About Climate Change, Uncertainty and Risk

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FloodNet

- Advance Knowledge on Flood Regimes (Past and Future) and Provide Guidelines for Infrastructure Design
- Advance Knowledge on Flood Forecasting Systems and Enhance Flood Forecasting in Canada
- Assess Impacts of Floods on People, Society and the Environment

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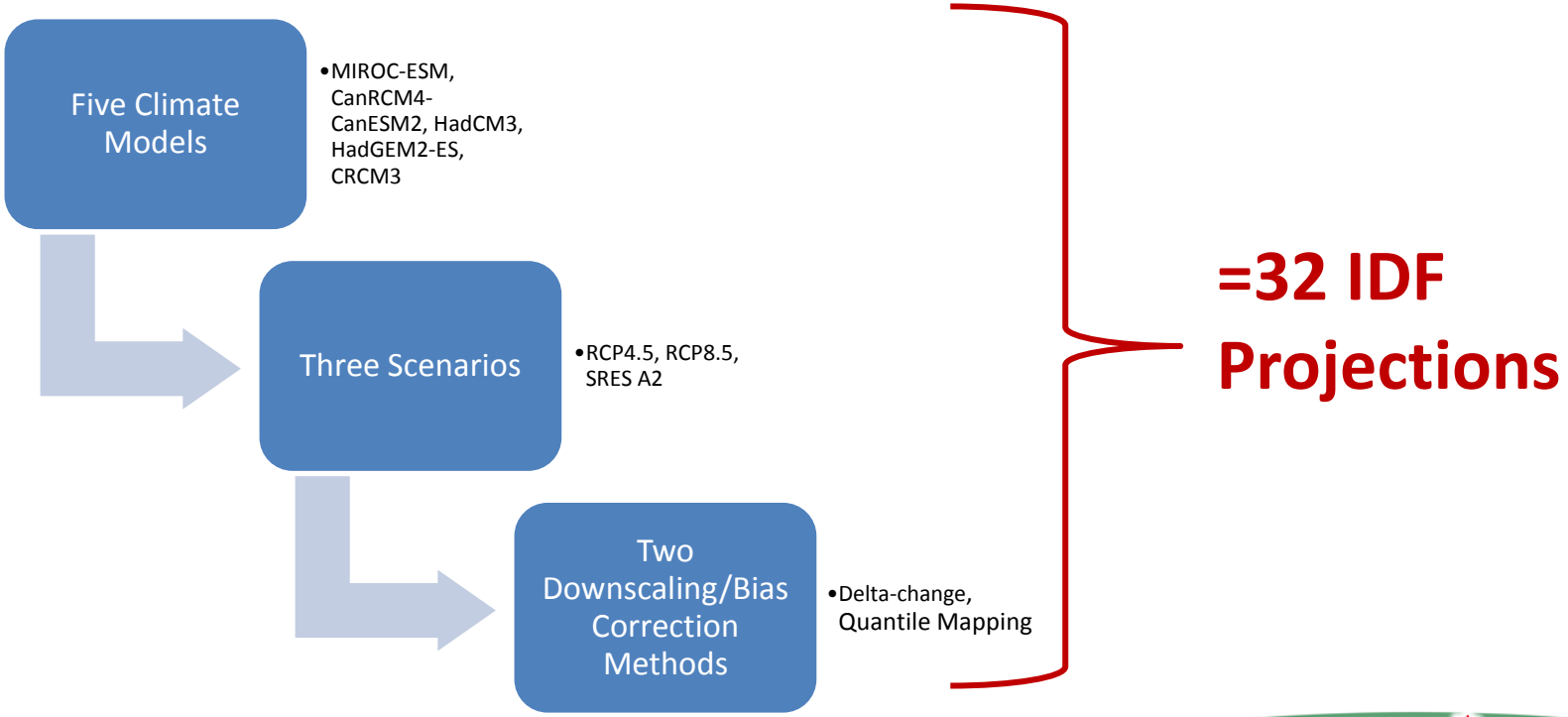
Agenda

