Evaluating the Response of the Terrestrial Biosphere to Significant Drought

Ian Shiach[1], Ian Baker[2]
[1]The Colorado College/CMMAP Summer Intern, [2]Colorado State University/CMMAP
CMMAP Student Colloquium, Summer 2011


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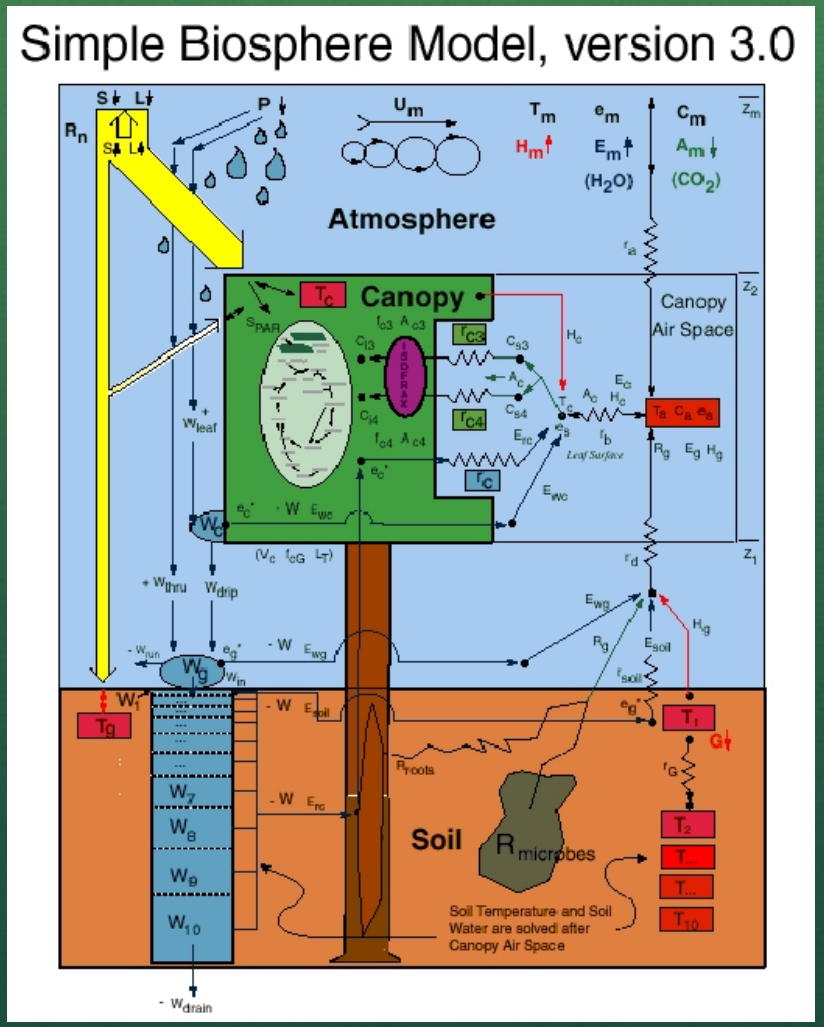
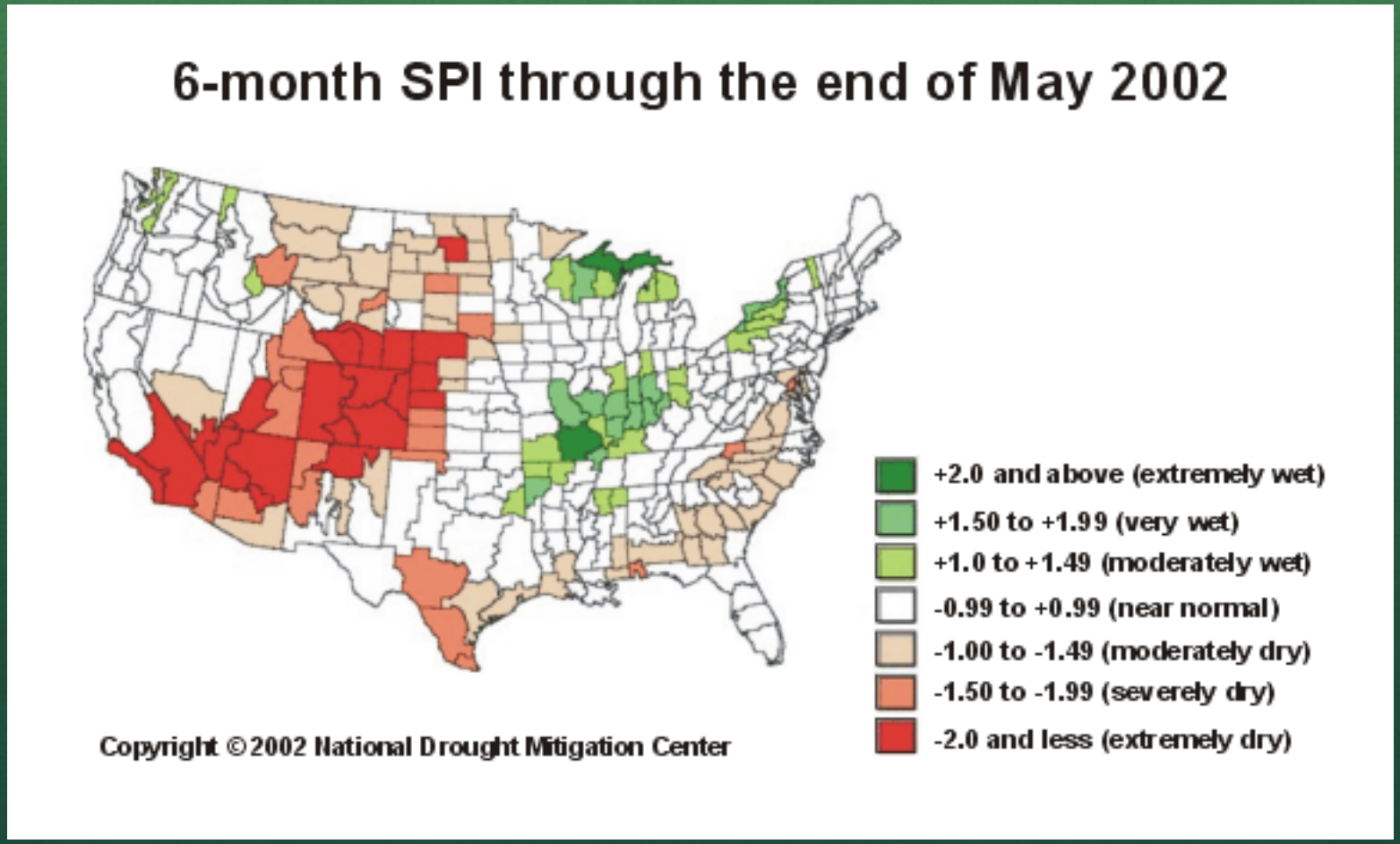
Contents

