AeroCom Trajectory Experiment

(GCMTraj)

Progress and Initial Results

AeroCom meeting 2019

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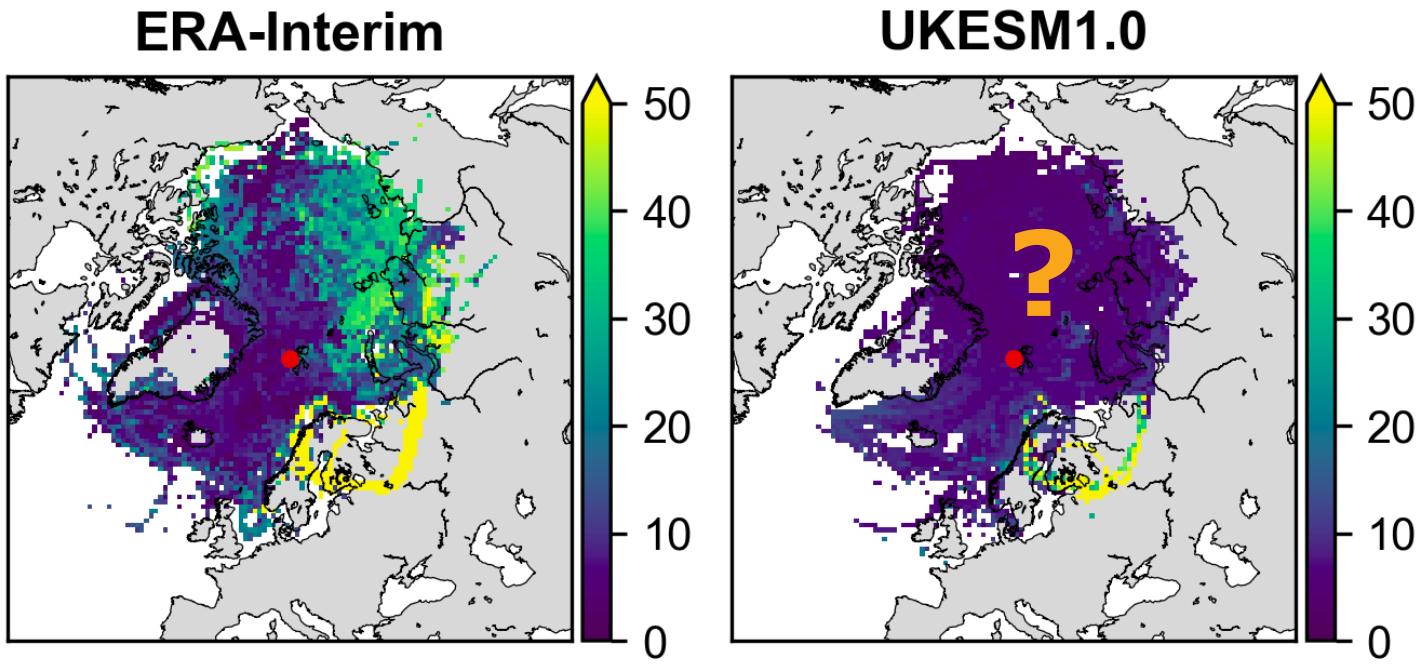
Presentation roadmap

1) **Experiment rationale.**
2) Experiment design, participants and state of progress.
3) Initial results.
    a) Eulerian aerosol comparison at Zeppelin station.
    b) Air mass footprint at Zeppelin station.
    c) Linking aerosol concentrations to source regions.
4) Future work.

Rationale



- Potential source regions of cloud active aerosol at Zeppelin station in the Arctic.
- Source of particles over Siberia & ice pack is missing in the model.
- What causes these differences?

Under-estimated source or over-estimated sink?

Experiment aims

Multi-model evaluation against reanalysis **combined** with observations in a **trajectory-based** Lagrangian framework.

Evaluate the discrepancies between models and observations as a function of aerosol **source & sink pathways during transport**.

Improve understanding of the impact of source and sink processes on aerosol life cycle and provide **Lagrangian constraints** for the representation of these processes in GCMs.

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Experiment design

Two stages

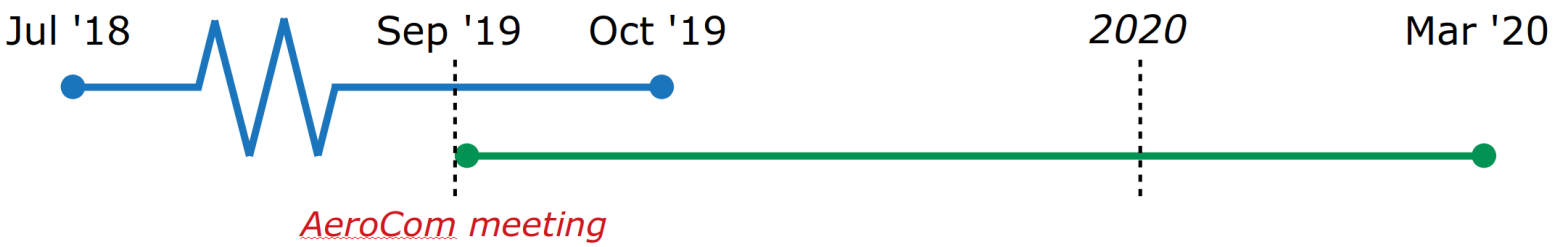
ArcticTraj-DE
DE: "Development Experiment"

6 months (summer 2006)
1 station (Zeppelin)

GlobalTraj-CE
CE: "Core experiment"

10 years
10 global stations

Timeline



Participants overview

Centre	Model
ECMWF	**ERA-Interim** & **ERA5** & ECMWF-IFS
ETH	**ECHAM6.3-HAM-P3**
NASA	GISS
NSC	NorESM1.2
PNNL	**CAM5.3(+)***
TROPOS	**ECHAM6.3-HAM-ECLIPSE**
UEF	**ECHAM6.3-SALSA2.0**
UKMO	**HadGEM3-UKCA**** & **UKESM1****
UMI	CESM-IMPACT
UOX	**ECHAM6.3-HAM2.2**
RIAM	MIROC-SPRINTARS

Modelling groups provide:

- 3-hourly aerosol data (CMIP6 emissions)
- 3-hourly trajectory data (winds nudged to ERA-Interim)

Development experiment results for models in **bold** are included in this presentation.

