

# Baseline S-RAD global model



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Uber

# Global S-RAD

- Aims
  - To establish a single S-RAD model capable of evaluating risks globally with at least comparable offline performance to current regional production models
  - To achieve performance using a subset of features likely to be approved for use by Regional Ops and PLC partners
  - To see evidence of sustained offline performance through time
    - *Still an open question*
  - To migrate model training pipelines to new Michelangelo platforms

# Features - What is in and what is out

- Trip context features
  - Time of day
  - Day of week
  - City specific incident rates
- Rider features
  - Historic trip characteristics (cancel rate, weekend rate, etc.)
  - Star rating feedback
  - Incident rates
- Driver features
  - Historic trip characteristics (Trip count, weekend rate, etc.)
  - Incident rates

## Included Features

- Driver/Rider gender
- Driver features
  - Cancellation history
    - Cancelled on rate
    - Cancellation rate
  - Star rating feedback
    - 1/2 star ratings given
    - 1/2 star ratings received

## Excluded Features

# Modeling challenges

- Creating/verifying globally robust modeling features
- Global differences in incident data quality and reporting behaviors
- Global data volume
  - Training data volume increased from ~60M to ~136M observations
- Managing regional performance tradeoffs
- Maintaining offline performance with a reduced feature set

# Regional performance comparison - Overall

Region	Trigger rate	Prod. recall †	Global cand. recall	% difference
United States*	1.25%	18.3%	19.2%	5.1%
Brazil**	1.10%	15.6%	17.3%	11.0%
LatAm - Mexico**	1.10%	12.8%	16.6%	29.0%
LatAm - ACAC**	1.10%	11.5%	15.0%	30.2%
LatAm - South Cone**	1.10%	10.8%	14.6%	34.8%

\*US production model used for comparison

\*\*LatAm production model used for comparison

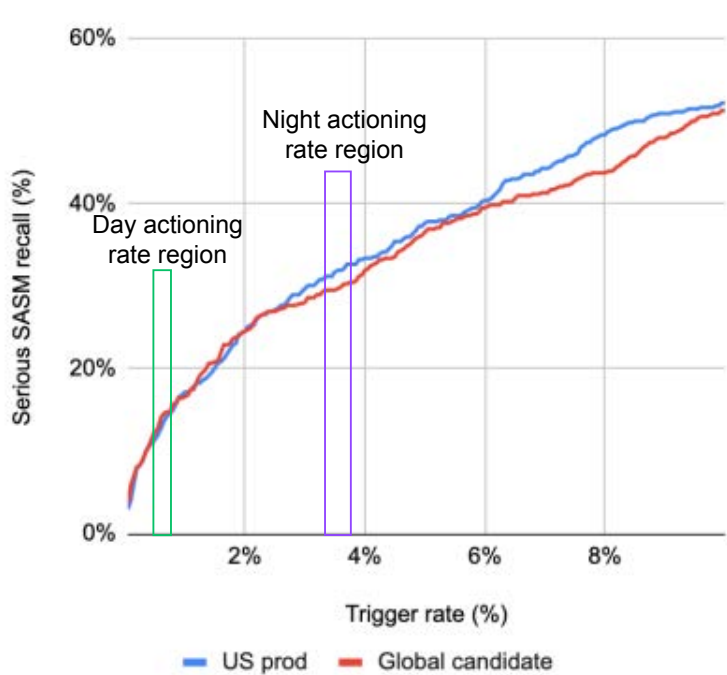
† Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uuid from 2022-11-01 to 2023-01-31

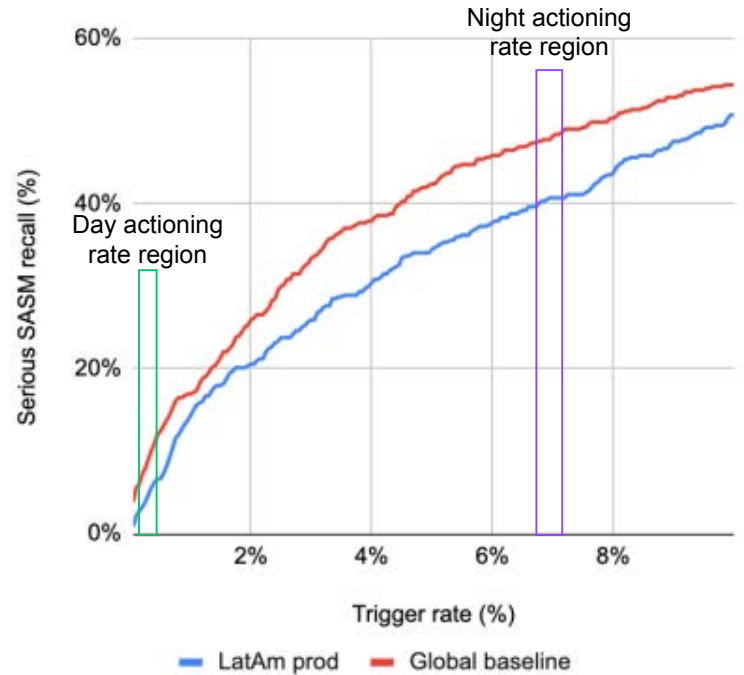
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# Time of day actioning also impacts expected performance



