Clouds and climate transitioning to post-fossil aerosol regime: CleanCloud

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CONSORTIUM

- Lead Coor. AU (DK), Sci. Coor. FORTH (GR)
- 14 EU partners + 4 UK partners + 2 CH partners
- Start date: 1 January 2024
- Collaboration with ACTRIS, ESA, NASA

- Hajime Okamoto (JAXA): Advisory Board

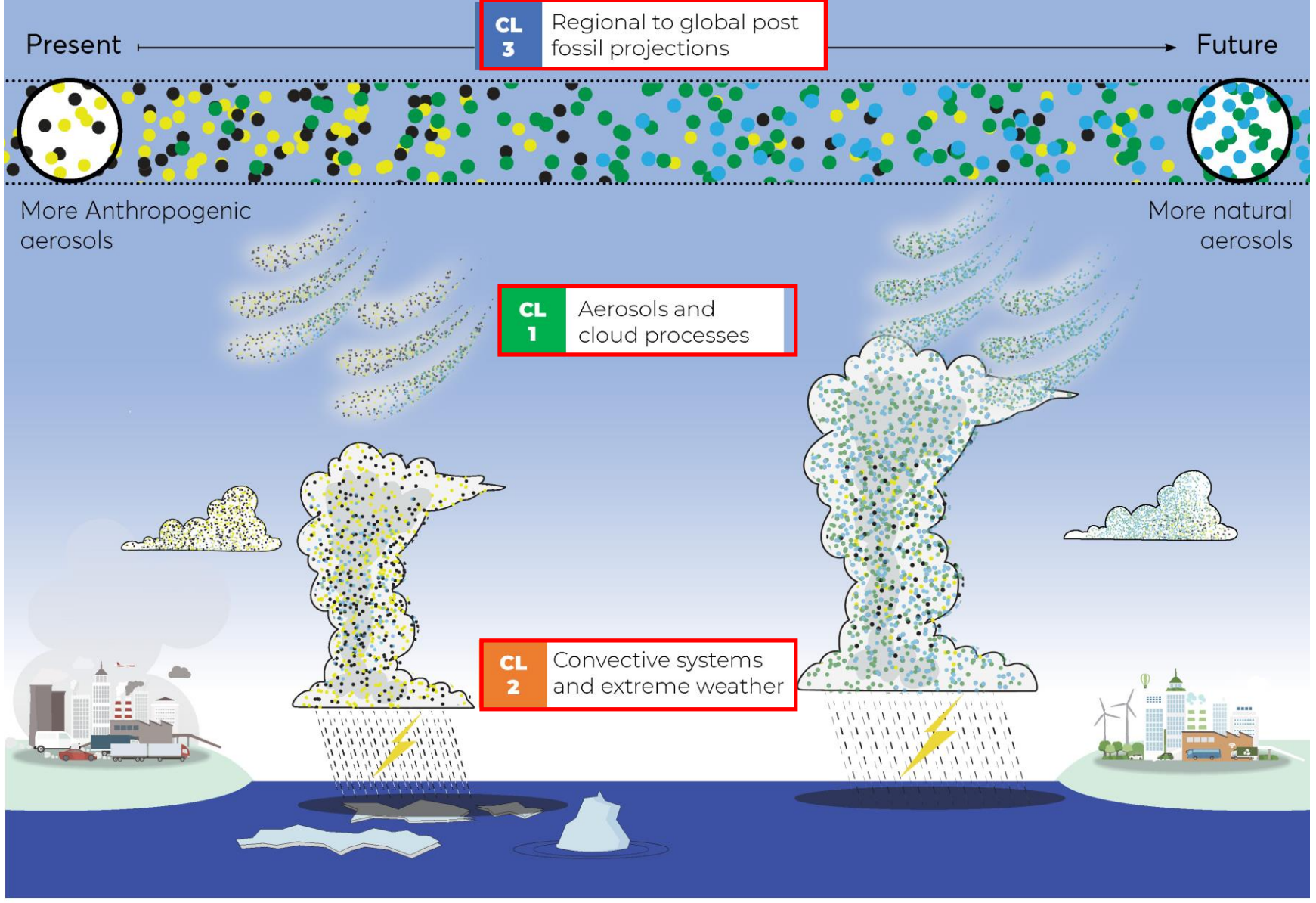
OBJECTIVES

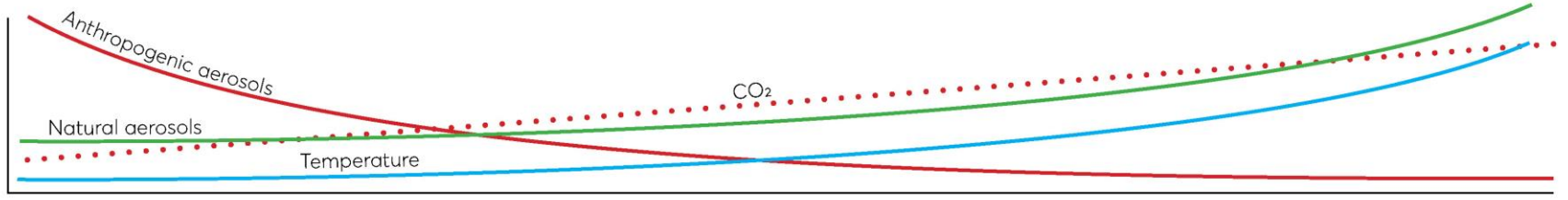
CleanCloud will

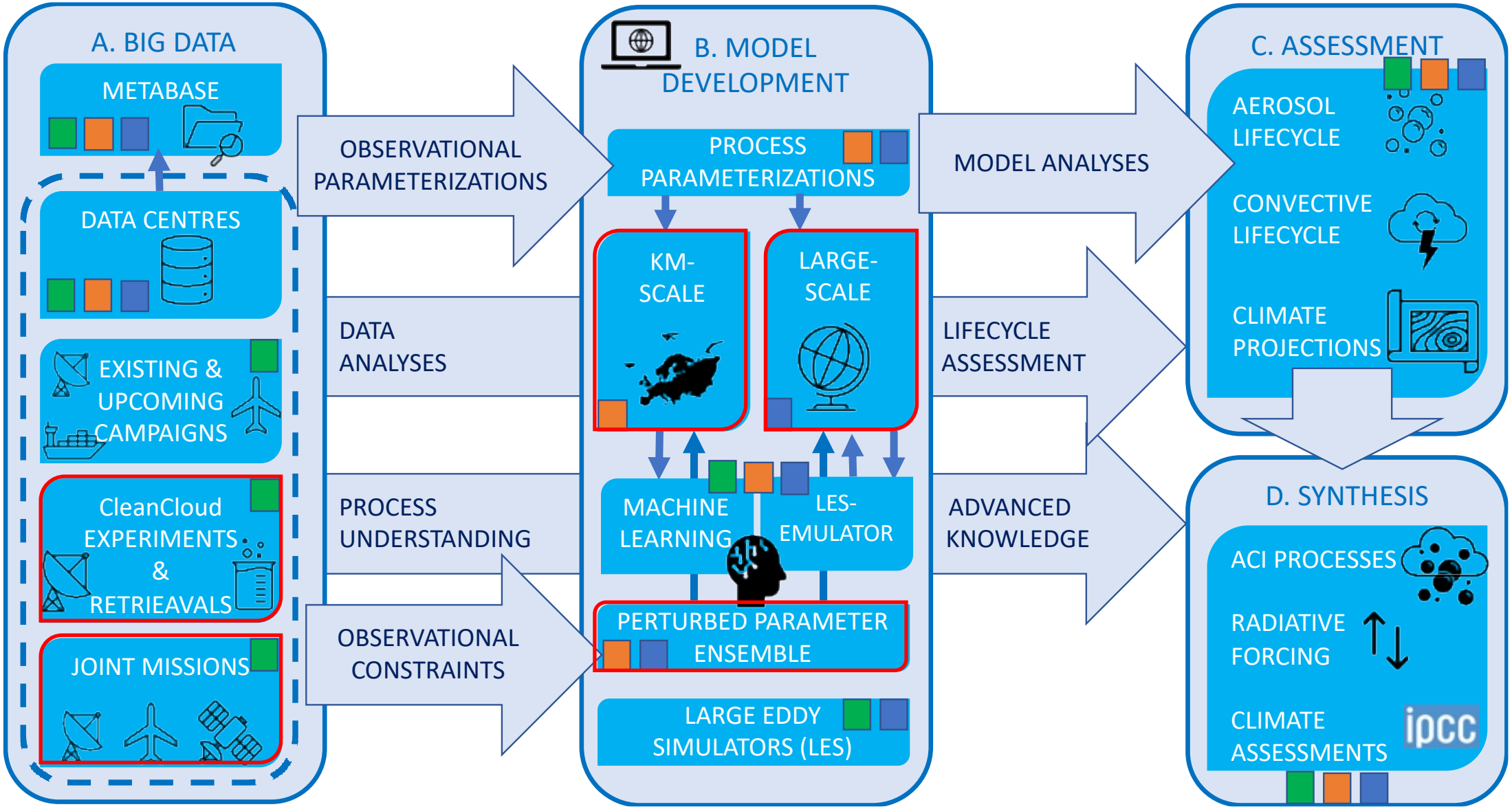
- *carry out targeted field experiments in European climate hotspots*
- *develop state-of-the-art algorithms to obtain new proxies and diagnostics for key ACI-related processes*
- contribute to the calibration and validation of upcoming satellite missions
- improve and better constrain kilometer- and large-scale climate models using advanced machine learning, data assimilation and model calibration
- assess the role of aerosols in the life cycle of convective systems and extreme events

