It is not the earthquake mate – it is the buildings!

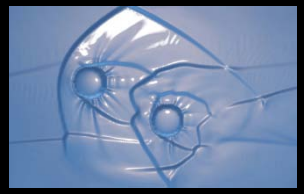
Ole Nielsen

Australia-Indonesia Facility for Disaster Reduction

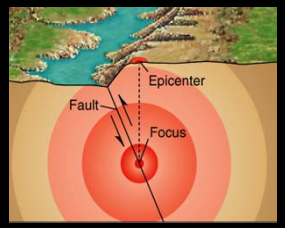
- Australian Government AID Program
- Supporting Indonesia's capacity to manage consequences of natural disasters
- Embedded in Indonesian Government
- Partnerships with science agencies
- Committed to Free and Open Source (sustainability, accessibility, reproducibility)

Open Source Python Modelling Tools

ANUGA: Hydrodynamic Hazards



EQRM: Probabilistic Earthquake Risk



TsuDAT: Tsunami Hazard

Python-FALL3D: Volcanic Ash

Risiko: Risk Mapping

Pypar: parallel computing

Four recent big earthquakes

Magnitude	Fatalities	$ Losses
7.0	?	?
7.6	?	?
8.8	?	?
9.0	?	?

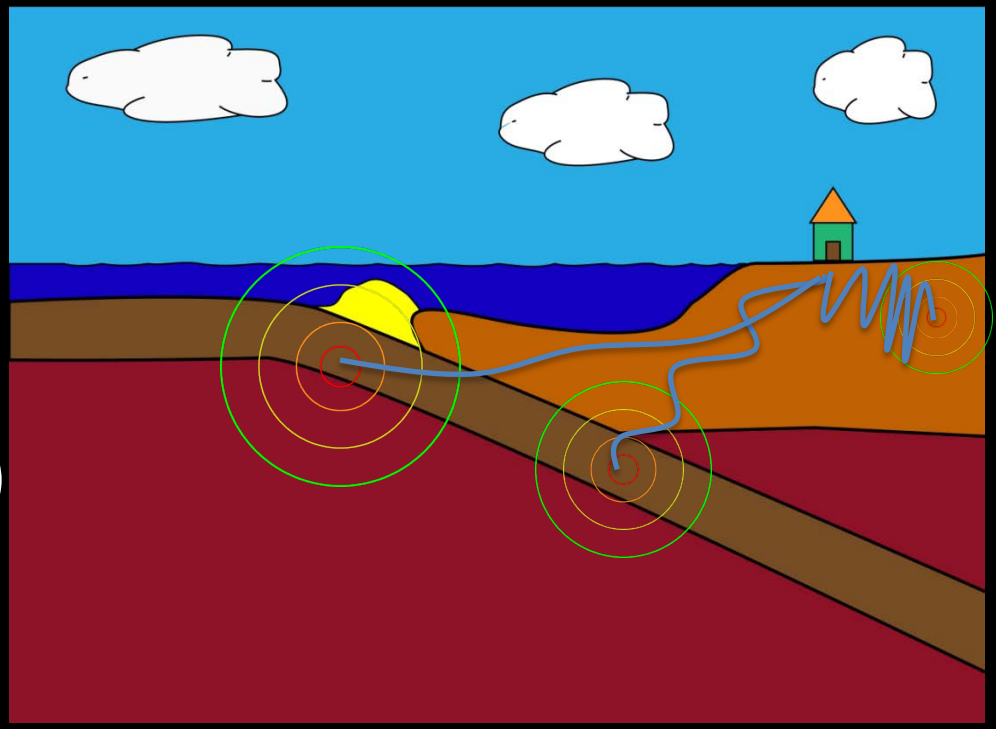
Which one was the worst?

Earthquake	Magnitude	Fatalities	Losses (billion USD)
Haiti 2010	7.0	~200000	~8
Padang 2009	7.6	~1000	~2
Chile 2010	8.8	~500	~30
Hongshu 2011	9.0	~10000 (many from tsunami)	~35

Sources: Wikipedia, Bappenas, USGS, NOAA

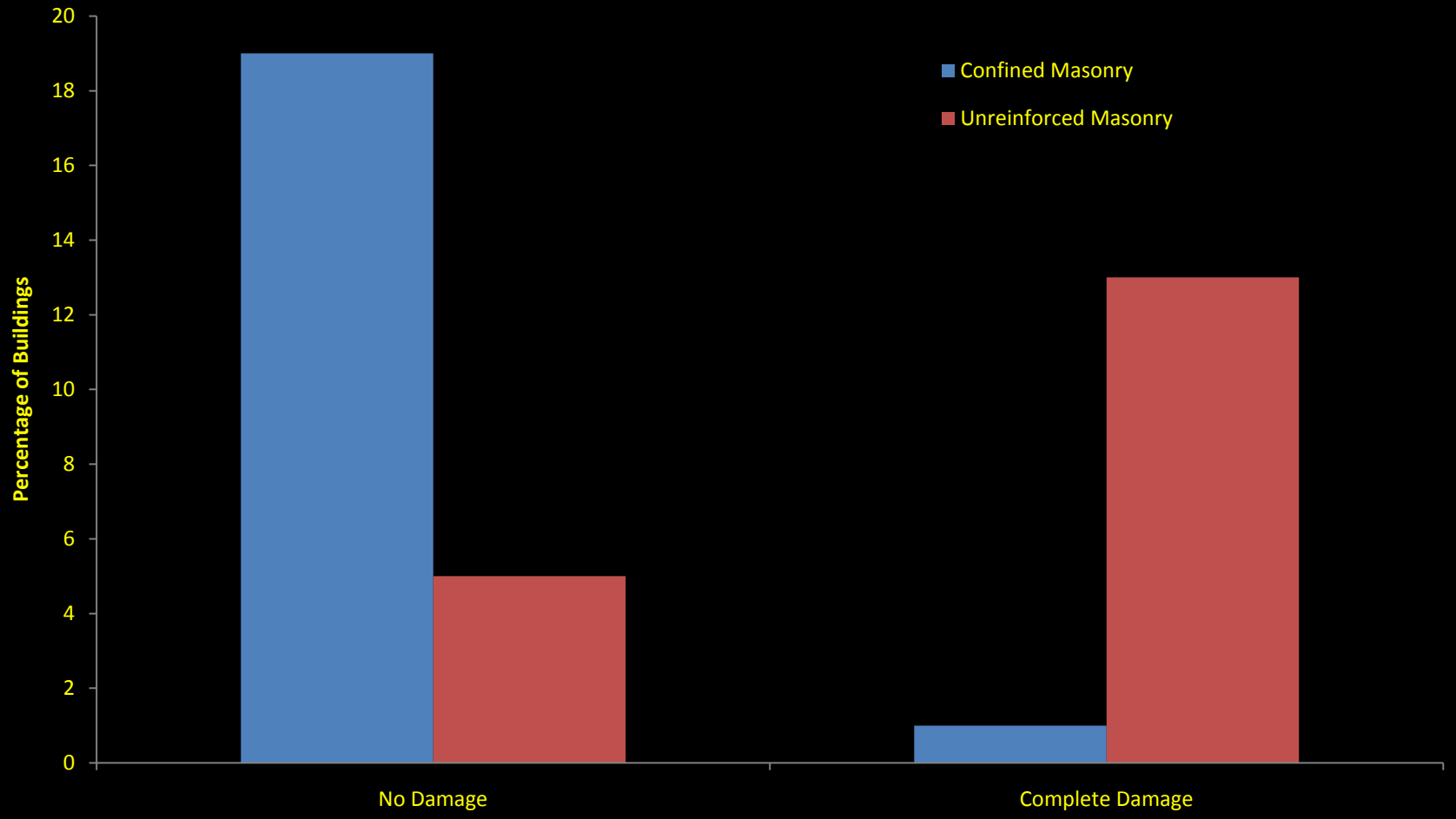
What determines the Impact of an Earthquake?

