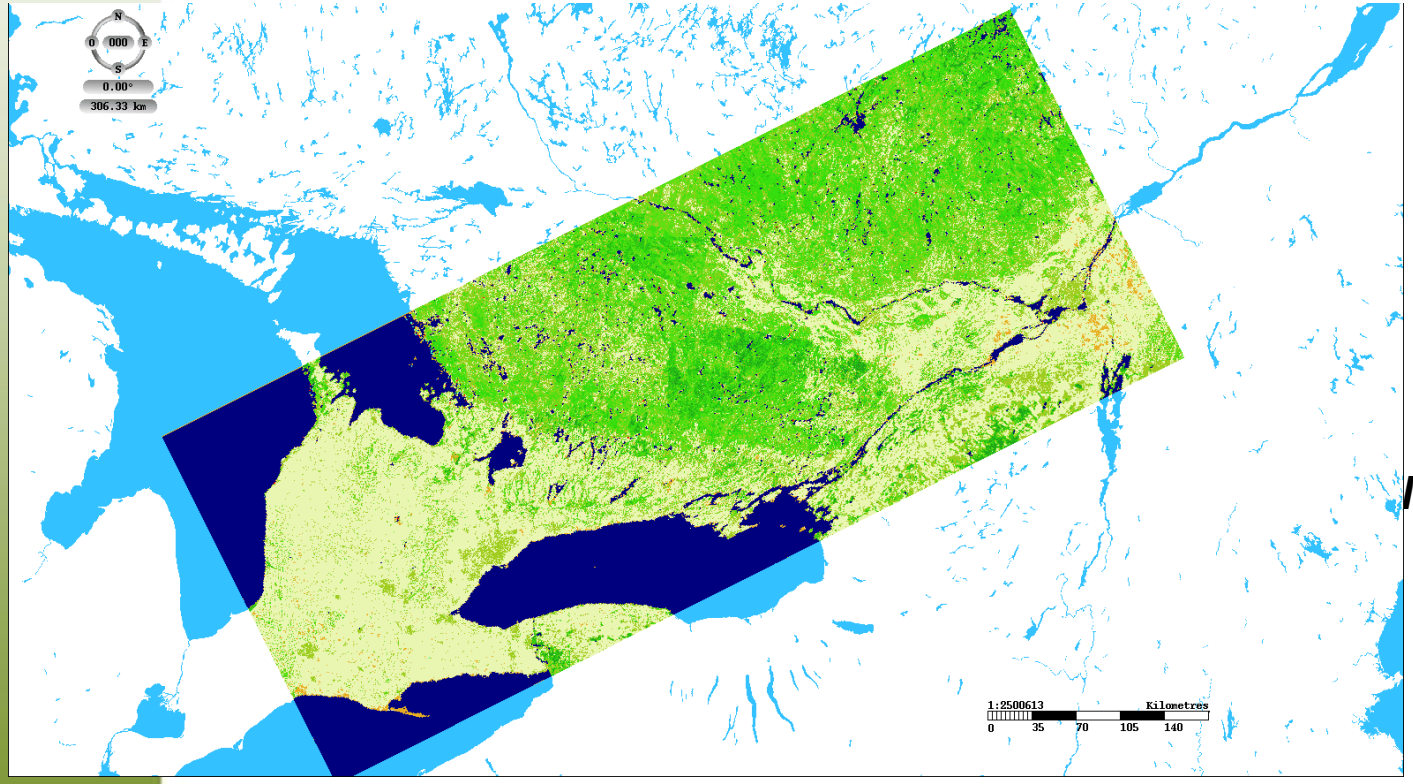
Environment Canada Environnement Canada

Canada

Progress on the Inclusion of Vegetation in EC's Land Surface Modeling and Assimilation Systems



Stéphane Bélair, Shunli Zhang, Marco Carrera, Syed Husain, and Maria Abrahamowicz
Environment Canada

Ottawa, 21 March 2013

OBJECTIVE of this SUB-COMPONENT of the CaLDAS PROJECT

A) Better initial conditions of soil moisture → improvement to carbon exchange through evaporation + improvement to vegetation analysis

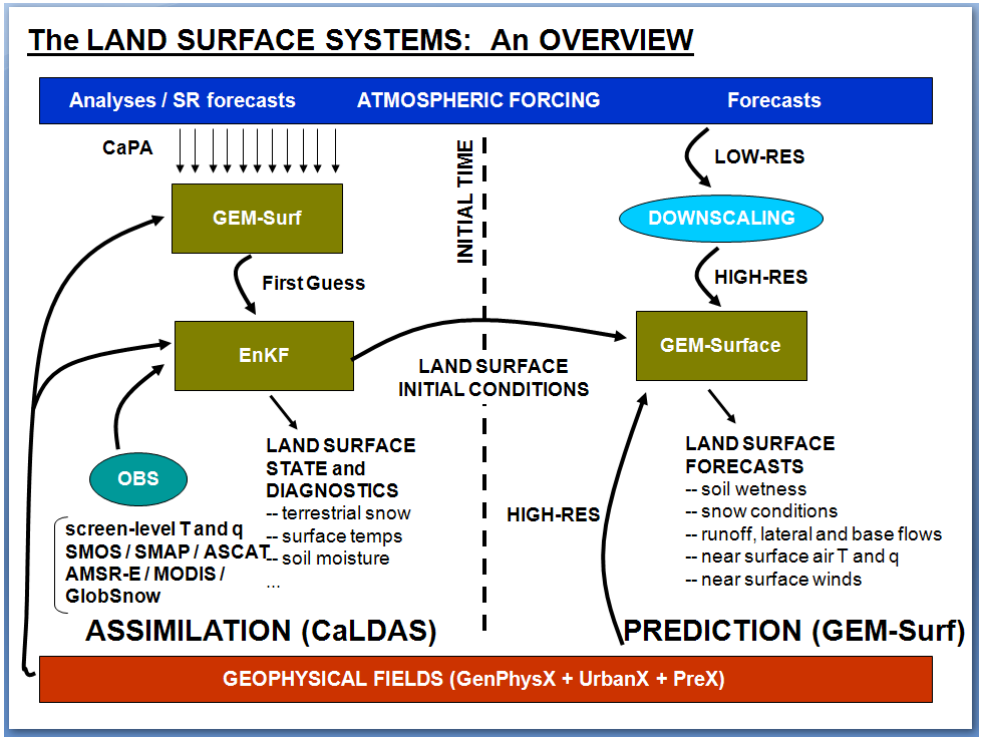
B) Better representation of vegetation and carbon exchanges → improvement in evapotranspiration and thus to soil moisture

