16th Conference on Aviation, Range, and Aerospace Meteorology – ARAM

ANALYSIS OF THE USE OF AEROSPACE METEOROLOGY IN THE BRAZILIAN SPACE PROGRAM

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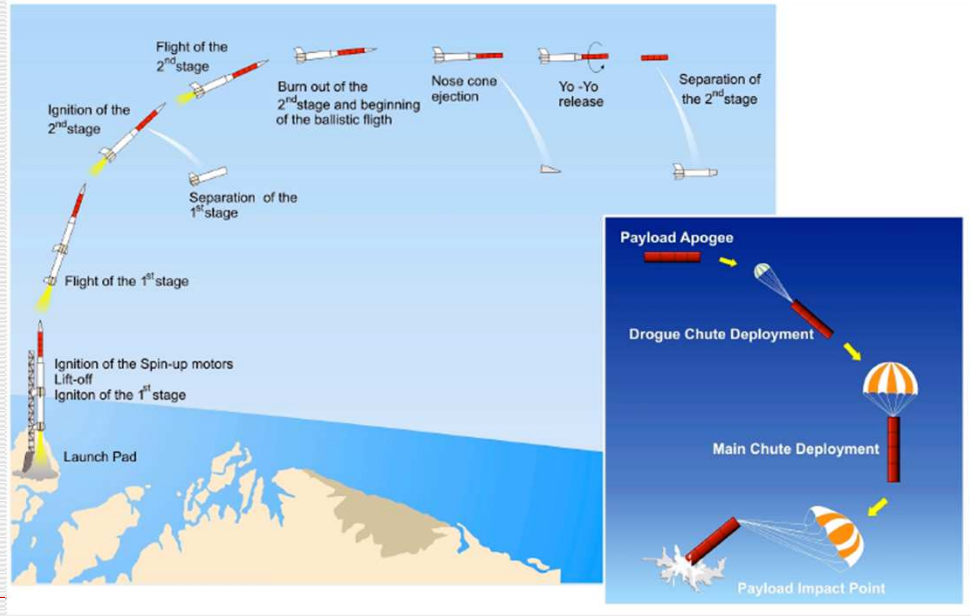
PLAN OF TALK

- Overview
- Introduction
- The Brazilian Space Program
- Materials and Methods
- Discussion
- Conclusion
- Future works

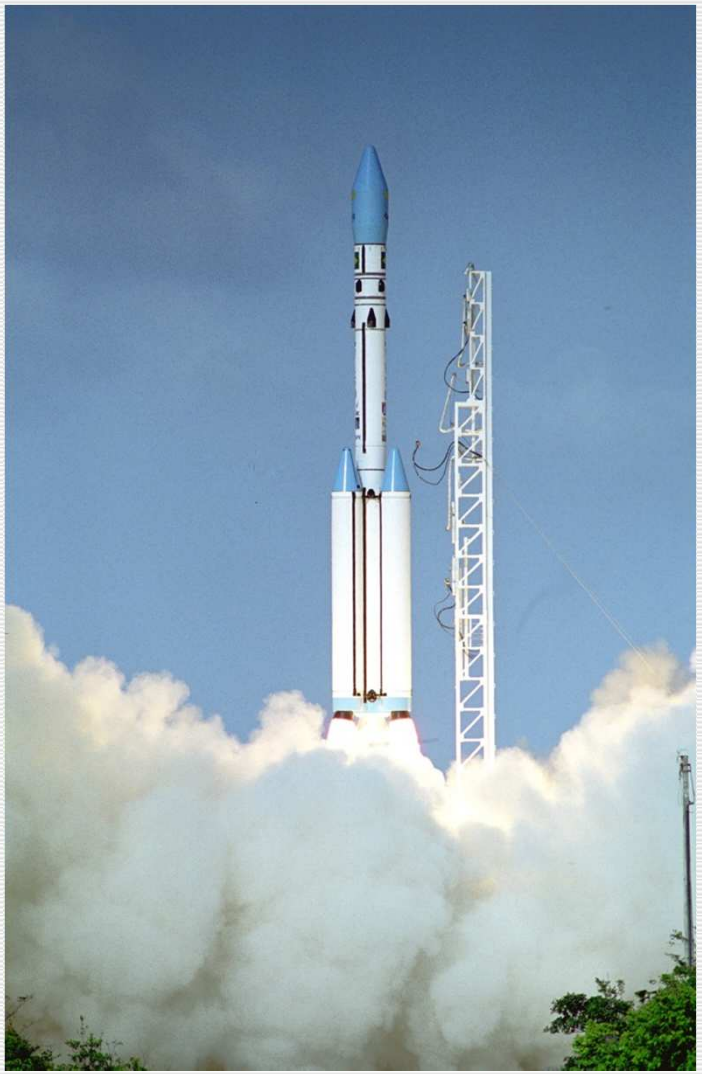
OVERVIEW – MOTIVATION

- The Brazilian Space Program is being restructured among different institutions
- Possibility of launching a liquid-propelled satellite launch vehicle from Brazil
- International launches with a Brazilian sounding rocket (VSB-30)



