49th ASECAP DAYS

Decarbonizing Road Infrastructure : Challenges, Perspectives and Actions in Tough Economy

ASECAP DAYS
BRUSSELS 2022

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An innovative AI system to improve road safety on the motorway

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Autoroutes du Maroc

الطرق السيارة بالمغرب

Autoroutes du Maroc

Why use an AI system?

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- ADM has 1800 Km long highway network, the second largest highway network in Africa.
- ADM has implemented a global transformation strategy which include offering a safer road for its customers through an ambitious plan : Global action for road safety (2017-2026).
- Since COVID 19, ADM has accelerated the pace of digitization and modernization of its activities, particularly data collection and treatment.
- Using AI has proven its effective impact on organizations by freeing up resources for higher-level tasks.

Benefits

- Reinforcing the primary, secondary and tertiary safety
- Effective decision making

AI in road safety

An AI decision support solution, allowing to automate and optimize the definition of proactive action plans

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MOHAMMED VI POLYTECHNIC UNIVERSITY

MAScIR
Moroccan Foundation for Advanced Science, Innovation and Research

For a road section :

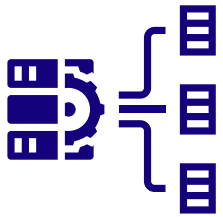
- Prediction of accident risk
- recommendation of adequate proactive actions

Method of AI

1

Data acquisition and storage

Collection of historical data



2

AI Core

- Preprocessing
- Traffic accident prediction models
- Road safety actions and recommendations

3

Validation and application

Road safety actors

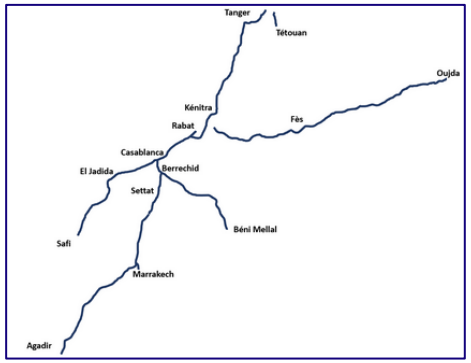
Input : Crash data

Moroccan Highway Network Accident History Database

33 475 lines and 44 variables (2015 - 2020)

- Analyzing the interdependencies between variables.
- Identifying non-significant variables.
- Treatment of missing values
- Feature engineering by creating more expressive variables

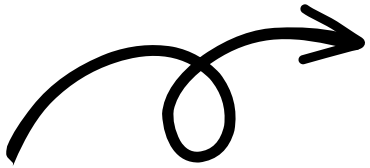
Input : segmentation and location

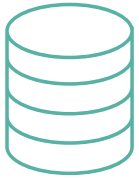


- Highway Network segmentation by interchange.
- GPS coordinates of kilometer posts.

- Identification of sections by axis and kilometer posts and adding them to the crash data
- Matching the GPS coordinates to kilometer posts in the crash data.
- Treatment of missing values

Input : Traffic data

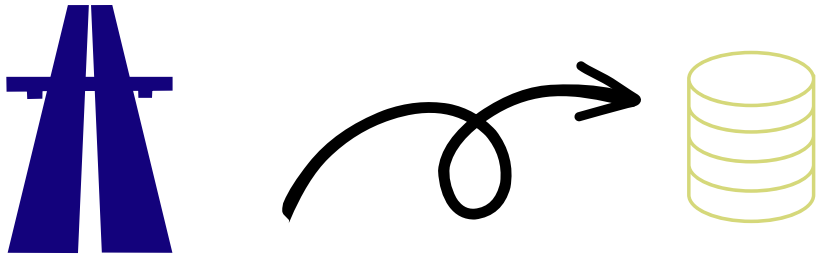




- Annual Average Daily Traffic per section
- Monthly Average Daily Traffic per section

- Matching sections and year in crash data with AADT
- Matching MADT in crash data with vehicle category
- Treatment of missing values

Input : Infrastructure data



- Location and type of bridges
- Safety barrier and traffic signs data
- Geometry data (Crossfall, curves, and sections with steep slopes)

- Matching bridges data with GPS coordinates
- Adding a binary variable matching bridges to kilometer posts (for a distance of 250 m) particularly for footbridges
- Adding a binary variable matching traffic signs and safety barriers in increments of 1 kilometer
- Adding data related to geometry in increment of 1 kilometer

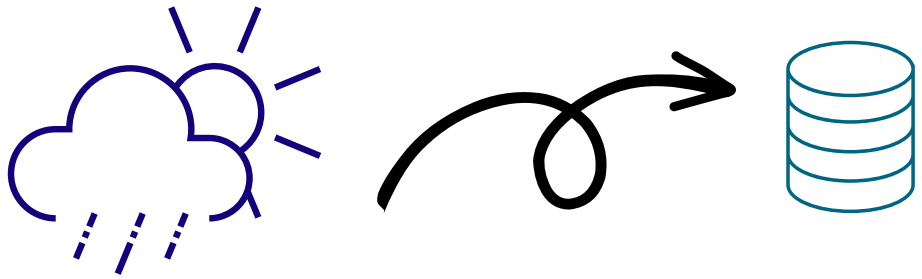
Input : Population data

Urban and rural populations from 2015 to 2021*

- Matching between prefecture, region, and highway network
- Adding new variables related to micro-urban and rural & macro-urban and rural areas

* HCP: High Commission for the Planning of Morocco

Input : weather data



Weather data*

- Collection of hourly and daily weather data by GPS coordinates of the kilometer posts for all the crash data

* Weather API

AI modeling

Building robust and reliable models to predict risk scenarios

- **M1** Crash occurrence
- **M2** Categories of vehicles involved
- **M3** The age group of the driver
- **M4** Causation factors
- **M5** Crash severity
- **M6** Pedestrian crashes
- **M7** Crash's location
- **M8** Daily crashes frequency

AI modeling

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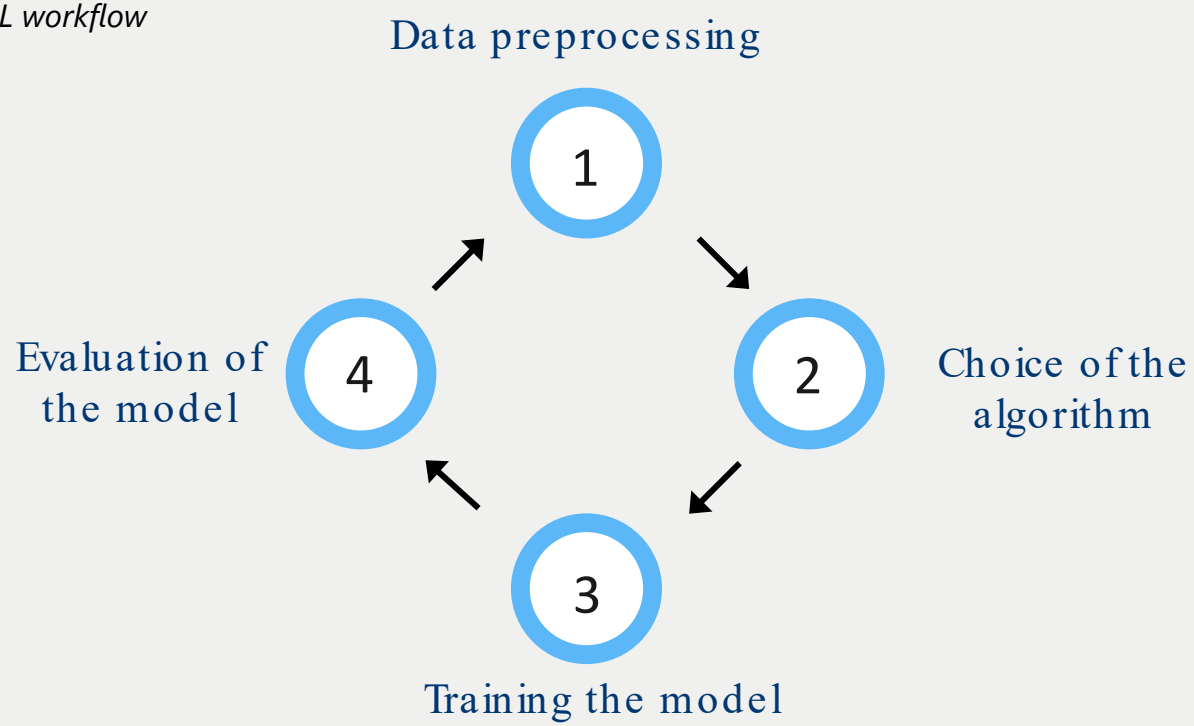
AI modeling

A model is built through a Machine Learning workflow

ML workflow

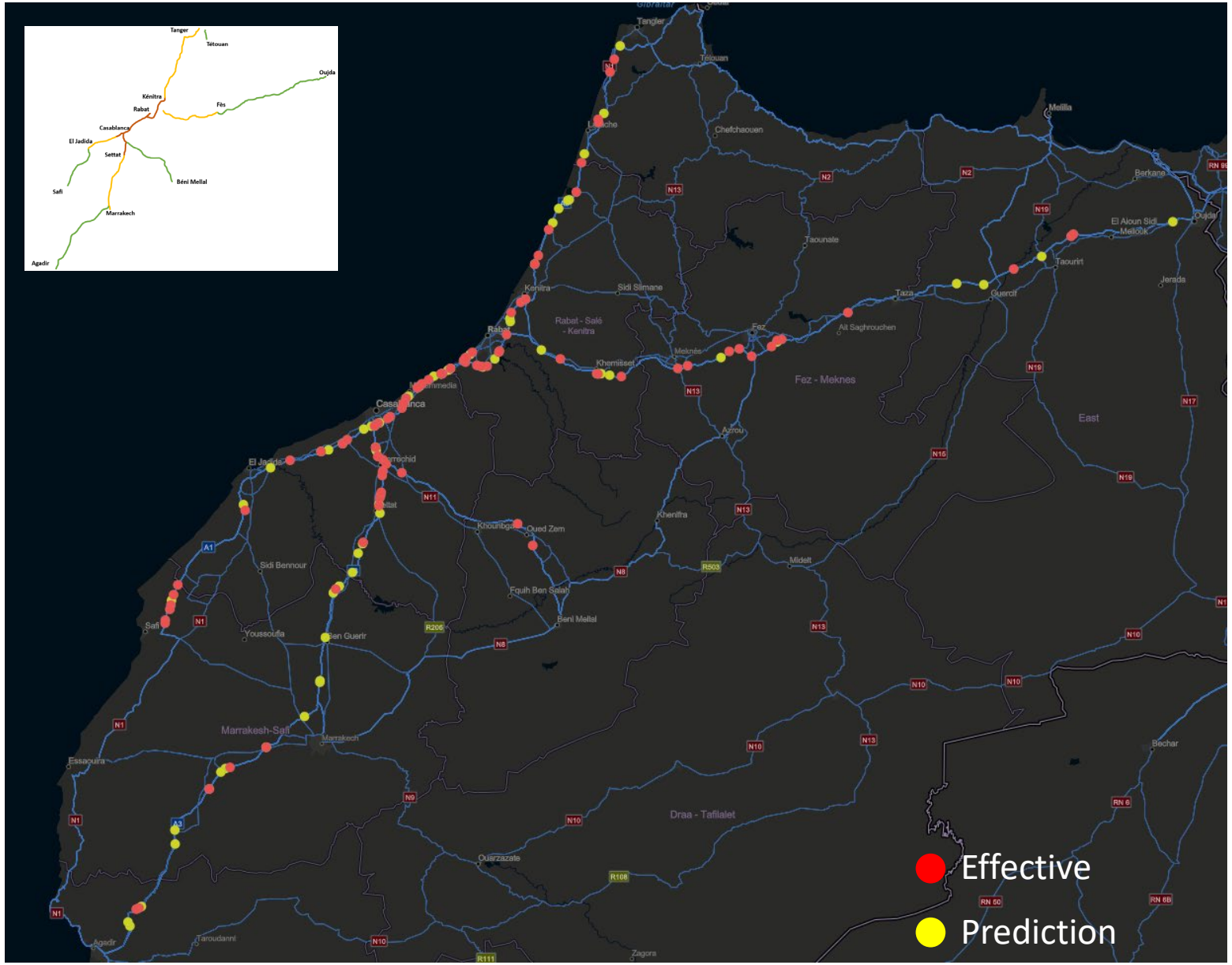


M1 Crash occurrence (binary result)

