Funded by the European Union

Coordinated by ECMWF

WP3: BALANCED INITIALIZATION OF LAND SURFACE FOR SEASONAL FORECASTS

Kick-off meeting, 17 January 2023

Jean-Christophe Calvet, Tim Stockdale
Meteo-France, ECMWF

WP3 team

WP3 Lead: Jean-Christophe Calvet (MF), Tim Stockdale (ECMWF)

WP3 Partners:

ECMWF	12.0 pm
MF	63.9 pm
DWD	71.0 pm
CMCC	53.0 pm
MetOffice	18.0 pm
TOTAL	217.9 pm ~ 5.2 FTE (42 months)

WP3 scientific / technical questions

- Can satellite-derived land surface products …
  - improve land reanalyses?
  - improve initial conditions for atmospheric seasonal predictions?

- Is timeliness of satellite observations sufficient?
  - Can it be improved?

- Are existing data assimilation techniques efficient in this context?
  - How do uncertainties propagate?
  - Can new developments be easily integrated in C3S operations?

- What techniques can we use to ensure that adding data does not degrade the time evolution of initial conditions?

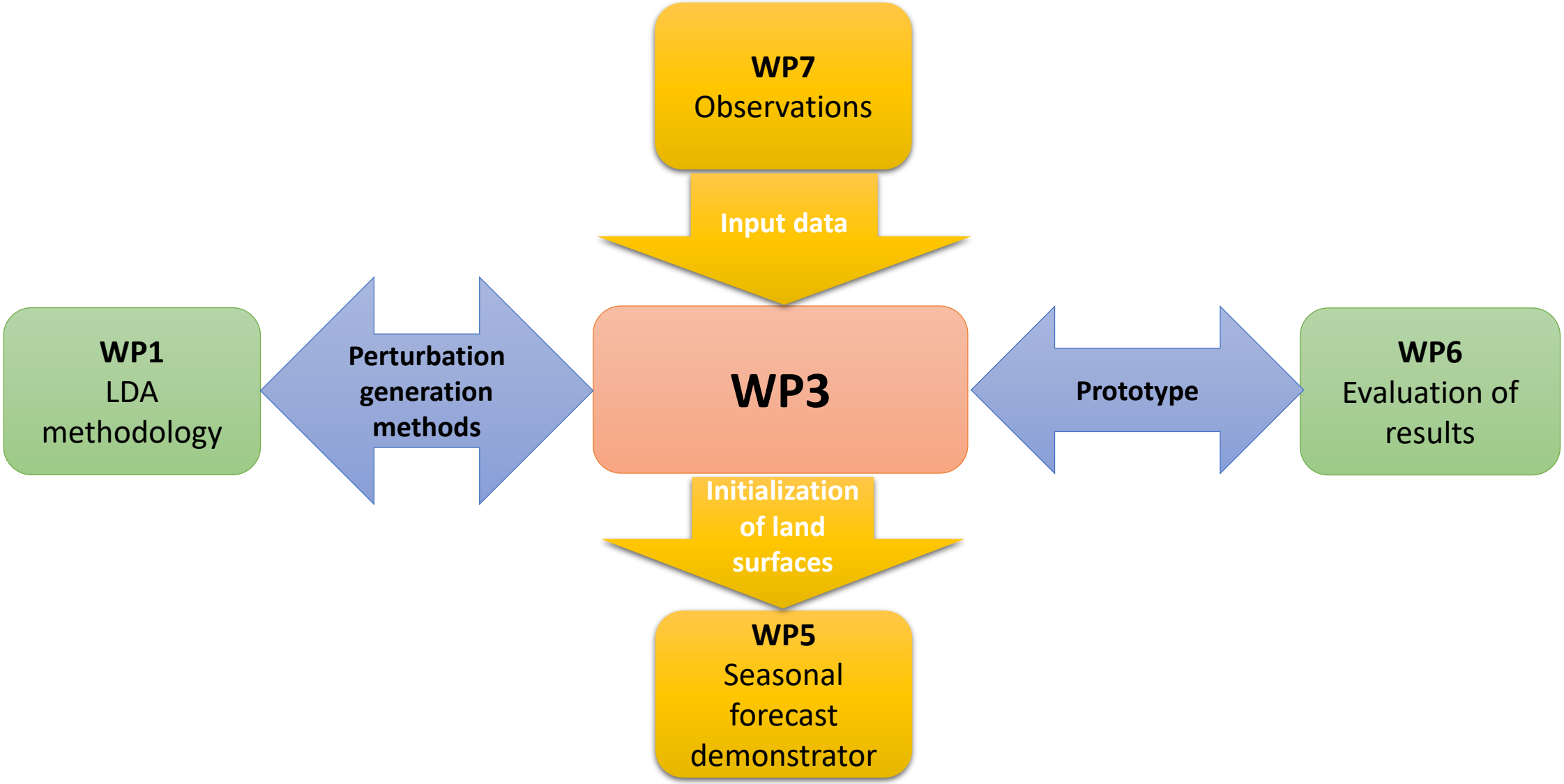
Goals of WP3

- Design of consistent and improved **land surface initial conditions** for the C3S seasonal multi-system

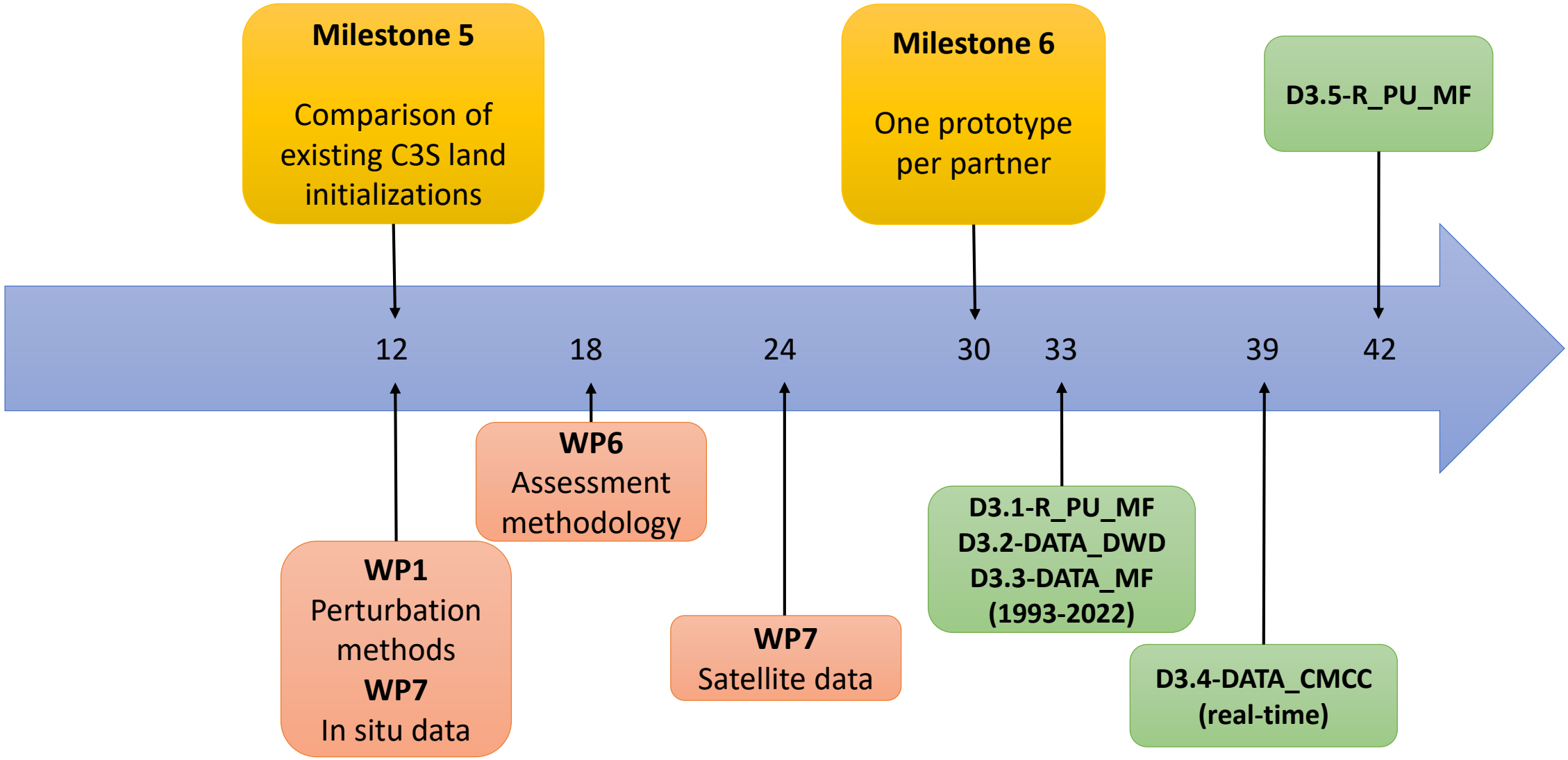
  - Individual models … but
    - Common assessments
    - Echange of ideas and experience
    - Use ECMWF reanalyses as a benchmark

