

Atmospheric nitrogen deposition in a Holm oak forest in central Spain

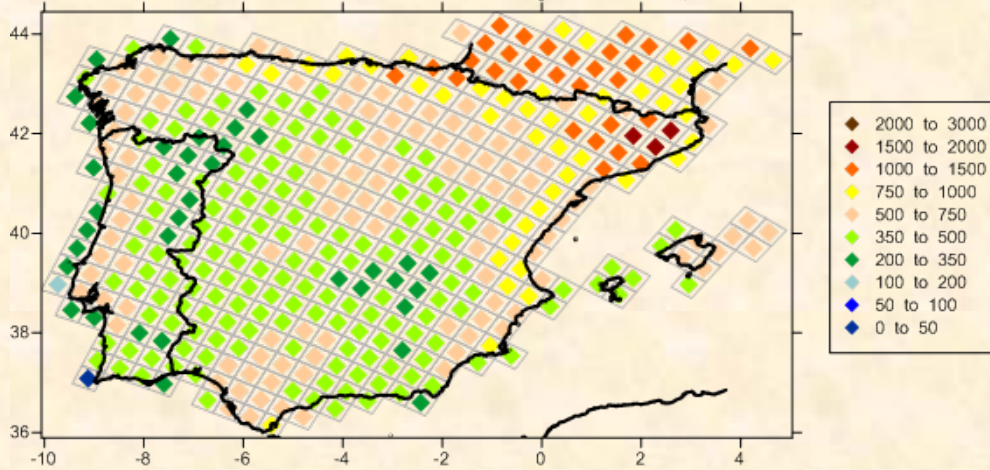
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Ecotoxicology of Air Pollution, CIEMAT, Madrid, Spain

Atmospheric N deposition in Spain

Modelled total N deposition (2008)

EMEP

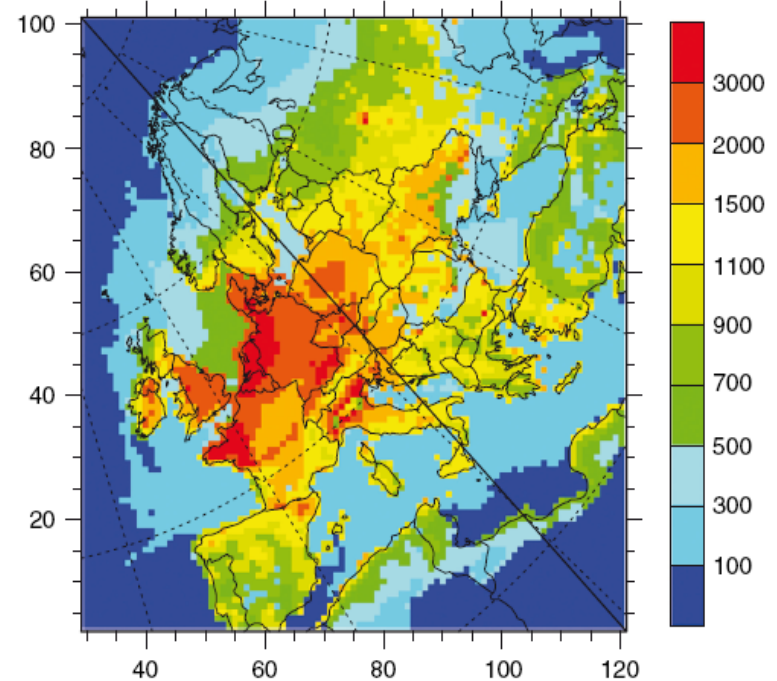
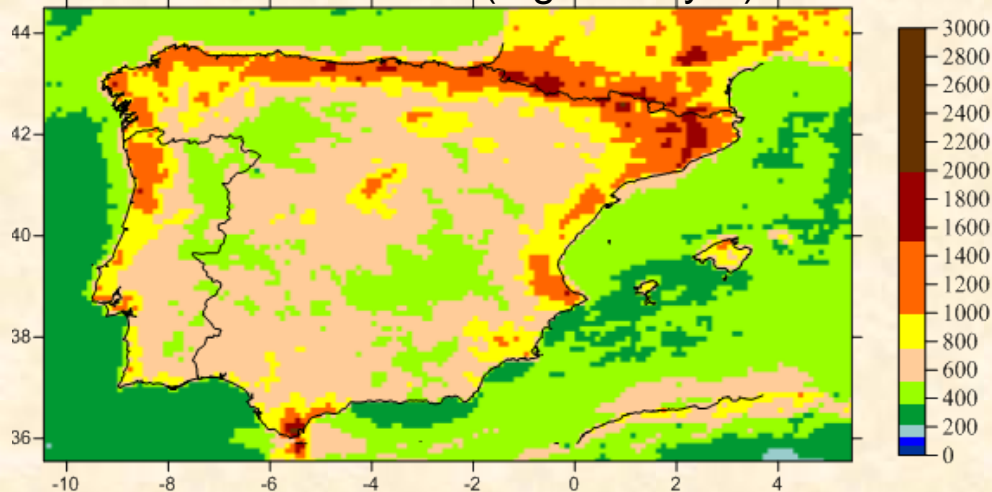
(mg N m⁻² yr⁻¹)



