STATUS of LAND SURFACE MODELING and DATA ASSIMILATION at ECCC

Stephane Belair (ECCC)

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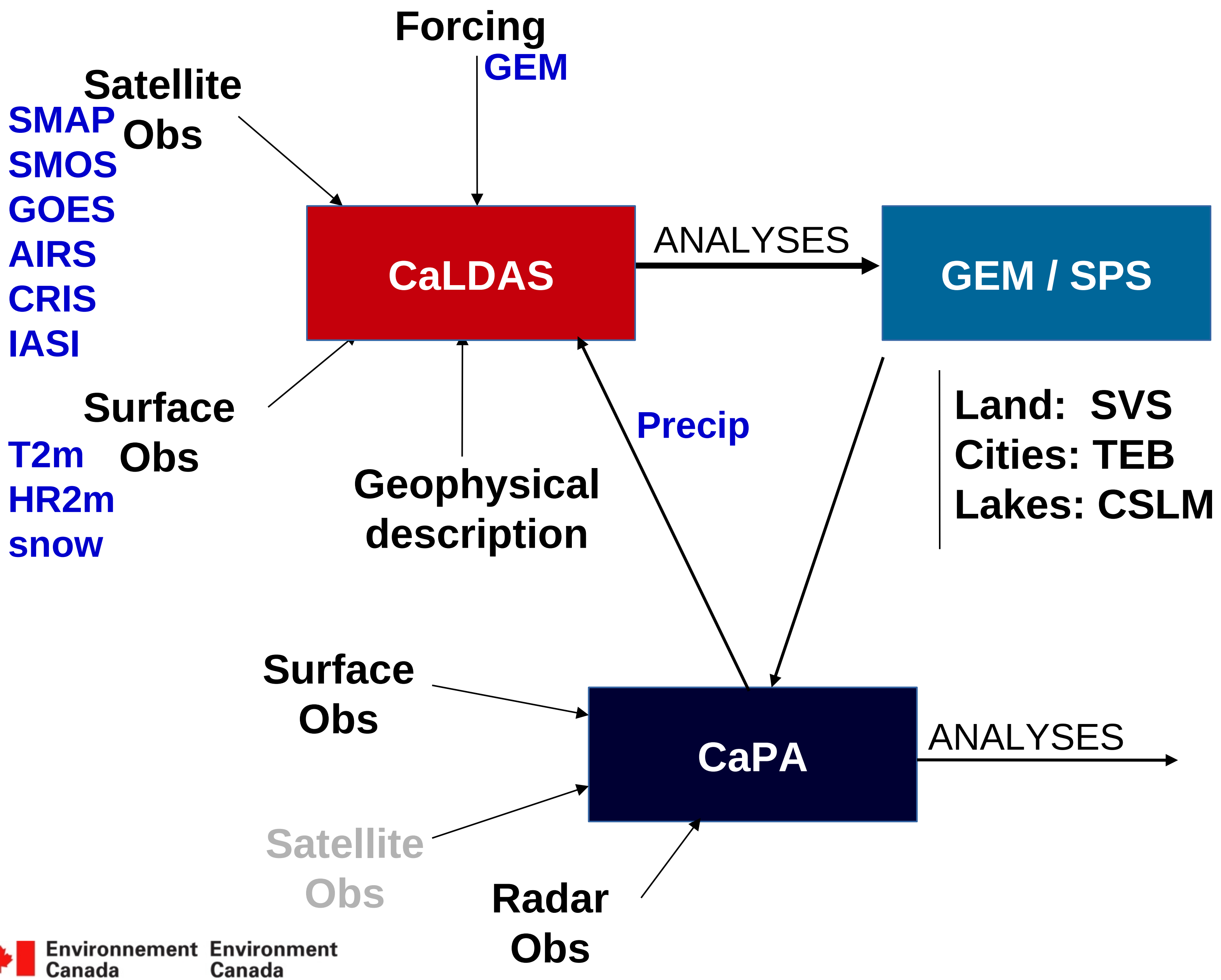
3rd ISWG Workshop, Montreal, 15-17 July 2019

Environment and Climate Change Canada | Environnement et Changement climatique Canada

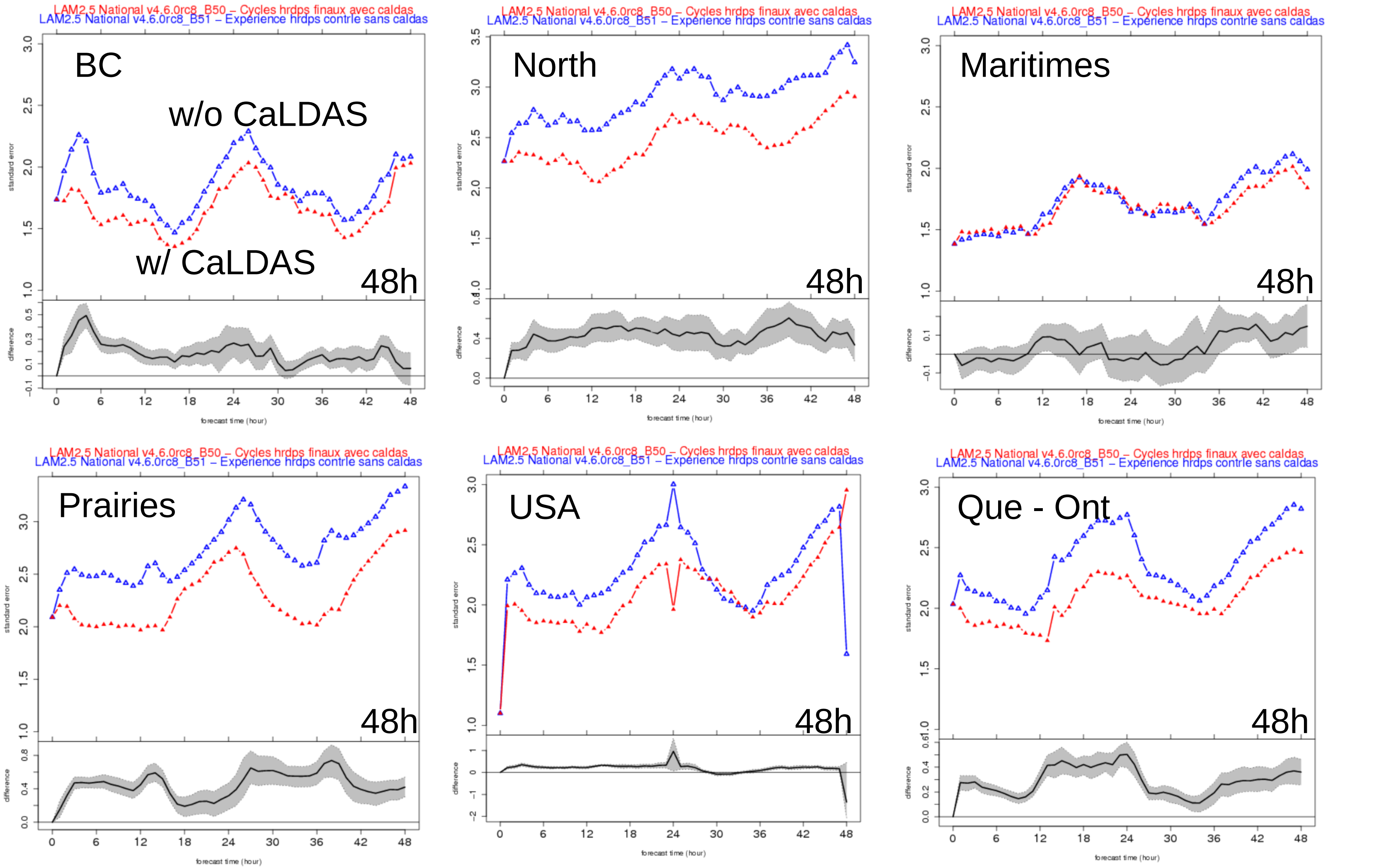
Canada

ECCC land surface (non-climate) “universe”