APPROACH:

Improve land surface modeling

Include link between water and carbon exchanges through photosynthesis

Couple land surface system with ecosystem model



The SOIL and VEGETATION SIMULATOR (SVS) (formerly known as MISBA)

Multiple energy and water budgets (new subgrid-scale tiling)

Multi-layer model for soil moisture

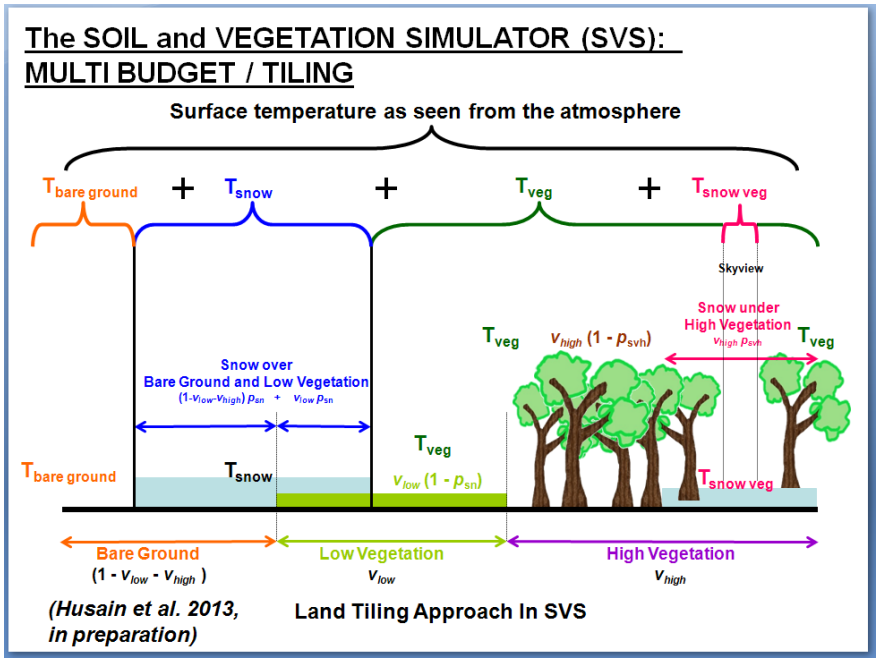
New snow pack under the vegetation

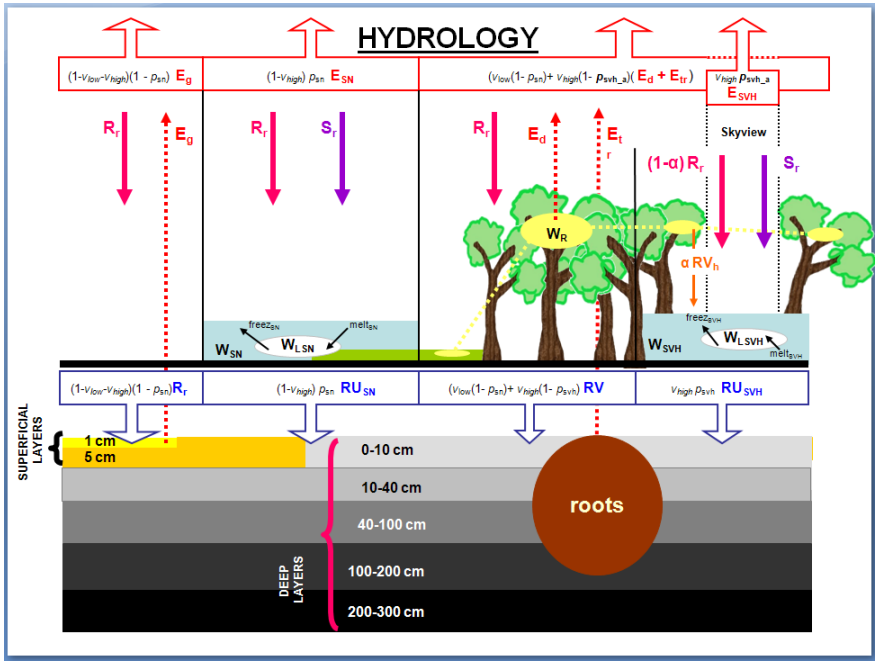
Root density function depending on vegetation type

