

WRF-Chem V3.8: A summary of status and updates

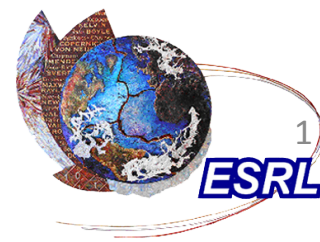
Georg Grell, Ravan Ahmadov (NOAA, Earth System Research Laboratory)

With contributions from:

S.E. Peckham (**CRREL**), K.Wong, L.Zhang, S. A. McKeen (**NOAA/ESRL**), R. Easter,
J. D. Fast , W. Gustafson, P.L. Ma, P. Rasch, B. Singh, (**PNNL**), A. Hodzic, M. Barth,
G. Pfister, S. Wolters, M.Bella (**NCAR**), S. Freitas (**NASA**), P. Tuccella (**Laboratoire
de Météorologie Dynamique and University of L'Aquila ITALY**), Yang Zhang
and Kai Wang (**NCSU**), Martina Klose (**University of Cologne, Germany**)
+ *many more national and international collaborators*

WRF-Chem web site: <http://wrf-model.org/WG11>

Email: wrfchemhelp.gsd@noaa.gov



Recent changes in the WRF-Chem development and support team at NOAA

- Steven Peckham has moved to another federal lab (still actively participating in WRF-Chem developments and closely collaborating with us).
- Members of the current WRF-Chem team at NOAA/ESRL/GSD: G.Grell, R.Ahmadov, L.Zhang, K. Wong
- Many other national and international collaborators from NOAA, NCAR, PNNL, universities still contribute and support the WRF-Chem developments.
- WRF-Chem support **is not a funded project**, we rely on a large user community for their in-kind contributions and support of the code.



Some WRF-Chem facts and news

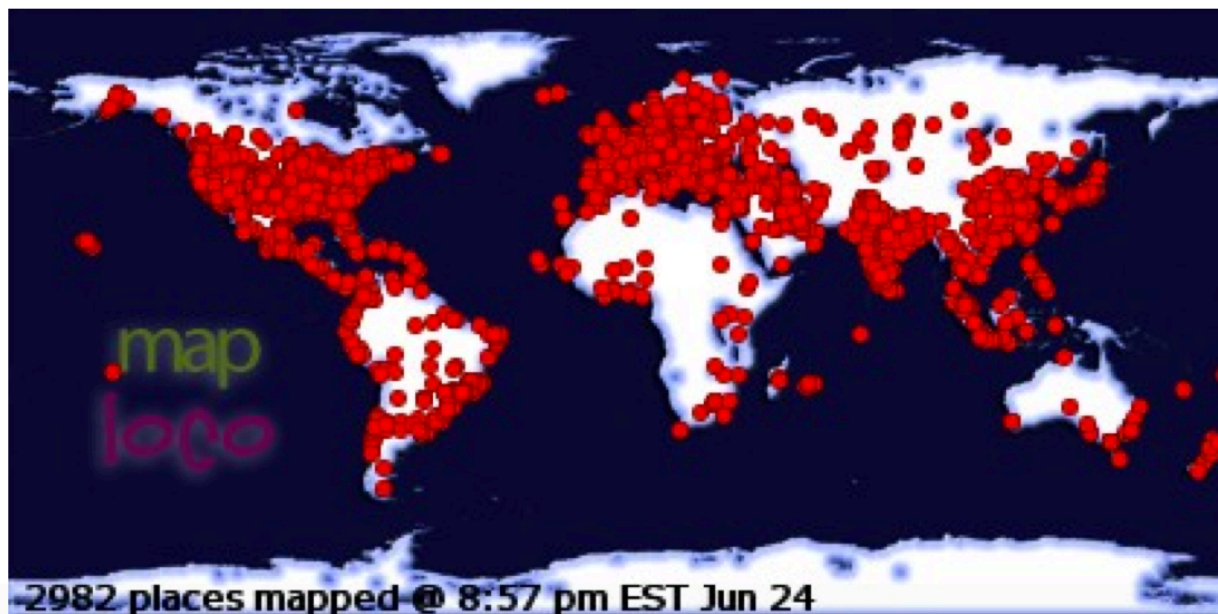
- Current version of WRF-Chem contains multiple parameterizations to simulate greenhouse gases, dust, fires, volcanoes, gas and aerosol chemistry (ranging from simple to more complex schemes), meteorology-chemistry interactions and so on.
- Among the registered WRF users **2860** selected chemistry as their main area of interest.
- WRF-Chem code downloads for the last 3 months: **80**
- Recently a new email discussion group was created: **wrf-chem@googlegroups.com**
- The WRF-Chem discussions group will help us to reach out to a large WRF-Chem and air quality modeling community, to inform users about ongoing and future developments, new features and bug fixes in WRF-Chem.
- [Contact the help desk \(wrfchemhelp.gsd@noaa.gov\)](mailto:wrfchemhelp.gsd@noaa.gov) for specific WRF-Chem related questions or suggestions.



