

*Long-term trends in deposition and soil water chemistry
at intensively monitored forest plots in Ireland: Results
of 20 years of forest monitoring.*

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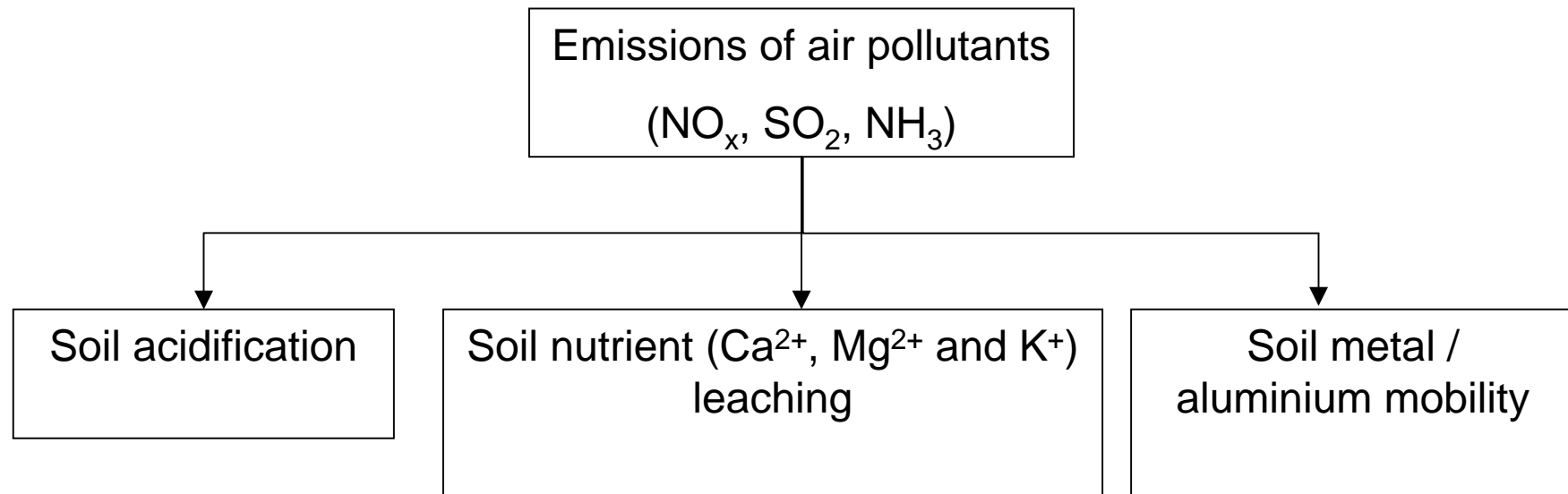
[ICP] Forest monitoring

Arose out of concern in relation to the effects of air pollution and other stress factors on forest condition

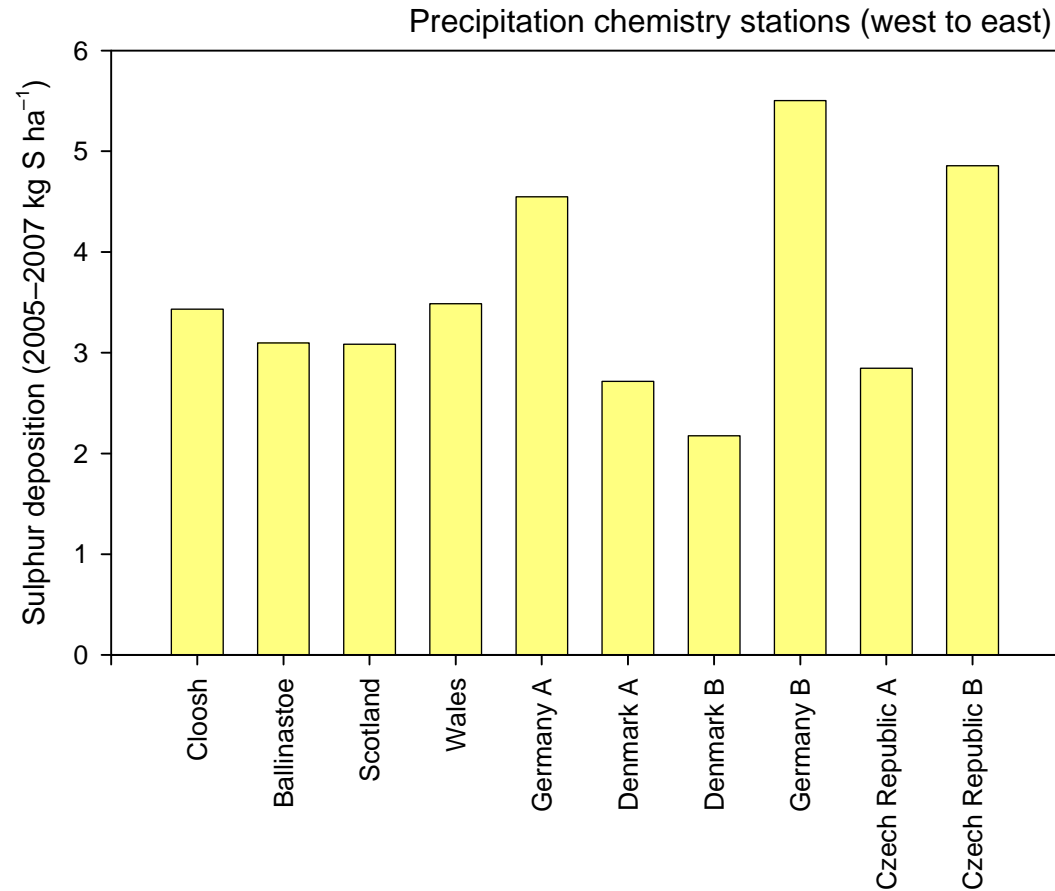
Aim: to gain a better understanding of the cause-effect relationships between the condition of forest ecosystems and anthropogenic as well as natural stress factors (in particular air pollution)

Principal focus has been on the effects of sulphur and nitrogen deposition on forest ecosystems.

Forest ecosystem response to pollutant stress



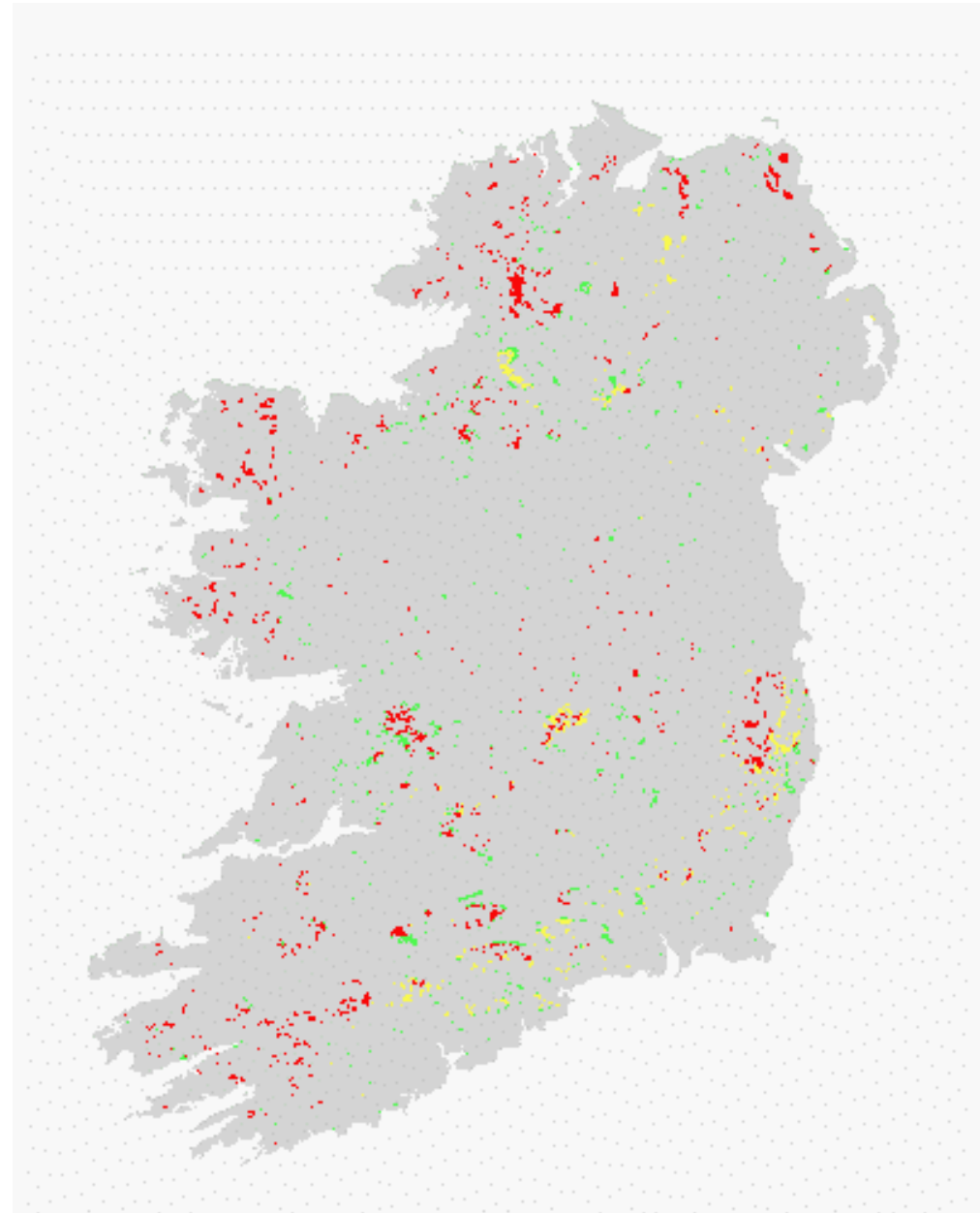
Sulphur deposition across Europe

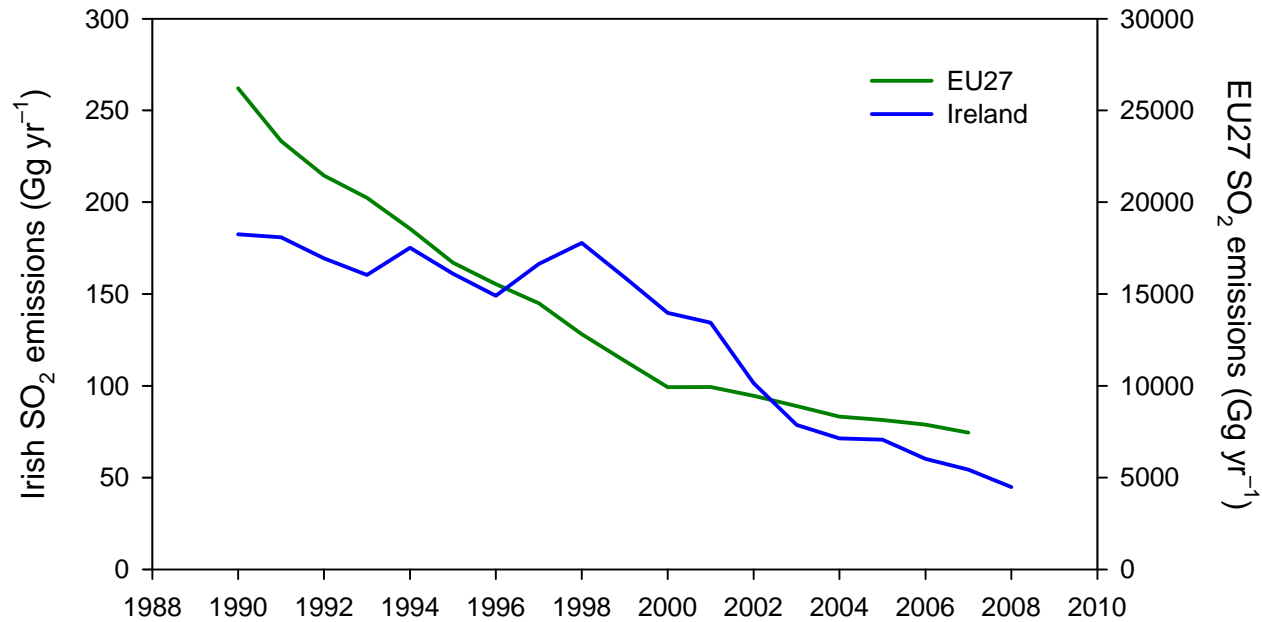


Much of the forest cover in Ireland is located on thin acid-sensitive soils (high sensitivity = low base cation status)

