	5285	11.14708	0.227675	19.29092	-20.4247	101.7944	
18/05/92 22:30	1956.46739	-0.0841975	0.39399	10.34504	6.8	80.35806	-42.645	10	5285	10.27769	0.229092	22.206	-22.2902	117.1437	
18/05/92 22:40	1875.16133	-0.1098247	0.450556	10.2036	6.8	80.35806	-41.4	10	5285	10.27769	0.244994	23.72778	-23.8374	125.1718	
18/05/92 22:50	1851.44531	-0.1150529	0.446898	9.831199	6.8	80.42485	-40.455	10	5285	10.22064	-2.01274	-196.936	196.9285	-1038.89	
18/05/92 23:00	1315398.927	-0.0076762	0.406817	2.84426	6.8	80.42485	-39.51	10	5285	11.7302	0.081879	7.298577	-7.35285	38.50641	
18/05/92 23:10	13660.5759	-0.0295694	0.485813	7.605143	6.8	79.35574	-37.405	10	5285	11.7302	0.306016	27.20761	-27.389	143.5541	
18/05/92 23:20	1661.56621	-0.1813794	0.643668	9.471304	6.8	80.91404	-33.27	12.62446	4173.595	9.812374	0.294154	29.53984	-29.9778	123.5815	
18/05/92 23:30	882.450223	-0.4319742	0.580644	9.714037	6.8	82.14793	-31.24	13.63787	3864.576	8.954004	0.152968	15.22473	-17.2764	58.99011	
18/05/92 23:40	201.038717	-2.0516875	0.565434	9.470536	6.8	83.01933	-29.57	16.66199	165.684	8.234344	0.145042	15.95035	-17.6163	50.64199	
18/05/92 23:50	190.873397	-1.6639308	0.463024	9.599082	6.8	82.57559	-27.9	19.1077	27.6253	8.543589	0.17151	19.02042	-20.0747	52.71699	
19/05/92 00:00	284.213183	-1.0542922	0.471142	9.640857	6.8	83.239613	-26.89	21.26386	2483.966	8.045689	0.148016	18.4686	-18.3969	41.05048	
19/05/92 00:10	162.338188	-1.1930022	0.461377	9.729414	6.8	82.24068	-25.48	22.56946	2341.152	8.785393	0.134306	14.53281	-15.2874	34.15783	
19/05/92 00:20	432.641855	-0.7546319	0.460792	9.688521	6.8	83.70792	-24.755	24.38995	187.614	7.774277	0.195919	23.51216	-24.3892	49.28421	
19/05/92 00:30	301.826899	-1.1479062	0.482818	9.820161	6.8	89.31821	-24.03	25.32881	2087.73	8.030899	0.140375	15.9438	-16.2526	36.80279	
19/05/92 00:40	450.604422	-0.8824284	0.593541	9.19321	6.8	82.44746	-22.78	23.10807	2286.934	8.635304	0.363449	16.39062	-17.5385	35.66488	
19/05/92 00:50	2370.57805	-0.3121703	0.880399	9.266808	6.8	82.44746	-21.78	25.13685	2021.488	8.815157	0.860362	77.54092	-78.1595	158.8313	
19/05/92 01:00	1792.37969	-0.5484342	1.477891	9.352141	6.8	82.44746	-20.3	25.928	2039.838	8.448894	0.360824	42.3992	-42.8829	79.0601	
19/05/92 01:10	1184.87908	-0.6185979	1.398325	9.181886	6.8	82.70934	-18.62	28.51471	1856.155	8.448894	0.322629	36.43538	-36.5994	73.97631	
19/05/92 01:20	1214.23099	-0.2837248	0.705131	9.281898	6.8	82.70934	-17.495	26.15512	2021.488	8.815157	0.355881	40.24391	-40.3715	78.37707	
19/05/92 01:30	1630.56635	-0.1639915	0.590028	8.666494	6.8	82.20009	-16.17	27.29105	1936.708	8.815157	0.265798	30.86254	-31.5552	60.36496	
19/05/92 01:40	2050.87356	-0.1275465	0.617481	8.576219	6.8	82.20009	-15.225	27.156	1948.274	8.104454	0.209104	24.51446	-24.7014	42.98321	
19/05/92 01:50	443.431903	-0.7026515	0.567316	8.369146	6.8	83.2088	-15.225	30.3487	1744.893	8.424757	0.264274	30.99149	-31.1115	58.97841	
19/05/92 02:00	1159.81121	-0.1989728	0.424957	8.667745	6.8	82.74387	-14.28	30.3487	1744.893	8.424757	0.182766	21.3699	-21.516	36.64732	
19/05/92 02:10	1251.65058	-0.1199501	0.414422	8.202525	6.8	82.64484	-13.785	27.93212	1894.595	8.494426	0.221251	24.68885	-24.9677	44.93072	
19/05/92 02:20	1075.45308	-0.1461405	0.398934	8.571758	6.8	82.64484	-13.29	31.04027	1706.351	8.494426	0.300312	33.77989	-33.8886	63.3082	
19/05/92 02:30	1517.1065	-0.0988689	0.371246	8.311771	6.8	82.1372	-13.17	29.4479	1797.81	8.861477	0.07798	11.35382	-113.535	598.9568	
