



**CATASTROPHE MODEL BLENDING:  
PRACTICALITIES  
*VIGNETTES FROM THE 2012 GIRO PAPER***

**ASTIN Colloquium**

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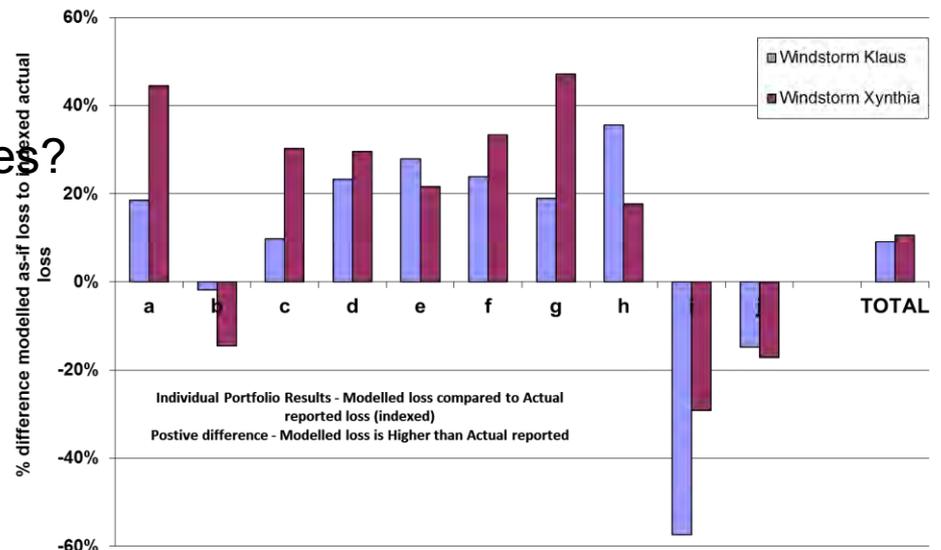
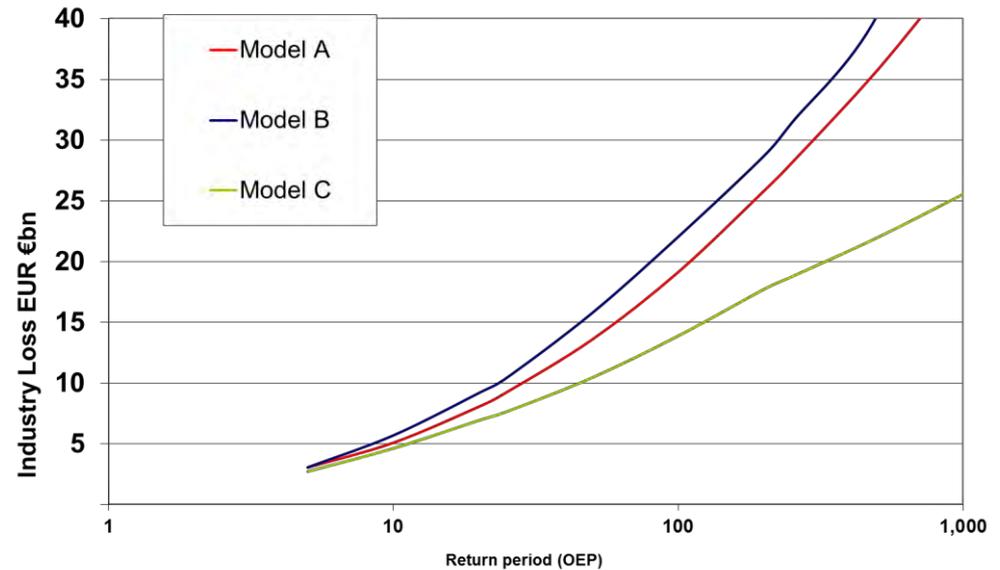
# 1. MOTIVATING CATASTROPHE MODEL BLENDING

- Significant Impact of Catastrophe Models since the 1990s
- Used to calculate expected losses for pricing contracts
- Used to calculate overall levels of accumulation of several risks to a given peril or all perils:
  - Reporting of loss percentiles
  - ELT/YLTs fed to stochastic capital models
- However significant degree of uncertainty associated with their use
  - Poor perception of accuracy
  - A still evolving science



# 1. MOTIVATING CATASTROPHE MODEL BLENDING

- Single v Multiple model use
- Rating agency view
- Actuarial based view
- Model revisions
  
- Model validation
- Own view of risk
- Harness underwriting perspectives?
  
