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

Tectonic deformation in the South Pacific, the effect on spatial references and what GIS professionals can do about it

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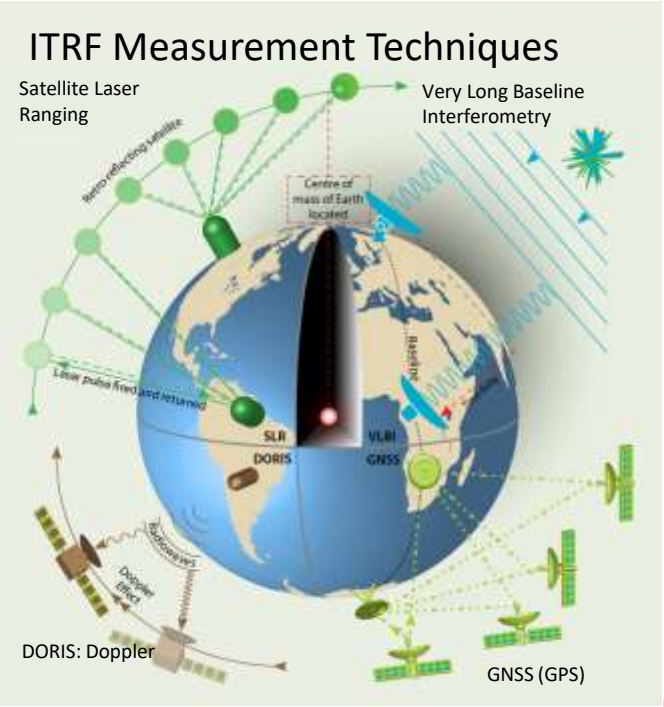
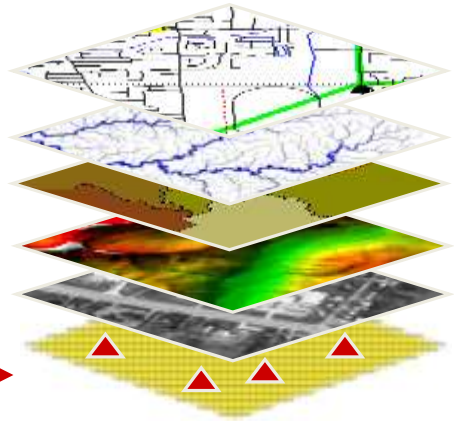


