

# BIDS formatting and Data sharing

Let's be more open!

# Agenda



- ▶ BIDS for “raw” data
- ▶ BIDS for “derived” data
- ▶ Data sharing & templates

# BIDS is for...



1. Lab PIs. Easier to hand over one dataset from one researcher to another.
2. Students/postdocs. Easier to check and process my dataset.
3. Workflow developers. Easier to write pipelines expecting a particular file organization.
4. Database curators. Accepting one dataset format will make curation easier.

# Source vs. Raw vs. Derived data in BIDS



Quick reminder:

Source data	Raw data	Derived data
'Straight from the machine', e.g. DICOM data	NIfTI format converted and renamed, minimally processed	Results from any pipeline applied on the 'raw data'
No specific formatting but <ul style="list-style-type: none"><li>• must be in <code>sourcedata</code> folder</li><li>• recommended folder naming "à la BIDS"</li></ul>	BIDS format imposed <ul style="list-style-type: none"><li>• dataset description and participant table files (raw)</li><li>• NIfTI images (3D/4D) with .JSON meta-data file</li><li>• organized per subject and image type (<code>anat</code>, <code>fmap</code>...)</li><li>• organized per pipeline name (in <code>derivatives</code> folder)</li></ul>	

BIDS = community effort !

```
└─ pipeline1/
  └─ sub-001/
    └─ anat/
      ├── sub-001_space-MNI305_T1w.nii.gz
      └─ sub-001_space-MNI305_T1w.json
    └─ func/
      ├── sub-001_task-rest_run-1_space-MNI305_desc-preproc_bold.nii.gz
      └─ sub-001_task-rest_run-1_space-MNI305_desc-preproc_bold.json
```

# Raw data are messy...

qMRI relies on

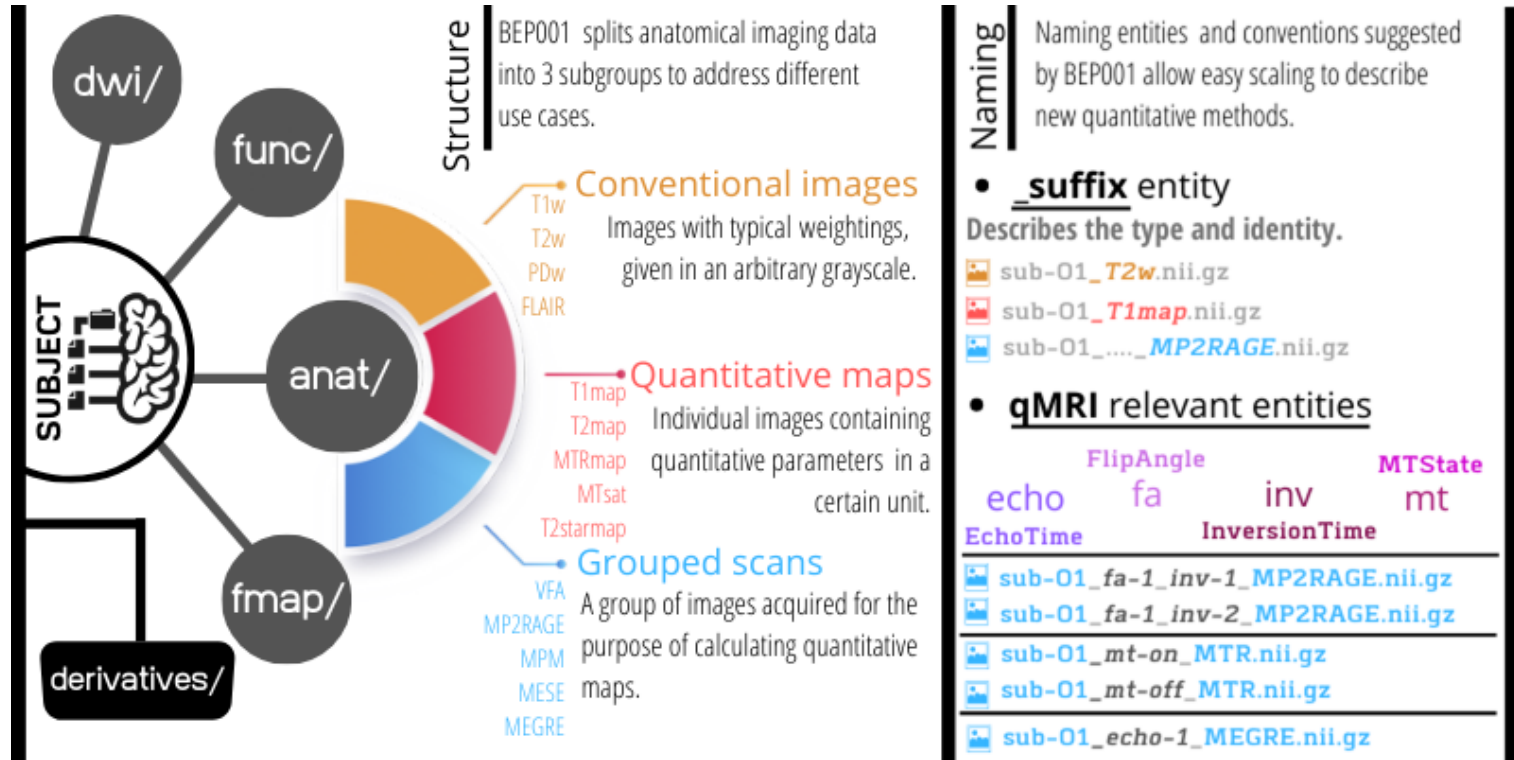
- multiple series of images (different weighting & field maps)
- specific acquisition parameters (echo times, flip angles,...)

