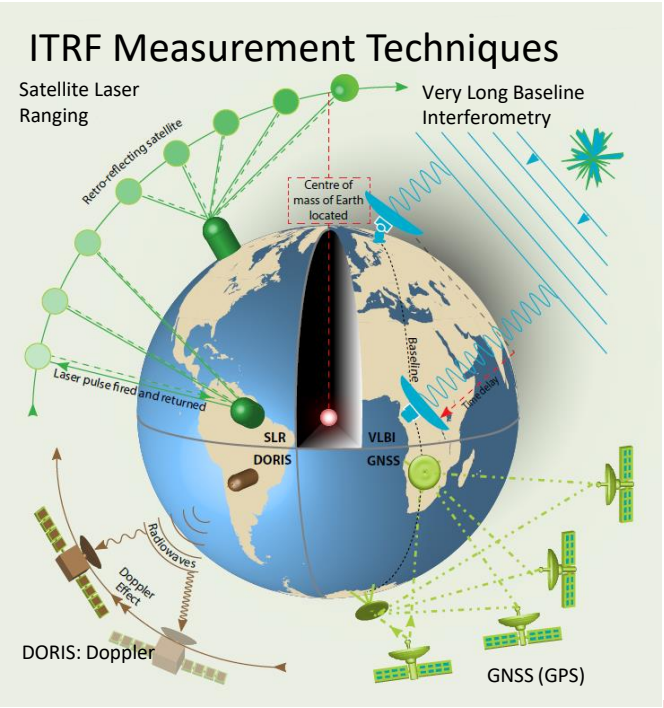
UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND
SAPERE AUDE

