De la Edafología a la Zona Crítica Terrestre: ¿Iniciativa Institucional o Cambio de Paradigma Científico?

Juan José Ibáñez
Centro de Investigaciones sobre Desertificación -CIDE-
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Contaminación De Suelos: Una Zona Critica Terrestre
El Soporte de la Vida Emergida

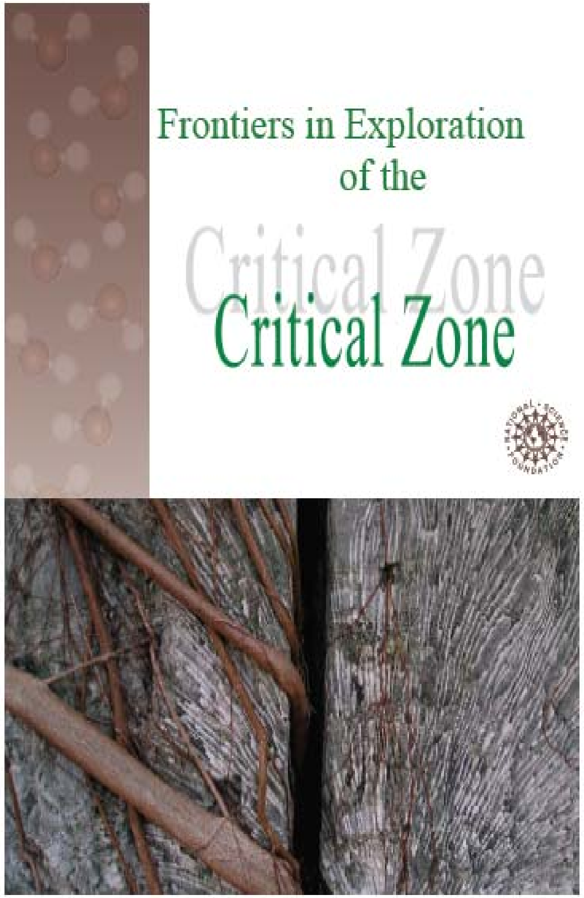
¿Pandemia Silenciosa?

Dimensiones Globales

Países Ricos

Países Emergentes

Países Pobres



Nuevos Materiales y Procesos edafogenéticos: Nueva WRB

Ciclo Hidrológico

Cambio Climático

Problemas Ambientales que Transcienden las Fronteras actuales del suelo

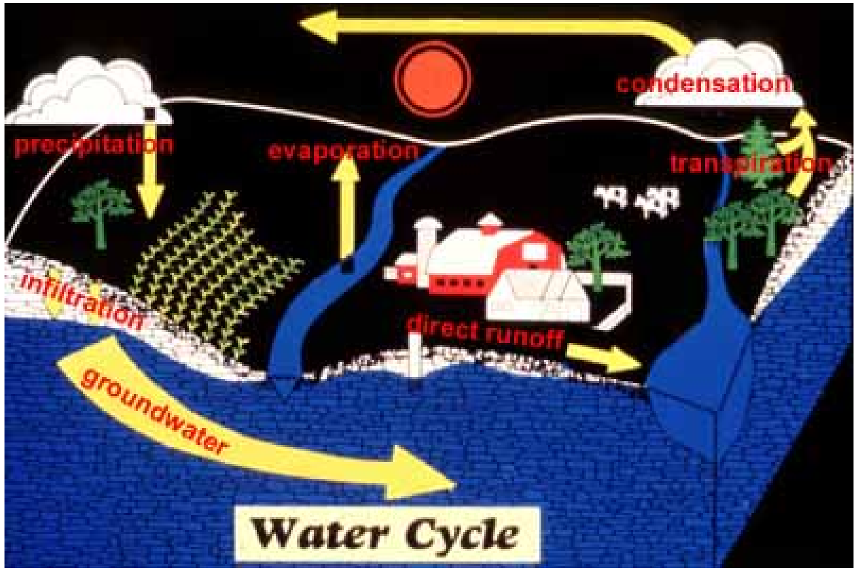
Concepto de Suelo" Más Amplio

Directiva UE Protección de Suelos

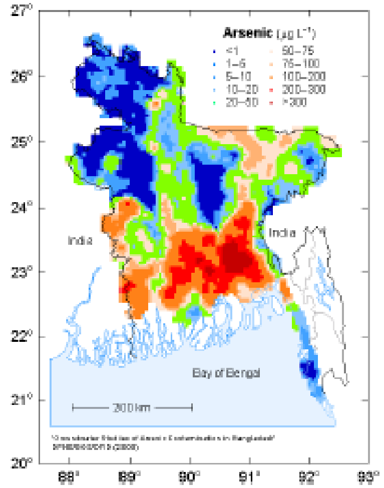
Estrategia Temática de la UE

SOIL AS A POROUS MEDIA, REGULATING THE WATER CYCLE

problem of 2m control section or soil classifications



Millions of people are affected by toxins in drinking water



Slide courtesy of Janet Hering

Photo credit: © 1999-2001 TH, MP, AT and RW
http://phys4.harvard.edu/~wilson/arsenic_project_pictures2.html

Picture credit: British Geological Survey

Paradigma Agronómico → Paradigma Ambiental

La necesidad de ampliar el concepto de: ¿Que Entendemos Como Un Suelo?

Distribución del Carbono Orgánico del Suelo a Nivel Mundial
En función de la Estructura de la Vegetación y Biomas
Fuente: ESTEBAN G. JOBBA´ GY1,3 AND ROBERT B. JACKSON1,2 (2000)

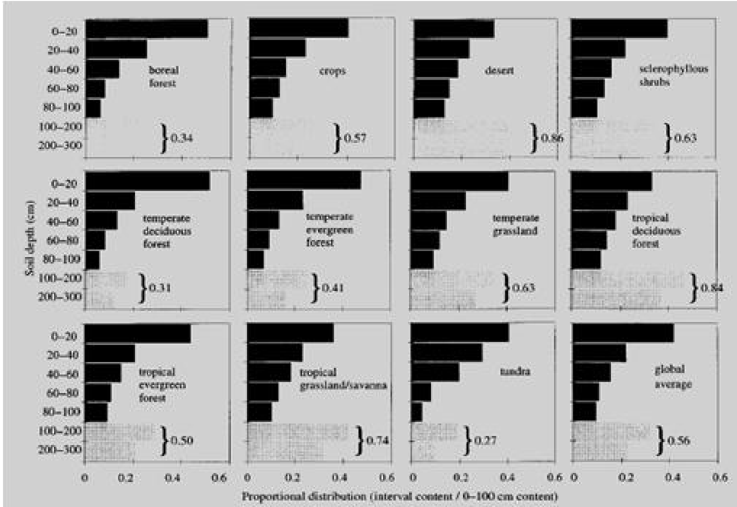


FIG. 5. Profiles of soil organic carbon distributions by biome. Black bars indicate the relative proportion of total organic carbon in the first meter of soil in 20-cm intervals (the sum of bars in the first meter is 1). Estimates were obtained by averaging proportional values for individual soils. Gray bars indicate the proportion of carbon added when the 100–200 cm and 200–300 cm intervals are considered, and the number at their right shows their combined contribution relative to the first meter. These values were obtained by averaging the extrapolations of the log–log model for each soil profile; see Table 3 for details.

Raíces: Figura de Distribución en Profundidad (Por Biomas)

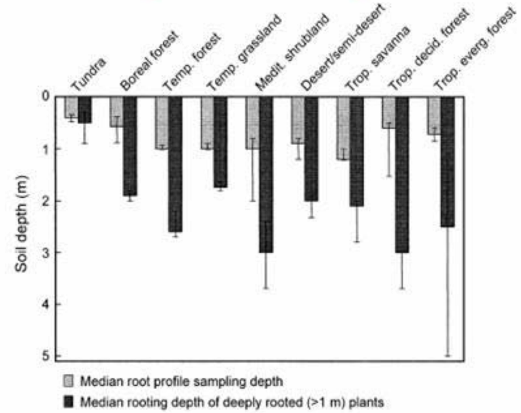
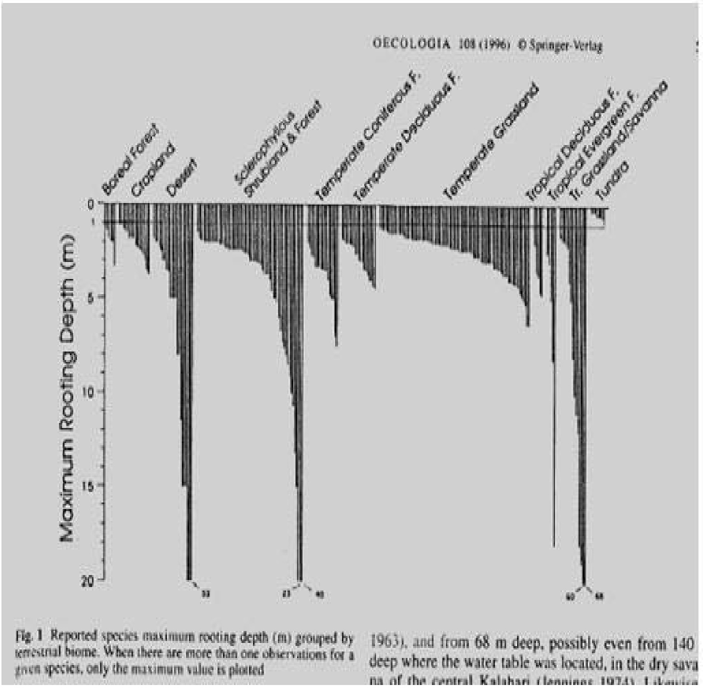


FIG. 3. Comparison between estimated rooting depths of global vegetation types and sampling depths used in quantitative studies of vertical root distributions. Rooting depths were estimated by calculating the median rooting depth of deeply rooted (≥1 m) plant species in that vegetation type from data contained in the database of Canadell et al. (1996) and Schenk and Jackson (2002). Median sampling depths were calculated from data in the global root profiles from this paper.

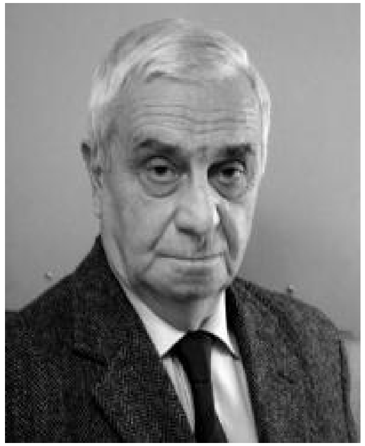
La necesidad de ampliar el concepto de: ¿que entendemos como suelo?

Raíces del Suelo: Profundidad Máxima por Biomas



Edafólogos Relacionados con la Ampliación del Concepto de Suelo





Del Suelo a la Geoderma

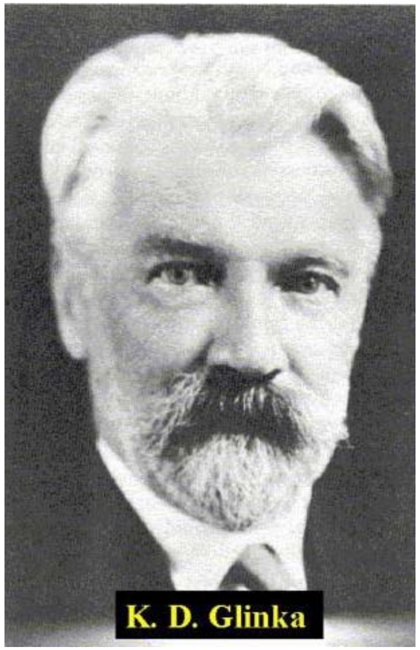
Antecedentes Bibliográficos Recientes

True Proposals to a change of Paradigm in Pedology

Tricart y Cailleux (1965) (geography)
Sánchez, 1994 (agronomy)
Yaalon 1995 (pedology)
Paton, et al 1995 (megapedology)
Ibáñez *et al.* 1994, 2001 (geoderma) Huggett 1995 (pedogeomorphology)
Phillips (pedogeomorphology)
Ollier y Pain (1996) (pedology and applied quaternary research)
Richter y Markewitz (1996) (Soil Biol)

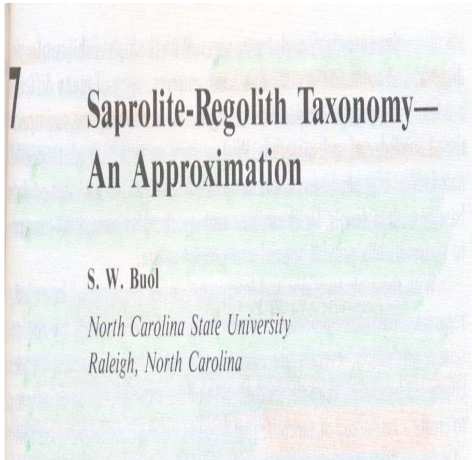
Old Championships Of the Soil-Regolith-Paradigm

- **Ramaan(1928)**
- **Glinka (1931)**



- **Cline (1961)**
- **Australian School**
- **Geoff Humphrey**

Descripción y Taxonomía de la Geoderma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Saprolite-Regolith Taxonomy—
An Approximation

S. W. Buol

North Carolina State University
Raleigh, North Carolina

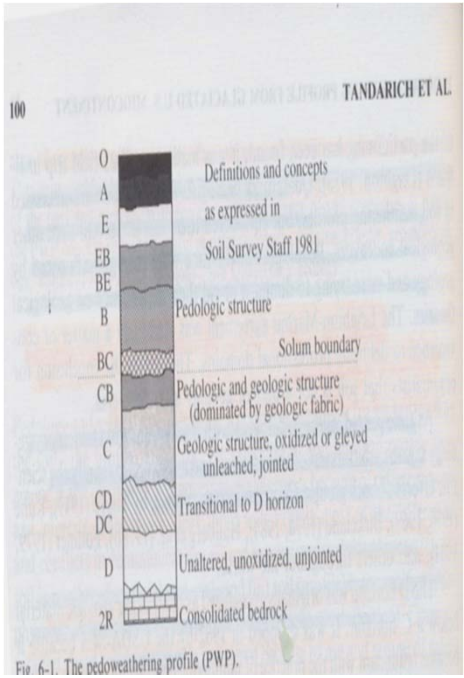
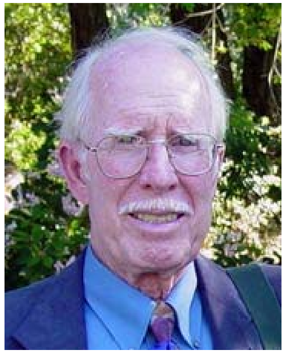


Fig. 6-1. The pedoweathering profile (PWP).