- Context
- Defining Uncertainty
- Uncertainty Sources
- Risk Tolerance

Context

- Intensity-Duration-Frequency (IDF) curves are widely used for water management
- TRCA, ERCA & OCC commissioned report to compare future IDF curves

Context



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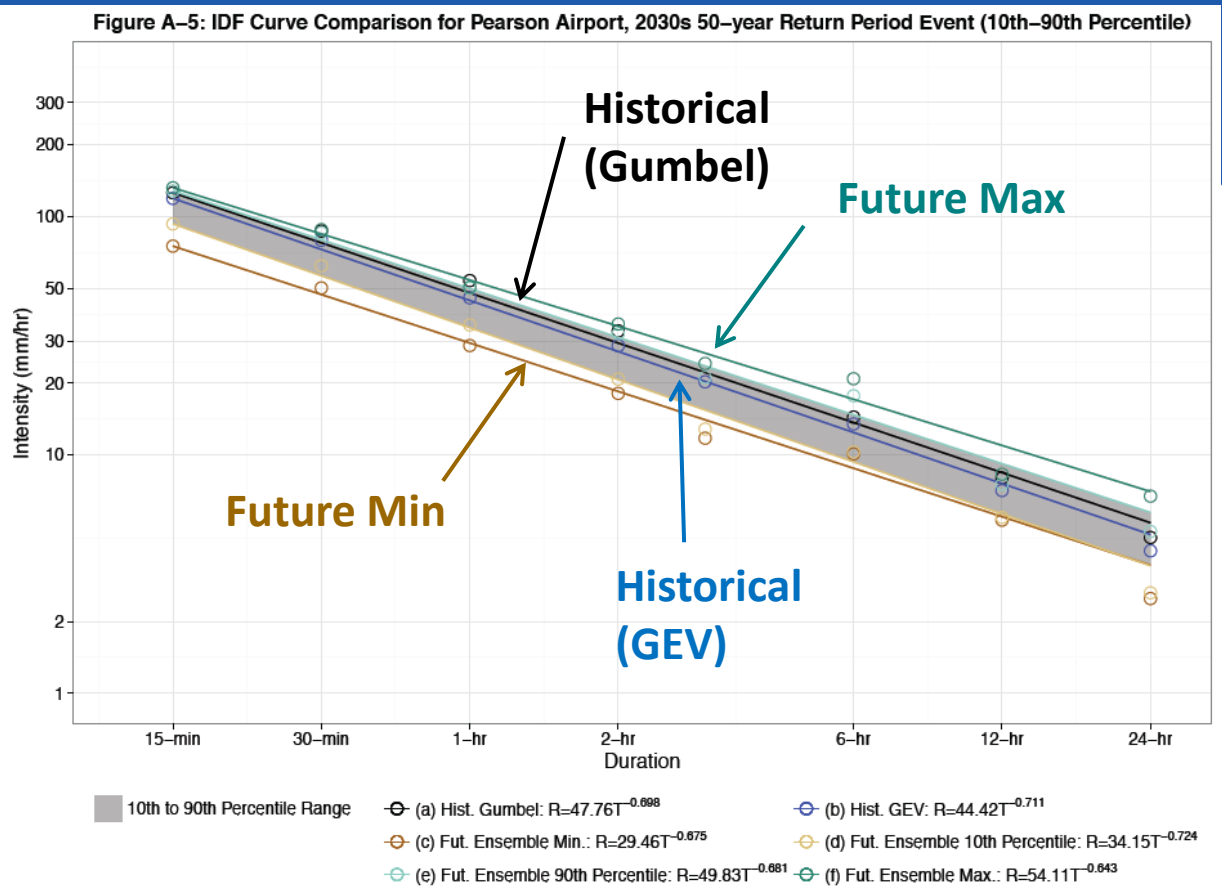
Context



Source: Coulibaly, Burn, Switzman, Henderson & Fausto (2016) A comparison of future IDF curves for Southern Ontario

Which do we use?

