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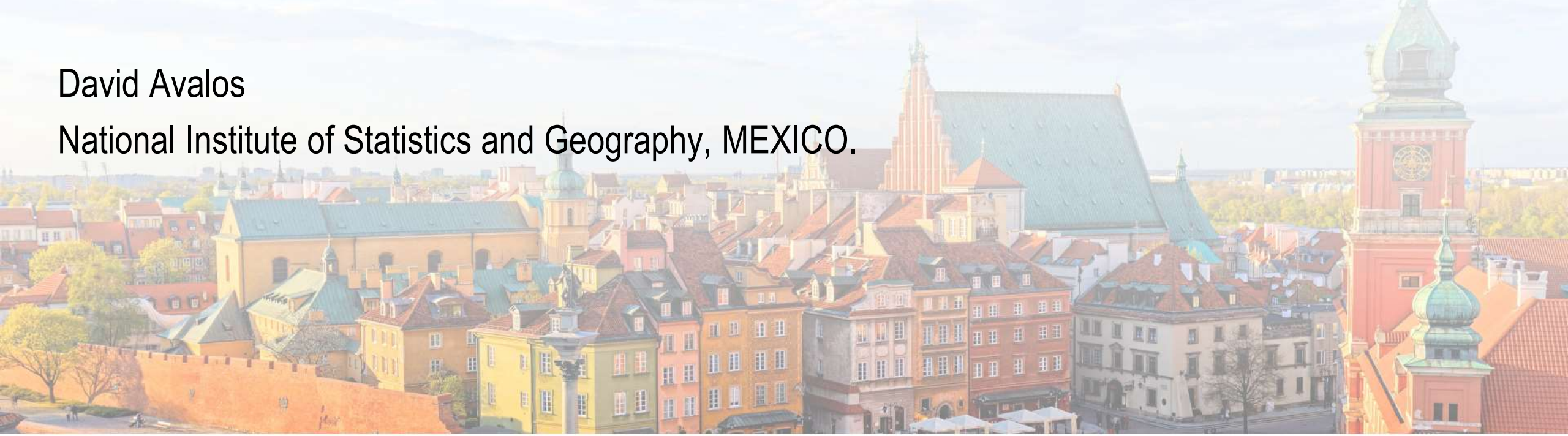
Volunteering for the future – Geospatial excellence for a better living

CONCEPTS RELATED TO MODERNIZATION OF VERTICAL CONTROL



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A **vertical reference system** is a set of conventional definitions and parameters, adopted as a basis to determine height values which are compatible and comparable for geodetic positioning.

Elements:

- Define the way Datum is reached or calculated,
- Define the type of height to be observed,
- Determine the units of measure,
- Determine the tide system,
- Determine the reference frame for positioning,
- Define the normal gravity field to be used,
- Define the way time variations are considered.

A **vertical reference frame** is a realization of the system, consisting of a dataset of height values associated to a corresponding set of physical marks and some declaration of the uncertainty in such values to allow users propagate the conventional heighting measure by relative observations.

