

The ECMWF land surface scheme and its initialisation in S2S reforecast applications

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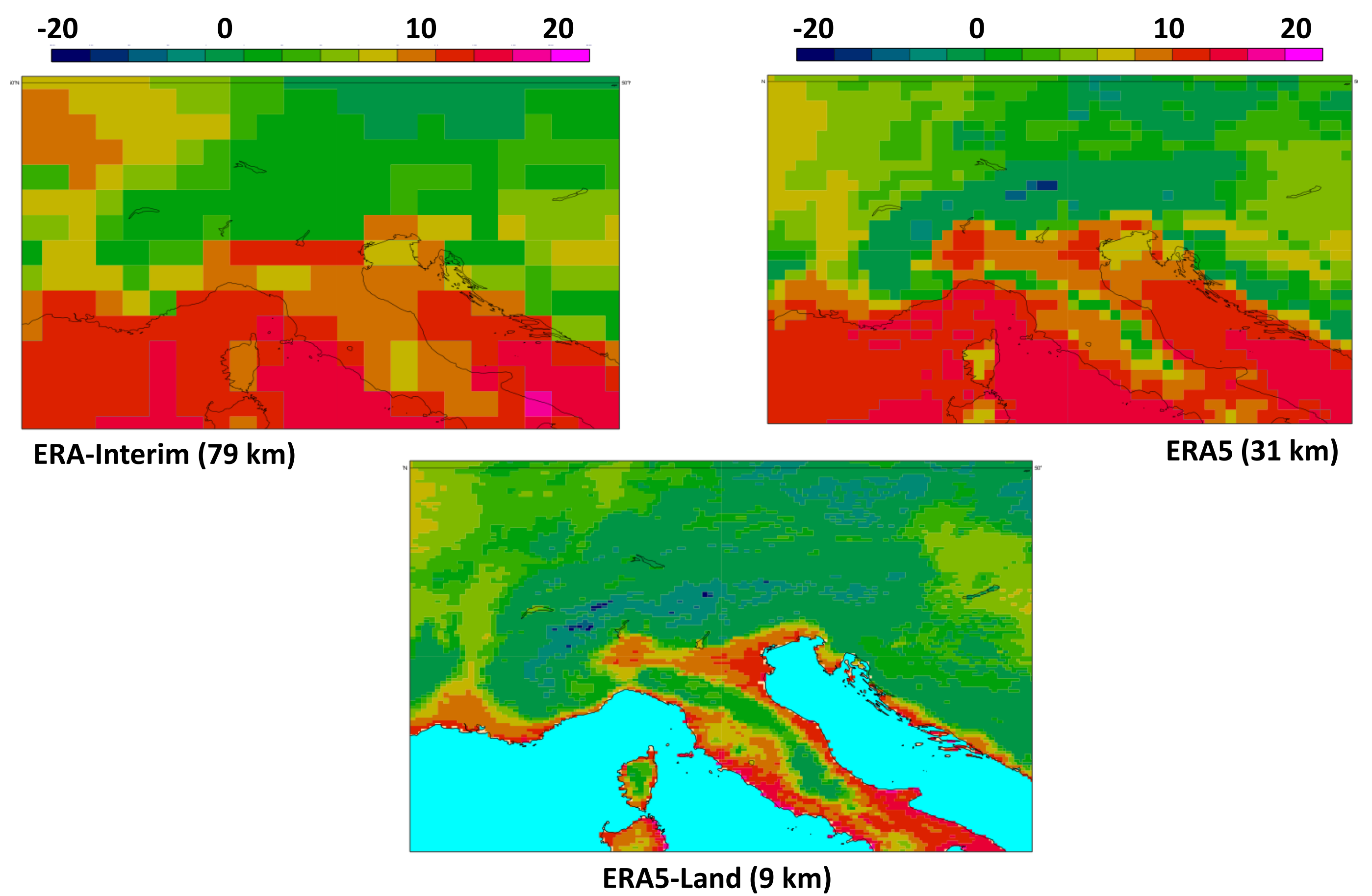
Outline

