Open Science Beyond Data Sharing

2022 ARM/ASR Open Science Workshop
May 10, 2022

Markus Petters

Open Science

Open Science is the practice of science in such a way that others can collaborate and contribute, where research data, lab notes and other research processes are freely available, under terms that enable reuse, redistribution and reproduction of the research and its underlying data and methods.
(https://www.fosteropenscience.eu/taxonomy/term/100)

I. Open access (Manuscript publication available free of charge to reader, manuscript content has a free license)

II. Open data (Data available in publicly accessible repositories without download restrictions)

III. Open software (Data acquisition and processing scripts available under free license. 100% free software tool chain)

IV. Open hardware (Instrument designs and specifications available and free of licensing restrictions)

Most state of the science commercial and home-built instruments are not compatible with open science, yet.

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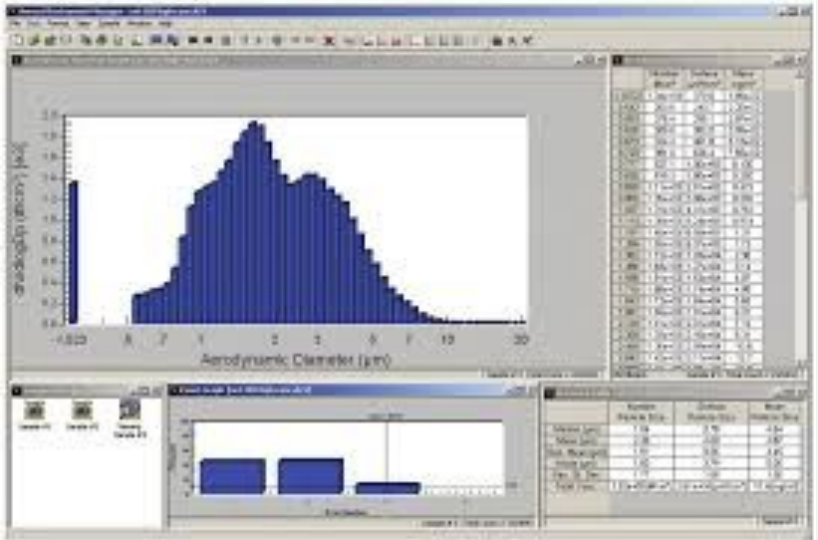
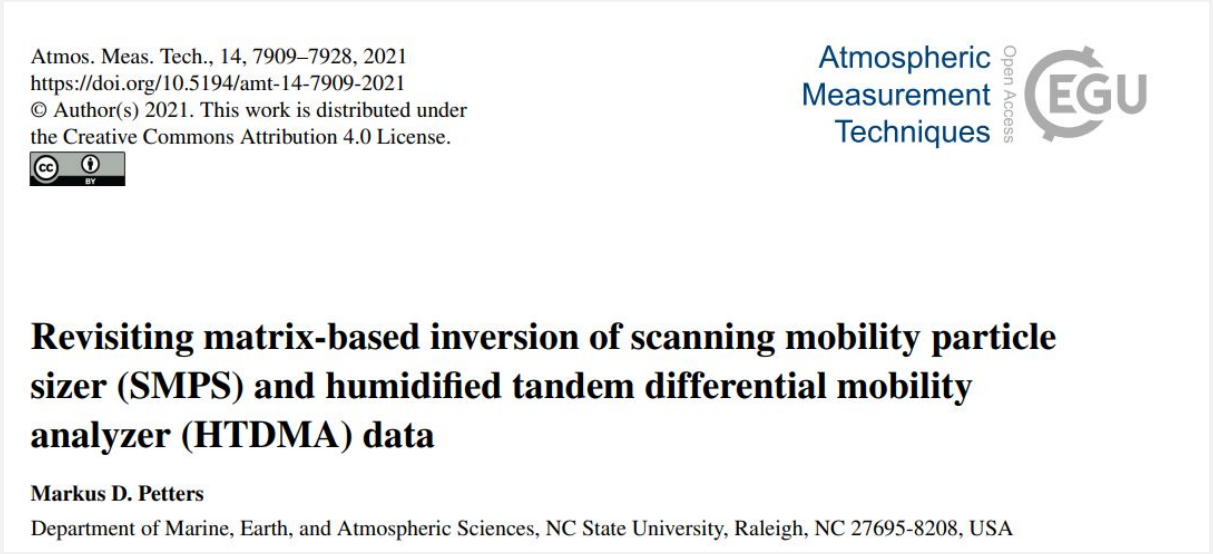


