Managing the Nitrogen Cycle

UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING
First Year Experience

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NAE GRAND CHALLENGES FOR ENGINEERING
NATIONAL ACADEMY OF ENGINEERING

Background

- Artificial nitrogen fixation has increased to support food production
- Harmful gases are released due to inefficient methods
- We need to know:
  - How nitrogen fixation use will change in the future
  - How much excess nitrogen is being wasted

Inputs/Outputs

Inputs:

Cost of Nitrogen [$/kg]
Nitrogen Fertilizer Use [kg]
Land [mi ^ 2]

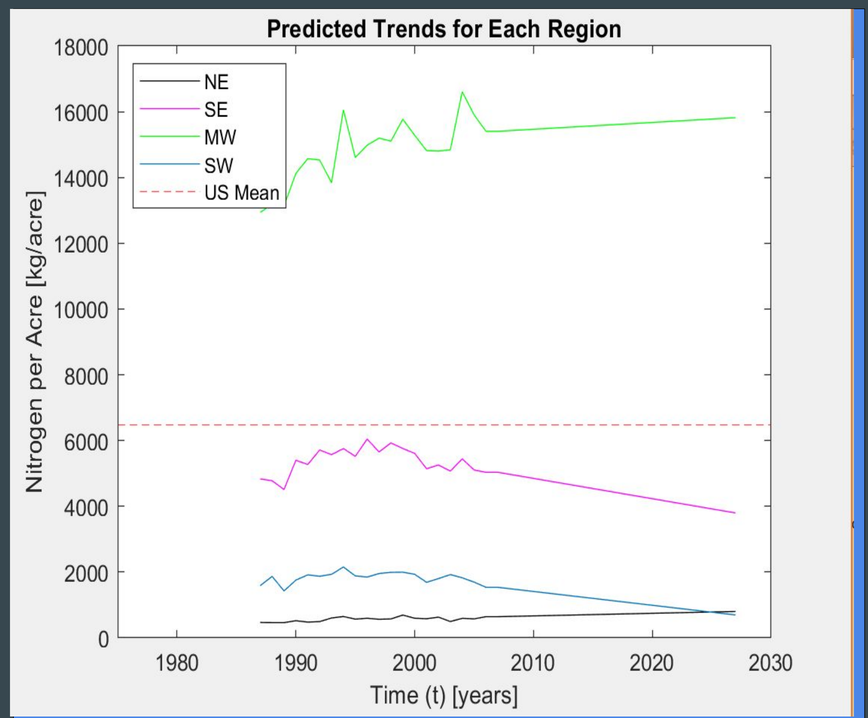
Outputs:

Extrapolated Nitrogen [kg/acres]
Excess Nitrogen [kg/acres]
Extrapolated Cost [$/kg]

Algorithm

1) **Input and Validation:** Input data and check if cost is valid, and if land and nitrogen data match properly.
2) **Conversion:** Convert Land [mi ^ 2] to [acres]
3) **Intermediate Calculations:**
   - **a)** Calculate nitrogen content [kg/acre] for each county and year
   - **b)** Calculate average change in nitrogen content [kg/acre] over the last three years
   - **c)** Calculate Current Mean Nitrogen level
   - **d)** Calculate Standard Deviation of Nitrogen level
4) **Final Calculations:**
   - **a)** Extrapolated Nitrogen levels based on calculated slope
   - **b)** Find Counties with excessive and depleted nitrogen levels(current and predicted)
   - **c)** Calculate Approximate cost to improve depleted regions
5) **Formatted Output:**
   - **a)** Graph nitrogen content from last three years
   - **b)** Graph predicted nitrogen content for the next 20 years

Results



- Western region omitted due to insufficient data.
- Only contains contiguous U.S, omits Hawaii and Alaska.

Conclusion

- Lower the nitrogen output in the midwest and northeast through more sustainable farming methods
- Collaberate with farmers to raise the nitrogen output in the southwest and southeast