100 years typhoon activities over the Philippines based on the recovery of historical typhoon track data

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Background

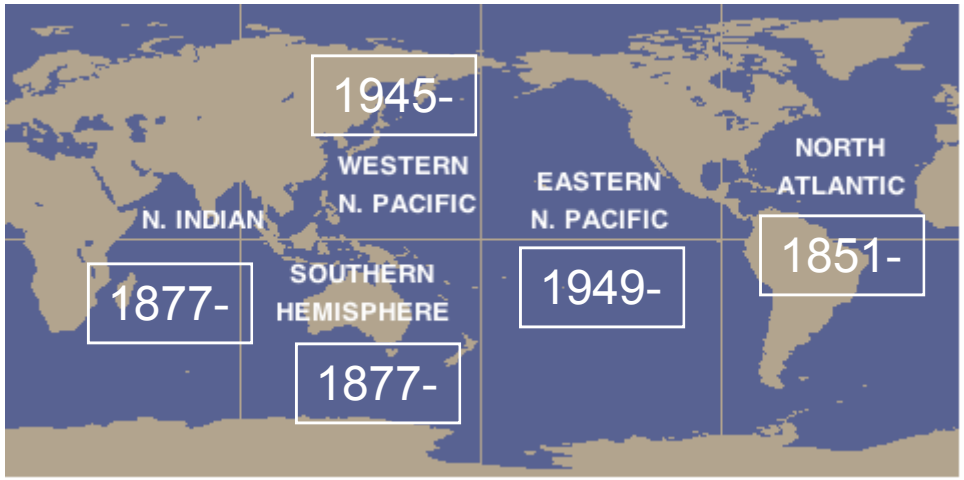
・Typhoon activity appears to be affected by global warming (Oouchi et al. 2006).

・On the other hand, typhoon activity has natural interdecadal variability (Yumoto and Matsuura 2001) .

・Typhoon database is created over the Atlantic basin from 1851 (Landsea et al. 2004).

・However, over the WNP, typhoon database is available from 1945 by JTWC (Joint Typhoon Warning Center) best track data.

