MODELING BIOGENIC EMISSIONS OF VOLATILE ORGANIC COMPOUNDS

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Model development

- **Isoprene**
- **Monoterpenes**
- **Other VOCs (bulk emission)**

LAI
Leaf age
Soil moisture

**Flux
mgC/m²/s**

Atmospheric CO_2

Emission Factor
VOC, PFT

Temperature
Radiation
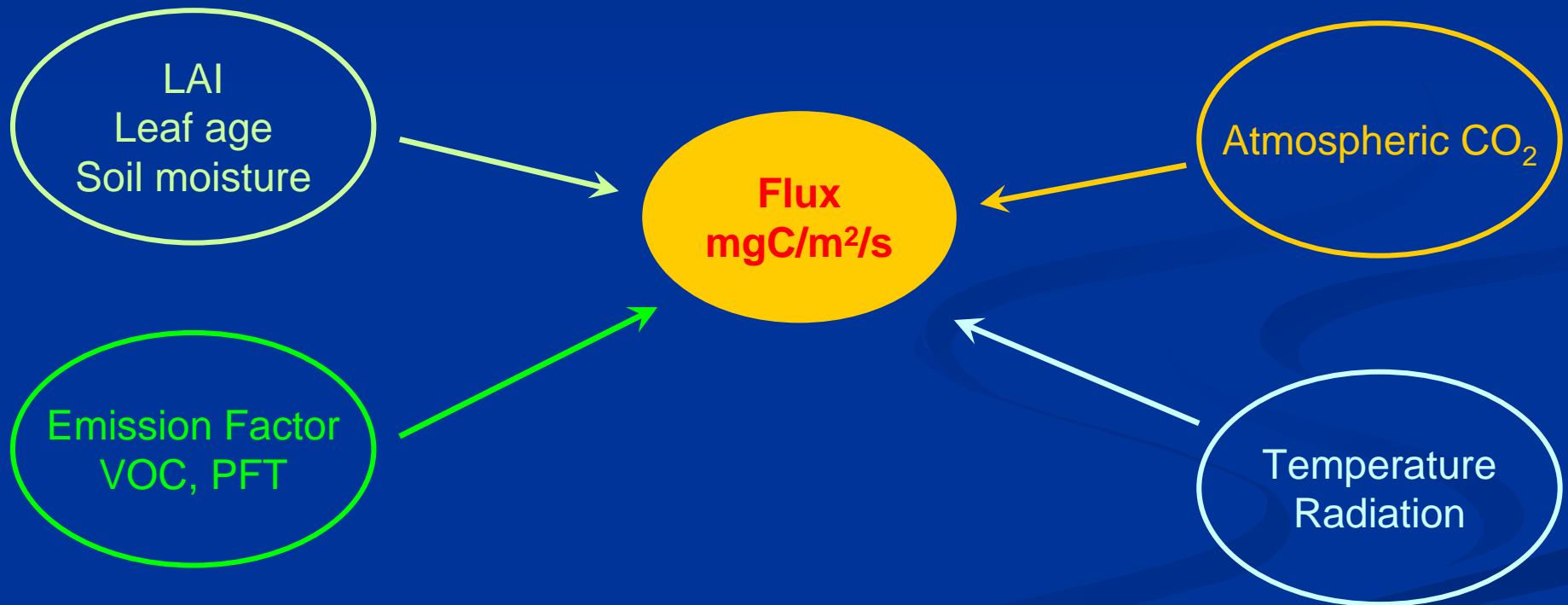
Model development

■ **Model structure**

① <u>Isoprene:</u> from Guenther et al. (2006) (MEGAN)

→ Temperature and radiation dependent
→ Soil moisture
→ Canopy loss: 4%
→ Leaf age
→ Global map for emission factors available for the present-day