- A stand-alone version of the ECMWF surface scheme CHTESSEL (Carbon and Hydrology Tiled ECMWF scheme for surface exchanges over Land) forced with the meteorology provided by atmospheric reanalysis is generating the land surface initial conditions for the ECMWF S2S reforecast system as operational in 2018.
- Compared to the version used in the ECMWF Interim Reanalysis (ERA-Interim), several changes have been implemented within :
 - Model representation of vegetation – LAI
 - A new snow scheme
 - Model Surface roughness – Aerodynamic Resistance
 - Improvement in the representation of water bodies
 - Improvement of the soil evaporation
 - Integration a biogenic carbon module

Land surface model status at ECMWF and evolution since ERA-Interim

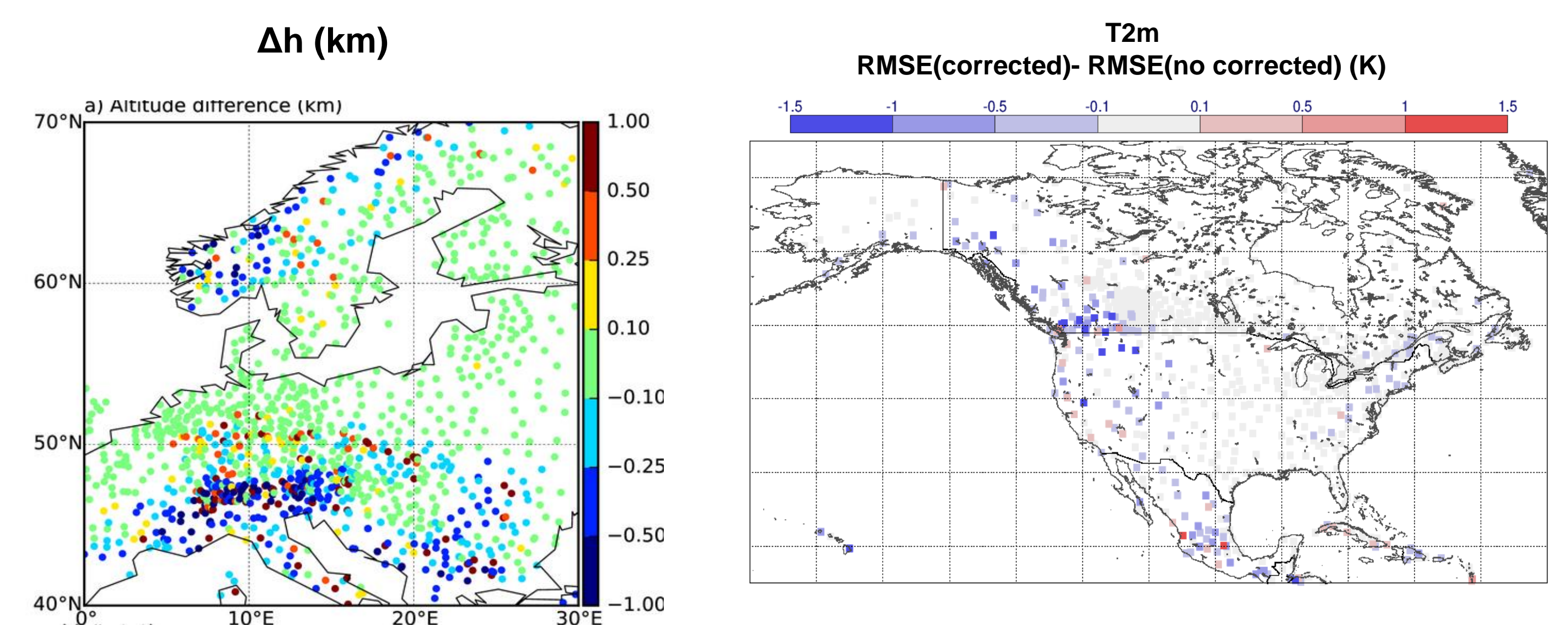
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|---|--|--|--|---|
| Hydrology-TESEL Balsamo et al. (2009) van den Hurk and Viterbo (2003) Global Soil Texture (FAO) New hydraulic properties Variable Infiltration capacity & surface runoff revision | NEW SNOW Dutra et al. (2010) Revised snow density Liquid water reservoir Revision of Albedo and sub-grid snow cover | NEW LAI Boussetta et al. (2013) New satellite-based Leaf-Area-Index SOIL Evaporation Balsamo et al. (2011), Albergel et al. (2012) | H₂O / E / CO₂ Integration of Carbon/Energy/Water Boussetta et al. 2013 Agusti-Panareda et al. 2015 | Flake Mironov et al (2010), Dutra et al. (2010), Balsamo et al. (2012, 2010) Extra tile (9) to for sub-grid lakes and ice LW tiling (Dutra) |
|---|--|--|--|---|