Open Software Examples/Challenges



Atmos. Meas. Tech., 14, 7909–7928, 2021
https://doi.org/10.5194/amt-14-7909-2021

Atmospheric Measurement Techniques Open Access EGU

Revisiting matrix-based inversion of scanning mobility particle sizer (SMPS) and humidified tandem differential mobility analyzer (HTDMA) data

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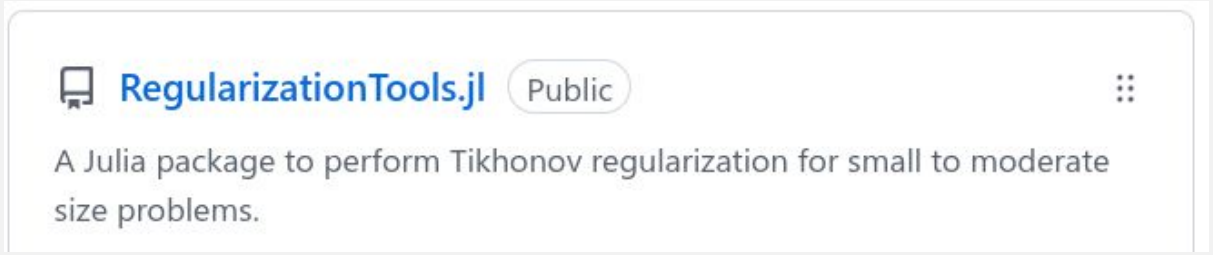
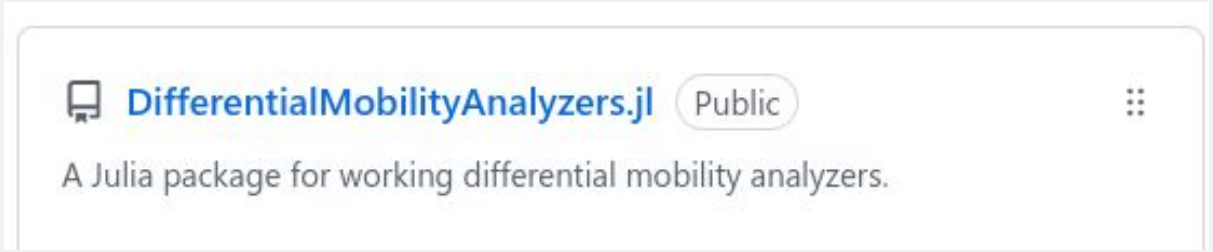


RegularizationTools.jl Public

A Julia package to perform Tikhonov regularization for small to moderate size problems.



DifferentialMobilityAnalyzers.jl Public

A Julia package for working differential mobility analyzers.

