

FABDEM – A 30m global map of elevation with forests and buildings removed

Peter Uhe, *Laurence Hawker*, Luntadila Paulo, Jeison Sosa, Christopher Sampson, and *Jeffrey Neal*

Italic are here in Vienna

EGU22-8994 GM2.3

ENVIRONMENTAL RESEARCH LETTERS (2022)

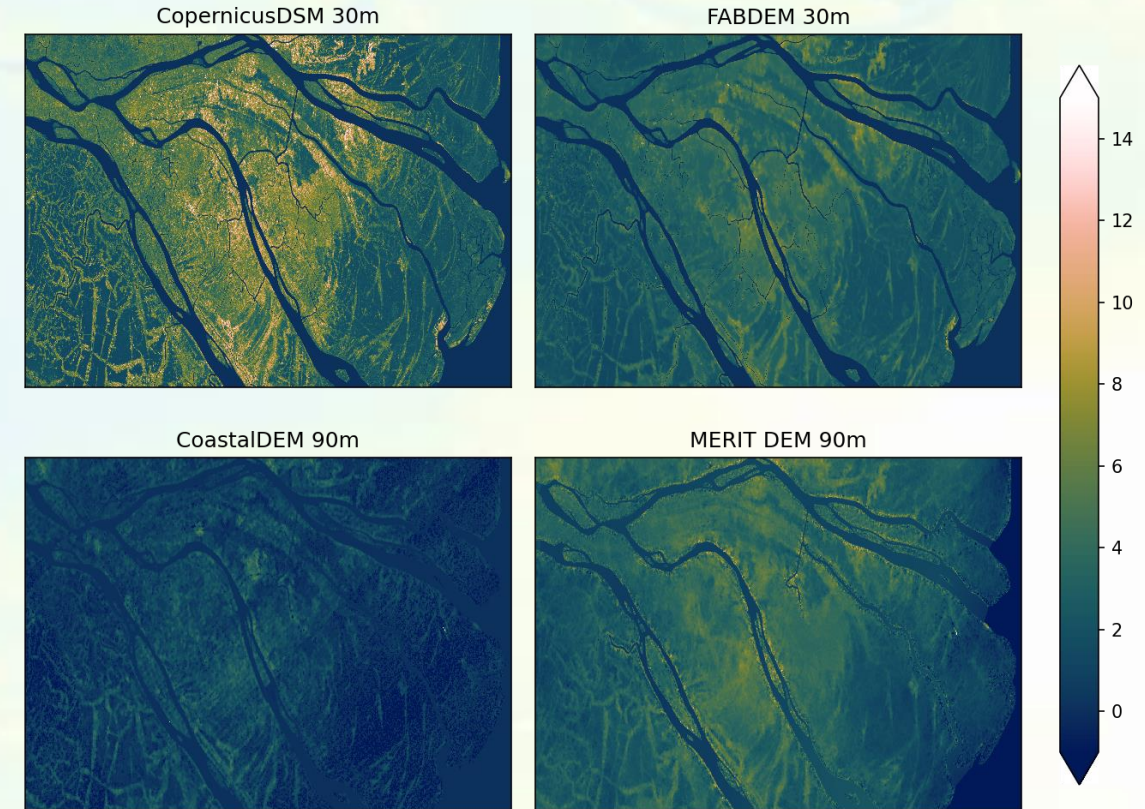
A 30 m global map of elevation with forests and buildings removed

Laurence Hawker; Peter Uhe; Luntadila Paulo et. al.



What is FABDEM?

- First freely available Global DEM to remove *both* forest and building artefacts
- Corrects Copernicus GLO-30 DSM
- Complete global coverage (unlike SRTM)
- First terrain map at 30m resolution
- Using a wide range of reference data for machine learning training



Why do we care? - No Global DTM!

- High Quality LiDAR based DTMs only available for a very small area of the world (estimated $\sim 0.005\%$ in 2018[^])
- A global DTM needed to fill in these gaps
- **MERIT DEM** closest global DEM to a DTM - major correction of SRTM and forests removed - **BUT no buildings removed**

[^] FRONTIERS IN EARTH SCIENCE (2018)

Perspectives on Digital Elevation Model (DEM) Simulation for Flood Modeling in the Absence of a High-Accuracy Open Access Global DEM

Hawker, Laurence; Bates, Paul; Neal, Jeffrey et. al.



