Estimating the Typhoon Radius Using Dropsonde and ASCAT Data

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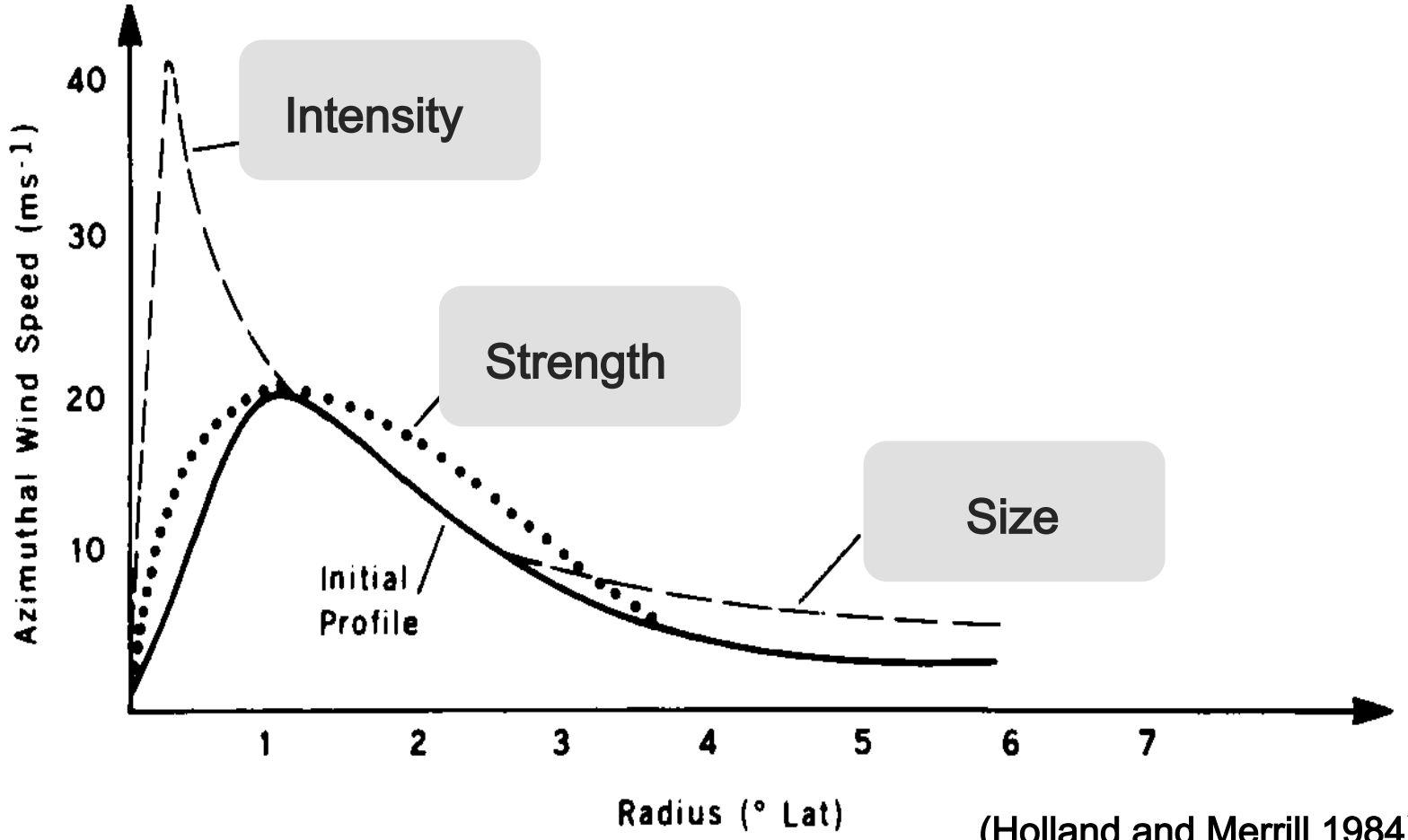
Purpose and Outline

- To build a TC wind structure dataset
- To study the factors affecting TC structure change, especially the gale -wind radii.

Data Method Result Application

Introduction: TC structure



(Holland and Merrill 1984)

Besides typhoon intensity, typhoon strength also poses a potential threat.

Dropsonde data

- Dropsonde data usually used as ground truth of TC structure
- MBL : $V_{0\sim500m}$ *0.8

  WL150 : $V_{0\sim150m}$ / 1.229 (Frankin et al. 2003)

There are limited dropsonde data in the western N. Pacific.