Available global typhoon database



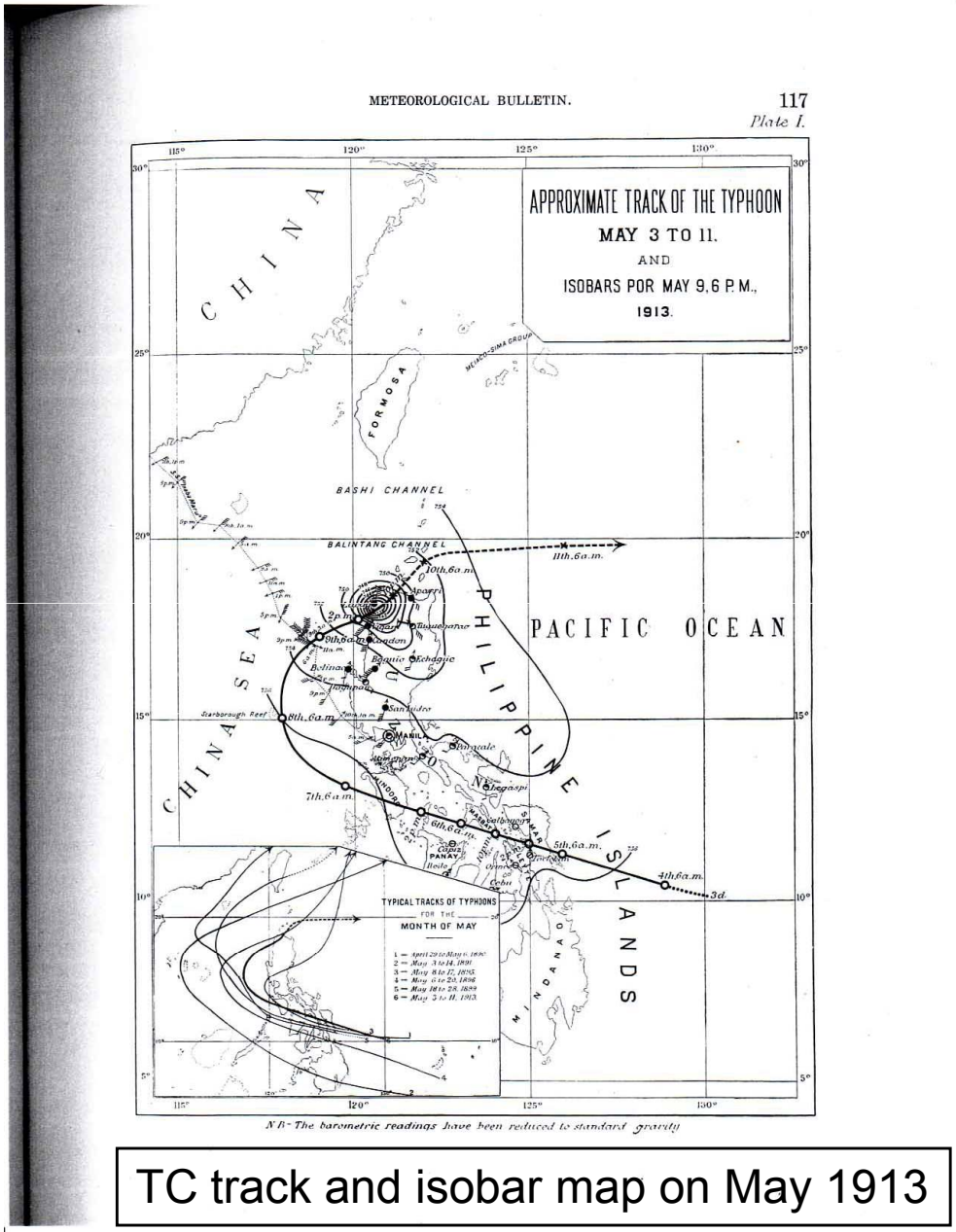
by NCAR

Objective

- A dataset of typhoon landfall numbers in the Philippines (TLP) is created from a historical observation record and JTWC from 1902 to 2005.
- Interdecadal variability of the TLP during the past 100 years is investigated.
- Preliminary results of 100 years typhoon activities over South China Sea will be presented.

Monthly Bulletins of Philippines Weather Bureau
(1901-1940)
stored in Hamilton Library
at University of Hawaii

