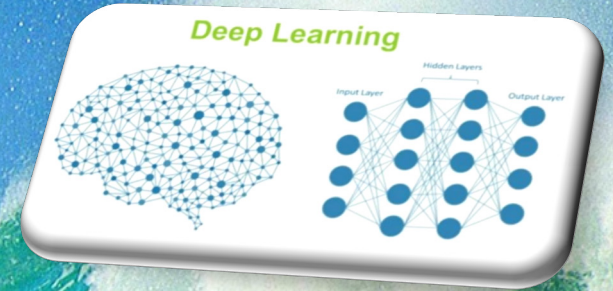


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# The Maximum Wave Height Acquisition from CFOSAT SWIM Based on Machine Learning

**WANG Jiuke, AOUF Lotfi**

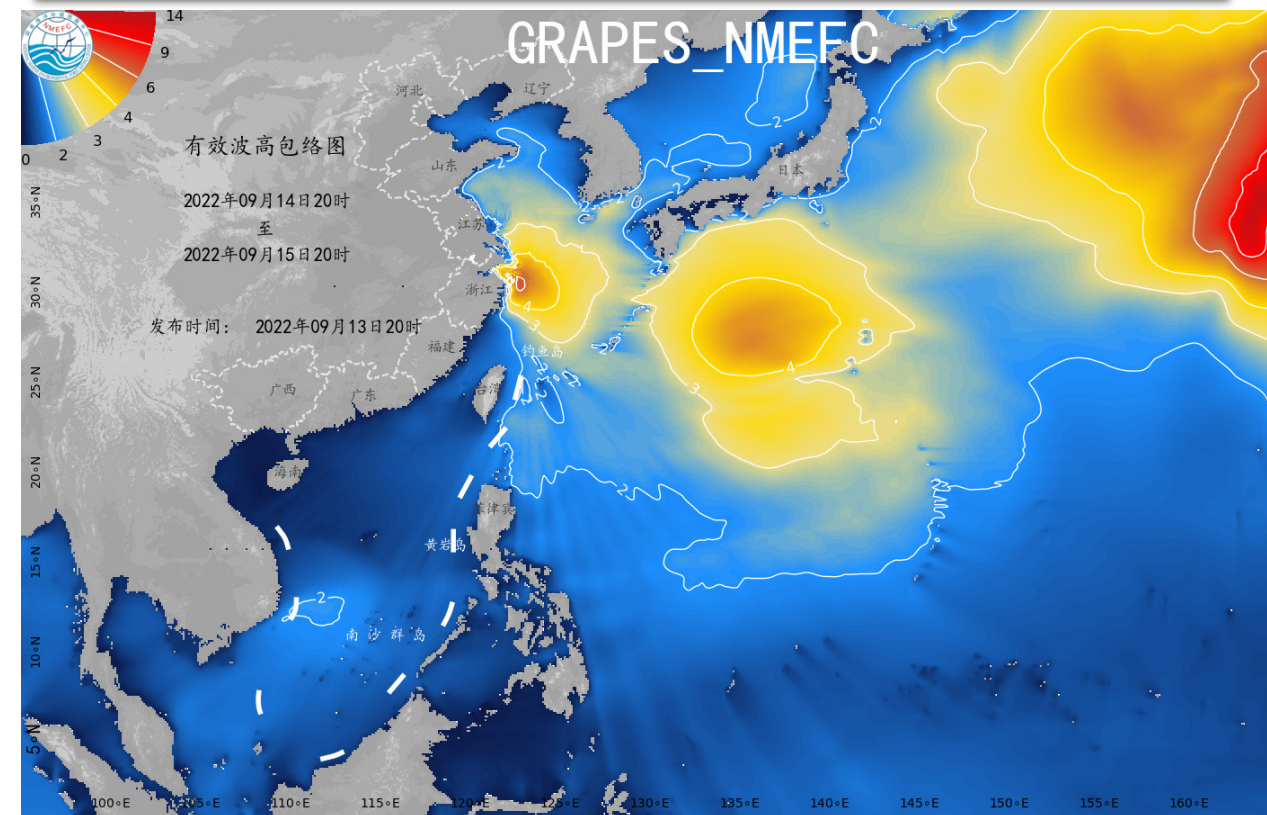
**National Marine Environmental Forecasting Center, Meteo France**

**2022.10.19 Dragon 5 Mid-term Symposium**

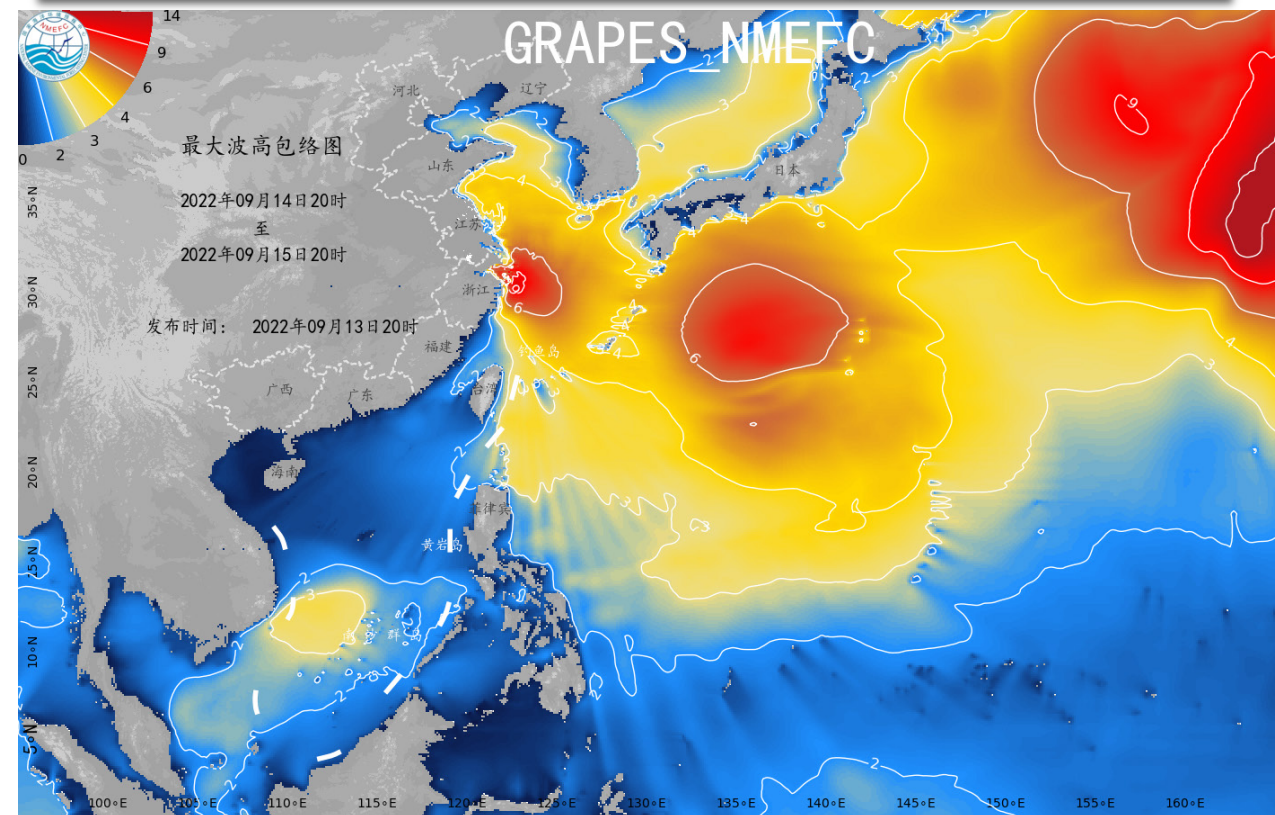
# Motivation: Urgent demand for operational marine forecasting