Credit: Peripitus, Wikimedia Commons

Introduction: Simple Biosphere Model 3 (SiB)



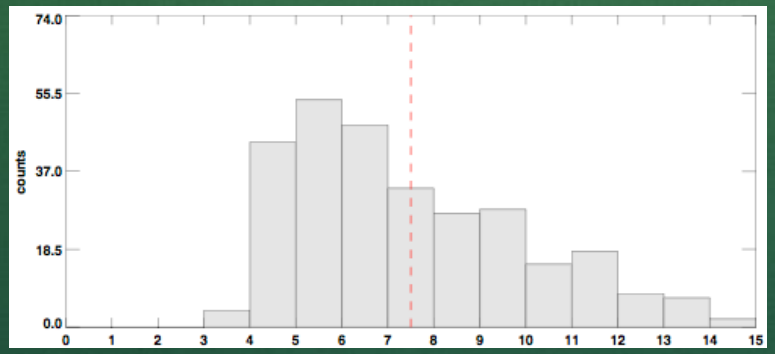
Introduction: Standardized Precipitation Index (SPI)



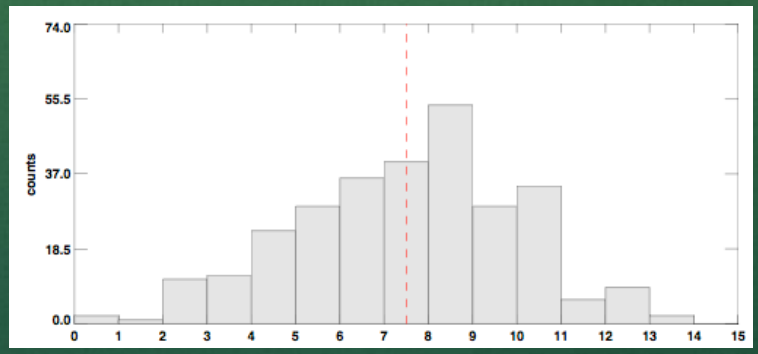
Methods

- SPI maps from SiB data
- "SVI" and non-standardized anomaly maps

Gross Primary Productivity



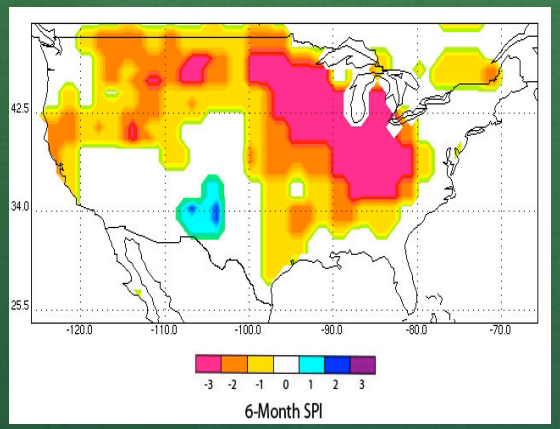
Net Ecosystem Exchange



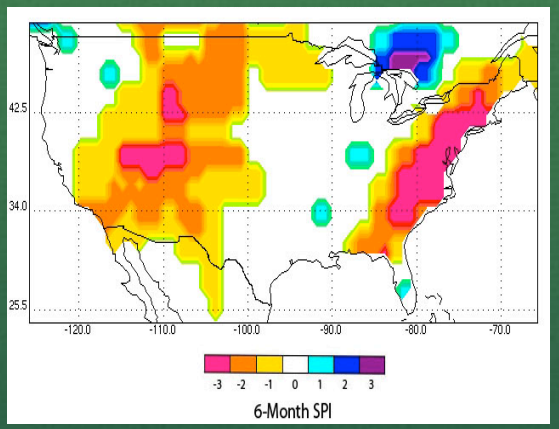
- Qualitative analysis for relationships
  - Duration, intensity, spatial extent
- Plots of response variables from model points

