Use of expert survey responses in the SOM analysis

HELCOM ACTION project
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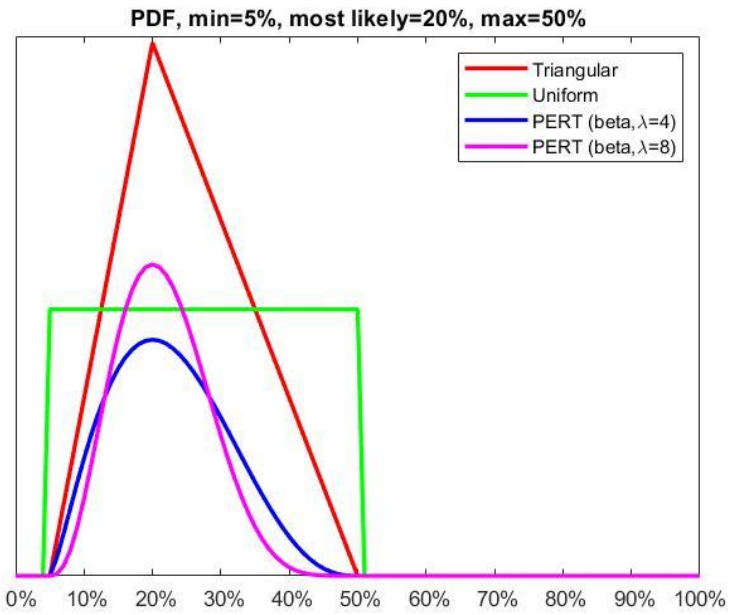
Survey responses

- Survey responses used to formulate three point estimates
- Minimum, maximum and most likely values for contribution of activities to pressures and required pressure reduction to reach GES / improvement in state
- Relative effectiveness of measure types, their certainties and the percent effectiveness of the most effective measure to form three point estimates for the effectiveness of measures

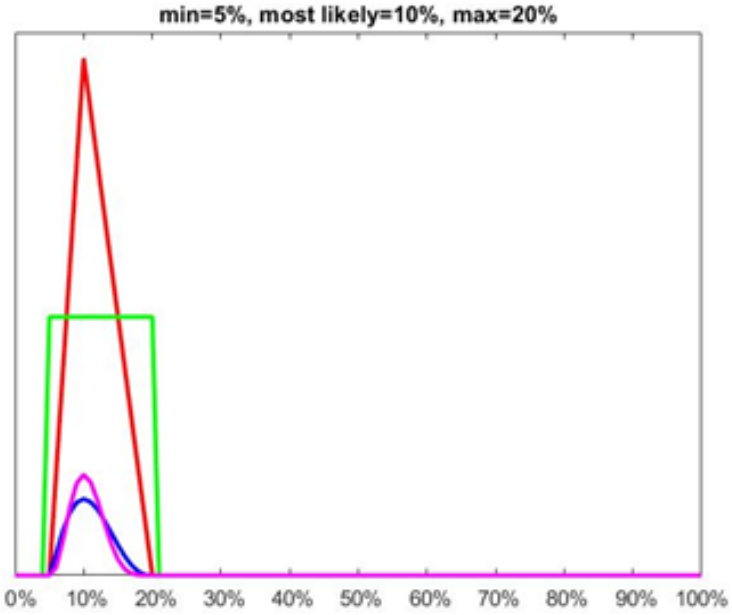
From survey responses to probability distributions

- Each three point expert estimate can be turned into a probability distribution
- Sets of point values drawn from these expert-specific distributions can be pooled over experts (pooling approach)
- Aggregate distributions can be defined based on these pooled values

Alternative distributional assumptions are possible



Example: Contribution of an activity to a pressure



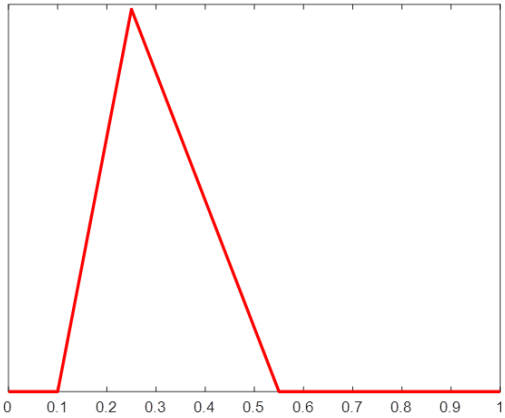
Example: Pressure reduction from a measure type

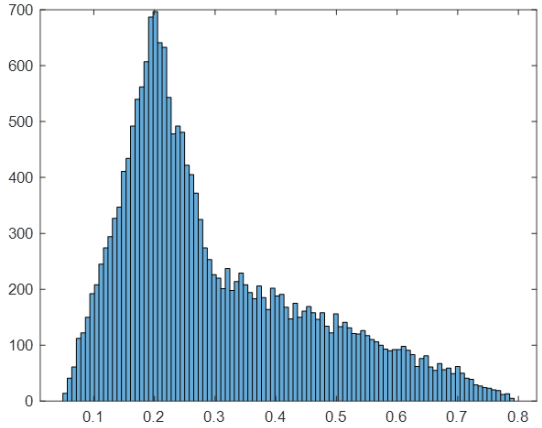
Different assumptions on the type of probability distribution can be made

