

# **On the presence of tropical vortices over the Southeast Asian Sea- Maritime Continent region**

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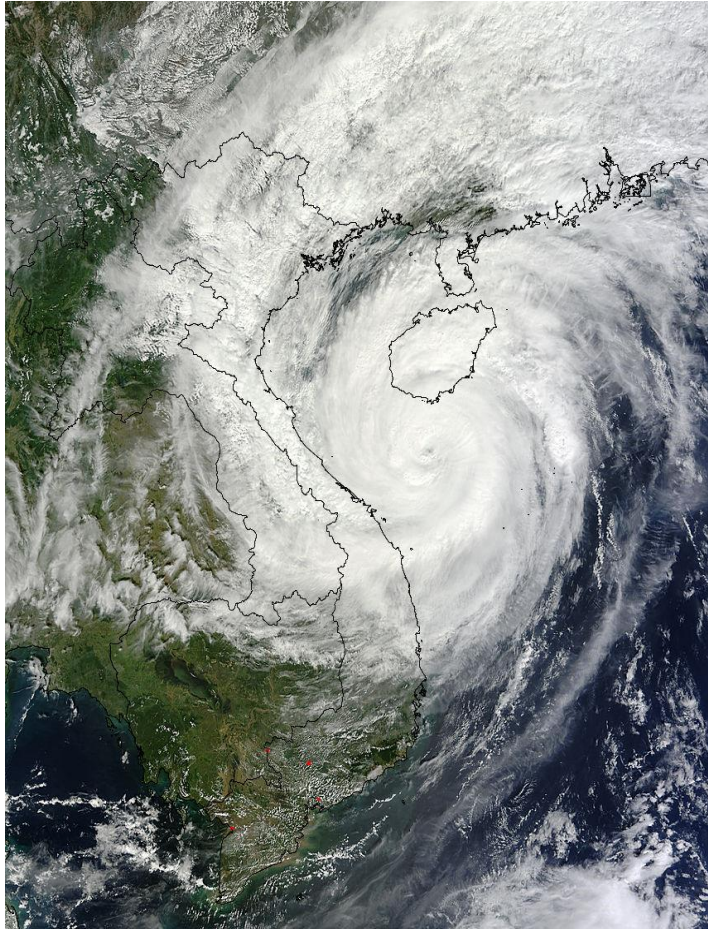
# OUTLINE

01. Motivations and Objectives

02. Data and Methodology

03. Key findings

# 1. Motivations and Objectives



5-6 TCs make landfall or indirectly affect to Vietnam.

Storm Season: 5-12 (6-11)

- >3000 km of coast line, highly vulnerable to typhoons, floods, droughts, **TCs induced rainfall.**
- Better understanding **natural variability of the climate system** will enable more effective forecasting which in turn will help to protect lives and property from natural hazards.
- Findings in 1930s showed that the maximum monthly rainfall in Vietnam varies from north to south in accordance with the seasonal cycle.

-Sadler and Harris (1970) found the migration of a rainfall centre from the Indochina peninsula (Oct) to the Borneo (Nov-Dec) then southward to the Java Sea (Jan-Feb).

-Vortices mostly land in northern Central Vietnam in Jun-Jul, Central in Aug-Sep-Oct, and cease in Nov-Dec in the South.

-The Winter Monsoon Experiment 1978 found the Borneo vortices.

-This study **seeks evidences of the existence of semi-permanent vortices** over the Southeast Asian Sea – Maritime Continent region

