

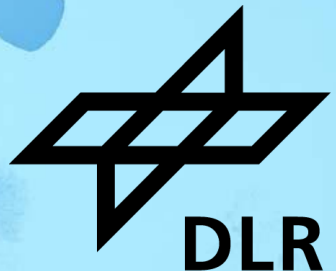
# TanDEM-X DEM 2020: What is new?

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<sup>3</sup> German Aerospace Center (DLR), Microwaves and Radar Institute, Oberpfaffenhofen, Germany



# TanDEM-X DEMs and value-added products



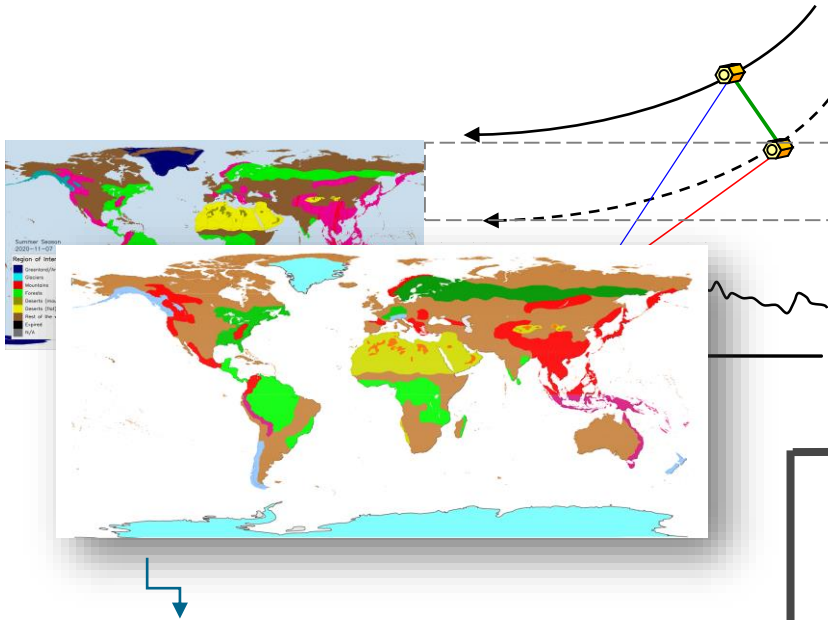
Acquisitions from 2010-2014	DEM products	Acquisitions from 2017-2021 (mainly)
 TanDEM-X DEM		TanDEM-X DEM 2020
 TanDEM-X PolarDEM 90m of Antarctica	Value-added DEM products	TanDEM-X 30m DEM Change Maps
 TanDEM-X 30m Edited DEM		
 TanDEM-X Forest/Non-Forest Map	Value-added products	
 GUF® - Global Urban Footprint® v1		
 World Settlement Footprint (WSF) 3D - Global, 90m		
 TanDEM-X Coastline		
 HydroSHEDS		

