Wind Speed Retrieving for Typhoon Using Neural Network for Combined Observations of Radiometer and Scatterometer onboard HY-2A

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Outlines

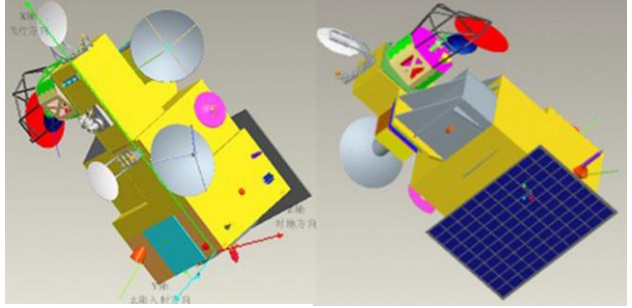
- Introduction
- Method
- Experiment
- Results and Discussion

Introduction: HY-2 Series

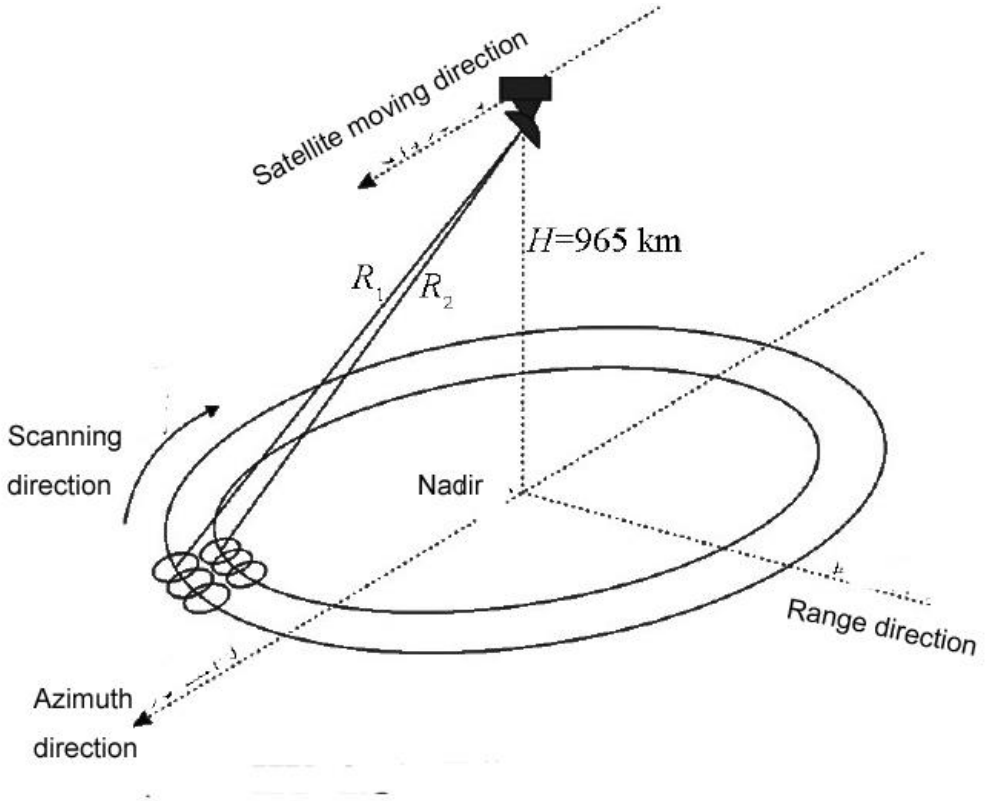
—China‘s ocean dynamic environment mission series,
Sea level, SWH, OSVW, SSS, SST, et al.

HY2 Series	Description
HY2-A(In operating)	Polar orbit. Scatterometer, Radiometer (Scanning), Altimeter & Radiometer(nadir-looking for path correction)
HY2-B(Planned in 2017)	Polar orbit. Scatterometer, Radiometer (Scanning), Altimeter & Radiometer(nadir-looking for path correction)
HY2-C(Planned in 2018)	Inclined-orbit. Scatterometer, Altimeter & Radiometer(nadir-looking for path correction)
HY2-Follow on (after 2021)	Wide-swath altimeter & Radiometer(nadir-looking for path correction), dual-frequency polarized scatterometer, polarimetric radiometer

