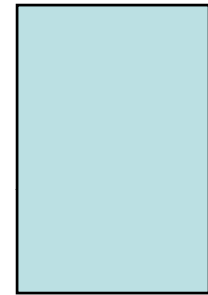
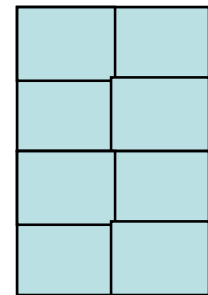
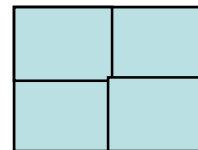
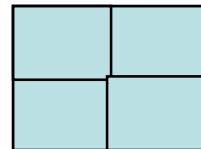


IP3 Basins Modeled with MESH

- 1 Grid-1 GRU models:



- Multiple grid, multiple GRU models:



DDS for MESH Program: Ongoing Work

- User documentation close to completion
- From model developers we need some model parameter information:
 - exhaustive list of parameters you would possibly consider changing
 - subset of above parameters you would recommend for calibration
 - initial ranges for each parameter
 - any relationships between parameters that constrain or define their feasible values beyond simple ranges:
 - e.g. Parameter A \geq Parameter B

DDS for MESH Program: Ongoing Work

- Initial Guidelines for using DDS with MESH
 - How many parameters should I calibrate with DDS?
 - however many you would have tried changing during manual calibration
 - anywhere from ~10 to around 30 have worked before
 - How many model runs will I need?
 - however many can be completed by the time you want a result (e.g. overnight or over the weekend)
 - probably at least 500-1000 to have some confidence the final result is not a poor solution

