SHyFT
INTRODUCTION TO STATKRAFT'S HYDROLOGIC FORECASTING TOOLBOX

Providing a framework for hydrologic forecasting in operational environments

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Developers: Burkhart, Matt, Abdella, Helset, Skavhaug

Statkraft

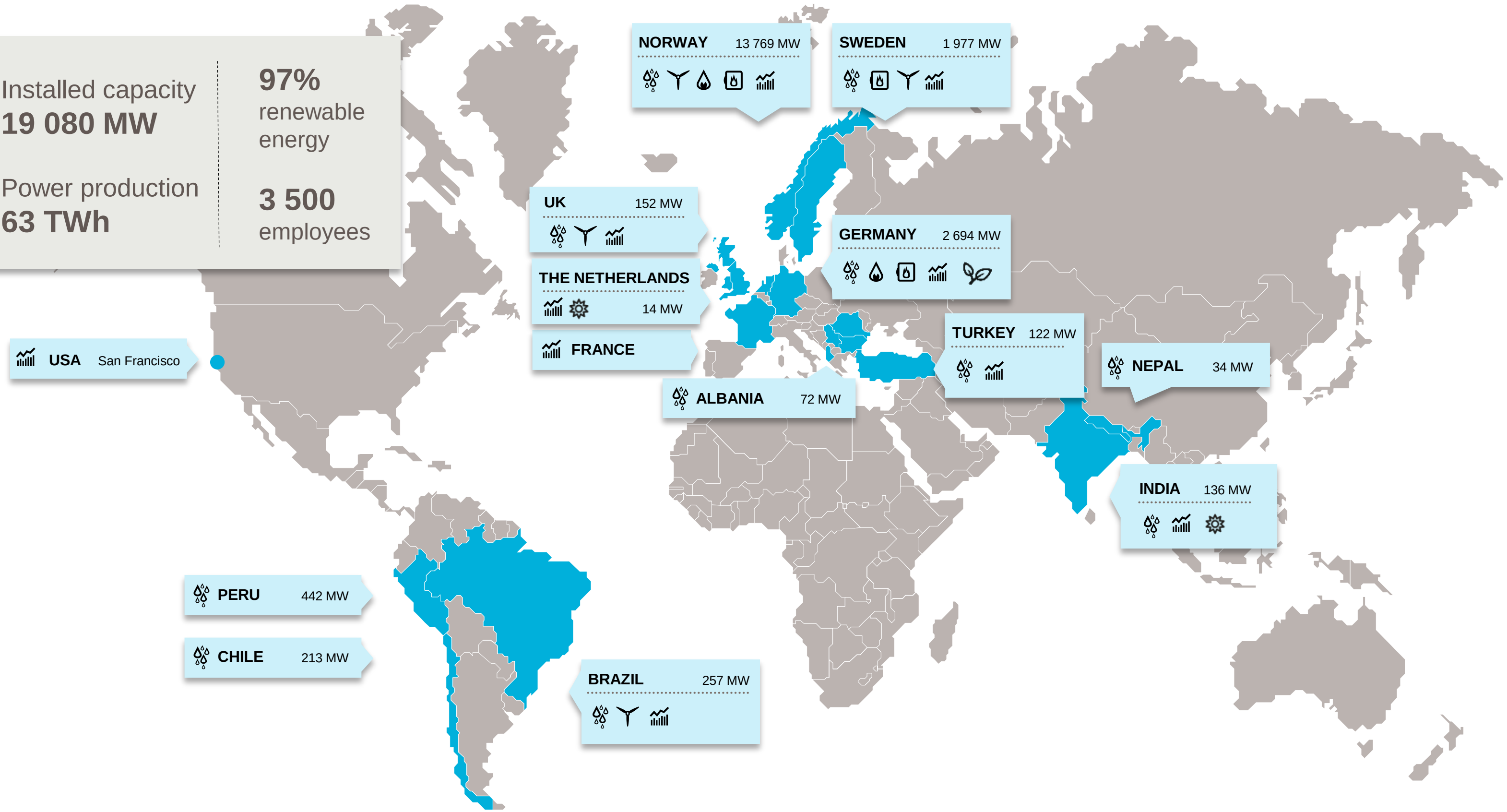
Statkraft's global presence – modeling challenges

