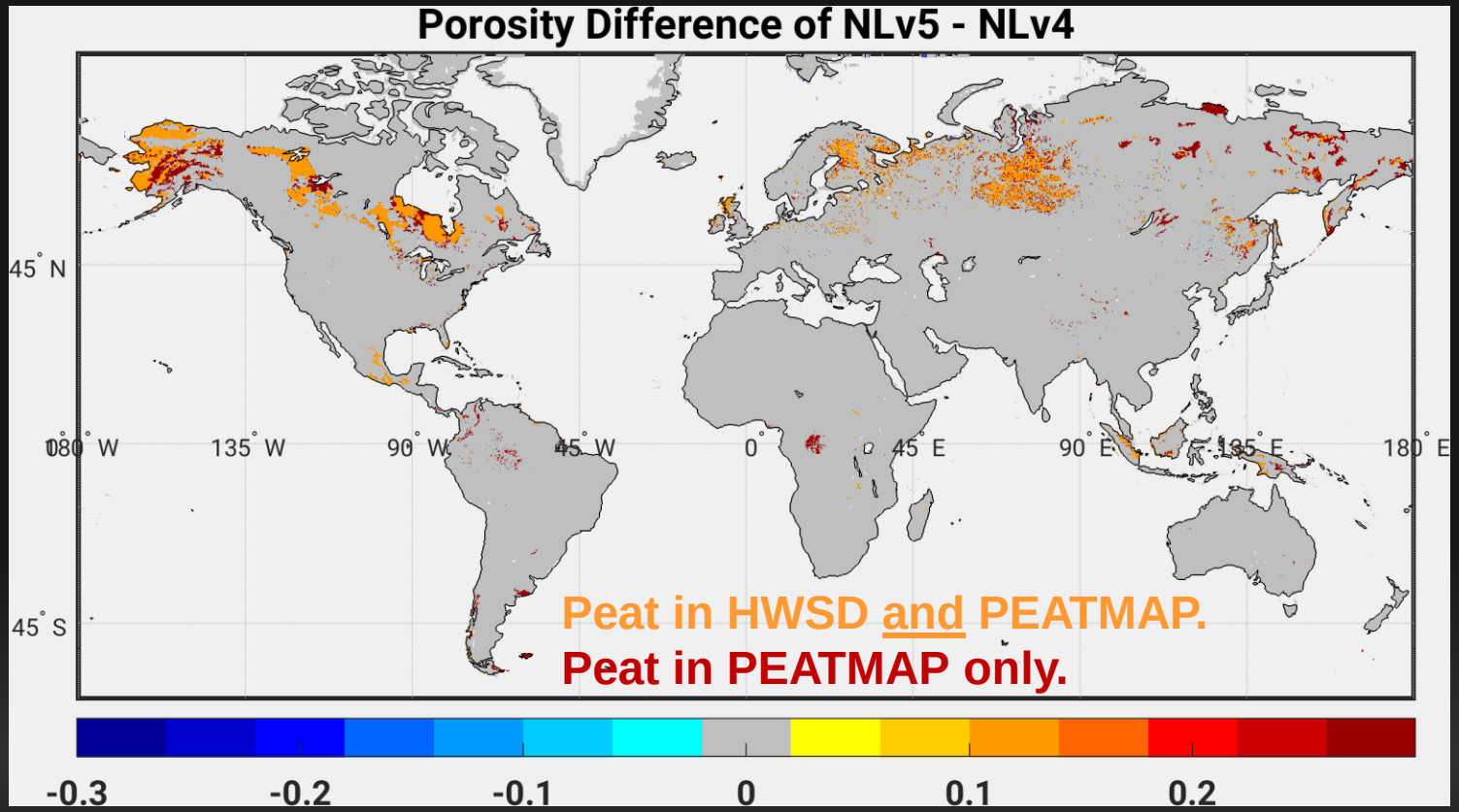
PEATCLSM

Model changes:

- PEATCLSM hydrology for peatlands (Bechtold et al. 2019, 2020).
- Revised land model parameters (NLv5 boundary conditions):
  - In NLv3 (GEOS-FP) and NLv4 (L4_SM Version 6) boundary conditions, the soil class of a tile is determined from the sand, clay, and organic carbon content of the Harmonized World Soil Database (HWSD).
  - In NLv5 (L4_SM Version 7), a global map of peatland area fraction (PEATMAP) is used in addition to HWSD to determine soil classes.

