

**Application of Land Use Adjustment Factors at the Cell Scale**

## Application of Land Use Adjustment Factors at the Cell Scale

The following is a step-by-step guide to how adjustment factors were applied at the cell level in a GIS environment. The work was performed in a File Geodatabase, as this was the only GIS format able to handle the large files (4.5 million records).

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### 4-1.1. Applying adjustment factors to GIS output File Geodatabase tables

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#### I. INPUT DATASETS

- **GridAllLCstats** =  
PC29098\Cohyst\LandUse\IrrigatedAcres\AllNRDs\COHYSTacres\_GISprogramOutput  
s.gdb\GridLC1950\_2011stats (4.5 million records)  
  
(In ArcCatalog, use connect to folder->Network to connect to PC29098\Cohyst- then  
navigate the rest of the path using the Catalog Tree)

- **DryIRRAdjFactors**=  
Server16\awright\COHYST\AgCensus\GISadjustments\AmyWorking\  
GISadjustments\_allCountiesDryland\_GISpotentialUpperLimit.xlsx

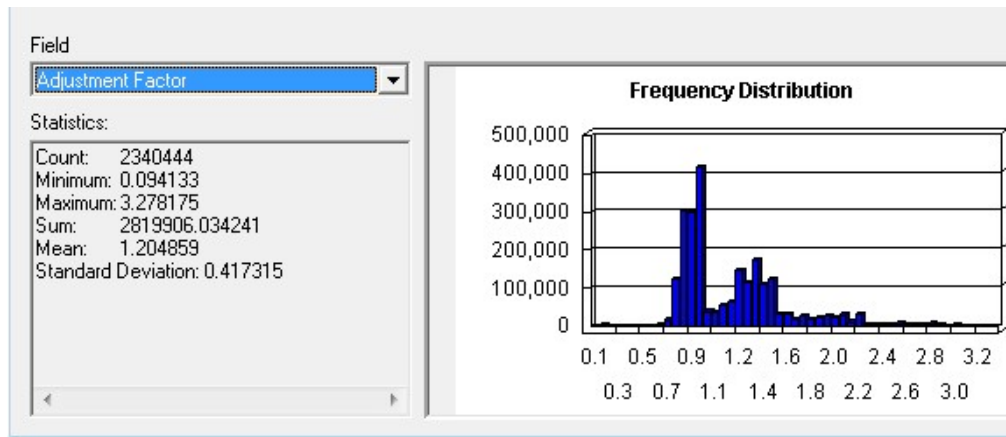
Use the worksheet called AllAdjFactors.

#### II. PROCESS STEPS

1. Create a new File Geodatabase to hold the new tables (the one discussed for this first run through is named "COHYSTacres\_GISadjust\_NormInterp.gdb"; it is in the same location as the geodatabase that contains GridAllLCstats)
2. Create a table with agricultural only cells with a year prior to 2008.
  - a. Add GridAllLCstats to an ArcMap project.
  - b. Use Select by Attributes (options tab in attribute table) to select Year < 2008. (or combine b. and c. by using the SQL: "Year" < 2008 AND "LCclass" <>'Rangeland')

- 
- c. Then use Select by Attributes to **remove** the rangeland features from the currently selected features:
    - "LCclass" = 'Rangeland'
  - d. There should be 2.34 million features selected at this point.
  - e. Export the selected features to the new geodatabase and name the table **GridLC1950\_2007\_AdjustedAgLand\_wOverages**.
  - 3. Create a table with grassland only cells with a year prior to 2008.
    - a. Clear the selection in GridAllLCstats.
    - b. Use Select by Attributes (options tab in attribute table) to select Year < 2008. (or combine b. and c. by using the SQL: "Year" < 2008 AND "LCclass" = 'Rangeland')
    - c. Then use Select by Attributes to **select** the rangeland features from the currently selected features:
      - "LCclass" = 'Rangeland'
    - d. Export the selected features to the new geodatabase and name the table **GridLC1950\_2007\_AdjustedGrassland\_wOverages**.
  - 4. Populate the "Adjustment Factor" and "Adjusted GIS" attributes for dryland in the **GridLC1950\_2007\_AdjustedAgLand\_wOverages** table.
    - a. Ensure no records are selected in the table.
    - b. Ensure the CountyYr attribute is populated for all records in the **GridLC1950\_2007\_AdjustedAgLand\_wOverages** table; if there are missing values, populate using the field calculator and following SQL: [County] & "\_" & [Year]
    - c. Add the **AllAdjFactors** excel worksheet to the ArcMap project (if there are problems in subsequent steps, convert this table to a .dbf and retry)
    - d. Join the **AllAdjFactors** to the **GridLC1950\_2007\_AdjustedAgLand\_wOverages** table using the CountyYear field as the join field.
    - e. Select by attributes LCclass = Dryland.
    - f. Use the field calculator to calculate Adjustment Factor for selected records to the DryAdjFactor from the joined spreadsheet.
    - g. Double check to make sure numbers/land cover categories calculated correctly. Do not clear selection.
  - 5. Populate the "Adjustment Factor" and "Adjusted GIS" attributes for Irrigated land in the **GridLC1950\_2007\_AdjustedAgLand\_wOverages** table.
    - a. Switch the selection. Options tab in the attribute table->Switch selection.
    - b. Ensure the irrigated land cover categories are selected (SW irrigated, GW irrigated, comingled).

