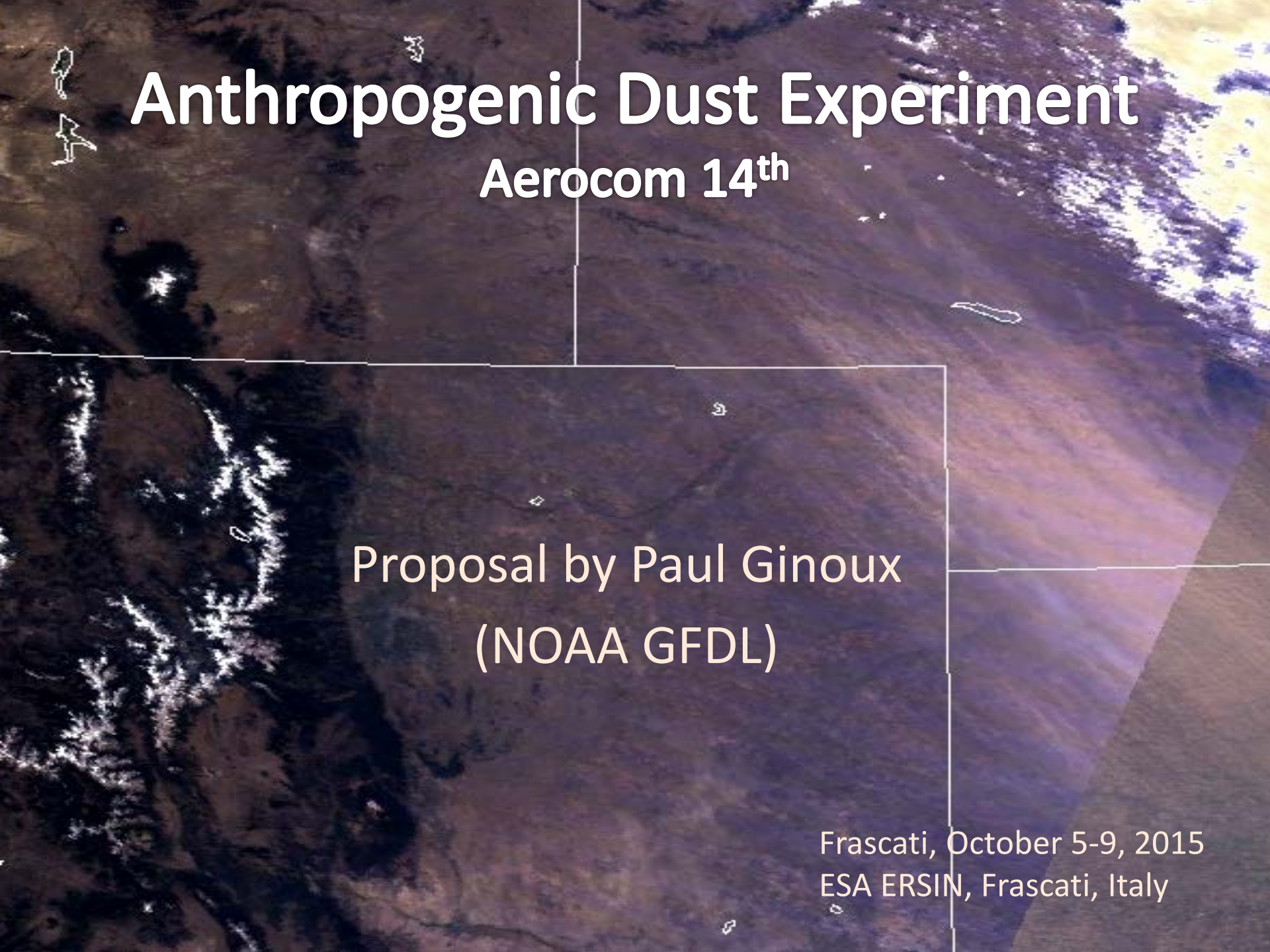


Anthropogenic Dust Experiment

Aerocom 14th

Proposal by Paul Ginoux

(NOAA GFDL)

