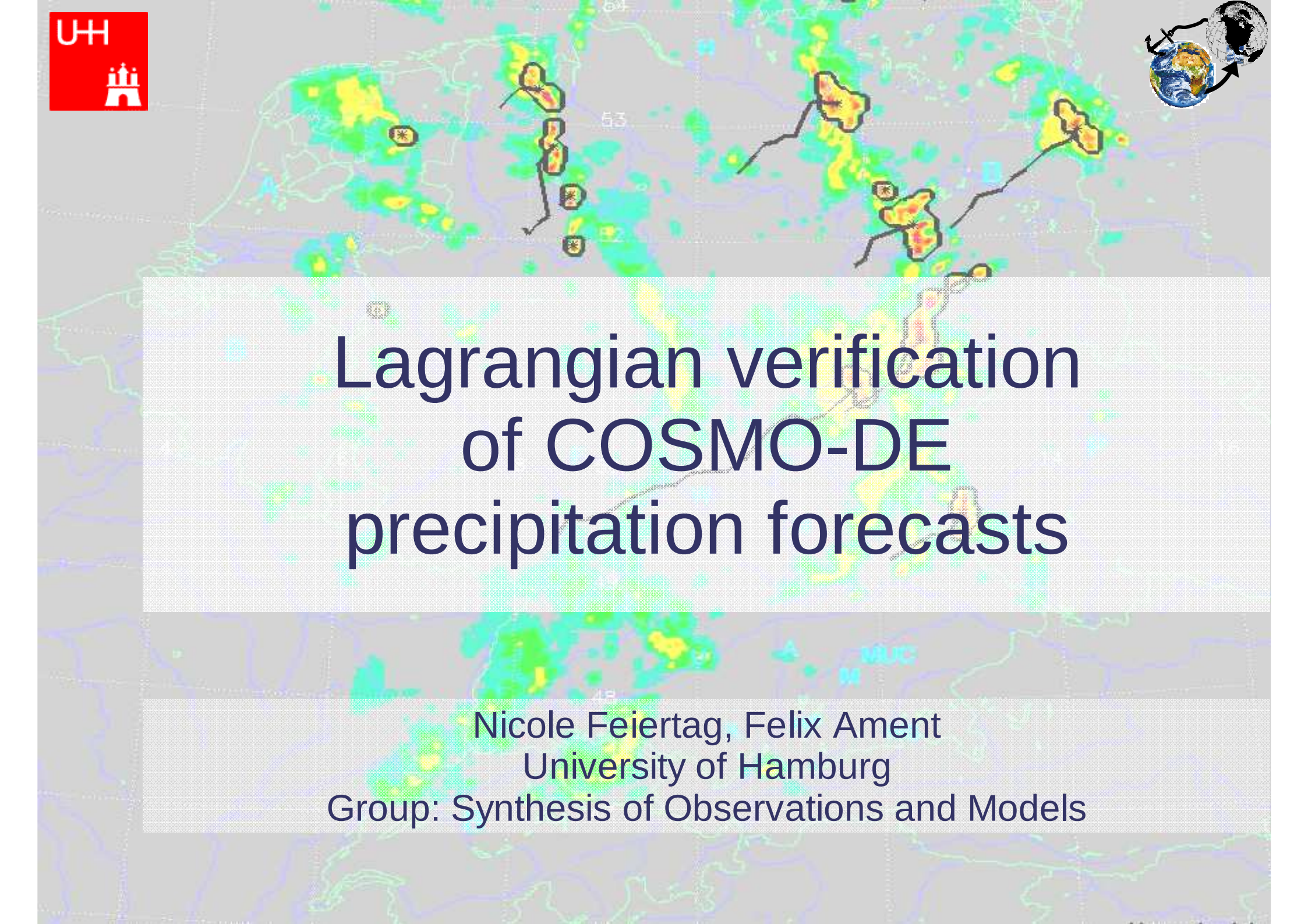


Lagrangian verification of COSMO-DE precipitation forecasts

Nicole Feiertag, Felix Ament
University of Hamburg
Group: Synthesis of Observations and Models

Outline

- Introduction
- Method
- Data
- Results
- Conclusion

Introduction

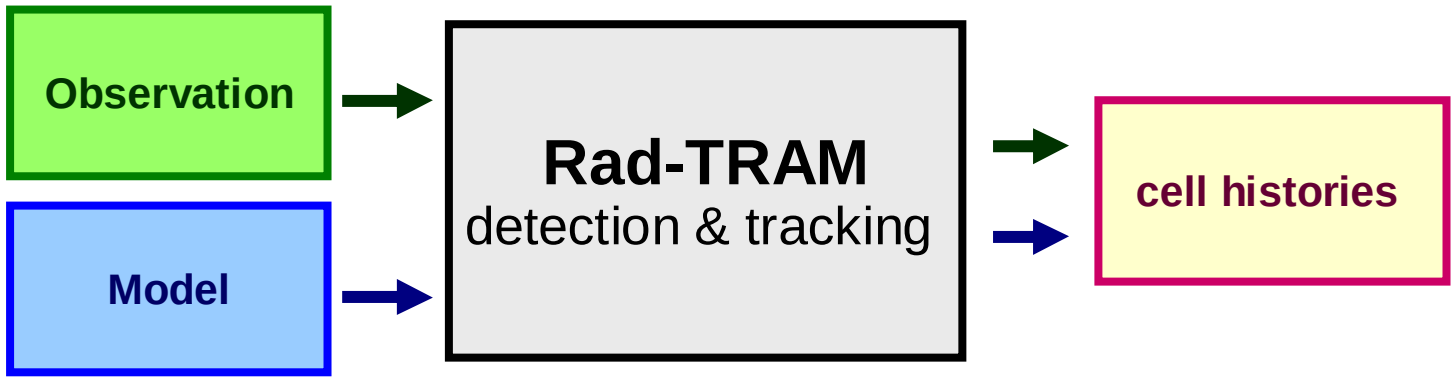
Motivation:

- With a grid spacing of 2.8 km, COSMO-DE resolves deep convection

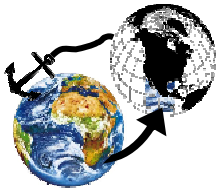
How precise can the model predict the characteristics of convective cells? → number and size of cells, lifetime, …

Method:

- Tracking and nowcasting algorithm Rad-TRAM written at the DLR to find the cell characteristics

