

IGWCO

Potential Support of the NASA Water Management Program for Capacity Building Programs in Latin America

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Goulburn-Murray Water



OUTLINE

- 1) NASA Science to Applications
- 2) NASA Applied Sciences Program (ASP) & Water Management
- 3) Current & Possible NASA ASP Support to GEO Water Capacity Building (WA-06-07)

◆ Activities

- Satellite and Modeling Products
- South American Land Data Assimilation System ('SALDAS')
- SERVIR – Meso America, Supports most of GEOSS Societal Benefit Areas. Sponsored by NASA, USAID, Panama and others.
- ASP Disaster Management: International Sustainable Development – African Initiative

- 4) Future Directions with Emphasis from NASA Water Management

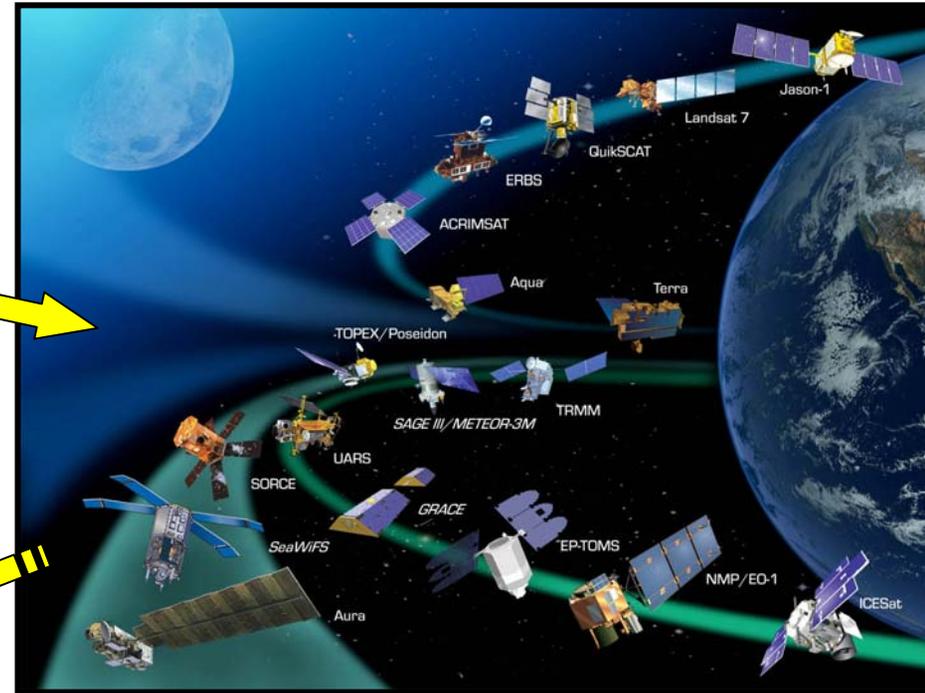


The NASA Role in Earth Sciences Research & Applications

- Develop satellite Earth observation systems
 - for Weather and Climate Research
 - for 6 Science Focus Areas
 - for Operational Transition (e.g. to NOAA)

- Utilization of satellite climate/Earth science data

- Develop highly accurate climate/Earth Science data records
- Develop and provide data analysis algorithms
- Provide access to climate/science data
- Improve modeling & predictions



- Satellite data applications
 - Provide Earth observations tuned to user's needs
 - Hand off data access to users
 - Collect and provide unique data sets
 - Applied Sciences Program to Spin-Off NASA products to benefit society

Observations to Knowledge Products

“from photons to electrons to neurons”

Petabytes 10^{15}

Multi-platform, multiparameter, high spatial and temporal resolution, remote & in-situ sensing

Terabytes 10^{12}

Calibration, Transformation To Characterized Geo-physical Parameters

Gigabytes 10^9

Interaction Between Modeling/Forecasting and Observation Systems

Megabytes 10^6

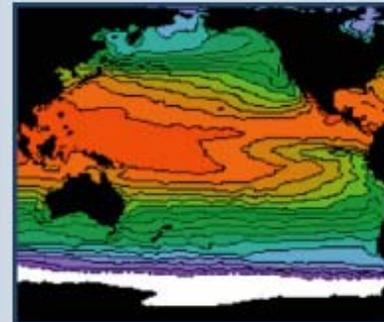
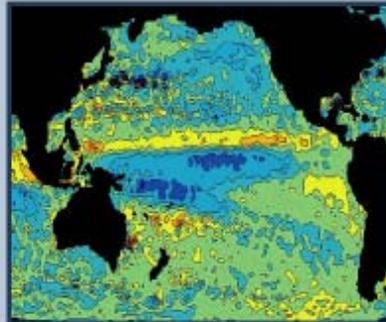
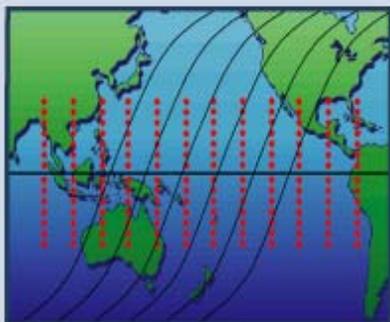
Interactive Dissemination and Predictions

