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DEVELOPMENT OF THE METHOD TO ESTIMATE MAXIMUM WIND SPEED OF TROPICAL CYCLONES USING GCOM/AMSR2 DATA

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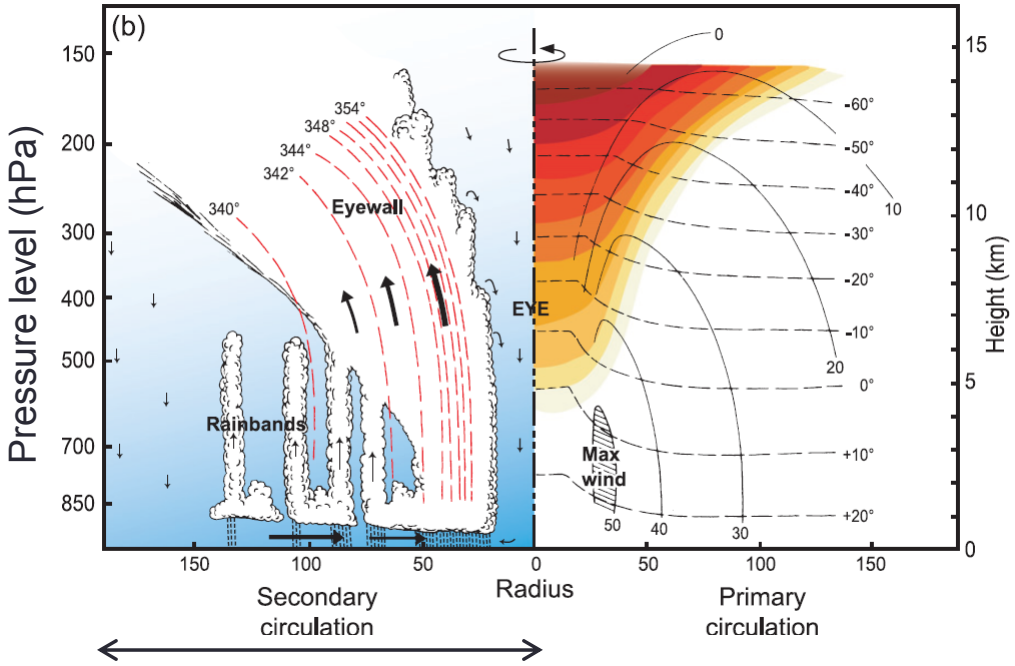
Basis of TC max wind speed estimation using microwave imager data (Hoshino and Nakazawa 2007)

Radial cross section through an idealized, axially symmetric hurricane
(Wallace and Hobbs 2006)



Inner core (radius < 100～200 km)

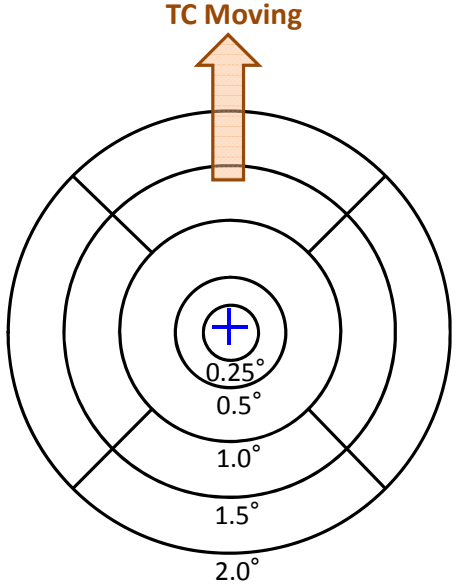
Convergence near the surface increases due to increase of inflow with tangential wind intensified,

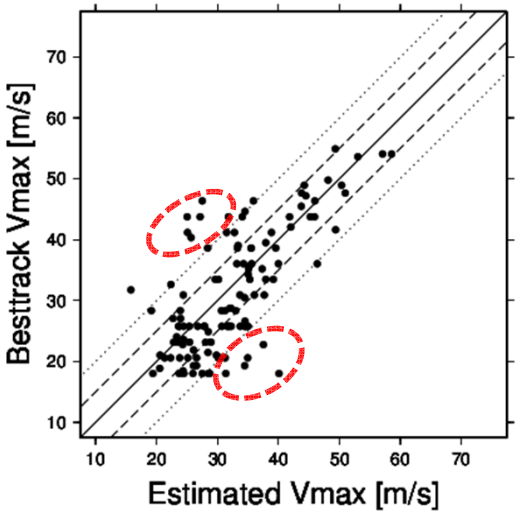
→

In TC inner core, cloud and rain water increases as eye walls and rain bands are formed.

Research toward better use of AMSR2 data for TC max wind speed estimation (1)

- In the 1st year of the RA (2011), a pattern classification procedure considering rain distribution asymmetry for TC max wind speed estimation was tested using TMI and AMSR-E data for an upgrade of Hoshino and Nakazawa (2007) scheme.
- Validations in the 2nd year (2012) revealed some problems in the methodology mainly due to some invalid uses of parameters computed from the TB data (TB parameters).
- This scheme for TMI is currently used at JMA on a trial basis.





