STATUS of LAND SURFACE MODELING and DATA ASSIMILATION at ECCC

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ECCC land surface (non-climate) "universe"



<u>CaLDAS "screen" (ISBA) in HRDPS (a few years ago)</u> <u>Dew point temp., STDE, summer, 00 UTC cases</u>



4.0

12

forecast time (hour



48h

42

2.0

S

0

12

forecast time (hour

48h

42



– Expérience hrdps linaux avec ca



forecast time (hour)

Implementation of CaLDAS "sat" 2.5-km regional (2019)Surface and River Prediction System Analysis Mode Forecast Mode HRDPS HRDPS GDPS days 1-2 forcing days 3-6 i forcing forcing CaLDAS-Sat HRDLPS Analyses of Continuous cycle, 2.5 km, soil moisture, snow depth, 6-day forecast, 2.5 km, SVS-based SPS, ensemble CaPA, SVS-based SPS land sfc. temperatures surface and satellite obs. Forecasts of surface Pseudo-analyses of runoff, subsurface Analyses of 2m Forecasts of soil surface runoff, subsurface lateral flow, drainage air temp. & lateral flow, drainage moisture, snow, land humidity sfc. temps., 2m air temp. & humidity, 10m winds DHPS DHPS Streamflow analyses Continuous cycle, 1 km, 6-day forecast, 1 km assim. of river discharge obs. Streamflow Forecast



Impact of CaLDAS "sat" on hydrological prediction



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Impact of CaLDAS "sat" on hydrological prediction





Implementation of cities in km-scale NWP





Impact of cities on HRDPS predictions

Emet 1. 48LTS12_D19wTEBd2 00z [20] 2. 48LTS9_D19 00z [20] 3.0 2.5 STDE Air No TEB 0 N temperature 23 879 237 20 Summer 5 879 2366 With TEB 881 2369 cases 1.0 USA 0.5 NIGHT NIGHT 0.0 numbers on the curves represent observations 3 12 15 27 30 33 36 39 9 18 21 24 Run Hour + Forecast Lead Time (hours)

ade synop United States of America

TEB will also be implemented in 2.5-km offline surface system for medium and long-range forecasts

Impact of snow on hydro forecasts (as part of motivation for TSMM mission)



(Abaza et al. 2019, under review)



Impact of snow on hydro forecasts (as part of motivation for TSMM mission)

BIAS streamflow

CaLDAS median (blue) vs CaLDAS control (no assimilation of surface snow depth obs – red)

Over the Great Lakes area



Verification of streamflow predictions for: 20190307 - 20190603, gls, all watersheds



Weakly coupled vs offline land DA cycles Impact on near-surface soil moisture

"coupled" minus "offline"



Figure 2. Two month difference of the mean of the top layer (5 cm) soil moisture analyses [m^o m^o] of the coupled and uncoupled experiments during summer 2016 (top; E16CPL-E16OFF) and winter 2017 (bottom; H17CPL-H17OFF) periods.

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(Bani Shahabadi et al. 2019, under review)

Weakly coupled vs offline land DA cycles Impact on atmospheric boundary layer



(Bani Shahabadi et al. 2019, under review)



Weakly coupled vs offline land DA cycles Impact on precipitation

a) FREQUENCY BIAS INDEX OF 24-HOUR ACC. PRECIPITATION (mm) 2017-01-01 @ 2017-02-28 accum 12h @ 36h run 0z valid 12z day 2 capa North America



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Canada

c) EQUITABLE THREAT SCORE OF 24-HOUR ACC. PRECIPITATION (mm) 2017-01-01 @ 2017-02-28 accum 12h @ 36h run 0z valid 12z day 2 capa North America



Field-scale soil moisture (in the soil moisture space)



(Dabboor et al. 2019)



Field-scale soil moisture (in the C-band backscatter space)

SVS+IEM





(Sun et al. 2019)



Ecosystems (CTEM) in SVS (based on Arora et al.)

V.K. Arora/Agricultural and Forest Meteorology 118 (2003) 21-47



Fig. 1. The structure of the terrestrial ecosystem module and the rate change equations for the carbon in five model pools: leaves (L), stem (S), root (R), litter or debris (D), and soil organic matter or humus (H).

Photosynthesis already included in SVS



Primary **Production** national)



Impact of photosynthesis on NWP

STANDARD DEVIATION (P-O) OF SURFACE TEMPERATURE (C) 2015-07-01 @ 2015-08-30 ade synop Canada



A few other items

Vegetation in cities

Traceability of errors related to land surface

Snow modeling (12-layer snow model, SVS-ES)

Snow data assimilation (IMS, passive MW, problem with snow depth obs)

Canadian precipitation analysis (satellite products, solid precipitation, hourly products).



