


The Role of Climate Science in U.S. Crop Insurance

A red combine harvester is shown in a golden field, harvesting crops. A large American flag is draped over the harvester. In the background, there is a tall, blue grain elevator and a utility pole. The sky is clear and blue.

Thomas P. Zacharias
www.tomz@ag-risk.org

National Crop Insurance Services



A World Of Information

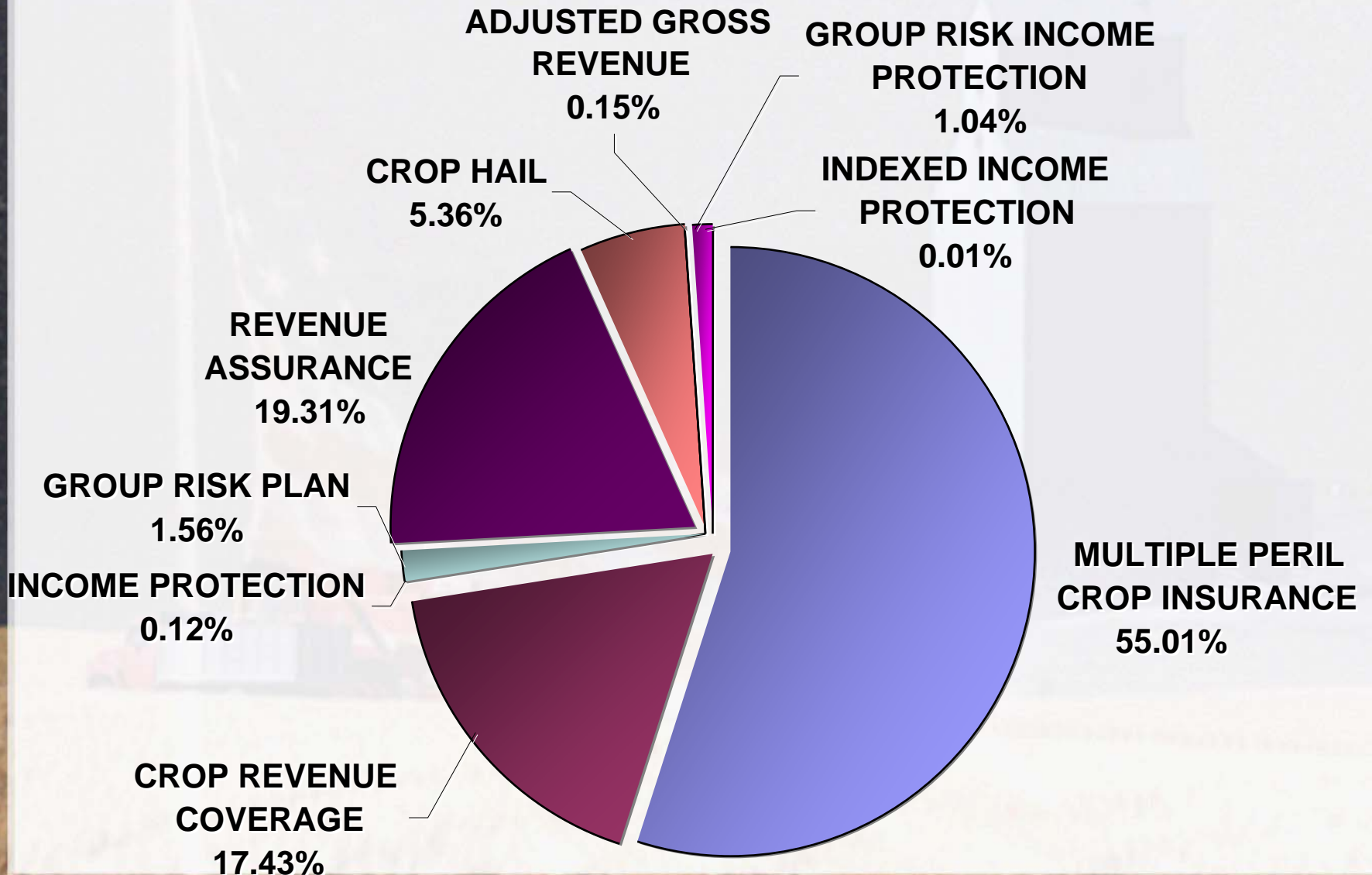
National Crop Insurance Services

www.ag-risk.org

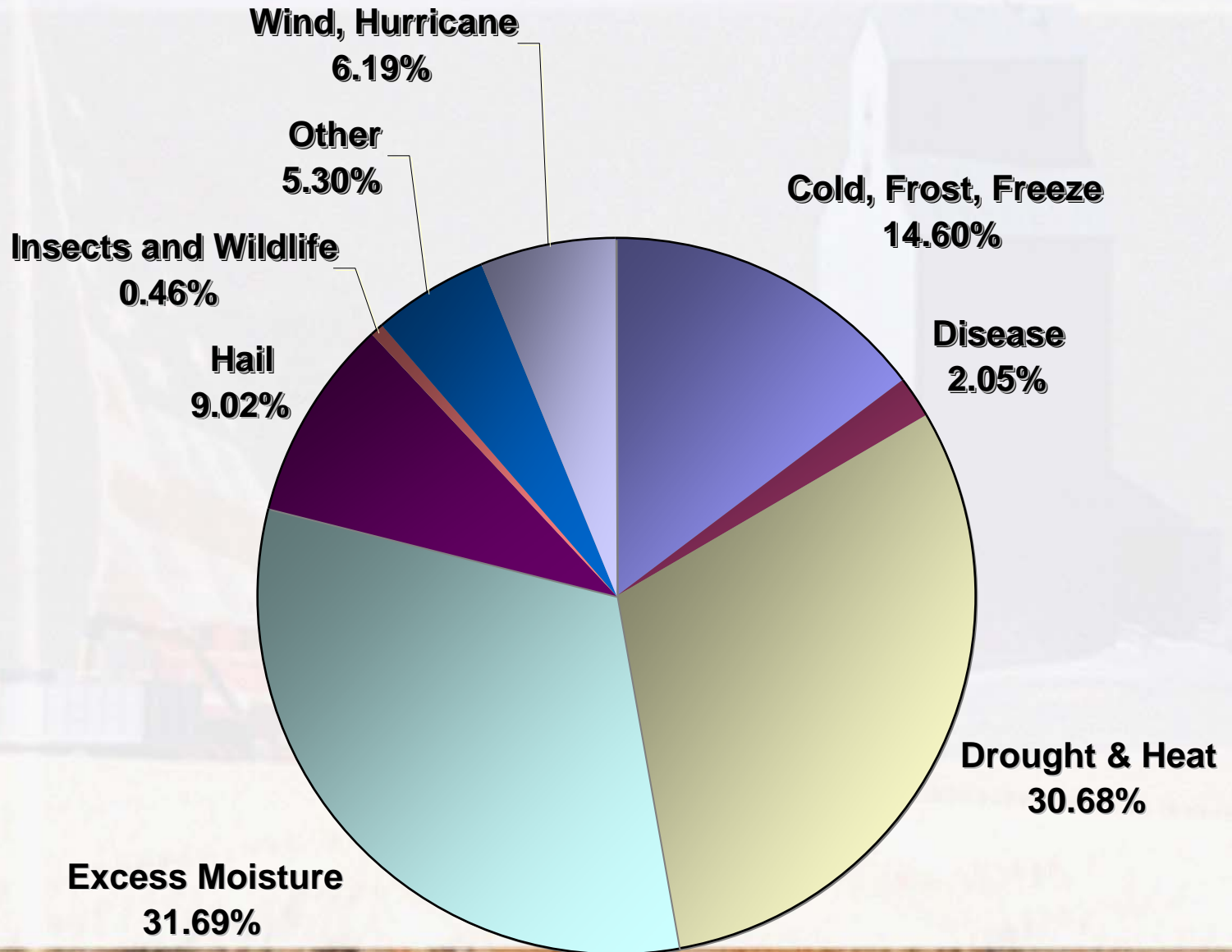
Organization of Presentation

- Overview of U.S. Crop Insurance
- Insurer Perspective
- Climate Science Program Framework
- Climate Science Impacts for Actuarial and Underwriting Considerations
- Conclusion

