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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 borne measurements. Forecasts from different chemistry-transport models were used for flight planning within the GEMS project

Snapshot Evaluation

Table >> gives details about the different forecast models used for flight planning during POLARCAT-France 2008 campaigns. MOZART3-IFS (GEMS Forecast system) consists of Integrated Forecast System model (IFS Cycle 32R3 <http://www.ecmwf.int/research/ifsdocs>) coupled to the MOZART3^[1] chemical transport model (CTM). The GEMS forecasts were initiated each day at 00:00 hr GMT and run for 3 days.

Fig. 1 >> Latitudinal x-sections of GEMS forecasts for CO European tracer (left) at 20° E are compared with FLEXPART^[2] forecast (right) for 09 April 2008, based on 08 April 2008 (T+36).

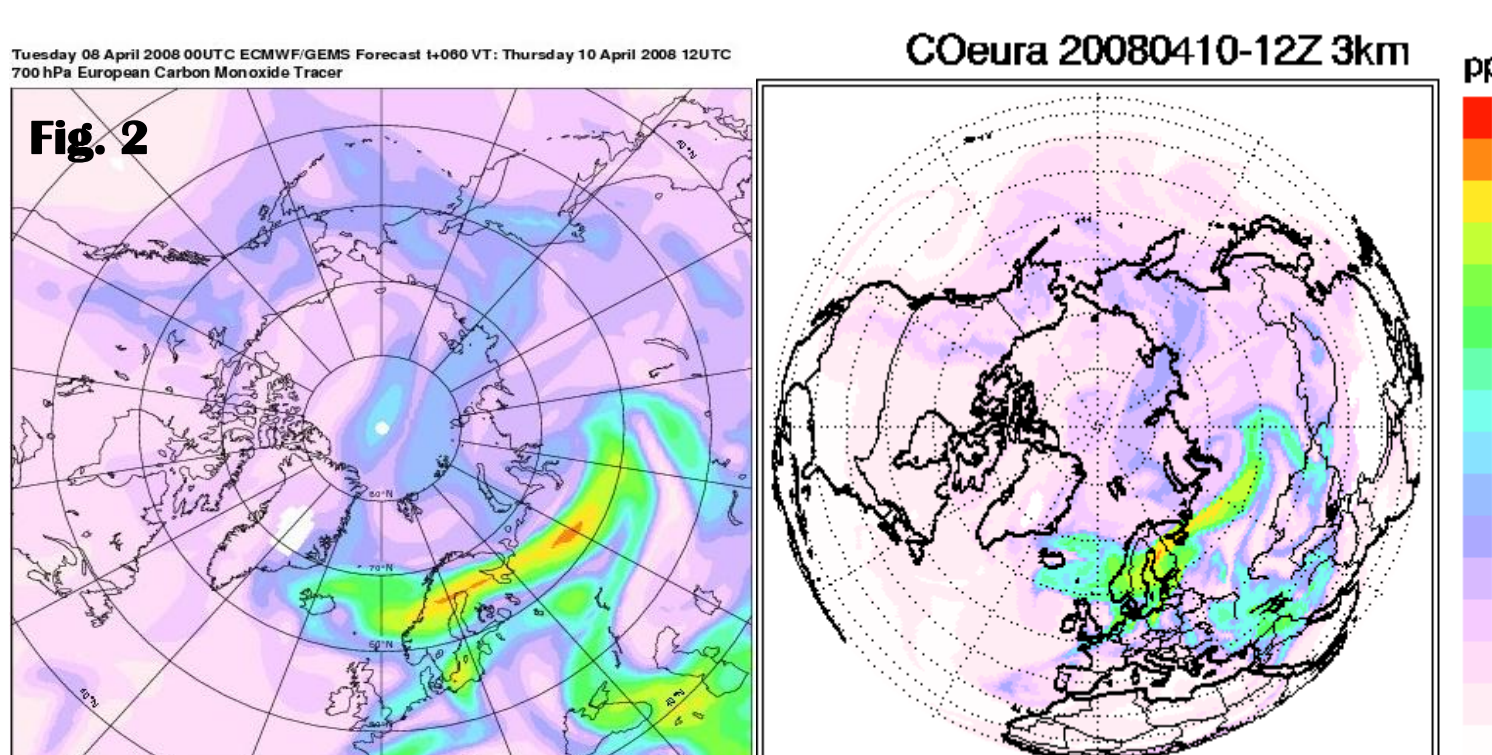
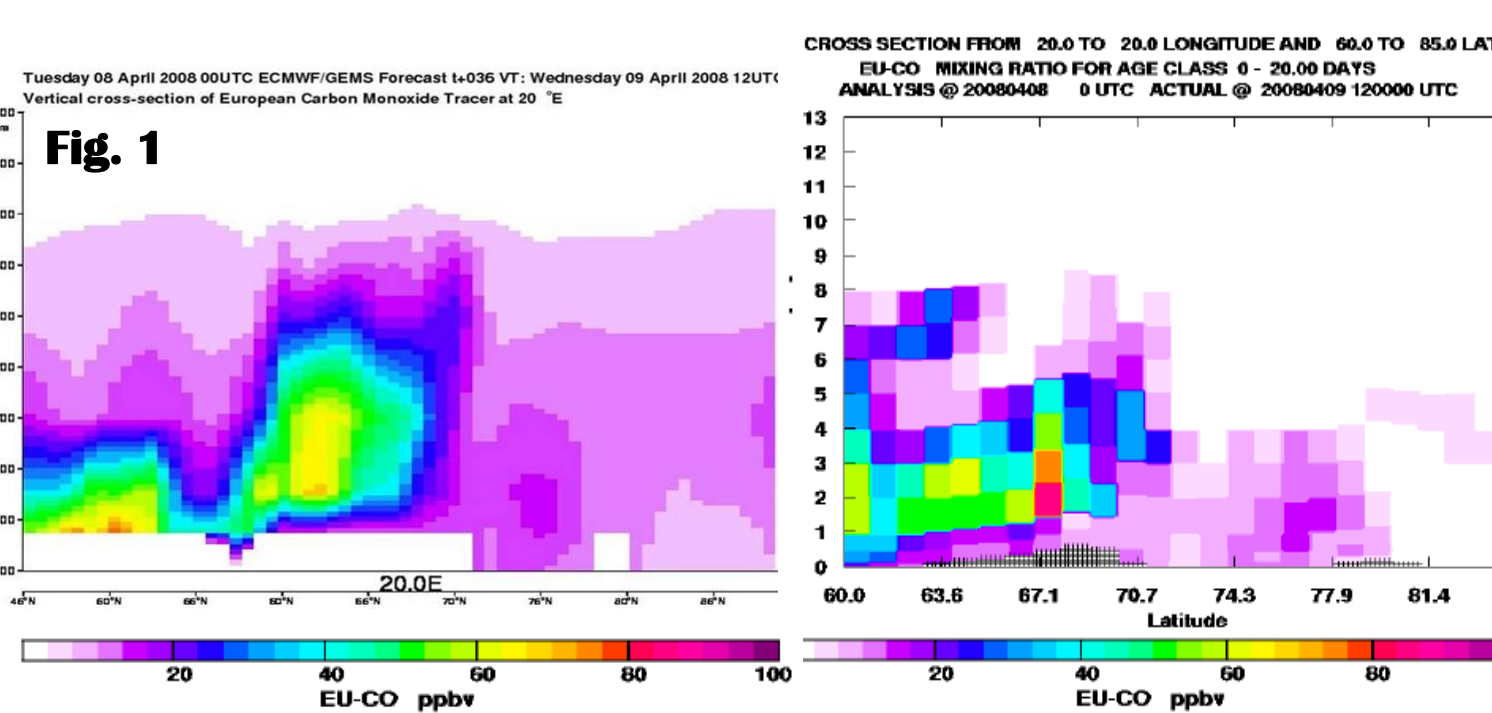
Fig. 2 >> Inter-comparison of CO European tracer (CO_EU) forecast at 700 hPa from GEMS (left) and MOZART-4/GFS^[3] (right) on 10 April 2008, based on 08 April 2008 (T+60)