GEOPHYSICAL RESEARCH LETTERS (2017)

A high-accuracy map of global terrain elevations

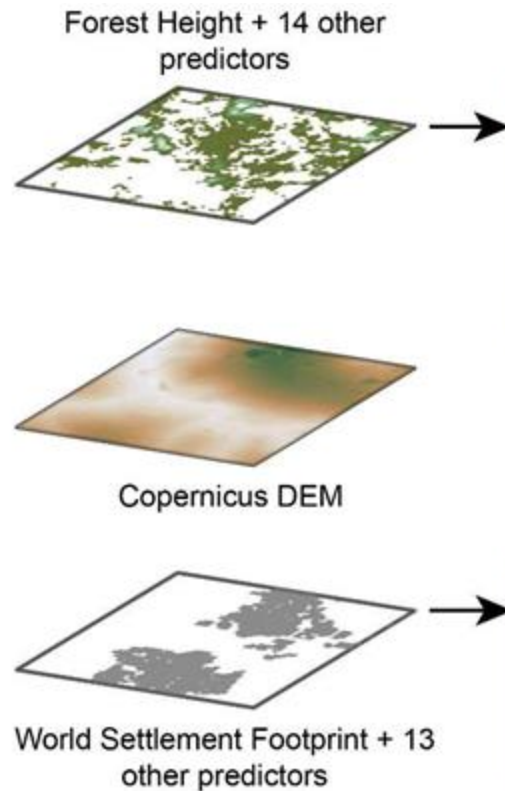
Yamazaki, Dai; Ikeshima, Daiki; Tawatari, Ryunosuke et. al.



General Workflow - Step I - Data Preparation for Random Forest

Data Preparation

Prepare most recent and relevant predictor data for machine learning

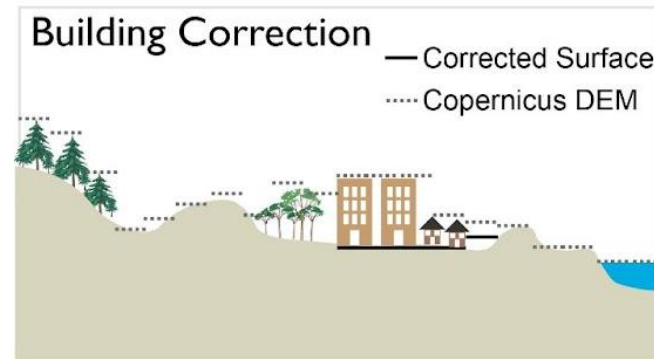
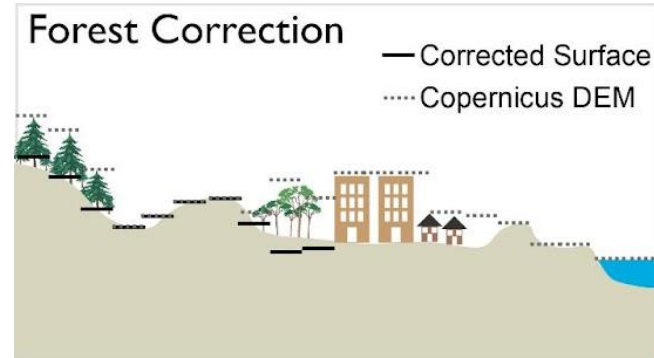