2004 All Crop Insurance Industry Premium



2004 MPCl Cause Of Loss



Crop-Hail and MPCCI Experience

By Region

- Liability
- Loss Costs: Loss/Liability
- Loss Ratios: Loss/Premium

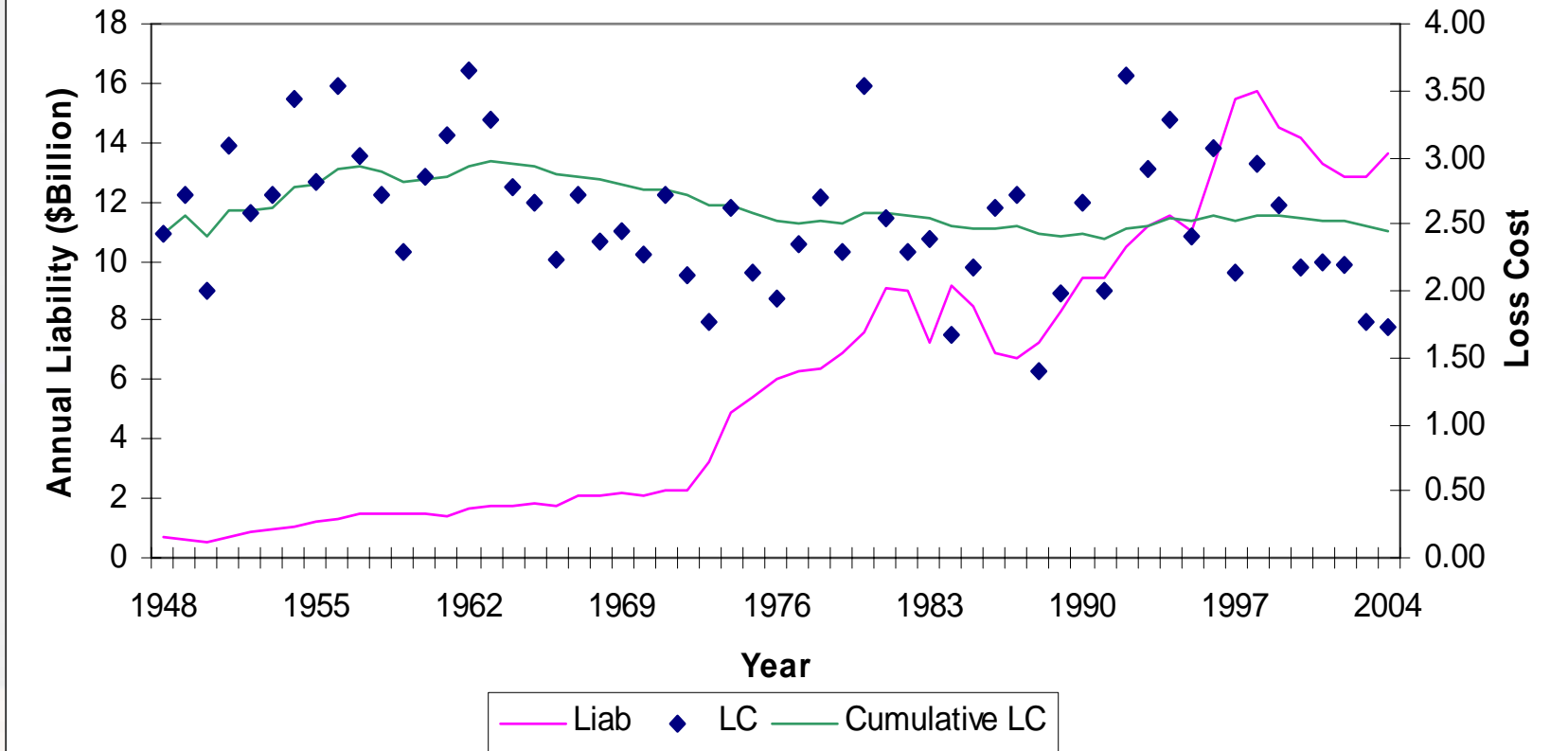
Annual and Cumulative

Crop-Hail

- Source: NCIS Insured Crop Summary
 - As of October 31, 2005
- State Groupings

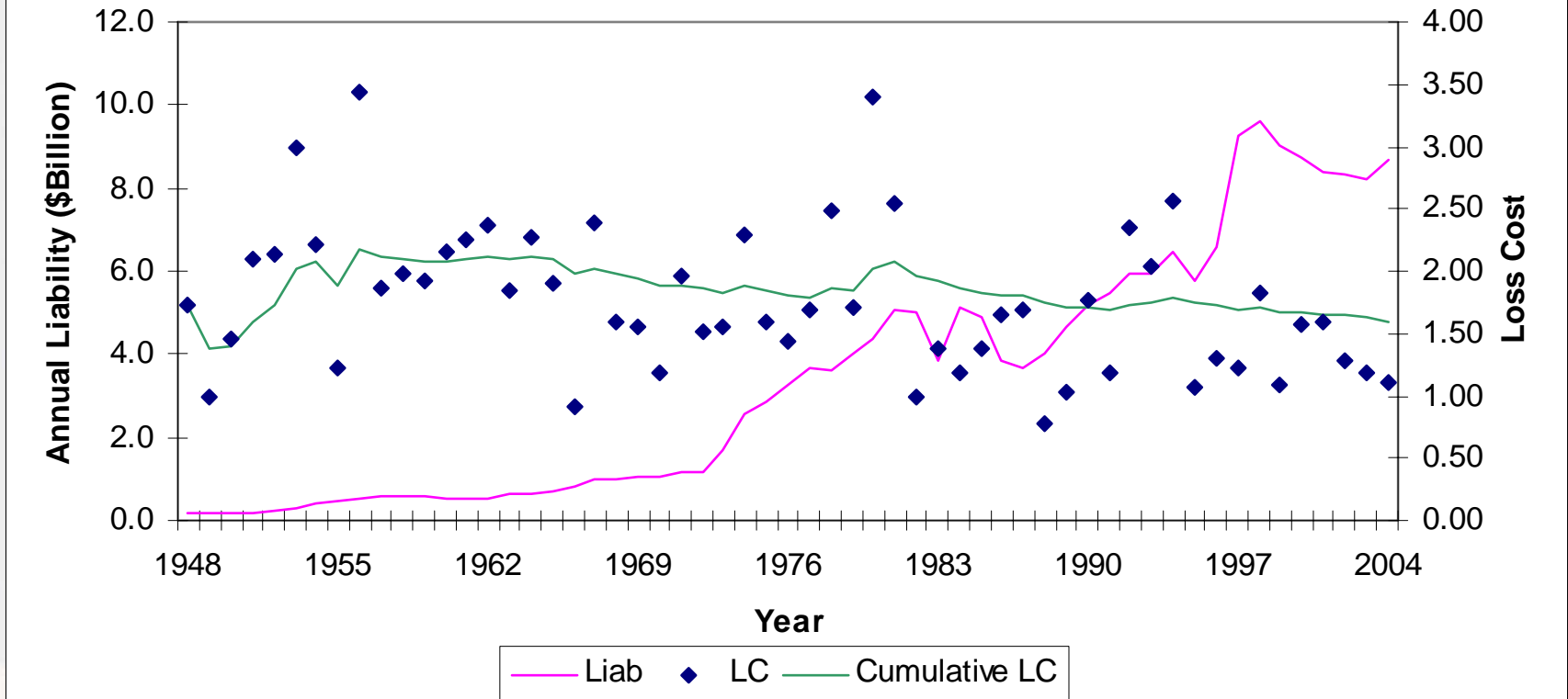
Region	States
Corn Belt	IL, IN, IA, MI, MN, MO, NE, OH, WI
Great Plains	KS, ND, OK, SD, TX
Northeast	CT, DE, MD, ME, MA, NH, NJ, NY, PA, RI, VT, WV
Northwest	ID, OR, WA
Mountain	CO, MT, WY
Southeast	AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA
Southwest	AZ, CA, NV, NM, UT

Crop-Hail: Countrywide Liability and Loss Costs



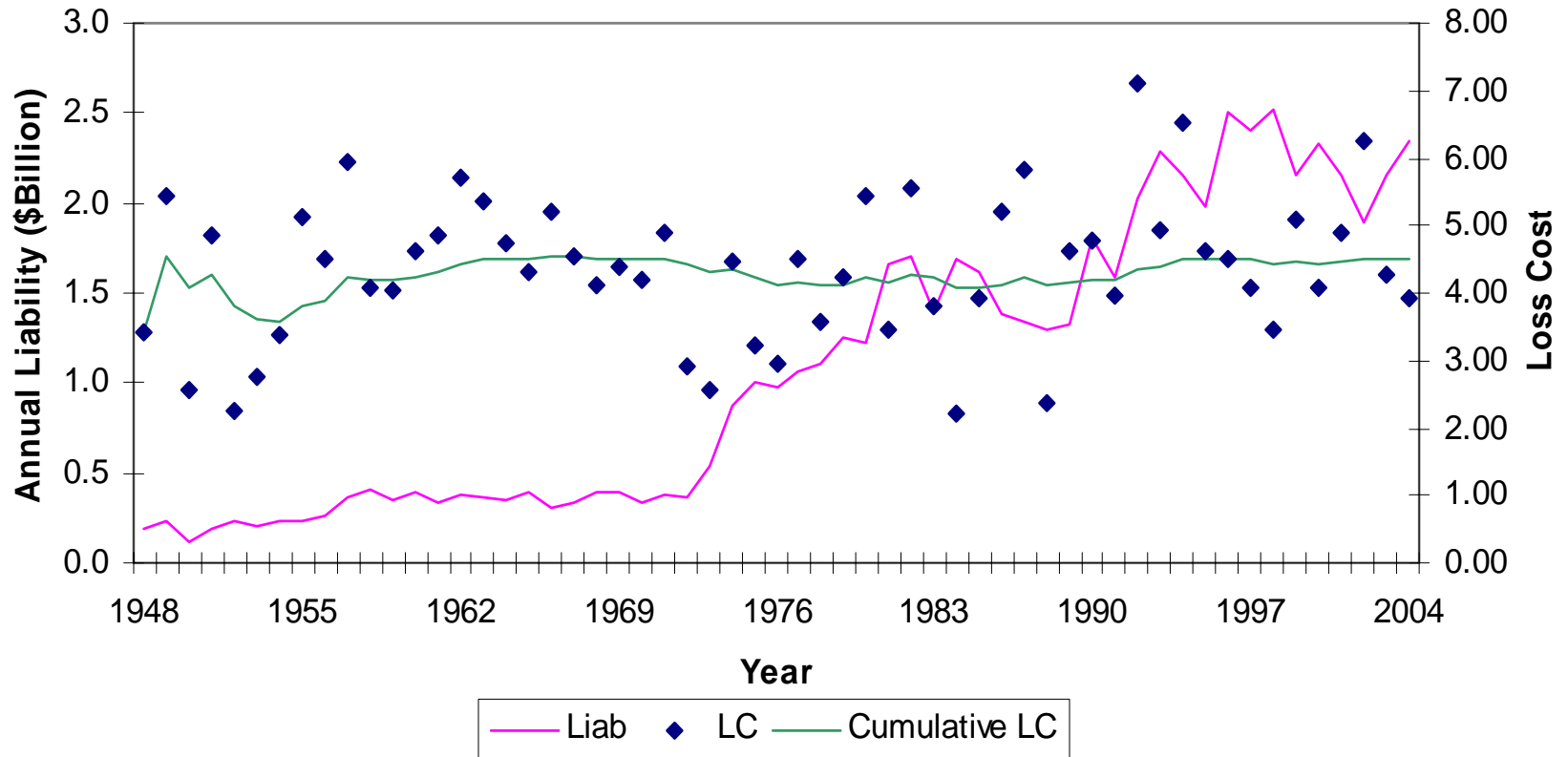
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Corn Belt Liability and Loss Costs



