Integrated Water Science Plan for the Next Decade

Improved monitoring and prediction of water-related hazards, water resources, and water quality

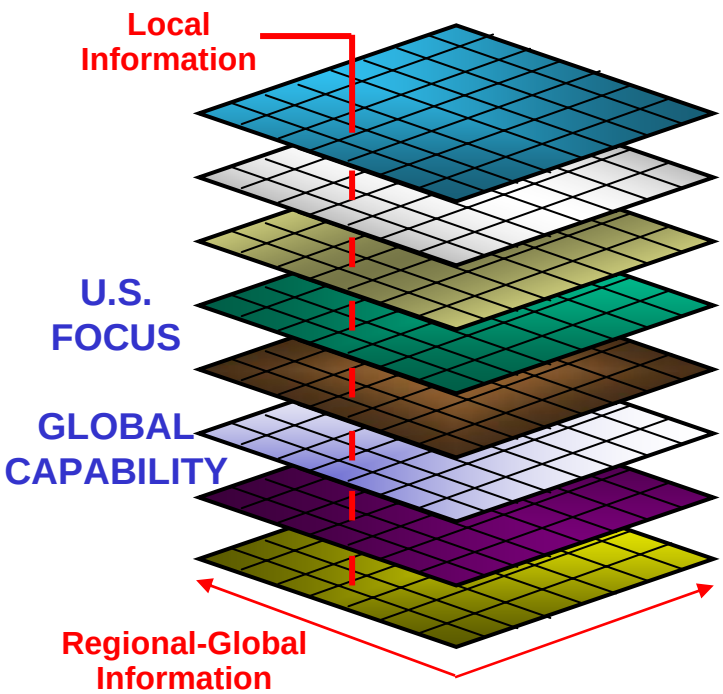
Storm near Elko, Nevada. NOAA

Spring snowmelt, Sonora Pass, California, USA
Photograph by Cagan Hakki Sekercioglu,
naturalphotos.com

Gary Carter
NOAA's Hydrology Program Manager
Hydrometeorological Testbed Meeting

Primary Objective: Integrated Products and Services

High-Resolution Gridded
Water Resources Product Suite (WRPS)



- Precipitation
- Snowpack
- Soil Moisture, Runoff
- Evaporation
- Groundwater
- River flow
- Surface Storage
- Water Quality
- Others

