NASA Assets that Support of the Water-Energy-Food Nexus

Richard Lawford
4th Regional WEF Nexus Workshop
Hilton, Pietermaritzburg, South Africa
November 21, 2016

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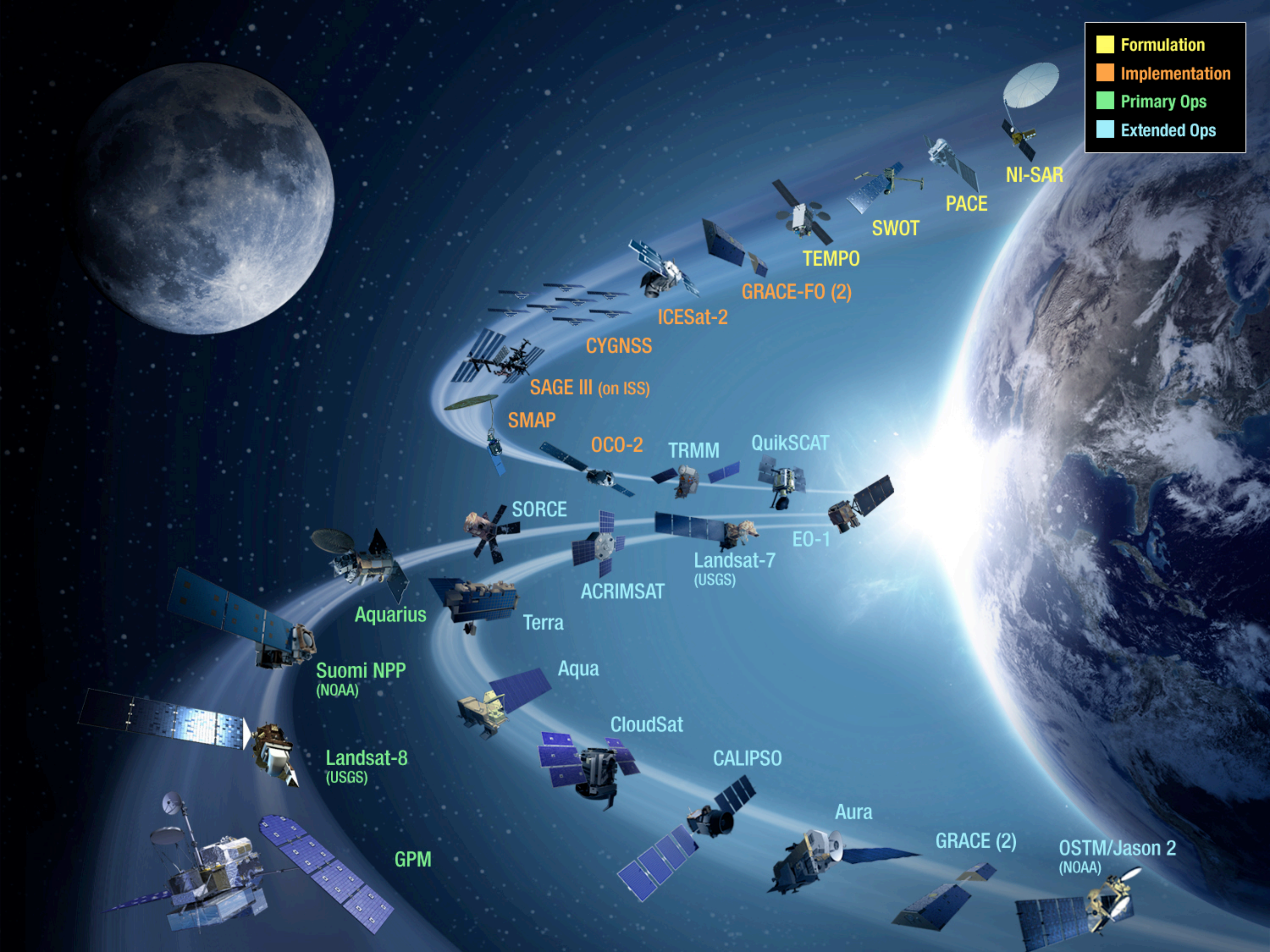
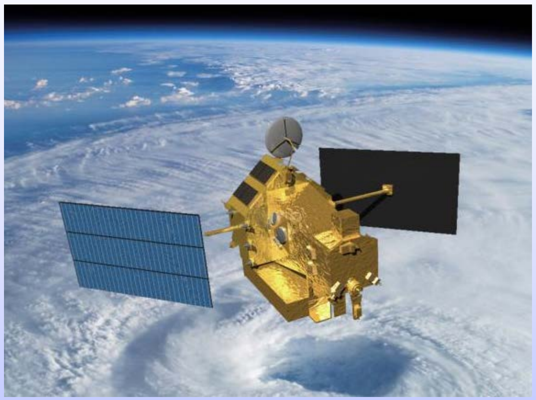
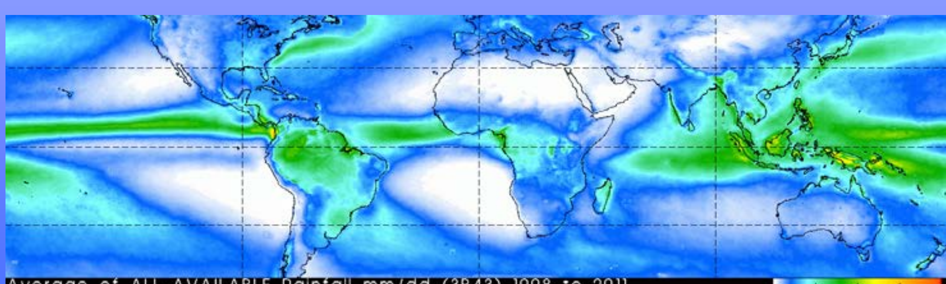

