Lake Sakakawea and Lake Mead Water Resources and Disasters
NASA Goddard Space Flight Center
Earthzine/DEVELOP Virtual Poster Session, Fall 2011
Video Transcript
Authors: Avery Sandborn, Robert Harrison, Gerasimos Michalitsianos

INTRODUCTION

Scene: Title slide, author names

NARRATOR
The NASA Applied Sciences Program and the DEVELOP National Program would like to present one of Goddard Space Flight Center's Fall 2011 Projects: "Lake Sakakawea and Lake Mead Water Resources and Disasters."

BACKGROUND

Scene: Two images of dams

NARRATOR
Current regional and global scale hydrological models typically do not take into account the release and storage of water by man-made dams. These models make gross assumptions about dam operation, impairing their accuracy and utility. In many less economically developed areas of the world, it is not possible to acquire information on the timing and extent of water release in dammed regions.

Scene: Flood image

NARRATOR
The uncertainty of dam operation could leave communities unprepared for potential flooding events. Therefore, a remotely sensed-based solution to this problem, by determining lake volume variability in dammed regions, is highly desirable.

Scene: Project goals header, bullet points describing goals

NARRATOR
The main goal of this project is to calculate volume changes in dammed lakes. To improve hydrological models, we need to determine the accuracy in estimating flow rates, validate and test flow-rate estimations, and compare multiple methods for calculating flow rates. Our methodology consists of merging MODIS surface water maps with a digital elevation model.

Scene: Study area header, Lakes Sakakawea image, Lake Mead image, text describing study area

NARRATOR

Because of the availability of accurate data, two lakes in the United States were studied. The Garrison Dam, on Lake Sakakawea, is located in North Dakota and the Hoover Dam, on Lake Mead, is located in Nevada.

METHODOLOGY

Scene: Excel imagery containing Garrison Dam data, USACE logo

NARRATOR
Before hydrological modeling was completed, the methodology needed to be validated based on truth data. This proof of concept was developed using the *in situ* Garrison Reservoir data, provided by partners at the United States Army Corps of Engineers.

Scene: Proof of concept header, three equations

NARRATOR
The first equation is the average area of the lake surface on two consecutive days, multiplied by the change in elevation between those two days to derive a volume change. The second equation finds the volume change based on the water balance equation and the given parameters in the *in situ* data set. Finally, the third equation finds the difference in volume based on the storage measurements in the *in situ* data.

Scene: Line graph of truth data

NARRATOR
The three equations were graphed to compare results. The blue line represents the first equation based on the trapezoid equation. The red line shows the water balance equation. Finally, the green line shows the difference in storage. All three lines show the same trends throughout the year and are very closely related.

Scene: Methodology header, text describing data sources

NARRATOR
Flow-rate estimations were computed by intersecting water extent maps with digital elevation models, also known as DEMs.

Scene: Earth imagery, Aqua MODIS sensor image, Terra MODIS sensor image

NARRATOR
The MODIS sensors aboard the Aqua and Terra satellites were used to derive water extent datasets.

Scene: USGS logo, HydroSHEDS website imagery,

NARRATOR
The USGS provided data from the HydroSHEDS DEM, used to help calculate volumetric changes. Together, the MODIS water extent datasets and the HydroSHEDS DEM were obtained over Lakes Sakakawea to compute volume.

Scene: Lake Sakakawea elevation change imagery

NARRATOR
The change in height between two MODIS extents provides the change in elevation. The digital elevation model provides the area of a pixel. These two parameters give the volume calculation.

RESULTS

Scene: Image of DEM and MODIS extents

NARRATOR
The DEM, shown in green, represents the terrain of the land. Water extents are grown within this model to represent the water surfaces. When the two water extents are overlaid on the DEM, shown in red and blue, a change in volume can be computed.

ERRORS

Scene: MODIS misalignment header, image of MODIS misalignment on Lake Sakakawea, zoomed-in section of image with greater detail

NARRATOR
Initial MODIS water extent datasets contained some registration errors. Three MODIS derived products show the differences in alignment. The Science Product is properly geo-referenced, while the LANCE and Flood Watch products are misaligned by several pixels. The three products' misalignments can be clearly observed and measured. Even though the misalignment appears minor, offsets of even a few hundred meters can induce serious error in the height measurement process.

Scene: MODIS misalignment header, three projected images of Lake Sakakawea

NARRATOR
To determine if the misalignment was due to warped pixels or offset imagery, raster images must be converted into polygons. A reflectance value was selected such that all values lower represent water, and all other values have no data. Reclassified images are then converted into a polygon. The consistency of the misalignment issues indicated that the images were offset and not warped.

Scene: Elevation variation header, water extent imagery on Lake Sakakawea, labels on imagery

NARRATOR

To determine the variation in elevations along the coastlines of a portion of Lake Sakakawea, both the MODIS imagery and the DEM were used. The extent of the lake, derived from MODIS, defined which pixels from the DEM to measure. Each pixel has an elevation associated with it. A change in color indicates a change in elevation.

Scene: Histogram of Lake Sakakawea coastline elevations

NARRATOR
Theoretically, the elevations should be the same around the entire coastline. This histogram shows the variability between elevation measurements. Error in elevation measurements could contribute to inaccurate calculations in volume change. Continual improvements are being made in order to obtain the most accurate water extent datasets available.

CONCLUSIONS

Scene: Future Work header, two dam images

NARRATOR
If selected for a second term, this project would focus on examining the potential errors more in depth, as well as developing the product to be handed off to partner organizations.

Scene: Pacific Disaster Center logo, Disaster-AWARE screenshot

NARRATOR
Partners at the Pacific Disaster Center are developing Disaster-AWARE, a tool that will provide decision support and awareness for disaster management and risk reductions around the world. The methodology in this project will be incorporated to help reduce flooding events in dammed areas.

Scene: Dam image

NARRATOR
Current hydrological models will benefit from a remotely sensed solution to estimating dam discharge.

Scene: NASA logo, Student Intern names, Advisor names, Mentor names, Credits

NARRATOR
We hope you enjoyed this presentation on determining lake volume variability in dammed regions.