Modeling the Biogenic Emissions using WRF/MCIP/MEGAN in Chile; a Comparison among three Urban Areas

Extended Abstract 252

Luis A. Díaz-Robles, Eddio Carimán, Pablo Etcharren, and Cristian Varela-Bruce
Air Quality Unit, School of Environmental Engineering, Catholic University of Temuco, Temuco, Chile. Manuel Montt #056, Temuco, Phone 56-45-205410, Fax 56-45-205430, E-mail ldiaz@uct.cl

Francisco Cereceda-Balic, Víctor Vidal, and Juan Luis Guevara
Laboratorio de Química Ambiental (LQA), Centro de Tecnologías Ambientales (CETAM), UTFSM, Valparaíso, Chile.
Biogenic Emissions

- Mainly from vegetation
- Isoprenes, terpenes, alkenes, alkynes, aldehydes, alcohols, esters, and so on. (about 30,000 species)
- Variables: temperature, light, humidity, physiological processes, and hydric stress.
- Several models: BEIS, Globeis, MEGAN 2.04 (Model of Emissions of Gases and Aerosols from Nature, Guenther et al., 2004)
Some Differences with BEIS

• BEIS uses type of trees (typical from US), like *Pinus radiata*, *Pseudotsuga*, *Quercus laurifolia*, etc.

• MEGAN uses type of leaves; broadleaf trees (evergreen and deciduous), acicular-leaved trees (evergreen and deciduous), shrubs, crops and grasses. Therefore, you can use MEGAN anywhere all over the World.
As an example

Rancagua urban area

Ozone polluted area
Max 8-h Ozone Concentration versus Max solar radiation in Rancagua, Chile (2005-2008)
WRF Conceptual Model

WEATHER RESEARCH & FORECASTING MODEL (WRF)

- Alternative Obs. Data
- Standard Observation Data
- WRF Terrestrial Data
- Gridded Data NAM, GFS, RUC, NNRP, AGRMER

External Data Sources

OBSGRID
WPS
Preparation of data for real simulation (domain, terrain and weather)

WRF Pre-Processing System

WRF-Var
Initialing and processing of real data necessary for simulation

WRF-ARW Model

Ideal Data
2D: Hill, Gray, Squall Line & seabreeze
3D: Supercell, LES & Baroclinic Waves

Observations on data interpolated

WRF/ARW Model

REAL
Application of the physical, dynamic and numerical component

Post-processing & Visualization

VAPOR
NCL
GrADS/Vis5D
RIP4
GrADS/Gempak

MET
Results of the simulation of meteorological fields

MCIP 3.4.1.1
MEGAN Conceptual Model

Sources external data
- Meteorological Variables (TEMP2 and RGRND)
- Leaf Area Index (LAI)
- Percent Plant Functional Type (PFT)
- Emission Factors Average (EF)

Format Conversion
- MG2IOAPI
  - Convert text format to IOAPI-netCDF format

MEGAN Model
- Calculate Gamma Values
- MG2MECH
  - Calculation of emission and chemical speciation.

Chemical Mechanism Species
- CMMZ
- SAPRC99
- RADM2
- RACM

Emission
- Results of biogenic emissions

TEMP2 instead of TEMP15
Ozone Modeling Performance (Rancagua Area)

Very significant modeling performance, Normalized bias less than 20%
Comparisson among urban areas

**BIOGENIC EMISSIONS**

- **RANCAGUA**
- **CONCEPCIÓN**
- **CHILLÁN**

<table>
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<tr>
<td>TERPENES</td>
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Conclusions

- Higher emission are found in Chillán than Concepción, about twice. Rancagua presented fewer emissions because this area is just a fruit and farm area. In Chillán it is possible to find a forestry area on the North of the city (higher emissions of isoprene and terpene) and an agricultural area surrounding the urban area.
Conclusions (Cont.)

• Concepción presented higher biogenic emissions along a small valley, the Biobío river valley, an area with plentiful shrubs and trees.

• Terpenes were the most abundant biogenic emissions in each of these areas under study, mainly in Chillán and Concepción.

• Chillán area could have severe ozone pollution problems, we recommend starting with a ozone and VOCs monitoring campaign.
Conclusions (Cont.)

• This approach demonstrates the potential of MEGAN to be applied to biogenic emissions estimates in other areas and countries.

• These results indicated that the WRF/MCIP/MEGAN model can be an effective tool to improve the biogenic emissions accuracy, as well as for recommending monitoring and news studies in areas potentially polluted with ozone.
ACKNOWLEDGMENTS
We would like to acknowledge the DIUCT Project number 2006-2-03 for provide the cluster Santa and the computing time used in this study.

THANKS

GRACIAS

See you in Calgary
PFT* – CROPS AND GRASS

BIOGENIC EMISSIONS INVENTORY
CHILLÁN -CHILE

* PLANT FUNCTIONAL
PFT – BROADLEAF TREE

BIOGENIC EMISSIONS INVENTORY

CHILLÁN -CHILE
LEAF INDEX AREA – FEBRUARY

BIOGENIC EMISSIONS INVENTORY
CHILLÁN -CHILE
LEAF INDEX AREA – AUGUST

BIOGENIC EMISSIONS INVENTORY
CHILLAN - CHILE
NITRIC OXIDE EMISSIONS FACTORS
BIOGENIC EMISSIONS INVENTORY
CHILLÁN -CHILE
TERPENES EMISSIONS

BIOGENIC EMISSIONS INVENTORY

CHILLÁN - CHILE
NITRIC OXIDE EMISSIONS

BIOGENIC EMISSIONS INVENTORY

CHILLÂN - CHILE
ISOPRENE EMISSIONS

BIOGENIC EMISSIONS INVENTORY

CHILLÁN - CHILE