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Accuracy of near real time updates in wind power forecasting with regard to different weather regimes

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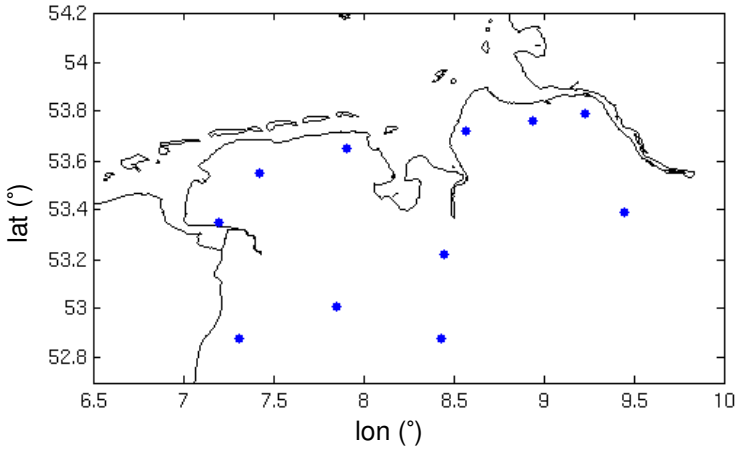
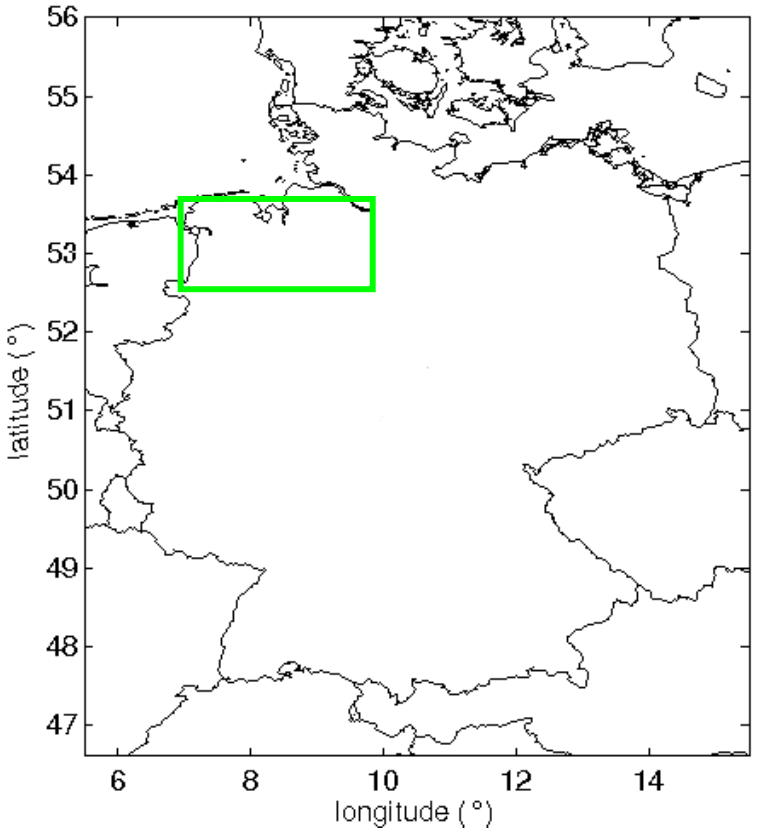
Outline

- Study site
- Wind power forecasting - method
- Cluster analysis – method and results
- Observed power by clusters
- Forecast errors by clusters
- Conclusions

Study site

North-West-Germany
single wind farms





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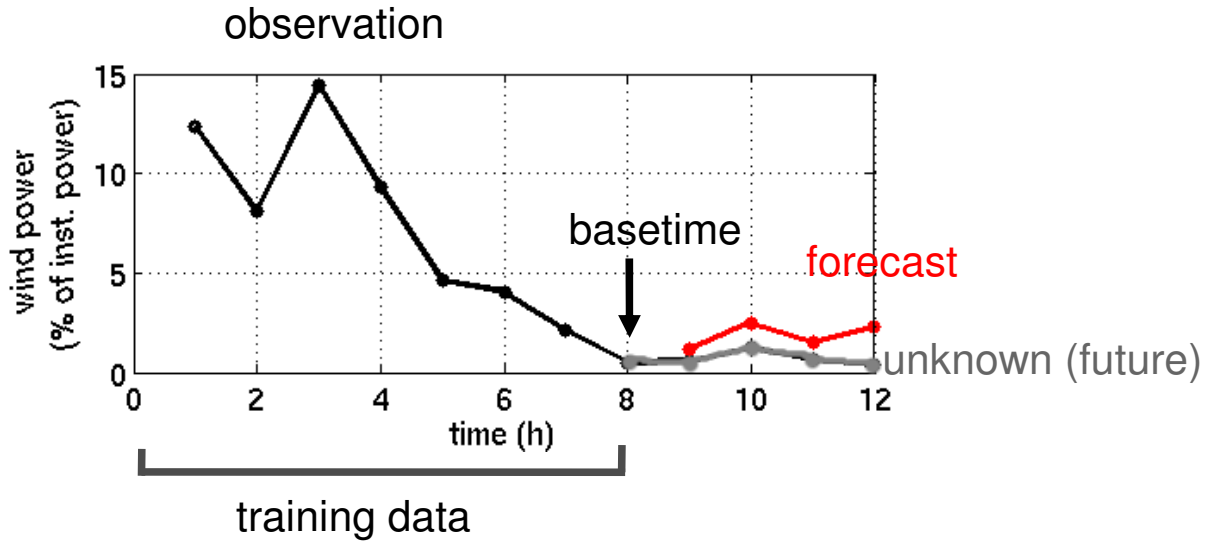
Wind power forecast

→ data ←
observed wind power input (2004 – 2006)

→ objective ←
forecast wind power of the next 4 hours
without wind speed information from weather forecasts (Numerical Weather Prediction)

→ method ←
Neural Networks



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Clustering

data: 500 hPa heights from ECMWF analysis data (6-hourly), Jan. 2005 – April 2007

Principal Component Analysis (PCA)

