GEMS WP_GRG observational data

Progress report

Workpackages in GRG

1. Assimilation of gas-phase chemical species in the stratosphere and troposphere
2. Implementation of state-of-the-art global chemistry transport models in the ECMWF operational system
3. Development of Prototype User Services
4. Evaluation of reanalysis simulations

WP 4 - Evaluation of reanalysis simulations

Tasks: (LA, SA)

1. Inventory of community-accessible data sets
2. Definition of parameters for model evaluation
3. Preliminary evaluation of reanalysis runs
4. Definition and preparation of case studies

WP 4 - Evaluation of reanalysis simulations

Milestones and expected results:

- **Month 3:** Contacts with representatives of observation networks established
- **Month 6**: Inventory of community-available surface and in-situ datasets compiled
- **Month 12**: Compiled datasets for selected species/stations available and quality checked,
  Methodologies for model validation available,
  Preliminary model outputs available (from WP_GRG_2)·
- **Month 18**: Case studies defined,
  preliminary evaluation of first reanalysis runs available

WP 4 - Inventory of community-accessible data sets

Tasks: (LA, SA)

Excel Table completed by C. Textor and JP Cammas

Aircraft

a. MOZAIC (Cammas, data protocol, NETCDF, BUFR)

b. CONTRACE 2 (Cammas/Huntrieser, data protocol, NETCDF)

c. Other aircraft campaigns ?: list of other campaigns (ACCENT-T&TP: NARE, TRACE-P, NOXAR, TRADEOFF, SPURT, CRYSTAL-FACE, ICARTT, … (SA-UPMC / Cammas)

d. O3 Airborne Dial (Flentje/Ehret, data protocol, NETCDF)

WP 4 - Inventory of community-accessible data sets

Tasks: (LA, SA)

Ground-based stations

a. WMO/GAW WDCGG (Berresheim/Flentje, data protocol, ASCII)
b. WMO/GAW WOUDC (Berresheim/Flentje, data protocol, ASCII)
c. CMDL (Granier/SA-UPMC)

WP 4 - Inventory of community-accessible data sets

Tasks: (LA, SA)

Sondes

a. SHADOZ (Cammas/Thompson, data protocol, NETCDF)
b. NDSC O3 sondes (Claude/Kurylo&Braathen, data protocol, NETCDF)
c. NKUA Lidar/Sondes (Melas, ?)

WP 4 - Inventory of community-accessible data sets

Tasks: (LA, SA)

Selected super sites

a. Hohenpeissenberg (Berresheim, ASCII)

Satellite data

a. MOPITT CO (Granier, NETCDF, HDF)

WP GRG_4: Strategies of model validation
Model outputs & Parameters for model evaluation

Model outputs:

- **Standard evaluation:** Three-hourly files: NETCDF, GRIB

  Specifications of output and NETCDF format to be adapted from the RETRO project

- **More rigorous evaluation**: Instantaneous fields interpolated at each simulation time step to all coinciding observations: NETCDF files

Parameters for model evaluation:

- Meteorological + tracer & chemical fields (O3, CO, NO, NO2, NOy, …)

WP GRG_4: Strategies of model validation
Model outputs

NETCDF format for model ouput from RETRO:

- **File 1:** Model horizontal grid definition (longitude, latitude, size of gridbox). Documentation: native vertical grid definition from model (hybrid level coefficients), formula used to calculate pressure
- **File 2:** 3D field of monthly model pressure (Pa) and temperature (K)
- **File 3:** 3D monthly mean fields for O3, CO, CH4, NO, NO2, OH, H2O, HNO3, …
- **File 4: Daily 10:30 local time tropospheric columns**
- **File 5: Daily 10:30 local time 3D fields**
- **File 6: 2D monthly dry and wet deposition fields**

- **File 9: Monthly ozone budgets including chemical production and destruction, stratospheric influx and surface deposition**
- **File 11: Daily ozone columns**
- **File 12: Surface station data**
- **File 13: Profile data**
- **File 14: TRADEOFF campaign data**