- **Ground Shaking**
  - Magnitude
  - Depth
  - Distance (attenuation)
  - Soil type (site response)
- **Impact**
  - Building Quality
  - Population



What makes an earthquake deadly? Lessons from Padang

Survey Results



Bukan Gempanya Tapi Bangunannya ! • Film Tentang Cara Membangun 'Rumah Aman Gempa'

BUKAN GEMPANYA TAPI BANGUNANNYA!

Jagalah **keselamatan** Anda

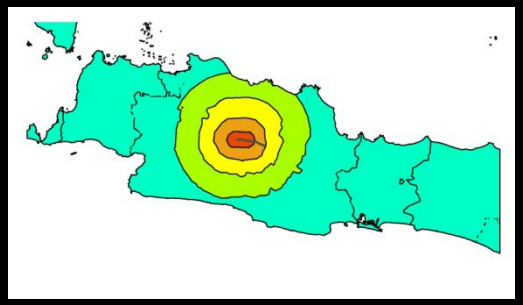
dengan membangun **rumah**

aman gempa

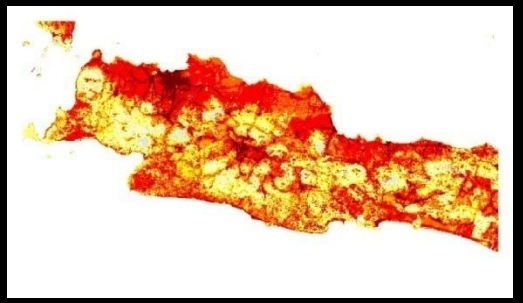
Film Tentang Cara Membangun 'Rumah Aman Gempa'

Generic Impact Mapping

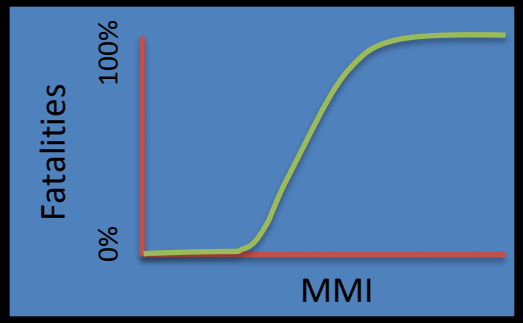
Hazard Footprint



Exposure



Impact Function



Risiko

- Framework for calculating spatial impact
- Aims at underpinning risk assessment requirements where needed
- Partnership with World Bank (Global Facility for Disaster Reduction and Recovery)

Risiko

- Spatial data distributed using GeoServer
- Input
  - Hazard map (earthquake ground shaking, tsunami inundation depth, volcanic ash load)
  - Exposure map (population density, buildings)
  - Plugin for calculating impact (vulnerability curves)
- Output
  - Map of calculated impact at exposure locations
  - Specific statistics

