

## Plan Overview

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*A Data Management Plan created using DMPTool*

**DMP ID:** <https://doi.org/10.48321/D1CH0J>

**Title:** Development, Verification, and Validation of G-LOC Model

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**Affiliation:** United States Department of Transportation (DOT) ([transportation.gov](https://www.transportation.gov))

**Principal Investigator:** Kyle Copeland

**Data Manager:** Kyle Copeland

**Project Administrator:** Kyle Copeland

**Contributor:** James Whinnery

**Funder:** Civil Aerospace Medical Institute ([faa.gov](https://www.faa.gov))

**Template:** U.S. Department of Transportation: Data Management Plan (DMP)

### **Project abstract:**

The published models of G-LOC and recovery in the public domain are based on empirical fits to data from centrifuge experiments and on blood pressure. A resource-flow based model of G-LOC and recovery built using more detailed physics and physiology will be developed. This new model is implemented via software and results will be compared with existing models for predicting symptoms known to occur in aeronauts during positive and negative Gz accelerations encountered in aerobatic flight and observed in centrifuge experiments.

**Start date:** 10-01-2018

**End date:** 03-31-2023

**Last modified:** 05-10-2023

**Copyright information:**

The above plan creator(s) have agreed that others may use as much of the text of this plan as they would like in their own plans, and customize it as necessary. You do not need to credit the creator(s) as the source of the language used, but using any of the plan's text does not imply that the creator(s) endorse, or have any relationship to, your project or proposal

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## Development, Verification, and Validation of G-LOC Model

### Persistent Link

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Include the persistent identifier (PID) that is associated with the dataset.

#### Persistent Link:

This Data Management Plan: <https://doi.org/10.48321/D1CH0J>

Presentation at 2021 annual meeting of the Aerospace Medical Association: <https://doi.org/10.21949/1528555>

Software User's Guide DOI: <https://doi.org/10.21949/1524438>

Software: <https://doi.org/10.21949/1524439>

Accepted version of peer reviewed journal article: <https://doi.org/10.21949/1524446>

Publisher's version of peer reviewed journal article: <https://doi.org/10.3357/AMHP.6917.2023>

### Recommended Citation

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The recommended data citation to be used when citing the dataset.

#### Recommended Citation:

U.S. Department of Transportation, Federal Aviation Administration, Civil Aerospace Medical Institute (2022). Development, Verification, and Validation of G-LOC Model: Data Management Plan. <https://doi.org/10.48321/D1CH0J>

Software User's Guide: Copeland, K. *CGEM User's Guide*. Federal Aviation Administration Office of Aerospace Medicine Report DOT/FAA/AM-23/5 (January 2023) <https://www.faa.gov/dataresearch/research/medhumanfacs/oamtechreports/CGEM-Users-Guide>, <https://doi.org/10.21949/1524438>

Software: Copeland, K. *CGEM* [SOFTWARE]. Federal Aviation Administration Office of Aerospace Medicine (March 2023) <https://github.com/AAM-631/CAMI-Gz-Effects-Model-CGEM-/releases/latest>, <https://doi.org/10.21949/1524439>

Accepted version of peer reviewed journal article: Copeland, K. & Whinnery J. E. *Cerebral Blood Flow Based Computer Modeling of Gz-Induced Effects*. Federal Aviation Administration Office of Aerospace Medicine Report DOT/FAA/AM-23/6 (January 2023). <https://www.faa.gov/dataresearch/research/medhumanfacs/oamtechreports/Cerebral-Blood-Flow-Based-Computer-Modeling>, <https://doi.org/10.21949/1524446>

Peer reviewed journal article: Awaiting information from publisher for complete citation

Presentation: Copeland, K. & Whinnery J. E. *CGEM: A CEREBRAL BLOOD FLOW BASED COMPUTER MODEL OF GZ-INDUCED EFFECTS [PRESENTATION]*. Presented at 2021 Annual Meeting of the Aerospace Medical Association, September 1, 2021, Denver Colorado. <https://doi.org/10.21949/1528555>

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## Change Log

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**Document the changes that are made to the DMP, any and all changes should be noted to ensure a more complete documentation.**

### Change Log:

2022-11-4: Initial Data Management Plan (DMP) written.

