# *Developing Consistent Earth System Data Records for the Global Terrestrial Water Cycle*

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# Project Objective

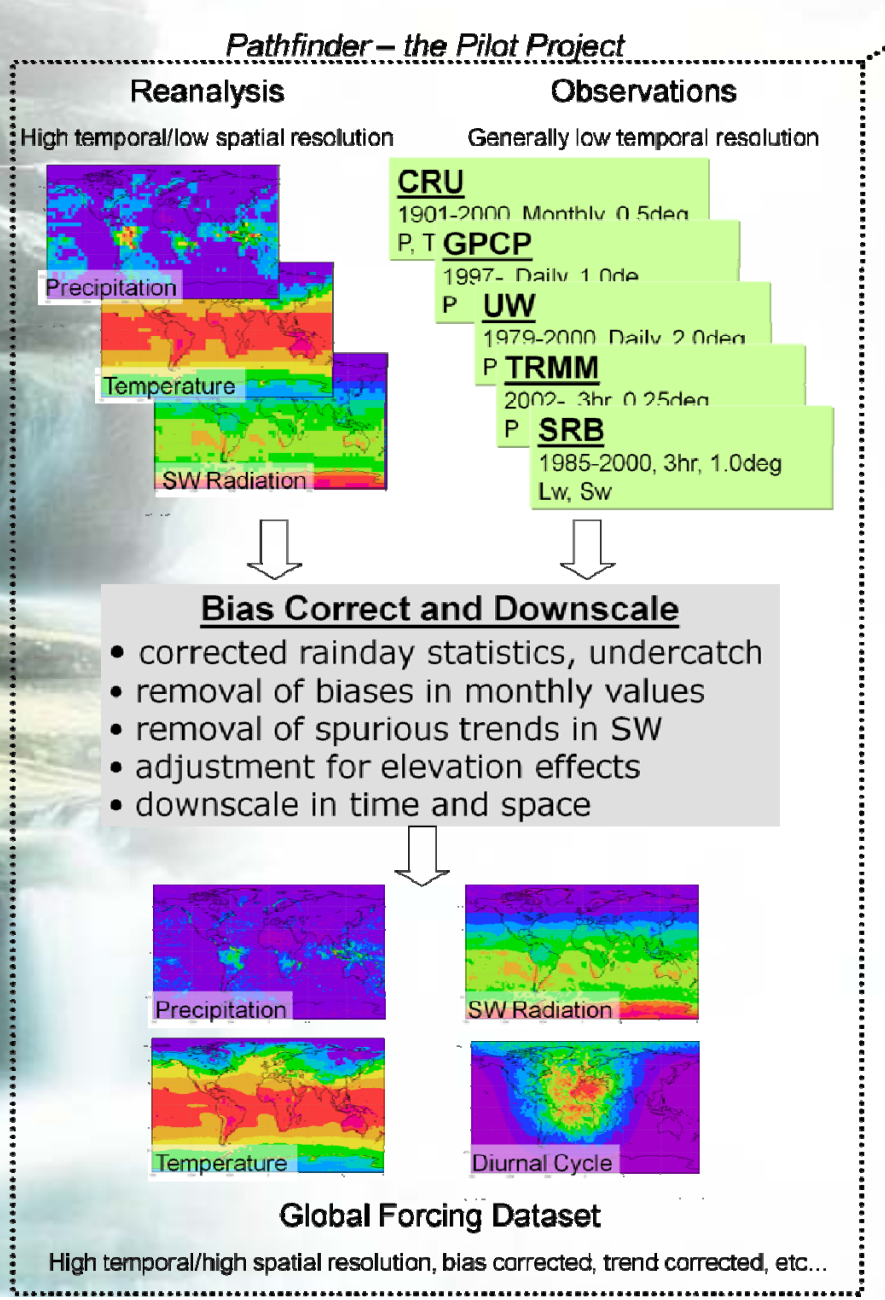
Project Objectives: *The overall goal is to develop consistent, long-term Earth System Data Records (ESDRs) for the major components (storages and fluxes) of the terrestrial water cycle at a spatial resolution of 0.5 degrees (latitude-longitude) and for the period 1950 to near-present.*

