

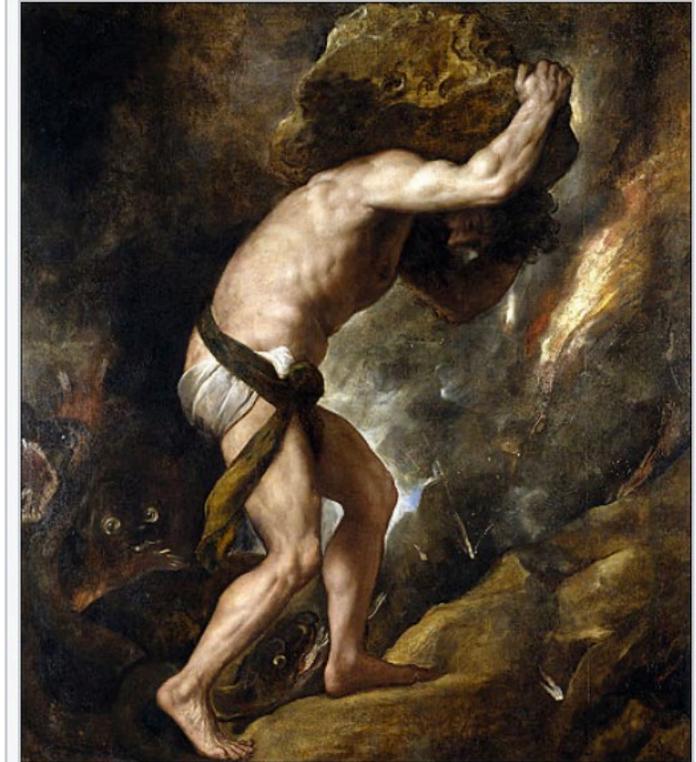
# Soil Science in the Bioenergy Transition

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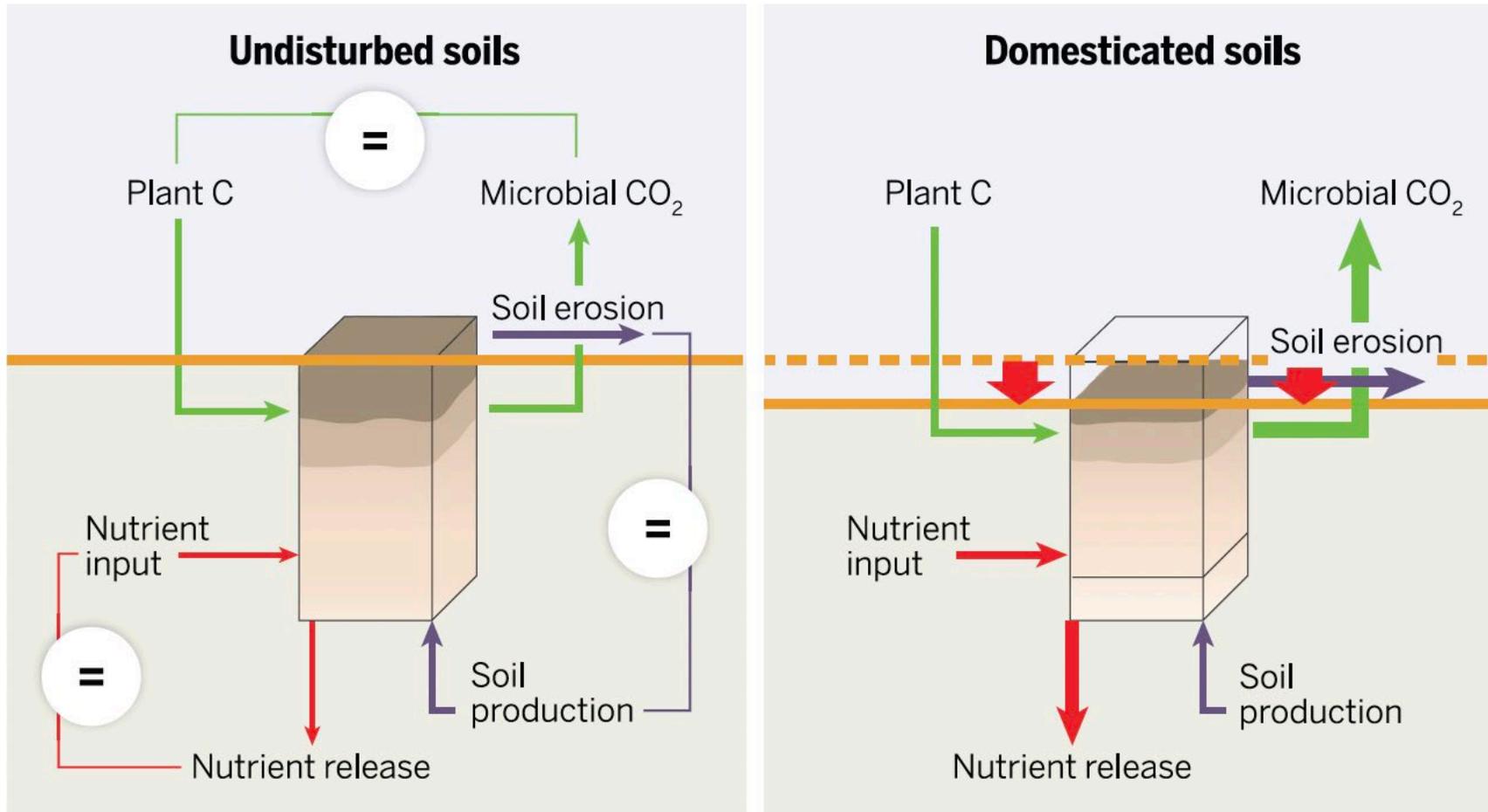
# Some hard questions or issues

- Science has been discussing the **potential** of soil C sequestration for 2 decades, will it be still doing so in 2050?
- Biofuel vs food crops?
- Scientists don't manage farms – **technical vs. achievable potential.**
- **Is soil C sequestration funding the best use of resources?**

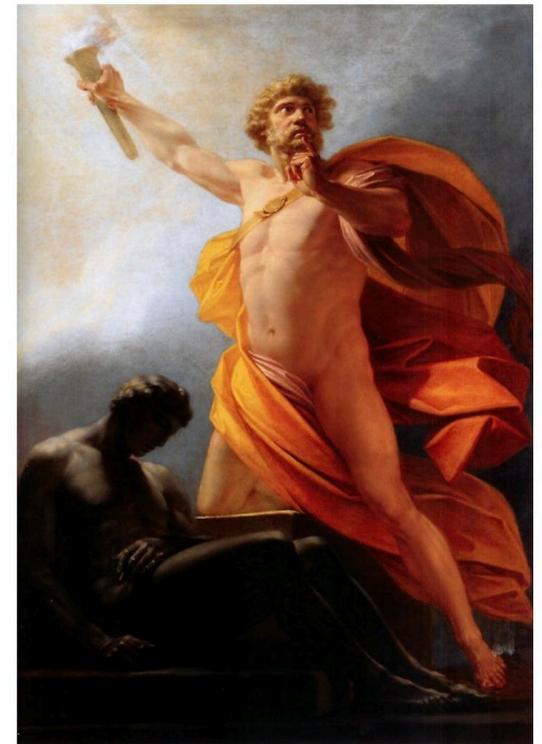


*Sisyphus* (1548–49) by Titian, Prado Museum, Madrid, Spain

# Soil management challenge: The unintended consequences of farming



Prometheus: God of Unintended Consequences



# Soil and Agriculture

- Soil processes have been out of balance since the invention of agriculture
- To assume we can obtain C neutrality (in an enterprise that adds  $\sim 2$  Gt C/y) in a few decades seems unrealistic