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

Table : Specifications of forecast models used during POLARCAT campaigns

| Models | Range/ Level ^a | Forecast tendency | Resolution | Wind fields |
|--------------|---------------------------|-------------------|------------|-------------------|
| MOZART3- IFS | 0 - 11km / 6 | 3 days | 1.9 x 1.9 | ECMWF |
| FLEXPART | 0 - 13km / 13 | 5days | 1 x 1 | ECMWF |
| MOZART-4/GFS | 0 - 9km / 4 | 3days | 2.8 x 2.8 | NCEP/ GFS |
| GEOS-5 | 0-31.2km / 27 | 5days | 0.5 x 0.62 | GMAO ^b |

^a: Levels for which forecasts were available
^b: GFS – Global forecast system
^c: National Centre for Environ. Prediction
^d: Global Modeling and Assimilation Office



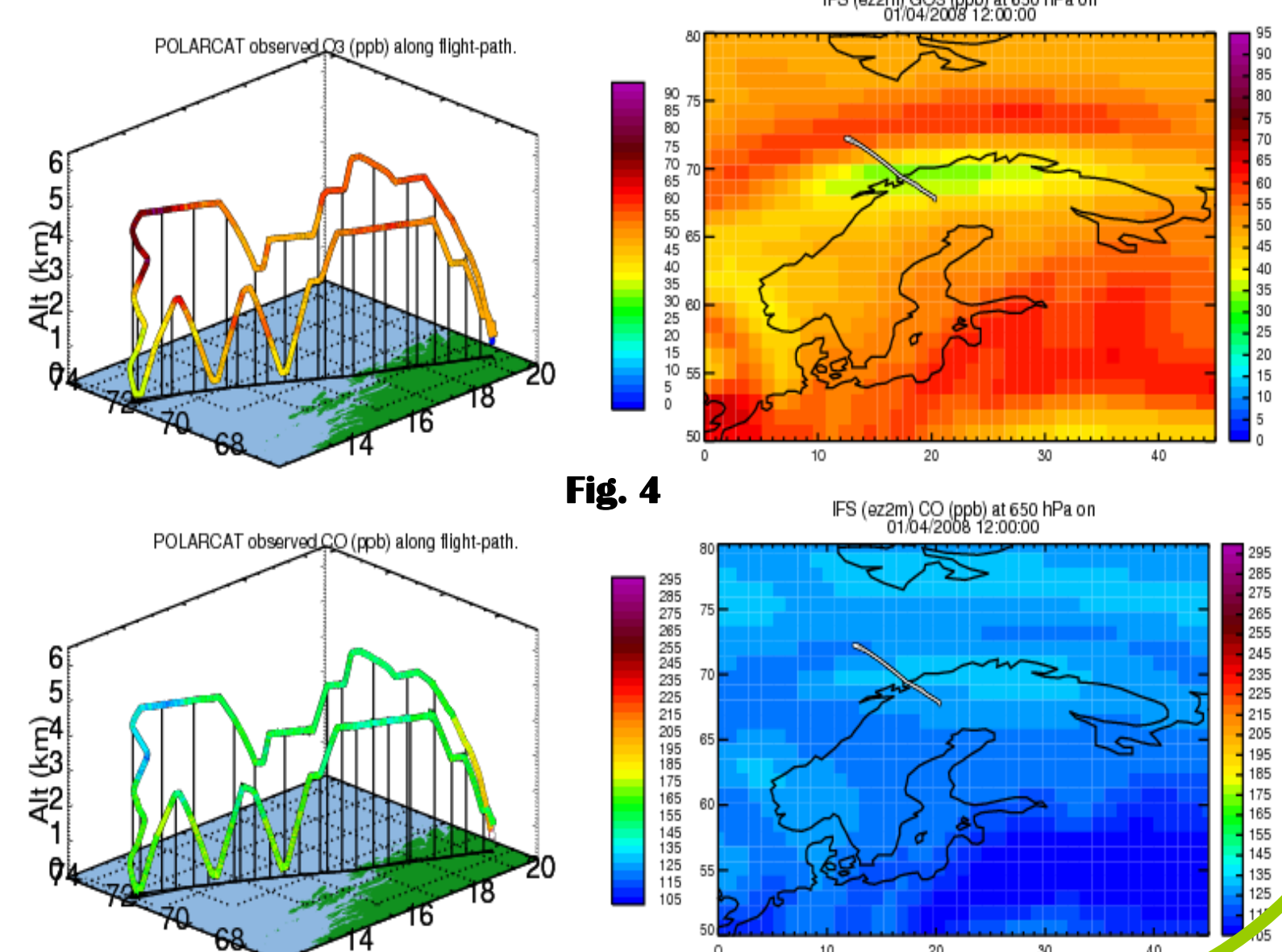