<https://geoservice.dlr.de/web/maps>

# What is new in TanDEM-X DEM Acquisition and Processing?

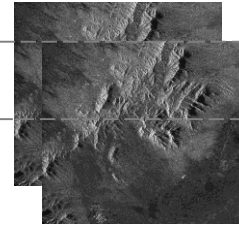


## Acquisition Planning

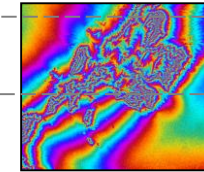


## Integrated TanDEM-X Processor (ITP)

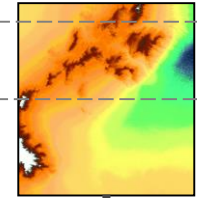
Radar data



Interferogram

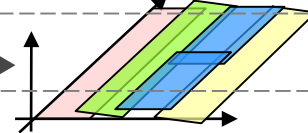


Raw DEM

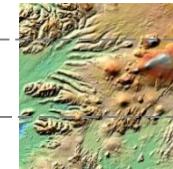


## Mosaicking and calibration processor (MCP)

Calibration

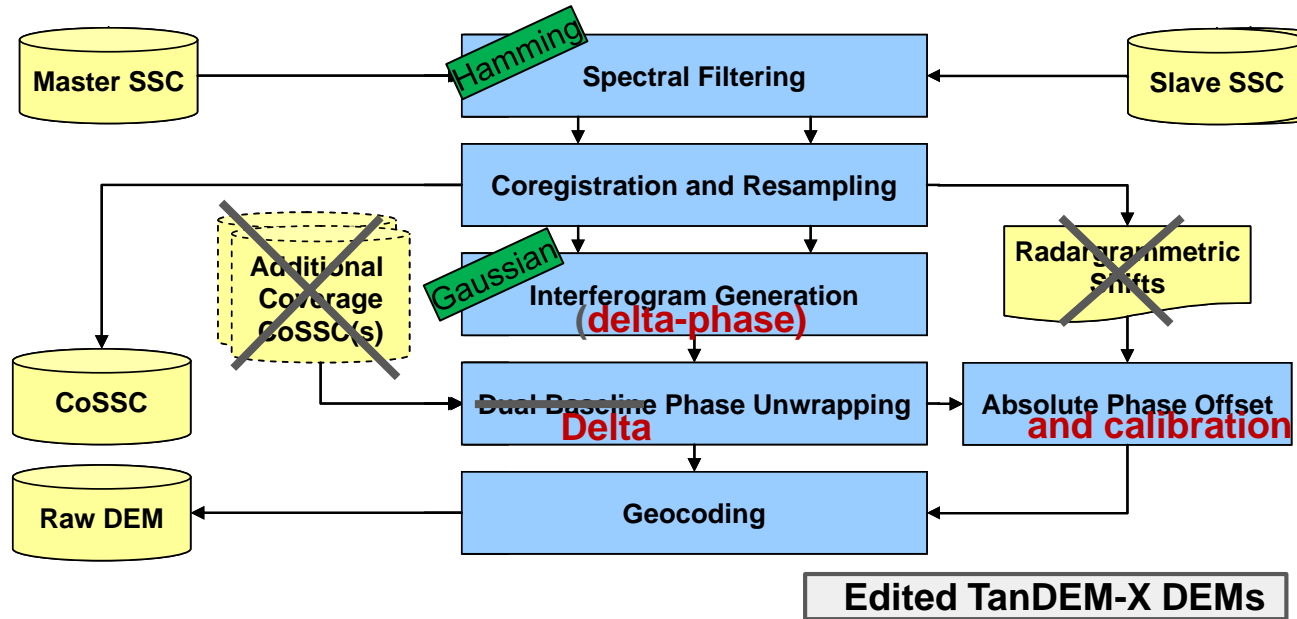


Final DEM

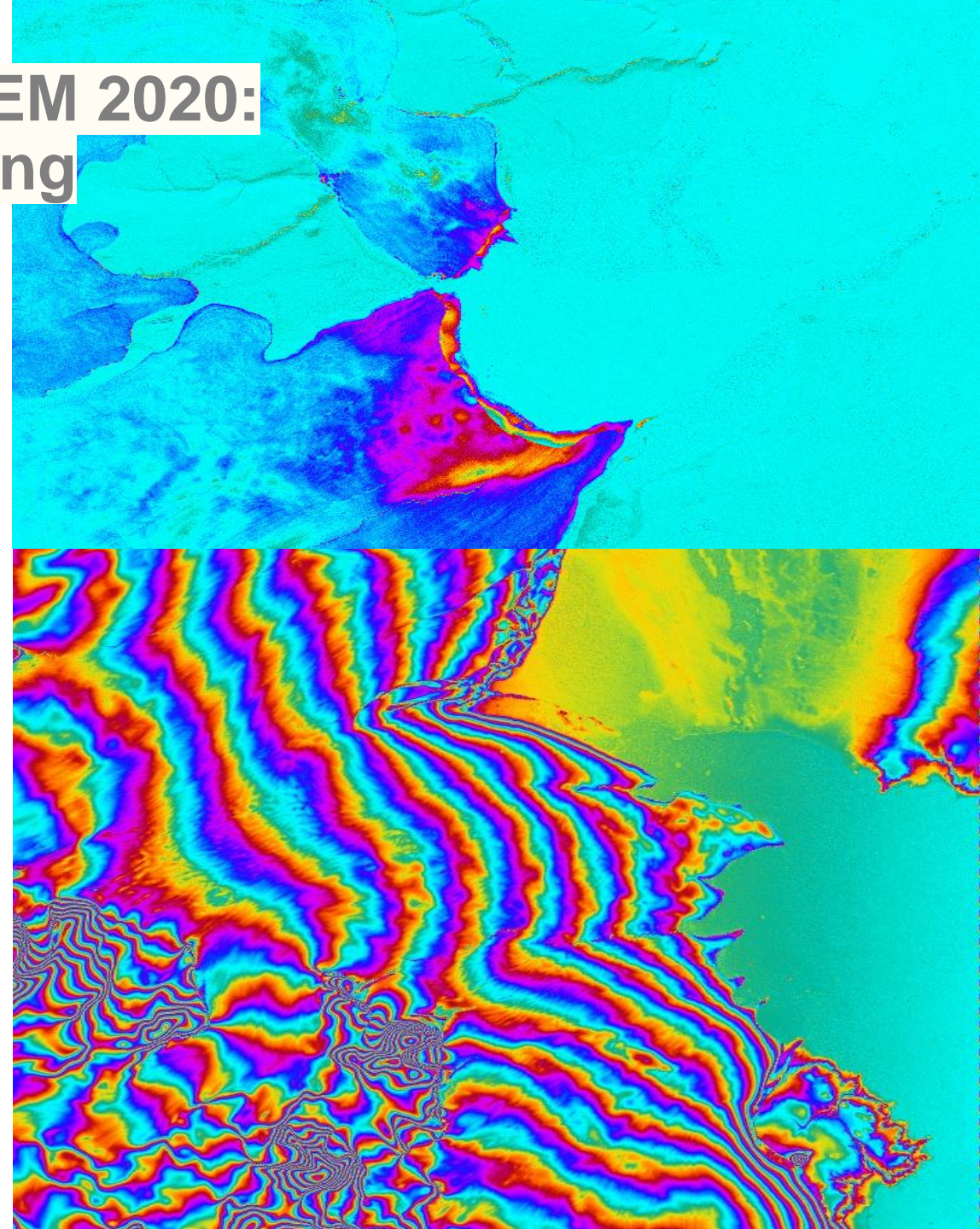


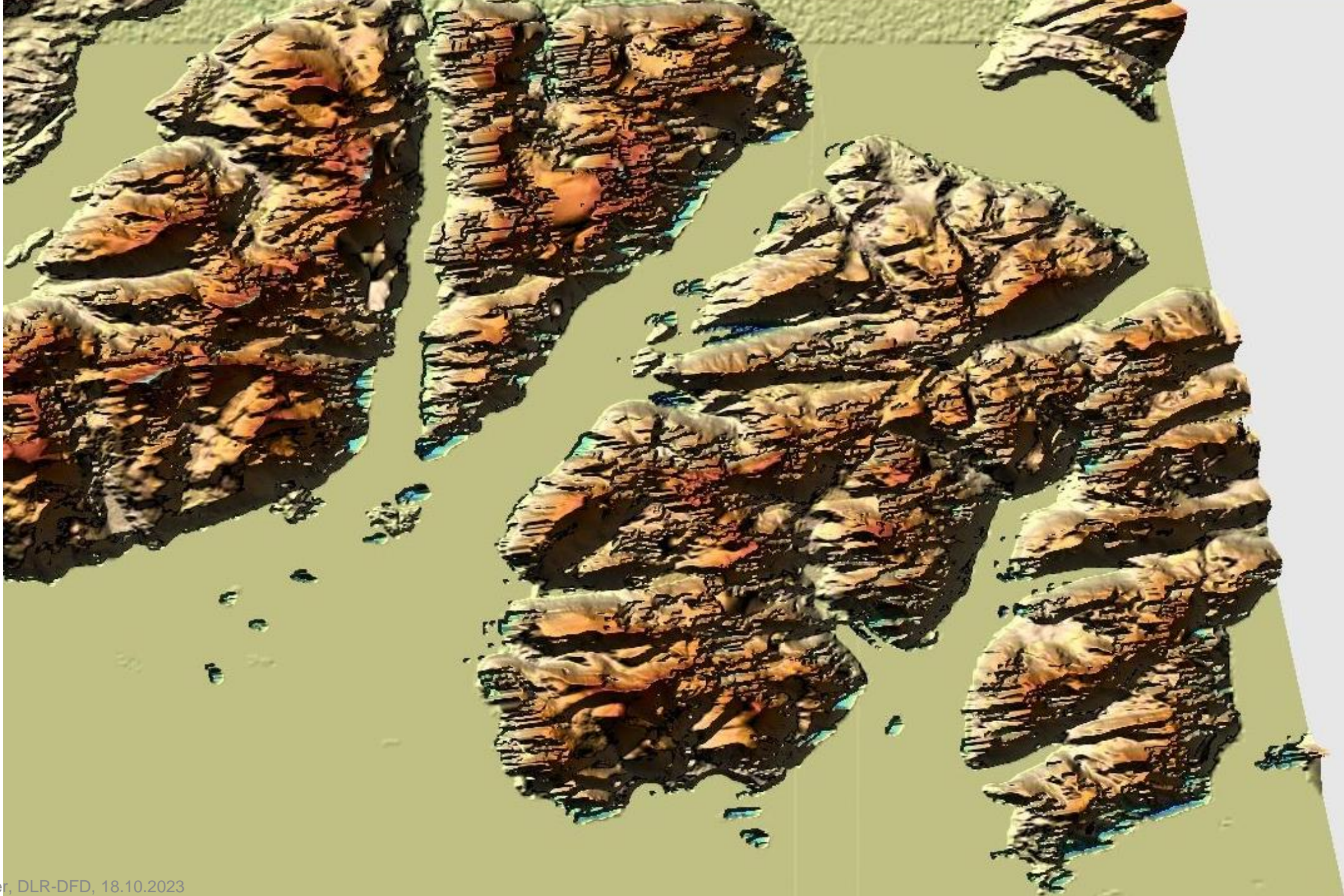
- Reduction to 1 coverage, only 2 coverages in difficult areas (red: mountains)
- Acquisitions on same season (blue) or with specific parameters (green, forest)

# InSAR processing for TanDEM-X DEM 2020: from dual- to delta-phase unwrapping



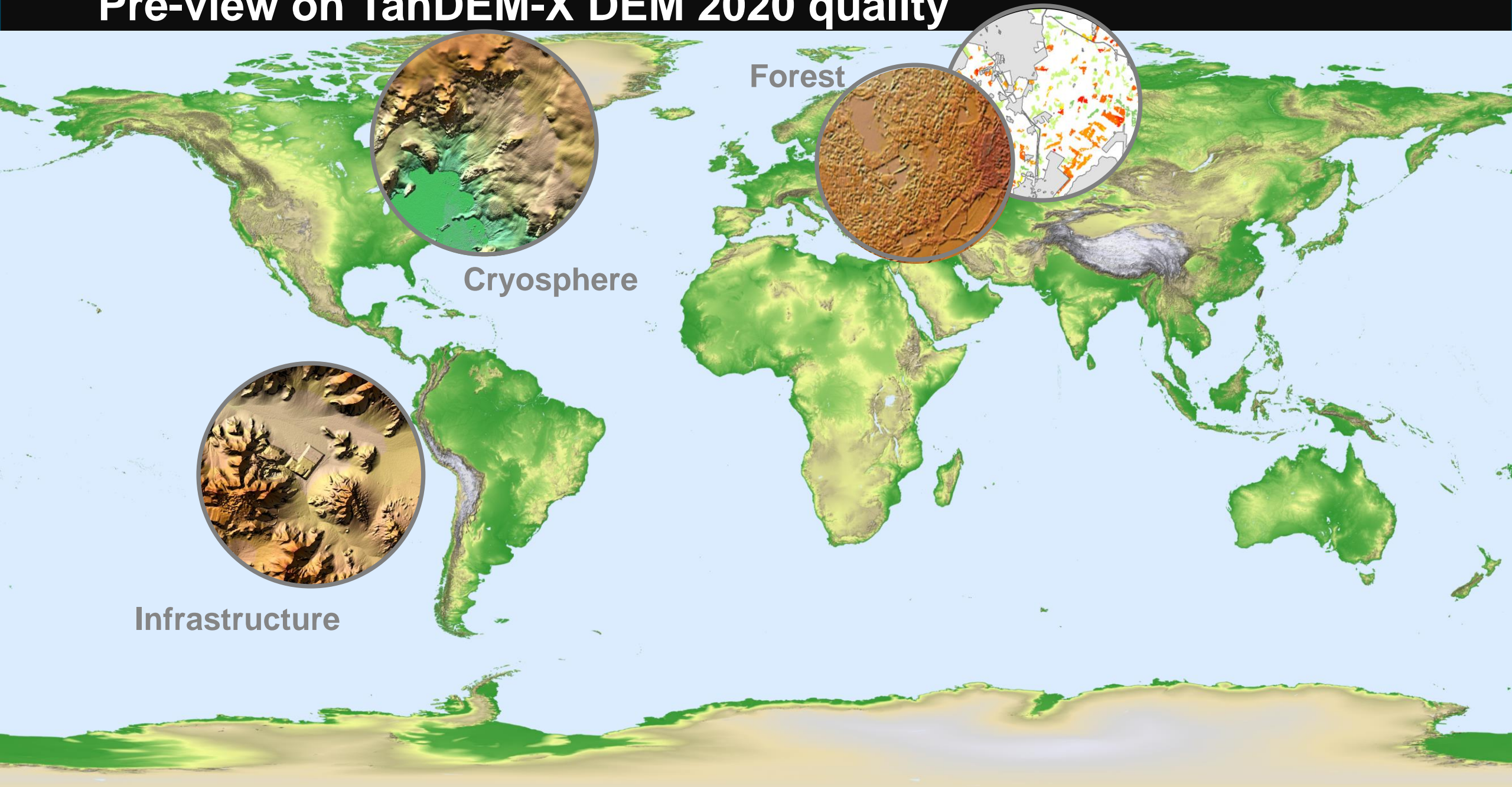
- Usage of edited DEM
- Delta-phase (also called differential phase e.g. in PSI)
- Better filtering (depending on the scene content)
- Pre-calibration to TanDEM-X