Installed capacity
19 080 MW

Power production
63 TWh

97%
renewable energy

3 500
employees



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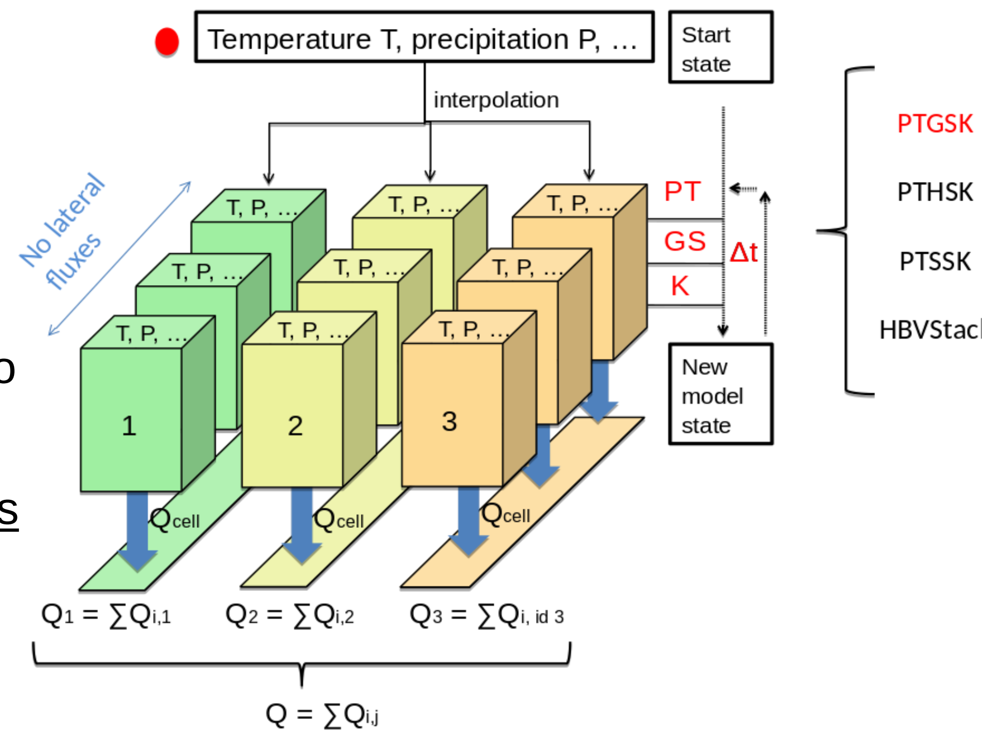
Shyft is a C++ and Python based toolbox designed to:

- provide a <u>flexible</u> hydrologic forecasting toolbox built for operational environments
- enable highly <u>efficient</u> calculations of hydrologic response at the regional scale
- use the multiple working hypothesis to obtain an <u>optimal</u> catchment forecast
- rapid implementation of <u>improvements</u> identified through research activities



⇒Give us controll of the sensitivity and uncertainty of model and the forcings

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Method of multiple *configuration* testing

By keeping the hydrologic model simple, and using a flexible API, SHyFT enables us to evaluate uncertainty and sensitivity resulting from **multiple forecast system configurations**

- Which model provides greatest fidelity to our forecast?
- What forcing datasets provide the best inflow forecasts?
- What is the impact of choice of calibration routine?
- Can we calibrate using remote sensing data?
- Energy balance or degree day?
- What is the appropriate scale?

”SHyFT is *not* a model!”