Advanced Sensors

Data Processing & Analysis

Information Synthesis

Access to Knowledge



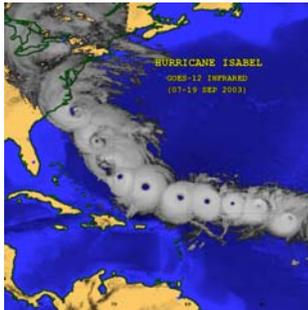
Global Earth Observing Systems of Systems (GEOSS) - 9 Societal Benefit Areas



Natural & Human Induced Disasters



Human Health & Well-Being



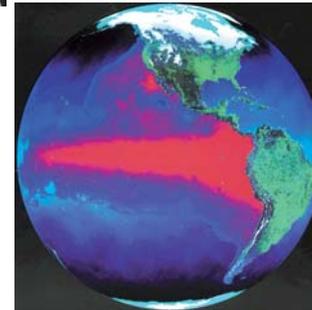
Weather Information, Forecasting



Energy Resources



Water Resources



Climate Variability & Change



Sustainable Agriculture & Desertification



Ecosystems



Oceans



NASA's APPLIED SCIENCES PROGRAM

12 Application Areas



Agricultural Efficiency



Air Quality



Aviation



Carbon Management



Coastal Management



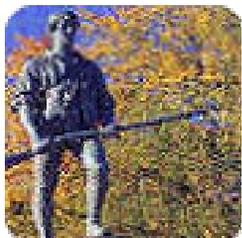
Disaster Management



Ecological Forecasting



Energy Management



Homeland Security



Invasive Species



Public Health



Water Management

Water Management



Water Integrated System Solution Management

EARTH SYSTEM MODELS

- Mesoscale Models: *MM5, CSU RAMS*
- General Circulation models: *GMAO (DAO & NSIPP), NCEP ETA*
- LSMs: *MOSAIC, Noah, VIC, Catchment, CLM2, SWAT*
- In Stream Water Quality Model: *QUAL2E*
- Non-Point source annual loading model: *FLOAD*
- Watershed loading and transport models: *HSPF*

**Supported Non-NASA Model*

Data

EARTH OBSERVATIONS

- Surface Temperature: *Terra, Aqua, GOES*
- Precipitation: *TRMM, Aqua, GOES*
- Soil Moisture: *Aqua, TRMM, NPOES*
- Snow Cover: *Aqua, Terra*
- Snow Quantity: *Aqua*
- Groundwater Change: *Grace*
- Land Use/Cover: *Terra, Aqua, Landsat*
- Surface Radiation: *GOES, Terra, Aqua, Aster*

Predictions

- Soil Moisture
- Evapotranspiration
- Precipitation
- Snow cover, accumulation, and water equivalent:
- Groundwater storage change
- Vegetation type
- River discharge height
- Flood and Drought Assessment and Prediction
- Seasonal Forecasts

Observations

DECISION SUPPORT TOOLS

- **BASINS (Better Assessment Science Integrating Point and Non-point Sources)**
 - Facilitate examination of environmental information
 - Provides an integrated watershed and modeling framework
 - Support analysis of point and non-point source management alternatives
 - Urban/Rural land use evaluations
- **AWARDS (Agricultural Water Resources Decision Support)**
 - Estimates of water consumption by crops
 - Crop suitability assessment
 - Irrigation requirements
- **RiverWare**
 - Estimates of river flow and water loss to vegetation
 - River sustainability assessment



VALUE & BENEFITS

- **Improvements in identifying:**
 - ◆ impaired surface waters
 - ◆ storm water management issues
 - ◆ drinking water source protection
- **Improvement in habitat management practices**
- **Improved efficiency of water use**
- **Increased Agricultural productivity**

Water Management Program Functional Themes – 8 Projects

<http://wmp.gsfc.nasa.gov>

FLOODS & STREAMFLOW FORECASTING

Three Water Management projects

- NOAA led examining **improved streamflow** for River Forecast Centers.
- Using NASA satellite and modeling products for **Seasonal Forecast** in W. US
- NASA-NOAA-USGS **Flash Flood** Project using NASA products and modeling.

IRRIGATION & WATER DELIVERY

Three Water Management projects are currently addressing various aspects of improving **Evapotranspiration estimates** for use in the BoR AWARDS-ET Toolbox, Army Corp Eng (ACE) and similar DSTs. Focus on using MODIS/Landsat/Aster data and LDAS/LIS estimates of ET & soil moisture.

DROUGHT

Project assesses the potential for AMSR-E, Quikscat/Sea Winds and MODIS satellite products to improve the performance of **multi-agency US Drought Monitor**. Also in support of the National Integrated Drought Information System (NIDIS).

WATER QUALITY

Nonpoint source pollution project to assess the impact of MODIS land data products and impact of LIS precipitation and ET products to improve the continuous hydrologic model, HSPF, used in the EPA BASINS DST.