- reduction of data
- take as much components to have 99 % of explained variance

Cluster analysis

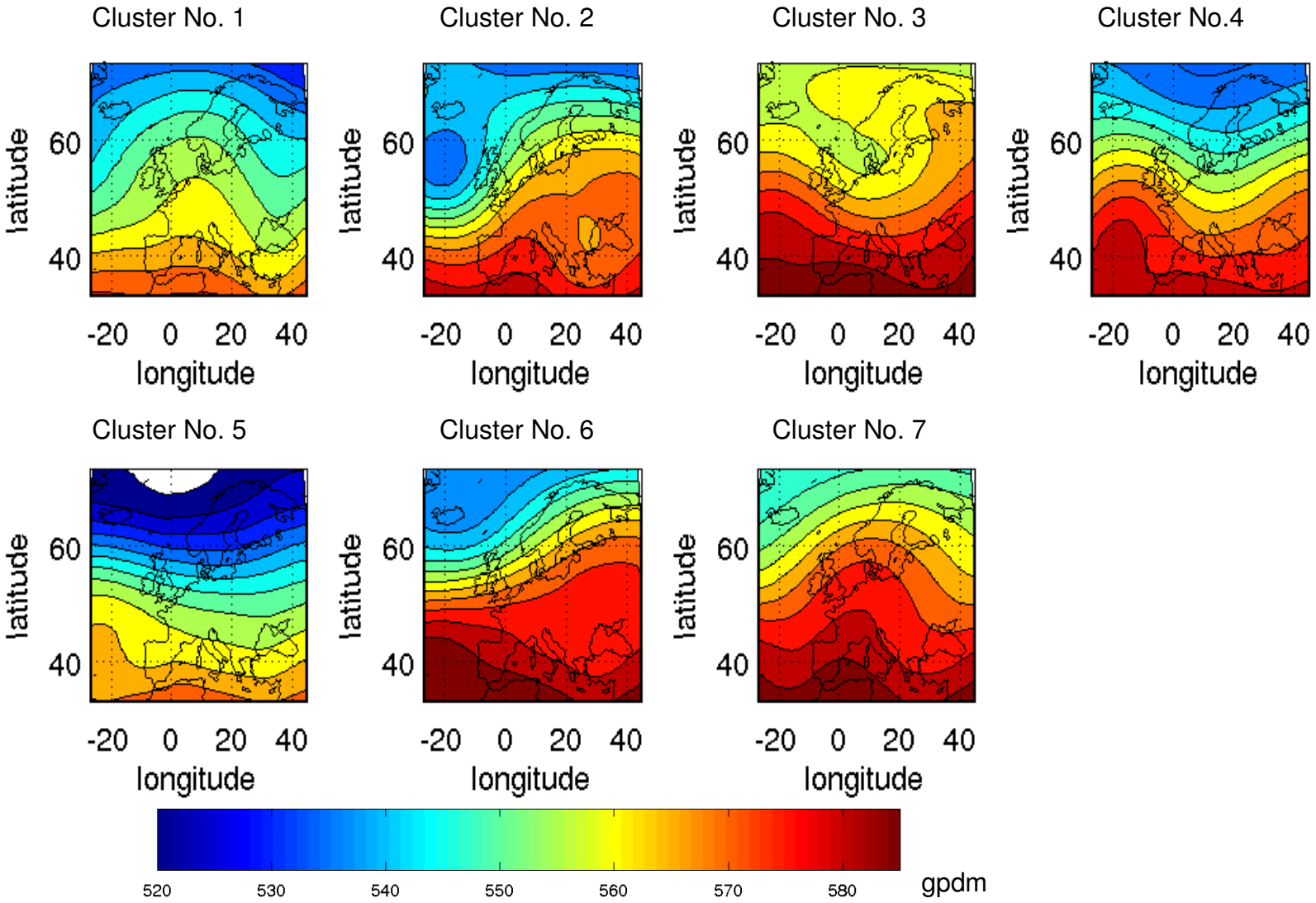
- k-mean clustering
- separately for:
summer (April - Sept) and
winter (Oct. - March)

→ relate single clusters to points in time

time	cluster
03-May-2005 06:00:00	1
03-May-2005 12:00:00	1
03-May-2005 18:00:00	1
04-May-2005 00:00:00	1
04-May-2005 06:00:00	1
04-May-2005 12:00:00	4
04-May-2005 18:00:00	4
05-May-2005 00:00:00	5
05-May-2005 06:00:00	5
05-May-2005 12:00:00	5
05-May-2005 18:00:00	5
06-May-2005 00:00:00	5
06-May-2005 06:00:00	5
06-May-2005 12:00:00	5
06-May-2005 18:00:00	5
07-May-2005 00:00:00	5