WP GRG_4: Strategies of model validation
Evaluation methods

Metrics

- **General existing metrics :** **NRMSE**, absolute correlations, anomaly correlations, tracer correlations, …

- **Additional metrics: Taylor Diagrams (TRADEOFF, RETRO, AEROCOM)**

Brunner et al. An evaluation of the performance of chemistry transport models by comparison with research aircraft observations. Part 1: Concepts and overall model performance *Atmospheric Chemistry and Physics*, Vol. 3, pp 1609-1631, 2003.

Brunner et al. An evaluation of the performance of chemistry transport models by comparison with research aircraft observations. Part 2: Detailed comparison with two selected campaigns *Atmospheric Chemistry and Physics*, Vol. 5, pp107-129, 2005.

WP GRG_4: Strategies of model validation
Objectives of validation

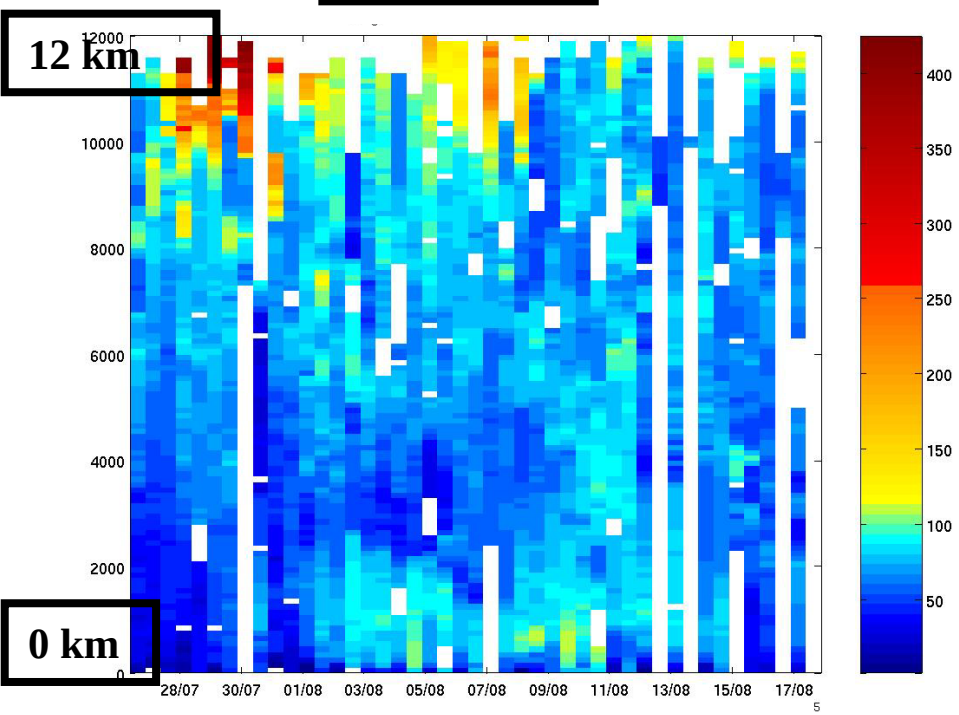
Objectives

- Seasonal cycles (UT&LS, PBL, regions)
- Tropopause height and vertical gradients
- Tropospheric columns (O3, CO, …)
- Stratospheric intrusion and PBL contents
- Budgets (STE, photochemistry, deposition)

