Overview of CALIPSO, CloudSat, CERES, and MODIS merged product

Seiji Kato[1], Sunny Sun-Mack[2],
Walt Miller[2], Fred Rose[2], Yan Chen[2],
and Elizabeth Heckert[2]
[1]NASA Langley Research Center
[2]Science Systems and Applications, Inc.

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CALIPSO-CloudSat-CERES-MODIS Merged Product

- Funded by the NASA Energy Water Cycle Study (NEWS) project.
- Not a climate data product

Expected contribution of the product

To provide a global data set along the lidar/radar ground track with the most accurate and comprehensive aerosol properties, cloud properties, and vertical radiative flux profiles to researchers.

Area of studies that are greatly improved by our data set includes:

1. Assimilation and prediction by global aerosol models through better understanding of aerosol layer location.
2. Better understanding of multi-layered and polar cloud systems and their radiative impacts.
3. Better understanding of frequency of occurrence of thin cirrus and boundary layer clouds and their radiative impacts.

Data

- CALIPSO – CloudSat derived cloud profile (along their ground track).
- MODIS derived cloud properties (along the ground track and full CERES footprint) by the CERES cloud algorithm.
- Cloud properties derived from the MODIS standard and enhanced algorithm
- CERES derived TOA irradiance and computed Irradiance profile
- More than 400 variables

Input data

MODIS (retrievals are done by the CERES cloud algorithm)

MAC021S1.AYYYYJDY.HHMM.*.hdf, MAC_GEO

MAC03S1.AYYYYJDY.HHMM.*.hdf

MAC_AEROSOL: MAC04S1.AYYYYJDY.HHMM.*.hdf

CALIPSO

CALIPSO_VFM:CAL_LID_L2_VFM-Prov-V2-01.YYYY-MM-DDTHH-*hdf

CALIPSO_05kmALay:CAL_LID_L2_05kmALay-Prov-V2-01.YYYY-MM-DDTHH-*hdf

CALIPSO_05kmCLay:CAL_LID_L2_05kmCLay-Prov-V2-01.YYYY-MM-DDTHH-*hdf

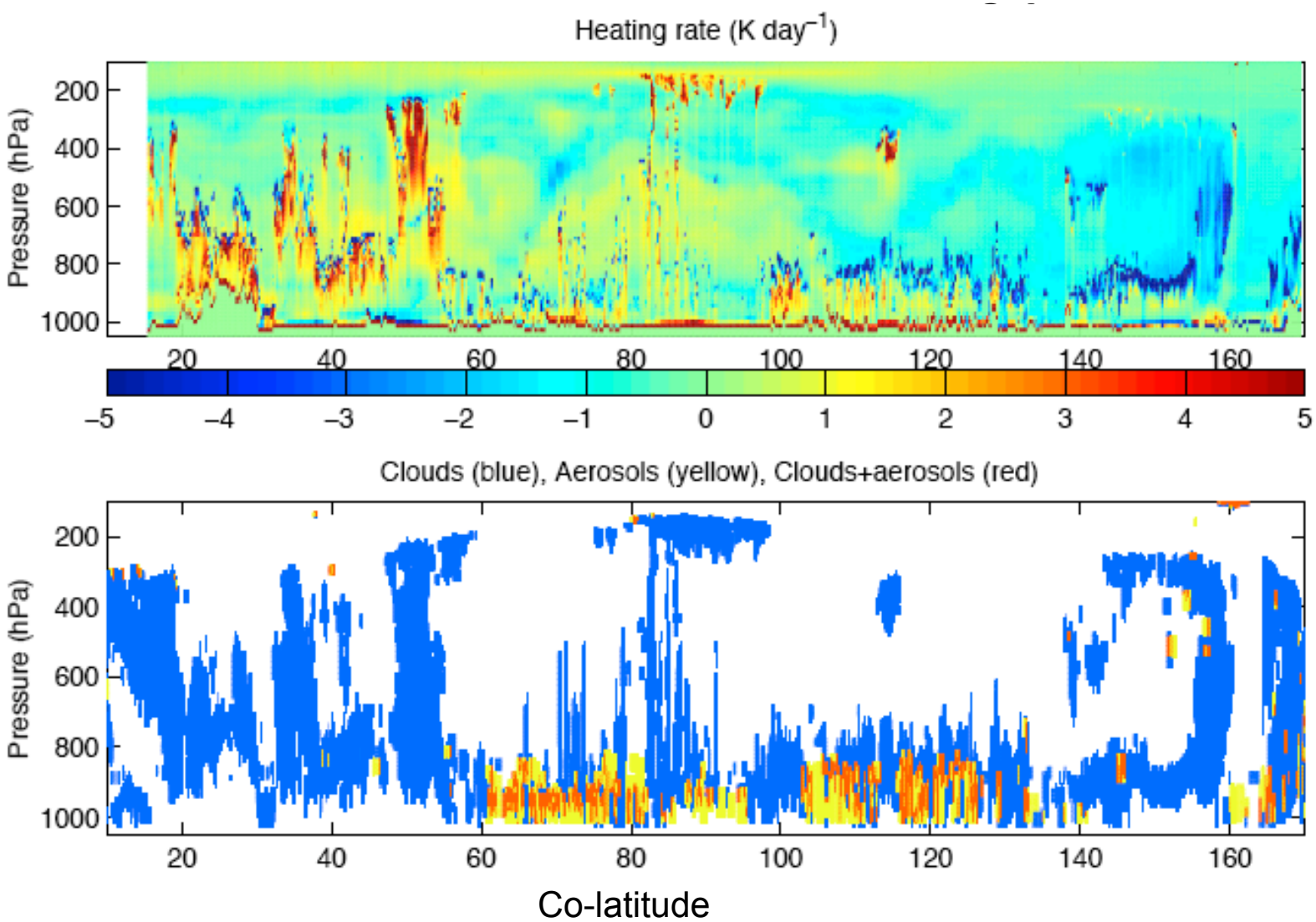
CALIPSO_05kmCPro:CAL_LID_L2_05kmCPro-Beta-V2-01.YYYY-MM-DDTHH-*hdf