Geoderma y la Biología del Regolito



How Deep Is Soil?

Soil, the zone of the earth's crust that is biologically active, is much deeper than has been thought by many ecologists

Daniel D. Richter and Daniel Markewitz

Earth is a most remarkable planet but not only because of its prodigious life, vast oceans, and oxygen-enriched atmosphere. Earth is remarkable because of its soil.

Soil is the biologically excited layer of the earth's crust. It is an organized mixture of organic and mineral matter. Soil is created by and responsive to organisms, climate, geologic processes, and the chemistry of the aboveground atmosphere. Soil is the rooting zone for terrestrial plants and the filtration medium that influences the quality and quantity of Earth's waters. Soil supports the nearly unexplored communities of microorganisms that decompose organic matter and recirculate many of the biosphere's chemical elements. Ecologists consider soil to be the central processing unit of the earth's environment (Sanchez 1994).

One of the most significant outcomes of biological evolution has been the coevolution of soil and terrestrial ecosystems. This coevolution was initiated during the Devonian era, approximately 350 million years ago. Plants spread across upland continental regions during the explosion of life that led directly to today's soils (Algeo et al. 1995, Retallack 1992). During the Devonian, the early forest ecosystems became complex, containing large, seed-bearing trees that were deeply rooted. As ecosystems affected and were affected by an increasing depth and volume of soil, respiration from roots and microbes increased the concentration of carbon dioxide in soil atmospheres, weathering underground rocks via carbonic acid dissolution and releasing nutrients for subsequent root and microbial uptake. Although there are various perspectives on the coevolution of soil and ecosystems (Beerbauer 1985, Berner 1992, Holland 1984, Keller and Wood 1993, Schwartzman and Volk 1991), soil changes and developments such as these are called soil genesis, or pedogenesis. Some typical soils that form during soil genesis are illustrated in Figure 1.

Once soils were considered only as deep as a plow could cultivate, but analysis of biogenic processes illustrates that many soils are tens of meters deep

Scientific understanding about soil developed rapidly during the nineteenth and early twentieth centuries in Russia, western Europe, and North America. The developments of soil science were propelled by both the practical need to increase crop-plant production and the basic scientific desire to understand soil as a natural component of ecosystems (i.e., to understand soil genesis). Soil science began as the study of temperate zones, often motivated by agricultural application. Now, soil science is more global and its applications are environmental as well as agricultural. Recent decades have brought enhanced agricultural yields and a better understanding of the depth of the biota's influence zone (Creemans et al. 1994, Holland and Zbinden 1988, Nepsted et al. 1994, Sinclare and Ghiorse 1989, Stone and Kalisz 1991); widely used systems of quantitative soil classification (Buol et al. 1989, Richter and Babbar 1991, Soil Survey Staff 1992); the first soil surveys and maps of enormous regions of the tropics (Richter and Babbar 1991); and increased application of soil sciences to environmental problems such as soil and water pollution, ecosystem sustainability, and soil-atmospheric issues that involve carbon dioxide, nitrous oxide, and methane (Sanchez 1994).

Throughout the development of soil science, the concept of soil as a component of ecosystems has included increasingly deeper layers of the earth's crust. Chizhikov (1968) traced this pattern, starting in late nineteenth-century Russia when only surface accumulations of soil or-

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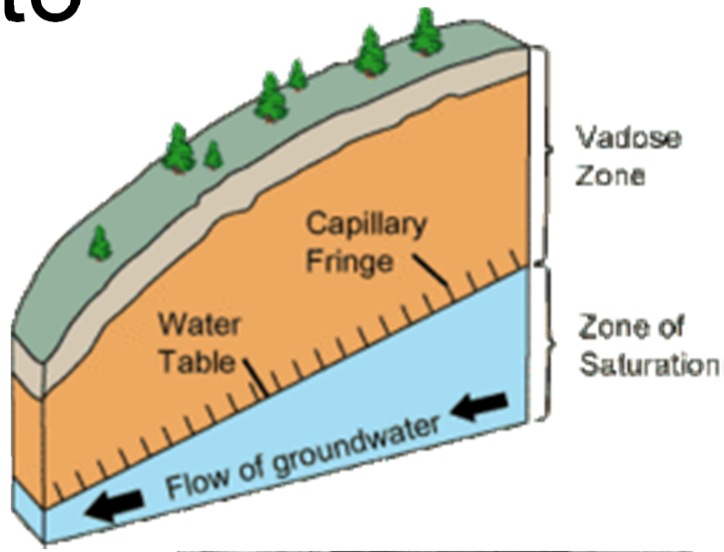
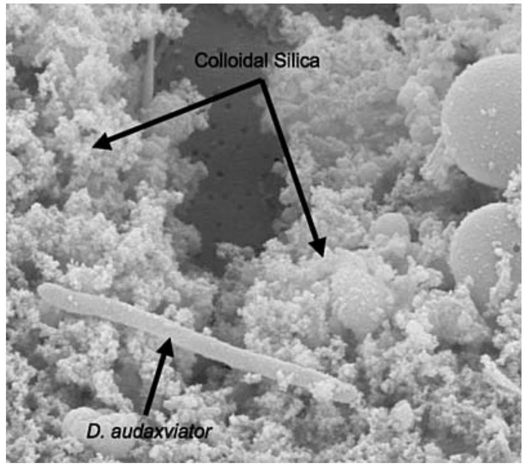
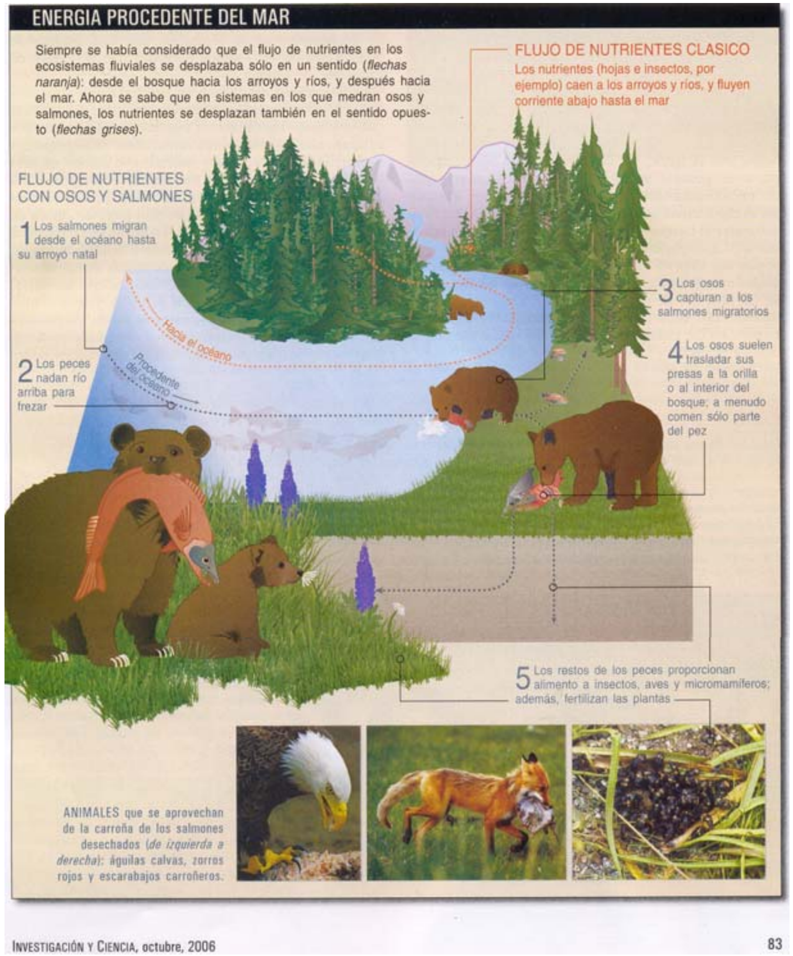
Johnson, D. L.; Lin, H.

Biomanto





Suelos y Ecología: Redes Biológicas (Cadenas Tróficas)



Fishes and the Forest

Expanding perspectives on fish–wildlife interactions

Mary F. Willson, Scott M. Gende, and Brian H. Marston

Every year, millions upon millions of anadromous fish come from the oceans to spawn in freshwater streams. In Southeast Alaska alone, these fish spawn in over 5000 streams (Halupka et al. in press). The best-known anadromous fishes on the Pacific coast are the seven species of Pacific salmon of the genus *Oncorhynchus* (including steelhead, *Oncorhynchus mykiss*, and sea-run cutthroat trout, *Oncorhynchus clarki*). Other, less-publicized and less well studied anadromous species include the chars (*Salvelinus* spp.) and smelt, such as the eulachon (*Thaleichthys pacificus*). In addition to anadromous species, several species of fully marine "forage fishes" use inter- and subtidal zones. For example, along the north Pacific coast, Pacific herring (*Clupea harengus pallasi*) spawn on rocky coastlines, and Pacific sand lance (*Ammodytes hexapterus*) can be found buried in soft sands, often near the mouths of streams.

These teeming hordes of fish fall prey not only to marine hunters, such as other fish, whales, and sea lions, but also to numerous terrestrial predators and scavengers. Historically, the predators were seen as competing with human harvesters of fish, and predator-control programs aimed at reducing the number of nonhuman consumers were a typical management tool. For example, in the first half of the twentieth century a bounty was placed on the bald eagles (*Haliaeetus leucocephalus*) in Alaska. Although this predator control program program resulted in the killing of over 100,000 eagles, its effect on fish populations was never assessed (Willson and Halupka 1995).

Mary F. Willson (e-mail: willsonm@ptialaska.net), Scott M. Gende (sgende@ptialaska.net), and Brian H. Marston are ecologists at the Forestry Sciences Laboratory, Juneau, AK 99801. They study ecological interactions in temperate rainforests.

Anadromous and inshore-spawning fishes constitute such an important prey base for terrestrial wildlife that conventional ecological dogmas need to be revised

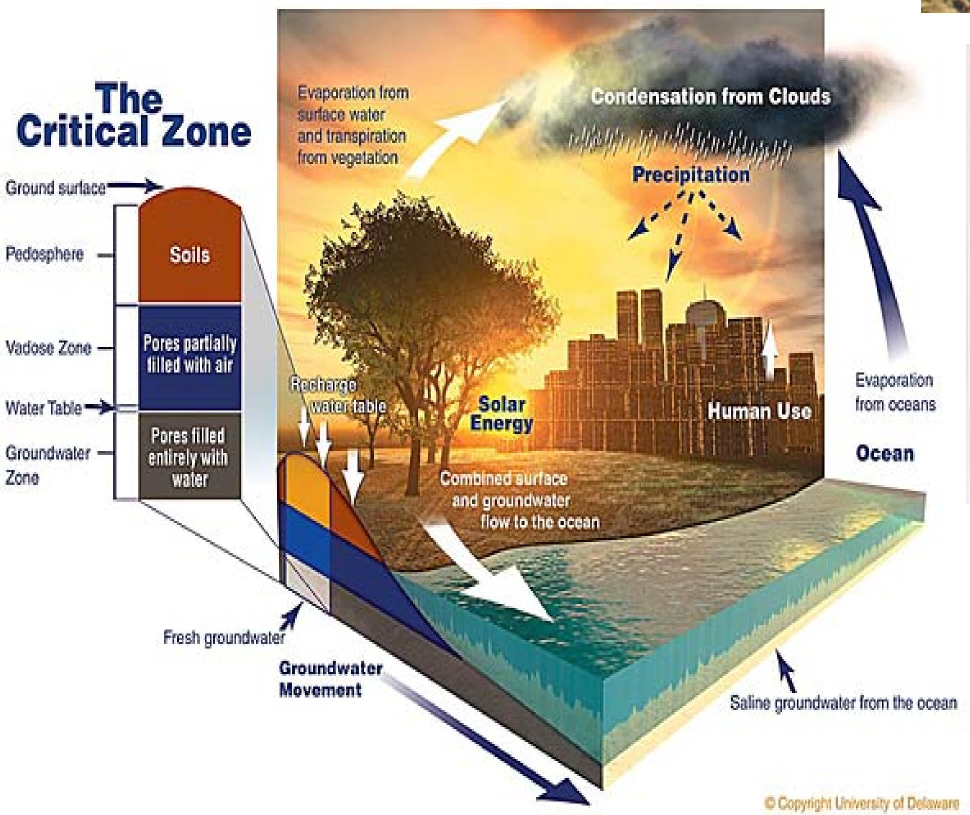
Proposals for predator control are still occasionally popular, but the view that predators simply reduce the availability of fish for humans is quite one-sided, and recent studies show that it is far too limited. Instead, the developing picture is one of critical and reciprocal interactions between aquatic and terrestrial systems. Many wildlife species, both aquatic and terrestrial, depend on fish as a food resource; population declines of many marine mammals and seabirds have been linked to diminishing populations of high-quality fish prey (e.g., Ainley et al. 1994, Merrick 1995) and to declines in prey diversity (Merrick et al. 1997).

