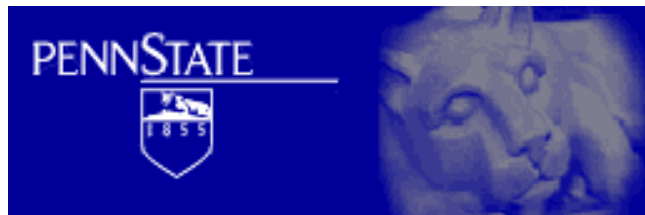


Carbon sequestration following stand-replacing fires in Spanish woodlands

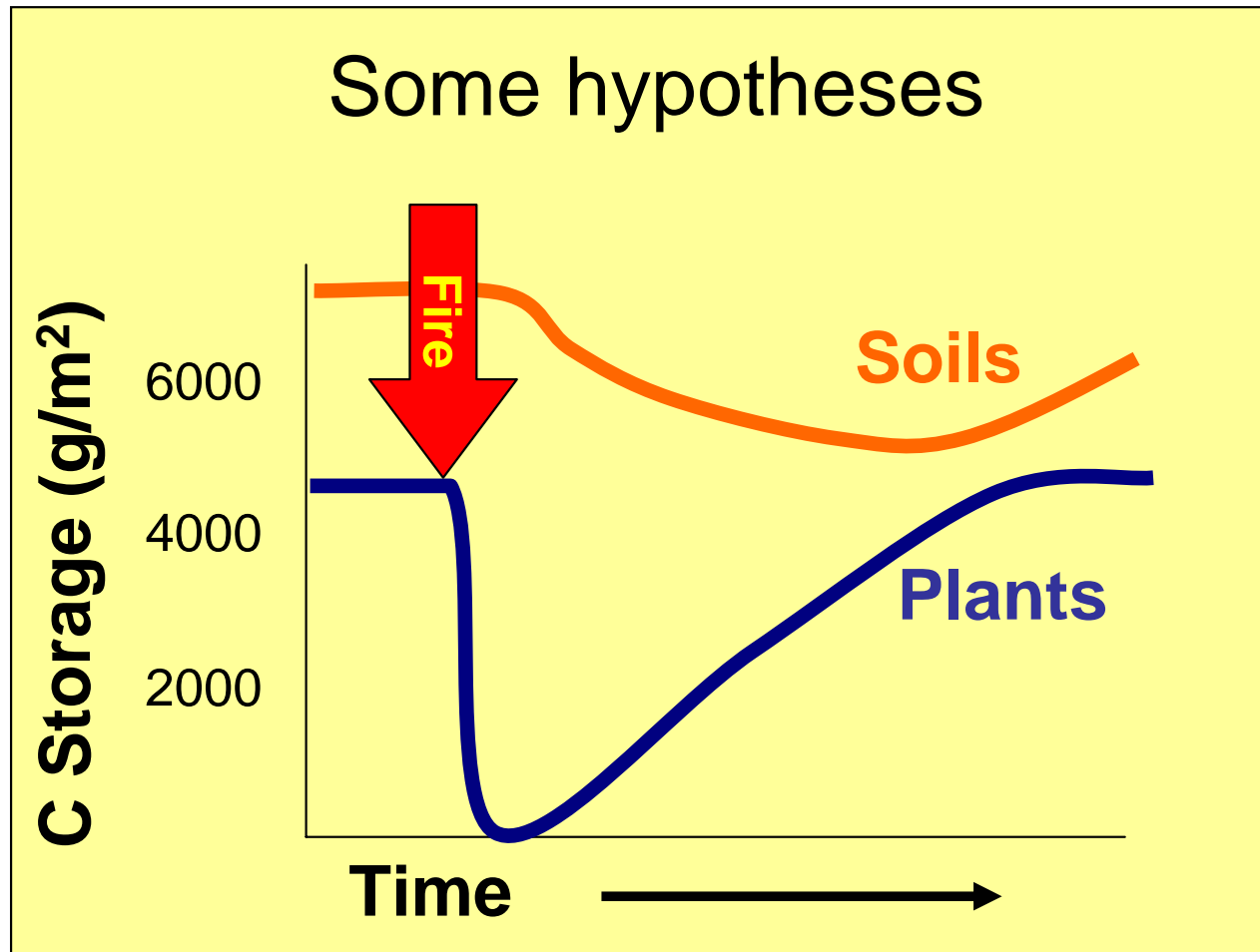
Jason Kaye



Joan Romanyá
Ramón Vallejo

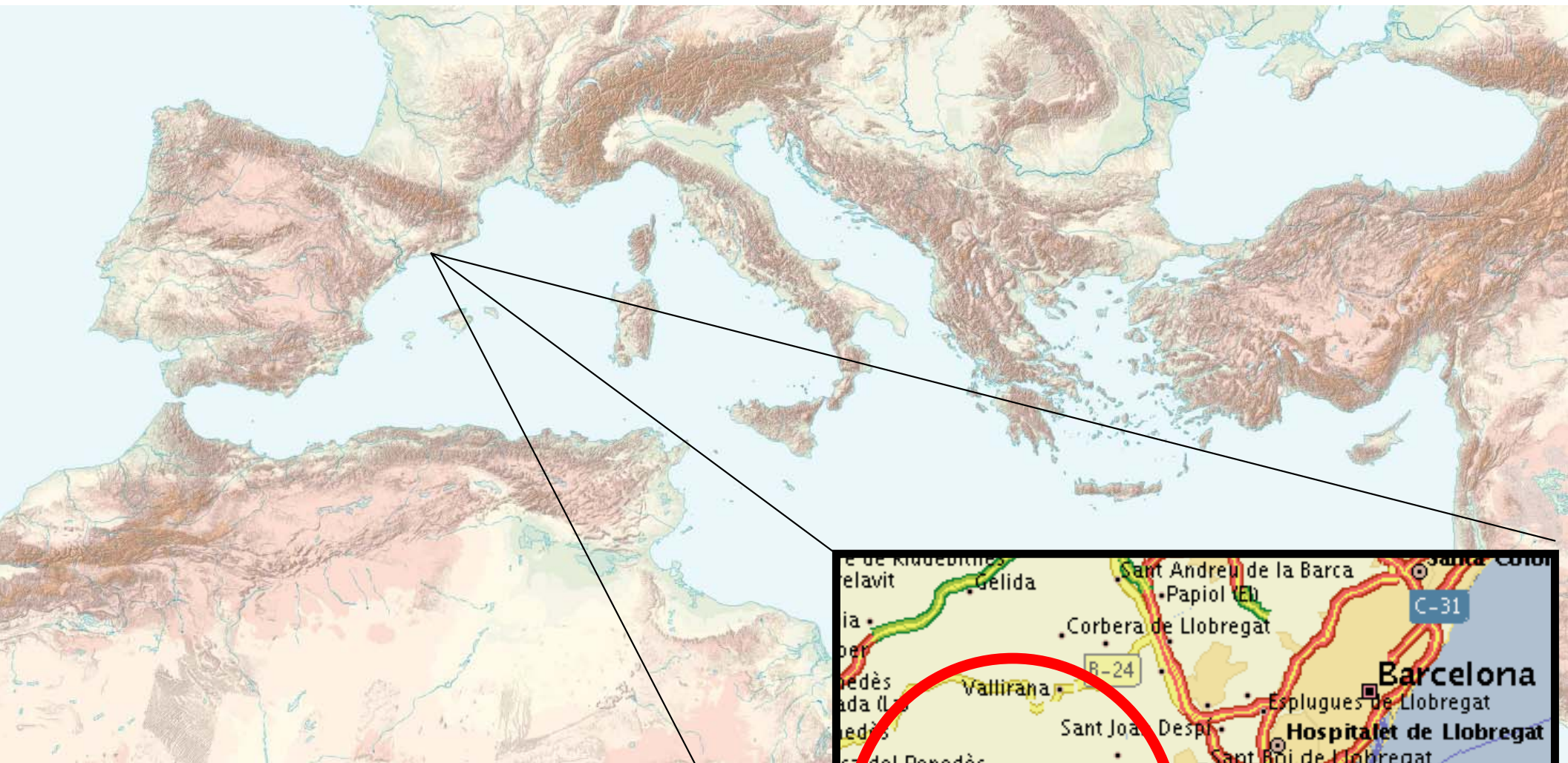


How does fire affect C storage in temperate forests?



Can fire affect country-scale C budgets?

- Well known in tropical and boreal ecosystems
- Surprisingly little work in temperate ecosystems
 - Like the U.S. and Spain
- Book-keeping models and simulations suggest:
 - In the 1980's US terrestrial C sink = 0.3 to 0.6 Pg/yr
 - Fire suppression accounted for 0.12 Pg/yr
- We need field data to back up the simulations
 - Our goal is to measure fire-C interactions in the field



Study Site:

Garraf massif

Garrigue = *Q. coccifera*

With *Pinus Halepensis*

Mediterranean climate

PPT: 600 - 700 mm

Intro to Mediterranean Woodlands



4 years after fire



18 years after fire



50+ years after fire



Old and new data from the site

- First fire-C storage work done in 1985
 - Chronosequence = 13 yrs
- Resampled and new sites added in:
 - 1989 Chronosequence = 17 yrs
 - 2003 Chronosequence = 30 yrs
 - In total 19 sites sampled

