ESTIMATION OF BIOGENIC NMVOCs EMISSIONS OVER THE BALKAN REGION

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GENERAL DESCRIPTION OF THE EMISSION INVENTORY

- ✓ **Estimation of biogenic Isoprene, Monoterpenes and Other VOCs emissions.**
- ✓ **Land use types: Forests, Shrub land, Grassland, Agricultural crops.**
- ✓ **Spatial resolution: 1km.**
- ✓ **Temporal resolution: Typical diurnal variation for every month of a year.**

GENERAL METHODOLOGY (1)

$$\text{Flux } (\mu g\text{-}C\ m^{-2}\ yr^{-1}) = \int \varepsilon \,.\, D \,.\, \gamma \, dt$$

ε = emission potential (µg-C g^{-1} h^{-1}) of species

D = foliar biomass density (g m^{-2})

γ = environmental correction factor (unit less) (*Guenther et al., 1993)*

Isoprene :

$$\gamma_{iso} = C_{Liso} \,.\, C_{Tiso}$$

$$C_{L_{iso}} = \frac{\alpha c_{L1} L}{\sqrt{1+\alpha^2 L^2}} \leftrightarrow$$

L= Photosynthetically Active Radiation flux (µmol photons (400-700nm) m^{-2} s^{-1}) (PAR)

$$C_{T_{iso}} = \frac{\exp(C_{T1}(T-T_s)/RT_sT)}{1+\exp(C_{T2}(T-T_M)/RT_sT)} \leftrightarrow$$

T= Leaf temperature (K)

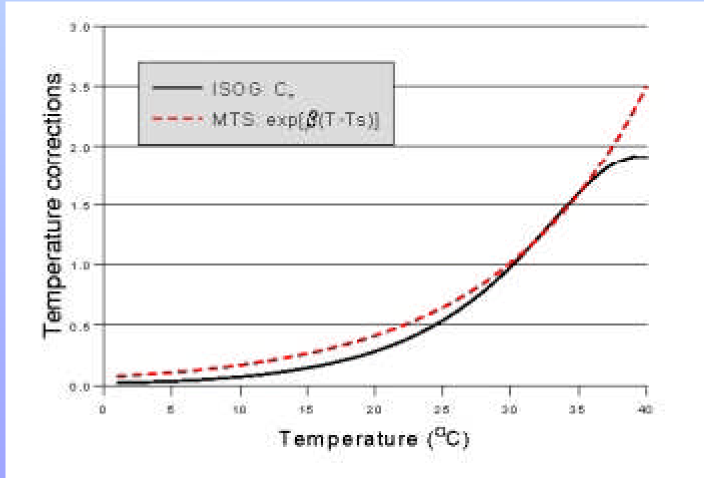
GENERAL METHODOLOGY (2)

Monoterpenes and OVOCs :

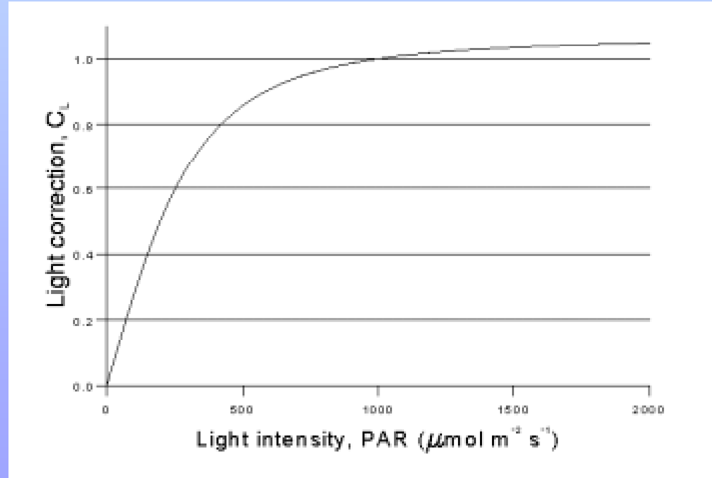
$$\gamma_{mts} = \exp(\beta * (T - T_S))$$