Who are looking at the WRF-Chem web-site?



<http://wrf-model.org/WG11>



Updates in anthropogenic emission inventories for WRF-Chem3.8 modeling

- The EPA NEI2011 emissions inventory (US domain) is available for using in WRF-Chem modeling. (thanks to S.McKeen from NOAA/ESRL)
- Additionally, the NEI2011 emissions for weekends, updated emissions for the US oil/gas sector can be provided to users.
- The new version of prep_chem source (1.5) includes HTAP2.2 emissions for the entire globe. (*see Janssens-Maenhout et al., ACP 2015*)
- A sample netcdf file with emissions processed for the RADM/RACM gas chemistry mechanisms over the CONUS domain will be provided to users.
- Currently there are many emission datasets available for air quality modeling, e.g. developed for specific field campaigns, estimated by inversion studies etc. Check the WRF-Chem publications list to learn more about those emission datasets.



Updates in the WRF-Chem 3.8 release

Contributed by Martina Klose (University of Cologne) mklose@nmsu.edu

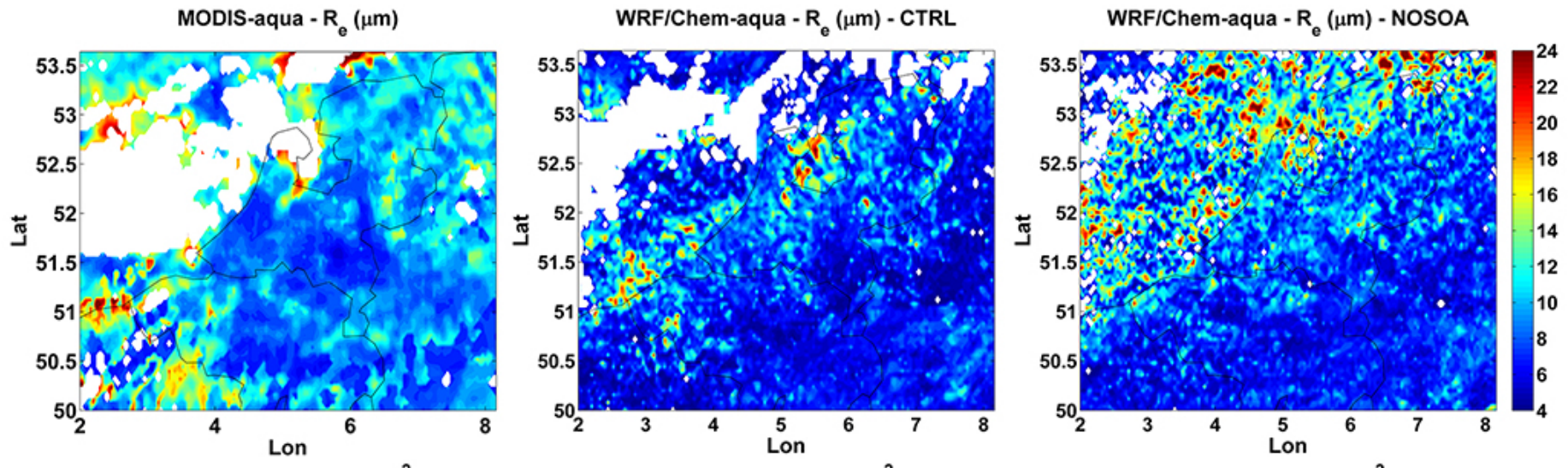
To improve and update the UoC dust modules (**dust emission schemes of Shao (2001), Shao (2004), and Shao et al. (2011)**)