Dataset	Version	Grid Spacing (arc seconds)	Additional Information	Model	Ref.
Forest Heights	2019	1		Forests	[6]
Forest Heights Image filters	2019	1	- Sobel 3x3 - Diff of Gaussian $\sigma_1 = 0.5, \sigma_2 = 1$ - Diff of Gaussian $\sigma_1 = 1, \sigma_2 = 2$ - Diff of Gaussian $\sigma_1 = 2, \sigma_2 = 4$ - Gaussian $\sigma = 3$ - Gaussian $\sigma = 5$ - Bilateral $\sigma_{dist} = 5, \sigma_{int} = 5$ - Unsharp Masking $\sigma = 3$	Forests	[6]
Land Cover 100m - Tree Cover	3.0.1	3		Global Forests	[20]
ICESAT2 canopy heights	4	point data	- h.canopy - h.mean.canopy - Inverse-distance weighted interpolation to COPDEM30 grid	Boreal forests	[21]
Travel Times	-	30	- Time to nearest city of 5-50 million people. Log transformed - Time to nearest city of 1-5 million people. Log transformed - Time to nearest city of 0.5-1 million people. Log transformed	Urban	[12]

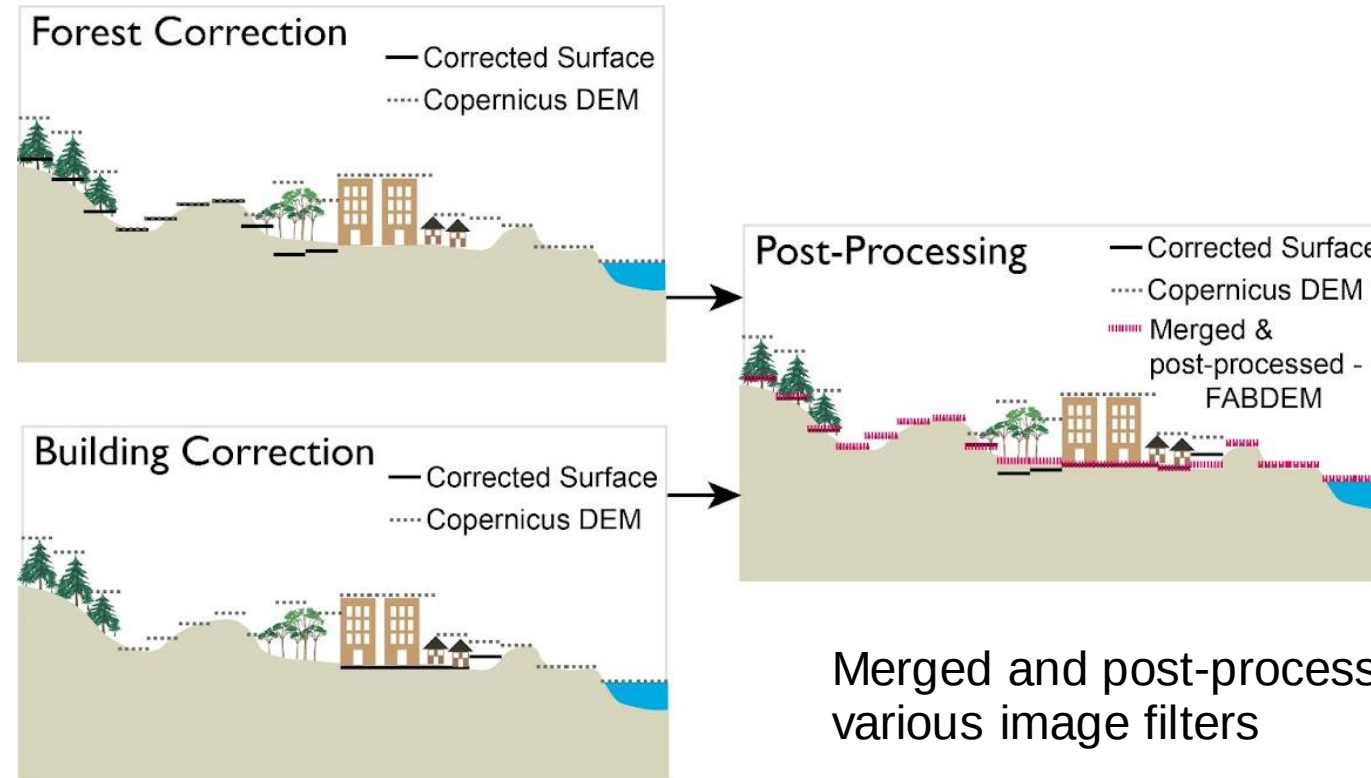
Night Lights	2016	15		Urban	[22]
WorldPop Constrained	2020	3	Log transformed	Urban	[11]
GHS Urban Centre Database 2019A	1.2	30	- Built-up area per capita (BU-CAP15) - Average greenness in the built-up area (E_GR_AV14) - Gross Domestic Product for 2015 divided by urban area and log transformed	Urban	[18]
World Settlement Footprint	2015	0.32	Fraction of COPDEM30 grid cell containing building footprint	Urban	[17]
Copernicus DEM (COPDEM30) Image filters	2020.2	1	- Sobel 3x3 - Diff of Gaussian $\sigma_1 = 0.5, \sigma_2 = 1$ - Diff of Gaussian $\sigma_1 = 1, \sigma_2 = 2$ - Diff of Gaussian $\sigma_1 = 2, \sigma_2 = 4$ - Unsharp Masking $\sigma = 1.5$ - Unsharp Masking $\sigma = 3$	- All - All - All - Global Forests - Urban - All	[1]

