

Responding to the flood emergency in Germany with the use of high tech from the space

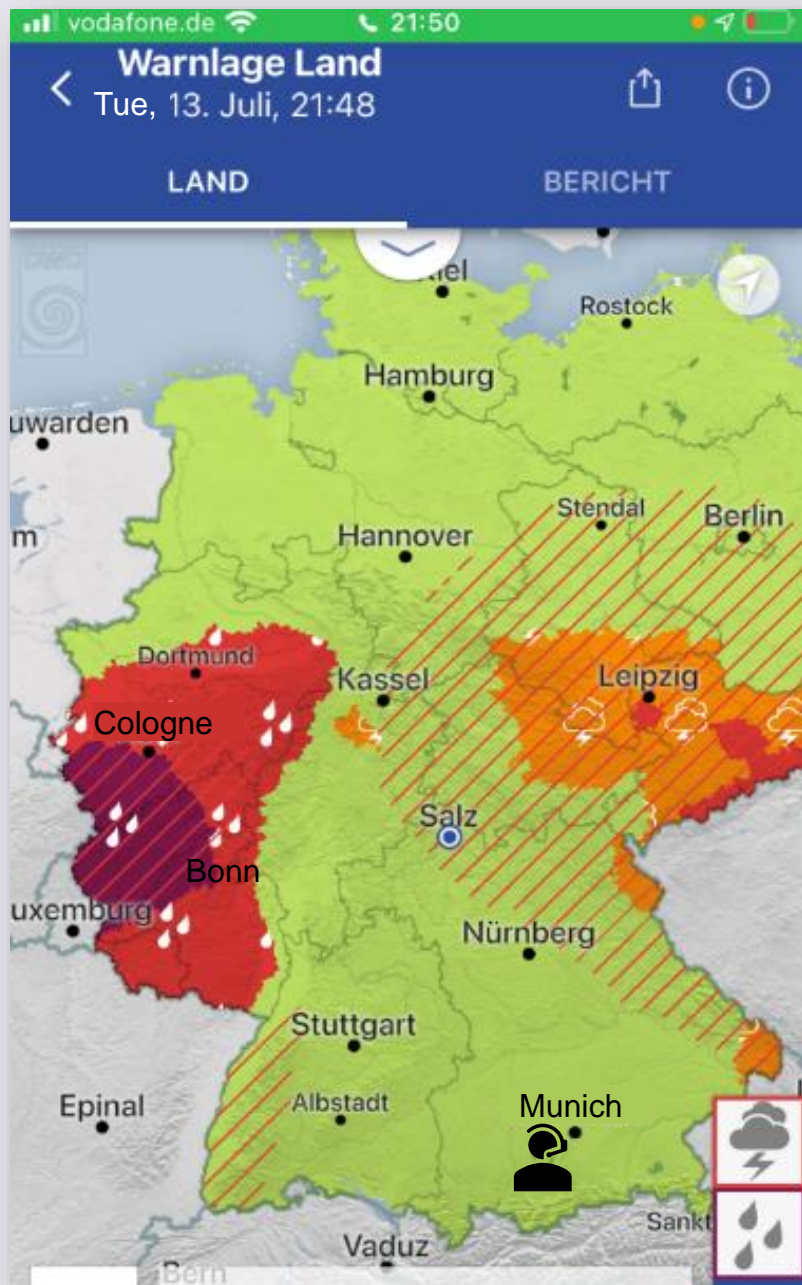
Gina Maricela Schwendemann

UN-SPIDER Conference for regional experts of Africa
Munich, 16th Nov. 2021



Wissen für Morgen





Wednesday, 14th July 2021



North Rhine-Westphalia and Rhineland-Palatinate

Accumulated water from Tuesday till Thursday morning will be from 80-180/200 l/m².

Floods happened in the night on 14th July 2021



Friday July, 16th 2021



Center for Satellite Based Crisis Information
– Emergency Mapping & Disaster Monitoring –
a service of DFD





©Uwe Kippnich





Flying hours

24 (utility craft),
17 (Helicopter),
7 (light aircraft)



Delivered Data

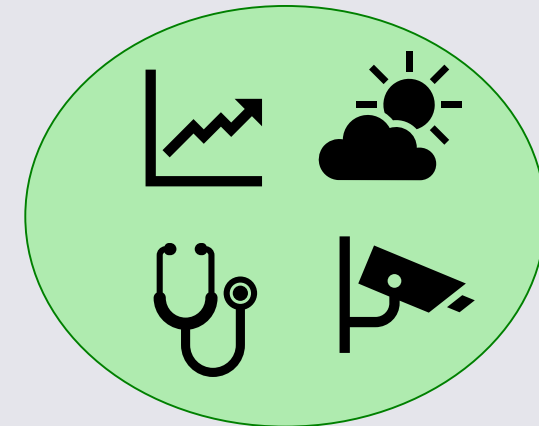
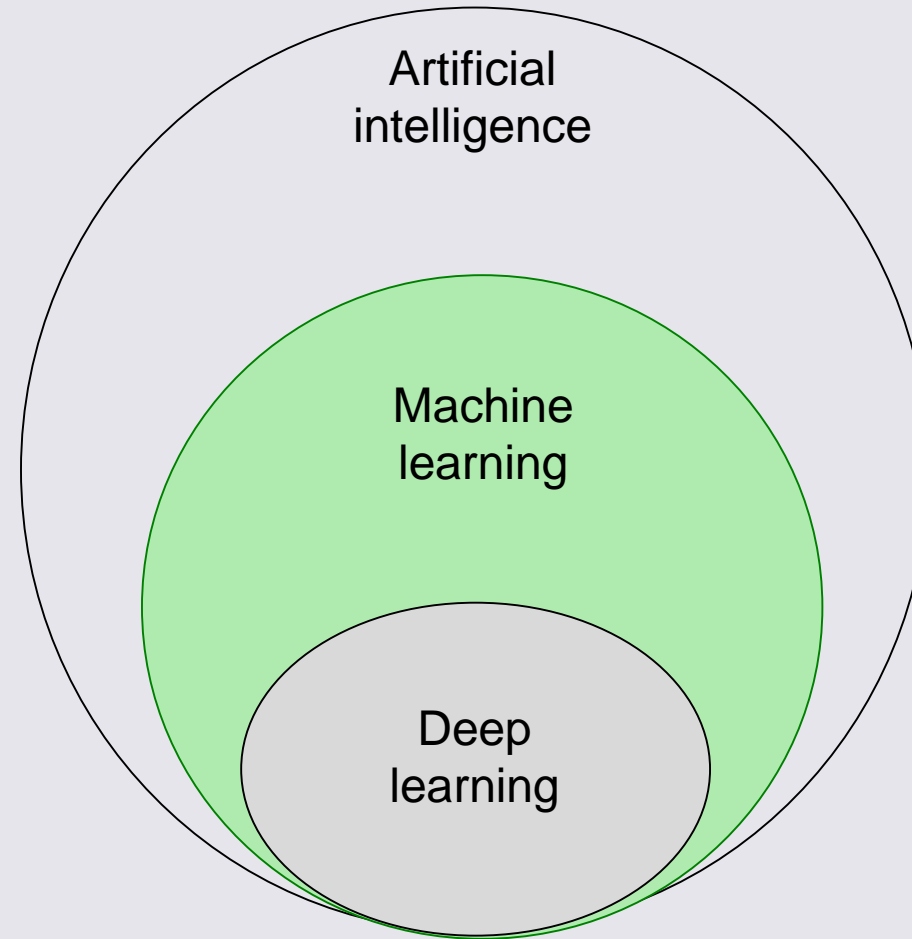
~ 600 GB