- (1) modification of dust size bins for consistency with other dust schemes and physics parameterizations in WRF, e.g. radiation schemes; new dust size bins are < 2 μm (bin 1), 2 - 3.6 μm (bin 2), 3.6 - 6. μm (bin 3), 6 - 12 μm (bin 4), and 12 - 20 μm (bin 5)
- (2) improvement of soil particle-size distribution calculations and data
- (3) inclusion of dust wet deposition scheme (Jung, 2004)
- (4) minor modifications and updates

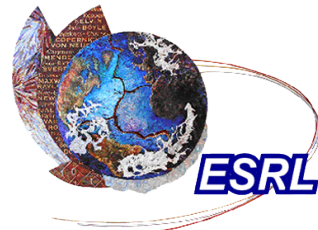


Updates in WRF-Chem 3.8

- A new chemistry option (#109) with secondary organic aerosol parameterization based on the volatility basis set approach, with direct and indirect cloud feedback, evaluated in Europe with data from a field campaign (*Tuccella et al., GMD, 2015*)



The 17–19 May 2008 averages of droplet effective radius at cloud top (first row), retrieved using MODIS-aqua observations (first column), predicted by model in the references run (CTRL, second columns) and sensitivity test without SOA (NOSOA, third column).



Updates in WRF-Chem 3.8

New development by L. Berg for Kain-Fritsch cumulus parameterization (Berg et al., GMD, 2015)

A new chemistry option (#203) for aqueous chemistry (developed by J. Fast, PNNL): SAPRC99_MOSAIC_8BIN_VBS2_AQ_KPP

Main features of the new chemistry option:

Modified Kain-Fritsch (deep convection) coupled with Cumulus Potential (CuP) (shallow convection) (Berg et al., 2013)

Aerosol activation

Vertical transport of chemical species

Aqueous chemistry

Wet removal



WRF-Chem MOZART gas scavenging developments

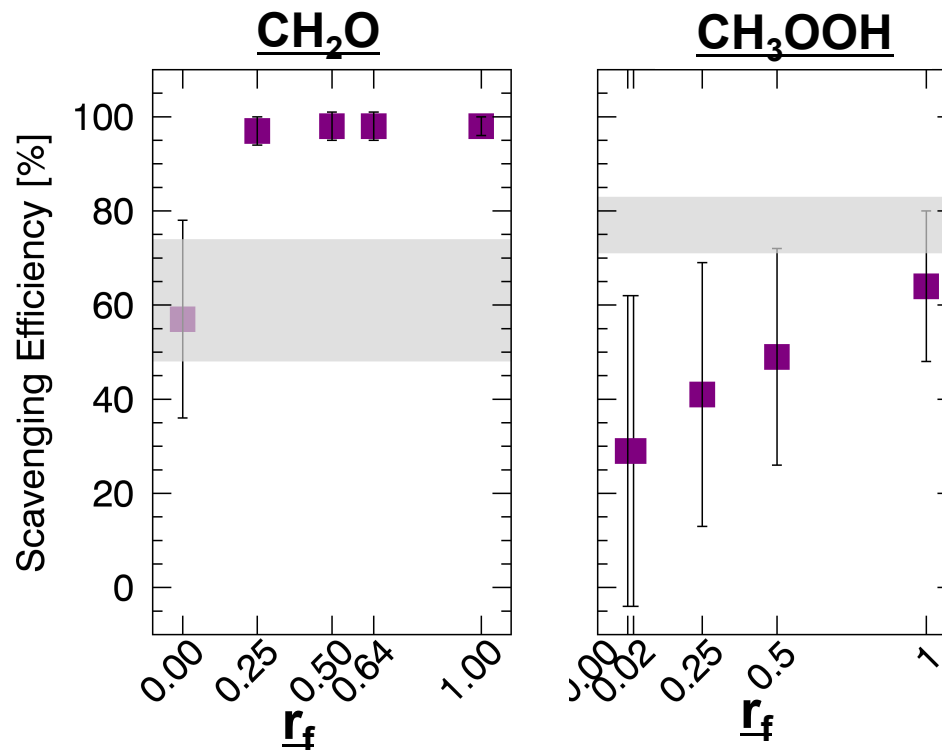
By M. Bela (CU Boulder), Megan.Bela@colorado.edu