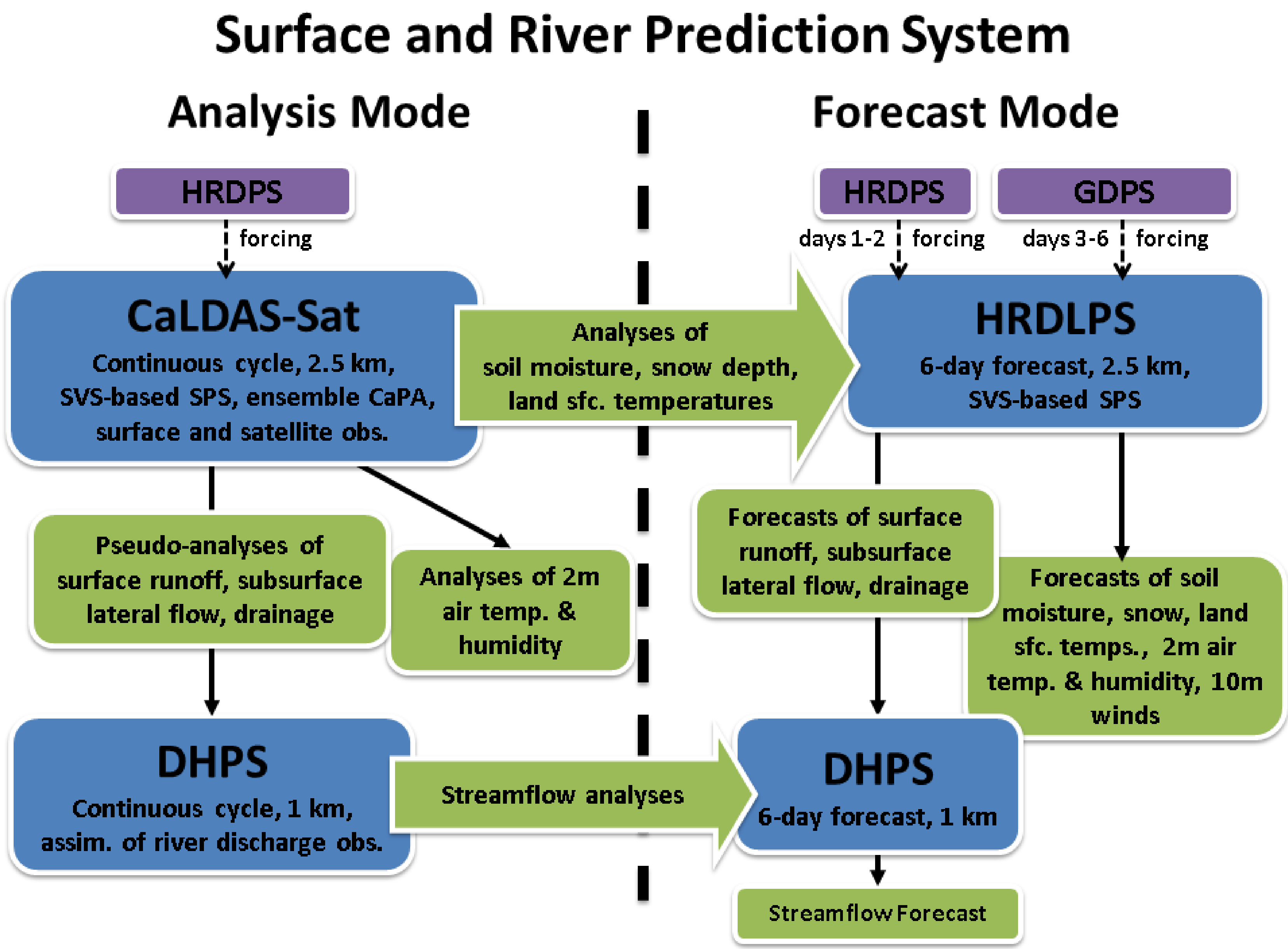


CaLDAS “screen” (ISBA) in HRDPS (a few years ago)

Dew point temp., STDE, summer, 00 UTC cases



Implementation of CaLDAS "sat" 2.5-km regional (2019)