A new geodetic datum for Nepal after the 2015 Gorka Earthquake

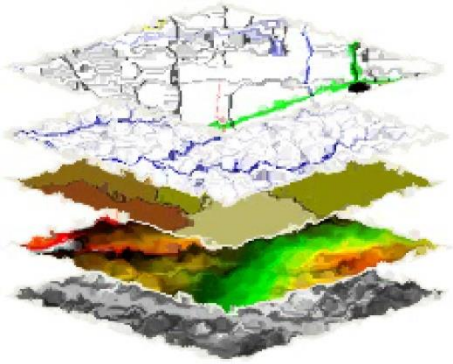
Chris Pearson
Niraj Manandhar


नवास फुड
ल्याण्ड



ITRF

Approximate transformation
No NDM



Required by GPS

No deformation model

Datums and epoch dates change frequently

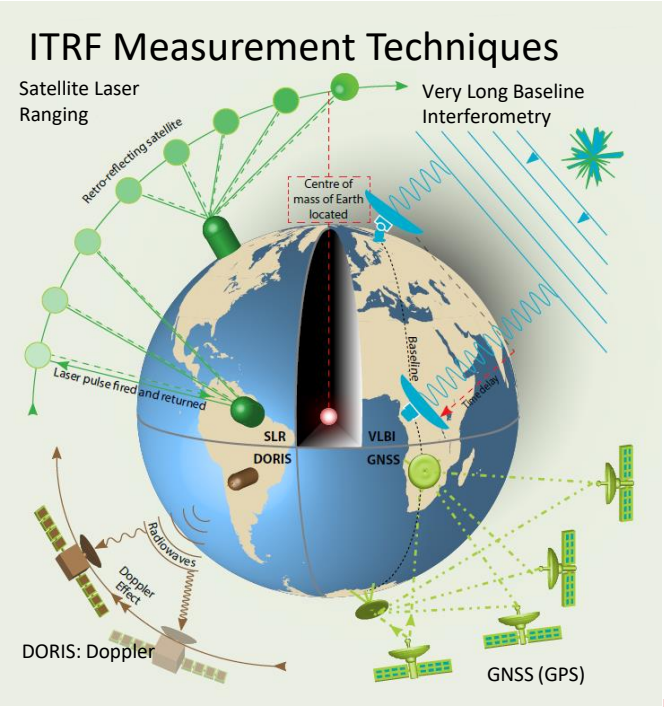
Nepal Everest

Inexact

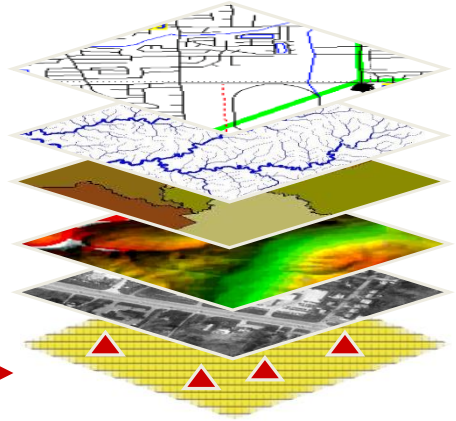
No deformation model

Nepal Everest datum has no mechanism to correct for crustal deformation

No epoch date



ITRF2014 NDM



Required by GPS

No deformation model

Datums and epoch dates change frequently

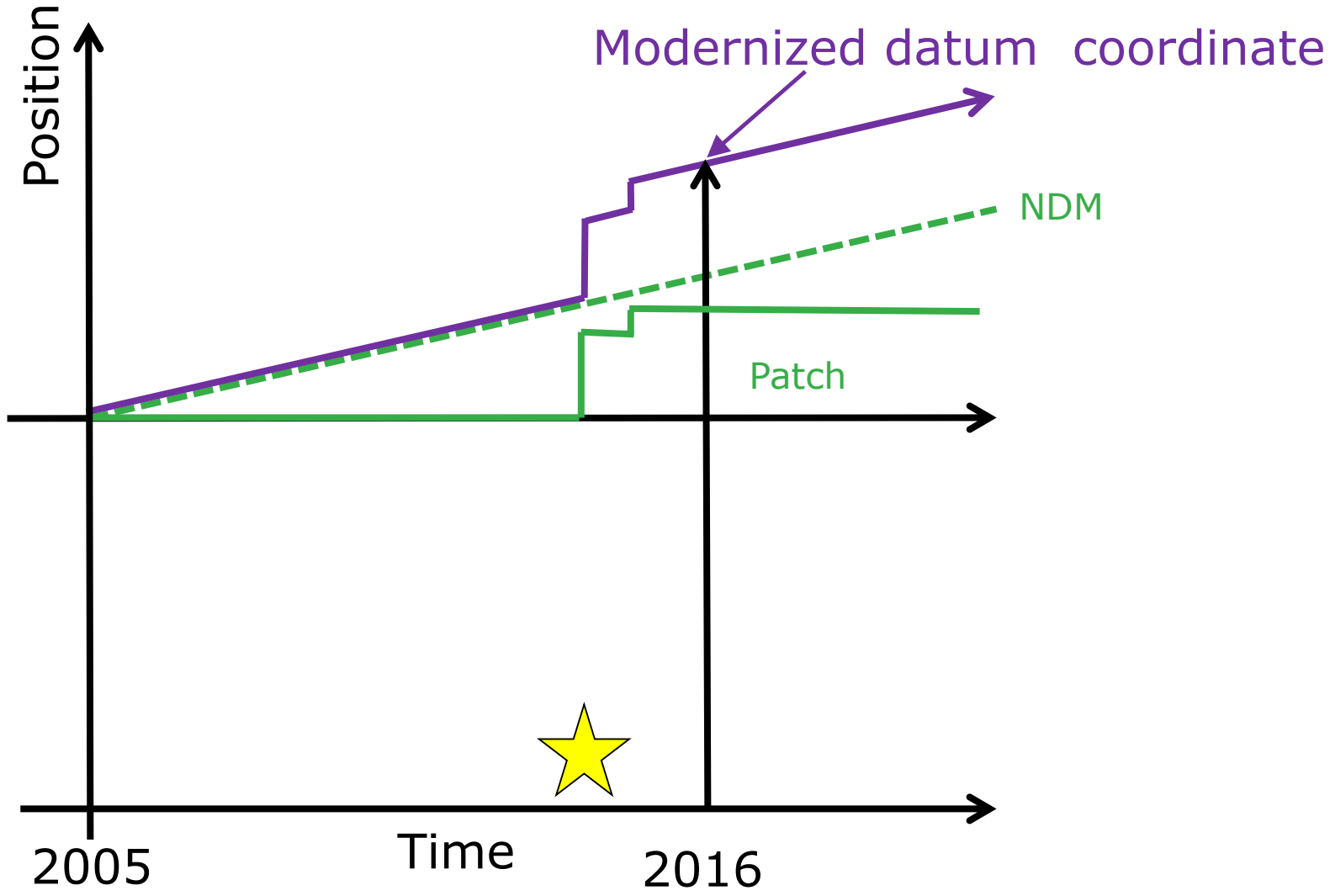
Modernized datum for Nepal

Stable coords

deformation model

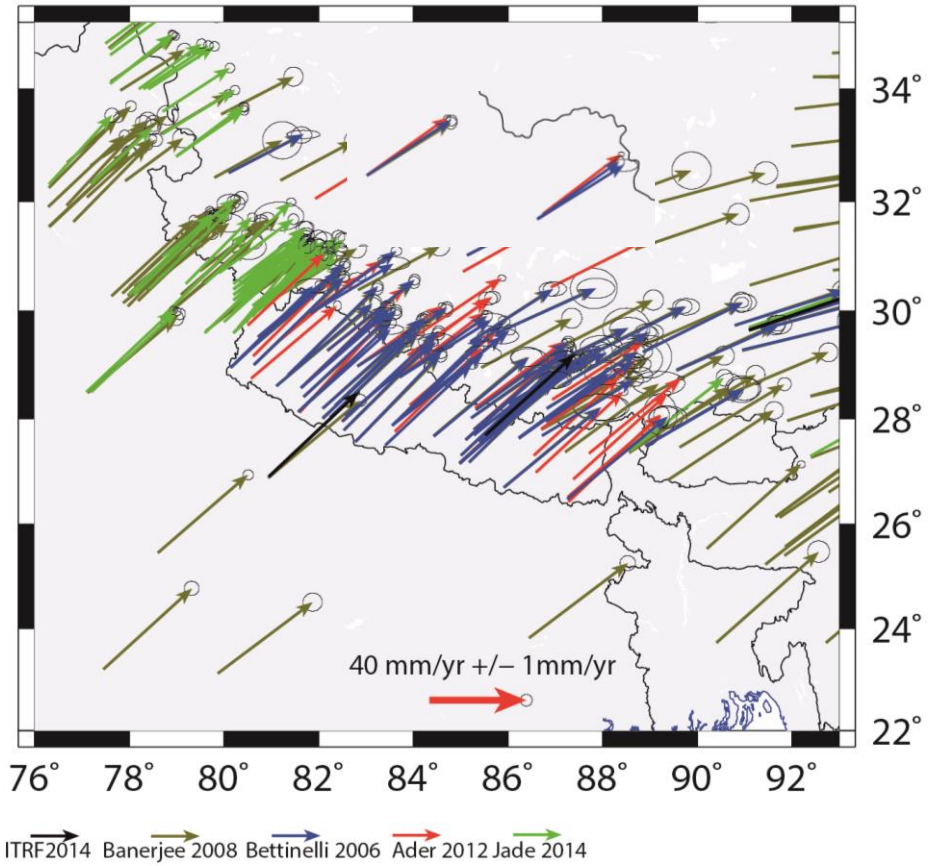
Modernized geodetic datum aligned with ITRF2014 Coordinates transformed to 1 Jan 2016 using the a national deformation model

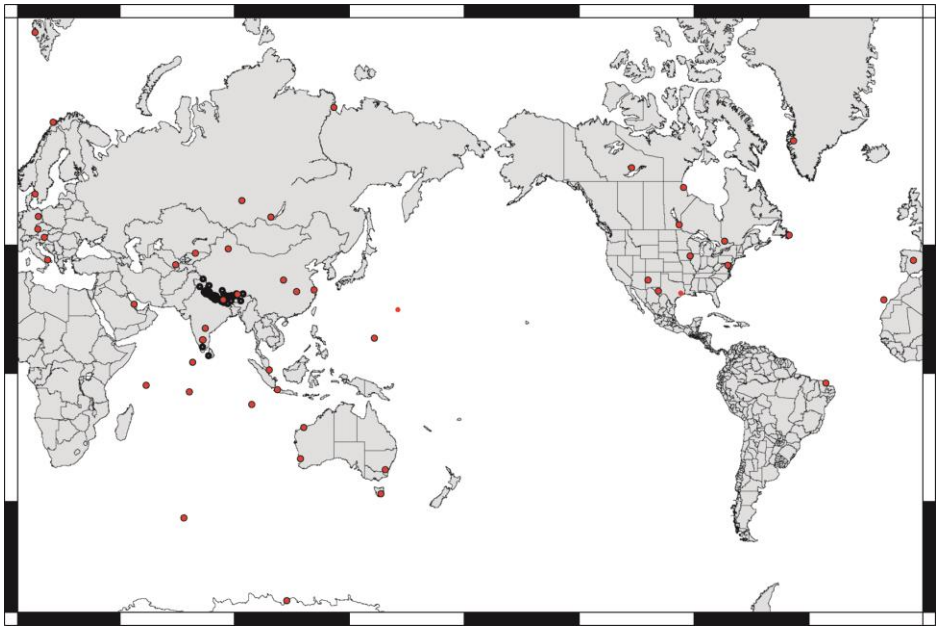
How the NDM works



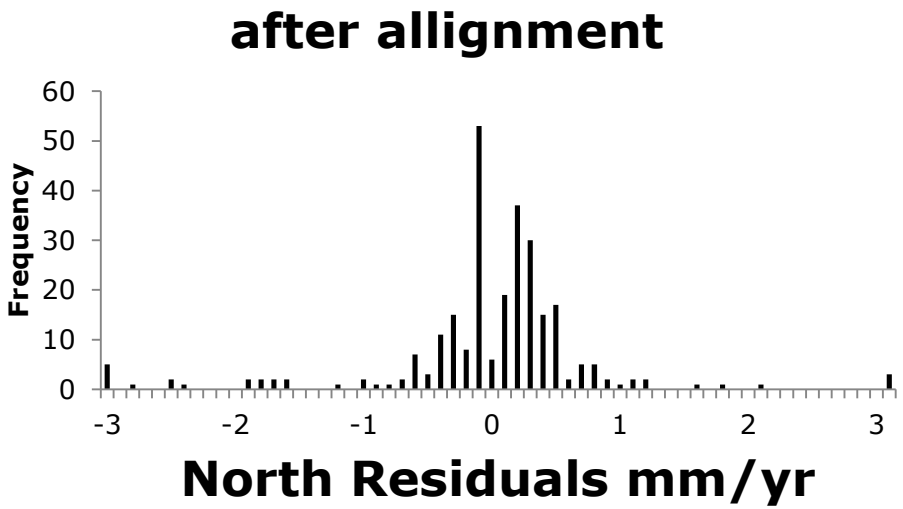
Secular velocity field

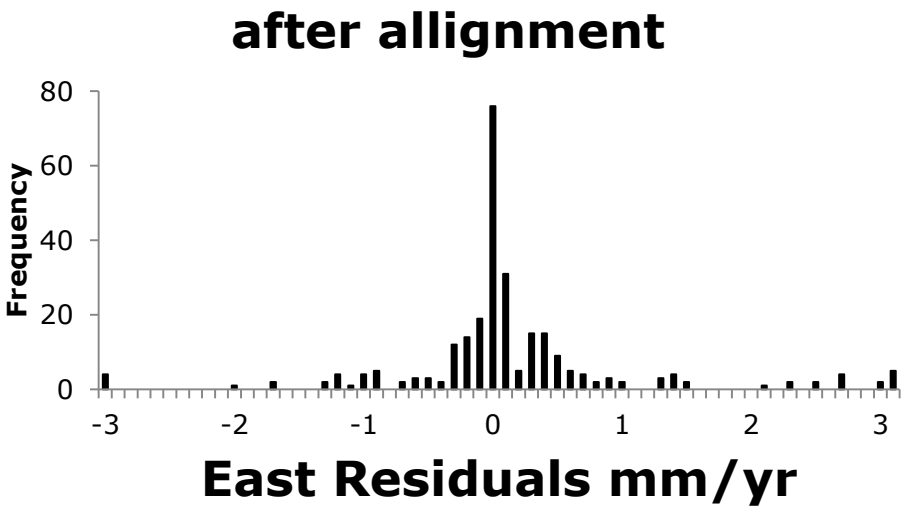
- Velocity from four recent studies were aligned with the ITRF2014 velocities
- The combined velocity field was used to produce a grid file with a density of 20 points/degree

