Casualty Actuarial Society
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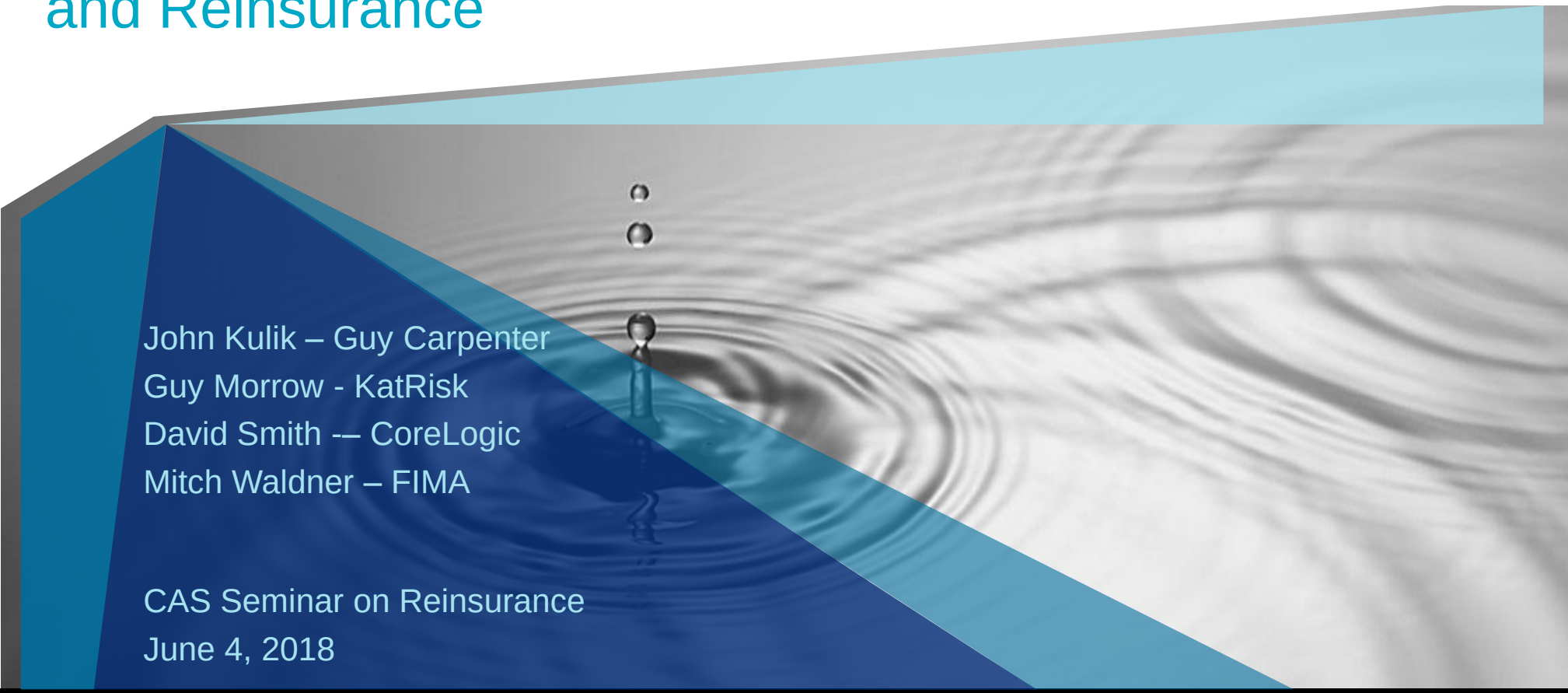
- The Casualty Actuarial Society is committed to adhering strictly to the letter and spirit of the antitrust laws. Seminars conducted under the auspices of the CAS are designed solely to provide a forum for the expression of various points of view on topics described in the programs or agendas for such meetings.
- Under no circumstances shall CAS seminars be used as a means for competing companies or firms to reach any understanding – expressed or implied – that restricts competition or in any way impairs the ability of members to exercise independent business judgment regarding matters affecting competition.
- It is the responsibility of all seminar participants to be aware of antitrust regulations, to prevent any written or verbal discussions that appear to violate these laws, and to adhere in every respect to the CAS antitrust compliance policy.

