

ChangeMatters: Three Gorges Dam



Objective:

Students will leverage some of the features available using the Esri ChangeMatters Viewer to visualize and assess the impacts of the Three Gorges Dam on its surrounding environment. As one of the largest engineering projects of its kind, the Three Gorges Dam radically changed the surrounding landscape and affected areas all along the Yangtze River in China.

Connections to Curriculum Topics:

- Natural Disasters
- Human Impacts on the Environment
- Exploitation and Utilization of Resources
- Energy Conservation
- Energy and Society
- Environment and Resource Management
- Scientific Solutions to Contemporary Environmental Challenges

Requirements:

- Internet browser (e.g., Internet Explorer, Firefox, Chrome)
- Adobe Flash Plug-in – <http://get.adobe.com/flashplayer/>

****Note:** In order to function properly, the ChangeMatters viewer requires the Adobe Flash Plug-in. When accessing the viewer for the first time, you may be prompted to install the latest version of Flash Player.

Background Information:

The Three Gorges Dam is one of the largest hydroelectric dams ever constructed. The dam spans over the Yangtze River in Central China and is the world's largest power station in terms of installed capacity. Upon completion, the plant will have the ability to generate up to 22,500MW of electricity. Despite the Three Gorges Dam being a modern engineering project, original plans for it date back to 1918 when Sun Yat-sen, viewed by many as the founding father of modern China, proposed the idea of building a dam across the Yangtze River. Since then, the project has been pursued by the Chinese Nationalist Government, Japanese occupying forces, the US Bureau of Reclamation, and the Communist Party of China. Major construction began on December 14, 1994, and although the facility is operational today, various construction projects remain ongoing.

The dam provides renewable energy to a number of provinces within 1,000km. The site has also increased flood protection, allowed for safer, more efficient shipping along the Yangtze, lowered the overall reliance on coal, and provided a number of jobs to local residents. Consequently however, the dam required the flooding of 632 km² of land and the relocation of an estimated 1.13 million residents. Moreover, many believe that the dam will prevent the natural process of sediment transfer in the river, damage local ecosystems, raise the frequency of landslides and lead to the build-up of unhealthy stagnant water.

References:

- **China Three Gorges Corporation** – <http://www.ctgpc.com/>
- **Timeline of Three Gorges Dam** – <http://timerime.com/en/timeline/65506/Three+Gorges+Dam/>
- **Engineering and Technology Magazine: Taming the Yangtze** – <http://eandt.theiet.org/magazine/2009/04/taming-the-yangtze.cfm>
- **Time Magazine: China's Three Gorges Dam Under Fire** – <http://www.time.com/time/world/article/0,8599,1671000,00.html>
- **CNN: China's Three Gorges Dam** – <http://www.cnn.com/SPECIALS/1999/china.50/asian.superpower/three.gorges/>
- **News.cn (Chinese)** – http://news.xinhuanet.com/ziliao/2003-05/30/content_896773.htm
- **The Three Gorges Dam** - <http://oraclephoto.com/3g01.html>

****Note:** Web sites accessed in October, 2011.

The Education team at Esri Canada makes every effort to present accurate and reliable information. The Web sites and URLs used in this lesson are from sources that were current at the time of production, but are subject to change without notice to Esri Canada. It is recommended that teachers test all links within the Web GIS lesson prior to students working through the individual lessons.

Getting Started:

This lesson will focus on the areas along the Yangtze River that have been affected by the construction of the Three Gorges Dam.


1. Click on this link to launch the *ChangeMatters* viewer centered on the Three Gorges Dam:
<http://changematters.esri.com/Explore?im=NaturalColor&yr=1990¢er=12356101.614628749.3613273.263303474&level=12>

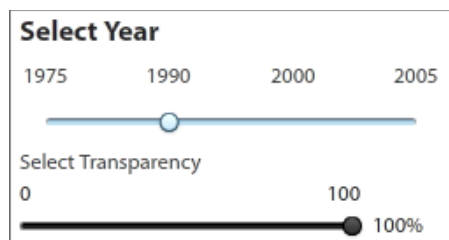
Alternatively, enter this link into the address bar of your Web browser - <http://bit.ly/oxncpG>

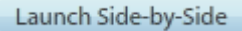
Similar to other Web maps, you can navigate your way around by double-clicking on the map, using the scroll wheel on your mouse to zoom in and out, using the arrow keys to pan in all directions or using the navigation tools available on the left-hand side of the viewer.