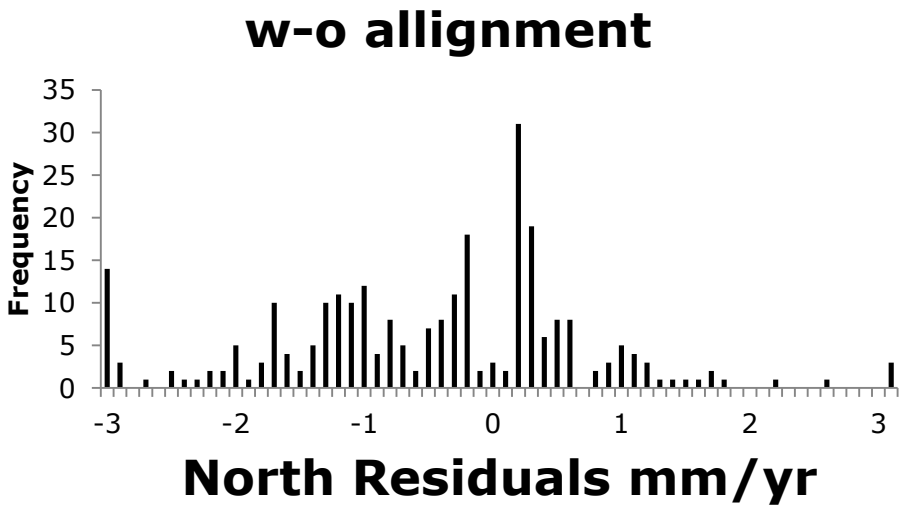


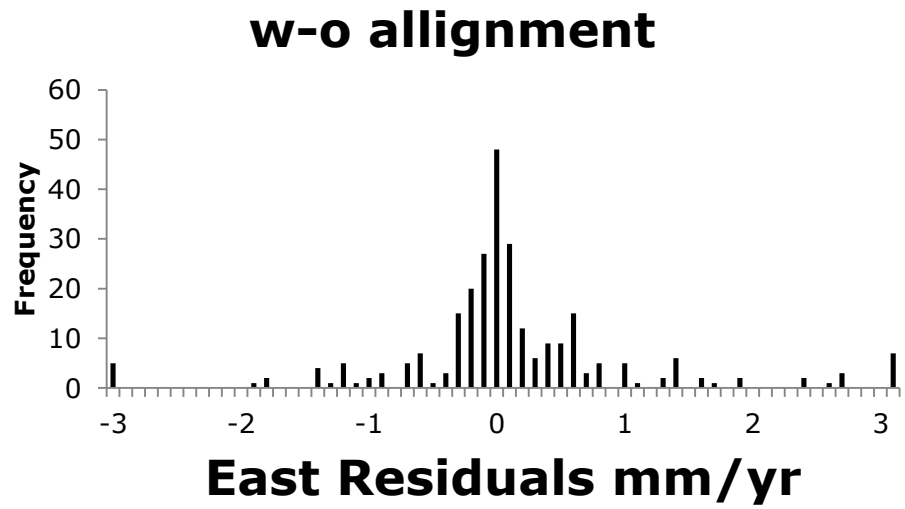


Residuals from alignment



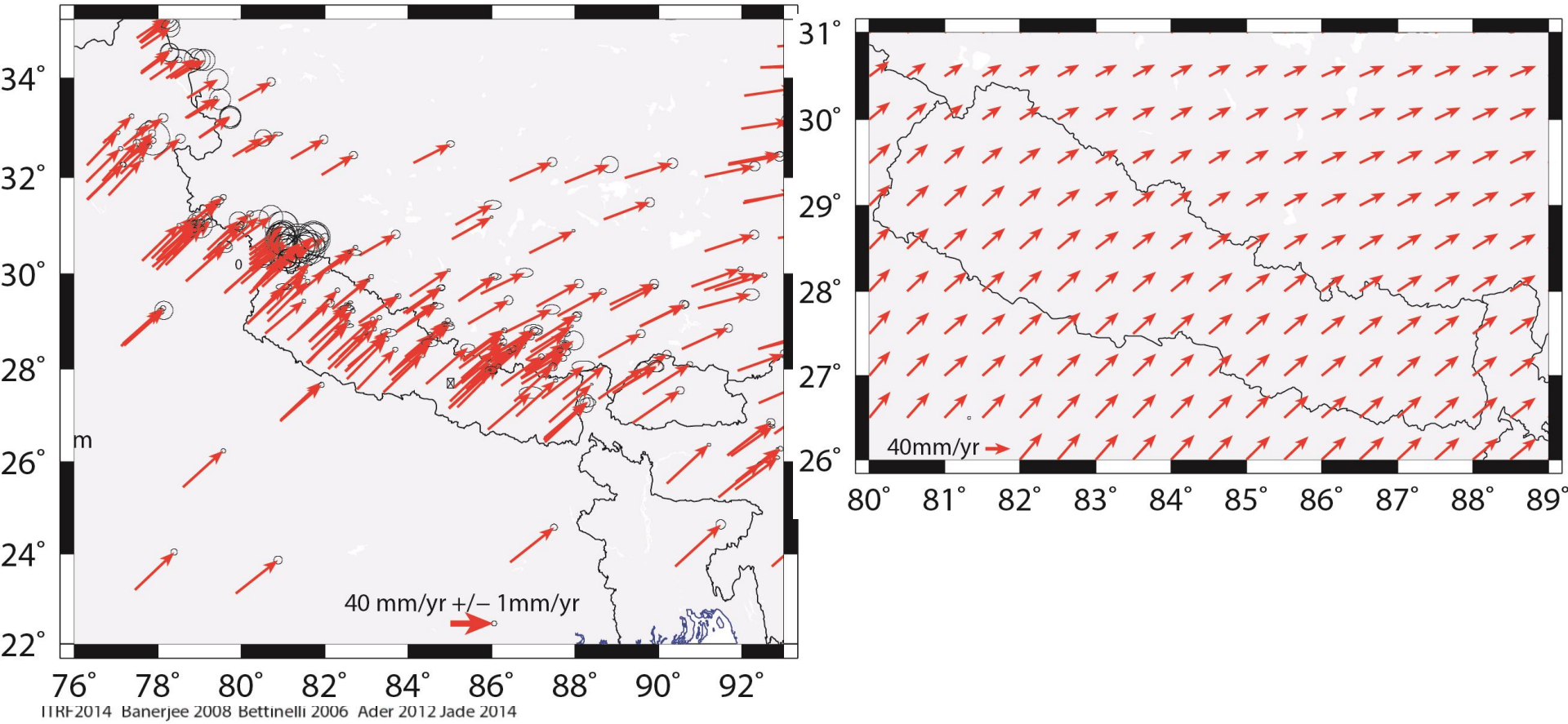




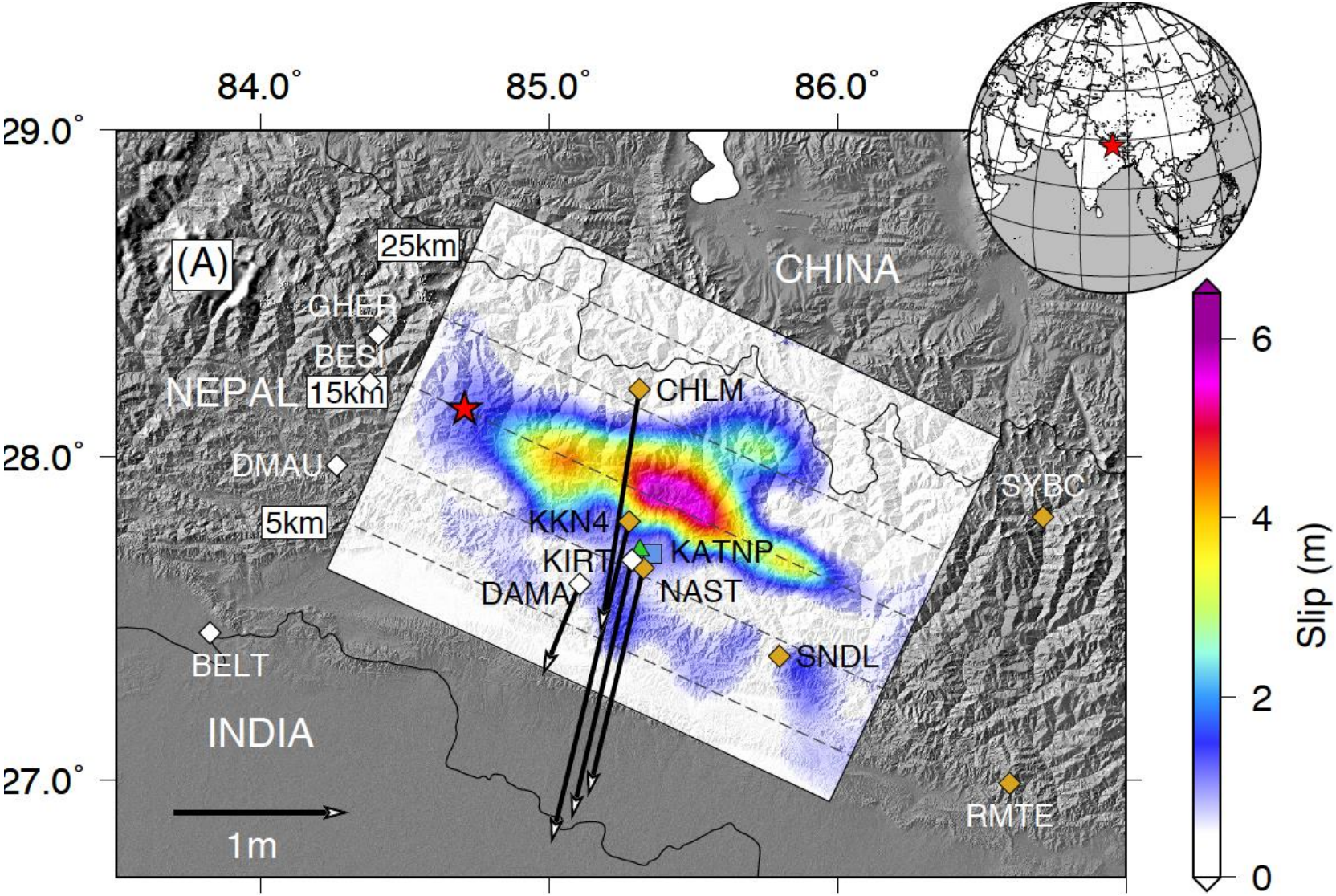


Secular velocity field

- Velocity from four recent studies were aligned with the ITRF2014 velocities

