Natural Sources SNAP 11: Update of Achievements

Contribution to the TFEIP Expert Panel
"Agriculture and Nature"

by

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The NatAir Project

Improving and applying methods for the calculation of natural and biogenic emissions and assessment of impacts to the air quality

Co-ordinators:

- **Rainer Friedrich:** ***rf@ier.uni-stuttgart.de***
- **Jochen Theloke:** ***jt@ier.uni-stuttgart.de***
- ***http://natair.ier.uni-stuttgart.de***

Participating Institutions

IER

systems research

AEA TECHNOLOGY ENVIRONMENT

Istituto Nazionale di GEOFISICA e VULCANOLOGIA

ies Institute for Environment and Sustainability

Sciences de l'environnement Institut Pierre Simon Laplace

APAT

JOENSUUN YLIOPISTO

Sources and Pollutants

Sources	Pollutants
Vegetation, esp. Forests	NMVOC
Biomass burning and forest fires (new)	NO_x, PM, CO, CO_2, CH_4, OC, EC, VOC
NO from soils	NO
Pollen (New)	PM
Wild animals	CH_4, NH_3
Anoxic soil processes (wetlands)	CH_4
Natural seepage of gas storage	CH_4, NMVOC
Wind blown dust (incl. Saharan) (new)	PM
Volcanoes	SO_x, NO_x, PM, HF, HCl, HNO_3
Lightning	NO_x
Sea, Coastal zones (New)	PM, DMS

Contributions for the GB-Update

- Improved methodologies
- Improved emission factors
- New source categories
- New data bases

→ Gridded output using GIS platforms

Summary Project Status

- First drafts available
- Second drafts of **all** source categories will not be ready before April 2007.
- Decison on delivery of final draft versions for review depends on publishing date of the new structure for the GB