- Beta distribution: values close to the most likely value are more likely
- Uniform distribution: all values from minimum to maximum are equally probable

Example on three point estimates of two respondents

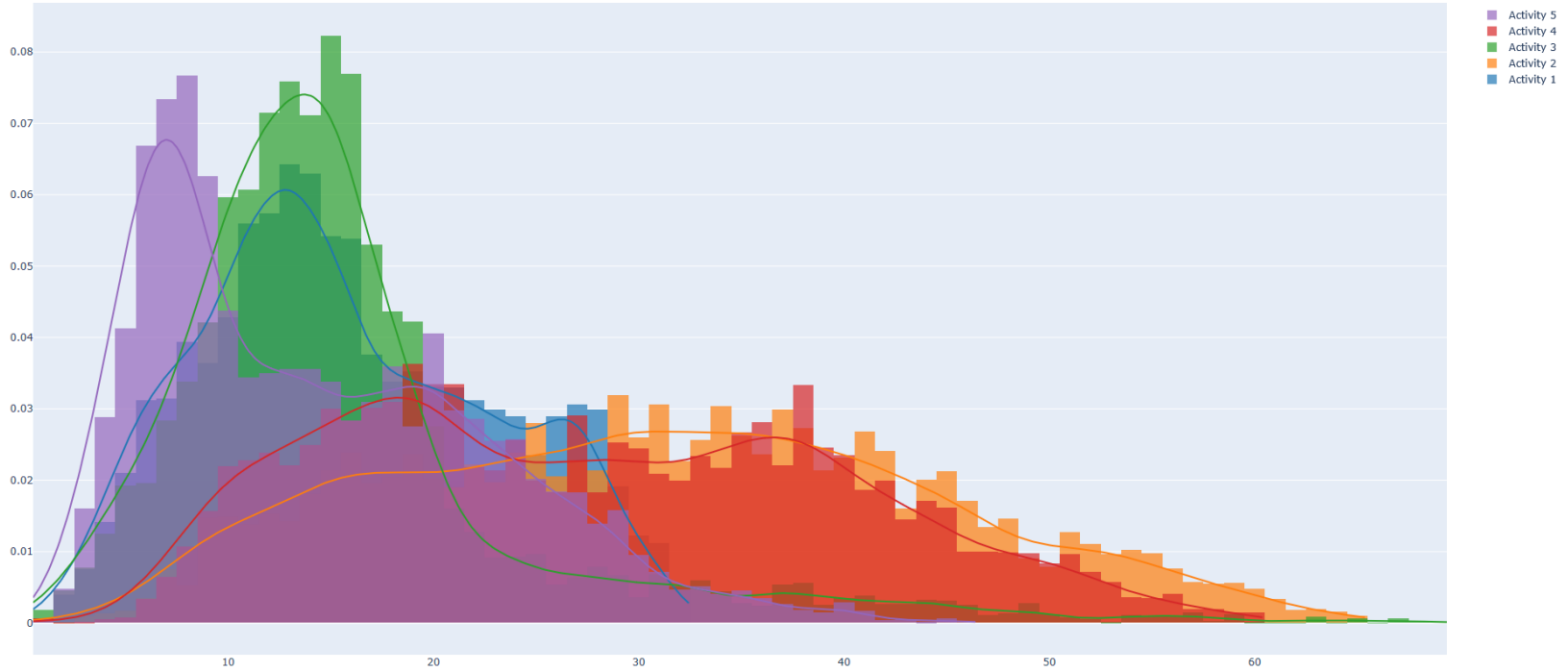
Estimates	Minimum	Most likely	Maximum
Expert 1	15%	30%	80%
Expert 2	5%	20%	30%





- Left: distribution based on the averages of the three point estimates of two experts
- Right: a discrete distribution aggregated from **pooled** values (pooling approach)
- Aggregated distributions of pooled values account better for the uncertainties and extreme values given by all respondents