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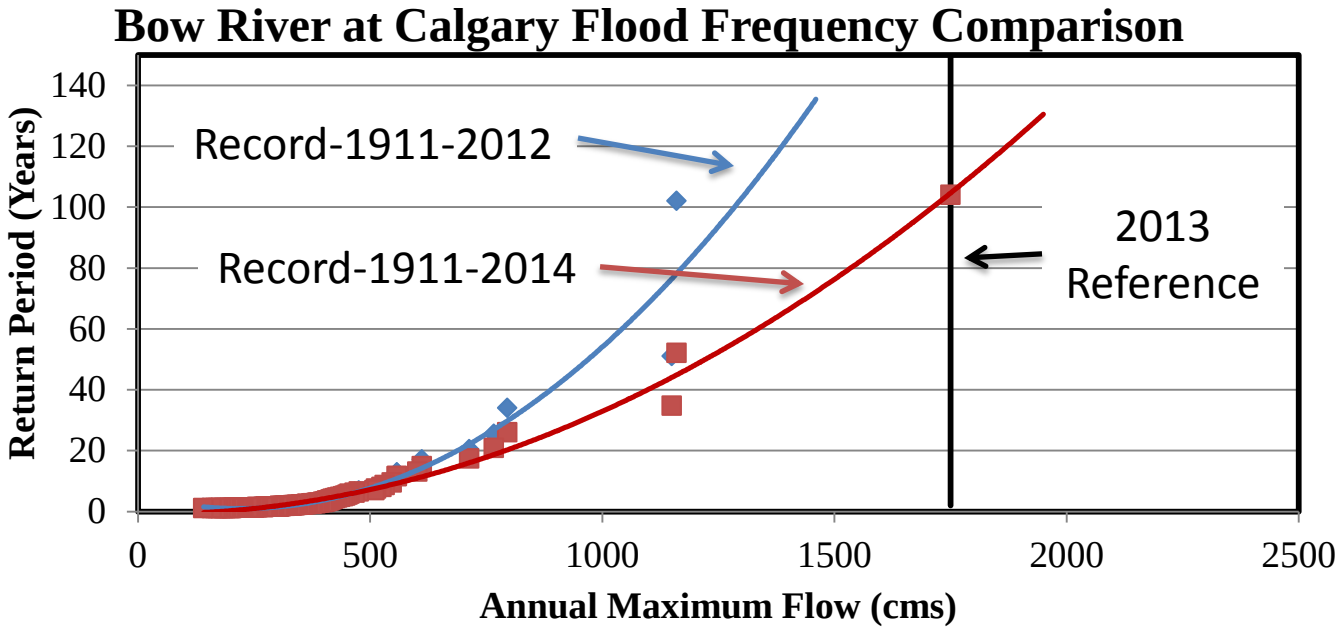
- Climate change is a myth!
- Models are not accurate enough for decision making!

Hydro-Climatic Uncertainty!

T'was Ever Thus!