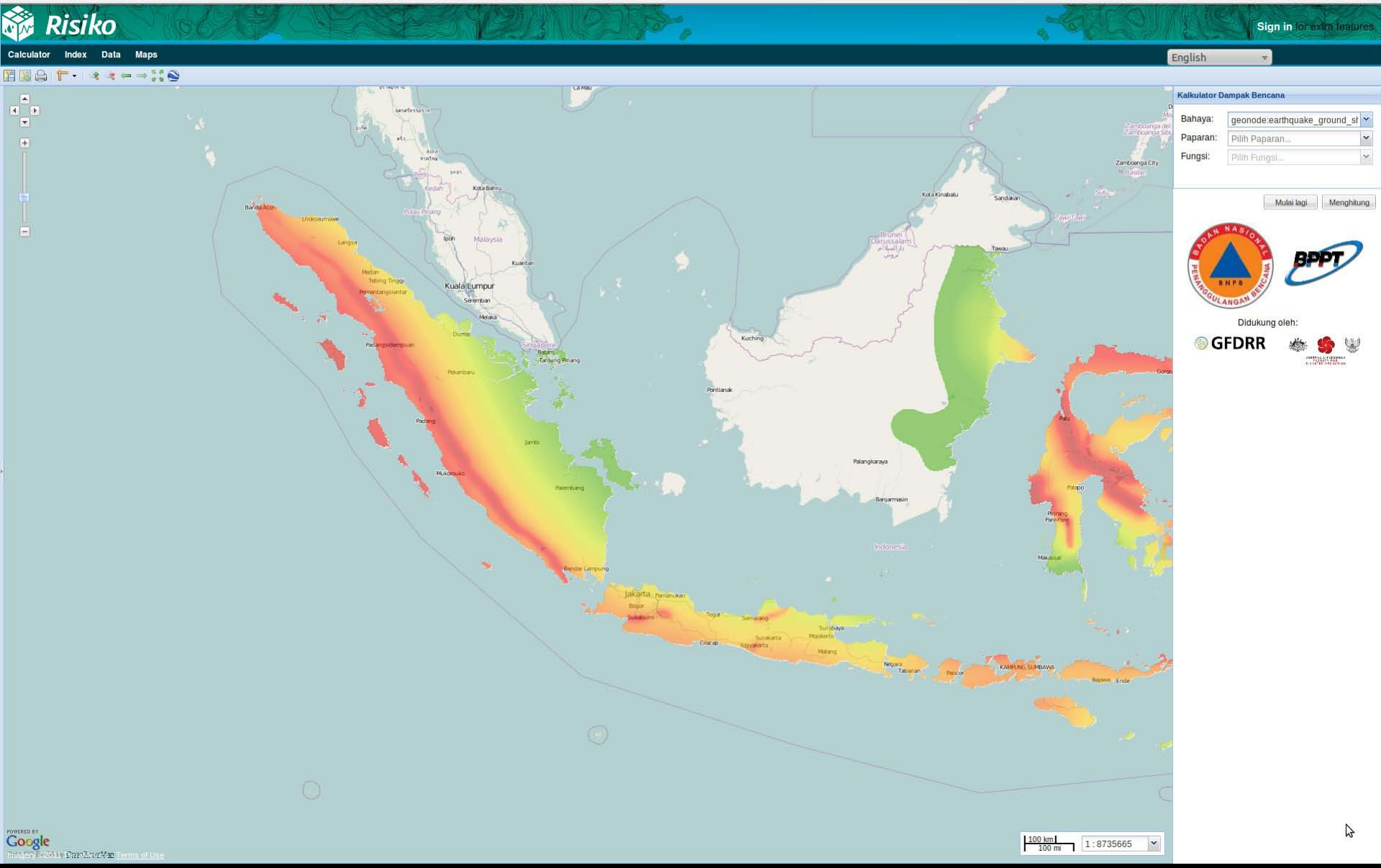
Risiko components

Server Side

- Django
- Python (scipy, numpy, gdal,)
- GeoServer

Client Side

- Javascript (OpenLayers, GeoExt,)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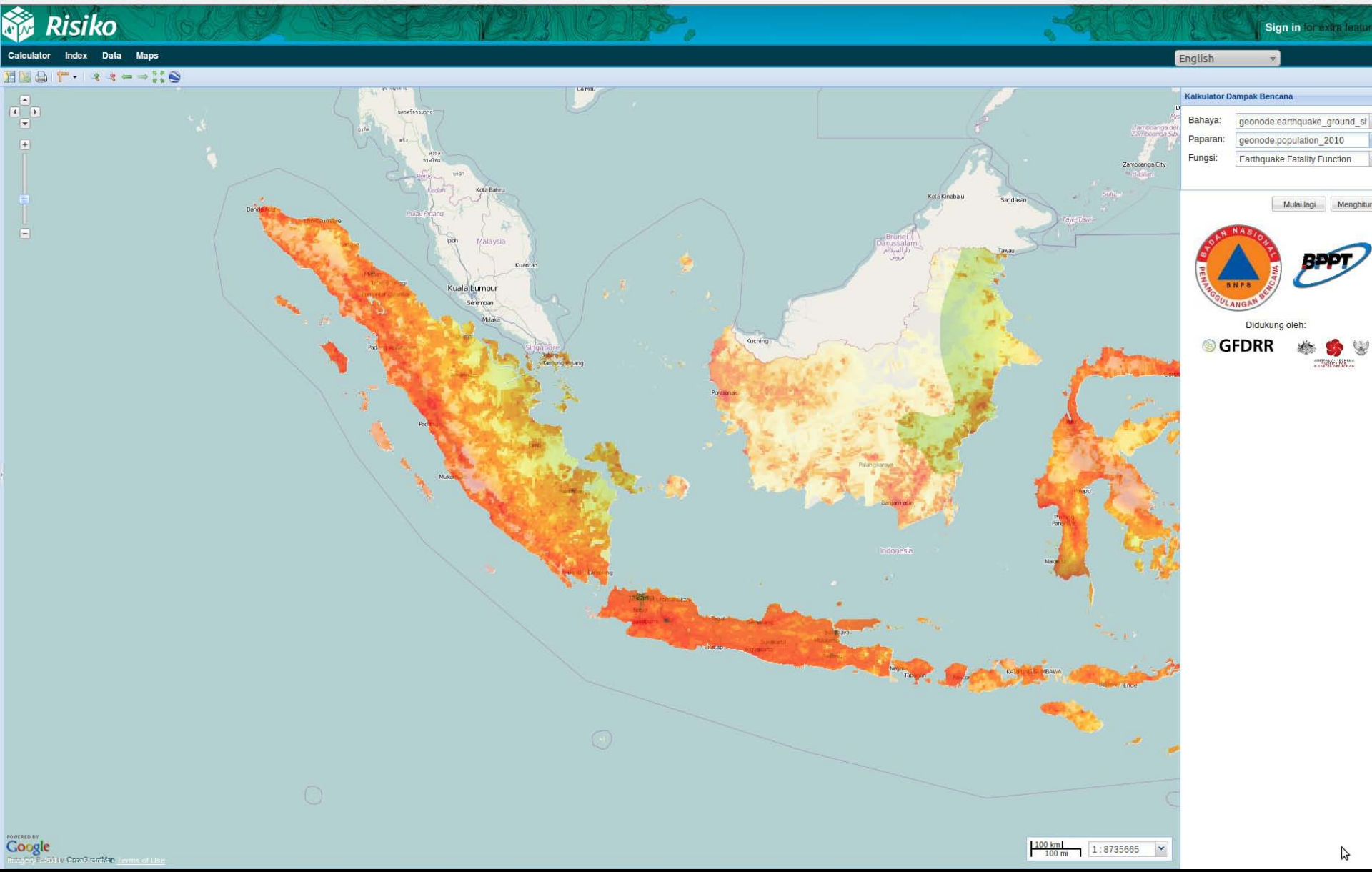
