XII giornata della modellistica in aria(net)
Milano, 25-26 marzo 2025

Modellazione dinamica delle emissioni biogeniche: aggiornamenti

Camillo Silibello, Sandro Finardi

FOCI – July 2018 test case

Outline

1. MEGAN 3 vs MEGAN 2

2. Preparation of MEGAN main input file for a FOCI domain

    a. Starting from global data (1 km^2 res.) available at https://zenodo.org/records/10939297

    b. Starting from user data (PSEM)

3. MEGAN 3.2 runs and comparison with PSEM, Sinderalova et al., 2022 (MEGAN 2.1) and Wang et al., 2024 (MEGAN 3.2)

MEGAN 3 vs MEGAN 2

https://www.westar.org/wpcontent/uploads/2022/08/GuentherWRAP2022.pdf

MEGAN Emission Sources

MEGANv2

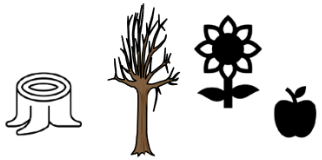
Whole ecosystem net flux to above canopy atmosphere

MEGANv3

Ecosystem component emission

Foliage, phyllosphere microbes

Soil, Soil microbes, roots



Other: Floral, fruits, trunk/stems, stumps, etc

MEGAN Emission Factors

MEGAN 2.1
Landscape average values based on expert judgement with little explanation or references.

MEGAN 3.0/3.1
More transparent approach, Emission Factor Processor (MEGAN-EFP Python/SQLite program), to integrate all reported emissions data while considering data quality.

MEGAN 3.2 and beyond
Simplified MEGAN-EFP Python/SQLite program with emission factors described in planned series of manuscripts summarizing emission factors for individual plant families. Also working on an alternative approach based on plant traits

MEGAN v3.2 formulation

MEGANv3.2 calculates the BVOC emissions rate (ER) as follows:

$$ER = EF \cdot EA$$

where EF and EA represent the standard emission factor (i.e., ER at “standard” conditions) and the nondimensional emission activity factor, respectively.

The EF map can be obtained by running the MEGANv3.2 emission factor processors, which combines growth form and ecotype data with plant species community and species emission factor datasets to generate the mean emission factor as follows:

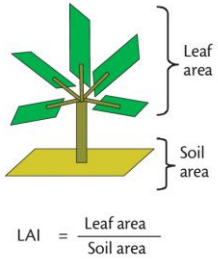
$$EF = EF_{tree} \cdot f_{tree} + EF_{shrub} \cdot f_{shrub} + EF_{grass} \cdot f_{grass} + EF_{crop} \cdot f_{crop}$$

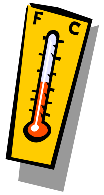
where EF_{tree}, EF_{shrub}, EF_{grass}, and EF_{crop} represent the species emission factors for the four types of growth forms (i.e., PFTs) and **f** is the fraction of the specific growth form in a model grid cell.

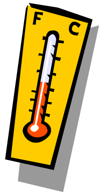
MEGAN v3.2 formulation

The emission activity factor considers the effect of various environmental factors and is calculated as:

$$EA = LAIv \cdot \gamma_p \cdot \gamma_T \cdot \gamma_A \cdot \gamma_{HT} \cdot \gamma_{LT} \cdot \gamma_{HW} \cdot \gamma_{O3} \cdot \gamma_{SM} \cdot \gamma_{CO2} \cdot \gamma_{BD}$$



where LAIv represents the leaf area index of vegetation covered surfaces (=LAI/VCF Vegetation Cover Fraction), γ_p, γ_T , γ_A, γ_{HT}, γ_{LT}, γ_{SW}, γ_{O3}, γ_{SM}, γ_{CO2}, and γ_{BD} represent the activity factors for downward shortwave radiation, 2m air temperature, leaf age, high temperature, low temperature, high wind, O_3 pollution, soil moisture, CO_2 concentration, and bidirectional exchange (vegetation can absorb and emit atmospheric species resulting in lower emissions).

In ***blue*** the stressor that can be activated by the user (specific logical flag).

The increases in temperature, radiation, and soil moisture favour the BVOC emissions, while high/low temperature (>40 or <10 °C) and strong wind (>12 m s^{-1}) as well as heavy O_3 pollution and high CO_2 concentration suppress the BVOC emissions. Currently, the inhibition effect of CO_2 on BVOC emissions (γ_{CO2}) in the model is available only for isoprene and the bidirectional exchange effect (γ_{BD}) only for ethanol and acetaldehyde.

Solar radiation, PAR, and PPFD

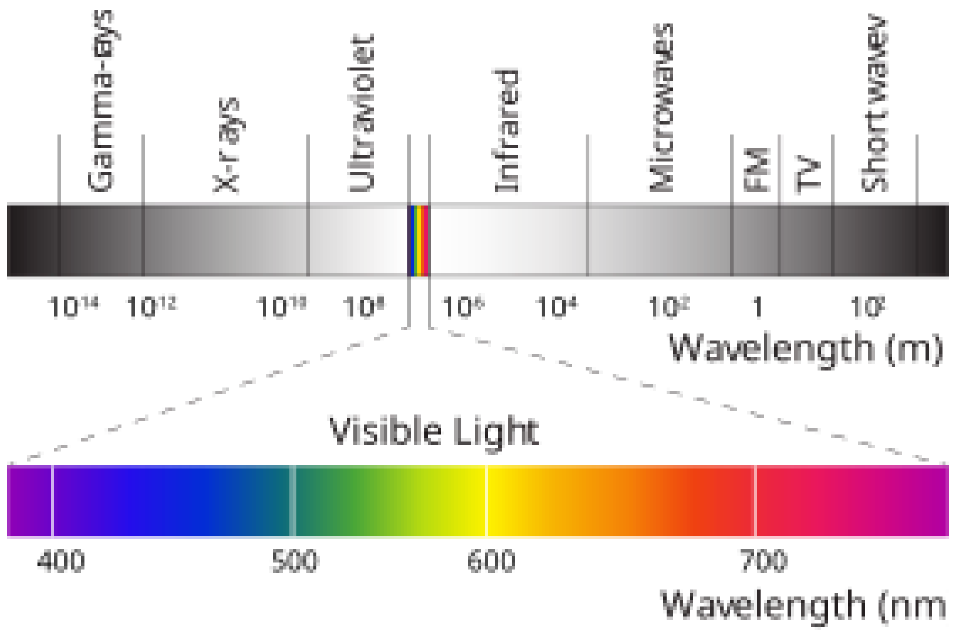
Solar radiation, PAR (Photosynthetically Active Radiation), and PPFD (Photosynthetic Photon Flux Density) are all related to how light energy is used by plants for photosynthesis. Here's a breakdown of the relationship between them:

- **Solar Radiation**: is the total amount of energy (light) that the Sun emits, which includes a broad spectrum of electromagnetic radiation, from ultraviolet (UV) to infrared (IR). The total amount of solar radiation that reaches the Earth's surface is typically measured in Watts per square meter (**W/m^2**). It encompasses all wavelengths, not just the ones plants can use.

- **PAR (Photosynthetically Active Radiation)**: is the portion of the solar radiation that is useful for photosynthesis. It refers to the light wavelengths in the range of 400 to 700 nanometers, which includes the visible spectrum (blue, green, and red light) that plants can absorb and use in photosynthesis.

- **PPFD (Photosynthetic Photon Flux Density)**: is a measure of the amount of light (in the 400-700 nm range) that is available for photosynthesis at a specific location. It measures how many photons in the PAR range are incident on a given area per second ($\mu mol/m^2/s$), and it's typically used in the context of plant growth and greenhouse settings to quantify the light that plants receive.

Solar radiation, PAR, and PPFD



If the **solar radiation** is **1000 W/m²** (a typical sunny day) using MEGAN3.2 values:

$$PAR\ (W/m^2) = 1000\ W/m^2 \times 0.5 = 500\ W/m^2$$

$$\text{PPFD } (\mu mol/m^2/s) = 500 \times 4.5 = 2250\ \mu mol/m^2/s$$

Typically, about **40-50%** of solar radiation falls within the PAR range (400-700 nm), though this can vary depending on atmospheric conditions, latitude, and time of day.

So, to derive **PAR** from **solar radiation**, you can use the following relationship:

$$PAR = Solar\ Radiation \times Fraction\ of\ Solar\ Radiation\ in\ PAR$$

MEGAN 3.2 uses a value of **0.5**

According to Thimijan and Heins (1983), in the range 400-700 nm the conversion factor from W/m² to *μmol/m²/s* is **4.57 μmol/J**.

$$PPFD\ (\mu mol/m^2/s) = PAR\ (W/m^2) \times 4.57$$

MEGAN 3.2 uses a value of **4.5 μmol/J**.

megan 1.0.0

megan 1.0.0
documentation

Search the docs ...

CONTENTS:

megan 1.0.0

megan executes the earlier version of MEGAN3 implemented in CMAQ (v5.4+) by Jeff Willison

Calling syntax ¶

```
megan <nmlfile> <EFfile> <laifile> <soilfile> <dayfile> <metfile> <megfile> <mechname>
```

Command-line arguments

Argument	Type	Description	Format
nmlfile	I	input namelist file	char(xx)
EFfile	I	input file (netCDF) containing EFs, LDFs and CTF (produced by megan-preprocessor)	char(xx)
lai file	I	input file (netCDF) containing LAI (if USE_MEGAN_LAI in namelist file	char(xx)
soilfile	I	input file (netCDF) containing soil texture	char(xx)
dayfile	I	input file (netCDF) containing LAI average temperature, PPFD and LAI (if NOT USE_MEGAN_LAI in namelist file) of the previous 24-hours.	char(xx)
metfile	I	input file (netCDF) containing meteorolo- gical variables	char(xx)
mechname	I	emission speciation label (NONE/ MECHNAME: 19 MEGAN3 species/ MECHNAME species. CB05,CB06,SAPRC99, CB05,SAPRC07T mechs currently available.	char(xx)

```
&megan_NML
USE_MEGAN_LAI = .TRUE.
USE_MEGAN_LAIV = .TRUE.
TSTLEN_MEGAN_LAI = 30
CO2 = 420.
GAMHT_YN = .false.
GAMLT_YN = .false.
GAMHW_YN = .false.
GAMAQ_YN = .false.
GAMSM_YN = .false.
GAMCO2_YN = .false.
GAMBD_YN = .false.
/
```

1) from global data

2) from user vegetation types distribution

1) Preparation of MEGAN "EF file" from global data

https://zenodo.org/records/10939297

zenodo | Search records... | Communities | My dashboard

Published April 8, 2024 | Version v1

Dataset | Open

MEGAN 3.2 input files

Guenther, Alex

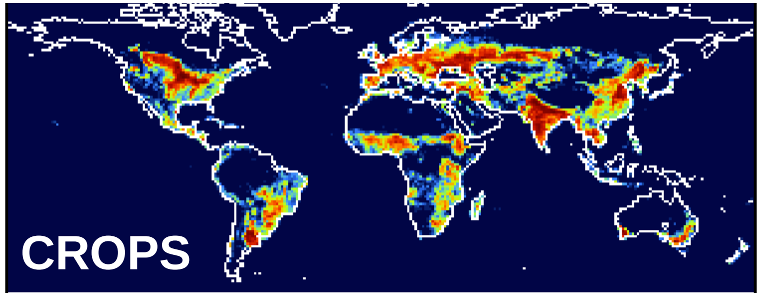
This document describes the contents of three zipped files for modeling BVOC emissions with MEGAN3.2

GFv7nc.zip:

These are global 1km2 maps of the four growth forms. All are in netcdf format

- TC30s7.nc (tree), CC30s7 (crop), SC30s7.nc (shrub), GC30s7.nc (herbaceous)