Formulation
Implementation
Primary Ops
Extended Ops
NI-SAR
PACE
SWOT
TEMPO
GRACE-FO (2)
ICESat-2
CYGNSS
SAGE III (on ISS)
SMAP
OCO-2
TRMM
QuikSCAT
SORCE
EO-1
Landsat-7
(USGS)
ACRIMSAT
Aquarius
Terra
Suomi NPP
(NOAA)
Aqua
CloudSat
Landsat-8
(USGS)
CALIPSO
Aura
GPM
GRACE (2)
OSTM/Jason 2
(NOAA)

Precipitation

Tropical Rainfall Measurement Mission (TRMM)



- Global (50S-50N) precipitation measurement
  - 10 ↔ 85 GHz radiometers
  - 13.6 GHz precipitation radar
  - Nov 1997 to Apr 2015



TRMM 14-year mean rainfall

Global Precipitation Measurement (GPM)

The GPM Core Observatory will provide improved measurements of precipitation from the tropics to higher latitudes

- Launched Feb 28, 2014
- Uses inputs from an international constellation of satellites to increase space and time coverage
- Improvements:
  - Longer record length
  - High latitude precipitation
    - including snowfall
  - Better accuracy and coverage

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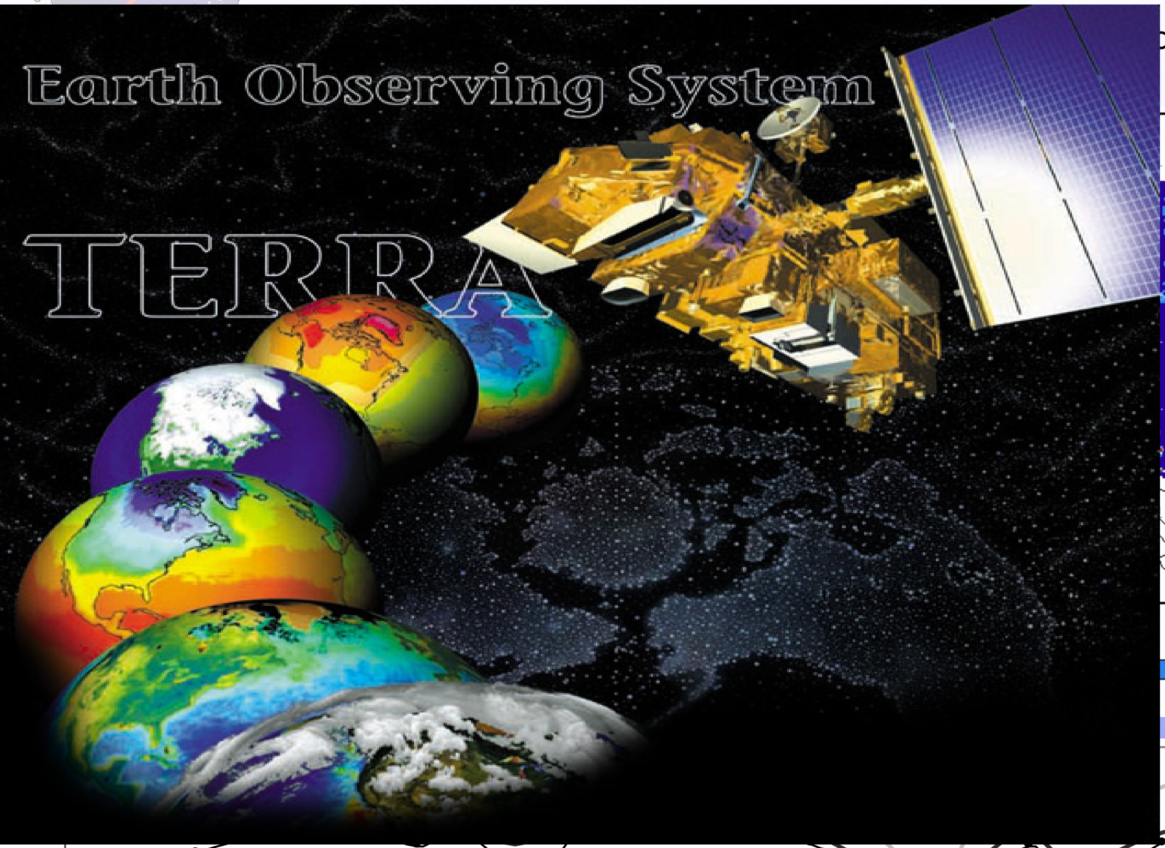
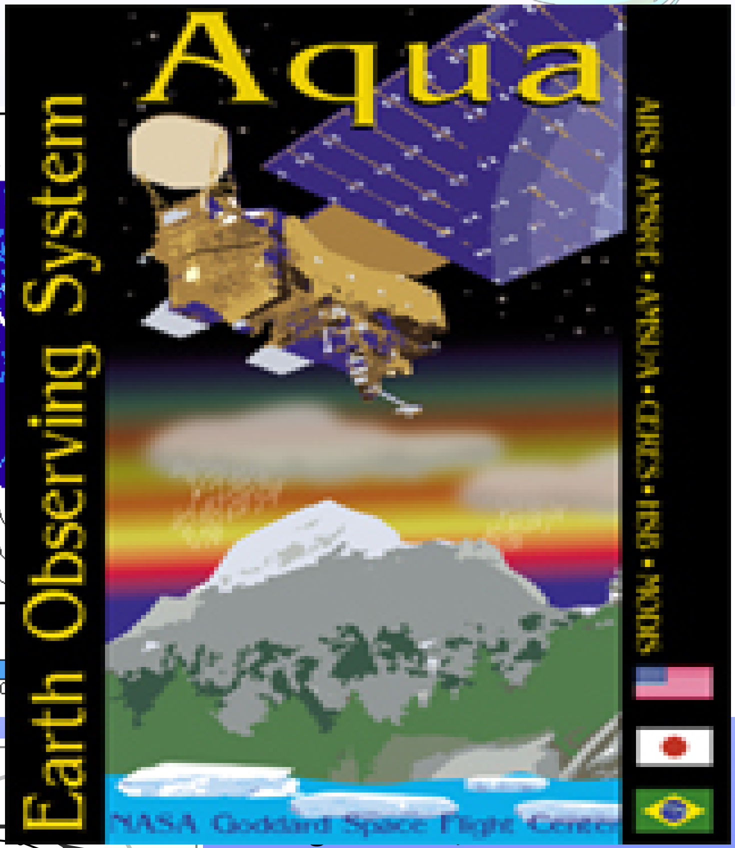
Irrigation Derived from MODIS Observations