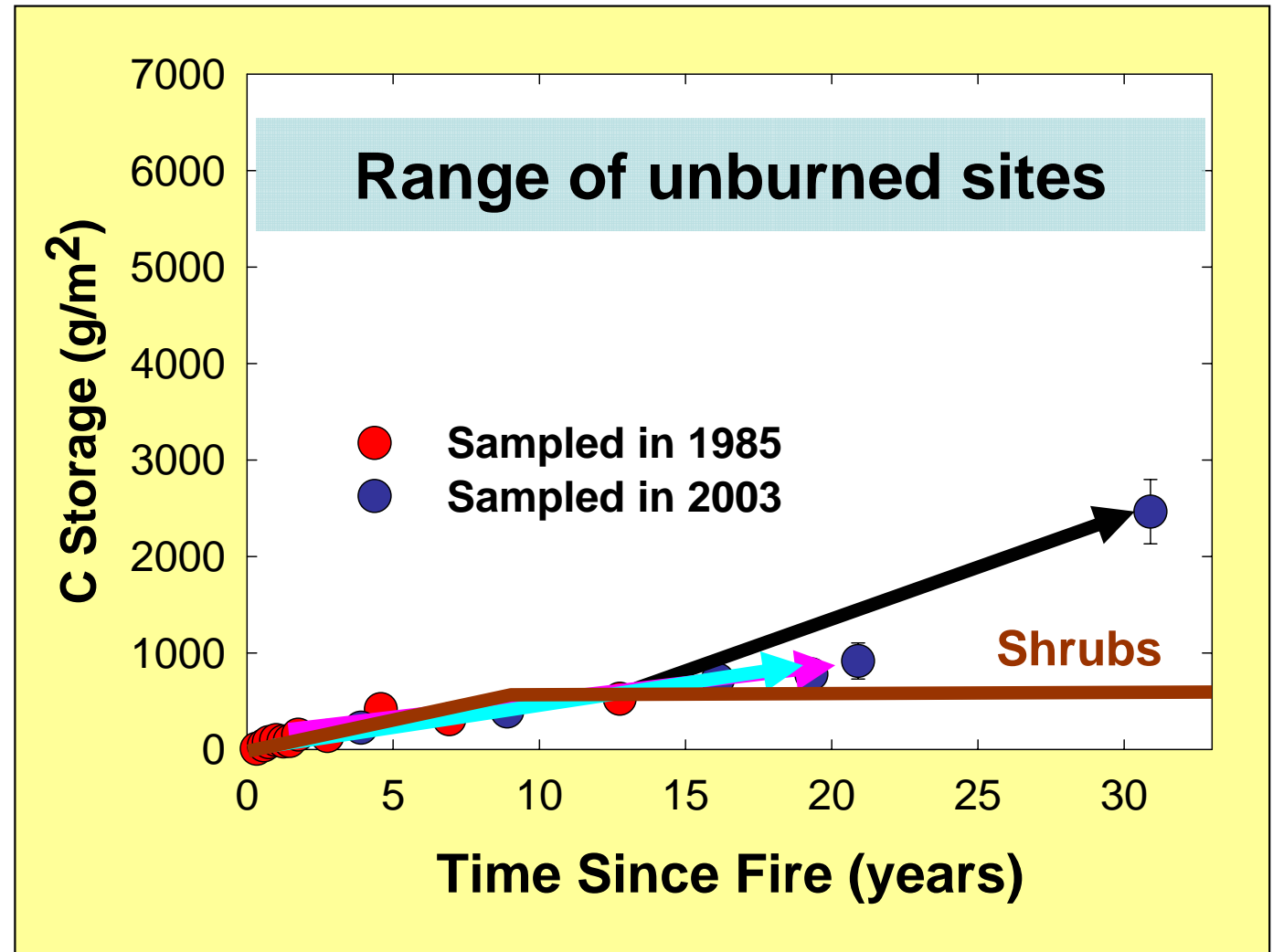
Seven C pools measured

1. Trees
 2. Shrubs
 3. Herbs
 4. Oi + Oe Layer: (LF)
 5. Oa layer: (H)
 6. Mineral soil 0 to 5 cm
 7. Mineral soil 5 to 10 cm
- Plant C**
- Soil C**
- No change**
-
- The diagram illustrates seven carbon pools measured, grouped into two categories: Plant C and Soil C. A 'No change' label points to the 5-10 cm mineral soil pool.
- Plant C** (Pools 1-3):
 - 1. Trees
 - 2. Shrubs
 - 3. Herbs
 - Soil C** (Pools 4-7):
 - 4. Oi + Oe Layer: (LF)
 - 5. Oa layer: (H)
 - 6. Mineral soil 0 to 5 cm
 - 7. Mineral soil 5 to 10 cm
- No change** (points to Pool 7)

