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# MODERNIZING GEODETIC INFRASTRUCTURE FOR THE FOURTH INDUSTRIAL REVOLUTION IN VIETNAM

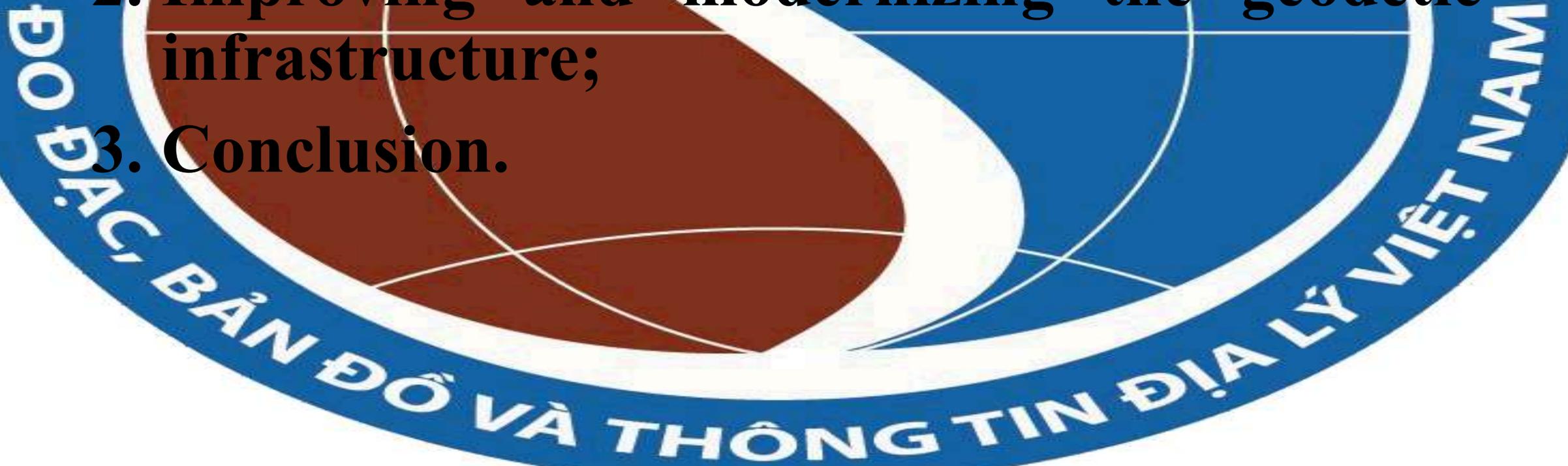
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My presentation consists of 3 parts

- 1. Current situation of the geodetic infrastructure of Vietnam;**
- 2. Improving and modernizing the geodetic infrastructure;**
- 3. Conclusion.**



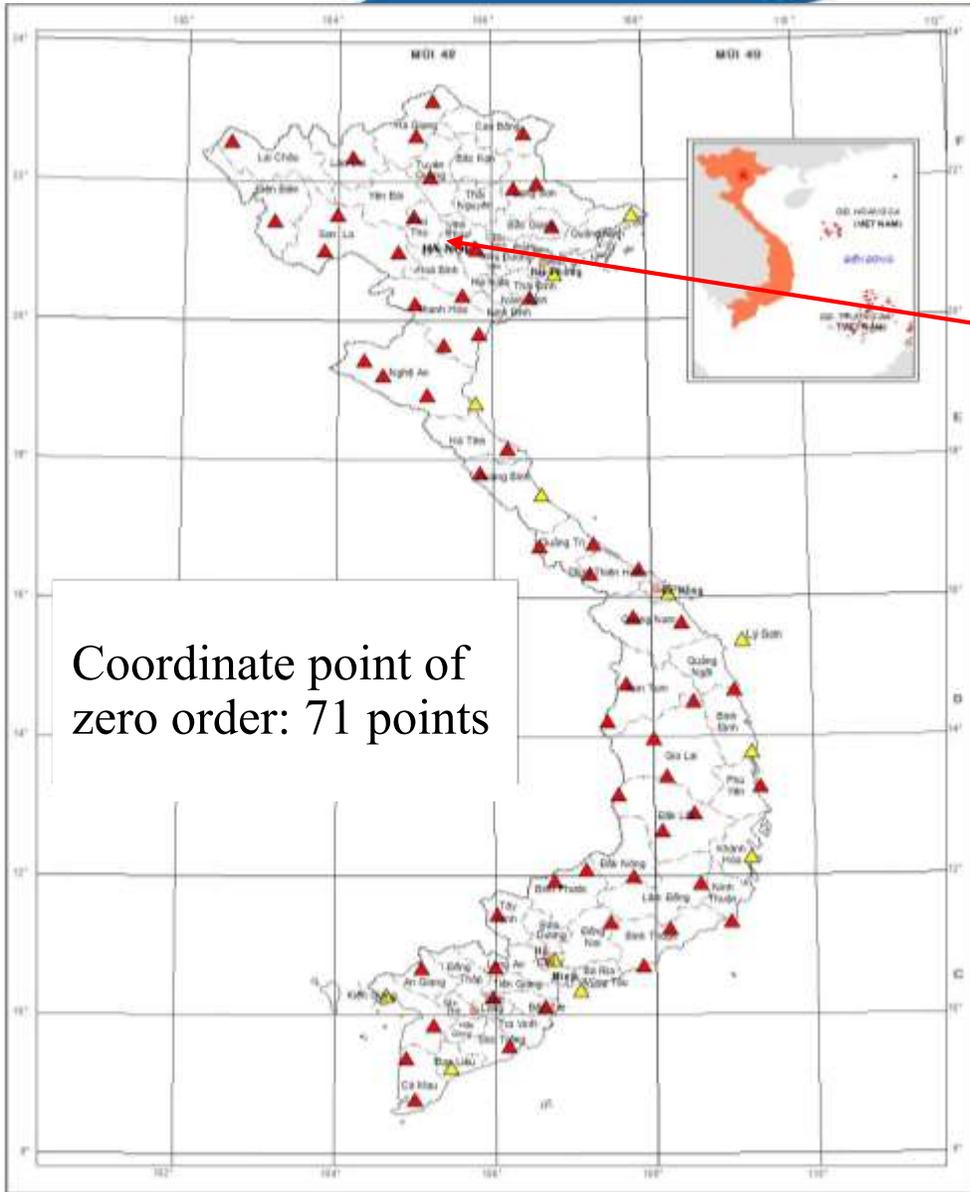
# I. Current situation of the geodetic infrastructure of Vietnam