↕

T= Leaf temperature (K)



Temperature dependency of biogenic NMVOCs emissions



Light dependency of biogenic NMVOCs emissions

(EMEP/CORINAIR Emission Inventory Guidebook)

GIS TECHNOLOGY

A Geographic Information System was used to integrate:

(i) Satellite land-use data

(ii) Vegetation type/species emission potentials and biomass densities

(iii) Climatic temperature data

(iv) Photosynthetically Active Radiation flux data

in order to produce the spatially and temporally resolved biogenic NMVOCs emission inventory over the Balkan Region.

LAND USE DATABASE

✓ **Global Land Cover Characterization database *(USGS – UNL – JRC)***

- **Data of 1-km nominal spatial resolution based on 1-km AVHRR data spanning April 1992 through March 1993.**
- **Use of the Seasonal Land Cover Regions classification legend.**
- **Calculations performed for 126 land use types consisted of one or more vegetation species / types.**

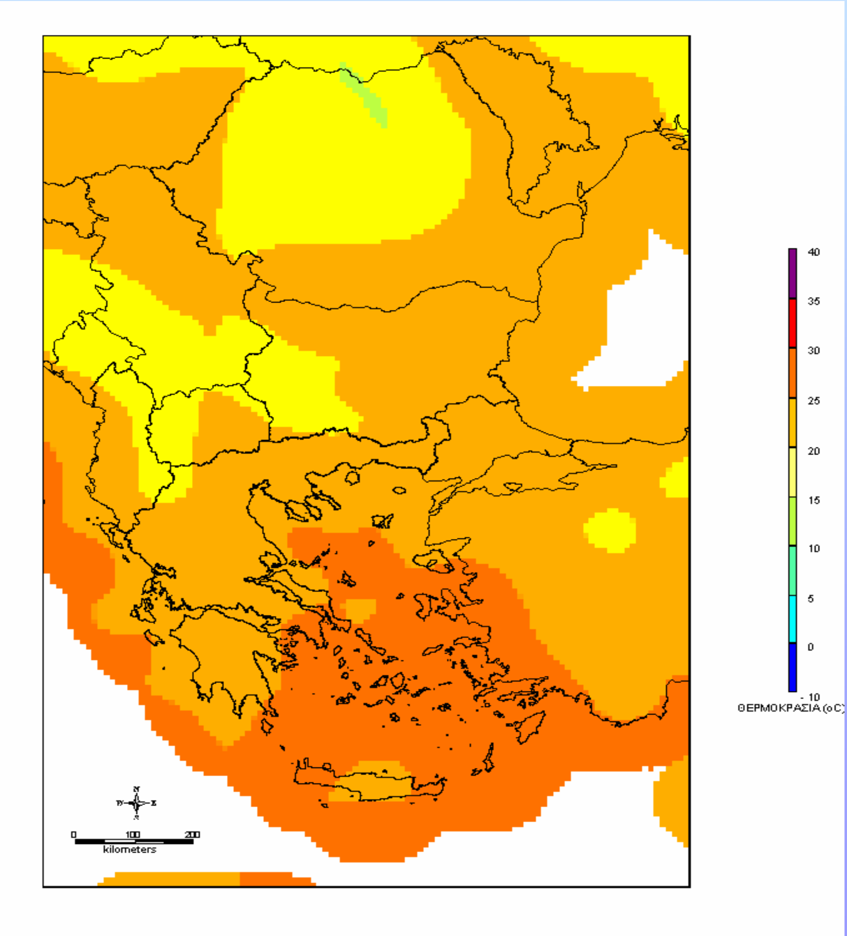
EMISSION POTENTIALS AND BIOMASS DENSITIES SOURCES

- **EMEP/CORINAIR Emission Inventory Guidebook**, 2002.
- **Guenther**, A., Hewitt, N., Erickson, D., Fall, R., Geron, C., Graedel, T., Harley, P., Klinger, L., Lerdau, M., McKay, W., Pierce, T., Scholes, B., Steinbrecher, R., Tallamraju, R., Taylor, J. and Zimmerman, P., 1995. A global model of natural volatile organic compound emissions. J. Geophys. Res., 100, pp. 8873-8892.
- **Guenther**, A., Zimmerman, P. and Wildermuth, M., 1994. Natural volatile organic compound emission rate estimates for U.S. woodland landscapes. *J. Geophys. Res.*, 28, pp. 1197-1210.
- **Geron**, C., Guenther, A. and Pierce, T., 1994. An improved model for estimating emissions of volatile organic compounds from forests in the Eastern United States. J. Geophys. Res., 99, pp. 12773-12792.
- **Lamb**, B., Gay, D., Westberg, H. and Pierce, T., 1993. A biogenic hydrocarbon emission inventory for the U.S.A. using a simple forest canopy model. Atmospheric Environment, 27, pp. 1673-1690.
- **Levis**, S., Wiedinmyer, C., Bonan, G. B. and Guenther A., 2003. Simulating biogenic volatile organic compound emissions in the Community Climate System Model. J. Geoph. Res., 108, No. D21, 4659, doi:10.1029/2002JD003203.
- **Parra**, R., Gasso, S. and Baldasano, J.M., 2004. Estimating the biogenic emissions of non-methane volatile organic compounds from the North Western Mediterranean vegetation of Catalonia, Spain. Science of the Total Environment, 329, pp. 241–259.

- **Emission potentials and biomass densities assigned for each land use type for every month of a year.**

TEMPERATURE DATABASE

✓ **CRU Global Climate Dataset *(IPCC Data Distribution Centre)***



Mean Temperature (^oC) - July

- **Monthly Climatic Temperature data of 0.5º latitude by 0.5º longitude resolution for the period 1981-1990.**
- **Use of the inverse distance interpolation method to increase the spatial resolution of temperature data to 10 km.**
- **Temperature diurnal variation simulated by a step function: temperature has minimum value at local sunrise, increases hourly until it reaches a peak value 2 hours after local afternoon and decreases again to reach minimum value.**

