Change in Tropical Cyclone Translation Speed (Uh) and the Impact on TC Intensification: Climate and Weather Scale Explorations

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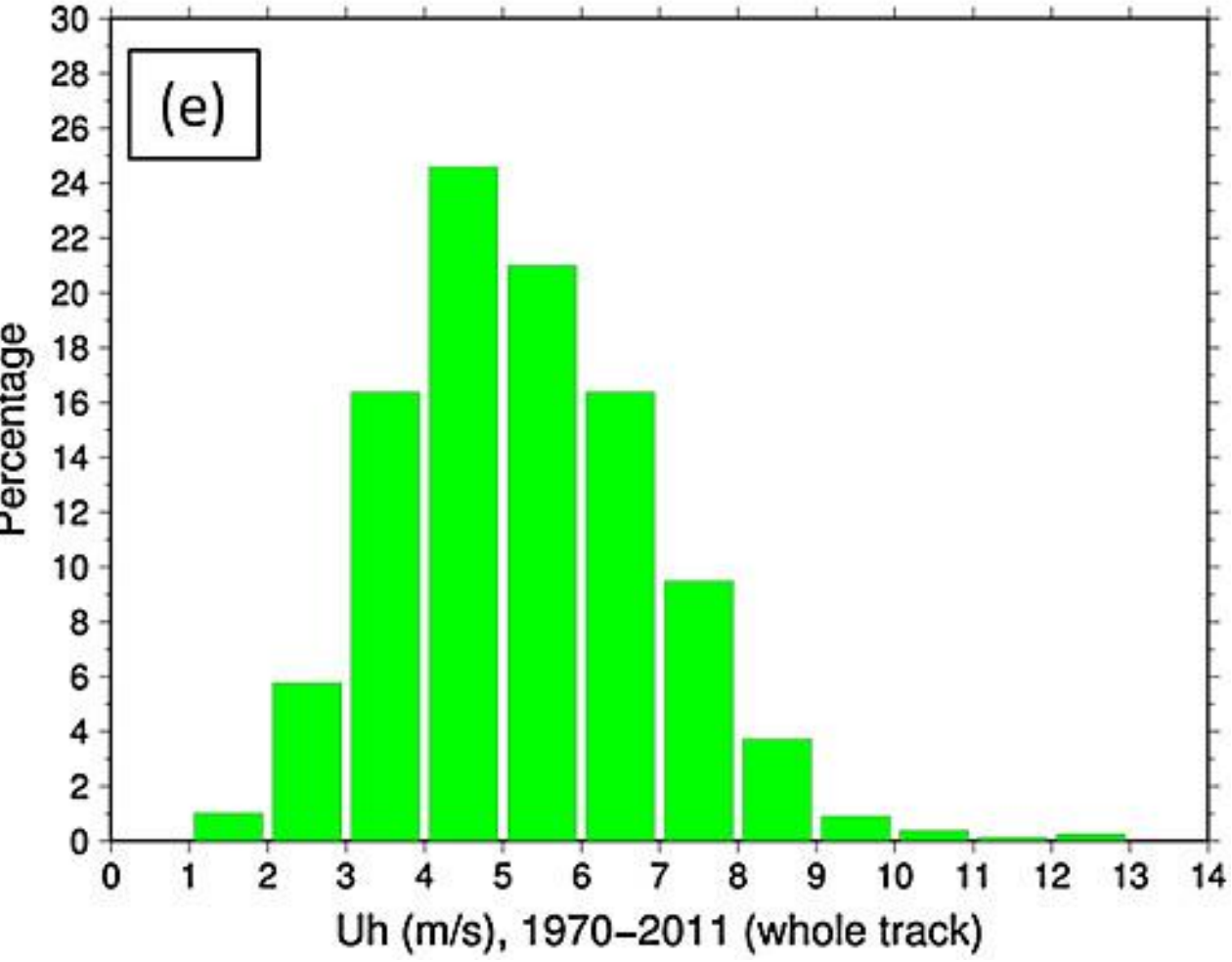
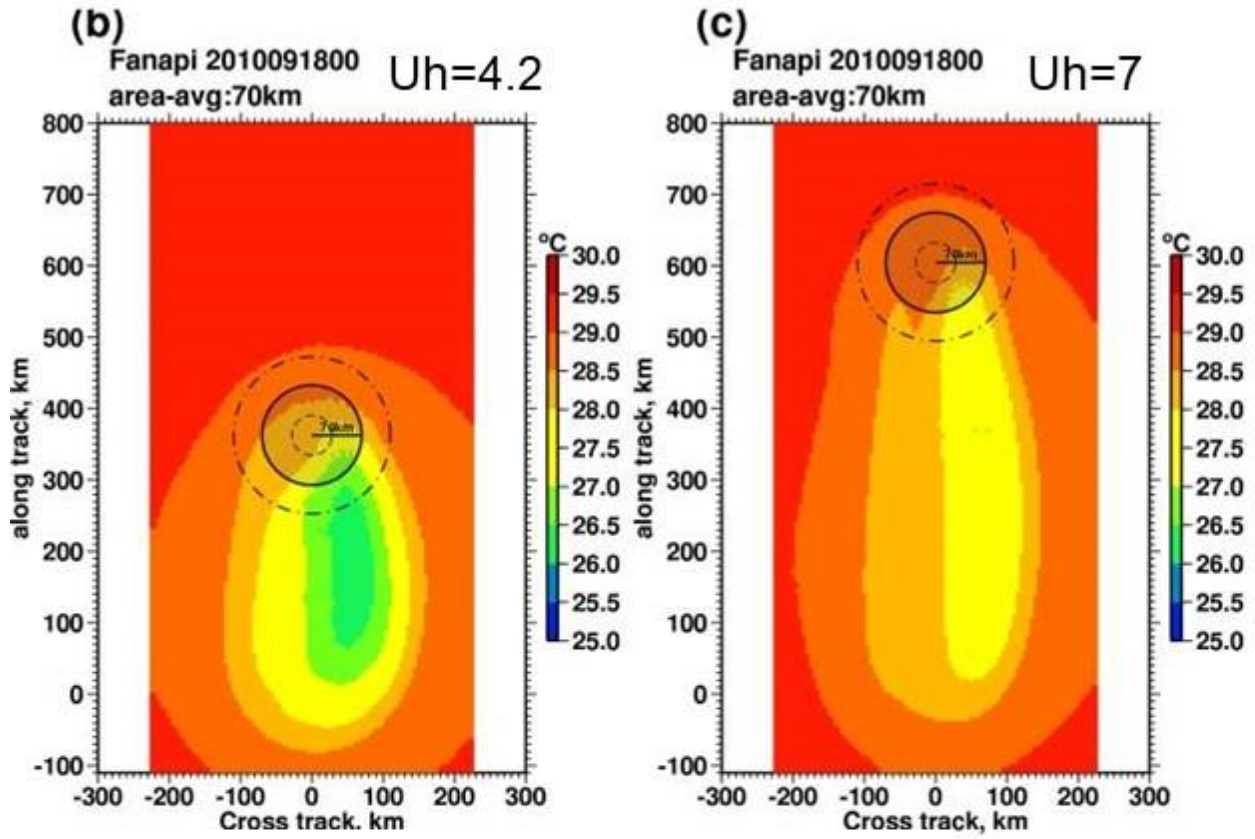
Lin et al. BAMS, in press, 2021; Chang et al. Sustainability, 2020; Kossin Nature 2018; Emanuel JC 2021

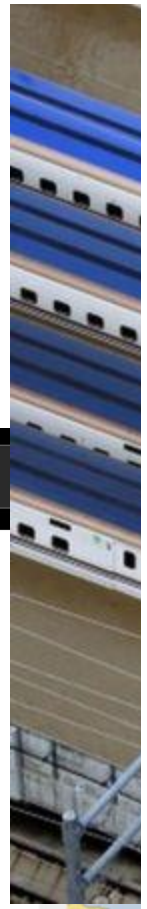
Take home message

How fast is fast?
Better to be fast or slow?





