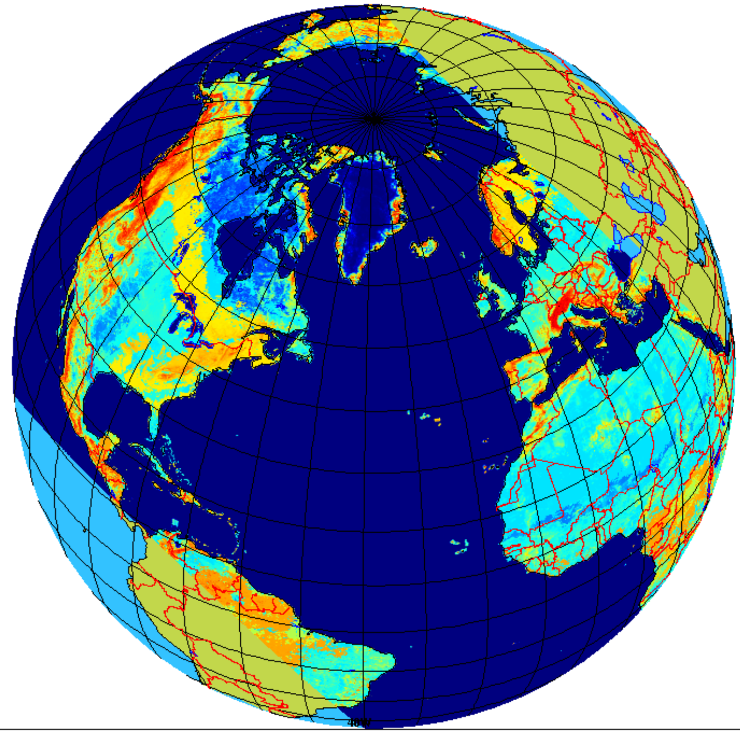
Environment Canada Environnement Canada

Canada

SMAP and its Importance for the Next Generation of ECCC’s Land Data Assimilation System



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Environment and Climate Change Canada (ECCC)

2017 SMAP-Canada workshop, 16-17 May 2017, University of Guelph

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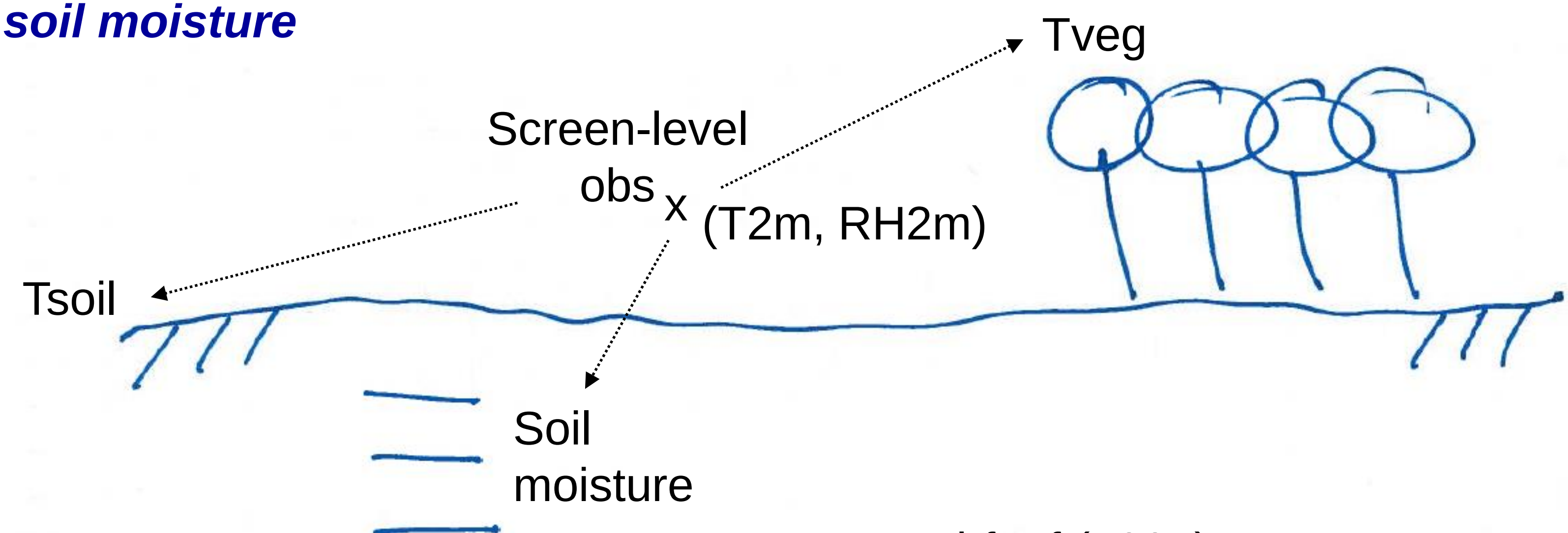
Land Data Assimilation for Numerical Weather Prediction (Now OP at ECCC)

The primary objective is to optimize the impact of land surface initial conditions (ICs) on atmospheric forecasts

Near-surface observations are now assimilated to increment surface temperatures and soil moisture

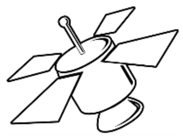


Mahfouf (1991)
Douville et al. (2000)
Belair et al. (2003)

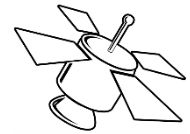
(case with no snow)

Land Data Assimilation for Numerical Environmental Prediction (in development)

L-band (SMOS / SMAP) for soil moisture



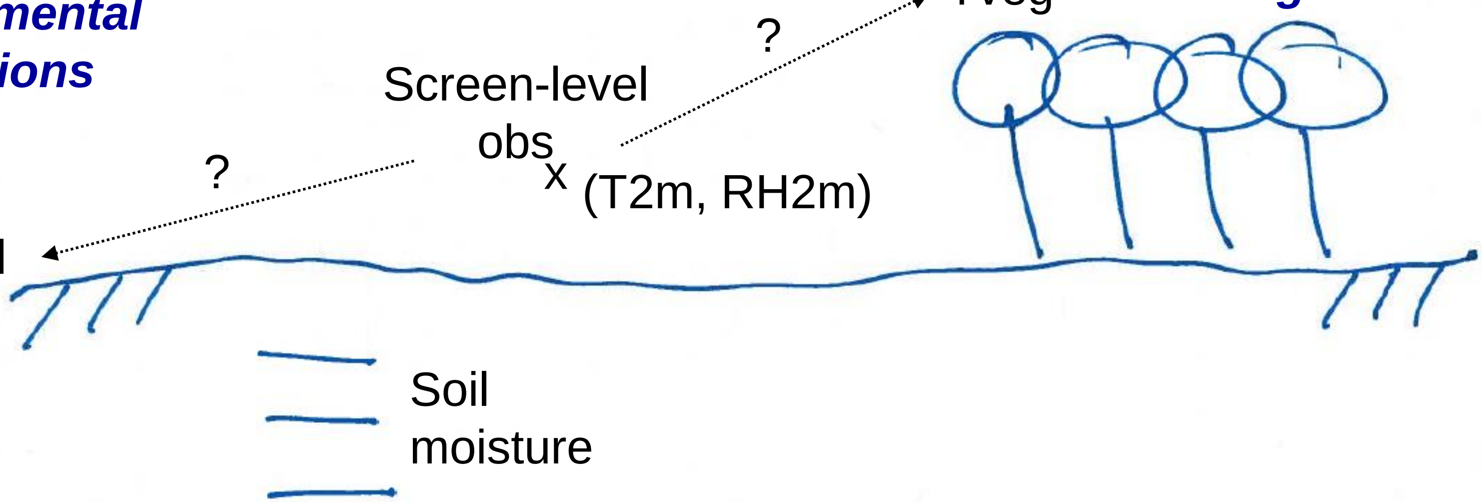
Use of space-based remote sensing data to enhance or replace near-surface observations



