

Re-establishment of the PNG94 geodetic datum and vertical reference system in the Papua New Guinea oilfields

after the Mw 7.5 earthquake on 26th
February 2018

Richard Stanaway

School of Civil and Environmental Engineering

University of New South Wales



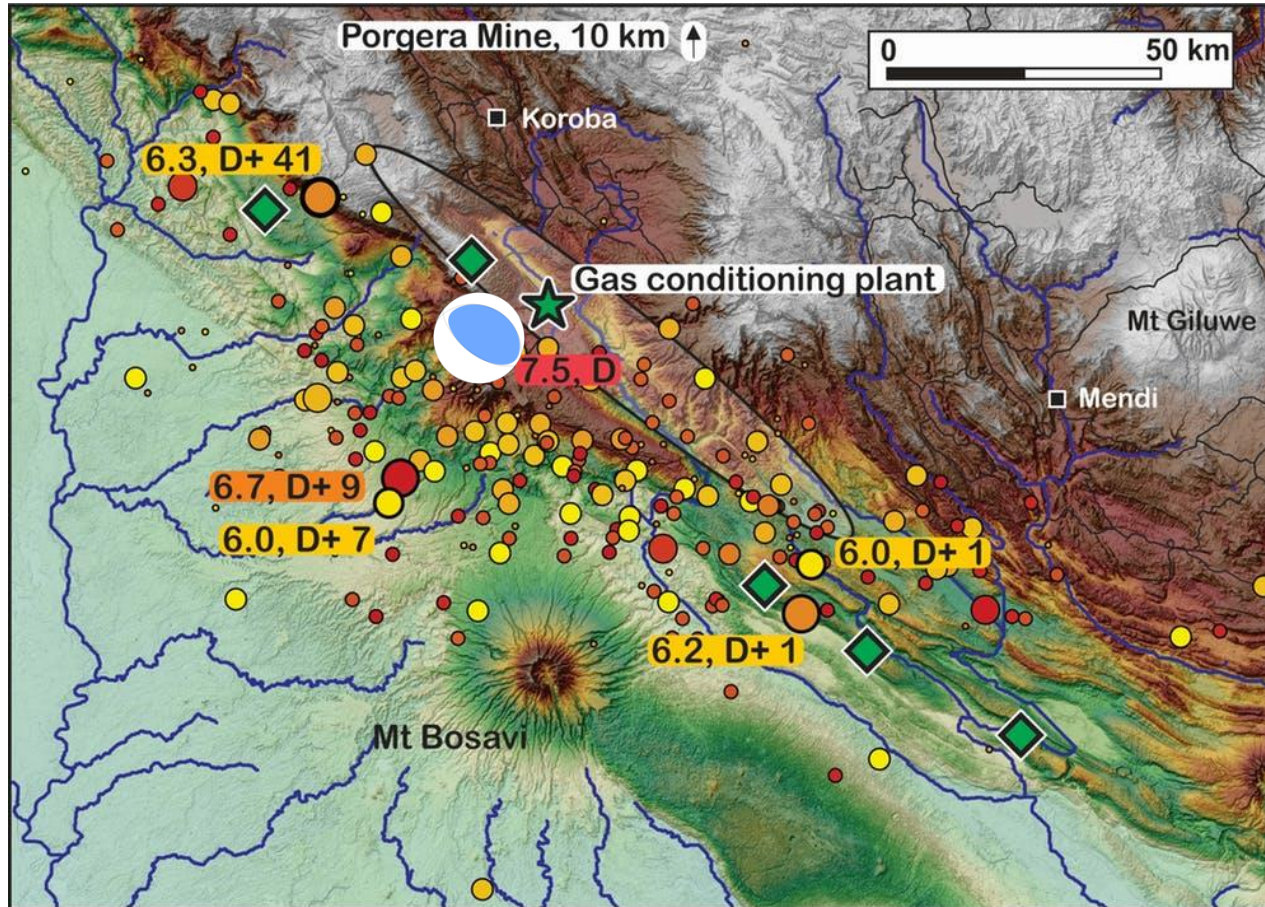


**Culturally diverse –
700+ language groups**

**PNG Highlands – first
contact with outside
world only 85 years ago**



2018 Highlands PNG earthquake sequence



Context of the 2018 PNG Highland Earthquake Sequence (USGS, Gilles Brocard, 2018)