NASA SUPPORT TO GEO Task WA-06-07 (Water)

- “Initiate capacity building programs to develop tools for using remote sensing data in support of water management, and to show the value of Earth observations generally in water resource management. The program will be initiated in Latin America and will then be extended to Asia and Africa.”



NASA Hydrology Related Missions

Water Cycle Missions

ICESat
- Ice elevation
- Cloud height

GRACE
- Column water-content

TRMM and GPM
- Global precipitation

HYDROS
- Surface wetness
- Frozen soil

Water and Energy Cycle Missions

EOS-Aura
- Atmospheric humidity
- Clouds

EOS-Terra
- Snow and ice
- Vegetation

CALIPSO
- Cloud properties

CloudSAT
- Cloud profiler

EOS-Aqua
- Atmospheric humidity
- Water storage
- Clouds
- Snow and ice

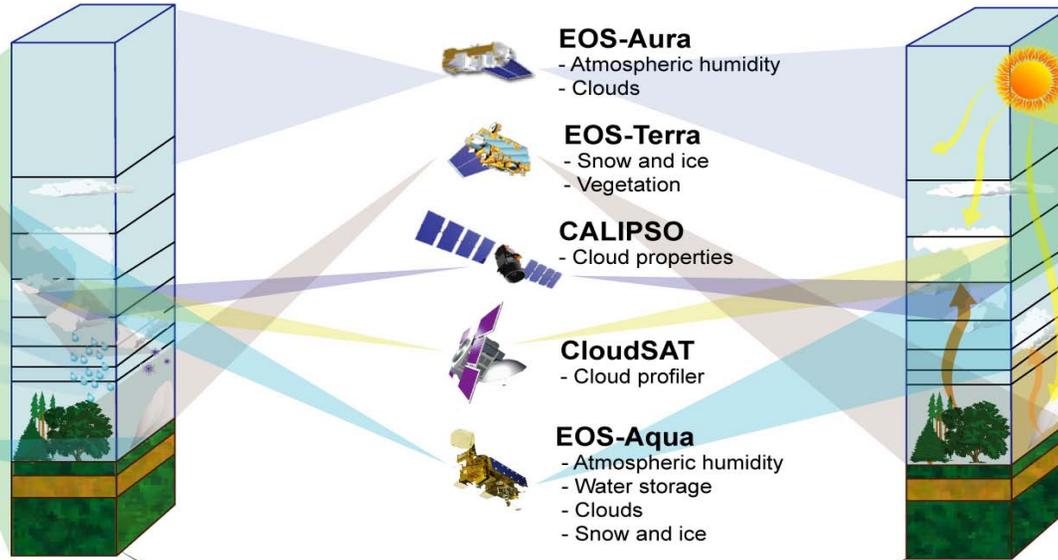
Energy Cycle Missions

TOMS
- Total column ozone

SORCE
- Total Irradiance measurements

SAGE
- Air quality
- Climate change

UARS
- Carbon management
- Air quality



Complementary Water and Energy Cycle Missions

QuikSCAT
- Sea-surface wind velocity



EO-1 LANDSAT and NMP EO-1
- Land cover



NPOESS
- Global environmental conditions



GOES
- Weather



Aquarius
- Global sea surface salinity



High Resolution Global to Local **Modeling** with the Land Information System (LIS)

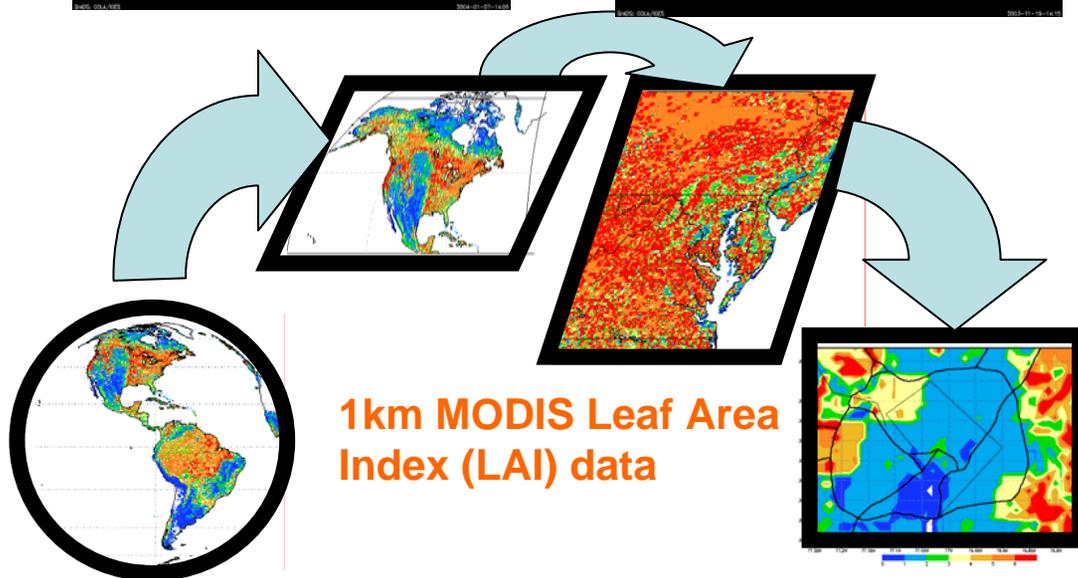
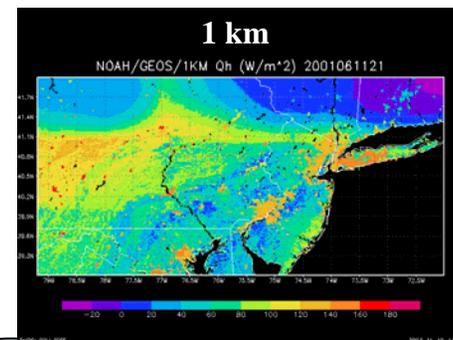
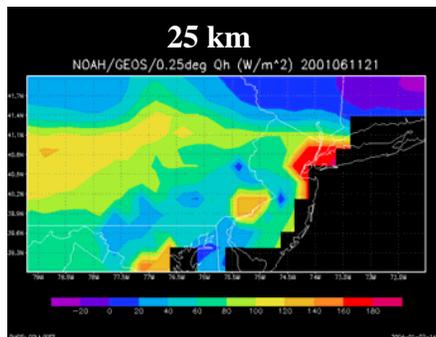
<http://lis.gsfc.nasa.gov>

