

# **Changes in tree uptake seasonality can affect nutrient leaching: simulated effects in Little Valley, Nevada**

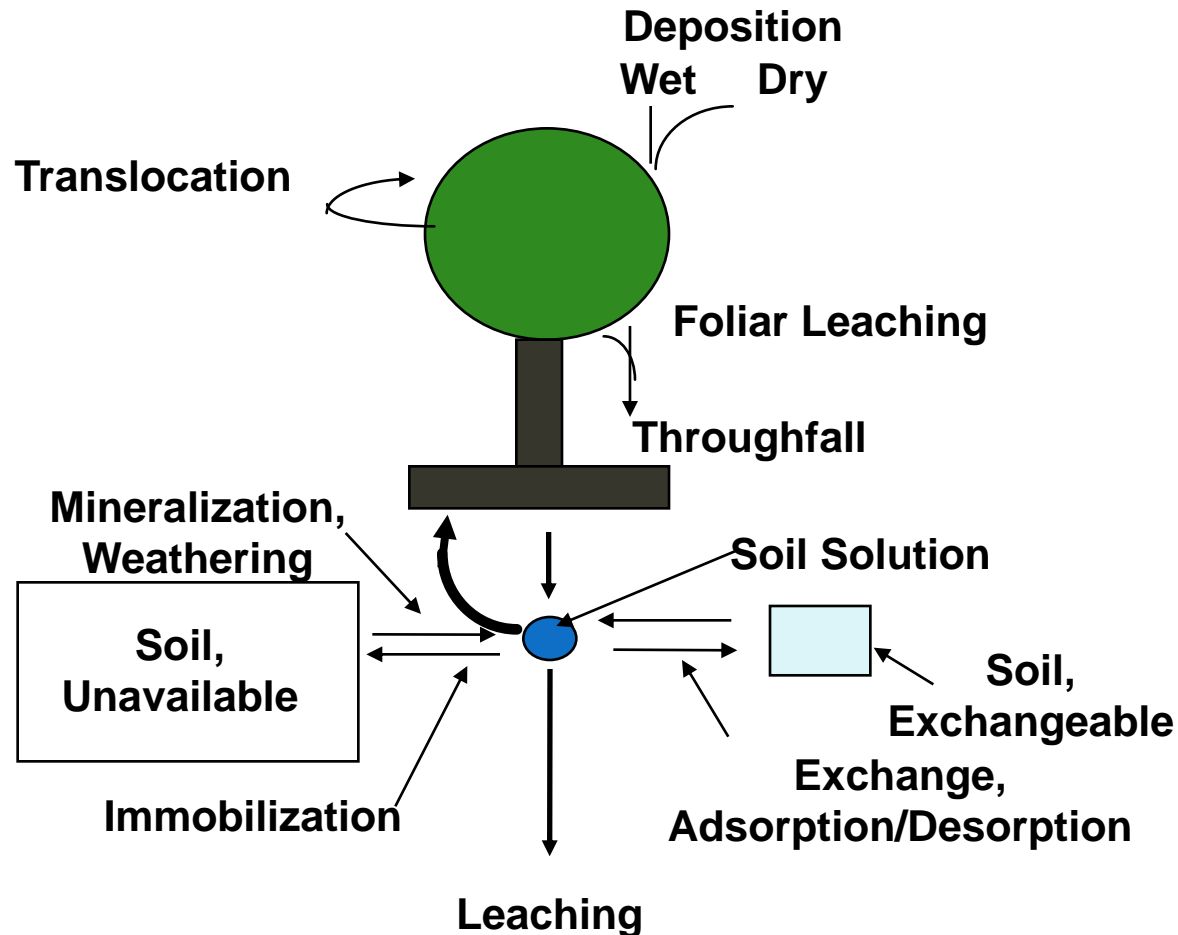
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# The Nutrient Cycling Model (NuCM)



## NuCM Version 2.02

Welcome to NuCM, Nutrient  
cycling in forest ecosystems.

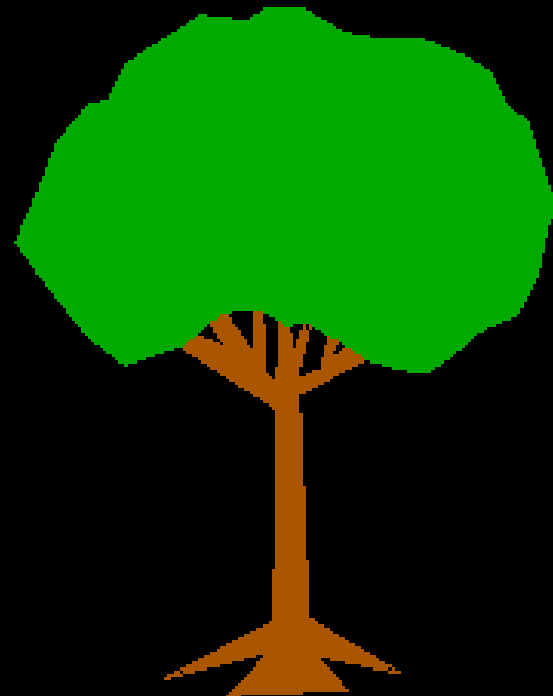
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TETRA TECH, Inc., Lafayette, CA  
This software is available for  
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Release date: January 1993



