

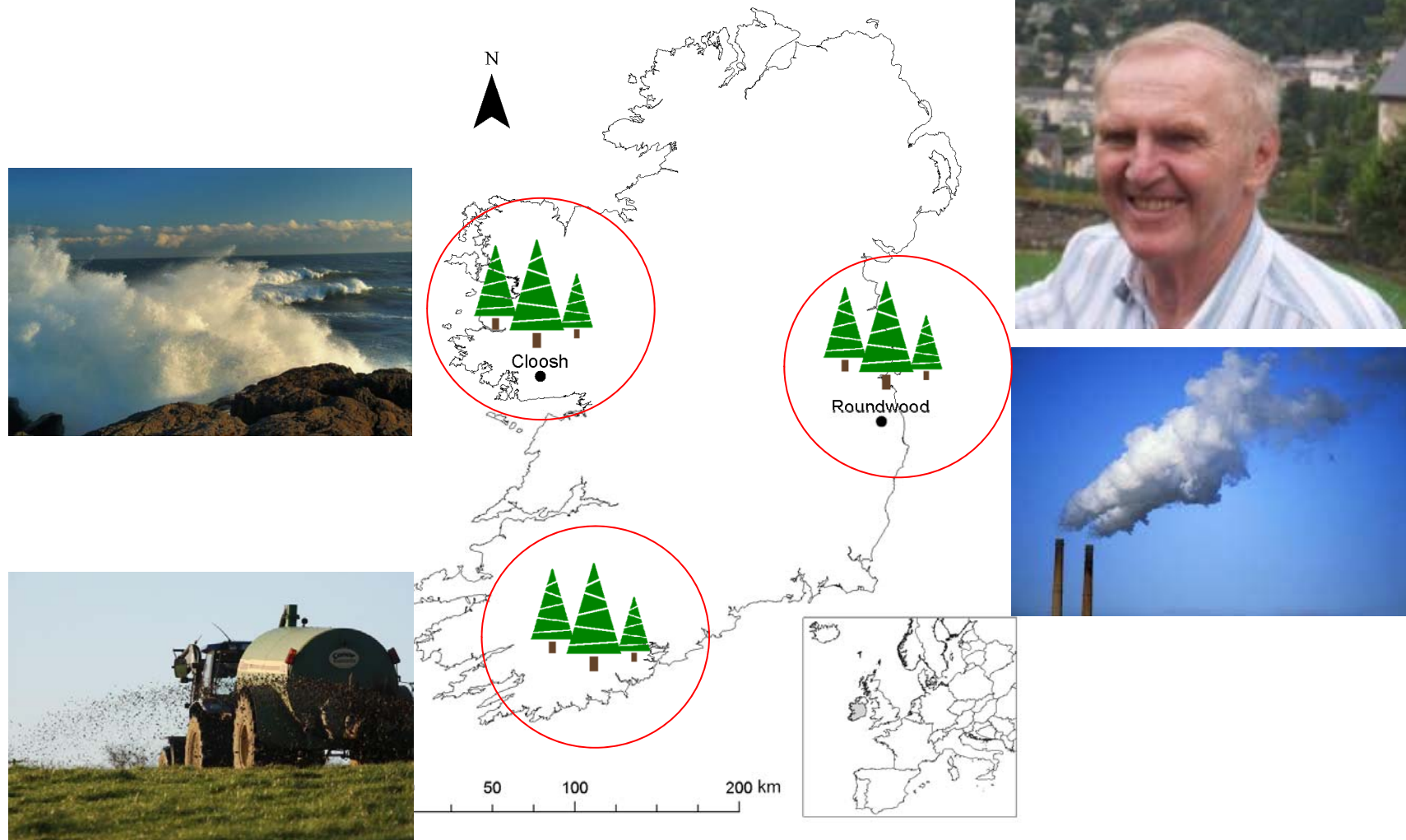
Contrasting responses of two Sitka spruce forest plots in Ireland to reductions in sulphur emissions: results of 20 years of monitoring

