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Reservoir Heights Project – Spring 2011
Virtual Power Point Presentation Text

Abstract

Accounting for the regulation of water flow imposed on watershed drainage by dam operations is currently a major challenge in hydrological modeling for near real-time global flood forecasting. This water flow information is only available in areas where authorities are willing to release this data, leaving other regions, such as the developing world, without data access. Global flood models cannot provide accurate results and predictions for areas affected by dams without this necessary data, making these communities vulnerable to flood disasters. In order to compensate for the lack of data, a method must be developed in which altimetry data from satellites can be incorporated to account for the impact of dams on current flood models. By comparing near real-time satellite data to real-time in-situ water data, a change in reservoir heights can be observed and the relationship to discharge rates can be determined in order to monitor changes in water storage of downstream releases. The methods of this project can be used to adjust global flood models to properly account for the affects of dams on a watershed and predict future floods, preventing economic loss and ultimately saving lives.

Transcript

Slide1:

One major challenge in hydrological modeling for near real-time global flood forecasting is accounting for the regulation of water flow imposed on watershed drainage by dam operations. Information on water flow regulation can generally be obtained in areas where authorities are willing to release this type of data, but it is not readily available for other regions, particularly in the developing world. Without this information, global flood models cannot provide the correct results for dam-affected areas, preventing improved response to flood disasters.
This project investigates the use of near real-time satellite radar altimetry data to infer the dams' operation in order to overcome the regional and global hydrologic models' limitations.

Slide2:

The community concerns are great, leaving them vulnerable to potential flood disasters with incorrect data. Therefore, with corrected and adjusted flood models, mitigation of flood events becomes possible.

Slide3:

The study area is Garrison Dam on Lake Sakakawea, North Dakota, which is part of the Missouri River Basin in the United States. The goal of this project is to develop a method in which satellite altimetry data can be incorporated to account for the impact of dams in current flood models (reducing the peak discharge). The methods of this project can be used to adjust global flood models to properly account for downstream releases and predict future floods.

Slide4:

Data Methodology encompasses NASA and European Space Agency altimetry satellites used to measure sea-surface height, with continuous near real time data. The revisit times are 10-day and 35-day cycles.
The specific altimeter satellites are: Jason-1, Jason-2 and Envisat. This particular study only used satellite data from NASA's Jason-2.

Slide5:

Specific parameters were used in our site selection and data processing. Reservoir size must be of a considerable size, mainly greater than 100km. Reservoir water body is created and contained by a man-made dam. The temporal scale is 2002-present. Satellite data must be available from NASA Jason-1, Jason-2 satellites or the European Space Agency (ESA) Envisat satellite.

Slide6:

Processed satellite data from Jason-2 was downloaded from the Aviso website for each relevant pass for the needed cycles that covered the study area. Files were viewed and manipulated using the Basic Radar Altimetry Toolbox (BRAT) program in order to obtain the desired data results or surface height.

Slide7:

A basic water balance calculation was derived while meeting the specific parameters within the project. The goal is to understand the volume of water in the reservoir based on its height. Simply, the delta or change in volume of the reservoir was determined from subtracting the total outflow of the reservoir from the total inflow of the reservoir, as is indicated here. Changes in height were related to changes in storage using existing Area/Capacity/Storage curves provided by the US Army Corps of Engineers.

Slide8:

Here is a time-series comparison of heights from collected in-situ or ground measurements, Jason-2 GDR satellite altimetry, and calculated water balance data. This graph indicates a close relationship among all three measurements, relatively speaking. Since the datum of in situ and satellite differed, satellite data were adjusted for overall bias.

Slide9:

Here is a 10-day change in reservoir storage measured from gage, bias corrected satellite data and a water balance analysis. This analysis may lead to important applications with satellite altimetry data in water management and global flood events.

Slide10:

In summary, there is a good correlation between the time series in situ and satellite elevations, and to corresponding storage changes. Therefore, high capability for using satellite altimetry to flood modeling, especially in reservoir routing. This approach potentially can be used with any altimetric measurement from existing and future satellites, especially Surface Water Ocean Topography Mission (SWOT).

Slide11:

Project partners consist of Pacific Disaster Center, Earth System Science Interdisciplinary Center (ESSIC), University of Oklahoma and U.S. Army Corps of Engineers. This project directly relates to the program's focused research on the global water cycle and results generated from using ESSIC data will be shared. Project gage data was obtained from the U.S. Army Corps of Engineers, while satellite data was obtained from NASA's Jason-2 satellite. The Pacific Disaster Center will be the end-user of the model, in order to more effectively account for possible flood situations in areas affected by dams.

Slide12:

Transition of the projects results will ultimately assist and compliment each of these partners' endeavors.

Slide13:

Future work will utilize the final results of this Reservoir Heights Project through proving the utility of data from both ground (in-situ) and space (satellite) source. These data should be incorporated into appropriate models and used by those who monitor reservoirs and water basins.