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Water Risks

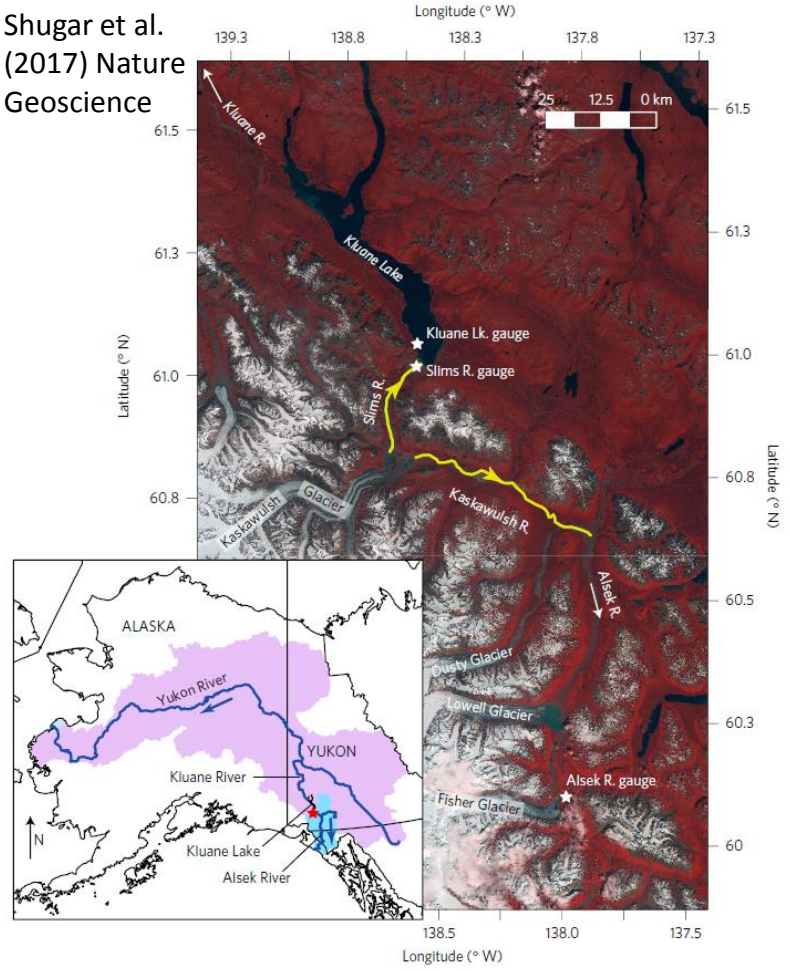
"are associated with the novelty of dynamical possibilities that have significant potential consequences to human and ecological systems, and not with probabilities based on historical precedence"

Kumar, 2015

D inty

- **True U**
  - Deep u gnorance
- **Uncert**
  - Quanti
  - Accour statistical errors