Jim Johnson, University College Dublin, Ireland

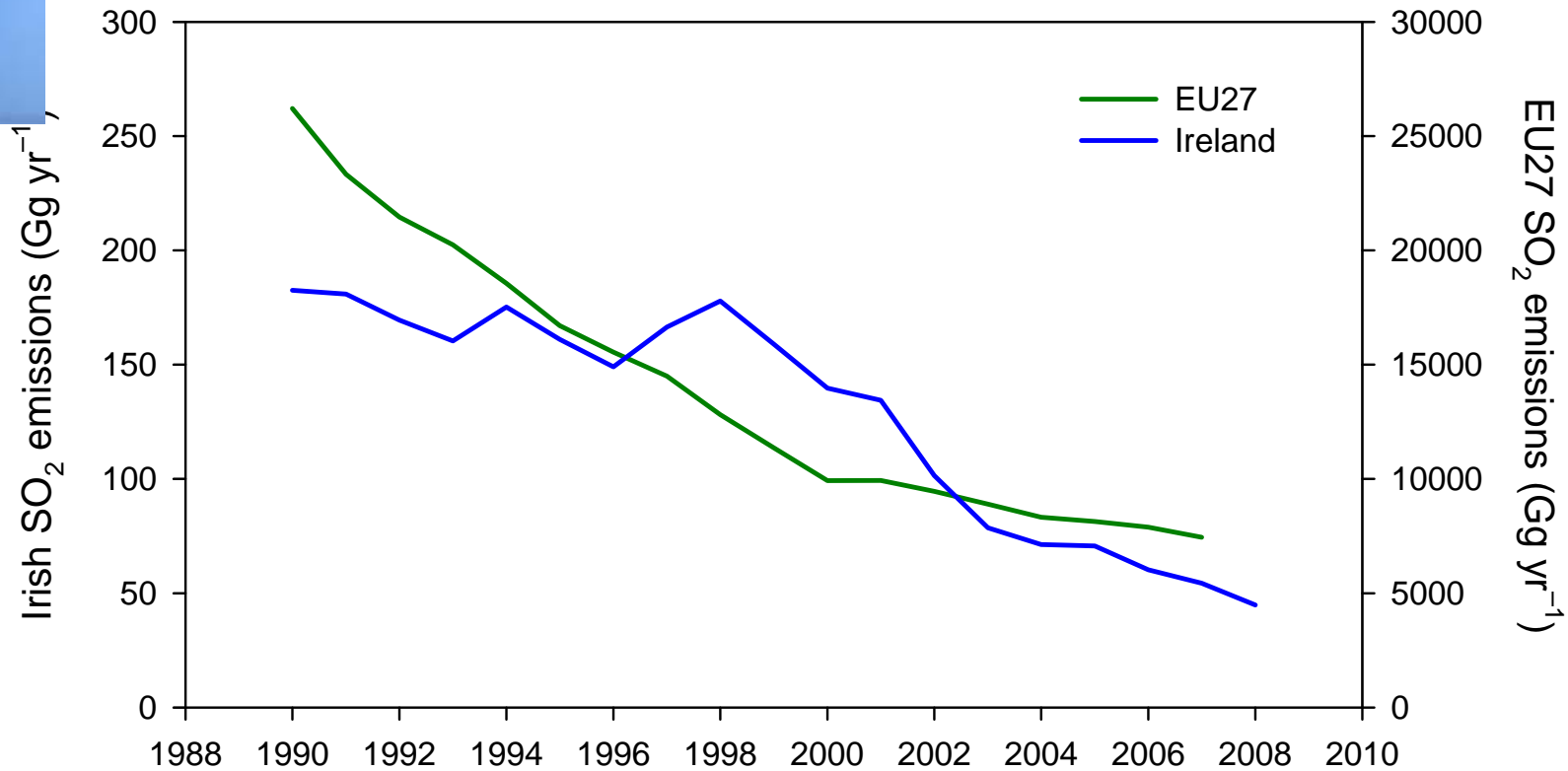


4th ICP Forests Scientific Conference 19th May 2015, Ljubljana, Slovenia

[ICP] Forest monitoring in Ireland 1991



Significant decline in sulphur dioxide (SO₂) emissions over the past 2 decades

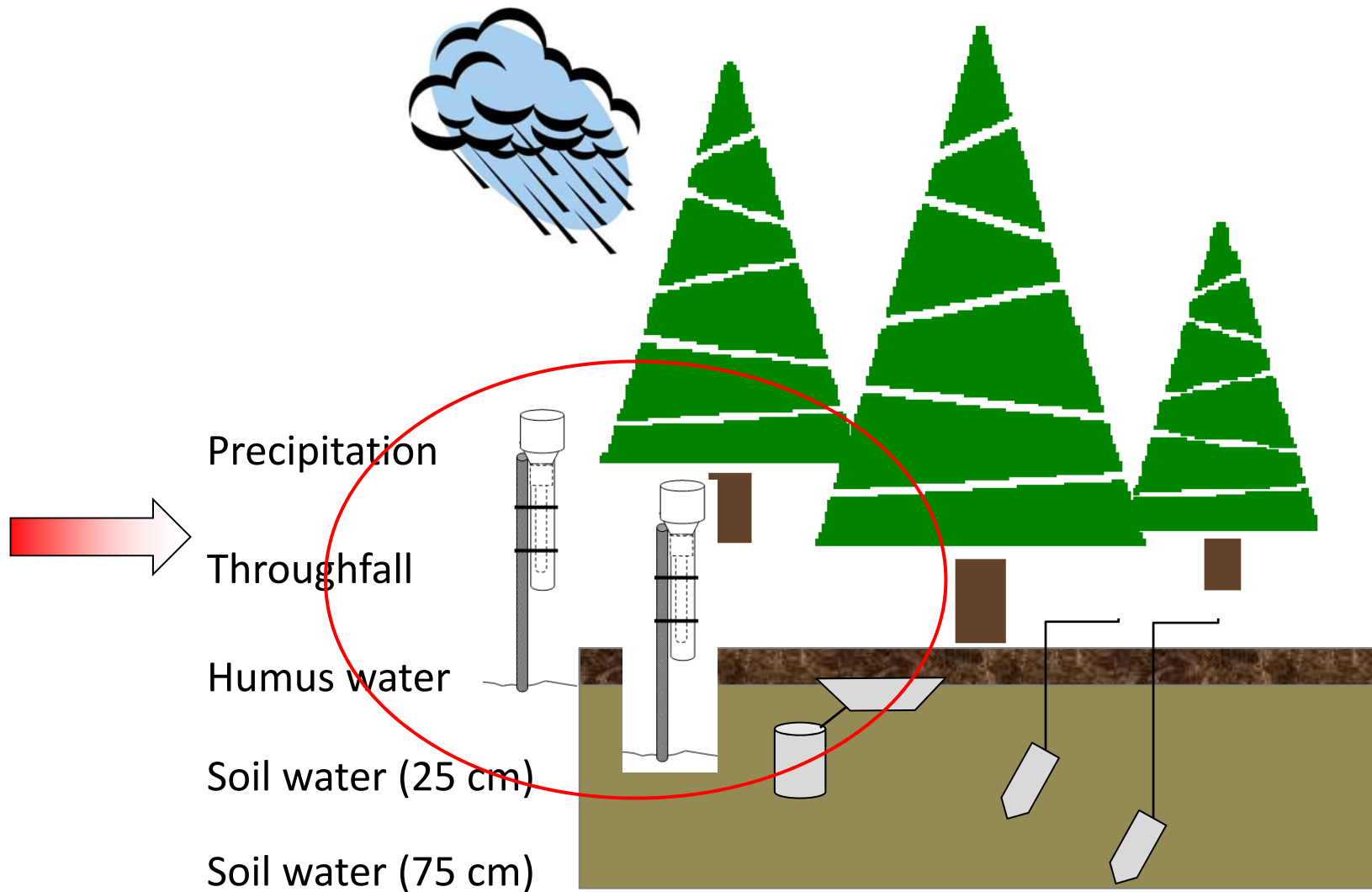




	Cloosh	Roundwood
Tree Species	<i>Picea sitchensis</i>	<i>Picea sitchensis</i>
Planting Year	1958	1955
Geology	Granitic	Schist & quartzite
Soil Type	Histosol	Podsol
Elevation (m)	102	395
Mean Annual Precip. (mm)	1952	1656
Mean Annual Temp. (°C)	10.5	7.8

