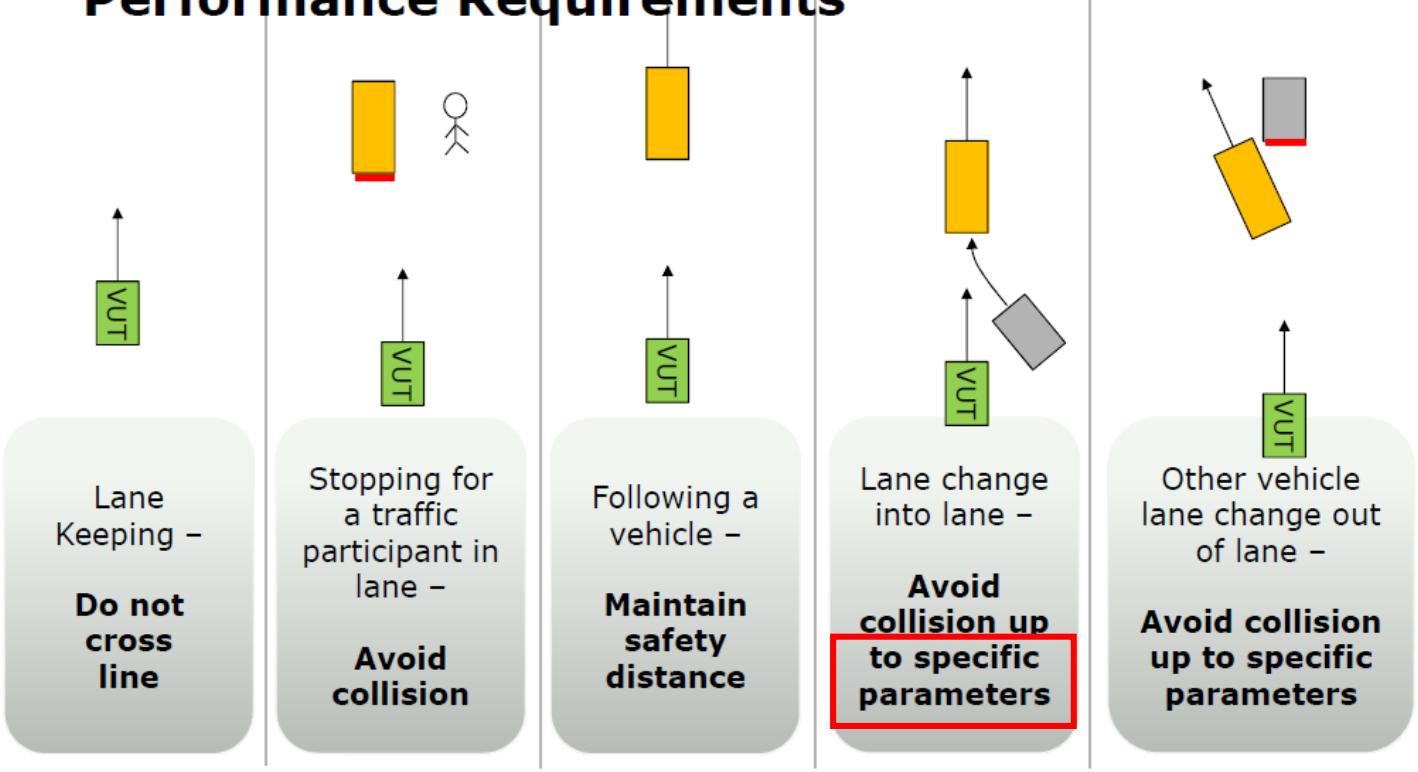
Submitted by Japan

Informal Document – ACSF-25-18

Proposal from Japan with regard to the proposal of the test threshold for cutting in from Germany/France

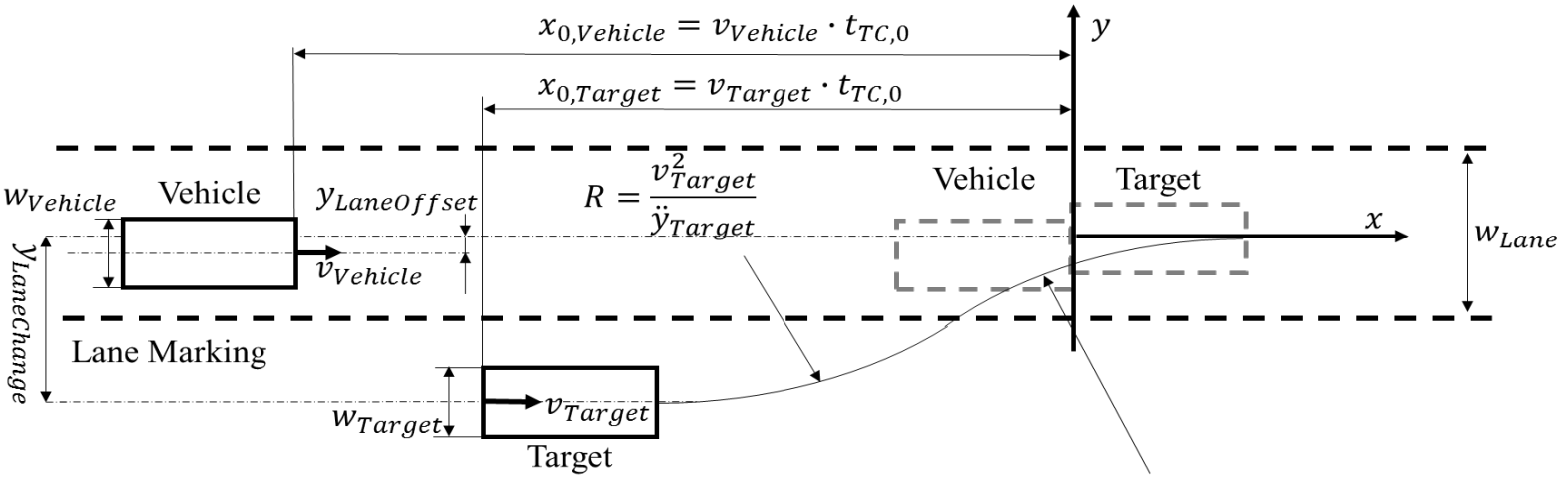
Global approach

Performance Requirements



Introduction | Methodology | Test Scenarios

Proposal from Germany/France with regard to the proposal of the test threshfold for cutting in