* modifications to improve wet scavenging of aerosols and convective transport (Wang et al., 2013).

** simulations led by the University of Exeter.

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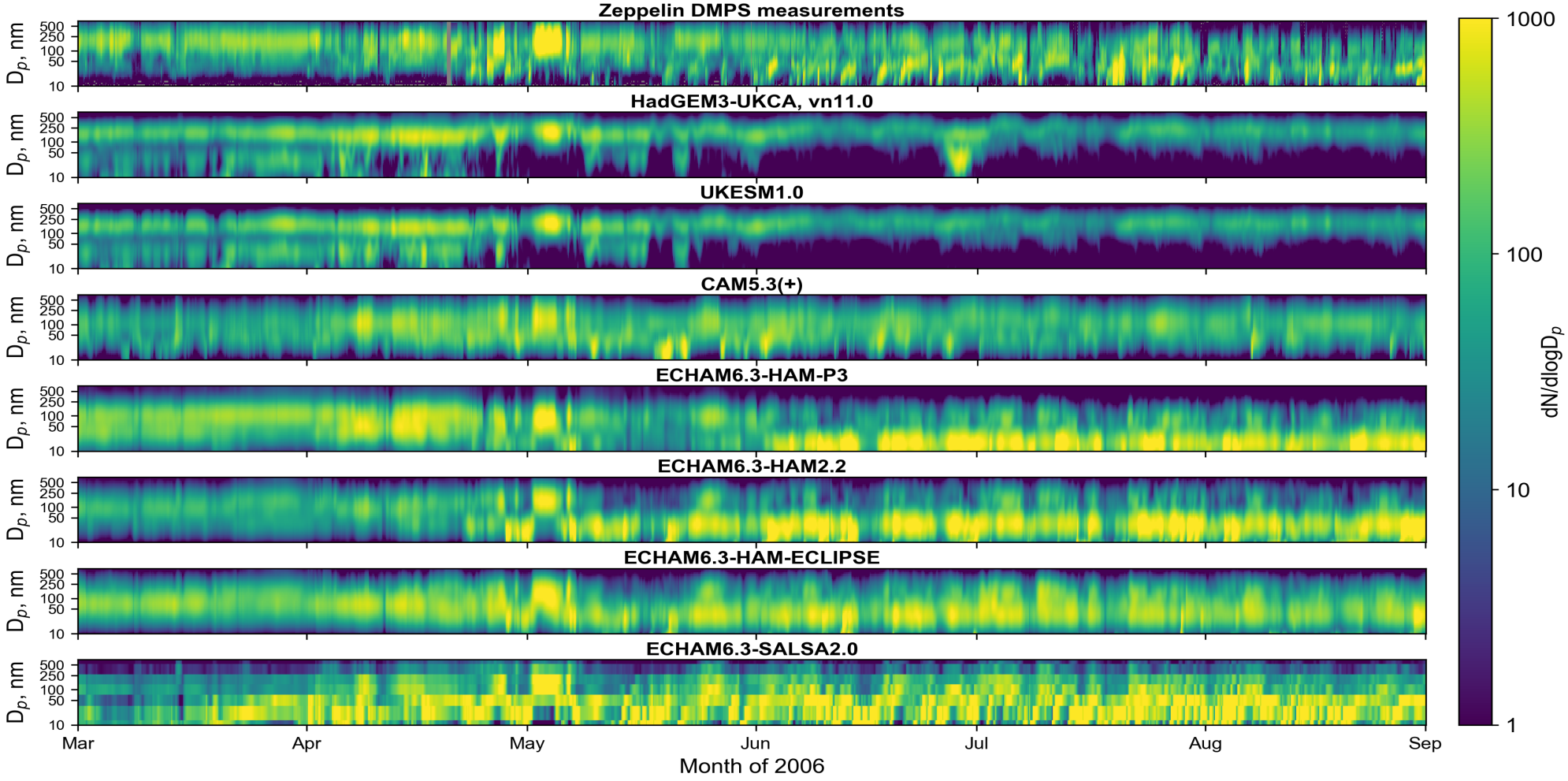
Eulerian evaluation at Zeppelin



