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CONPHYDE

Climate-based **O**peratio**N**al **P**redictions for **HY**dropower **DE**cision

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Introduction

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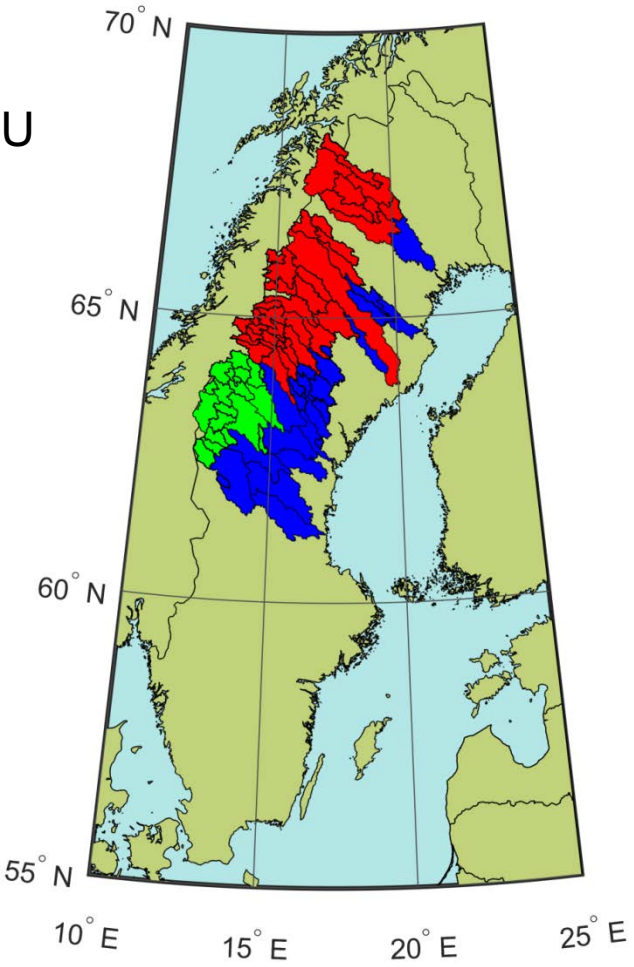
- Sweden is the biggest hydropower producer in the EU and 10th worldwide (IEA 2012)

- 7 hydropower rivers in northern Sweden
  - Number of regulation points: 825+
  - Number of power stations: 170+
  - Hydropower production (2014) : ~47 TWh
  - Value of water managed annually: 3B sek



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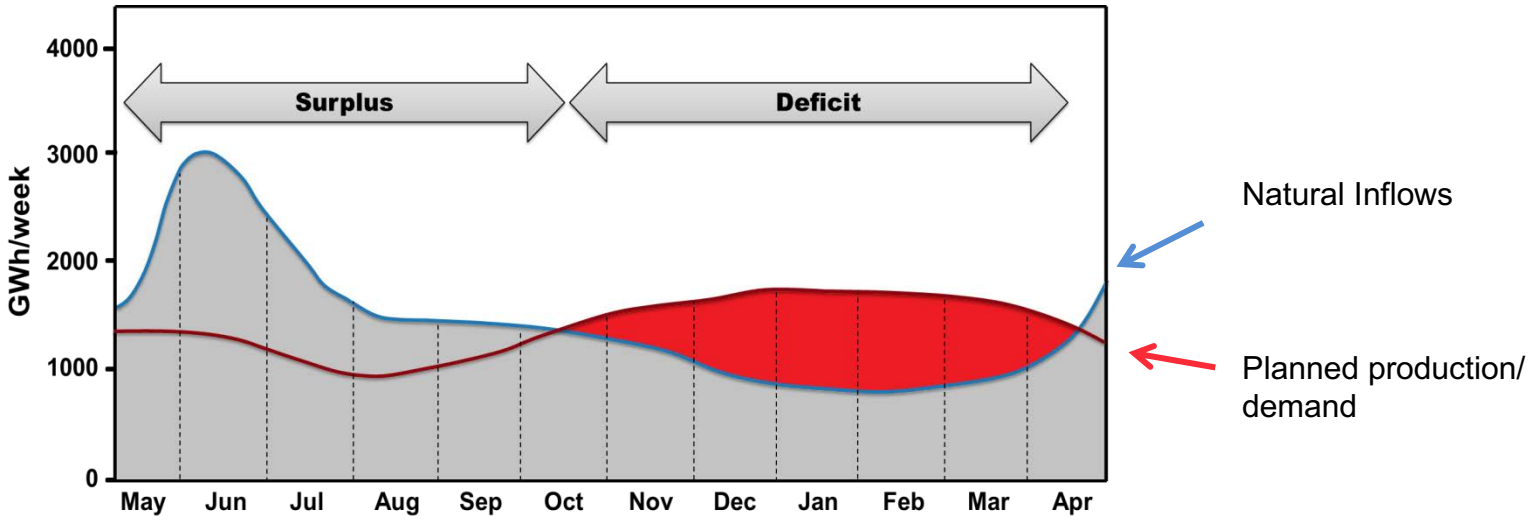
Introduction - problem

- Asymmetric distribution of inflows and demand over the year



- Current operational system
  - Climatological ensemble of P and T used to run HBV (ESP)
  - Forecast typically issued in February
  - Forecasts of inflow volume for the period May-June-July
  - Little improvement in forecast errors over the last 30 years