Total N deposition in Spain:
5-30 kg N ha⁻¹ yr⁻¹

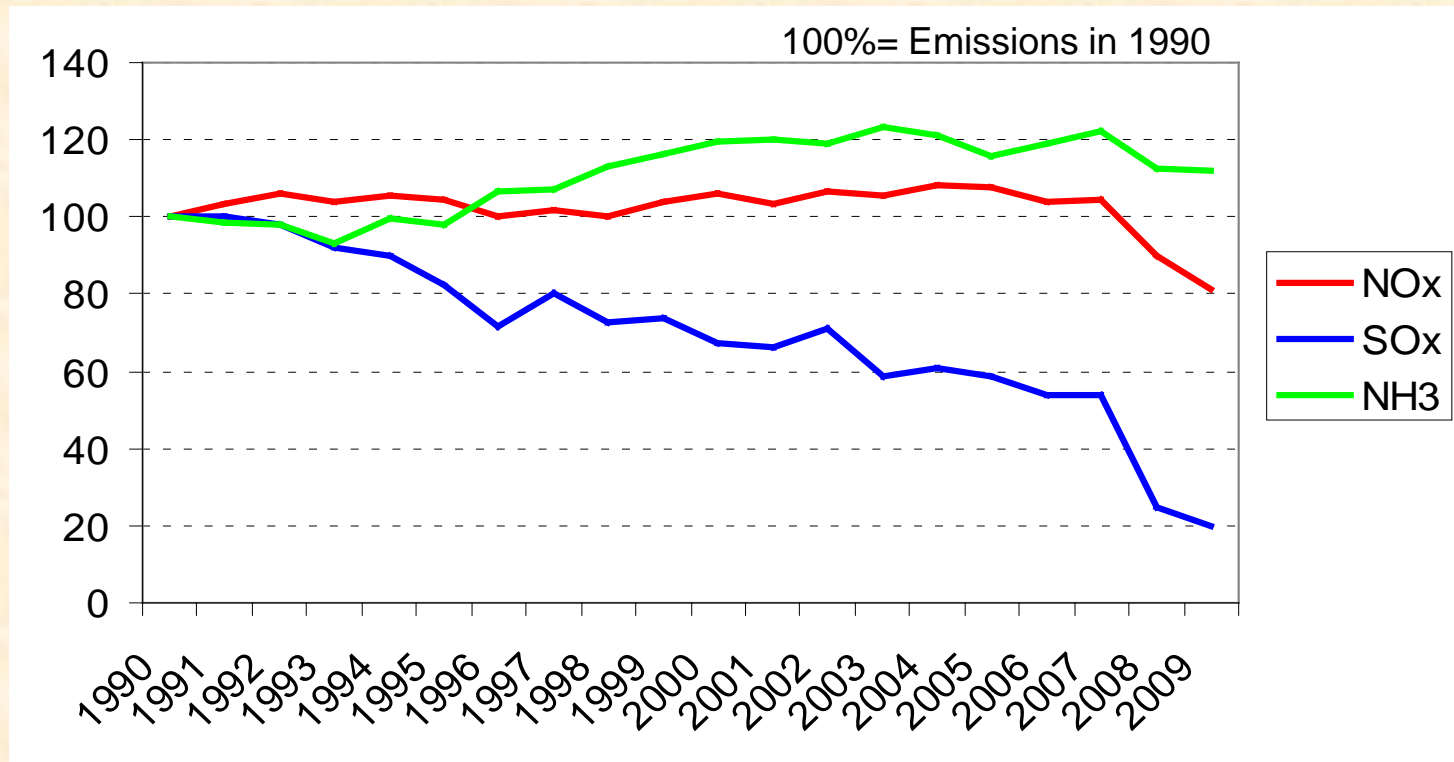
CHIMERE

(mg N m⁻² yr⁻¹)



Atmospheric N deposition in Spain

Gas emissions in Spain 1990-2009

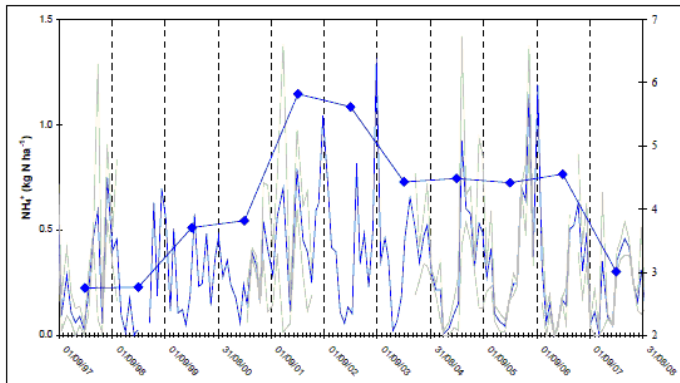


(MARM, 2011)

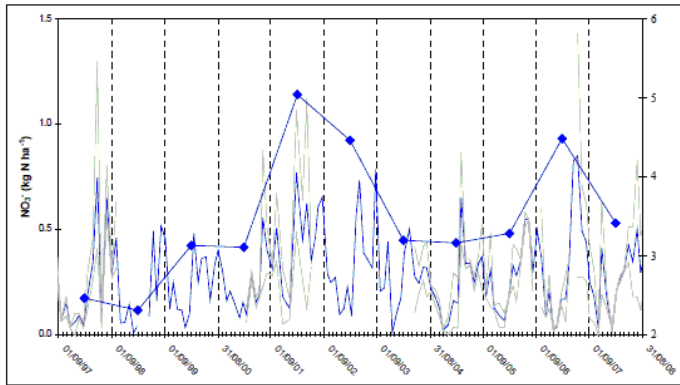
Atmospheric N deposition in Spain

N wet deposition in Pyrenees 1997-2007

NH_4^+



NO_3^-

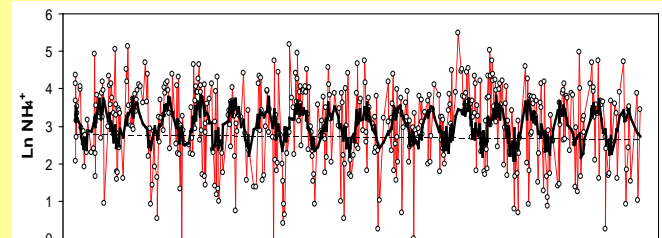


Camarero & Aniz (2010)

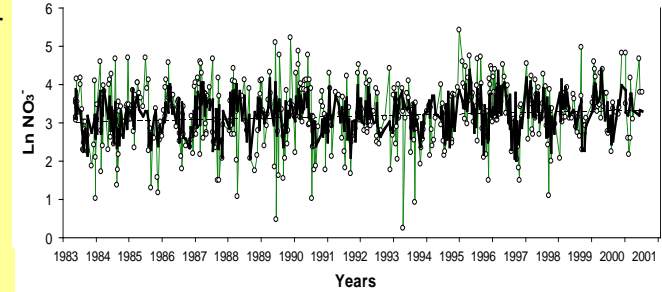


N wet desposition in La Castanya (Catalonia) 1983-2007

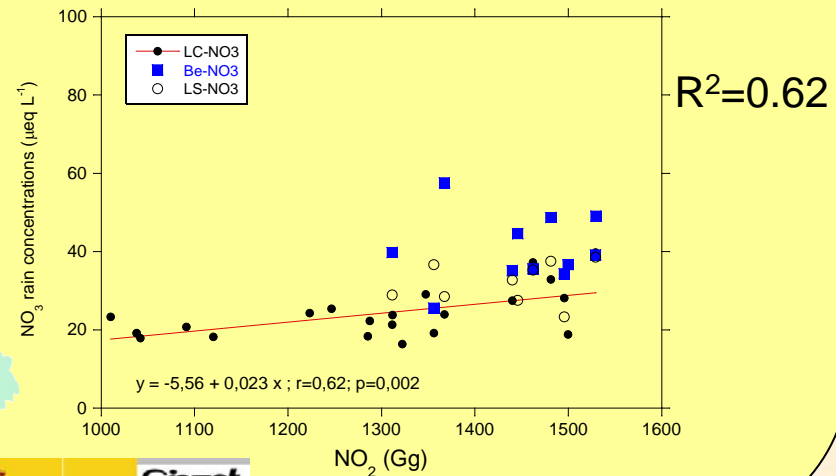
NH_4^+



NO_3^-



Relationship between rainfall [NO_3^-] and NO_2 emissions 1983-2006



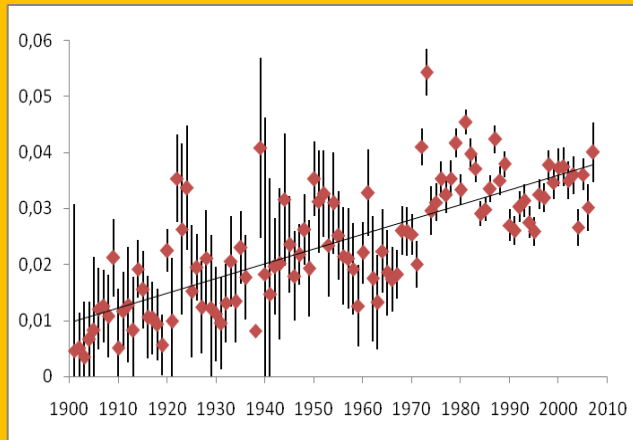
Centre de Recerca Ecologica i Aplicacions Forestals
CREAF