- Blending of views





## 2. FREQUENCY AND SEVERITY BLENDS

- See Ian Cook's slides from 2011 Catastrophe seminar in the UK
- The “Common Approach” is where we average by return period
  - We call it “severity blending” in the paper, following Guy Carpenter's December 2011 report on Managing Catastrophe Uncertainty
  - Model A gives 200 for the 1 in 100 year return period, and Model B gives 300, then the “50-50” severity blend for the 1 in 100 year would be 250
- The “Alternative Approach” is where we average by loss amounts
  - In the paper, this is “frequency blending”
  - Model A gives 1% of EP for loss amount of 200, and Model B gives 2%, then the “50-50” frequency blend for the loss amount of 200 would be 1.5%
  - Cook gives two ways of doing so – we follow the simulation approach, which is very common in climate modelling, where it is known as Multimodel Ensemble Models.
- You need to be very lucky for the two blends to give you equal answers!
- Both have pros and cons: *Frequency Blending* is the better approach for accumulating catastrophe exposures



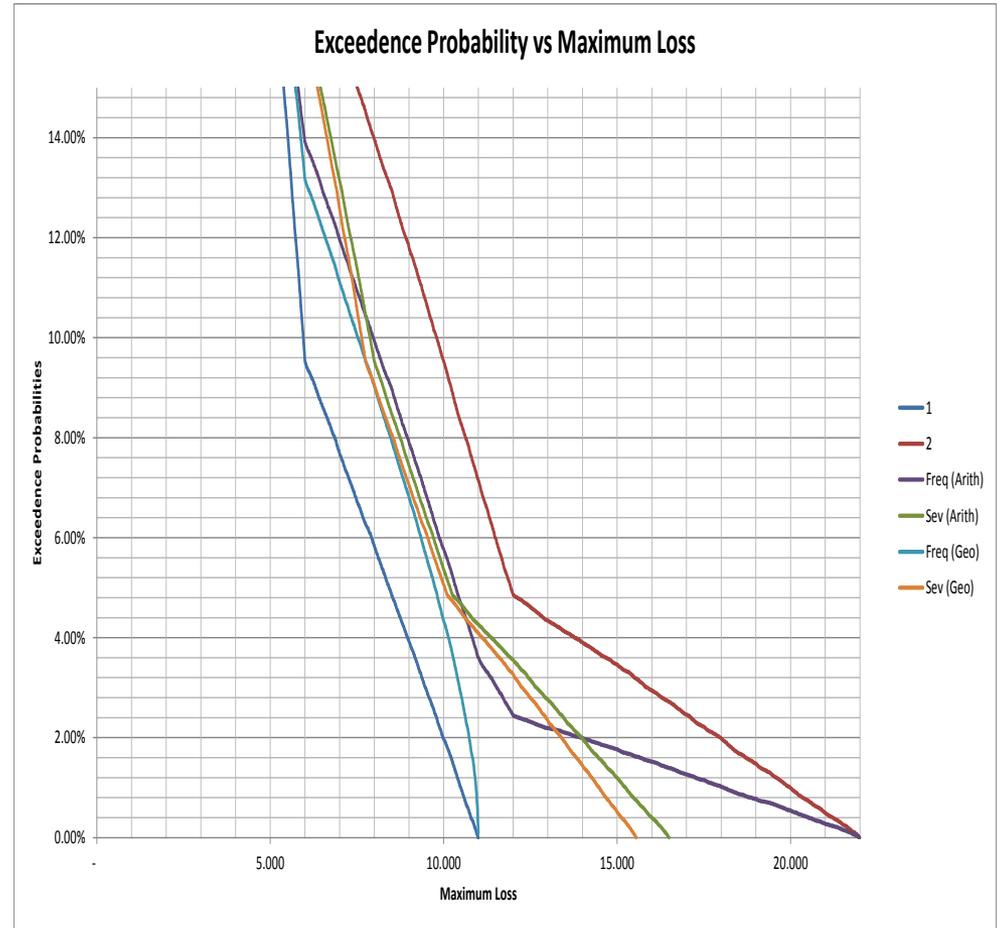
## 2. FREQUENCY BLENDING IS BETTER

- Frequency Blending is better for catastrophe exposure accumulations for the following reasons
  - It is consistent with the typical practice in pricing of taking (weighted) averages of model expected loss outputs
  - It gives event sets for accumulation, helping to blend dependencies and clashes between portfolios
  - Event sets helps with modelling of reinsurance recoveries and reinstatement premiums
  - Operationally, the blended outputs can be fed direct into stochastic capital models
  - For communication, it allows richer interpretation of regards to uncertainty
  - It (or at least one version of it – see next slide!) has the ability to attain the higher model outputs in the tail
- Possibly the key downside of frequency blending is difficulties of doing back-of-envelope calculations