Changes to vegetation thermal coefficient, albedo, and emissivity

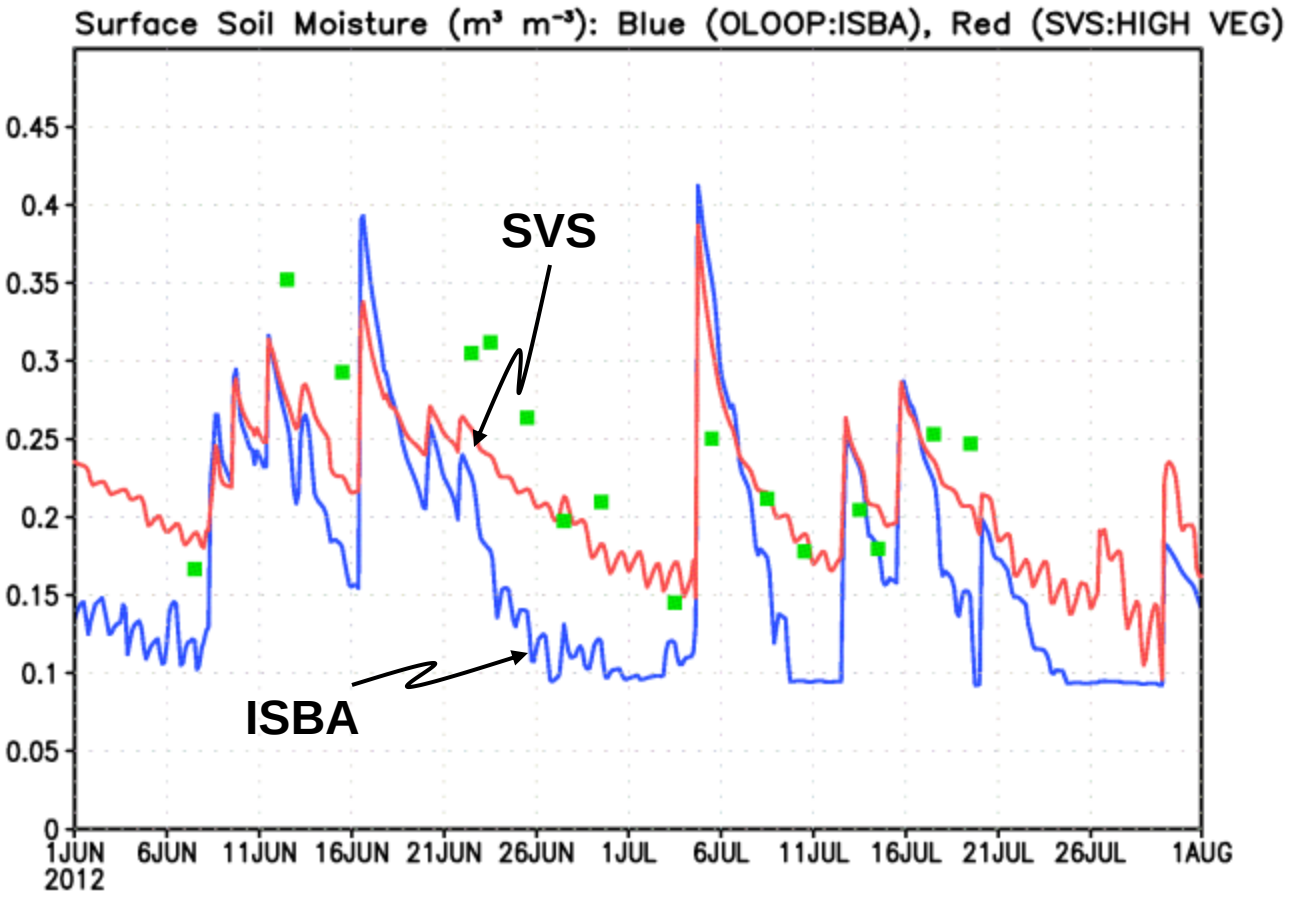
Not changed: still a single canopy layer scheme (not for long…), and same representation of evaporation resistance

In development: new hydrology (surface, sub-surface, and base flows), and better representation of freeze-thaw processes.