**United States**



**Brazil**

# Regional performance comparison - Overall

Region	Trigger rate	Prod. recall †	Global cand. recall	% difference
ANZ*	1.25%	10.8%	15.1%	40.1%
United Kingdom*	1.25%	16.5%	14.7%	-10.6%
EMEA - NEE*,**	1.25%	14.1%	22.1%	57.1%
EMEA - MEA*	1.25%	11.7%	17.0%	45.5%
EMEA - WSE*	1.25%	8.2%	11.8%	42.9%
India SA* <sup>x</sup>	1.25%	10.1%	13.8%	35.7%

\*US production model used for comparison

\*\*Excludes United Kingdom

<sup>x</sup>Includes India, Bangladesh, and Sri Lanka

† Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uuid from 2022-11-01 to 2023-01-31

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# Regional performance comparison - TOD

Region	Time of day	Trigger rate	Prod. recall †	Global recall	% difference
United States*	Day	0.8%	14.8%	13.3%	-10.2%
	Night	3.5%	23.1%	23.6%	2.0%
Brazil**	Day	0.5%	8.0%	11.7%	46.2%
	Night	7.0%	21.7%	31.5%	45.2%
LatAm - Mexico**	Day	0.5%	3.4%	10.6%	208%
	Night	7.0%	29.8%	28.6%	-4.1%
LatAm - ACAC**	Day	0.5%	4.8%	8.3%	75%
	Night	7.0%	25.4%	32.0%	25.8%
LatAm - South Cone**	Day	0.5%	7.0%	8.7%	25.0%
	Night	7.0%	23.5%	29.6%	26.1%

\*US production model used for comparison

\*\*LatAm production model used for comparison

† Recall = # serious SASM incidents / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# Regional performance comparison - TOD

Region	Time of day	Trigger rate	Prod. recall <sup>†</sup>	Global recall	% difference
ANZ*	Day	0.8%	12.7%	13.2%	3.8%
	Night	3.5%	13.4%	18.2%	35.5%
United Kingdom*	Day	0.8%	18.3%	18.2%	-0.8%
	Night	3.5%	15.8%	14.5%	-7.7%
EMEA - NEE**,**	Day	0.8%	14.3%	23.2%	62.5%
	Night	3.5%	15.1%	24.7%	64.3%
EMEA - MEA*	Day	0.8%	6.7%	12.3%	83.3%
	Night	3.5%	19.4%	25.0%	28.6%
EMEA - WSE*	Day	0.8%	12.9%	14.3%	11.1%
	Night	3.5%	13.0%	12.0%	-7.7%
India SA**×	Day	0.8%	5.0%	6.9%	40.0%
	Night	3.5%	13.5%	27.0%	100%

\*US production model used for comparison

\*\*Excludes United Kingdom

×Includes India, Bangladesh, and Sri Lanka

<sup>†</sup>Recall = # serious SASM incidents flagged / # total serious SASM incidents

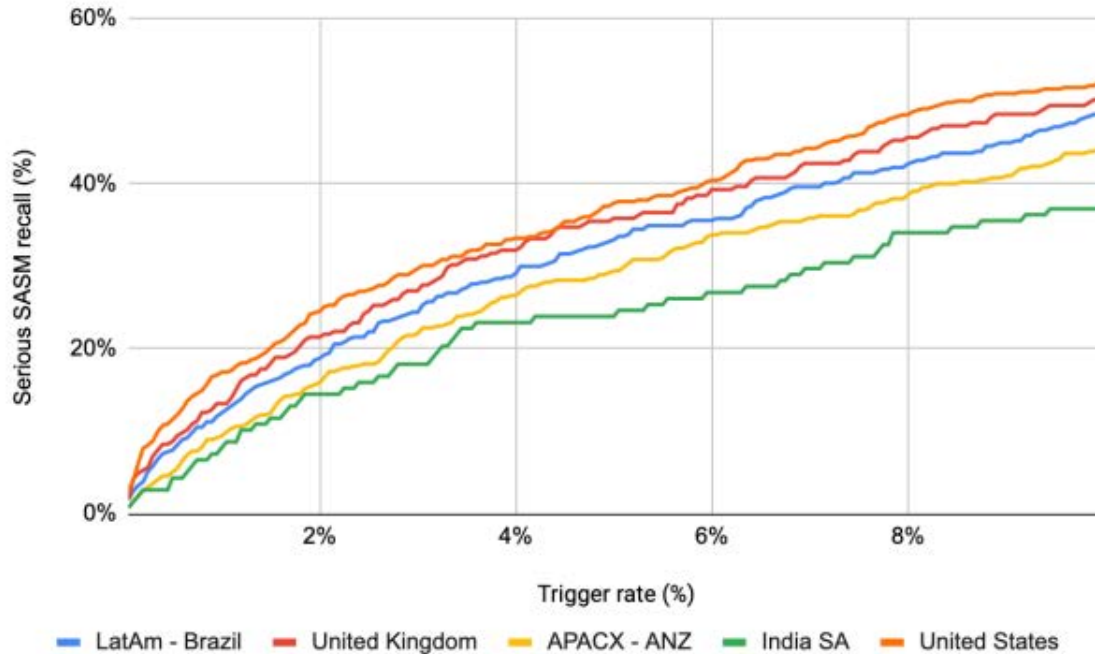
Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uuid from 2022-11-01 to 2023-01-31

