Carbon sequestration in agricultural soils and climate change policy in California

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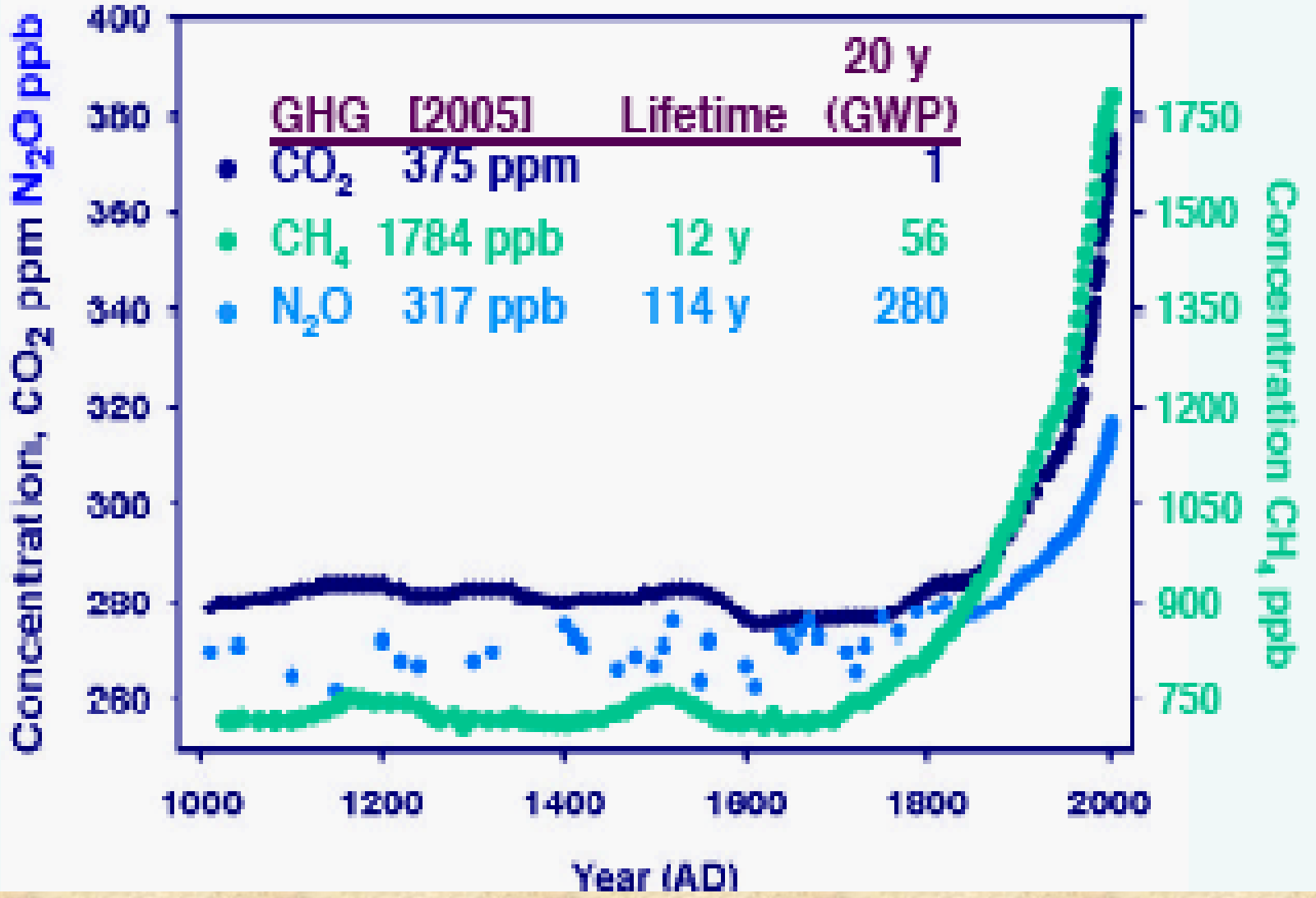