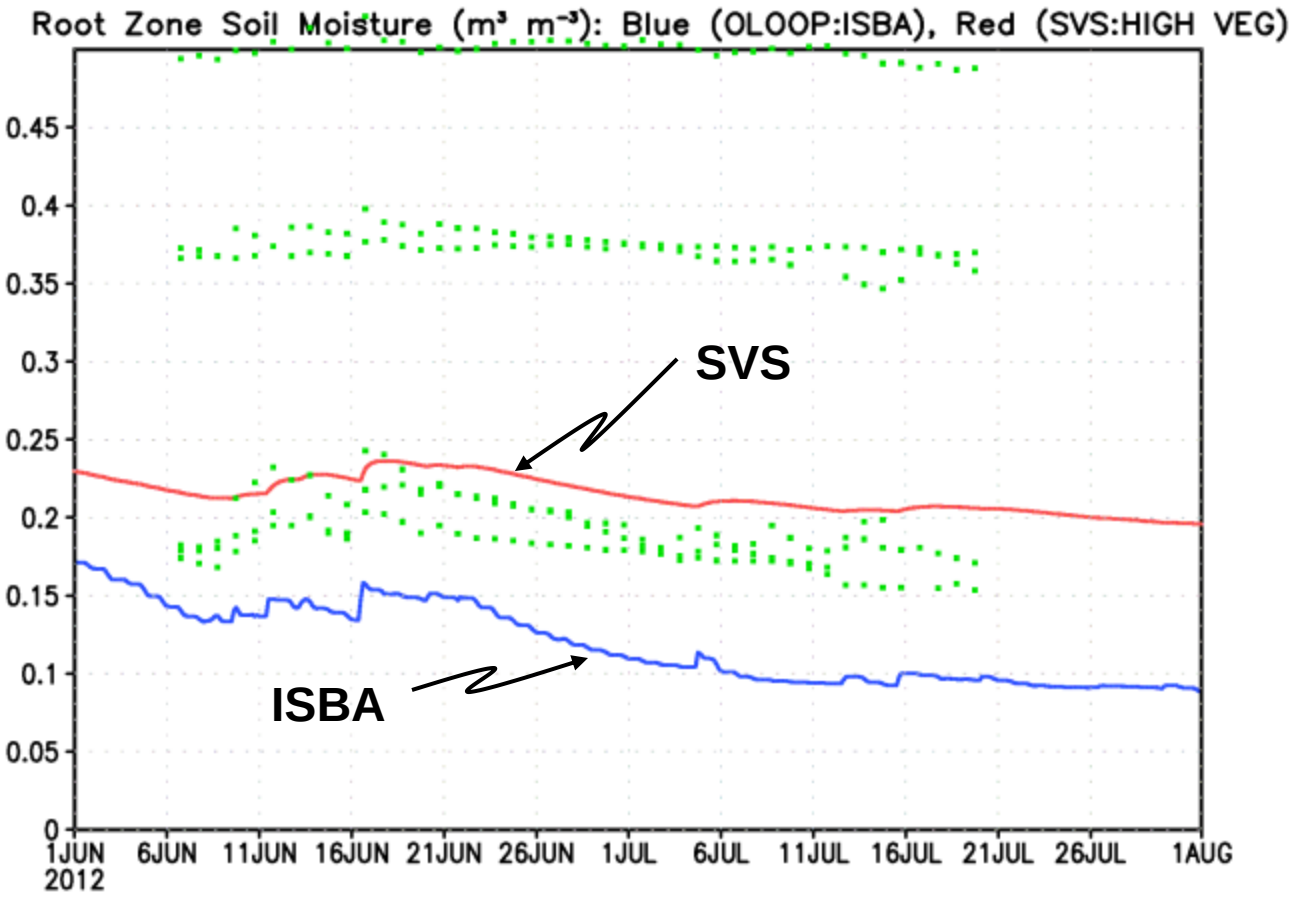




IMPROVEMENT with SVS, with RESPECT to ISBA
VERIFICATION AGAINST SMAPVEX12 FIELD OBSERVATIONS
NEAR-SURFACE SOIL MOISTURE

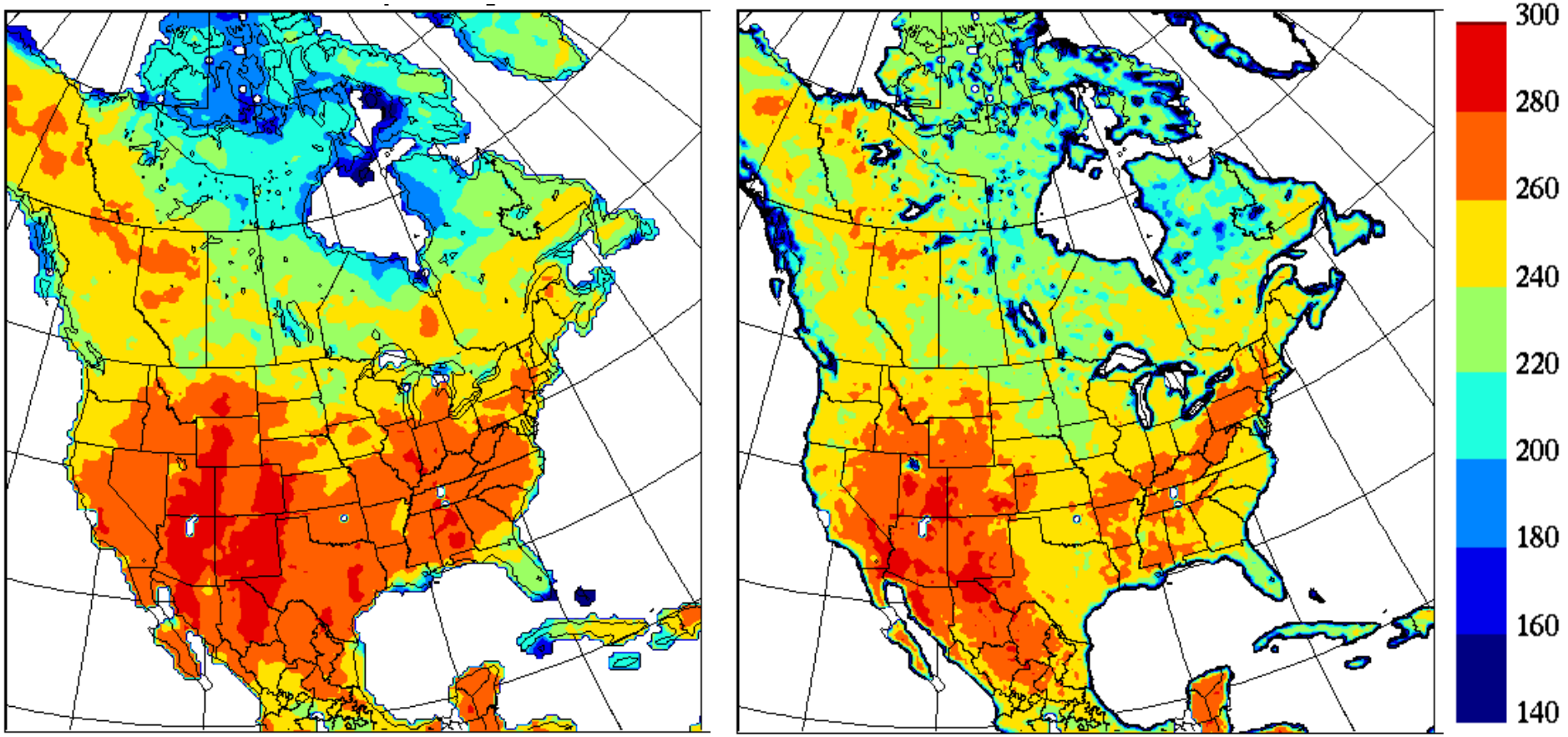


IMPROVEMENT with SVS, with RESPECT to ISBA
VERIFICATION AGAINST SMAPVEX12 FIELD OBSERVATIONS
ROOT-ZONE SOIL MOISTURE (first 50 cm in this case…)



IMPROVEMENT with SVS, with RESPECT to ISBA
L-BAND BRIGHTNESS TEMPERATURE (H pol, 40 degree)
CALCULATED USING CMEM

