What do precipitation forecast tell us about the second aerosol indirect effect?

Olivier Boucher, Met Office, Now at Laboratoire de Météorologie Dynamique, Paris

Marie Doutriaux-Boucher, Met Office, Now at EUMETSAT, Darmstadt, Germany

Sean Milton, Met Office, Exeter, U.K.

Jean-Jacques Morcrette, Angela Benedetti, ECMWF, Reading, U.K.

Nicolas Huneeus, Laboratoire des Sciences du Climat et de l'Environnement, IPSL, Gif

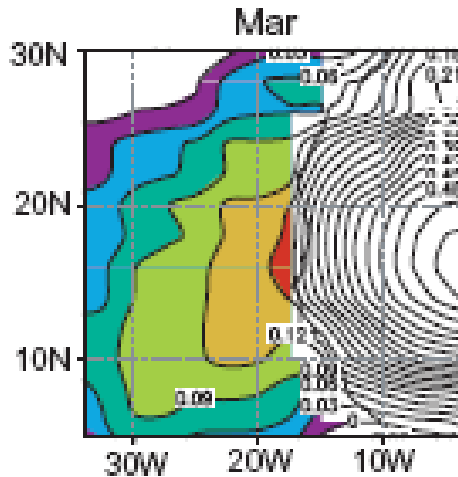# Inspiration for the study

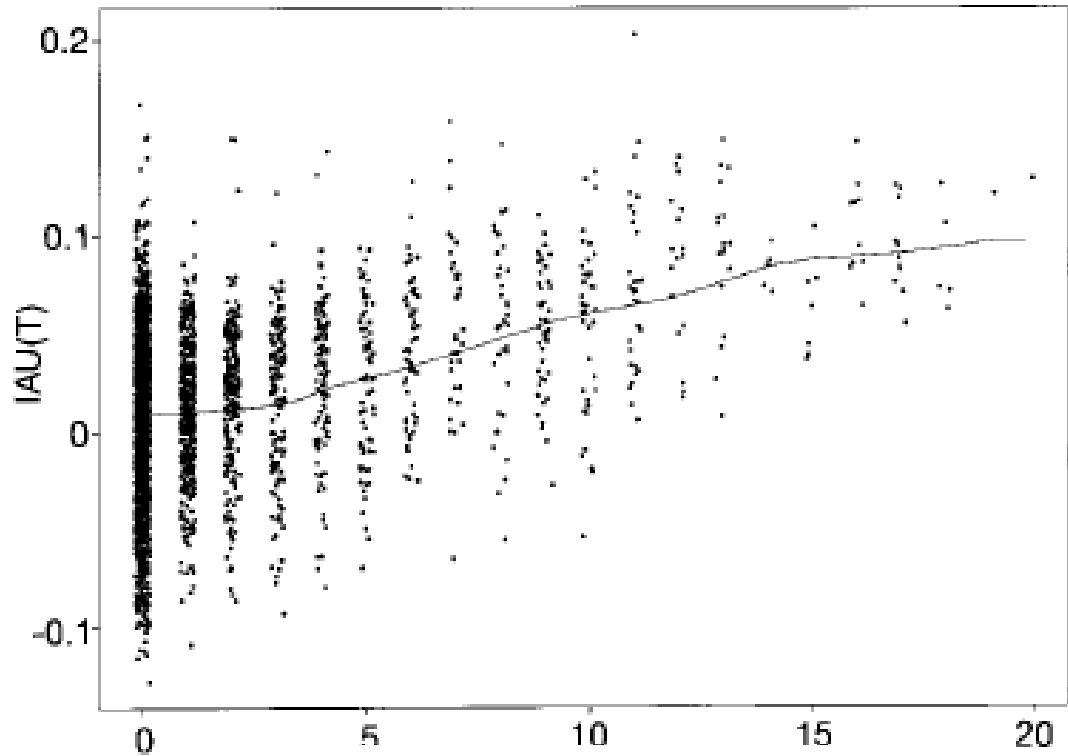
Monthly mean incremental analysis update in atmospheric temperature (K)

Number of dusty in months

"a GCM without aerosol physics within a data assimilation system"

Alpert et al., Nature, 1998

MACC aerosol forecast and monitoring system
(refer to J.-J. Morcrette's presentation on Monday)

MACC aerosol forecast and monitoring system
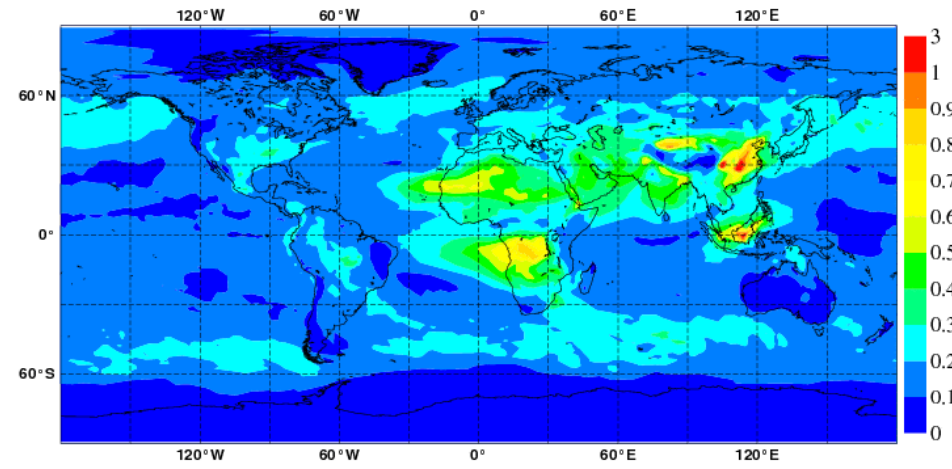## (refer to J.-J. Morcrette's presentation on Monday)

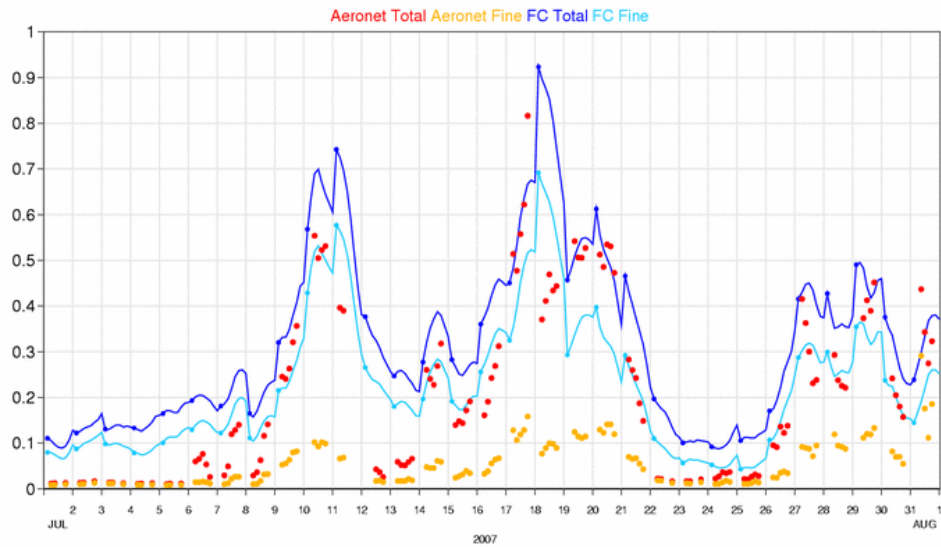Aeosol model in the ECMWF IFS

Observation error covariance matrix

MODIS total AOD

Background error covariance matrix

4-D-VAR

Comparison of model (fe00) AOT at 550nm and L1.5 Aeronet AOT at 500nm over Izana (28.31°N, 16.5°W). Model: 00UT, 1-31 Jul 2007, T+3 to T+24.
Aeronet Total   Aeronet Fine   FC Total   FC Fine