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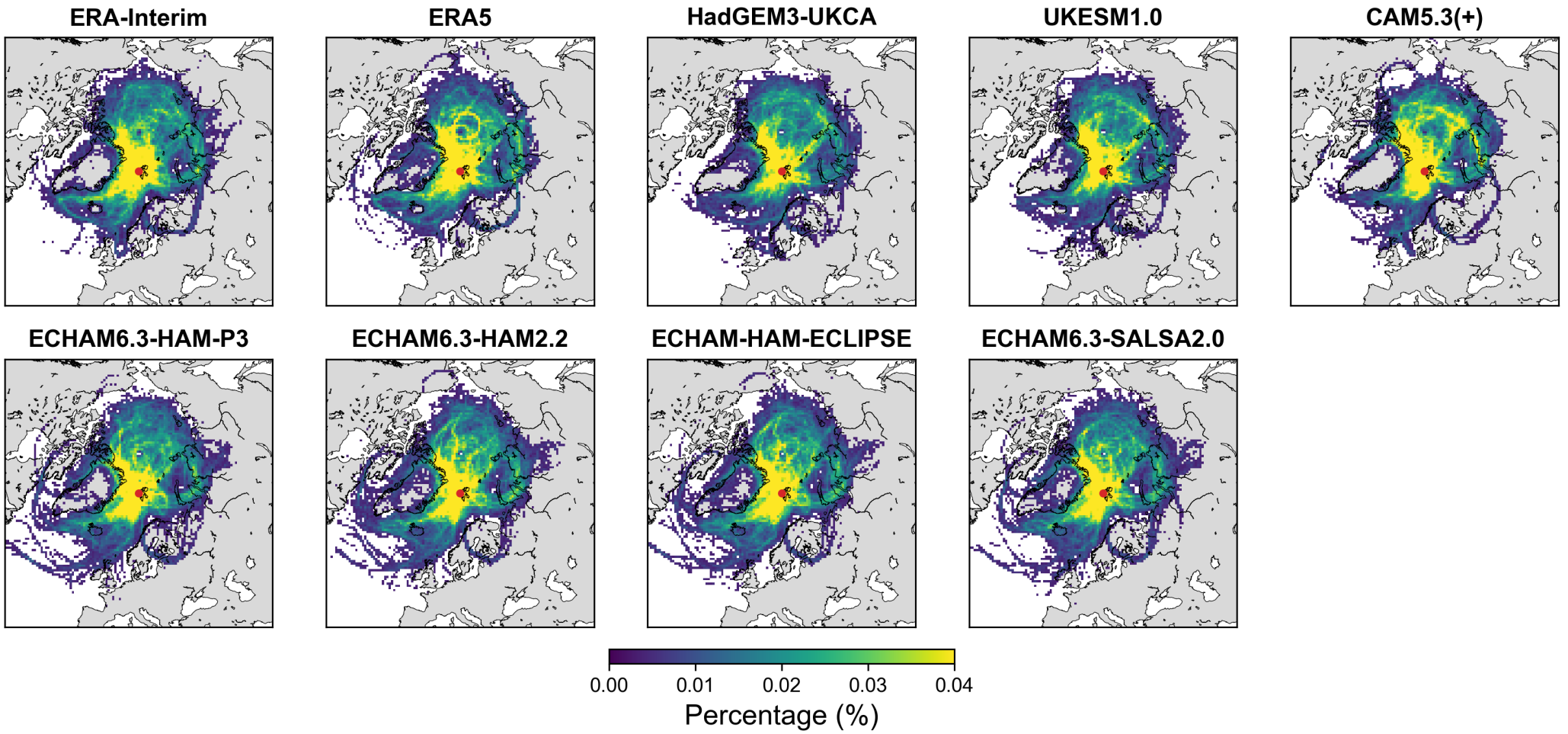
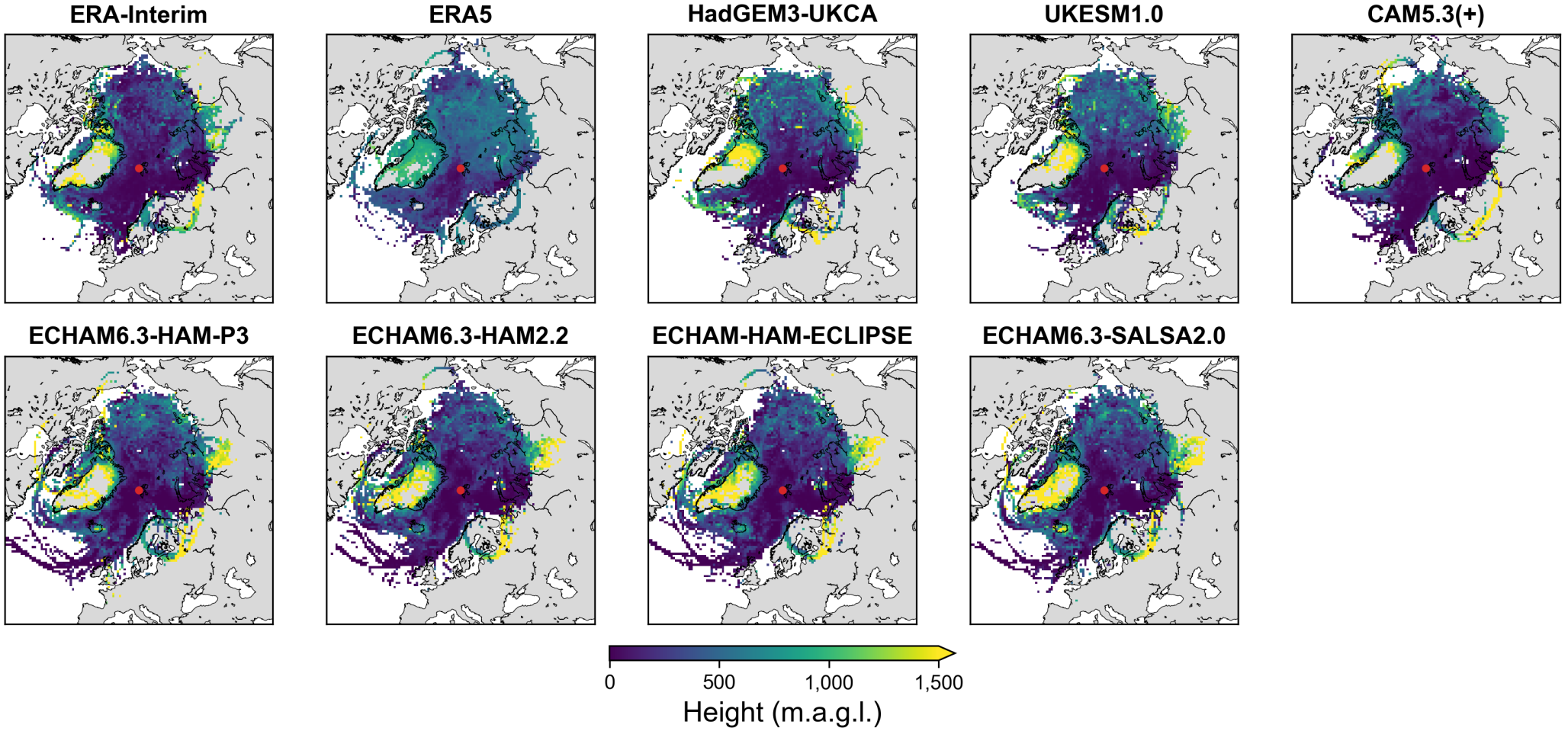
Zeppelin: air mass footprint