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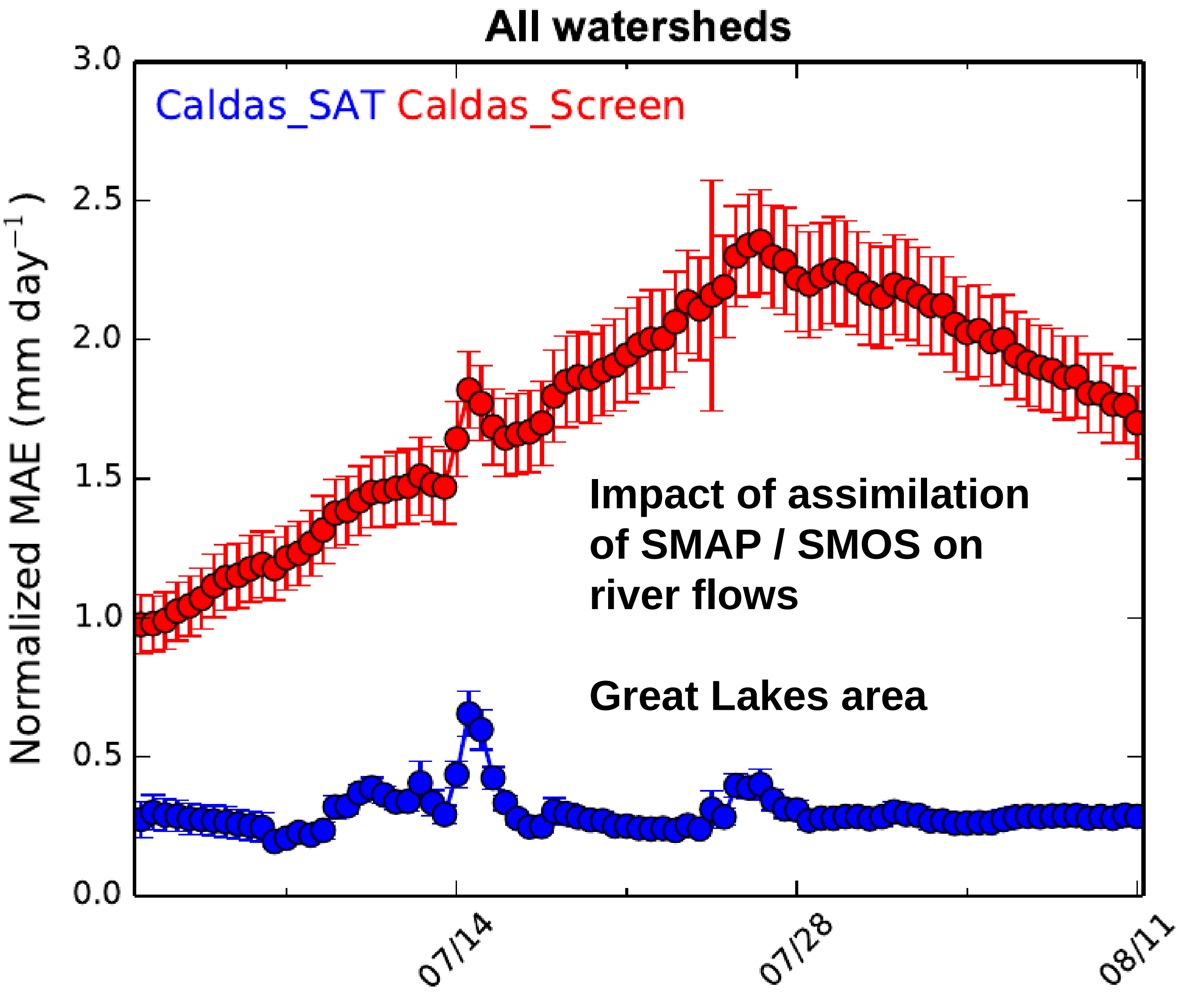
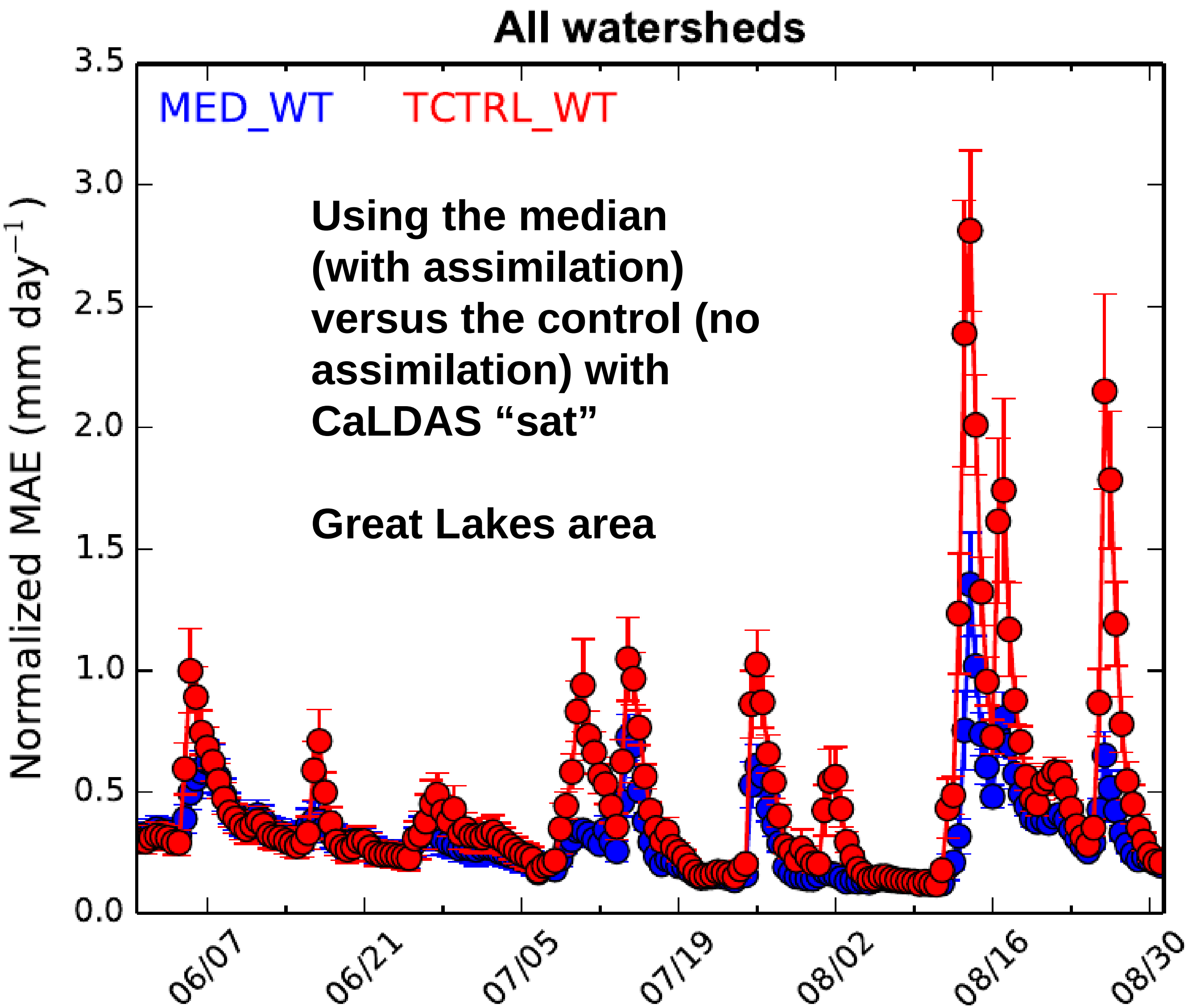
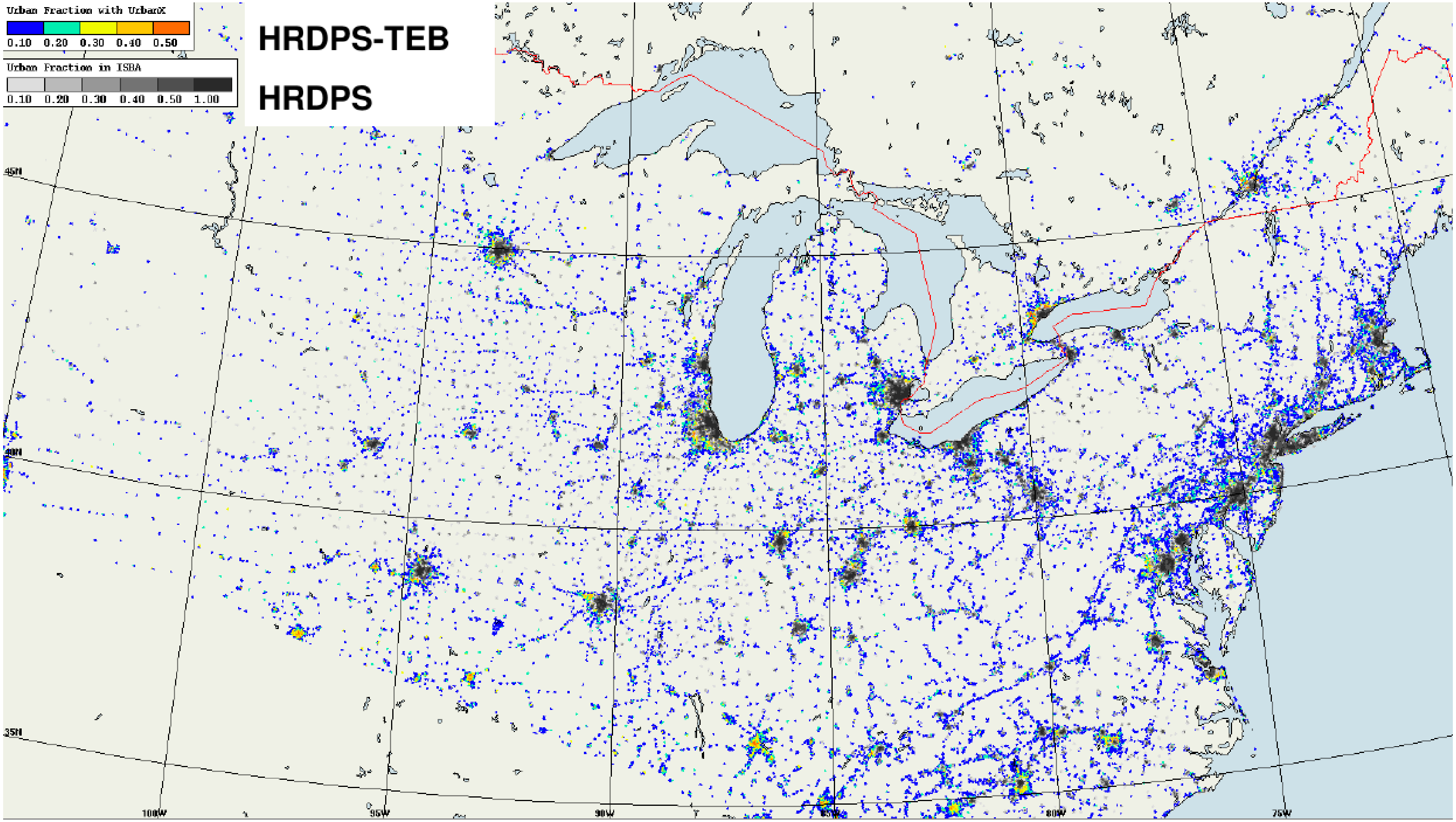
Impact of CaLDAS "sat" on hydrological prediction