Peatlands

Rolf's original understanding.



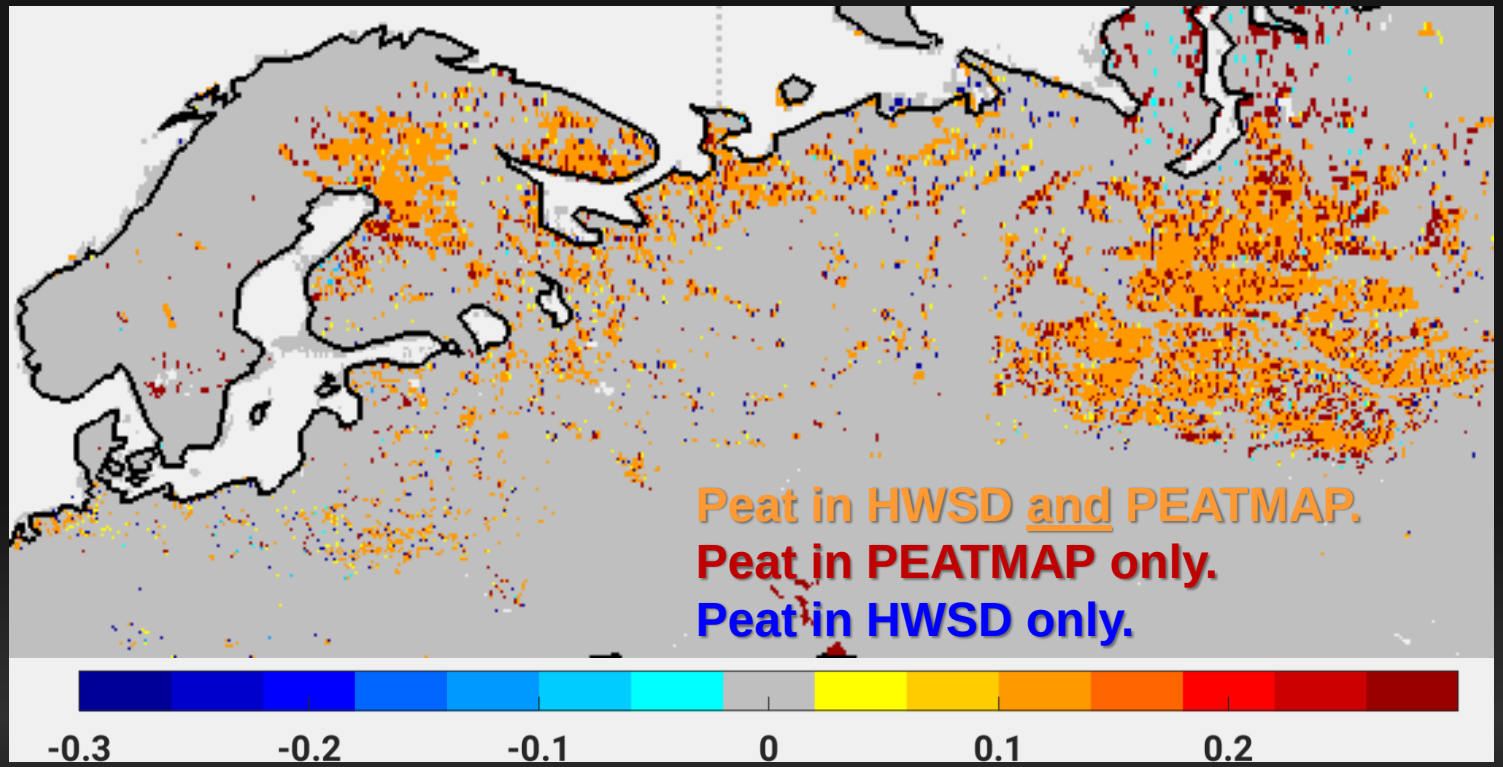
Three key changes:

1. In NLv5 bcs, peatlands are union of peatlands in HWSD and PEATMAP.
2. Porosity assigned to peatlands increased from 0.80 to 0.93.
3. Major revisions to hydrology in peatlands in NRv10 / L4_SM v7 (PEATCLSM).

L4_SM	Nature Run	BCS	Soil parameters	Porosity	Hydrology
V6	NRv9.1	NLv4	HWSD	0.80	Catchment
V7	NRv10	NLv5	HWSD+PEATMAP	0.93	PEATCLSM

Peatlands

Look again (zoom)…



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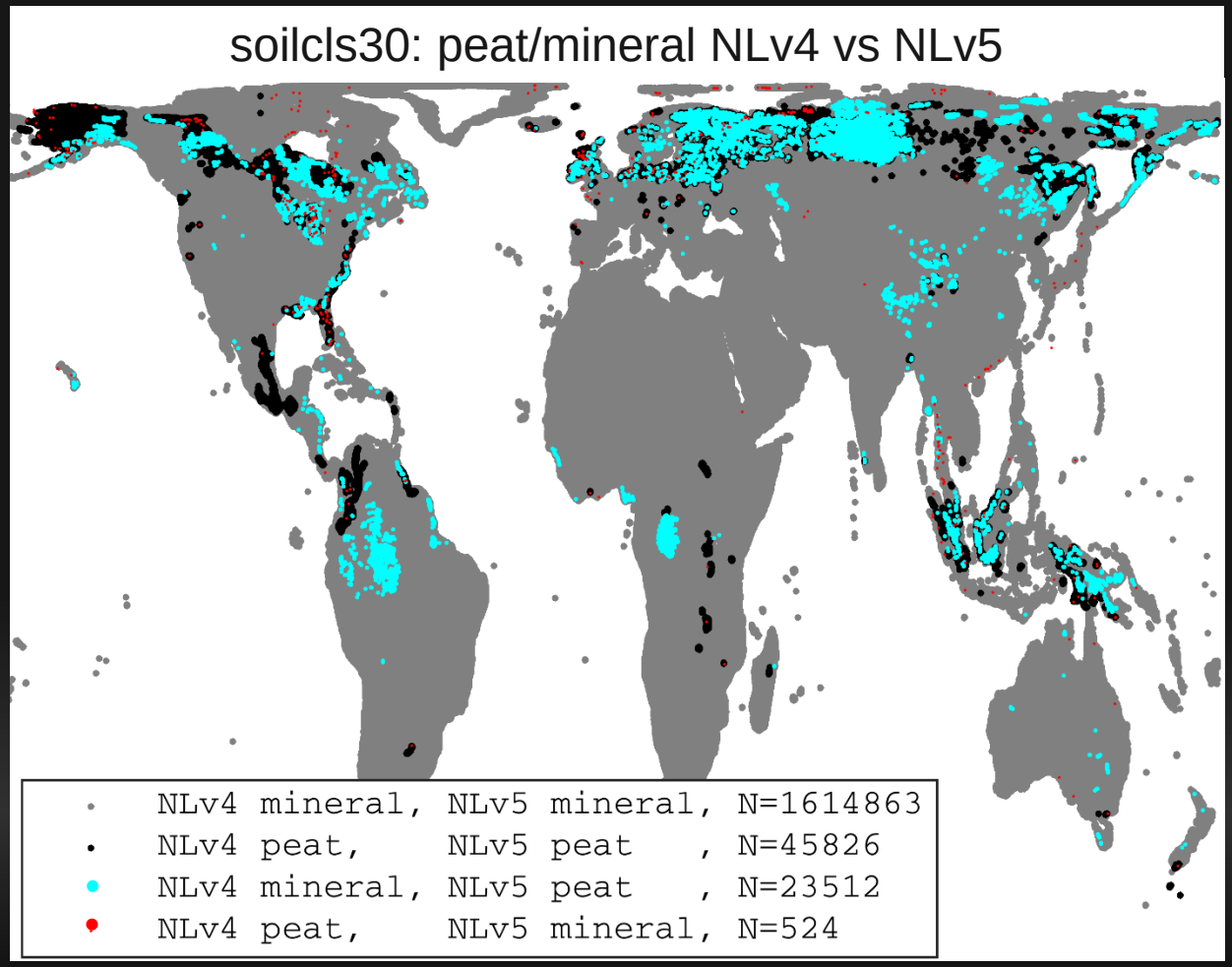
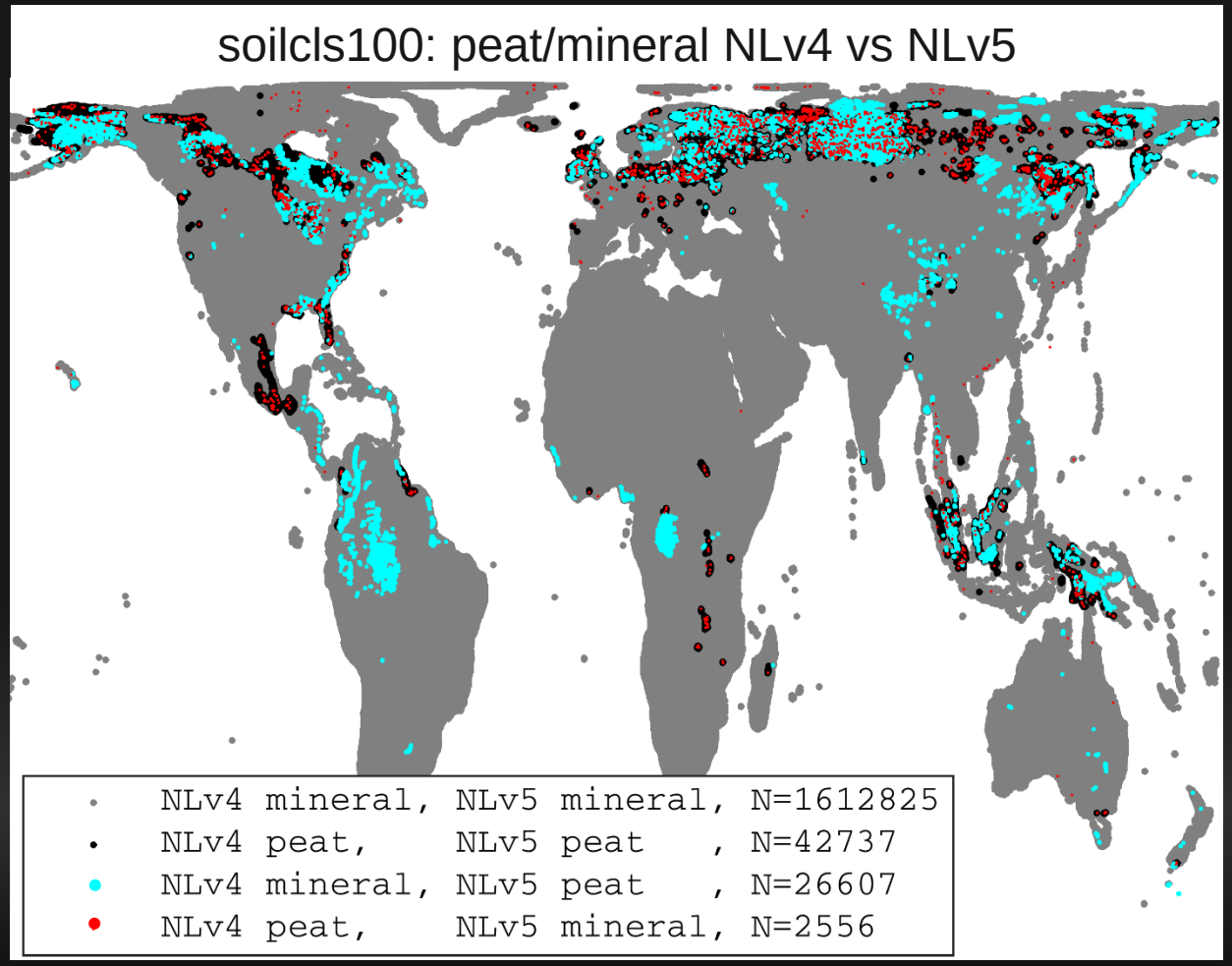
Peat in NLv4 vs. NLv5