Properties of Vehicle:
Lane Offset $y_{\text{LaneOffset}}$
Width of Target w_{Target}
Width of Vehicle w_{Vehicle}

Parameters of Test:
Lateral acceleration of Target
Lane change lateral distance $y_{\text{LaneChange}}$
Beginning of Lane Change $t_{\text{tC,0}}$
Speed of Target v_{Target}
Speed of Vehicle v_{Vehicle}
Lane Width w_{Lane}

Assumptions:
Target x-Component independent of lateral movement

$TTC_{LaneIntrusion} > v_{rel}/(2 \cdot 6\text{m/s}^2) + [0.35s]$

Where:

v_{rel} = relative velocity between both vehicles, positive for vehicle being faster than the cutting in vehicle

$TTC_{\text{LaneIntrusion}}$ = The time-to-collision value when foremost point of the intruding vehicle has fully crossed the lane marking.

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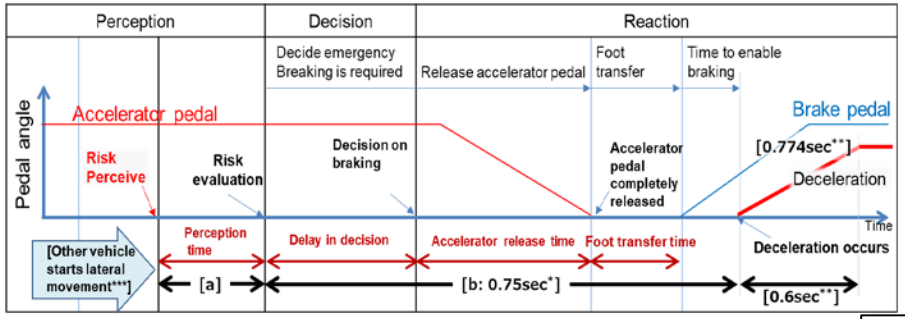
Driver model

In low-speed ALKS scenario, the avoidance capability required for the driver model is braking control only. This driver model is separated into the following three segments: “Risk perceive situation”, “Delay in time”, and “Deceleration degree and Max. G-force

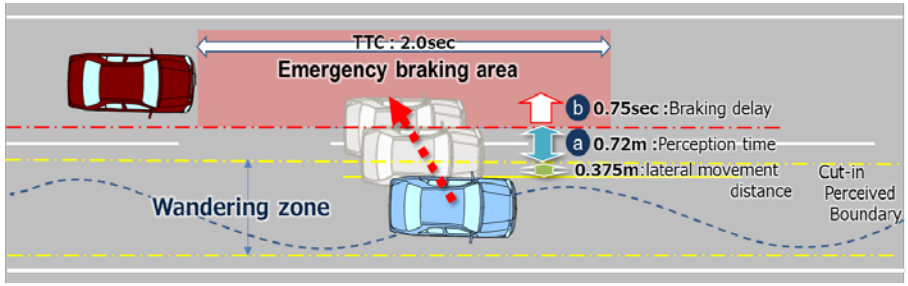
Driver basic model for Cut in / Cut out / Deceleration



Note: [a] depend on each scenario

[*/ = 0.75sec is a common data in Japan.
**/ = 0.6sec and 0.774G are a data from experiments of NHTSA and Japan.（Coefficient of road friction is 0.6.)
***/= Timing of other vehicles start moving from lane keep to cut-in (or cut-out). It is indicated by lateral movement distance.]

Cut in



[0.375m] is lateral movement distance of side vehicle when it starts lateral movement.
The Cut-in perceived boundary is defined by the distribution of lateral movement distance of side vehicles (without lane change).
[a] is perception time. Risk perceived position of side vehicle is determined by lateral movement speed of it. [a] from the following formula;
[a:0.72m] = (Max lateral movement speed: 1.8m/s) x (Risk evaluation delay time: 0.4sec)
Max lateral movement speed is real world data in Japan.
Risk evaluation delay time is driving simulator data in Japan.
It specified [2sec*] as the maximum Time To Collision (TTC) to define the danger perception area in longitudinal direction.
[*/=TTC 2.0sec is based on the UNR guidelines on warning signals.]

Proposal from Japan with regard to the proposal of the test threshfold for cutting in

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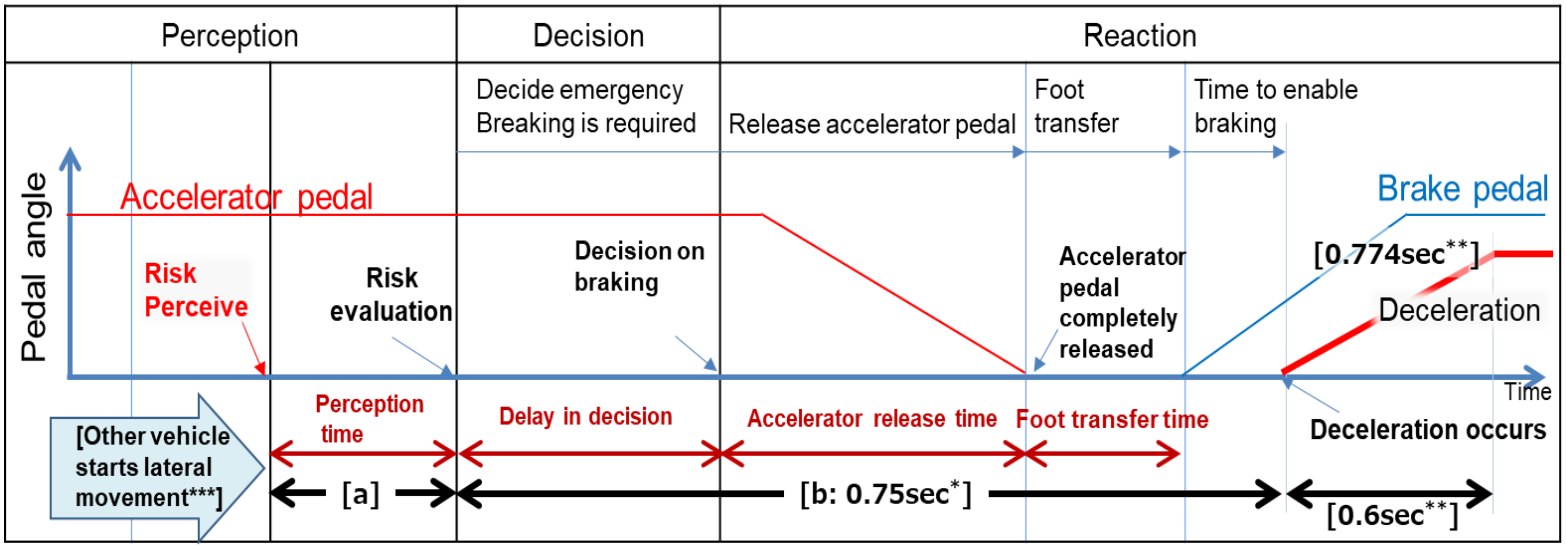

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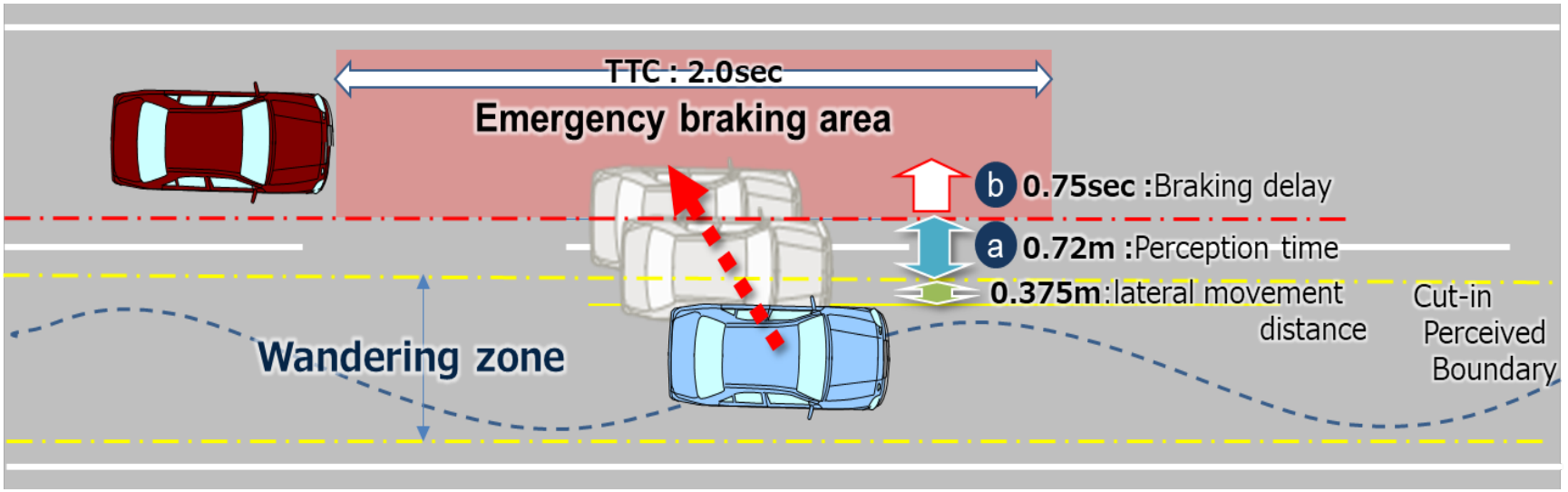
Proposal from Japan with regard to the proposal of the test threshfold for cutting in

