Reexamining the Estimation of Tropical Cyclone Radius of Maximum Wind from Outer Size with an Extensive Synthetic Aperture Radar Dataset

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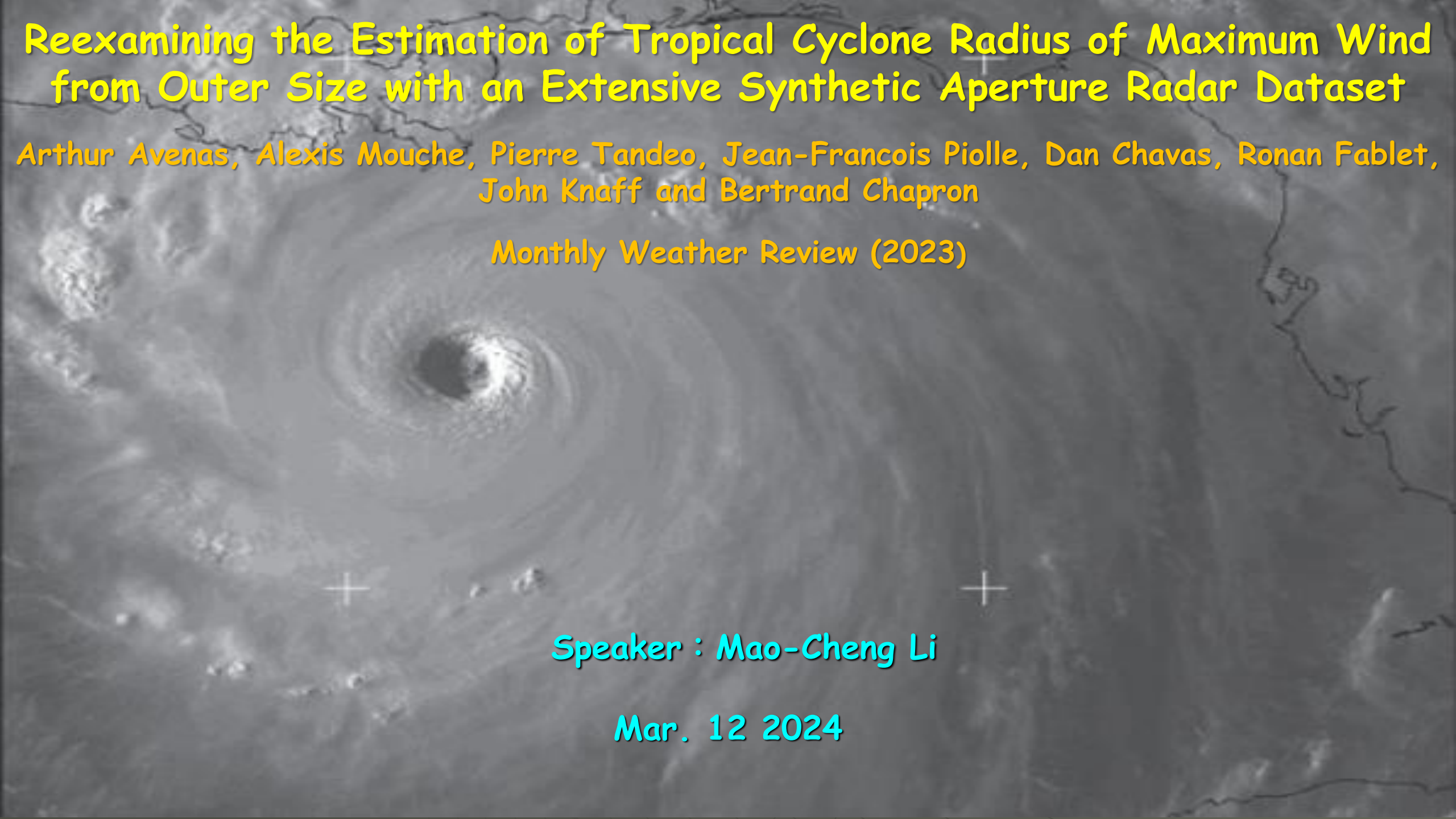
Monthly Weather Review (2023)



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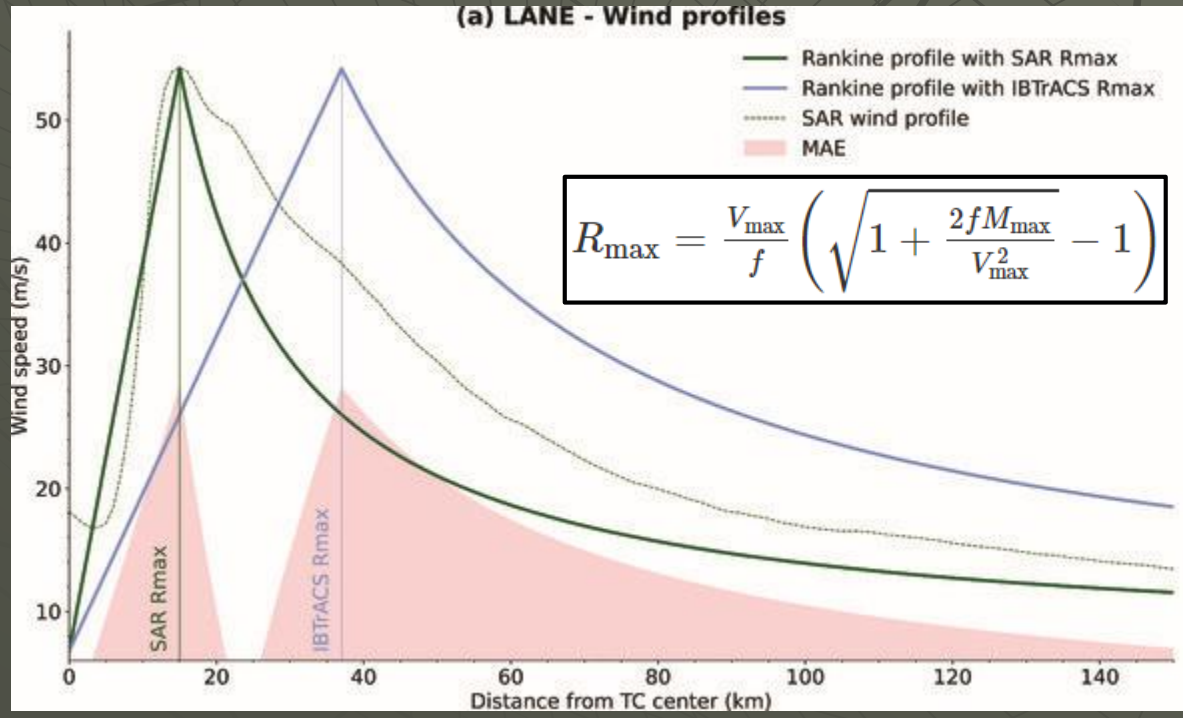
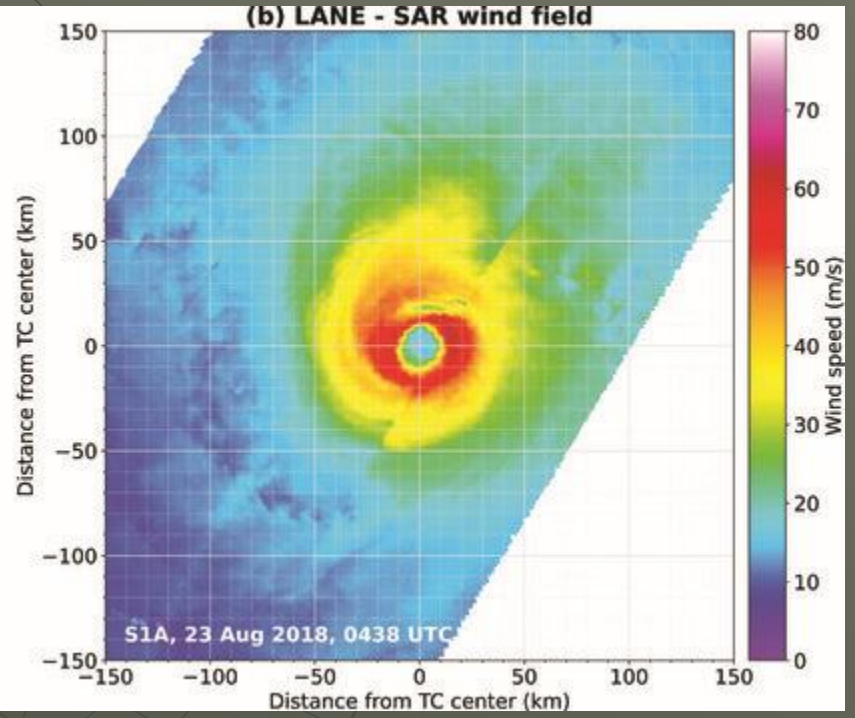
Outline