Q. Describe your first impressions of the area. What do you see?

Hint: Use the legend at the bottom of the viewer as a guide to help you distinguish between areas on the map

2. Using the **Select Year** box located on the right-hand side of the viewer, move between the years 1990, 2000 and 2005. Click **Don't show this again** in the *Notice Regarding 2005 Imagery* box that appears and then close  the window. You can safely dismiss any similar pop-ups that occur later.



3. Check the **Overlay Change** box and set the *Select Date Range* to be 1990-2005. Areas along the banks of the Yangtze that are highlighted in pink have experienced a significant decrease in vegetation between these two dates.
4. Select the  button. A new tab will open within your Web browser.

This new viewer allows the user to visually compare imagery from different years next to one another while keeping the scale and extent synced together. In addition, a third window will display the Normalized Vegetation Index (NDVI) change between the two dates being examined.

5. Ensure that *Select Image Map* is set to **Natural Color** and change *Select Dates* to be **1990 – 2005**. Examine this area and make note of how the landscape has changed.



6. Change *Select Image Map* to **Land/Water Boundary** in order to make the changes more visible.

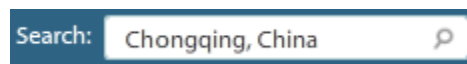
Q. How has the landscape in this area changed between these two time periods?

Q. What caused this change?

7. Change *Select Dates* to be **2000-2005** and examine the NDVI change map. You can see that areas along the river where vegetation is now covered by water display as dark pink, indicating a decrease in vegetation.

The physical / environmental landscape isn't the only thing affected by the building of the dam. Approximately 450km south-west of the Three Gorges Dam is the Municipality of Chongqing. With the flooding of the Yangtze and the completion of the ship locks, the city of Chongqing became far more accessible to ocean-going vessels, helping to secure its position as an economic centre for much of inland China.

8. Within the **Search** box in the top left-hand corner of the viewer type **Chongqing, China**.



Note: You can return to the original extent at any time by simply searching **Three Gorges Dam, China**.

9. Zoom-out until you can see the full extent of the city, and then set the map to display **natural colour** images for **1990 and 2005**.

****Note:** You may notice that the scan line corrector failure is present for some of the imagery. For additional information on this, visit the following Web page: <http://www.esri.com/library/whitepapers/pdfs/landsat-anomaly.pdf>

Q. Describe how the city has changed during this time. What areas of the city have experienced the most change?

The Yangtze River has a history of flooding during periods of heavy rainfall. This, coupled with a human tendency to settle in flood zones, can lead to loss of life and property. Severe floods have occurred in this region a number of times in the last century, claiming hundreds of thousands of lives and causing significant damage to homes and infrastructure.


Q. What benefits could a dam provide during floods and periods of heavy rainfall?

Q. List any other positive and negative impacts that you think may occur as a result of the dam.

Extension Exercise:

- Click on this link to launch the *ArcGIS MapViewer* centered on the Three Gorges Dam – <http://www.arcgis.com/home/webmap/viewer.html?webmap=384f46e8ae2e4d84953a6a5de68d8c1f>

Alternatively, enter this link into the address bar of your Web browser - <http://bit.ly/rz9T2l>

- Select **Play** on the time slider and watch the change over time. **Pause** the time slider once the majority of construction has finished and the time slider reads “**December 31, 2005 to December 31, 2007**”.
- Under the *Measure* button, select the **Area**  tool to measure the size of the lake created as a result of damming the Yangtze. With the *Area* tool still open, resume the time slider as it loops and examine the difference in river width before and after the dam construction. Try measuring the area for the same stretch of river from before the dam was constructed.




Q. Record your findings for both measurements in square kilometres.

Post-construction: _____ km²

Pre-construction: _____ km²

Q. Remember that construction of the dam is said to have flooded 632km² of land. Does the lake account for the majority of this inundated land? Where else should one expect to find additional inundated land?

- Try measuring the following:
 - The distance by river between the town of Badong and the dam site
 - The distance by river between the city of Chongqing and the dam site
 - The change in river width at the town of Badong before and after the dam construction

Hint: Use the *Bookmarks* button to help locate each area in question. You may also wish to view the underlying basemap by selecting  *Show Contents of Map* and turning the **NaturalColor** layer on and off. Keep in mind, turning the **NaturalColor** layer on and off will reset the time slider.