Shugar et al. (2017) Nature Geoscience



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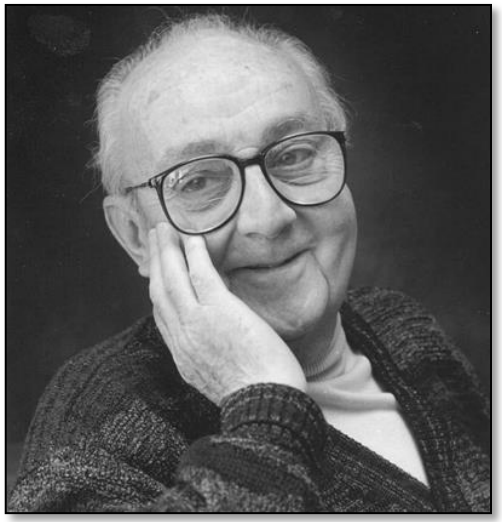
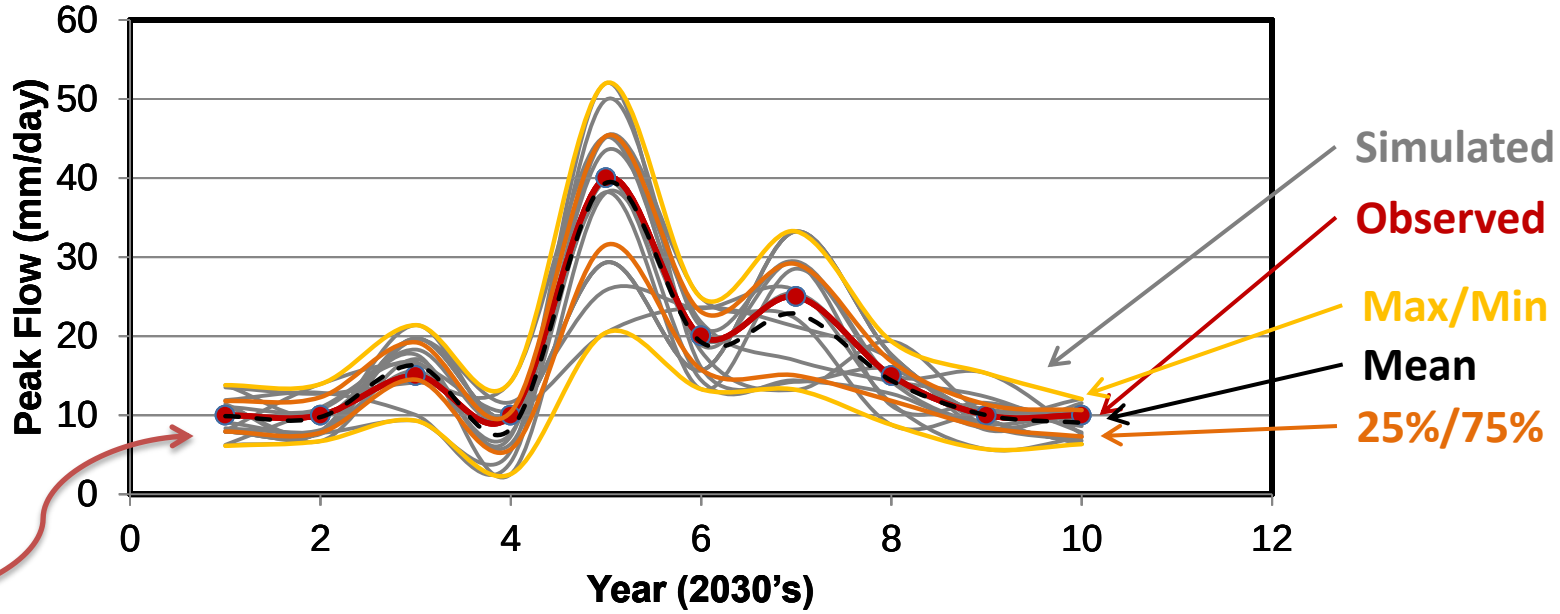
"Essentially, all models are **wrong**, but some are USEFUL"

George E. P. Box (1951)



Uncertainty!



Model Structure, Model Parameters, Climate/Meteorology, Initial Conditions, Land-use, Transient Processes (i.e. ice jams)