Summer - Cluster

500 hPa level January 2005 - April 2007



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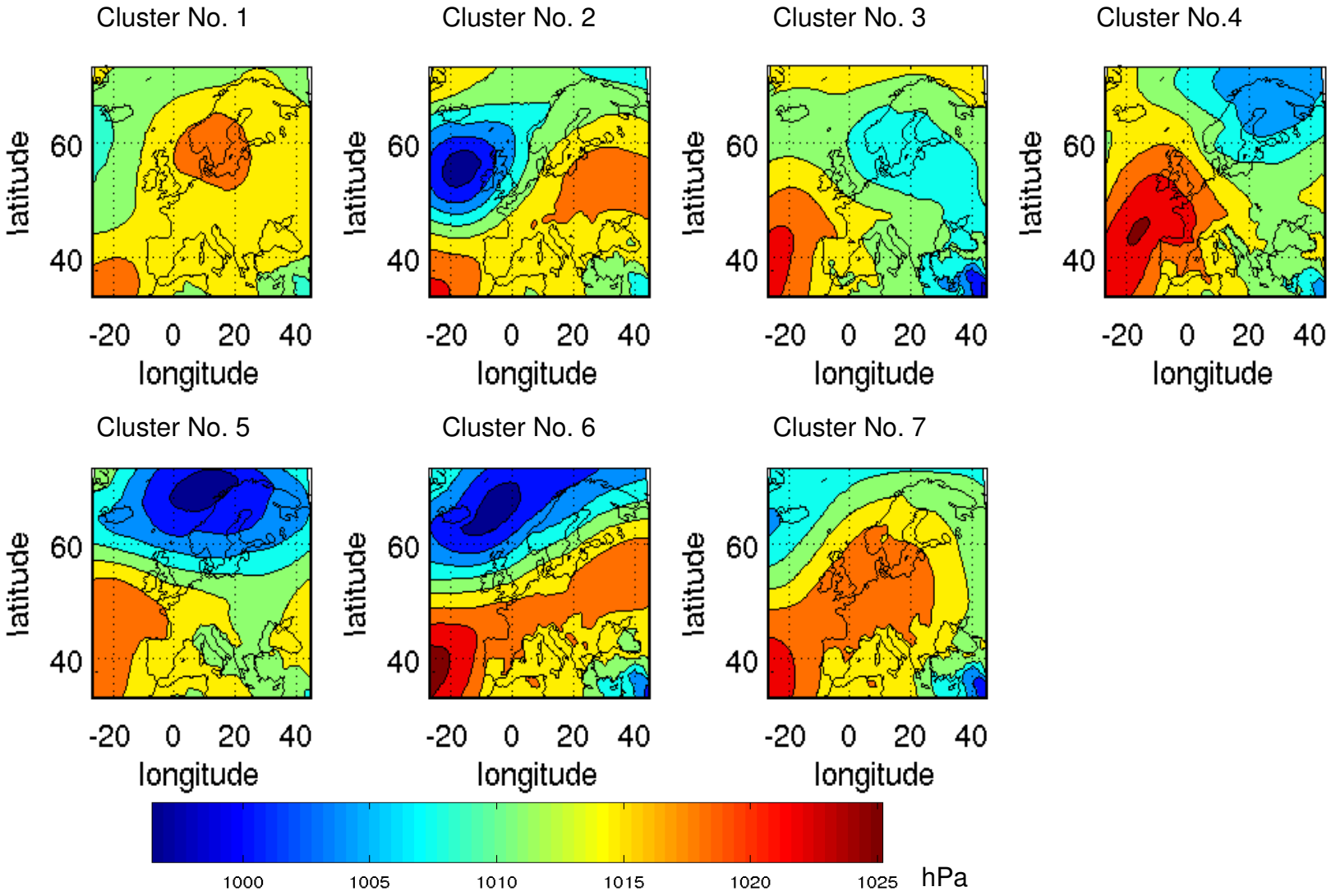
Summer - Cluster

sea level January 2005 - April 2007



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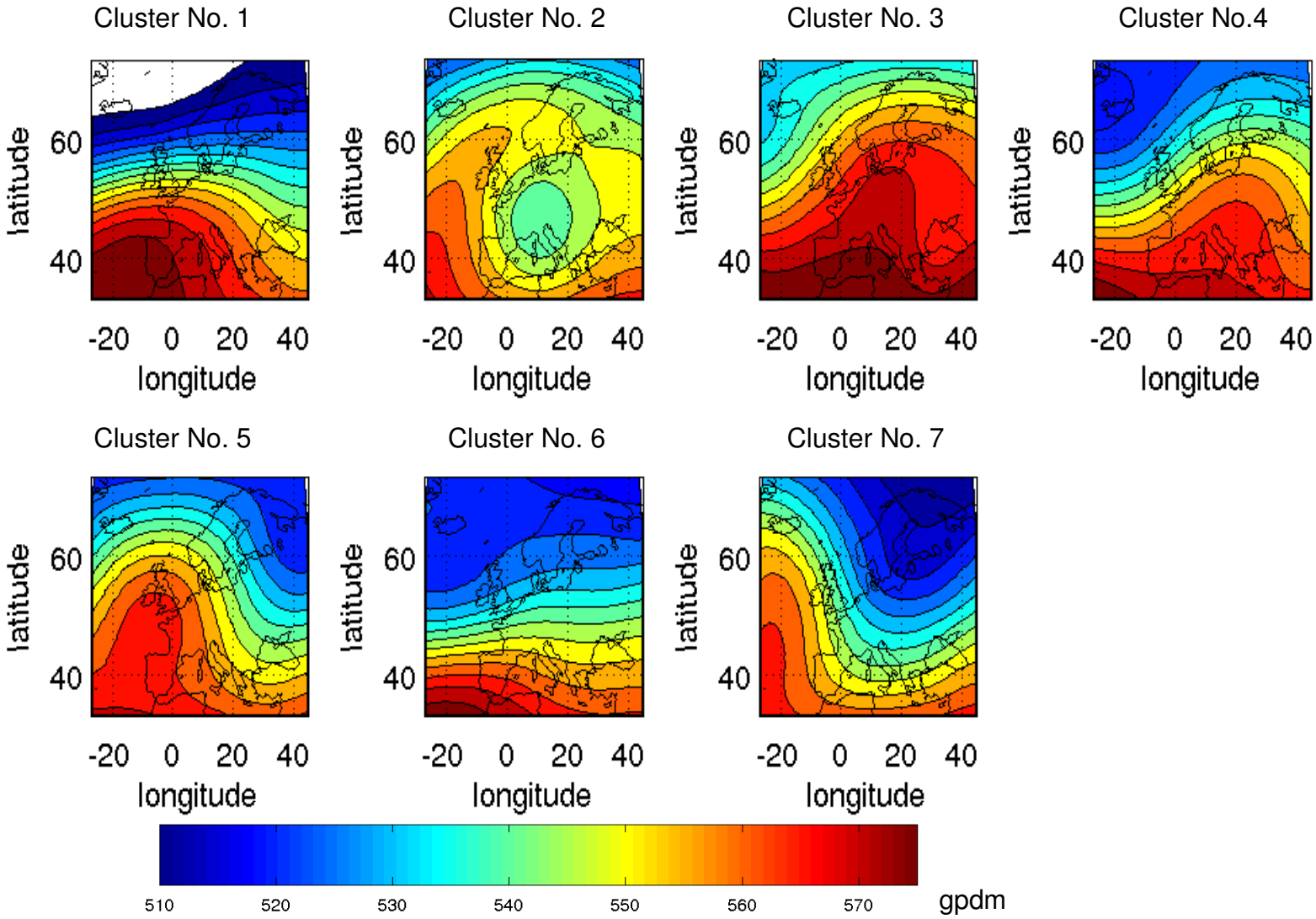
Winter - Cluster