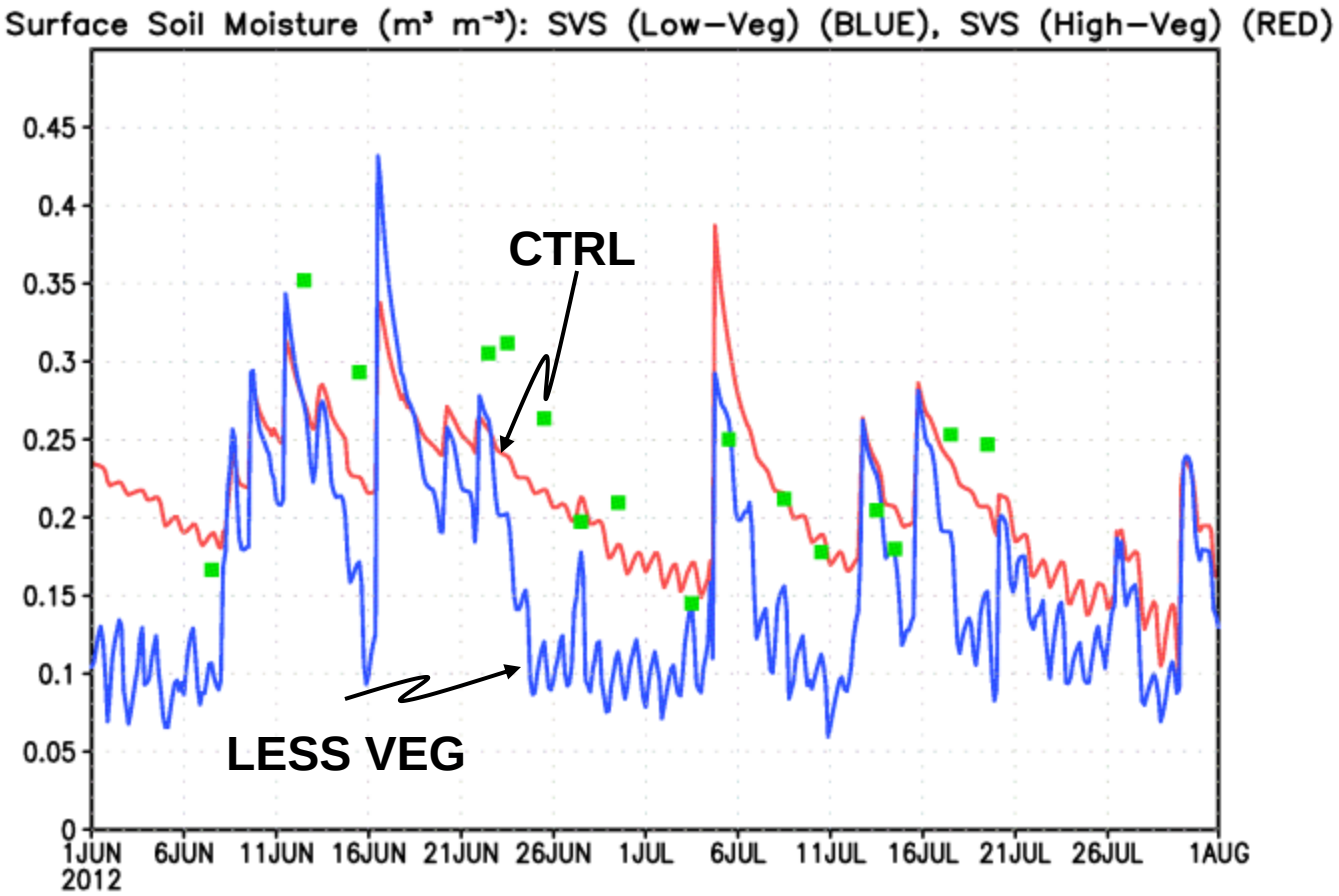
SMOS **SVS**



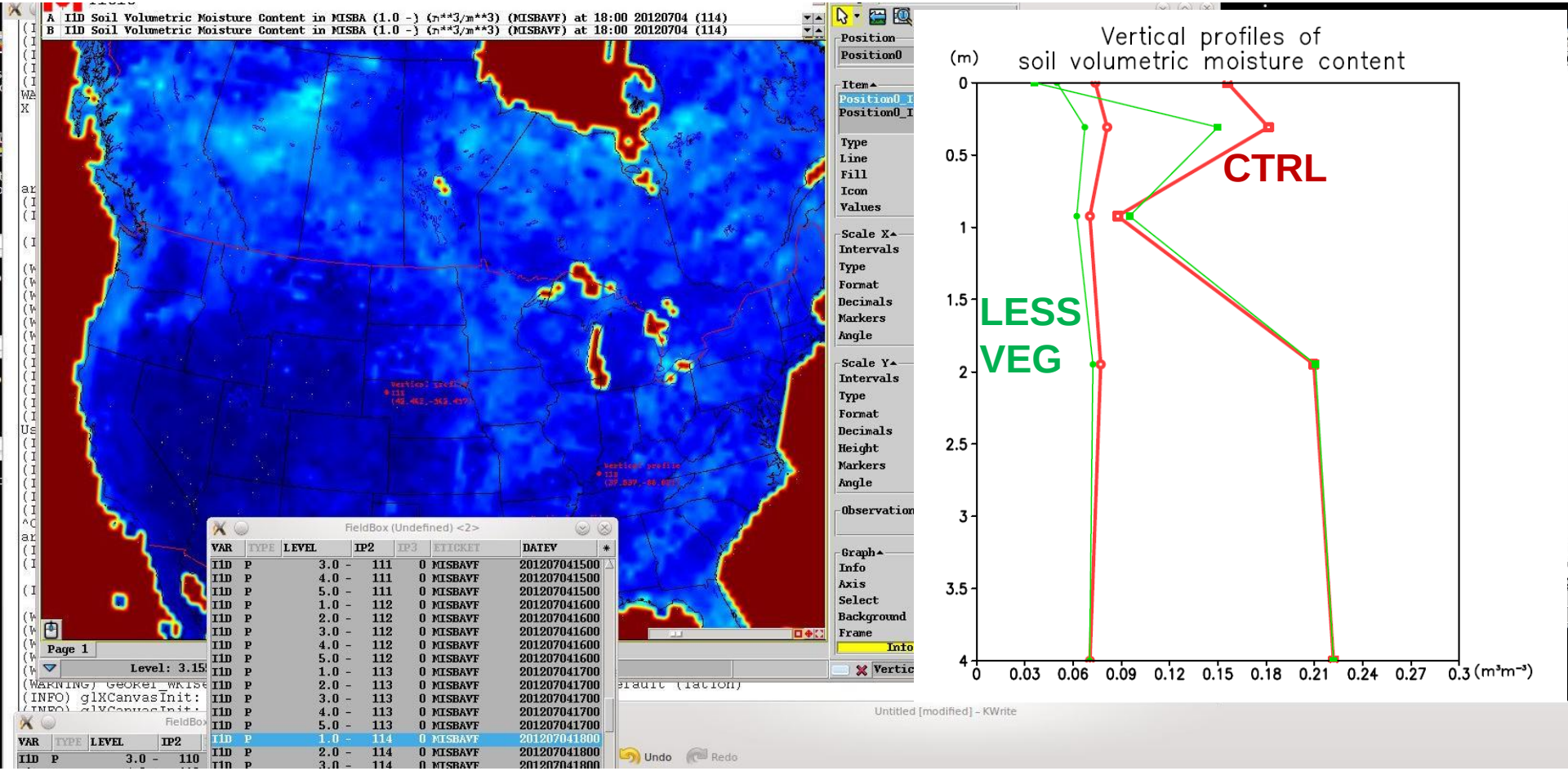
Valid June 25th, 2012

For May to August 2012: correlations SMOS / SVS (**0.50**) and SMOS / ISBA (**0.44**)