2022-11-8: Added citation information for this DMP to "Persistent Link" and "Recommended Citation"; revise Section 3 – “Access Policies” to indicate NTL as and CAMI as locations where data will be publicly available; revised Section 3 – “If applicable, describe how you will de-identified your data before sharing” to indicate data do not require de-identification; revised Section 4 – “Describe how your data will be licensed for reuse, redistribution and derivative products” to indicate that a license is not required and use of the data sets and other artifacts is not limited.

2023-3-24 Corrected the sections Recommended Citations and Persistent Links, adding a new project output and removing an erroneous DOI to this DMP.

2023-3-27 Corrected error in description of project; added 2021 AsMA presentation as product

2023-3-31 Added DOIs for DMP and presentation, fixed error in ORCID.

2023-4-27 Added DOI and other citation information for journal article published in *Aerospace Medicine and Human Performance*. Added presentation to government owned data list.

## CONTENTS

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**Include a table of contents, in order to better organize the DMP.**

### CONTENTS:

0. Dataset and Contact Information
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3. Access Policies

4. Re-Use, Redistribution, and Derivative Products Policies
5. Archiving and Preservation Plans
6. Policies Affecting this Data Management Plan

## 0. Dataset and Contact Information

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Please provide the following information:

- Name of the dataset or project for which data is being collected
- Project number, contract number, or other number used to link this DMP
- Name of the person submitting this DMP -ORCID of the person submitting this DMP
- Email and phone number of the person submitting this DMP
- Name of the organization for which the person submitting this DMP is working for
- Email and phone number for the organization
- Link to organization or project website
- Date the DMP was written

### 0. Dataset and Contact Information:

- Name of the dataset or project for which data is being collected: Development, Verification, and Validation of G-LOC Model
- Project number, contract number, or other number used to link this DMP: BLI AM11J-OC25.1
- Name of the person submitting this DMP -ORCID of the person submitting this DMP: Kyle Copeland, ORCID 0000 0002 8480 3614
- Email and phone number of the person submitting this DMP: kyle.copeland@faa.gov, (405) 954-6275
- Name of the organization for which the person submitting this DMP is working: U.S. FAA CAMI Aerospace Medical Research Division
- Email and phone number for the organization:
- Link to organization or project website: [https://www.faa.gov/data\\_research/research/med\\_humanfacs/aeromedical](https://www.faa.gov/data_research/research/med_humanfacs/aeromedical)
- Date the DMP was written: 10/26/2022

## 1. Data Description

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Name the data, data collection project, or data producing program.

1. Data Description: These data are products of the project "Development, Verification, and Validation of G-LOC Model"

**Describe the purpose of your research.**

The research investigates the question of how well a resource-flow based model of G-LOC and recovery built using more detailed physics and physiology compares with existing models for predicting symptoms known to occur in aeronauts during positive and negative Gz accelerations encountered in aerobatic flight and observed in centrifuge experiments. If the resulting software implementation of the model proves better than existing software models, it will better enable aeronauts and accident investigators to evaluate flight accelerations data for risk to aeronauts to G-LOC and related medical symptoms, as well as estimated recovery times, based on aeronaut physiology, medical factors, anti-g safety systems, and other significant factors.

**Describe the data that will be generated in terms of nature and scale (e.g., numerical data, image data, text sequences, video, audio, database, modeling data, source code, etc.).**

The project will result in these data: source code and executable (1 MB); a descriptive technical report of the model including data collected from referenced sources and data generated by the executable computer software built from the source code, used for verification and validation of the model (2 MB); and a user guide (1 MB).

**Describe methods for creating the data (e.g., simulated; observed; experimental; software; physical collections; sensors; satellite; enforcement activities; researcher-generated databases, tables, and/or spreadsheets; instrument generated digital data output such as images and video; etc).**

Data used in verification and validation were either collected from referenced sources or generated by the executable program computer program implementing the model and built from the source code. The source code, descriptive technical report, and user guide were written by the Principal Investigator.

**Discuss the period of time data will be collected and frequency of update.**

Data collection will be considered complete upon notification of acceptance for publication of the report describing the model and its verification and validation by the target peer-reviewed journal, as no new data will be needed at after this event. Future revisions of the model, software, and supporting data are possible in a later project.

**If using existing data, describe the relationship between the data you are collecting and existing data.**

Existing data from sources referenced in the data is used to inform the model and for verification and validation of model software output.