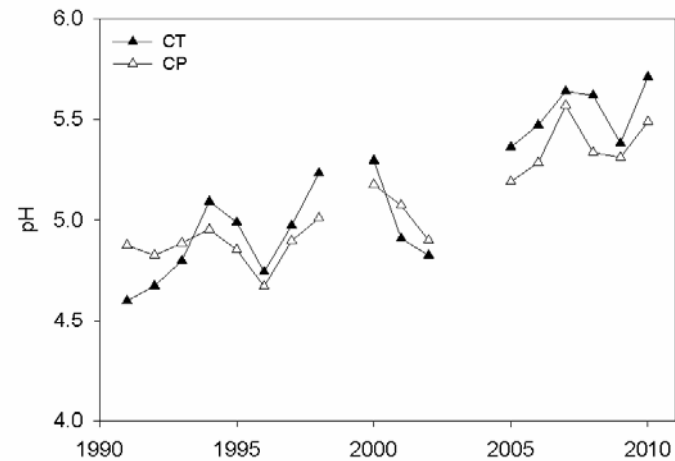
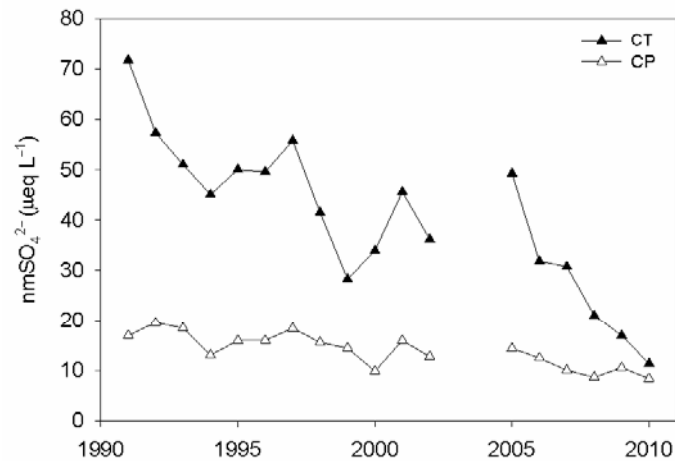


Intensive plot measurements

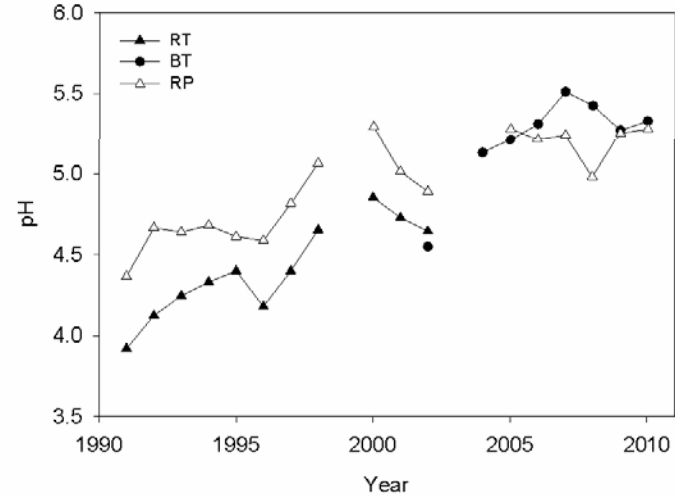
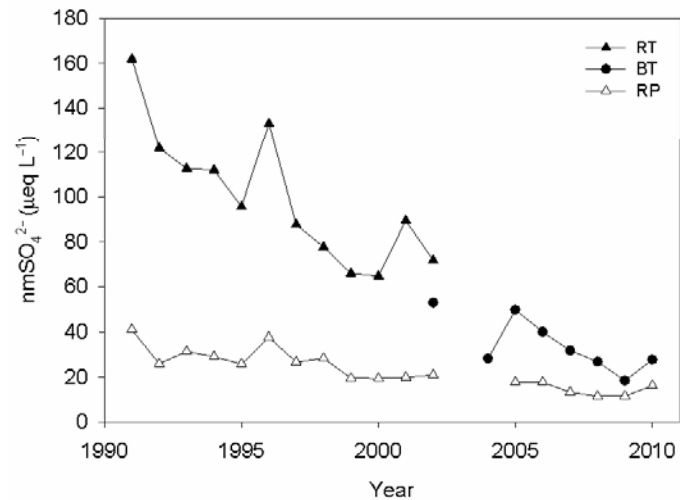


