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Global ocean wind speed estimation with CyGNSSnet

Tackling Climate Change with Machine Learning Workshop at NeurIPS 2021

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Global Ocean Wind Speed Estimation

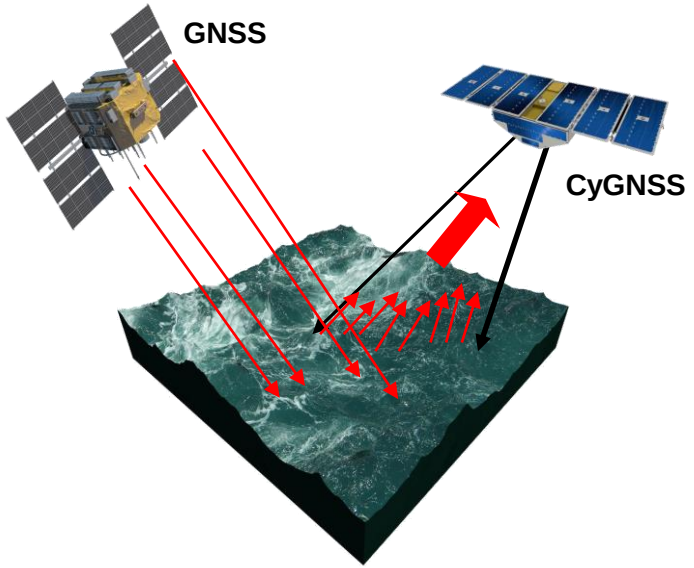
Cyclone GNSS

Mission

- CyGNSS: 8 satellites for remote sensing
- Global navigation system signals (GNSS) reflected off the ocean surface
- Surface roughness ↔ wind speed

Impact

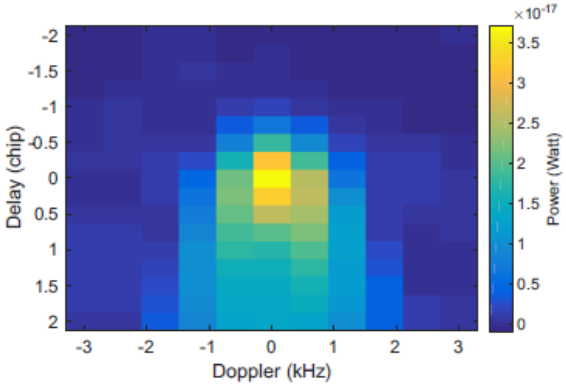
- Provide global ocean wind speed measurement
- Monitor cyclone evolution



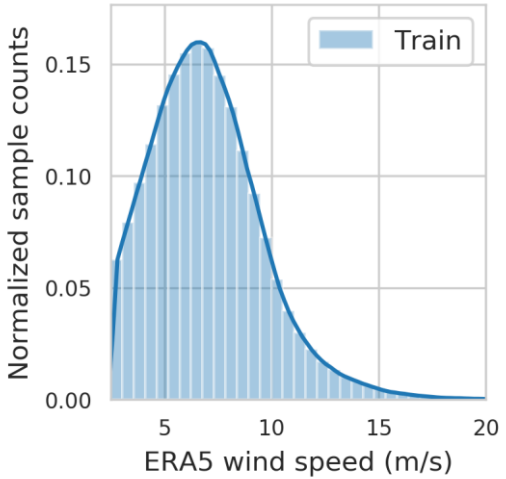
CyGNSS Dataset

Jan 2018 – Mar 2019

- Main measurement: Delay-Doppler map
- 10 additional parameters (→ paper)
- Label: Wind speed (ERA5 reanalysis)



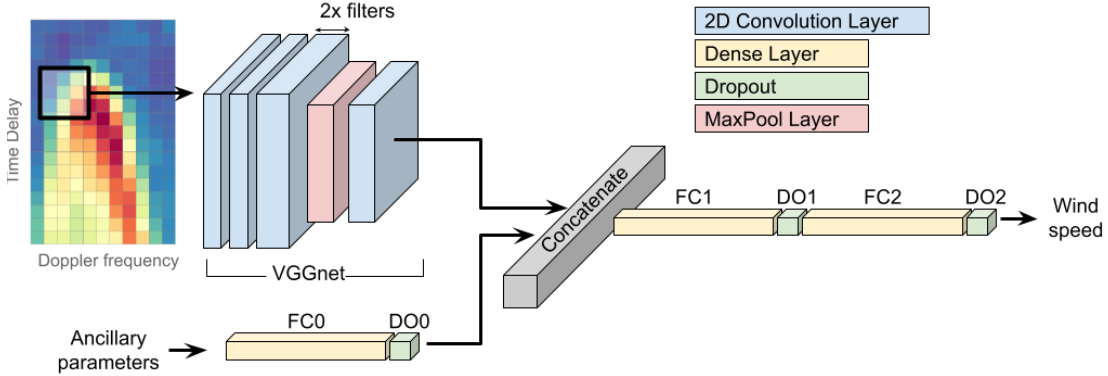
- 7.2 million training samples
- Wind speed distribution non-uniform
- Extreme values beyond 12 m/s – 5%