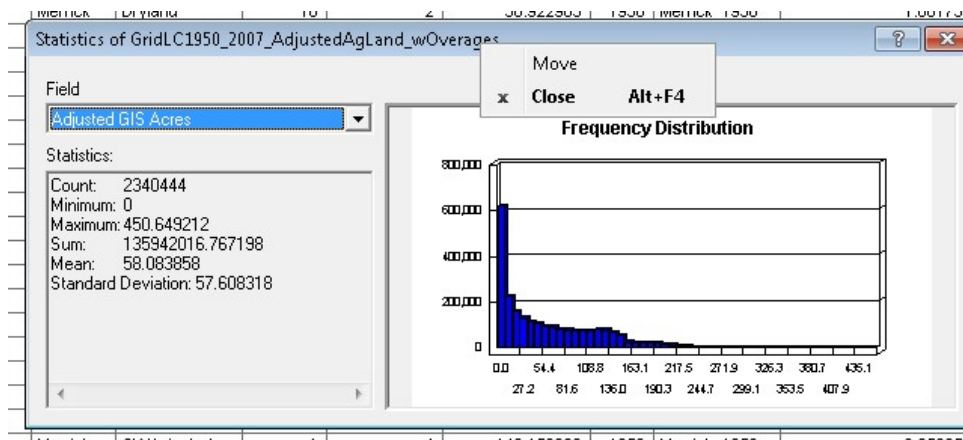
- c. Use the field calculator to calculate the Adjustment Factor for selected records to the IrrAdjFactor from the joined spreadsheet.
- d. Double check to make sure numbers/land cover categories are correct.
- e. Clear selected records.
- f. View the statistics of the Adjustment Factor field to ensure all values are populated (e.g. no minimum values of 0).