Deposition trends: nmSO_4^{2-} and pH

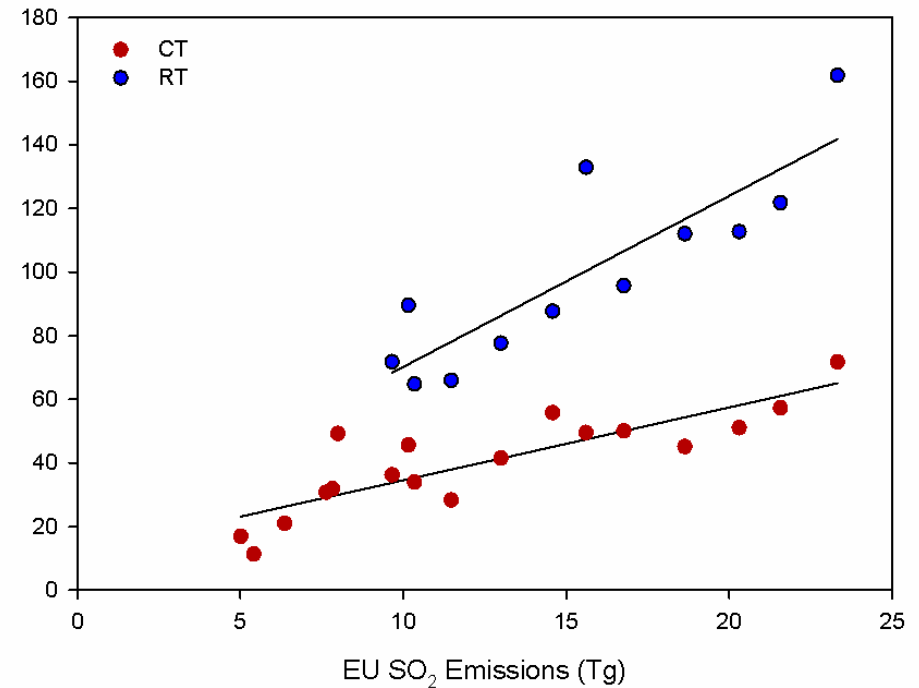
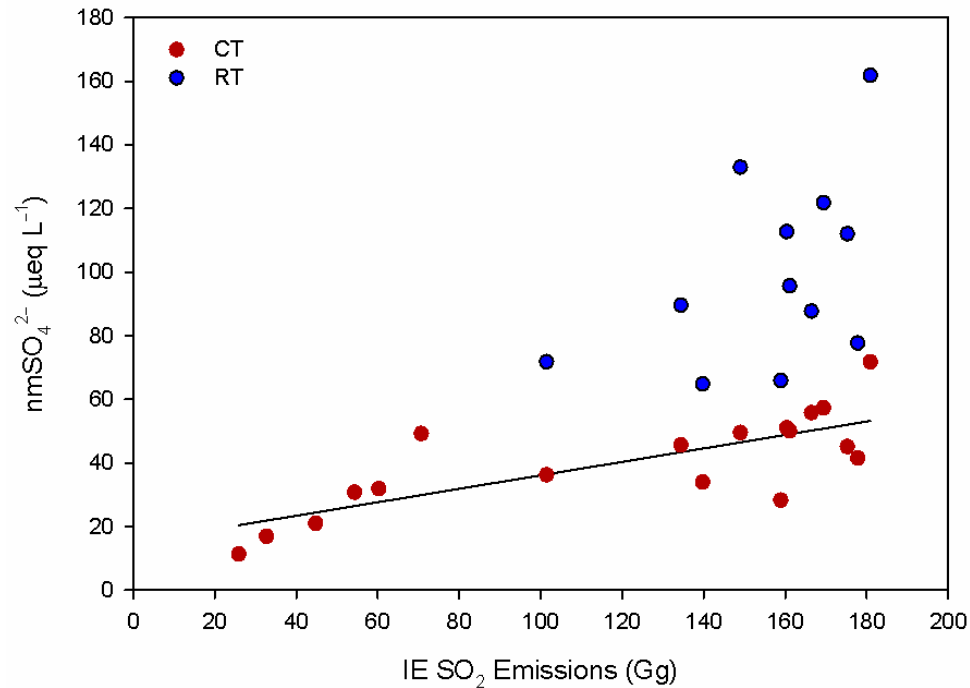
a. Cloosh