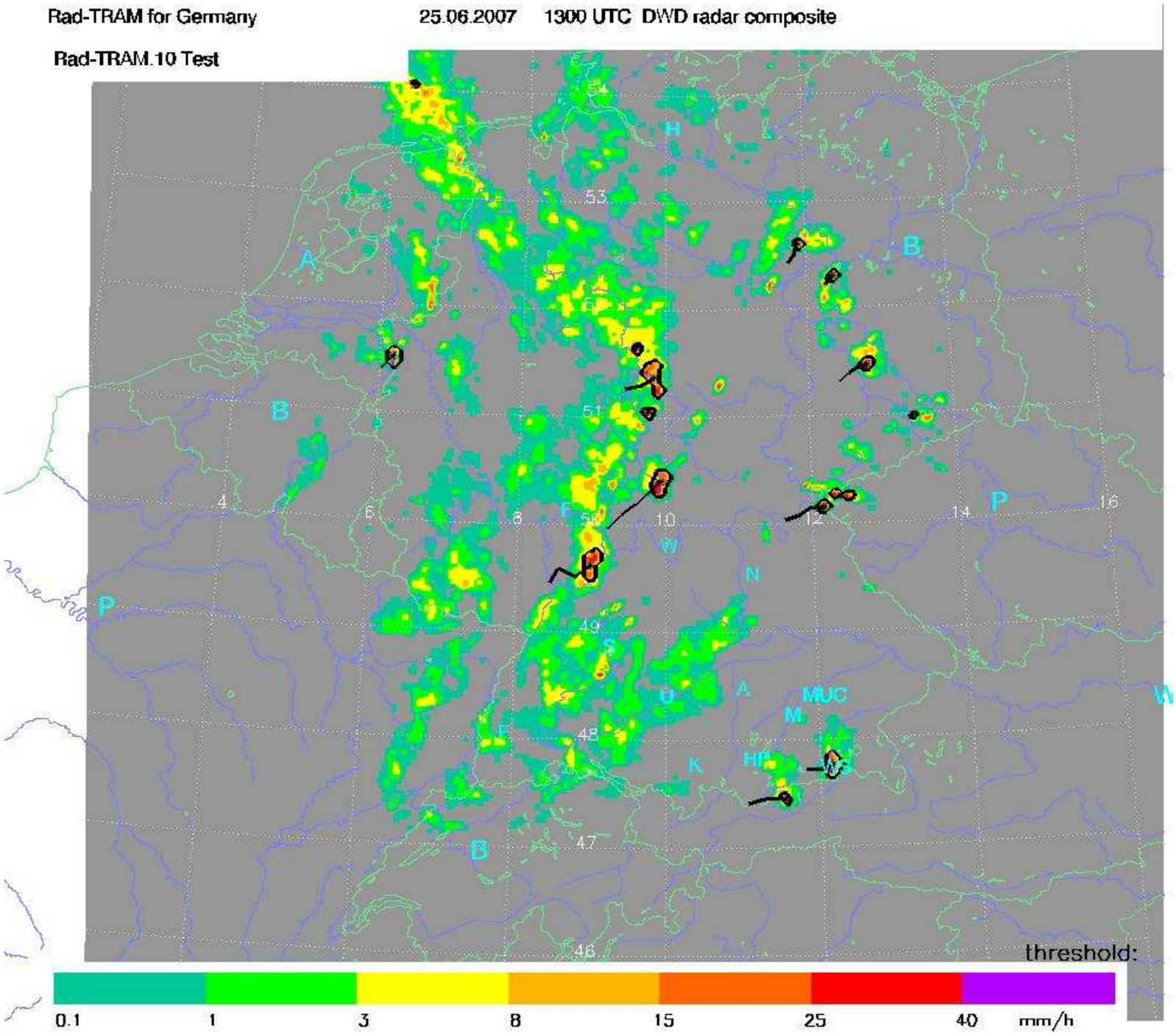


Rad-TRAM

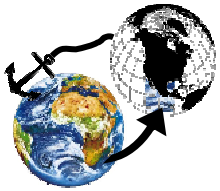


- **Algorithm developed at the „Deutsches Zentrum für Luft- und Raumfahrt (DLR) to identify, track and nowcast thunderstorm clouds** *(Kober, 2009)*
- **Based on the tracking algorithm Cb-TRAM** *(Zinner, 2008)*
- **Consists of 4 mainparts:**

(1) Extraction	for describing the cloud motion a disparity vector field is extracted from two consecutive images
(2) Detection	identifying cells with the aid of a threshold
(3) Tracking	connect detected cells at different time steps with each other and creating files with information on the detected patterns (cell history)
(4) Nowcasting	extrapolation of detected cells