Soil sensitivity

- High (50 %)
- Moderate (20 %)
- Low (30%)





Emissions of sulphur dioxide (SO₂) have been significantly reduced in Ireland and Europe during the past two decades

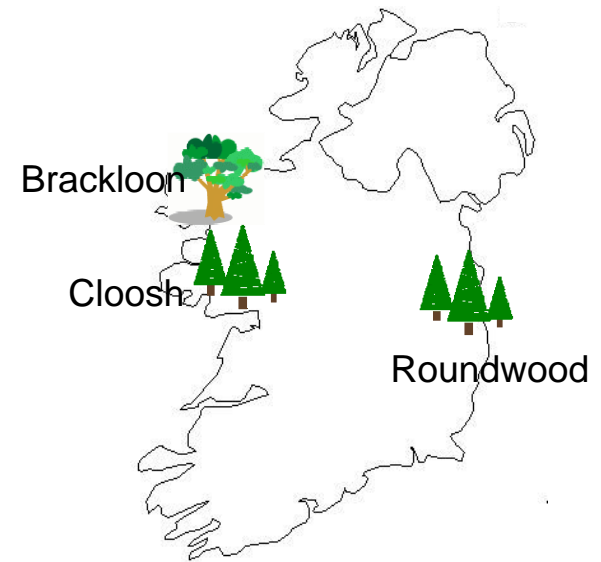
What has been the effect of these reductions on deposition to forests in Ireland?

Do we see any changes in forest soils as a result?

How do we answer these questions?

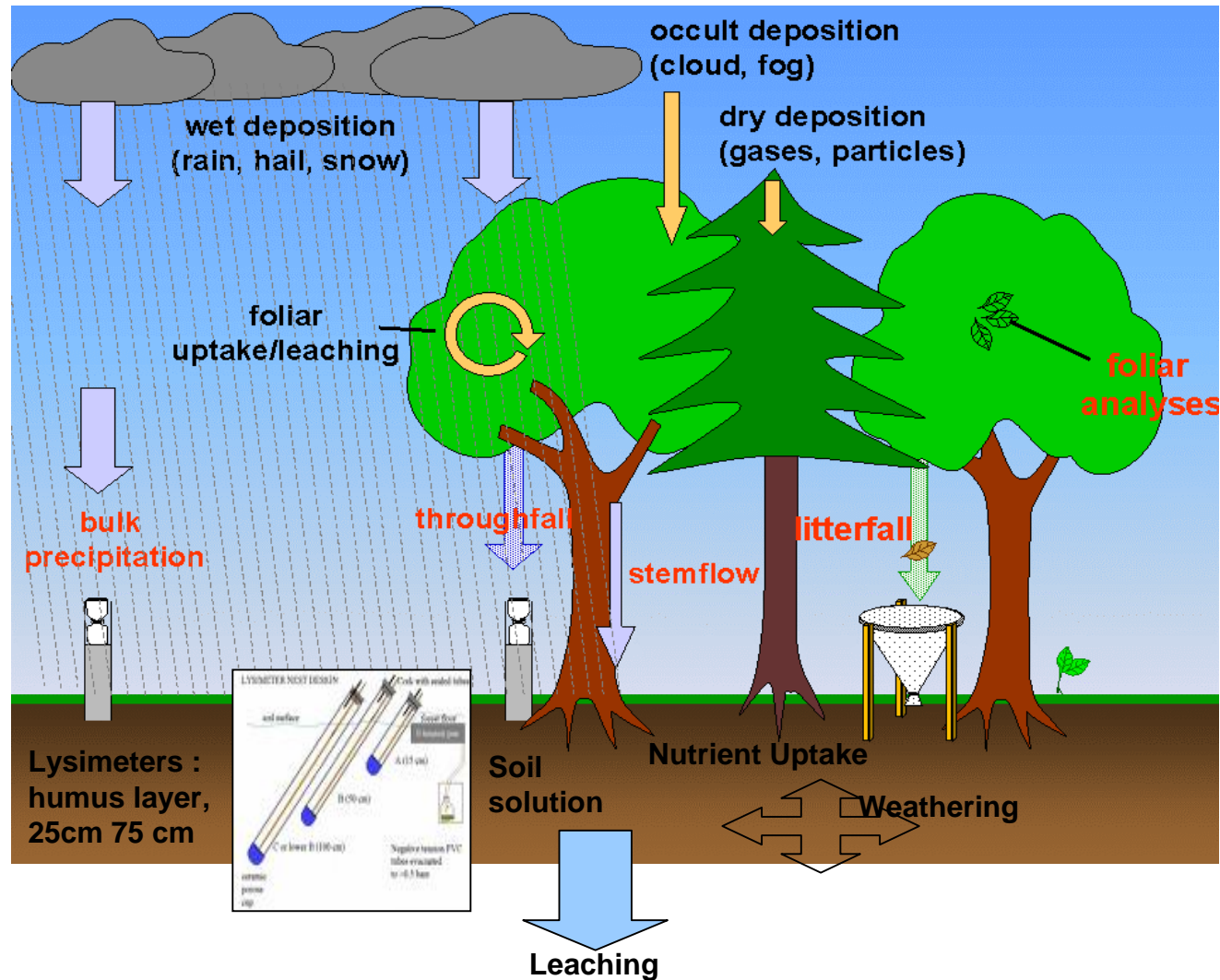
Intensively monitored plots in Ireland

Three Level II plots (since 1991)

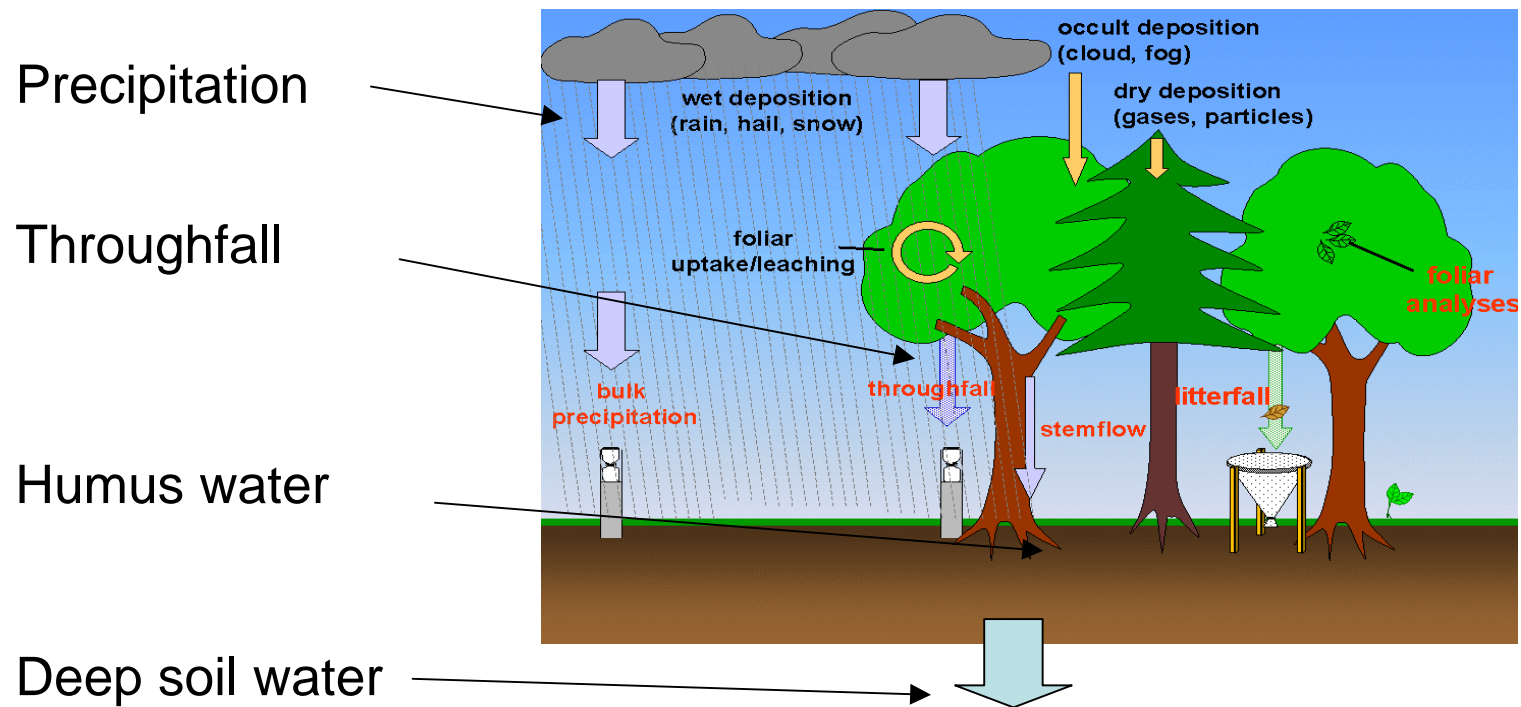


	Roundwood	Cloosh	Brackloon
Tree Species	<i>Picea sitchensis</i>	<i>Picea sitchensis</i>	<i>Quercus petraea</i>
Planting Year	1955	1958	> 150 years
Geology	Schist and quartzite	Granitic	Schist and gneiss
Soil Type	Peaty podzol (Spodosol)	Atlantic blanket peat (Histosol)	Peaty podzol (Spodosol)
Elevation (m)	395	102	75
Yield Class	16	18	-
Mean Annual Precip. (mm)	1656	1952	1628
Mean Annual Temp. (°C)	7.8	10.5	10.5