Cut in



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Driver Model Structure

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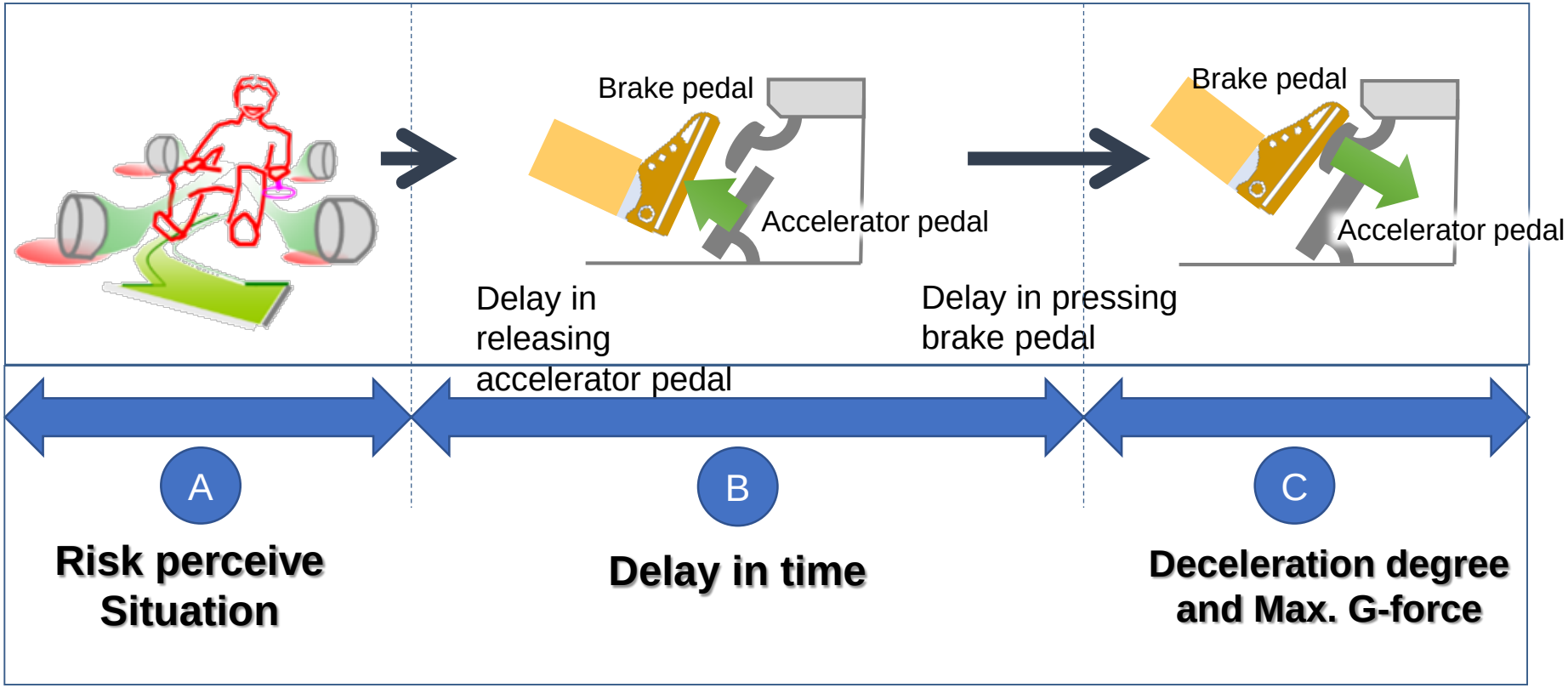
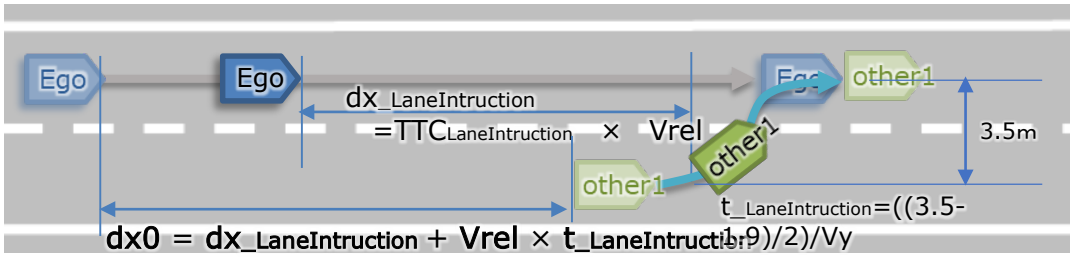


Test Requirement Comparison between GE/FR and JAPAN

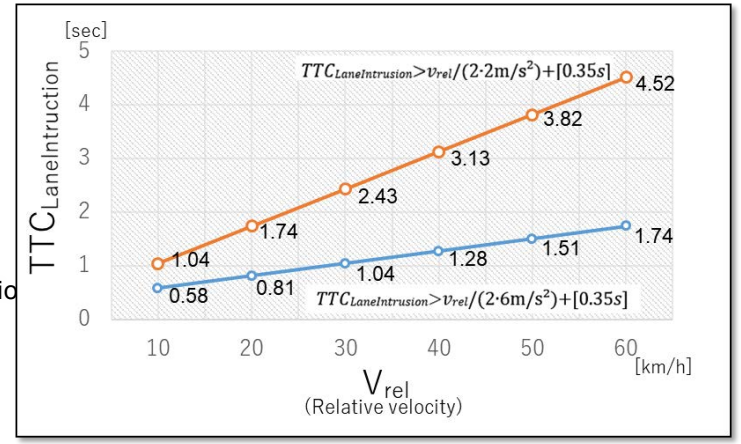
$$TTC_{LaneIntrusion} > v_{rel}/(2*6m/s^2)+[0.35s]$$