19/05/92 02:40	1404.78467	-0.1097092	0.45443	8.124429	6.8	81.30899	-13.015	28.37457	1866.248	8.861477	1.288012	132.4638	-132.461	698.709	
19/05/92 02:50	42356.2289	-0.1158096	0.479606	-2.00812	6.8	81.30899	-12.98	10	5285	9.494576	-9.60221	-987.508	987.5072	-5208.83	
19/05/92 03:00	181296.638	0.00299217	0.595353	-11.7726	6.8	81.02299	-12.8	10	5285	9.729688	1.176398	-136.807	136.807	689.3808	
19/05/92 03:10	303542.186	-0.002057	0.774877	-128.439	6.8	81.02299	-12.62	10	5285	9.729688	0.750598	87.29896	-87.2491	255.59	
19/05/92 03:20	8608374.85	-0.001202	0.774877	-128.439	6.8	82.49253	-11.78	10.47121	5028.745	8.602934	0.310203	39.36193	-39.603	66.7021	
19/05/92 03:30	8991.79396	0.04741321	0.845435	5.092691	6.8	82.49253	-10.94	18.07783	2919.168	8.602934	1.489557	169.1885	-168.873	419.6766	
19/05/92 03:40	5180.97097	0.04882923	0.492435	6.11939	6.8	82.19271	-10.435	10	5285	8.820585	0.310203	39.36193	-39.603	66.7021	
19/05/92 03:50	20964.6	0.11414688	0.55525	6.458151	6.8	82.19271	-9.93	21.35965	2472.905	8.820585	0.303327	43.31213	-43.6049	59.76227	
19/05/92 04:00	2051.08396	0.3156326	0.842168	6.420886	6.8	83.61769	-7.943	26.48999	1996.881	7.932821	0.225264	32.33932	-32.3829	47.12702	
19/05/92 04:10	2259.98984	0.11888559	0.7401	8.815917	6.8	83.61769	-5.956	31.04027	1475.805	7.932821	0.605579	72.99088	-73.3737	88.42786	
19/05/92 04:20	1534.59306	-0.2410276	0.680282	7.176415	6.8	85.04204	-1.9875	38.66545	1372.801	6.956272	0.225264	32.33932	-32.3829	47.12702	
19/05/92 04:30	1538.80391	-0.2927451	0.754097	7.500497	6.8	85.04204	-1.981	36.57637	1450.276	6.956272	0.605579	72.99088	-73.3737	88.42786	
19/05/92 04:40	6150.43142	-0.0429705	0.48955	6.381716	6.8	82.99034	8.1255	57.42769	929.219	8.253347	0.605579	72.99088	-73.3737	88.42786	
19/05/92 04:50	1523.20869	-0.3828636	1.18876	8.361014	6.8	82.99034	8.1255	57.42769	929.219	8.253347					



19/05/92 14:40	45.5672576	-9.99550159	2.974653	27.66831	6.9	57.73824	414.9	726.4041	87.27362	87.68152	21.92009	27.22099	-37.216	4.894888	81.50969
19/05/92 14:50	41.869288	-21.317592	3.08585	27.84242	6.8	58.22086	406.95	722.008	87.71368	65.0231	12.54383	12.54383	-33.8818	3.302089	53.45935
19/05/92 15:00	47.8132276	-25.25489	3.152592	27.95347	6.8	58.22372	405	715.6883	88.358	65.0231	29.92077	29.92077	-33.8818	3.302089	53.45935
19/05/92 15:10	47.285437	-22.365498	3.163611	27.910411	6.9	58.20033	392.6	699.1678	90.68829	65.13442	9.966664	9.966664	-32.3332	3.1603891	48.83947
19/05/92 15:20	49.3729569	-22.469104	3.204136	27.91166	6.8	58.20074	390.2	693.1244	91.85277	65.13442	9.966664	9.966664	-32.1618	2.965071	48.49279
19/05/92 15:30	46.7160697	-30.668443	3.43573	28.10948	6.9	57.54964	370.15	671.6641	93.16403	66.73322	2.063115	2.063115	-30.0029	2.0018	31.80455
19/05/92 15:40	44.0020958	-24.988124	3.741331	28.0983	6.9	57.55102	360.1	658.5059	94.72594	66.73322	2.063115	2.063115	-34.7886	3.32028	52.84302
19/05/92 15:50	40.3871478	-26.722625	3.912771	27.87987	6.9	58.39063	342.4	633.7778	97.83688	75.73651	7.514674	7.514674	-34.2373	3.328227	54.25885
19/05/92 16:00	58.5960986	-23.784347	3.906827	27.88576	6.9	56.39227	324.7	610.8365	100.9474	75.73651	33.1863	33.1863	-34.62463	3.462463	56.41012
19/05/92 16:10	49.5512375	-20.725258	3.674836	27.28261	6.8	58.87174	306.6	582.8394	105.0763	79.08333	2.161213	2.161213	-27.5368	2.161213	34.28514