Introduction: HSCAT



HY-2A Scatterometer（HSCAT）

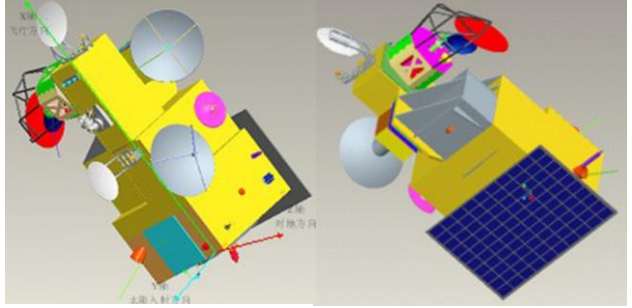


Schematic diagram of the HY−2A scatterometer observation

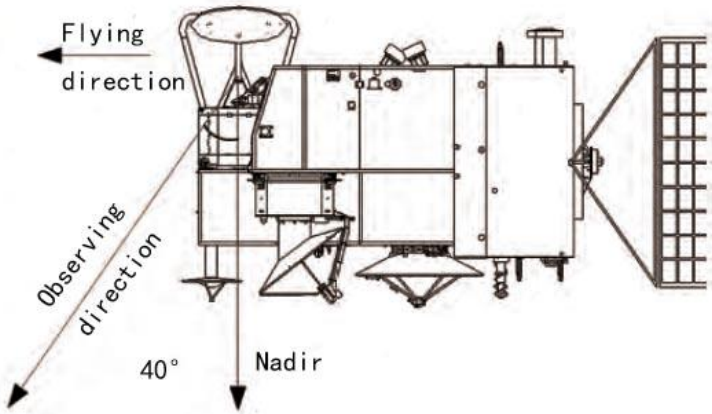
The technical specification of HSCAT

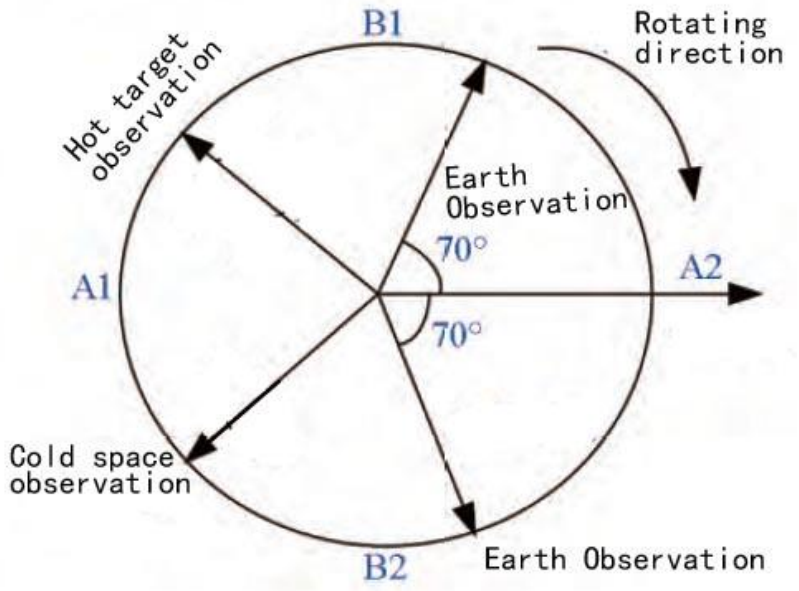
Parameters	Specifications	
Working Frequency (GHz)	13.256	
Swath(km)	Outer beam: ≥ 1700	Inner beam: ≥ 1400
Resolution (km)	25	
Sigma0 measuring accuracy (dB)	0.5	

Introduction: RAD



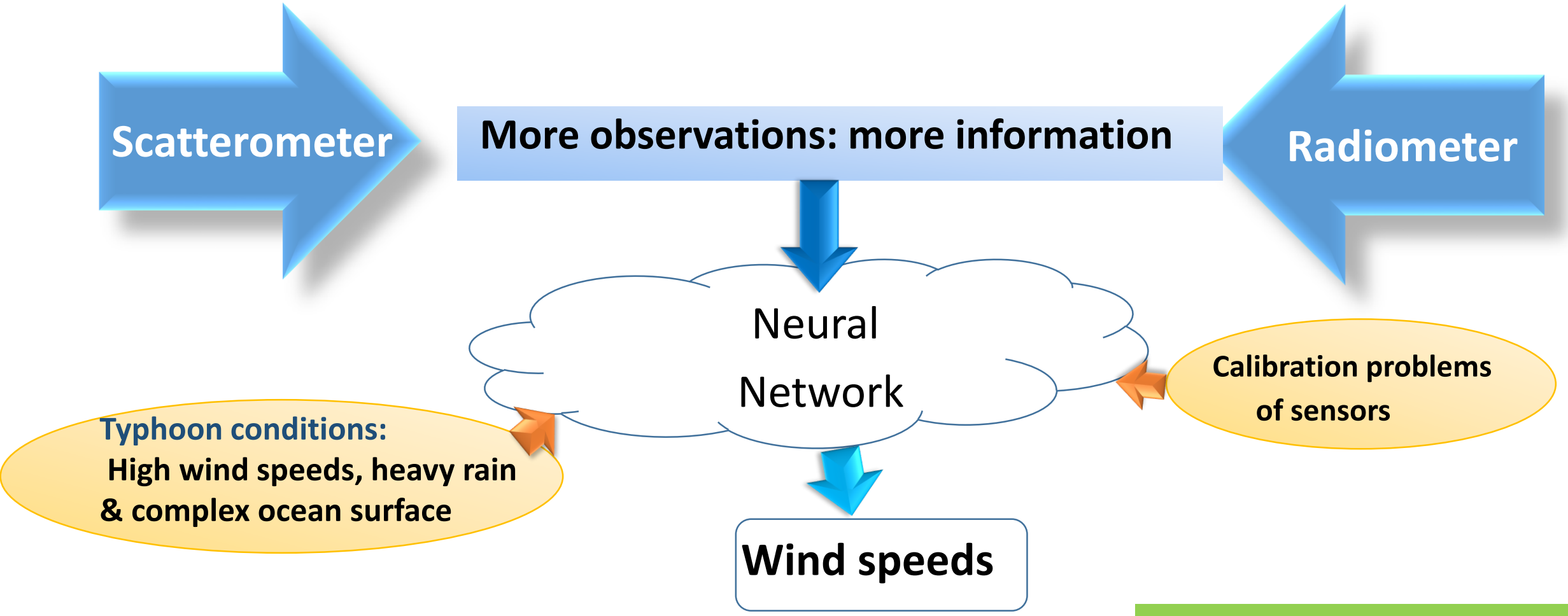
HY-2A Scanning Radiometer（RAD）The technical specification of RAD





Frequency（GHz）	6.6	10.7	18.7	23.8	37.0
Pol	VH	VH	VH	V	VH
swath（km）	≥1600				
footprit（km）	100	70	40	35	25
Sensitivity（K）	Better than 0.5				≥0.8
Measurement range	3~350K				
Calibration accuracy	1.0K（180~320K）				

