





### **CT Pedosphere**

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... soil resource and availability

### Total land surface area of the earth: 13 Bill. ha



Forested land 3.89 Bill. ha



## **TERENO**

s out Willard Galdy Indestructed and access the Maharat and Creat Plains, although no-till agriculture has recently steruned later

osion



on tillate has left 19% of topsoil across Cantral and Eastern furipe too demaily packed to allow sufficient water and natrients to exact plant roots.

with buildings and rands has

WESTERN EUROPE

Sealing

**IRAQ** pollution During the first Gulf War, 40 million tons of Name to sell were drenched with all Experts four that soils in loss are being demand by Audi and other chemicals spilled skeing the ourient conflict.

n deservitication Dyinkage of the Arol Sea, due to diversion of water from its tributaries. Nes expressed a seabed load with furtilizers and pesticides. The tainted dot is picked up by the arted and policies families.

CHINA Desel

tion

Soil and Trouble

WHEN PEOPLE INTENSIVELY TILL FIELDS and clear-cut forests, they can damage or destroy topsoil that took centuries to accumulate. Just how vulnerable soils are depends on underlying conditions. Mismanaged soils in windswept lands can easily turn into desert, for example, and saline soils can become

This map shows the main barriers to productive farming, along with erosion risk, derived from climatic and soil conditions. Overlaid as cross-hatching are regions reported to be highly or very highly degraded according to a global survey of soil experts published in 1990. The hot spots illustrate examples of the worst soil degradation, from the most common physical type-water erosion-to chemical forms, such as that caused by pollution from industrial chemicals and war.

An interactive version of this map appears online at www.sciencemag.org/cgi/content/ summary/304/5677/1614.

SOURCES, Adapted from Major Land Resource Constraints may created April 2004 by P. Anich and P. Spranzer of USEA/HICS Set Sarvey Decears Muld Set Resources, Washington, D.C., from WSF Sail Closeste Map and Mill Sed Map of the World, TRUE CLAUDD data 3: R. Christense et al., 1997() perceided by 6. Selection 1978. Data on compaction in Gample New SCATLANSING (1981

Science. 304. 11. Juni 2004



PHYSICAL DEGRADATION A CHEMICAL DEGRADATION

> High and very high levels of soil degradation per Global Assessment of Soil Degradation (GLASOD)

Highly erodable by wind or water Few constraints



**Climate Constraints** 

High tampendams Seasonal cold Sensonally excess water Seasonal dryness Continuous cold Continuous drymess



High shrink/swell patantial

Low structural stability

Impeded damage

Shallow solls.

Minor root restricting layer

Law water holding capacity

**Physical Constraints** 

#### **Chemical Constraints**

HIMALAYAS eros

where east, and rates

are already high baca

Low organic matter High arrian exchange capacity High aluminum Calcareoux, gypeetus condition Low nutrient holding capacity Low moliture and nutrient status



High phosphorus, nitrogen, and trigenic retention tigh organic matter

which has the highest rates of water erosis

in the userial

Salinity/alkalinity

NOTE: Acid sulfate condition (0.09% of total map area) and steep lands (obscared by eension risk) are not shown.



#### salt-encrusted wastelands.





or

## Soil and water resources under pressure: biomass production for food, feed, fiber, and energy

Agrosphere Institute, Forschungszentrum Jülich









### Agriculture is based on Pedosphere

- Pedosphere interlinks all terrestrial environmental processes.
- Pedosphere is dynamic in function of time and space.
- Pedosphere is affected by climate change, landuse and land management changes.