- Max wave height (MaxH) is dangerous for ships or marine structure, NMEFC now starts to concern.
- MaxH is also a crucial symbol of “Freak Wave”.
- However, MaxH is seriously lack of observation, especially globally.
- MaxH can be obtained from wave model but from empirical methods.

## Significant Wave Height



## Maximum Wave Height

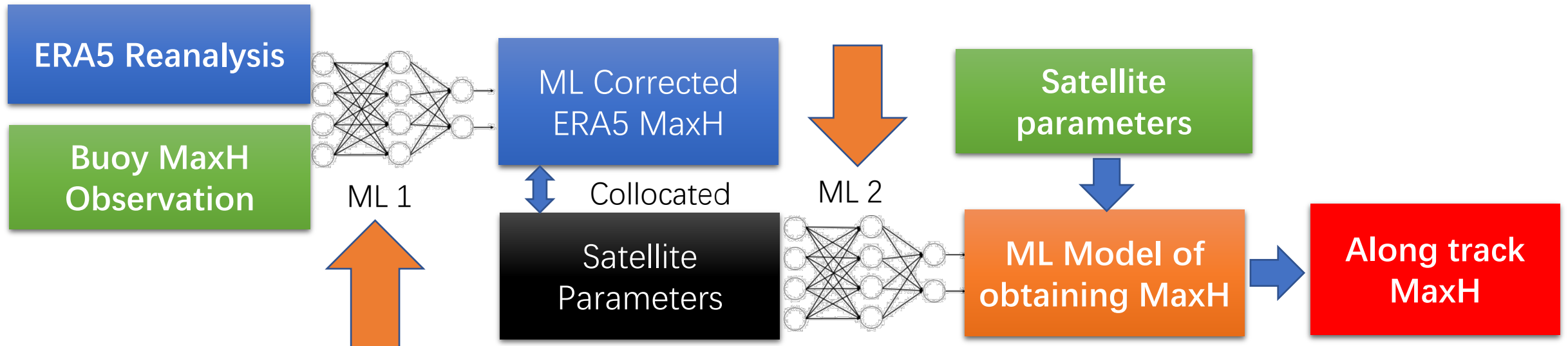


# Objectives and Method

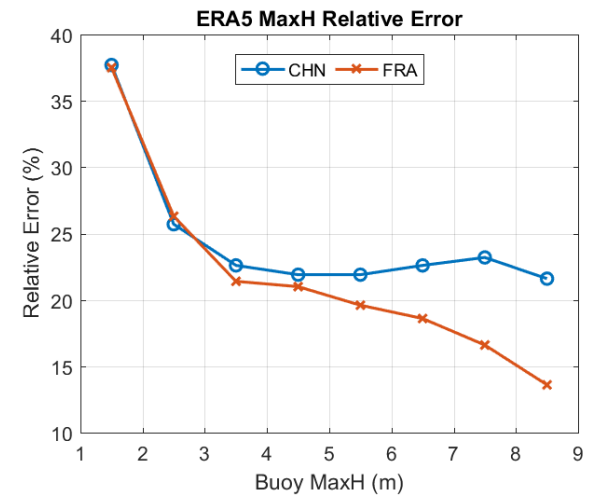
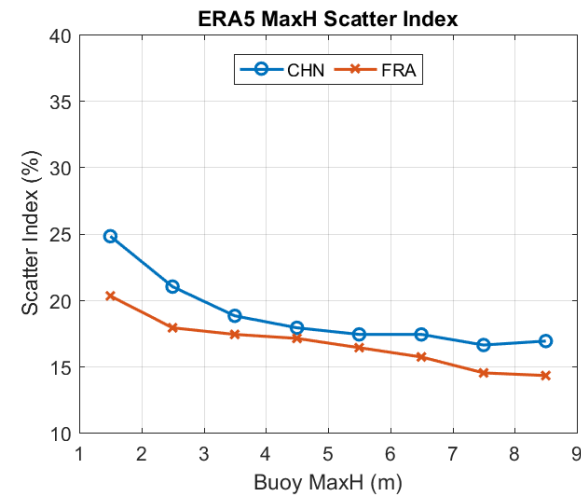
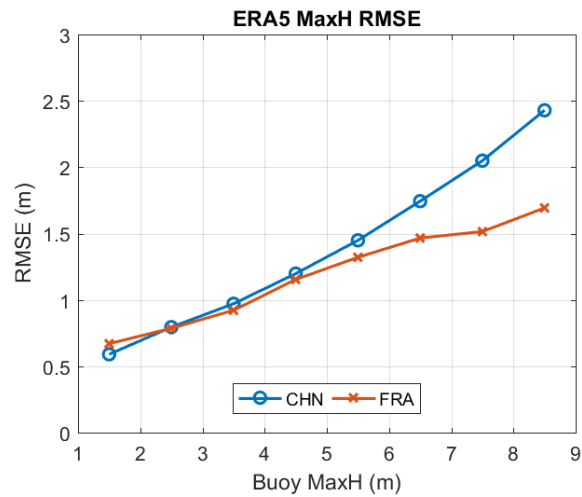
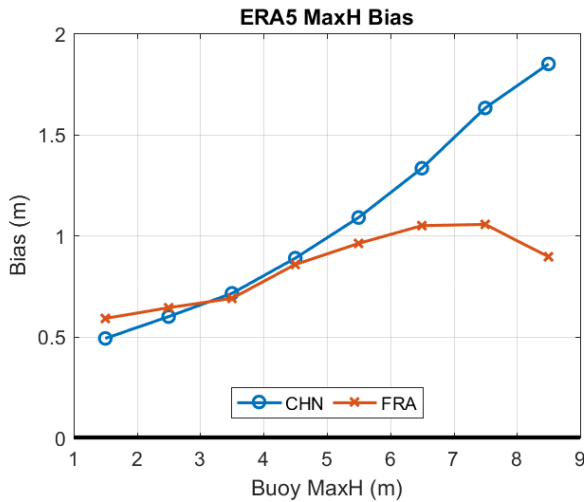
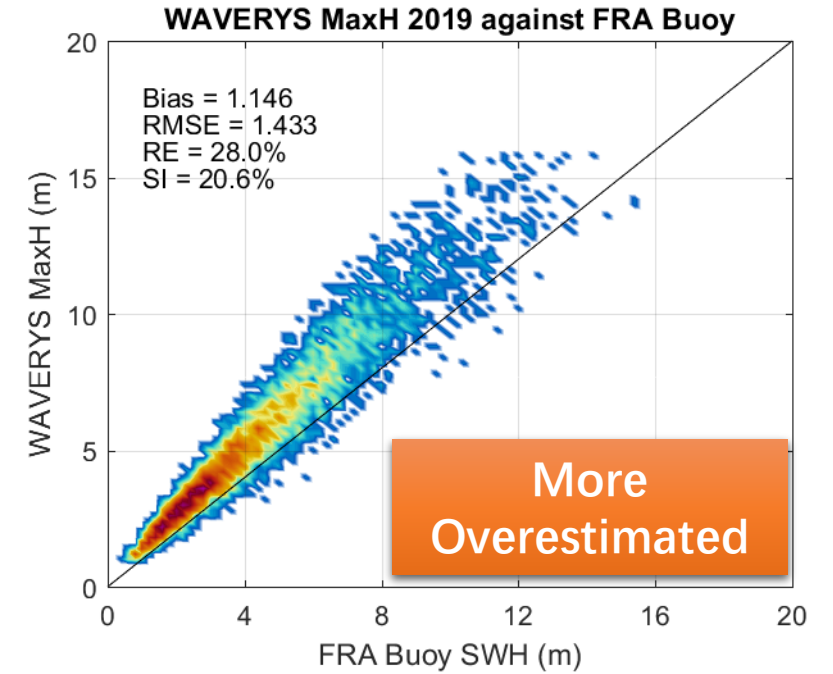
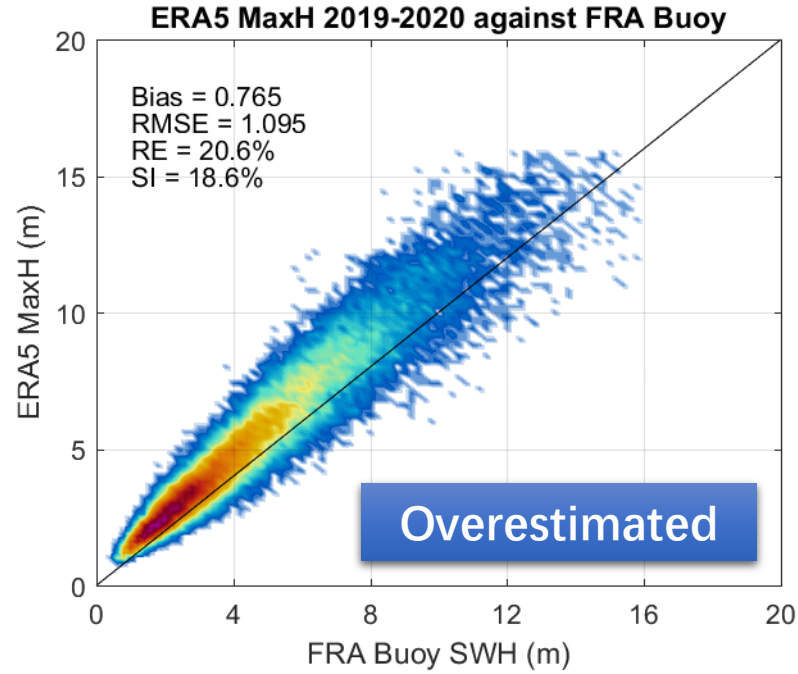
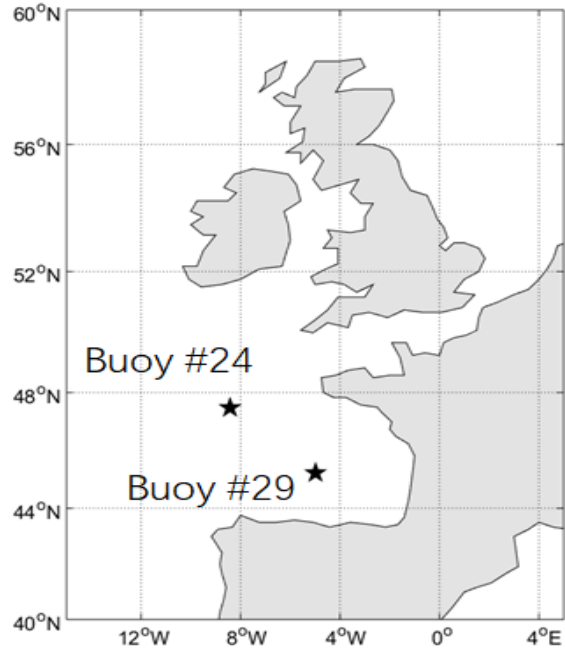
The objective: obtain the MaxH based on Along Track observation through ML

- 1) Build ML model to correct ERA5 MaxH against buoy observation (use buoy MaxH as truth);
- 2) Correct ERA5 MaxH using ML, and collocate HY2/CFOSAT with ERA5
- 3) Build ML model 2 to obtain MaxH from satellite parameters (use corrected ERA5 as truth)
- 4) So ML 2 is the model to obtain MaxH from satellite.

