Global comparison between ocean ambient noise modelling and infrasound network observations

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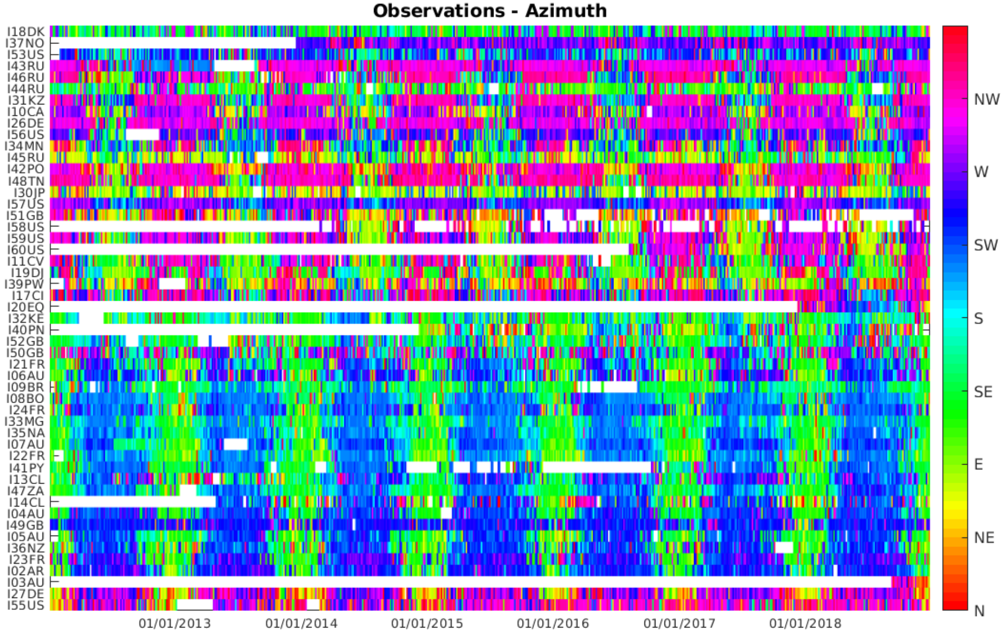
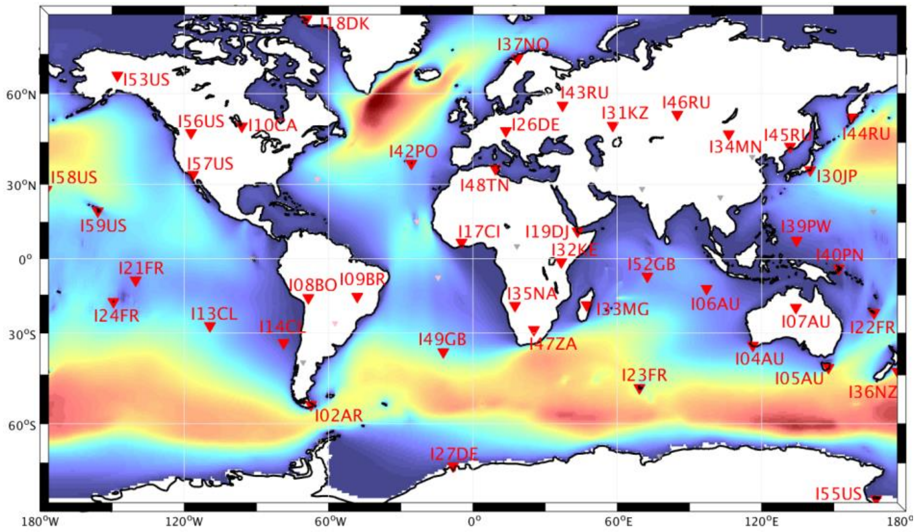
Introduction

- Microbaroms: continuous infrasound noise generated by wave-wave interactions (0.1-1 Hz)
- Detected everywhere (all IMS stations)
- Different source models:
    - Waxler et al. 2007: strong bathymetry impact
    - De Carlo et al. 2020: weak bathymetry impact



Microbarom dominant azimuth detected at IMS stations (ordered by latitudes) [2012 - 2018]



Microbarom sources, 2018 average, with IMS stations

Motivation for the study:

Run simulations on global scale to compare different ocean wave models, wave model parametrizations and propagation models