Measurements at intensive plots

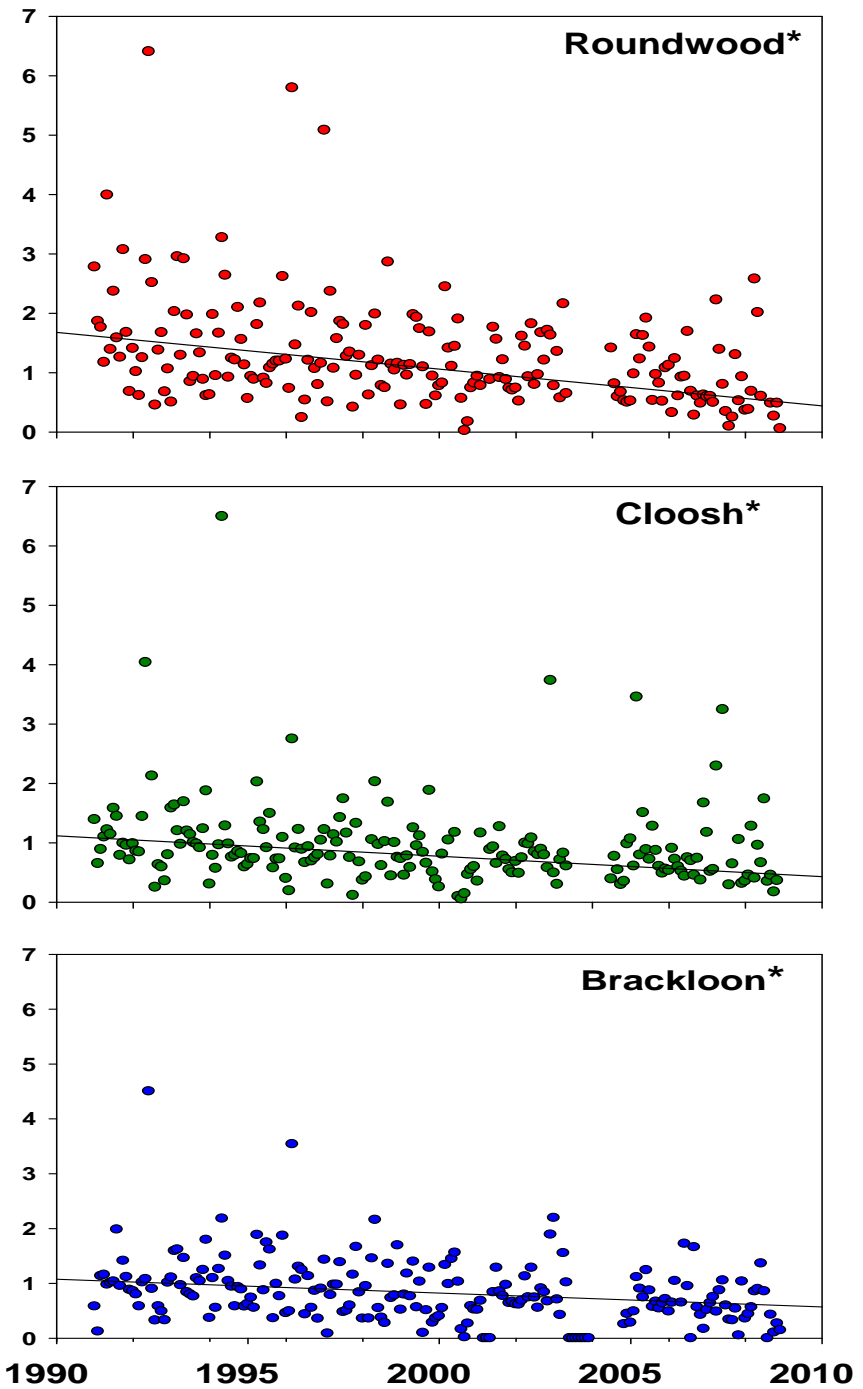
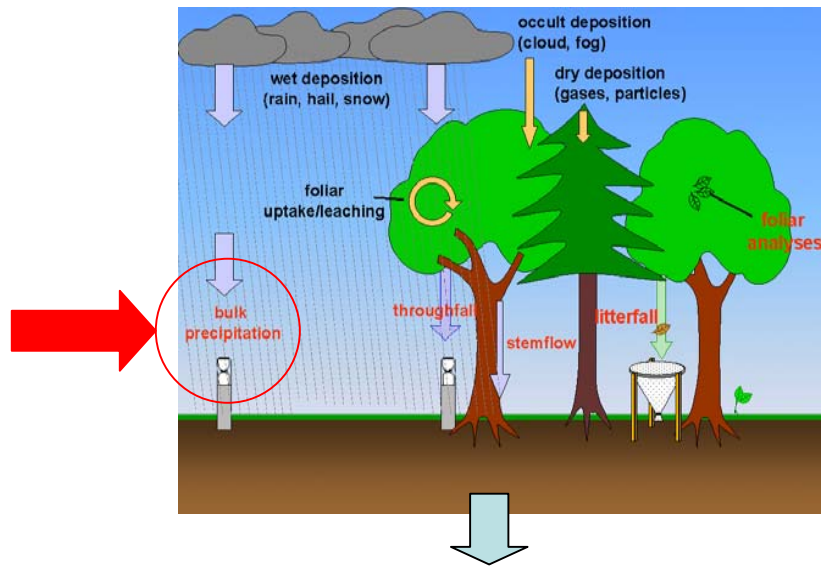


This presentation describes the long-term trends in chemistry at different levels within the forest plots

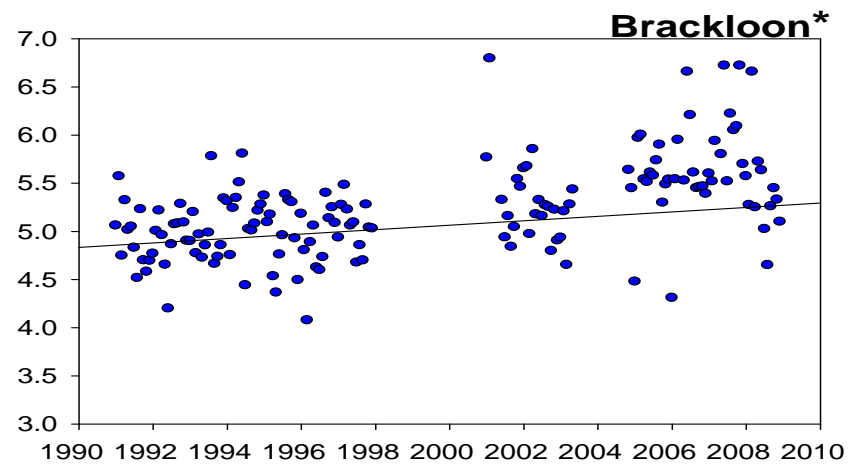
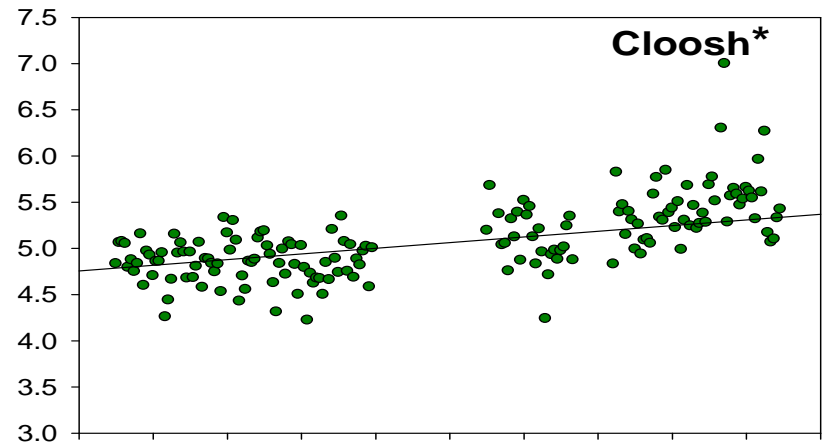
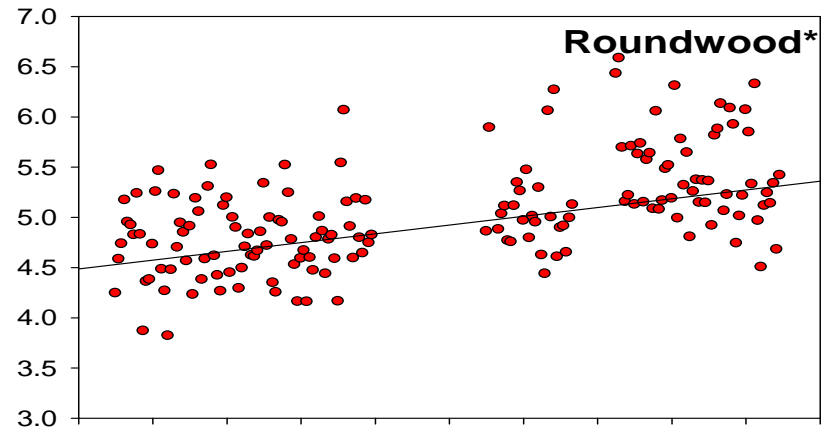
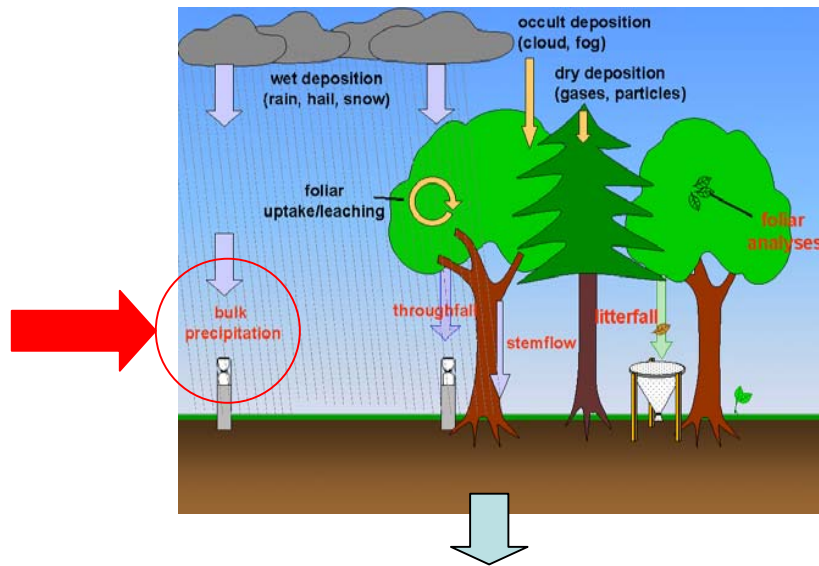


Long-term trends (20 years) were evaluated using the Mann-Kendall non parametric statistic (trends at $p < 0.05$ were assumed to be significant).