→ Impact of atmospheric CO_2 implemented
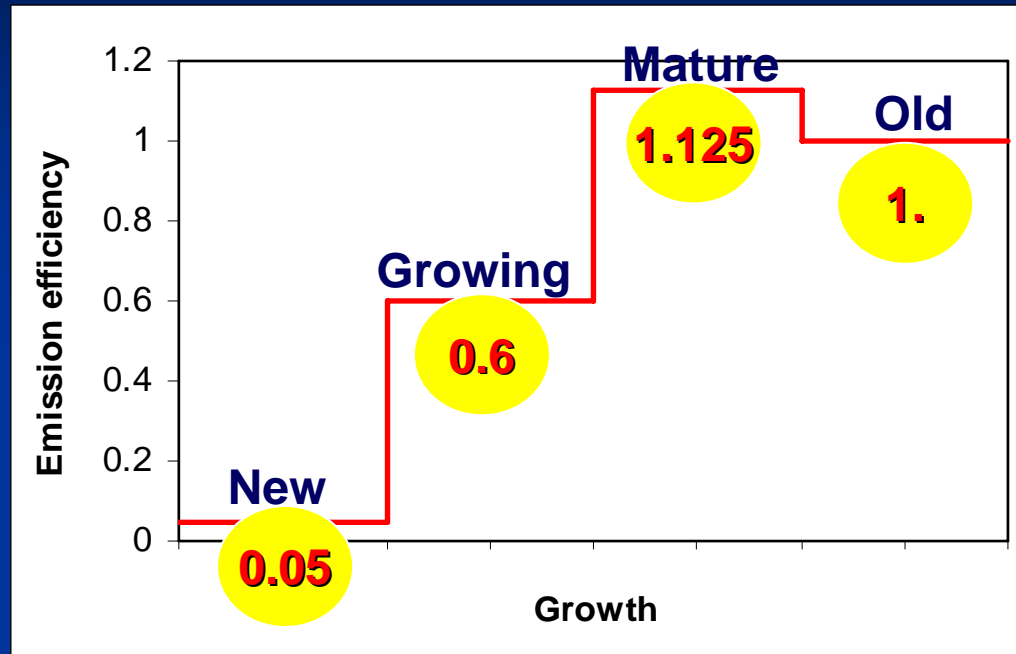
Model development: Isoprene

- **Impact of soil moisture: limitation of emission**

→ **Wilting Point:** moisture level below which the plant can't extract the water from the soil anymore.
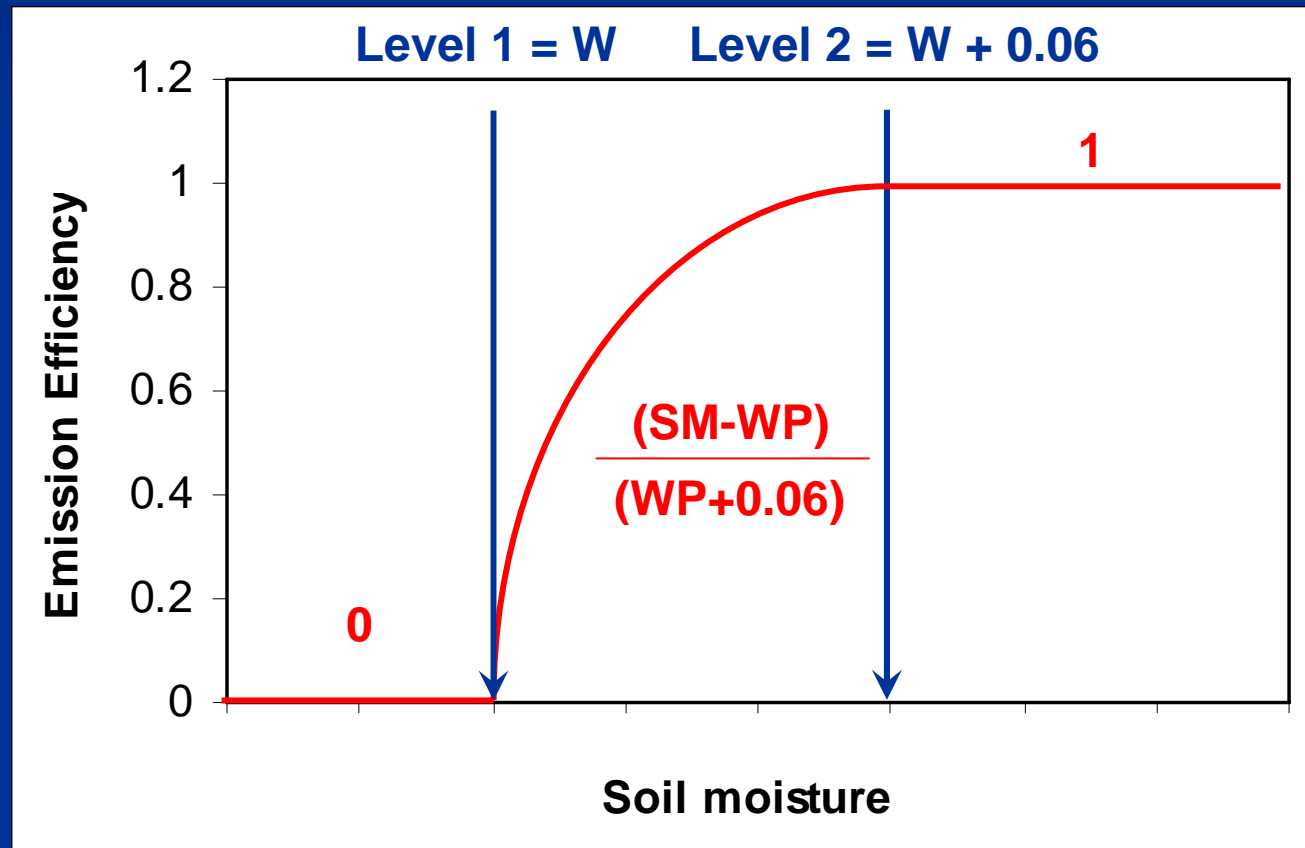
Model development: Isoprene