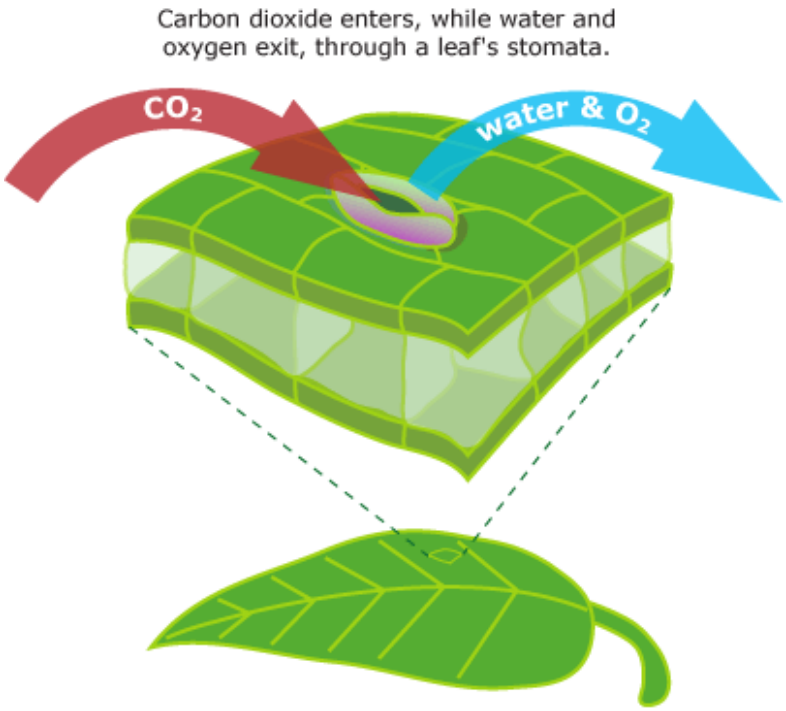
IMPACT of VEGETATION
On SOIL MOISTURE DURING SMAPVEX12
With SVS



IMPACT of VEGETATION
VERTICAL PROFILES of SOIL MOISTURE



PHOTOSYNTHESIS BEING CODED in SVS



(http://evolution.berkeley.edu)

Approach now used in SVS is the same as ISBA and is based on Jarvis (1976)

$$r_c = r_{\min} f_1(S) f_2(\Delta e) f_3(w) f_4(T_a)$$

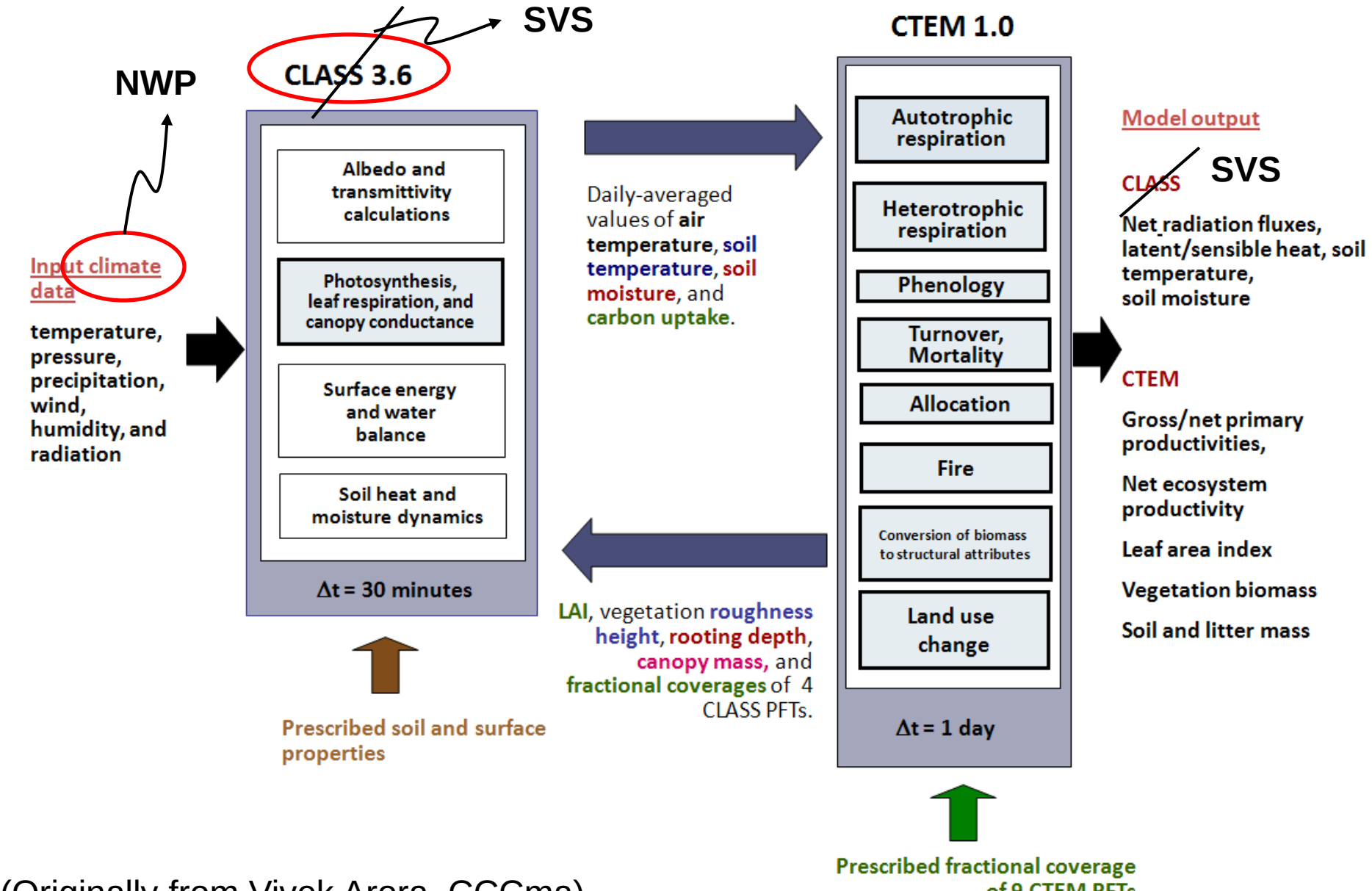
Following implementation in CLASS by Vivek Arora (CCCma), the Biochemical approach is being implemented in SVS (Farquhar et al. 1980)

$$A_0 = f(\text{environmental conditions}, c_i)$$

The photosynthesis / stomatal conductance coupling is modeled by Ball et al. (1987) or by Leuning (1995).

A two-leaf (sunlit and shaded) option is possible, but not included yet.

