When software is constantly evolving, how can we ensure software quality?

Benefits of Open Source Software
- Encourages collaboration
  - Development, testing, debugging can be shared
  - Transparency exposes implementation details critical to scientific reproducibility, often excluded by scientific journals
  - More optimal use of funding
    - Funding can be pooled across diverse sets of projects/budgets
    - Rather than pay for licensing fees, pay for additional development
    - Infinite benefit to those unfunded graduate students
  - Community contributions can drive the code to evolve beyond original vision
- The original or modified source code may not be sold for profit
- Third-party software linked or wrapped around PFLOTTRAN may be proprietary

Open Source Development
- Software Configuration Management
  - PFLOTTRAN employs the Git distributed source control management tool for configuration management.
  - Git tags all changes to a code repository
  - Version control
  - Code can be rolled back if a mistake was made
  - Git allows developers to:
    - Clone the base repository
    - Modify and test code in a development branch
    - Merge changes back into base repository
  - Pinpoint problematic changesets (snapshots of code versions)
  - Hosted on Bitbucket.com

Automated Testing Suites
- PFLOTTRAN has automated testing suites for verification and validation.
- Code can be rolled back if a mistake was made.
- Developers are encouraged to run the suite.

Online Documentation
- PFLOTTRAN uses a documentation generator program called Sphinx (www.sphinx-doc.org).
- The documentation is version controlled and the repository is hosted on Bitbucket.com.
- When you roll back the code, you can roll back the documentation too!
- Sphinx creates html files as well as LaTeX -> pdf.
- We host the html files on our documentation website http://www.documentation.pflotran.org.
- The pdf User’s Guide and Theory Manual can be downloaded or printed, and never falls behind the online documentation
- http://www.sphinx-docs.org

Example regression test failure:
- An unsuccessful run of the unit and regression tests.
- Note several failing unit and regression tests!