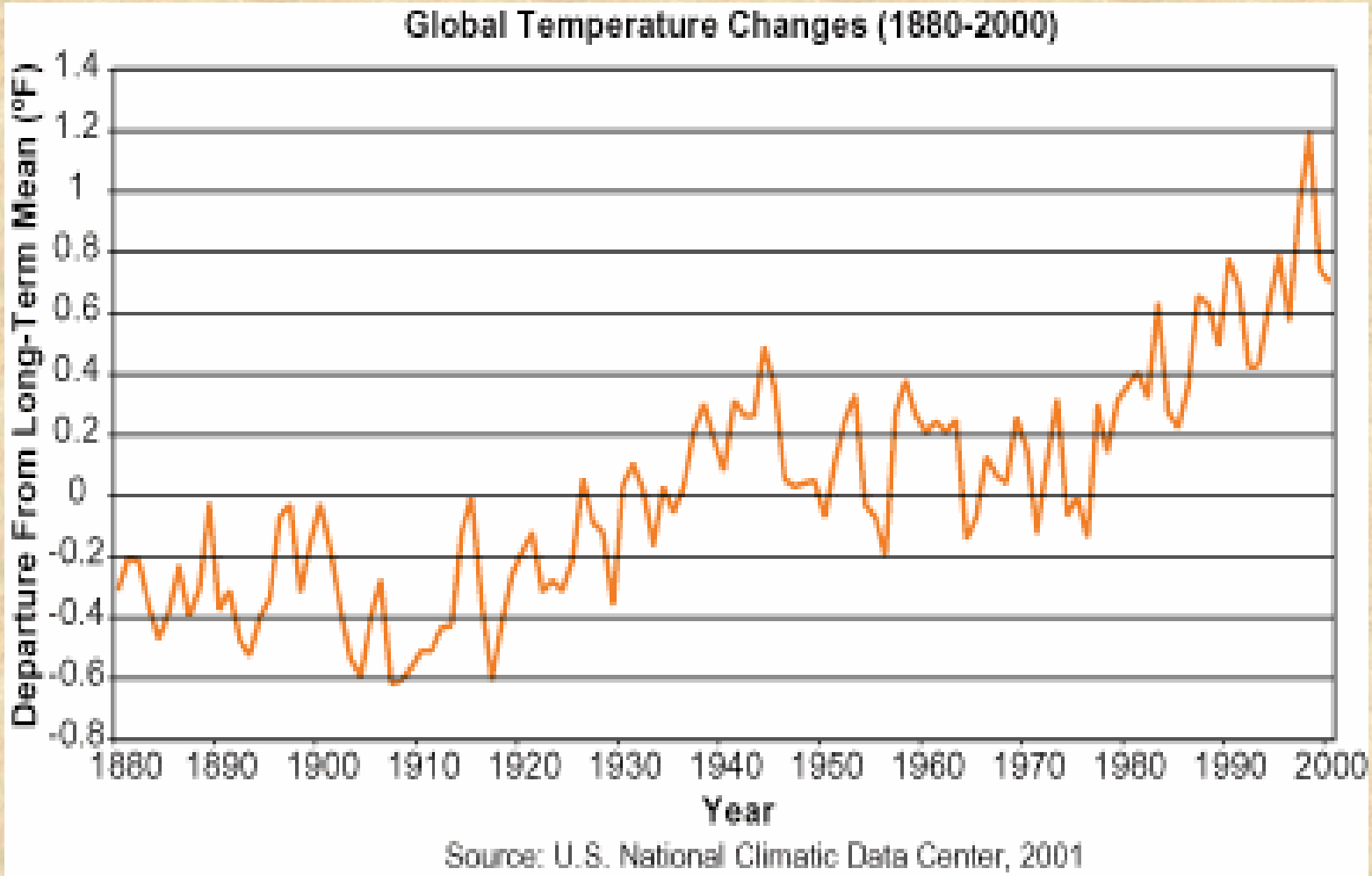
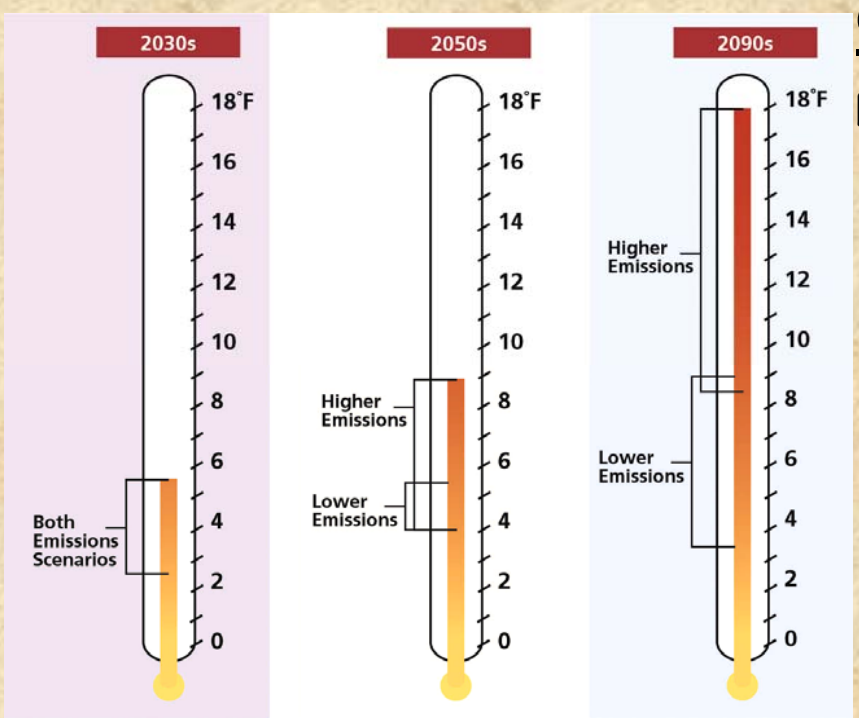
Sharp rises in greenhouse gases (GHG) over last century