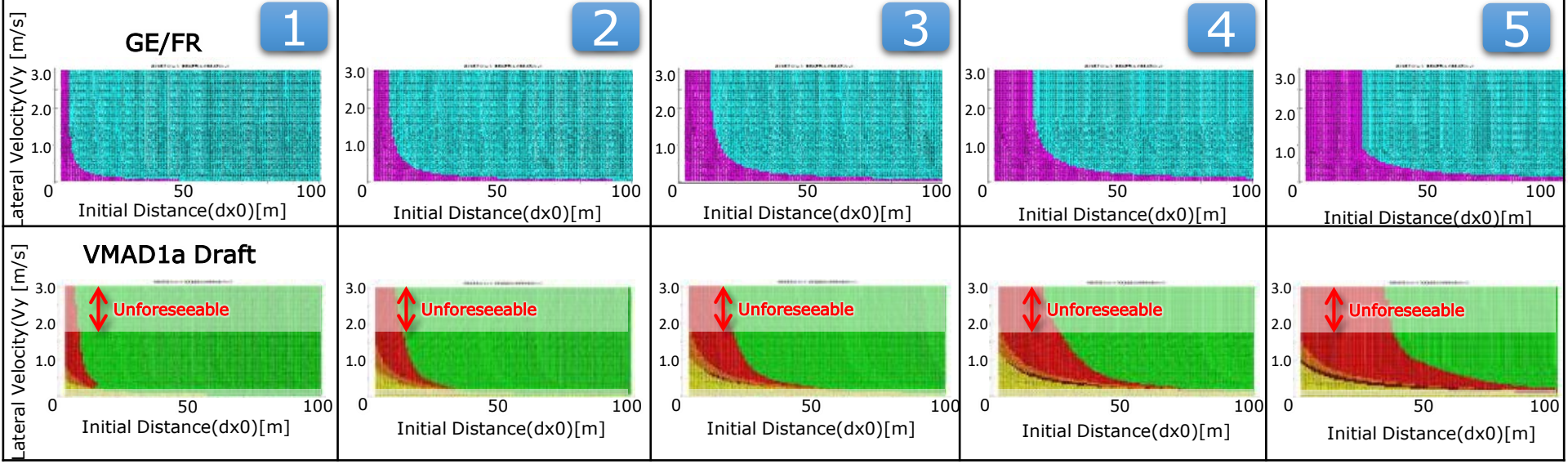
t_LaneIntruction : time duration between the beginning of the lateral movement and lane intrusio

dx0 : Distance at the beginning of the lateral movement and lateral velocity

In order to compare the GE/FR and JAPAN threshhold, both are described on the same axis X:dx0, Y:Vy

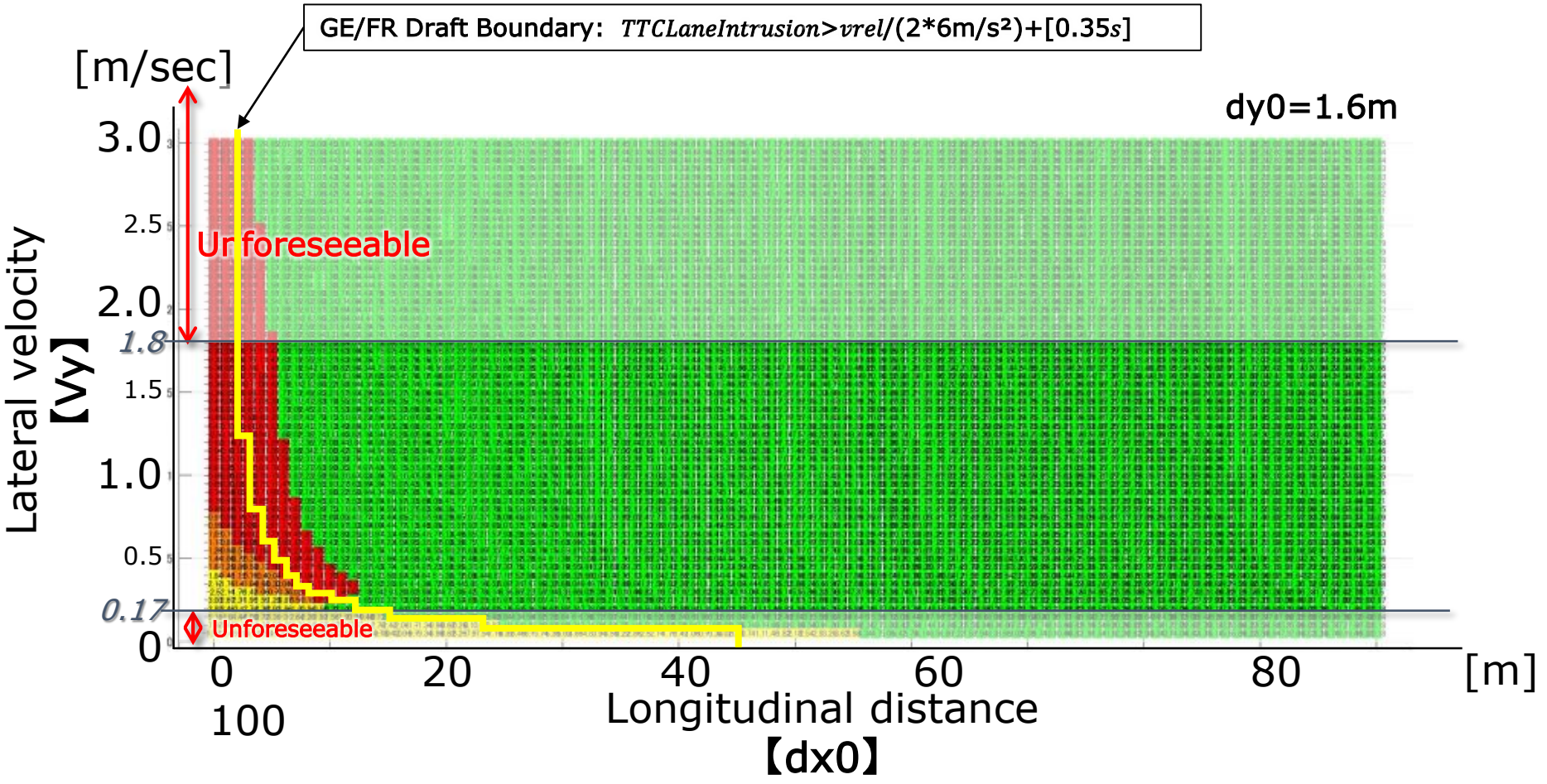


Relative Velocity(V_{ref}):10km/h	20km/h	30km/h	40km/h	50km/h
GE/FR 1	2	3	4	5
VMAD1a Draft				