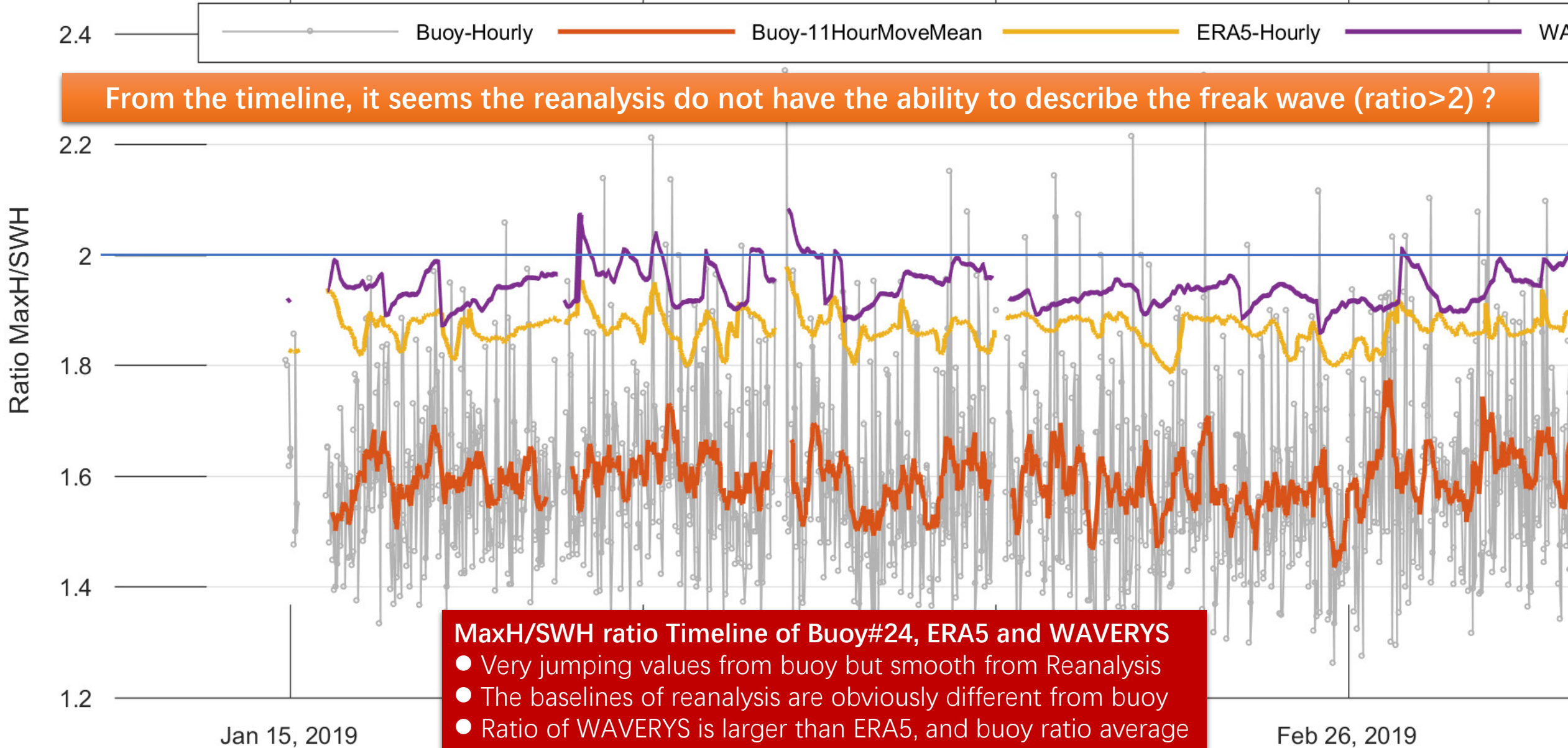
## The Method:



# MaxH Assessment against French Buoy



# Ratio of MaxH/SWH against French Buoy



# ERA5 MaxH Correction from DNN and Random Forest

DNN

*ERA5 Parameters*

Maximum wave height

Significant wave height

Period of MaxH

SWH of total swell

SWH of Windsea

BFI

Spectral Directional Width

Mean wave period

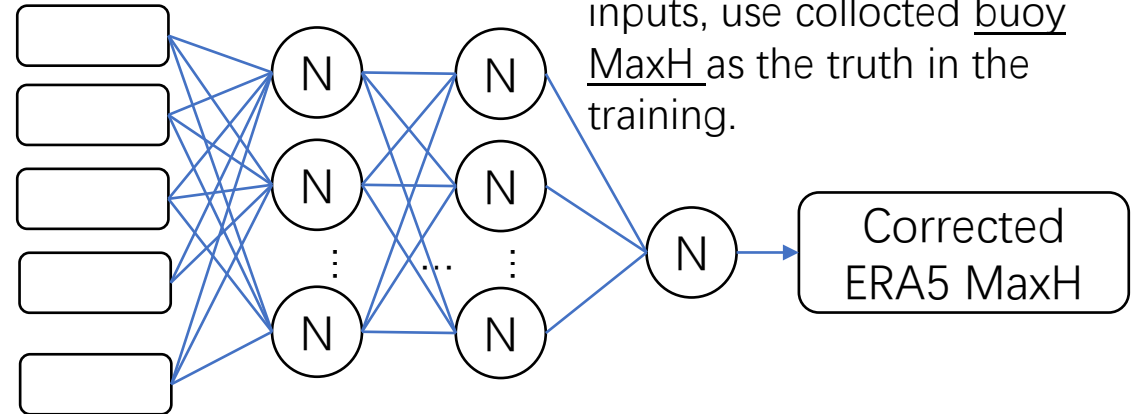
Mean square slop of waves

Spectral Peakedness

