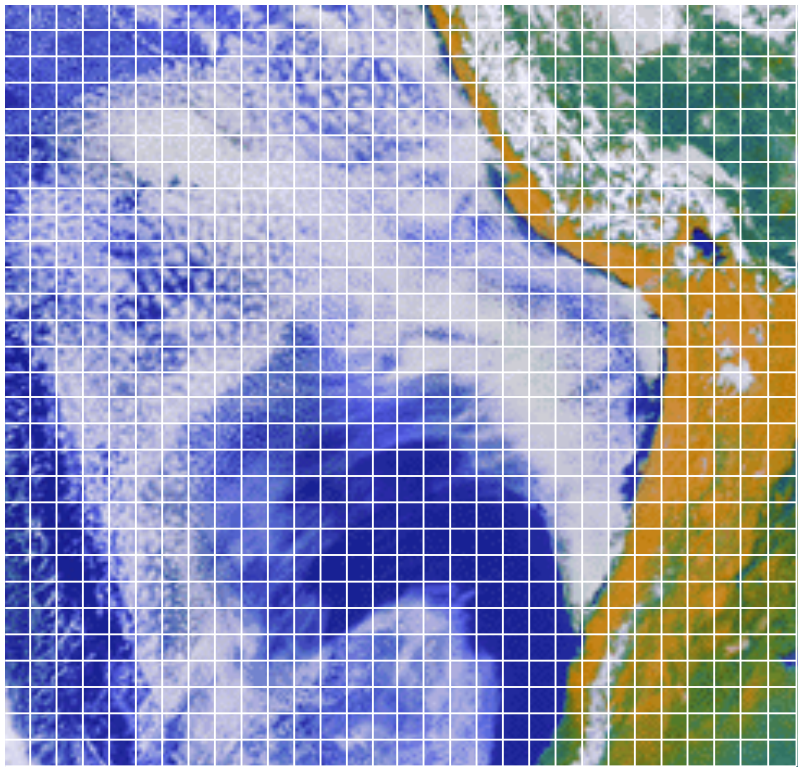
Boundary layer clouds and climate change

Jan Kazil

NOAA GOES 8



100 km

- **Climate change:** Future cloud abundance and brightness?
- **Feedback to climate:** Amount of sunlight reflected by clouds?

