Towards the establishment of a reference hydrographic surface (RHS) in Spanish waters: Application and validation of CMEMS IBI-Reanalysis data

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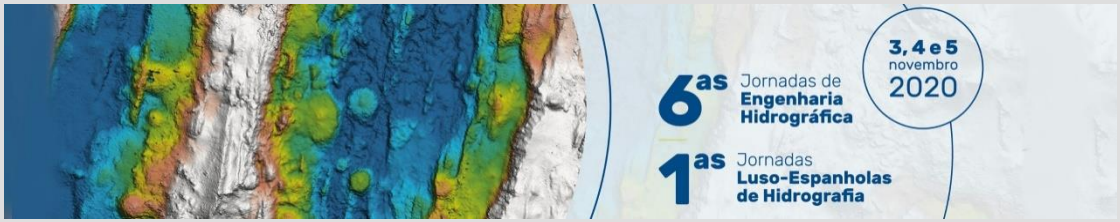

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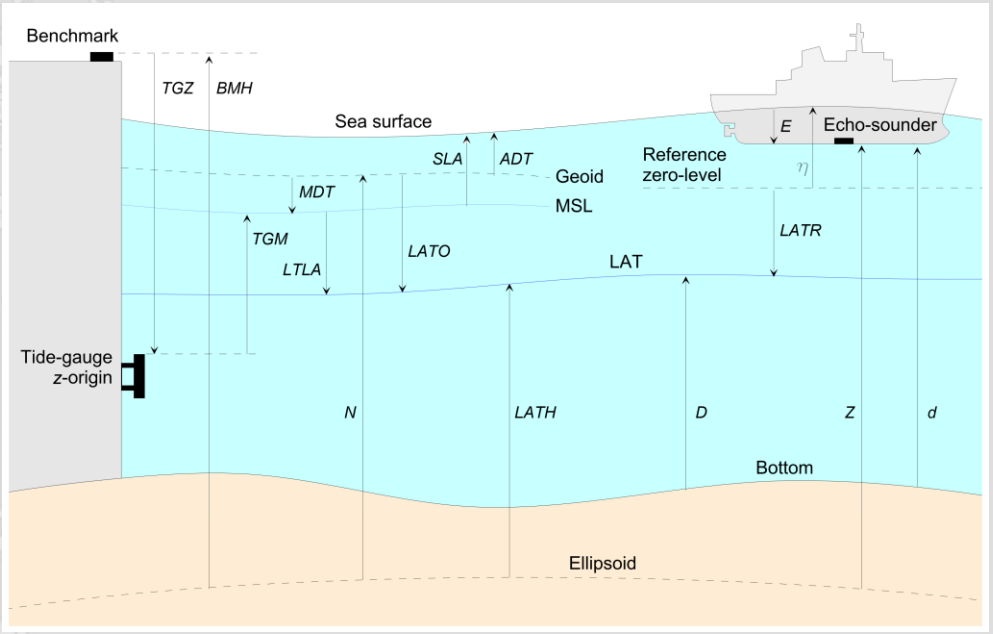
Introduction



'Traditional' Hydrography:

$$D = d - E + LATR - \eta$$

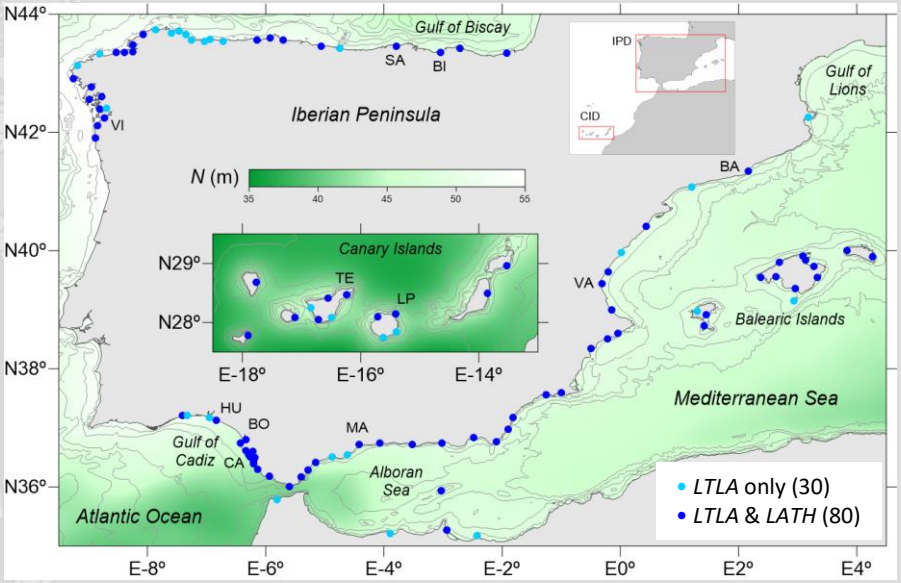
GNSS-based Hydrography:

$$D = d + LATH - Z$$

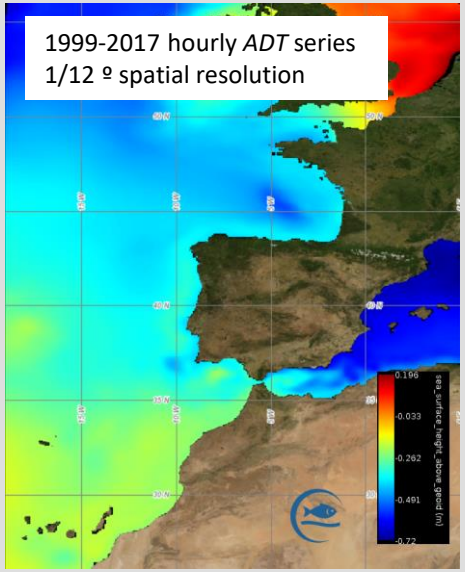
Reference Hydrographic Surface (RHS)

Methodology: data sources

110 experimental tide-gauge stations: IHM, PdE, IGN, SOCIB



ADT series-fields: CMEMS Atlantic-Iberian Biscay Irish - Ocean Physics Reanalysis (**IBIre**)



Geoid undulation (*N*): EGM2008-REDNAP (IGN)
1/60 ° spatial resolution
2 domains: Iberian Peninsula (IPD), Canary Islands (CID)
WGS84 ellipsoid

Comparison: DTU10 global tidal model
1/8 ° spatial resolution
Constituents M2, S2, N2, K2, K1, O1, P1, Q1, S1, M4
+ *MDT* global field 1/60 ° spatial resolution

Methodology: determination of the *LATH*

Sea-level hourly-averaged series

De-trending & de-biasing

TGM (tide-gauges)

MDT (IBIre)