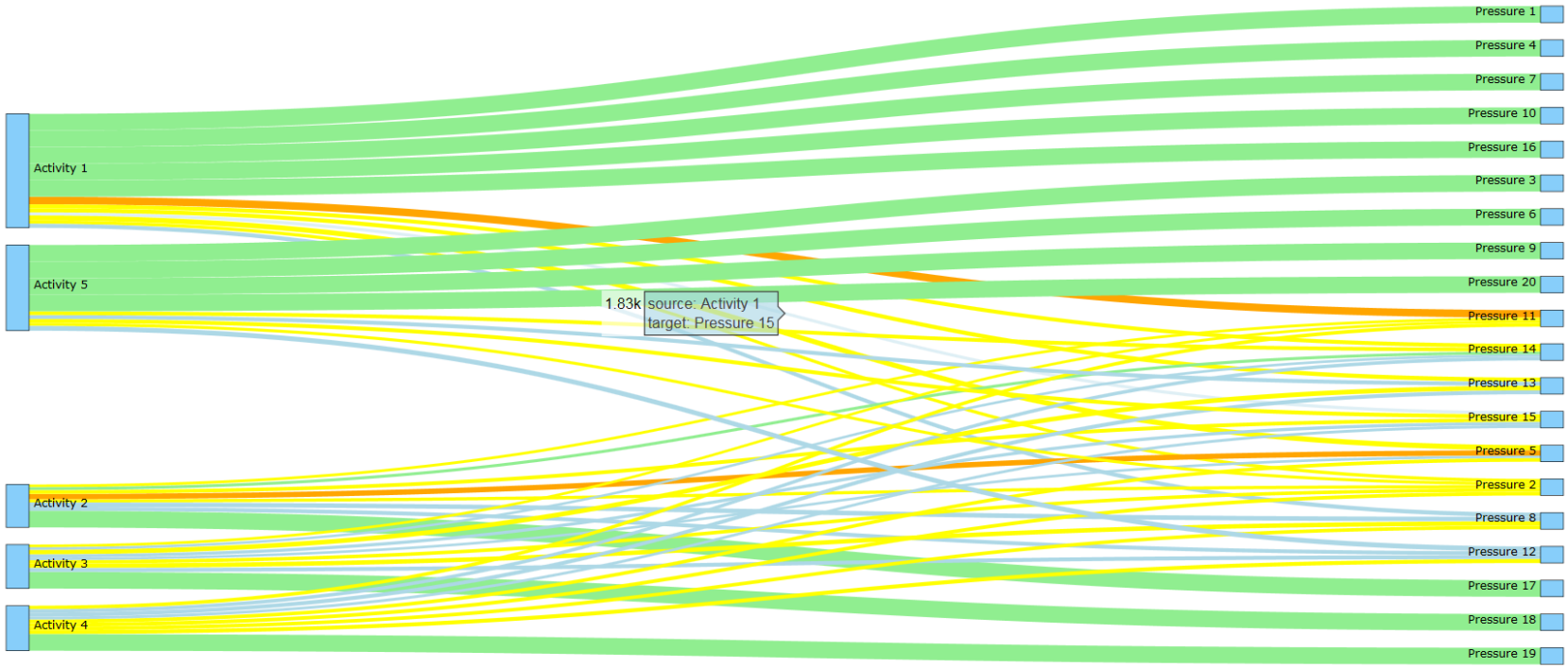
%-Contribution of activities to pressures



Example: How activities 1-5 contribute to pressure X? Distributions pooled from four expert specific beta (PERT) distributions, based on mock data

Expert-specific distributions are defined from responses on minimum, maximum and most likely contribution of activities to pressures

%-Contribution of activities to pressures



Example: Based on the distributions we can map the activity-pressure contributions.

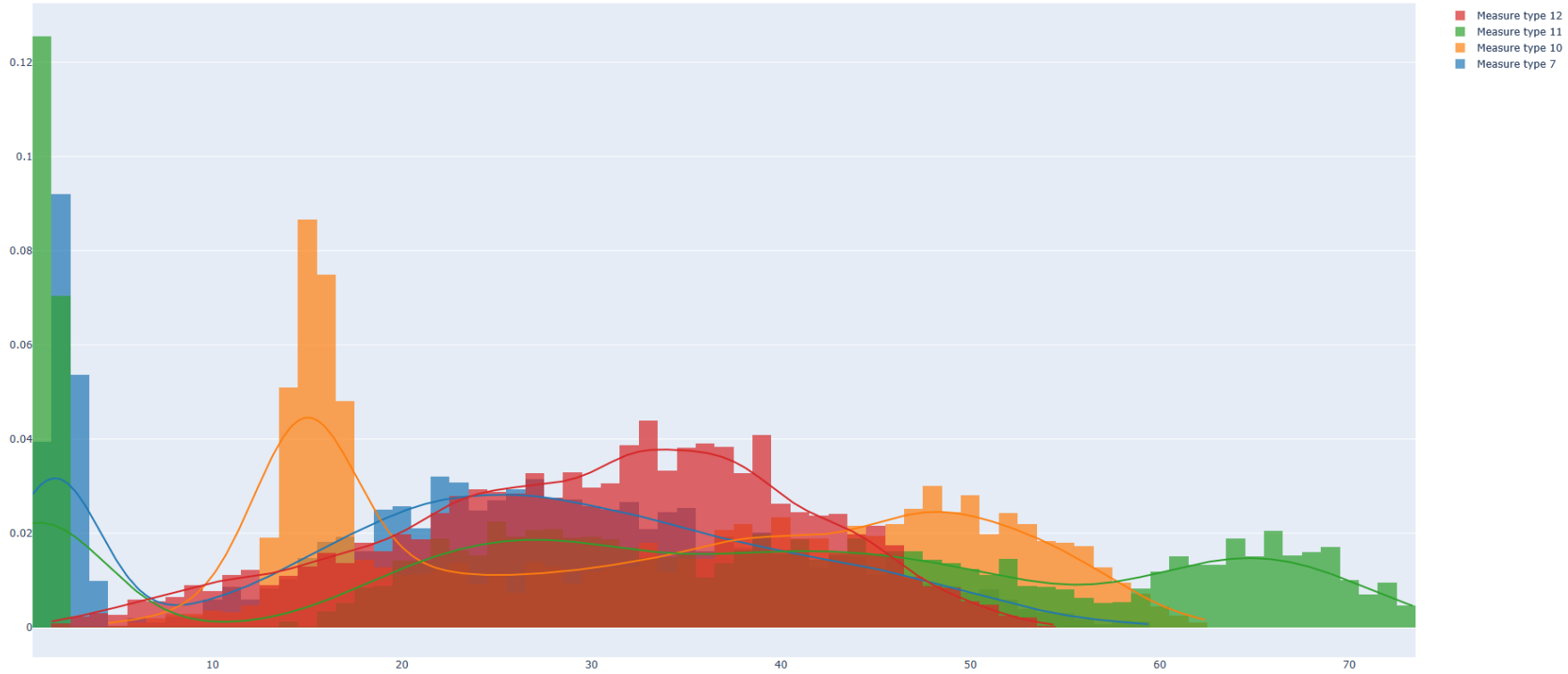
How do activities contribute to different pressures?
Which activities contribute to multiple pressures?
How significant are the contributions and what are their uncertainties?