Extensive landslides and damage to infrastructure



Mananda Ridge

Hegigio River

Moran 12 well pad

Photo: R. Stanaway, 2018



Photo: R. Stanaway, 2018

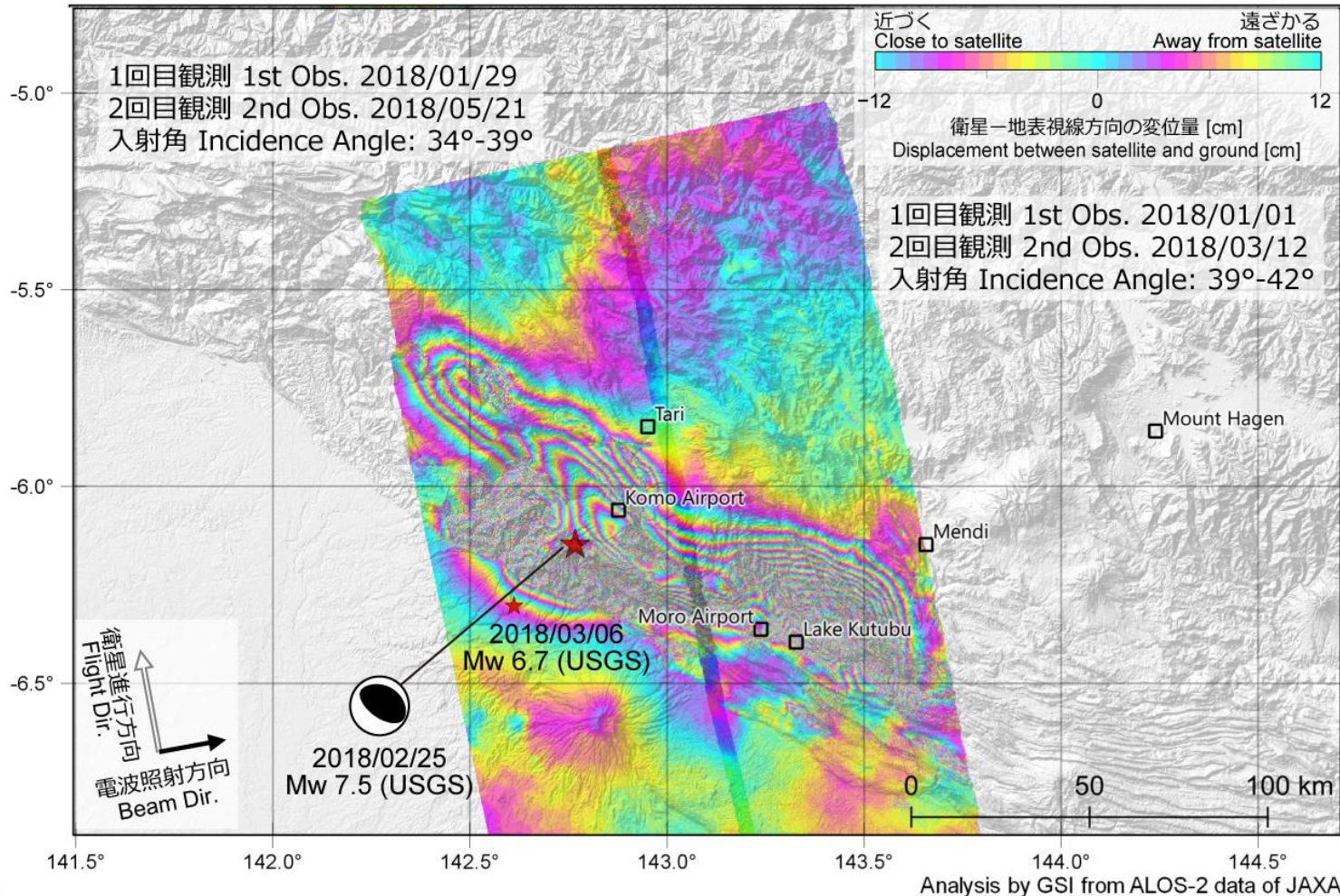


Photos: R. Stanaway, 2018

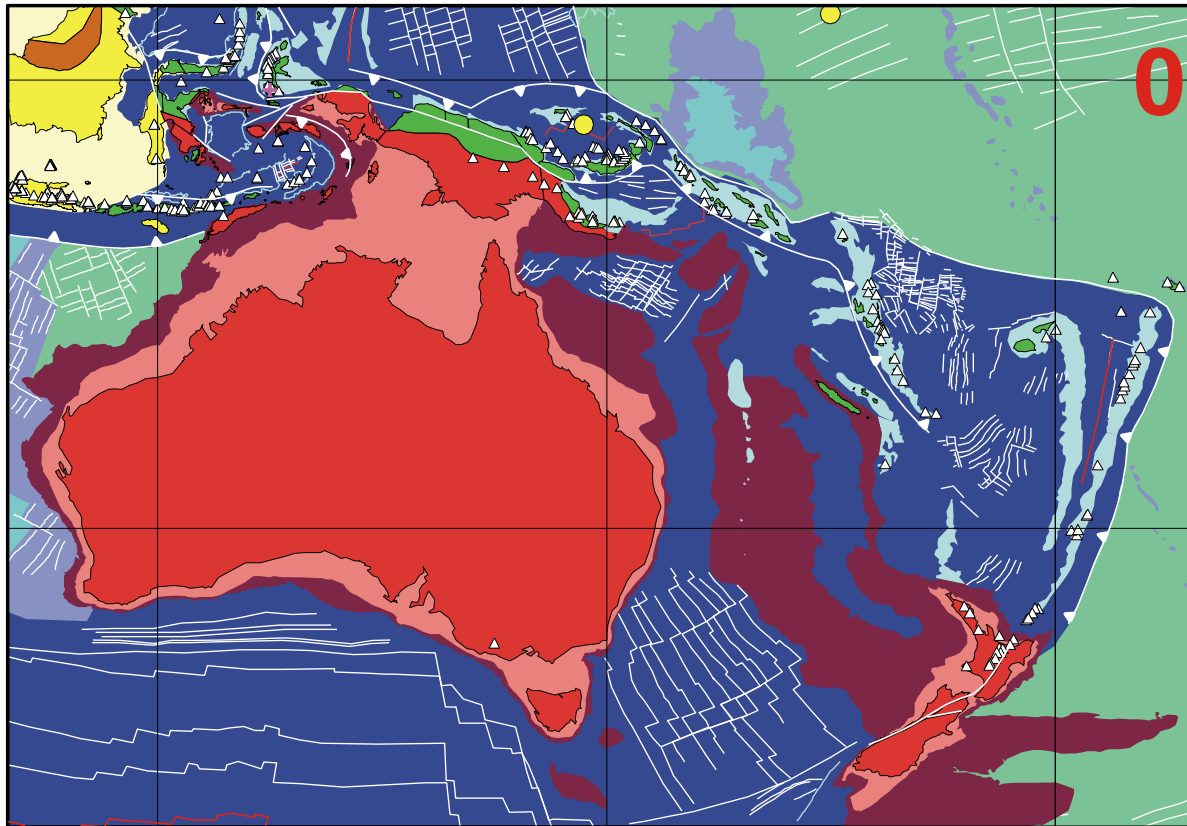




Initial INSAR Analysis – JAXA – ALOS2



Evolution of the Australian plate boundary

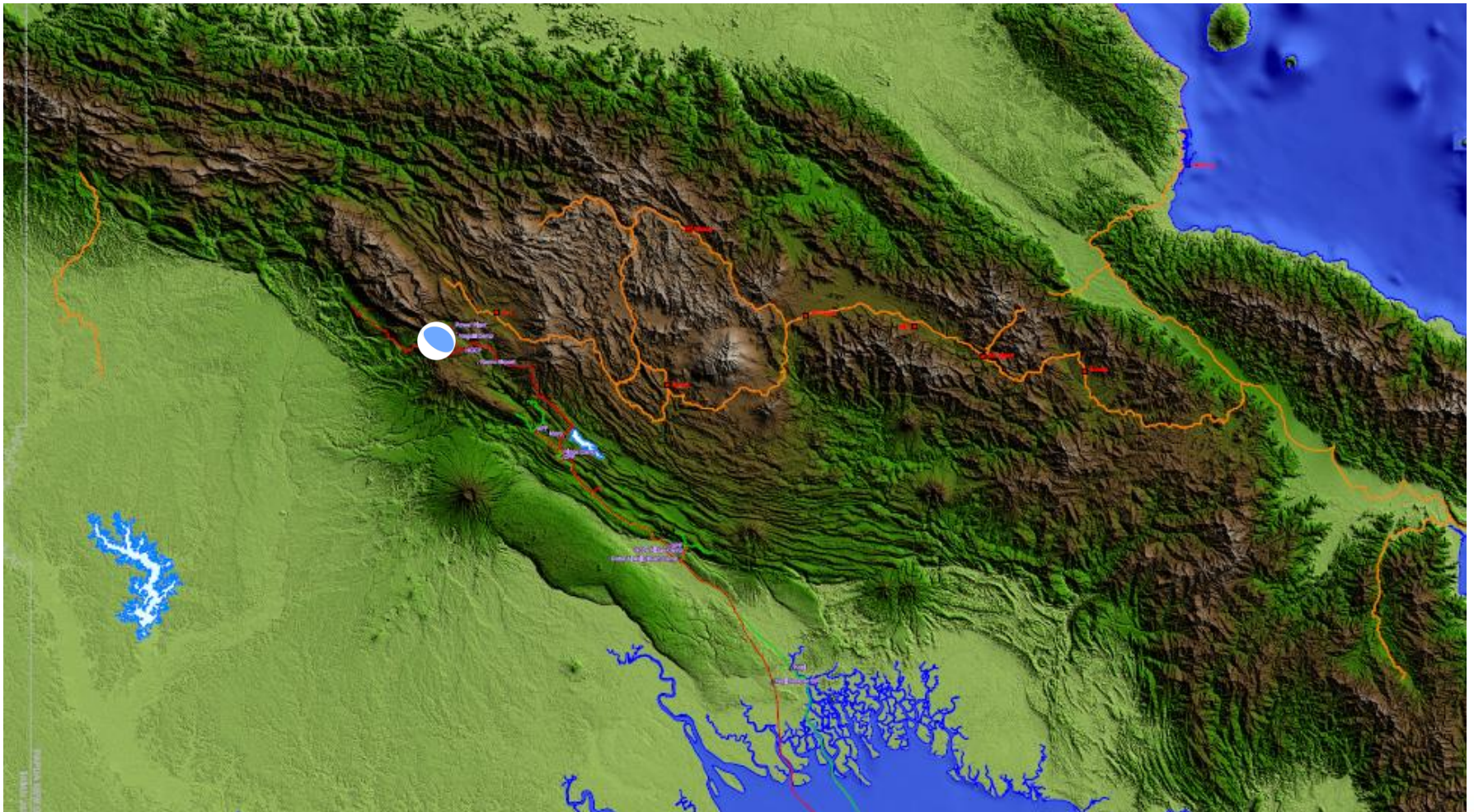


← Millions of
Years b.p.

← “paleo”
ITRF/WGS84

From Hall, R. 2002. Journal of Asian Earth Sciences, 20 (4), 353–434.

