



Federal Agency for  
Cartography and Geodesy



# BSCD2000 height transformation grid and continuity management

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# BSCD2000 height transformation grid

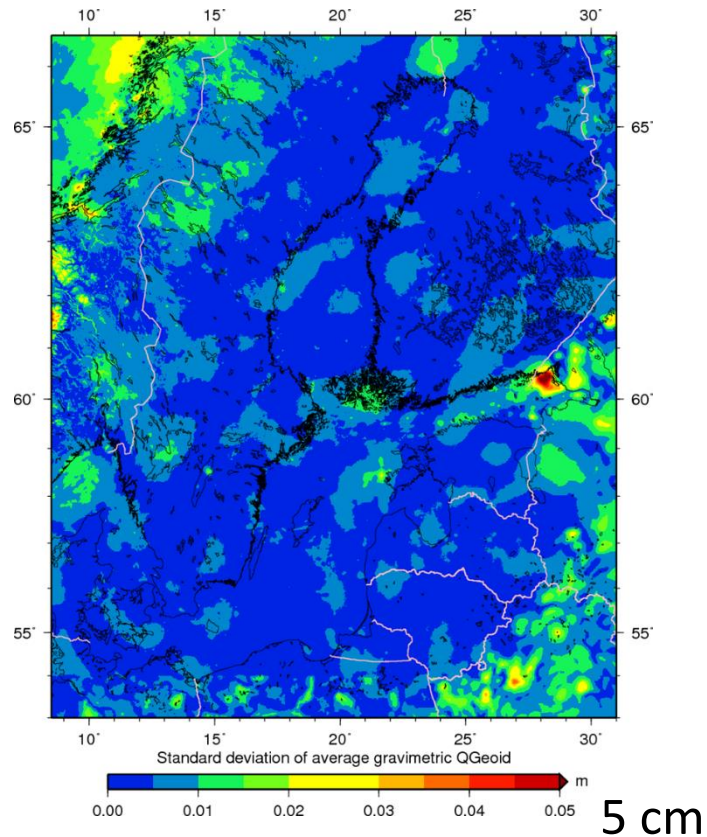
- January 2024: Gravimetric quasigeoid solutions by LM, TUT, DTU and BKG computed
- Summer 2024: Final computations for BSCD2000 height correction grid (corrector surface and blending with national geoid models)
  - „Last minute“ updates for DK and FI (GNSS/leveling and geoid)
- November 2024: Publication on BSHC website
  - Release Note in IHR Volume 29(2) → [DOI](#) , [PDF](#)
  - BSCD2000 Landing Page → <https://www.bshc.pro/iho-bscd2000/> with [DOI](#)
    - BSCD2000 height transformation grid for use in navigation and hydrography (fitted to national realizations according to BSCD2000 specifications)
    - Gravimetric quasigeoids for scientific use (GRS-80/zero-tide, Topex/mean tide)
    - Further information and material (country-specific differences BSCD2000 vs. national geoid)