500 hPa level January 2005 - April 2007



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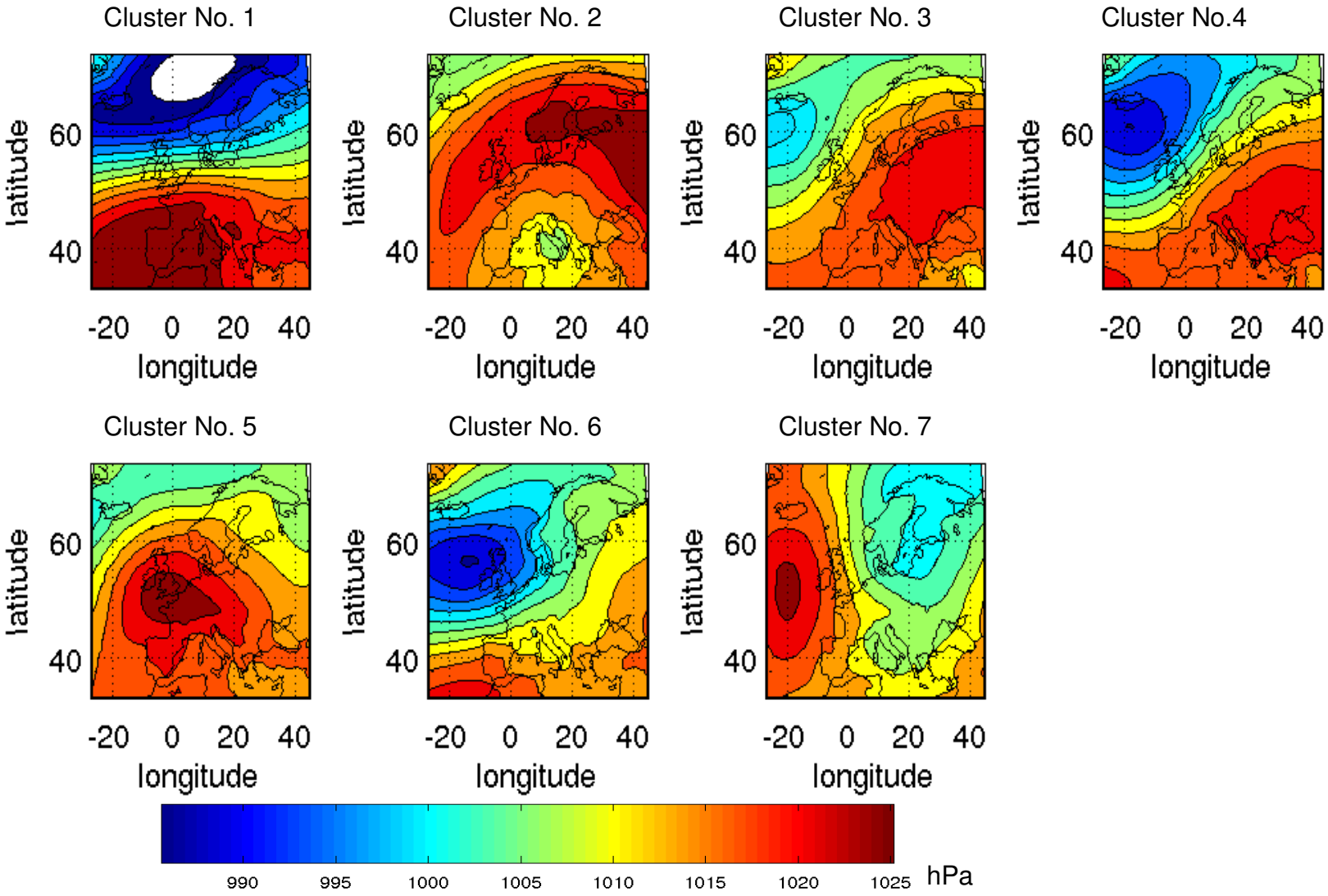
Winter - Cluster

sea level January 2005 - April 2007



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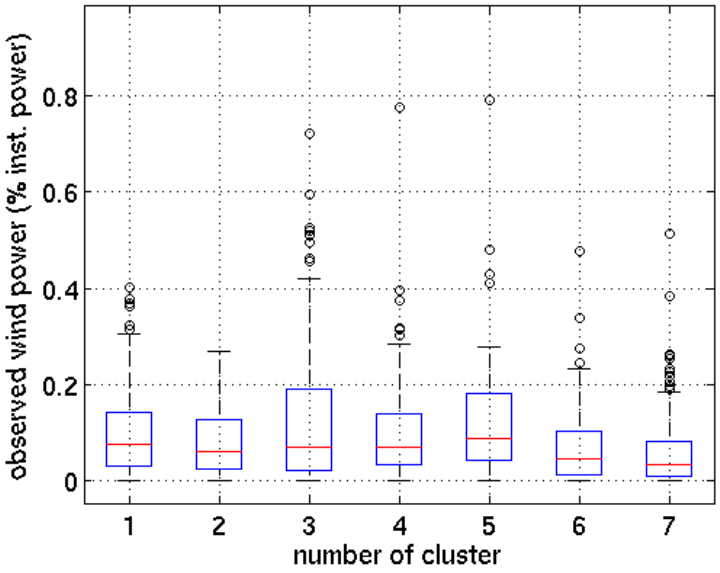
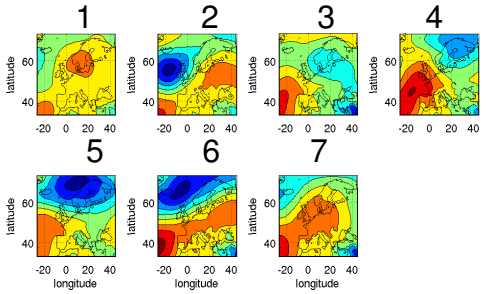
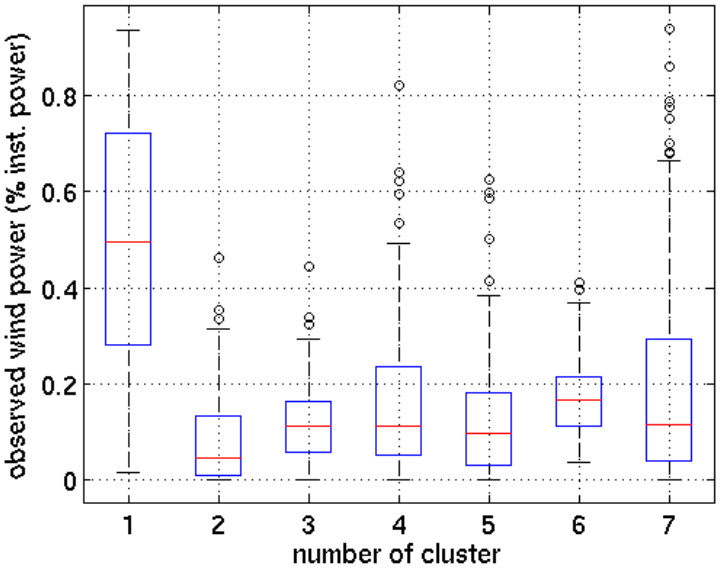
Observed wind power input for different clusters