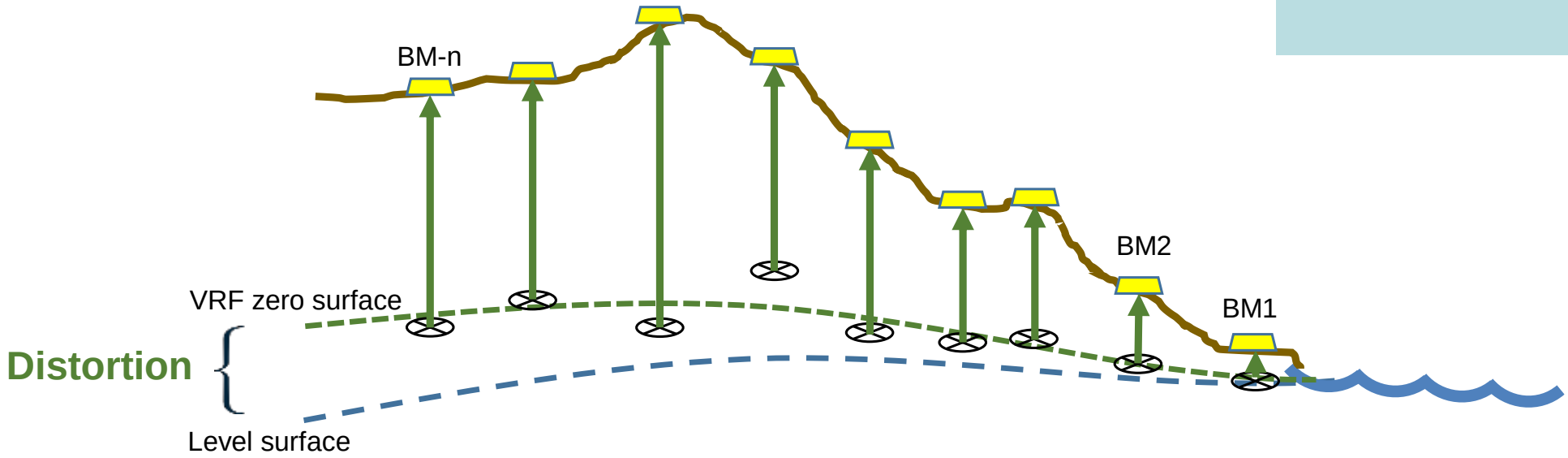
It should contain:

- Site descriptions and associated height values,
- Declaration of uncertainty,
- Description of the methodology implemented,
- An estimate of time variations in Datum or heights.