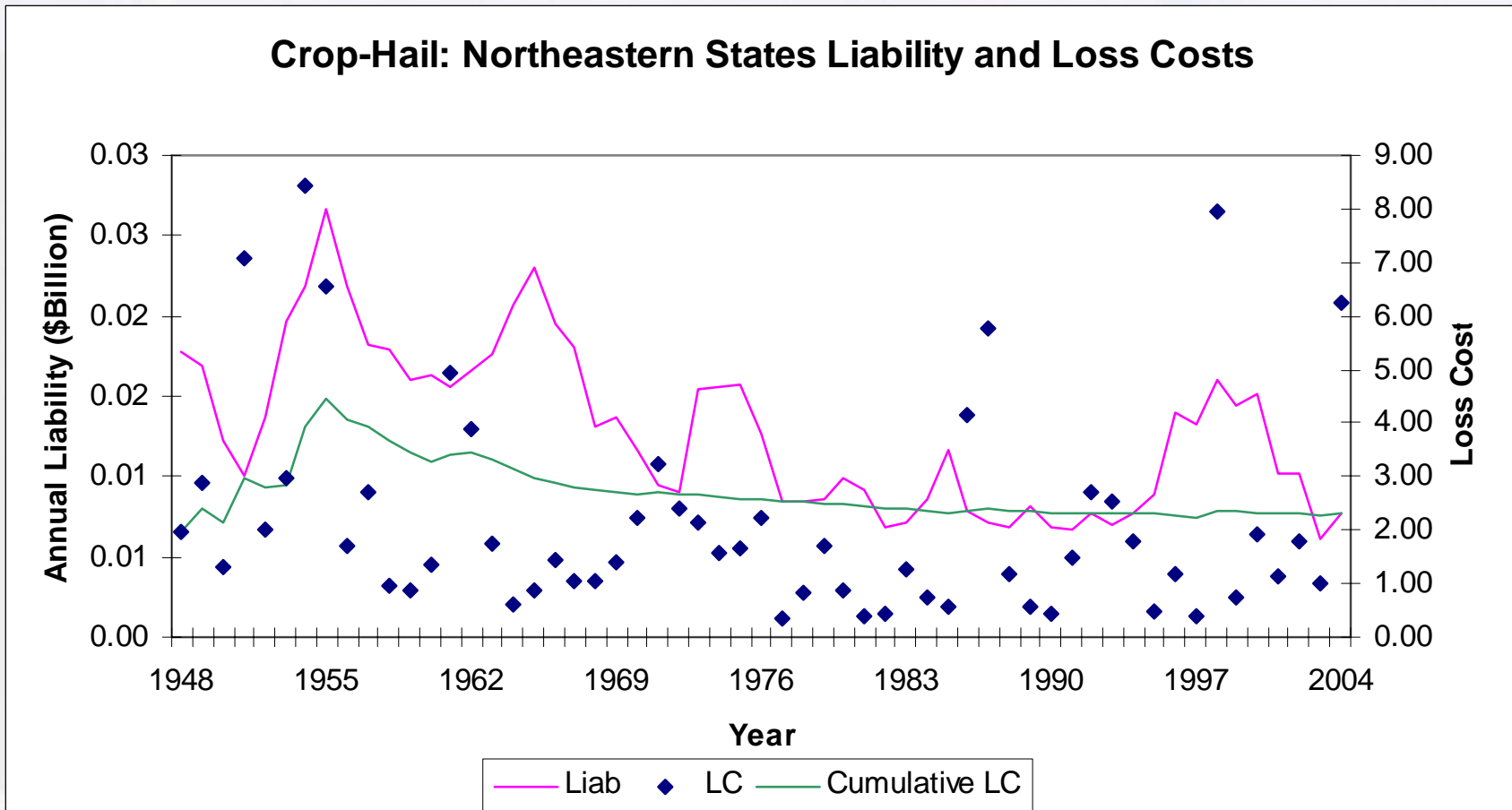
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Great Plains States Liability and Loss Costs



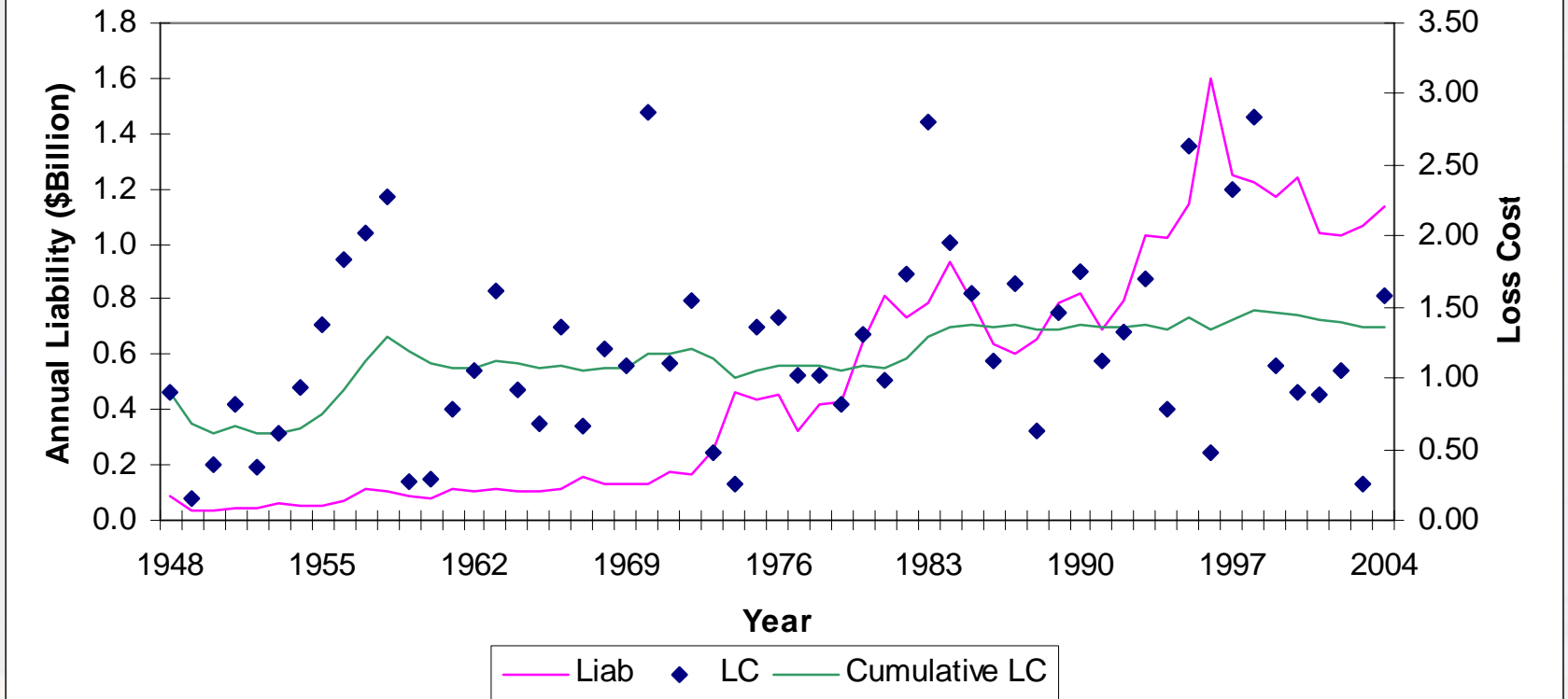
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Northeastern States Liability and Loss Costs



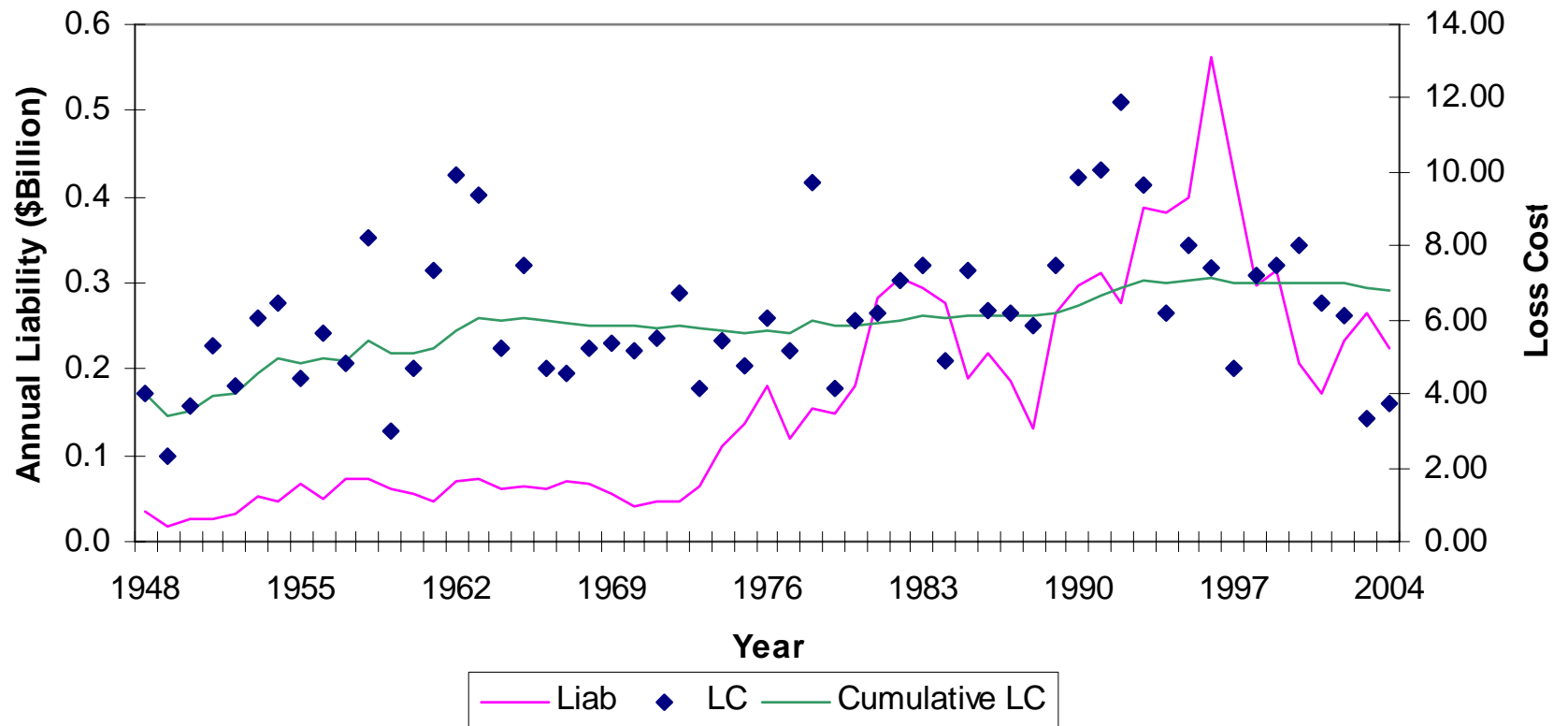
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Northwestern States Liability and Loss Costs



