Appendix 4-G

GIS Adjustment Methods for Potential Irrigated Lands

GIS Adjustment Methods for Potential Irrigated Lands

4-G.1 Background

The GIS process gave the potential for irrigation for a specific model cell in a specific year. The potential irrigation was based on the number of certified acres that had a well completion date prior to or equal to the year of interest. It was recognized, however, that not all certified acres were irrigated in a given year, and so other data sources were utilized to develop relationships between potential irrigation and estimated actual irrigation. In this way, a downward adjustment factor was calculated and applied to the GIS potential for all years, to develop a curve that represented the best estimate of actual irrigation through time.

The best available datasets to develop the GIS adjustment factors for irrigated lands were considered to be:

1. 2007 NRD Near InfraRed (NIR) imagery analysis of irrigation in Buffalo, Hall, Lincoln, Arthur and Keith Counties.
2. 1982, 1997, 2001 and 2005 CALMIT irrigated lands layers (the CALMIT "center pivots" and CALMIT "other irrigation" vector layers were combined to estimate total irrigated lands for these years).
3. Census of Agriculture reports (hereinafter referred to as "Ag Census") from 1950, 1954, 1959, 1964, 1969, 1974, 1978, 1982, 1987, 1992, 1997, 2002 and 2007.

The "normalized interpolation" method was used to estimate actual irrigation by adjusting GIS irrigation potential downward. This method utilized a combination of NIR and CALMIT data (hereinafter referred to as RS data) as well as Ag Census data to develop the adjusted curves. Ag Census statistics were initially scaled for partial counties. To scale the Ag Census for partial

counties, the ratio of agricultural land area (shown by 2005 CALMIT) that occurred in the COHYST portion of county over the total agricultural land area in that county (also shown by 2005 CALMIT) was applied (Table 1 and Figure 1).

4-G.1.1 Priority Rules and Adjustments

Prior to application of the normalized interpolation method, the following priority rules were established:

1. The GIS irrigation potential data summed by county were considered the best estimate of the upper limit of irrigated acres.
2. The RS data summed by county (1982, 1997, 2001 and 2005 CALMIT and 2007 NIR data when available) were considered the best estimate of actual irrigated acres at the county scale, as long as the values were not higher than GIS potential.
3. The GIS irrigation potential and Ag Census data were used capture the trend of irrigation, especially in years where there was no RS data.

The following initial adjustments were applied to the respective curves prior to application of the normalized interpolation equation. The adjustments were necessary so the estimated actual irrigation curve would intersect RS data points, while capturing the trends of GIS irrigation potential and Ag Census:

1. Any RS data point that was higher than the respective GIS irrigation potential data point was lowered to equal the GIS potential data point.
2. If any RS data point fell below the Ag Census interpolated curve, the entire Ag Census curve was lowered so all RS data points would be at or above the Ag Census. To do this, the ratio of the lowest outlying RS data point to the Ag Census at that point was applied to all Ag Census values.

4-G.1.1.1 Equation Used

Once the initial adjustments were made, the normalized interpolation equation was applied as follows to develop a curve showing estimated actual irrigated acres:

$$I = G - (RS * (G - A))$$

Where:

I = Estimated actual irrigated land (acres)

G = GIS irrigation potential (acres)

RS = CALMIT or NIR remotely sensed irrigated land (acres)-interpolated for years between data points. For the years 1950 -1982, the 1982 CALMIT value was used; and for the years 2005 – 2007 (when NIR was not available) the 2005 CALMIT value was used.

A = Ag Census reported irrigated land (acres)-interpolated for years between data points.

