Do we need new definitions for the EVRS and EVRF?

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Yes, it is unavoidable

- **Background**
  - **EVRS2000 is defined as a World Height System: reference level is the potential of the Mean Earth Ellipsoid ($\Rightarrow$ geoidal potential W_0)**
  - **EVRF2000 realizes this through the conventional NAP (Normaal Amsterdams Peil) datum W_{NAP}**
  - **however, at present observation accuracy it is already known that W_0 and W_{NAP} differ,**
  - **best estimate now $(W_0 - W_{NAP})/\gamma = -11 \pm 8$ cm**
  - **error going down very fast with GRACE and then GOCE**
  - **either EVRS2000 or EVRF2000 or both must be revised**

Questions and (my) answers

- If the EVRS2000 definition as WHS is kept, how to define the new EVRF? (OK)
- Does a continental European datum different from WHS offer important advantages?
  - Continuity (some)
  - Other advantages (none)
- If a continental datum is adopted, how to define it stably and accessibly ? (WHS + offset)

Putting the world datum into EVRF

- $W(x,y,z)$ geopotential model
- Fix a W_0 ; the W_0 best fitting the global sea level
- $W(x,y,z)$ is averaged over 3-D points throughout the UELN using potential differences from the UELN, to get the relationship to W_0
- note in addition that $W(x_1,y_1,z_1) - W(x_2,y_2,z_2)$ is ”a levelling observation” which at large distances competes with the UELN result
- the above can be formulated equivalently in terms of geoid heights

Do we need a continental European datum offset from, or moving relative to a WHS?

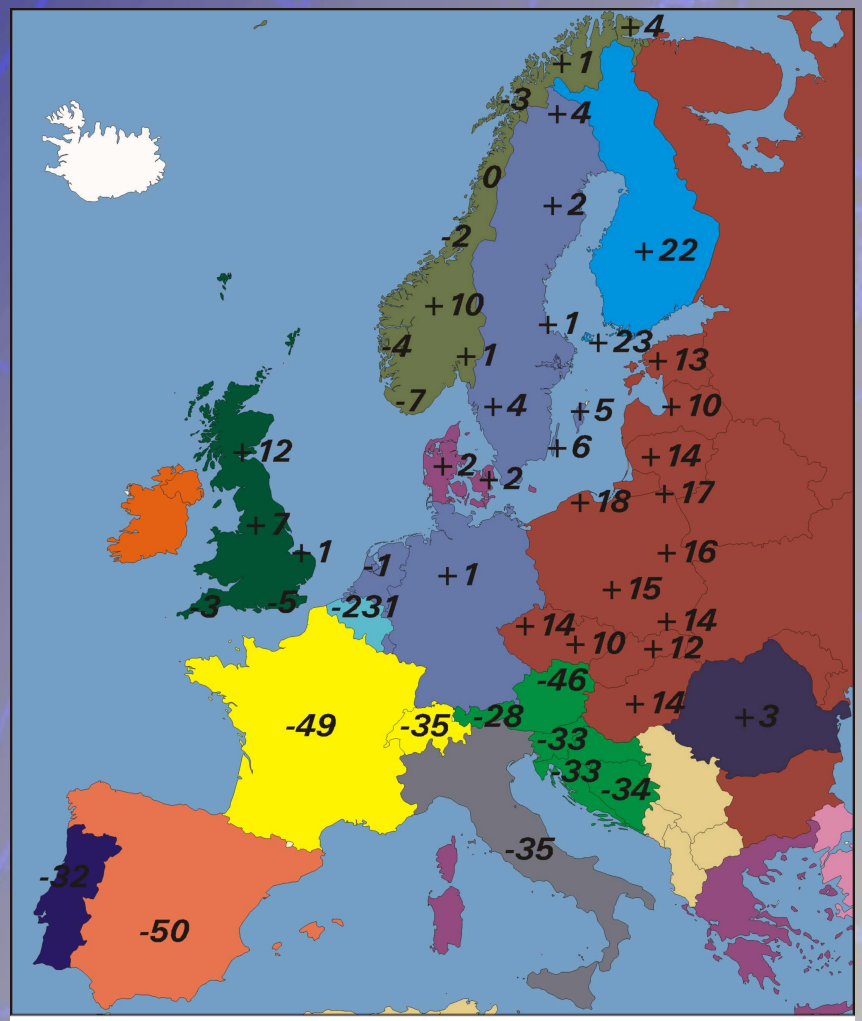
- no common-mode vertical motion of Europe needs to be eliminated (unlike in ITRS, plate motion eliminated by ETRS89)
- coastal sea levels in WHS
  - Baltic 0.0...0.1 m
  - Mediterranean -0.4...-0.5
  - others in between
  - i.e., no need for offset
- Conclusion: no fundamental physical need for a special European datum