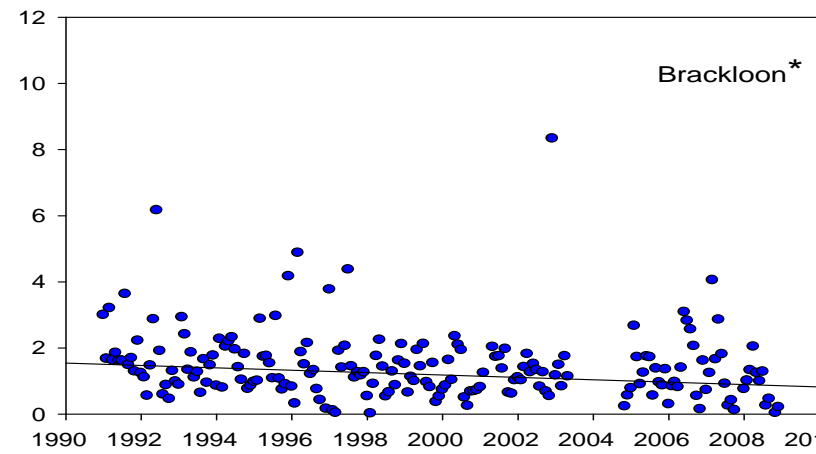
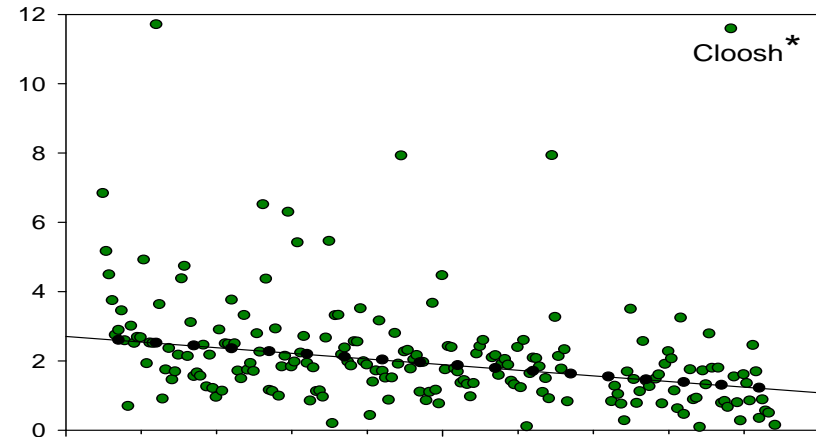
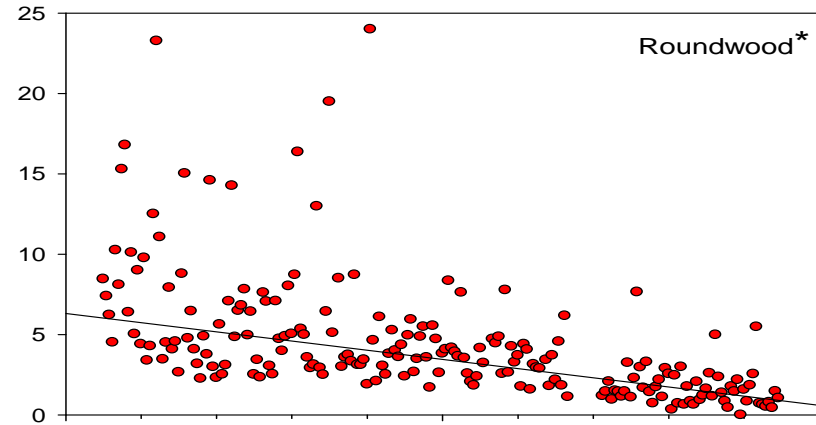
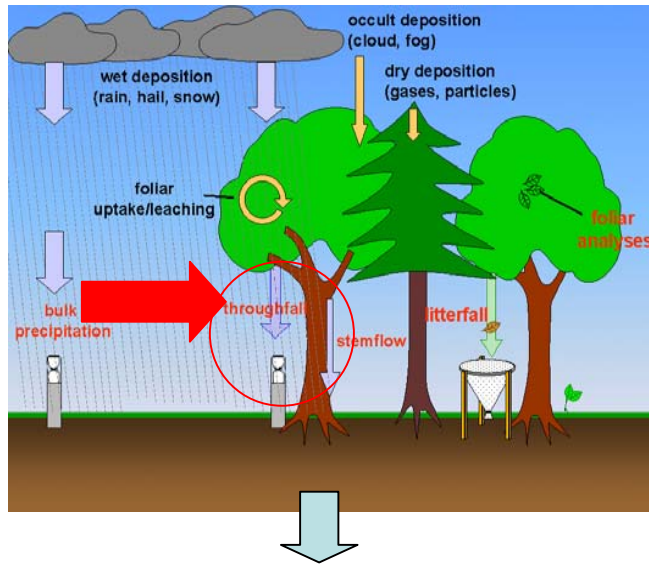
The concentration of non marine sulphate (mg/L) in precipitation has declined significantly at the three sites



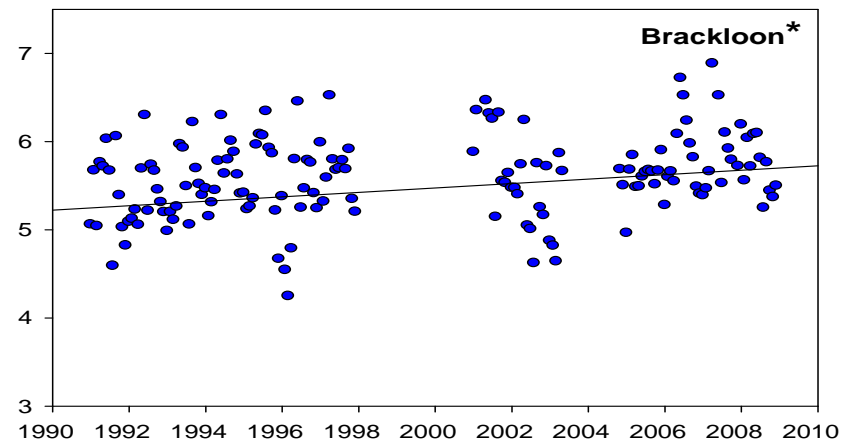
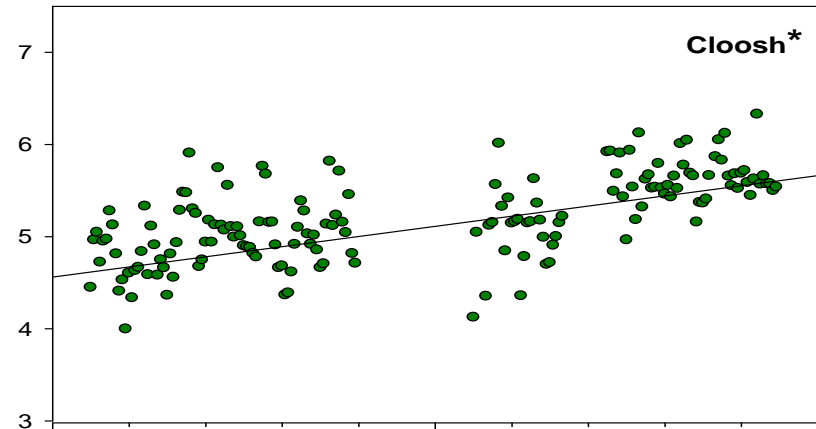
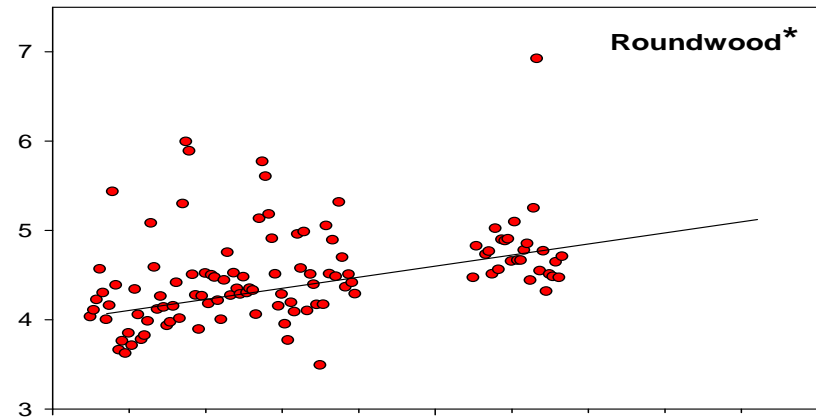
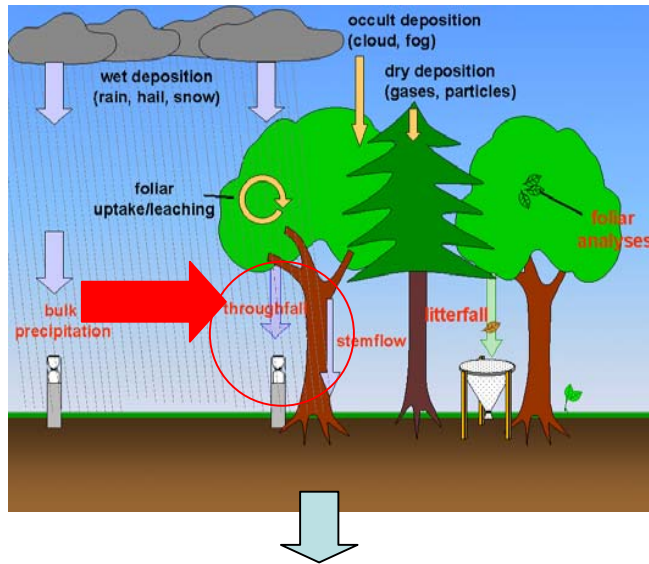
The pH of precipitation has increased significantly at the three sites



