Integrating local sensors into the flood and drought monitor

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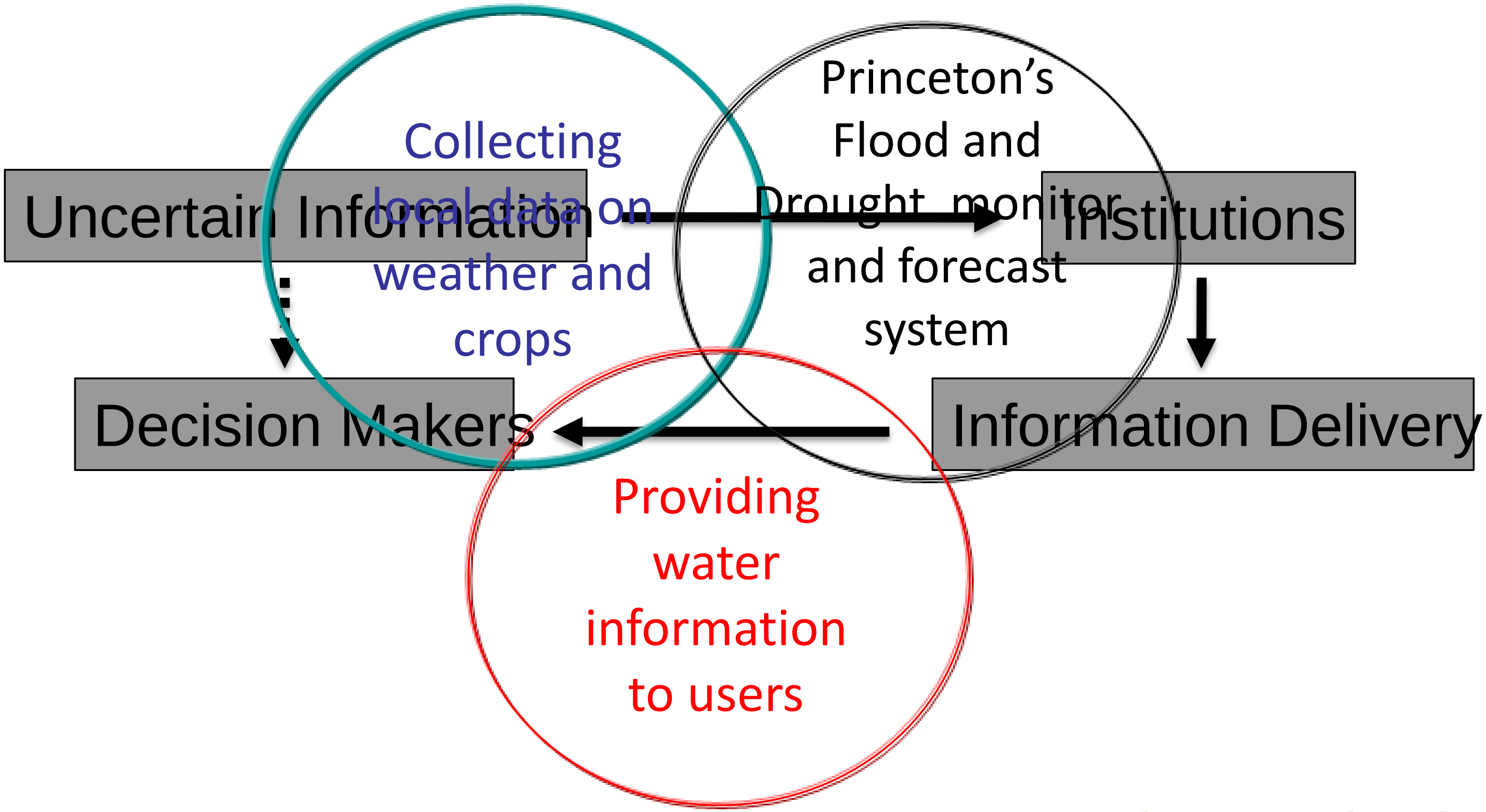
Implementation of the Latin-American and Caribbean Flood and Drought Monitor:
Calibration and Validation by National Hydrological Services
17-18 November 2014

The information transfer challenge – empowering local people

How can local communities obtain weather and drought information to help them make decisions and developing coping strategies?

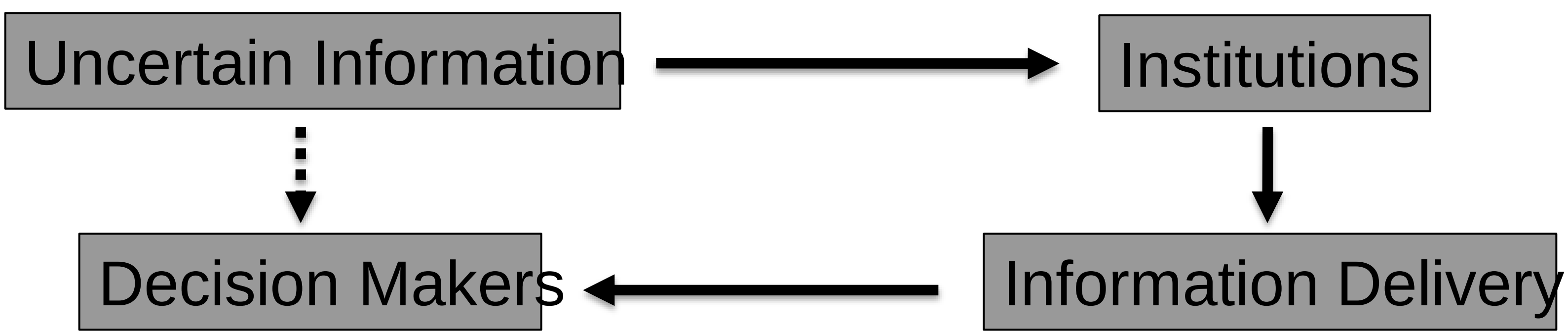


Some Big Challenges

1. Identifying new sources of observational data to enhance real-time monitoring and improve initialization of forecasts; improving forecast skill at time and space scales relevant for decision making

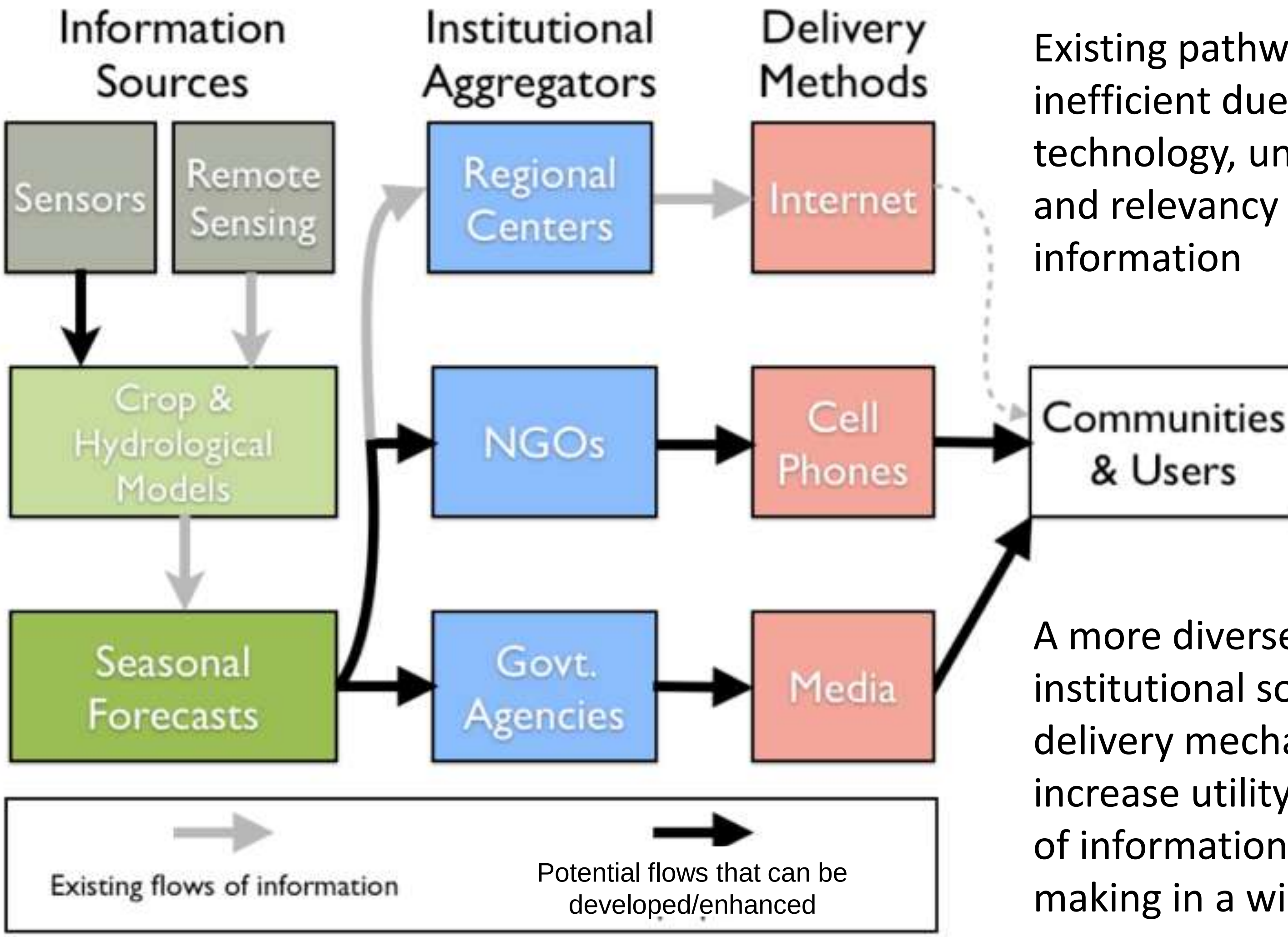
2. How knowledge/technology can be transferred to universities and practitioners for sustainable solutions to achieving water and food security, and improve livelihoods for mitigation and improved resilience?