Terms of Use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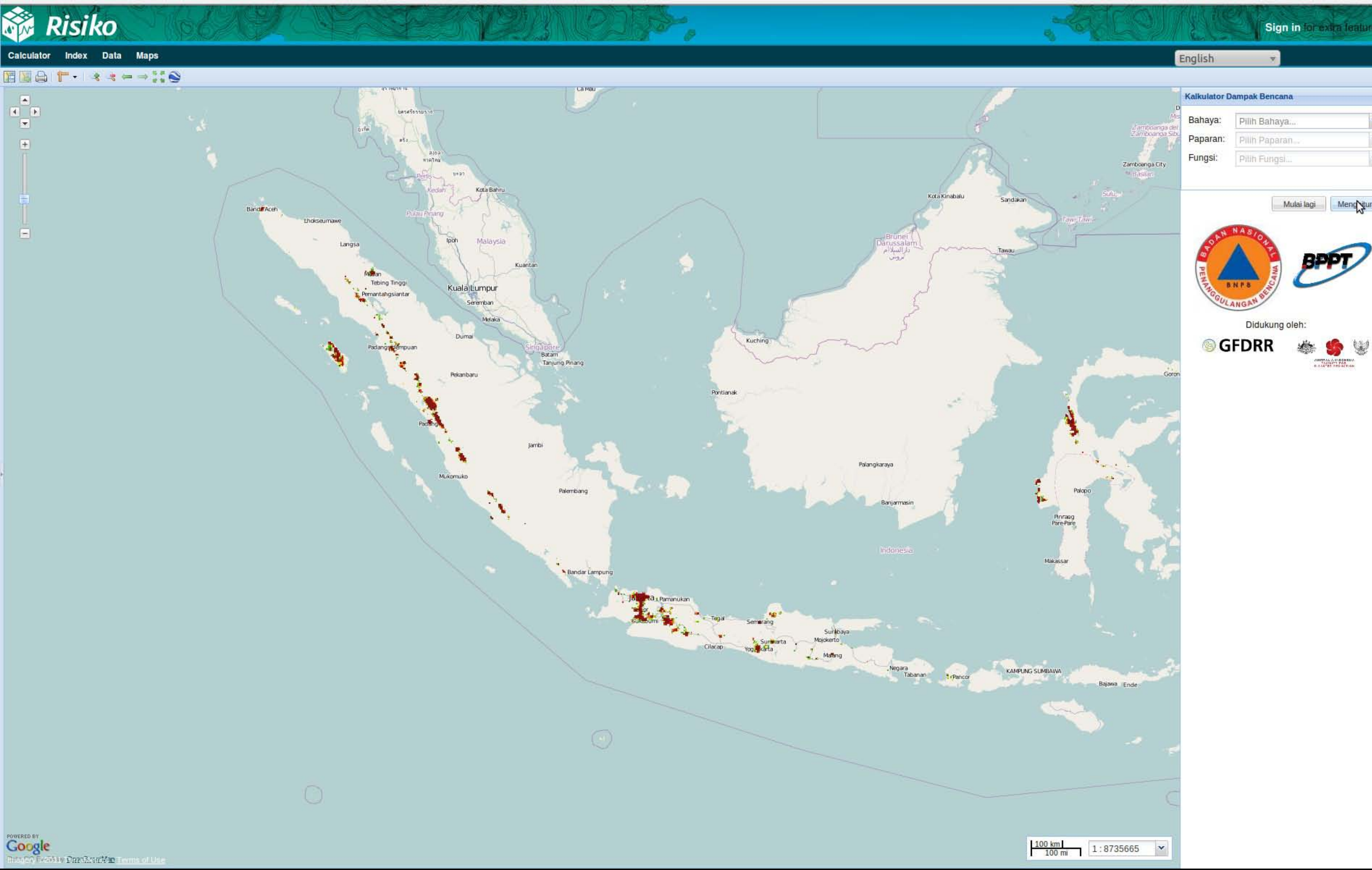
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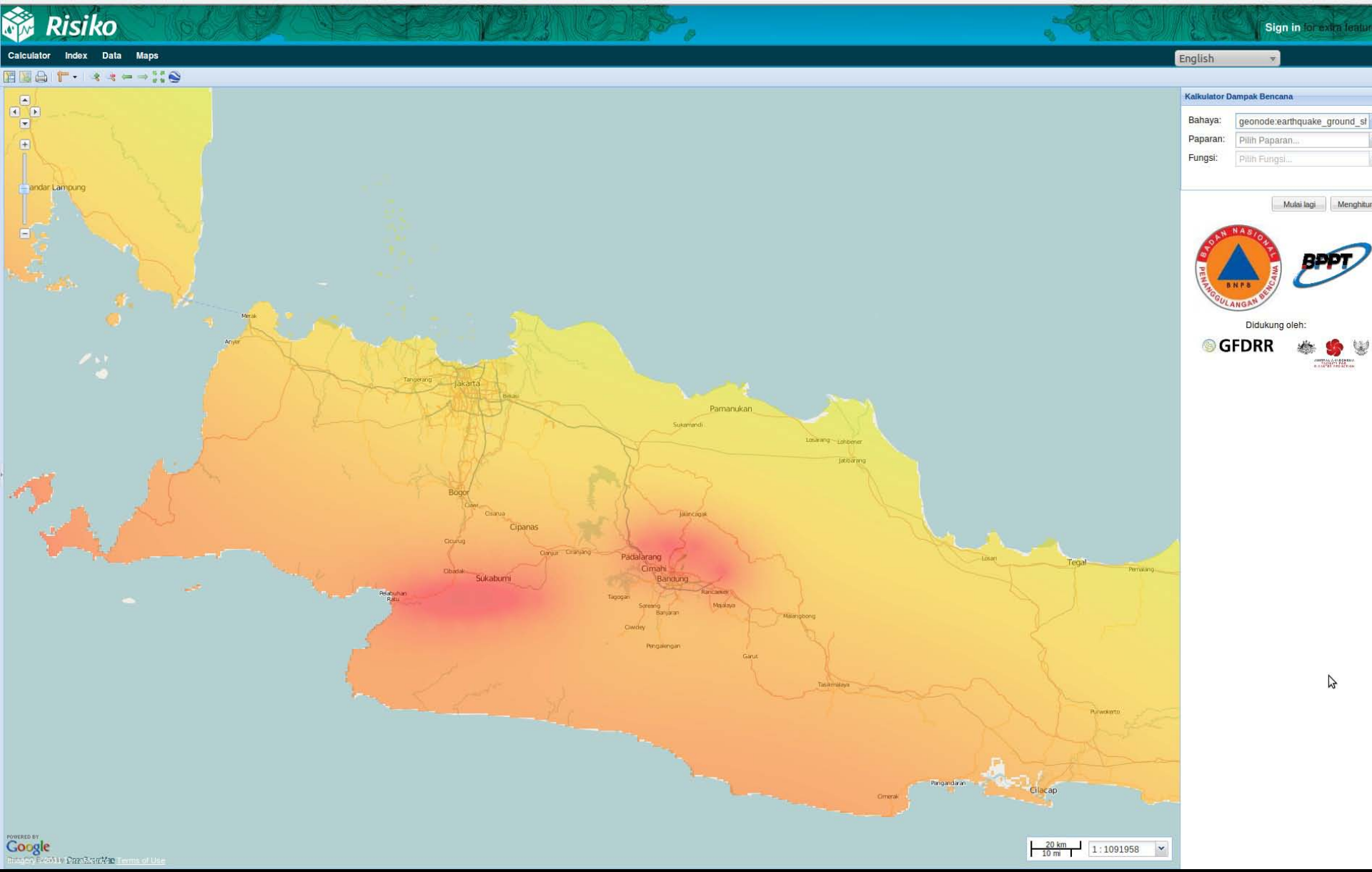
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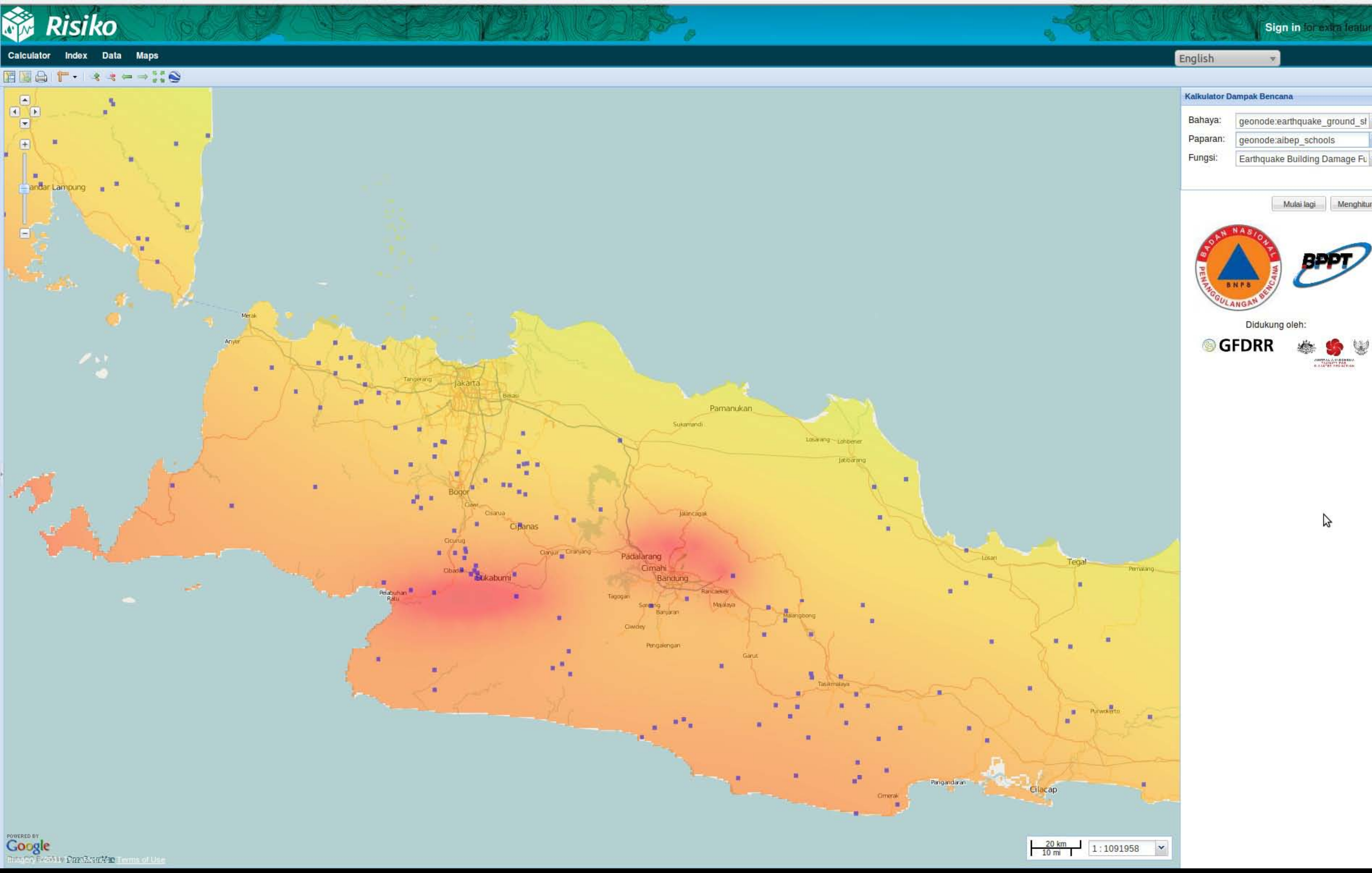