Plant C accumulates - slowly

Native shrubs
have limited C
storage potential

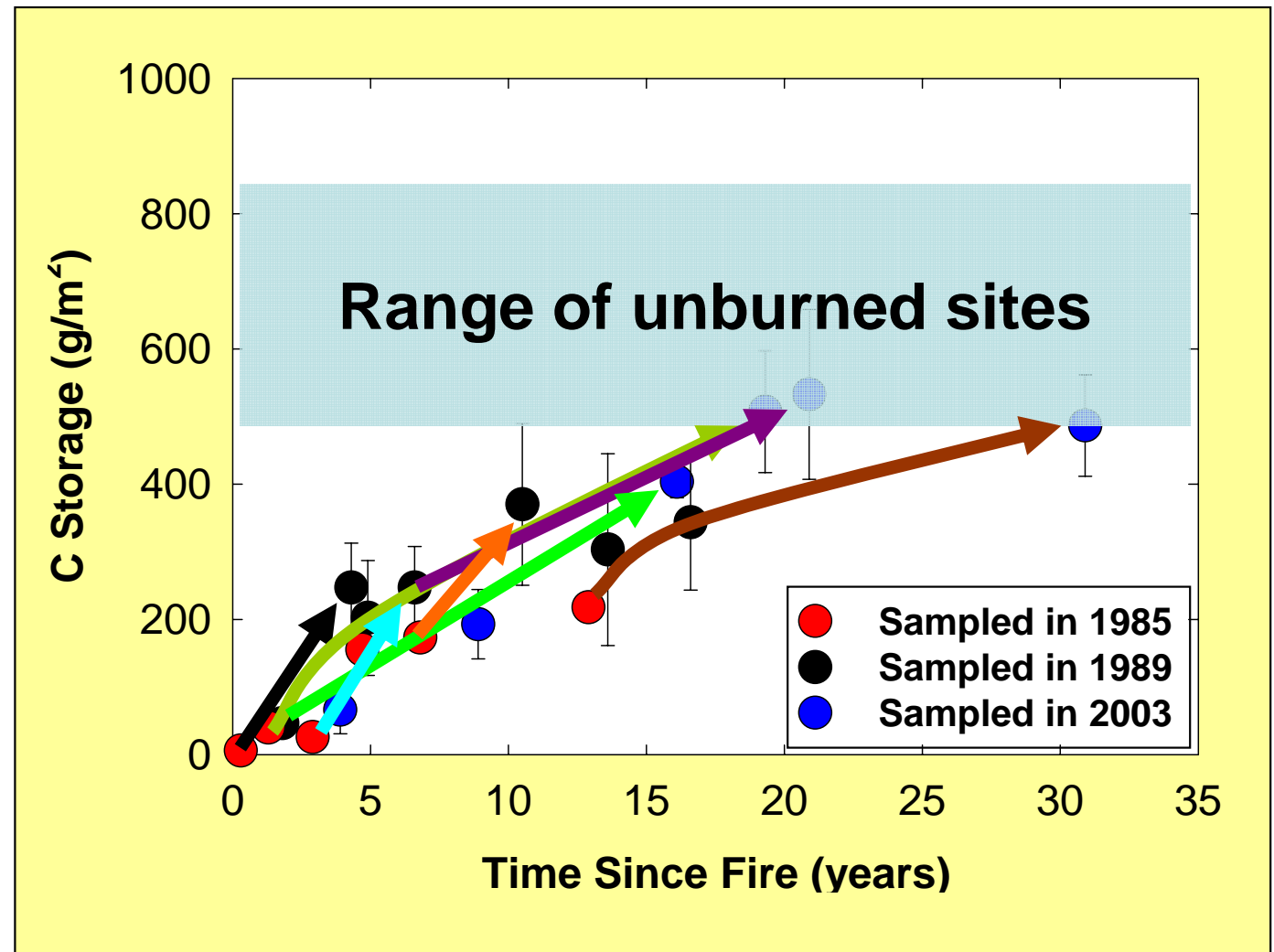
Pines increase
storage 10x



