Improvements to the WRF-Chem model for quasi-hemispheric simulations of aerosols and ozone in the Arctic

Louis Marelle, Jean-Christophe Raut, Kathy S. Law, Larry K. Berg, Jerome D. Fast, Richard C. Easter, Manishkumar Shrivastava, Jennie L. Thomas

To cite this version:

Louis Marelle, Jean-Christophe Raut, Kathy S. Law, Larry K. Berg, Jerome D. Fast, et al.. Improvements to the WRF-Chem model for quasi-hemispheric simulations of aerosols and ozone in the Arctic. 2017 CATCH (the Cryosphere and ATmospheric CHemistry) Workshop, Apr 2017, Guyancourt, France. insu-01567300

HAL Id: insu-01567300

https://hal-insu.archives-ouvertes.fr/insu-01567300

Submitted on 24 Jul 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Results - aerosols in the Arctic

Motivations

- Improve WRF-Chem’s performance compared to recent intercomparisons (AMAP, 2015) in order to study aerosols and ozone in the the Arctic (long-range transport, local sources).
- We identify missing processes in WRF-Chem 3.5.1, update the model, and evaluate the corrected model in the Arctic.

WRF-Chem model setup

WRF-Chem 3.5.1 simulations, 1 March 2008 to 1 August 2008
- MOSAIC aerosols (cloud chemistry and SOA), SAPRC-99 gas-phase chemistry
- Morrison 2-moment microphysics
- KF-CuP cumulus parameterization
- Noah Land Surface Model
- MOZART boundary and initial conditions
- Nudging to NCEP FNL

Evaluation against mean PM$_{10}$ in the Arctic (60°N – 90°N, April-July average)
- KFCUP_CHEM decreases are mostly due to increased wet removal by cumuli
- NOAH_SEAICE reduces sea ice skin temperatures, increasing stability over sea ice, reducing vertical mixing.

Evaluation against mean rBC profiles from the ARCTAS campaigns (2008)
- BC RMSE reduced by 28 % (spring) and 50 % (summer), due to KFCUP_CHEM.

Results - ozone in the Arctic

Main conclusions

- Model updates reduce RMSE significantly (-10 % to -50 %) for all datasets. Large improvements for BC, especially during summer.
- NOAH_SEAICE (improving skin temperatures over ice and stability) and KFCUP_CHEM (including cumulus cloud interactions with aerosols and gases) have the largest effect on aerosols.
- Improved deposition and photolysis over snow (SNOWDEP & SNOWPHOT) have a large effect on ozone.
- Halogen chemistry and detailed DMS gas-phase chemistry, as well as higher resolutions are needed to improve results further.

References: