How to anticipate risk situations in buildings

1º Encontro LxDataLab

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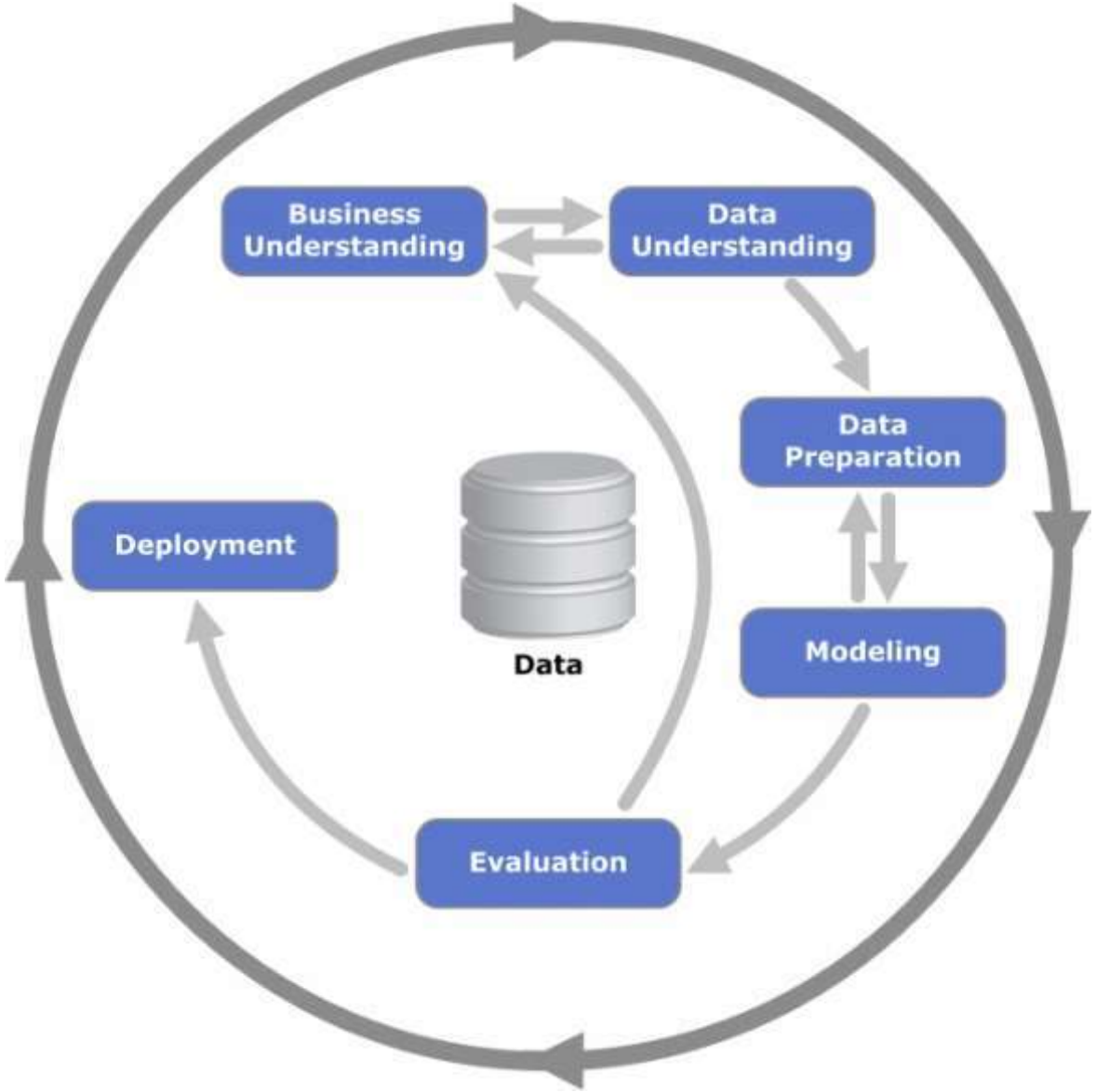
CRISP-DM


Business Understanding
Data Understanding
Data Preparation
Modeling
Evaluation
Deployment
Data

Business Understanding

- Lisbon is often in the news for collapsed buildings, in most cases without loss of human life;
- In order to be able to predict new incidents, we will analyze which phenomena could be the reason to trigger such events.

Expected results

Being able to detect patterns in which certain events occur

Being able to relate these patterns to other factors (temperature, age, area, ...)

Data Understanding

Data on the building stock

```
'YEAR'                          - survey year
'GEO_COD'                       - ??
'GEO_COD_DSG'                   - description of the GEO_COD
'LEVEL'                         - ??
'LEVEL_DSG'                     - ??
'N_BLDS_1OR2_FLOORS'            - no. of buildings with 1 or 2 storeys
'N_BLDS_3OR4_FLOORS'            - number of buildings with 3 or 4 floors
'N_BLDS_5OR_MORE_FLOORS'        - number of buildings with 5 or more floors
'N_BLDS_BEFORE_1919'            - number of buildings constructed before 1919
'N_BLDS_BUILT_1919TO1945'       - number of buildings constructed between 1919 and 1945
'N_BLDS_BUILT_1946TO1960'       - number of buildings built between 1946 and 1960
'N_BLDS_BUILT_1961TO1970'       - number of buildings built between 1961 and 1970
'N_BLDS_BUILT_1971TO1980'       - number of buildings built between 1971 and 1980
'N_BLDS_BUILT_1981TO1990'       - number of buildings built between 1981 and 1990
'N_BLDS_BUILT_1991TO1995'       - number of buildings constructed between 1991 and 1995
'N_BLDS_BUILT_1996TO2000'       - number of buildings built between 1996 and 2000
'N_BLDS_BUILT_2001TO2005'       - number of buildings built between 2001 and 2005
'N_BLDS_BUILT_2006TO2011'       - number of buildings built between 2006 and 2011
```

Data Understanding

Occurrences registered by the Fire Brigade Regiment (between 2011 and 2018)

```
ID                      - Occurrence ID
DATE_OCCURRENCE         - Occurrence date
LATITUDE                - Latitude of occurrence
LONGITUDE               - Longitude of occurrence
ADDRESS_ID              - ID of address where the occurrence took place
OCO_NUM_POL             - ?
ADDRESS                 - Address where the event occurred
ID_PARISH               - ID of the parish where the event occurred
PARISH                  - Town where the incident occurred
STATE_ID                - ID of the occurrence state (only have values 4 and 3 - meaning ??)
DATE_ALTERATION_STATE   - Change date of the state of occurrence
STATE_DESIG             - ?? (only has the values FA and FO)
FRACTION                - ??
REFERENCE               - floor/door where the event occurred (null represents Street??)
INCIDENT_TYPE           - Event Nature ID
INCIDENT_NAME           - Description of the nature of occurrence
DESCRIPTION             - Description of the event
ENT_ID                  - ID of the entity that took over the occurrence?
ENT_DESC                - Entity that took over the occurrence?
RISK                    - Risk of the occurrence ? (values 2., 1., 0.)
YN_SUSPENDED            - ?? (values N and S - presumable yes and no)
FALSE_ALARM             - If the occurrence was a false alarm ??(values nan, 1., 0.)
ENT_ID_VPD              - ID of ?
NUM_VEHICLES            - Number of vehicles that went to the occurrence
NUM_ELEMENTS            - Number of elements that went to the occurrence
```

Data Understanding

Building structure data

```
47   YEAR                          - year of the survey
48   GEO_COD                       - ??
49   GEO_COD_DSG                   - GEO_COD descriptive
50   LEVEL                         - ??
51   NIVEL_DSG                     - ??
52   N_BLDS_STRUT_CONCRETE         - Nr. of buildings in concrete
53   N_BLDS_STRUT_WITH_PLAQUE      - nº of buildings with plaque
54   N_BLDS_STRUT_WITHOUT_PLAQUE   - nº of buildings without plaque
55   N_BLDS_STRUT_ADOBE_STONE      - number of buildings in adobe and stone
56   N_BLDS_STRUT_OTHER            - number of buildings with "other" structure
```

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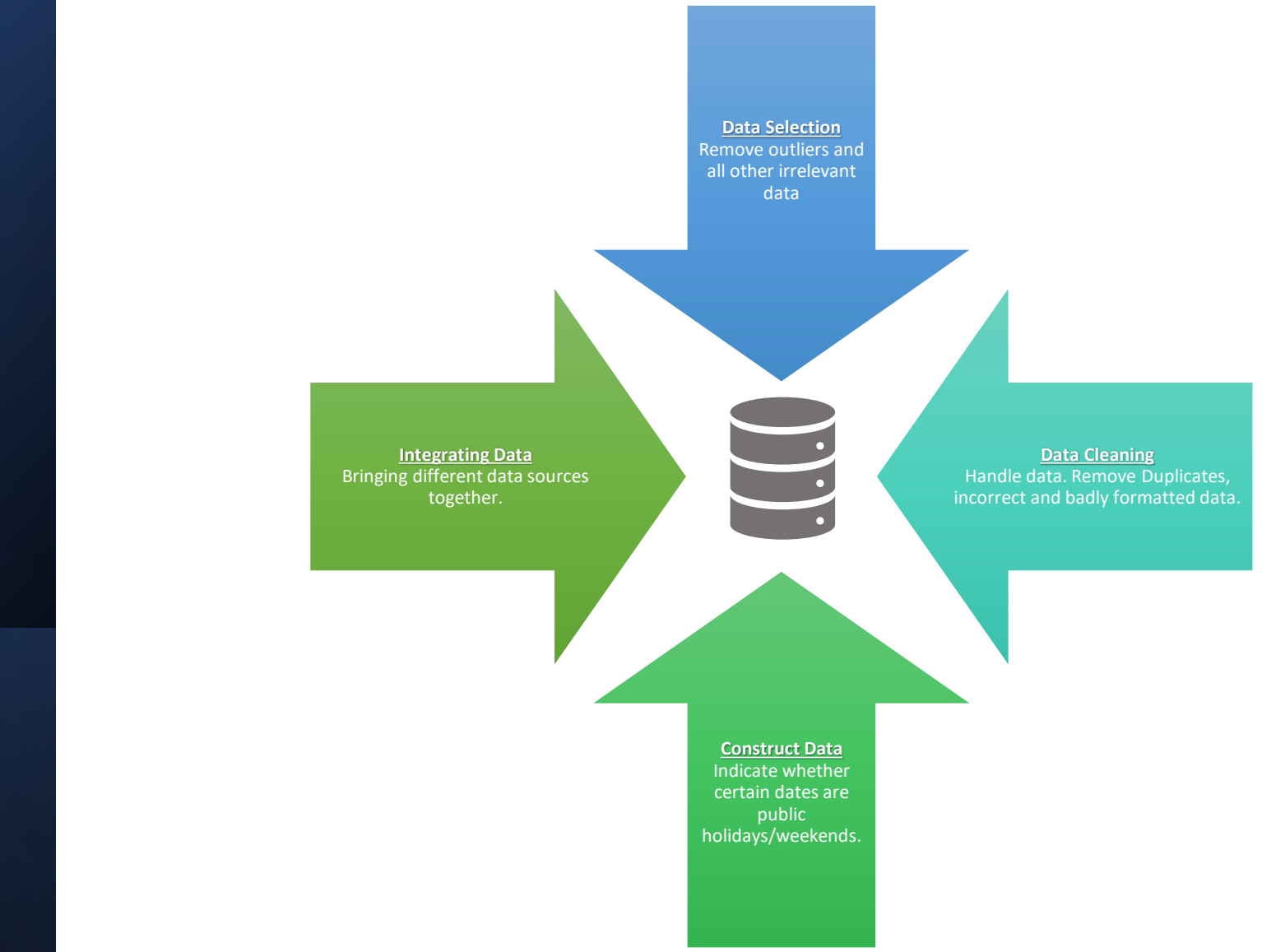
Data Preparation



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External Data

Calendar - Holidays / Weekends

Temperature

Feature engineering

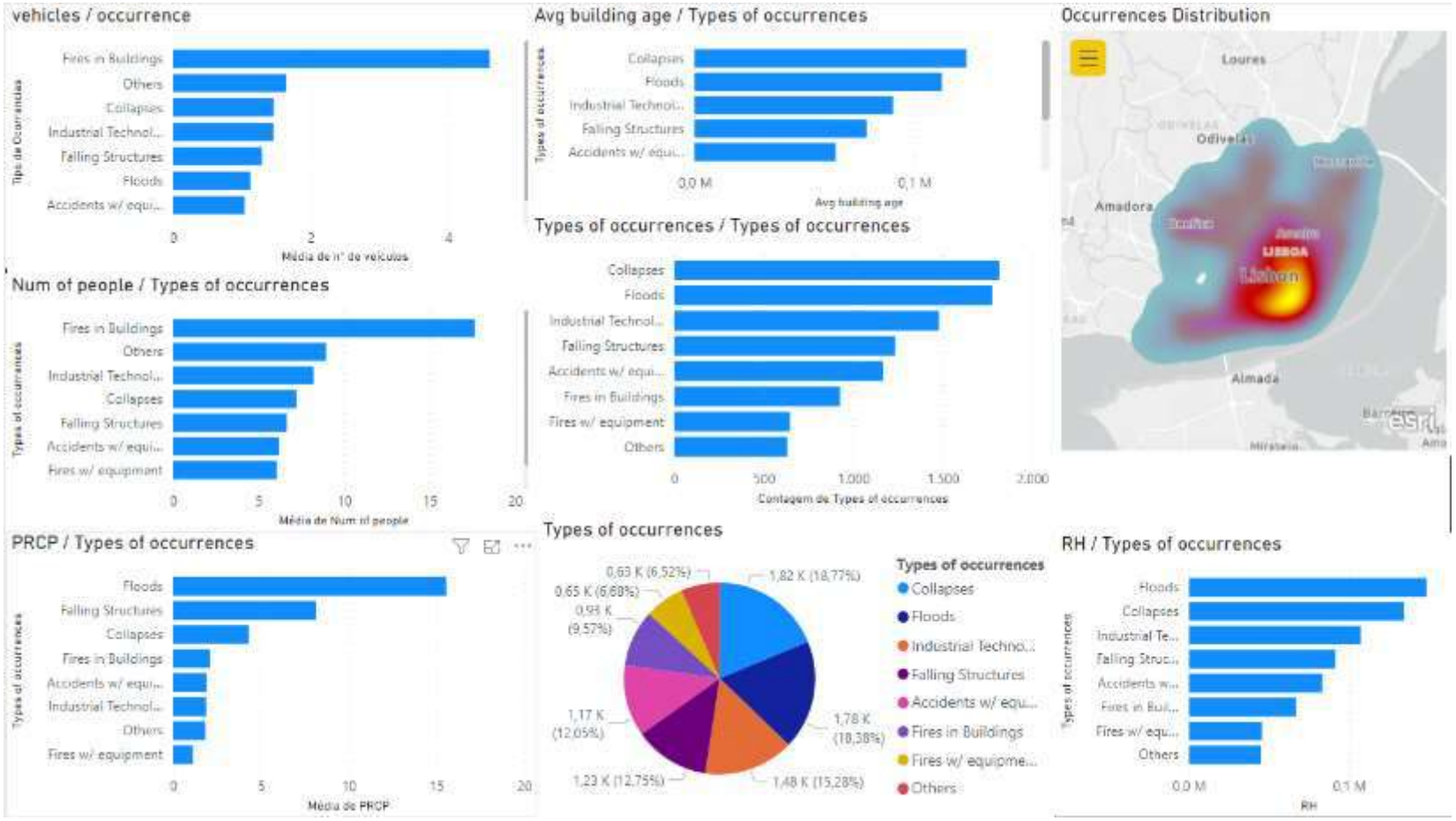
- Binnig of occurrences and atmospheric data
- Understanding whether the weather is good or bad
- Reduce the number of types of occurrences. E.g.: We have 10 types of fires.

```
'1401 - Fire - Building (Infrastructure/Facility) - Residential',
'1402 - Fire - Building (Infrastructure/Facility) - Parking',
'1403 - Fire - Building (Infrastructure/Facility) - Services',
'1404 - Fire - Building (Infrastructure/Installation) - School',
'1405 - Fire - Building (Infrastructure/Facility) - Hospital/Healthcare',
'1406 - Fire - Building (Infrastructure/Facility) - Entertainment/Leisure/Religious Cult',
'1407 - Fire - Building (Infrastructure/Installation) - Hotel and similar',
'1408 - Fire - Building (Infrastructure/Facility) - Commercial/Shops/Fairs/Transport Station',
'1410 - Fire - Building (Infrastructure/Facility) - Military/Security Forces',
'1411 - Fire - Building (Infrastructure/Facility) - Industry/Workshop/Warehouse',
'1420 - Fire - Building (Infrastructure/Facility) - Returned/Degraded Building',

'2500 - Accidents - Equipment',
'2501 - Accidents - Equipment - Lifts',

'3501 - Infrastructure and Communication Routes - Private Space Flooding',
'3800 - Infrastructure and Communication Routes - Falling Structures',

'6301 - Industrial Technological - Gas Leak - Piping/Conduct',
'6302 - Industrial Technological - Gas Leak - Bottle',
'6303 - Industrial Technological - Gas Leak - Storage/Storage Tank/Reservoir',
'6401 - Industrial Technological - Suspicious Situations - Check for Smoke',
'6402 - Industrial Technological - Suspicious Situations - Check Smells',
```

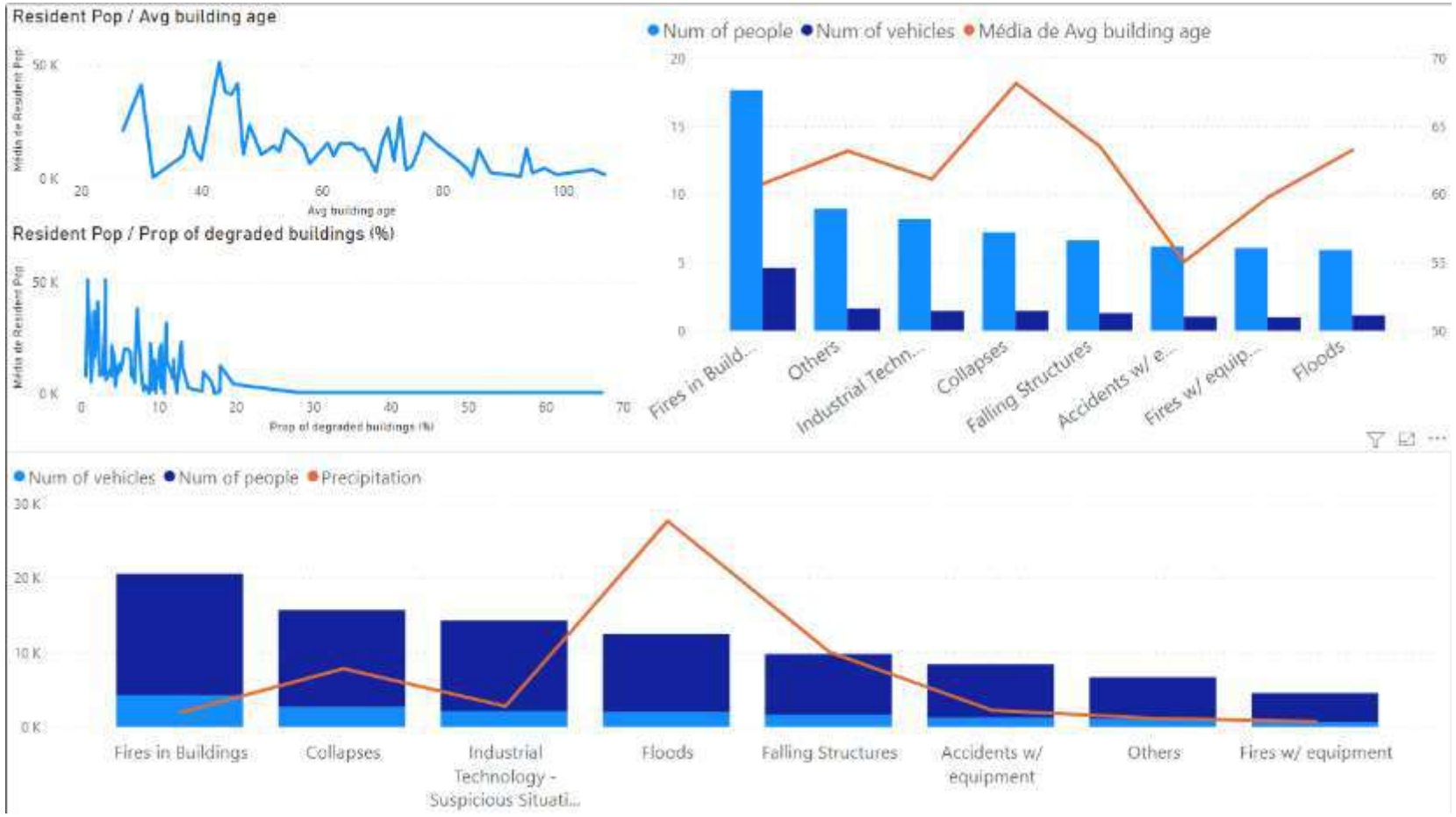
New Variables

- Rainfall days
  - Inferred from temperature and atmospheric pressure data for each day

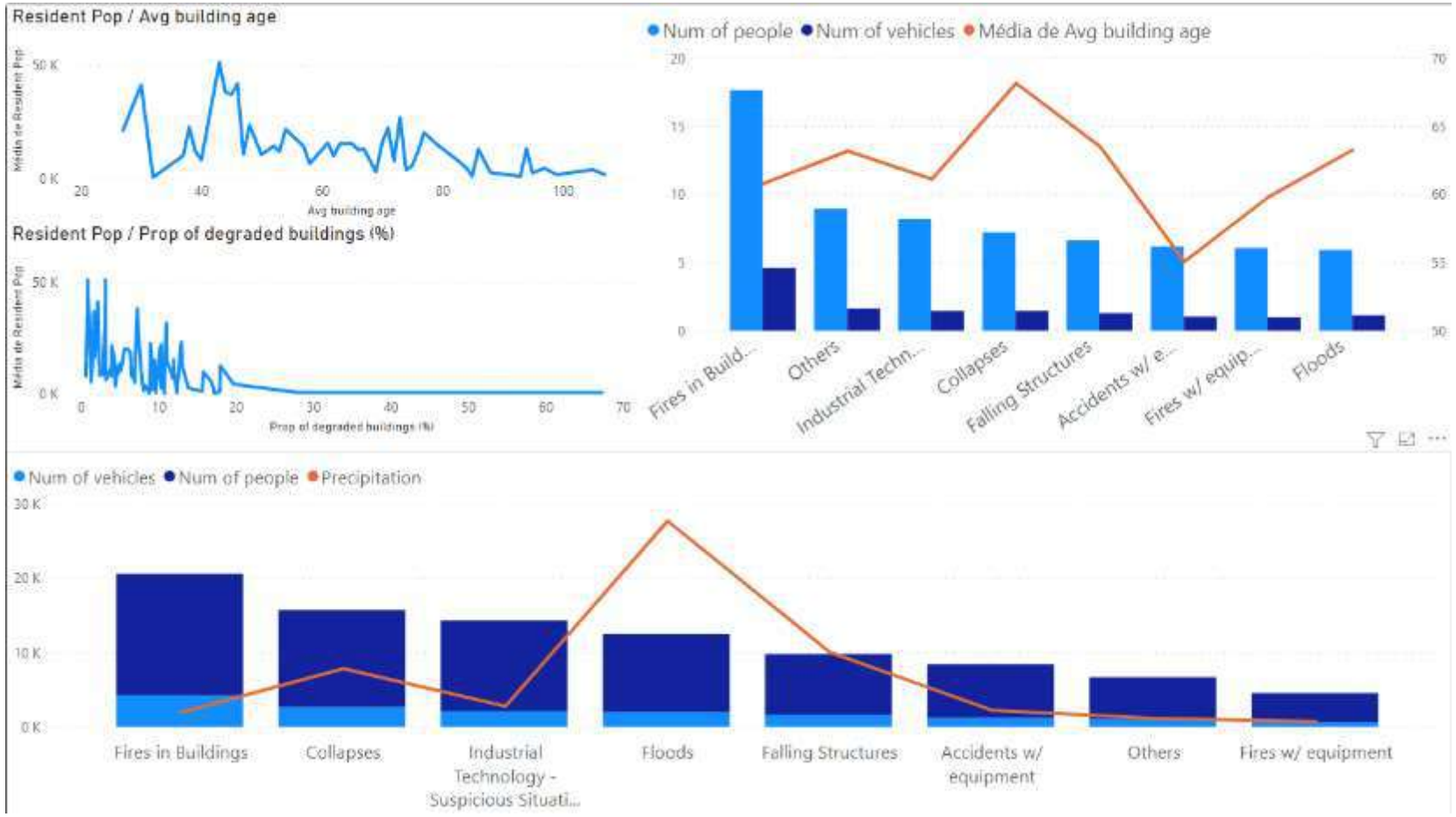
Dashboards


vehicles / occurrence
Fires in Buildings
Others
Collapses
Industrial Technol...
Falling Structures
Floods
Accidents w/ equi...
Tipo de Ocorrencias
0
2
4
Média de nº de veículos
Avg building age / Types of occurrences
Collapses
Floods
Industrial Technol...
Falling Structures
Accidents w/ equi...
Types of occurrences
0,0 M
0,1 M
Avg building age
Occurrences Distribution
Loures
Odivelas
Amadora
LISBOA
Lisbon
Almada
Barreiro
Mitrena
esri
Num of people / Types of occurrences
Fires in Buildings
Others
Industrial Technol...
Collapses
Falling Structures
Accidents w/ equi...
Fires w/ equipment
Types of occurrences
0
5
10
15
20
Média de Num of people
Types of occurrences / Types of occurrences
Collapses
Floods
Industrial Technol...
Falling Structures
Accidents w/ equi...
Fires in Buildings
Fires w/ equipment
Others
0
500
1.000
1.500
2.000
Contagem de Types of occurrences
PRCP / Types of occurrences
Floods
Falling Structures
Collapses
Fires in Buildings
Accidents w/ equi...
Industrial Technol...
Others
Fires w/ equipment
Types of occurrences
0
5
10
15
20
Média de PRCP
Types of occurrences
0,63 K (6,52%)
1,82 K (18,77%)
0,65 K (6,68%)
0,93 K (9,57%)
1,17 K (12,05%)
1,78 K (18,38%)
1,23 K (12,75%)
1,48 K (15,28%)
Types of occurrences
Collapses
Floods
Industrial Techno...
Falling Structures
Accidents w/ equi...
Fires in Buildings
Fires w/ equipme...
Others
RH / Types of occurrences
Floods
Collapses
Industrial Te...
Falling Struc...
Accidents w...
Fires in Buil...
Fires w/ equ...
Others
Types of occurrences
0,0 M
0,1 M
RH

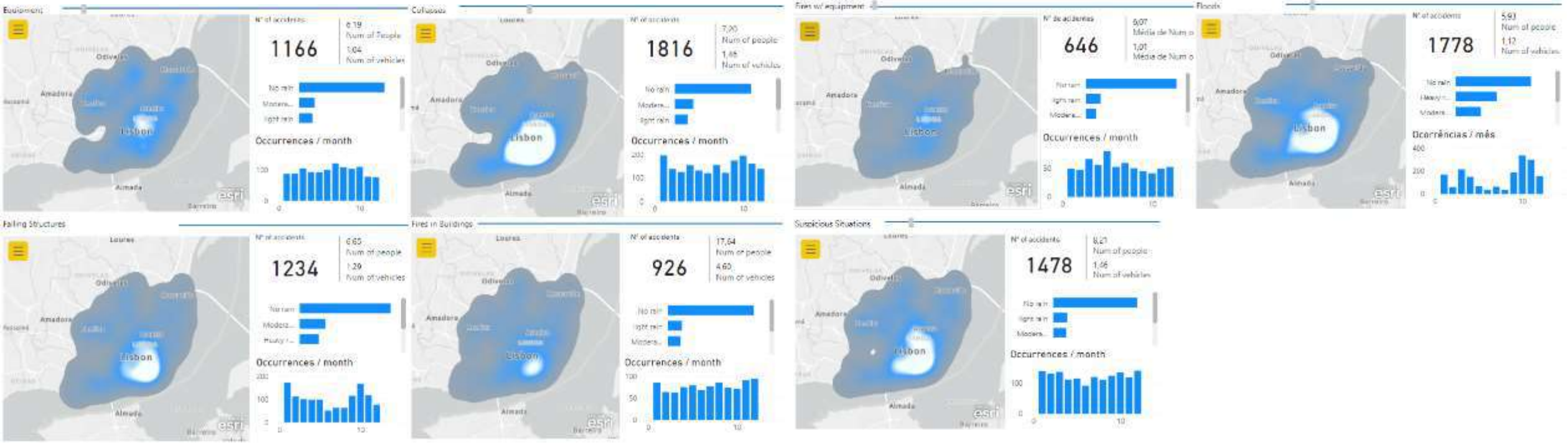
Dashboards


Resident Pop / Avg building age
Média de Resident Pop
50 K
0 K
20
40
60
80
100
Avg building age
Resident Pop / Prop of degraded buildings (%)
Média de Resident Pop
50 K
0 K
0
10
20
30
40
50
60
70
Prop of degraded buildings (%)
Num of people
Num of vehicles
Média de Avg building age
20
15
10
5
0
70
65
60
55
50
Fires in Build...
Others
Industrial Techn...
Collapses
Falling Structures
Accidents w/ e...
Fires w/ equip...
Floods
Num of vehicles
Num of people
Precipitation
30 K
20 K
10 K
0 K
Fires in Buildings
Collapses
Industrial Technology - Suspicious Situati...
Floods
Falling Structures
Accidents w/ equipment
Others
Fires w/ equipment

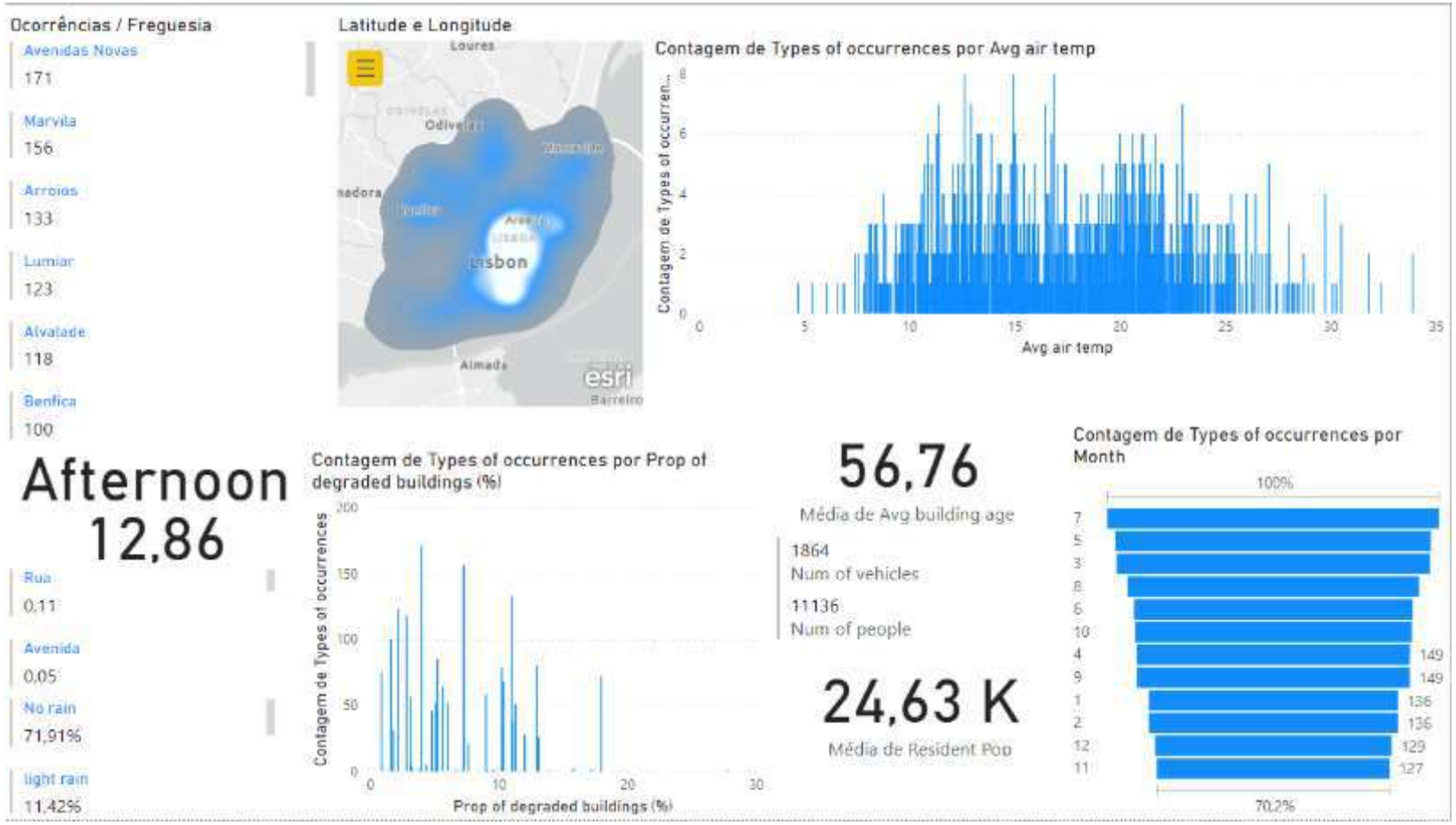
Dashboards


Resident Pop / Avg building age
Média de Resident Pop
50 K
0 K
20
40
60
80
100
Avg building age
Resident Pop / Prop of degraded buildings (%)
Média de Resident Pop
50 K
0 K
0
10
20
30
40
50
60
70
Prop of degraded buildings (%)
Num of people
Num of vehicles
Média de Avg building age
20
15
10
5
0
70
65
60
55
50
Fires in Build...
Others
Industrial Techn...
Collapses
Falling Structures
Accidents w/ e...
Fires w/ equip...
Floods
Num of vehicles
Num of people
Precipitation
30 K
20 K
10 K
0 K
Fires in Buildings
Collapses
Industrial Technology - Suspicious Situati...
Floods
Falling Structures
Accidents w/ equipment
Others
Fires w/ equipment

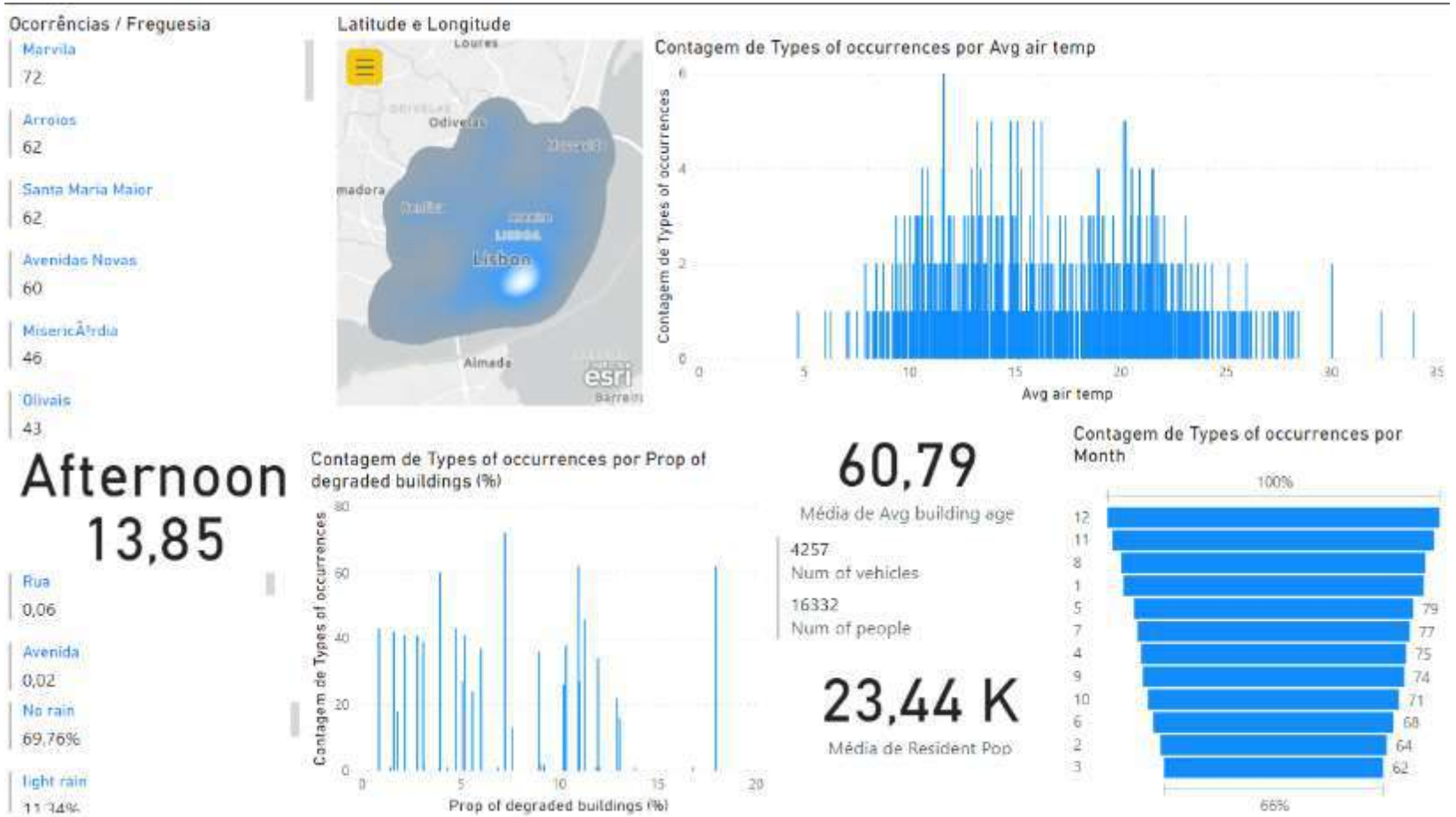
Dashboards


Equipment
1166
Occurrences / month
Collapses
1816
Occurrences / month
Fires w/ equipment
646
Occurrences / month
Floods
1778
Ocorrências / mês
Failing Structures
1234
Occurrences / month
Fires in Buildings
926
Occurrences / month
Suspicious Situations
1478
Occurrences / month
Lisbon
Almada
Amadora
esri