Frascati, October 5-9, 2015

ESA ERSIN, Frascati, Italy

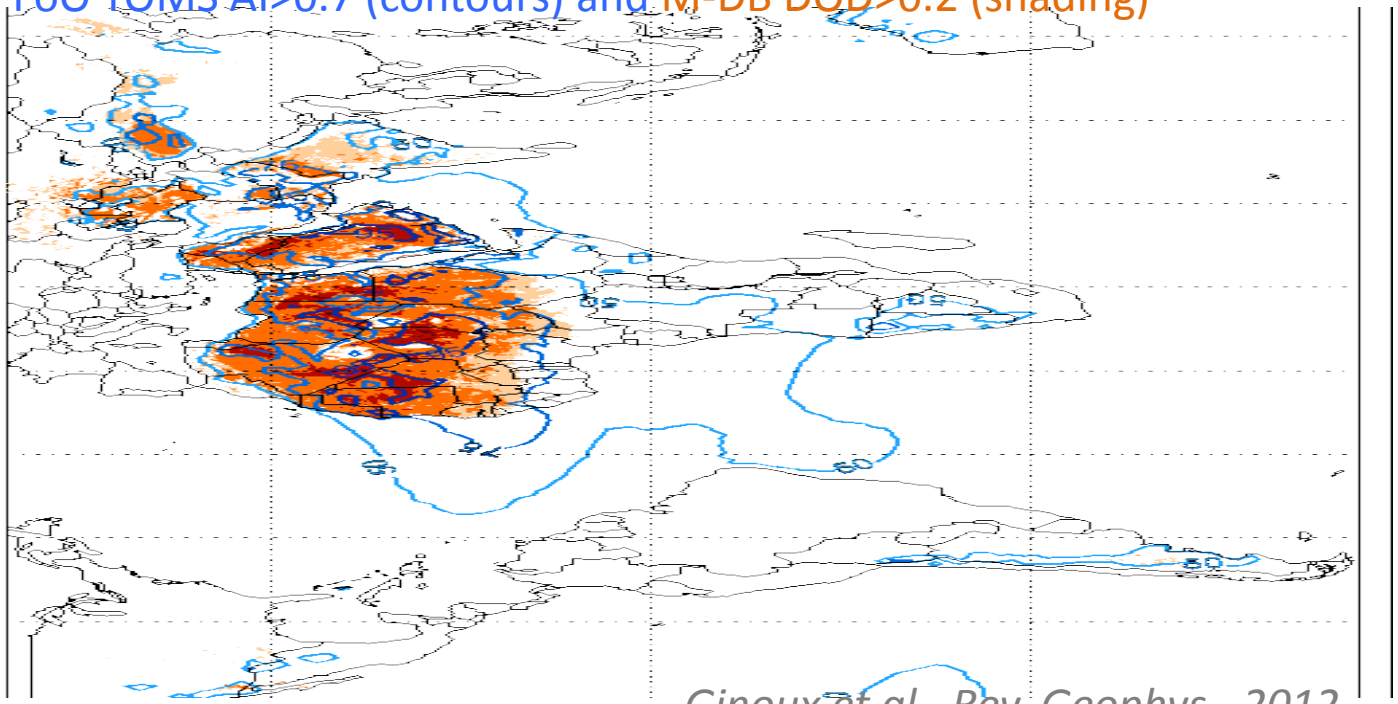
Motivation

- Dust from landuse (cropland and pasture) represents 25% of global emission (*Ginoux et al., Rev.. Geophys., 2012; Stanelle et al., J. Geophys. Res., 2014*) with large continental variability, but is generally ignored in aerosol models,
- Mineralogy of natural and landuse dust differs, which has implication for radiative forcing, ocean biogeochemistry, heterogeneous reactions with gas phase chemistry,
- Landuse dust and NH_3 hotspots are often collocated (*Ginoux et al., Atm. Chem. Phys., 2012*) which has implication for nitrate production (*Paulot et al., Atm. Chem. Phys. Disc., 2015*).

MODIS based dust sources

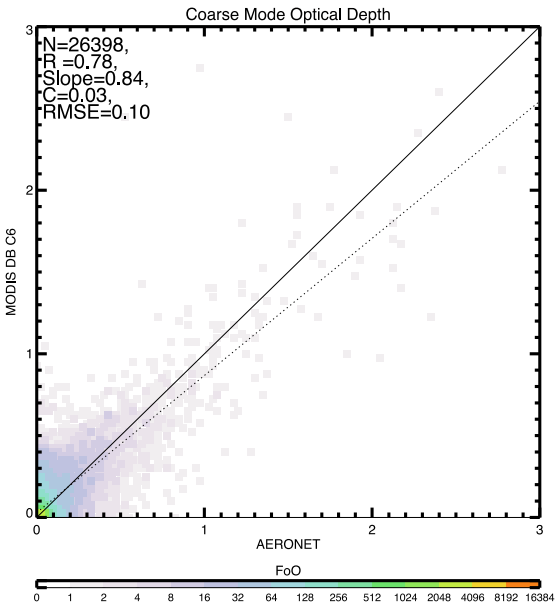
- Dust Optical Depth (DOD) derived from daily MODIS-DB level-2 C6 aerosol products (AOD(λ), QA, and SSA) from 2003-2014,
- Frequency of Occurrence (FoO) of DOD>0.2 per year over 12 years = dust sources
- Anthropogenic sources = FoO>0 and landuse>30% (landuse dataset for 2005 from *Klein Goldwijk, Global Biogeochem. Cycles, 2001*)