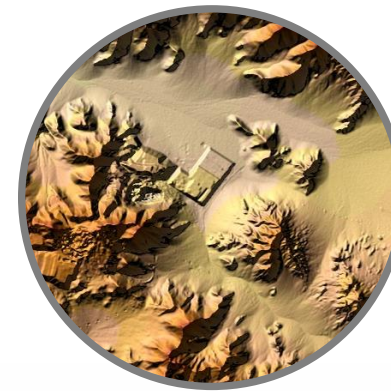


# Pre-view on TanDEM-X DEM 2020 quality



# Mining in Chile

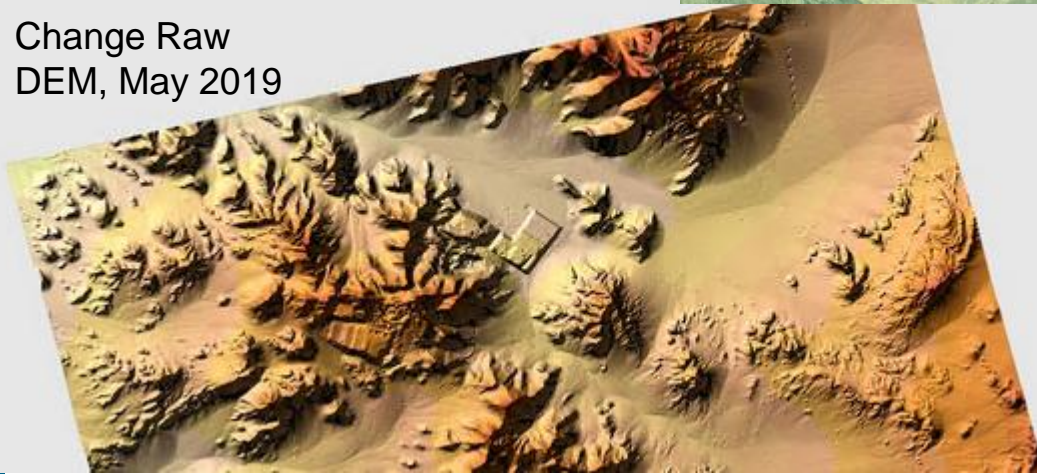
(23,5° S, 69,5° W)



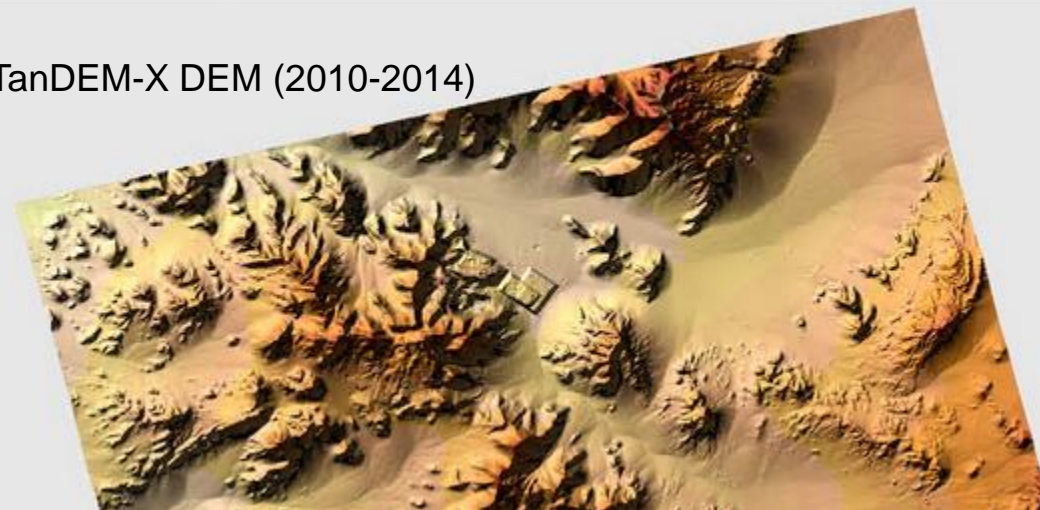
Change Raw DEM – COP DEM  
(90m scale)



Change Raw  
DEM, May 2019



TanDEM-X DEM (2010-2014)

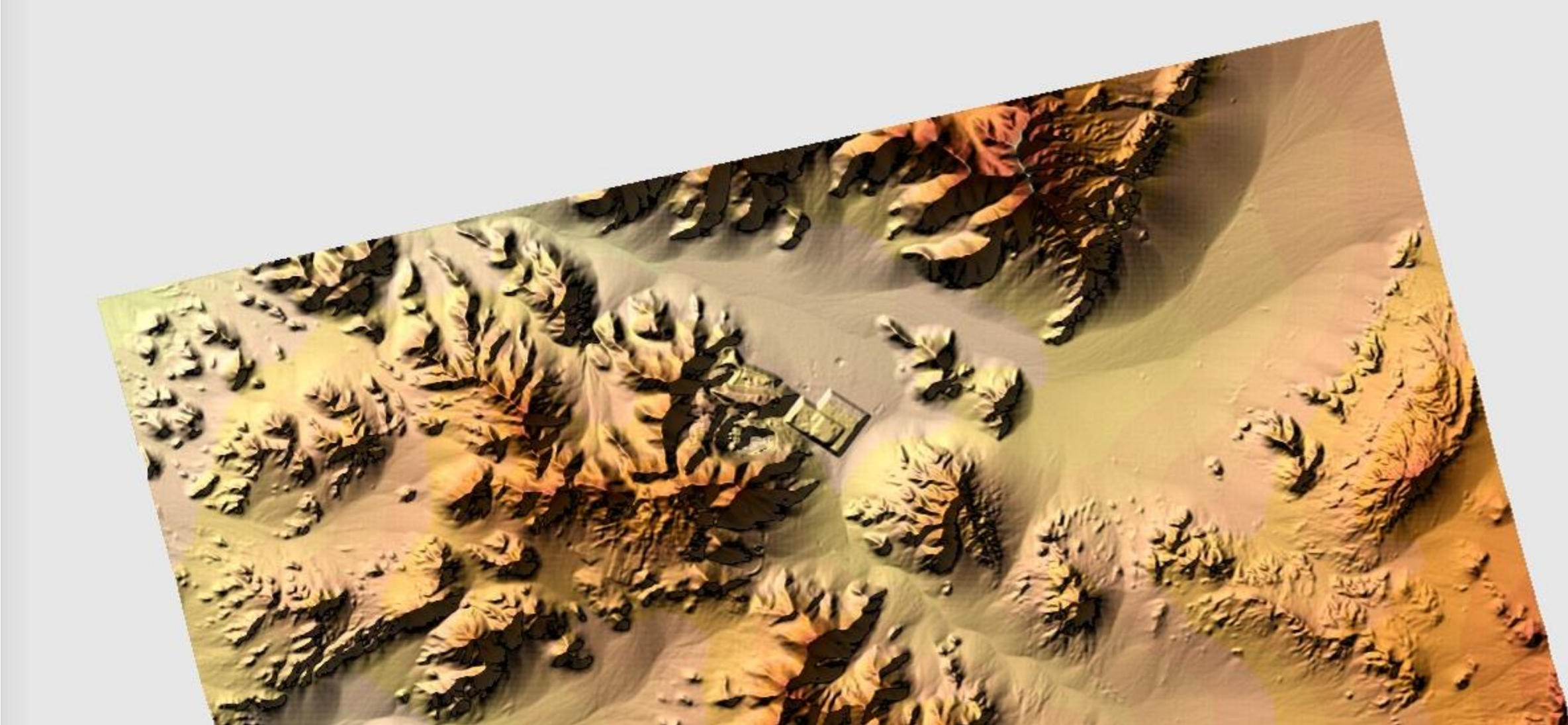




# Mining in Chile



(23,5° S, 69,5° W) Global TanDEM-X DEM (2010-2014)

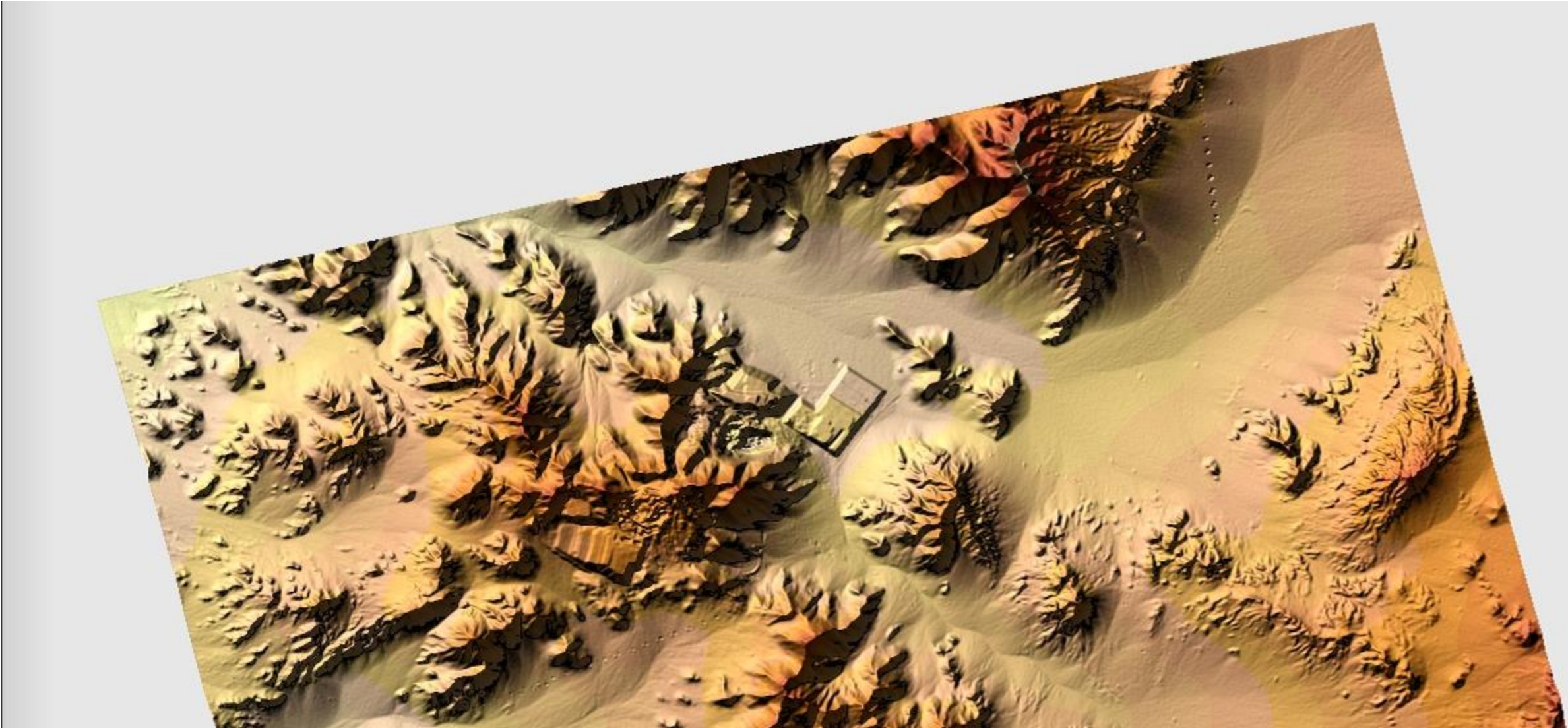


# Mining in Chile



(23,5° S, 69,5° W)

Change RAW DEM scene (2019-05-10)



# Mining in Chile

(23,5° S, 69,5° W)

Change RAW DEM scene (2019-05-10)



TanDEM-ICESat

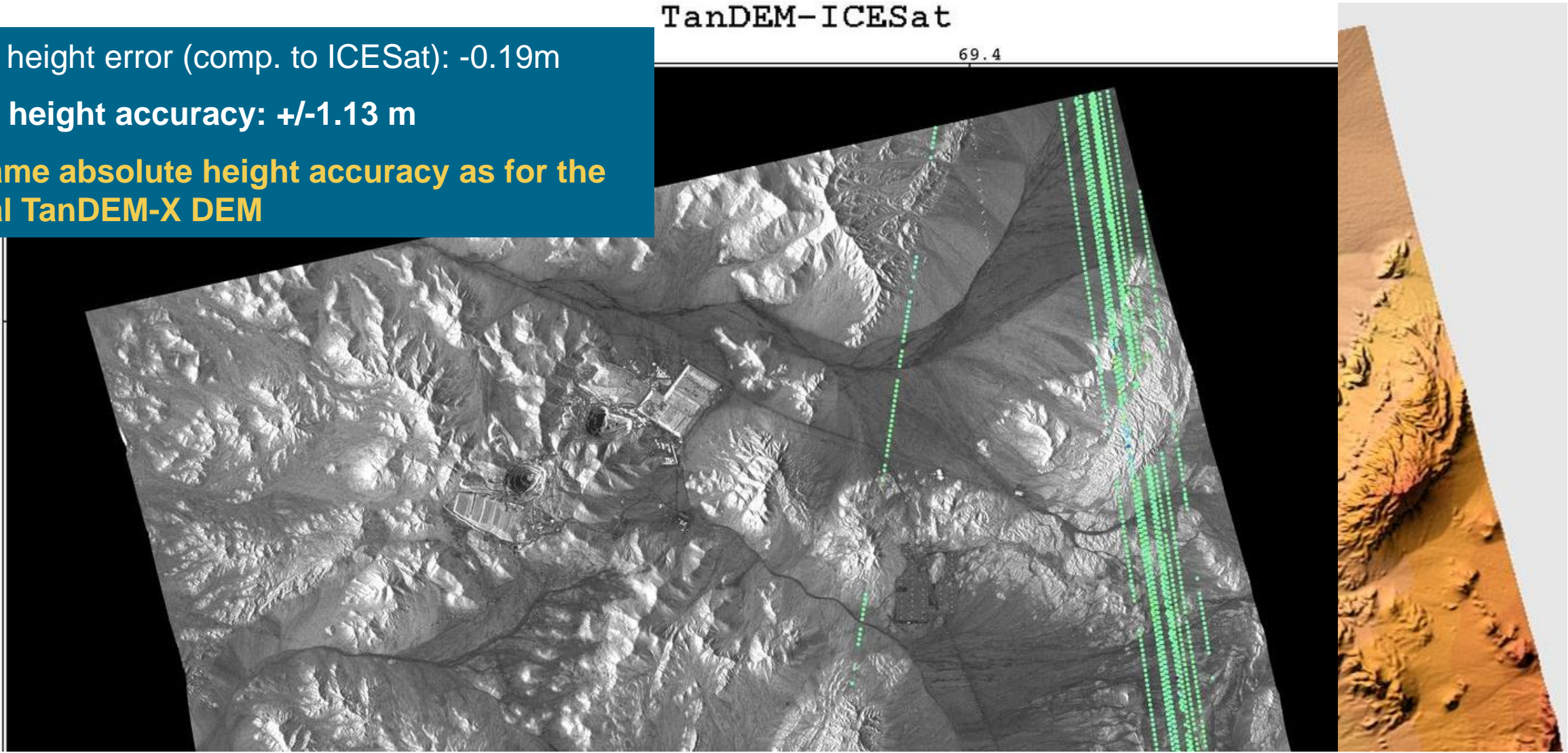
Mean height error (comp. to ICESat): -0.19m

Mean height accuracy: +/-1.13 m

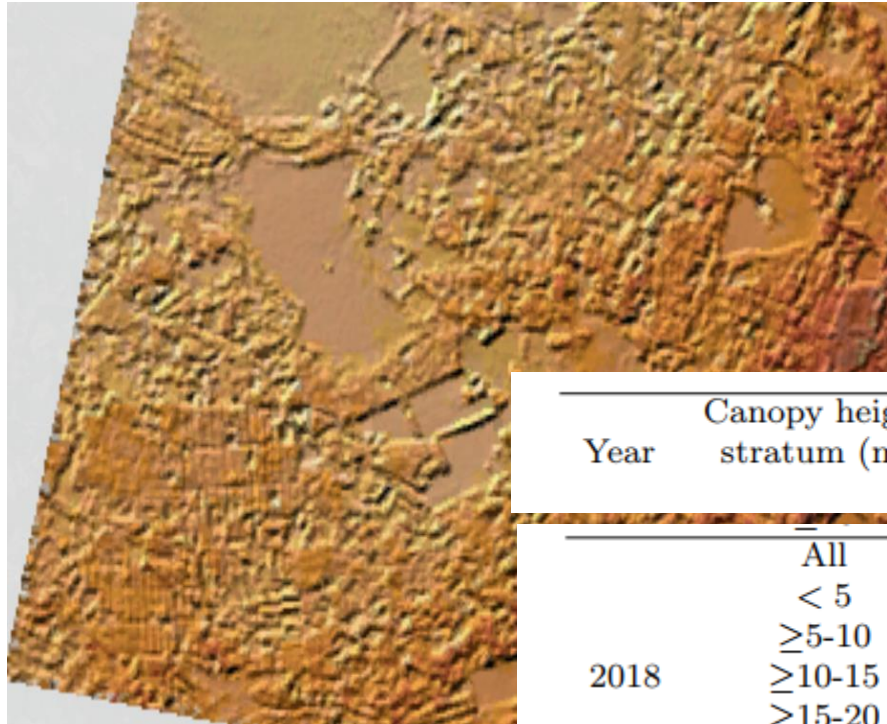
=> Same absolute height accuracy as for the global TanDEM-X DEM

69.4

23.4



# Forest height accuracy & change 2018 – 2012 Tallinn, Estonia (Project IKEBANA)



Accuracy of TanDEM-X heights (2018) versus LiDAR  
With different penetration bias approaches