Introduction – seasonal forecasting

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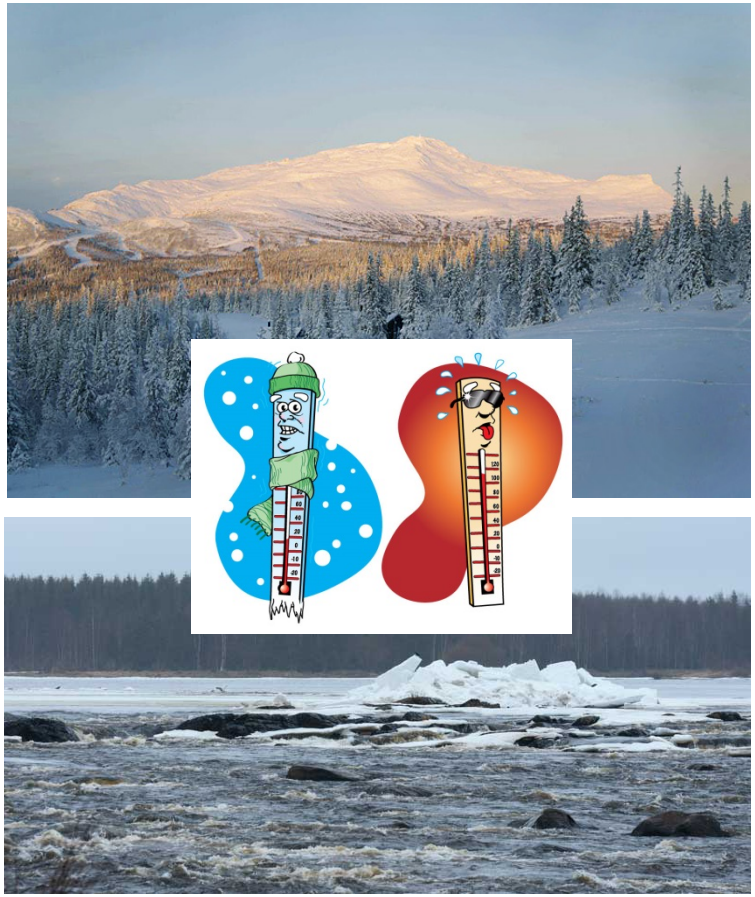
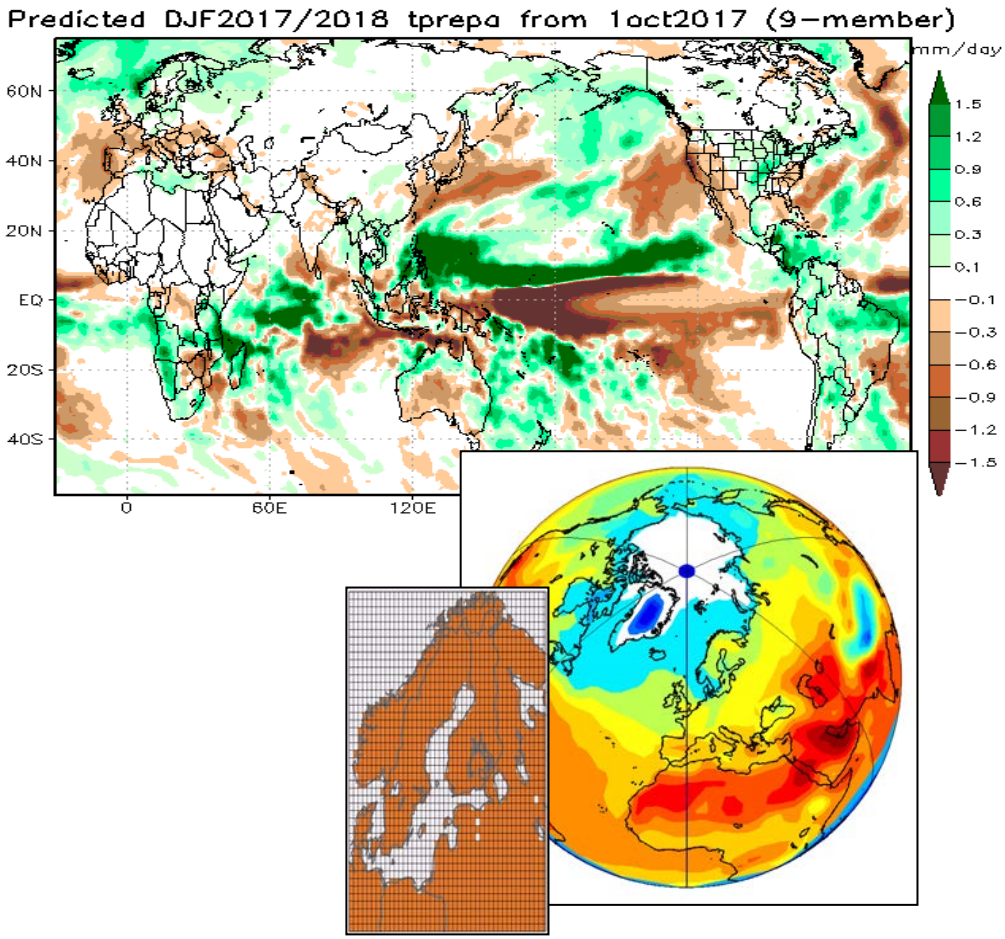
Initial conditions



Knowledge of weather
during the forecast period



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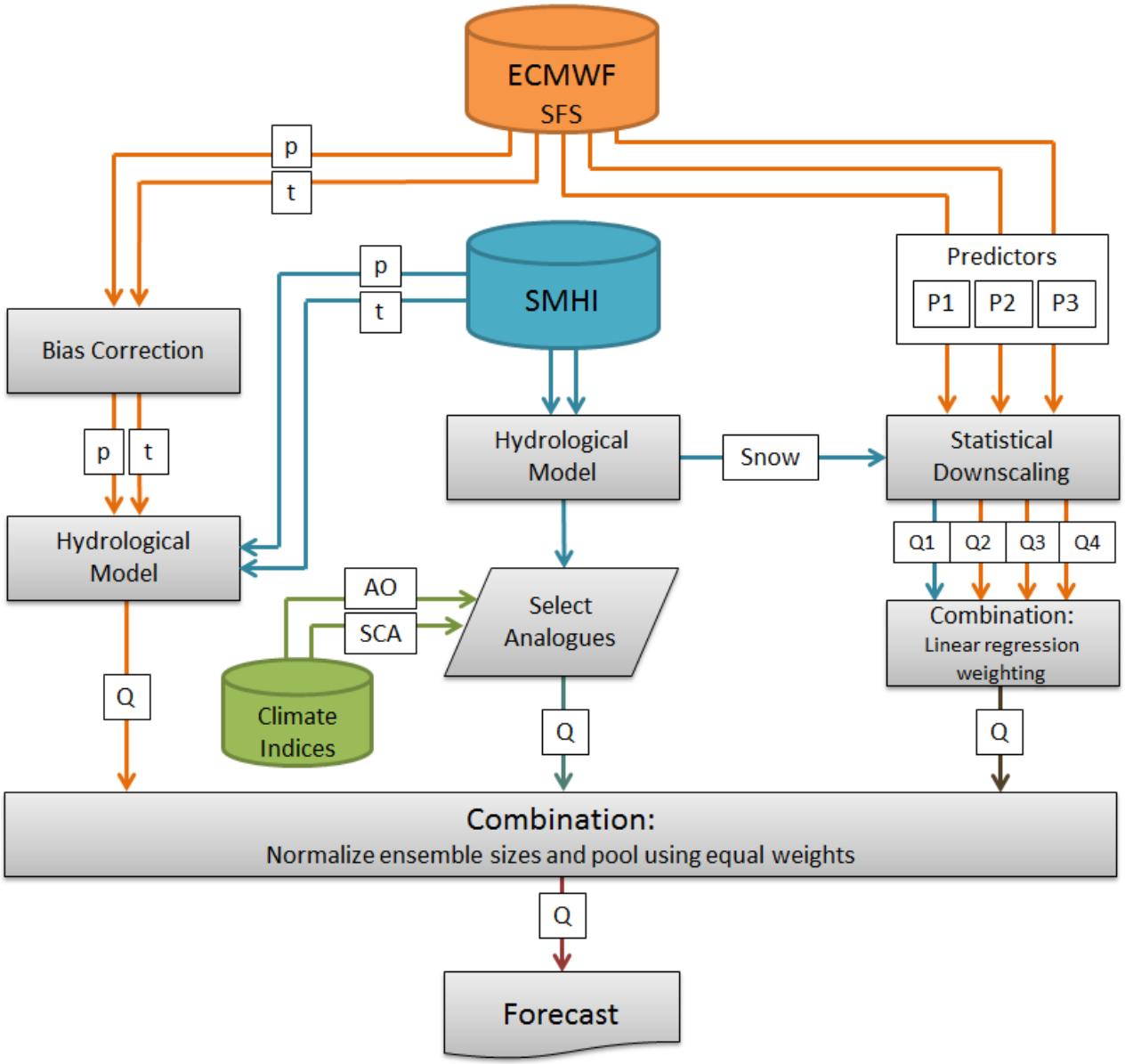