- Introduction
- Data
- Methods and data analysis
- Results
- Discussion
- Conclusions and perspectives

1. Introduction

$$V_{\text{Rankine}}(r) = \begin{cases} V_{\min} + (V_{\max} - V_{\min})\left(\dfrac{r}{R_{\max}}\right) & \text{if } r \le R_{\max} \\ V_{\min} + (V_{\max} - V_{\min})\left(\dfrac{R_{\max}}{r}\right) & \text{if } r > R_{\max} \end{cases}$$





2. Data

Radiometer	SMOS	SMAP	AMSR-2	WindSat
Period	2010–20	2015–20	2012–20	2010–19
Spatial resolution	50 km	50 km	50 km	50 km
Pixel spacing	25 km	25 km	25 km	25 km
Frequency	L band	L band	C band; X band	C band; X band
Scatterometer	ASCAT	HSCAT	OSCAT	RSCAT
Period	2010–20 (*MetOp-A*) 2012–20 (*MetOp-B*) 2019/20 (*MetOp-C*)	2012–15 (*HY-2A*) 2019/20 (*HY-2B*)	2010–14 (*Oceansat-2*) 2017–20 (*Scatsat-1*)	2014–16
Spatial resolution	25 km	50 km	50 km	50 km
Pixel spacing	12.5 km	25 km	25 km	25 km
Frequency	C-band	Ku-band	Ku-band	Ku-band

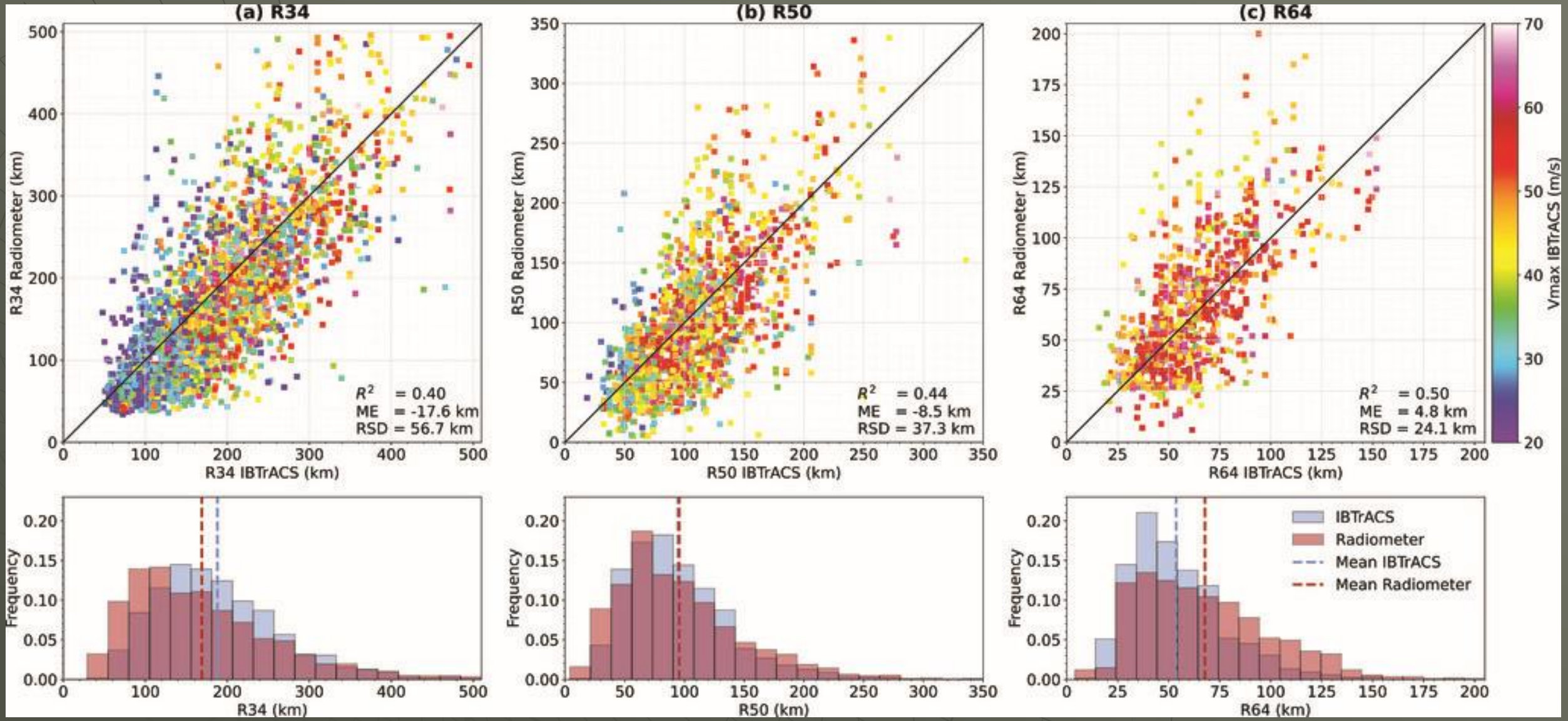
SAR	*S1A*	*S1B*	*RS2*
Period	2016–21	2016–21	2012–21
Spatial resolution	3 km	3 km	3 km
Pixel spacing	1 km	1 km	1 km
Frequency	C band	C band	C band

