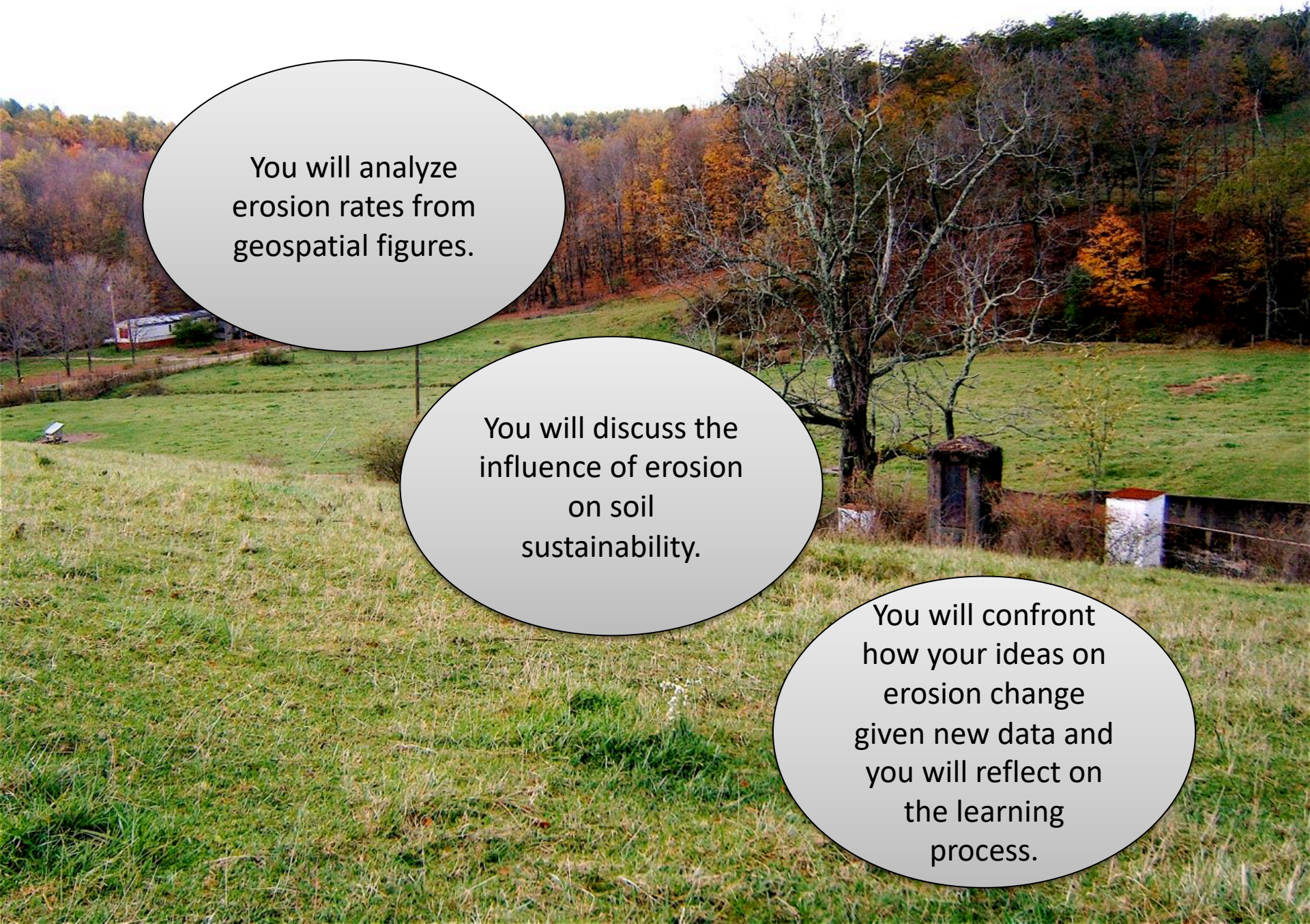
Interpreting geospatial (i.e. map) data to identify threats to sustainability



Which environment is most erosive?

Marek Slusarczyk cc

Mountains?

Or agricultural landscapes?

Directions

In small groups, examine 2 figures showing erosion in the United States: A) showing natural/geologic erosion (non-human) & B) showing erosion from human activity

On a notecard:

1. Identify units of erosion measurement in Figure A. Convert the average erosion rate into mm/yr.
2. Figure A: Determine which regions in the United States have the highest continental erosion rates and predict why these locations have the highest rates.
3. Figure B: Determine which regions in the United states have the greatest erosion from human activity.
4. Describe how that rate compares to the natural (continental) rate of erosion.
5. Predict the potential source of human erosion in Figure B.