# Current national geodetic reference system realizations

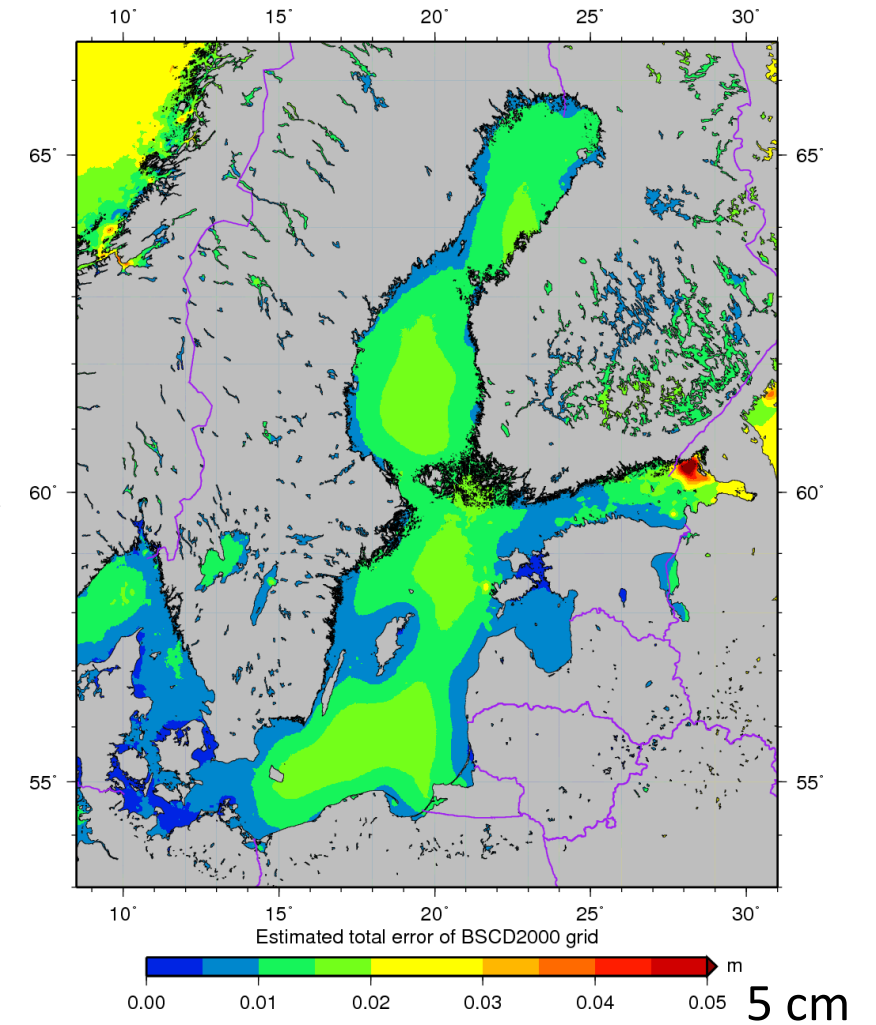
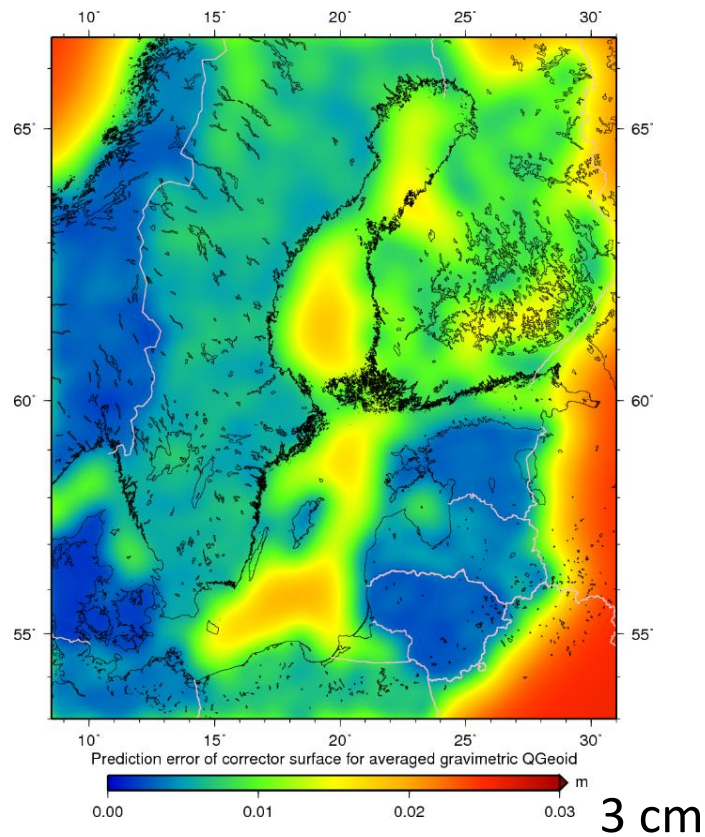
	Country	National height real. (zero-tide)	National ETRS89 realization (tide-free)	National height reference surface (mixed tide systems)
<b>DE</b>	Germany	DHHN2016 ( <i>m.t.</i> )	ETRS89/DREF91/R2016	GCG2016
<b>DK</b>	Denmark	DVR90 ( <i>tide-free</i> )	EUREF-DK94	<b>DKgeoid2023</b>
<b>EE</b>	Estonia	EH2000	EUREF-EST97	EST-GEOID2017
<b>FI</b>	Finland	N2000	EUREF-FIN	<b>FIN2023N00</b>
<b>LT</b>	Lithuania	LAS07	LKS-94 (EUREF-NKG-2003)	LIT20G
<b>LV</b>	Latvia	LHS-2000,5	LKS-92	LV'14
<b>NO</b>	Norway	NN2000	EUREF89	Href2018b (Href2016b ☺)
<b>PL</b>	Poland	PL-EVRF2007-NH	PL-ETRF2000	geoid2021-PL-EVRF2007-NH
<b>SW</b>	Sweden	RH2000	SWEREF99	SWEN17_RH2000

# Combined error estimate for BSCD2000 grid

Gravimetric Qgeoid  
(*STD of weighted mean*)