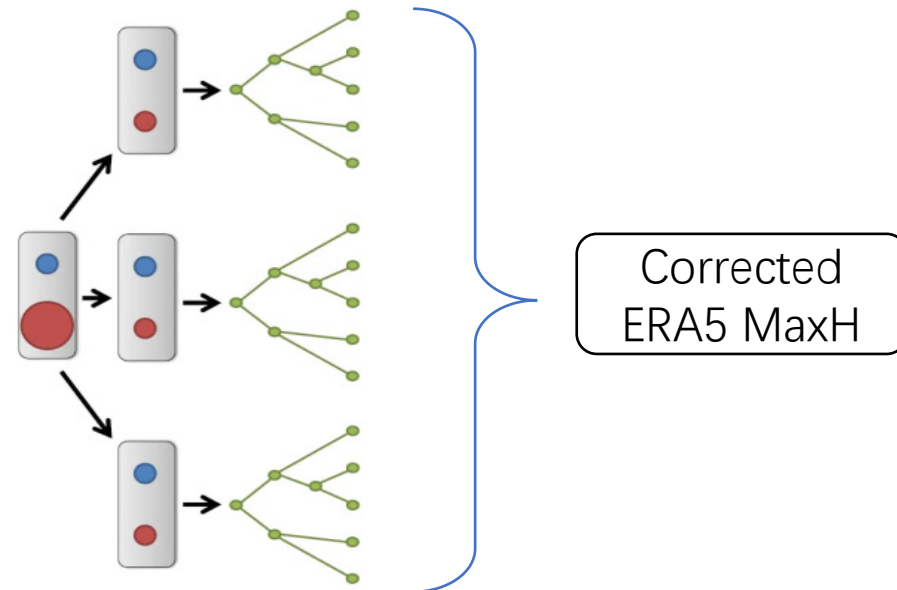
Wave spectral kurtosis

Wave spectral skewness

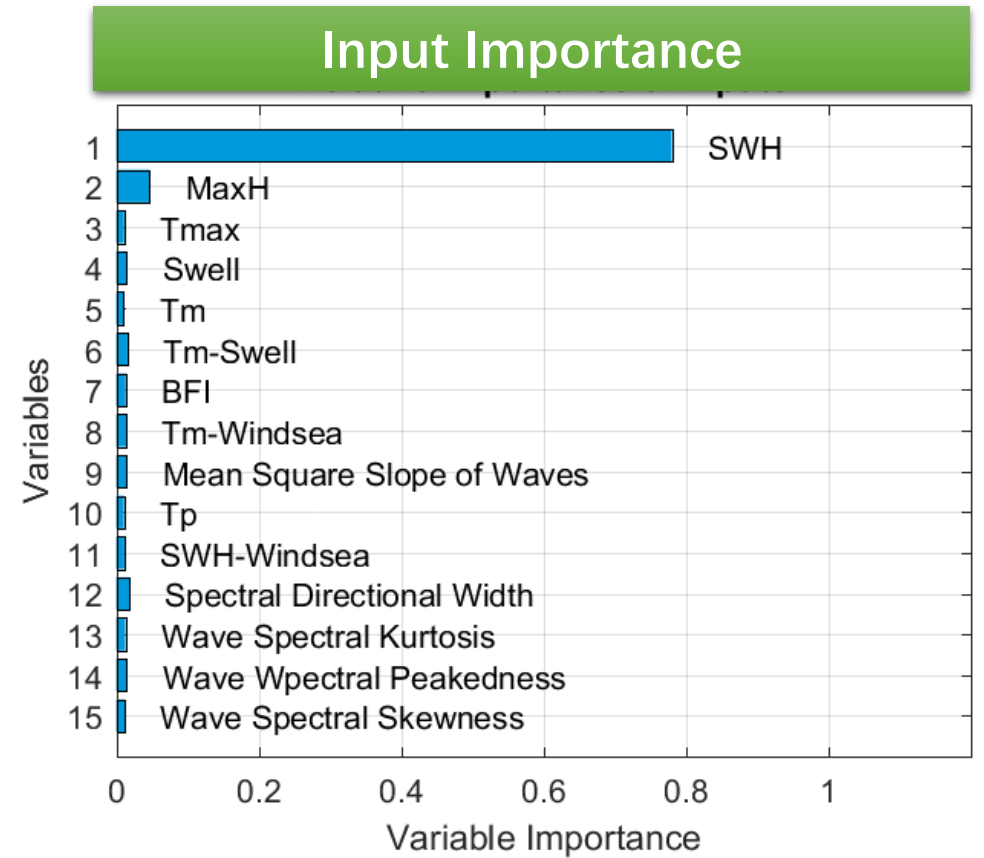
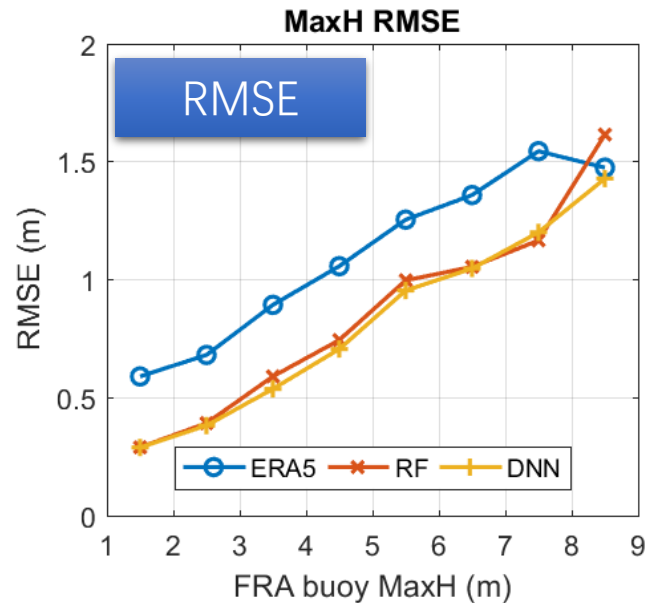
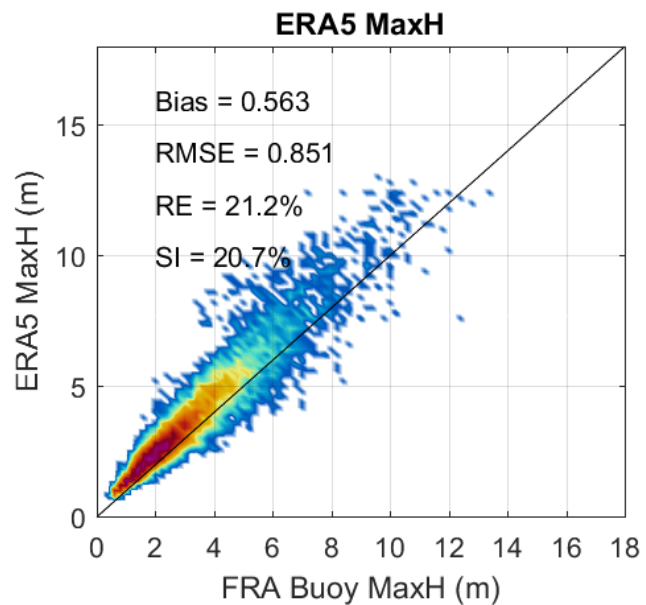
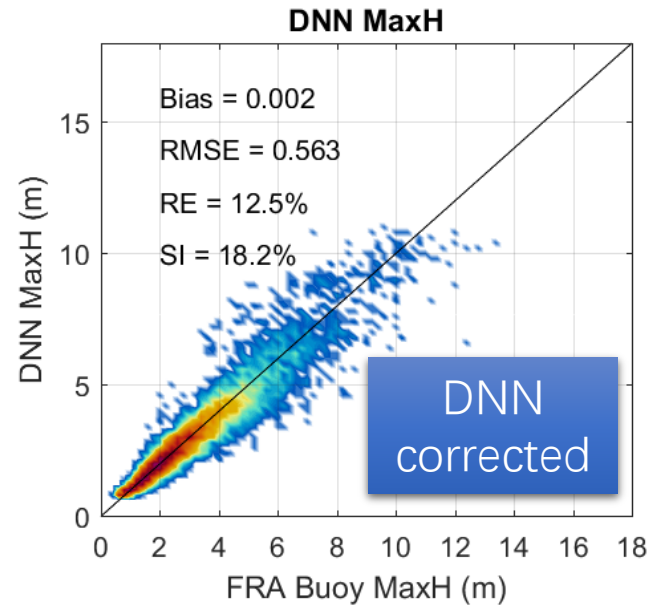
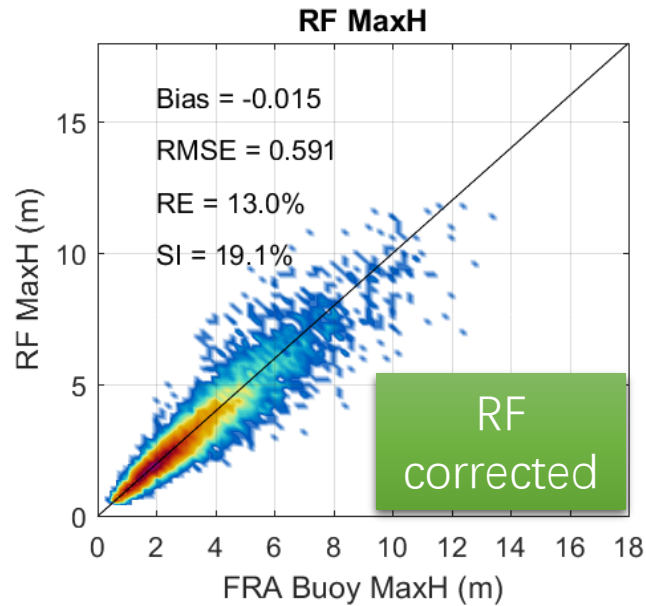
Use ERA5 Parameters as the inputs, use collected buoy MaxH as the truth in the training.