ITRF

NDM



Required by GPS

No deformation model

Datums and epoch dates change frequently

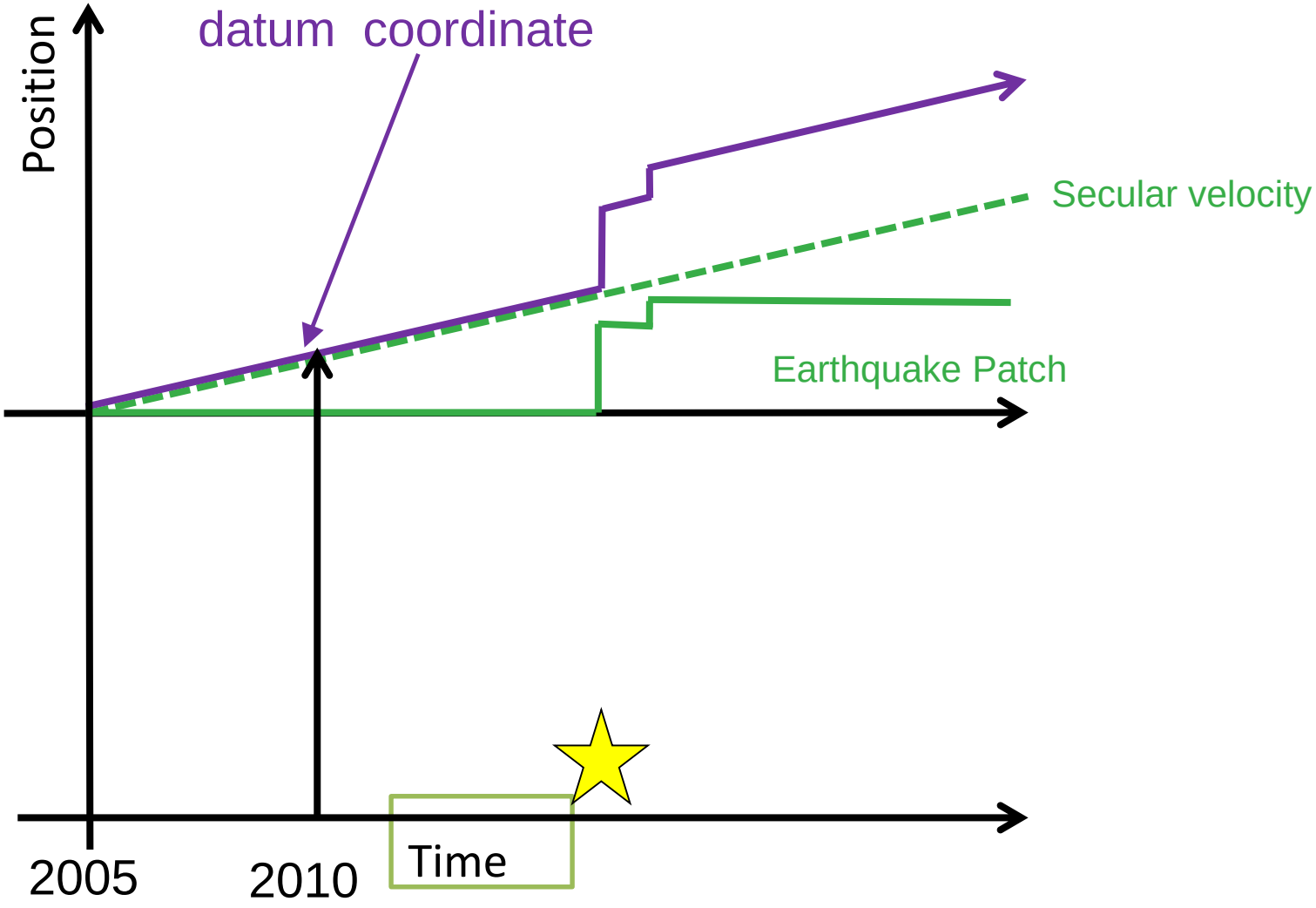
Semi dynamic datum

Stable coords

