

ERA5-Land State-of-the-art land surface reanalysis

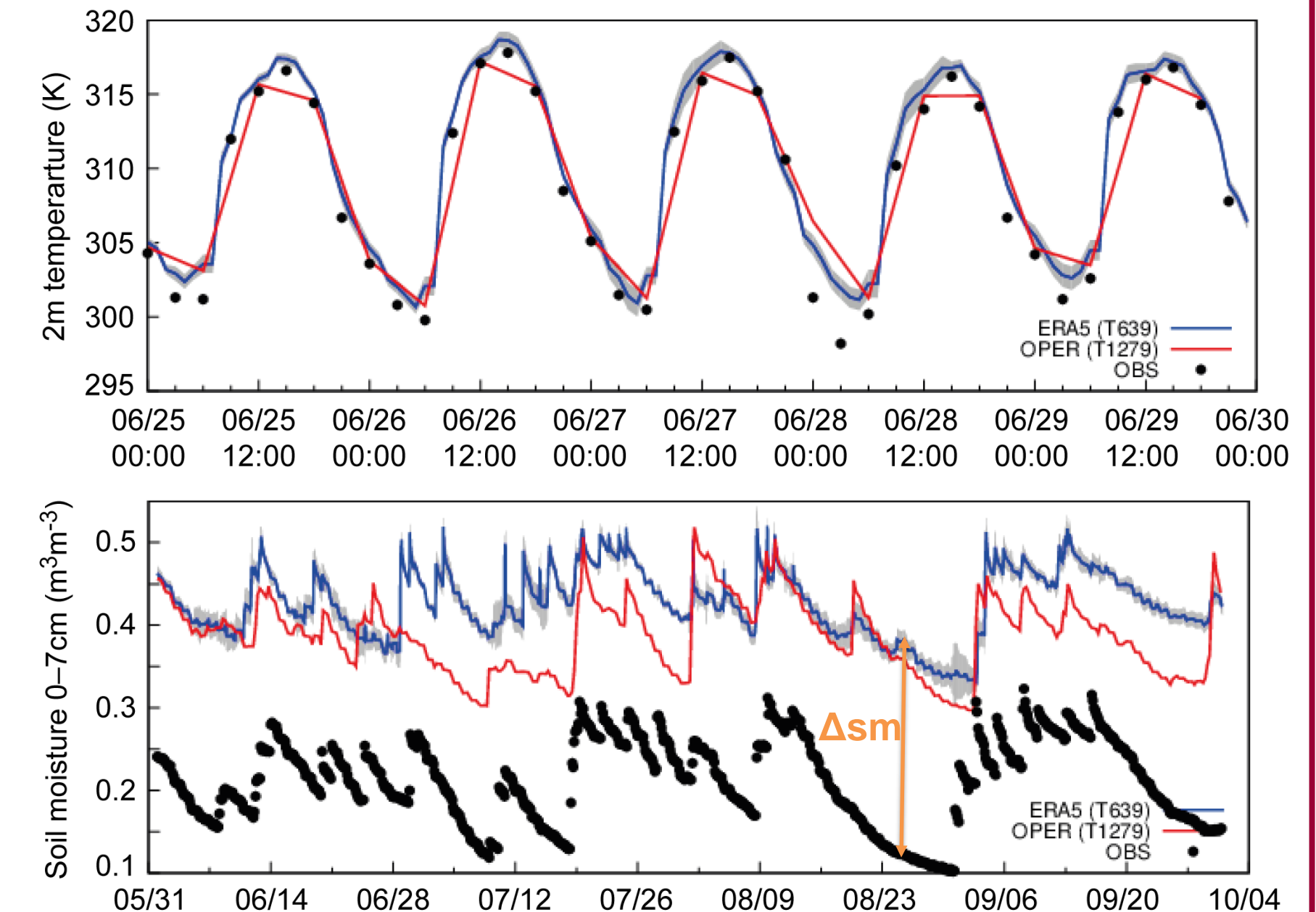
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Motivation