2. Data cont.

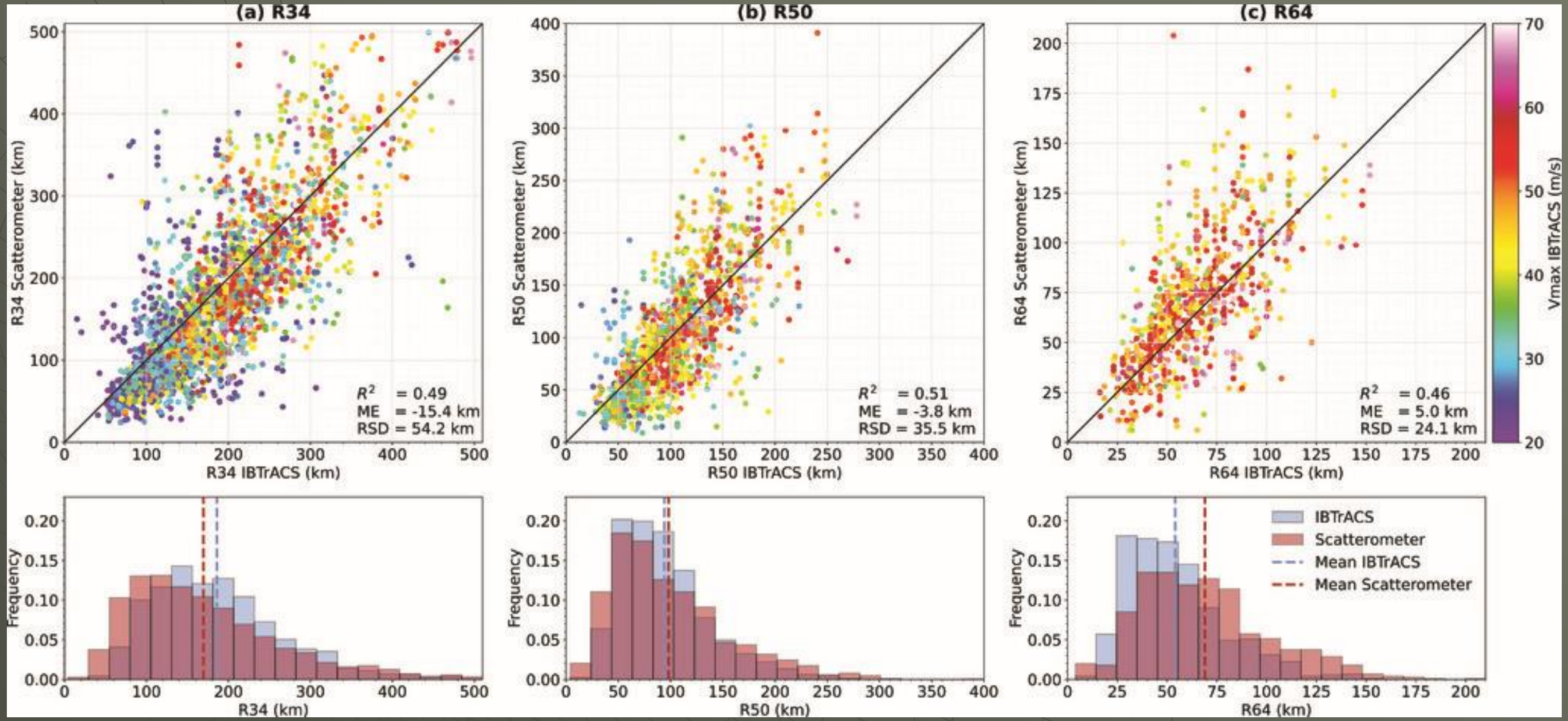
Data filtering:

1. V max > 20 m s^-1
2. R max < 150 km
3. any wind radius must be > 5 km
4. absolute latitude < 30°
5. distance to closest land > R34