Effectiveness of measures: reducing pressure from an activity

Measure type pressure reductions (%)

- Based on relative effectiveness of measure types, certainty of the effectiveness and expected effectiveness of the most effective measure type (%)
- Effectiveness responses used to assess most likely effectiveness
- Certainty responses used to assess minimum and maximum effectiveness

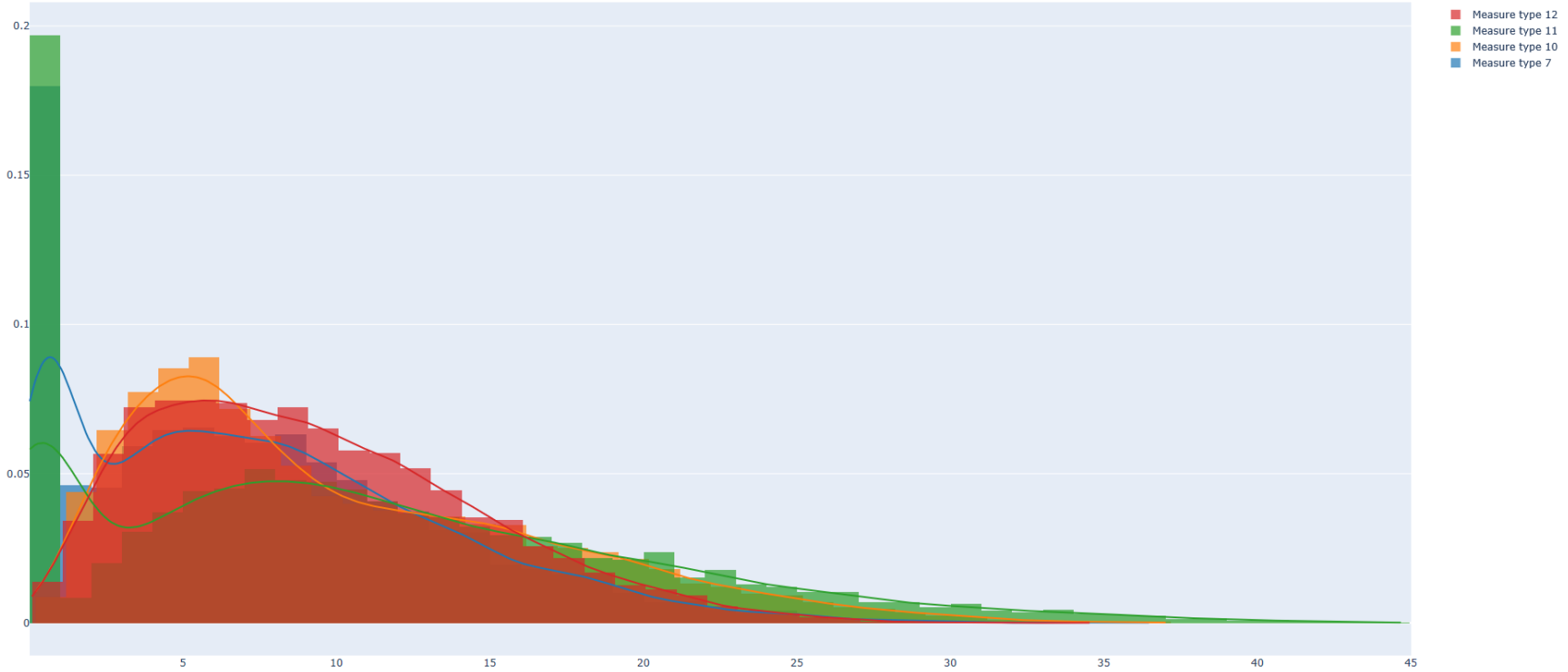
Measure type effectiveness: %-reduction of pressure from an activity



Example: Reduction of pressure X from activity Y by all measure types that reduce pressure X from activity Y.