IR imagery for surface temperature

Weakly coupled with upper-air assimilation system, i.e., land surface has its own configuration

The main objective is to produce land surface ICs for all environmental applications



(case with no snow)

Requirements for the next operational land data assimilation system at ECCC

*Setup and optimized **first** to minimize errors against surface observations of control variables, i.e., surface temperatures, soil moisture, snow, vegetation*

***One** system for all applications: weather, hydrology, and other clients such as agriculture, forest fires, ecosystems.*

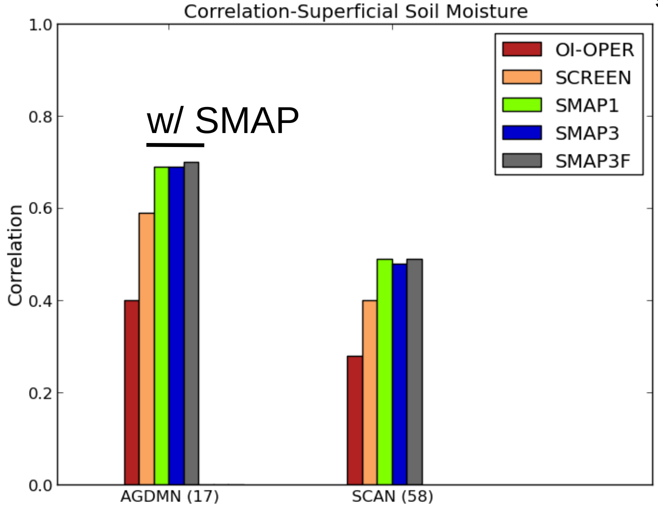
But, has to have a positive impact on numerical weather prediction (first / host client)

Km-scale over North America, 5-10 km grid spacing worldwide

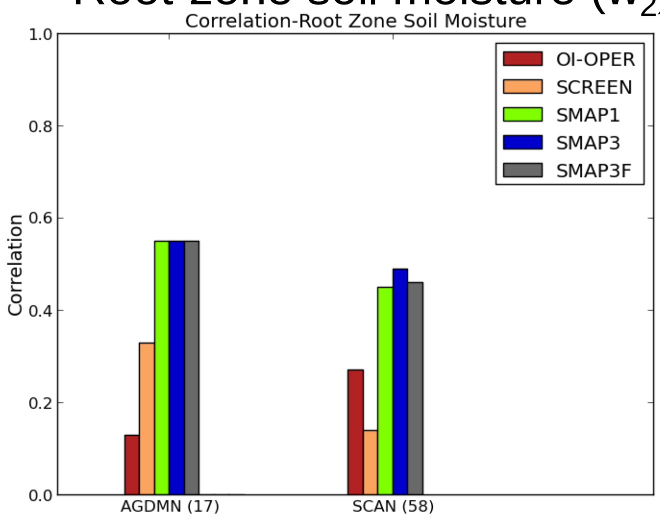
Weakly coupled with upper-air data assimilation systems (i.e., surface has its own operational process).

Impact of SMAP on Soil Moisture (corr)

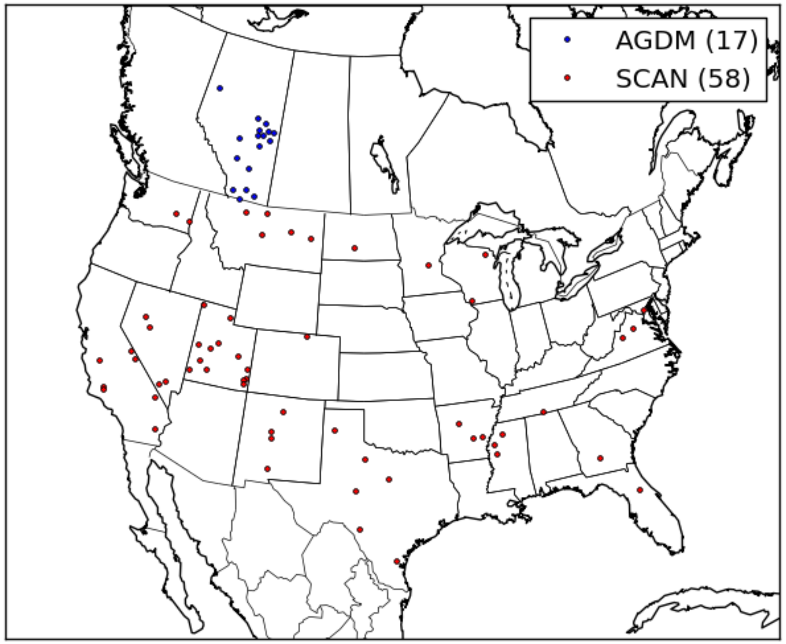
Near-surface soil moisture (w_g)



Root-zone soil moisture (w_2)



For July-August 2015



<u>AGDMN</u> = Alberta Ground Drought Monitoring Network (5, 20, 50, 100 cm)

<u>SCAN</u> = Soil Climate Analysis Network (5, 10, 20, 50, 100 cm)

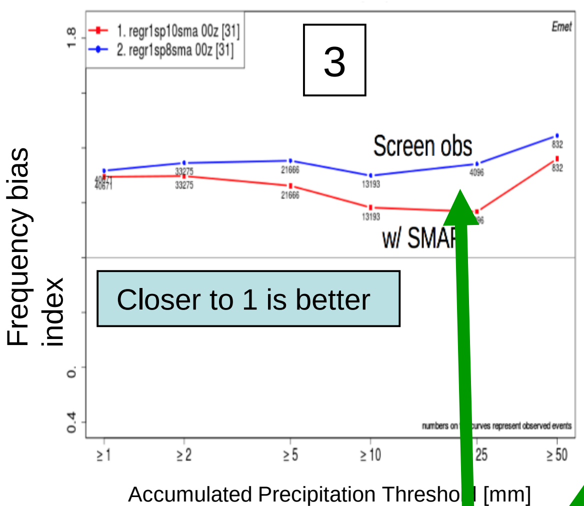
Optimizing Impact of SMAP for Weather Prediction in North America

SMAP Early Adopter: Environment and Climate Change Canada, Stephane Belair, Marco Carrera

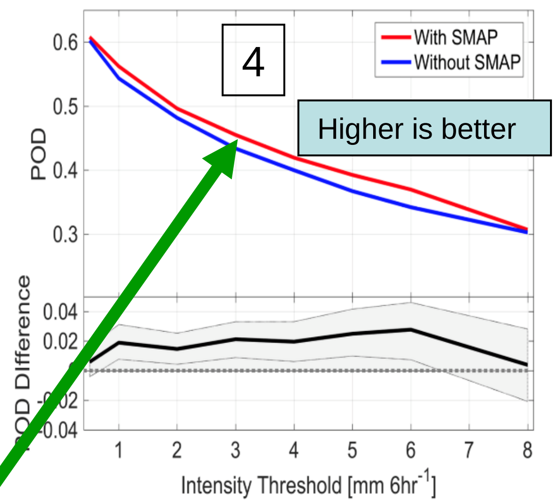
Environment Canada

Positive impact of SMAP on Precipitation forecasts

a. Reducing frequency bias



b. Better detection of convective events



Improvements obtained through the use of SMAP data may appear small, but in the forecasting game, any true, significant increase in skill is considered a major accomplishment. Seemingly small increases in skill can have significant economic benefits.