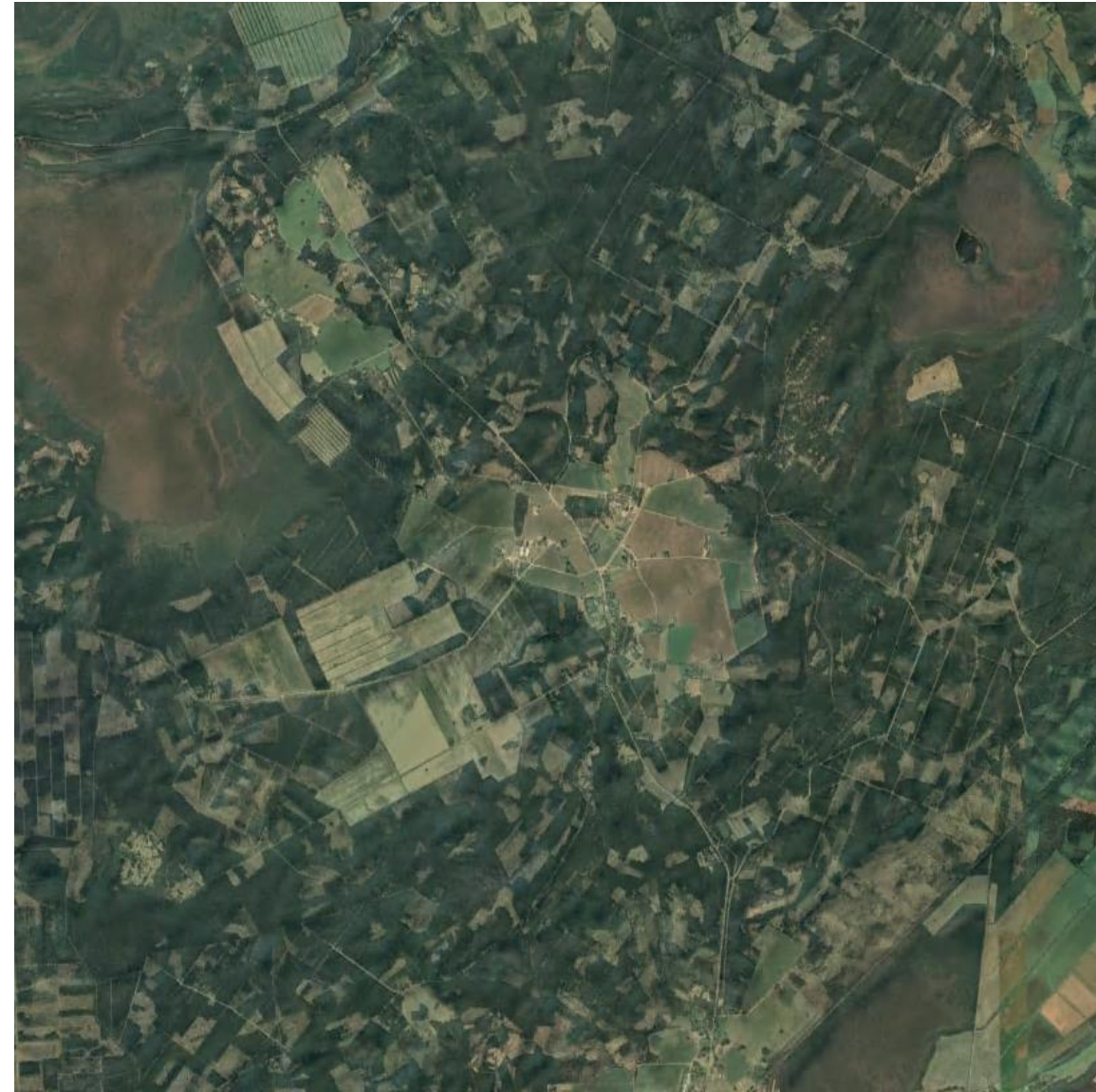
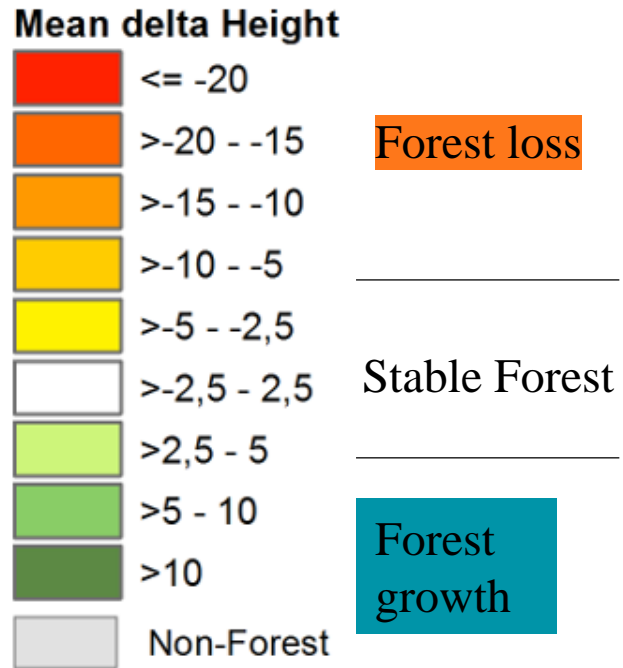
Year	Canopy height stratum (m)	Coverage of stratum (%)	Penetration depth compensation								
			None			Overall			Selective		
			RMSE	ME	$R^2$	RMSE	ME	$R^2$	RMSE	ME	$R^2$
2018	All	100	5.25	-3.26	0.79	3.89	1.26	0.81	3.72	-0.49	0.80
	< 5	34.5	1.93	-0.54	0.98	4.02	3.06	0.96	2.99	0.28	0.95
	≥5-10	13.4	4.14	-3.22	0.95	3.47	1.27	0.93	4.03	0.39	0.89
	≥10-15	19.2	5.66	-4.99	0.95	2.87	0.07	0.94	3.48	-0.27	0.91
	≥15-20	24.5	7.18	-6.49	0.93	3.14	-0.91	0.93	3.57	-1.06	0.91
	≥20-25	10.6	9.59	-8.70	0.88	4.57	-2.38	0.89	5.00	-2.53	0.86
	≥25	1.9	12.92	-11.69	0.77	7.07	-4.49	0.78	7.68	-4.72	0.74

TanDEM-X  
Change  
RawDEM 2018



# Canopy height change 2018 – 2012 Tallinn, Estonia (Project IKEBANA)

## Legend

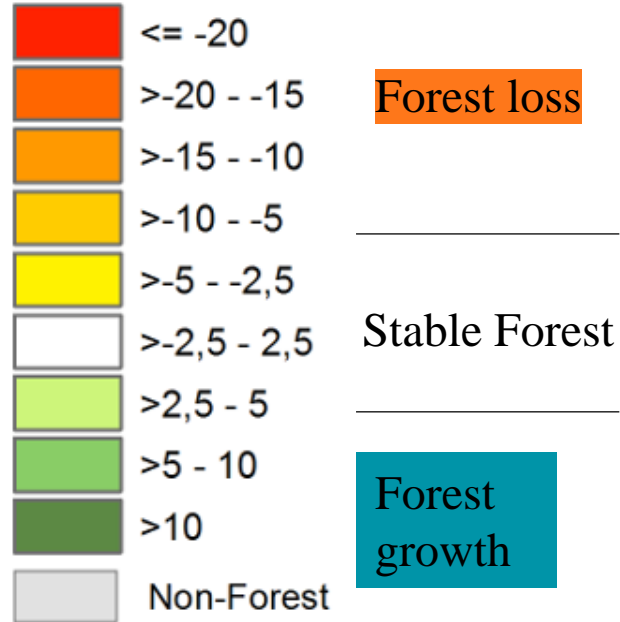


Paper „Assessment of TanDEM-X DEM 2020 data on temperate forests and its application to canopy height change“  
Schlund, Poncét, Wessel, Schweisshelm, Kiefl, PFG, 2023

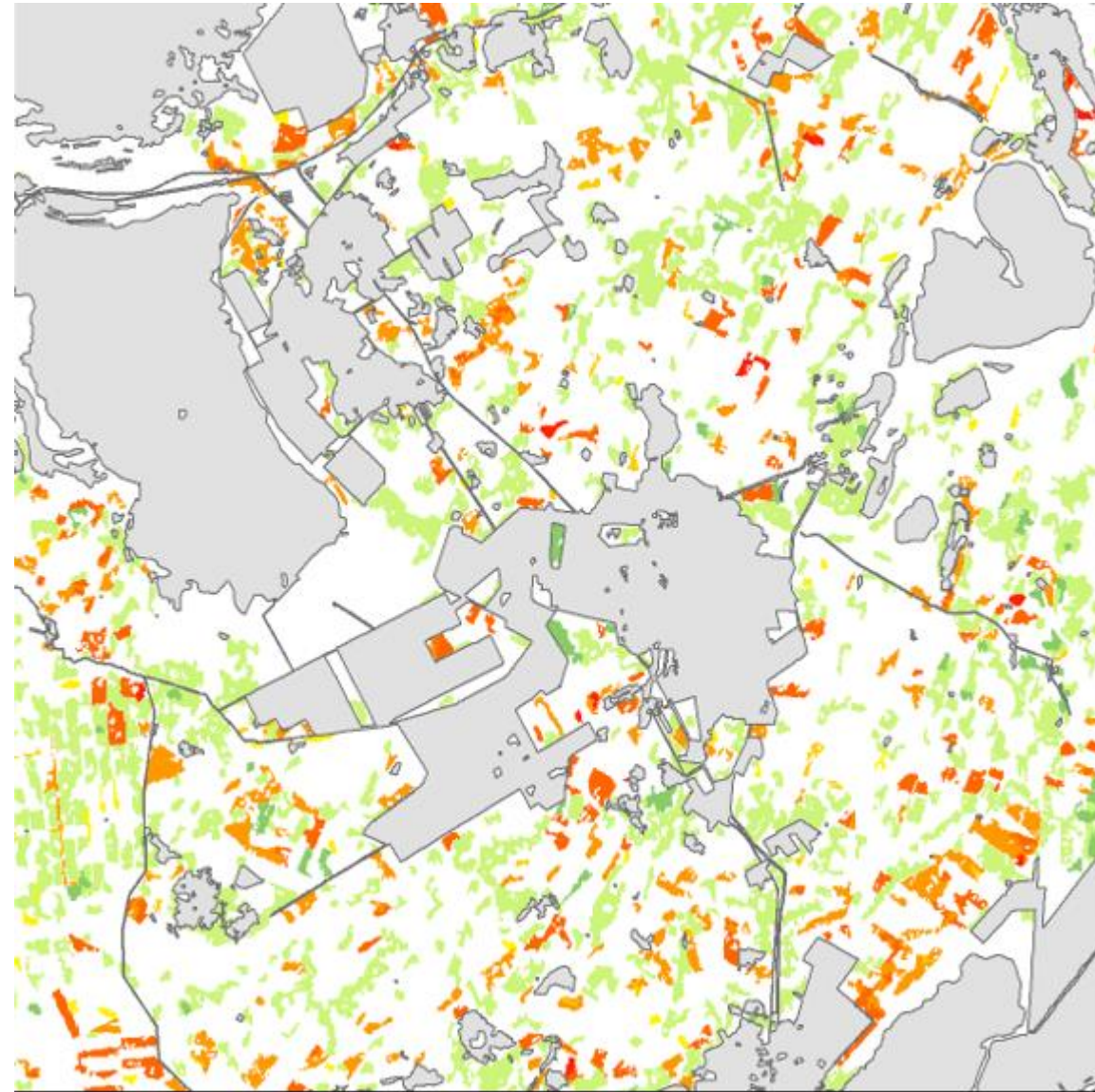
# Canopy height change 2018 – 2012 Tallinn, Estonia (Project IKEBANA)