圖片取自:
http://typhoon.as.ntu.edu.tw/DOTSTAR/tw/intro/equip.php

Satellites that observe surface wind field

QuikSCAT

1999 ~ 2009 Beam -width (BW) = 1800km

- Estimated radius by QuikSCAT data

(Chan and Chan 2015; Chavas and Emanuel 2010; Chavas et al. 2015; Lee et al. 2010; Schenkel et al. 2017; Touma et al. 2019)

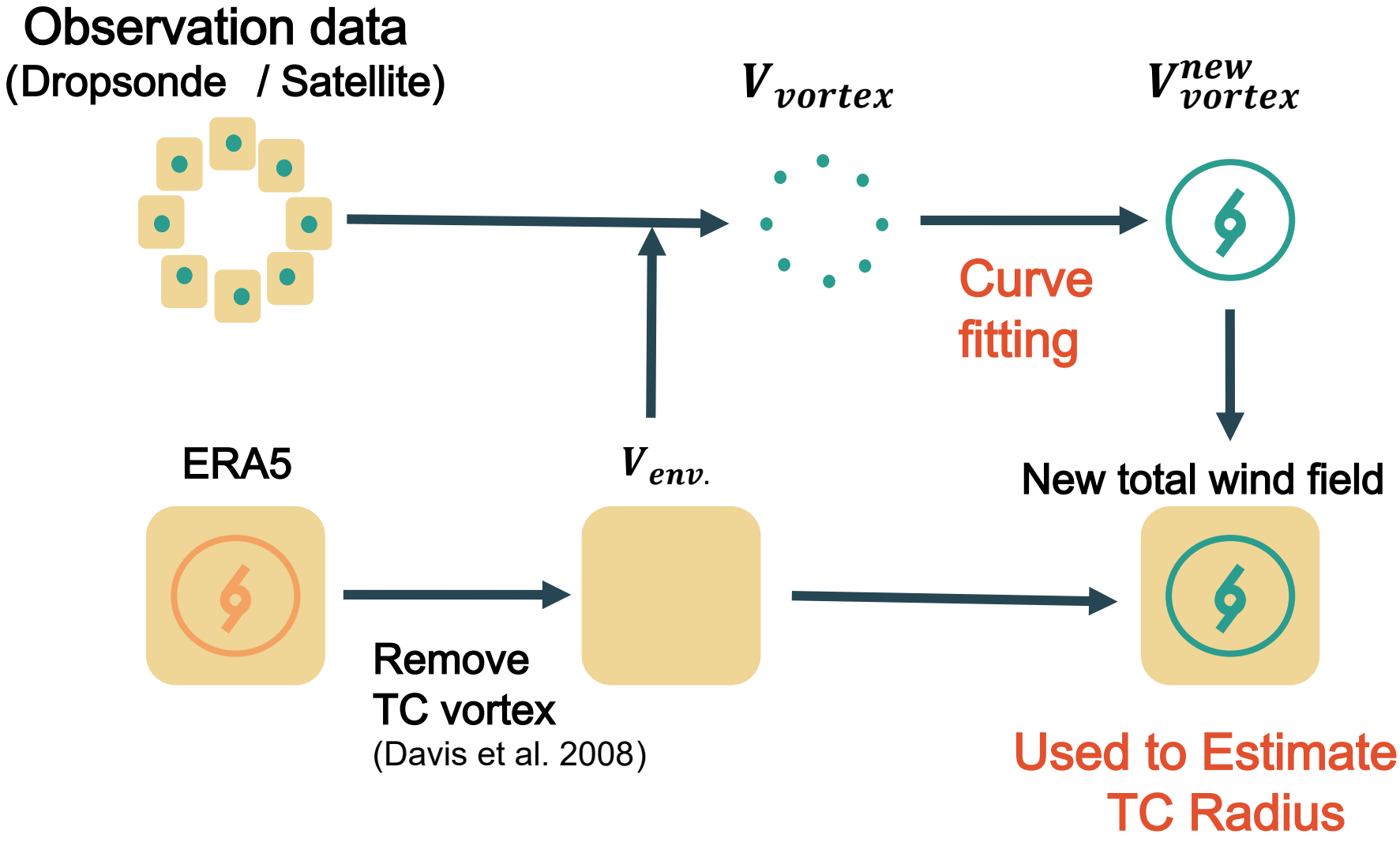
ASCAT

2006 ~ BW = 500km*2

- No research use only ASCAT data to estimate radius. ∵ narrow BW.
- Better quality and sustained