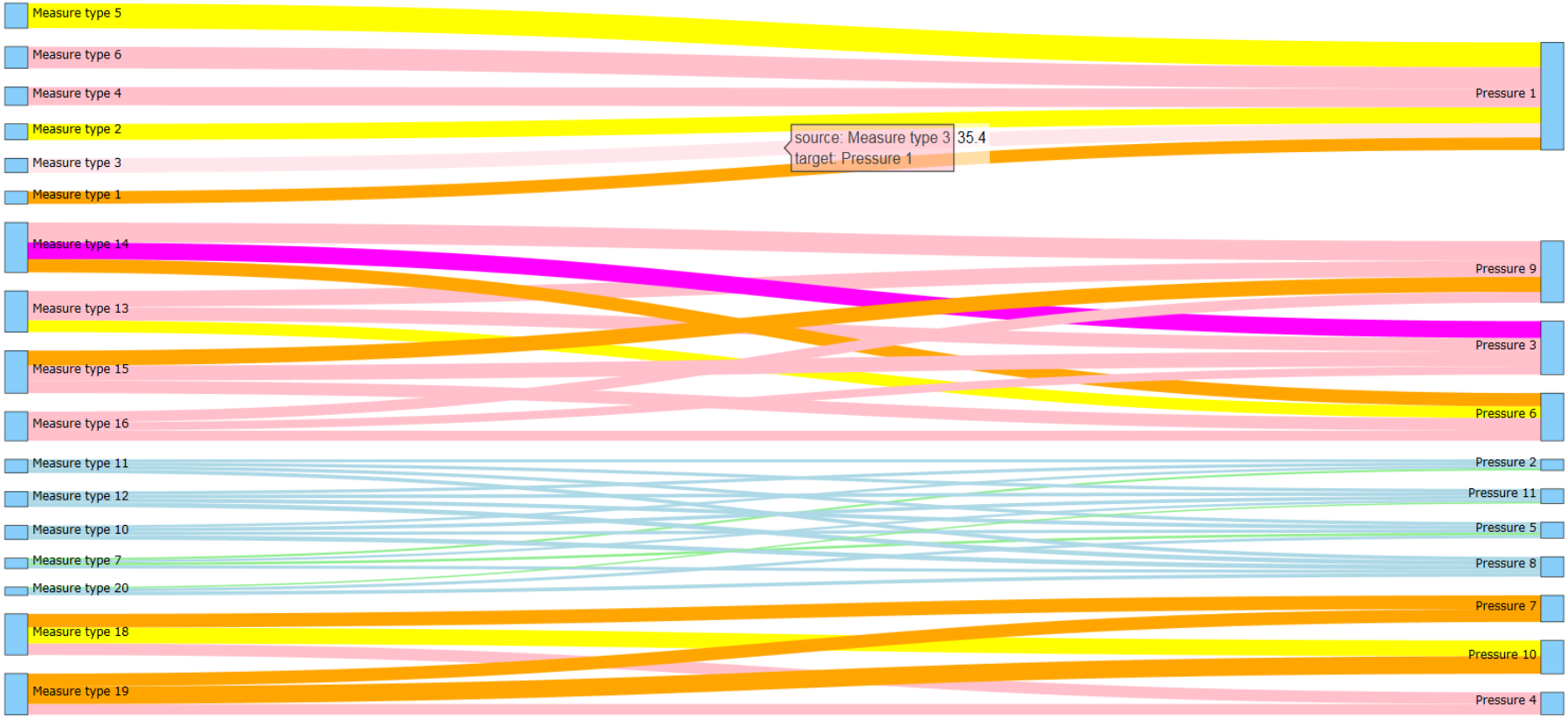
How much does a measure type reduce pressure X resulting from activity Y?

