The challenge of inferring stakeholder behaviour from data

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06/11/2018

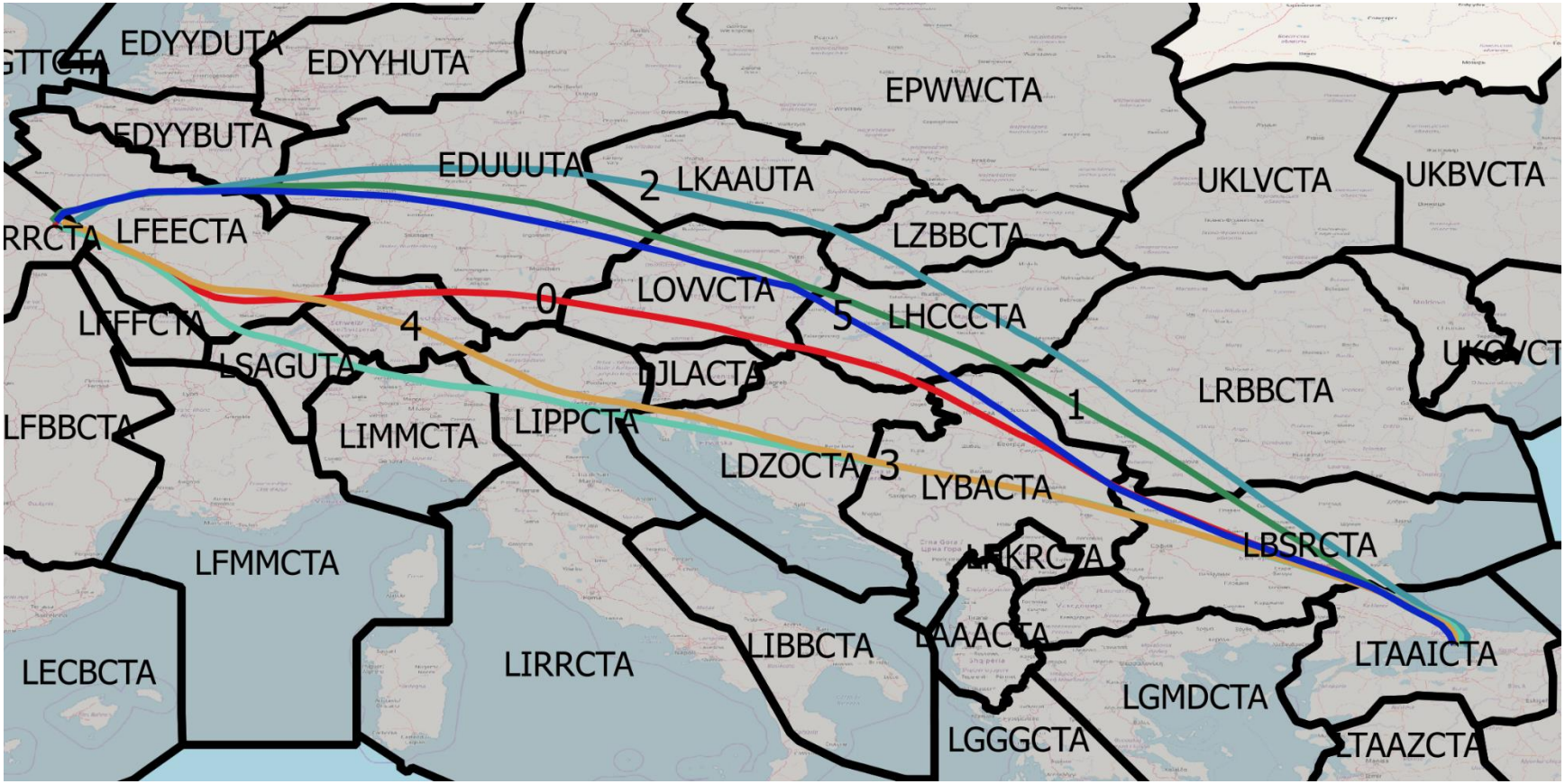
Background: TP and SESAR vision

- Current prediction
  - Short-term: surveillance data
  - Tactical: Flight Plans
  - Pre-tactical: basic similarity criteria
- SESAR vision (TBO):
  - holistic
  - seamless
  - continuous
  - fully collaborative
- New approaches investigated in ER and IR, but still some challenges to be addressed