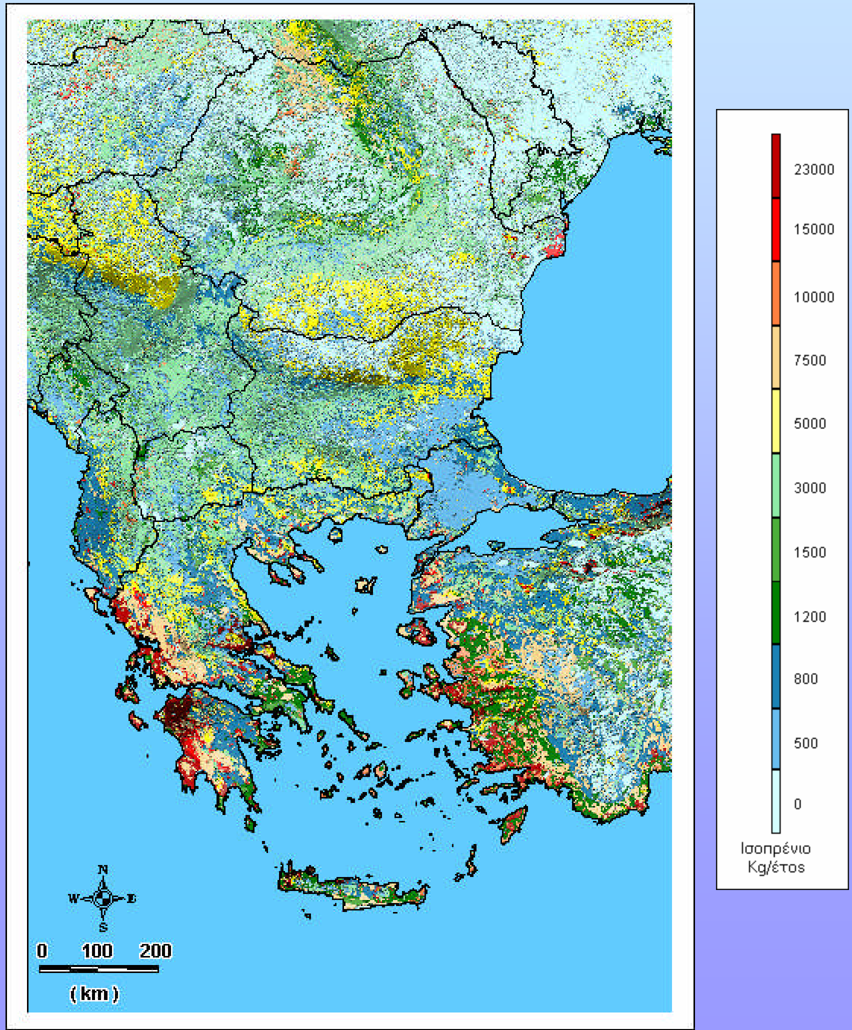
PHOTOSYNTHETICALLY ACTIVE RADIATION

✓ **PAR calculated using the Tropospheric Ultraviolet and Visible model (TUV version 4.0) *(Madronich, 1993)***

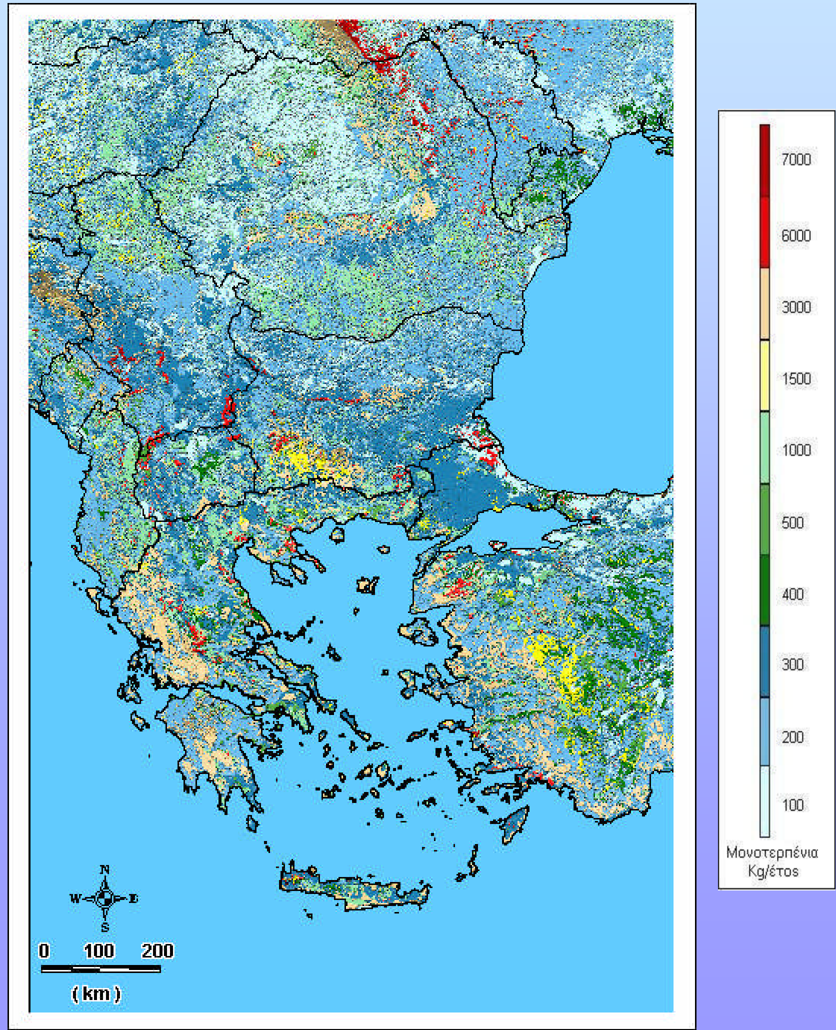
- **Calculations of typical diurnal variation of PAR for every month of a year at selected points covering the study area.**
- **Spatial resolution of calculations = 50 km increased to 10 km using the inverse distance interpolation method.**
- **Elevation data from the Global Land One-Kilometer Base Elevation (GLOBE) Digital Elevation Model (DEM) of 30'' spatial resolution *(National Geophysical Data Center of NOAA)*.**
- **Total ozone = 300 D.U.**
- **Cloudless sky.**
- **Aerosol optical depth = 0.38**
- **Use of optical properties for continental type aerosols.**

