Use and Validation of GEMS Chemical Forecasts during the POLARCAT – France 2008 Campaigns

The main objectives of the spring campaign were to study the inter-continental transport of Siberian and Canadian fire plumes, North American and European anthropogenic pollution transported to Greenland, their impact on chemical composition and to validate satellite observations over Greenland (IASI, CALIPSO etc).

POLARCAT- France Spring 2008 Campaign

The main objectives of the spring campaign were to study the Arctic haze and its climate impact by performing air and ship board measurements. Forecasts from different chemistry-transport models were used for flight planning within the GEMS project.

Snapshot Evaluation

Table 1 gives details about the different forecast models used for flight planning during the POLARCAT- France 2008 campaigns. MOZART-IFS (GEMS Forecast system) consists of Integrated Forecast System model (IFS Cycle 32R3 http://www.ecmwf.int/research/studios) coupled to the MOZART2 (chemical transport model). The GEMS forecasts were initiated each day at 00:00 hr GMT and run for 3 days.

Fig. 1: Latitude-time sections of GEMS forecasts for CO European tracer (left) at 20° E are compared with FLEXPART model (right) for 09 April 2008, based on 08 April 2008 (T=36).

Fig. 2: Inter-comparison of CO European tracer (left) forecast at 700 hPa from GEMS (left) and MOZART-4/IFS (right) on 10 April 2008, based on 09 April 2008 (T=36).

>> GEMS forecasts exhibit almost similar CO plume distributions when compared to forecasts from other CTMs.

AER42- Aircraft data over Kiruna, Sweden

POLARCAT-France conducted 12 flights during a measurement campaign at Kiruna, Sweden in spring 2008.

Fig. 3: A snapshot of MOZART-IFS simulations (solid line) with POLARCAT-France flight data (dashed line): CO (red) and O3 (blue) on 1 April 2008.

Fig. 4: A snapshot of MOZART-IFS simulations (solid line) with POLARCAT-France flight data (dashed line): CO (red) and O3 (blue) on 1 April 2008.

>> MOZART-IFS simulation output (from the nearest grid box) captured the temporal variability in both CO and O3 (except a peak around 09:30 hours).

Fig. 5: A snapshot of POLARCAT flight data for O3 (top) and CO (bottom) at flight altitude (left). MOZART-IFS plots are shown for 700 hPa; lines indicate AER42 flight track.

POLARCAT-France conducted 12 flights during a measurement campaign at Kangerlussuaq, Greenland in summer 2008.

Fig. 6: A snapshot of MOZART-IFS simulations (solid line) with POLARCAT-France flight data (dashed line): CO (red) and O3 (blue) on 1 May 2008.

>> MOZART-IFS simulation output (from the nearest grid box) reproduces the temporal variability in both CO and O3.

Fig. 7: A snapshot of POLARCAT flight data for O3 (top) and CO (bottom) at flight altitude (left). MOZART-IFS plots are shown for 700 hPa; lines indicate AER42 flight track.

Conclusions

>> GEMS (MOZART-IFS) forecast products are not yet operational since they were prepared only on an experimental basis for the POLARCAT campaigns during spring and summer 2008.

Acknowledgments

Authors gratefully acknowledge the cooperation and data provided by POLARCAT-France, NASA-DC8 and IASI teams, and CALIPSO evaluation team, as well as financial support by GEMS and CSD International Workshop on Air Quality Forecasting Research.

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References

GEMS: Global Environmental Multi-scale Model
CSD International Workshop on Air Quality Forecasting Research 2-3 December 2009 Boulder, USA

DC8 aircraft data over Canada

The NASA DC8 (DC8 aircraft during the Composition of the Troposphere from Aircraft and Satellites project, which is part of the International Polar Year, conducted DC8 research aircraft flights to monitor the long range transport of pollution to the Arctic. Boreal forest fires and their implications for atmospheric composition over high latitude regions are also investigated.

Fig. 8: A snapshot of MOZART-IFS simulation output (from the nearest grid box) captured the temporal variability in both CO and O3 but missed the larger CO peaks because GEMS forecasts used only climatological fires.

>> High peaks in CO (1 ppb) and O3 (400 ppb) are observed by the DC8 aircraft, which intercepted a fire plume over Canadian forest region.

Fig. 9: A snapshot of DC8 aircraft data over Kangerlussuaq, Greenland.

>> Nevertheless, GEMS forecasts showed a good consistency compared to other CTMs forecasts, AER42 and DC8 aircraft preliminary data, and IASI NRT analysis.

Drought days in CDOEM

Fig. 10: A snapshot of MOZART-IFS NRT analysis run (ez2m - solid line) with preliminary data from NASA-DC8 flight (green line) for CO in red (courtesy: G. Diskin) and O3 in blue (courtesy: A. Weinheimer) on 19 June 2008.

However, it is not so easy to retrieve the CO plume entering Canada and Russian forests.

Fig. 11: A snapshot of DC8 aircraft data over Kangerlussuaq, Greenland.

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