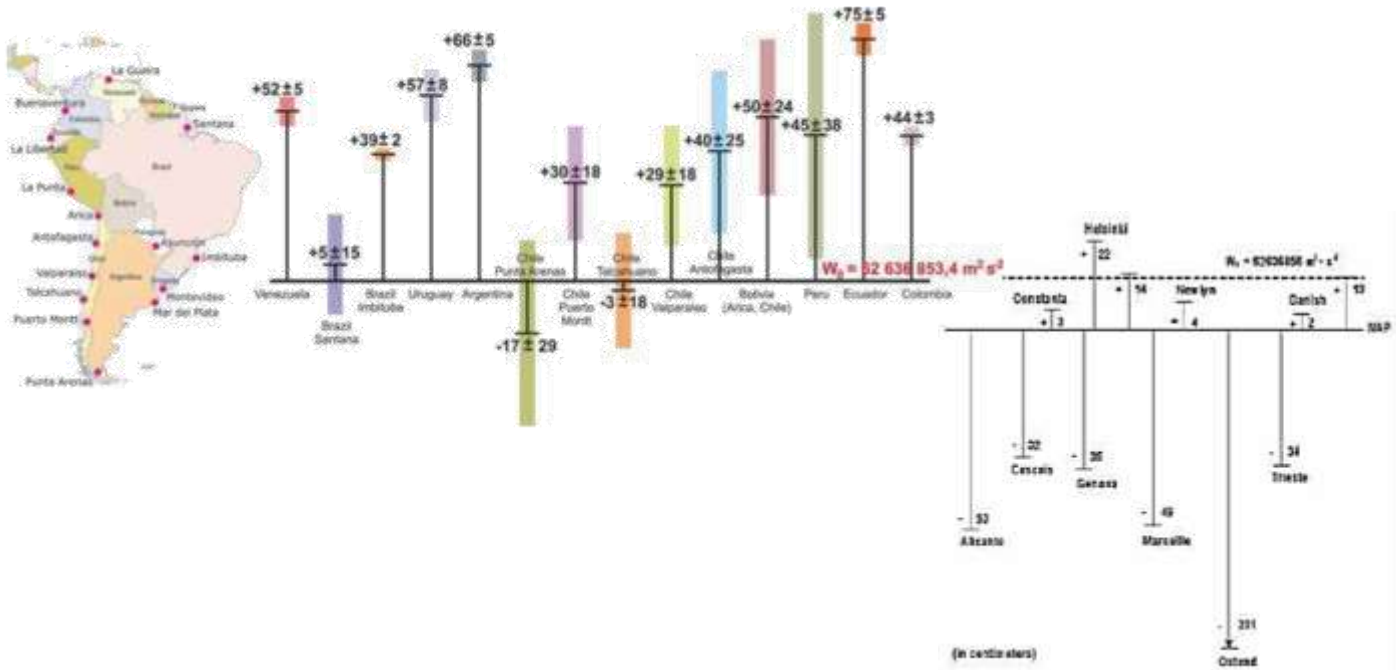
Datum and distortions

The error in heights from a vertical reference frame, can be interpreted as an actual error in the datum propagation; i.e. an estimate of the datum distortion.

Datum distortion: is the systematic part of the error in the datum track.



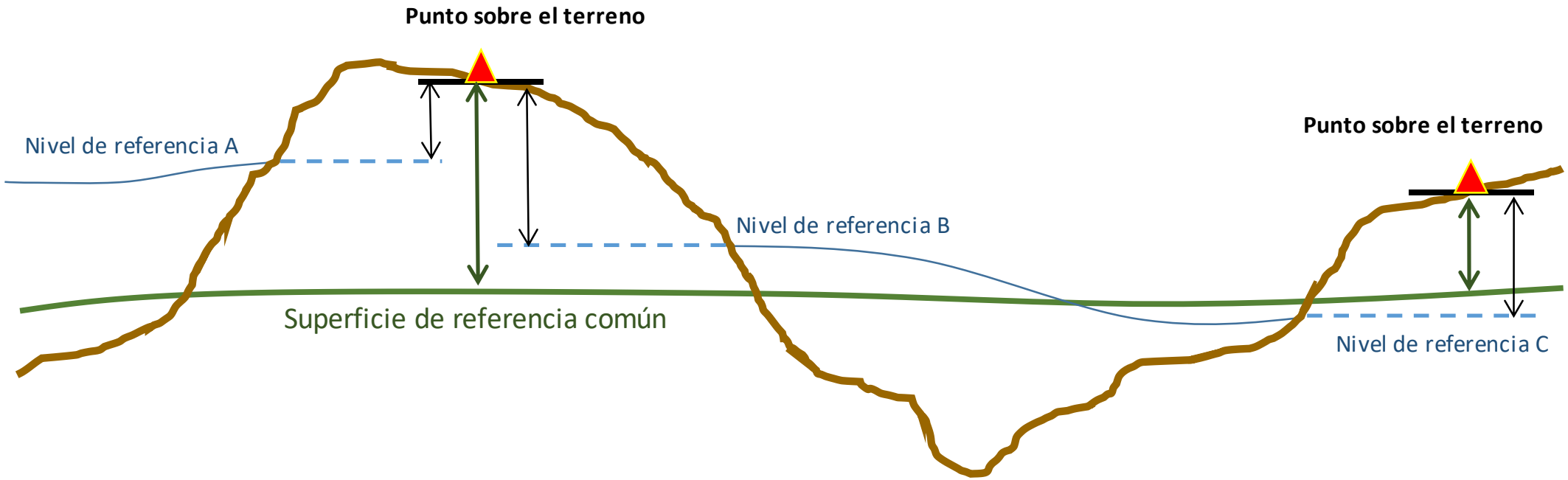
There are more than 100 national datums, all with significant differences.



Source: http://www.bkg.bund.de/geodIS/EVRS/

IHRS

The determination of a single reference level will allow the unification of height systems.