19/05/92 16:20	52.1533655	-22.976166	3.385599	27.38207	6.8	58.86606	288.9	559.8171	108.7866	75.12277	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 16:30	43.1033546	-19.017423	3.333984	27.38206	6.8	57.78623	274.25	541.2816	111.992	79.64867	2.161213	2.161213	-28.5826	3.247553	35.96229
19/05/92 16:40	52.1533655	-22.976166	3.385599	27.38207	6.8	58.86606	288.9	559.8171	108.7866	75.12277	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 16:50	40.3871478	-26.722625	3.912771	27.87987	6.9	58.39063	342.4	633.7778	97.83688	75.73651	7.514674	7.514674	-34.2373	3.328227	54.25885
19/05/92 17:00	62.7800251	-26.279097	3.405121	28.79659	6.8	57.37681	236.15	487.1947	122.9503	69.78133	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 17:10	65.0329438	-28.873487	3.848374	28.34549	6.8	59.34928	193.05	427.5823	137.7834	59.18832	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 17:20	63.3228833	-24.04111	3.458565	28.38355	6.8	62.50667	143.65	358.5993	162.2241	45.4943	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 17:30	90.0477555	-18.304407	3.528477	25.47892	6.8	62.50667	143.65	358.5993	162.2241	45.4943	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 17:40	77.8018722	-14.061971	3.083168	25.1234	6.8	64.64103	101.1	298.5557	180.9466	38.08147	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:00	110.773095	-20.955221	3.16786	25.19626	6.8	64.64103	101.1	298.5557	180.9466	38.08147	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:10	120.055489	-10.893369	2.803112	24.35923	6.8	67.41728	76.54	280.7097	216.3734	29.83808	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:20	118.135881	-12.367651	2.586694	24.5314	6.8	67.56273	64.75	248.7093	227.8011	29.83808	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:30	294.686408	-4.5482496	2.453355	23.92879	6.8	69.99982	51.96	225.4562	247.8612	24.37354	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:40	71.4478128	-26.879748	2.665932	23.78187	6.8	70.24072	39.14	207.673	297.8012	23.8811	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 18:50	84.6893424	-28.658586	2.605624	23.26868	6.8	66.66908	26.07	165.5006	296.0179	32.16002	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 19:00	56.660471	-9.4948202	2.402084	22.86848	6.8	66.66908	26.07	165.5006	296.0179	32.16002	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 19:10	45.2474524	-29.2556801	2.802236	22.5794	6.8	67.41358	1.91	150.7569	323.2278	32.16002	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 19:20	16.10725	-27.618143	2.770362	21.79292	6.8	68.1133	-17.095	135.7035	363.3438	30.2539	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 19:30	57.5652203	-9.9766066	2.205895	21.92196	6.8	68.08902	-25.01	110.1536	491.6073	28.56156	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 19:40	53.7681779	-16.463652	2.116813	20.94984	6.8	69.66339	-30.065	96.26851	560.3497	25.05407	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:00	49.2516993	-21.307588	2.240577	20.90009	6.8	69.68378	-35.12	89.33088	602.7327	25.01559	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:10	51.6785091	-25.375874	2.657649	20.30398	6.8	69.68378	-35.12	89.33088	602.7327	25.01559	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:20	47.9730898	-49.433561	3.831746	20.20108	6.8	69.68378	-35.12	89.33088	602.7327	25.01559	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:30	71.8743384	-31.799341	3.658518	19.05946	6.8	71.52779	-39.97	69.93274	772.218	21.49229	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:40	