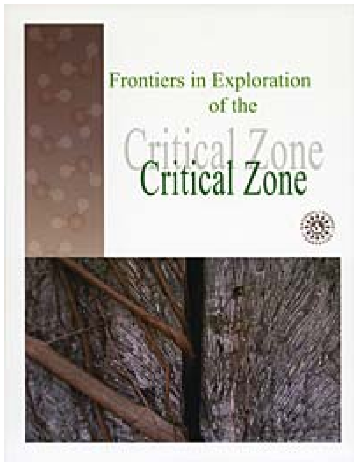
In this article, we argue that anadromous and inshore-spawning marine fish provide a rich, seasonal food resource that directly affects the biology of both aquatic and terrestrial consumers and indirectly affects the entire food web that knits the water and land together. In addition, we suggest that the presence of a seasonally abundant food resource has helped to shape the evolution of aquatic and terrestrial consumers and that predators have probably exerted reciprocal evolutionary pressures on their prey, potentially influencing the life history and morphology of these fishes. Finally, we suggest that anadromous and inshore-spawning fishes constitute such an important prey base for terrestrial wildlife that conventional ecological and management dogmas need to be revised. Interactions between anadromous fishes and wildlife have been recognized as having some general ecological importance (e.g., Brown 1982), but only recently have the ramifications of these interactions and their potential magnitude begun to be explored. Because many of the nuts and bolts of the ecological links still need to be described and quantified, we concentrate on sketching an outline of the interactions, documenting the effects where possible but also noting effects that seem probable, subject to future research.

The seasonal food resource

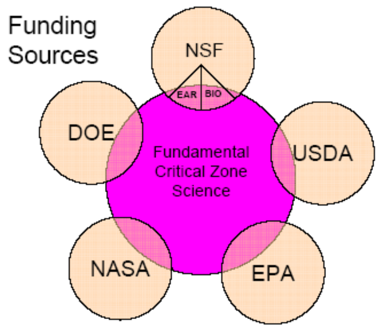
The potential number of fish returning to spawning areas along shorelines and in freshwater streams is

Zona Crítica Terrestre Suelos: Un Nuevo Paradigma

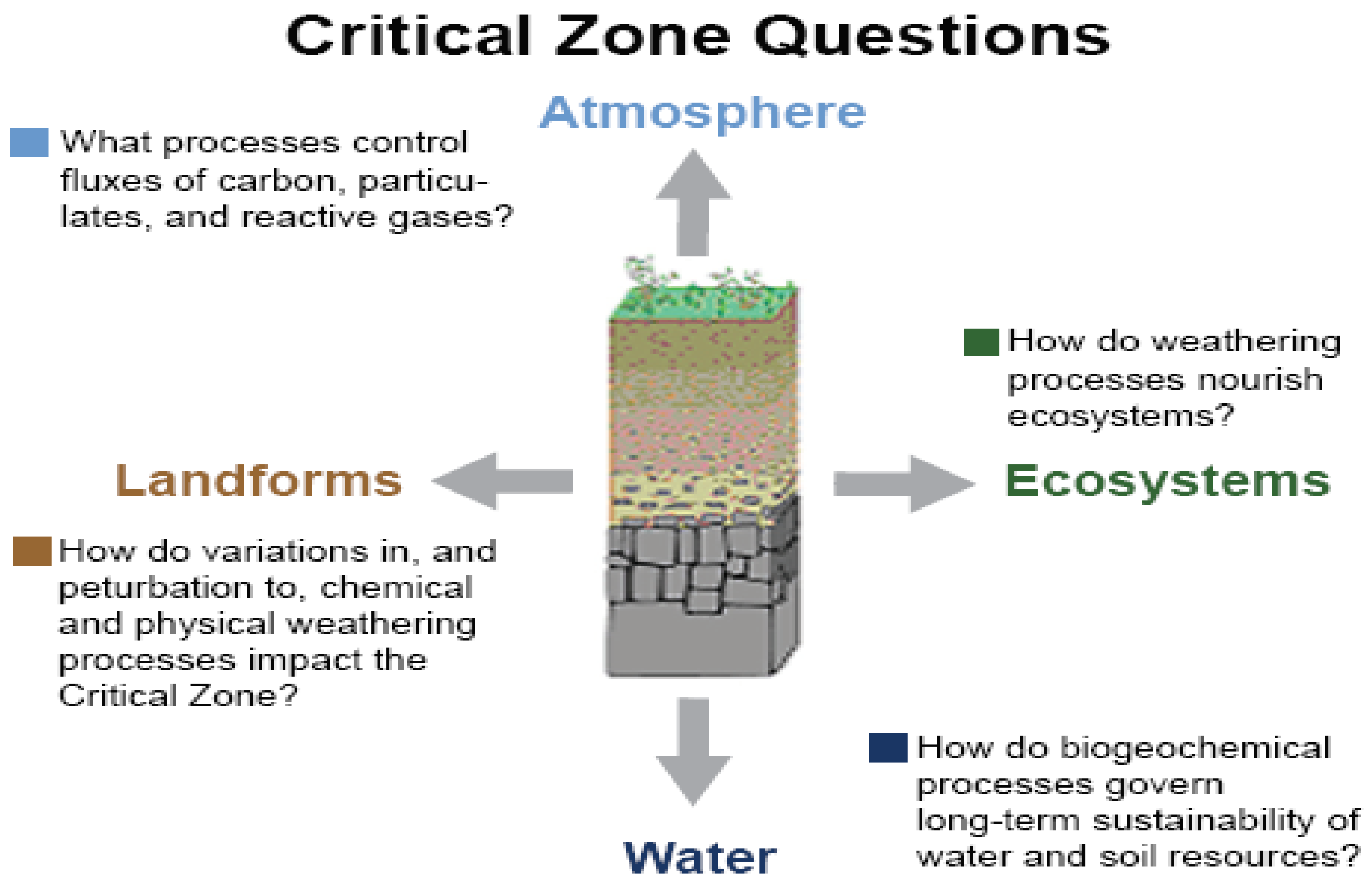




EE.UU.. Pone Toda la Carne en el asador



La Zona Crítica Terrestre: Los Cuatro Problemas a Resolver



Estructuración del Programa ECZ

- **Question 1: How are the rates of physical and chemical weathering perturbed by environmental forcing?**
- **Question 2: How do important biogeochemical processes occurring at Critical Zone interfaces govern long-term sustainability of soil and water resources?**
- **Question 3: How do processes in the Critical Zone nourish ecosystems and how do they respond to changes in external forcing?**
- **Question 4: What processes in the Critical Zone control biosphere-atmosphere exchanges of atmospherically important gases and particulates?**
- **Each question have several items and**
- **A Research Agenda**

- **Question one items**
- *What controls the thickness of the Critical Zone?*
- *What controls the vertical structure and heterogeneity of the Critical Zone?*
- *What controls the rate of chemical and physical weathering?*
- *How is weathering linked to hydrology in the Critical Zone?*
- *How is weathering linked to biology in the Critical Zone?*
- *What weathering thresholds produce irreversible changes in the Critical Zone?*
- **Research Agenda**
- *(1) develop tools to access and characterize the CZ from the surface down into bedrock*
- *(2) apply geophysical methods to profile regolith depths, densities and structures;*
- *(3) characterize hydrologic flow paths, fluid potentials, and hydraulic conductivities*
- *(4) measure exposure ages and the rates of chemical and physical processes*
- *(5) develop tools to study biophysical and biochemical processes in the CZ and particularly in bedrock*
- *(6) develop isotopic techniques to trace nutrient cycling and to distinguish between lithogenic versus biogenic sources.*

Estructuración del Programa ECZ

- **Algunos comentarios a la Primera Pregunta:**

- **Shallow soils and soil structures have been extensively characterized and classified by soil scientists. In contrast, the structure of deep soil horizons down to unweathered bedrock is generally poorly documented. Can we develop a unified approach to characterize the environmental conditions and mechanisms that produce differences in soil types and individual horizons over the full weathering or soil profile?**

- **Time and climate sequence studies demonstrate that the CZ commonly exhibits trends in composition and structure that evolve non-linearly, suggesting that irreversible processes occur that limit responses to environmental variability.**

Puntualizaciones Personales

Datos, modelos y diseños de instrumentación serán de acceso para todos los grupos participantes en el Programa

Zona Crítica Terrestre Suelos:

¿Un Nuevo Paradigma o Iniciativa Institucional?

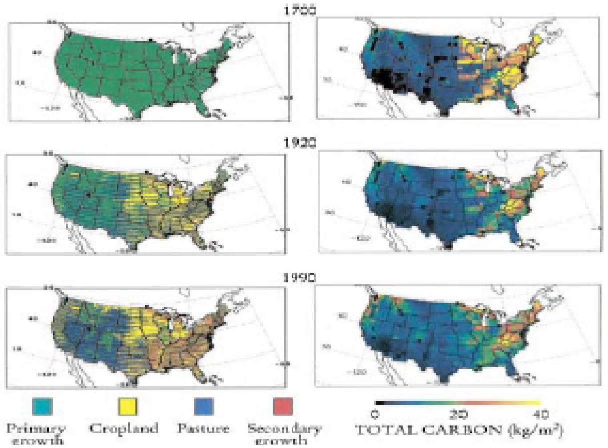
Given our growing ability to forecast weather and climate, how is it that we lack the ability to earthcast the associated changes in the "Critical Zone"?

In a nutshell, we cannot achieve this because the slow mixing rates of the surface earth allow extreme heterogeneities to develop and persist in physical fluxes, chemistry, and biology over space and time. We are not yet successful in characterizing or modeling this heterogeneity in the rock + regolith + sediment + water + air + biota system. We are more successful in modeling the homogeneous fluids of the atmosphere or ocean and earthcasts should be similarly possible. *(Hooper, Brantley, and Paola, in review, EOS 2006)*

Humans are transforming the surface of the lithosphere

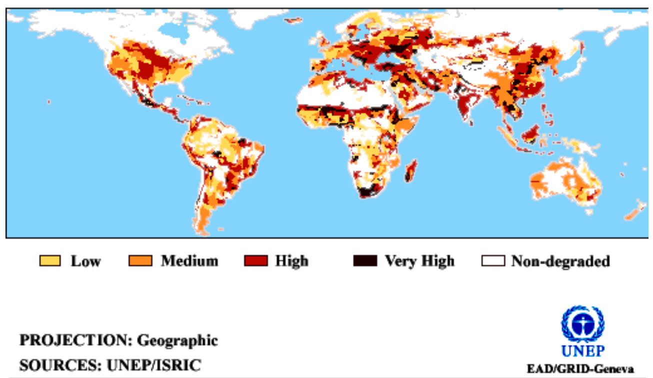
Land use change from 1700 to 1990

Green = primary vegetation, yellow = crops, blue = pasture)



U.S. land use and total carbon 1700-1990, kg/m2 (Sarmiento+Gruber, 2002)

Soil Degradation Severity



Suelos en Riesgo de Extinción
Suelo Domesticados vs. Suelos Naturales

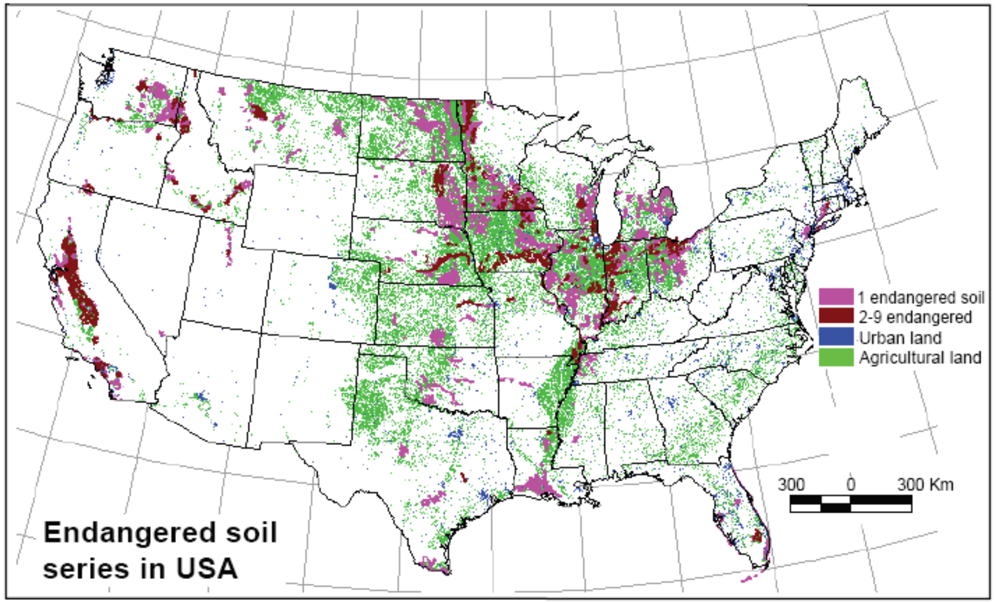


Figure 4. Top: Map showing the distribution of agriculture (green) and urban lands (blue) in the USA, and the distribution of soil types (series) that have lost 50% or more of their original area to combined human uses. Bottom: Map showing the geographical distribution of endangered soil types (series) in the USA. Endangered soils are those that naturally have a distribution of 10,000 ha or less which have lost 50% or more of their area to combined human disturbances. Figure after AMUNDSON ET AL. (2003). Reproduced with permission from Elsevier.