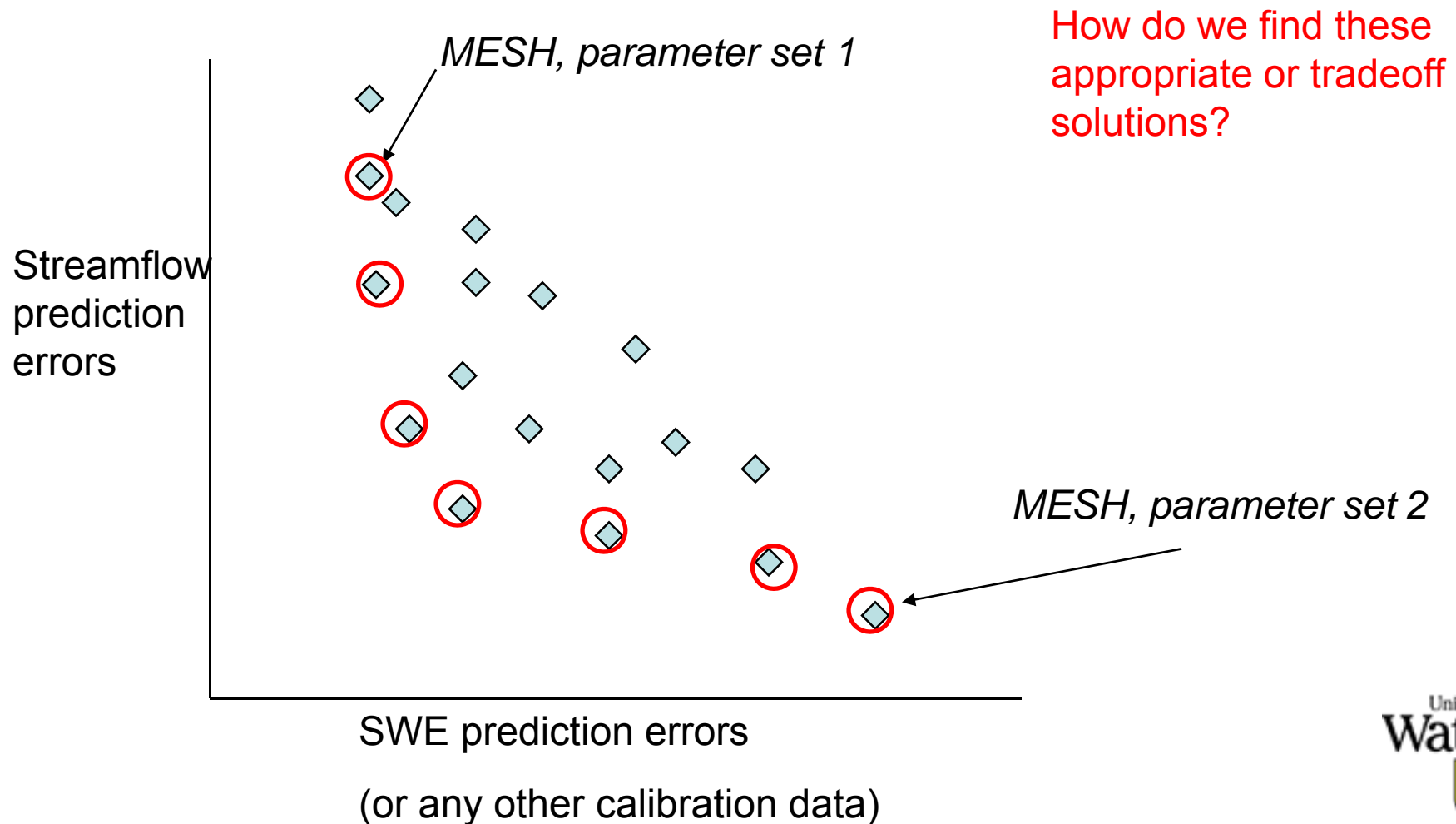
DDS for MESH Program: Ongoing Work

- Initial Guidelines for using DDS with MESH
 - How important are the parameter ranges?
 - can be very important and do impact DDS efficiency
 - they can always be changed (increased) in a second or third DDS optimization run
 - What initial/starting parameter set should be used?
 - two approaches are:
 1. program finds one based on a random sampling experiment
 2. modeller provides one
 - recommend #2: the more modelling knowledge you provide DDS, the better it should do
 - consider some results ...

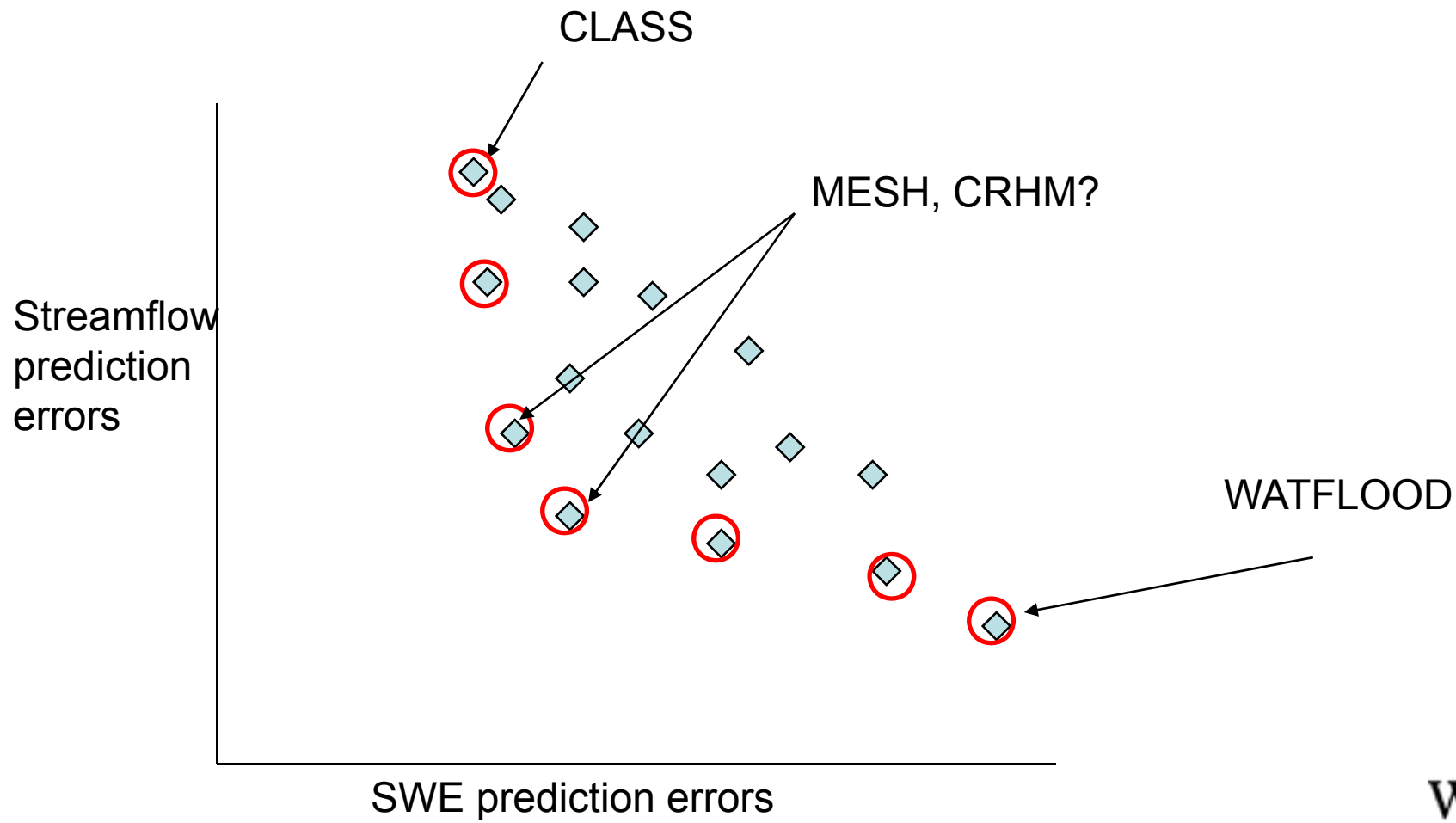
Future IP3: A Multi-objective Framework for Model Application and Development