Perspectives of enhanced horizontal resolution



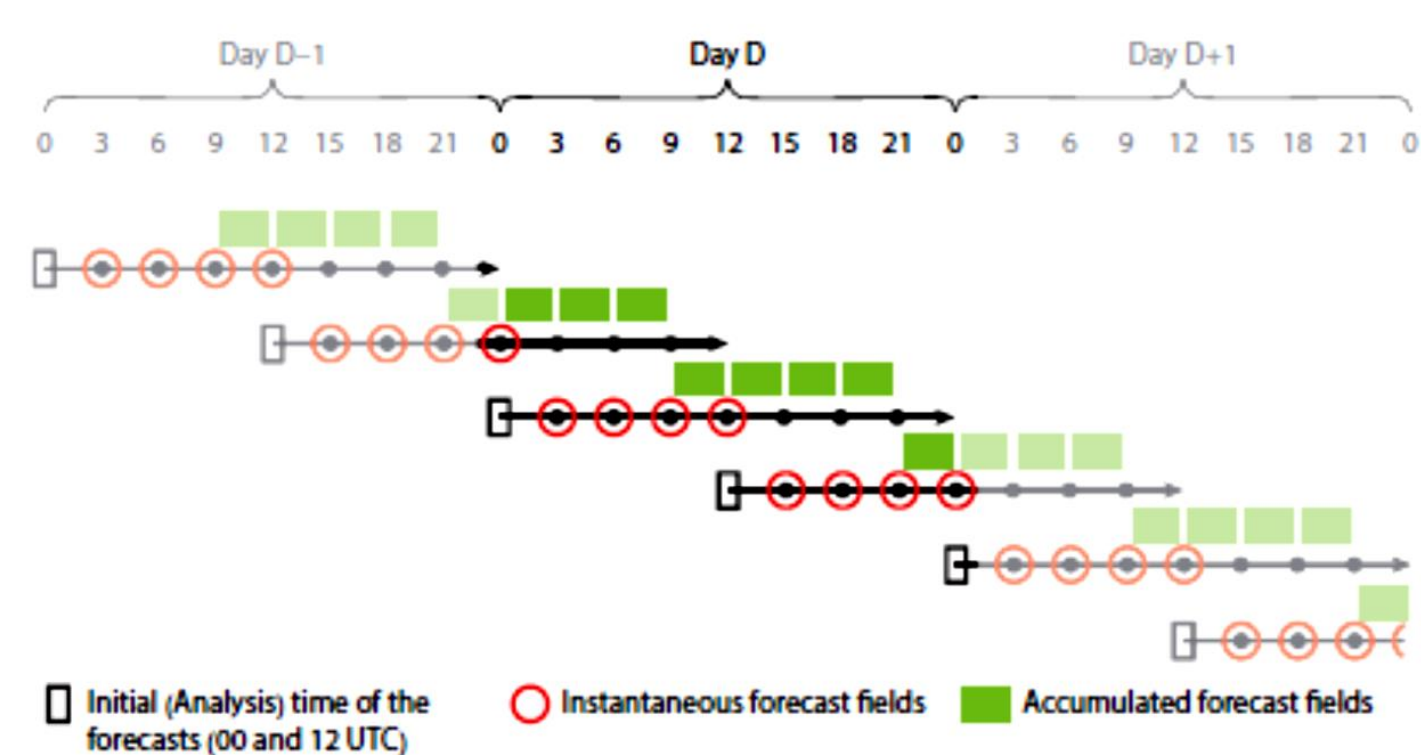
Added value of higher spatial resolution on Soil Temperature (15 March 2010)

Impact of horizontal resolution



Correct for differences in orography due to different model resolutions, with lapse rate adjustment.