Build over 3 scientific clusters

1) Process understading
2) Convective life cycle
3) Predictions & Projections

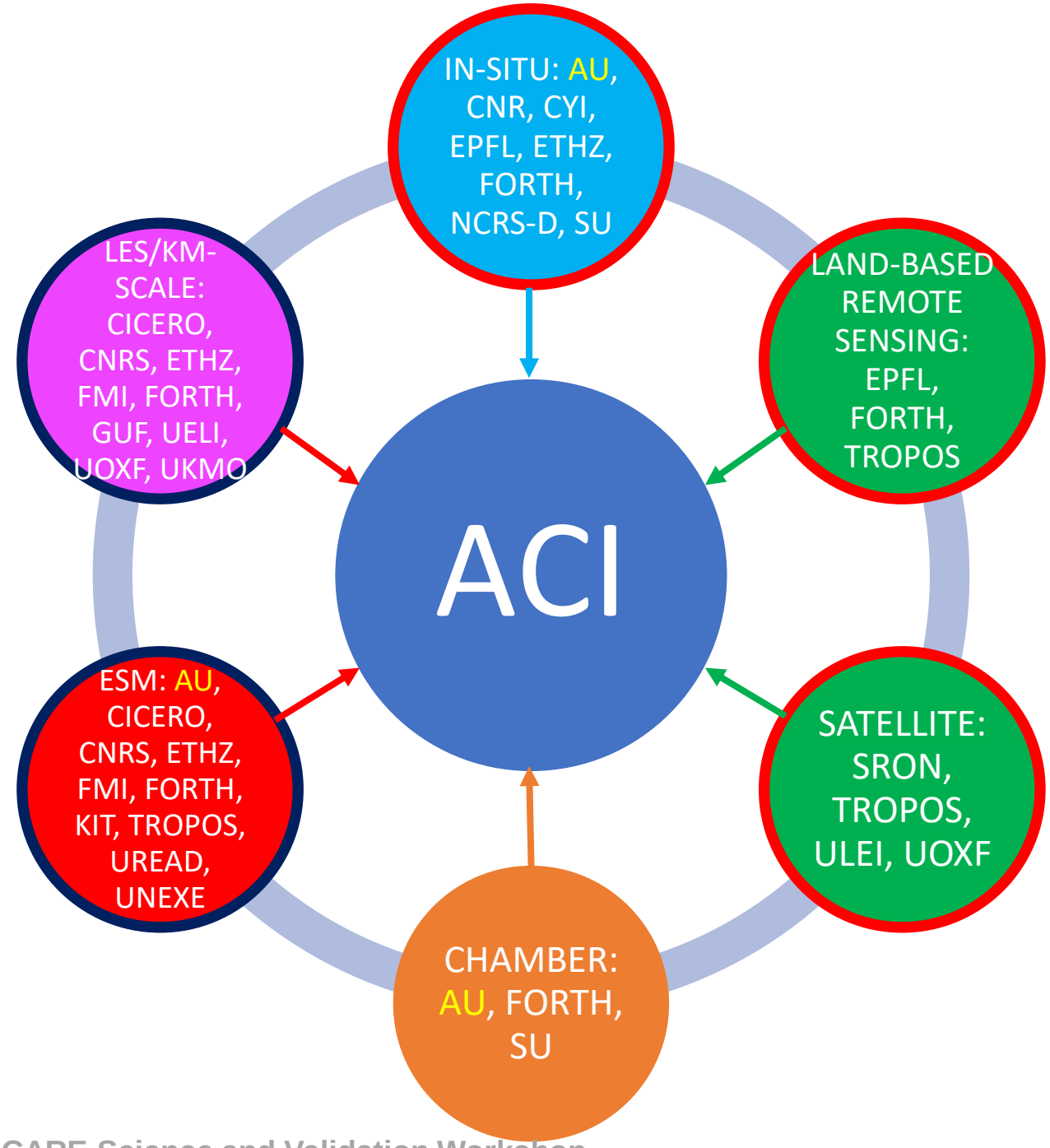





A. BIG DATA
METABASE
DATA CENTRES
EXISTING & UPCOMING CAMPAIGNS
CleanCloud EXPERIMENTS & RETRIEAVALS
JOINT MISSIONS
OBSERVATIONAL PARAMETERIZATIONS
DATA ANALYSES
PROCESS UNDERSTANDING
OBSERVATIONAL CONSTRAINTS
B. MODEL DEVELOPMENT
PROCESS PARAMETERIZATIONS
KM-SCALE
LARGE-SCALE
MACHINE LEARNING
LES-EMULATOR
PERTURBED PARAMETER ENSEMBLE
LARGE EDDY SIMULATORS (LES)
MODEL ANALYSES
LIFECYCLE ASSESSMENT