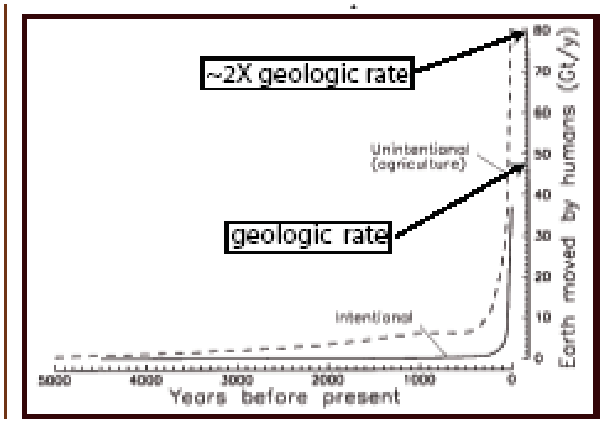
Frontiers in Exploration of the Critical Zone

An NSF-Sponsored Workshop
University of Delaware
Newark, Delaware
Monday October 24 - Wednesday October 26, 2005

Workshop Organizing Committee

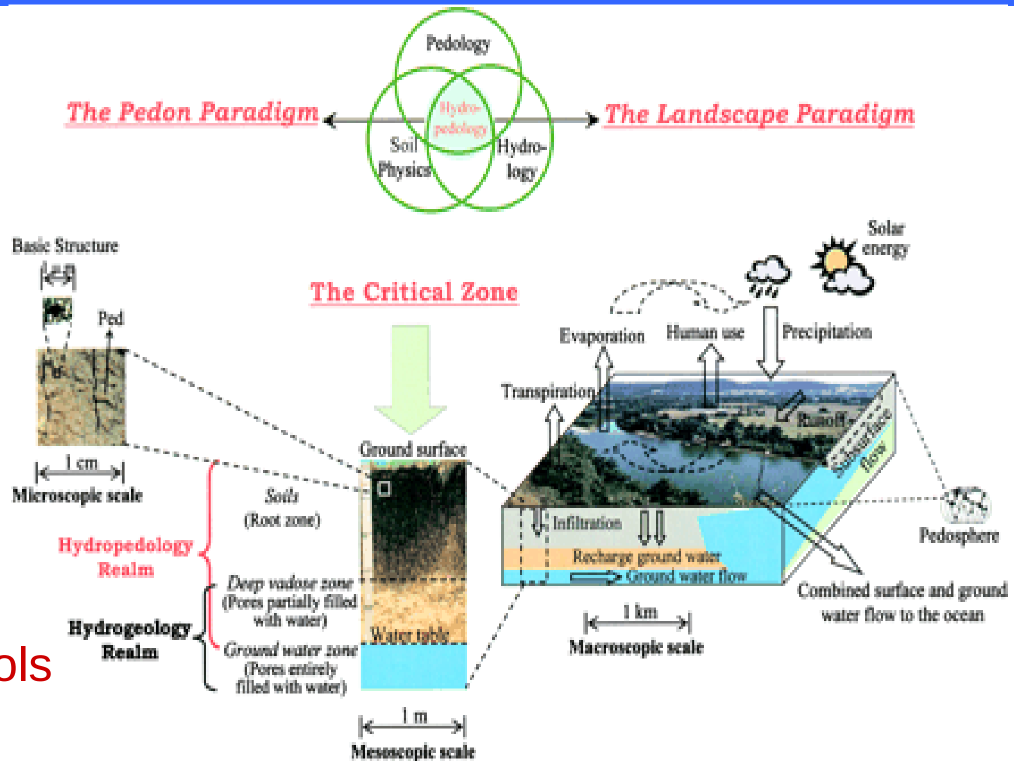
Don Sparks, Co-Chair, University of Delaware
Sue Brantley, Co-Chair, The Pennsylvania State University
Jon Chorover, The University of Arizona
Mary Firestone, University of California, Berkeley
Dan Richter, Duke University
Art White, USGS, Menlo Park

Figure 7. Estimate of the total amount of earth moved annually by humans as a function of time. Curves (from HOOKE, 2000) were calculated from earth movement per capita multiplied by population. Humans now move about 10 times more sediment as all natural processes combined..

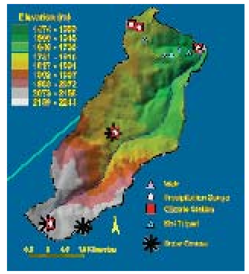


Zona Crítica Terrestre Suelos:

Un Nuevo Paradigma



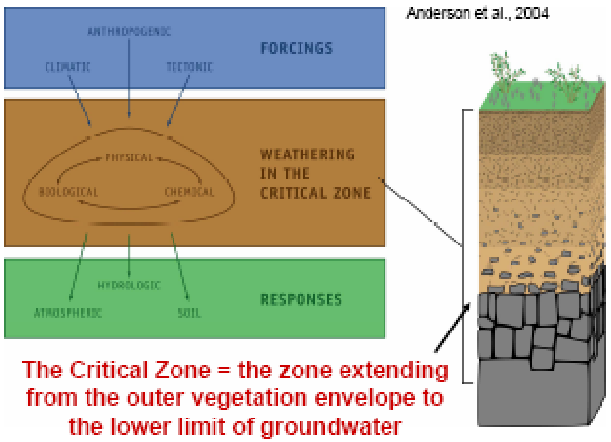
Instrumentalización de Cuencas de Drenaje

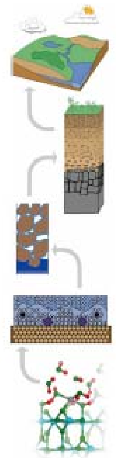


New Tools

- Cosmogenic isotopes allow dating of exposure surfaces
- New isotopes and other tracers can document biological cycling, age of comminution, rates equilibrium
- Environmental imaging tools for soil observatories
- New molecular biological techniques
- New nanoscale spectroscopies probe chemistry of mineral-soil-water-biota interface
- Environmental sensors for investigating field sites
- 3-D reactive transport and hydrologic models

Zona Crítica Terrestre Suelos: Un Nuevo Paradigma





Escalas Espaciales

Escalas Temporales →

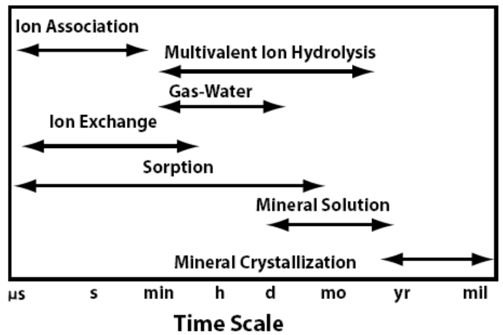


Figure 3. Like spatial scales, the timescales of water-rock interaction span over many orders of magnitude. To understand the Critical Zone will require multi-disciplinary scientists working over this vast scale of time. Figure from AMACHER (1991). Reproduced with permission from Elsevier.

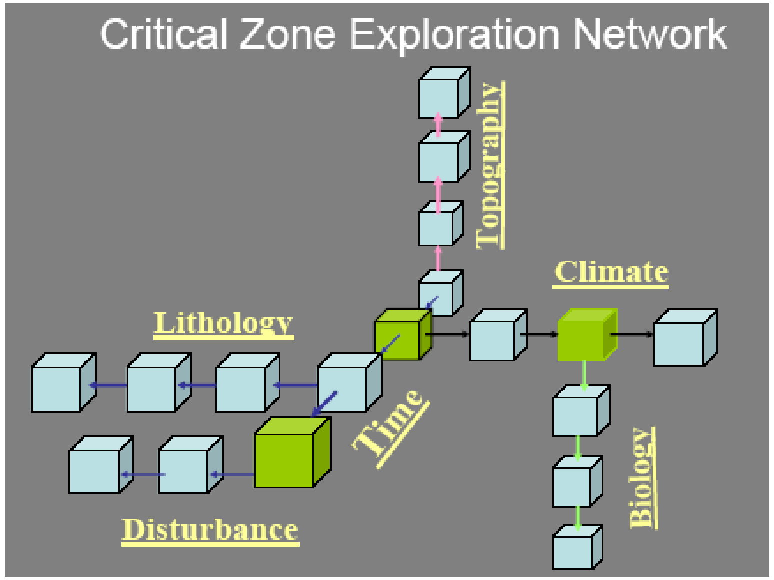
Zona Crítica Terrestre Suelos: Un Nuevo Paradigma

- *The surface of the Earth is rapidly changing, largely in response to anthropogenic perturbation. How will such change unfold, and how will it affect humankind? The Critical Zone is defined as the external terrestrial layer extending from the outer limits of vegetation down to and including the zone of groundwater. This zone sustains most terrestrial life on the planet.*

- *Despite its importance for life, scientific approaches and funding paradigms have not promoted and emphasized integrated research agendas to investigate the coupling between physical, biological, geological, and chemical processes in the Critical Zone.*

Zona Crítica Terrestre Suelos =

Suelo y Sus Factores Formadores + Investigación transdisciplinar

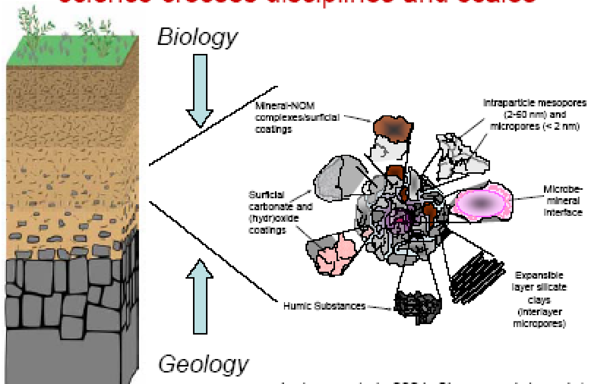


Escalas: espacio y Tiempo

Why non-integrative approaches have failed

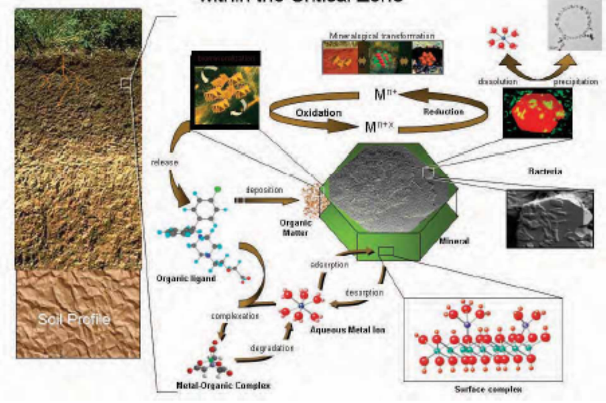
- This is not a hydrologic problem
- This is not a solid earth problem
- This is not a biological problem
- This a problem that couples hydrology, geology, geomorphology, biology, soil science, geochemistry….

The human resources challenge: critical zone science crosses disciplines and scales



Anderson et al., 2004; Chorover, J. (unpub.)

Intergraded Processes Controlling Elemental Cycling within the Critical Zone



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Suelos de Zonas Húmedas

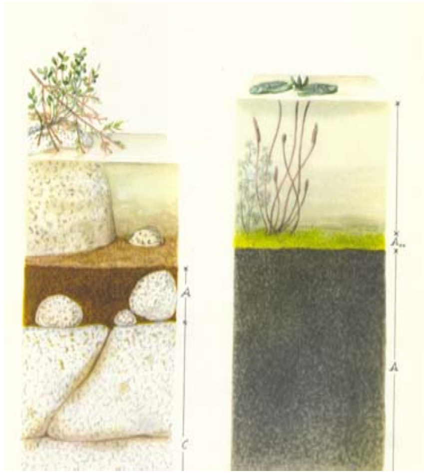
Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

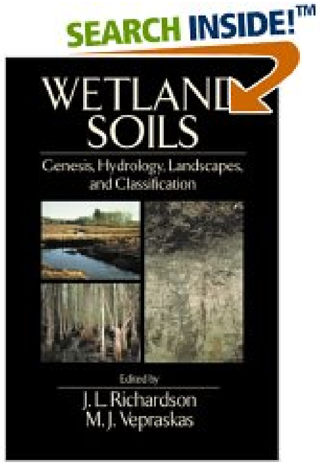
Wetlands generally include swamps, marshes, bogs, and similar areas.