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CONPHYDE – NWP Chain

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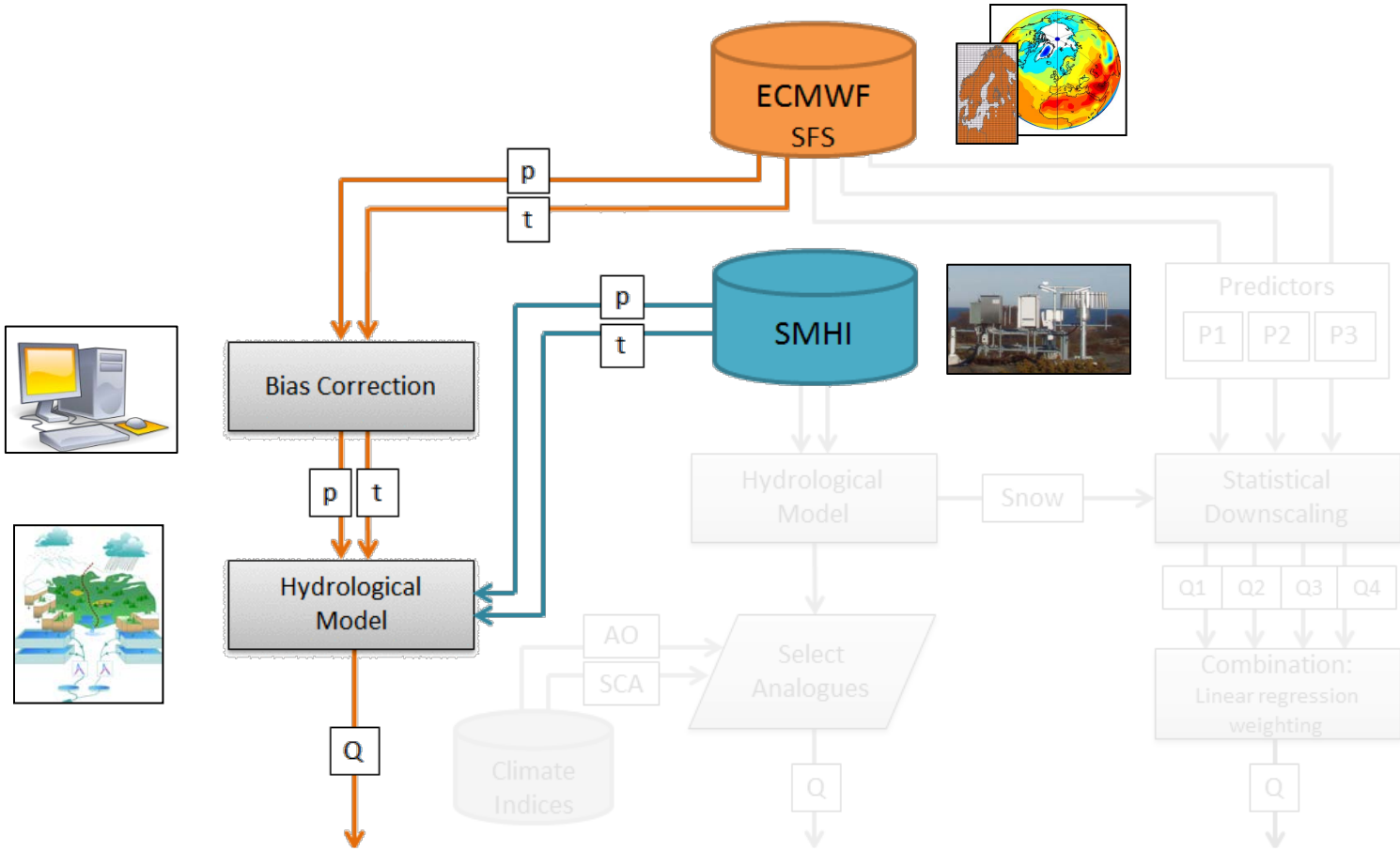