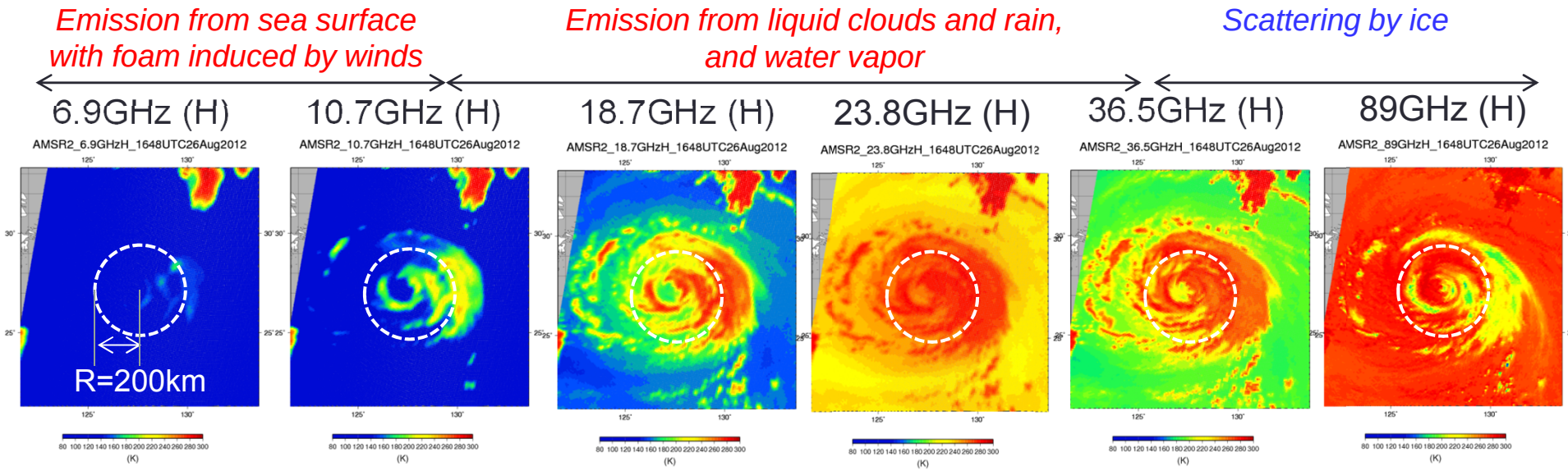
Validation using TMI observations of TCs during 2009-2010

Num of obs: 121

Max wind speed
= A0 + Σ {A(n) x TBparameter(n)} (Num =6)

Research toward better use of AMSR2 data for TC max wind speed estimation (2)

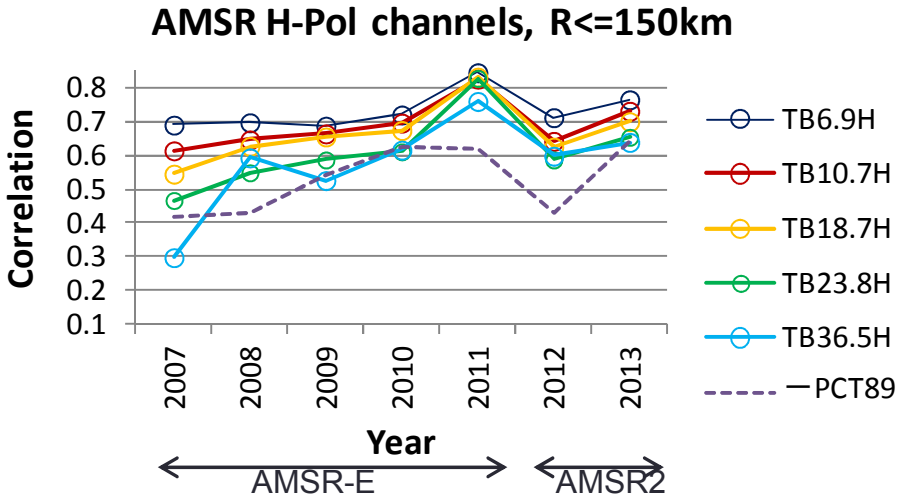
- To improve the current scheme based on multi-TB parameters (average, max, and min TBs within 50～200-km radius from TC center, etc.), we investigated to find effective AMSR2 channels (6.9～89 GHz) and TB parameters on TC max wind speed estimation with reference to TC max wind speed of JMA best-track data (10-minute average wind).
- 6 GHz (onboard only AMSR) and 10 GHz and H-Pol channel have advantages for wind retrieval (e.g., Shibata (2006)).

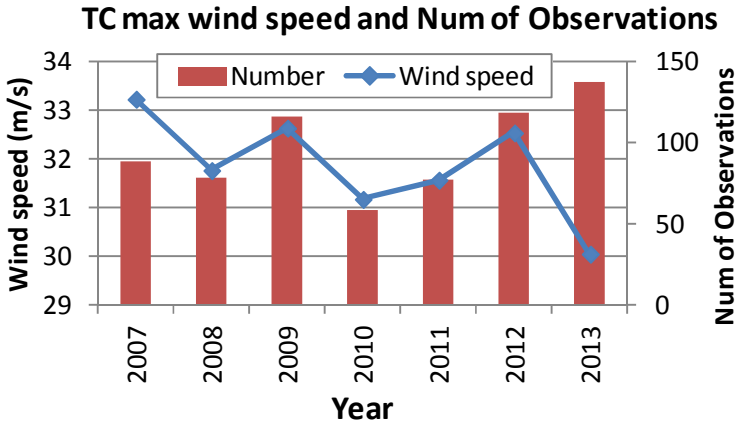


AMSR2 L1B TB images for BOLAVEN (1215) at 1648UTC on 26 August 2012

Yearly correlation between TB parameter and TC max wind speed for channel frequencies from 2007 to 2013