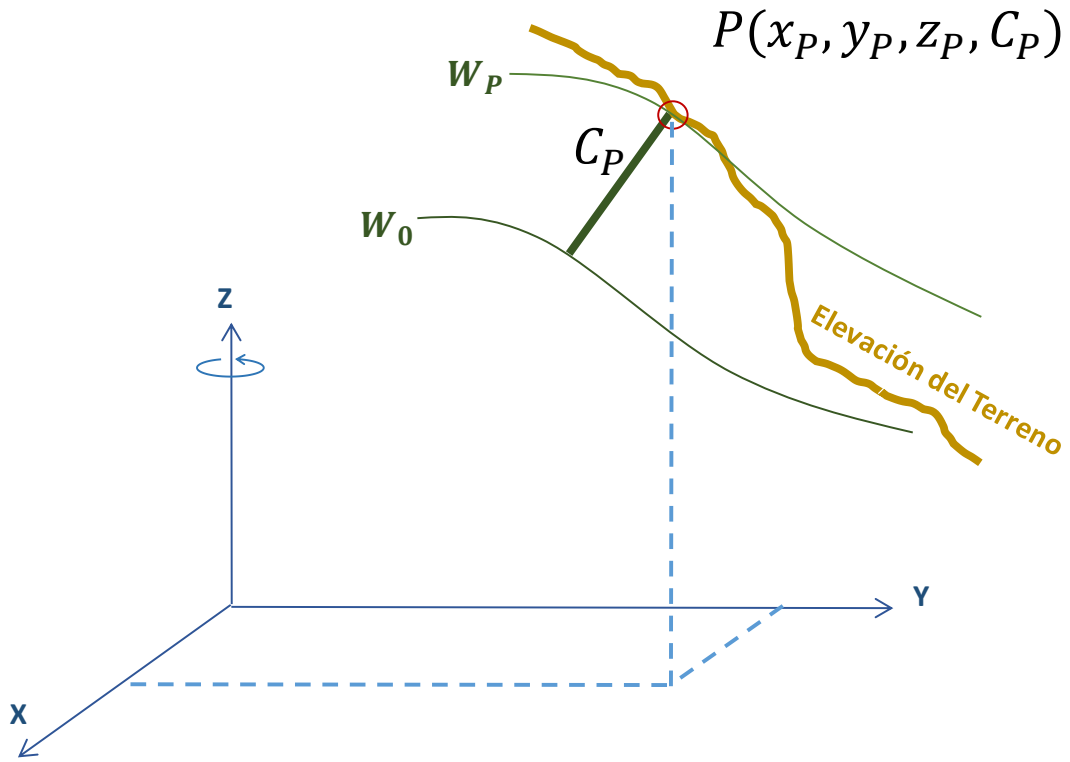
IHRS:

- The vertical reference is an equipotential surface with a fixed Wo value.