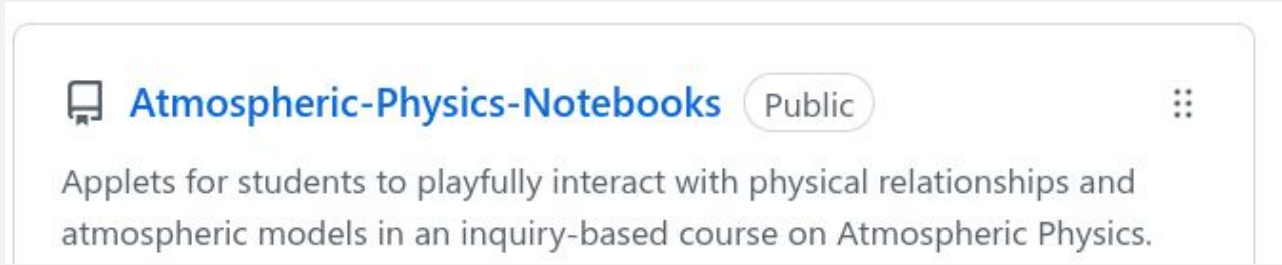
Specialized Domain-Specific Software

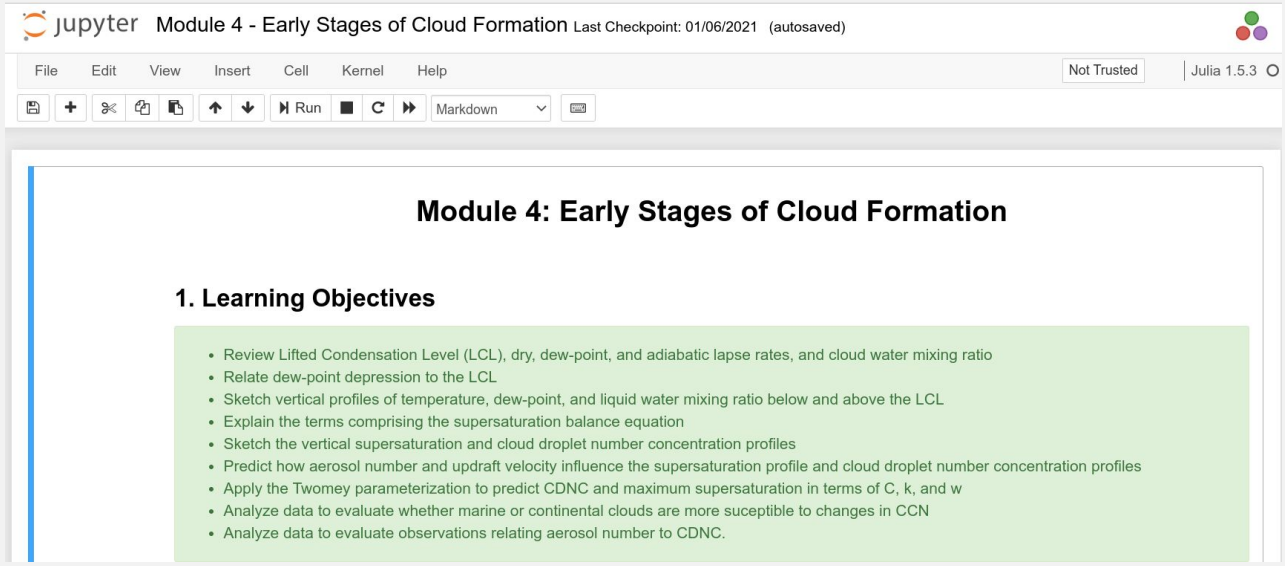
- Software tool to help with inversion
- Specialized language
- Targeted to “developer”

Challenges

- Documentation
- Software evolves but paper is static
- Must be maintained with moving open source ecosystem
- Not easy to install/learn/use
  - Needs front end for users (static software, web interface)
  - Tutorials
  - Containerization
- **Time commitment**