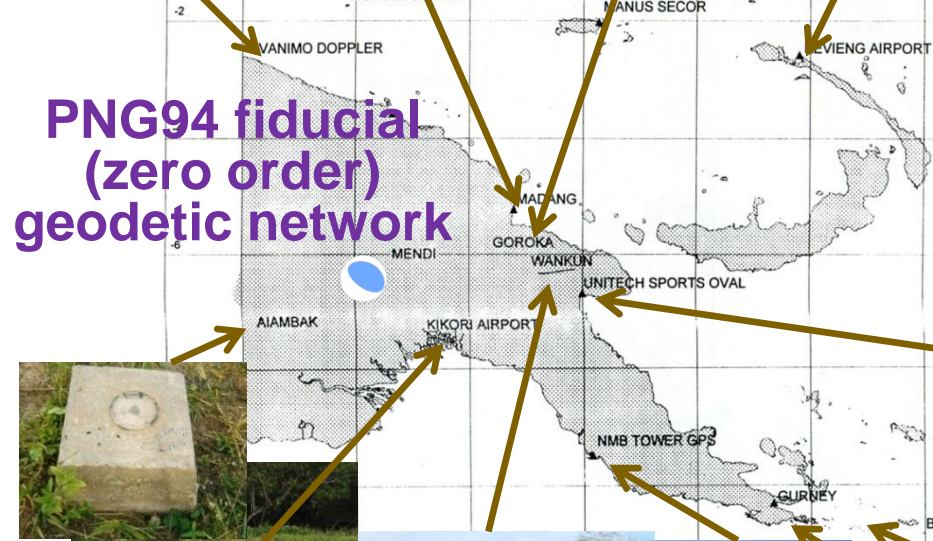
Papuan Fold and Thrust Belt – SRTM topography



Geomorphology – Hindenburg Wall

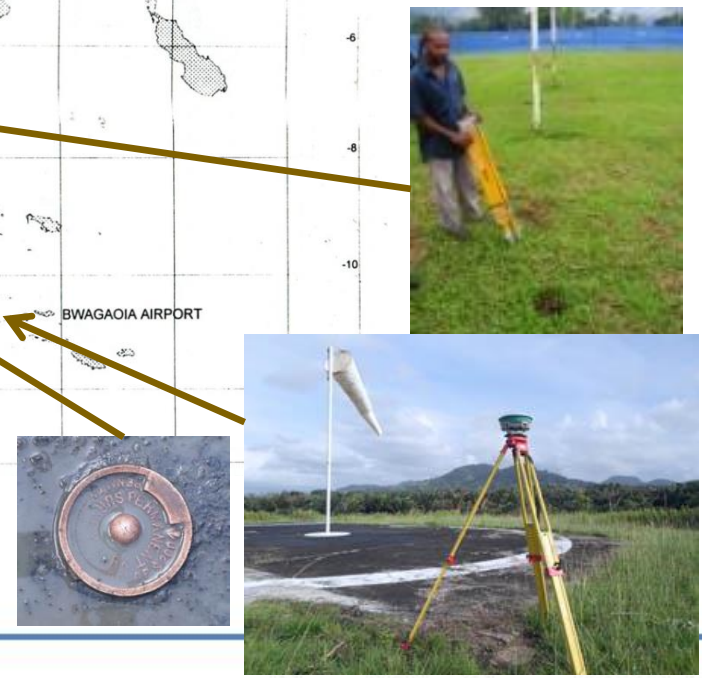


© www.GrantDixonPhotography.com.au

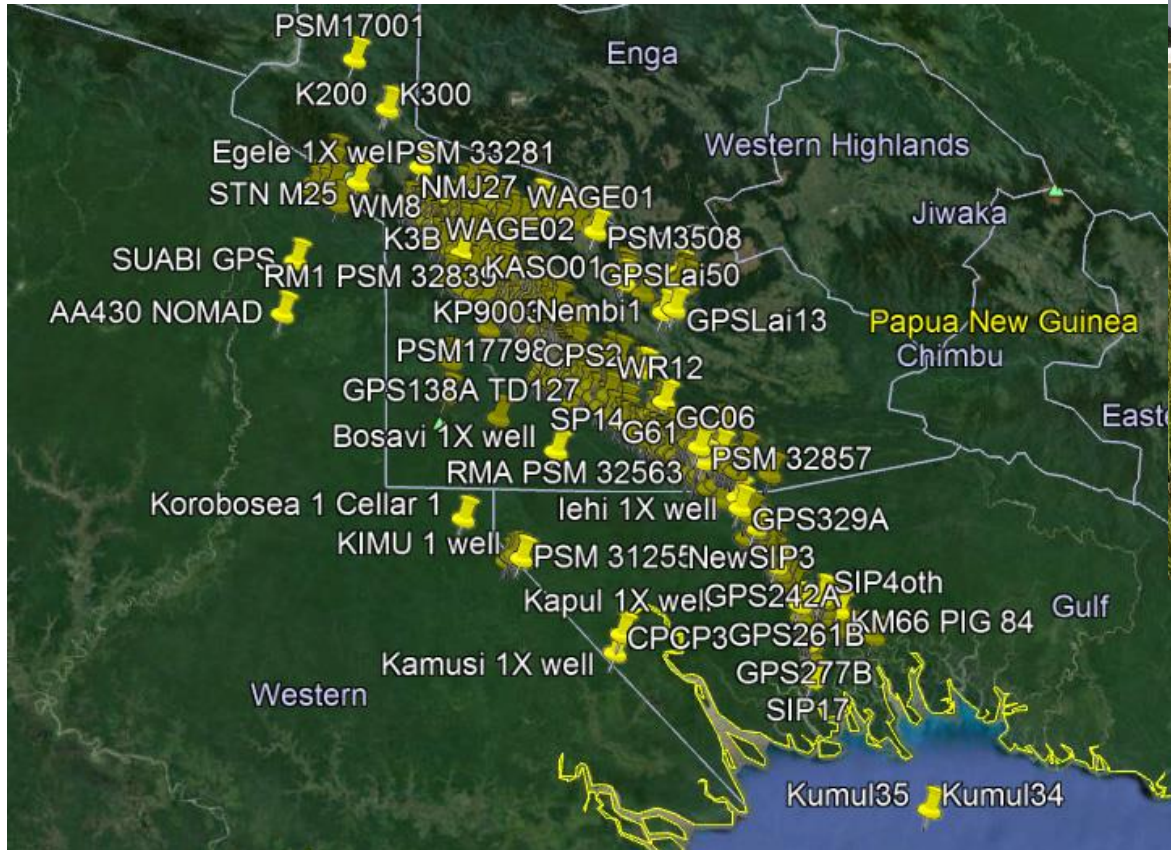


Site ID	Site Name	Monument number	PNG94 Latitude	PNG94 Longitude	PNG94 Ellipsoidal Height
MORE	NMB TOWER GPS	PSM 15832	-9°26'02.76968"	147°11'12.20017"	116.610
AIAM	AIAMBAK	PSM 9550	-7°20'51.81934"	141°16'01.44646"	95.465
MIS1	BWAGAOIA AIR	PSM 9195	-10°41'19.90490"	152°49'58.93878"	87.456
GOKA	GOROKA	PSM 9833	-6°04'53.07151"	145°23'30.44618"	1664.580
ALT2	GURNEY	PSM 9538	-10°18'37.50877"	150°20'18.09080"	94.871
KAVI	KAVIENG AIR	PSM 9513	-2°34'53.06528"	150°48'22.53578"	78.828
KIKO	KIKORI AIRPORT	PSM 5583	-7°25'24.65305"	144°14'55.76611"	88.965
MAD1	MADANG	GS 15495	-5°12'41.28824"	145°46'56.19305"	73.293
MANU	MANUS SECOR	PSM 9522	-2°03'02.29337"	147°21'37.63577"	129.751
MEND	MENDI	PSM 3507	-6°08'36.73422"	143°39'22.16540"	1815.154
9799	UNITECH SPORTS	PSM 9799	-6°40'16.96985"	146°59'52.37457"	130.389
VANI	VANIMO DOPPLER	PM 63/1	-2°41'05.28039"	141°18'15.65564"	80.516
NM34	WANKKUN	PSM 15029	-6°08'52.07208"	146°04'52.44226"	510.015
WUVU	WUVULU ISLAND	PSM 15456	-1°44'07.59465"	142°50'10.07846"	79.056