**List potential users of the data.**

These data will be useful to aeronauts (e.g., pilots involved in aerobatics), aviation physiologists, flight surgeons, accident investigators, researchers, and others involved in acceleration related aeronaut education and aviation safety research and simulation.

**Discuss the potential value of the data have over the long-term for not only your institution, but also for the public.**

These data will be useful for education and for evaluation of flight acceleration data with respect to aeronaut risk of experiencing G-LOC and related medical symptoms, as well as estimated recovery times from symptoms, based on aeronaut physiology, medical factors, anti-g safety systems (if any), and other significant factors.

**If you request permission not to make data publicly accessible, explain rationale for lack of public access.**

Data will be made publicly available

**Indicate the party responsible for managing the data.**

These data will be made publicly available through the National Transportation Library, as well through links on the Federal Aviation Administration Civil Aerospace Medical Institute websites

**Describe how you will check for adherence to this data management plan.**

Adherence to this data management program will be reviewed at least once per quarter.

## **2. Standards Employed**

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**List in what format(s) the data will be collected. Indicate if they are open or proprietary.**

**2. Standards Employed:**

Data is anticipated to be collected and developed electronically on secured government furnished equipment.

Data formats will be as follows:

1. Software User's Guide: PDF file
2. Software: Source code related files will be in text format
3. Peer reviewed journal article: PDF file

**If you are using proprietary data formats, discuss your rationale for using those standards and formats.**

Proprietary data formats are not anticipated for inclusion at this time.

**Describe how versions of data be signified and/or controlled.**

Data versioning will be maintained by the PI using a standard naming convention. Electronic data files will be retained on secured government furnished equipment.

**If the file format(s) you are using is(are) not standard to your field, describe how you will document the alternative you are using.**

The file formats anticipated for use are standard to my field.

**List what documentation you will be creating in order to make the data understandable by other researchers.**

Anticipated documentation will include two reports (user's guide and a descriptive report on model), both including graphs and tables as necessary, to explain the results of this study.

**Indicate what metadata schema you are using to describe the data. If the metadata schema is not one standard for your field, discuss your rationale for using that scheme.**

A specific schema has not yet been selected.

**Describe how will the metadata be managed and stored.**

Electronic data files will be retained on secured government furnished equipment. Any paper notes, documentation, or responses will be scanned or entered into an electronic data file.

**Indicate what tools or software is required to read or view the data.**

A computer or other internet-connected electronic device with a text editor and Adobe PDF reader will be required to access documents and software related files. To use the software requires either a Microsoft Windows 64-bit OS or, for native compilation of source code, a Fortran95 capable compiler.

**Describe your quality control measures.**

The PI will ensure the files are maintain on the government furnished equipment in accordance with DOT and FAA data accessibility policy. PI will ensure the files open and have retained the data entered.

### **3. Access Policies**

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**Describe what data will be publicly shared, how data files will be shared, and how others will access them.**

#### **3. Access Policies:**

All data sets and documents noted in this DMP will be available publicly. Data files will be shared through the National Transportation Library and CAMI web sites and will be accessible through these institution's respective websites.

**Indicate whether the data contain private or confidential information. If so:**

- **Discuss how will you guard against disclosure of identities and/or confidential business**



information.

- List what processes you will follow to provide informed consent to participants.
- State the party responsible for protecting the data.

The data contain no private or confidential information.

**Describe what, if any, privacy, ethical, or confidentiality concerns are raised due to data sharing.**

The data do not raise any privacy, ethical, or confidentiality concerns.

**If applicable, describe how you will deidentify your data before sharing. If not:**

- Identify what restrictions on access and use you will place on the data.
- Discuss additional steps, if any you will use to protect privacy and confidentiality.

As there are no identification-related issues for these data, no de-identification will occur.