Image Series No.	Sequence Name	Description
4	mfc_seste_b1map_v1e	B <sub>1</sub> <sup>+</sup> Mapping Data
5	gre_field_mapping_1acq_rl	B <sub>0</sub> Mapping Magnitude
6	gre_field_mapping_1acq_rl	B <sub>0</sub> Mapping Phase Difference
7	mfc_smaps_v1a_Array	Net Receive Sensitivity Mapping of Array
8	mfc_smaps_v1a_QBC	Net Receive Sensitivity Mapping of Body Coil
9	pdw_mfc_3dflash_v1i_R4	Lower flip angle multi-echo FLASH
<i>Participant moved to new position via primary rotation about z</i>		
10	mfc_smaps_v1a_Array	Net Receive Sensitivity Mapping of Array
11	mfc_smaps_v1a_QBC	Net Receive Sensitivity Mapping of Body Coil
12	mtw_mfc_3dflash_v1i_R4	FLASH acquisition with MT pre-pulse
<i>Participant returned to approximate alignment with the original position</i>		
13	mfc_smaps_v1a_Array	Net Receive Sensitivity Mapping of Array
14	mfc_smaps_v1a_QBC	Net Receive Sensitivity Mapping of Body Coil
15	t1w_mfc_3dflash_v1i_R4	Higher flip angle multi-echo FLASH

- hmri\_sample\_dataset\_with\_maps
- gre\_field\_mapping\_1acq\_rl\_0005
- gre\_field\_mapping\_1acq\_rl\_0006
- mfc\_seste\_b1map\_v1e\_0004
- mfc\_smaps\_v1a\_Array\_0007
- mfc\_smaps\_v1a\_Array\_0010
- mfc\_smaps\_v1a\_Array\_0013
- mfc\_smaps\_v1a\_QBC\_0008
- mfc\_smaps\_v1a\_QBC\_0011
- mfc\_smaps\_v1a\_QBC\_0014
- mtw\_mfc\_3dflash\_v1i\_R4\_0012
- pdw\_mfc\_3dflash\_v1i\_R4\_0009
- t1w\_mfc\_3dflash\_v1i\_R4\_0015

Name	Type	Size
anon_s2018-02-28_18-26-190921-00001-00224-1.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-00224-1.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-00448-2.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-00448-2.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-00672-3.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-00672-3.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-00896-4.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-00896-4.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-01120-5.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-01120-5.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-01344-6.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-01344-6.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-01568-7.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-01568-7.nii	NII File	39.201 KB
anon_s2018-02-28_18-26-190921-00001-01792-8.json	JSON File	101 KB
anon_s2018-02-28_18-26-190921-00001-01792-8.nii	NII File	39.201 KB