Unlike the porosity difference map shown on the previous slides, the maps above show categorical data based on soil class.

NLv5 Boundary Conditions

- On 15 April 2022, Sebastian Apers (KULeuven) reported inconsistent parameter values for six EASEv2 M09 tiles (out of 1.6 million). These six tiles have mineral soil classes for the top (0-30cm) layer and peat for the profile (0-100cm) layer, with “ar”, “bf”, and “ts” parameters for peat tiles but soil depth and “tau” parameters for mineral tiles.

- To date, we learned that:

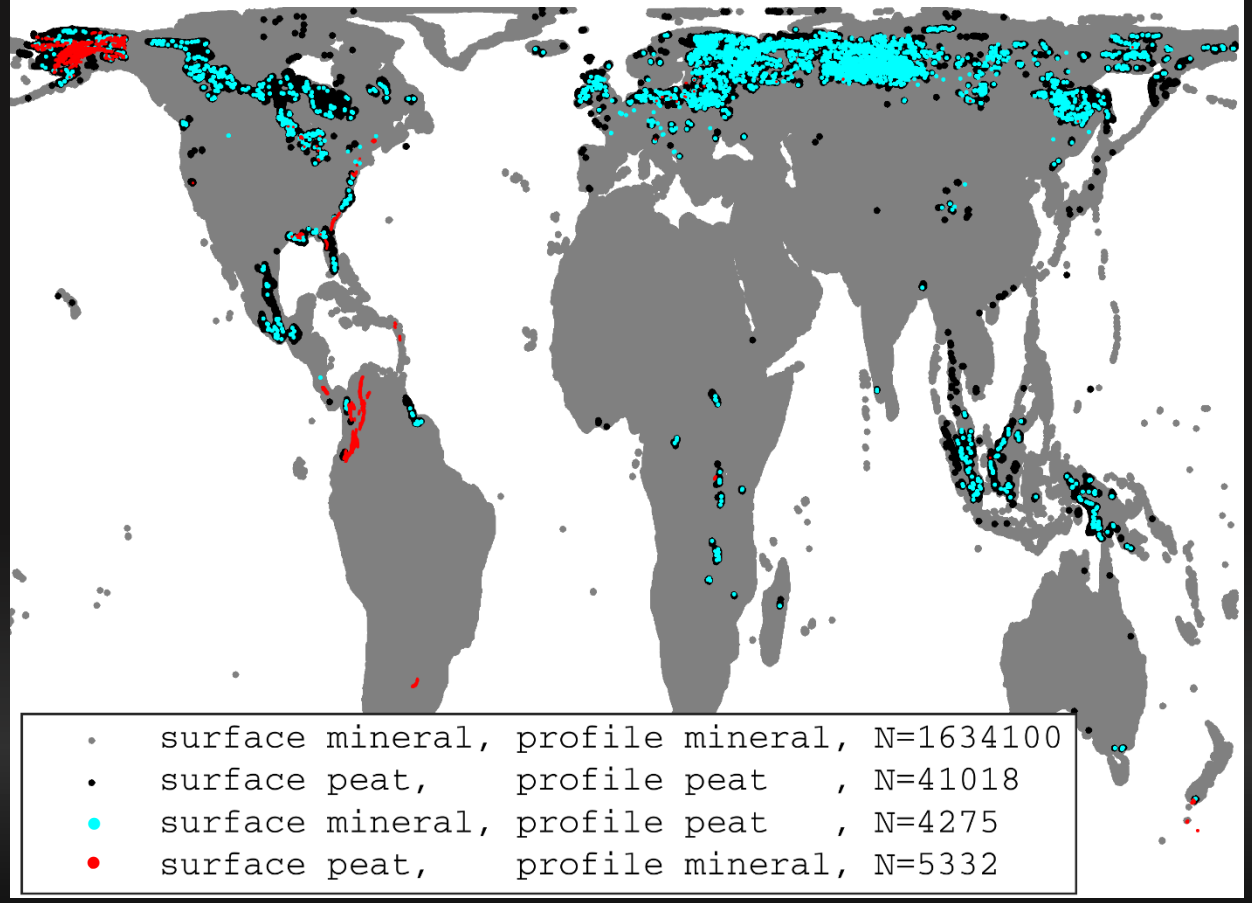
  1. The peat tiles in NLv5 are <u>not</u> the union of HWSD peat tiles and PEATMAP (see previous slides).

