Introduction of CREST Model

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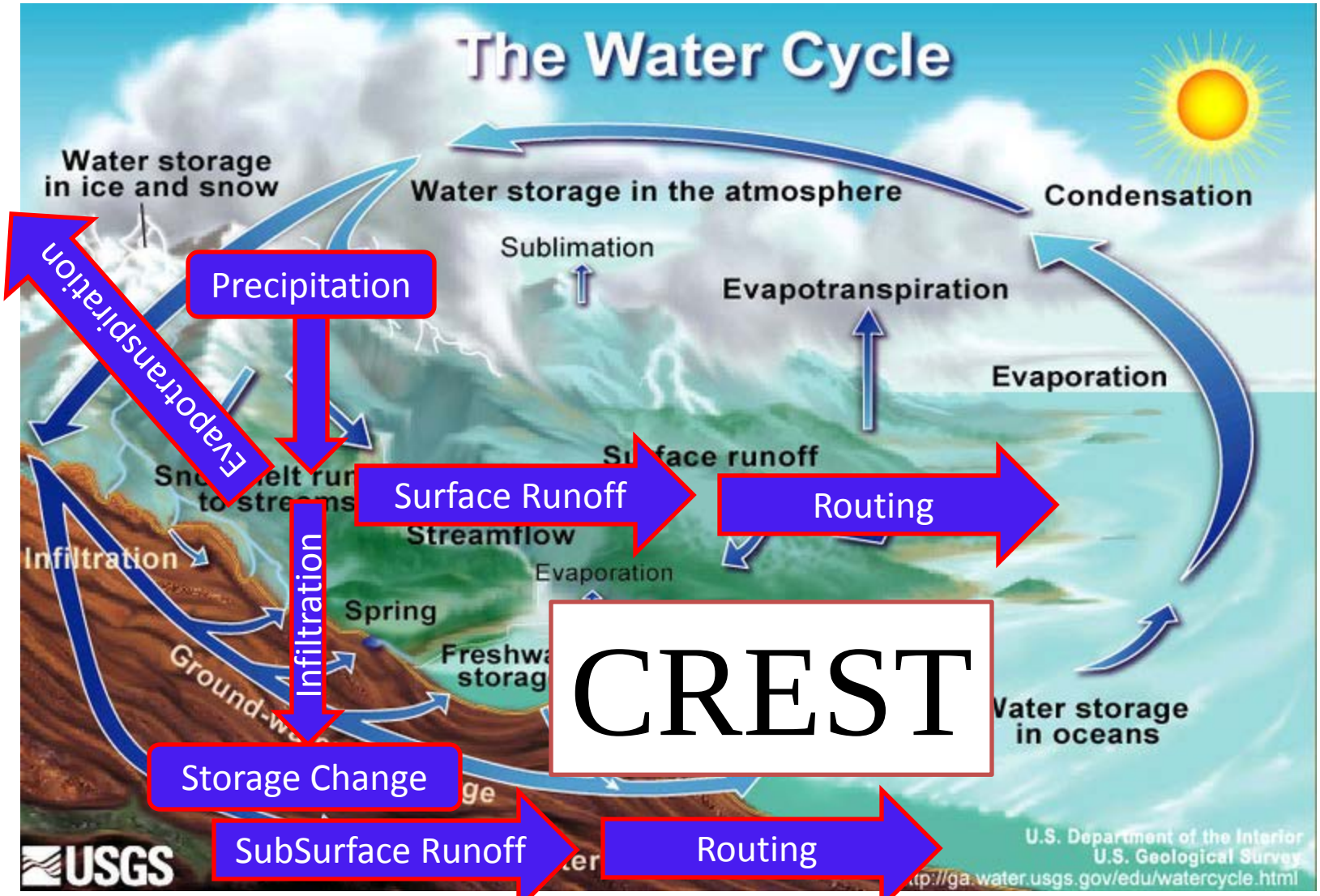
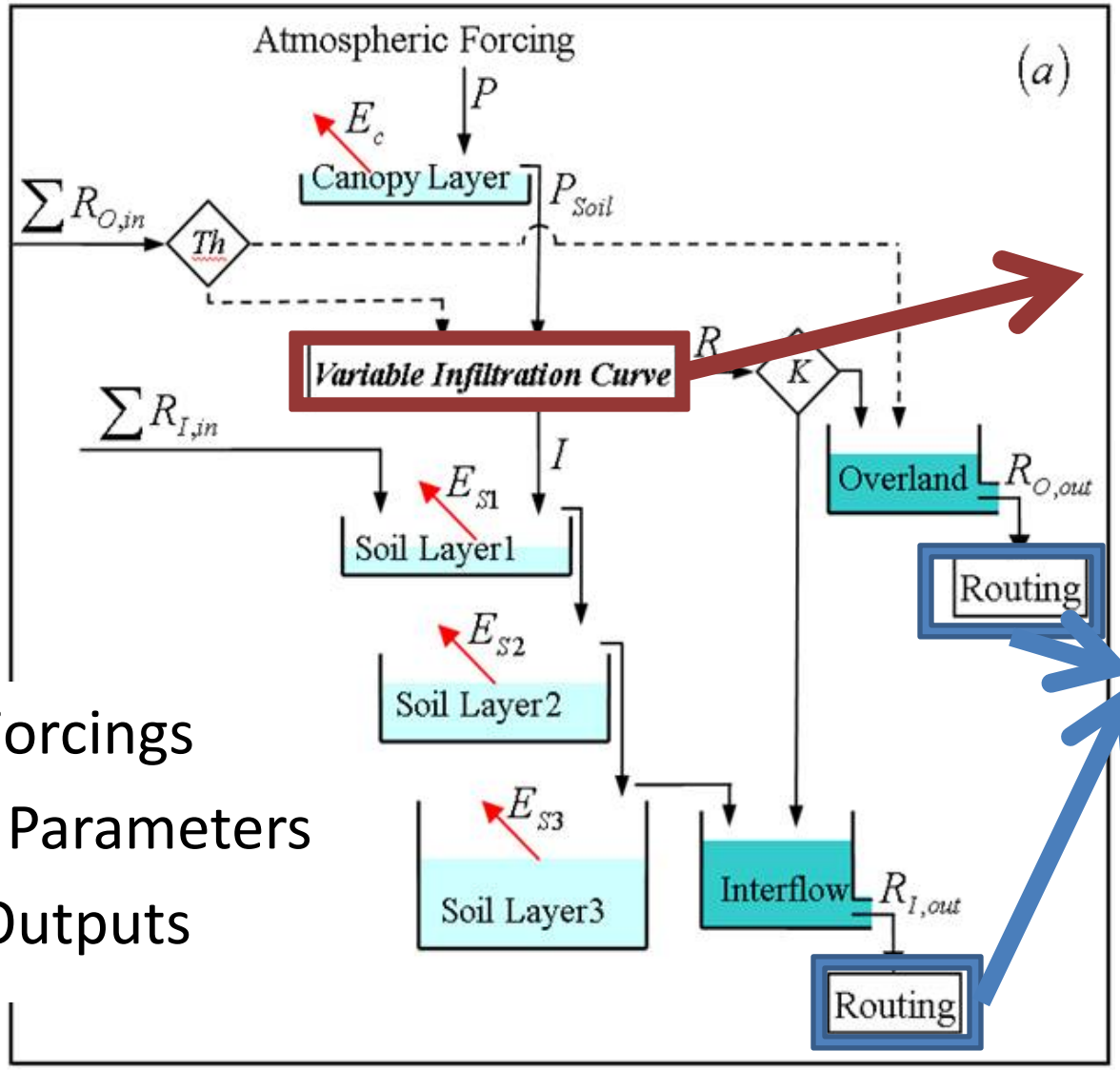
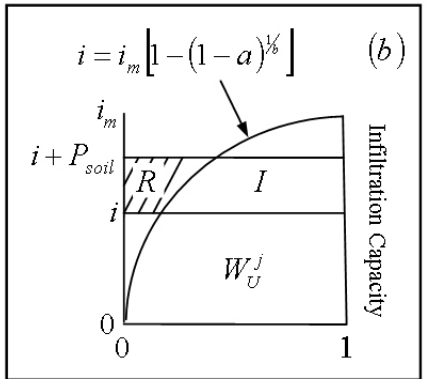
What is CREST Model