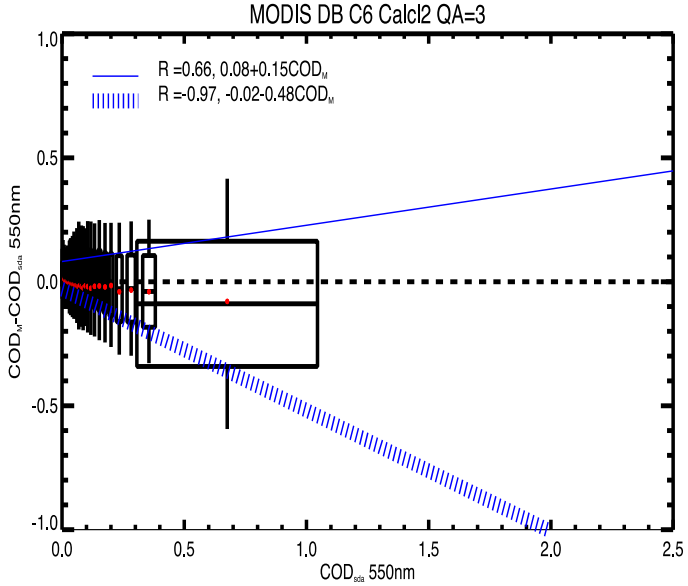
Comparison FoO TOMS AI>0.7 (contours) and M-DB DOD>0.2 (shading)