ADVANCED KNOWLEDGE
C. ASSESSMENT
AEROSOL LIFECYCLE
CONVECTIVE LIFECYCLE
CLIMATE PROJECTIONS
D. SYNTHESIS
ACI PROCESSES
RADIATIVE FORCING
CLIMATE ASSESSMENTS
ipcc

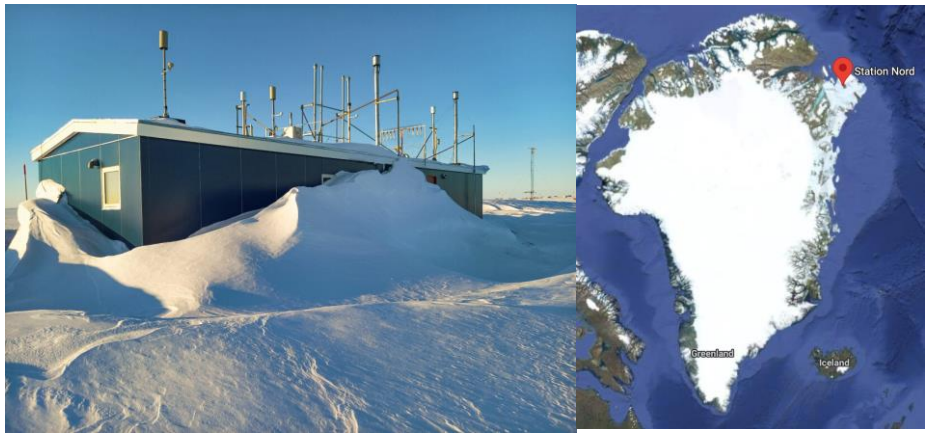
Use of EarthCARE in CleanCloud

- Field closure experiments to develop new retreival algorithms
- Use these new algorithms in EarthCARE Cal/Val activities
- Use new retriavals in creating PPEs in km-scale and large-scale climate models



FIELD CAMPAIGNS

- Arctic (Villum: Spring & Summer 2024)



- Mediterranean: Mt. Helmos (Autumn 2024)

- HALO-South & ATTO (TROPOS)