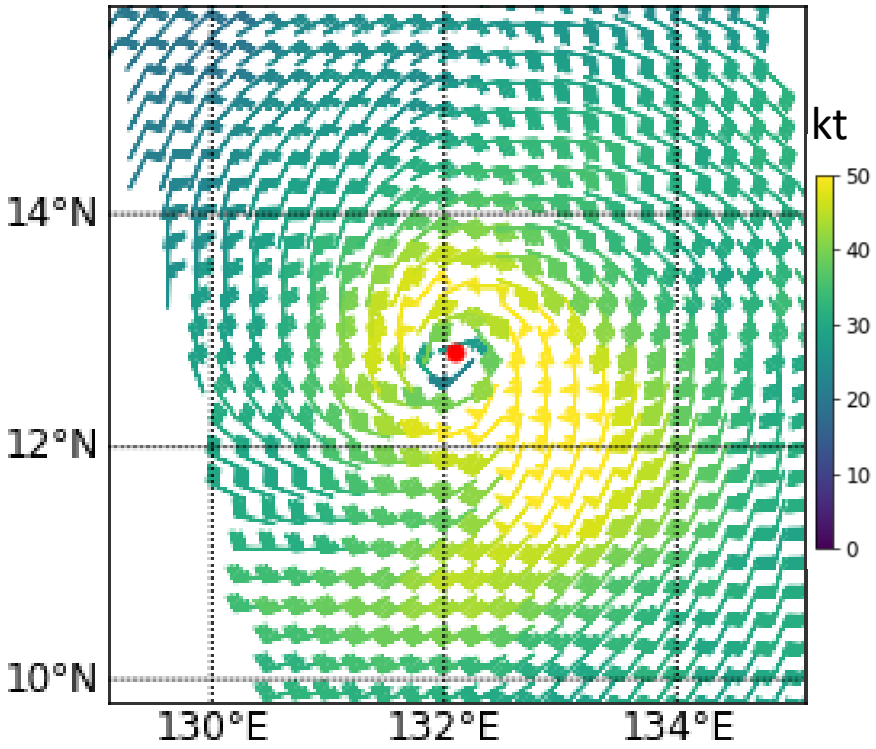
(Bentamy et al. 2008; Chou et al. 2013)