### **CT Pedosphere & Soil Functions:**

- Nutrient Cycle
- Water Budget
- Biodiversity and Habitat
- Filtering and Buffering
- Physical Stability and Support







### **Pedosphere & Scientific Challenge:**

- Understand and control storage, filter, buffer, degradation, and inactivation functions of soils and their maintenance and optimized use in resource conserving systems.
- Process Understanding
- Management Options







#### Catchment scale (macro)









### **Pedosphere: Parameters, Instruments, Methods**

ca. 17 Parameters and 18 Instruments/Methods







#### Example: Parameters, Instruments, Methods: Characterizing C and Water fluxes at the field scale











### **Soil Organic Matter and Climate Change**

### **CT-Pedosphere aimes at regional assessments**

#### Will climate change:

- 1. Amplify SOM depletion
- 2. Exacerbate soil erosion
- 3. Alter gobal C cycle more drastically
- 4. Affect NPP through CO<sub>2</sub> fertilization effect

Will soil processes:

- **1. Have mitigative impact**
- 2. Adversely impact agronomic yield
- 3. Increase the land-based C sink
- 4. Decrease SOM pool through C-input in soil at high temperatures



after Lal, R.: Energy Environ. Sci., 2008, 1, 86-100





# Direct benefits of an increasing SOM Pool

- 1. Improves soil structure
- 2. Reduces erosion
- 3. Decreases non-point
  - source pollution
- 4. Purifies water
- 5. Denatures pollutants
- 6. Increases plant available water
- 7. Stores plant nutrients
- 8. Improves crop/biomass yield
- 9. Provides food/energy for soil biota
- **10.Buffers impact of perturbation**

on soil properties



after Lal, R.: Energy Environ. Sci., 2008, 1, 86-100





# Indirect benefits of an increasing SOM Pool

- 1. Sequesters atmospheric CO<sub>2</sub>
- 2. Enhances soil's ability to oxidize CH<sub>4</sub>
- 3. Restores degraded ecosystems
- 4. Increases soil/terrestrial biodiversity
- 5. Enhances use efficiency of water and nutrients
- 6. Improves wild life habitat
- 7. Decreases nutrient and water loss from the ecosystem
- 8. Enhances ecosystem resilience
- 9. Strengthens recycling mechanisms
- **10. Improves the environment**







# Lysimeter experiment with radiolabelled Metribuzin in Piracicaba, Brasil

(residual data shown: 25 months after the application, applied amount = 100%)



No tillage (23 years)		Conv. tillage		H <sub>3</sub> C CH <sub>3</sub>
Lysimeter L 1	% of appl.	L 3	% of appl.	H <sub>3</sub> C N N
	47.1		31.8	O‴─N∕─S─   NH₂
				Metribuzin
L 2		L 4		
	44.7		33.1	



·CH<sub>2</sub>





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## **TERENO**

# 500 L CH<sub>4</sub> per day x 1.3 Billion cows worldwide!

#### Rülps-Sauger

Um die 500 Liter Methan pro Tag, das macht dann bei geschätzten 1,3 Milliarden Kühen weltweit. . . Nun, jedenfalls sehr viel Treibhausgas, hoch wirksames Treibhausgas zumal. Methan ist in der Erdatmosphäre etwa 23-mal so klimawirksam wie das viel zitierte Kohlendioxid. Es kommt nur nicht aus Schloten und Auspuffen, sondern unter anderem aus dem Verdauungstrakt von Kühen, wo mehrere Kilogramm Mikroben daran arbeiten, die Nahrung zu zersetzen. Diesen Vorgang quittiert eine Kuh etwa alle 40 Sekunden mit einem Rülpser. Argentinische Forscher vom Nationalen Institut für Agrarforschung in der Nähe von Buenos Aires GWP: CH<sub>4</sub> is 23x times more relevant compared tod CO, Irt Rulpsund laber eine art Rülps-Staubsauger entwickelt, der die Abgase einer Kuh zum Zwecke weiterer Analysen in einem Beutel auffängt. Das 50 % of the worldwide CH<sub>4</sub> emission evolves from agriculture ben des Weltklimarats IPCC

ben des Weltklimarats IPCC die Hälfte des weltweiten Methan-Ausstoßes aus der Landwirtschaft. Foto: Reuters