Software learnt and think like humans

Algorithm learnt without explicit being Programmed

Artificial neural network learnt from big amount of data



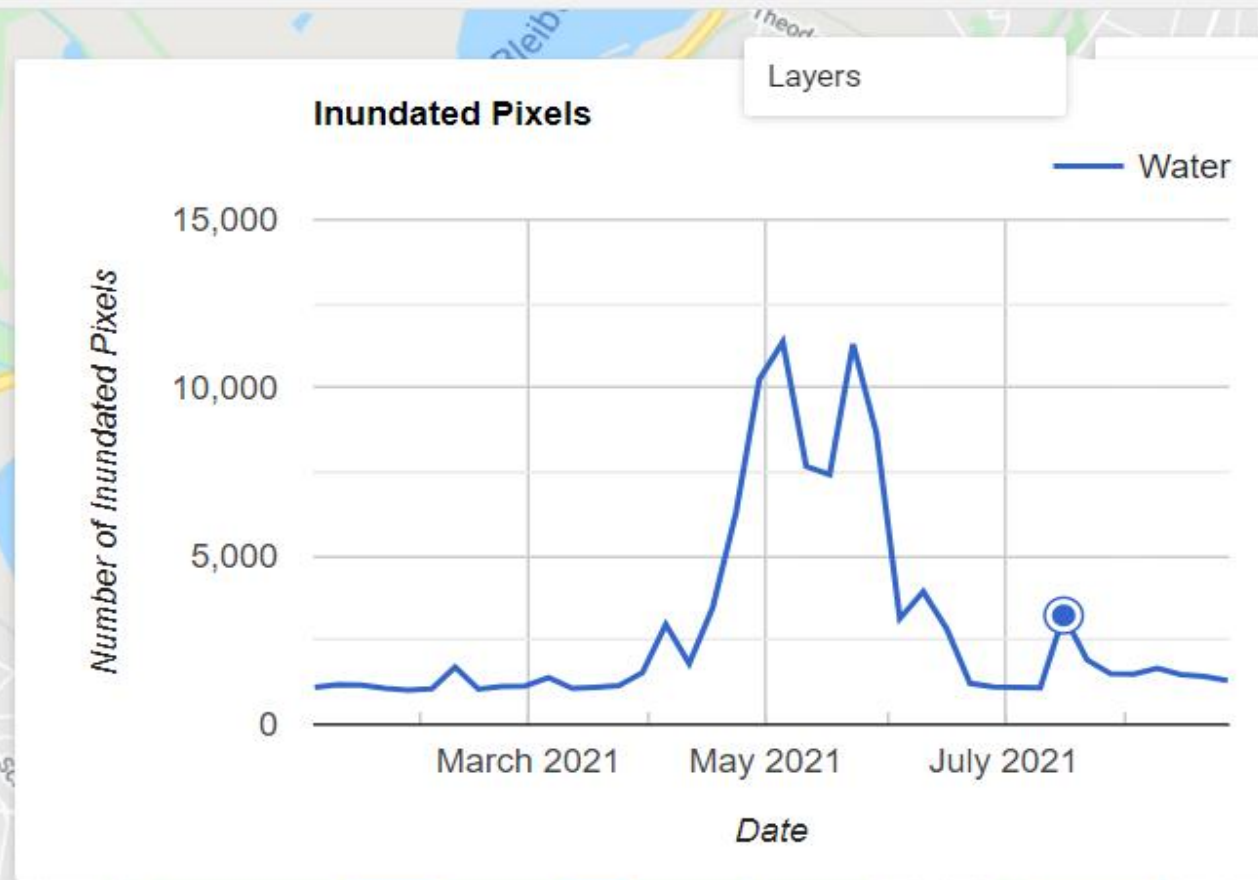
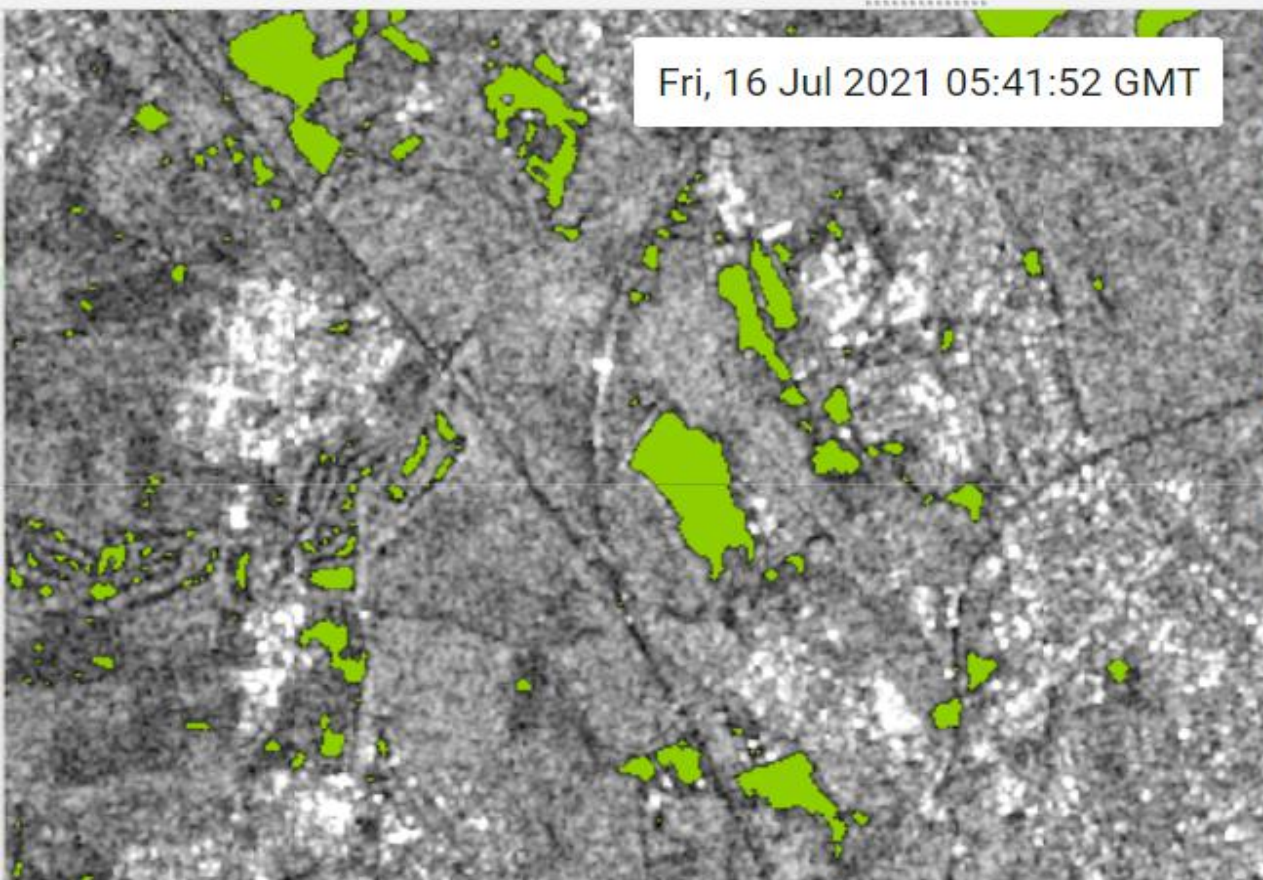
Source:zekiah.com