Objective:

A high performance, high resolution (<1 km) data integration system for local to global land modeling & data assimilation of satellite and ancillary data.

Applications:

Water supply, demand & forecasting. Hydro-Energy, Irrigated Agriculture, Water Quality, Mobility Assessment, etc. Short-term and Long Term Predictions.



Resolution	1/4 deg	5 km	1 km
Land Grid Points	2.43E+05	5.73E+06	1.44E+08
Disk Space/Day (Gb)	1	28	694
Memory (Gb)	3	62	1561

Potential Support of the NASA Water ... - 14 March 2007



Water Management



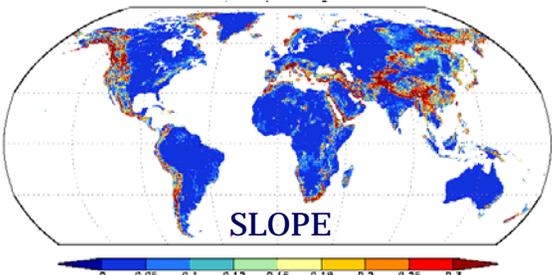
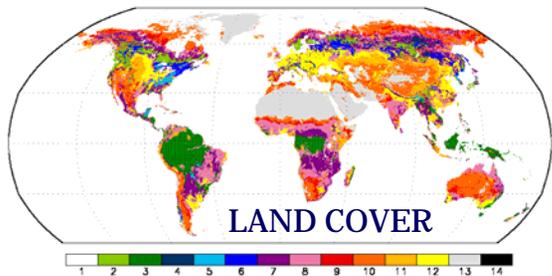
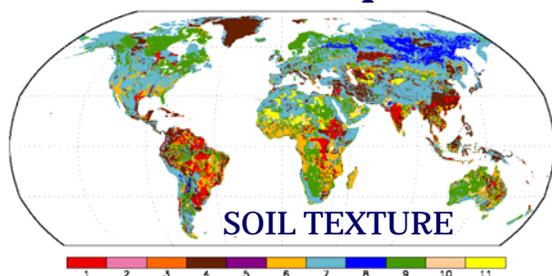


Global Land Data Assimilation System (GLDAS)

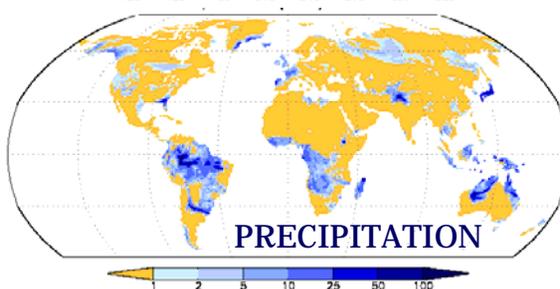
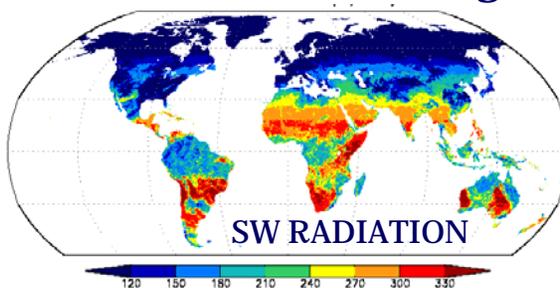


GOAL: Integrate data from multiple sources within Land Information System (LIS) LSMs to produce optimal fields of land surface states and fluxes