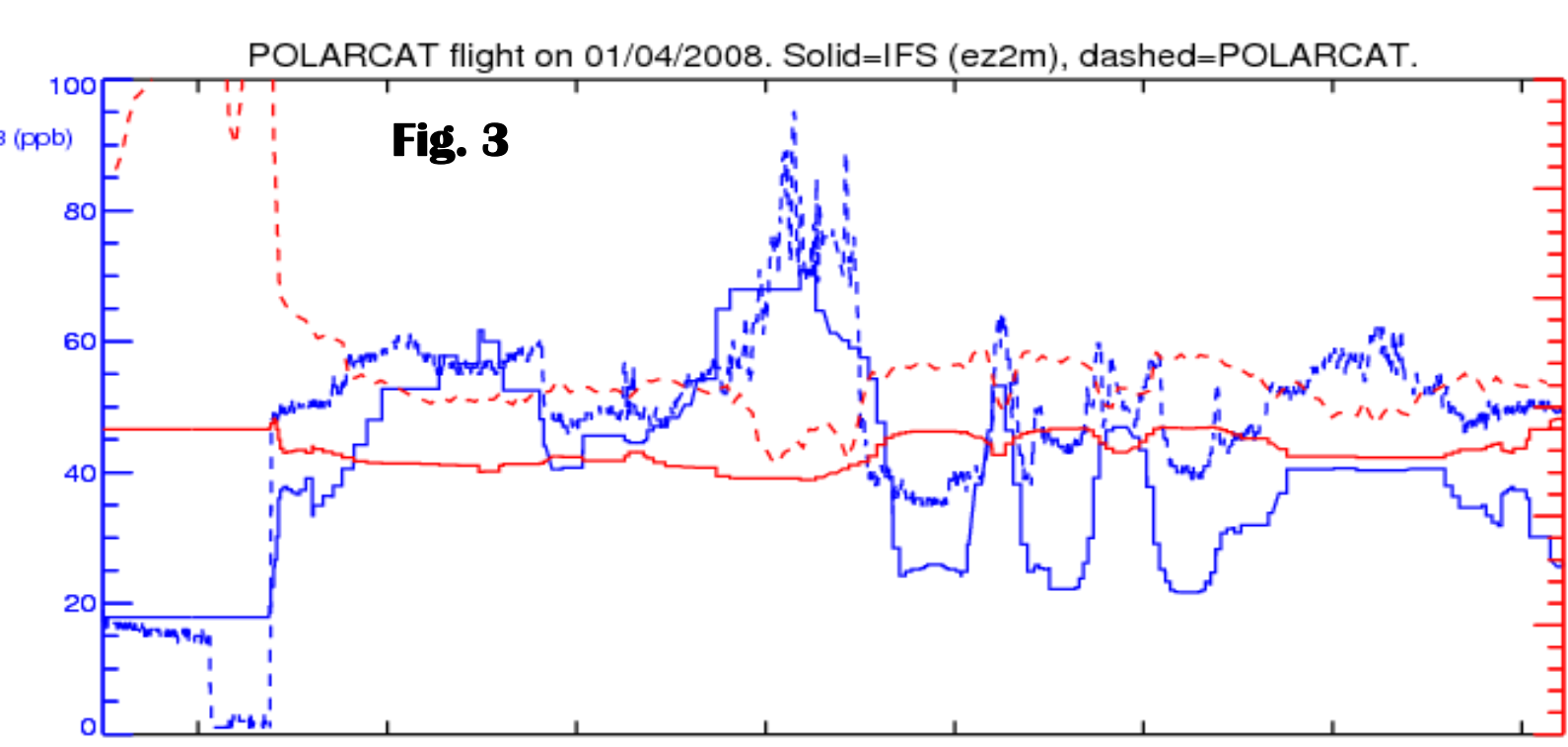
ATR42- aircraft data over Kiruna, Sweden

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

Fig. 3 >> shows a comparison of MOZART3-IFS simulations (solid line) with POLARCAT-France flight data (dashed line): CO (red) and O₃ (blue) on 1 April 2008.

>> MOZART3-IFS simulation output (from the nearest grid box) captured the temporal variability in both O₃ and CO (except a peak around 09:30 hours)

Fig. 4 >> 3D plot showing POLARCAT flight data for O₃ (top) and CO (bottom) at flight altitude (left). MOZART3 - IFS plots are shown for 650 hPa; lines indicate ATR42 flight track.



POLARCAT- France Summer 2008 Campaign

The main objectives of the summer 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).