TB parameter: Average TB within 150-km radius from TC center



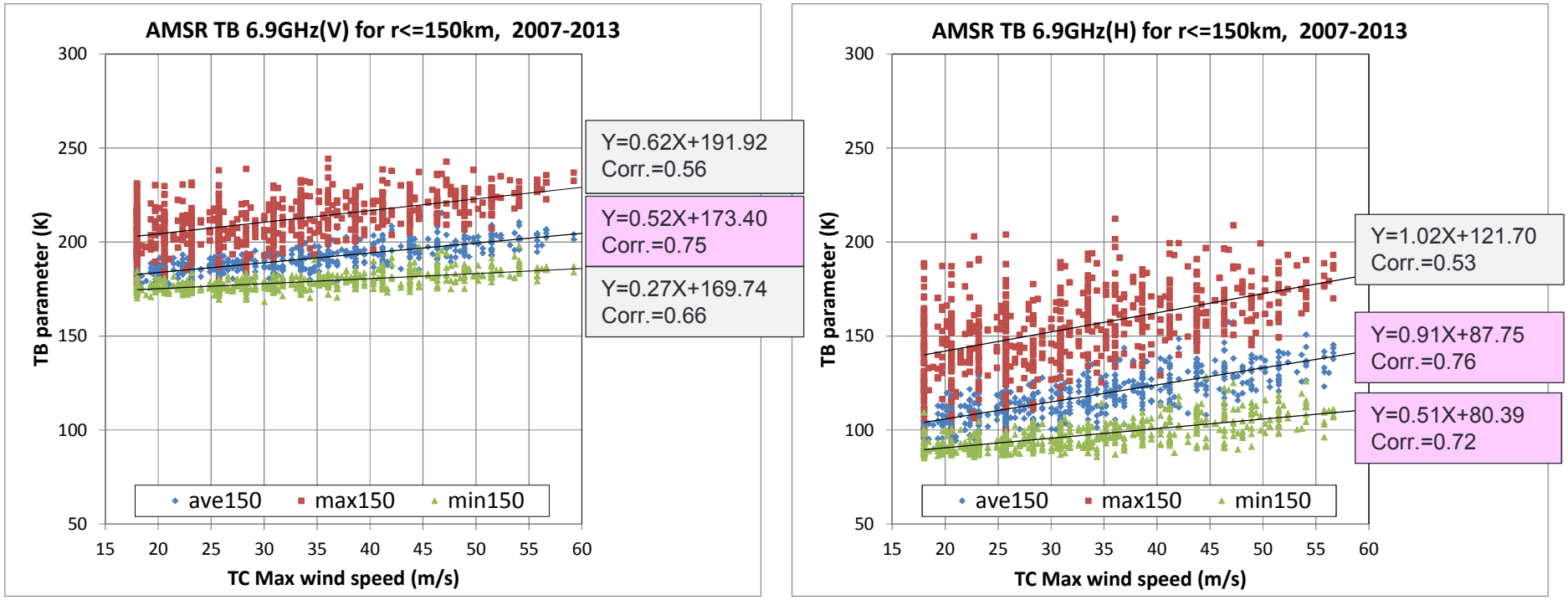


- Correlations for low-frequency channel are large.
- Dependence of correlations on satellite is not clear.
  -> AMSR-E and AMSR2 are possibly comparable in terms of TB parameters.

Scatter plots between TB parameter and TC max wind speed (2007-2013)