Results: SPI Maps

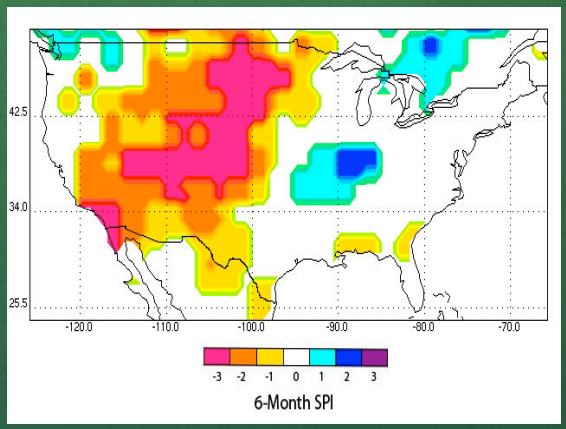
U.S. Midwest—1988



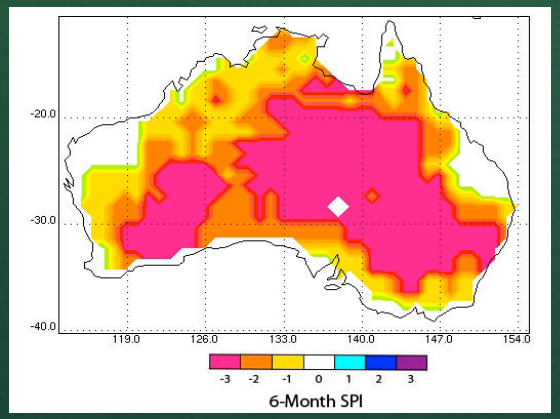
U.S. Southeast—2000



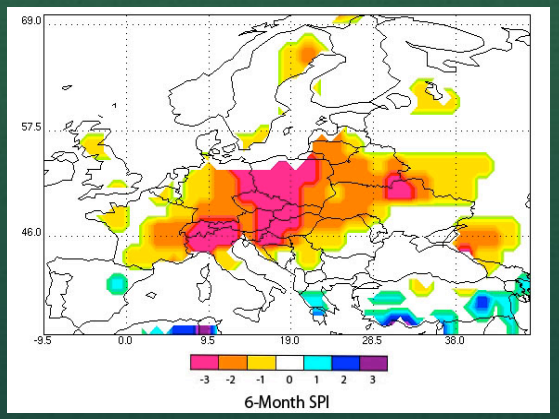
U.S. Southwest—2002



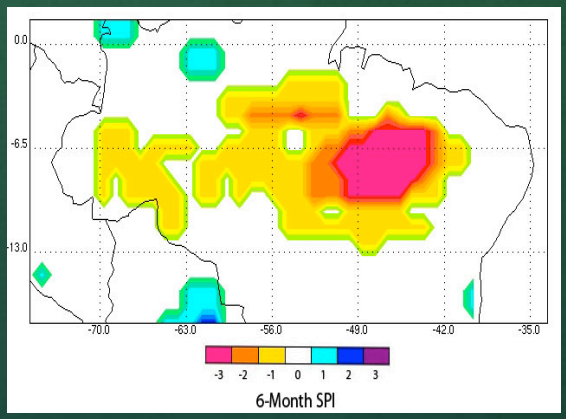