83.6583304	-11.23889	2.048474	19.22357	6.8	71.44631	-39.7	70.3346	755.1184	21.59844	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 20:50	68.4667769	-19.218038	2.062654	18.67756	6.8	73.53458	-39.6	67.05601	797.9276	18.1487	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:00	52.6816748	-21.26115	2.03301	18.61899	6.8	73.59182	-39.5	66.72015	801.6686	18.06234	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:10	57.8845178	-13.463073	1.916078	18.18095	6.8	73.69571	-39.31	63.80677	837.7968	17.946653	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:20	84.958576	-11.138650	1.822178	13.10795	6.8	73.4907	-39.12	63.5187	841.5417	18.21519	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:30	77.7992408	-15.405339	2.024138	17.52227	6.8	72.75043	-38.545	60.01934	889.718	19.37324	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:40	284.74736	-2.9457995	2.135877	17.48146	6.8	72.05687	-37.97	60.47094	889.1856	20.32883	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 21:50	414.481041	-1.527295	1.872286	16.68175	6.8	73.40611	-35.98	55.87311	954.8291	18.4946	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:00	373.126373	-1.8020204	1.629676	16.43039	6.8	74.73169	-35.15	52.05728	1023.505	16.42557	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:10	1001.28014	-0.4463083	1.450537	15.79577	6.8	74.73169	-34.61	50.94263	1045.589	18.42557	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:20	1782.6545	-0.1563312	1.271028	15.54089	6.8	73.5035	-34.01	50.32116	1058.299	18.19576	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:30	1567.72047	-0.2881263	1.388473	15.34301	6.8	74.2888	-33.41	49.21414	1081.767	17.04342	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:40	105.72394	-7.9244375	1.493332	15.07593	6.8	74.2888	-33.41	49.21414	1081.767	17.04342	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 22:50	1567.72047	-0.2881263	1.388473	15.34301	6.8	74.2888	-33.41	49.21414	1081.767	17.04342	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:00	568.63191	-1.124833	1.491935	14.83107	6.8	71.43739	-33.47	47.41145	1122.321	21.6145	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:10	1125.57887	-0.5926629	1.588328	13.73774	6.8	69.72197	-33.035	40.39888	1315.797	24.93735	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:20	1355.72586	-1.799374	1.799374	13.48079	6.8	69.72197	-32.6	39.20007	1404.185	24.93735	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:30	1255.58866	-0.1845782	1.461069	13.48079	6.8	70.26189	-32.53	39.20007	1404.185	24.93735	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:40	1584.16341	-0.0434014	1.453023	13.90486	6.8	70.26189	-32.46	42.23888	1257.928	23.8339	1.970646	1.970646	-28.5826	3.247553	35.96229
19/05/92 23:50	1143.54394	-0.1863652	1.34931	12.56208	6.8	76.1188	-32.2	33.28885	1592.199	14.63853	1.970646	1.970646	-28.5826	3.247553	35.96229
20/05/92 00:00				4.171939	6.8	76.1188	-31.94			5	10515	14.83253			



chart [NH4+]

### Apoplastic NH4+ concentration derived from Ft measurements and Rw parameterisation - parameterised Rs -

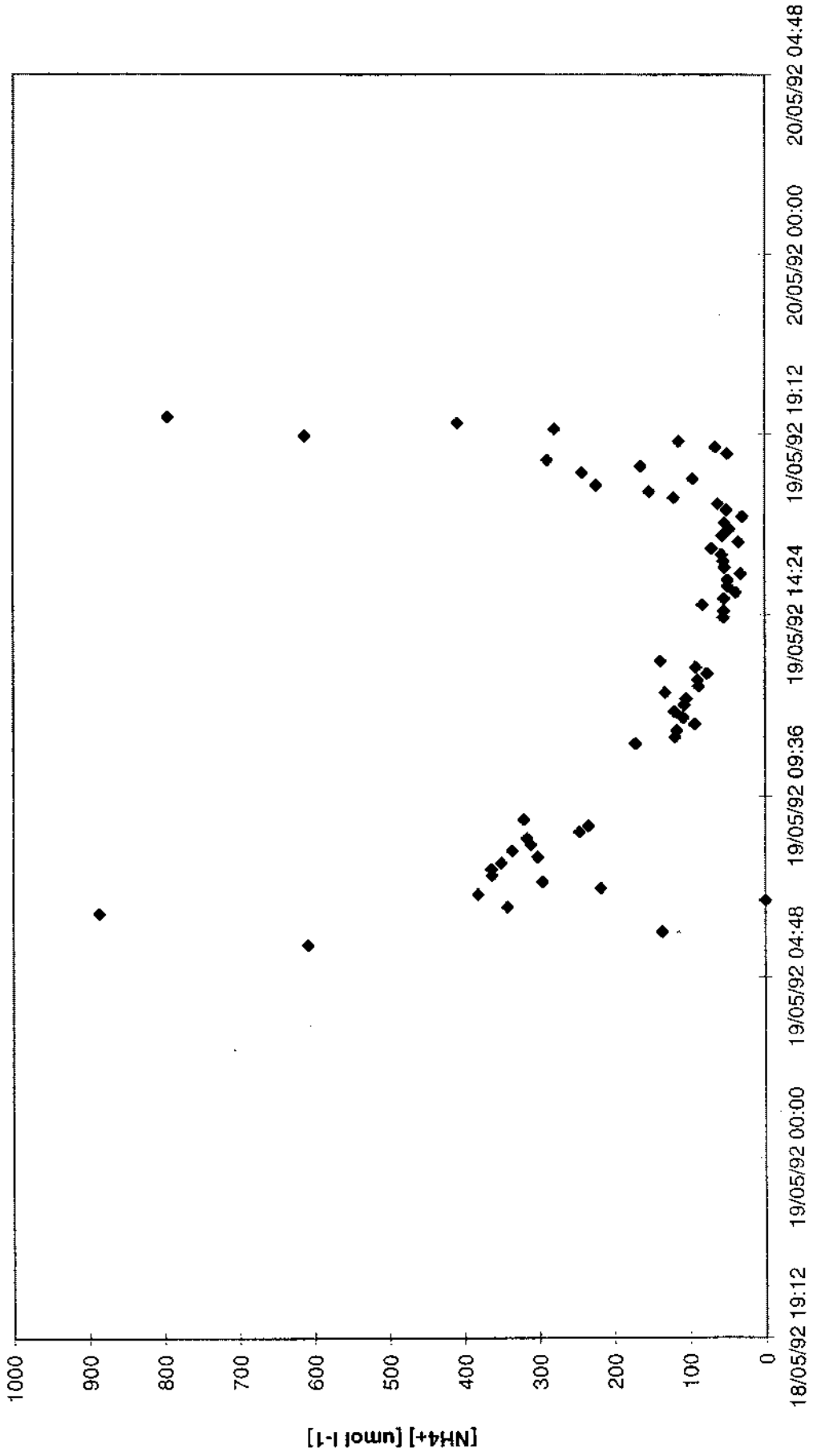
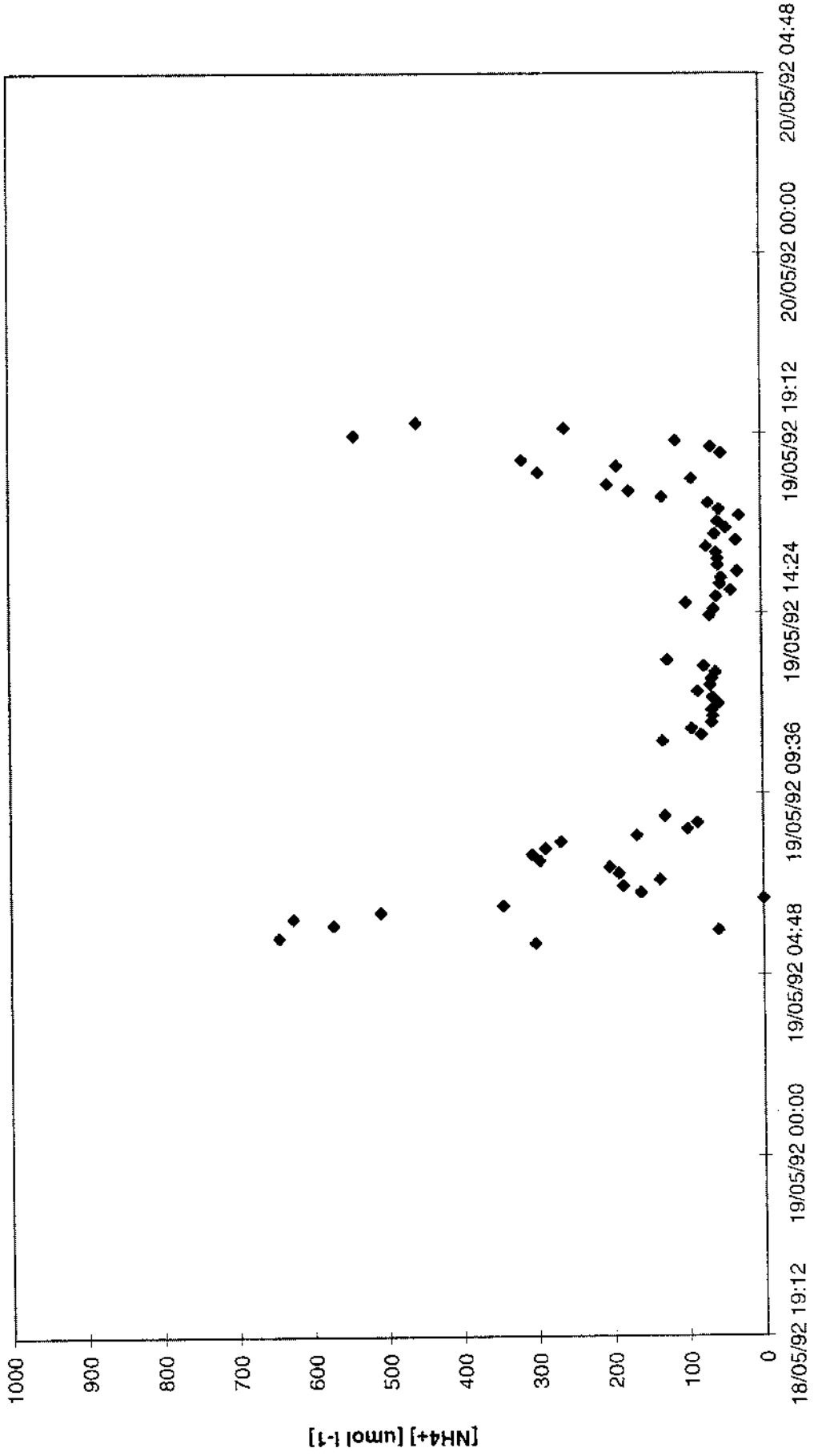


chart [NH4+]

### Apoplasmic NH4+ concentration derived from Ft measurements and Rw parameterisation - measured Rs -





19/05/92 05:00	1575.34054	-0.52419	1.0983077	8.39415	75	6.8	14.27	64.98654	500	0.267198	0.446784	0.359172	-0.89336	44.4353