3. Understanding the utility of climate/drought information to
   (i) inform policy making at national scales and
   (ii) improve agricultural decision making at all levels



There is Potential to Improve Information Utility and Transfer to Decision Makers

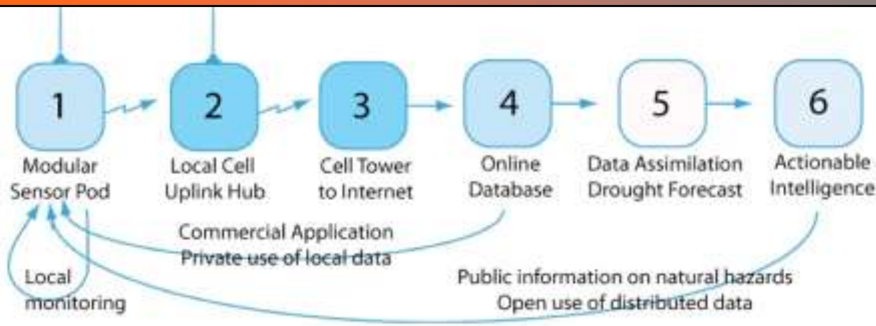
Alternative pathways of information delivery to users.

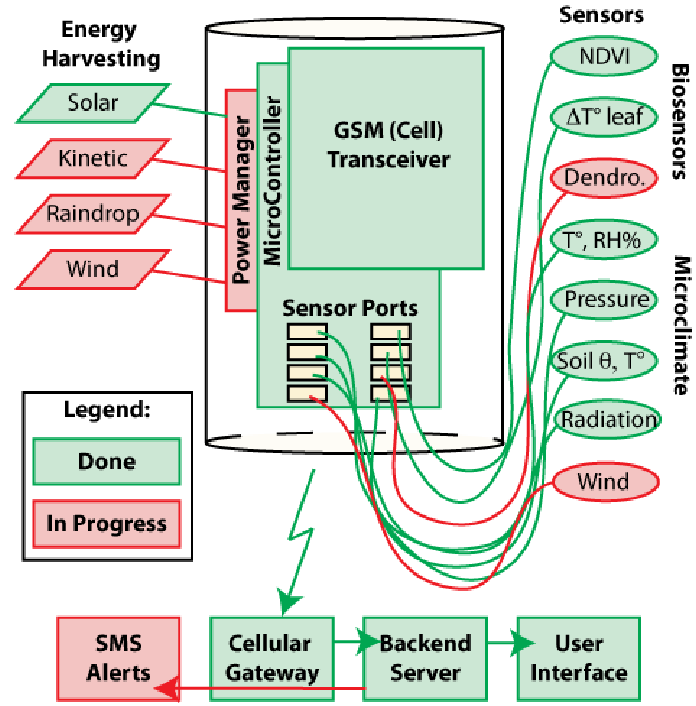


Existing pathways may be inefficient due to lack of technology, understanding and relevancy of the information

A more diverse suite of institutional sources and delivery mechanisms may increase utility/specificity of information for decision making in a wider range of contexts.

Overcoming the Lack of Observations: Potential of Low-Cost Environmental Sensors Communicating over the Cell Network





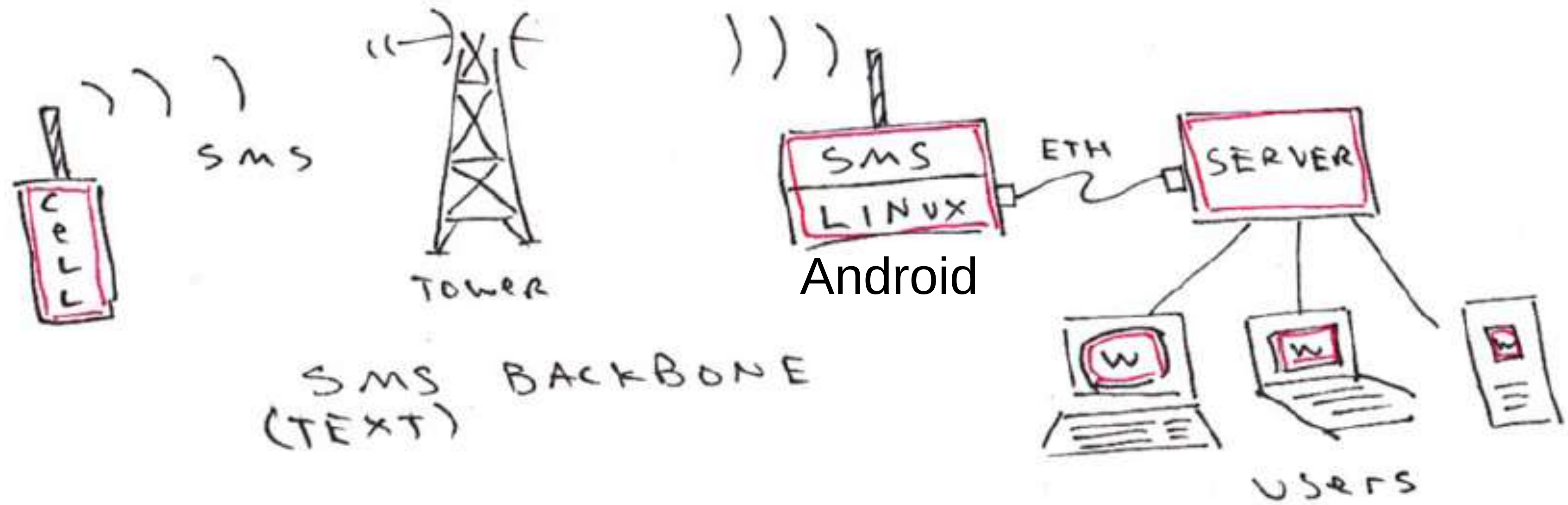
There's a large and rapidly growing cellphone network in Latin America

The infrastructure is maintained by private sector and is ubiquitous in populated areas

How can global systems be enhanced with local information, particularly in data sparse regions of the world?

Princeton University is developing **low cost** sensors to create community level crop and drought networks

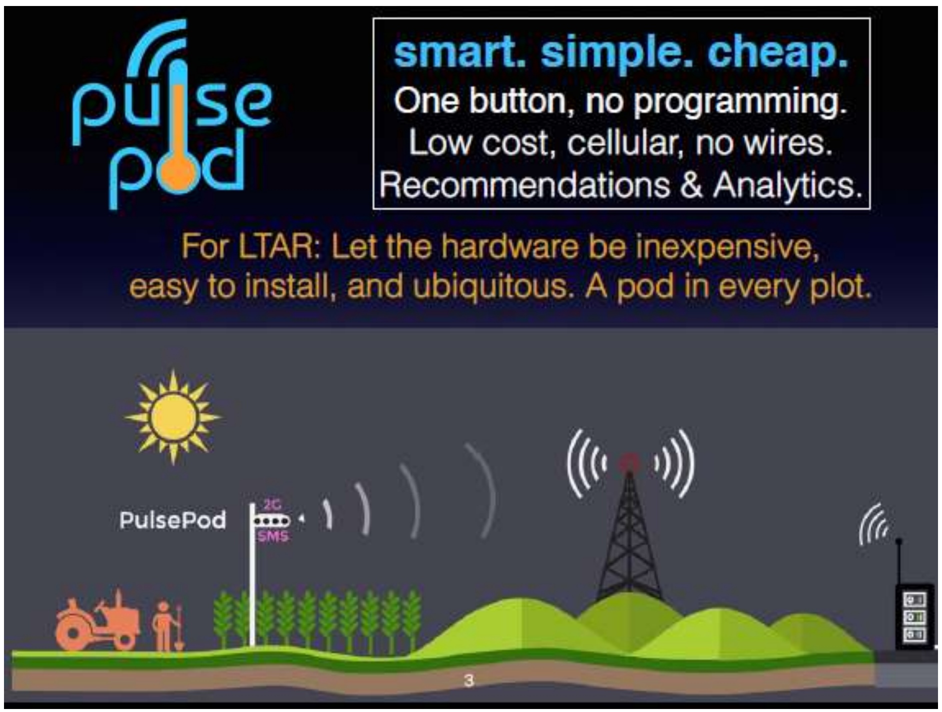
And communicating in **real-time** to local users