## I.1. The national coordinate system

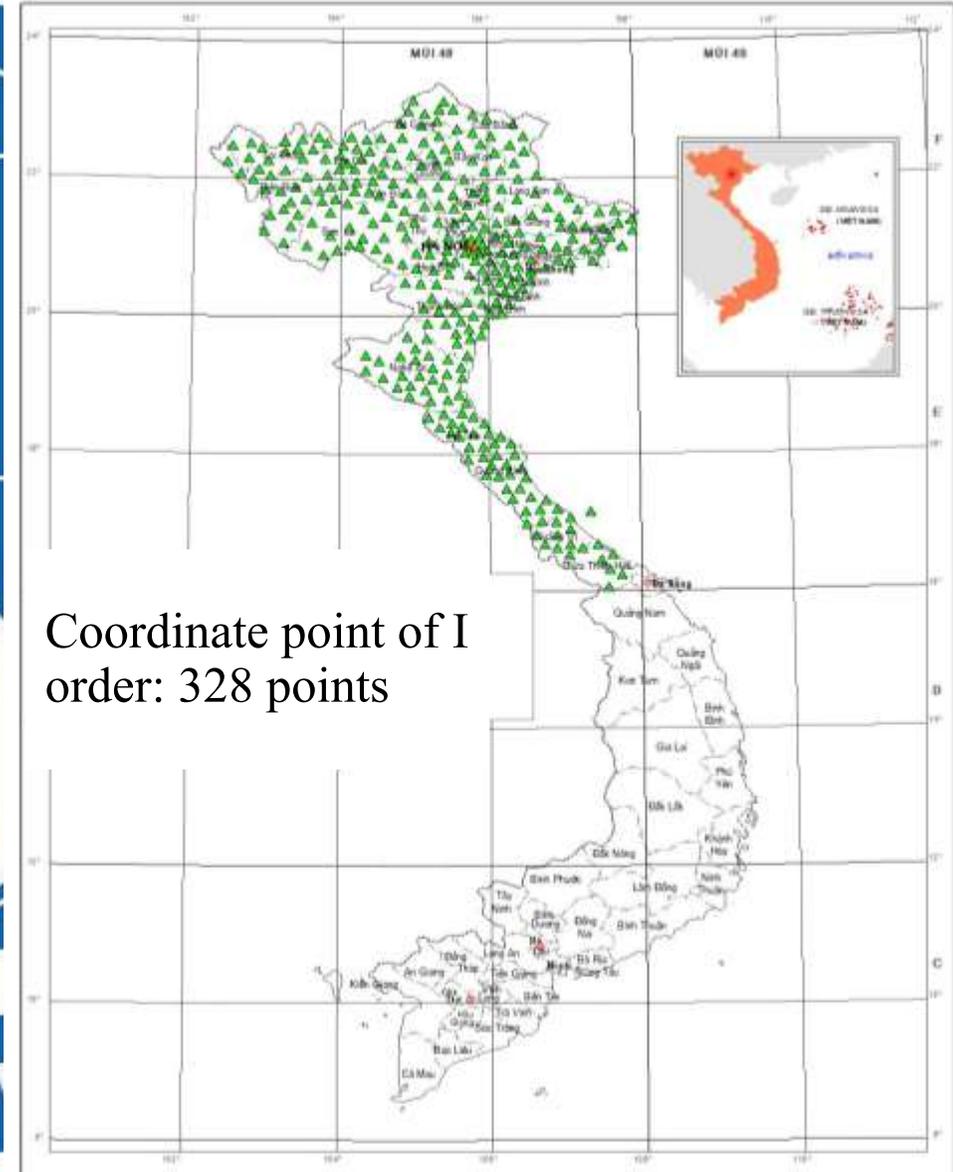
- Included 4 networks: zero, I, II and III order;
- Began to develop from the 1960 and completed in the last years of the 20th-century;
- National coordinate system called VN-2000 and used uniformly in whole country from 2000;
- Some main parameter of the VN-2000:
  - Ellipsoid: WGS-84 positioned consistent with Vietnam's territory;
  - The National origin coordinate point: N00 Point set in the Campus of Department of Survey, mapping and Geo-information of Vietnam.
  - The coordinate system: Universal transverse Mercator (UTM)
- Total points of coordinate system: 14.234 points.