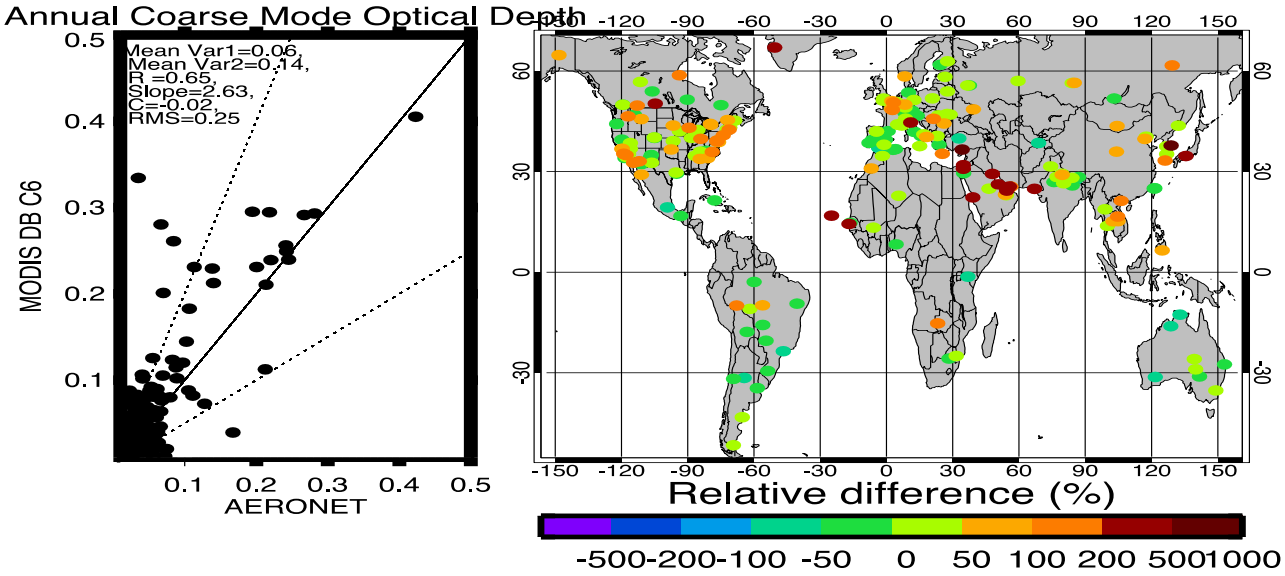
Ginoux et al., Rev. Geophys., 2012

Error Analysis





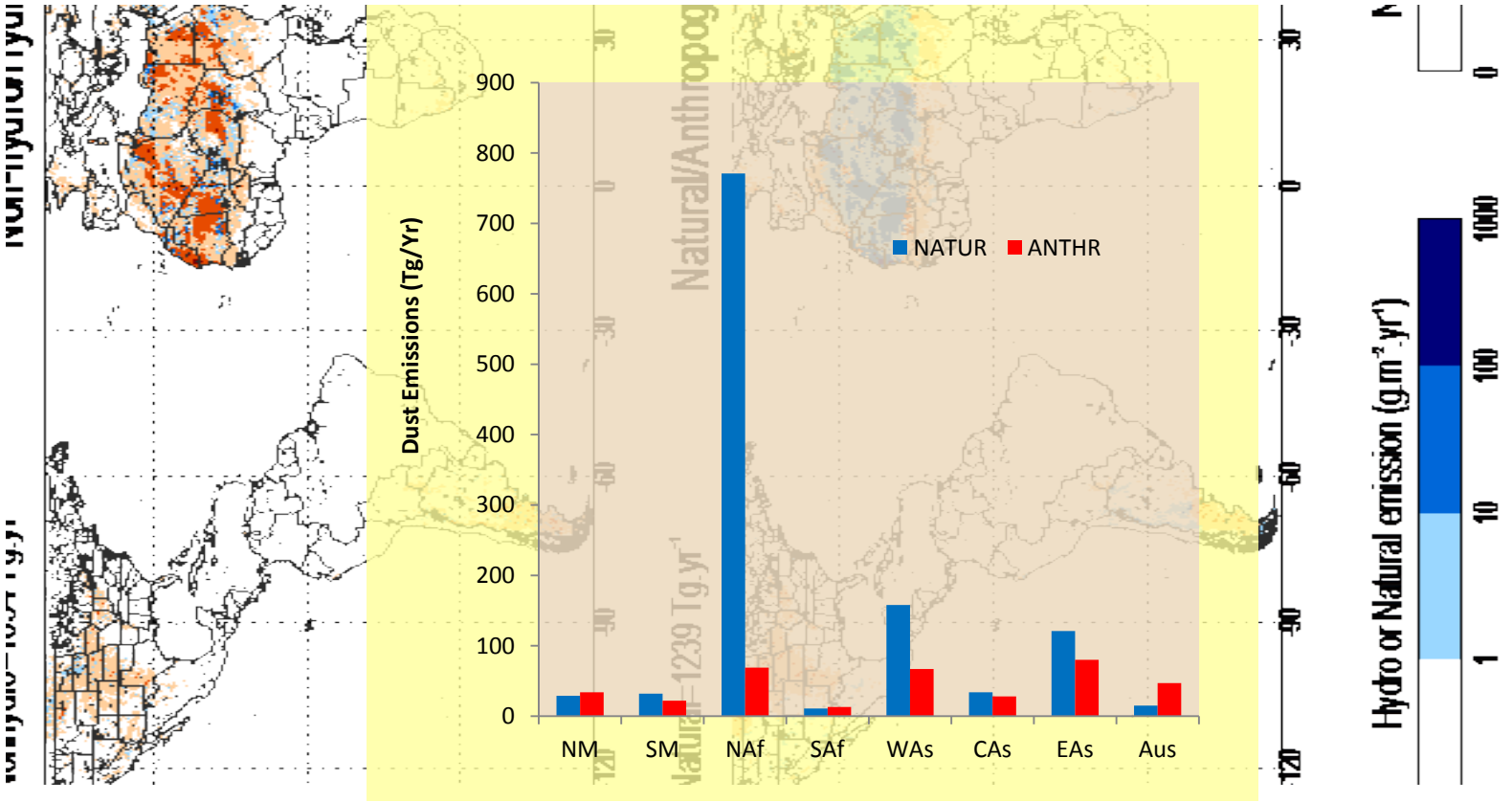
Comparison M-DB2 C6 Dust Optical Depth (DOD) with collocated (+/–10 km, +/- 30 min) AERONET SDA L2 *(O'Neill et al., J. Geophys. Res., 2003)* Coarse Mode optical depth (COD)



