Nowcasting Flash Floods and Steps towards a Universal Radar Validation Framework

Samira S. Soltani

PI: Stefan Kollet

Agrosphere (IBG-3), Research Centre Jülich, Germany

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Outline

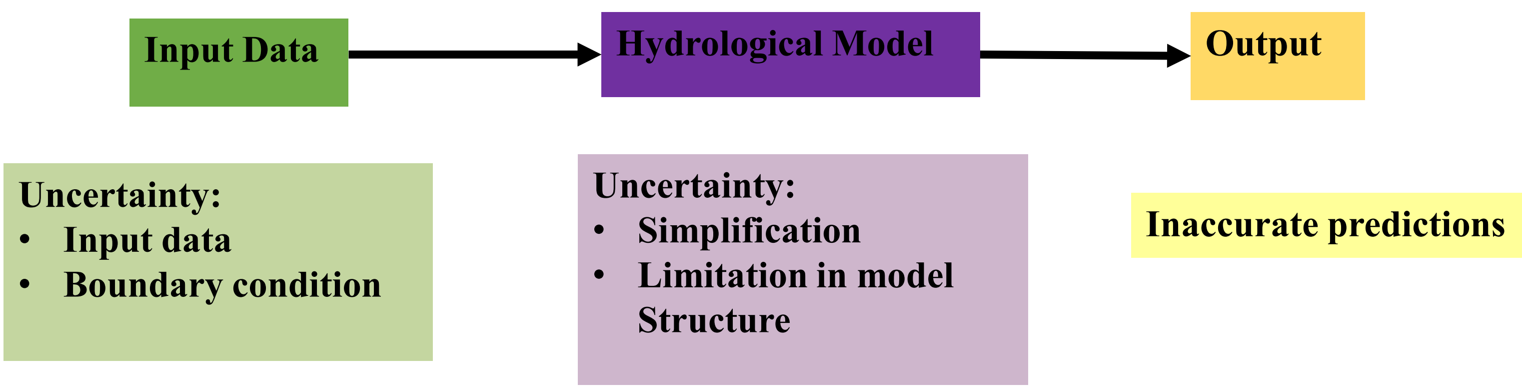
- **Problem Statement/Motivations**
  - Improving Flood Forecasting by Data Assimilation (DA)
- **Methodology**
  - Modeling
    - ParFlow-CLM model
  - DA Method
    - Kernelized EnKF (an extension of the traditional EnKF)

Problem Statement

Uncertainties hydrological models

- Simplification of meteorological physical processes
- Lack of input data
- Inaccuracies and uncertainties in input data

Planning and management of hydrological systems “without appropriate data and model” is gambling.



Motivations

- **1. Overcoming on EnKF limitations (Kernelized EnKF)**
  - The main benefit of kernelized EnKF lies in its ability to handle nonlinear and non-Gaussian systems more effectively.
    - Nonlinear System Representation
    - Improved State Estimation
    - Enhanced Filtering Performance
    - Flexibility

Motivations

2. Multivariate Data Assimilation

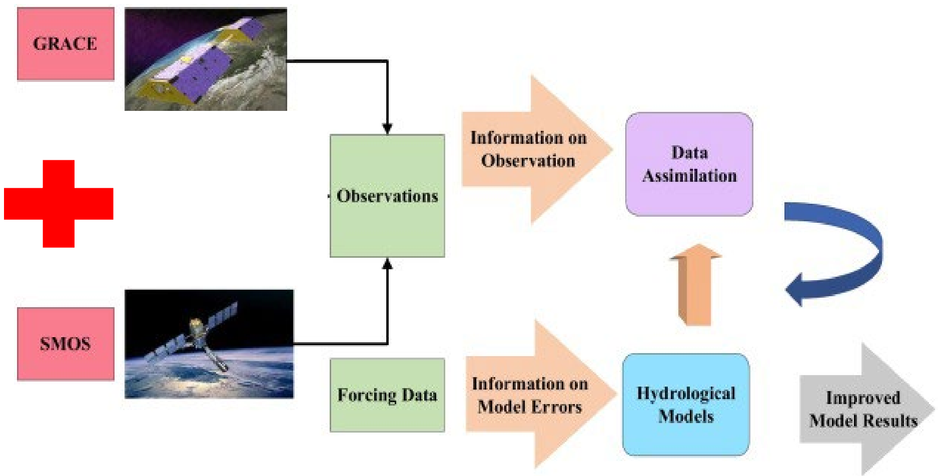
- ❑ Previous studies on DA are widely based on one source of data (GRACE or SMOS).