Parameter Inputs

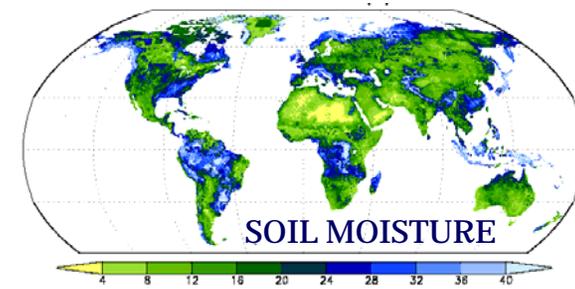
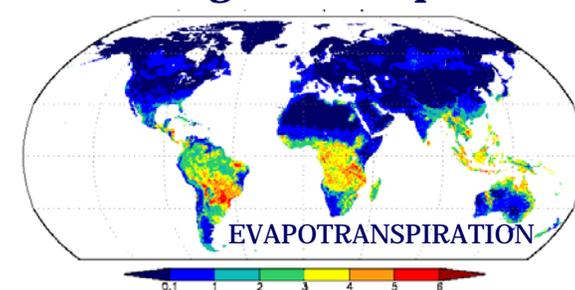


Satellite Based Forcing



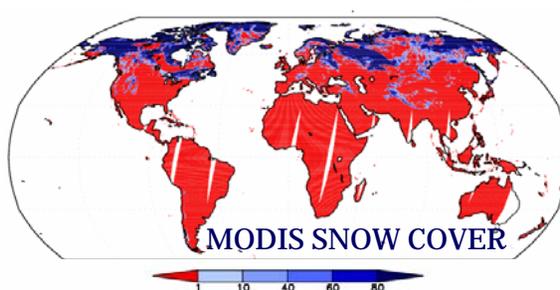
USES: Forecast initialization studies, water resources applications, and hydrometeorological investigations

Integrated Output



AVAILABILITY: Output from 1979-present simulations of Noah (1/4°; 1°), CLM (1°), and Mosaic (1°) available by request (Matthew.Rodell@nasa.gov)

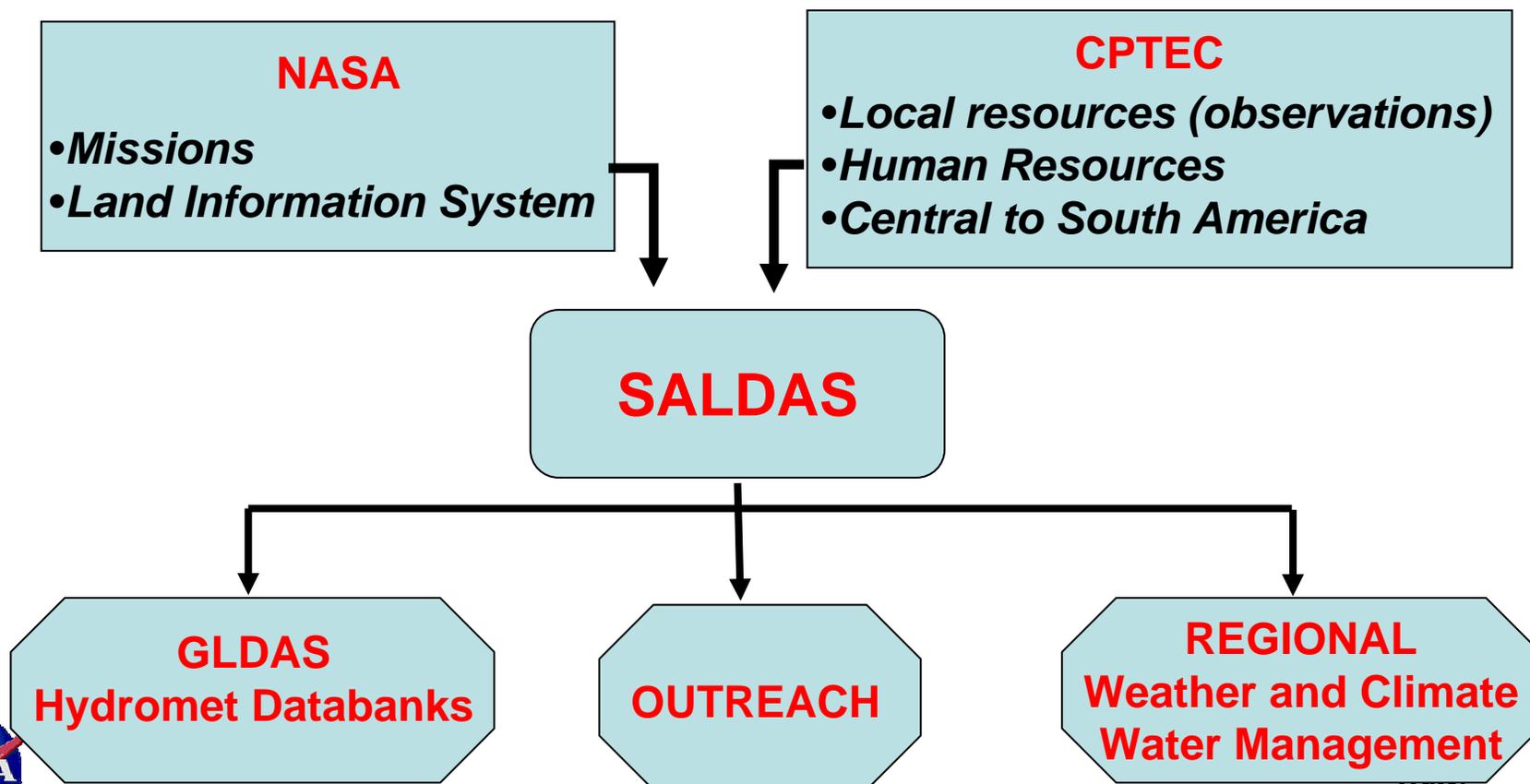
Assimilated Observations



South American Land Data Assimilation System (SALDAS) NASA & CPTEC (“Centers for Weather & Climate Predictions”)