19/05/92 05:10	145.33322	-2.93724	0.596372	9.495231	75	6.8	19.75	80.05633	300	0.169494	0.520355	0.877153	-3.81439	44.4353
19/05/92 05:20	2344.52868	-0.15054	0.623095	9.482921	75	6.8	25.28	87.12008	400	0.271049	0.519519	0.828234	-0.97877	44.4353
19/05/92 05:30	138.959727	2.8194	0.663212	10.40868	75	6.8	33.13	103.5042	227.8542	0.215042	0.583804	1.618128	-4.43752	48.46866
19/05/92 05:40	117.105947	-4.8708	0.551267	10.41044	75	6.8	40.98	113.7109	233.6254	0.055865	0.583933	2.260357	-7.13115	7.83284
19/05/92 05:50	111.392597	-3.7434	0.533121	10.96846	75	6.8	43.13	120.2681	151.2466	0.116254	0.926219	3.371751	-7.11515	16.33889
19/05/92 06:00	83.6364901	-3.54569	0.318022	10.96214	75	6.8	45.29	123.0241	189.2194	0.018768	0.926725	3.207714	-6.75341	2.778346
19/05/92 06:10	66.4790178	0.662478	0.086553	11.73323	75	6.8	50.66	135.4749	112.7741	0.130593	0.688686	4.950507	-4.28803	30.45535
19/05/92 06:20	78.545351	0.074881	0.08731	11.73984	75	6.8	56.41	143.0131	175.107	0.093005	0.692886	3.423779	-3.3468	27.78613
19/05/92 06:30	82.0069884	-0.18289	0.082255	12.53218	75	6.8	61.706	155.7292	201.1958	0.067257	0.710092	3.494332	-3.67722	18.29006
19/05/92 06:40	59.2268736	-0.46822	0.064577	12.93475	75	6.8	67	162.2948	341.2119	0.028357	0.765053	2.15813	-2.82435	11.18637
19/05/92 07:00	55.6461158	-0.15192	0.040506	12.9074	75	6.8	70.65	189.4234	361.1514	0.042073	0.799397	2.158899	-2.05968	20.42689
19/05/92 07:10	59.272694	-0.17003	0.031377	13.44674	75	6.8	79.8	173.9751	192.9116	0.032052	0.796706	5.753104	-5.90503	5.487865
19/05/92 07:20	56.0358759	0.18486	0.018486	13.43138	75	6.8	85.3	184.8471	252.8492	0.019509	0.851395	3.278734	-3.44679	5.686132
19/05/92 07:30	40.3942701	0.698002	0.008692	13.82782	75	6.8	104.65	191.8834	192.0311	0.027115	0.849789	6.230908	-6.08228	4.49079
19/05/92 07:40	53.8400719	0.638043	0.00365	13.82405	75	6.8	124	219.7674	132.1257	0.036868	0.892148	6.473079	-5.77508	6.387397
19/05/92 07:50	56.2645368	0.827318	-0.00148	14.67629	75	6.8	131.75	244.671	126.864	0.040302	0.891736	6.708631	-6.08859	6.641105
19/05/92 08:00	52.4441866	0.896788	0.00643	14.72866	75	6.8	139.5	260.895	181.8898	0.045066	0.889583	5.19282	-4.3655	10.32332
19/05/92 08:10	40.3504688	1.260755	-0.00798	14.87827	75	6.8	138.4	270.9514	178.721	0.040603	0.995914	4.528146	-3.62938	11.18726
19/05/92 08:20	52.8467994	0.937629	-0.01027	14.9109	75	6.8	137.3	289.7525	175.8664	0.038282	1.018244	5.442716	-4.50509	8.718551
19/05/92 08:30	54.2571338	-1.090277	-0.01184	15.56735	75	6.8	140.8	278.893	106.2003	0.047318	1.10185	9.829649	-8.83937	5.363098
19/05/92 08:40	54.9835813	0.967241	-0.01617	15.55282	75	6.8	144.3	283.378	79.66109	0.037016	1.100713	13.35278	-12.3656	2.98852
19/05/92 08:50	50.5819463	1.046874	-0.01717	16.15292	75	6.8	154.65	301.0834	68.75063	0.035855	1.183408	16.89153	-15.6449	2.291821
19/05/92 09:00	54.084724	1.25758	-0.01746	16.15292	75	6.8	165	314.5304	72.38586	0.060967	1.183518	15.84609	-14.3884	3.542193
19/05/92 09:10	52.076452	N/A	N/A	17.27334	75	6.8	194.3	361.4251	75.3592	N/A	1.354529	N/A	N/A	N/A
19/05/92 09:20	49.2210127	N/A	N/A	17.31439	75	6.8	224.8	400.5237	66.43525	N/A	1.36054	N/A	N/A	N/A
19/05/92 09:30	48.1456021	N/A	N/A	19.22041	75	6.8	290	499.0932	60.11736	N/A	1.706196	N/A	N/A	N/A
19/05/92 09:40	45.0450179	N/A	N/A	19.35401	75	6.8	355.2	594.7526	51.04852	N/A	1.73329	N/A	N/A	N/A
19/05/92 09:50	50.1236124	N/A	N/A	20.4247	75	6.8	377.3	621.3899	38.88266	N/A	1.965537	N/A	N/A	N/A