Equations Used to Adjust GIS dryland potential-Amy Wright and Atefeh Hosseini, November 16, 2011

Background

The normalized interpolation method was also used to adjust GIS potential dryland acres to acquire the best estimate of actual dryland acres. This method utilized a combination of CALMIT and Ag Census data to develop the adjustment curve; there was no data NIR data available for dryland acres as there was for irrigated acres. Ag census statistics were scaled for partial counties using the same method discussed for irrigated acres (Table 1 and Figure 1)

Priority Rules and Initial Adjustments for Dryland Acres

Prior to application of the normalized interpolation method, the following priority rules were established as follows:

1. The RS data (1982, 1997, 2001 and 2005 CALMIT dryland data) summed by county were considered the best estimate of actual dryland acres at the county scale.
2. The GIS dryland potential and Ag Census data were used to capture the trend of irrigation, especially in years where there was no RS data.

Additional notes for dryland priority rules (as compared to GIS irrigation potential rules):

1. The GIS dryland potential was **not** considered upper limit data source as it was for GIS irrigation potential, because there was a much higher level of uncertainty with this dataset (e.g. there was no way to attach definitive years to dryland, as there was by associating well years to certified irrigated acres).
2. Because there was no upper limit defined by GIS dryland potential, the RS data was **not** adjusted downward as it was for GIS irrigation potential, in cases where a RS data point was higher than the respective GIS potential data point.

The following initial adjustments were applied to the respective curves prior to application of the normalized interpolation equation. The adjustments were necessary so application of the normalized interpolation equation would result in the GIS curve intersecting RS data points, while capturing the trends of GIS dryland potential and Ag Census:

1. If a RS data point fell above the GIS dryland potential, the entire GIS dryland potential curve was moved upward so that all RS data points would fall at or below adjusted GIS dryland potential. To do this, the ratio of the highest outlying RS data point to the GIS dryland potential value at that point was added to all GIS dryland potential values.
2. If any RS data point fell below the Ag Census interpolated curve, the entire Ag Census curve was lowered so all RS points would be at or above the Ag Census. To

do this, the ratio of the lowest outlying RS data point to the Ag Census value at that point was added to all Ag Census values.

Equation Used

Once the initial adjustments were made, the normalized interpolation equation was applied as follows to develop a curve for estimated actual dryland acres:

$$D = G - (RS * (G - A))$$

Where:

D = Estimated actual dryland (acres)

G = adjusted GIS dryland potential (acres)

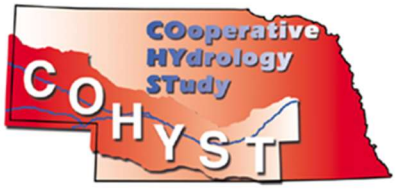
RS = CALMIT (acres)-interpolated for years between data points. For the years 1950 - 1982, the 1982 value was used; and for the years 2005 – 2007 the 2005 value was used.

A = Ag Census reported dryland (acres)-interpolated for years between data points.

Visual Explanation of Equations Used to Adjust GIS Irrigated and Dryland-Doug Hallum, November, 2011

The following slides explain the process used to define the relationship between Census of Agriculture reported acres, GIS potential dryland/irrigated acres (based on certified acres) and remotely sensed acres. The slides also explain the equations used to develop a trend showing estimated actual acres, while taking aspects from all data sources into consideration.

Platte River
Cooperative Hydrology Study
(COHYST)



TechnicalWorkshop -

Input Data: Acres Classifications

November 28-30, 2011

Method - Irrigated

- Digitized certified acres are irrigated lands cap (irrigation potential)
- Relate to CALMIT, IR, Census of Agriculture
  - CALMIT/IR data is king: data must match these
- Adjust Census of Agriculture time series to honor CALMIT/IR data (i.e. remotely sensed data)

Method - Irrigated

- Equation used

$$I=G-(RS*(G-A))$$

I = estimated actual irrigated acres
G = potential acres (shown by GIS processed certified acres)
A = reported acres (census of Ag)
RS = remotely sensed acres