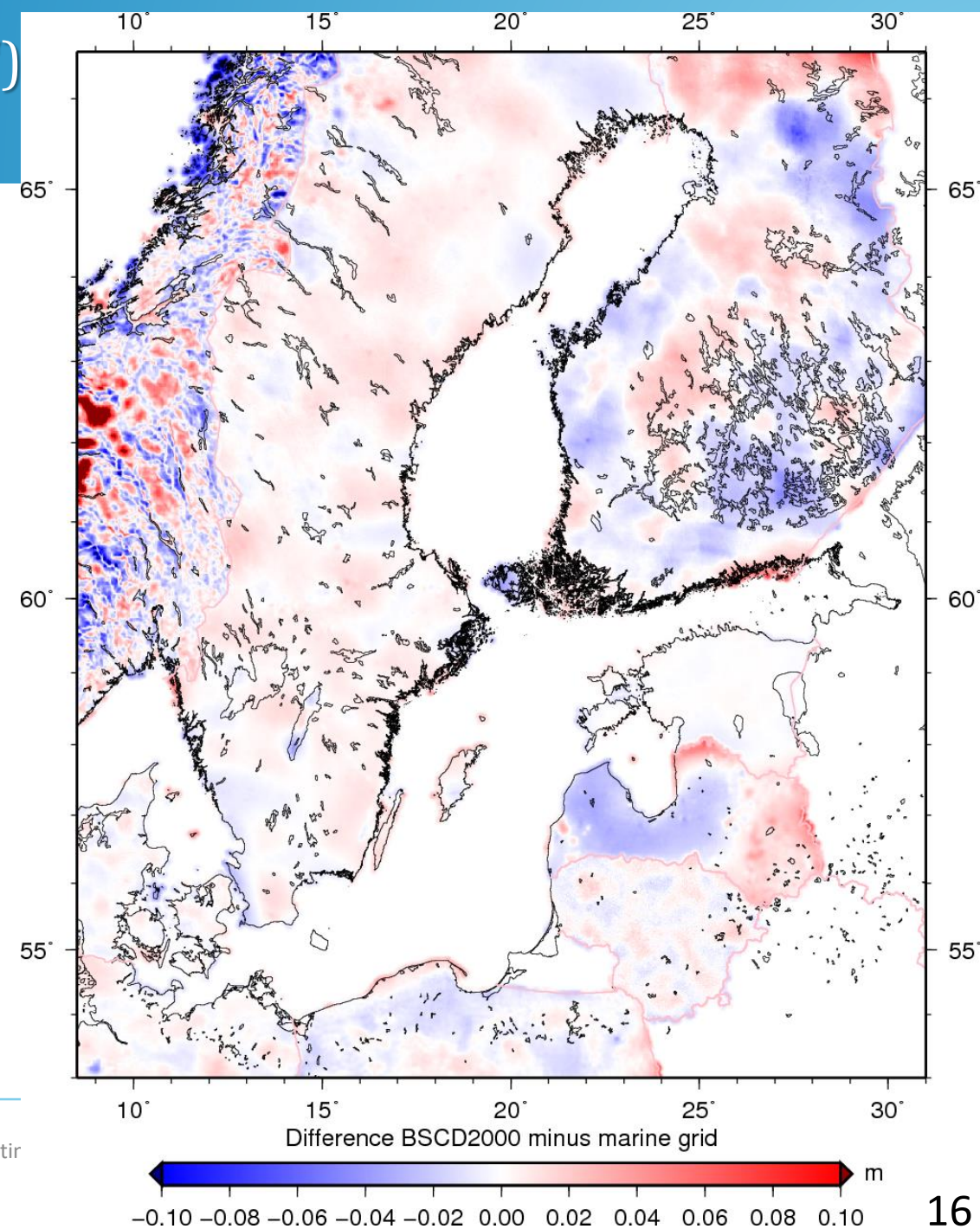
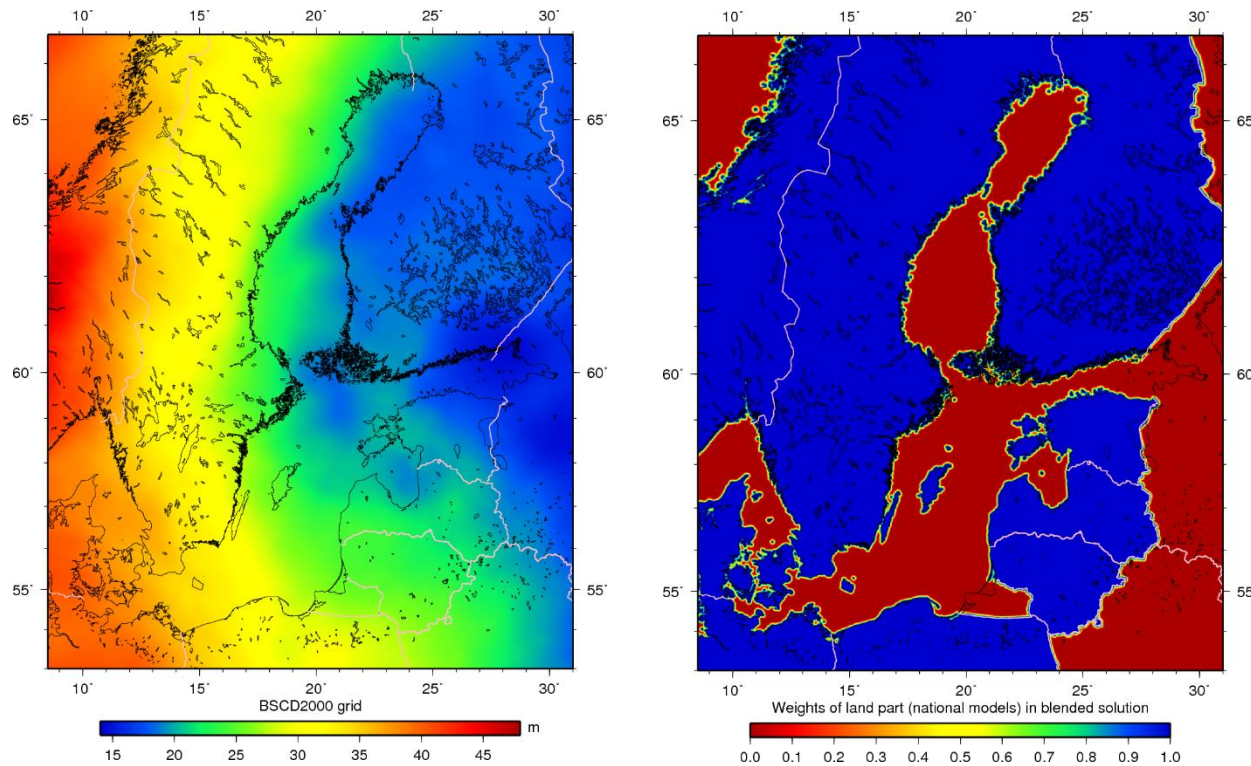
Corrector surface  
(*Predicted error*)