# Diagram of National Coordinate Network

## a. National Coordinate Network of zero Order



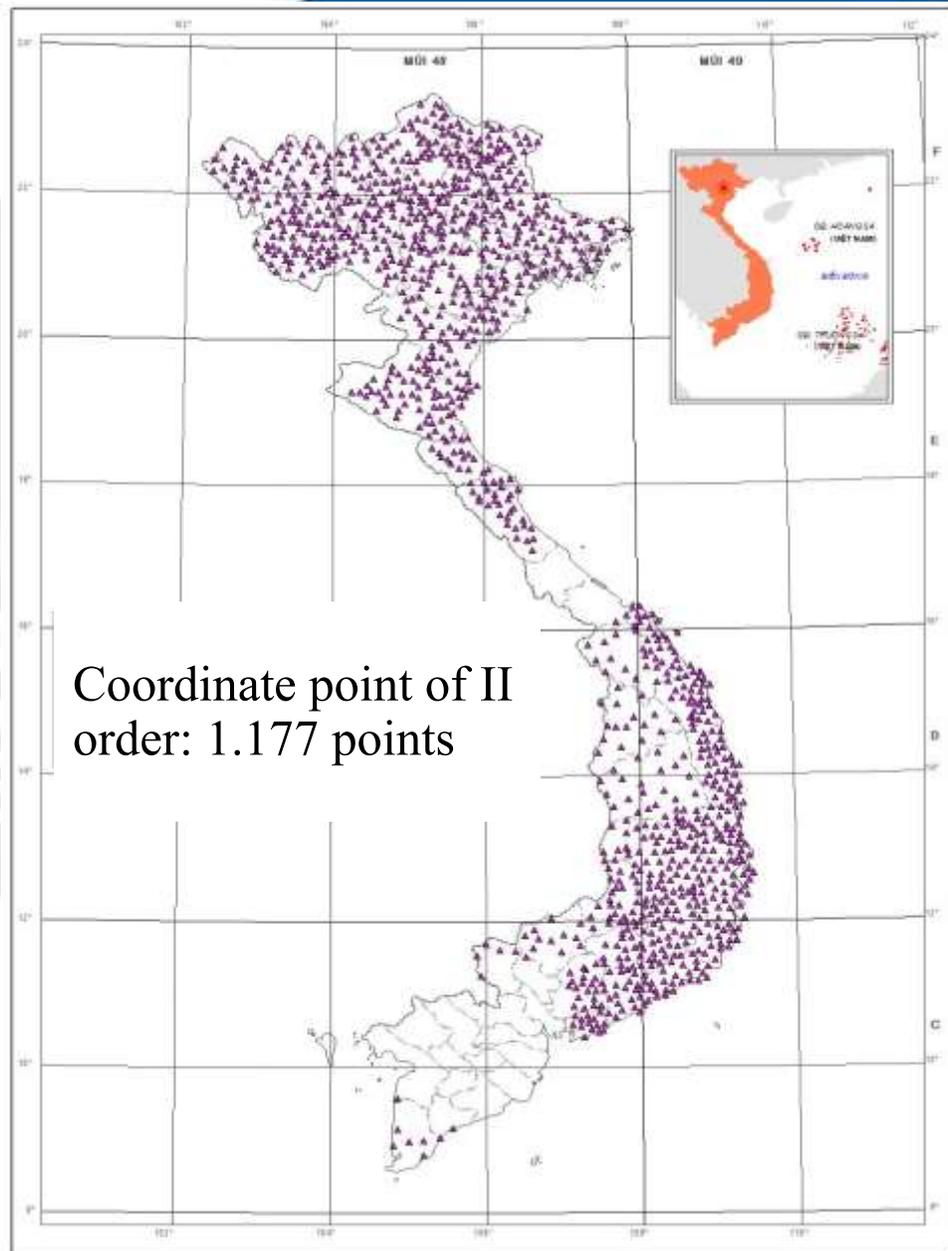
## b. National Coordinate Network of I Order