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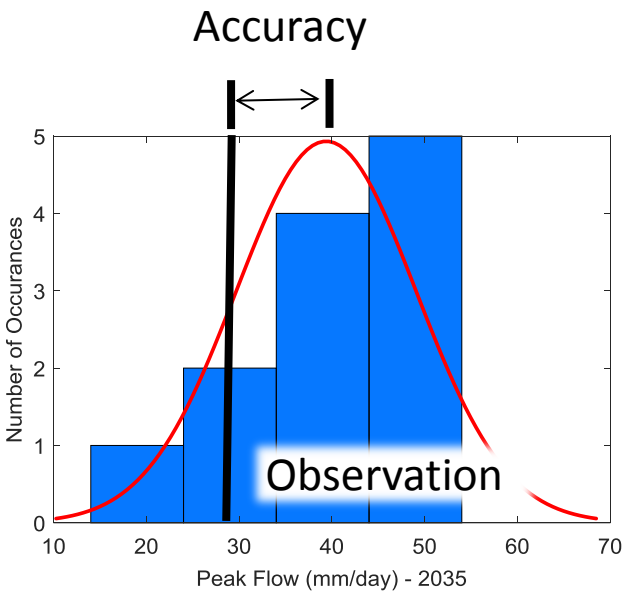
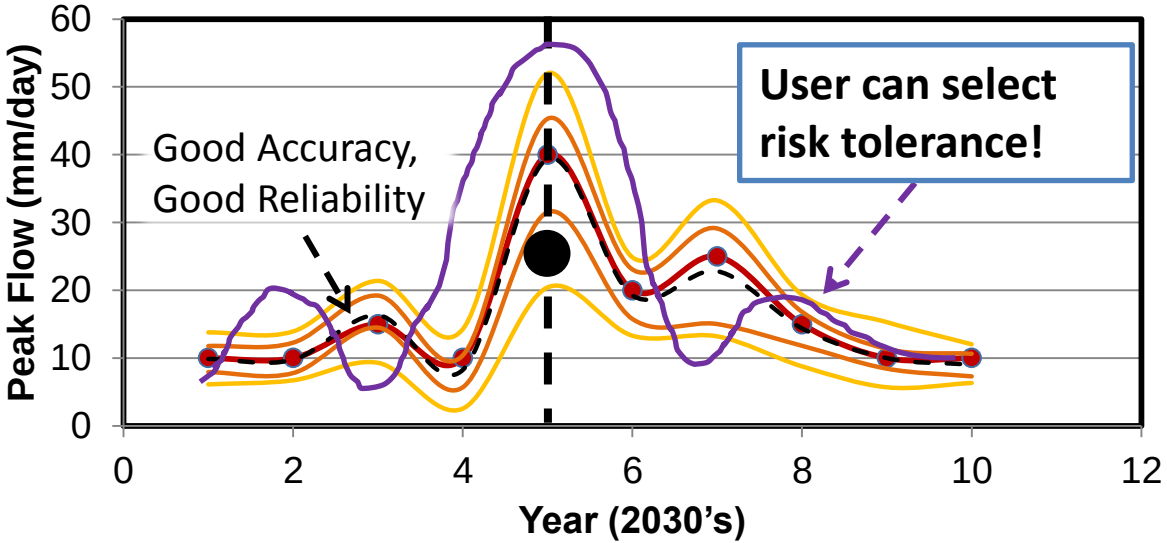
Uncertainty!





Accuracy – Mean distance from observed

Reliability – Observations contained in ensemble

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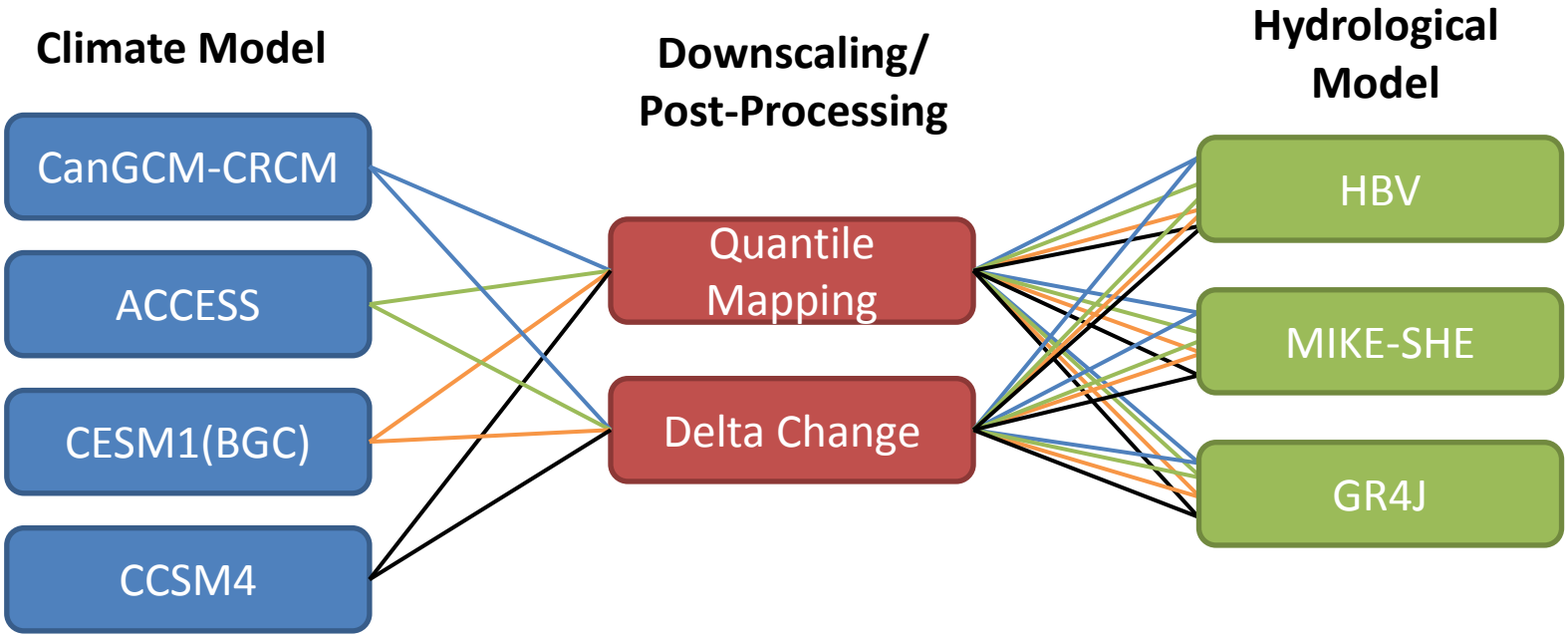
Quantifying Uncertainty