CLOSURE EXPERIMENTS & NEW ALGORITHMS

ESA EartCARE

ARCSIX Aircraft

UAVs

Helikite

Wind Lidar

Cloud Radar

Aerosol Lidar

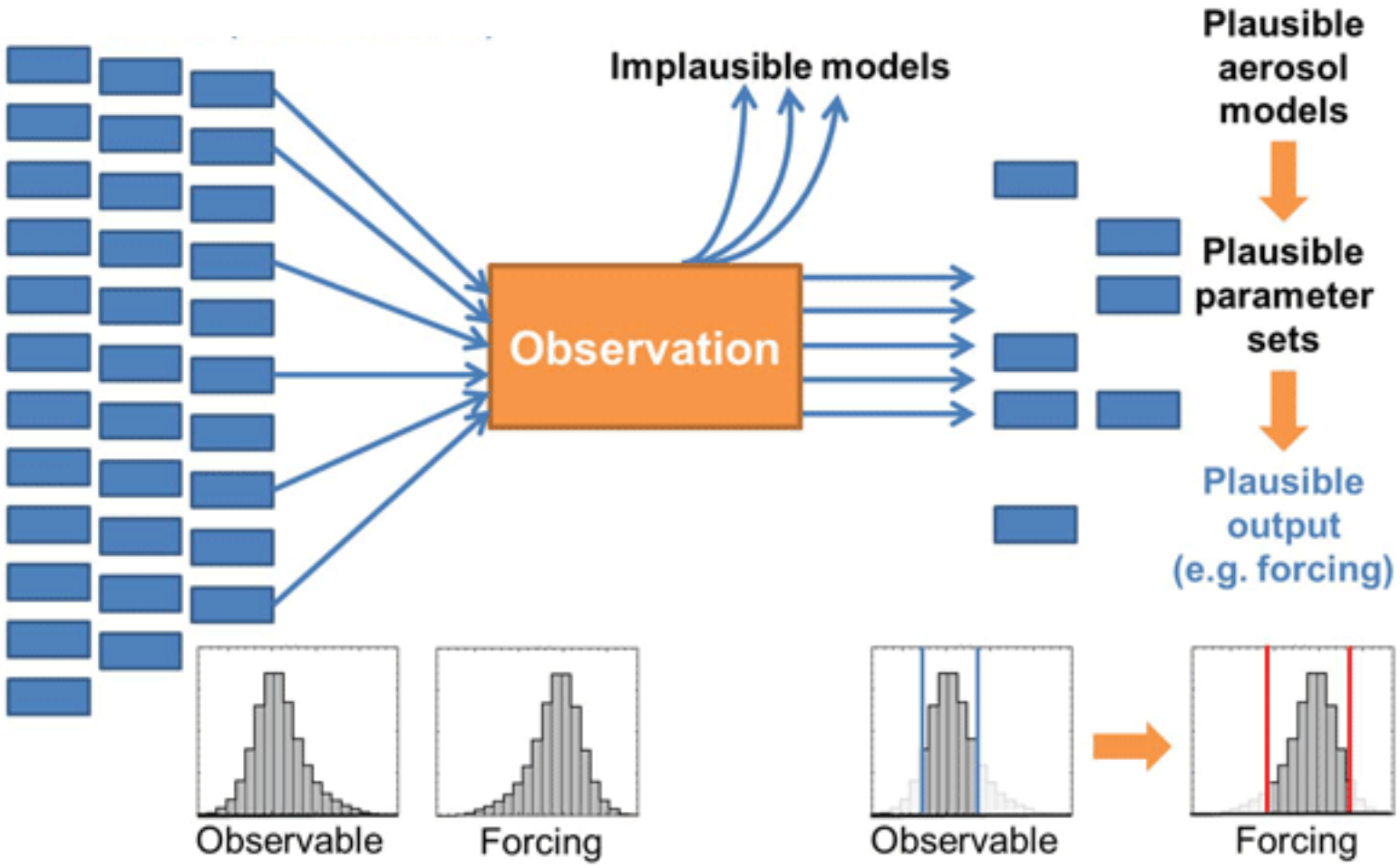
In-situ Surface Monitoring

- Develop new satellite retrieval algorithms that focus on determining the processes active in mixed-phase clouds, i.e. SIP: rime splintering, droplet shattering and ice-ice collisions.
- Improve existing algorithms for retrieving droplet number and ice crystal number concentration in both liquid-and mixed-phase clouds.

- ACTRIS sites with lidar and cloud radar
- HALO-South
- ATTO
- NASA PACE
- **Cal/Val activities**

MODEL CONSTRAINTS

- Perturbed Parameter Ensemble (PPE)s for km-scale climate models:
  - ICON-HAM-Lite
  - ICON-HAM
  - EC-Earth
- Aerosols
- Clouds