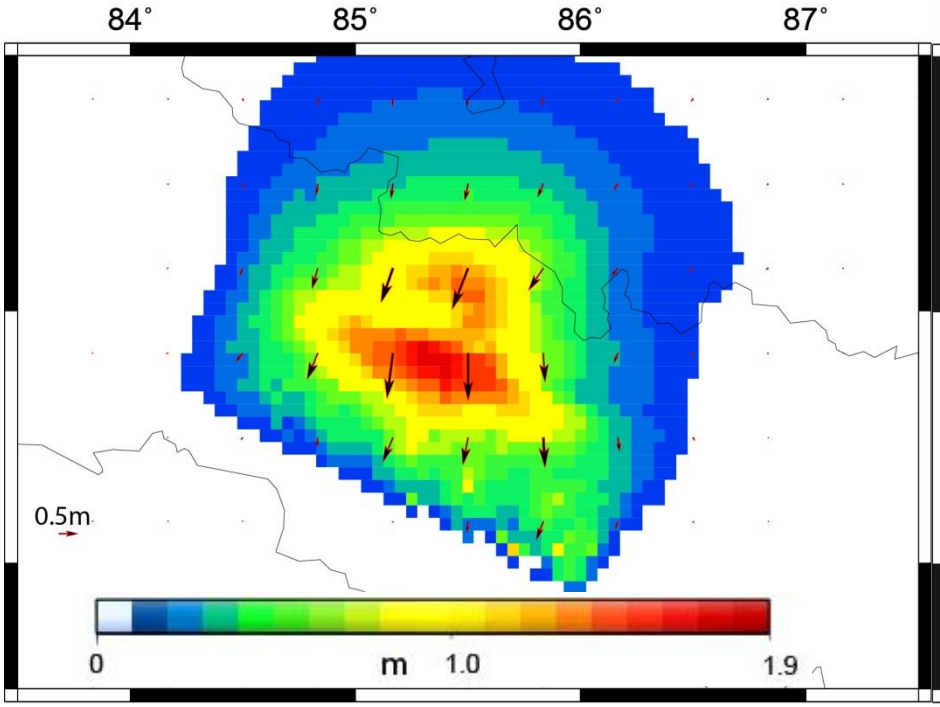


Verification of earthquake models

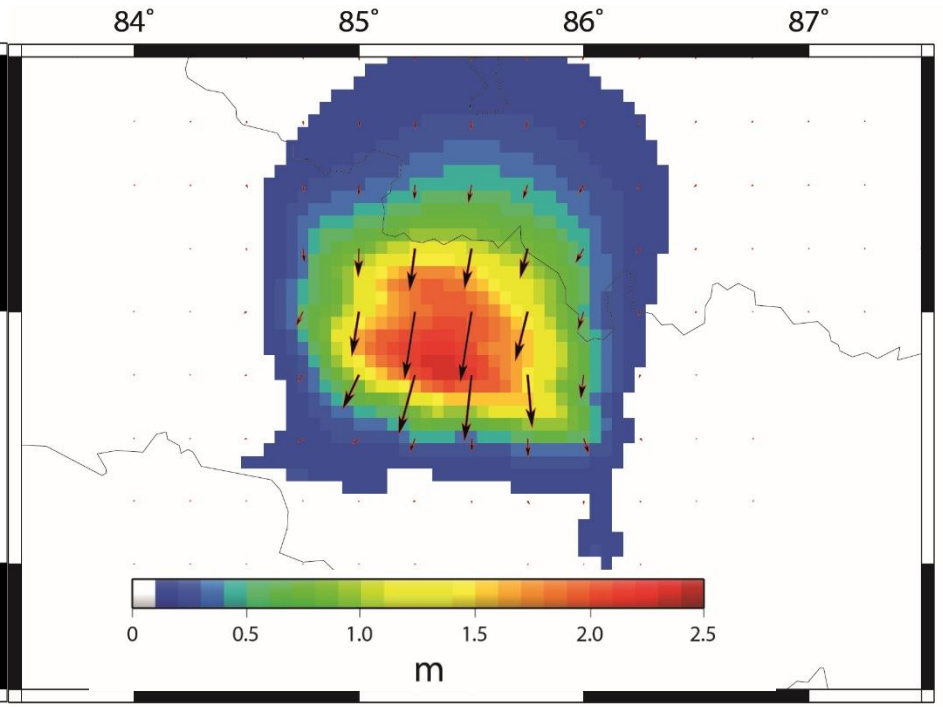


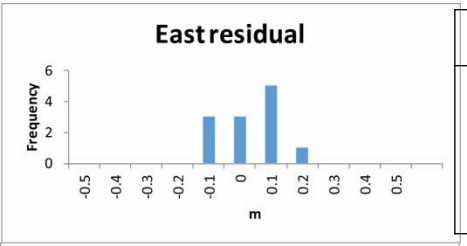
Two possible models for Gorka Earthquake

Galetzka et al. 2015 (JPL)