(Ávila et al., 2010)

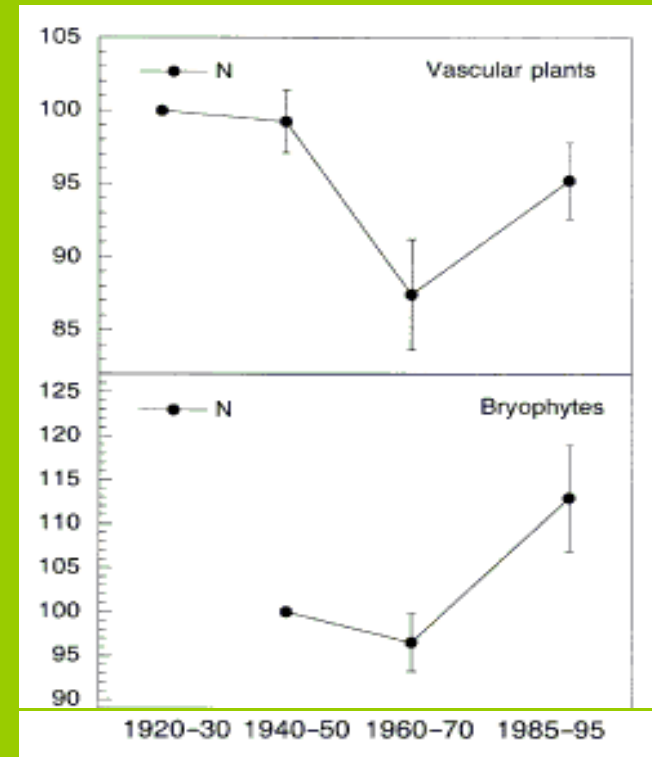
Evidences of N enrichment in Spanish ecosystems

Increasing n° nitrophilous species in herbaria 1900-2008



(Ariño et al., 2010)

Relative changes (%) foliar N content in herbaria



Peñuelas & Filella (2001)

Other evidences:

Increasing NO_3^- in rivers of NE-Spain:

- Pyrenees (Camarero et al., 2010)
- Montseny (Ávila & Rodá, 2011)

Effects of nitrogen deposition in Mediterranean evergreen Holm oak forests (EDEN)

Objectives:

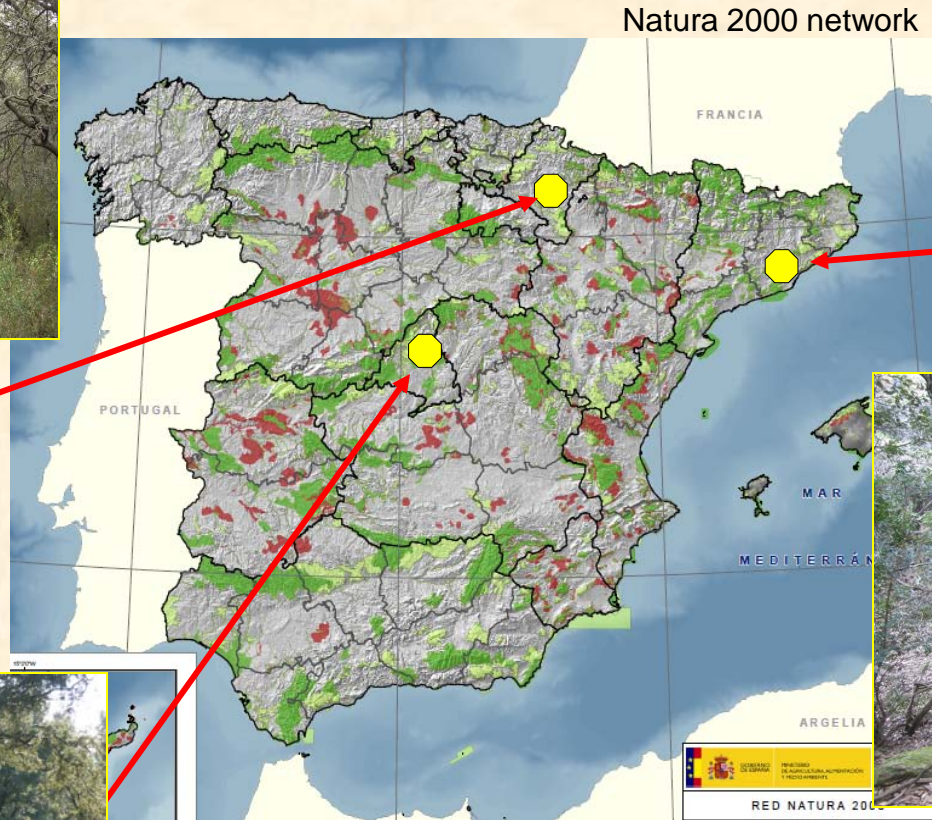
- Estimate seasonal changes of N deposition (including dry deposition) in Hom oak forests comparing different methods
- Evaluate the effects of deposition on N content and circulation in vegetation, soil and ground water
- Implications for estimating N critical loads for evergreen oak forests in Spain



Effects of nitrogen deposition in Mediterranean evergreen Holm oak forests (EDEN)



continental forest on calcareous substrates (Pamplona)