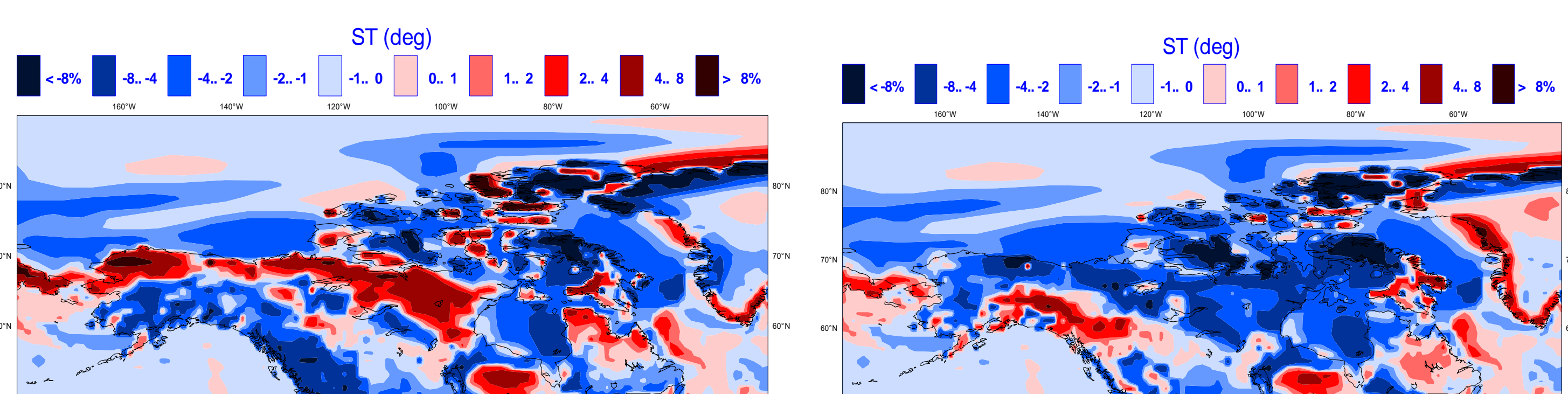
Forcing and Surface offline configuration



Schematic representation of the ERA-Interim meteorological forecasts concatenation for the creation of the 3-hourly forcing time series used in ERA-Interim/Land for a given day.

- Orange circles indicate instantaneous variables valid at their time stamp: 10m temperature, humidity, wind speed, and surface pressure.
- Green boxes indicate fluxes valid on the accumulation period: surface incoming short-wave and long-wave radiation, rainfall, and snowfall.

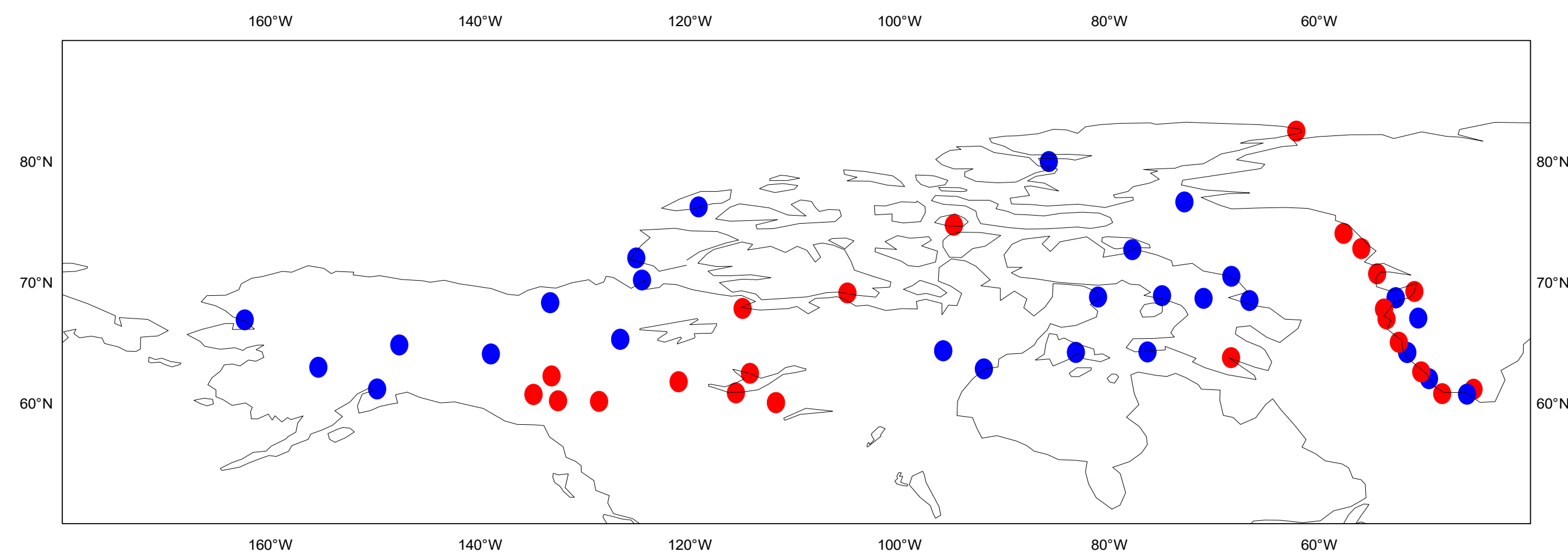
Better initialisation consistency of the reforecast system with the real time analysis