Examples & case studies from MOZAIC

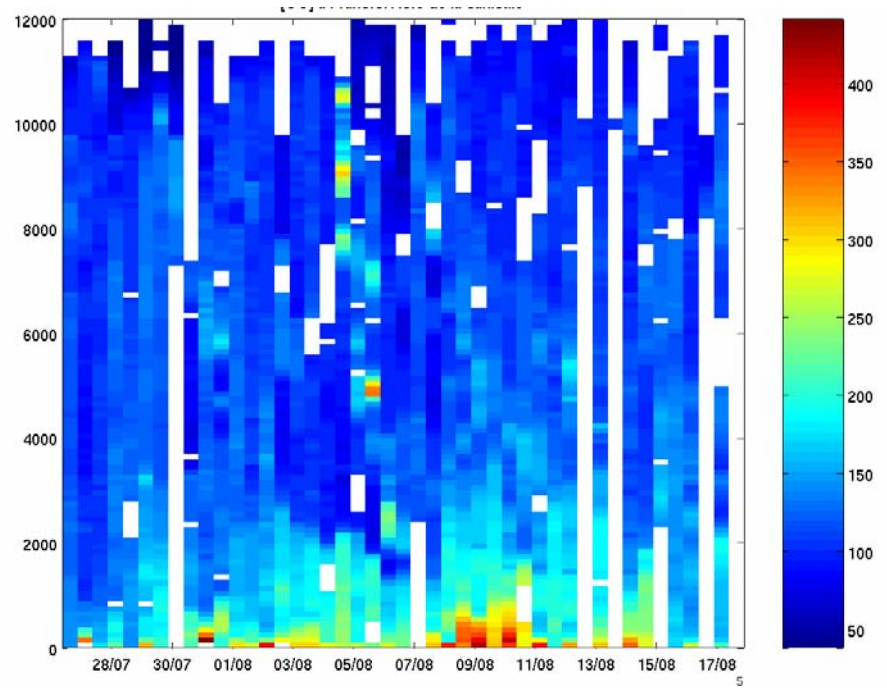
Summer 2003 Heat Wave in Frankfurt: MOZAIC observations

O3 (ppbv)



July 26 → August 17

CO (ppbv)