deformation model

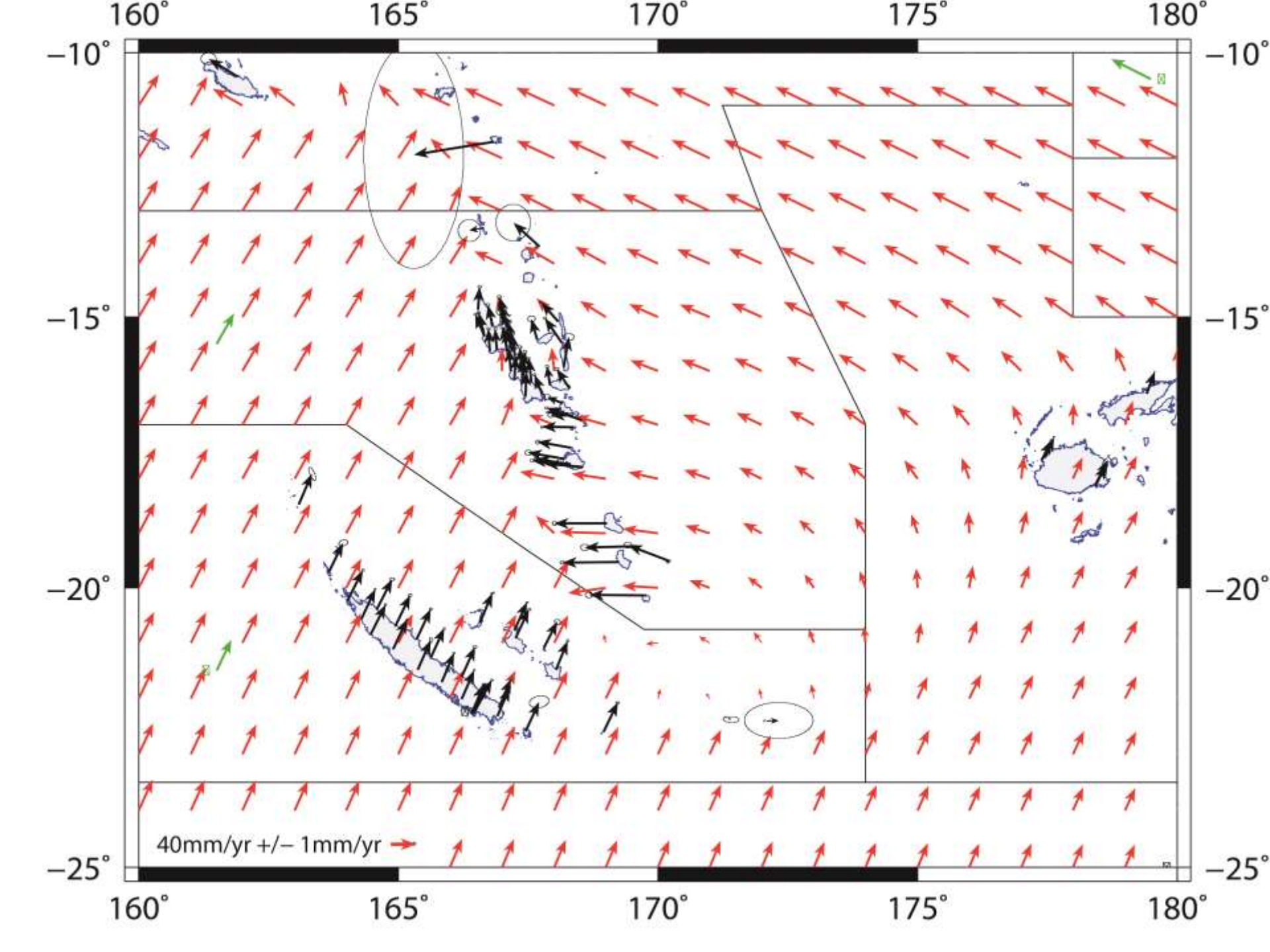
Semi dynamic datums are aligned with the ITRF Coordinates transformed reference epoch using the national deformation model