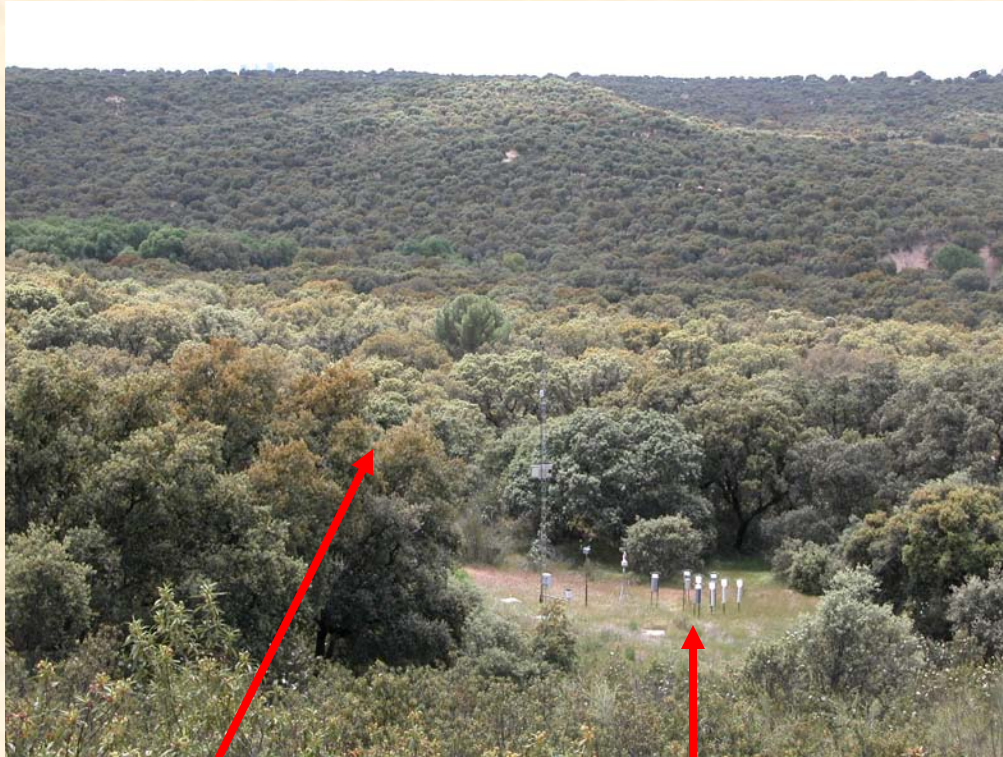


coastal forest on siliceous soils (Barcelona)



continental forest on acid soils (Madrid)

EDEN methodology: meteorology and air pollutants



below canopy plot

open field plot

Meteorology:

- temperature
- relative humidity
- wind speed and direction
- PAR
- precipitation
- soil water content (2 m depth)



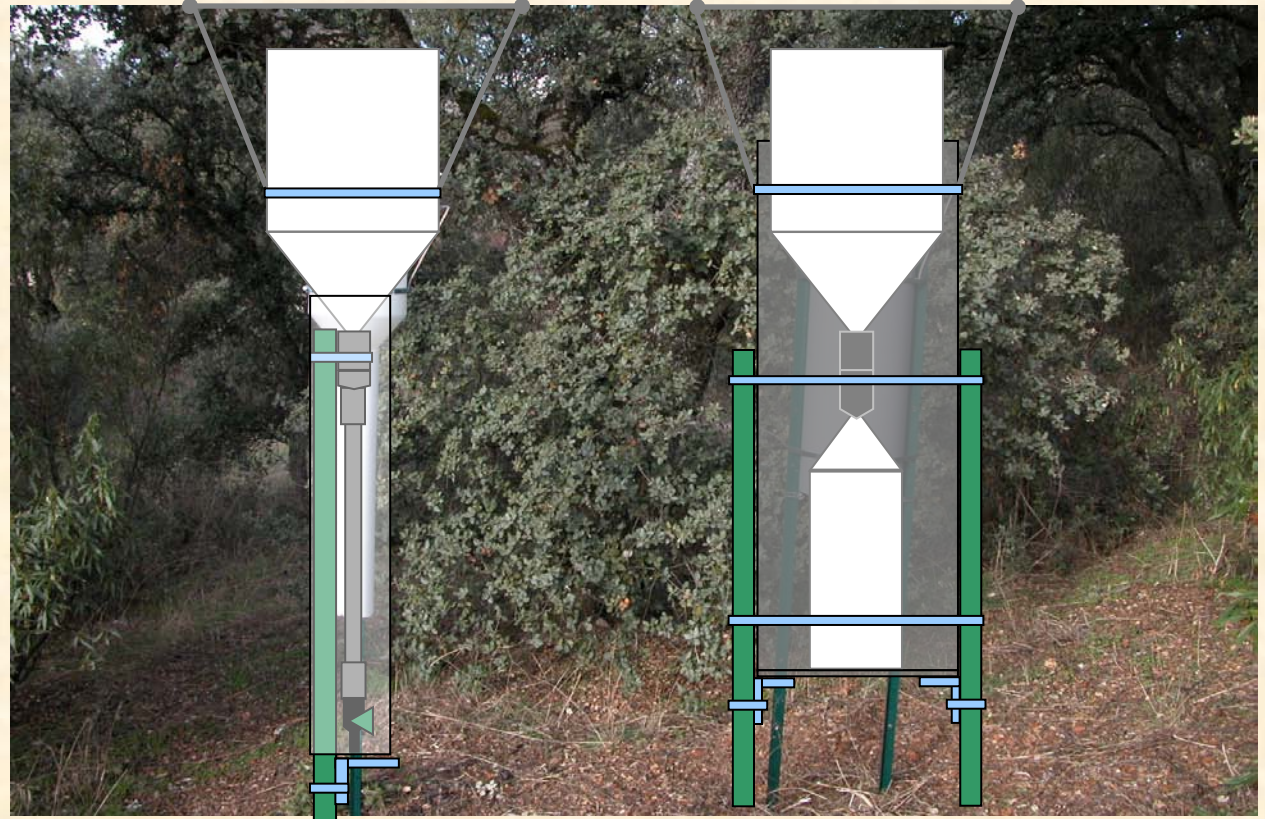
Air pollutants

- Passive samplers: NO_2 , NH_3 , HNO_3 , O_3
- Monitors: NO_x , O_3 , particulate matter

EDEN methodology: wet and dry deposition

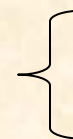


wet-only



bulk (n=4)

throughfall (n=12)



bottles

IE resin tubes

→ weekly

→ 3 months

EDEN methodology: wet and dry deposition

rinsing Holm oak branches seasonally:

- branches of live plants (NB)
- lyophilized branches (LB)