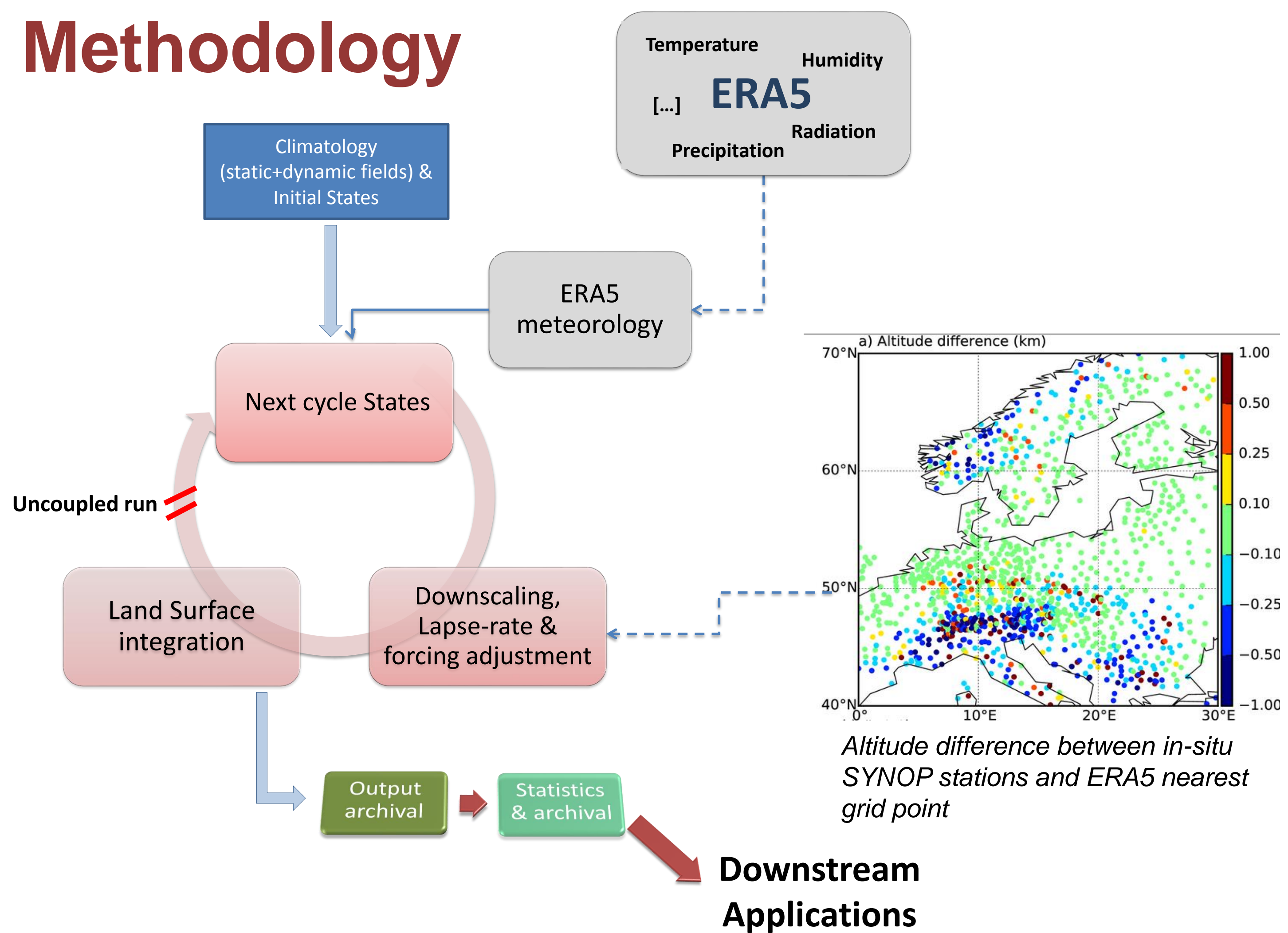
- Climate reanalysis provides consistent fields over all dimensions and across variables for several decades, but they are not conducted very often (once per decade per institution)
- Land model developments occur rapidly, and there is a need to integrate them to long, consistent time series in a cost-effective way
 - Support hydrological studies addressing global water resources
 - Provide consistent land initial conditions to weather and climate models.
 - Foster research into intra-seasonal forecasting
 - Provide dedicated datasets to support and encourage downstream land applications