Lin et al. GRL 2013; 2014



Typhoon Hagibis: Japan postpones Emperor Naruhito's enthronement parade

18 October 2019

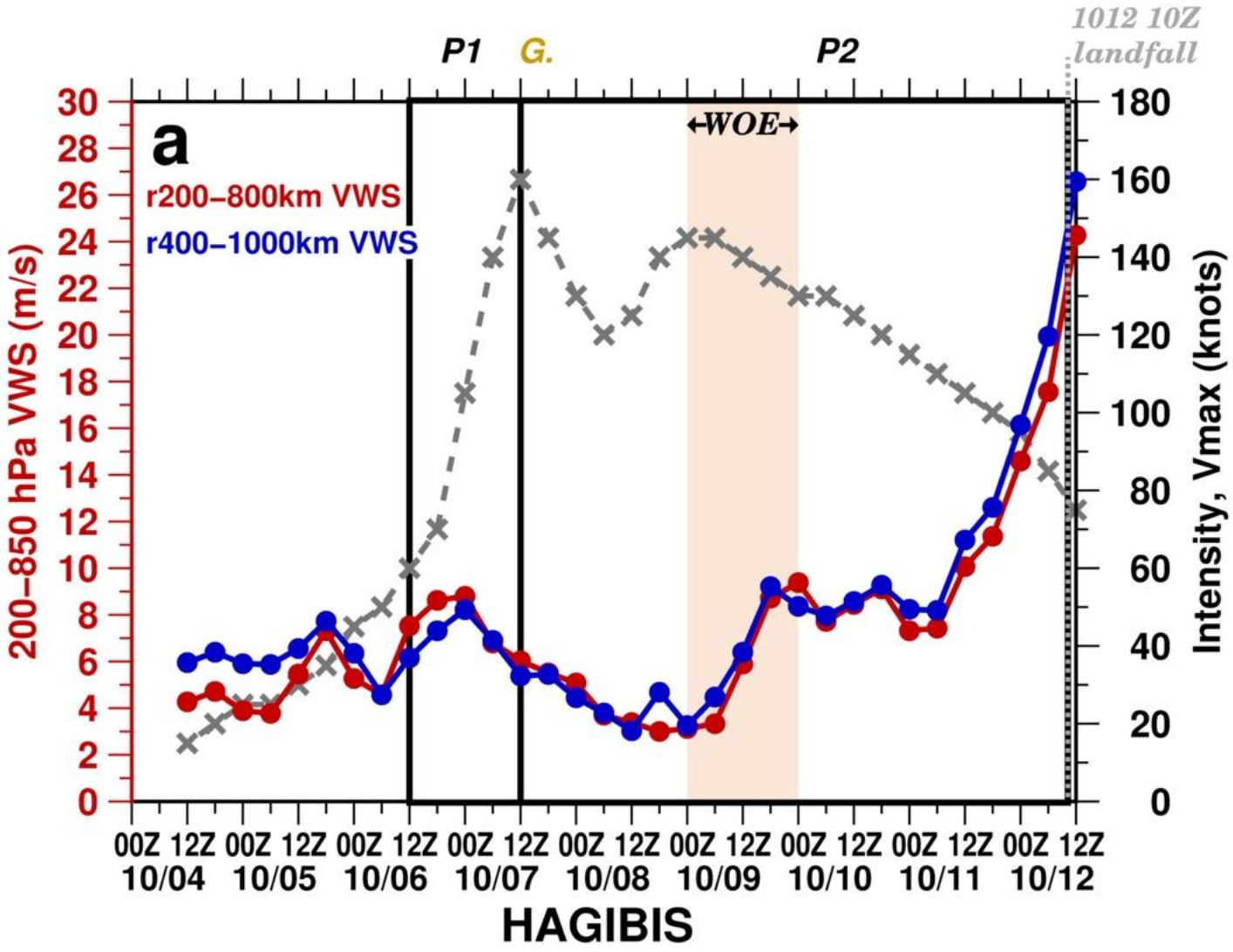
Typhoon Hagibis

BBC

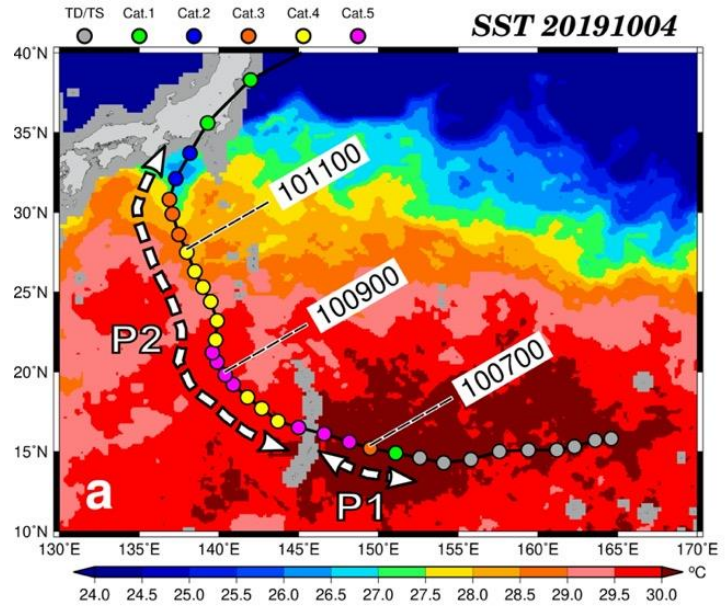
The foreca

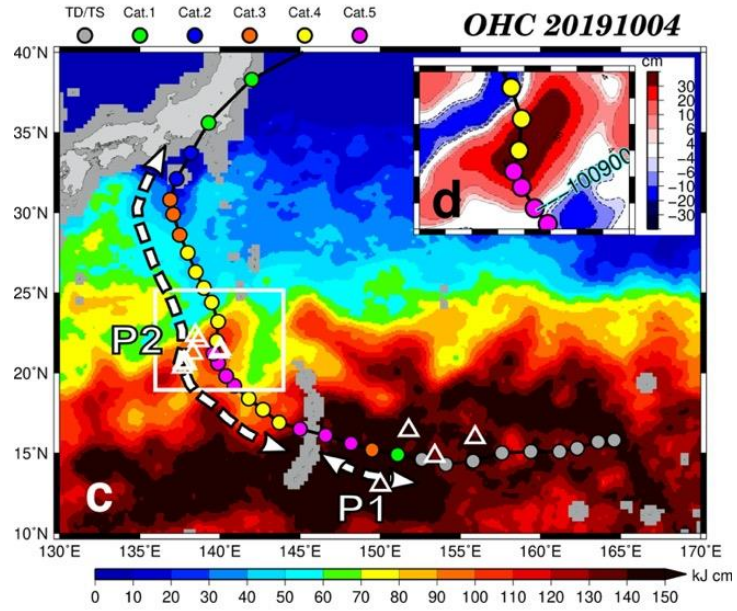
Explosive Intensification: 100 kt in 24h!

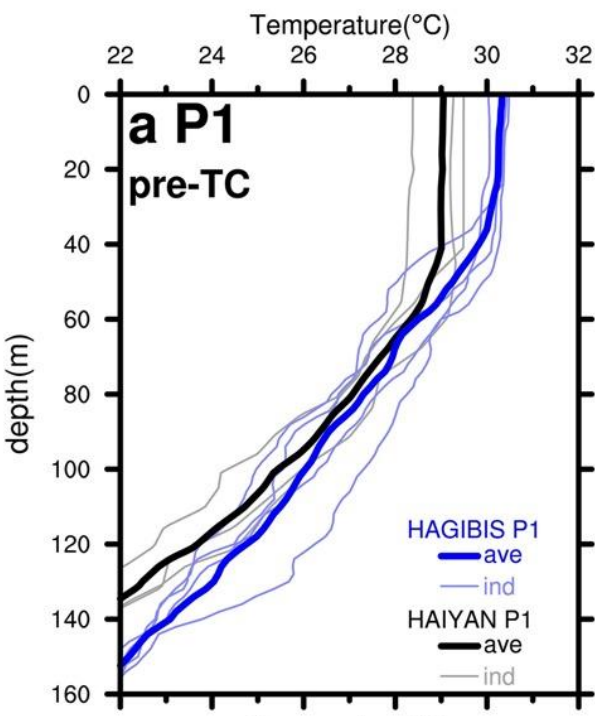
333% of the RI (Rapid Intensification threshold, Kaplan & DeMaria 2003)