Algorithm:

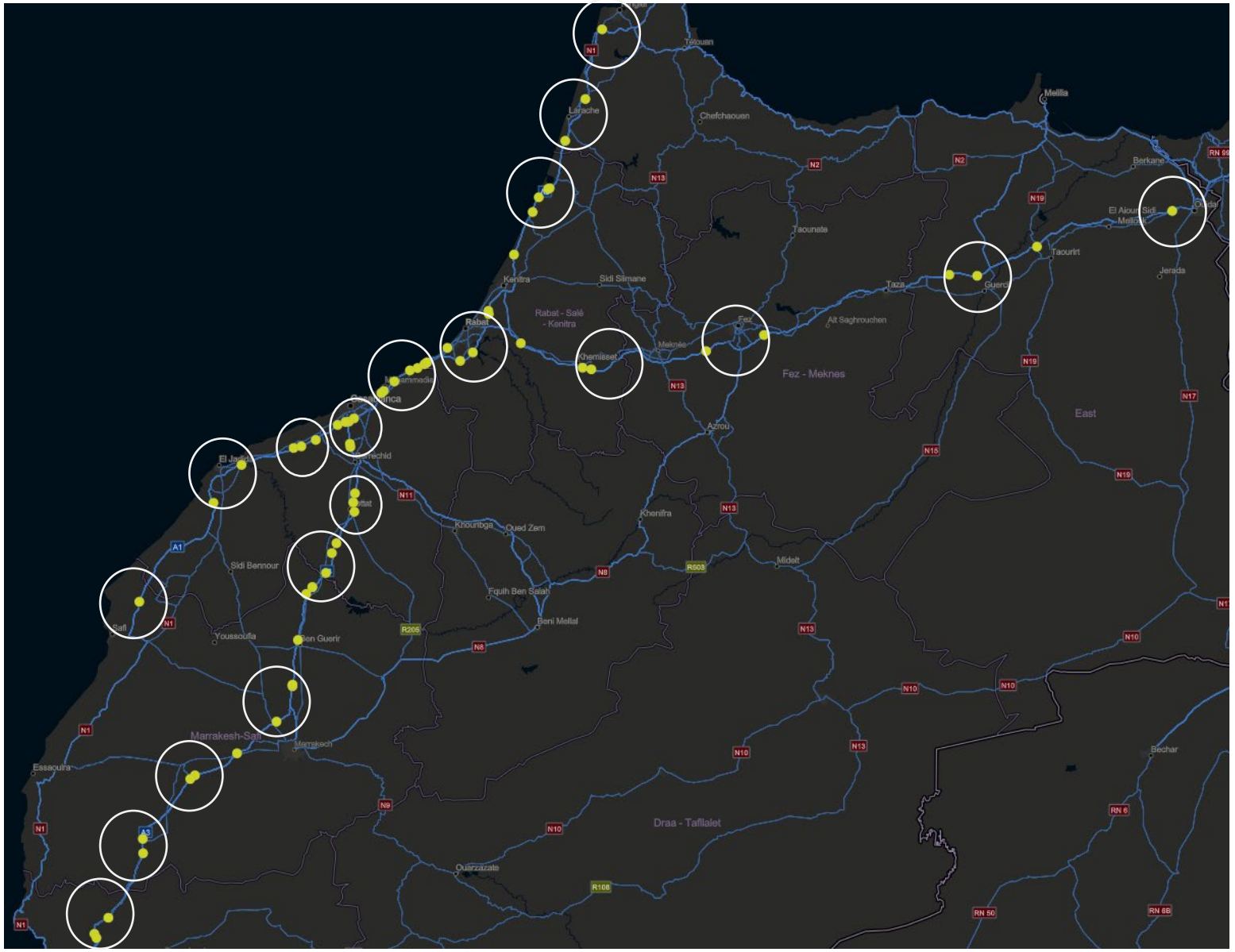
- two-dimensional convolutional neural networks (2DCNN) [Precision : **0,85**]
- DecisionTree Classifier [Precision: **0,88**]