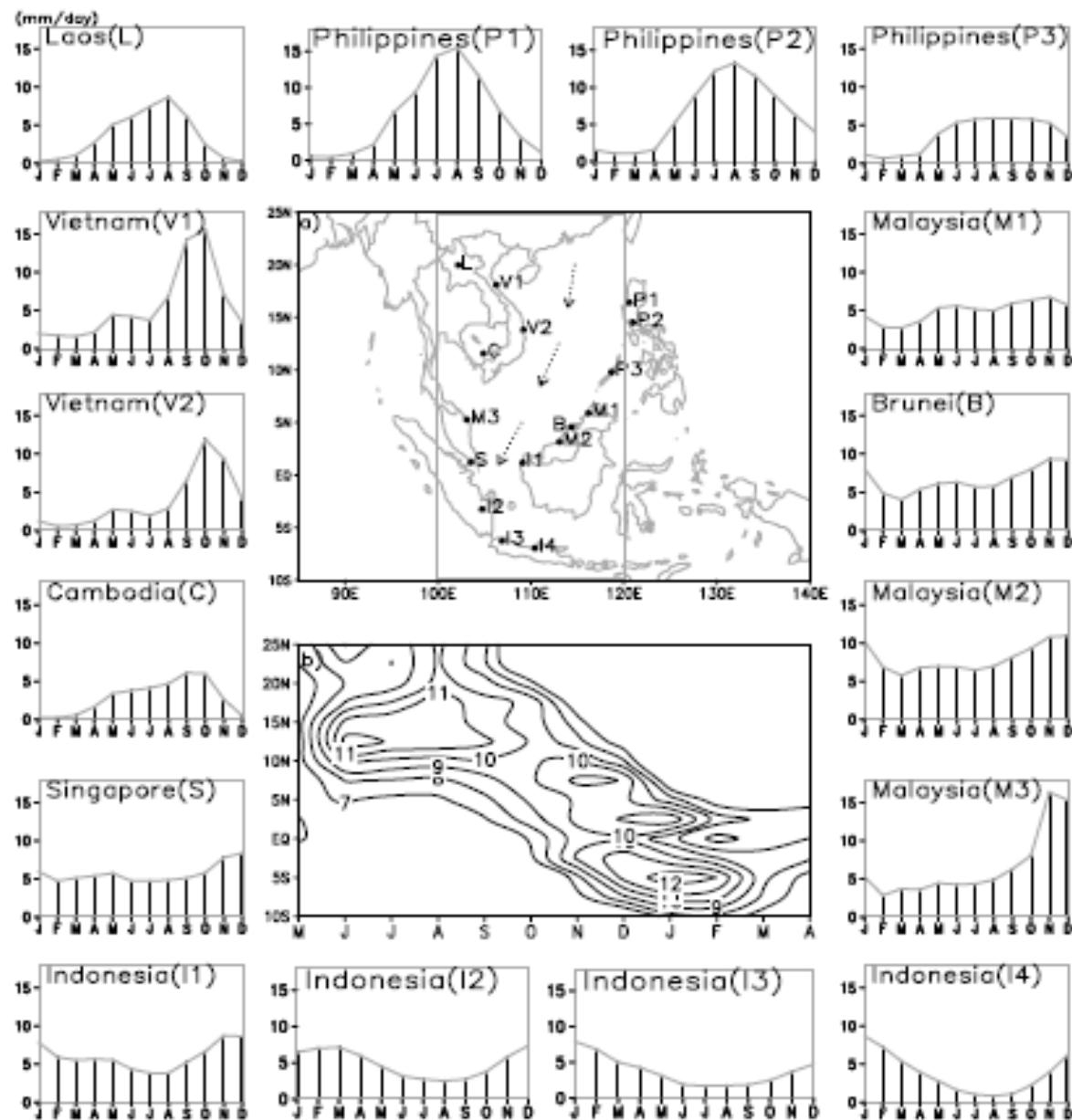


Fig.1. The rainfall clim. for the stations in ASEAN countries.

## 2. Data and Methodology

- APHRODITE, CMAP, 60 stations in Vietnam are used for land and ocean rainfall analysis.
- Use JRA-25, JRA-55, NCEP-DOE, ERA-Interim to detect and confirm the existence of vortices; the IBTrACS tropical cyclone data to locate TCs from vortices.
- To explore non-TC vortices that are less mature than TCs and not recognised by IBTrACS, the Nguyen and Walsh (2001) criteria are used..
- The 500km-radius criteria is used to determine the vortex-induced rainfall (VR) and IBTrACS tropical cyclone-induced rainfall (TR) days.

# Key findings (2)

## • Seasonal evolution of Vortices

-Fig. 2 shows: the average SMV's location migrates north-south across the region, passing two stations named Hoang-Sa and Truong-Sa, from summer to winter.

-The averaged probability of the existence of vortices in the region varies by season, rising from a minimum of about 20% in Apr-May, to 50% in Jun-Jul-Aug, 70% in Sep-Oct-Nov, and 85% in Dec-Jan-Feb-Mar.

-In Jun-Jul-Aug, the SMV's location is farthest north, about 21°N, extending zonally from the Gulf of Tonkin to the Hoang-Sa station, central North Southeast Asian Sea. About three months later, its mean position is close to the Truong-Sa station, central coast of Vietnam; during this time the SMV can be formed as far south as Borneo Island. In winter the SMV mean position is around the Borneo island.