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## BASE CASE INPUT DATA

### SITE DATA

- |                                   |                            |
|-----------------------------------|----------------------------|
| 1) Physiographic Data             | 4) Meteorological Data     |
| 2) Biomass Characteristics        | 5) Deposition Quality Data |
| 3) Soil Chemistry Characteristics | 6) Soil Temperature Data   |

### EQUILIBRIUM CONSTANTS

- |                         |                           |
|-------------------------|---------------------------|
| 7) Carbonate System     | 10) Exchange Coefficients |
| 8) Aluminum System      | 11) Sorption Coefficients |
| 9) Organic Acid Systems |                           |

### RATE COEFFICIENTS

- |                                 |                        |
|---------------------------------|------------------------|
| 12) Vegetation Growth           | 15) Nitrification      |
| 13) Foliar Leaching & Exudation | 16) Mineral Weathering |
| 14) Organic Matter Decay        | 17) Stream Processes   |

Enter input data set option :

**F1**

Continue

**F2**Previous  
Screen**F3**Restart  
Program**F4**

Help

**F5**Return to Base  
Case Options Menu**F9**

Quit

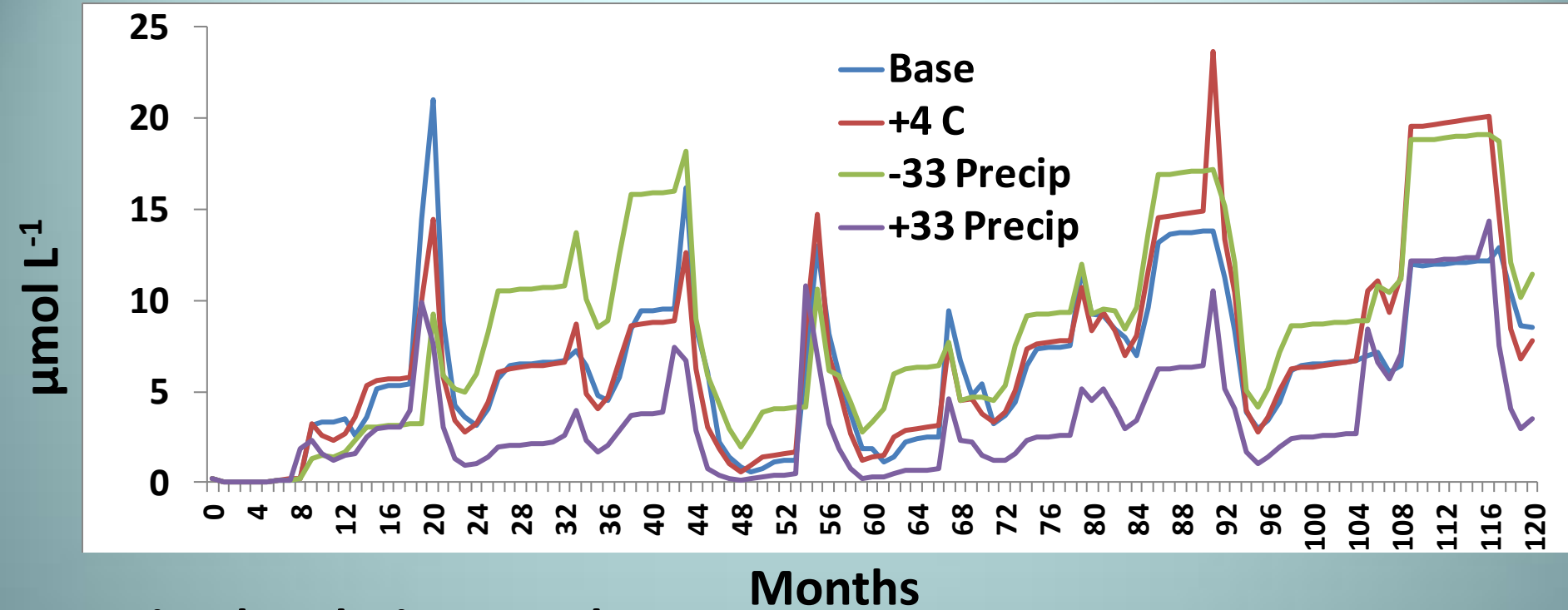
**In a previous paper, the Nutrient Cycling Model (NuCM) was used to simulate the effects of climate change on a forest ecosystem in Little Valley, Nevada by imposing the following scenarios:**