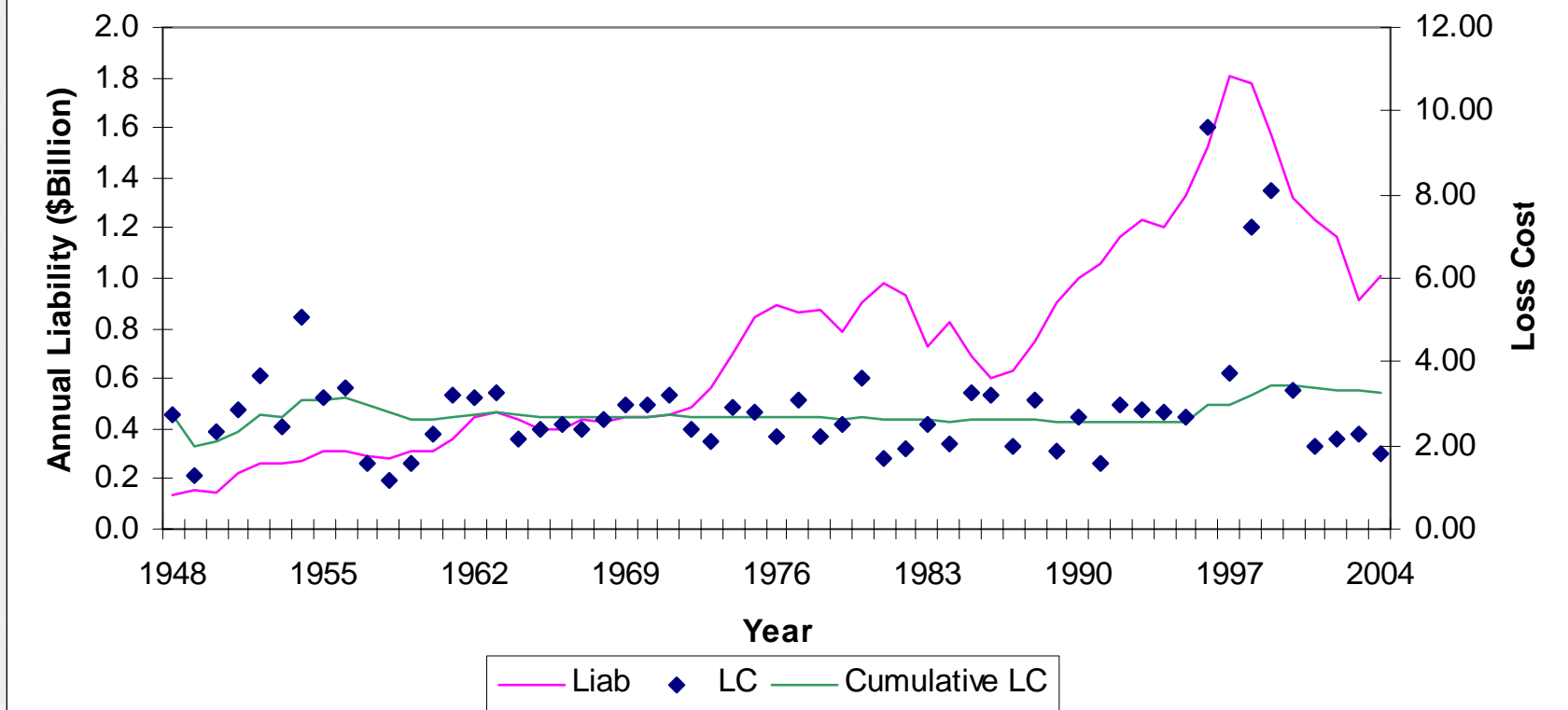
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Mountain States Liability and Loss Costs



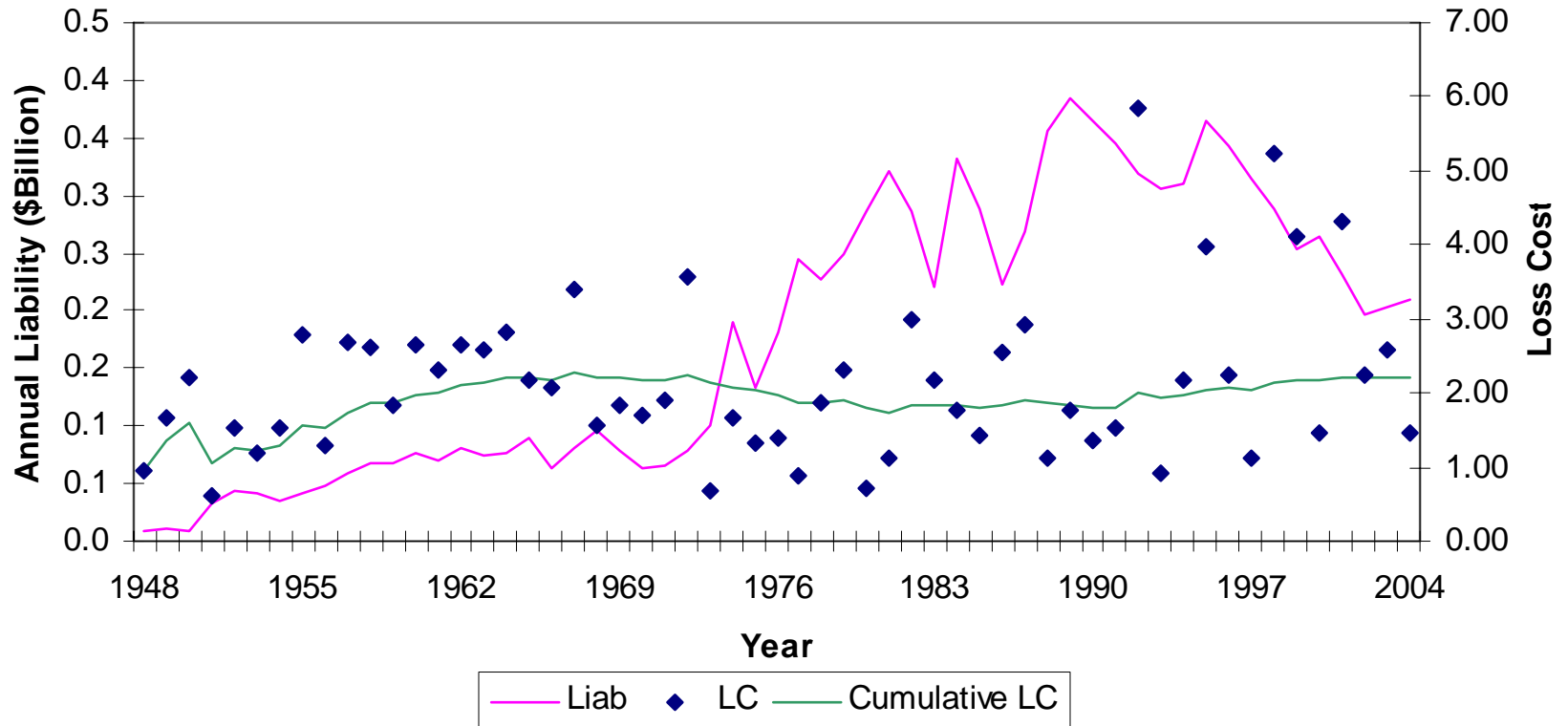
Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Southeastern States Liability and Loss Costs