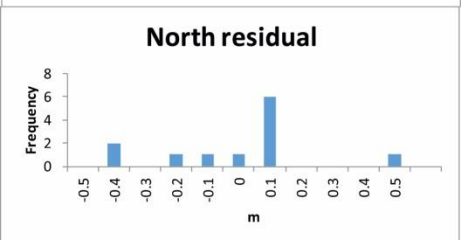


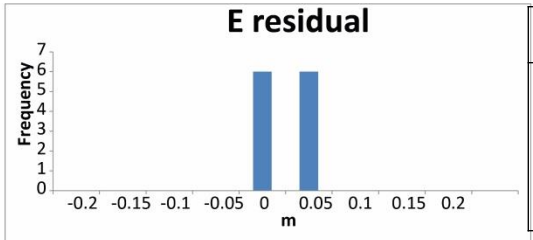
Wang et al in prep (SOPAC)



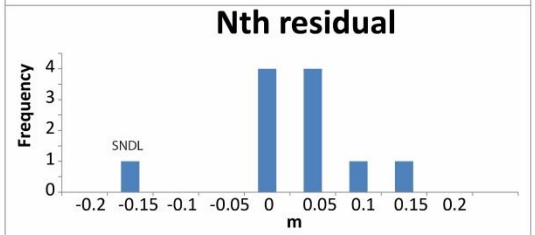


RMS	Galetzka
E m	0.21
N m	0.11
U m	0.08

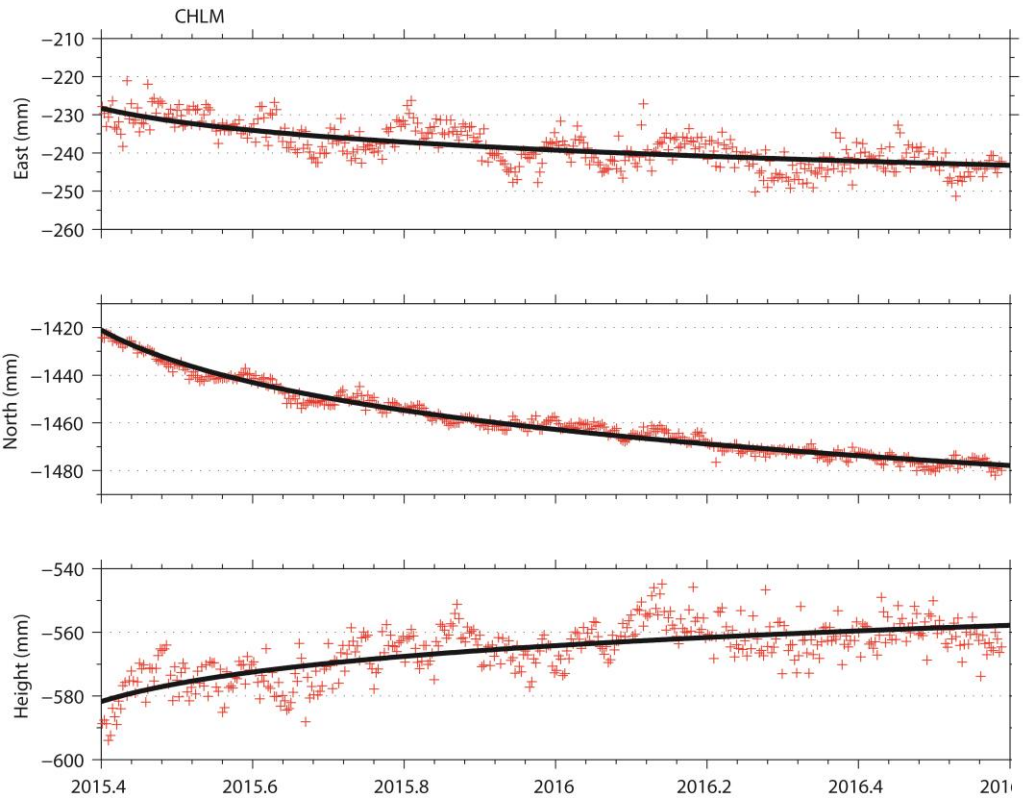




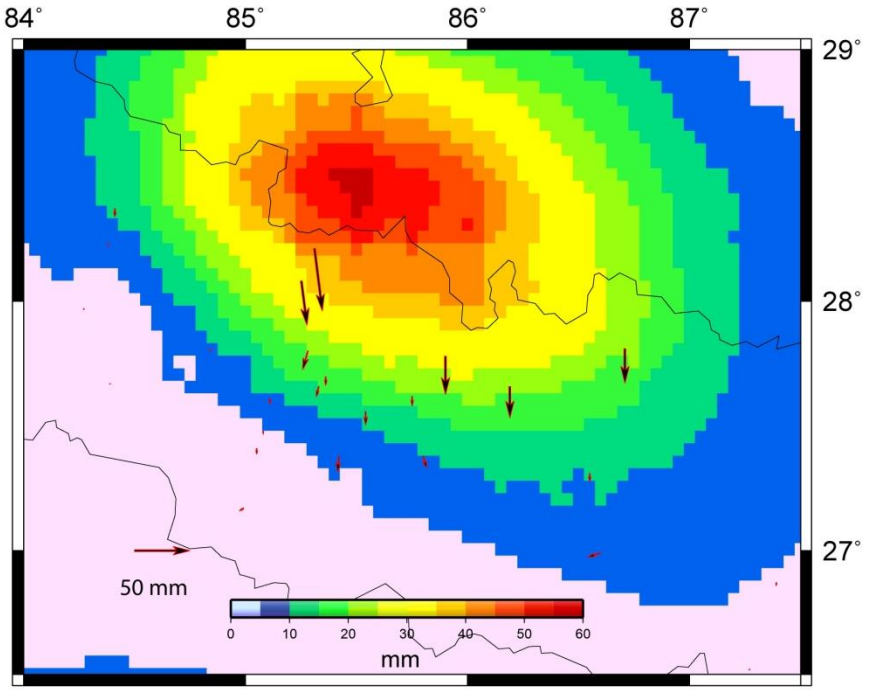
RMS	Wang
E m	0.07
N m	0.02
U m	0.03



Post seismic relexation



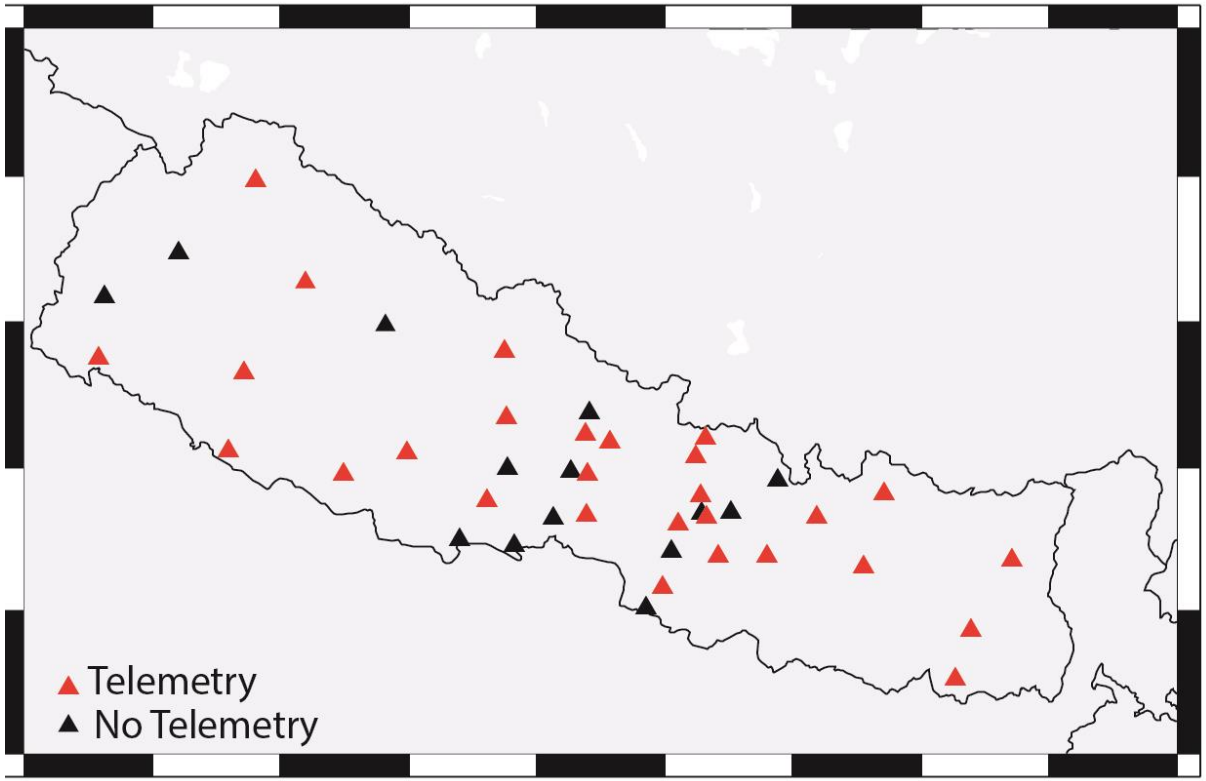
Mencin et al