Method used to estimate TC wind radii

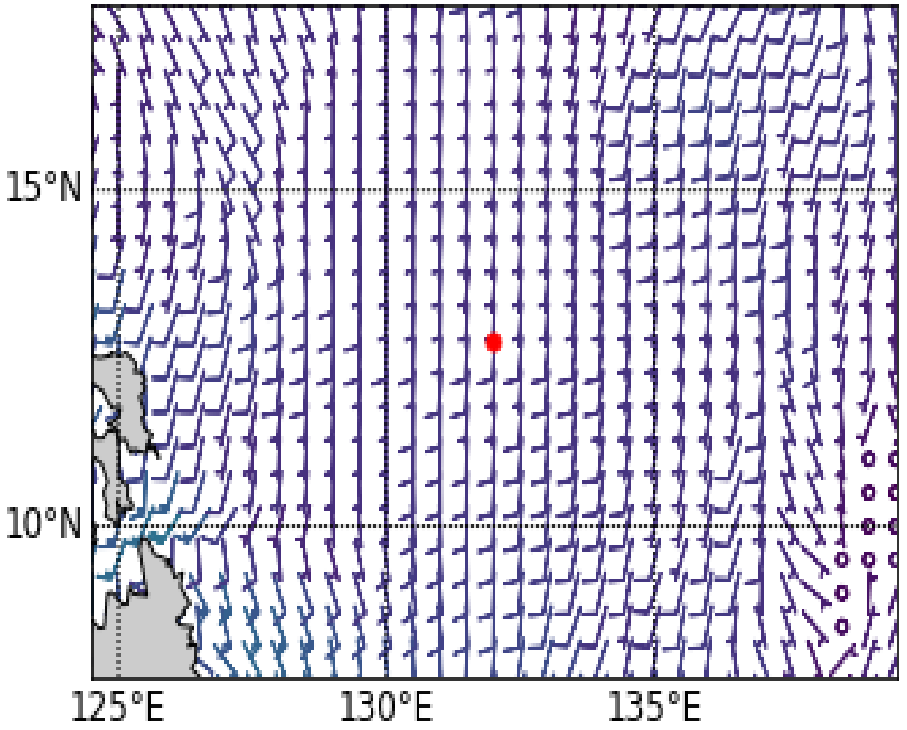


Advantage of this method

ASCAT



Environmental wind

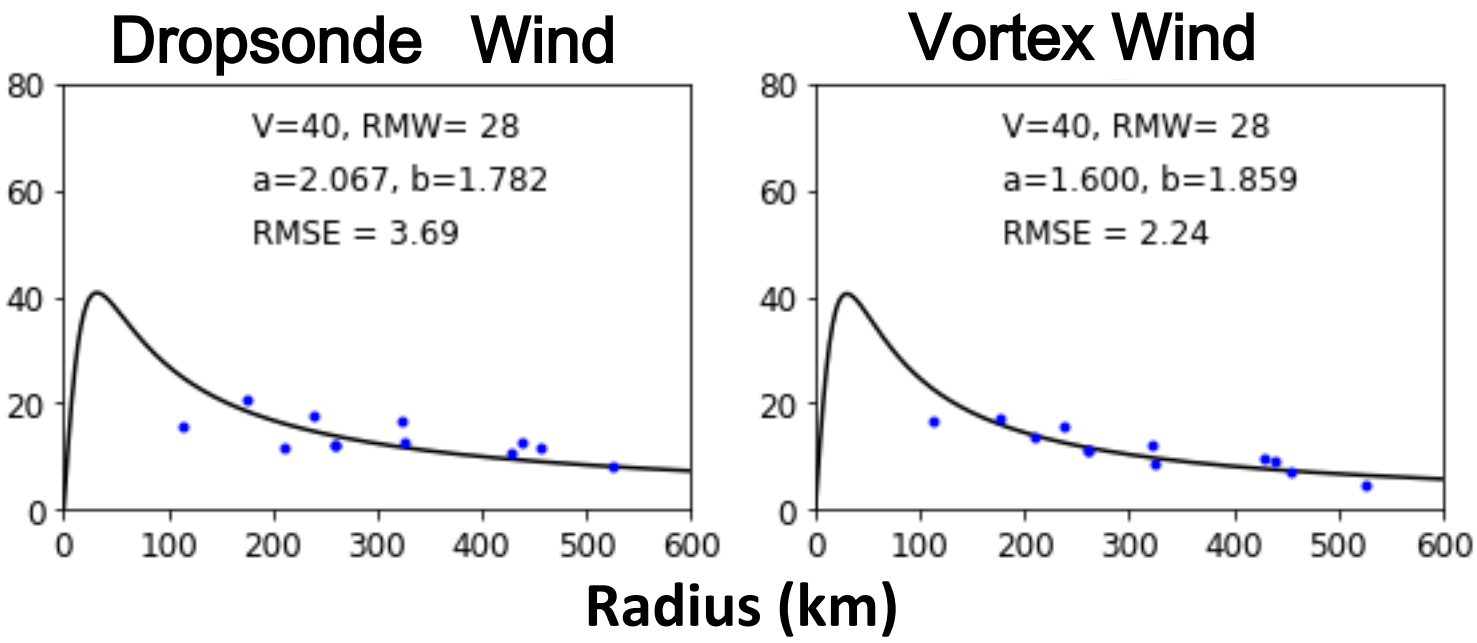


Can obtain a symmetry TC structure even when only part of TC data are available.