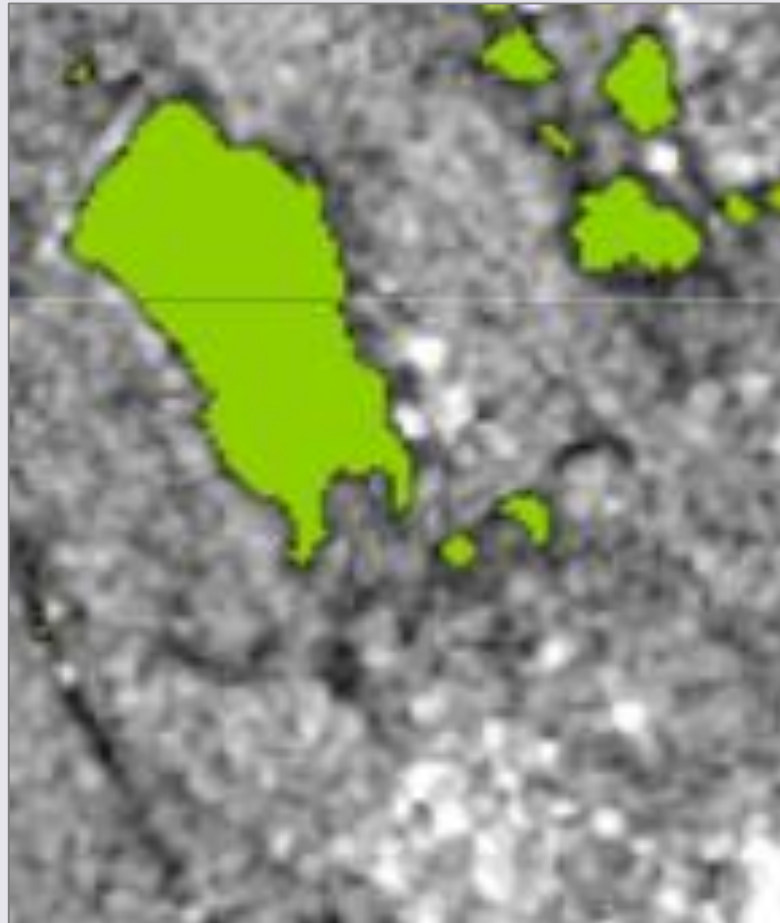

```

41 // CLASSIFY WATER
42 //=====
43 var classifyWater = function(img) {
44   var vv = img.select('VV_Filtered');
45   var water = vv.lt(-16).rename('Water'); //Identify all pixels below threshold and set them equal to 1.
46   //All other pixels set to 0
47   water = water.updateMask(water); //Remove all pixels equal to 0
48

```



Flood detection by means of Machine learning based on Sentinel-1 (SAR image), 10 m resolution on July, 16th 2021



Aerial photography mosaic of Erfstadt as of Friday, 16th and Sunday, 18th July 2021, RGB, 0.15 m resolution