  2. Additional NLv5 tiles (not identified by Sebastian) have questionable sets of parameters. E.g., in NLv4 tile #524122 is peat, but in NLv5 it is mineral (top & profile soil class #207) because the PEATMAP area fraction is 0; curiously, in NLv5 orgC(top)=32.3% and orgC(prof)=8%.

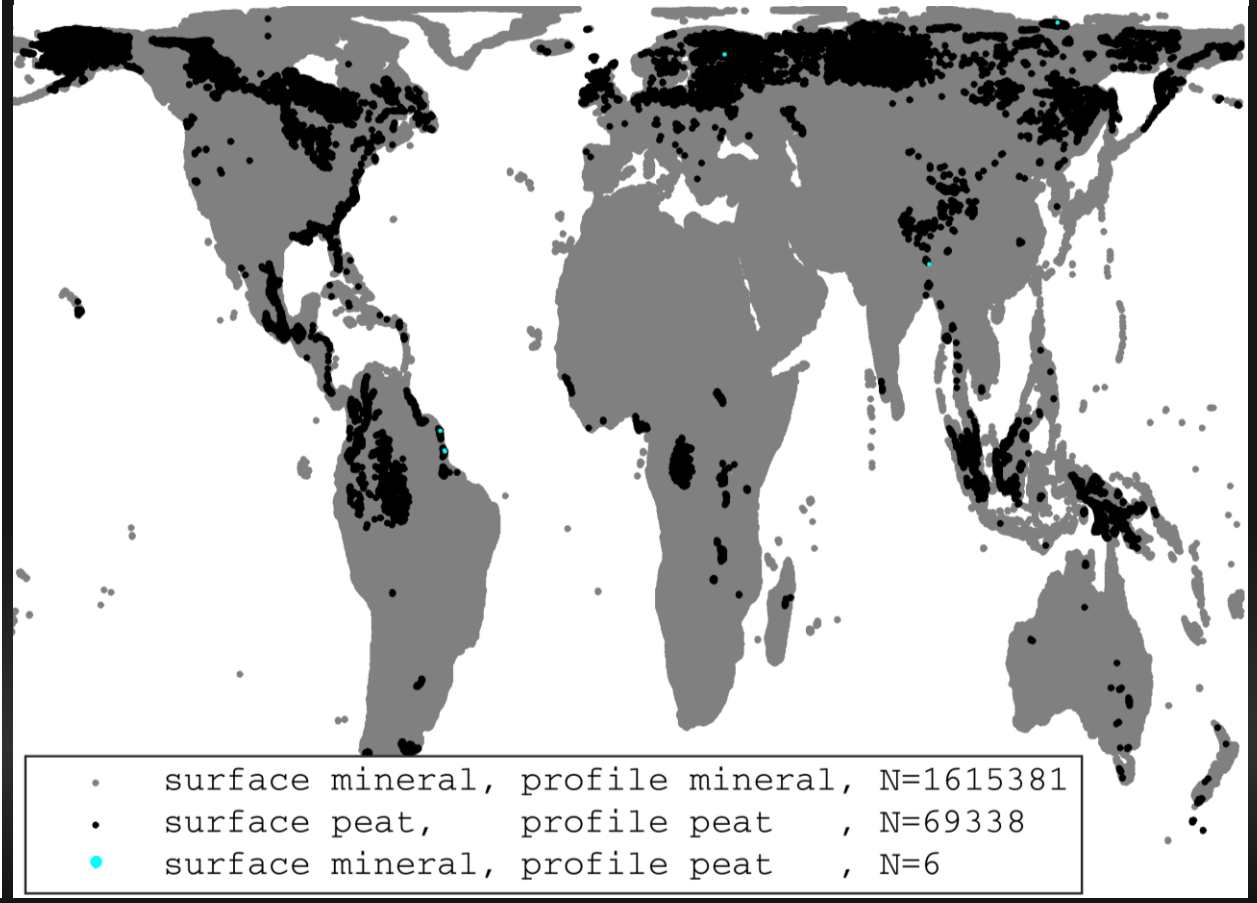
     Note that 8% is also the arbitrary value assigned to the sub (30-100cm) layer of raster grid cells with HWSD sub-layer organic carbon content > 8.72% [=orgC threshold for peat.]
     In NLv4 (i.e., HWSD), this tile has orgC(prof)=33.6% and orgC(top)=30.7%.