■ **Leaf age: varying efficiency for isoprene**

→ **Foliage separated in 4 leaf age classes**
→ **Foliage Efficiency calculation:**

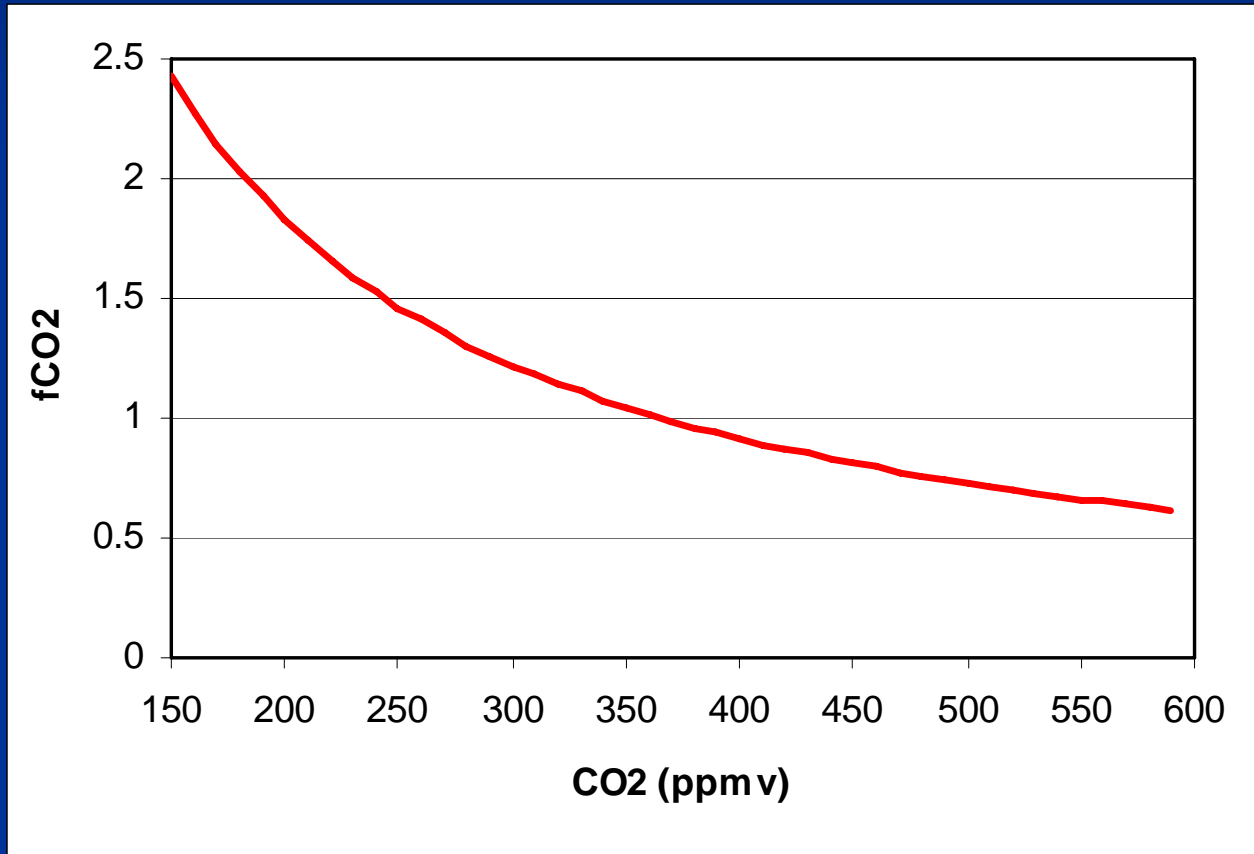▪ **Deciduous PFTs:**
$$FE = \sum (EmEf_i \times Frac_i) \text{ with } i = \text{new, growing, mature, old}$$