6.9 GHz for V-Pol (left) and H-Pol (right)

TB parameters (average, max, and min TBs) for area within 150-km radius

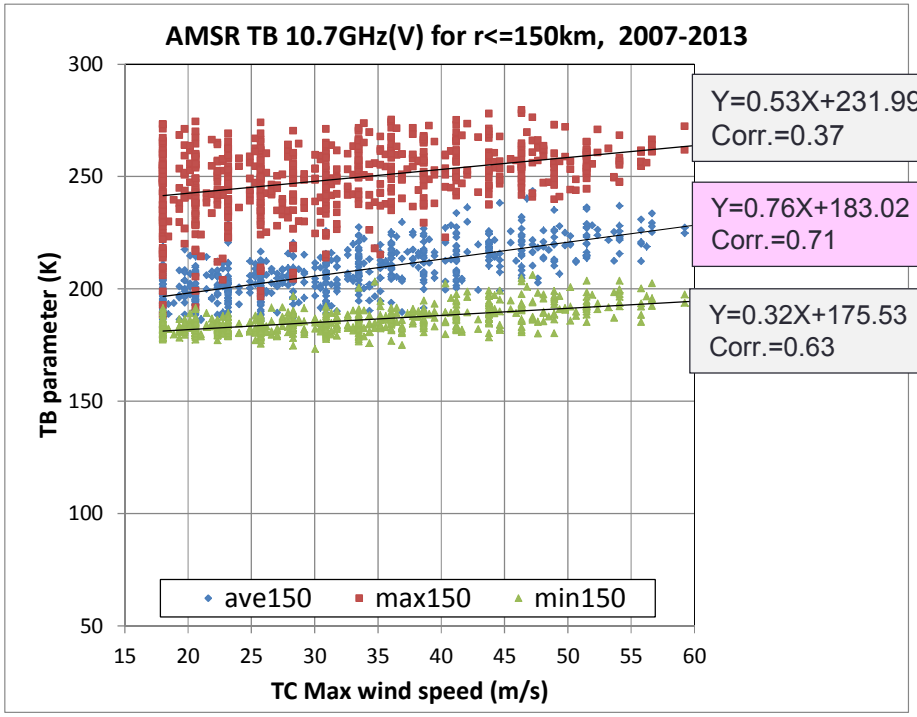


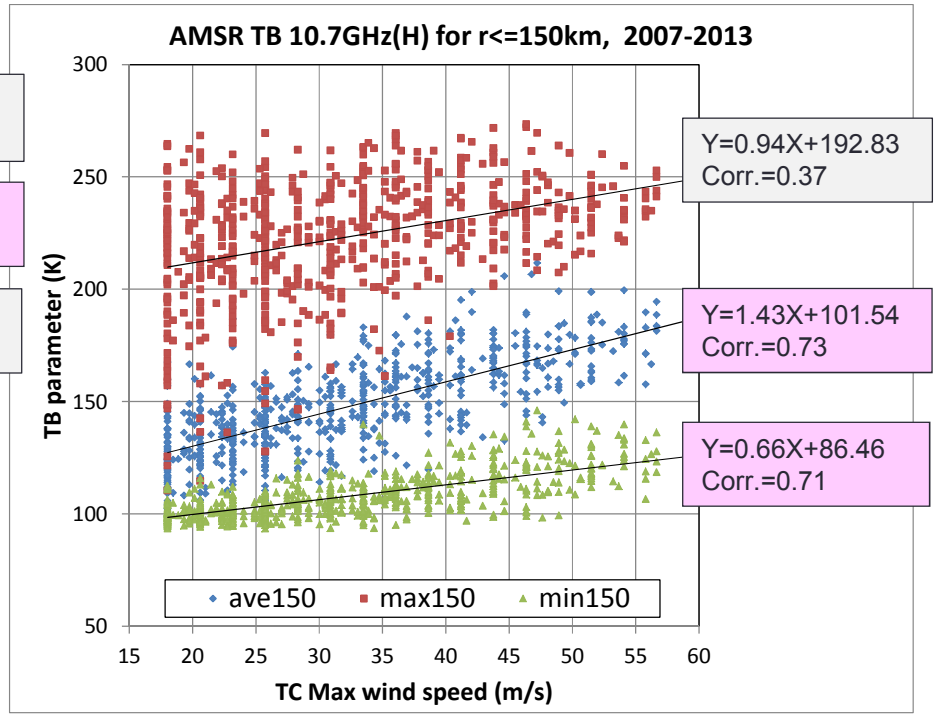
- TB parameters of 6GHz have the largest correlation to TC max wind speed of all channels.
- H-Pol is more sensitive to TC max wind speed than V-Pol.
- Correlation for average TB is larger than those for max and min TBs.

Scatter plots between TB parameter and TC max wind speed (2007-2013)