The need: infer stakeholder behaviour

- Stakeholders influence the executed trajectory:
  - Airlines – route planning decisions
  - ANSPs – airspace configuration, ATC
  - Airports – departure/arrival
  - Military – route availability
- Stakeholder criteria often driven by ‘hidden’/sensitive information (e.g., Cost Index)
  - Plans are not binding
  - Qualitative differences in the information available at each time-horizon / for each stakeholder

Examples (1/3) Airline route choices



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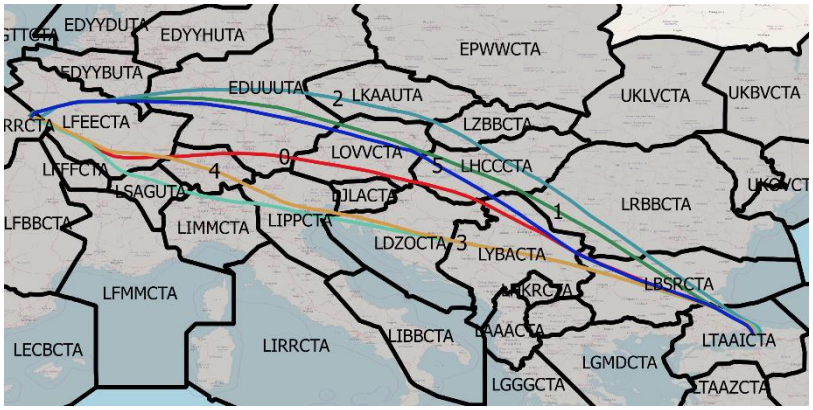
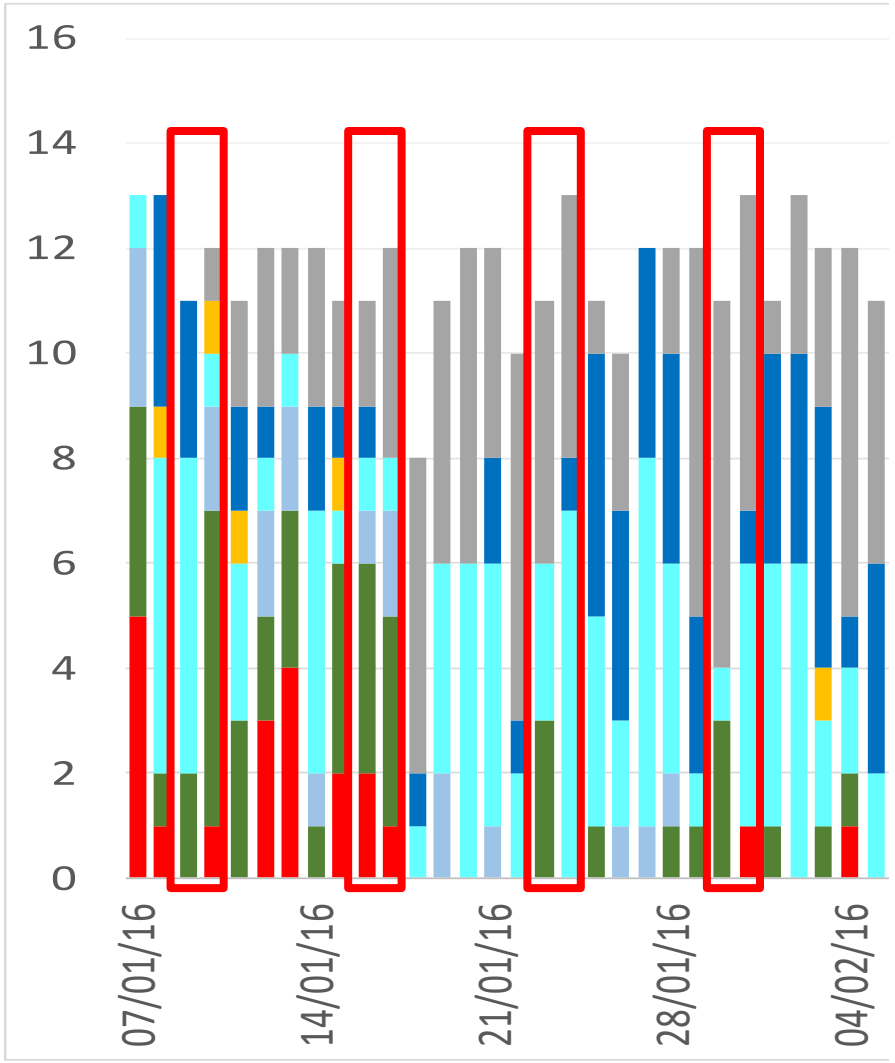
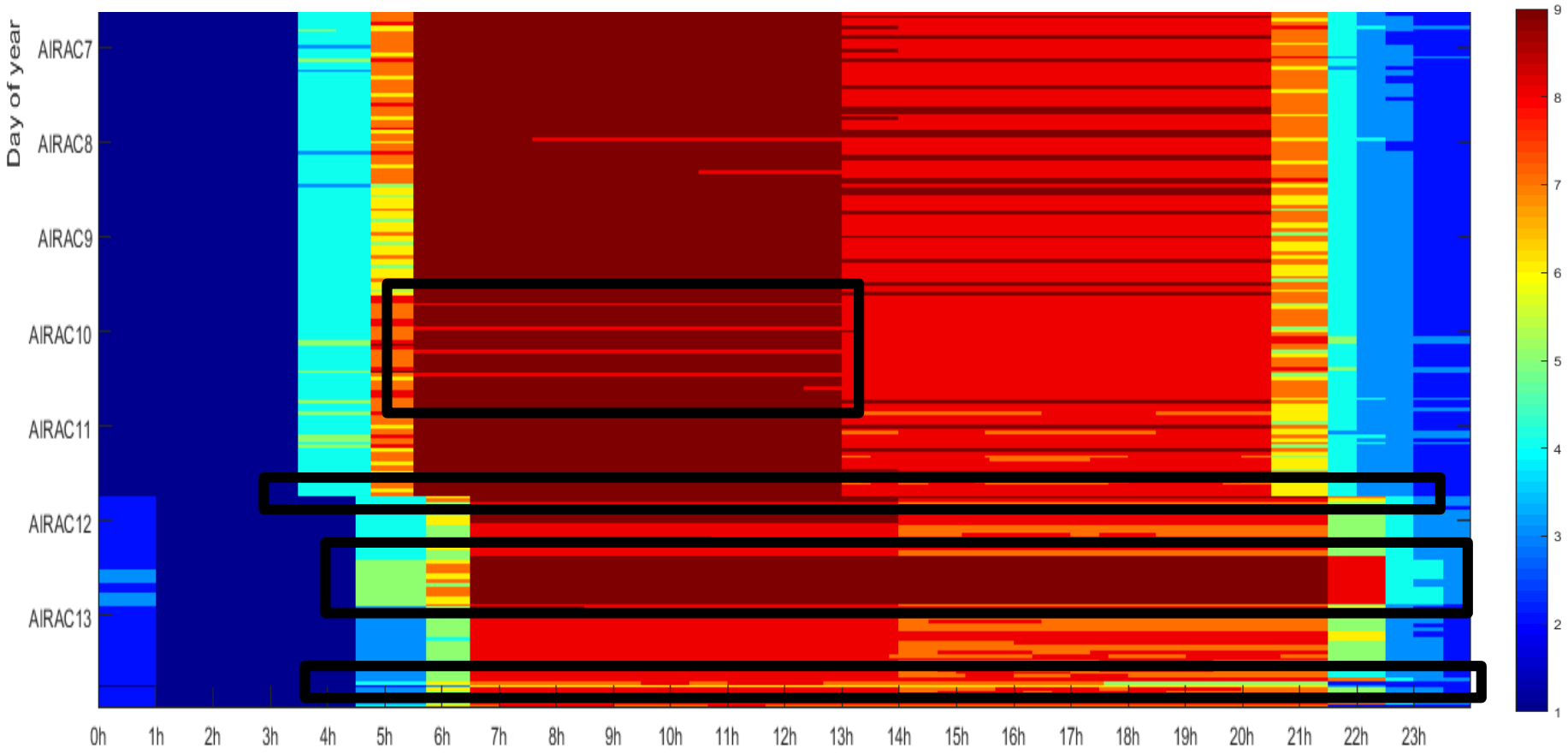
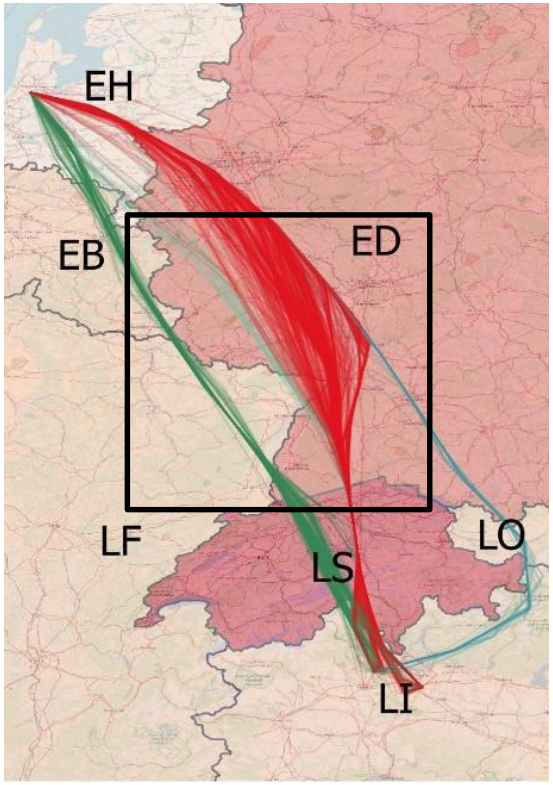