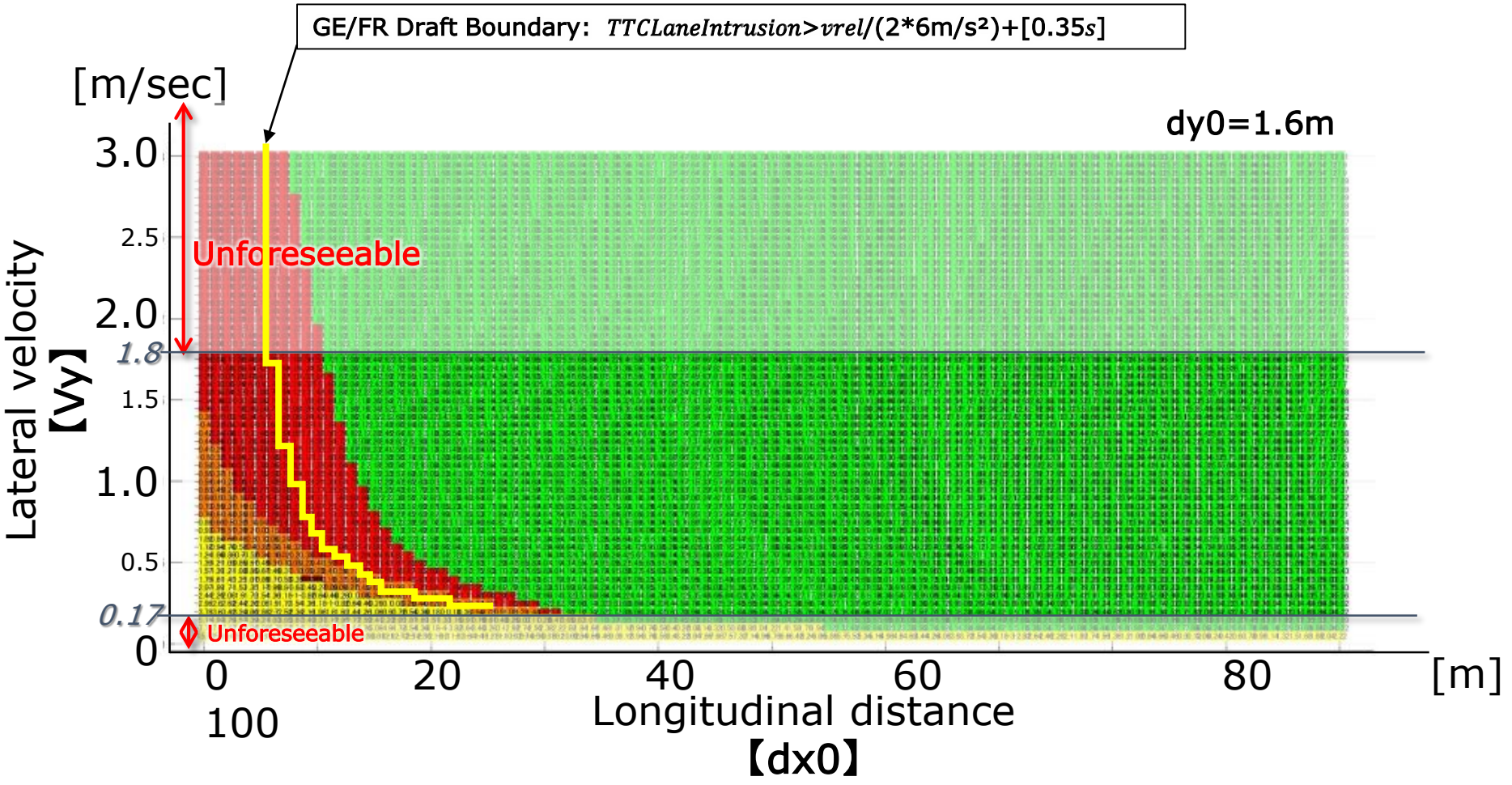
a

Ego vehicle velocity【Ve0】 : 60[kph]
Relative velocity【Ve0-Vo0】: 10[kph]