Old Soil Initial Conditions (Era-I)

New Soil Initial Conditions (Era-I-Land)

Surface Temperature Anomalies
01/05/2011- Day 5-11

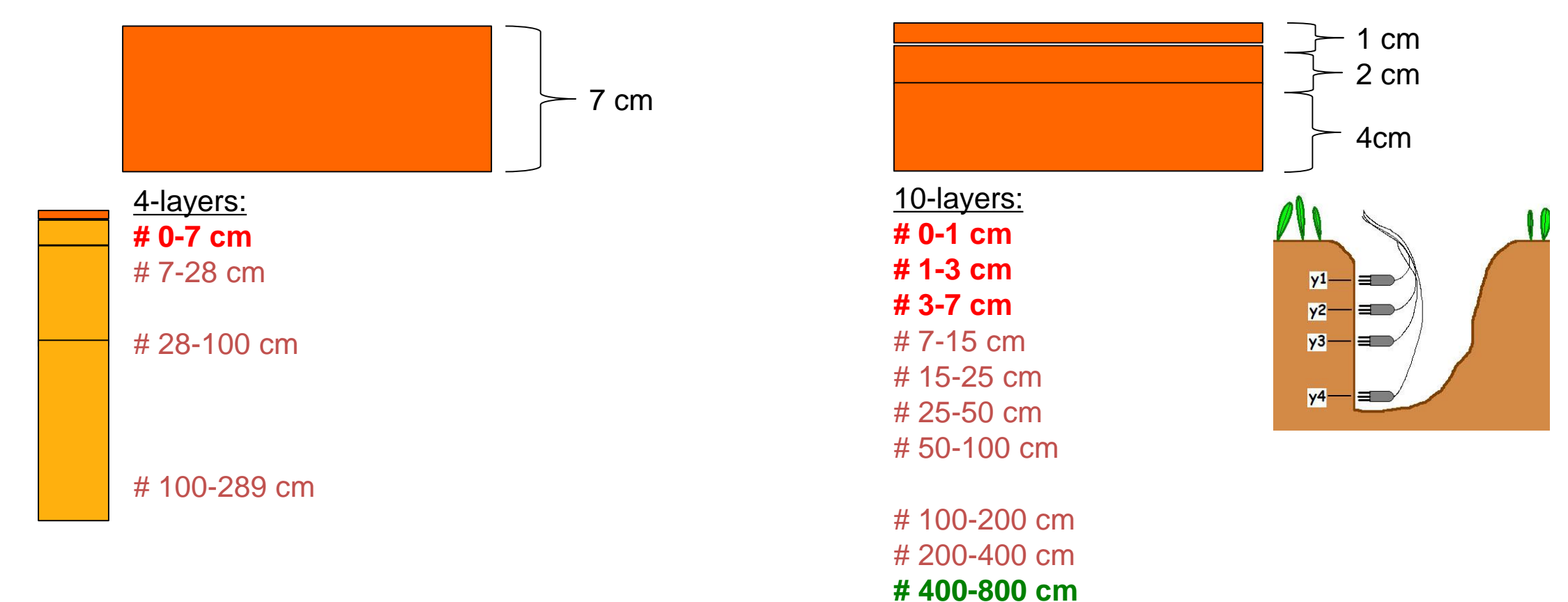
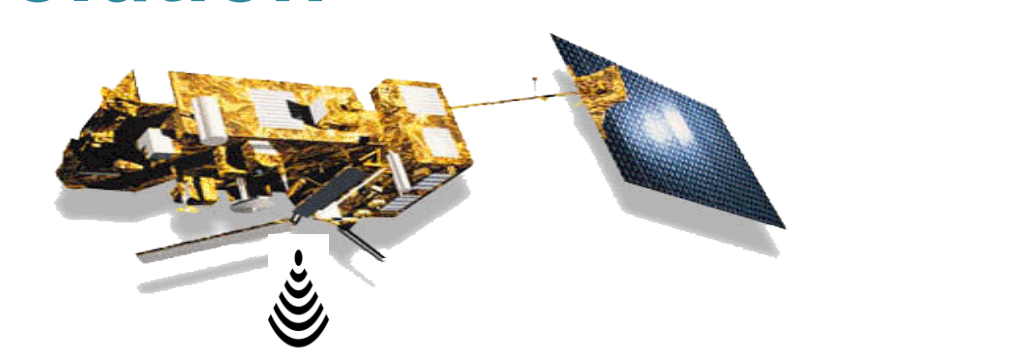