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CONPHYDE – ESP Chain

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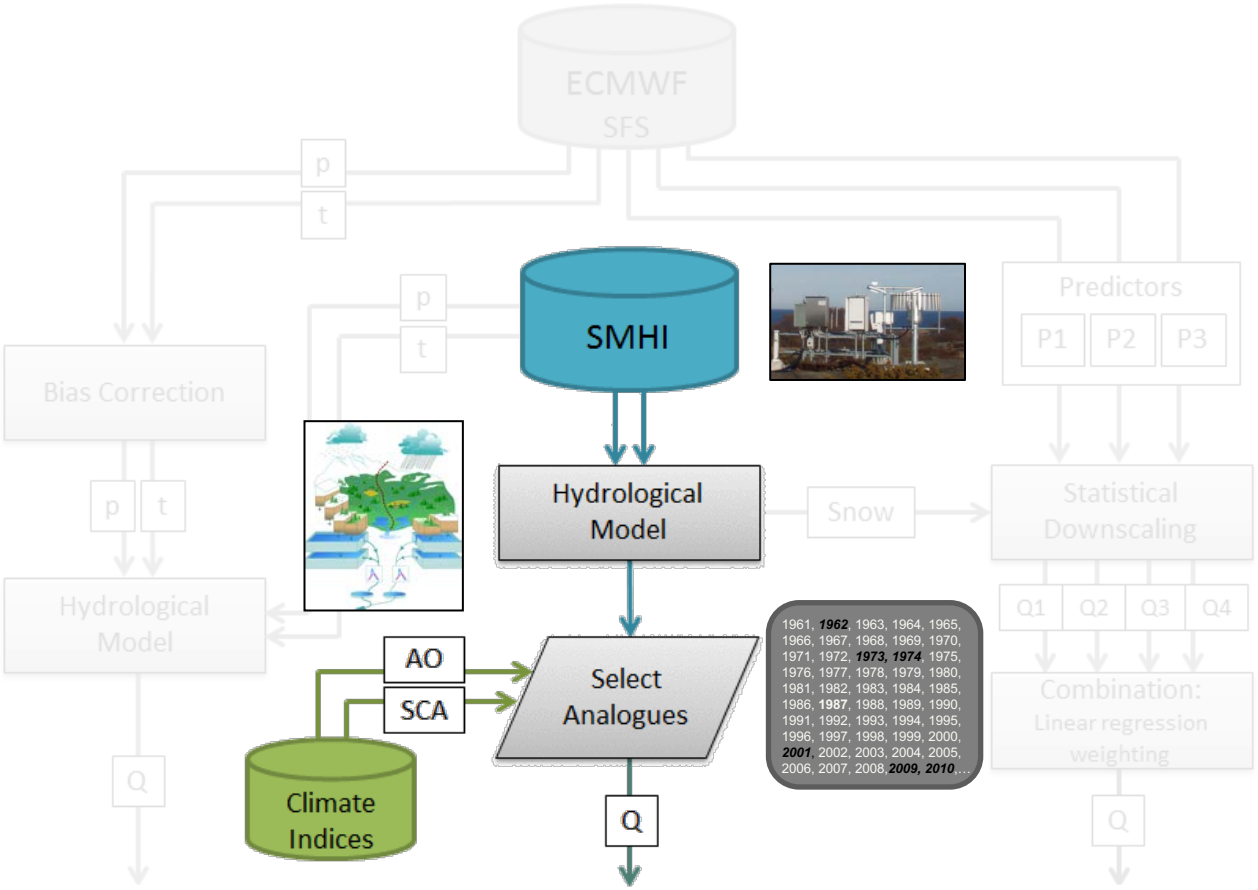

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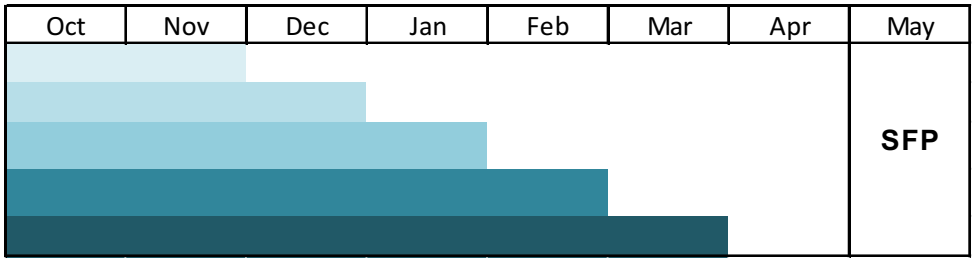
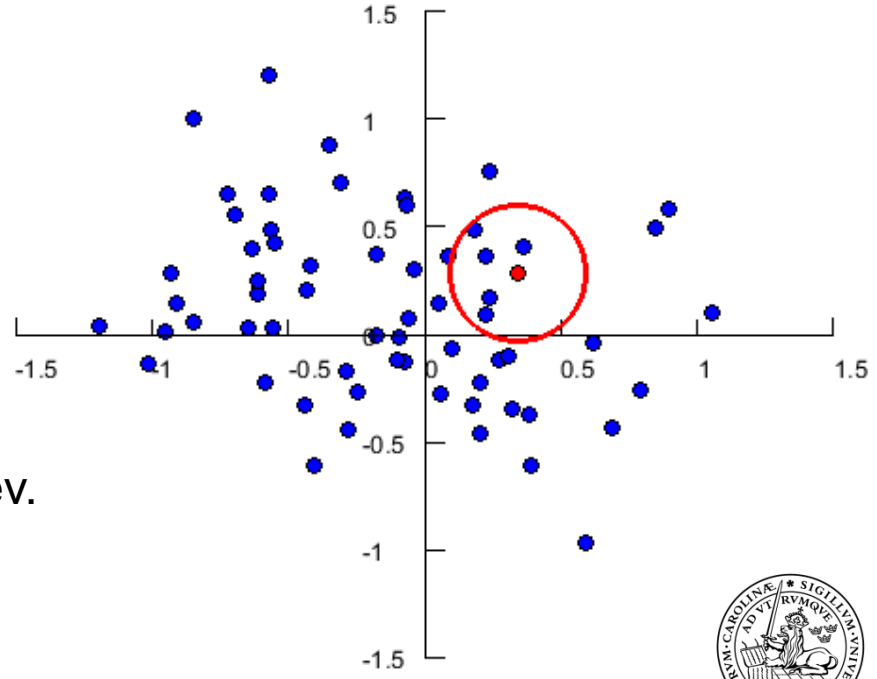
CONPHYDE – ESP Chain cont.

- Teleconnection indices
  - AO (~NAO)
  - SCAND





- Select years with similar climate setup
  - Euclidean distance < 0,25 std. dev.