Introduction



Wind directions of products are similar as GRAPS

Introduction: Data Used

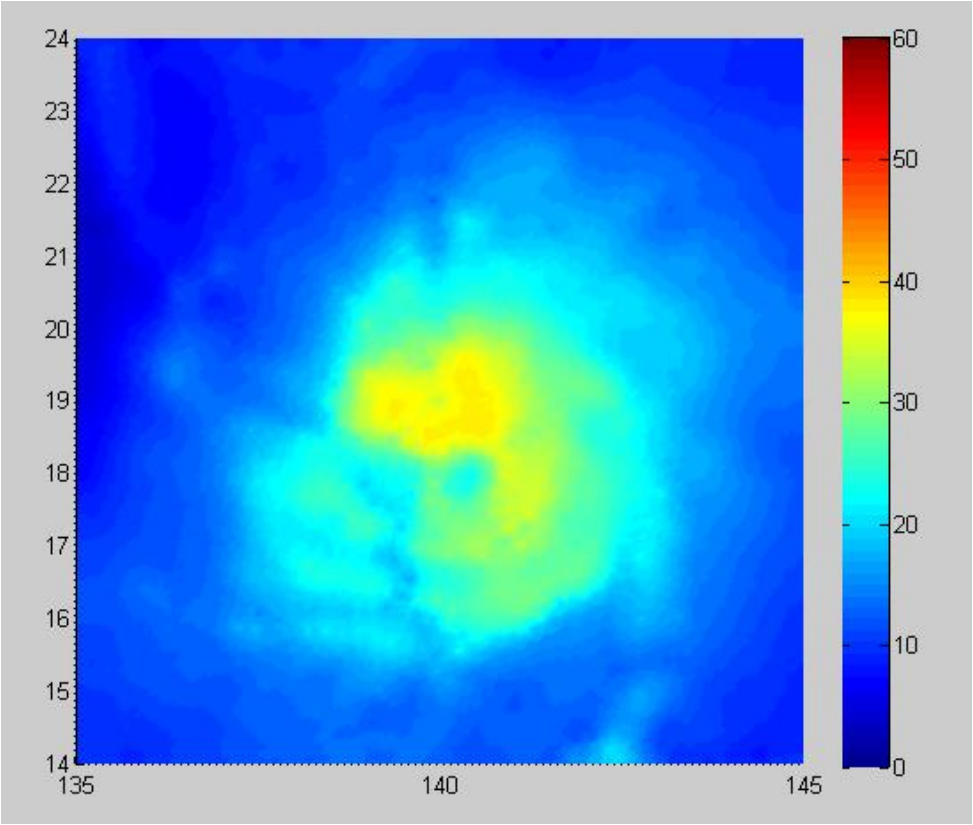
Data	Description
HSCAT L2A	Sigma0s of return pulses with wind cell(30km) IDs, polarizations, and azimuthal angles.
RAD L1B	Brightness temperatures of all frequencies and polarizations, sampled to 35km grids and azimuthal angles. Observed simultaneously with HSCAT.
Numeric products of GRAPS(global/regional assimilation and prediction system) of China Meteorological Adm.	Time resolution: 1 hour, Spatial resolution: 0.125° x 0.125° http://data.cma.cn/data/index/69be9dbf72605049.html

Time: June, July, Aug. of 2015

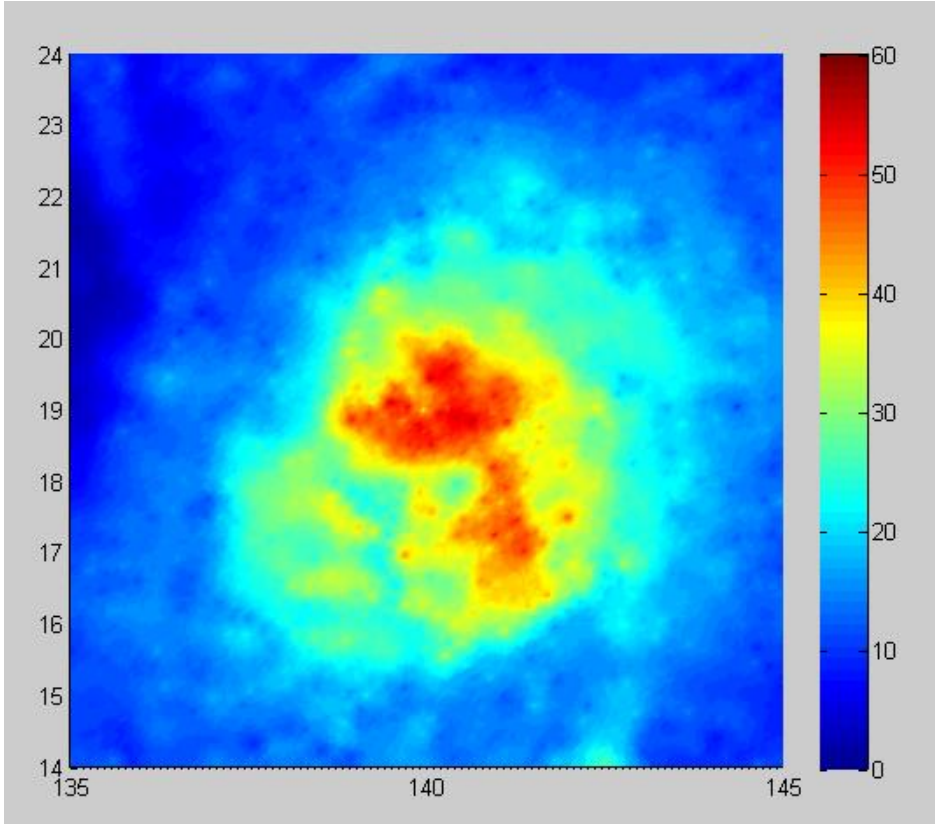
Introduction:

HSCAT and RAD product in Typhoon v.s. Numerical model values (Typhoon Nangka (20150710 0721 GMT), as an example)

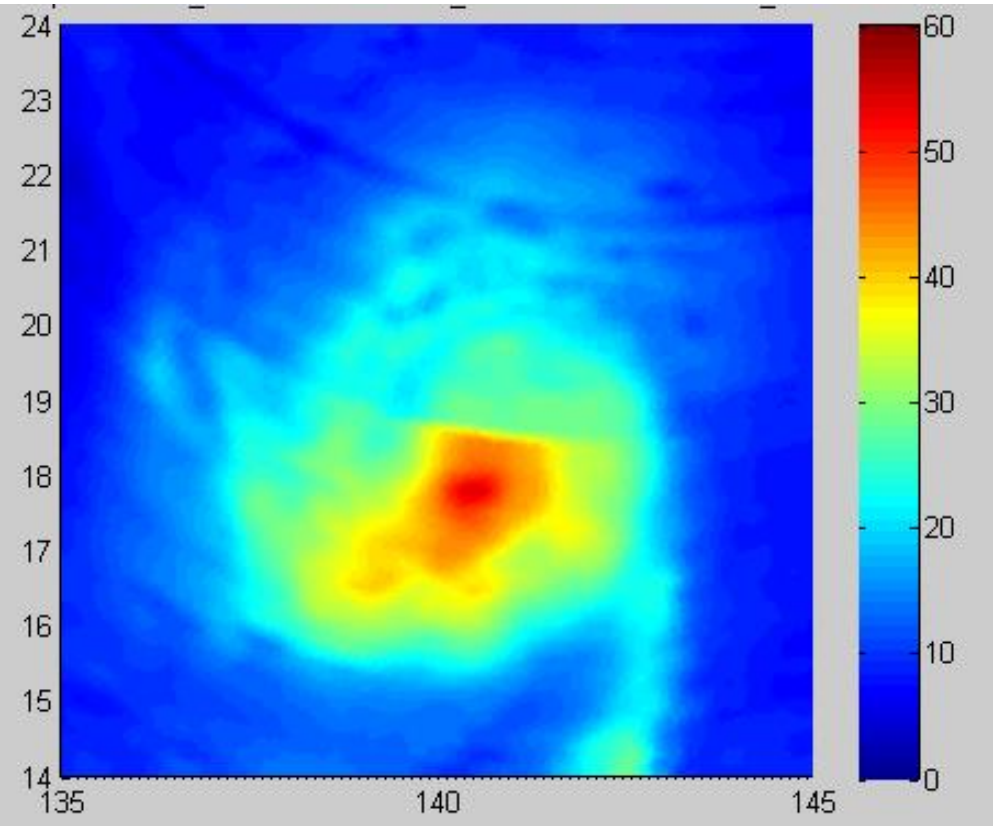
Wind speeds of wind of HY-2 HSCAT operational product by NSOAS