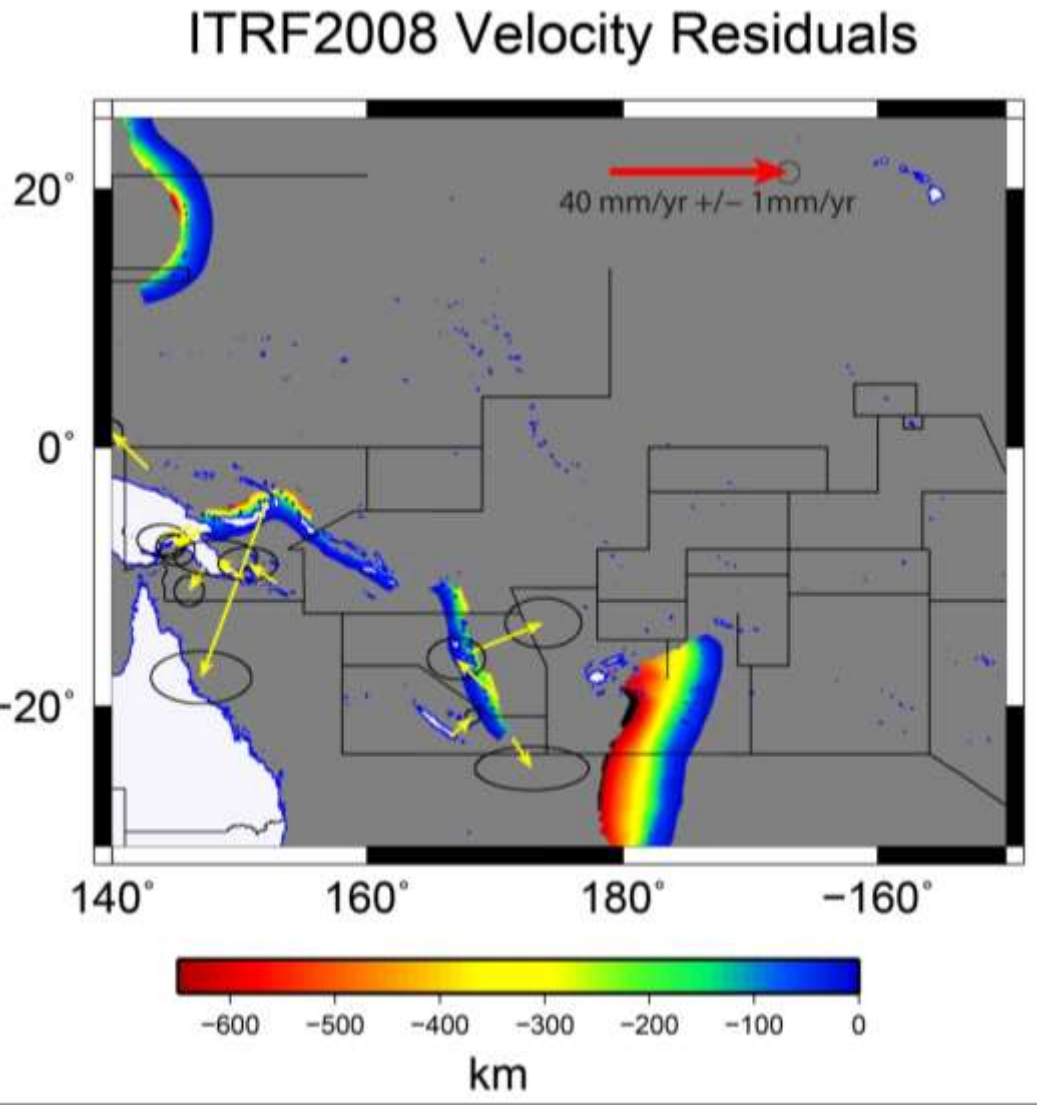
How the NDM works



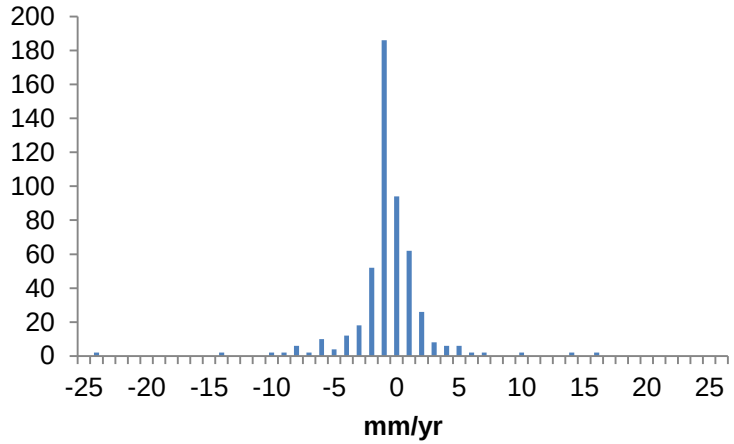
Problem with coordinates

- Using emerging technologies like Precise Point Positioning PPP and commercial PPk service (real time) cm level positioning is available is available globally.
  - However these are in coordinates in the ITRF represent the instantaneous position of the point the epoch of observation
- But almost all applications for precise coordinates require coordinates at particular time up to 20 years in the past.