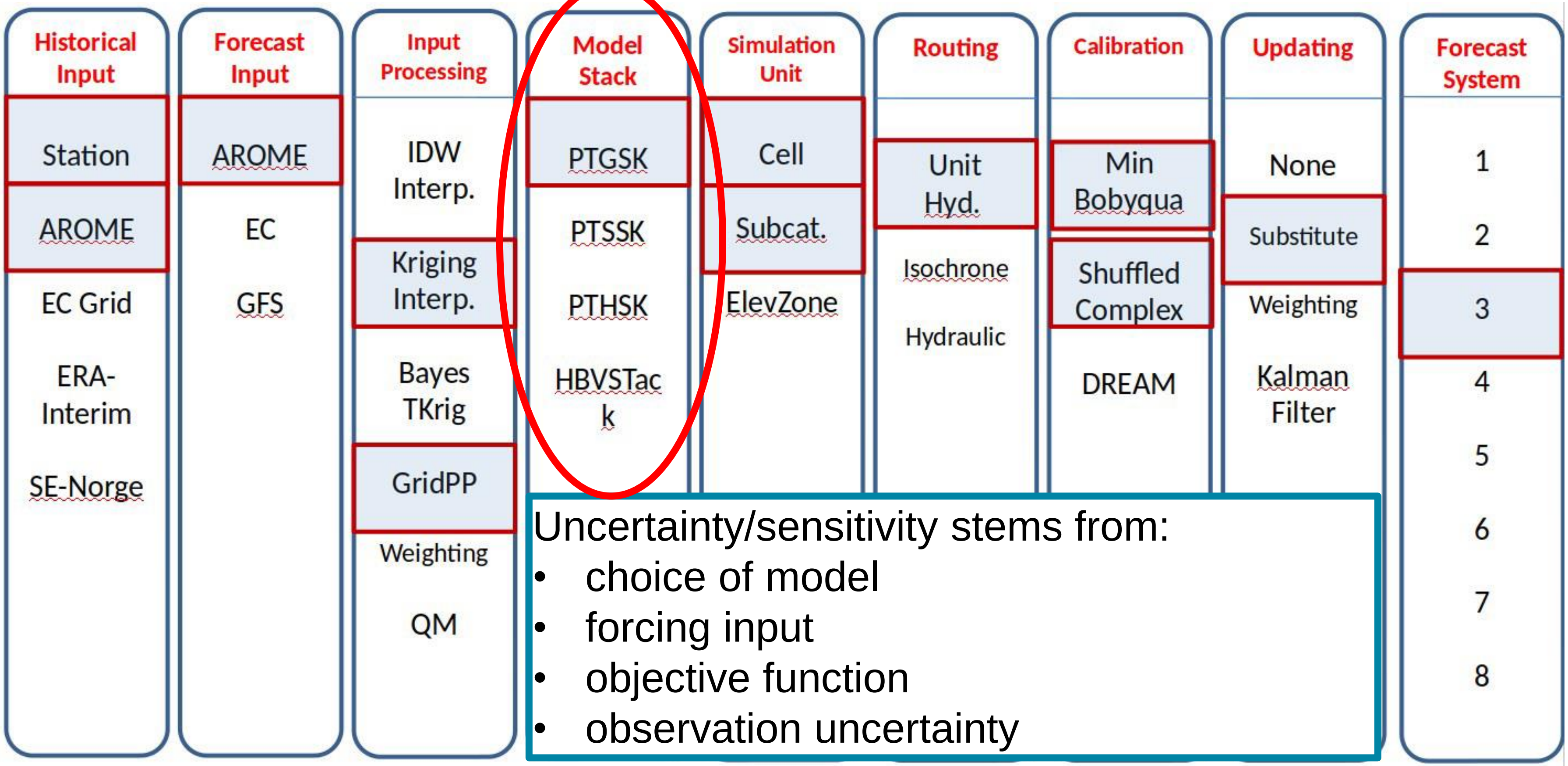
”SHyFT *is* a platform, with an API!”

```
from shyft import api

params = api.pt_gs_k.PTGSKParameter()
model = api.pt_gs_k.PTGSKModel(cell_data_vector, params)

model.run_cells()
```