Assimilation of SMAP brightness temperature leads to significant improvement in surface and root-zone soil moisture estimates *vs*. the current operational system of Environment and Climate Change Canada (ECCC). This improvement further leads to a positive impact of SMAP on Numerical Weather Prediction (NWP) as shown in the quantitative precipitation forecasts in ECCC's North America NWP systems.

ECCC is continuing to work on the optimal incorporation of SMAP products into the Canadian Land Data Assimilation System (CaLDAS). The operational implementation of CaLDAS-SMAP is targeted for Spring 2018.

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SMAP Alone not Sufficient… More is Needed

Assimilate more observations in CaLDAS

e.g., surface temperature from geostationary IR (GOES, MSG, Himawari)

Better characterization of the land surface

(soils and LU/LC databases, satellite-based information for vegetation – roughness, fractional coverage, albedo, emissivity, LAI)

Better land surface modeling

New land surface scheme SVS Including photosynthesis

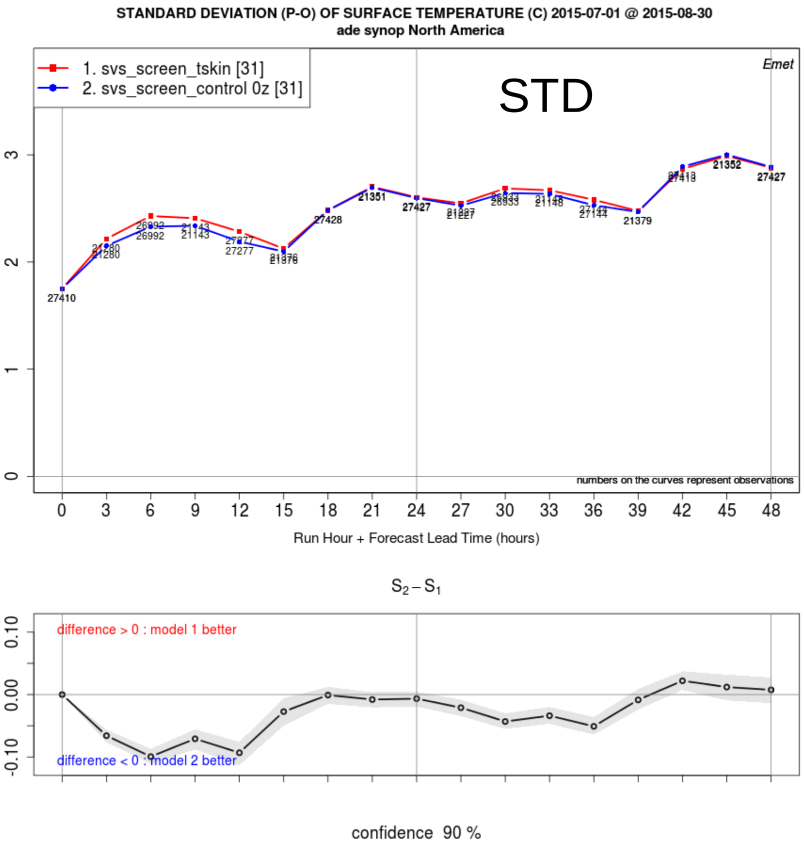
“Assimilation” of “calibration” of the surface stomatal resistance

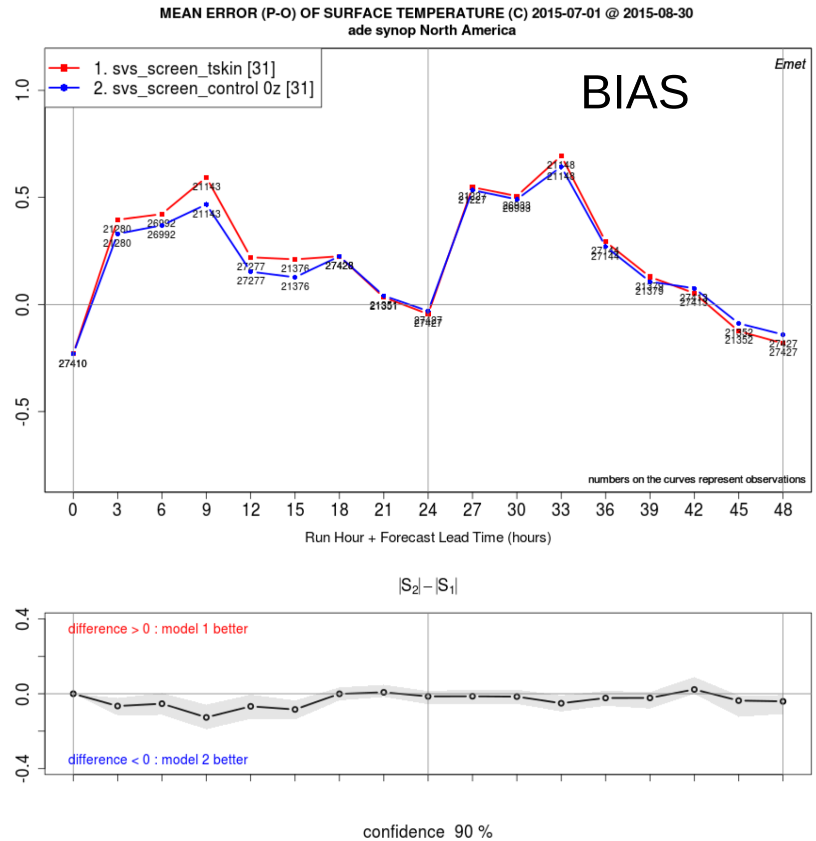
Possible, or desirable?

Assimilating Retrieved Tskin from GOES Impact on T2m forecasts

From Garand's presentation that was cancelled

Tskin assim - 2-m obs assim





July and August 2015
North America

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Assimilating Retrieved Tskin from GOES Impact on TD2m forecasts

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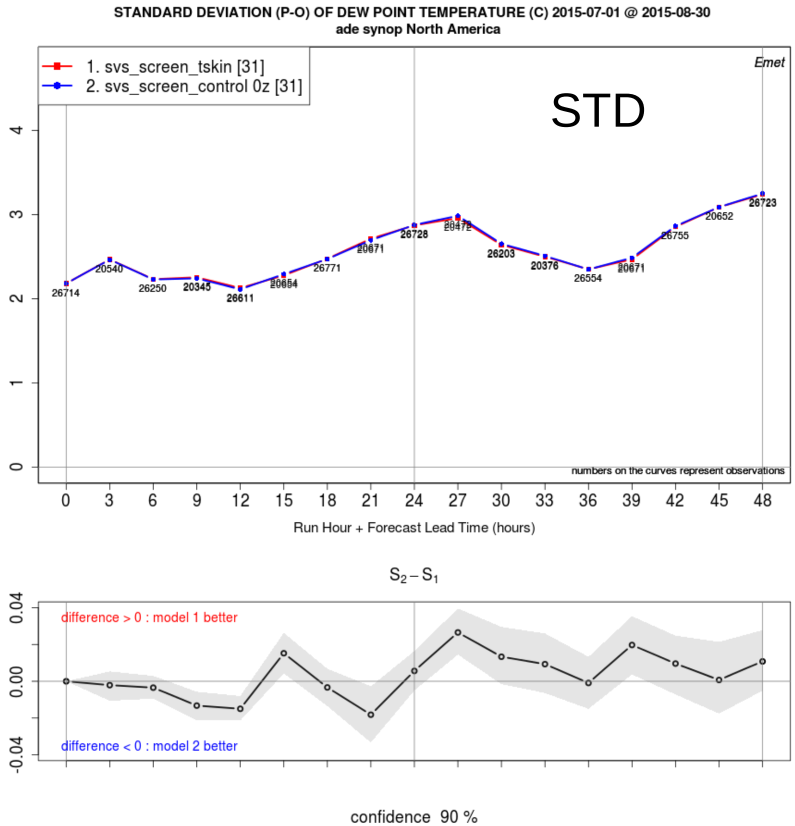