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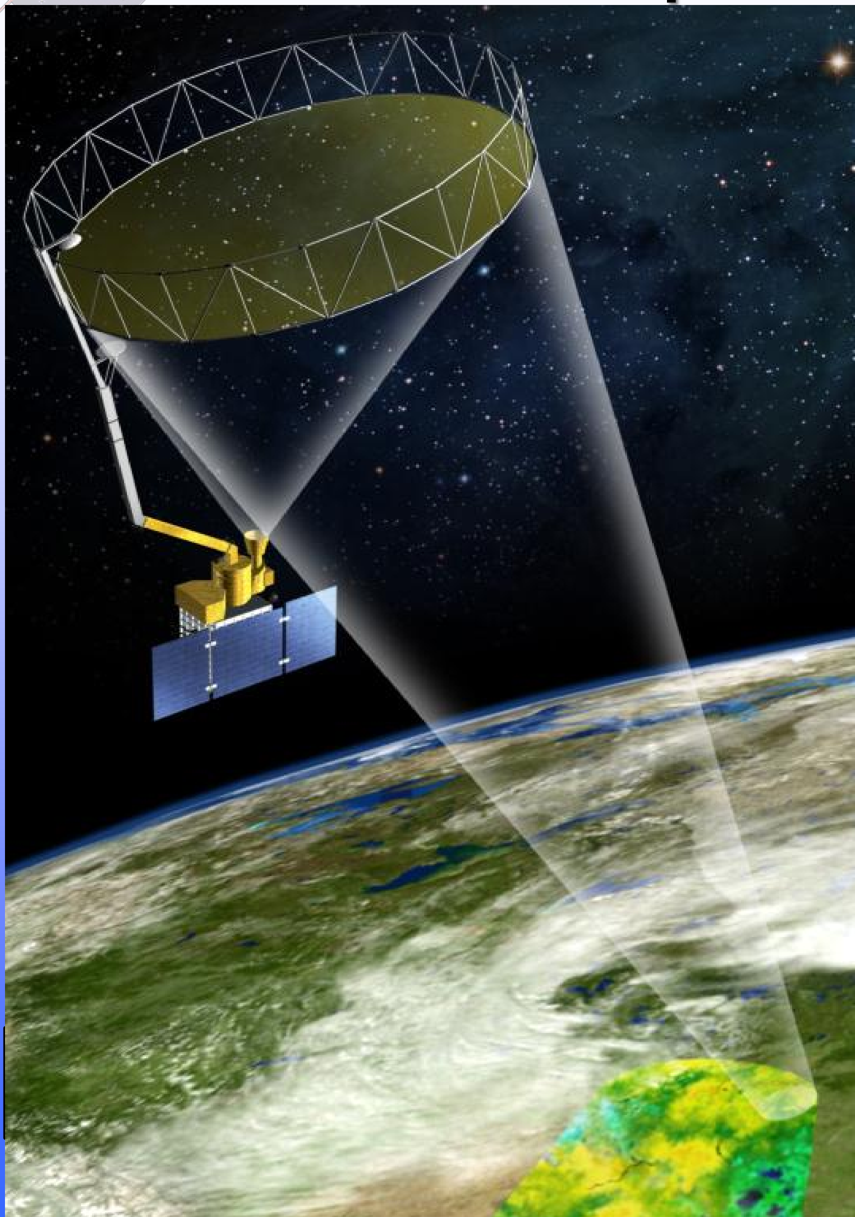
(gray line), irrigation run (black line), and observations (dots)

SMOS and SMAP Based Soil Moisture Used by USDA/FAS for Improved Agricultural Forecasting



SMAP Facts

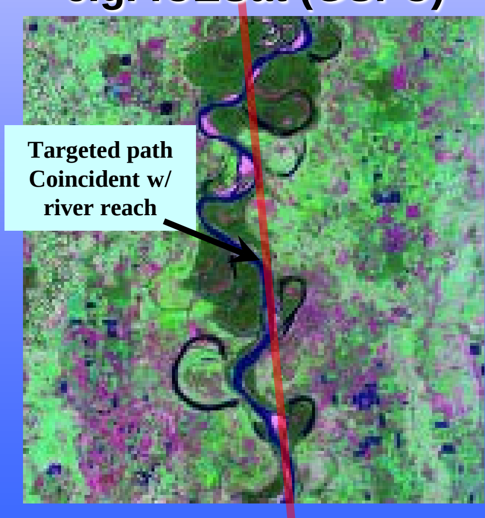
- **Resolution: 10 km**
- **Instruments: L-band Radar and Radiometer**
- **Launch: January 31, 2015**
- **Mission Duration: 3 years**