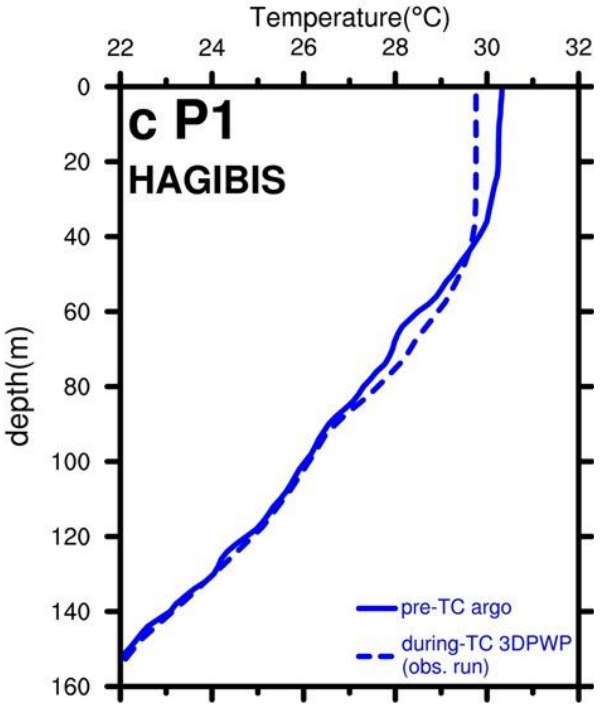


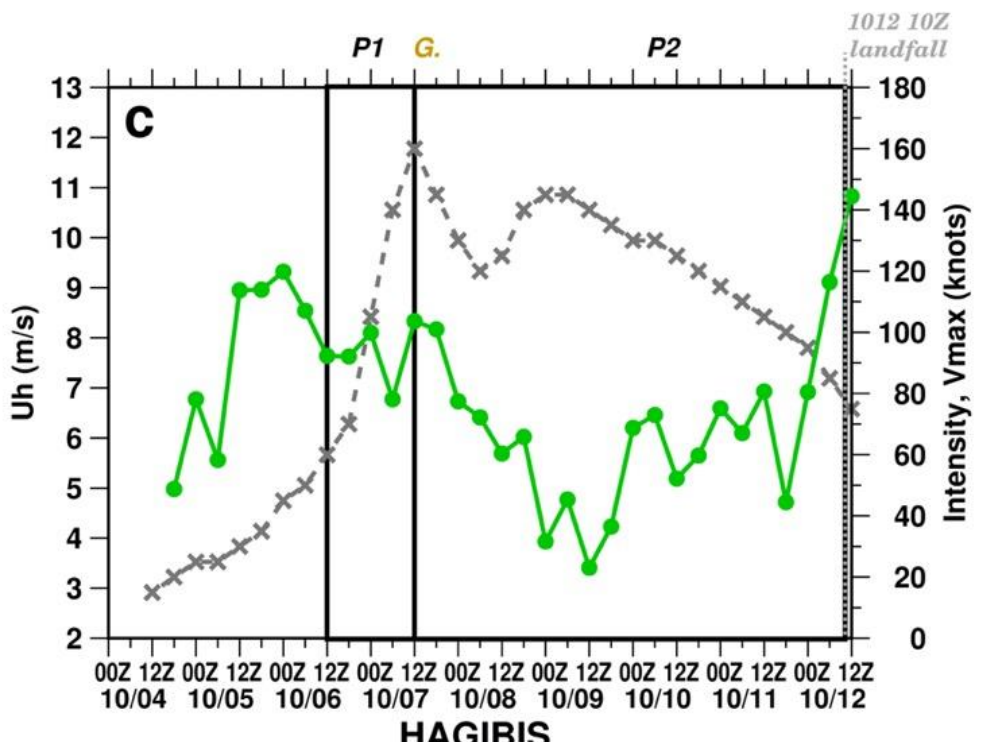
Lin et al. BAMS 2021

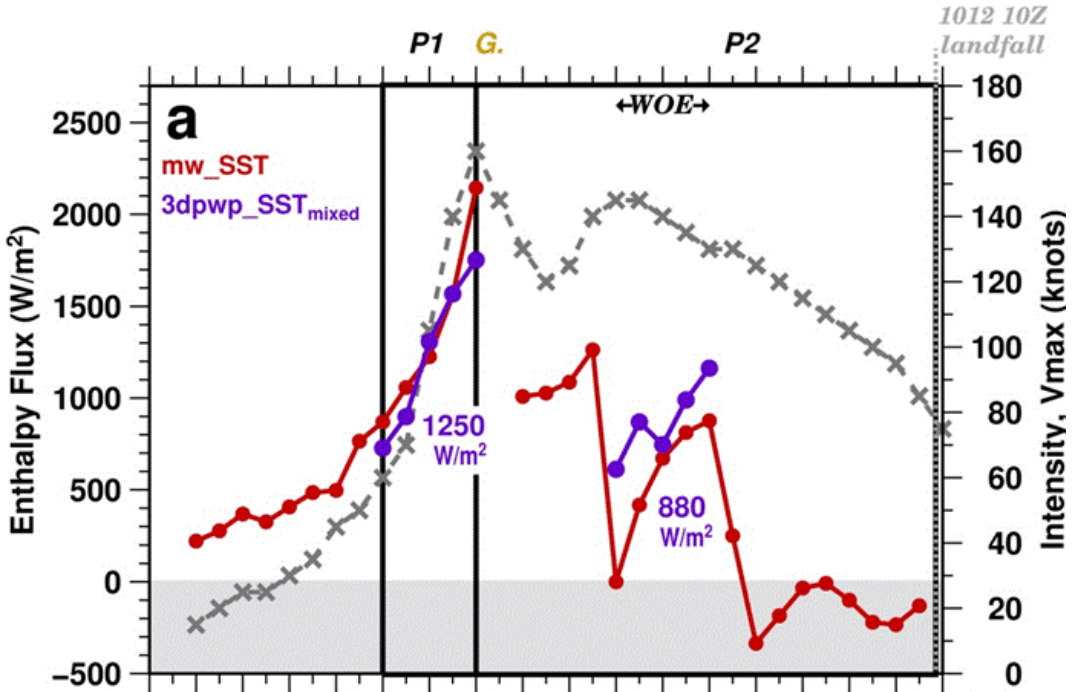












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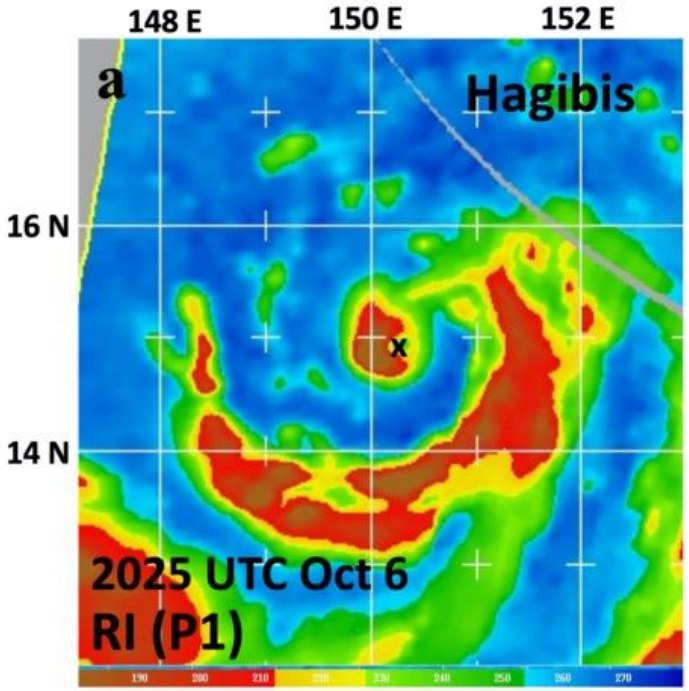


Air-Sea Coupled SST
(i.e., During TC SST)
=
(Pre_TC SST) – (Cooling effect)

Cooling effect: TC intensity, Uh,size, and pre-TC ocean profile (Ocean Heat Content, D26, Stratification, Mixed Layer depth)

Record holder

Lin et al. 2014
Mori et al. 2014
Lagmay et al. 2015

The Economist | World politics | Business & finance | Economics | Science & technology | Culture | Blogs | Debate | Multimedia

