

Title

Subtitle

Author



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# Abstract

**Abstract: accurate and informative?** Remember to include numerical results of your best model.

Oppskrift abstract.

1. Introduce topic and why its important
2. introduce a challenge or unresolved issue with the topic (that you will try to solve)
3. what have you done to solve this
4. Main Results
5. The implications in the context of 1+2

Never been investigating in detail.



# Acknowledgement

This thesis is a joint work between oslomet, simulamet and uio.

Legg inn abriviations



# Contents





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# Introduction

**Introduction: status of problem and the major objectives.**

Presenter innholder i kapitlet.

Citing **einstein** before it shows up in the bibliography. Referencing figure ???. You can reference the chapters like this ?? and sections like this ??.

## **If this pilot project works, where could it be useful?**

1. Could it be useful for making more advanced parametrizations of clouds in climate models?
2. In that case it would be usefull to include tipical parametrizations in models? ERA5 models?

Answer questions like: What do we know about clouds

Forslag til hypotese: Maskinlæringsmodeller kan bidra til økt innsikt/forbedring i parametrisering av skyer.





# Theory

Presenter innholder i kapitlet.

## Study area and Data

**Add image of map**

Data in the period of 2004-2018 was downloaded at a hourly resolution.

## ERA5

**General paragraph on Re-Analysis**

**Temperature**

**Surface pressure**

**Specific and Relative humidity**

## Satellite images METEOSAT

**Make image showing the history of satellite images read the filenames and correlate MSG X with date and time.**

- Why this satellite – only one over Europe which is geostationary. Doing machine learning on satellites which is not in geosynchronous orbits are difficult due to the temporal inhomogeneity.
- Where is the data downloaded.
- Four generations of meteosat satellites. It exists older satellites from meteosat but they used a different sensor and they are not available online.

## ReGridding satellite images to fit ERA5 platecarre grid.

Husk at du regridder noe som allerede er usikker så det er ikke sikkert du tilfører noe usikkerhet.

**Add equation for area.**

**Image : View from space arrow view from era5 - cartopy maps.**

**Estimating dlon and dlat based on matrices of lat lon.**

**Explain overestimated the area**

Because of equation for area doesn't allow different d-lat dlon at each edge (should be trapesodial shape) (we don't have the information to calculate this either.)

Because of this overestimation we weight the pixels with

$$\frac{area \cdot ERA_a}{AREA_{allpixels}} \quad (2.1)$$

# Methods

Presenter innholder i kapitlet.

Tar det enkleste først også følger mer og mer detaljer..

**Formalism/methods: Discussion of the methods used and their basis/suitability.**

## Implementations, benchmarks and testing

### Training and Testing split

How is the split? There is one obvious downside to using a separate training and test set.

### Statistical models

**Linear model - AR model  $t_s = 0$**

**AR model  $t_s > 0$**

**Confidence intervals on beta coefficients.**

**Why not shrinking-methods? L1 and L2 penalties**

They only reduce noise, so if there is no noise present in theory their performance should not increase. Extra hyper parameter to introduce.

### Machine Learning models

General what can machine learning models do.

**Do I need to describe the traditional dense neural net? If only to say that it doesn't work well for this purpose.**

## **Convolutional LSTM model**

**Convolutional operation**

**Recurrent neural nets**

First to loop information back. READ PHD from bergen to describe this one.

**LSTM unit**

**Tower Architecture**

**Architecture from precipitation nowcasting.**

## **Hyperparameters**

### **Normalization/Standardization**

If the data are not standardized, and the predictors are of vastly different scales, then this can lead to some very large parameters which would be unfairly penalized when shrinkage is applied.

### **Model evaluation - metrics**

**Accumulated MSE**

# Results

Write summary of the contents of this chapter. Bare presenter resultatet ikke

**Analysis:** of results and the effectiveness of their selection and presentation. Are the results well understood and discussed?

**Linear model - AR model  $t_s = 0$**

**AR model  $t_s > 0$**

1. Heatmaps of score. Micheal suggested accumulated mse not mean.

**Convolutional LSTM model**



# Conclusions

**Conclusions, discussions and critical comments: on what was learned about the method used and on the results obtained. Possible directions and future improvements?**





# Discussion

Her skal resultatene drøftes. Ca. 30 sider om du skriver 110 sider.

## Datagrunnlag og sikkerhet i resultater

Diskuter problemer med reanalysis og satellitte bilde.

## Trekk inn det fra feltet fra før

Precipitation nowcasting artikkel??

*Results and interpretations in the context of other work and discussions in the field.*

## Implications - think big!

Reflekter over deres bidrag i internasjonale og større kontekstert.

Klassikerne i dette fagfeltet?

## DONT'S

1. Ikke referer til lærebøker
2. Only recent source - include old articles. Ikke stol på siteringer i introduksjon.
3. Les det du siterer.
4. Ikke siter upubliserte ting (Johanne).
5. Copy of ideas and approaches.



# **Appendix**

## **Section title**



## **An additional appendix**