300 stations observation data
Typhoon tracks over the WNP



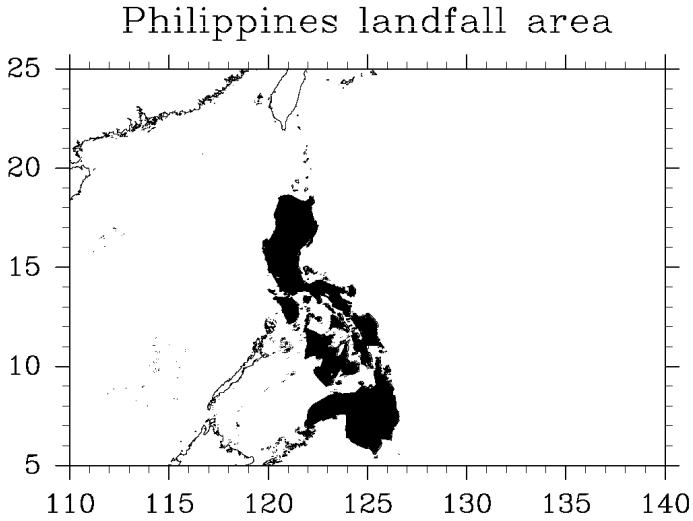
TC track and isobar map on May 1913

Definition of Typhoon landfall numbers in the Philippines

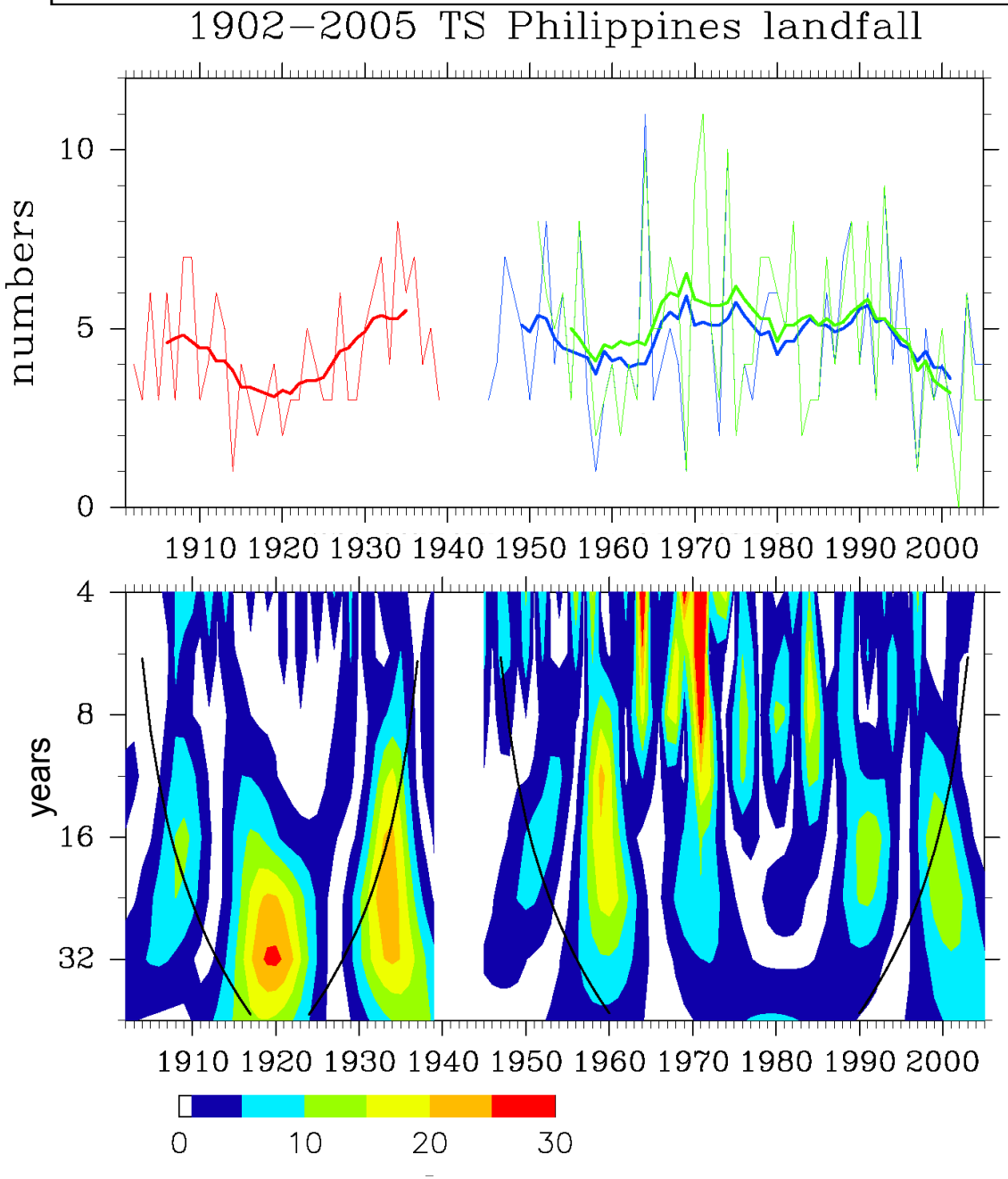
- 1945-2005 when TS passed over Philippines
  Max wind speed >35kt (JTWC TS best track data)
  (JMA best track data used for comparison)
- 1902-1939 when TS passed over Philippines
  ps <1000hPa observed at station using
  Monthly Bulletins of Philippines Weather Bureau

Comparison between two definitions
(1964,67-76, 11years) of TC landfall
by reports of “Tropical Cyclones of 1964” etc.

Max wind speed >35kt	TS 57(JTWC),	60(JMA)
Ps<1000 hPa	51	56
	(difference 10.5%,	6.7%)