Australia—2002



Europe—2003

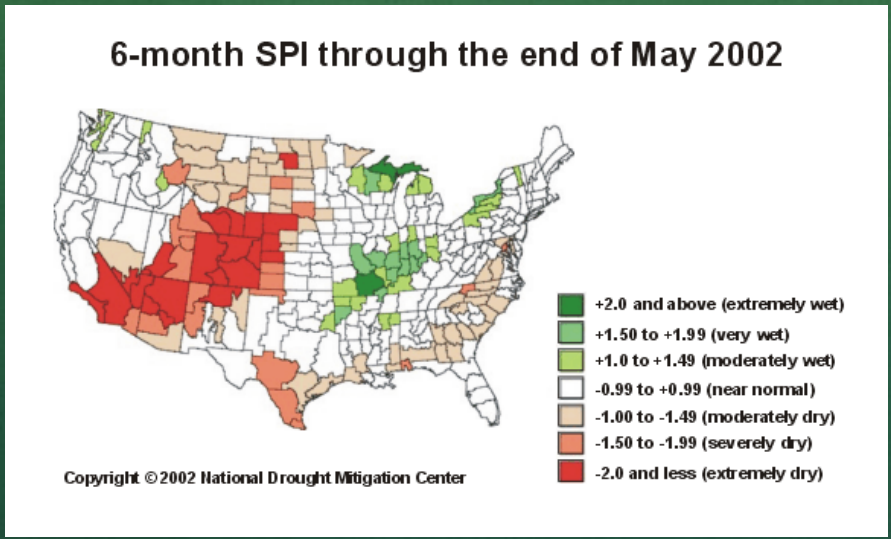


Amazon—2005

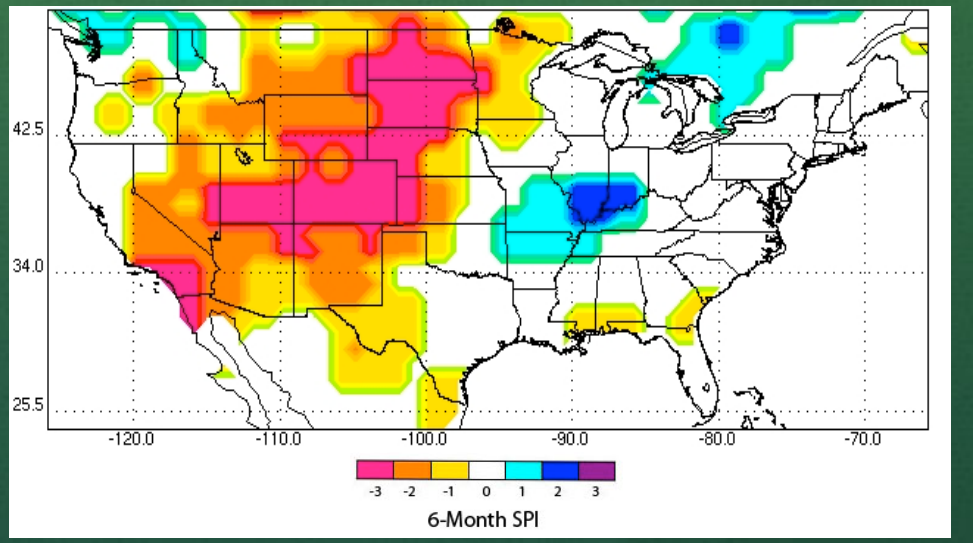


Results: U.S. Southwest 2002

May 2002 Actual SPI 6-Month

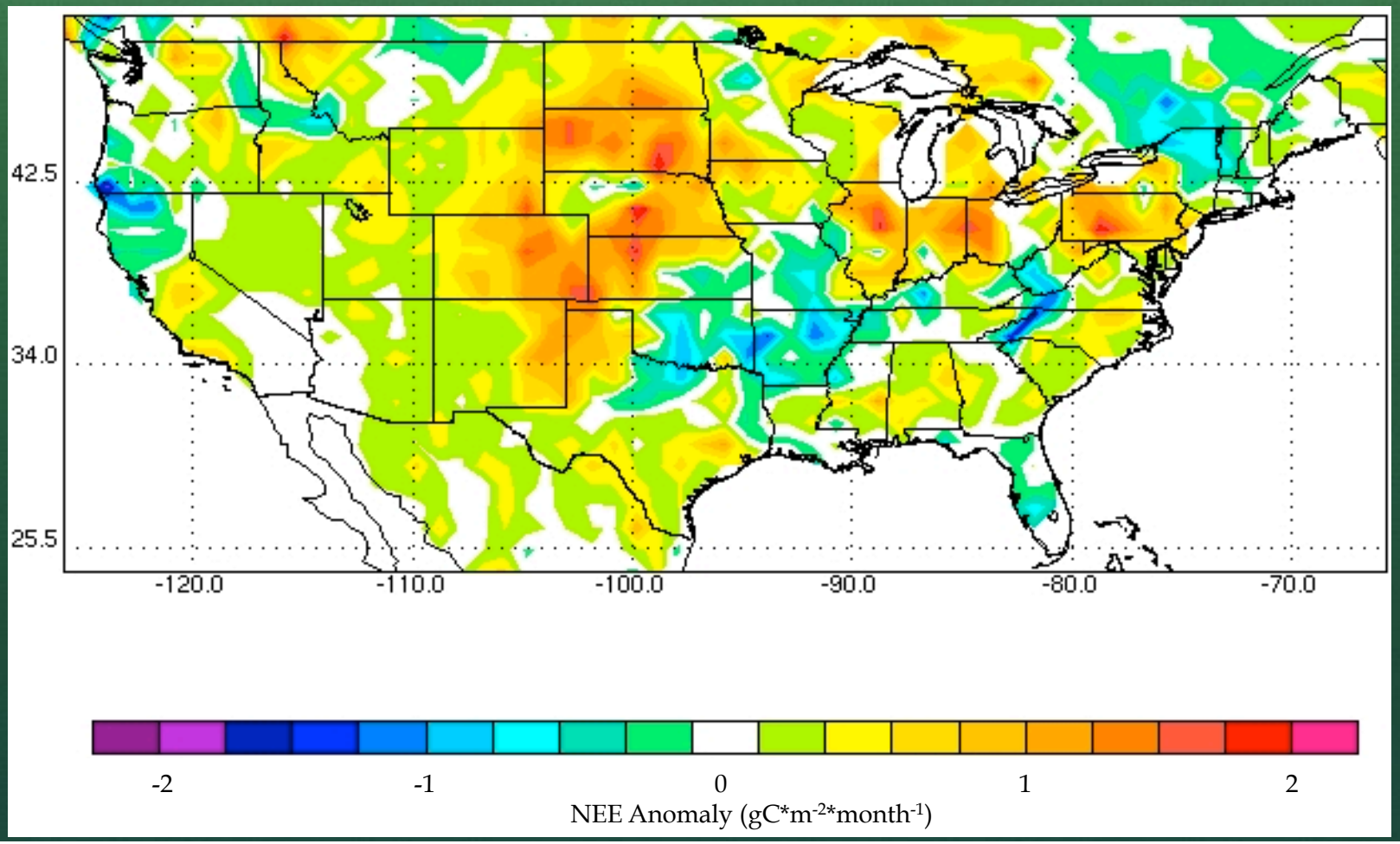