Random Forest

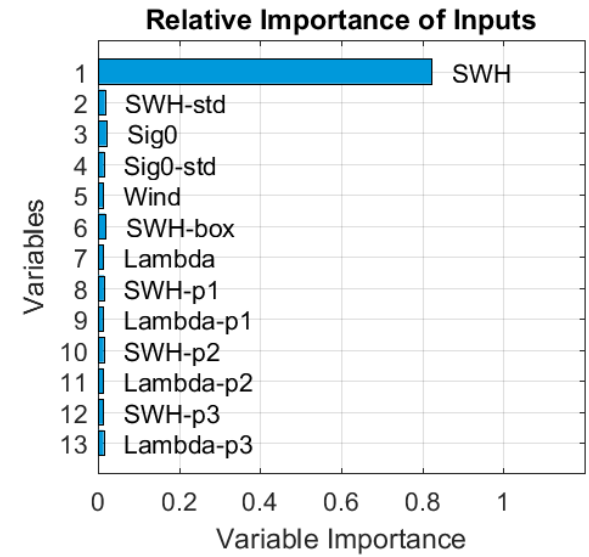
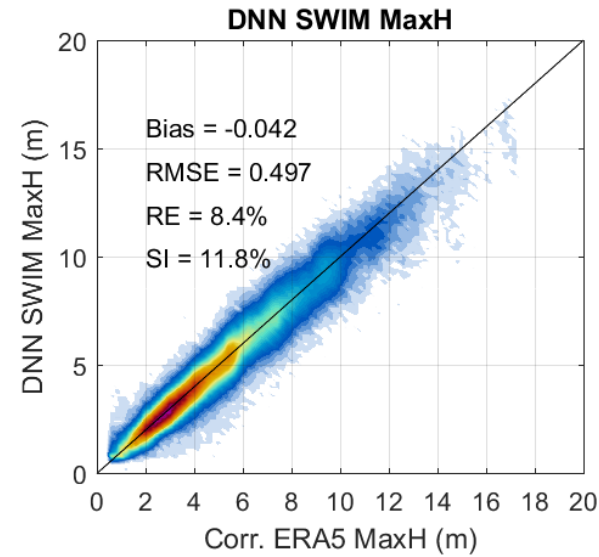
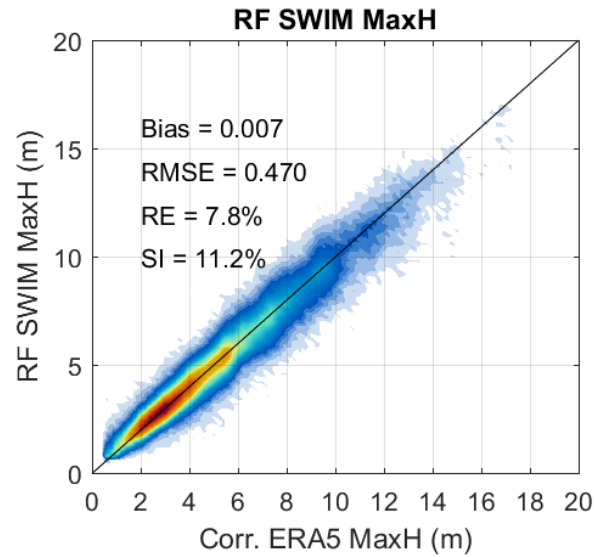
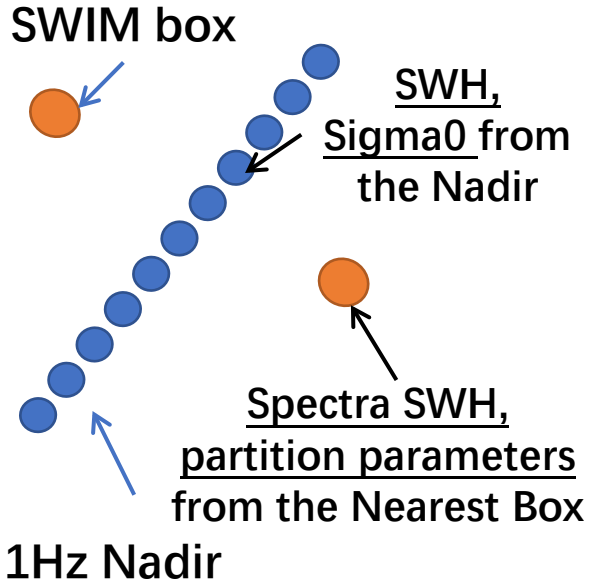