EDEN methodology: effects

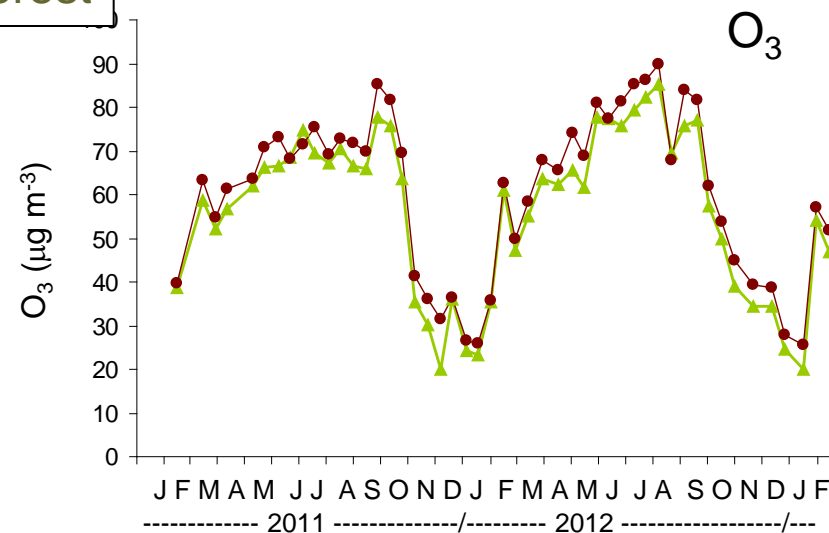
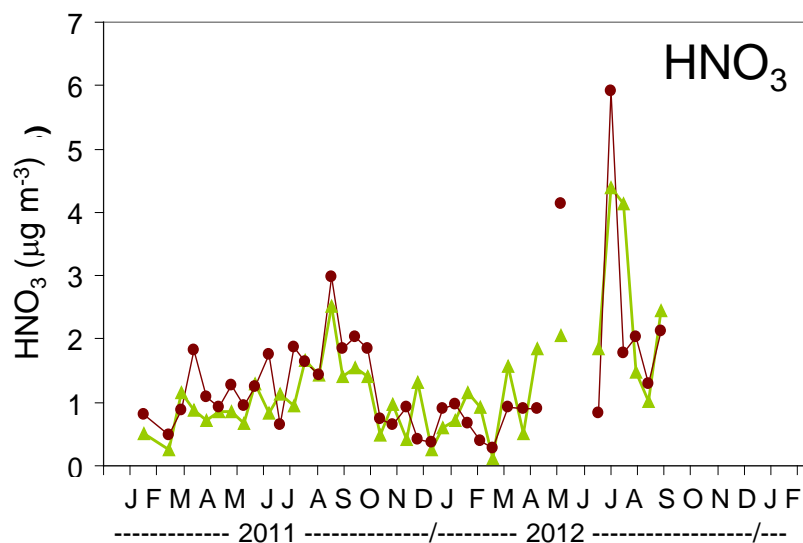
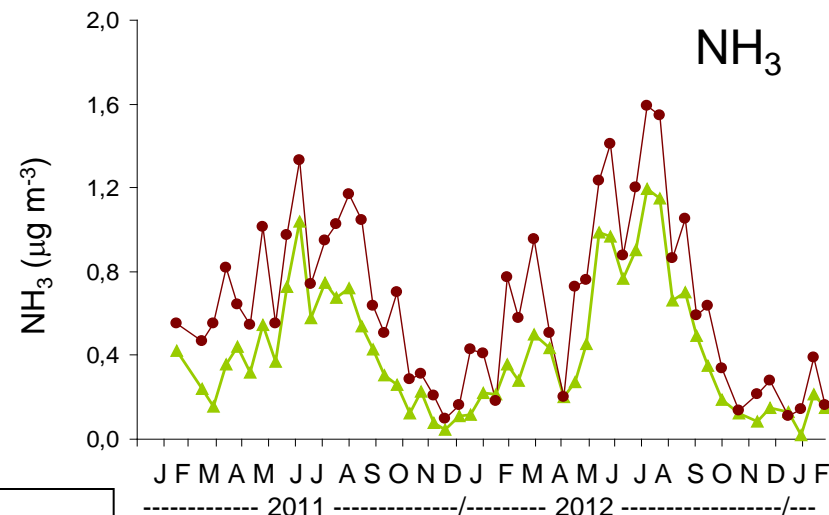
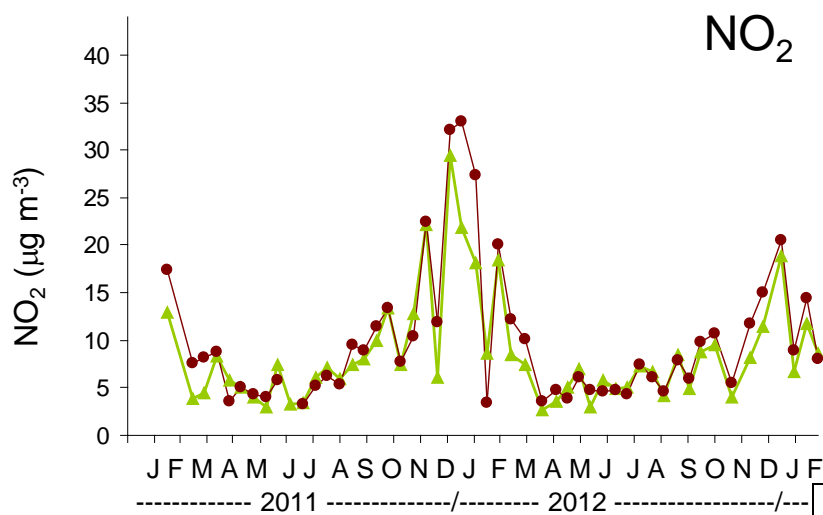


- Soil chemistry
- Soil water chemistry
- Litter
- Nutrient content: trees and mosses
- Lichen richness