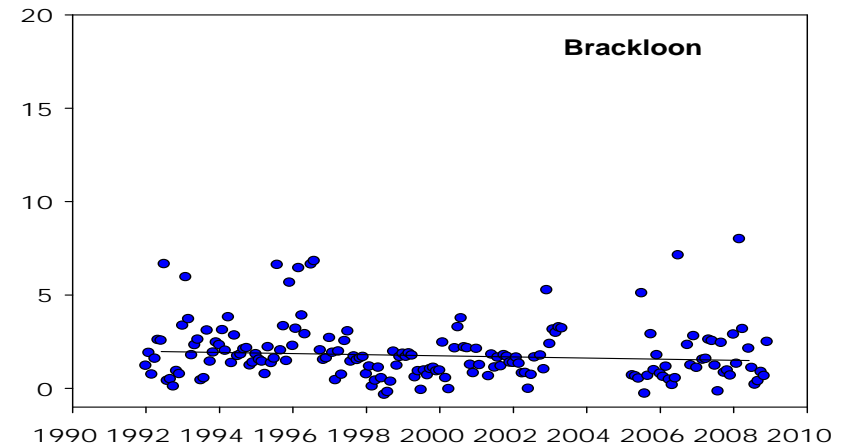
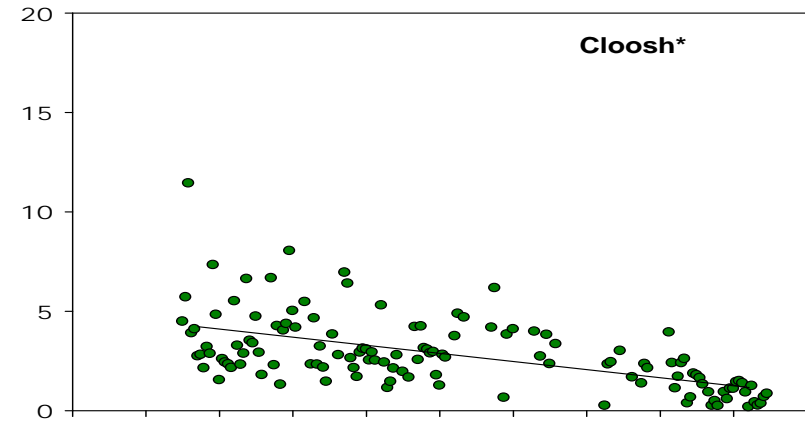
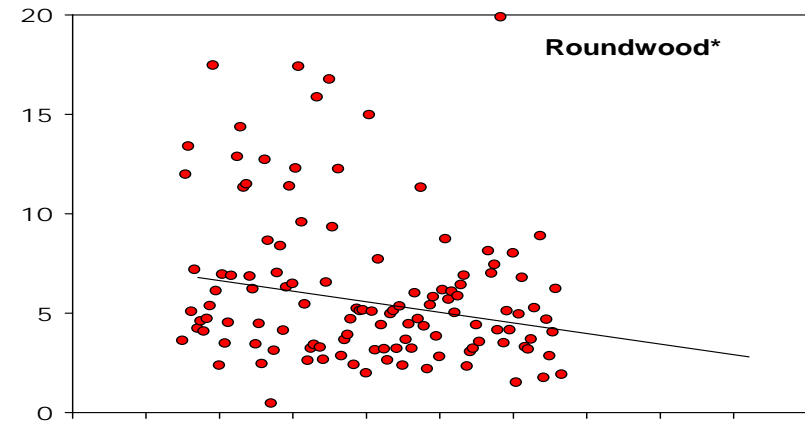
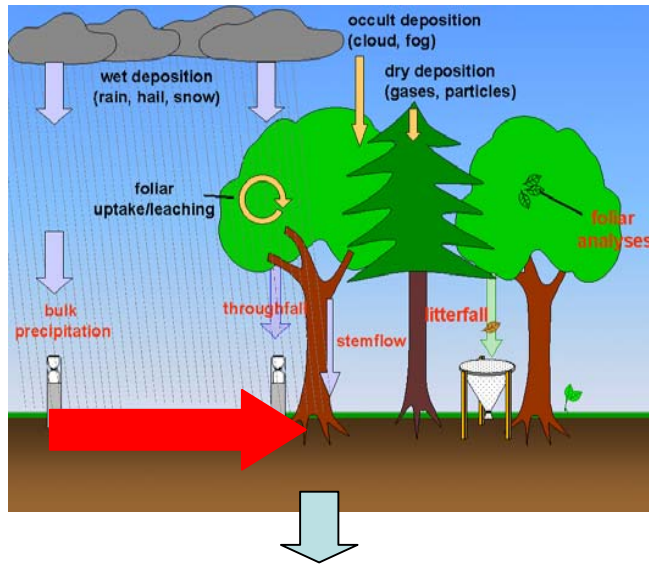
The concentration of non marine sulphate (mg/L) in throughfall has declined significantly at the three sites



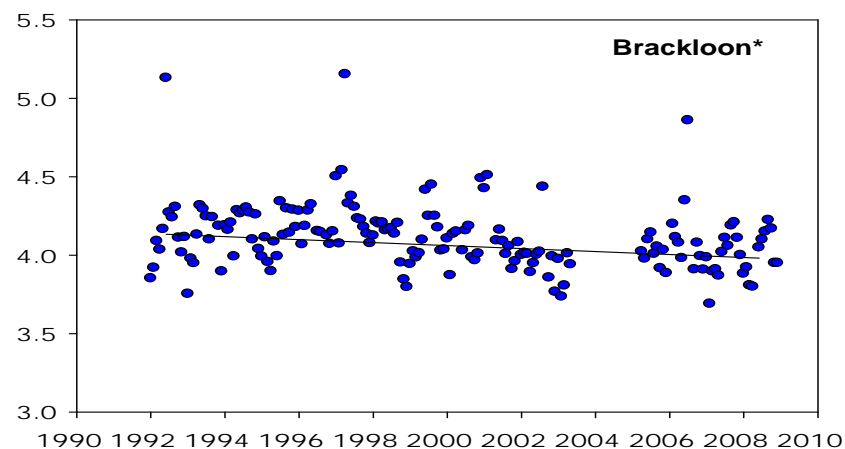
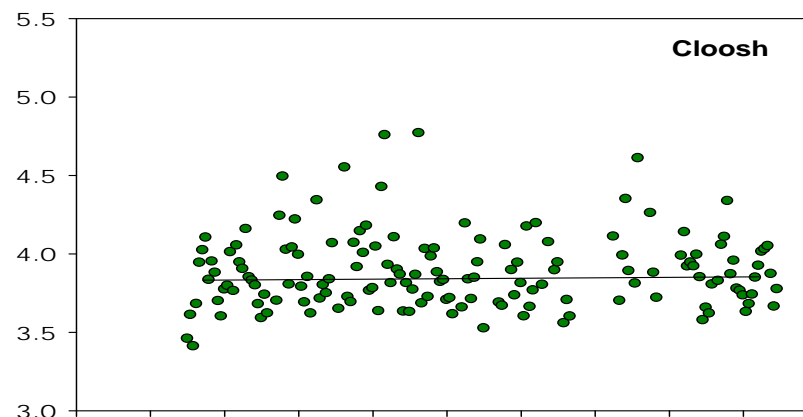
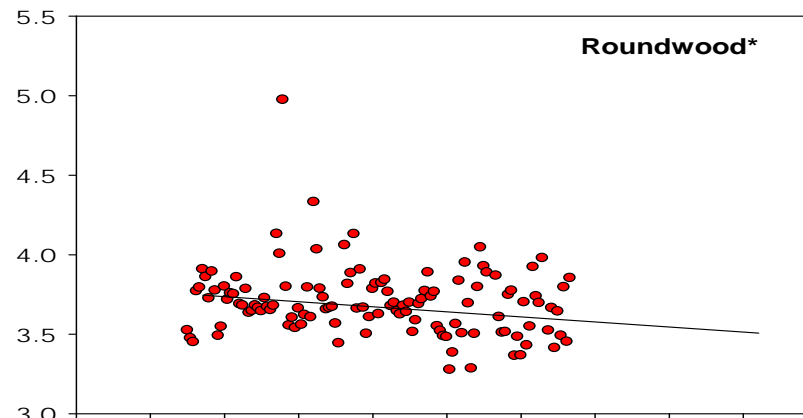
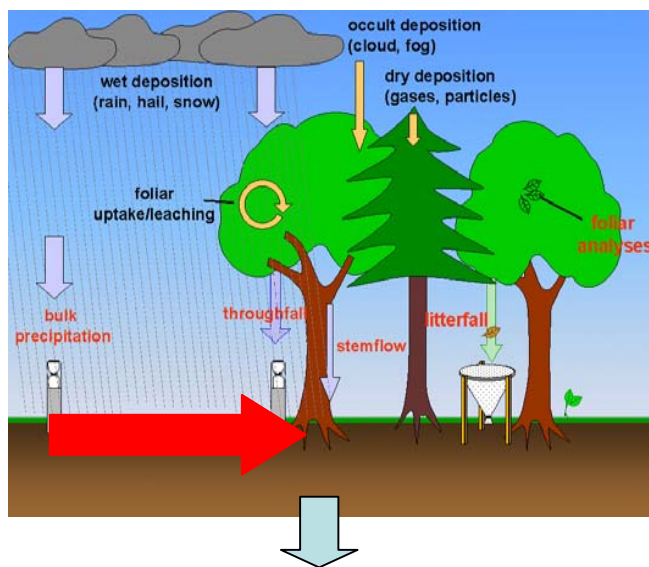
The pH of throughfall has increased significantly at the three sites



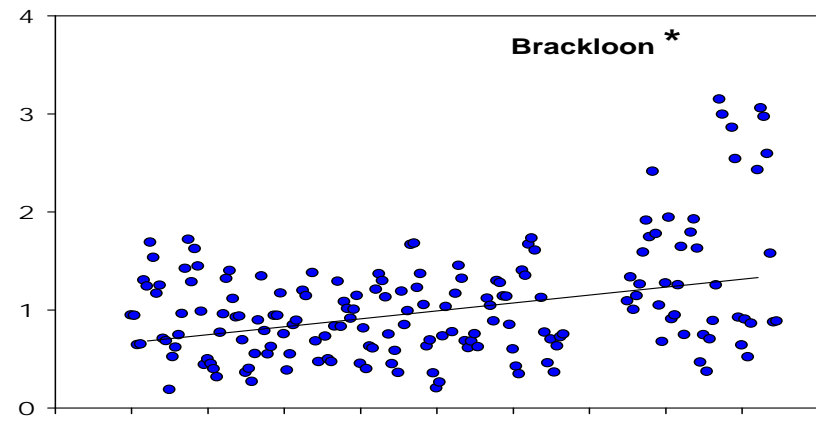
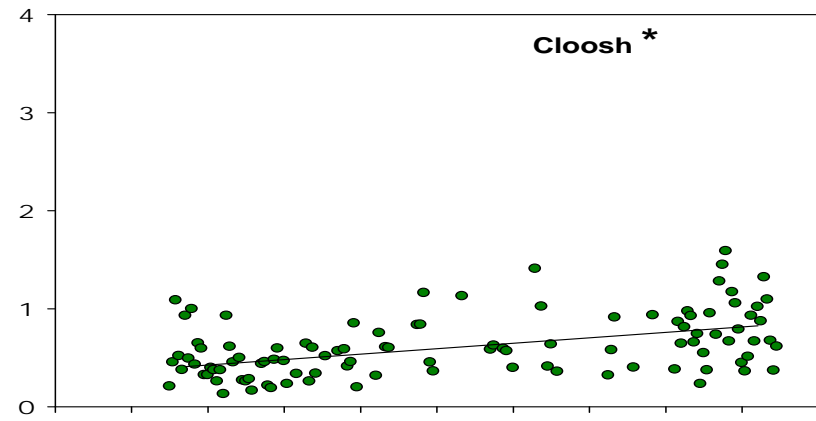
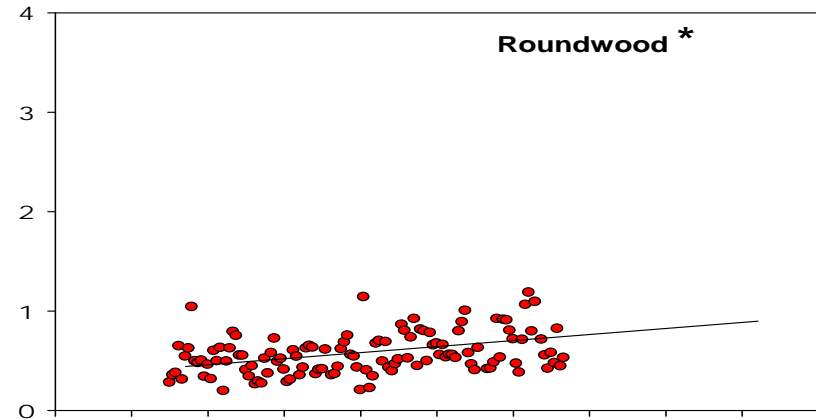
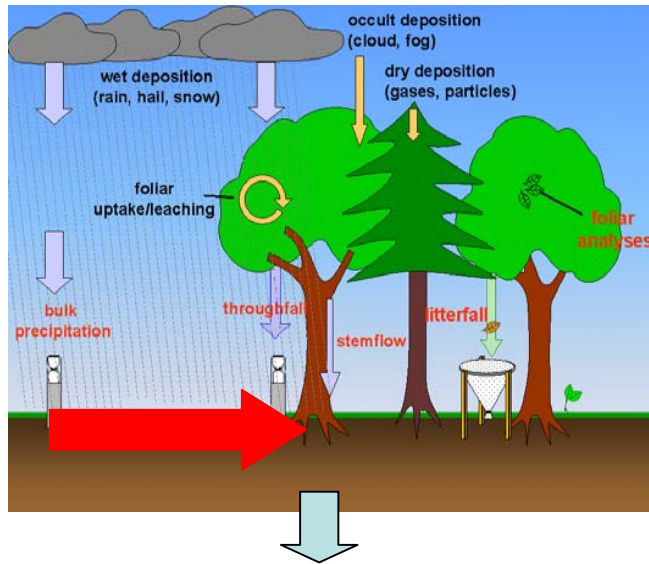
The concentration of non marine sulphate (mg/L) in humus water has declined at Roundwood and Cloosh