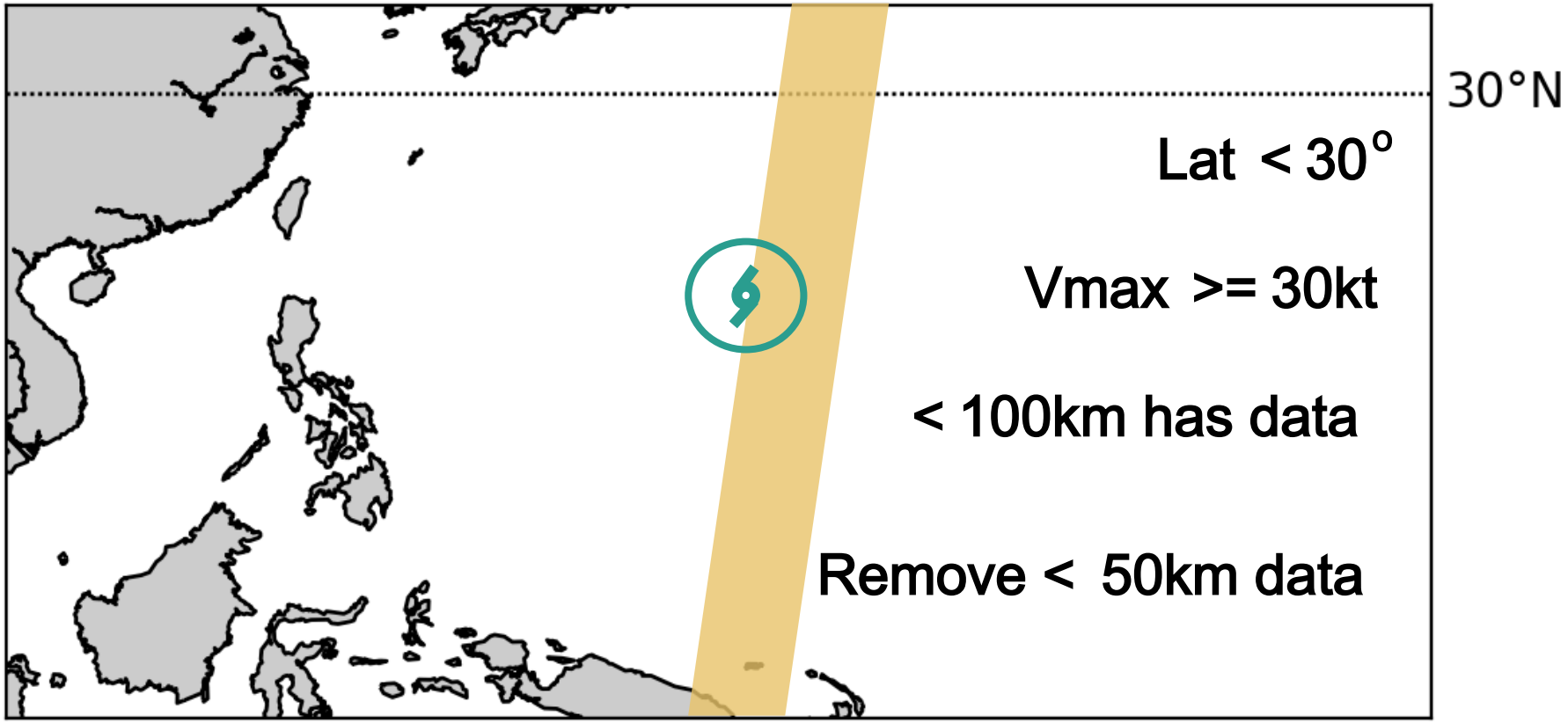
Formula to fitting TC wind profile

RV $V(r) = Vm(\frac{R_m}{R})^{a}$ (Rankine Vortex)