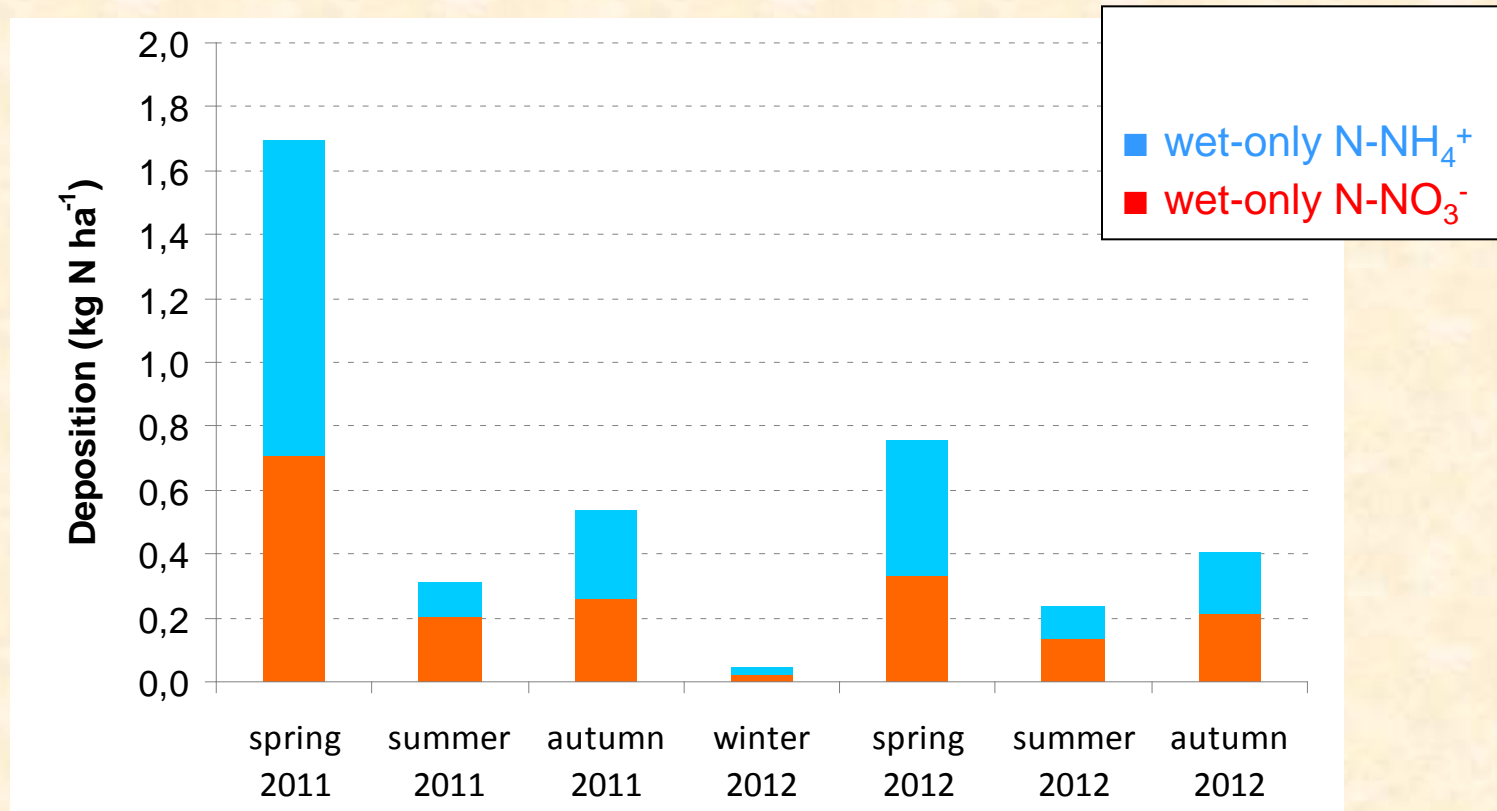
Madrid preliminary results:

Air pollutants



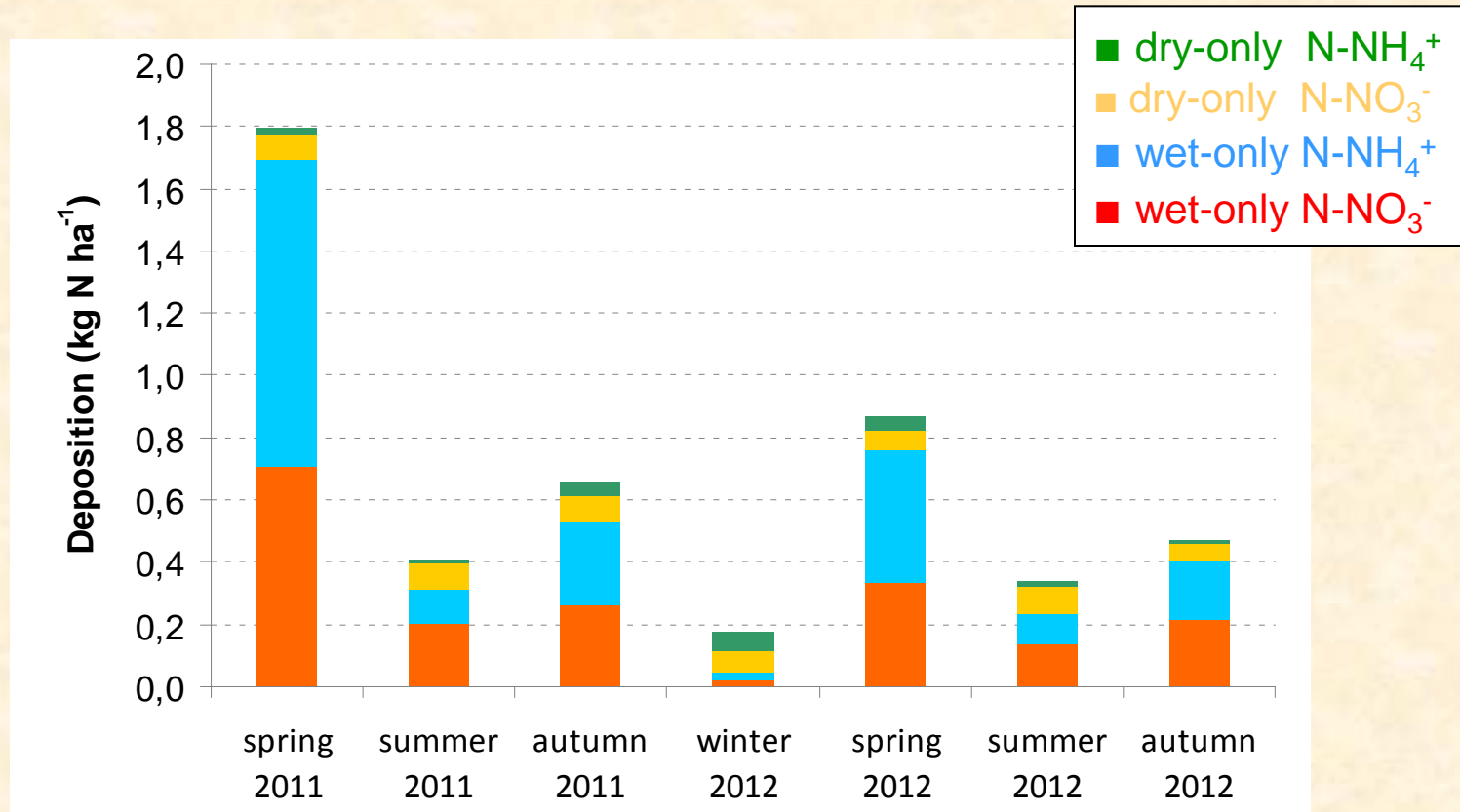
Madrid preliminary results:

seasonal changes in wet-only



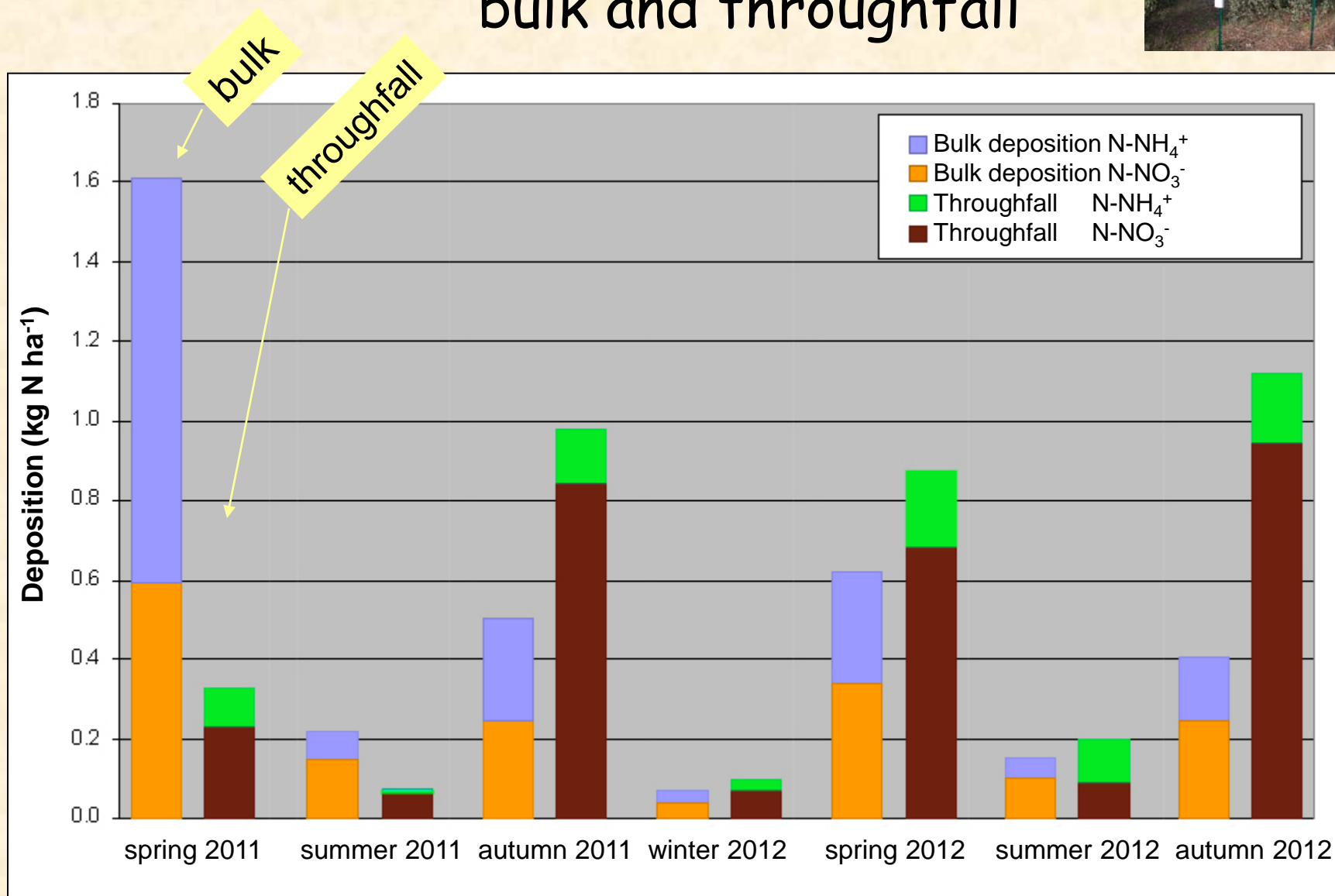
Madrid preliminary results:

seasonal changes in wet-only & dry-only



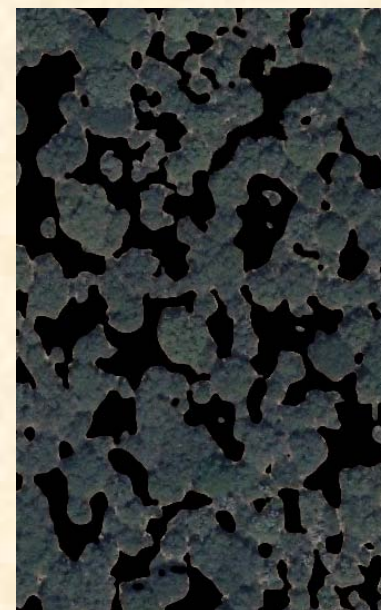
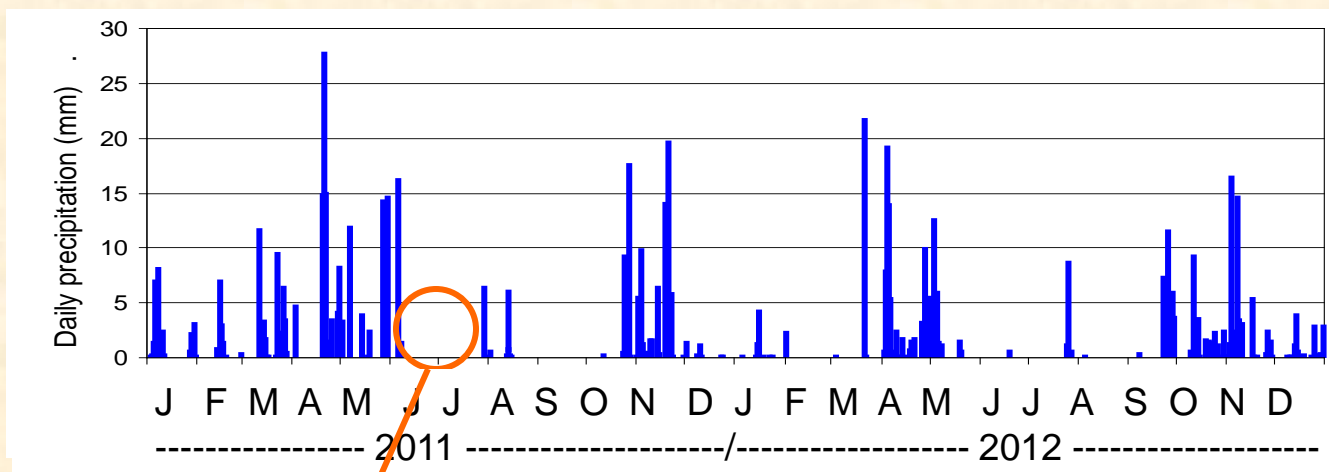
Madrid preliminary results:

bulk and throughfall

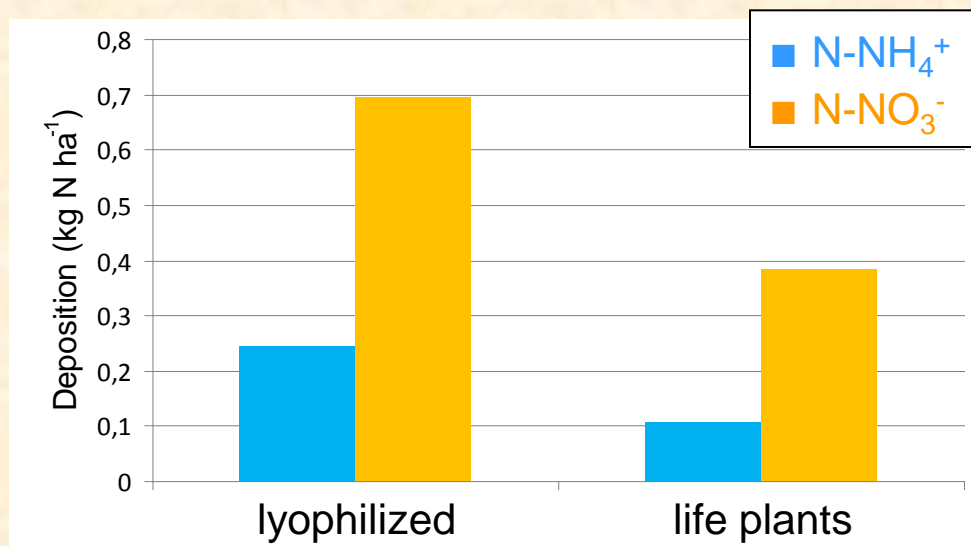


Madrid preliminary results:

rinsing branches



rain-free period = 51 days



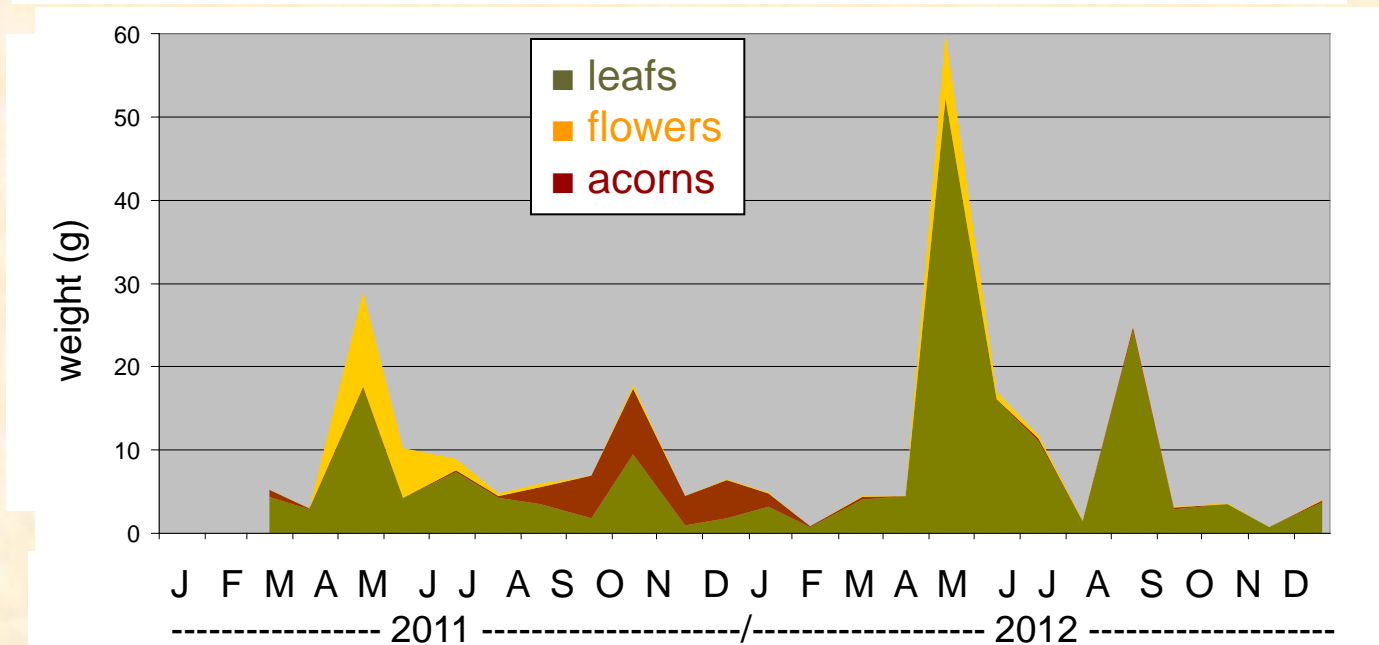
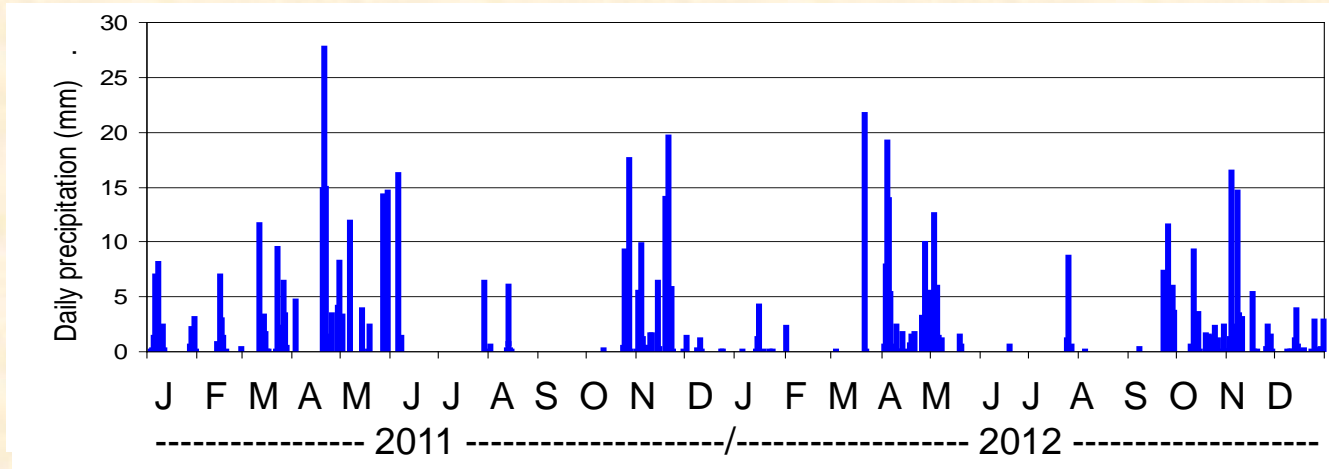
leaf surface area

LAI=3

tree density 72%

Madrid preliminary results:

precipitation and ground water chemistry



litter

Preliminary findings:

- ✓ Meteorology and N deposition show important seasonal and inter-annual variations
- ✓ Total bulk inorganic N deposition $\pm 2.6 \text{ kg N ha}^{-1} \text{ yr}^{-1}$
- ✓ Throughfall is not a good indicator of total N deposition in Holm oak forests
- ✓ Loss of NO_3^- in soil water when atmospheric N inputs occur while low biological activity
- ✓ ...

THANKS!

Consolider-MONTES, MINECO
EDEN, MINECO
AGRISOST, Com. Madrid
ECLAIRE, EU-FP7