SLA hourly series

Harmonic analysis

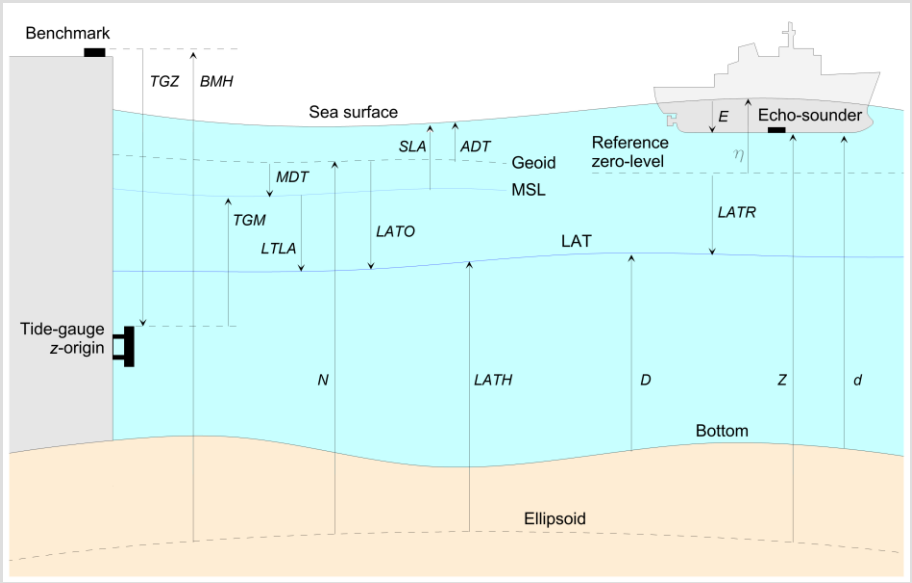
Tidal harmonics

Tidal prediction

19-year predicted *SLA* series

Absolute minimum

LTLA



Experimental stations:

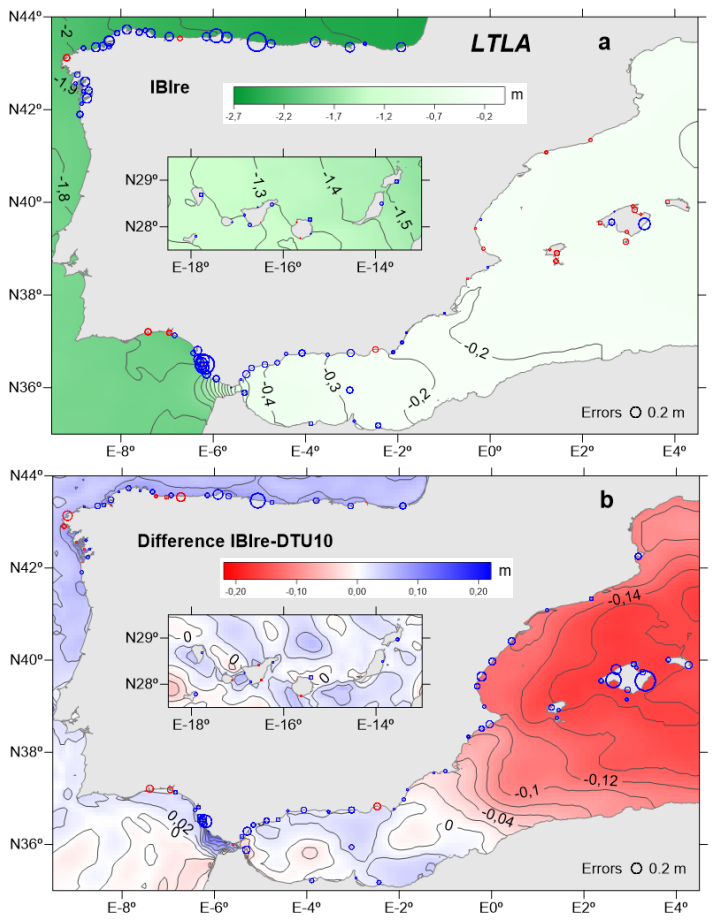
LATH = *BMH + TGZ + TGM + LTLA*

MDT = LATH - N - LTLA (for validation)

IBIre fields:

LATH = *N + MDT + LTLA*

Results: Lowest tidal sea-level anomaly (*LTLA*)