  - Produce new initial conditions
    - Compare with the existing ones in C3S
    - Assess real-time compatibility of prototypes

WP3 links to other WPs



WP3 42-month timeline



Task 3.1 - Land surface analysis systems for seasonal forecast initialisation

- Start: now ; Deliverables 3.1 and 3.5 (public reports)
- Tool development at **MF**, DWD, CMCC
  - new initialisation methodologies for seasonal forecasts
  - individual models
    - MF: LDAS-Monde within SURFEX
      - Assimilation of snow and LAI variables ; Time-evolving land cover
    - DWD: ICON system
      - NWP-style snow and soil moisture initialization ; Assimilation of LAI
      - SYNOP data
    - CMCC: CLM + DART
      - Assimilation of snow, LAI, soil moisture variables

Task 3.2 - Land initial conditions from existing C3S systems and new prototypes

- Start: April 2023
- First-look assessment
  - **ECMWF** will make a comparison of existing C3S systems
  - Uptake of assessment methodology from WP6
    - Comparison with in-house methodologies (MF, DWD, CMCC)
    - Focus on snow and soil moisture analyses

Task 3.3 - Generation of initial conditions for seasonal forecast demonstrators

- Start: now ; Deliverables 3.2, 3.3, 3.4 (data)
- Data production and sensitivity experiments
  - Produce initial conditions for seasonal forecasts for 1993-2022
    - **DWD**: (1) no DA, (2) NWP-style SYNOP, (3) LAI and improved SYNOP
    - MF: (1) soil moisture, (2) snow and LAI, from LDAS-Monde
    - CMCC: (1) ERA5 forcing, (2) weakly coupled DA in CAM
    - MetOffice: (1) ERA5 forcing, (4) ERA6 forcing
    - ECMWF: (1) ERA5 forcing, (4) ERA6 forcing
  - Provide data to WP5 and to WP6

Task 3.4 - Real-time initialisation demonstrators

- Start: now
- Assess real-time compatibility (**CMCC**, MF, DWD, MetOffice)
  - 1-year production (2023 TbC) using real-time data only

Funded by the European Union

Coordinated by ECMWF

Thank you

ECMWF, MetNorway, SMHI, Météo-France, DWD, CMCC, BSC, MetOffice, DMI, ESTELLUS, IPMA, NILU

The CERISE project (grant agreement No 101082139) is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Commission. Neither the European Union nor the granting authority can be held responsible for them."

DWD overall contribution to WP3

- Who? Nils Noll, NN, Kristina Fröhlich, Gernot Geppert
- What? Three sets of ICs for DWD's seasonal forecast system with varying degrees of land surface initialization.
  Real-time initialization demonstrator.
- Why? Assess impact of land surface initialization on seasonal predictions.
  Improve seasonal predictions over land.
- How? Add NWP-style land surface DA; add LAI and boundary layer features DA
- When? IC set 0 at M12, IC set 1 at M17, IC set 2 at M33,
  real-time demonstrator at M39

DWD first 12 months in WP3

- Finish level 0 model setup and assess model climate wrt. to land surface
- Produce level 0 ICs with ICON-Seamless (without land surface DA)
- Set up monitoring of land surface variables for level 0 system
- Set up quality control and transfer workflow for level 0 hindcasts
- Assess level 0 ICs wrt. to land surface
- Adapt snow analysis from NWP to seasonal forecast sytem
- Adapt soil moisture analysis from NWP to seasonal forecast sytem