GUY CARPENTER

FEMA

NATIONAL FLOOD INSURANCE PROGRAM

US Flood Insurance:
Latest Developments in US Flood Modeling, Rating, and Reinsurance



John Kulik – Guy Carpenter
Guy Morrow - KatRisk
David Smith -– CoreLogic
Mitch Waldner – FIMA

CAS Seminar on Reinsurance
June 4, 2018

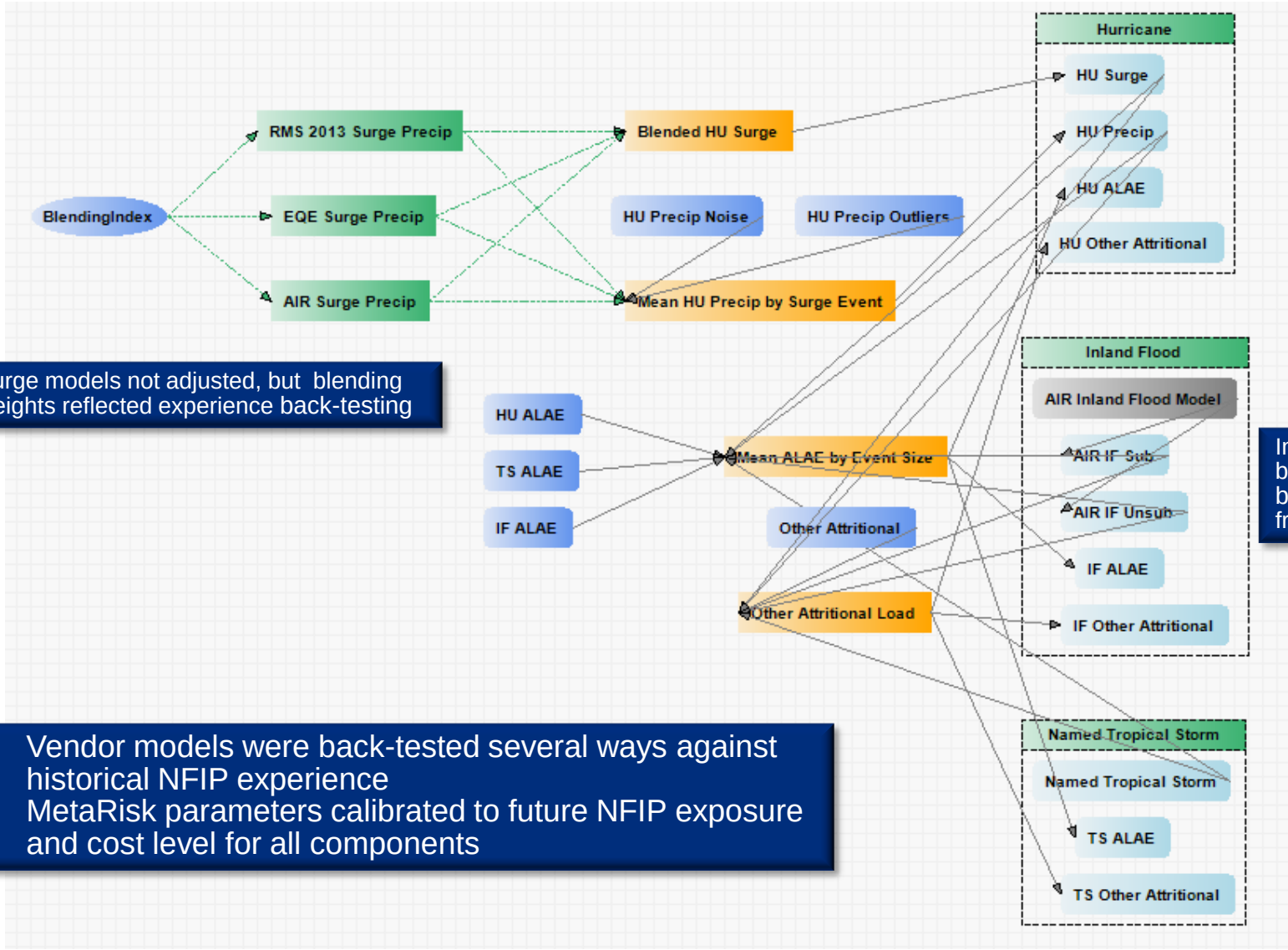
MARSH & McLENNAN COMPANIES

OUTLINE

LOSS MODELING

- Ensemble Model: NFIP View of Risk and Components
- Model Output by Sub-Peril
- Estimation of Non-Modeled Loss Distributions