▪ **Evergreen PFTs:**
$$FE = 1$$

Model development: Isoprene

- **Atmospheric CO_2 (Possel et al. 2005)**

Model development: Isoprene

- **Emission factors:**
  - **Present-day: global maps 0.5°x0.5 °**

Fineleaf evergreen trees   **Crops**

→ **Very low / No emission capacity**

→ **No vegetation for the present-day**

2. (0.01-13)

mgiso/m²/h

0.09 (0.01-1)
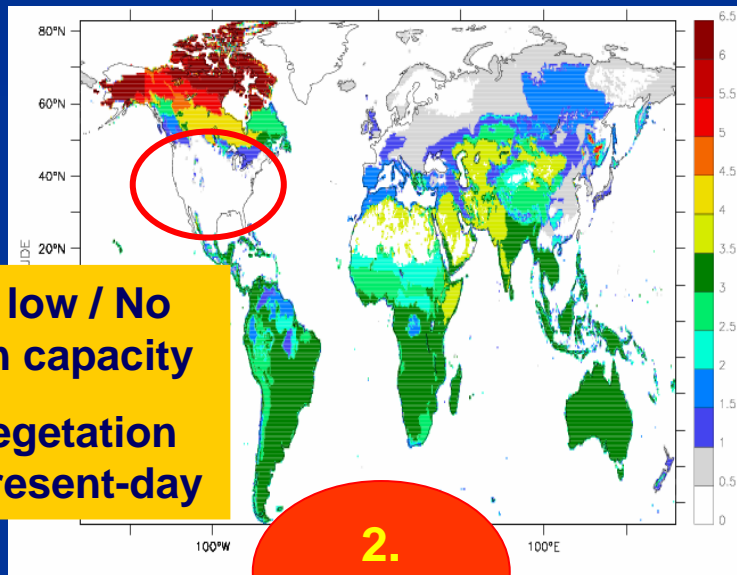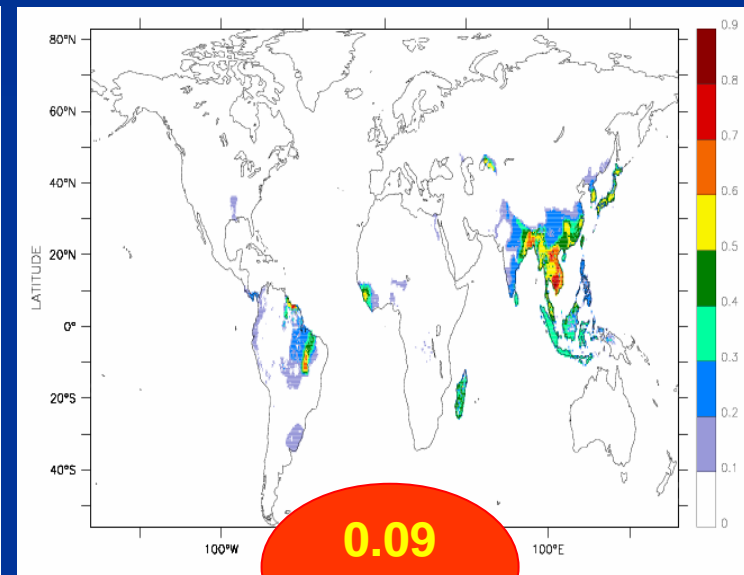
  - **Past and Future scenarios**

Model development

■ **Model structure**

① **Isoprene:** from MEGAN (Guenther et al., 2006)

→ **Temperature and radiation dependent**
→ **Leaf age, soil moisture**
→ **global map for emission factors available for the present-day**
→ **Impact of atmospheric CO_2 implemented**

② **Monoterpenes: from Guenther et al. (1995)**

→ **Temperature dependent**
→ **EF assigned for each PFT**

③ **Other VOCs: from Guenther et al. (1995)**

→ **Bulk emission**
→ **Temperature dependent**
→ **One EF for every PFTs**

Monoterpenes and Other VOCs: EF

Plant Functional Types	Emission Factor (µgC/g/h)	
SDGVM	Monoterpenes	Other VOCs
Bare soil	0	
C3 grass	0.8	
C4 grass	1.2	
Evergreen broadleaf tree	0.4	1.5
Evergreen needleleaf tree	2.4	
Deciduous broadleaf tree	0.8	
Deciduous needleleaf tree	1.2	

Using the BVOC emission model

- **FORTRAN 90 program: off-line model (intercomparisons)**
- **Monthly input/output**