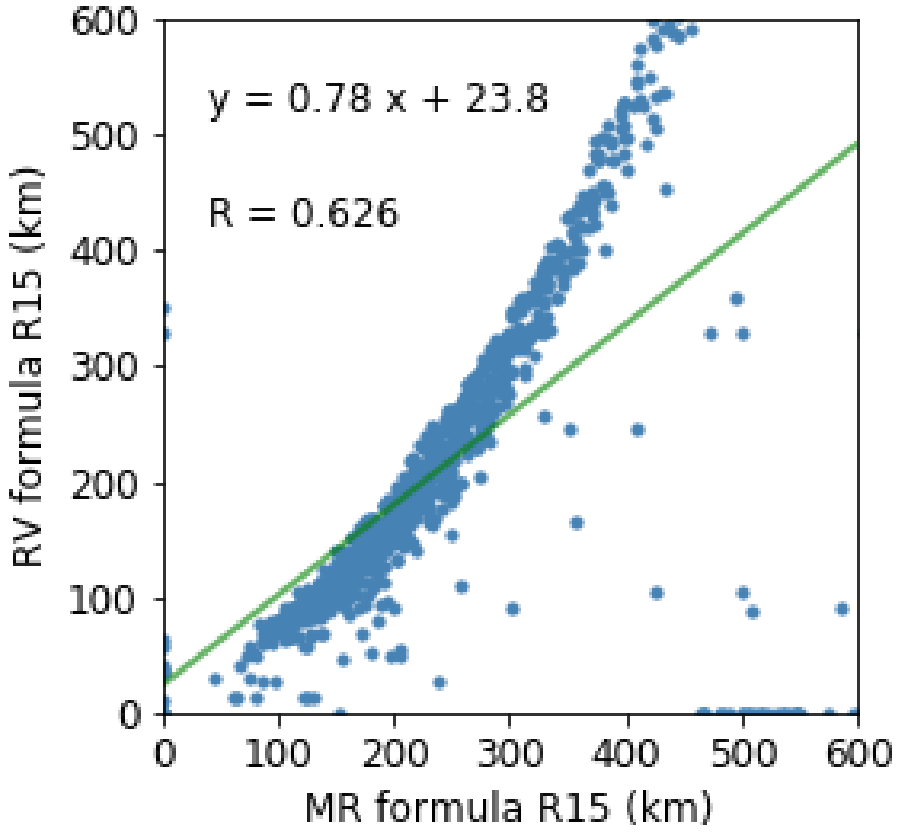
MR $V(r) = \frac{2r(R_m V_m + \frac{1}{2} f R_m^2)}{R_m^2 + a r^b} - \frac{fr}{2}$ (Morris and Ruf 2017)



Criteria used to ASCAT cases selection



R15 estimated from RV and MR



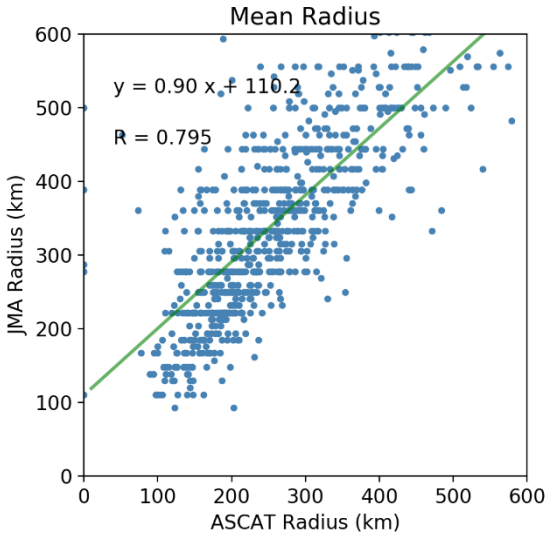
R15:
radius of 15m/s
10-mins wind speed

Wind speed decreases slowly away from TC center when RV formula is used.

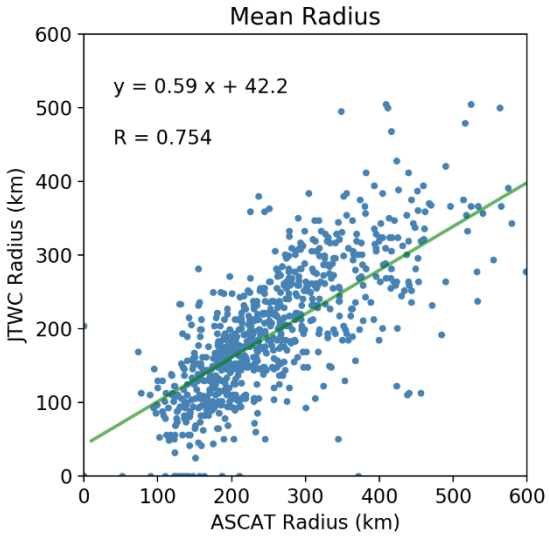
MR formula provides more reasonable estimates at TC outer region.

ASCAT R15 compared with those of other agencies

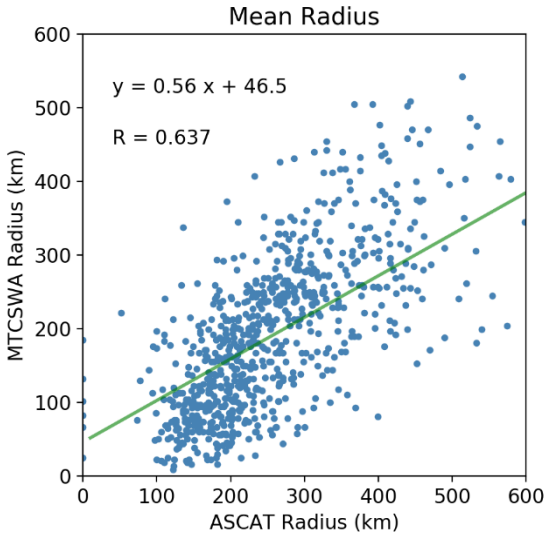
JMA 10-mins R30



JTWC 1-min R34



MTCSWA 1-min R34



Correlation: JMA > JTWC > MTCSWA

Summery

- dropsonde data :

