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Aerosols from Geostationary Imagers

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Introduction

Geostationary imagers are excellent tools for studying diurnal variation of fires, clouds and aerosols.

Current geostationary sensors can provide complementary information to polar orbiting satellites on diurnal variation of aerosol properties.

These products could be valuable for climate and air quality studies.

GOES-R will provide enhanced capabilities for aerosol studies both for climate and air quality purposes.

GOES Aerosols

Our previous studies (see list of publications) used GOES data for

1. Biomass burning fire/aerosol analysis in South America and Central America
2. Dust aerosol analysis during Puerto Rico Dust Experiment (PRIDE) and assimilation into Regional Models.
3. Diurnal variation of dust aerosols.
4. Geostationary fire assimilation into regional models for forecasting particulate matter air quality.
5. Geostationary satellite analysis of biomass burning aerosol transport and process studies.
6. Other studies have focused on geostationary satellite retrievals of cloud properties.
7. ACE-Asia aerosol analysis from GMS-5.

Data

GOES-8, GOES-9, GMS5

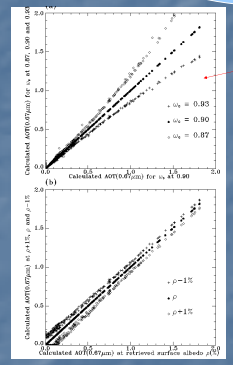
GOES Aerosols

Primarily used to

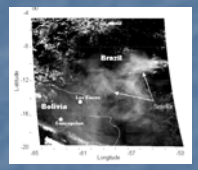
a) Detect biomass burning aerosols using multi-spectral and spatial techniques.
b) Leverage field experiment data such as PRIDE and SCAR-B.
c) Mie and T-Matrix calculations for aerosol properties.
d) Discrete Ordinate Solver for look up tables.
e) AERONET data for intercomparisons.
f) AVHRR for AOT comparison.
g) CERES TOA flux data for comparing calculated radiative fluxes.

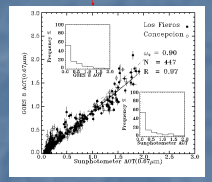
Selected Results AOT

Region specific aerosol models and proper characterization of Surface is necessary for retrieving AOT from geostationary sensors.

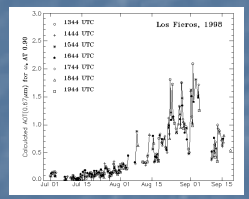


Sensitivity studies with DISORT



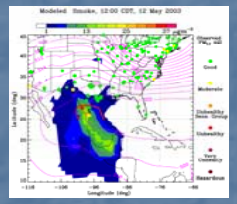


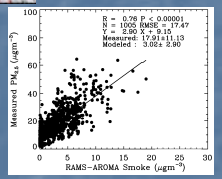
Excellent agreement with AERONET



Seasonal and diurnal variations well captured with GOES-8

Selected Results PM2.5





PM2.5 predicted values from RAMS-AROMA is
In excellent agreement with measured PM2.5 mass.
-Wang et al (JGR, Vol 111, 2006)

-Can be used to study radiative and non-radiative processes
- Wang and Christopher (JGR, 2006, in press)

RAMS-AROMA

Regional – Atmospheric Modeling System – Radiation Online Modeling of Aerosols

Key Features

Satellite derived fires and smoke emission

Excellent tool for forecasting particulate matter air quality for pollution originating from outside the Continental United States.

Built on RAMS but now has improved radiation and aerosol processes and satellite product assimilation capabilities.

Can simulate smoke and dust transport to the United States

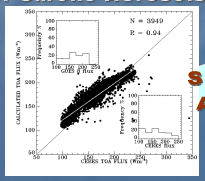
Three key JGR publications

Summary

Current Geostationary satellite sensors largely under utilized for aerosol research.

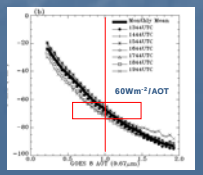
GOES-R with improved spectral, spatial and radiometric resolutions will offer superior capabilities for aerosol research.

Radiative Effects of Smoke Aerosols



Excellent agreement with CERES provided aerosol model is correct

Diurnal Forcing Efficiency



Selected Results Aerosol Forcing

GOES Publications

Wang, J., S.A. Christopher, U.Nair, J.S.Reid, E.M.Prins, J.Szykman, J. Hand, Mesoscale transport of Central American Transport to the United States, Part 1: Top Down Assessment of Emission Strength and Diurnal Variation Impacts, Journal of Geophysical Research, 111, D05S17, doi:10.1029/2005JD006416, 2006.
Wang, J., and S.A. Christopher, Mesoscale Modeling of Central American Smoke Transport to the United States, Part II, Smoke Radiative Impact on Surface Energy Budget and Boundary Layer Evolution, Journal of Geophysical Research - Atmospheres, 2005 – in press, 2006.
Wang, J., U. Nair, and S.A. Christopher (2004), GOES-8 Aerosol Optical Thickness Assimilation in a Mesoscale Model: Online Integration of Aerosol Radiative Effects, Journal of Geophysical Research -Atmospheres, Vol. 109, No. D23, D23203 04, 2004.
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Christopher, S. A., and J. Zhang, Daytime variation of shortwave direct radiative forcing of biomass burning aerosols from GOES 8 imager. Journal of the Atmospheric Sciences, 59(2), 681-691, 2002.
Zhang, J., S. A. Christopher, and B. Holben, Intercomparison of aerosol optical thickness derived from GOES-8 Imager and Ground-Based Sun Photometers, Journal of Geophysical Research, 106, 7387-7398, 2001.

Acknowledgements

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