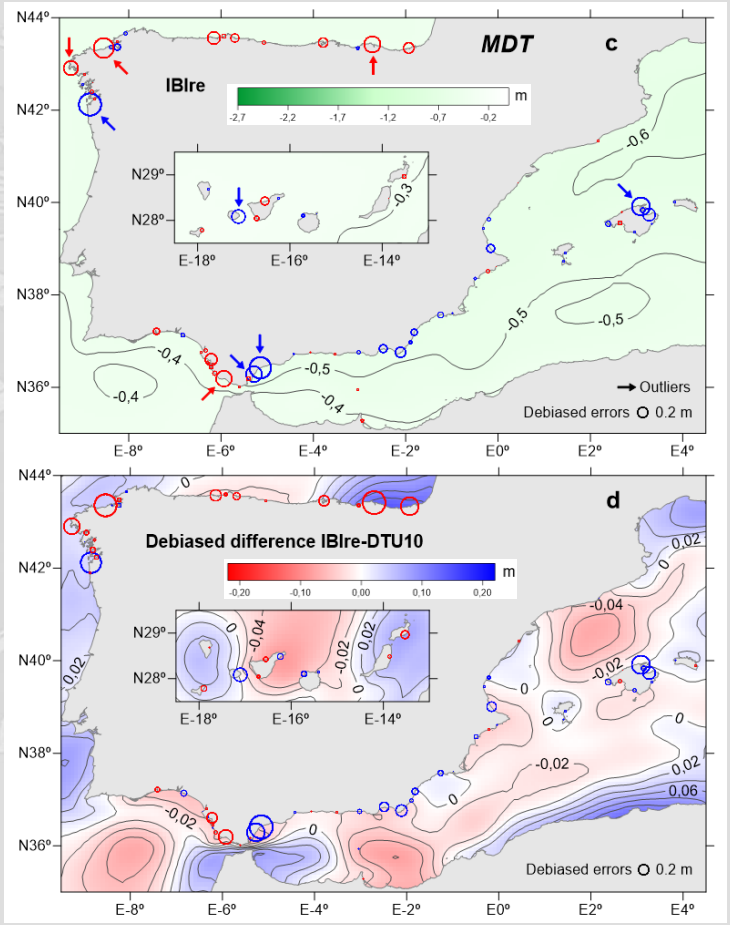
Error (mean ± s.d.; cm); R^2:

	IBIre	DTU10
IPD:	6.9 ± 10.5; 0.989755	6.7 ± 8.7; 0.991594
CID:	3.7 ± 3.3; 0.935133	1.9 ± 3.7; 0.920629

Validation of tidal harmonics: errors

Constituent	Amplitude (cm)		Phase-constant (°)	
	IBIre	DTU10	IBIre	DTU10
Long-period				
SA[2]	-0.2 ± 1.1	-	9.5 ± 16.4	-
SSA[2]	-0.5 ± 0.4	-	-6.6 ± 17.4	-
MM[1]	-0.2 ± 0.6	-	-23.7 ± 18.6	-
MF[1]	-0.4 ± 0.5	-	-1.9 ± 30.6	-
Diurnal				
O1[1]	0.4 ± 0.4	-0.1 ± 0.4	-5.1 ± 8.8	-1.4 ± 5.2
P1[1]	-0.2 ± 0.3	0.0 ± 0.1	-3.7 ± 11.8	3.0 ± 9.9
S1[2]	-0.7 ± 0.8	-0.3 ± 0.8	-17.6 ± 109.0	-55.7 ± 101.4
K1[1]	0.7 ± 0.8	0.0 ± 0.3	2.8 ± 8.0	-2.9 ± 6.5
Semi-diurnal				
N2[1]	0.4 ± 1.1	0.5 ± 1.0	3.4 ± 9.6	-4.7 ± 7.7
M2[1]	1.0 ± 4.9	0.8 ± 3.9	4.8 ± 12.8	-0.6 ± 3.0
S2[1]	-0.4 ± 2.0	0.8 ± 1.9	-2.9 ± 13.1	-1.9 ± 3.7
K2[1]	-0.2 ± 0.6	-0.3 ± 0.8	1.2 ± 17.0	7.0 ± 11.3
Shallow-water				
MN4[3]	-0.7 ± 0.6	-	3.5 ± 73.4	-
M4[1]	-0.6 ± 0.7	-0.4 ± 0.6	9.8 ± 22.1	-4.9 ± 50.9
MS4[3]	-0.6 ± 0.6	-	-26.5 ± 78.2	-
M6[3]	-0.4 ± 0.4	-	-4.0 ± 105.4	-