# BIDS, with qMRI extension...



# Raw data sorted...

```
{
  "Manufacturer": "SIEMENS ",
  "ManufacturersModelName": "Prisma_fit",
  "DeviceSerialNumber": "167025",
  "StationName": "MRC35437",
  "MagneticFieldStrength": 3,
  "ScanningSequence": "RM",
  "SequenceName": "fl3d_i13d6",
  "PulseSequenceDetails": "mtw mfc 3dflash v1i R4",
  "RepetitionTimeExcitation": 0.025,
  "EchoTime": 0.0092,
  "FlipAngle": 6,
  "MTState": 1,
  "NumberShots": 1,
  "PhaseEncodingDirectionsSign": 1,
  "history": {
    "procstep": {
      "descrip": "dicom to nifti import",
      "version": "spm_dicom_convert.m - version 6899 - SPM12 (12.3)",
      "procpar": []
    },
    "input": {
      "filename": "AnonymousFileName",
      "history": []
    },
    "output": {
      "imtype": "ORIGINAL\\PRIMARY\\M\\ND ",
      "units": "a.u."
    }
  }
}
```

- sub-01		
- anat		
sub-01_acq-MTw_echo-1_flip-1_mt-on_MPM.json	804 B	
sub-01_acq-MTw_echo-1_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-MTw_echo-2_flip-1_mt-on_MPM.json	804 B	
sub-01_acq-MTw_echo-2_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-MTw_echo-3_flip-1_mt-on_MPM.json	818 B	
sub-01_acq-MTw_echo-3_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-MTw_echo-4_flip-1_mt-on_MPM.json	804 B	
sub-01_acq-MTw_echo-4_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-MTw_echo-5_flip-1_mt-on_MPM.json	804 B	
sub-01_acq-MTw_echo-5_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-MTw_echo-6_flip-1_mt-on_MPM.json	804 B	
sub-01_acq-MTw_echo-6_flip-1_mt-on_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-1_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-1_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-2_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-2_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-3_flip-1_mt-off_MPM.json	818 B	
sub-01_acq-PDw_echo-3_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-4_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-4_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-5_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-5_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-6_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-6_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-7_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-7_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-PDw_echo-8_flip-1_mt-off_MPM.json	804 B	
sub-01_acq-PDw_echo-8_flip-1_mt-off_MPM.nii	40.1 MB	
sub-01_acq-T1w_echo-1_flip-2_mt-off_MPM.json	805 B	
sub-01_acq-T1w_echo-1_flip-2_mt-off_MPM.nii	40.1 MB	

- sub-01		
- anat		
- fmap		
sub-01_acq-bodyMTw_RB1COR.json	1.2 kB	
sub-01_acq-bodyMTw_RB1COR.nii	39.8 kB	
sub-01_acq-bodyPDw_RB1COR.json	1.3 kB	
sub-01_acq-bodyPDw_RB1COR.nii	39.8 kB	
sub-01_acq-bodyT1w_RB1COR.json	1.3 kB	
sub-01_acq-bodyT1w_RB1COR.nii	39.8 kB	
sub-01_acq-headMTw_RB1COR.json	1.2 kB	
sub-01_acq-headMTw_RB1COR.nii	39.8 kB	
sub-01_acq-headPDw_RB1COR.json	1.3 kB	
sub-01_acq-headPDw_RB1COR.nii	39.8 kB	
sub-01_acq-headT1w_RB1COR.json	1.3 kB	
sub-01_acq-headT1w_RB1COR.nii	39.8 kB	
sub-01_echo-1_flip-01_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-01_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-02_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-02_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-03_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-03_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-04_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-04_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-05_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-05_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-06_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-06_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-07_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-07_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-08_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-08_TB1EPI.nii	295.3 kB	
sub-01_echo-1_flip-09_TB1EPI.json	2.2 kB	
sub-01_echo-1_flip-09_TB1EPI.nii	295.3 kB	

# BIDS for “raw” data, issues



- ▶ BIDS (re)organization for raw data **is difficult**
  - › Mixing MRI acquisition info with subject & experiment details
  - › MPM is one acquisition among others (functional, anatomical, diffusion...)
- ▶ Parameter names & definition may/does differ between hMRI & BIDS conventions
- ▶ Code for maps reconstruction should take in BIDS-ified data
- ▶ Maps created should follow BIDS “derived data” requirements
- ▶ Raw data should stay **untouched!**
  - *copy them for processing*



# BIDS for “raw” data



## What to do ?

- ▶ Get the demo data into BIDS format
- ▶ Have DICOM-to-NIfTI conversion with BIDS formatting in Tbx ?
- ▶ Ensure that
  - any new acquisition protocol has a BIDS format, esp. parameters & metadata ?
  - map reconstructions, incl. fieldmaps, takes in BIDS-ified data ?
  - all our data are BIDS-ified ?