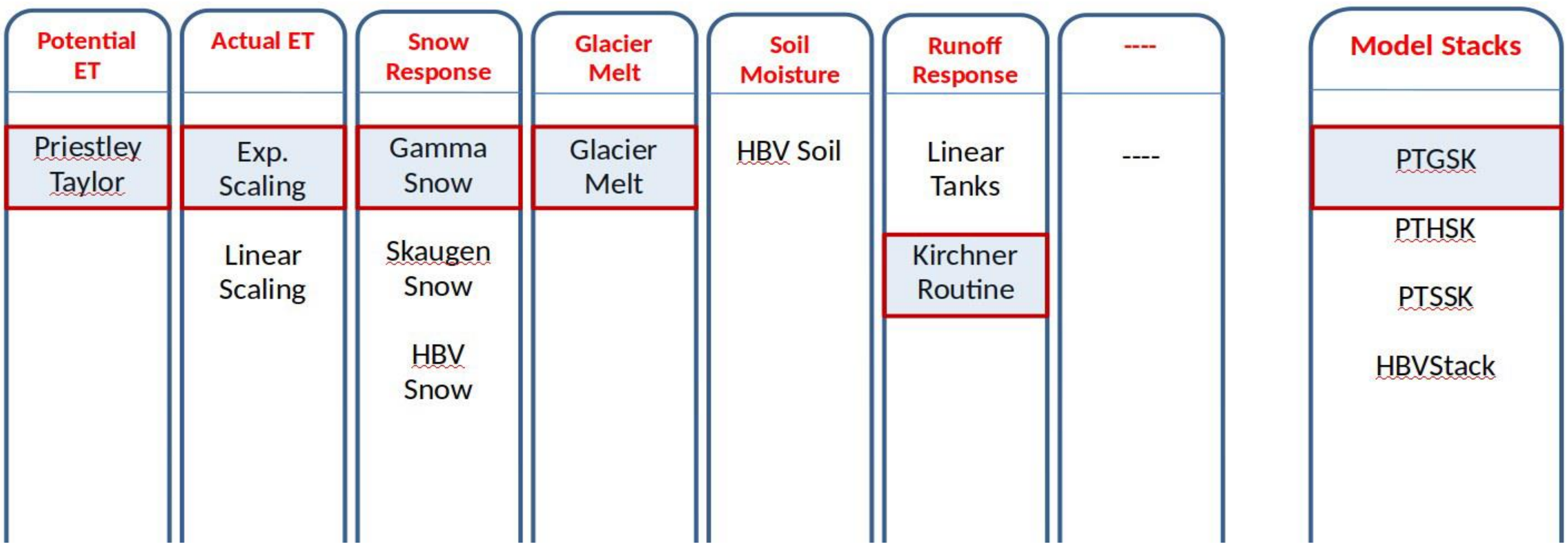
True flexibility is gained in evaluation of multiple configurations



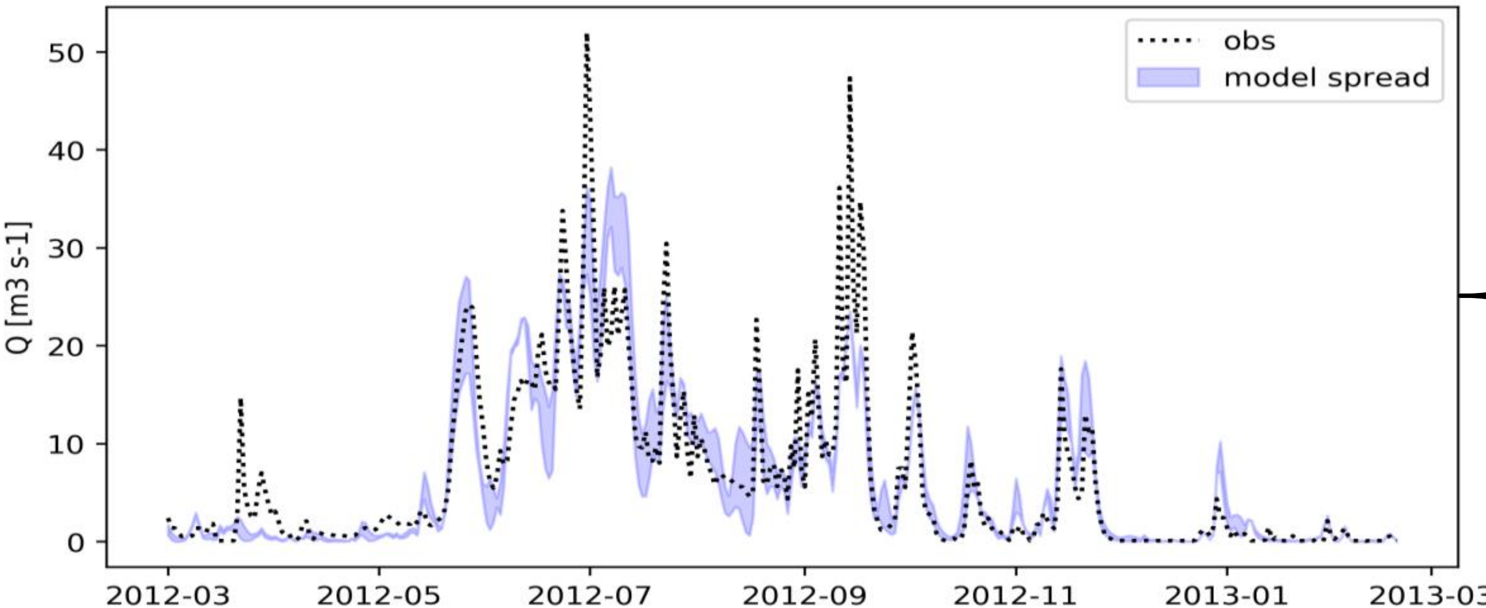
Uncertainty/sensitivity stems from:
- choice of model
- forcing input
- objective function
- observation uncertainty