+ LiDAR from 12 countries, covering wide range of urban landscapes and climatic zones

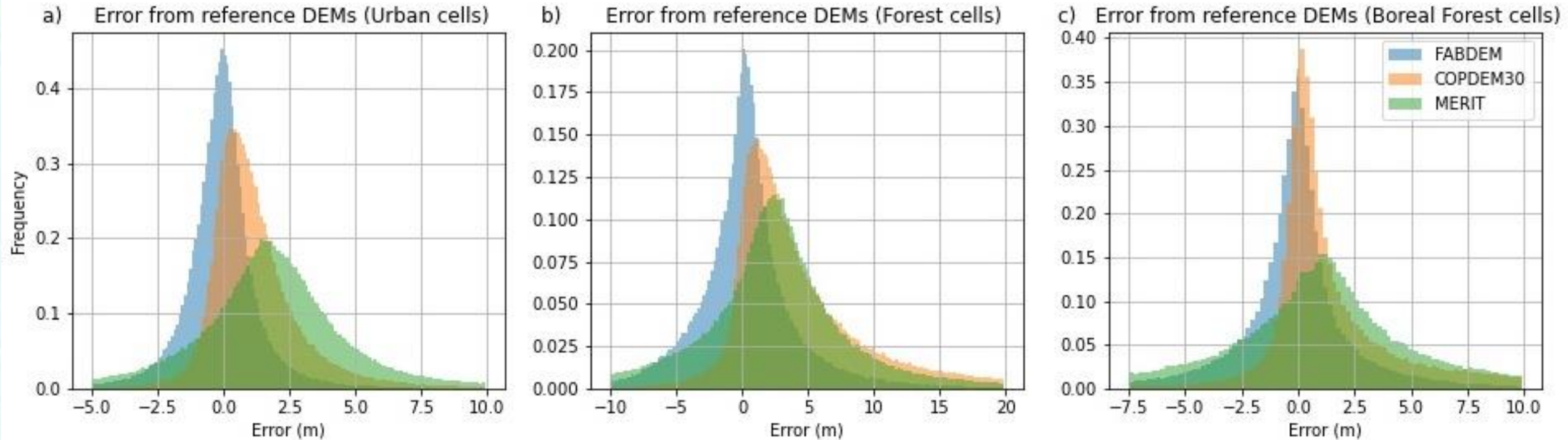
General Workflow - Step 2 – Forest + Urban Correction