INTRODUCTION

- In launching aerospace vehicles, the weather and environmental conditions are crucial → *"Aerospace Meteorology"*
- Relationship: weather risk ↔ decision analysis (with Brazilian parameters)



INTRODUCTION

- Systemic view:
  - *operational procedures have to be mapped*
  - *limiting weather factors have to be identified*
  - *the infrastructure at the launch centers has to be analyzed (and among many other aspects)*

- **GOAL**: use mapping and application AM in the Brazilian Space Program

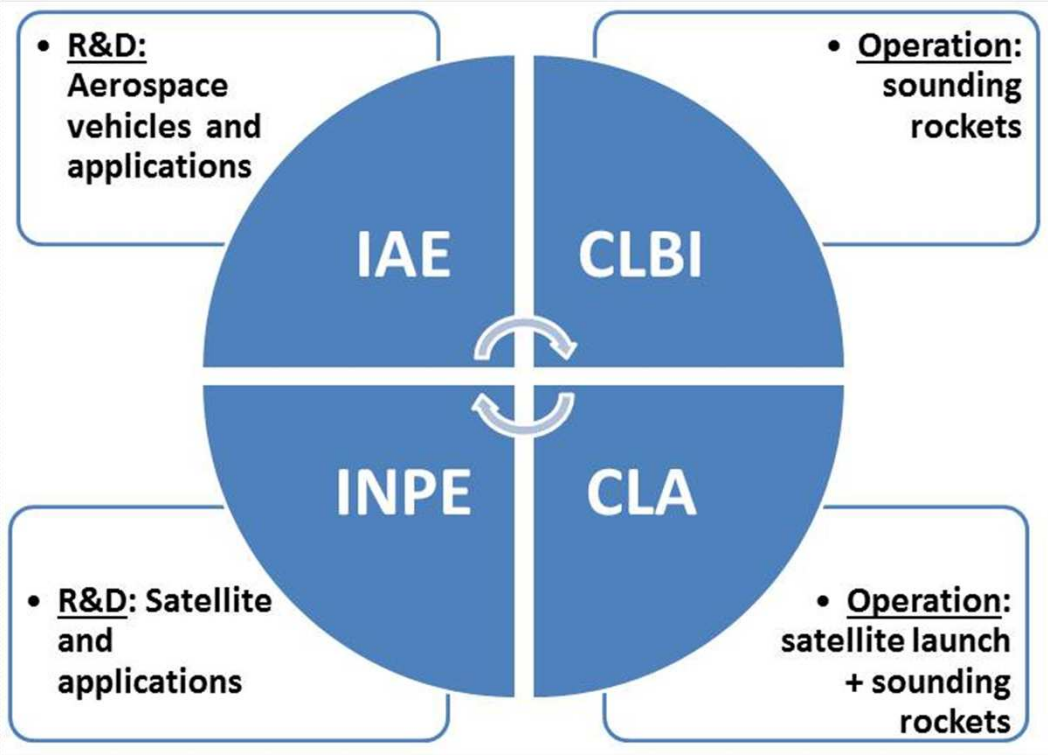
BRAZILIAN SPACE PROGRAM

- Brazilian Space Program (PEB) began operating in 1965 with the launch of the first sounding rocket from Brazil

- In the late 1970s the Brazilian government defined three main goals for the PEB: to launch a satellite with a rocket, both made in Brazil, from a Brazilian launch center

BRAZILIAN SPACE PROGRAM

- R&D at the PEB: Institute of Aeronautics and Space (IAE), and the National Institute for Space Research (INPE)
- Operational: Barreira do Inferno Launch Center (CLBI) and Alcantara Launch Center (CLA)



BRAZILIAN SPACE PROGRAM

MATERIALS AND METHODS

- 13 interviews with different stakeholders in the PEB – into three groups:
  - "meteorologists" and atmospheric scientists (5 interviews)
  - "direct users" of weather information (5 interviews)
  - "top decision makers", directors and chief of general operations (3 interviews)