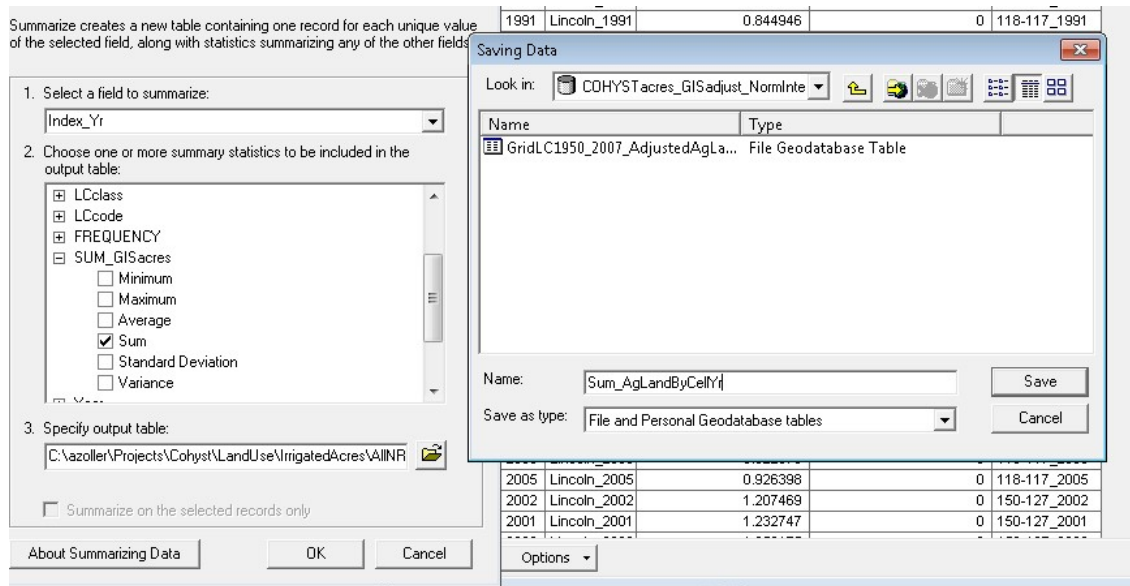
- g. Remove the Join to the spreadsheet

## 6. Calculate the Adjusted GIS Acres field

- a. Use the field calculator to populate the Adjusted GIS acres field. The calculation follows:  $\text{AdjustedGIS Acres} = \text{Sum\_GISacres} * \text{Adjustment Factor}$ .
- h. When finished, double check a couple values in the Adjusted GIS acres field to make sure operation worked properly, then view the statistics of the Adjusted GIS acres field to ensure all values are populated (0's in the the below statistics are actually very small values, e.g.  $1.23 \times 10^{-7}$ ).

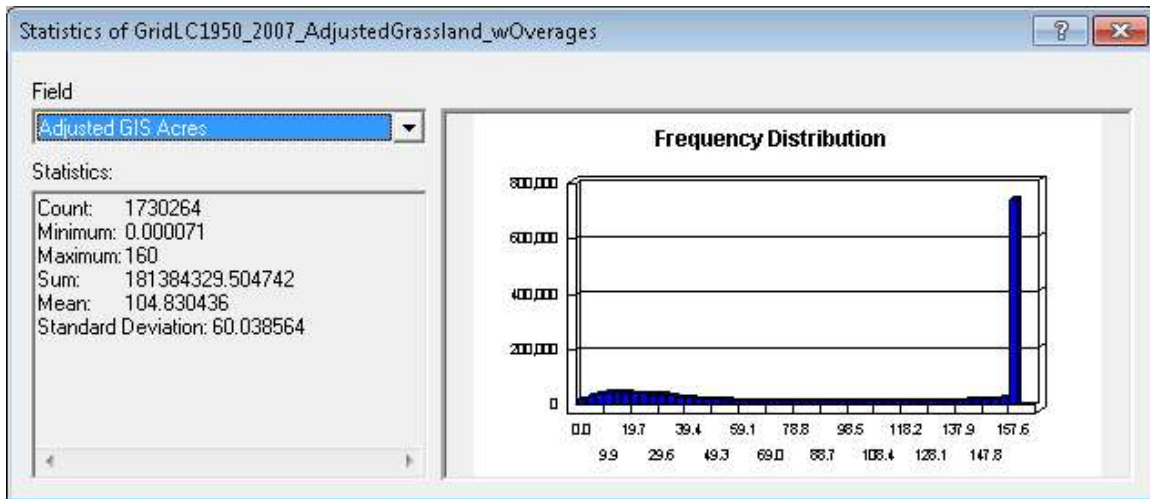


7. Run Summary statistics to add all acres of Adjusted agricultural land for each unique combination of cell and year. The sum of adjusted agricultural land will be used to calculate the residual for grassland.
  - a. Right click on the Index\_Yr attribute heading. Select Summarize. Specify that the sum of the adjGISacres (Adjusted GIS acres) field will be included in the output table. Export the new table to the geodatabase created in step 1, and name it **AdjustedAgLandWithOveragesSummedByCellYr** or similar.



8. Assign a residual value (160 – agland acres) to grassland cells
  - a. Add the **GridLC1950\_2007\_AdjustedGrassland\_wOverages** table to the ArcMap project.
  - b. Add a field called SumAgLand (double) to the **GridLC1950\_2007\_AdjustedGrassland\_wOverages** table.
  - c. Calculate the CountyYR attribute using the field calculator and following SQL:  
[County] & "\_" & [Year]
  - d. Join the **AdjustedAgLandWithOveragesSummedByCellYr** table to the **GridLC1950\_2007\_AdjustedGrassland\_wOverages** table. Use the Index\_YR field as the join field in both tables.