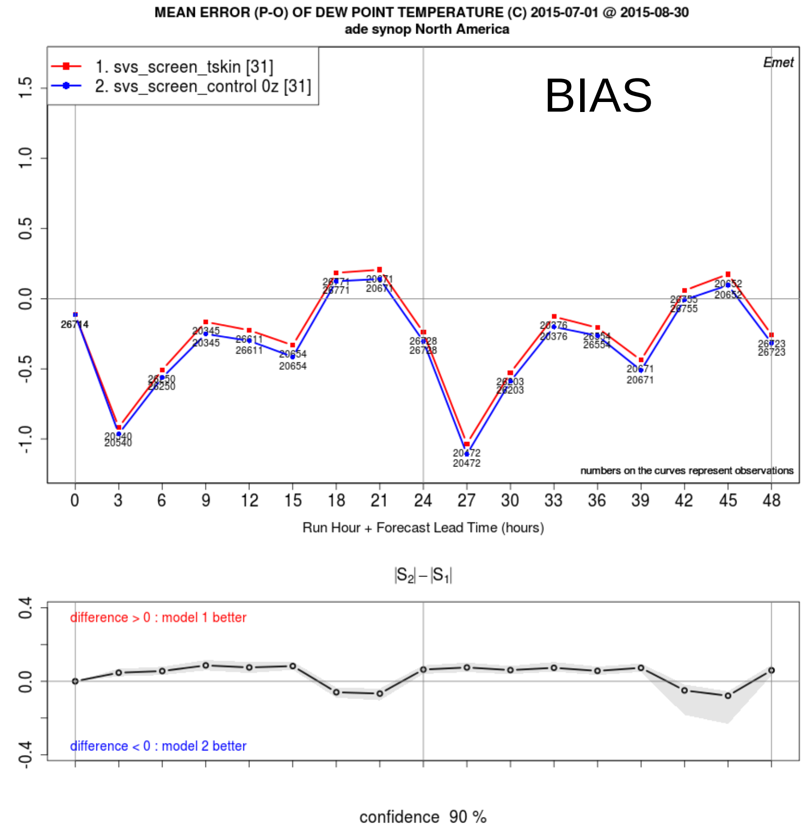

July and August 2015
North America

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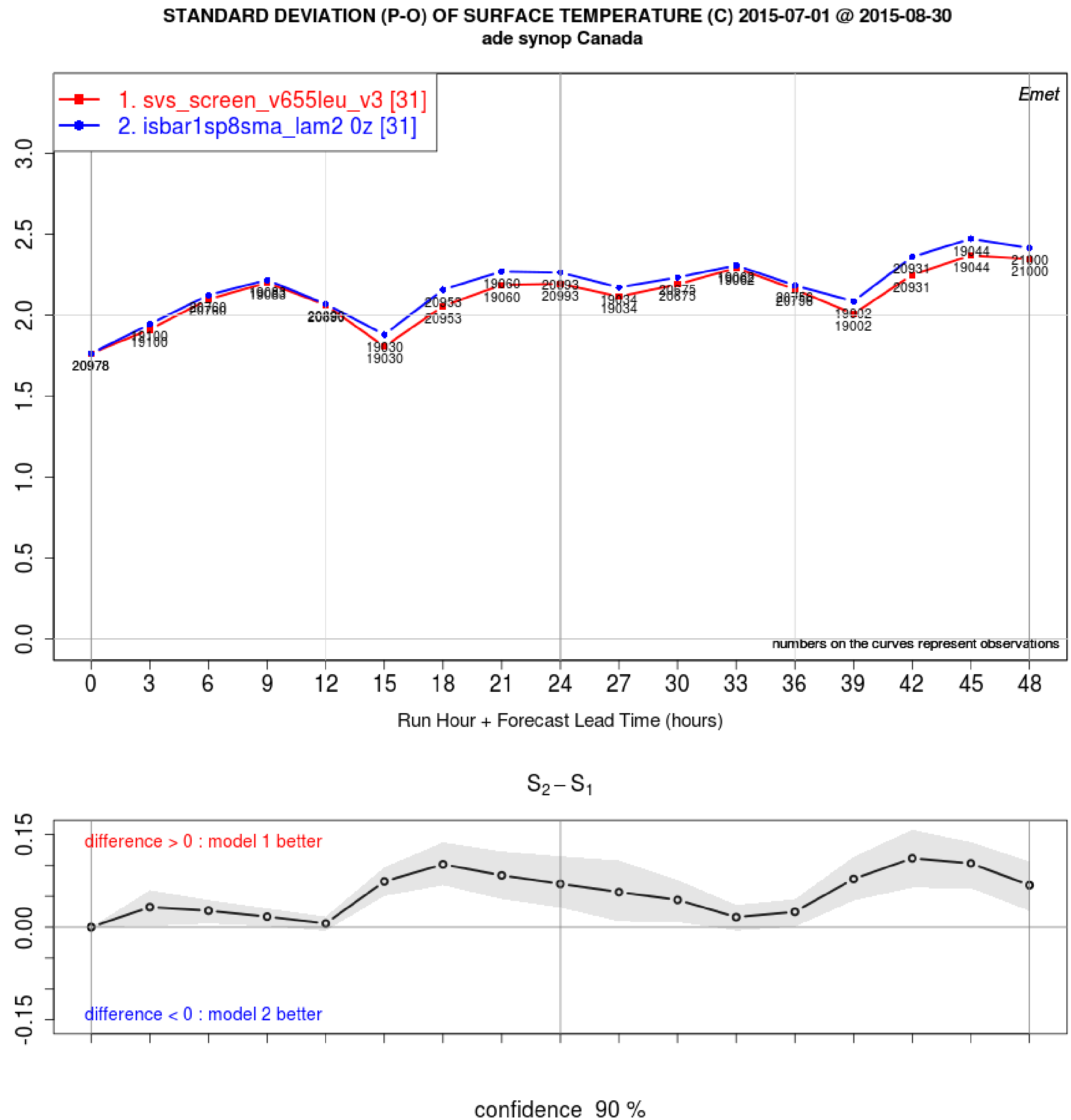
SVS vs ISBA for NWP Forecasts

