



River ice modeling and its applications in Norwegian river

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What are the ice problems?

- Intake blockage
- Ice breakup and ice runs
- Changing winter environment

Intake Blockage



Photo:TEV

Ice Jams flood



Photo: NVE

Ice in bypass reach

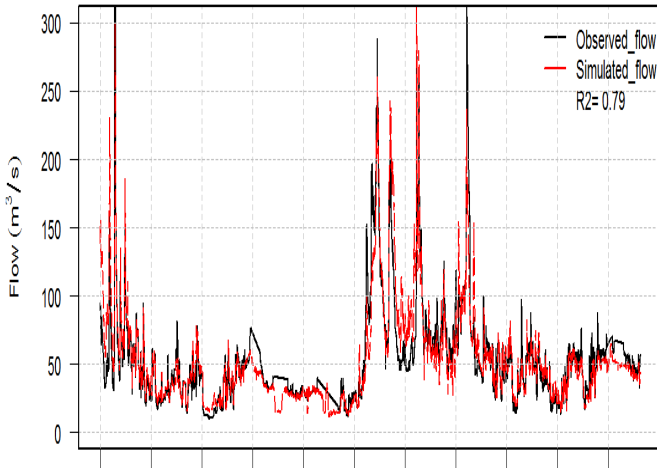


Ice free downstream of hydropower outlet

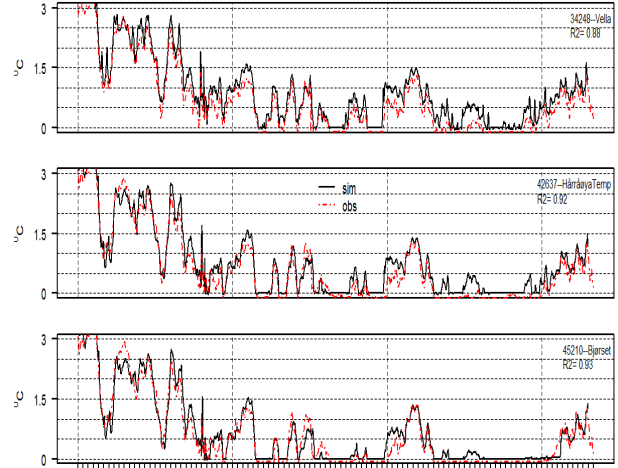
The solution

- Established a tool to understand the ice processes -Mike Ice

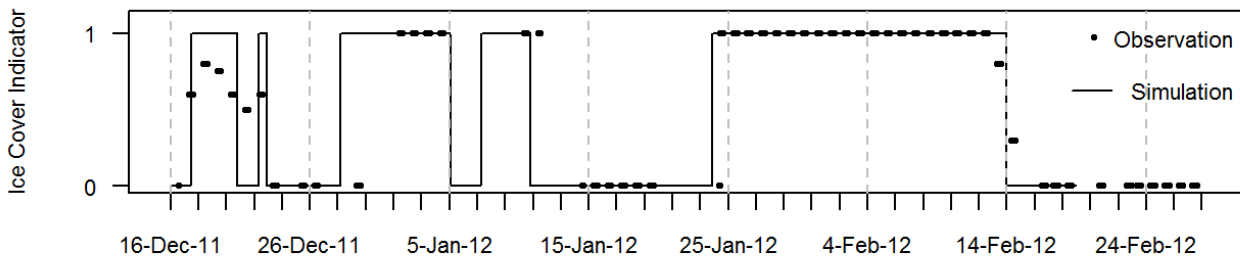
Source: Timalsina et. al. , 2013



Source: Timalsina et. al. , 2013