- 1) +4° temperature increase,**
- 2) minus 33% precipitation, and**
- 3) plus 33% precipitation**

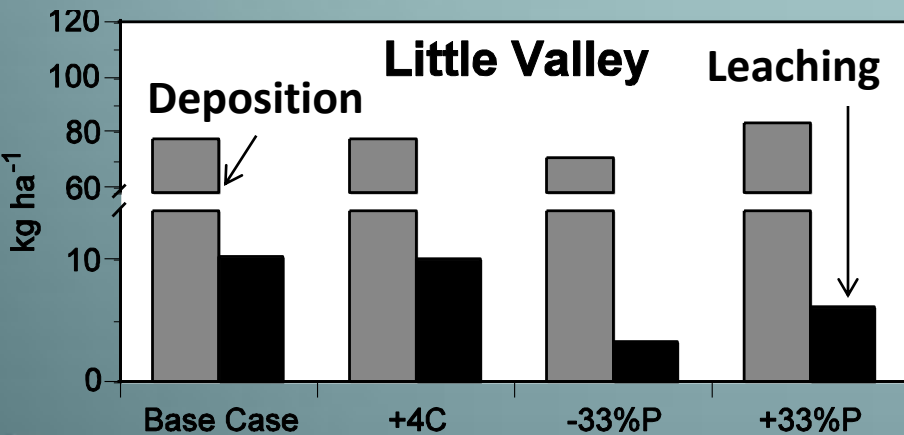
**With the exception of changes in soil water flux, these simulations showed only minor affects nutrient cycling and water quality.**

**Johnson, D.W., R.B. Susfalk, H.L. Gholz, and P.J. Hanson. 2001. Simulated effects of temperature and precipitation change in several forest ecosystems. *J. Hydrology* 235: 183-204.**

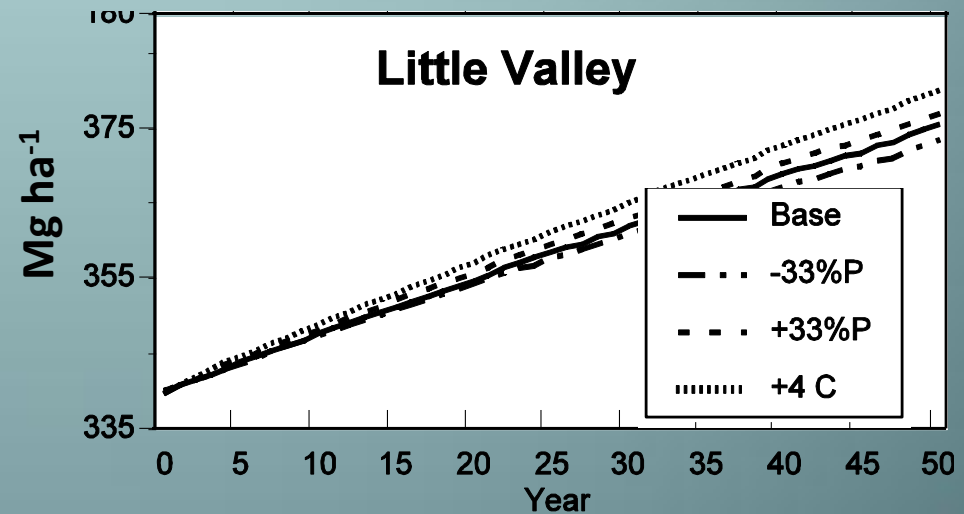
# Simulated Soil Solution Nitrate Concentrations