Typhoon Haiyan

Print edition

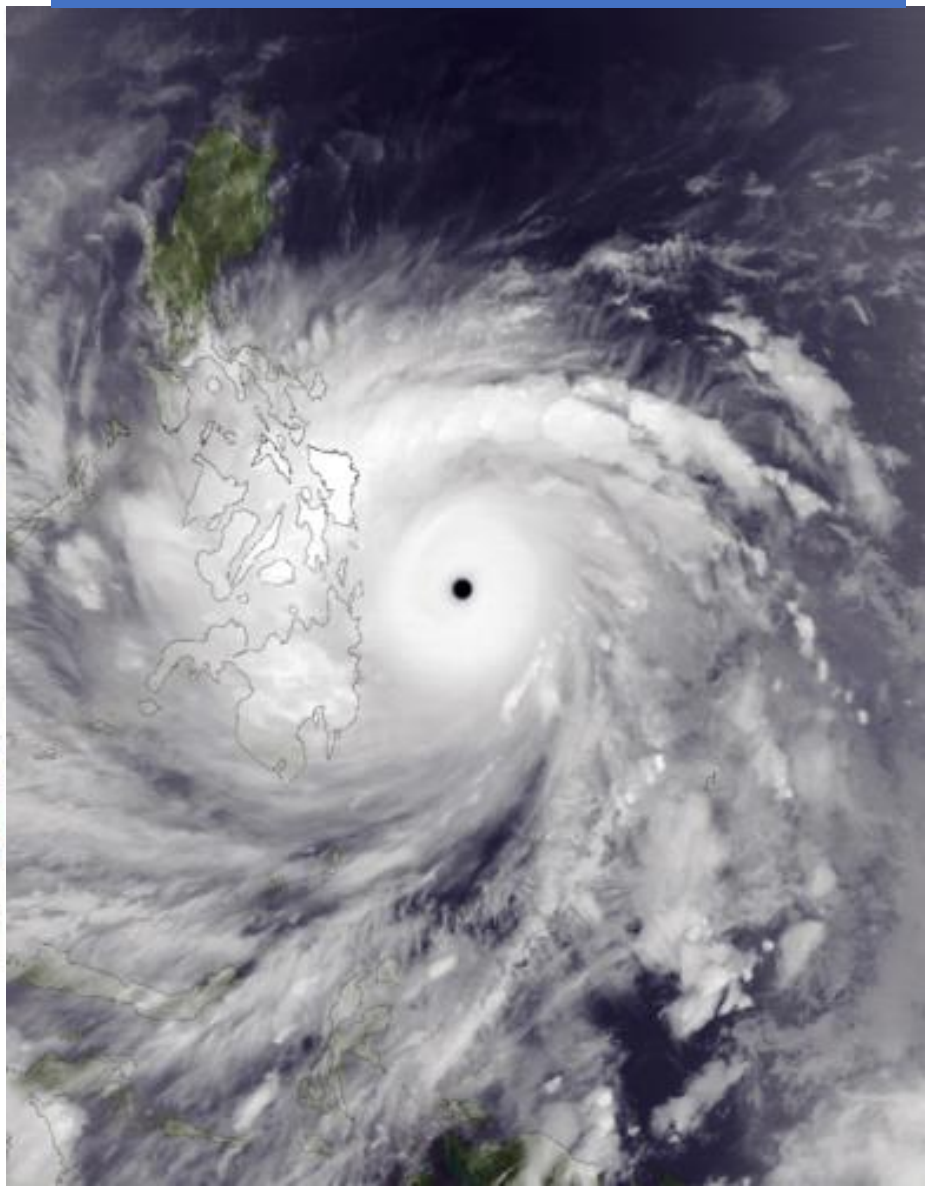
Worse than hell

One of the strongest storms ever recorded has devastated parts of the Philippines, and relief is slow to arrive

Nov 16th 2013 | CEBU, HANOI AND MANILA | From the print edition

Timekeeper Like 33 Tweet 37

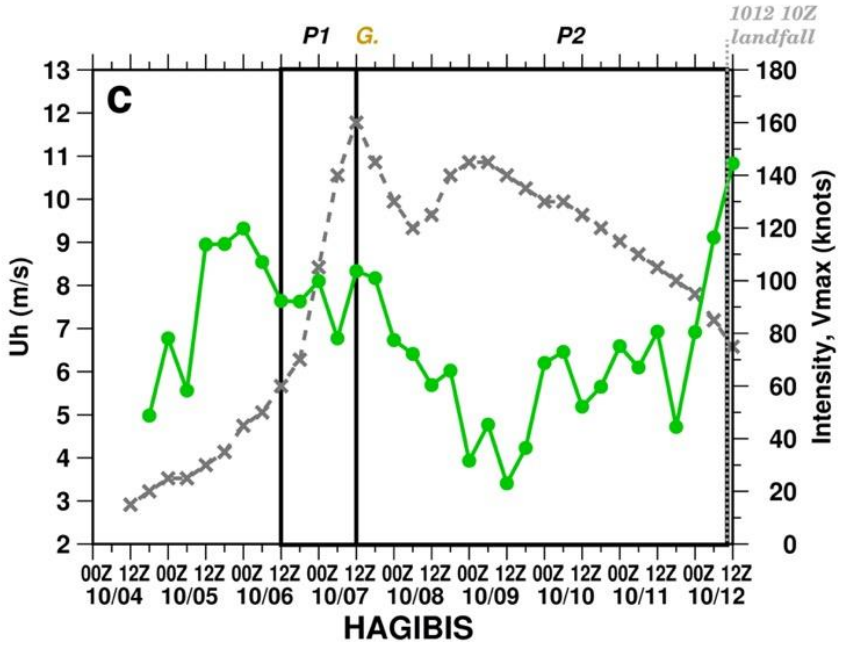
Cat. '6', Haiyan (海燕颱風): 170kts!

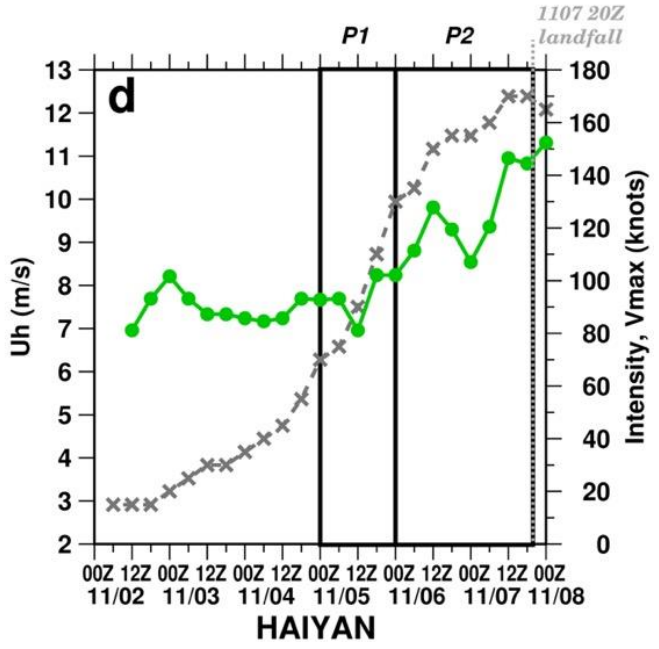


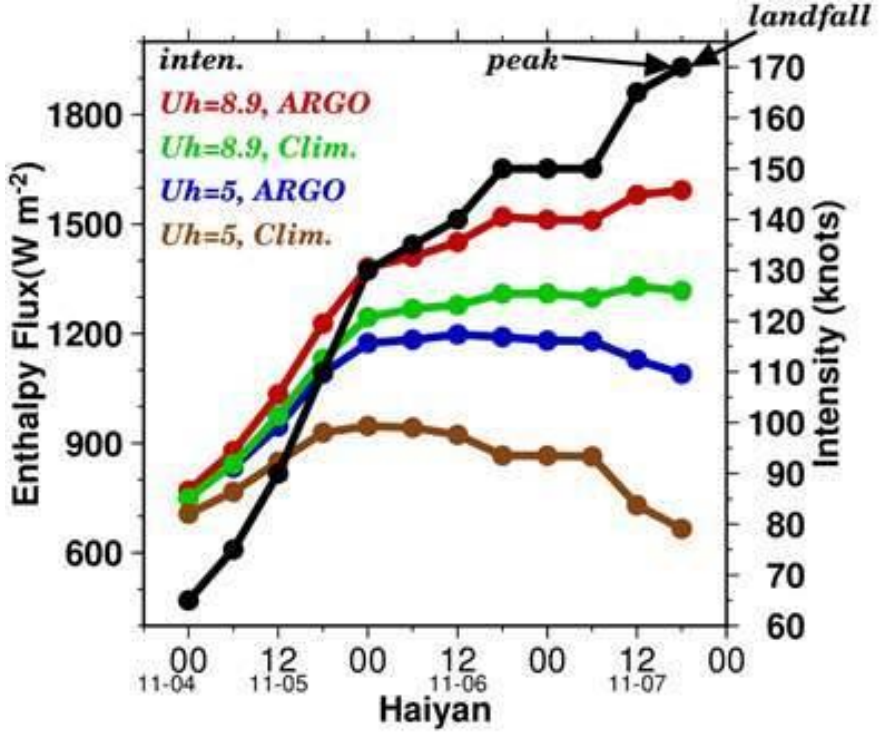
Death: 6300; Injured: 28689;

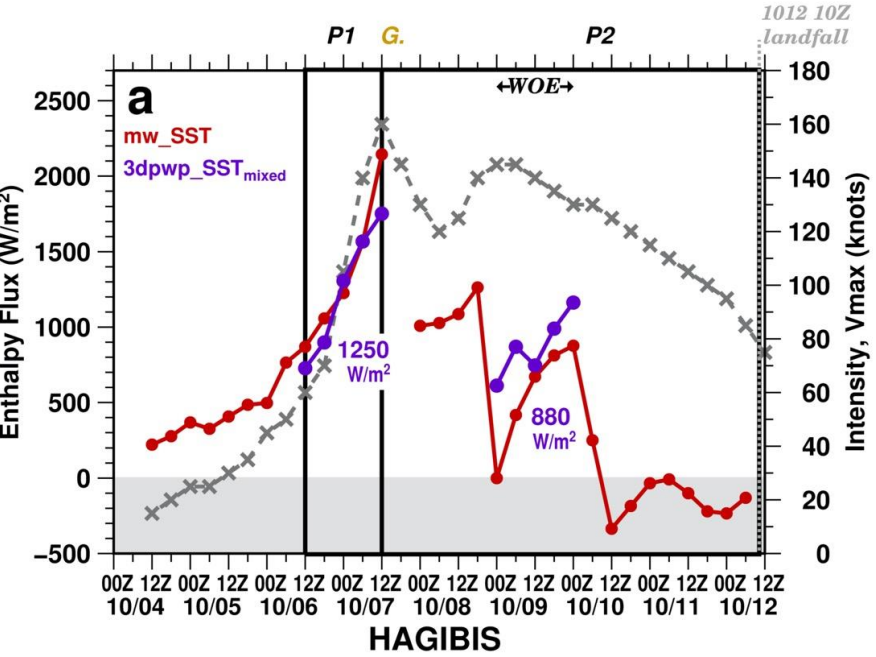
Damage : US $ 2,051,710,653 (2 billion)