Source: NCIS Insured Crop Summary
As of October 31, 2005

Crop-Hail: Southwestern States Liability and Loss Costs



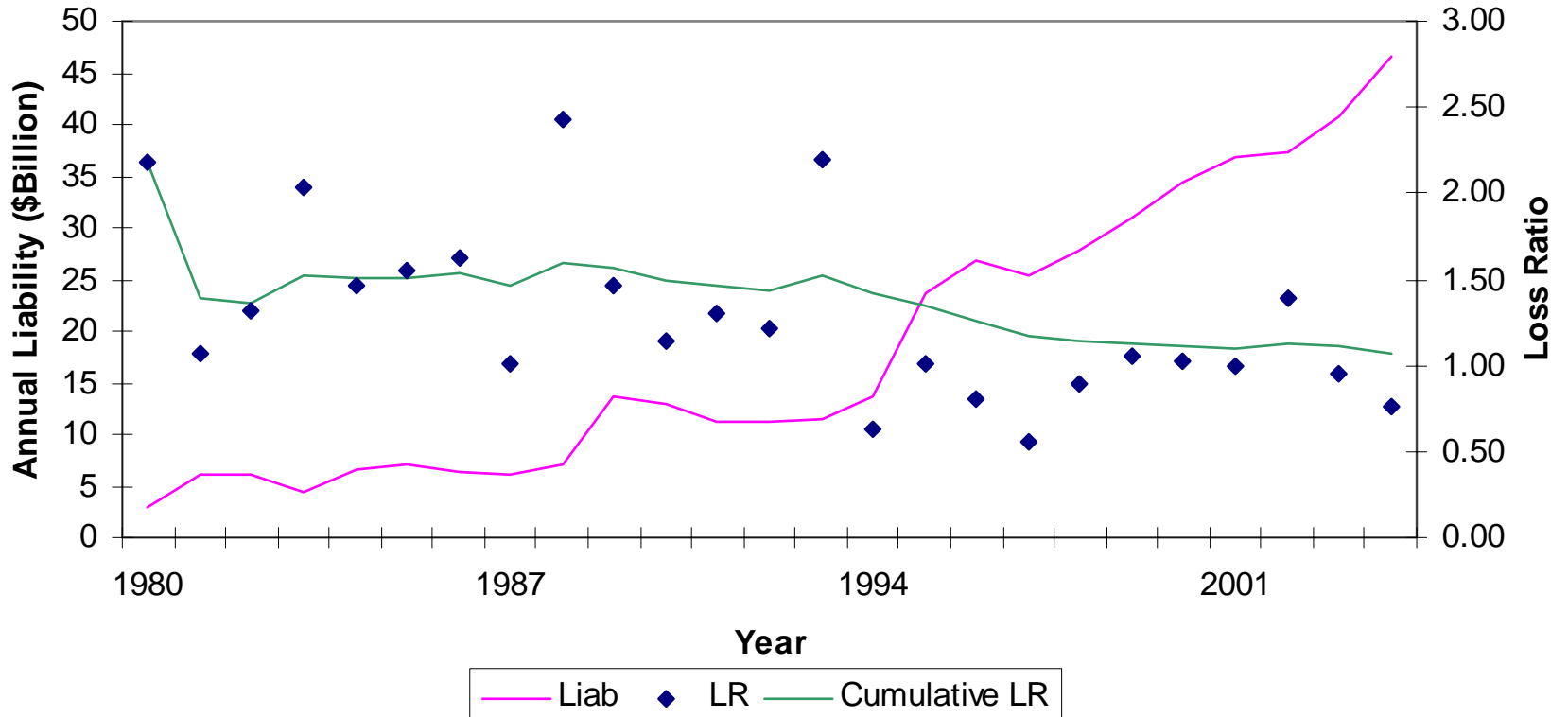
Source: NCIS Insured Crop Summary
As of October 31, 2005

MPCI

- Source: Summary of Business Tables
 - As of Oct. 31, 2005
- State Groupings

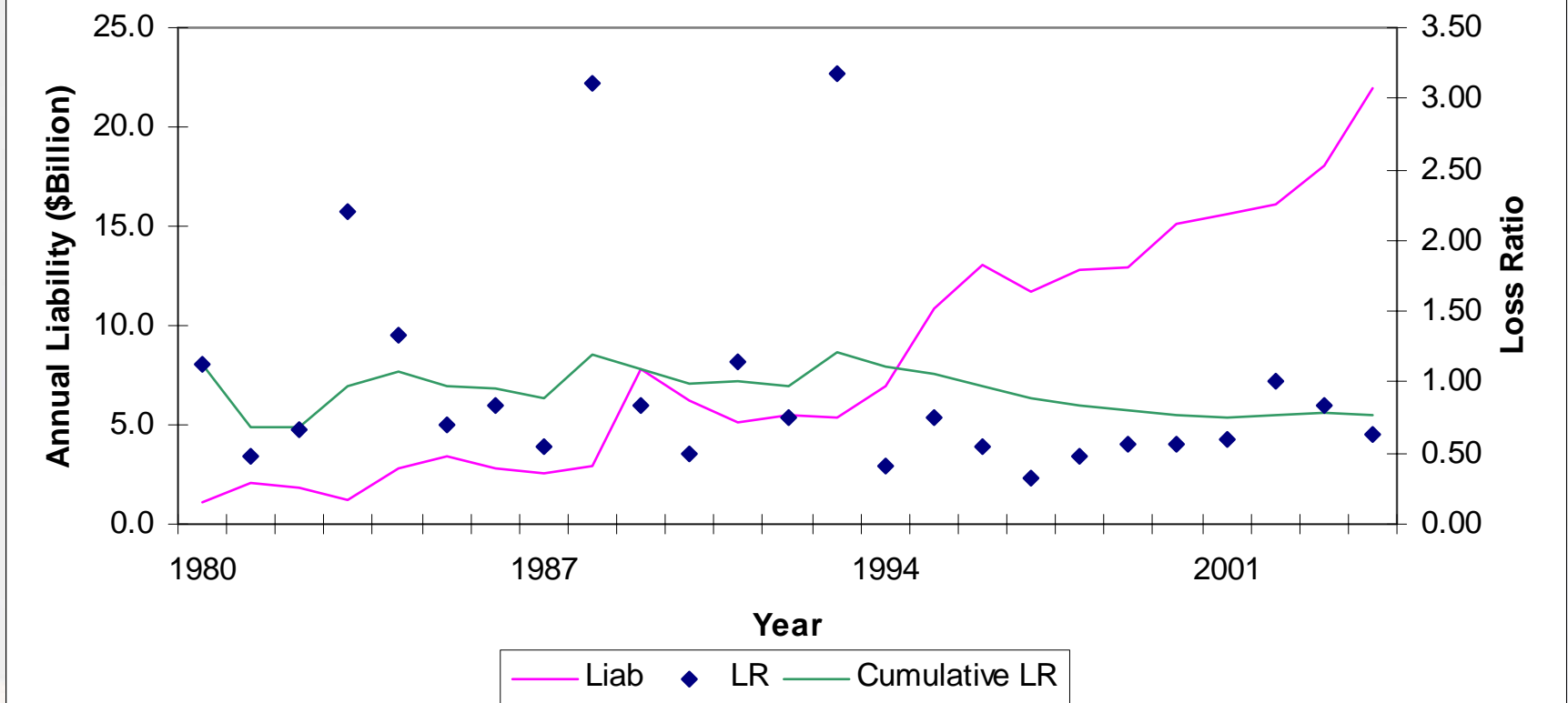
Region	States
Corn Belt	IL, IN, IA, MI, MN, MO, NE, OH, WI
Great Plains	KS, ND, OK, SD, TX
Northeast	CT, DE, MD, ME, MA, NH, NJ, NY, PA, RI, VT, WV
Northwest	ID, OR, WA
Pacific	AK, HI
Mountain	CO, MT, WY
Southeast	AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA
Southwest	AZ, CA, NV, NM, UT

MPCI: Countrywide Liability and Loss Ratios



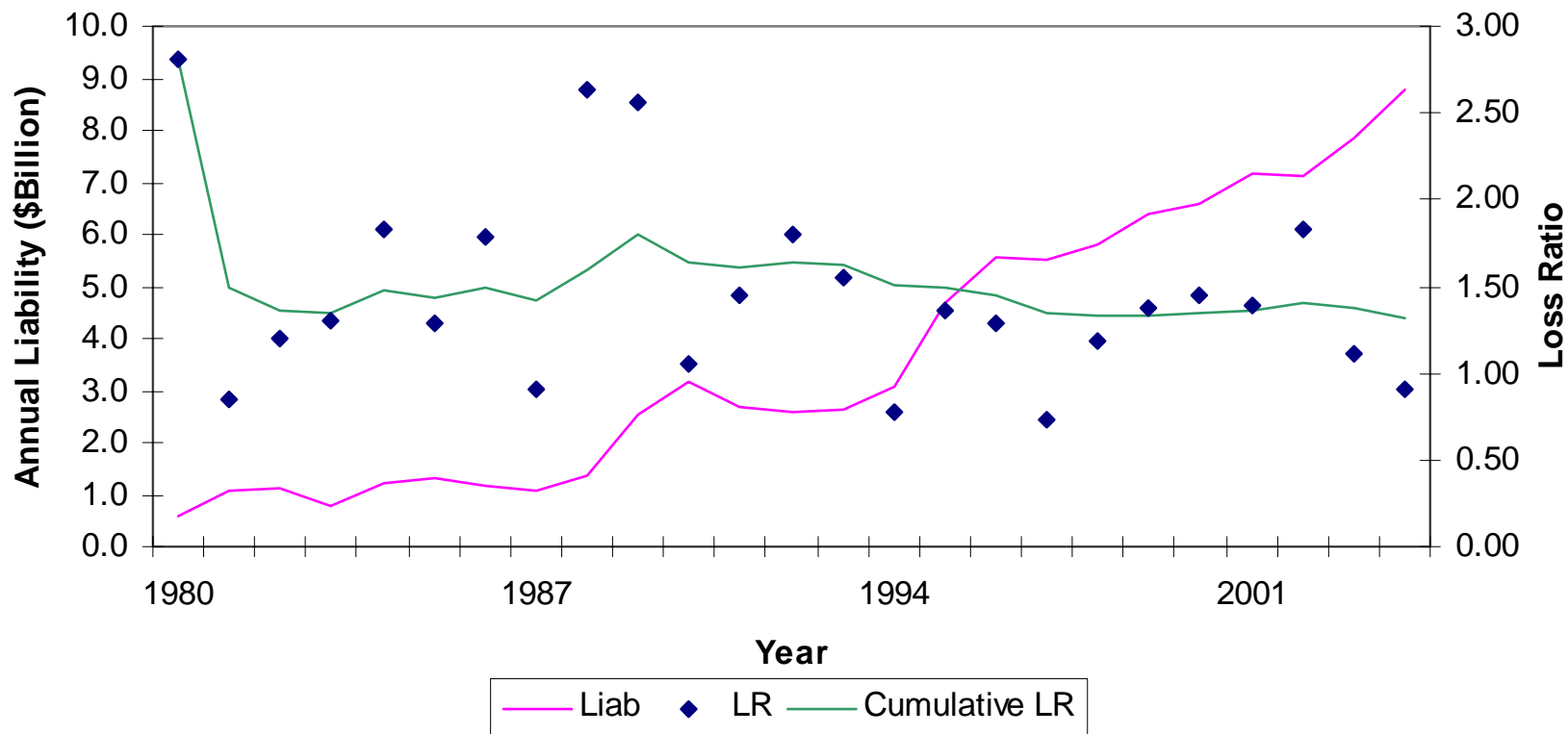
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Corn Belt Liability and Loss Ratios