Wind products GRAPS



Wind speeds of wind of HY-2 RAD operational product by NSOAS



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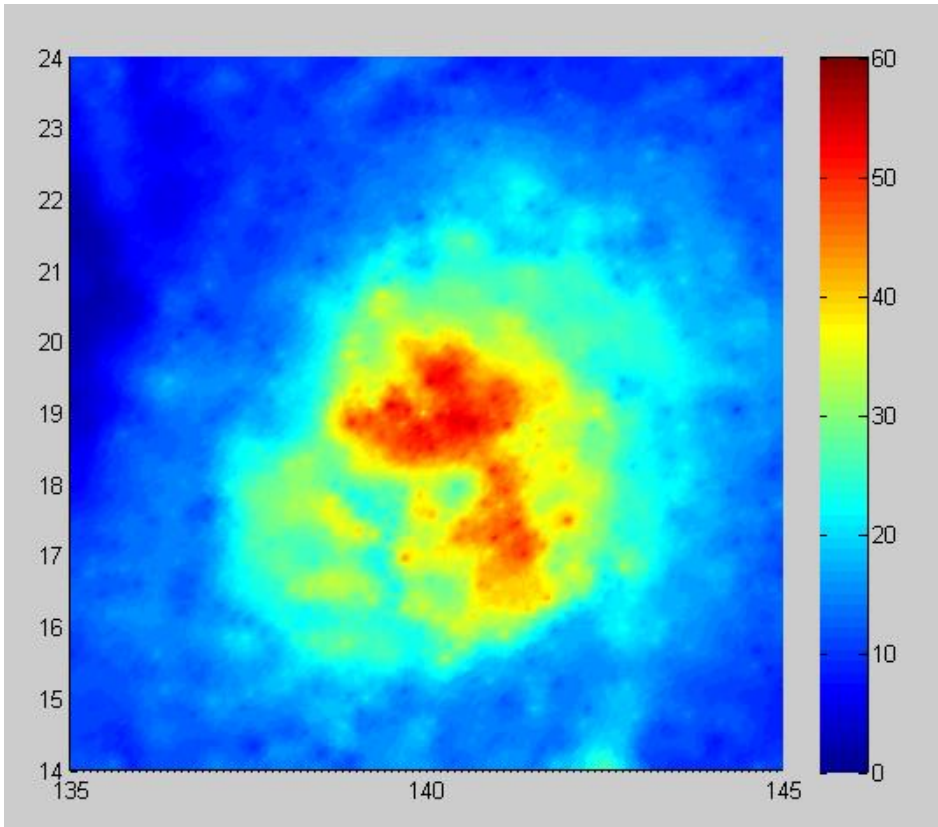
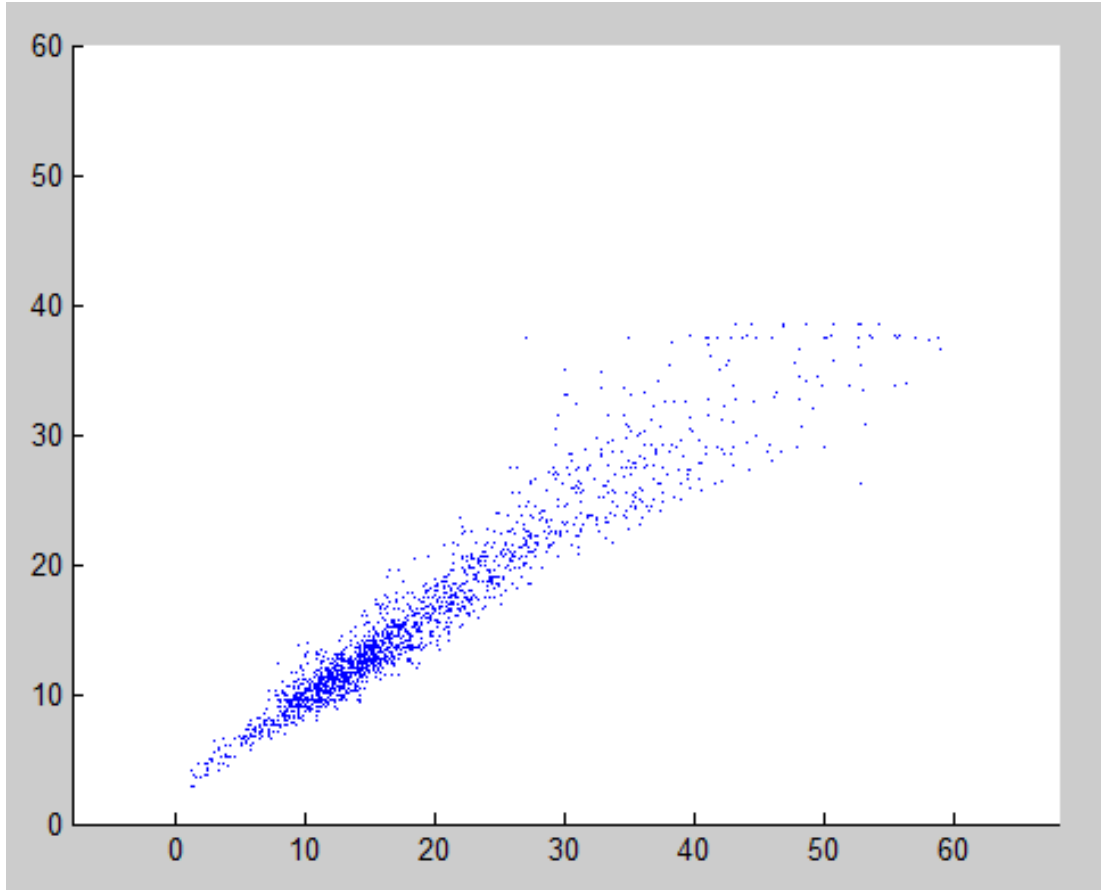