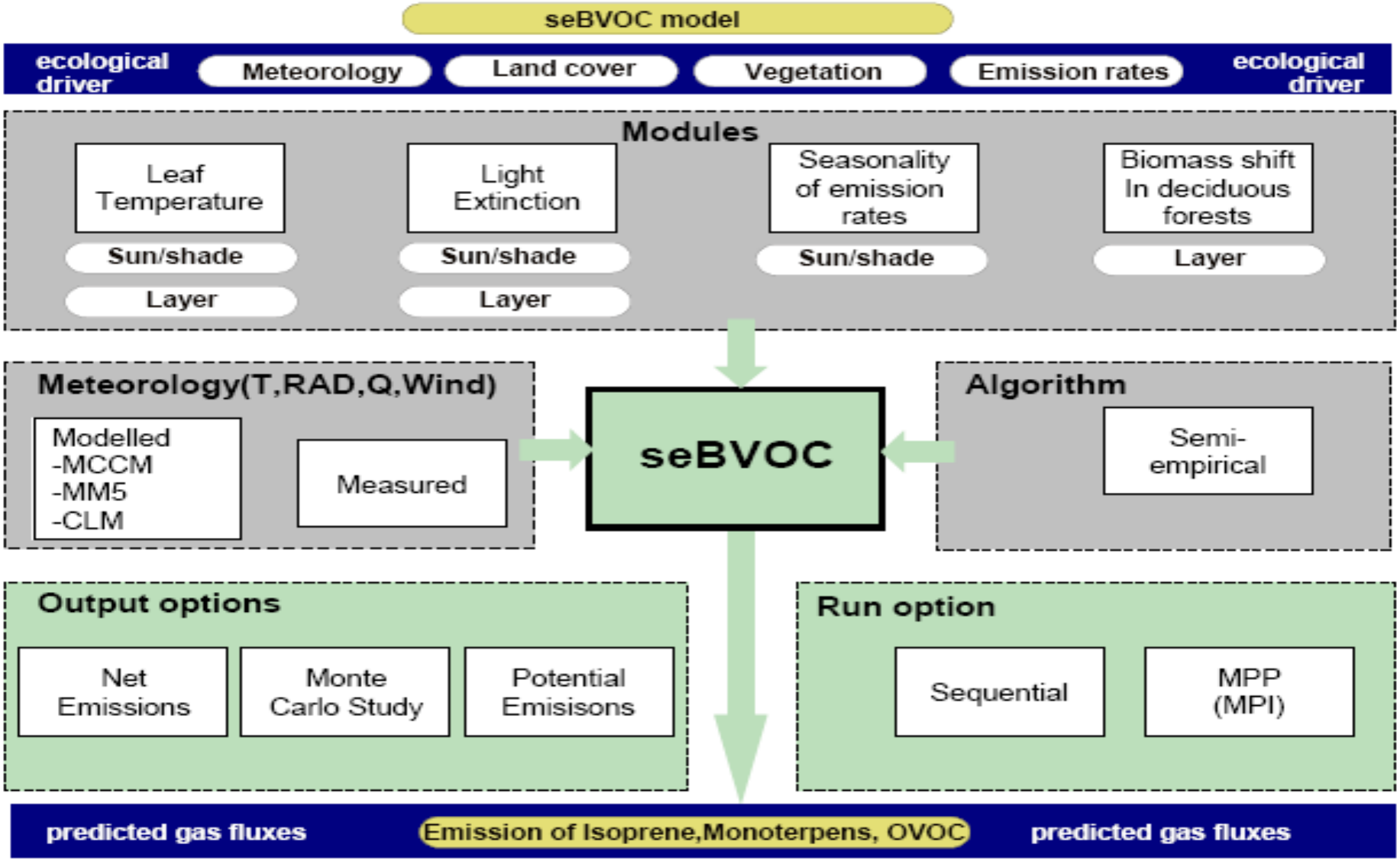
⇒ Delayed

Status Forest VOC

Rainer Steinbrecher and Gerhard Smiatek (IMK-IFU)

- First draft available
- New methodology
- New emission factors
- New land use data base

Forest VOC: Methodology



Forest VOC: Emission Factors

- Chemical speciation

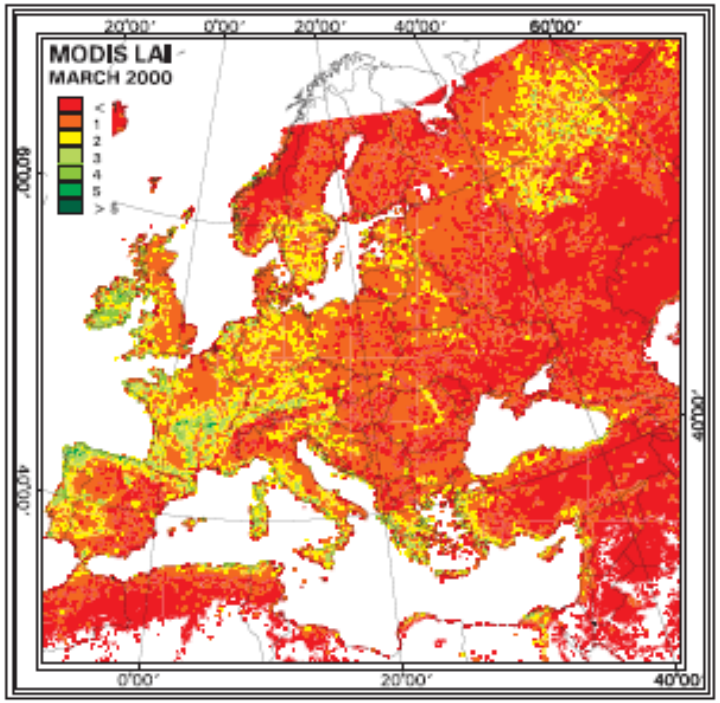
VOC Split

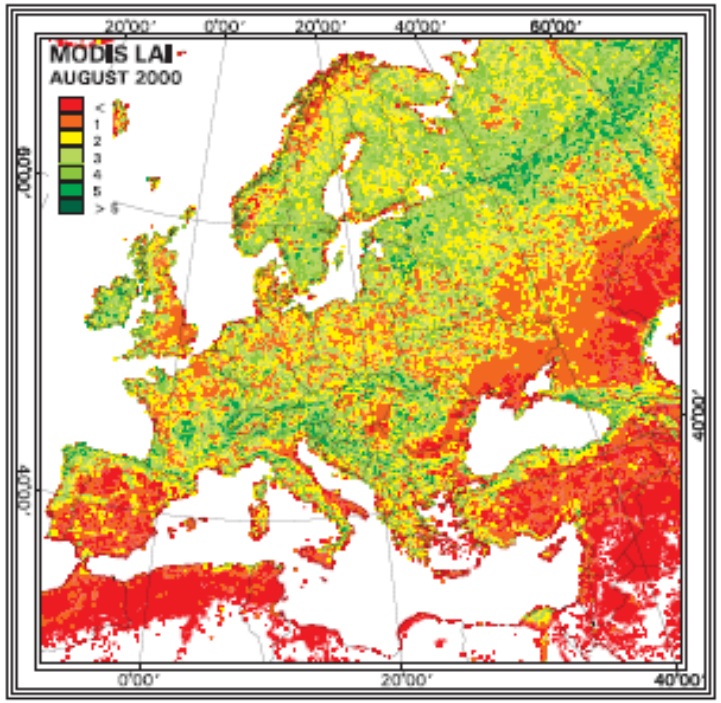
- Isoprene
- Monoterpenes: α-Pinene β-Pinene, d-Limonene, α-Terpinene, γ-Terpinene, Camphene, Δ^3-Carene, Myrcene, Cymene, Trans-β-Ocimene, cis-β-Ocimene, α-Phellandrene, α-Fenchene, β-Phellandrene, Sabinene, 1,8-Cineol, Tricyclene, α-Thujene Linalool
- Sesquiterpenes
- Other VOC: Methanol, Formaldehyde, Formic acid, Ethanol, Acetaldehyde, Acetone, Acetic acid

