Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2018-30-RC1, 2018

Geoscientific Model Development Discussions

Open Access

Interactive comment on "DATeS: A Highly-Extensible Data Assimilation Testing Suite" *by* Ahmed Attia and Adrian Sandu

Anonymous Referee #1

Received and published: 10 May 2018

Review of GMD-2018-30-1

DATeS is aiming to provide a flexible and highly-extensible data assimilation testing suite.

It seeks to provide a unified testing suite for data assimilation applications allowing data assimilation researchers to easily compare different methodologies in different settings with minimal coding effort.

The core of DATeS is written in Python. The main functionalities, such as model propagation, filtering, and smoothing code, can be written in low-level languages such as C or Fortran to attain high levels of computational efficiency.

It allows for easy interfacing with external third-party code written in various languages,

Printer-friendly version

Discussion paper

e.g., linear algebra routines written in Fortran, analysis routines written in Matlab, or "forecast" models written in C. This should help the researchers to focus their energy on implementing and testing their own analysis algorithms.

The DATeS architecture abstracts the following generic components of any DA system:

1. linear algebra routines,

2. a "forecast" computer model that includes the discretization of the physical processes,

3. error models, e.g. observation and background error,

4. an analysis methodology, e.g., a filter or a smoother.

At this stage the authors tested it on several popular test models for data assimilation:

(i) lorenz_models.Lorenz3: A class implementing the 3-variables Lorenz model Lorenz (1963).

(ii) lorenz_models.Lorenz96: An implementation of the Lorenz96 model Lorenz (1996).

(iii) cartesian_swe_model.CartesianSWE: Cartesian shallow-water equations model Gustafsson (1971); Navon and De-Villiers (1986) written in C, with a SWIG wrapper.

(iv) qg_1p5_model.QG1p5: Quasi-geostrophic (QG)model with double-gyre wind forcing and bi-harmonic friction Sakov and Oke (2008) written in Fortran, with a F2Py wrapper.

DATeS provides the following classes for several versions of the EnKF, the HMC family of filters, and a vanilla implementation of the particle filter:

The authors plan to continue developing DATeS with the long-term goal of making it a complete data assimilation testing suite that includes support for variational methods, as well as interfaces with complex.

My main issues to address regarding this interesting contribution are:

1. The paper has the character of a user manual and a missing essential part is that of highlighting in detail the difficulties, both technical and theoretical to use a full physics 4- D Var operational model and its adjoint in DATeS framework.

2. They should mention and discuss use of minimization algorithms to minimize the cost functional in particular for non-differentiable optimization.See Steward et al (2012,2014)

3 How to implement state of the art data assimilation methods for high-dimensional non-Gaussian problems.

See Vetra-Carvalho et al (2018)

4. How to deal with check-pointing and incremental 4-D VAR in the framework of DaTeS.

5. How to deal with model error in weal constraint data assimilation

6.The authors should present advantages and shortcomings of DATeS as well as expectations of benefits of its use.

Due to its perceived useful application I recommend the paper be accepted subject to addressing these medium/minor revisions.

References

J. L. Steward, I.M.Navon,M. Zupanski and N. Karmitsa:Impact of Non-Smooth Observation Operators on Variational and Sequential Data Assimilation for a Limited-Area Shallow Water Equations Model.Quart. Jour. Roy. Met Soc. , Volume 138, Issue 663, 323–339, January 2012, Part B (2012)

Jeff L Steward, Ionel Michael Navon, Napsu Karmitsa, and Milija Zupanski : User Manual for code of the paper Impact of Non-Smooth Observation Operators on Variational and Sequential Data Assimilation for a Limited-Area Shallow Water Equations Model in QJRMS (2014)

Sanita Vetra-Carvalho, Peter Jan van Leeuwen, Lars Nerger, Alexander Barth, M. Umer Altaf, Pierre Brasseur, Paul Kirchgessner & Jean-Marie Beckers (2018):State-of-the art stochastic data assimilation methods for high-dimensional non-Gaussian problems, Tellus A: Dynamic Meteorology and Oceanography, 70:1, 1445364, DOI: 10.1080/16000870.2018.1445364

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-30, 2018.

Printer-friendly version

Discussion paper