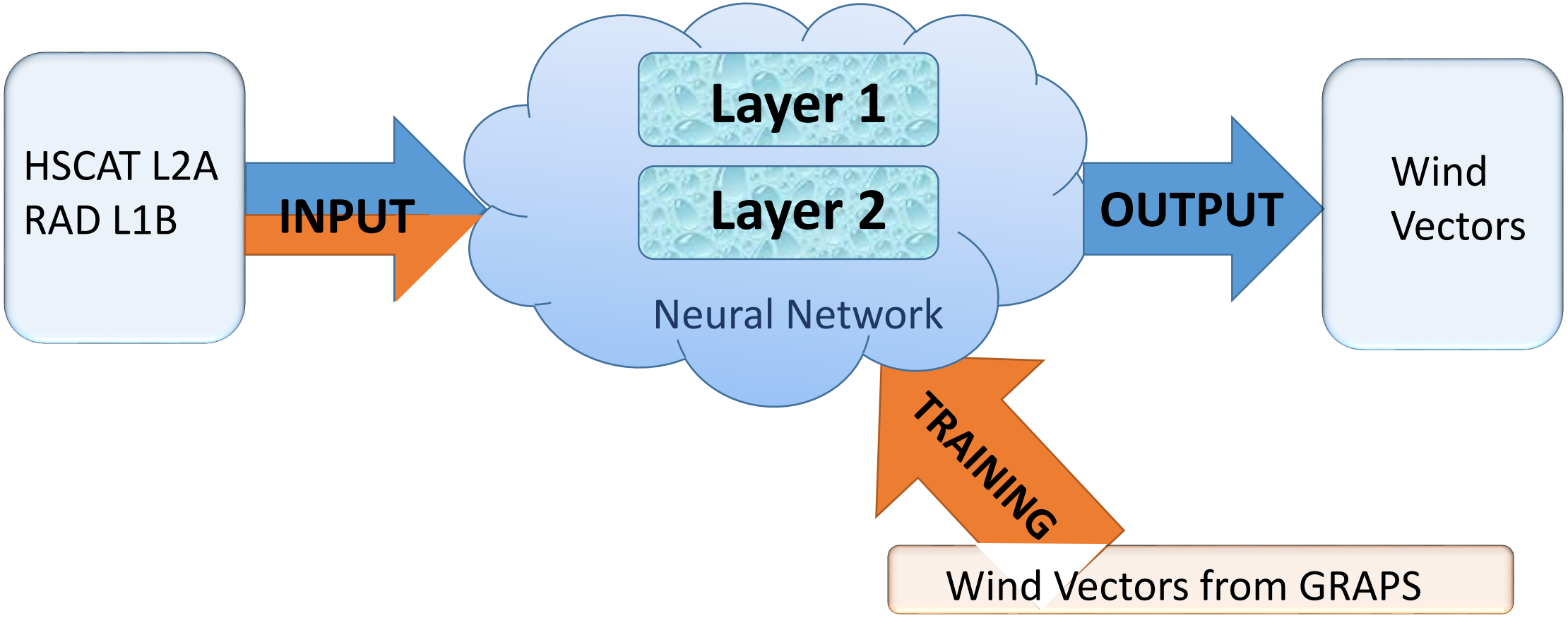
Introduction: HSCAT and RAD product in Typhoon v.s. Numerical model values (Typhoon Nangka as an example)

- Wind operational products of HSCAT v.s. GRAPS Values



Graps_Speed(m/s)	HSCAT2B_Speed(m/s)	HSCAT2B_Stddev
5	4.9	0.7
10	8.4	1.0
15	11.3	1.2
25	14.5	1.7
30	18.6	2.3
35	21.9	2.6
40	25.6	4.3
45	29.2	5.0
50	32.3	5.6
55	35.3	4.3

Method



BP Network composed by layer 1 and layer 2. Layers are both formed by 12 neural.

Experiment

Data matching

- ***HSCAT and RAD data:*** Observed simultaneously (time differences less than 30s for the same location). RM BT products were interpolated to SCAT WVCs.

- ***Training & Verification data:*** Matched with HY-2 data. Distance less than 25 km, time differences less than 30min.

Experiment

Data Selection & Training of Neural Network

- Data of matched SCAT, RAD and GRAPES wind fields were selected from data obtained in June, July and Agu. 2015. With multiple-time observations of one typhoon, 165 data groups of entire typhoons were selected.