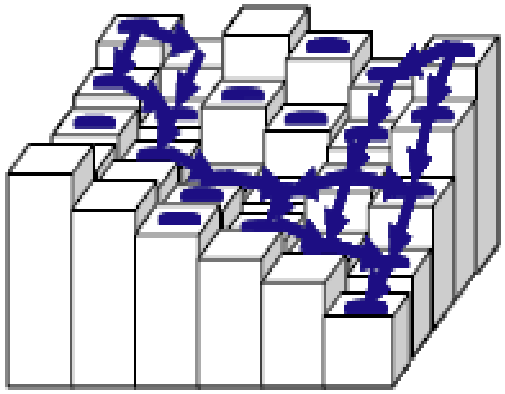
CREST Model





CREST

- 2 Forcings
- 17 Parameters
- 9 Outputs



Cell-to-Cell Flow Routing

CREST

What is CREST Model

- CREST Model is the abbreviation of **C**oupled **R**outing and **E**xcess **ST**orage (CREST) Distributed Hydrological Model

- CREST is jointly developed by the University of Oklahoma and NASA SERVIR

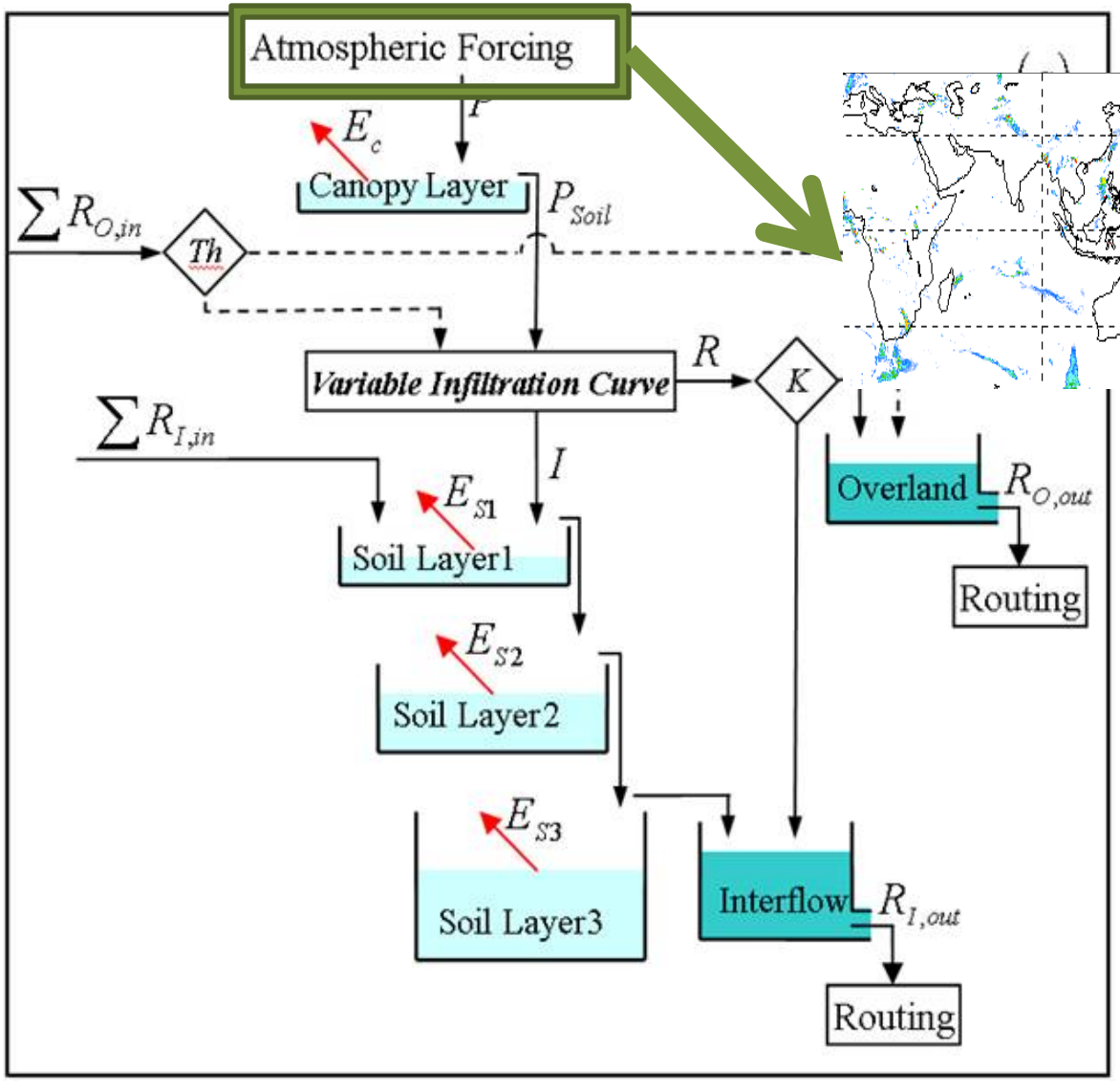
- CREST is a distributed hydrological model, developed to simulate the **spatial** and **temporal** variation of land surface and subsurface water fluxes and storages by cell-to-cell simulation

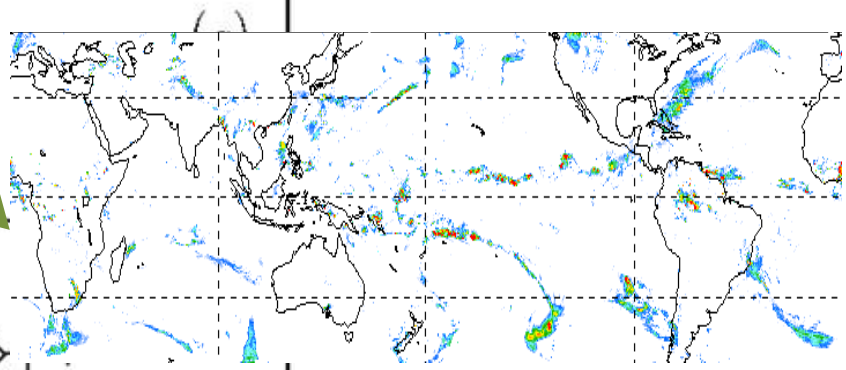
Wang, J., Y. Hong, L. Li, et al. (2011), The coupled routing and excess storage (CREST) distributed hydrological model, *Hydrological Sciences Journal*, *56*(1), 84 - 98.

CREST's Distinguishing characteristics

- Distributed rainfall-runoff generation and cell-to-cell simulation
- Coupling between the runoff generation and routing components via three feedback mechanisms
- Scalability through the representation of soil moisture variability (using a variable infiltration curve) and routing processes (using linear reservoirs) at the sub-grid scale
- Easy to use and simulate effectively

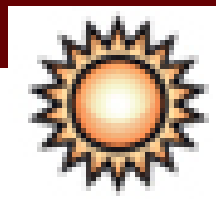
CREST Model Input



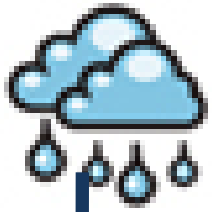


- TMPA 3B42RT
- TMPA 3B42 V6
- NWP QPF
- Rain Gauges
- Ground Radar
- Gridded Precip

CREST Model



Evapotranspiration



Precip.

