Customer and Data Services (CDS)

Hazus Release 3.0

FAQ for Homogeneous and Dasymetric State Datasets

Version 0.1

October 16, 2015

Document Management History

Revision History

Version Number	Date	Summary of Changes	Team/Author
0.1	10/16/15	Initial version	Risk MAP CDS

Contents

1. What changes to data should we expect with the release of Hazus 3.0?

Hazus 3.0 makes some changes to the way that dasymetric data is packaged and used. Dasymetric data was first introduced for flood analysis with Hazus 2.2 Service Pack 1 (SP01). Previous versions of Hazus contained only structural inventory exposure data of uniform distribution (i.e. homogeneous). The new dasymetric data uses the National Land Cover Dataset (NLCD) to remove areas where few or no structures are present. This provides users with more accurate results when introducing a flood hazard to a geographic area – portions of census blocks which have no exposure are no longer included. With the release of Hazus 2.2 SP01, users were given the option to download either homogeneous or dasymetric data, and provided instructions for using both and switching between the two in their flood analyses.

Hazus 3.0 will offer two significant changes to the state datasets:

1. The HAZUS data download page will no longer offer separate data packaging for the two types of data. State data downloads will be a single executable zip file containing both homogeneous and dasymetric datasets.
2. All study regions will be created (aggregated) using the homogeneous data, however in Hazus Flood, dasymetric data will be used when analysis is performed. If desired, flood analysis using homogeneous data can be done with some data manipulations (see #4 below).

The purpose of this document is to illustrate for advanced users how to make use of both datasets within the package, and when it might be appropriate to override the default settings.

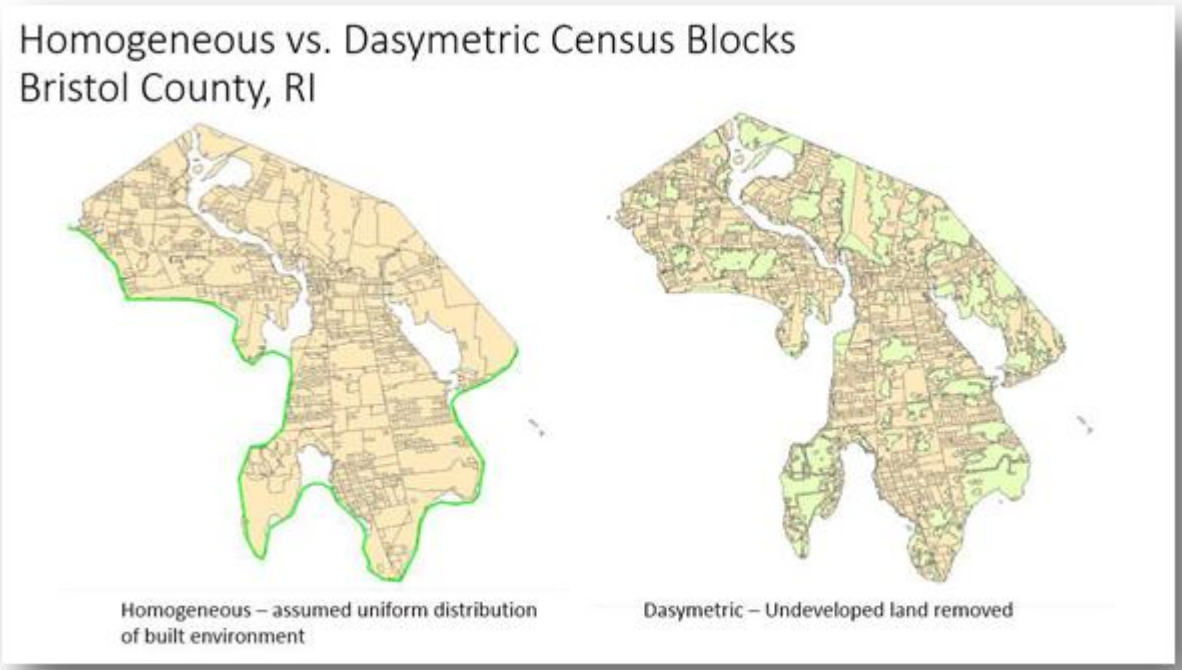
2. What is the difference between homogeneous and dasymetric data?

