Sacramento-San Joaquin Delta Disasters and Water Resources:

NASA RADAR Remote Sensing for Levee Health Assessment

by

NASA DEVELOP – Jet Propulsion Laboratory

Austin Madson (Center Lead)

Scott Barron (UCLA)

Robin Sehler (CSUN)

Scene 1:

NIGHT TIME ISS FLYOVER FOOTAGE OVER NORTH AMERICA
BACKGROUND MUSIC

Caption:
DEVELOP AT JPL PRESENTS

Scene 2:

NIGHT TIME ISS FLYOVER FOOTAGE OVER NORTH AMERICA
BACKGROUND MUSIC

Austin (Voiceover)
During the fall of 2012, three DEVELOP students at the Jet Propulsion Laboratory in Pasadena, California set out to rapidly produce accurate products for our end user. Working closely with our science advisor and end users at the California Department of Water Resources, we sought to formulate methodologies using airborne NASA RADAR data in order to keep better tabs on the ever-important Sacramento-San Joaquin Delta Levee System

Scene 3:

STILL SHOT OF UAVSAR PLANE AND SENSOR
BACKGROUND MUSIC AND JET FLY-BY

Caption:
Sacramento-San Joaquin Delta Disasters and Water Resources:
NASA RADAR Remote Sensing for Levee Health Assessment

Scene 4:

FOOTAGE OF DR. CATHLEEN JONES INTRODUCING HERSELF
BACKGROUND MUSIC

Caption:
Dr. Cathleen Jones
DEVELOP JPL Science Advisor

Cathleen Jones
Hi, I'm Cathleen Jones. I am the science advisor for the fall 2012 DEVELOP project.

Scene 5:

FOOTAGE OF SCOTT BARRON INTRODUCING HIMSELF
BACKGROUND MUSIC

Caption:
Scott Barron
UCLA

Scott Barron
I'm Scott Barron. I'm a fourth-year Geography/Environmental Studies major, and GIS minor at UCLA.

Scene 6:

FOOTAGE OF ROBIN SEHLER INTRODUCING HERSELF
BACKGROUND MUSIC

Caption:
Robin Sehler
CSUN

Robin Sehler
Hi, my name's Robin Sehler and I study geology at Cal State Northridge.

Scene 7:

FOOTAGE OF AUSTIN MADSON INTRODUCING HIMSELF
BACKGROUND MUSIC

Caption:
Austin Madson
DEVELOP JPL Center Lead

Austin Madson
Hi, I'm Austin Madson. The Center Lead here at JPL DEVELOP.

Scene 8:

STILL SHOTS OF THE DELTA, DELTA WILDLIFE, CANAL, AND LEVEE BREAKS
BACKGROUND MUSIC

Austin Madson (Voiceover)
Not only is the Sacramento-San Joaquin Delta home to important agricultural land and faunal habitats, but it's also the source of nearly 2/3 of California's fresh water. With our state's reliance on this vast fresh water source, it becomes ever so clear just how important of a role levees play in keeping this water supply intact.

Scene 9:

FOOTAGE OF SCOTT BARRON IN FRONT OF GOOGLE EARTH IMAGERY OF STUDY AREA
BACKGROUND MUSIC

Scott Barron
The purpose of this study is to use UAVSAR data to quickly and accurately produce and automate methodologies to locate seeps along the protected side of levees.

Scene 10:

FOOTAGE OF ROBIN SEHLER IN FRONT OF GOOGLE EARTH IMAGERY OF STUDY AREA
BACKGROUND MUSIC

Robin Sehler
To determine areas with constant seeps.

Scene 11:

FOOTAGE OF AUSTIN MADSON IN FRONT OF GOOGLE EARTH IMAGERY OF STUDY AREA
BACKGROUND MUSIC

Austin Madson
And to also delineate locations where seeps are increasing, or decreasing, from one data acquisition to the next.