## Simulated Nitrogen Fluxes (over 50 years)



## Simulated Biomass



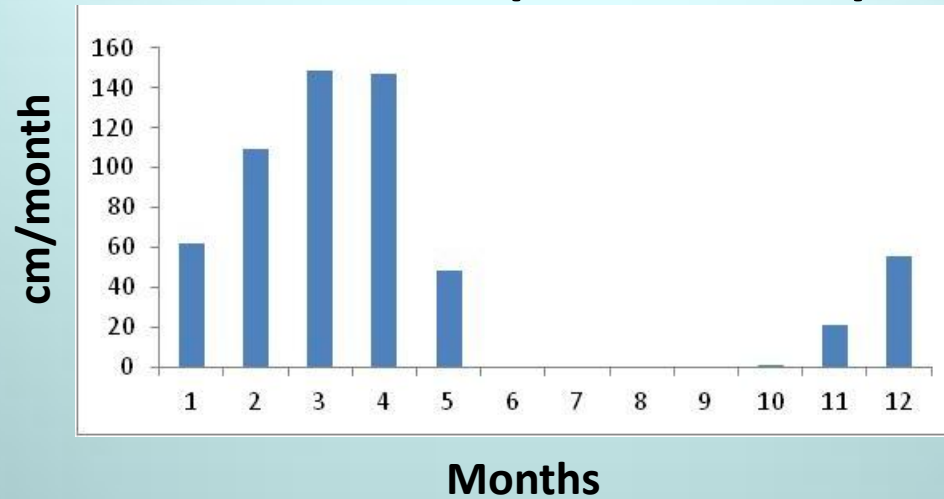
**In this presentation, we took another approach to simulating climate change effects on the same ecosystem by varying the seasonality of nutrient uptake by trees.**

**Scenarios:**

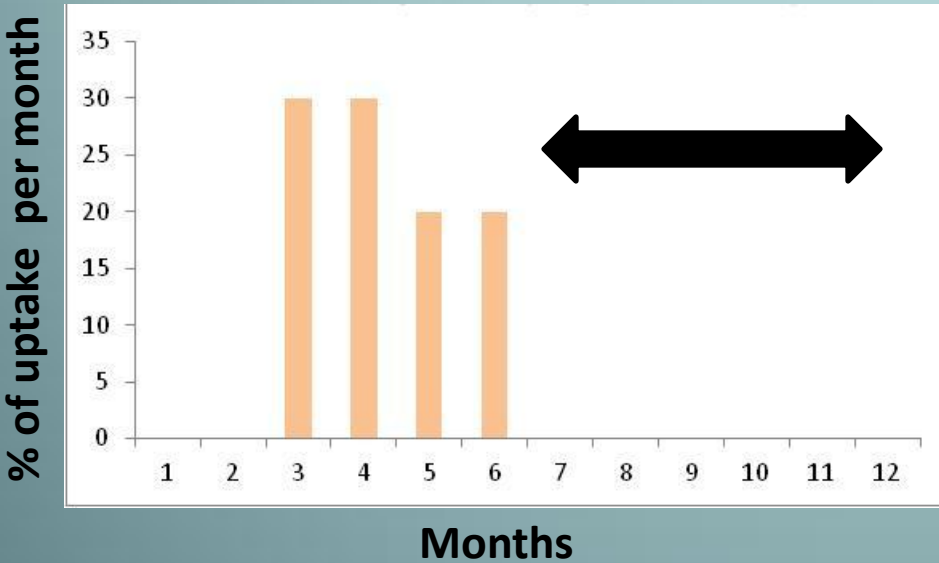
- **Nutrient uptake was concentrated in the spring only before soils dry out (SPR)**
- **Nutrient uptake was concentrated in both spring and late fall (SPF)**

**Late fall uptake may be expected in the future, if predictions of wetter summers and later snowpack development are realized.**

# Snow cover (1978-1987)

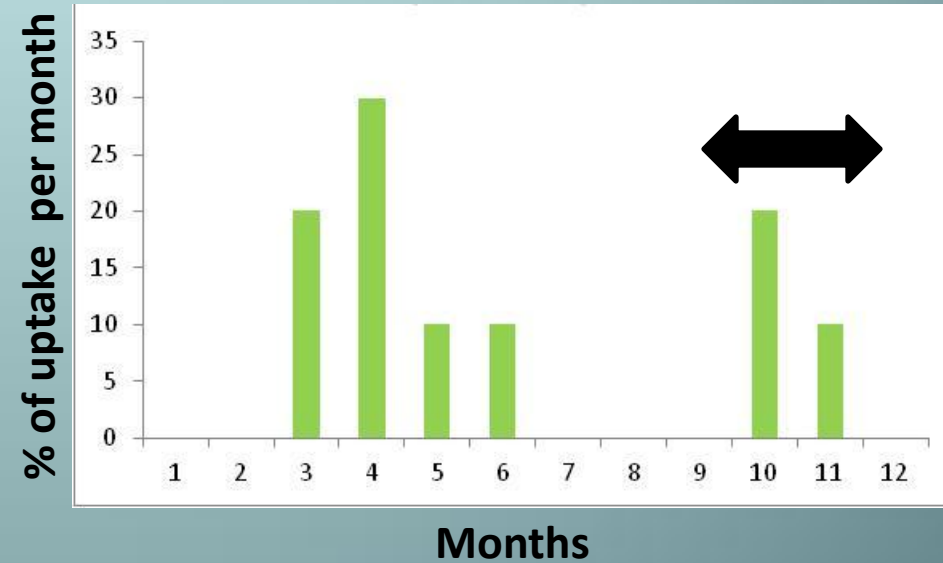


## SPR scenario



**Dry soil in summer and early snowpack  
--> uptake is not possible**

## SPF scenario



**More rainfall in summer and later  
snowpack --> possible uptake during Fall**



## Interplay of Rooting Patterns, Uptake, and Leaching:

NuCM forces the user to decide how much of total annual uptake takes place each month (who knows this?)