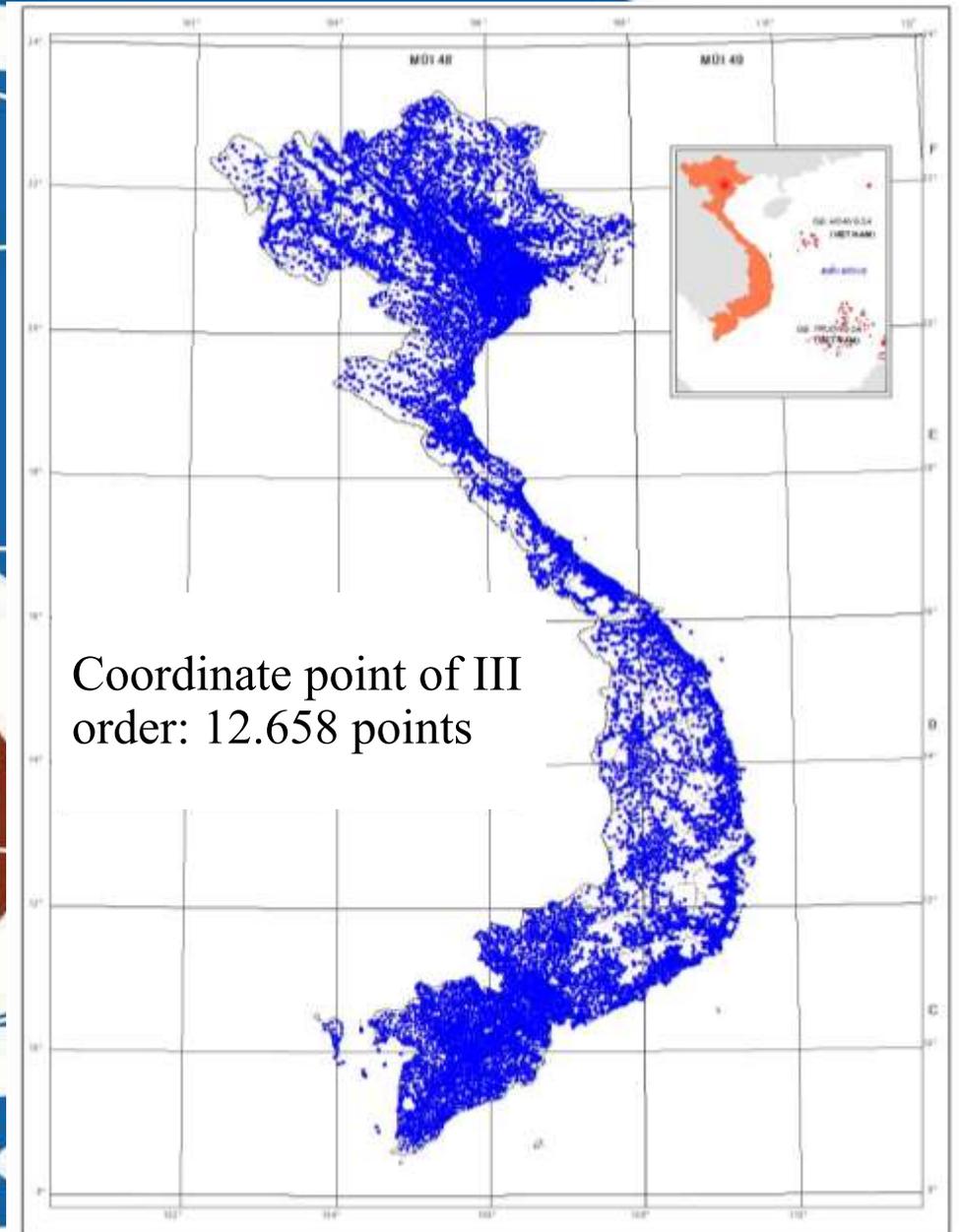
**N00 point in DOSMVN**

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### c. National Coordinate Network of II Order



### d. National Coordinate Network of III Order

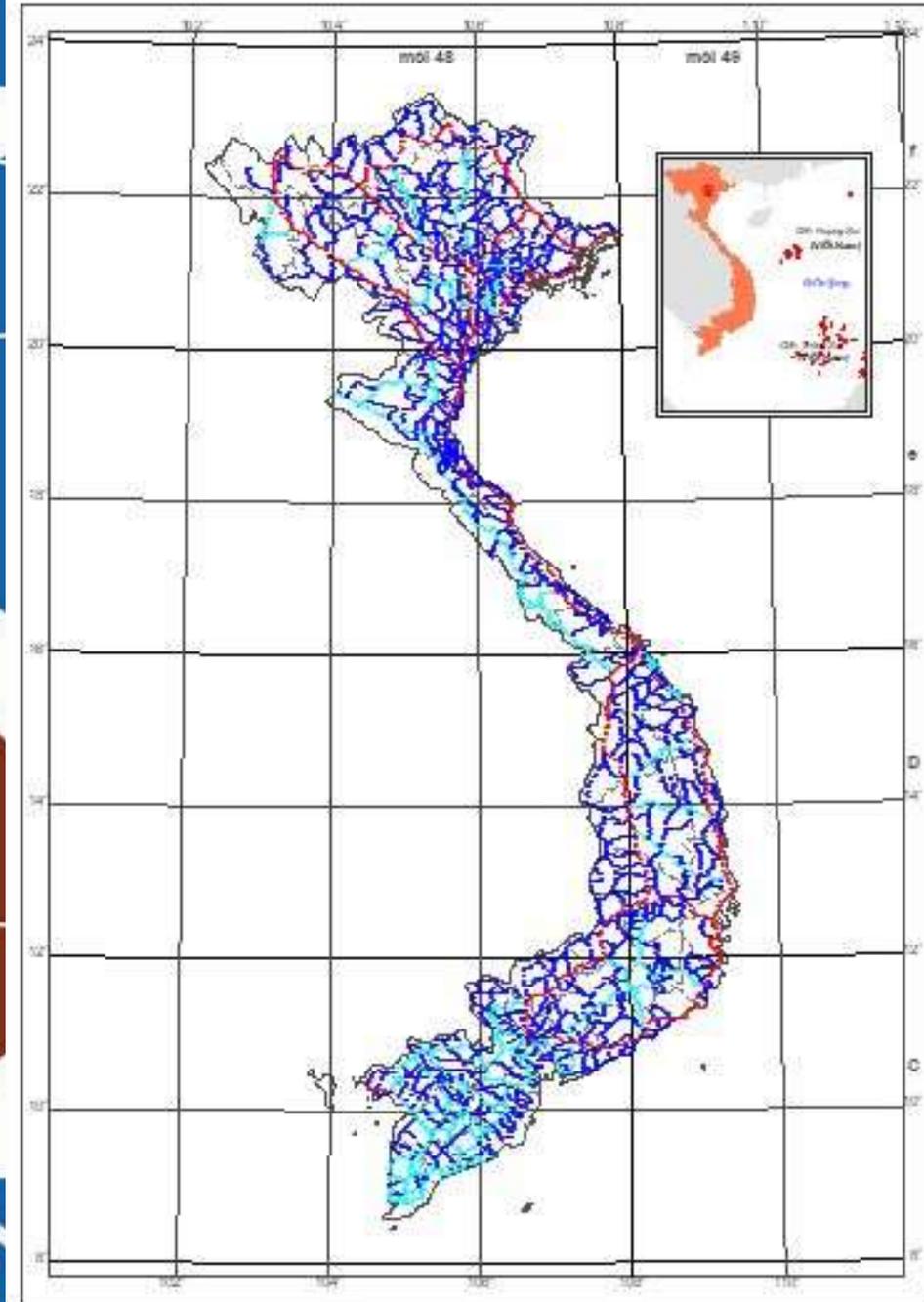


## **I.2. The national height system**

- Included 3 networks: I, II and III order;
- Began to develop from 1959 to 2008;
- National height system is called Hon Dau, Hai Phong and is used uniformly in whole country since 1992;
- National origin height point located in Do Son, Hai Phong;
- The “0” value of height system was determined by using the observation data of tide at Hon Dau island (near Do Son, Hai Phong) in period from 1950 – 1992.
- Total points of height system: 6.931 points.