Applications

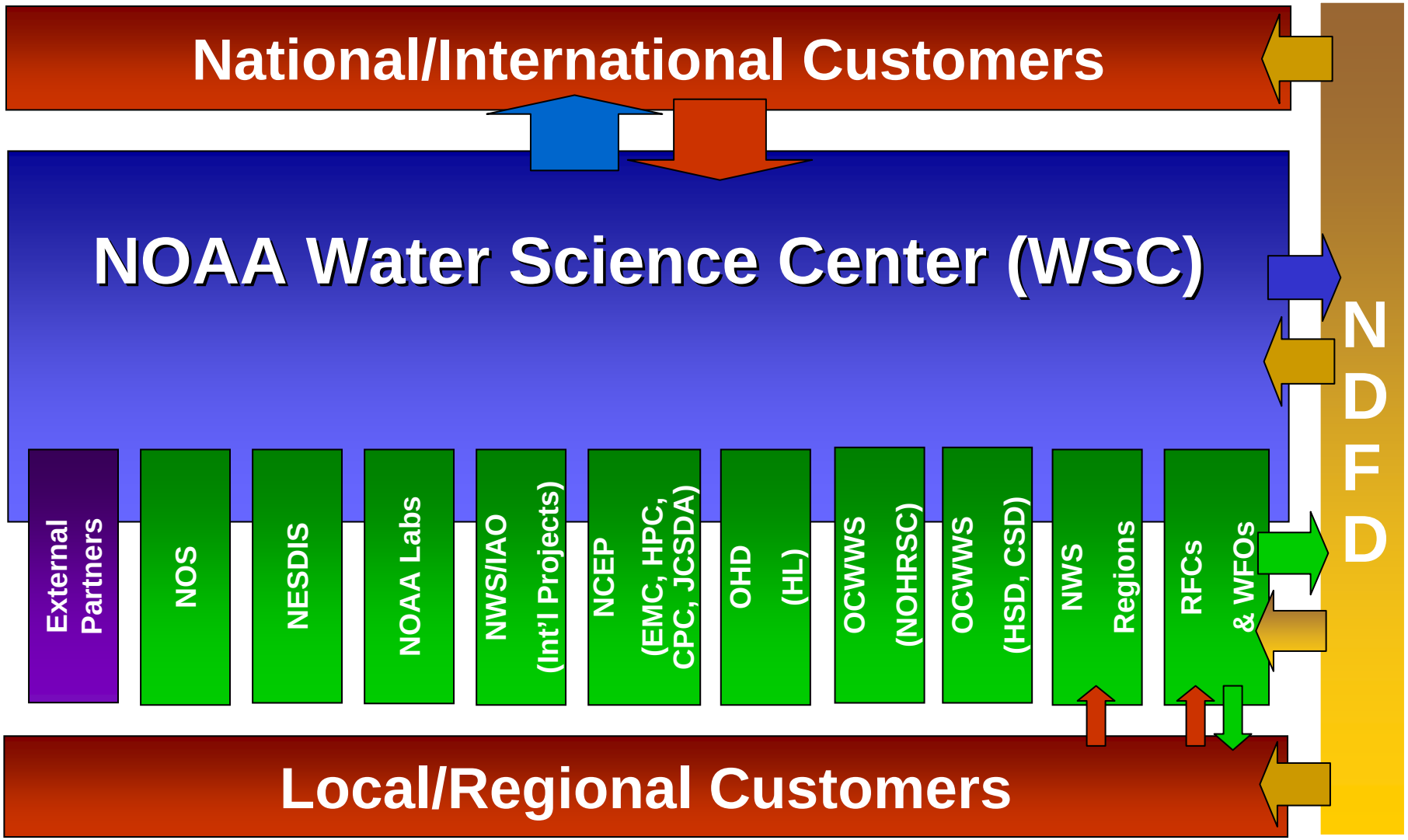
Drought
Flood Management
Flash Flood Prediction
Water Supply
Transportation
Emergency Management
Agriculture
Debris Flows
Ecosystems Management
Research

Customers

NWS
NOAA
Federal Agencies
Tribal Agencies
State Agencies
Local Agencies
Private Sector
Academia

The WRPS includes a comprehensive suite of high-resolution (1-10 km) gridded hydrologic state variable and flux datasets and derived products to support a wide range of future applications and services. Temporal characteristics of WRPS range from current-hour analyses to forecasts of several months. Datasets include rainfall, snowfall, snow water equivalent, snowpack temperature, snowmelt, soil moisture, soil temperature, evaporation, sublimation, streamflow, and surface storage. Other hydrologic variables such as groundwater, fuel moisture, soil stability (e.g. debris flows potential), water quality, etc. are also possible in this framework.