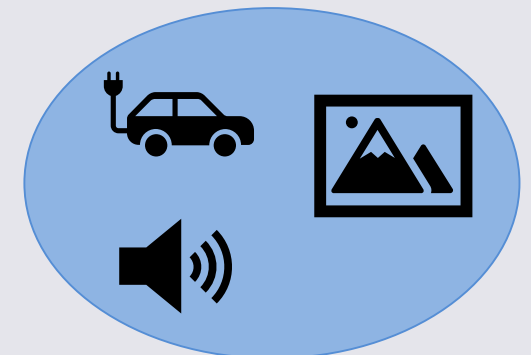
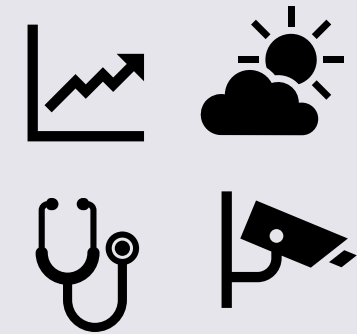
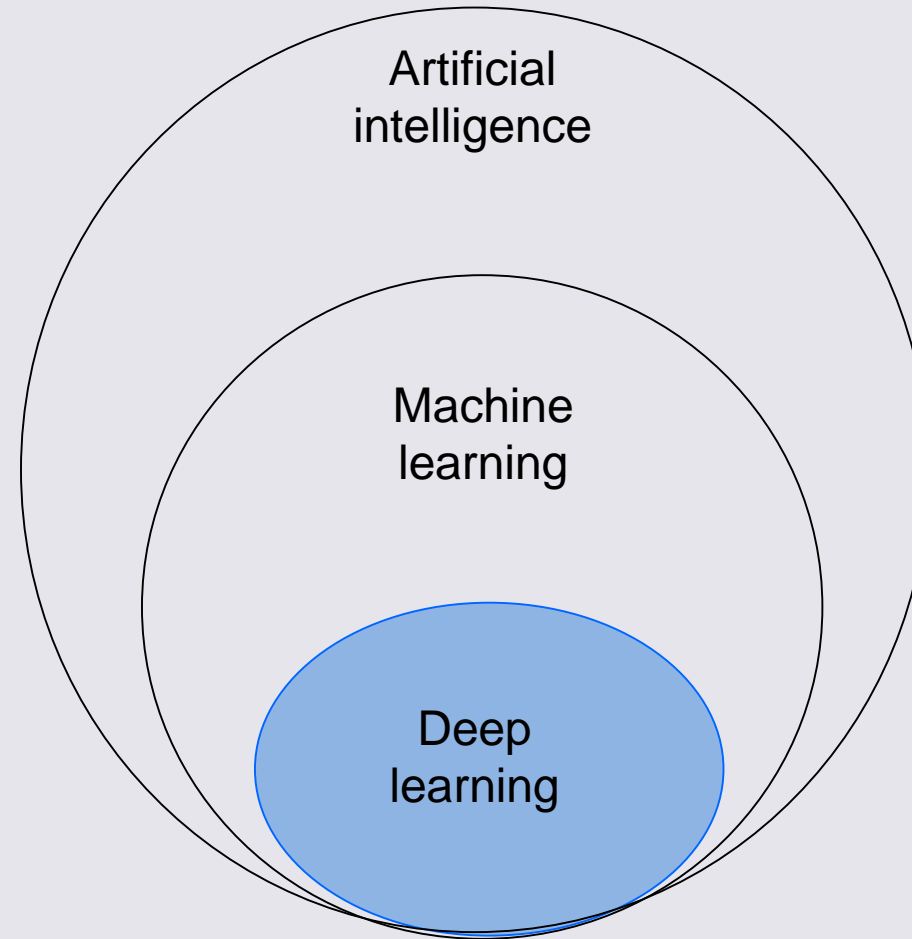
Raw output of flood detection by means of Deep learning