INCLUDING VEGETATION MODELING and the CARBON CYCLE with CTEM

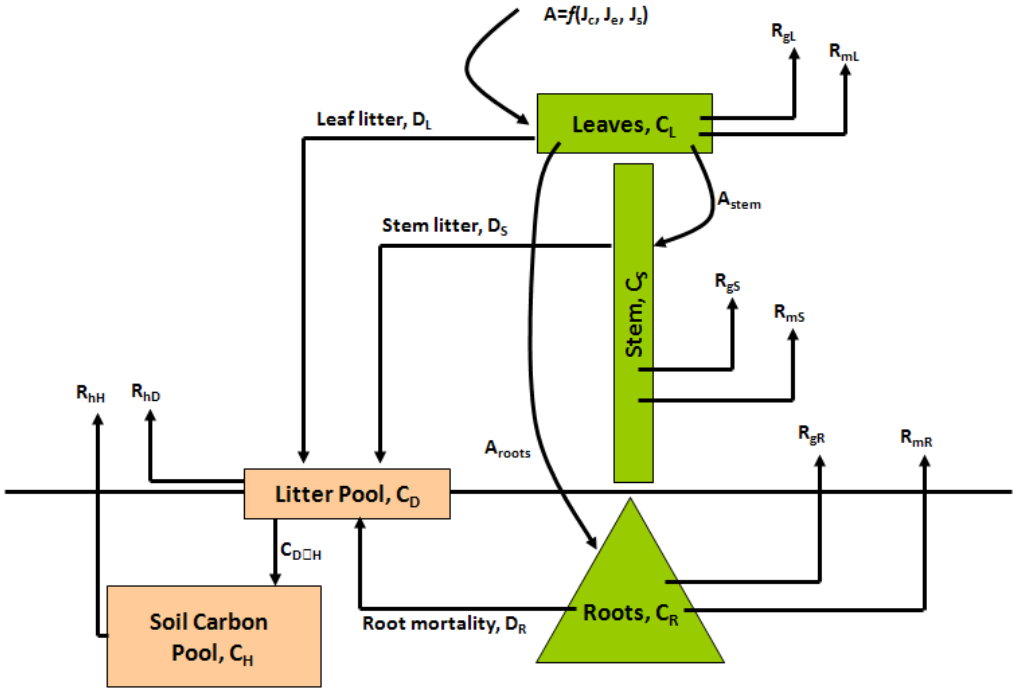


(Originally from Vivek Arora, CCCma)

STATUS and PLANS

Coding of photosynthesis in SVS is progressing quickly.

CTEM will be running in RPN's modeling environment before this summer



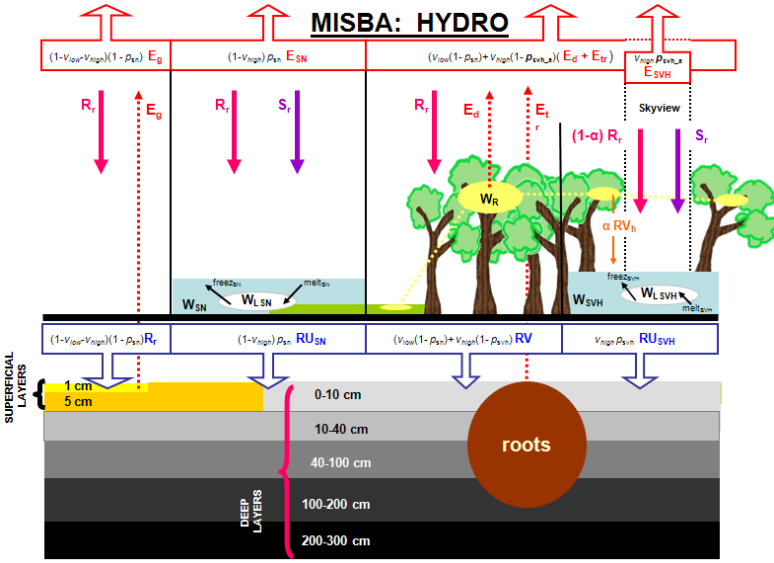
Collaborations with University of Toronto (Prof. Jing Chen) to test more sophisticated methods for photosynthesis (sunlit and shaded sources, vegetation clumping, link with evapotranspiration)

10-year global and NAM reanalyses are planned (5-10 km grid spacing for global and 1-2 km for NAM)

Evaluation using surface networks, tower measurements, impact on NWP and hydrology

Freeze-thaw with SMAP: The modeling aspect

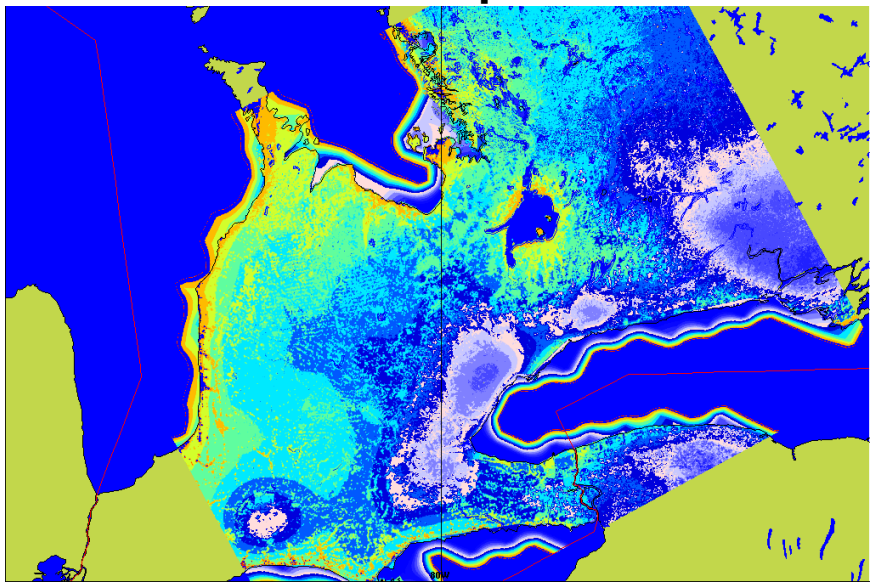
- Less emphasis on this aspect (at EC at least)
- Multi-layer surface scheme required (temp and moisture)
- Total soil depth in current scheme not very large