Impervious Area

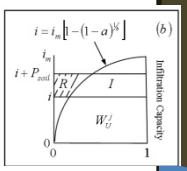
Soil/Vegetation

Direct Surface Runoff

Overland Reservoir

Grid Cell Routing (RS)

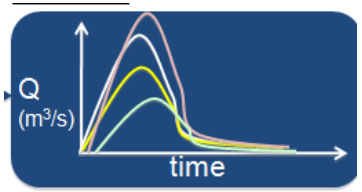
Infiltration



VIC Curve

Grid Cell

Stream flow



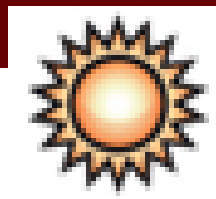
Interflow

a vertical profile of the cell

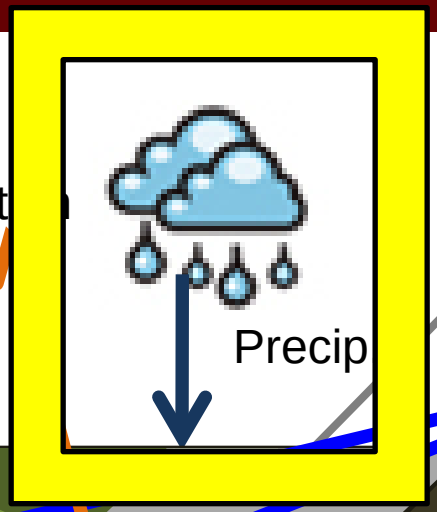
Interflow Reservoir

Grid Cell Routing (RI)

CREST Model Output



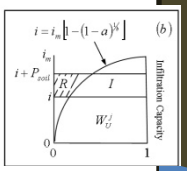
Evapotranspirat



Precip

Soil/Vegetation

Infiltration



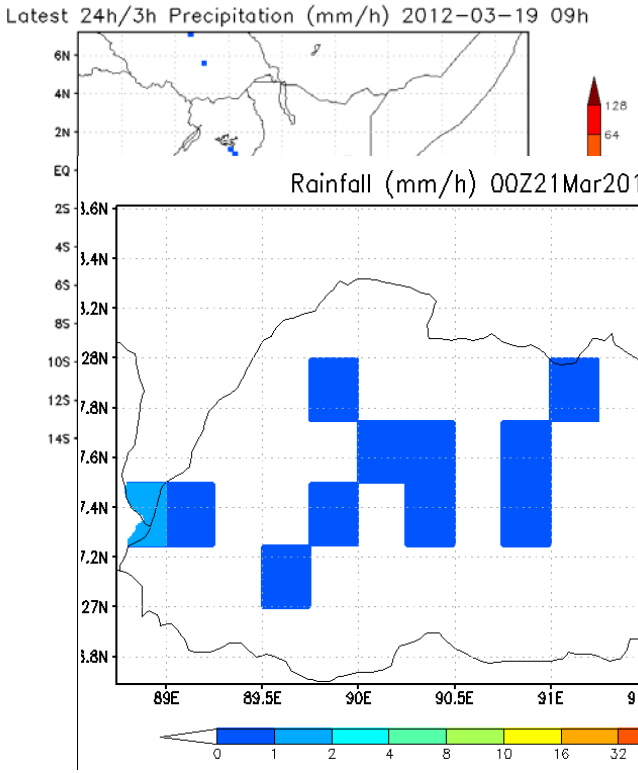
VIC Curve

Grid Cell

Interfl

Rain Output

- **Spatially interpolated output of precip. Input forcing**

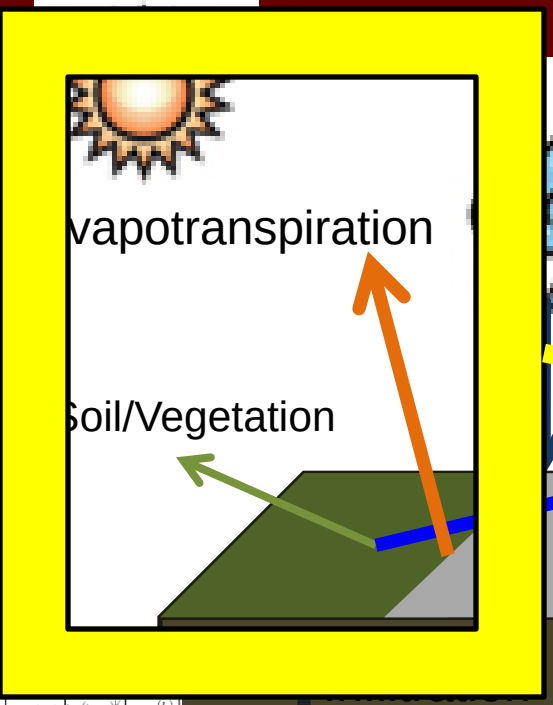


Interflow Reservoir

S)

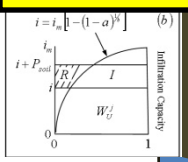
Routing (RI)

CREST Model Output



PET Output

- **Spatially interpolated output of potential evapotranspiration Data**



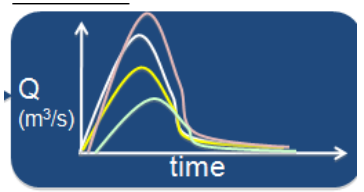
VIC Curve

Grid Cell

Overland Reservoir

Grid Cell Routing (RS)

Stream flow

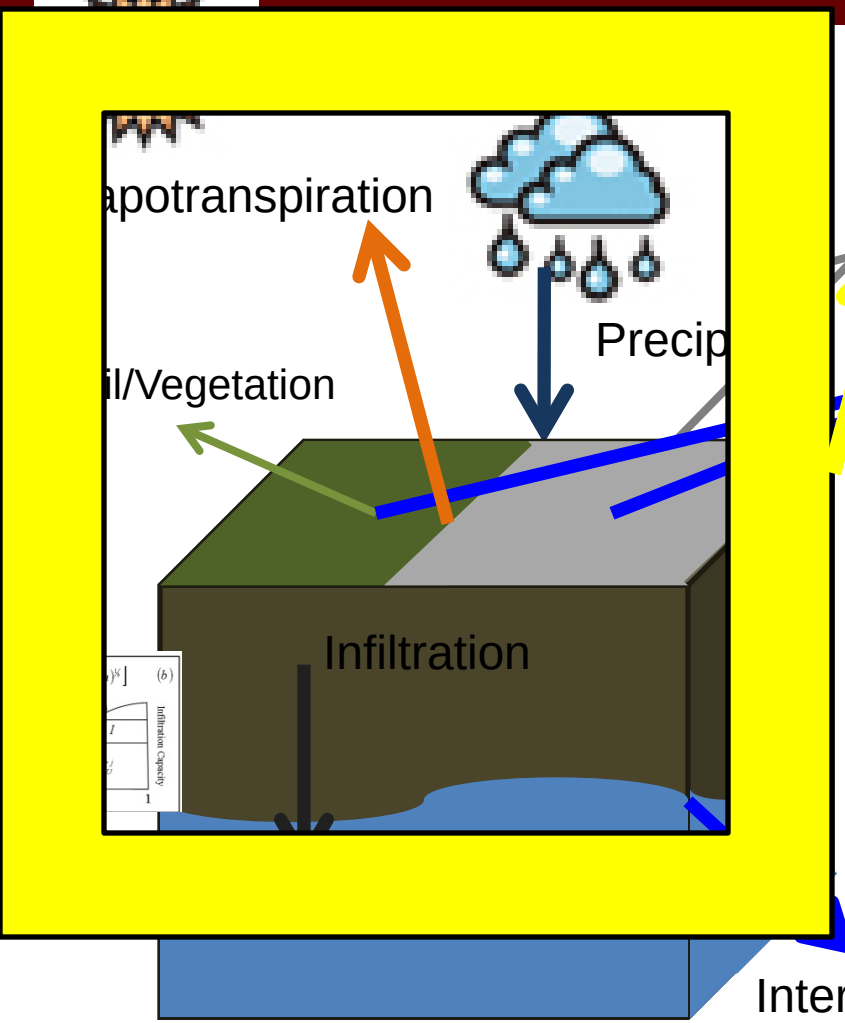


Interflow

Interflow Reservoir

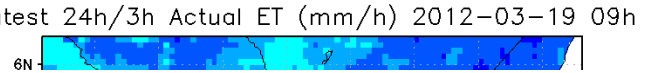
Grid Cell Routing (RI)