NFIP Ensemble Loss and ALAE Model
By Sub-Peril and All Combined

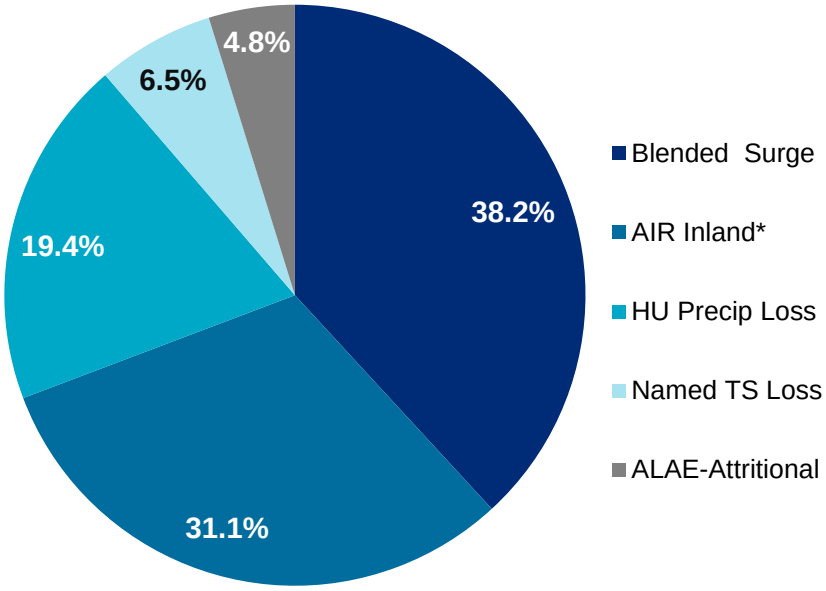


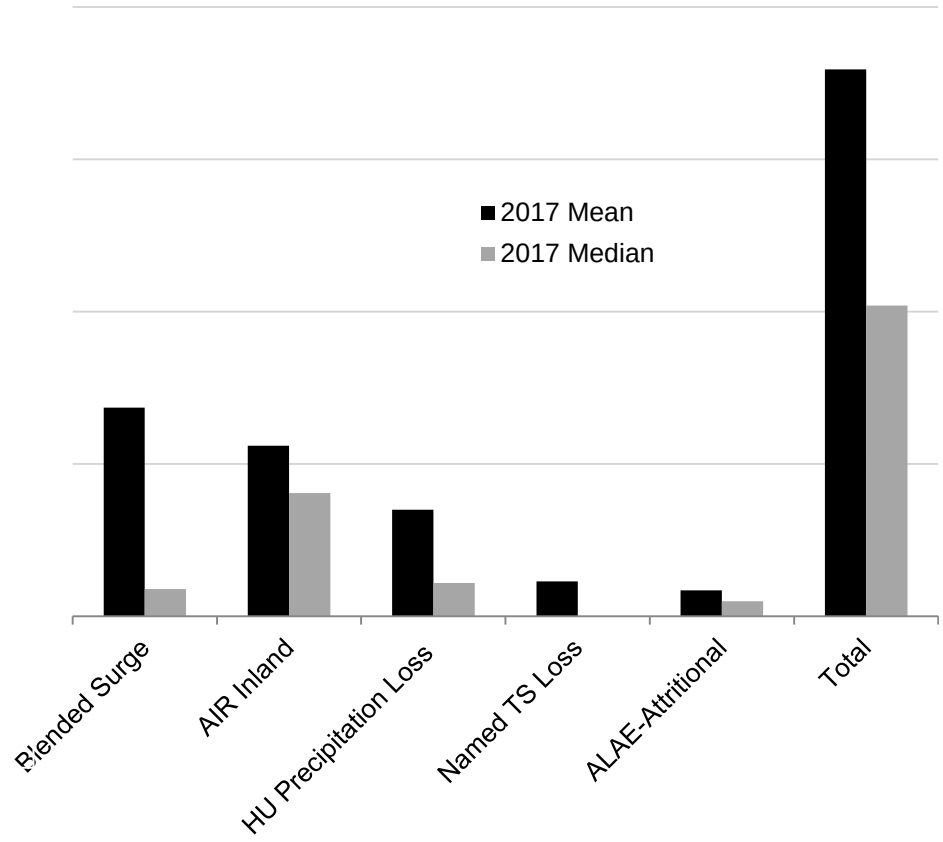
- Vendor models were back-tested several ways against historical NFIP experience
- MetaRisk parameters calibrated to future NFIP exposure and cost level for all components