Future Vision: National Center of Excellence for Water Science



Note: NDFD – National Digital Forecast Database

Hydrologic Modeling Challenges

Physical, Institutional, & Legal Features

Meteorological inputs

Topography

Vegetation, land use

Lakes, glaciers

Dams, locks, levees

Reservoir operations

Soil properties

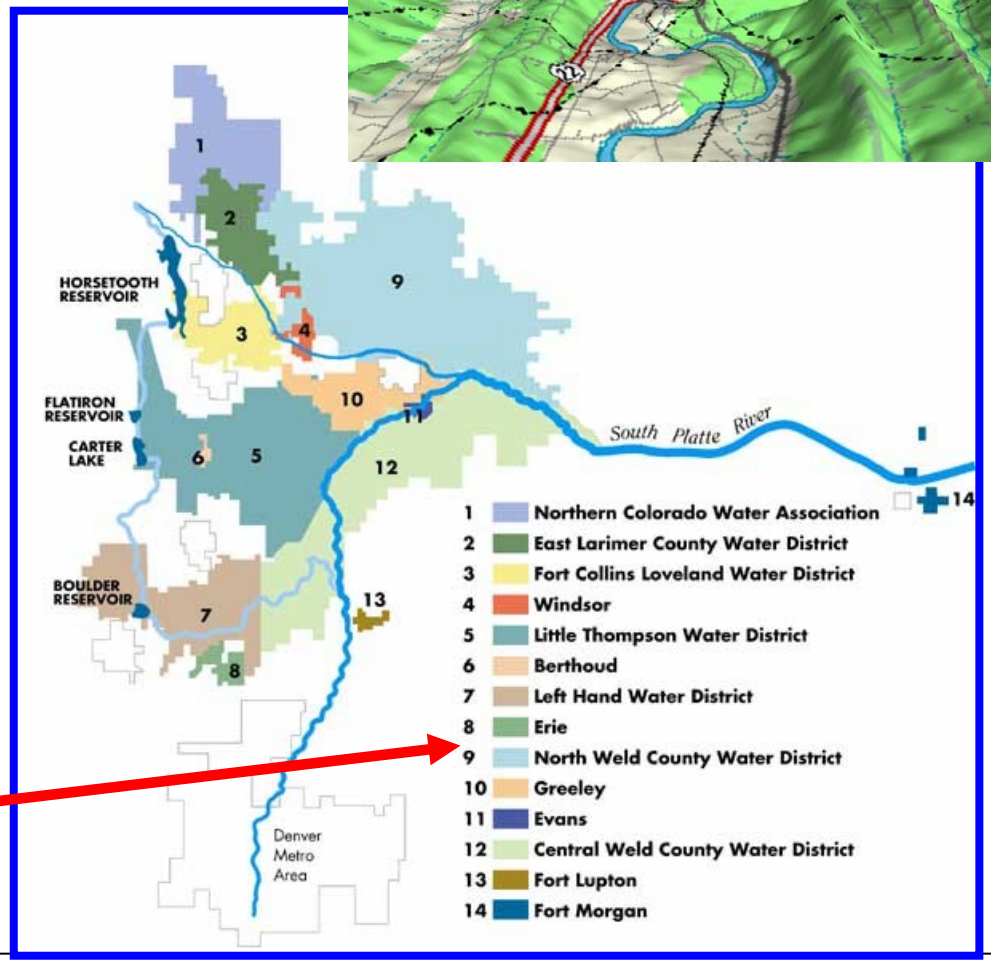
Irrigation, drains

River channel shape

River depth/flow relationships

Water rights

Ground water



Major Science Elements Included in Water Science Objectives

Forcings

- **Precipitation**
  - QPE
  - QPF
  - Liquid, solid, Extreme Events, Space-Time Variability
- Air Temperature Humidity
- Winds
- Radiative
  - Solar
  - Longwave
- **Anthropogenic**
  - Aerosols
  - Irrigation

Infiltration

- Soil Hydraulics
  - Soil Characteristics
- Soil Heterogeneity

Storage

- Snow
  - SWE, Depth
  - Cover Extent
  - Snowmelt
- **Lakes**
  - Location
  - Size
  - Water Quality
- **Marshes & Wetlands**
- Reservoirs
  - Location
  - Size
  - Management/ Operations
- Soil Moisture & Temperature
  - Moisture Profile
  - Temperature Profile
  - Frozen Soil
- Channel Storage
  - Channel geometry
  - Channel loss
- **Canopy Interception**
- **Ground -water**
  - Withdrawal
  - Recharge
  - Quality
- **Geologic Transport**
  - Karst Topography
  - Volcanic Regions
  - Fault Zones

Evaporation

- Soil Evaporation
- Water Surfaces
- Snow Sublimation
- Evapotranspiration

Flow

- **Water Quality**
  - Sediment Transport
  - Temperature
  - Pollutants
  - Salinization
- Runoff
  - Surface Flow
  - Subsurface Flow
- River Flow
  - River Ice
  - Diversions & Return Flows
  - Extreme Events
  - Channel Geometry
- **Coastal Zones**
  - Freshwater Inflow to Estuaries
  - Tidal Influences
- **Debris & Snow Flows**
- Ungauged Basins