General Workflow - Step 3 – Post-Processing



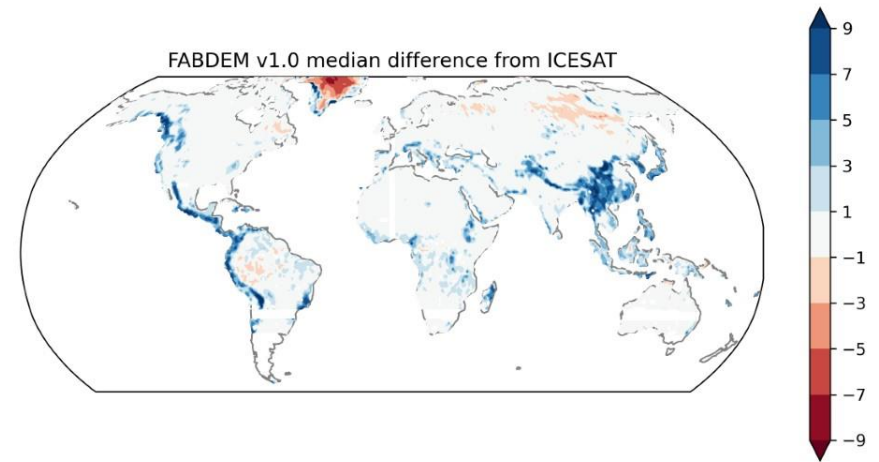
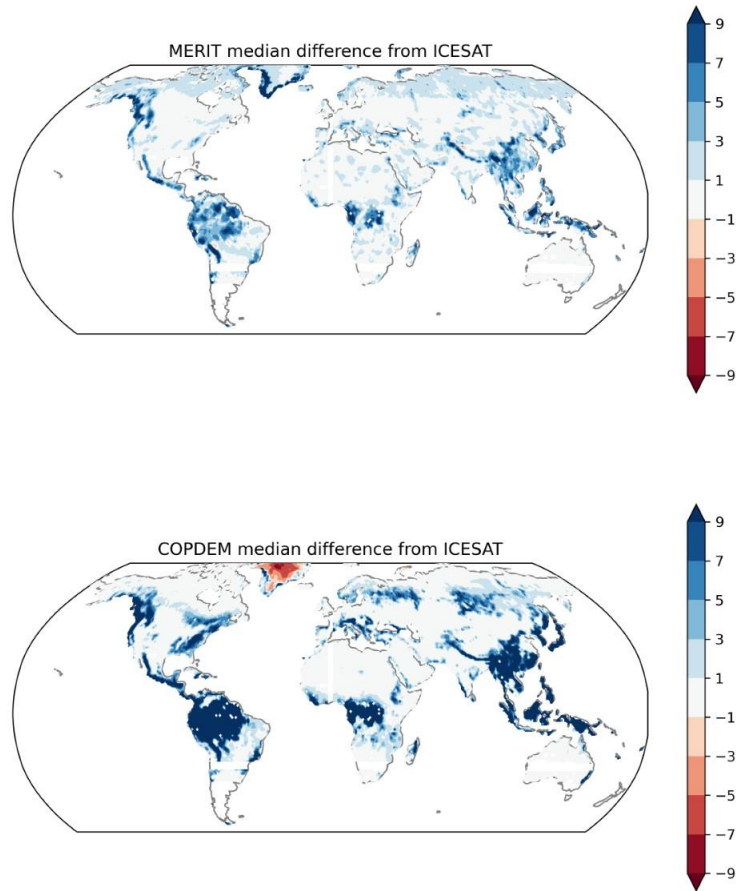
Error Stats