However the pH of humus water shows no change (Cloosh) or has declined (Roundwood and Brackloon)

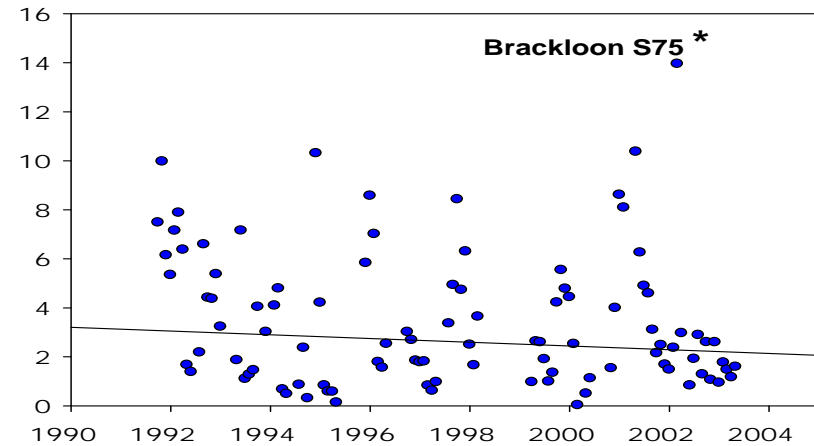
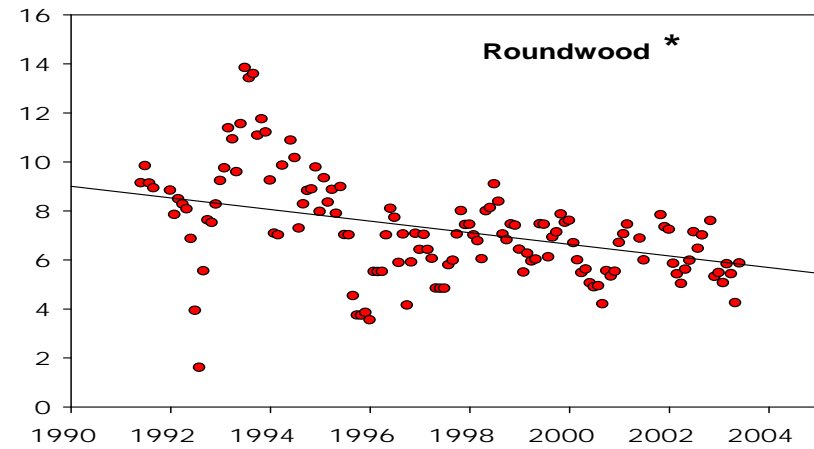
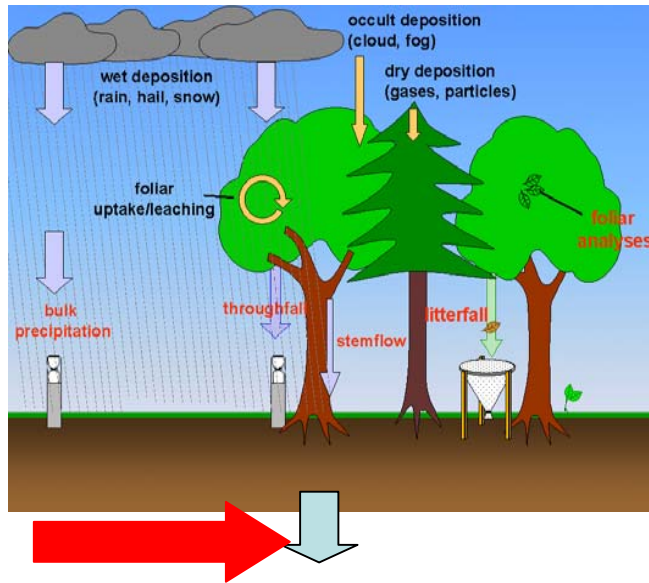


Concentration of DOC
(absorbance at 320 nm) has
increased significantly in the
humus layer at each site

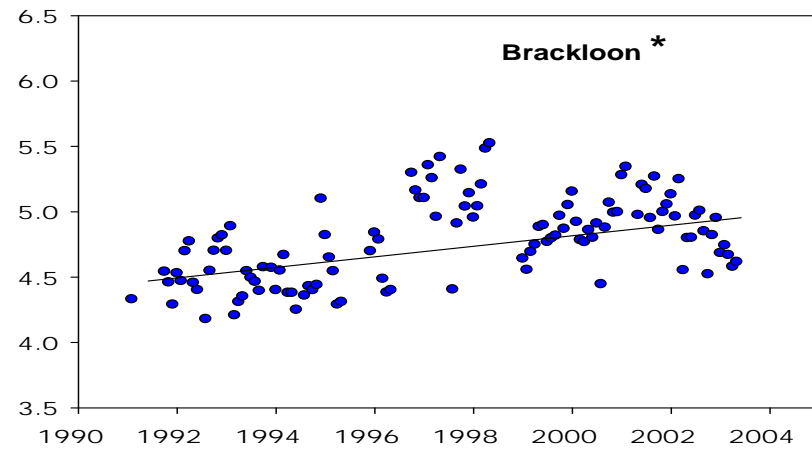
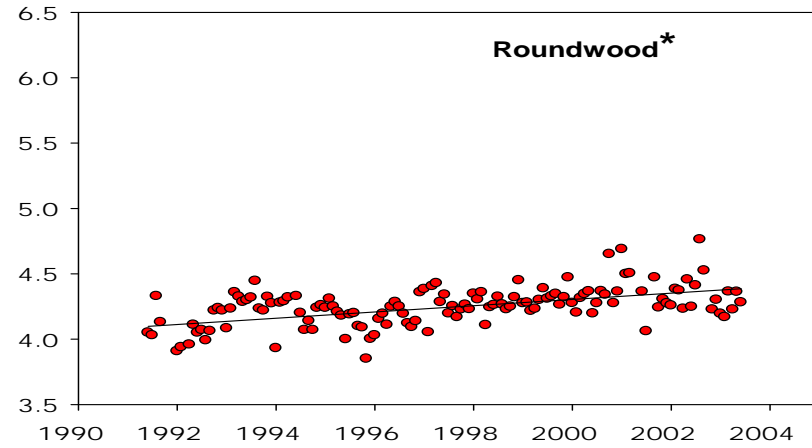
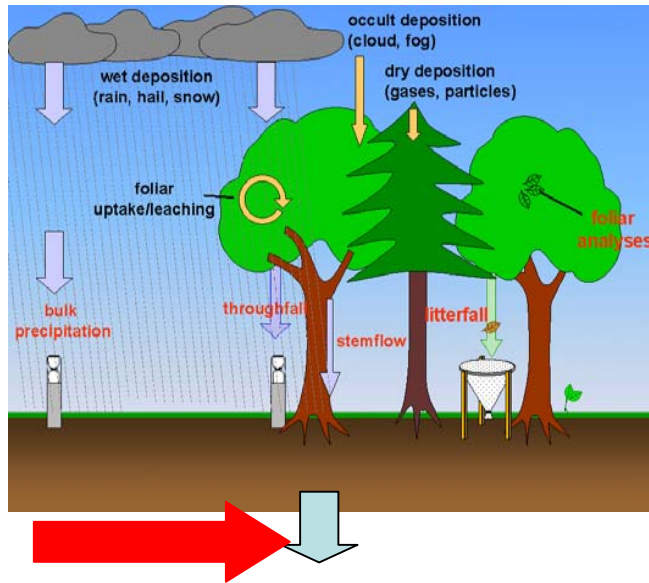


1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

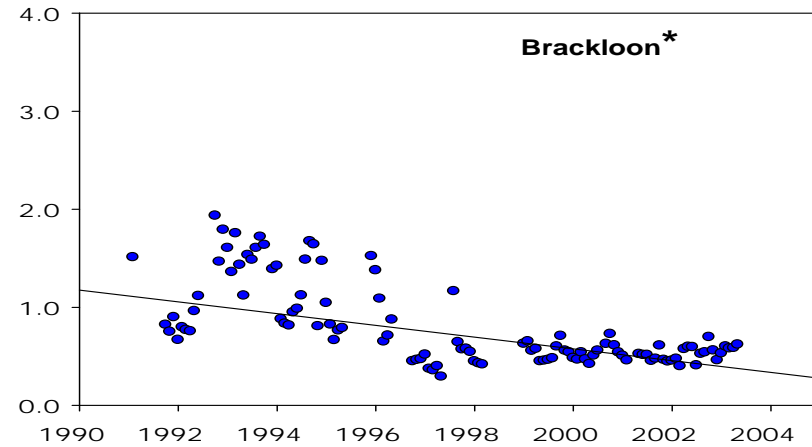
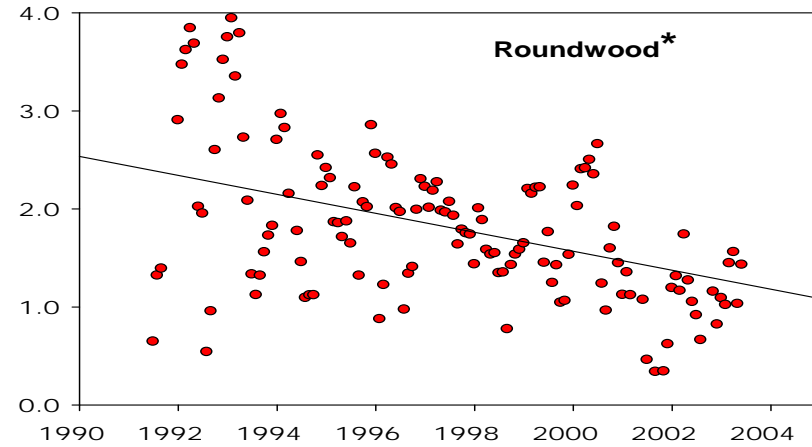
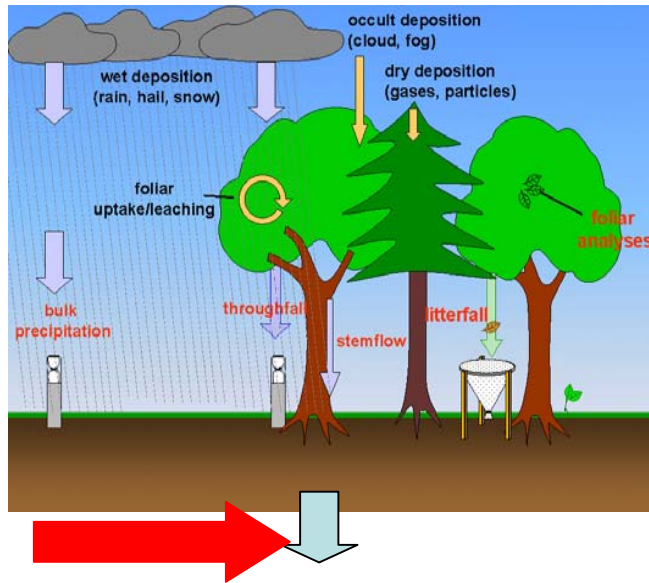
Deep soil water:
the concentration of non marine
sulphate (mg/L) has declined at
Roundwood and Brackloon