July 26 → August 17

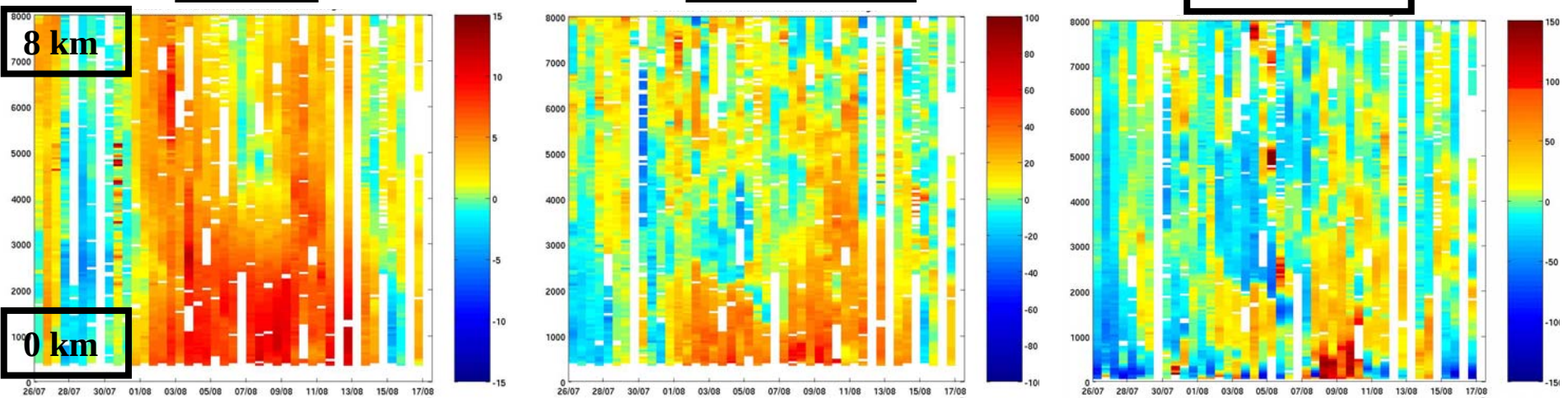
M. Tressol, Ph.D. thesis

Summer 2003 Heat Wave in Frankfurt: Deviations from the MOZAIC climatology

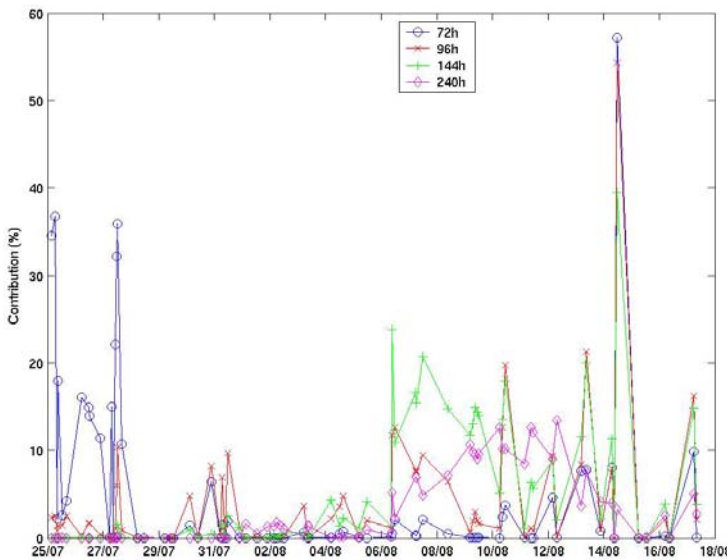
T (°C)

O3 (ppbv)

CO (ppbv)