  2006 ~ 2017 (60 cases)

  Used to develop the method

  MR is more reasonable than RV at TC outer region

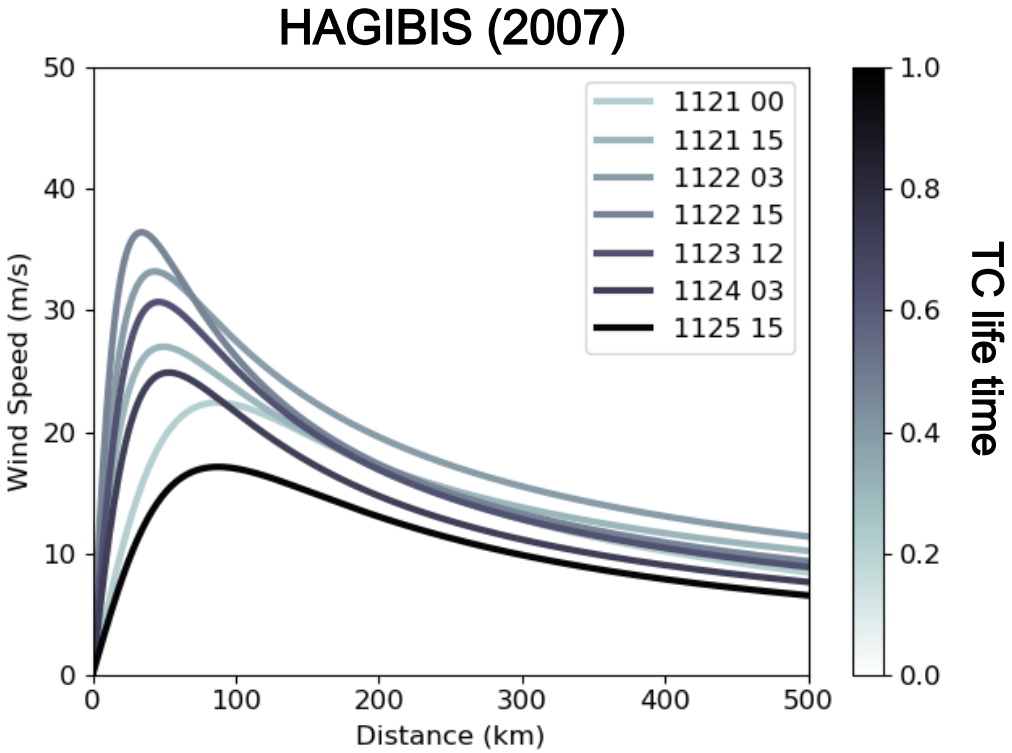
- ASCAT data:

  2007 ~ 2018 (189 TCs, 961 cases)

