# Towards implementing dynamic datum data management in GIS

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## Outline

- Motivation
- Reasons for dynamic datums
- Managing dynamic data
- GIS approach
- Issues to address
- Conclusion

## Motivation

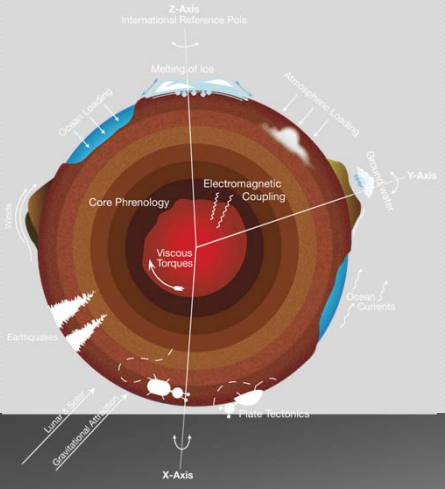
- ITRF pervasiveness – datum of choice
- GNSS pervasiveness
- Measureable crustal motion
- Regional spatial data infrastructures: INSPIRE
  - Infrastructure for Spatial Information in the European Community
- Broad scale dissemination via GIS

## Dynamic Geodetic Datum –

A geodetic datum that, by accounting for geodynamic phenomena, intrinsically yields coordinates that vary measurably with time.

***Measurability*** ***Scale*** ***Time interval***

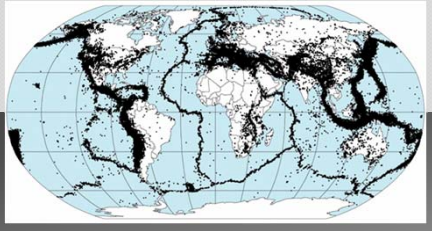
# Why dynamic datum?

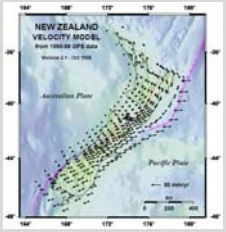


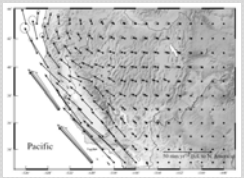

- Solid earth moves with respect to the reference frame
- Global mass redistribution
- Measurable geodynamic phenomena
- More accurate space geodetic data
- Improved geophysical models

## Coordinates are in motion

Tectonic plate motion





Regional crustal motion

## Who cares?


Significant even for surveys requiring only half-meter (±0.5 m; ±1.6 USFT) accuracy

## Managing dynamic coordinates

- Complex coseismic and postseismic displacement models
- Models can change with time after an event

Episodic event displacements

- 7-parameter similarity (Helmert) transformation
- 7 time derivatives of these parameters

Reference frame transformation $f_1 \rightarrow f_2$

$$X^{f_2}(t_k) = f(X_{f_1}(t_{k-1}), T, V, D) = T_{f_1}^{f_2}(t_k, t_0) + V^{f_2}(t_k, t_{k-1}) + D^{f_2}$$

Coordinates at epoch $t_{k-1}$ in frame $f_1$

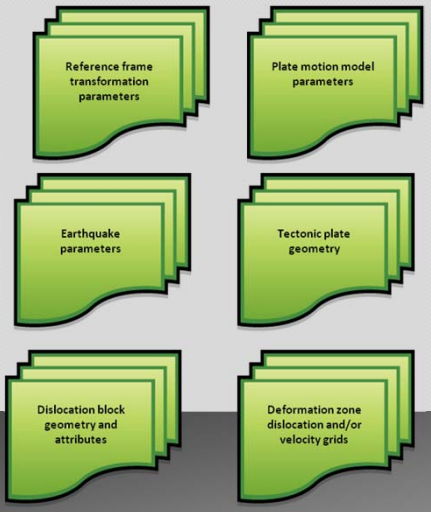
Crustal motion translation

- Gridded secular velocity models in deformation zones
- Global tectonic plate motion models in plate interiors