SYNOP data verification

Improvement in predicted surface temperature anomalies when initialised with Era Interim Land justified in better consistency between real time analysis and reforecast initialisation.

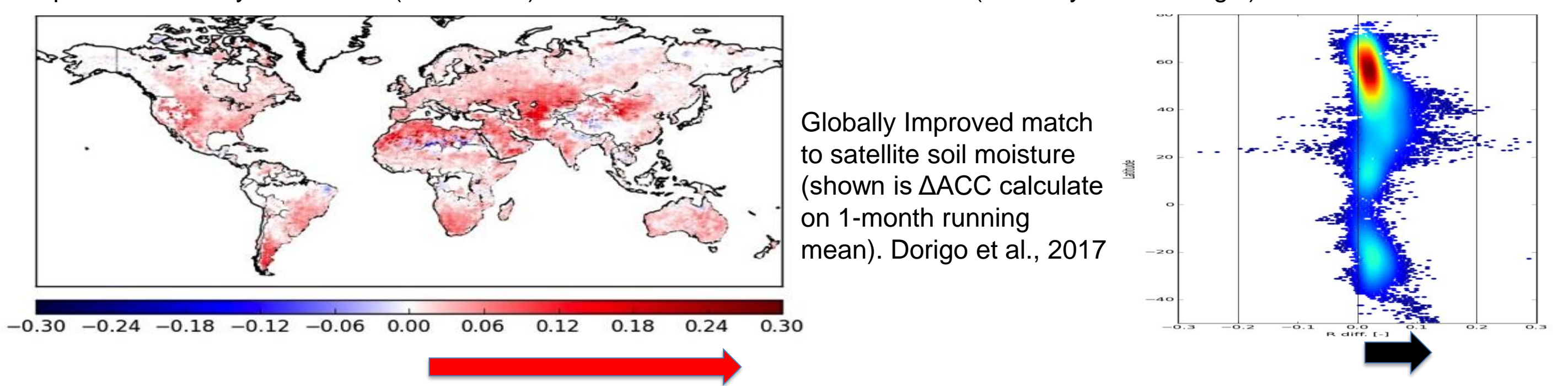
Perspectives of enhanced soil vertical resolution

The model bias in Tskin amplitude shown by *Trigo et al. (2015)* motivated the development of an enhanced soil vertical discretisation to improve the match with satellite products.



Impact of soil vertical resolution compared to ESA CCI soil moisture

Impact on Anomaly Correlation (1988-2014) with ESA-CCI satellite soil moisture (courtesy of C. Albergel)



Globally Improved match to satellite soil moisture (shown is ΔACC calculate on 1-month running mean). Dorigo et al., 2017

Summary

- A consistent initialisation of the reforecast system with the real time analysis based on up-to-date land surface model version is beneficial for the predicted surface parameters.
- Surface model improvement can be readily tested in S2S system in a flexible way.

Perspective

- Improved horizontal and vertical resolutions within CHTESSEL showed potential improvement on surface and near surface parameters for a better initialisation of the reforecast system.