Measure type effectiveness: %-reduction in total pressure through activity



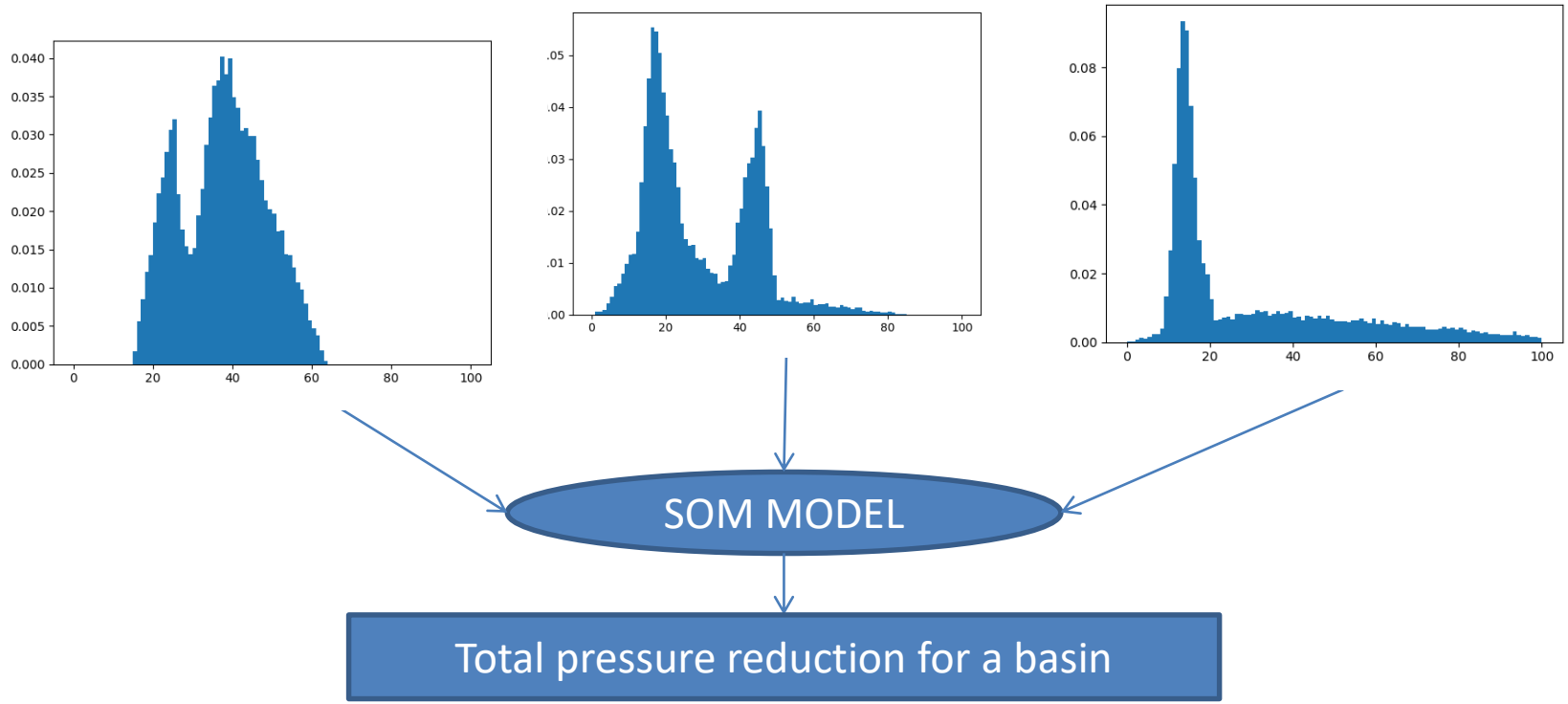
Example: Reduction in total pressure X through activity Y by all measure types that reduce pressure X from activity Y.
How much does a measure type reduce pressure X in total by reducing it from activity Y?
Here both activity-pressure contribution and measure type effectiveness on pressure from activity is taken into account.

Effectiveness of measure types on all pressures through all activities



Example: What are the expected total pressure reductions resulting from measure types through all activities? Which measure types are effective in reducing different pressures?

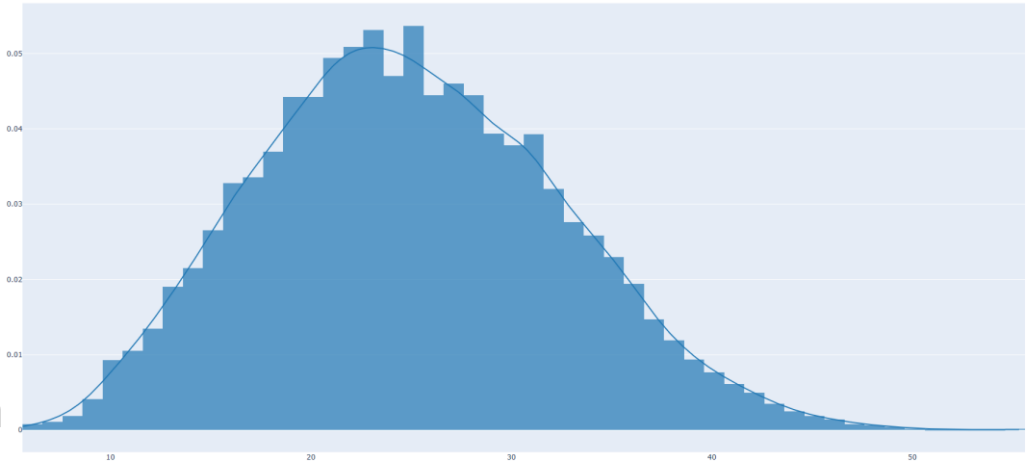
Effectiveness of actual measures on total pressures: simulation