CC30s7.nc

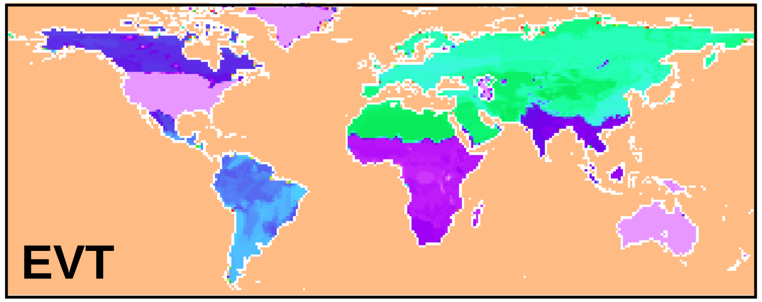


EVT3d.zip:

This is a global 1km2 map of Emission type (EVT) distribution. It is in netcdf format

- EVT3d.nc

EVT3d.nc



EFP20240120.zip:

These files go in the "inputs" folder of the MEGAN EFP emission factor processor. All are in Comma Separated Values ASCII text format

-EFv20240120.csv contains emission factors

-SpeciationCrop230822.csv, SpeciationHerb230822.csv, SpeciationShrub230822.csv, SpeciationTree230921.csv each contain plant species composition for one of the major growth form types.

1) Preparation of MEGAN input "EF file" from global data

Four growth form composition for each ecotype

SpeciationTree230921.csv

EcoTypeID	VegID	treeSpecfrac	EcoTypeDescription	Domain
-999	GFBtr	0.5	Generic Broadleaf Tree	Generic
-999	GFNtr	0.5	Generic Needleleaf tree	Generic
999	AustraliaBtr	1	no vegetation	Australia
1001	AustraliaBtr	1	cool rainforest	Australia
1002	AustraliaBtr	1	tropical rainforest	Australia
1003	Eucalyptus	1	eucalyptus	Australia
1004	Eucalyptus	1	eucalyptus	Australia
1005	Eucalyptus	1	eucalyptus	Australia
1006	AustraliaBtr	1	warm rainforest	Australia
1007	Eucalyptus	1	eucalyptus	Australia
1008	Eucalyptus	1	eucalyptus	Australia
1009	Eucalyptus	1	eucalyptus	Australia
1010	Eucalyptus	1	eucalyptus	Australia
1011	AustraliaBtr	1	tropical mixed	Australia
1012	Callitris	1	Callitris	Australia
1013	Acacia harpophylla	1	Acacia harpophylla	Australia
1014	Acacia	1	Acacia	Australia
1015	Melaleuca	1	Melaleuca	Australia
1016	AustraliaBtr	1	Australian other trees	Australia
1017	AustraliaBtr	1	Australian other trees	Australia
1018	Eucalyptus	1	eucalyptus	Australia
1019	Eucalyptus	1	eucalyptus	Australia
1020	Acacia aneura	1	Acacia aneura	Australia
1021	Acacia	1	Acacia	Australia
1022	Acacia	1	Acacia	Australia
1023	Acacia	1	Acacia	Australia
1024	Acacia	1	Acacia	Australia
1025	Acacia	1	Acacia	Australia
1026	Allocasuarina	0.5	Allocasuarina	Australia
1026	Casuarina	0.5	Casuarina	Australia
1027	Eucalyptus	1	eucalyptuc	Australia
1028	Acacia	0.34	Acacia	Australia
1028	Banksia	0.33	Banksia	Australia
1028	Melaleuca	0.33	Melaleuca	Australia

SpeciationCrop230822.csv

EcoTypeID	VegID	ropSpecFra
-999	GFCrop	1
999	GFCrop	1
1001	GFCrop	1
1002	GFCrop	1
1003	GFCrop	1
1004	GFCrop	1
1005	GFCrop	1
1006	GFCrop	1
1007	GFCrop	1
1008	GFCrop	1
1009	GFCrop	1
1010	GFCrop	1
1011	GFCrop	1
1012	GFCrop	1
1013	GFCrop	1
1014	GFCrop	1
1015	GFCrop	1
1016	GFCrop	1
1017	GFCrop	1
1018	GFCrop	1
1019	GFCrop	1
1020	GFCrop	1
1021	GFCrop	1
1022	GFCrop	1
1023	GFCrop	1
1024	GFCrop	1
1025	GFCrop	1
1026	GFCrop	1
1027	GFCrop	1
1028	GFCrop	1

SpeciationHerb230822.csv

EcoTypeID	VegID	erbSpecFra
-999	GFHerb	1
999	GFHerb	1
1001	GFHerb	1
1002	GFHerb	1
1003	GFHerb	1
1004	GFHerb	1
1005	GFHerb	1
1006	GFHerb	1
1007	GFHerb	1
1008	GFHerb	1
1009	GFHerb	1
1010	GFHerb	1
1011	GFHerb	1
1012	GFHerb	1
1013	GFHerb	1
1014	GFHerb	1
1015	GFHerb	1
1016	GFHerb	1
1017	GFHerb	1
1018	GFHerb	1
1019	GFHerb	1
1020	GFHerb	1
1021	GFHerb	1
1022	GFHerb	1
1023	GFHerb	1
1024	GFHerb	1
1025	GFHerb	1
1026	GFHerb	1
1027	GFHerb	1
1028	GFHerb	1

SpeciationShrub230822.csv

EcoTypeID	VegID	ShrubSpecFrac
-999	GFShrub	1
999	GFShrub	1
1001	GFShrub	1
1002	GFShrub	1
1003	GFShrub	1
1004	GFShrub	1
1005	GFShrub	1
1006	GFShrub	1
1007	GFShrub	1
1008	GFShrub	1
1009	GFShrub	1
1010	GFShrub	1
1011	GFShrub	1
1012	GFShrub	1
1013	GFShrub	1
1014	GFShrub	1
1015	GFShrub	1
1016	GFShrub	1
1017	GFShrub	1
1018	GFShrub	1
1019	GFShrub	1
1020	GFShrub	1
1021	GFShrub	1
1022	GFShrub	1
1023	GFShrub	1
1024	GFShrub	1
1025	GFShrub	1
1026	GFShrub	1
1027	GFShrub	1
1028	GFShrub	1

1) Preparation of MEGAN input “EF file” from global data

suez ARIANET

Emission factors: EFv20240120.csv

Possibility to insert «user» Efs !