## 2. WHAT IS A “50-50” BLEND?

- We need to qualify how the blend is produced
  - Frequency or severity blend?
  - Arithmetic or geometric average?
- We can get very different results!!





## 2. INCORPORATING UNCERTAINTY OR MANAGING ITS CONSEQUENCES

- Frequency blending: aims to incorporate uncertainty into the statistical modelling direct by simple Bayesian techniques
  - $P(X) = P(X|\text{Model A}).P(\text{Model A}) + P(X|\text{Model B}).P(\text{Model B}) + \dots$
  - The volatility (and hence, for example, capital allocations) would automatically be updated with our uncertainty between the models
- Severity blending: seems to try to manage the consequences of getting answers wrong
  - Suppose: Model A gives answer 100 and Model B gives answer 200, and both models are judged equally good
  - Then “true answer” can be argued to more likely lie above 100 than below, and more likely lie below 200 than above
  - So there is a good chance that the “true answer” lies between 100 and 200
  - Any estimate is almost certainly going to be wrong, but given the above, the mid point of 150 would be one that would not be so badly wrong when it is wrong
- NOTE: frequency blending is consistent with severity blending of AALs
  - When pricing with frequency blending, we are working with views simultaneously



## 2. BLENDING IS NOT A PANACEA

- Blending does not solve all our catastrophe modelling problems
  - Yes, it helps to bring in the thinking of more than one model
  - Yes, it helps us to be less reliant on some deficient features
  - But the component models need to be good in the first place!
- It reduces some epistemic and implementation uncertainty
  - Epistemic uncertainty: uncertainty from our lack of knowledge – can in principle be reduced by more data, better understanding of processes, etc.
  - Implementation uncertainty: uncertainty from the implementation of the models – e.g. uncertainty of interpretation of data, uncertainty introduced from practical implementation of scientific theory, etc.
- The more independent and different the modelling assumptions are, the more powerful frequency blending is
  - Data, interpretation of data, scientific theory
- Component models need to model the same things
  - E.g. the same regions and perils, the same secondary events



## 2. A STEP BY STEP GUIDE

- A key aim is to be able to accumulate and price consistently
- Event sets are derived by frequency blending
  - Monte Carlo simulations from Event Loss Tables (ELTs), giving the Year Event Table (YET)
  - The event sets act to hold exposures from different portfolios together, a little like copulas
- Portfolio losses are derived from the component models, possibly with adjustments
  - Bouncing the YET on ELTs to give Year Loss Tables (YLTs)
  - Pre adjustment: “standard agreed blend”
  - With adjustments: “bottom-up adjusted blend”
  - Two targetting algorithms for adjustments: one to adjust on specified parts of the OEP curve; one to adjust whole curve, based on AALs
  - Adjust on “pre treaty” losses
  - To incorporate experience and other portfolio-specific analyses



### 3. GOVERNANCE – STANDARD BLEND APPROACH

- Robust governance process is essential with Cat Models and Blending
- Standard agreed blend - Model validation process:
  - Extensive validation of models and parameters needed
  - Independent evidence to support selection and weights
  - Model change
  - Model Limitation's
- Sign off by governance committees
  - Balanced membership
  - Materiality principles



### 3. GOVERNANCE – “BOTTOM UP” VIEW

- Bottom up based view, adjust fixed blend to reflect/reconcile ‘account’ specific model differences
- More challenging than fixed view from a governance perspective
- Document rationale for adjustments
- Peer-review process essential
- Strategic review – monitor / review portfolio difference
- Essential to review and report multiple perspectives then determine if best rationale
- Acceptance by regulators / Solvency 2?