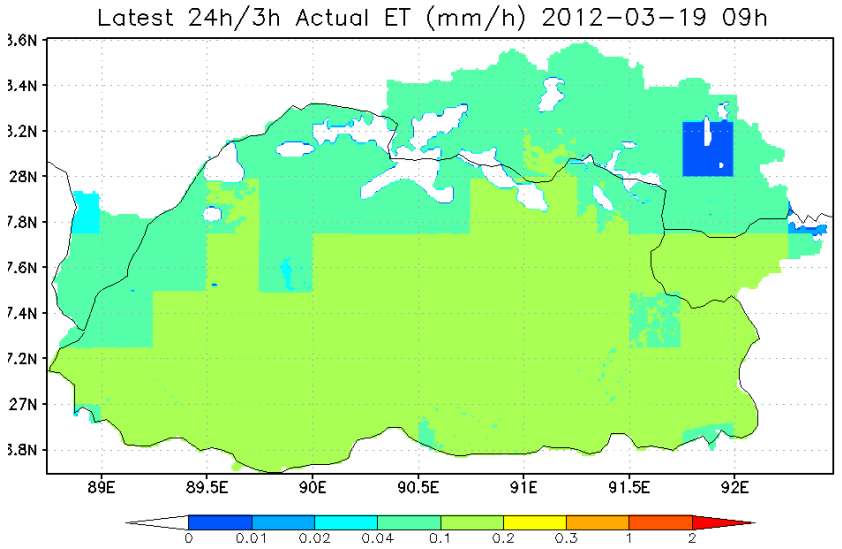
CREST Model Output



Actual ET Output

- **Amount of liquid that actually evapotranspirated from the precipitation and soil**





CREST Model Output

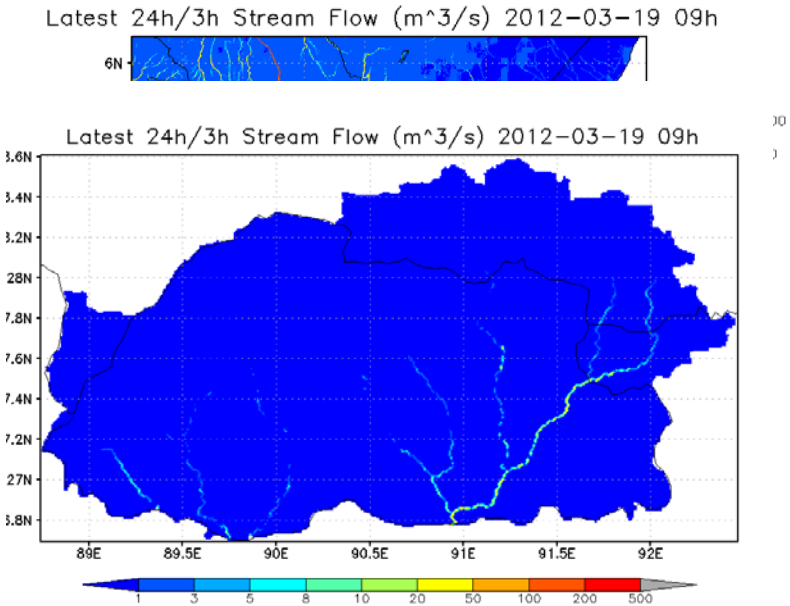
Evapo

Soil/Ve

VIC Curve

Runoff

- **Volume of water flowing over the grid cell per unit time**



us

rect Surface Runoff

Overland Reservoir

Grid Cell Routing (RS)

Stream flow

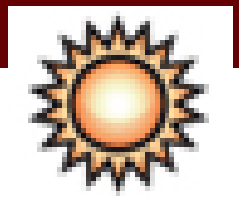
Q (m^3/s)

time

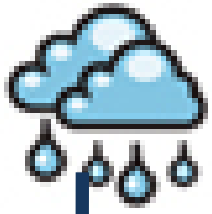
Interflow Reservoir

Grid Cell Routing (RI)

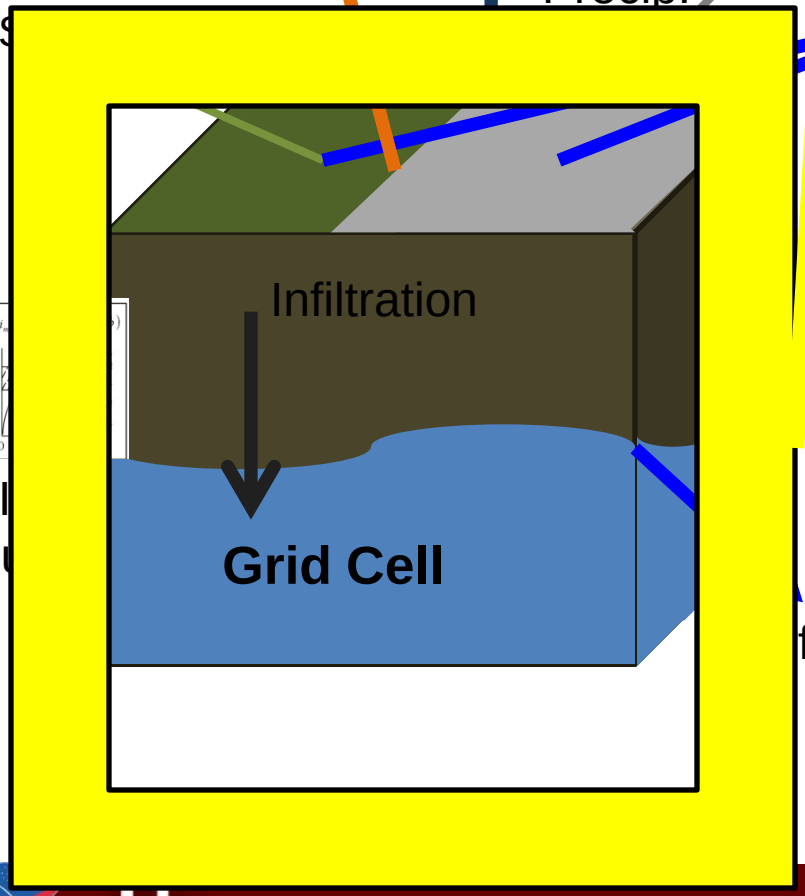
CREST Model Output



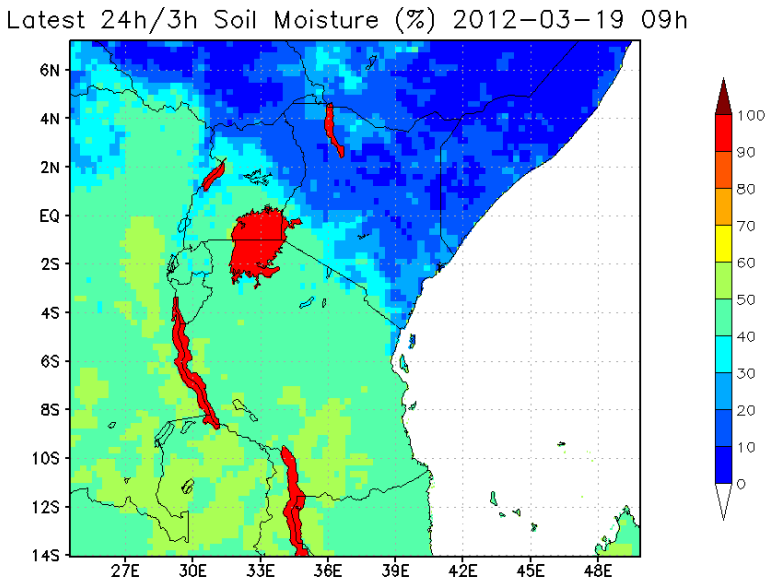
Evapotranspiration

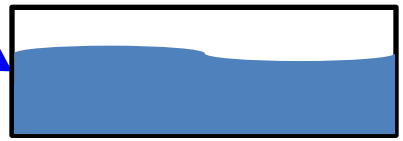


Precip.