CONPHYDE – Statistical Chain

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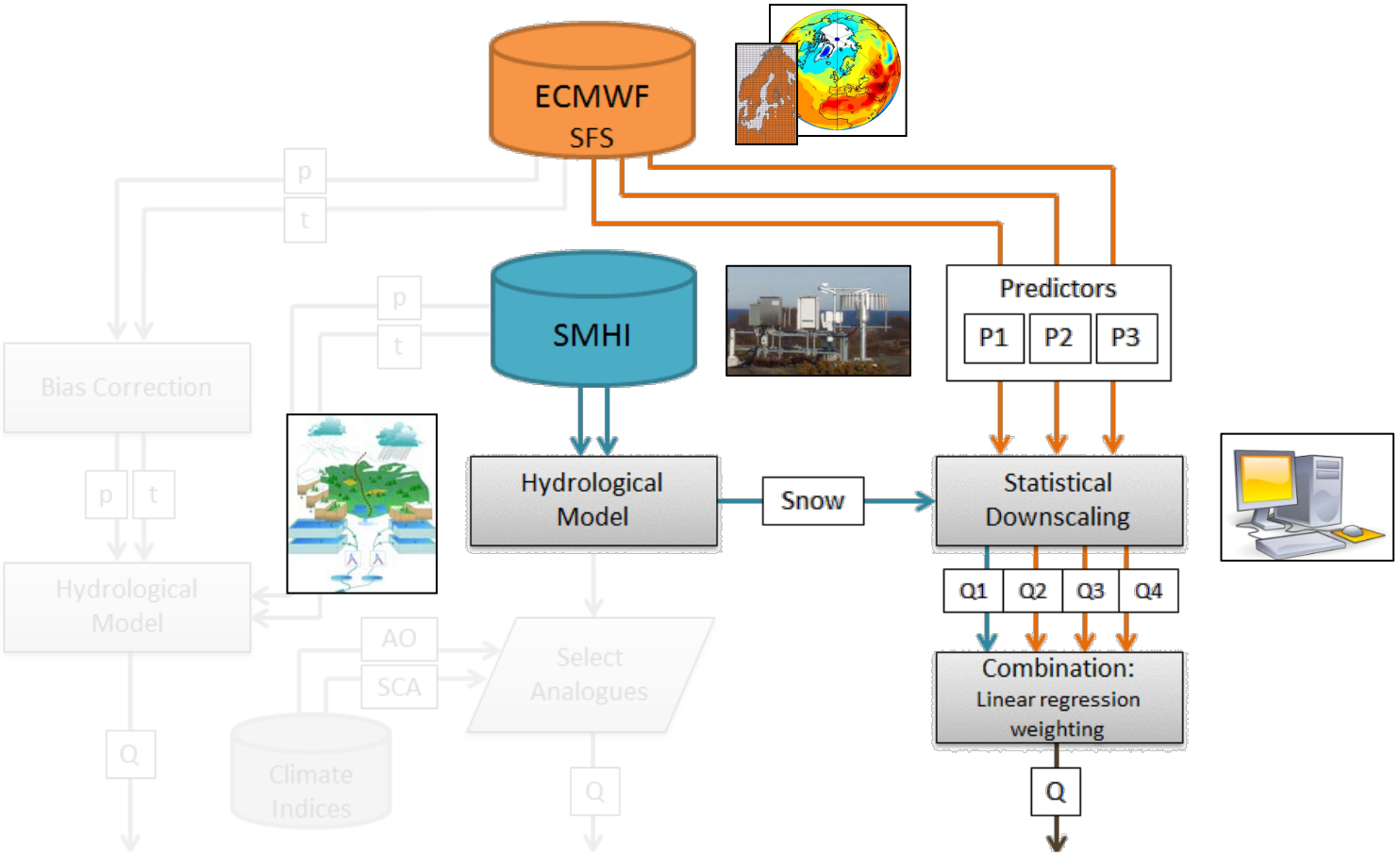

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CONPHYDE – Statistical Chain cont.

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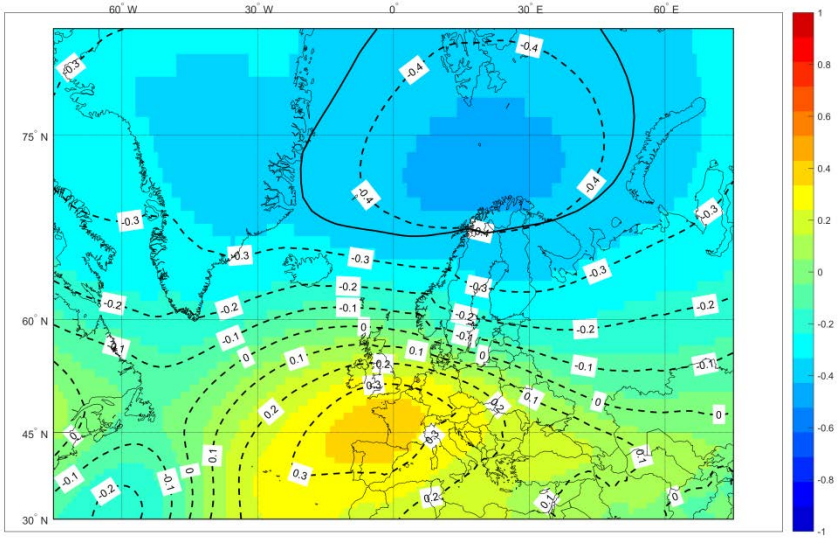