2-m Air Temperature STDE

Based on 31 forecasts (48h) in July and August 2015

CANADA



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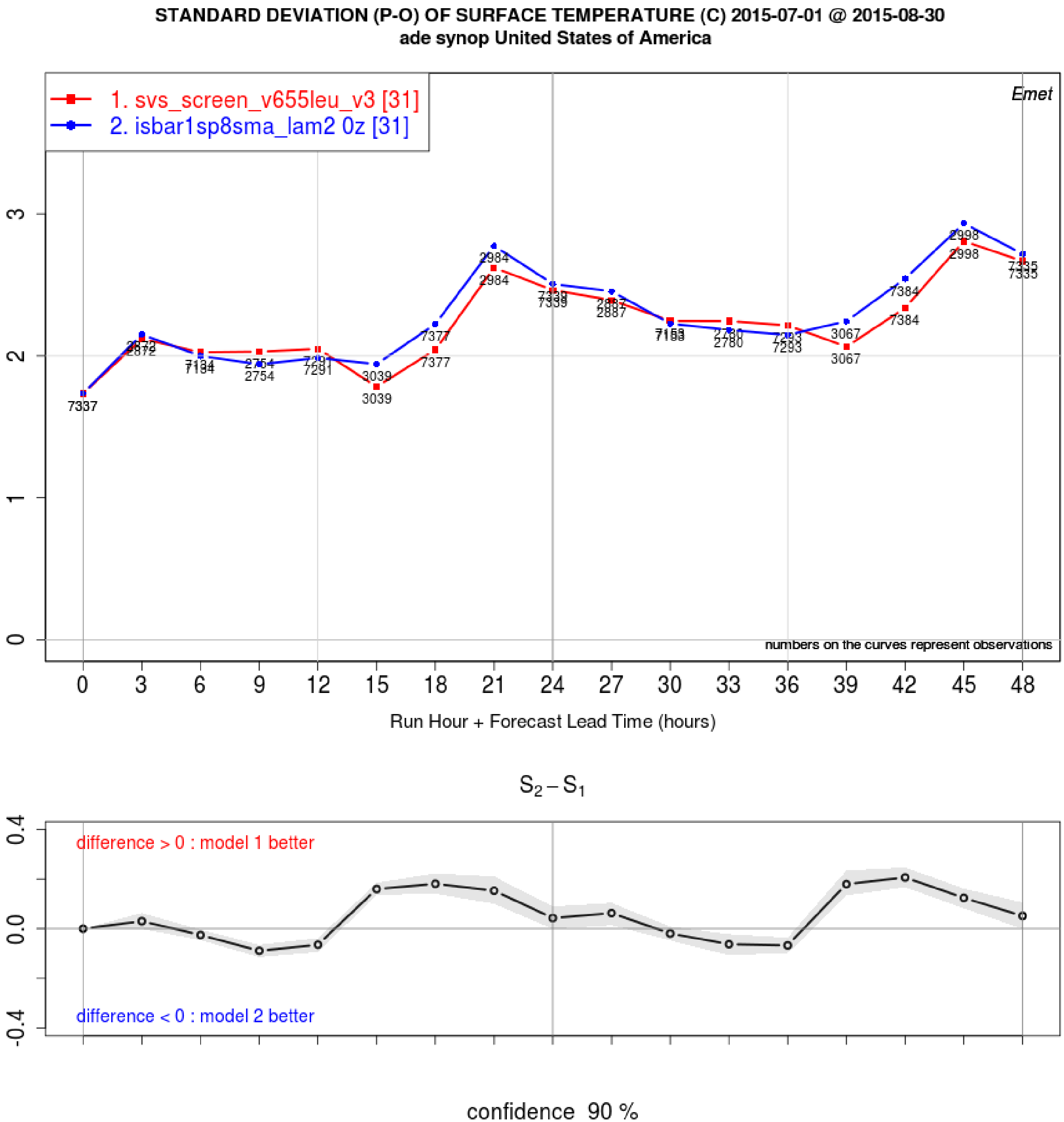
SVS vs ISBA for NWP Forecasts

2-m Air Temperature STDE

Based on 31 forecasts (48h) in July and August 2015

USA



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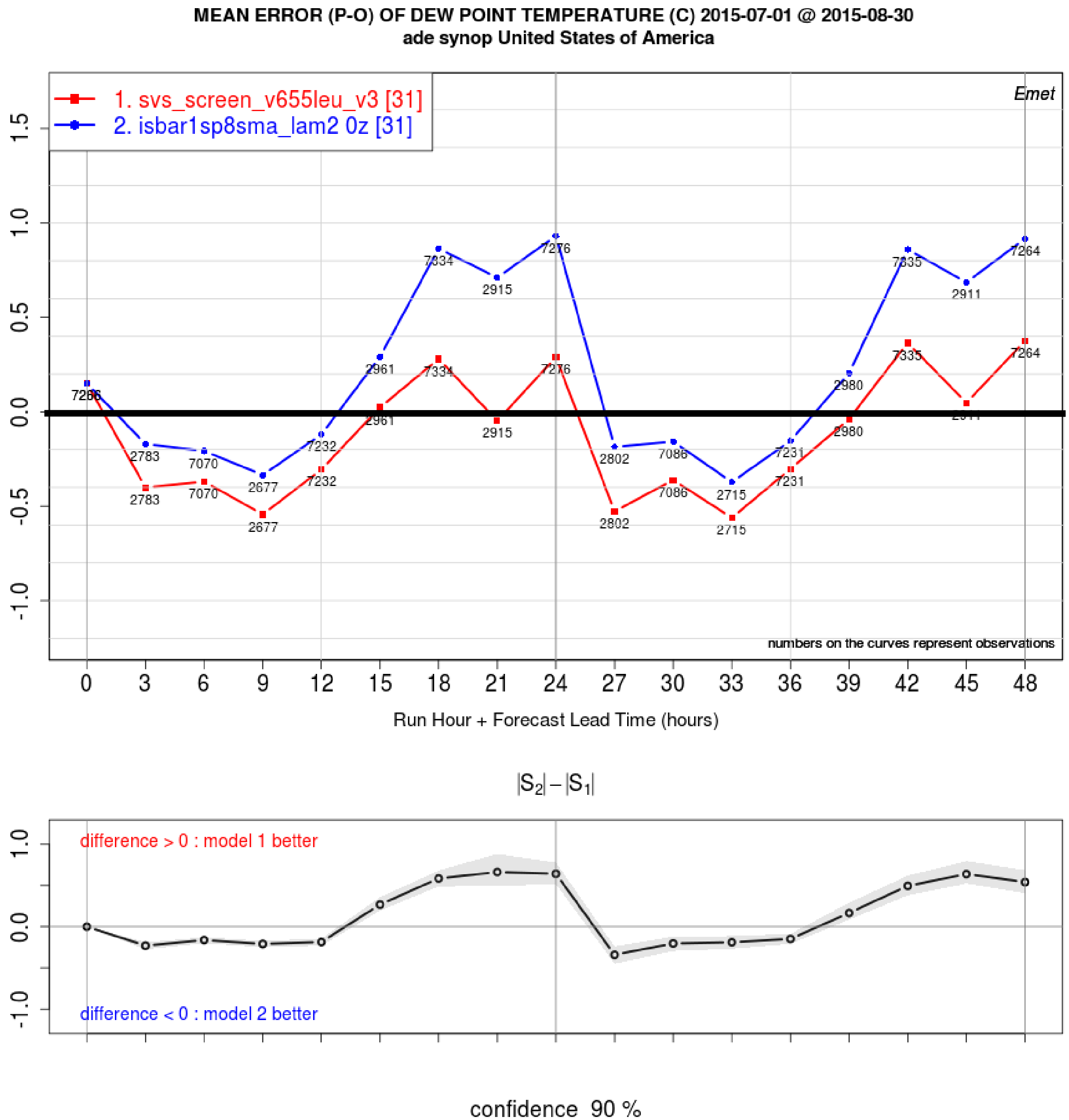
SVS vs ISBA for NWP Forecasts