Method - Dryland

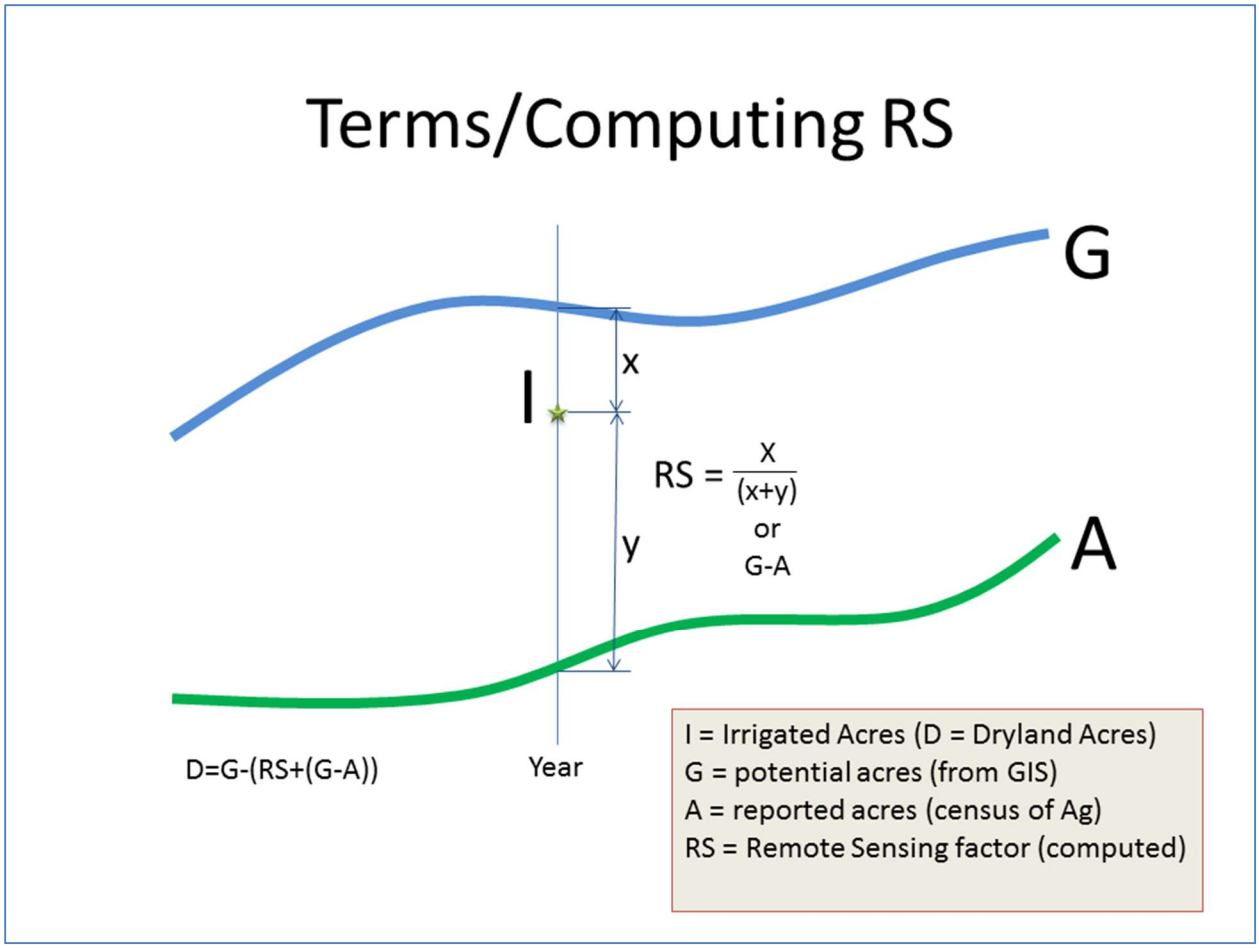
- Same as Irrigated
- Adjust Census of Agriculture and "potential" time series to honor CALMIT
- D=G-(RS+(G-A))