CloudSat

CLOUDSAT_CLDCLASS:YYYYJDY*_CS_2B-CLDCLASS_GRANULE_P_R04_E00.hdf

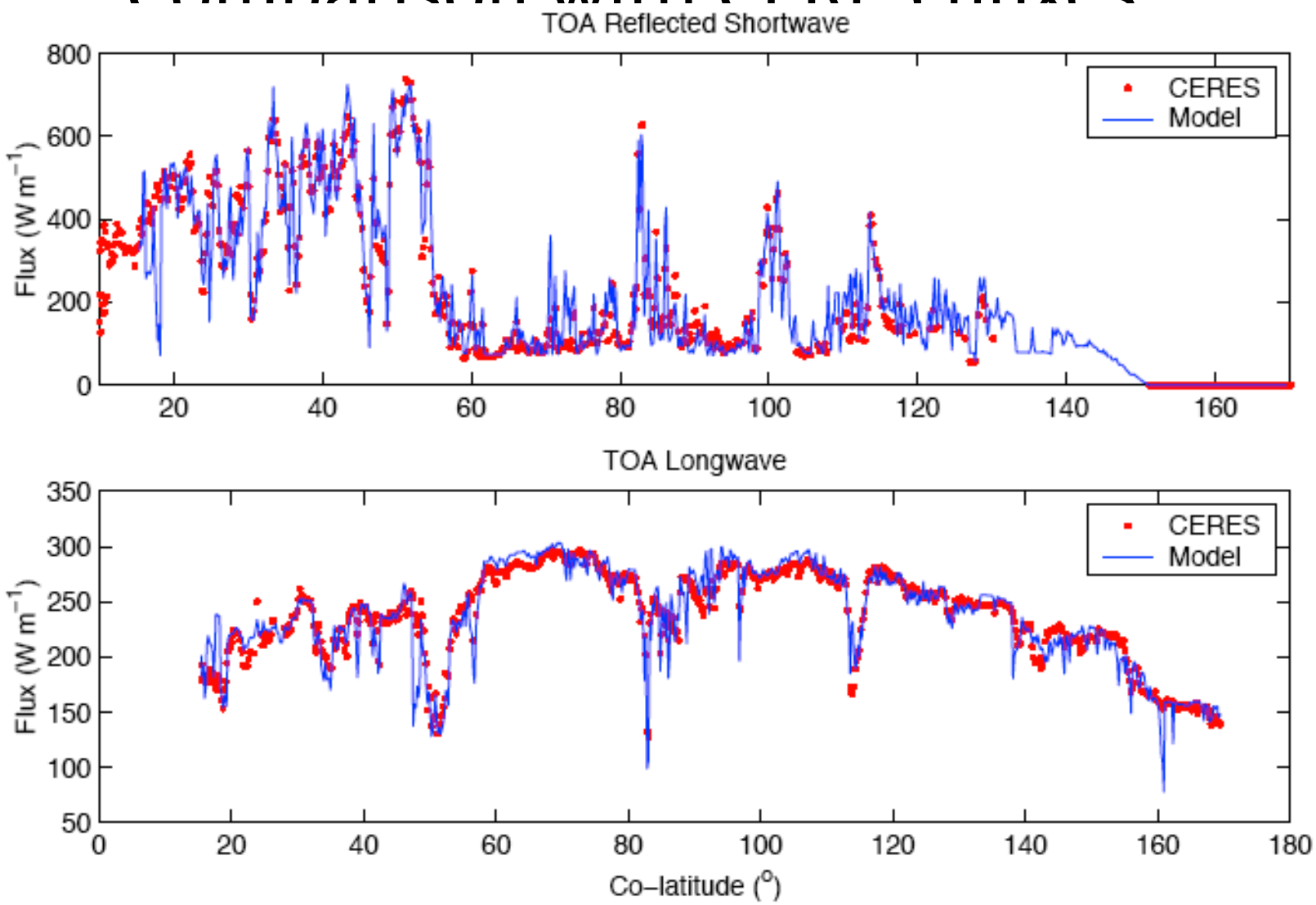
CLOUDSAT_2B-TAU:YYYYJDY*_CS_2B-TAU_GRANULE_P_R04_E02.hdf