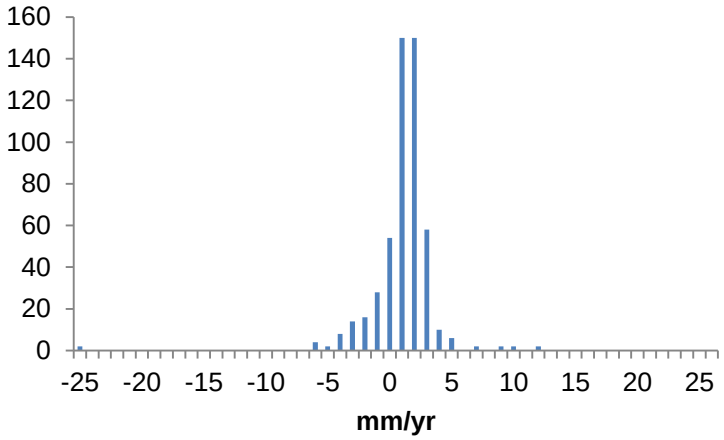

160°
165°
170°
175°
180°
−10°
−15°
−20°
−25°
40mm/yr +/− 1mm/yr

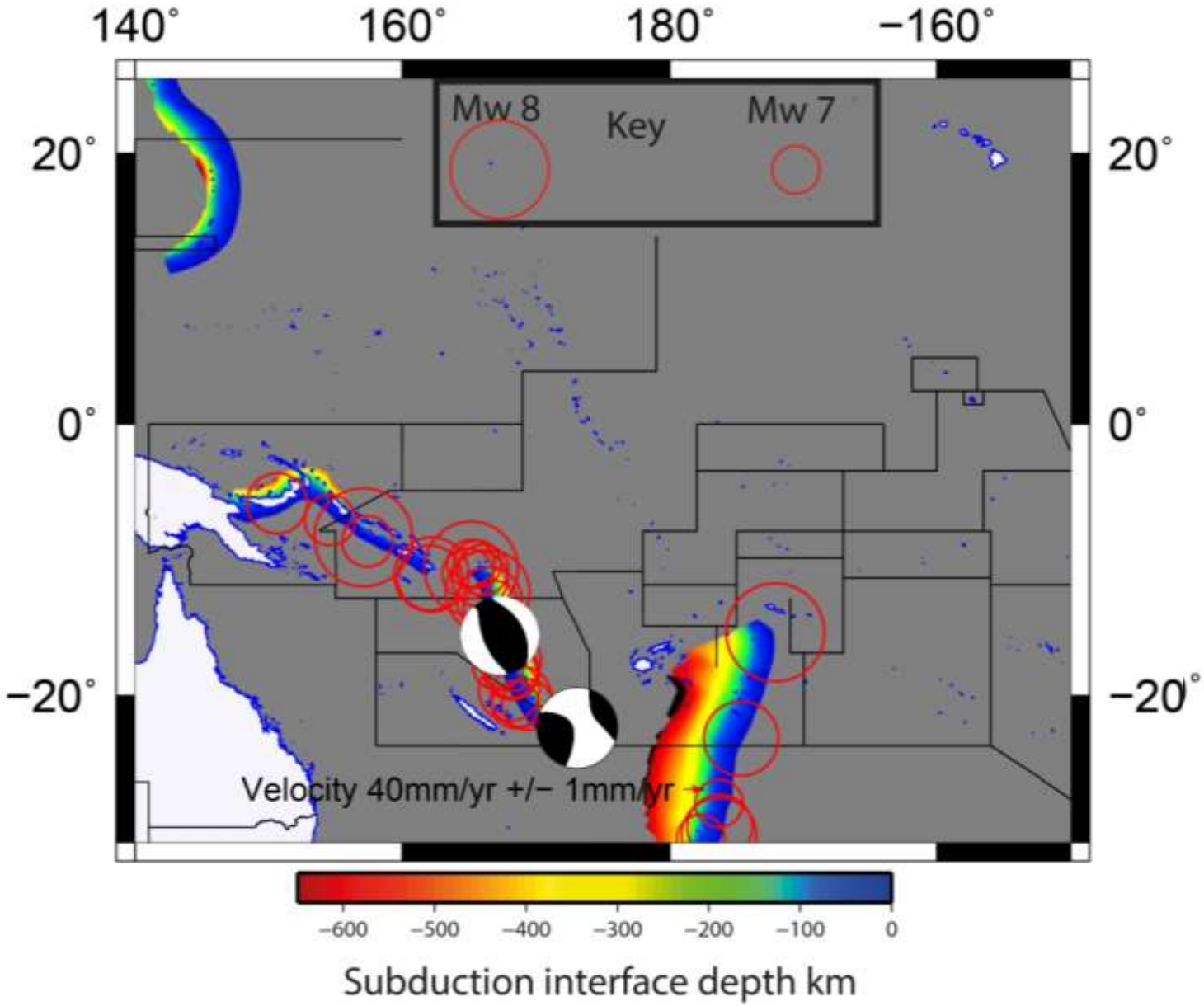