100 years Tropical Storms numbers landfall at Philippines



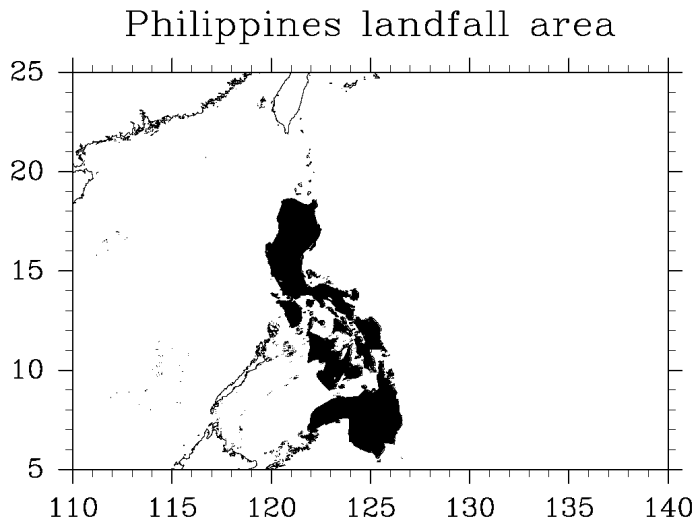
MBP

JTWC

JMA

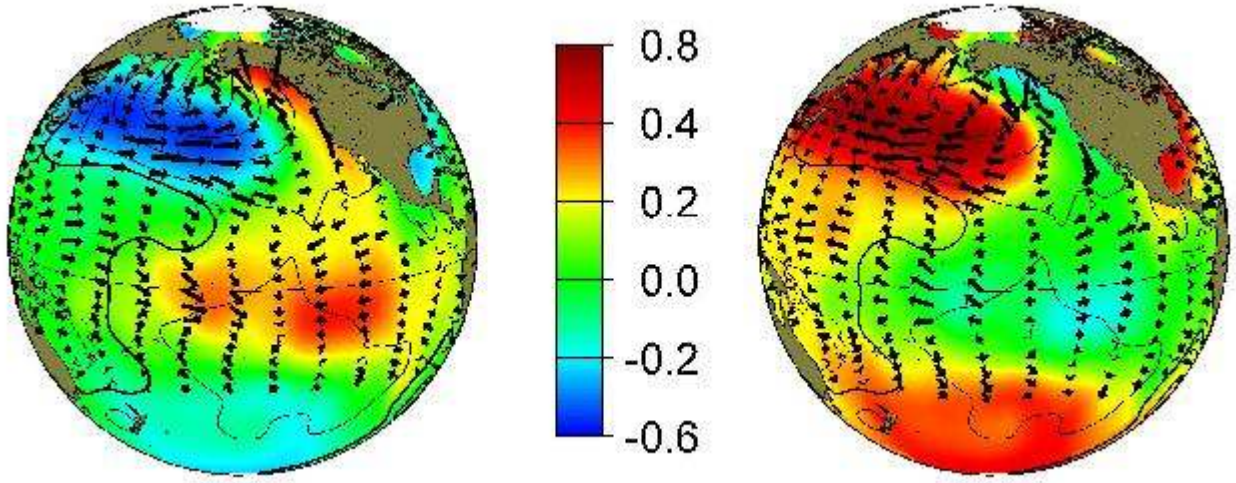
:10 years running mean

Wavelet analysis



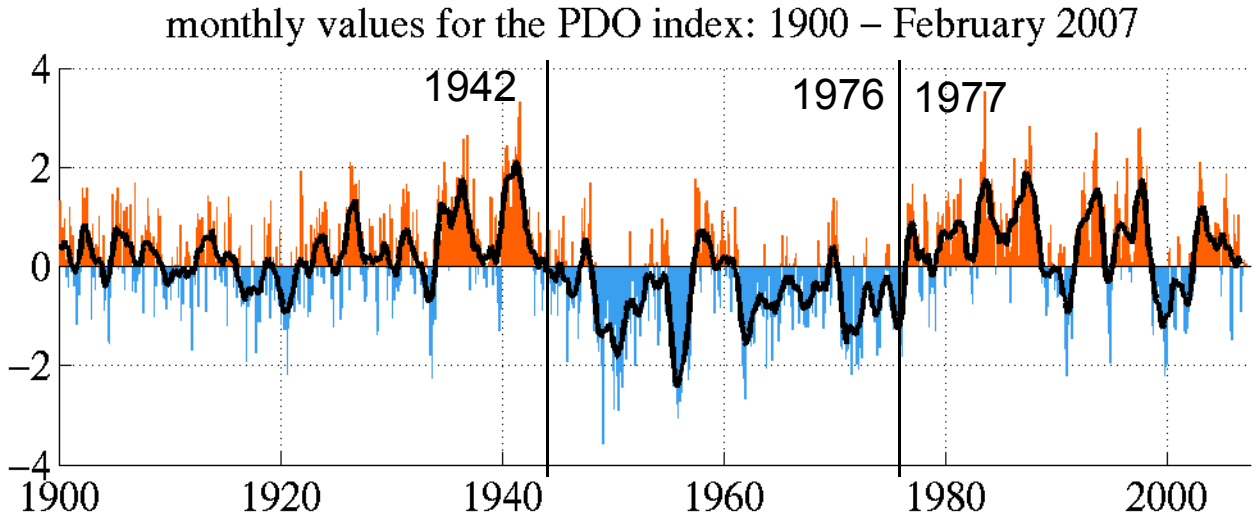
The Pacific Decadal Oscillation (PDO)

High phase



Low phase

SST: colors
SLP: contours
Surf.W: vectors



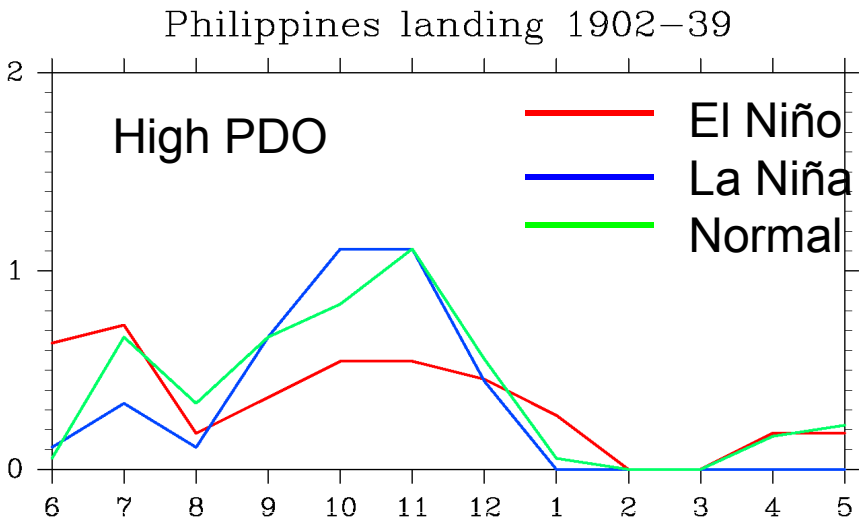
Mantua et al. (1997)