Forest VOC: Land use

- Plant species, LAI distribution maps

LEAF AREA INDEX



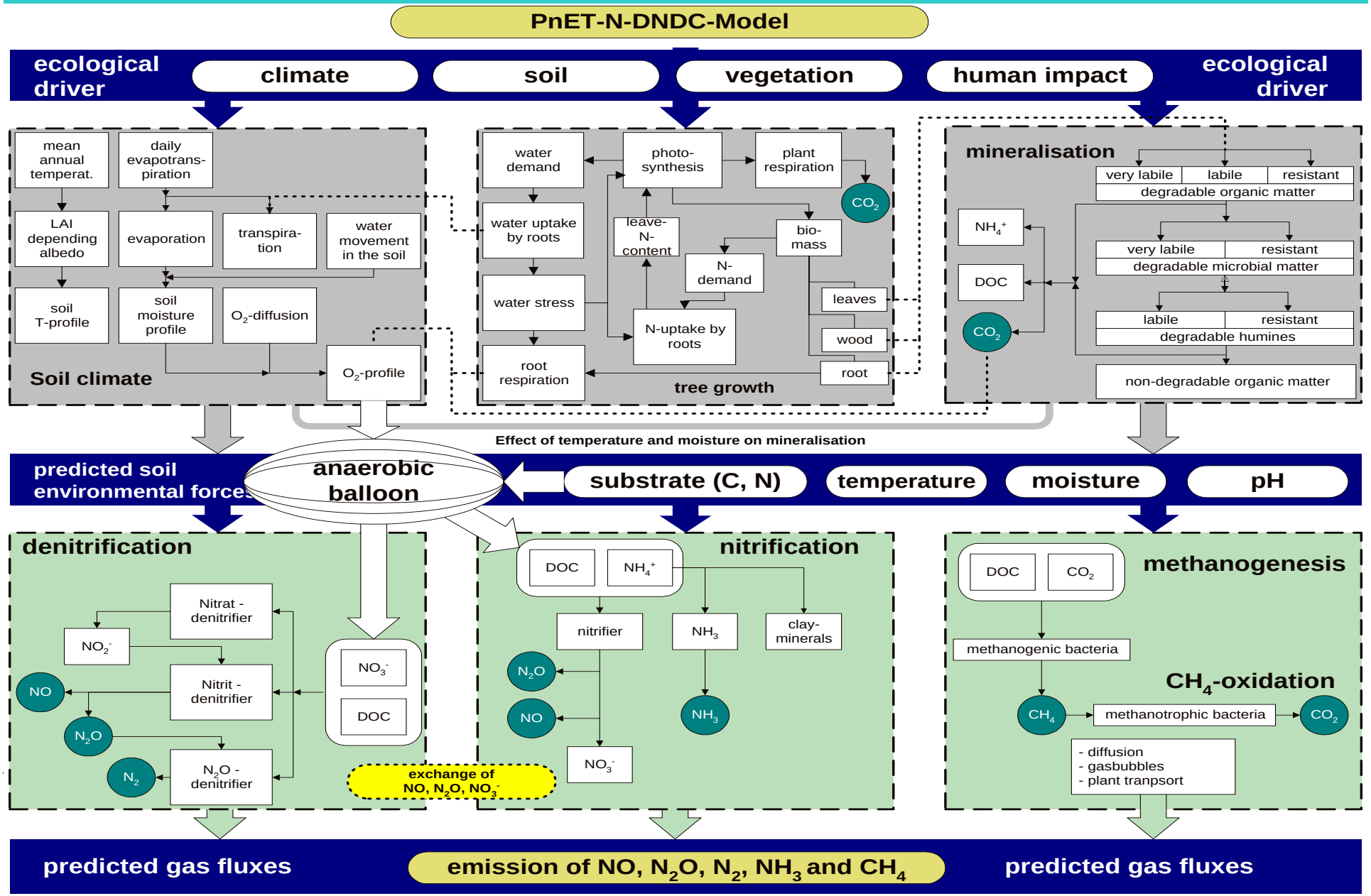


Status Soil NO Emissions

Magda Kahl and Klaus Butterbach-Bahl (IMK-IFU)