## Diagram of National height networks of I, II, III Order

- Height point of I order: 1.211 points
- Height point of II order: 1.119 points
- Height point of III order: 4.601 points



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## Geoid model

- Geoid model established in 2011 base on EGM2008, 1.038 GPS-leveling points and about 30.000 detail gravity points, which distributed in plains and midlands (~55% of mainland) with standard grid 3' x 3'.
- Geoid model is used to determine height by GNSS technology on whole country since 2012.
- Accuracy of geoid model: 8 cm for the Plains, 20 cm for the Midlands.

# Current situation of coordinate and height marks in the field

- Due to historical reasons, almost of coordinate and height marks were set up in mountain, low land, farm, belongs to transportation system... about 35% of marks lost, subsidence or damaged.



Total marks surveyed: 2330

Lost and damaged marks: 810 ~ 35%

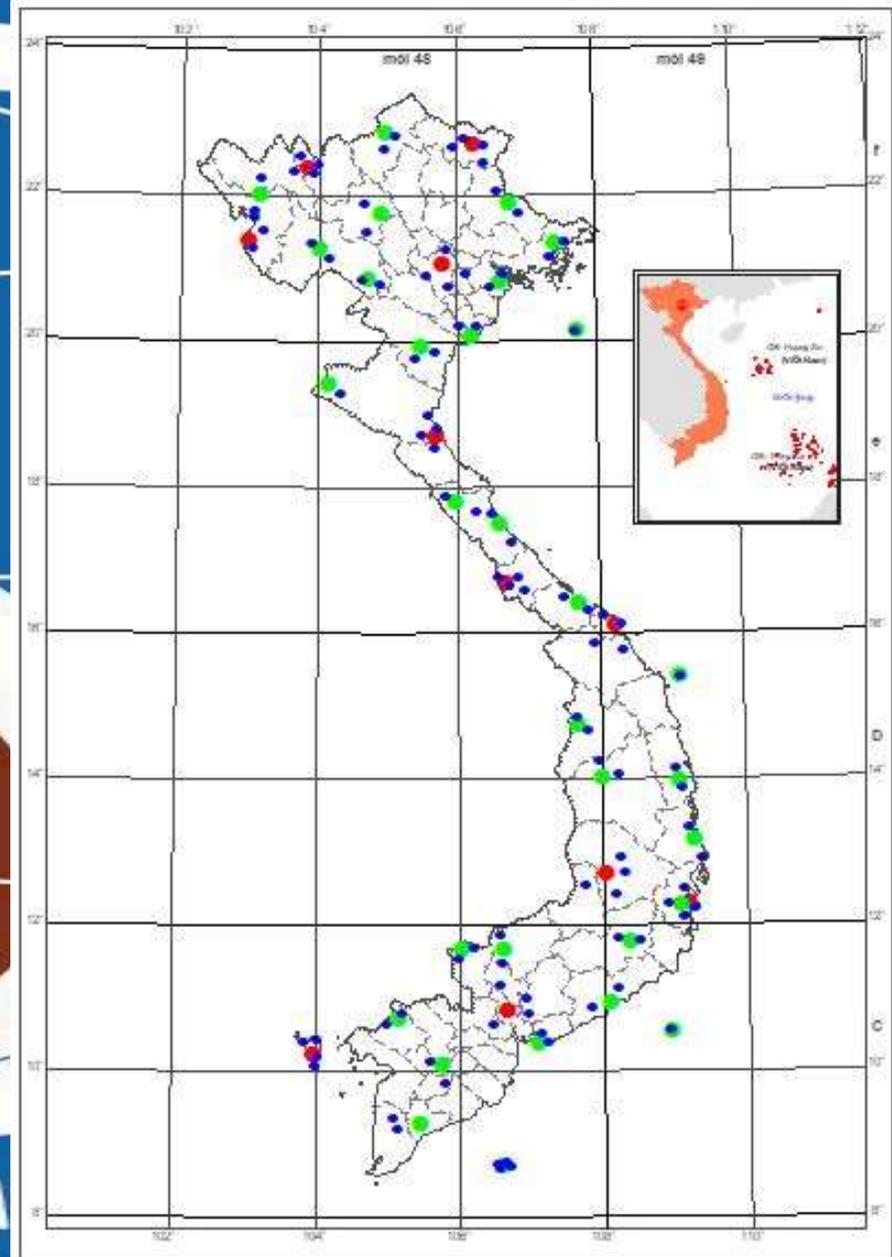
Remain marks: 1520 ~ 65%

### **I.3. The national gravity system**

- Included 3 networks: basic, I, II order;
- Began to develop since 1973 and was completed in period from 2003 to 2011;
- National original gravity point located in address 108, Chua Lang street, Ha Noi;
- Total points of gravity system: 148 points.
- Accuracy of basic gravity points  $\pm 5 \mu\text{Gal}$ ; I order  $\pm 10\text{-}14 \mu\text{Gal}$ ; II order  $\pm 30 \mu\text{Gal}$ .

