# RAS-NASA cooperation (ESJWG) on Space Geodesy techniques application for the Natural Hazards monitoring and prevention

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**RF –USA Workshop on Geo-Disaster Risk Reduction in the Northern Asia-Pacific Region**
**Moscow , 17-19 July, 2012**

# RAS –NASA cooperation in SOLID EARTH STUDIES AND SPACE GEODESY

- Current RAS-NASA agreement covers the cooperation in Space Geodetic Science applications to Climate Change and natural hazards research. The main objectives of this cooperation are:
- Collaboration to strengthen the Global Geodetic Observing System's (GGOS) with the use of ground stations in Russia.
- Upgrading of the existing Russian networks: GNSS, NEDA, Quasar and SLR.
- Strengthen scientific exchange.
- Explore cooperation on coordinated Earth Observation Strategies including SAR, Gravity, Geomagnetics for Geohazards studies, such as Voulcanous erruptions and Crustal deformations.

- **At the last meeting of the Earth's Sciences NASA-RAS Joint WG in 2004, the new item of the joint Program has been discussed:**

**•Establish and strongly support Asia-Pacific Natural Hazard Laboratory (APaNL)- as a component of the multinational Circum-Pacific geodetic monitoring network that could operate in real time.**

- **Given the peril of major volcanic eruptions on air traffic, and earthquakes associated tsunamis- such a circum Pacific network would be critical.**
- **China, Japan, Canada, and the US have fairly advanced networks and a Russian network might be very effective under the A-PaNL.**

# RUSSIAN GNSS (GPS/GLONASS) NETWORK

# Project of enlarging of the Geodetic VLBI-Network «Quasar», collocation with other techniques. Modernization of the Ussurjisk 70 m antenna.(after 2011)

# Doris Beacon at the ”Quasar” Geodetic VLBI Observatory “Badary

**Frequency – 2036,25, Power in Pulse – 40 W**
**Frequency – 401,25, Power in Pulse – 20 W**
**Azimuth angle – 0-360°, Elevation angle – 0-70**

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# Recent crustal movements of Russian Far East as seen from GPS observations

Shanghai, August 18, 2010

# Participants of this work

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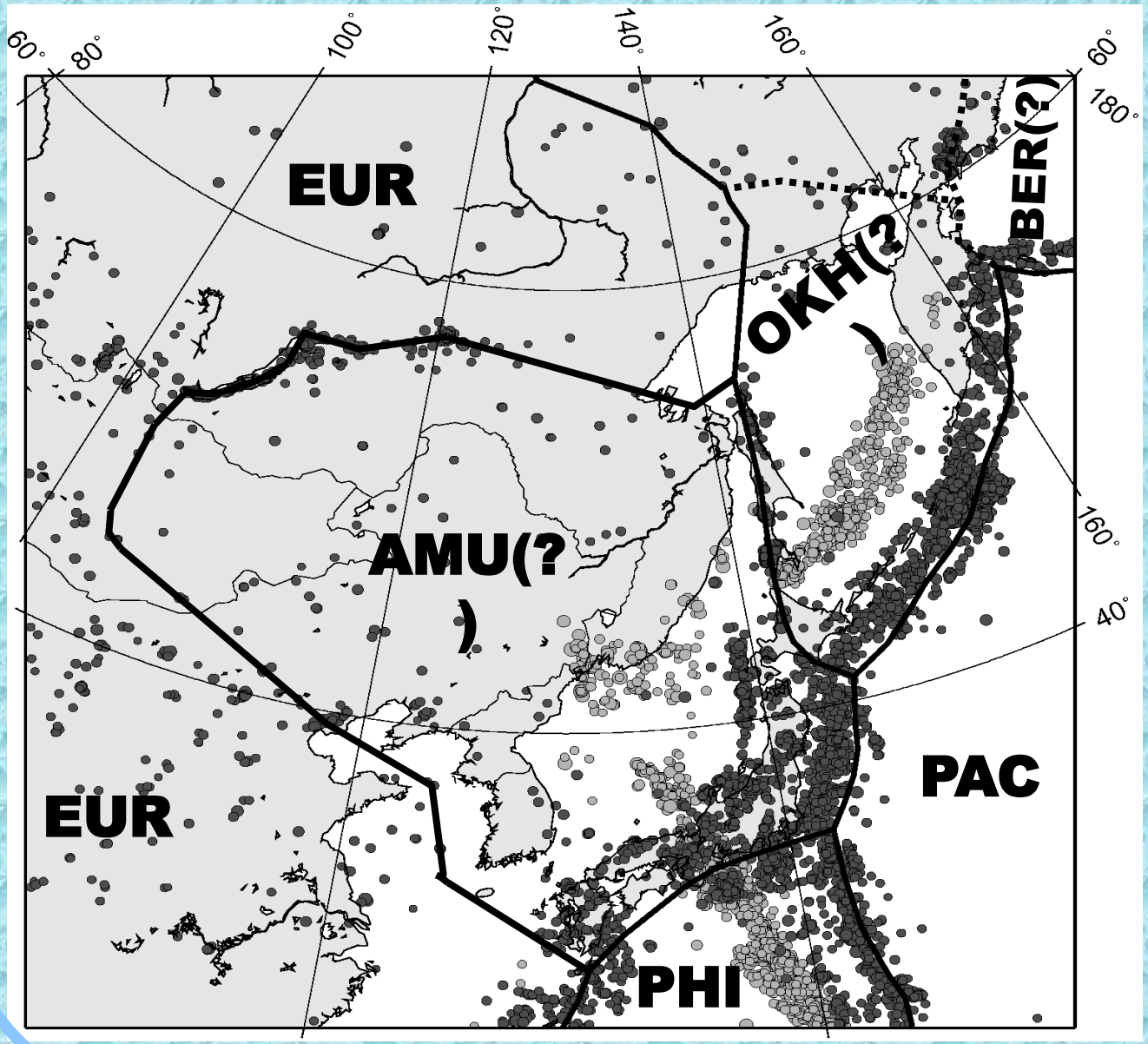
# Tectonic sketch of northeast Asia