#### **4. Re-Use, Redistribution, and Derivative Products Policies**

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**Name who has the right to manage the data.**

#### **4. Re-Use, Redistribution, and Derivative Products Policies:**

These data are managed by the Department of Transportation, Federal Aviation Administration. The data are in the public domain and may be re-used without restriction. Citation of the data is appreciated. Please use the following recommended citations:

1. U.S. Department of Transportation, Federal Aviation Administration, Civil Aerospace Medical Institute (2022). Development, Verification, and Validation of G-LOC Model: Data Management Plan. <https://doi.org/10.21949/1524442>
2. Software User's Guide: Copeland, K. *CGEM User's Guide*. Federal Aviation Administration Office of Aerospace Medicine Report DOT/FAA/AM-23/5 (January 2023), <https://doi.org/10.21949/1524438>
3. Software: Copeland, K. (2023) *CGEM*, Federal Aviation Administration Office of Aerospace Medicine, <https://doi.org/10.21949/1524439> (points to the latest version at Github.com)
4. Accepted version of journal article: Copeland, K. & Whinnery, J. E. *Cerebral Blood Flow Based Computer Modeling of Gz-Induced Effects*. Federal Aviation Administration Office of Aerospace Medicine Report DOT/FAA/AM-23/6 (January 2023) <https://doi.org/10.21949/1524446>
5. Copeland, K. and Whinnery J. E. CGEM: A CEREBRAL BLOOD FLOW BASED COMPUTER MODEL OF GZ-INDUCED EFFECTS [PRESENTATION]. Presented at 2021 Annual Meeting of the Aerospace Medical Association, September 1, 2021, Denver Colorado, <https://doi.org/10.21949/1528555>

The following article is published in *Aerospace Medicine and Human Performance*, for restrictions consult the publisher's policy for use.

1. Peer reviewed journal article: Copeland, K. & Whinnery, J. E. (2023). "Cerebral Blood Flow Based

Computer Modeling of Gz-Induced Effects". Aerospace Medicine and Human Performance, 94(5):409-416, doi <https://doi.org/10.3357/AMHP.6917.2023>.

**Indicate who holds the intellectual property rights to the data.**

The Federal Aviation Administration holds the intellectual property rights to this data

**List any copyrights to the data. If so, indicate who owns them.**

Data are in the public domain.

**Discuss any rights be transferred to a data archive.**

Any rights to be transferred to a data archive are unknown at this time.

**Describe how your data will be licensed for reuse, redistribution, and derivative products.**

Data will be available to the public for reuse, redistribution, and creation of derivative products in accordance DOT and FAA policy regarding U.S. government funded research products, i.e., the data are in the public domain and may be re-used without restriction, with citation of source appreciated.

## **5. Archiving and Preservation Plans**

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**Discuss how you intend to archive your data and where (include URL).**

**5. Archiving and Preservation Plans:**

Data archiving will be accomplished through the National Transportation Library services.

**Indicate the approximate time period between data collection and submission to the archive.**

The approximate time period between data collections and submission to the archive is anticipated to be less than one year.

**Identify where data will be stored prior to being sent to an archive.**

The data will be temporarily stored on government furnished equipment before being sent to archive.

**Describe how back-up, disaster recovery, off-site data storage, and other redundant storage strategies will be used to ensure the data's security and integrity.**

The data security and integrity will be maintained by the Federal Aviation Administration and the data management and protection will be subject to the standards and methodologies used by the Administration.

**Describe how data will be protected from accidental or malicious modification or deletion prior to receipt by the archive.**

The data security and integrity will be maintained by the Federal Aviation Administration and the data management and protection will be subject to the standards and methodologies used by the Administration.

**Discuss your chosen data archive's policies and practices for back-up, disaster recovery, off-site data storage, and other redundant storage strategies to ensure the data's security and integrity for the long-term.**

The data security and integrity will be maintained by the Federal Aviation Administration and the data management and protection will be subject to the standards and methodologies used by the Administration.

**Indicate how long the chosen archive will retain the data.**

The National Transportation Library will archive the data indefinitely.

**Indicate if the chosen archive employs, or allows for the recording of, persistent identifiers linked to the data.**

The National Transportation Library allows persistent identifiers linked to the data.

**Discuss how your chosen data repository meets the criteria outlined on the [Guidelines for Evaluating Repositories for Conformance with the DOT Public Access Plan](#) page.**

It is understood that the National Transportation Library complies with the following attributes:

1. Promotes an explicit mission of digital data archiving;
2. Ensures compliance with legal regulations, and maintains all applicable licenses covering data access and use, including, if applicable, mechanisms to protect privacy rights and maintain the confidentiality of respondents;
3. Has a documented plan for long-term preservation of its holdings;
4. Applies documented processes and procedures in managing data storage;
5. Performs archiving according to explicit work flows across the data life cycle;
6. Enables the users to discover and use the data, and refer to them in a persistent way through proper citation;
7. Enables reuse of data, ensuring appropriate formats and application of metadata;
8. Ensures the integrity and authenticity of the data;
9. Is adequately funded and staffed, and has a system of governance in place to support its mission; and
10. Possesses a technical infrastructure that explicitly supports the tasks and functions described in internationally accepted archival standards like Open Archival Information System (OAIS).