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Source:zekiah.com

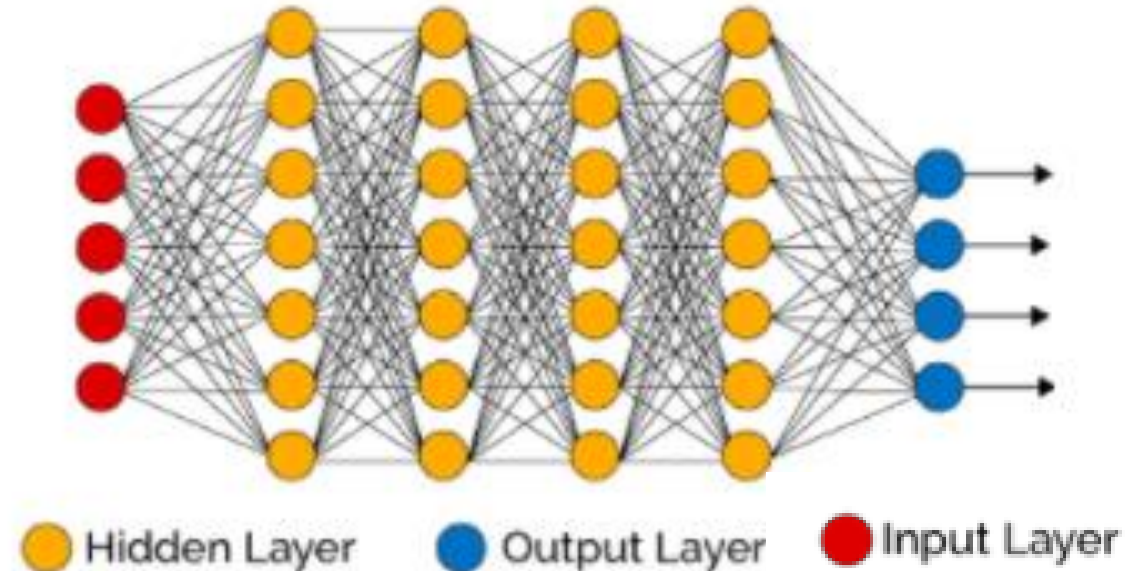


CNN – Convolutional Neural Network



Source: www.medium.com

Deep Learning Neural Network



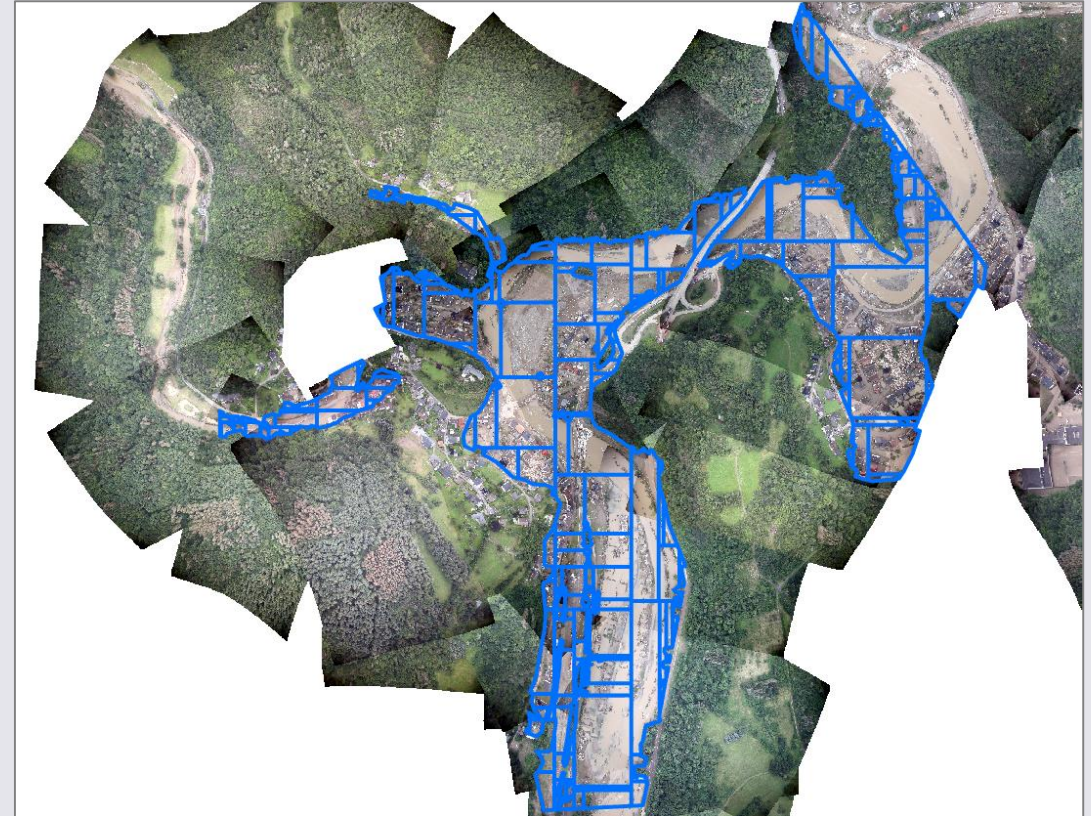
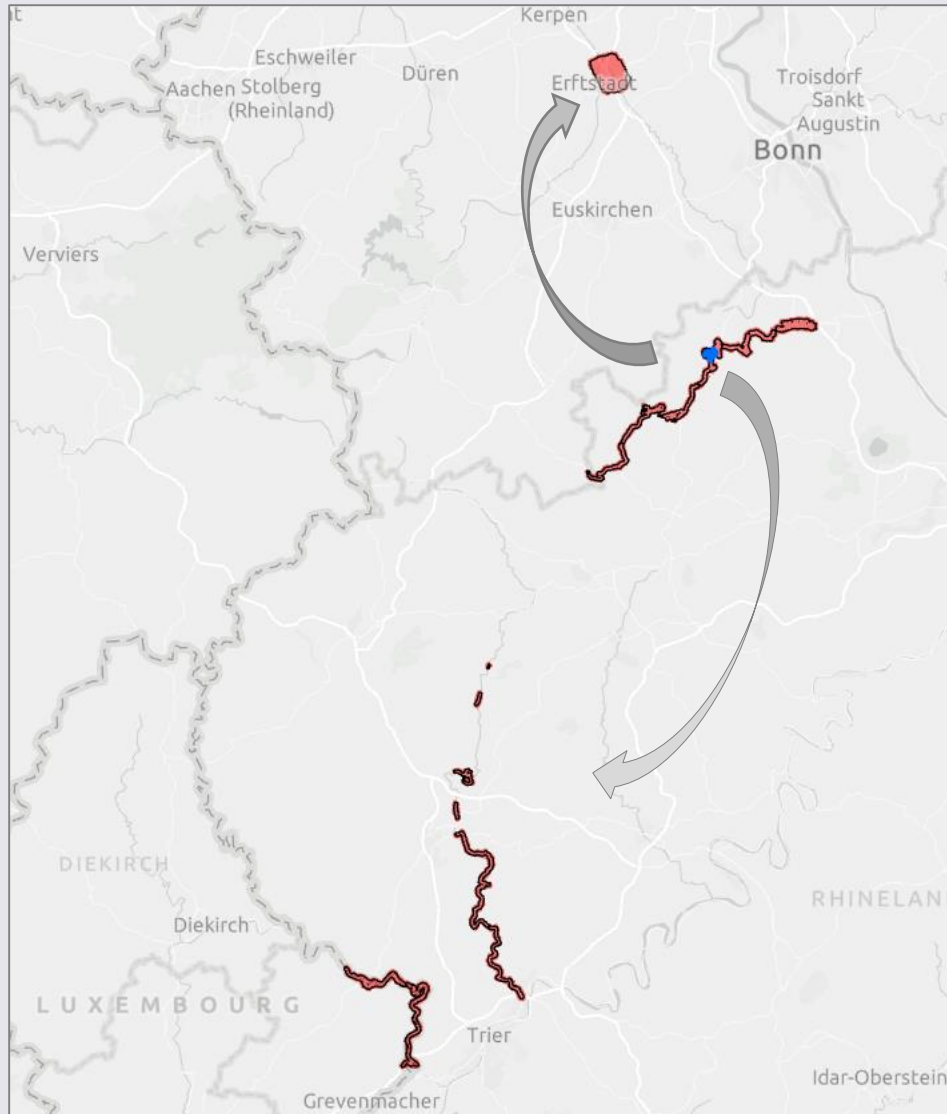
Source: <https://towardsdatascience.com/>

```
X_train = X_train.reshape(-1,28,28,1)
X_test = X_test.reshape(-1,28,28,1)

model = tf.keras.models.Sequential() # 28*28
model.add(tf.keras.layers.Conv2D(32, (3, 3), padding = 'same', activation=tf.nn.relu,
                                input_shape=(28, 28, 1))) # 28*28*32
model.add(tf.keras.layers.Dropout(0.5)) # 28*28*32
model.add(tf.keras.layers.MaxPooling2D((2, 2))) # 14*14*32
model.add(tf.keras.layers.Conv2D(64, (3, 3), padding = 'same', activation=tf.nn.relu)) # 14*14*64
model.add(tf.keras.layers.Dropout(0.5)) # 14*14*64
model.add(tf.keras.layers.MaxPooling2D((2, 2))) # 7*7*64
```



Deep learning in the everyday work



Deep learning in the everyday work



Geoprocessing

Export Training Data For Deep Lear...