CLOUDSAT_CWC-RO:YYYJDY*_CS_2B-CWC-RO_GRANULE_P_R04_E01.hdf



Radiative effect of Cirrus, cloud overlap, cloud-aerosol overlap

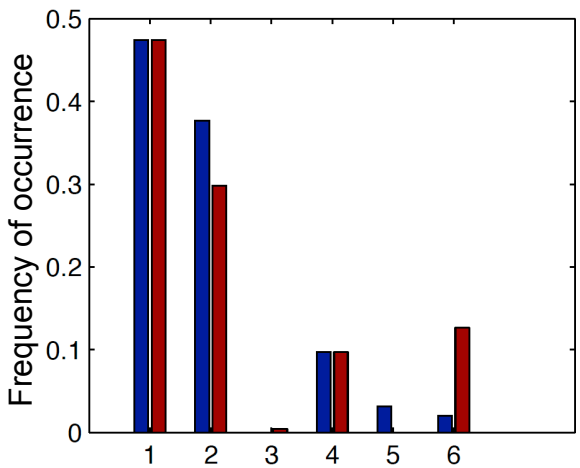
Comparison with CERES fluxes



Cloud mask merging

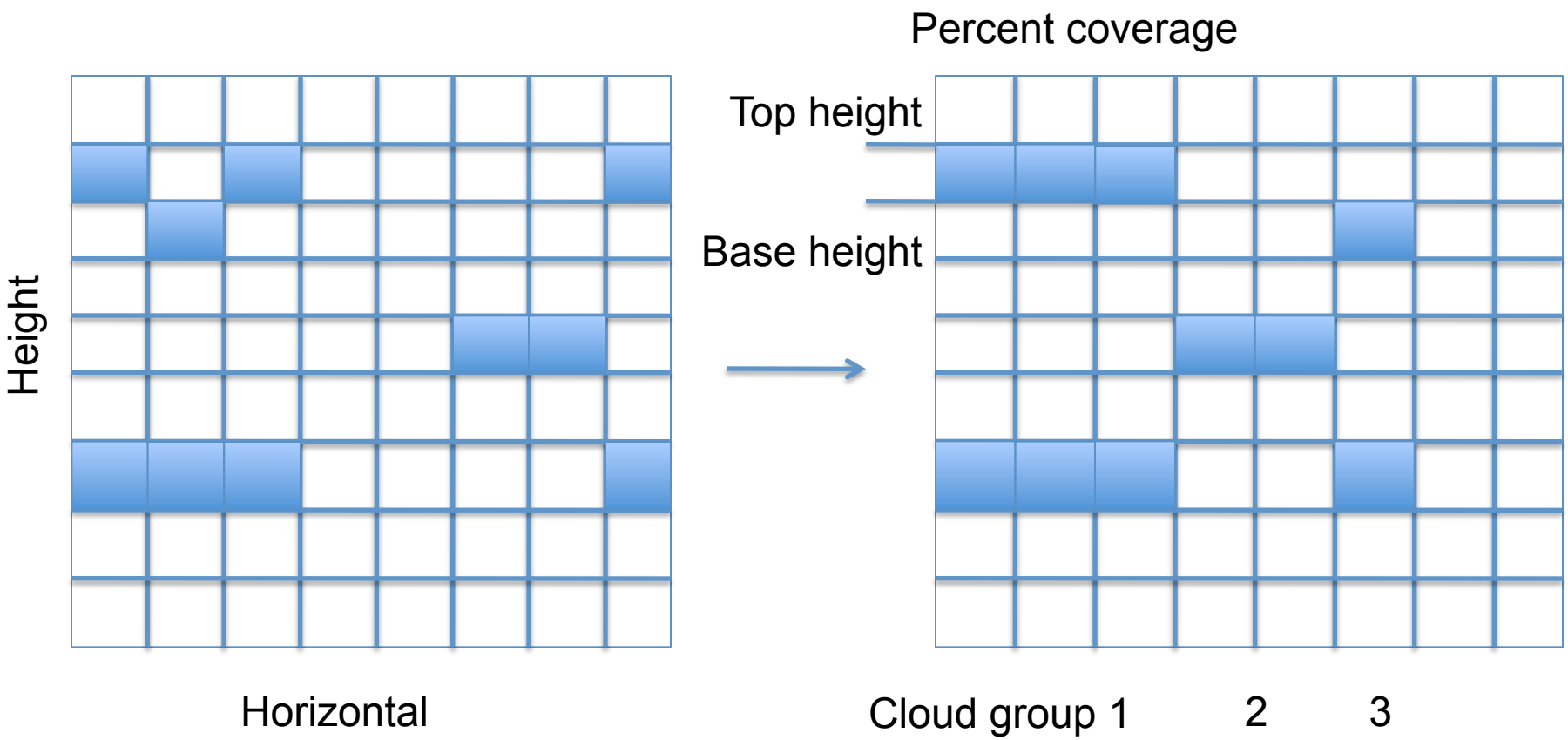
Cloud boundary	CALIPSO	CloudSat	Merged Cloud boundary
Top	Detected	Detected	Higher cloud top
Top	Detected	Undetected	CALIPSO cloud top
Top	Undetected	Detected	CloudSat cloud top
Base	Not completely attenuated	Undetected	CALIPSO cloud base
Base	Not completely attenuated	Detected	CALIPSO cloud base
Base	Totally attenuated	Detected	CloudSat cloud base
Base	Totally attenuated	Undetected	CALIPSO lowest unattenuated base