19/05/92 10:00	51.5363942	N/A	N/A	20.4474	75	6.8	399.4	650.2603	31.15909	N/A	1.970764	N/A	N/A	N/A
19/05/92 10:10	37.6880566	N/A	N/A	21.24668	75	6.8	419.8	677.564	48.725	N/A	2.164134	N/A	N/A	N/A
19/05/92 10:20	44.2755824	N/A	N/A	21.31993	75	6.8	432.2	699.3909	40.47703	N/A	2.18189	N/A	N/A	N/A
19/05/92 10:30	43.3830321	N/A	N/A	22.30872	75	6.8	438.95	715.6313	51.79868	N/A	2.446809	N/A	N/A	N/A
19/05/92 10:40	45.8079511	N/A	N/A	22.31351	75	6.8	445.7	724.4347	51.13355	N/A	2.44819	N/A	N/A	N/A
19/05/92 10:50	46.5788721	N/A	N/A	23.27353	75	6.8	456.6	745.919	61.52499	N/A	2.734231	N/A	N/A	N/A
19/05/92 11:00	44.1071132	13.18545	0.153008	23.10048	75	6.8	467.5	758.7484	62.23289	0.735029	2.890272	45.23497	-33.4655	19.48766
19/05/92 11:10	42.8631794	11.78944	0.14769	24.06164	75	6.8	474.45	775.1712	51.73225	0.854517	3.010431	37.46501	-26.5717	24.63213
19/05/92 11:20	47.1682984	10.59033	0.140839	24.11467	75	6.8	481.4	784.6073	62.88906	0.952165	2.992272	45.23497	-33.4655	19.48766
19/05/92 11:30	40.0801302	10.24247	0.19882	24.87418	75	6.8	484.25	794.2076	54.39737	0.903339	3.282164	49.14421	-38.9017	15.86355
19/05/92 11:40	44.3619534	10.85523	0.260055	24.91792	75	6.8	487.1	798.2501	42.88568	0.734073	3.298497	59.82326	-49.138	14.93899
19/05/92 11:50	43.5833053	11.32484	0.496823	25.58822	75	6.8	490.2	807.5084	36.92296	0.990197	3.557711	69.53708	-58.2122	17.01011
19/05/92 12:00	44.1022848	-0.89122	1.087431	25.49491	75	6.8	493.3	810.8158	33.34136	1.057697	3.521197	73.889	-74.8602	14.18121
19/05/92 12:10	44.2098411	-1.0151	1.23265	26.21066	75	6.8	495.35	819.1135	41.01925	1.187773	3.817106	84.09998	-65.1151	18.24113
19/05/92 12:20	42.4102581	-0.978	1.542787	26.18455	75	6.8	497.4	821.5896	42.60717	1.305946	3.887464	47.99442	-59.0461	22.11741
19/05/92 12:30	38.1085713	-1.0517	1.72711	26.37315	75	6.8	503	830.3538	53.78786	1.380285	3.908399	51.01565	-64.8401	21.28722
19/05/92 12:40	39.3076021	-13.8244	1.92367	26.42097	75	6.8	508.6	837.9934	49.55806	1.45688	4.070067	47.9072	-69.914	20.83818
19/05/92 12:50	37.4153894	-2.0068	2.280272	26.78232	75	6.8	499.5	829.0334	54.54885	1.719288	4.067496	39.37714	-65.0182	26.44319
19/05/92 13:00	35.504533	-25.6339	2.629601	26.77668	75	6.8	490.4	817.1704	59.05356	2.529448	4.268979	24.6678	-48.9602	53.70584
19/05/92 13:10	34.2045812	-24.2924	3.460359	27.25069	75	6.8	492.45	823.6085	67.87497	0	4.271175	55.71113	-55.7111	
19/05/92 13:20	34.2319317			27.21346	75	6.8	494.5	825.9738	76.86646	0	4.356266	51.2275	-51.2275	
19/05/92 13:30	35.3031942			27.30016	75	6.8	494.75	827.7099	85.03265	0	4.387526	42.10703	-42.107	
19/05/92 13:40	34.1598479			27.4133	75	6.8	495	828.2197	103.7244	0	4.365881	32.77018	-32.7702	
19/05/92 13:50	36.7077395			27.4098	75	6.8	471.25	797.3475	133.2254	0	4.366682	32.80266	-32.8027	
19/05/92 14:00	38.2722364			27.45253	75	6.8	447.5	766.8462	133.7295	0	4.505163	37.51826	-37.5183	
19/05/92 14:10	37.957168			27.69369	75	6.8	451.5	773.9719	120.1059	0	4.509682	20.37377	-31.5952	56.88374
19/05/92 14:20	43.4154662	-11.2215	2.347832	27.7007	75	6.8	455.5	778.2228	130.0316	1.860448	4.509682	20.37377	-31.5952	56.88374
19/05/92 14:30	35.418022	-14.9016	2.526394	27.68903	75	6.8	435.2	752.7855	121.381	1.998611	4.503823	20.63925	-35.5408	56.23424

19/05/92 14:40	45.5672576	-9.985602	2.974653	27.68931	75	6.8	414.9	726.4041	126.4173	2.519208	4.503962	15.70092	-25.695	98.04268