Surface Properties

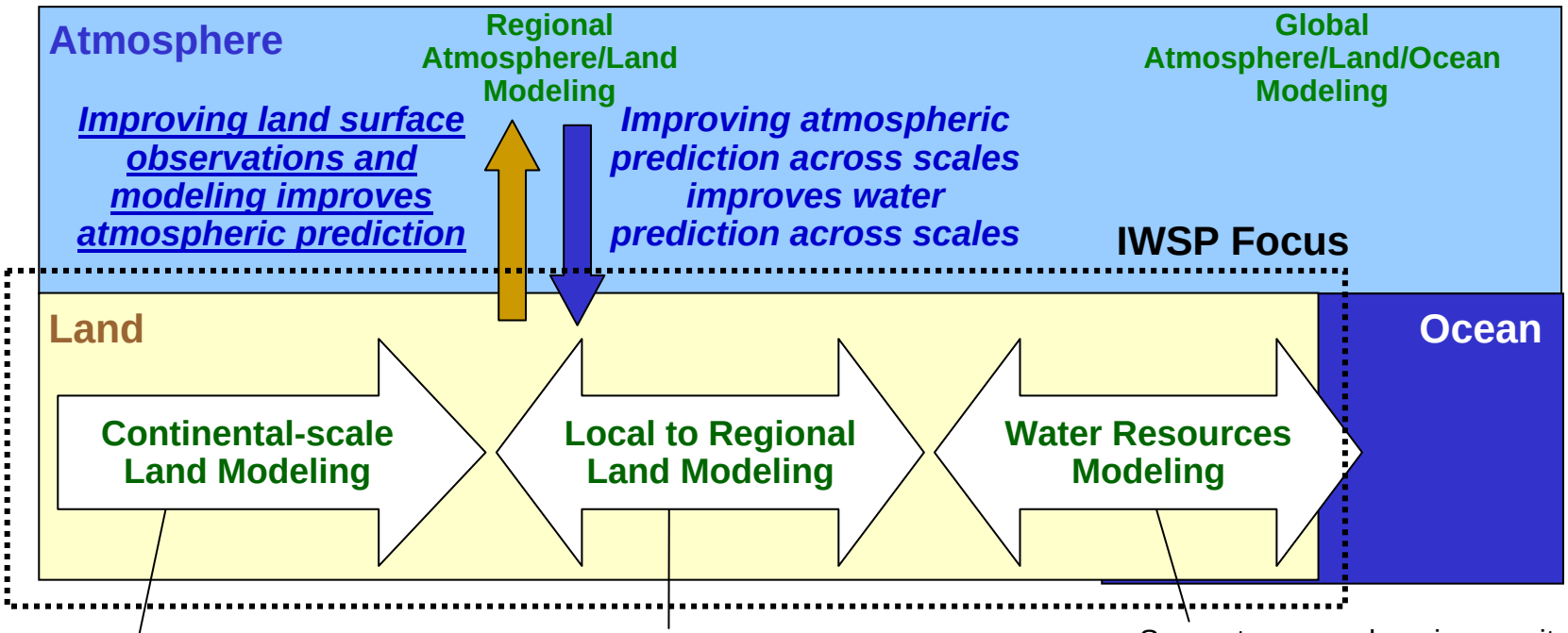
- Land Use/Cover
  - Vegetation Type, Density
  - Seasonal Phenomenology
  - Forest Burn Areas
- Soil Characteristics
- Topography
  - Stream Networks
  - Basin Boundaries
  - Radiative Transfer Modeling
- Albedo

Varying capability in NWS

Little or No Current Capability in NWS

Water Science Vision: Integrated Hydrologic Land Surface Modeling

Integrated, end-to-end hydrologic land-surface modeling framework is centerpiece of new water science vision. This is necessary to improve monitoring and prediction of water cycle at local, regional, continental and global scales.