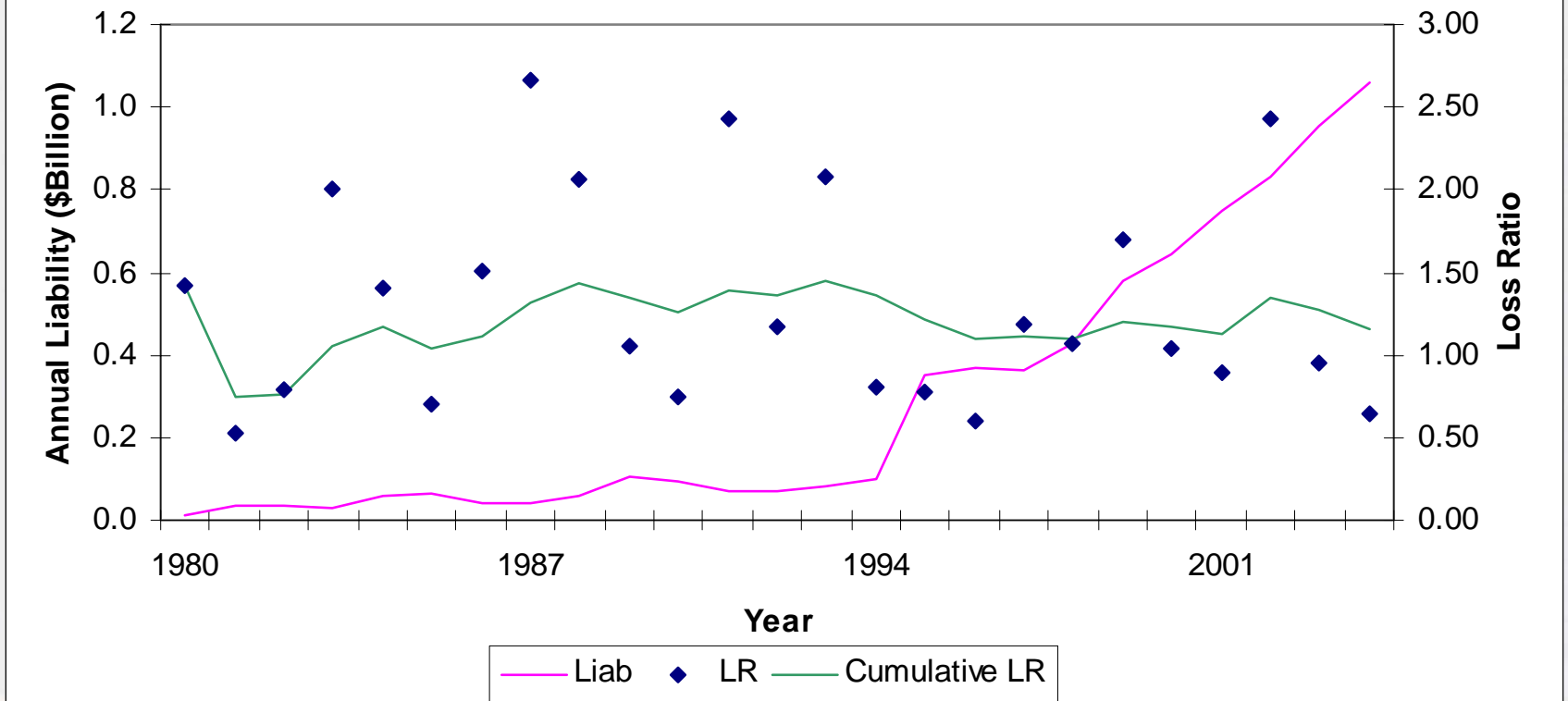
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Great Plains States Liability and Loss Ratios



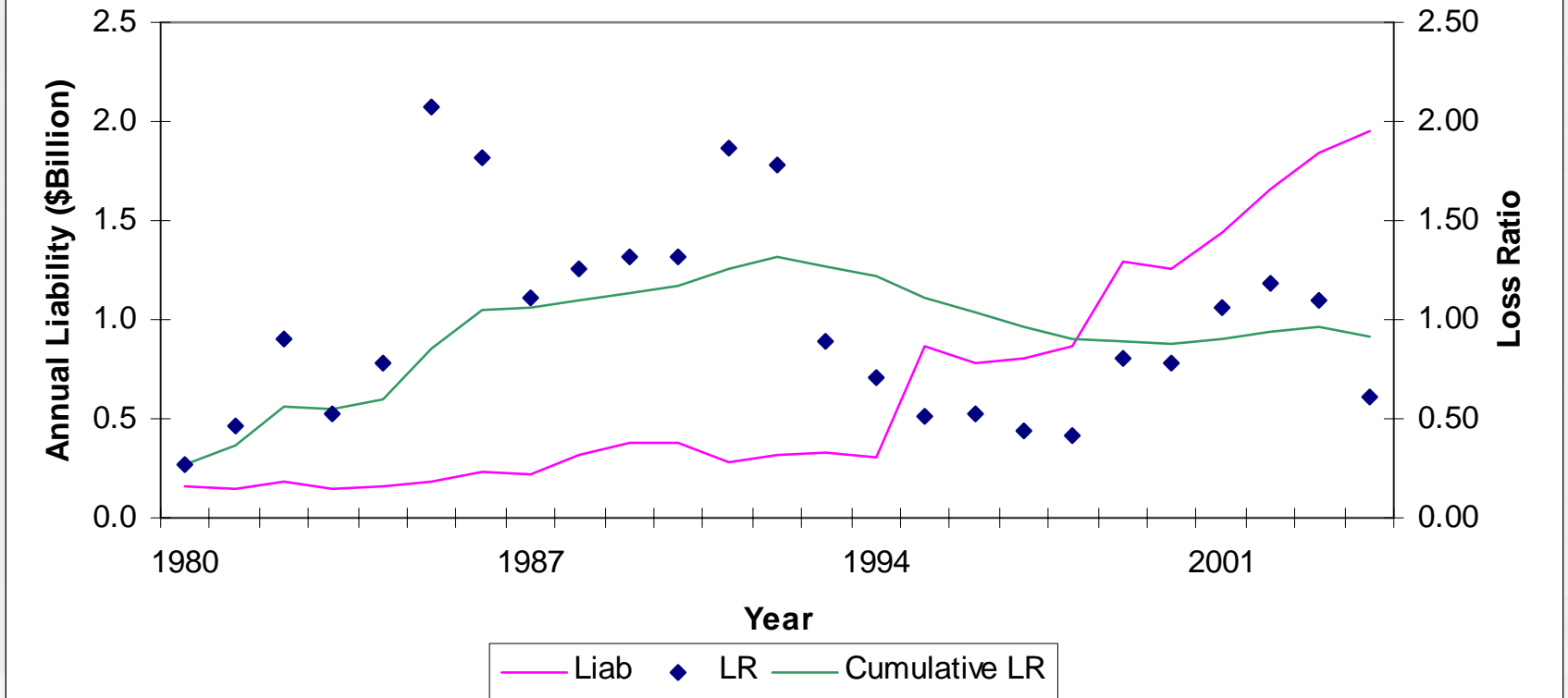
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Northeastern States Liability and Loss Ratios



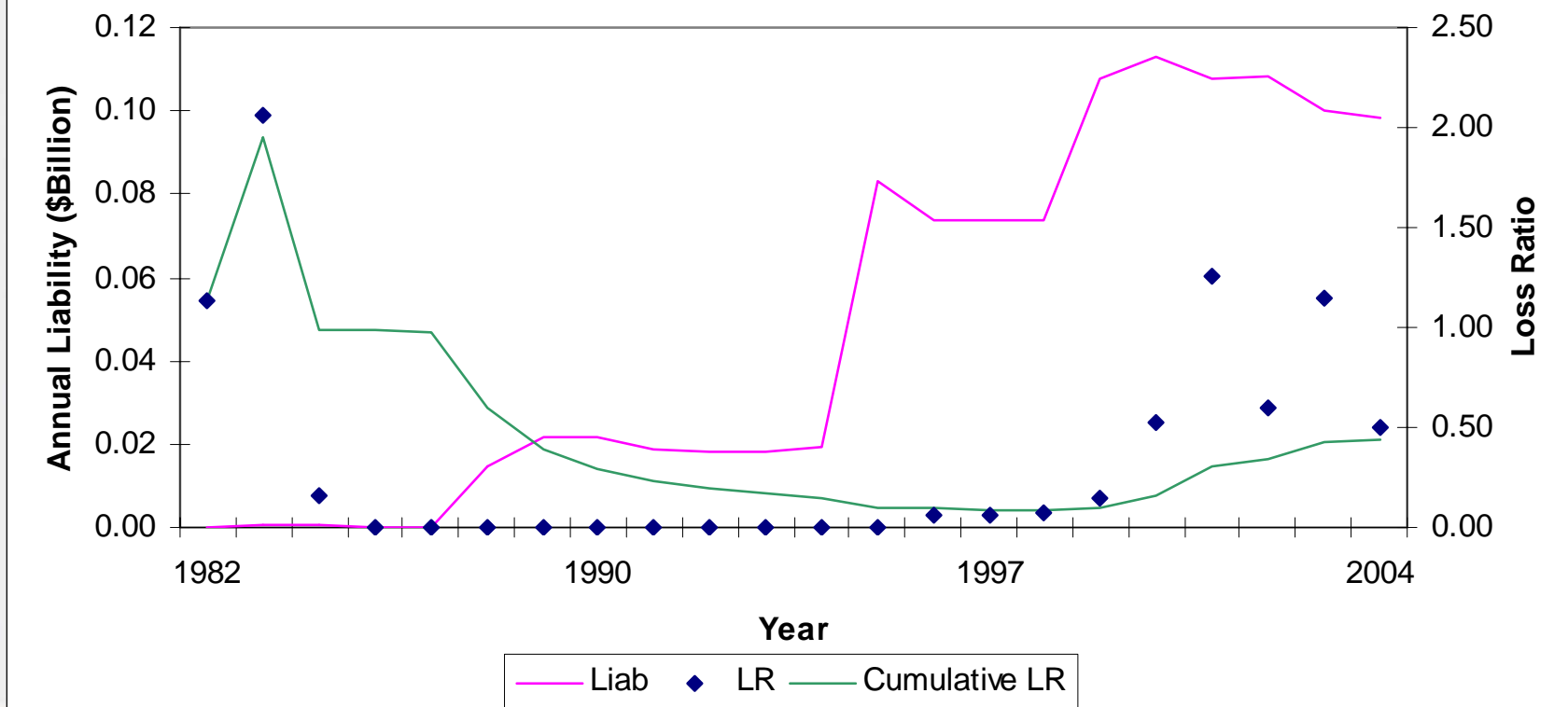
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Northwestern States Liability and Loss Ratios