Note: Names are samples only!

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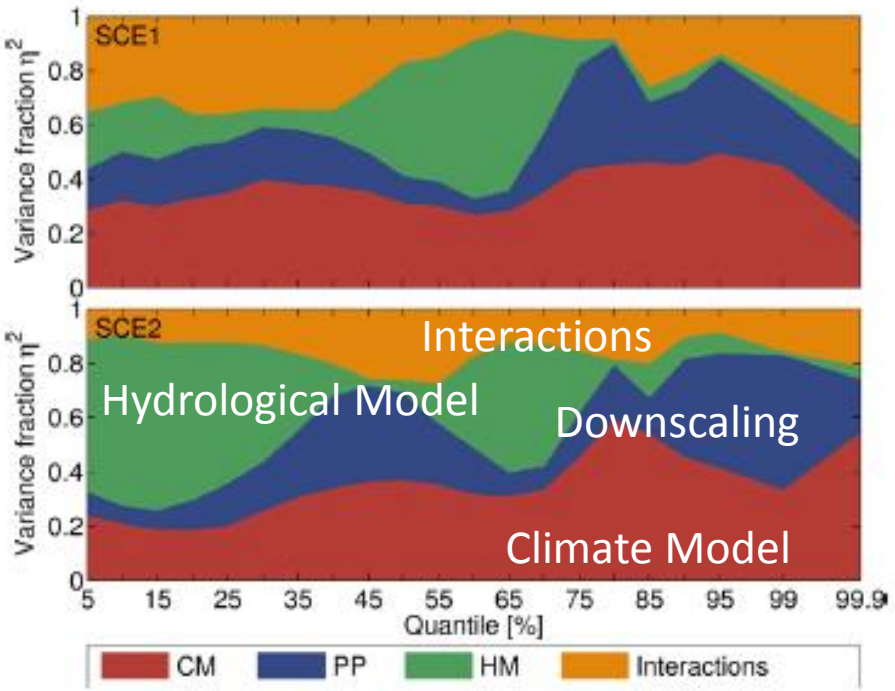
Uncertainty Sources

- ANOVA to quantify uncertainty contribution by source
  - Rhine River



Source: Bosshard et al. (2013) Quantifying uncertainty sources in an ensemble of hydrological climate-impact projections, Water Resources Research (doi:10.1029/2011WR011533)