## 4. CONCLUSIONS

- Consideration of multiple models is important for a company with significant catastrophe exposures
  - Different models have different strengths and weaknesses
  - Where one model stands out as superior, then natural to deploy that model without blending
  - Where two or more models are judged to be significantly contributing to the estimations, then blending must be an option
  - There are technical and governance issues – we have considered both today
  - The proposed method of blending allows aggregation of judgement, informing governance

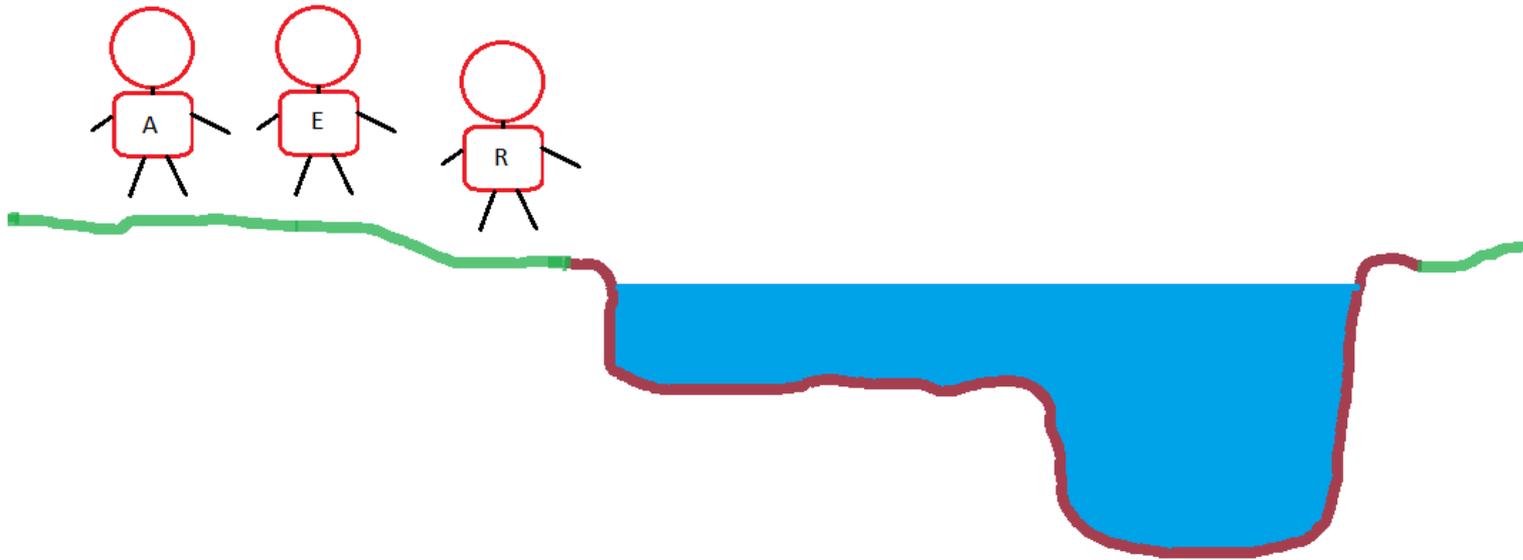


## 4. FINAL WORDS

- Domains of the component models
  - Need to be careful to avoid blending models that model different perils
  - Another pitfall is when having different blends in sub regions of a correlated zone
- Non-Modelled Perils
  - Secondary and inter-related perils
  - Perils with no available models
- Future Direction for Blending
  - Vendor model transparency
  - Understanding of different perils increases?
  - Component blending