See the list of “entities”, for MPM protocol

Format	<a href="#">sub-&lt;label&gt;</a>	<a href="#">ses-&lt;label&gt;</a>	<a href="#">task-&lt;label&gt;</a>	<a href="#">acq-&lt;label&gt;</a>	<a href="#">ce-&lt;label&gt;</a>	<a href="#">rec-&lt;label&gt;</a>	<a href="#">run-&lt;index&gt;</a>	<a href="#">echo-&lt;index&gt;</a>	<a href="#">flip-&lt;index&gt;</a>	<a href="#">mt-&lt;label&gt;</a>	<a href="#">part-&lt;label&gt;</a>	<a href="#">chunk-&lt;index&gt;</a>
<a href="#">anat</a> (MPM MTS)	REQUIRED	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	REQUIRED	REQUIRED	OPTIONAL	OPTIONAL

# BIDS for “derived” data



- ▶ Some (not yet definitive) imposed format for derived data
- ▶ ...but general principles are simple:
  - Keep original data "untouched"
  - Put results from "pipeline A" in a `pipeline_A` folder
  - Keep data organized per type, i.e. anat, fmap, dwi...
  - Each Derivatives filename **MUST** be of the form:  
`<source_entities>[_keyword-<value>]_<suffix>.<extension>`  
(where `<value>` could either be an `<index>` or a `<label>` depending on the keyword)
  - Should include a "provenance" or "sources" description

```
└─ sub-01/  
  └─ func/  
    ├── sub-01_task-rest_desc-preproc_bold.nii.gz  
    └─ sub-01_task-rest_desc-preproc_bold.json
```

```
{  
  "Sources": ["bids:raw:sub-01/func/sub-01_task-rest_bold.nii.gz"]  
}
```

# BIDS for “derived” spatially processed data



- ▶ Improve naming of generated quantitative maps & supplementary images?
- ▶ For example

P2021\_MS7T\_test > MS7T\_Data > derivatives > qMRI > sub-002 > anat

Search anat

Name	Date modified	Type	Size
Supplementary	16/09/2024 11:57	File folder	
sub-002_acq-te0_mt-off_PDw.json	21/08/2024 15:17	JSON File	9 KB
sub-002_acq-te0_mt-off_PDw.nii	21/08/2024 15:18	NII File	174.448 KB
sub-002_acq-te0_mt-off_T1w.json	21/08/2024 15:17	JSON File	9 KB
sub-002_acq-te0_mt-off_T1w.nii	21/08/2024 15:18	NII File	174.448 KB
sub-002_acq-te0_mt-on_PDw.json	21/08/2024 15:17	JSON File	8 KB
sub-002_acq-te0_mt-on_PDw.nii	21/08/2024 15:18	NII File	174.448 KB
sub-002_MTsatsat.json	21/08/2024 15:18	JSON File	11 KB
sub-002_MTsatsat.nii	21/08/2024 15:18	NII File	174.448 KB
sub-002_PDmap.json	21/08/2024 15:18	JSON File	11 KB
sub-002_PDmap.nii	21/08/2024 15:24	NII File	174.448 KB
sub-002_R1map.json	21/08/2024 15:18	JSON File	11 KB
sub-002_R1map.nii	21/08/2024 15:18	NII File	174.448 KB
sub-002_R2starmap.json	21/08/2024 15:18	JSON File	11 KB
sub-002_R2starmap.nii	21/08/2024 15:18	NII File	174.448 KB

# BIDS for “derived” qMRI data



- ▶ See "BIDS Extension Proposal 11 (BEP011): The structural preprocessing derivatives", work in progress since 2018 (at least) and PR open since 2020!  
[https://docs.google.com/document/d/1YG2g4UkEio4t\\_STIBOqYOwnLEs1emHIXbGKynx7V0Y/edit?tab=t.0](https://docs.google.com/document/d/1YG2g4UkEio4t_STIBOqYOwnLEs1emHIXbGKynx7V0Y/edit?tab=t.0)  
<https://github.com/bids-standard/bids-specification/pull/518>
- ▶ Specs for
  - Discrete Segmentations, i.e. tissue masks.  
E.g. 

```
pipeline/sub-001/  
  anat/  
    sub-001_space-ACPC_label-GM_dseg.nii.gz
```
  - Probabilistic Segmentations, i.e. SPM's unified-segmentation output.  
E.g. 

```
pipeline/sub-001/  
  anat/  
    sub-001_space-ACPC_label-BG_probseg.nii.gz  
    sub-001_space-ACPC_label-WM_probseg.nii.gz
```
  - Maps normalized into some specific space

NOTE: SPM is not helping here with their prefixing...