ANNUAL BIOGENIC NMVOCs EMISSIONS

Isoprene (kgr-C/year)

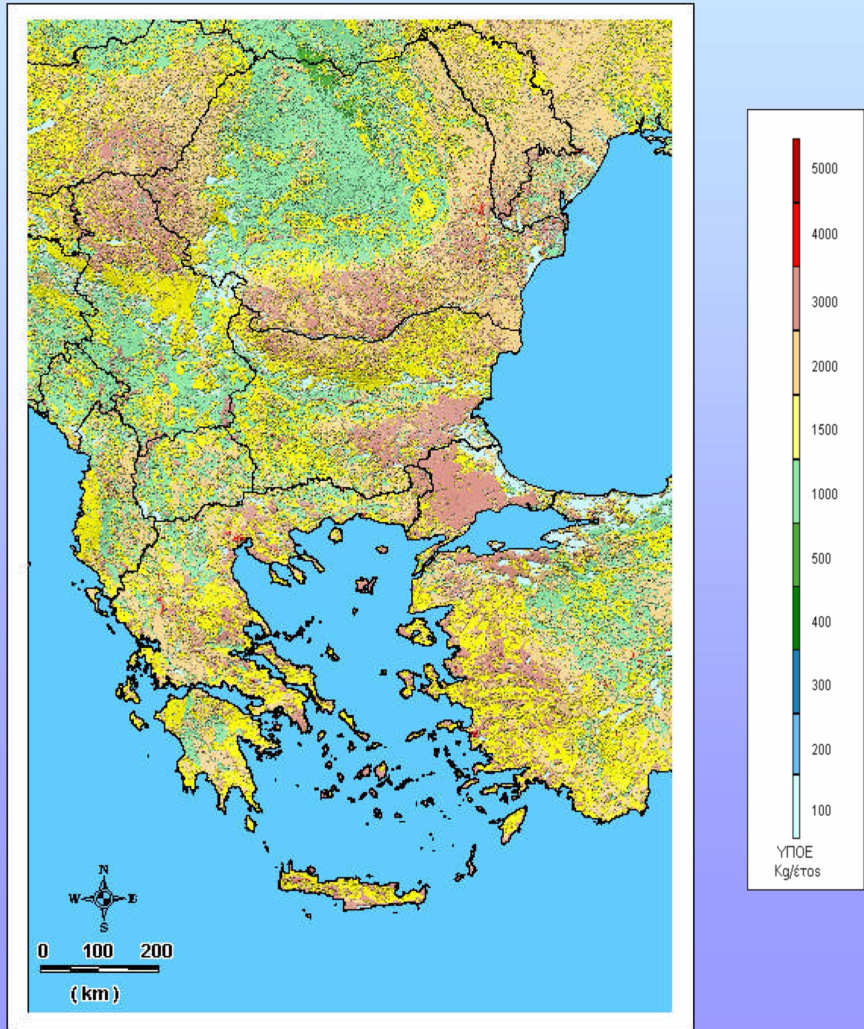


Monoterpenes (kgr-C/year)



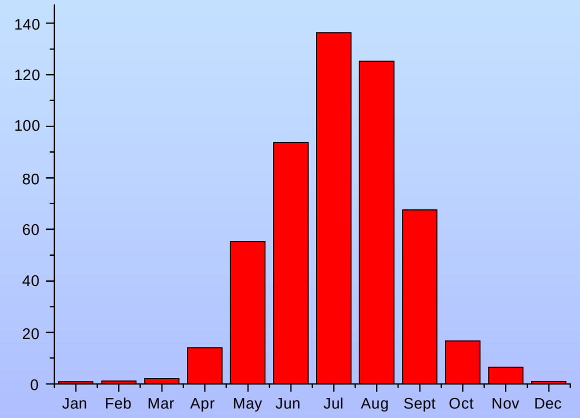
ANNUAL BIOGENIC NMVOCs EMISSIONS

OVOCs (kgr-C/year)