Parameters Environments

* Input Raster

Additional Input Raster

* Output Folder

Input Feature Class Or Classified Raster Or Table

Class Value Field

Buffer Radius 0

Input Mask Polygons

Image Format
TIFF format

Tile Size X 256

Tile Size Y 256

Stride X 128

Stride Y 128

Rotation Angle 0

Reference System
Map space

Output No Feature Tiles

Metadata Format
RCNN Masks

Run

jupyter DE_Flood_damage_with_MaskRCNN_model Last Checkpoint: 04.08.2021 (autosaved)

Flood damage detection with Mask RCNN model

```
In [1]: import arcgis
from arcgis.learn import MaskRCNN, prepare_data

In [2]: data = prepare_data(path='C:\...',
batch_size = 4,
chip_size = 400) #chip 400, stride 0

In [3]: data.show_batch(rows = 2, alpha = 0.3, statistics_type='DRA')
```

```
In [4]: model = MaskRCNN(data) #model = MaskRCNN(data = data, pointer

In [5]: lr = model.lr_find()
```

```
In [6]: # Training
model.fit(30, lr = lr) #model.lr_find() #model.fit(epochs=10,
```

epoch	train_loss	valid_loss	time
0	4.196047	3.385234	00:46
1	2.805269	2.355183	00:46
2	2.070822	1.951641	00:46