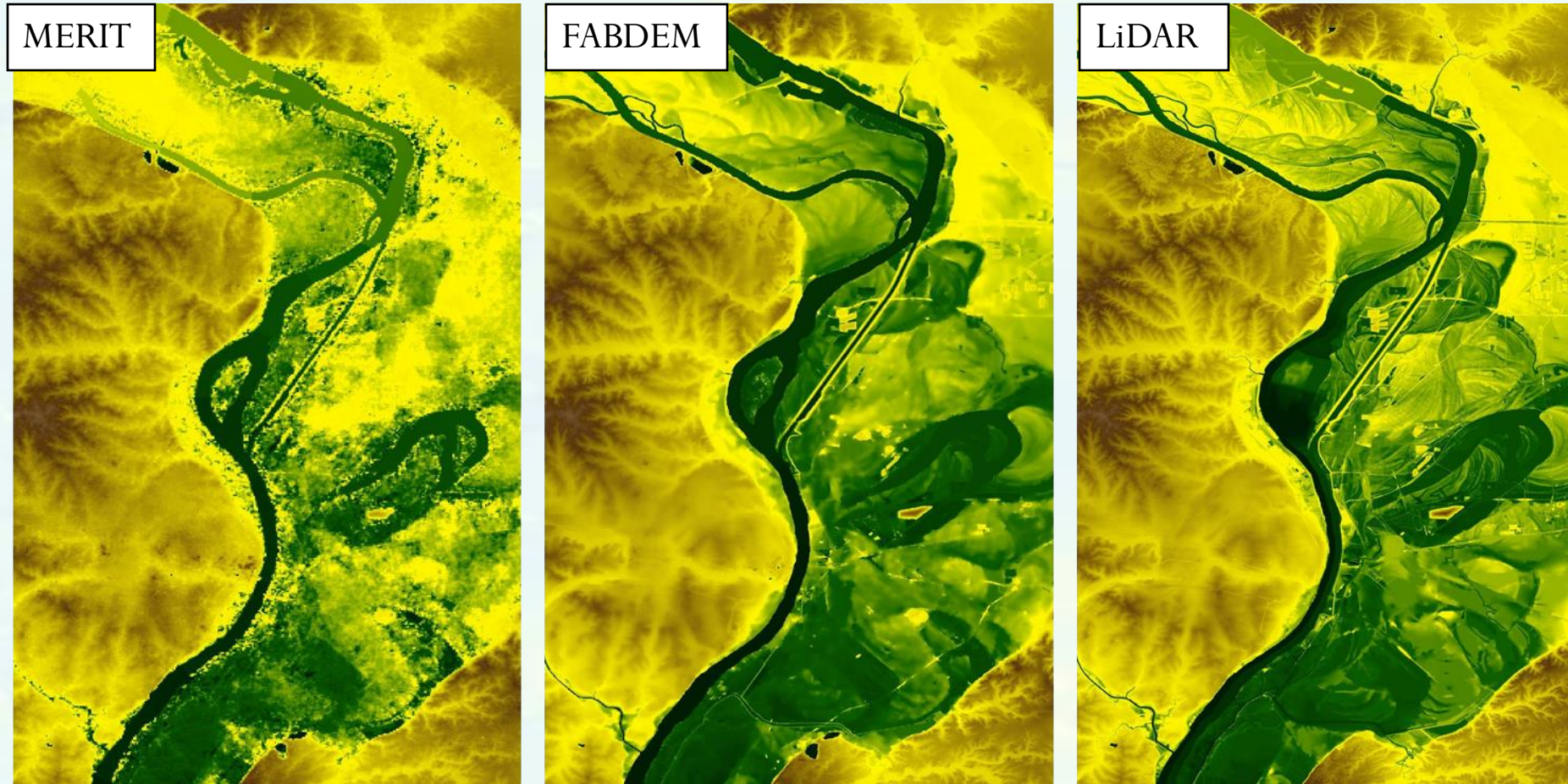
Urban – Copernicus GLO30 -> FABDEM
Median error: 0.86m -> -0.08m
Mean absolute error: 1.61m -> 1.12m

Forest – Copernicus GLO30 -> FABDEM
Median error: 2.93m -> 0.20m
Mean absolute error: 5.15m -> 2.88m

Error Maps



Comparison with other DEMs, St Louis, USA



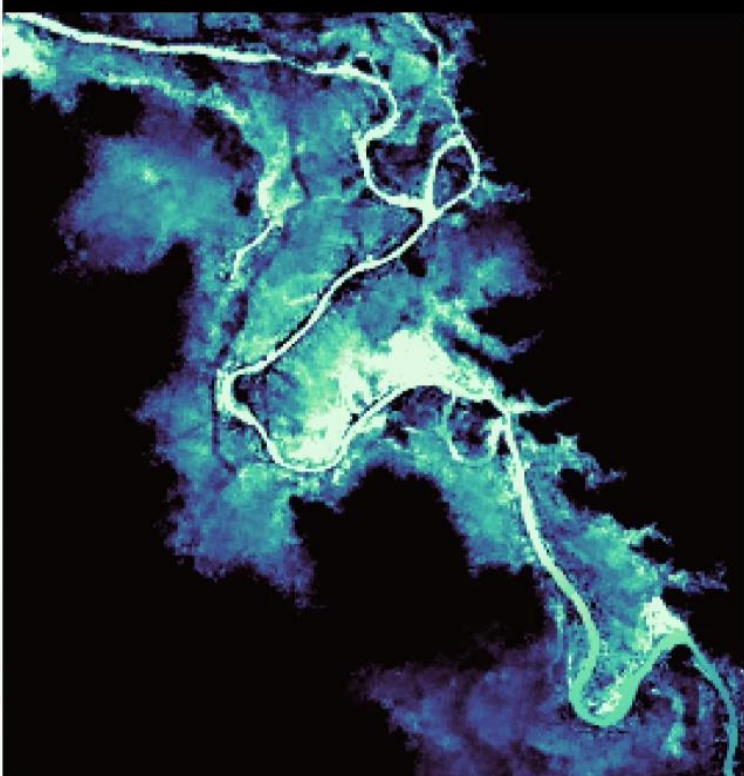
Elevation (m)