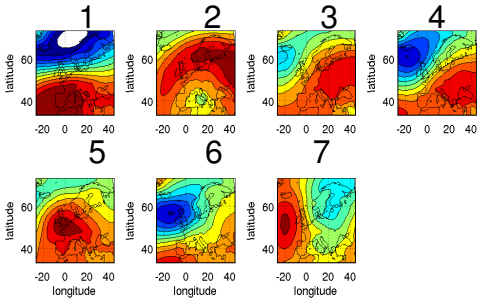
Summer





Winter





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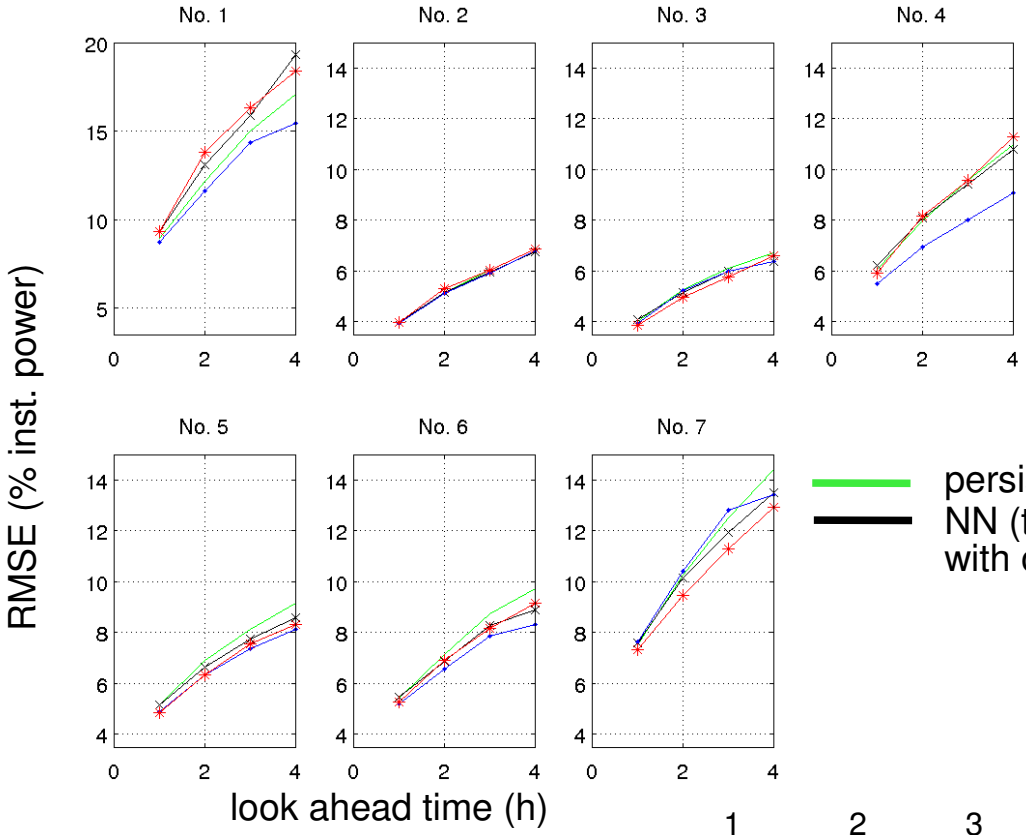
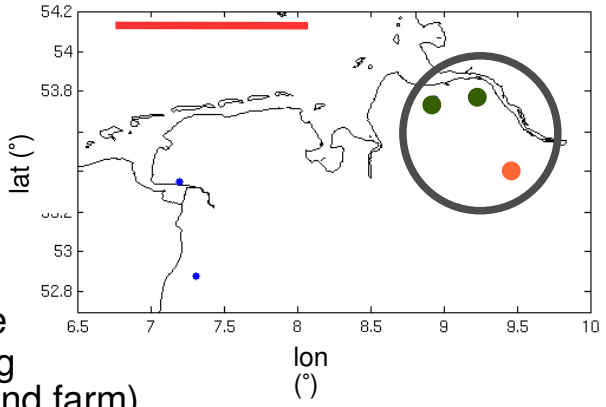
Forecast errors (RMSE) of wind power forecasts depending on clusters - winter

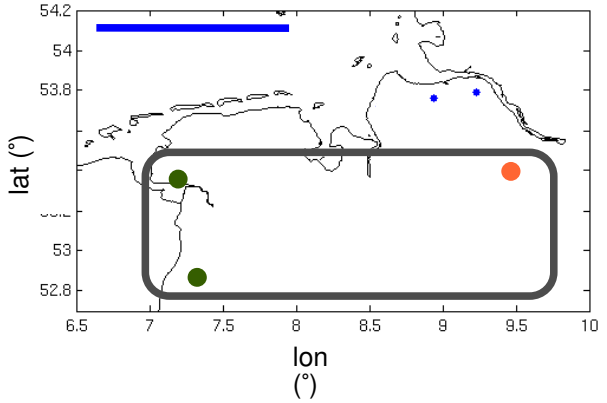


persistence

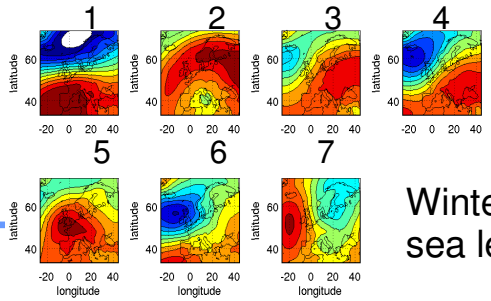
NN (training with one wind farm)

