C31-W132B: Project for the Intercomparison of Land Data Assimilation Systems (PILDAS)

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1. Description and Objectives

The Project for the Intercomparison of Land Data Assimilation Systems (PILDAS) is a community effort organized through the GEWEX/GLASS panel to:

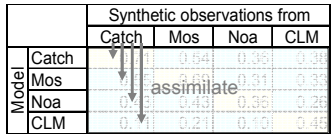
- Enable better **communication** among LDAS developers.
- Develop and test a **framework for LDAS comparison** and evaluation.
- Compare land assimilation **methods**.
- Conduct sensitivity studies of **assimilation input parameters** (such as model and observation errors).
- Provide **guidance and priorities for future** land assimilation research and applications.
- Ultimately, produce **enhanced global data sets** of land surface fields.

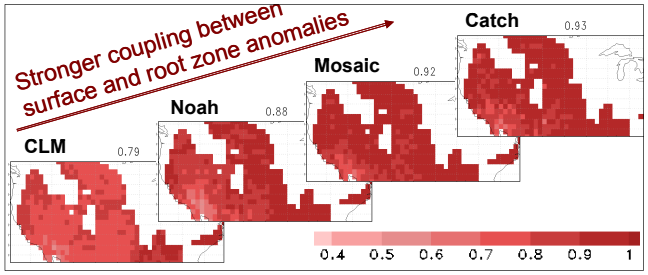
2. Heritage Pilot Study (Kumar et al. 2009)

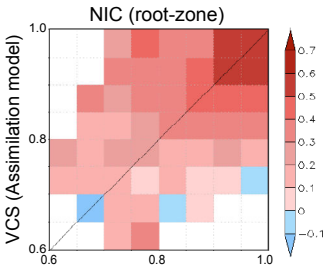
How does land model formulation impact assimilation estimates of root zone soil moisture?

Synthetic soil moisture assimlation with multiple land models but only one assimilation method (EnKF) and only one institution (NASA/GSFC).

Kumar, Reichle, Koster, Crow, and Peters-Lidard (2009), Role of subsurface physics in the assimilation of surface soil moisture observations, *J. Hydromet.*, *10*, 1534-1547, doi:10.1175/2009JHM1134.1







VCS = vertical coupling strength

NIC = Normalized ROOT ZONE soil moisture improvement from assim. of surface soil moisture

Key findings:

- Identical twin experiments overestimate the skill contributed by the assimilation.
- Stronger coupling between surface and root zone (VCS) leads to more efficient assimilation.
- If assimilation system is properly set up, the skill improvement depends only weakly on the land model.
- It is prudent to overestimate VCS in the assimilation model.

3. The First Experiment (PILDAS-1)

The **first experiment** (PILDAS-1) will focus on

- systems targeted for weather and seasonal forecasting at operational centers and research institutions,
- **soil moisture assimilation**, and
- development of a framework for LDAS comparison.

PILDAS-1 will use

- various assimilation approaches (EnKF, EKF, …),
- multiple "off-line" land models (not coupled to atmosphere), and
- synthetic observations.

Future experiments will assimilate satellite observations and use coupled land-atmosphere modeling and assimilation systems.

a) PILDAS-1 Setup

DRAFT

Domain (~Oklahoma):
- 100°W-94.5°W Lon.
- 34.5°N–37°N Lat.

Resolution:
- 0.125°x0.125° Lat./Lon.

Experiment period:
- 2001 – 2011

		"TRUTH" FORCING			
		LSM-1	LSM-2	...	LSM-N_T
		MEASUREMENT NOISE			
		OBS-1	OBS-2	...	OBS-N_T
"LDAS" FORCING	LDAS-1	↓	↓	...	↓
	LDAS-2	↓	↓	...	↓
	...	...	...	...	...
	LDAS-N_A	↓	↓	...	↓

Assimilate N_T sets of synthetic obs. into N_A assimilation systems.