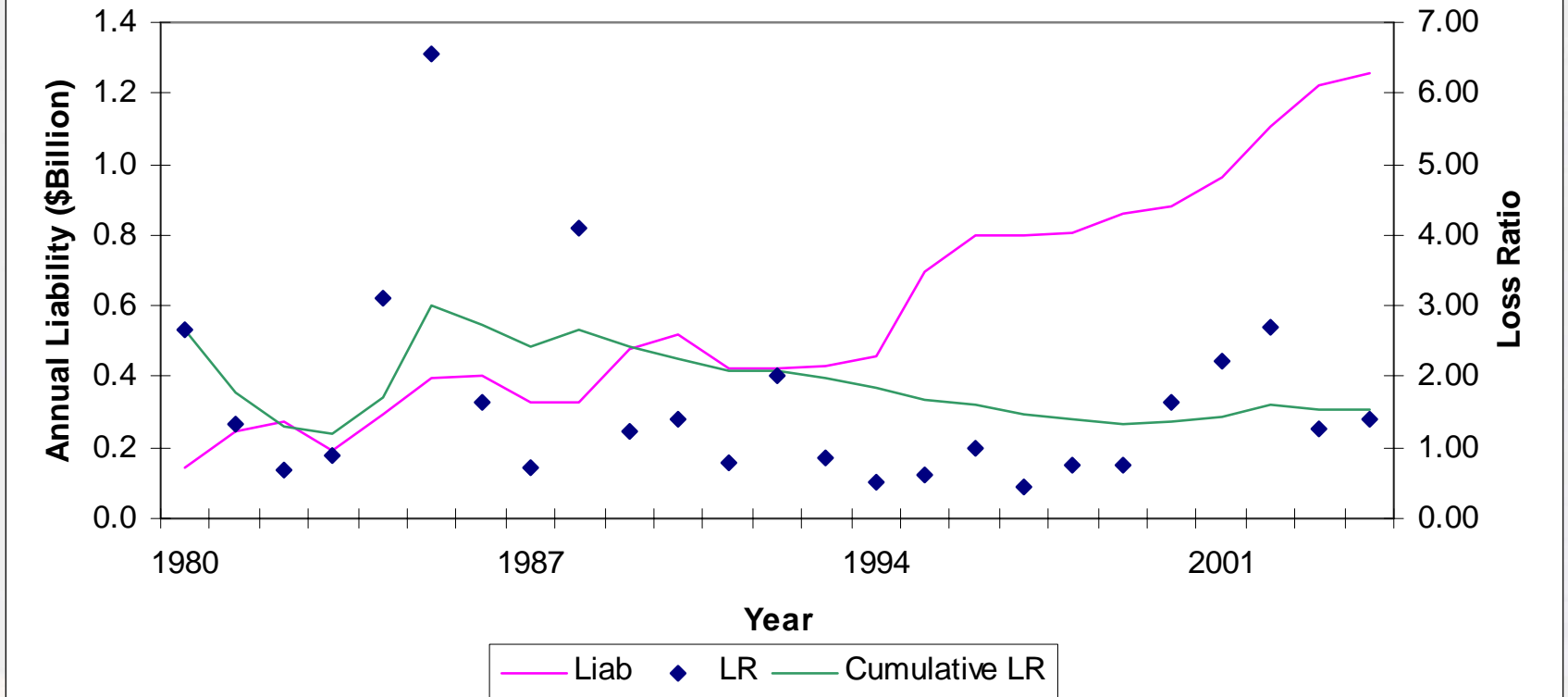
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Pacific States Liability and Loss Ratios



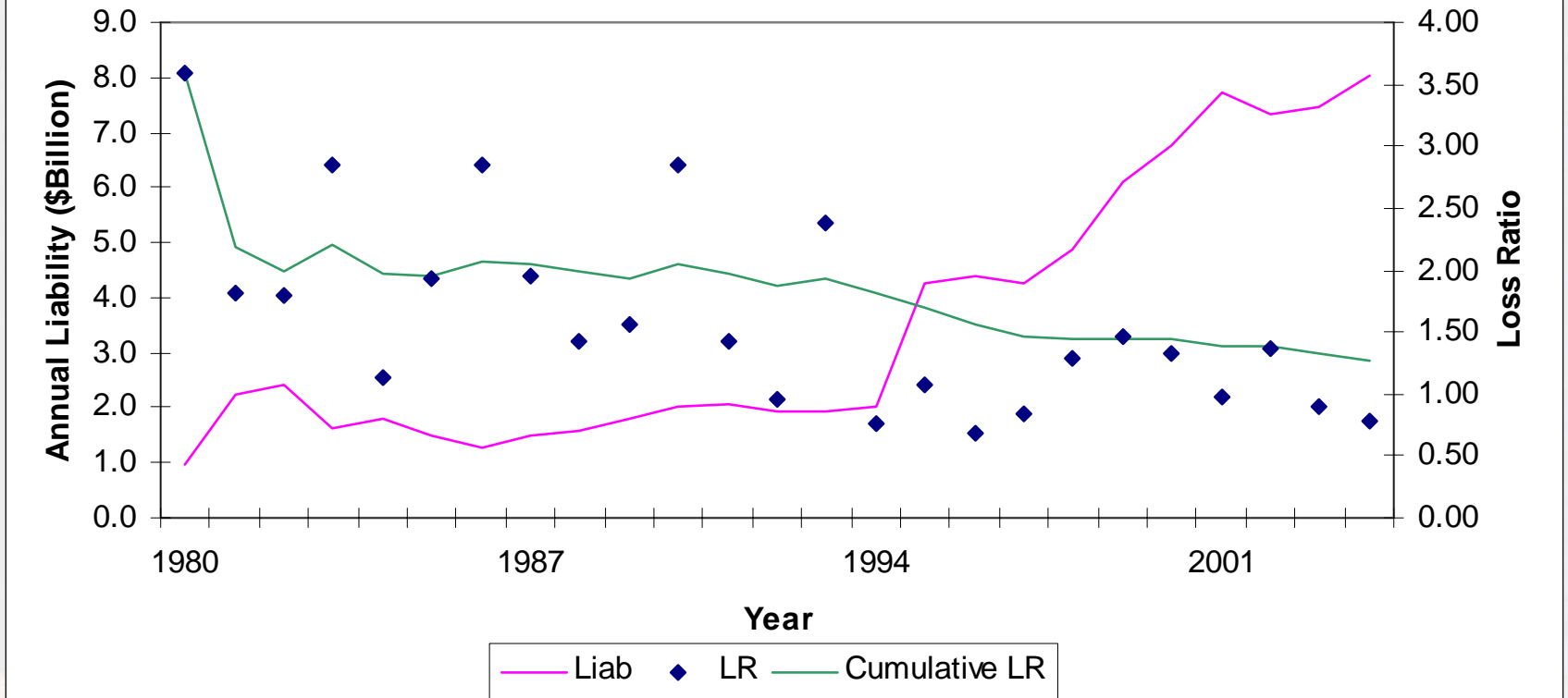
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Mountain States Liability and Loss Ratios



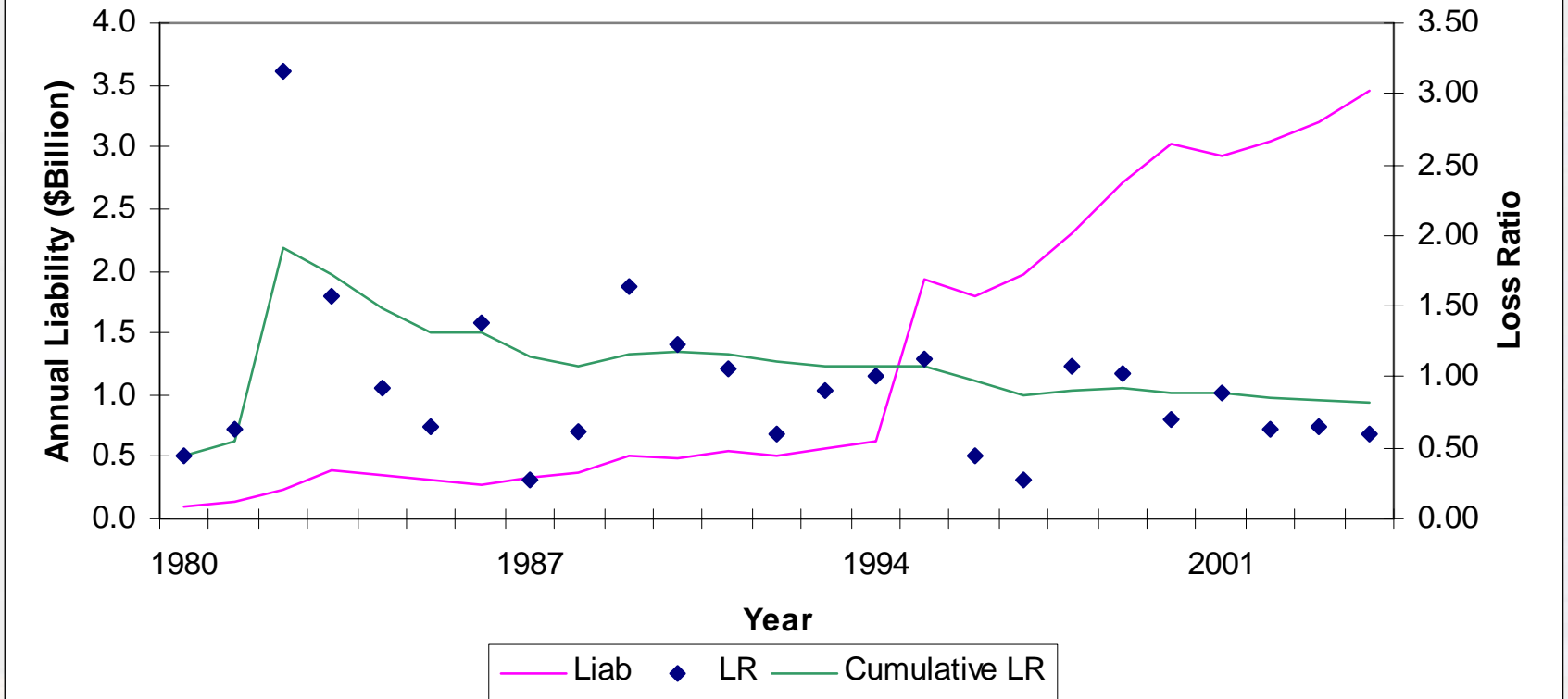
Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Southeastern States Liability and Loss Ratios