NN (training with three wind farms)





forecast:
one wind farm (●), 2005
training with data of 2004



Winter cluster
sea level pressure

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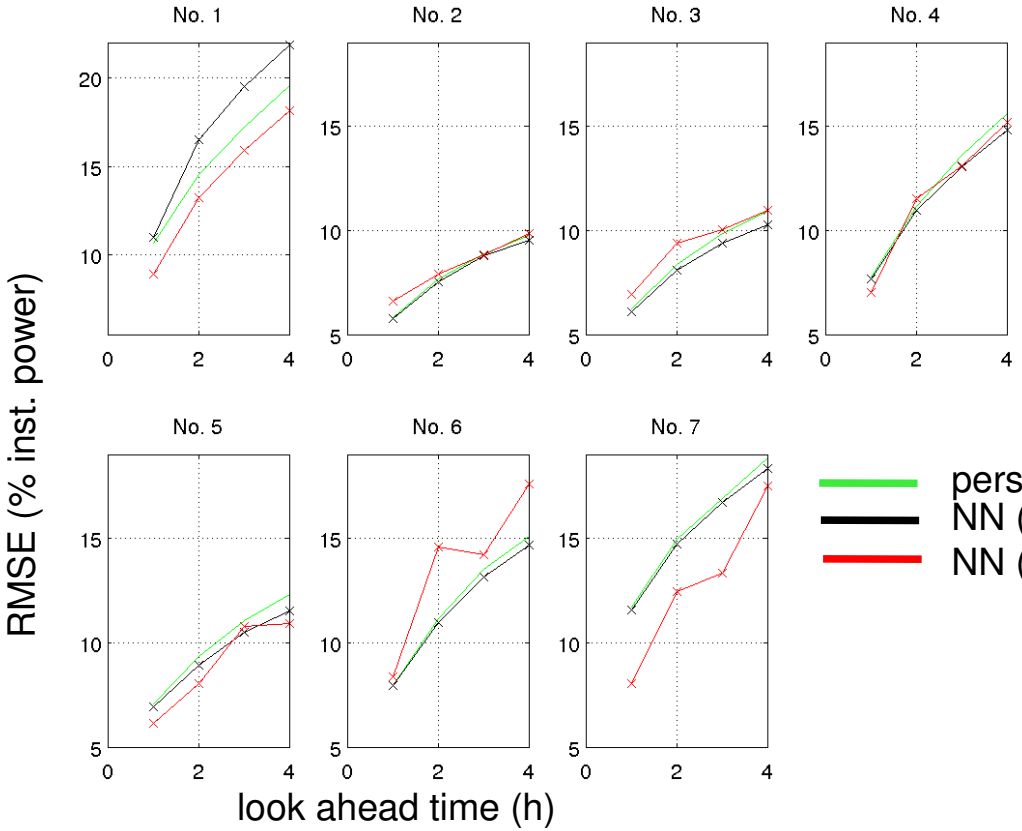
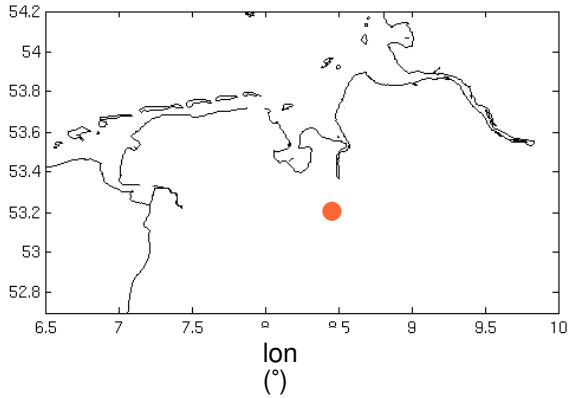
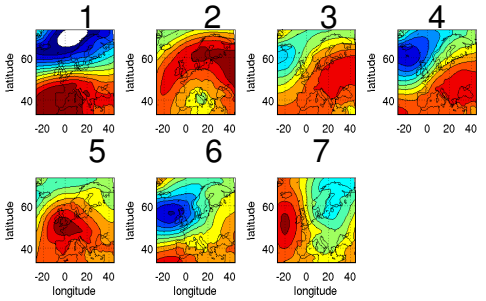
Traing *within* clusters
Forecast errors (RMSE) - winter





persistence
NN (training with complete data)
NN (training within the single clusters)



forecast:
one wind farm (●), 2006
training with data of 2005,
separatly for each cluster

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Conclusions

- near real time updates, require: near real time wind power data
- advantage: **no NWP data** necessary – very actual shortest term forecasts possible
- wind power input and forecast errors depend on **weather situation** (clusters)
- for some clusters **improvements** are possible (as shown):
- consideration of geographical distribution of the wind farms
- training differentiation by clusters

Perspectives

- larger data set including **more wind farms**
- more sophisticated methods to capture **spatial patterns**
- apply **different methods**: Neural Networks, autoregressive models
- combine with model using NWP

Thank you for your attention.