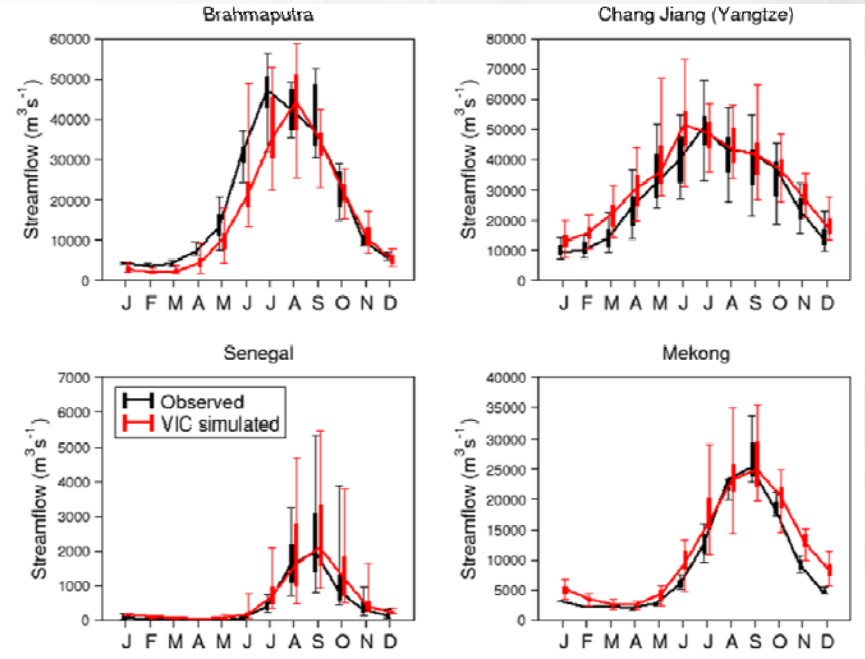
Data Records: *The resulting ESDRs are intended to provide a consistent basis for estimating the mean state and variability of the land surface water cycle at the spatial scale of the major global river basins.*

ESDRs:

- *surface meteorology (precipitation, air temperature, humidity and wind),*
- *surface downward radiation (solar and longwave) and*
- *derived and/or assimilated fluxes and storages such as surface soil moisture storage, total basin water storage, snow water equivalent, storage in large lakes, reservoirs, and wetlands, evapotranspiration, and surface runoff.*