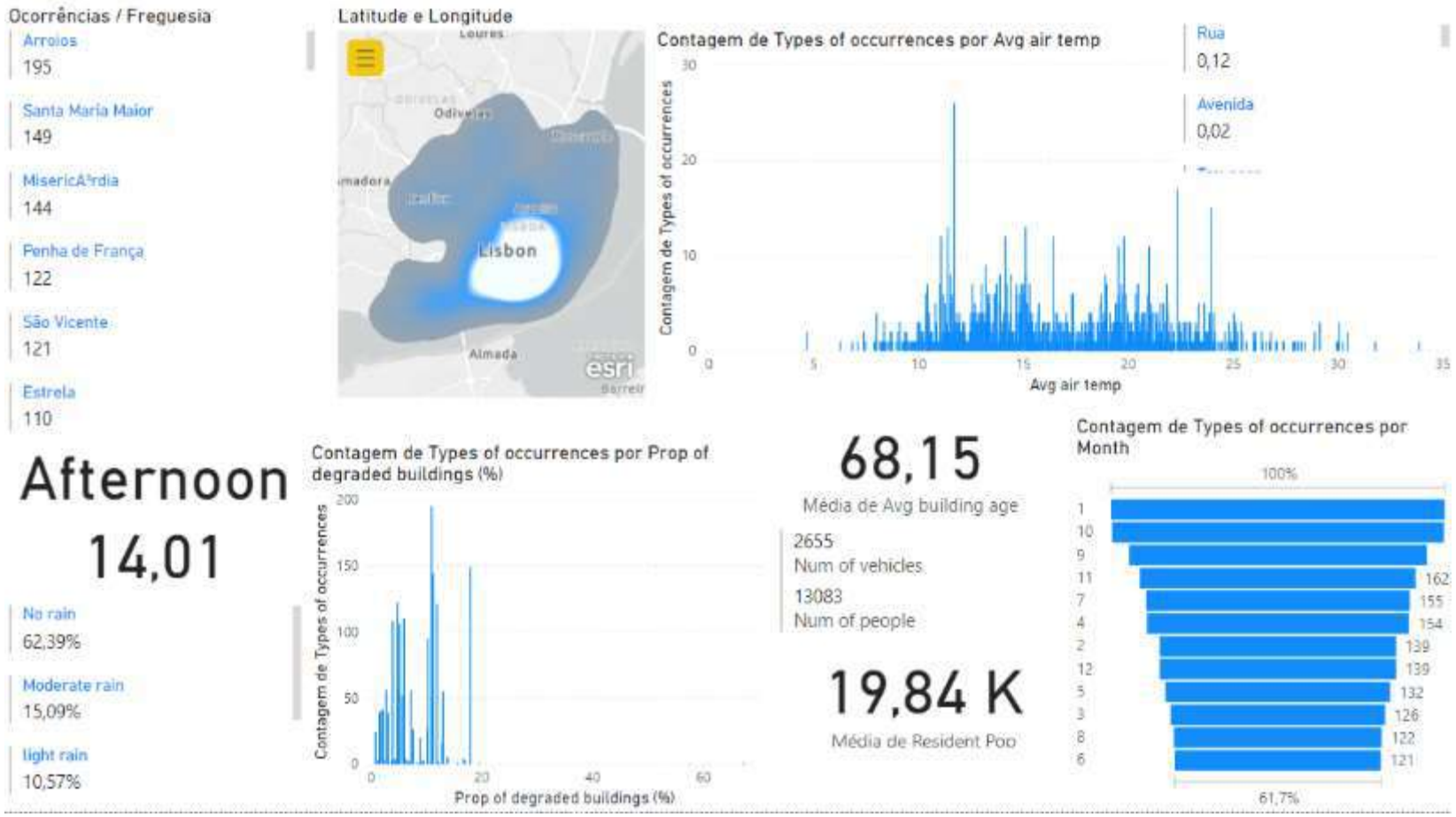
Dashboards - Equipment



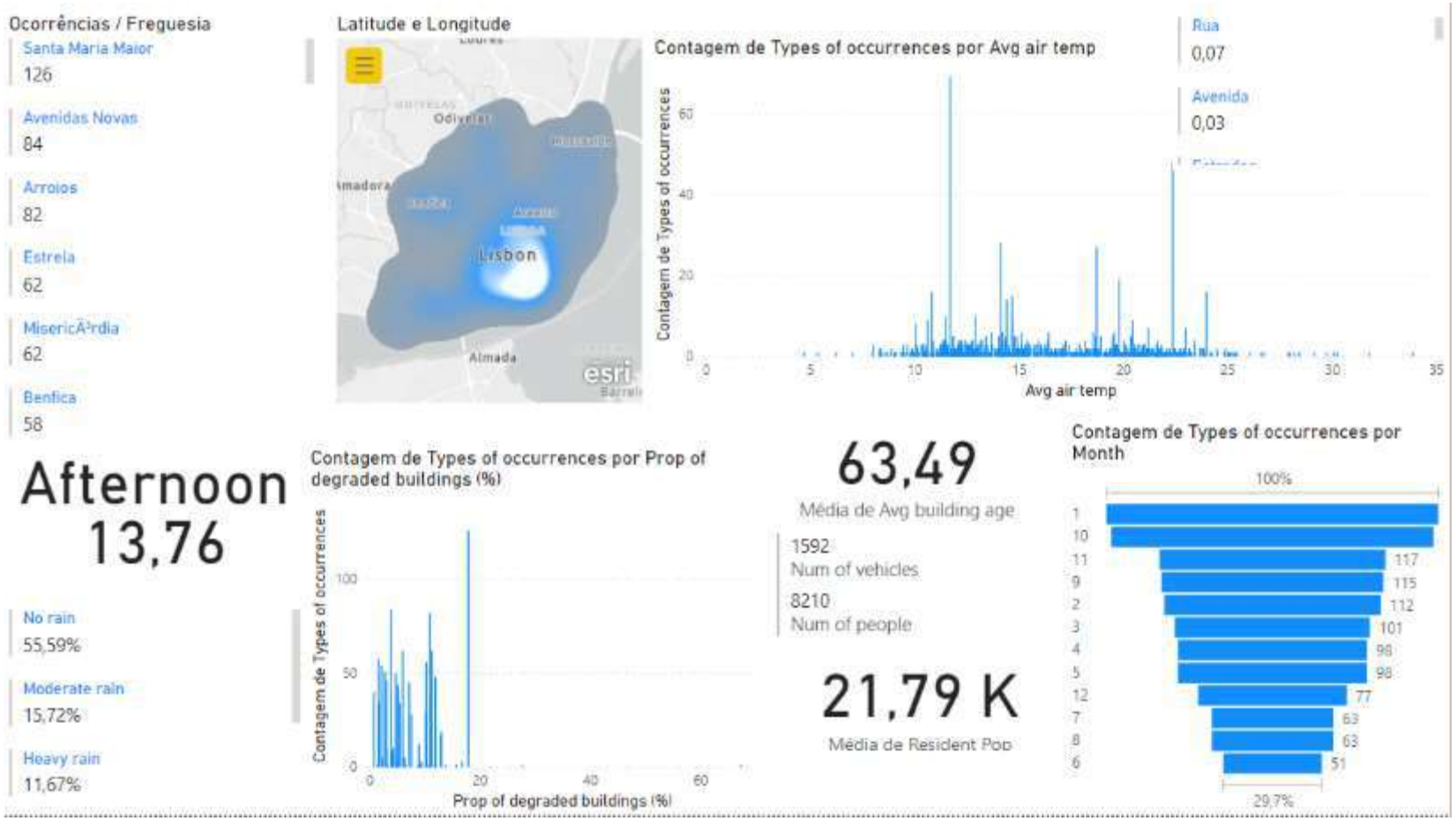
Dashboards - Fires



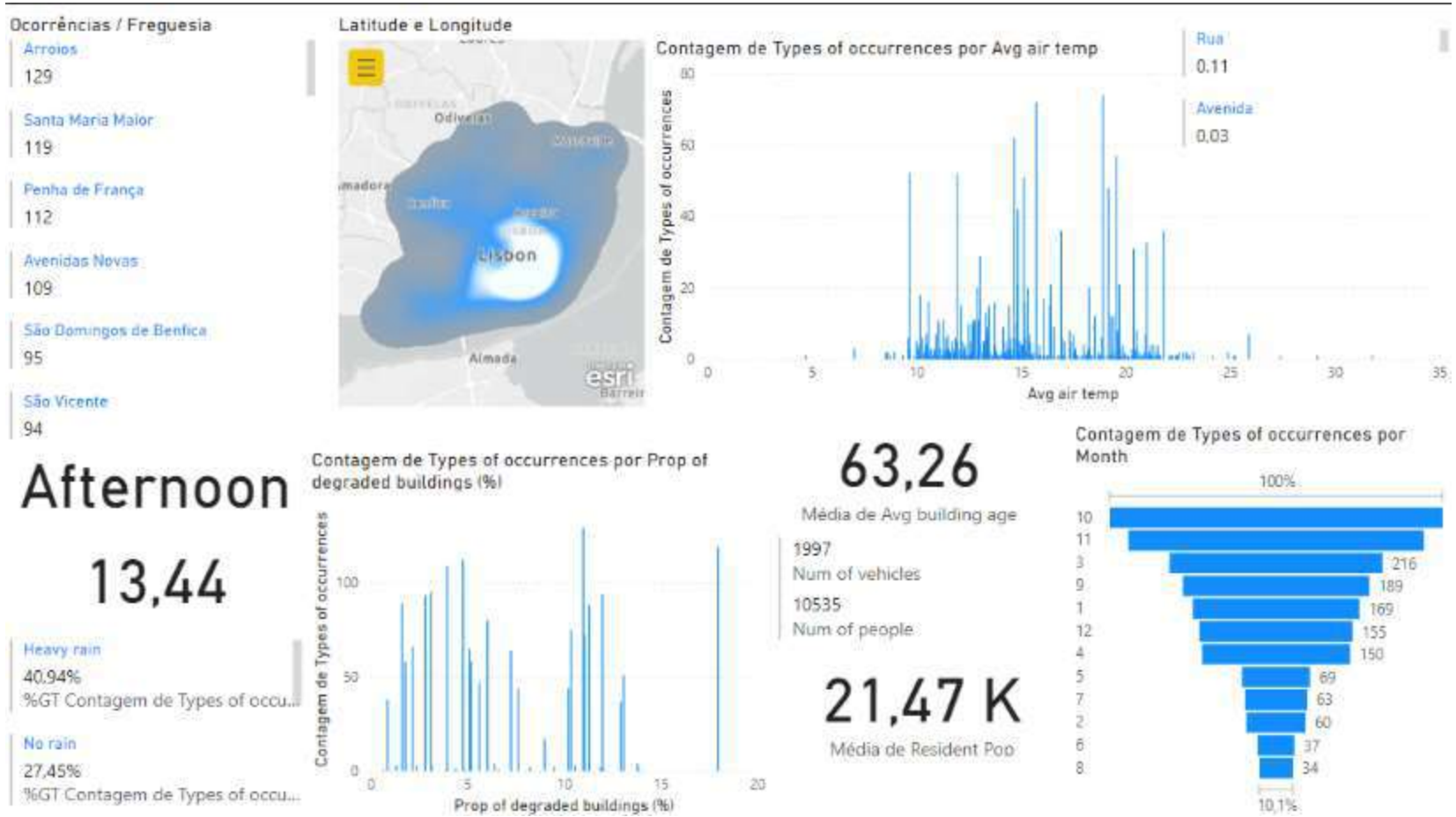
Dashboards - Collapses