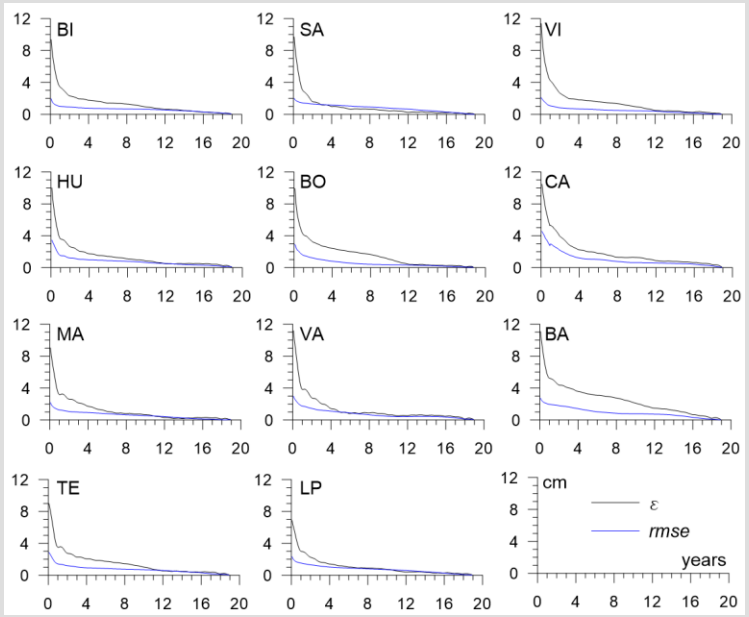
Results: Mean dynamic topography (*MDT*)



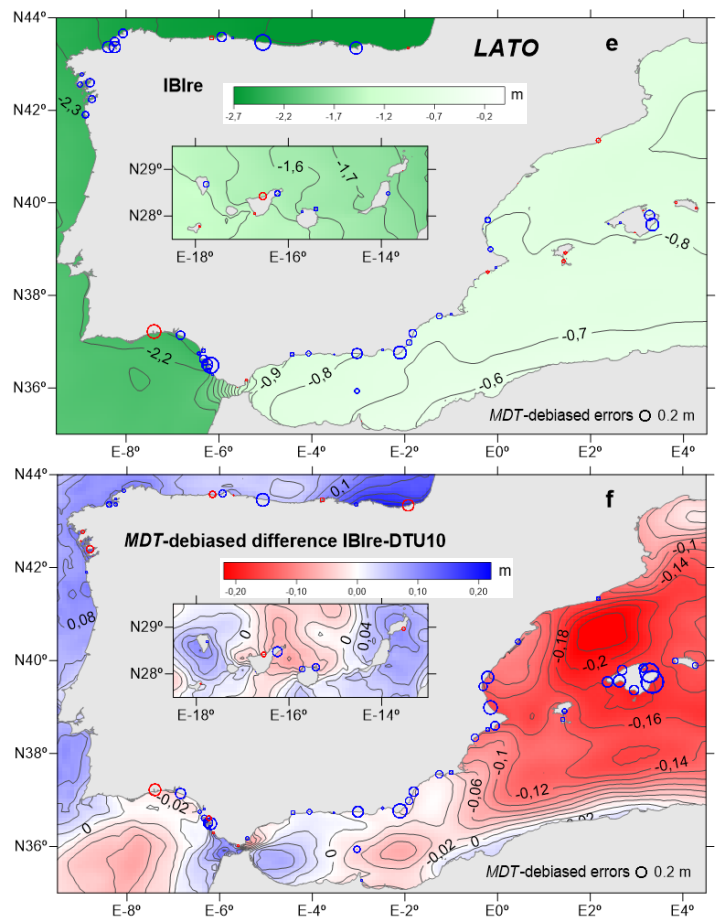
Error (mean ± s.d.; cm); R^2:

	IBIre	DTU10
IPD:	-67.6 ± **10.0**; **0.549786**	-15.5 ± 10.4; 0.435832
CID:	-35.8 ± **6.8**; **0.110002**	15.1 ± 8.8; 0.038917

Effect of the time-averaging period:



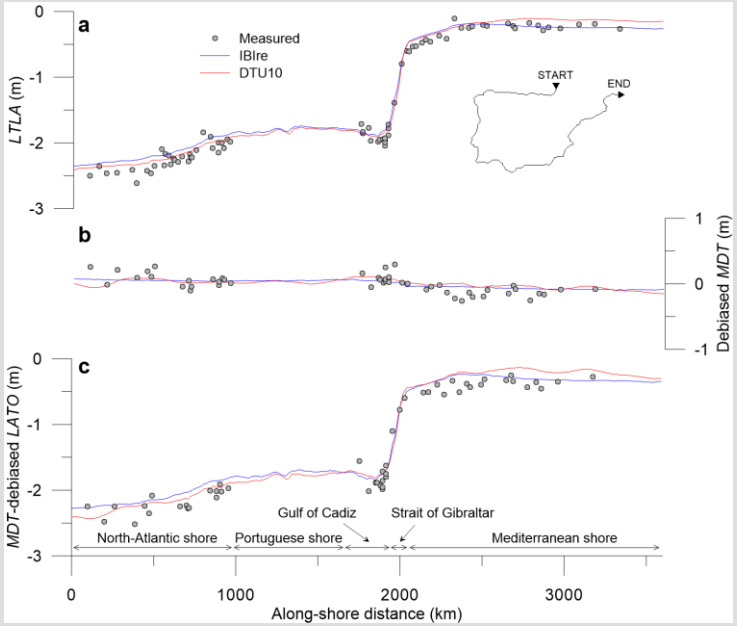
Results: Orthometric height of the LAT (*LATO* = *LTLA* + *MDT*)



Error (mean ± s.d.; cm); R^2:

	IBIre	DTU10
IPD:	-59.1 ± 10.6; 0.985246	-6.6 ± 12.1; 0.985273
CID:	-30.7 ± 7.4; 0.820241	18.7 ± 8.8; 0.749008

Along-shore variability:



Results: Fitted orthometric (*LATO*) and ellipsoidal (*LATH*) heights of the LAT

IBIre *LATO* fields

↓ Linear fitting to observations

Fitted *LATO* fields

↓ 2-D cubic-spline densification

1/60 ° resolution fitted *LATO* fields

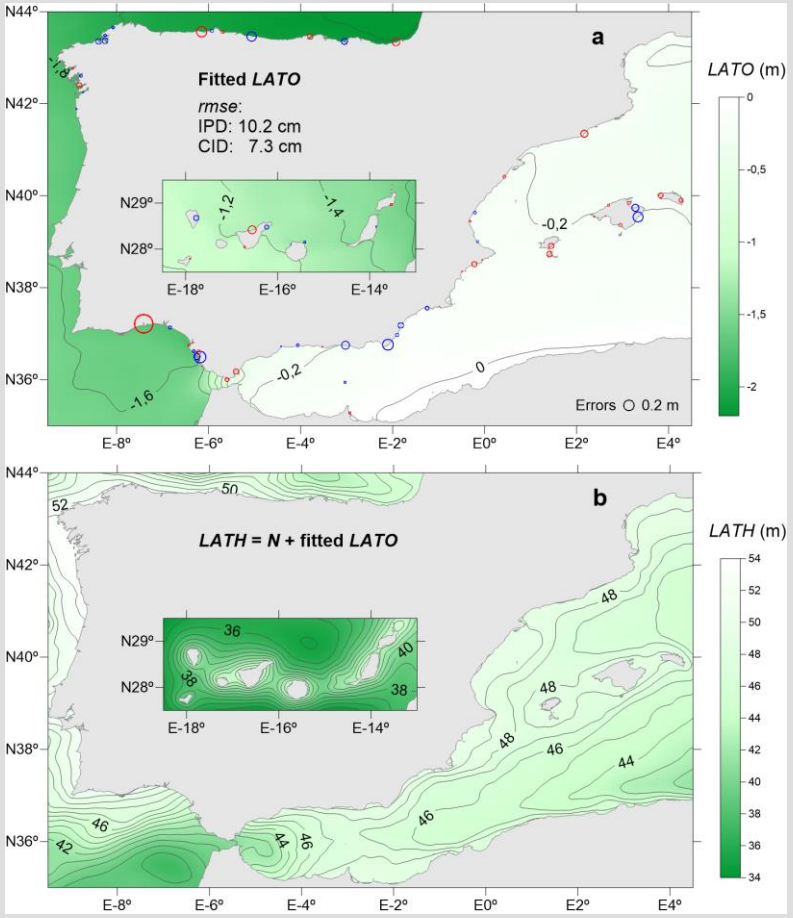
↓ + *N* (EGM2008-REDNAP)