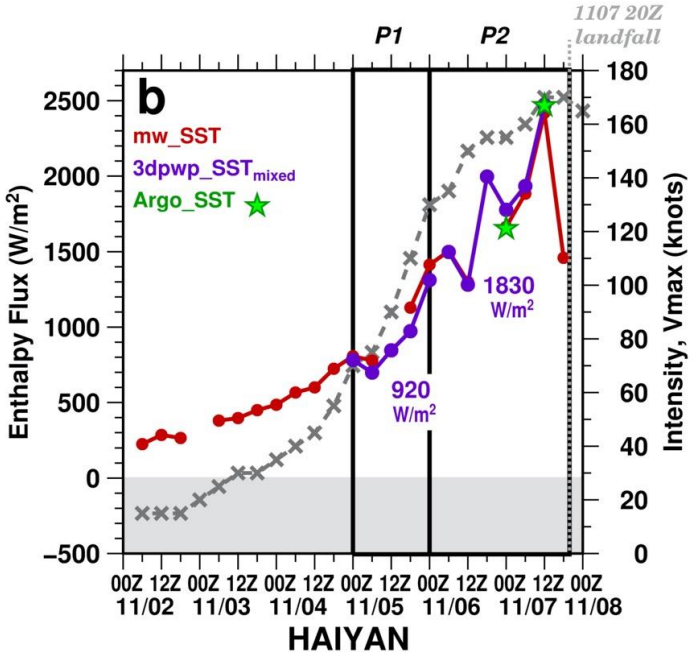
http://en.wikipedia.org/wiki/Typhoon_Haiyan