Application : M1 Crash occurrence



Example of a Week prediction vs effective crashes

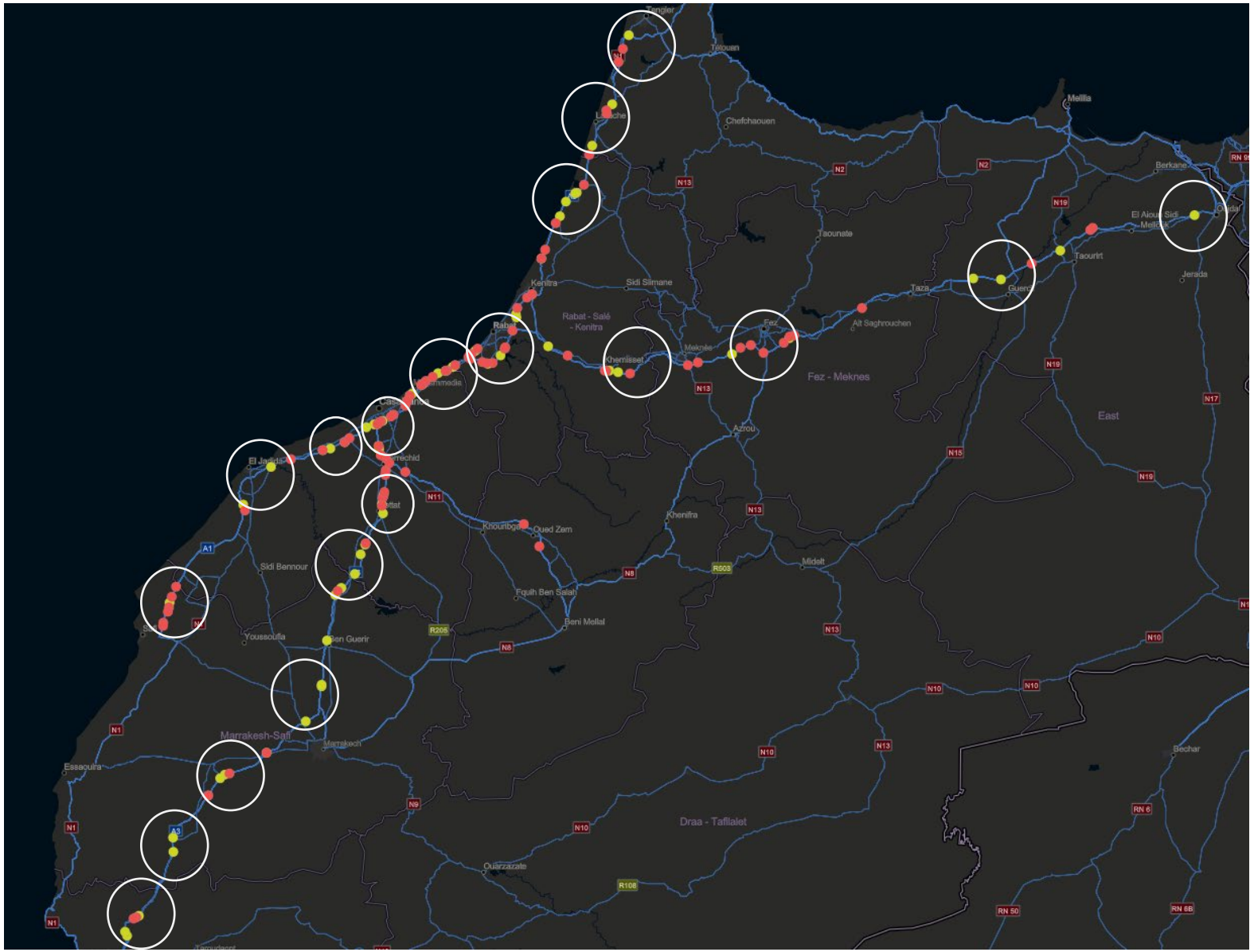
Application : M1 Crash occurrence



Preventive actions :

- The Management of the operating mode of patrols (Repositioning of the hold points)
- Dissemination of road safety awareness messages by the call center, ADM Traffic App, and also through VMS near sections with predicted crashes
- Monitoring risk sections through cameras at the control tower

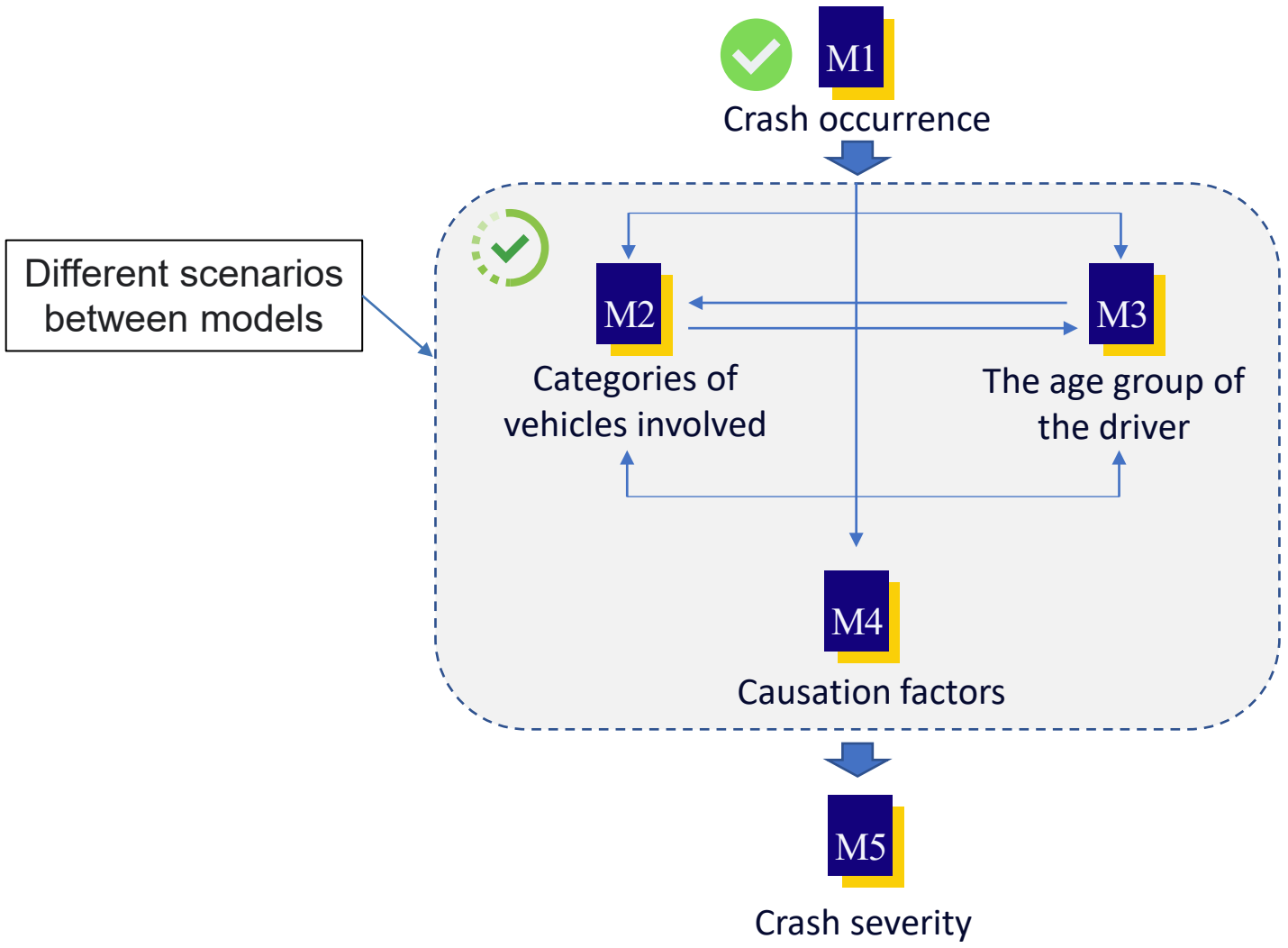
Application : M1 Crash occurrence



The prediction model will allow us a maximum coverage of effective crashes

- Road users with awareness-rise (avoiding crashes)
- Reducing warning and intervention time (Targeted management at the operational level)

What's next?



M6 Pedestrian crashes

M7 Crash's location

M8 Daily crashes frequency

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THANK YOU FOR YOUR ATTENTION

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