19/05/92 14:50	41.4569288	-21.3118	3.08585	27.94242	75	6.8	409.95	722.008	117.6614	2.201801	4.532589	20.66114	-41.9791	52.44989
19/05/92 15:00	47.8132278	-25.2549	3.152392	27.95347	75	6.8	405	715.6683	117.23	1.945074	4.638286	22.97375	-48.2286	40.33028
19/05/92 15:10	47.285437	-22.3665	3.163611	27.90411	75	6.8	392.6	699.1676	121.7738	2.106002	4.612905	20.58656	-42.9531	49.03031
19/05/92 15:20	49.3795589	-22.4691	3.204136	27.91166	75	6.8	380.2	683.1244	119.4233	2.064768	4.616775	21.11821	-43.5873	48.05915
19/05/92 15:30	46.7190897	-30.6654	3.49573	28.10948	75	6.8	370.15	671.5664	119.6851	2.063115	4.71937	-52.8601	39.02968	
19/05/92 15:40	54.0020956	-24.9851	3.741331	28.0953	75	6.8	360.1	658.5059	120.3515	2.391392	4.712467	19.28141	-44.2695	54.03085
19/05/92 15:50	49.3871478	-26.7226	3.912171	27.87987	75	6.8	342.4	633.778	120.3515	2.599017	4.600466	18.80041	-43.4027	59.74325
19/05/92 16:00	58.5963996	-23.7849	3.905927	27.88578	75	6.8	324.7	610.8395	117.1515	2.513222	4.603513	17.72692	-41.5119	60.54227
19/05/92 16:10	49.5512375	-20.7593	3.674835	27.93261	75	6.8	289.9	582.8394	117.4086	2.647872	4.308036	14.14904	-34.8743	75.92616
19/05/92 16:20	49.7362857	-29.0177	3.401323	27.93237	75	6.8	269.9	559.8171	152.449	2.275598	4.322831	14.17796	-43.1957	50.03303
19/05/92 16:30	53.1033545	-19.9124	3.333984	27.38206	75	6.8	274.25	541.2816	144.3314	2.187359	4.353211	18.59014	-34.2636	66.38469
19/05/92 16:40	52.1513555	-22.9762	3.385599	27.38387	75	6.8	259.6	522.27	116.5054	2.019449	4.080077	13.41665	-35.3758	57.08559
19/05/92 16:50	57.9443751	-26.2791	3.405121	26.79659	75	6.8	236.15	487.1947	159.5874	1.755318	4.076581	12.19038	-38.4695	45.62886
19/05/92 17:00	66.0329438	-28.8735	3.848374	26.34549	75	6.8	212.7	456.8793	190.4176	1.970546	3.875402	9.859622	-38.7331	50.87756
19/05/92 17:10	63.3228833	-24.0411	3.455865	26.36245	75	6.8	173.4	402.2057	190.7205	1.933513	3.888274	10.22313	-34.2642	56.42946
19/05/92 17:20	90.0477555	-18.3044	3.526437	25.47892	75	6.8	143.65	358.5993	194.7255	1.878166	3.514841	8.86004	-27.1644	69.14059
19/05/92 17:30	77.8018722	-14.3238	3.081486	25.48741	75	6.8	113.9	318.0295	214.9257	1.967069	3.518214	7.217119	-21.5409	91.31793
19/05/92 17:40	90.1016491	-14.052	3.383168	25.1234	75	6.8	101.1	298.5657	169.0106	2.116161	3.378241	7.455629	-21.5176	98.34556
19/05/92 18:00	110.773095	-20.5952	3.61788	25.10626	75	6.8	88.3	281.7884	191.0578	1.338463	3.569592	10.64195	-31.2372	42.78439
19/05/92 18:10	92.2474524	-29.2558	2.602236	22.5794	75	6.8	78.54	246.7093	271.4601	1.495303	3.095531	5.894891	-16.7883	89.06837
19/05/92 18:20	118.1358981	-12.3677	2.586894	24.82314	75	6.8	64.78	246.7093	271.4601	1.125663	3.153825	7.47143	-19.8991	56.73802
19/05/92 18:30	294.686408	-4.54825	2.455355	23.92879	75	6.8	51.96	225.4562	274.8986	1.864145	2.849405	10.65111	-11.6603	159.8681
19/05/92 18:40	71.4478128	-26.8797	2.685932	23.78187	75	6.8	39.14	207.873	291.8641	0.745422	2.898155	7.375766	-34.2555	21.76095
19/05/92 18:50	54.4683291	-29.3379	2.674236	23.10542	75	6.8	26.07	185.5006	309.5397	1.076248	2.681969	34.5254	-34.5254	31.17265
19/05/92 19:00	48.6893424	-28.6586	2.605624	23.26866	75	6.8	13	169.7778	320.4418	1.210256	2.732704	4.751088	-33.4097	36.22471
19/05/92 19:10	56.660471	-9.49462	2.402084	22.6648	75	6.8	-9.1	150.7569	316.4275	1.478486	2.524439	2.838791	-32.0946	46.0665
19/05/92 19:20	46.10725	-27.8181	2.770362	21.79292	75	6.8	-25.01	119.4568	515.9245	1.487744	2.305055	1.584167	-29.4023	50.59957