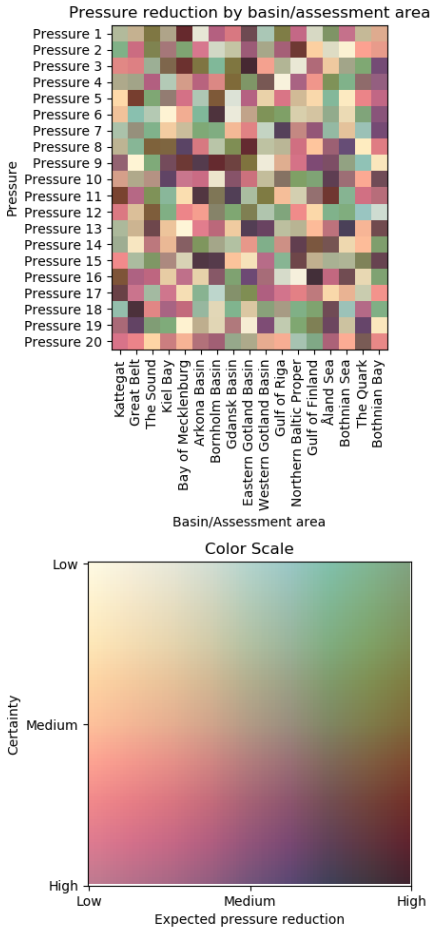
- Actual measures are linked to respective measure types and simulated accordingly.
- Data is randomly drawn from distributions that represent pooled activity-pressure contributions and pooled pressure reductions from measure types
- A large number of values is drawn from each distribution (Monte Carlo simulation)

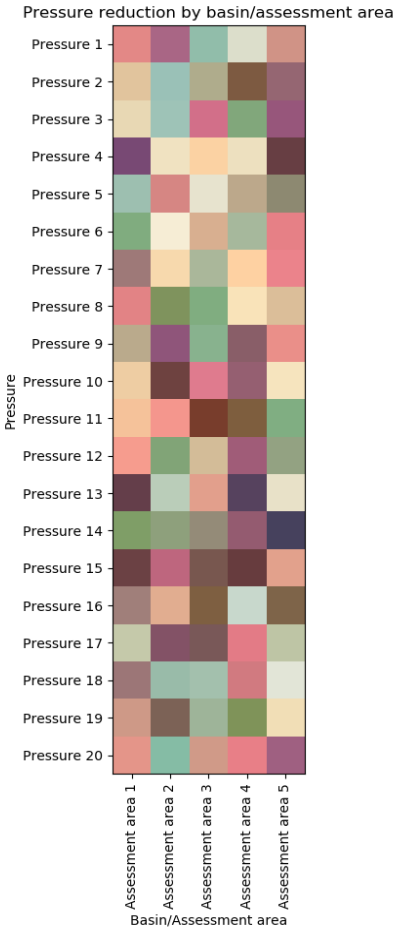
Effectiveness of measures: Total pressure reduction from actual measures

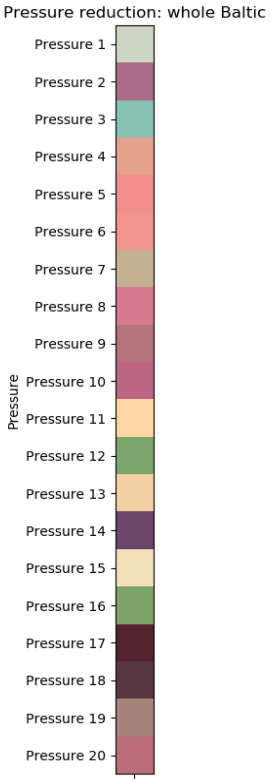
- Result: Total reduction in pressure (%) presented as a probability distribution
- Expected reduction in pressure (%) can be estimated
- Possible to assess the likelihood that reduction in pressure is less/more than some percent and that pressure reduction is between some percent values.



Presentation of simulation results: examples







Results and data can be represented on a spatial scale from individual basins to whole Baltic Sea.
Results and data allow the use of more coarse/descriptive/qualitative means of presentation: color scale, low-medium-high scale etc.