## Legend

### Mean delta Height



TanDEM-X  
height change

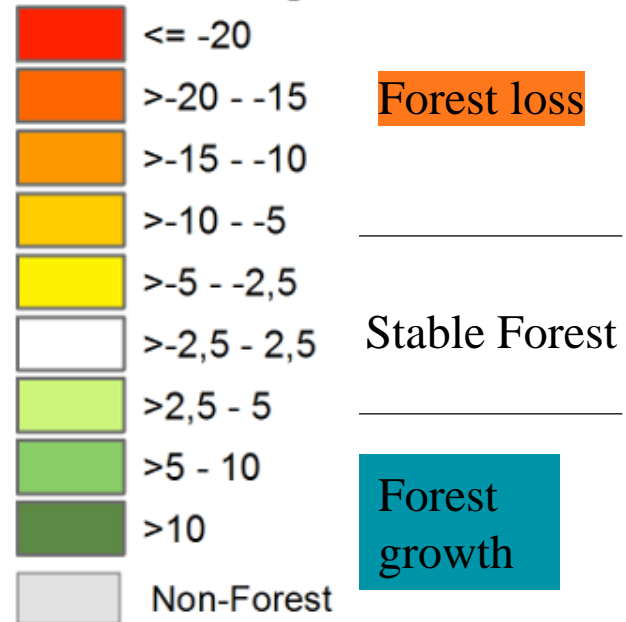


Paper „Assessment of TanDEM-X DEM 2020 data on temperate forests and its application to canopy height change“  
Schlund, Poncét, Wessel, Schweishelm, Kiefl, PFG, 2023

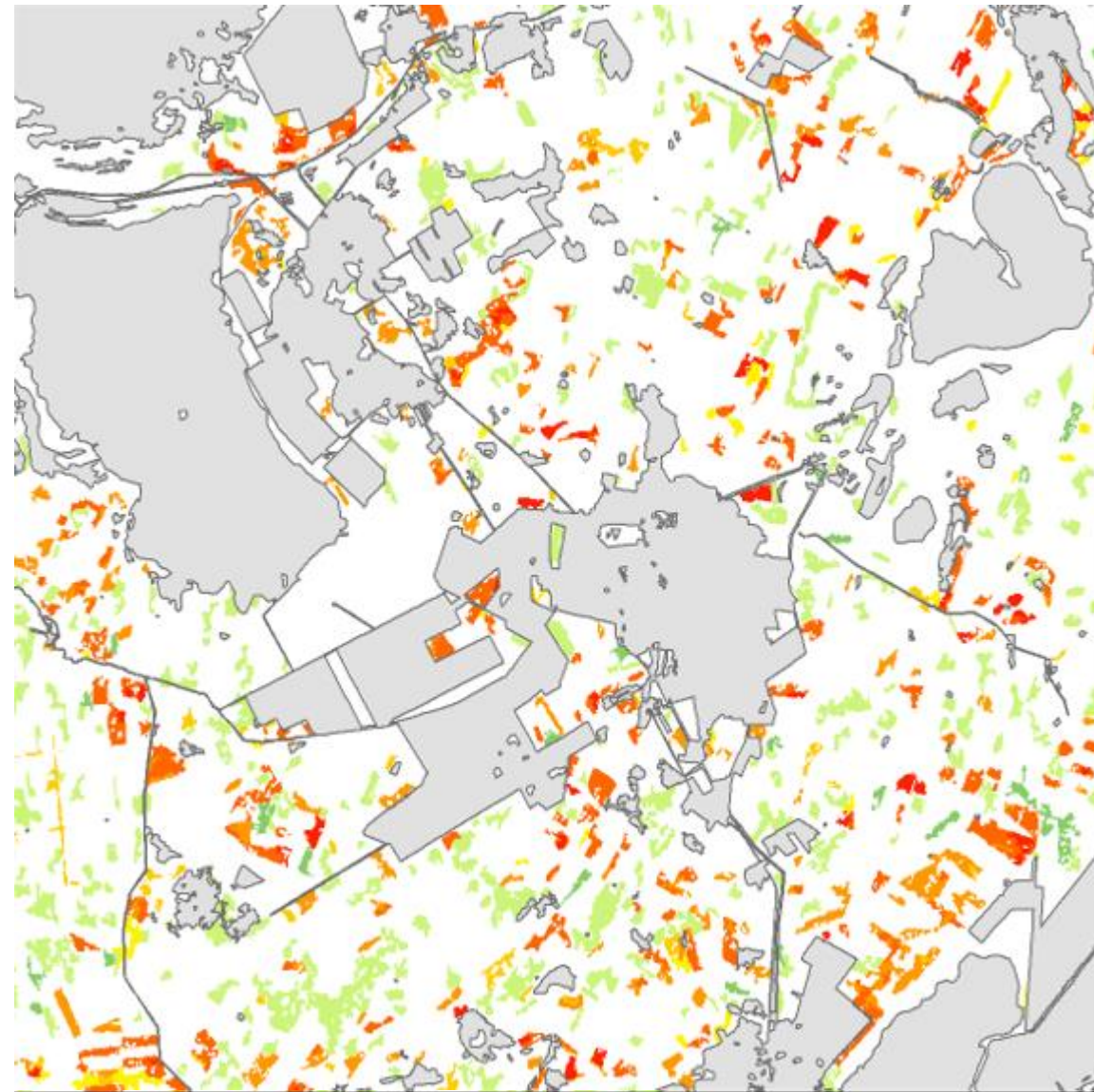
# Canopy height change 2018 – 2012 Tallinn, Estonia (Project IKEBANA)

