# Discussion about aerosol type in Helsinki at Aerocom 2017

# Discussion about aerosol type in Helsinki at Aerocom 2017

Ralph: We can give modelers the aerosol types that we infer
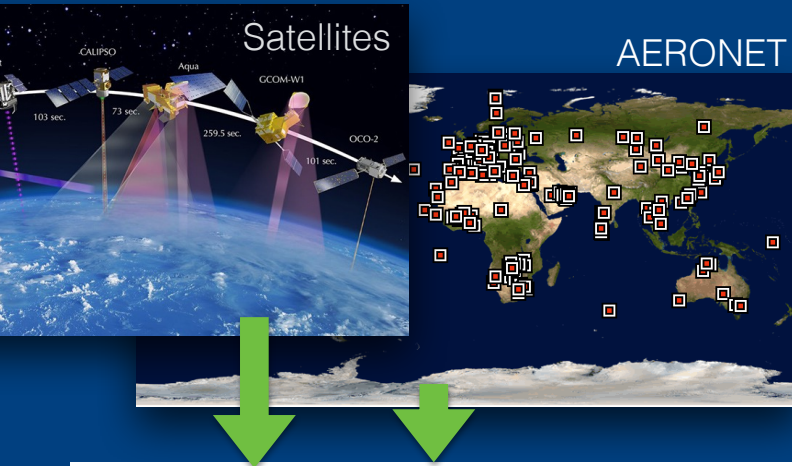        from satellite retrievals.

Mian: We don't need that, but we can give you our aerosol
       species for your retrievals.

Ralph: We don't need that, but we can give you aerosol type.

Mian: We don't need that, but we can give you our aerosol
       species.

Ralph: Maybe we need to think about this a bit more.

**Remote sensing begins with radiance measurements**

Satellites

AERONET

**Modeling begins with emissions inventories**

EDGAR-HTAPV1 SO₂ total emissions in ton per 0.1°x0.1°

**Measurements (radiances)**
**Forward model:**
- Somehow iterate size and refr index

**Compute radiances:**
- Save microphysics that provide "best fit" to measured radiances.

**Output Aerosol Optical Properties**
- Aerosol Optical Depth
- Angstrom Exponent or Fine Fraction
- Absorption AOD (and/or SSA)
- Absorption Angstrom Exponent

**Insert**

**?**

**Compare**

**Emissions (mass)**
- e.g., sulfate, dust, black carbon (BC), organic matter (OM), sea salt

**Transport**
- Winds, wet and dry deposition, etc.

**Assign particle microphysics**
- Assume species-dependent size distributions
- RH => Species-dependent aerosol hydration
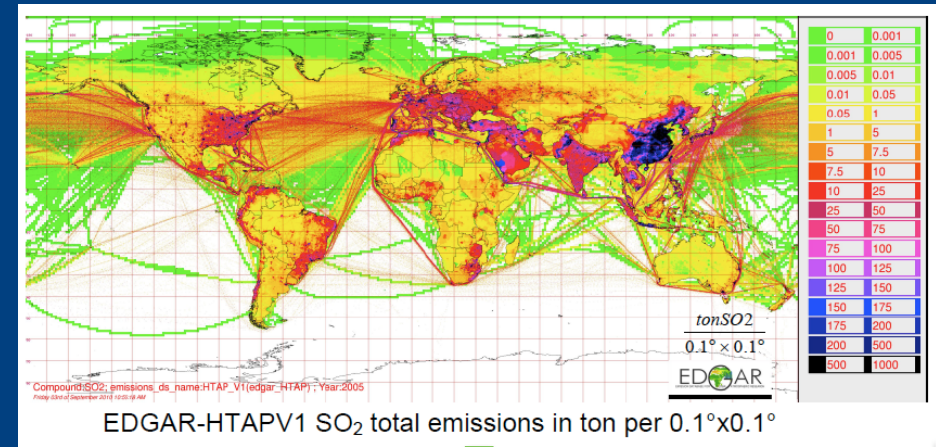
**Compute Aerosol Optical Properties**
- Aerosol Optical Depth
- Angstrom Exponent or Fine Fraction
- Absorption AOD (and/or SSA)
- Absorption Angstrom Exponent

**Aerosol Type**
- **Background / Clean Continental (low extinction)**
- **Marine (High AE with little absorption)**
- **Urban / Pollution (High AE, absorption)**
- **Biomass burn (high AE, AAE, absorption)**
- **Dust (low AE or low FMF; high linear depol)**
- **Non-quantitative Combinations (polluted dust, etc.)**