Open Software Examples/Challenges





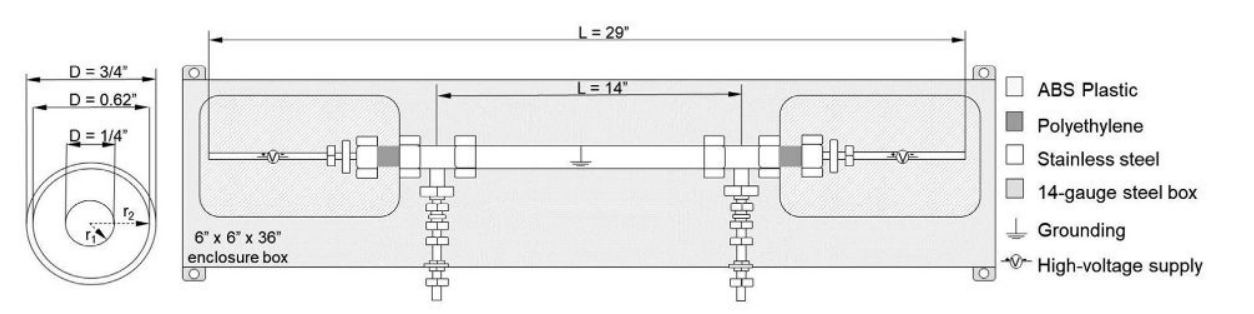
Designed to be

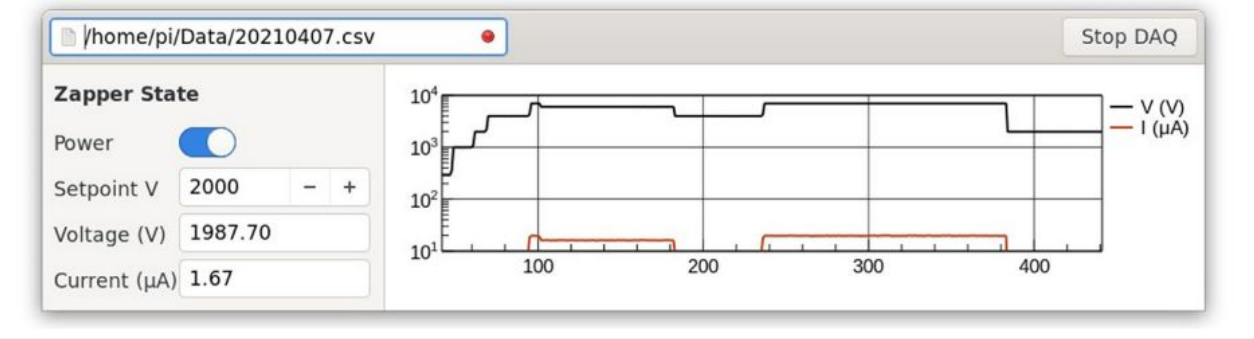
- Teaching material for instructors
- Learning material for students
- Adaptable for place-based learning
- Engagement and participation

Challenges

- Software installation
- Requires maintenance (software packages evolve).
- Scalable delivery to students
- Performance optimization