East Residuals

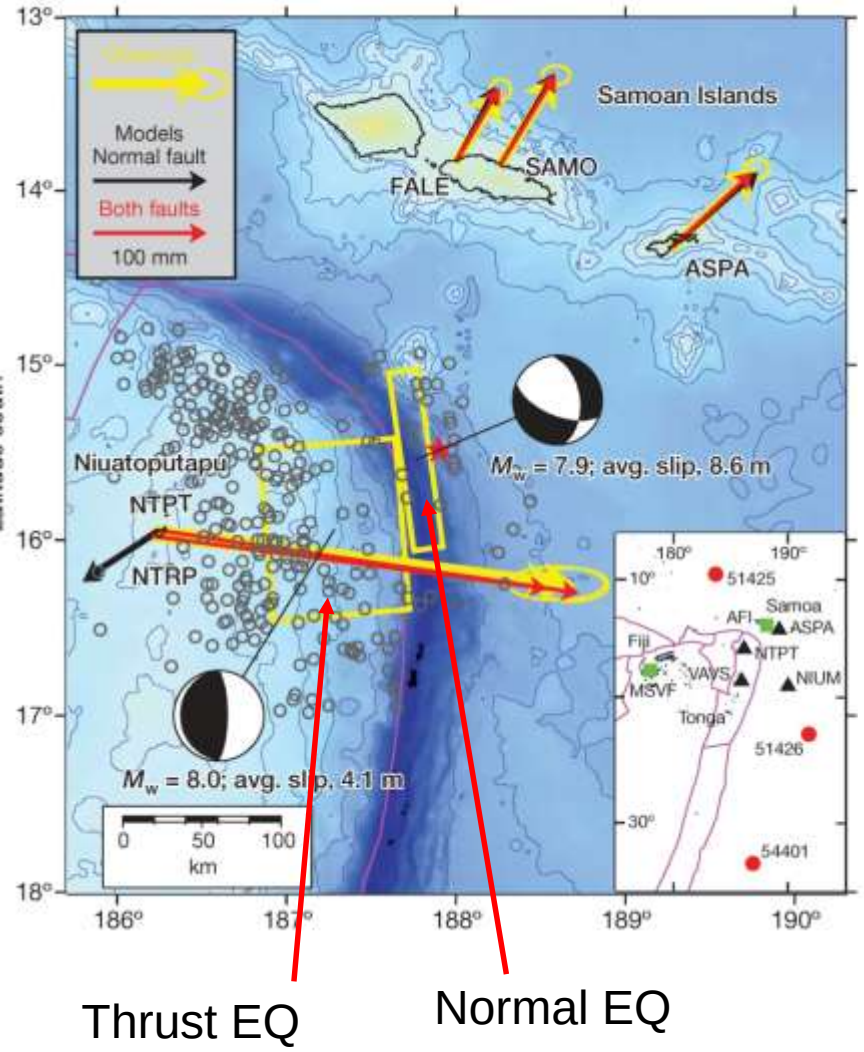


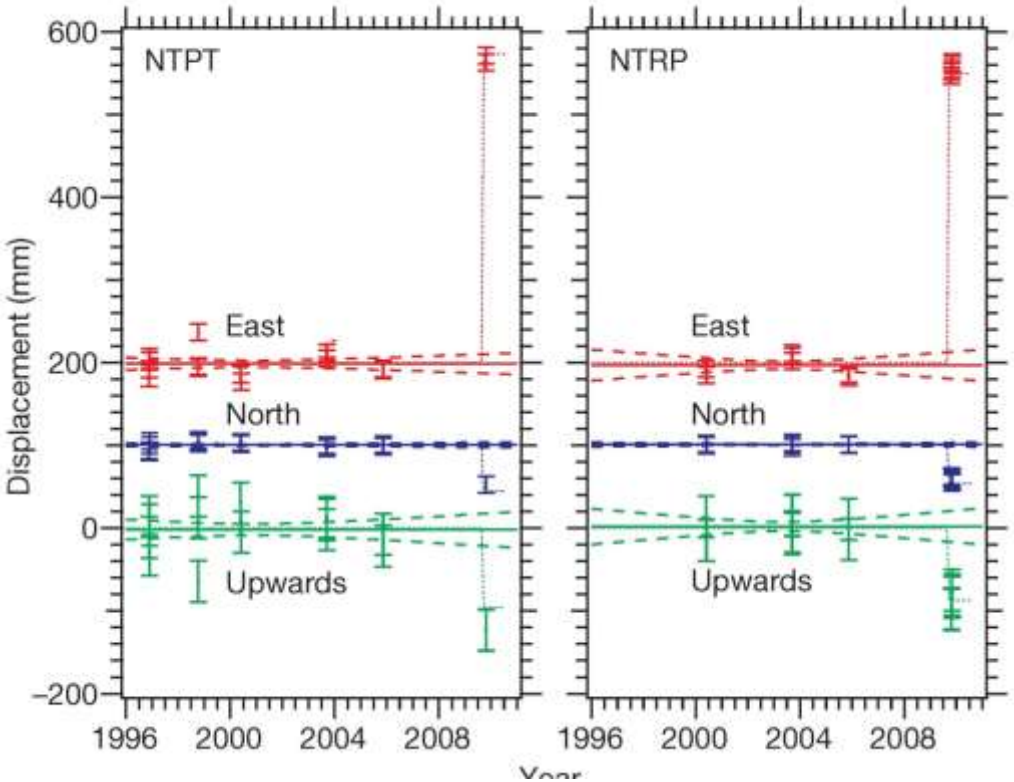
North Residuals




140°
160°
180°
−160°
20°
0°
−20°
Mw 8
Key
Mw 7
Velocity 40mm/yr +/− 1mm/yr
−600
−500
−400
−300
−200
−100
0
Subduction interface depth km