# Erosion

- Only in last 2 decades do we have **real** rates of soil production
- "Tolerable soil erosion rates" greatly exceed measured rates of soil production
- Maintenance of soil mass is the most critical challenge for US agriculture

# Nutrient balance

- USA soils have only been farmed ~ 150 years
- **Biomass removal = soil nutrient mining** (including elements not commonly considered: Zn, Cu, Si, etc)
- Biomass energy should be based on a **circular nutrient economy**, with returns to site of production

# Organic Matter



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## Photosynthetic limits on carbon sequestration in croplands

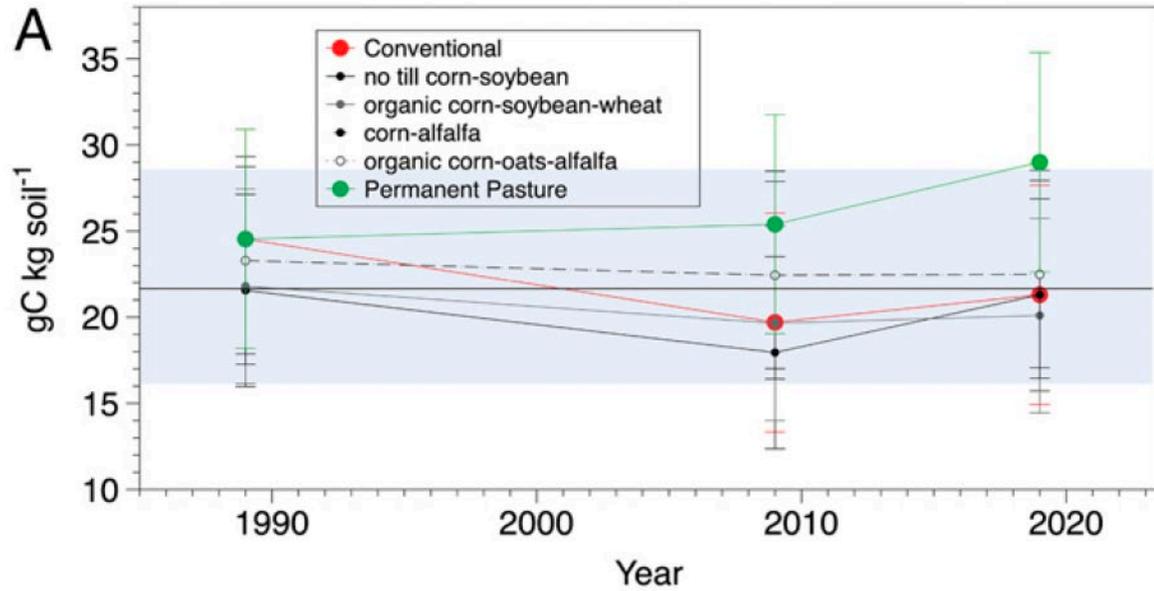
H. Henry Janzen <sup>a</sup>, Kees Jan van Groenigen <sup>b</sup>, David S. Powlson <sup>c</sup>, Timothy Schwinghamer <sup>a</sup>, Jan Willem van Groenigen <sup>d</sup>  

### Highlights

- Estimates for maximum soil C sequestration rates often take soil as starting point.
- Our “Fermi approach” suggests instead to take photosynthesis as the starting point.
- Our results suggest maximum sequestration rates in global croplands of 0.2 Pg yr<sup>-1</sup>.
- This is an order of magnitude lower than most previous estimates.
- Uncertainty analysis suggests that our results, while relatively rough, are robust.

# The Pandora's box of soil carbon

Ronald Amundson<sup>a,1</sup> 





# Concluding comments

- We shouldn't feel locked into soil C as a mitigation tool simply because they have lost C over time, and because **investment** is now accelerating
- We must consider alternative strategies and **their costs**
- We should focus on holistic policies for soil sustainability, **that may be more effective than a C-centric approach**