Next Step Space Weather Benchmarks

proposed and highly tentative outline

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This document is under review and is subject to modification or withdrawal. It should not be cited in other publications.

Executive Summary

This is a proposed outline for the final report. On the second day of the workshop, please engage with your working groups to sketch out your vision for the final report’s organization. You are in no way bound by the current outline, but all groups should (mostly) agree upon an outline before the end of the third day of the workshop. That way everyone can be working toward the same goal.

Contents

[1. Introduction 1](#_Toc5371966)

[A. Space Weather Phase 1 Benchmarks 1](#_Toc5371967)

[B. Next Step Benchmarks 1](#_Toc5371968)

[2. Analysis of Induced Geo-electric Fields Benchmark 3](#_Toc5371969)

[A. Analysis of Phase 1 Benchmark Values 3](#_Toc5371970)

[B. Operational Utility of the Benchmark Value 3](#_Toc5371971)

[C. Current Understanding of the SWx Phenomenon 3](#_Toc5371972)

[D. Prioritized List of Gaps Inhibiting High Quality Benchmark Values 3](#_Toc5371973)

[E. Recommendations for Effectively Closing Gaps 3](#_Toc5371974)

[F. Recommendations for Phase 2 Benchmark Process 3](#_Toc5371975)

[3. Analysis of Ionizing Radiation Benchmark 4](#_Toc5371976)

[4. Analysis of Ionospheric Disturbances Benchmark 4](#_Toc5371977)

[5. Analysis of Solar Radio Bursts Benchmark 4](#_Toc5371978)

[6. Analysis of Upper Atmosphere Expansion Benchmark 4](#_Toc5371979)

[7. Conclusion 4](#_Toc5371980)

[Appendix A. Title of Appendix A-1](#_Toc5371981)

[Appendix B. Title of Appendix B-1](#_Toc5371982)

[References 1](#_Toc5371983)

[Abbreviations 7-1](#_Toc5371984)

# Introduction

## Space Weather Phase 1 Benchmarks

Directed by the Presidential Executive Order 13744 (October 29, 2015), the National Science and Technology Council (NSTC) crafted and released the National Space Weather Strategy (NSWS) and Space Weather Action Plan (SWAP) with the goal of improving our understanding and forecasting of space weather events. NSWS and SWAP identified six major strategic goals that guide national efforts to reduce our vulnerability to space weather. The first goal in NSWS and SWAP calls for the development of benchmarks for five types of space weather events:

* Induced geo-electric fields
* Ionizing radiation
* Ionospheric disturbances
* Solar radio bursts
* Upper atmospheric expansion

The benchmarks describe the nature and intensity of extreme space-weather events, providing a point of reference from which to improve understanding of the effects of space weather. The Phase I effort, which involved Federal departments and agencies only, developed benchmarks using existing data sets and studies, where available. In order to improve the benchmarks produced in Phase 1, inputs from the research community across academia and the private sector, and possibly other international partners should be solicited.

## Next Step Benchmarks

This Next Step Benchmarks (NSB) activity seeks to leverage the expertise of the worldwide scientific community to update/refine the existing Phase 1 NSTC SWORM Benchmarks and fill in gaps for which benchmarks have not yet been sufficiently defined. Community engagement will be achieved through a workshop, a town hall, and a request for community input from the scientific community across academia, industry, and other entities.

The charge to the community in the NSB activity is to provide updates to the benchmarks based on advances in published literature and ongoing studies. Equally important is to identify areas where new research or measurements are needed to fill gaps in understanding at least the 1-in-100-year and worst-case values of key space weather parameters identified in the National Space Weather Action Plan. This information is valuable for updating SWORM on the gaps of the Phase 1 benchmarks and guiding subsequent Phase 2 (more refined) benchmarks.

The report developed out of the NSB process should ideally contain at least the following elements:

* Comments on the SWORM Space Weather Phase 1 Benchmarks values, derived from published literature, ongoing studies, and/or global expertise
* Identified challenges and gaps in understanding or capabilities that need to be addressed to inform the development of Phase 2 benchmarks
* Recommendations for the development of Phase 2 benchmarks to better incorporate user needs and other considerations

# Analysis of Induced Geo-electric Fields Benchmark

## Analysis of Phase 1 Benchmark Values

Summarize the data, methodology, and fidelity of the benchmark values, then point out potential flaws, inconsistencies, and gaps that could be addressed.

## Operational Utility of the Benchmark Value

What does an operator need to know to make a decision? Is a 1-in-100-year or theoretical maximum value useful? What level of precision and confidence is necessary to be useful for a planner or an operator?

## Current Understanding of the SWx Phenomenon

Highlight new or previously un-used data sets, methodologies, and analyses that could be brought to bear on the benchmark values.

If it is possible to create a benchmark value where one was previously lacking, then you are encouraged to do so if time permits. Existing benchmark values may be updated if it is easy, though this is not the focus of the task.

## Prioritized List of Gaps Inhibiting High Quality Benchmark Values

Gaps may be data sets, observational capabilities, methodologies, models, etc. Consider how your gaps may be shared by other benchmark phenomena. Describe your method for prioritizing the gaps and then rank them.

## Recommendations for Effectively Closing Gaps

For example, science gaps may be filled through new NSF and NASA programs. A better understanding of operator needs may be addressed by some other means.

## Recommendations for Phase 2 Benchmark Process

How should Phase 2 proceed methodologically? Which gaps need to be filled before Phase 2 could begin? Approximately when would that happen?

# Analysis of Ionizing Radiation Benchmark

Same structure as Induced Geo-electric Fields.

# Analysis of Ionospheric Disturbances Benchmark

Same structure as Induced Geo-electric Fields.

# Analysis of Solar Radio Bursts Benchmark

Same structure as Induced Geo-electric Fields.

# Analysis of Upper Atmosphere Expansion Benchmark

Same structure as Induced Geo-electric Fields.

# Conclusion

###### Title of Appendix

What information should go into appendices?

###### References

NOTE: Author-Date style from *The Chicago Manual of Style* (17th edition) is the recommended style for STPI products. See *The Chicago Manual of Style Online* (<http://www.chicagomanualofstyle.org/tools_citationguide/citation-guide-2.html>) for additional examples. Chicago’s notes and bibliography style is also acceptable. (<http://www.chicagomanualofstyle.org/tools_citationguide/citation-guide-1.html>).

One STPI-specific departure from guidance in *The Chicago Manual of Style*: author names should include only initials for first and middle names instead of full names, even if full names are given on the cited publication itself.

Last name, F. M. Year. “Article Title.” *Journal Title* 12 (2): 25–34. doi: XXXXXXX.

Organization Name (ON). Year. *Report Title*. Other Identifying Information. <http://XXXXXXXXXXX.pdf>.

###### Abbreviations

IDA Institute for Defense Analyses

OSTP Office of Science and Technology Policy

STPI Science and Technology Policy Institute