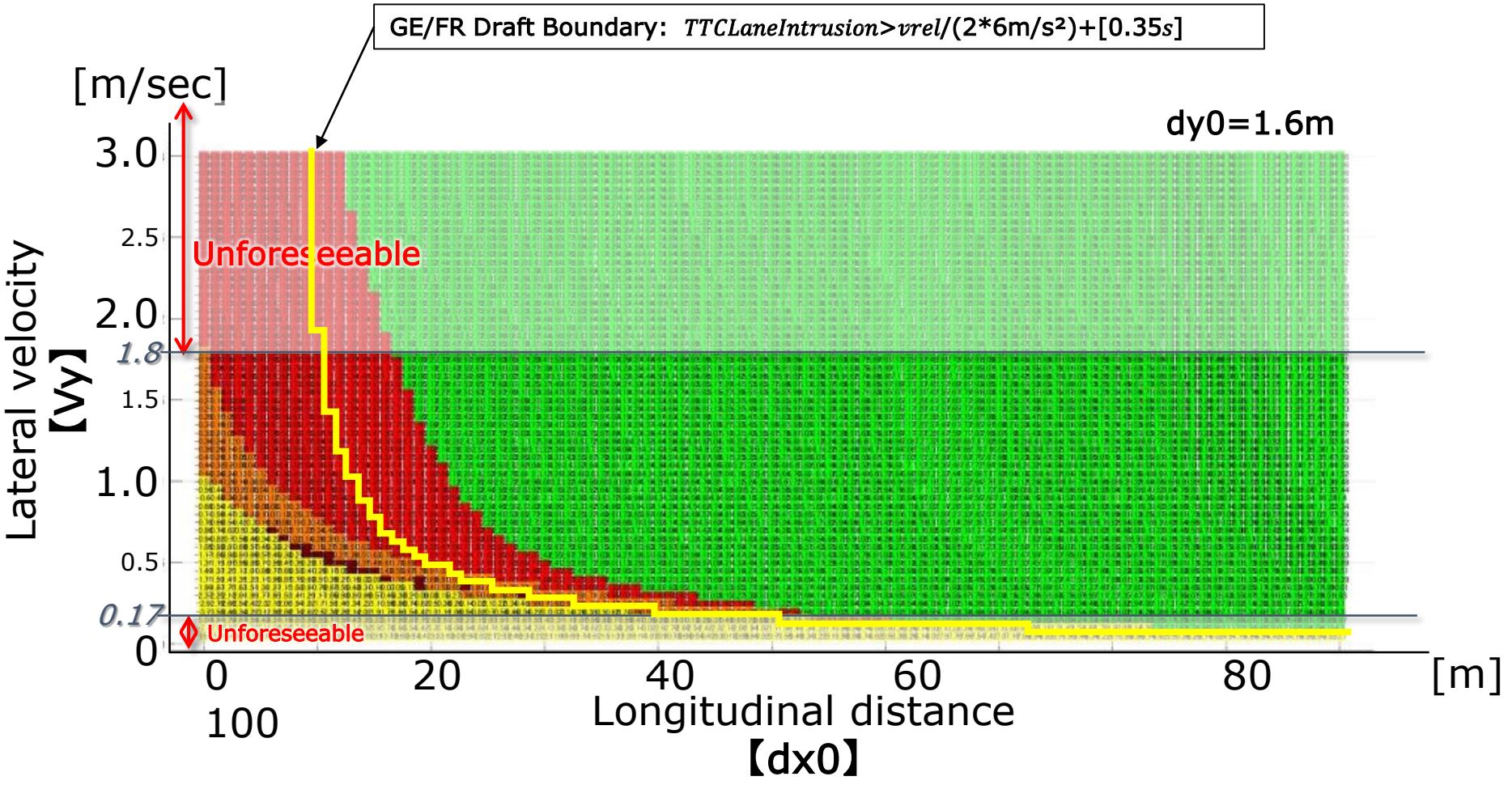
b

Ego vehicle velocity【Ve0】：60[kph]
Relative velocity【Ve0-Vo0】：20[kph]