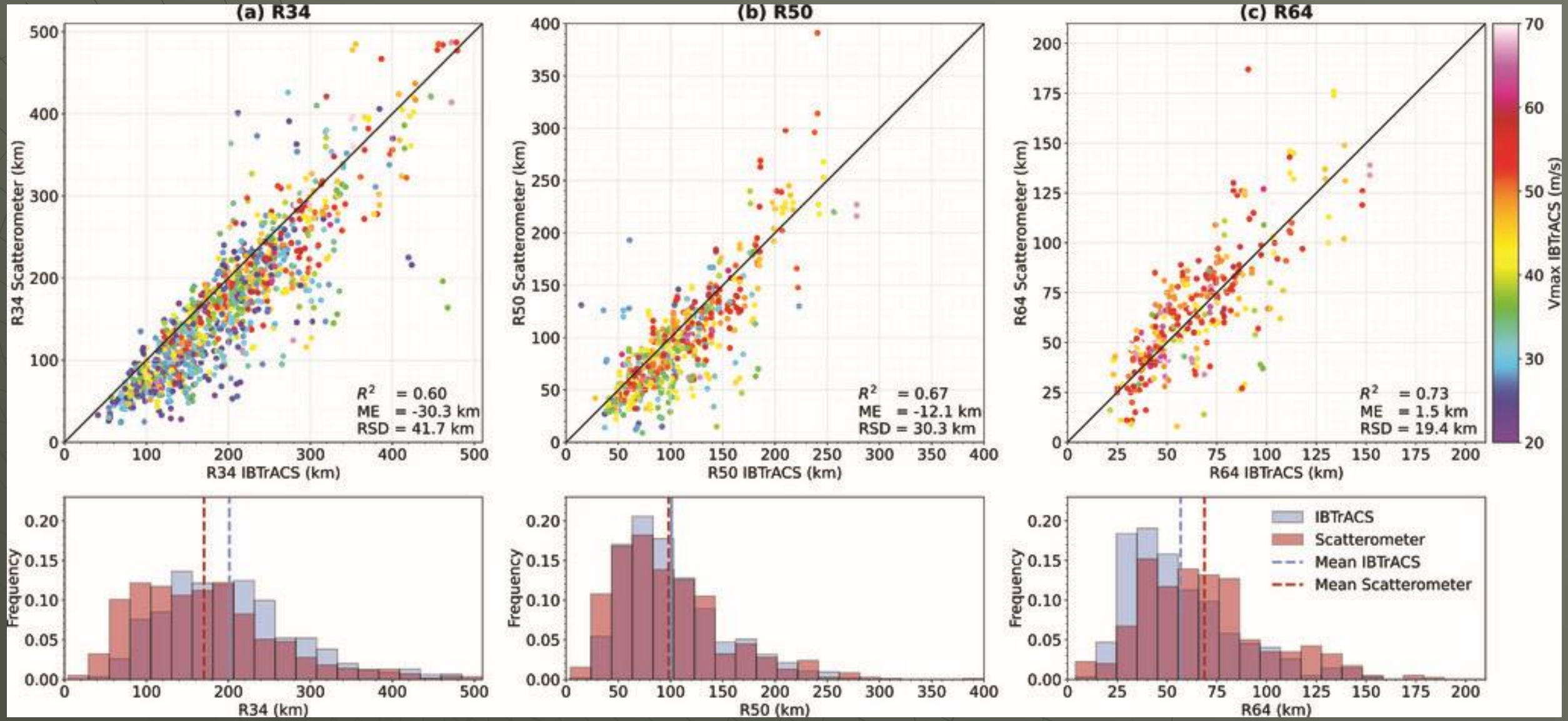
3. Methods and data analysis



3. Methods and data analysis cont.



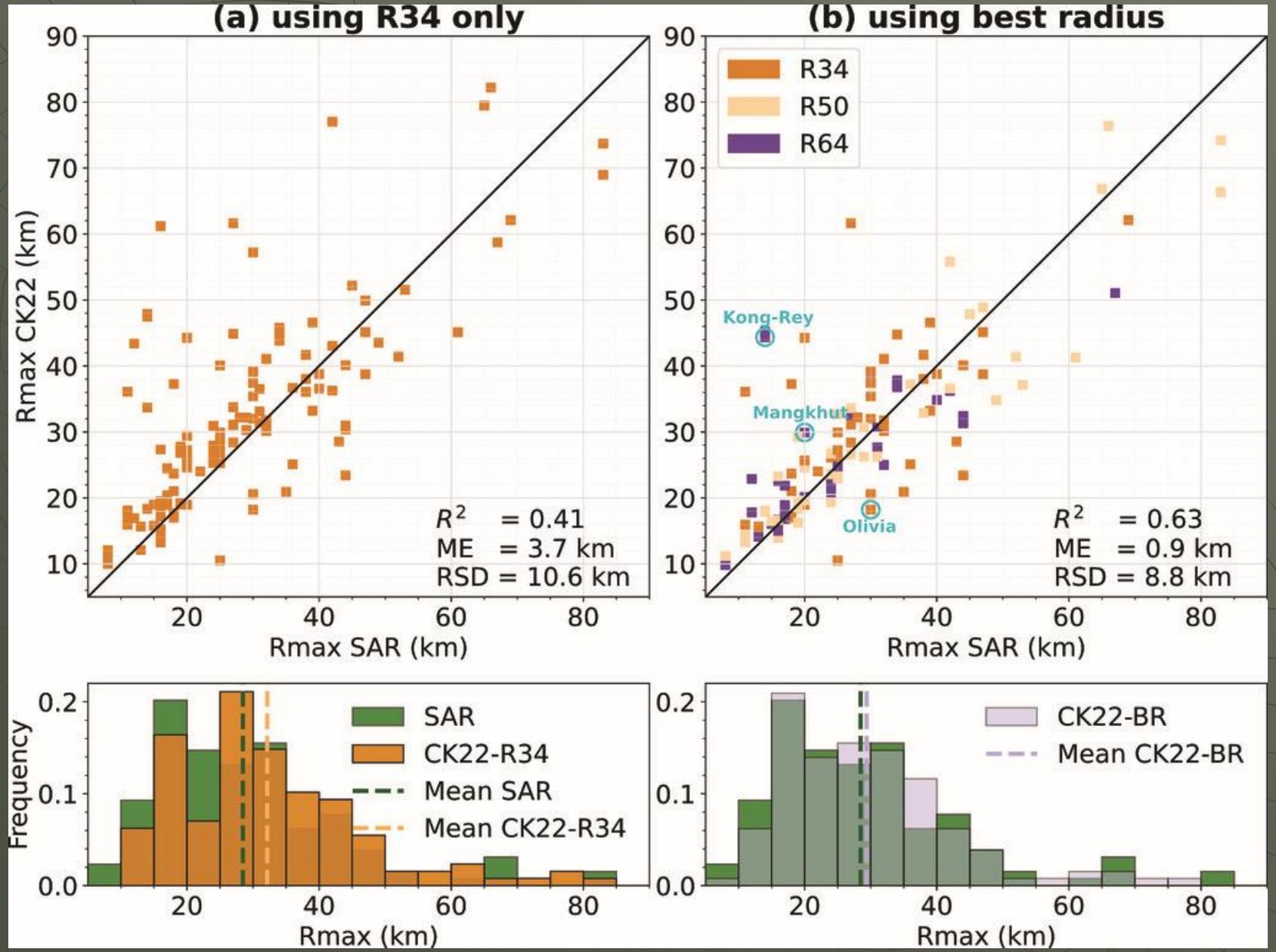
3. Methods and data analysis cont.



3. Methods and data analysis cont.

	SMOS	SMAP	AMSR-2	WindSat	ASCAT	TOTAL
Before filtering	106	63	0	100	0	269
After filtering	67	33	0	45	0	145
Avg Δt (min)	12	21		31		19