Goal: combine local observations and parameters with NASA technology and advanced hydrological modeling expertise and capabilities to improve Global and SA NWP, climate and water management through collaboration with various centers (government, universities and research institutes)



South American Land Data Assimilation System (SALDAS) Outputs of Water & Energy Balance

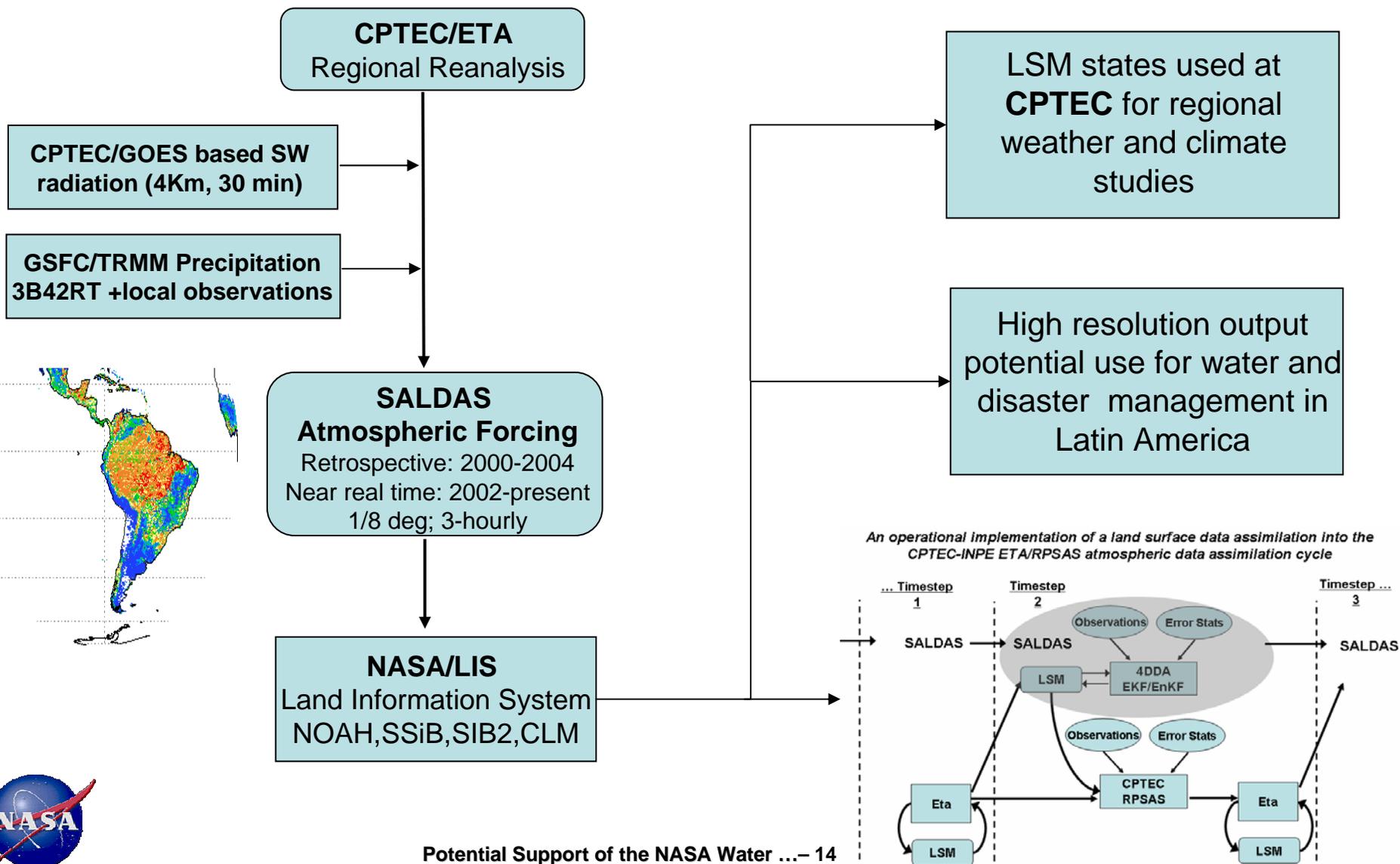


Goal: combine local observations and parameters with NASA advanced hydrological modeling expertise and capabilities to improve Global and SA NWP, climate and water management through collaboration with various centers (government, universities and research institutes). SALDAS is seeks to enhance regionally GLDAS by using local capabilities.