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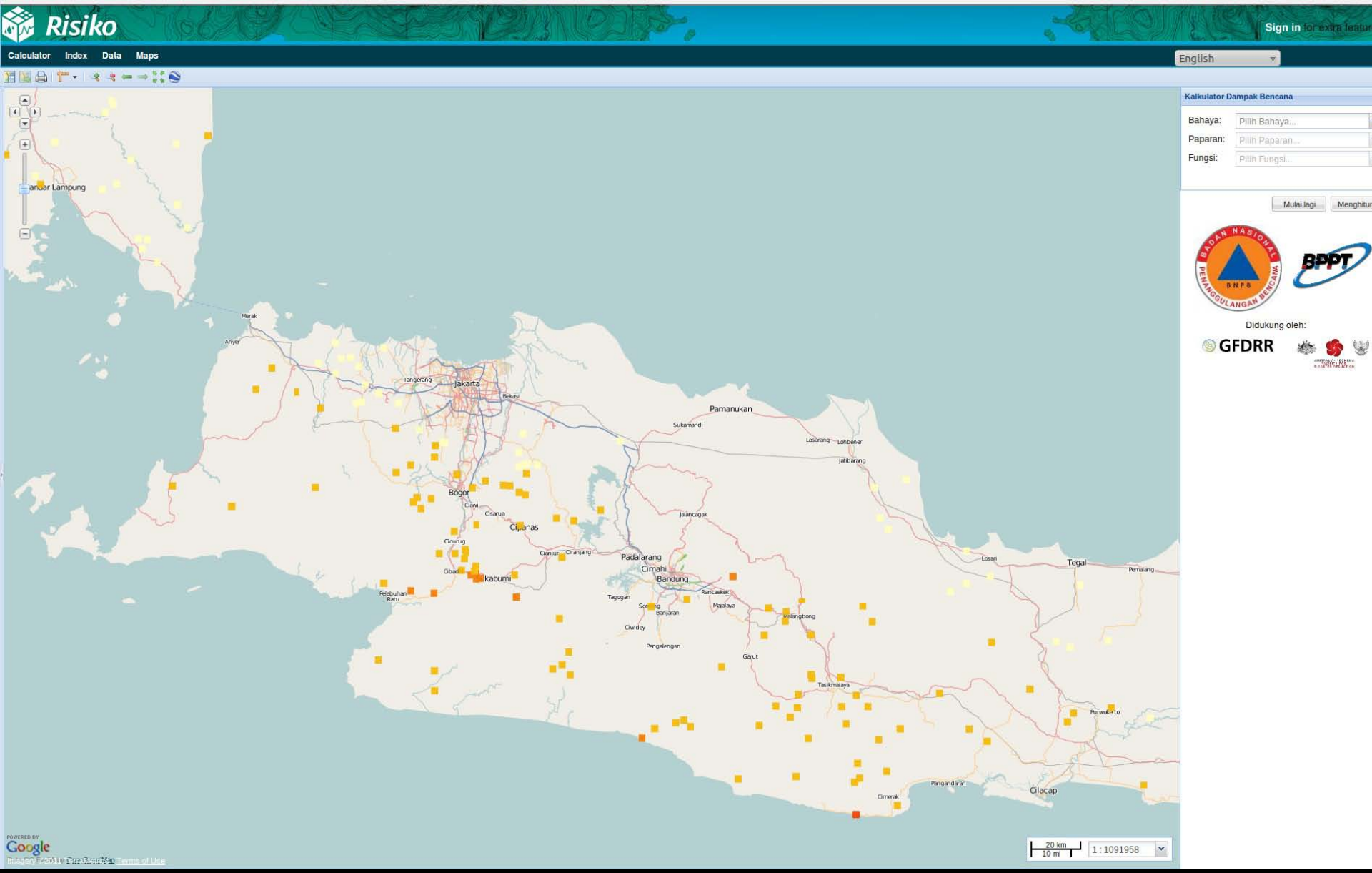
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20 km
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Impact Functions