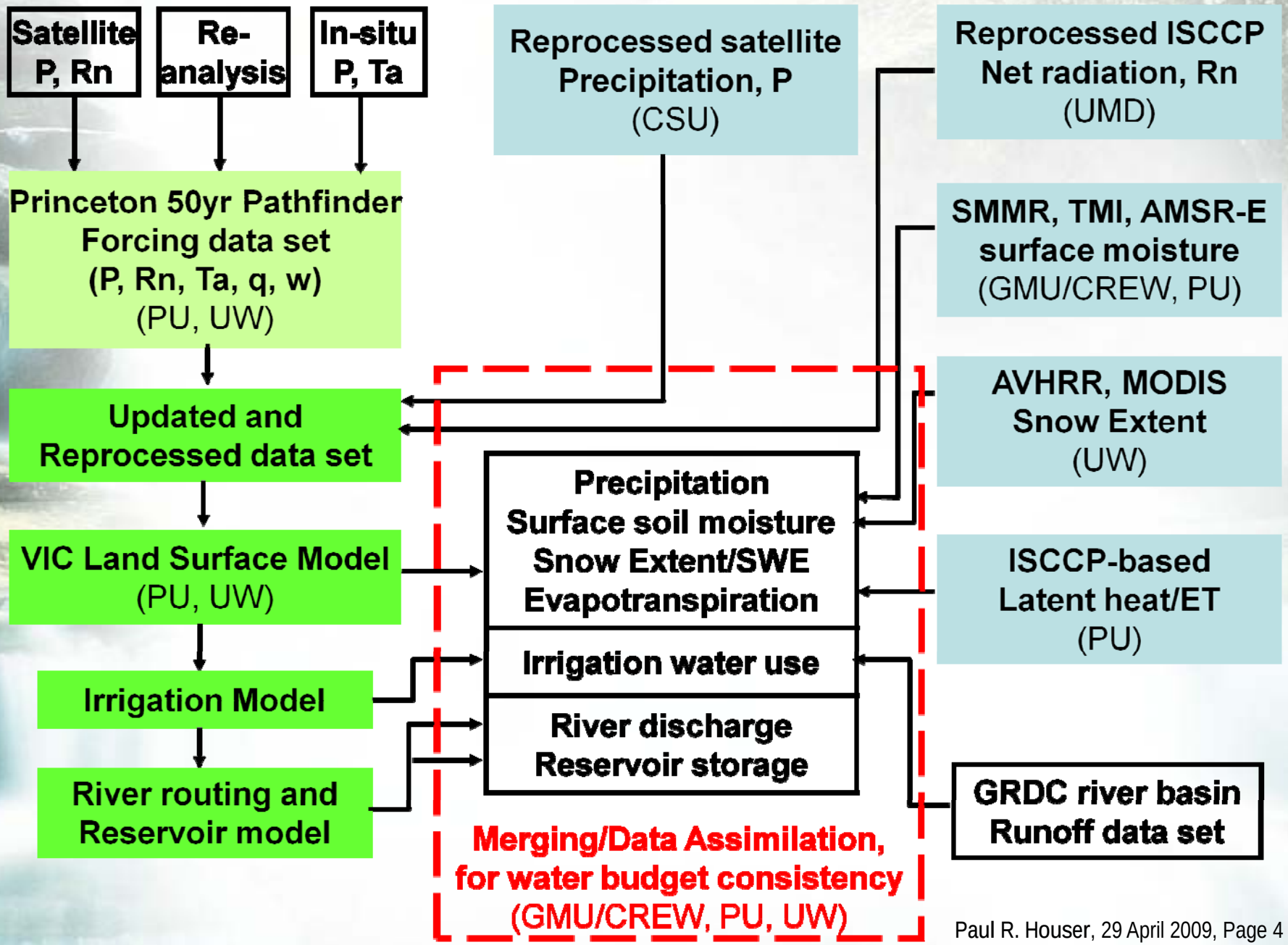
# 50year Pathfinder



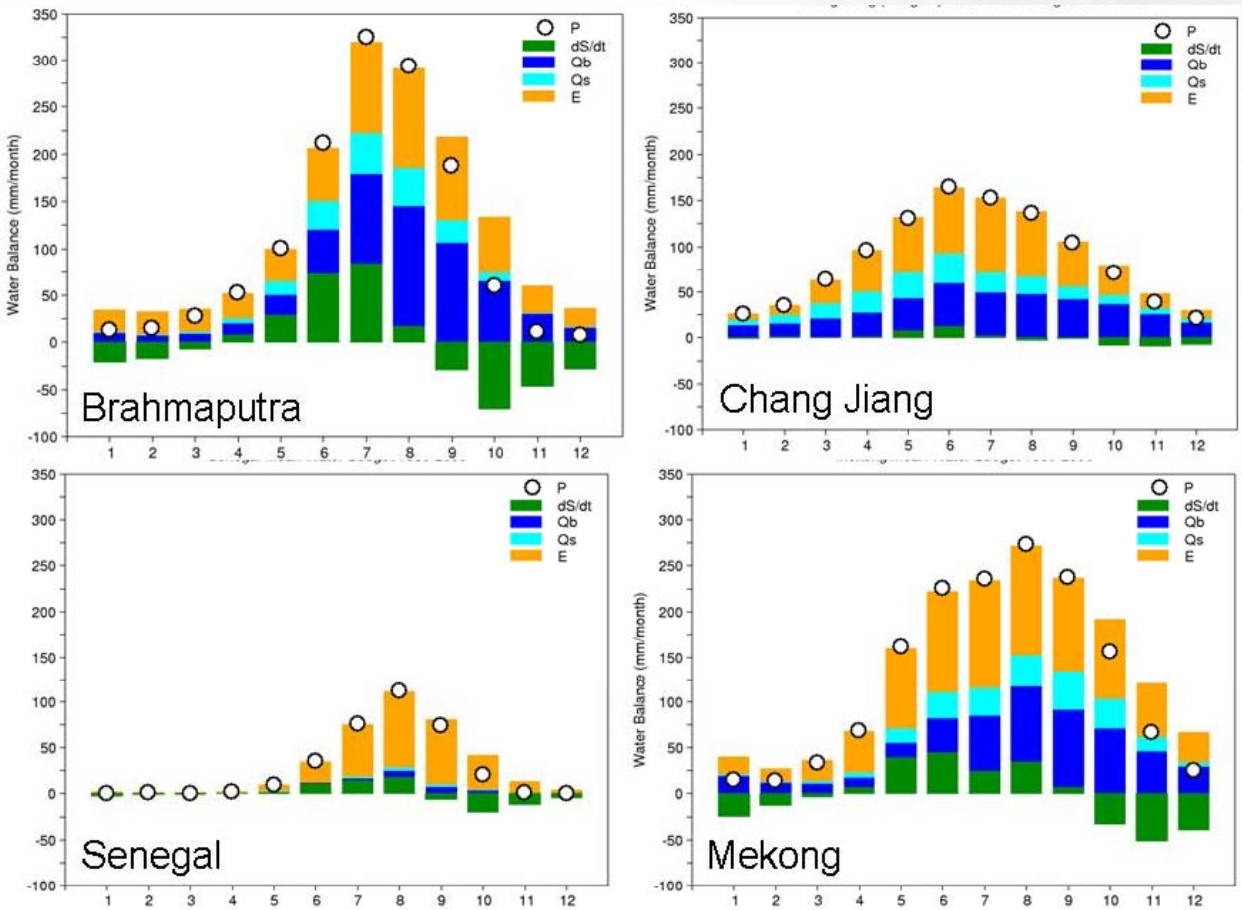

Simulated (using the VIC model) mean seasonal cycle and variability, and observations for four large global rivers.

# Schematic of Water Budget ESDRs



# Methodology

The ESDRs will merge satellite-derived products with predictions of the same variables by LSMs driven by merged satellite and in situ forcing data sets (most notably precipitation), with the constraint that the merged products will close the surface water budget.




Monthly mean water budgets for selected basins, 1950-2000. P = precipitation, E = evapotranspiration, Qs = surface runoff, Qb = baseflow, dS/dt = change in storage (soil moisture + snow).

# Data Sources

**Precipitation Forcing:** formed by merging model (reanalysis) and in situ data with satellite-based precipitation products such as TRMM, GPCP, and CMORPH.

**Derived products:**

- soil moisture (TRMM, AMSR-E, SMMR, SSM/I passive and ERS MW scatterometers)
- snow extent (MODIS and AVHRR)
- evapotranspiration (model-derived using ISCCP radiation from geostationary and LEO satellites),
- runoff (LSM predictions and in-situ measurements).

Data records will be produced at a number of different levels – each of them will have different sources and levels of processing, for example:

- Downscaled Pathfinder Water Cycle Forcing Data;
- Merged Multi-sensor Precipitation;
- VIC Model Derived Water Budget Variables;
- Reservoir Storage and Irrigation Water Use;
- Radiative Fluxes;
- Satellite Soil Moisture, Evapotranspiration and Snow;
- Merged model derived and satellite products.

# MEaSUREs: Global Terrestrial Water Cycle Data Products

1. Land Surface Model Input Forcing Data Products
2. Land Surface simulated Water Cycle Data Products
3. Satellite Derived Water Cycle Data Products