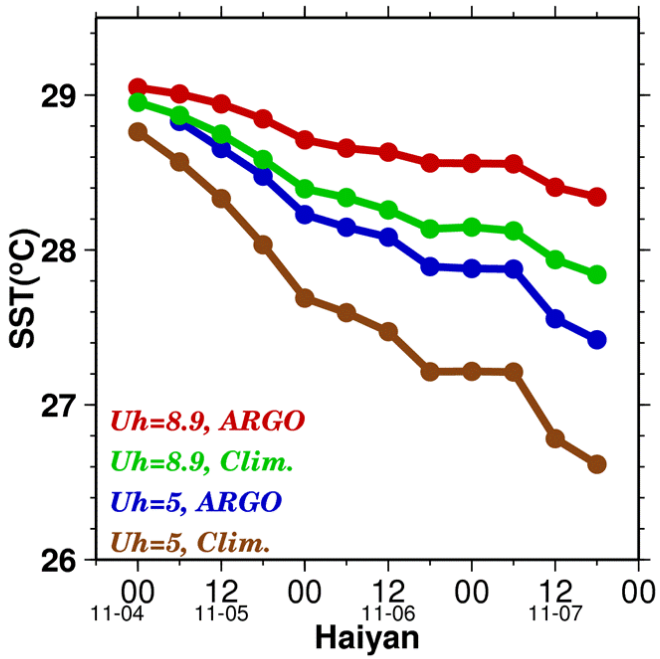












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a natureresearch journal

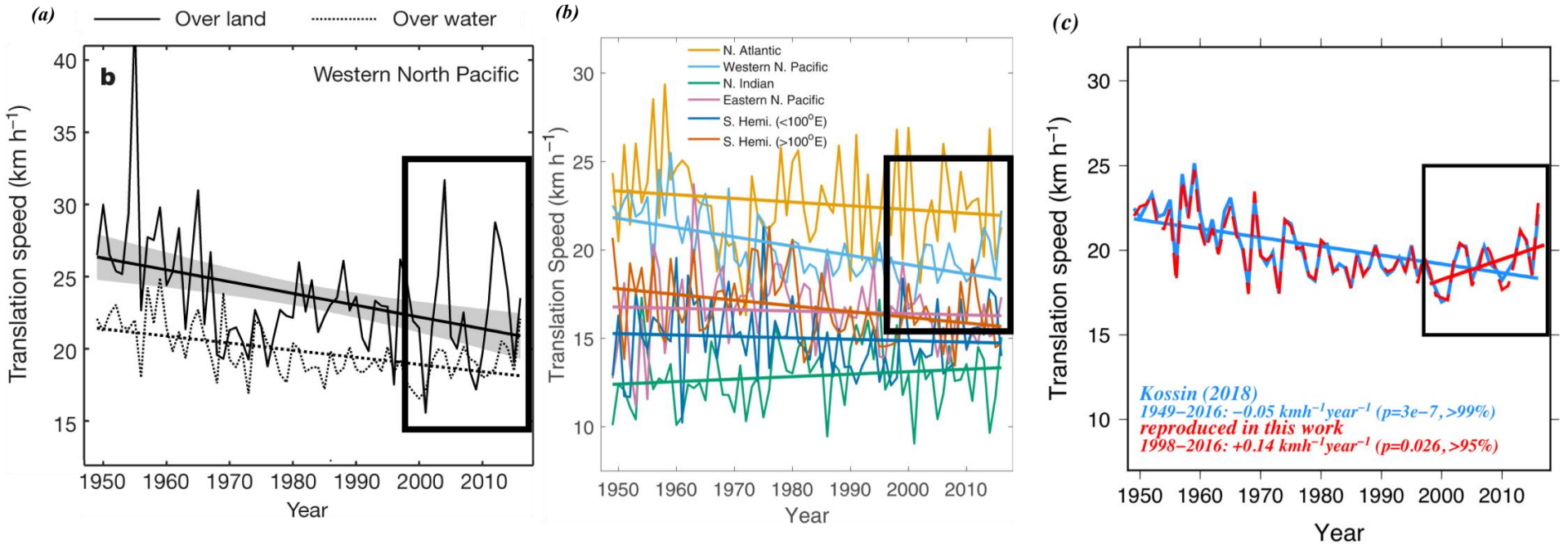
nature

Letter | Published: 06 June 2018

A global slowdown of tropical-cyclone translation speed

James P. Kossin

Nature **558**, 104–107(2018) | Cite this article



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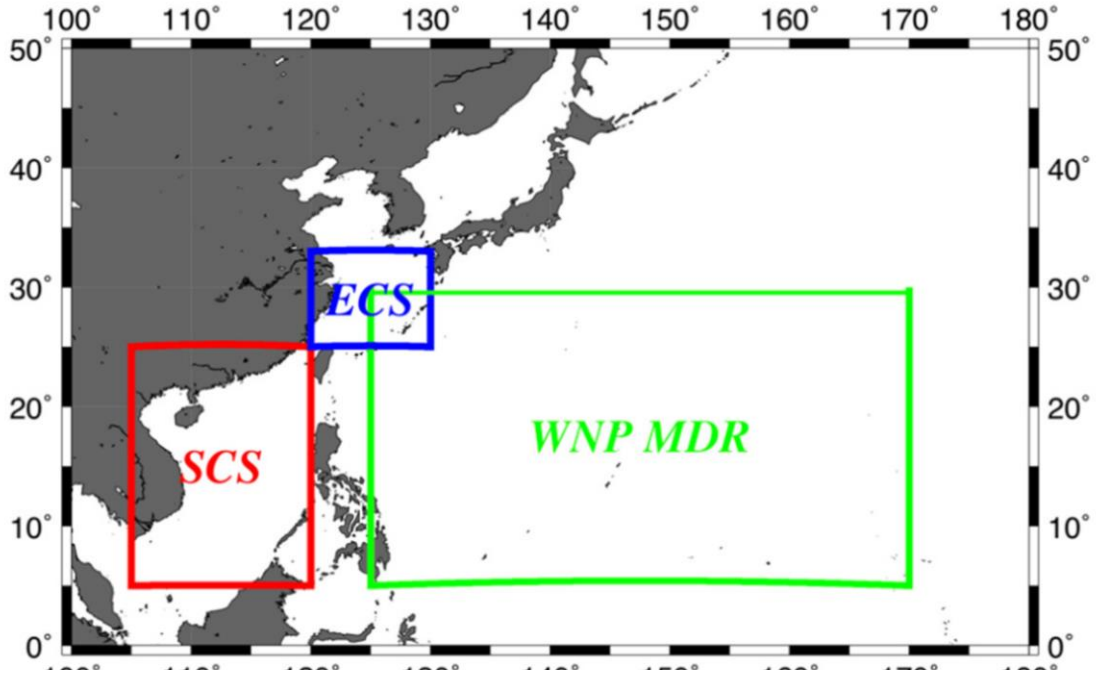
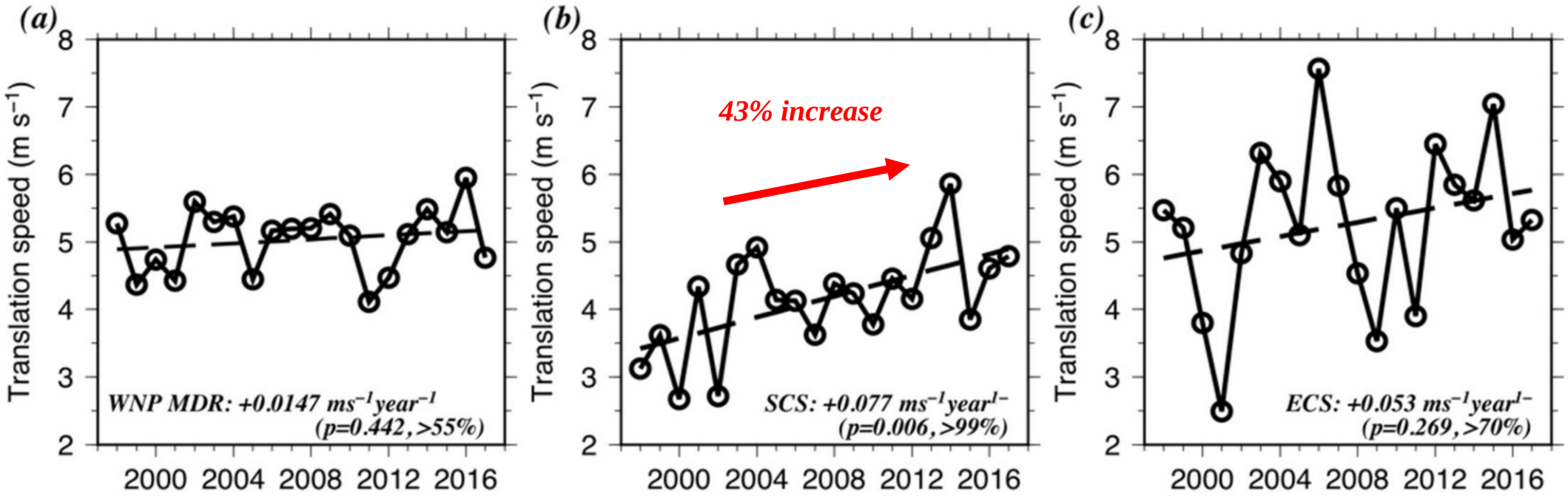
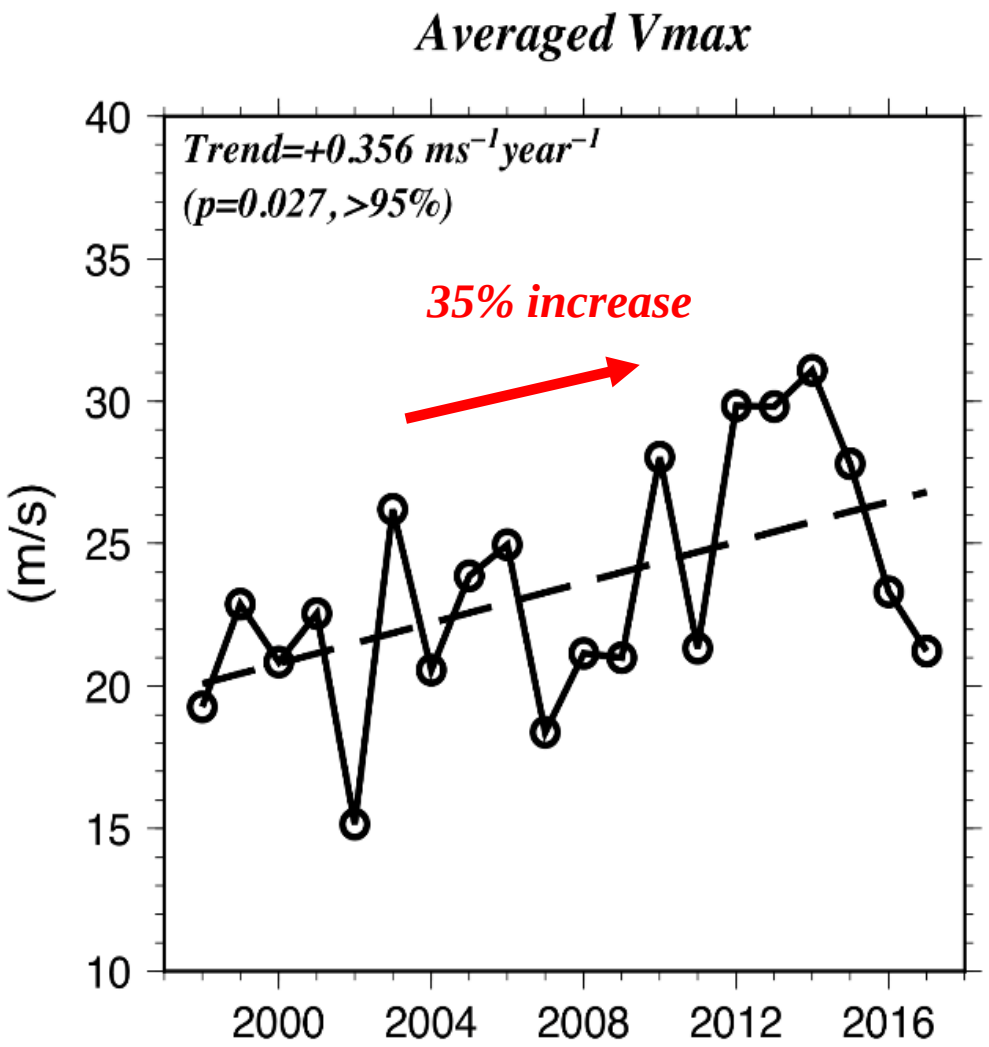
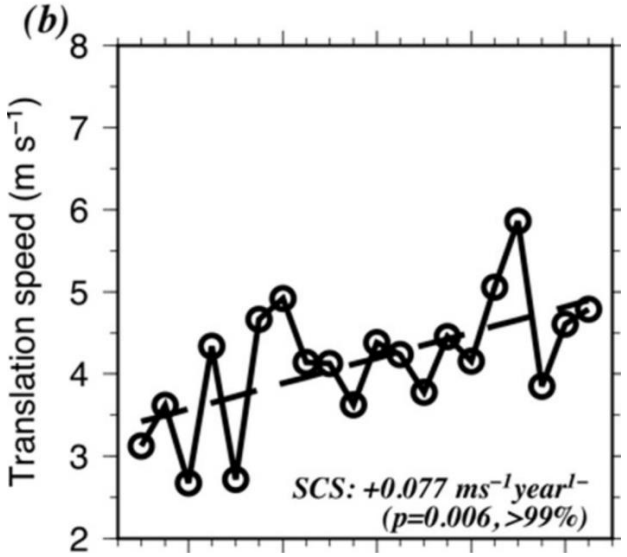
Sustainability 2020