Nature Geosciences 2016



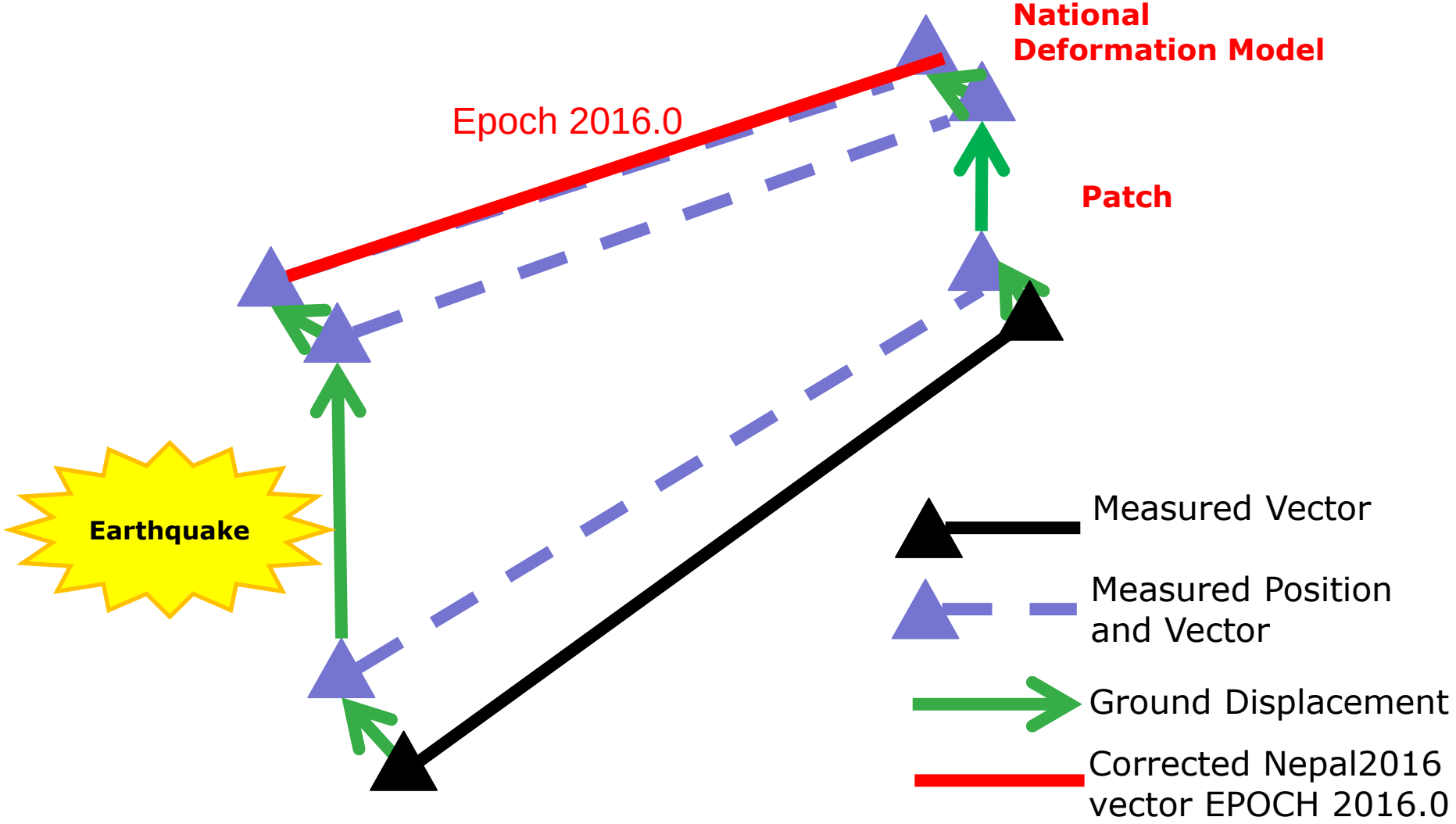
$$m_k(t) = v_k t + E_k H(t - t_i) + P_k H(t - t_i)\left(1 - e^{(t-t_i)/43}\right)$$

Control

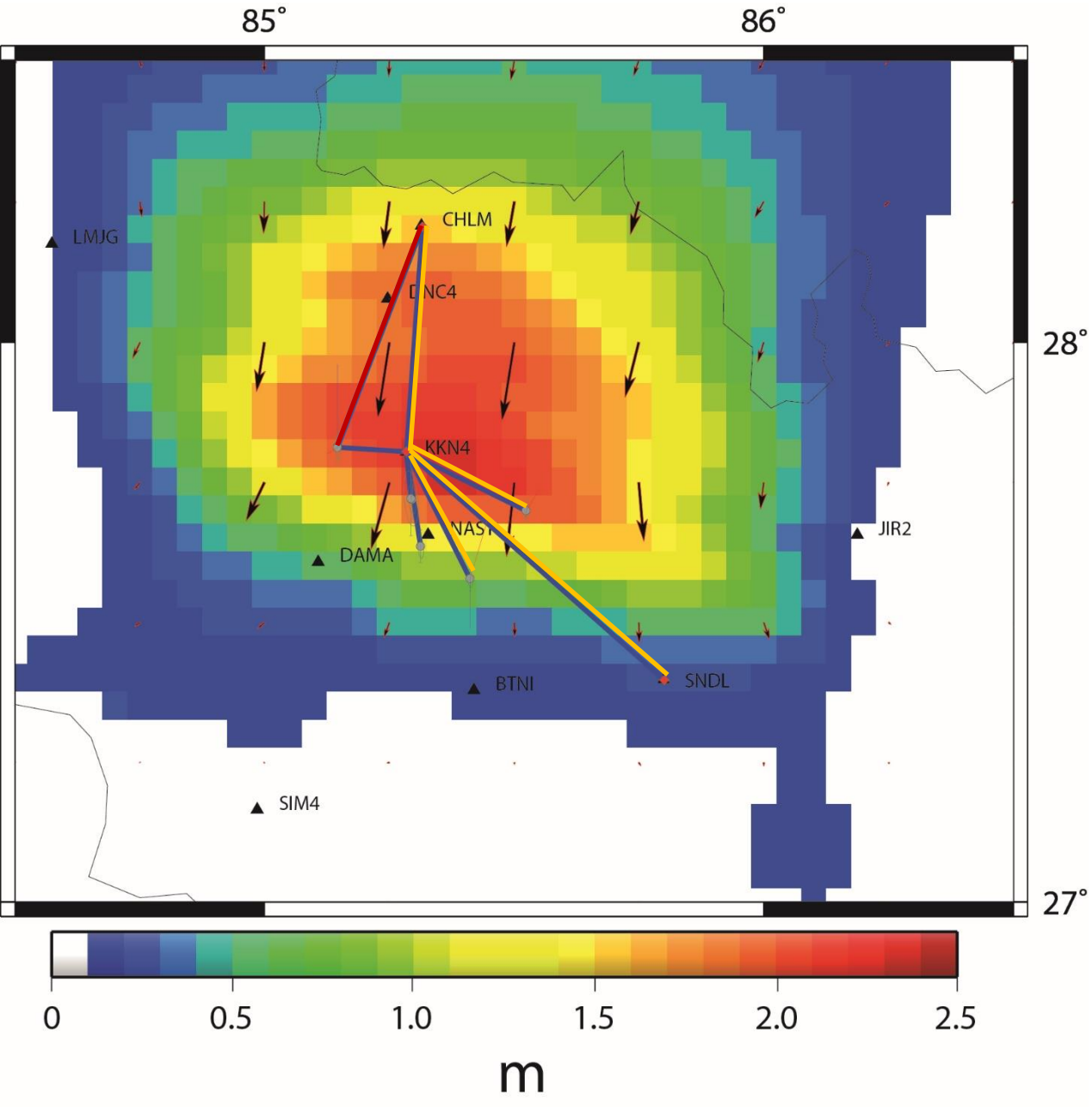
- The stations of the CALTECH network now operated by UNAVCO can be adopted as a 0 order network of CORS
- Coordinates determined using specialist GNSS software to give coordinates precisely aligned to the ITRF at epoch 2016.0