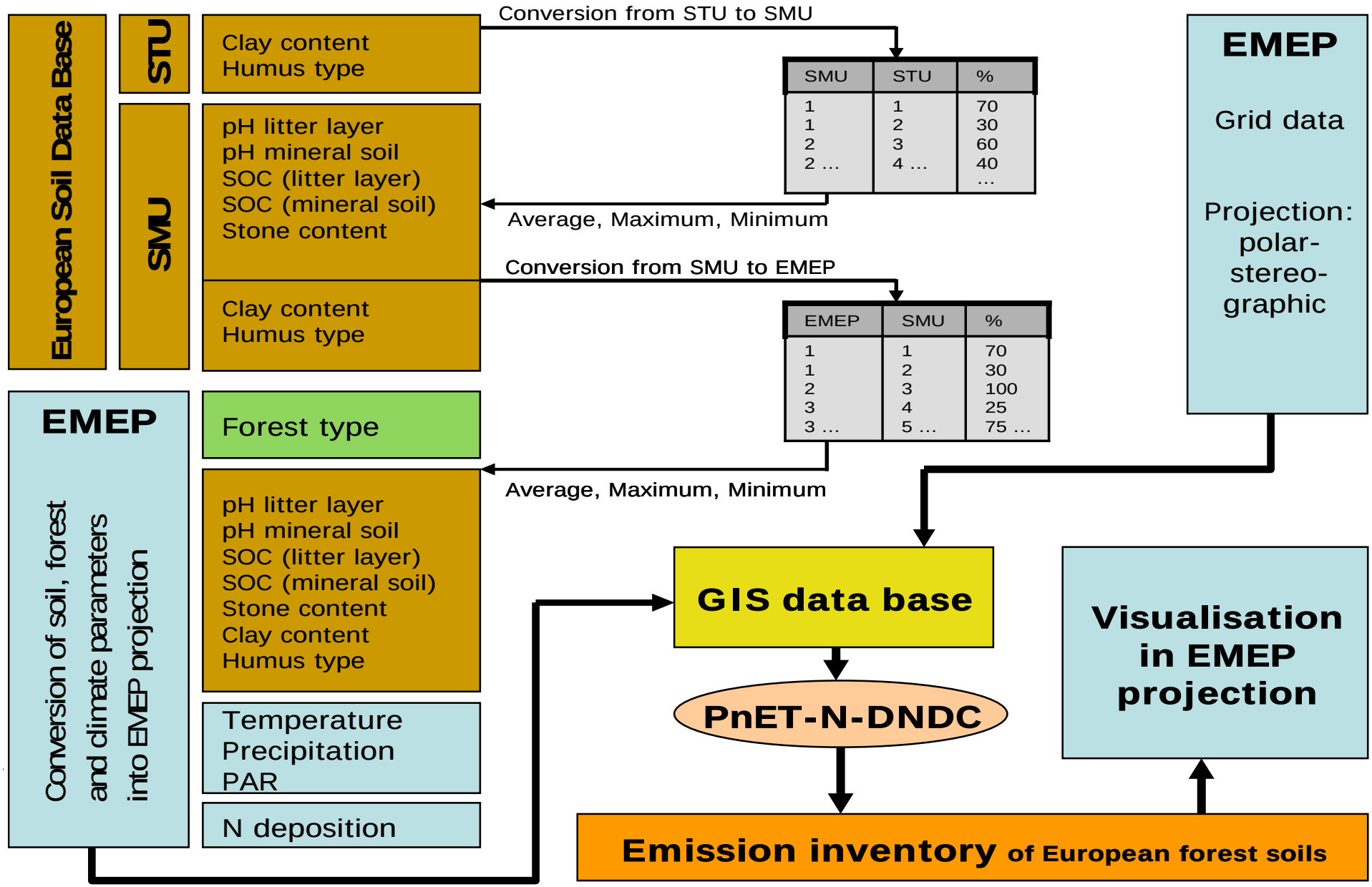
- First draft available
- New methodology
- New soil data base
- New land use data base
- New fertilzer application data base

Soil NO: Methodology



Natural Sources

Soil NO: Data Bases



Status: Volcanos

Domenico Gaudioso (APAT)

- First draft available
- New compounds
- New emission factors
- New data base

Volcanos: Compounds

- More detailed information on SO_2/HCl and HCl/HF ratios for Mount Etna.
- HNO_3/SO_2 ratios for Villarrica, Masaya, Etna and Lascar from recent literature.
- Particle size distribution and flux estimates from the summit of Mount Etna in October 1997
  - mean effective radius: 0.83 µm (0.35<r<1.6 µm)
  - total aerosol mass flux: 4.5-8.0 kg/s
  - sulphate flux: 0.5-0.8 kg/s,
  - SO_2 flux: 10 kg/s.

Volcanos: Data Base

- Data from all sub-aerial volcanoes located in the whole geographical area of Europe (erupted at least once since 1st January 1964).
- Volcanoes have been differentiated between arc and nonarc volcanoes.