Experimental setup

CTRL: control experiment, no aerosol direct and indirect effects

DIR: aerosol direct effect, no aerosol indirect effect

IND: no aerosol direct effect, aerosol indirect effect

DIR+IND: aerosol direct and indirect effects

==> One year (2003) of daily 72h weather forecasts initialised from 00Z with the full-ECMWF 4D-VAR extended to the aerosol state at T255 resolution
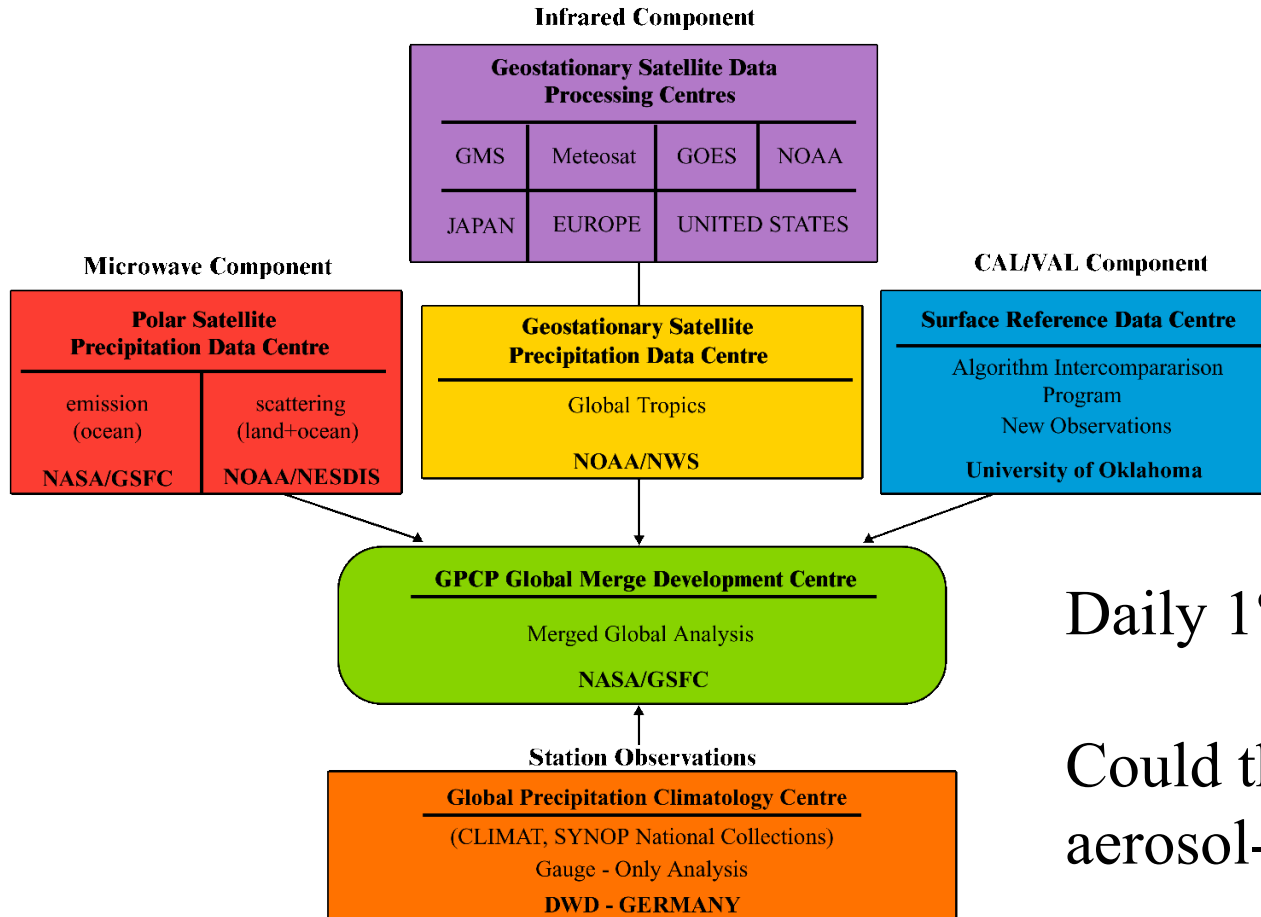
==> CTRL=aerosol climatology

==> DIR=aerosol radiative effects switched on

==> IND=CCN number from sea-salt, sulfate and OM aerosols
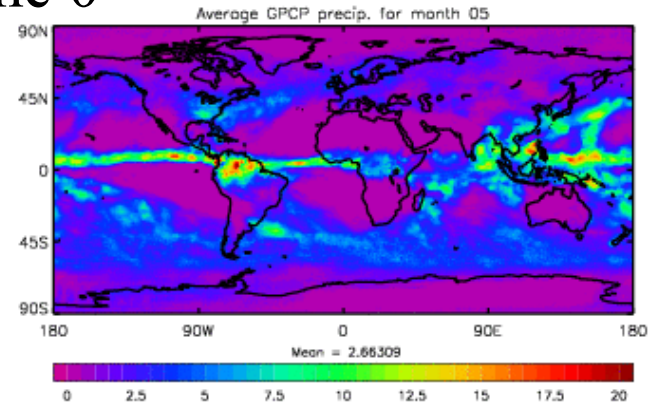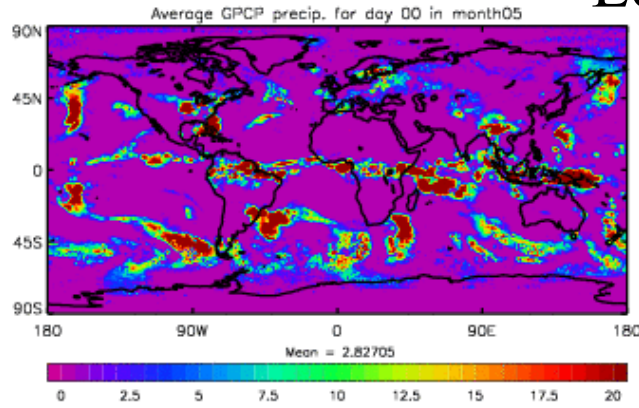
Precipitation data: GPCP
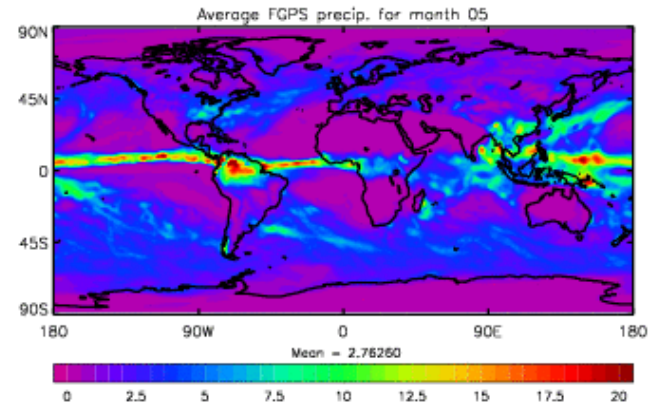

