



Development of the MusicBox Chemistry Model and Applications as a Tool for Education

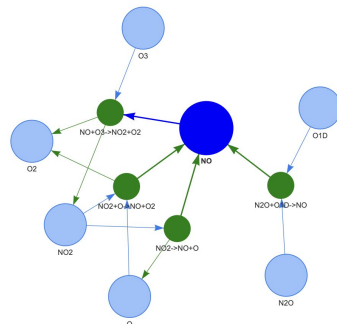


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The MusicBox Model

MusicBox is a **runtime configurable chemistry box model**. MusicBox is distributed as a docker container, and the MusicBox Interactive user interface is run as a **locally hosted web application**. The model uses the CAMP chemistry solver which allows the chemical mechanism to be changed at runtime with no code compilation, and includes **built-in tools for plotting and analysis**. MusicBox interactive is designed to be intuitive and easy to use, **built for those with no previous modeling experience** and limited computer science knowledge. The model allows for easy downloading, sharing, and uploading of model configurations.



Relationships between chemical species shown by the MusicBox interface.



Goals for a Curriculum

Group Goal

Use the tool to generate publicly available exercises and validate the results. The process of creating mechanisms helped the team work through existing bugs.

Professor's Goal

Professors Ave Arellano and Yang Li plan to use this tool in university undergraduate and graduate course work. The mechanisms would be used as a basis for teaching Tropospheric and Stratospheric chemistry in simplified and more complex forms. The project allowed the professors to evaluate the applicability of the tool for instruction.

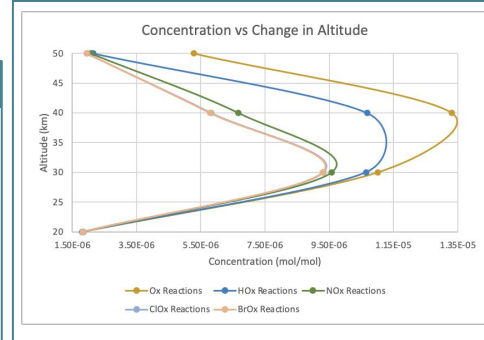
MusicBox-Interactive Development

- Continuous **integration testing**.
- Addition of **Bootstrap** and **jQuery** for responsive and functional HTML and JS.
- Addition of the NCAR color scheme.
- Hosted container on Docker Hub allows for **easy downloading and running**.
- Addition of **unit conversion tools** to meet the demands of scientists.
- **Increasing functionality** along with the development of MusicBox features.
- Alpha and Beta testing before a full release.
- Addition of **examples and instructions** for use in the user interface.



The user interface running a mechanism in the Stratosphere at 50km. The graphs show diurnal cycles over the course of 5 days.

Results



Future Development, Uses and Improvement

- Updated GitHub repository with new mechanisms.
- Expanded user interface to **incorporate integrated reaction rates**.
- **Automatically generated reactions** suggested for simplification of mechanism creation.
- **Simplified** model for use by younger students in middle and high school.
- MusicBox as a **hosted web service** allowing use online.
- **New chemical reaction types**.
- Additional form **validation** to prevent user errors during configuration.
- Connections between GitHub mechanism repository and MusicBox Interface.

Acknowledgements

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github.com/NCAR/music-box
github.com/NCAR/musicbox_curriculum_exercises