The main difference between the datasets is the distribution of exposure within a given census block.

Homogeneous: assumes an even (homogeneous) distribution of exposure across a single census block. This is frequently inaccurate, as the placement of structures within a given census block are typically clustered due to topography, road networks, and zoning laws.

Dasymetric: assumes exposure only exists within areas which satellite and land-use data confirm as a built environment. The Hazus dasymetric data was developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Impact Assessment Team (HEC-FIA Team) in partnership with the Federal Emergency Management Agency (FEMA), using the 2011era NLCD (published in 2014) and geospatial techniques to remove undeveloped areas. Information on the development of this data is available in the methodology section (#5) of this document.

The map below provides an illustration of the difference in coastal Rhode Island. The Hazus study region is shaded in pink. Note for the homogeneous data, all blocks within the county are shaded in pink, implying a built environment exists across the entire area. However, in the dasymetric study region, pink shading includes only those areas which are considered “built” environment by the 2011 NLCD.



3. When should I use the different data types?

It is important to note that the flood model in Hazus 3.0 will be set up with new default settings for state data analysis:

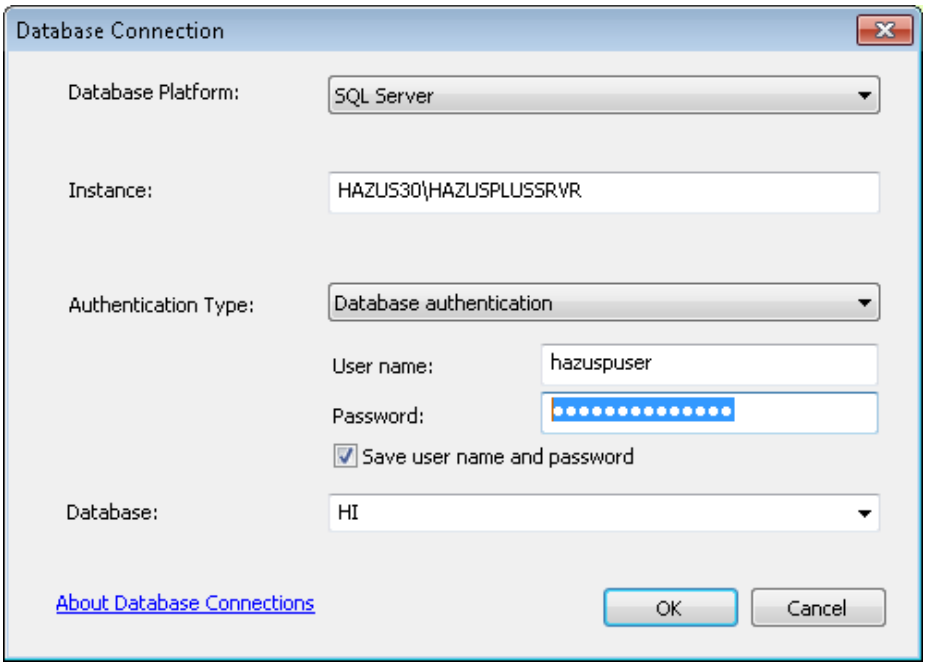
- **Aggregation** of flood study regions will be done using the **homogeneous** data
- **Analysis** within flood study regions will be done using the **dasymetric** data
- Aggregation **and** analysis for the Earthquake and Hurricane model will use homogeneous data **only**. These models aggregate at the census tract level and therefore do not make use of the dasymetric census blocks

Dasymetric data is the recommended dataset for analysis, but users may have reasons to use the homogeneous blocks for analysis. For example, if a user is conducting a level 2 inventory update they may find that new development has occurred on previously undeveloped land as reflected by the 2011 era NLCD data. In such a case, the user may determine that the homogeneous data would be more appropriate for analysis and would need to manually switch the data, as described in the next section.