Validation of the model



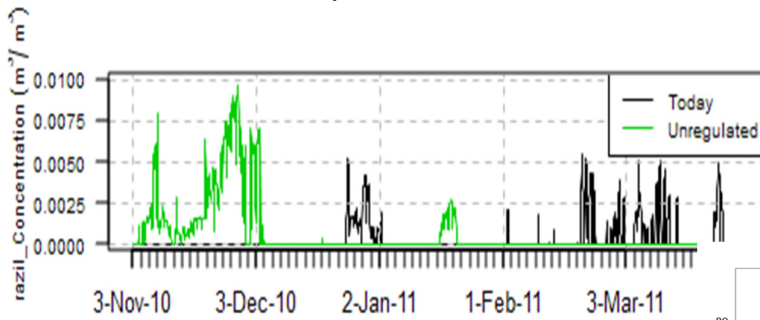
- Model correctly simulates Ice Cover at Bjørset (1:Complete Cover, 0: Open water)

Source: Timalsina et. al. , 2013

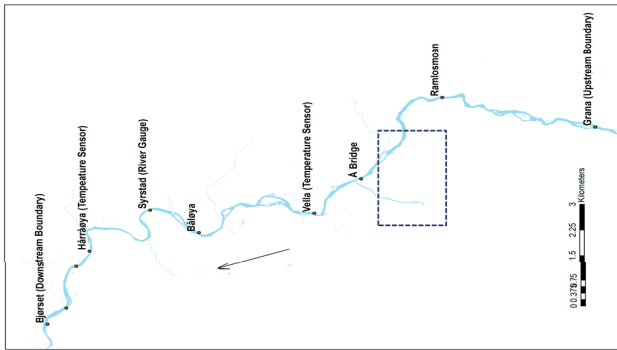


Application of the Modeling tool- Frazil production and ice cover assessment

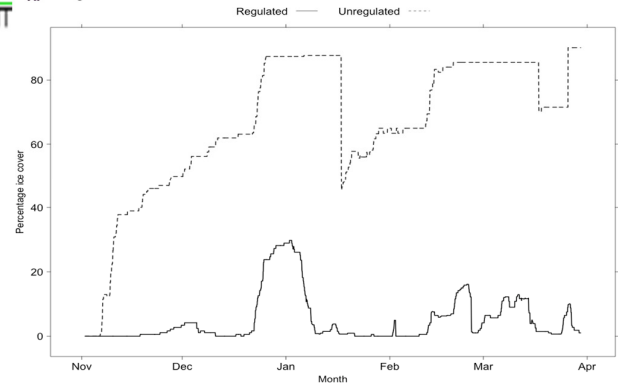
Frazil ice production at Å



Source: Timalsina et. al. , 2013 (modified)



Ice cover comparison



Source: Alfredsen and Timalsina., 2014

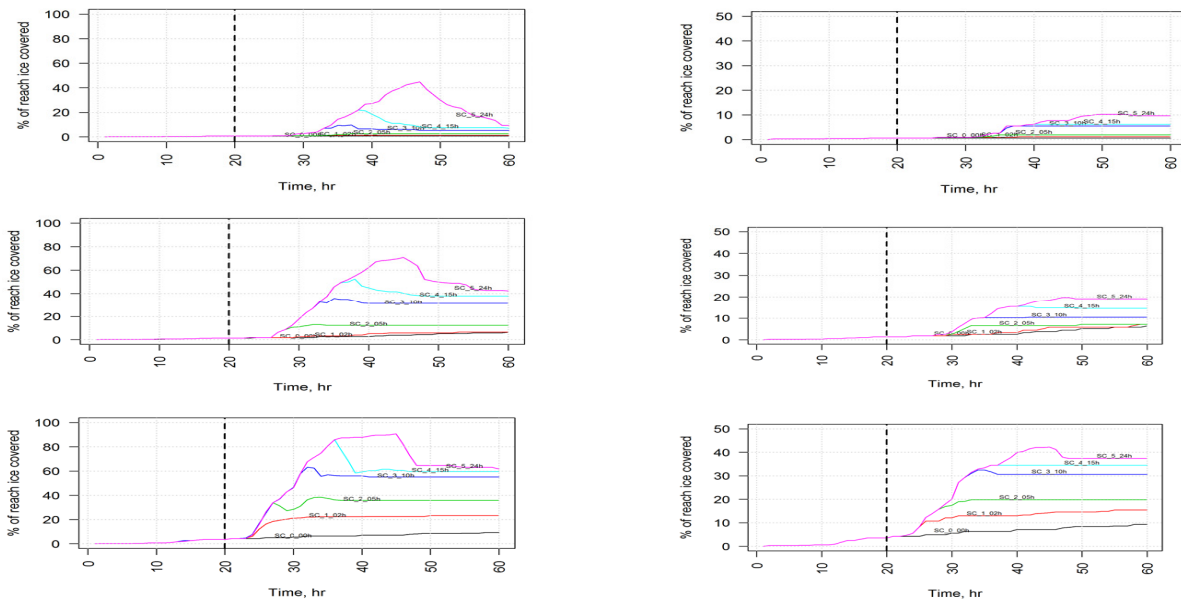
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Application of the Modeling tool- Mitigation measures

