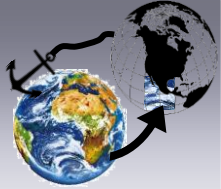


The background of the slide is a weather map of Europe. It features a color-coded precipitation forecast with green, yellow, and orange areas. A black line with arrows indicates a path across the map, likely representing a Lagrangian trajectory. The map includes a grid of latitude and longitude lines, with some numerical labels like '54', '53', '49', and '16' visible.

Lagrangian verification of COSMO-DE precipitation forecasts

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Group: Synthesis of Observations and Models



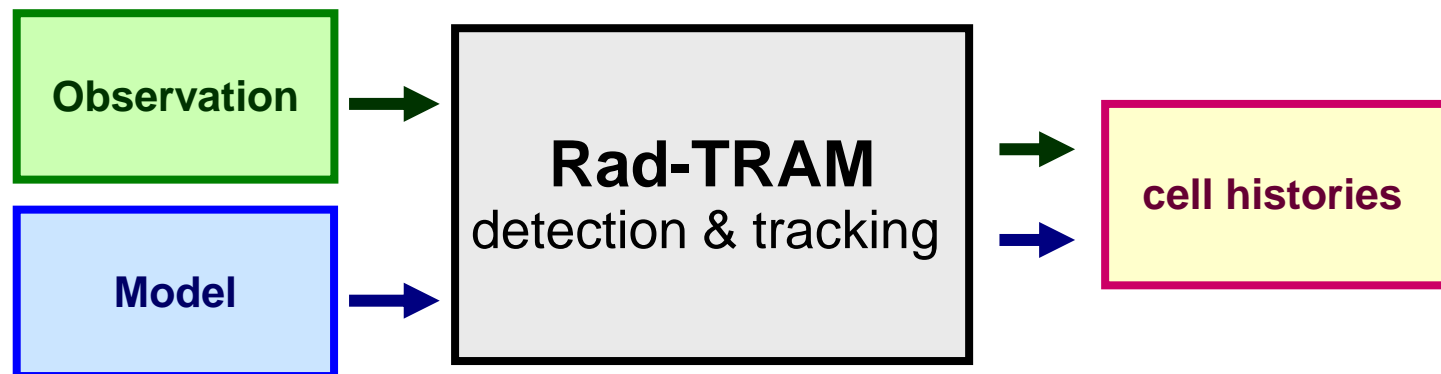
Motivation:

- 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





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



- **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

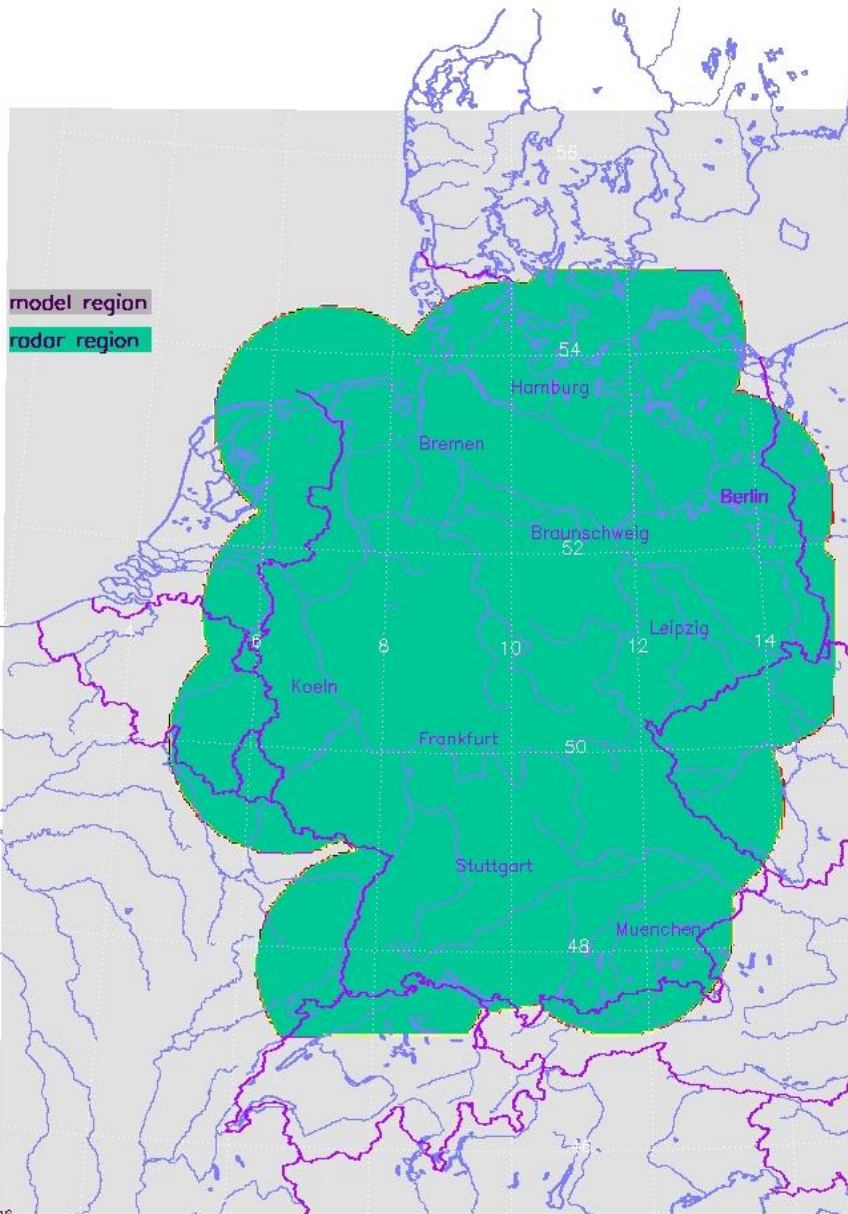
- **Region:** Germany

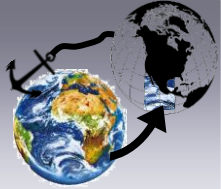
→ model area restricted to radar boundaries

- **Resolution:**

421x461 2,8 km 15 min

→ Observation data adjusted to model grid

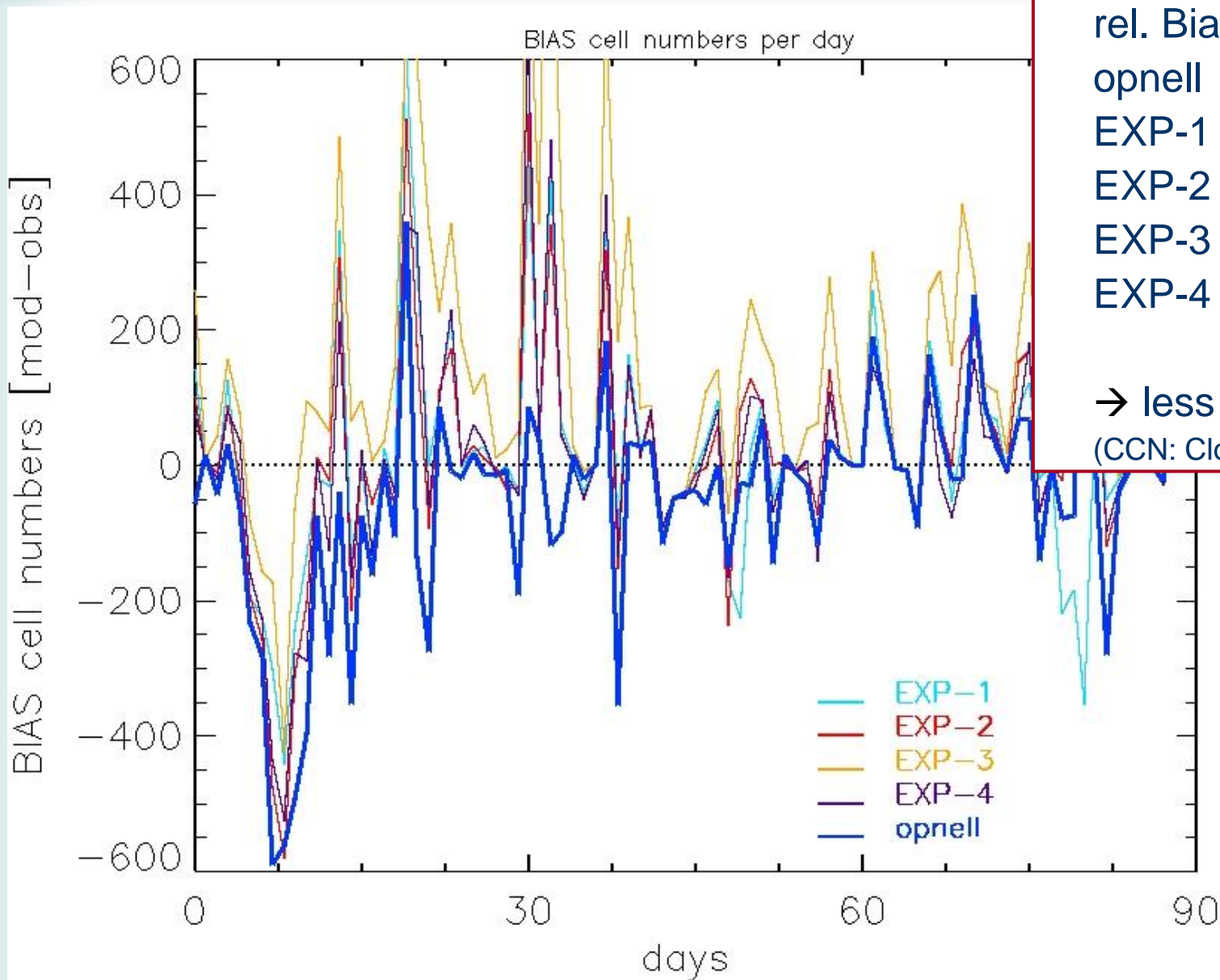




Model versions differ with respect to cloud microphysics parameterizations

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

Cell Numbers



rel. Bias of total number:

opnell - 0.20

EXP-1 + 0.07

EXP-2 + 0.12

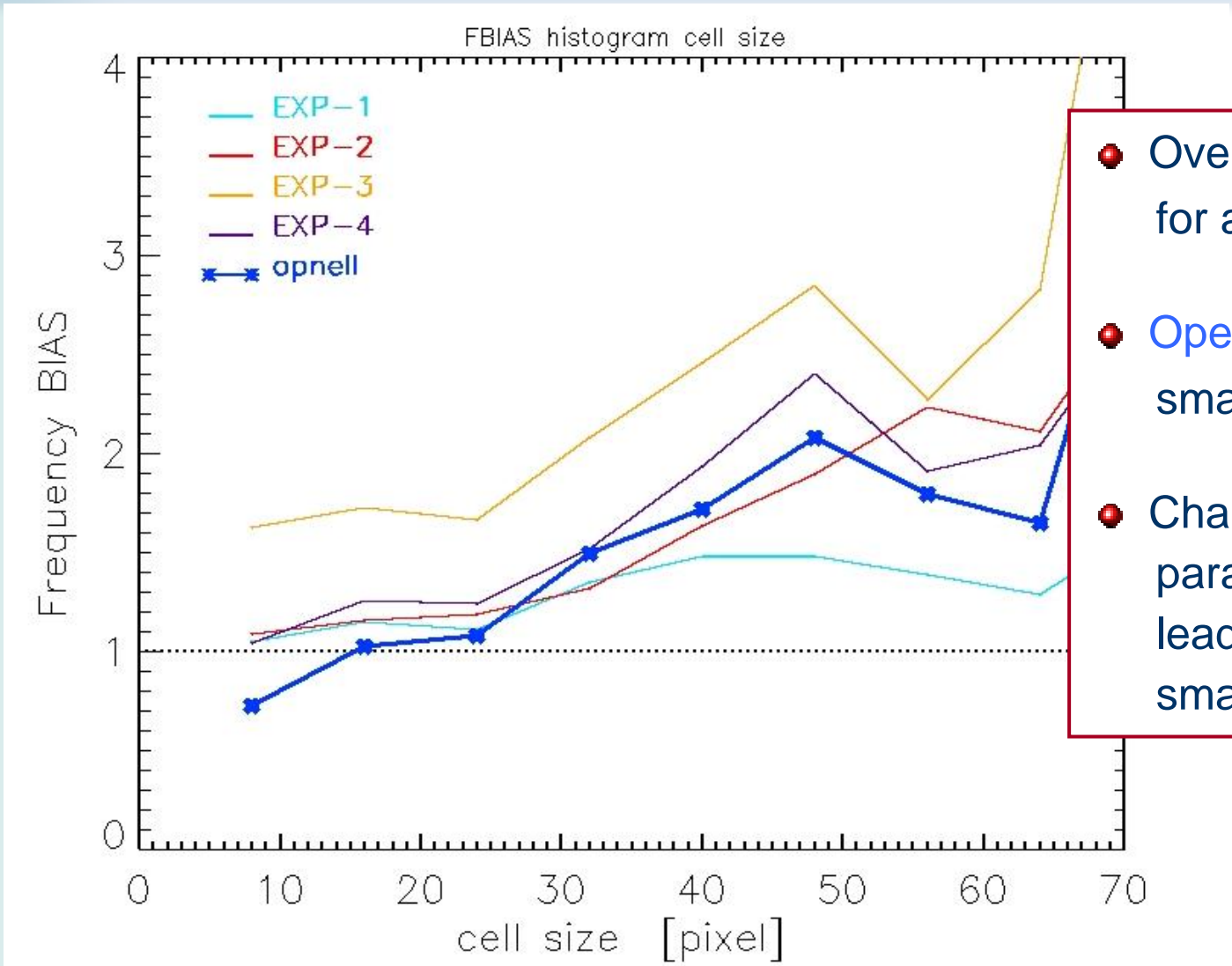
EXP-3 + 0.67

EXP-4 + 0.09

→ less CCN more cells

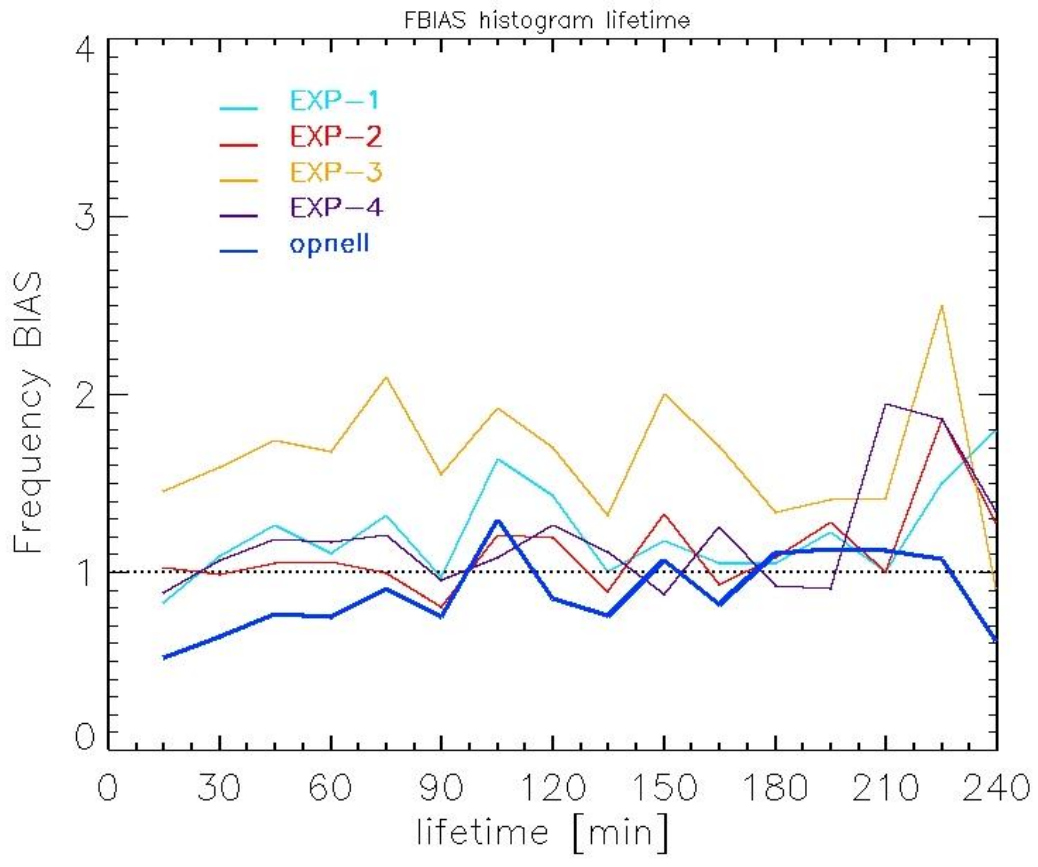
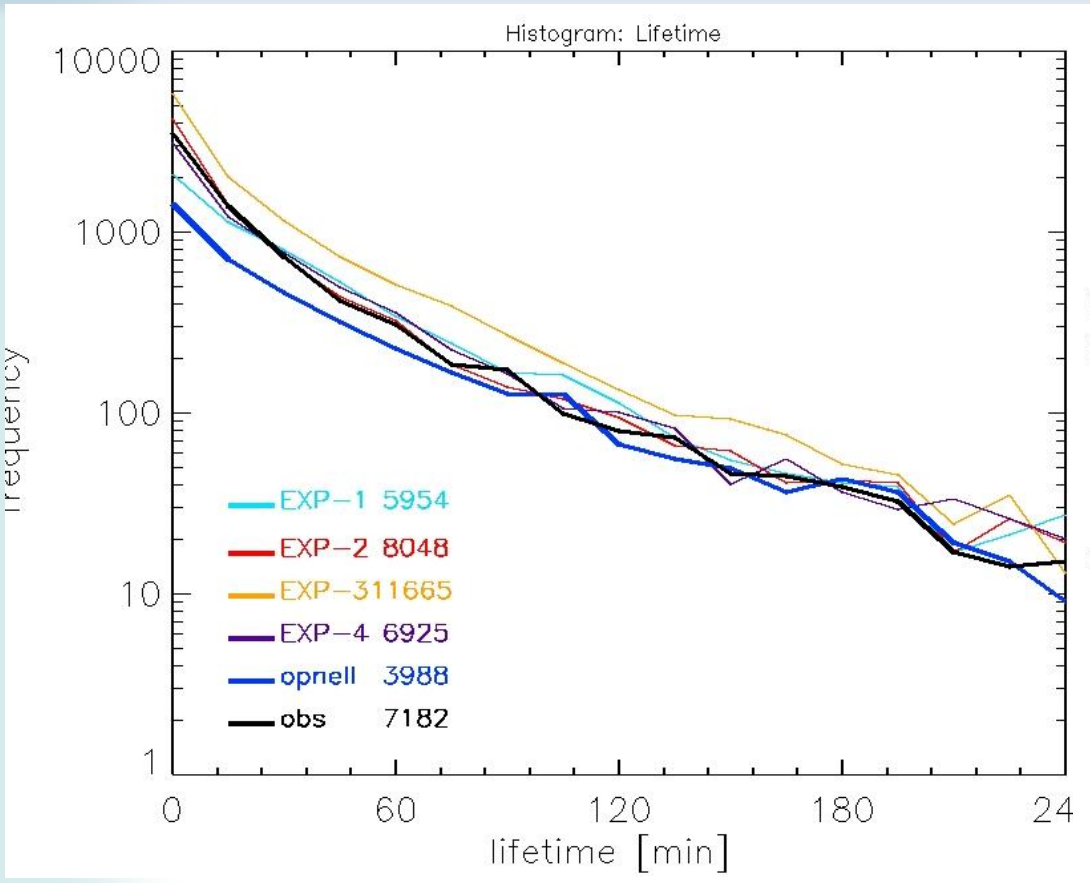
(CCN: Cloud Condensation Nuclei)

Cell Size



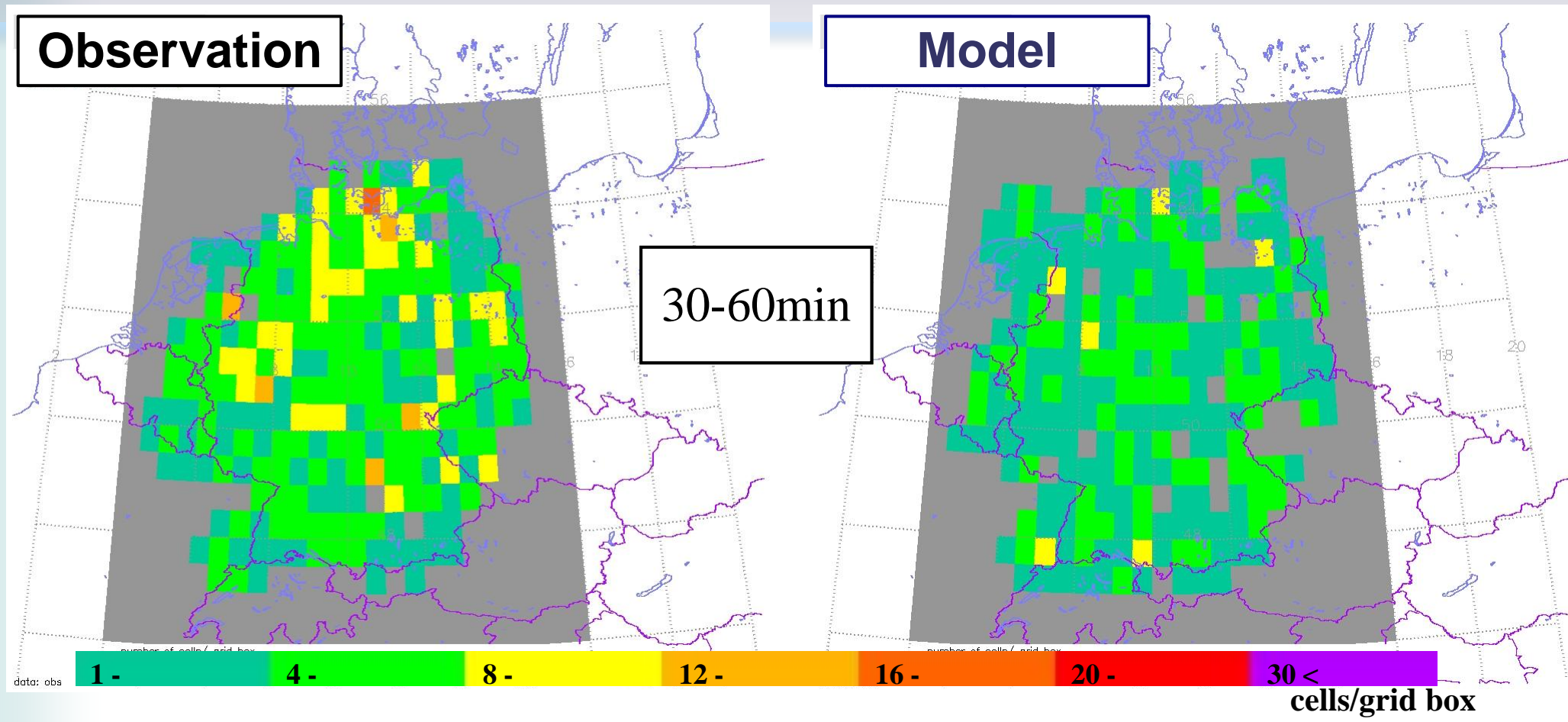
- Overestimation of large cells for all model versions
- Operational run shows too little small cells
- Changes in boundary layer parameterization in EXP-1 lead to less large and more small cells

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**

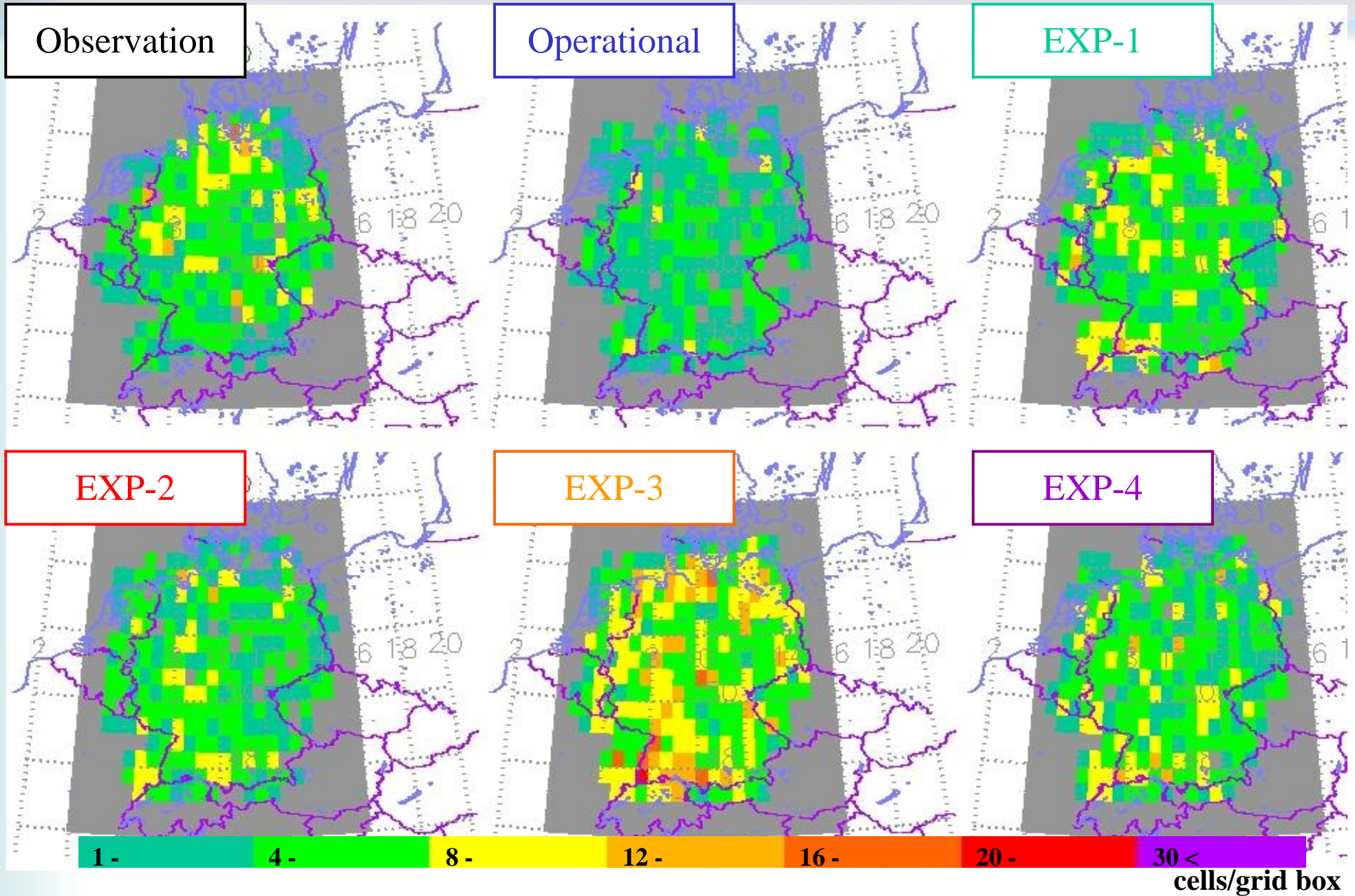
Location of Onset



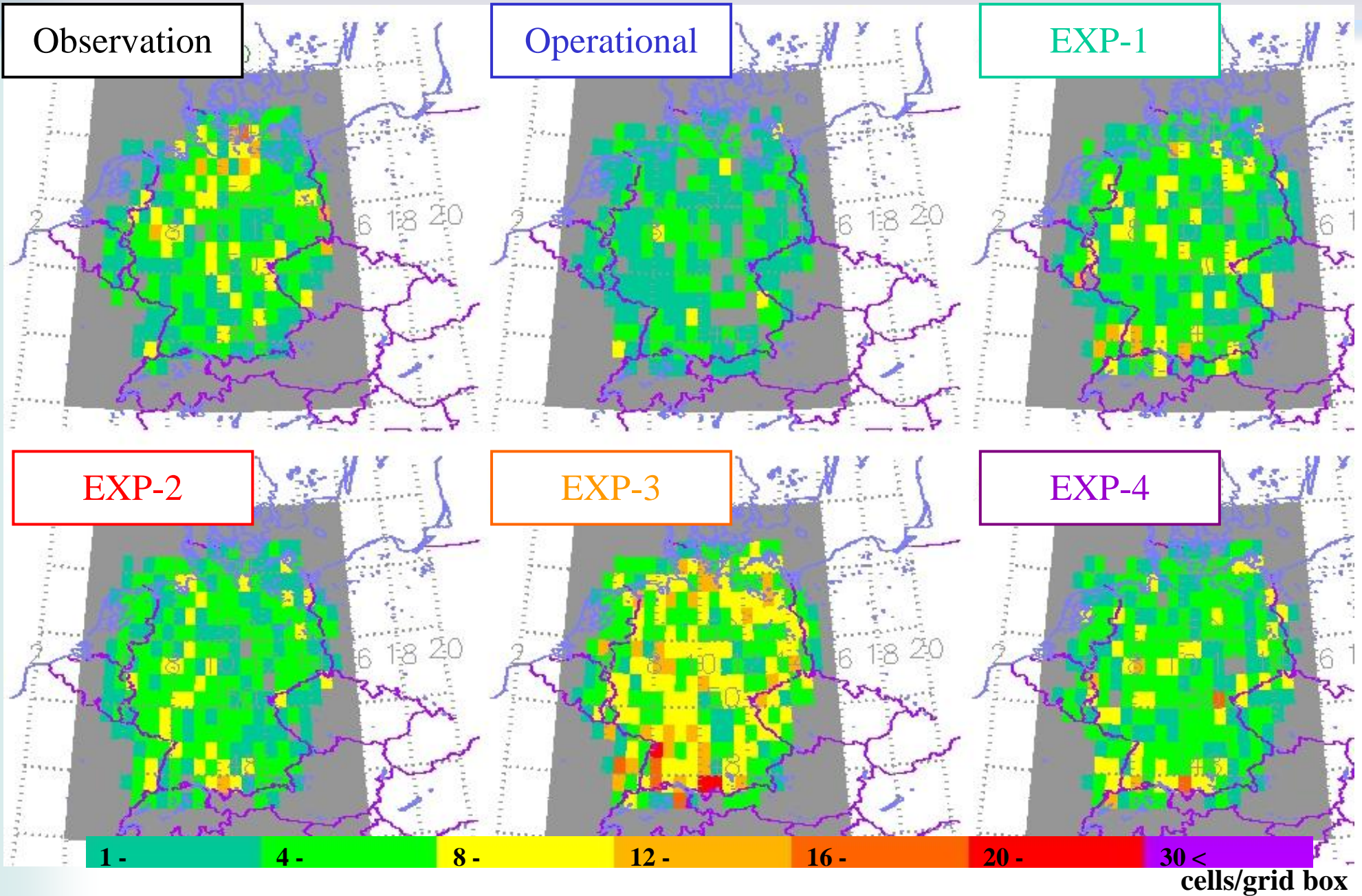
- for better interpretation use of low grid sum

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

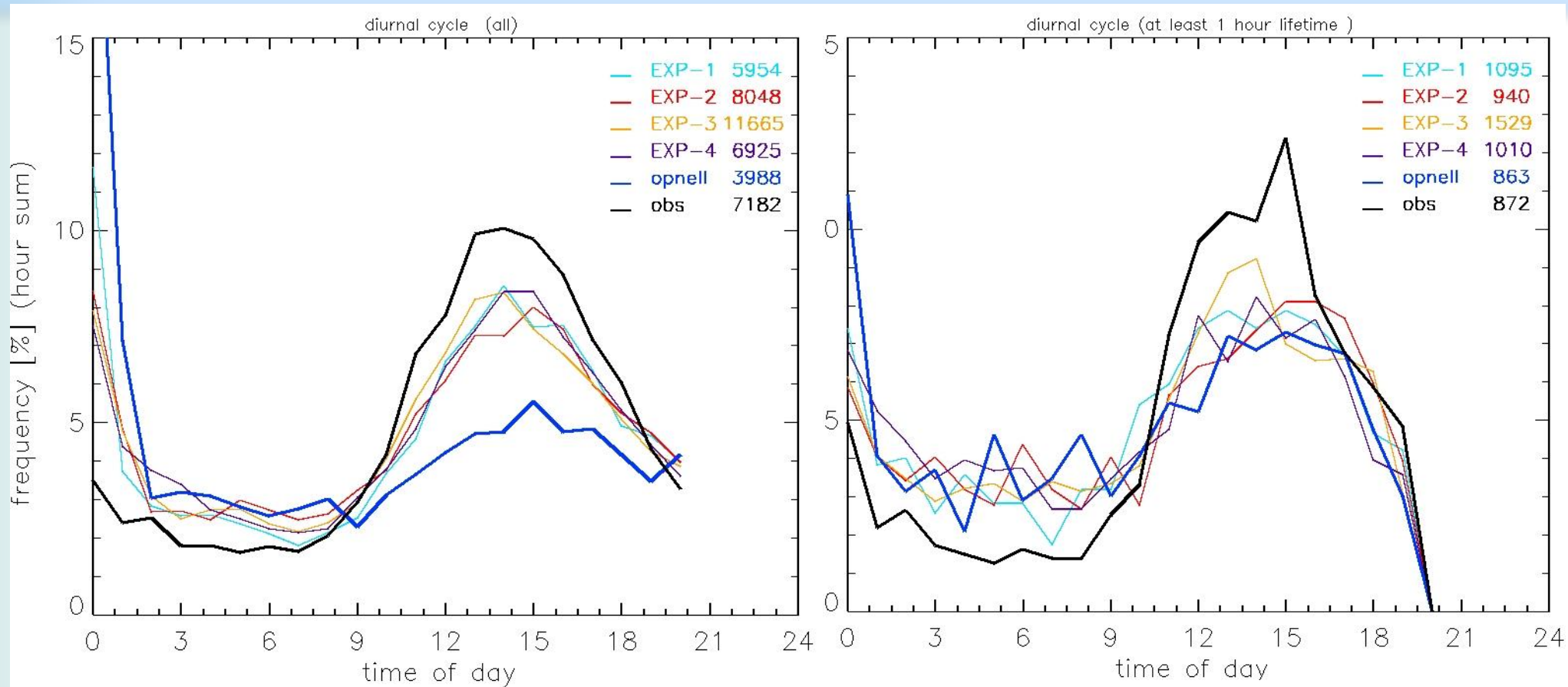
Location of Onset



Location of Decay

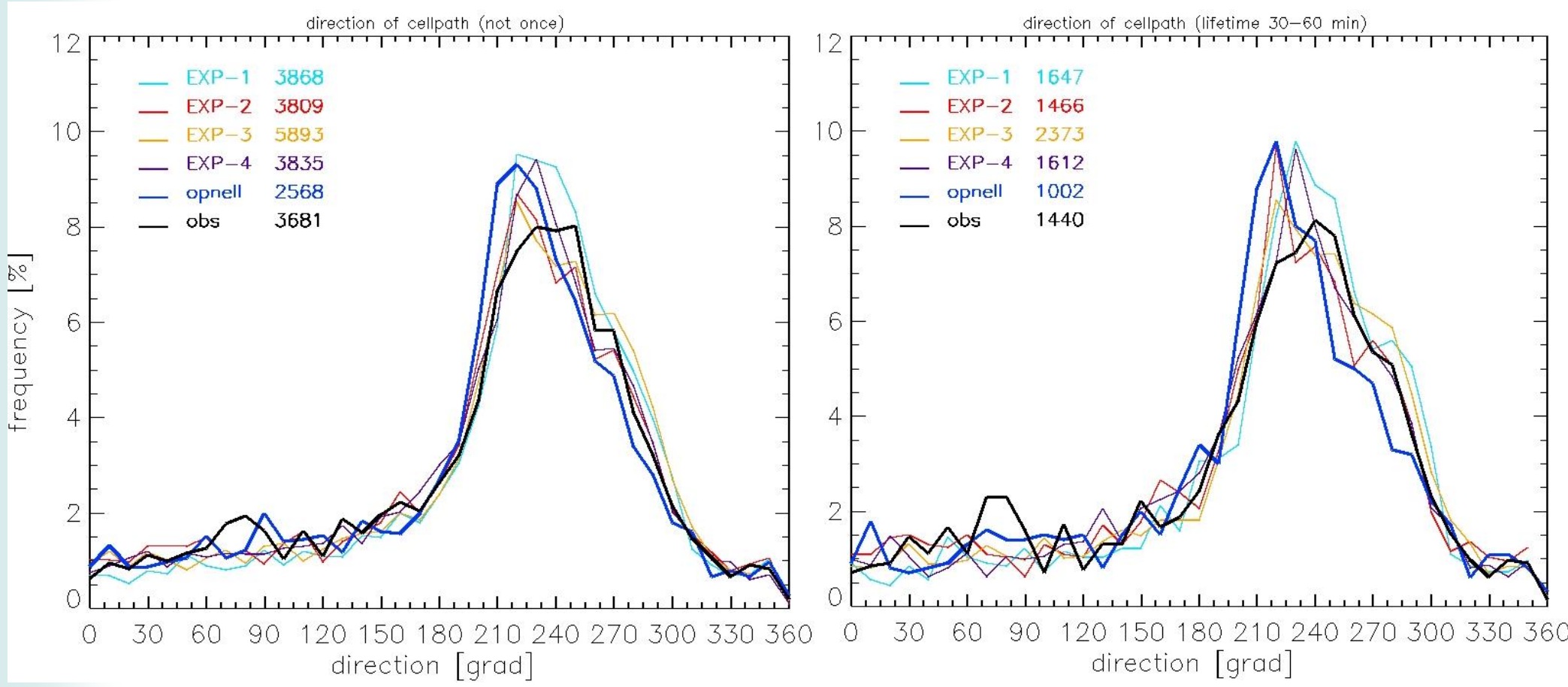


Diurnal Cycle of Onset

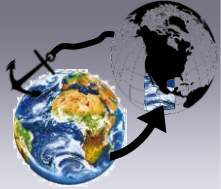


- Operational run can not predict the diurnal cycle of onset
 - Model experiments shows a clear improvement
 - Effect is only for the short-lived cells
- a less active parameterization of boundary layer processes results in a better initiation of radiation induced convection

Direction of Cells



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

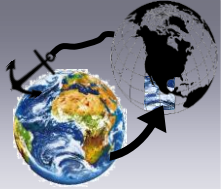


operational COSMO-DE is showing following effects for Summer 2007:

- 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 – less large 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:**
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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.
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