Daily 1° x 1° resolution
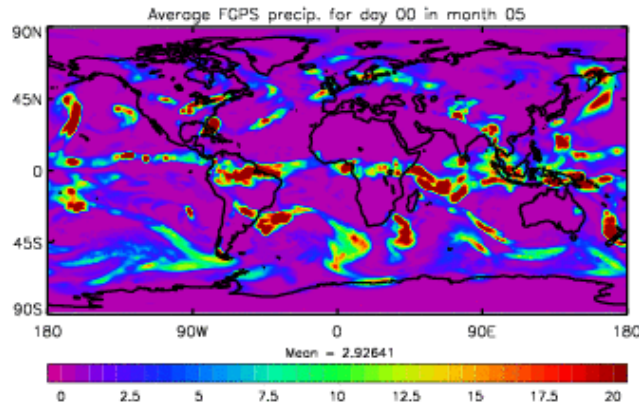
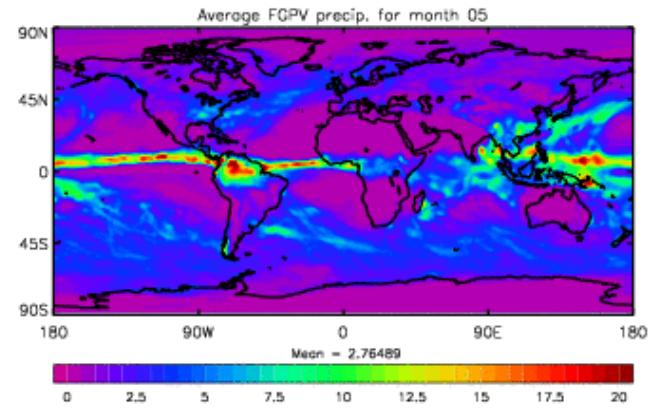Could there be any aerosol-related bias?

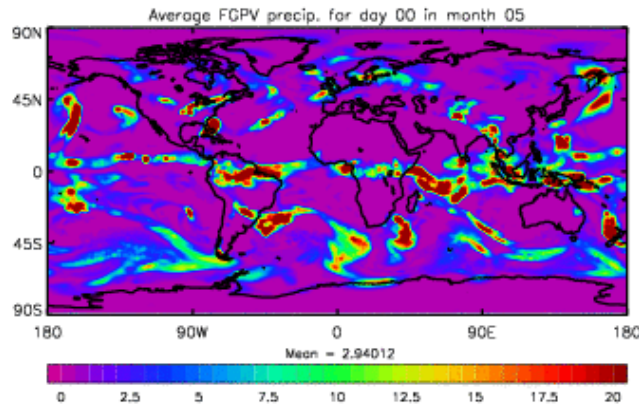Precipitation data
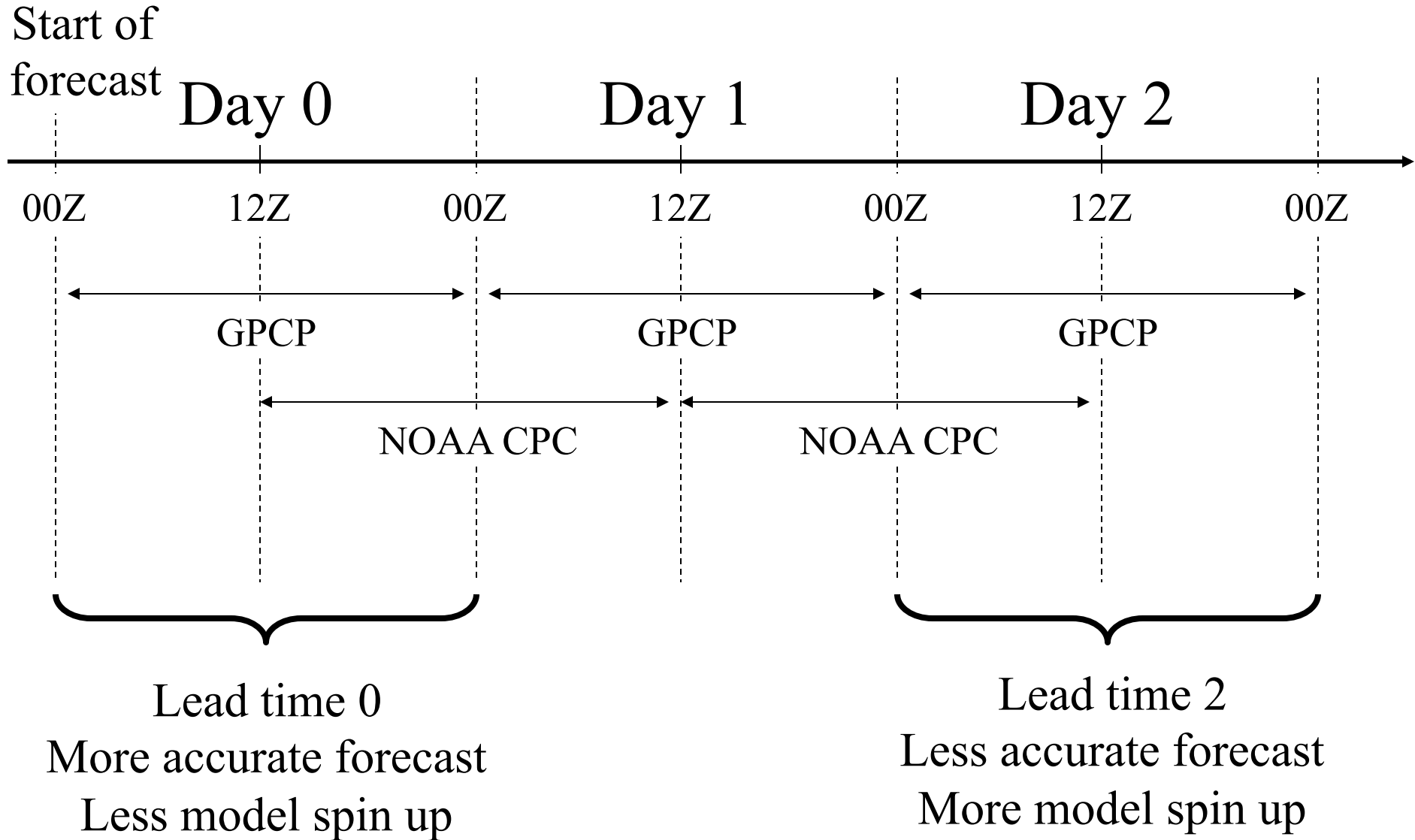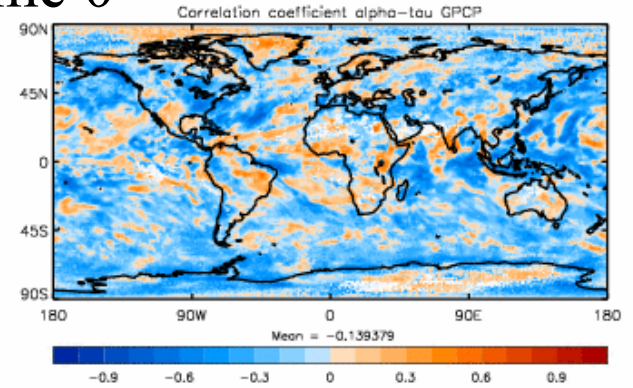
Lead time 0
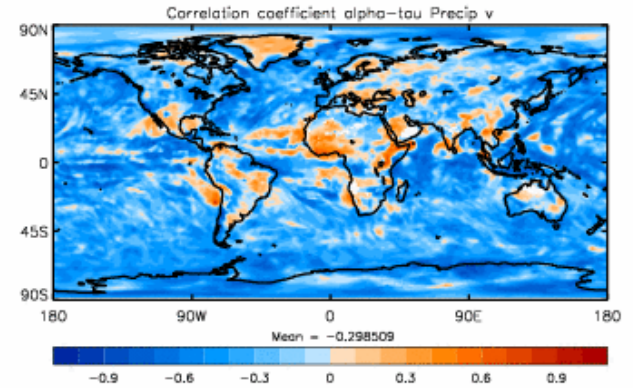
GPCP