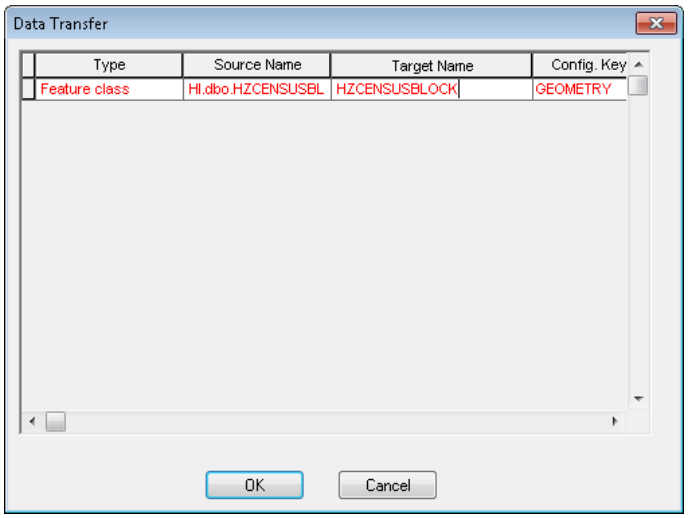
4. How do you switch between homogeneous and dasymetric data in the flood model?

These steps outline the process to switch from the default dasymetric to the homogeneous blocks by editing the State SQL database using ArcCatalog:

1. Open ArcCatalog
2. Connect to the State SQL data base using ArcCatalog's Add Database Connection completing the dialog box as shown (Username "hazuspuser" and Password "gohazusplus_01" for database connections is provided in the Hazus Registry) and selecting the State Database you wish to modify:



3. Right click on hzCensusBlock and select RENAME and change name to hzCensusBlock_Dasymetric.
4. Right click on HZCENSUSBLOCK_TIGER and select COPY
5. Right click on HAZUS30 SDE connection and select PASTE, changing the Target Name to HZCENSUSBLOCK. This will create a new data table from the original homogeneous data that will be used for Hazus study region aggregation and analysis:



Note: The Data Transfer field names are red since you are copying a Feature Class that already exists in the SQL table, but by changing the Target Name, you will not overwrite the existing feature class. Also note that you can display and view the data in ArcMAP from the SQL database connections, however, a new ObjectID will be created and introduce errors if that data are then reimported back into the SQL database.

5. What is the methodology behind the dasymetric data changes?

A fundamental premise of the Hazus Level 1 Flood Loss methodology is that the inventory (building count, square footage and value) is uniformly distributed throughout the census blocks. Census blocks, especially in rural areas, may cover uninhabited land. In order to increase the accuracy with which structures are located, the Hazus census block polygons have been clipped to areas known to be urbanized. The goal of this effort is to provide users a significant improvement for Level 1 (out of the box) census block based loss estimations, not to replace the need for site specific data enhancements using parcel data or building footprints. In fact, users will find some areas outside the dasymetric blocks with occasional structures, likely due to either more recent development, or where the LULC determinations missed development. The LULC product overview and accuracy is described here: http://pubs.usgs.gov/fs/2012/3020/fs2012-3020.pdf and can vary by regional geography and specific class type.

NLCD products are created on a five year cycle by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of federal agencies led by the USGS. The HEC-FIA team performed the clipping of the census blocks based on the NLCD 2011 era data, published in 2014 at http://www.mrlc.gov/. For Hawaii and Puerto Rico, 2001 NLCD data published in 2007 were used: http://www.mrlc.gov/nlcd01_data.php.

Sometimes entire census blocks may be determined to be non-urbanized by the NLCD while Census data for the block indicates structures. A typical example would be a house located under dense tree cover. Since the NLCD is derived from aerial imagery, it may not report a structure being there, while the Census survey would. In this situation, HAZUS dasymetric data retains the entire block, unclipped. For the majority of states, these situations represent less than 1% of the buildings in each state.

6. What classes were removed in developing the dasymetric approach?

NLCD 2011 is a LULC classification scheme that has been applied consistently across the contiguous U.S. at a spatial resolution of 30 meters. NLCD 2011 is based primarily on the unsupervised classification of Landsat Enhanced Thematic Mapper+ (ETM+) flown circa 2011. As shown in the Table below, the Developed classes 21, 22, 23 and 24, as well as the Cultivated classes 81 and 82 were maintained in each census block, while the undeveloped, riparian, wetlands, and other classes were removed from the census block polygons:

Class\Value	Classification Description
Water	
11	**Open Water** - areas of open water, generally with less than 25% cover of vegetation or soil.
12	**Perennial Ice/Snow** - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.
Developed	

21	**Developed, Open Space** - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	**Developed, Low Intensity** - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover. These areas most commonly include single-family housing units.
23	**Developed, Medium Intensity** – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
24	**Developed, High Intensity** – highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
Barren	
31	**Barren Land (Rock/Sand/Clay)** – areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Forest	
41	**Deciduous Forest** – areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
42	**Evergreen Forest** – areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
43	**Mixed Forest** – areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Shrubland	
51	**Dwarf Scrub** – Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.