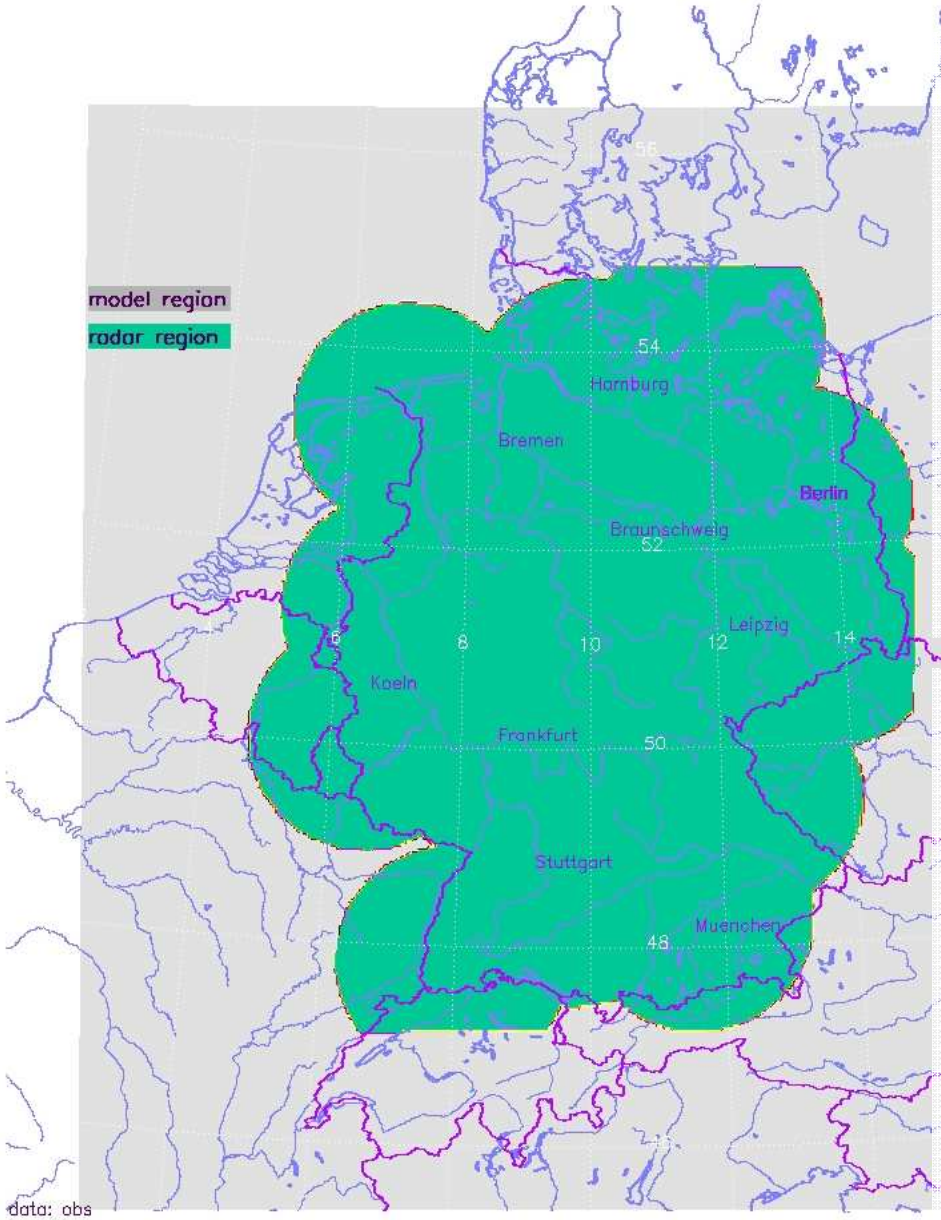

Rad-TRAM for Germany
25.06.2007 1300 UTC DWD radar composite
Rad-TRAM.10 Test
54
53
52
51
50
49
48
47
46
4
6
8
10
12
14
16
MUC
threshold:
0.1
1
3
8
15
25
40
mm/h

Characteristics of Cells



- Number
- Size
- Lifetime
- Location of Onset and Decay
- Diurnal Cycle of Onset
- Direction of Cells

Data



- **Summer 2007 (COPS)**

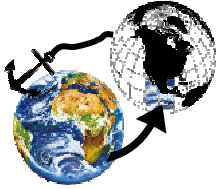
  (02.06.-31.08.2007)
- **Observation:**

  German radar network of DWD
  (RY-Product)
- **Model:**

  COSMO-DE
  (operational Data + 4 model experiments)
- **Value:** Precipitation rate mm/h
- **Region:** Germany
  - model area restricted to radar boundaries
- **Resolution:**