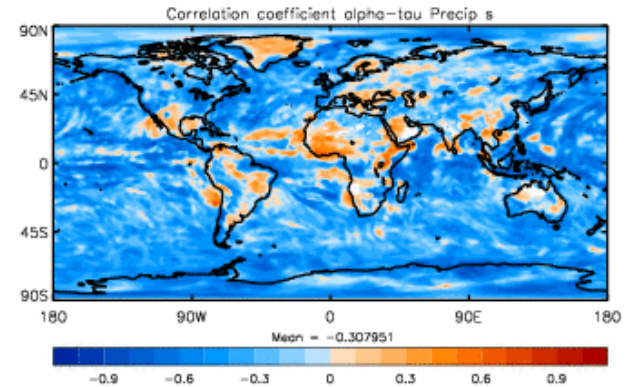CTRL

DIR+IND

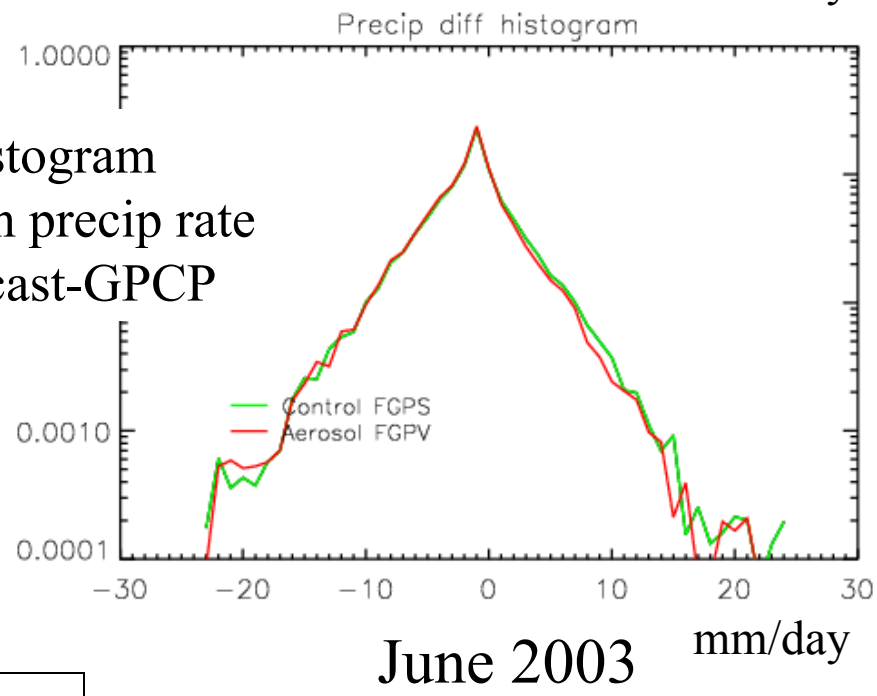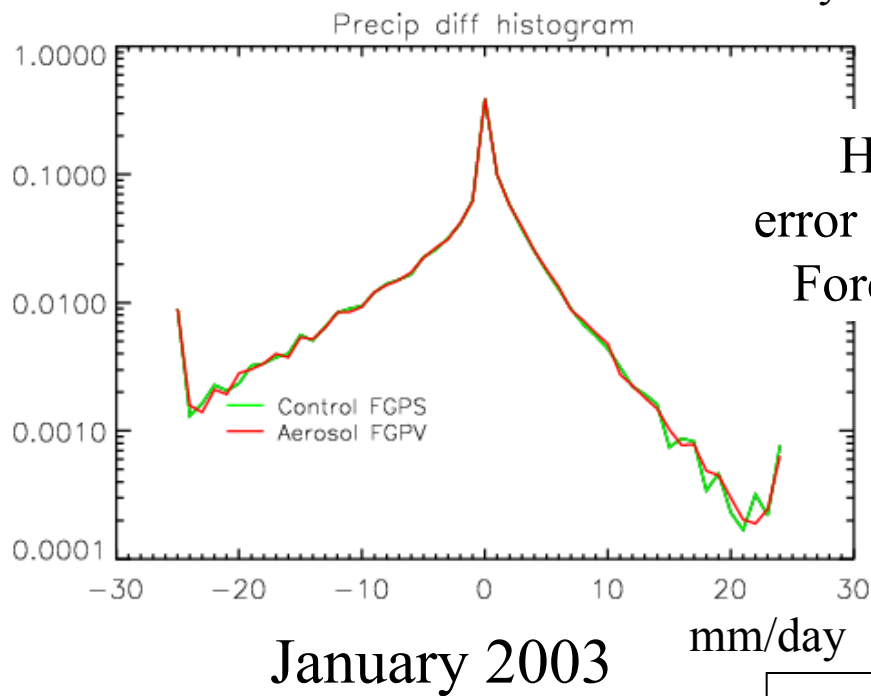1 May 2003   May 2003

Lead time 0

GPCP

CTRL

DIR+IND

R(τ, precip)   May 2003   R(ατ, precip)

