Federated Digital Twins for Flood Prediction and Analysis

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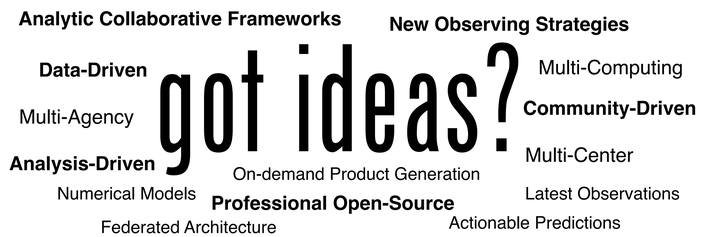
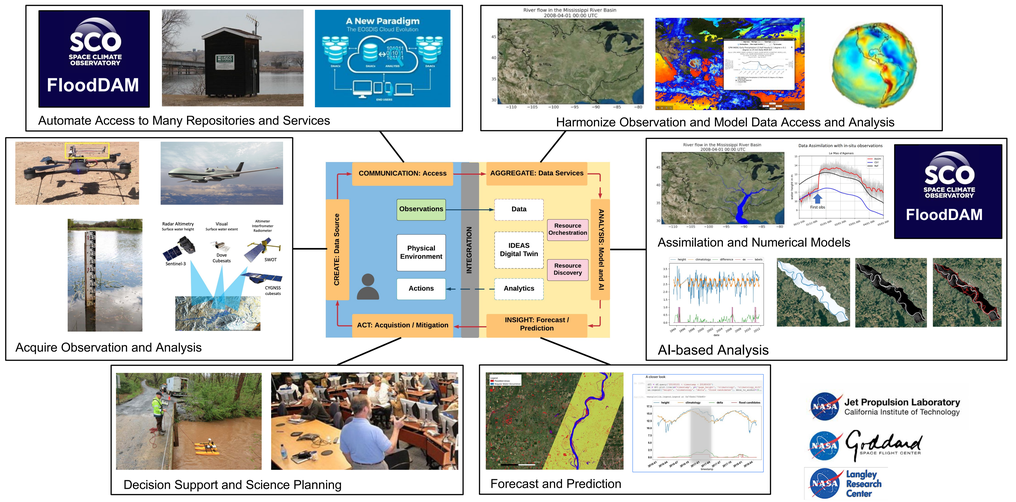
Clearance: CL#22-6455

Abstract

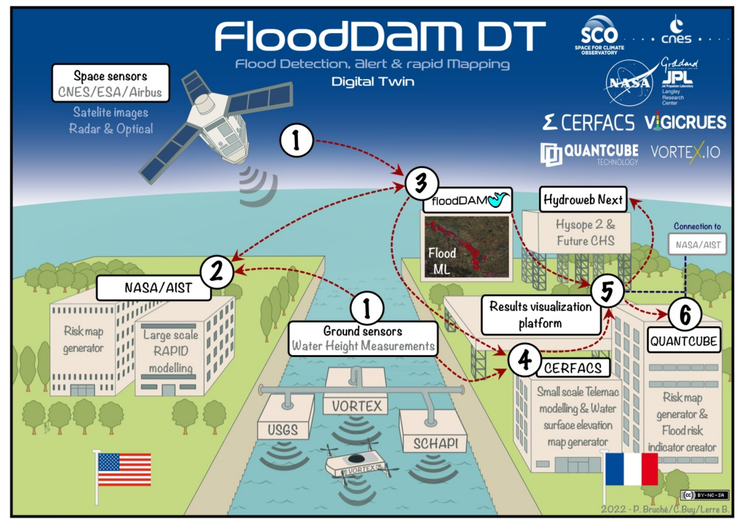
Water resource science is multidisciplinary in nature, and it not only assesses the impact from our changing climate using measurements and modeling, but it also offers science-guided, data-driven decision support. An Earth System Digital Twin (ESDT) is a dynamic, interactive, digital replica of the state and temporal evolution of Earth systems. It integrates multiple models along with observational data, and connects them with analysis, AI, and visualization tools. Together, these enable users to explore the current state of the Earth system, predict future conditions, and run hypothetical scenarios to understand how the system would evolve under various assumptions. NASA's Advanced Information Systems Technology (AIST) Integrated Digital Earth Analysis System (IDEAS) project partners together with the France's Science for Climate Observatory (SCO) FloodDAM Digital Twin effort is to establish an extensible architectural solution to develop digital twins of our physical environment for Earth Science. The joint effort delivers a formal system architecture with mechanisms for the outputs of one model to feed into others; for driving models with observation data; and for harmonizing observation data and model outputs for analysis. The work presents a multi-agency joint effort to define and develop digital twin for Earth system that includes continuous integration and harmonization of the latest measurements, assimilates model simulations, AI-driven scenario-based actionable predictions, and dynamic integration of the most recent, relevant observations, here with an initial focus on water resources and flood analysis case studies for proof of concept.