**Russian Far East has a complicate geological structure and tectonics because of three tectonic plates (Eurasian – EUR, North American – NAM and Pacific – PAC) converge and the existence of several independent microplates (Okhotsk – OKH, Amurian – AMU and Bering – BER) is hypothesized here.**

**During the last 15 years GPS technique has been using for studying of the recent crustal velocities in this region.**

Legend:

**Epicenter locations for the earthquakes with M ≥ 4 and depth**:

- 0 ≤ H ≤ 30 km
- 300 ≤ H ≤ 700 km

# Types of geodynamic GPS observations

Three types of geodynamic GPS observations were carried out in Russian Far East since 1995:

- Continuous
- Semi-continuous
- Campaign (survey) mode

# Main characteristics of the deployed GNSS systems

**Equipment:**

- GNSS receivers Trimble NetR5 with internal power back up system
- GNSS antennas Zephyr Geodetic Mdl.2 without radomes

**Operation mode:**

- automatic continuous GNSS observations
- elevation mask 3°
- sampling rate 1 sec.
- 24-hours session

**Data storing and acquisition system:**

- 16-32Gb flash drive or hard disk connected to receiver

**GNSS data volume**

- Raw Trimble format, one 24-hours GNSS file ~19,5 Mb (~7 Gb per year)
- RINEX-format one 24-hours GNSS file ~110 Mb
- Comp. RINEX-format one 24-hours GNSS file ~12 Mb (~4.3 Gb per year)