MF overall contribution to WP3

- **Who**?
  - J.-C. Calvet, C. Ardilouze, B. Bonan, D. Specq , 2 postdocs to be hired
- **What**?
  - The 4 tasks of WP3 (Development of land surface analysis systems, assessment of land initial conditions from existing C3S systems and from prototype land surface analysis systems, generation of initial conditions for seasonal forecast demonstrators, real-time initialization demonstrators)
- **Why**?
  - Balanced initialization of land surface for seasonal forecasts in CNRM-CM6-1
- **How**?
  - Adaptation of LDAS-Monde, nudging the land component of the initialization coupled simulations towards LDAS-Monde outputs
- **When**?
  - Milestones 5 (Month 12) and 6 (Month 30)

MF first 12 months in WP3

- Perform historical coupled ESM simulations (ocean and atmosphere relaxed towards reanalysis) with and without soil moisture and snow nudging derived from a stand-alone land simulation without DA
- Initialize ESM components from these coupled simulations in order to run (and evaluate) ensemble JJA reforecasts
- Update LDAS-Monde in the new version of SURFEX (v9)
- Start integrating time-evolving land cover and preparing NRT capacity
- Interact with WP7 about input satellite-derived LAI and snow products
- Technical decisions to prepare the operational version of LDAS-Monde suite (availability and frequency of near real time data, HPC porting, regridding for climate application, real-time monitoring etc.)

CMCC overall contribution to WP3

- Who: Luis Gustavo Concalves, Giovanni Conti, Swapan Mallick, Daniele Peano, Silvio Gualdi, Carla Cardinali + external collaborators
- What: 2 sets of ICs, 1. off line SPREADS/CLM; 2. WCDA SPREADS/CAM83/CLM
- Why: Improve Analysis and Seasonal Forecast quality
- How: Develop a Weakly Coupled Land Atmosphere Assimilation
- When: T24-T42

CMCC first 12 months in WP3

- List of activities:
  1. Observations selections (L2 products): snow cover fraction and snow water equivalent from ESA-CCI (2001 to present). LAI from GLASS (Zhao et al. 2013) (2001-2018) followed by ESA-CCI (2018-present). Soil moisture brightness temperature observations level 2 from ESA-CCI (2001 to present)
  2. Off-line land assimilation experiments using SPREADS (From DART to SPREADS: CMCC Scalable PaRallelised EArth Data-assimilation System) and the land model CLM (Lawrence et al., 2018)
  3. A series of tests will be performed to selects the best atmospheric boundary condition between the NCAR re-analysis and ERA5

MetOffice overall contribution to WP3

Task 3.3: Generation of initial conditions for seasonal forecast demonstrators

- Develop methods to create GloSea6 initial conditions directly using atmosphere and land surface reanalysis data from ECMWF reanalyses
- Update and apply these methods to the new global land reanalysis product(s) exploiting improved land-data assimilation being produced in WP4
- Extend ocean reanalysis from 2016 to 2022 to allow full hindcasts to be provided in WP5

MetOffice first 12 months in WP3

Martin Andrews will work on system development in WP3, with input from Jeff Knight, Adam Scaife and Jamie Kettleborough

Work will start later in the year on suite development to initialise GloSea6 with existing ECMWF land surface analyses

Tammy Collier will commence the production of an ocean reanalysis with input from Jamie Kettleborough

ECMWF overall contribution to WP3

- Who? Tim Stockdale, Jonny Day
- What? First look evaluation of existing C3S land surface initial conditions; preparation of ICs for sensitivity experiments
- Why? Provide feedback on what problems need to be addressed
- How? Inter-model correlation, comparison of dynamic range, links to T2m differences
- When? First look evaluation – complete within first 12 months (Milestone 5)

ECMWF first 12 months in WP3

- Retrieve C3S soil moisture and snow data for operational models
- Inter-compare initial conditions (i.e. data for step 0)
- Consider relation of model IC differences to subsequent T2m forecast differences
- Identify any model ICs which are outliers
- Check whether real-time and re-forecast ICs appear to be consistent
- Assess whether any model ICs are definitively problematic

Funded by the European Union

Coordinated by ECMWF

Thank you

ECMWF, MetNorway, SMHI, Météo-France, DWD, CMCC, BSC, MetOffice, DMI, ESTELLUS, IPMA, NILU

The CERISE project (grant agreement No 101082139) is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Commission. Neither the European Union nor the granting authority can be held responsible for them."