EnviroAtlas

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Fact Sheet

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Estimated Floodplain Map of the Conterminous U.S.

This EnviroAtlas national map displays areas estimated to be inundated by a 100-year flood, also known as the 1% annual chance flood. These data are based on the Federal Emergency Management Agency (FEMA) 100-year flood inundation maps with the goal of creating a seamless floodplain map at 30-meter resolution for the conterminous United States. This map identifies a given pixel's membership in the 100-year floodplain and completes areas that FEMA has not yet mapped.

Photo: Missouri River flooding, S. Hillebrand, USFWS

Why are floodplain estimates important?

Flooding occurs when river or stream flow exceeds the channel's volume. Floodplains are the land areas adjacent to rivers and streams where the overflow is displaced during flooding. Floodplains provide several important ecosystem services. They store water during storm events, thereby reducing flooding in downstream communities. In addition, floodplains are high in biodiversity and are among the most species-rich environments, and they provide opportunities for recreation and ecotourism.[1] Although floodplains are areas of high value, they are often modified by agricultural, industrial, and urban land use pressures.[2] As a result of land use change, natural floodplains are one of the most imperiled ecosystems in the world.[3] In addition, the use of tile drainage, ditching, and channelization in floodplains has altered the primary function of these ecosystems.[4] Consequently, the decline in floodplain functionality and ecosystem services can lead to extensive damage to natural ecosystems, human infrastructure, and agricultural lands. Floods are now one of the leading causes of natural disaster losses in the United States, where annual average flood damage losses were almost $10 billion annually in the 2000s.[5]

Flood hazards are known to result in numerous adverse environmental, economic, and social impacts, including ecosystem degradation, property damage, disease, and loss of life. Floodwater is often contaminated by sewage, chemicals, or other harmful substances; these can be transported into streets and buildings, as well as onto farmland and drinking water source areas.[6]

Floods can also cause substantial damage to infrastructure, such as powerlines, roads, and bridges, for which repair costs are typically considerable.[7] Furthermore, floods often result in significant injury and mortality including skin rashes, acute asthma, respiratory infections, and water- and vector-borne diseases. Potential long-term health effects include post--traumatic stress disorder and mental illness.[8] These adverse psychological health effects can be more serious than physical illness or injury from flood hazards.

How can I use this information?

The map, Estimated Floodplains, identifies a given pixel's membership in the 100-year floodplain. This map can be used to inform decisions about resource restoration, use, and conservation. For example, it can be overlaid with land cover data from the 2011 National Land Cover Database to determine the level of anthropogenic pressure by examining the presence or absence of cultivated and developed land cover classes in the floodplain. EnviroAtlas also provides layers related to natural land cover in stream buffers that can be used with the floodplain layer to identify anthropogenic pressures and areas of potential restoration or conservation. Other potential applications include identifying agricultural vulnerability to flooding by using EnviroAtlas layers on crop yields and planted areas or identifying contaminated sites (e.g. brownfields, Resource Conservation and Recovery Act, Superfund, or Toxic Release Inventory sites) located in floodplains.

How were the data for this map created?

These data were developed using random forest classification of nationally available biophysical datasets. Three datasets were acquired: National Land Cover Dataset (NLCD), 30-meter digital elevation model (DEM), and Soil Survey Geographic Database / U.S. General Soil Map (SSURGO/STATSGO2). Ten derivatives of these datasets

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were developed including measures of distance to nearest channel, slope, and soil taxonomy. These ten spatially complete datasets were used as explanatory variables along with existing spatially incomplete data from FEMA's Special Flood Hazard Area (SFHA) as the response variable in a random forest classification. Random forest is a machine learning algorithm that uses multiple decision trees based on numerous random subsets of training data to develop a prediction model. Models were developed and applied for each level-4 hydrologic unit (HUC-4, n=202) in the conterminous U.S. The classified results were a binary raster (0–not in 100-year floodplain; 1–within 100-year floodplain). HUC-4 models were mosaicked to form a spatially-complete, national 100-year floodplain prediction. A full description of the classification techniques is given in the data layer's metadata.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with these data. These data are based on models and large national geospatial databases. Calculations based on these data are estimations of the truth founded on the best available science.

Hit rate, the percentage of pixels correctly classified by the random forest model assuming the FEMA data are accurate, was 0.79 for the CONUS but this varied geographically. Typically, performance was better in temperate ecoregions and worse in the arid southwest. These data were derived exclusively from biophysical datasets (elevation, soils, and land cover) and do not use hydrodynamic modeling or take in to account anthropogenic infrastructure (flood walls, culverts, etc.). Therefore, these data cannot replace FEMA's detailed flood inundation studies or be used in scenario testing or modeling of return periods other than the 1% annual chance of flooding.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. To acquire the elevation data (NED), soils data (SSURGO/STATSGO2), land cover data (NLCD), or existing floodplain data (FEMA SFHA) used to generate this floodplain map, please visit the respective web sites for those datasets.

Where can I get more information?

For more information on how flood hazards and their reduction may affect human health, visit the Water Hazard Mitigation section of the Eco-Health Relationship Browser. For additional information on how the data were created or their limitations, access the metadata for the data layer or the peer-reviewed journal article listed below.[9] To ask specific questions about these data, please contact the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. Ward, J.V., K. Tockner, and F. Schiemer. 1999. Biodiversity of floodplain river ecosystems: Ecotones and connectivity. *River Research and Applications* 15(1–3):125–139.

2. Schindler, S., Z. Sebesvari, C. Damm, K. Euller, V. Mauerhofer, A. Schneidergruber, M. Biró, F. Essl, R. Kanka, S. Lauwaars, and C. Schulz-Zunkel. 2014. Multifunctionality of floodplain landscapes: Relating management options to ecosystem services. *Landscape Ecology* 29(2):229–244.

3. Phelps, Q.E., S.J. Tripp, D.P. Herzog, and J.E. Garvey. 2015. Temporary connectivity: The relative benefits of large river floodplain inundation in the lower Mississippi River. *Restoration Ecology* 23(1):53–56.

4. Bayley, P.B. 1995. Understanding large river floodplain ecosystems. *BioScience* 45(3):153–158.

5. Association of State Floodplain Managers (ASFPM). 2013. Flood mapping for the nation: A cost analysis for the nation's flood map inventory. ASFPM Report, ASFPM, Madison, Wisconsin. 15 p.

6. Euripidou, E. and V. Murray. 2004. Public health impacts of floods and chemical contamination. *Journal of Public Health* 26(4):376–383.

7. Gillespie N, A. Unthank, L. Campbell, P. Anderson, R. Gubernick, M. Weinhold, et al. 2014. Flood effects on road–stream crossing infrastructure: Economic and ecological benefits of stream simulation designs. *Fisheries* 39(2):62–76.

8. Gray, S. 2008. Long-term health effects of flooding. *Journal of Public Health* 30(4):353–354.

9. Woznicki, S.A., J. Baynes, S. Panlasigui, M. Mehaffey, and A. Neale. 2018. Development of a spatially complete floodplain map of the conterminous United States using random forest. *Science of The Total Environment* 647(10):942–953.