JOINT ASSIMILATION OF SATELLITE SOIL MOISTURE AND FLOOD EXTENT MAPS FOR CALIBRATING A CONCEPTUAL HYDROLOGICAL MODEL : A PROOF OF CONCEPT STUDY.

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CONTEXT





A powerful tool for flood management and prediction : hydrological modelling

Need for observations to set up, calibrate and evaluate these models. Issues:

- Traditional observations are punctual (pb of representativeness).
- Observations are scarcely distributed and observation networks tend to be further reduced (e.g. stream gauges)
- Ground observations not always reliable during flood events.

=> Need for new observation techniques : good candidates : satellite SAR flood images, and satellite derived soil moisture products



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MORE AND MORE READILY AVAILABLE (RADAR) OBSERVATIONS

CC CSA grid processing on demand

Day-Night-All weather acquisitions

Synoptic view of large areas







Simulated SWS at satellite acquisitions + Simulated SWS continuous time series

Research question: Are these EO datasets sufficient for calibrating a distributed conceptual hydrological model ?

THE CONCEPTUAL HYDROLOGICAL MODEL









ASSIMILATION DESIGN





Satellite flood extent maps



THE ASSIMILATION DESIGN PARAMETER UPDATING STRATEGY





THE ASSIMILATION DESIGN: A TEMPERED PARTICLE FILTER

Bayes Theorem:

$$p(\theta|o) = \frac{p(o|\theta)}{p(o)} p(\theta) = \prod_{n=1}^{K} \frac{p(o|\theta)^{\varphi_n - \varphi_{n-1}}}{p(o)} p(\theta)$$
$$0 = \varphi_0 < \varphi_1 < \varphi_2 < \dots < \varphi_K = 1$$





SYNTHETIC TWIN EXPERIMENTS





SYNTHETIC TWIN EXPERIMENTS: SYNTHETIC TRUTH AND OBSERVATION





SYNTHETIC TWIN EXPERIMENTS: MODEL CALIBRATION USING SM+FA





SYNTHETIC TWIN EXPERIMENTS: MODEL CALIBRATION USING FA ONLY





SYNTHETIC TWIN EXPERIMENTS: CALIBRATED MODEL EVALUATION





CONCLUSION & NEXT STEPS

- We carried out a synthetic experiment using a TPF of the joint assimilation of satellite flooded area and soil moisture observation
- The results are really promising as the calibrated model is predicting surface runoff accurately both during the calibration and the validation periods
- This opens the floor for applications at large scale over poorly gauged areas

Next steps:

- To further investigate the added value of soil moisture data
- To carry out real test case experiments



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