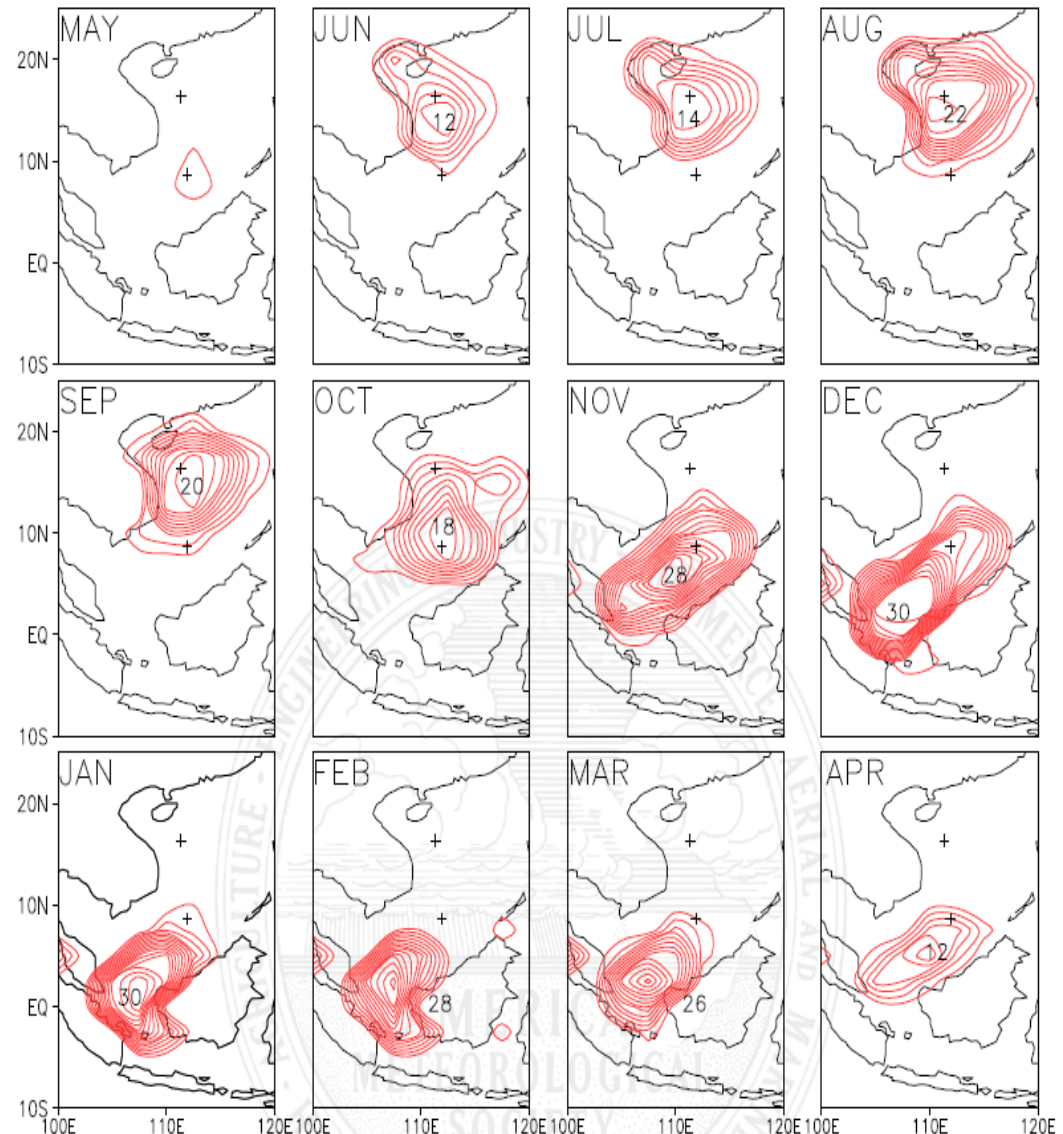


Fig. 2: Monthly occurrence of vortices in 1979-2010. Contours: nb of vortices in each month, interval of 2. North and South plus (+) signs indicate Hoang-Sa and Truong-Sa stations.



# Key findings

- **The presence of Southeast Asian – Maritime Vortices (SMV).**

-**Noted that** vortices in Fig. 2 consist of not only those forming and moving inside the SEAMC region, but also TCs coming into the region from the Northwestern Pacific

-To confirm the existence of semi-permanent vortices, we **remove all TCs identified** in the IBTrACS database from the set of daily vortex occurrences and reassess the remaining vortices.