Non-arc volcano: volcano on a hot spot or rift zone - erupts more frequently, total number is smaller

Arc volcano: volcano at a subduction zone - eruptions are more violent

Status: Gas Seeps, Mud Vulcanos

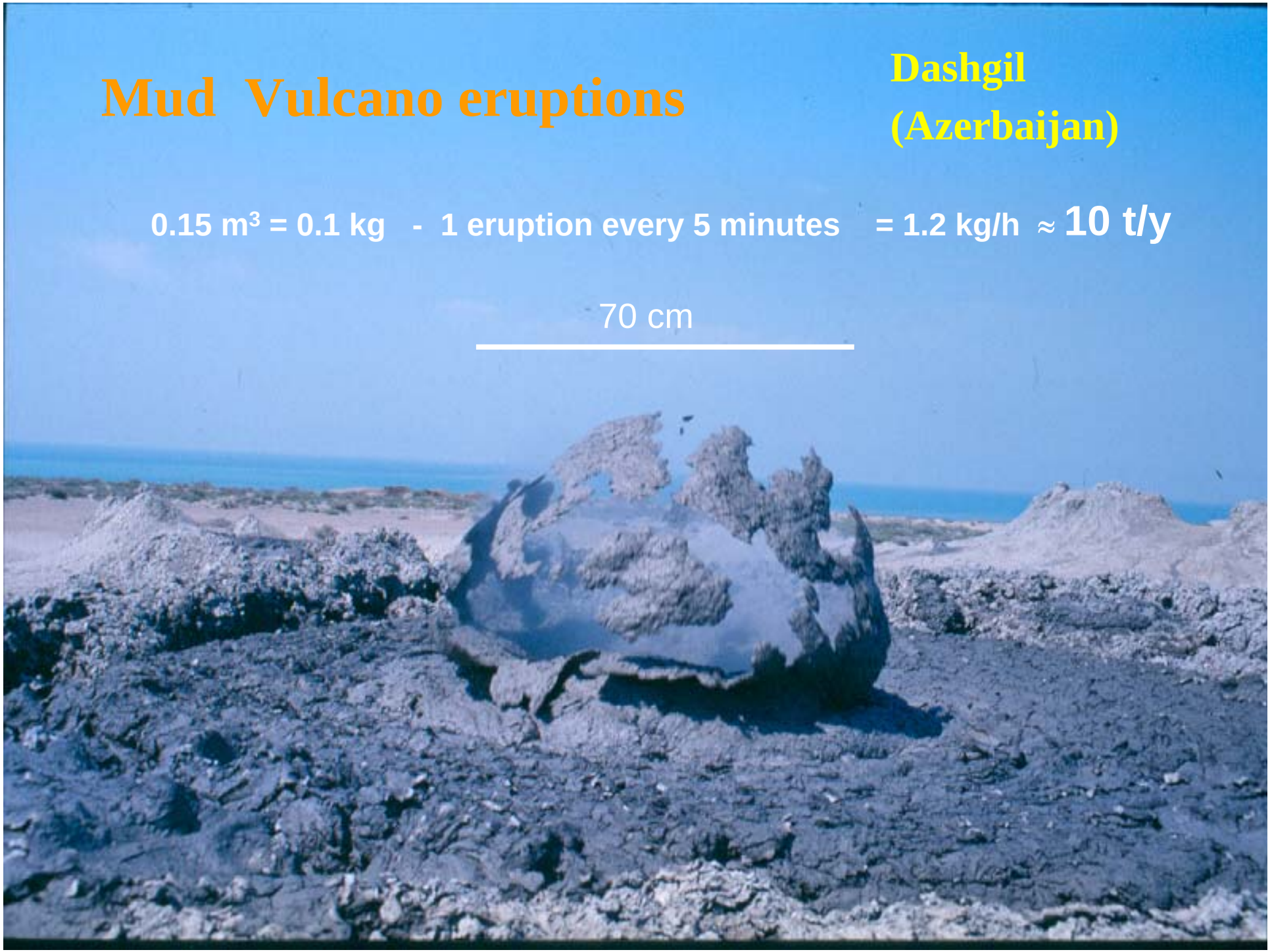
Guiseppe Etiope (INGV)

- First draft available
- New source
- Updated methodology
- New data base

Mud Vulcano eruptions

Dashgil (Azerbaijan)

0.15 m^3 = 0.1 kg - 1 eruption every 5 minutes = 1.2 kg/h ≈ 10 t/y



Status: Marine Aerosol and DMS

Chris Dore (AEA)

- First draft available
- New methodology
- New data base

Marine Aerosol: Methodology

The Gong et al. Model

- Sea salt aerosol generation through the action of wind
- Vertical transport (turbulence and convection)
- Dry Deposition and gravitational settling
- Wet removal processes (in & below cloud scavenging)
- No aerosol chemistry
- Model considers only marine boundary layer, not long range transport.