Advantages from continuity from keeping ”NAP”?

- how much is just psychological?
- all numerical values will be changing in any new EVRF
- no widespread use of EVRF outside the scientific community so far
- but national systems adopted between now and new ”world EVRF” do have a problem

Size of transformation parameters from present-day national systems

Transformation from National Height Datums in Europe into the EVRF 2000 Datum (NAP) (Sacher et al., 2002)



Differences between UELN heights and national heights in Europe (in cm)

Subtract 11 cm to get transformation parameters to ”World EVRF”

Conclusions drawn

- The only argument for a continental datum is continuity (?)
- So the competition is between NAP and a WHS
- I prefer WHS
- But, assuming that NAP is kept anyway, how to proceed?
- NAP must be re-defined!

NAP definition problems and methods

- Present definition through BM geopotential(s) in a moving region unsatisfactory
- Original historical definition through TG intraceable
- Re-definition through one or more TG datums possible but brings problems in maintenance in a moving Europe
- Re-definition: through the average of multiple BMs in EVRF2000, and maintenance by keeping their centroid fixed in future EVRF

Preferred New NAP

- Define EVRS200x by $W_0 + W_{offset}$
  - W_{offset} is determined empirically at the creation of EVRF200x
  - $W_{offset} \approx W_{NAP} + W_0$ is chosen to provide (on the average) the same reference as NAP in EVRF2000
  - keep the W_{offset} fixed ever since
  - then EVRS200x is accessible just as a WHS system would be, even without access to UELN, in the Antarctica if needed...

Practical steps I

- Keep the EVRS2000 and EVRF2000 unchanged for the time being
- Except for time-tag for the W_0 later, EVRS2000 can stand “forever”
- EVRF200x will be a genuine realization of the WHS using:
  - UELN0x with all levellings brought to the zero tidal system and including
  - model corrections for postglacial rebound
  - A time-tag for the heights
  - The post-GRACE global geopotential model
  - EUVN_DA
  - The beta-version of the European Gravimetric Geoid EGG200x

Practical steps II

- The EVRF20xx will be a cm-order genuine realization of the WHS using, in addition
  - corrections from an highly accurate European velocity field from EPN and ECGN and other sources
  - time-tag and associated velocities for the heights
  - the post-GOCE global geopotential model
  - A big number of EPN and other CGPS stations joined to the UELN0x
  - The final version of the EGG200x

If the NAP is retained (or rather re-introduced) as an offset to WHS, then

- Determine and fix W_{offset} at STEP 1
- Use W_{offset} again at STEP 2
- No other changes

Proposed resolution

- endorsing
  - the definition of the European Vertical Reference System EVRS2000 as adopted at the Tromsö meeting in 2000
- noting
  - that the progress in geopotential models will soon make possible its realization as a genuine World Height System
- requires
  - that the TWG prepare the technical specifications for a new EVRF, and presents them to the EUREF meeting of 2005, with a view of the new EVRF becoming available in 2006