NFIP Ensemble Model
Output by Sub-Peril and All Combined

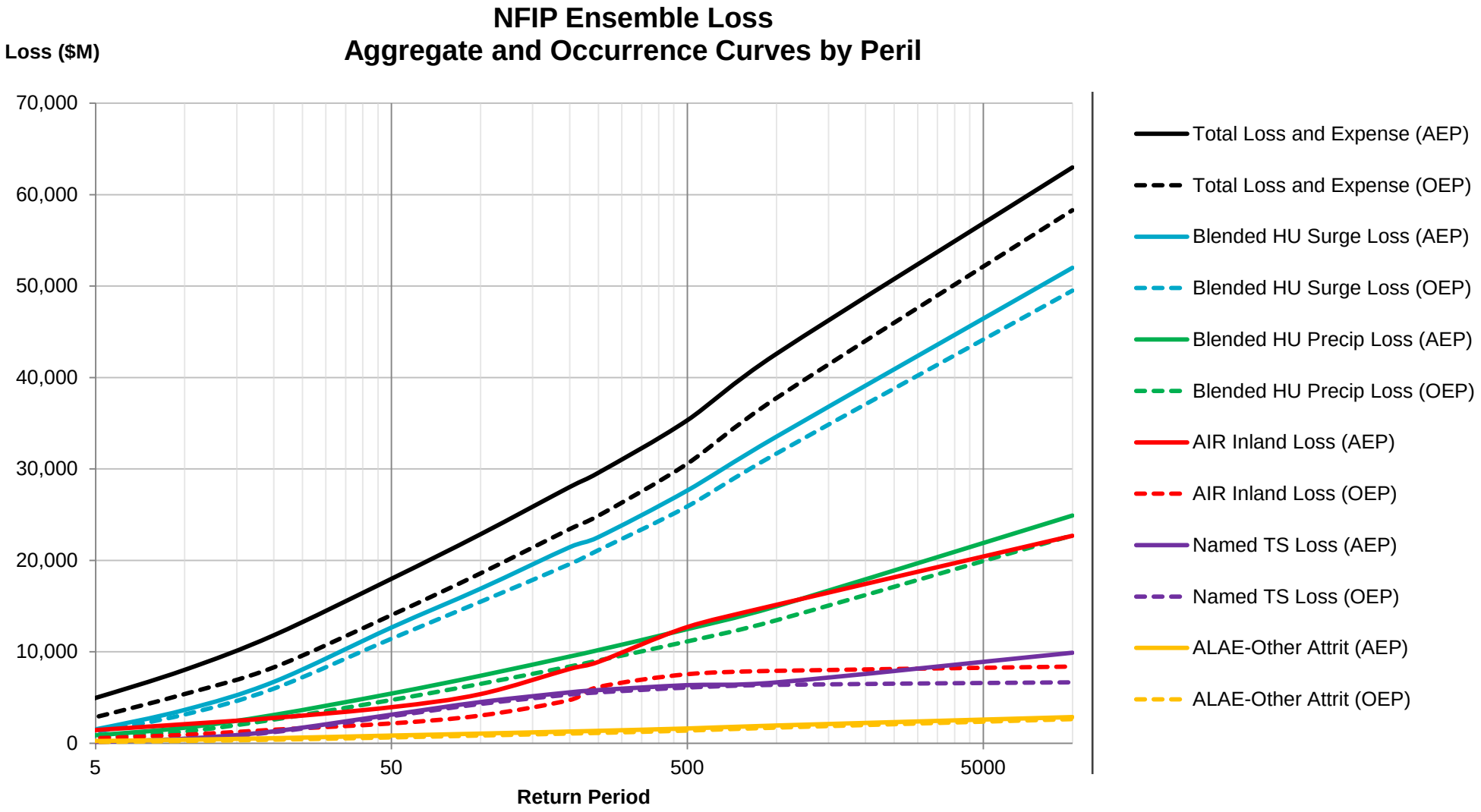
- model output reflects final weightings, adjustments, and recalibrations updated in 2016
  - *remains a "work in progress" as US flood modeling continues to develop and improve*
  - *new US flood models have more recently been introduced by KatRisk and CoreLogic*

