

Commission

Towards a standardized European vertical datum for coastal mapping

EUREF 2016, San Sebastian

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EMODnet iniative

- European Marine Observation and Data Network (EMODnet): cooperation between organisations assembling marine data, products and metadata made freely available to users
- "Collect once, use many times"
- Data dissemination through eight thematic data portals
- Coastal mapping was initiated in 2015 (at the end of EMODnet phase II)





Coastal mapping project objectives

- Assess the current availability of digital coastal maps in the EU
- Disseminate this information by EMODnet
- Share experience of coastal mapping in the EU
- Develop standards for best practices
- Propose how a future Joint European Coastal Mapping Programme could operate





Mapping

Consortium

• Hydrographic offices:

France, Belgium, Germany, Greece, Ireland, Italy, Latvia, Norway, Portugal, Slovenia, Sweden

Regions: CPMR, Regione Lazio

- **Public Bodies:** ISPRA, RWS, GeoEcomar, DDNI
- IT company: Worldline











- Set up an infrastructure enabling partners to prepare, update and disseminate self-produced data
- Maintenance and administration of the infrastructure
- Capacity building activities







- Assess consistency of existing vertical datums
 - List and summarize past experiences on coastal survey
 - Develop an algorithm for coastal survey planning
 - Build a technical and economic strategy
- Sharing platforms







- Inventory of economic models and governance of data management
 - Study current EU fundings
 - Validate the proposed programme
 - Submit a data acquisition programme







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- Inventory of the used vertical references of the contributing countries.
- Inventory of available transformations to the candidate single vertical references
- Description of current developments in this field
- Analysis of the INSPIRE requirements with respect to coastal data.
- Analysis of differences in adjacent data sets





- Many definitions, realizations and methodologies
- Direct transformations between datums not always defined



Coastal Mapping



Many definitions, realizations and methodologies

Coastal

Mapping

Example: Chart Datum North Sea (Dorst et al, 2010)





Many definitions, realizations and methodologies

Example: LAT reference surface (Slobbe, 2013)



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Chart Datum

• Reference level in the nautical charts and tables

• IHO guideline (resolution 3/1919 as amended):

2a: ... It is further resolved that the Lowest Astronomical Tide (LAT), or as closely equivalent to this level as is practically acceptable to Hydrographic Offices, be adopted as chart datum where tides have an appreciable effect on the water level. ...

Note i: LAT (...) is defined as the lowest (...) tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions. ...

Note ii: In non-tidal waters, in order to allow the development of regional solutions, it is recommended that an appropriate long term range of low (...) water definitions of the lower (...) 94-100 percentile be adopted."





Existing vertical datums

• Questionnaire among consortium partners:

- Responsible organization
- Inventory of reference surfaces
- Chart datum
- Methodology
- Relation to ETRS89/EVRS
- Land reference system
- Developments







Vertical datums: Dutch example



NEVREF: determine geoid for Dutch continental shelf and provide relations H_{LAT} and h_{LAT}

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Inventory of vertical reference surfaces

Country	VD	Portal
Belgium	LAT	LAT
France	Chart datum, MSL, Ellipsoid, land datum, etc.	CD
Germany	LAT, NHN(=EVRS2007), MSL	NHN
Greece	LLW, MSL	LLW
Ireland	VORF LAT	VORF LAT
Italy	MSL, Chart datum	MSL
Latvia	BAS77, LAS2000.5	BAS77
Netherlands	MSL, LAT, NAP	NAP
Norway	Chart datum	CD
Portugal	NMA Cascais 1938 (MSL), Chart Datum (ZH=LAT)	CD
Romania	Black Sea 1975 (MSL), Baltic Sea, Black Sea-Sulina	Black Sea 1975
Slovenia	Chart datum	CD
Sweden	RH2000 (EVRS2007)	RH2000