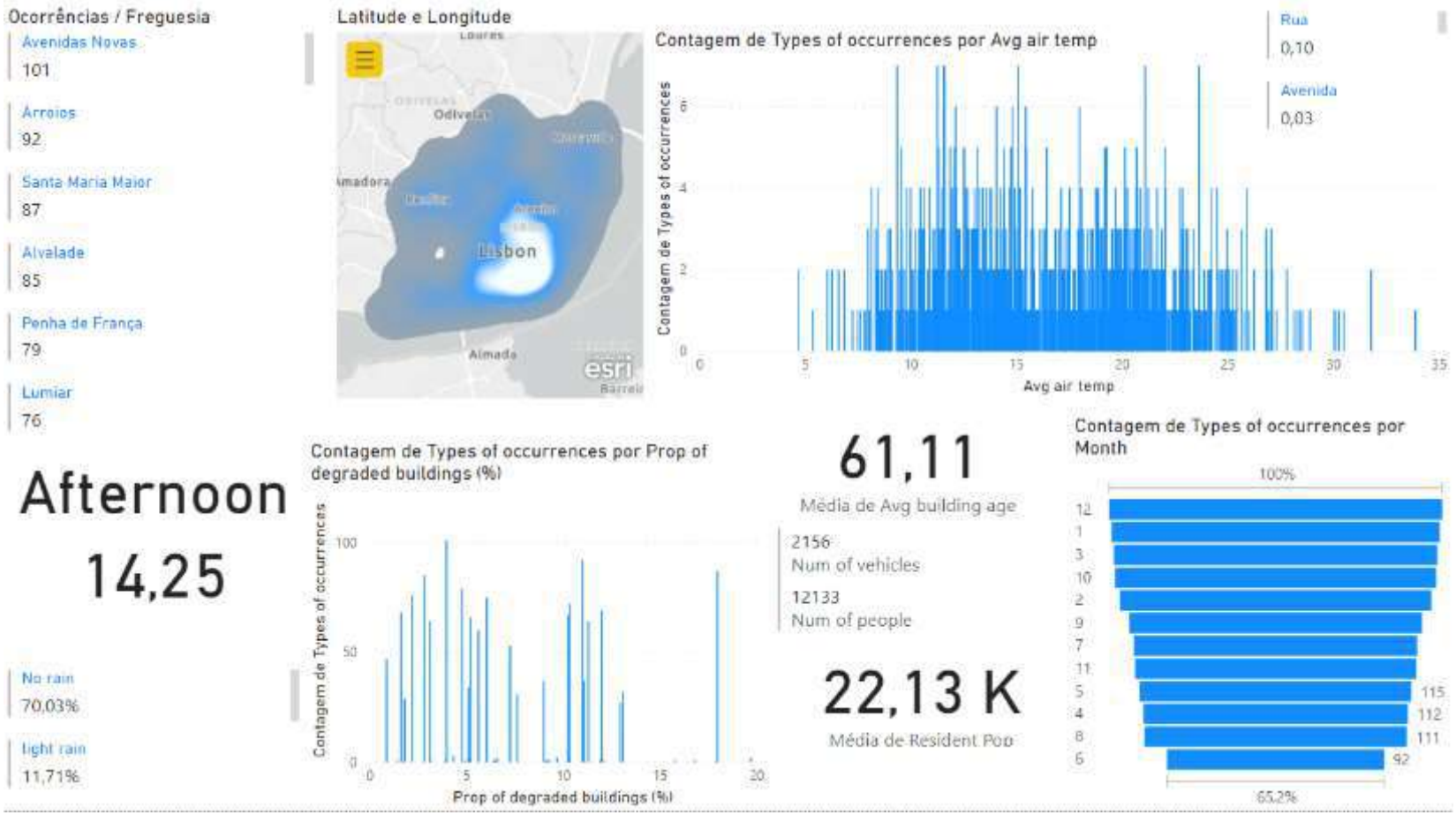
Dashboards – Falling Structures



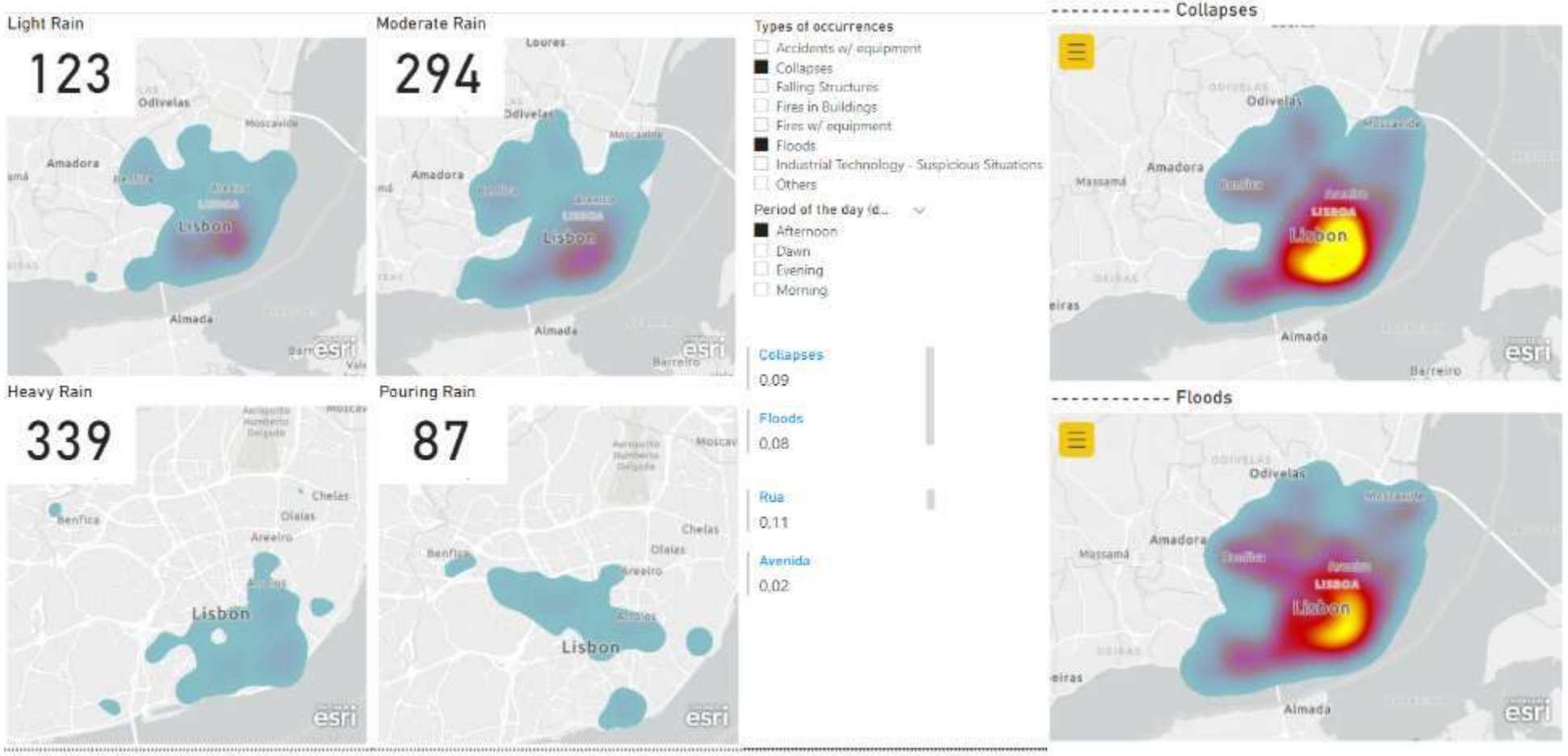
Dashboards – Floods



Dashboards – Technological (Suspicious Situations)



Dashboards – Filters



Thank you.