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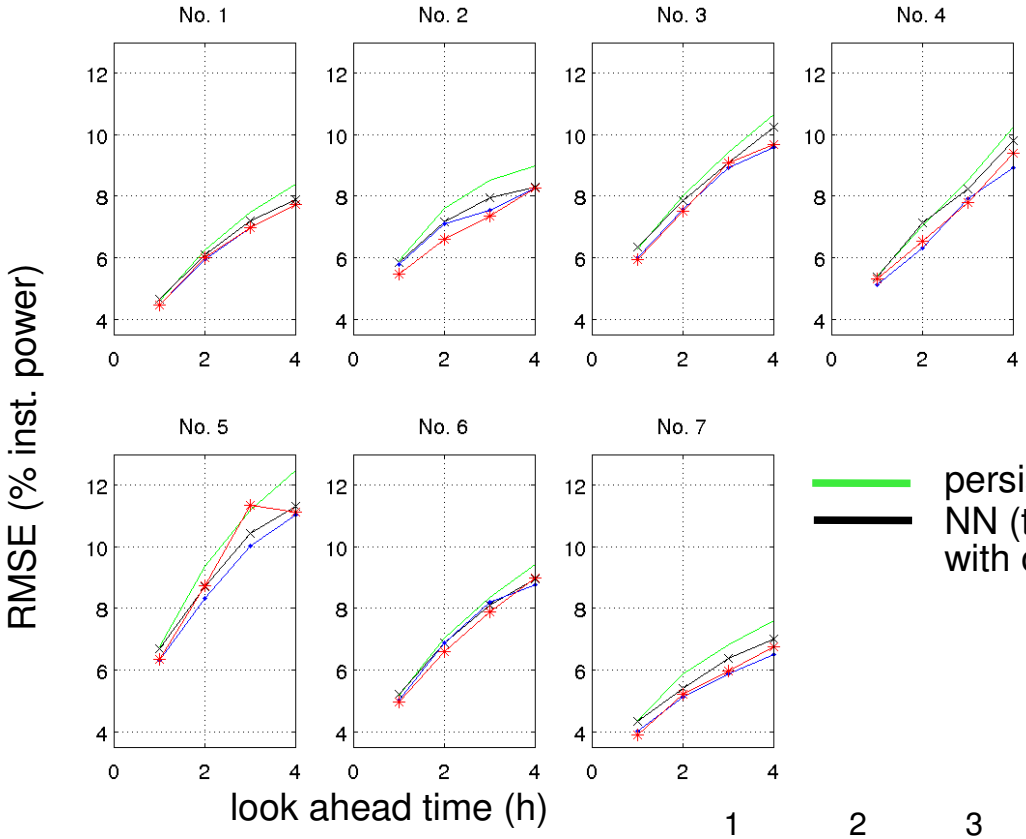
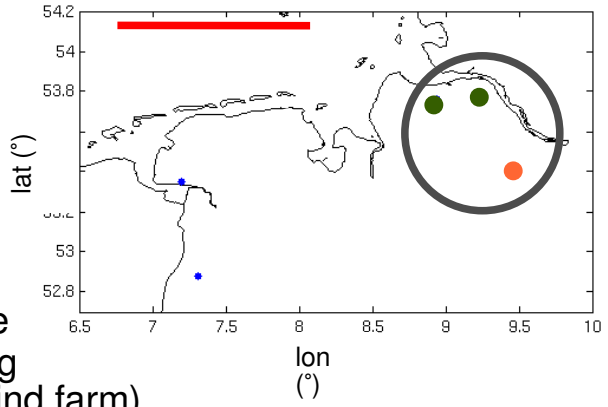
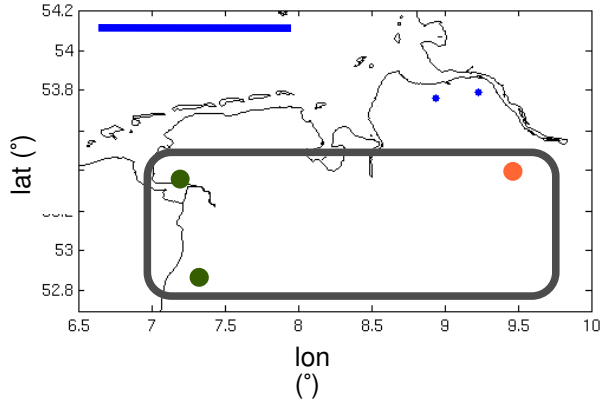
Forecast errors (RMSE) of wind power forecasts depending on clusters - summer



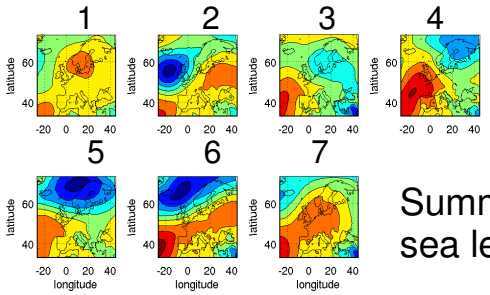
persistence
NN (training with one wind farm)

NN (training with three wind farms)