Surface Water Mission Concept (SWOT)
Stream Discharge and Surface Water Height

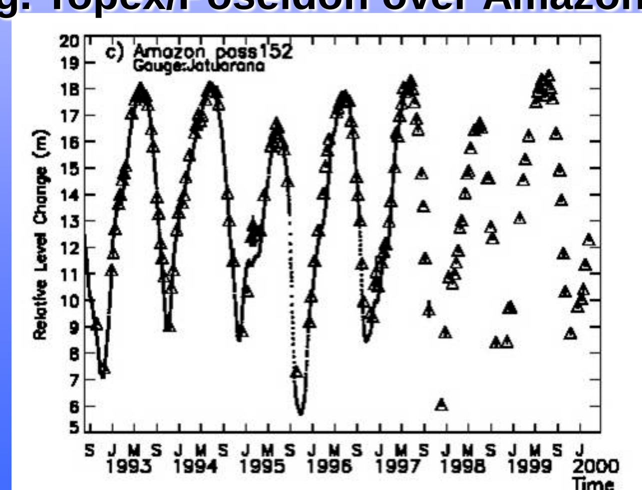
Motivation:
- critical water cycle component
- essential for water resource planning
- stream discharge and water height data are difficult to obtain outside US
- find the missing continental discharge component

Mission Concepts:

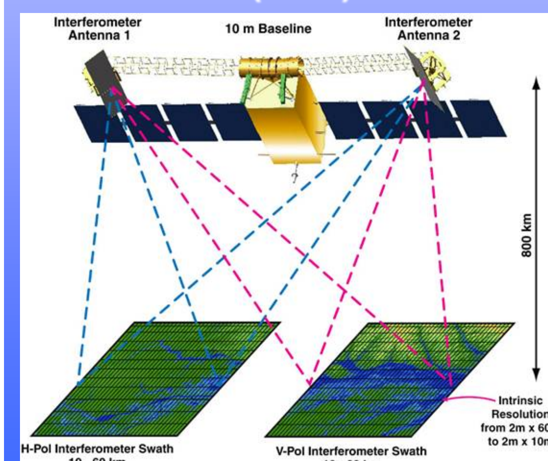
Laser Altimetry Concept
e.g. ICESat (GSFC)



Radar Altimetry Concept
e.g. Topex/Poseidon over Amazon R.



Interferometer Concept
(JPL)



Source: M. Jasinski/614.3

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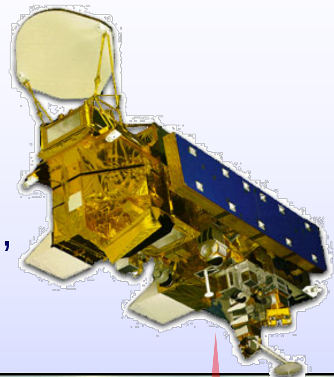
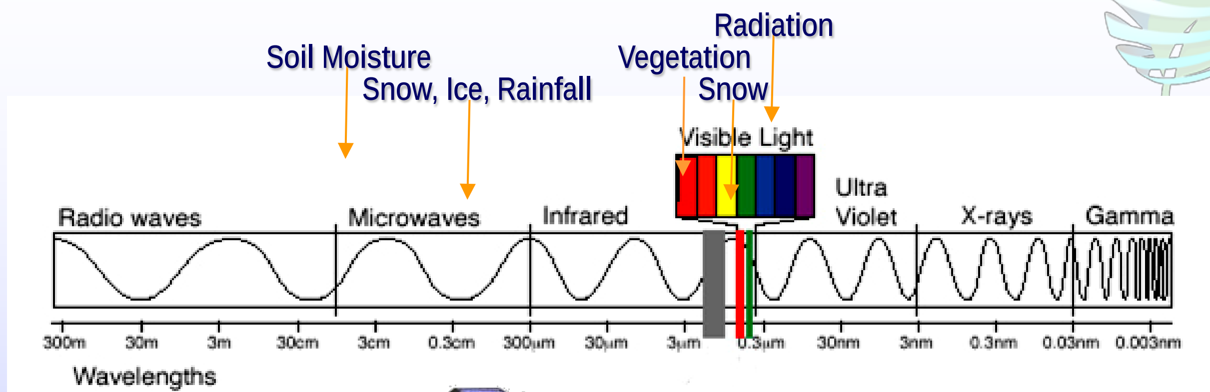
Gravity Recovery and Climate Experiment (GRACE)

Aqua: MODIS, AMSR-E, etc.