Impact of CaLDAS “sat” on hydrological prediction



Implementation of cities in km-scale NWP



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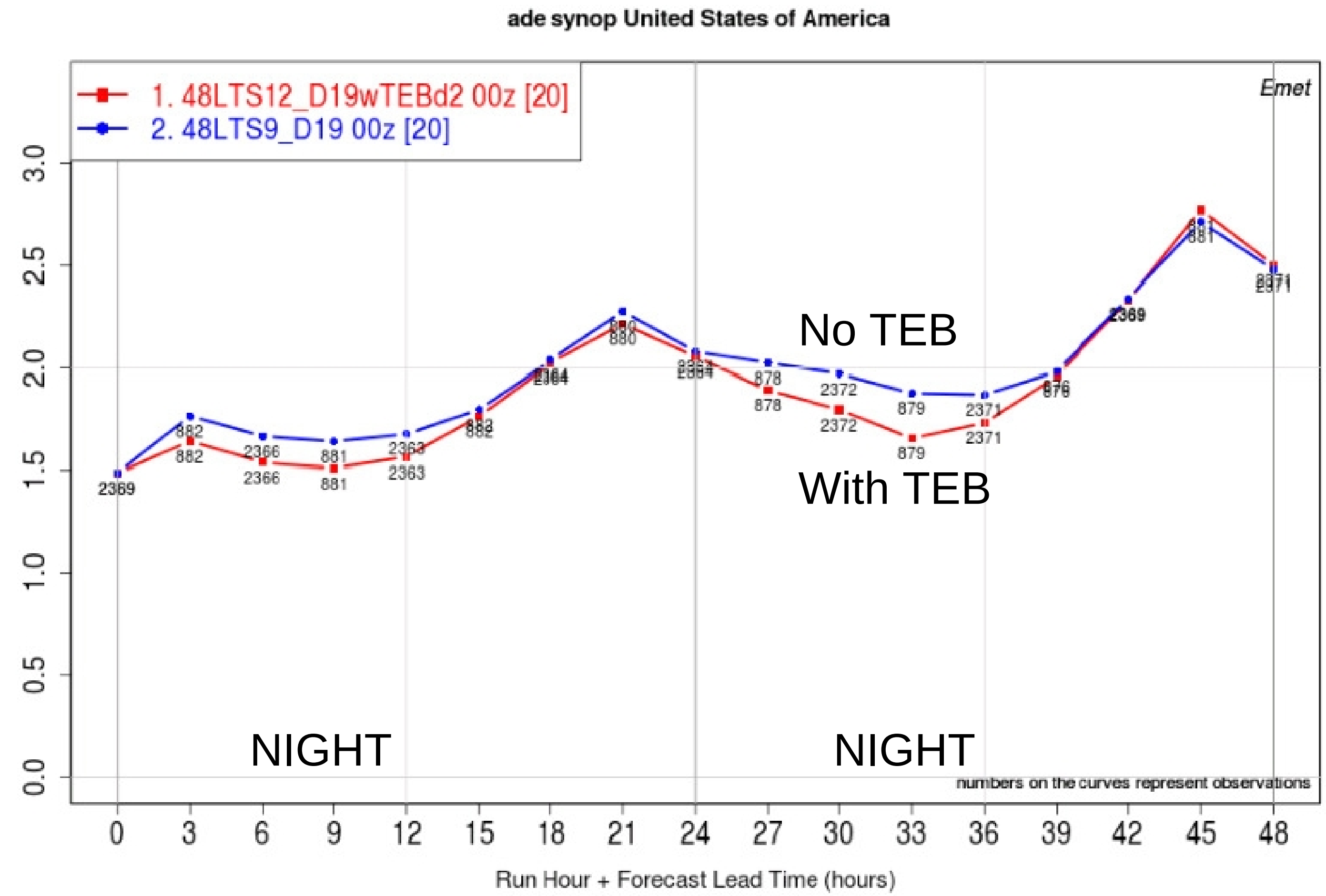
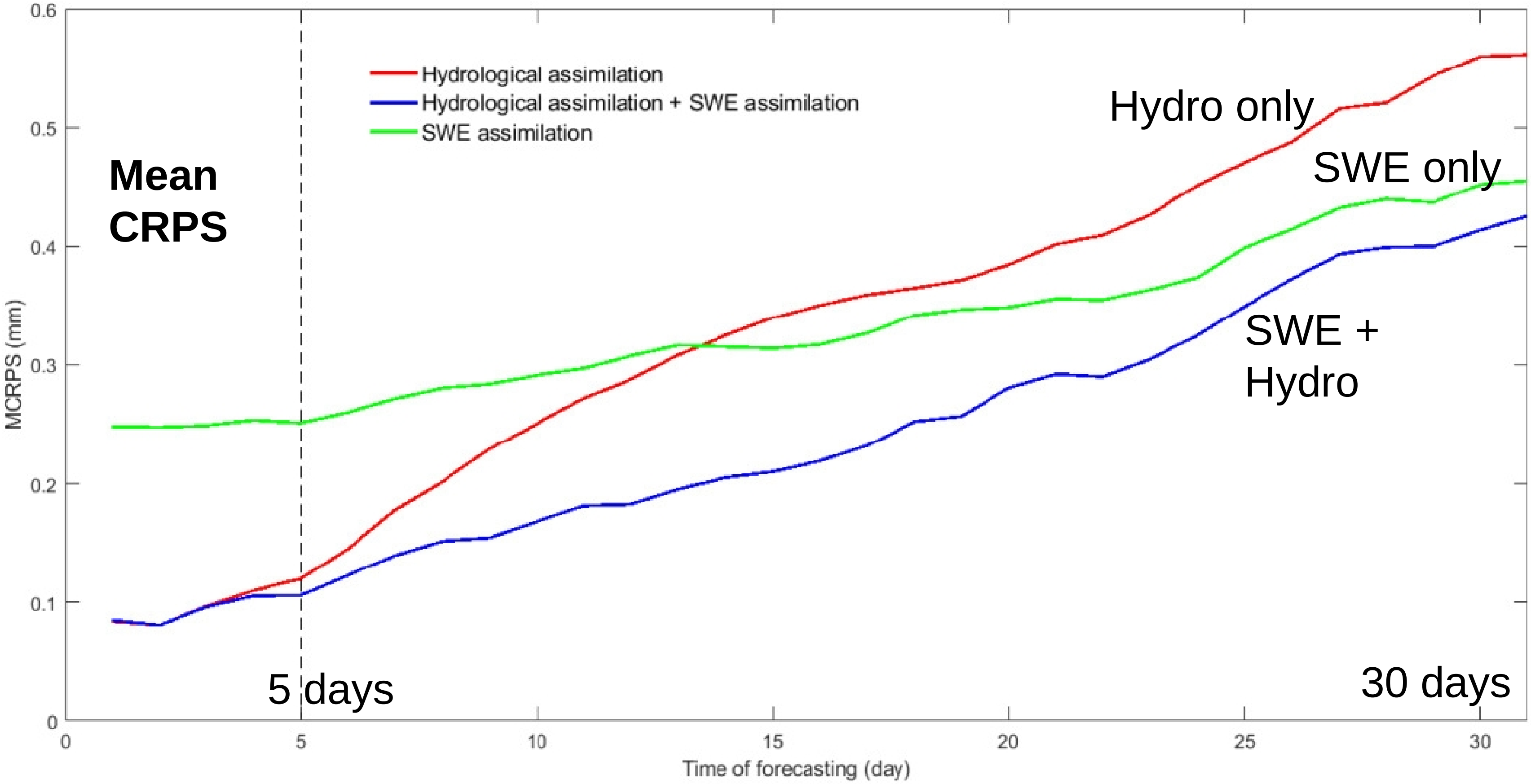
Impact of cities on HRDPS predictions

STDE
Air temperature
20 Summer cases
USA



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)

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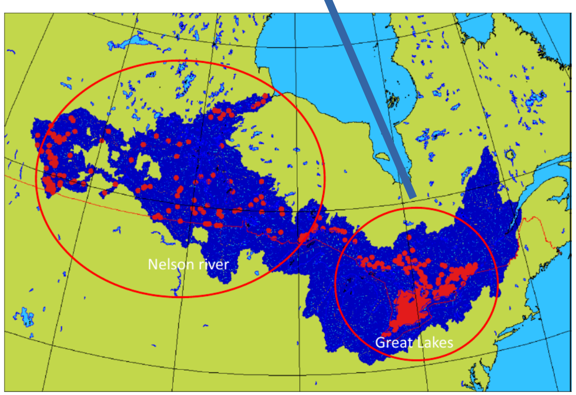
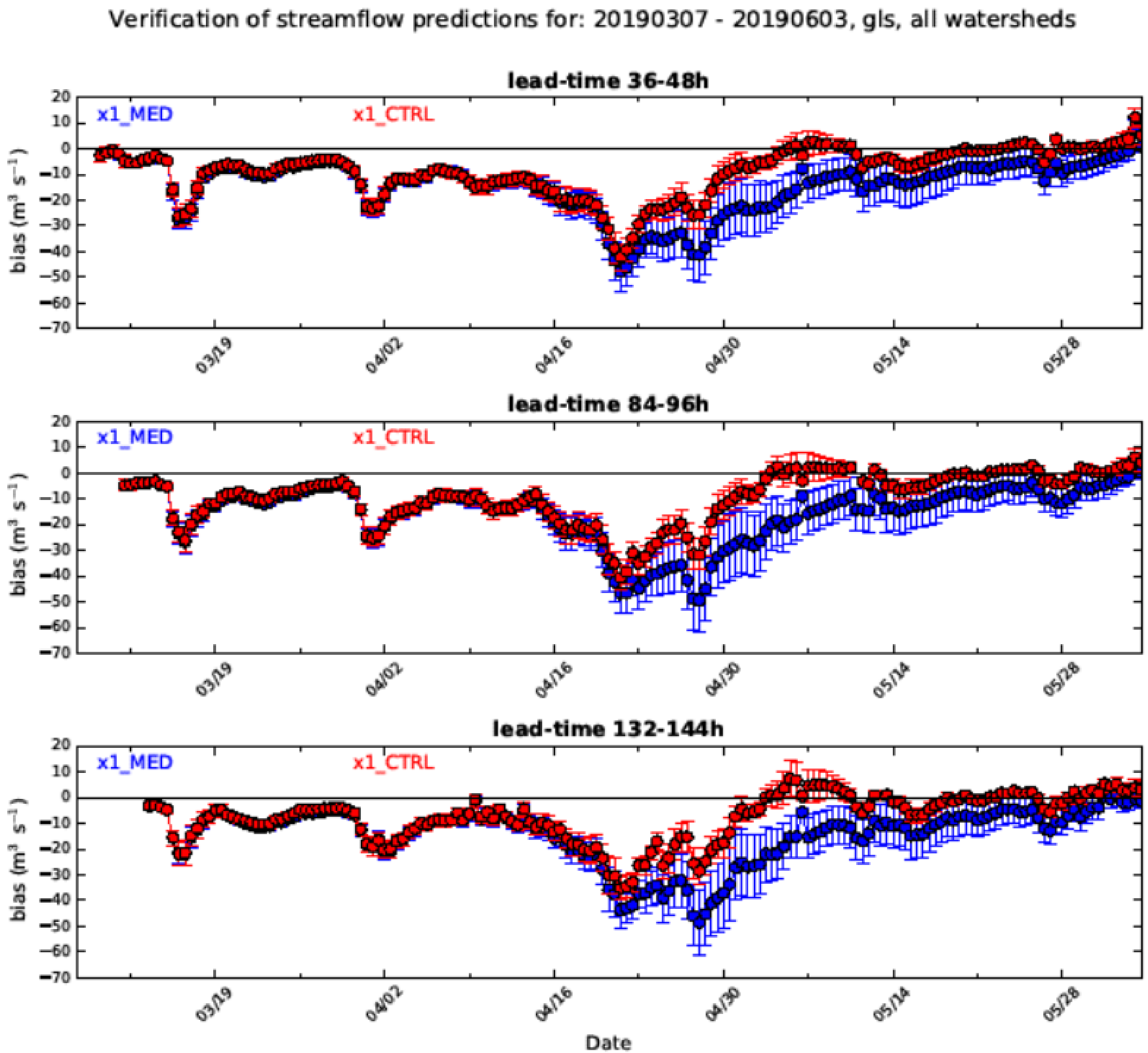
Impact of snow on hydro forecasts (as part of motivation for TSMM mission)