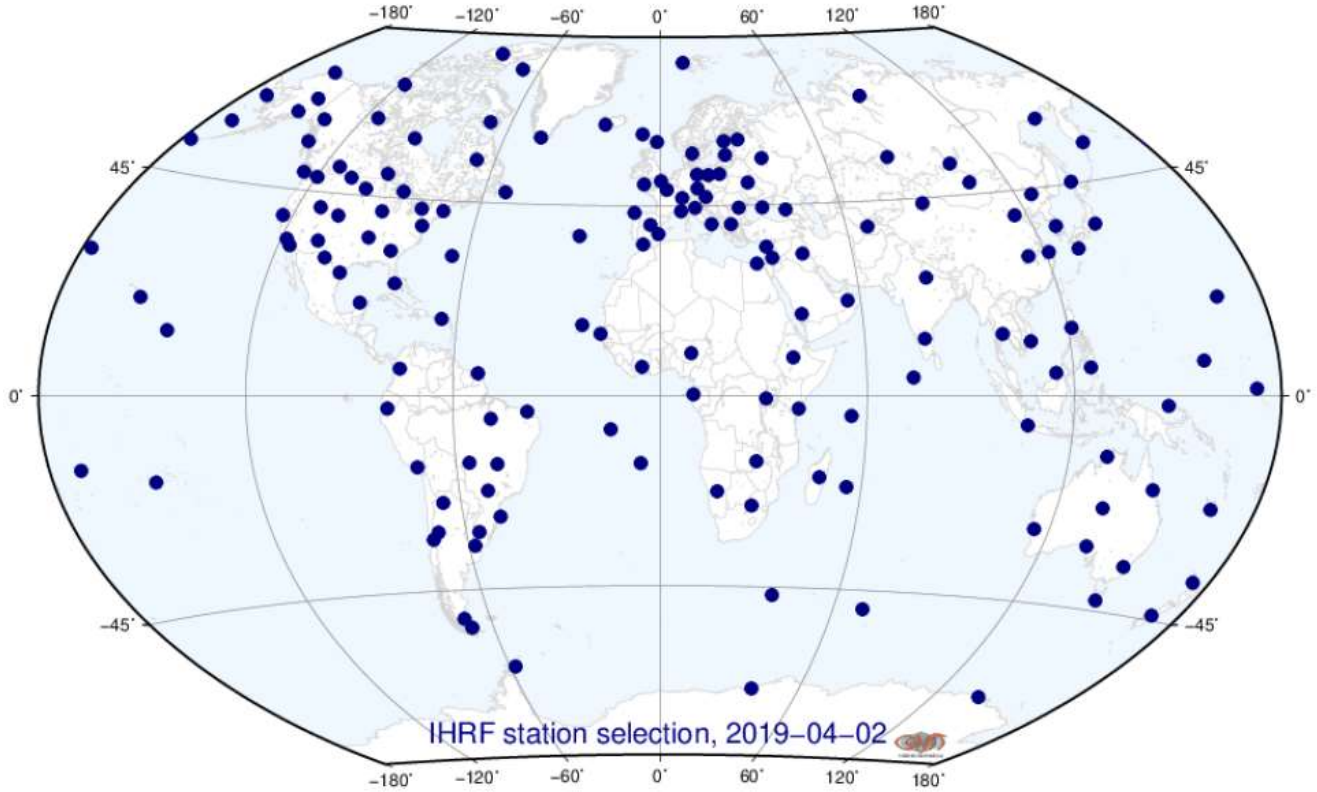
  Wo = 62 636 853.4 m^2s^{-2}

- Heights are determined by differences of gravity potetial.

$$H_B = \frac{W_0 - W_B}{\hat{g}} = \frac{C_B}{\hat{g}}$$



Every country is encouraged to produce and maintain its IHRS stantions, computing the potential Wp as accurate as possible.



Preliminary reference network for the IHRF:
170 stations welldistributed worldwide, materialized by GNSS continuously operating stations and co-located with:

- VLBI (30 sites),
- SLR (40 sites),
- DORIS (35 sites),
- absolute gravity – IGRF (77 sites),
- tide gauges (26 sites),
- national levelling networks (23 sites).

This is how we get the potential fon an IHRS station:

A) The Wp value can be extracted from a global geopotential model. This can be achieved with very simple steps, but is less recommended option.

B) Derive Wp from existing national geoid or quasigeoid model.

$$W_P = W_{P,satellite-only} + W_{P,high-resolution}$$

C) Enhance the resolution of available gravity field modeling, by specialized computations capable to combine satellite and terrestrial data. This can be more precise than any geoid model.

$$W_P = U_P + \gamma\,\zeta_P + (W_0 - U_0)$$

Conclusions

- Every local or national VRF contain distortions that have to be modeled and declared.
- Distortions in VRF based on gravimetric geoids/cuasigeoids tend to be random and smaller as technology advances.
- The world trend is to determine heights on a gravimetric reference that supports the epoch variation.