July 26 → August 17

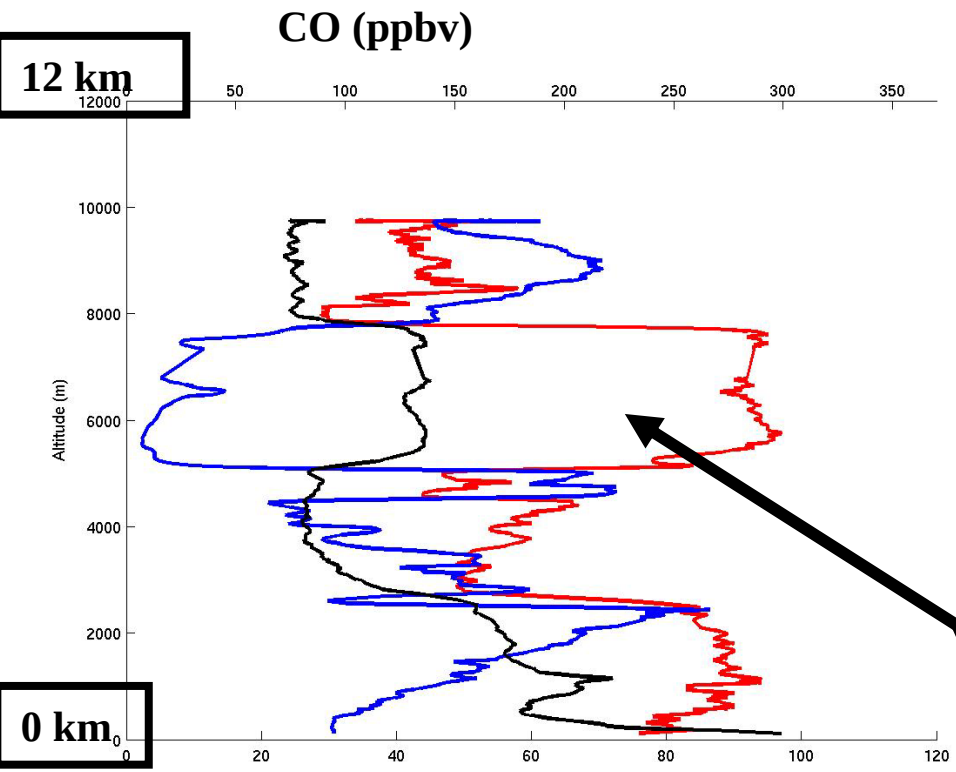


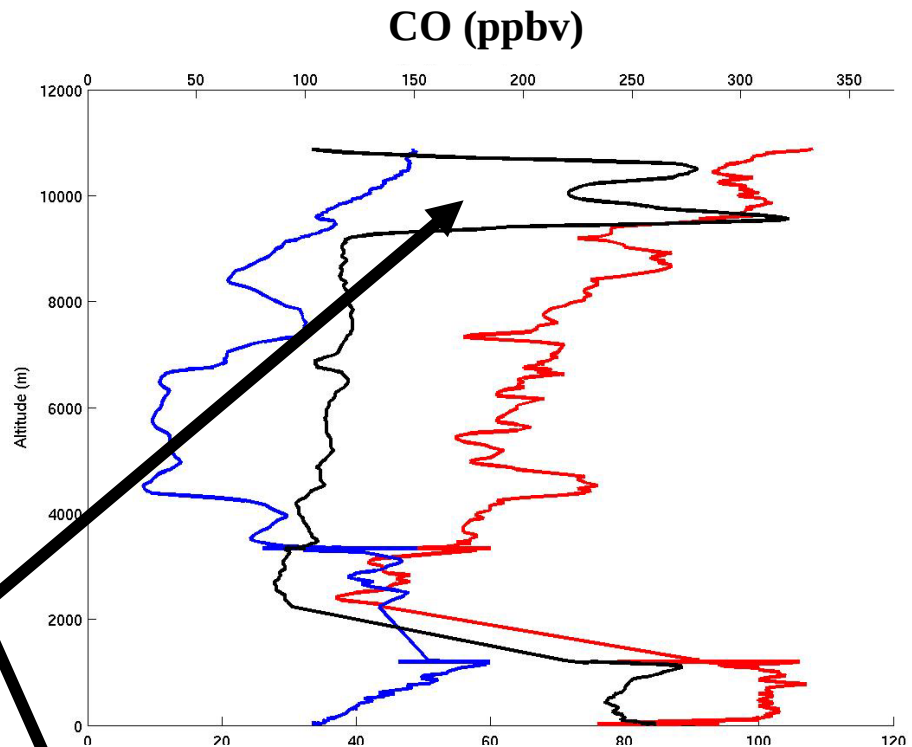
Boundary layer air composition in Frankfurt: Contribution of air masses affected by biomass-fires over Portugal