MATERIALS AND METHODS

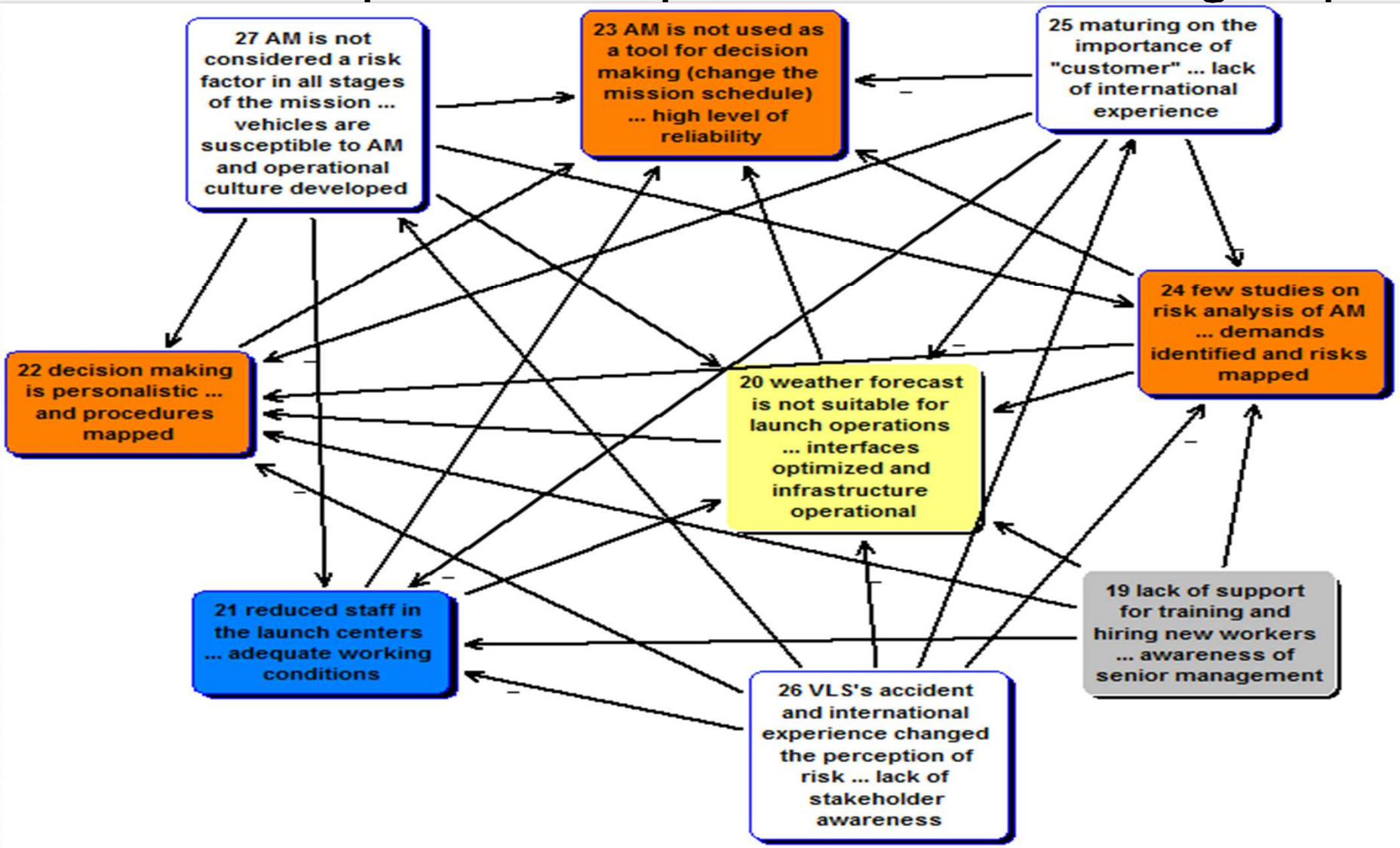
- Problem Structuring Method (PSM) was used to analyze the interviews (Strategic Options Development and Analysis – SODA):
  - uses cognitive map techniques
  - build a map that incorporates the goals for each stakeholder involved in decision making
  - bipolar construct design
  - constructs are identified (viewpoints) and the relationship with the decision-making process

RESULTS

- Current situation of the use of AM during launch operations for aerospace vehicles in Brazil
- Encouraged to indicate what points should be improved – (identified 5 clusters):
  - gray: related to senior management of PEB
  - yellow: infrastructure in the launch centers
  - blue: technical staff and crew
  - orange: general procedures
  - white: operational/ strategic vision

RESULTS

- SODA map of the "top decision makers" group



DISCUSSION

- Possible to identify several of the same aspects among the three groups
  - AM is not used as an effective tool for decision making in the launching of aerospace vehicles (weather forecast does not change the mission schedule)
  - Increased risk perception of space activity and importance of the end customer (after VLS-1 accident and international launches with a Brazilian sounding rocket)

CONCLUSION

- Last 10 years: new paradigm, problems not considered before (e.g recently purchased for the CLA: Weather Radar and Wind Profile)

- Strategic options identified:
  - Improve infrastructure/ keep equipment operating
  - Make a specific weather forecast for each type of mission and aerospace vehicle
  - Research in risk and decision analysis in AM

CONCLUSION

- Future works:
  - Increase the number of respondents/ interviews
  - Review SODA maps among all respondents
  - Identify best practices and potential improvements for the development of AM in Brazil
  - Draw up risk analysis and evaluate environmental factors limiting
  - Parameterize a Decision Support System (DSS) using Aerospace Meteorology

THANK YOU FOR YOUR ATTENTION!

Questions or suggestions?

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