Bundesministerium für Bildung und Forschung

TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

CT Pedosphere

Peter Burauel and colleagues

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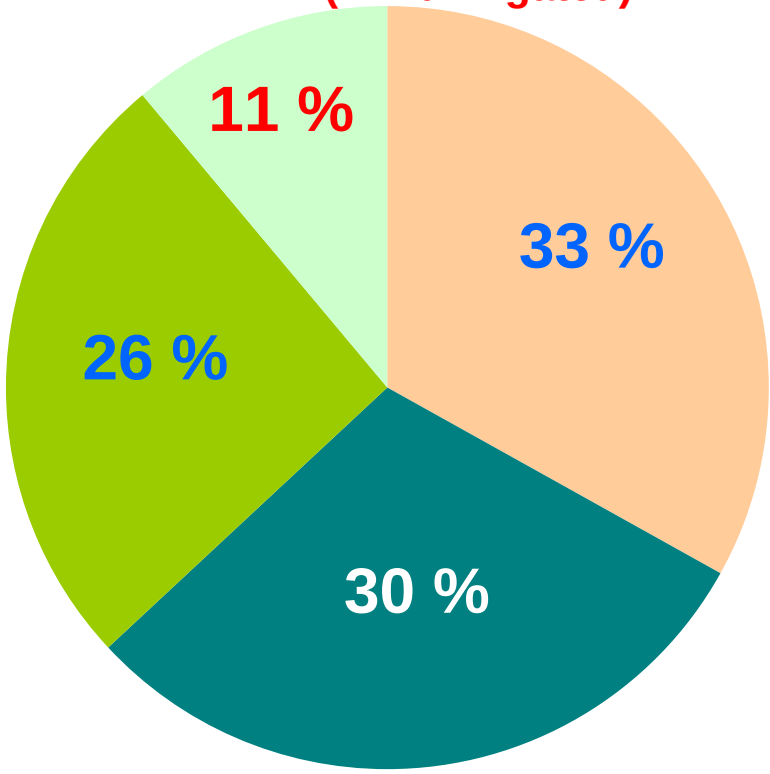
… soil resource and availability

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

Farmland
1.44 Bill. ha (17 % irrigated)