VegID	CommonName	GenusGroup	Family	GrowthFo	Type	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9	EF10	EF11	EF12	EF13	EF14	EF15	EF16	EF17	EF18	EF19	LDF3	LDF4	LDF5	LDF6
Abies	fir	Abies	Pinaceae	Ntr	genus	0.5	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies alba	silver fir	AbiesIso2	Pinaceae	Ntr	species	8	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies amabilis	Pacific silver fir	Abies	Pinaceae	Ntr	species	0.003	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies balsamea	balsam fir	Abies	Pinaceae	Ntr	species	0.003	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies borisii-regis	fir	AbiesIso	Pinaceae	Ntr	species	8	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies bornmulleriana	Uludag fir	Abies	Pinaceae	Ntr	species	0.5	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies bracteata	bristlecone fir	Abies	Pinaceae	Ntr	species	0.003	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies cephalonica		AbiesIso	Pinaceae	Ntr	species	8	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies cilicica		AbiesIso	Pinaceae	Ntr	species	8	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies concolor	white fir	Abies	Pinaceae	Ntr	species	0.003	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies equi-trojani	fir	AbiesIso	Pinaceae	Ntr	species	8	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Abies fraseri	Fraser fir	Abies	Pinaceae	Ntr	species	0.5	0.003	0.2	0.2	0.05	0.2	0.03	0.05	0.09	0.06	1.6	0.4	0.7	0.4	1.5	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4

Ecotype: 1028

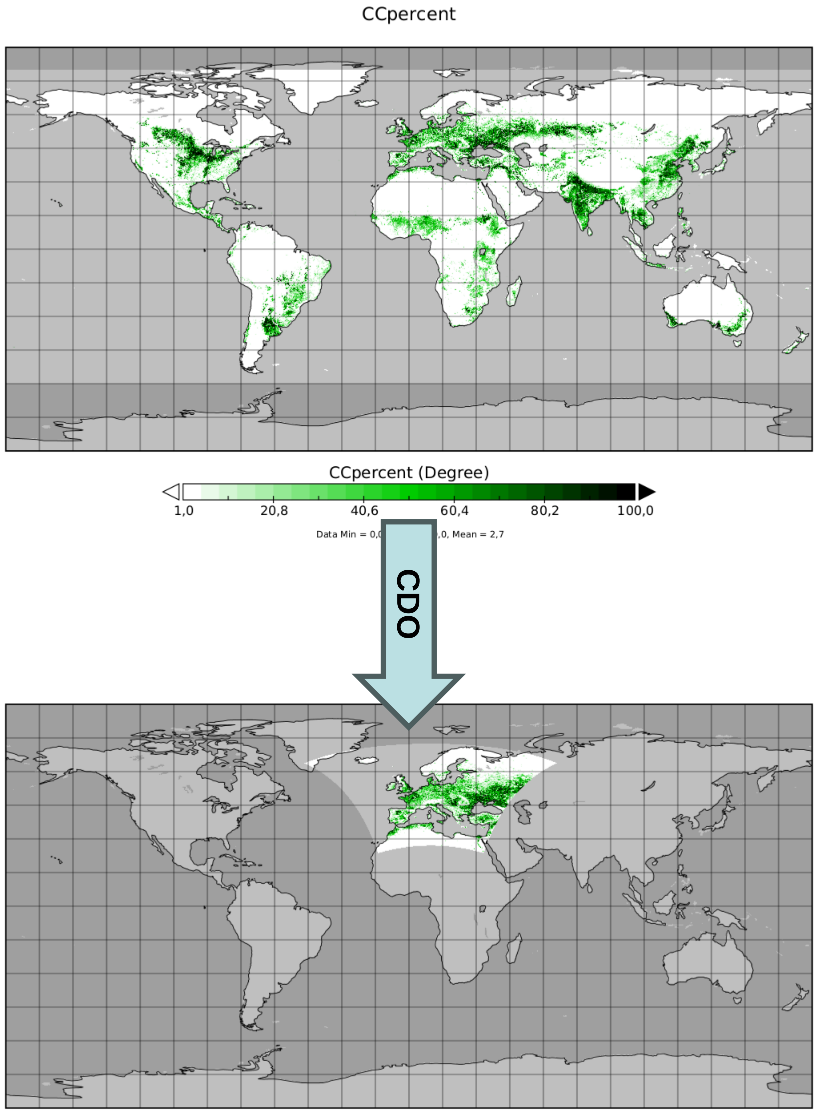
VegID	CommonName	GenusGroup	Family	Growth	Type	EF1	EF2	EF3	EF4	EF5	EF6	EF	EF	EF9	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF	LD	LD	LD	LD
Acacia	acacia	Acacia	Fabaceae	Btr	genus	5	0.003	0.3	0.1	0.1	0.1	0.03	0.05	0.06	0.04	1.6	0.4	0.7	0.4	1.2	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Banksia		Banksia	Proteaceae	Unknown	genus	6	0.01	0.4	0.3	0.18	0.25	0.03	0.05	0.06	0.04	1.4	0.4	0.7	0.4	1.2	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
GFCrop		Crop	Crop	Crop	GF	0.05	0.01	0.05	0.08	0.03	0.05	0.03	0.5	0.01	0.01	0.8	0.2	0.35	0.1	1	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
GFHerb		Herb	Herb	Herb	GF	1	0.01	0.1	0.12	0.03	0.05	0.03	0.5	0.01	0.01	0.8	0.2	0.35	0.1	1	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
GFShrub		Shrub	Shrub	Shrub	GF	4	0.1	0.4	0.35	0.12	0.2	0.03	0.05	0.06	0.04	1.6	0.4	0.7	0.4	1.2	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4
Melaleuca	melaleuca	Melaleuca	Myrtaceae	Btr	genus	16	0.003	0.4	0.25	0.1	0.3	0.03	0.05	0.06	0.04	1.6	0.4	0.7	0.4	1.2	0.1	0.2	0.04	1	0.5	0.8	0.3	0.4