Source: Summary of Business Tables
As of Oct. 31, 2005

MPCI: Southwestern States Liability and Loss Ratios



Source: Summary of Business Tables
As of Oct. 31, 2005

Insurance Company/Insurer Perspective

Goals of the Insurer

- Earn a profit
- Meet customer needs
- Comply with legal requirements
- Fulfill duty to society

For this presentation, focus is actuarial and underwriting tools of the insurer. Some consideration of business operation.

Source:

Myhr, A.E. and J.J. Markham, “Insurance Operations, Regulations, and Statutory Accounting.” American Institute for Chartered Property Casualty Underwriters/ Insurance Institute of America. 2003.

Climate Science Program Framework

Core Approaches

1. Research: Plan, sponsor, and study changes in climate and related systems.
2. Observations: Enhance observation and data management systems for a comprehensive set of variables needed for research on changes in climate and related systems.
3. Decision support: Develop improved science-based decision support resources.
4. Communications: Communicate results to domestic and international scientific and stakeholder communities stressing openness and transparency.

Source: Climate Change Science Program Strategic Plan:
(<http://climatescience.gov/Library/stratplan2003/final/ccspstratplan2003-execsum.pdf>)

Climate Science Program Framework Cont.

- Climate Change Science Program can be viewed as a Public Good.
- Public Good: Good or service that can be consumed simultaneously by everyone and from which no one can be excluded.
(www.econ100.com/eu5e/open/glossary.html)
- Consequently, the benefits/information from climate science are essentially available to both insurer and the insured.

Underwriting Considerations

Underwriting: The process of determining what loss exposures will be insured, for what amount of insurance, at what price, and under what conditions. (Myhr and Markham)

Crop Insurance Applications

- Loss Exposures: what Crops to insure in which regions.
- Amount of insurance: generally dollars per acre of coverage and associated deductibles.
- Price: premium rate charged to the farmer.
- Conditions: terms of the policy, farmer's responsibility – planting and harvesting dates, cultural practices, etc.



2005 NCIS Crop Research



Corn in IL & NE

- Looking at:

- Effects of defoliation during the reproductive stages on newer transgenic hybrids versus traditional hybrids.
- Four levels of defoliation (0, 33, 66, and 100%) at two stages of crop development (R-1 {silking}, and R-3 {milk}).
- Treatments applied on four different hybrids.



Actuarial Considerations

The primary goal of ratemaking is to develop a rate structure that enables the insurer to compete effectively while earning reasonable profit on its operations.

Ratemaking Criteria

- Be Stable
- Be Responsive
- Provide for Contingencies
- Promote Loss Control
- Be Simple

Source: Myhr and Markham

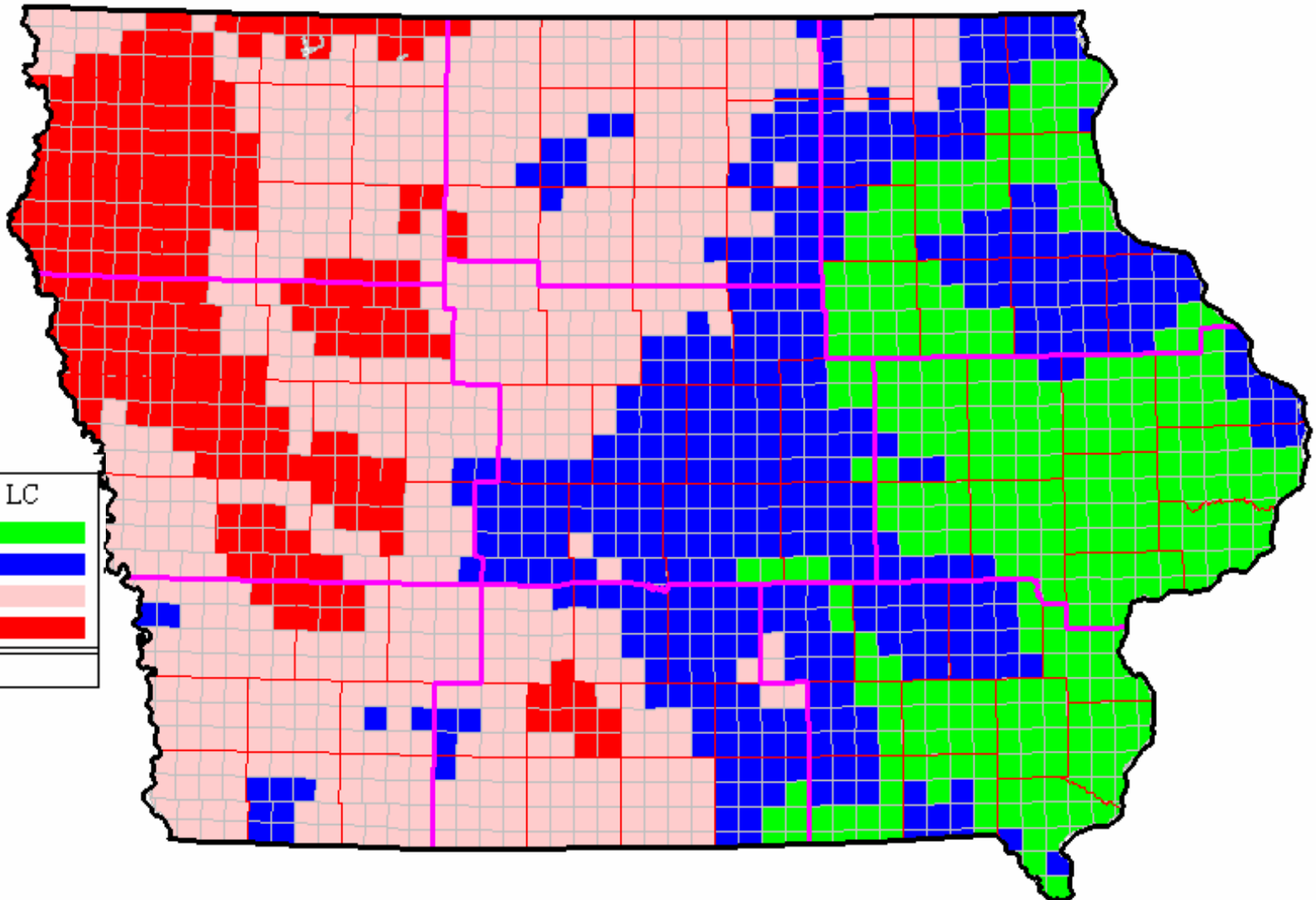
Actuarial Considerations Cont.

- In the mainstream Property Casualty Industry \$1.00 of premium is approximately 35 – 40% expenses and profit loading; the remainder 60 – 65% is allocated for expected losses.
- Thus, loss estimates, or loss statistics represent well over half the price of the insurance product.
- Federally supported crop insurance premium does not directly include an expense and profit load.
- Thus, MPCCI premium represents 100% annual expected losses for the program.
- Currently, this is about \$4 billion annually.

Actuarial Considerations Cont.

- Expected Losses = Frequency * Severity
- Frequency typically estimated using publicly available historical weather time series data.
- Severity measure incorporate insurance liability measures combined with engineering estimates.
- Property Casualty Insurers currently use sophisticated weather simulation technology.
- Crop Insurance Product Development utilizes both historical crop insurance experience and weather modeling.
- Spatial statistical and econometric techniques in combination with actuarial credibility and Bayesian methods are not uncommon.

Expected Loss Cost for Iowa Corn (1948-2004)



Expected LC

[0.00 - 0.50]	Green
(0.50 - 1.00]	Blue
(1.00 - 2.00]	Pink
(2.00 - 3.50]	Red

NCIS 2000 - 2004

Impacts of Climate Science on Associated Technologies

Improvements in Geographic Information Systems

GIS: Better automated mapping and overlay technology, both actuarial and underwriting impacts.

Improvements in Geographic Positioning Systems

GPS: Precision farming, loss mitigation, more efficient claims processing.

More obvious short run impacts on underwriting

Long run impacts on rates and premium

Conclusion

- Crop Insurer's demand for climate science information will be a derived demand via the farmer's risk management choices.
- This derived demand will have direct and indirect linkages in the process of insurance company operations.

Conclusion Cont.

- Insurance Company Operational Linkages.
- Actuarial: Fairly direct linkage in terms of improved frequency and severity modeling processes.
- Underwriting: Indirect link via crop science technology and agronomic response to climate change, resulting in modification of insurance policy and conditions of insurability.
- Business Processes: Adoption of related climate-science “spin-off” technologies such as GIS and GPS for improved claims handling and various quality control functions (fairly direct link).