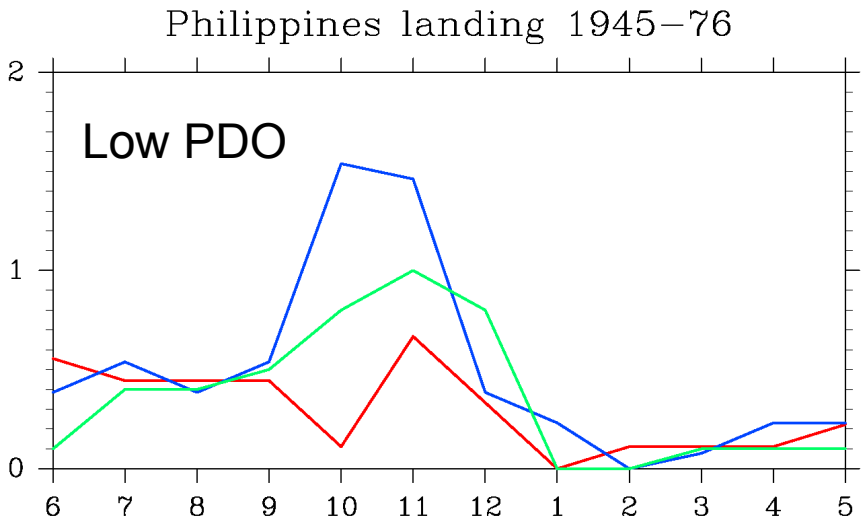
TC landfall at Philippines associated with ENSO and PDO phases

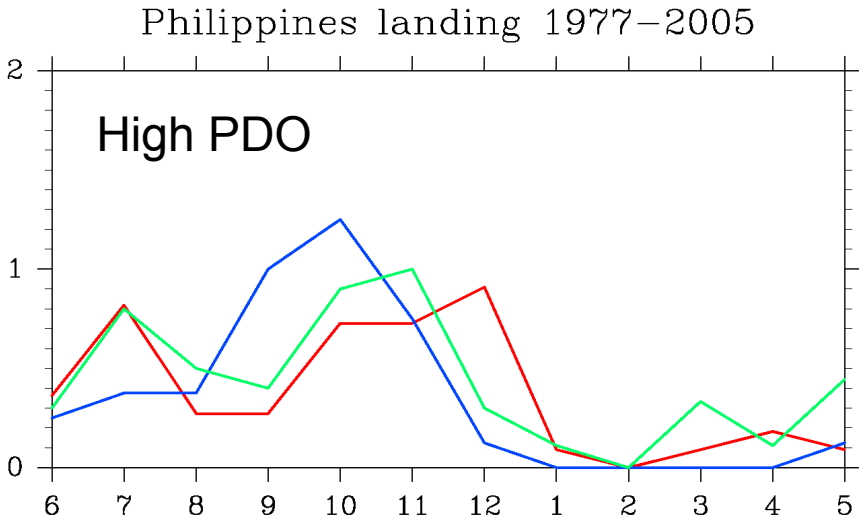
Annual landfall

	1902-39	1945-76	1977-2005
PDO	high	low	high
El Niño	4.1	**3.6**	4.5
La Niña	3.9	**6.0**	4.3
Normal	4.7	4.3	5.1