forecast:
one wind farm (●), 2005
training with data of 2004



Summer cluster
sea level pressure

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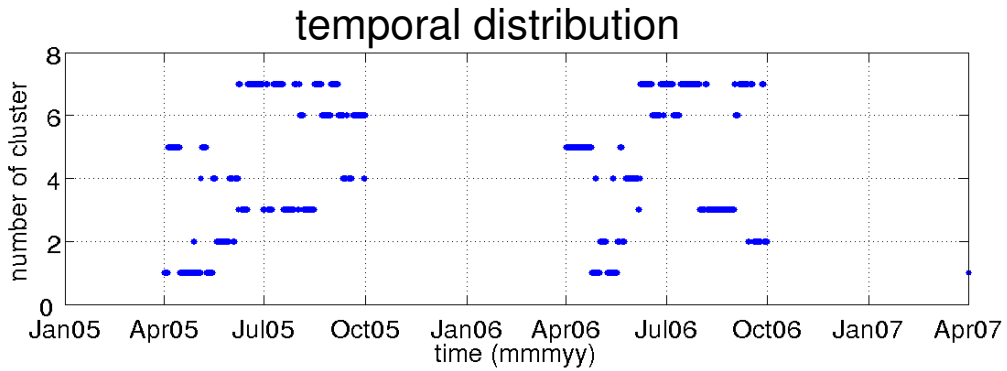
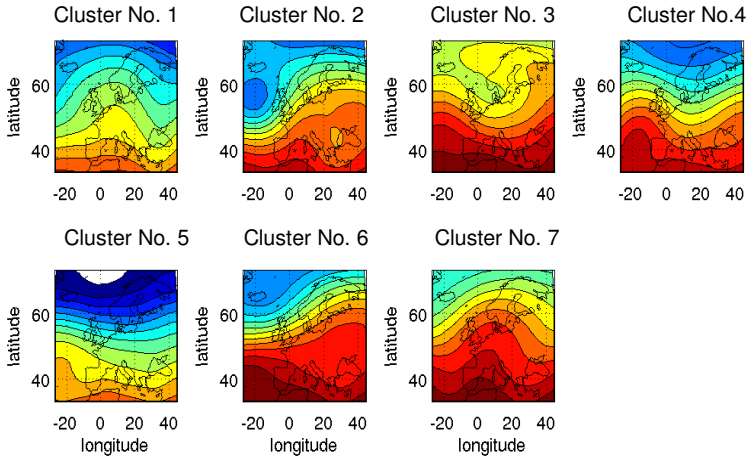
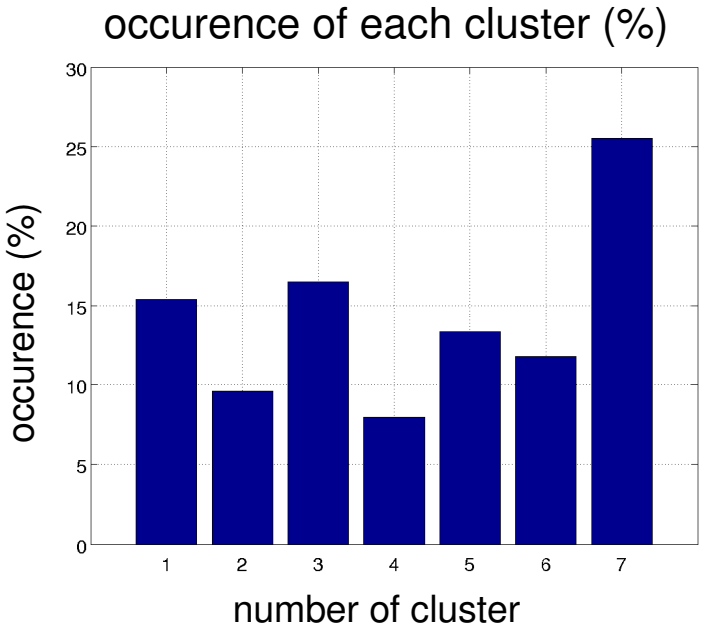
Summer – Cluster







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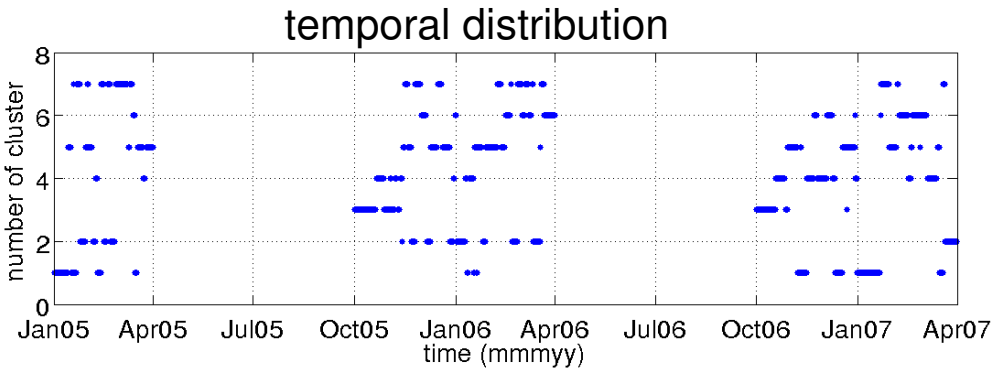
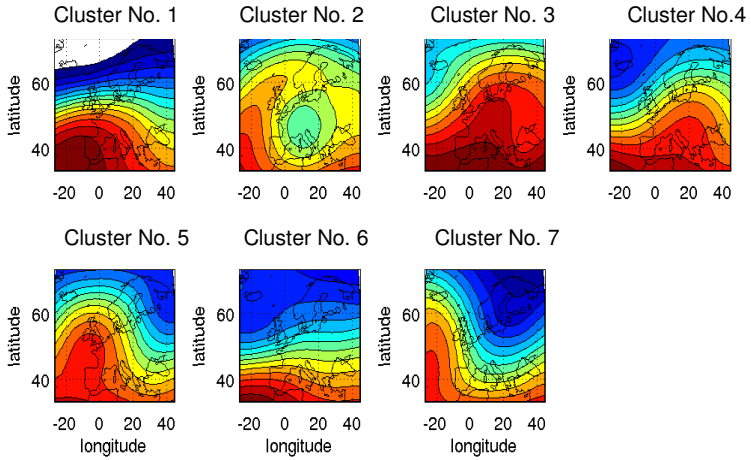
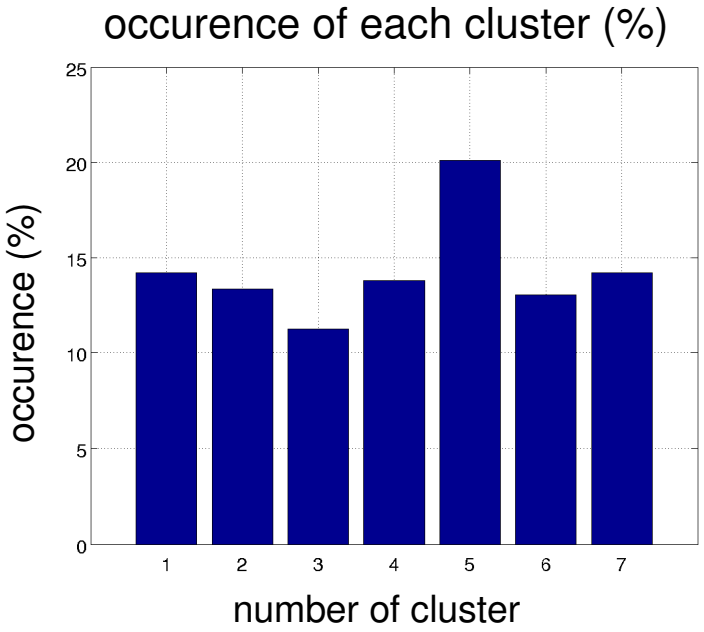
Winter – Cluster







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