4. Results

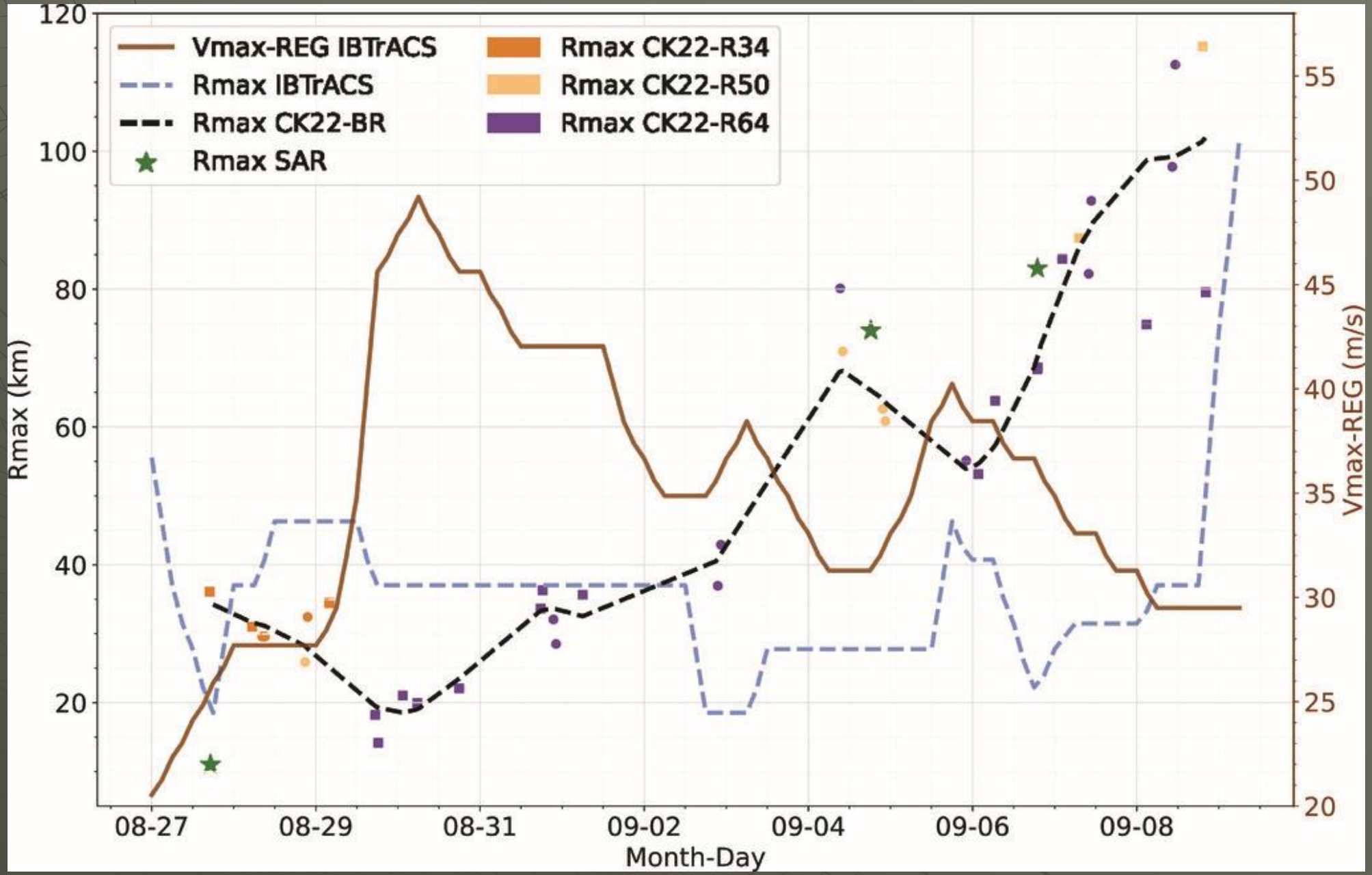


$$M_{\max}/M_{34} = 0.531 \exp\{-0.002\,14(V_{\max}^{\mathrm{REG}} - 17.5\ \mathrm{m\ s^{-1}}) - 0.003\,14(V_{\max}^{\mathrm{REG}} - 17.5\ \mathrm{m\ s^{-1}})[(1/2)fR_{34}]\},$$

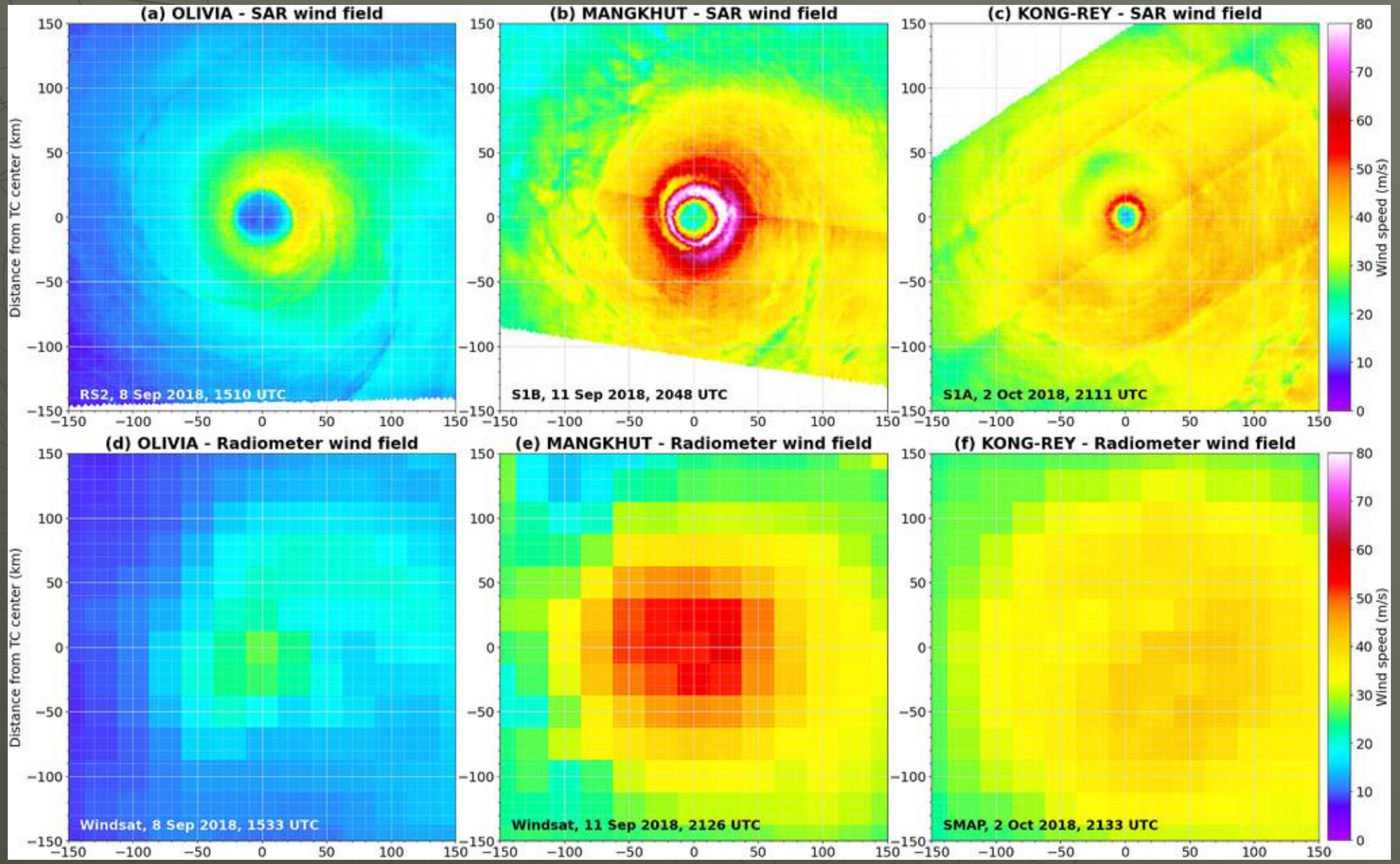
$$M_{\max}/M_{50} = 0.626 \exp\{0.002\,82(V_{\max}^{\mathrm{REG}} - 25.7\ \mathrm{m\ s^{-1}}) - 0.007\,24(V_{\max}^{\mathrm{REG}} - 25.7\ \mathrm{m\ s^{-1}})[(1/2)fR_{50}]\},$$

$$M_{\max}/M_{64} = 0.612 \exp\{0.009\,46(V_{\max}^{\mathrm{REG}} - 32.9\ \mathrm{m\ s^{-1}}) - 0.011\,83(V_{\max}^{\mathrm{REG}} - 32.9\ \mathrm{m\ s^{-1}})[(1/2)fR_{64}]\}.$$