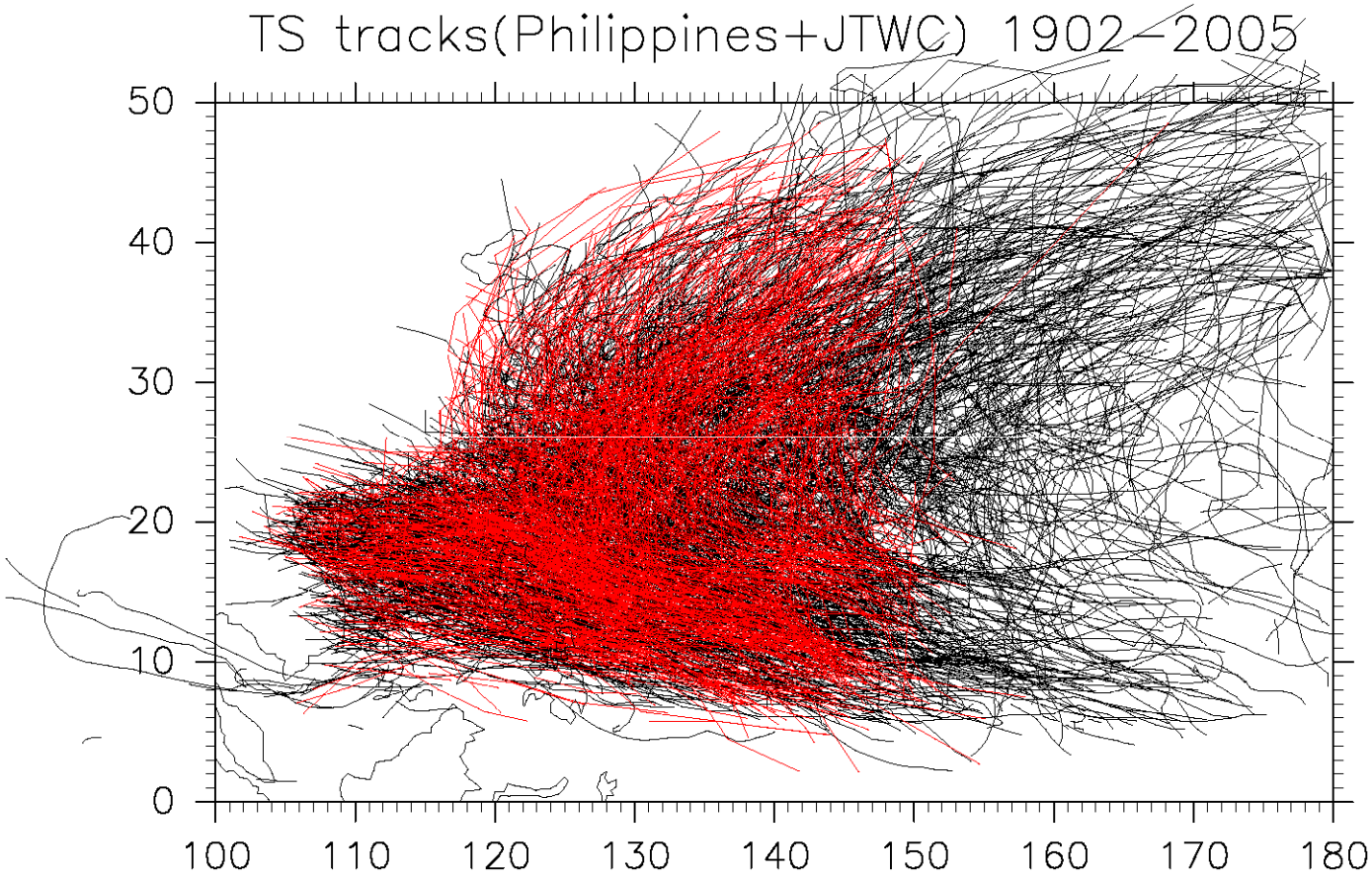
colored : 95% significance







Typhoon tracks（JTWC＋Monthly Bulletins of Philippines）



Quality check of the TC track data

- **Distinguish TS from TD or extra tropical cyclone**

  Threshold of 1000hPa is used for TS.

  compare TC tracks to JTWC best track data

  performed from 1902 until 1924

- **Count enough numbers of TS throughout the year**

  Check TS passage through the perturbation of the nearest station pressure data

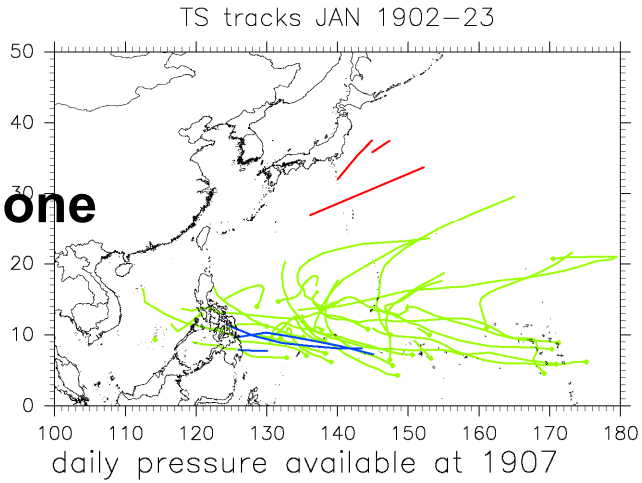
  performed in the vicinity of Philippines (detect enough TS numbers from 1909)

