

Progress of the IESWG and items for coordination with CGMS

Presented to CGMS-54 Plenary

Requirement and Gap Analysis

Purpose: Identify past and ongoing efforts to establish requirements for satellite land surface observations for use in numerical weather prediction

Specifically:

- identify pre-existing efforts that expose gaps between what we need and we have
- identify pre-existing efforts to establish requirements for these variables
- highlight areas where gaps remain poorly defined

Action: Integrating community requirements into the WMO RRR process to ensure global compatibility and iterative updates; 06Mar2026 meeting of IESWG with WMO RRR focus area provided information on how to provide this information

Outcome: IESWG will leverage the WMO RRR vehicle to translate identified requirements—including resolution and error thresholds—into formal application-specific guidance targeting primarily the NWP application areas

Boundary Conditions and State of Affairs

Very **small group** of experts relative to atmospheric NWP

- Relatively few specialists at each agency - with highly **variable priorities**
- No **explicit funding** for this coordination

Land processes are simulated as model physics

- Underlying theory is consistent between most models
 - But not all: Meteo-France's ISBA, NASA's Catchment are fundamentally different
- Differing methods of solving equations, parameterization schemes, vertical resolution, treatment of horizontal homogeneity, use of ancillary data, etc.
 - Fewer opportunities for shared requirements and metrics

Requirements, metrics, evaluation methods for land variables differ from those for the atmosphere, and land requirements for NWP differ from those for other land applications

- Need cross-disciplinary effort to establish land requirements for NWP

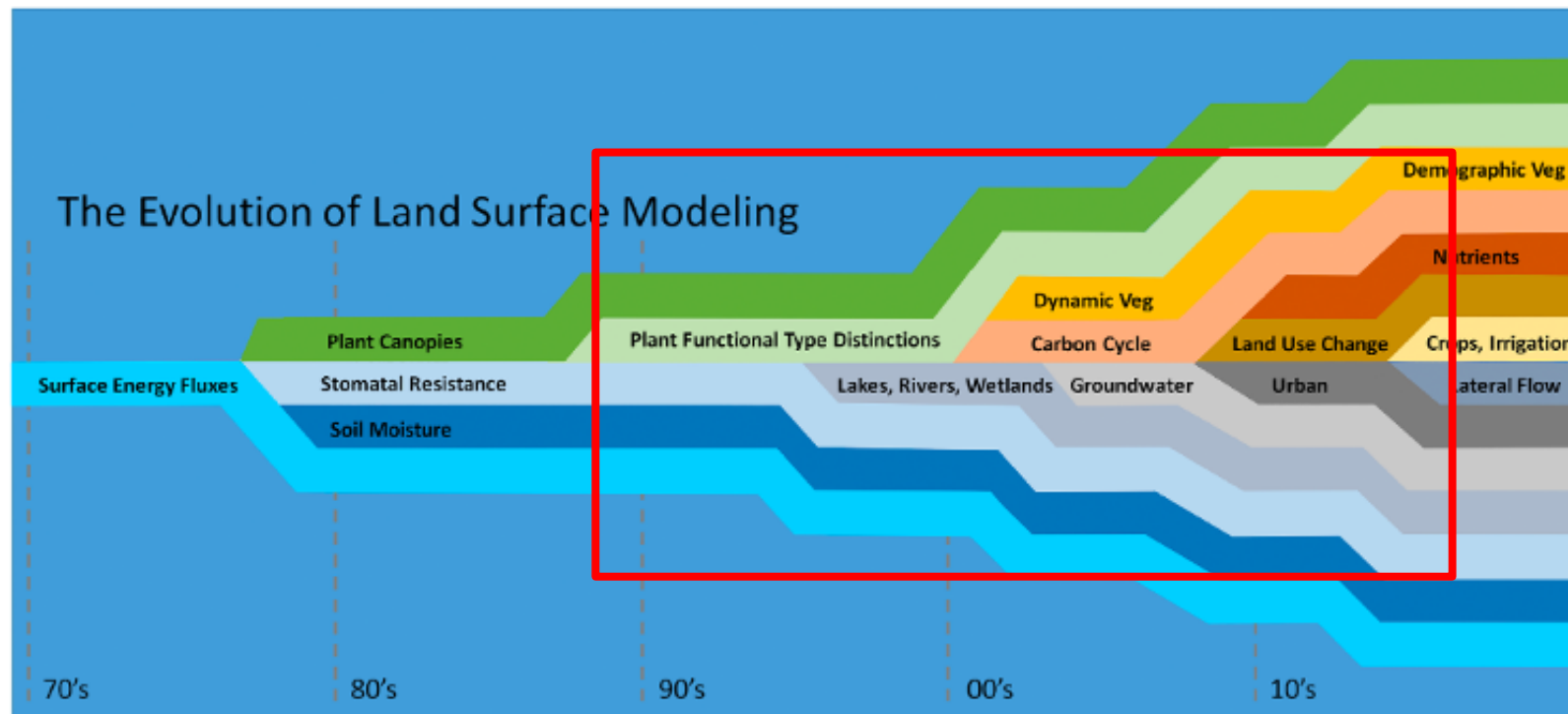
Global **in-situ land observations** and their maintenance are critical for training, refining parameterizations and for the modernization of land systems

A bit of context

Evolution of land surface models has driven changes to:

- variables
- metrics to assess their quality and impact

Dynamic vegetation becoming critical for performance in modern systems



Fisher and Koven, 2018

Evolution of Earth Surface Variables

Fisher and Koven (2018) provide a historical overview of surface modeling and an illustration of progression of variables required for the systems.

In particular, **dynamic vegetation** is now used and variables like SIF (or VOD) are being explored for this proposal; IESWG align NWP application areas land surface variables and collect requirements

Next target observables are:

- SWOT and similar surface water observations
- Geostationary data, especially LST

Incomplete metrics: Existing uncertainty requirements used values that in general can confirm physical reality but not necessarily **meaningful values** for many locations (e.g. 0.04 m³/m³ RMS surface soil moisture)

- limits the relevance and uptake of remotely sensed data for operation use

Use of AI/ML with satellite platforms offer global coverage, however operational uptake depends on in-situ networks for training and model parameterizations. This creates two critical vulnerabilities:

- **data imbalance:** networks are dense in some regions but non-existent in others
- **transfer learning limits:** severe spatial heterogeneity defeats transfer learning, preventing models

from generalizing globally

Key issues of relevance to CGMS:

- CGMS-53-CGMS-WP-27 HLPP support of items:
 - 4.3.5 development of a snow water equivalent (SWE) product and applications
 - 4.6.3 microwave radiative transfer over complex surface (e.g. snow, desert, etc.)
 - All of 4.8
- Development and use of solid surface observations of snow, soil and vegetation and their water content are critical to other CGMS Science Working Groups
 - Review variables and their geophysical uncertainty starting with:
 - soil moisture
 - snow water equivalent
- Dynamic vegetation variables require review and convergence of variable naming conventions (for NWP focus) – this recently occurred for cryosphere

To be considered by CGMS:

- Continued support for missions capable of making measurements of SWE
- Coordination of the IESWG and other CGMS Science groups with the WMO RRR
- Confirmation of IESWG within CGMS