Data Assimilation Enhancements to Air Force Weather’s Land Information System

Introduction

• The United States Air Force (USAF) has a proud and storied tradition of enabling significant advancements in the area of characterizing and modeling land state information.
• 557th Weather Wing (557 WW; DoD’s Executive Agent for Land Information) provides routine geospatial intelligence information to warfighters, planners, and decision makers at all echelons and services of the U.S. military, government and intelligence community.
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Recent Data Assimilation Enhancements

• Updates to the meteorological analysis (e.g., improved precipitation processing using the bratseth scheme, consistency to the ISMR ensemble (ppm.nasa.gov/data-access/downloads/ppm);
• New generation of 10-km “USAF Snow and Ice analysis (USAF-SA)” (SAF [5]); Enables decommissioning of legacy SNOEPR application; DA-method of Direct Insertion replaced with EnKF.
• New 10-km configurations of Noahv3.9.1 (Last), Noahv4.0.1 and JULESv5.0 or combinations of [All of which possess optimized tuned EnKF of USAF Snow & Ice Analysis’, SMAP L2, and ASCAT Metop-A/AVHRR in model space on a common 10-km grid];

Other Significant Enhancements to Operations

• Southern limit of domain extended from 60° S to 90° S (now truly global).
• Replaced undocumented, outdated, multi-step pre-processing method with streamlined, LDT-contained methodology using the latest/greatest source data available (to include Met Office Ancillaries needed for initialization of GALWEM).
• Replaced SOILPARM.TBL (Cosby, 1983) used with Noah with corrected SOILPARM.TBL coefficients.
• In-house LIDSpert replaced with LTV. Improved functionalities enabled.
• Improved Upon GOFs (Improves upon both 1/4° navysst used by WRF and 1/20° SSTs and Sea Ice Fraction and thickness to 1/20° (~5-km) OSTDIA (produced by Met Office)], respectively.) Enables GALWEM COOP under INFOCON-1 (.mil-to-.mil).
• Uncertainty estimation applied on 12-member ensemble and mean to derive standard deviations of several parameters; Enables satisfaction of (most) vertical profiles of land state variable requirements for PAIS; and
• Transition from Grb-1-to-Grb-2 (Enables decommissioning of legacy data flows).
• DISA STIG-compliant with zero vulnerabilities/findings.

Future Work

• Direct radiance assimilation of NRT SNAP L1 Tb (9-km).
• Enabling NRT-assimilation of albedo, vegetation conditions, and Tsfc from MODIS/VIIRS for the Noah LSM to the NOFS LSMS.
• Extend the data assimilation capabilities of LTV to allow for the assimilation of near-real-time (NRT) soil moisture products from ESA’s Soil Moisture and Ocean Salinity (SMOS) mission.
• Extend the data assimilation capabilities of LTV to allow for the assimilation of next-generation, global 10-km “USAF Snow and Ice analysis (USAF-SA)” (SAF [5]); Enables decommissioning of legacy SNOEPR application; DA-method of Direct Insertion replaced with EnKF.
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References


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Fig 1. Primary Subsystems comprising the LIS Framework.

Fig 2. LIS Version 7.3 System Level View.

Fig 3. Mean of station bias values by latitudinal band with 95% confidence intervals shown in red.

Fig 4. Summary of CONUS results (4/1/15 - 12/31/15).

Fig 5. Difference RMSE between SNOEPR and USAF-SA vs. SNODAS. Warm colors indicate improvement and cool degradation. USAF-SA performance improved over 16.6%, degraded 23.4% locations.