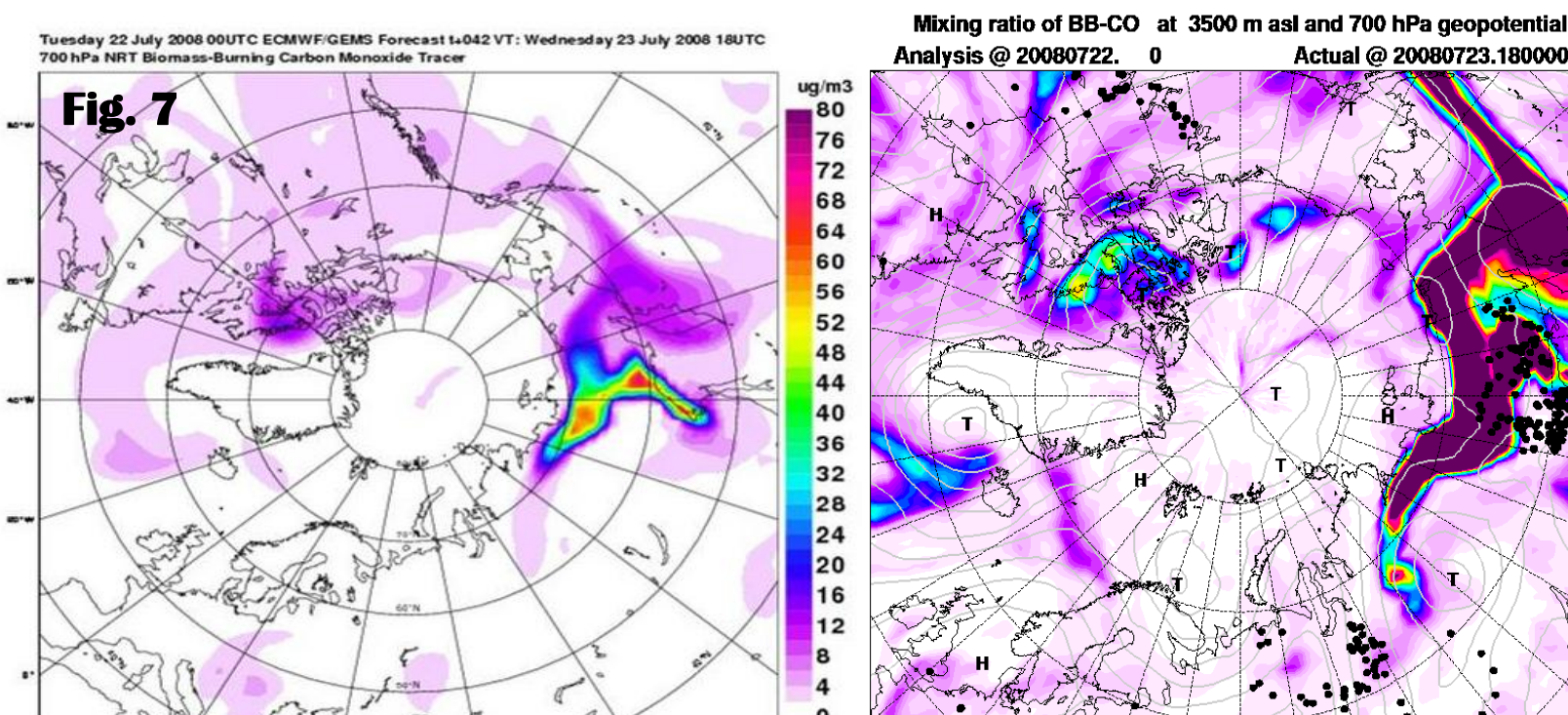
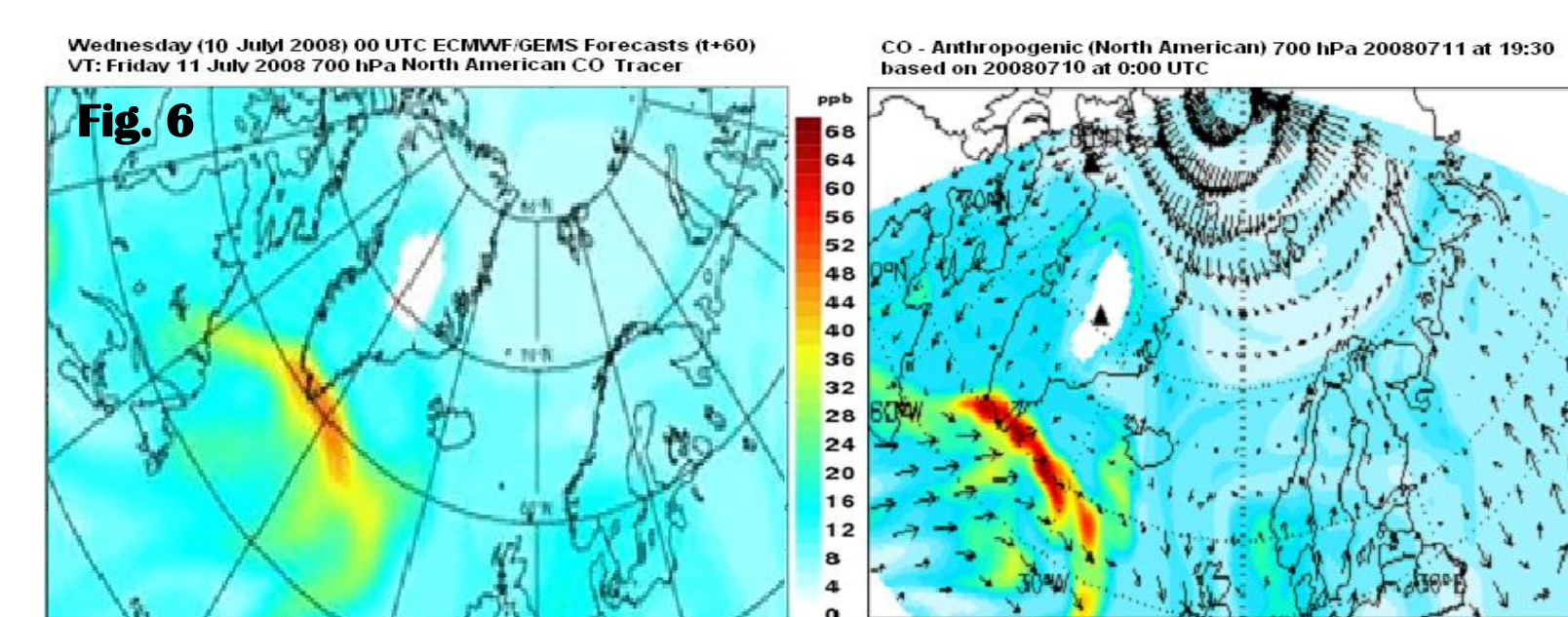