- e. Calculate the SumAgLand field to the values of the Sum\_adjGISAcres. Double check values to make sure calculation worked. If it did, remove the join.
- f. Select values > 0 from the SumAgLand field. Switch selection (this is to select everything with a NULL value). Calculate all selected values as "0". In this way, the NULL values will be replaced with a 0.
- g. Use select by Attributes to select features with summed AgLand of less than 160 acres. "SumAgLand" < 160
- h. Use the field calculator to populate the Adjusted GIS acres field as residual acres for the selected records.  $\text{AdjustedGIS Acres} = 160 - \text{SumAgLand}$ .
- i. Switch the selection. Start editing (make sure Catalog is closed). Delete selected records. These records show a changed grassland status for certain cells. There were grassland acres after initial processing; however, after adjustments were made (most likely high upward adjustments of dryland) there were no longer any residual grassland acres. Hence, these grassland records having a "0" value do not need to be retained. Save edits, recheck table and stop editing.
- j. Check statistics for the Adjusted GIS Acres fields from the **GridLC1950\_2007\_AdjustedGrassland\_wOverages** table. Ensure that all values are >0 and <= 160.



9. Combine Grassland and Agland tables to create a comprehensive historical land cover dataset.

a. In the **GridLC1950\_2007\_AdjustedAgLand\_wOverages** table, hide all fields except-

- RowCol\_ID
- County
- LCclass
- LCcode
- Year
- CountyYr
- Adjustment Factor
- Adjusted GIS Acres
- Index\_Yr
- 

b. Export selected features into a new File Geodatabase Table, in the geodatabase created in step 1. Name the new table:

**GridLC1950\_2007\_AdjustedAllLandUse\_wOverages**. In ArcCatalog, inspect the new table's attributes and values. It currently contains only AgLand values.

c. Load the grassland data into the

**GridLC1950\_2007\_AdjustedAllLandUse\_wOverages**. To do this, right click on the **GridLC1950\_2007\_AdjustedAllLandUse\_wOverages** table and select Load....

Choose the **GridLC1950\_2007\_AdjustedGrassland** table as the source data you will be loading from. The target table is

**GridLC1950\_2007\_AdjustedAllLandUse\_wOverages**. Don't load rows into a

subtype. Then, ensure the mapping of attributes is as shown below, so all attributes are populated with values from the grassland layer:

Target Field	Matching Source Field
RowCol_ID [string]	RowCol_ID [string]
County [string]	County [string]
LCclass [string]	LCclass [string]
LCcode [short int]	LCcode [short int]
Year [short int]	Year [short int]
CountyYR [string]	CountyYR [string]
AdjFactor [float]	AdjFactor [float]
AdjGISacres [double]	AdjGISacres [double]
Index_Yr [string]	Index_Yr [string]

- d. Specify “load all of the source data” and “finish”. Review the table after the load has finished.
10. Add in grassland records for certain cells. These cells had a downward adjustment for AgLand, but contained no grassland records to calculate the residual for. These situations result in cells with less than 160 acres (because grassland residual was not added in).
    - a. Add the **GridLC1950\_2007\_AdjustedAllLandUse\_wOverages** table to an ArcMap project.
    - b. Use the summarize function on the Index\_YR field (right click on the field name->Summarize) to sum values from the Adjusted GIS acres field. This time include the following attributes in output:
      - i. RowCol\_ID (first)
      - ii. County (first)



- iii. Year (minimum)
- iv. County Yr (First)
- v. AdjGIS acres (Sum).

Place the output table in the geodatabase created in step one, naming it :  
**Sum\_AllLandUseByCellYRwithOverages\_preliminary.**

- c. Query the new table. Select all records that have a sum\_AdjGISacres of less than 160. Export these records to a new table named “**Under160acres\_wOverages**”.
  
- d. Modify this table to mimic the land cover table. To do this, add the following fields:
  - i. LCclass (text, 20)
  - ii. LCcode (short integer)
  - iii. Difference (double).

Populate all records with LCclass = ‘Rangeland’, LCcode = ‘20’ and Difference = [160 - Sum\_AdjGISacres].

- e. Close ArcMap. Open Catalog. Load...the **Under160acres\_wOverages** table into the table using the following map attribute scheme:

Simple Data Loader

For each target field, select the source field that should be loaded into it.