# BSCD2000 = fitted FAMOS model („marine grid“) + national models on land

- Example: Land grid blended with fitted FAMOS model (10 km cosine taper offshore)



- The seamless height reference surface is harmonized with the current national geodetic coordinate and height realizations according to the BSCD2000 specifications.
- This means that it is fitted to GNSS/leveling benchmarks and coincides with the national geoid models on land and at the coastline, except for minor effects at the cm level (resampling effects between grids, discrepancies in the transition zone along national borders).
- **The BSCD2000 geoid grid is not a purely gravimetric surface.**
- **It is a transformation surface which absorbs various effects (all < 5 cm), e.g.**
  - different geodetic standards (tide system) for GNSS coordinates and leveling heights
  - residual datum differences along the borders
  - regional differences between geoid model, GNSS and leveling

## Summary (continued)

- Update of national geoid in DE in the Baltic Sea area coordinated with BSCD2000 publication (effective 5 Dec 2023)
- Final version of new national geoid in FI also including values from BSCD2000 grid in the marine area
- In DE and FI, national geoid models and BSCD2000 grid are practically identical on land and sea (except for minor interpolation differences and transition zone along the borders)
- SE endorses national geoid model on land and BSCD2000 grid at sea (other countries implicitly by doing nothing)
- Question how to handle future updates of national geodetic coordinates and geoid
  - „Continuity management“, discussed at CDWG14, draft concept by Patrick and Joachim developed in August 2023