Precip histogram — Histogram precip rate

GPCP
Control FGPS
Aerosol FGPV

mm/day

Precip histogram — Histogram precip rate

GPCP
Control FGPS
Aerosol FGPV

mm/day

Precip diff histogram — Histogram error on precip rate Forecast-GPCP

Control FGPS
Aerosol FGPV

mm/day

Control FGPS
Aerosol FGPV

mm/day

January 2003
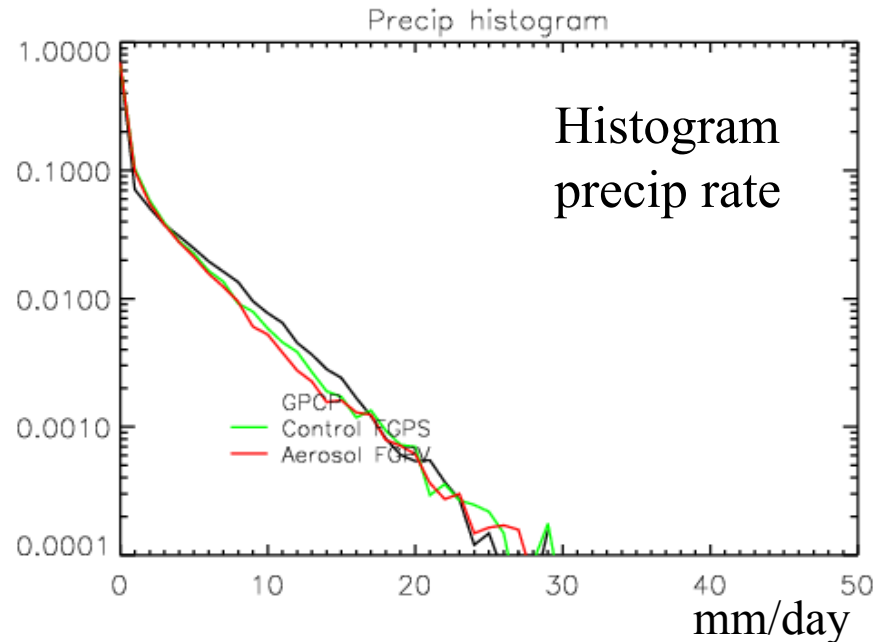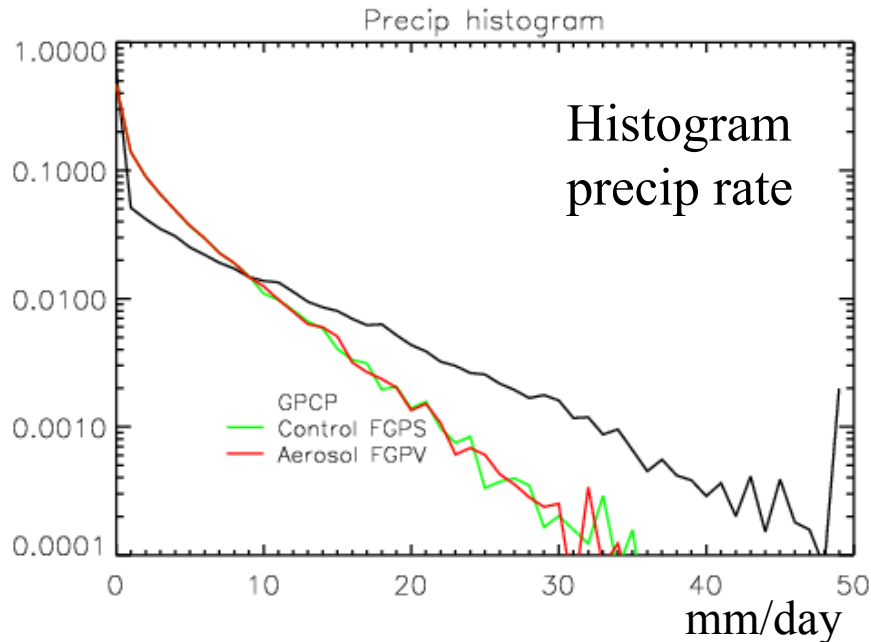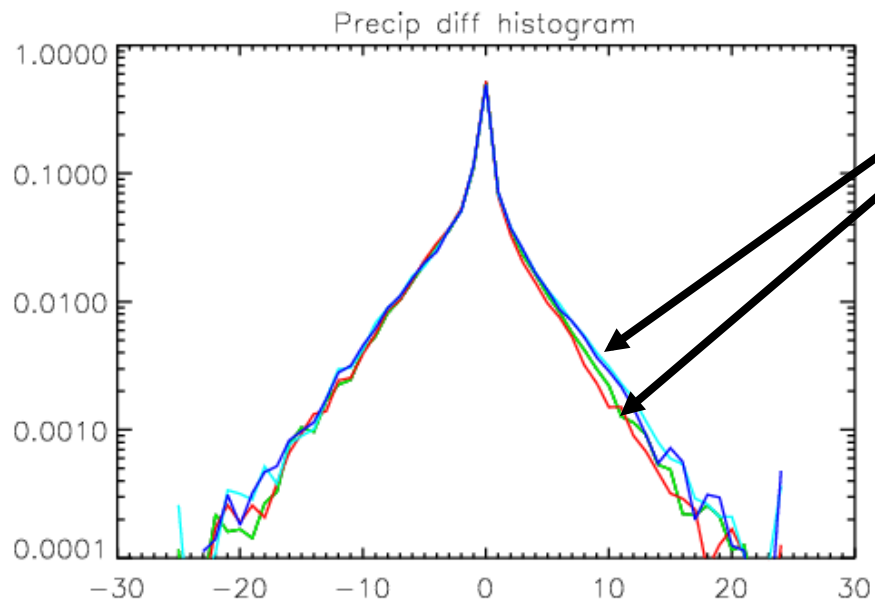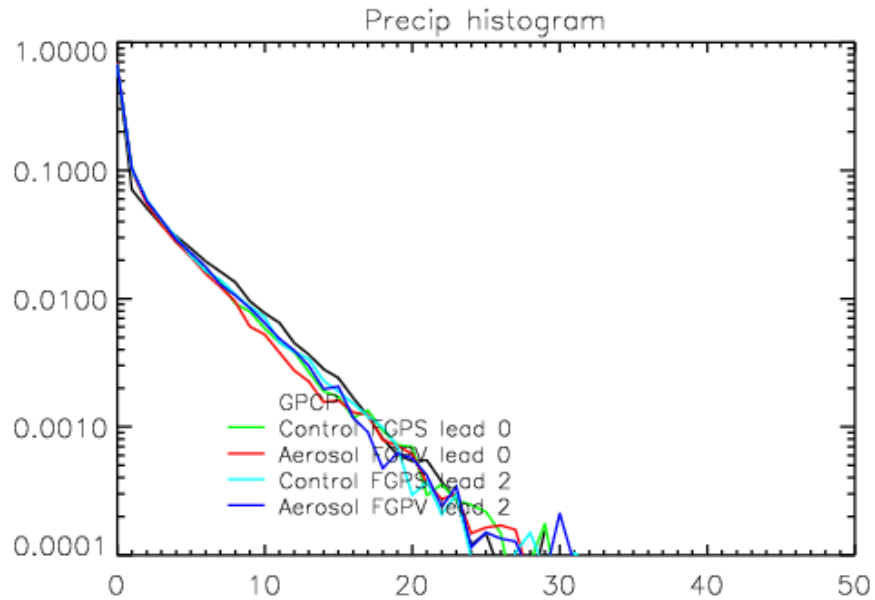
June 2003