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# Regional composite performance

Region	Trigger rate	Prod. recall <sup>†</sup>	Global cand. recall	% difference
United States*	1.18%	18.3%	17.3%	-5.1%
Brazil**	0.97%	12.2%	17.8%	45.6%
LatAm - Mexico**	1.32%	13.8%	17.7%	27.9%
LatAm - ACAC**	1.23%	11.5%	16.0%	39.5%
LatAm - South Cone**	1.72%	14.6%	18.3%	25.8%
ANZ*	1.36%	15.6%	15.9%	1.5%
United Kingdom*	1.37%	16.1%	16.1%	0.0%
EMEA - NEE*,**	1.37%	20.8%	24.2%	16.1%
EMEA - MEA*	1.10%	12.0%	16.0%	33.3%
EMEA - WSE*	1.50%	12.4%	12.9%	4.8%
India SA* <sup>x</sup>	1.11%	10.9%	12.3%	13.3%

# Existing S-RAD US



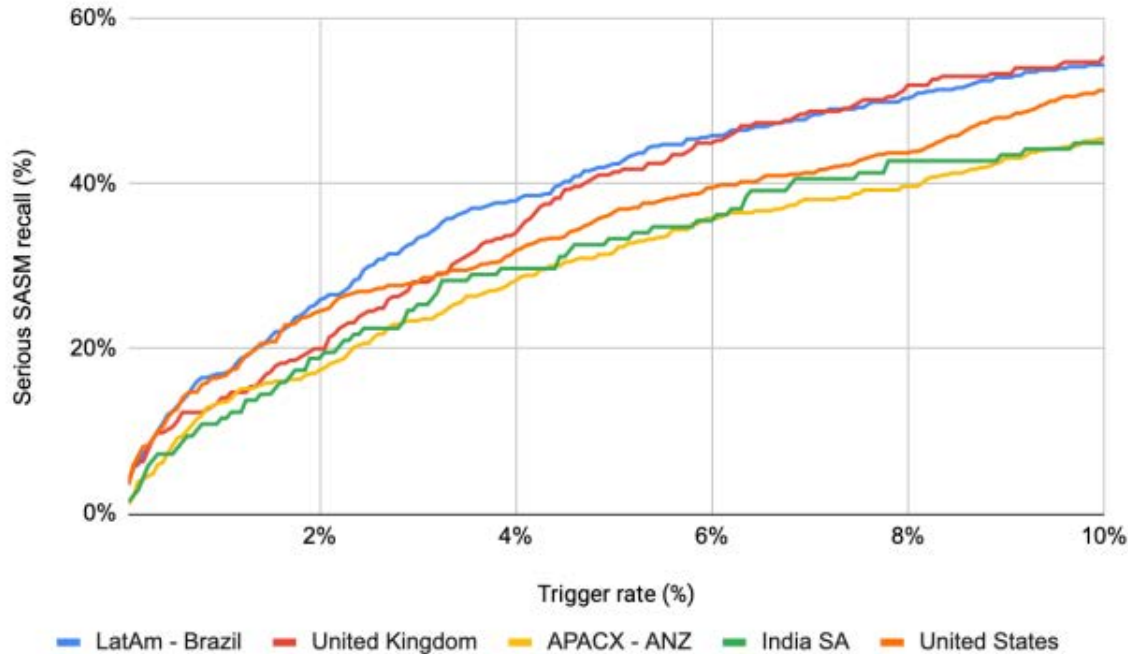
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uuid from 2022-11-01 to 2023-01-31

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# Baseline candidate global model