Anthropogenic and natural dust emissions

- $Emission = C * FoO * u^2 * (u - u_t)$

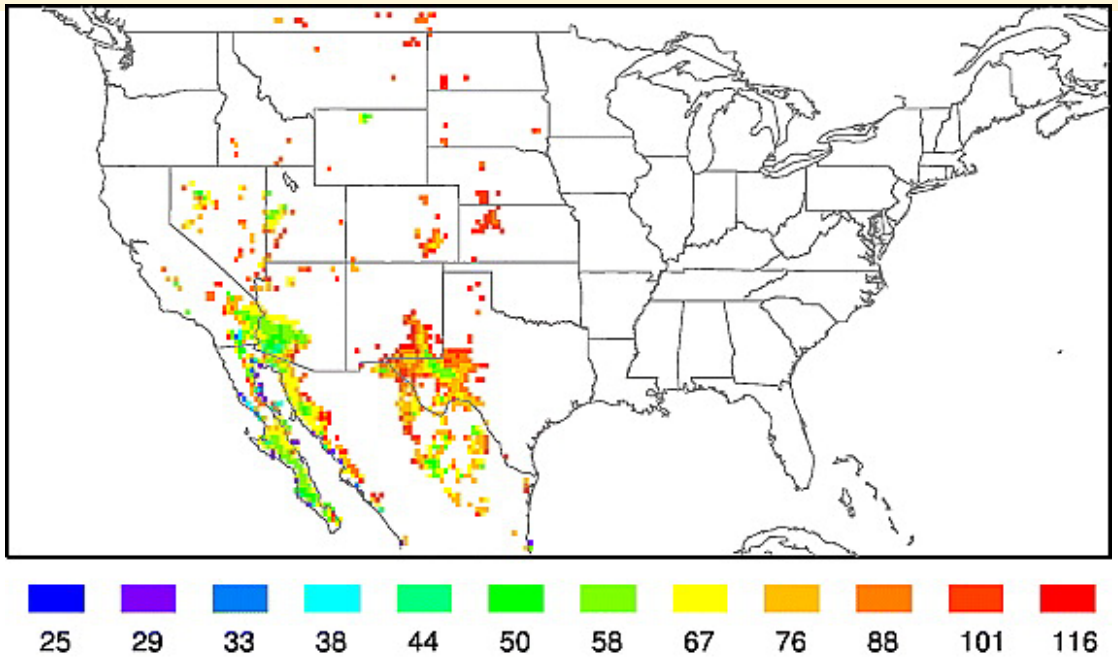
  with threshold velocity u_t= 6 m/s (landuse<30%) and 10 m/s (landuse>30%)



Ginoux et al., Rev. Geophys., 2012

Main uncertainty: U_t

- Ut depends on soil moisture (weather but also irrigation), vegetation cover, harvesting litters
- Knowing daily M-DB2 DOD, Ut can be defined as the velocity that has the same frequency of as the 0.75 AOD *(Draxler et al., J. Geophys. Res., 2010)*. Problem: the work is limited to the US.
- To estimate anthropogenic contribution to global dust emission, Ginoux et al. (Rev Geophys., 2012) is using fixed values Ut= 6 m/s for natural dust, and 10 m/s for anthropogenic dust based on *Draxler et al. (J. Geophys. Res., 2010)*



Annual average threshold friction velocity (cm s−1) from *Draxler et al., J. Geophys. Res., 2010)*

Proposed Experiment

- Simulation of dust using M-DB2 anthropogenic dust sources (FoO DOD>0.2 with landuse >30% from KG2000) for 2010-2012 (+spin-up) with different values of threshold wind speed ($0.5*U_t$, U_t, $2*U_t$)
- Best estimated of U_t by regions determined from minimization (as proposed by Cakmur et al., J. Geophys.Res., 2005) of simulated dust concentration and dust optical depth with:
  - surface concentration (comparison with surface stations from Prospero, LISA, IMPROVE)
  - Vertical profile (comparison with CALIOP)
  - Optical Depth (comparison with M-DB2 DOD, AERONET SDA)

Scientific Results

- Best estimated anthropogenic dust emission
- Best estimated anthropogenic dust distribution -> ice/warm clouds
- Best estimated anthropogenic dust deposition -> fertilization of land and ocean biosphere
- Best estimated radiative forcing of anthropogenic dust -> IPCC

Model input

- Source fraction (0-1) at 0.1x0.1 or 0.25x0.25

Model output

- Static:
  - Vertical coordinate system
  - Altitude above sea level
  - Land/sea mask
- 2-D daily:
  - Surface pressure
  - for each dust size bins
    - Emission
    - Deposition (wet and dry)
    - Dust burden
- 3-D daily:
  - Temperature
  - Specific humidity
  - For each dust size bins: Dust concentration

Timeline

- Send an email to paul.ginoux@noaa.gov to receive the input file
- January-May, 2016 simulations
- June 2016: send the output files
- July-August 2016: Analysis
- September 2016: First results
- June 2017: submitted paper