DMS: Methodology

The Liss & Merlivat Model

$$F \sim K_w C_{Water}$$

- Piston velocity defined for three regimes of wind speed at 10 m height (U_{10}):
- **Smooth** surface regime (0-3.6 m s^{-1})
- **Rough** surface regime (3.6-13 m s^{-1})
- **Breaking** wave regime (>13 m s^{-1}).

Marine Aerosol and DMS: Data Bases

- Wind speed in 10 m hight a.s.l
- Sea surface temeprature
- DMS concentrations

Status: Lightning

Jochen Theloke (IER)

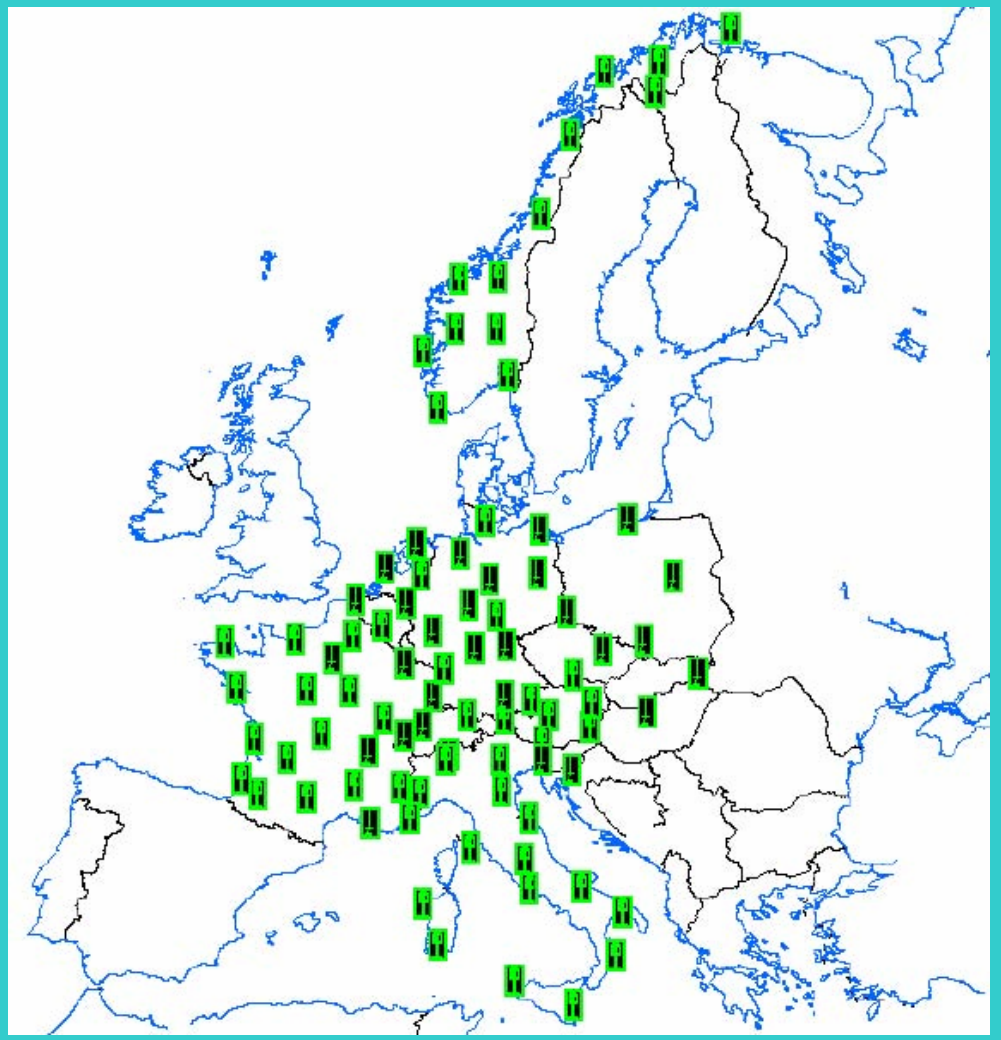
- First draft available
- New methodology
- New emission factors
- New data base

Lightning: Methodology

- NO emissions for lightning flashes in study area
- Number of cloud-to-ground (CG) flashes recorded
- Efficiency of the CG network
- Emission factor for NO for each CG lightning flash
- Latitude of the study area in degrees
- Emission factor for NO for each inter-/intra cloud (IC) lightning flash

Lightning: Data Bases

Lightning density data for Europe from the EUCLID network with a resolution of 24 x 24 km for the months July and August 2003