## Legend

### Mean delta Height

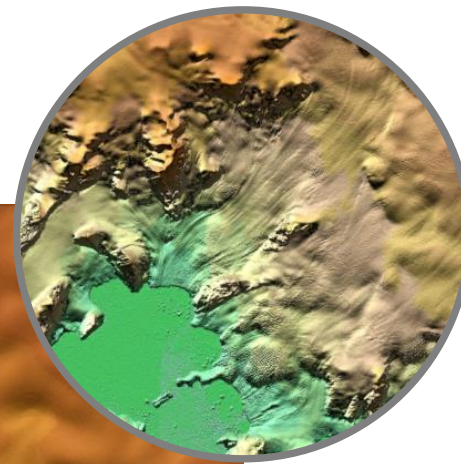
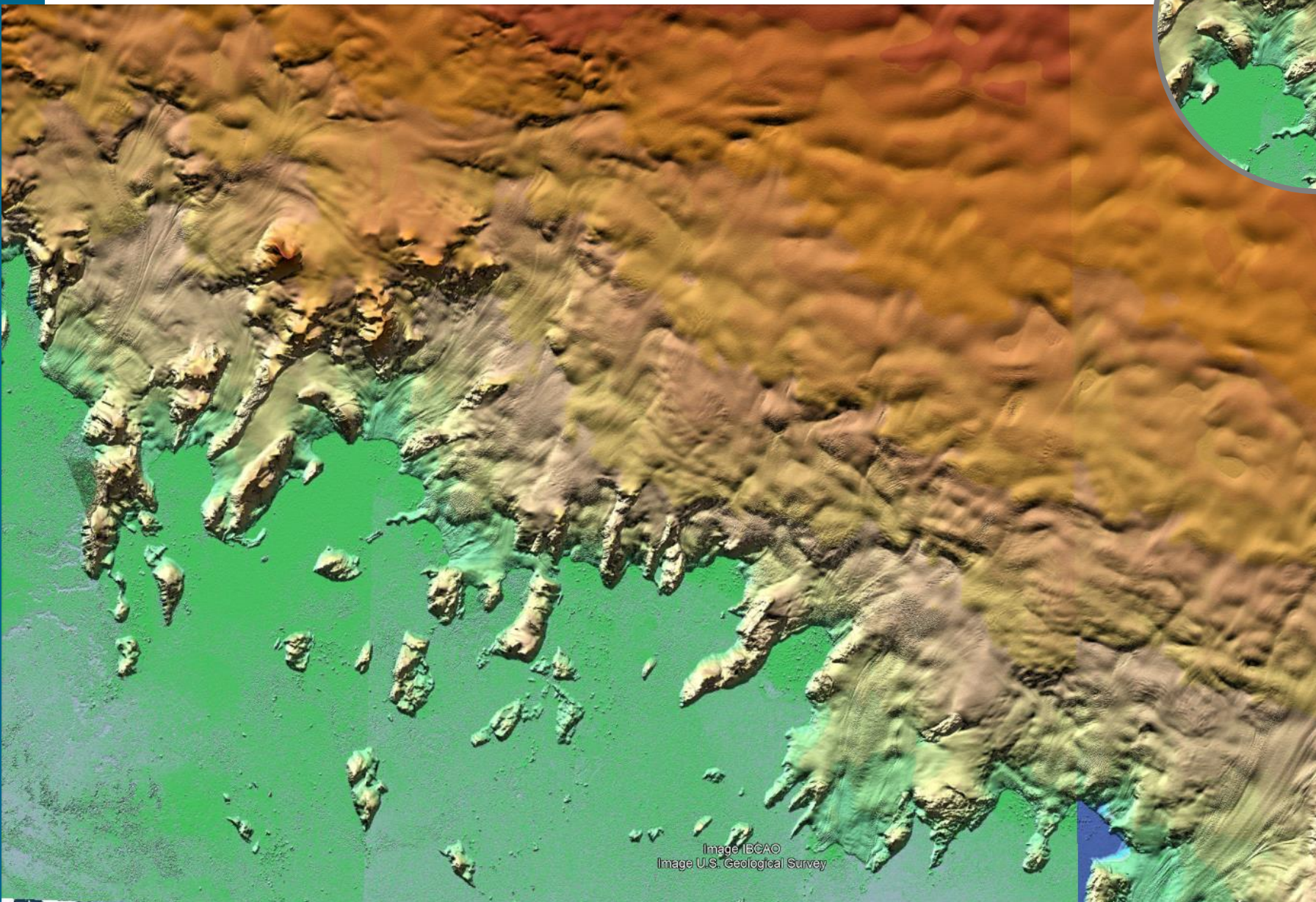


LiDAR  
height change



Paper „Assessment of TanDEM-X DEM 2020 data on temperate forests and its application to canopy height change“  
Schlund, Poncét, Wessel, Schweisshelm, Kiefl, PFG, 2023

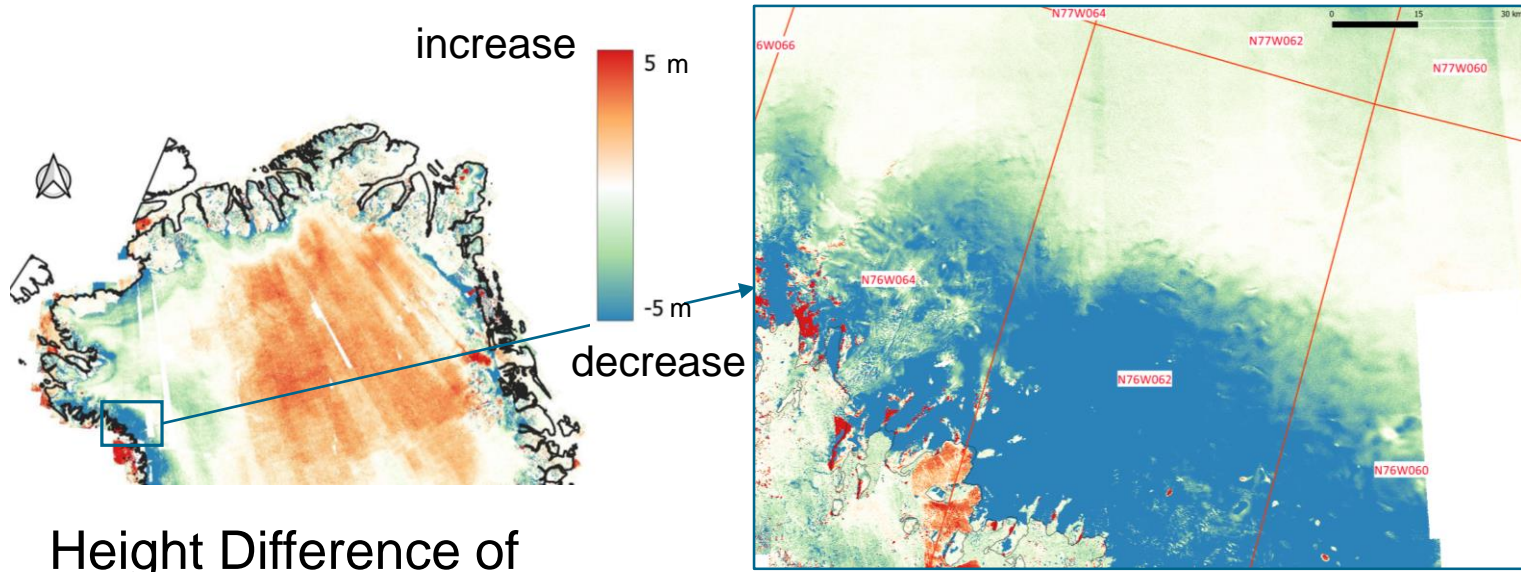
# TanDEM-X changes on glaciers



Mosaic of TanDEM-X  
DEM 2020 data over  
Greenland  
N76W062



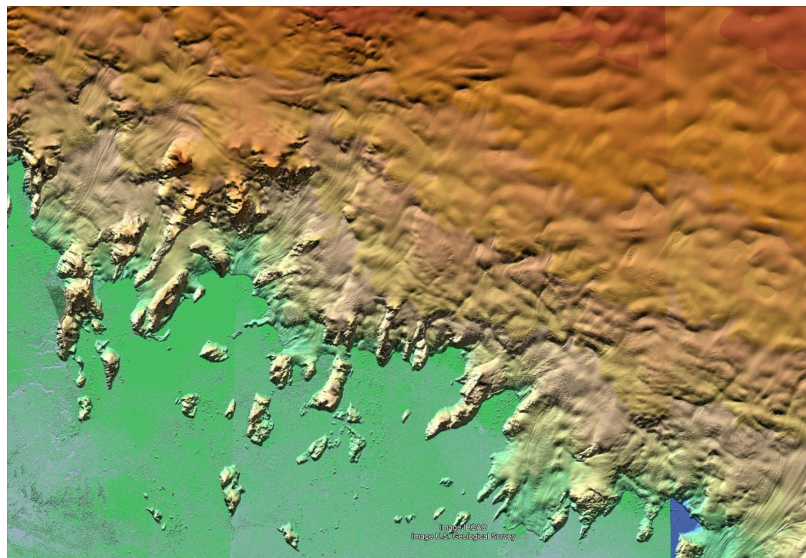
# TanDEM-X changes on glaciers



Height Difference of  
2016/17 minus 2010/11  
in Greenland



Height decrease  
more than 5m



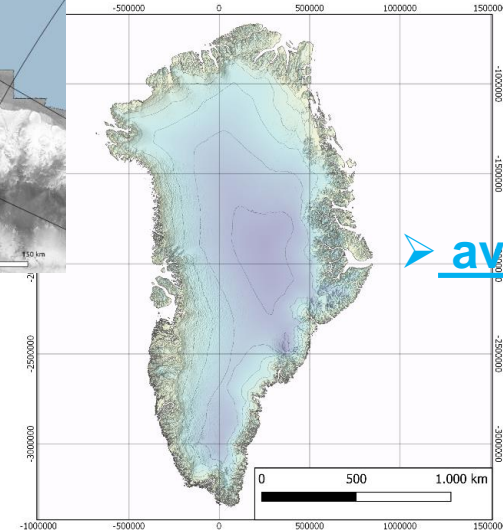
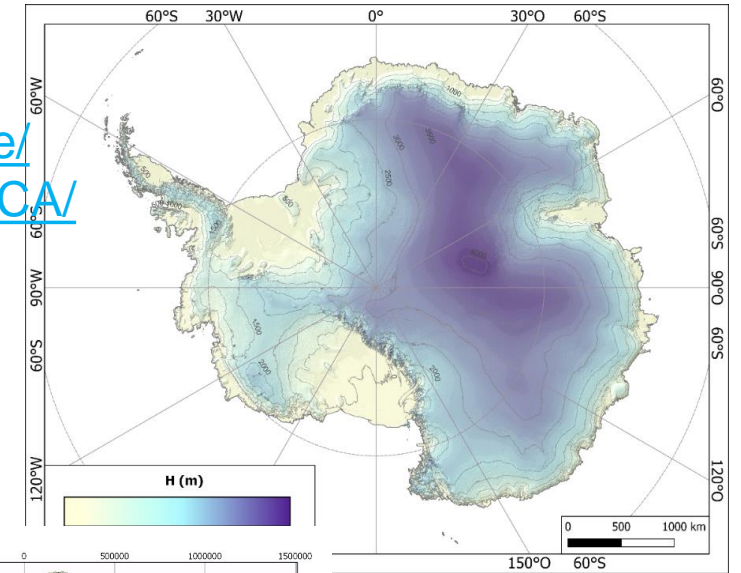
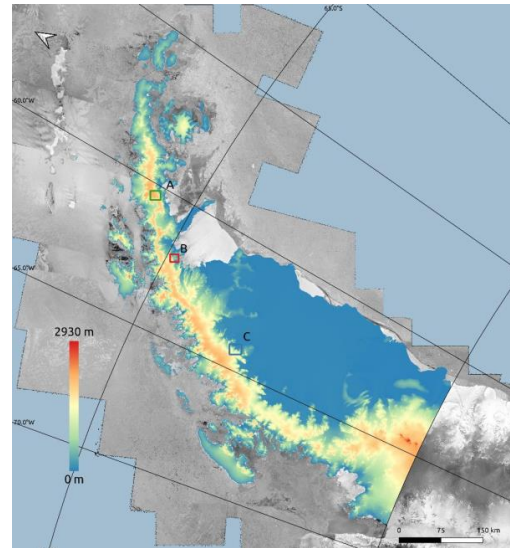
# TanDEM-X PolarDEM Framework