1	ISOP	isoprene
2	MBO	MBO
3	MT_PINE	monoterpenes: pines (alpha and beta)
4	MT_ACYC	monoterpenes: acyclic, 3 = (e.g., myrcene, ocimenes)
5	MT_CAMP	monoterpenes: carene, camphene, others
6	MT_SABI	monoterpenes: sabinene, limonene, terpinenes, others
7	MT_AROM	C10 aromatic: cymenes
8	NO	Nitric oxide
9	SQT_HR	Highly reactive SQT (e.g., caryophyllene)
10	SQT_LR	less reactive SQT (e.g., longifolene, copaene) and salates
11	MEOH	methanol
12	ACTO	acetone
13	ETOH	acetaldehyde and ethanol
14	ACID	organic acids: formic acid, acetic acid, pyruvic acid
15	LVOC	C2 to C4 HC (e.g., ethene, ethane)
16	OXPROD	oxidation products: aldehydes
17	STRESS	Stress compounds (e.g. linalool)
18	OTHER	other VOC (e.g., indole, pentane, methyl bromide)
19	CO	carbon monoxide

1) *Preparation of MEGAN input "EF file"* from global data

SUEZ ARIANET

a) Regrid global 1 km² maps (netCDF) of the four growth forms and EVT to the given domain



b) Run "megan-preprocessor" to prepare the MEGAN3.2 input file containing gridded EFs, LDFs and CTFs for the given domain

megan-preprocessor 1.0.0 documentation

Search the docs ...

CONTENTS:

megan-preprocessor 1.0.0

megan-preprocessor produces a gridded netCDF file containing: - emission potentials (EF) for 19 MEGAN 3.2 species (nmoles m2_leafarea s-1); - light depending factors (LDF) for 4 MEGAN 3.2 species (adimensional); - fractional information for six canopy types.

Calling syntax

```
megan_preprocessor <vegfile> <cropfile> <herbfile> <shrubfile> <treefile> <EFinfile> <EFoufile>
```

Command-line arguments

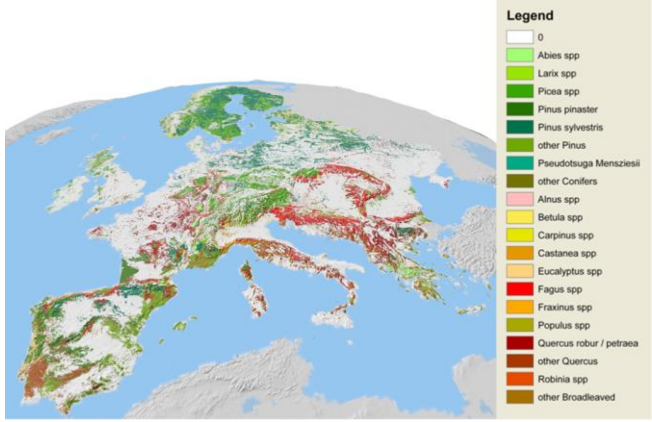
Argument	Type	Description	Format
vegfile	I	input binary archive (netCDF) containing Emission Vegetation type (EVT) distribution and crops, herbaceous, shrub and tree cover fractions	char(xx)
cropfile	I	input file (csv) containing crop composition for each EVT (ecotype)	char(xx)
herbfile	I	input file (csv) containing herbaceous composition for each EVT (ecotype)	char(xx)
shrubfile	I	input file (csv) containing shrub composition for each EVT (ecotype)	char(xx)
treefile	I	input file (csv) containing tree composition for each EVT (ecotype)	char(xx)
EFinfile	I	input file (csv) containing vegetation emission factors	char(xx)
EFoufile	O	output file (netCDF) containing vegetation EF, LDF and canopy information	char(xx)

2) Preparation of MEGAN input *"EF file"* from user VTD

a) Prepare maps (netCDF) containing vegetation types distribution (used by PSEM)

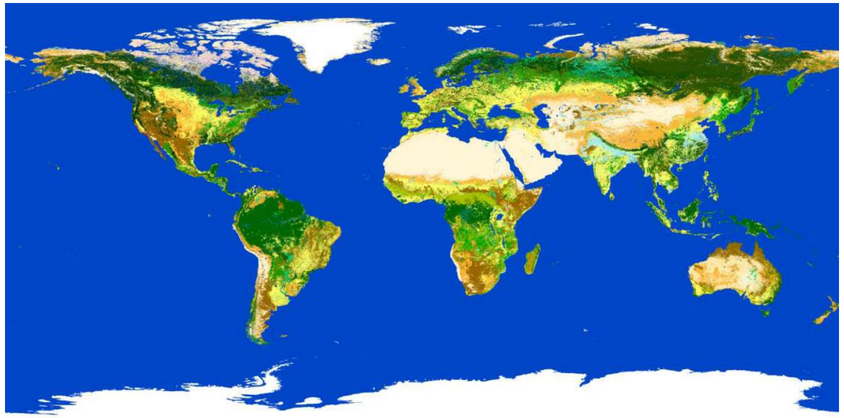
EFI: 1x1 km tree species maps of 20 tree species distribution over Europe (Brus et al. 2011).

https://www.efi.int/knowledge/maps/treespecies



ESA Land Cover CCI: global annual and consistent LC maps from 1992 to 2015, 300m resolution.

https://www.esa-landcover-cci.org/



VEGFILE

EFI tree species maps for European forests patched with ESA Land Cover

Range and resolution: lon: -26÷46; lat: 29÷73; 0.0125x0.0125 deg.

2) Preparation of MEGAN input "EF file" from user data (e.g. PSEM VTP)

b) Run "psem2megan" to prepare the MEGAN3.2 input file containing gridded EFs, LDFs and CTFs for the given domain

psem2megan 1.0.0 documentation

Search the docs ...

CONTENTS:

psem2megan 1.0.0

psem2megan produces a gridded netCDF file containing: - emission potentials (EF) for 19 MEGAN 3.2 species (nmoles m2_leafarea s-1); - light depending factors (LDF) for 4 MEGAN 3.2 species (adimensional); - fractional information for six canopy types.