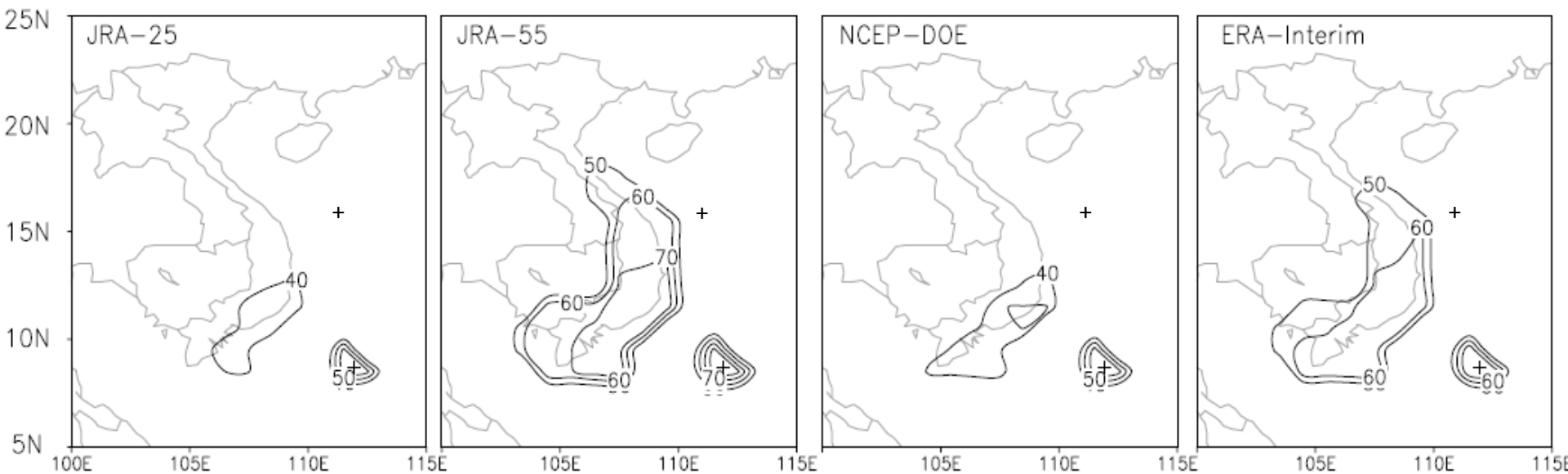


Fig. 3: Vortex-induced rain (**VR**) days after extracted tropical cyclone-induced rain (TR) days, as a percentage of the total (11680) number of days in 32-year record (1979-2010). Contour interval: 10%. Only regions that have  $VR \geq 40\%$  are displayed. The plus (+) signs assigned Hoang-Sa (north) and Truong-Sa (south) island stations.

-Both four reanalysis datasets display the highest and most consistent frequency of rain days around the southern coast of central Vietnam. The number of VR days varies from about 50% in JRA-25 (equivalent to 5840 days of the total 11680 days in 1979-2010) to 80% in JRA-55.

## Key findings

During 1979-2010 there are 334 TCs observed over the domain (3-25°N, 100-120°E). On average each TC lasts 3-5 days, therefore the maximum total IBTrACS tropical cyclone-induced rainfall days over the region is about 1000-2300 days, equivalent to only 10-20% of identified VR days in total.

Fig. 3 depicts the VR days after the typhoon induced rainfall days were removed from each reanalysis data set. There are reductions of up to approximately 20%, but the patterns remain the same in all reanalysis datasets.

**=> Clear evidence is found for the presence of a permanent vortex over the Southeast Asian Sea – Maritime Continent region.**



- In The Southeast Asian Sea – Maritime Continent vortices have been named as Equatorial Vortex/Disturbance, Borneo vortex, Tropical Depression-Type Disturbance, and Cold Surge vortex. The analysis presented here shows the existence of vortices through the whole seasonal cycle and over the full latitude range of the SEAMC region. **It suggests that this phenomenon could be more accurately known as the SMV.**
- The SMV **first appears** in coastal North Vietnam - West Philippines in summer, **moving southward** during autumn, reaching Singapore-Borneo in winter, and **stays around** the Borneo region into spring until a new yearly cycle comes again in summer. The frequency of the SMV occurrence is highest in winter and then decreases gradually in summer, autumn, and spring, correspondingly. **This annual variation aligns well with the picture of the seasonal onset of rainfall over the region.**

