

National Aeronautics and Space Administration



Soil Moisture
Active Passive
Mission
SMAP

Science Team

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Jet Propulsion Laboratory
Pasadena, CA

Update on the
implementation
of SMAP at ECCC

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Environment and Climate Change Canada



Environment and
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Environnement et
Changement climatique Canada





Land Surface Team at ECCO



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(Hydrology group)



SMAP at ECCO Operations... through CaLDAS



**Canadian Land
Data Assimilation System
(national 2.5 km)**

SMAP

**National
Surface
and
River
Prediction
System
(NSRPS)**

**High-
Resolution
Deterministic
Prediction
System
(HRDPS)**

**Regional
Ensemble
Prediction
System
(REPS)**

**Canadian Land
Data Assimilation System
(global 15 km)**

SMAP

(tech transfer still
to be confirmed)

**Global
Deterministic
Prediction
System
(GDPS)**

**Global
Ensemble
Prediction
System
(GEPS)**

National Surface and River Prediction System



ANALYSIS

HRDPS (atm)

forcing

CaLDAS (w/ SMAP)

2.5 km,
SVS-based SPS, ensemble CaPA,
surface and satellite obs.

Pseudo-analyses of
surface runoff, subsurface
lateral flow, drainage

DHPS (hydro)
Continuous cycle, 1 km,
assim. of river discharge obs.

Analyses of
soil moisture, snow depth,
land sfc. temperatures

Analyses of
2-m air temp.
& humidity

Streamflow
analyses

FORECAST

(atm) HRDPS

days 1-2 forcing

GDPS

days 3-6 forcing

HRDLPS (land)

SVS-based SPS
National 2.5-km grid
6-day forecasts

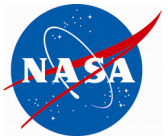
Forecasts of surface
runoff, subsurface
lateral flow, drainage

DHPS (hydro)
6-day forecasts
1km

Streamflow forecast

Forecasts of
soil moisture, snow,
surface temps.,
2-m air temp. &
humidity,
10-m winds

National Surface and River Prediction System



Example of the impact of the assimilation of SMAP+SMOS in CaLDAS on hydrologic analysis system