**PNG94 fiducial
 (zero order)
 geodetic network**

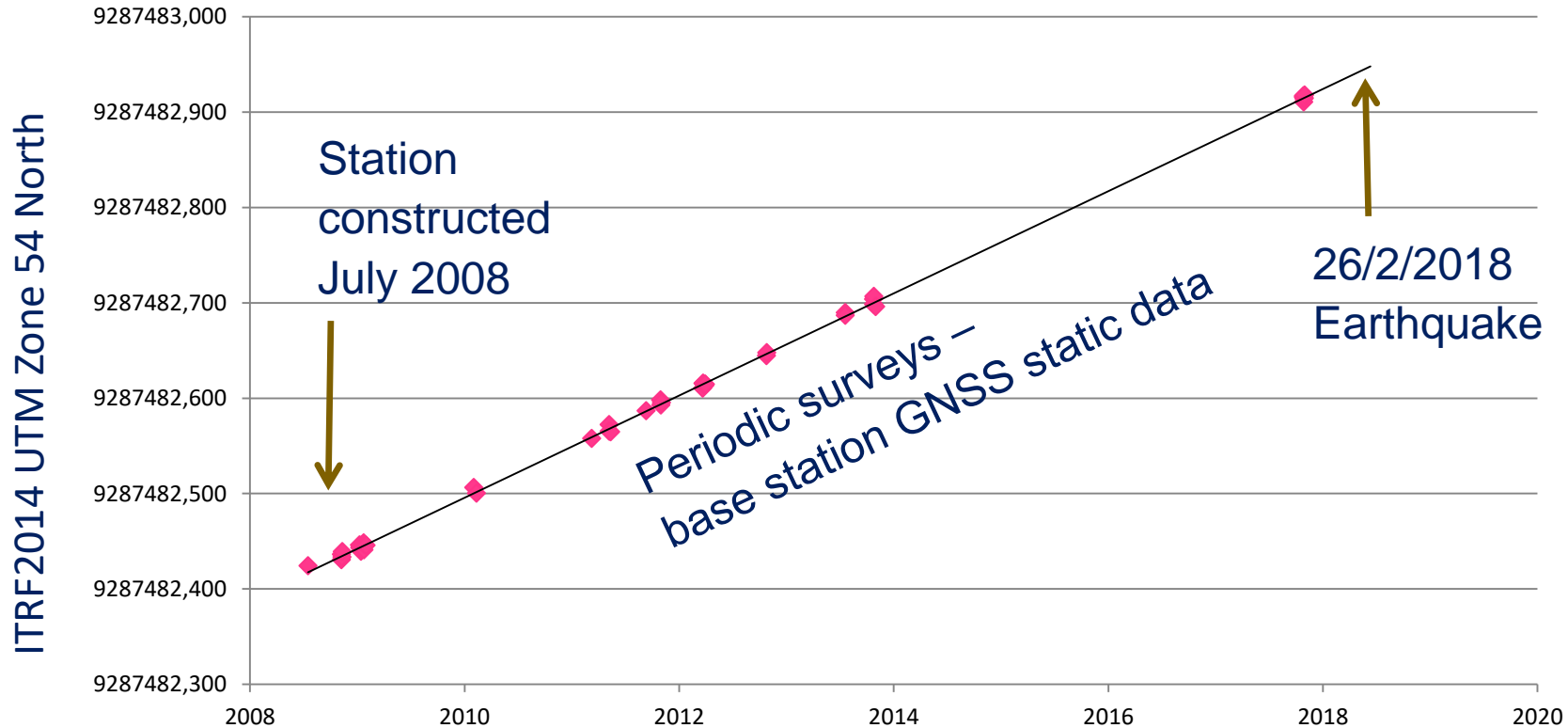


PNG Oilfields – Geodetic Network



>700 geodetic stations surveyed to a PU of better than 30 mm horizontal and 50 mm in height using GNSS