How does C storage change? – **Organic soil horizons**

Oe + Oi Layer

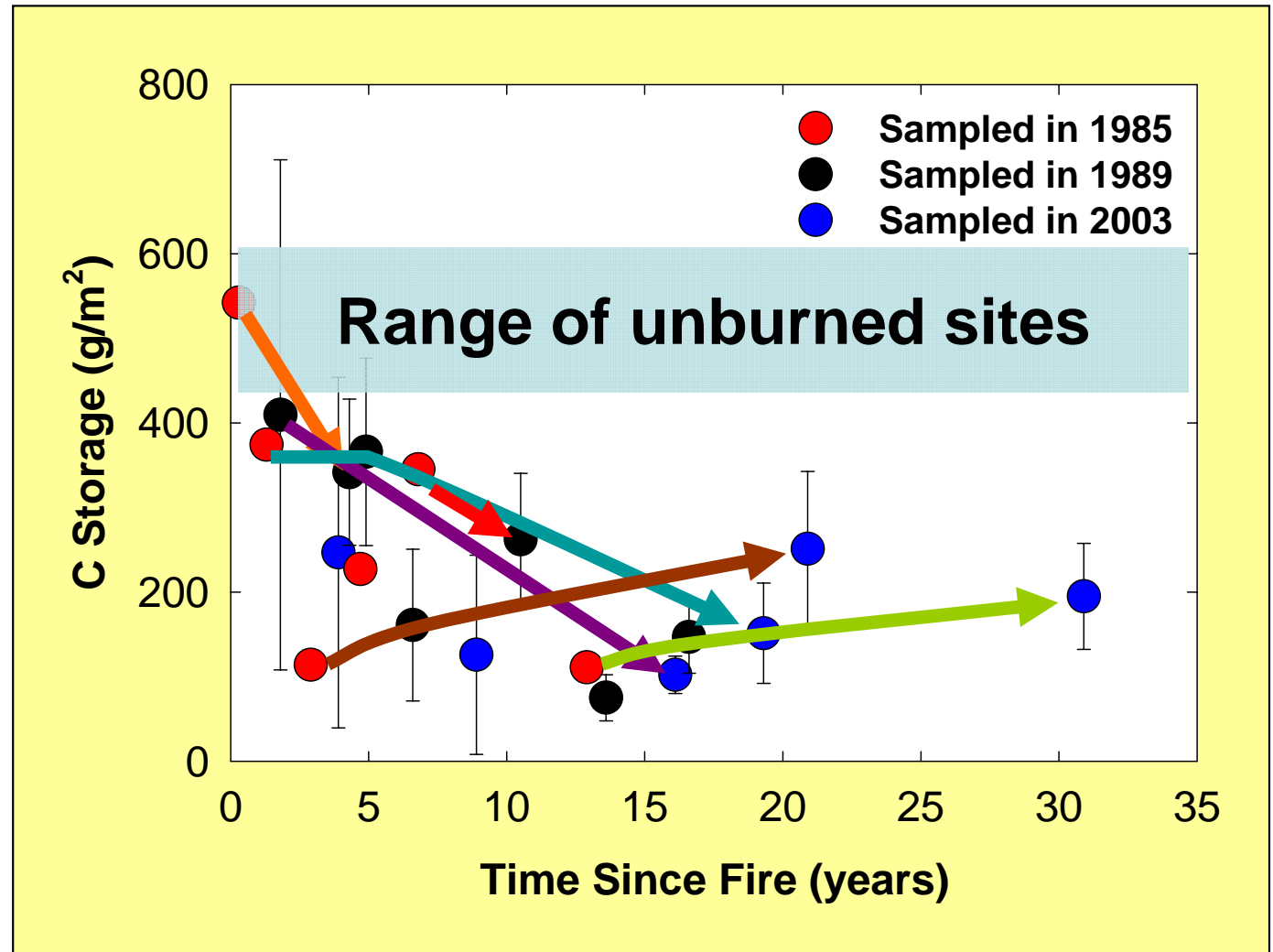
A very predictable
small
accumulation
~ 600 g/m²