Nelson River shown here

Two experiments forced by CaLDAS-sat and ensemble precipitation analyses

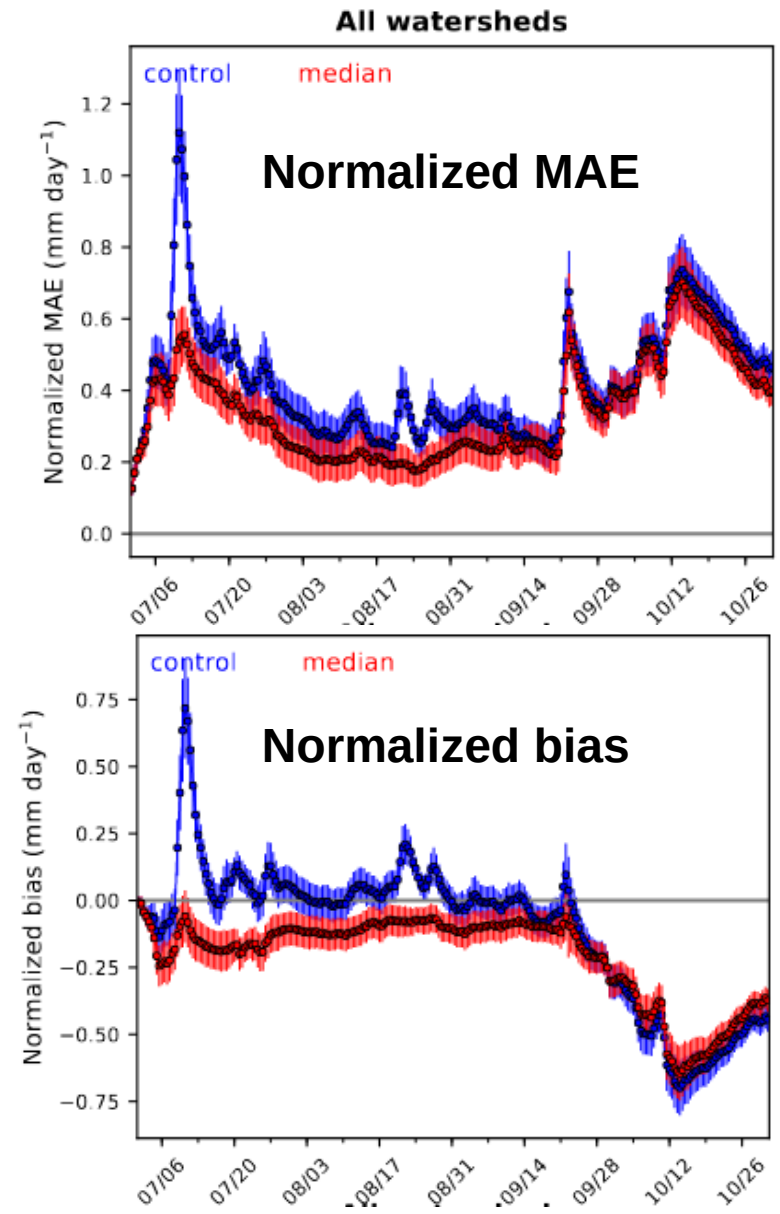
Period of 20190701 to 20191031

Analysis mode, but no assimilation of river flows (to better isolate the effect of SMAP and SMOS)

Blue: DHPS (hydro) forced with CaLDAS control member (no assimilation)

Red: DHPS (hydro) forced with median of CaLDAS analyses (w/ **SMAP** + SMOS)

(PROVIDED by ETIENNE GABORIT)



List of proposed modifications

CaLDAS with **SMAP**, SMOS, AIRS, CrIS, and IASI

SVS land surface scheme instead of ISBA

Update to land surface fields

+ a few other changes, including:

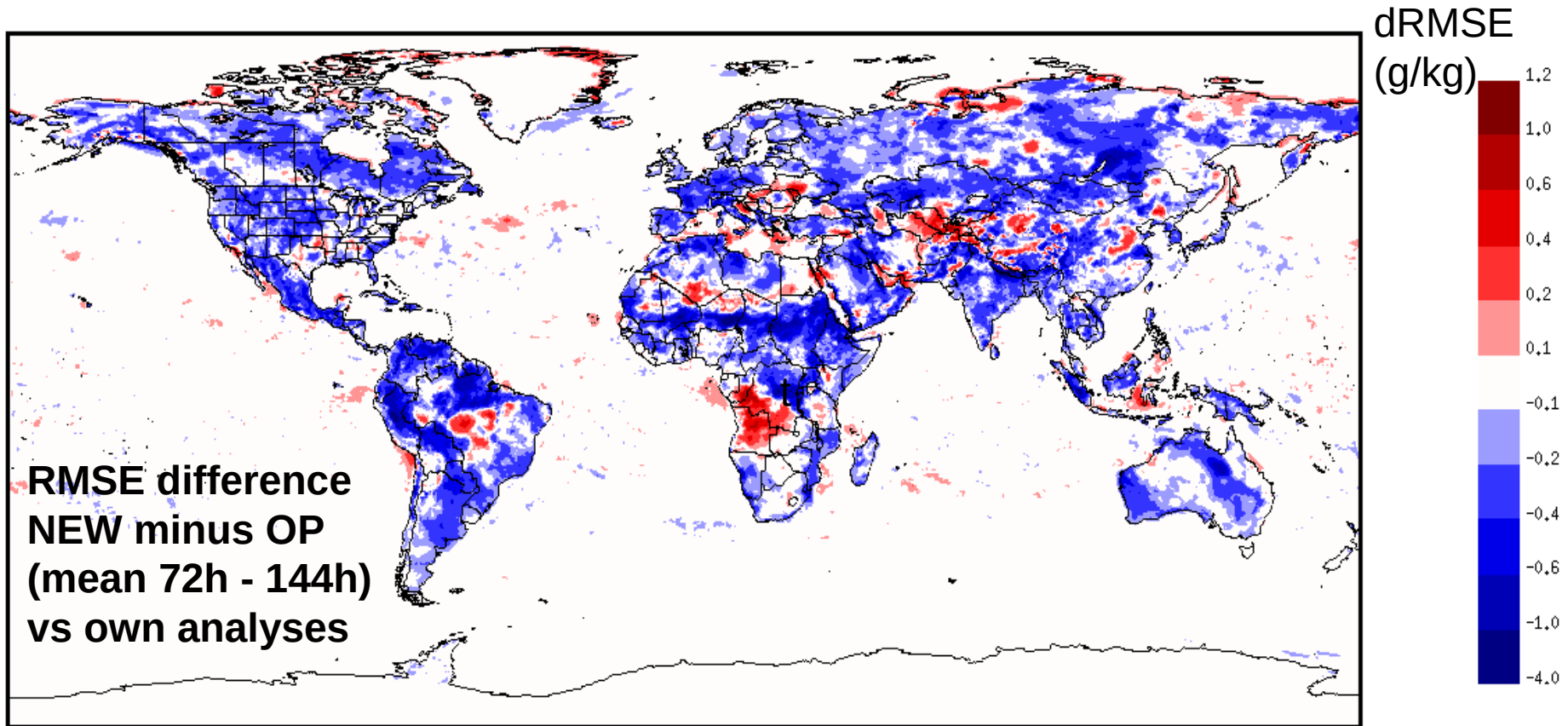
Flux spatial filtering, orographic form drag, dynamic z0h/zom,