## **6. Policies Affecting this Data Management Plan**

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**Include policies that the data management plan was created to meet, such as the DOT public access plan.**

### **6. Policies Affecting this Data Management Plan:**

This data management plan was created to meet the requirements enumerated in the U.S. Department of

Transportation's "Plan to Increase Public Access to the Results of Federally-Funded Scientific Research"  
Version 1.1 << <https://doi.org/10.21949/1520559> >> and guidelines suggested by the DOT Public Access  
website << <https://doi.org/10.21949/1503647> >>, in effect and current as of November 4, 2022.

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## **Planned Research Outputs**

### **Software - "Civil Aerospace Medical Institute G Effects Model"**

The Civil Aerospace Medical Institute (CAMI) G Effects Model (CGEM) software models effects of extreme Gz accelerations, including visual symptoms, G-LOC, and return to consciousness following G-LOC. The software accommodates Gz acceleration profiles experienced by most civilian and military pilots and also reproduces historical centrifuge experiments. Effects such as dehydration and fatigue are readily accommodated through changes in physiological parameters. Future planned developments include extending the model to include monitoring additional brain centers to facilitate inclusion of A-LOC symptoms, anti-G equipment failure, an improved lung function model, direct inclusion of a library of acceleration profiles for standard aerobatic maneuvers used in airshows, and a more user-friendly means of inputting effects of pilot dehydration and fatigue beyond adjusting the current input parameters.

### **Text - "CGEM User's Guide"**

Guide for users with instructions describing the software that does the calculations needed to get results from the Civil Aerospace Medical Institute (CAMI) G Effects Model (CGEM) and how to use it.

### **Text - "Cerebral Blood Flow Based Computer Modeling of Gz-Induced Effects"**

Accepted version of a paper intended for publication in the peer-review scientific literature describing the Civil Aerospace Medical Institute G-Effects Model [CGEM], possible applications, and its verification and validation by comparison to published data from experiments and earlier models. Published as report DOT/FAA/AM-23/6.

### **Audiovisual - "CGEM: A CEREBRAL BLOOD FLOW BASED COMPUTER MODEL OF GZ-INDUCED EFFECTS"**

This is a narrated slide show describing the CGEM model originally presented at the 2021 Annual Meeting of the Aerospace Medical Association in Denver, CO on 1 September 2021.

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## **Planned research output details**

Title	Type	Anticipated release date	Initial access level	Intended repository(ies)	Anticipated file size	License	Metadata standard(s)	May contain sensitive data?	May contain PII?
Civil Aerospace Medical Institute G Effects Model	Software	2023-03-30	Open	None specified		None specified	None specified	No	No
CGEM User's Guide	Text	2023-01-30	Open	None specified	1 MB	None specified	None specified	No	No
Cerebral Blood Flow Based Computer Modeling of Gz- ...	Text	2023-01-30	Open	None specified	2 MB	None specified	None specified	No	No
CGEM: A CEREBRAL BLOOD FLOW BASED COMPUTER MODEL O ...	Audiovisual	2023-03-30	Open	None specified	25 MB	None specified	None specified	No	No

## Related Works

### Articles

- <https://doi.org/10.21949/1524446>

### Softwares

- <https://doi.org/10.21949/1524439>

### Supplemental informations

- United States. Department of Transportation. Federal Aviation Administration. Office of Aviation. Civil Aerospace Medical Institute. 2021. "CGEM User's Guide." [Supplemental information]. <https://doi.org/10.21949/1524438>.
- United States. Department of Transportation. Federal Aviation Administration. Office of Aviation. Civil Aerospace Medical Institute. 2021. "CGEM: A Cerebral Blood Flow Based Computer Model of Gz-Induced Effects." [Supplemental information]. <https://doi.org/10.21949/1528555>.