Open Hardware Examples/Challenges





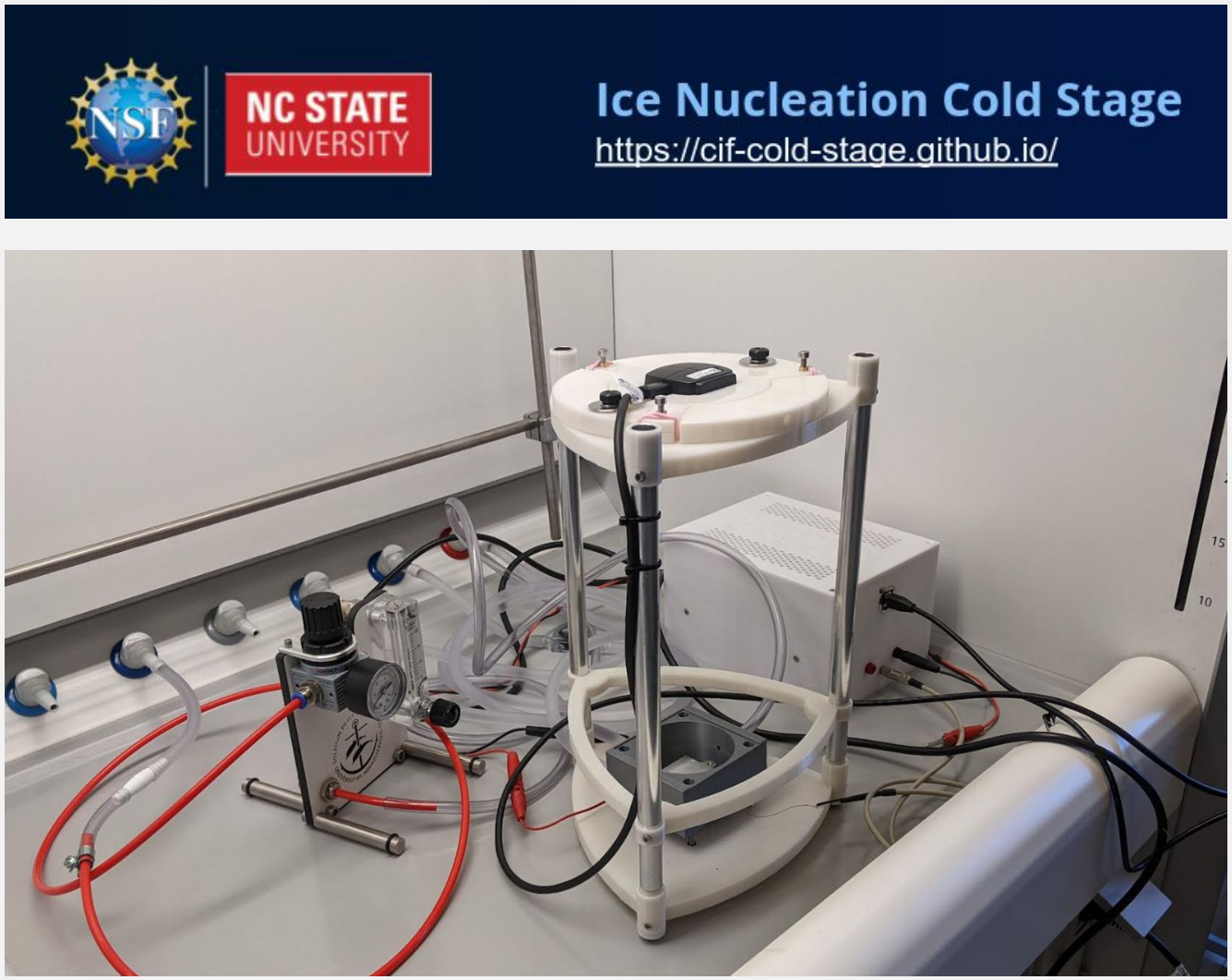
Designed to be

- Low cost
- Self manufacture for grad. student
- Enable participation
- Simple parts
- Accelerate innovation

Challenges

- Documentation
- Multiple repositories
- Software/hardware platform aging
- Time requirement to publication
- Means to share back improvements and getting credit (GitHub vs. Zenodo; “paper” vs. “project”)

Open Hardware Examples/Challenges



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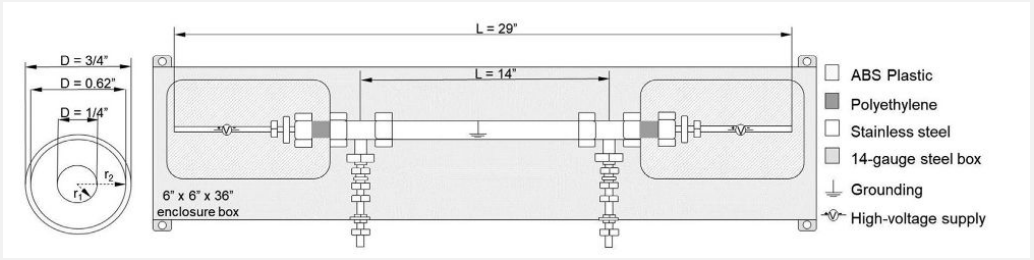
- **“Skill” of customers (designs, manufacturing, tools)**

The Virtuous Cycle Promise of Open Science

build tool at moderate cost



- answers science question
- gained hands on skills

Student/research group has a science question

share design improvements

Better Graduates – Faster Science – Cheaper Science – Improved Instrumentation

DOE Office of Science Definition from FOA

SC is dedicated to promoting the values of openness in Federally supported scientific research, including, but not limited to, ensuring that **research may be reproduced** and that the results of Federally supported research are **made available to other researchers**. These objectives may be met through any number of mechanisms including, but not limited to, data access plans, data sharing agreements, the use of archives and repositories, and the use of various licensing schemes.

Themes for Discussion

Incentives
- Time
- Funding
- “Recognition”

Philosophical Questions
- What should we consider as archivable data?
- What types and how should we archive software?
- How do we balance “publication” vs. “maintained project?”
- For whom do we generate these products?

Technology
- Complex tooling landscape
- No 100% satisfactory solutions yet