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 (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
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)
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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