Zeppelin: air mass average height



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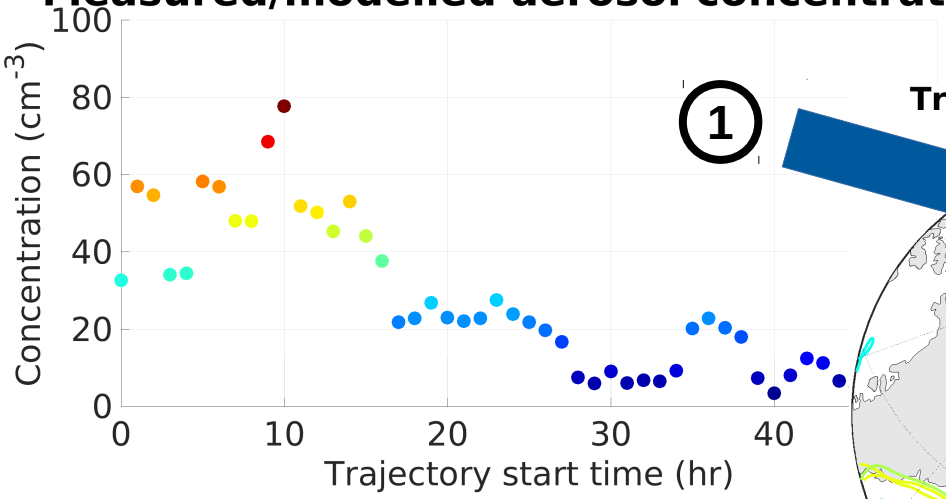
Potential source contribution