4. Satellite-Model Merged Water Cycle Data Products

# Land Surface Model Input Forcing Data Products

| | Variable Name | Time Period | Spatial Resolution | Temporal Resolution | Data Volume |
|---|---|---|---|---|---|
| Pathfinder forcing Data | Precipitation | 1950-2008 | 0.5deg | 3hr | 1.25 tb |
| | 2m-Air Temperature | | | | |
| | Specific Humidity | | | | |
| | Surface Pressure | | | | |
| | Down Longwave Rad | | | | |
| | Down Shortwave Rad | | | | |
| | Wind Speed | | | | |

# Land Surface simulated Water Cycle Data Products

| | Variable Name | Time Period | Spatial Resolution | Temporal Resolution | Data Volume |
|---|---|---|---|---|---|
| VIC Model Output Products | Precipitation | 1950-2008 | 0.5 deg | 3hr | 1.43 tb |
| | Evapotranspiration | | | | |
| | Soil Moisture | | | | |
| | Snow Water Equivalent | | | | |
| | Runoff | | | | |
| | irrigation water use data | | | | |
| | river discharge | | | | |
| | reservoir storage | | | | |

## Satellite Derived Water Cycle Data Products

| | Variable Name | Time Period | Spatial Resolution | Temporal Resolution | Data Volume |
|---|---|---|---|---|---|
| Satellite Derived Products | Precipitation | 1983-2008 | 0.5 deg | daily | 62 gb |
| | Reservoir storage | | | | |
| | Irrigation Water Use | | | | |
| | Radiative Fluxes/ Net Radiation | | | | |
| | Evapotranspiration | | | | |
| | Soil Moisture | | | | |
| | Snow Cover Extent | | | | |

## Satellite-Model Merged Water Cycle Data Products

| | Variable Name | Time Period | Spatial Resolution | Temporal Resolution | Data Volume |
|---|---|---|---|---|---|
| Satellite-Model Merged Data Products | Soil Moisture | 1983-2008 | 0.5 deg | daily | 50 gb |
| | Snow water Equivalent | | | | |
| | Evapotranspiration | | | | |
| | Reservoir storage/ Irrigation Water Storage | | | | |
| | Reservoir storage | | | | |