Calling syntax

```
psem2megan <vegfile> <mapfile> <EFinfile> <EFoufile>
```

Command-line arguments

Argument	Type	Description	Format
vegfile	I	input binary archive (netCDF) containing PSEM vegetation types disribution	char(xx)
mapfile	I	input file (csv) containing mapping between PSEM and MEGAN vegetation types	char(xx)
EFinfile	I	input file (csv) containing vegetation emission factors	char(xx)
EFoutfile	O	output file (netCDF) containing vegetation EF, LDF and canopy information	char(xx)

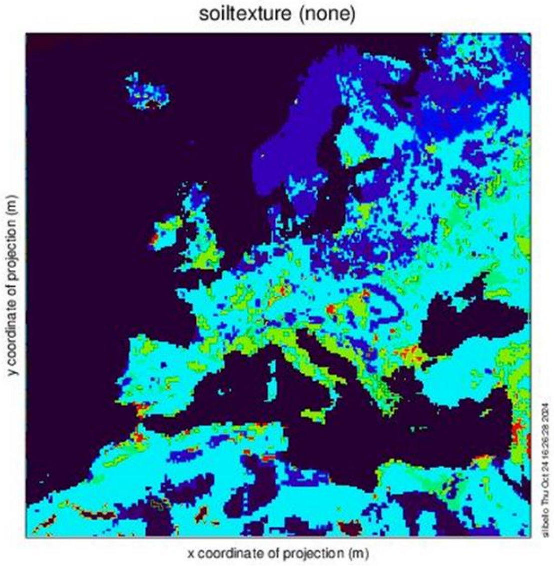
PSEM2MEGAN.csv (mapfile)

EFI: rows AbiesSpp – RobiniaSpp; ESA: rows c_10 – c_180

PSEM name	# Megan	percentage	Megan Name	percentage	Megan Name	percentage	Megan Name	percentage	Megan Name	percentage	Megan Name
AbiesSpp	1	100	Abies								
AlnusSpp	1	100	Alnus								
BetulaSpp	1	100	Betula								
Broadleaf	1	100	GFBtr								
Carpinus	1	100	Carpinus								
Castanea	1	100	Castanea sativa								
Conifers	1	100	GFNtr								
Eucalyptus	1	100	Eucalyptus								
FagusSpp	1	100	Fagus								
Fraxinus	1	100	Fraxinus								
LarixSpp	1	100	Larix								
PiceaSpp	1	100	Picea								
PinusMis	1	100	Pinus								
PinusPin	1	100	Pinus pinaster								
PinusSyl	1	100	Pinus sylvestris								
PopulusSpp	1	100	Populus								
PseudotsugaM	1	100	Pseudotsuga menziesii								
QuercusMis	1	100	Quercus								
QuercusR-P	1	100	Quercus robur								
RobiniaSpp	1	100	Robinia								
c_10	1	100	GFCrop								
c_20	1	100	GFCrop								
c_30	5	60	GFCrop	7	GFBtr	7	GFNtr	13	GFHerb	13	GFShrub
c_40	5	40	GFCrop	10	GFBtr	10	GFNtr	20	GFHerb	20	GFShrub
c_50	1	100	GFBtr								
c_60	1	100	GFBtr								
c_70	1	100	GFNtr								
c_80	1	100	GFNtr								
c_90	2	50	GFBtr	50	GFNtr						
c_100	4	15	GFBtr	15	GFNtr	40	GFHerb	30	GFShrub		
c_110	4	10	GFBtr	10	GFNtr	60	GFHerb	20	GFShrub		
c_120	1	100	GFShrub								
c_130	1	100	GFHerb								
c_140	1	100	Sphagnum								
c_150	4	17	GFBtr	17	GFNtr	33	GFHerb	33	GFShrub		
c_160	1	100	GFBtr								
c_170	1	100	GFBtr								
c_180	2	50	GFHerb	50	GFShrub						

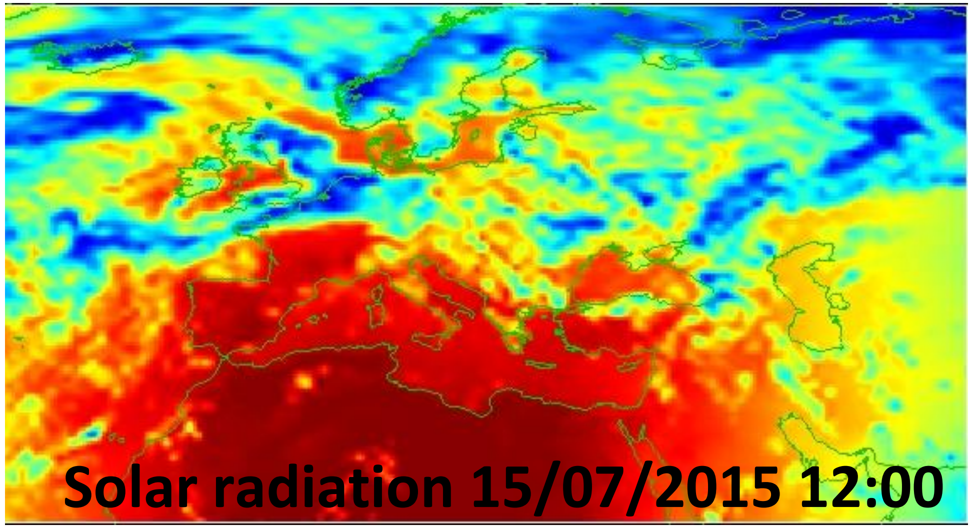
Preparation of MEGAN input "soilfile" (γ_{SM})

Soil type	wilting point
1. Sand	0.068
2. Loamy Sand	0.075
3. Sandy Loam	0.114
4. Silt Loam	0.179
5. Silt	0.155
6. Loam	0.175
7. Sandy Cay Loam	0.218
8. Silty Clay Loam	0.25
9. Clay Loam	0.219
10. Sandy Clay	0.283
11. Silty Clay	0.286
12. Clay	0.286
13. Organic Materials	0.286
14. Water	0.286
15. Bedrock	0.286
16. Other	0.286