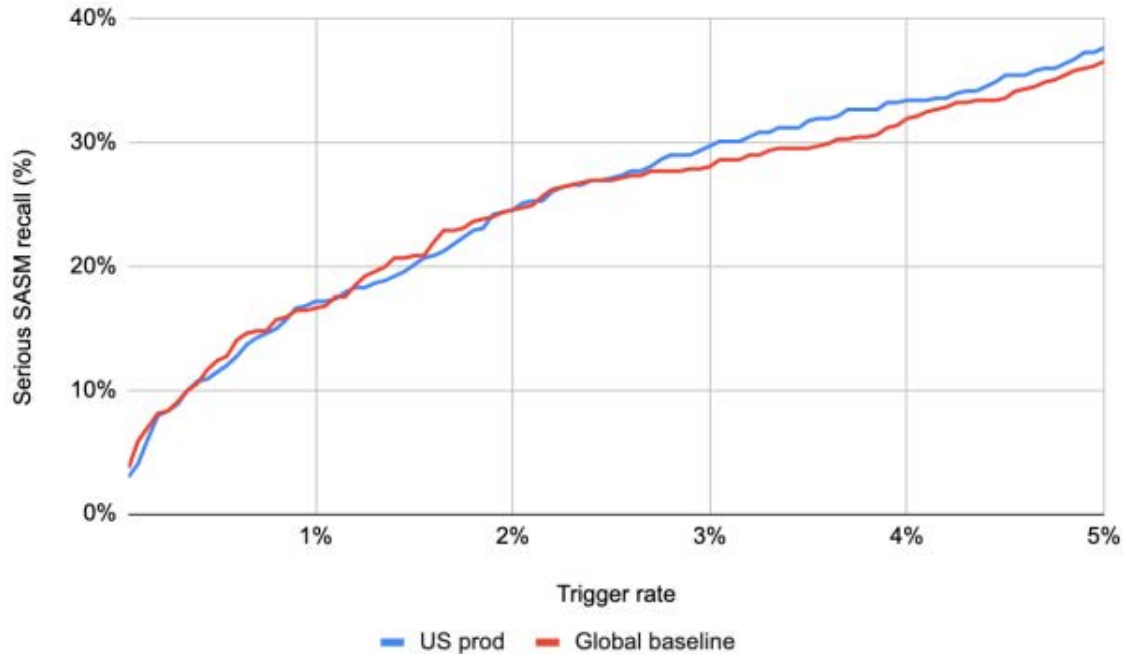
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uuid from 2022-11-01 to 2023-01-31

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# United States comparison



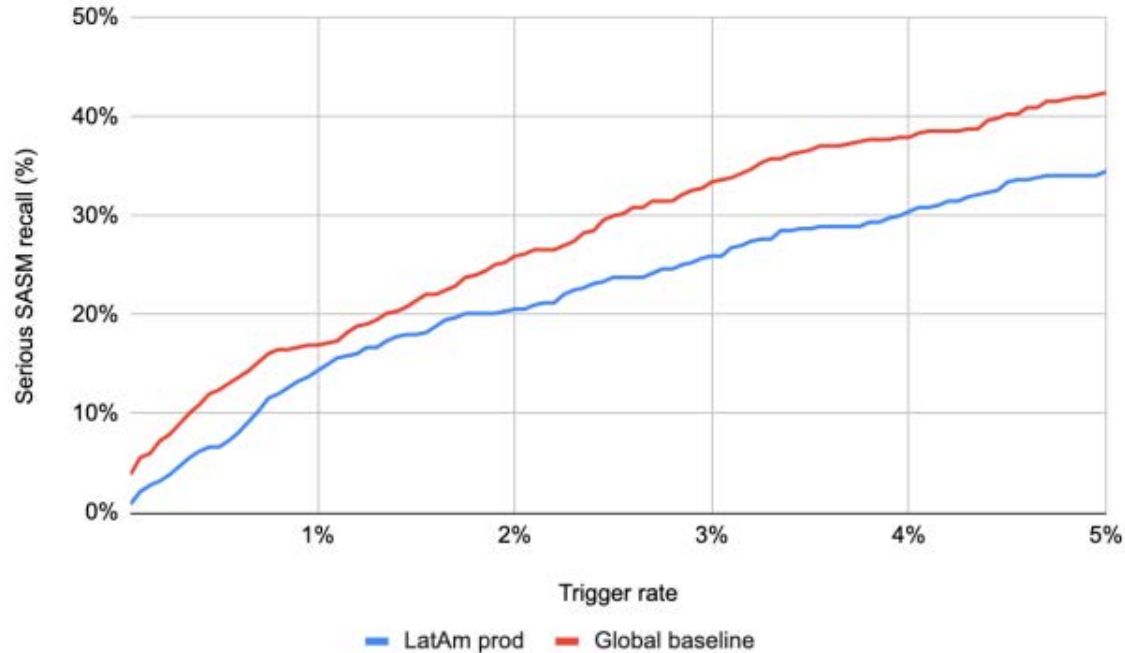
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# Brazil comparison