  A dataset of symmetry TC surface wind profile

  A dataset of asymmetry 2D surface wind field

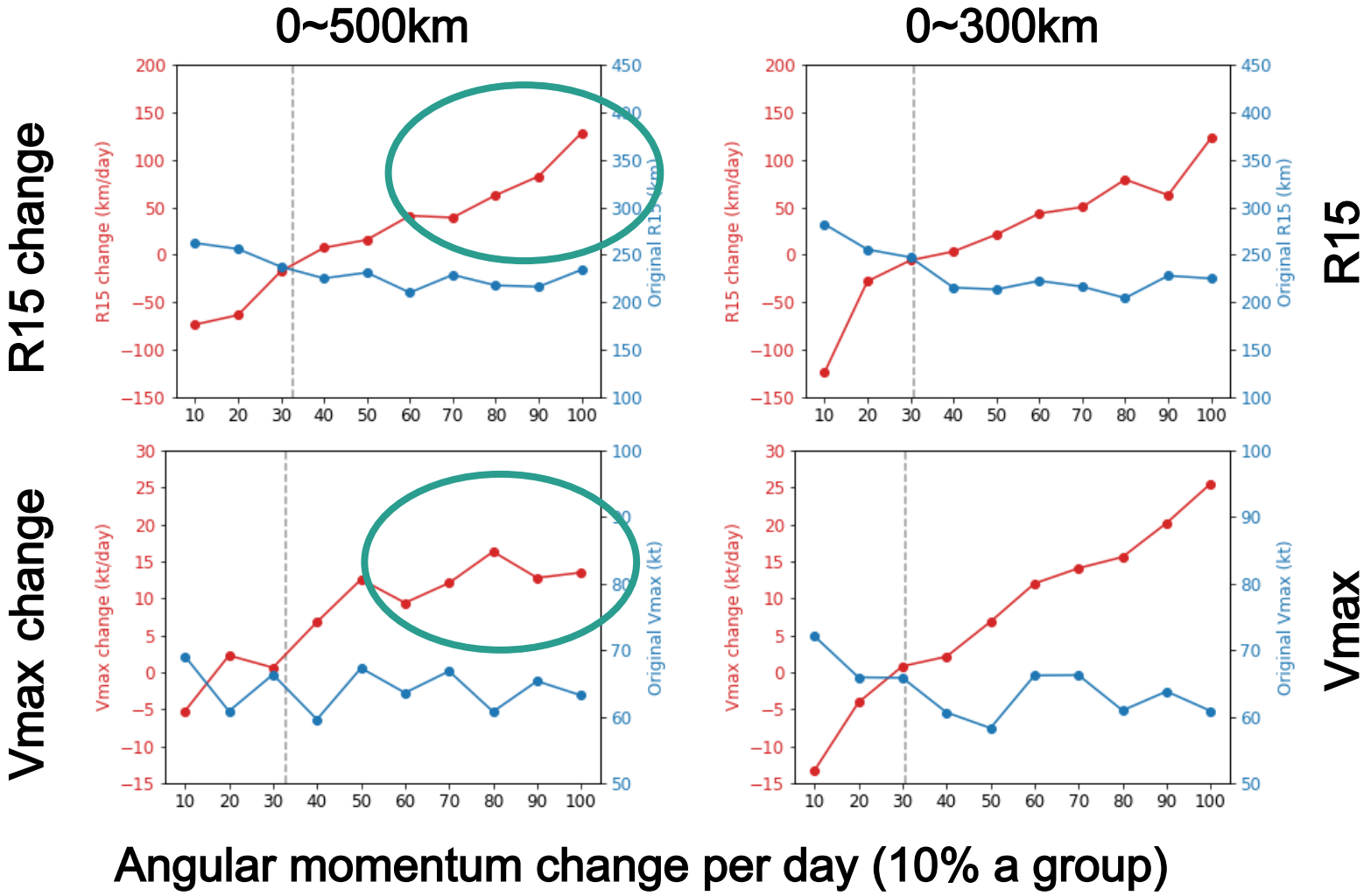
Preliminary analyses using this dataset



Using the constructed wind profile to calculate the angular momentum.

The changes of angular momentum are also calculated.

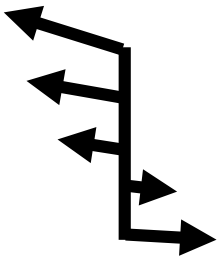
Factors affecting angular momentum change



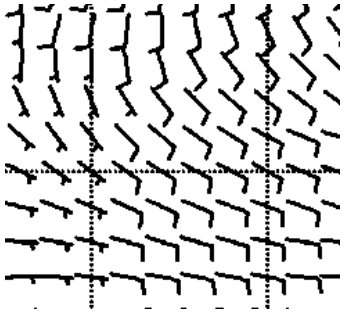
Factors affecting TC structure change

Internal dynamics

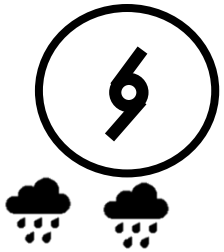
Synoptic forcing (Cocks and Gray 2002)



Vertical wind shear
(Frank and Ritchie 2001 ;
Chen et al. 2018, 2019a)



Low -level flow
(Lee et al. 2010;
Chen et al. 2011, 2012;
Chen et al. 2018, 2019a)



Outer rain -band
(Chen et al. 2014b;
Tsuji and Nakajima 2019)

Thank you for listening!