Ice cover conditions due to operational constraints



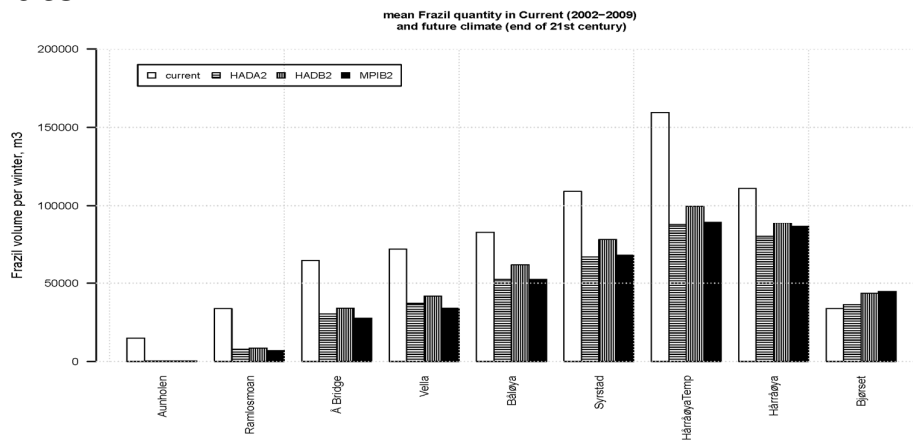
Source: Timalsina et. al 2014 (manuscript)

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Application of the Modeling tool- Ice conditions in future climate



Source: Gebre et. al. 2014

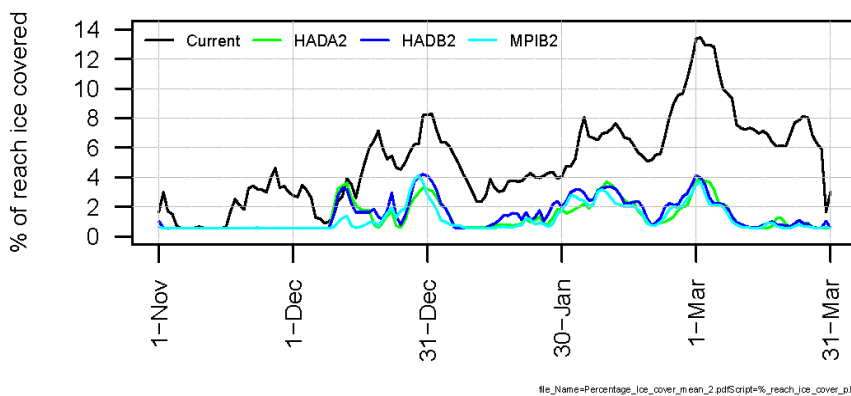


Fig: Ice cover in future climate

Timalsina et. al. 2013(b)



Conclusion

- Model has been established to understand the ice conditions
- A tool is useful to study ice regime changes due to regulation
- A tool to predict ice problems
- Propose the mitigation measures
- Prediction of the ice conditions on future climate and operational scenarios

Thank you

Takk skal du ha

Acknowledgements

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References:

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