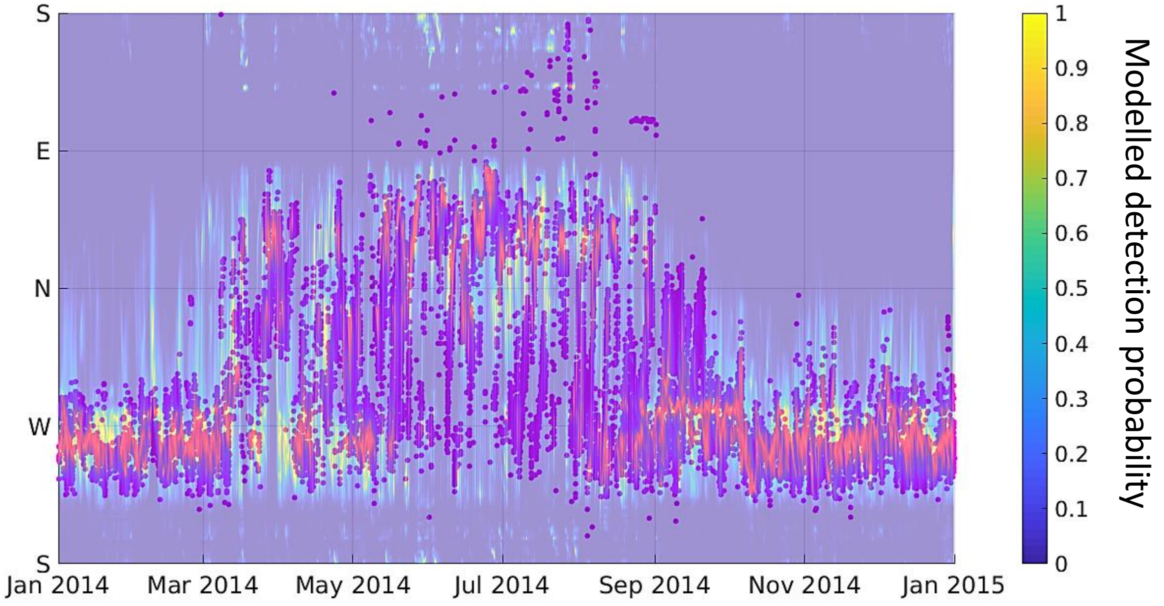
Model

- Wave model: WW3 (*Ardhuin et al. 2011*)
  [ftp://ftp.ifremer.fr/ifremer/ww3/]
  - With coastal reflection
  - Without coastal reflection
- Source Models
  - Waxler et al. 2007 : high bathymetry impact
  - De Carlo et al 2020 : weak bathymetry impact
- Propagation: attenuation law (Le Pichon et al 2012)
  - Without wind
  - With uniform wind (at the station)

⇒ Directional spectrum at IMS stations, normalized by time step (3 hours), for 0.1 Hz-wide frequency bands

Observations

- PMCC global reprocessing (*Ceranna et al. 2019*)
- Detections
  - 51 stations
  - From 2012 to 2018
  - Between 0.1 and 0.6 Hz
  - Family sizes > 20



Example: For 0.3-0.4 Hz, model (in color) vs PMCC detections (blue and magenta dots) IS37, Norway