BIAS streamflow

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

Over the Great Lakes area





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

"coupled" minus "offline"

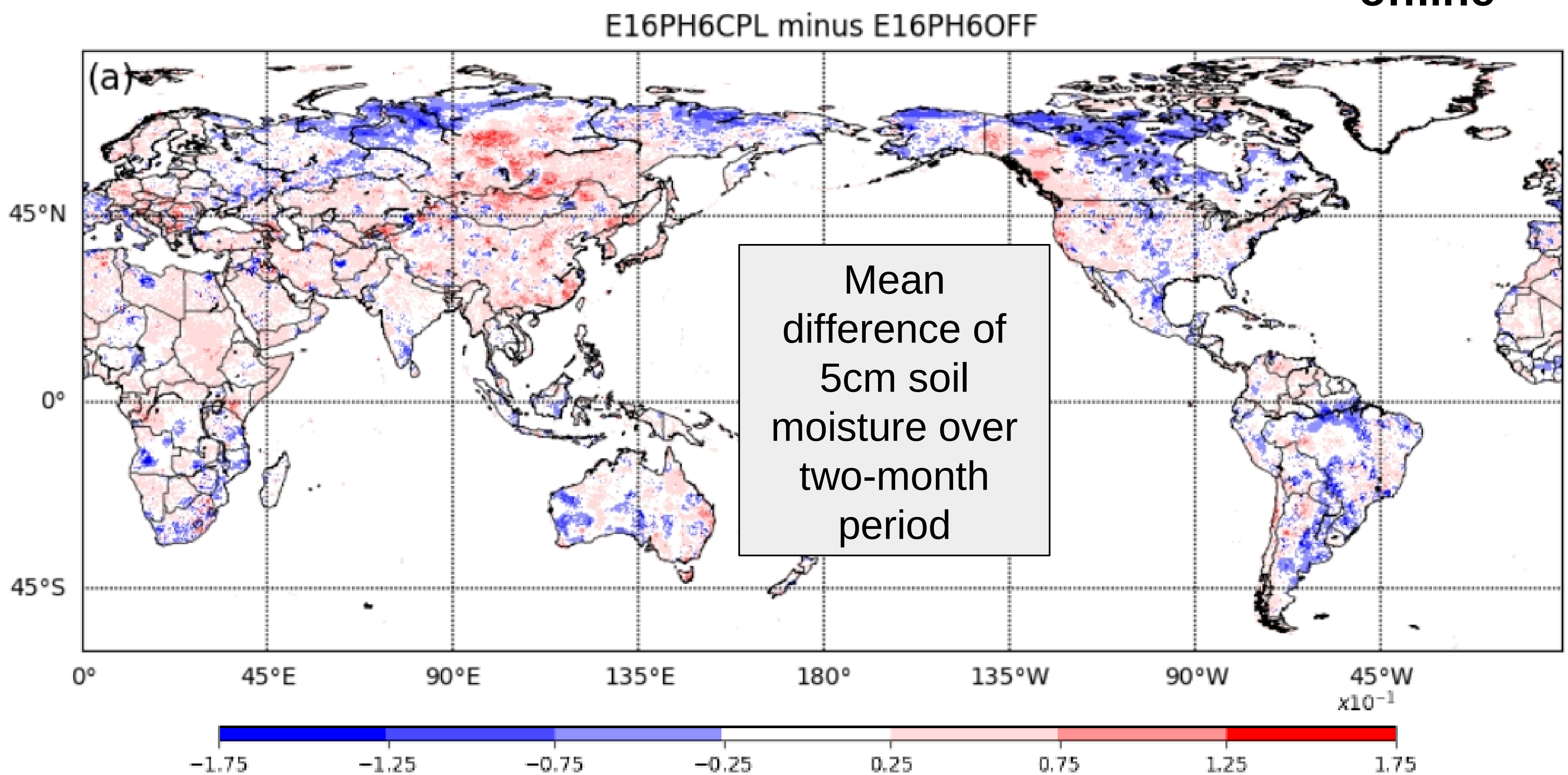
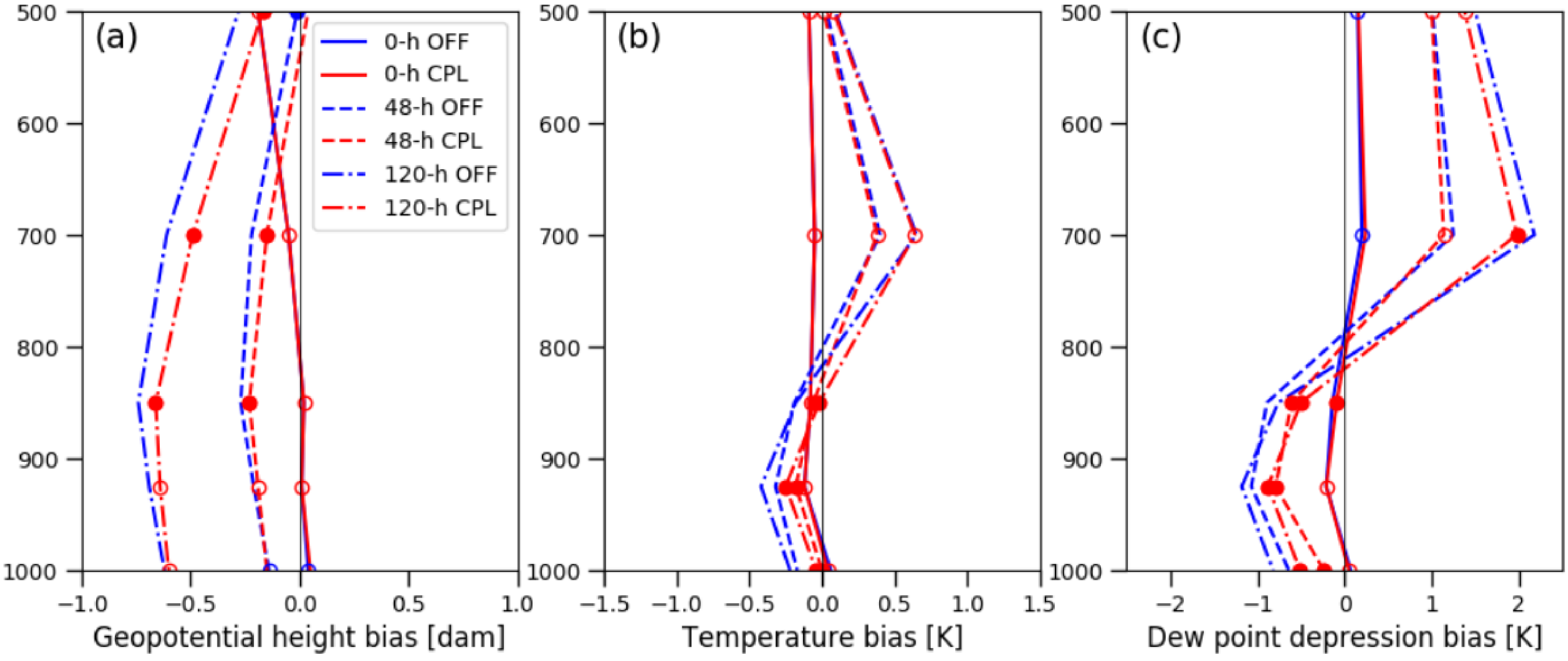


Figure 2. Two month difference of the mean of the top layer (5 cm) soil moisture analyses [m^3 m^{-3}] of the coupled and uncoupled experiments during summer 2016 (top; E16CPL-E16OFF) and winter 2017 (bottom; H17CPL-H17OFF) periods.