  421x461 2,8 km 15 min
  - Observation data adjusted to model grid

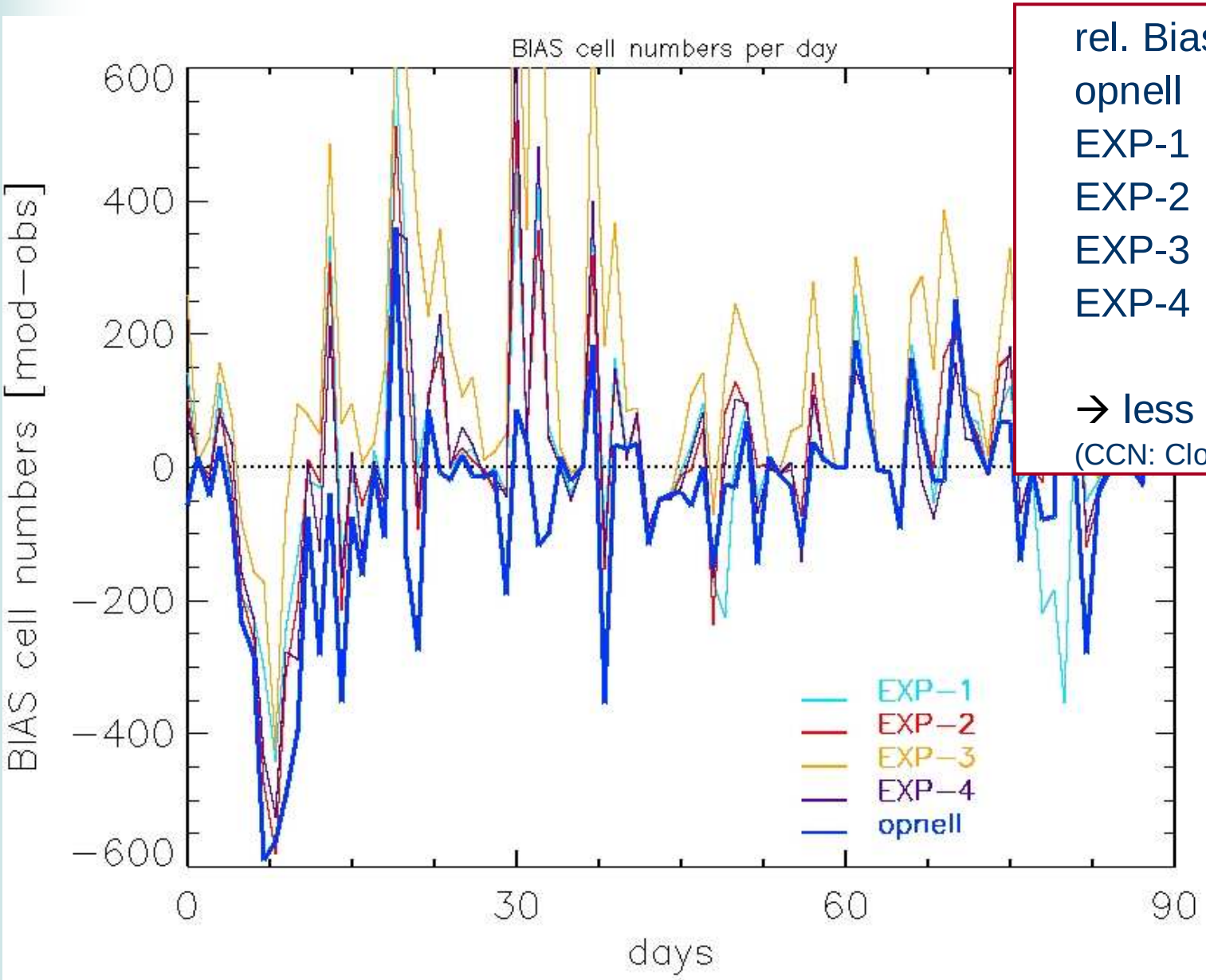
Model Data



Model versions differ with respect to cloud microphysics parameterizations

- **Operational:** **one-moment** cloud microphysics scheme → predicts cloud water, rain water, cloud ice, snow and graupel
- **Experiment 1:** *(since Sept. 2008 operational)* like operational but with a **less active parameterization of boundary layer processes**
- **Experiment 2:** *(Seifert & Beheng 2004)* like experiment 1 but with **high CCN** concentration and a **two-moment** scheme additionally with hail
- **Experiment 3:** like experiment 2 but with **low CCN** concentration
- **Experiment 4:** like operational with a **one-moment** scheme but predicts **twomoments for rain water**

Cell Numbers



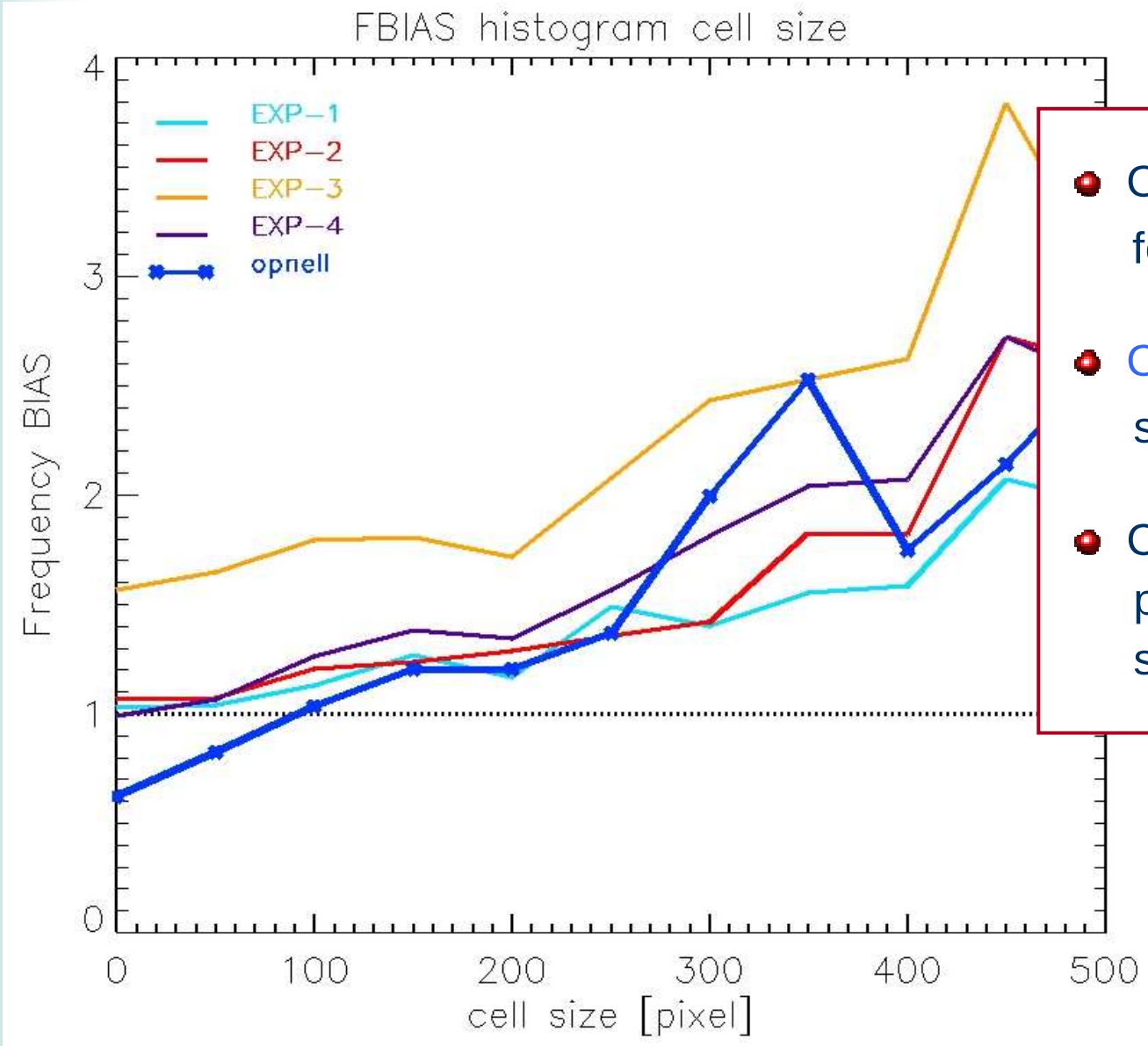
rel. Bias of total number:

opnell	- 0.20
EXP-1	+ 0.07
EXP-2	+ 0.12
EXP-3	+ 0.67
EXP-4	+ 0.09

→ less CCN more cells

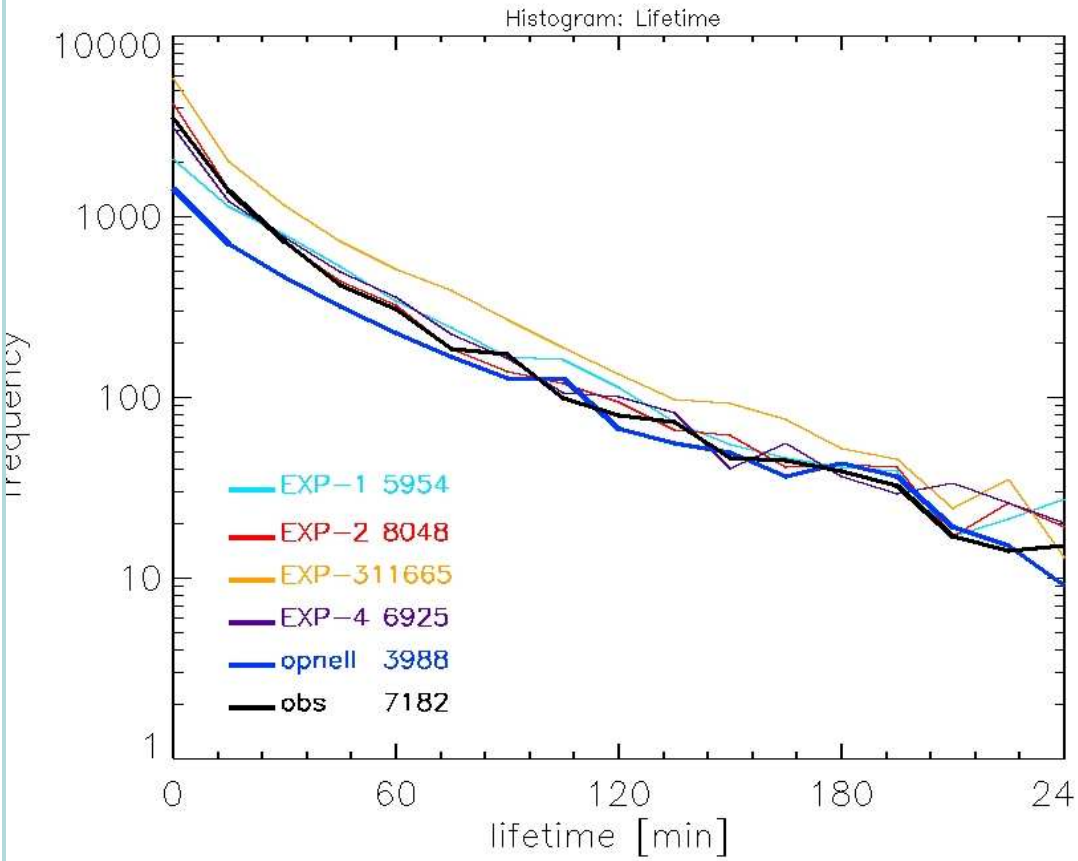
(CCN: Cloud Condensation Nuclei)

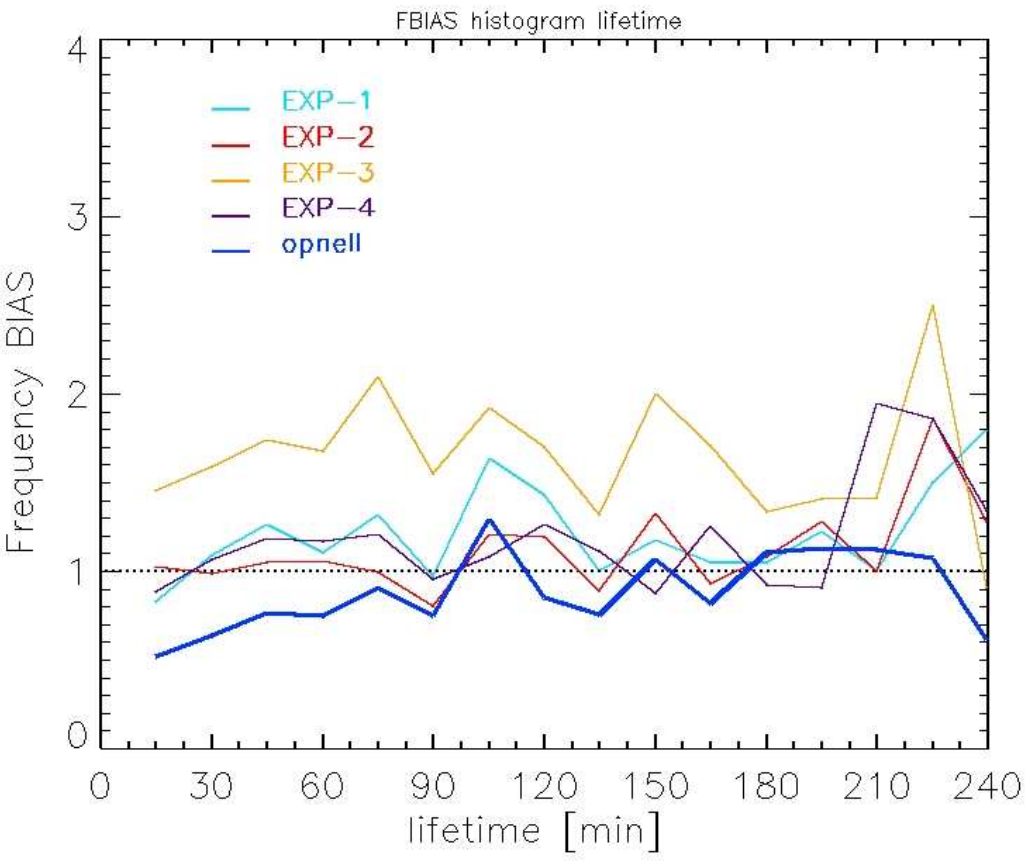
Cell Size



- Overestimation of large cells for all model versions
- Operational run shows to little small cells
- Changes in boundary layer parameterization lead to more small cells

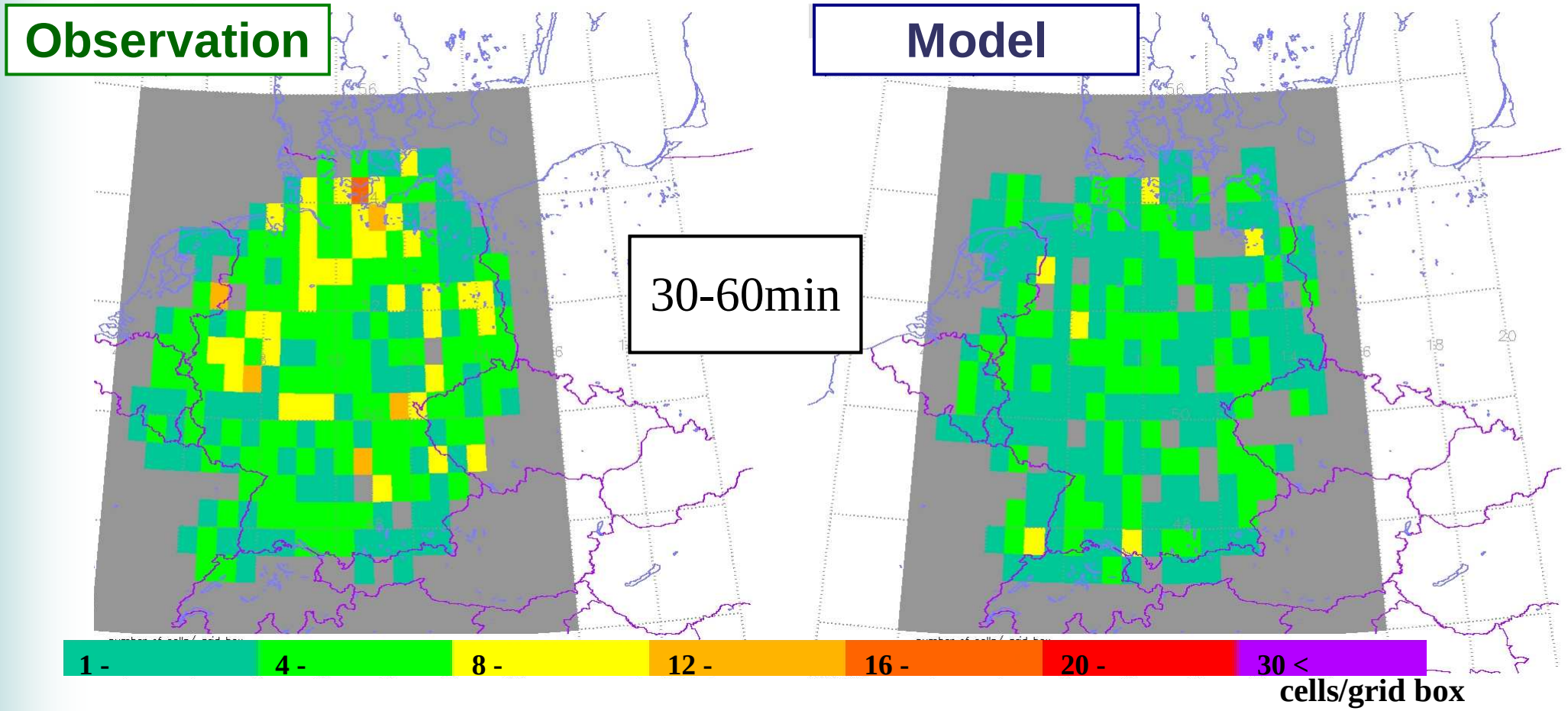
Lifetime





- Distribution of cell lifetime is quite accurately for all model versions
- Due to the high cell number there is a upper overestimation for EXP-3

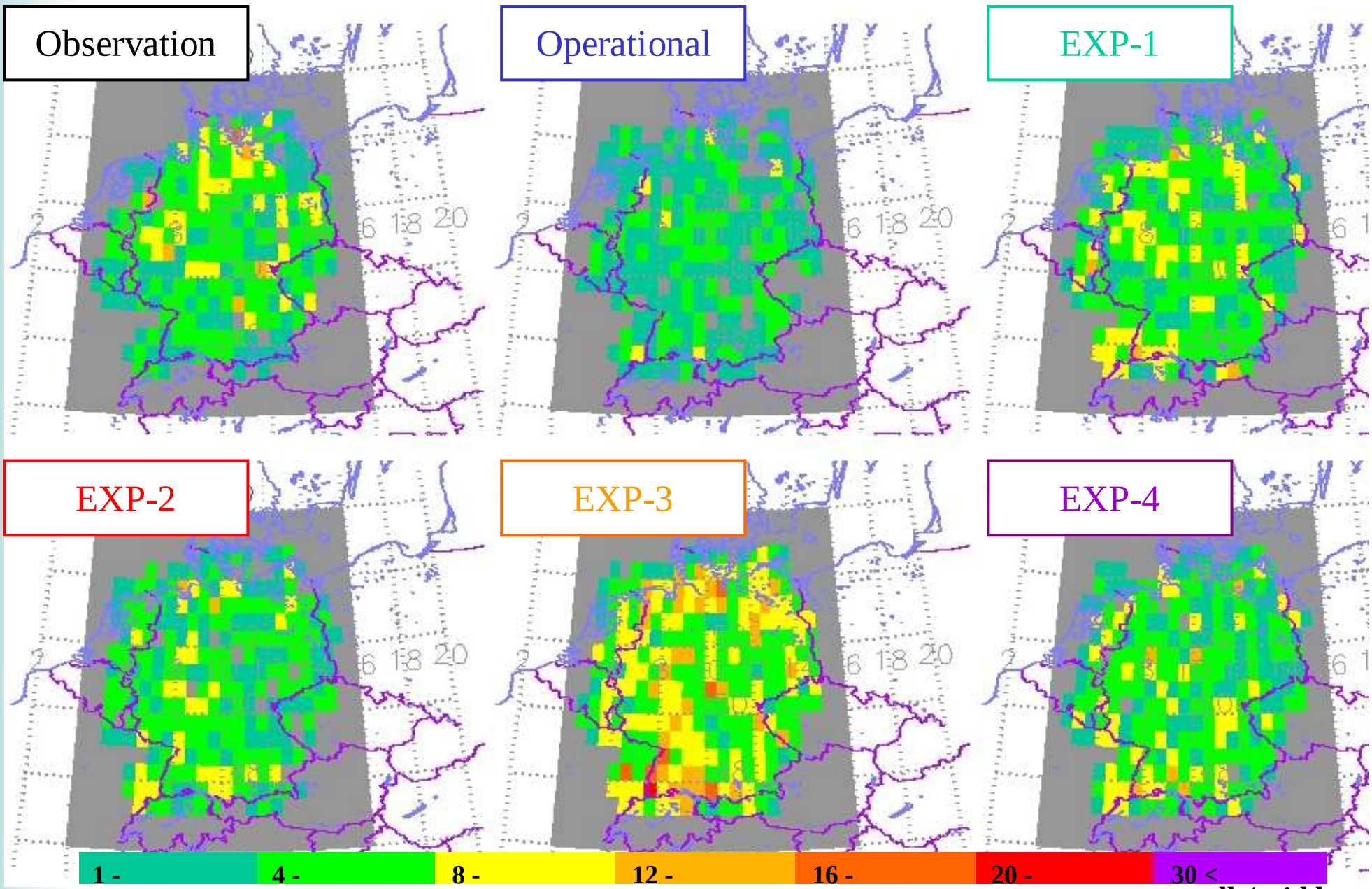
Location of Onset



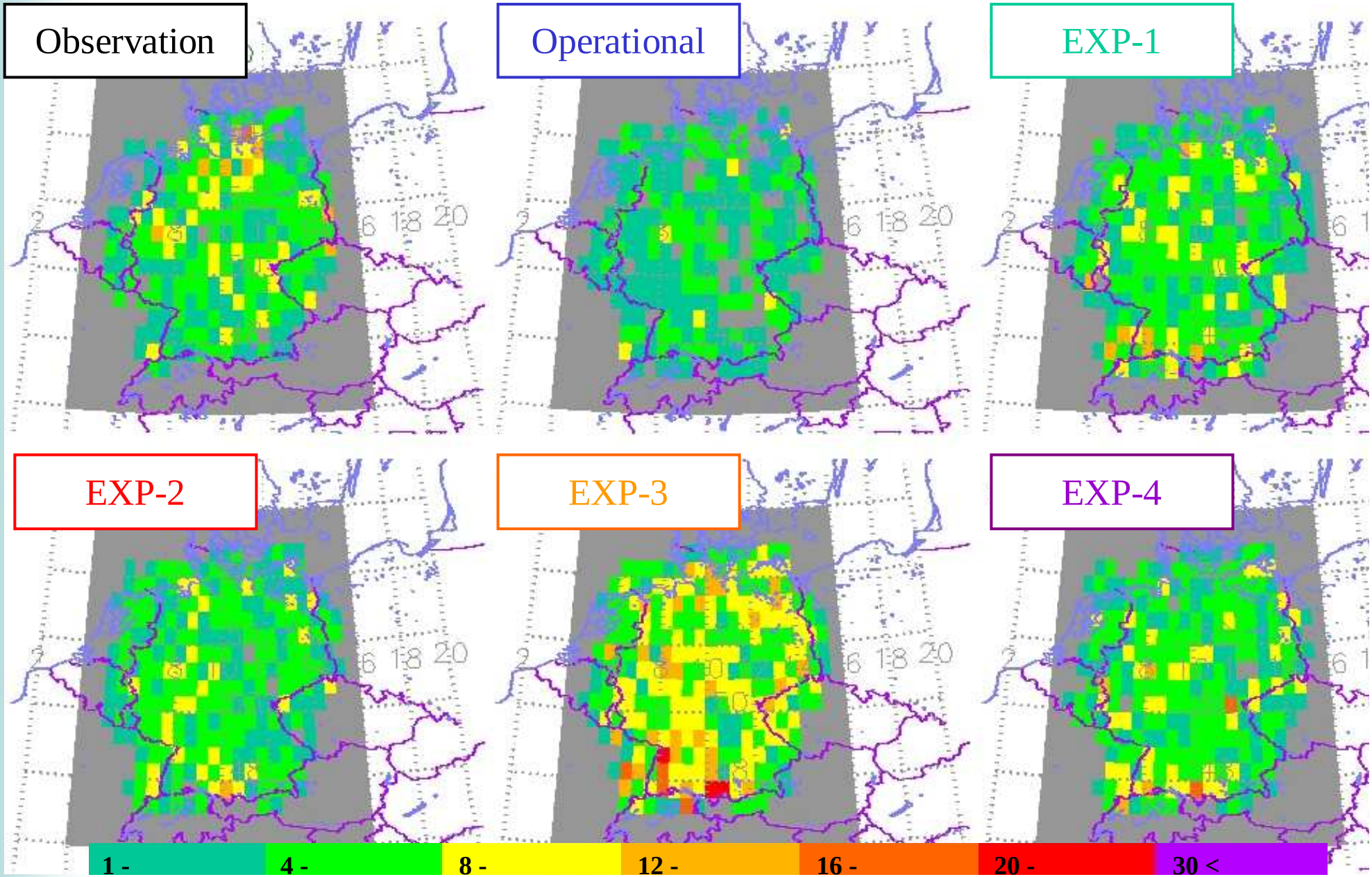
- **for better interpretation use of low grid sum**