- Models must evolve/improve based on all available data
- If a model is developed (i.e. optimized) for streamflow, it is unlikely to predict other state variables of system as well as it could
- Conversely, if a model is developed (i.e. optimized) to predict SWE, it is unlikely to predict streamflow as well as it could

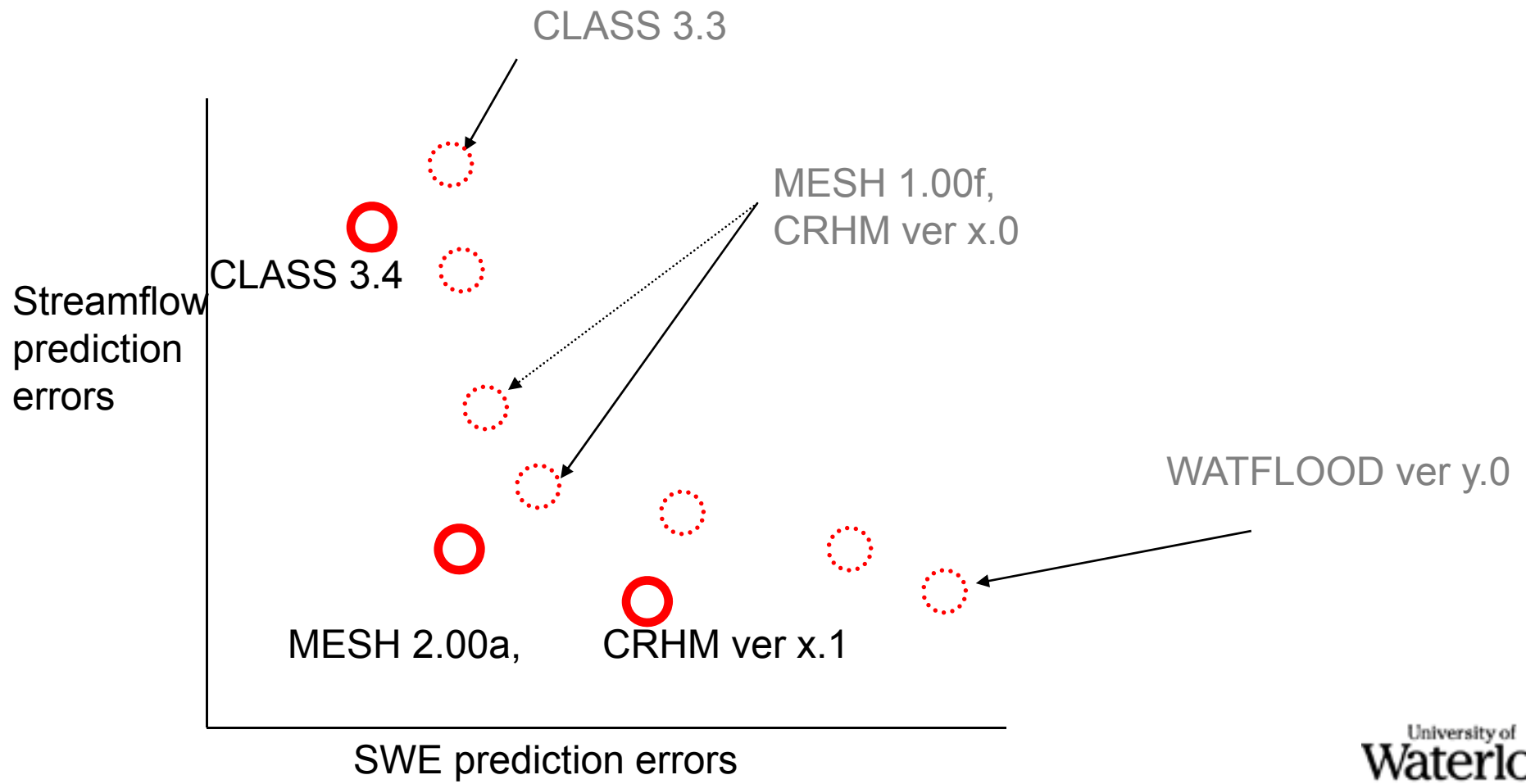
Conceptual example showing spectrum of model prediction quality



Perhaps (?) with our IP3 models
we have roughly the following



Ideally, as IP3 Models Improve we would like to see...



Goals for IP3 Work

2. Generate baseline (best or optimized) MESH parameter sets for each IP3 basin
 - note that other modellers may already have identified a very good parameter set
 - started with 1-grid, 1-GRU model of each basin
 - suspect that most basins require more than one GRU to generate reasonable results
 - move to more spatial discretization
 - What level of predictive improvement do we see when we include more grids, more GRUs?

Goals for IP3 Work

3. Improved Predictions in Ungauged Basins (PUB)

- Based on all IP3 (and other available basins), generate a default MESH model parameter set that can be recommended for other Cold Region Basins in Canada
- 7-10 basins with calibration data
- Find the best “average” parameter set
- Large scale optimization study
- Results will also yield multiple parameter sets → can describe prediction uncertainty