Soil Moisture

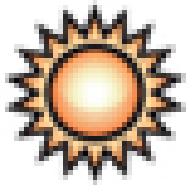




Interflow Reservoir

Grid Cell Routing (RI)

CREST Model Output



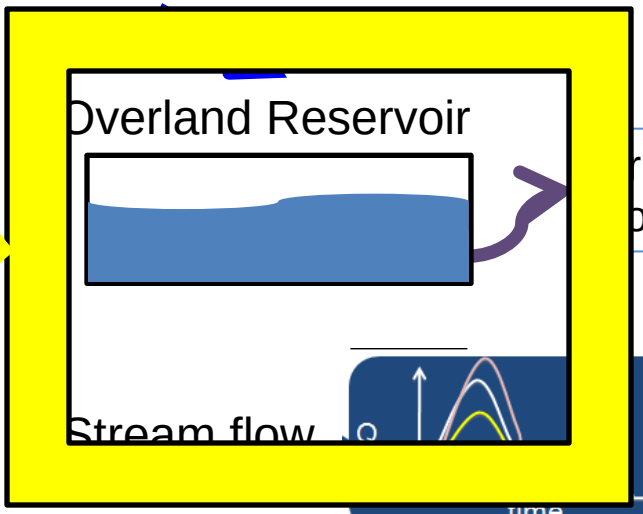
Evapotranspiration

Impervious

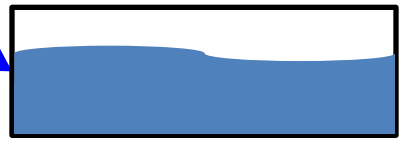
Direct Surface Runoff

Overland Reservoir Depth

- **Amount of water in the overland reservoir that will be contributing to Runoff**



rid Cell
outing (RS)



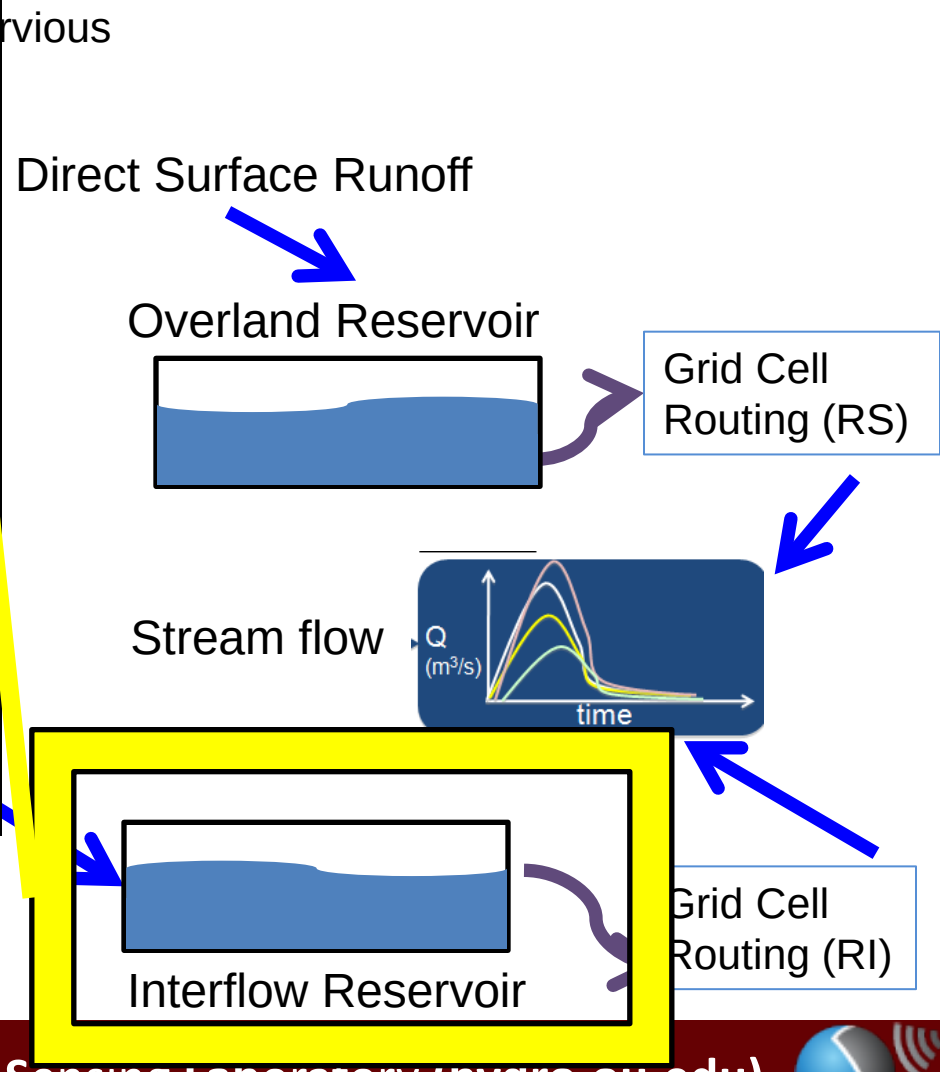
Interflow Reservoir

Grid Cell
Routing (RI)

CREST Model Output

Interflow Reservoir Depth

- **Amount of water in the interflow reservoir that will be routed and contribute to base flow Runoff**



Issues of CREST v1.6c

Earlier, we had CREST v1.6c, now, we run CREST v2.0

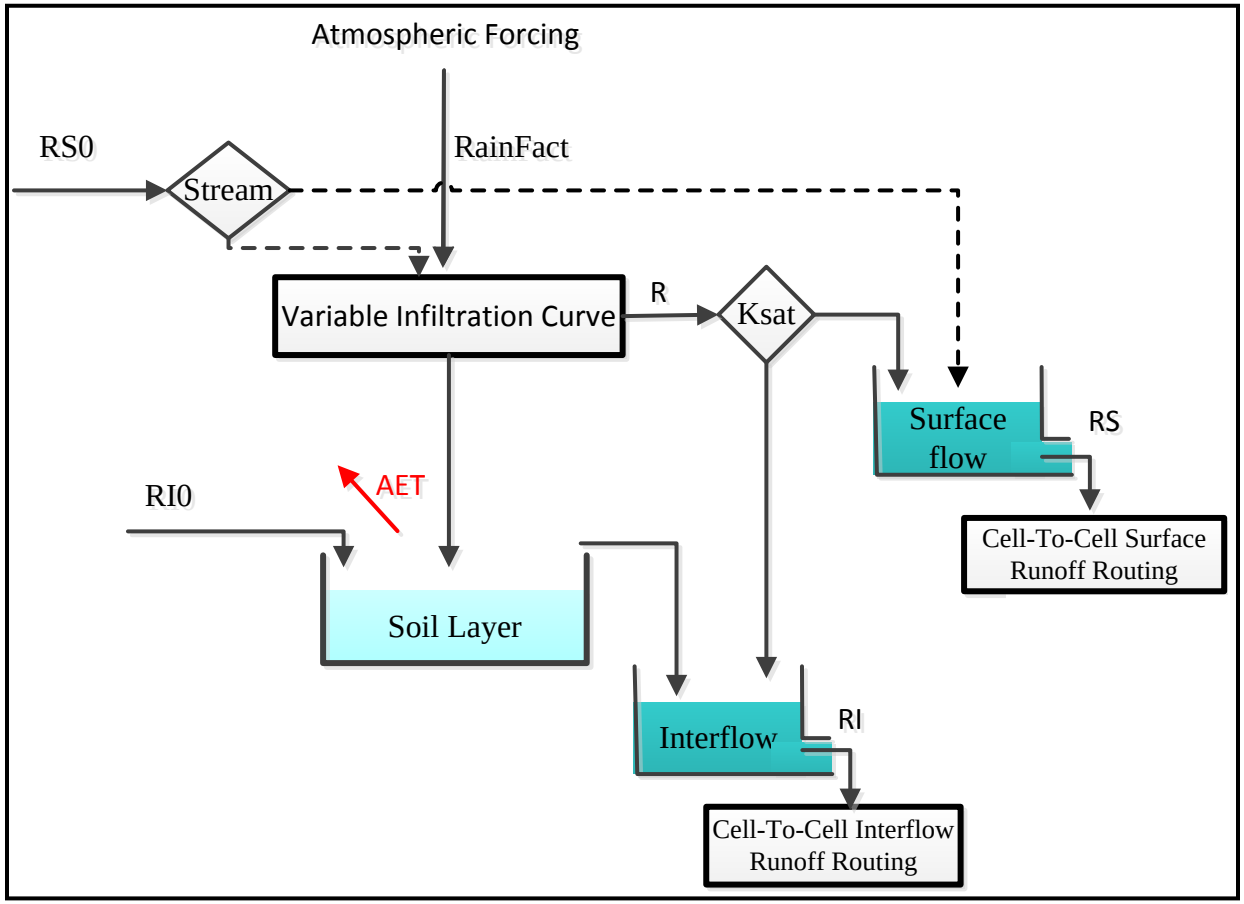
- Only inputs uniform parameters' value
- Only calibrated the uniform parameters dataset
- Auto-calibrated the parameters slowly
- Did not use the matrix Manipulation, inefficient
- Was not flexible when it outputs the results
- Was difficult to add new processes by the beginners
- ……