How does C storage change? – **Organic soil horizons**

Oa layer

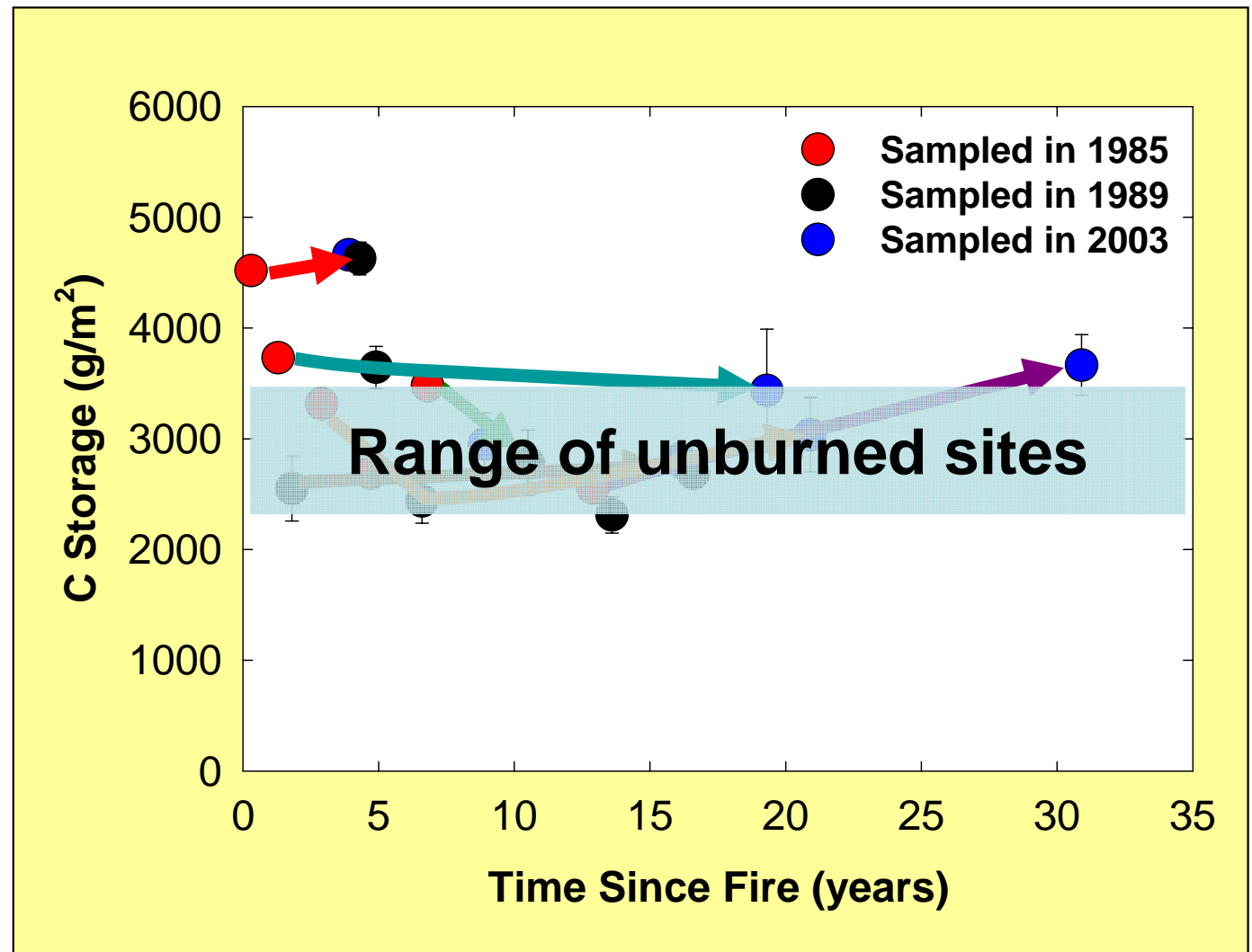
A small loss with
high variance
~300 g/m²