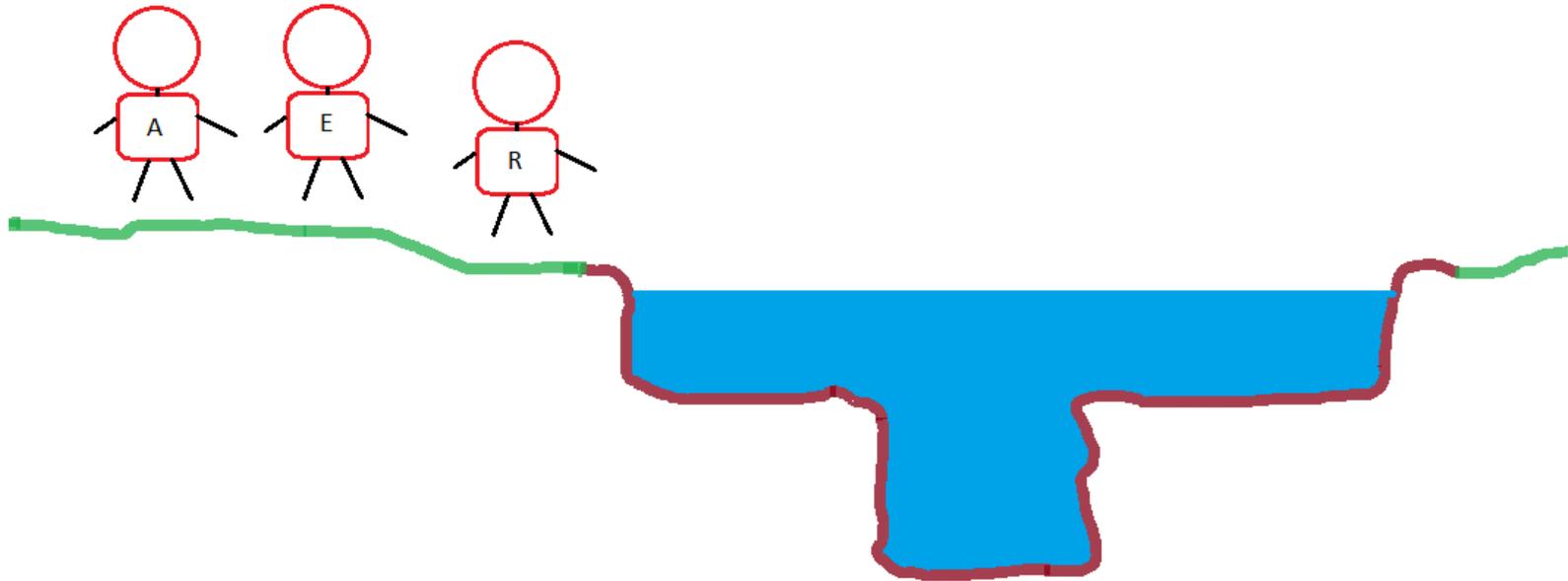


## 4. RIVER CROSSING EXAMPLE – PURE MODEL R



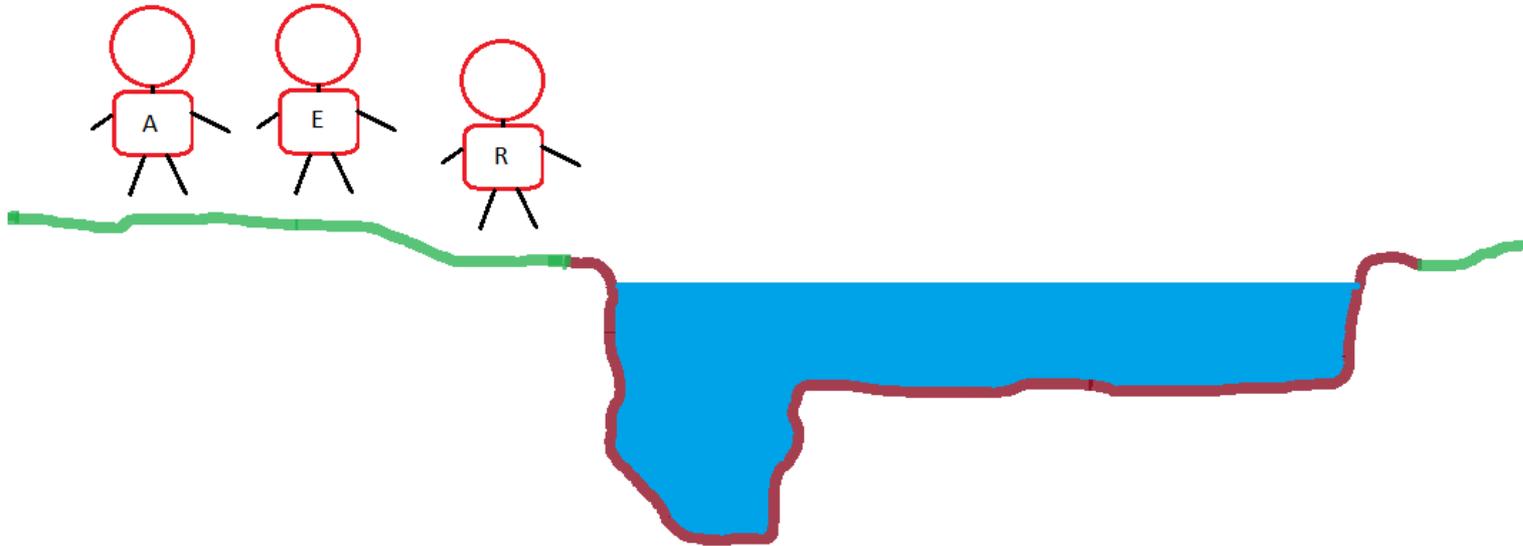


## 4. RIVER CROSSING EXAMPLE – PURE MODEL E



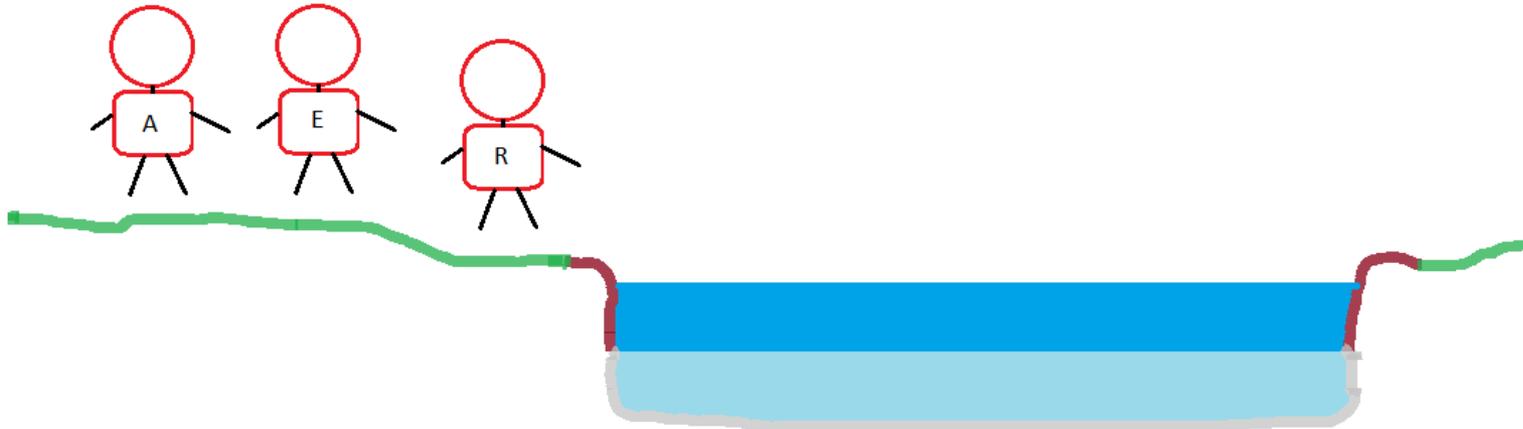


## 4. RIVER CROSSING EXAMPLE – PURE MODEL A



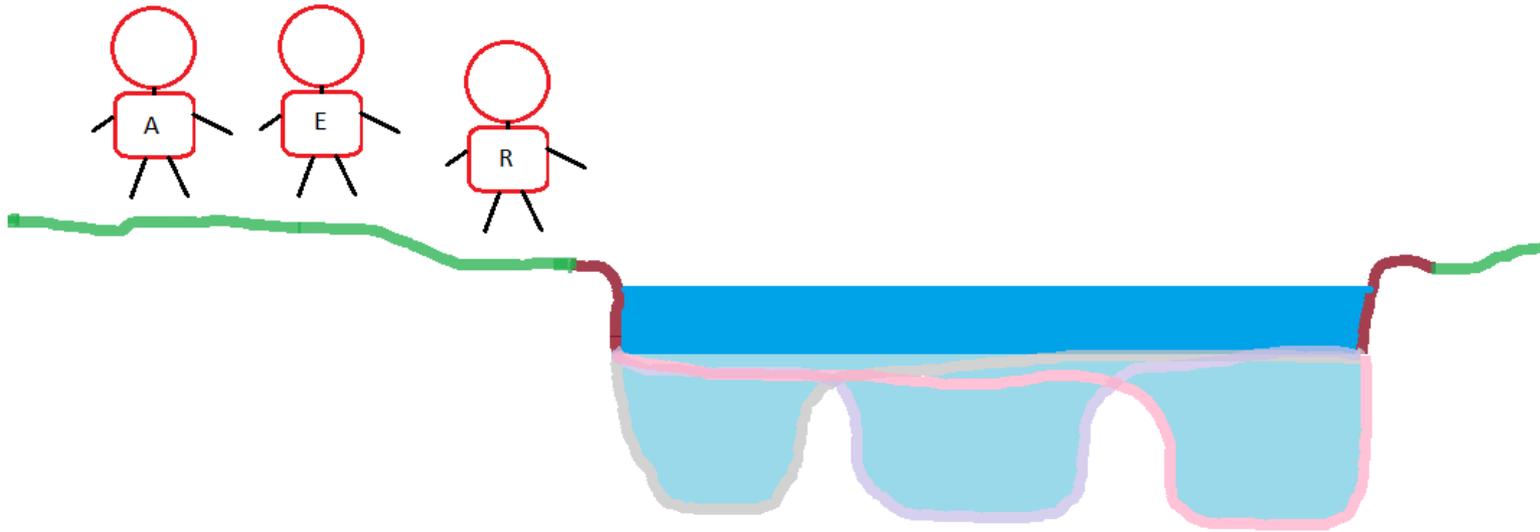


## 4. RIVER CROSSING EXAMPLE – SEVERITY BLENDING



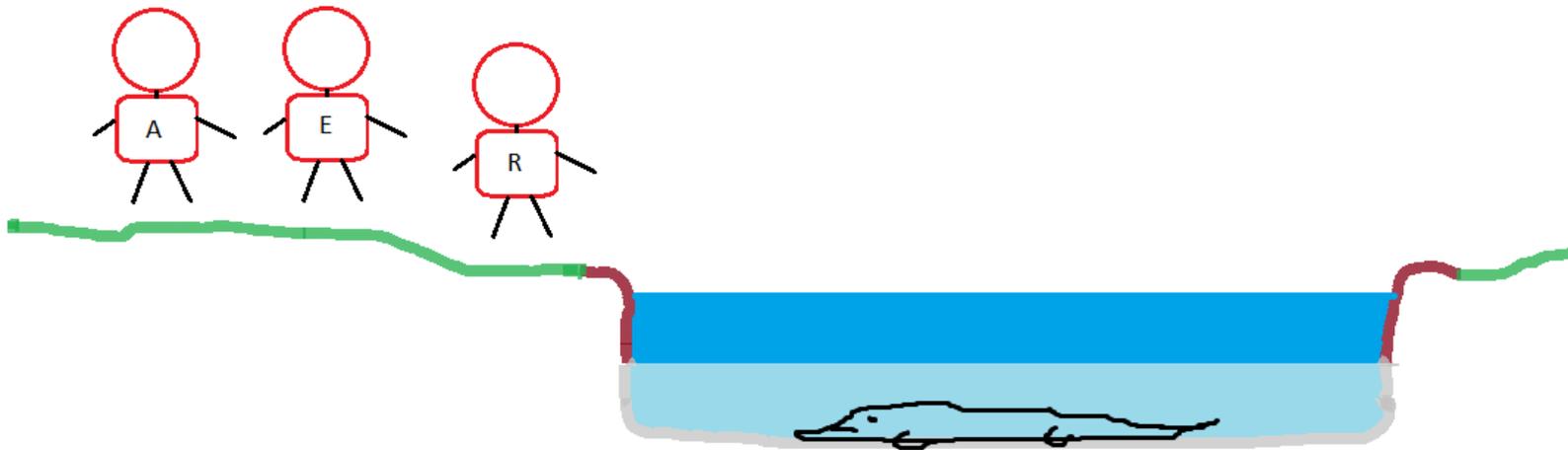


## 4. RIVER CROSSING EXAMPLE – FREQUENCY BLENDING





## 4. RIVER CROSSING EXAMPLE – UNMODELLED PERILS





## 5. Q&A

- Is blending worth all the effort?
- How should we set the weights for blending models?
- Is the industry doing enough R&D of its own or are we relying on vendor models too much?
- Is there room for an industry consortium to explore common issues? Or does it quickly become too commercially sensitive?
- Who is pricing and accumulating consistently? Do they need to be consistent?
- Is blending helping with understanding uncertainty?
- Are there any other types of blending being used in the market?
- Component blending – is anyone doing this?
- Does it lead to better understanding?
- Does whole process lead to blending?



I THANK YOU