Cloud mask source flags are included



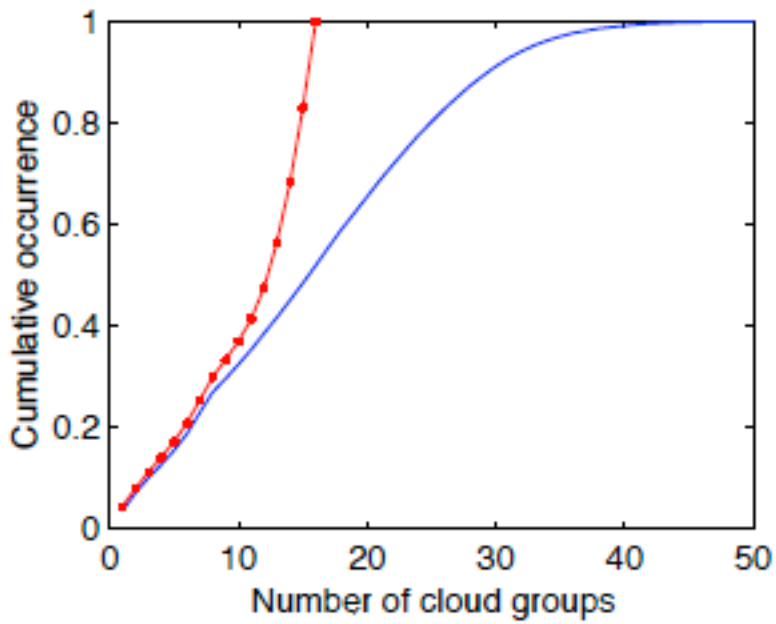
1: CALIPSO only
2: CALIPSO height but CloudSat also detected
3: CALIPSO lowest signal height
4: CloudSat only
5: CloudSat height, CALIPSO signal not attenuated
6: CloudSat height, CALIPSO signal attenuated