ECMWF operational analyses and ERA5 reanalysis

The charts show hourly data from ECMWF's operational analyses and the ERA5 reanalysis of (top) 2-metre temperature compared to a location in the Sahara Desert (coordinates: 26.5°N, 8.42°E) from 25 to 30 June 2014 and (bottom) of soil moisture compared to in-situ observations from a station of the SCAN network in the US (coordinates: 36.0°N, 85.13°W) from June to Sept 2014.



Methodology



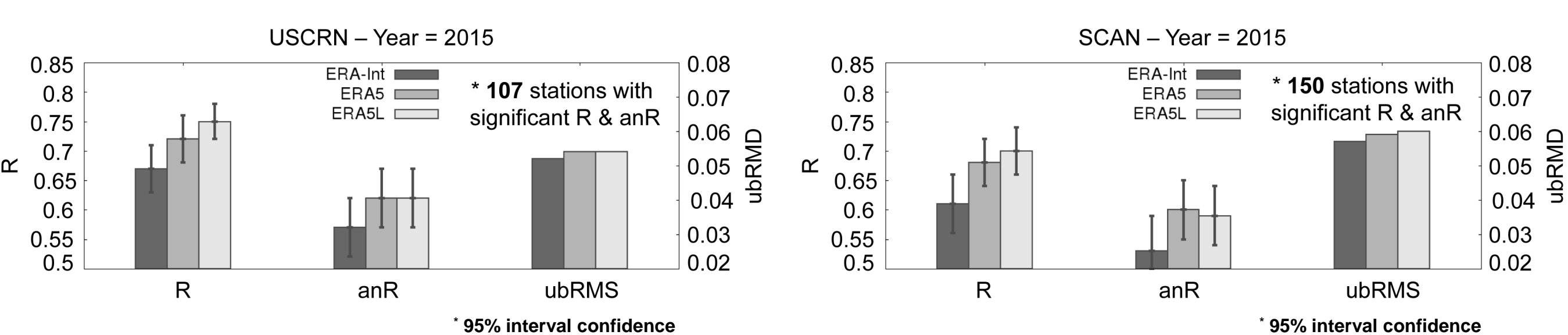
ERA5-Land fact sheet

- H-TESEL soil hydrology (Balsamo et al., 2009, <https://doi.org/10.1175/2008JHM1068.1>)
- Snow hydrology (Dutra et al., 2010, <https://doi.org/10.1175/2010JHM1249.1>)
- Vegetation seasonality (Boussetta et al., 2012, <http://dx.doi.org/10.1080/01431161.2012.716543>)
- Bare soil evaporation (Balsamo et al., 2011, ECMWF Spring Newsletter number 127)
- Surface dynamical downscaling (allows capturing details associated to processes as topographic forcing)
- Daily lapse-rate correction

	ERA-Int	Era-Int/Land	ERA5	ERA5-Land
Period covered	Jan 1979 – NRT ^(*)	Jan 1979 – Dec 2010	Jan 1950 - NRT	Jan 1950 - NRT
Spatial resolution	~79km / 60 levels	79 km	~32 km / 137 levels	~9 km
Model version	IFS (+TESSEL)	HTESSEL cy36r4	IFS (+HTESSEL)	HTESSEL cy43r1
LDAS	cy31r1	NO	cy41r2	NO
Uncertainty estimate	-	-	Based on a 10-member 4D-Var ensemble at 62 km	Based on a 10-member atmospheric forcing at 31 km
Output frequency	6-hourly Analysis fields	6-hourly Analysis fields	Hourly (three-hourly for the ensemble)	Hourly (three-hourly for the ensemble)