BZO

### BIOMASS CHARACTERISTICS II FOR **OVERSTORY** CANOPY

Monthly Uptake of Trees (fraction/year) :

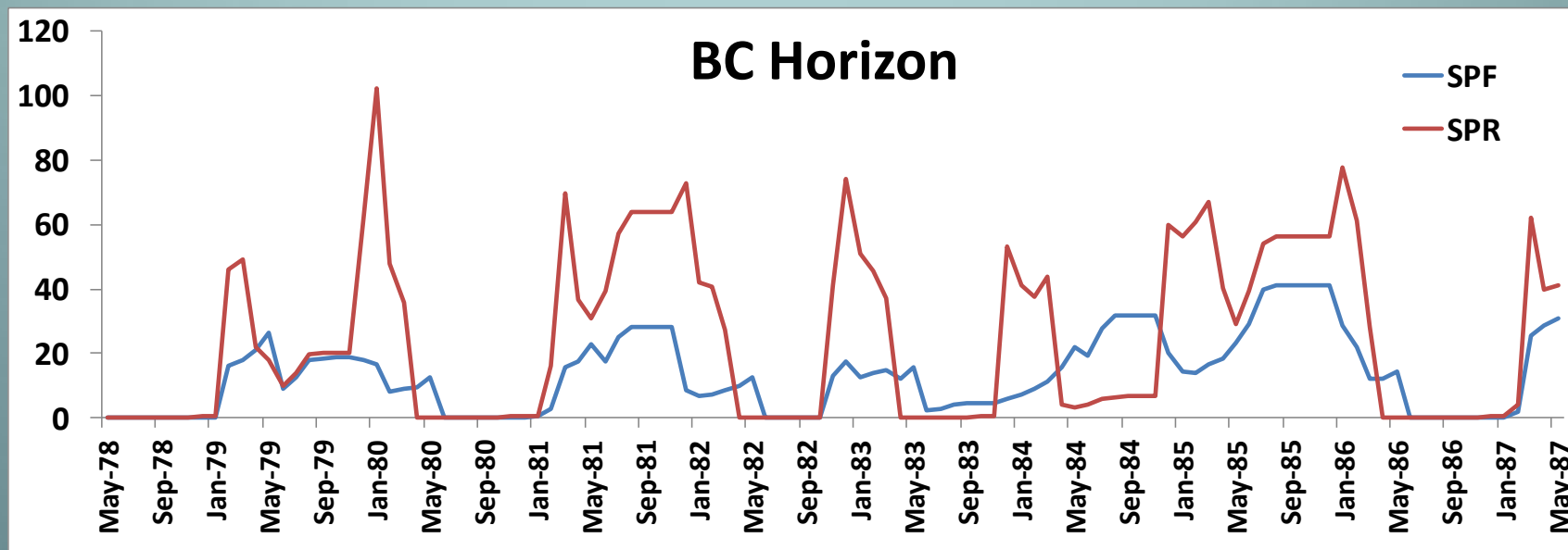
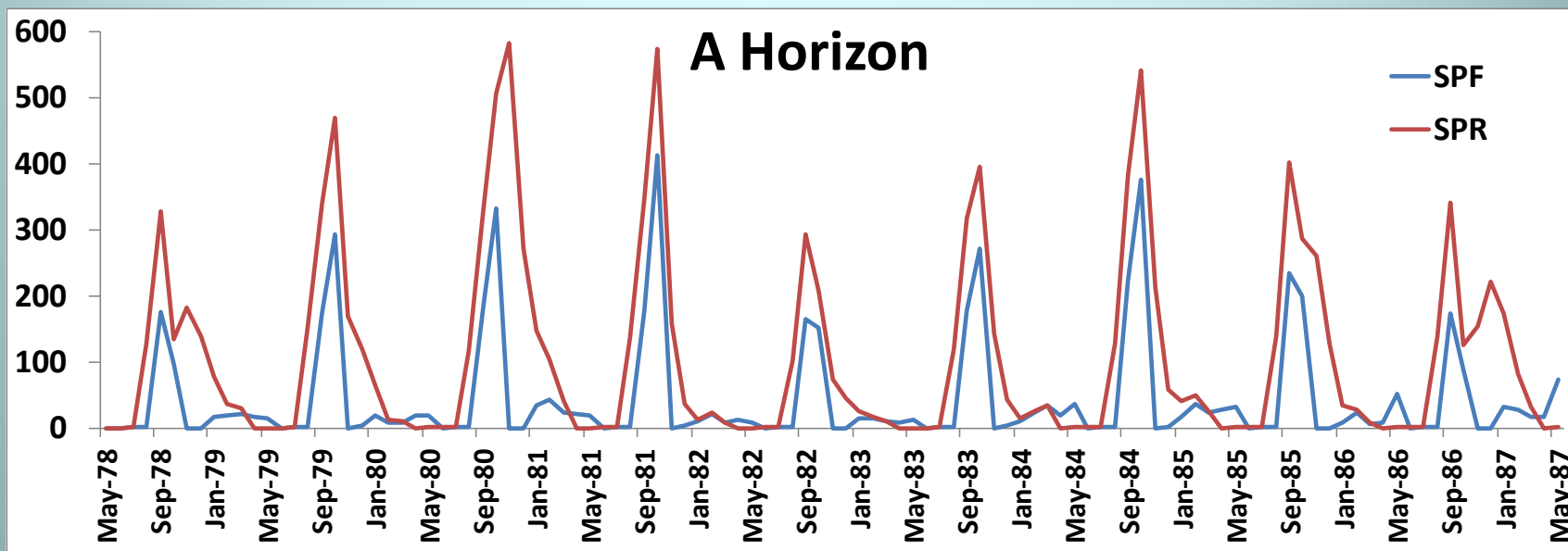
	Jan	Feb	Mar	Apr	May	June
Deciduous	<b>.030</b>	.030	.030	.030	.140	.140
Coniferous	.000	.000	.000	.000	.000	.000
Open	.000	.000	.000	.000	.000	.000
	July	Aug	Sept	Oct	Nov	Dec
Deciduous	.140	.140	.140	.060	.030	.030
Coniferous	.000	.000	.000	.000	.000	.000
Open	.000	.000	.000	.000	.000	.000