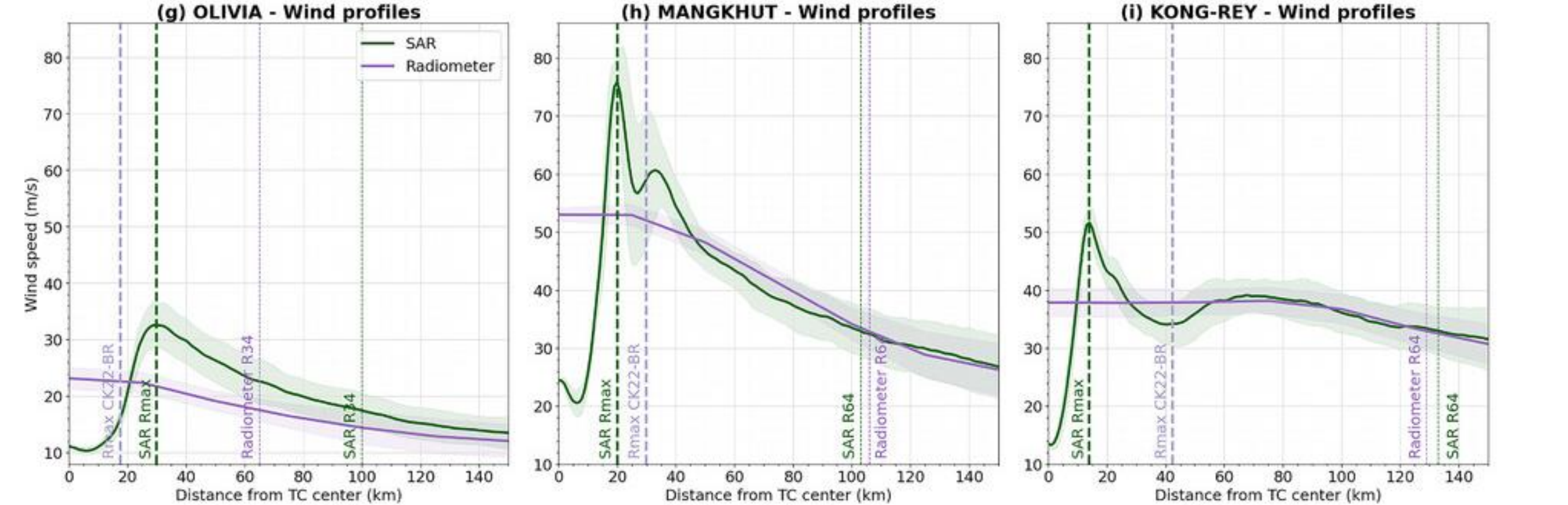
4. Results cont.



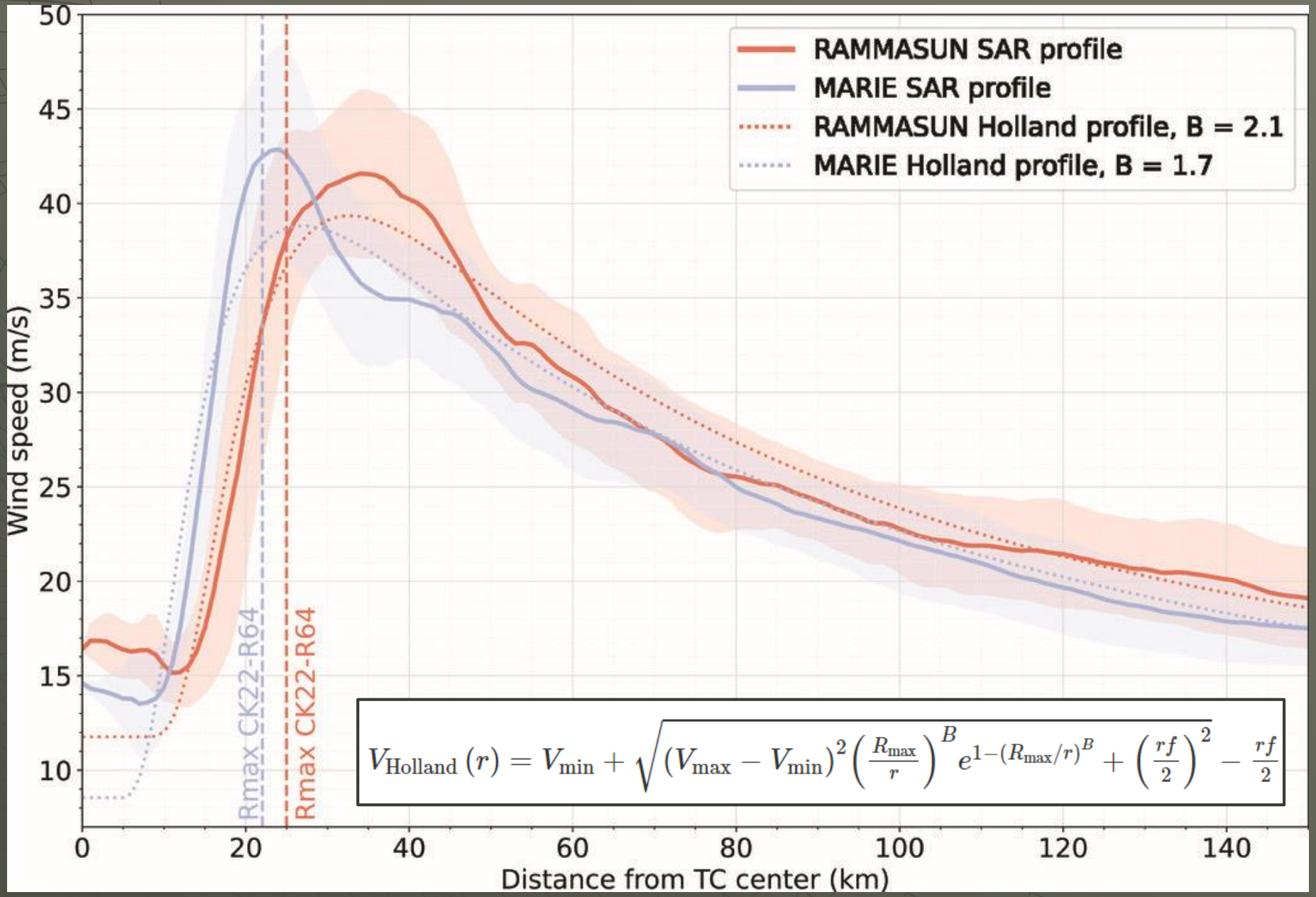
5. Discussion



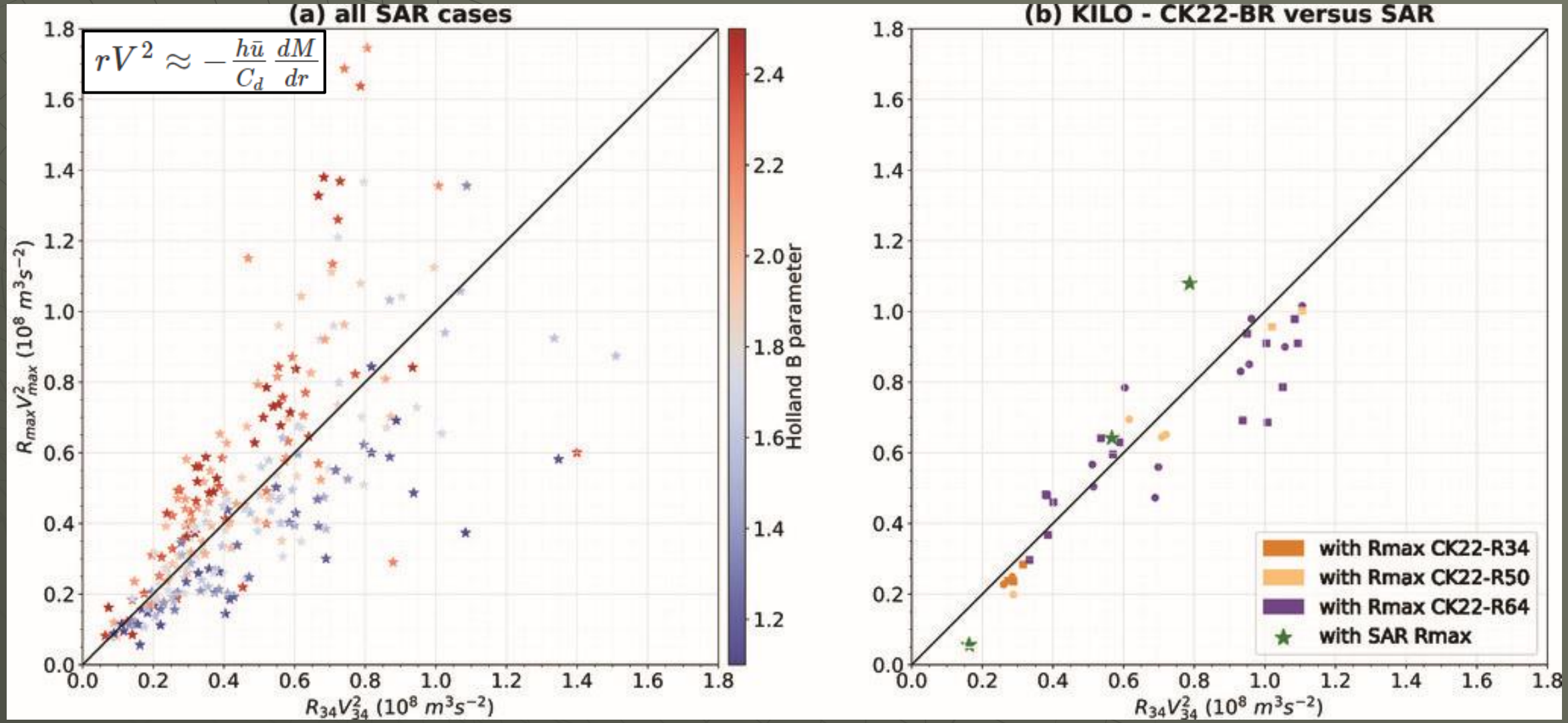
5. Discussion cont.