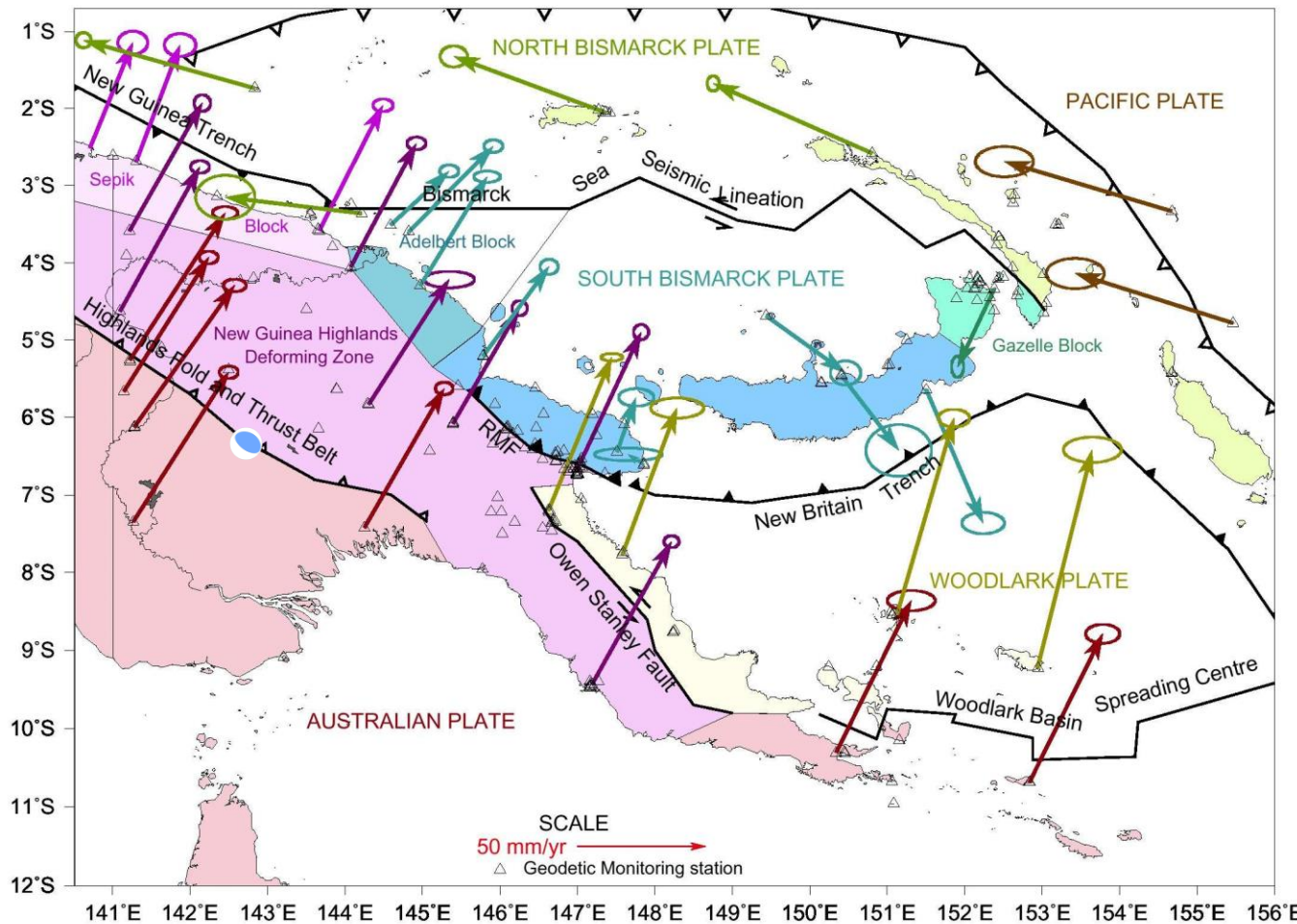
Site motion – measured by static GPS



Example – IAGI PSM 32567 Ridge Camp – NORTH

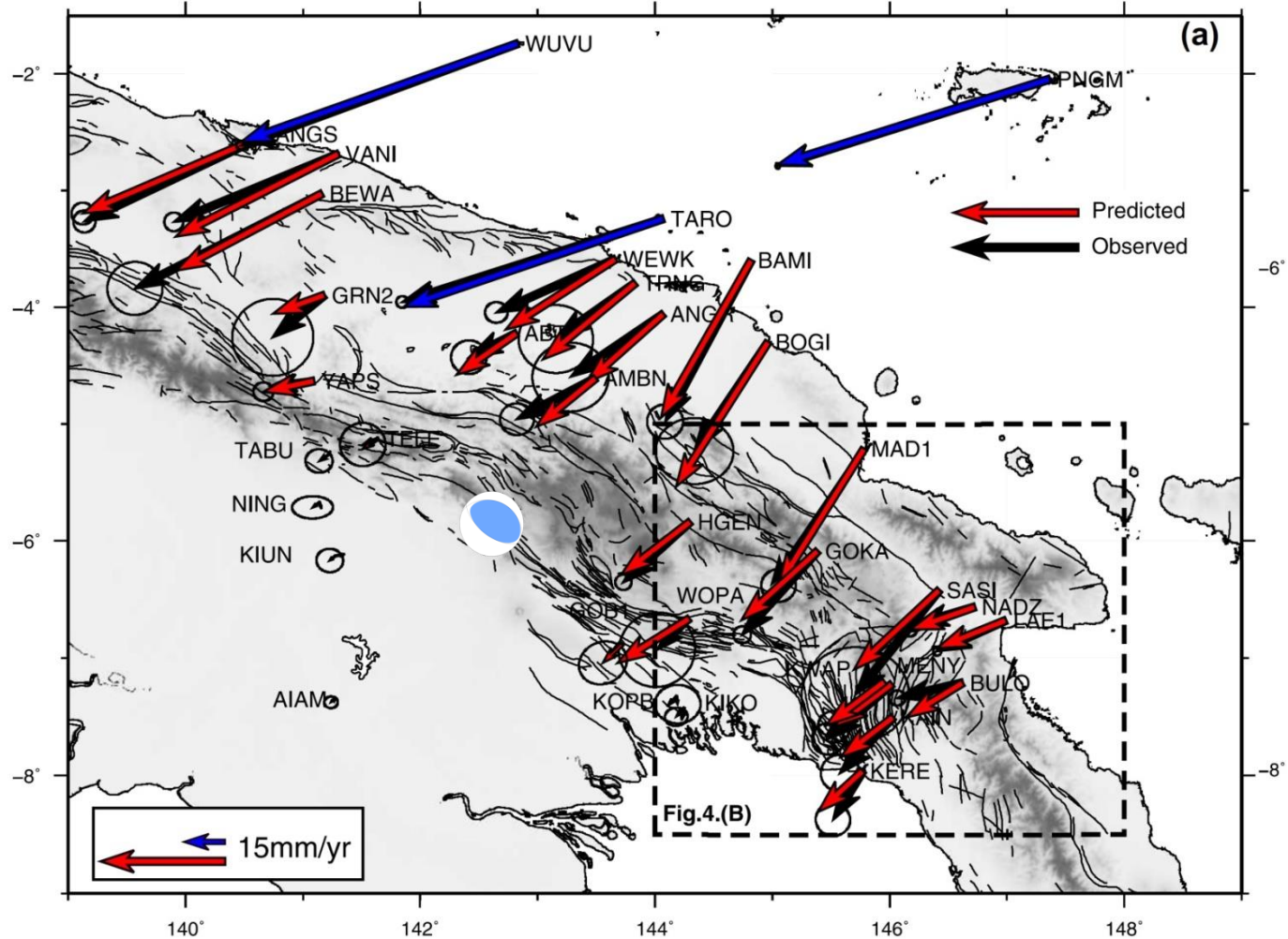
Interseismic motion – typically highly linear

PNG Tectonic model from GNSS site velocities



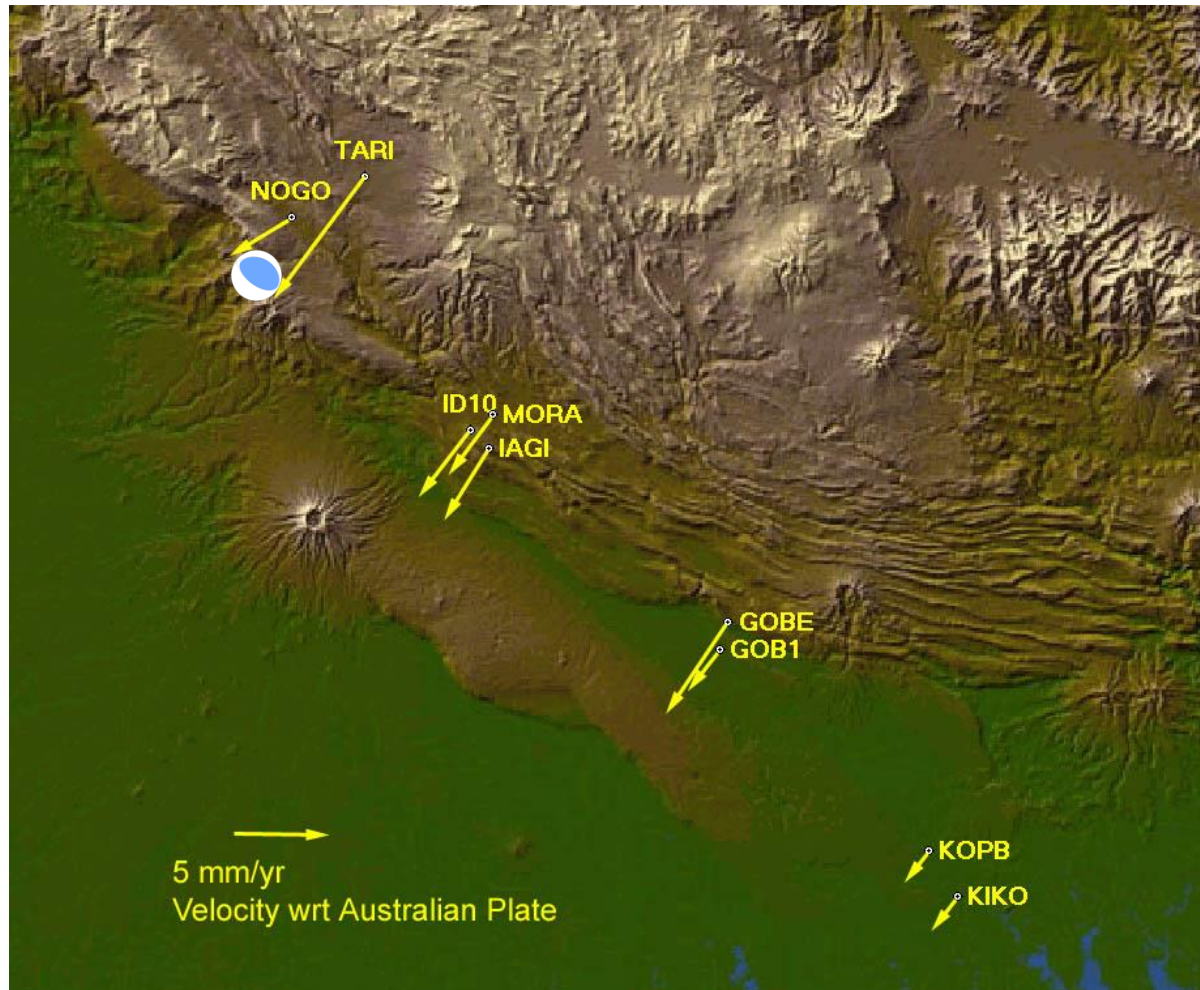
Stanaway et al., 2004

Site motion in stable Australian Plate frame



Koulali et al., 2015

PFTB site motion in stable Australian Plate frame



March-June 2018 – Post-earthquake geodetic surveys

Re-establish geodetic control

- Quantify deformation of geodetic network
- Pipeline integrity monitoring and strain estimation
- Ground truthing for Lidar
- Ground Control Points (GCP) for Drone surveys
- Develop deformation model for coordinate and elevation conversions
(coseismic displacement model)