2 — **Vegetation characteristics**

Model Run or Observations

Temperature
Humidity
Precipitations

UM/CRU

1 — **Climate**

Temperature
Radiation
Humidity
Precipitations

Model or Data

SDGVM

Vegetation distribution
Leaf Area Index

Soil
moisture

Temperature
Radiation

3 — **BVOC emission Model**

Isoprene, Monoterpenes and ORVOC
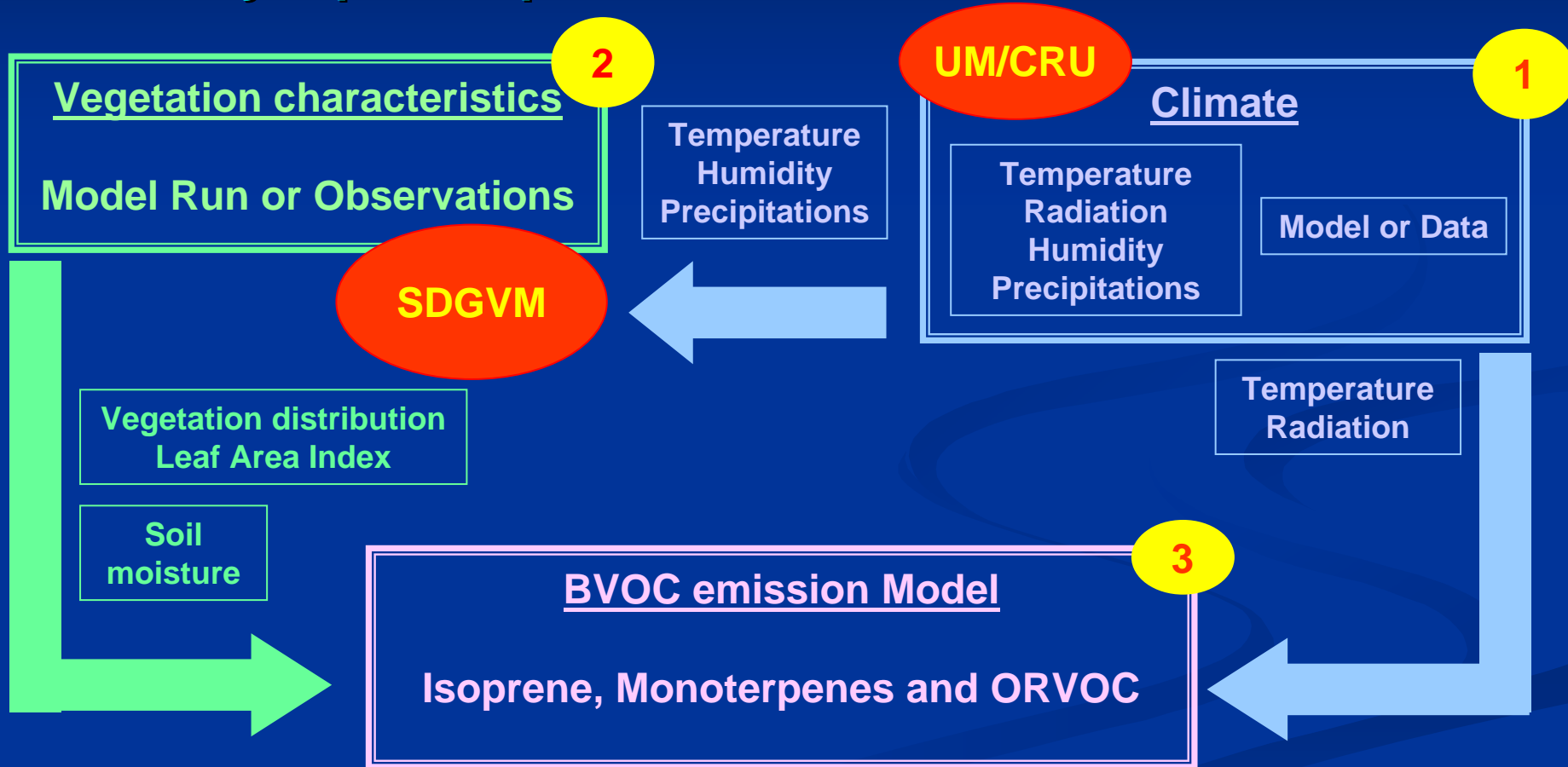
Implementation in JULES

- **Model: off-line FORTRAN 90 (< 1000 lines)**
  - → **Can be easily implemented in any other model**
    - **Reasonable estimates**

- **Designed for global scale study / computing resources**
  - **Monthly input/output**
  - **History of past temperature/radiation (last day and last 10 days) not considered**
    - → **Can be easily modified based on JULES timestep**
    - → **Other individual BVOCs could be implemented**

- **Poster:** "Two centuries of changing isoprene emissions from the terrestrial biosphere: 1900 to 2100 AD"