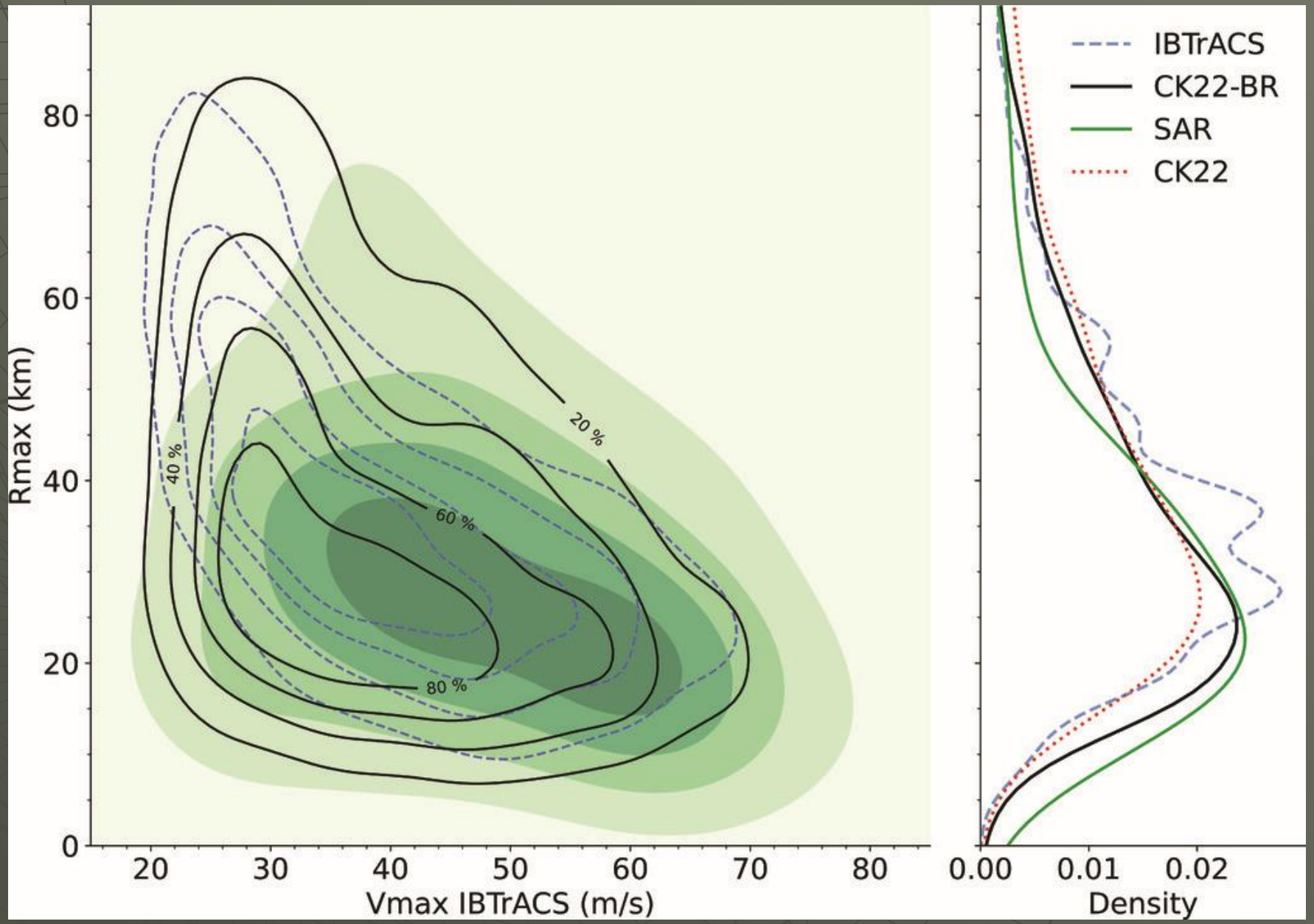
5. Discussion cont.