Plan to report your small group findings (from your notecard) to the class as the figures are projected.

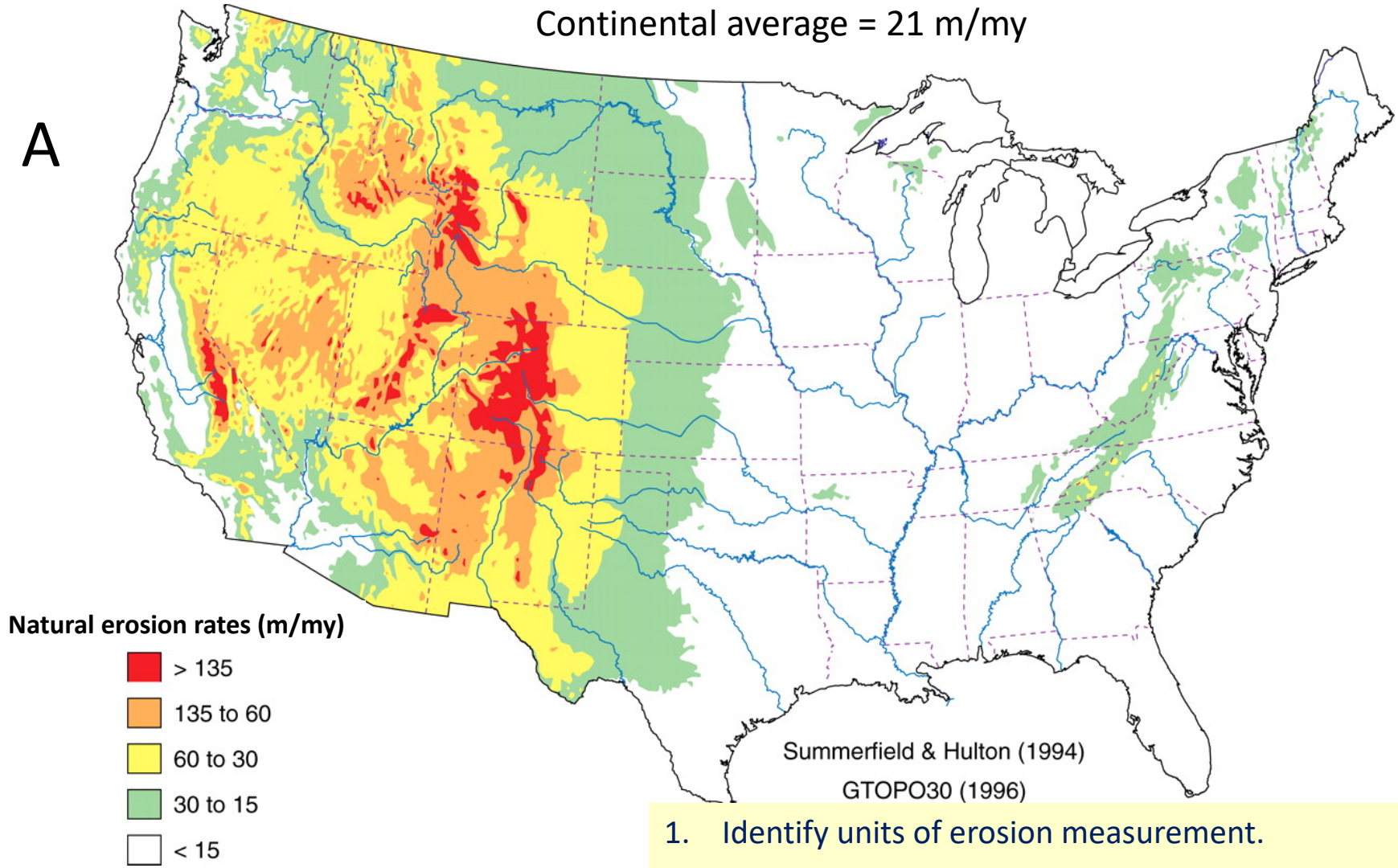
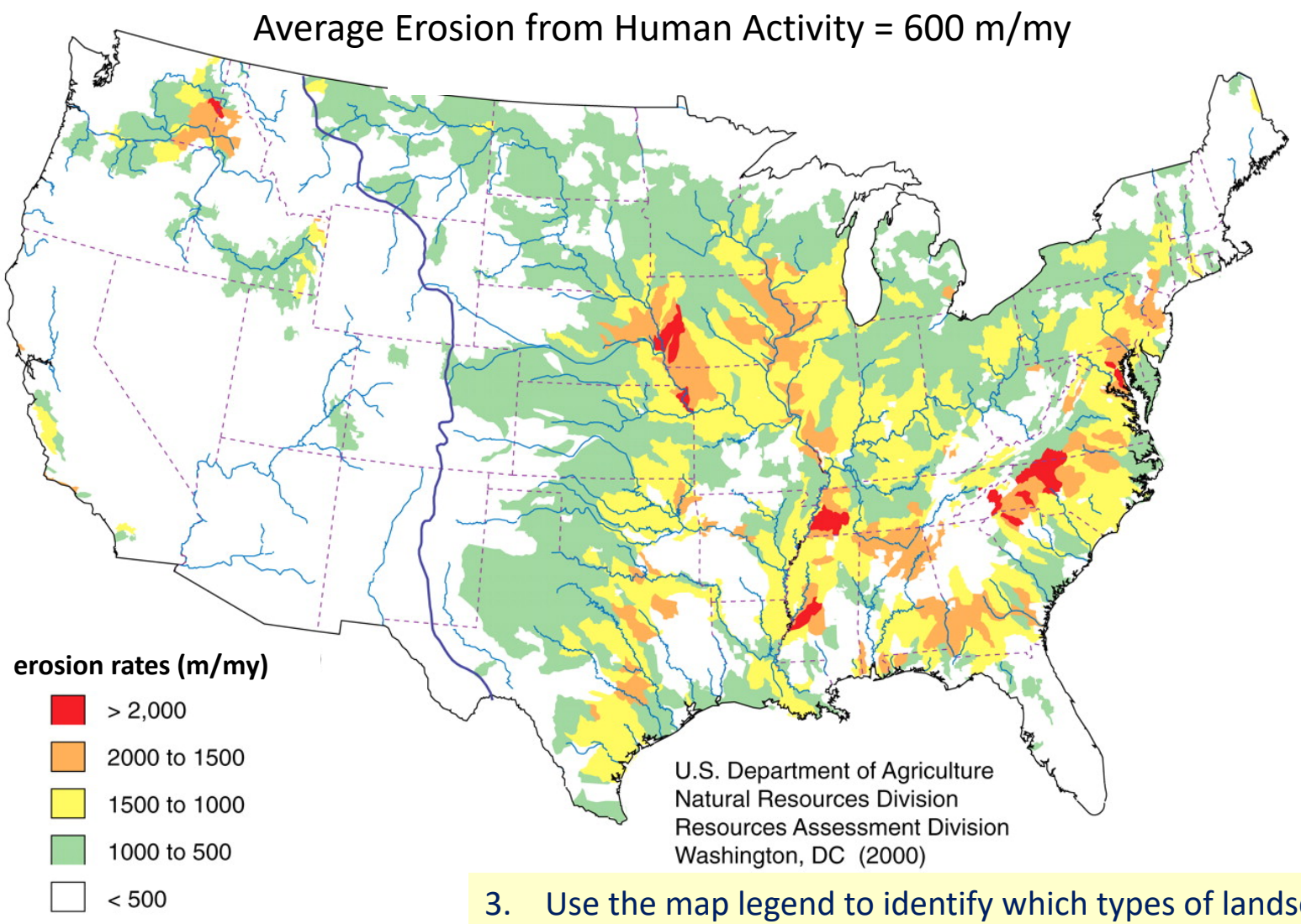