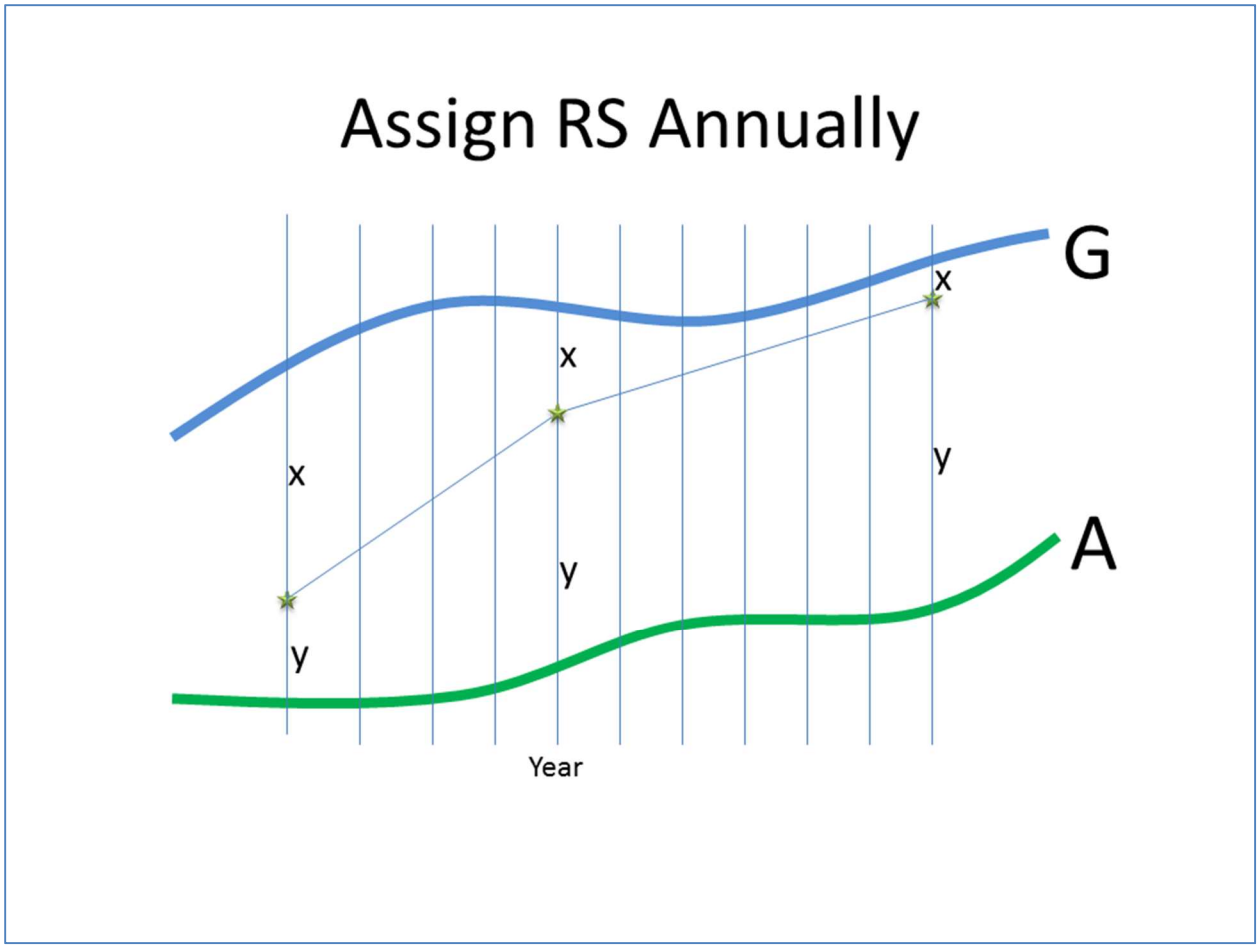
Method - Dryland

- Equation used

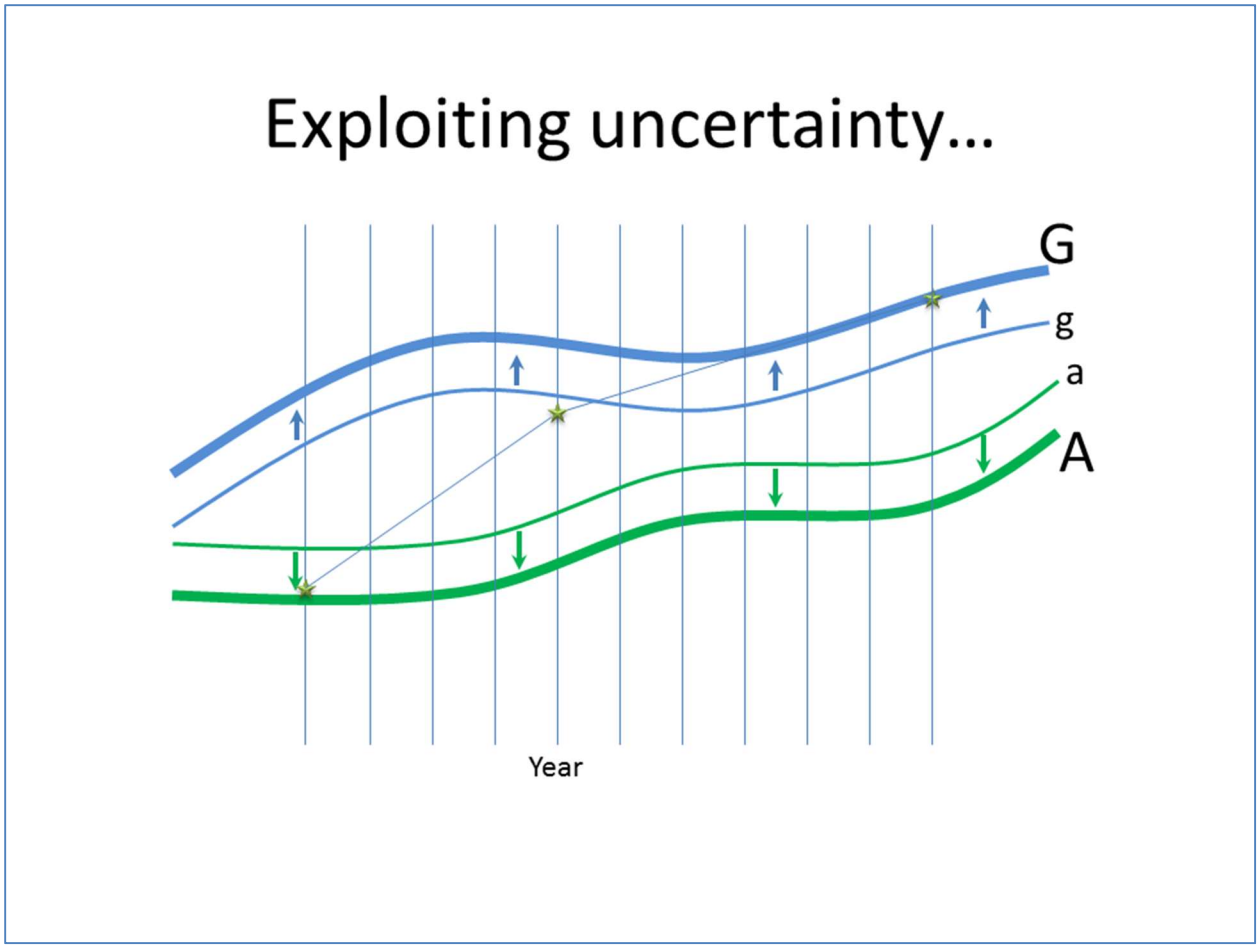
$$D=G-(RS+(G-A))$$

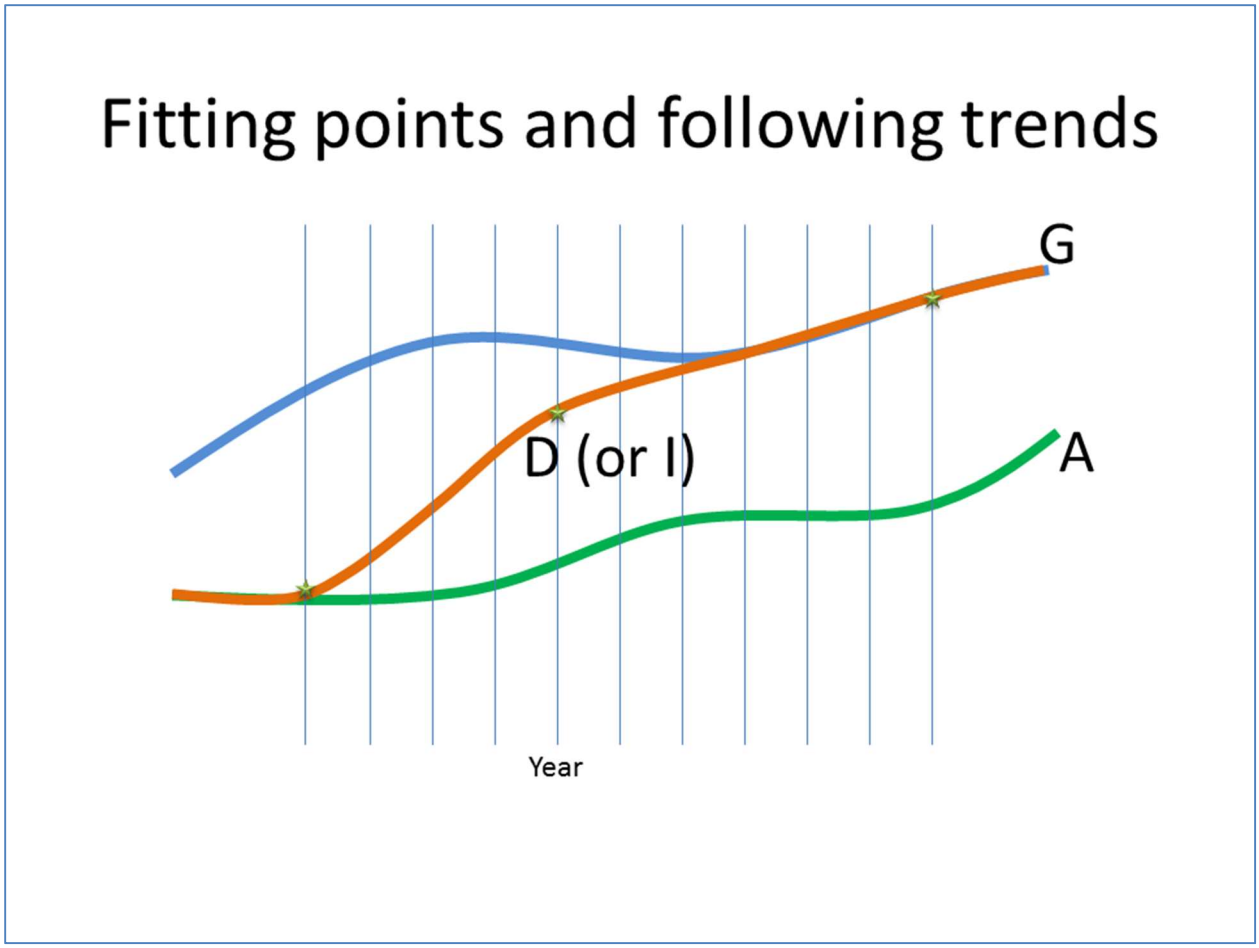
D = estimated actual dryland acres
G = potential acres (shown by GIS processed certified acres)
A = reported acres (census of Ag)
RS = remotely sensed acres


Terms/Computing RS
G
x
I
RS = X/(x+y)
or
G-A
y
A
D=G-(RS+(G-A))
Year
I = Irrigated Acres (D = Dryland Acres)
G = potential acres (from GIS)
A = reported acres (census of Ag)
RS = Remote Sensing factor (computed)


Assign RS Annually
G
A
x
x
x
y
y
y
Year


Non-conforming data?
g
a
Year


Exploiting uncertainty…
G
g
a
A
Year


Fitting points and following trends
G
D (or I)
A
Year