Scene 12:

FOOTAGE OF SCOTT BARRON IN FRONT OF GOOGLE EARTH IMAGERY OF STUDY AREA
GOOGLE EARTH "FLY-TO" OF STUDY AREA
BACKGROUND MUSIC

Scott Barron
Our study area is a portion of the Sacramento-San Joaquin Delta, located approximately fifty miles east/northeast of San Francisco, and containing about eleven-hundred miles of levees within the delta itself.

Scene 13:

FOOTAGE OF ROBIN SEHLER IN FRONT OF GOOGLE EARTH IMAGERY OF STUDY AREA WITH RIVER GAGE POINTS
BACKGROUND MUSIC

Robin Sehler
We received water gage data from our partner at the California Department of Water Resources, and supplemented the data gaps with gage readings from the California Data Exchange Center. We then pulled out the water levels at the time of data acquisition for each UAVSAR acquisition date.

Scene 14:

FOOTAGE OF AUSTIN MADSON INTERVIEWING CATHLEEN JONES
BACKGROUND MUSIC

Austin Madson
So, Cathleen, can you explain briefly why these products are so useful?

Cathleen Jones
Well, one of the things that tells people whether a levee is healthy or not is whether there is underseepage. So, being able to locate where there is underseepage in particular when there is a lot of water in the channels is really important.

Scene 15:

FOOTAGE OF SCOTT BARRON IN FRONT OF PRODUCT OVERLAYS
BACKGROUND MUSIC

Scott Barron
For our first product, we wanted to modify previous seep detection methodologies and fine-tune them to our study area. A band ratio was then applied to the VV and HH polarization images. Next, an unsupervised classification scheme was applied on the ratioed image, and the classes clumped accordingly leaving us with a bi-class image displaying areas of increased soil moisture content, and areas without.

Scene 16:

FOOTAGE OF AUSTIN MADSON IN FRONT OF PRODUCT OVERLAYS
BACKGROUND MUSIC

Austin Madson
Our second product expands on the first seep detection methodology in order to detect the change in areas classed as having increased soil moisture content

between two different UAVSAR acquisitions. The end result is an image displaying which areas saw an increase, a decrease, or no change in the excess soil moisture class pixels.

Scene 17:

FOOTAGE OF ROBIN SEHLER IN FRONT OF PRODUCT OVERLAYS
BACKGROUND MUSIC

Robin Sehler
Our third product also expands on the first seep detection methodology in order to pick out areas where there seem to be constant seeps along the levee throughout our study period.

Scene 18:

FOOTAGE OF AUSTIN MADSON INTERVIEWING CATHLEEN JONES
BACKGROUND MUSIC

Austin Madson
So, Cathleen, can you explain why the automation aspect of this project is of great value?

Cathleen Jones
Well, whenever an emergency occurs you have to get the information out in the field as fast as possible, and so having everything done and automated is really important to that time critical element.

Scene 19:

STILL SHOT OF CHANGE DETECTION MODEL AND ALGORITHM
BACKGROUND MUSIC

Austin Madson (Voiceover)
This model can be run during a high water event in order to determine how levee seeps are changing. The model outputs a kmz file displaying areas where seeps are increasing, decreasing, or that remain unchanged. By using the previously described geoprocessing methods, and a simple, yet effective algorithm. The image on the bottom is a portion of the output kmz file where the red pixels delineate levee seeps that have increased between data acquisitions

Scene 20:

STILL SHOT OF STUDY AREA
BACKGROUND MUSIC

Austin Madson (Voiceover)

These automated methodologies provide our end user at the California Department of Water Resources with the products they need to keep a better eye on this ever-important water source.

Scene 21:

STILL SHOT OF VIDEO SOURCES
BACKGROUND MUSIC

Caption:
Video Sources
California Bureau of Land Management
California Department of Water Resources
Image Science & Analysis Laboratory, NASA Johnson Space Center
JPL/Caltech
NASA

Scene 22:

FOOTAGE OF EARTH FORM SPACE

Caption:
NASA DEVELOP
http://develop.larc.nasa.gov