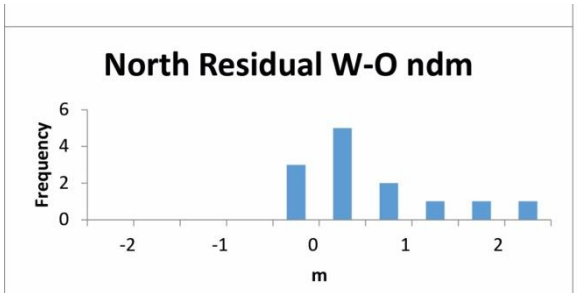


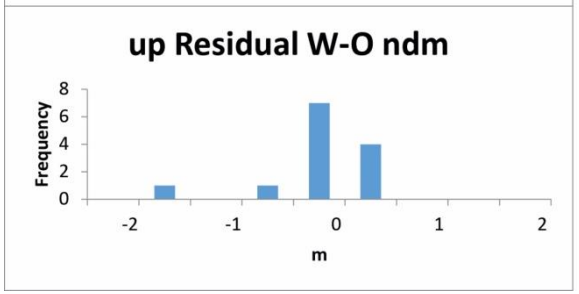
Deformation models in survey adjustments
Example: Patch for an Earthquake

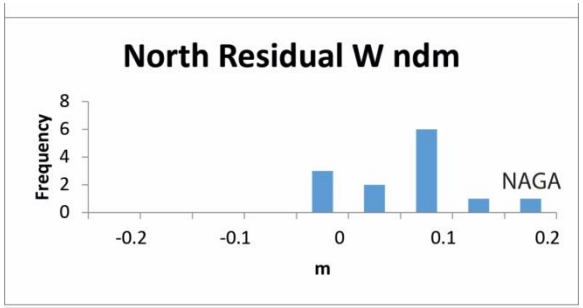


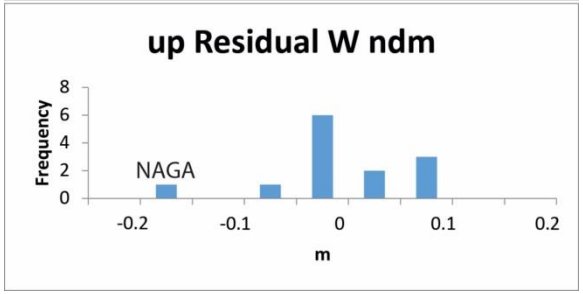
Adjustment of GPS before and after the Gorkha Earthquake