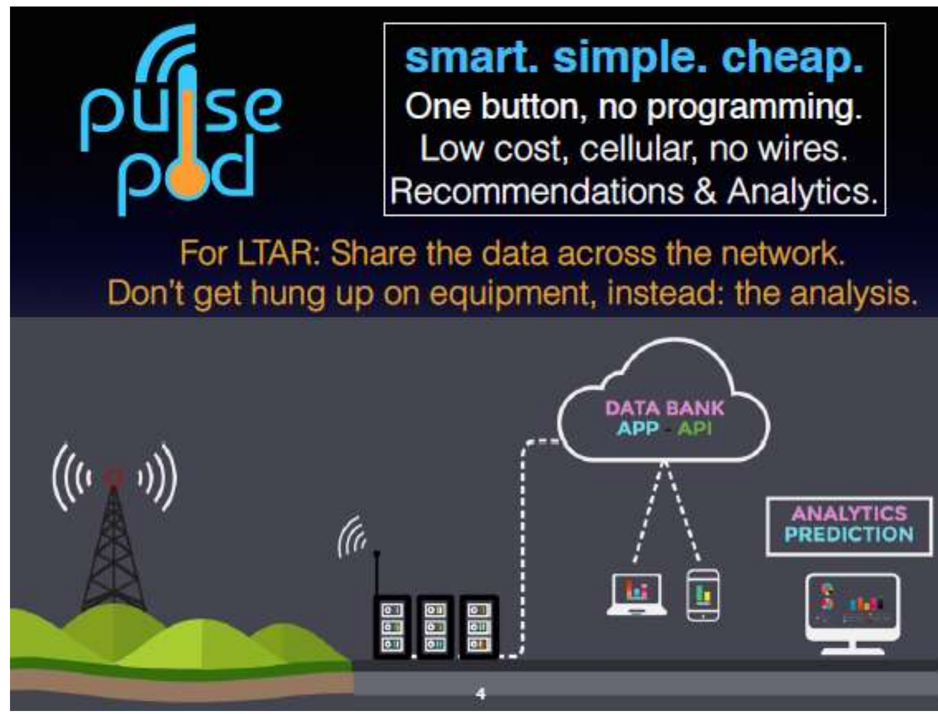


Pods send SMS messages to a gateway that posts messages onto the internet


www.pulsepod.io
pulse pod
Environmental data. Simplified.
1


our usual loggers:
expensive, error prone, offline
2


pulse pod
smart. simple. cheap.
One button, no programming.
Low cost, cellular, no wires.
Recommendations & Analytics.
For LTAR: Let the hardware be inexpensive,
easy to install, and ubiquitous. A pod in every plot.
PulsePod
2G
SMS
3

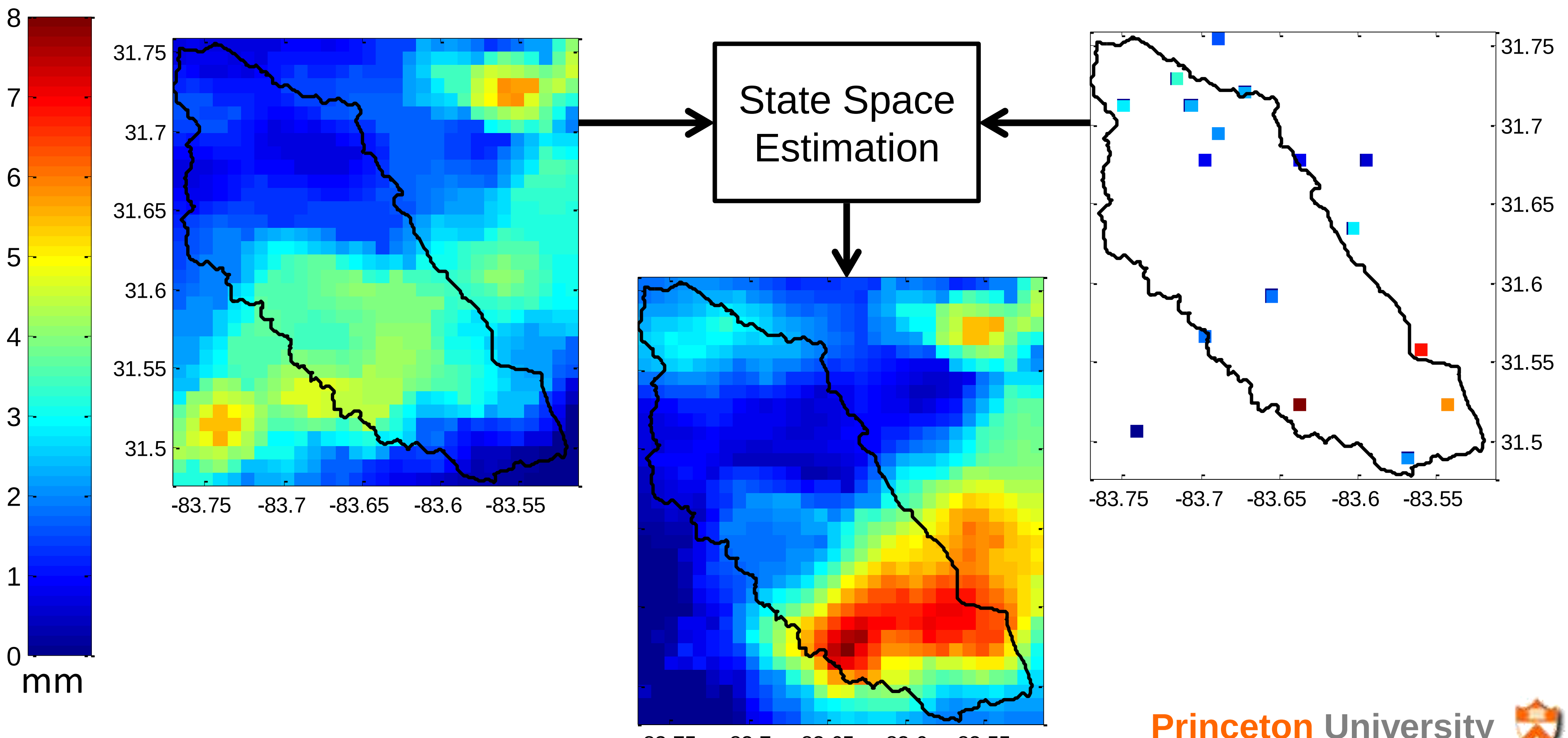

pulse pod
smart. simple. cheap.
One button, no programming.
Low cost, cellular, no wires.
Recommendations & Analytics.
For LTAR: Share the data across the network.
Don't get hung up on equipment, instead: the analysis.
DATA BANK
APP - API
ANALYTICS
PREDICTION
4

Merging Local Monitoring with Spatial Measurements

Generating high resolution precipitation.

combine the spatial variability, but poor accuracy of satellite data with the local accuracy of rain gauges.

- Use the state – space linear estimation to correct the radar data with rain gauges (*Chirlin G. R. and Wood E. F., 1982*).



Current Status of the PulsePod system within the flood and drought monitor

They are currently being field deployed in in the USA and Africa in a test mode. This will assess the design elements as well as the robustness of the sensors under actual conditions.

Algorithms have been developed to integrate the point measurements with spatial measurements (e.g. satellite and model estimates).

Bringing the two elements together (point, in-situ data and spatial estimates) will be completed in the near future.

ANY QUESTIONS??

7-Day and Seasonal Forecasting within the Flood and Drought Monitor

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United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme
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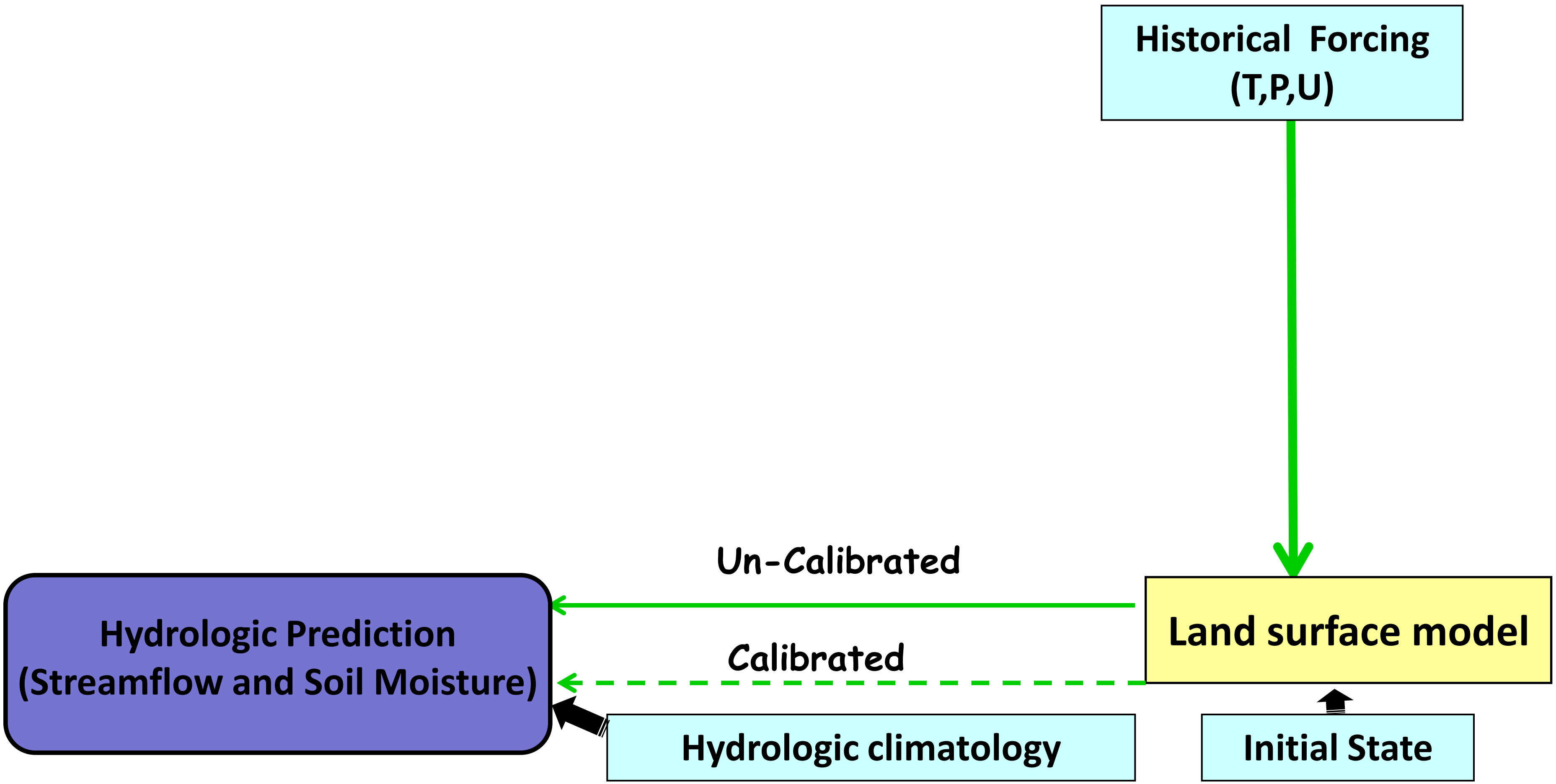
Princeton University