May 2002 SiB SPI 6-Month



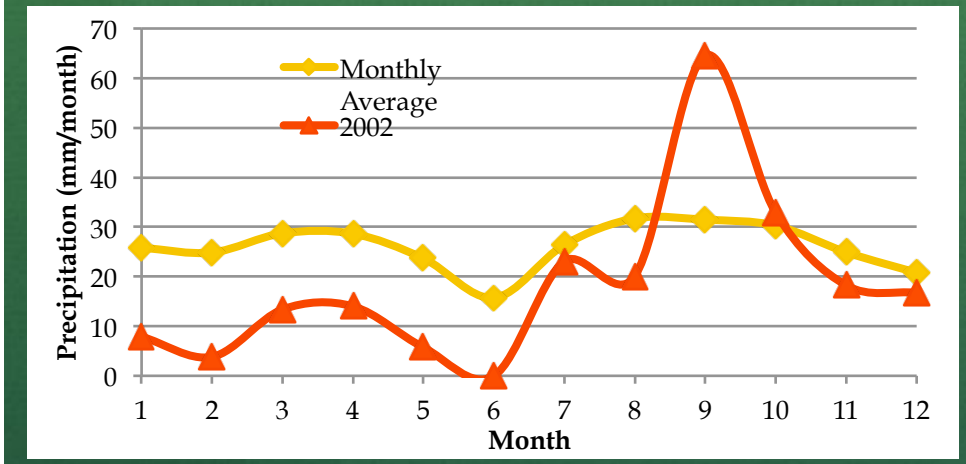
Results: U.S. Southwest 2002

June 2002 SiB NEE Anomaly

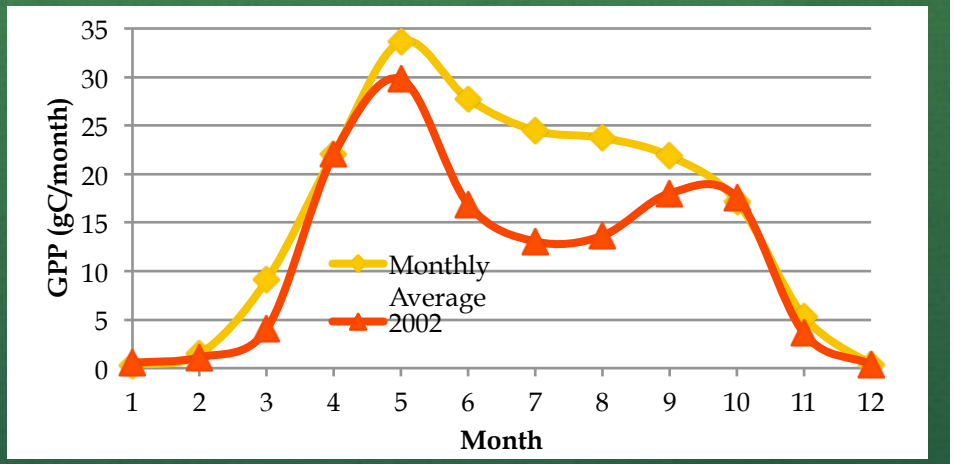


Results: U.S. Southwest 2002

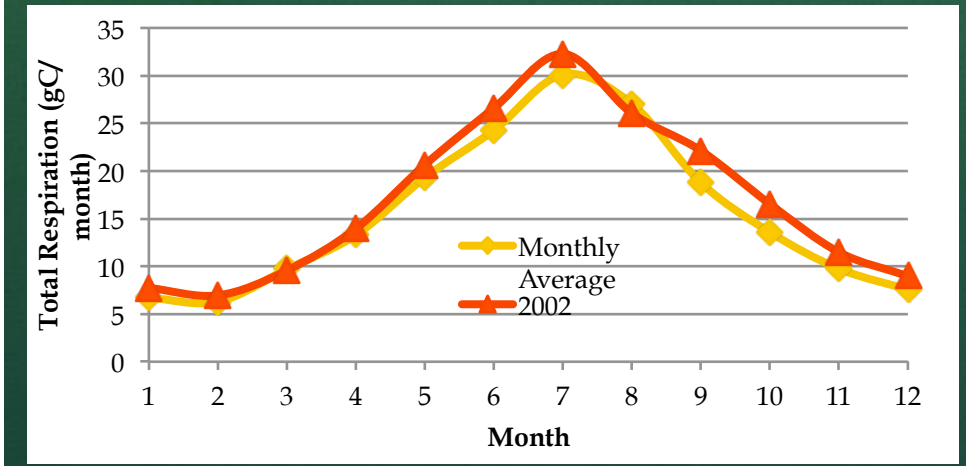