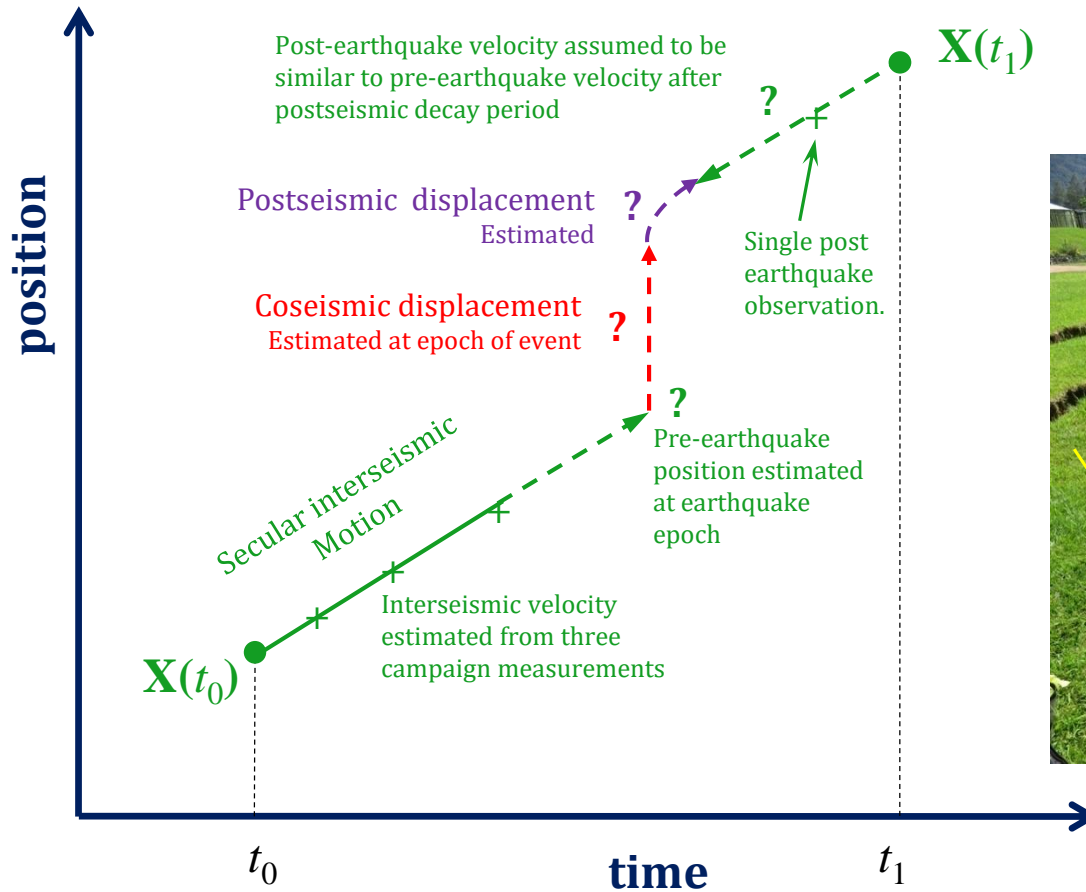
Post-earthquake surveys



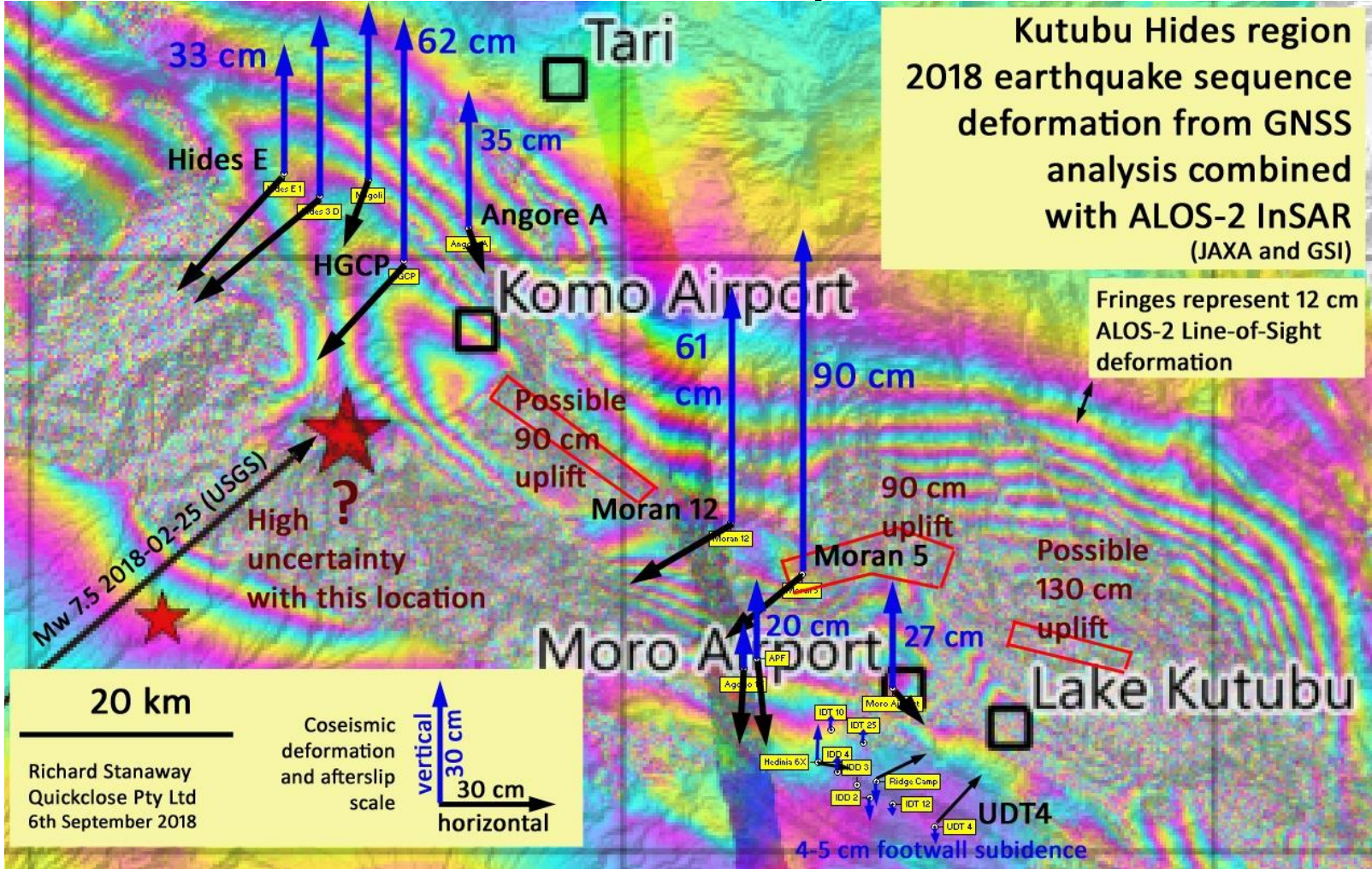
Computation of earthquake deformation using GPS