Traditional radiation-based remote sensing technologies cannot sense water below the first few centimeters of the snow-canopy-soil column

GRACE

GRACE is unique in its ability to monitor water at all levels, down to the deepest aquifer

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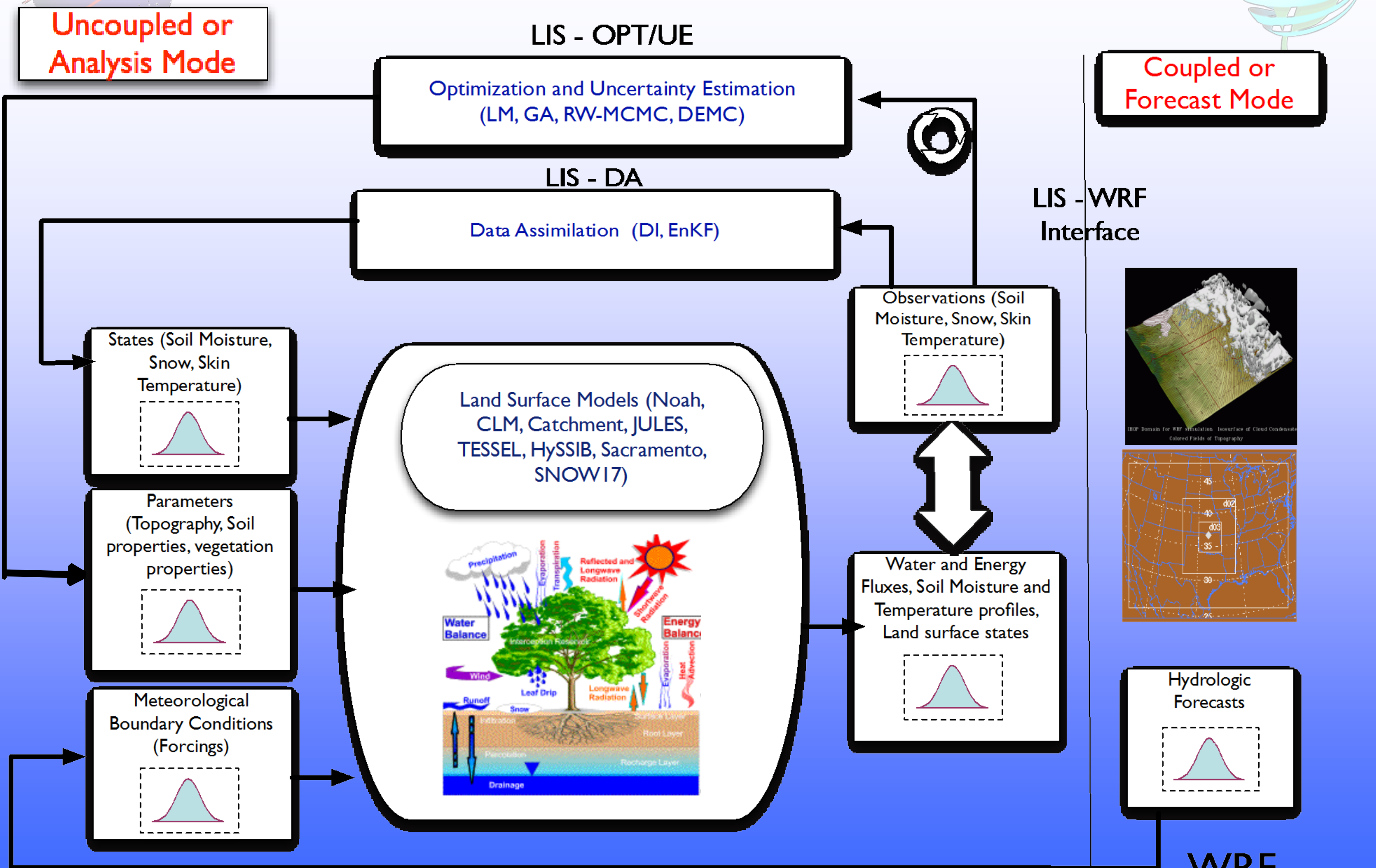
Computational subsystems and coupled models with LIS



Kumar, S.V., C.D. Peters-Lidard, J.L. Eastman, W.-K. Tao (2007), An integrated High Resolution Hydrometeorological Modeling Testbed using LIS and WRF, *Environmental Modeling and Software*, 23(2), 169-181.