Optics are linked to emissions

Linked to radiances

**Aerosol Type**
- **Background / Clean Continental (low extinction)**
  - Sparse numbers of tiny particles
- **Marine (High AE with little absorption)**
  - Hygroscopic salt
  - Insolubles?
  - **Water**
- **Urban / Pollution (High AE, absorption)**
  - Hygroscopic salts (sulfate, nitrate, etc.)
  - Black Carbon
  - Water-soluble   OC (non-absorbing)
  - Water-insoluble OC (non-absorbing)
  - **Water**
- **Biomass burn (high  AE, AAE, absorption)**
  - Black Carbon
  - Water-soluble   OC (non-absorbing and absorbing)
  - Water-insoluble OC (non-absorbing and absorbing)
  - **Water**
- **Dust (low AE or low FMF; high linear depol)**
  - Clays and Silts
  - Iron oxide (hematite and goethite)
  - **Water?**
- **Non-quantitative Combinations (polluted dust, etc.)**
  - **Water**

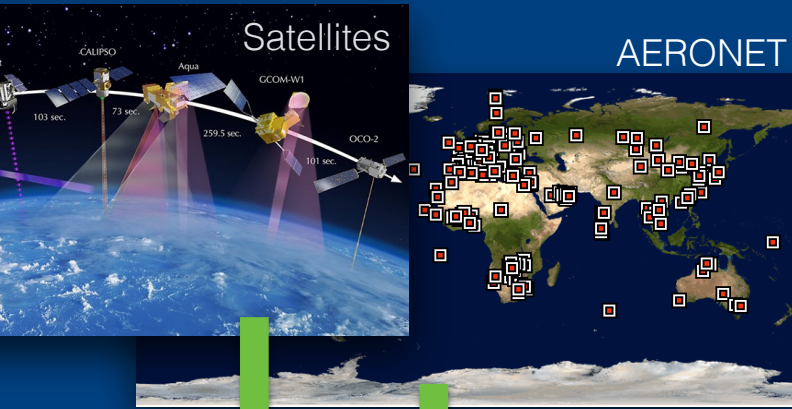| Component | Fine Mode | Coarse Mode |
|-----------|-----------|-------------|
| solubles | salts and WSOC | sea salt |
| insolubles | clays and WIOC | clays and silts |
| Absorbers | BC, BrC, Free iron | Free iron |
| **water** | yes | ? |

AERONET
- Bond 2013
- Schuster, ACP 2016

Parasol
- L. Li, U. Lille PhD, 2018,
- Chen, ACP, 2018

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**Modeling begins with emissions inventories**

EDGAR-HTAPV1 SO$_2$ total emissions in ton per 0.1°x0.1°

tonSO2
0.1° × 0.1°

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**Insert?**

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**Output Aerosol Optical Properties**
- Aerosol Optical Depth
- Angstrom Exponent or Fine Fraction
- Absorption AOD (and/or SSA)
- Absorption Angstrom Exponent

**Compare**

**Compare proportions**

**Compare component optics**
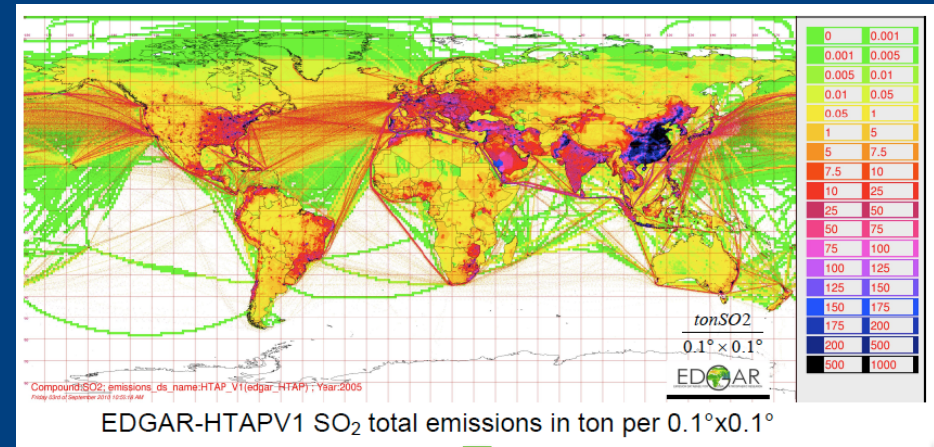
**Aerosol Type**

| Component | Fine Mode | Coa... |
|-----------|-----------|--------|
| solubles | salts and WSOC | s... |
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| Absorbers | BC, BrC, Free iron | Free iron |
| water | yes | ? |

Optics a...

Linked to radian...

$$\sum_i AAOD_i \neq AAOD$$

● + ○ ≠ ◉

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|---|---|---|
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| **water** | yes | ? |

Discussion
- How to link aerosol type definitions in models and retrievals?
- How to best use satellite constraints?
- What to use as "ground truth" (or, how to assess uncertainty and then validate?)
- How can in situ help?
  - parameterizations… gHGF or f(RH)?
- Should we use model emissions to aid retrievals?

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