Figure 6. Estimates of average natural erosion (denudation) rates inferred from GTOPO30 area-elevation data and global fluvial erosion-elevations relations from Summerfield and Hulton (1994). Mean rate of denudation for the entire area of the contiguous United States is ~21 m/m.y. (Wilkinson and McElroy, 2007, *GSA Bulletin January/February, 2007 vol. 119 no. 1-2 140-156*)

1. Identify units of erosion measurement.
2. What is the average natural erosion rate in millimeters per year (1 meter = 1000 millimeters)?
3. Use the map legend to identify which types of landscapes have the highest natural (not impacted by humans) erosion rates and predict why these locations have the highest rates.

B



3. Use the map legend to identify which types of landscapes or environments have the greatest erosion from human activity.
4. How does that average rate compare to the average natural rate of erosion?
5. Predict the potential source of human erosion in Figure B.

(Wilkinson and McElroy, 2007, *GSA Bulletin January/February, 2007 vol. 119 no. 1-2 140-156*)

Mountains

Maximum erosion rates = >135 m/my

Agricultural Lands

Maximum erosion rates = > 2000 m/my

Visualize how much soil thickness will change in your lifetime

Recall average natural rates of cropland erosion is 600 m/my or 6 mm/decade

(Wilkinson and McElroy, 2007, *GSA Bulletin January/February, 2007 vol. 119 no. 1-2 140-156)*

Visualize the average cropland erosion in 1 year = 0.6 mm

Approximately equivalent to the thickness of
- 2 business cards
- One credit card

Visualize the average soil formation in 1 year = 0.036 mm

Approximately equivalent to the thickness of
- 2 pieces of aluminum foil
- Half the thickness of a piece of copier paper

Visualize the average cropland erosion in 1 decade = 6 mm

Approximately equivalent to the thickness of
- 3 quarters + 1 dime
- A slim cell phone

Visualize the average soil formation in 1 decade = 0.36 mm

Approximately equivalent to the thickness of
- Four $100 bills
- One business card

Average rate of cropland erosion = 6 mm/decade.
Average rate of soil formation = 0.36 mm/decade.
An average soil thickness = ~15 cm (150 mm).

At these rates, how much soil would be lost in the remainder of your lifetime (~60 years)?

At current rates, how long would it take to completely remove 15 cm of soil?

Average rate of cropland erosion = 6 mm/decade.
Average rate of soil formation = 0.36 mm/decade.
An average soil thickness = ~15 cm (150 mm).

At these rates, how much soil would be lost in the remainder of your lifetime (~60 years)? = 33.84 mm

At current rates*, how long would it take to completely remove 15 cm of soil? = 266 years

**Erosion rates = soil eroded – soil formed = 6-0.36 = 5.64 mm/decade*

Average rate of cropland erosion = 6 mm/decade.
Average rate of soil formation = 0.36 mm/decade.
An average soil thickness = ~15 cm (150 mm).

At these rates, how much soil would be lost in the remainder of your lifetime (~60 years)? = 33.84 mm

At maximum rates*, how long would it take to completely remove 15 cm of soil? = 63 years

**Maximum erosion rates = soil eroded – soil formed = 24-0.36 = 23.64 mm/decade*

In Figure A, exploring natural erosion rates, areas in white and green have erosion rates that are less than soil production rates (30 m/my). In figure B, exploring cropland erosion rates, all regions that are colored in have erosion rates that exceed soil production rates. **Based on the two figures, 1) how much area could potentially generate new soil? (Estimate to the nearest 10%.) 2) Is the soil at your location threatened under present erosion rates?**

Figure A.