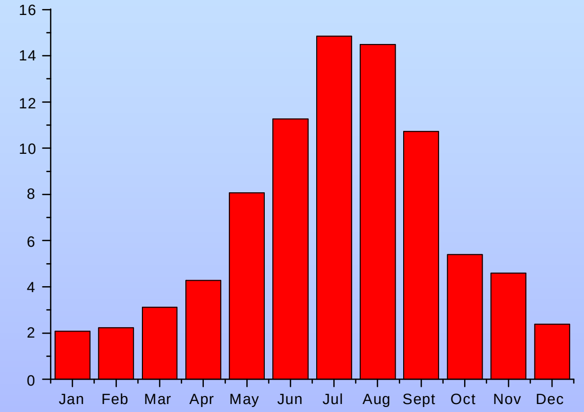


SEASONAL VARIATION OF BIOGENIC NMVOCs EMISSIONS OVER GREECE

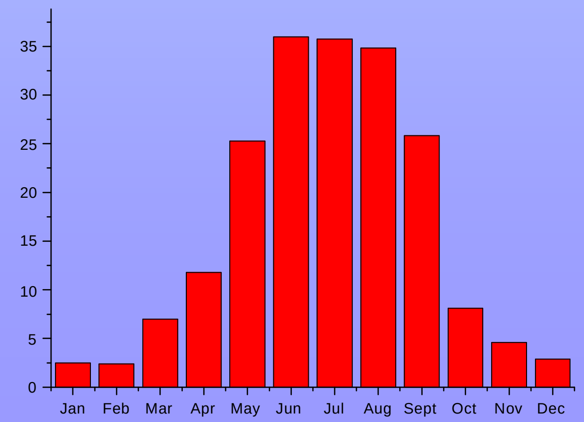
Isoprene (Gg-C)



Monoterpenes (Gg-C)

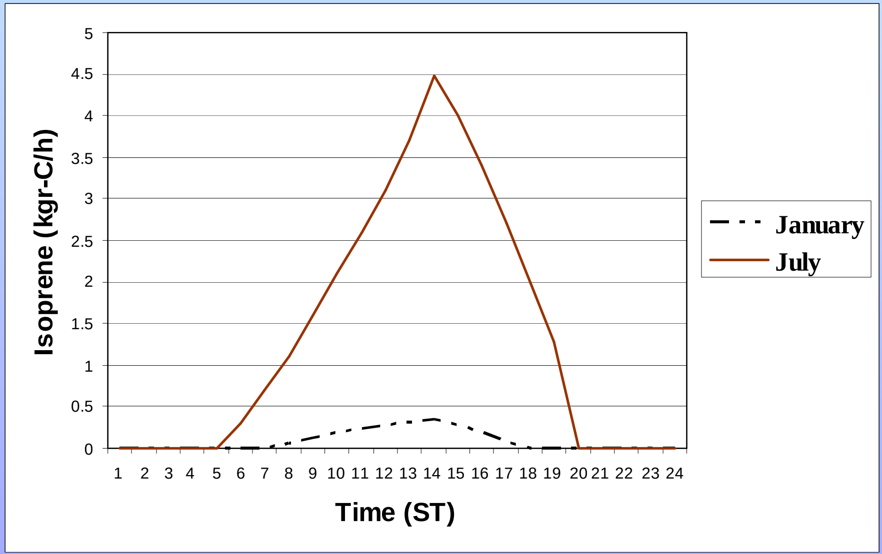


OVOCs (Gg-C)



DIURNAL VARIATION OF BIOGENIC NMVOCs EMISSIONS

Southern Greece



Central Greece