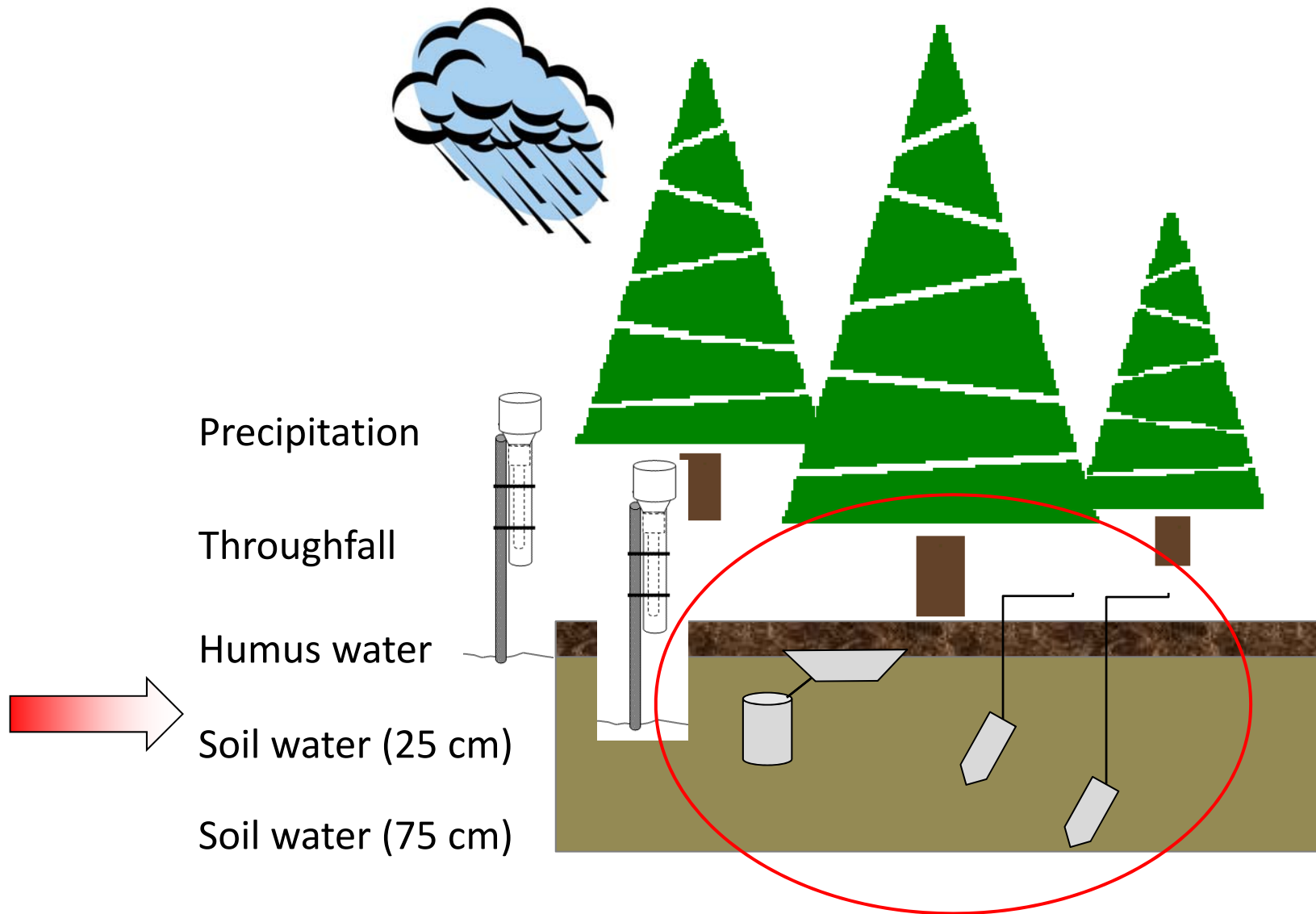
b. Roundwood/Ballinastoe



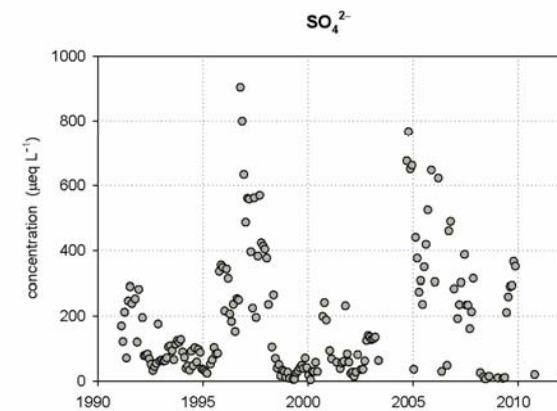
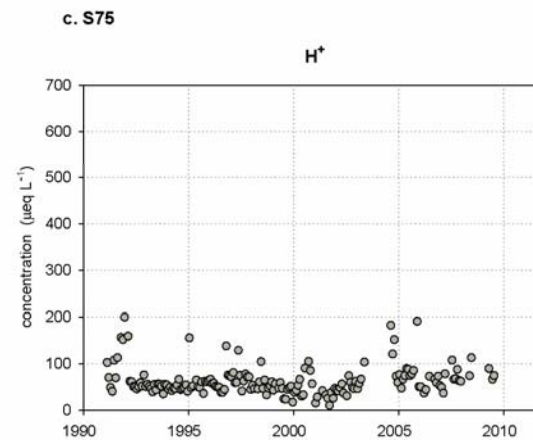
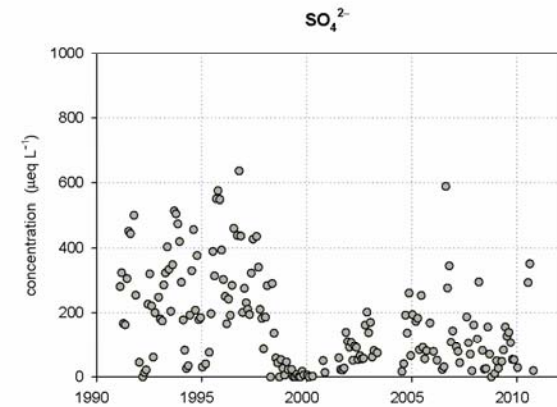
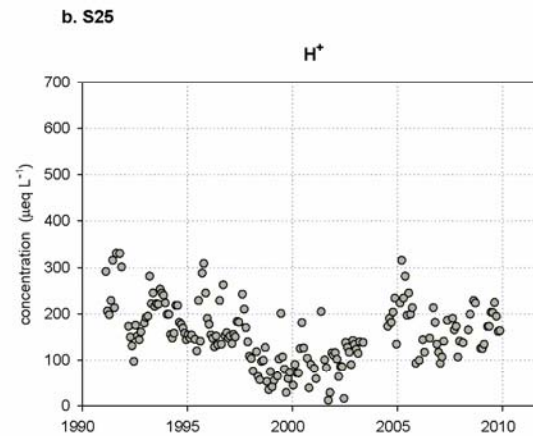
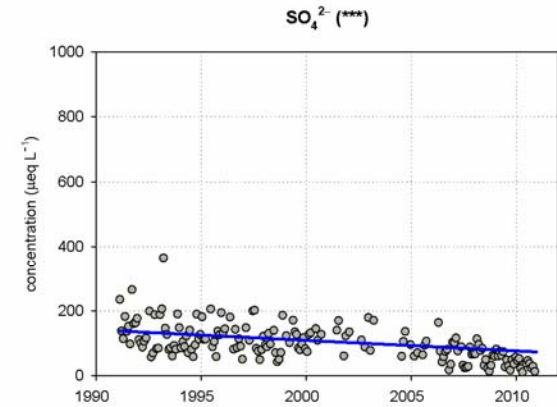
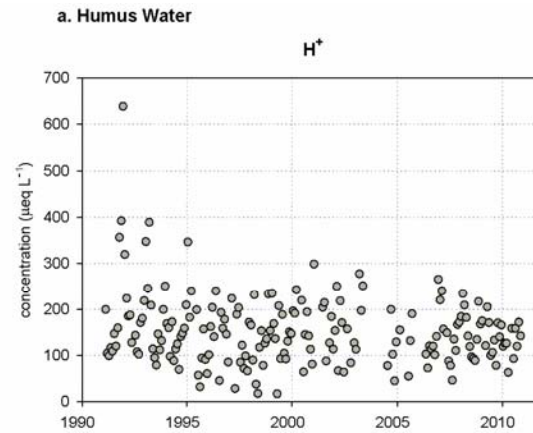
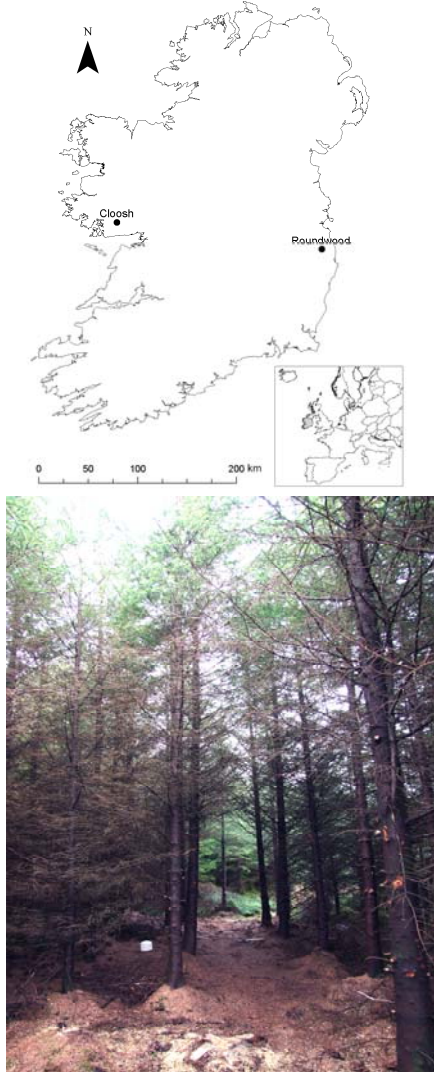
nmSO_4^{2-} : throughfall vs emissions (IE & EU)