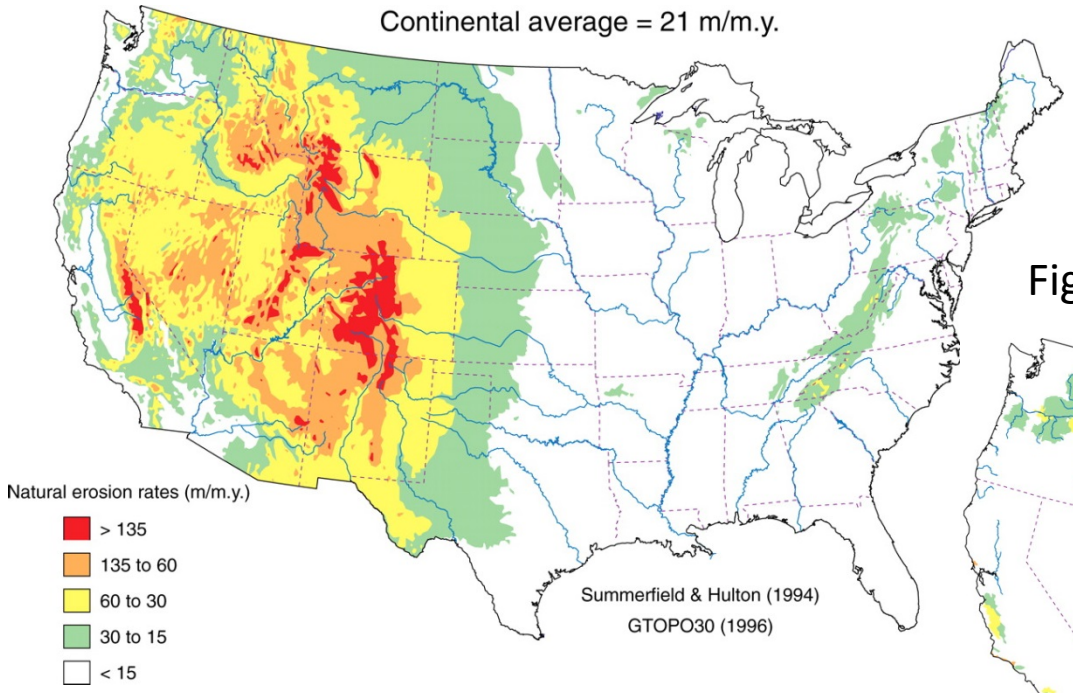
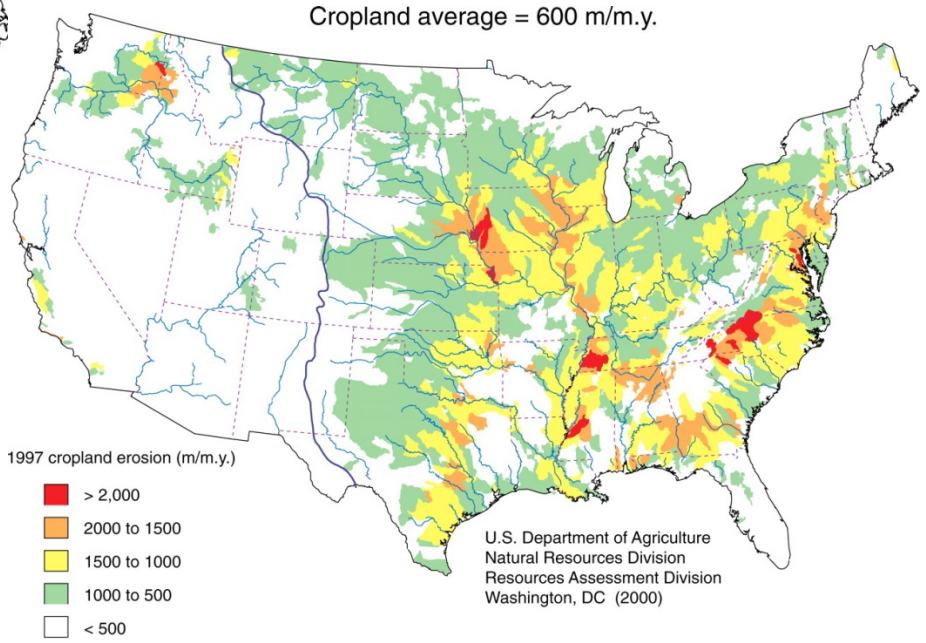


Figure B.



(Wilkinson and McElroy, 2007, *GSA Bulletin January/February, 2007 vol. 119 no. 1-2 140-156*)

In figure A, exploring natural erosion rates, areas in white and green have erosion rates that are less than soil production rates (30 m/my). In figure B, exploring cropland erosion rates, all regions that are colored in have erosion rates that exceed soil production rates. **Based on the two figures, 1) how much area could potentially generate new soil? (Estimate to the nearest 10%.) 2) Is the soil at your location threatened under present erosion rates?**

1) 20%
2) If your location is not contained within the circled areas, topsoil is threatened.

Figure A.