Uncertain - Challenge for climate models

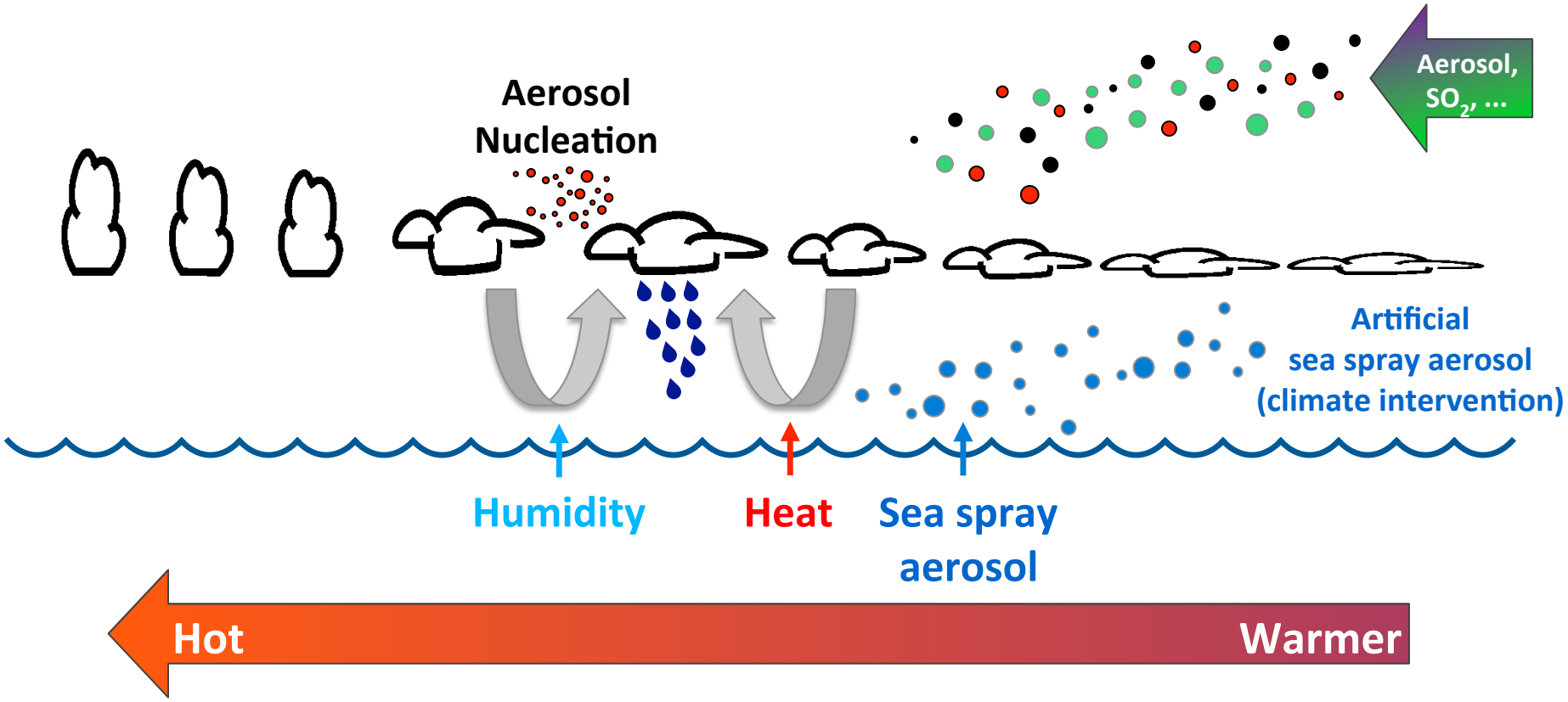
- **CSD: High resolution, fully coupled chemistry-aerosol-cloud model**

➡ **Understand processes and mechanisms not resolved by climate models**

➡ **Insight and parameterizations for climate research community and modeling**

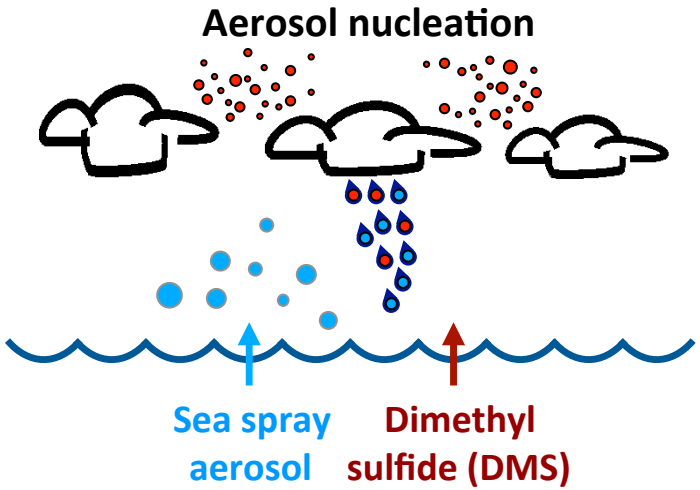
Challenge for climate models:
Processes on small scales