Challenges for the next version of CREST

- Input the distributed parameters
- Calibration of the distributed parameters
- Need output for more state variables, and any locations and the specified date time
- Modular design to incorporate modification of the model using few lines of codes
- More flexible input files format
- ……

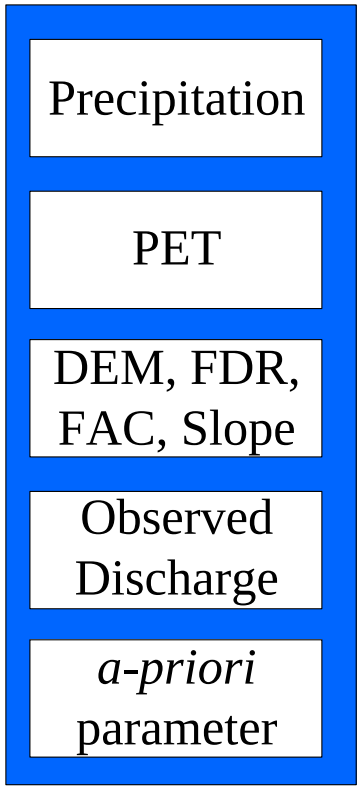
CREST v2.0

CREST v2.0

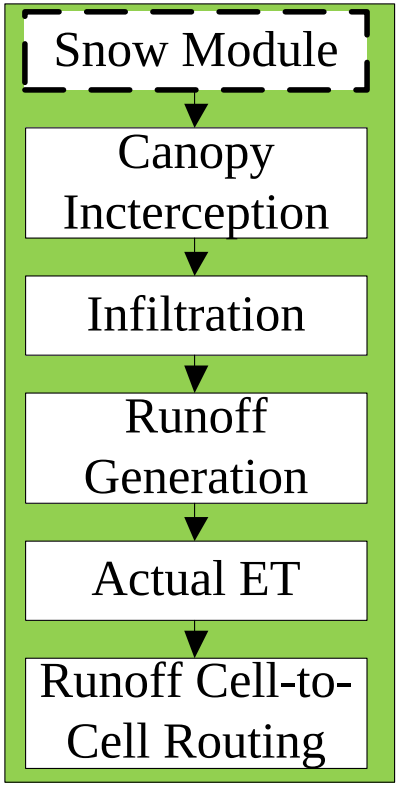


- 2 Forcing Data (Rainfall, PET)
- 11 Parameters
- 11 Outputs available for Any Time Steps and Any Locations

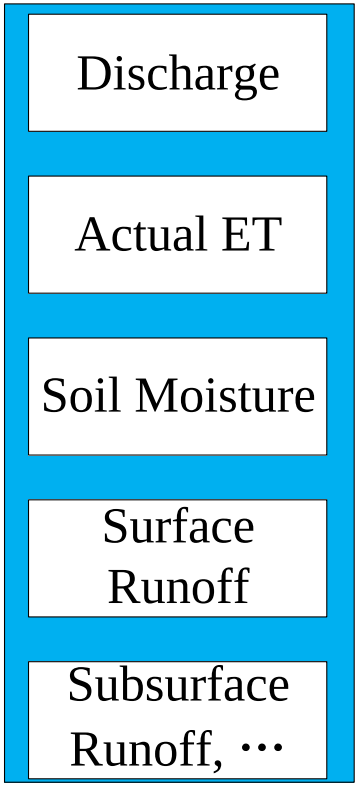
Modular design framework of CREST v2.0 (Inputs)



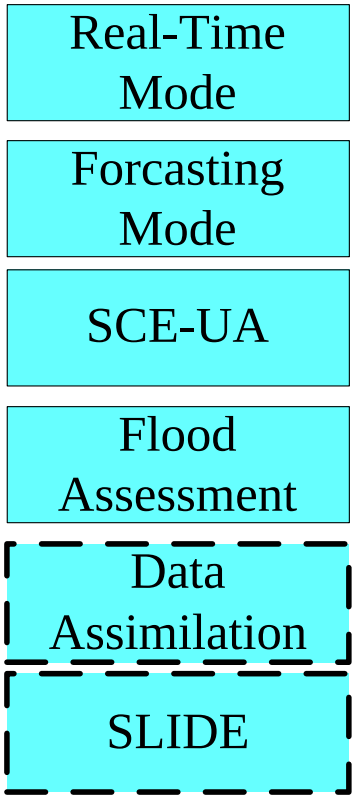
Modular design framework of CREST v2.0 (Simulation)