Johnson et al., ACP, 2018

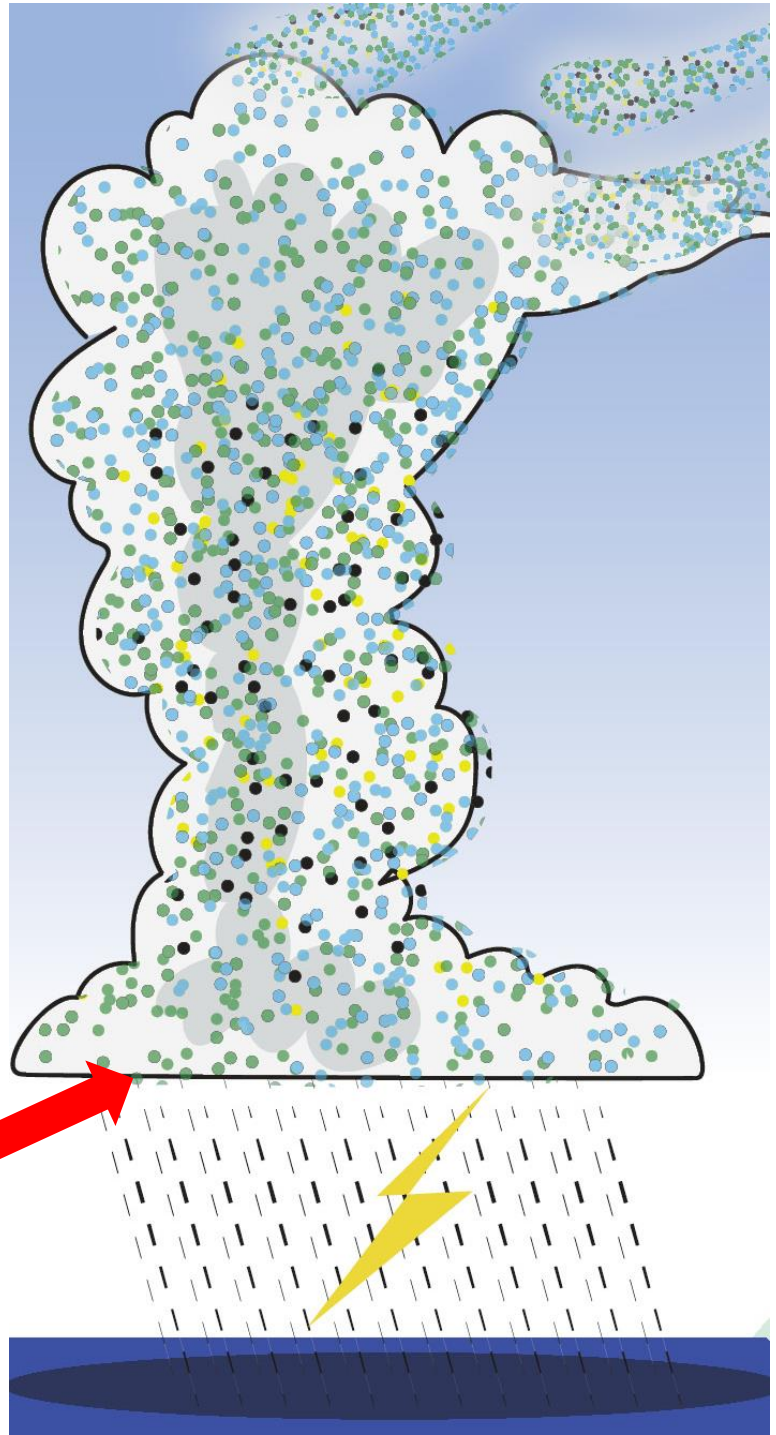
MODEL CONSTRAINTS

Better proxies for CCN (e.g. aerosol water content and dry size distribution):

- Aerosol absorption,
- Aerosol number,
- Aerosol concentration,
- Aerosol size distribution
- Aerosol refractive index

Cloud-base aerosol concentrations and type using vertical profiles:

- Aerosol extinction,
- Aerosol backscatter,
- Aerosol depolarization



Vertical profiles and uncertainty:

- Cloud phase,
- Ice water content,
- Vertical motions,
- precipitation rates,
- particle size,
- aerosol extinction

SUMMARY

- What CleanCloud can offer to EarthCARE:
  - New datasets for Cal/Val
  - New proxies for CCN, INPs, vertical velocity, and cloud processes
  - New remote sensing retreival algorithms

- What EarthCARE can offer to CleanCloud:
  - Improved aerosol and cloud products
    - Better proxies for CCN, INP, etc
    - Vertical profiles → Model constraints
  - Repository for non-ACTRIS datasets?
  - Postdocs and graduate students to carry out research for CleanCloud.

THANK YOU !

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Please follow us on Twitter/X: @CleanCloud_HE