Precipitation



Gross Primary Productivity



Respiration



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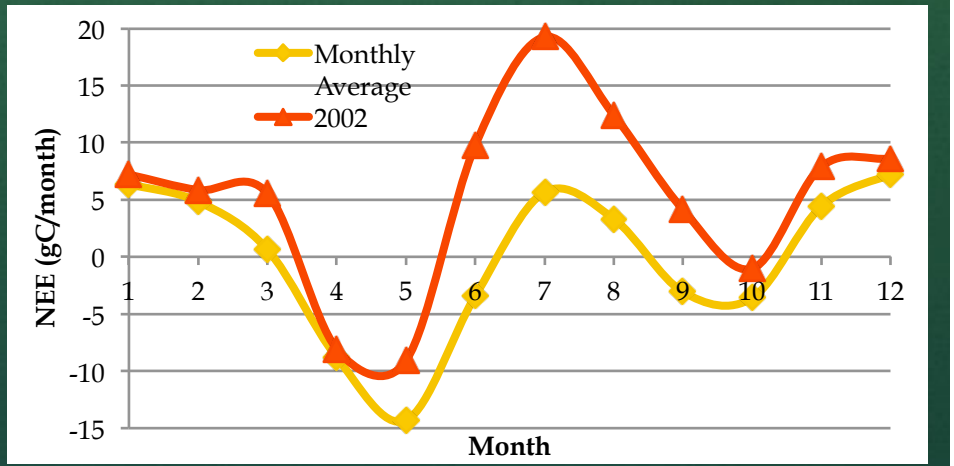
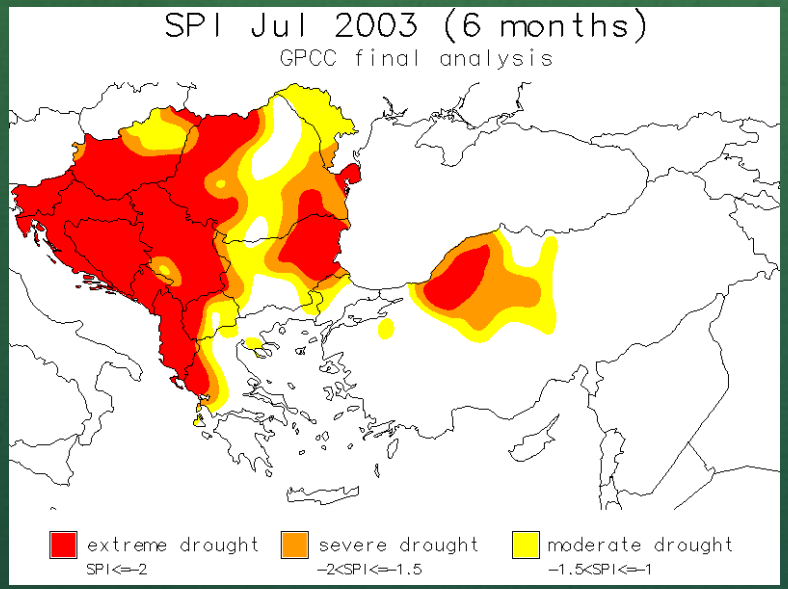
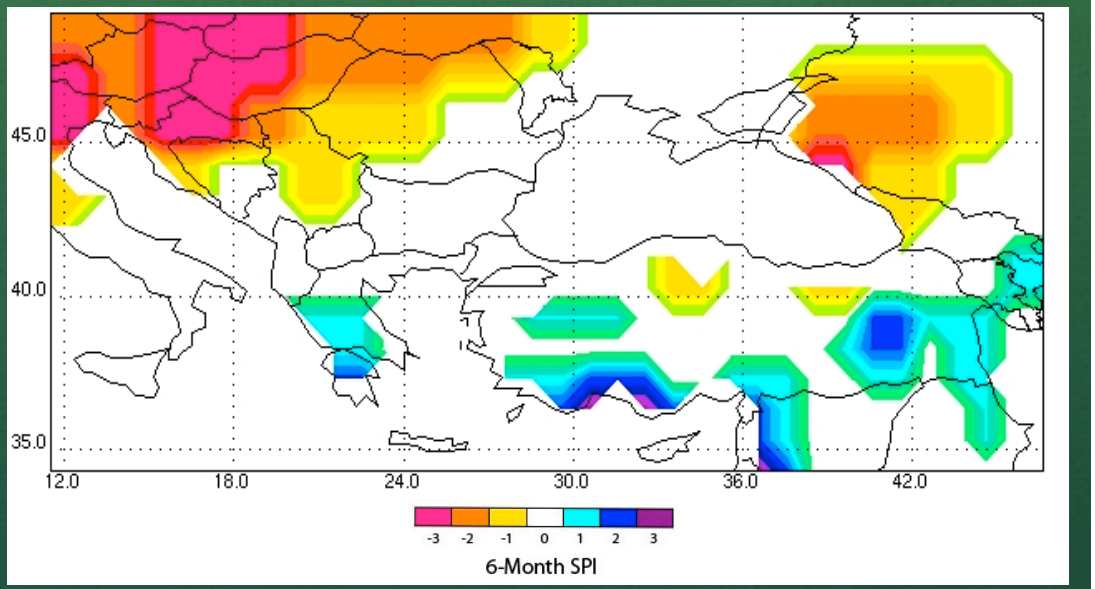