Delage (1997) stable layer, effective resistance for flux agg.

Global Deterministic Prediction System



Evaluation vs own analyses, screen-level, humidity, summer 2019

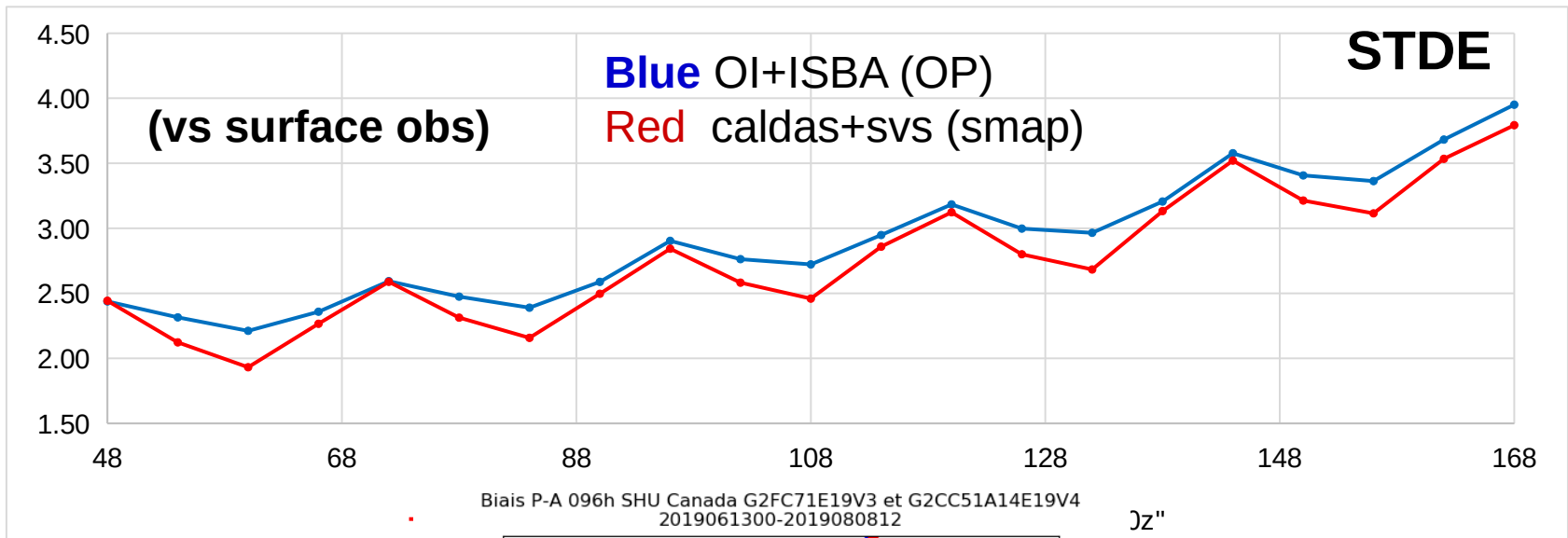


Blue caldas+svs (w/ SMAP) better
Red OI+isba better

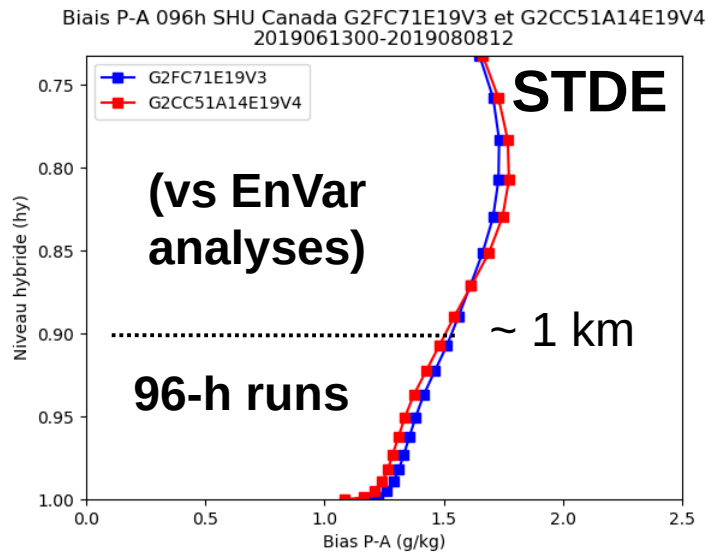
Global Deterministic Prediction System



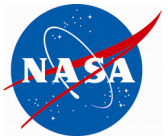
Summer 2019, screen-level, humidity (dew point), Canada



All 00 UTC runs



Global Deterministic Prediction System



Plan "A" versus Plan "B"... a difficult choice?

ScoreCard against ECMWF

(- % change in RMS error)

2019061300-2019083112

STDE improvement averaged over 10 days and over Canada

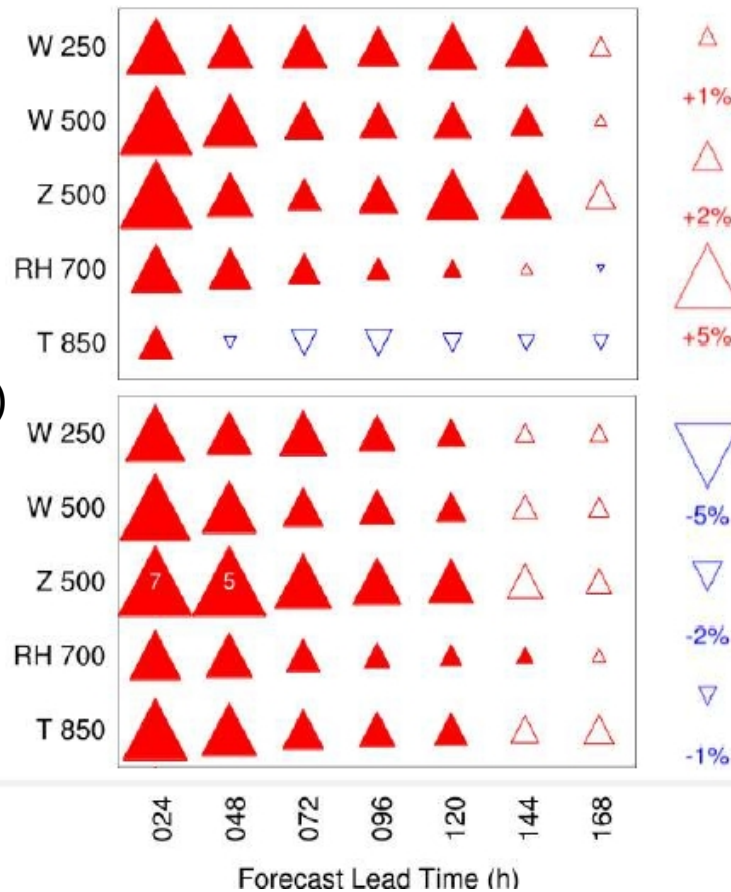
Summer 2019
Northern extratropics

A Northern ET
 $\Delta nwp-index$
 $+ 1.82\%$

Innovations from both surface and weather prediction groups
Caldas (w/ SMAP)

B Northern ET
 $\Delta nwp-index$
 $+ 2.53\%$

Innovations from only the weather prediction group



| | | |
|----|-------|-------|
| PO | 0.00% | 0.74% |
| TD | 7.86% | 5.76% |
| TT | 4.61% | 3.38% |
| UV | 1.14% | 2.12% |

00 UTC 12 UTC

| | | |
|----|-------|-------|
| PO | 0.72% | 0.32% |
| TD | 0.69% | 1.14% |
| TT | 1.23% | 0.46% |
| UV | 0.67% | 0.31% |

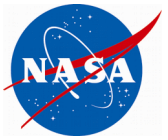
00 UTC 12 UTC

SURFACE
(vs obs)

(ADAPTED from a PRESENTATION by VINCENT FORTIN)



A few words



SMAP used successfully in land and river prediction system (now in the process of being transferred at ECCO Operations)

Technological transfer more difficult for NWP

Not clear at this time when other NWP systems will be implemented with CaLDAS and SMAP

Several articles on the way related to this effort of the last few years