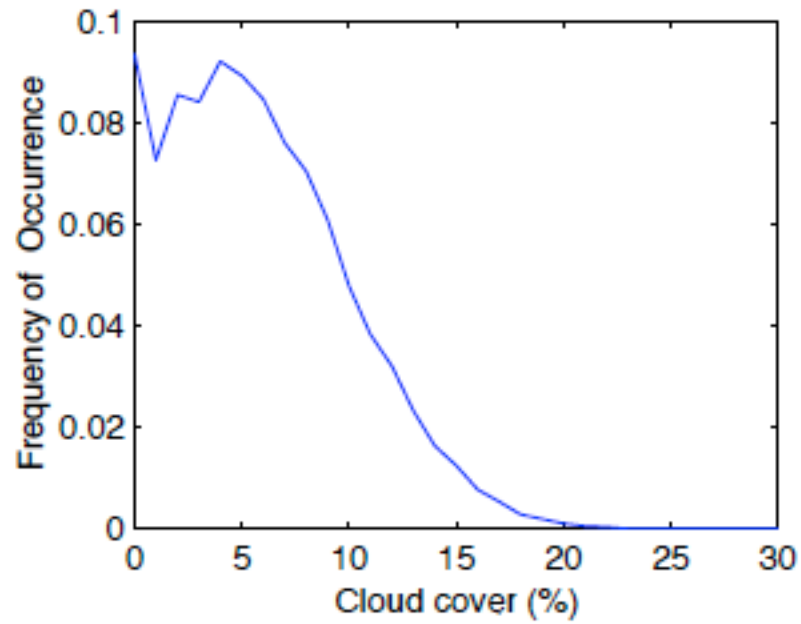
Cloud Grouping



Up to 16 groups in a CERES footprint
Up to 6 vertical layers in a profile

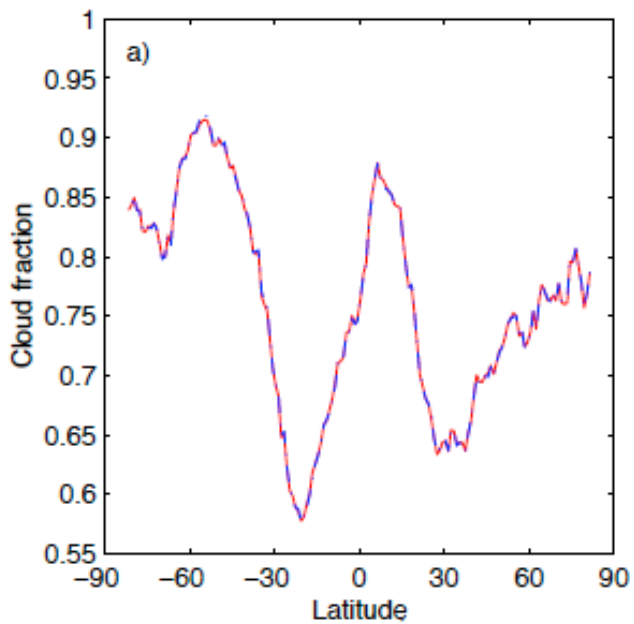
Convolution validation

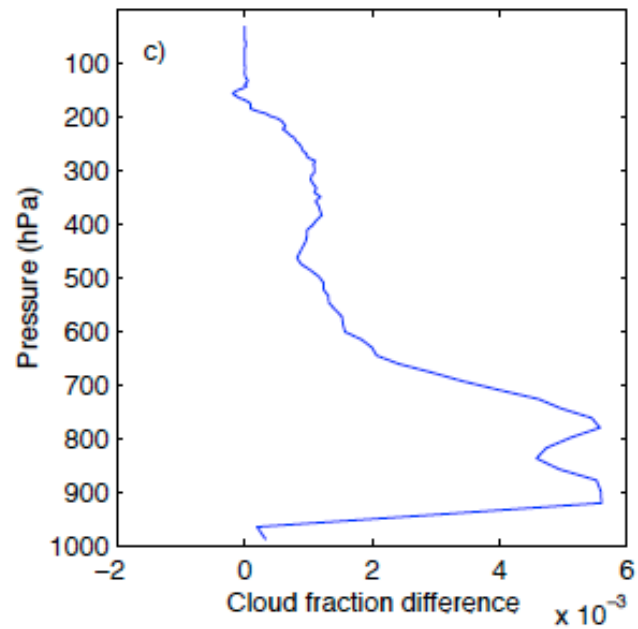




Cloud fraction of Cloud Group 10 to 16

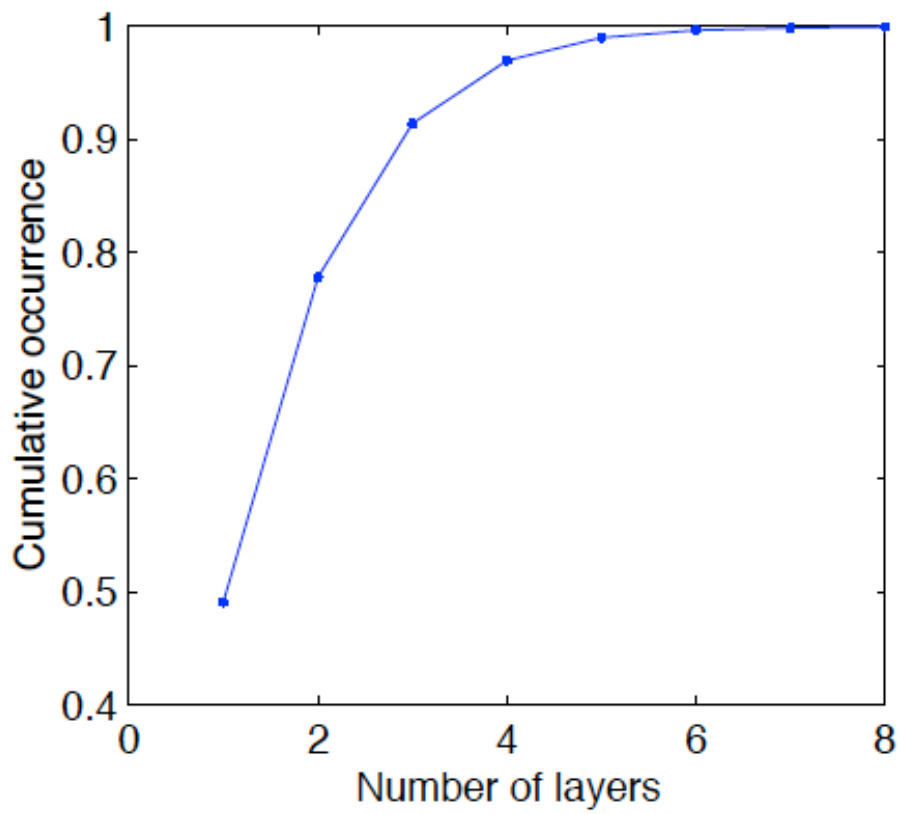
Cloud fraction difference





Red: before grouping
Blue: after grouping

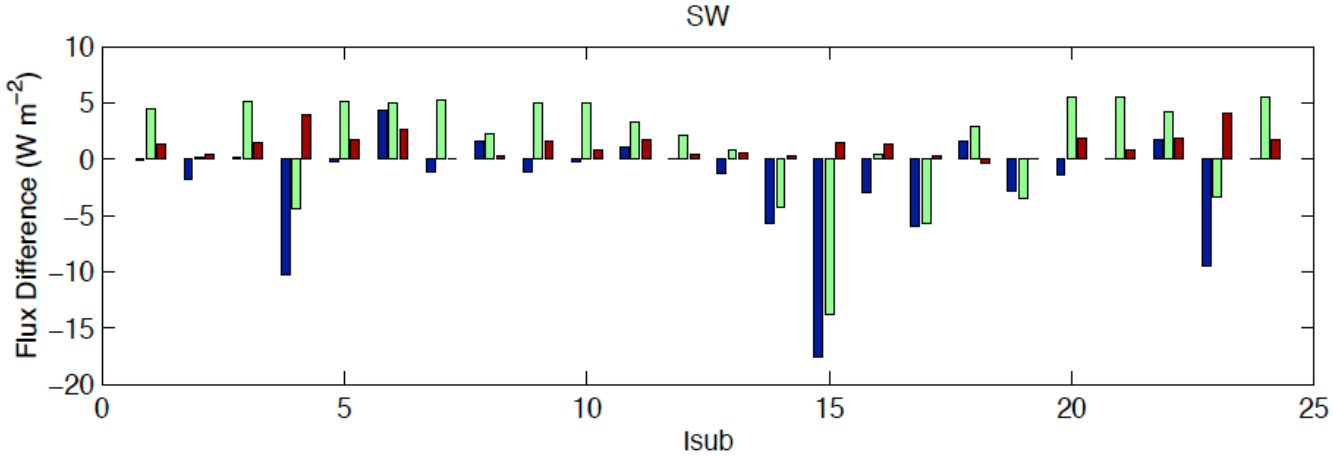
Number of overlapping layers



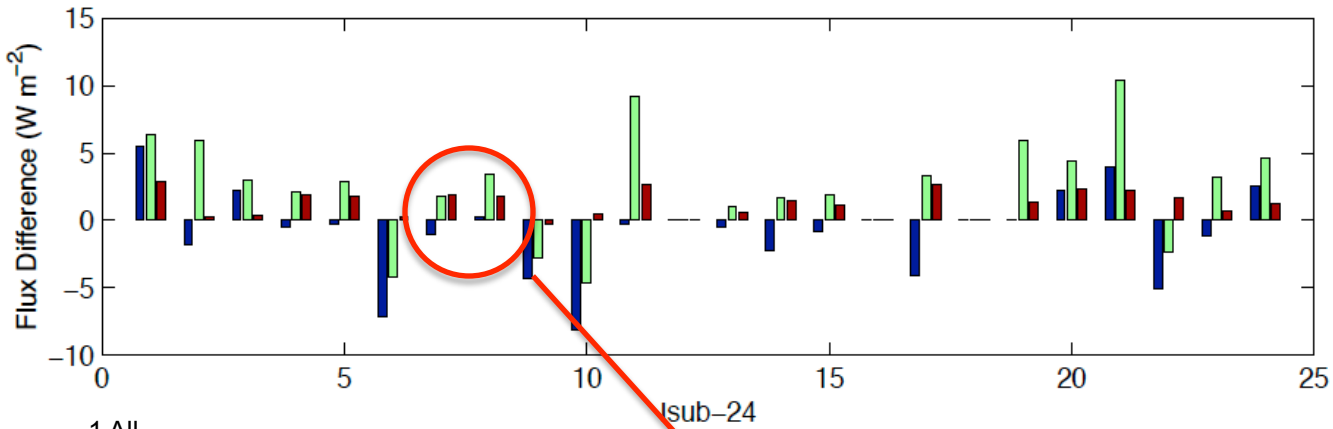
Aerosols related variables

- MODIS clear percent coverage over CALIPSO-CloudSat cloud-free area (CCCM-27).
- Aerosol layer top and base height (up to 16 layers cloud free area)(CCCM-23, 24).
- Aerosol layer top and base height overlapping with cloud (1 layer for a cloud group)(CCCM-18, 19).
- Mean CALIOP-derived 532 and 1064 nm aerosol optical depth (CCCM-43, 46).
- Relative humidity of aerosol layer (CCCM-47).
- Mean CALIOP-derived optical thickness over cloud-free area (CCCM-49).
- CloudSat precipitation flag (CCCM-17)