Tongan Earthquake of September 2009





Thrust EQ

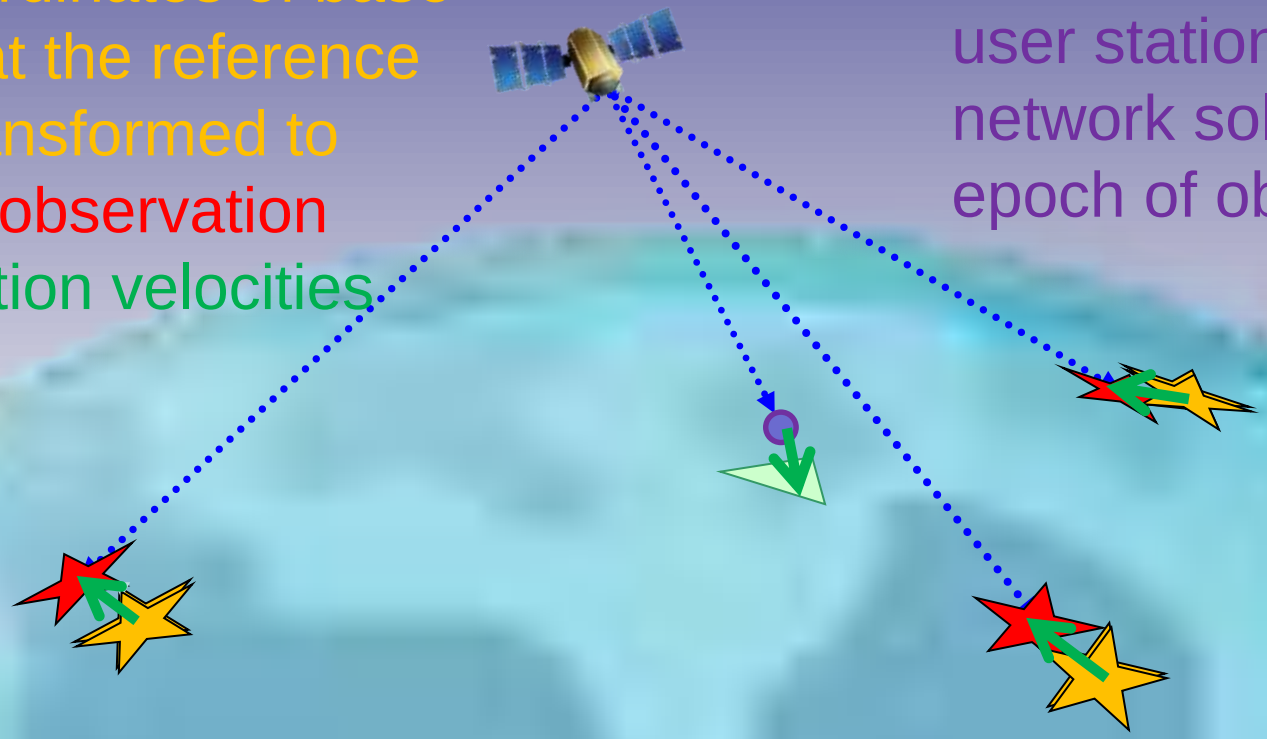
Normal EQ

Summary of PPP, PPk and AUSPOS processing

ITRF coordinates at reference epoch transformed to epoch of observation

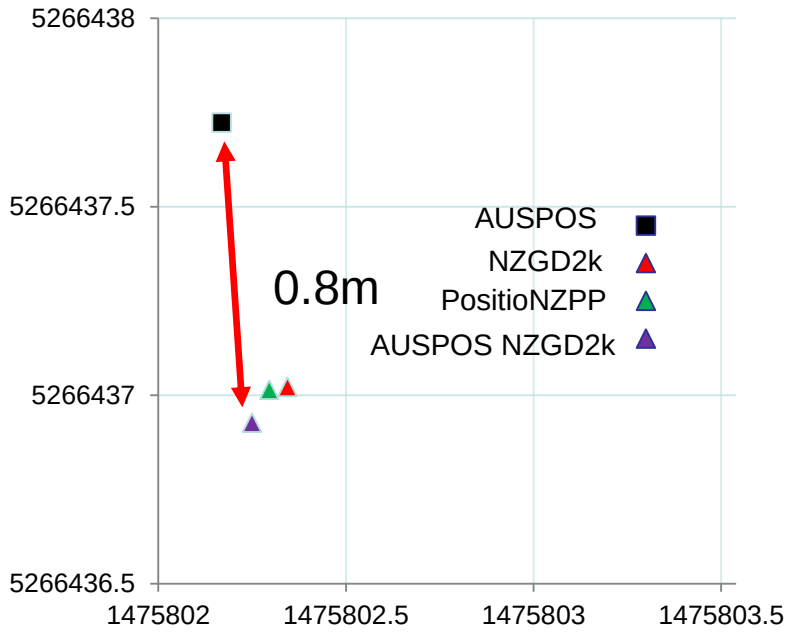
ITRF coordinates of base stations at the reference epoch transformed to epoch of observation using station velocities

ITRF coordinates from user station from a network solution a epoch of observation



ITRF coordinates need to be projected from epoch of observation to the reference epoch using NDM

Coordinate comparison



- All PPP and most Network RTK coordinates are actually in the ITRF datum at the epoch of observation
- Occurs because none of the commercial codes presently apply the deformation model
  - Produces nearly 1 m shift in vs NZGD2000 in New Zealand
  - On line position services like PositioNZ-PP do apply their national deformation model
  - Currently PPP and PPk users have to manually apply the deformation models

Conclusions

- The use of emerging technologies means that cm level positioning is available globally to the public.
  - Use of these positions require the development of accurate models to correct for crustal deformation
  - Our study indicates that a global velocity field model provide a reasonable estimate of the secular velocities but in rapidly deforming areas it is not accurate enough for geodetic purposes
  - Earthquakes are more of a problem. Future work should focus on the timely development of earthquake patches.