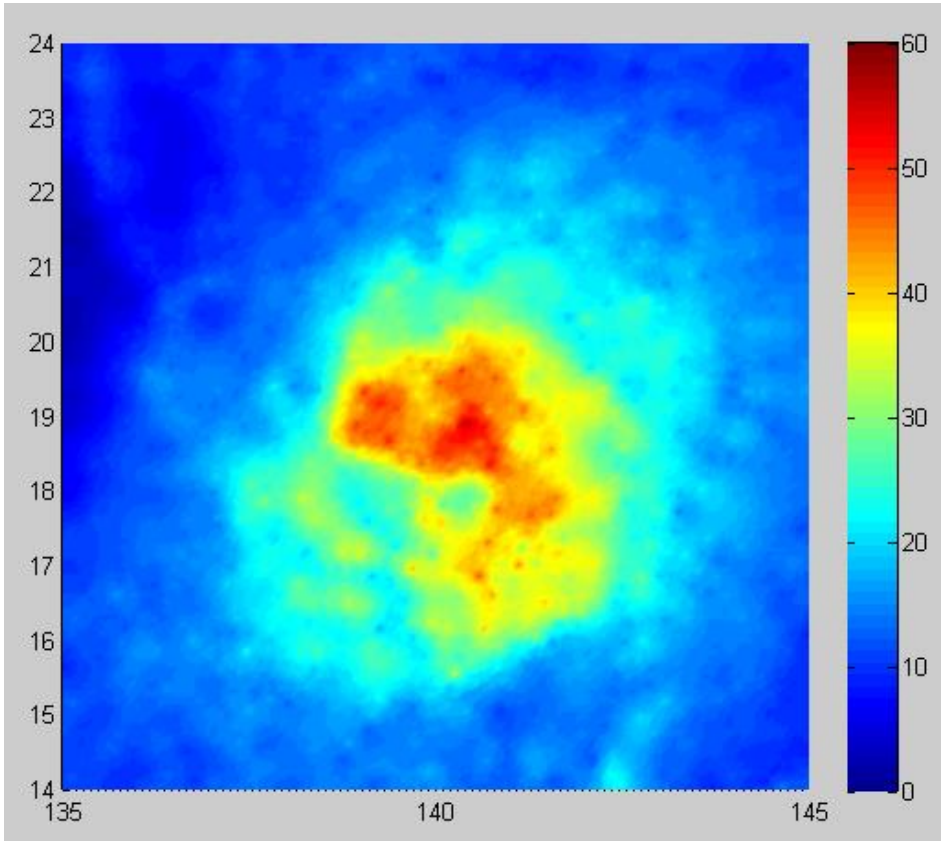
- Data ranged to 5° from eye centers were picked for experiments.

- Among them 120 data groups with wind speed larger than 30m/s, samaller than 70m/s were selected as training data, rested for validation.