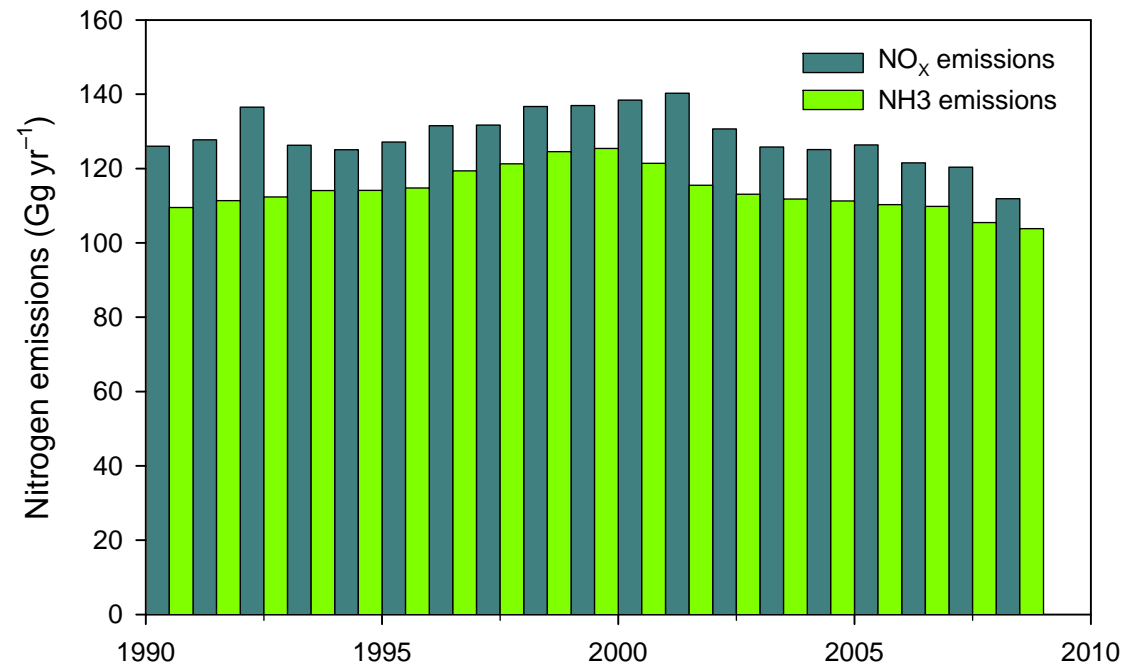


Deep soil water: pH has increased at Roundwood and Brackloon



Deep soil water:
Total aluminium concentration
(mg/L) has decreased at
Roundwood and Brackloon



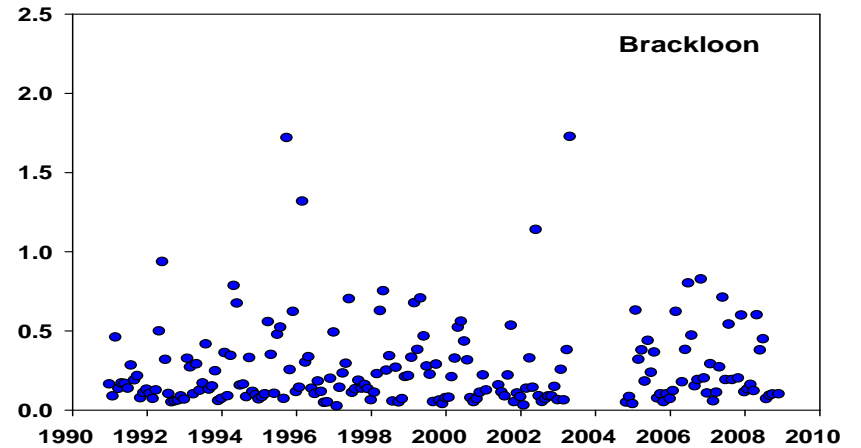
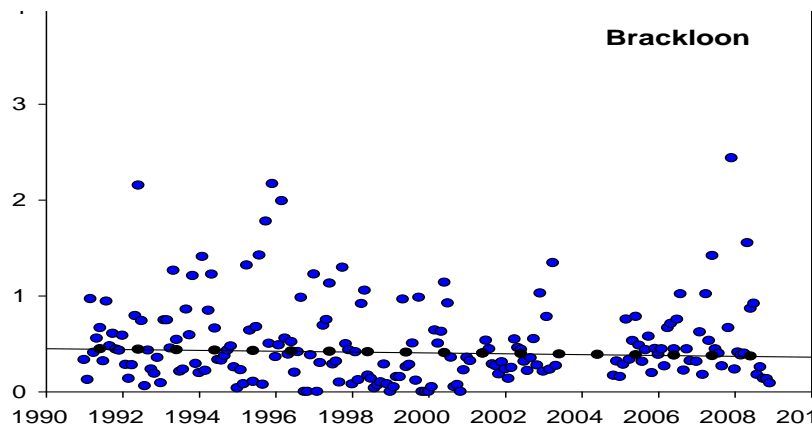
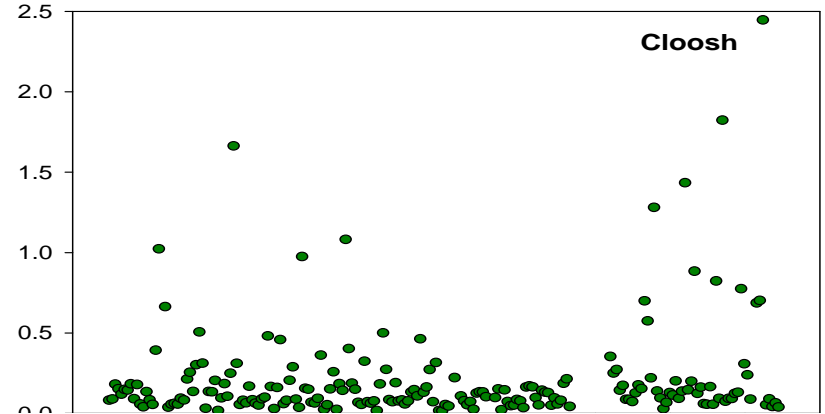
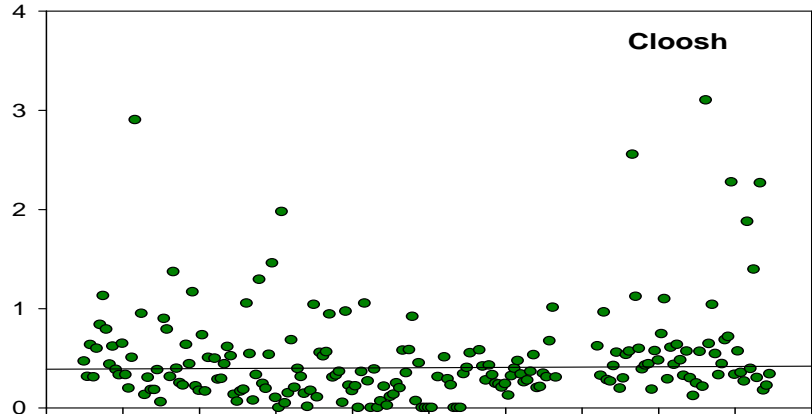
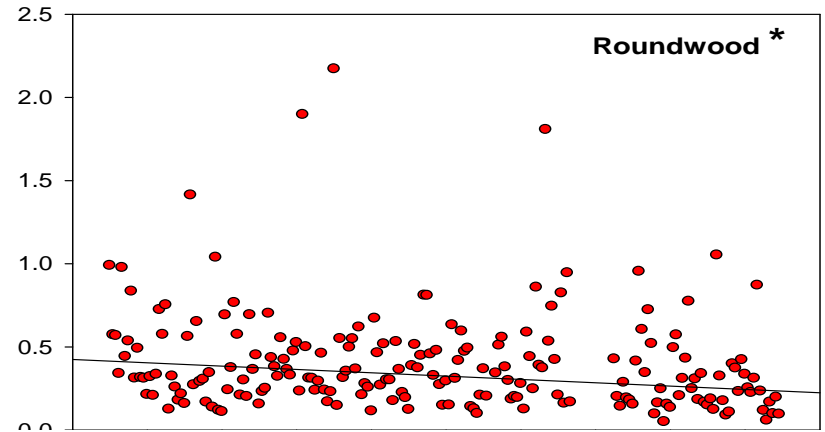
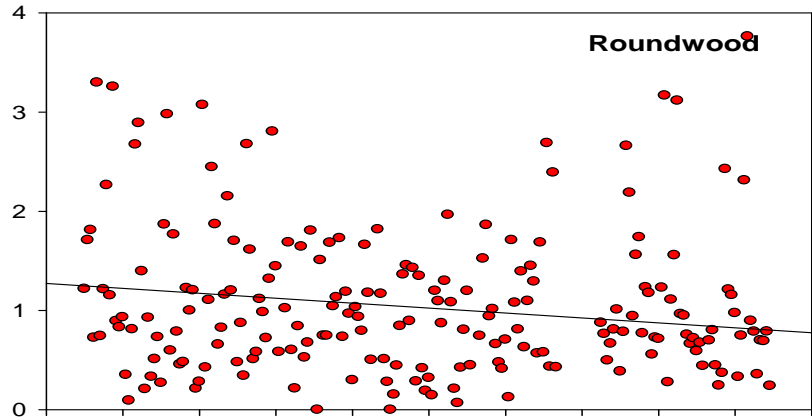


Emissions of nitrogen (oxides [NO_x] and ammonia [NH₃]) have not significantly reduced in Ireland during the past two decades