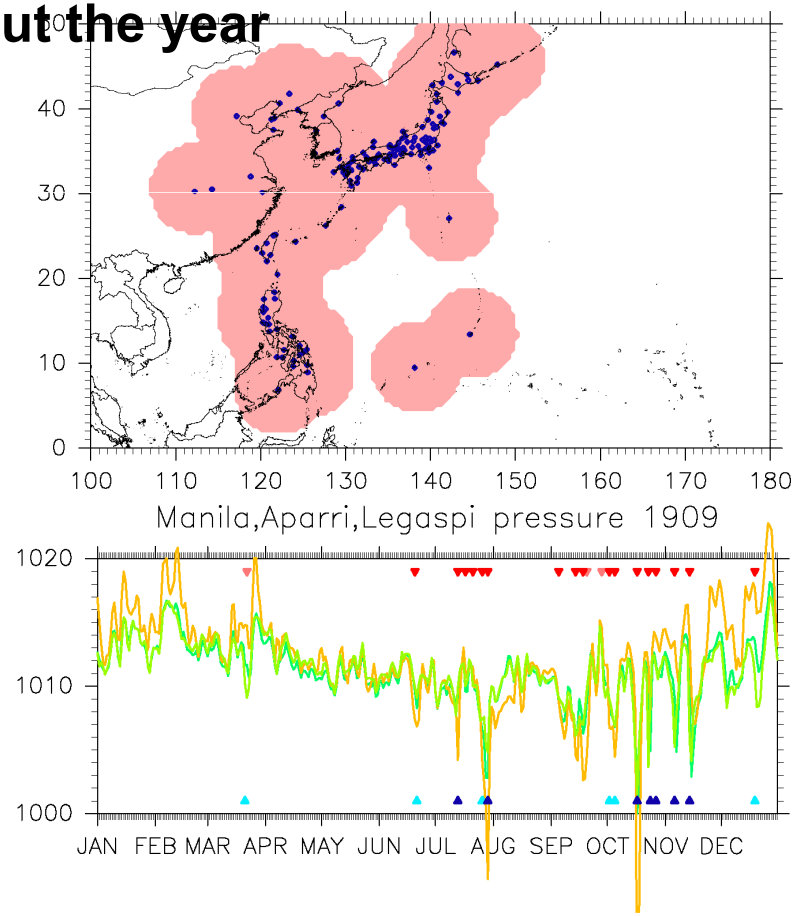
- **Reliability of TC tracks**

  compare other historical TC track datasets

  not preformed yet

▼: available TC tracks
▲: TC landfall





Other historical TC track data over Western North Pacific

- **Taiwan Central Weather Bureau (1897-1996) (Taiwan)** digitalized

  Shieh, S.-L., S.-T. Wang, M.-D. Cheng, and T.-C. Yeh, 1998: Tropical cyclone tracks over Taiwan and its vicinity 1897-1996. Central Weather Bureau, Ministry of Transportation and Communications, 413pp.

- **Taiwan Central Weather Bureau (1892-1977) (WNP)**

  Xu, H. et al. 1973: Eighty years typhoon tracks invading Taiwan, 八十年來颱風路徑圖 Central Weather Bureau, 661pp. (in Chinese)

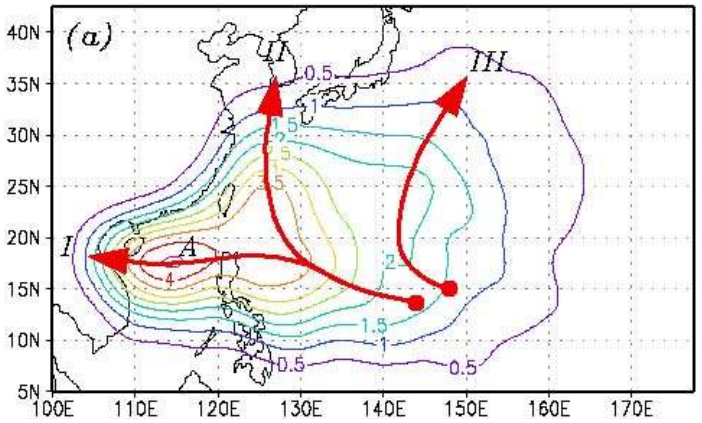
- **Hong Kong Royal Observatory (1884-1953) (WNP)**

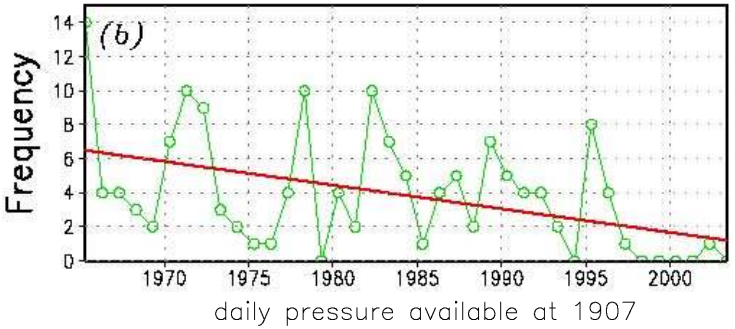
  Chin, P. C., 1958: Tropical cyclones in the Western Pacific and China Sea area from 1884 to 1953. Royal Observatory, Hong Kong, 85pp.