10.7 GHz for V-Pol (left) and H-Pol (right)

TB parameters (average, max, and min TBs) for area within 150-km radius



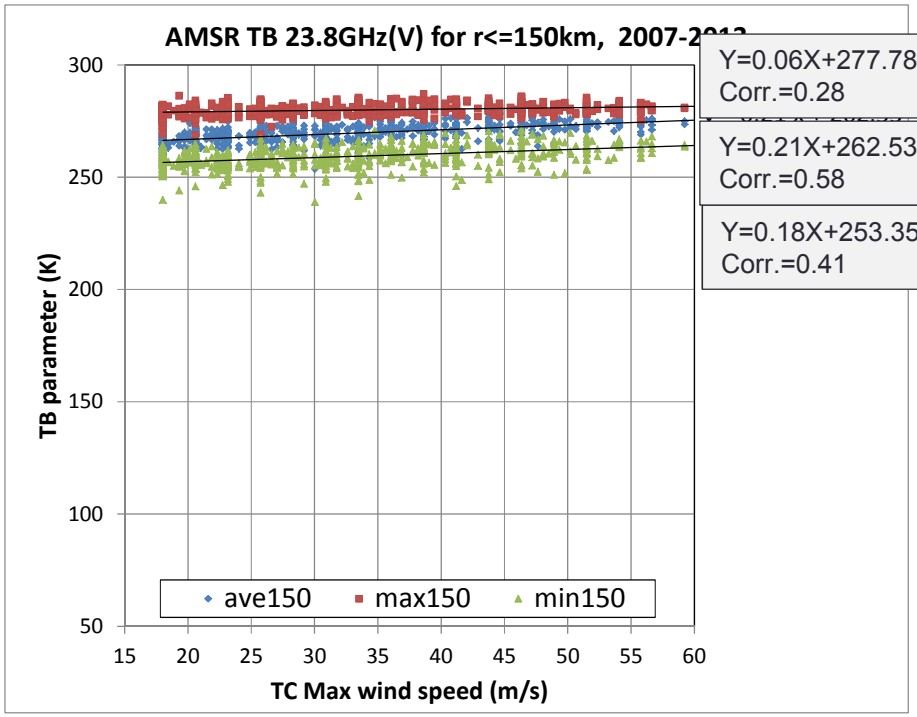


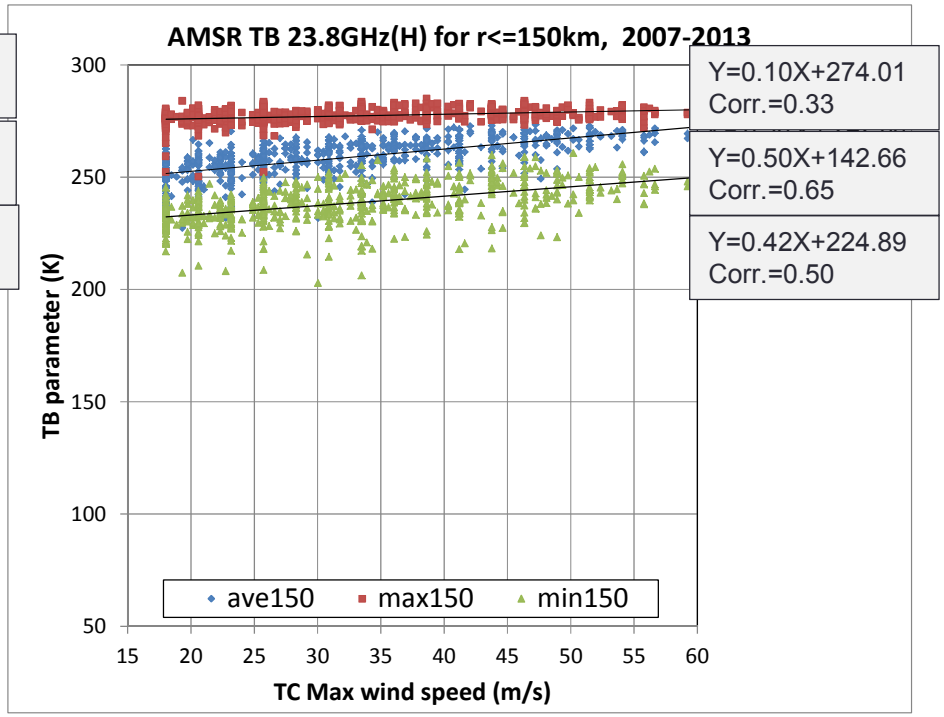
- Correlations for 10.7GHz are slightly less than those for 6.9GHz.
- Slope of the regression for 10.7GHz tends to be larger than that for 6.9GHz.

Scatter plots between TB parameter and TC max wind speed (2007-2013)

23.8 GHz for V-Pol (left) and H-Pol (right)

TB parameters (average, max, and min TBs) for area within 150-km radius



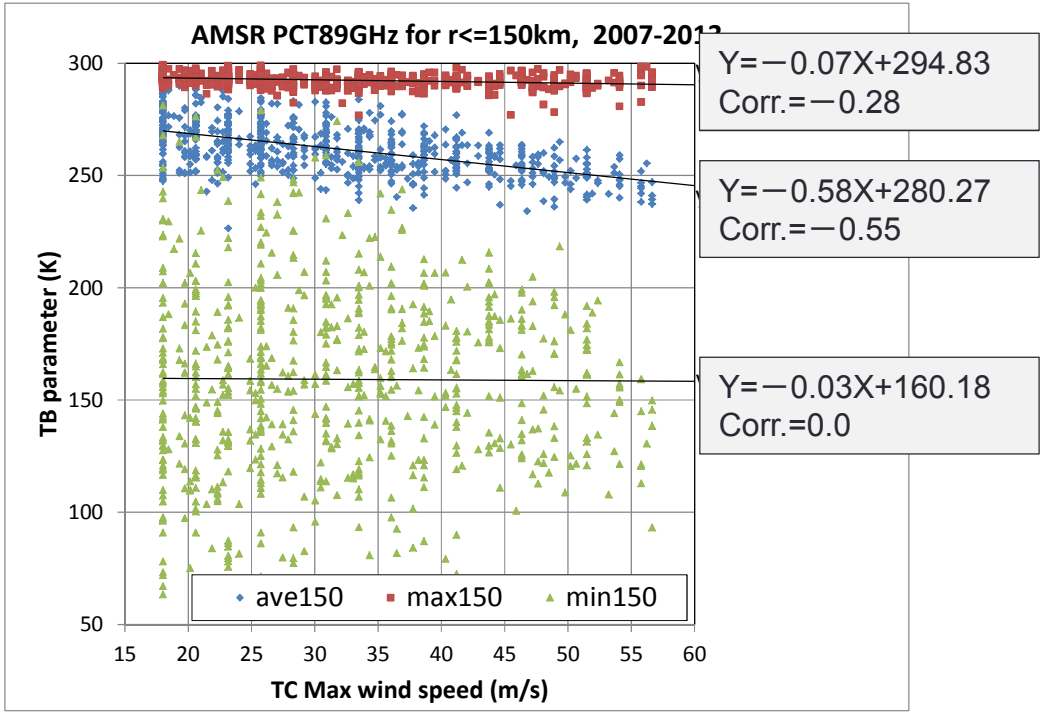


- Correlation and slope for 23.8 GHz are small for all TB parameters, possibly due to a influence of emission from water vapor.