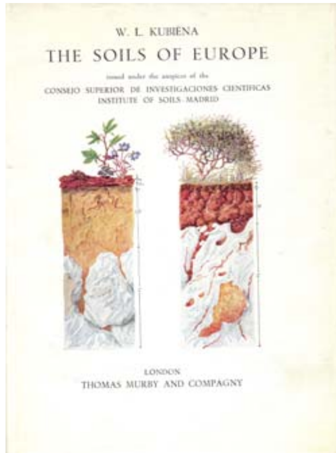
Hidroedafología: Suelos Hídricos

- *Hydric soils can be either organic or mineral soils.*
- *Organic hydric soils are commonly referred to as peat or muck. Organic soils formed in waterlogged situations, where decomposition is inhibited and plant debris slowly accumulates, are called Histosols. All histosols are hydric soils except Folists.*
- *Mineral hydric soils are those soils periodically saturated for sufficient duration to produce chemical and physical soil properties associated with a reducing or anaerobic environment. Under conditions of a fluctuating water table, mineral soils may exhibit a variety of contrasting colors within the soil profile.*
- *Mineral hydric soils are usually gray and/or mottled immediately below the surface horizon, or have thick, dark-colored surface layers overlaying gray or mottled subsurface horizons. The Munsell Soil Color Charts contain pages, called gley pages, with color chips for the gray, blue, and green colors often found in mineral hydric soils.*

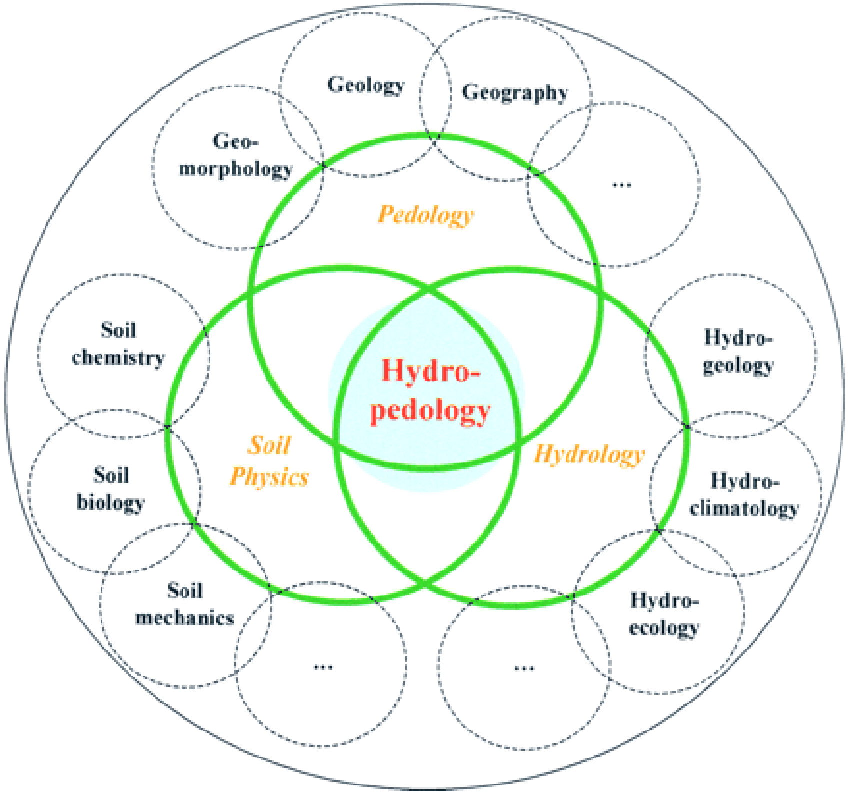
Suelos Hídricos y Su Olvidado Proponente (W. Kubiena)

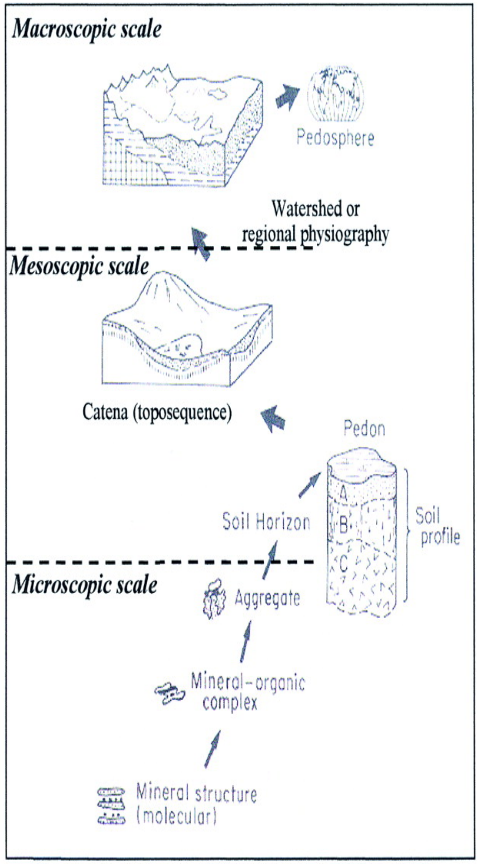


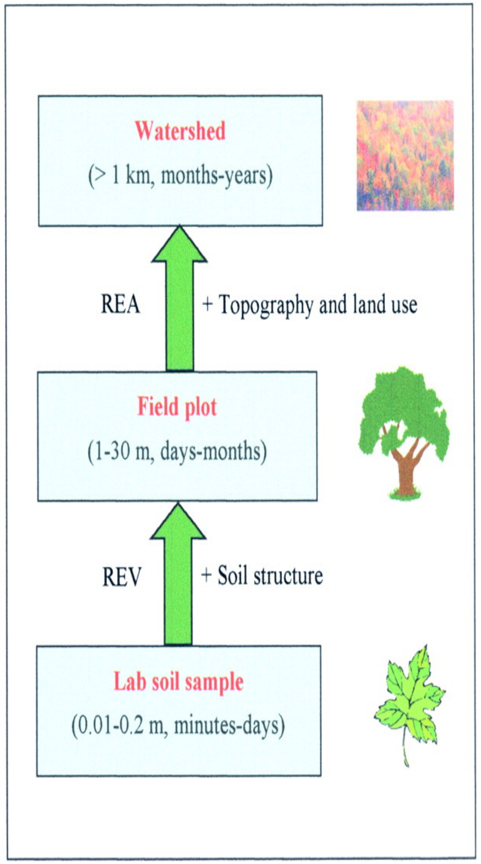




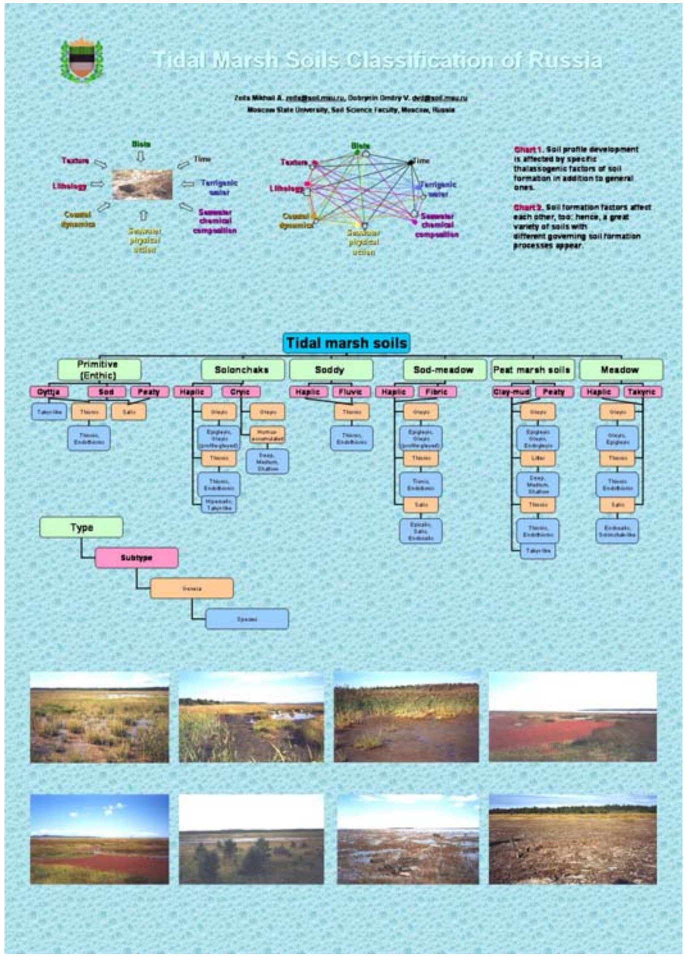
Hidroedafología y Escalas

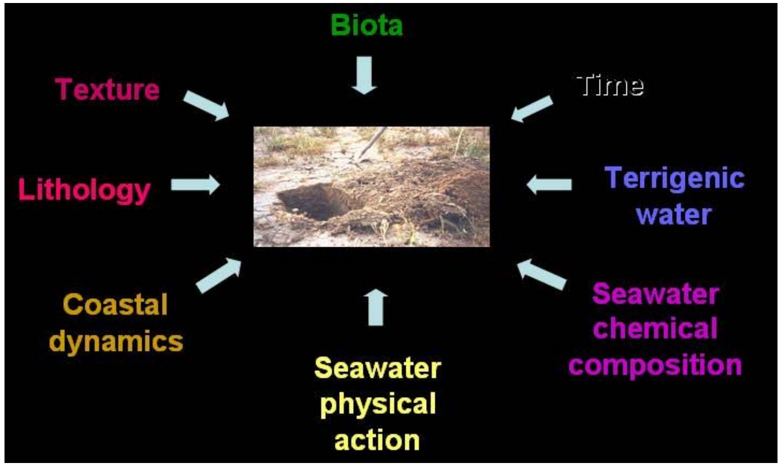






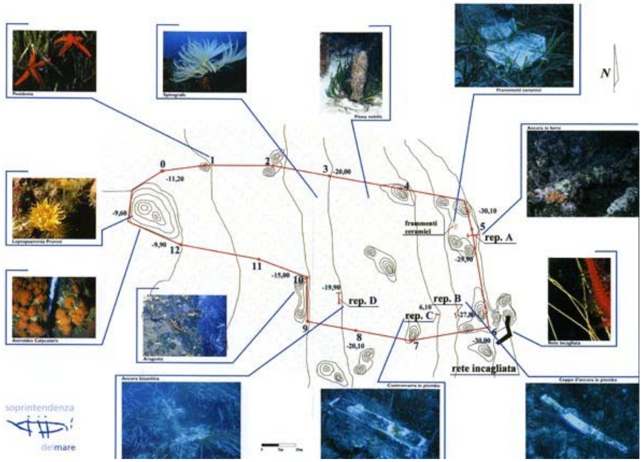
Clasificación de los Suelos de las Zonas Intermareales y Estuarios

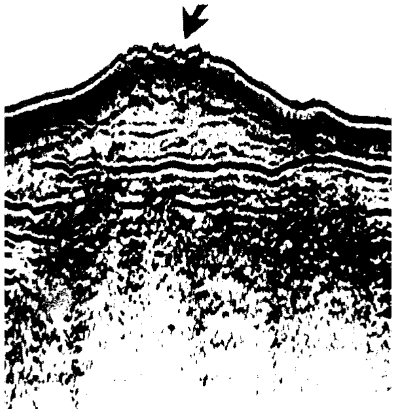


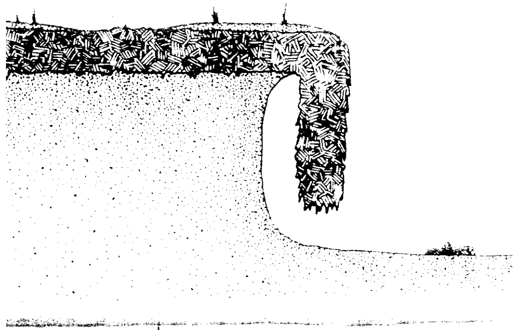


¿Suelos Flotantes Y móviles?