number of cells	Observation	Model
all	7182	3988
30-60 min	1440	1002

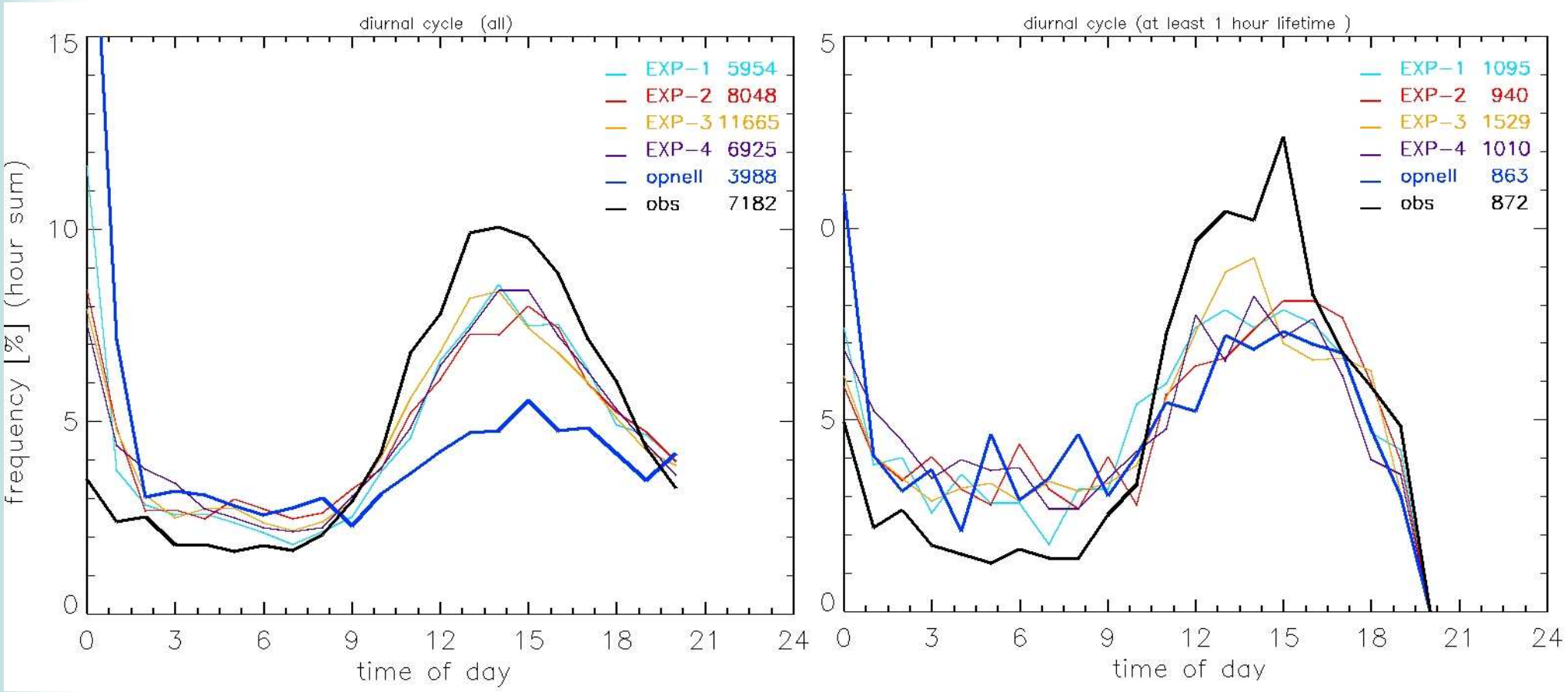
Location of Onset



Location of Decay



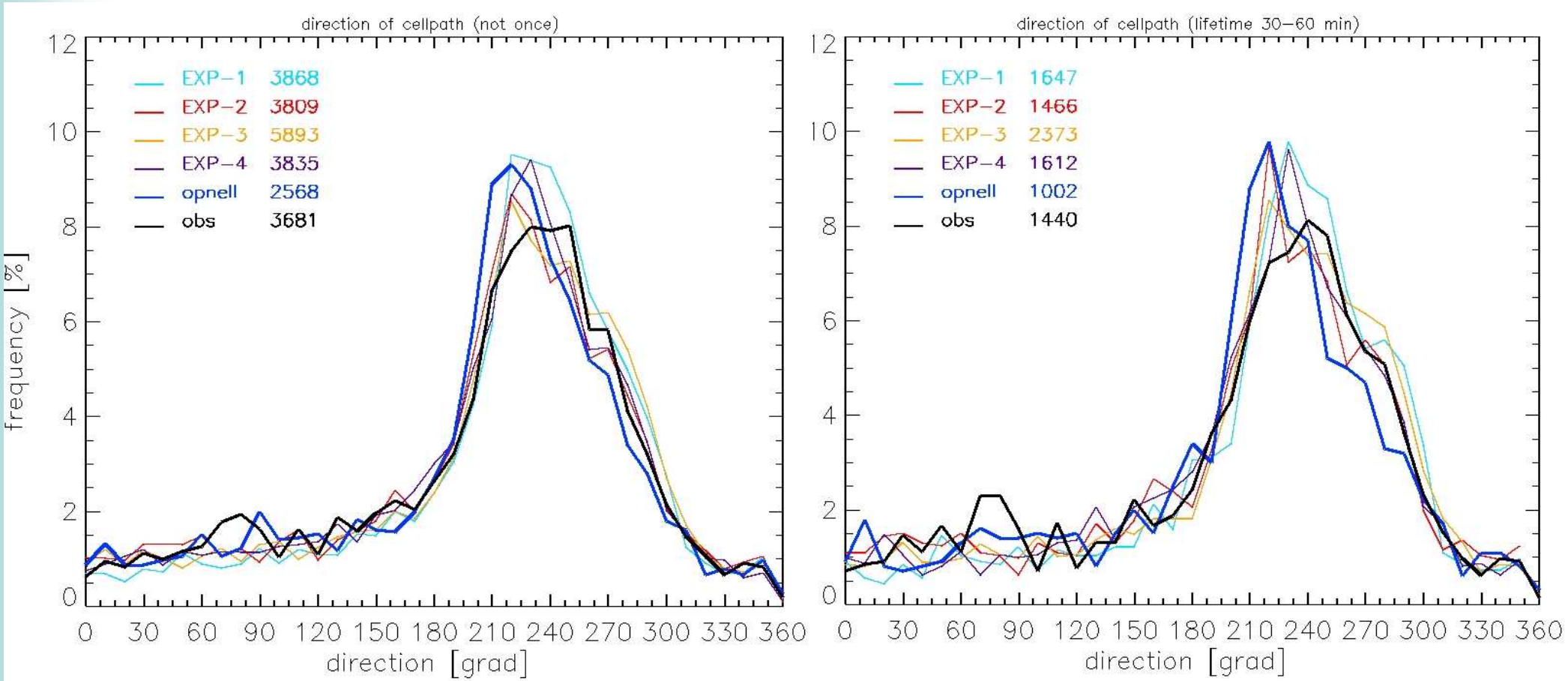
Diurnal Cycle of Onset



- Operational run can not predict the diurnal cycle of onset
- Model experiments shows a clear improvement
- Effect is only for the short-lived cells

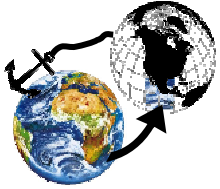
→ a less active parameterization of boundary layer processes results in a better initiation of radiation induced convection

Direction of Cells



- Most cells start in southwest
- Start point from operational run slightly shifted to south
- Model experiments do not show this effect so clear

Conclusion



operational COSMO-DE is showing following effects for Summer 2007:

- Underestimation of small cells – Overestimation of large cells
- Problems with the diurnal cycle of onset
- Prediction of lifetime distribution is very well (independent of model changes)
- Main direction of cells is also quite accurately, but slightly shifted to south

Model changes are visible in cell characteristics:

- **Changes in boundary layer parameterization**

→ more realistic activation of radiation-induced convection in diurnal cycle
→ more small cells – more realistic distribution of cell size

- **low concentration of aerosols**

→ Overestimation of cell numbers, especially of large cells

Thanks for your Attention!

References:

- *KOBER K., A. TAFFERNER, 2009:*
  Tracking and nowcasting of convective cells using remote sensing data from radar and satellite.
  Meteorologische Zeitschrift, Vol-1, No. 18, 075-084.

- *ZINNER T., H. MANNSTEIN, A. TAFFERNER, 2008:*
  Cb-TRAM: Tracking and monitoring severe convection from onset over rapid development to mature phase using multi-channel Meteosat-8 SEVIRI data.
  Meteor. Atmos. Phys. 101, 191-210, DOI 10.1007/s00703-008-0290-y.

- *SEIFERT A., K.D. BEHENG, 2006:*
  A two-moment cloud microphysics parameterization for mixed-phase clouds. Part 2: Maritime vs. continental deep convective storms.
  Meteor. Atmos. Phys. 92, 67-82, DOI 10.1007/s00703-005-005-0113-3.