- ❑ **Multi-mission (joint) satellite DA has not been widely implemented.**

- ❑ Is Joint DA possible?

- ❑ What is the appropriate way to do it?

- ❑ Does using multi-mission data improve DA?

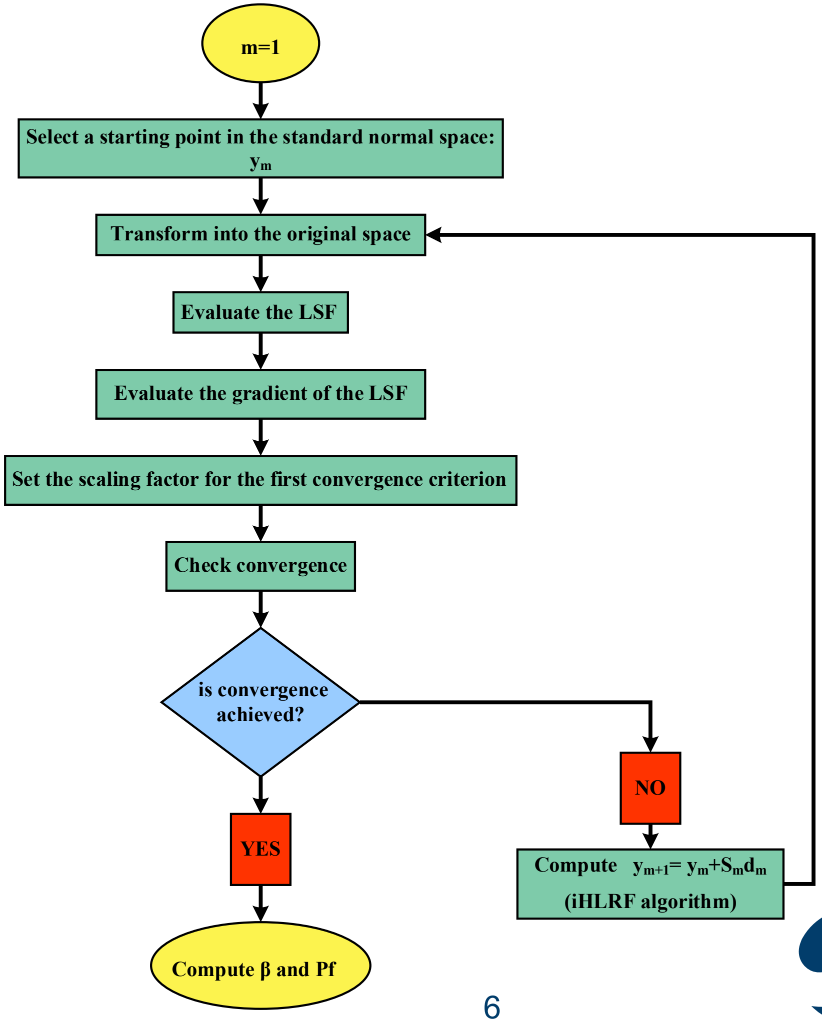


❑ Which strategy is the best?

- GRACE DA
- SMOS/SMAP DA
- Joint GRACE and SMOS/SMAP DA

Motivations

- 3. **Application of The first order reliability method (FORM) for validation purposes**