Europe

Histogram
Forecast – GPCP
Error on precip rate

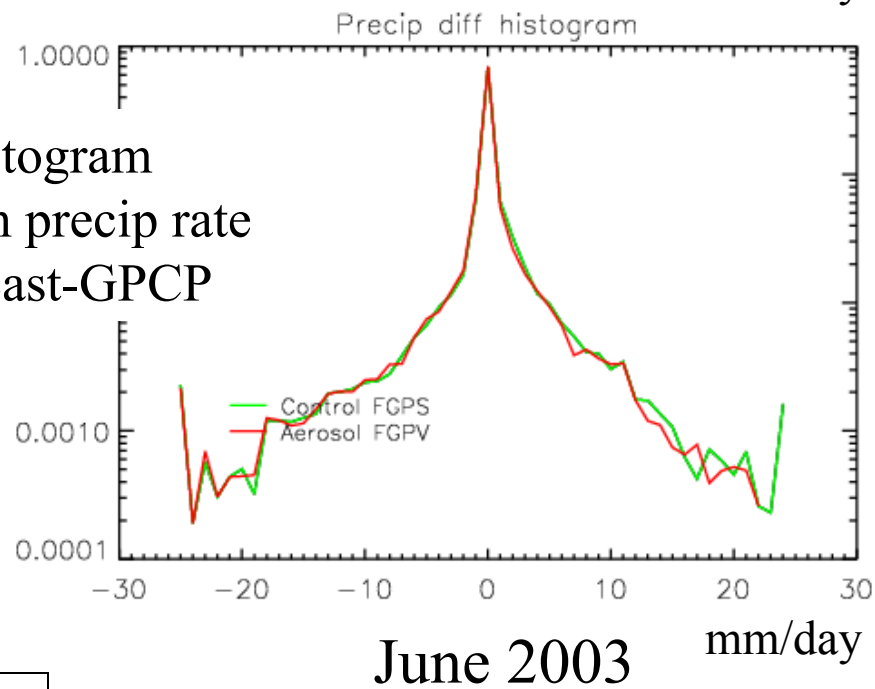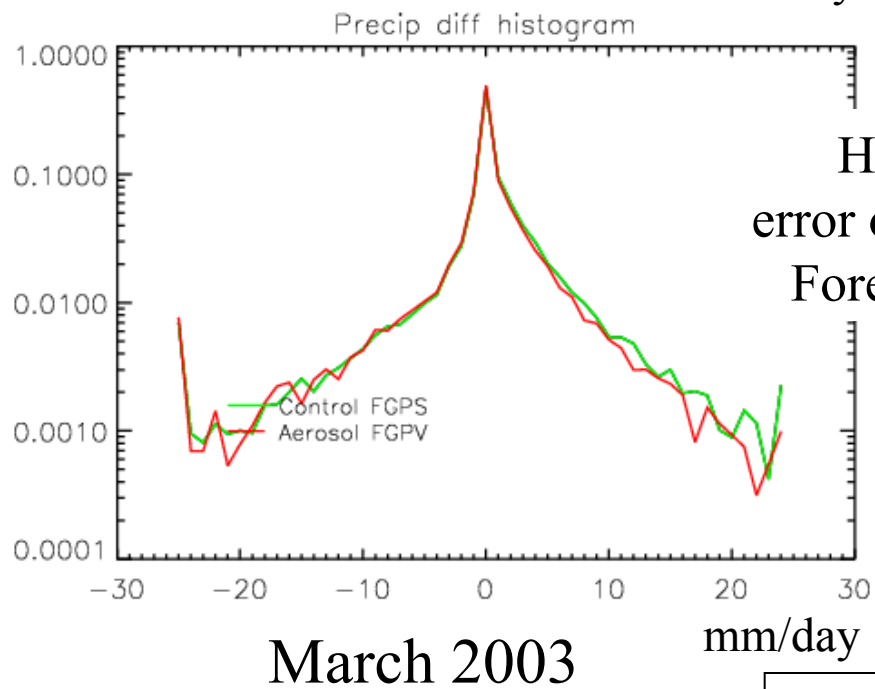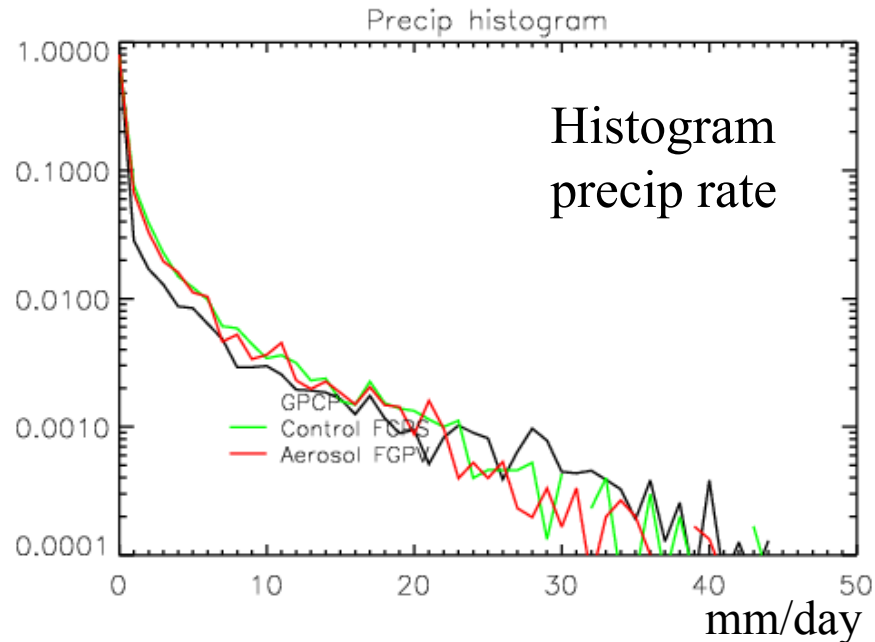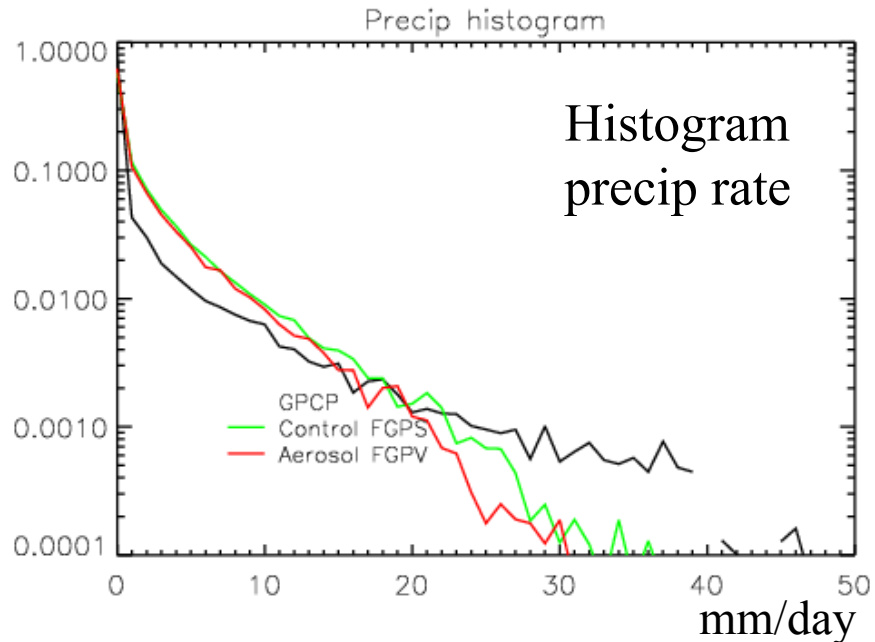Slightly better forecasts for a lead time of 0 day as compared to a lead time of 2 days ...