Results: Europe 2003

July 2003 Actual SPI 6-Month



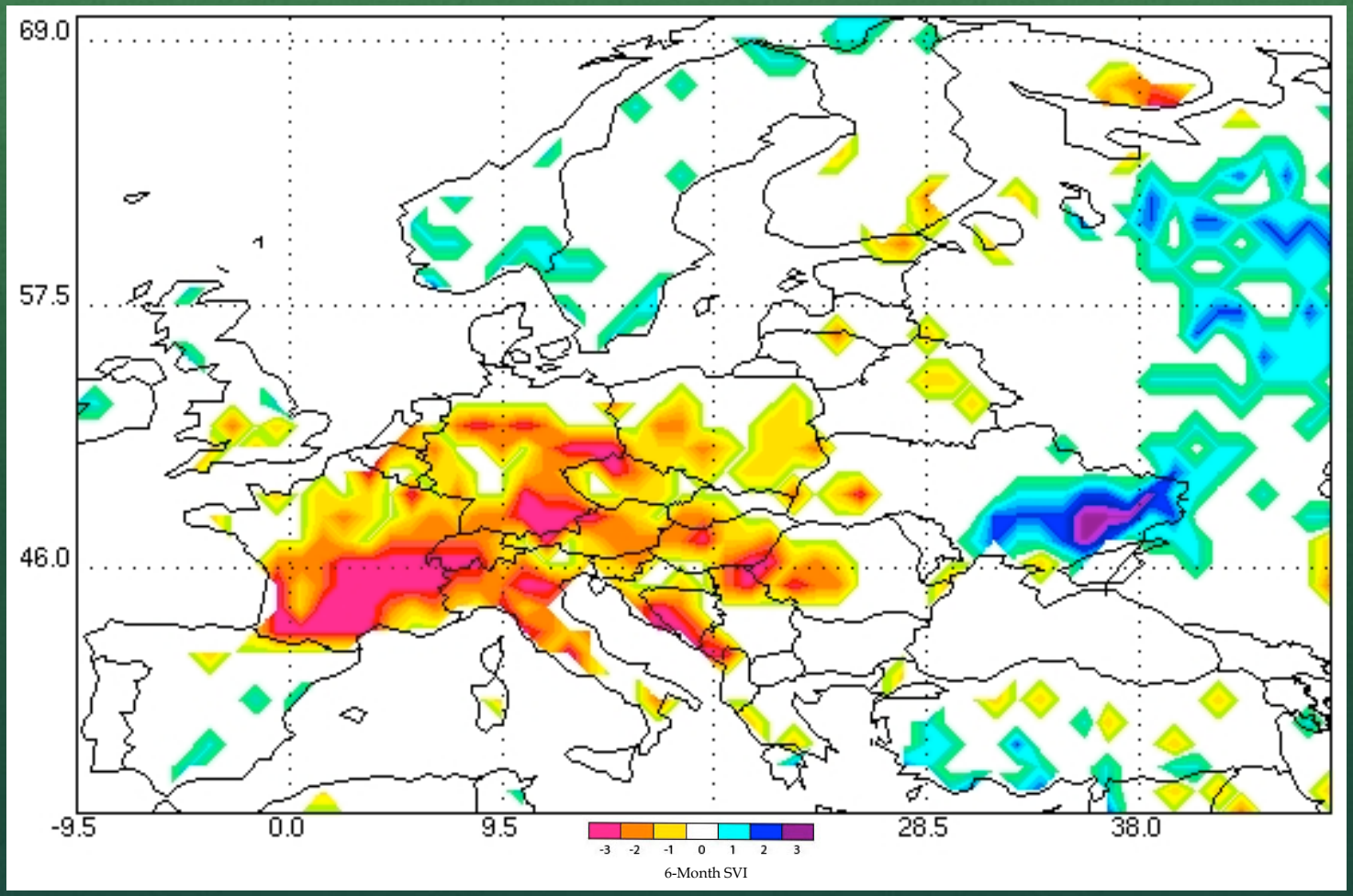
July 2003 SiB SPI 6-Month



Source: Drought Management Centre for Southeastern Europe

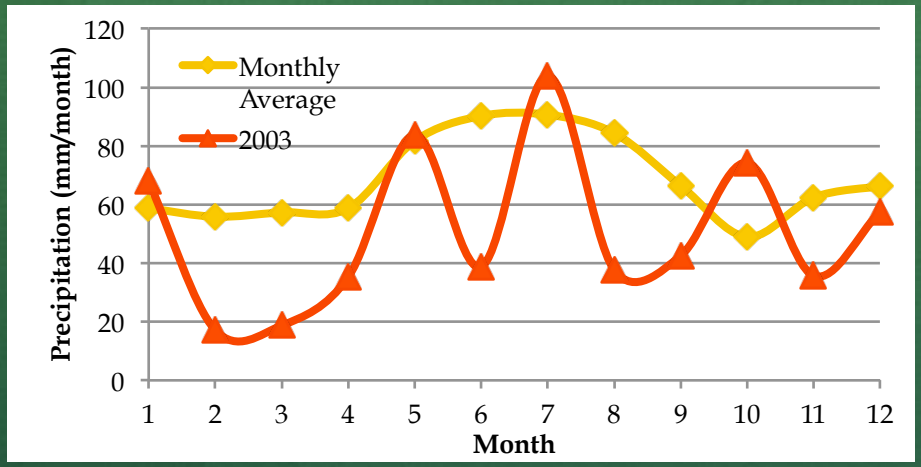
Results: Europe 2003

December 2003 SiB SVI 6-Month—GPP



Results: Europe 2003

Precipitation



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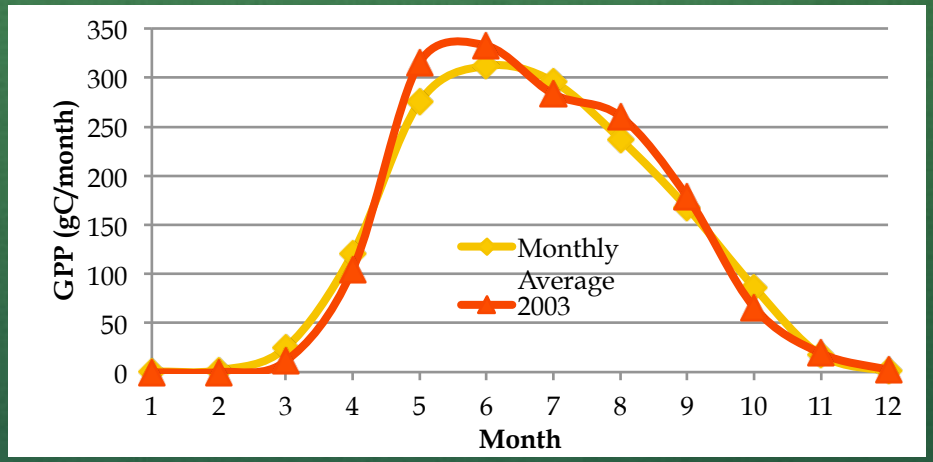
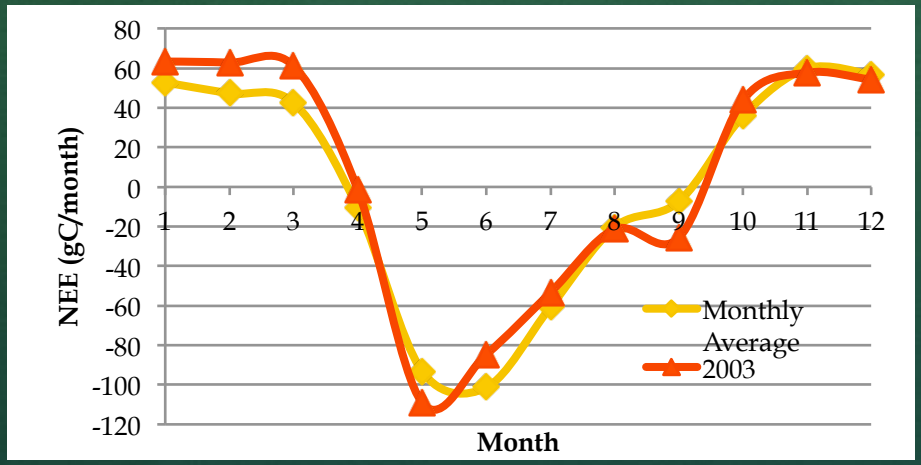
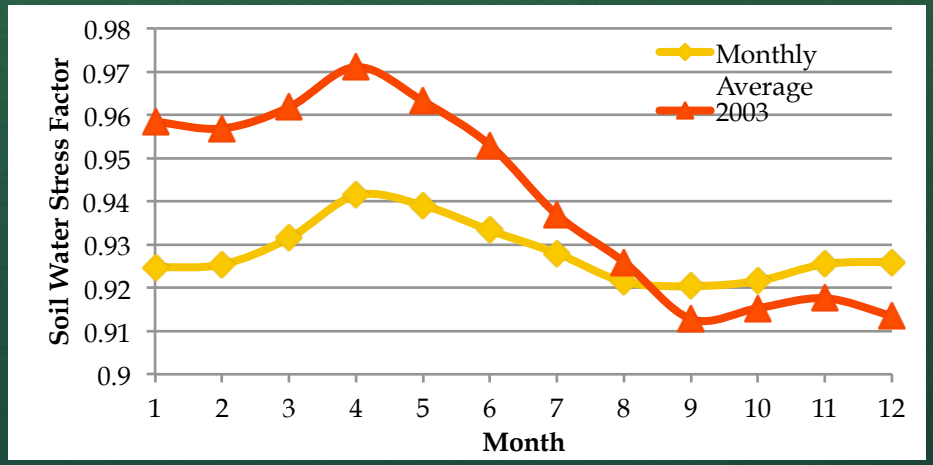


Net Ecosystem Exchange



Soil Water Stress Factor



Conclusions and Future Research

- SiB3 can represent drought well…
  - U.S. Midwest 1988, U.S. Southwest 2002
- …but this is not always the case!
  - Under-responsive: Europe 2003, Amazonia 2005
  - Over-responsive: Australia 2002
  - Not present: U.S. Southeast 1993 and 2005
- Next Steps
  - Objective, quantitative analysis
  - Other drought indices
  - Statistical analysis of variable distributions
  - SiB runs from post-2006

Acknowledgements

- Ian Baker, Scott Denning, John Kleist
- Howard Drossman, Barbara Whitten, Eric Perramond
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