Global warming: rising temperatures



California will be hit hard based on estimates of improved climate models



CA Climate Projections

by end of century

- Higher emissions yield higher summer temperatures
  - "Higher scenario" summer: + 8.5 to 18° F
  - "Lower scenario" summer: + 3.5 to 9° F
- Heat waves 2-5 times more common, more intense, and longer lasting
- Reduction of snowpack; precipitation variable
- Sea level rise 3-5" by 2050
- Threat to levees

"Emissions pathways, climate change, and impacts on California" *Hayhoe et al., Proceedings of National Academy of Science* August 2004

World's Largest GHG Emitters

		2000 Emissions (Mt CO2)	Per Capita Emissions
1.	USA	5,661	19
2.	China	2,795	02
3.	Russia	1,437	10
4.	Japan	1,186	09
5.	India	1,073	01
6.	Germany	787	10
7.	UK	569	09
8.	Canada	437	13
9.	California	430	12
10.	Italy	429	07
11.	South Korea	428	09
12.	Mexico	425	04

Sources: Oak Ridge National Lab & The Tellus Institute

CA is part of the problem but can play important role in the solution

"I say the debate is over. We know the science. We see the threat. And we know the time for action is now."

-- Governor Schwarzenegger
June 1, 2005
World Environment Day

Governor's Executive Order S-3-05 signed on June 1, 2005

- Reduce GHG emissions to 2000 levels by 2010
- Reduce GHG emissions to 1990 levels by 2020
- Reduce GHG emissions to 80% of 1990 levels by 2050
- Established the Climate Action Team led by CalEPA

- Climate Action Team
  - Lead by Secretary Loyd and Deputy Secretary Anne Baker
  - Multi-agency - ARB, PUC, RA, CalTrans, CEC (PIER), IWMB, CDF
  - Developing scenarios
  - Evaluating Cap and Trade program
  - Offsets

- Climate Action Registry
  - **Diane Wittenberg President**

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  - New forestry protocol
  - Model for agriculture?

Analysis of climate change scenarios for CA (UC, LLNL, LBL, other univ)

- Impact analyses underway of impacts of different climate scenarios on public health, water, agriculture (Cavagnaro, Jackson and Scow), forests, coast. Identification of adaptation and mitigation strategies (including C sequestration)
- Identification and analysis of various cap and trade strategies