… but no impact of the aerosol indirect effect

Europe - June 2003

Precip histogram

Histogram
precip rate

GPCP
Control FGPS
Aerosol FGPV

mm/day

Precip diff histogram

Histogram
error on precip rate
Forecast-GPCP

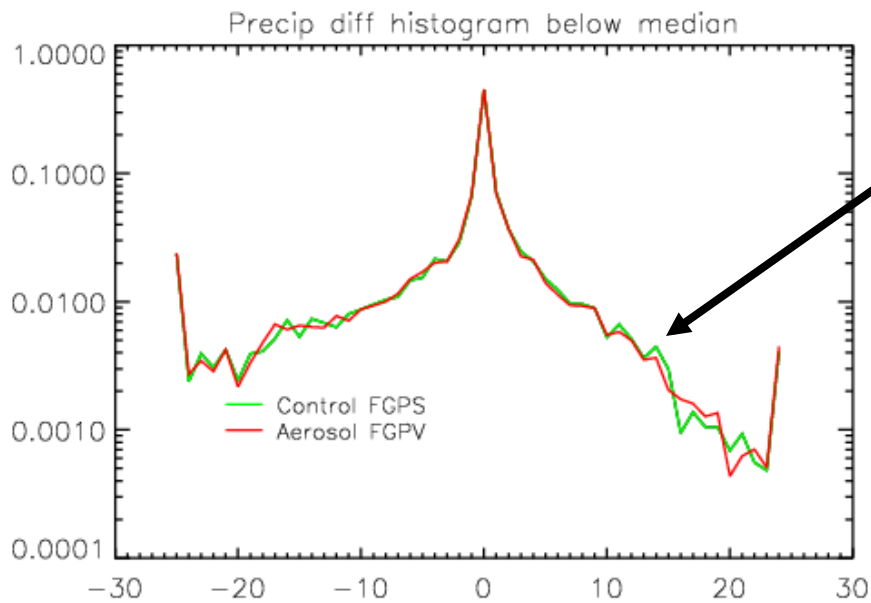Control FGPS
Aerosol FGPV

March 2003

mm/day

June 2003
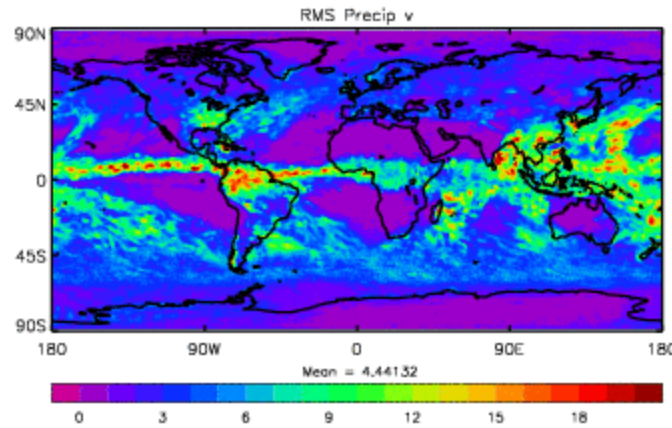
mm/day

China

Histogram
Forecast - GPCP
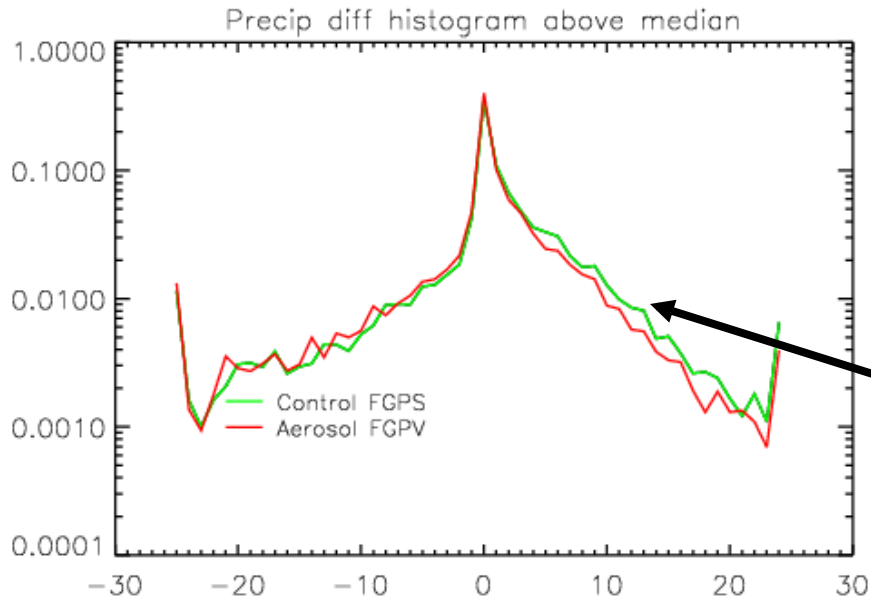
Slightly smaller large deviations to the observations when aerosol content is above the median as compared to below the median
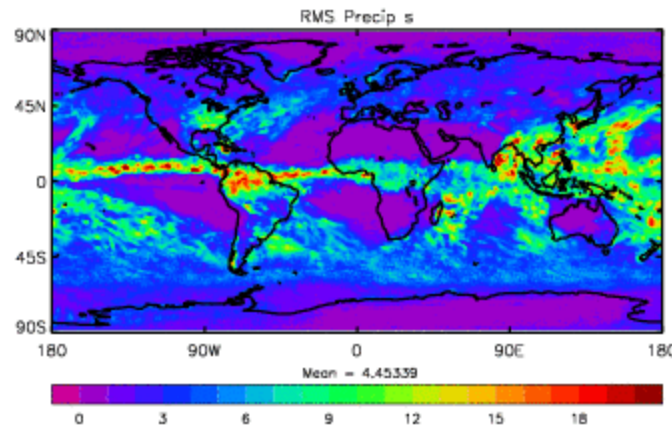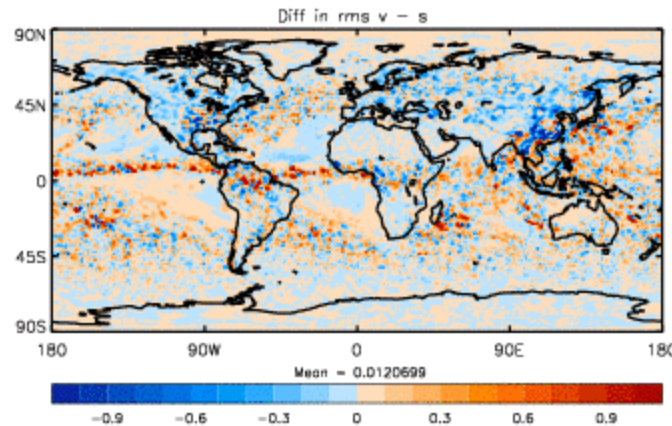
Is this significant?

