Climate Variability, Hydrology, and Flooding

Introduction to MODIS-based Inundation Mapping and GIS Applications
Objective

• To provide an overview of the MODIS Inundation Mapping Tool
Outline

- About MODIS and the Inundation Mapping Concept
- *Near-Real Time Global MODIS Flood Mapping Tool*
- Importing MODIS Inundation Data in GIS
About MODIS and Inundation Mapping Concept
MODerate Resolution Imaging Spectroradiometer (MODIS)
http://modis.gsfc.nasa.gov

- Flying on-board Terra and Aqua – polar orbiting satellites
- Global measurements, 1 to 2 times per day
- 36 spectral bands observing atmosphere, ocean, and land properties
- Measurement footprints vary from 250 m to ~1 km

Flooding along the White Nile, Sudan from the Natural Hazards page of earthobservatory.nasa.gov
MODIS Data for Inundation Mapping

MODIS Reflectance in Optical Bands 1, 2, and 7:
(620-670 nm), (841-876 nm), and (2105-2155 nm)

- MODIS provides observations of land-surface. MODIS reflectance from these bands indicates the presence of water on land surface, previously not covered by water.
- A global reference database of water bodies is formed – inundation is mapped with respect to the reference water.

Spatial Resolution: 250m x 250m
Spatial Coverage: Global
Temporal Resolution: Daily, 8-day, 16-day
Temporal Coverage: 1998 to present
MODIS Data for Inundation Mapping

Strengths:

▪ High Resolution, Globally Consistent

▪ Can provide Coastal Inundation Mapping due to storm surge or tsunamis

Limitations:

▪ MODIS provides surface inundation mapping only outside the water bodies, it does not provide information about water depth or water flow

▪ It can not view the surface in the presence of clouds

▪ Mountain and cloud shadows may be erroneously interpreted as water inundated surfaces
MODIS-Based Interactive Flood Tools

- Near-Real Time Global MODIS Flood Mapping
- Dartmouth Flood Observatory (DFO)
Near-Real Time Global MODIS Flood Mapping Tool
MODIS Inundation Mapping

http://oas.gsfc.nasa.gov/floodmap/

View in ArcGIS Online Map Viewer

10°x10°
MODIS Inundation Mapping: Zoom on a region

http://oas.gsfc.nasa.gov/floodmap/

- Red Shading Shows Inundated Surface
- Blue Shading Shows Reference Water
- White Shading Shows Cloud Cover

Regional Mapping

Pixel size 250 m

Rio das Mortes
MODIS Inundation Mapping
http://oas.gsfc.nasa.gov/floodmap/

PRODUCTS:

**MFM:** MODIS Flood Map = annotated 10x10 degree map/graphic product (currently available in png format).

**MSW:** MODIS Surface Water (Pixel classified with presence of water = *Reference Water* + Flood Water). This is based on a ratio of MODIS bands 1, 2, and 7 reflectance values.
*Reference Water:* based on MODIS reflectance and Shuttle Radar Topography Mission Water Body Data.

**MFW:** MODIS Flood Water – Obtained by subtracting Reference Water from MSW.

**MWP:** MODIS Water Product (Each pixel is assigned a number to identify as either undecided, water not detected, reference water detected, flood water detected where there is no reference water present)
MODIS Inundation Mapping

Archive Available since 2010

Composite Map

10-day Sequencing

png, kmz, geotiff images available

Check slide show for the last 10 days.
Importing MODIS Inundation Data in GIS
Display MODIS Inundation in ArcMap

MFW shapefiles and MWP geotiff files can be easily imported into ArcMap.

Open the Add data icon and click Add Data

Select the MFW (MODIS Flood Water) shapefile or the MWP geotiff file and click Add.
The shapefiles have been imported. You may wish to adjust the symbology color in order to visualize the inundated lands better.

Right click the layer, navigate to layer properties, Symbology tab, click the symbol color and choose the desired color. Click ok.
MWP: MODIS Water Product (geotiff file)
0 : Insufficient data to make water determination (cloudy, missing images, swath gaps swaths, or bad data values)
1 : No water detected
2 : Water detected AND coinciding with reference water (e.g., not flood)
3 : Water detected, beyond reference water, so is likely flood

You can adjust the symbology of the geotiff file through through the layer properties, symbology tab. Within the Show window, choose Unique Values and alter the colors assigned to each pixel category. For example :
0=No color
1=No color
2=Blue
3=Red
Repeat the process for all files for your chosen dates

Assigning different colors for each of the following dates can assist in visualizing inundated lands over time.
### List of Common GIS Data Layers that can be combined with MODIS inundation layers for spatial analysis

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Data Source</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers/Basins</td>
<td>USGS HydroSHEDS</td>
<td><a href="http://hydrosheds.cr.usgs.gov/">http://hydrosheds.cr.usgs.gov/</a></td>
</tr>
<tr>
<td>Elevation</td>
<td>NASA LP DAAC</td>
<td><a href="https://lpdaac.usgs.gov">https://lpdaac.usgs.gov</a></td>
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<tr>
<td></td>
<td>Consortium for Spatial Information (CGIAR-CSI)</td>
<td><a href="http://srtm.csi.cgiar.org/">http://srtm.csi.cgiar.org/</a></td>
</tr>
<tr>
<td>Reservoirs</td>
<td>NASA Socioeconomic Data and Applications Center (SEDAC)</td>
<td><a href="http://sedac.ciesin.columbia.edu/">http://sedac.ciesin.columbia.edu/</a></td>
</tr>
<tr>
<td>Soil Type</td>
<td>ISRIC - World Soil Information</td>
<td><a href="http://www.isric.org/">http://www.isric.org/</a></td>
</tr>
<tr>
<td>Dams</td>
<td>NASA Socioeconomic Data and Applications Center (SEDAC)</td>
<td><a href="http://sedac.ciesin.columbia.edu/">http://sedac.ciesin.columbia.edu/</a></td>
</tr>
</tbody>
</table>
Next Presentation will be on:

The Dartmouth Flood Observatory