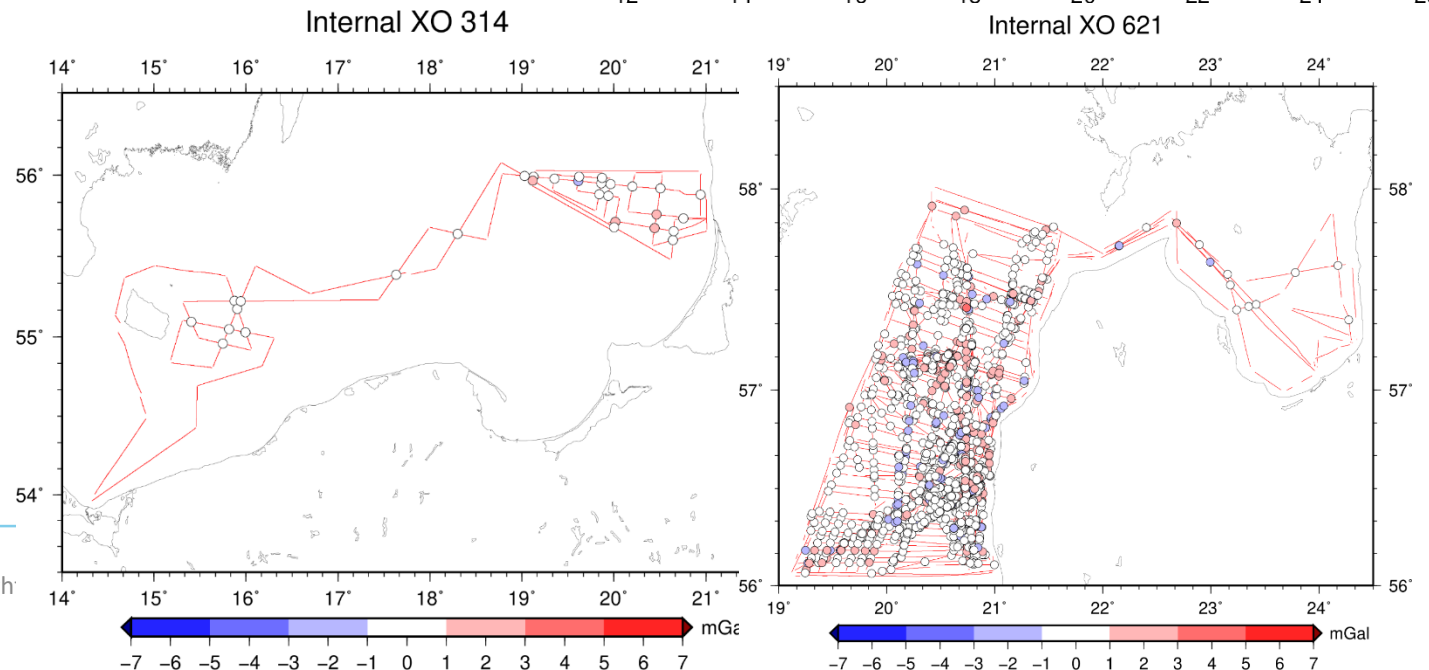
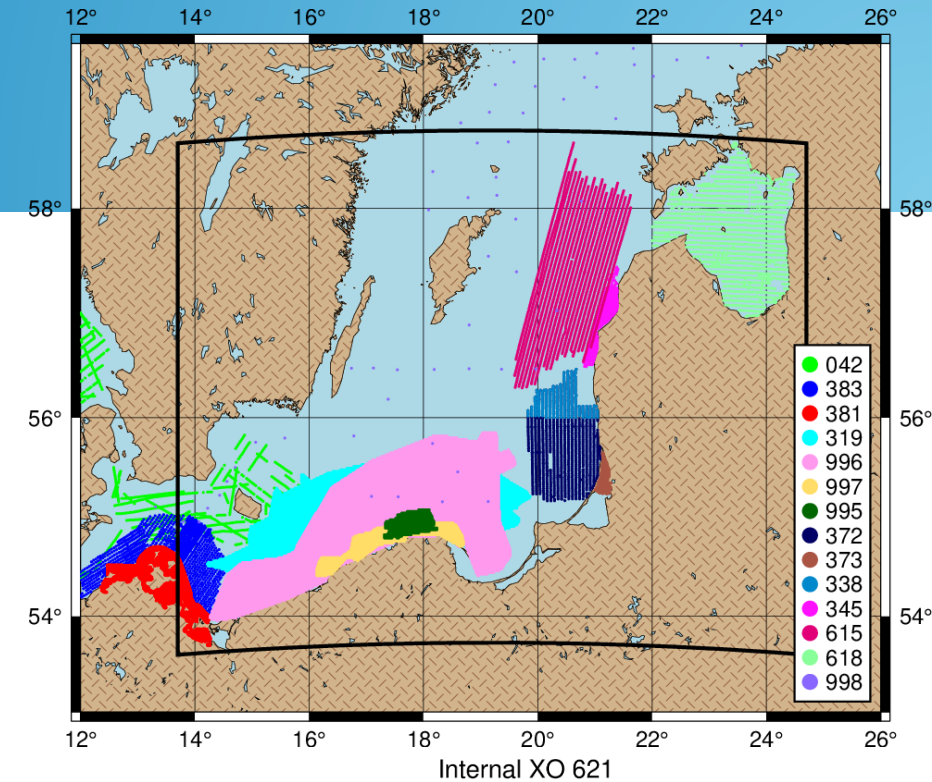