2-m Dew point temp Bias

Based on 31 forecasts (48h) in July and August 2015

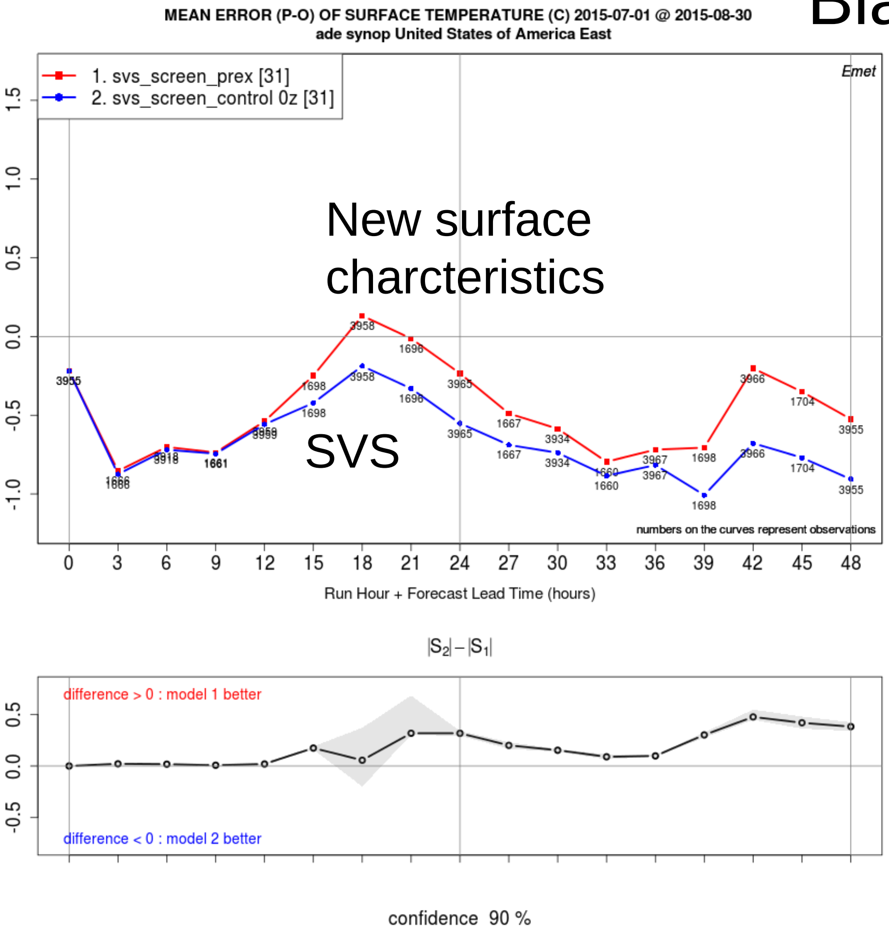
USA



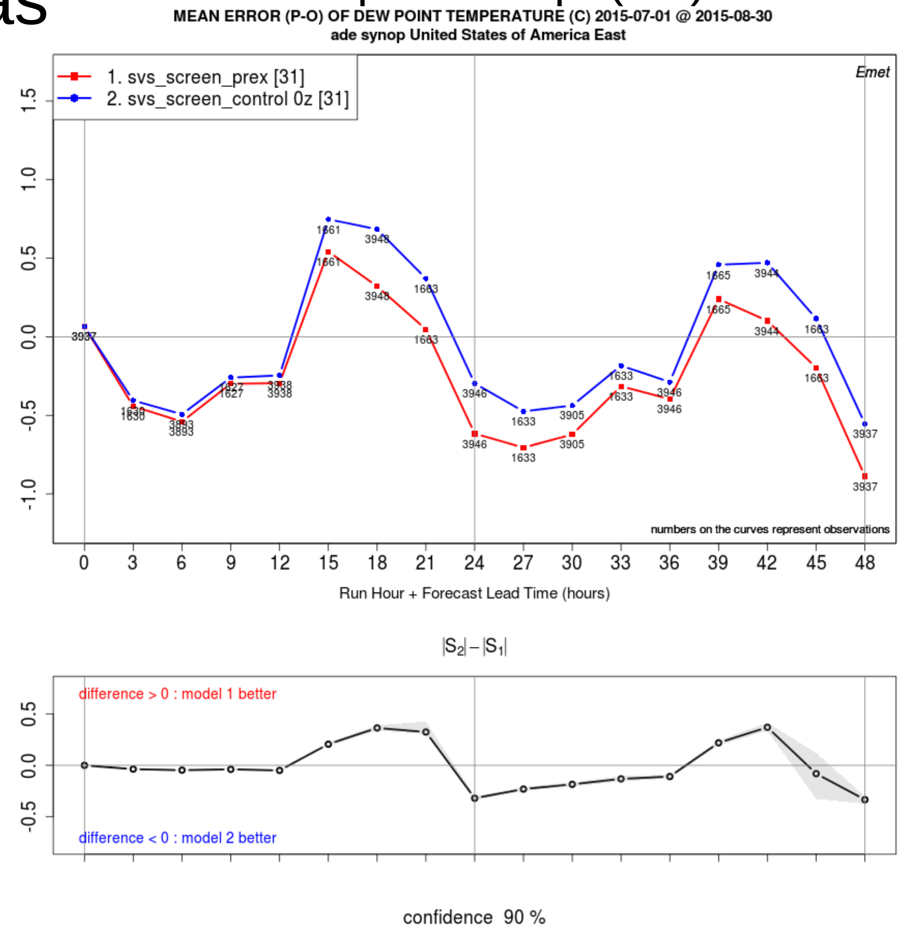
Vegetation characteristics from MODIS

Bias

Air temperature (2m)



Dew point temp. (2m)



