2016 Workshop: Data Assimilation for Space Weather

Long title
Data Assimilation for Space Weather: What works and what does not
CEDAR-GEM
Conveners
Marcin Pilinski
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Description

It has been 14 years since the first Data Assimilation session was organized at CEDAR. In 2002 the dominant view was that Data Assimilation was going to revolutionize modelling and solve most problems in Space Weather. We would like to review the successes and challenges encountered over the last 10 years, assess the present state, and discuss the future of Data Assimilation in view of the new sources of data from SWARM, COSMIC II, GOLD, ICON, and ground based instruments. We invite papers that describe results from different data assimilation approaches. We are particularly interested in data assimilation talks with emphasis on what works and what does not.

Agenda

13:30-13:35

Marcin Pilinski

Introduction

13:35-13:45

Mihail Codrescu

On Data Assimilation for Large, Strongly Forced Systems (pdf)

13:45-14:00

Eric Sutton

Data Assimilation Scheme for Driven Systems (pdf)

14:00-14:15

Tomoko Matsuo

Ensemble data assimilation for upper atmosphere specification and forecasting (pdf)

14:15-14:30

Marcin Pilinski

Developing the next generation Assimilative Drag Model: Lessons Learned (pdf)

14:30-14:45

Aaron Ridley

Retrospective Cost Model Refinement (pdf)

14:45-15:00

Humberto Godinez

Data Assimilation for the Inner Ring Current using Ensemble Kalman Filter: comparisons between filtering methods (pdf)

15:00-15:15

Adam Kellerman

Data assimilation of radiation belt electrons using multi-point observations and the VERB code: lessons learned and future developments (pdf)

15:15-15:30

David Koronczay

AWDANet (Automatic Whistler Detector and Analysis Network (pdf)

Justification

The challenge in Space Weather assimilation techniques has been to combine various sparse, globally distributed data sources with realistic models of the near-earth space environment in a way that takes into account the dynamic nature of Sun-Earth interactions and the coupling of atmospheric regions. The assimilation challenge involves topics of geospace-system dynamics, forcing and coupling science, as well as modeling techniques. As such, it is a good fit for a joint CEDAR-GEM session.

Assimilation is relevant to the Geospace Systems Science GEM/CEDAR focus area. Geospace Systems Science can benefit from a physics-based assimilation approach. This focus area calls for "advanced data analysis tools to explore multiscale interactions in observations and simulation models", an effort which can be aided by physics-based assimilation techniques by bringing together varied data sources distributed around the globe. The 2013 Addendum to CEDAR Strategic Plan specifically includes data-assimilation as one of the methods for addressing the problems of CEDAR science.

To address the space-weather assimilation challenge, the community has begun to couple data-assimilation schemes with first principles models. Further steps are being taken to increase the variety of data assimilated and to augment the ingestion of data-sets which better help specify forcing and coupling parameters in the models. A constant challenge is the prompt availability of globally distributed measurements specifying thermospheric, ionospheric, and magnetosperic state variables. These measurements are needed to better quantify the state of the system but are also critical in providing sources of comprehensive validation. We encourage all presenters to devote one slide to validation of their techniques, in particular comparing assimilation outputs with data which was not ingested into the models and including validation metrics such as standard deviation, bias, modeled-to-observed parameter ratio, RMSE, and prediction efficiency. This is the primary way in which progress can be quantified for this challenge.

Several groups are currently working on data assimilation topics focused on Space Weather specification. We propose that scientists working in the field present on their assimilation efforts with a focus on what works and what does not and that this distinction is supported by a validation analysis.

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