# GPS data processing

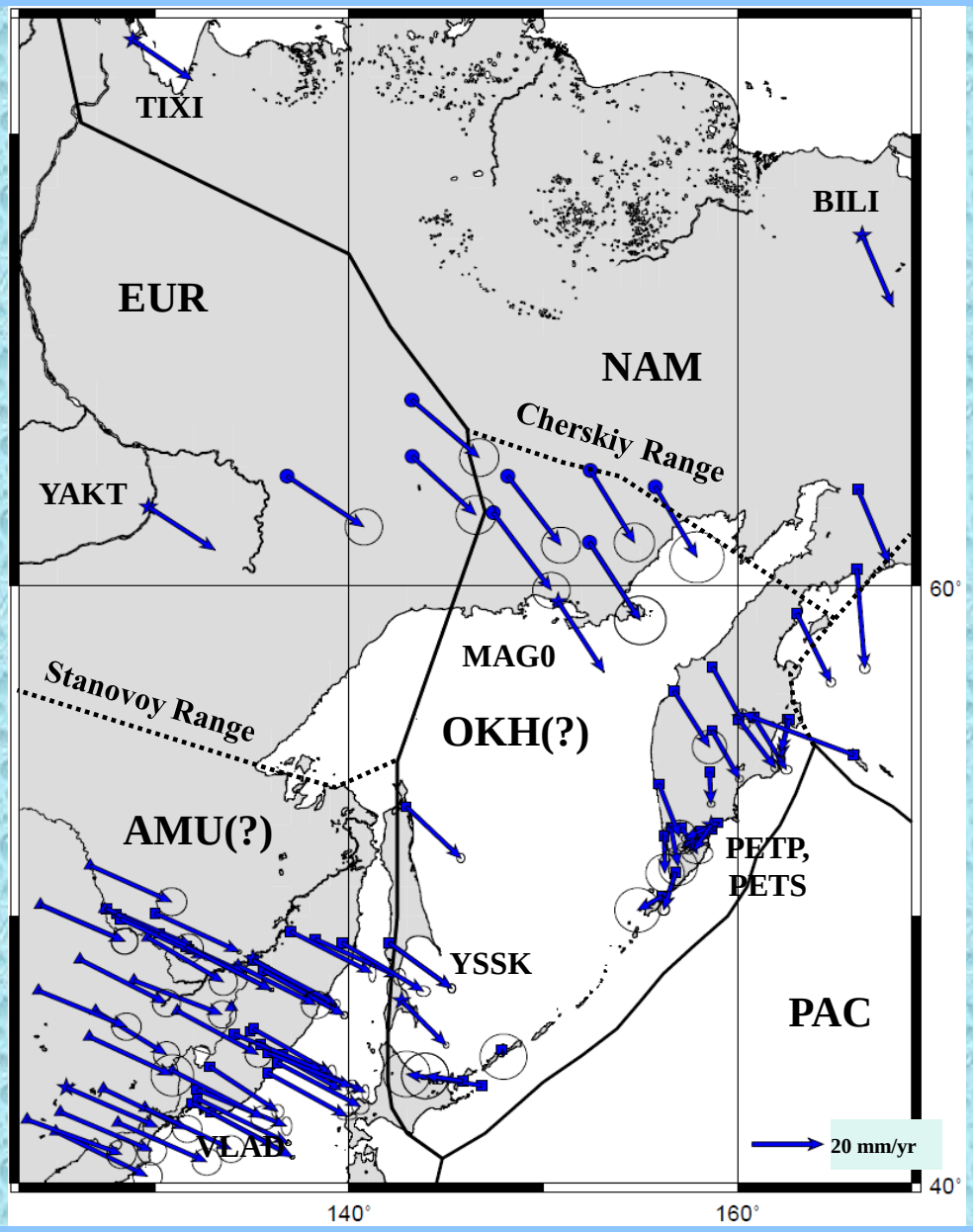
At present there are five Russian scientific groups which analyze geodynamic GPS data obtained by the Russian Far Eastern sites. They are working at:

- FENU&IAM FEB RAS, Vladivostok (BERNESE 5.0)
- KB GS RAS, Petropavlovsk-Kamchatsky (GAMIT/GLOBK)
- IPGG SB RAS, Novosibirsk (GAMIT/GLOBK)
- IEC SB RAS, Irkutsk (GAMIT/GLOBK)
- GS RAS, Obninsk (GAMIT/GLOBK)

# Conclusions

- **Recent crustal velocities of the northern part of the Russian Far East are defined by the NAM-plate rigid rotation (western part) and interaction with PAC-plate (eastern part).**
- **The GPS velocity field of Sakhalin Island demonstrates sub-latitudinal contraction and stress accumulation. The EUR-velocities are increasing from north (4 mm/yr) to south (8 mm/yr) of the island.**
- **There are GPS velocity boundary between continental part and Sakhalin Island.**
- **GPS velocities of the south-east of Russian Far East referenced to EUR are small enough (less than 5 mm/yr, a median value around 1 mm/yr) and are showing domination of the east component. They don't correspond perfectly to well-known AMU-microplate rigid rotation model.**

# ITRF2008 velocities of the Russian Far East



# On-going Projects in Support of A-PaNL:

- **New RAS geodynamic project:**
  **«Recent geodynamics, active geologic structures and natural hazards of Russian Far East» is realized now.**

- **NASA supports on-going satellite monitoring of volcanic eruptions using it ModVol software system for the MODIS optical sensors aboard the Terra and Aqua satellites in support of the A-PANL.**
  **NASA also supports the development of the Integration of Terra and Aqua Datasets Into the ASTER Urgent Request Protocol (URP) for the scheduling of ASTER acquisitions upon appropriate triggering data.**

