

# A Deep Learning Method for Short-Range Point Forecasts of Wind Speed

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### OBJECTIVE

short-range **point forecasts** for  
**wind speed** related applications.

### REQUIREMENT

computational **efficiency** and forecast **accuracy**  
based on **gridded input** data.

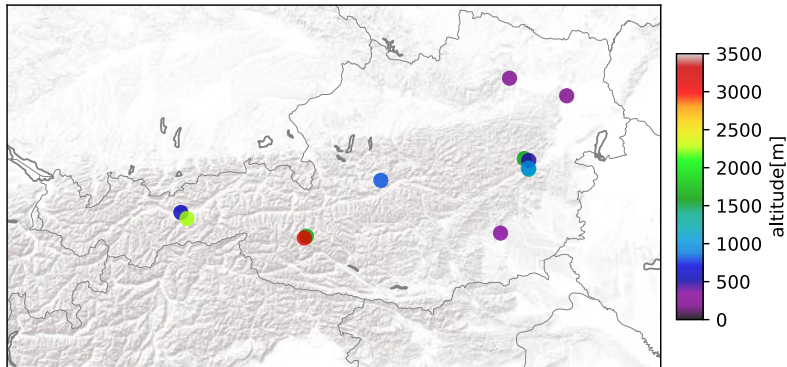
Available data sources:

**ECMWF IFS**  
NWP, 9x9 km

**INCA analysis**  
gridded OBS, 1x1 km

**TAWES**  
OBS of stations

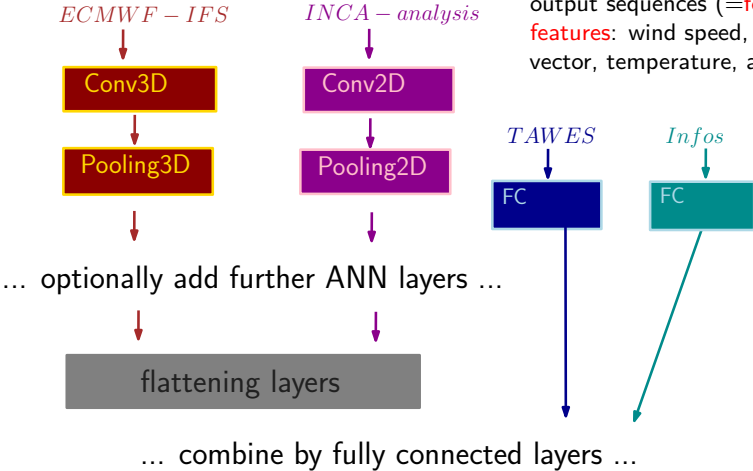
# Case study of 12 Selected TAWES/observation sites



Test period	Training period	Altitude
1 year: 2019	3 years: 2016 - 2018	3109 - 198 m

→ investigate deep learning ANN models

# Example architecture: CNN-3D



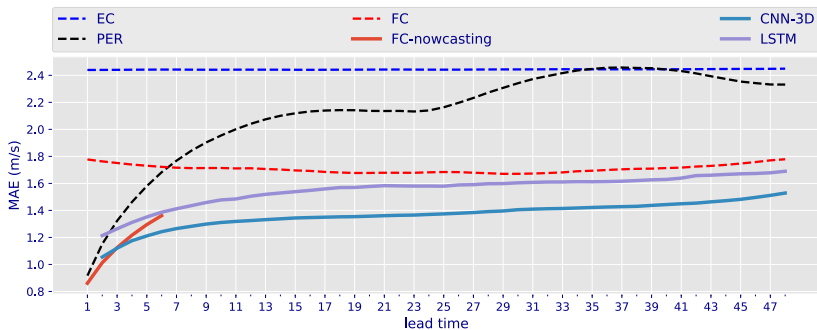
**input parts:** process the input for different data sources.

**common part:** combines parts for output sequences (=forecasts).

**features:** wind speed, wind vector, temperature, air pressure

output: vector of all/subset of specific lead times

# Mean absolute error (MAE): 2019, all 12 sites



**LSTM**

**CNN-3D**

**FC**

**FC-nowcasting**

**EC**

**PER**

long short-term memory model of ECMWF input, INCA analysis as CNN, observation as FC layer

convolutional 3D + pooling layer for ECMWF, INCA analysis as CNN, observation as FC layer

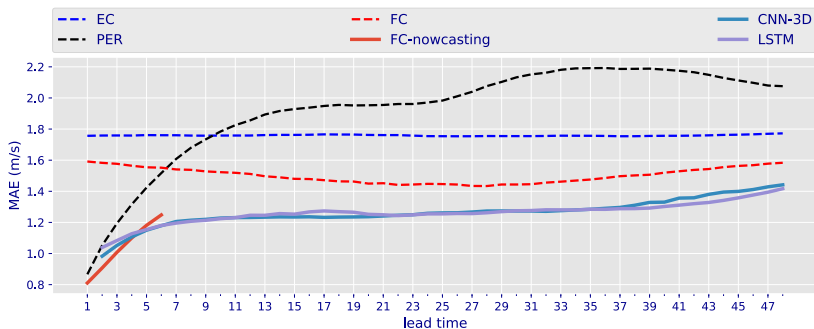
fully connected ("feed-forward") model using all inputs flattened

fully connected model based on observations optimized for up to +6 hours

ECMWF-IFS closest grid point

persistence model (current wind speed assumed for +48 hours)

# Mean absolute error (MAE): 2019, Wien Hohe Warte



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**CNN-3D**

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# Conclusion

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Does our approach work for wind speed forecasts? **YES!**

Good results in the nowcasting and short-range: outperforms wind speed forecasts of raw NWP and persistence.

However, critical is ...

- ▶ good **spatial/temporal selection**, especially in complex terrain.
- ▶ **sufficient training** data.
- ▶ meaningful selection of NWP grid points regarding topography.
- ▶ proper processing (normalization, outlier/missing value treatment).