	Current Specifications	Planned Specifications
Spatial Extent	South America (12N/60S - 85W/30W)	<i>Same</i>
Spatial Resolution	1/8 Degrees	<i>Same</i>
Time Period	Retrospective (2000-2004)	Near real time (2002-present)
Temporal Resolution	15 minute time steps, 3-hourly output fields	<i>Same</i>
Land Surface Models	NOAH, SSiB	NOAH, SSiB, CLM, SiB3
Output Format	BIN, GRIB	<i>Same</i>
Elevation Definition	GTOPO30	<i>Same</i>
Vegetation Definition	University of Maryland, 1 km	UMD, CPTEC/INPE, MODIS maps
Soils Definition	Reynolds, Jackson, and Rawls [1999]	CPTEC/INPE soils maps



SALDAS Interaction with the Center for Weather Forecasts and Climate Studies (CPTEC) of the National Institute for Space Research (INPE)



Regional Visualization & Monitoring System ('SERVIR')

SERVIR The Mesoamerican Regional Visualization and Monitoring System

WED, MAY 17, 2006

Español
 English

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Your "One Stop Shop" for Decision Support, and Information
 Mesoamerica Today, 17 May 2006 14:15 UTC
 Go to SERVIR Real-time Images for the Latest GOES image

Disasters	Fires
Ecology	Hurricanes
Weather	Volcanoes
Climate	Earthquakes
Oceans	Food Security
Water	Floods
Agriculture	Landslides
Human Health	
Energy	

17 May 2006 14:15 UTC
 Cloud free, very warm surface temperatures
 Weak, warm cloud tops, low altitude
 Intense, cold cloud tops, high altitude

SERVIR Movies
 A Vision of the Future (Quicktime movie 18.2 MB). Click image to view movie.
 Video Tierra ceniza... o bosques saludables (WMV file). Click image to view movie.
 Time Lapse of Fires (MPEG 17.89 MB). Click image to view movie.

Web Site

<http://servir.msfc.nasa.gov/>

Four Main Sections

- 1) SERVIR Data
- 2) Online Maps
- 3) GEOSS Decision Support
- 4) 3-D Visualizations

Highlights

- Real-time views of weather around Mesoamerica.
- Tools to monitor wildfires, floods, volcanoes, harmful algal blooms and ecological changes