Measured/modelled aerosol concentration



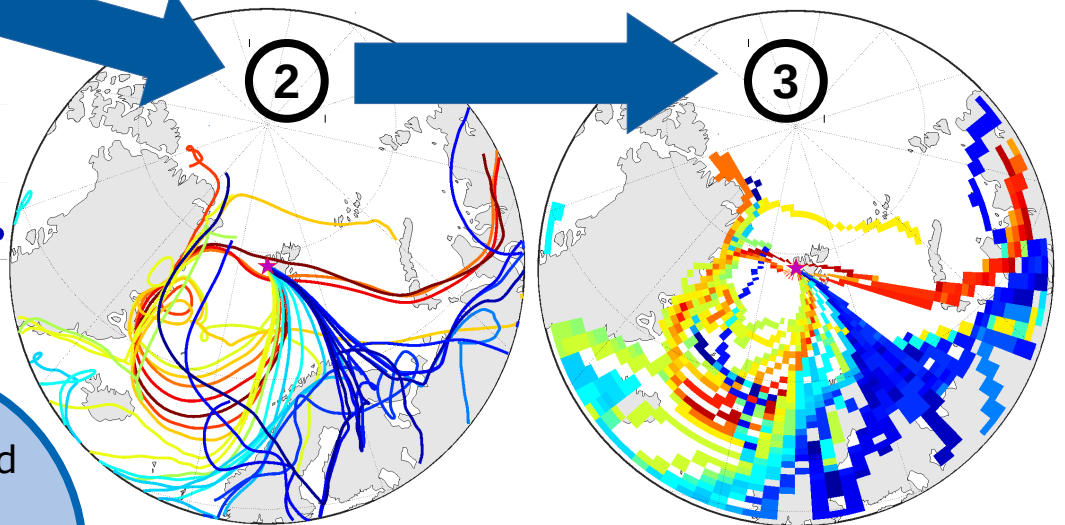
1

Trajectory assignment

2

Potential source contribution

3

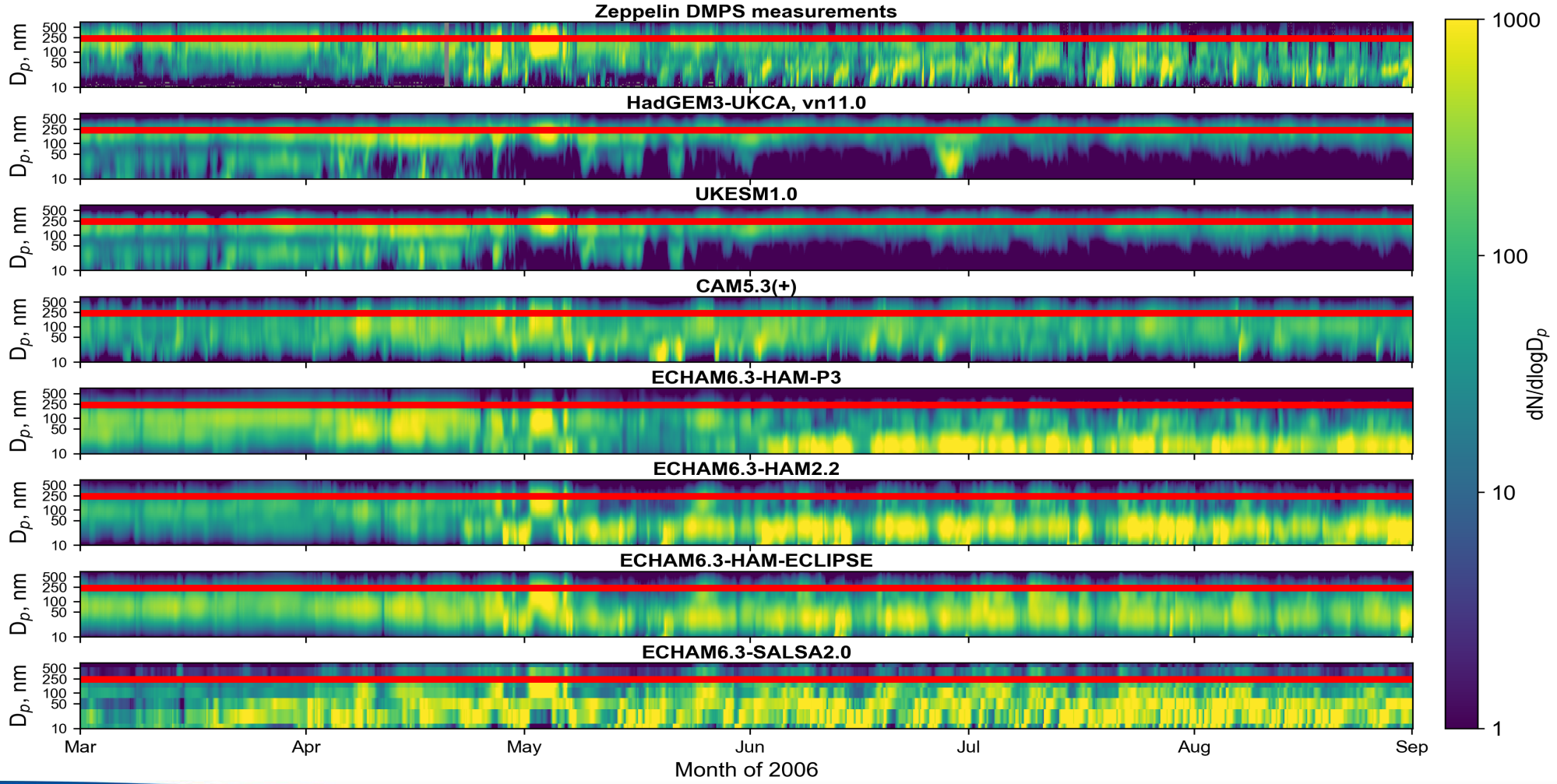


1) One trajectory per measured/modelled value at the receptor.

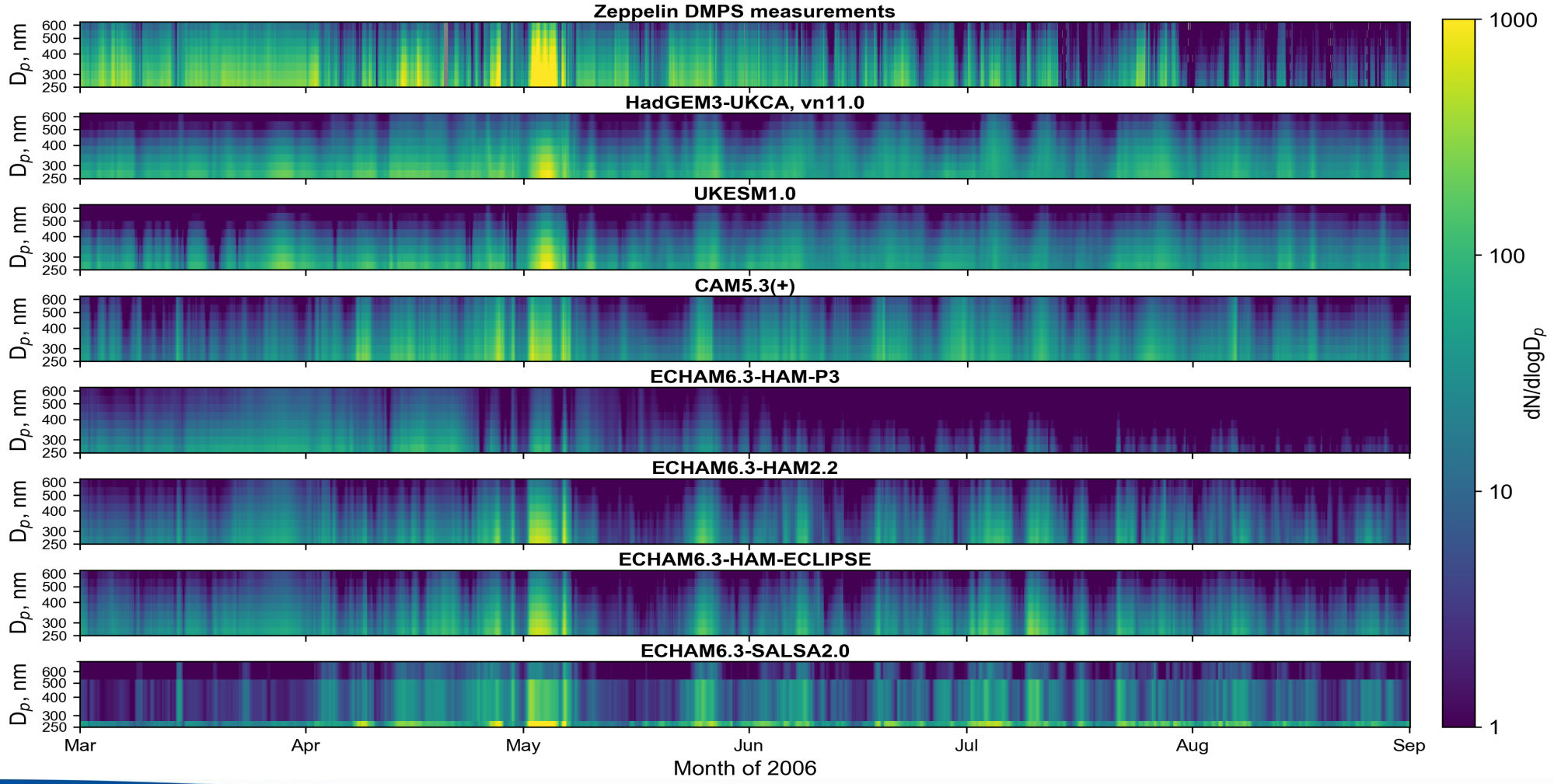
2) Each value is assigned along the entirety of it's corresponding trajectory.