# Diagram of National gravity system (2003 -2011)

- Gravity point of basic order: 11 points
- Gravity point of I order: 31 points
- Gravity point of II order: 106 points



## I.4. Satellite navigation system

### *DGPS stations:*

- Build in the period 1996 to 2008;
- 3 GNSS permanent stations in Do Son, Vung Tau and Quang Nam for navigation and sea survey;
- 3 stations in Dien Bien, Ha Giang and Cao Bang for demarcation of Vietnam-China boundary on the Mainland.

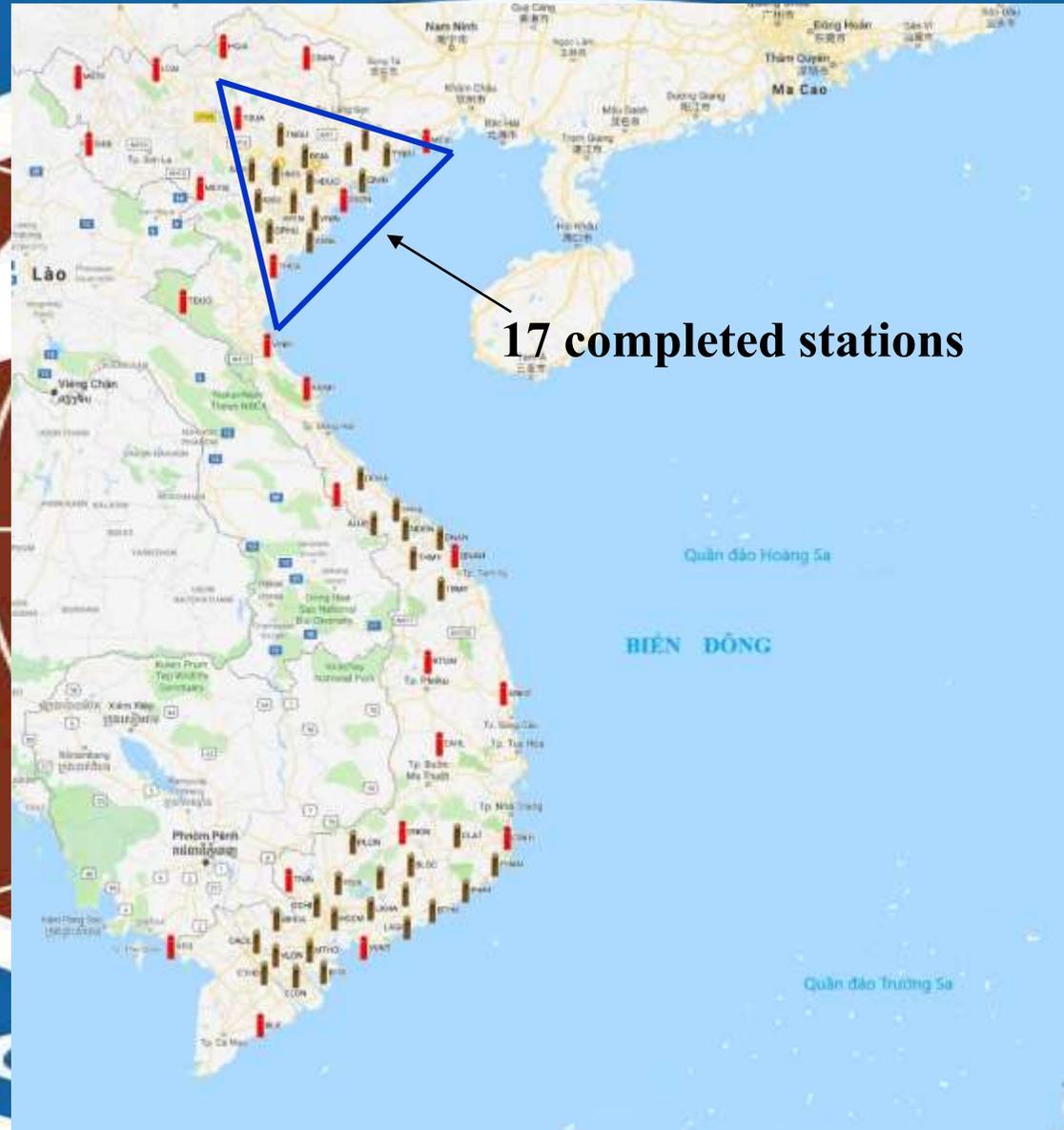


## ***Continuous Operating Reference Station (CORS) - VNGEONET:***

- **Phase 1: 65 stations including 24 geodetic CORS, 41 NRTK CORS**
  - Started to build in 2016 and expect to finish in the end of 2019;
  - Distance between NRTK CORS stations is 50-80 km; between Geodetic CORS stations is 150-200 km;
  - Average depth of 24 marks of geodetic CORS is 44m;
  - 37 marks of NRTK CORS have solid concrete base with the size 1,5m x 1,5m x 2,8m;
  - 4 marks of NRTK CORS located on the roof;
  - Up to now completed 17 stations in the northern provinces;
  - CORS characteristics:
    - + Using technology and software of Leica;
    - + Coordinate accuracy 2-4 cm; height accuracy 7-10 cm for the plain areas and 15-20 cm for the mountains.