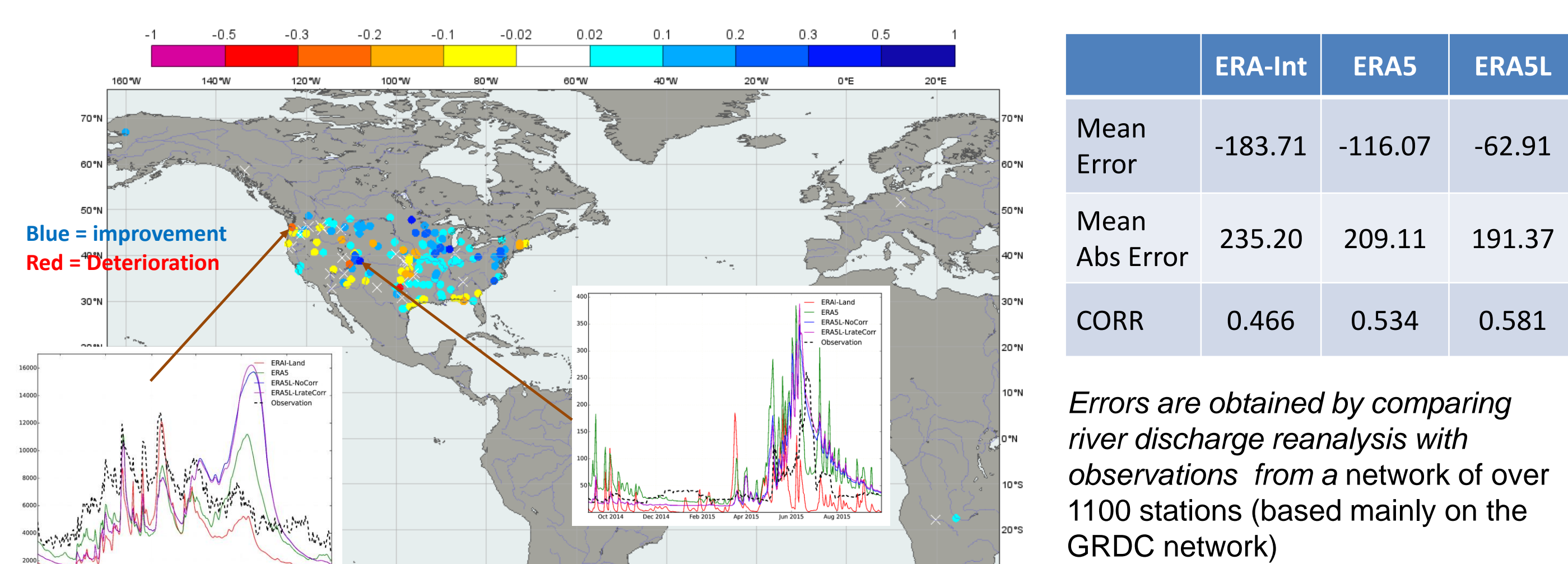
Results from scout runs

Impact on soil moisture



Soil moisture reanalyses The chart shows correlation (R), anomaly correlation (anR) and Unbiased Root Mean Square Errors (ubRMS) of ERA-Interim, ERA5 and ERA5-Land reanalysis compared to in-situ stations of the USCRN and SCAN networks in the US, averaged for the year 2015