# BalMarGrav project (EU Interreg BSR)

- 10/2022 – 09/2024
- Focus on Poland, Lithuania, Latvia
- Revitalization of historical marine gravity data in PL
- Validation also for LT and LV
- 2 more shipborne campaigns 2023
  - TU Gdansk with Szczecin U:  
Szczecin/PL – Rønne/DK – Klaipeda/LT
  - LM with TU Riga: Latvian coast



Co-funded by  
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# BSCD2000 continuity management scheme

The first release of BSCD2000 complies with the geodetic coordinates used in the respective countries for now. Since updates of the geodetic reference can occur at any time in any country, their transfer to BSCD2000 must be specified. Synchronizing these updates with the BSCD2000 development cycles is obviously not feasible. Therefore, a pragmatic approach is needed to handle national updates in between regular (cumulative) updates of BSCD2000. This continuity management (CM) includes

1. to monitor the national coordinates, heights and geoid models, as well as active announcement of changes (including contact information) by the countries in due time;
2. to compute a provisional update of the BSCD2000 grid and analysis of the changes, including effect on neighboring countries;
3. to invoke a change request, i.e., proposal for decision within the CDWG
  - a) to fully implement the update or
  - b) to inform users about differences between the new national geodetic reference and the BSCD2000 grid.

# BSCD2000 continuity management scheme

A reasonable criterion for the decision to update the BSCD2000 grid would be a certain threshold of changes, e.g. 2–3 cm commensurate with the tolerable deviations of the national geodetic reference frames as stated in section 2c of the BSCD2000 specifications. However, we suggest to see this rather as a guideline. Other circumstances or constraints may give reason to individual solutions. The final decision shall remain with the hydrographic offices of the affected countries.

Furthermore, the long-term development of BSCD2000 in view of the dynamic reference frames (land uplift and sea level variations) and their relation to the regional (NKG\_ETRFxx), European (ETRFxx, EVRFxx, prospective: European Height Reference Surface) and global (ITRFxx) reference frame realizations will be a general topic within the CDWCWG in the future.

# BSCD2000 continuity management scheme

## Proposed action

A Continuity Management (CM) mechanism shall be implemented. It shall consist of

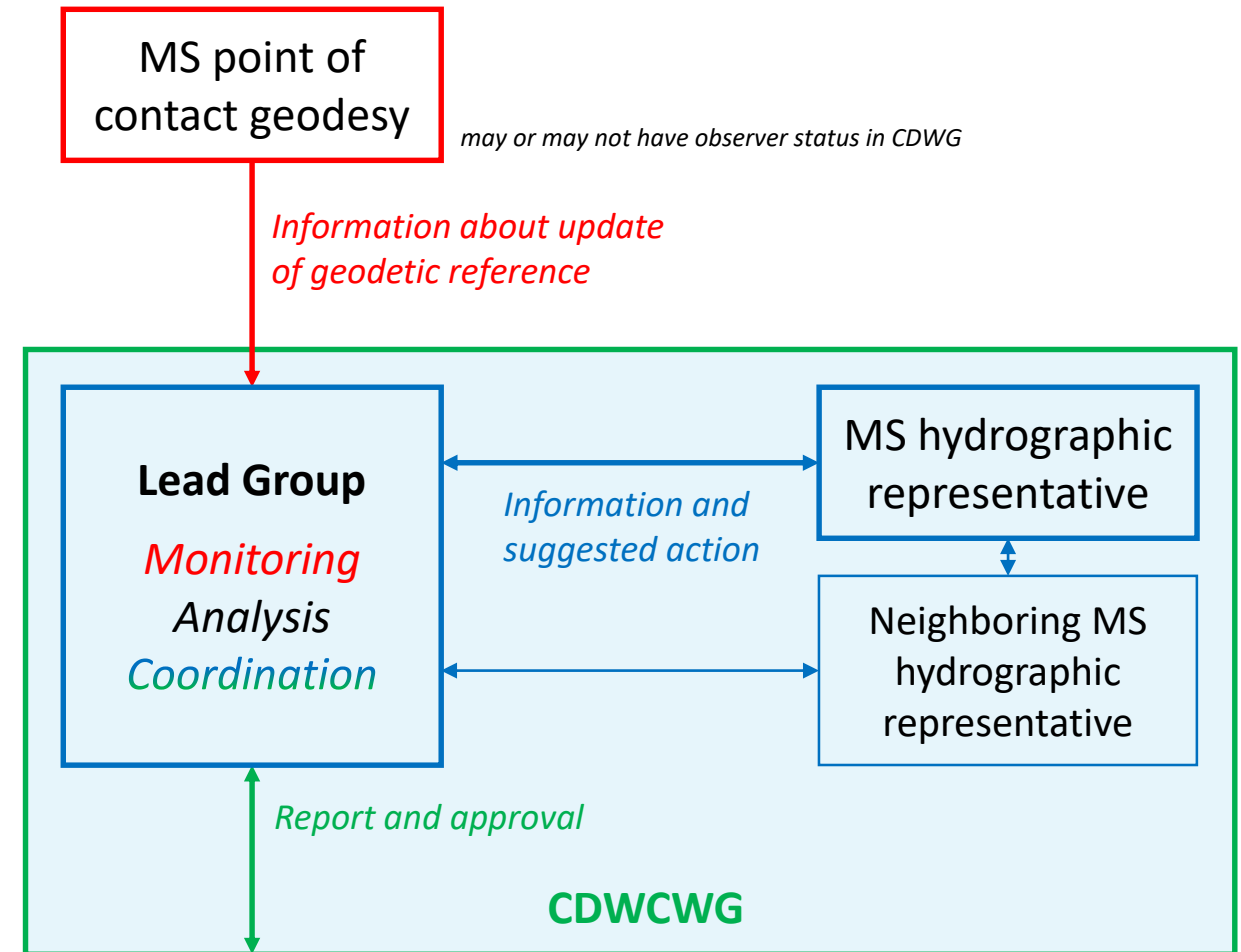
- Lead Group:  
J. Schwabe (principal investigator), P. Westfeld (deputy), Th. Hammarklint (CDWCWG Chair)
- Advisory Board for dynamic reference frames (land uplift, reference epochs etc.):  
A. Jensen (Secretary), P. Häkli (NKG Transformations 2020),  
N.N. (*J. Ågren, P.-A. Olsson, A. Alfredsson, M. Lidberg, ... ?*)
- Points of contact of the responsible national geodetic institutions as well as representatives of the national hydrographic offices of each member state (MS) → *see separate list*