# Next steps ...

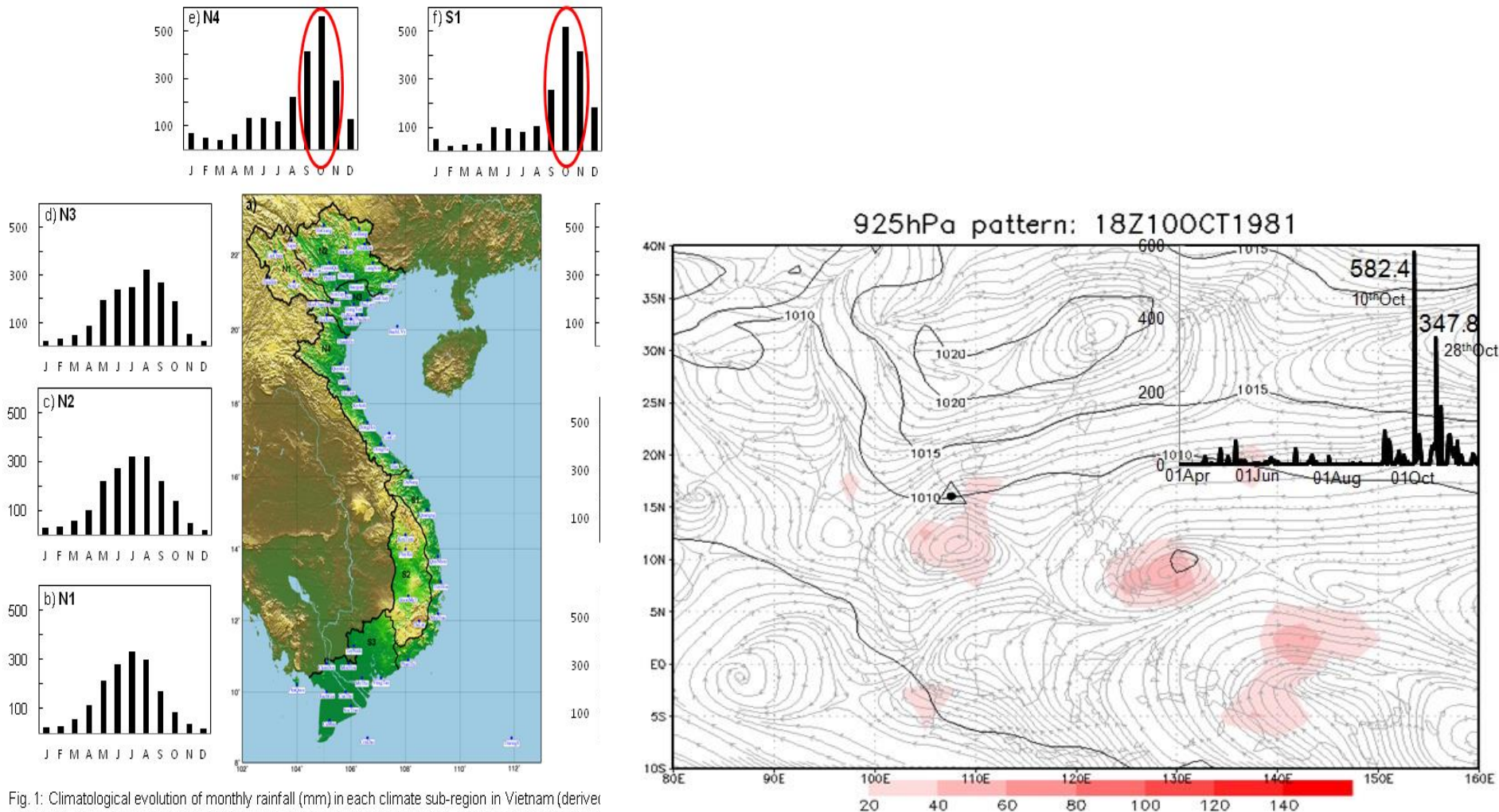


Fig. 1: Climatological evolution of monthly rainfall (mm) in each climate sub-region in Vietnam (derived from N4 and S1 is the coastal region that has the late rainy season till November. IS is the Truong-Sa station).

A study on Contribution of a Tropical Vortices to the Rainy Season in Viet Nam and Southeast Asian countries – **Welcome to join to build and submit proposals somewhere!!!**