2017 Workshop: Assimilating auroral observations

Long title
Assimilating auroral ionospheric observations: remote sensing, in situ observations, and local-scale and global modelling
Conveners
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Rob Pfaff
Roger Varney
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Description

Recent rocket campaigns have sought to leverage analysis strategies based on rigorous incorporation of in situ and remote sensing measurements into physics-based models to yield improved inferences about auroral ionospheric electrodynamics, and related thermospheric responses. The Poker Flat Alaska 2017 winter rocket campaign added several more flights to our database of rocket/groundbased conjunction studies of magnetosphere-ionosphere-thermoshere coupling in auroral regions. The Isinglass flights included multipoint observations of ionospheric plasma parameters complemented by ground based diagnostics in the form of incoherent and coherent scatter radars and filtered medium-field and allsky cameras. The ISINGLASS rockets flew into two separate dynamic auroral displays. The combination of in situ and remote sensing observations provides the opportunity to explore ionospheric electrodynamics on different scale sizes. The Auroral Jets mission included two simultaneous rocket flights with different apogees (190 km and 331k m) over an initially stable auroral arc to provide new insights into neutral wind structures generated by auroral forcing. These missions utilized a combination of ground-based FPI array data, incoherent scatter radar, TMA releases, and in situ measurements from the rockets to determine the neutral winds. All these recent launches seek to build on results from previous missions (e.g. GREECE and MICA) that have explored the use of combining in situ data, imagery, and modeling in various ways.

In this workshop we welcome discussion of these case studies as well as discussion of other related efforts combining different data sources as inputs to ionospheric models. The goal of this workshop is to present early science results from these recent rocket missions and to discuss data analysis strategies that that may, more generally, be used in other combined in situ and ground-based conjunction experiments. In addition, this workshop seeks to discuss possibilities of developing an assimilative approach applicable to local scale auroral magnetosphere-ionosphere-thermosphere coupling studies.

Agenda

4:00-4:15 Overview group:

Lynch, Isinglass campaign

Pfaff/Clemmons, Jets campaign

4:15-4:35 Previous assimilative examples group:

Zettergren to introduce

Schierless, examples of assimilated data modelling

Chartier, assimilative example: TEC/neutrals

4:35-5:25 Local data combine/compare group:

Local-scale estimation and sort of assimilation, combining/comparing disparate data sets

Don Hampton organizing

Pfaff Jets team, ground based and in situ and imagery comparisons

Gillies, SuperDARN+RISR

Isinglass team, groundbased and in situ and imagery comparisons

5:25-5:45 local scale modelling group:

Zettergren organizing

Walterscheid, thermosphere-ionosphere modeling

Grubbs, Burleigh, auroral inversions and radar modelling

5:45-6:00 discussion moderators:

Lynch/Zettergren/Pfaff/Varney/Hysell

Panel discussion goal/focus:

• local scale assimilative techniques panel discussion.

• Strategies for and challenges with developing local-scale data assimilation methods

• Science questions that can benefit from local scale assimilation - we will solicit suggestions from likely participants beforehand and put up a list to talk around.

• what local scale assimilative strategy might look like and some of the challenges.

• guided discussion of progress and future plans; guided discussion of development of analysis metrics and plan.

• proposal for some sort of explicit CEDAR effort/challenge/workinggroup

Justification

The Poker 2017 campaign has brought together a large science team focussed on synergistic use of models and data with an eye toward developing assimilative analysis strategies for these types of experiments. We would like to continue and expand upon the collaborations formed during the campaign.

Science challenge: how do we combine varied observational data sources to best effect in feeding local-scale and global models of the auroral ionospheric system? i. Associated questions to be addressed involve the system science of the lower auroral ionosphere and its coupling both to the magnetosphere through currents, and to the thermosphere through winds. ii. Existing resources include a variety of conjugate observation case studies, and existing assimilative models. Planned/needed resources include more fully developed and capable assimilative models, as well as good plans for incorporating different data sources into them. iii. Progress metrics: Conjugate studies as described here allow for a test of the models' intepretation by comparing to in situ data. A metric for progress is the extent to

which the developed/improved models can be used to interpret remote sensing data with confidence without the checkpoint of in situ comparison.

The challenge described in (a) is justified by the CEDAR strategic plan strategic thrusts #1,2,4, and 6: systems perspective, interfaces and boundaries, observational and instrumentation strategies, and geoscience data and models.

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