(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)

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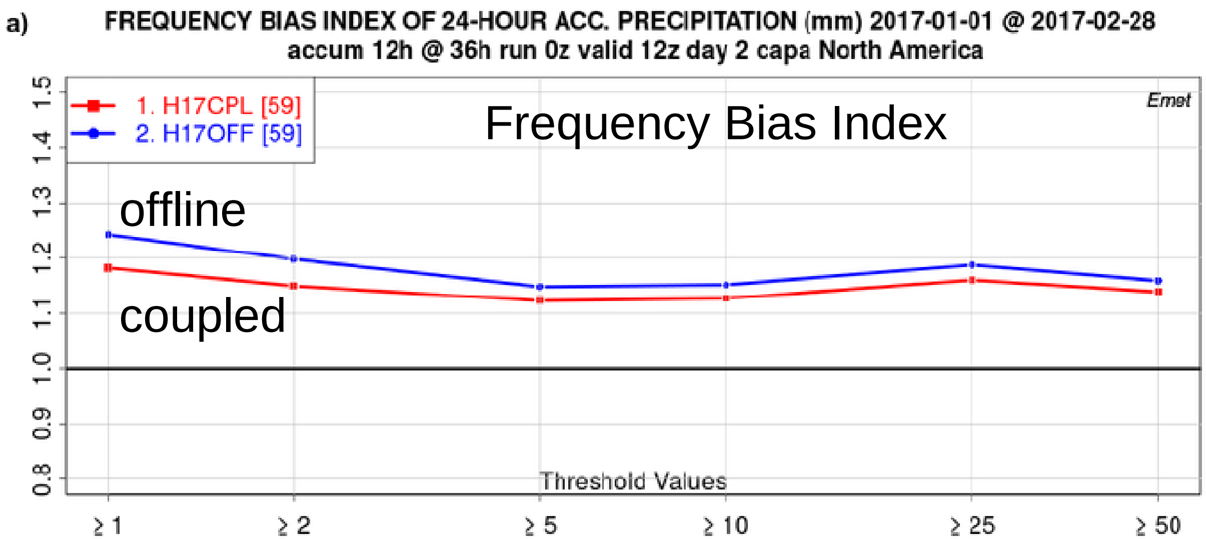
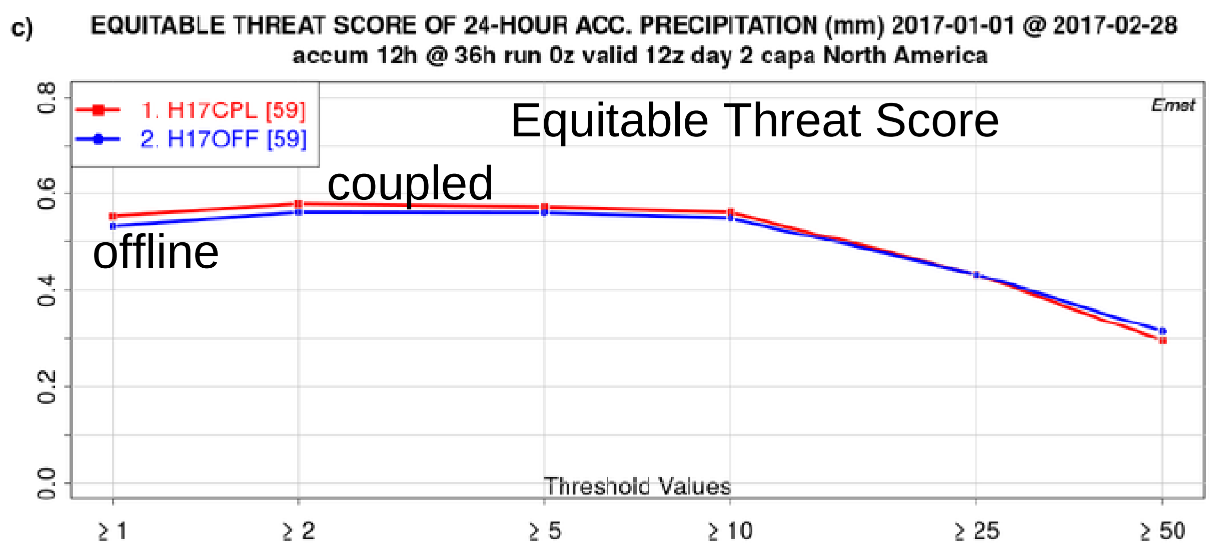
Weakly coupled vs offline land DA cycles
Impact on precipitation





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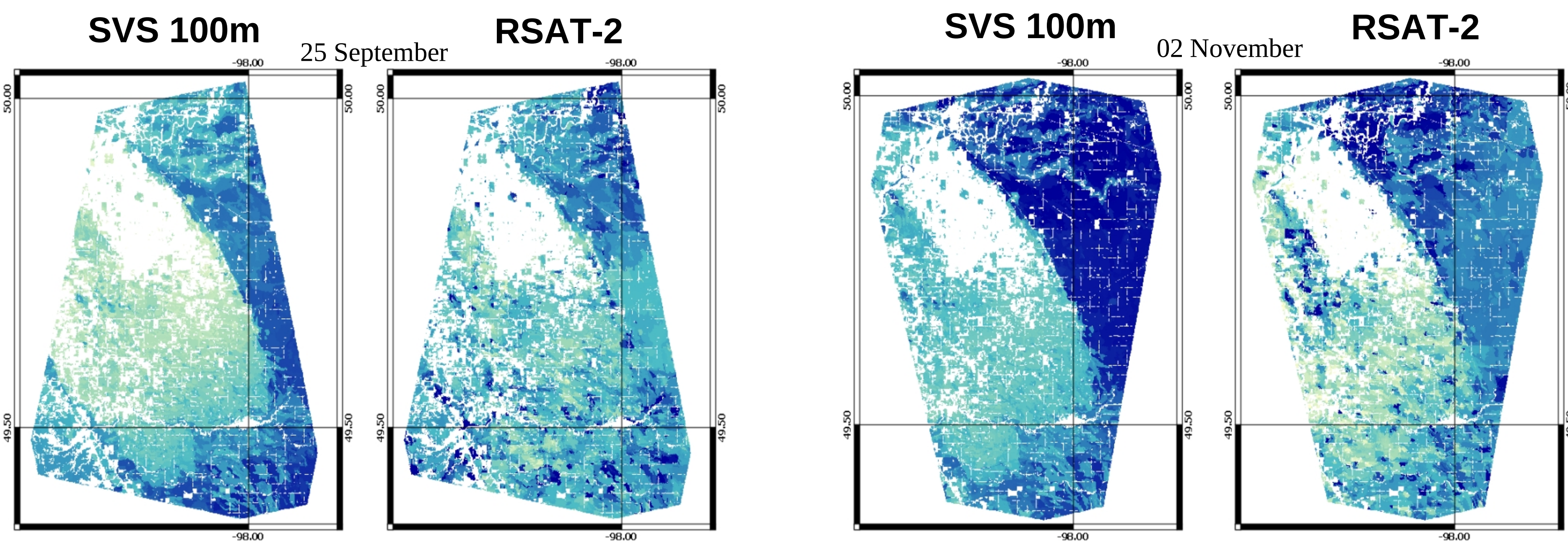
(Bani Shahabadi et al. 2019, under review)

