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# Modelling Feedbacks between Biogenic Emissions and Air Chemistry from Site to Globe

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## Background

Biogenic volatile organic compounds (BVOCs) are important drivers for tropospheric air chemistry, i.e. ozone levels and aerosol formation - and thus climate change. However, even for the best known compounds, emission estimates are highly uncertain.

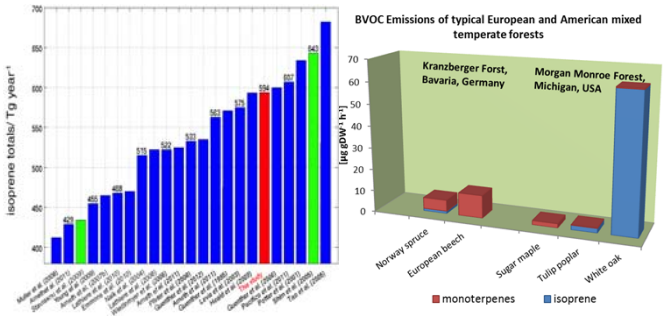


Fig.: Left: Estimates of global isoprene emissions from various publications (Sindelarova et al. 2014 (ACP)); Right: Emissions of typical species of the same plant vegetation type in different regions.

## Simulation results

- Emission responses to environmental conditions are sensitive to parameters used in photosynthesis models
- Different emission response patterns can be represented based on photosynthesis processes, without using species-specific BVOC parameterization
- The new emission model produces similar but somewhat higher emission patterns as 'state-of-the-art' approaches when implemented into a coupled global-air chemistry model (CESM)

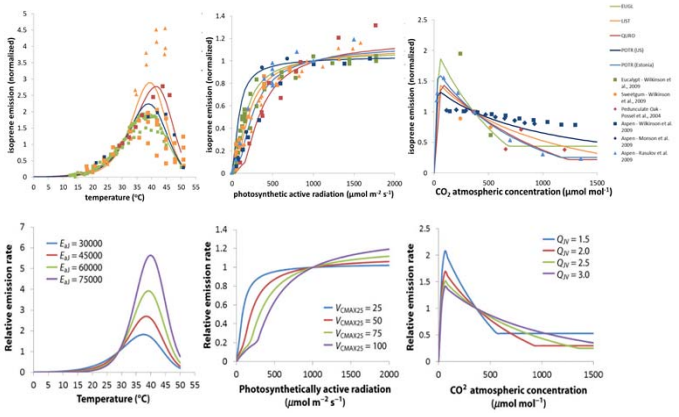


Fig.: Top: Measured (points) and simulated (lines) isoprene emission responses to temperature, radiation, and $CO_2$ conc. of 5 tree species. Bottom: Impact of the most sensitive photosynthesis parameters to isoprenoid emission rate (from Grote et al. 2014 (PCE)).

## Modelling

The new model derives isoprenoid BVOC emission directly from the electron transport potential of photosynthesis. Model requirements are designed to be met by land-surface models that apply the Farquhar assimilation scheme, e.g. JULES or CLM.

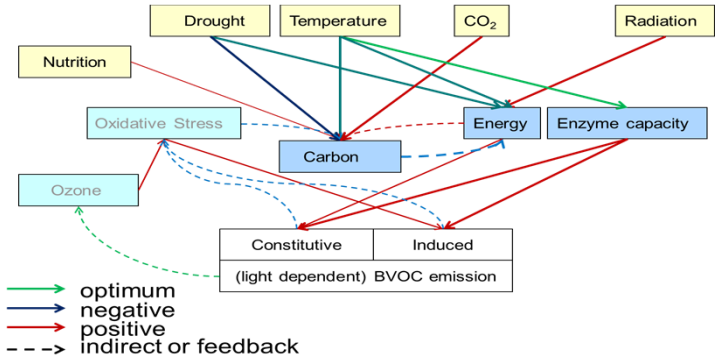


Fig.: Concept of the newly developed JJV model. Light blue sections are in preparation to consider the ozone impact on photosynthesis (negative feedback) and BVOC induction (positive feedback).

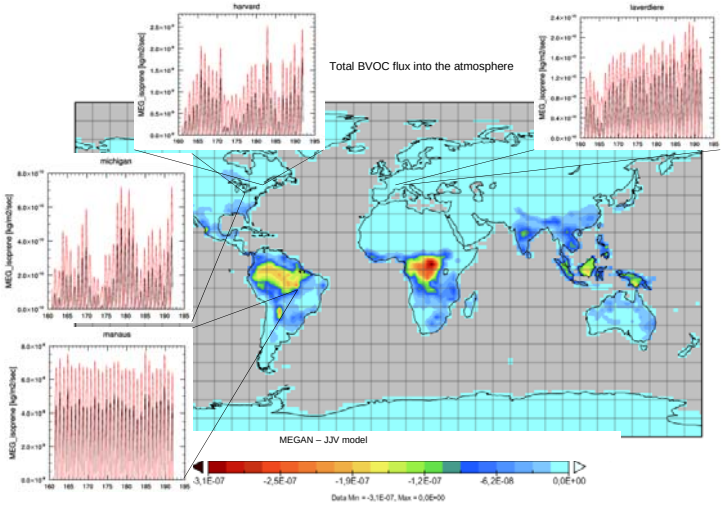


Fig.: Difference between isoprene emissions simulated with JJV and with MEGAN globally and for specific sites during 5 weeks in summer (Red: JJV model, Black: MEGAN model).

## Conclusion and Outlook

The new mechanistic approach represents the commonly observed decrease of (isoprene) emission with increasing $CO_2$ air concentration. Emission responses are tightly coupled with photosynthesis. Further work will consider air pollution impacts and improve the plant-functional type concept.