# Data sharing, atlases & templates



Martina's ageing data, BIDS-ify all the derivatives, at subjects & population level

AgingData/derivatives/SPM12dartel/

sub-S123/anat/

sub-S123\_MTsat\_space-MNI\_desc-smomod\_label-GM\_probseg.nii

sub-S123\_MTsat\_space-MNI\_desc-smomod\_label-WM\_probseg.nii

sub-S123\_MTsat\_space-MNI\_desc-smomod\_probseg.json

sub-S123\_space-MNI\_desc-GMsmo\_MTsat.nii

sub-S123\_space-MNI\_desc-WMsmo\_MTsat.nii

sub-S123\_space-MNI\_desc-GMsmo\_PDmap.nii

sub-S123\_space-MNI\_desc-WMsmo\_PDmap.nii

sub-S123\_space-MNI\_desc-GMsmo\_R1map.nii

sub-S123\_space-MNI\_desc-WMsmo\_R1map.nii

sub-S123\_space-MNI\_desc-GMsmo\_R2starmap.nii

sub-S123\_space-MNI\_desc-WMsmo\_R2starmap.nii

AgingData/derivatives/SPM12dartel/

atlas-GM\_space-MNI\_mask.nii

atlas-GM\_space-MNI\_mask.json

atlas-WM\_space-MNI\_mask.nii

atlas-WM\_space-MNI\_mask.json

atlas-MTsat\_space-MNI\_desc-mean.nii

atlas-MTsat\_space-MNI\_desc-mean.json

atlas-PDmap\_space-MNI\_desc-mean.nii

atlas-PDmap\_space-MNI\_desc-mean.json

atlas-R1map\_space-MNI\_desc-mean.nii

atlas-R1map\_space-MNI\_desc-mean.json

atlas-R2starmap\_space-MNI\_desc-mean.nii

atlas-R2starmap\_space-MNI\_desc-mean.json

Could be publicly shared, e.g. for stats tool comparison.

# Data sharing, atlases & templates



- ▶ See "BIDS Extension Proposal 38 (BEP038): Atlas Specification", work in progress since 2023 and no PR yet!

<https://docs.google.com/document/d/1RxW4cARr3-EiBEcXjLpSIVidvnUSHE7yJCUY91i5TfM/edit?tab=t.0#heading=h.gjdgxs>

*“Atlases are broadly defined as a mapping between locations in standard spatial coordinate systems and descriptions associated with those locations.”*

- ▶ Dataset level (raw/source) or derivatives level, e.g.

```
bids/atlas/atlas-HarvardOxford/  
  atlas-HarvardOxford_dseg.json  
  atlas-HarvardOxford_dseg.tsv  
  atlas-HarvardOxford2_dseg.nii.gz  
bids/derivatives/pipeline-<name>/  
  sub-01/  
    anat/  
      sub-01_T1w.nii.gz  
      sub-01_space-T1w_seg-HarvardOxfordThr50_res-2_dseg.nii.gz  
      sub-01_space-T1w_seg-HarvardOxfordThr50_res-2_dseg.json  
      sub-01_space-T1w_seg-HarvardOxfordThr50_res-2_dseg.tsv
```

# Data sharing, atlases & templates



## Publish some template & qMRI atlas ?

- ▶ `eTPM.nii` from Lorio et al. ?
- ▶ quantitative atlases, for Mtsat, PD, R1, R2\*,  
e.g mean & std maps,
  - use as a reference,
  - check the normality of estimated maps.
- ▶ Questions
  - Age specific template and atlases ? E.g. 20-30, 30-40, etc.
  - Dynamic age-trajectory atlases ?

NOTE: SPM should be more aligned with BIDS convention!!!

# Data sharing, atlases & templates



Publish “our” data ? Or encourage our users to...

- ▶ Sharing in mind from the start, NOT after
- ▶ Which data ?
  - DICOMs → hmmm, nope.
  - Raw BIDS- curated → hmmm, yeah but...
  - Quantitative maps → ha, yes but...
  - Spatially processed → of course !
- ▶ Ethical & GDPR issues, esp. anonymization !