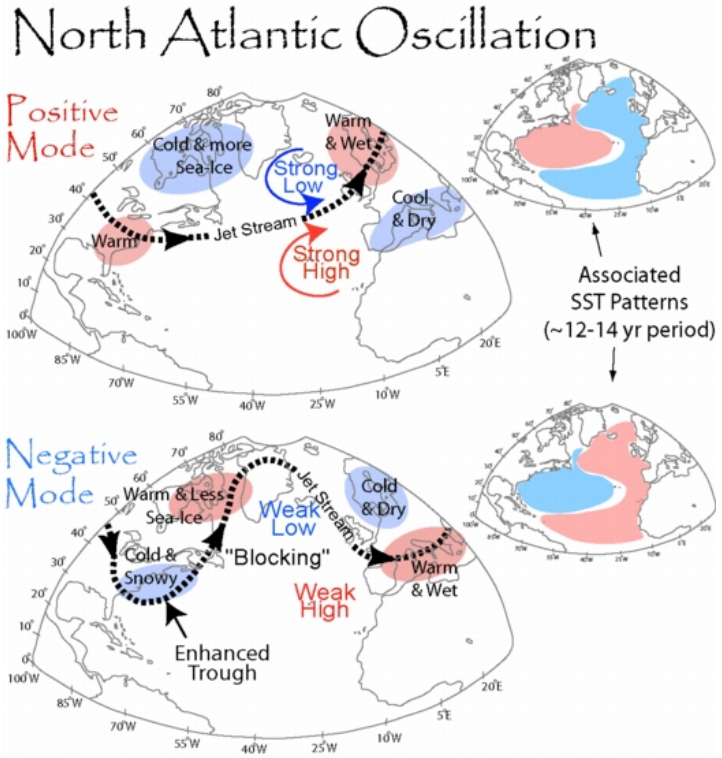

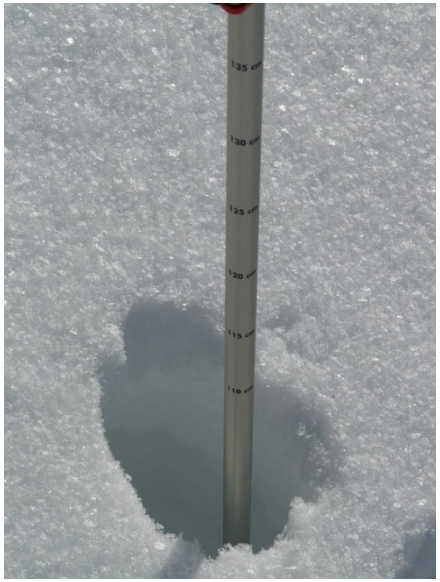

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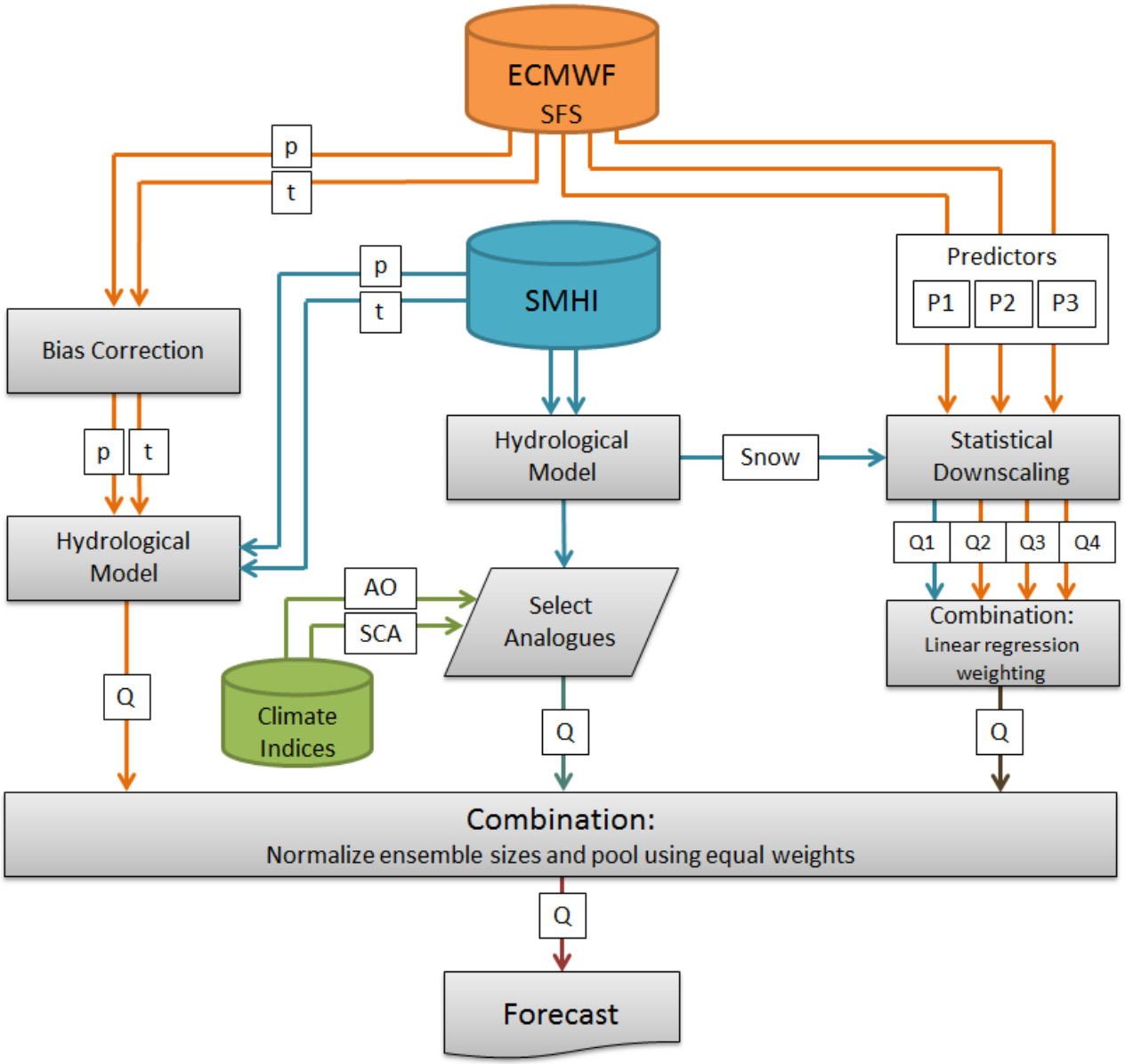

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Visualisation - Excel

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	A	B	C	D	E	F
1	Date	Min	25	50	75	Max
2	CONPHYDE Spring Flood Volume	3161.547	3847.529	4126.82	4291.473	5344.86
3	CONPHYDE Seasonal Volume	3500.333	4142.426	4427.939	4625.405	5754.163
4	Onset Day	60	76	84	92	105
5	01-feb-17	5.96284	6.18193	6.23729	6.614095	17.95974
6	02-feb-17	11.22714	11.7815	11.9947	12.46509	40.85259
7	03-feb-17	15.95739	16.61585	16.88225	17.75177	66.99053
8	04-feb-17	20.31863	21.19873	21.44161	22.71431	88.50938
9	05-feb-17	24.23827	25.50105	25.86165	27.30889	105.4732
10	06-feb-17	27.90994	29.52171	30.01952	32.51729	124.6277
11	07-feb-17	31.58345	33.16011	33.75565	36.65921	140.5081
12	08-feb-17	35.27062	36.6376	37.24586	41.22094	154.2915
13	09-feb-17	38.65729	40.16914	40.94494	45.37949	184.4775
14	10-feb-17	41.95452	43.80975	44.57373	49.74241	210.7489
15	11-feb-17	45.16636	47.0556	48.22143	53.90027	230.9298
16	12-feb-17	48.29646	50.39656	51.91013	57.4026	247.6069
17	13-feb-17	51.40107	53.57383	55.65188	61.78807	262.029
18	14-feb-17	54.3802	57.05468	59.50392	65.13325	274.3689