How does C storage change? – **Mineral Soil**

Surface Mineral Soil

A large loss with
high variance
~2000 g/m²



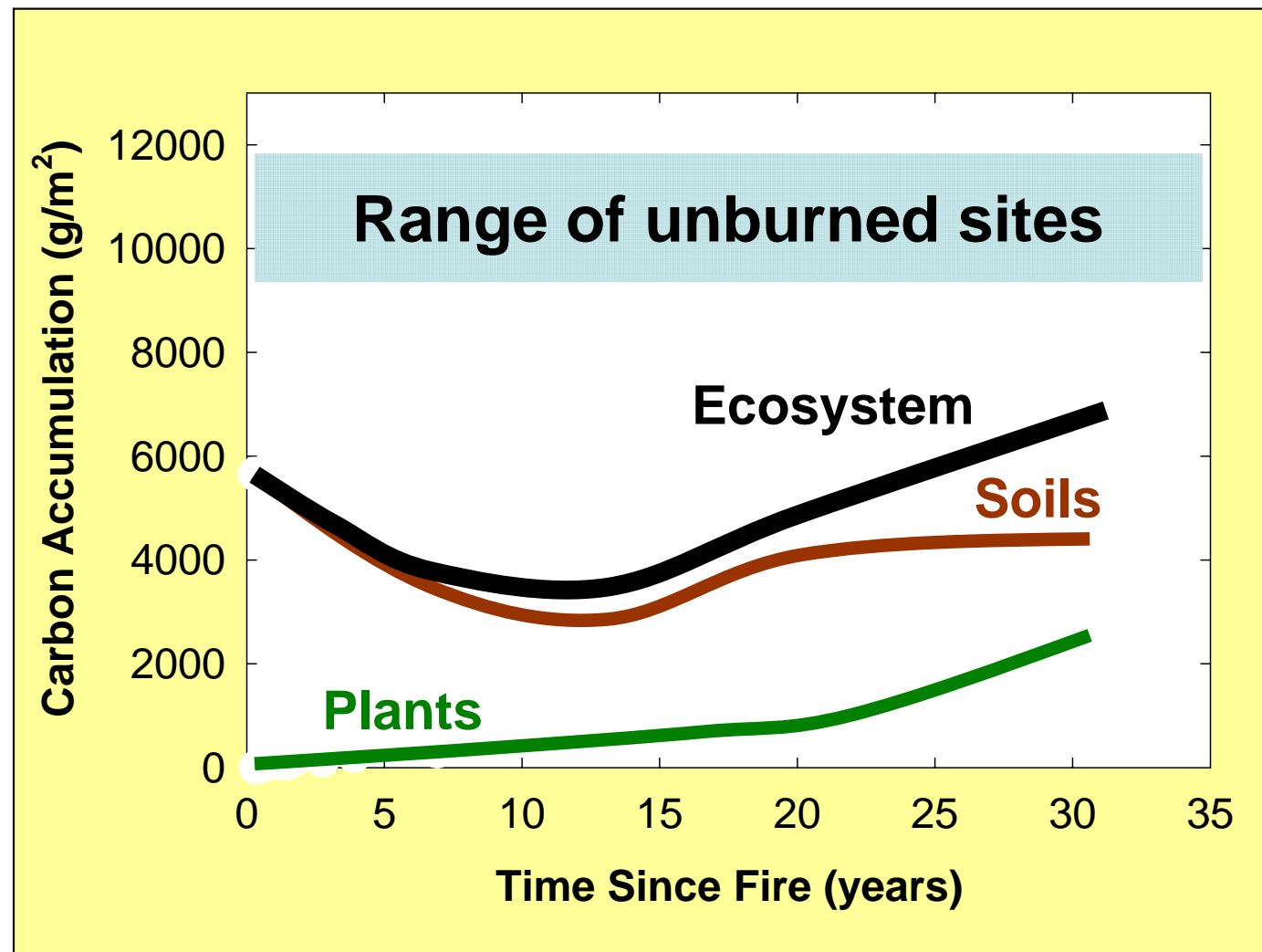
How does C storage change? – **Plants + Soils**

~5000 g/m² lost
at burning
(mostly plants)

~2000 g/m² lost
from 0-15yrs
(mostly soil)

~2000 g/m²
gained from 15
to 30 yrs

~3000 g/m² could
accumulate in the
future



Implications

- Plantations provide a Kyoto sink
- Unless they burn – then a Kyoto emission
- In eastern Spain, more fires burning a larger area than any time over the past century
- Our research provides the first step toward accurate reporting of sinks and emissions
- We also identified some interesting ecological interactions along the way.

What controls tree C accumulation?

- Pines have serotinous cones
 - Seeds viable w/in two years of fire
 - Competition with resprouting shrubs
- Reproductive maturity at 10+ years
 - Fire intervals less < 10 years = no trees
- This sets the stage for multiple stable states of C storage in plants