- Separating calculations from GIS and formats
- Specific to hazard and exposure data
  - metadata keywords in layers (e.g. category:hazard, subcategory:earthquake)
  - plugin requirements stated in docstring

  :param requires category=='hazard' and subcategory=='earthquake'

  :param requires category=='exposure' and subcategory=='population'
- The topic of Dr Ted Dunstone's talk!

```python
from impact.plugins.core import FunctionProvider
from impact.storage.raster import Raster


class EarthquakeFatalityFunction(FunctionProvider):
    """Risk plugin for earthquake damage

    :author Allen
    :rating 1
    :param requires category=='hazard' and \
                subcategory.startswith('earthquake') and \
                layer_type=='raster'
    :param requires category=='exposure' and \
                subcategory.startswith('population') and \
                layer_type=='raster'
    """

    @staticmethod
    def run(layers,
            a=0.97429, b=11.037):
        """Risk plugin for earthquake fatalities

        Input
          layers: List of layers expected to contain
              H: Raster layer of MMI ground shaking
              P: Raster layer of population data on the same grid as H
        """

        # Identify input layers
        intensity = layers[0]
        population = layers[1]

        # Extract data
        H = intensity.get_data(nan=0)
        P = population.get_data(nan=0)

        # Calculate impact
        F = 10 ** (a * H - b) * P

        # Create new layer and return
        R = Raster(F,
                   projection=population.get_projection(),
                   geotransform=population.get_geotransform(),
                   name='Estimated fatalities')
        return R
```

Why Python?

- Productivity (let's me focus on the problem)
- Vast number of libraries
- Memory management!
- Unit testing framework
- Extensibility (C or F77 only where needed)
- I converted in 1999 and still happy

Challenges

- Dependencies (Geoserver, GeoNode, GDAL)
- Example: Asking for resolution 0.03x0.03
- http://localhost:8001/geoserver/ows?version=1.0.0&service=wcs&request=getcoverage&format=GeoTIFF&store=false&coverage=shakemap&crs=EPSG:4326&bbox=122.5775,-2.0025,126.6025,2.0225&resx=0.03&resy=0.03
- Pixel Size = (0.030037313432836,-0.030037313432836)

- Work-in-progress but suffered from being demoed too often.