Intensive plot measurements



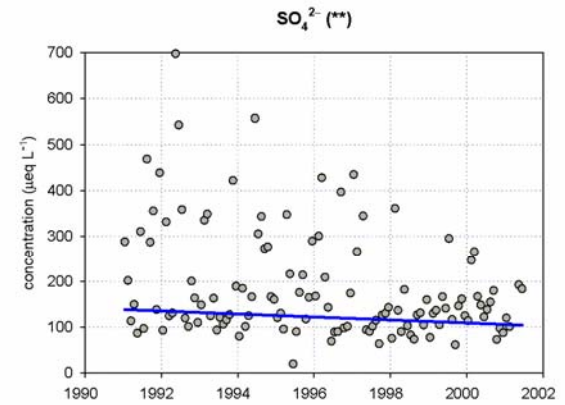
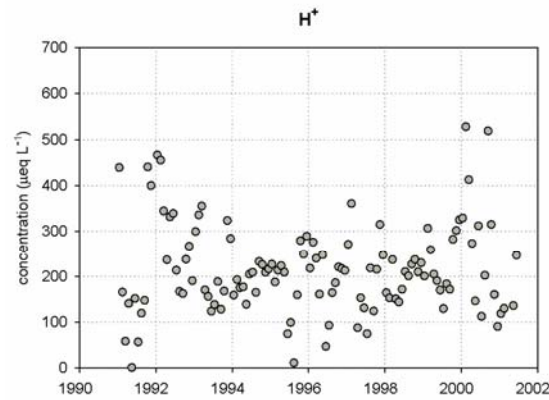
Trends in humus and soil water: Cloosh



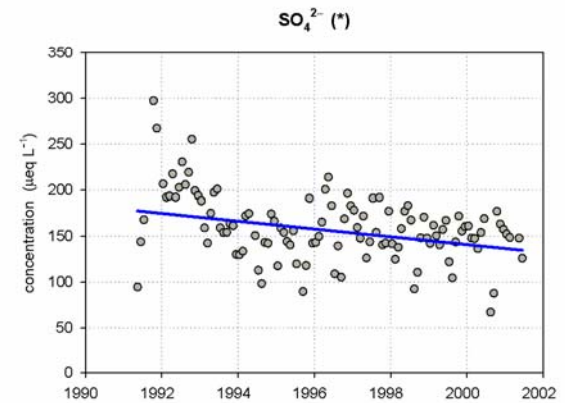
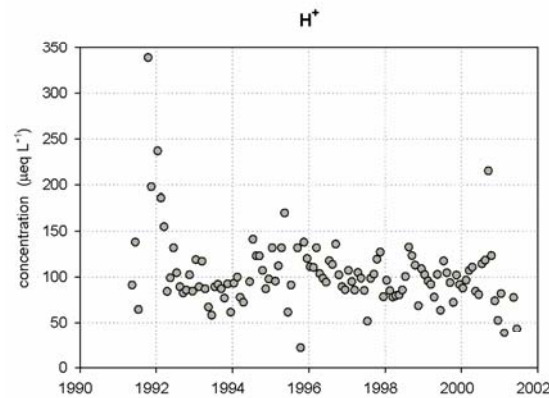
Trends in humus and soil water: Roundwood