Impact on river discharge



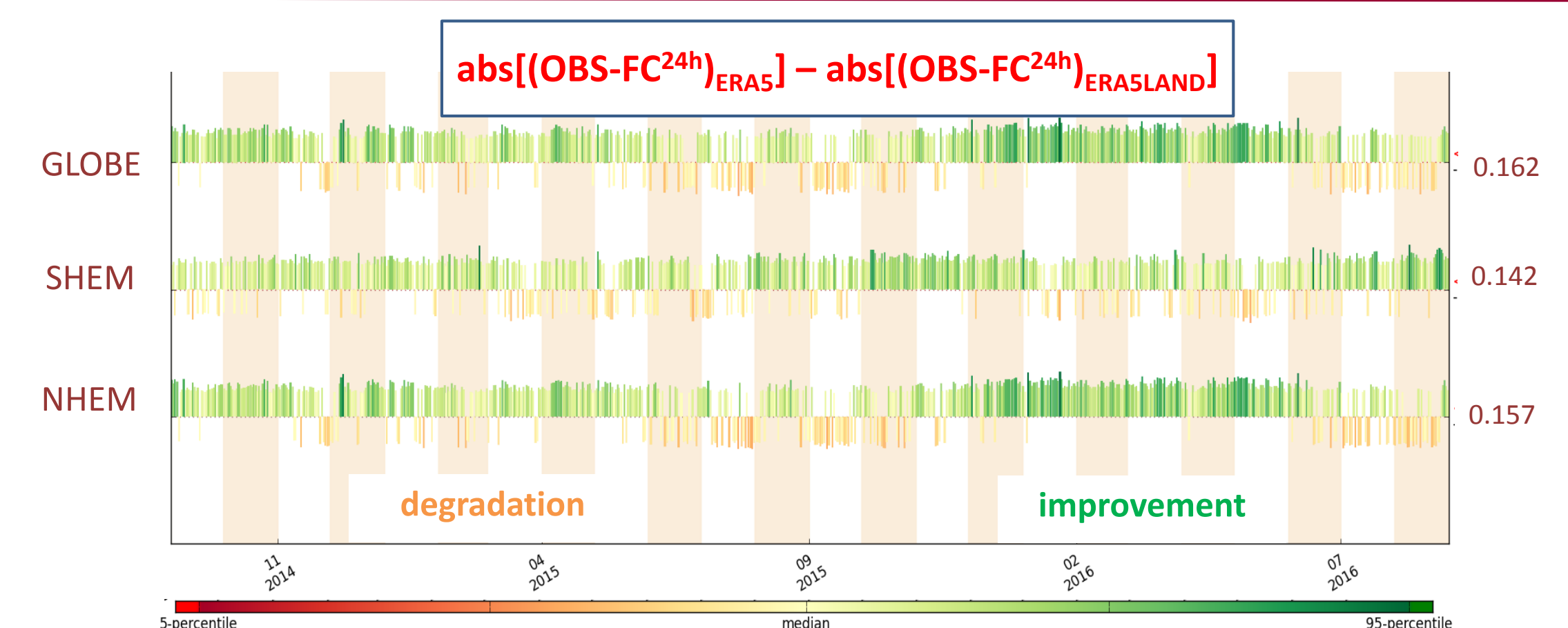
Discharge time series correlation difference ERA5-Land (no lapse rate) vs. ERA5, between Sept 2013 and Sept 2014

	ERA-Int	ERA5	ERA5L
Mean Error	-183.71	-116.07	-62.91
Mean Abs Error	235.20	209.11	191.37
CORR	0.466	0.534	0.581

Errors are obtained by comparing river discharge reanalysis with observations from a network of over 1100 stations (based mainly on the GRDC network)

Impact on 2 m temperatures

- Observations reference are SYNOP network
- Period: Sept 2014 to Sept 2016



Final Remarks

- ERA5-Land is part of ERA5 dedicated-focus reanalysis (ocean, land, chemistry, etc.) and not a separate initiative, therefore it will cover the entire duration of ERA5.
- ERA5-Land is a Copernicus operational product following closely near-term climate (with a short delay) and not a research product
- ERA5-Land adopts a new concept being the HRES adaptation
 - via a cost-effective resolution enhancement,
 - with the main benefit coming from surface description at a finer grid and a thermodynamic orographic adjustment.
- ERA5-Land serves as a "baseline" (preserves hydrological consistency) towards a future land reanalysis incorporating the data assimilation methodology.
- Production will start in Q1-2018 and it will be released from 2018