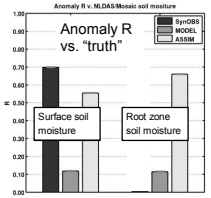
N_T = # truth integrations (no more than # participant groups)

N_A = # LDAS integrations (possibly $N_A >> N_T$)

➔ N_A open loop (no assimilation) integrations

➔ $N_T \cdot N_A$ assimilation integrations

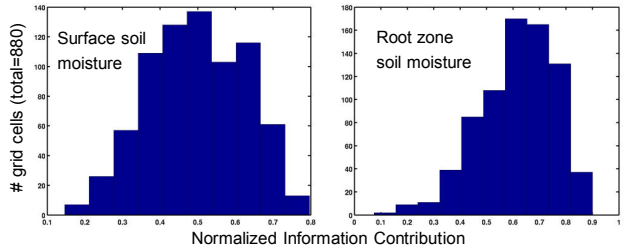
b) PILDAS-1 Early Test



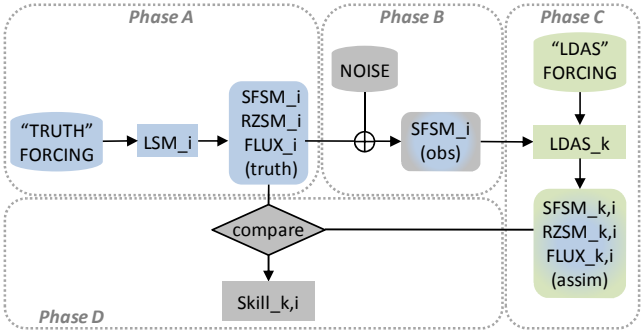
Truth integration:
- NLDAS/Mosaic data product

Synthetic surface soil moisture observations:
- Based on NLDAS/Mosaic "truth" 0-10 cm soil moisture
- Added uncorrelated Gaussian noise with error std-dev=0.04 m^3/m^3.

Model and assimilation integrations:
- Catchment model with 5 cm surface layer and MERRA forcing
- GMAO EnKF



c) PILDAS-1 Flowchart and Timeline



Preparations (Oct 2011*):

*Tentative start date.

Refine experiment plan in discussions with participants, prepare forcing data sets, dry-run with two institutions.

Phase A (Mar 2012*):

Generate truth for i=1:N_T land models (participants).

Phase B (Jun 2012*):

Generate i=1:N_T sets of synthetic observations (core group).

Phase C (Aug 2012*):

Generate N_A open loop and $N_A \cdot N_T$ assim. runs (participants).

- Participants **should** assimilate all N_T sets of synthetic observations at least once into their default LDAS.
- Participants **may** additionally use LDAS variants (different model, different assimilation method, different assimilation parameters,…).
- Participants choose assimilation algorithm and assimilation parameters
- LDAS output must include assimilation diagnostics (O-F, increments, error parameters, …)

Phase D (Oct 2012*):

Analyze results (all).

- Core group computes skill metrics, including NIC, VCS, and statistics of assimilation diagnostics.
- Draft publications.

4. Participants

PILDAS is a community effort and open to all interested parties.

The table below lists confirmed PILDAS-1 participants.

If you would like to participate, please contact:

Rolf Reichle (rolf.reichle@nasa.gov, +1-301-614-5693)

Institution	POC	Land model	DA method
ECMWF	Patricia de Rosnay, Gianpaolo Balsamo	HTESSEL	EKF
Environment Canada	Stephane Belair, Marco Carrera, Bernard Bilodeau	ISBA	EnKF
Ghent University	Valentijn Pauwels, Niko Verhoest	Toplats	*(tbd)*
Meteo-France	Jean-Francois Mahfouf	ISBA	EKF
Monash University	Jeff Walker	*(tbd)*	*(tbd)*
NASA/GMAO	Rolf Reichle, Qing Liu	Catchment	EnKF
NASA/Hydrological Sciences Lab	Sujay Kumar, Christa Peters-Lidard	LIS models (Noah, Mosaic, CLM, Catchment, VIC, TESSEL, ...)	EnKF
Norwegian Institute for Air Research (NILU)	William Lahoz, Tove Svendby	ISBA	EKF, EnKF
USDA/ARS Hydrology and Remote Sensing Lab	Wade Crow	*(tbd)*	EnKF