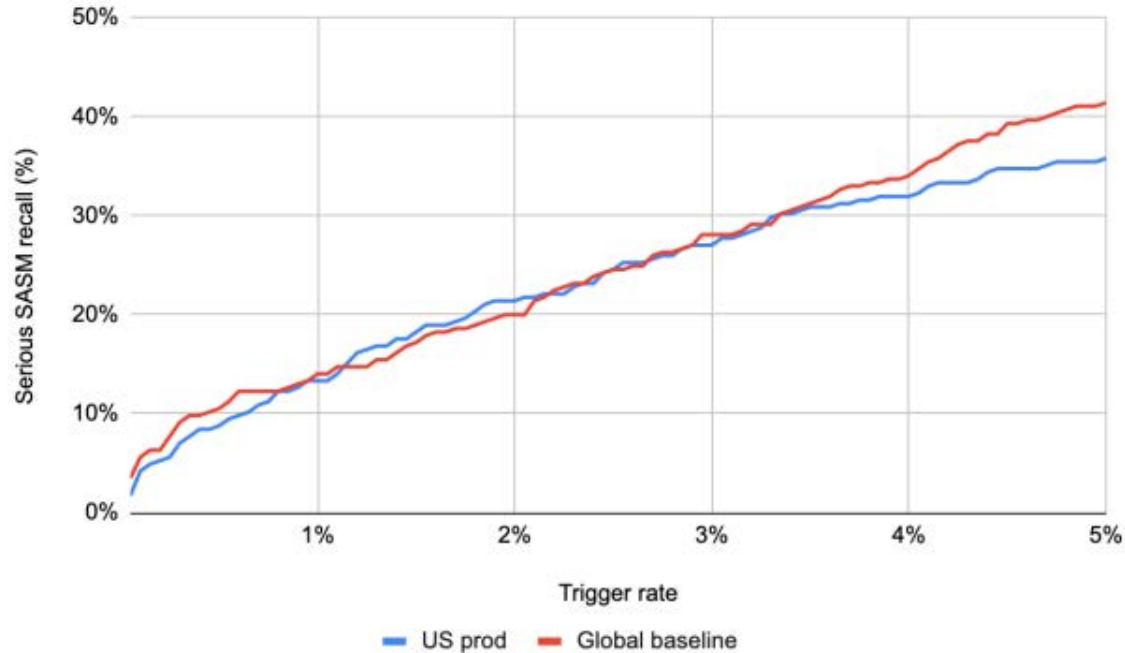
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# United Kingdom comparison



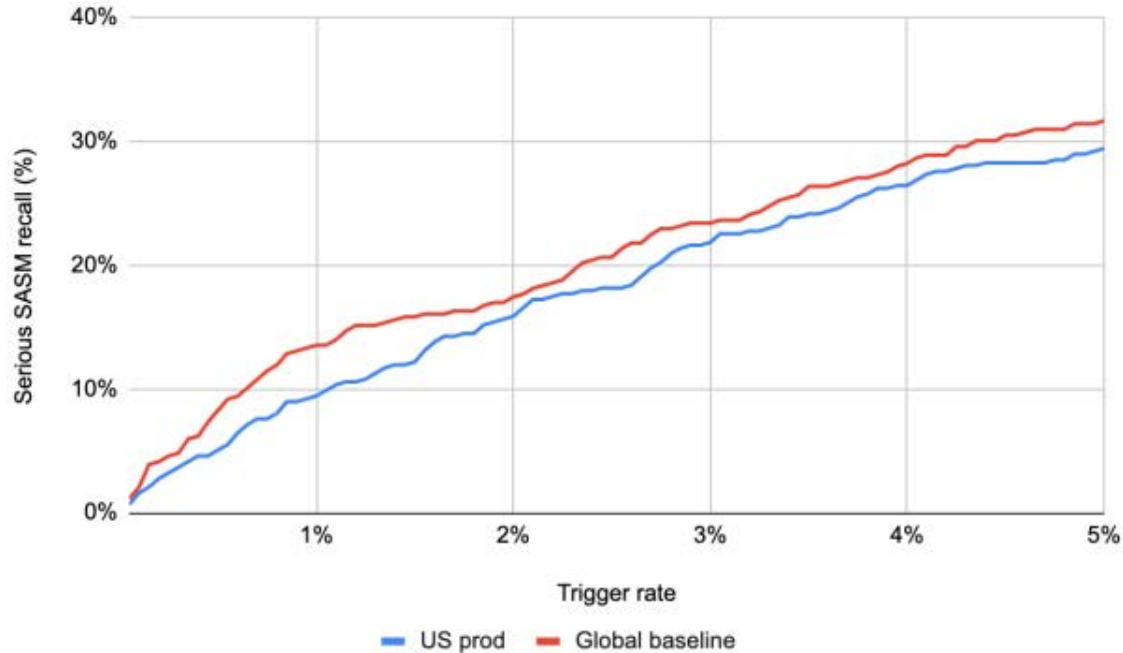
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# ANZ comparison