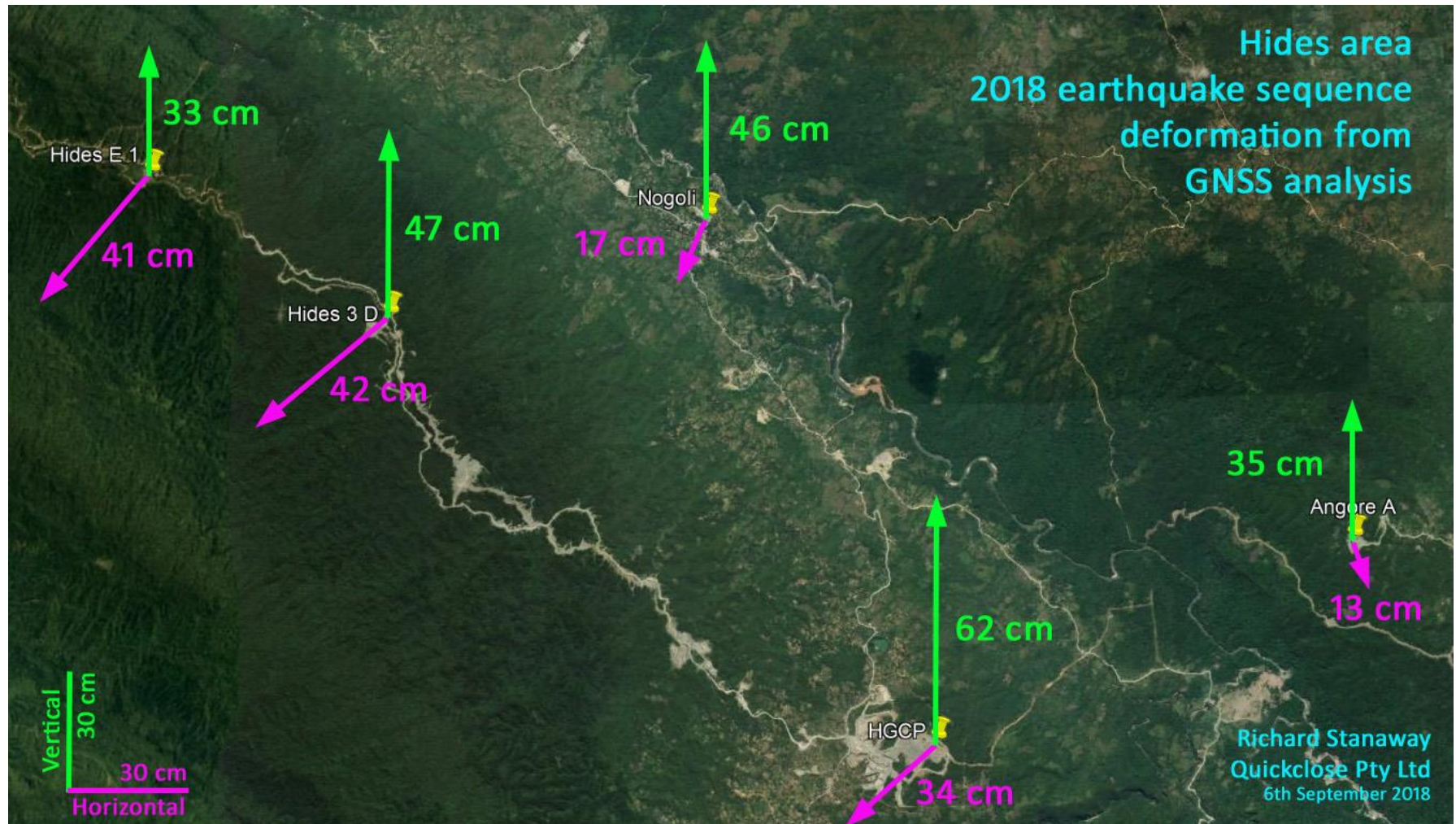
- Reprocess GPS data archive in ITRF2014 using AusPOS
- Estimate ITRF2014 time series for each 1st order station
- Estimate coseismic offset at each 1st order station
- Reprocess pre-earthquake surveys using ITRF2014 at epoch of survey
- Reprocess post-earthquake surveys also using ITRF2014
- Estimate deformation by differencing of solutions
- Some postseismic afterslip included in displacement estimation
- Apply correction to existing PNG94 coordinates and elevations

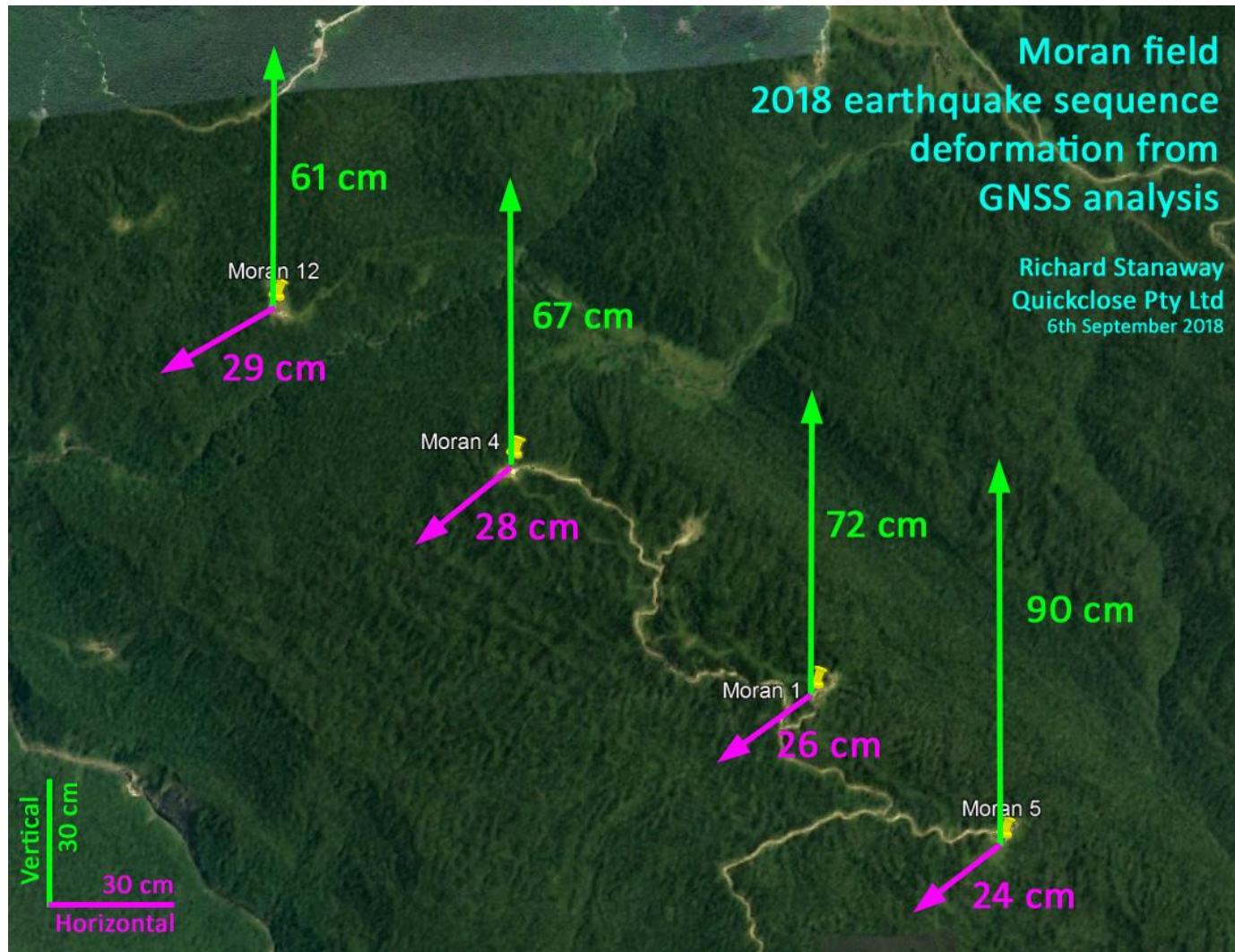
Some assumptions made using campaign GNSS data