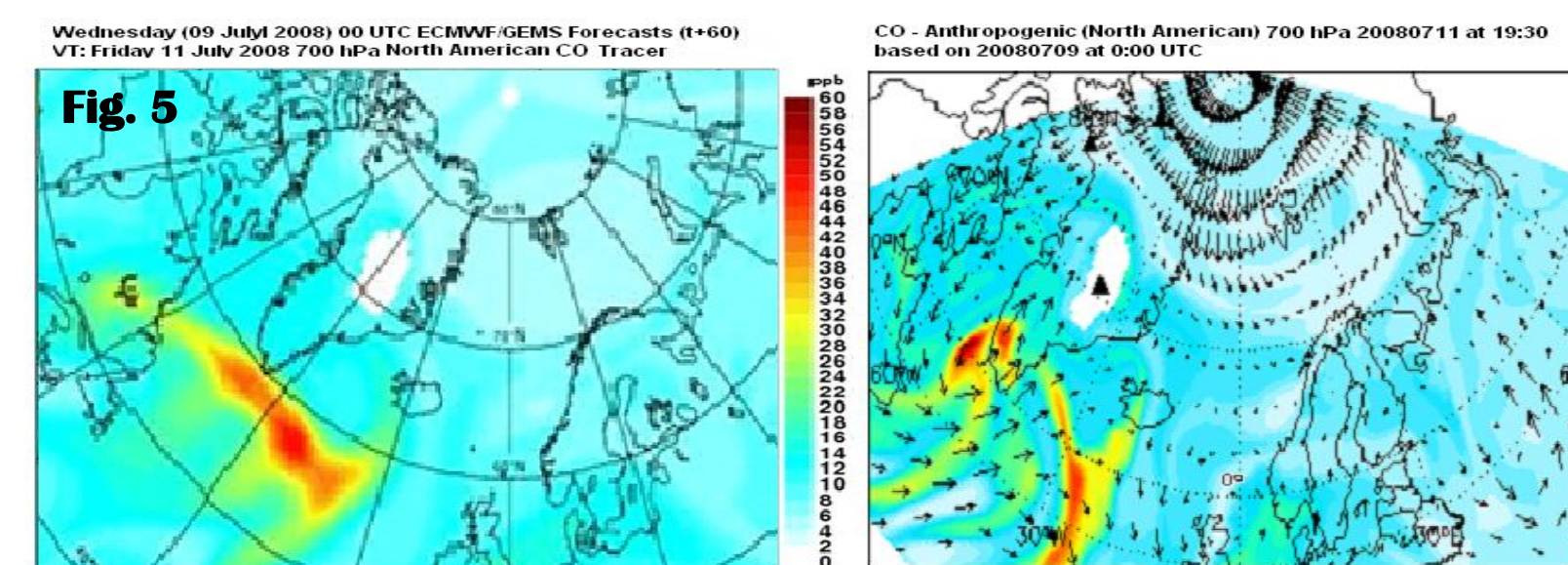
Snapshot Evaluation