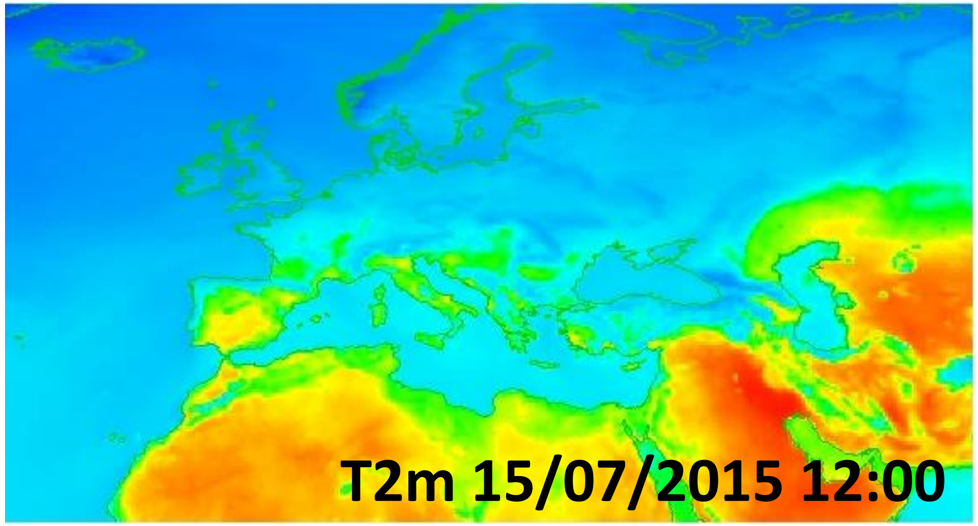


Preparation of MEGAN input "metfile"

Meteorological data from ERA5: 'TEMP2','RGRND','PRSFC',’WSPD10','Q2','SOIM1','SOIM2','SOIT1','RN','RC’/ 'RN' and ‘RC' not mandatory assumed to be null if not available



Solar radiation (RGRND)



Temperature (TEMP2)

Supplemetary data:

LAI: ERA5 or **Yuan monthly global LAI,** Global monthly mean 0.05-degree resolution, 2010-2023 or **ORNL/DAAC** Global Monthly Mean Leaf Area Index Climatology, 1981-2015.

Soil moisture (SOIM1, SOIM2) and soil temperature (SOIT1): ERA5

Reference BVOC emissions data for comparison

MEGAN 2.1 – (Sinderalova et al., 2022)

Earth Syst. Sci. Data, 14, 251–270, 2022
https://doi.org/10.5194/essd-14-251-2022

Open Access
Earth System Science Data

High-resolution biogenic global emission inventory for the time period 2000–2019 for air quality modelling

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MEGAN 3.2 (Wang et al., 2024)

Atmos. Chem. Phys., 24, 3309–3328, 2024
https://doi.org/10.5194/acp-24-3309-2024

Atmospheric Chemistry and Physics
Open Access
EGU

Research article

Regional to global distributions, trends, and drivers of biogenic volatile organic compound emission from 2001 to 2020

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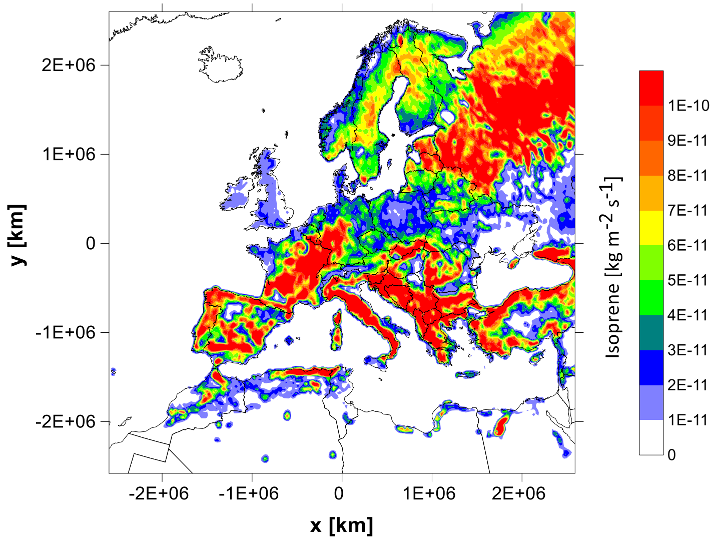
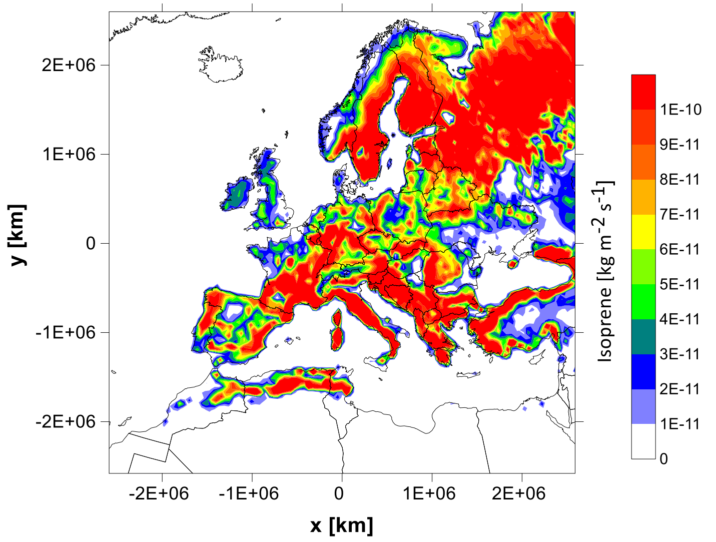
Received: 10 August 2023 – Discussion started: 11 August 2023
Revised: 14 January 2024 – Accepted: 5 February 2024 – Published: 18 March 2024