Hydrologic Forecast Methodology



Types of Drought and the Corresponding Forecasts

Short-term Forecasts:
7 to 14 days and usually based on dynamical weather models (single model or multi-model). Particularly focused on flood forecasting, heat waves, and alleviation of drought conditions.

Seasonal Drought Forecasts

Meteorological Drought:

Standardized Precipitation Index (SPI), 1 to 12 months; or a Temperature based index

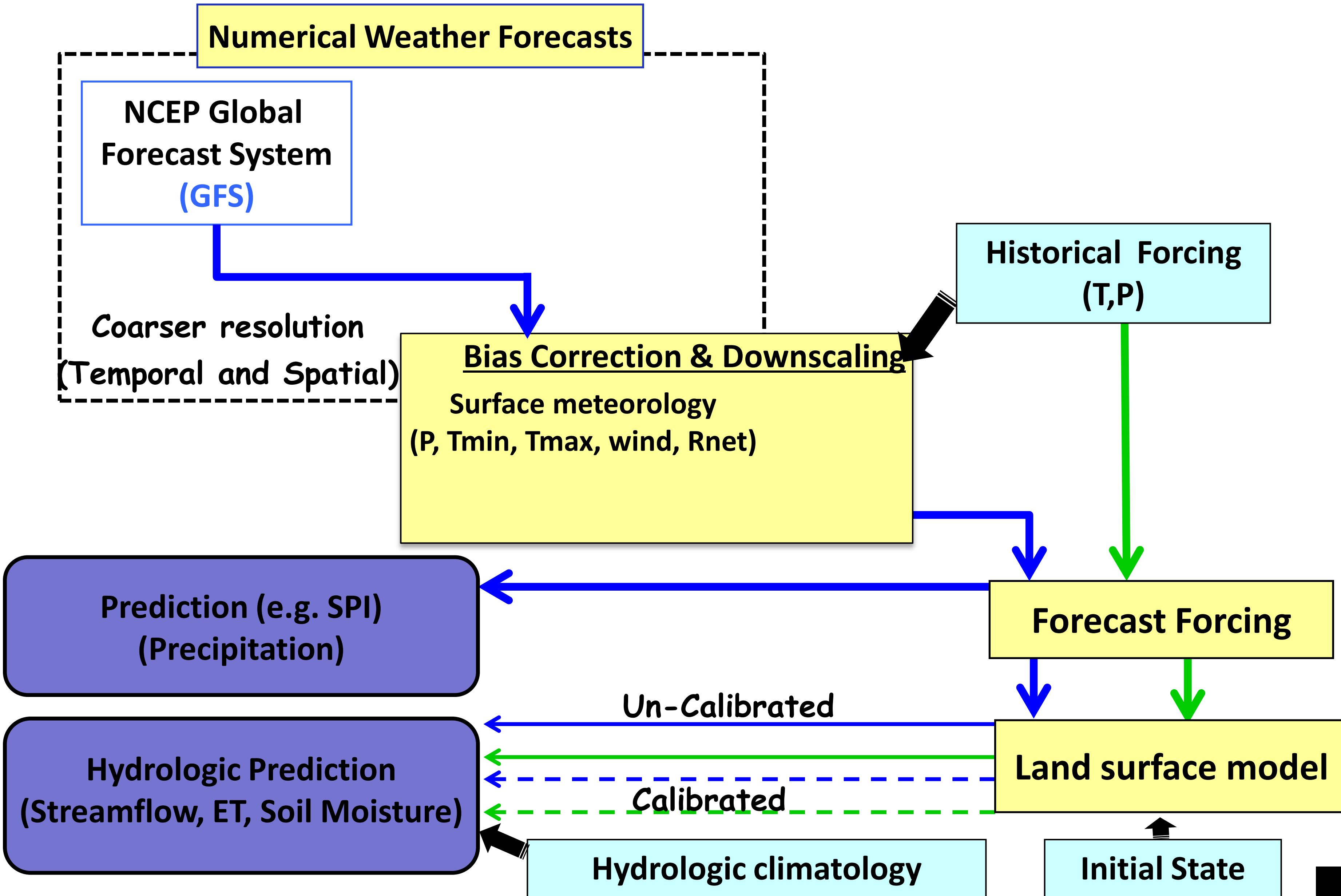
Agricultural Drought:

Based on soil moisture (e.g. SM percentiles), a evaporative stress index or vegetation stress index (e.g. NDVI)

Hydrological Drought:

Based on streamflow percentiles, or reservoir percentiles

7-Day Forecast Methodology



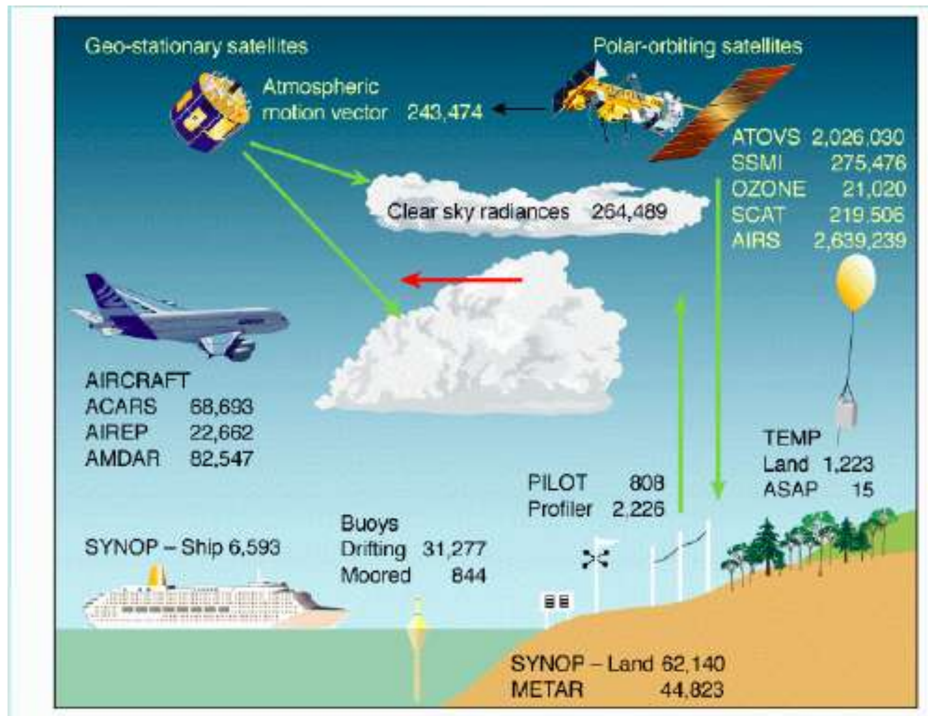
Real-Time and 7-day Meteorological Data: Weather Model

Global Forecast System

1. Global weather forecasting model.
2. Run by NOAA (National Oceanic and Atmospheric Administration).
3. Run every 6 hours at 00,06,12,18 hours UTC.