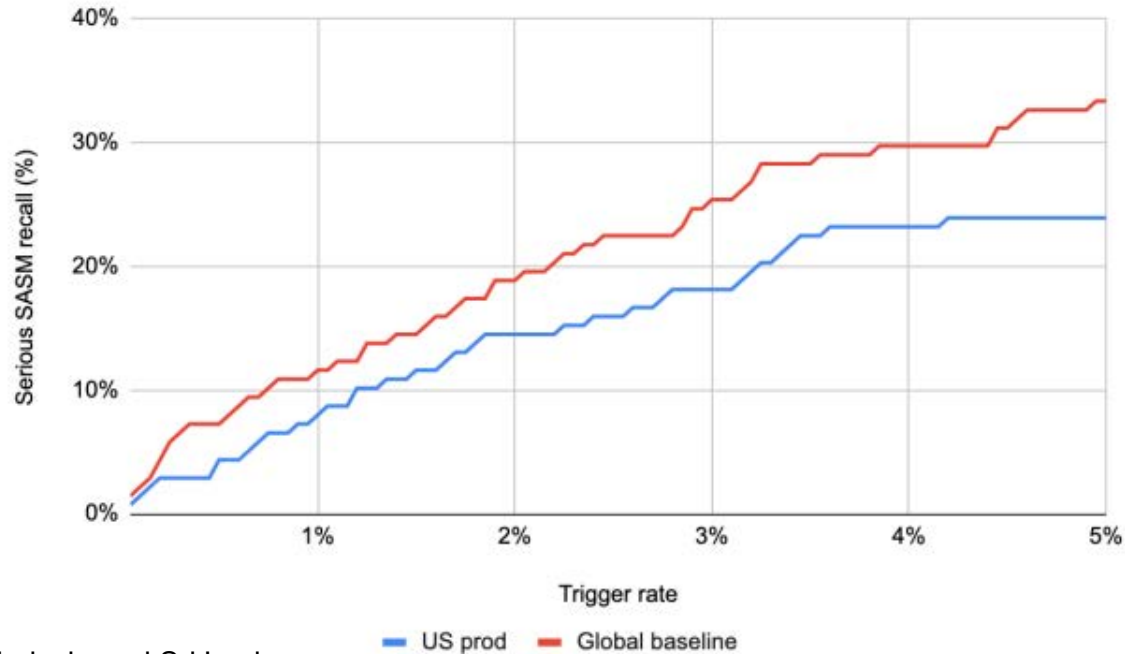
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# India SA comparison



Includes India, Bangladesh, and Sri Lanka

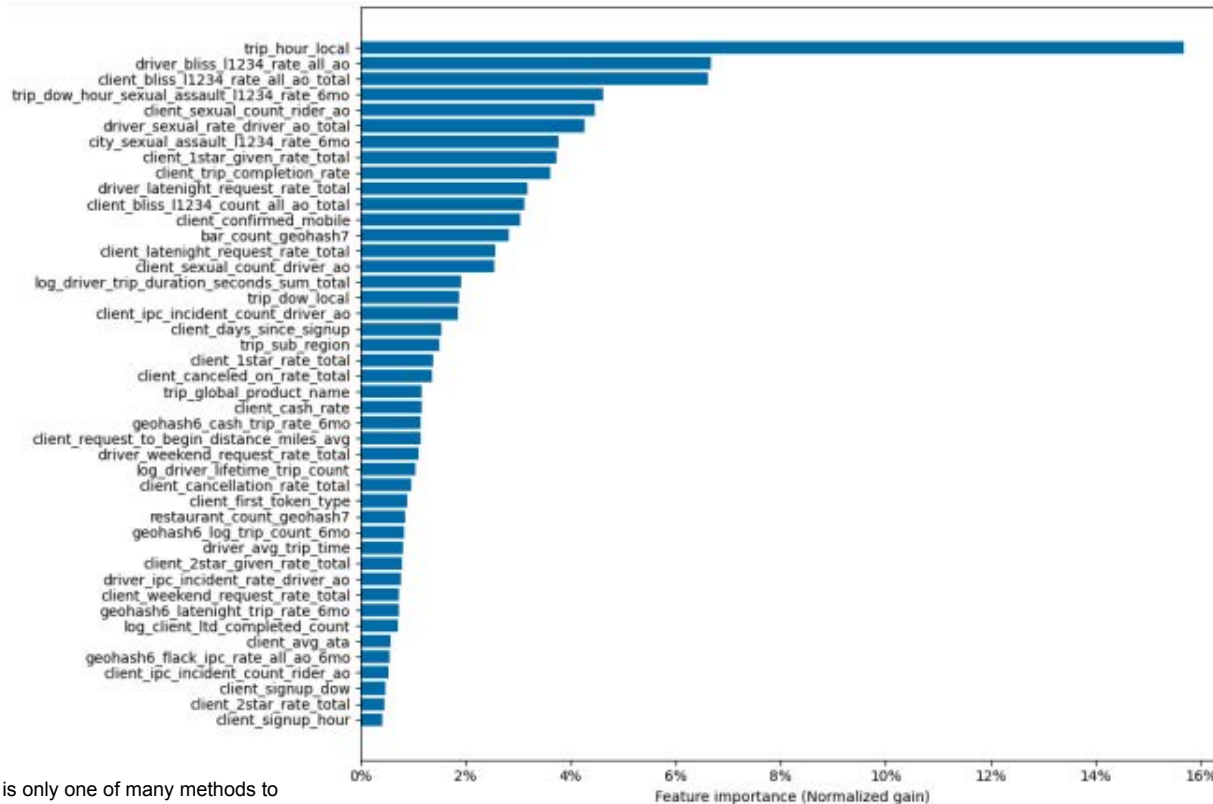
Recall = # serious SASM incidents flagged / # total serious SASM incidents