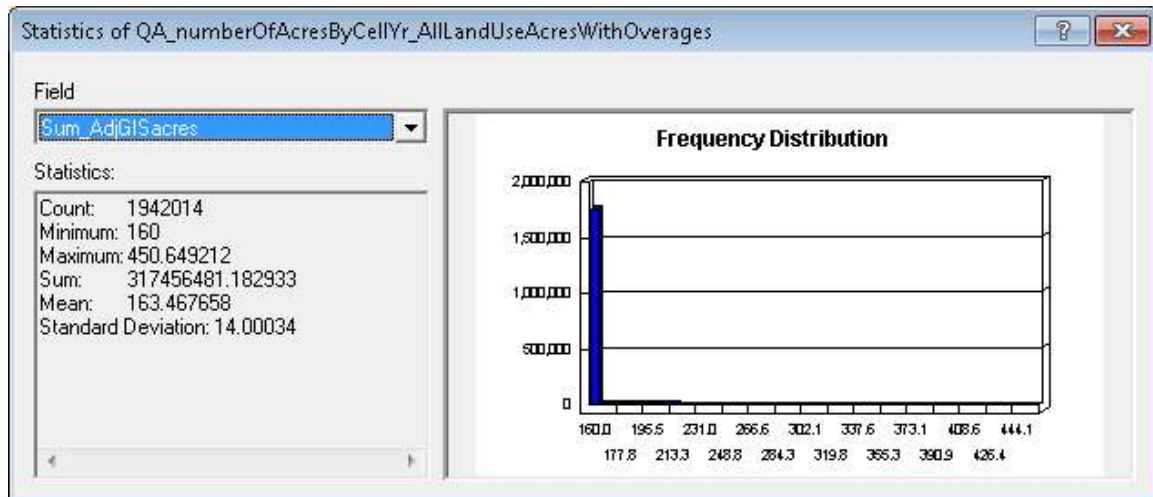
Target Field	Matching Source Field
RowCol_ID [string]	First_RowCol_ID [string]
County [string]	First_County [string]
LCclass [string]	LCclass [string]
LCcode [short int]	LCcode [short int]
Year [short int]	Min_Year [short int]
CountyYR [string]	First_CountyYR [string]
AdjFactor [float]	<None>
AdjGISacres [double]	Difference [double]
Index_Yr [string]	Index_Yr [string]

Reset

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### III. QA COMPLETED TABLE

1. Sum number of acres by cell QA (Ensure all cells have combined land cover area of at least 160 acres)
  - a. Add the **GridLC1950\_2007\_AdjustedAllLandUse\_wOverages** table to an ArcMap project.
  - b. Use the summarize function on the Index\_YR field (right click on the field name->Summarize) to sum values from the Adjusted GIS acres field. Place the output table in the geodatabase created in step one, naming it: **QA\_numberOfAcresByCellYr\_AllLandUseAcresWithOverages**.
  - c. When the summarize is finished review the resulting table's statistics by to ensure all values have at least 160 acres.



2. QA for missing values for any given cell or year. One way to do this is to query Year < 2008 from the **GridAllCstats1950\_2011** table. Create a new table “**GridAllCstats1950\_2007**” by exporting selected features. Join the **GridLC1950\_2007\_AdjustedAllLandUse\_wOverages** table to the using the IndexYr field. Perform an additional query on the **GridAllCstats1950\_2007** table of AdjGISacres >= 0. All records should be selected. There should be no NULL values.
  
3. QA to check if dryland cell values summarized by county and year match curves where dryland adjustments were originally calculated. To do this, select dryland from the **GridLC1950\_2007\_AdjustedAllLandUse\_wOverages** table and summarize by CountyYR. Use the output values to add a GIS dryland output curve to original adjustment charts (GISadjustments\_allCountiesDryland\_GISpotentialUpperLimit.xlsx). Do this for the eight representative counties. The GIS dryland output curves should match the adjusted dryland curves.
  
4. QA to find/correct GIS artifacts of cells slightly over 160 acres for irrigated only. 24 of these occurred for GWirrigated cells in the creation of the COHYST 2010 dataset. These occurred when an entire cell was irrigated AND the adjustment factor was 1.0 or very close to it (e.g. 0.98). It is a GIS artifact possibly related to projection-cells shouldn't equal more than 160 after processing, but just a few totalled 160.3 or similar. To fix perform the following queries, ensure the value is the result of a GIS artifact (i.e. very close to 160) and not indicative of some other problem, and for selected cells calculate “adjustedGISacres” to 160:
  - a. “LCclass” = ‘GWirrigated’ AND “adjustedGISacres” > ‘160’.

- b. "LCclass" = 'SWirrigated' AND "adjustedGISacres" > '160'.
- c. "LCclass" = 'Comingled' AND "adjustedGISacres" > '160'.
- d. Finally, with only the irrigated land cover classes selected (GW, SW, comingled), perform a Summary Statistics on the IndexYr field to calculate the sum of adjustedGISacres field. Sort to check if there are values over 160 in the output. If so, these would need to be fixed manually. There were no such cases in the COHYST 2010 acres dataset.