

A multi-sensor approach for estimating aerosol radiative forcing from Terra and Aqua

Overall Objectives

Use combined MODIS and CERES data to study Top of Atmosphere Aerosol Radiative Effect and Forcing

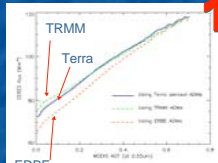
Data

Level 2 MODIS AOT
CERES Radiance and Flux

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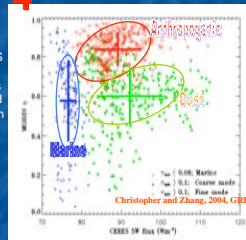
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ALL AEROSOLS Direct Radiative Effect (DRE)

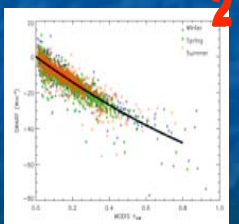


New Angular Models for CERES
(Zhang, Christopher, Kaufman, Remer, JGR, 2005a)

Estimating anthropogenic forcing using MODIS fine mode fraction and CERES measurements is now possible because ADM as function of τ available and anthropogenic fraction can be separated using MODIS measurements (Kaufman et al., 2005, GRL)

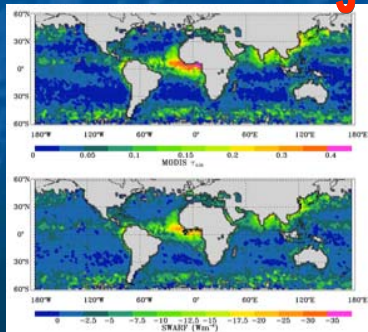


With New Angular Models estimate DRE of all aerosols over Oceans
(Zhang, Christopher, Kaufman, Remer, JGR, 2005b)



Radiative Efficiency

The spatial and seasonal distributions of $\tau_{0.55}$ and the independently derived SWARF show a high degree of correlation.



Comparison with selected studies (Yu et al., 2006)

Study	Clear sky over oceans Wm^{-2}
Haywood et al, 1999	-6.7
Boucher et al., 2000	-5.5
Loeb and Kato, 2002	-4.6
Bellouin et al., 2003	-5.2
Chou et al., 2002	-5.4
Yu et al., 2004	-4.6
This study	-5.3 ± 1.7

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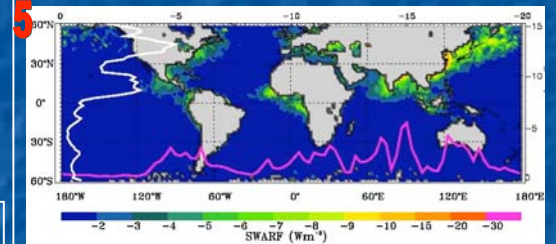
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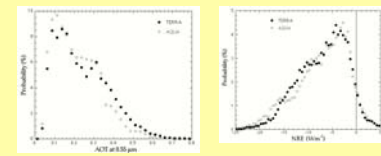
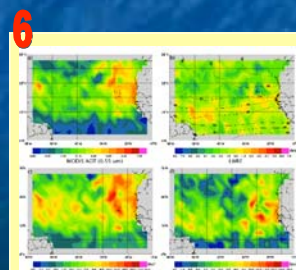
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Anthropogenic - Direct Climate Forcing (DCF)



Anthropogenic Aerosol Forcing using Fine Mode Fraction
(Christopher, Zhang, Kaufman, Remer, 2004)

Reference	Instrument	Data Analyzed	Brief Description	Clear sky DCF (Wm^{-2})
Yu et al (2004)	MODIS/GOCART	Nov 2000-Oct 2001	Integration of MODIS/GOCART AOT and RT calculations	-1.3(Ocean)
Bellouin et al (2005)	MODIS/TOMS	2002	MODIS FMF with TOMS AI and Radiative Transfer Calculations	-0.8 (Ocean)
Kaufman et al (2005)	MODIS	2001-2002	MODIS fine mode fraction and forcing efficiencies	-1.4 ± 0.4 (Ocean)
Christopher et al (2006)	MODIS/CERES	Nov 2000-August 2001	MODIS FMF, Angular Models from Zhang et al (2005a) and CERES TOA fluxes	-1.4 ± 0.9 (Ocean)
Yu et al (2004)	MODIS/GOCART	Nov 2000-Aug 2001		-1.4 (Land + Ocean)
Bellouin et al (2005)	MODIS/TOMS	2002	FMF from 5 AEROCOM Global Models and RT calculations	-1.9 ± 0.3 (Land + Ocean)
Chang et al (2005)	GOCART/MODIS/TOMSAERONET/ESCP	2001-2003	MODIS AOT with GOCART anthropogenic fraction and RT calculations	-1.08 (Land + Ocean)



Terra - Aqua AOT and Net radiative (NRE) differences are less than 10%
Jones and Christopher, GRL submitted 2006

20% of shortwave cancelled by longwave (Christopher and Jones, GRL, 2006, submitted)

DUST AEROSOLS