Fig. 5 >> An inconsistency is observed by comparing GEMS forecasts for CO North American tracer (left) at 700 hPa with GEOS-5^[4] forecasts (right) for 11 July 2008 (T+60 hrs) based on 9 July 2008.

Fig. 6 >> Forecasts for the same day but based on 10 July 08 (T+42) are shown and now both forecasts exhibit a more consistent behaviour.

Fig. 7 >> GEMS forecasts of CO biomass burning tracer (left) compared with FLEXPART CO fire tracer (right) for 4 July 2008 based on 3 July 2008 (T+42 hrs) at 700 hPa.

>> GEMS started forecasts for biomass burning CO tracer on 3 July 2008, and the forest fire tracer did not have time to build up. Black dots in FLEXPART map indicate the location of European agricultural and Siberian forest fires



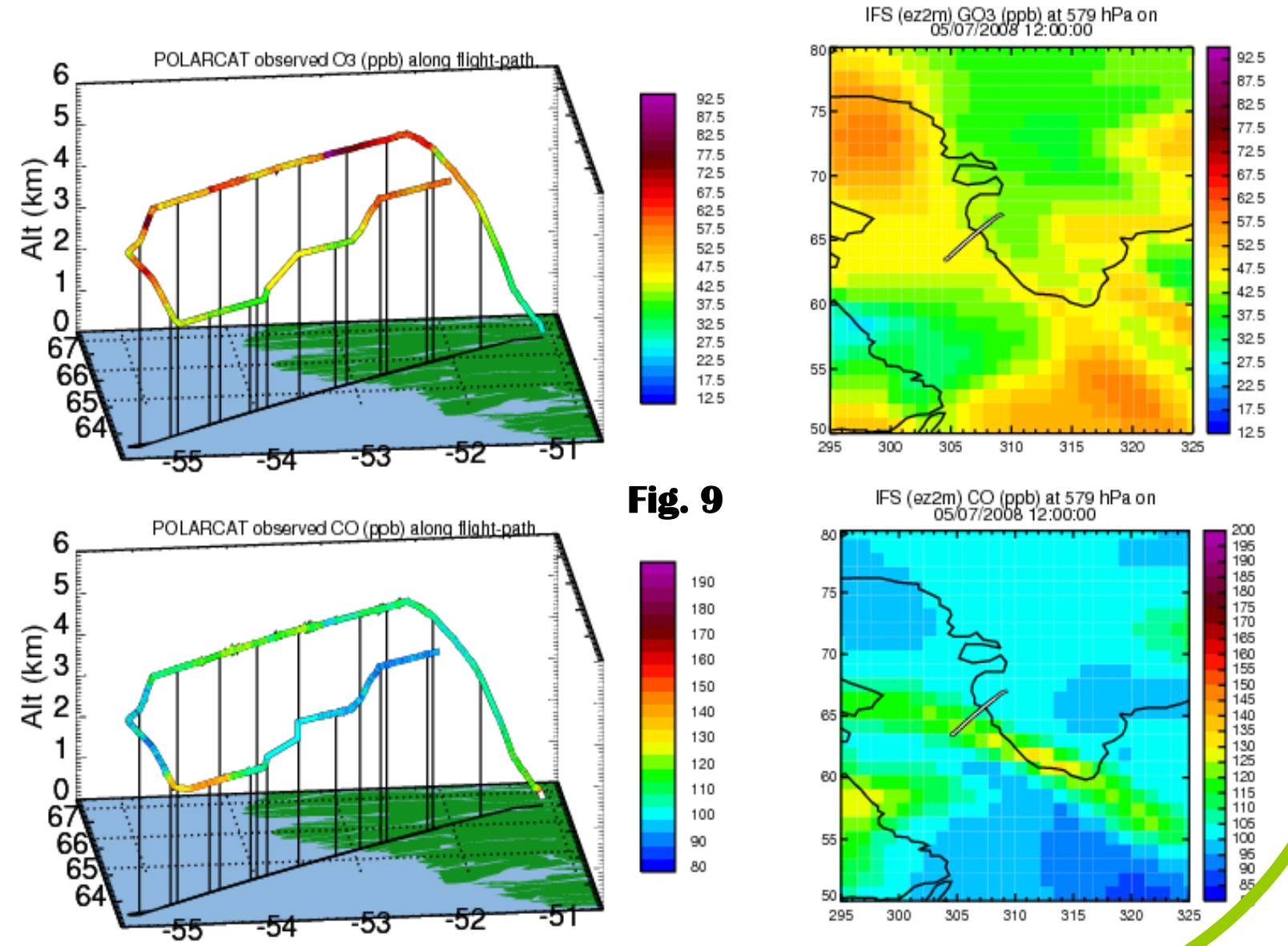
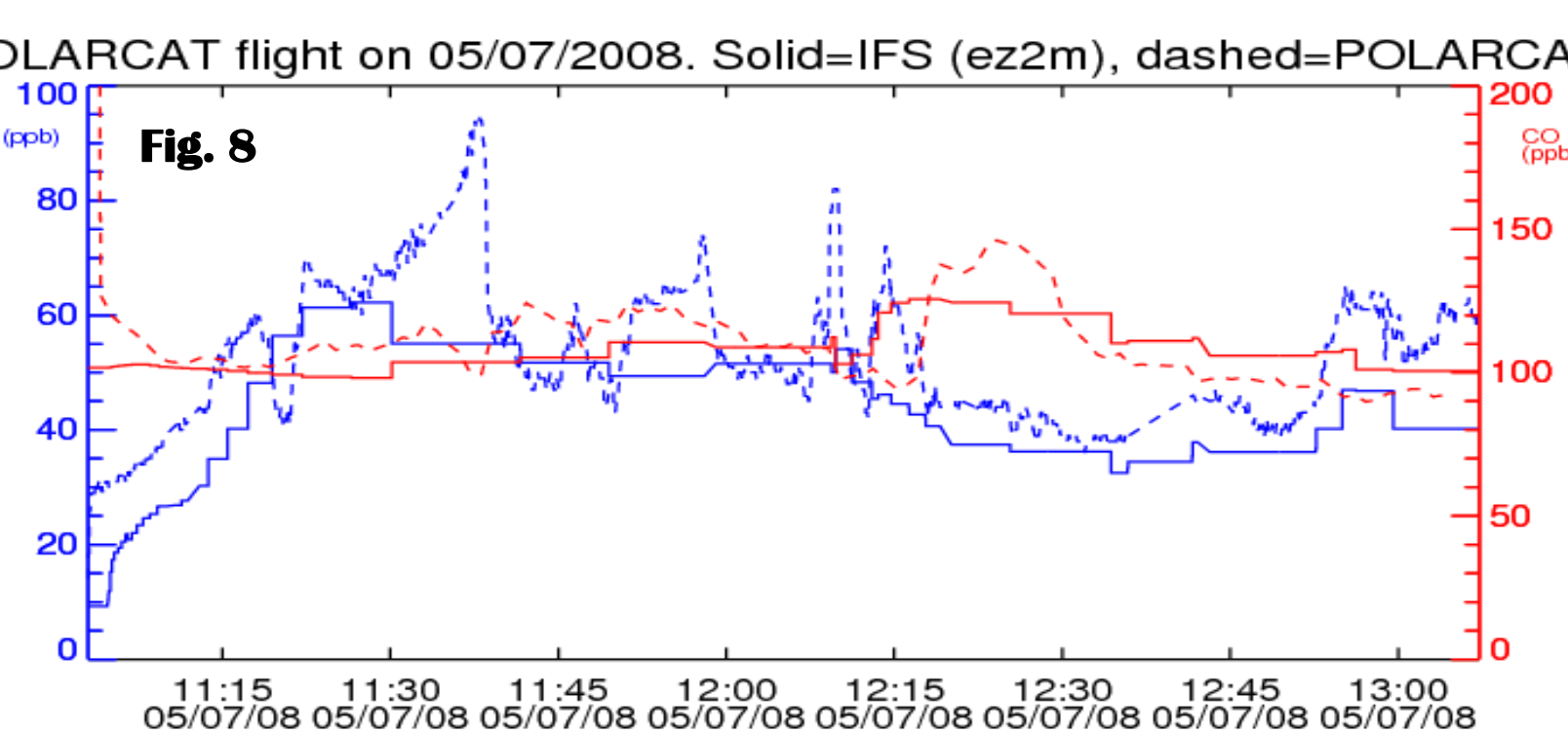
ATR42- aircraft data over Kangerlussuaq, Greenland

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

Fig. 8 >> shows a comparison of MOZART3-IFS simulations (solid line) with POLARCAT-France flight data (dashed line) for CO in red and O₃ in blue on 5 July 2008.

>> MOZART3-IFS simulation output (from the nearest grid box) reproduces the temporal variability in both CO and O₃

Fig. 9 >> 3D plot showing POLARCAT flight data for O₃ (top) and CO (bottom) at flight altitude (left). MOZART-IFS plots are shown for 579 hPa; lines indicate ATR42 flight track.