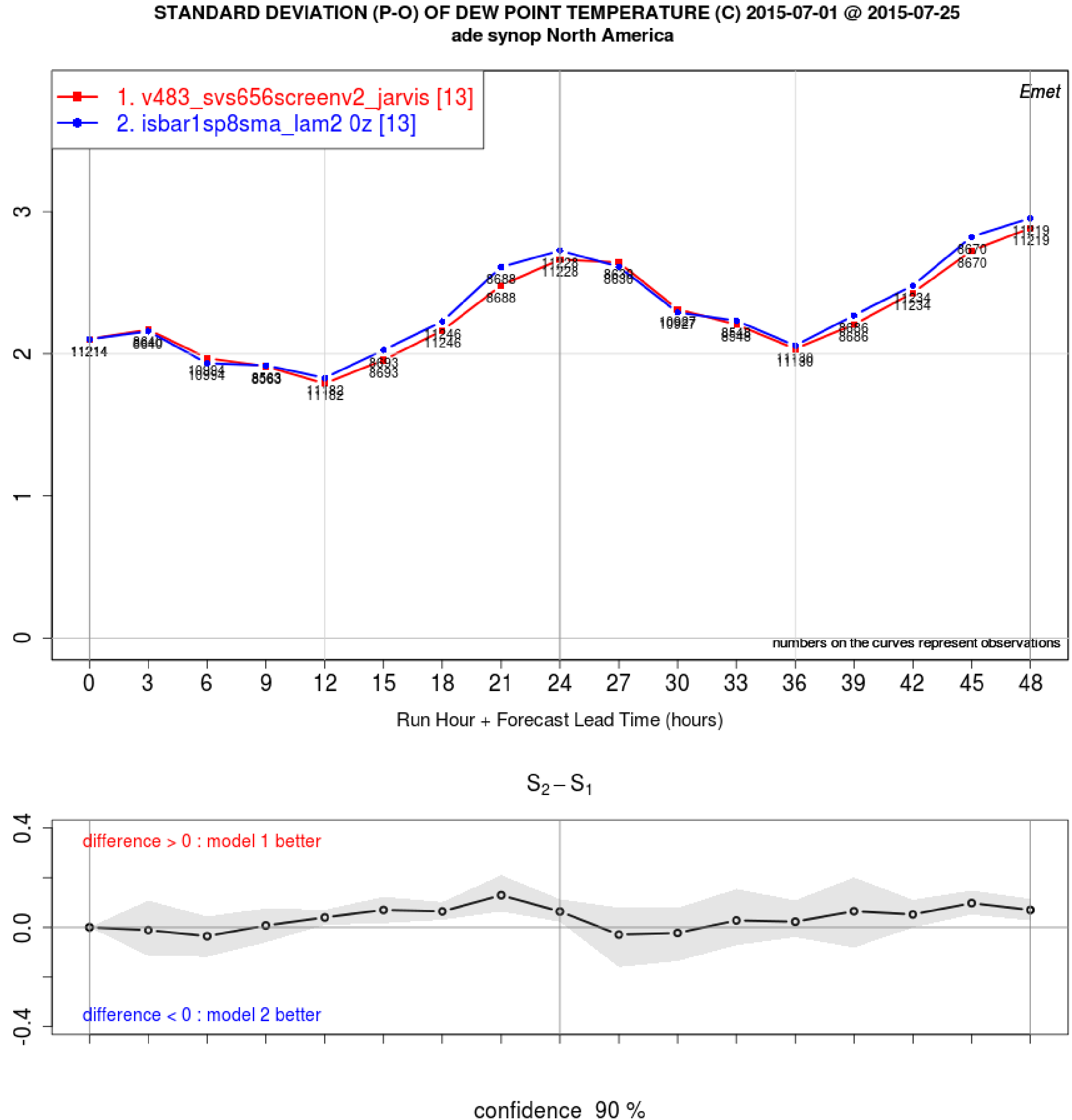
July and August 2015
USA East

CaLDAS-SMAP Cycle with SVS (vs OP)

2-m Dew point temp STDE

Based on (only) 13 forecasts (48h) in July 2015

North America



CaLDAS-SMAP Cycle with SVS (vs OP)

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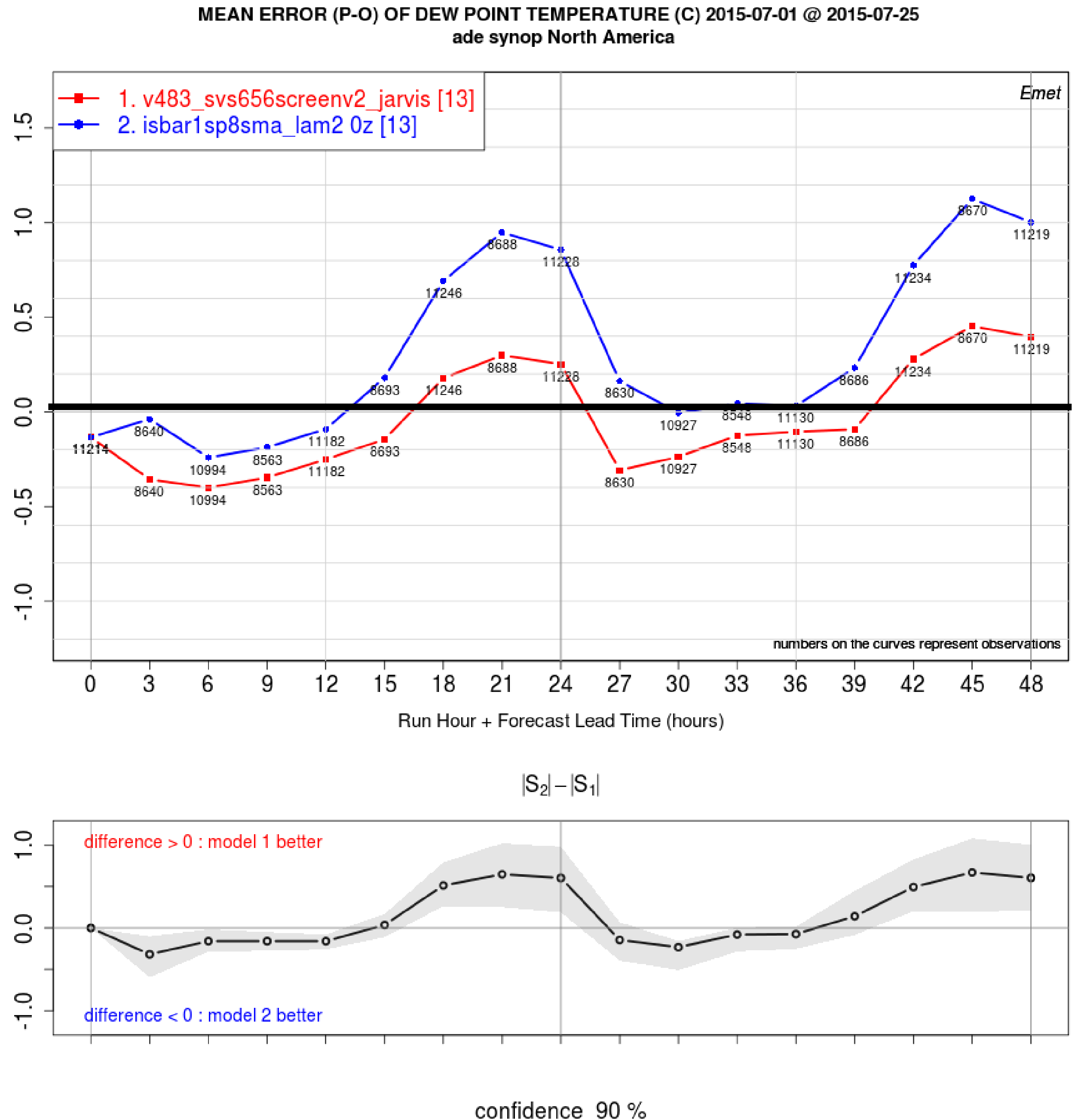

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Are we there yet?