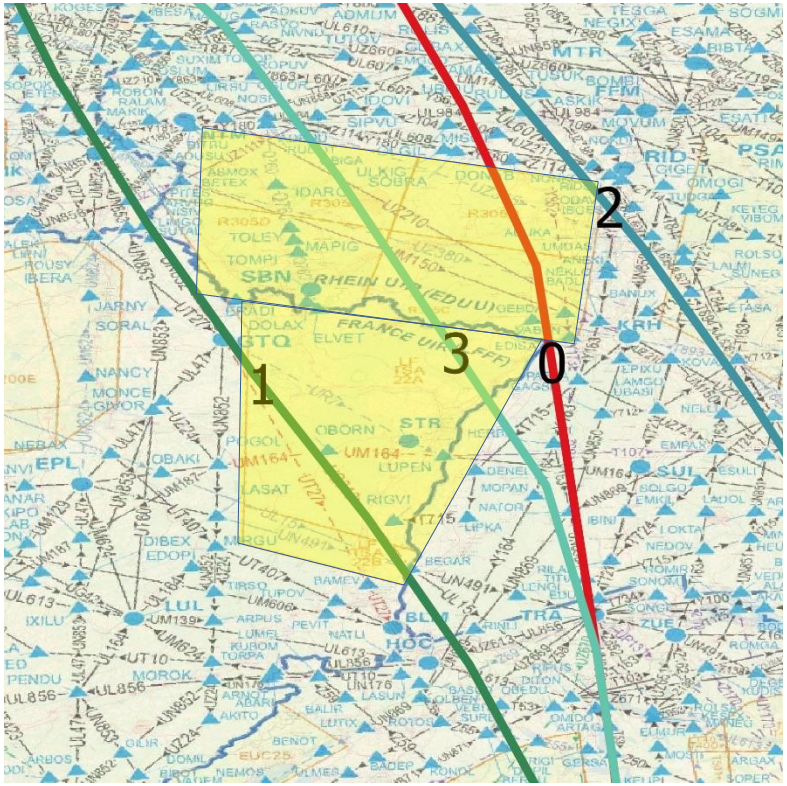


Examples (2/3) – LECMCTA configuration



Examples (3/3) Military airspace





Stakeholder behaviour: challenges

Seamless prediction with different levels of information:

- Pre-tactical: mainly flight intentions
- Tactical: initial, intermediate and final flight plans
- Short-term: surveillance

Airline behaviour:

- Route preference:
  - Infer sensitive information (Cost Index, take-off weight)
  - Influence of inbound delay
  - Congestion
- 'Irrational' behaviour (e.g., routes considered)

Other stakeholders:

- Route availability
- Congestion (rerouteings, regulations, number of sectors, etc.)
- Tactical actions (direct routeing)

Promising avenues

Data-driven:

- Early prediction with limited trajectory data
- Consideration of historical ‘irrational’ behaviour
- Intrinsic consideration of all factors
- Probabilistic consideration of tactical actions

Model-driven:

- More explanatory power
- Cleansing of unrealisable predictions
- Performance evaluation
- Highly reliable when data is available

Multi-model integration:

- Seamless, coherent prediction
- Real-time update
- Probabilistic forecast

Conclusions

- Traditional approaches fail to capture deviations from planning information and ‘irrational behaviour’
- Behaviour of stakeholders needs to be predicted well in advance
  Predictions cannot rely only on shared information
- The whole set of influences need to be captured and adapted to the data availability
- A coherent, seamless, real-time integration of models is needed
- The best approach for Trajectory Prediction may differ for each planning phase

Suggestions for further research

- Promising data-driven approaches have been investigated in ER: Catalyst funding could help to fully validate before upscale to IR
- Is TP even needed? Is it worth investigating direct prediction of aggregate demand indicators? (at least for some planning horizons)
- Applications go beyond ATFCM:
  - Performance monitoring
  - Performance evaluation for new policies / ConOps

Thank you for your attention!

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