Rest including wasteland and urbanized land 4.35 Bill. ha

Permanent grassland and pasture 3.36 Bill. ha

Forested land 3.89 Bill. ha

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Science. 304. 11. Juni 2004

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or

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

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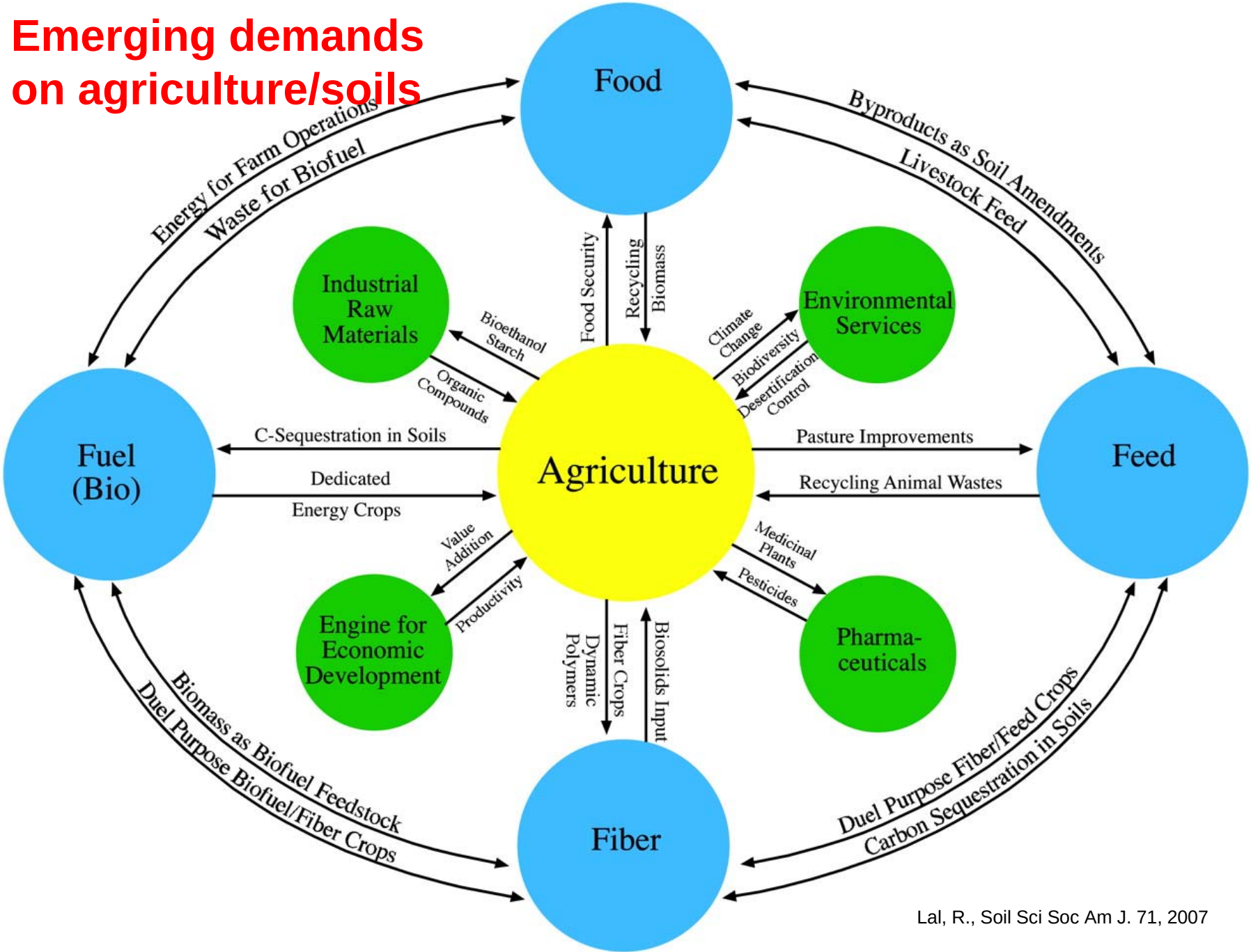
Emerging demands on agriculture/soils



Lal, R., Soil Sci Soc Am J. 71, 2007

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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.

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CT Pedosphere & Soil Functions:

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

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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**

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Catchment scale (macro)

Region

Understanding

Field

Lysimeter

Column scale

Point scale

Management

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Pedosphere: Parameters, Instruments, Methods

- **ca. 17 Parameters and 18 Instruments/Methods**

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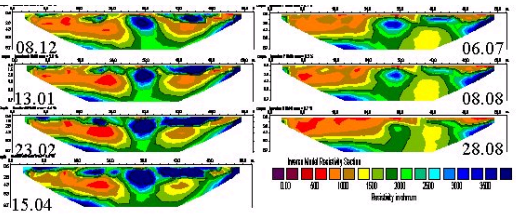
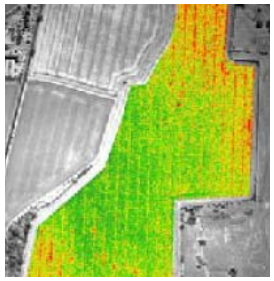
Example: Parameters, Instruments, Methods:
Characterizing C and Water fluxes at the field scale

Electrical Resistivity Tomography	L-Band Radiometry	Infrared Thermography	Eddy correlation	CO_2 efflux chambers
				
2D/3D spatial distribution of water content	spatially averaged near surface water content	spatial distribution of surface temperature	spatially averaged CO_2 and water flux	spatial distribution of local soil respiration