Recall computed using all non S-RAD actioned, UberX trips with valid driver\_uid from 2022-11-01 to 2023-01-31

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# Feature importance



\*Total gain is only one of many methods to measure feature importance

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# Effect of training data size and recency

Region	Training data end date	Baseline US: 2 yr, 11 m BR: 2 yr, 10 m Eval trigger rate	1 year			2 year			3 year		
			2020-12-31	2021-12-31	2022-08-30	2020-12-31	2021-12-31	2022-08-30	2020-12-31	2021-12-31	2022-08-30
			US: 2020-10-31 BR: 2020-09-30								
United States	1.25%	18.3%	15.5%	15.7%	18.5%	18.6%	18.1%	19.2%	17.5%	17.7%	18.8%
Brazil	1.10%	15.6%	14.1%	16.1%	17.6%	16.9%	15.6%	18.0%	16.1%	17.3%	17.8%
ANZ	1.25%	10.8%	8.9%	9.9%	14.0%	12.2%	12.6%	14.0%	12.6%	13.8%	14.0%
United Kingdom	1.25%	16.5%	9.8%	15.8%	14.7%	13.3%	13.7%	14.7%	13.7%	15.1%	15.8%
India	1.25%	10.1%	8.0%	5.8%	13.0%	10.1%	10.1%	13.0%	10.1%	10.1%	11.6%

Color legend
Max regional recall
± 5% prod recall

For a fixed training window, models tend to perform better with more recent training data

Models with 2 years of training data seems to perform best, though peak COVID observations may be biasing certain training runs

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# Effect of regularization

Adding additional constraints to limit overfitting appears to result in models with more **sustained** offline performance

Region		No additional regularization			With terminal leaf regularization			Percent difference		
	Training data start date	2018-01-01	2019-01-01	2020-01-01	2018-01-01	2019-01-01	2020-01-01	2018-01-01	2019-01-01	2020-01-01
	Eval trigger rate									
United States	1.25%	17.5%	18.6%	15.5%	18.1%	18.6%	17.2%	3.2%	0.0%	10.7%
Brazil	1.10%	16.1%	16.9%	14.1%	17.3%	18.4%	17.3%	8.0%	8.9%	22.7%
ANZ	1.25%	12.6%	12.2%	8.9%	15.4%	14.5%	13.1%	21.8%	18.9%	46.2%
United Kingdom	1.25%	13.7%	13.3%	9.8%	15.1%	14.7%	15.4%	10.3%	10.5%	57.1%
India	1.25%	10.1%	10.1%	8.0%	13.0%	10.9%	11.6%	28.6%	7.1%	45.5%

Training end date: 2020-12-31

Evaluation period: 2022-11-01 to 2023-01-31

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# Effect of regularization

Adding additional constraints **does not meaningfully impact** immediate post training recall

Region	Training data start date	No additional regularization			With terminal leaf regularization			Percent difference		
		2019-09-01	2020-09-01	2021-09-01	2019-09-01	2020-09-01	2021-09-01	2019-09-01	2020-09-01	2021-09-01
United States	1.25%	18.8%	19.2%	18.5%	18.6%	19.2%	18.6%	-1.0%	0.0%	1.0%
Brazil	1.10%	17.8%	18.0%	17.6%	18.6%	17.3%	17.3%	4.8%	-3.6%	-1.2%
ANZ	1.25%	14.0%	14.0%	14.0%	14.9%	15.1%	15.4%	6.6%	8.2%	9.8%
United Kingdom	1.25%	15.8%	14.7%	14.7%	15.1%	14.7%	16.5%	-4.4%	0.0%	11.9%
India	1.25%	11.6%	13.0%	13.0%	12.3%	13.8%	13.0%	6.2%	5.6%	0.0%