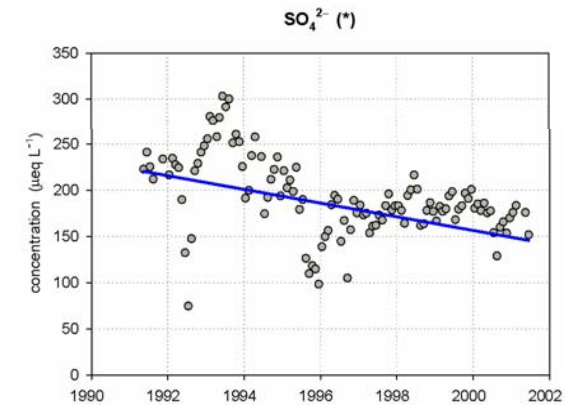
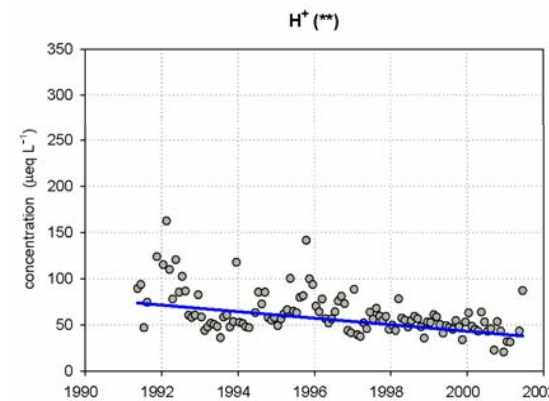
a. Humus Water



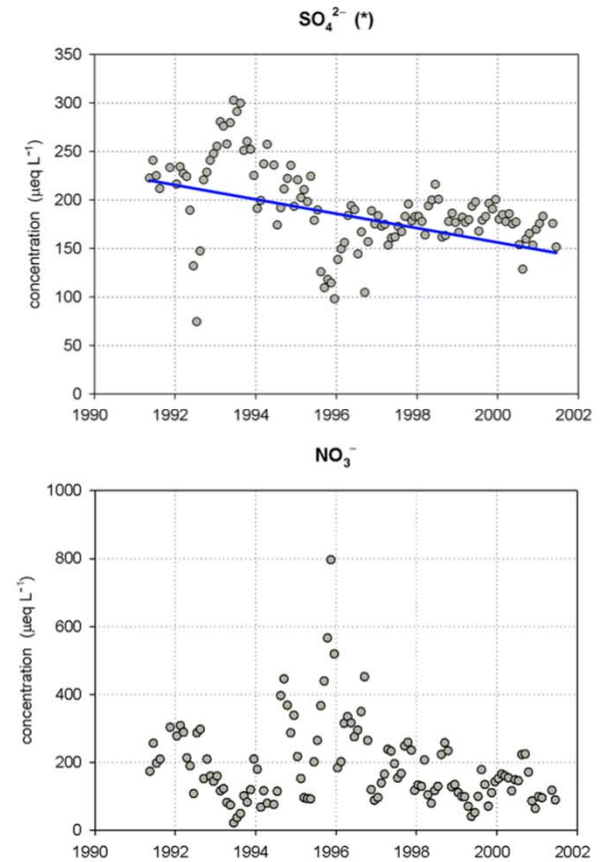
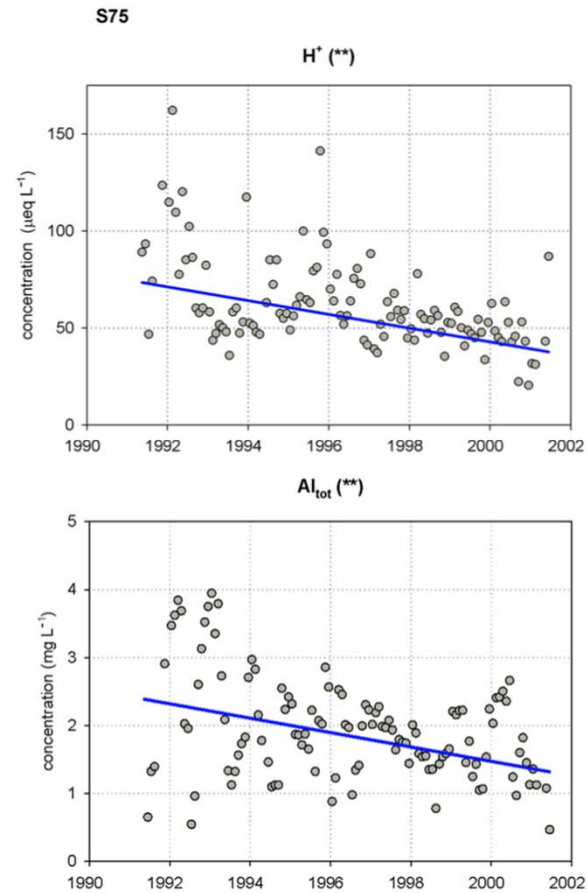
b. S25



c. S75



Trends in humus and soil water: Roundwood



Principal components in deposition and soil water @Roundwood

Table 6 Principal component factor loadings for throughfall, humus water, soil water at 25 and 75 cm at Roundwood



Observation	Variable	Component				% Variance
		TF1	TF2	TF3	TF4	
Throughfall	Na ⁺	0.97				87
	Cl ⁻	0.91				81
	Mg ²⁺	0.94				97
	nmSO ₄ ²⁻	0.79				84
	SO ₄ ²⁻	0.88				92
	Ca ²⁺	0.83				96
	Mn ²⁺	0.92				94
	H ⁺	0.95				77
	NO ₃ ⁻	0.43	0.69			89
	K ⁺		0.92			78
	NH ₄ ⁺		0.84			84
	% Variance	72	15			87



Soil Water 75 cm	Variable	S75_1	S75_2	S75_3	S75_4	% Variance
	Na ⁺		0.93			88
	Cl ⁻		0.94			89
	Mg ²⁺	0.41	0.78			87
	SO ₄ ²⁻			0.38	0.86	84
	Ca ²⁺	0.84				84
	Mn ²⁺	0.66		0.31	-0.35	86
	H ⁺			0.46	-0.60	68
	NO ₃ ⁻	0.62		0.39	-0.35	86
	K ⁺	0.96				84
	Al _{tot}		0.56	0.66		83
	DOC			-0.83		69
	% Variance	36	23	16	8	83