Scatter plots between TB parameter and TC max wind speed (2007-2013)

89 GHz PCT

TB parameters (average, max, and min PCTs) for area within 150-km radius

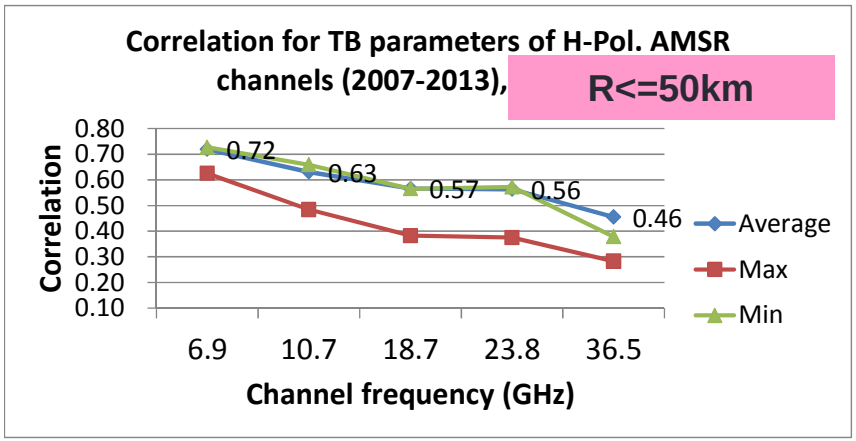


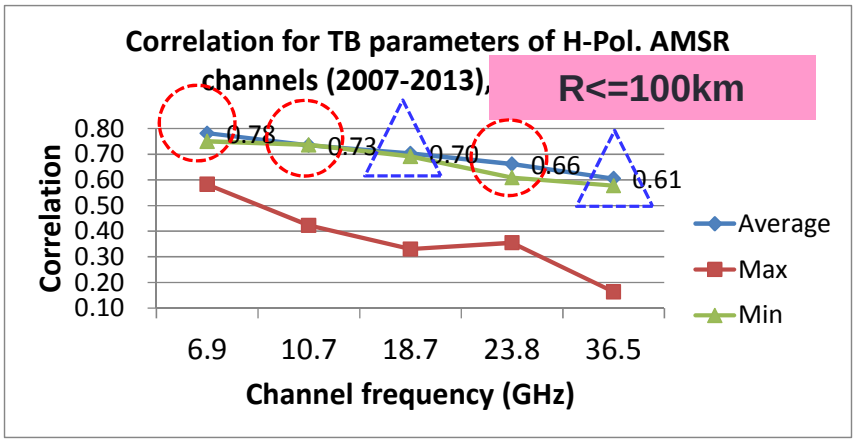
- Correlation and slope for 89 GHz are negative (The TB reflects MW scattering).
- Min TB has no correlation with TC max wind speed, possibly due to a local strong microwave scattering caused by deep convections.

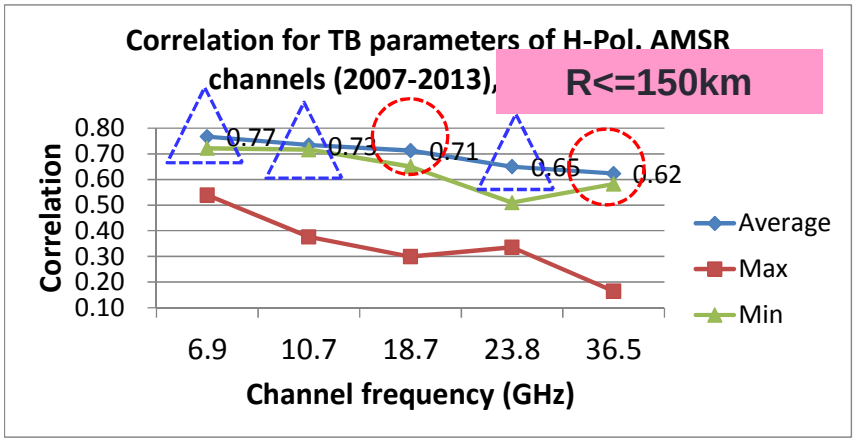
"Correlations" between TB parameter and TC max wind speed for 4 radii (2007-2013), **6.9 ~ 36.5 GHz (H-Pol)**