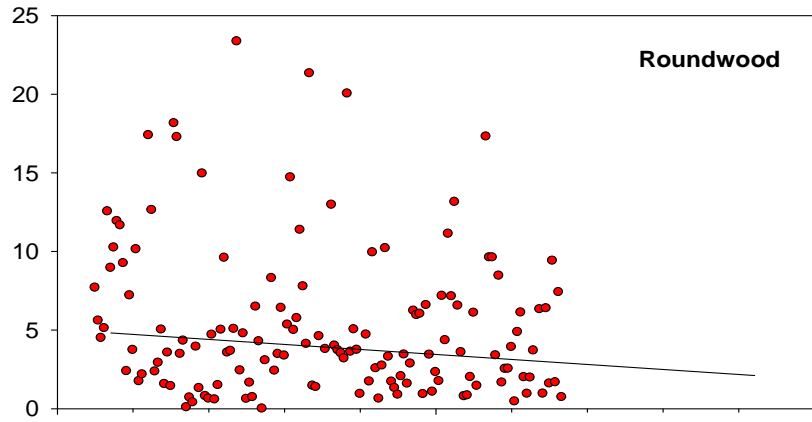
Nitrate mg/l

Trends in Precipitation

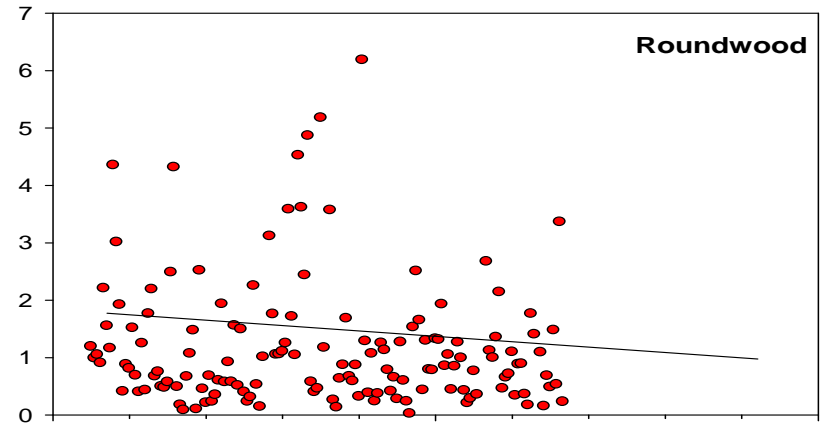
Ammonium-N mg/l



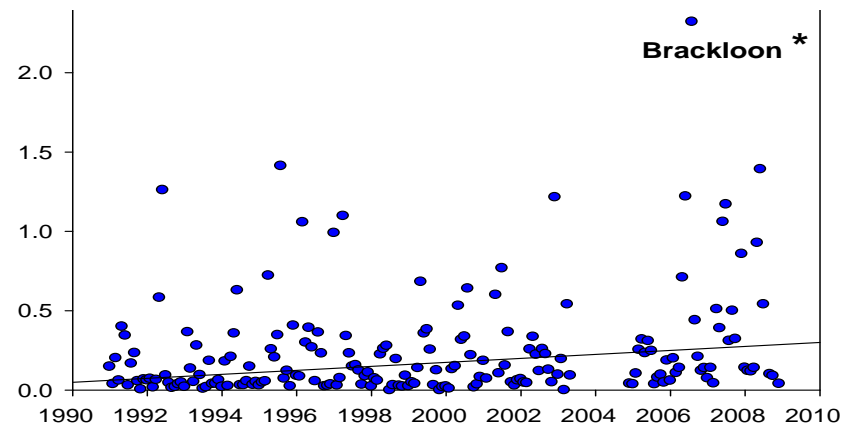
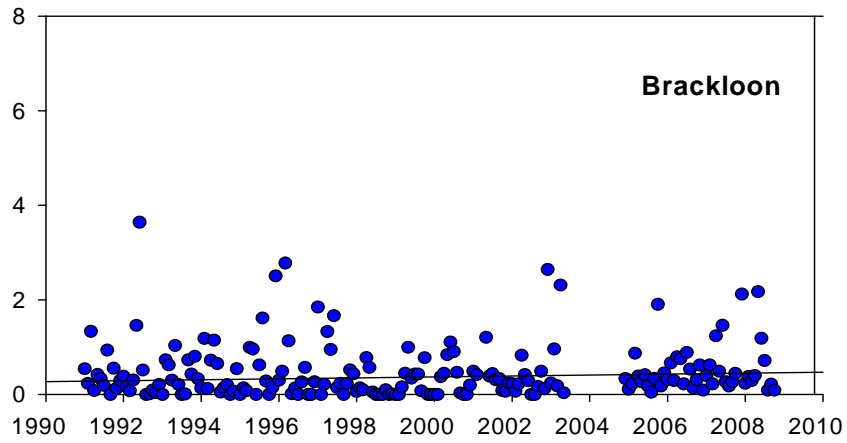
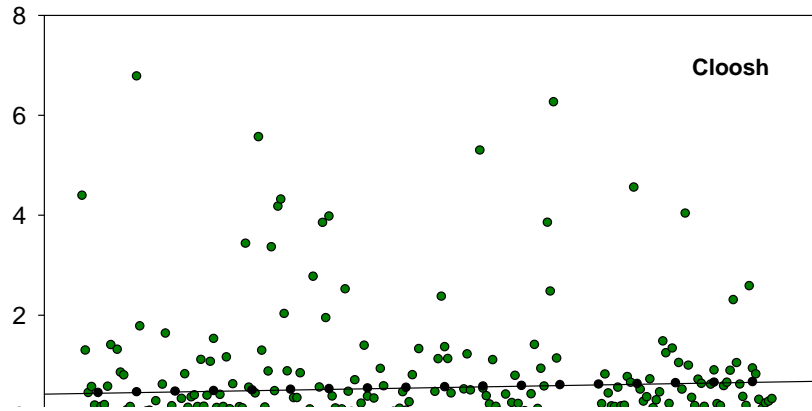
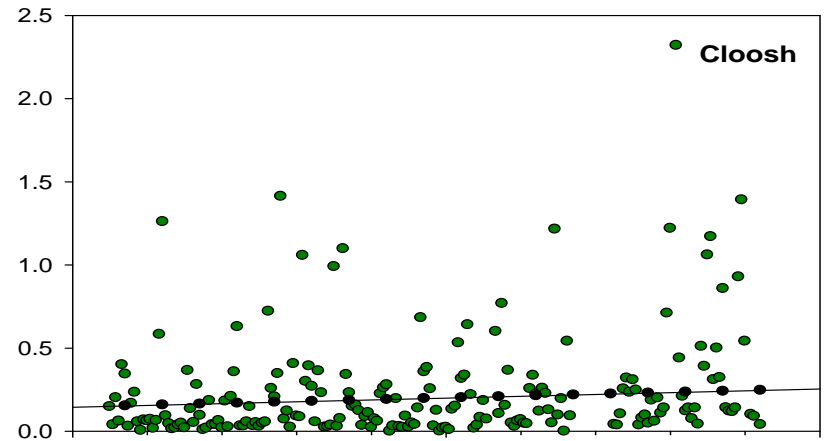
Nitrate mg/l



Trends in Throughfall



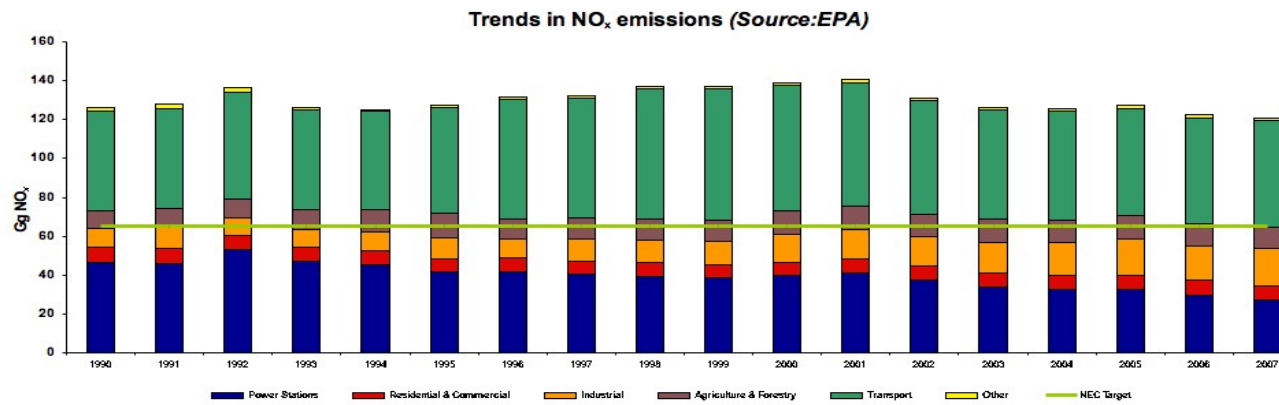
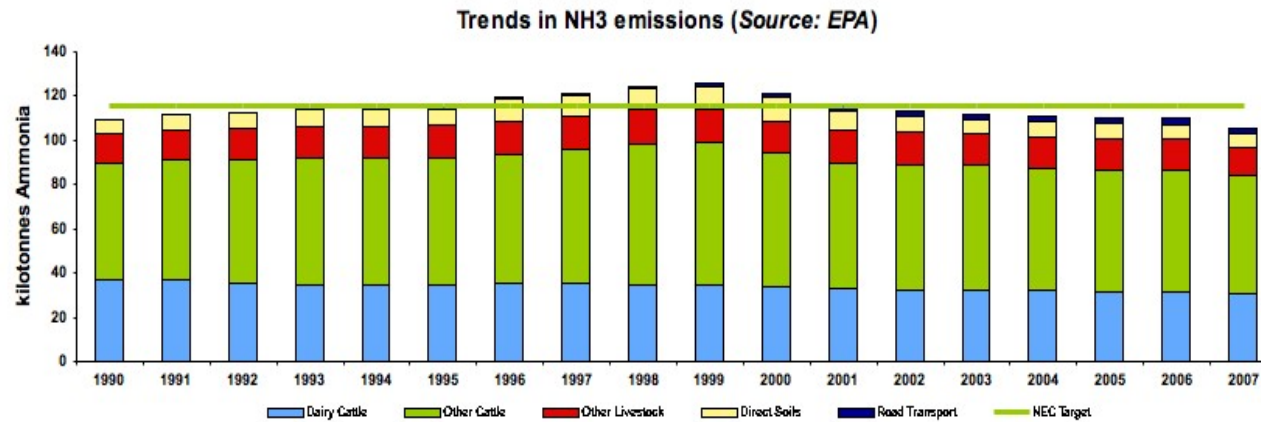
Ammonium-N mg/l



Conclusions

- Deposition data confirms emissions reductions in sulphur.
- Reductions in deposition are being reflected within the forest ecosystems:
 - In deep soil water - increase in pH and reduction in total aluminium.
- Emergence of trends in DOC
- Nitrogen deposition unchanged

Trends in nitrogen emissions



Gratefully acknowledgement the
many individuals involved in the
monitoring during the past two
decades



Department of
**Agriculture,
Fisheries and Food**

An Roinn
**Talmhaíochta,
Iascaigh agus Bia**



Forest Service



National Development Plan 2007 - 2013