120

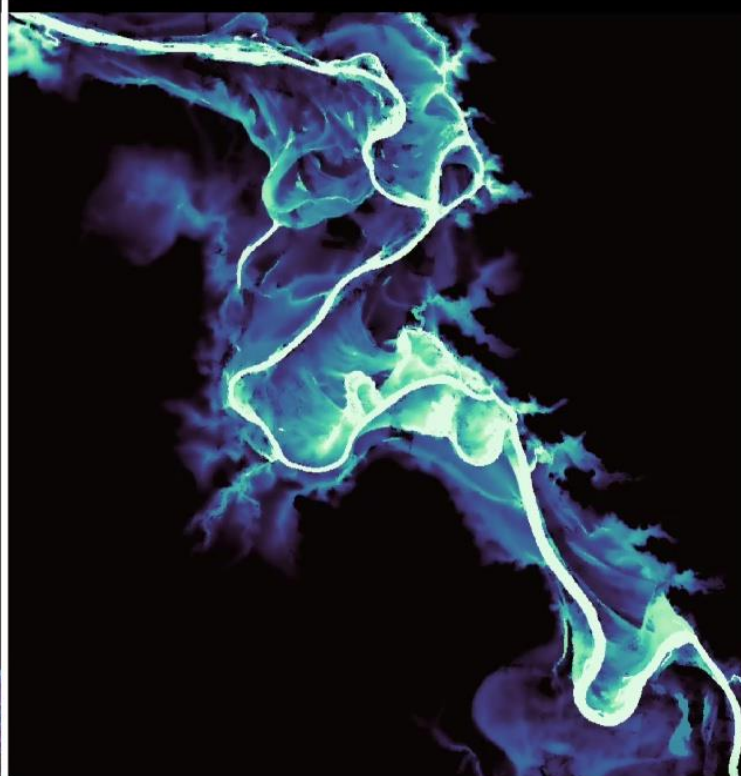
280

An application – hydrodynamic models

MERIT DEM



FABDEM



LiDAR



Depth (m)

Useful Details

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A 30 m global map of elevation with forests and buildings removed

Laurence Hawker^{4,5,1,2} , Peter Uhe^{4,1,2,3} , Luntadila Paulo³, Jeison Sosa³, James Savage³, Christopher Sampson³ and Jeffrey Neal^{1,2,3}

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FABDEM

FABDEM (Forest And Buildings removed Copernicus DEM) is a global elevation map that removes building and tree height biases from the Copernicus GLO 30 Digital Elevation Model (DEM). The data is available at 1 arc second grid spacing (approximately 30m at the equator) for the globe. The FABDEM dataset is licensed under a Creative Commons "CC BY-NC-SA 4.0" license.

For commercial use queries, please contact fabdem@fathom.global

This dataset is published in support of the paper "A 30 m global map of elevation with forests and buildings removed" published by IOP in Environmental Research Letters at <https://dx.doi.org/10.1088/1748-9326/ac4d4f>.

Complete download (zip, 462.2 GiB)

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Total size	462.2 GiB

Data Resources

 license.txt	Explore
 N00E000-N10E010_FABDEM_V1-0.zip	Explore
 N00E010-N10E020_FABDEM_V1-0.zip	Explore

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