Future

- Early days!
- Risiko to help set standards for risk modelling
  - Abstracting the GIS components
  - Use of data standards (OGC)
  - Facilitate collection of exposure data
- Other types of modelling (environmental, socio-economic)
- Grow development community

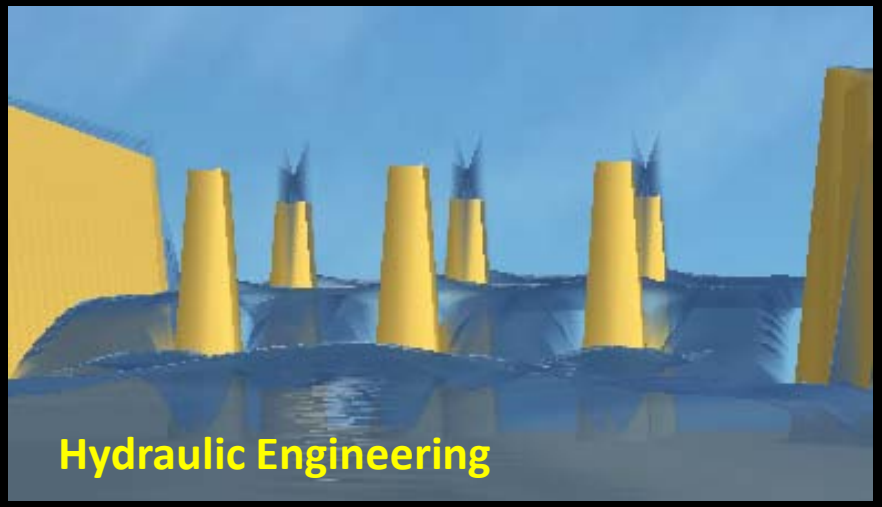
Thank You

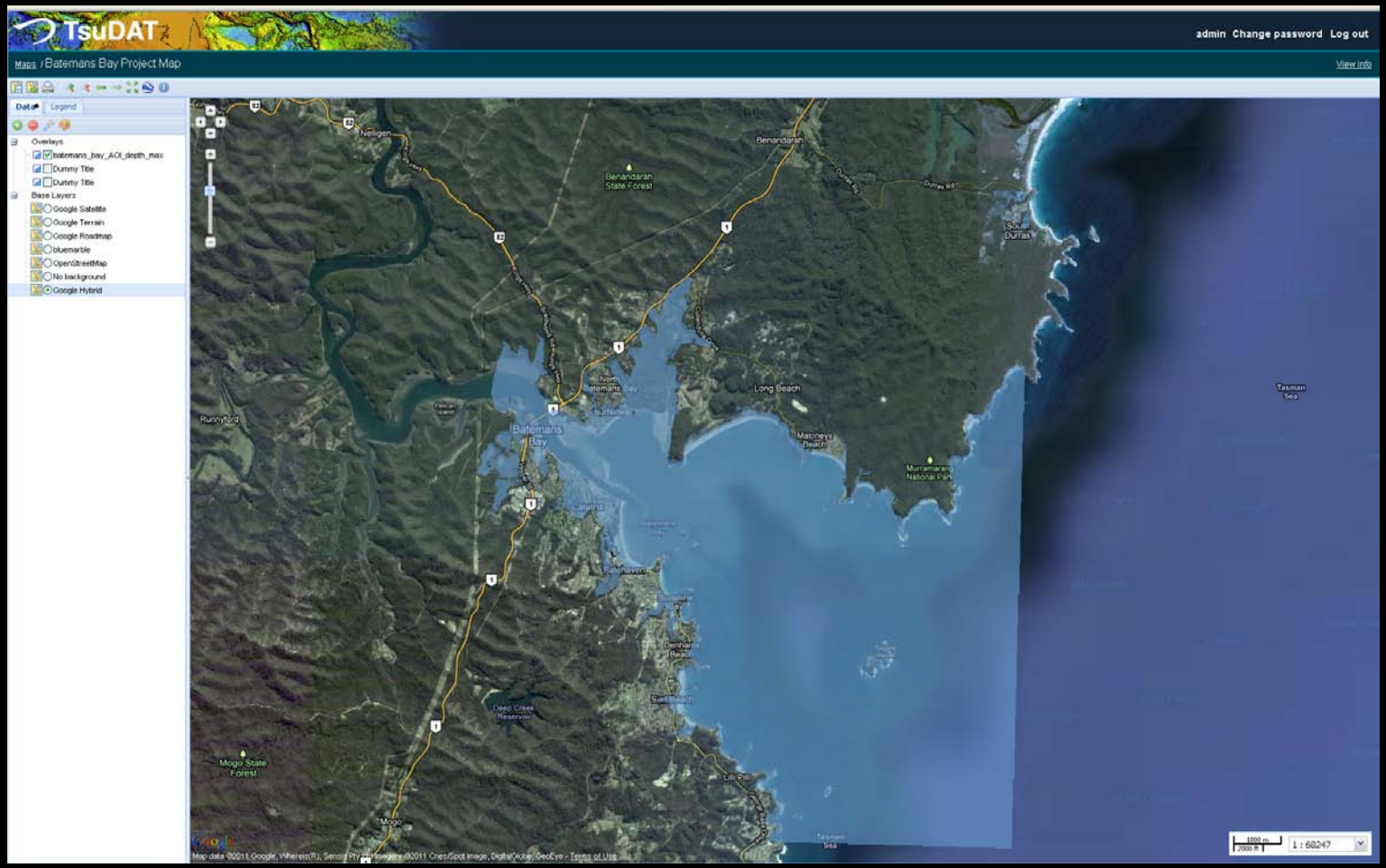
Source (github), issue tracker and docs:

http://riskinabox.org

Ole.Nielsen@aifdr.org

What is ANUGA

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Base Layers
Google Satellite
Google Terrain
Google Roadmap
bluemarble
OpenStreetMap
No background
Google Hybrid
Narooma
Nelligen
Benandarah
Benandarah State Forest
Durras
South Durras
Long Beach
Tasman Sea
Runnyford
Batemans Bay
Maloneys Beach
Murramarang National Park
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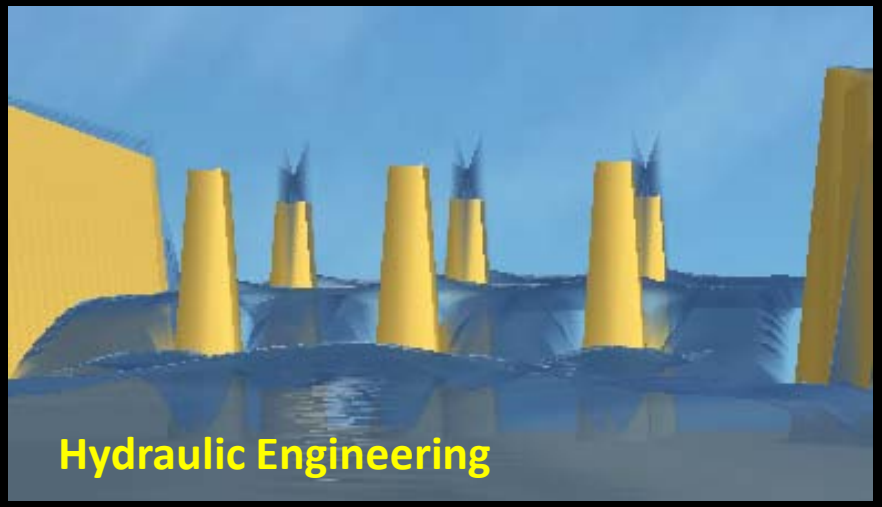
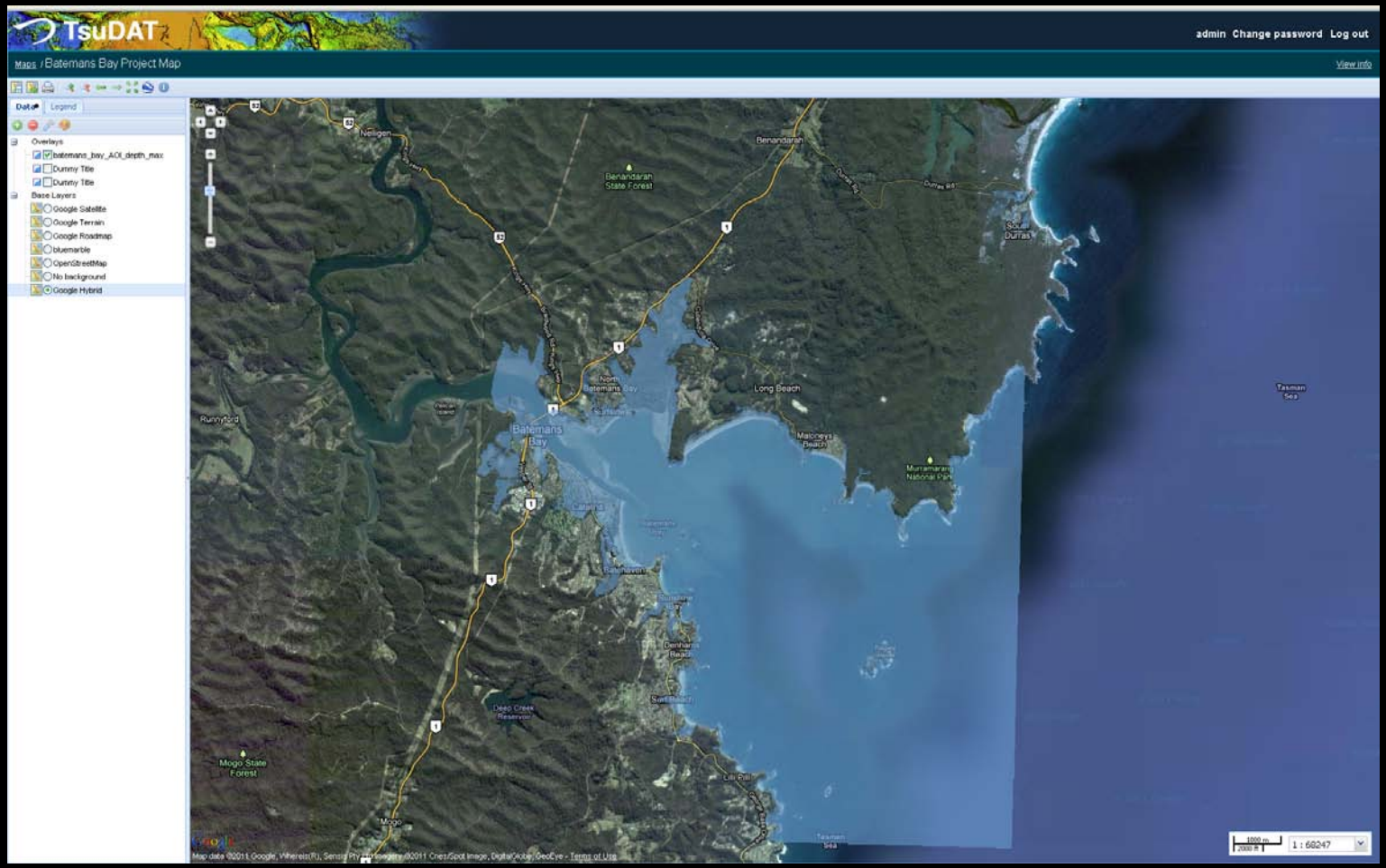
What is ANUGA

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bluemarble
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No background
Google Hybrid
Narooma
Nelligen
Benandarah
Benandarah State Forest
Durras
South Durras
Long Beach
Tasman Sea
Runnyford
Batemans Bay
Maloneys Beach
Murramarang National Park
Denhams Beach
Deep Creek Reservoir
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Source (github), issue tracker and docs