# DNN and RF MaxH Correction Comparisons on Test Datasets



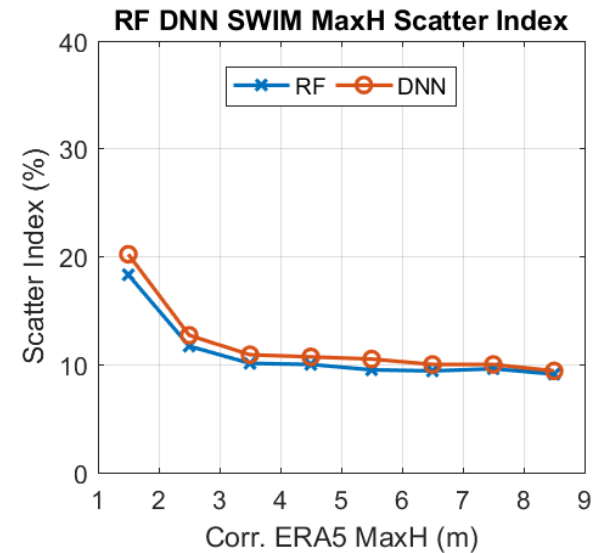
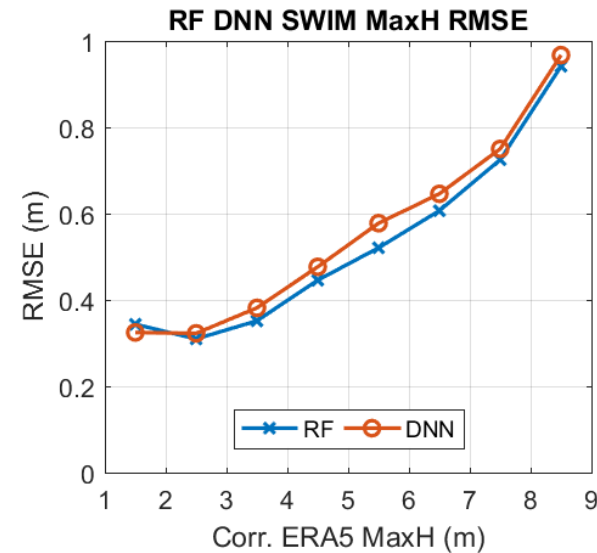
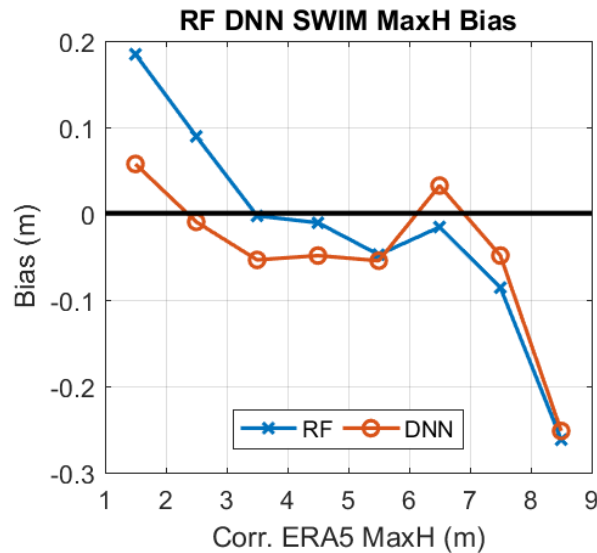
	Bias	RMSE	RE	SI
ERA5	0.563	0.851	21.2%	20.7%
RF	-0.015	0.591	13.0%	19.1%
DNN	0.002	0.563	12.5%	18.2%

# SWIM MaxH Assessment Against Corrected ERA5 MaxH



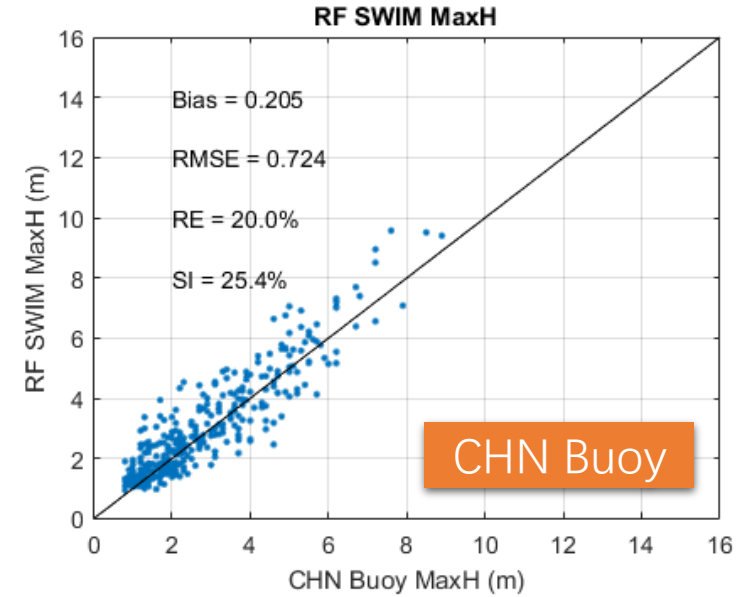
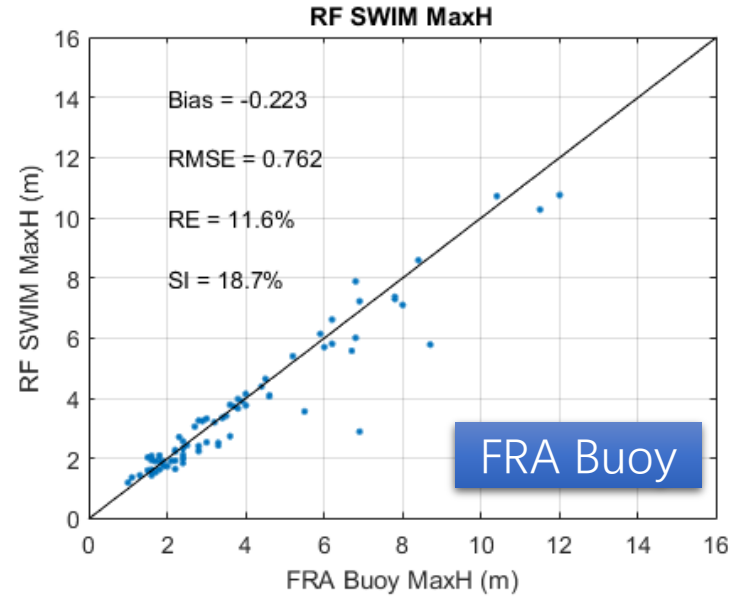
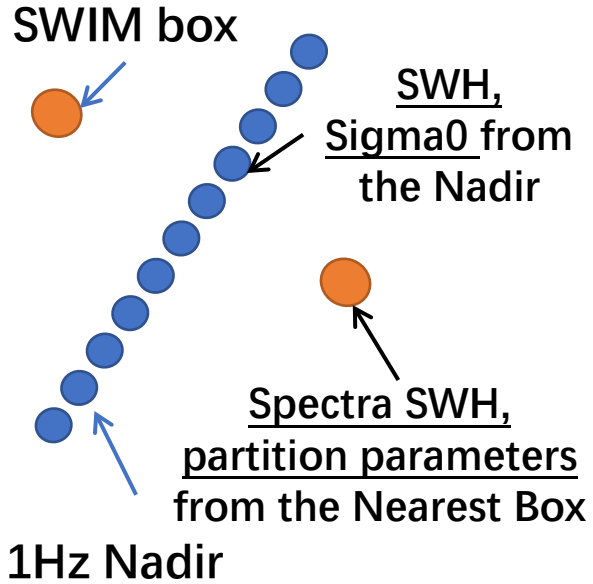
● The training dataset is in 2019-2020