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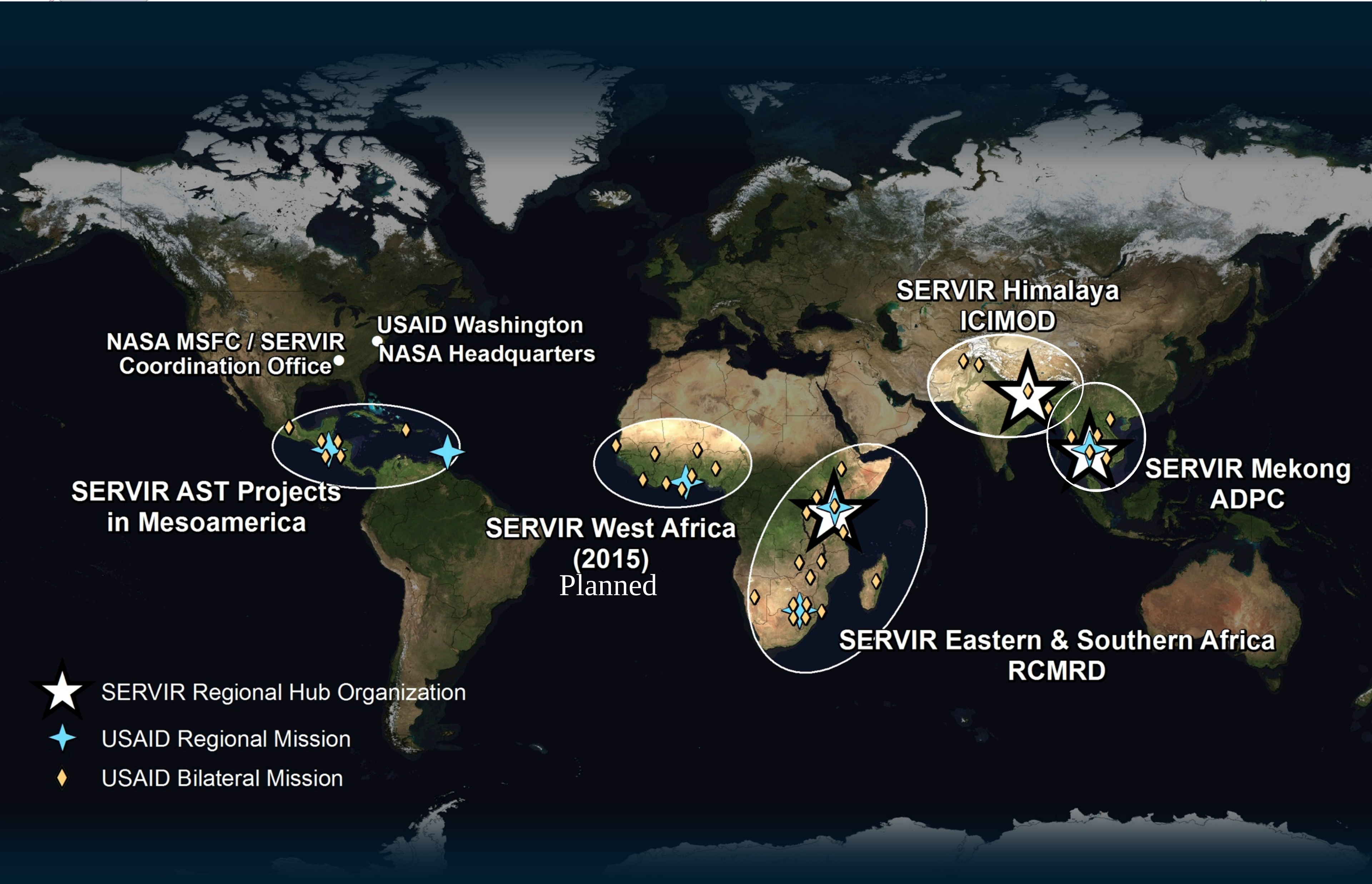
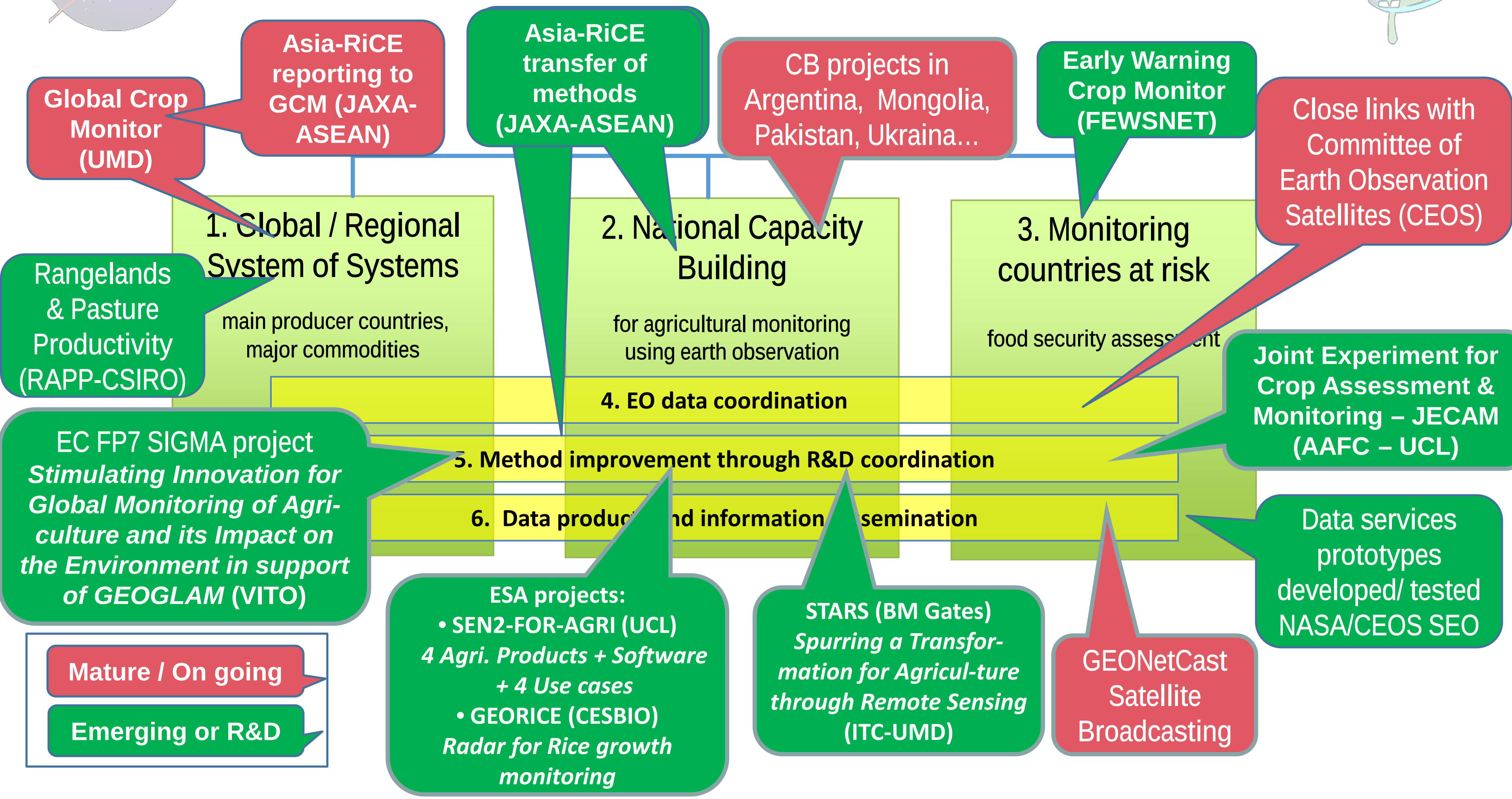
The SERVIR Network



GEOGLAM Achievements & Plans



GEOGLAM : a global collaborative initiative with already significant achievements…

… with a need for continuous support
to address monitoring of continuously changing global agricultural issues

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Summary and Future Prospects

• Current relevant satellite observing systems include GPM (precipitation), MODIS & VIIRS (vegetation, irrigation, etc.), ET (water use for irrigation, SMOS & SMAP (soil moisture), GRACE (terrestrial water storage), and Landsat 8 (land use / land cover)

•These space-based observation of water-energy-food related variables data are essential to supplement in-situ ground-based observations.

•NASA's policy of free and open data access has expanded use of the data and generated large returns from its investment in EO missions.

• Future relevant satellite observing systems will include GRACE EO (terrestrial water storage), SWOT (surface water and river stage), Landsat 9 (land use / land cover)