19/05/92 19:30	57.5652203	-9.97556	2.205895	21.92198	75	6.8	-30.085	110.1586	902.901	1.631592	2.339781	0.882036	-10.6586	150.258
19/05/92 19:40	57.6891779	-16.4837	2.116813	20.94984	75	6.8	-35.12	96.25965	904.5354	1.230517	2.088966	0.950045	-17.4337	70.58285
19/05/92 20:00	49.2518983	-21.3076	2.240577	20.90009	75	6.8	-37.68	89.33088	782.6202	1.191142	2.077777	1.118612	-22.4262	53.11386
19/05/92 20:10	51.6785091	-25.3757	2.657649	20.30398	75	6.8	-40.24	81.55557	1048.672	0.460265	1.914738	0.4169	-49.8503	29.29292
19/05/92 20:20	49.7308998	-49.4336	3.831746	20.20109	75	6.8	-39.97	77.46544	1090.125	1.372955	1.672866	0.28767	-32.087	42.78848
19/05/92 20:30	71.8745384	-31.7993	3.659518	19.05346	75	6.8	-39.7	69.33274	1042.656	1.108248	1.706832	0.481748	-11.7206	94.55523
19/05/92 20:40	83.6583304	-11.2389	2.048474	19.22357	75	6.8	-39.6	70.9346	1242.626	0.936047	1.800141	0.720968	-19.839	47.09597
19/05/92 20:50	58.4687769	-19.218	2.062684	18.87753	75	6.8	-39.5	67.05601	915.9528	0.912937	1.588123	0.481718	-21.7429	41.98787
19/05/92 21:00	52.6816748	-21.2611	2.033001	18.61989	75	6.8	-39.31	66.72015	1401.619	1.588123	1.588123	0.481718	-21.7429	41.98787
19/05/92 21:10	84.9258576	-11.1385	1.922178	18.10735	75	6.8	-39.12	63.60877	1388.183	1.136728	1.508594	0.265862	-13.7299	82.79257
19/05/92 21:20	54.9258576	-11.1385	1.922178	18.10735	75	6.8	-39.12	63.61767	1874.045	0.976231	1.495452	0.277059	-11.4156	85.51755
19/05/92 21:30	77.7392408	-16.4053	2.024198	17.52227	75	6.8	-38.545	60.01934	1940.001	0.926539	1.394765	0.282895	-15.8982	52.65172
19/05/92 21:40	284.74738	-2.9458	2.135877	17.48148	75	6.8	-37.97	60.07094	1000	1.297068	1.387975	0.090905	-9.0367	42.71901
19/05/92 21:50	414.481041	-1.5273	1.872286	16.88175	75	6.8	-36.83	56.19281	1000	1.239251	1.261212	0.021961	-11.54926	799.9011
19/05/92 22:00	373.126373	-1.80202	1.629676	16.43039	75	6.8	-36.89	55.87311	1000	0.957295	1.223676	0.266381	-11.0884	452.8188
19/05/92 22:10	1001.28014	-0.44681	1.450537	15.79677	75	6.8	-35.15	52.05728	1000	1.003638	1.123672	0.130015	-0.37632	
19/05/92 22:20	1782.65545	-0.15633	1.271028	15.64089	75	6.8	-34.61	50.94283	1000	0.992344	1.099125	0.108731	-0.26511	
19/05/92 22:30	105.72047	-0.28813	1.388473	15.54301	75	6.8	-34.01	50.32116	1000	0.936772	1.079309	0.136318	-0.42444	
19/05/92 22:40	169.722394	-0.792444	1.493032	15.07593	75	6.8	-33.41	49.21414	1000	0.623544	1.038871	0.416321	-8.35976	74.76757
19/05/92 22:50	157.444895	-4.58822	1.360384	15.39434	75	6.8	-33.44	47.41145	1000	0.637932	1.079787	0.441795	-5.93002	126.8369
19/05/92 23:00	588.63191	-1.12448	1.491935	14.83107	75	6.8	-33.47	47.41145	1000	0.8330028	1.008404	0.178376	-1.30296	
19/05/92 23:10	1125.57887	-0.55266	1.588328	13.73774	75	6.8	-33.035	40.32888	1000	0.966262	0.882352	-0.08391	-0.46875	
19/05/92 23:20	1355.72586	-0.62571	1.799374	13.29471	75	6.8	-32.16	37.91971	1000	0.951088	0.855631	-0.11546	-0.51025	
19/05/92 23:30	255.56866	-0.18458	1.461069	13.48079	75	6.8	-32.56	39.20007	1000	0.929317	0.834963	-0.37435	0.189775	
19/05/92 23:40	1584.15341	-0.0434	1.453023	13.90486	75	6.8	-32.48	42.23898	1000	1.384269	0.906007	-0.48356	0.44026	
19/05/92 23:50	1143.54994	-0.16837	1.34931	12.56298	75	6.8	-32.2	33.28695	1000	1.158777	0.763448	-0.39333	0.224964	
20/05/92 00:00		0	4.171939		75	6.8	-31.94	10	1000	#DIV/0!	0.150252	#DIV/0!		



chart Rw

### Calculation of Rw from measurements of Ft and estimates of [NH4+] - parameterised Rs -