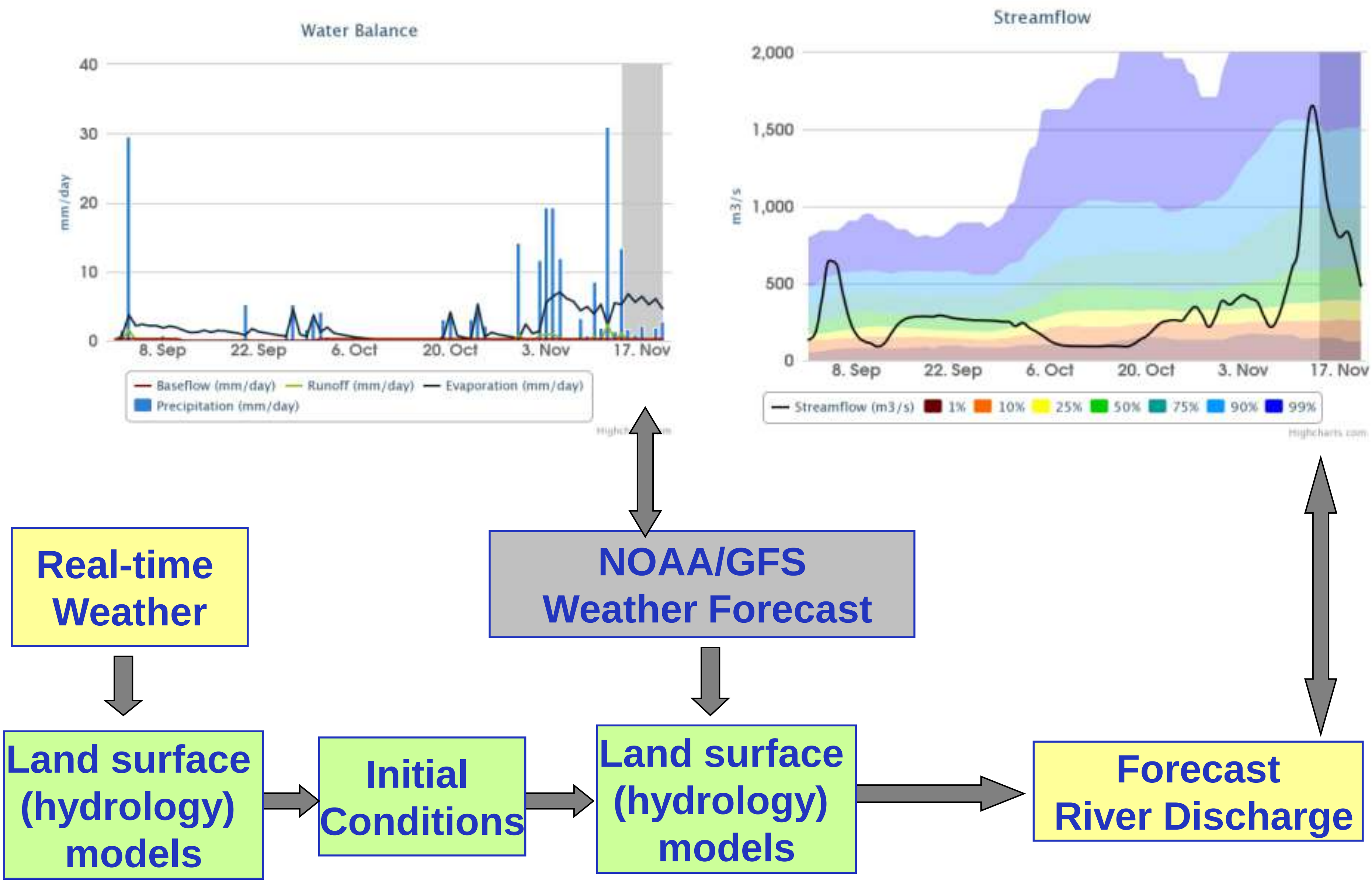
GFS analysis fields

- Initial conditions are necessary at the beginning of each forecast.
- The Initial conditions come from GDAS (Global data assimilation system)
- Merge multiple data sources