Contribution to NFIP Ensemble Gross AAL



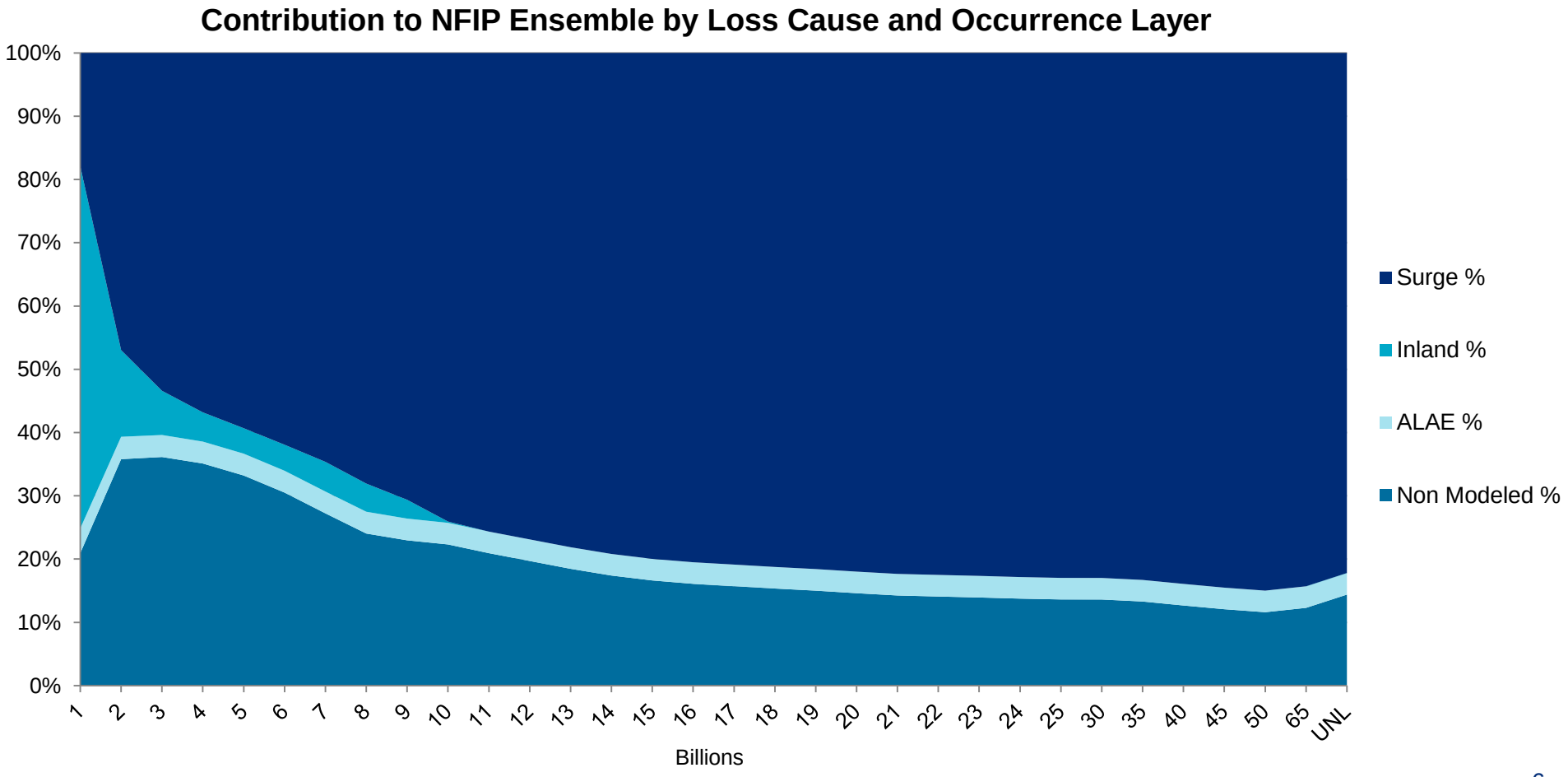


NFIP Ensemble Model
AEP and OEP Output by Sub-Peril and Combined



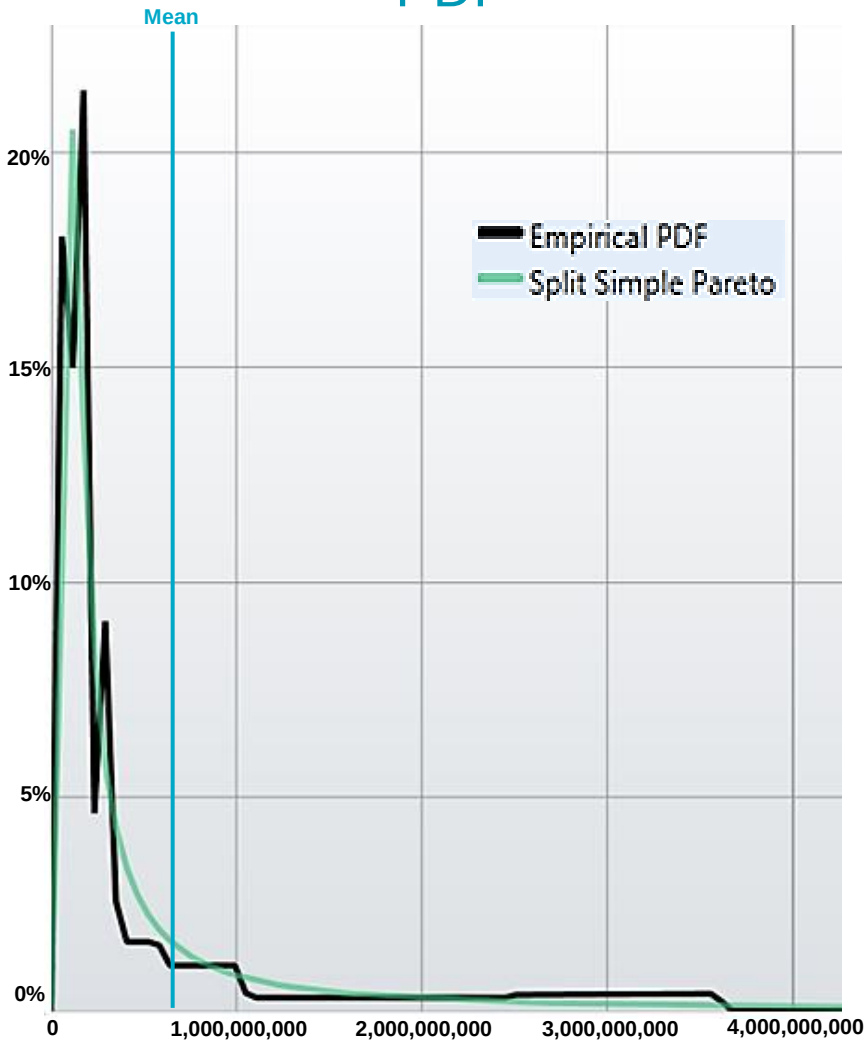
NFIP Ensemble Model
By Peril and Incremental Occurrence Layers

- inland and non-modeled exposure diminish significantly as occurrence layer attachment increases
- thus beyond lower attachments, occurrence layers can be more confidently priced in the near term