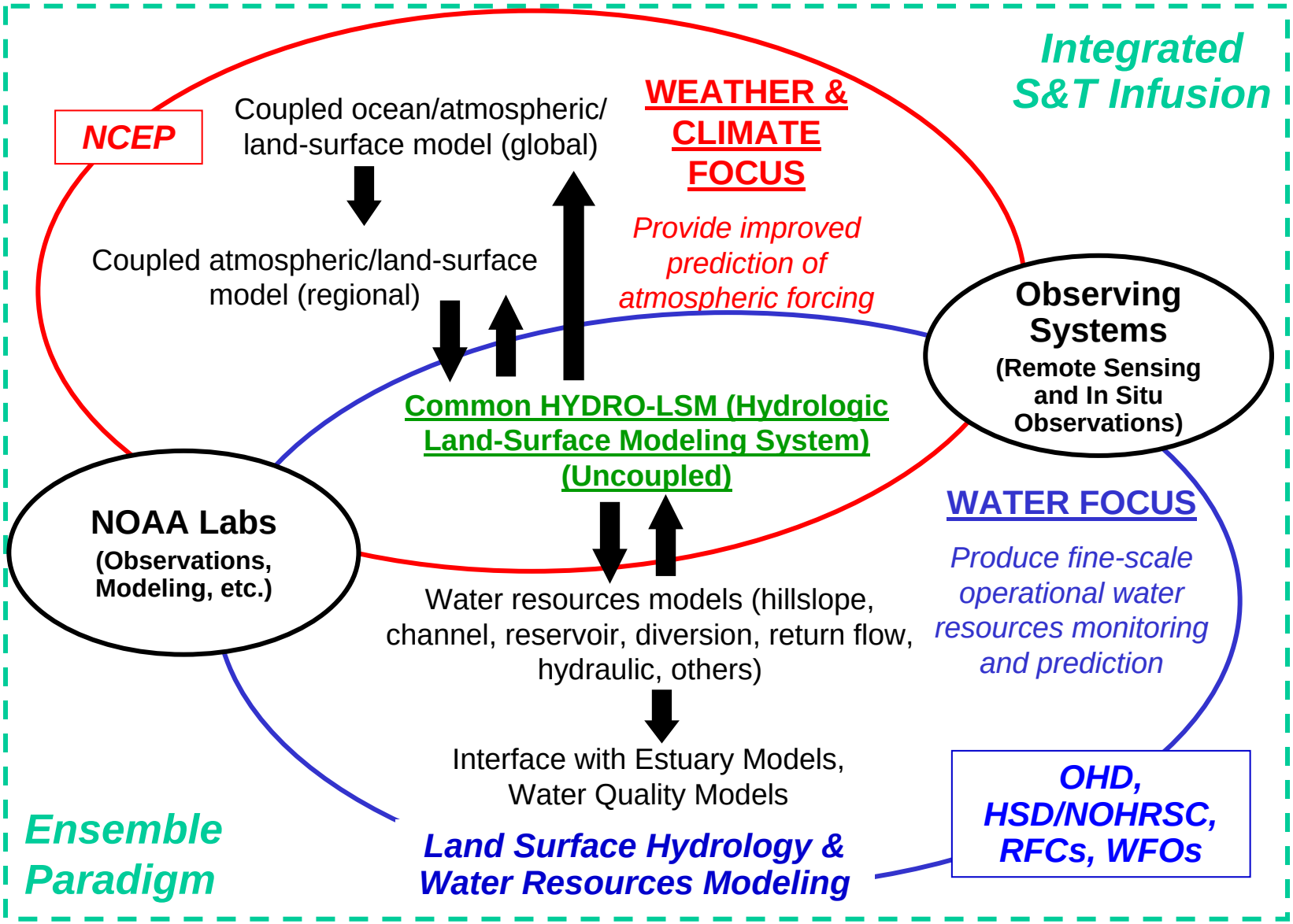


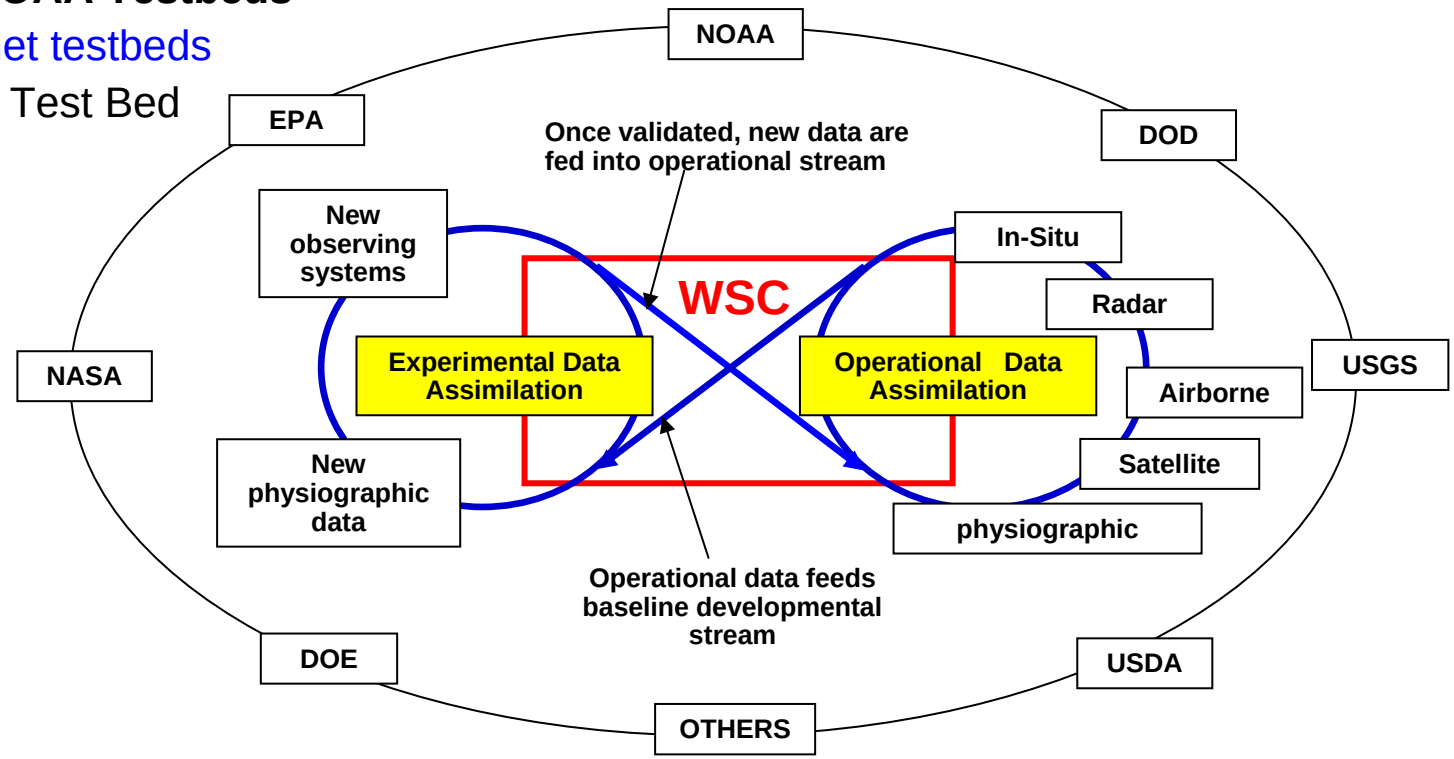
Generates U.S.-focused, high-resolution, short- to long-range Water Resources Product Suite (WRPS)

Supports local to regional applications, including prognostic analysis of land surface/use changes

Supports comprehensive monitoring and prediction of flow, storages and quality of water, including coupling with estuaries and tidal influences

New Water Science Framework



WSC Hydro-Testbed

- **Development System for National Hydro-LSM and Water Resources Models**
  - Science center for RFC Hydro-LSM and water resources models
- **Experimental Hydrologic Operations – "Experimental RFC"**
  - National domain
  - International capability
  - Develop and test new science, demonstrate pathway to operations, conduct retrospective analyses
- **Leverage NOAA Testbeds**
  - Hydromet testbeds
  - Climate Test Bed