Analysis of convective initiation using Meteosat Rapid Scans

Fumiko Aoshima, Andreas Behrendt, Hans-Stefan Bauer and Volker Wulfmeyer

Institute of Physics and Meteorology, University of Hohenheim, D-70599 Stuttgart, Germany

aoshima@uni-hohenheim.de

Introduction

With the support of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), a Rapid Scanning Service (RSS) from Meteosat-8 (MSG) was available during COPS every five minutes covering the latitude belt 15 to 69ºN. With these high-temporal resolution data, we identified convection initiation events (CIs) in the COPS domain during all COPS Intensive Observation Periods (IOPs) for which Meteosat-8 data were available, i.e., on 30 days within 16 IOPs (Aoshima, 2007). In total, 94 CIs were found on these days. The locations of CIs are shown in section 2.2. We also grouped the CIs according to time and found a clear diurnal cycle with a maximum at around 1300 UTC (see section 2.3.).

1. Identification of convection initiation

Step 1: Find deep convective clouds on MSG images in IR10.8 (at 10.8 µm) and High-Resolution Visible (HRV) channels by visual analysis.

Step 2: Go back in time and search for the first occurrence of 10.8 µm brightness temperature smaller than 250 K. This pixel is labeled as CI site.

Fig. 1. Cumulus congestus cloud shown also in Figs. 2 and 3 seen from Hornisgrinde at 1430 UTC which is identified as CI time by the algorithm used in this study.

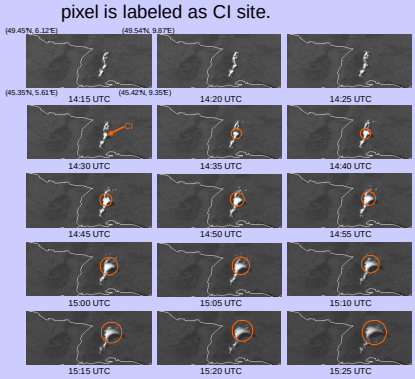

Fig. 2. Satellite imagery in HRV channel of the COPS domain. The images were taken on 15 July, 2007 (IOP8b).

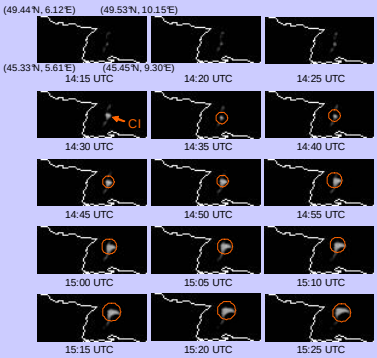

Fig. 3. Same as Fig. 2, but IR10.8 channel is shown instead of HRV channel

2. Results

2.1. Overview

Table 1. Number of CI for each IOP

IOP No.	Date	No. of CIs
1	05 Jun	5
	06 Jun	6
	07 Jun	6
	08 Jun	18
2	12 Jun	4
3	14 Jun	No RSS data
	15 Jun	No RSS data
4	19 Jun	No RSS data
	20 Jun	No RSS data
5	01 Jul	2
	02 Jul	8
6	04 Jul	1
7	08 Jul	0
	09 Jul	3
8	14 Jul	0
	15 Jul	1
9	18 Jul	3
	19 Jul	0
	20 Jul	6
10	23 Jul	5
11	25 Jul	0
	26 Jul	0
12	30 Jul	1
13	01 Aug	0
	02 Aug	5
14	06 Aug	No RSS data
	07 Aug	No RSS data
	08 Aug	No RSS data
	09 Aug	2
15	12 Aug	2
	13 Aug	0
16	15 Aug	5
	16 Aug	4
17	21 Aug	0
	22 Aug	5
18	24 Aug	2
	25 Aug	0
Total		94

2.2. Locations of CIs

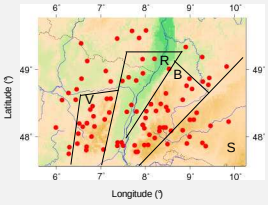

Fig. 4. Locations of CI sites, V: Vosges, R: Rhine Valley, B: Black Forest, and S: Swabian Jura.

Locations of CIs are distributed in the COPS region with a clustering in southern mountain areas.

2.3. Timing of CIs

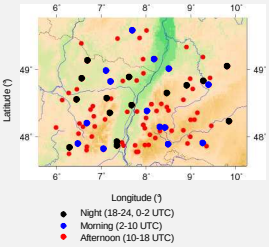

Fig. 5. Locations of CI sites according to their occurrence time.

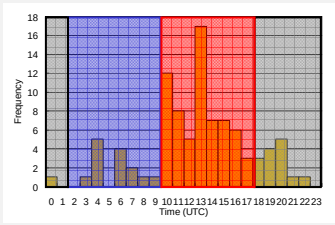

Fig. 6. Histogram of CI according to their occurrence time.

Convection mainly developed in the afternoon (10-18 UTC), and less convective developments took place during nighttime (18-24, 0-2 UTC).

2.4. Wind direction and CIs

77 out of 94 CIs were classified according to wind direction in 10 m above ground using data of the GFS model provided by Wetter3 (http://www.wetter3.de). These data were unavailable on 05, 06, and 07 June. A wind direction from west or south-west was dominant in the COPS region for the analyzed days.

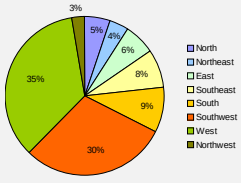

Fig. 7. Distribution of CIs according to the wind direction in 10 m above ground.

2.4.1 Westerly flow

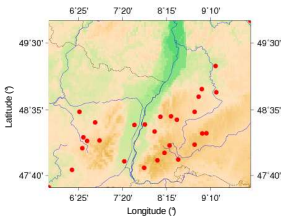

Fig. 8. CIs under westerly flow.

The most active areas occurred over the Black Forest and the Swabian Jura. A few CIs were found over the western part of COPS area.

2.4.2 Southwesterly flow

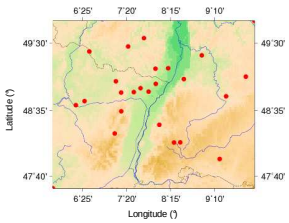

Fig. 9. CIs under southwesterly flow.

- CI is weak in the whole COPS domain
- Some CIs occurred over the Rhine Valley

Conclusions

- Convection initiation mainly occurred in the afternoon, only a few convective developments took place at night. As this study covers only IOPs, we can state that the COPS IOPs cover – like intended – dominantly CI cases for which insolation plays an important role.
- Under westerly flow, the most CI-active areas were over the Black Forest and the Swabian Jura, and a few CIs were found over the western part of the COPS area. This is in agreement with the conceptional idea that orographic lifting triggers CI.
- In cases of southwesterly flow, CI is weak within the whole COPS domain

Acknowledgements

We thank EUMETSAT for providing the rapid scanning data.

Reference

Aoshima, F., 2007: Analysis of convection using Meteosat Reduced Scans, Master Thesis, University of Hohenheim.