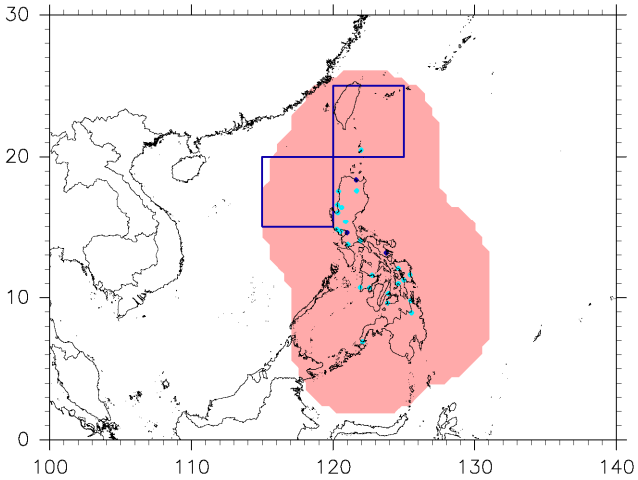
- **Japan JMA Geophysical Review（1900-2002）(WNP)**

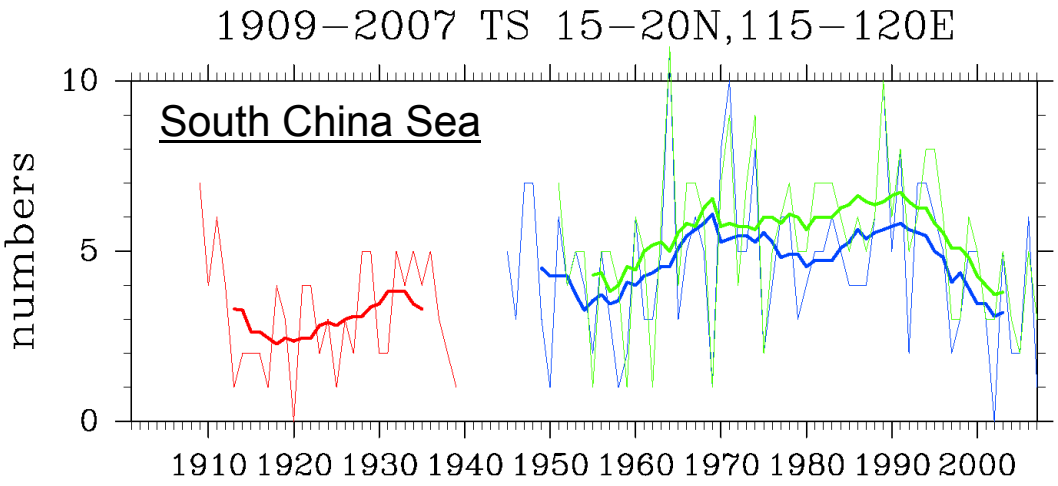
  partly digitalized

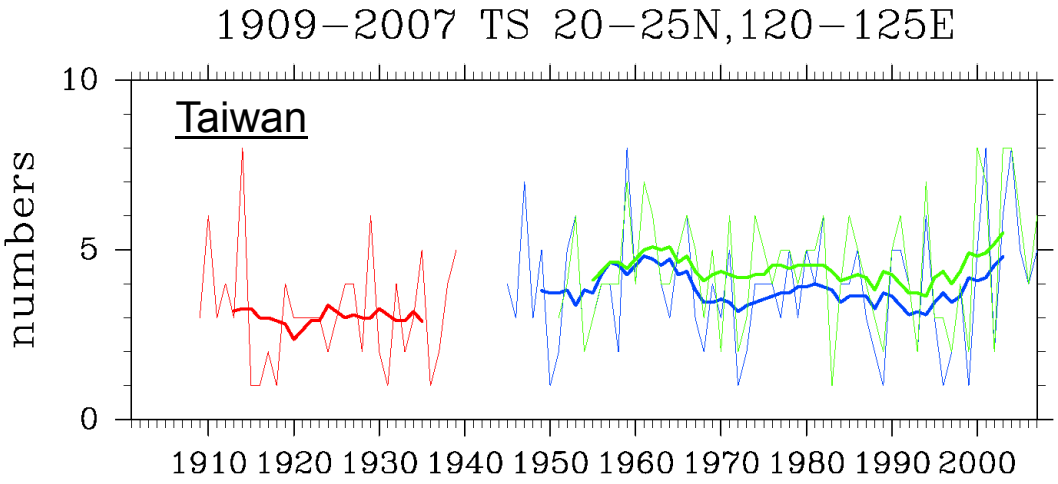
100 years Typhoon numbers in the vicinity of Philippines











MBP
JTWC
JMA

Summary

- A dataset of TC landfall numbers at Philippines (TLP) is made by combination of historical observation record of Monthly Bulletins of Philippine Weather Bureau and JTWC best track data from 1902 to 2005.
- TLP was defined by using TC track and station pressure data before 1939. After 1945, JTWC best track data was used. Difference of two definitions were less than 11% in acceptable level.
- Interdecadal variability of TLP is found to be related to ENSO and PDO phases. The annual TLP has an apparent oscillation of about 32 years before 1940 and about 10 to 22 years after 1945. No long-term trend was found.
- During low PDO phase, annual TLP has high sensitivity associated with ENSO phases. But it cannot be seen during high PDO phases.
- In TLP, there is a dominant natural variability.
- Over South China Sea, decrease of typhoon numbers can be seen not only in 1990s but also in 1910s and 1950s.