ATS/CIRA Colloquium

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Hosted by Peter Jan van Leeuwen

3 p.m. Thursday, November 16
ATS 101 and Zoom

Advancing the Ensemble Data Assimilation of Geostationary Satellite Infrared Radiances

The advent of modern geostationary satellite infrared (GeoIR) imagery has ushered in a new era in atmospheric observations. Tremendous progress has been made in using GeoIR observations with ensemble data assimilation (EnsDA) to improve the analyses and forecasts of convective events. This progress also highlighted the weaknesses of current EnsDA methods.

This seminar is broken into three parts:

1. Demonstrating the potency of using the state-of-the-art Ensemble Kalman Filter (EnKF) for GeoIR EnsDA

2. An exciting novel approach to efficiently increase ensemble sizes without requiring more forecast model runs, and,

3. A new EnsDA method that avoids the weaknesses of EnKF-based GeoIR EnsDA.

In part 1, I will present the crystallization of my research on EnKF-based GeoIR EnsDA: a regional high-resolution Tropical Mesoscale Convective Systems Reanalysis (TMeCSR; “tea-mixer”; 9-km grid spacing). The TMeCSR not only captures the characteristics of more than 1200 summertime tropical MCSs, but also outperforms the gold standard ERA5. This new dataset is currently used to investigate tropical MCSs and evaluate climate models.

In part 2, I will introduce an efficient method that utilizes the user’s knowledge of forecast statistics to create new ensemble members from existing forecast ensemble members: the Probit-space Ensemble Size

Expansion for Gaussian Copulas (PESE-GC). A preliminary test of PESE-GC with a WRF ensemble indicates that the new members can be visually indistinguishable from the actual WRF ensemble.

In the final part of this seminar, an early form of PESE-GC is used to combat a weakness of EnKF-based GeoIR EnsDA. Specifically, an ensemble that is unsure about the present/absence of clouds has nonlinear forecast statistics. This nonlinearity violates the linearity assumption underlying the EnKF! I applied an early form of PESE-GC to create a new EnsDA method that handles those nonlinearities: the Bi-Gaussian EnKF (BGEnKF). Virtual reality tests with WRF reveal that the BGEnKF outperforms the EnKF at assimilating GeoIR observations.

Colloquia page: atmos.colostate.edu/colloquia