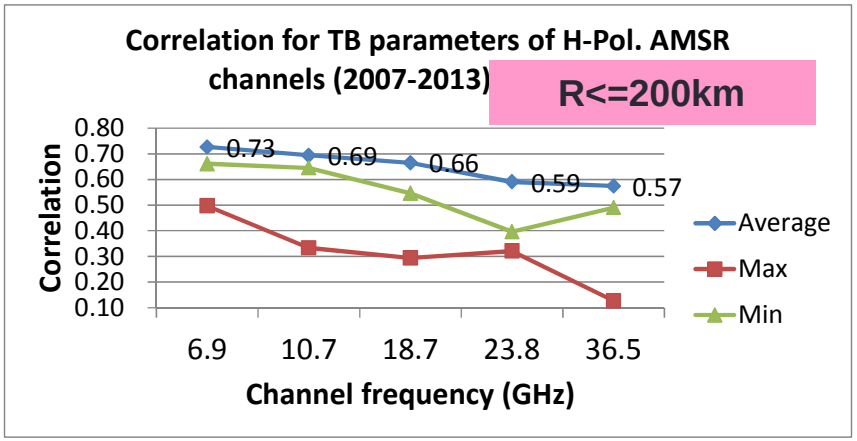
○ *The largest correlation of 4 radii*

△ *The 2nd largest correlation of 4 radii*





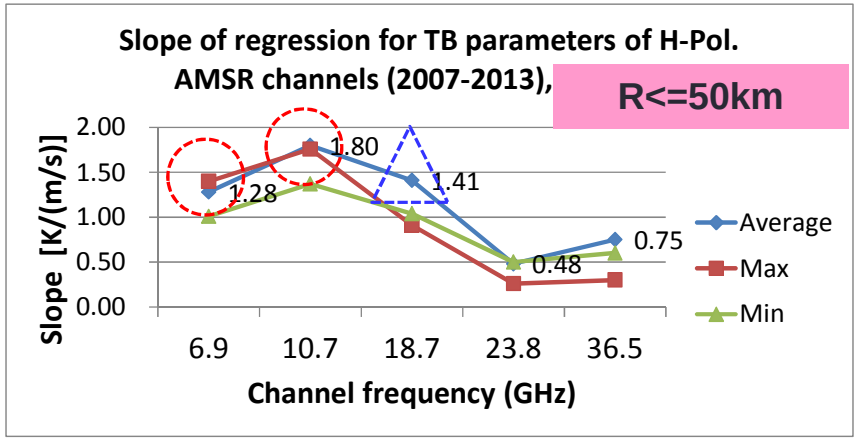


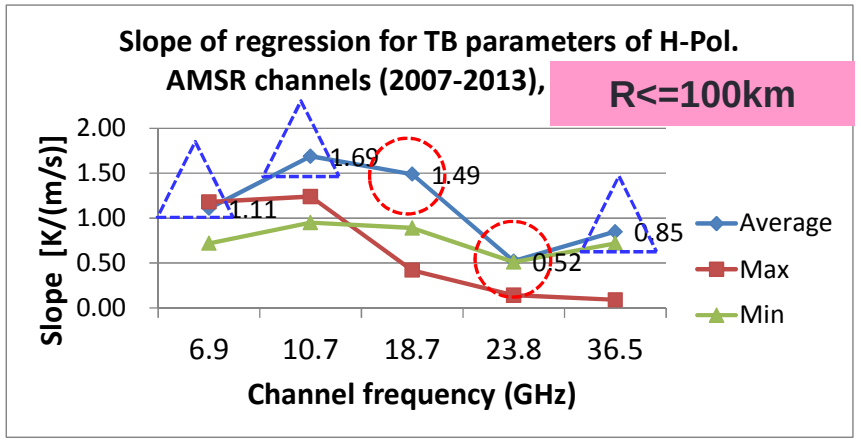


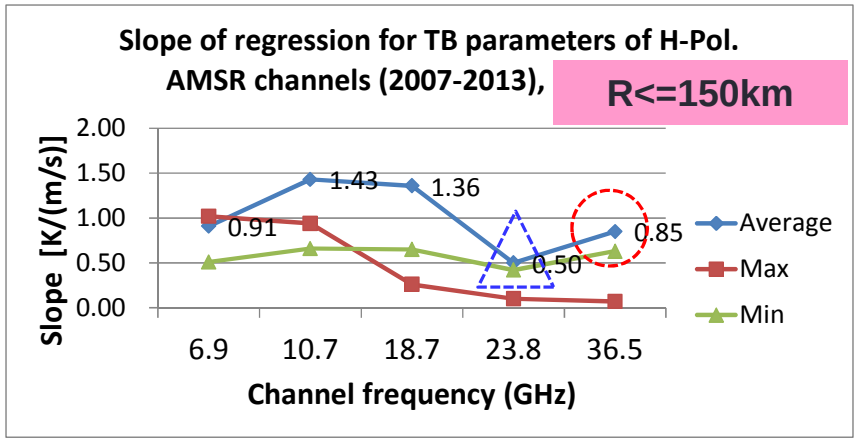
"Slopes of regression" between TB parameter and TC max wind speed for 4 radii (2007-2013), **6.9 ~ 36.5 GHz (H-Pol)**