Flexpart calculations

M. Tressol, Ph.D. thesis

Summer 2003 Heat Wave in Frankfurt: MOZAIC observations





Biomass fire plumes from Alaska & Canada

M. Tressol, Ph.D. thesis

WP GRG_4: Evaluation of performance of CTM with Taylor Diagrams

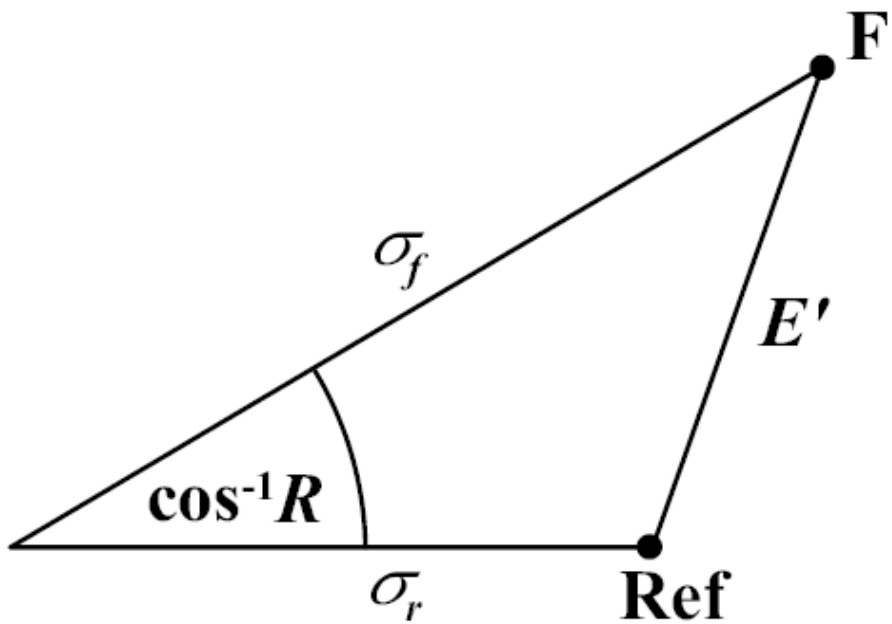
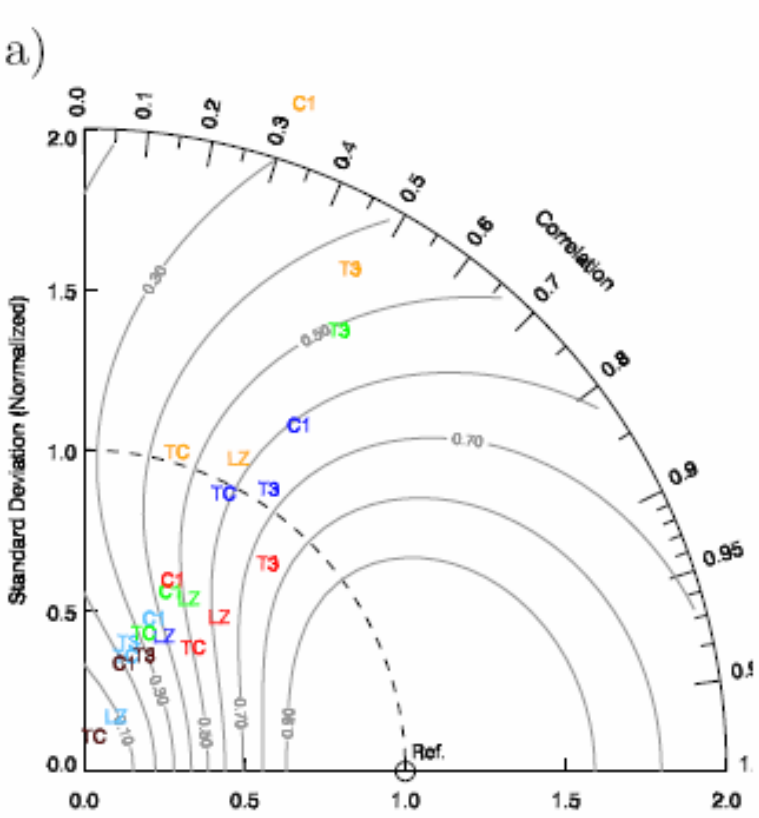


Fig. 3. Geometric relationship in a Taylor diagram between the correlation coefficient R, the root mean square (RMS) error E' and the standard deviations of the test field σ_f and reference field σ_r, respectively.

WP GRG_4: Evaluation of performance of CTM with Taylor Diagrams



XX = O_3 XX = CO XX = NO XX = HNO_3 XX = H_2O_2 XX = PAN

Fig. 6. Taylor diagrams of model performance for the PEM-Tropics A campaign. **a)** All measurements at p <400 hPa and between 0 and 35° S latitude (same data as in Fig. 2), **b)** flights 5–10 over eastern South Pacific only, **c)** flights 15–18 over western South Pacific only, **d)** vertical profiles at Tahiti (same data as in Fig. 3). All points of a given model are represented by a specific label: T3=TM3, C1=CTM-2 version 1, TC=TOMCAT, and LZ=LMDz-INCA. Different colors indicate different tracers (see legend at the bottom). Grey contours are isolines of model skill as defined in Eq. (1).