REPORT TO GOVERNOR JAN 2006

Carbon Sequestration in agricultural soils

Potential for U.S. Agriculture to Mitigate CO2 Emissions

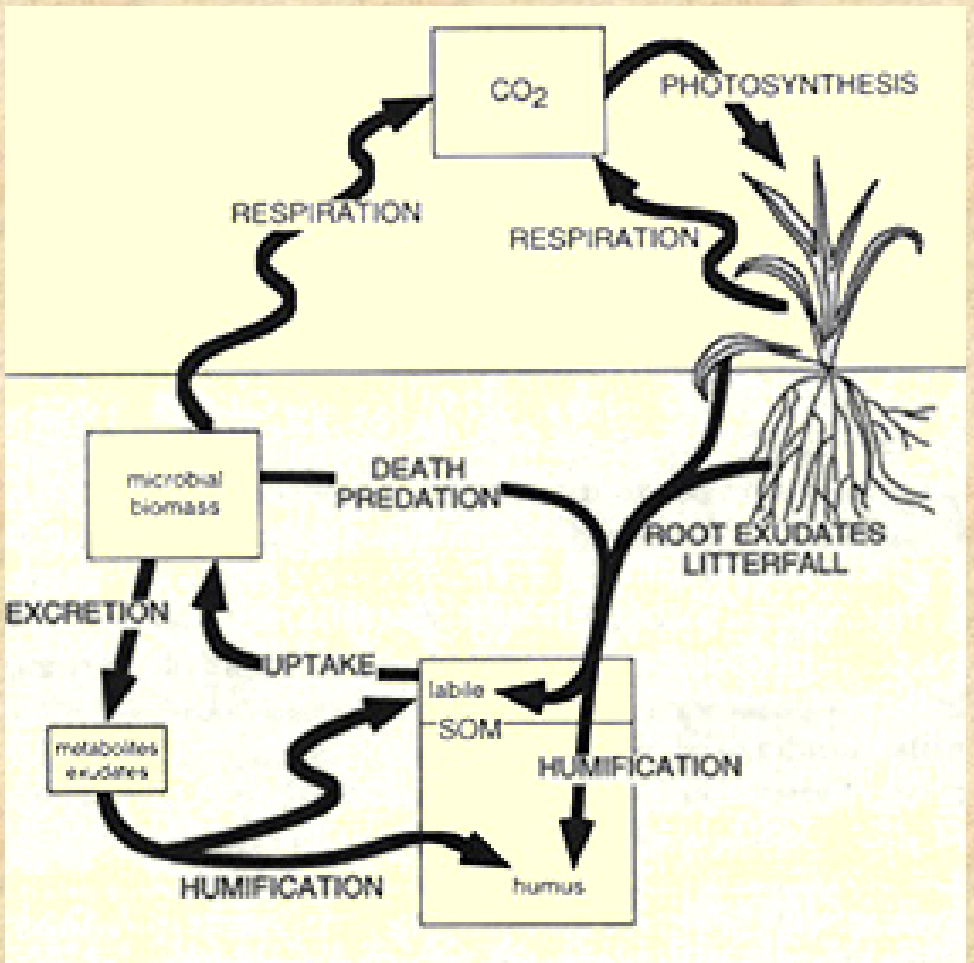
Scenario	MMTC/yr
C sequestration in cropland	132 (69-195) 8%
C sequestration in CRP	13
C sequestration in rangelands	58 (30-110) 5%
Biofuel production (C offset)	~50
Saving in fuel consumption	1-2
Reduction of C emitted from eroded sediments	~15
Total	*270*

(Lal et al., 1999, 2003)

US emissions: **~1800 MMTC/yr**

Opportunities for C sequestration in soil

- Carbon sequestration is long term storage of C in environment (soil, water, biota, rocks)



- Soils contain 75% of terrestrial C pool
- Soil C can be increased by reducing losses and increasing inputs

Estimates of potential C sequestration in US soils

75-200 Tg C in croplands (Lal et al. 1998)

30-90 Tg C in grazing lands (Follett et al. 2001)

- *Assumes widespread adoption of improved management practices.*
- *Does not account for changes in other biogenic greenhouse gases (nitrous oxide and methane) that may be by-products of management changes.*

THUS C sequestration in terrestrial ecosystems can account for about 6.4% of emissions (based on 5000 Tg C per yr in 1990).

Management-induced C sequestration in soil is only a temporary and partial solution to the greenhouse gas problem.