5. Discussion cont.



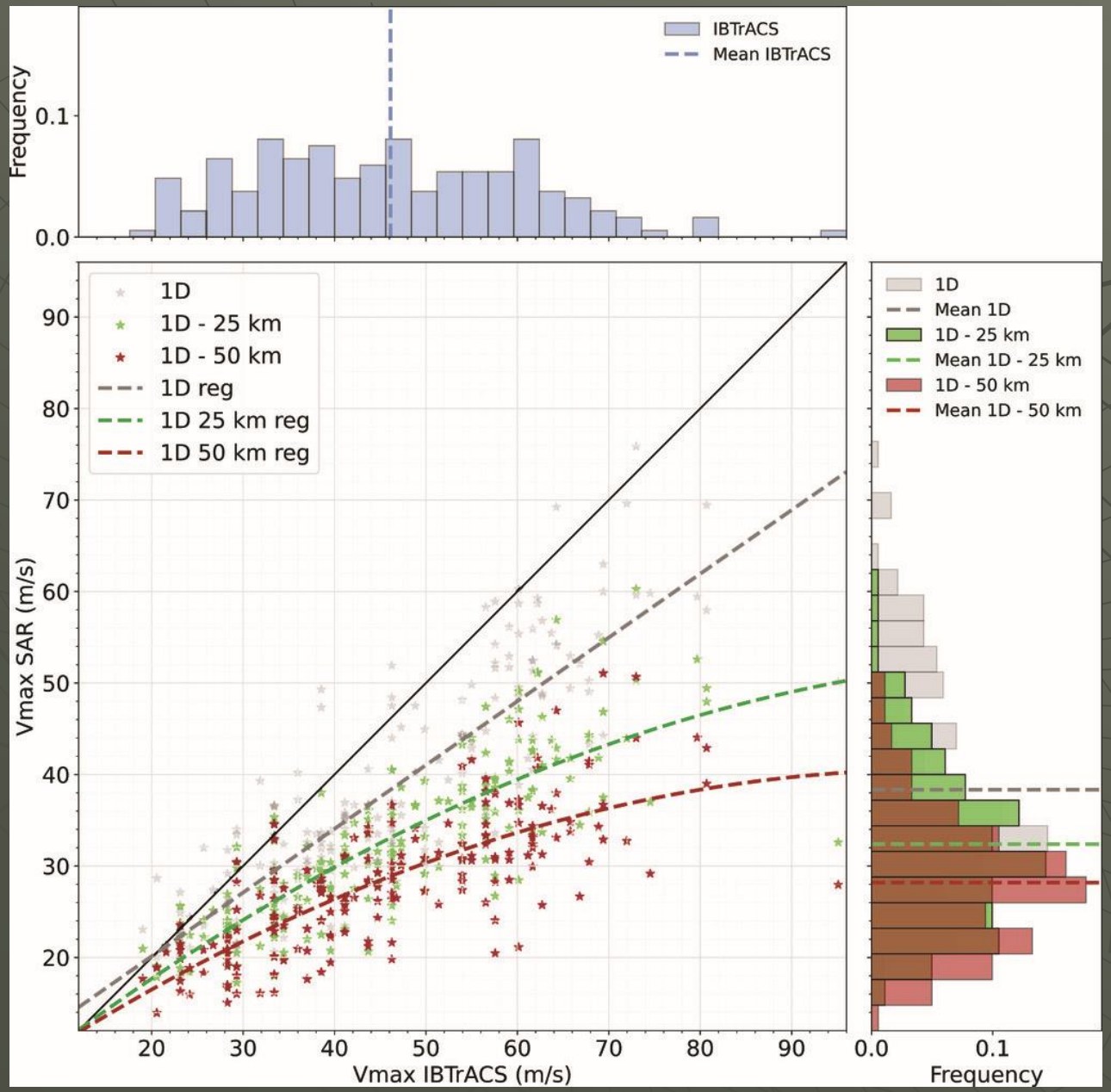
5. Discussion cont.



6. Conclusions and perspectives

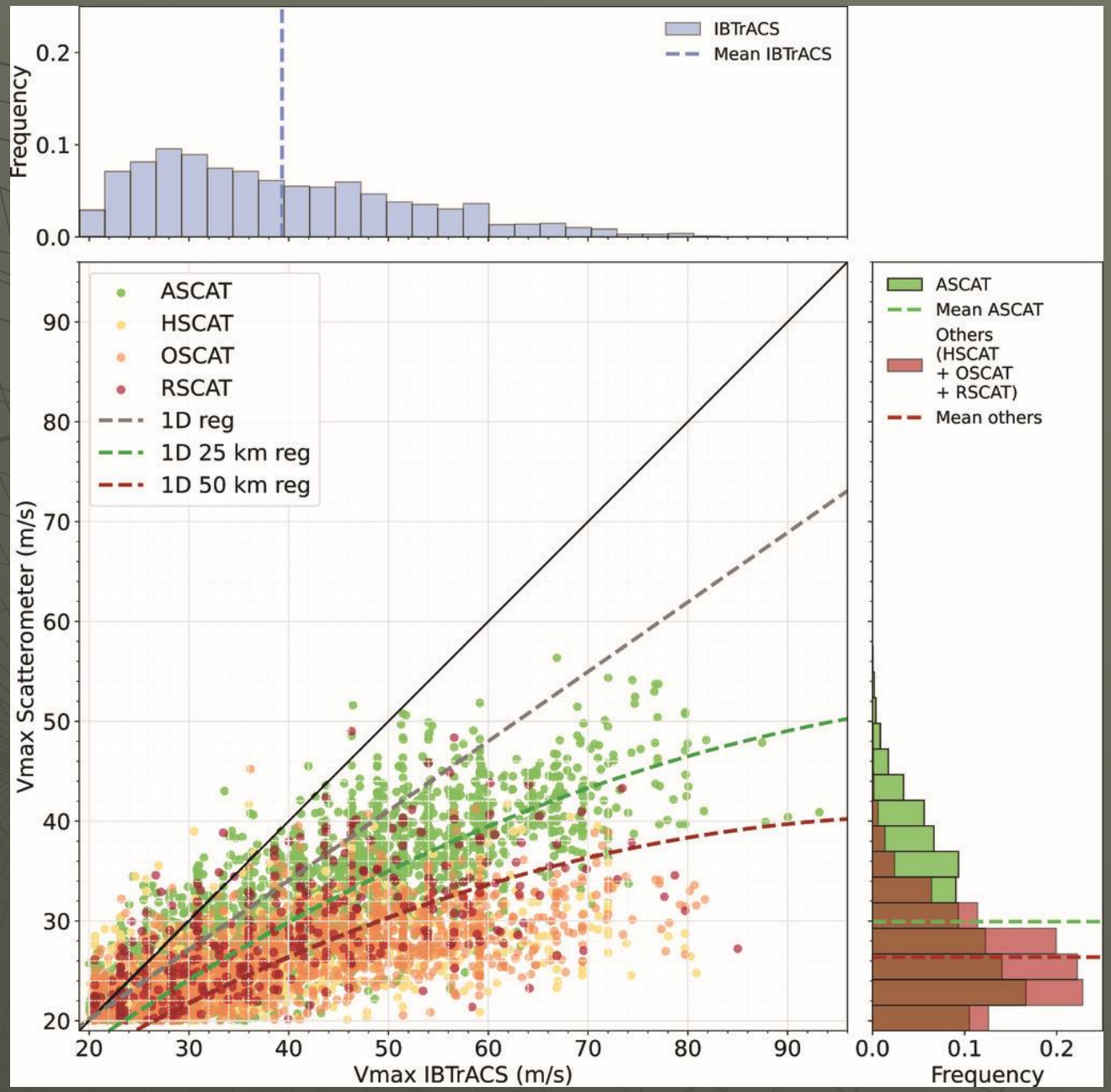
- More specifically and because of high-resolution (SAR) data, it is now possible to more systematically estimate Rmax.
- Fitted with SAR estimates and used in conjunction with the closest wind radius to Rmax, our study proposed a revised CK22 model. It is shown to be an efficient tool to provide improved reliable estimates, with an average uncertainty of ~9 km.
- Because outer-core wind radii can be estimated from radiometer or C-band scatterometer data, the developed framework thus allows to produce a more extensive dataset of reanalyzed Rmax estimates.
- The resulting time series are generally more realistic than those obtained from best-track Rmax estimates.

APPENDIX A



$$V_{\max}^{\mathrm{REG}} = 0.6967 V_{\max}^{\mathrm{IBTrACS}} + 6.1992$$

APPENDIX A cont.




The End…
Thanks !
Questions??