Los Suelos de las Praderas De Posidonia: Un Ecosistema en Riesgos de Extinción

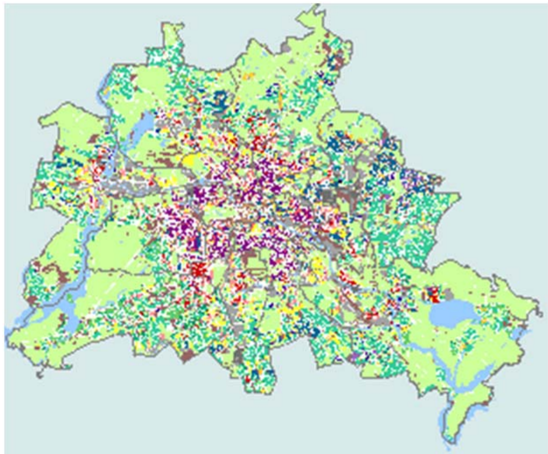


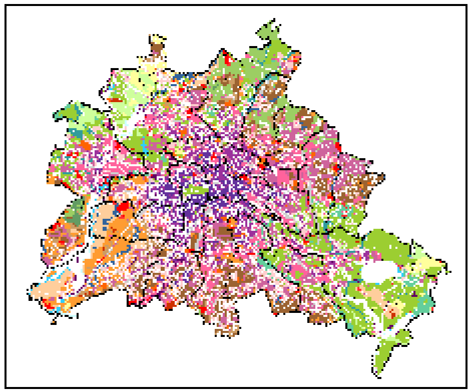




Urbisuelos

Mapa de Suelos de la Ciudad de Berlín





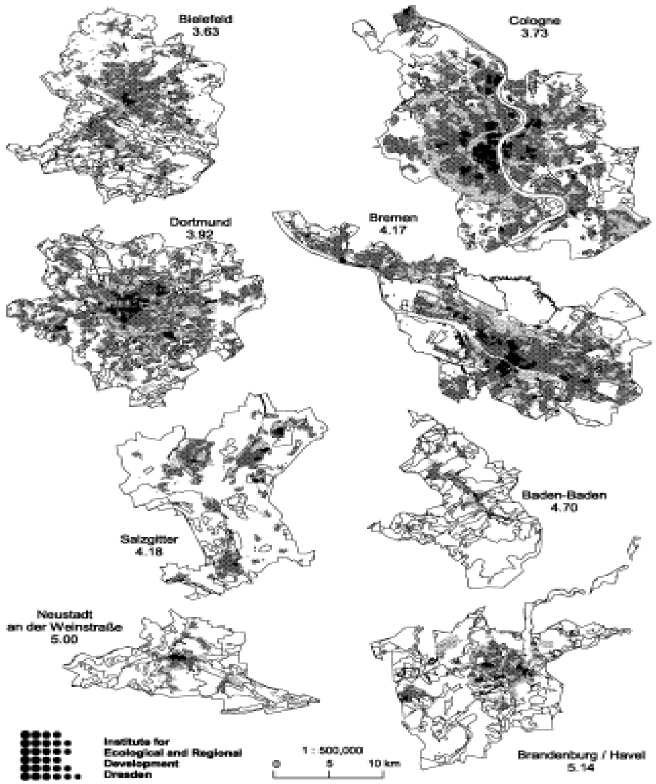
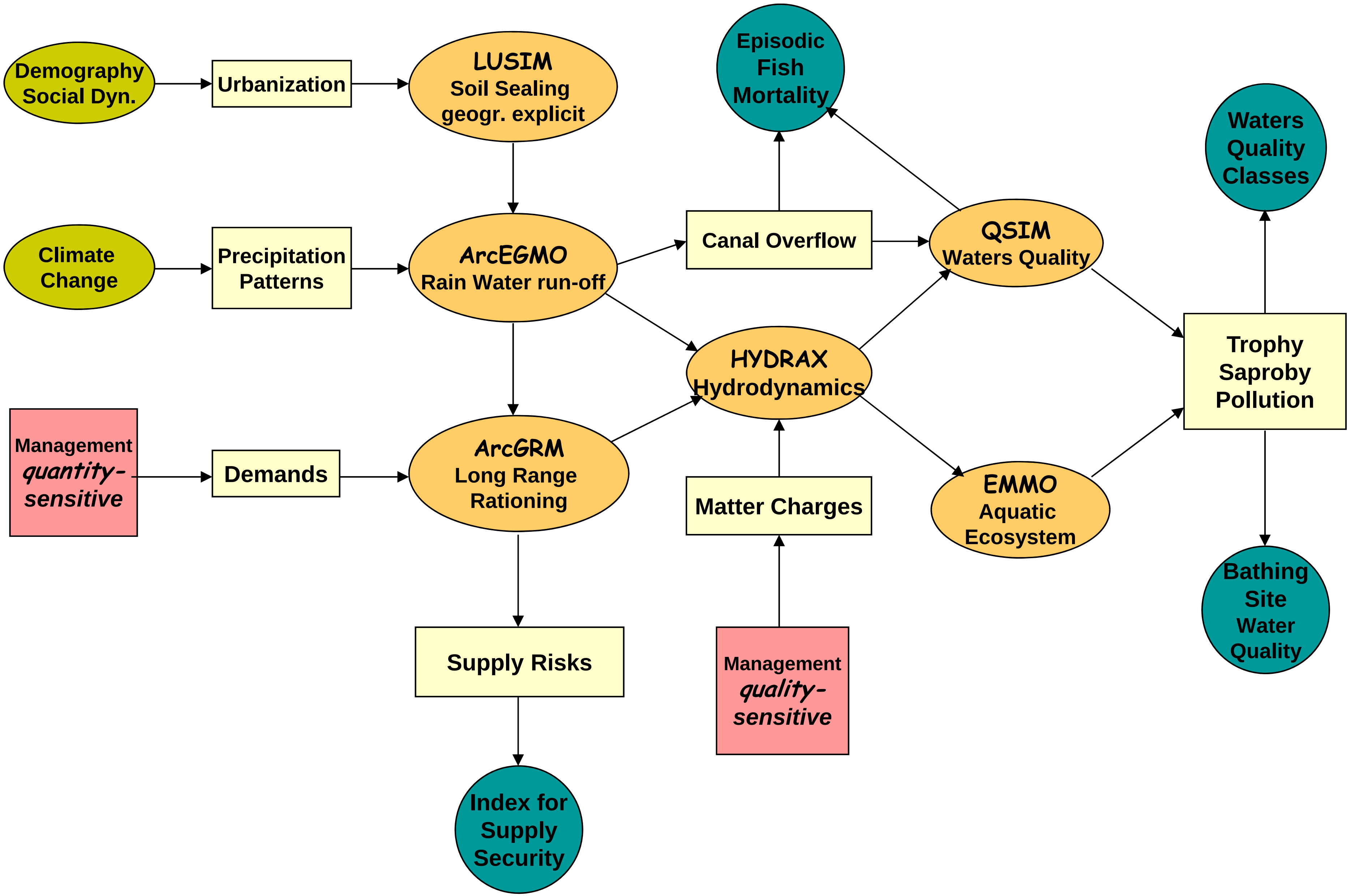
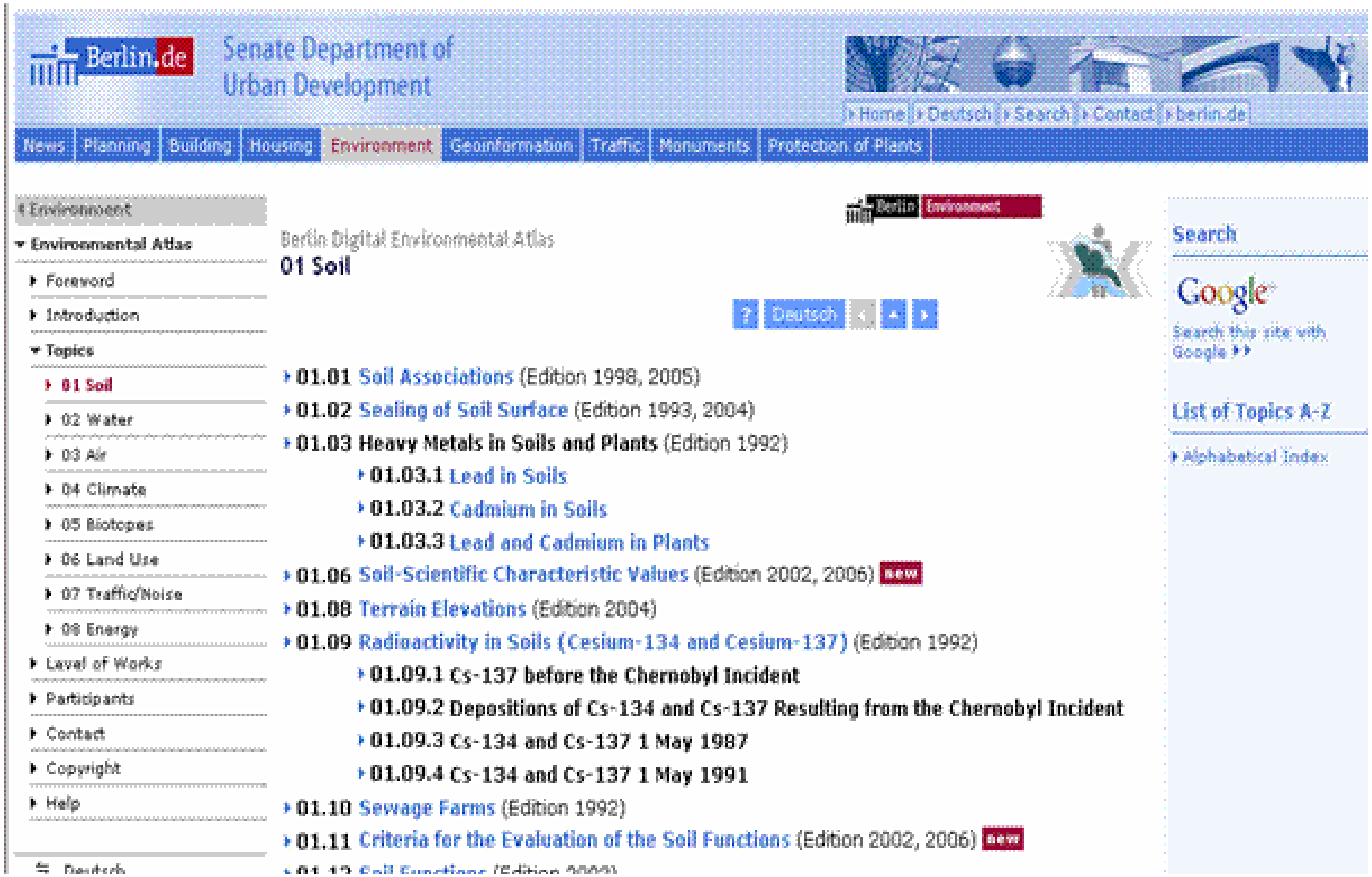


Fig. 6. The next eight least compact German Regional Cities.

Greater Berlin: Integrated waters model



Los Suelos En el Atlas del Medioambiente de Berlín



Zona Crítica Terrestre en España Posible Participación

- ECZ Busca Partners en **Diferentes Zonas del Mundo** que cubran una malla predeterminada para **formar una "Red"**
- La Malla está compuesta por un **Red de Estaciones para proyectos de corta Duración que** abordarán aspectos específicos (financiación de 5 años prorrogable)
- En los Nodos Principales Se establecerán **Estaciones de Mayor Envergadura** que aborden las cuatro cuestiones planteadas por la Iniciativa con **financiaciones a largo plazo**
- Varios países se han adherido (algunos europeos ya se han) adherido: Taiwan, India Hungary, Poland, Czech Republic, France (2 sites), Norway, Sweden, England, Guadeloupe, Iceland

- ¿Y España?, ¿Y la UE que dice?

Table 2. Attributes to be Considered in Site Selection for CZEN

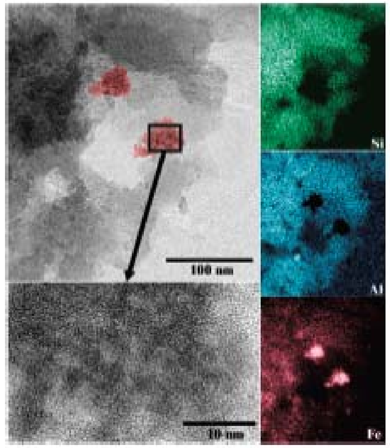
Parent lithology	Chemical, mineralogical, and physical properties
Topography	Slope, aspect, uplift and erosion rates
Climate	Temperature, precipitation, seasonality
Hydrology	Drainage characteristics, saturated versus unsaturated
Biota	Abundance, diversity, and distribution of biota
Time	Exposure age, rock age, time evolution
Logistical considerations	Ease of accessibility, availability of prior data
Quality of site	Pristine or disturbed characteristics, suitability for upscaling, suitability for lab-scale modeling/experimentation
Isolation of variables	Site allows observational testing of one isolated variable
Outreach potential	Opportunities to encourage education

Table 4. Examples of Proposed Activities and Instruments for Sites in CZEN

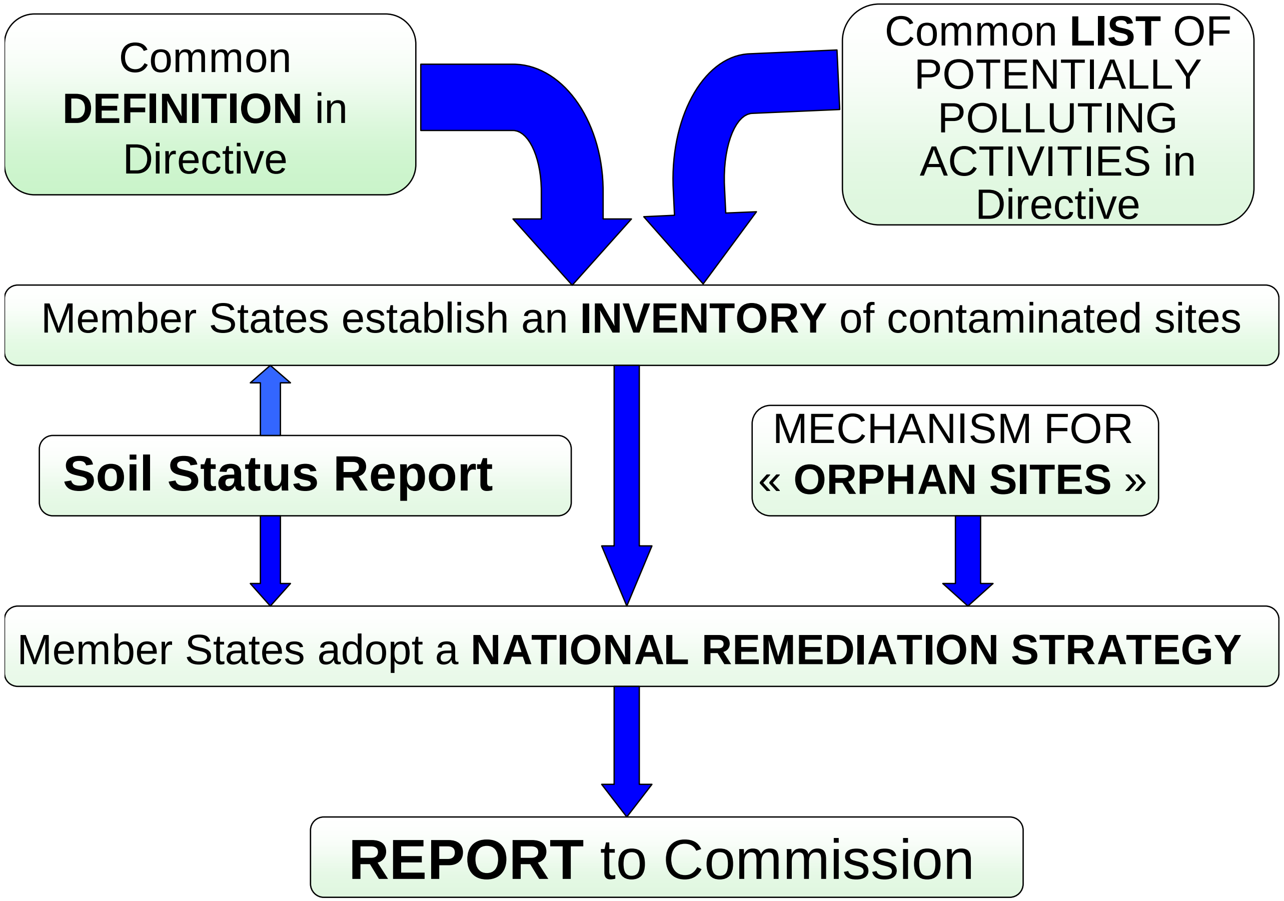
Stream measurements	Continuous stage recorders
	Automated water samplers
	Sediment collectors
	Satellite linkups (stream gauge + weather station)
Climate/weather measurements	Precipitation gauges
	Temperature gauges
	Humidity sensors
	Wind sensors
	Wet- and dry-fall collectors
	Radiometers
	Soil moisture detectors
	Thermistors for soil temperature
Water, gas, soil measurements	Unsaturated zone monitoring nests
	Suction water samplers
	Tensiometers
	Thermocouple psychrometers
	Time domain reflectometry
	Gas samplers and flux chambers
	Portable gas chromatographs
	Ground water monitoring wells
	Piezometers
	Recording pressure transducers
	Sampling pumps
	Drilling equipment
	Soil Sampling
Biological measurements	Electrochemical analyzers for water chemistry
	Rhizotrons, mini-rhizotrons, stereo microscopy
	Deployable units for molecular biological analysis