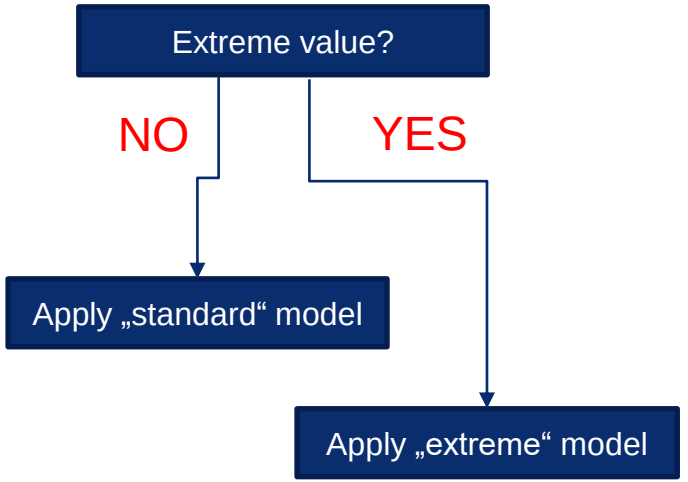
CyGNSSnet

Hierarchical model

- Supervised learning
- Trained two instances of CyGNSSnet
  - Standard: all wind speeds
  - Extreme: only wind speeds > 10 m/s



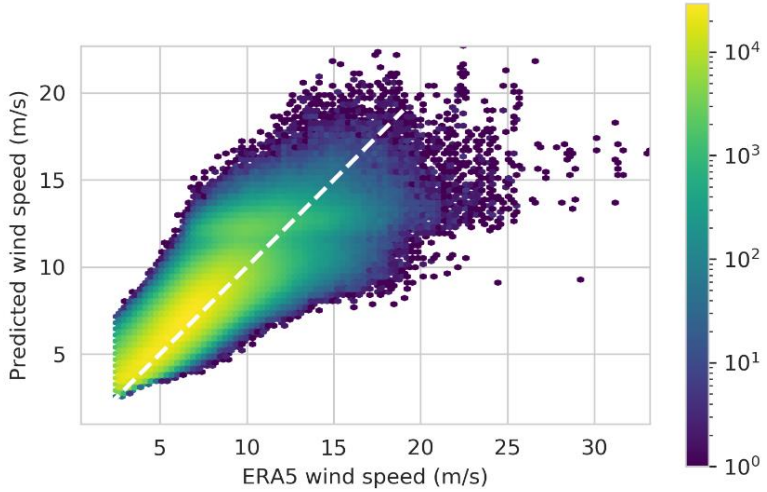
- Classifier: XGBoost



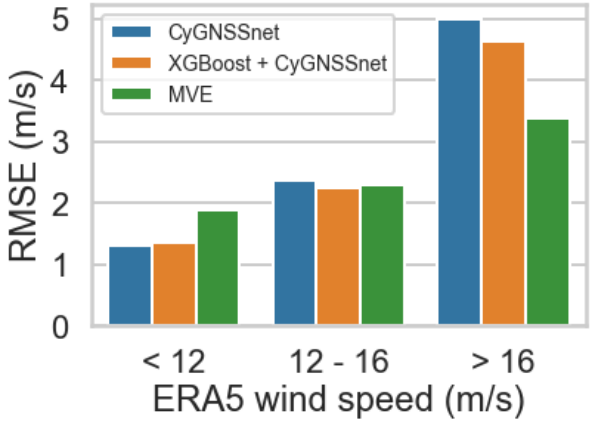
Test set predictions

Different wind speed ranges

- Test set separated in time
- Current operational algorithm: MVE
- RMSE = 1.39 m/s → -27% to MVE



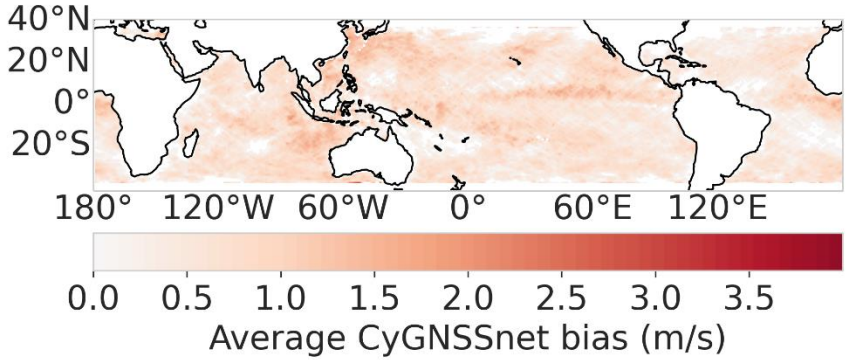
- Performance degrades at high wind speed
  - Few samples
  - Generally harder task
- Hierarchical model improves performance

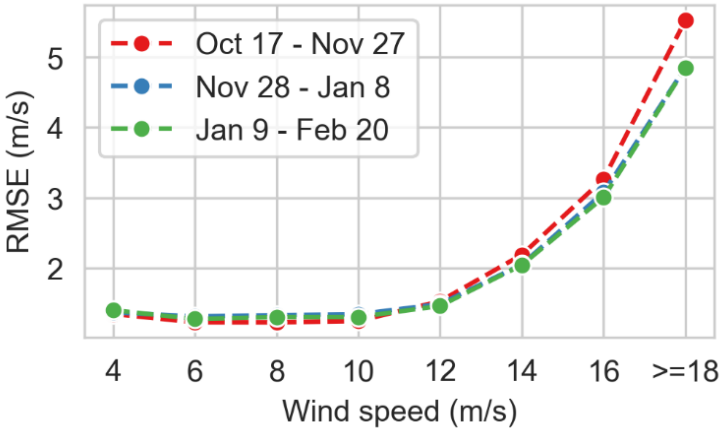


Test set predictions

Time and space

- Comparable performance in different regions
- Error constant in time
- → Important for potential operational use





More details? Have a chat at the virtual poster session!