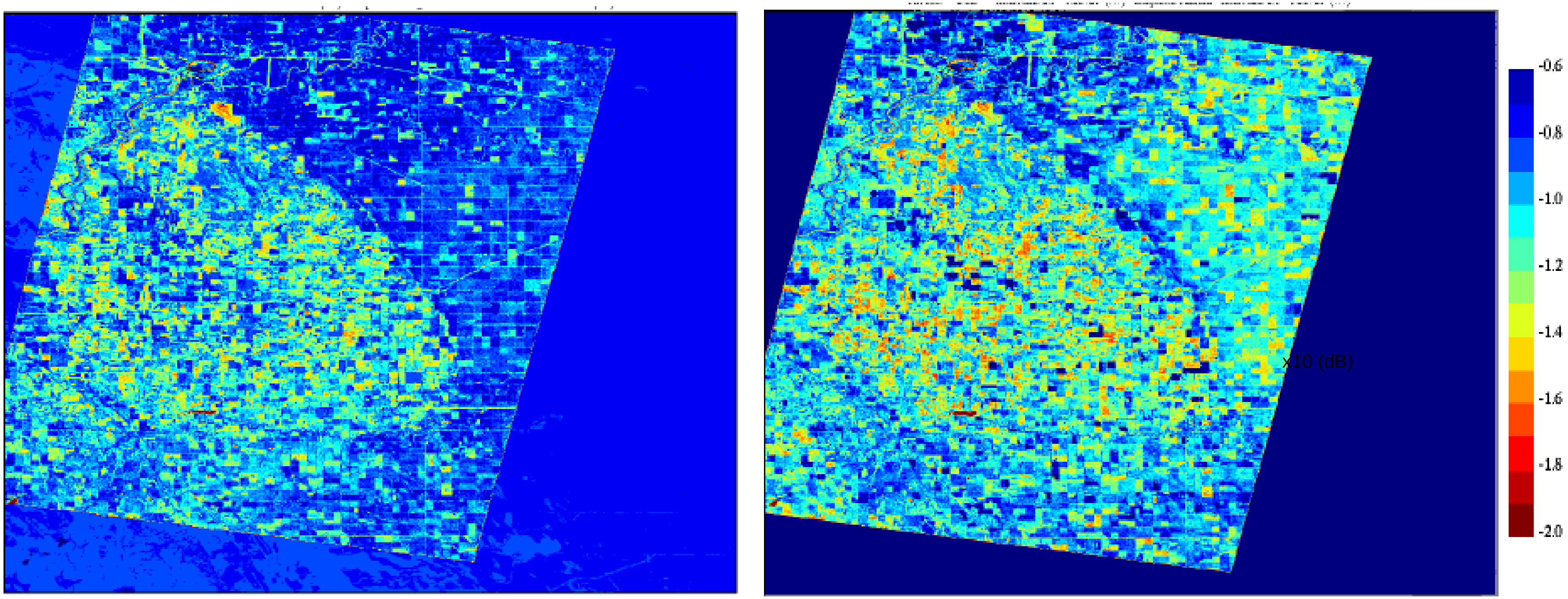
Field-scale soil moisture (in the soil moisture space)



(Dabboor et al. 2019)

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

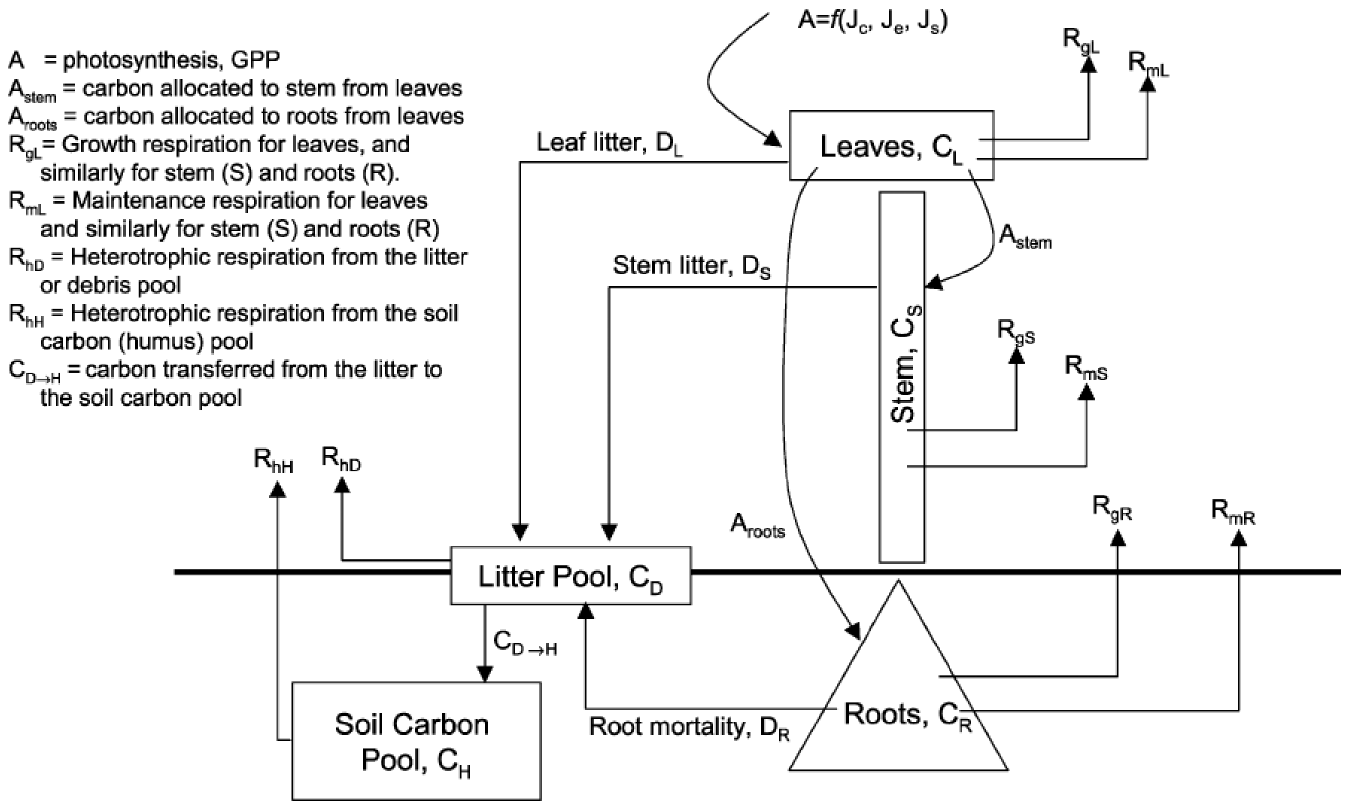
SVS+IEM RSAT-2



(Sun et al. 2019)