The hydrological model in SHyFT

’Model Stacks’ allow us to address uncertainty and sensitivity due to model selection by providing a **simple** collection of routines for hydropower inflow forecasting.



Shyft allows for multiple working hypothesis



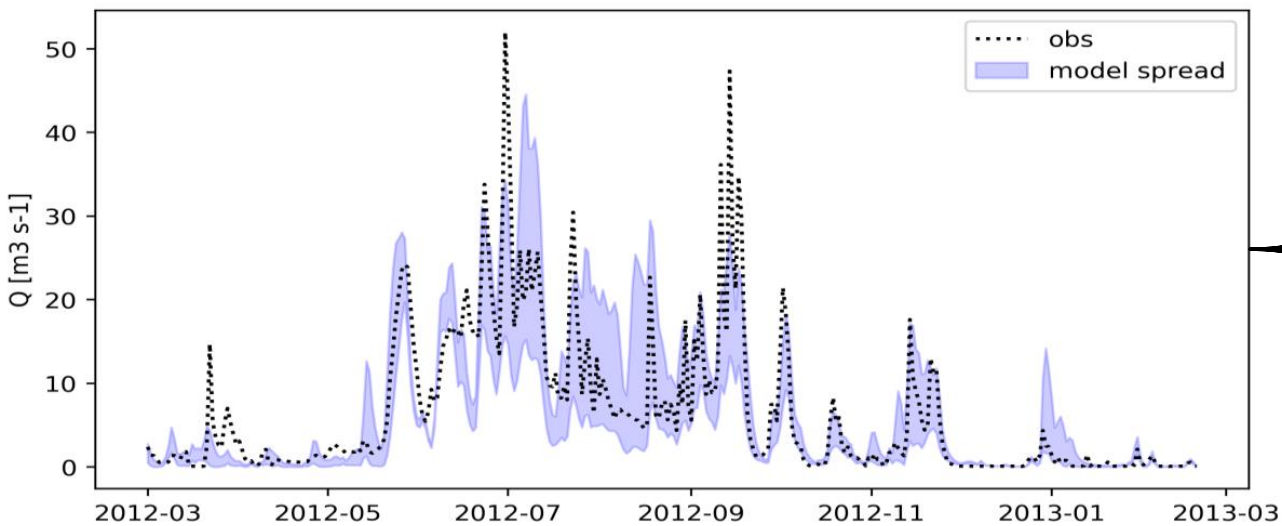
Models:

PTGSK

PTHSK

PTSSK

Computational efficiency allows for testing of a large number of model configurations



Models:

PTGSK

Param 1

Param 2

…

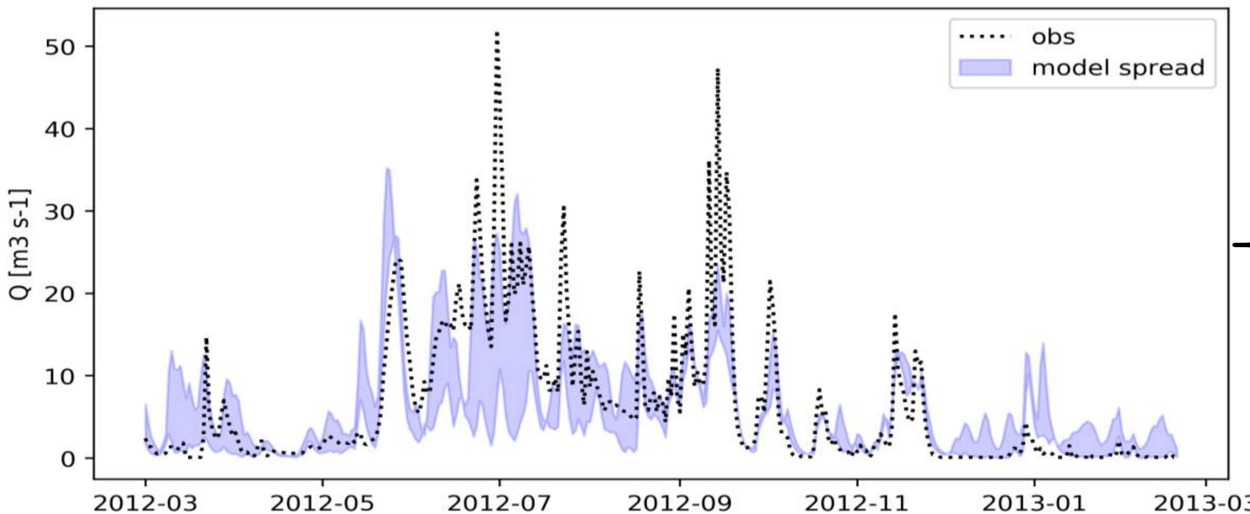
PTHSK

PTSSK

Forcing data represents the «truth», but what is the correct forcing?

Historical Input	Forecast Input	Input Processing	Model Stack	Simulation Unit	Routing	Calibration	Updating	Forecast System
Station	**AROME**	IDW Interp.	**PTGSK**	**Cell**	**Unit Hyd.**	**Min Bobyqua**	None	1
AROME	EC	**Kriging Interp.**	PTSSK	**Subcat.**	Isochrone	**Shuffled Complex**	**Substitute**	2
EC Grid	GFS	Bayes TKrig	PTHSK	ElevZone	Hydraulic	DREAM	Weighting	**3**
ERA-Interim		**GridPP**	HBVSTack				Kalman Filter	4
SE-Norge		Weighting						5
		QM						6
								7
								8

Repository concept allows for fast analysis of different data sources



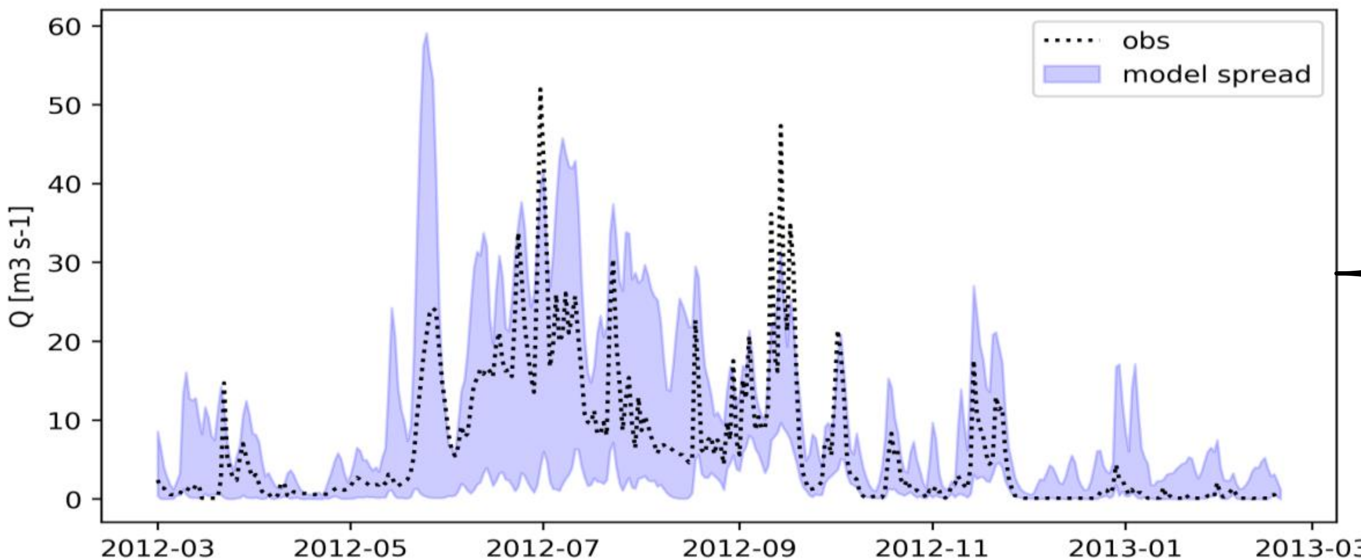
Models:

PTGSK
- SeNorge
- ECMWF
- ...

PTHSK

PTSSK

Model spread resulting from various sources of uncertainty and sensitivities



Model spread from uncertainty in:

Model structure

Model parameters

Model forcing data

Operational forecasting with uncertainty

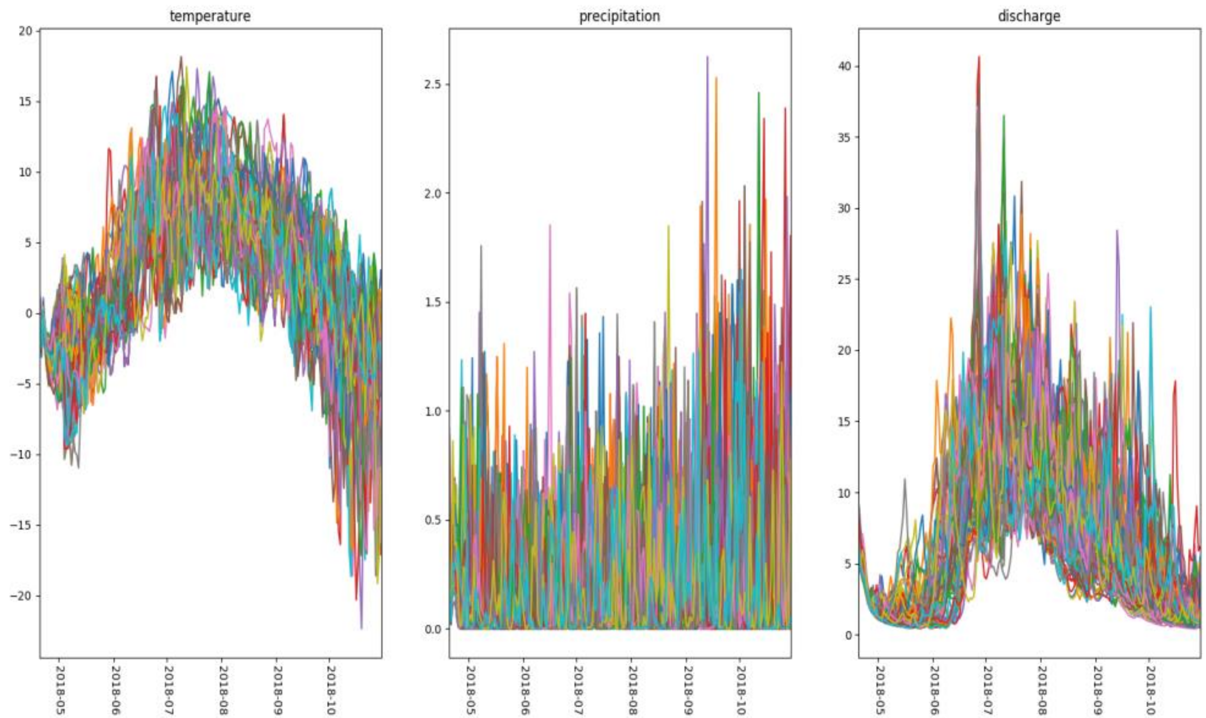
Forcing data:

gridded data from a weather generator

Horizon: 200 days

Simulation time resolution: hourly

Simulation spatial resolution: 2x2 km



THANK YOU

SHyFT is available from:
https://github.com/statkraft/shyft

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