SERVIR: Floods

Dartmouth
Flood Observatory

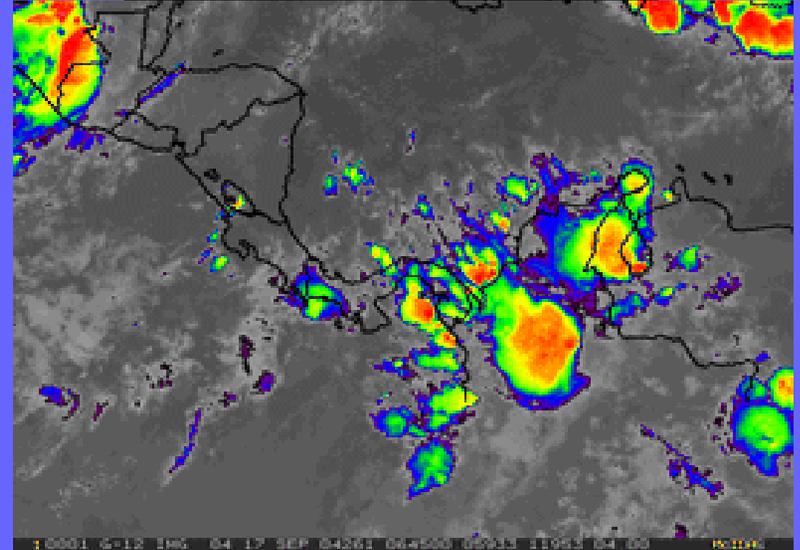
Nicaragua
Flooding

2005

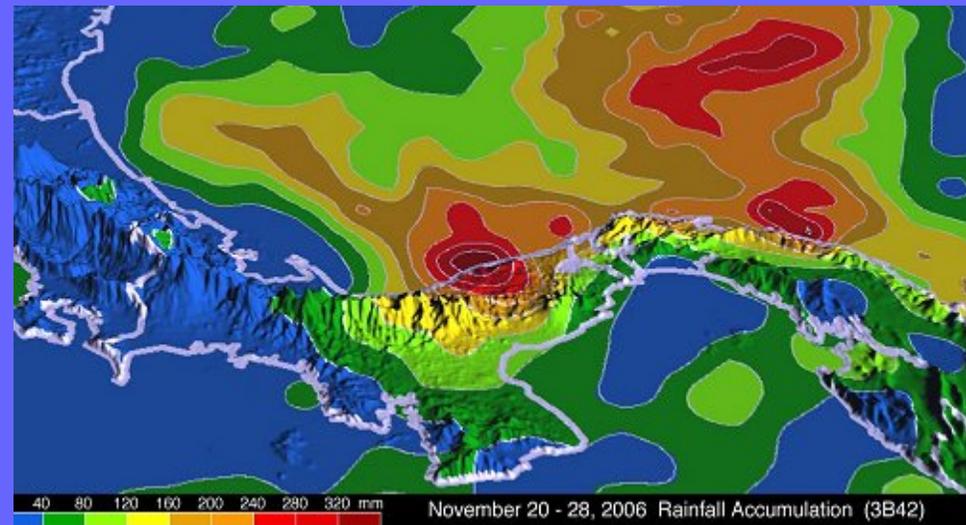
2004

1998

Panama City Floods
of 17-18 September 2004
GOES IR imagery



Through SERVIR the Panama National civil defense agency issued an advisory to two regions for evacuation. Accumulated rainfall during Panama floods as detected by the Tropical Rainfall Measuring Mission (TRMM) and included by SERVIR. *TRMM image courtesy Hal Pierce, Dr. Robert Adler/TRMM Project.*

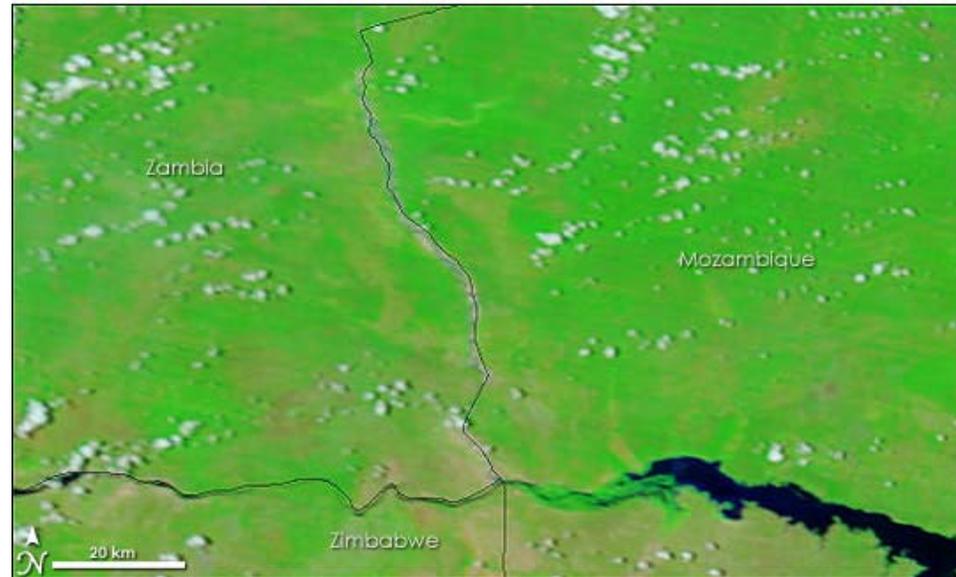


NASA ASP 'International Sustainable Development Using NASA Research Results'

- **NASA Applied Science Program.** Module 3 (Disaster Management & Conflict) CEOS WSSD Follow-Up Program.
- **Emphasis within Africa for *Disaster Management*** and addressing issues of sustainability.
- **Application Types – *Floods, Droughts, Earth Quake, Food Security, Public Health, Water Management, etc.***
- **ROSES 2007 Decision Support**, Disaster Management – Seeking ~ 2-1SD African projects. <http://nspires.nasaprs.com/external/>



February 8, 2007



December 24, 2006

NASA MODIS Imagery showing Flooding. Mozambique ordered the evacuation of 2,500 people as water levels on the Zambezi River continued to rise

Water Management



SUMMARY & FUTURE DIRECTIONS

Ongoing:

- 1) South American LDAS (SALDAS & GLDAS) with Continued 'CPTEC' Support
- 2) SERVIR – Central America
- 3) NASA ASP Disaster Management. International Sustainable Development Using NASA Research Results. See ROSES '07 Decisions Support
- 4) IGWCO Meetings & Latin America Capacity Building
- 5) North American HELP (Hydrology for Environment, Life, and Policy) Coordinator with Links to Latin American Test Sites
- 6) Satellite, Modeling, Visualization, Data, and Education/Public Outreach Systems:
 - NASA/NOAA/DoD/JAXA Precipitation Products from TRMM, AMSR, SSM/I, AMSU
 - Earth Observer System: Satellite Data, Training, Education, Media, etc.
 - NASA Software: SERVIR-VIS, NASA-WINDS, Land Information System (LIS), etc.
 - Dartmouth flood observatory, including Central America (SERVIR)

Future:

- 1) Continued IGWCO Workshop, Capacity Building, Training and Meeting Support
- 2) Continued GLDAS/South American LDAS; SERVIR; ISD in Africa
- 3) Sponsor Latin America visits to NASA (e.g., CPTEC & Latin American Universities)
- 4) Establish NASA Water Management Capacity Building Team for Latin America
- 5) Coordinate with other Agencies Capacity Building efforts (EPA, NOAA, etc.)
- 6) Recommend for NASA Water Management, ROSES Decisions '08 a Latin American Focused Project