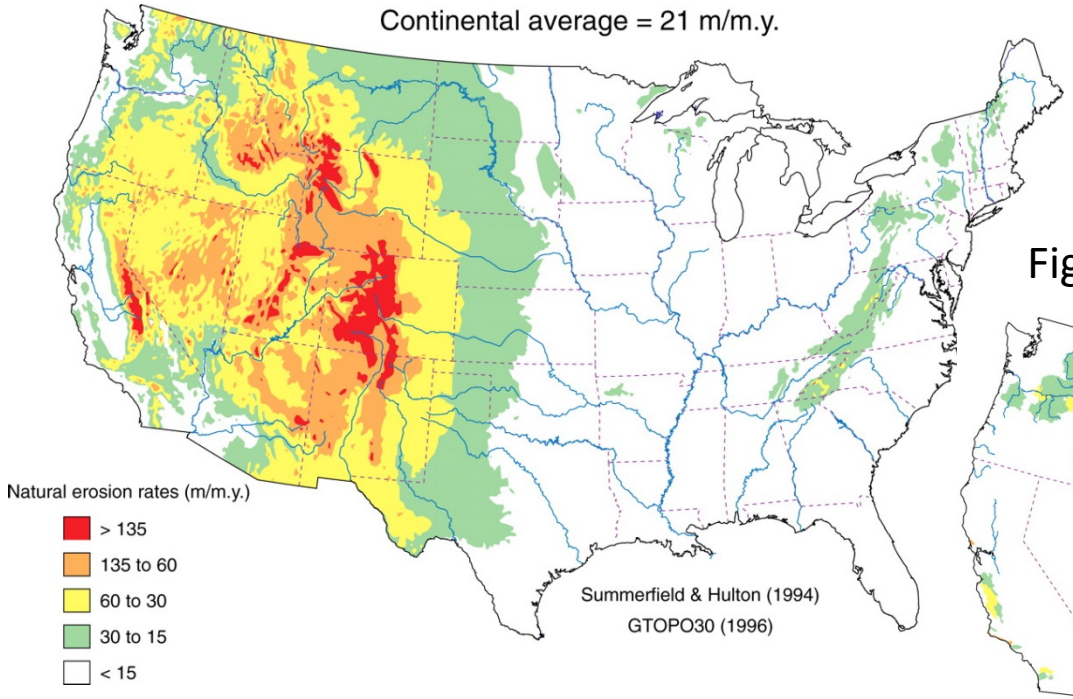
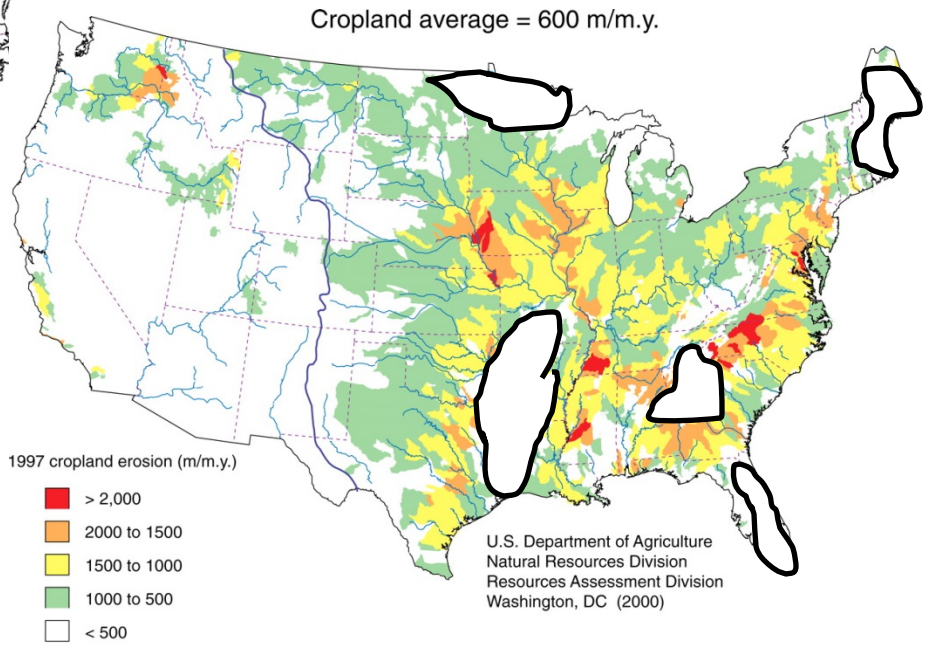


Figure B.



(Wilkinson and McElroy, 2007, *GSA Bulletin January/February, 2007 vol. 119 no. 1-2 140-156*)

Follow-Up Assignment

1) Based on your work today, how does agriculture threaten the sustainability of soil? (2 pts)

A correct answer will consider how the balance of available fertile soil relates to soil erosion and soil production. (1 pt) It should also consider the spatial extent of erosion (1 pt).

2) Does what you learned today through exploring the figures of natural and cropland erosion support or conflict with your initial perceptions of erosion? (1 pt)

(Your answer should refer to your initial impressions of erosion as we looked at the pictures of agricultural and mountain erosion. Did you think mountains or croplands were more erosive? Is this consistent with what you learned by looking at the figures?)

3) Reflecting on your comparison between the two erosion figures, what question(s) do you still have?

1 question required, more allowed (1 pt).