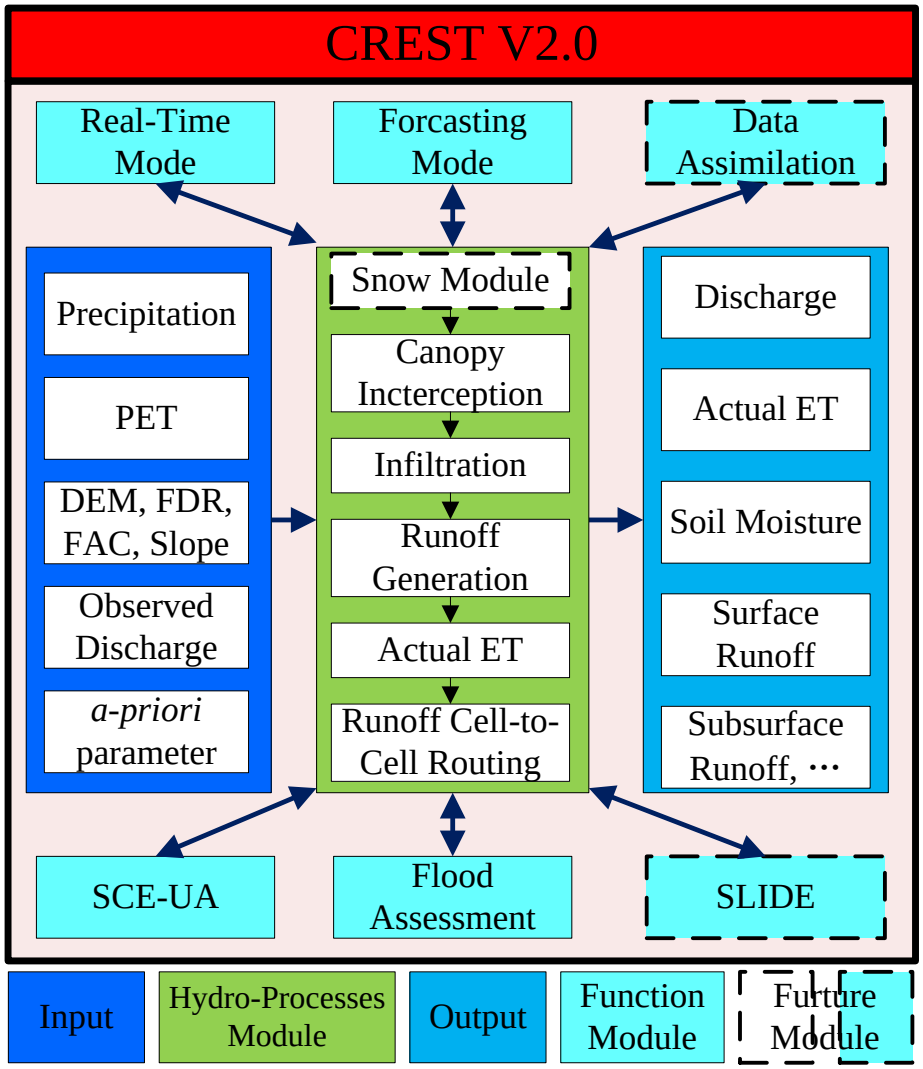
Modular design framework of CREST v2.0 (Outputs)



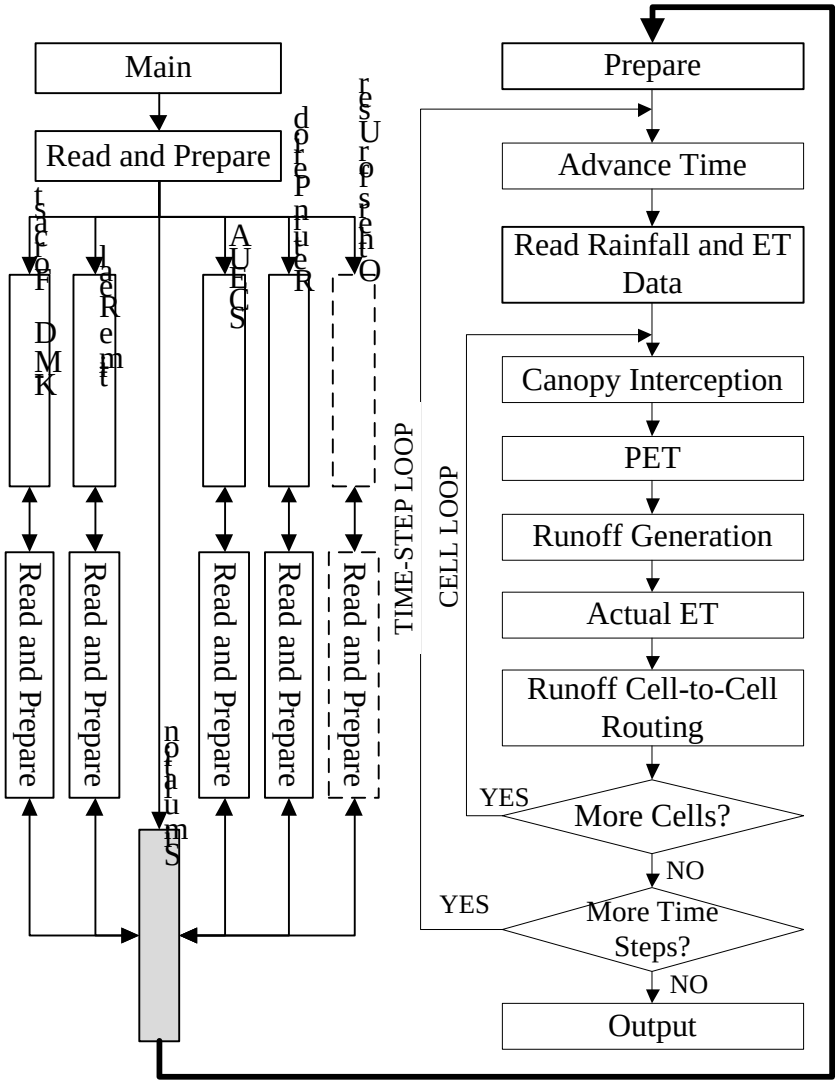
Modular design framework of CREST v2.0 (Modes)