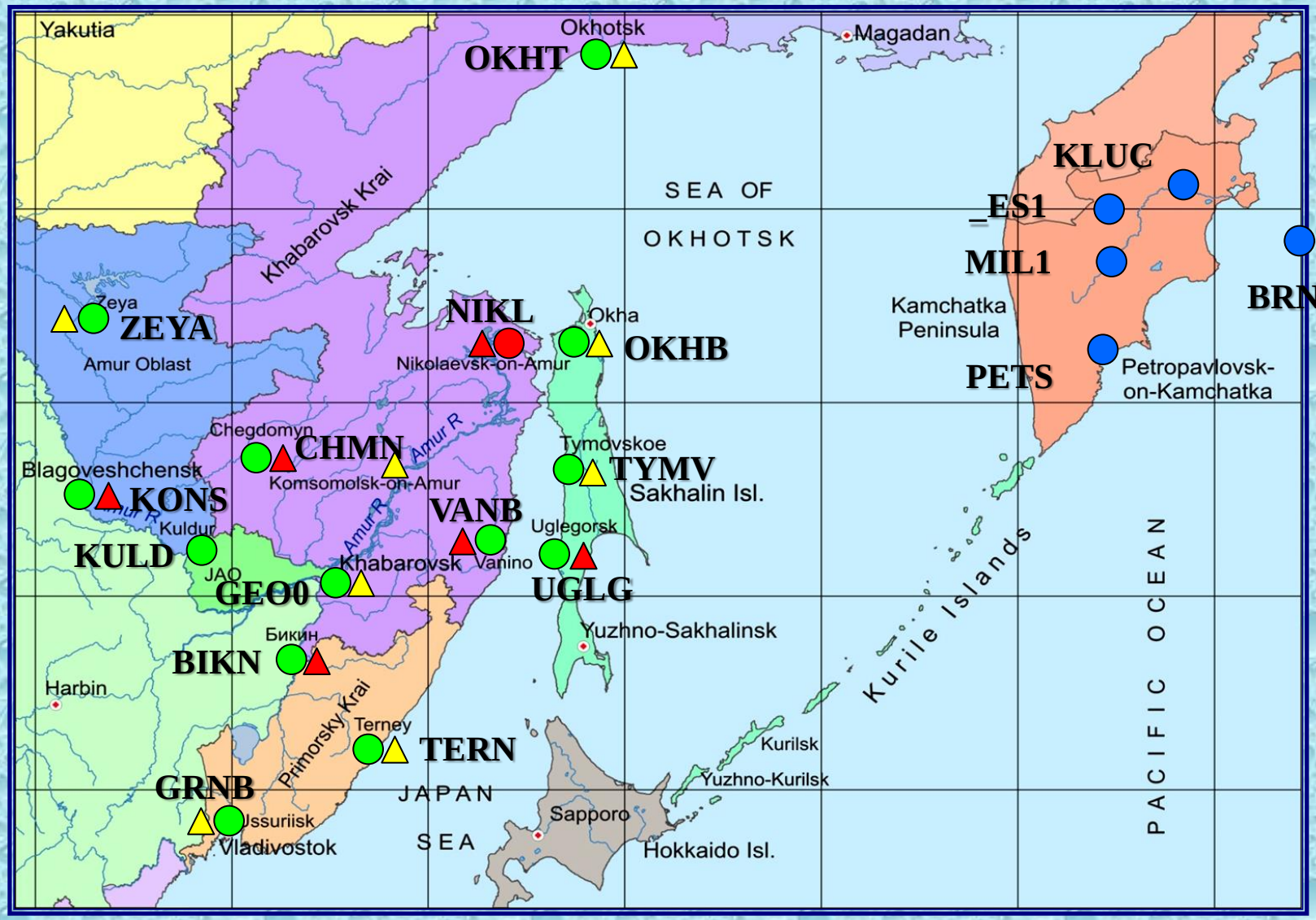
**NASA has provided regional topography at 90 meters resolution for the region from its Shuttle Radar Topography Mission and supports continued efforts to upgrade this data base from ASTER GDEM and other sources.**

**NASA supports the maintenance of the ASTER Volcano Archive data base (http://ava.jpl.nasa.gov) and rapid response program for the ASTER sensor aboard the Aqua satellite.**

**Future NASA-RAS A-PaNL activities:**

- **Via our newly established agreement, the RAS and NASA intend to advance the implementation of the A-PaNL with special attention to enhanced satellite, airborne, and GNSS ground network measurement efforts.**

# New FEB RAS geodynamic project: «Recent geodynamics, active geologic structures and natural hazards of Russian Far East»




△ - Seismic station **DATAMARK** ▲ - Seismic station **REFTEK** ● - **GNSS** station ● - KAMNET GPS station

# Location of the newly deployed GNSS network in Russian Far East with respect to the previously done GPS observations