

**East-AIRE 2005**

The objectives of the East Asian Study of Tropospheric Aerosols: An International Regional Experiment (East-AIRE) are (Li et al., 2007):

1. To acquire and understand the physical, chemical and optical properties of dominant natural and anthropogenic aerosols and their precursor gases in China and
2. To gain insights into the direct and indirect effects of these aerosols on radiation, cloud, precipitation, atmospheric circulation and the environment.

**Aerosol Radiative Forcing**

Shortwave aerosol radiative forcing (SARF) can be determined by SBDART simulations:

\[
\Delta F_{\text{SARF,TOA}} = \Delta F_{\text{SARF,atmos}} - \Delta F_{\text{SARF,non-aerosol}}
\]

\[
\Delta F_{\text{SARF,atmos}} = (\Delta F_{\text{AOT,TOA}} - \Delta F_{\text{AOT,atmos}}) - (\Delta F_{\text{AOT,non-aerosol}} - \Delta F_{\text{AOT,non-aerosal}})
\]

Input data for SBDART (Ricchiazzi, 1998):

- Aerosol model
  - All AOTs and Angstrom exponents from Hazemeter (36,731 cases).
  - Monthly mean SSAs from Lee et al. (2007).
  - Spectral aerosol optical properties by Mie theory calculation.
  - Extinction by different RH condition has been considered. Surface RH data for each station are from NCEP/NCAR reanalysis.
- Atmosphere model
  - Atmospheric profile from NCEP/NCAR reanalysis
  - Aerosol vertical profile (MPL L1,5 extinction).
  - RH (NCEP/NCAR), Atmospheric profile (NCEP/NCAR), Ozone (OMI), Surface reflectance (MOD09).
- Surface model
  - MODIS spectral surface reflectance products (MOD09)
  - MODIS 7 year (2000~2006) mean AOT
  - Annual AOT change rate (\(\Delta AOT/yr\))
- Potential Temperature (K)
  - 280 290 300 310 320 330
- Heating Rate (K/day)
  - 0 1 2 3 4 5 6
- Dust (April 29, 2005)
  - 1~5 km layer, heating rate = 3.1 K/day at 1.6 km
- Dust storm (April 29, 2005)
  - 1.11
- Haze (May 3, 2005)
  - Under 2 km, heating rate = 1.9 K/day at 1.1 km
- Summary
  - The national mean annual SARF values are
    - 21.1 ± 11.6 (surface),
    - 2.7 ± 2.4 (TOA), and
    - 18.4 ± 10.8 (atmosphere), respectively.
  - So does 87.2% of surface SARF according to the aerosol absorption in the atmosphere.

Obviously, large cooling (surface) and heating (atmosphere) effects are shown by absorbing aerosols.

**Atmospheric Heating Rate**

Heat rates by absorbing aerosol using Micro pulse LIDAR measurement data:

- AOT, Angstrom, SSA from AERONET.
- Aerosol vertical profile (MPL L1,5 extinction).
- RH (NCEP/NCAR), Atmospheric profile (NCEP/NCAR), Ozone (OMI), Surface reflectance (MOD09).
- Temporary variations of the normalized relative backscatter signal profiles from MPL level 1.0 data at Xianghe, China.

**Summary**

- The solar aerosol radiative forcing (SARF) and heating rate by absorbing aerosols over China is estimated during measurements made under the EAST-AIRE campaign in 2005.
- The unprecedented AOD and SSA datasets allow to determine aerosol radiative effects across China for the first time.
- Aerosols in the region exert a very large cooling effect at surface and warming in the atmosphere, but little effect at the top of the atmosphere.
- The vertical profiles of diurnal atmospheric heating rate due to aerosol absorption were also calculated using Micro Pulse Lidar (MPL) data.

Further reading