Esquema Hipotético de Una Participación Española “fuerte” en la Iniciativa ECZ

- SECS y el GT de la Zona Vadosa con Apoyo de:
- Un OPI de Implantación Nacional y:
- Apoyo Institucional & económico del MEC ¿y del MIMAN?
- Posibles OPIs: CIEMAT, IGME y CSIC

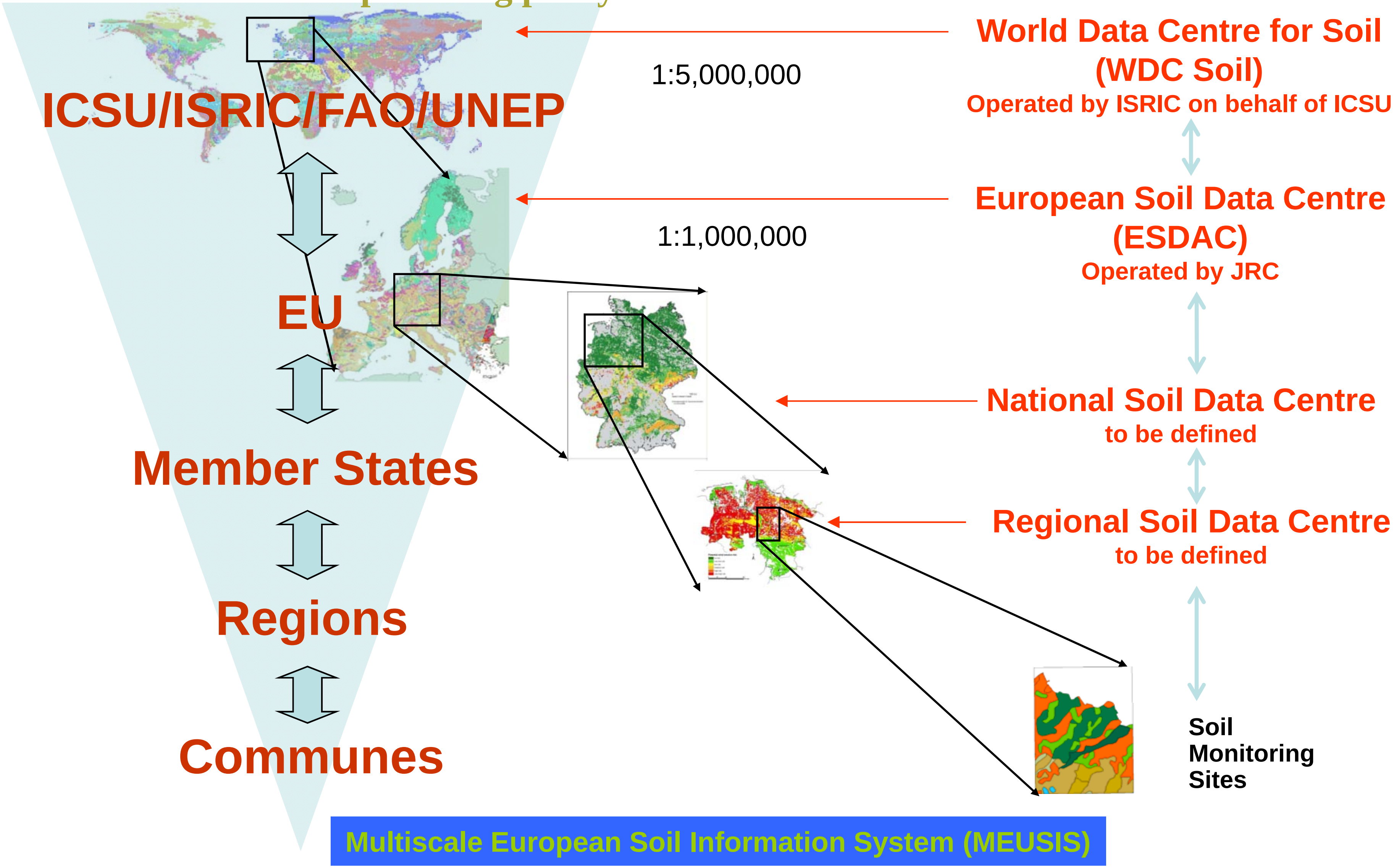


La Directiva Comunitaria de la Protección de Suelos: ¿Solo Contamination?



From the Local to the Global Scale
ESDAC as part of a nested system of soil data centres

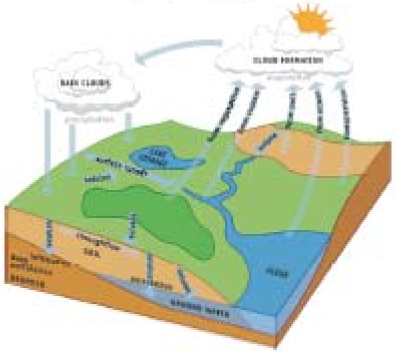
Data centers providing policy relevant soil information for different scales

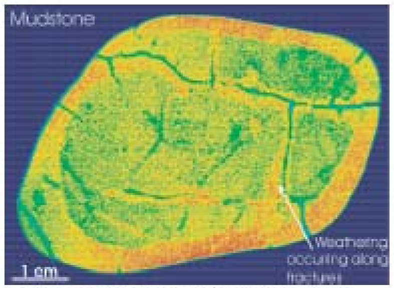


Fin

(...¿de una Era?...)

Eos, Vol. 85, No. 28, 13 July 2004





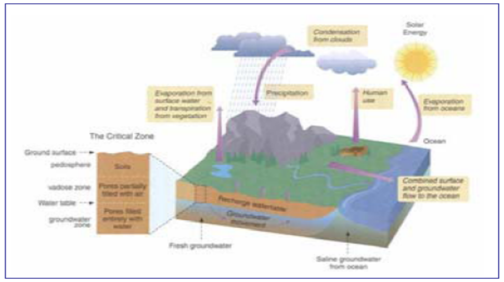


Figure 3. Geochemical cycling of elements during weathering can be monitored through solute and water budgets measured at the watershed scale for comparison to weathering measured at the profile scale (Figure 1) [National Research Council Committee on Basic Research Opportunities in the Earth Sciences, 2001].

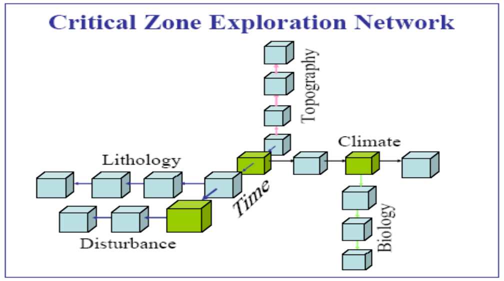
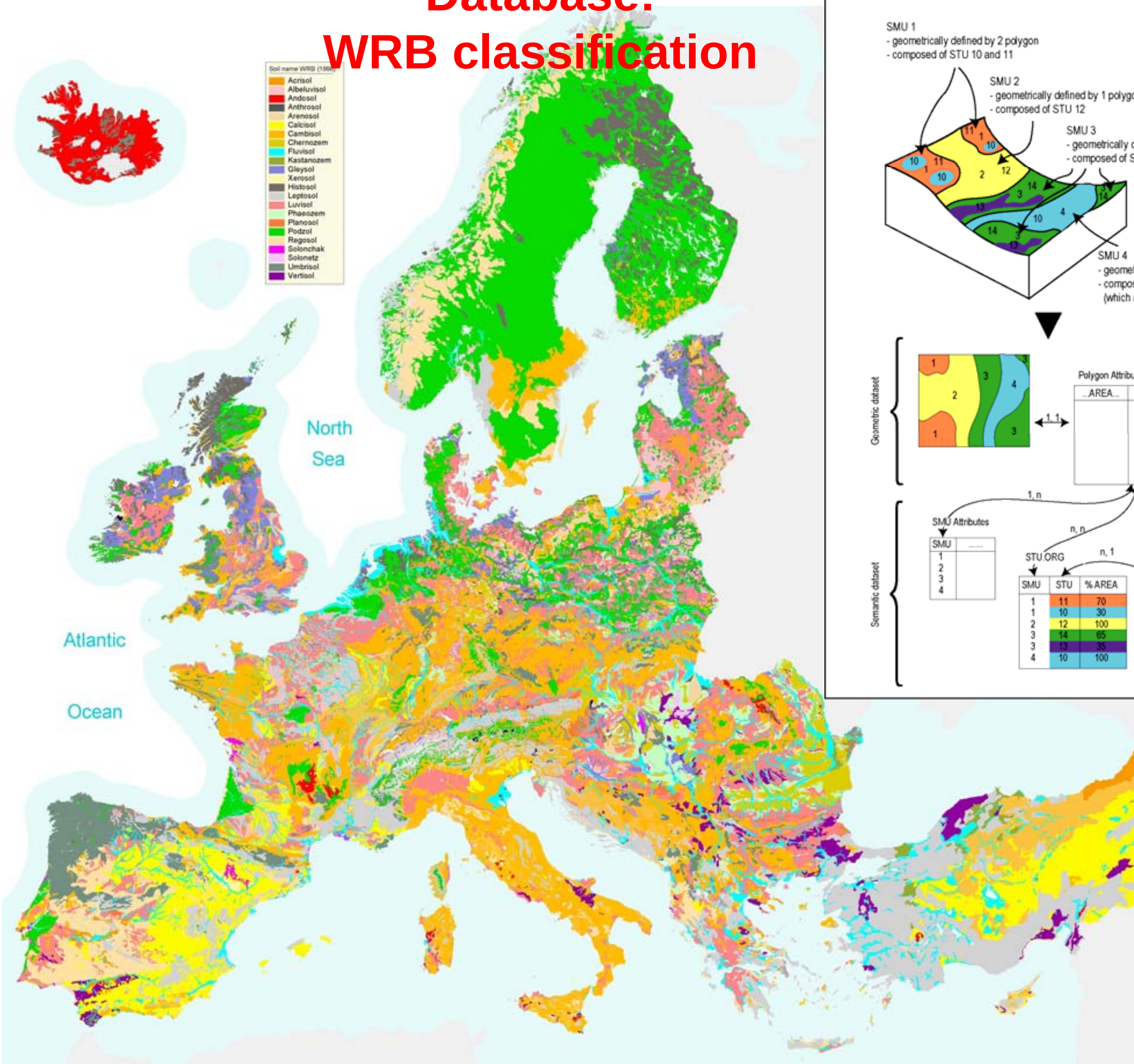


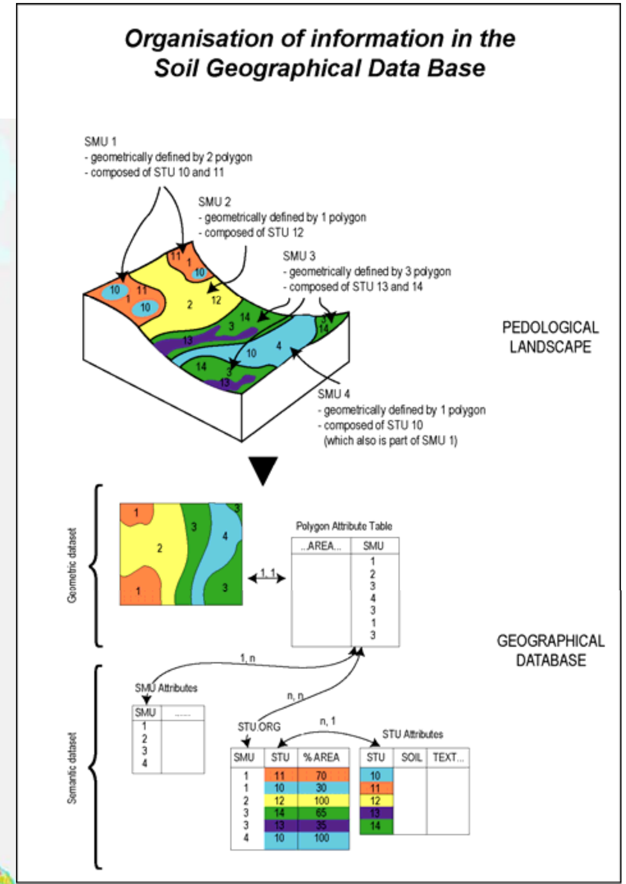
Figure 4. Each Critical Zone Observatory (CZO) will establish the baseline for a matrix of additional related satellite sites that investigate parameters that vary from those of the CZO. For example, a full set of sites might define a chronosequence (variable = time), a lithosequence (variable = lithology), a biosequence (variable = biology), etc.