Detect Objects Using Deep Learning

Parameters Environments

* Input Raster

* Output Detected Objects

* Model Definition

Arguments

Name	Value

Non Maximum Suppression

Run





Image on June, 30th 2019



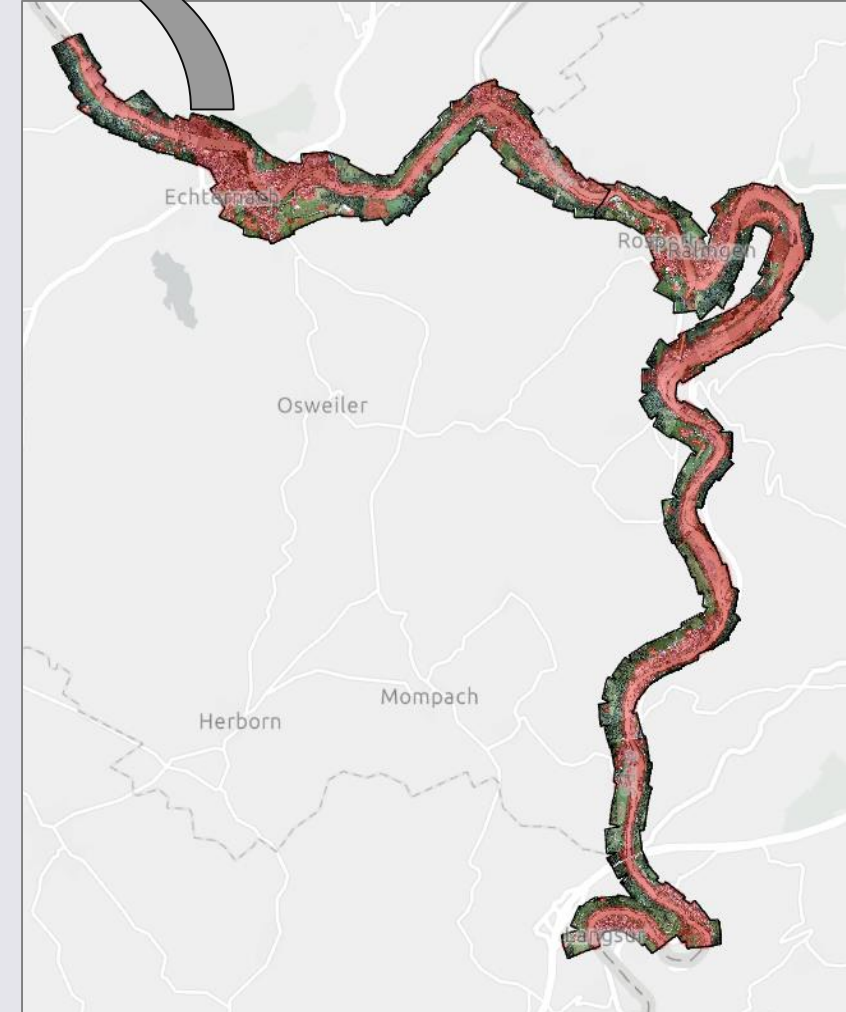
Image on July, 16th 2021

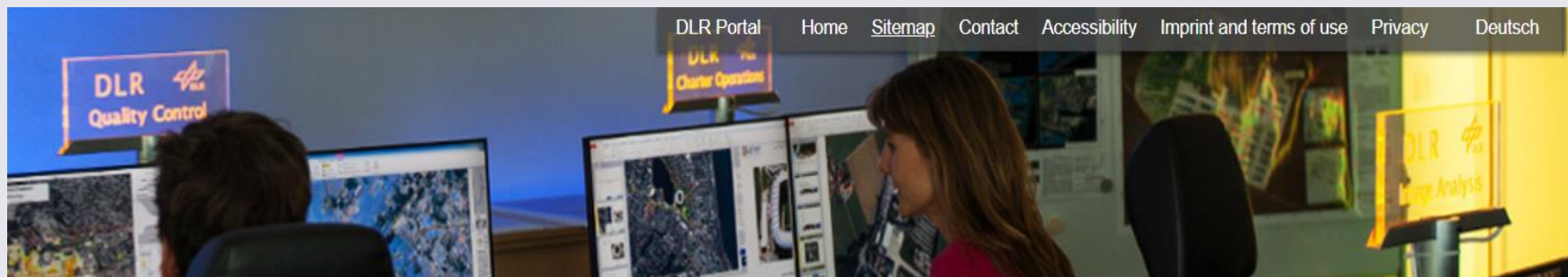


Raw output of flood detection by means of Deep learning



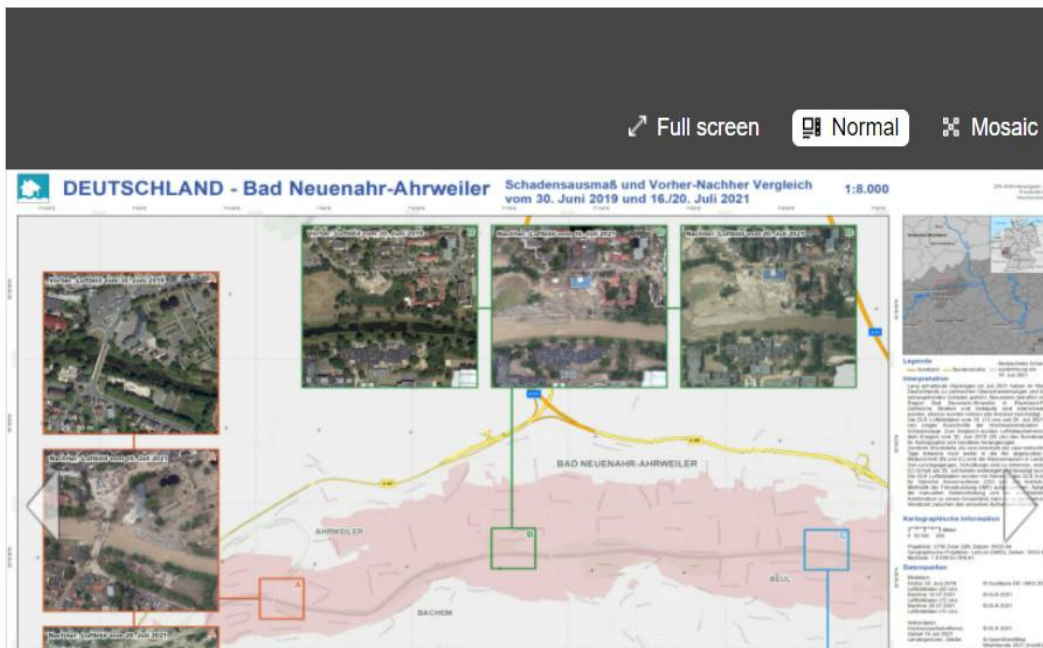
Results after post-processing





Center for Satellite Based
Crisis Information (ZKI)

- Research and Development
- Services and Operations
- News Archive
- Activations
- FAQs
- Contact



ZKI Cornerstones



IF-Bund

Innovative Remote Sensing
for the German Federal
Administration



Europe

Participation in the European

www.zki.dlr.de

11 years helping countries
around the world in
emergency response

Germany's flood emergency in July
in Numbers:



Maps
26



Images
~ 40,000



Center for Satellite Based Crisis Information
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Sunday, 25th July 2021



Center for Satellite Based Crisis Information
– Emergency Mapping & Disaster Monitoring –
a service of DFD