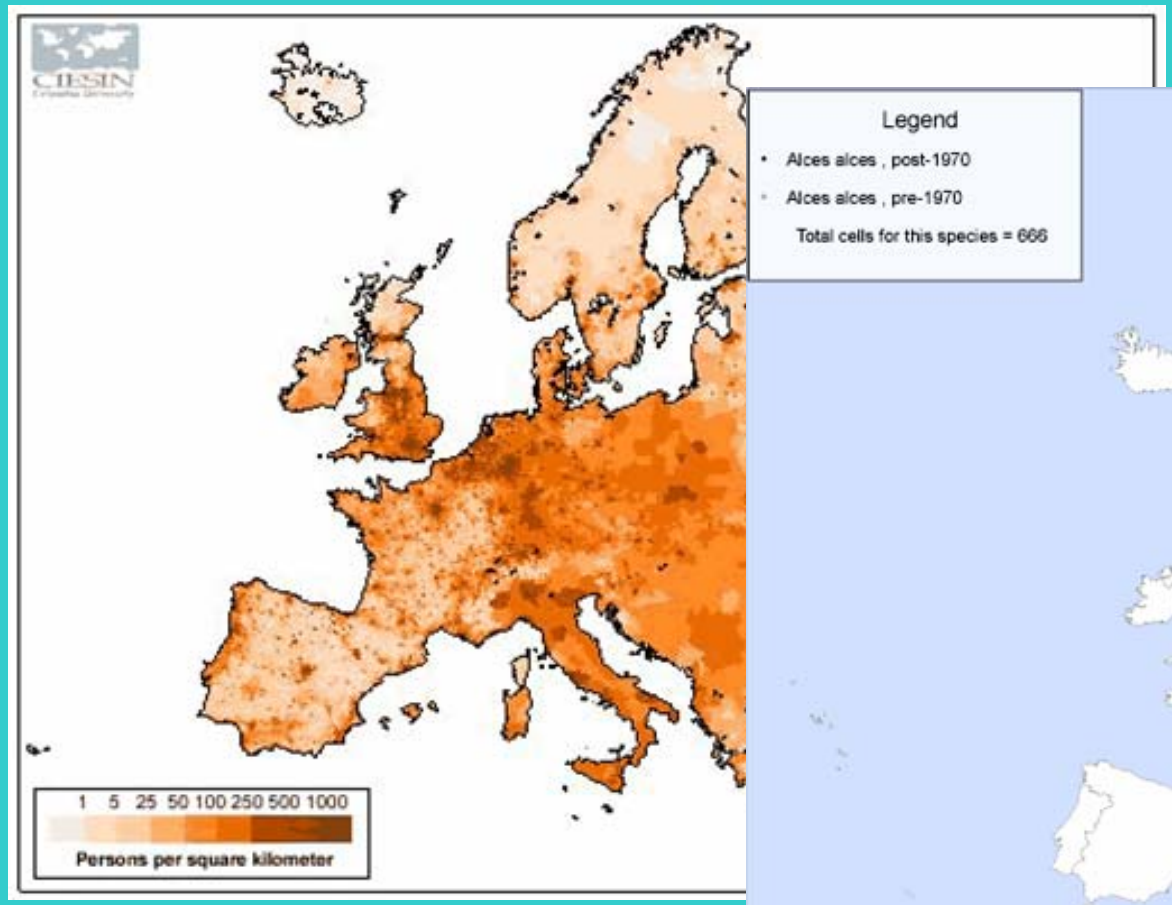


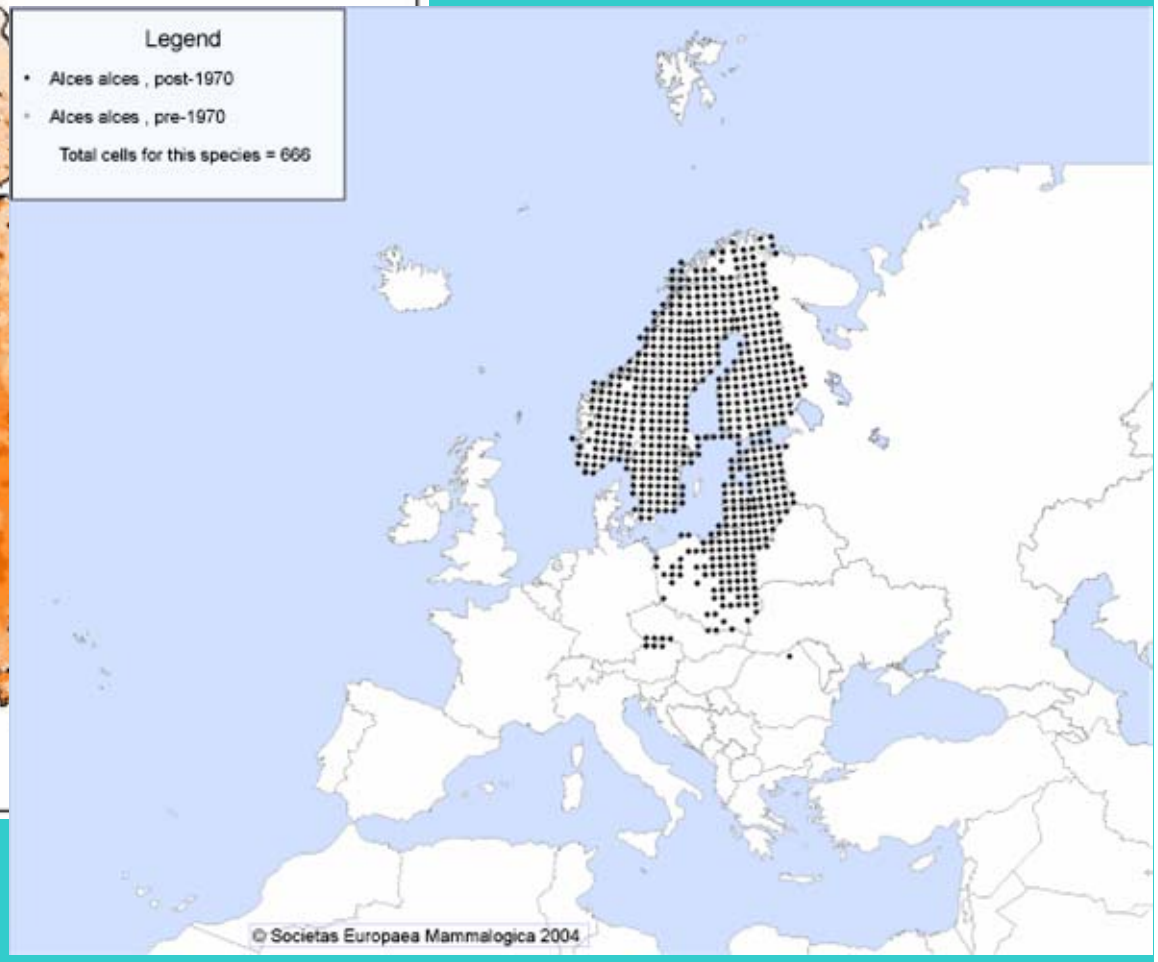
Status: Humans, Pets and Wild Animals

Ernst Gebetsroither (Systems Research)

- First draft available
- Updated emission factors
- New data base

Humans, Pets and Wild Animals





Status: Wind Blown Dust

Marek Korcz (IETU)

- First draft available
- New methodology
- New emission factors
- New data base

Wind Blown Dust

Emission calculation

$$E_{(\text{mass/unit area})} = \{\text{land area, } m^2\} \times \{[\text{spike emission rate, } g\ m^{-2}] + [(\text{duration of wind event, } h) \times (\text{emission factor, } g\ m^{-2}\ h^{-1})]\}$$

Vertical emission = E *ALFA

ALFA (unit less factor) dependent on:
-soil texture group
-wind friction velocity
-applied ALFA ~1*10-4, adjusted for the Netherlands inventory (~40 +-20 Mg – calculated 64 Mg)

Status: Primary Biological Aerosol Particles

Wilfried Winiwarter (Systems Research)

- First draft available
- New methodology
- New emission factors
- New data base

Primary Biological Aerosol Particles

Determine emission flux (“source term”)

- Compare PBAP to other conservative compound (TRAC)

$$\frac{c_{PBAP}}{c_{TRAC}} = \frac{E_{PBAP}}{E_{TRAC}} \quad \text{or} \quad E_{PBAP} = \frac{E_{TRAC}}{c_{TRAC} / c_{PBAP}}$$

- “Tracers”:
  - Levoglucosan
  - Primary particles