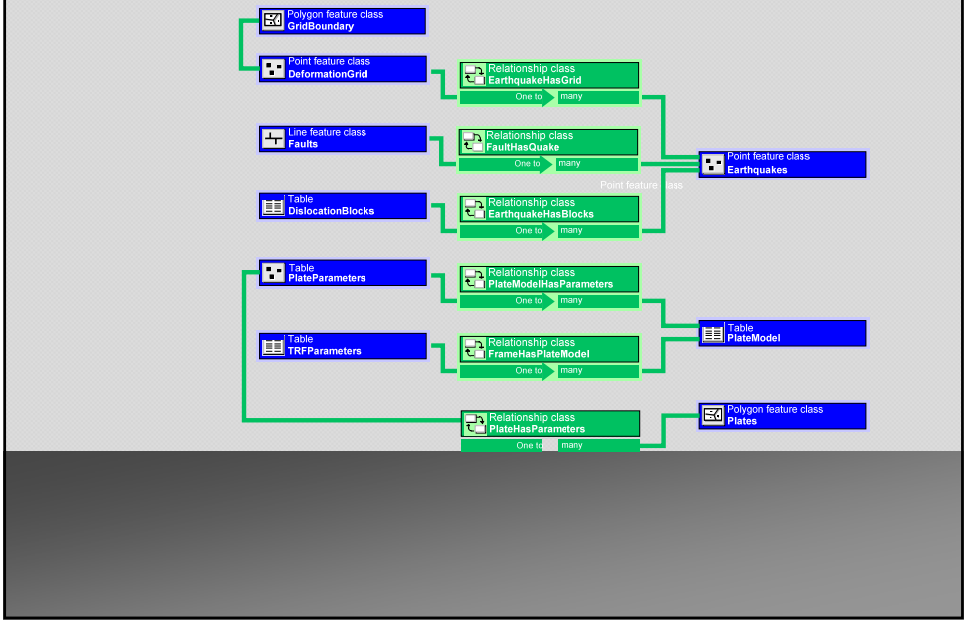
## GIS approach

- Unprecedented geospatial data manager
- Structure data and model inter-relationships
- Widespread use in geospatial community
- Disseminate models and tools
- Assist in generation of models and tools
- Flexibility and extensibility

## Dynamic Datum Data Model Components



## Crustal Motion Data Model Example

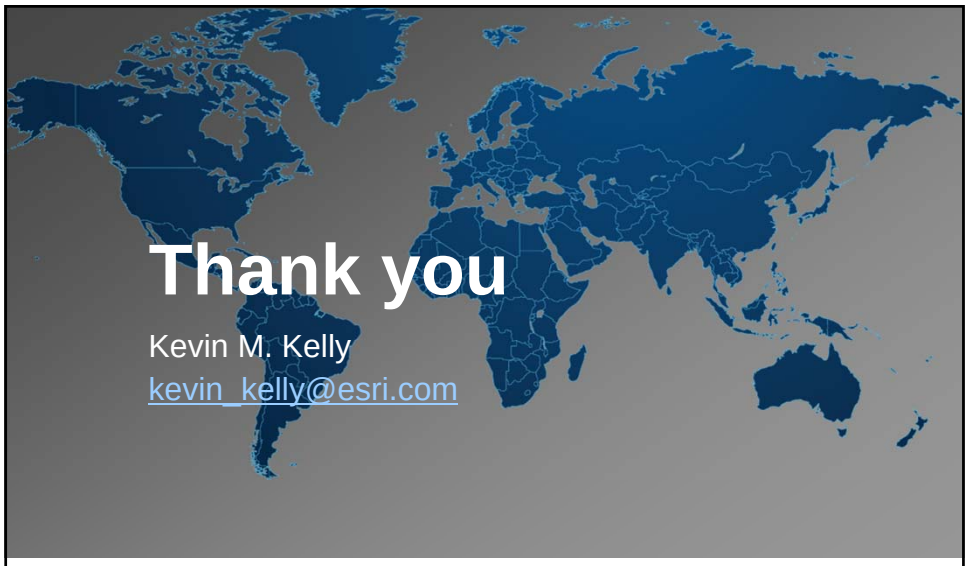



# Issues to resolve

- Representation of deformation/displacements
  - Multiple grids
  - Multi-resolution grids
  - TIN
  - Equation based
- Standardization
  - Data formats
  - Metadata and headers

## Conclusions

- Positional coordinates are in motion
- Measurable and significant for many geospatial activities
- Dynamic geodetic datums can handle this
- Dynamic datums can be implemented in GIS
- GIS can disseminate models and tools to transform positions over time
- Problems of model representation and standardization remain to be solved



# Thank you

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