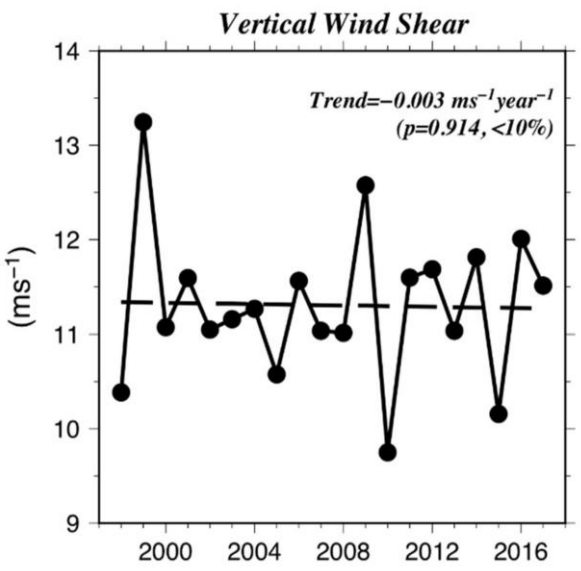
1998-2017

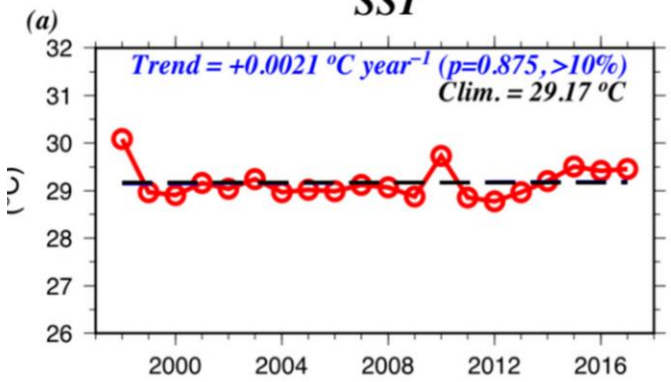


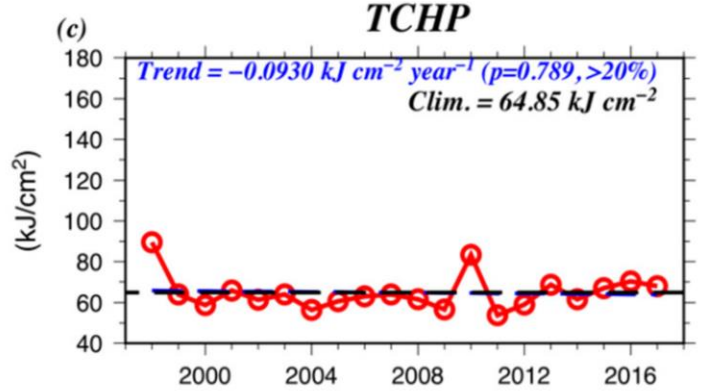


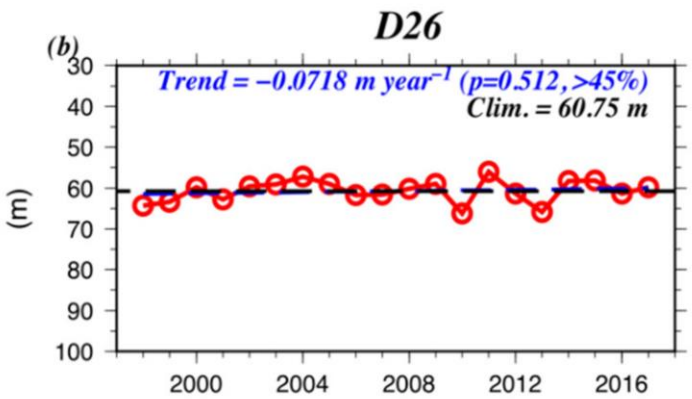


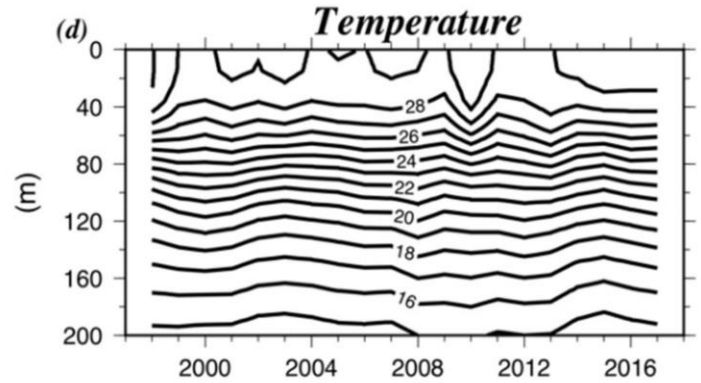












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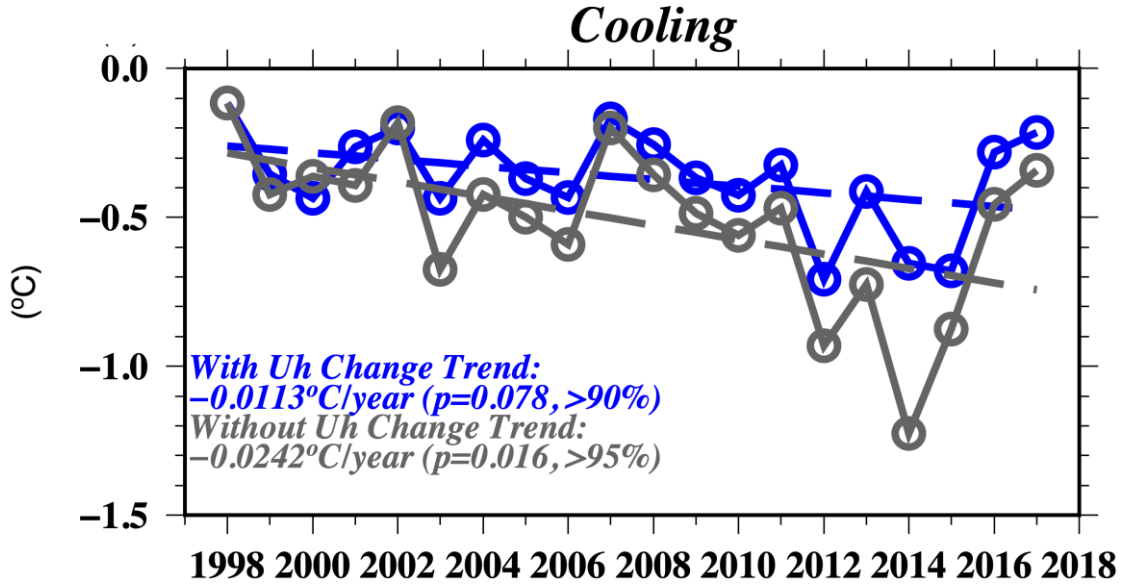
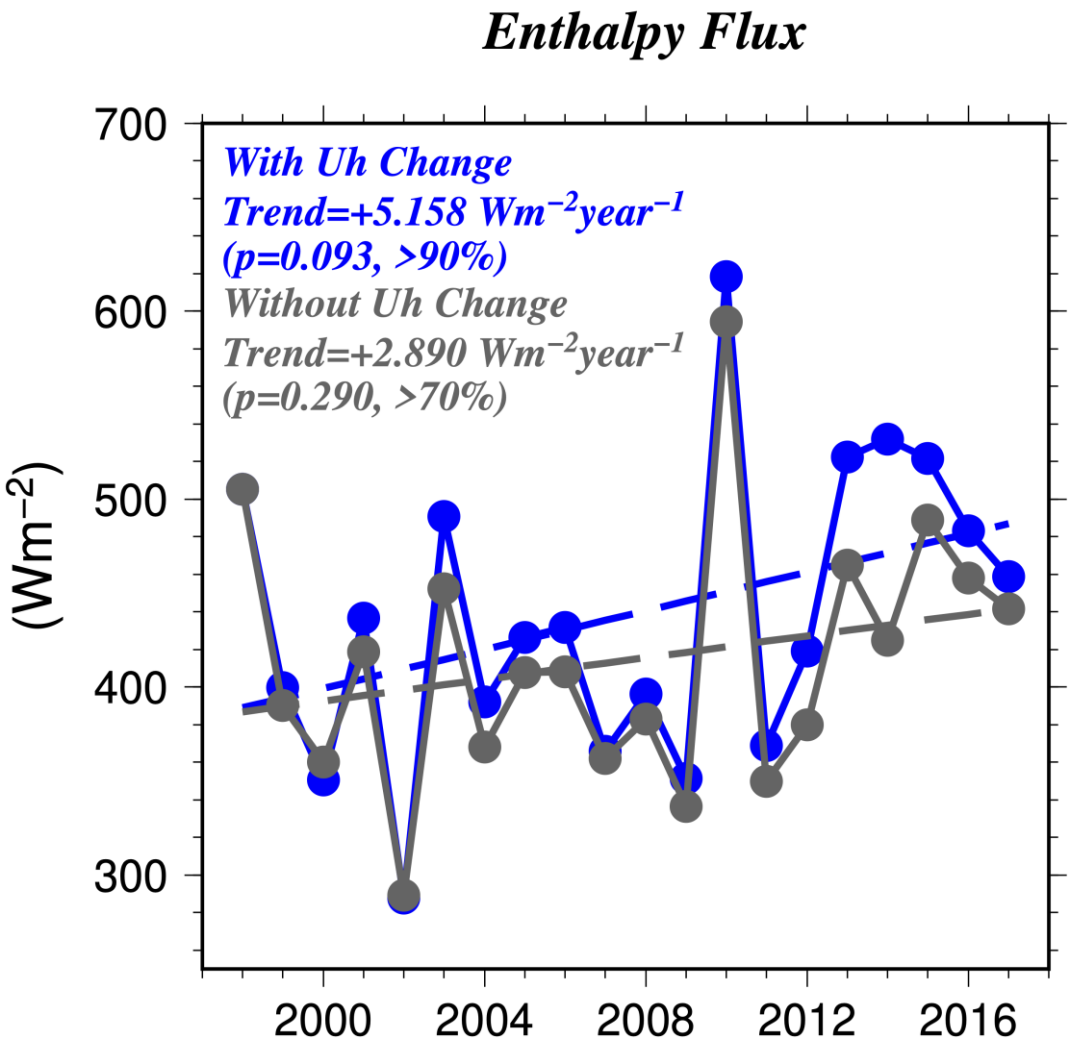