Chart Datum







Relation to ellipsoid

Country	Relation
Belgium	LAT via MSL (GEONZ97/EGM96)
France	Bathyelli
Germany	Separation grid LAT-GRS80, MSL realized as GCG11 quasigeoid
Greece	VD are linked to GRS80 at tide gauges
Ireland	VORF
Italy	unknown
Latvia	Vertical datum BAS77 is linked via local geoid LV'98
Netherlands	LAT via MSL (GEONZ97), to be replaced by NEVREF (2017)
Norway	VD are linked to GRS80 at tide gauges
Portugal	VD are linked to GRS80 at tide gauges
Romania	linked via quasigeoid (based on EGG97)
Slovenia	VD to be linked in 2016/2017 via AGS2000 geoid
Sweden	Separation between VD and ellipsoid described by geoid model SWEN08_RH2000





Vertical Datum on land

Country	National	Datum	Type of heights	Offset EVRS
	System	(tide gauge)		(in cm)
Albania		Durres	normal orthometric	
Belgium	TWA (DNG)	Ostend	no gravity correction	-232
Bosnia and Herzegovina		Trieste	normal orthometric	
Bulgaria	Baltic 1982	Kronstadt	normal	+23
Croatia	HRVS71	Trieste	normal orthometric	-31
Denmark	DVR90	10 Danish tide gauges	normal	0
Estonia	BHS-77 (BK77)	Kronstadt	normal	+19
Finland	N2000	NAP (Amsterdam)	normal	-1
France	IGN69	Marseille	normal	-47
Germany	DHNN92	NAP (Amsterdam)	normal	+1
Greece		Piraeus	orthometric	
Italy	Genova1942	Genova	orthometric	-30
Ireland	MOD	Malin Head	orthometric	
Latvia	LAS2000,5	NAP (Amsterdam)	normal	0
Lithuania	NGVN	Kronstadt	normal	+12
Netherlands	NAP	NAP (Amsterdam)	no gravity correction	+2
Norway	NN2000	NAP (Amsterdam)	normal	-1
Poland	Kronstadt2006	Kronstadt	normal	+17
Portugal	RNGAP	Cascais	orthometric	-20
Romania	Black Sea 1975	Constanta	normal	+6
Slovenia	SI-NVN99	Trieste	normal orthometric	-42
Spain	REDNAP	Alicante	orthometric	-49
Sweden	RH2000	NAP (Amsterdam)	normal	-1
United Kingdom	ODN	Newlyn	orthometric	+5

Based on Rummel et. al, 2014; updated

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Developments

With respect to realization and transformation:

- NEVREF
 - (Netherlands + Belgium)
 - Development of vertical reference (geoid + LAT) for the Dutch and Belgian continental shelf
- BATHYELLI (France)
 - Development of a CD referenced to the ellipsoid
- VORF (UK+Ireland)
 - Project aiming to provide abilitity to transform height information in the coastal zone



source: SHOM



Developments

With respect to harmonization:

- BLAST/NSHC TWG (North Sea)
 - Assessment of consistency of VD and creation of a common CD/LAT for the North Sea
- BSHC Chart datum DWG (Baltic Sea)
 - EVRS-based harmonized vertical reference for hydrography and navigation (presented by J.Mononen, EUREF2015)





Towards a European standard

"Assess consistency of existing datums (Chart Datum and associated lowest astronomical tide and highest astronomical tide levels) as used ... for bathymetric mapping (navigational charts) and recommend a European standard and how to eliminate discontinuities between national systems."

> Coastal Mapping

Considerations:

- Type of datum:
 - Tidal datum (LAT/...)
 - Geodetic datum (MSL/geoid/EVRS)
 - Geometrical datum (ETRS89)
- Aimed at data exchange or hydrographic/navigational tasks (or both)?
- Region specific?





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Towards a European standard

- Harmonized CD
 - tidal vs non-tidal
 - probabilistic approach
- EVRS
 - not defined on sea
 - not suitable for CD in tidal areas
- Ellipsoidal surveying
 - requires separation models (see eg. FIG pub. no. 62)











































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