3) The average concentration for each grid cell is calculated.

Looking at aerosol in the range D_p = 250-630nm



Looking at aerosol in the range D_p = 250-630nm

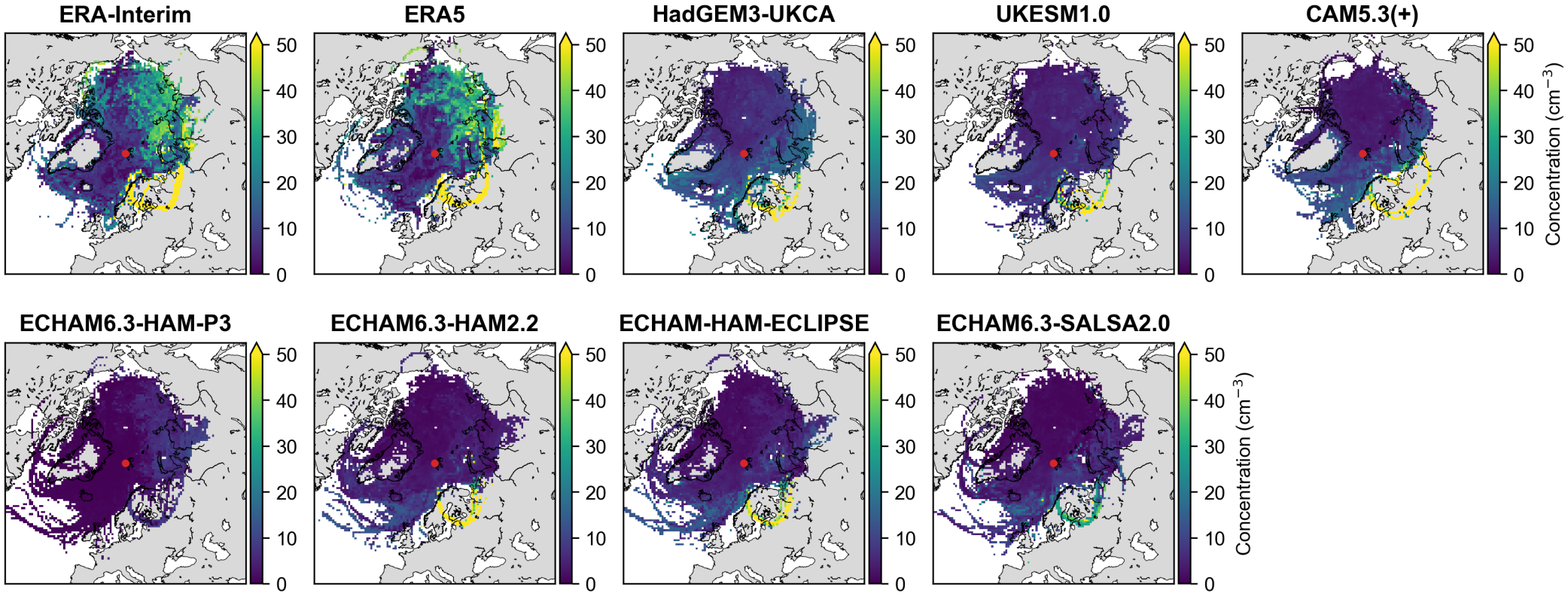


Arctic smoke – record high air pollution levels in the European Arctic due to agricultural fires in Eastern Europe in spring 2006

A. Stohl[1], T. Berg[1,*], J. F. Burkhart[1,2], A. M. Fjæraa[1], C. Forster[1], A. Herber[3], Ø. Hov[4], C. Lunder[1], W. W. McMillan[5], S. Oltmans[6], M. Shiobara[7], D. Simpson[4], S. Solberg[1], K. Stebel[1], J. Ström[8], K. Tørseth[1], R. Treffeisen[3], K. Virkkunen[9,10], and K. E. Yttri[1]