DC8 aircraft data over Canada

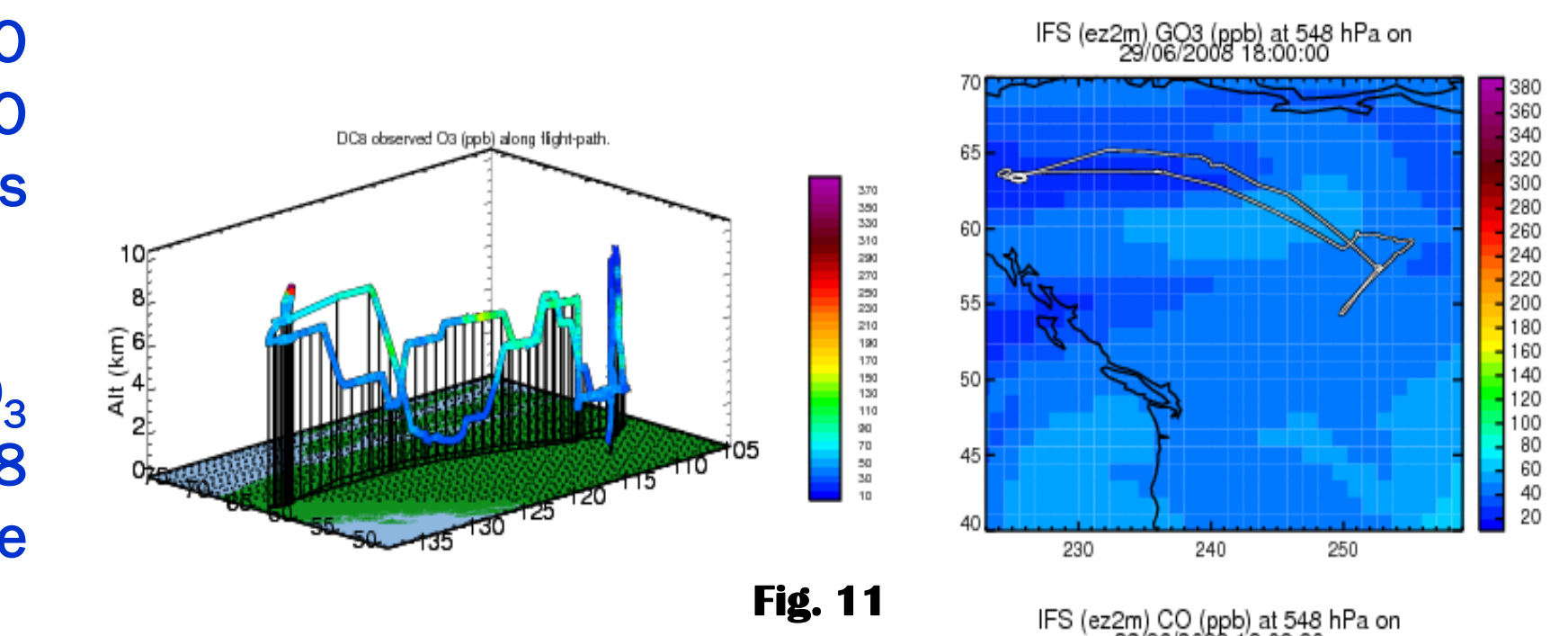
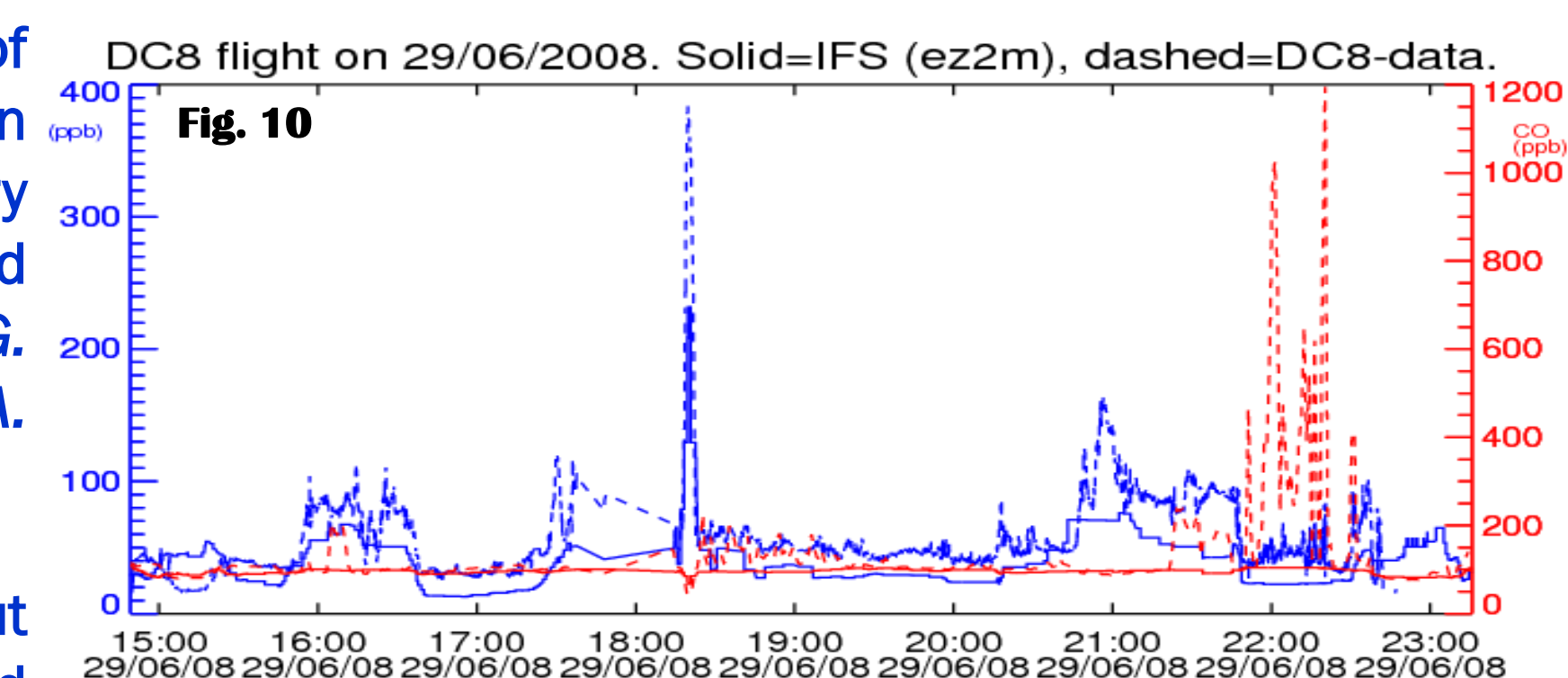
The NASA ARCTAS (Arctic Research of the Composition of the Troposphere from Aircraft and Satellites) project, which is part of the International Polar Year, conducted DC8 research aircraft flights to monitor the long range transport of pollution to the Arctic. Boreal forest fires and their implications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