Status: Wetlands

Sanna Saarnio (JOY)

- First draft available
- New methodology
- New emission factors
- New data base

Wetlands

LPJ model estimations

*process-orientated model (moisture, temperature, vegetation vs. CH_4 production, oxidation and transport)

*include following wetland categories:

Corine CLC90

Inland marshes, Peat bogs, Salt marshes, Salines, Intertidal flats

GLC2000 (global legend)

Tree Cover, regularly flooded, fresh water (& brackish)

Tree Cover, regularly flooded, saline water, (daily variation of water level)

Regularly flooded Shrub and/or Herbaceous Cover

Status: Forest Fires

Guenther Seufert (JRC)

- First draft available
- New methodology
- New emission factors
- New data base

Forest Fires

Methodology

$$CO_2 = \sum_f A_f \times B_v \times C \times E_f$$

A_f	burned area (m^2)
B_f	fuel load ($g\ m^{-2}$)
C	burning efficiency ($g\ g^{-1}$)
E_f	emission coefficient for CO_2
f	fuel class

Emissions can also be estimated for (CO2), carbon monoxide (CO), methane (CH4), 2.5-micron particulate matter (PM2.5), 10- micron particulate matter (PM10), total particulate matter (PM), non-methane hydrocarbon (NMHC), volatile organic compounds (VOC), nitric oxide (NOX), organic carbon (OC), and elemental carbon (EC).

Thanks‘

Let’s look forward to completing the up-date!