COSMO model simulations for COPS, 15 July 2007 (IOP 8b)

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OUTLINE

- The Convective and Orographically-Induced Precipitation Study, COPS
- COPS IOP 8b, 15 July 2007
- COSMO model simulations
- Evaluation of the model simulations
- Conclusions and Outlook
COPS 2007

- Convective- and Orographically-induced Precipitation Study
- One of the largest meteorological field experiments ever conducted
- International: Germany, France, UK, Switzerland, Austria, Italy, USA....

**Goal:** Investigate the processes associated with deep convection in mountainous terrain
- 1 June to 31 August 2007

Region: Southwestern Germany, eastern France
Date: 1 June – 31 August 2007
Features: Severe thunderstorm activity but low QPF skill
Information: [www.uni-hohenheim.de/cops/](http://www.uni-hohenheim.de/cops/)
COPS 2007

- 18 Intensive Observational Periods (IOPs), 34 IOP days
- 94 events of convective initiation

Spatial Distribution

Diurnal Cycle

COPS Field Report, analysis by Fumiko Aoshima, Uni Hohenheim
COPS Operation Plan:
On Sunday, the high-pressure ridge remains dominating over the COPS region. Although the instability is slightly greater than on Saturday, especially along the Rhine valley and the Black Forest, the prevalent air mass is very dry. Fair weather convection prevails during the afternoon, mainly over the mountains. **There is a small chance of one or two isolated thunderstorms towards the evening over the mountains.**
COPS IOP 8b, 15 July 2007

MODIS true color image, 15 July 2007

Achern
COPS IOP 8b, 15 July 2007

\[ T = 30 \, ^\circ C \]
\[ q_v = 12 \, g \, kg^{-1} \]
\[ CAPE = 500 \, J \, kg^{-1} \]
\[ CIN = 320 \, J \, kg^{-1} \]
Diurnal Variation

- increase of mixed layer height
- increase of low level moisture
COPS IOP 8b, 15 July 2007
Feldberg radar, 1320 UTC

- South-westerly flow
- Convergence line on the east side of the mountain crest
COPS IOP 8b, 15 July 2007
Feldberg radar, 1300 - 1600 UTC

- Appearance of the first radar signal at 1420 UTC
- Lifetime of the convective cell about 60 minutes
COPS IOP 8b, 15 July 2007

Observations from POLDIRAD, 1445 UTC

Reflectivity

Intra-Cloud and Cloud-to-Ground Lightning

provided by Martin Hagen, DLR
COPS IOP 8b, 15 July 2007

Gauge-adjusted radar precipitation, RW-product

- max precipitation: 11.7 mm
- no surface observation of precipitation, despite the dense network during COPS
Operational Forecasts

Data provided by Matthias Zimmer from MAP D-PHASE archive.

Radar-derived precipitation

Single cell convective events are extremely difficult to forecast. This event seems to have some predictability, because of the orographic forcing.
COSMO-IPA simulations

- Use ‘operational’ COSMO-DE setup
- Grid point distance: 2.8 km
- Hourly boundary conditions from operational COSMO-EU Analysis
- Start of the model simulations at 07 UTC, 15 July 2007
COSMO-IPA simulations

- Successful reproduction of the operational forecast
- ‘Tuning’ of model parameters did not improve model performance
COSMO-IPA simulations

Model result, Achern 11 UTC

Achern, 15 July 2007, 11 UTC

- Strength of the capping inversion underestimated
- Moisture and wind speed also underestimated

Obs, Achern 11 UTC
COSMO-IPA simulations

Diurnal variation

Model result, Achern; 8, 11, 14 UTC

- Growth of the mixed layer underestimated

Obs, Achern; 8, 11, 14 UTC
COSMO-IPA simulations

Diurnal variation

Model result, Achern; 8, 11, 14 UTC

• Growth of the mixed layer underestimated
• No moistening of the mixed layer

Obs, Achern; 8, 11, 14 UTC
COSMO-IPA simulations

Integrated water vapor (IWV), 14 UTC

Model result, ECMWF

GPS derived water vapor

• Underestimation of IWV on regional scale
• ECMWF simulation improves IWV

provided by Galina Dick, GFZ Potsdam
COSMO-IPA simulations

10m wind, 1300 UTC

- Convergence line is simulated by the COSMO model
MESO-NH simulations

- MESO-NH has predicted convective cell, but
- underestimates temperature, over-estimates moisture

MESO-NH Data provided by Evelyne Richard, Meteo France Toulouse
Conclusions and Outlook

• COPS has collected an enormous amount of data, analysis has just started
• Air mass convection on 15 July (IOP 8b), challenging case for NWP models
• COSMO models did not predict convective event
• Convergence line is present in the model simulations
• Underestimation of low level moisture in the model simulations
• Further analysis will make use of additional data collected during COPS
Thank you for your attention!
COPS IOP 9c, 20 July

Satellite image (NOAA 06 UTC)
COPS IOP 9c, 20 July
COPS IOP 9c: 20 July 2007