# BSCD2000 continuity management scheme

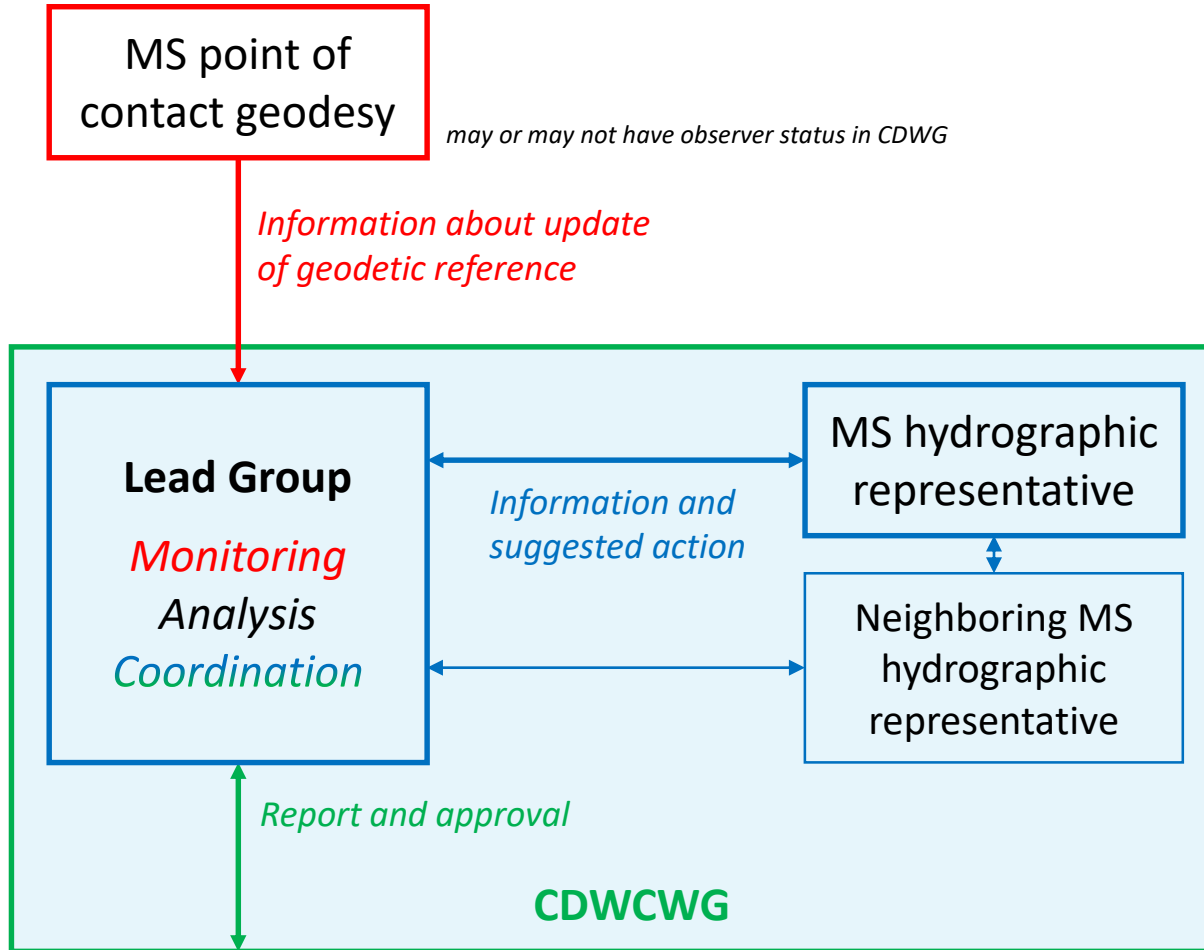
The mechanism in case of a national update shall consist of three stages (Fig. 1):