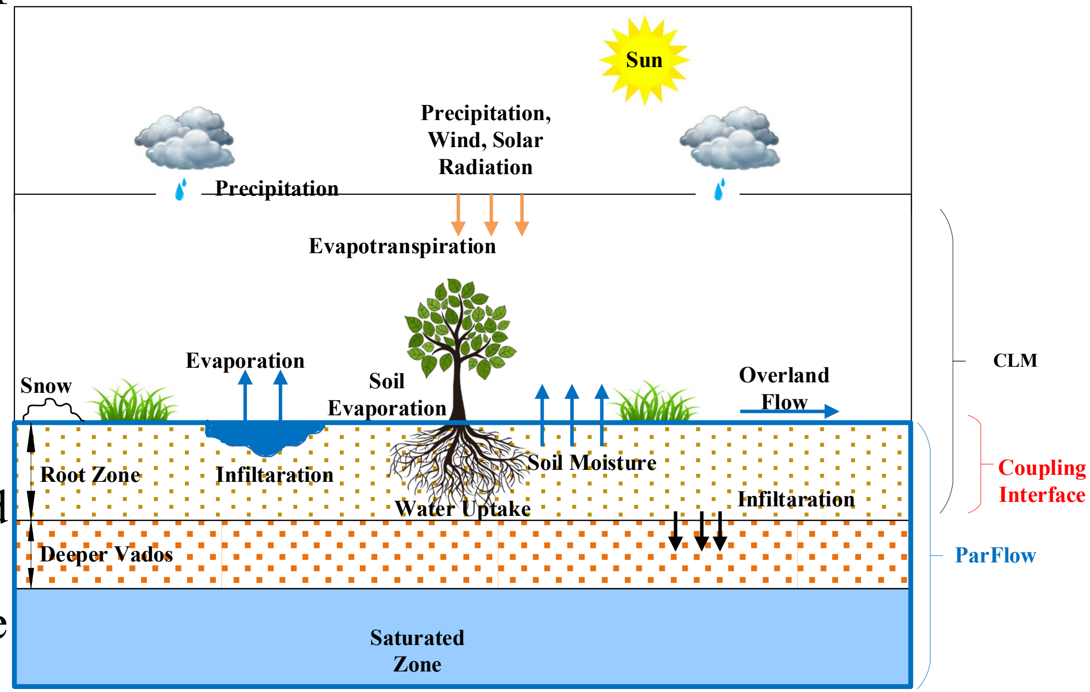


Methodology

❑1. Modeling: Coupled Surface-Subsurface Models

- The model should account for surface and subsurface process of water cycle.
- In this study:

ParFlow + CLM



- ParFlow for subsurface part
- CLM for land surface part
- ParFlow cannot account for land surface processes.
- CLM generally does not simulate deeper subsurface flows.

Methodology

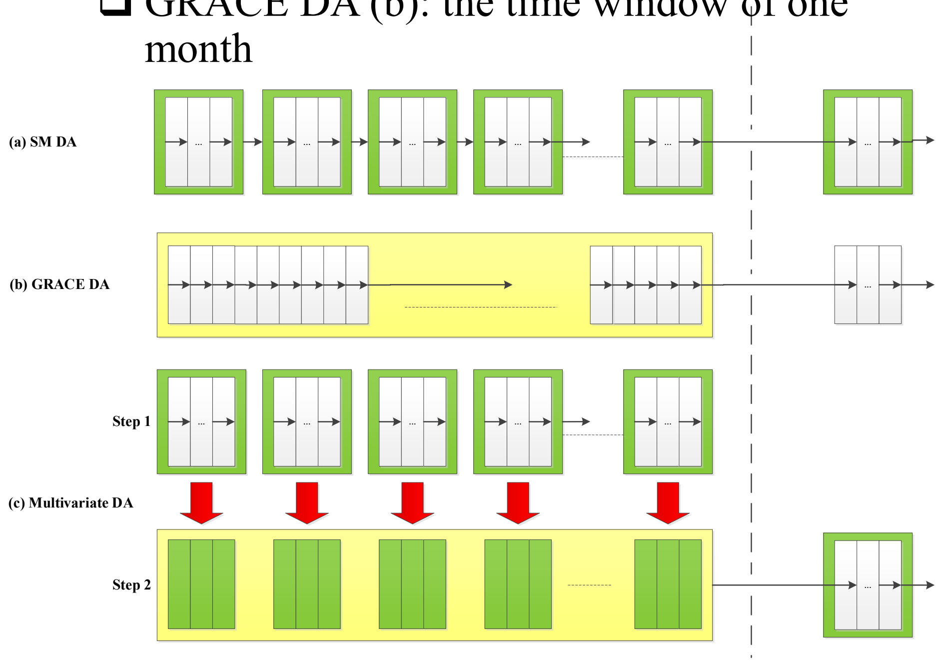
- **ParFlow**
  - **Hydraulic Conductivity**
  - **Van-Genuchten Parameters (α and n)**
  - **Specific Storage**
  - **Porosity**
  - **Digital Elevation Model (DEM)**

- **CLM**
  - **Precipitation**
  - **Wind Speed**
  - **Specific Humidity**
  - **Plant Functional Type**
  - **Barometric Pressure**
  - **Soil Texture Data**
  - **Near Surface Air Temperature**
  - **Downward Longwave Radiation**
  - **Downward Shortwave Radiation**