Correlation between deposition and soil water chemistry @ Roundwood



	Variable	Component				% Variance
		TF1	TF2	TF3	TF4	
Throughfall	Na ⁺	0.97				87
	Cl ⁻	0.91				81
	Mg ²⁺	0.94				97
	nmSO ₄ ²⁻	0.79				84
	SO ₄ ²⁻	0.88				92
	Ca ²⁺	0.83				96
	Mn ²⁺	0.92				94
	H ⁺	0.95				77
	NO ₃ ⁻	0.43	0.69			89
	K ⁺		0.92			78
	NH ₄ ⁺		0.84			84
	% Variance	72	15			87
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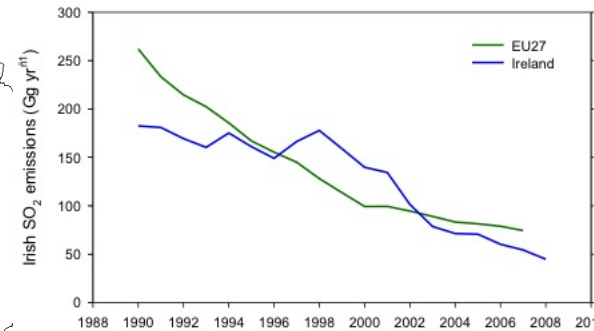
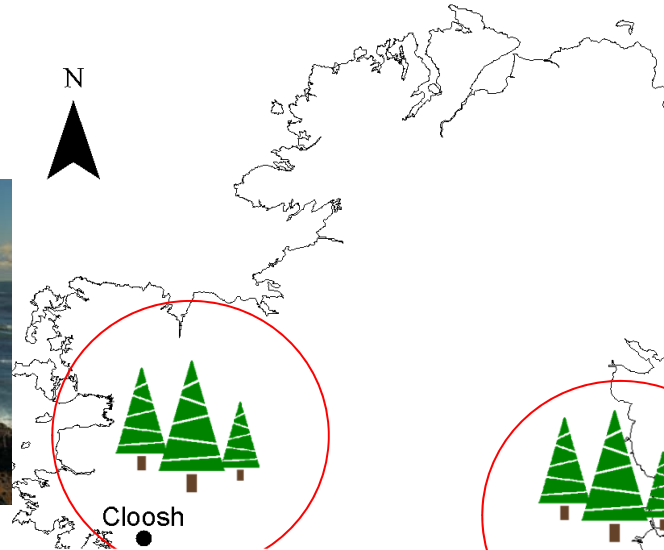
Table 7 Spearman rho correlation between principal components in throughfall (TF1, TF2, TF3) and humus (H), shallow (S25) and deep soil water (S75) at Roundwood

Observation	Component	Variables	TF1				TF2	
			Na ⁺	Cl ⁻	Mg ²⁺	SO ₄ ²⁻	K ⁺	NH ₄ ⁺
			Ca ²⁺	Mn ²⁺	H ⁺	NO ₃ ⁻		NO ₃ ⁻
S75	S75_1	K ⁺ Ca ²⁺ Mn ²⁺ Mg ²⁺ NO ₃ ⁻	-0.08				0.24*	
	S75_2	Na ⁺ Cl ⁻ Mg ²⁺ Al _{tot}	0.20				0.02	
	S75_3	-DOC Al _{tot} H ⁺ NO ₃ ⁻ SO ₄ ²⁻ Mn ²⁺	0.22*				0.09	
	S75_4	SO ₄ ²⁻ -H ⁺ -NO ₃ ⁻ -Mn ²⁺	-0.06				-0.10	

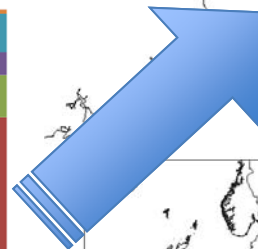
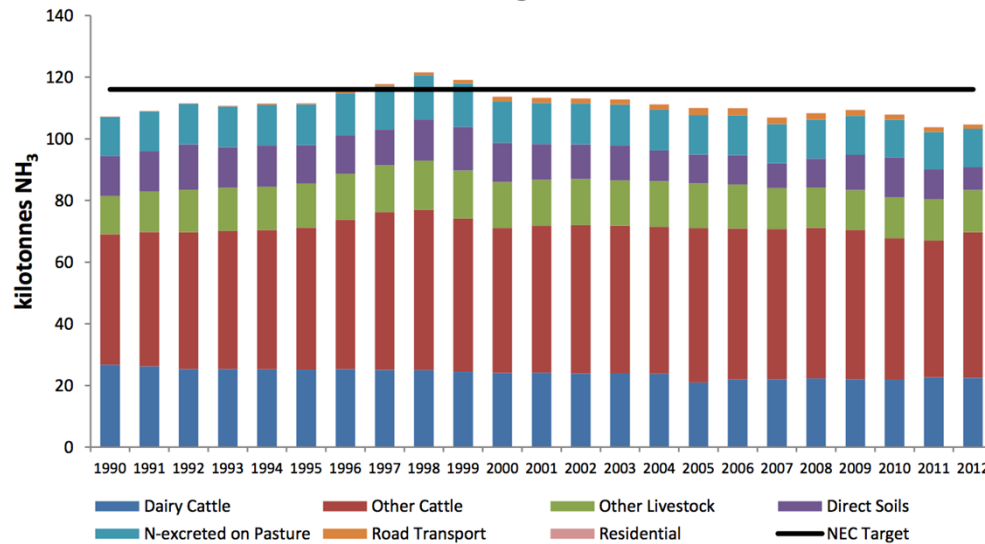
The variables associated with each component are included. Levels of significance are as follows: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$



[ICP] Forest monitoring in Ireland



Trends in NH₃ emissions



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30 years ICP Forests
1985 - 2015



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**Agriculture,
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An Roinn
**Talmhaíochta,
Bia agus Mara**



Thank you.