Vmax V. S.	corr. Coeff.	p-Value
Uh	0.553	0.011, >95%
SST	0.010	0.965, < 5%
D26	0.212	0.370, >60%
TCHP	0.131	0.583, >40%
VWS	-0.0956	0.6886, >30%
cooling with Uh change	0.615	0.004, >99%
cooling without Uh change	0.236	0.317, >65%



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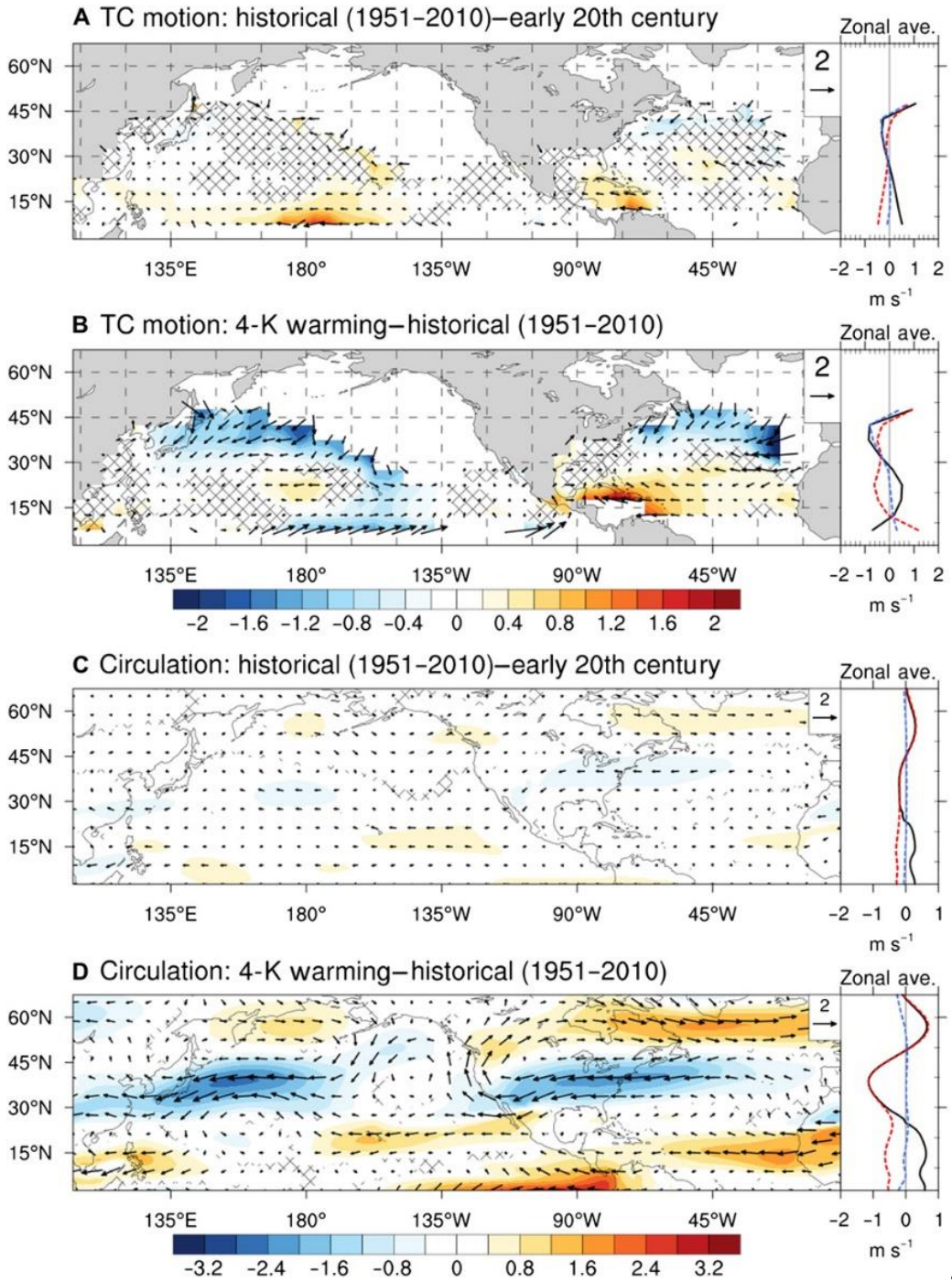
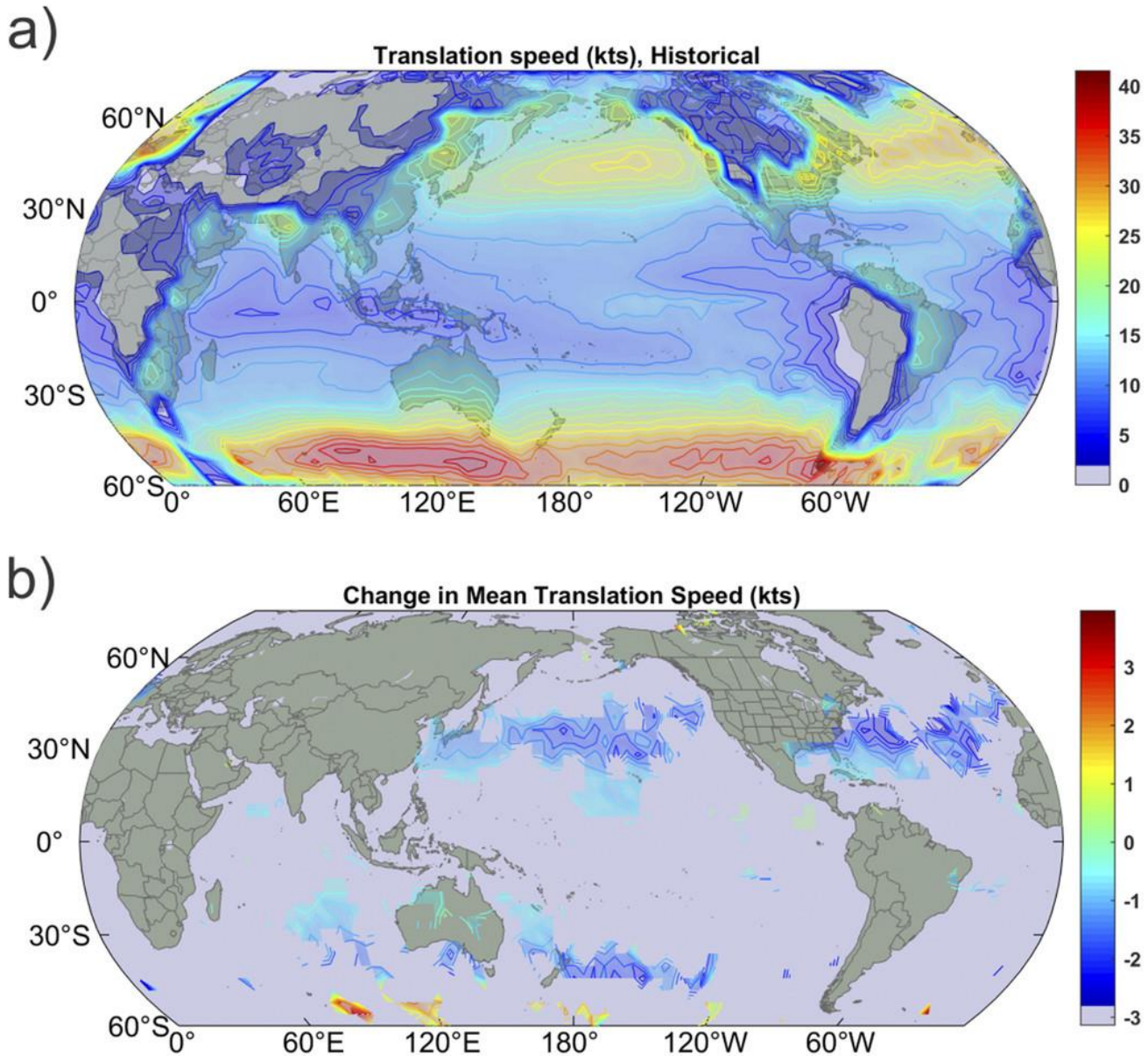


Zhang et al. Sci Adv 2020



Emanuel JC 2021

Conclusions

1. Fast Uh contributes to Hagibi's Explosive RI and Uh Slow Down stalls its intensification

2. Fast Uh contribute to Haiyan's RI and record breaking Category -6 Intensity of 170 kts (via ocean cooling reduction and increase in air-sea enthalpy flux).

3. Uh in SCS increase by 43% from 1998 to 2017 with statistical significance.
   TC intensity in the SCS increase by 35% from 1998 to 2017 with statistical significance.
   Among all parameters tested, Uh and TC intensity has the highest correlation ~ 0.6.
   Fast Uh likely to be a positive contributor to TC intensity increase in the SCS.

4. Why SCS Uh increase in 1998-2017 deserves future exploration. Association with large-scale circulation? If so, it may also influence YMC related phenomena?

5. TC Uh change in global warming still at debating stage and no consensus yet.

6. TC Uh over land .vs. TC Uh over ocean.