NASA Advanced Information Systems Technology

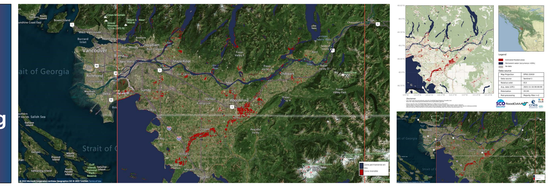
IDEAS: Integrated Digital Earth Analysis System



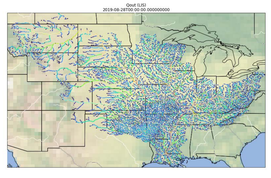
Space for Climate Observatory

FloodDAM DT

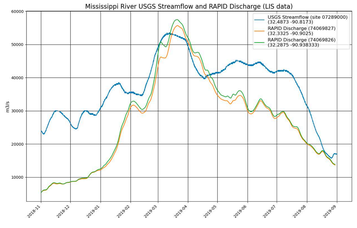
Flood Rapid Mapping



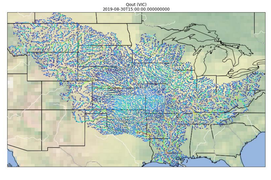
Mississippi River 2019-03 - 2019-08



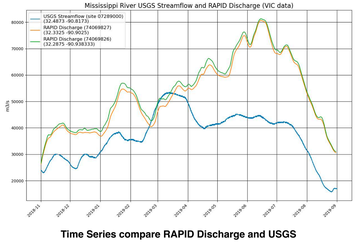
RAPIID Computed River Discharge using LIS Runoff



Time Series compare RAPID Discharge and USGS

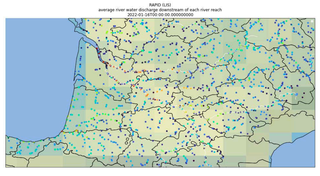


RAPIID Computed River Discharge using VIC Runoff

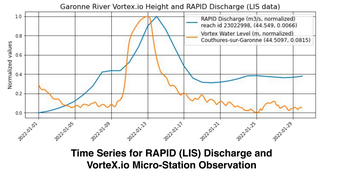


Time Series compare RAPID Discharge and USGS

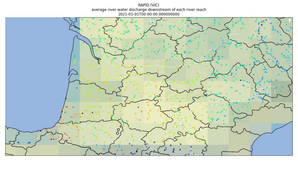
Garonne River 2022–01-01 - 2022-01-31



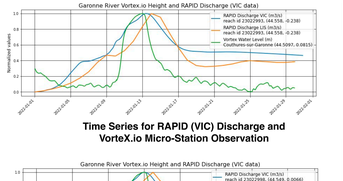
RAPIID Computed River Discharge using LIS Runoff



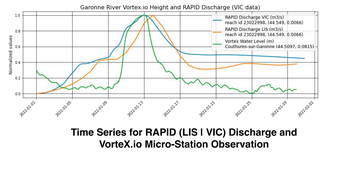
Time Series for RAPID (LIS) Discharge and VorteX.io Micro-Station Observation



RAPIID Computed River Discharge using VIC Runoff

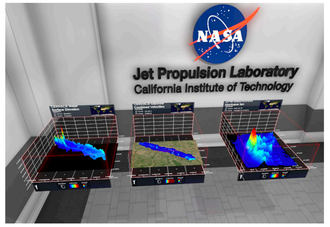


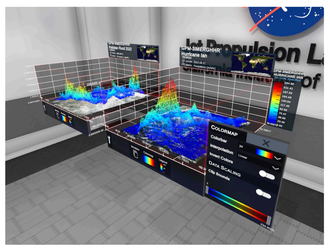
Time Series for RAPID (VIC) Discharge and VorteX.io Micro-Station Observation

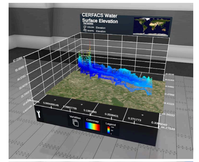


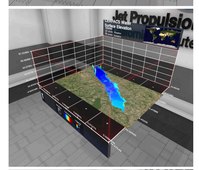
Time Series for RAPID (LIS I VIC) Discharge and VorteX.io Micro-Station Observation

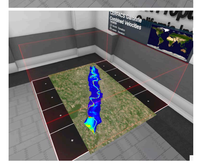
Immersive Science











Water Level Map