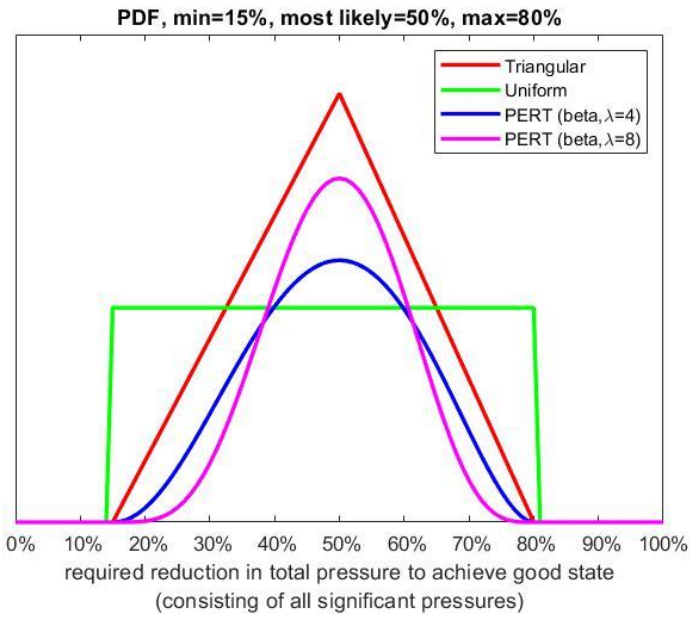
Pressure-state linkages

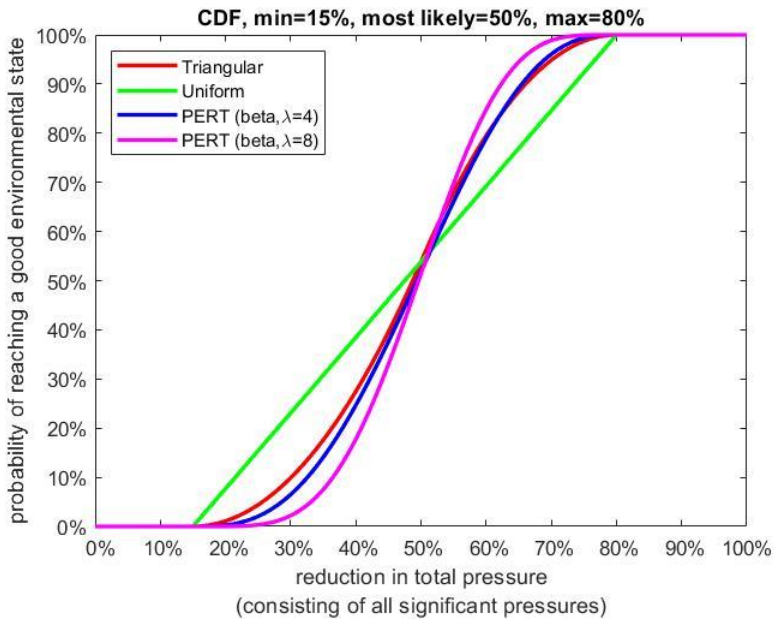
- Three point estimates can be defined based on survey responses (min, max, most likely)
- What are the significant pressures affecting each state component?
- Two alternatives
  - GES threshold exists: How much significant pressures need to be reduced to reach good state?
  - No GES threshold: How much significant pressures need to be reduced to reach a specific improvement in state?

Pressure-state: GES threshold

- Pressure reduction - good environmental status cumulative distribution
  - based on three point estimates for state components with known GES thresholds
  - defines the probability of reaching GES given a reduction in total pressure (significant pressures) affecting the state component

Probability of achieving GES





- Cumulative probability of achieving GES: defined from the probability distribution of required reduction in total pressure to achieve GES
- Results are used to assess what is the probability that GES is achieved given the pressure reduction - good state cumulative distribution functions

Pressure-state: no GES threshold

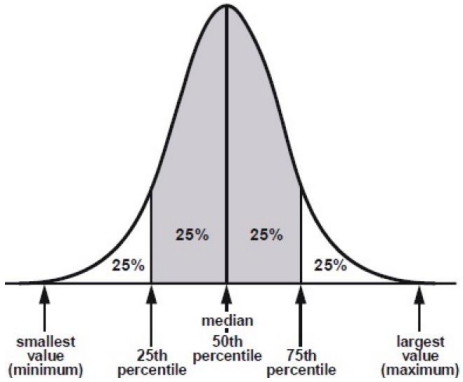
- Probability to achieve GES cannot be assessed for state components without a GES threshold
- Probability of achieving specific state improvements from reduction in significant pressures
- Probability distribution and cumulative distribution of reduction in total pressure required for state improvements

Pressure-state results

- Based on the simulated pressure reduction results we can estimate what is the expected reduction in total pressure affecting the state, by weighing the the pressure reductions by their significance to given state component.
- Significance scores and cumulative distributions to reach GES or state improvement also allow the mapping of activities and measure types to state:
  - What activities affect different state components?
  - What measure types can be effective in improving different state components?

Pressure-state results

- State components are assessed as populations/entities that can cover multiple basins
- Based on the expected reduction in total pressure one can estimate what is the expected probability to achieve good state/ improvement in state?
- Or e.g. what is the probability range to reach good state when pressure reductions are between the 25 and 75 percentile of the simulated pressure reduction distributions.



GES/noticeable improvement in state component is achieved by a%-b% probability

Reductions in significant pressures

Interpretation of the SOM results

- Results and data of the model can be transformed to more descriptive categorical values (e.g. low, medium, high)
- Final results on the total reduction of pressure or achieving GES should be interpreted in the context of the model, relative to the other results!
- Additional results, e.g. on the effectiveness of measure types in reducing pressures and summaries of the activity-pressure contributions
  - Can be used to interpret the final results and to identify what type of new measures are needed.

Interpretation of the SOM results

- Reductions in pressures can be presented in actual units of measures or reflected to actual pressure levels and reduction targets if such data exists
- Estimates from literature can be used
  - to complement/replace survey data or intermediate results of the SOM analysis
  - as reference points to compare the results