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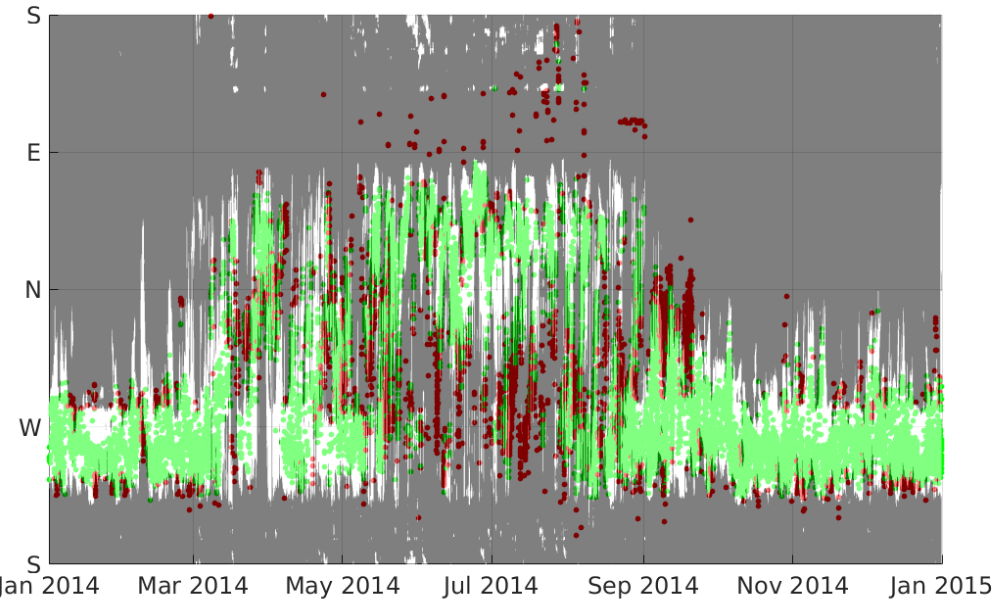
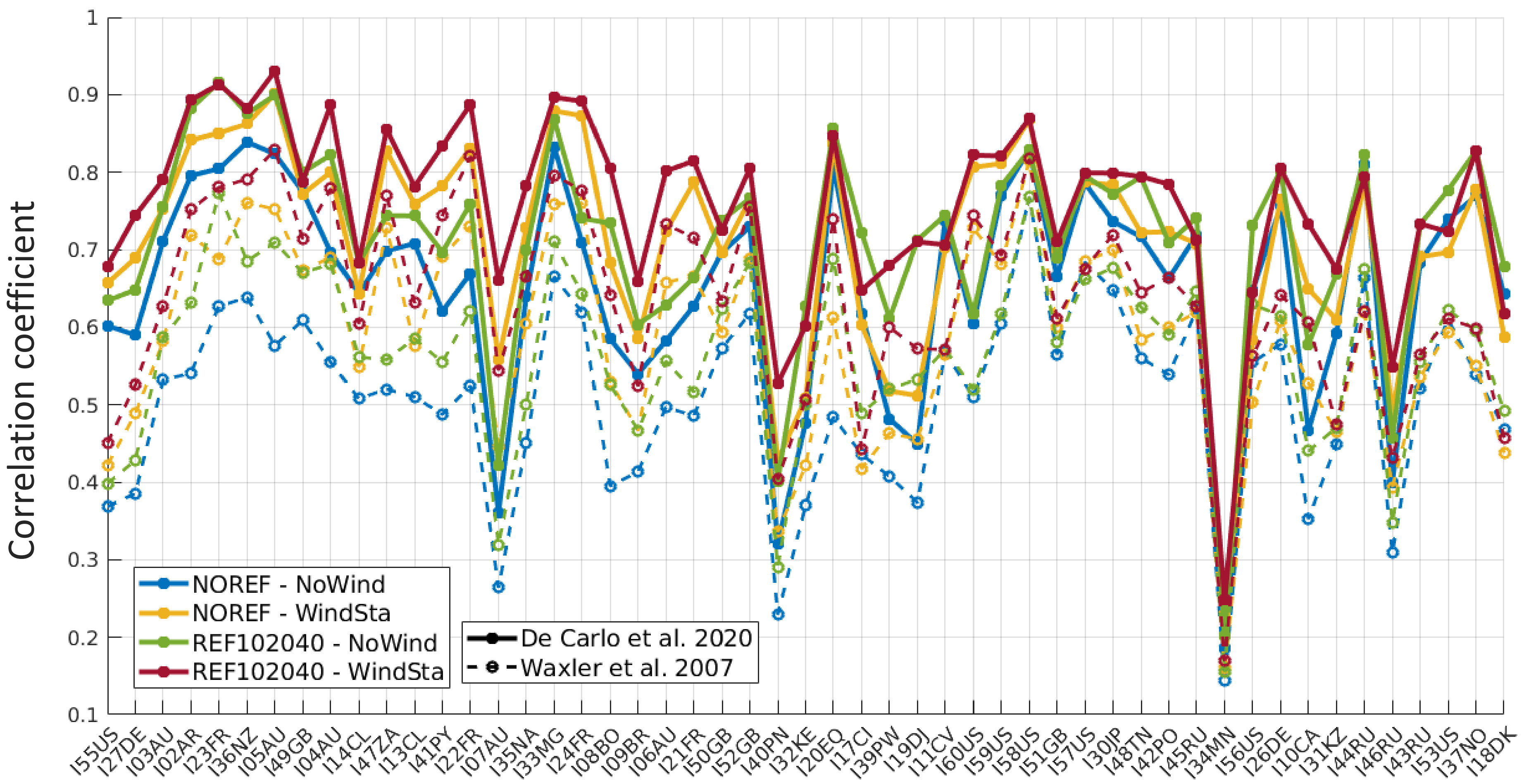


Binarization of the model (with a threshold)
=> in green: detections predicted by the model



- **39 stations** (over 51) have a coefficient **> 0.7** (70% of the observations are predicted by the model)
- For most stations:
  - ⇒ **Improved simulations**:
    - with coastal reflection
    - with wind at the station
    - with low bathymetry effect for shallow angle (e.g. stratospheric)
- Some stations with poor coefficient :
  - Propagation issues (e.g. I34MN, with sources in the other hemisphere)
  - Sources issues (e.g. I40PN: island in the middle of Pacific Ocean with noise clutter overlapping microbaroms)

- Global and multi-year comparison between microbarom observations and modelling results
- Comparison between 8 different models including coastal reflections, propagation effects, bathymetry and source directivity effects in finite depth ocean
- Highest correlations are obtained when coastal reflections, wind along propagation the path, and De Carlo et al. 2020 source model are considered
- Limitations
  - Uniform wind not adapted for long propagation range (e.g. across the equator line)
  - Observations and models are not of same nature: a proxy is used for their comparison (here the binarization of the model), that could be improved
  - High-resolution detection algorithms should be considered to discriminate between multiple overlapping microbarom sources

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