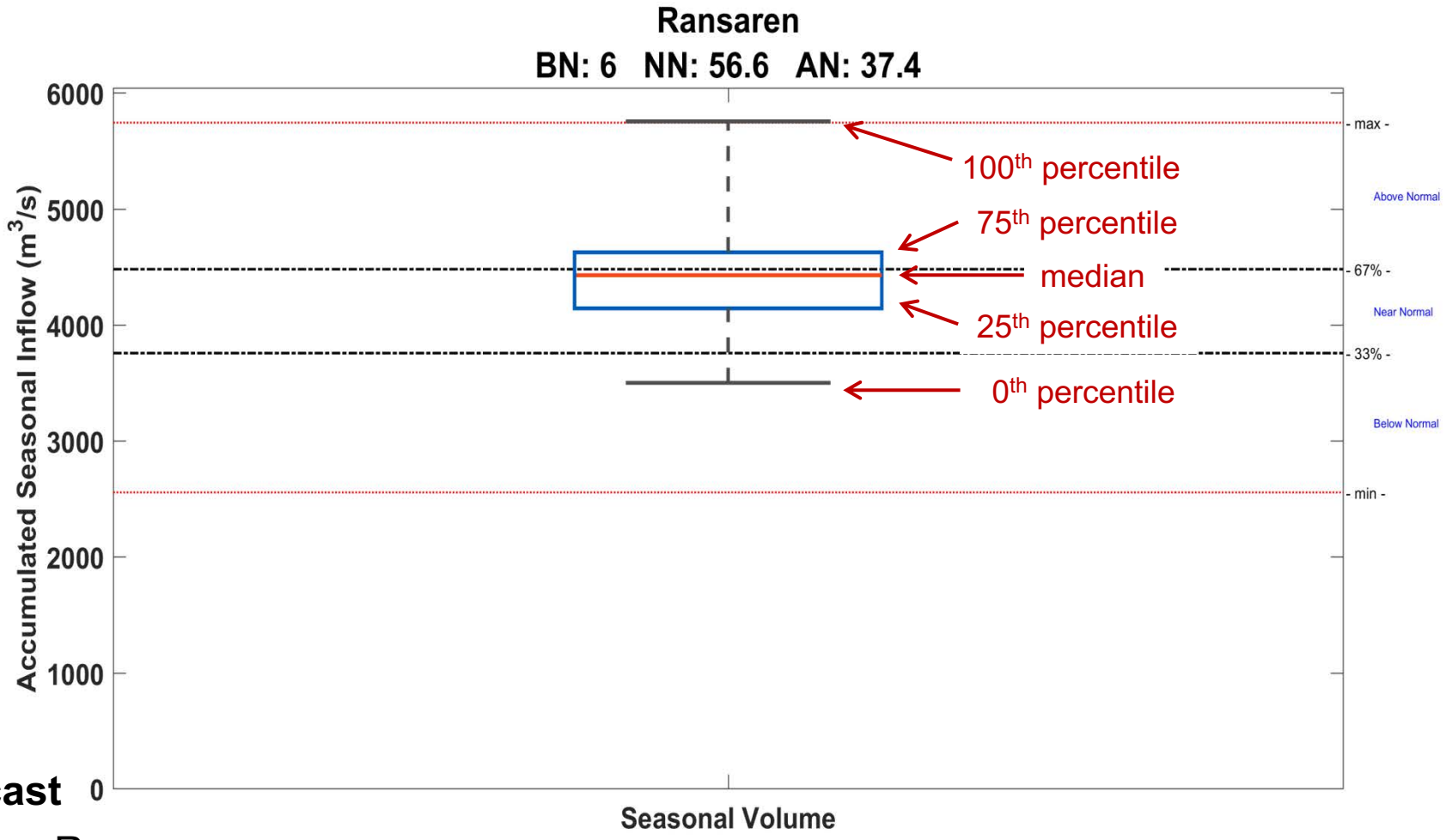
Forecast

Station: Ransaren

Year: 2017

FC-date: February

Visualisation - boxplot



Forecast

Station: Ransaren

Year: 2017

FC-date: February

Visualisation - OnsetVolume Box

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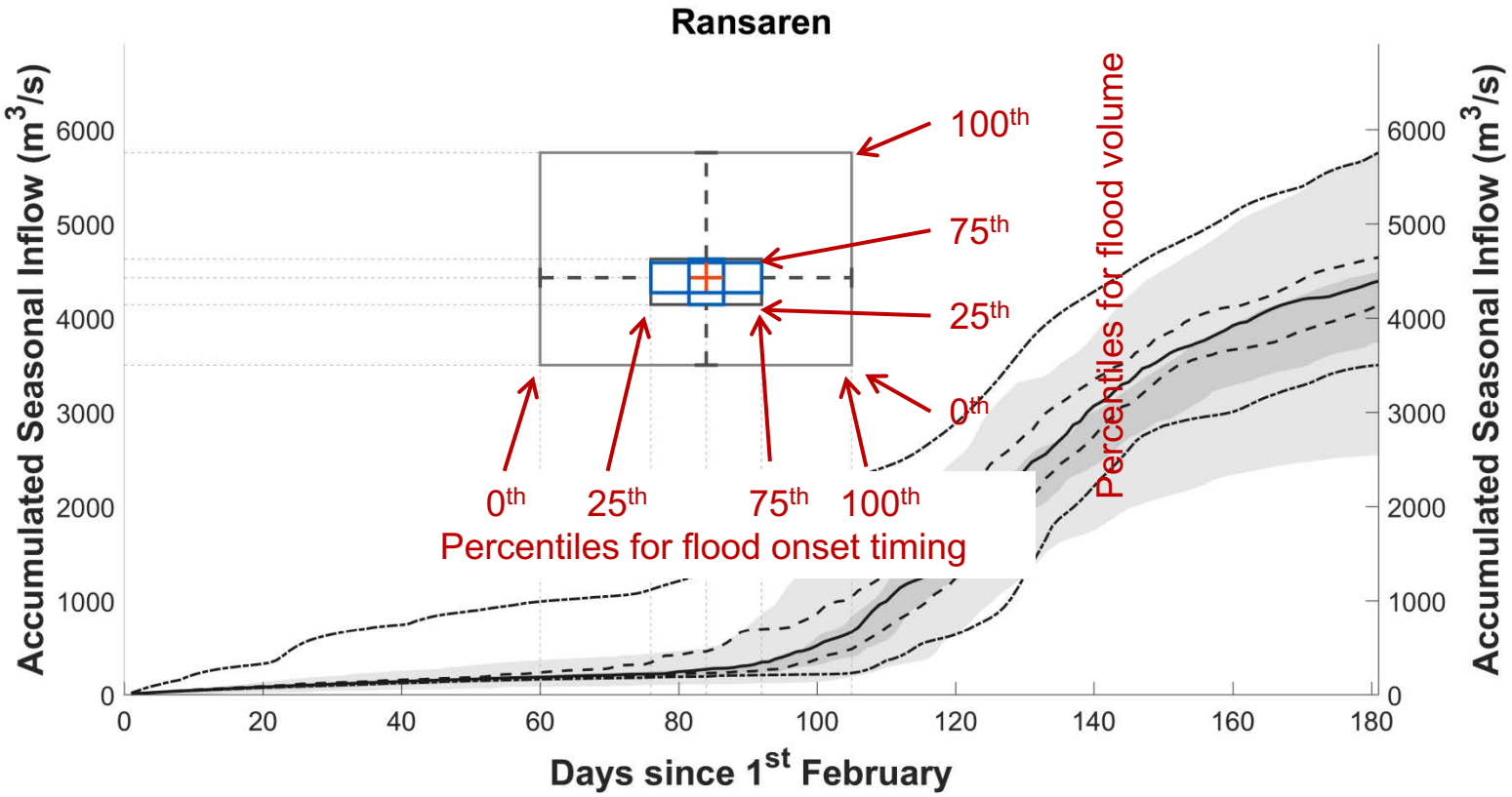