# National CORS network – VNGEONET (Phase 1)

- Geodetic CORS
- NRTK CORS



# Process of building geodetic CORS mark (pictures 1-6)





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# Process of building NRTK CORS (pictures 7-9)



# Completed CORS

10



Geodetic CORS Do Son

11



NRTK CORS Ba Vi

12



NRTK CORS Dinh Lap

13



NRTK CORS Ha Noi  
(DOSMVN)

## Servers of Control Center in DOSMVN



## Screens of Control Center



## CORS equipment box in the field



# II. Improving and modernizing the geodetic infrastructure

## II.1. The necessary:

- For building e-Government, e-Economy, smart cities;
- For national development planning;
- For promoting application of the fourth industrial revolution;
- For responding climate change, sea level rise and environment protection;

## II.2. Main objectives:

Build the modern, precision geodetic infrastructure, which will be a platform to collect, process and build national geospatial data in uniform system;

## II.3. Expectation Results:

- Build and announce data system of national geodetic origins, national coordinate system, national height system (including geoid model) and national gravity system;
- Announce parameter of transfer between national coordinate system and international coordinate system (WGS 84; ITRF...)

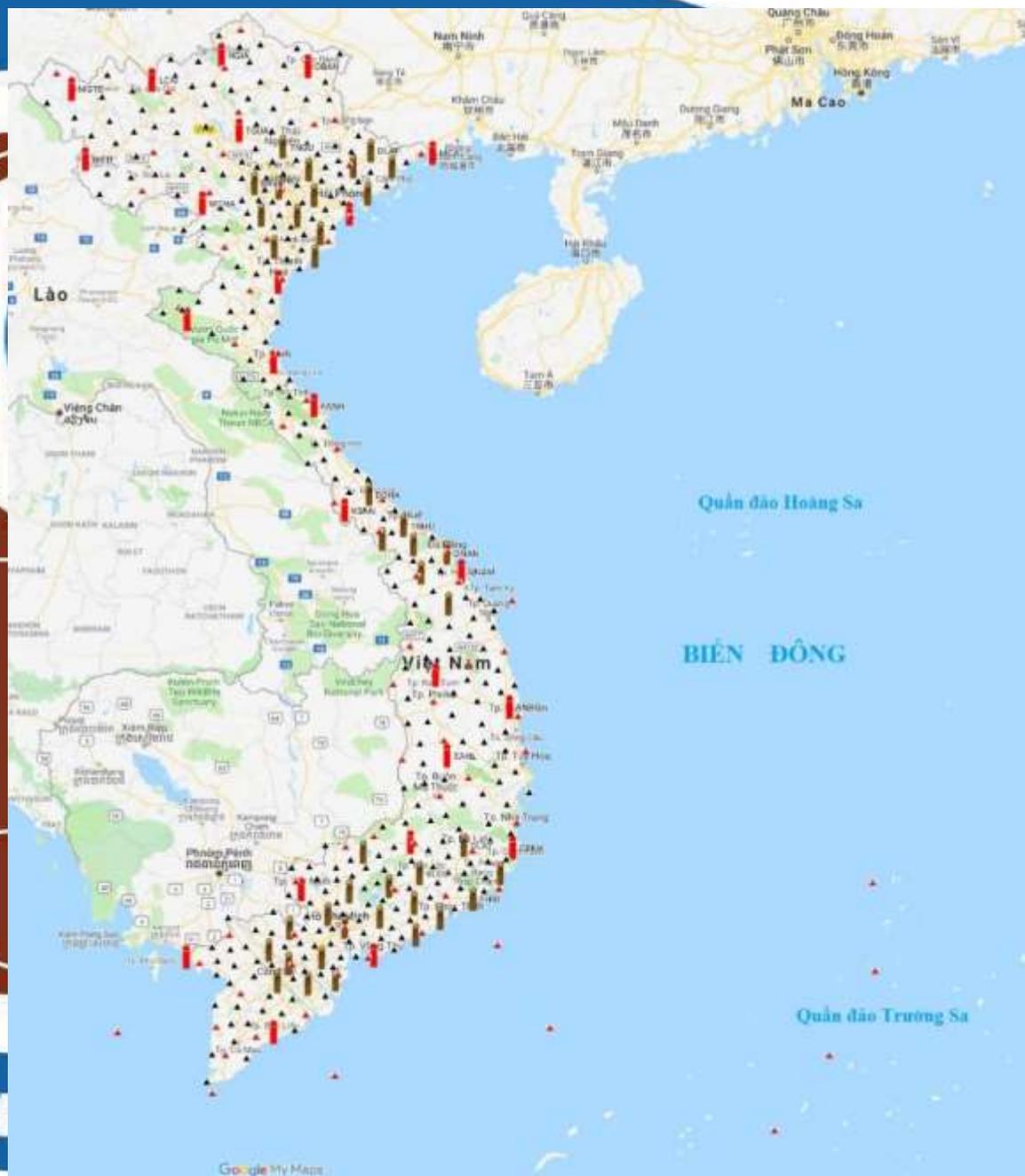
## II.4. The main content:

### *a) Improve and modernize the national coordinate system*

- Improve and modernize the national 3D dynamic coordinate system base on VN2000 system using GNSS technology;
- Decrease the number of marks on the field (remain 500-550);
- Modern national coordinate system consists of stations in VNGEONET; 71 coordinate points of zero order, some coordinate points of I, II order of VN2000;
- Distance between points in national coordinate system about 30km;
- Connect with international coordinate systems.