Training end date: 2022-08-30

Evaluation period: 2022-11-01 to 2023-01-31

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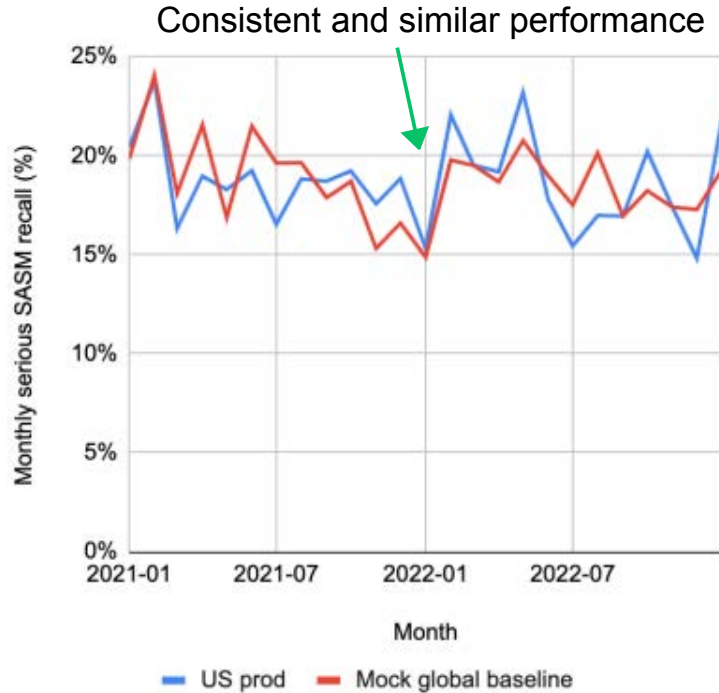
# Impact of excluded variables

Region	Eval trigger rate	Prod recall	Global model recall			
			Baseline	Driver cancel vars	Driver star rating vars	Driver cancel + star rating vars
United States	1.25%	18.3%	18.8%	18.8%	18.5%	18.5%
Brazil	1.10%	15.6%	17.3%	17.3%	18.8%	19.5%
ANZ	1.25%	10.8%	9.9%	14.7%	16.6%	15.4%
United Kingdom	1.25%	16.5%	15.8%	16.8%	18.6%	18.9%
India	1.25%	10.1%	12.3%	11.6%	14.5%	13.0%

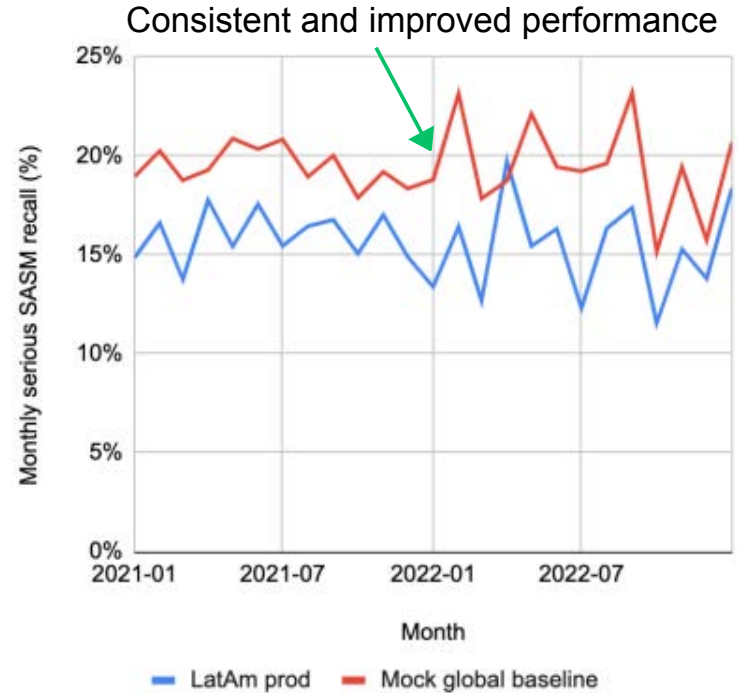
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# Expected model stability



**United States**



**Brazil**

# Additional checks

- Overlap analysis between flagged users
- Online/offline score comparison
- Marketplace impact
  - If we need to change flagging rates, what does that mean for performance?
- Driver fairness
- Plan swapability