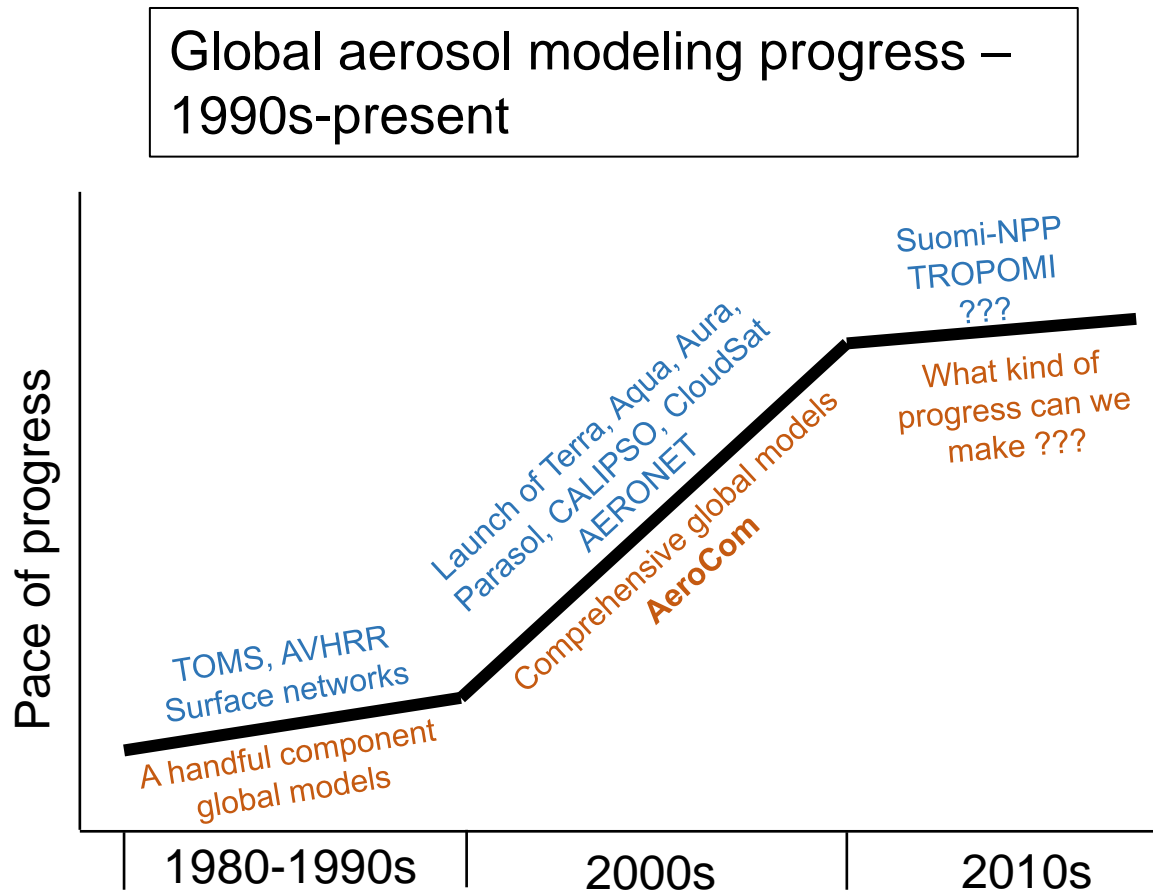


# **New challenges for AeroSat – global modeling perspective**

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# Global aerosol model advancement is closely tied to satellite observational capabilities



- The launch of the Terra and A-train satellites in the 2000s with dedicated aerosol instruments have made the breakthrough aerosol observing capabilities
- There is no doubt that these observations had pushed extraordinary advancement of global aerosol model development and helped continuous model improvements
- Now the model progress seems to be incremental and have plateaued, because there is no breakthrough advancement of satellite observability, leaving some key model elements to remain unconstrained

# Basic modeling components that cannot be directly verified with satellite data

- Satellite retrieves optical properties whereas model simulates mass – need to have RH,  $r_e$ ,  $\rho$ , refractive indices, particle size, mixing state, and particle shape to communicate between satellite data and model results
- Satellite measures total optical properties, whereas model simulates aerosol chemical composition – satellite data is unable to constrain the model simulated aerosol composition, at least not quantitatively
- Satellite observes the atmospheric state of aerosols, whereas model calculates the state as a result of multiple atmospheric processes – most of them (emission, chemical transformation, dry deposition, wet removal) are not observable by satellite, leaving them unconstrained
- Satellite aerosol retrievals have to avoid clouds, whereas model calculations do not – how do we know if the model is doing ok where the skies are cloudy?

# Example of two modeling/analysis topics that need aerosol-related quantities constrained by observations

- Aerosol-cloud-radiation-precipitation connections
  - Aerosol vertical profiles (extinction profile only is not sufficient; need absorption profile, species profile, size profile, concentration profile)
  - Vertical velocity
  - CCN/IN
- AOD-PM2.5 relationship:
  - Vertical profiles of aerosol (including mixing layer height)
  - Aerosol composition and size distribution
  - Water amount in AOD

**Models have responsibility for future projection – need to have credibility that is measured by the ability to reproduce the past and present in multiple scales**

- Most of the above listed processes/variables are not available by remote sensing – how should we move forward?



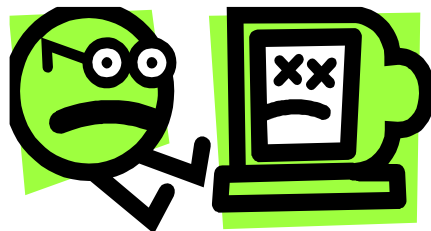
- 👍 Continuous spatial/temporal coverage
- 👎 Limited retrievable quantities



- 👍 Stable record with known accuracy
- 👎 Limited spatial coverage



- 👍 Capability of measuring chemical, physical, optical properties
- 👎 Limited spatial/temporal coverage



- 👍 Integrating current knowledge and projecting future
- 👎 No one believes it