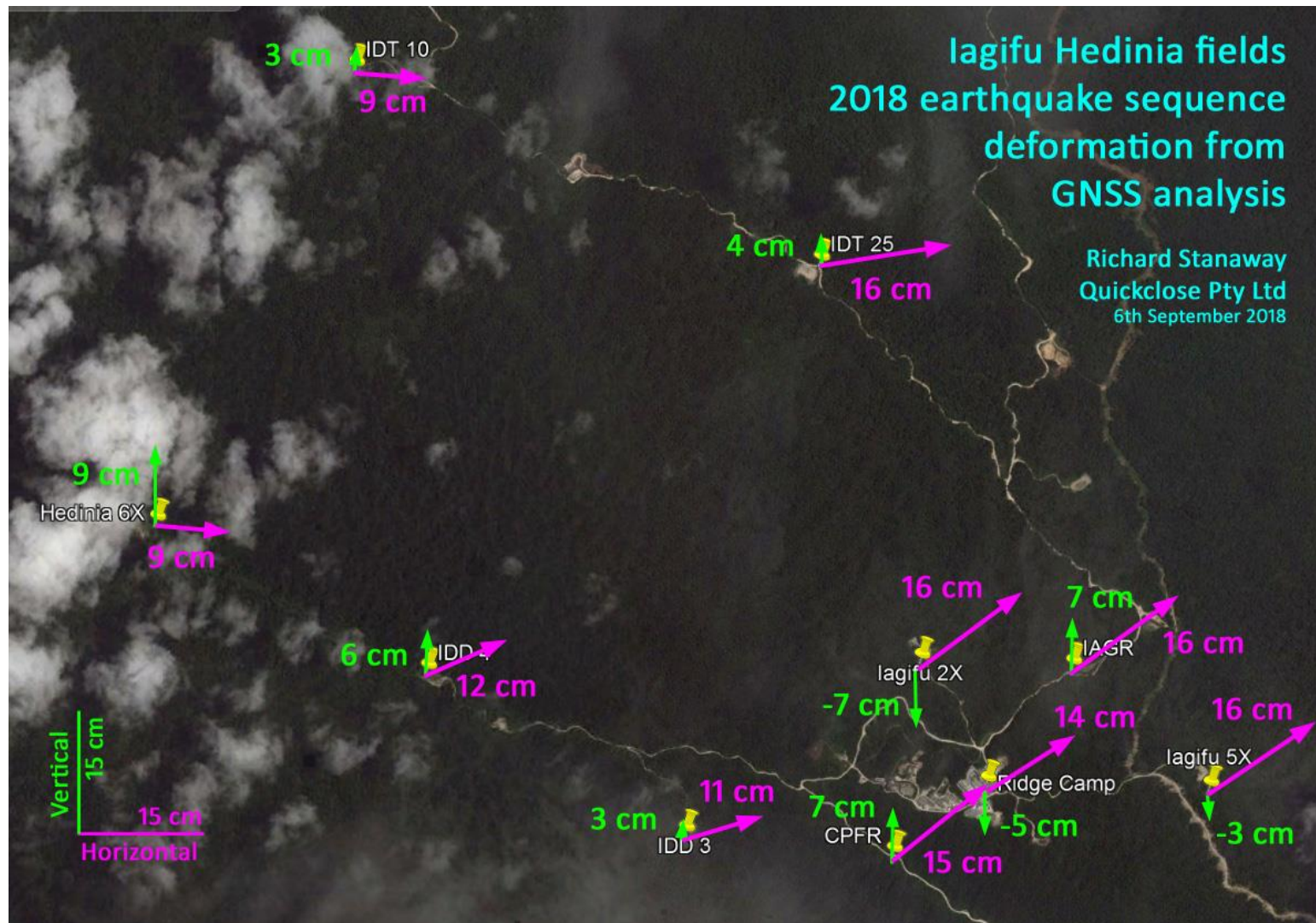


GNSS derived displacements

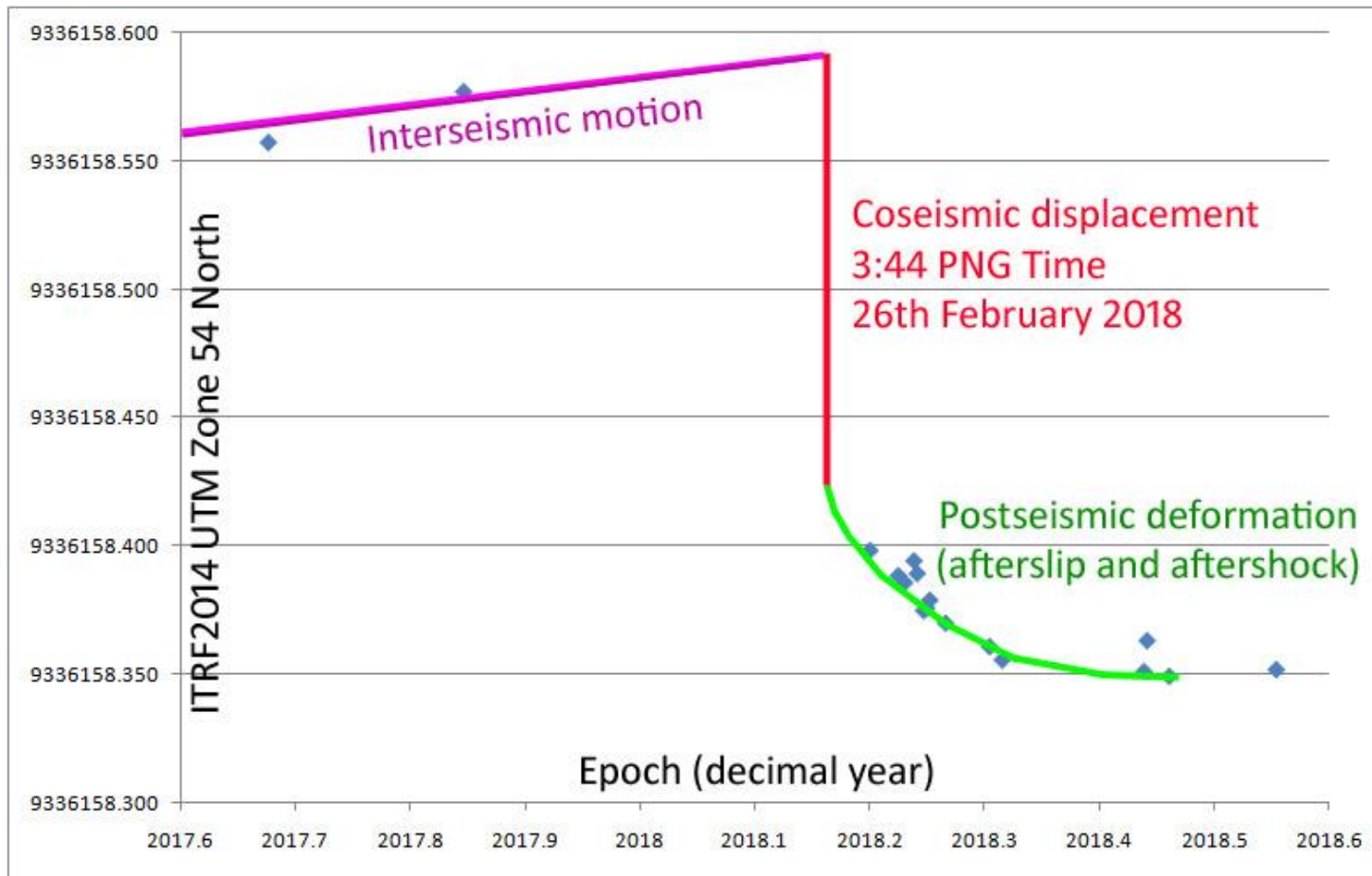








Displacements – Pillar 11 Hides - North



Additional work – currently in progress

- Infilling GNSS static observations
- Adjustment of epicentral locations
- Integration with InSAR analysis
- Develop coseismic/postseismic displacement grids
- Monitor postseismic deformation



Tenk yu tru -Thank you!