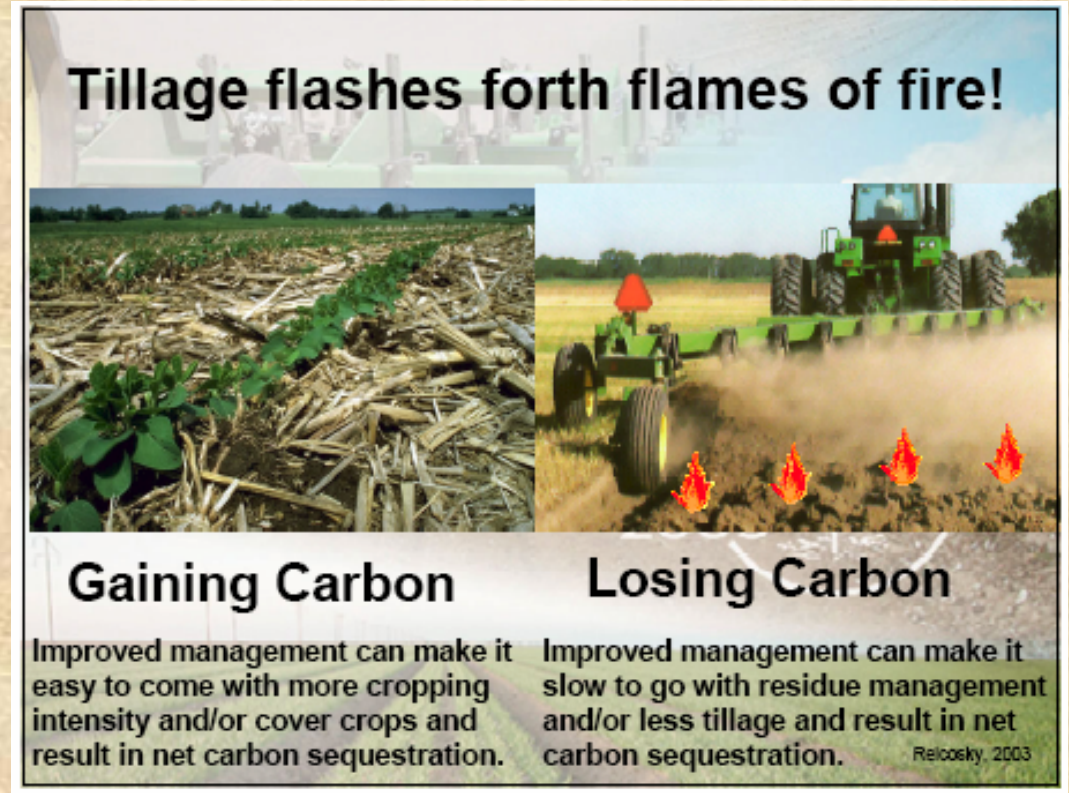
Focus on CO2 can lead to neglect of importance of other GHGs

- Global Agriculture Activity Accounts for About:
  - 5% of CO_2 emissions
    - root & soil respiration
  - 30% of CO_2 emissions (if land use change included)
    - deforestation & shifting cultivation
  - 45-60% of CH_4 emissions
    - rice cultivation
    - livestock production
    - deforestation & shifting cultivation
  - 5-70% of N_2O emissions
    - nitrogen fertilizer
    - animal wastes
    - deforestation & shifting cultivation

Can be important trade-offs between C sequest. and release of other GHGs

(International Panel on Climate Change, IPCC 1997)
(Mosier et al. 1998 *Nut. Cycling Agroecosystems* 52:225)

Opportunities for Offsetting Greenhouse Gas Emissions



Croplands . . .

- Less tillage
- Increase crop intensity, reduce fallow
- Use of cover crops
- Fertility and water management
- High biomass crops

Animal Agriculture. . .

- Improved feed and forage
- Methane capture

Rangeland or Pasture . . .