Fig. 10 >> shows a comparison of MOZART3-IFS NRT analysis run (ez2m - solid line) with preliminary data from NASA -DC8 flight (dashed line) for CO in red (courtesy: G. Diskin) and O₃ in blue (courtesy: A. Weinheimer) on 29 June 2008.

>> MOZART3-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

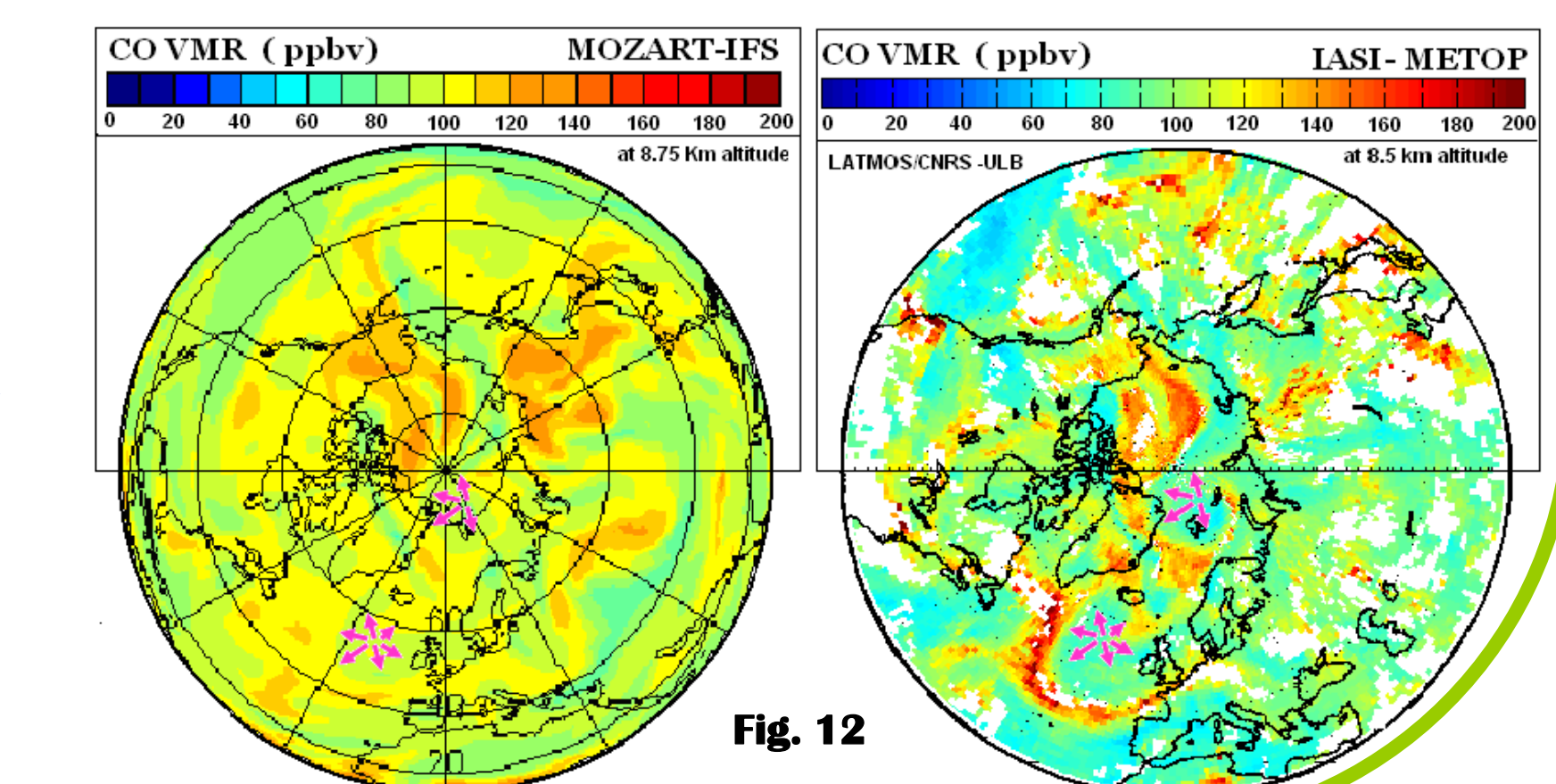
>> High peaks in CO (>1 ppm) and O₃ (400 ppb) are observed by the DC8 aircraft, which intercepted a fire plume over Canadian forest region

Fig. 11 >> 3D plot showing POLARCAT flight data for O₃ (top) and CO (bottom) at flight altitude (left) and MOZART3-IFS (ez2m) concentration plots at 548 hPa with the line indicating DC8 flight track



IASI Validation

Fig. 12 >> MOZART3-IFS NRT analysis (ez2m) of global CO tracer (left) at 8.75 km altitude for 10 July 2008, based on 9 July, is compared with IASI-METOP^[5] map (right): NRT analysis of CO concentrations at 8.5 km on 10 July 2008 is shown.



Conclusions

>> GEMS (MOZART3-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.

>> Nevertheless, GEMS forecasts showed a good consistency compared to other CTMs forecasts, ATR42 aircraft and DC8 aircraft preliminary data, and IASI NRT analysis.

Acknowledgment

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References

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- [4] For details see: <http://coco.atmos.washington.edu/cgi-bin/ion-pag-arctas>
- [5] Clerbaux et al. submitted to Atmos. Chem. Phys. Discuss., IASI Special Issue, 2009