Non-Modeled Perils – Loss Estimation
NFIP Named Tropical Storm – Fitted Severity

PDF



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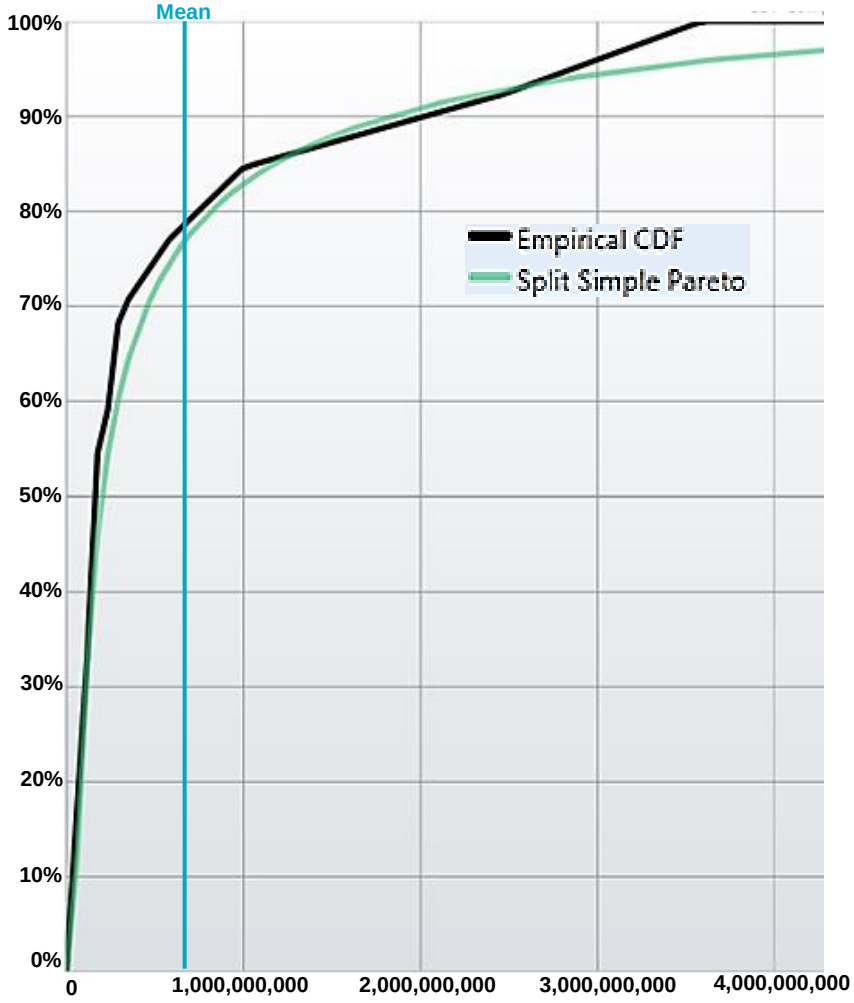
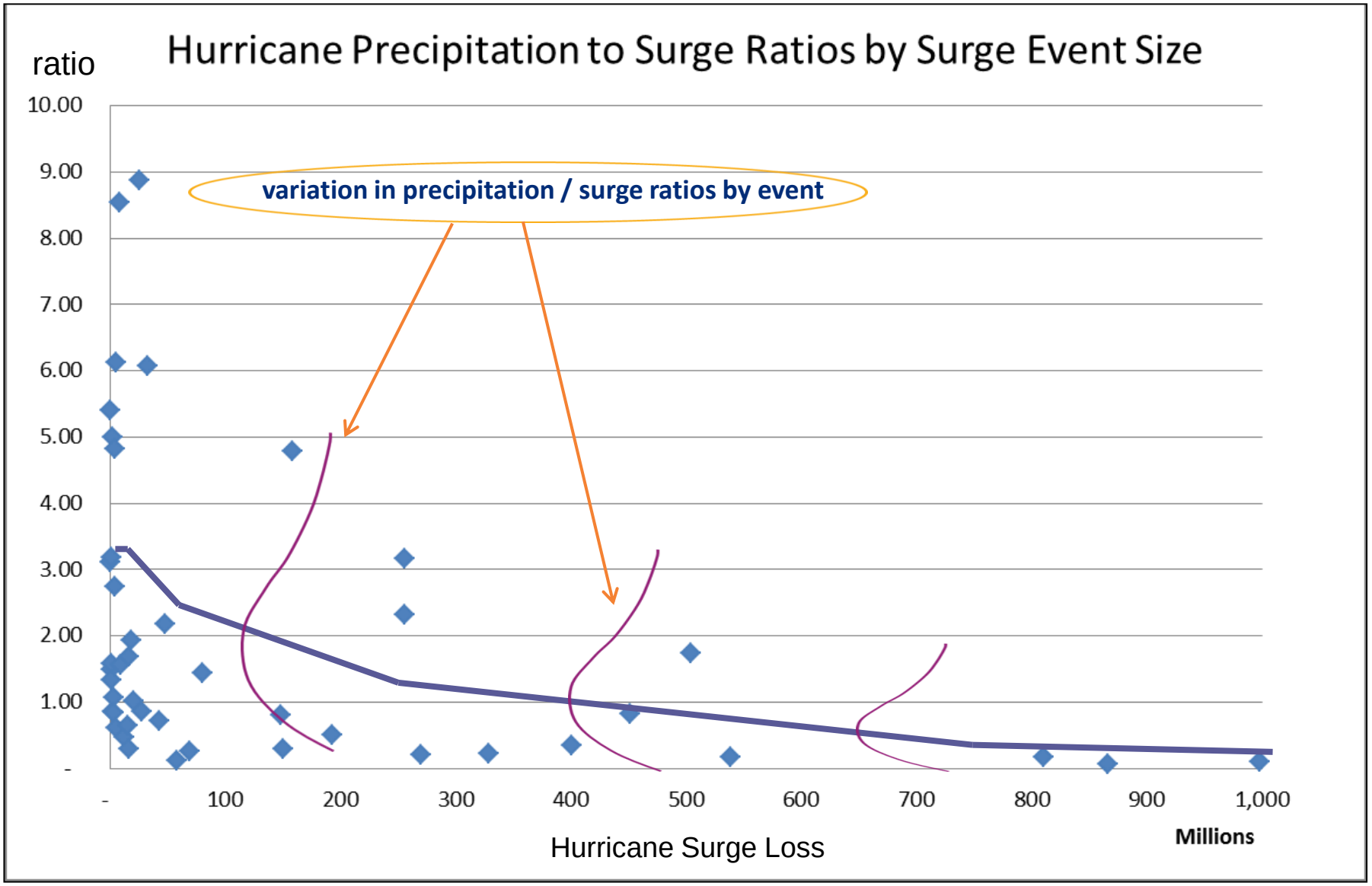