SMAP essential for new generation of CaLDAS

Only one test away from completing tests with the light 10-km North America configuration (i.e., with photosynthesis)

The configuration: CaLDAS w/ SMAP/SMOS, screen-level obs for Tsurf, no changes to snow assimilation, SVS w/ photosynthesis

The two target configurations:

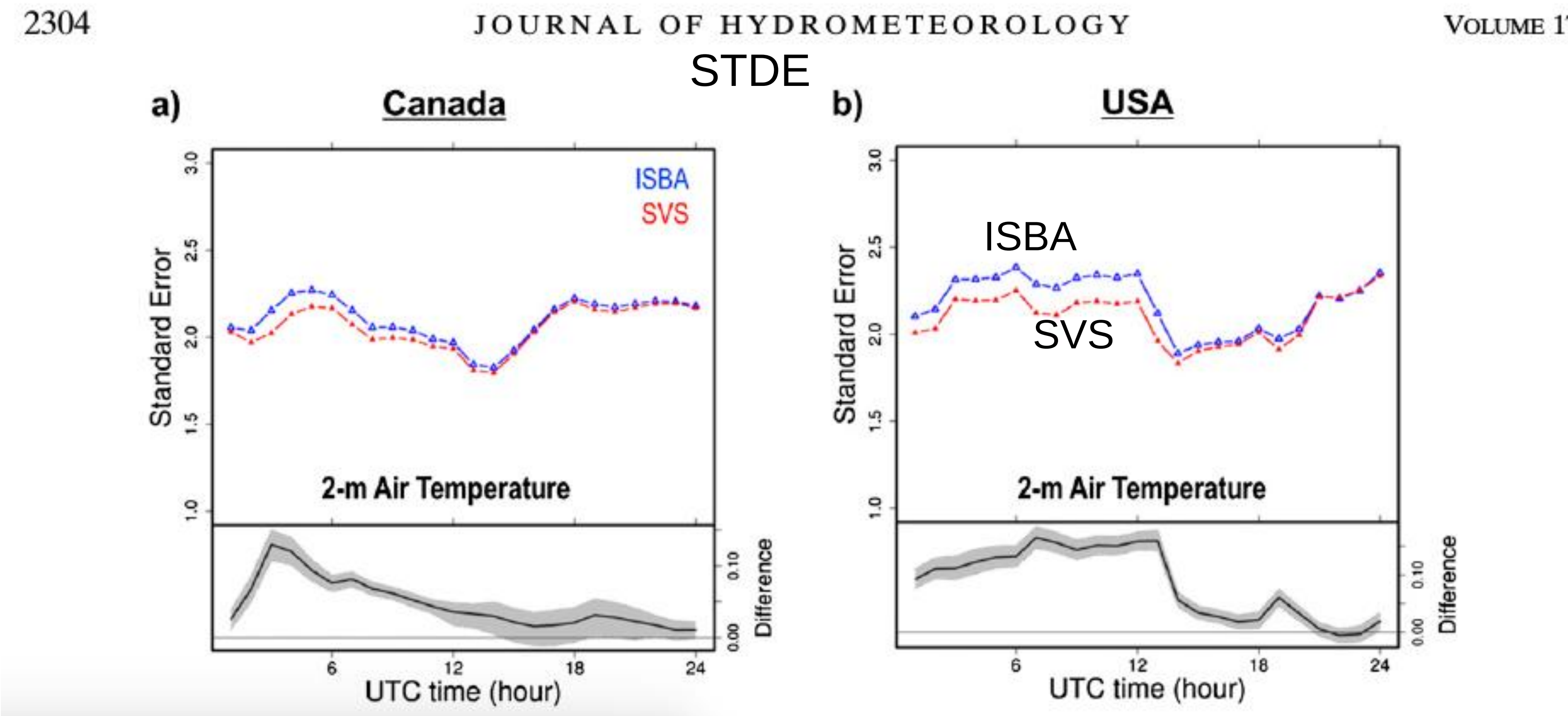
- *a) 2.5-km North America*
- *b) 15-km global (or 10-km)*

Timeline for operational implementation still uncertain (early 2018 seems most likely)

Data distribution via CMC-Operations (geomet, datamart) + other less official means (rpn-wms, collaboration web page)

Backup Slides

Land surface modeling… SVS vs ISBA



From an open loop cycle, evaluation over North America for June, July, and August 2012

From Husain et al. (2016)

Land surface modeling… SVS vs ISBA

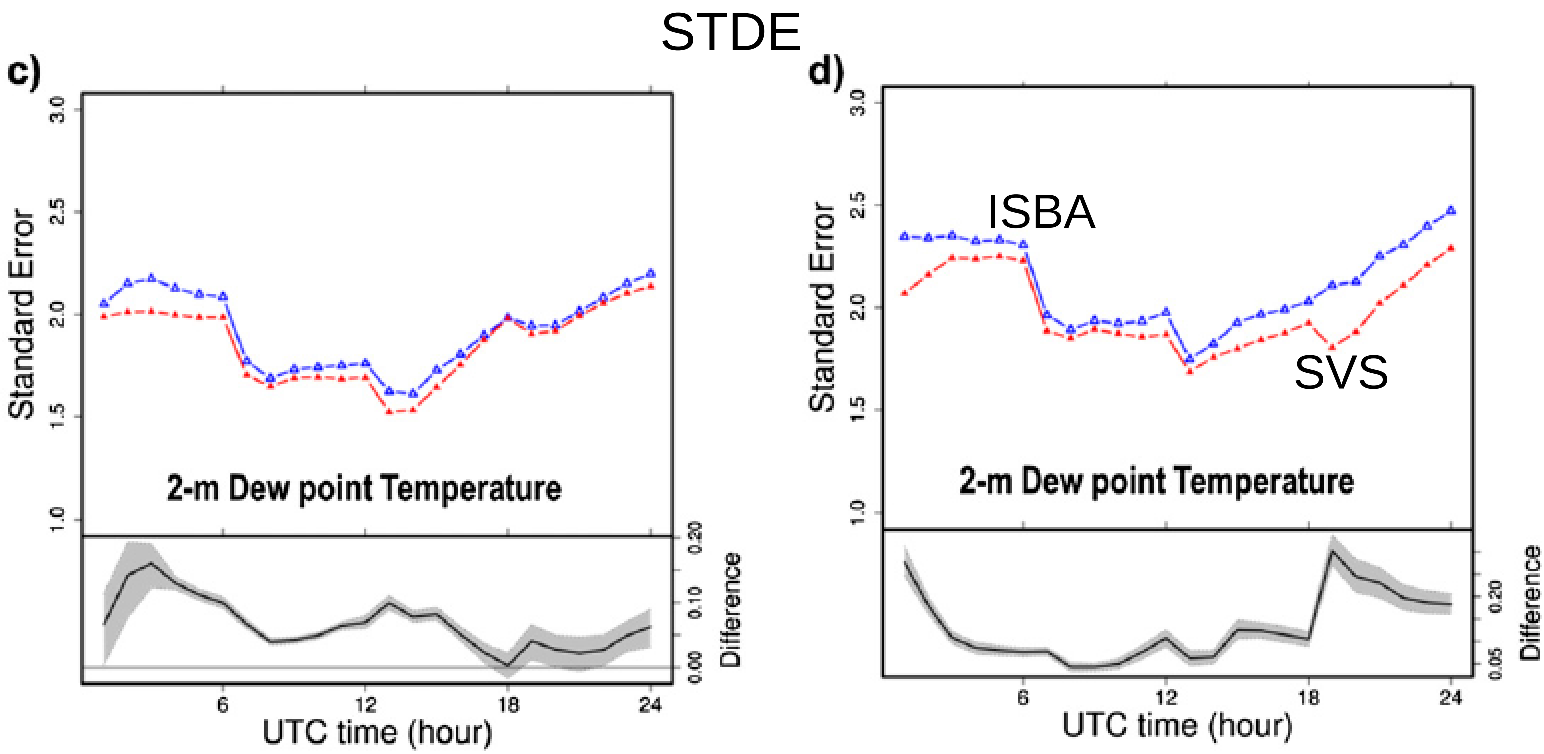


FIG. 6. As in Fig. 5, but for diurnal variations in standard error of screen-level air and dewpoint temperature (°C) with the ISBA scheme and the SVS scheme. The lower part of (a)–(d) illustrates the difference in standard error between the two schemes [see Eq. (21)].

From an open loop cycle, evaluation over North America for June, July, and August 2012

From Husain et al. (2016)