Ongoing: WSM6 microphysics coupled to MOZART gas scavenging (currently coupled for Thompson/Morrison microphysics)

New in V3.8: ice retention fractions (r_f – fraction remaining in condensed phase when cloud water is transformed into frozen precipitation) specified for each species

Scavenging efficiencies (fraction of gas removed between storm inflow and outflow) from simulations of a severe storm in Oklahoma with different r_f values

Obs.
WRF-Chem



Bela et al. (JGR, 2016)



Other updates in WRF-Chem 3.8 and 3.8.1 (upcoming bug fix release)

- A new option for vertical mixing of chemical species within the new MYNN PBL scheme (*see talk by J. Olson on Wednesday*), the same as for heat and moisture;
 - If `bl_mynn_edmf` = 1 or 2, chemical and physical mixing will use the selected mass flux sub-scheme. This will enhance vertical mixing in convective boundary layers, and provide vertical mixing through shallow convection if present.
 - **Contact us if you are interested in testing this option for chemicals!**
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- A bug fix (tuning factor for dust emissions) in the gocart dust option (`dust_opt=1`)
 - Mapping of wildfire emissions (size distributions) when using the mosaic sectional 8-bin aerosols scheme (emissions module for the MOSAIC options)



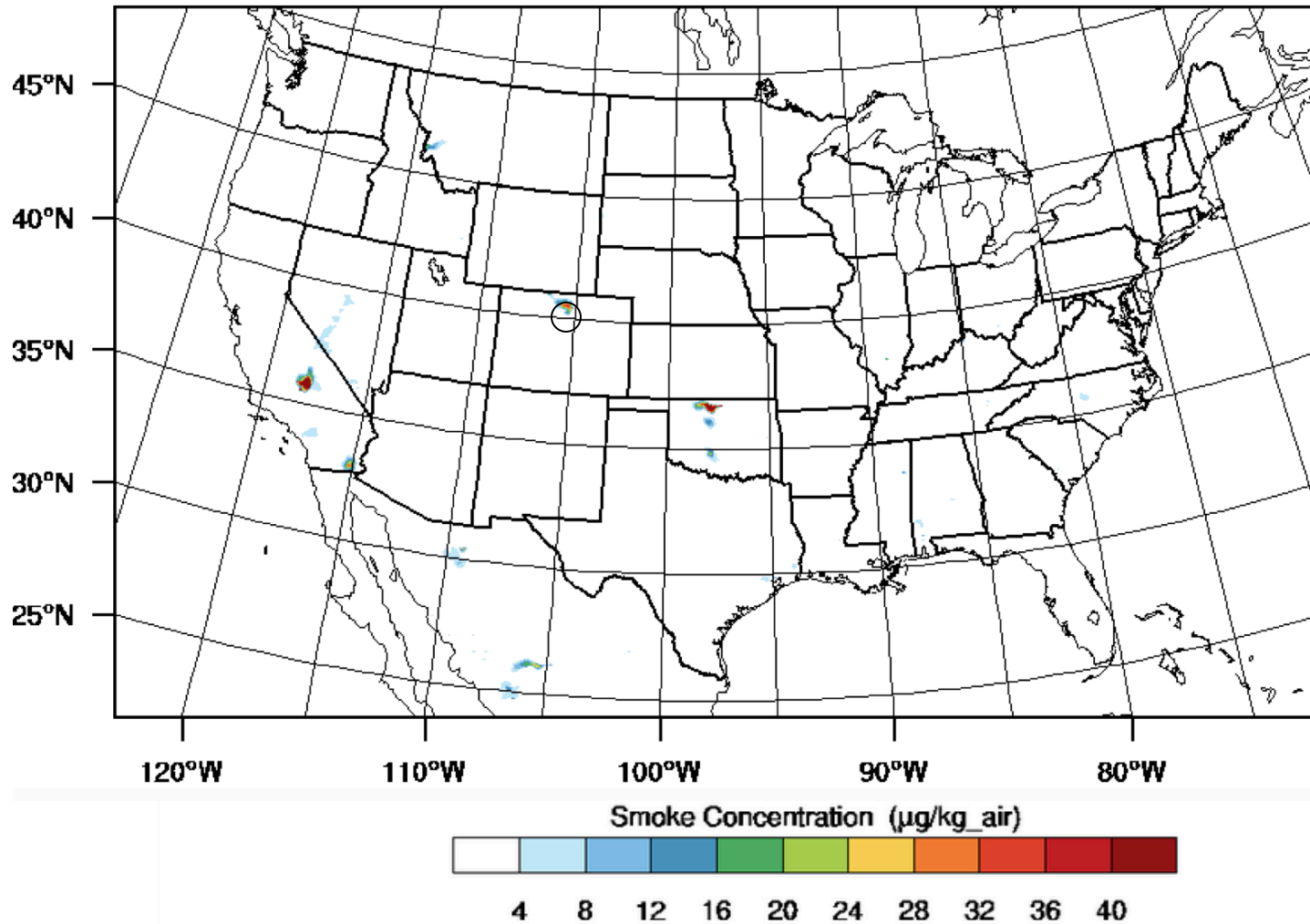
Ongoing WRF-Chem developments by different groups