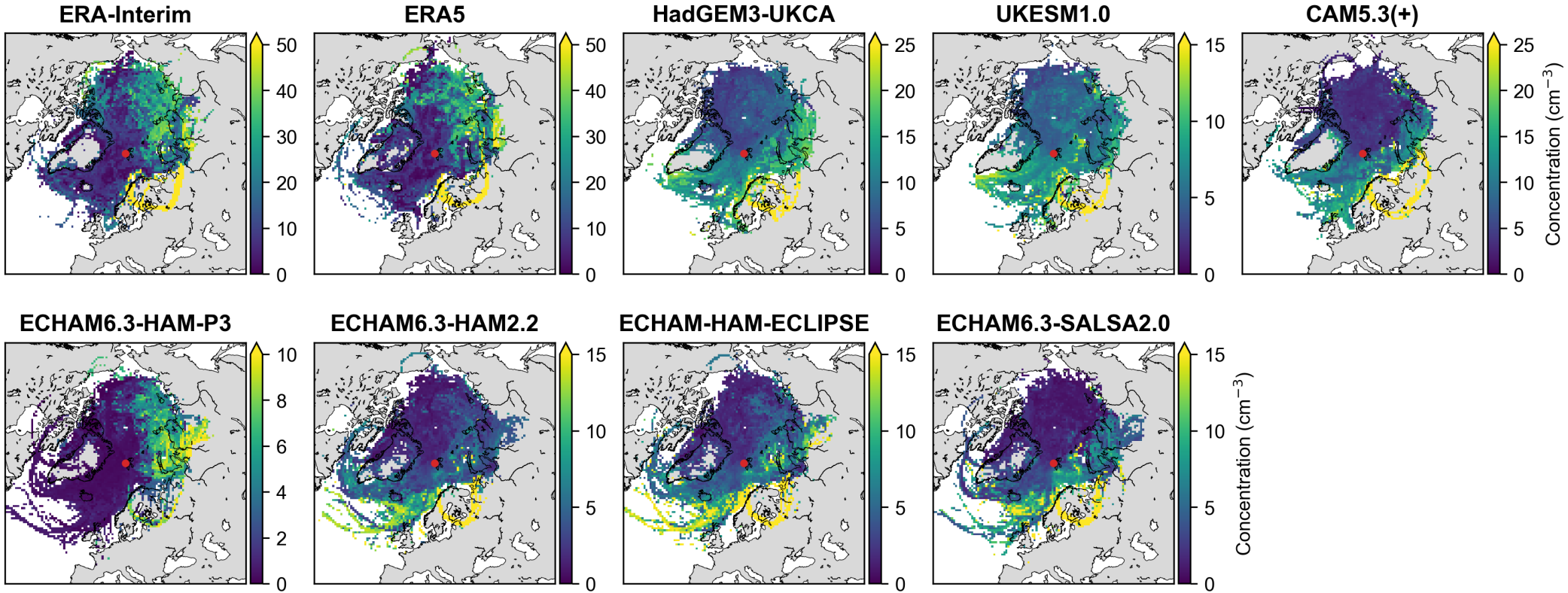
Zeppelin: potential source contribution

Number concentration (D_p = 250-630nm) cm^{-3}



Zeppelin: potential source contribution

Number concentration (D_p = 250-630nm) cm^{-3}



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GlobalTraj-CE

Aerosol life cycle during transport: use model output **spatially and temporally collocated** along trajectories.

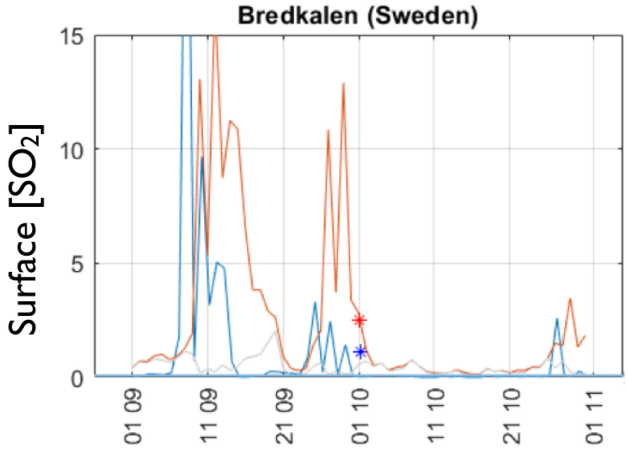
Investigate the representation of **sources and sinks** during aerosol life cycle.

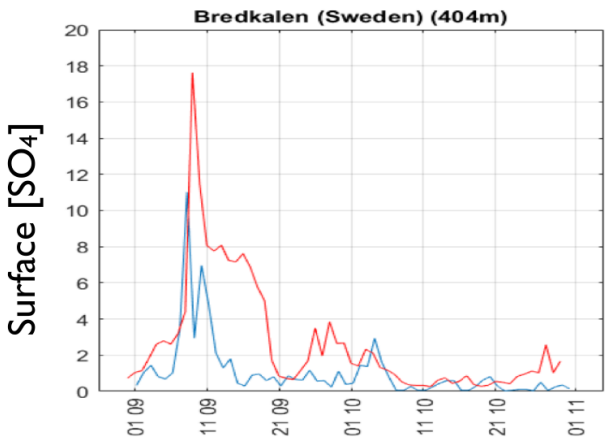
Constrain the impact of source and sink parameterisations on aerosol life cycle and aerosol burden.

Analyse the impact of precipitation experienced during transport on resulting aerosol concentrations.

Begin GlobalTraj-CE cycle, pick stations to include and links to VolcACI.