Peat in Surface vs Profile Layer

NLv4: peat/mineral surface vs profile



NLv5: peat/mineral surface vs profile



→ 6 problem tiles identified by Sebastian

NLv5 intent (?): Top & profile both mineral or top & profile both peat.

Implementation: Profile layer set to peat when top layer is peat.
However, if profile layer is peat, top layer is not forced to peat.

NLv5 Soil Parameters

At the start of NLv5 bcs processing, the maximum possible sub-layer (30-100cm) orgC value is capped at 8%.
Then how can tiles have a mineral soil class for the top-layer and be peat for the profile layer?

Example: Consider a (fictional) tile made up of 3 raster grid cells.

Raster Grid Cell	**orgC top** (0-30cm)	**orgC sub** (30-100cm)	**orgC prof** (0-100cm)
1	30%	8%	14.6%
2	5%	8%	7.1%
3	5%	8%	7.1%
Avg	*13.3%*	*8%*	*9.6%*

If the PEATMAP area fraction of a **raster grid cell** is >=0.5, orgC(top) is set to 33%.
This threshold is not used to modify orgC(sub). Instead, orgC(sub) is capped at 8% for all raster grid cells.

The orgC class of a **tile** is determined by majority vote (in terms of organic carbon classes):

The top-layer orgC class of a **tile** is peat if an absolute majority of the contributing raster grid cells is peat.
The top-layer soil class of the example tile is therefore mineral.
(*In NLv4, peat vs mineral of a tile was determined by a relative majority among the organic soil classes of the contributing raster grid cells.*)

The profile orgC class of a tile is peat if a relative majority of the contributing raster grid cells is peat, with the top-layer and sub-layer orgC classes receiving weights of 0.3 and 0.7, respectively.
The example tile should thus be a mineral tile with orgC class #3, despite orgC(prof)=9.6%.

It remains unclear how the tiles identified by Sebastian end up with peat as profile soil class.

Summary

When there is conflicting information from PEATMAP and HWSD, it is not always resolved consistently.