Zona Crítica Terrestre Suelos: Un Nuevo Paradigma

- *to include the "heterogeneous, near surface environment in which complex interactions involving rock, soil, water, air, and living organisms regulate the natural habitat and determine the availability of life-sustaining resources."*
- *The critical zone includes the land surface, vegetation, and water bodies, and extends through the pedosphere, unsaturated vadose zone, and saturated groundwater zone. The critical zone is the most heterogeneous portion of the Earth.*

European Soil Database: WRB classification



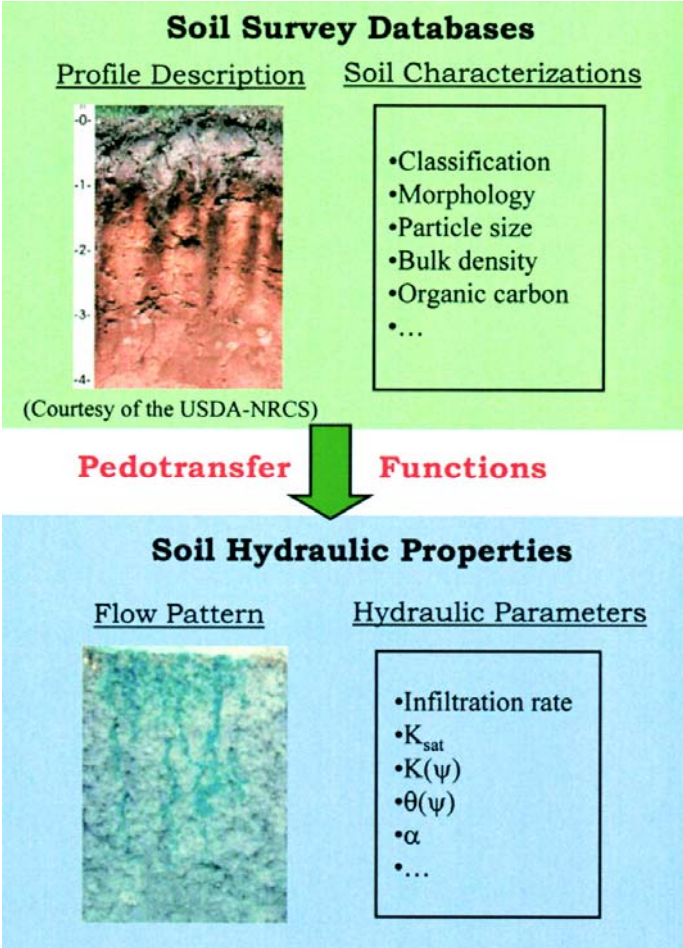


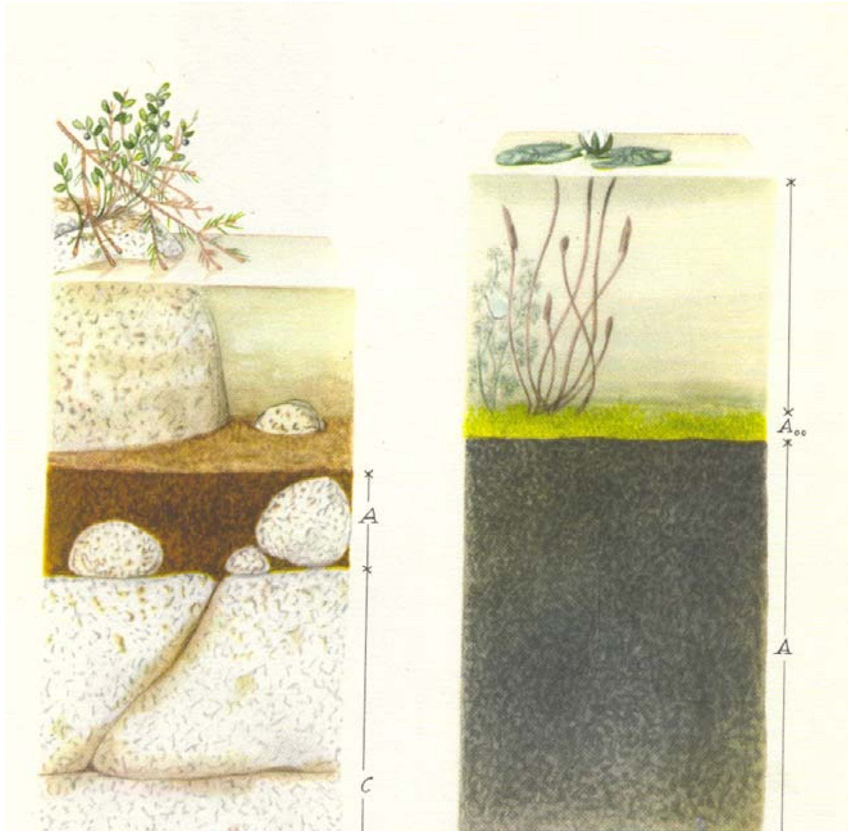
http://eusoils.jrc.it

Objetivos de la Zona Crítica Terrestre

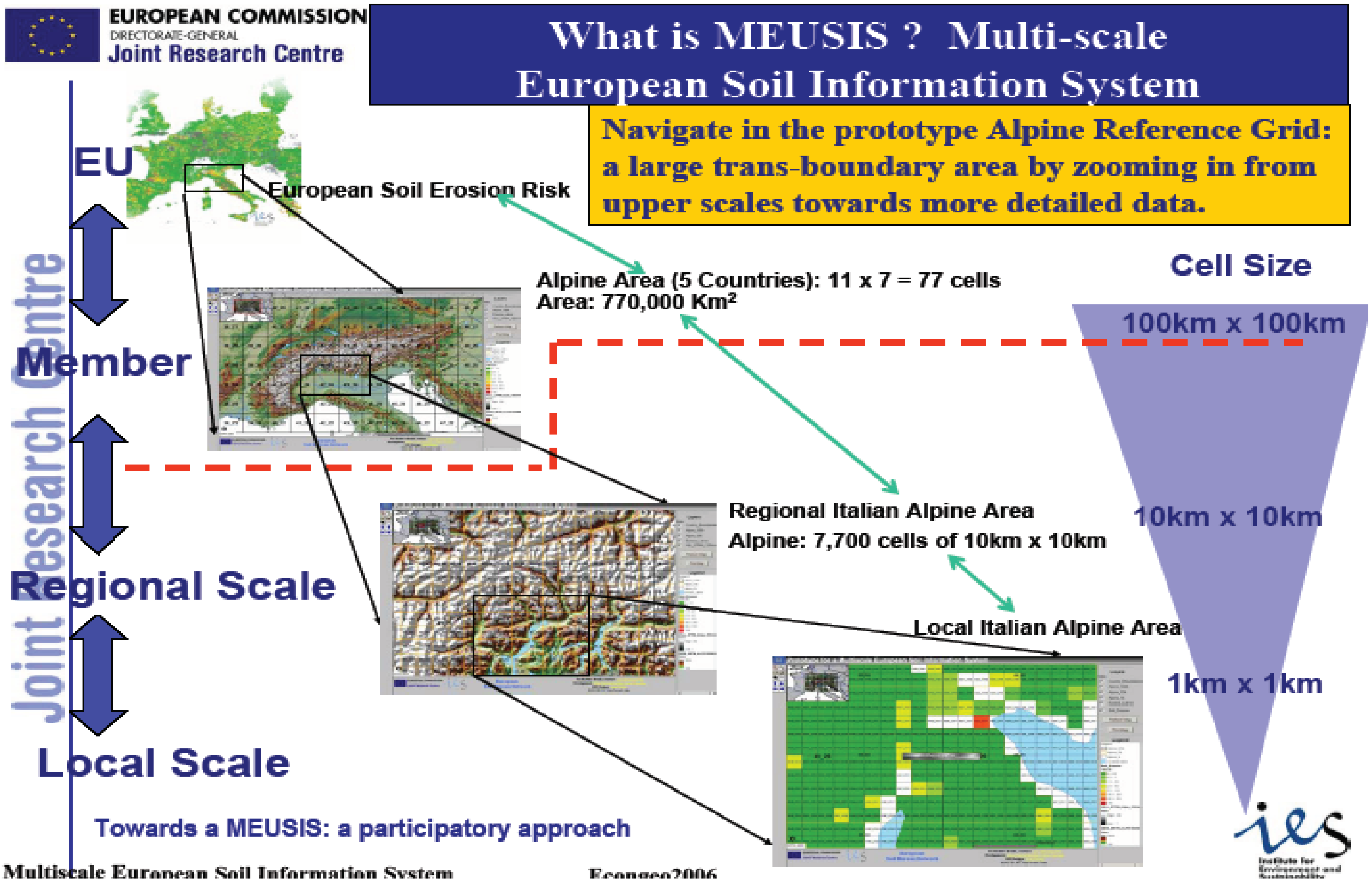
How do the physical, chemical, and biological components of Earth's weathering engine transform mineral and organic matter to nourish and sustain ecosystems, regulate the migration and fate of toxics, sculpt terrestrial landscapes, and control the exchange of greenhouse gases and dust with the global atmosphere?

Hidroedafología y
Suelos de Zonas Húmedas





Sistema de Información de Suelos de la UE

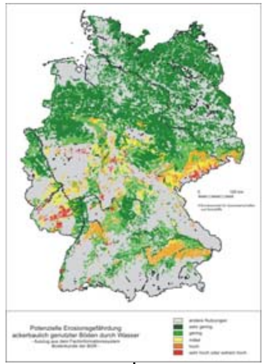


Starting from 2007 (FP7):
<u>ESDAC- European Soil Data Centre</u>

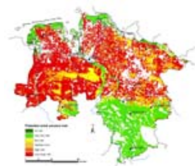
Data requirements → Data collection/ updating → Data management/ harmonization → Data dissemination

DG ENV, MS → European Soil Bureau Network → Qa and Qc → European Soil Information System

National Soil Data Centers



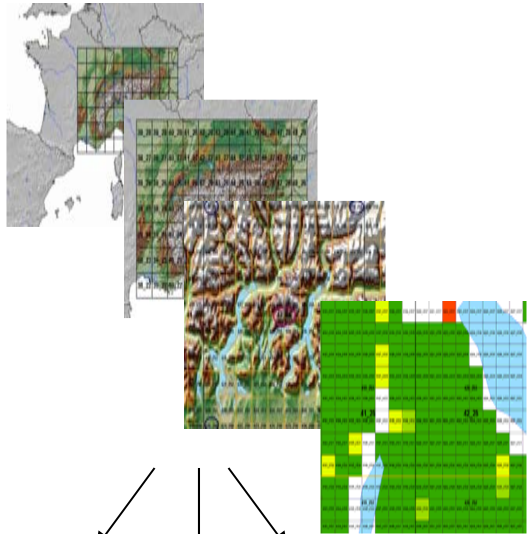
Regional Soil Data Centers



JRC

<u>JRC added value products</u>

e.g. Multiscale European Soil Information System



Access over <u>eu-geoportal</u>:
http://eusoils.jrc.it

Arquitectura de la Web y de La Naturaleza

Curvas de Willis, Leyes de Escala, Pequeños Mundos, Fractales, Diversidad, Conectividad, Redes y Jerarquías

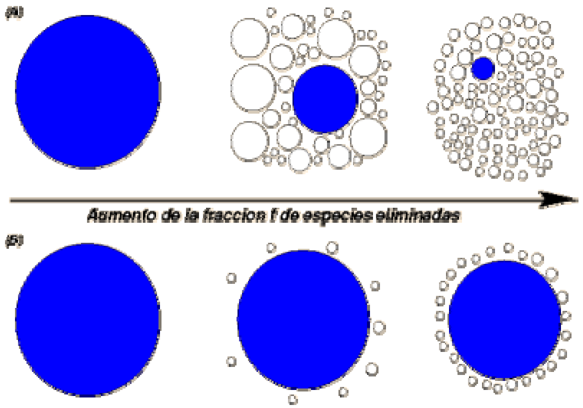


Figura 6: Fragmentación de una red (con topología de mundo-pequeño y distribución potencial de las conexiones) en subredes al ir aumentando la fracción de especies *f* eliminadas por (A) un ataque selectivo dirigido a las especies más conectadas y (B) mediante un ataque no selectivo eliminando especies al azar. El radio de los círculos refleja el número de especies contenidas en cada subred. El círculo azul hace referencia al grupo de especies más numeroso con viabilidad ecológica (en la cadena trófica hay al menos una especie basal). La eliminación de especies al azar permite a la red mantenerse conectada (los círculos pequeños son las especies que hemos eliminado y alguna otra especie que se coextingue) (B), mientras que para una fracción muy pequeña de eliminación de especies muy conectadas, el ecosistema se fragmenta en varias subredes desconectadas entre sí (A). El riesgo de extinción de otras especies aumenta cuanto más fragmentada se encuentre la red (ver texto).

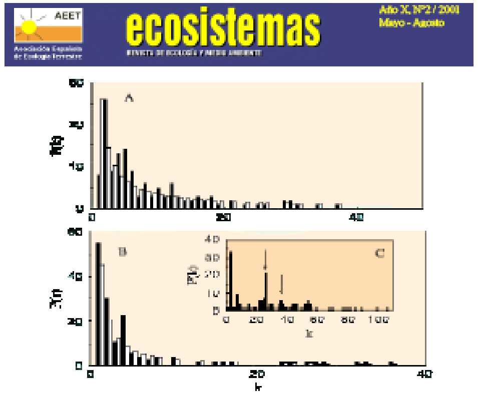


Figura 4: Histogramas de las conexiones totales (de presa a depredador y de depredador a presa) entre las especies para las tres redes tróficas analizadas (barras negras): (A) Estuario de Ythan, (B) Silwood Park y (C) Lago de Little Rock. P(k) indica el número de especies con k conexiones. A los histogramas de las redes tróficas A y B se les adjunta el mejor ajuste a una ley potencial (barras blancas). La red trófica del lago de Little Rock tiene algunos saltos en la distribución (algunos de ellos indicados en la figura), debido probablemente a la baja resolución taxonómica de algunos de sus nodos (no son especies taxonómicas, sino grupos de especies que comparten presas y depredadores). Los ajustes con una regresión de mínimos cuadrados sobre los datos transformados logarítmicamente son, para el estuario de Ythan (A), $R^2 = 0.83$, $p < 0.01$; para Silwood Park (B), R2 = 0.79, $p < 0.01$;). Para Little Rock (C) el ajuste no es significativo.