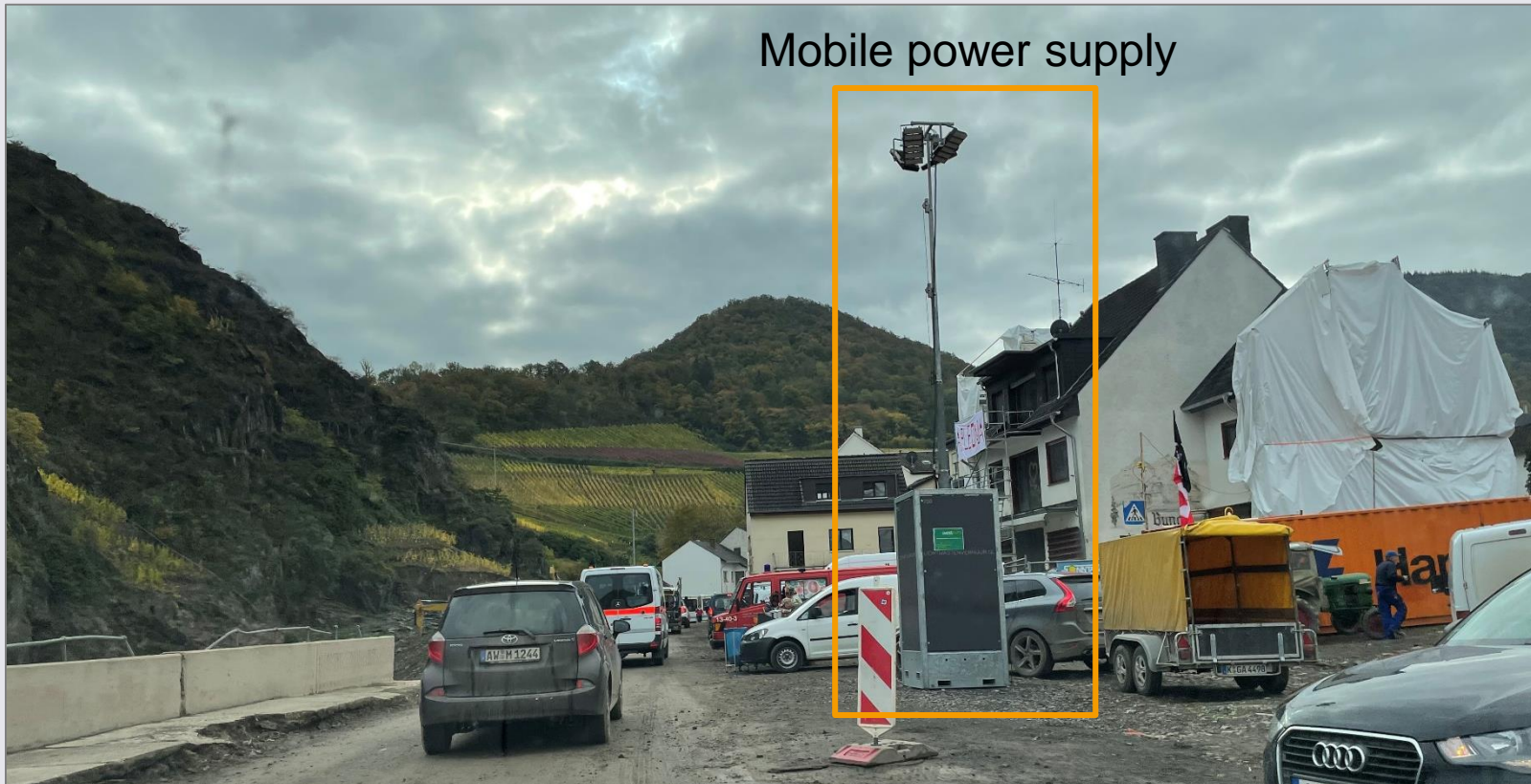
Emergency generator



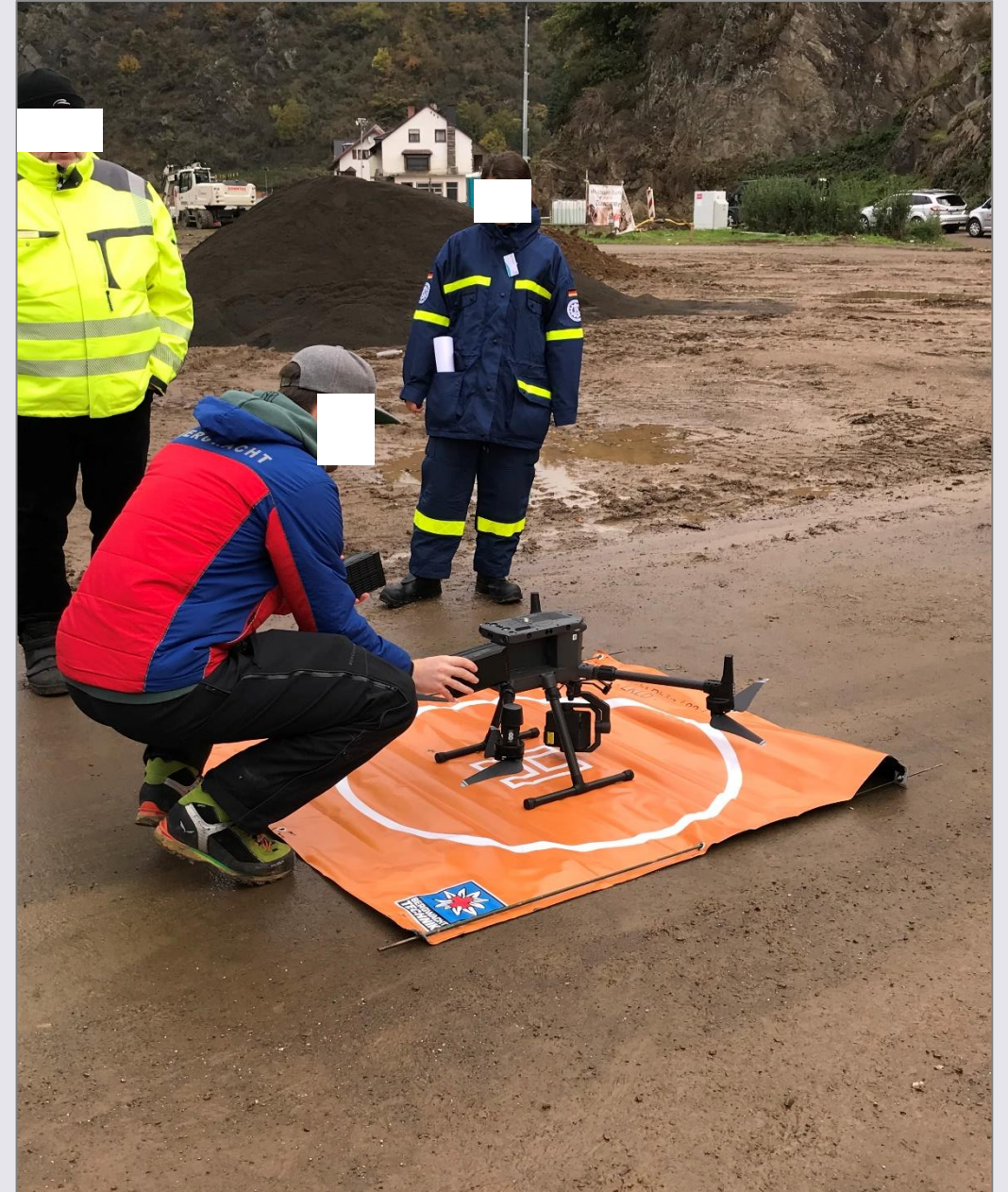
Spacex internet Mobile power supply



Mobile power supply

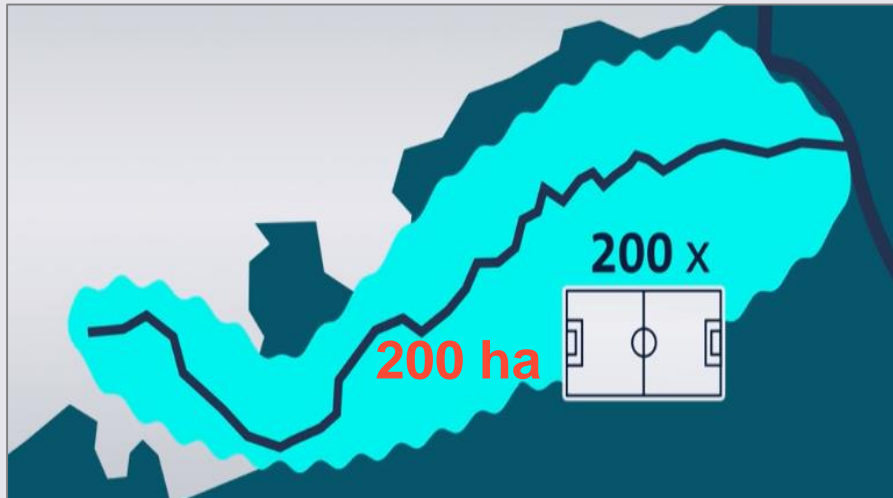


October, 29th 2021

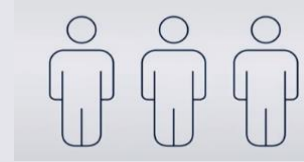


Facts

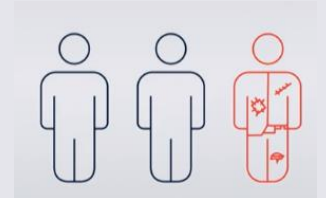
- Floods on 15th July 2021 caused 182 casualties in North Rhine-Westphalia and Rhineland-Palatine.
- Maps were an excellent instrument for decision makers and rescue operations.
- Important to have an expert of safety research for the know-how transfer on the ground.
- Flood damage is estimated at 29 million EUR.



56,000
Inhabitants



17,000
Lost their
possessions



Source: www.swr.de

4,200
Buildings



3,000
Damaged
buildings



467
Destroyed
buildings



Responding to the flood emergency in Germany with the use of high tech from the space

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