52	**Shrub/Scrub** – areas dominated by shrubs; less than five meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Herbaceous	
71	**Grassland/Herbaceous** – areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
72	**Sedge/Herbaceous** – Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
73	**Lichens** – Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.
74	**Moss** – Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.
Planted/Cultivated	
81	**Pasture/Hay** – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
82	**Cultivated Crops** – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Wetlands	
90	**Woody Wetlands** – areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
95	**Emergent Herbaceous Wetlands** – areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Limitations:

The HEC-FIA Team processing incorporates error checking for bad census blocks that cannot be processed. In addition, if a census block contains no LULC developed code grid cells, the block is not

clipped. This is not an issue provided there is no Hazus inventory in that block. However, there are plenty of cases where the USGS LULC data indicate that an entire block is undeveloped, but Hazus indicates there is inventory in that block. Therefore, the HEC-FIA Team processing algorithm provides statistics on the number of blocks and the number of structures that are contained in those blocks. We use those statistics for each state to estimate the potential impacts where U.S. Geological Survey (USGS) and Hazus datasets do not agree. For the vast majority of states processed, the inventory in these blocks is less than 1% of the total inventory and considered to have insignificant impacts. We did find several (mostly Western) states where this ratio is somewhat higher.

Resolution, Tolerance and Geometry Repair

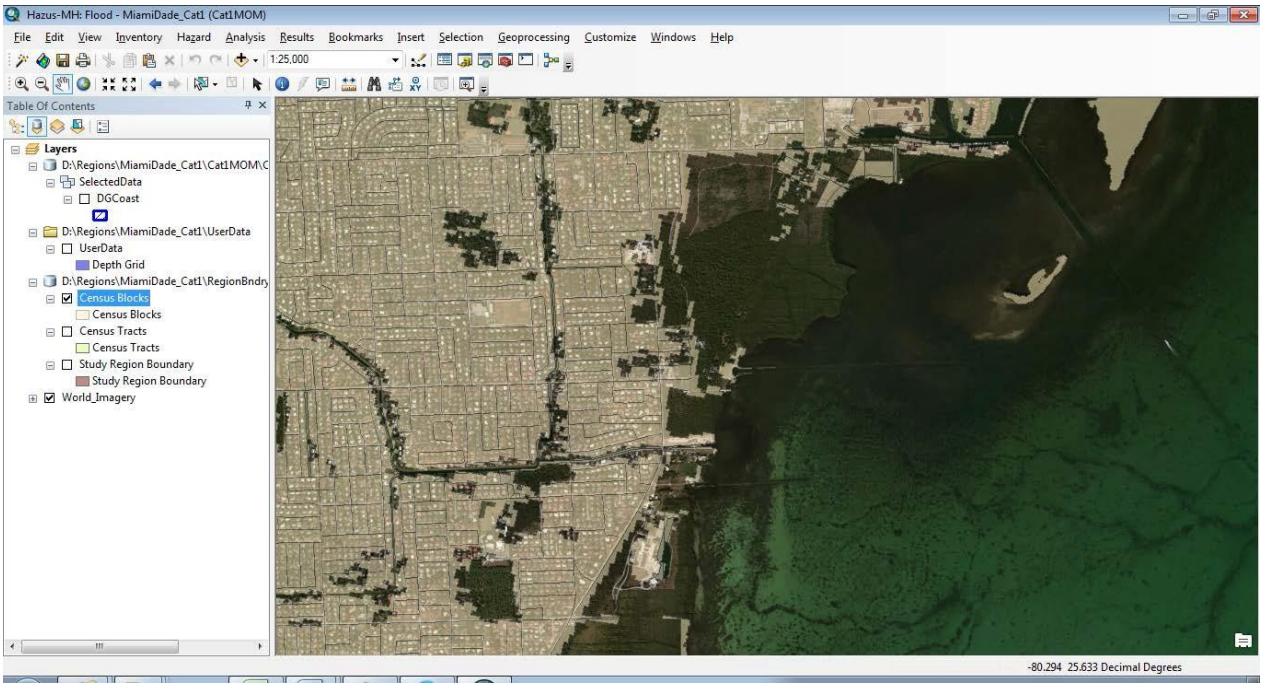
The original Hazus census block data contained topology errors and tolerance and resolution settings that prevented ArcGIS from repairing these geometries. Therefore, post processing of the data was necessary prior to publication. These steps included creating a new hzCensusBlock feature class with appropriate tolerance and resolution settings of **0.000000002 XY** and **0.000000001 XY** degrees, respectively, and loading the clipped census blocks into the new feature class. After this step, geometries were repaired and the geodatabase was compacted. Finally, each state was tested to ensure agreement between the number of feature class geometries and the census block based data tables. A test case building flood study regions at the census block level was performed for each state and test flood loss case studies were performed for Colorado, Florida, Iowa, New York, and North Carolina indicating improved results.