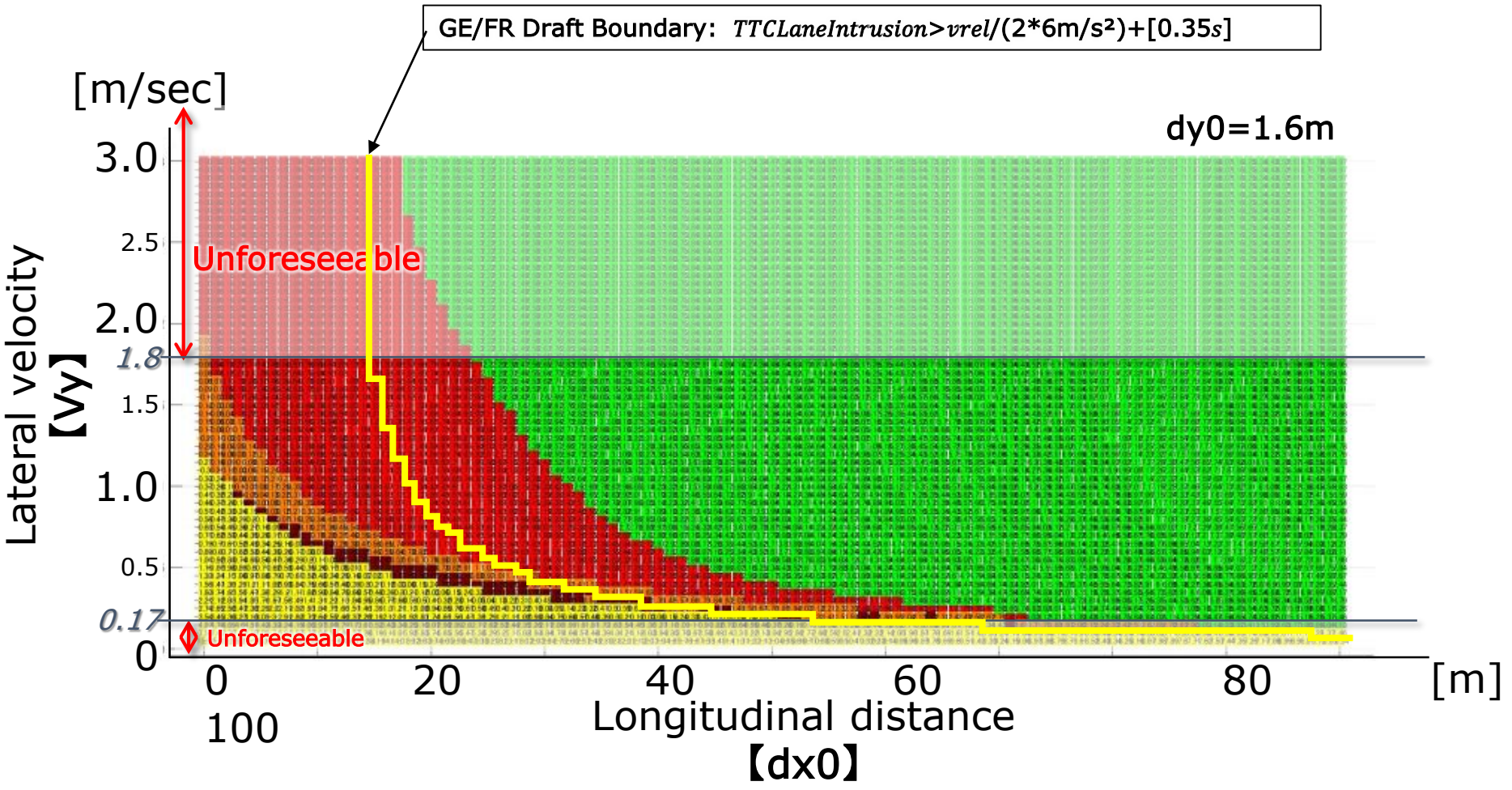
C

Ego vehicle velocity【Ve0】 : 60[kph]
Relative velocity【Ve0-Vo0】: 30[kph]



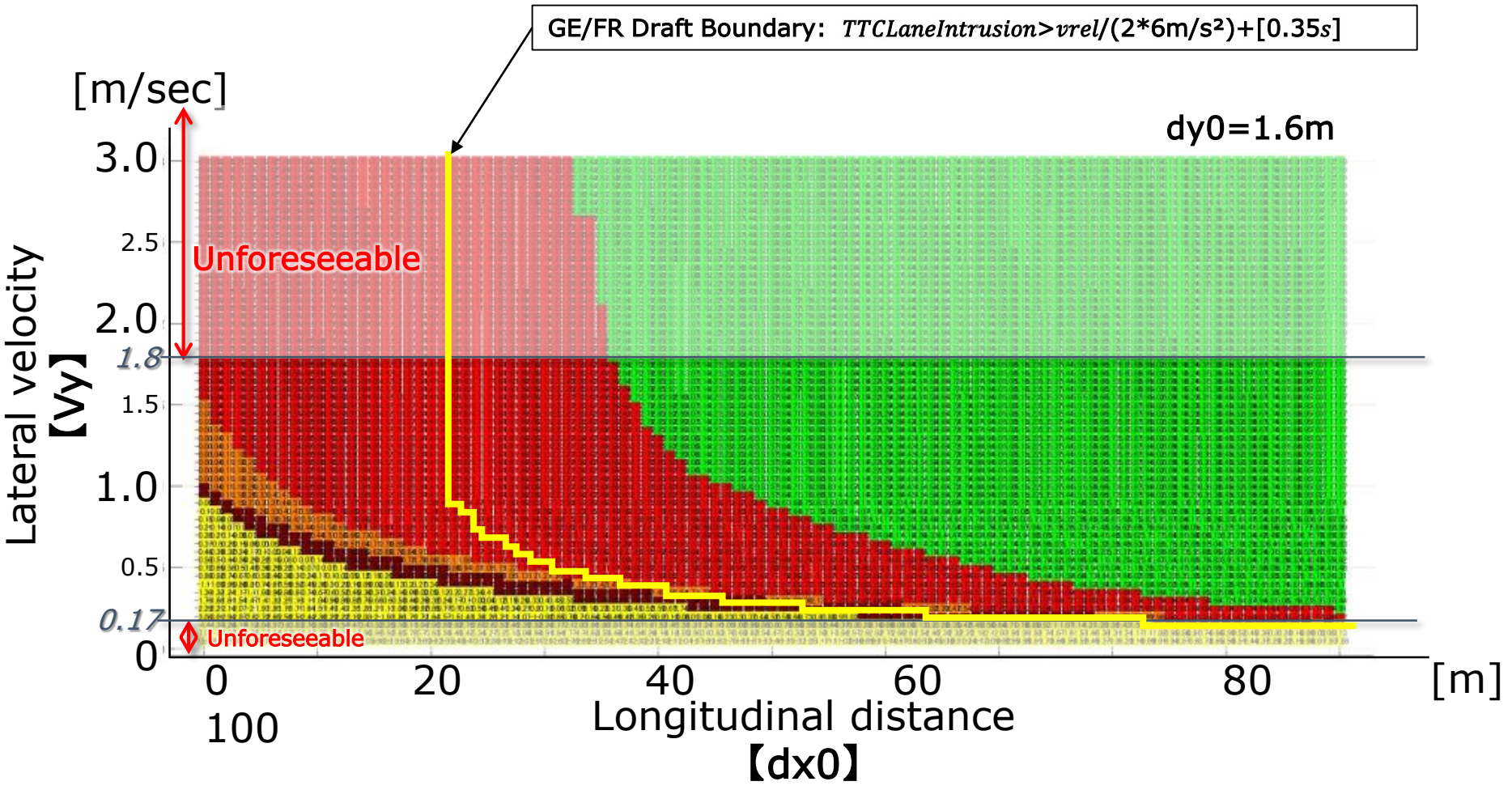
d

Ego vehicle velocity【Ve0】：60[kph]
Relative velocity【Ve0-Vo0】：40[kph]



e

Ego vehicle velocity【Ve0】 : 60[kph]
Relative velocity【Ve0-Vo0】: 50[kph]



Accident Rate Caused by Human Factors of Driver (Highway)

- 97% of the accidents were related to the human factors of driver. **(of which 60% was due to delay in perception)**
- Most of the accidents can be prevented **if the driver's level of attentiveness is high.**

■Data collection criteria:
Accidents occurred on highways in Japan in which the primary responsible party was
a vehicle (automobile/motorcycle) (2017)