Methodology

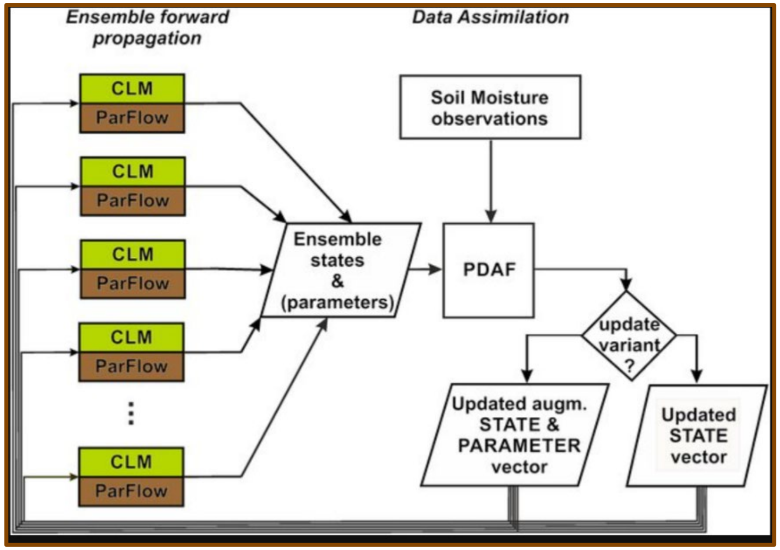
❑2. Three different DA schemes

- ❑ The SM DA (a): the time window of five days
- ❑ GRACE DA (b): the time window of one month



❑Implementation

- ❑ Parallel Data Assimilation Framework (PDAF)



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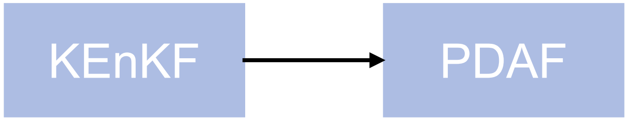
Current Status and outlook

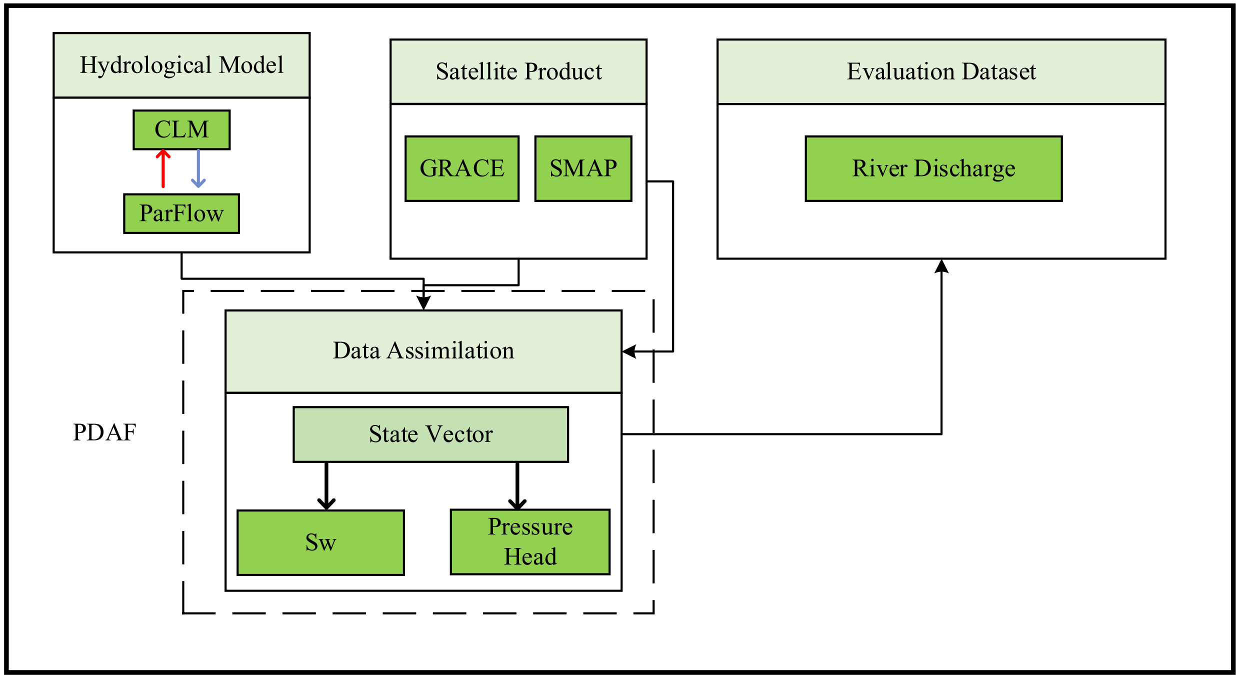
- ❑ **1. Implementing DA method: KEnKF**



- ❑ **2. Modelling: Surface-subsurface model development**

Current Status and outlook

- 3. Assimilating GRACE and SMAP/SMOS into the ParFlow-CLM model



Thank you for your attention!