● While the assessment is done based on the data in 2021



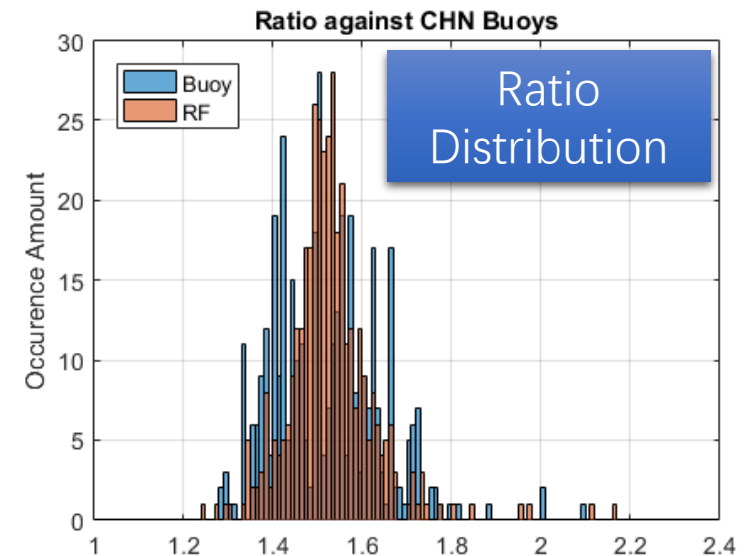
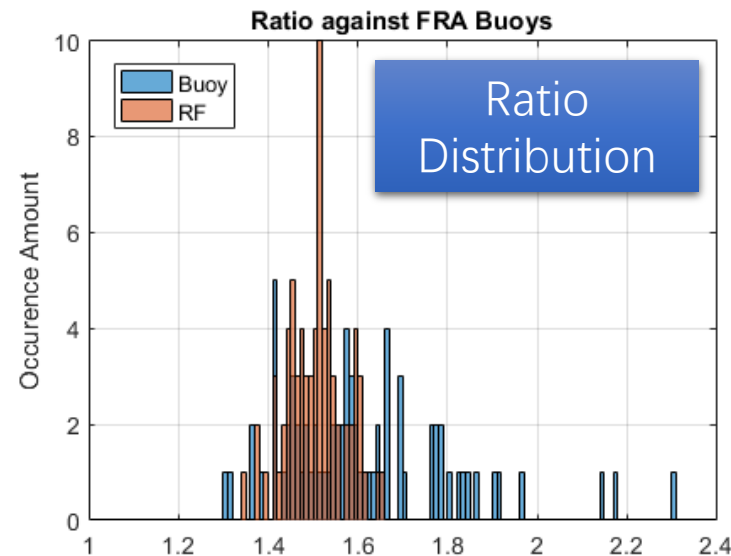


# CFOSAT MaxH Assessment Against FRA/CHN Buoy



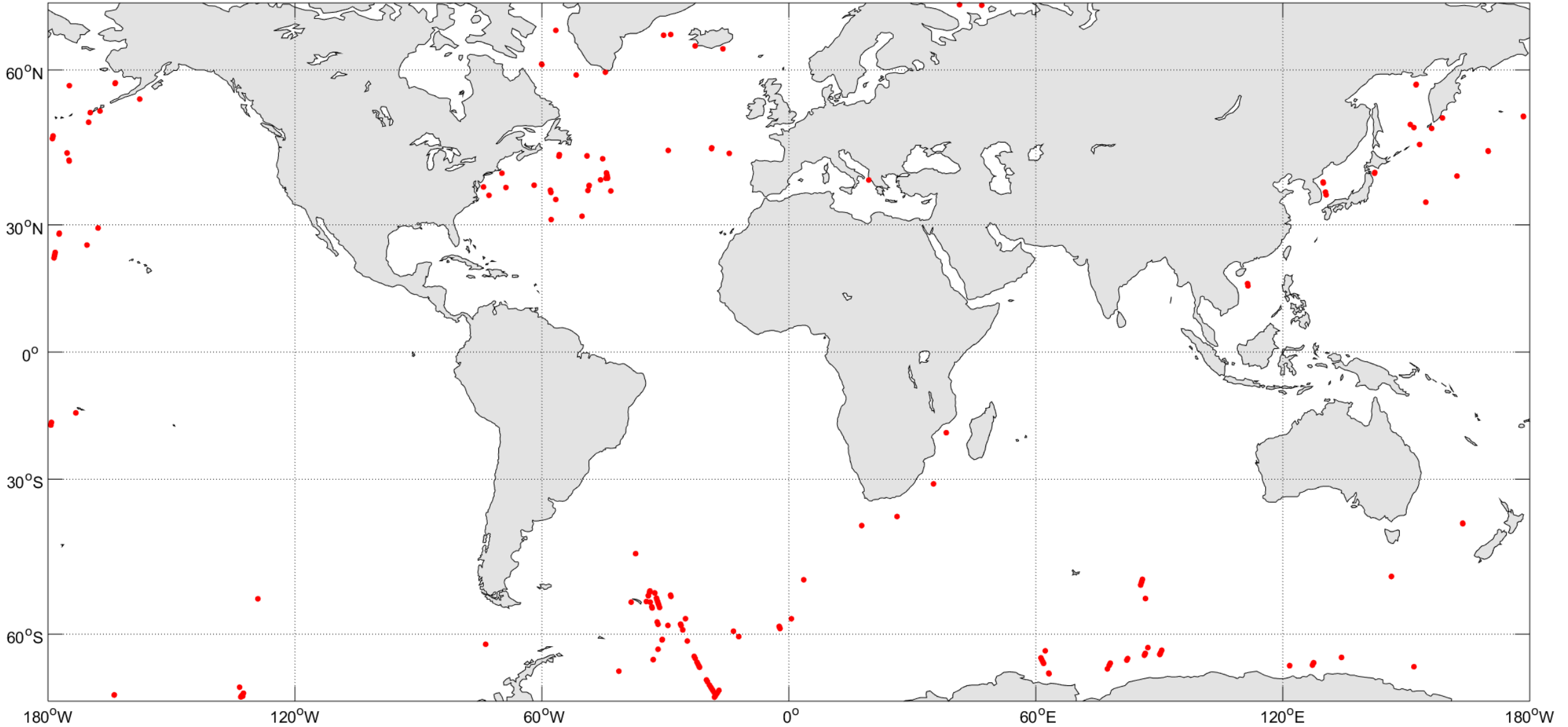
- The training dataset is in 2019-2020

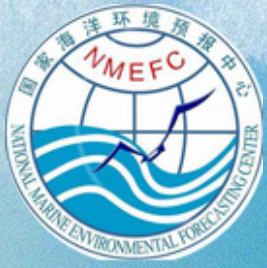
- While the assessment is done based on the data in 2021



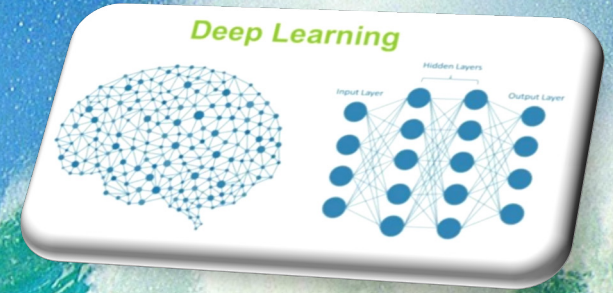
# SWIM "Freak Wave" Occurrences (Ratio > 2 & SWH > 2)

202101 SWH > 2 and RF-Hmax/Hs > 2 points





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**Thank you very much!**

**Suggestions and comments are extremely welcome**

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**National Marine Environmental Forecasting Center, Meteo France**

**2022.10.19 Dragon 5 Mid-term Symposium**