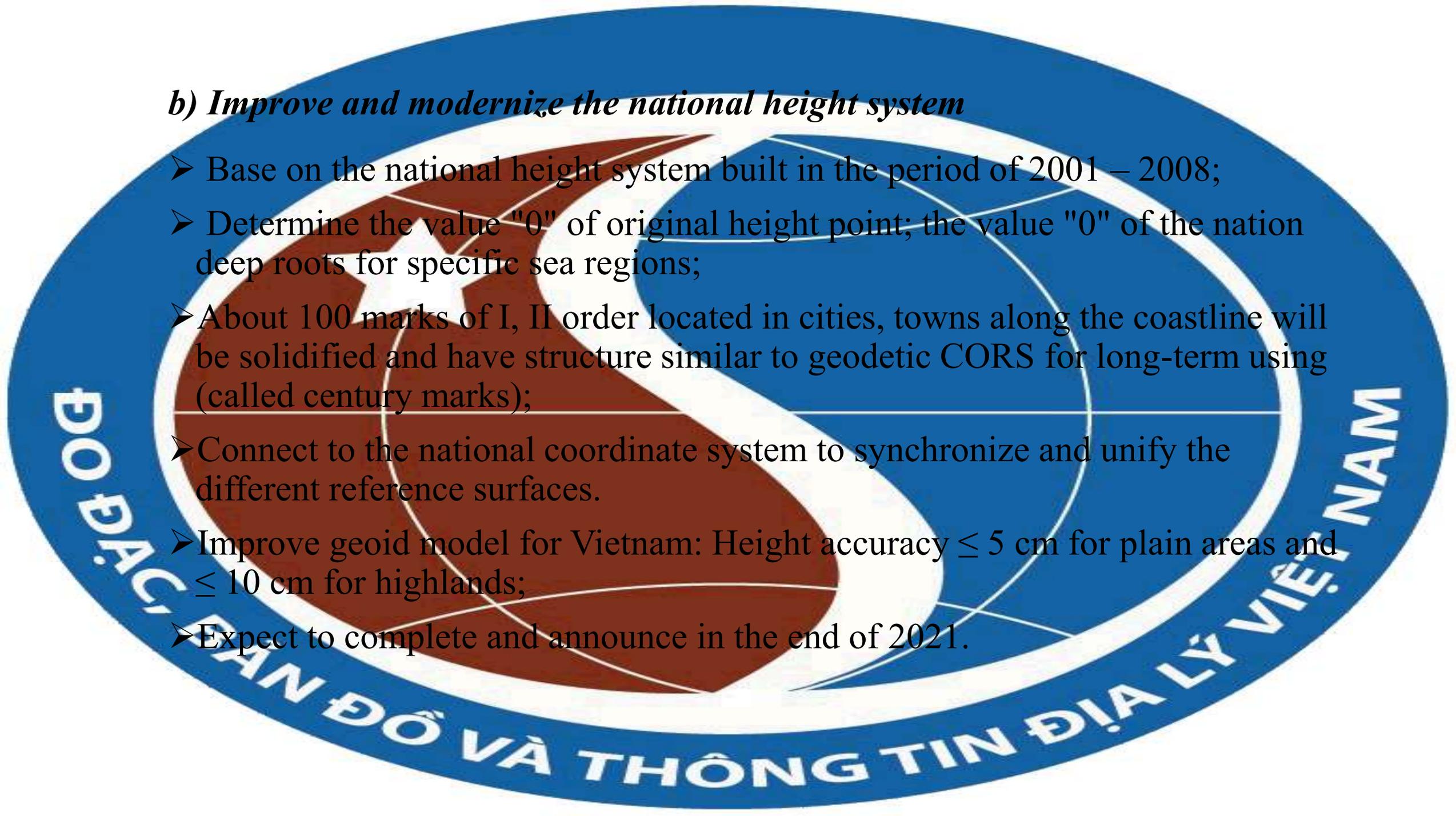
# Diagram of the National 3D dynamic coordinate system

- Geodetic CORS
- NRTK CORS
- ▲ Coordinate point of zero order
- ▲ Coordinate point of I, II order



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VIỆT NAM

The logo is a large blue oval with a white border. Inside the oval, there is a stylized map of Vietnam in white and red. The text "TRUNG ƯƠNG" is written vertically on the left side, and "VIỆT NAM" is written vertically on the right side. At the bottom, the text "TRUNG ƯƠNG VÀ THÔNG TIN ĐỊA LÝ VIỆT NAM" is written horizontally.

***b) Improve and modernize the national height system***

- Base on the national height system built in the period of 2001 – 2008;
- Determine the value "0" of original height point; the value "0" of the nation deep roots for specific sea regions;
- About 100 marks of I, II order located in cities, towns along the coastline will be solidified and have structure similar to geodetic CORS for long-term using (called century marks);
- Connect to the national coordinate system to synchronize and unify the different reference surfaces.
- Improve geoid model for Vietnam: Height accuracy  $\leq 5$  cm for plain areas and  $\leq 10$  cm for highlands;
- Expect to complete and announce in the end of 2021.

### ***c) Improve VNGEONET***

- Total of station in VNGEONET: 140-145 stations;
- Phase 1 of VNGEONET finish in the end of 2019 built 65 stations in Hanoi, Ho Chi Minh, northern delta, southern delta and central provinces;
- Phase 2: additional building of 75-80 NRTK CORS to ensure VNGEONET covering whole mainland and big islands of Vietnam, expect to complete in 2022;
- After 2022, all survey activities will be implemented using VNGEONET.

### III. Conclusion

- Improving and modernizing the geodetic infrastructure in Vietnam today is an important and urgent task for the country's development requirements.
- Modernization should be developed at the same time and sync, to ensure surveying and mapping industry of Vietnam to reach the level of advanced countries in the region.
- Contents of improvement and modernization of the geodetic infrastructure in Vietnam are necessary, feasible, has science-based and in accordance with practice.
- Importance to implement the provisions of the Law on Survey and mapping./.



**THANK YOU  
FOR YOUR ATTENTION!**