Future work: links to VolcACI

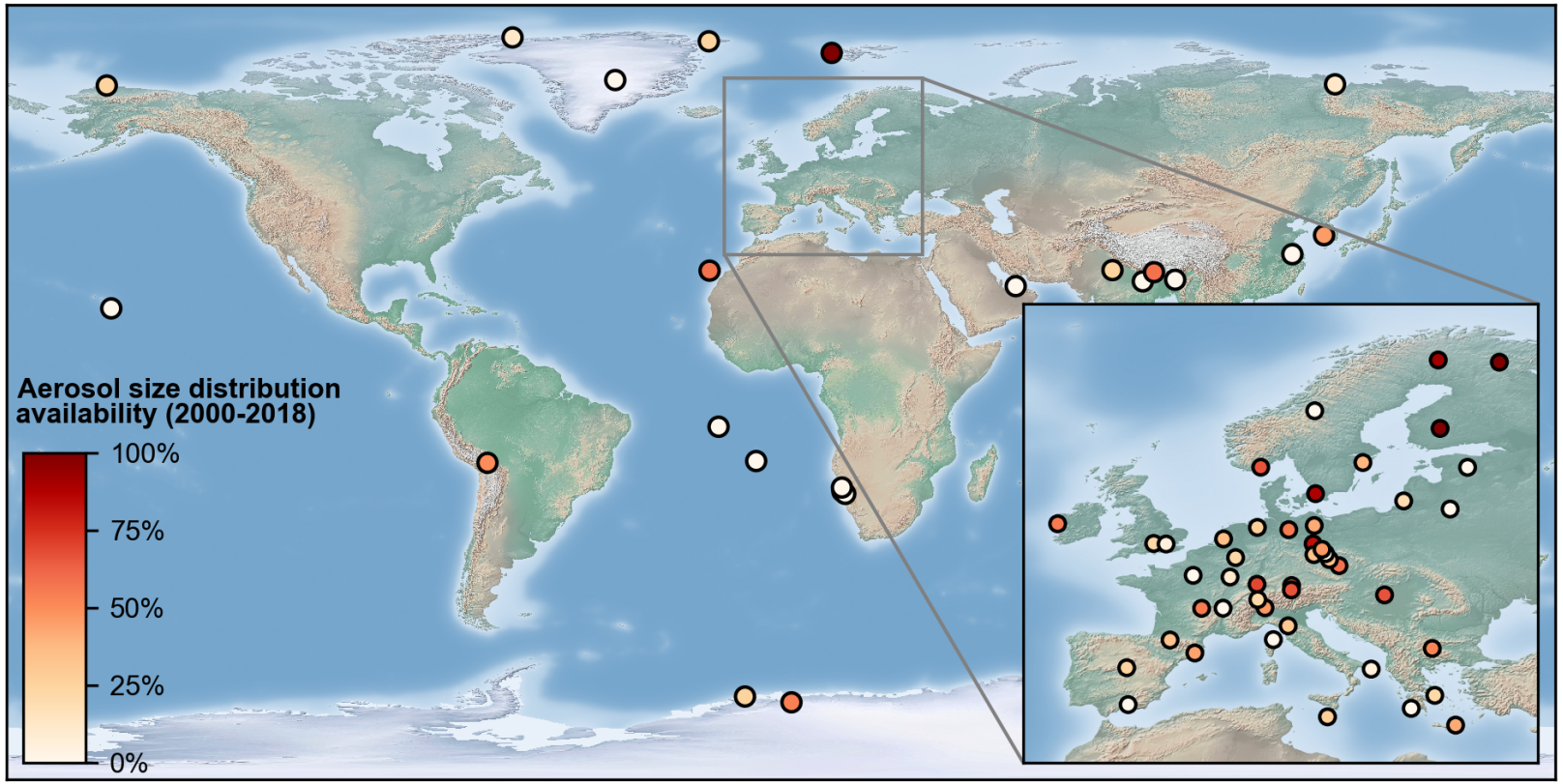




Use overlap from simulations to investigate volcanic plume lifecycles.

Assess the forcing effects over larger spatial scales.

GlobalTraj-CE: station selection

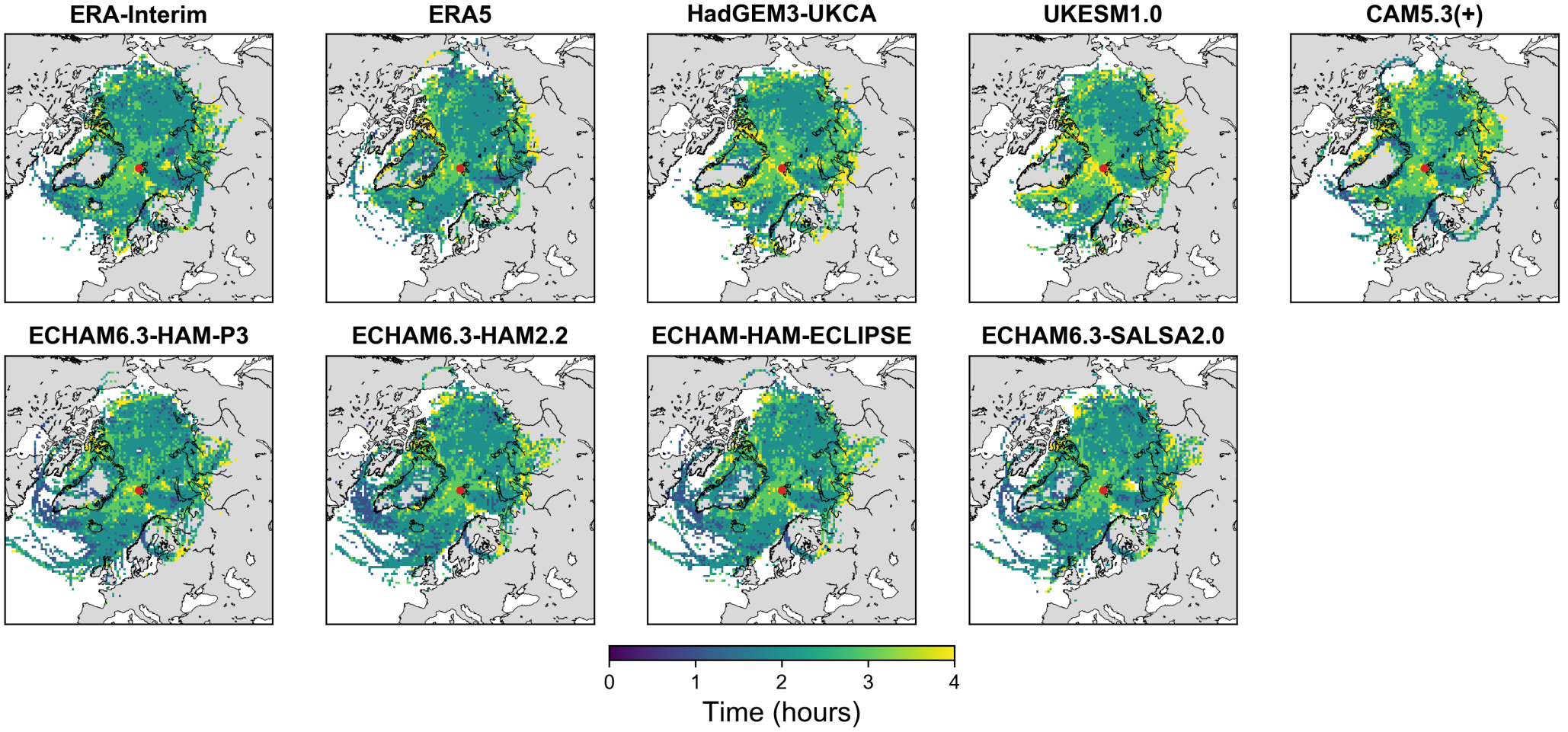


Pick **five** stations in order of preference to be analysed in the core experiment (subject to data availability).

Thank you for listening

You can contact me at: **p.s.kim@exeter.ac.uk**

Zeppelin: residence time



Number concentration (D_p = 20-70nm) cm^{-3}