Hazus Runtime with Dasymetric Blocks

The runtime with the dasymetric blocks appears identical to analysis time with homogeneous blocks. There is no change in the number of blocks for an identical study region for either the dasymetric or homogeneous block approach. The runtime for both the homogeneous and dasymetric blocks for Miami-Dade using the Cat 3 MOM from the Coastal Flood Loss Atlas was 1 hour 45 minutes.

7. What did the testing results reveal based on running a dasymetric vs. a homogenous analysis on the same census block?

Using the Corp deliverable and the repair steps above, we built and tested study regions from each state data folder. The results are very encouraging. As expected, losses are generally less, especially in rural areas and for more minor flooding. This is expected since the riparian and wetlands areas, including the coastal Florida examples below, have been removed from the loss calculation. Whereas, we once considered all buildings to be evenly distributed throughout the census block, now we concentrate them within only the developed areas based on LULC. Urban areas show less reduction since their blocks are generally more densely developed.



During testing, we do see structures in areas where we have defined them as not developed. These cases appear to be relatively rare and the overall concentrations of structures in the areas of the blocks we have defined as developed is a very strong correlation. The use of the dasymetric blocks is a significant enhancement over the previous areas weighting Level 1 approach, as highlighted in the table below. We continue to encourage users to utilize site-specific inventories where available.

Coastal Dasymetric Building Loss Testing						
	Original CFLA		**Homogeneous 2.2 Data**		**Dasymetric 2.2 Data**	
Urban County	Cat 1 ($M)	Cat 3 ($M)	Cat 1 ($M)	Cat 3 ($M)	Cat 1 ($M)	Cat 3 ($M)
Miami-Dade, Florida	$ 2,066	$ 16,418	$ 2,125	21,63	$ 2,071	$ 21,122
	Original CFLA		**Homogeneous 2.2 Data**		**Dasymetric 2.2 Data**	
Rural County	Cat 1 ($M)	Cat 3 ($M)	Cat 1 ($M)	Cat 3 ($M)	Cat 1 ($M)	Cat 3 ($M)
Plaquemine Parish, LA	$ 556	$ 955	$ 1,331	$ 2,414	$ 1,292	$ 2,401

8. What will I need to do to get the new version of Hazus downloaded?

Since this release will be a major version update for the Hazus software, users of any older Hazus versions will need to uninstall Hazus on their computers and install the new version, which will be available for download on the Hazus page on the Map Service Center. Users who want to know a little more about how to install or uninstall Hazus can check out the Download Tutorial and Quick Reference Guide on the FEMA Document Library and the Getting Started Guide, also available in the Document Library. Note: although the container may say 2.1 manuals, these are the most recent versions and can be used with more recent versions of Hazus.

Users wishing to preserve their study regions and transfer them to Hazus 3.0 may do so, but only if they are operating on the most recent version of Hazus (2.2 SP01). They will be able to follow the steps outlined in the Getting Started Guide to extract their study regions in Hazus 2.2 SP01 and then upload them into Hazus 3.0 once it is downloaded. Users that are operating on a version of Hazus older than 2.2

SP01 **will not** be able to extract their study regions and upload to Hazus 3.0 due to major underlying changes occurring in this release. For questions or issues, feel free to contact the Hazus Help Desk at helpdesk@support.hazus.us.