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

V.K. Arora/Agricultural and Forest Meteorology 118 (2003) 21–47 23



$$\frac{dC_L}{dt} = A - R_{gL} - R_{mL} - A_{roots} - A_{stem} - D_L$$

$$\frac{dC_S}{dt} = A_{stem} - R_{gS} - R_{mS} - D_S$$

$$\frac{dC_R}{dt} = A_{roots} - R_{gR} - R_{mR} - D_R$$

$$\frac{dC_D}{dt} = D_L + D_S + D_R \quad R_{hD} \quad C_{D\to H}$$

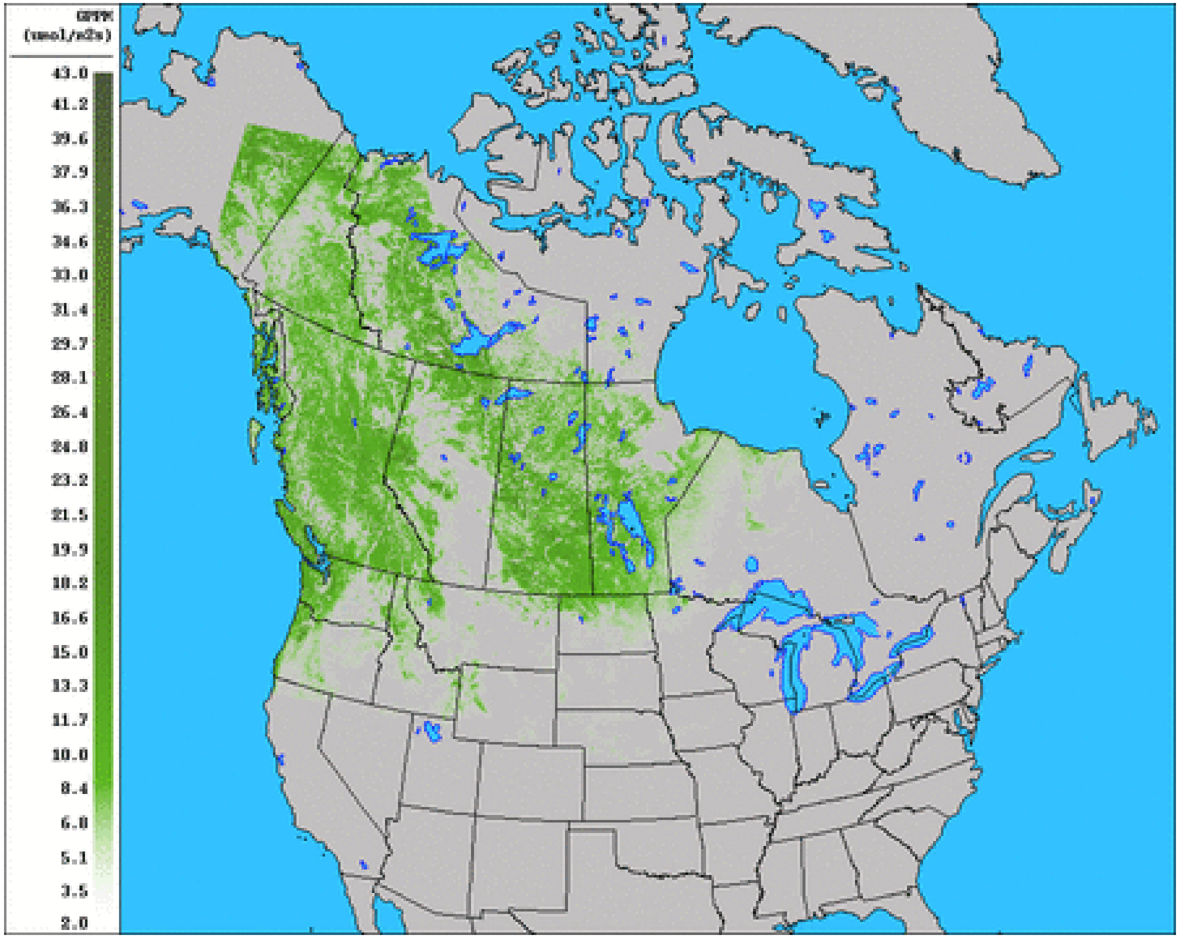
$$\frac{dC_H}{dt} = C_{D\to H} - R_{hH}$$

$$\frac{dC_{(L+S+R+D+H)}}{dt} = A - R_{g(L+S+R)} - R_{m(L+S+R)} - R_{h(D+H)}$$

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

Gross Primary Production from SVS (2.5km national)

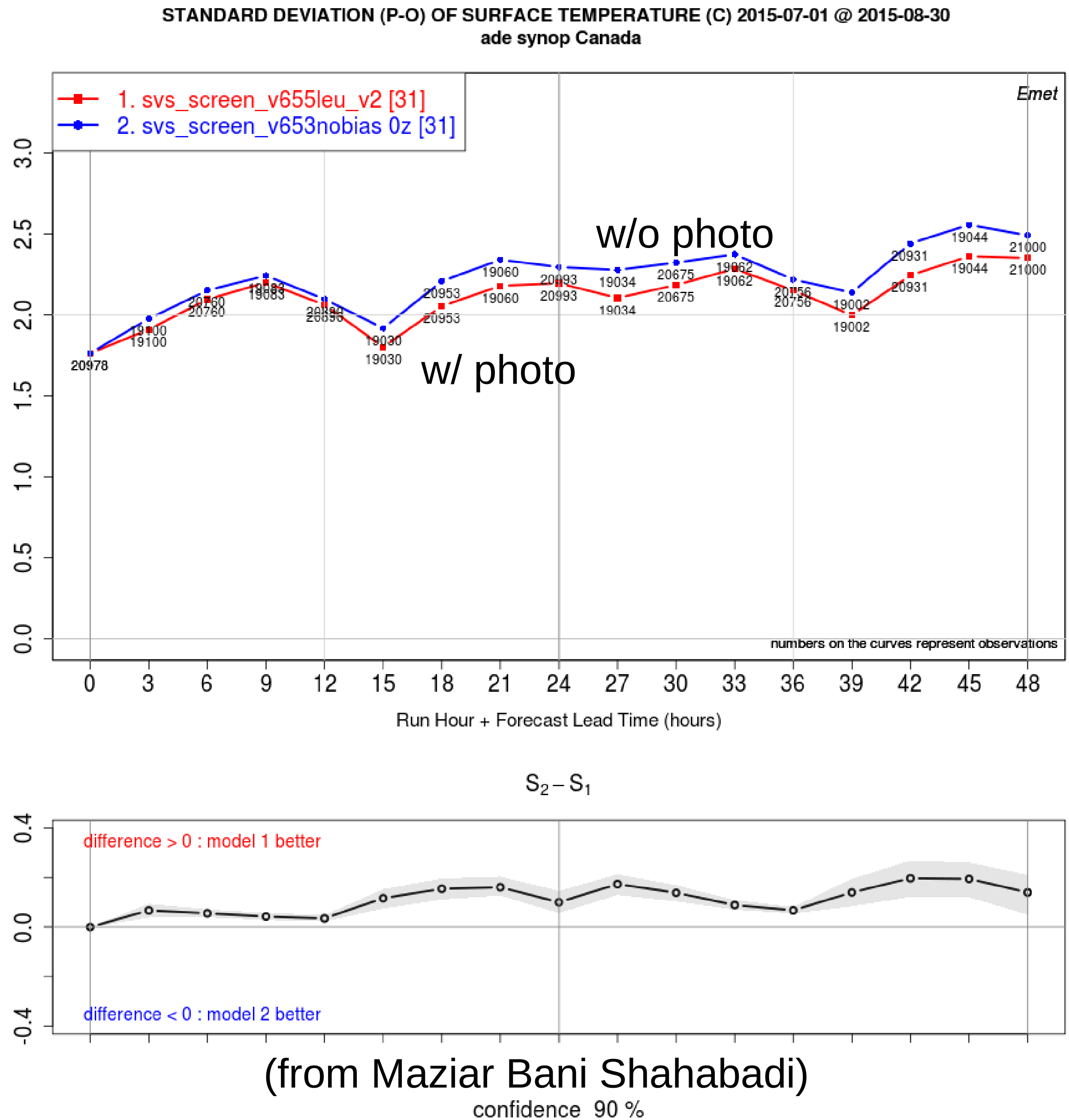


Impact of photosynthesis on NWP

2-m Air Temperature STDE

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

CANADA



(from Maziar Bani Shahabadi)

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A few other items

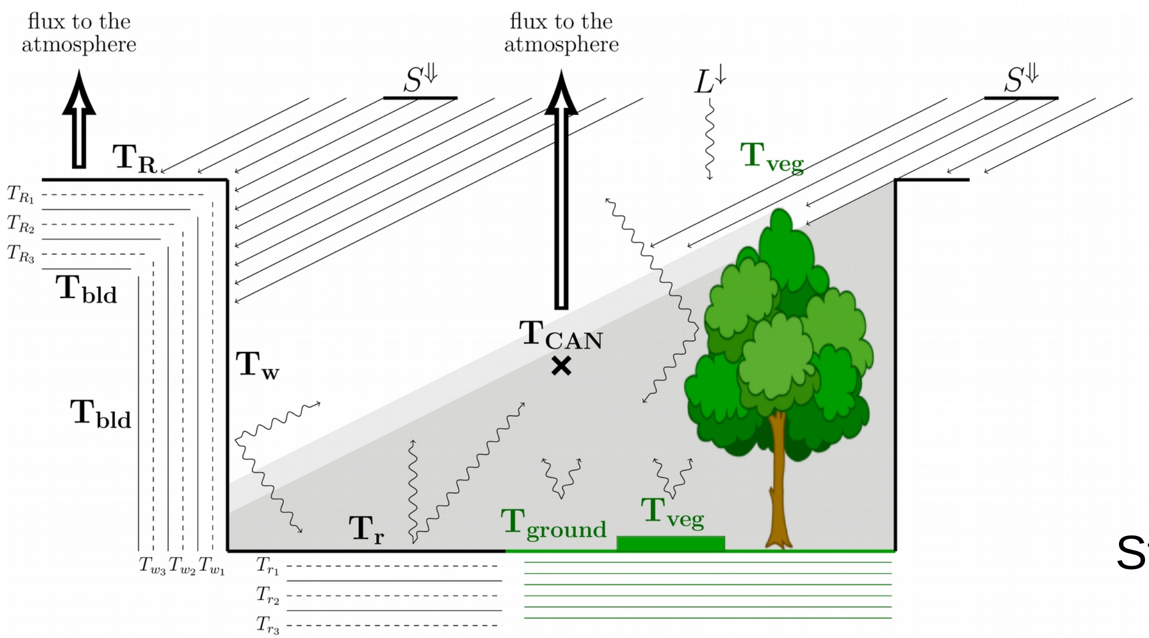
Vegetation in cities

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).



Stephane Belair, Montreal,
15 July 2019