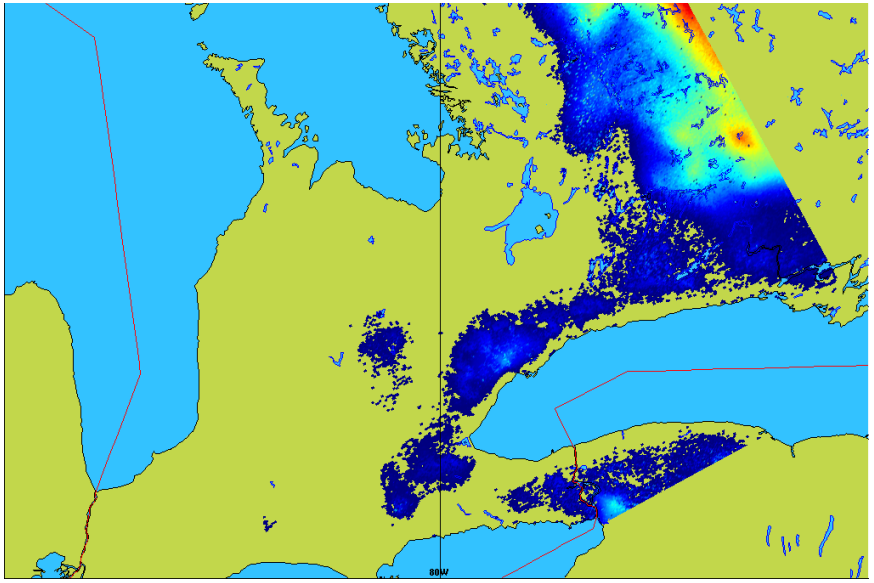
New land surface scheme

Ex: 200-m external run

Surface temperatures



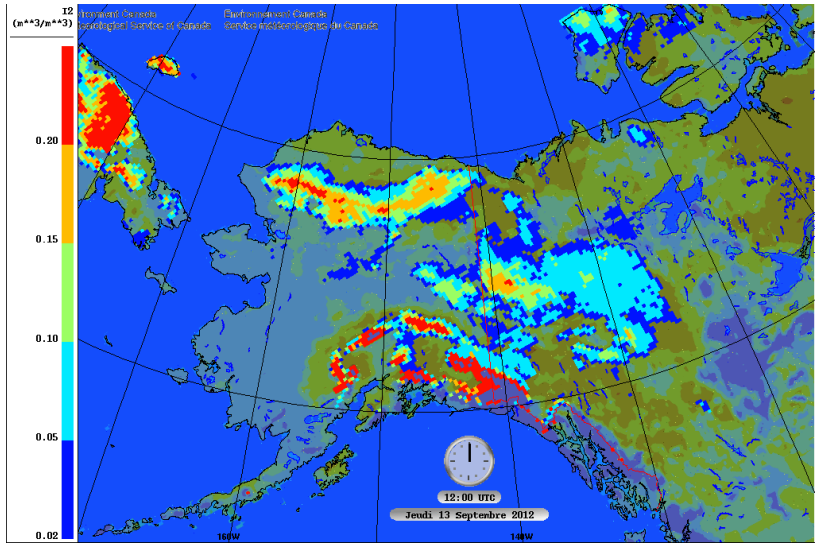
Frozen soil moisture



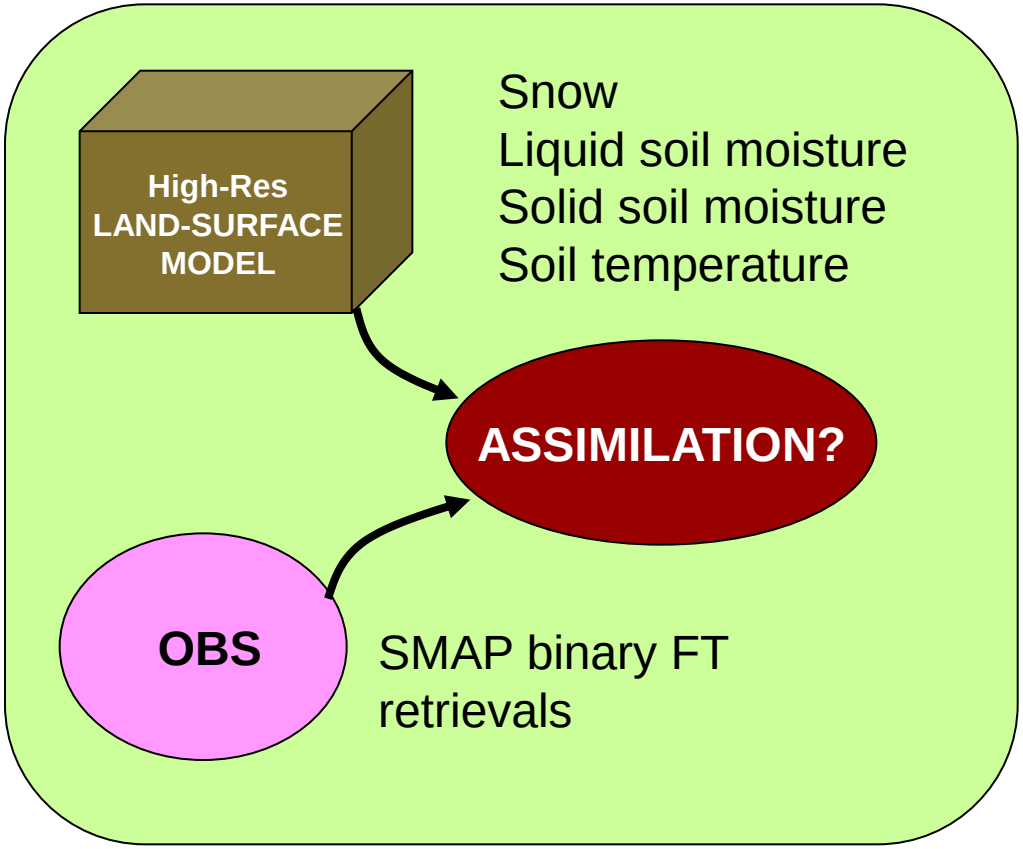
Valid 0000 UTC 4 November 2011

Freeze-thaw with SMAP: Assimilation plans
High-resolution version

Thursday 13 Sept. 2012



OP - Liquid / solid soil moisture (root-zone layer)



Increment for liquid / solid soil moisture only if no snow and if Tsoil between To-ΔT and To+ ΔT

Increment for soil temperature if inconsistent with FT state