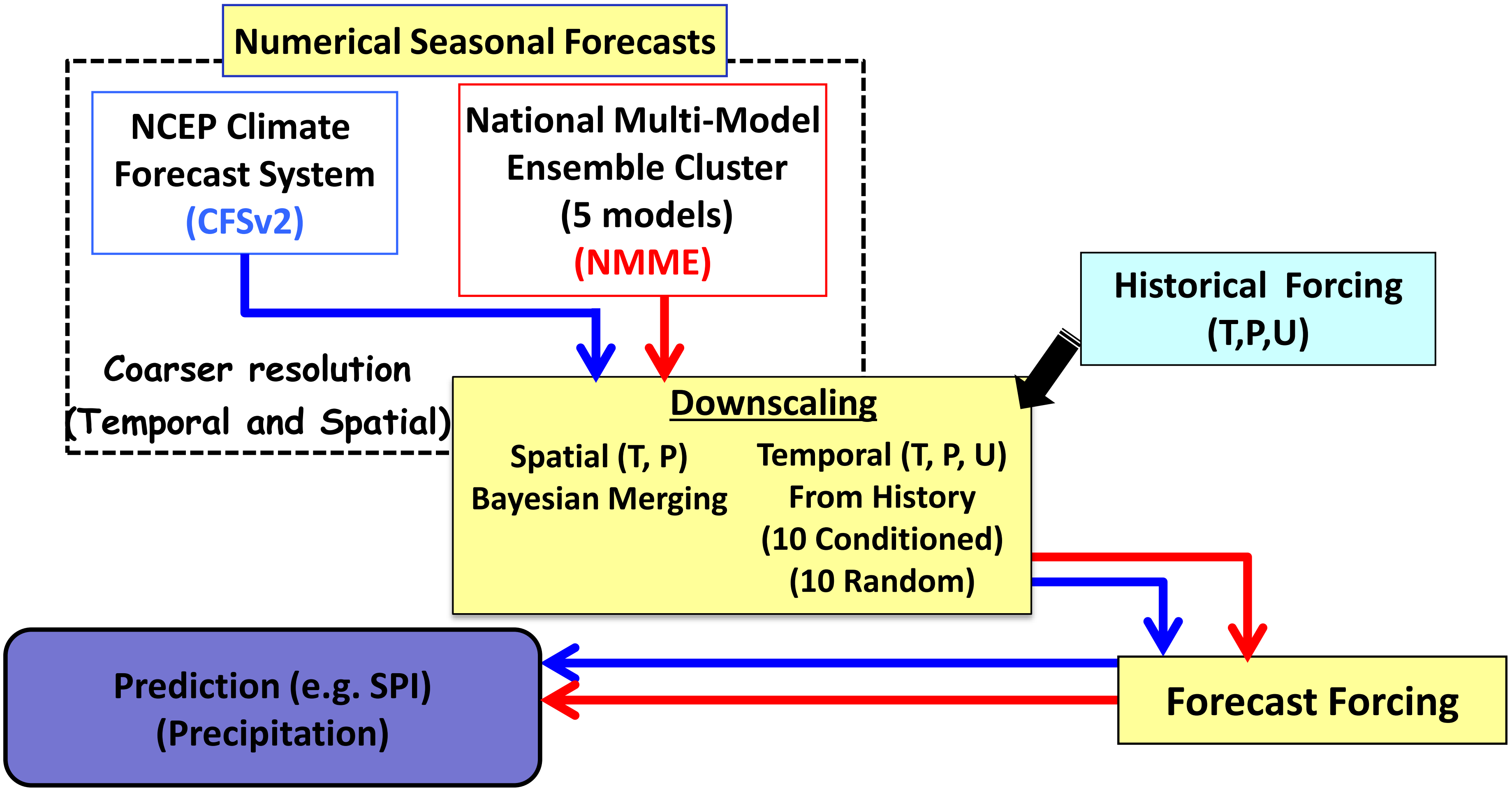


7-day forecasting based on NCEP's GFS

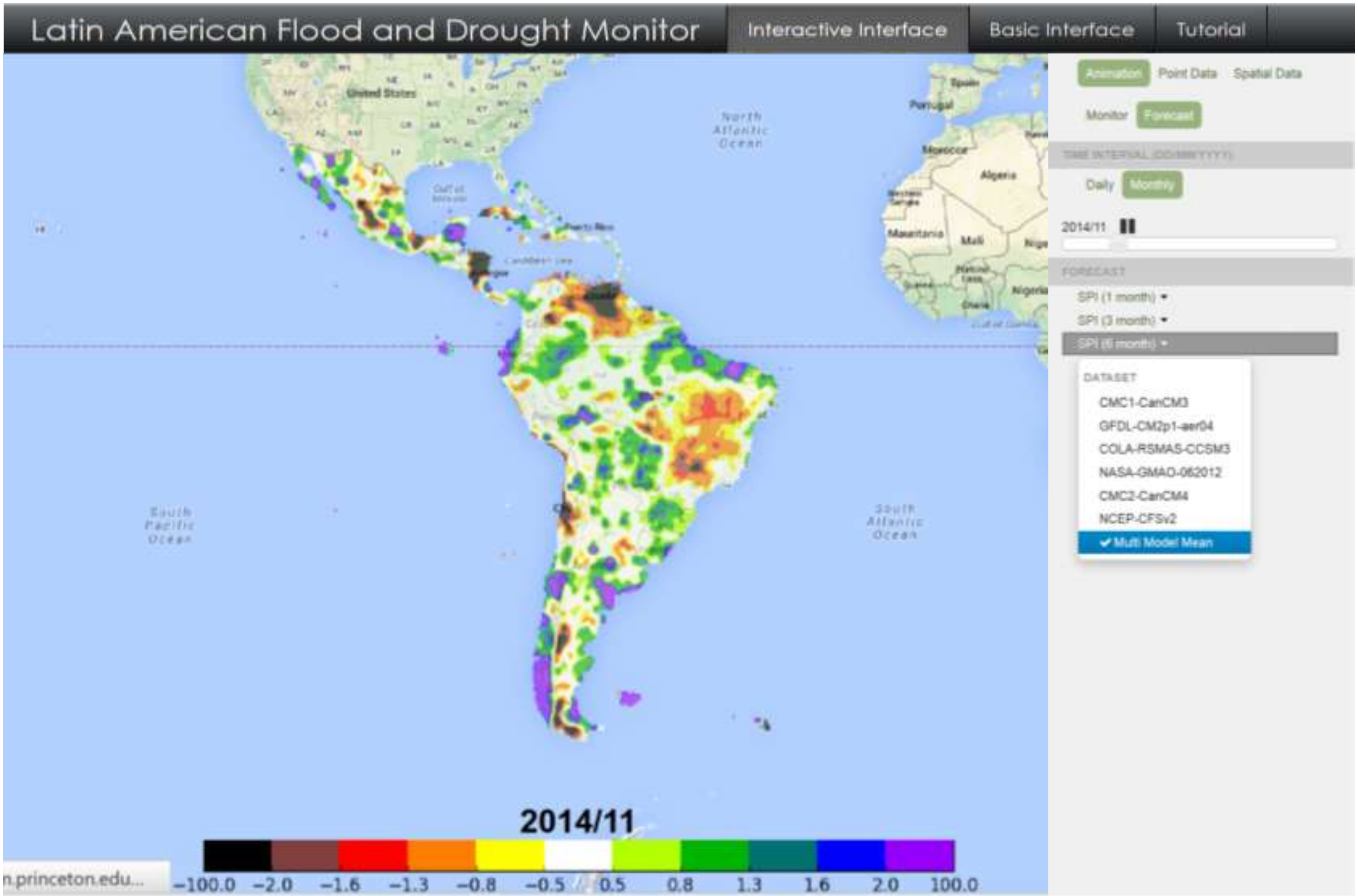
Streamflow Monitoring and Short-Term Forecasts



Seasonal Forecast Methodology

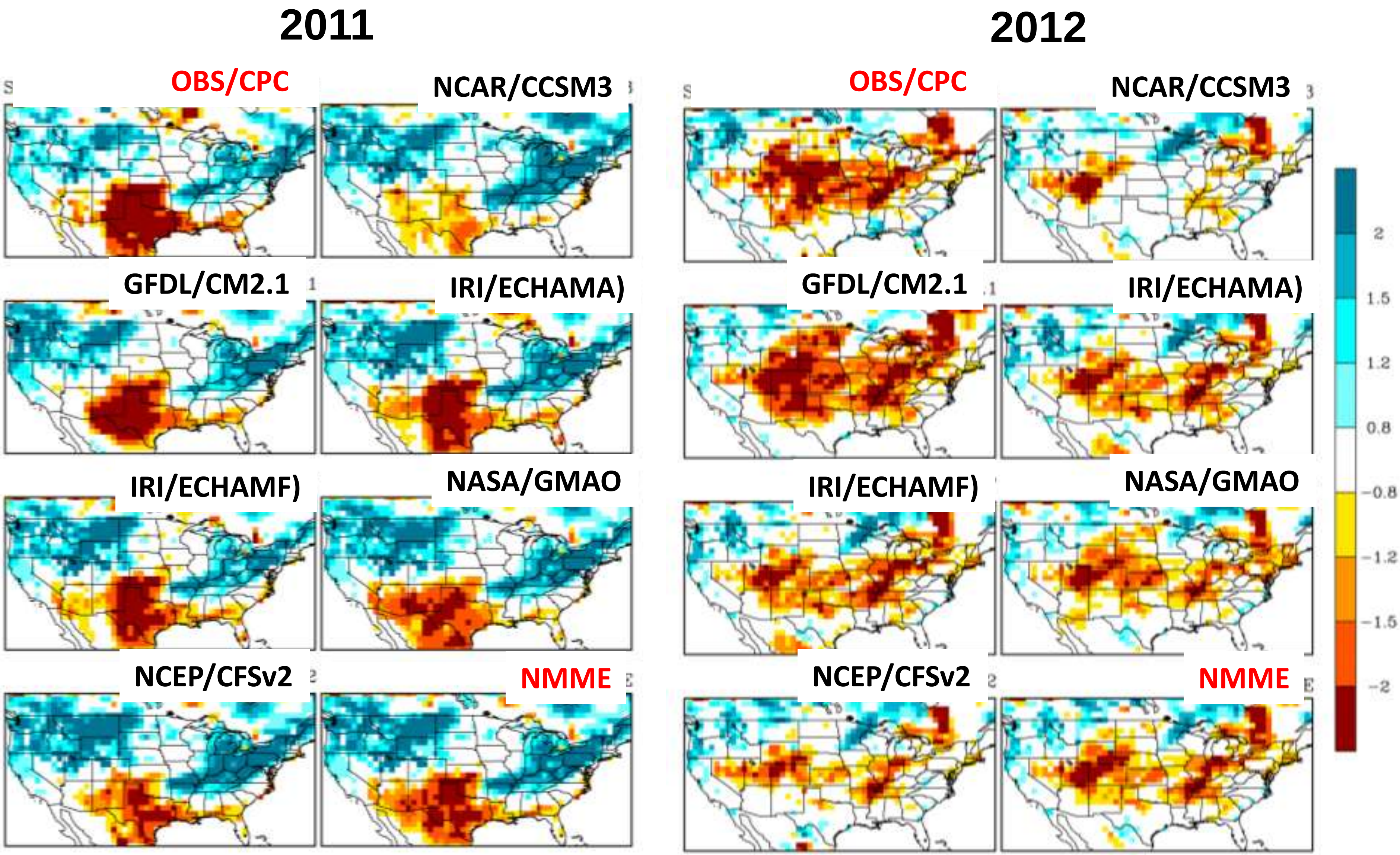


Seasonal SPI-6 (6-month) forecast (for 11/14 from 10/14)



SPI6 for MAMJJA, 2011 & 2012

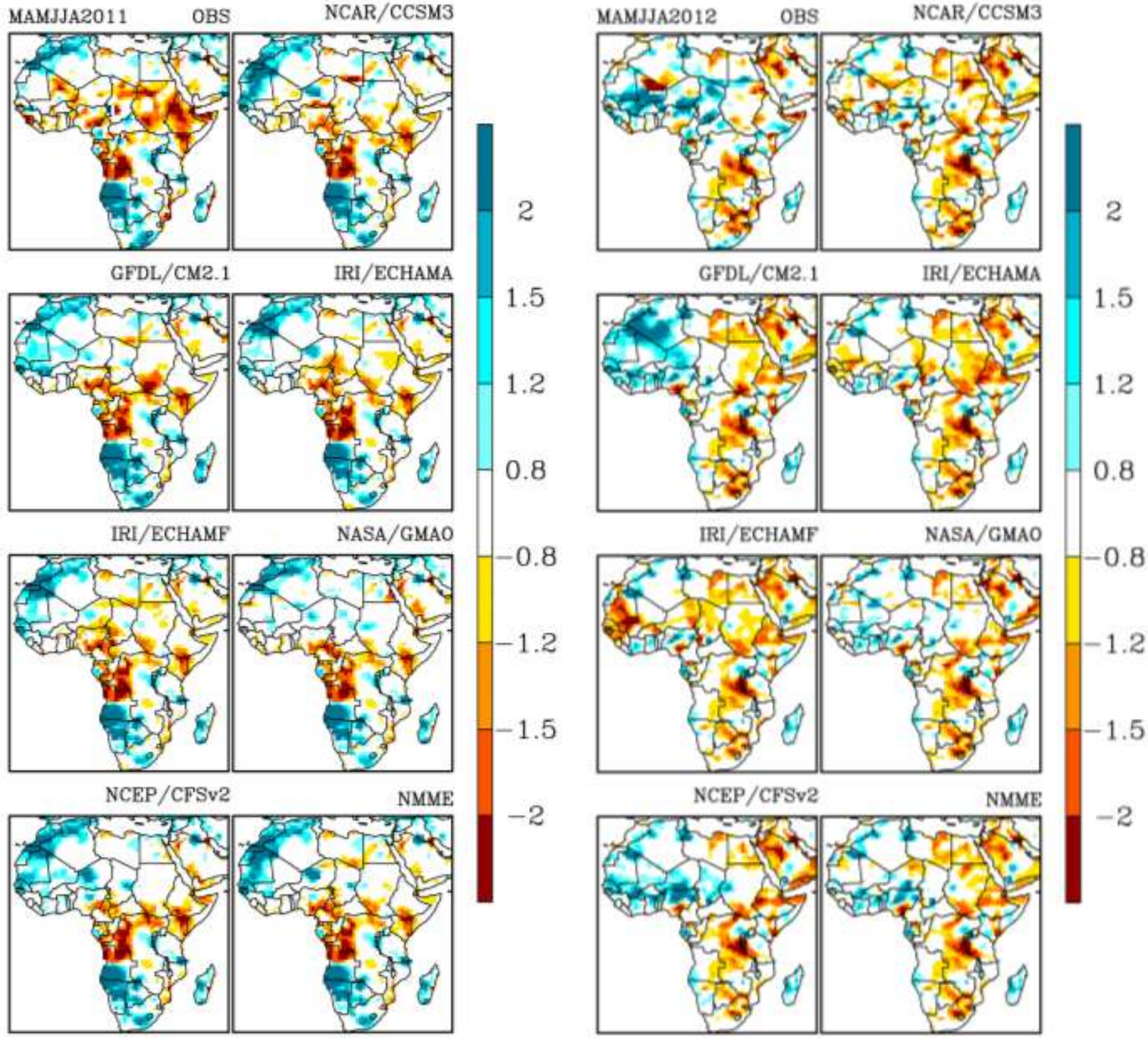
SPI6: Prior 3-month (MAM) observation with the current (JJA) 3-month forecast