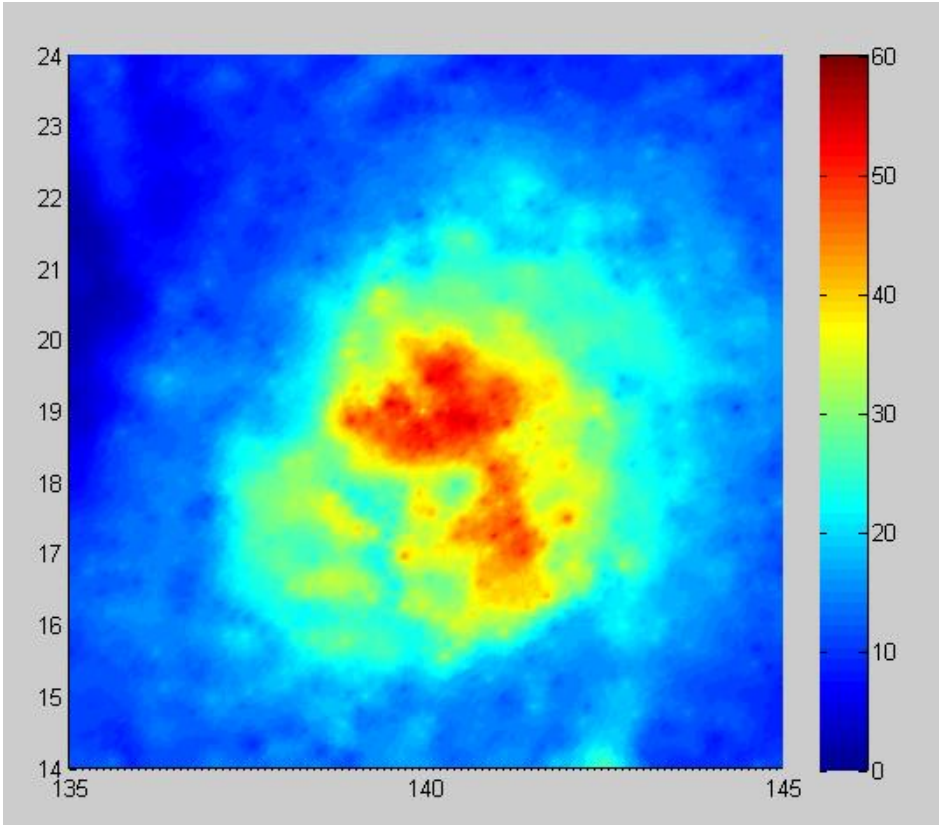
ANN Application & Results

Typhoon Nangka as an example

Wind products of ANN applying RAD and HSCAT data

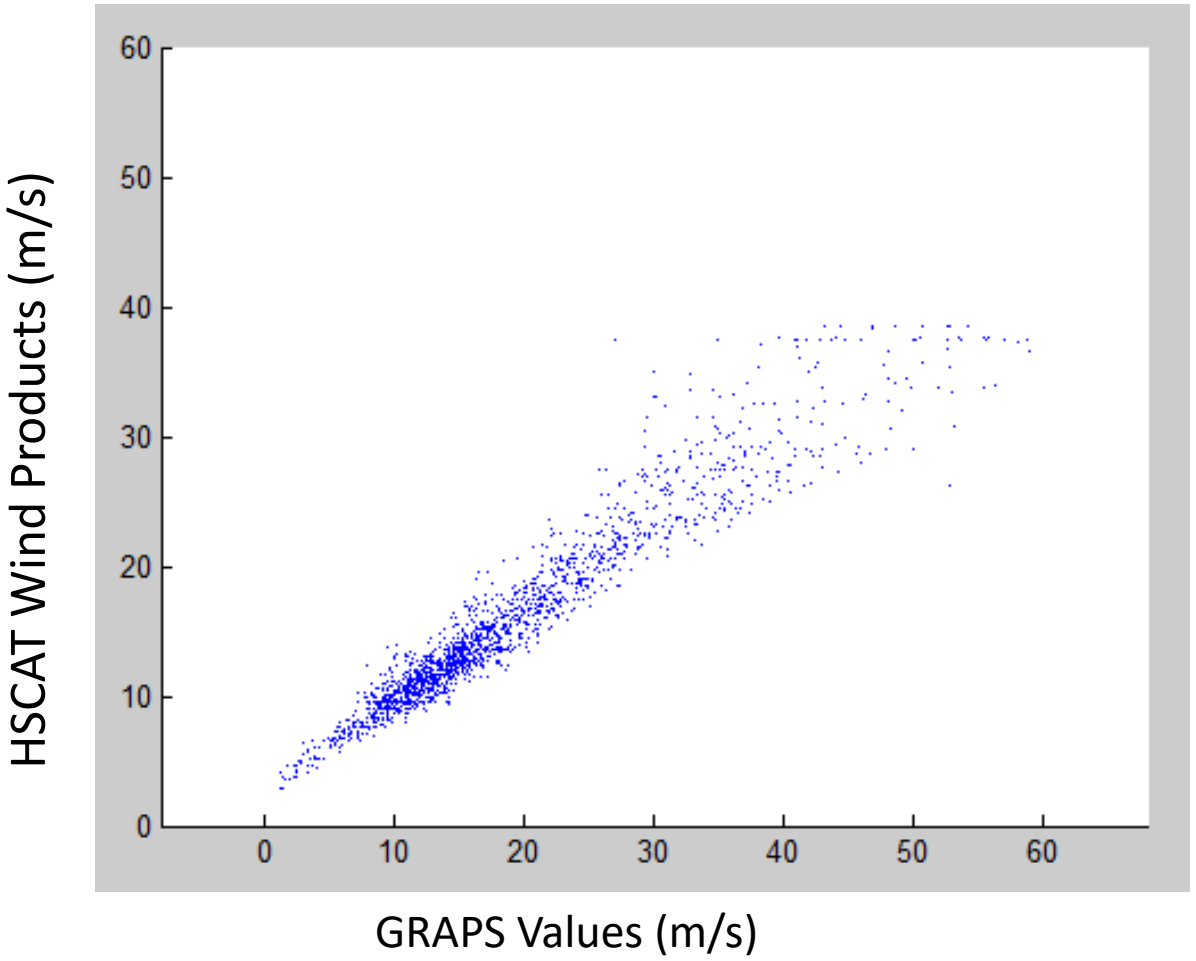


Wind products GRAPS

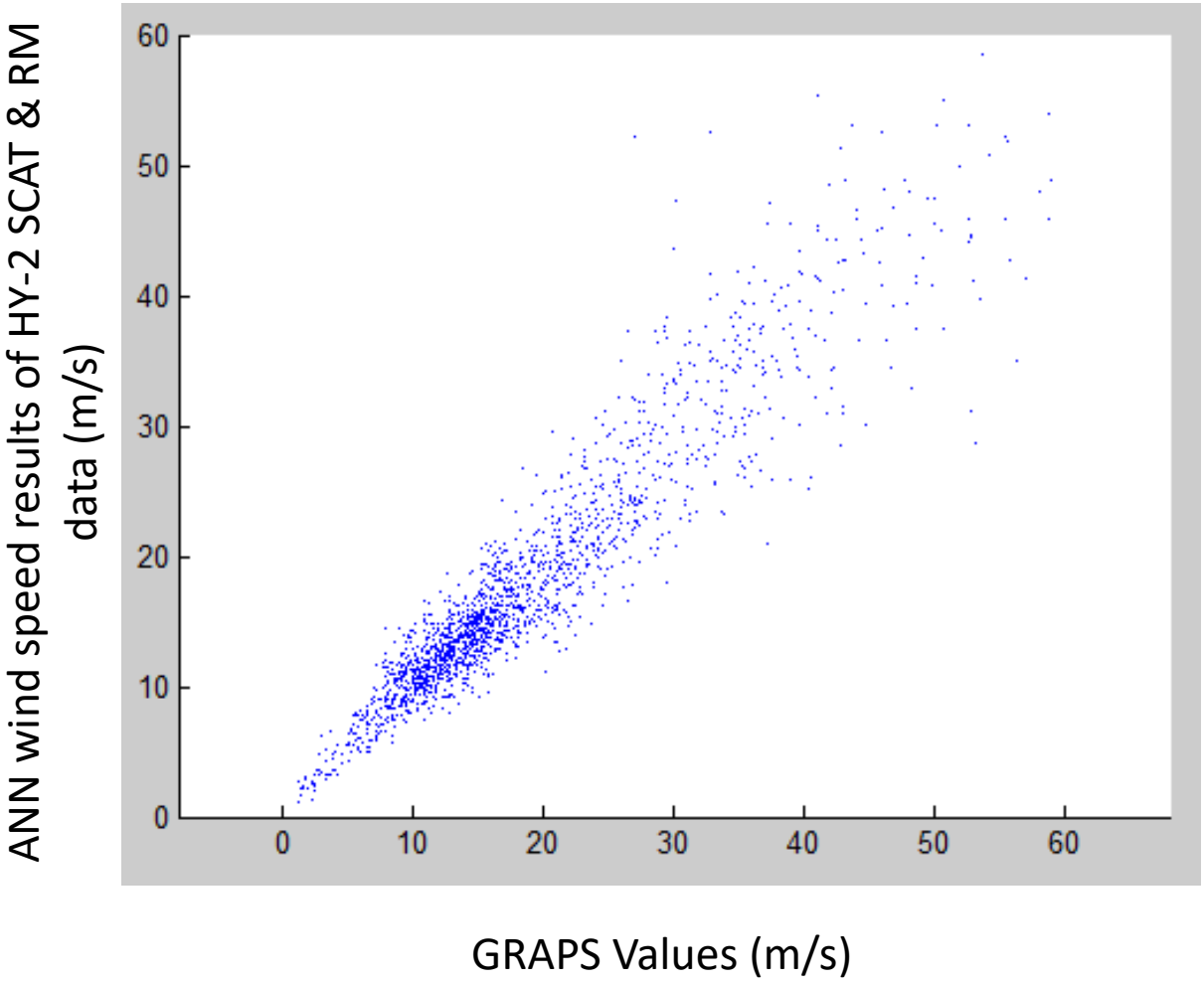


Validation

- Wind products of HSCAT v.s. GRAPS Values

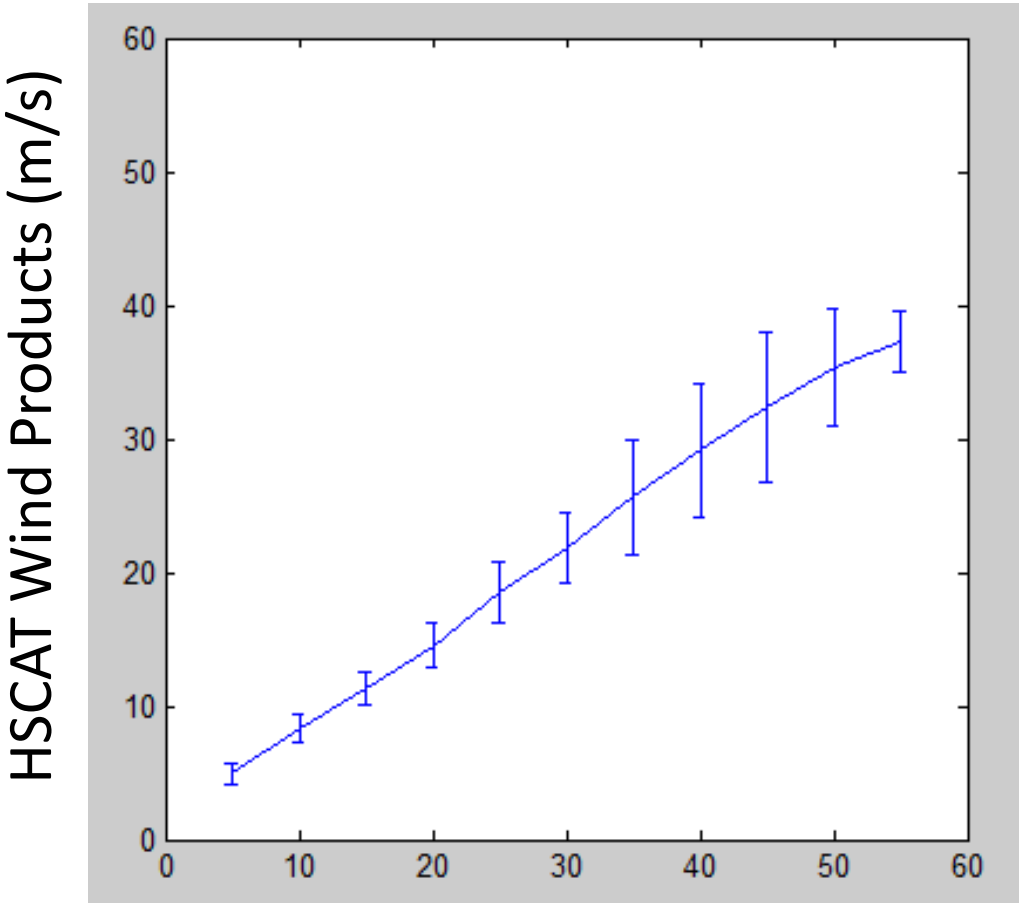


- Wind Results of ANN v.s. GRAPS Values

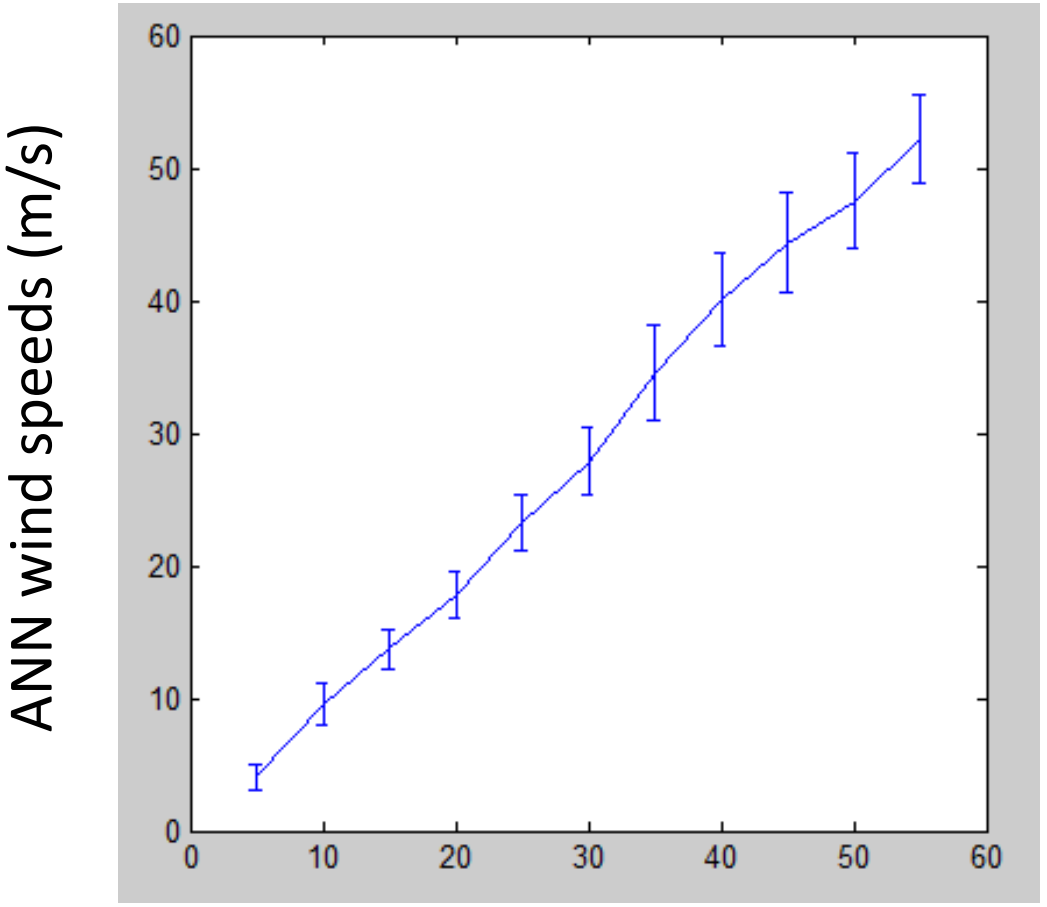


Validation

Wind products of HY-2 SCAT v.s. GRAPS Values



Wind Results of HY-2 v.s. GRAPS Values



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35	21.9	2.6	27.9	2.5
40	25.6	4.3	34.5	3.6
45	29.2	5.0	40.1	3.6
50	32.3	5.6	44.4	3.8
55	35.3	4.3	47.5	3.6

Conclusion & Discussion

- Combined Observation: Better results in values and resolution than using only SCAT and RAD.

Next Steps:

- Larger data set for networks training
- The detailed of typhoon structure with rains and changes in lifetime are not considered.
- Refinement of neural network for low wind speeds.

Thanks !