Non-Modeled Perils – Loss Estimation
NFIP Hurricane Precipitation



NFIP Hurricane Precipitation – Loss Estimation
Loading for Precipitation Outlier Hurricane Events

- Data in previous exhibit excluded a few outlier events with very large precipitation ratios
  - *the few outlier ratios fall significantly above the piecewise linear curve*
  - *thus the average lognormal mean is understated and requires a loading for outliers*

- To address the outliers, a multiplier to the means is generated stochastically by event
  - *Default multiplier = 1.0 is applicable the vast majority of the time*
  - *Surge loss to which the stochastic multiplier is applied is capped based on history*

- Harvey is the first hurricane precipitation outlier since the historical data that was used

- Harvey did not significantly change the indicated outlier frequency
  - *thus the original formula and parameters are still basically valid*

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This report is not intended to be a complete actuarial communication. Upon request, we can prepare one. We are available to respond to questions regarding our analysis.

There are many limitations on actuarial analyses, including uncertainty in the estimates and reliance on data. We will provide additional information regarding these limitations upon request.

As with any actuarial analysis, the results presented herein are subject to significant variability. While these estimates represent our best professional judgment, it is probable that the actual results will differ from those projected. The degree of such variability could be substantial and could be in either direction from our estimates.

The estimated cash flows may vary significantly from amounts actually collected, particularly in the event that a reinsurer is unwilling or unable to perform in accordance with the terms of the reinsurance contract.

In performing this analysis, we relied on FEMA for historical NFIP claims data, current financial data and information, and information and assumptions regarding future NFIP revenue and expense levels. We did not perform an independent review of these estimates.

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In performing this analysis, we relied on AIR for estimates regarding claim inflation and exposure trend of historical NFIP claims and exposures to current cost and exposure levels, as well as the amount of historical NFIP losses for subperils for which their current software models do not provide estimates. We did not perform an independent review of these estimates.

In performing this analysis, we relied on Moody's for estimates regarding economic scenarios of future interest rates and inflation rates. We did not perform an independent review of these estimates.

The results in this report are generated with software models provided by Risk Management Solutions, Inc.
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