1/60 ° resolution fitted *LATH* fields

Errors: ± 10.2 cm (IPD); ± 7.3 cm (CID)

⇩

Preliminary RHS



Concluding remarks

Enough quality of CMEMS IBIre data to constitute a reliable basis of the RHS in Spanish waters

Improvements/updates:

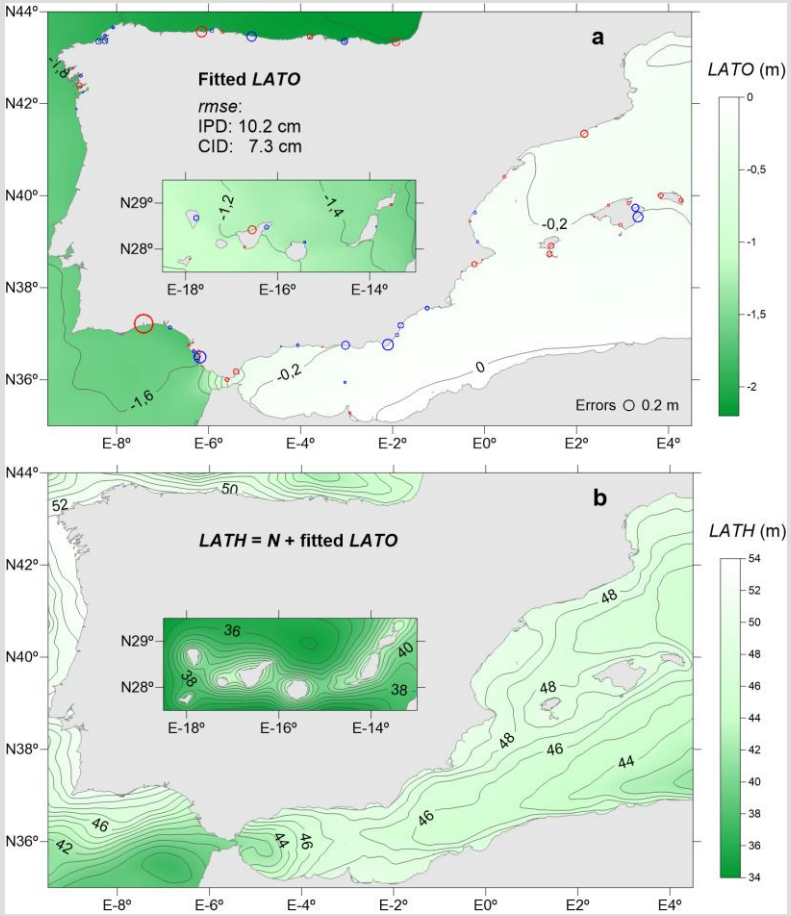
· Normalization of experimental MSL values

· Increasing number of *BMH* GNSS-measurements

· Inclusion of data from open-sea buoys

· Product validation during hydrographic surveys

· Nesting of regional/local hydrodynamic models



Thank you

Obrigado

Gracias

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