- WRF-Chem aerosol feedback simulations through the aerosol aware microphysics scheme, by P.Saide, G.Thompson, T.Eidhammer (NCAR)
- Emission inversions using WRFDA-CHEM (*talk by Guerrette, J.J., WRF-Chem session*).
- An updated MEGAN parameterization (v2.1) by NCAR and PNNL groups (*Zhao et al., 2016, GMDD*)
- New aerosol and gas chemistry schemes by Y.Zhang et al. (NCSU)
- Updates to the MOZART gas chemistry by Pfister et al. (NCAR)
- Modeling of fire emissions and smoke using the VIIRS satellite fire radiative power data (*talk by Ahmadov R., WRF-Chem session*)
- A new chemistry option with heterogenous chemistry, Hong Kong Polytechnic University (*Zhang et al., JGR, 2016; Li et al., ACPD, 2016*)
- *Some of the new developments will be added to future WRF-Chem releases.*



Fire smoke forecast for yesterday evening

(<http://rapidrefresh.noaa.gov/HRRRsmoke/>)



WRF-Chem model on the 3km resolution CONUS domain, run at NOAA/ESRL
No chemistry, primary emissions of aerosols by fires
VIIRS satellite fire detection data are used.



WRF-Chem publications

- WRF-Chem special issue in ACP and GMD:
- Periodically updated list of the papers:
- Please send us your WRF-Chem papers: wrfchemhelp.gsd@noaa.gov

Future plans

- Add multiple regression tests for major chemistry options
- Update the WRF-Chem web-site
- Modify the online exercises
- Update the user's guide
- Set up a WRF-Chem wiki-page
- Next WRF-Chem tutorial planned for winter of 2017



- ***Chemistry session is Thursday morning***
- ***Posters are Wednesday afternoon***
- ***Publication list online:***

<http://ruc.noaa.gov/wrf/WG11/References/WRF-Chem.references.htm>

***Please use this list to find papers to read and cite.
Please send us your publications too!***

WRF-Chem web site - <http://wrf-model.org/WG11>

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WRF-Chem forum: wrf-chem@googlegroups.com

Thank you!