- Point of contacts for geodesy from MS report upcoming changes of national reference frames to the Lead Group.
- Lead Group (PI) analyses the new data, recomputes the BSCD2000 grid and communicates potential changes to the hydrographic representatives of the affected MS. A proposal for a decision is prepared and agreed between the Lead Group and the affected countries. The Advisory board is consulted if necessary.
- Hydrographic representatives and Lead Group report proposed changes to the CDWCWG. Decision and implementation of updated BSCD2000 grid (including information to users).



# BSCD2000 continuity management scheme

MS	Geodesy	Hydrography
Denmark	Kristian Keller <a href="mailto:krkel@sdfi.dk">krkel@sdfi.dk</a> Agency for Data Supply and Infrastructure (SDFI)	Nikolaj Møller <a href="mailto:nikmn@gst.dk">nikmn@gst.dk</a> Danish Geodata Agency (DGA/GST)
Estonia	Artu Ellmann <a href="mailto:artu.ellmann@taltech.ee">artu.ellmann@taltech.ee</a> Tallinn Technical University	Gabriela Kotsulim <a href="mailto:gabriela.kotsulim@transpordiamet.ee">gabriela.kotsulim@transpordiamet.ee</a> Republic of Estonia Transport Administration
Finland	Mirjam Bilker-Koivula <a href="mailto:mirjam.bilker-koivula@maanmittauslaitos.fi">mirjam.bilker-koivula@maanmittauslaitos.fi</a> Finnish National Geospatial Research Institute FGI	Jarmo Mäkinen <a href="mailto:jarmo.makinen@traficom.fi">jarmo.makinen@traficom.fi</a> Finnish Transport and Communications Agency (Traficom)
Germany	Joachim Schwabe <a href="mailto:joachim.schwabe@bkg.bund.de">joachim.schwabe@bkg.bund.de</a> Federal Agency for Cartography and Geodesy (BKG)	Patrick Westfeld <a href="mailto:patrick.westfeld@bsh.de">patrick.westfeld@bsh.de</a> Federal Maritime and Hydrographic Agency (BSH)
Latvia	Ivars Liepiņš <a href="mailto:ivars.liepins@lgia.gov.lv">ivars.liepins@lgia.gov.lv</a> Latvian Geospatial Information Agency	Bruno Špēls <a href="mailto:bruno.spels@lhd.lv">bruno.spels@lhd.lv</a> Maritime Administration of Latvia
Lithuania	Eimuntas Paršeliūnas <a href="mailto:eimuntas.parseliunas@vilniustech.lt">eimuntas.parseliunas@vilniustech.lt</a> Vilnius Gediminas Technical University	Mindaugas Zakarauskas <a href="mailto:mindaugas.zakarauskas@ltsa.lt">mindaugas.zakarauskas@ltsa.lt</a> Lithuanian Transport Safety Administration (LTSA)
Norway	Olav Vestøl <a href="mailto:olav.vestol@kartverket.no">olav.vestol@kartverket.no</a> Kartverket	N/A (BSCD2000 not in use in Norway, Norwegian Hydrographic Service not represented in CDWG)
Poland	Jarosław Somla <a href="mailto:jaroslaw.Somla@ugik.gov.pl">jaroslaw.Somla@ugik.gov.pl</a> Head Office of Geodesy and Cartography (GUGiK)	Witold Stasiak <a href="mailto:w.stasiak@ron.mil.pl">w.stasiak@ron.mil.pl</a> Hydrographic Office of the Polish Navy
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- ? **Updated marine geoid model ~2026 due to BalMarGrav and new NKG geoid?**  
(BSCD2000 Roadmap currently until 2028)
- **Continuity management**
  - Draft concept by Joachim and Patrick
  - Update national points of contact





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# Thank you for your kind attention!

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