



Ozone formation

(Resource ID: 214)

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This teaching resource is allocated to following University:

BOKU - University of Natural Resources and Life Sciences Vienna

<http://www.sustainicum.at/en/modules/view/214.Ozone-formation>



Plenum



**Independent of
the number of
students**



15 to 30 min



English, German

The building block explains the chemical formation of the secondary air pollutant ozone in the troposphere by means of a dynamical presentation. Interactively, during a lecture, the meteorological conditions and the amount of emissions of the ozone precursors may be chosen. Then, the concentrations of the relevant species in the atmosphere are shown. These had been calculated with a complex photochemical model, since ozone formation is a non-linear process. The selection of the order and the kind of shown model results is free. Additional material (text and presentation) is provided. Most of the other presentations have some interactive functionality. The building block can be used offline or online. The online access also provides the possibility for repetition by the students.

Basic idea of the building block

The chemical formation of the secondary air pollutant ozone in the troposphere from its precursors (nitrogen oxides, NO_x , and hydrocarbons, VOC) is a non-linear process, depending on the meteorological conditions and the emissions. A linear description of the impacts is not possible. Therefore, some exemplary situations were calculated in advance with a complex photochemical model. The results are recallable on a dynamical web site. This allows to demonstrate the influence of various parameters (NO_x emission, VOC emission, season, wind speed, cloudiness) of the ozone formation during a lecture in a vivid way.

Detailed description of the building block

The main part of the building block is a dynamical web site that may be projected. The lecturer can show, how changing meteorological conditions and different amounts of emissions of ozone precursors effect the ozone formation in the atmosphere. The single conditions are chosen by simple clicks and the result is immediately displayed graphically.

The following parameters may be chosen:

Two seasons with influence on temperature and solar radiation (February and July).

Three wind speeds.

Cloudiness (yes/no) with influence on temperature and radiation (July only).

Three levels of anthropogenic NO_x emissions.

Three levels of anthropogenic VOC emissions.

Biogenic emissions (yes/no), dependant on temperature and radiation. This allows to demonstrate their effect (July only).

This choice affords 135 model calculations. These have been performed during the preparation of the building block with the photochemical model CAMx for an exemplary landscape. It describes a city in the middle of a rural area. The model results were postprocessed for graphical display in this interactive tool. For every scenario the following plots are available:

Development of the concentration of the relevant substances (ozone, NO_x , VOC) along a transection through the model domain as animation for the daily course.

The plot above, frozen at the time of the highest ozone concentration.

The diurnal course of the emissions of NO_x and VOC at the three land use types (urban, rural, forest).

The diurnal course of the concentrations of O_3 , NO_x , and VOC at three typical locations in the model domain ("measurement stations").

The diurnal course of temperature.

By simple clicks during the presentation it is possible to switch between the scenarios and the graphs.

Additional material

Additional information to describe the used model and the basics of ozone chemistry are provided as text and as viewgraph. This material as well as the interactive presentations are available online to allow the students a repetition.

<http://www.sustainicum.at/files/projects/214/en/index.html>

Description of the application during a lecture

The whole material is available for download and can be used offline during a lecture. A web browser is the only software requirement (Firefox, Chrome, IE10). Web access is needed for an online application. The format is optimized for a projection (full screen mode). The order and the selection of the shown interactive viewgraphs can be chosen freely.

What is the special effect for the students?

It is shown in a vivid way, which effect different conditions have on the ozone formation in the atmosphere.

Teaching Tools & Methods



Computer program Written material

Learning Outcomes

The effect of various parameters on the formation of the secondary air pollutant ozone is displayed.

Relevance for Sustainability

Air quality and the understanding of the origin of air pollutants. High ozone concentrations may be harmful to health.

Related Teaching Resources

Basics of atmospheric chemistry. The chemistry of ozone generation is explained in the accompanying material.

Preparation Efforts

Medium

Access

Free

Sources and Links

<http://www.sustainicum.at/files/projects/214/en/index.html>

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