Different DEM products for polar regions (north/south 60°)

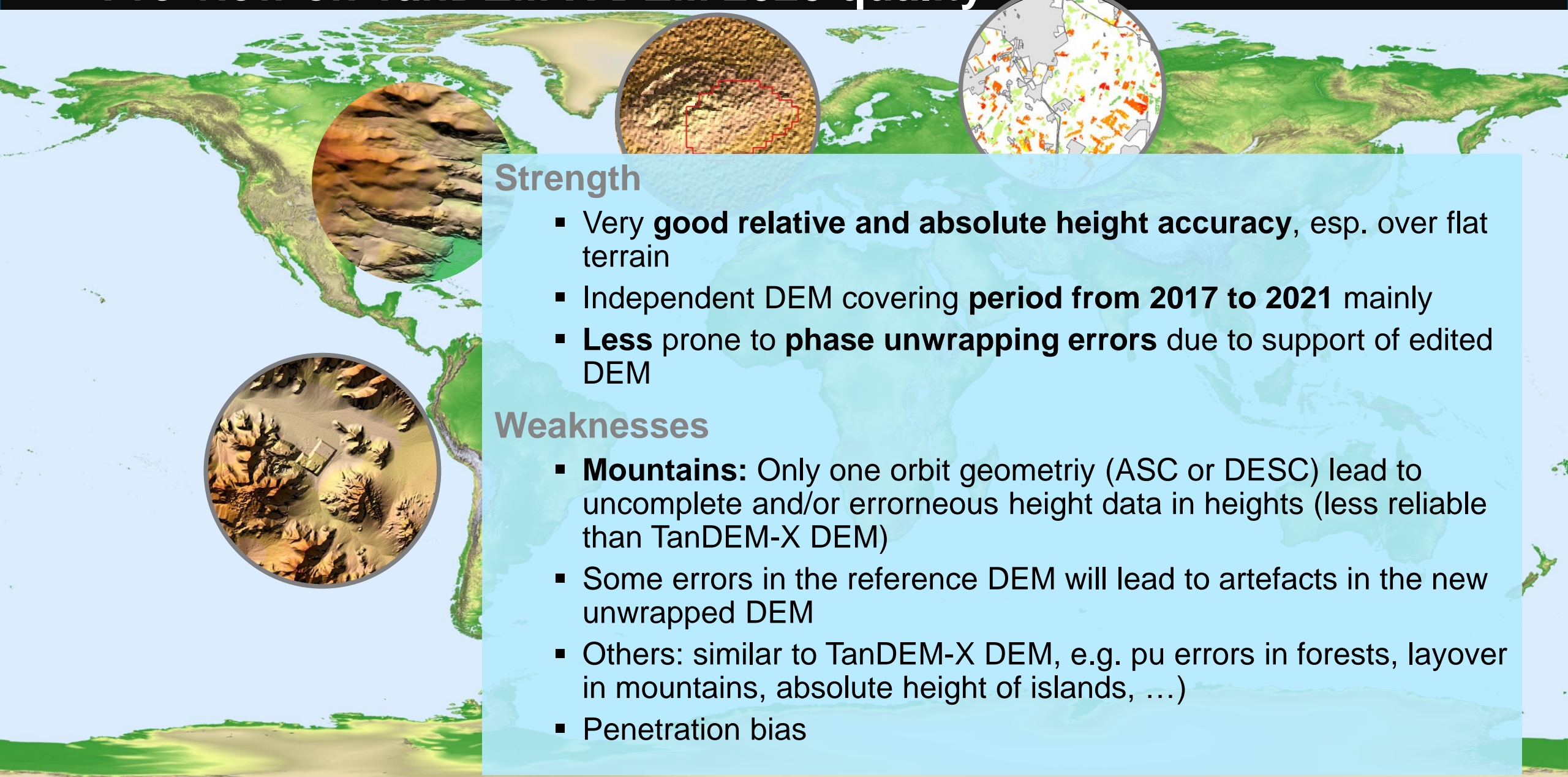
- TanDEM-X PolarDEM 90m of Antarctica
- TanDEM-X PolarDEM 32m of the Arctic
  - Greenland (Download in prep. in 32m)
  - Rest Arctic successively 2023/2024
- TanDEM-X Antarctic Peninsula DEM 12m
  
- Penetration depth corrections (ongoing)
- Time Tagged TanDEM-X PolarDEM 90m Greenland
  - Winter 2010 / 2011 (finished)
  - Winter 2016 / 2017 (finished)

[available in 90m UPS at https://download.geoservice.dlr.de/TDM\\_POLARDEM90/ANTARCTICA/](https://download.geoservice.dlr.de/TDM_POLARDEM90/ANTARCTICA/)



[available soon in 32m](#)

# Pre-view on TanDEM-X DEM 2020 quality



## Strength

- Very **good relative and absolute height accuracy**, esp. over flat terrain
- Independent DEM covering **period from 2017 to 2021** mainly
- **Less** prone to **phase unwrapping errors** due to support of edited DEM

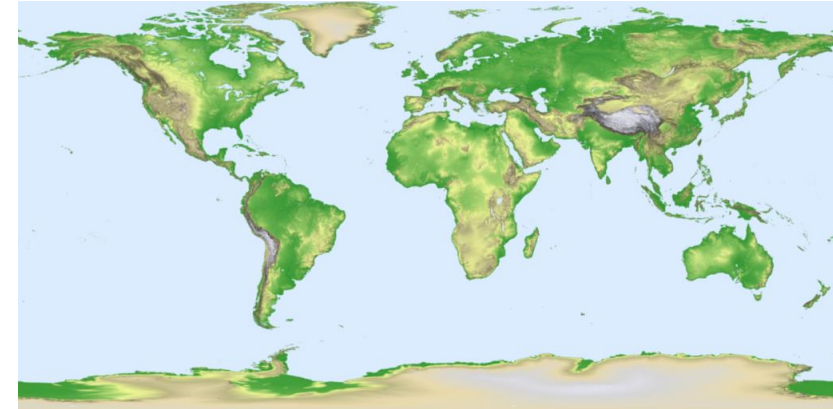
## Weaknesses

- **Mountains:** Only one orbit geometriy (ASC or DESC) lead to uncomplete and/or erroneus height data in heights (less reliable than TanDEM-X DEM)
- Some errors in the reference DEM will lead to artefacts in the new unwrapped DEM
- Others: similar to TanDEM-X DEM, e.g. pu errors in forests, layover in mountains, absolute height of islands, ...)
- Penetration bias

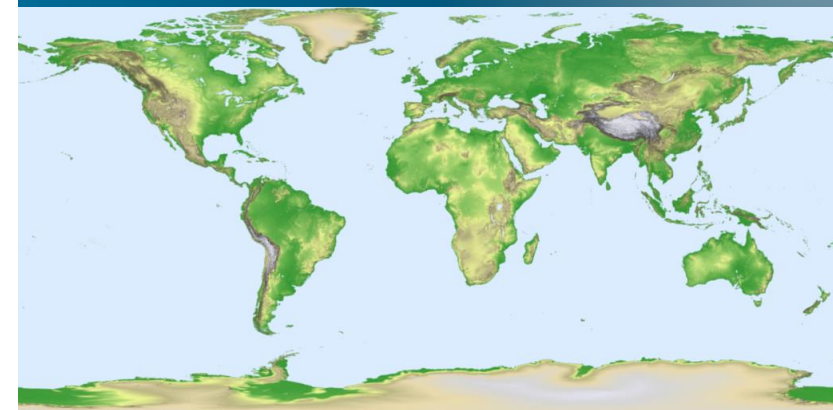
## Summary, cont.

- Production of the input Change RawDEM scenes – done (CoSSC's are available)
- **TanDEM-X DEM 2020** calibration and mosaicking – **mid 2024 complete product release**
- The orig. TanDEM-X DEM and the TanDEM-X DEM 2020 will have **comparable quality**
- This additional dataset will allow monitoring topographic changes in comparison to the TanDEM-X DEM (change maps, change indication maps)
- **Potential for 3D change**

TanDEM-X DEM (2010-2014)



TanDEM-X DEM 2020 (2017-2021)



# Iceland: changes on glaciers



Bárðarbunga volcano, Iceland

TanDEM-X DEM 2020 mosaic minus TanDEM-X DEM/Copernicus DEM