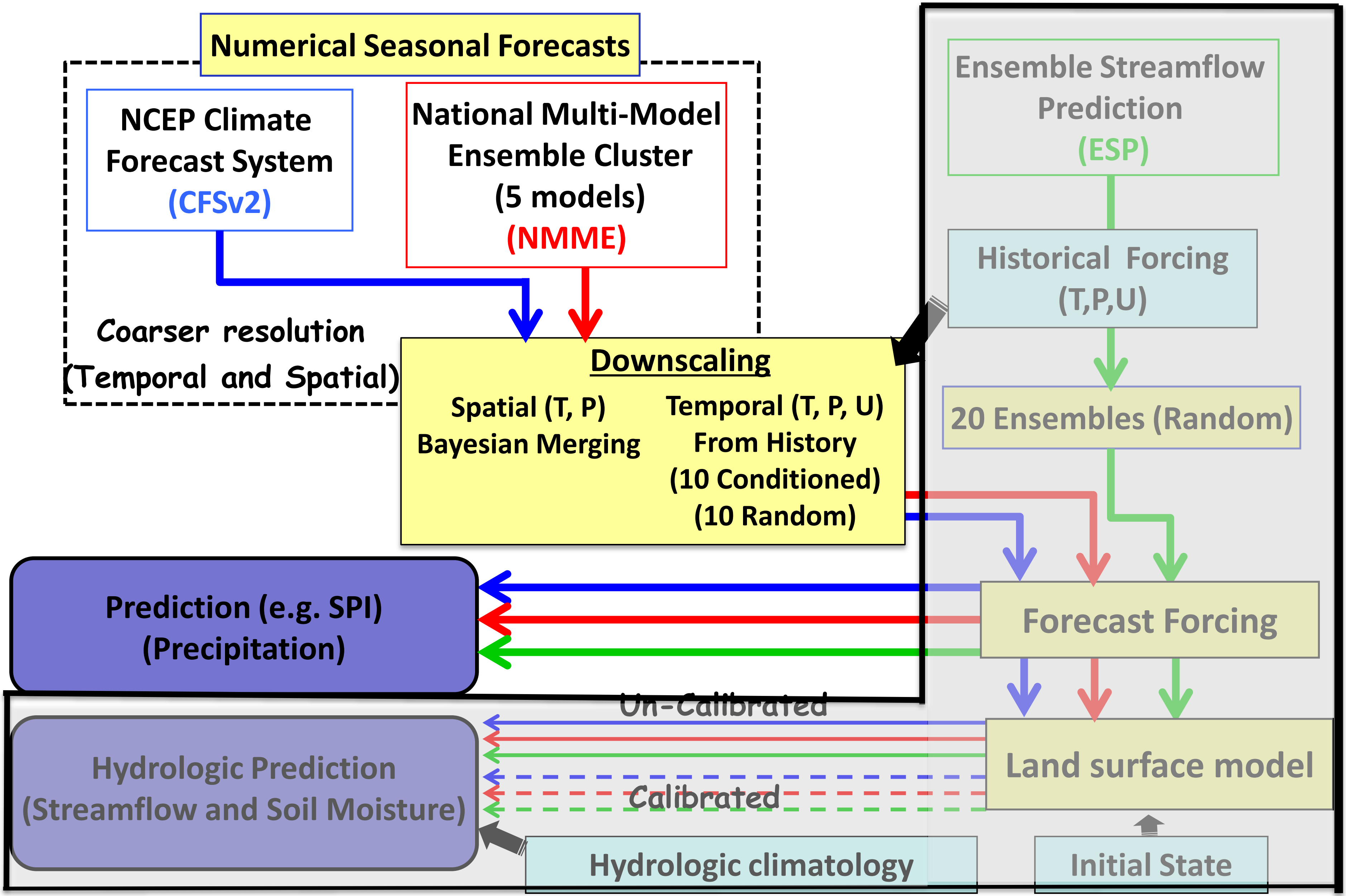
SPI6 for MAMJJA, 2011 & 2012

SPI6: Prior 3-month (MAM) observation with the current (JJA) 3-month forecast

2011 left 2012 right	
OBS (CPC)	NCAR (CCSM3)
GFDL (CM2.1)	IRI (ECHAMA)
IRI (ECHAMF)	NASA (GMAO)
NCEP (CFSv2)	NMME



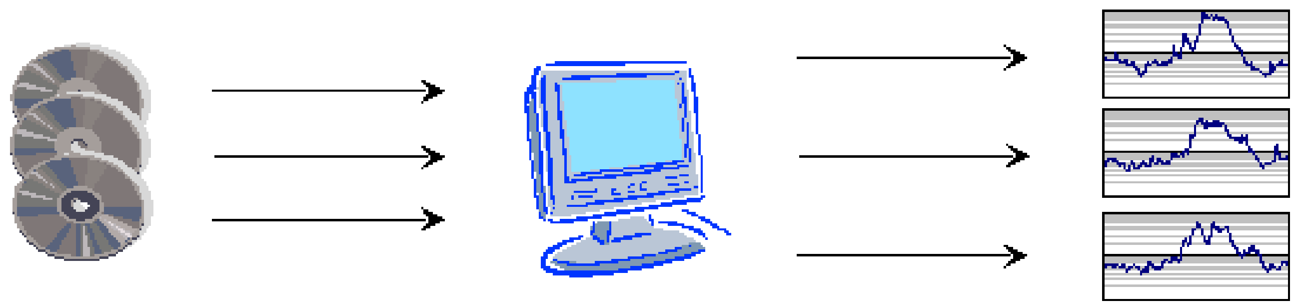
Hydrologic Forecast Methodology



Ensemble Approach

Definition of the ensemble (or scenario) approach to forecasting

- Scenario-based deterministic model
  - Multiple runs produce probabilistic values
  - Model states saved based on current conditions
  - Multiple input datasets used
    - Based on the historic record or short-term forecasts
  - Examples include Ensemble Streamflow Prediction (ESP)