<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F8</b>	<b>F9</b>
Continue	Previous Screen	Restart Program	Help	Return to Input Options Menu	Undo Changes	Quit

# Simulated Soil Solution Nitrate Concentrations

(on the calibration period [1978-1987])

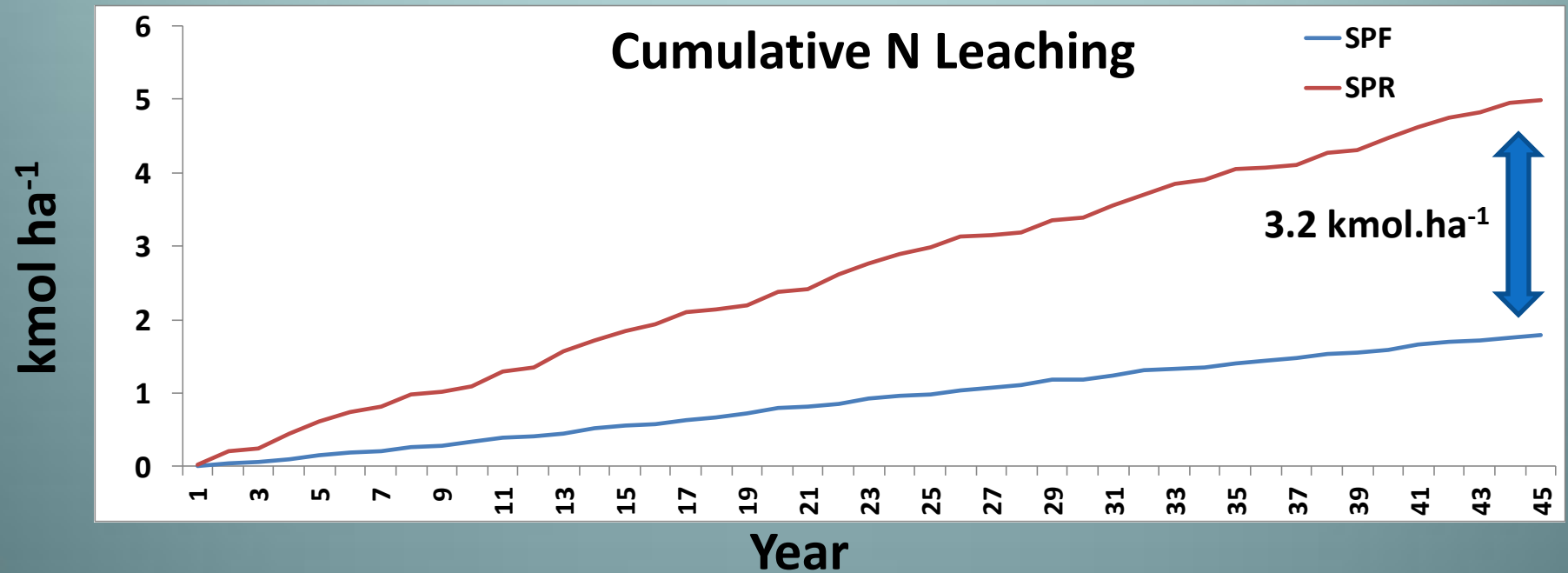
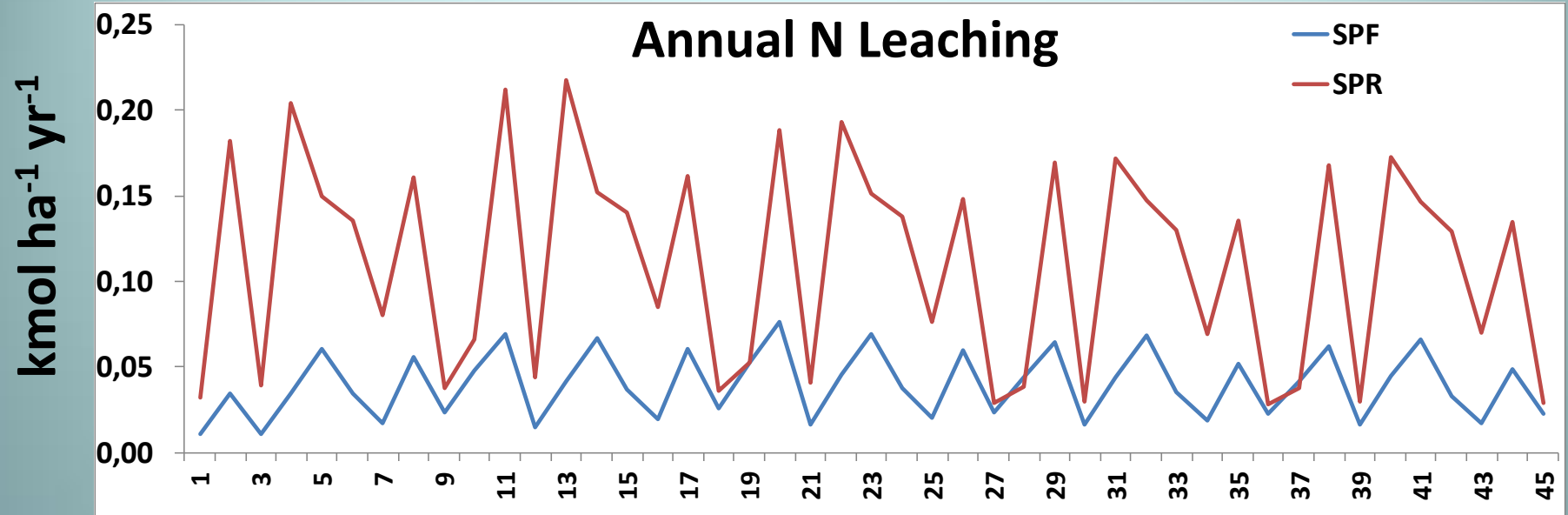
$\mu\text{mol L}^{-1}$