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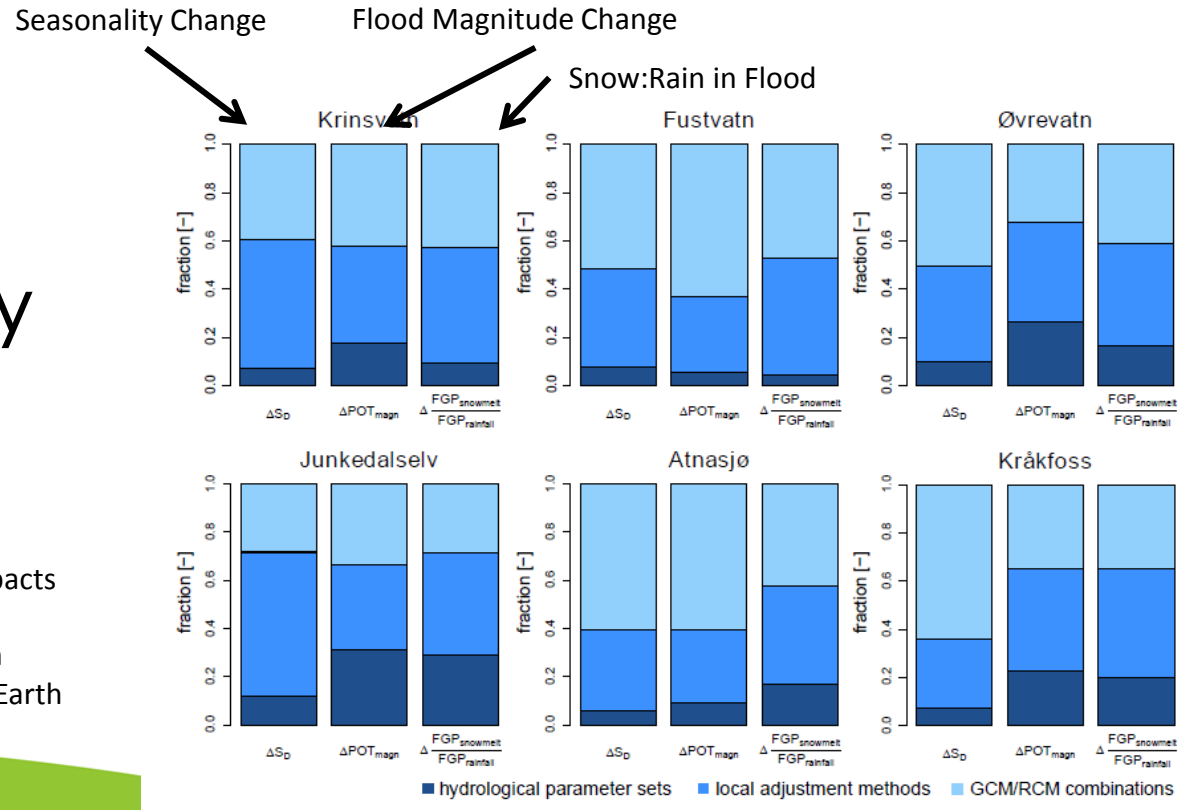
Uncertainty Sources

- ANOVA to quantify uncertainty contribution by source
  - Norway



Source: Vormoor et al. (2015) Climate change impacts on the seasonality and generation of floods – projections and uncertainties for catchments with mixed snowmelt/rainfall regimes. Hydrology and Earth Systems Science (doi:10.5194/hess-19-913-2015)

Risk Tolerance

- Risk = Probability × Consequence
  - Selection of Return Period/IDF Curve

- Risk Tolerance
  - Which scenario to accept from ensemble
  - i.e. 75th percentile of 50 year return flood

Challenges

- Communication
- Regulated design storms
- Data availability
- One line policies (i.e. flood plain map)
- Cost

The NSERC Canadian FloodNet

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