Scenario-based input (historic data / forecasts) *(Ensembles)*

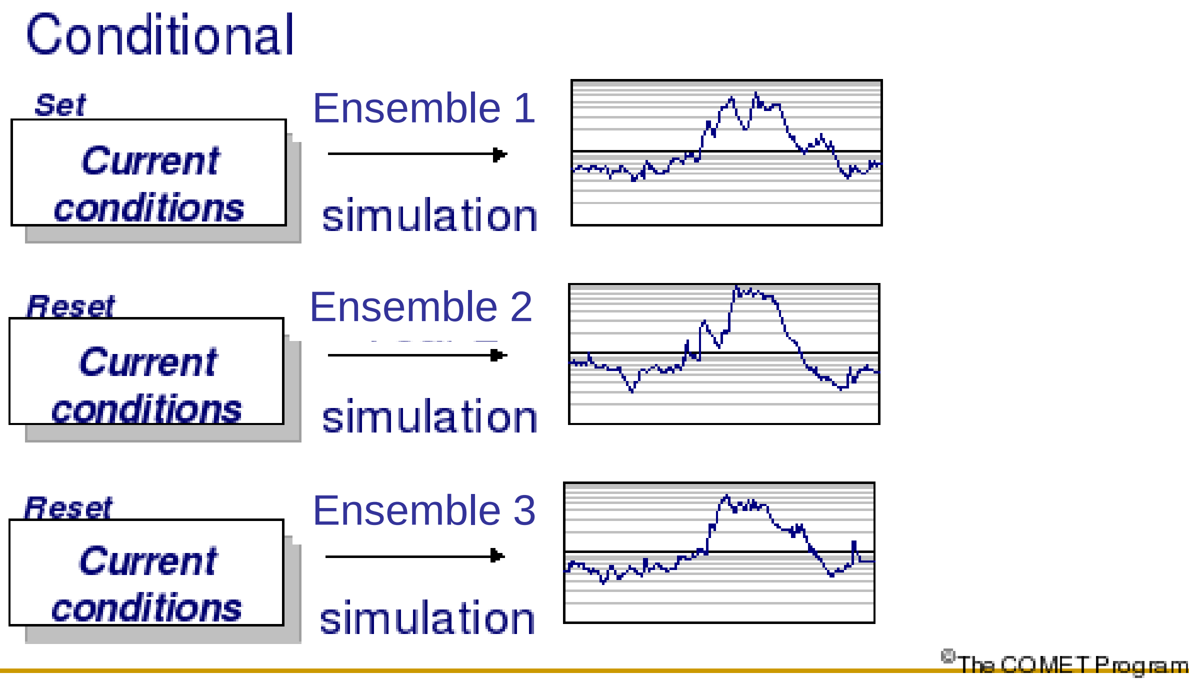
Deterministic hydrologic model

Multiple possible outputs

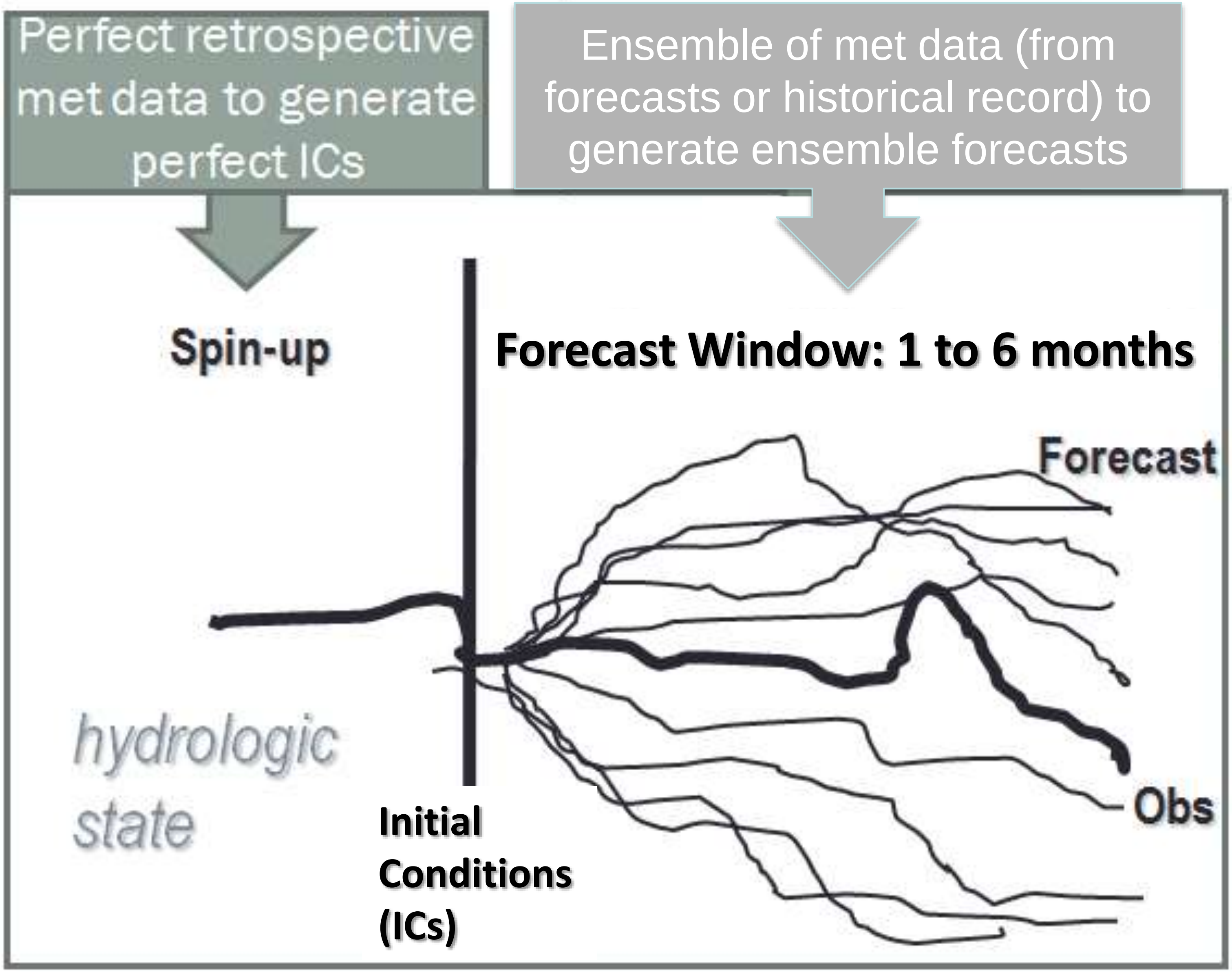
ESP Technique

ESP scenario (ensemble) simulation uses current hydrologic states with <u>resampling historical</u> or <u>forecast</u> meteorology

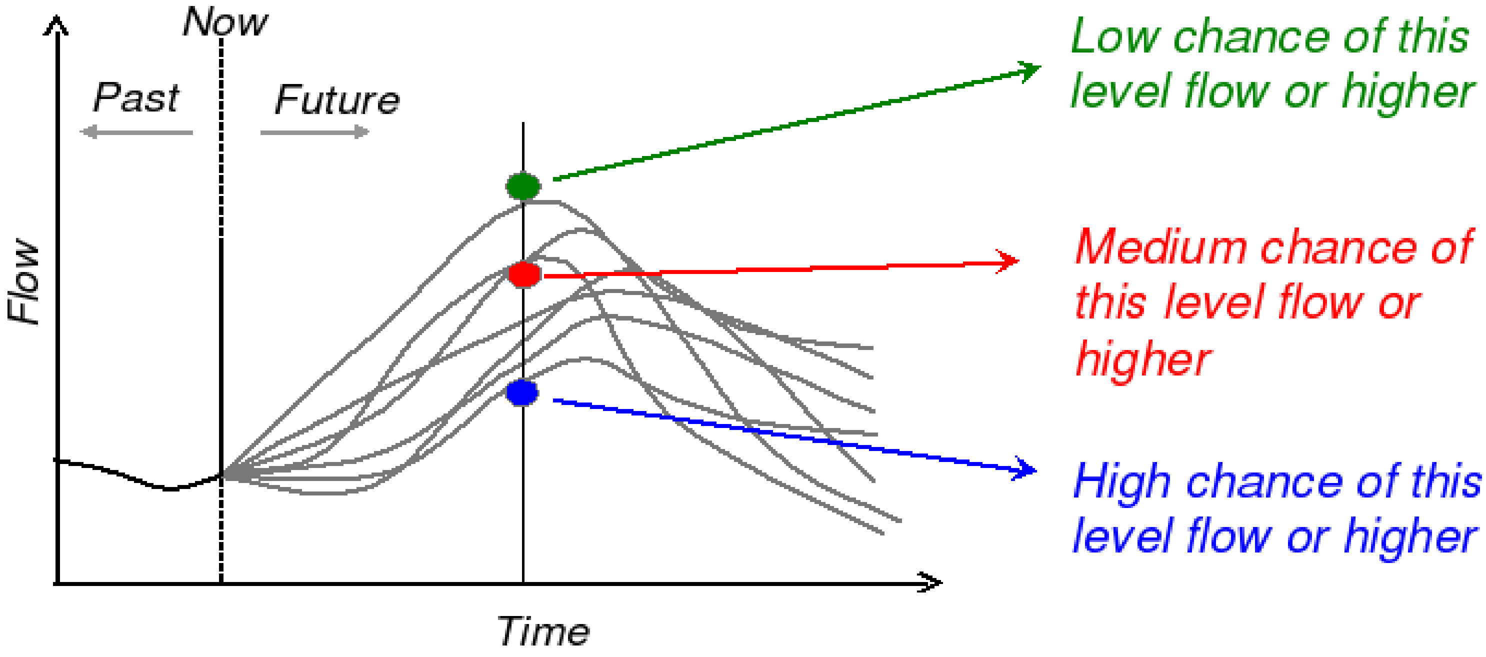
- Starts the model at current model states
- Resets to the current model states for each year
- Each simulation begins with the same conditions



ESP Approach



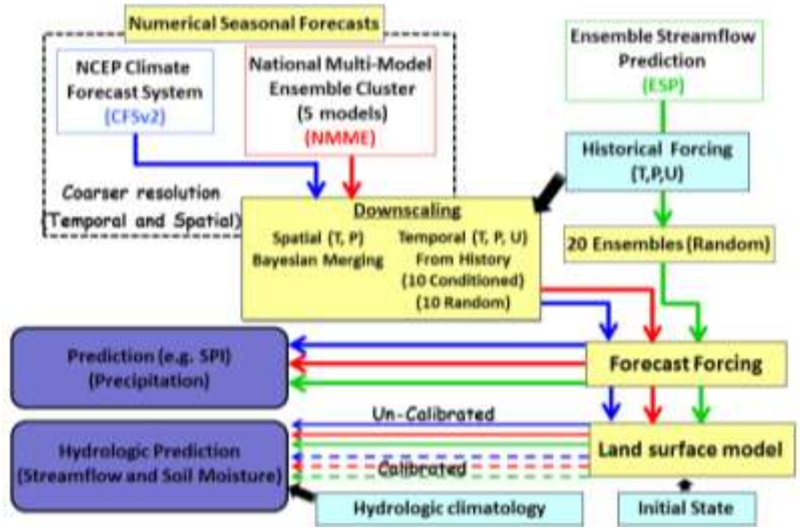
ESP Technique → Risk Assessment



Summary

LAFDM is an <u>objective flood drought monitoring and forecasting system</u>. LAFDM can play a central role in between historic drought analysis and long-term climate change projections.

A potential pathway forward for a drought monitoring and forecasting system is to integrate monitoring with seasonal forecasting, but challenges exist for data access and quality for monitoring, and seasonal forecast skill is insufficient for water and food management.



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