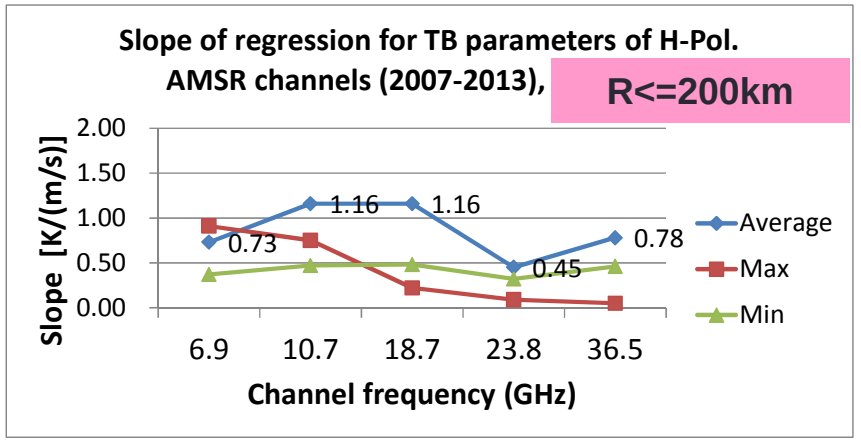
○ *The largest slope of 4 radii*

△ *The 2nd largest slope of 4 radii*









“Correlation” and “Slope of regression” between TB parameters and TC max wind speed for 4 radii in 2007-2013, **89 GHz (PCT)**

Correlation

	area	Average PCT	Max PCT	Min PCT
	R<=50km	−0.33	0.00	−0.22
③	R<=100km	−0.49	−0.18	−0.10
①	R<=150km	−0.56	−0.28	−0.01
②	R<=200km	−0.55	−0.31	0.04

Slope of regression

	area	Average PCT	Max PCT	Min PCT
②	R<=50km	−0.62	0.00	−1.04
①	R<=100km	−0.66	−0.07	−0.43
③	R<=150km	−0.58	−0.07	−0.03
	R<=200km	−0.49	−0.07	0.15

Conclusion of “research toward better use of AMSR2 data for TC max wind speed estimation”

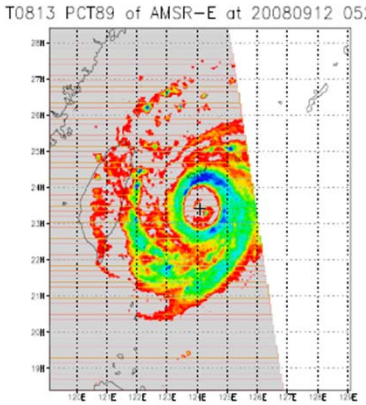
- This statistical research showed that TB parameters of 6.9, 10.7, and 18.7GHz channels for 100 -150km radii were more useful for TC max wind speed estimation than the other parameters. Especially, average TB could be more useful one for TC max wind speed estimation than max and min TBs.

- These results suggest a possibility of improving the current scheme by optimizing the use of TB parameters from 9 channels. Considering TC size maybe also important for effective use of TB parameters using several radii.

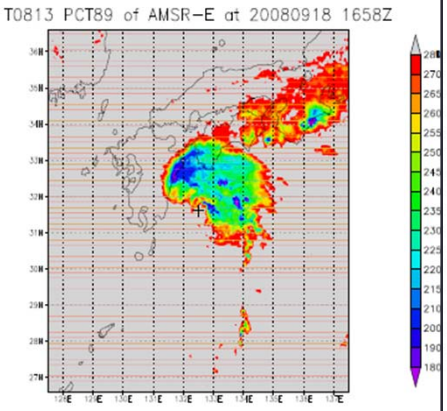
- According to yearly correlation between TB parameter and TC max wind speed of JMA best-track data, AMSR-E and AMSR2 are possibly comparable in terms of TB parameters.

Entire summary of the RA

- To improve the current tropical cyclone max wind speed estimation based on multi-TB parameters of TMI and AMSR-E data, a pattern classification procedure considering rain distribution asymmetry was tested.
- This scheme for TMI is currently used in RSMC-Tokyo Typhoon Center at JMA on a trial basis.
- Some problems found by the validation need to be improved by future development.

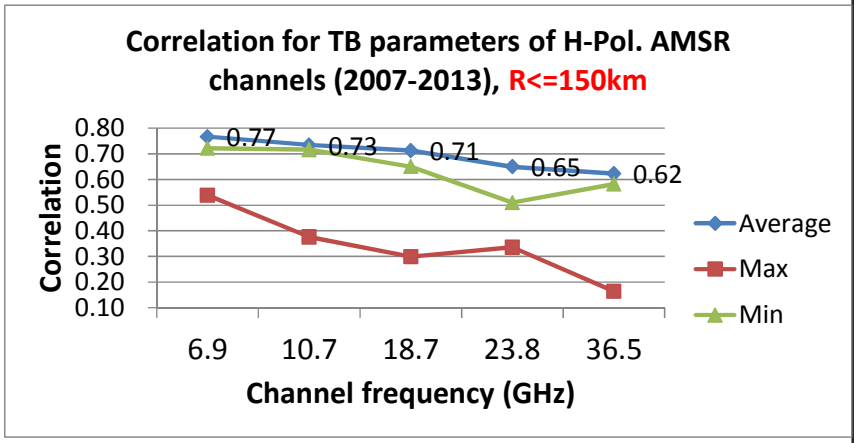


Symmetric pattern with “Eye”



Asymmetric pattern without “Eye”

- Research toward better use of AMSR2 data for TC max wind speed estimation showed TB parameters of 6.9, 10.7, and 18.7GHz channels (especially average TB) for radii of 100-150km could be more useful for TC max wind speed estimation than the others.
- This result suggests a possibility of improving the current scheme by optimizing the use of AMSR TB parameters.



Thank you