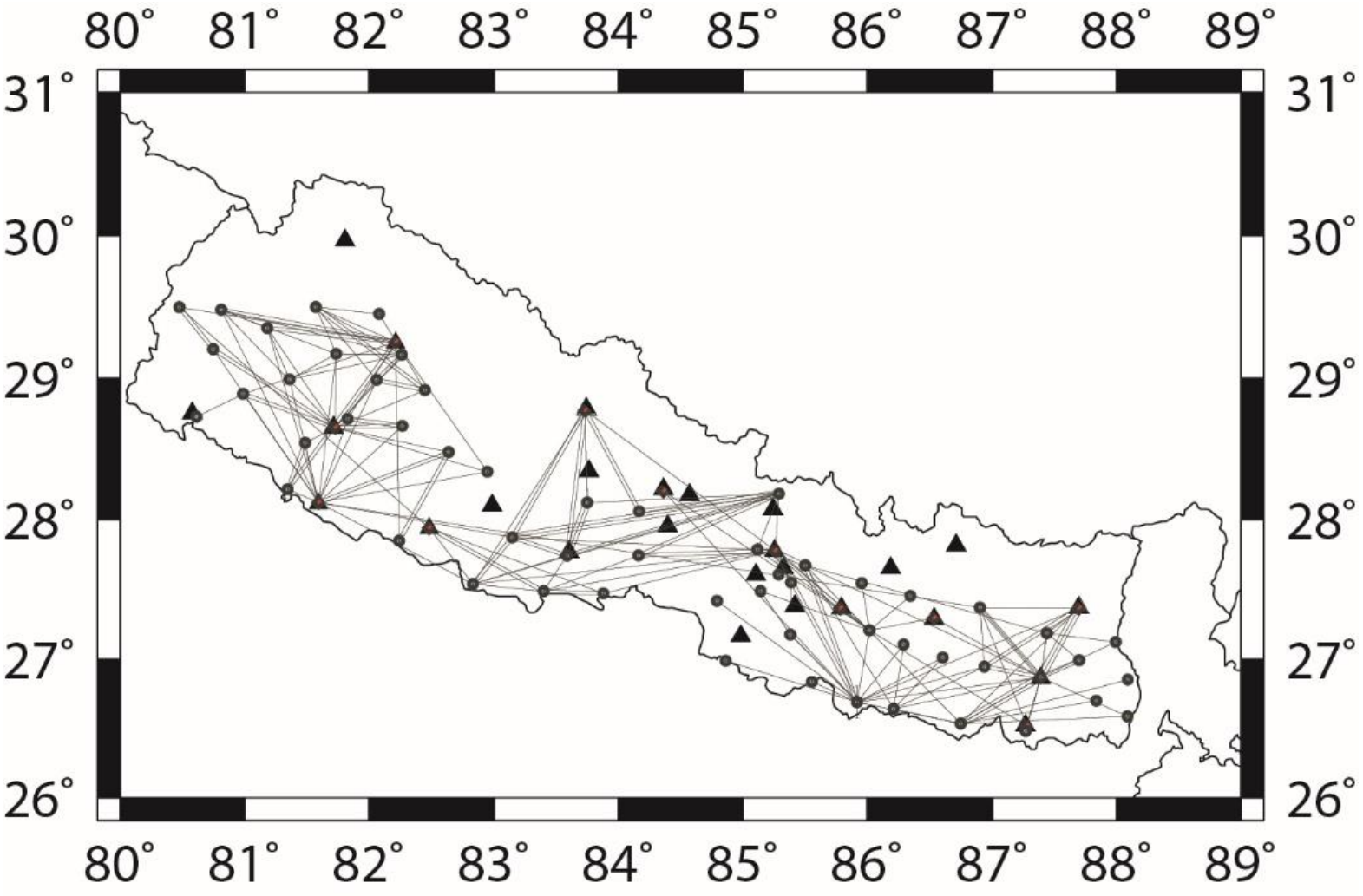






First Order adjustment Preliminary results

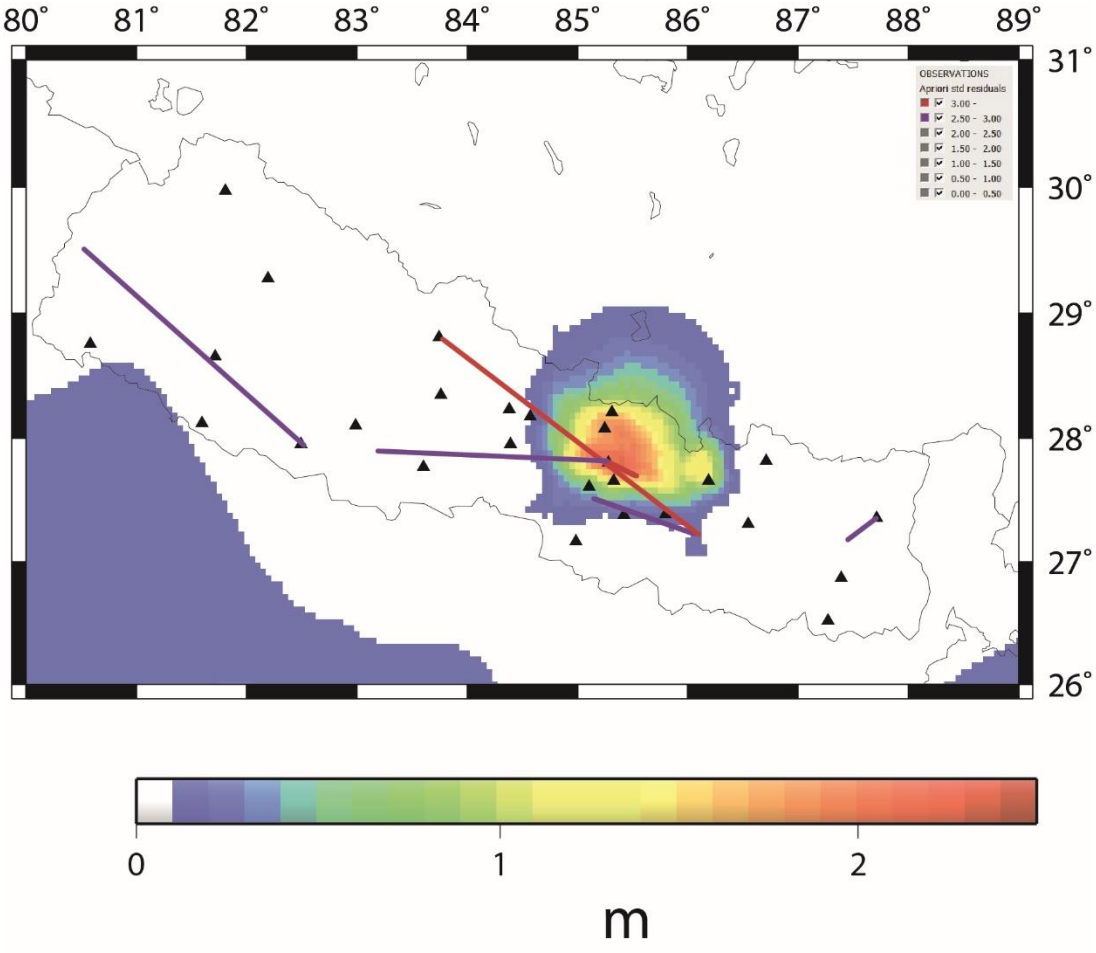
- Data from 2009-2016
- 222 baselines 217 used 5 rejections



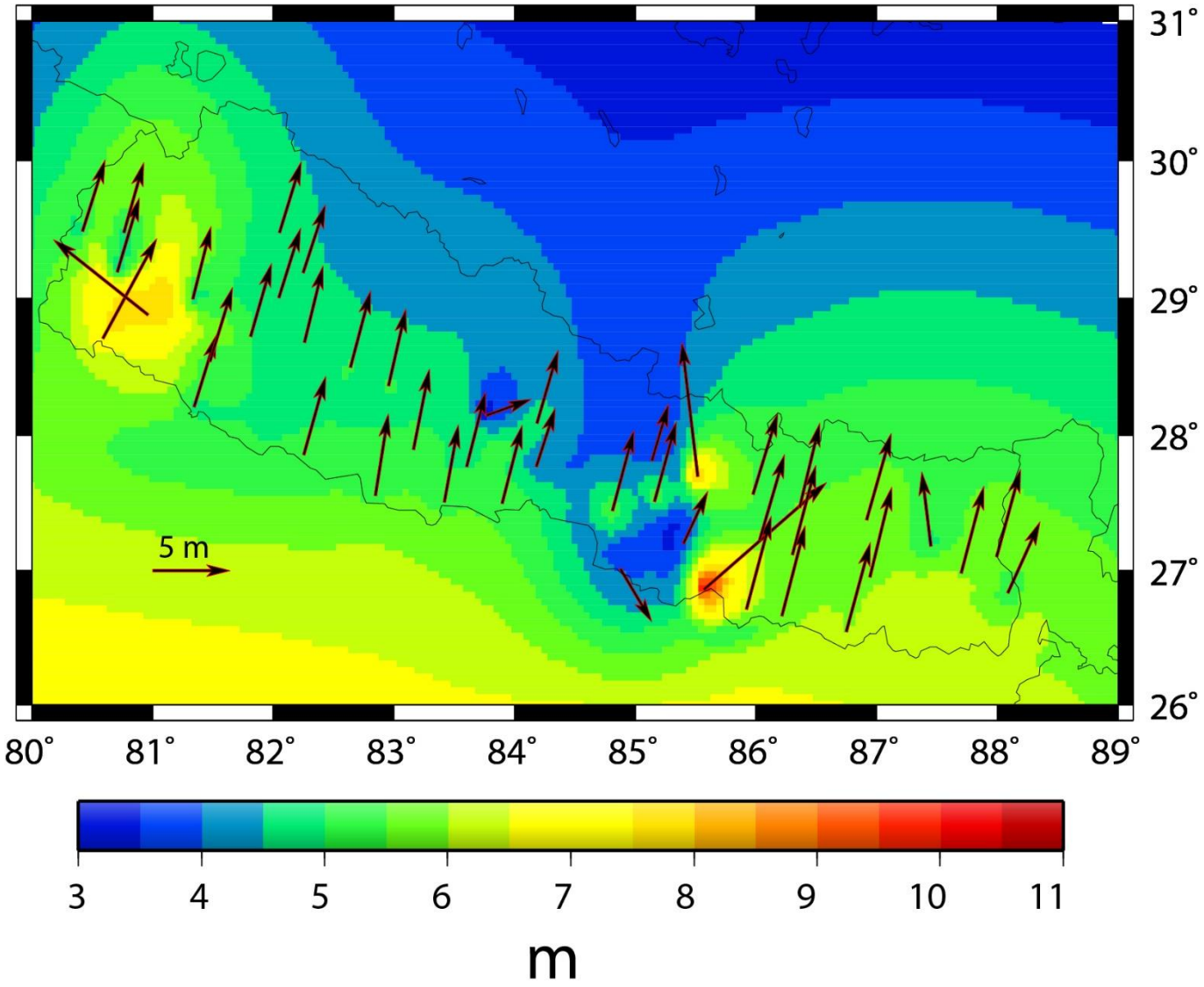
Results from adjustment

	max	min	mean	+- 1 sig	RMS
	m	m	m	m	m
Combined pre & post free adjustment seuw=					1.03
E	0.11	-0.12	-0.001	0.002	0.022
N	0.15	-0.29	0.000	0.002	0.027
U	0.34	-0.39	-0.003	0.005	0.069
Combined pre & post constrained adjustment					Seuw=1.2
E	0.09	-0.12	-0.002	0.002	0.023
N	0.15	-0.29	-0.001	0.002	0.027
U	0.32	-0.38	-0.005	0.005	0.074
Combined pre & post constrained wo NDM					Seuw=26.7
E	0.30	-0.49	0.000	0.008	0.104
N	0.92	-1.73	-0.022	0.028	0.383
U	1.19	-0.85	0.005	0.022	0.295

Significant baselines without aftershock model



Distortion grid Nepal 2016.0 – Nepal-Everest transformation



Conclusions

- datum aligned to a realization of the ITRF
- common reference epoch after the recent sequence of earthquakes
- deformation model
  - Velocity model
  - Earthquake displacements
- Control
  - Top level control CORS network
  - Establish lower order control relative to the CORS
    - New marks surveyed with GPS
    - Readjust existing measurements starting with 1st order
- correction grids to transform GIS coordinates from Nepal Everest into the new system.

DONE

to do or underway

Combined vertical displacements from Gorka earthquake and May aftershock