China - September 2003

CTRL

DIR+IND

DIR+IND
- CTRL

May 2003

Root mean square error of the precipitation forecast

(Very small) positive impact over the NH continents. Is it real?

**Atmospheric
Chemistry
and Physics
Discussions**

Aerosol-cloud-precipitation effects over Germany as simulated by a convective-scale numerical weather prediction model

A. Seifert[1], C. Köhler[1,2], and K. D. Beheng[3]

[1]Deutscher Wetterdienst, Offenbach, Germany
[2]Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen, Germany
[3]Karlsruher Institut für Technologie, Karlsruhe, Germany

Discussion Paper | Discussion Paper | Discussion Paper | Discussion Paper |

ACPD

11, 20203–20243, 2011

Aerosol-cloud-precipitation effects over Germany

A. Seifert et al.

Title Page

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Conclusions	References
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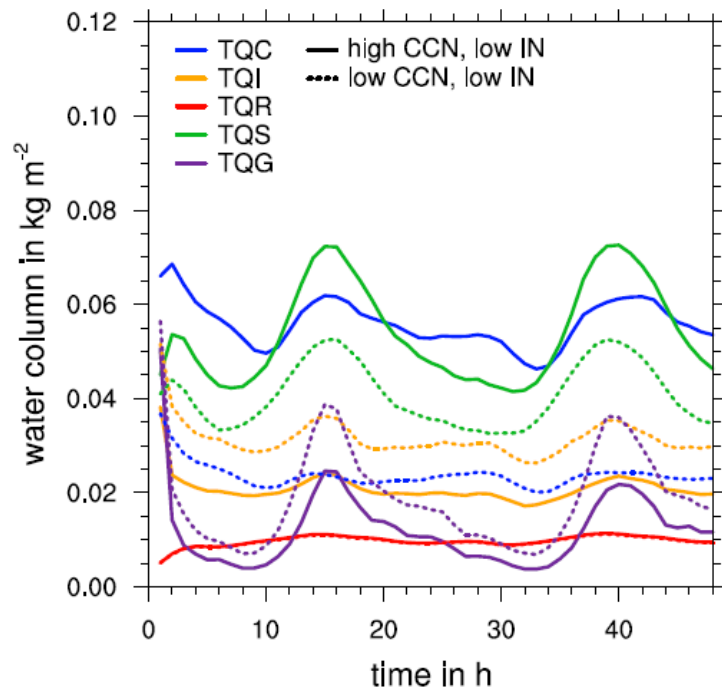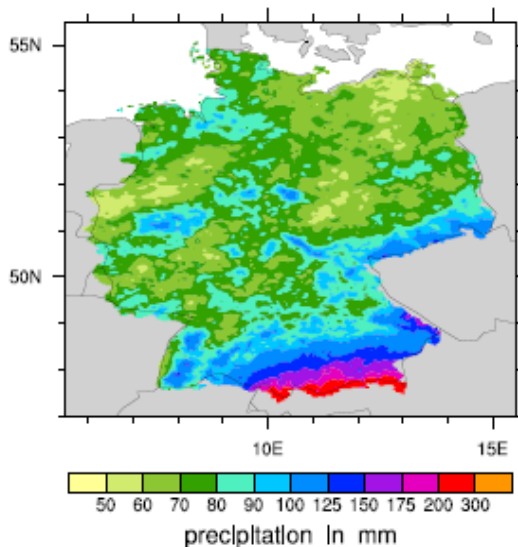Back | Close

Full Screen / Esc

Printer-friendly Version

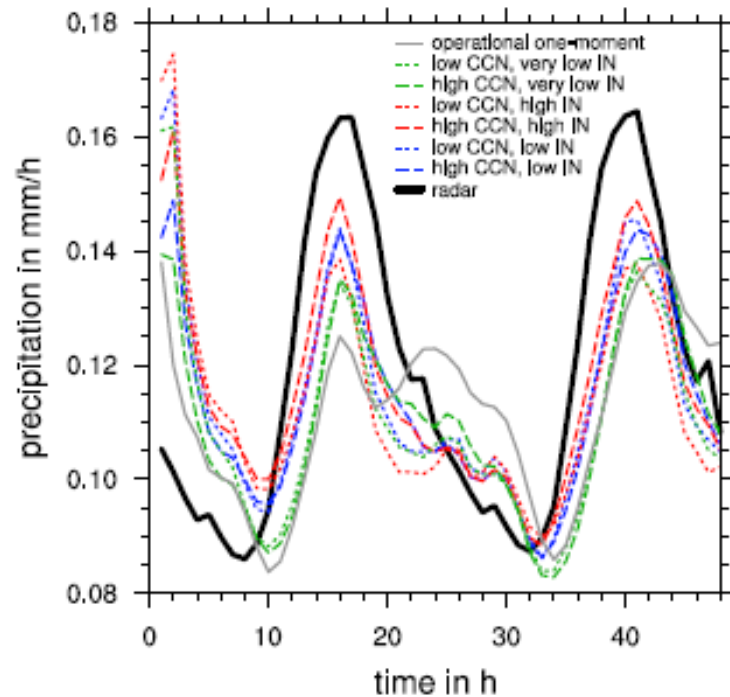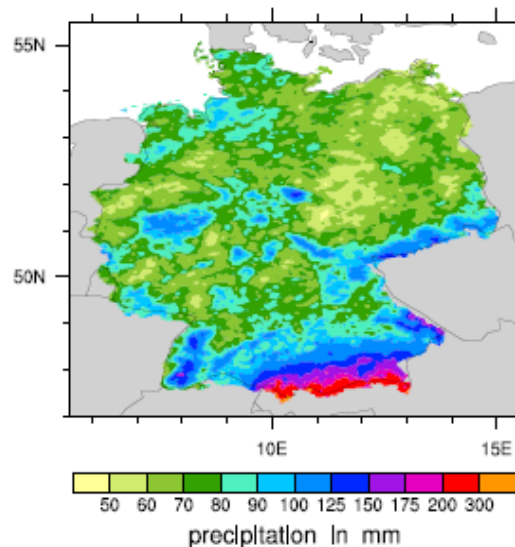Interactive Discussion

20203

a) Experiment 1: high CCN, low IN

b) Experiment 2: low CCN, low IN

Conclusions

• We have performed a series of global weather forecasts with and without interactive aerosols as part of the MACC project.

• There is very little impact of having interactive aerosols when it comes to forecasting precipitation on the large-scale (1°x1°). Effects could be larger at the smaller scale, and in the case of orographic precipitation.

• Possibly very small positive impact (as compared to GPCP) over the continents (rms error) and over China in particular (less large positive errors).

• More sophisticated precipitation skill score needed.

• Try other parametrisations of the aerosol indirect effect?

Thank you for your attention

Questions?