Flux QC, SW

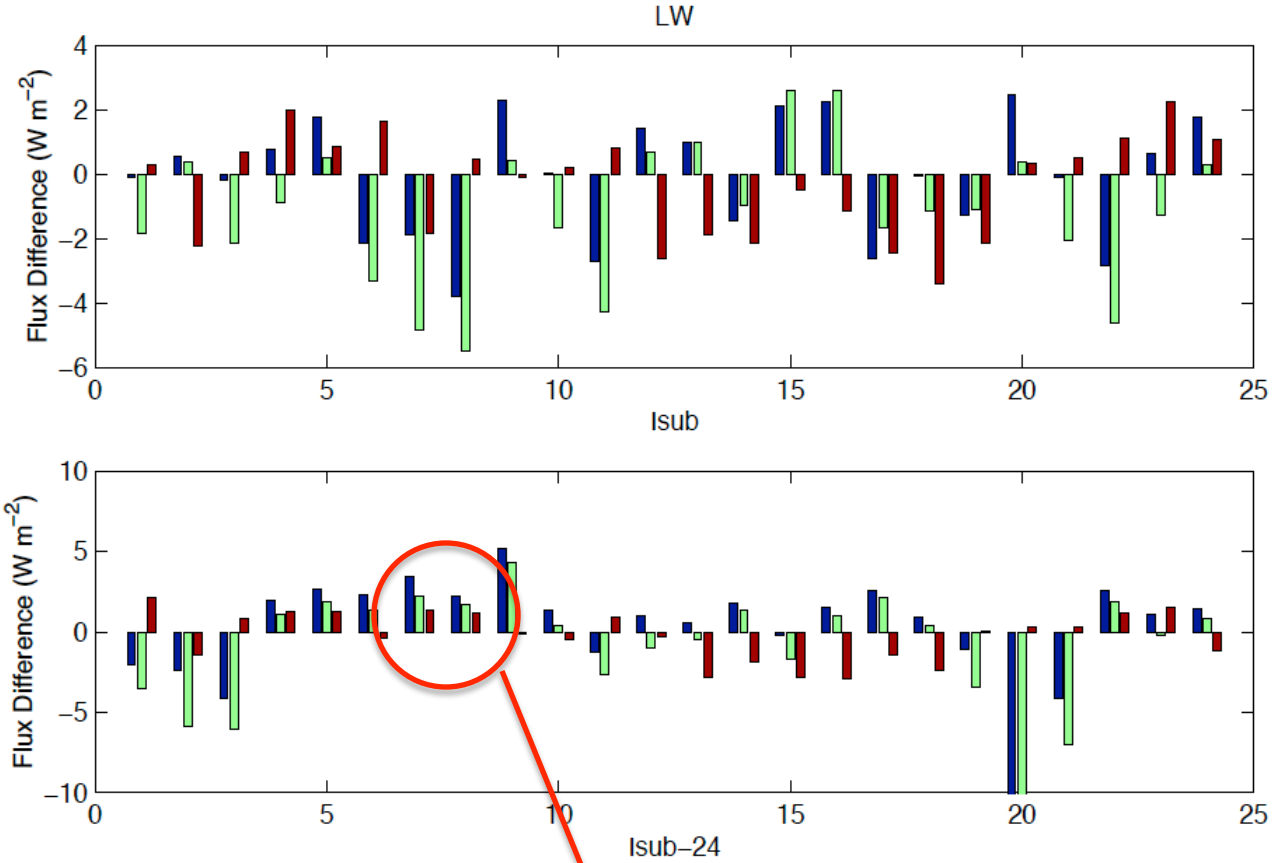


Blue: Enhanced
Green: Standard
Red: MODIS only (CRS like)



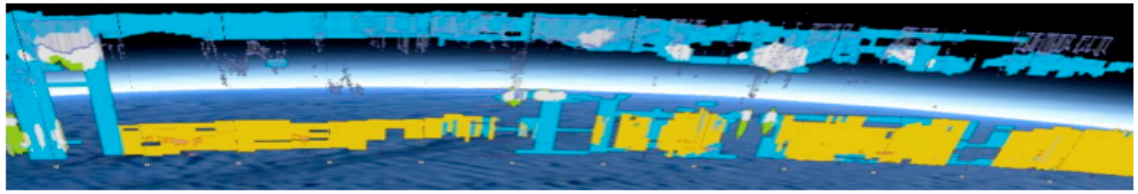
1 All
2 CLR
3 CLD
4 COAST_ALL
5 OCEAN_ALL
6 ICEOCE_ALL
7 LAND_ALL
8 SNOLND_ALL
9 TROP_ALL
10 MIDL_ALL
11 POLE_ALL
12 TROP_CLR
13 MIDL_CLR
14 POLE_CLR
15 COAST_CLR
16 OCEAN_CLR
17 ICEOCE_CLR
18 LAND_CLR
19 SNOLND_CLR
20 TROP_CLD
21 MIDL_CLD
22 POLE_CLD
23 COAST_CLD
24 OCEAN_CLD1
25 ICEOCE_CLD
26 LAND_CLD
27 SNOLND_CLD
28 OVC
29 OCEAN_OVC
30 LAND_OVC
31 HOMO_OCEAN_OVC
32 INHOMO_OCEAN_OVC
33 HOMO_LAND_OVC
34 INHOMO_LAND_OVC
35 DAY
36 NIGHT
37 CLRCOM
38 CLRCOM_OCE
39 DAY_CLRCOM
40 NIGHT_CLRCOM
41 DAY_OCEAN_CLRCOM
42 NIGHT_OCEAN_CLRCOM
43 NOCLOUD
44 MODIS_ONLY
45 MODIS_CALIPSO
46 MODIS_CLDSAT
47 MOD_CAL_CDS
48 SSF_CLD

Flux QC, LW



Blue: Enhanced
Green: Standard
Red: MODIS only (CRS like)

1 All	13 MIDL_CLR	25 ICEOCE_CLD	37 CLRCOM
2 CLR	14 POLE_CLR	26 LAND_CLD	38 CLRCOM_OCE
3 CLD	15 COAST_CLR	27 SNOLND_CLD	39 DAY_CLRCOM
4 COAST_ALL	16 OCEAN_CLR	28 OVC	40 NIGHT_CLRCOM
5 OCEAN_ALL	17 ICEOCE_CLR	29 OCEAN_OVC	41 DAY_OCEAN_CLRCOM
6 ICEOCE_ALL	18 LAND_CLR	30 LAND_OVC	42 NIGHT_OCEAN_CLRCOM
7 LAND_ALL	19 SNOLND_CLR	31 HOMO_OCEAN_OVC	43 NOCLOUD
8 SNOLND_ALL	20 TROP_CLD	32 INHOMO_OCEAN_OVC	44 MODIS_ONLY
9 TROP_ALL	21 MIDL_CLD	33 HOMO_LAND_OVC	45 MODIS_CALIPSO
10 MIDL_ALL	22 POLE_CLD	34 INHOMO_LAND_OVC	46 MODIS_CLDSAT
11 POLE_ALL	23 COAST_CLD	35 DAY	47 MOD_CAL_CDS
12 TROP_CLR	24 OCEAN_CLD1	36 NIGHT	48 SSF_CLD



NASA Fact

A mile, also called a "statute mile," is the unit of distance most U.S. citizens are familiar with. To convert statute miles into kilometers multiply the statute miles by 1.609347.

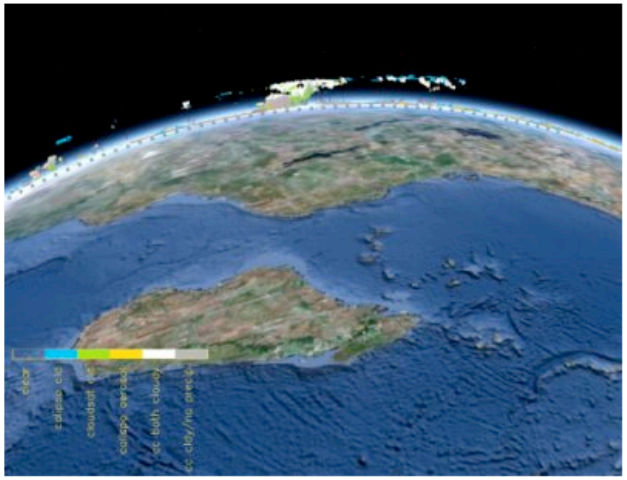
More NASA facts...