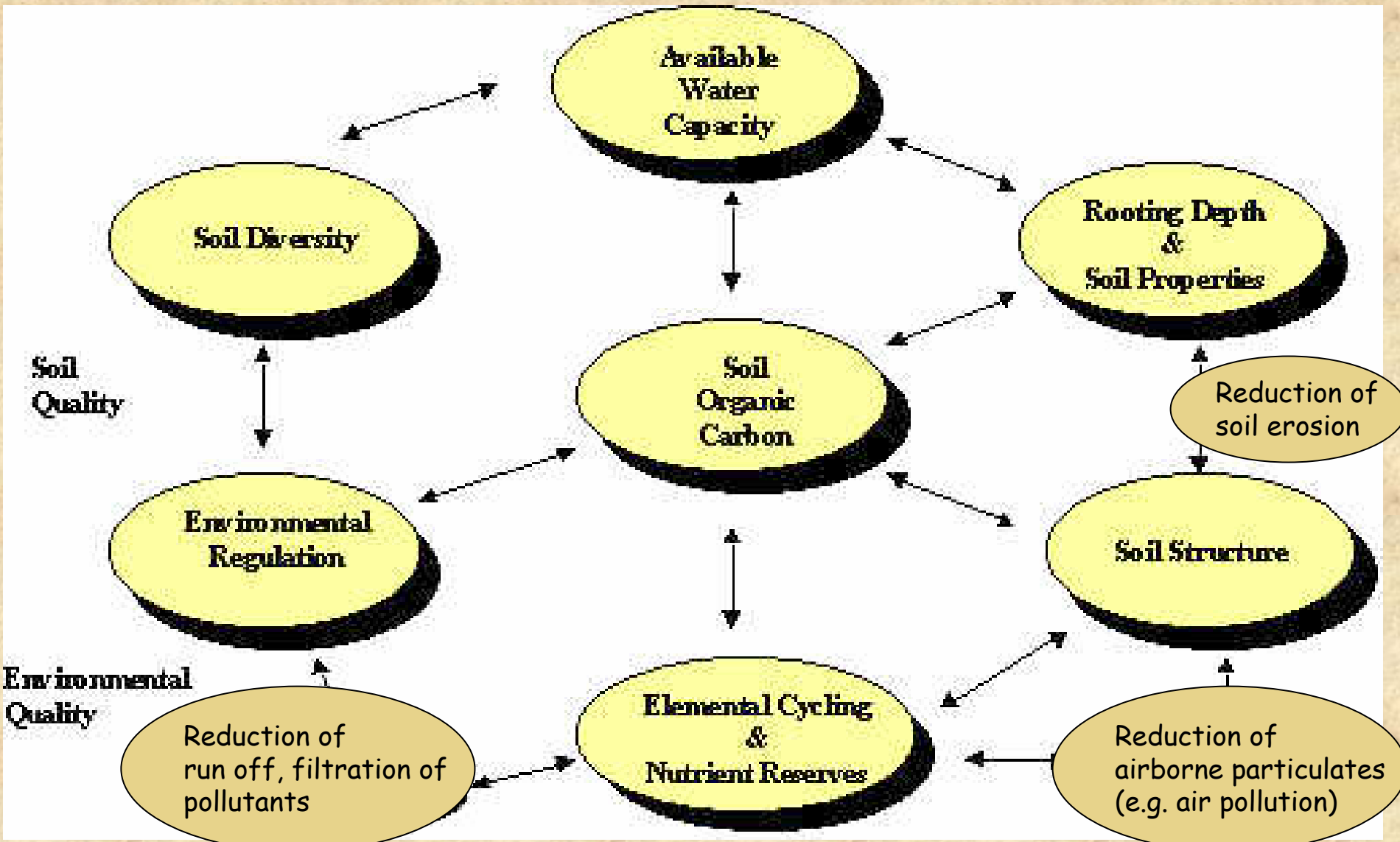
- Management of marginal lands
- Adding legumes
- Improved grazing management
- Fertility and water management

Take Action Against Global Warming, Retire GHG Emission Reductions

Click here to enter the site or choose a link below.

- Who We Are
- Taking Action
- Where Does the Money Go
- Where Do Our ERCs Come From
- Calculate Your Emissions
- Buy Some GHG Emission Reductions
- Check-out Our Online Registry

SOIL CARBON HAS MANY OTHER (often unrecognized) ECOSYSTEM SERVICE BENEFITS



Research Areas

Technical strategies to increase soil C and reduce GHGs

- Where can it work and how much can be sequestered?
- How to manage, maintain, monitor?
- Interaction with irrigation, soil type,environmental factors, microbial communities
- Trade offs with other demands/restrictions

- Inventory of C stocks
- Models for management and decision making
- Developing market, managing risk