+ invasive methods e.g. multi-step outflow, TDR, temperature probes

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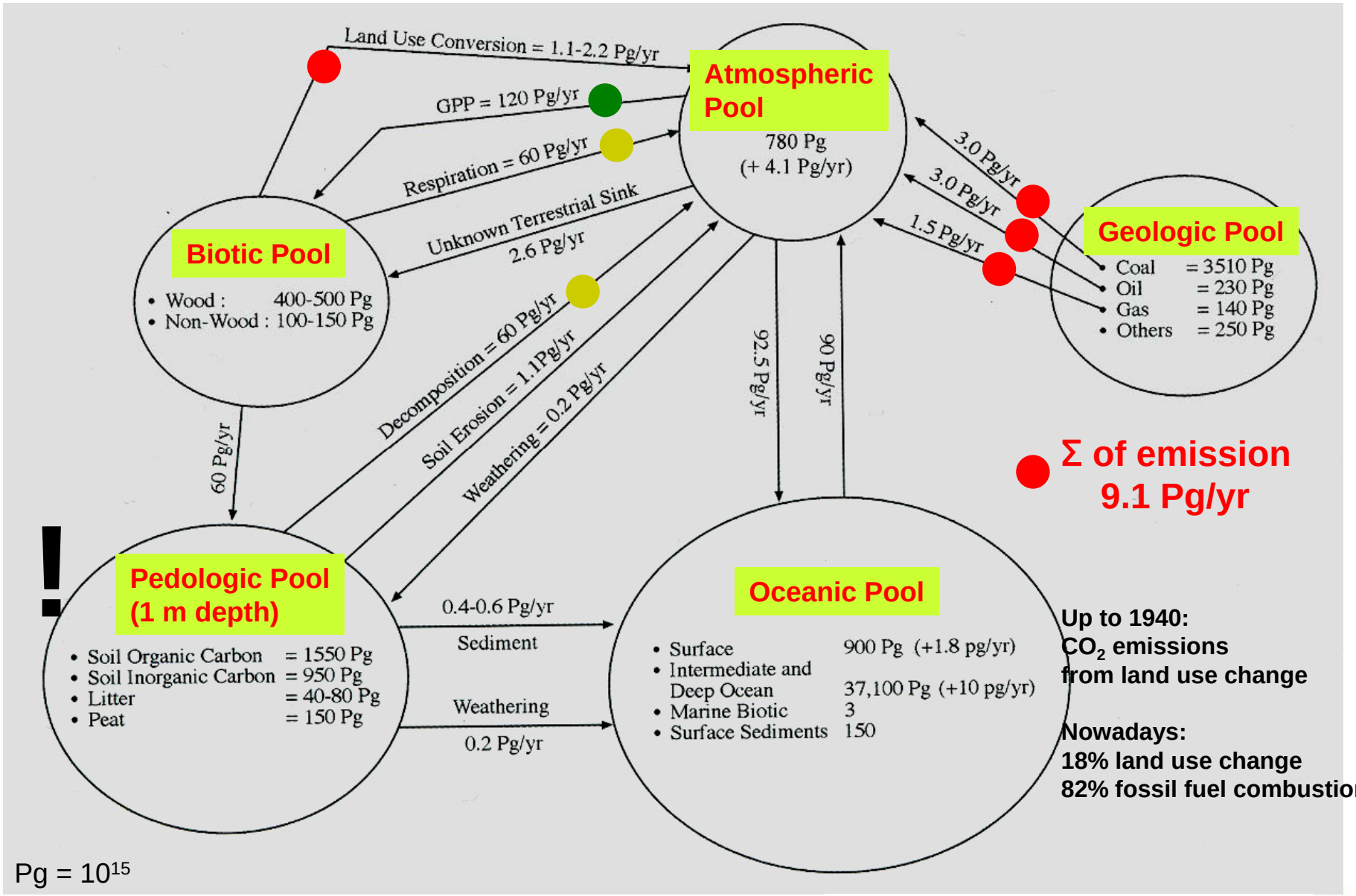
The Global C Pools



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

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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_2 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

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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

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Indirect benefits of an increasing SOM Pool

1. Sequesters atmospheric CO_2
2. Enhances soil´s ability to oxidize CH_4

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

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Think integrative!!!