July 2018, Monthly averaged emissions: Isoprene

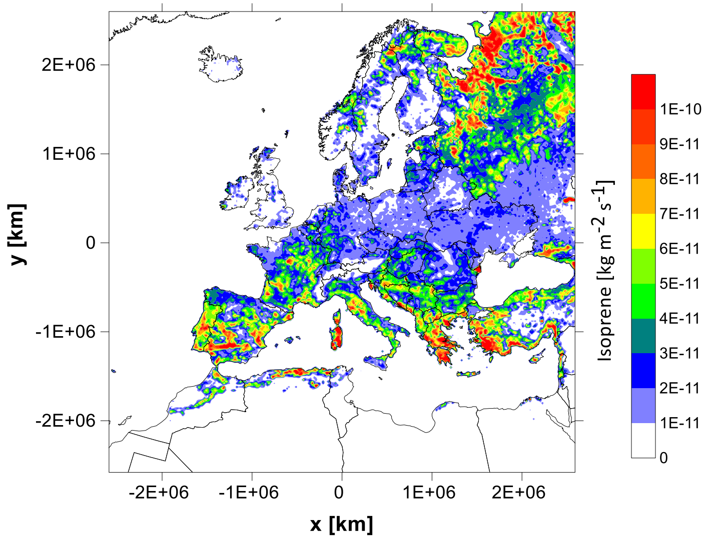
MEGAN 2.1



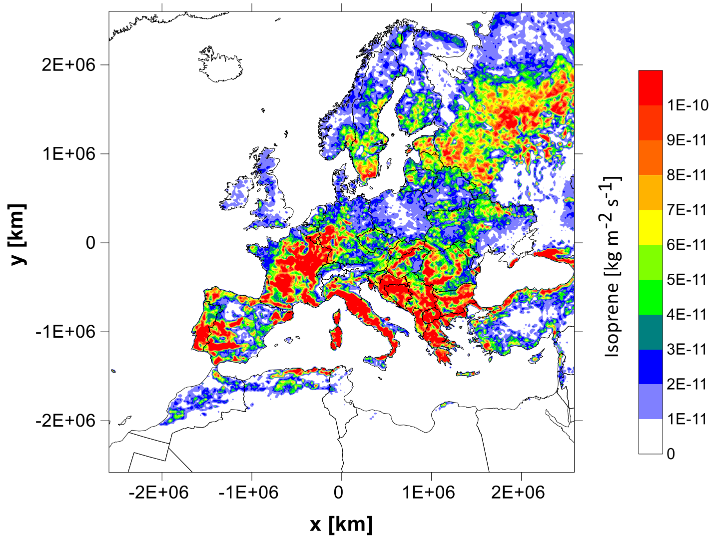
MEGAN 3.2



PSEM



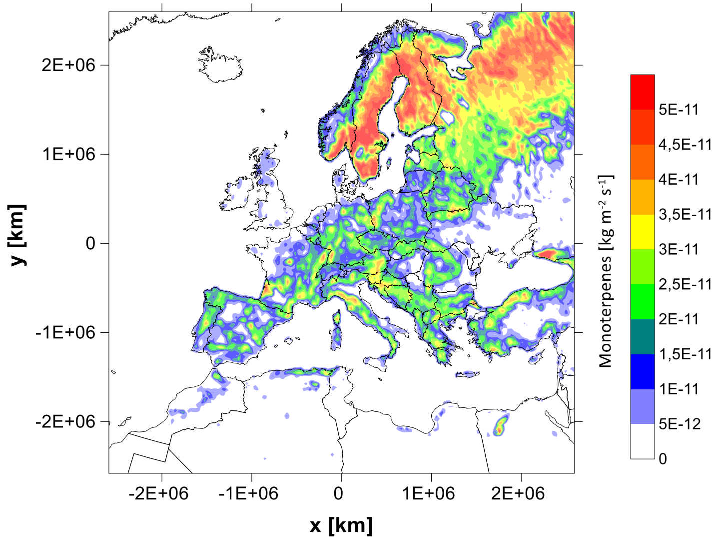
MEGAN 3.2 (ARIANET)



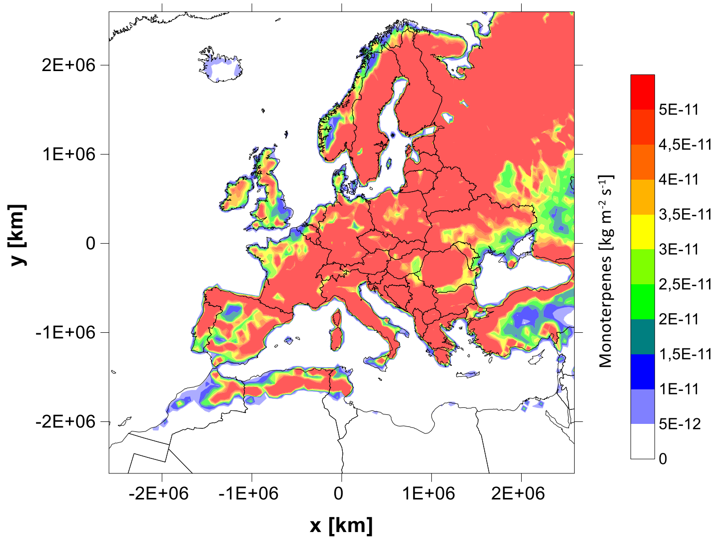
"EFfile" from user data (EFI patched with ESA)

July 2018, Monthly averaged emissions: Monoterpenes

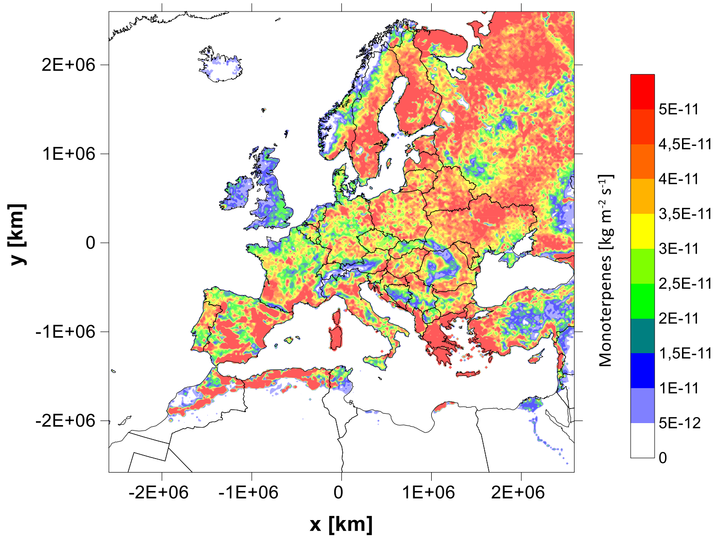
MEGAN 2.1



MEGAN 3.2



PSEM



“EFfile” from user data (EFI patched with ESA)

MEGAN 3.2 (ARIANET)