More broken clouds: additional warming



Sea surface temperature

Maintenance of clouds: chemistry and aerosol

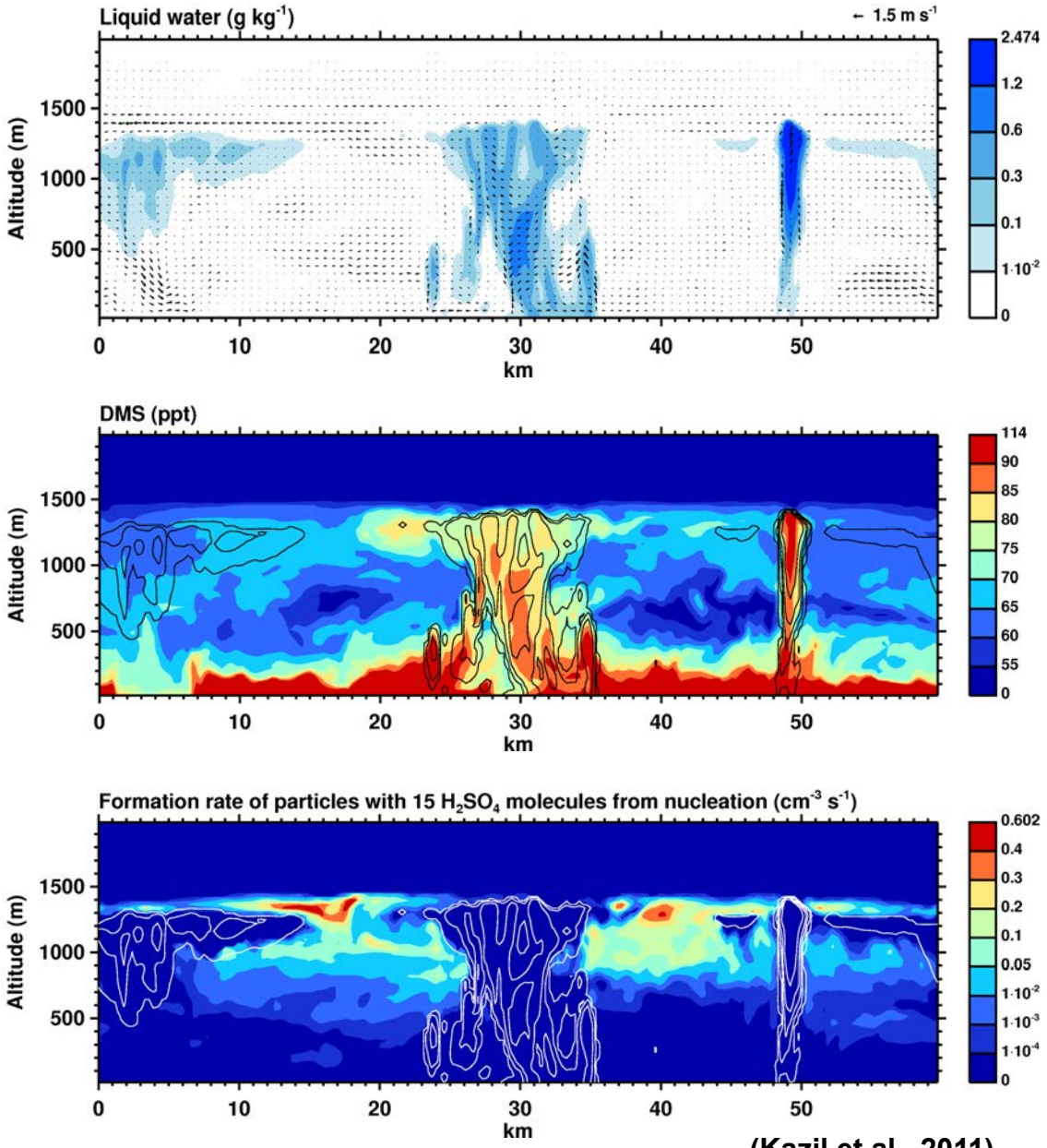


CSD research:

- Aerosol sources needed to prevent cloud collapse (Wang, Feingold, Wood, Kazil, 2010)
  - ➔ Sea spray emissions
  - ➔ Aerosol nucleation

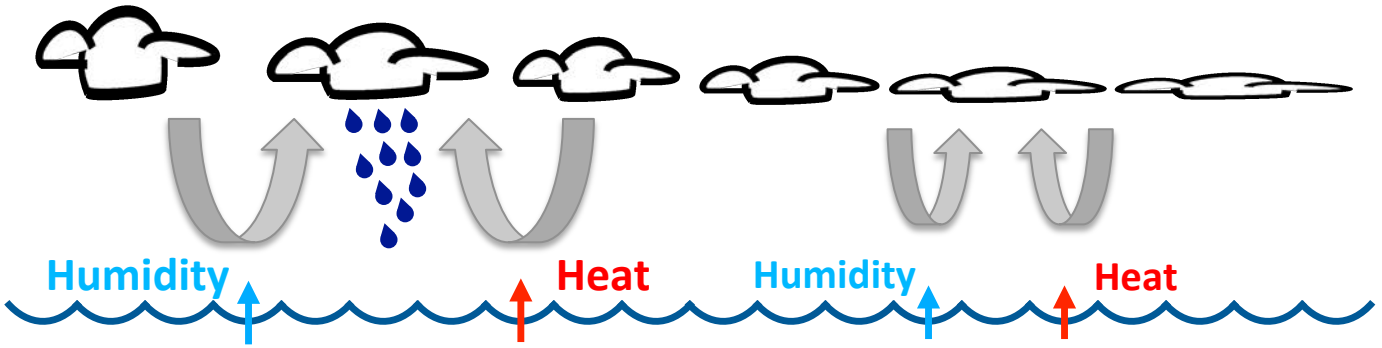
CSD development:

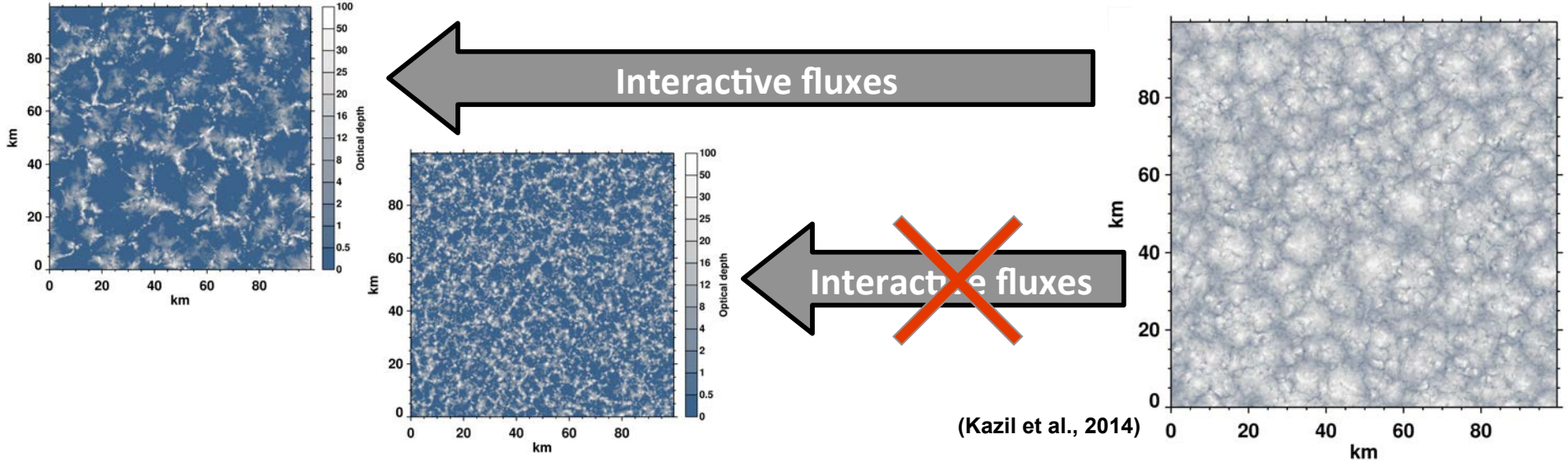
- Parameterization of aerosol nucleation (Kazil et al., 2010)
  - From CSD laboratory experiments (Froyd and Lovejoy, JPC, 2003a,b)
  - Now used in climate models
- Reproduces:
  - DMS obervations
  - Aerosol observations
- Explains:
  - Mechanism leading to observed aerosol nucleation (Kazil et al., 2011)



(Kazil et al., 2011)

Maintenance of clouds: dynamics





➡ Climate modeling: • Cloud dynamics drives surface fluxes
• Resulting surface fluxes maintain clouds

Summary

- Unique, high resolution, fully coupled chemistry aerosol-cloud model
- Uses CSD laboratory data
  - Parameterization now used in climate modeling
- High resolution simulations have produced:
  - Understanding of processes controlling clouds
  - Information for climate research and modeling

Future work:

- Investigate cloud-climate feedbacks on scales not resolved by climate models
- Prepared to do research on climate interventions