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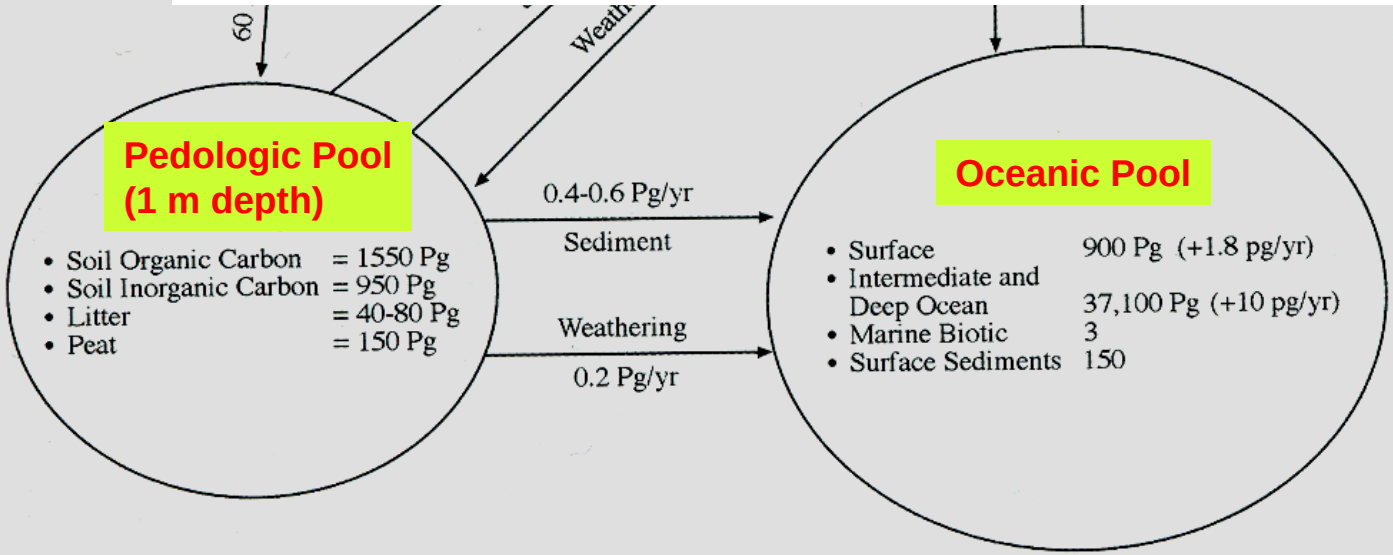
Fossil fuel emissions can be offset by 10-15% by a global increase of the C sink capacity of soils

(0.6 – 1.2 Pg per year for 25-50 years necessary!)

via restoration of degraded soils and adoption of recommended management practices e.g. conservation tillage

Hypothesis: Conservation tillage influences the fate of pesticides in soil.



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Lysimeter experiment with radiolabelled Metribuzin in Piracicaba, Brasil

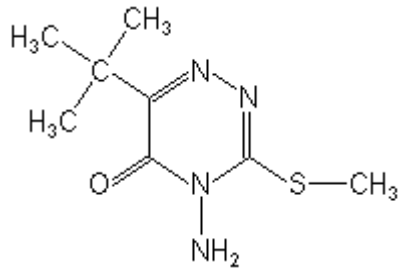
(residual data shown: 25 months after the application, applied amount = 100%)

No tillage (23 years)

Lysimeter	% of appl.
L 1	**47.1**
L 2	**44.7**

Conv. tillage

	% of appl.
L 3	**31.8**
L 4	**33.1**



Metribuzin

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Indirect benefits of an increasing SOM Pool

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2. **Enhances soil´s ability to oxidize CH_4**
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500 L CH_4 per day x 1.3 Billion cows worldwide!

SZ 07/10/08

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 sehen [illegible] Forschungsbedarf und [illegible]rt Rülps-Staubsauger entwickelt, der die Abgase einer Kuh zum Zwecke weiterer Analysen in einem Beutel auffängt. Das [illegible] ben des Weltklimarats IPCC die Hälfte des weltweiten Methan-Ausstoßes aus der Landwirtschaft. *Foto: Reuters*

GWP: CH_4 is 23x times more relevant compared to CO_2!

50 % of the worldwide CH_4 emission evolves from agriculture

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