Forecast

Station: Ransaren

Year: 2017

FC-date: February

Climatological range of observed inflows

Forecast ensemble members

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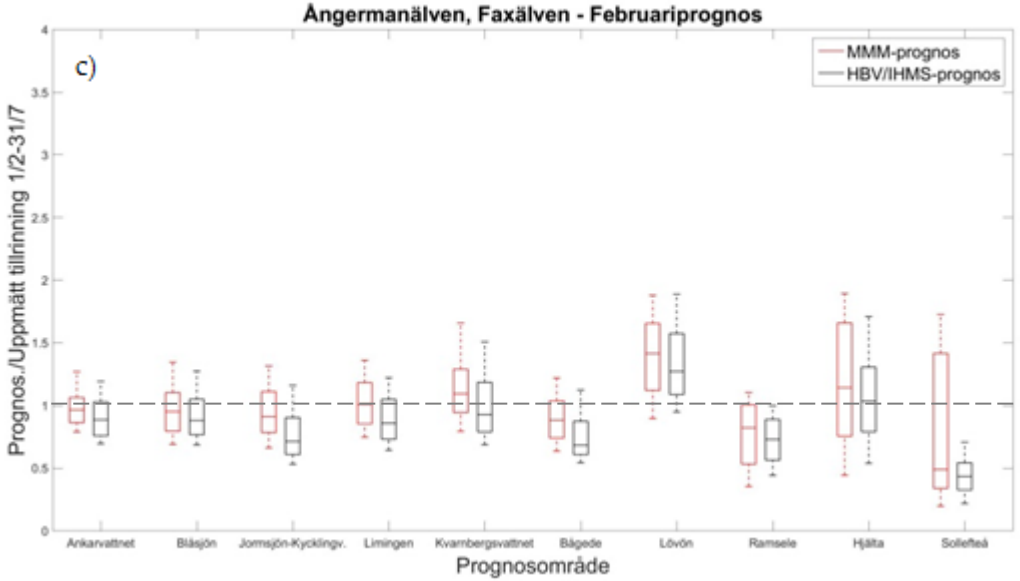
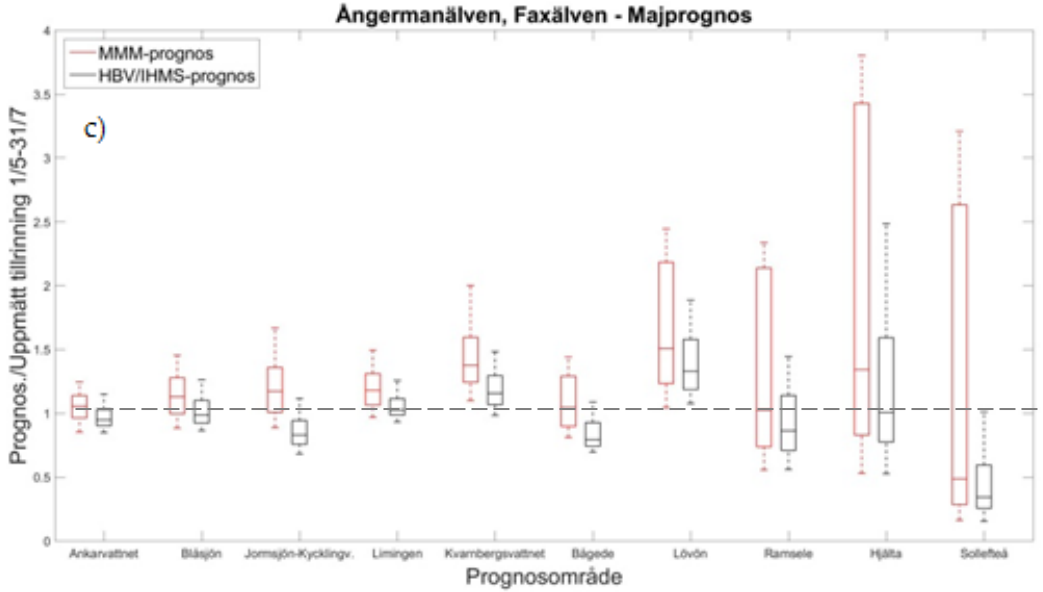
Evaluation - 2017





Comments

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Cons

- Data requirements
- Statistical validity
- Semiregular re-calibration

Pros

- ~6% error reduction
- Better 65% of the time
- Plug-and-play
- Semiregular re-calibration

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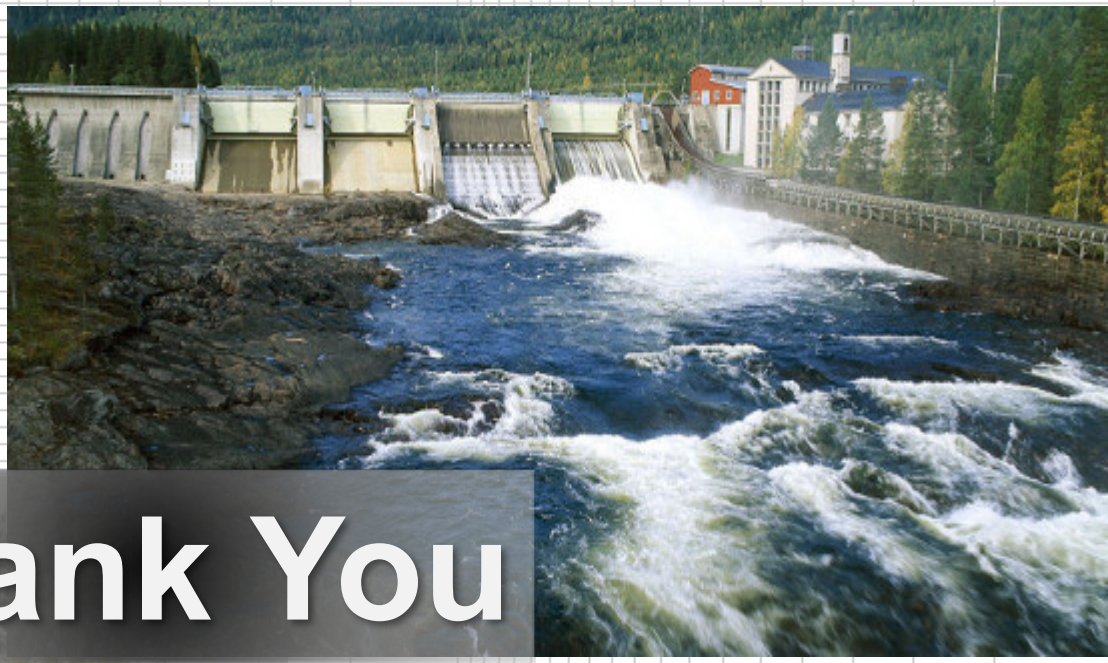

Thank You

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MISSION:

- ❑ **Develop SMHI infrastructure / operations**
- ❑ **Linking met/clim and hydrology**
- ❑ **World-wide multi-basin modelling**
- ❑ **Current Scientific challenges:**
  - ➢ Extreme precipitation
  - ➢ Climate change impact
  - ➢ Water quality
  - ➢ Earth observations and data-assimilation

We Understand Water!

WATER RESOURCES ENGINEERING

LUND UNIVERSITY, SWEDEN

More information:

www.smhi.se/hydrology-research

Open Source Codes: **http://hype.sourceforge.net/**

Open Data: **http://hypeweb.smhi.se/**

http://www.tvrl.lth.se/english