Modular design framework of CREST v2.0

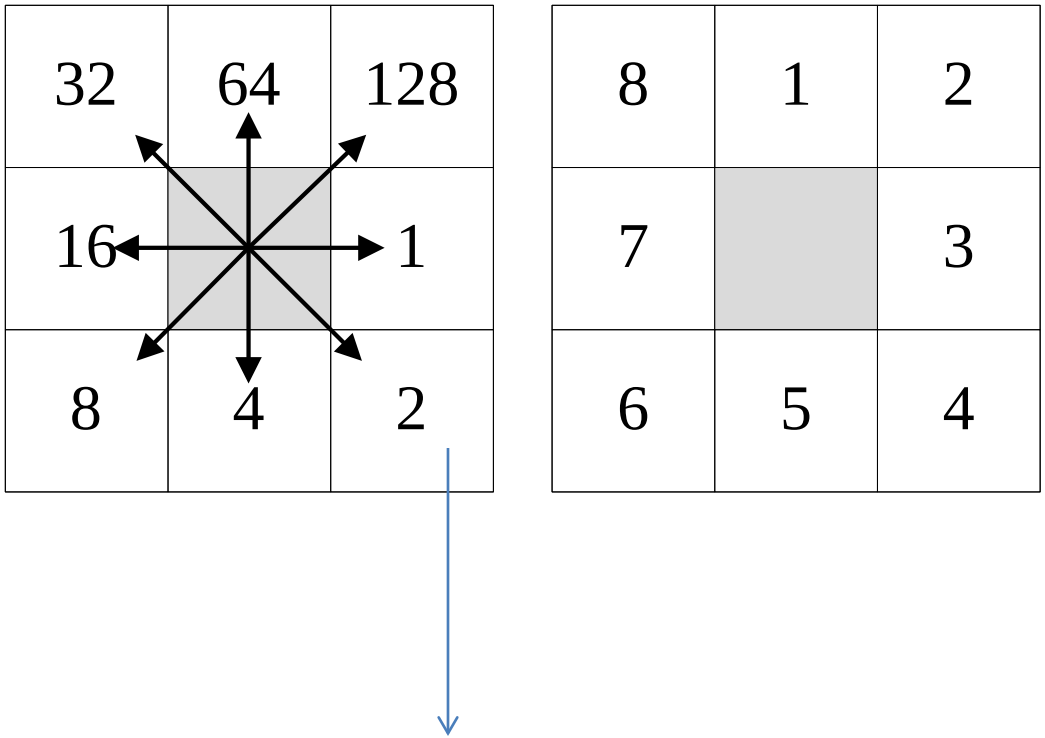


Flowchart of Running CREST



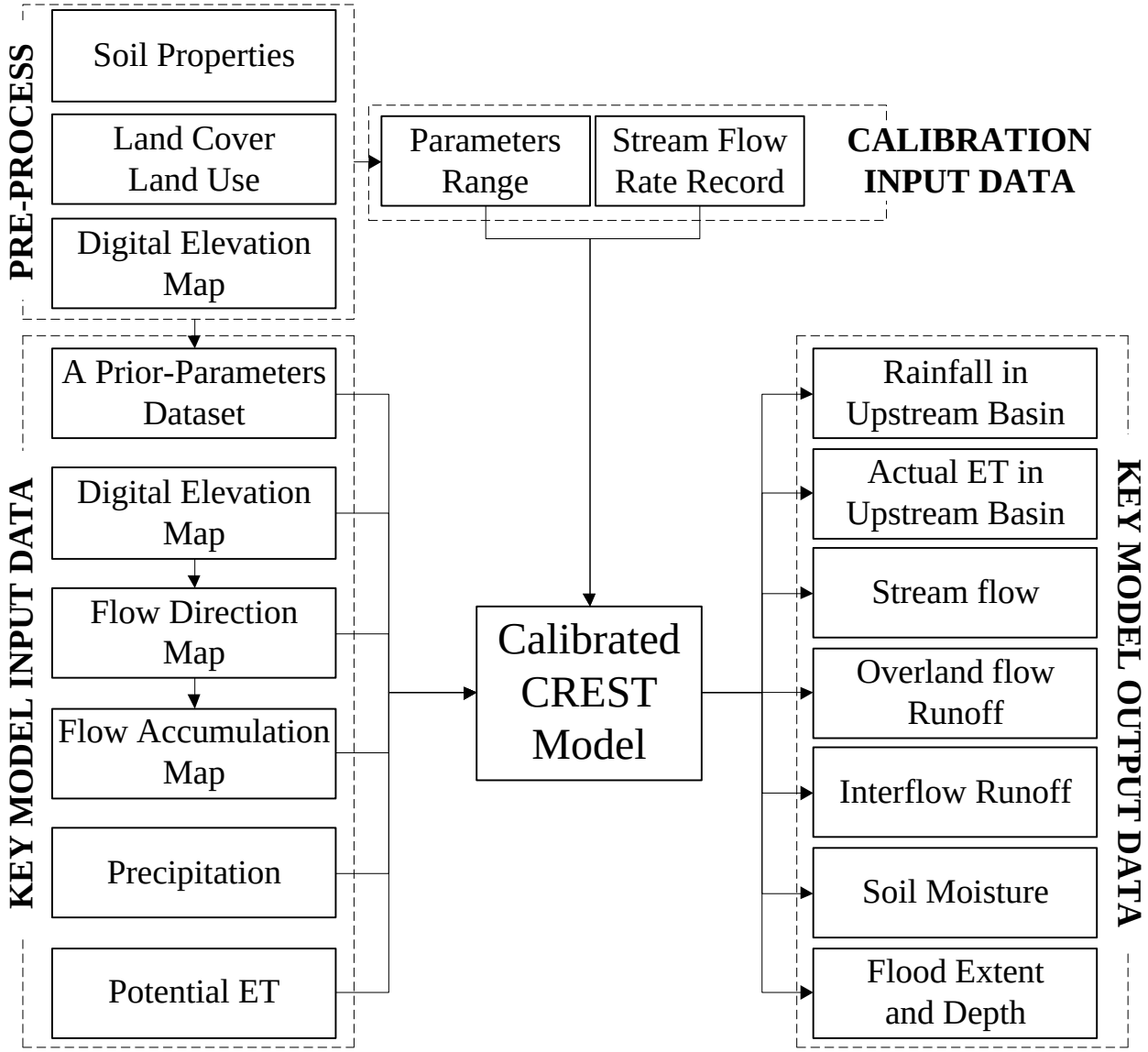
Organization of the Files

Flow Direction (FDR) Method



Most of the software/Data use this method, like ArcGIS and HYDROSHEDS

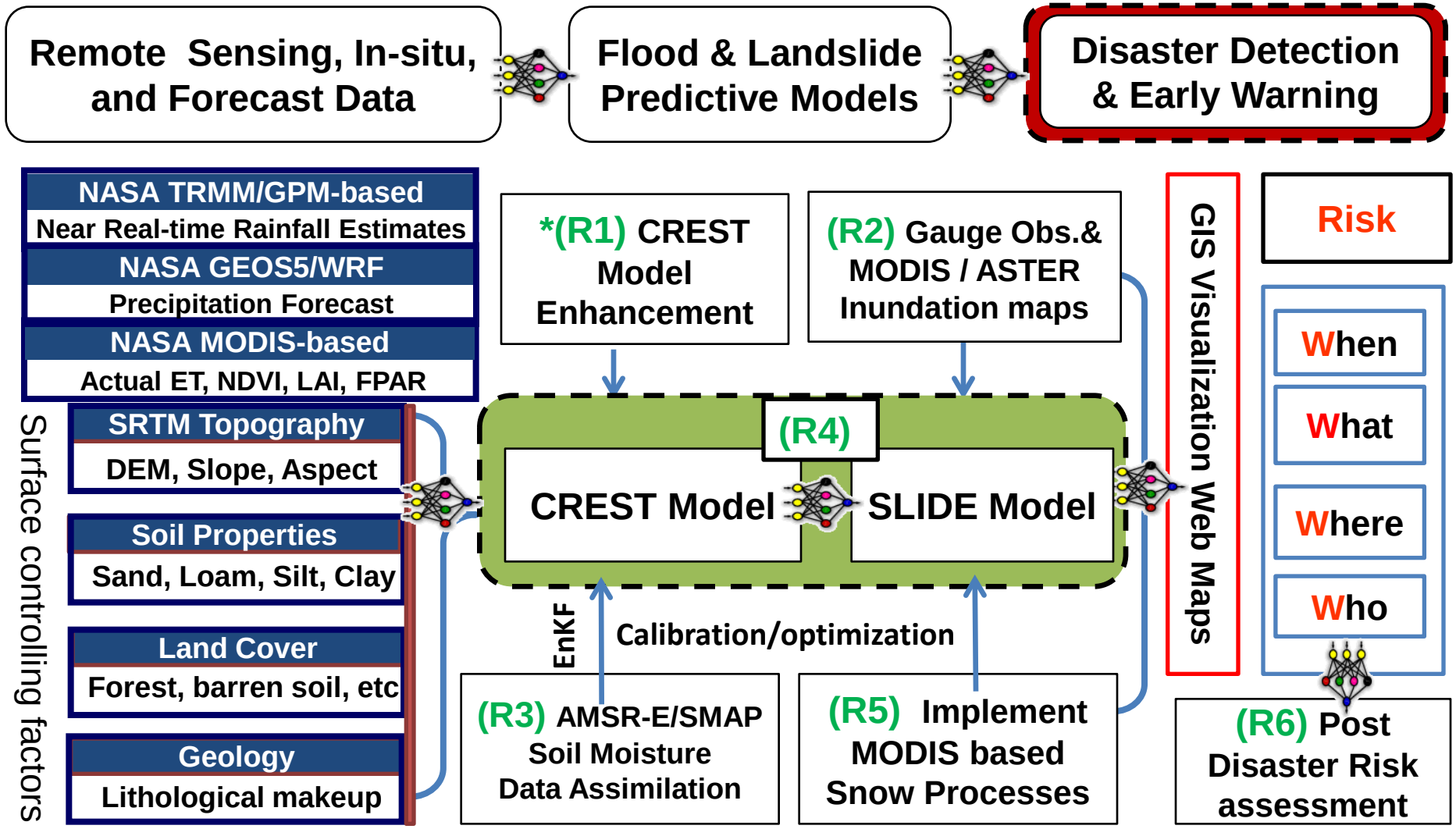
CREST v2.0 Inputs and Outputs



The Main Features of CREST v2.0

- Modular framework to easily understand, modify and add new processes for a particular application
- Include both uniform and distributed parameters for simulation and calibration
- Integrate CREST with SCE-UA to improve the CREST Calibration Capability
- Use matrix manipulation to accelerate the simulation speed
- Output more data for modelers

DEWS: A Flood and Landslide Disaster Early Warning System for Africa, Central America, and the Himalaya Region



*(R) refers to Research Task

Thank you for your attention!

Any questions and/ or comments?