Atmospheric Data Fusion (ADF) Group

Welcome to the ADF Group Homepage **04.14.2008**

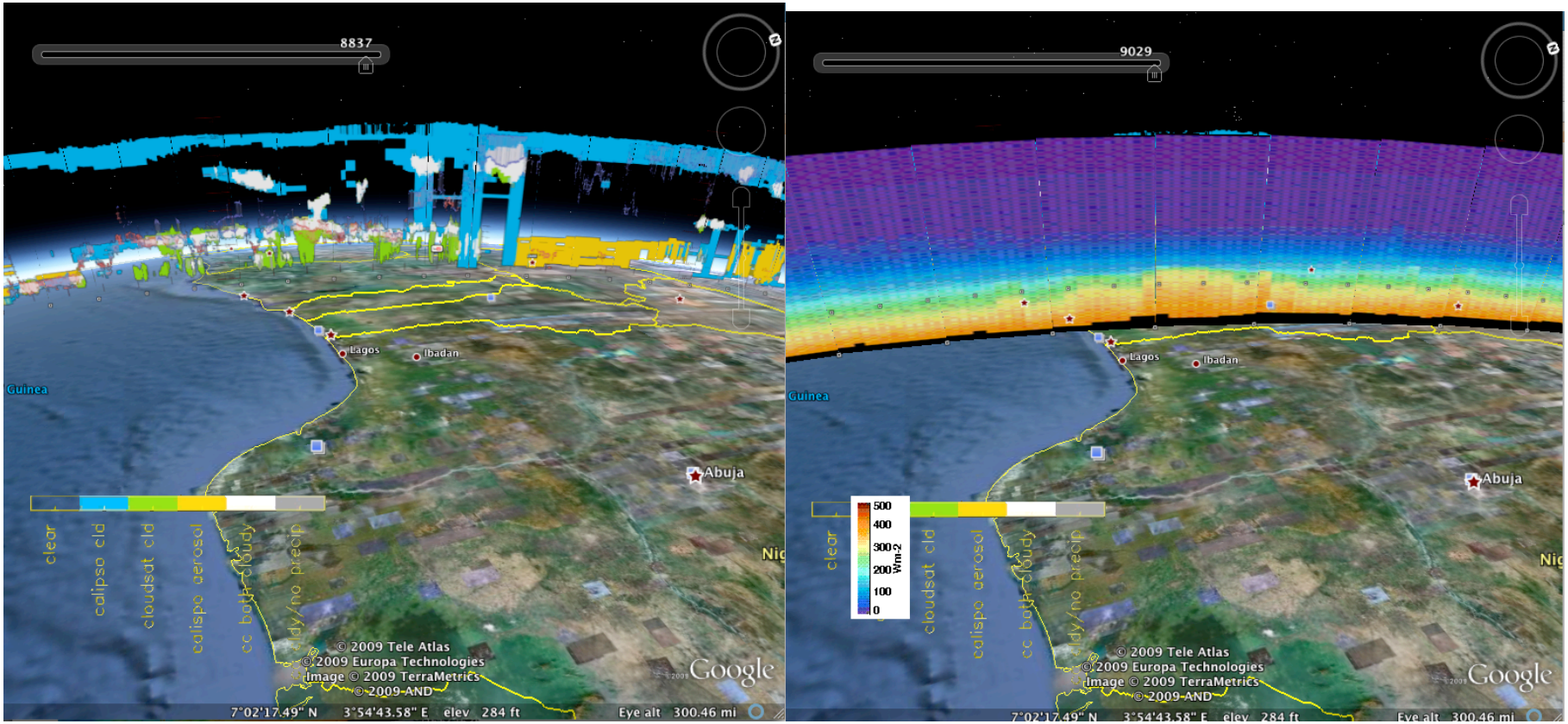
Our group integrates atmospheric data taken from multiple satellite instruments and provides data products for scientific analyses. Integrating data taken from multiple satellite instruments often increases information contents and potentially becomes more accurate description of atmospheric states.

Our group is currently working on integrating Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), CloudSat, Clouds and the Earth's Radiant Energy System (CERES) and Moderate Resolution Imaging Spectroradiometer (MODIS) data to provide global vertical profiles of aerosols, clouds, and broadband radiative flux. All of these instruments are flying in formation as part of what is called the Aqua Train, or simply, A-Train. These new data will provide unprecedented ability to test and improve global cloud and aerosol models, to investigate aerosol direct and indirect radiative forcing, and to validate the accuracy of global aerosol, cloud and radiation data sets especially in polar regions and for multi-layers cloud conditions.



Principal Investigator: Dr. Bruce A. Wielicki
(NASA Langley Science Directorate)

WEB visualization tool



Production schedule

- One month (July 2006) beta version.
- Beta version (July 2006, Jan. 2007, April 2007, and Oct. 2006) by end of May or June.
- Produce 1 year of data by the end of 2009.