Month

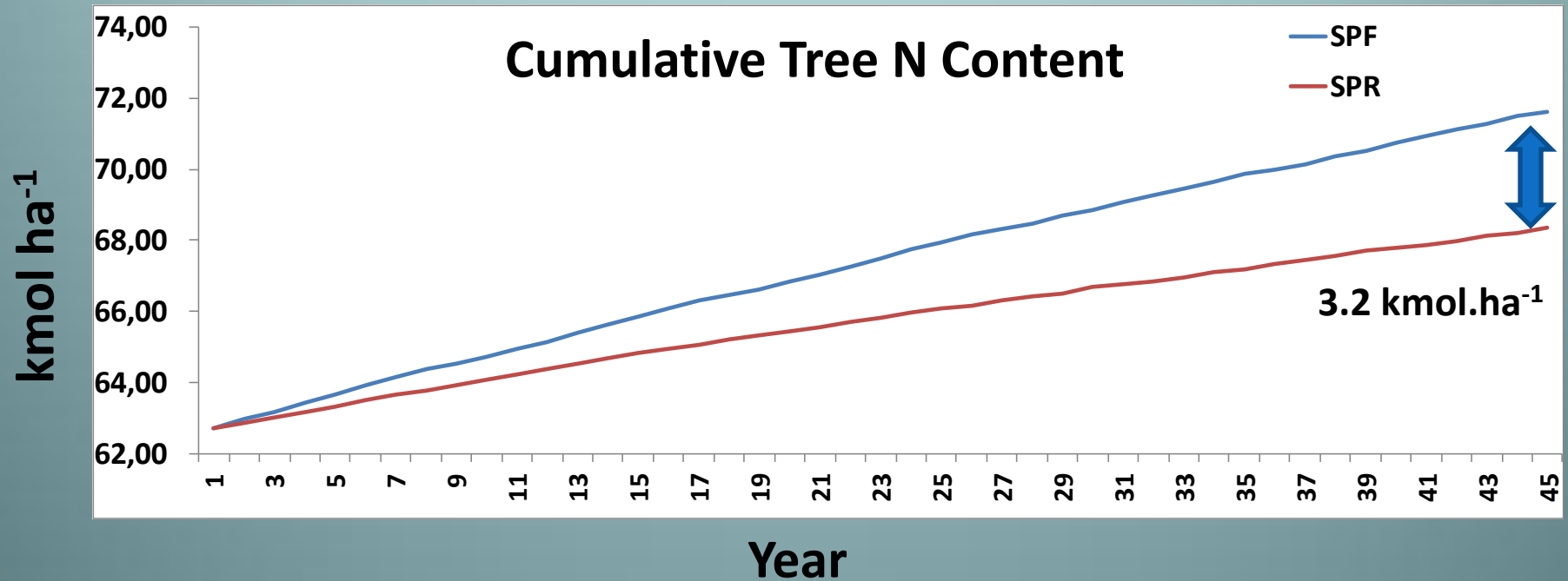
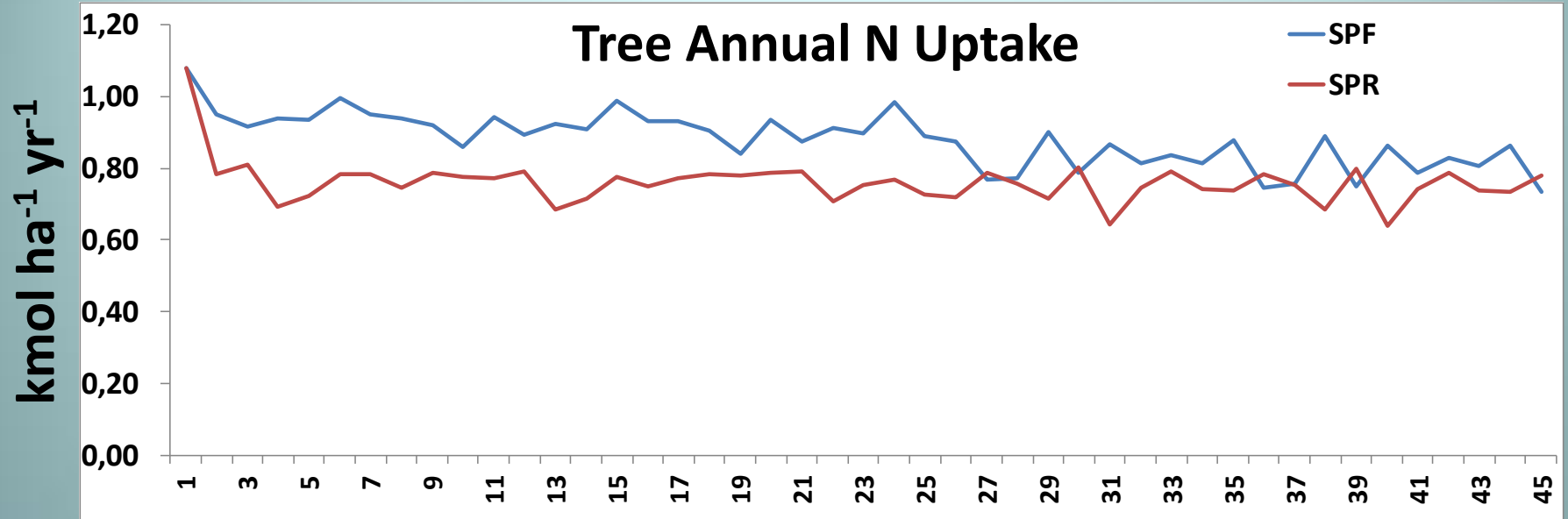
# Simulated Soil Solution Nitrogen Leaching

(simulation over a 45 years period)



# Simulated Tree N Uptake

(simulation over a 45 years period)



# Summary

The simulations showed that :

- N leaching was higher for the SPR scenario compared to SPF
  - N uptake by trees was higher for the SPF scenario compared to SPR
- if predictions of wetter summers and later snowpack are realized in the future, tree uptake during Fall might reduce N leaching and also cations leaching.

We used these simulations to provide hypotheses as how plant uptake patterns might affect water quality.

We also illustrated the importance of a temporal synchronization between nutrients bioavailability and uptake by plants.