SETAC EMAG Pest SDLM Working Group

Harmonised Framework for Spatially Distributed Leaching Modelling of Pesticides Initiative: A 2022 Update

ABSTRACT

Spatially distributed leaching modelling (SDLM) of pesticides is a methodology to estimate leaching potential over a large spatial extent such as national or European level. SDLM can help setting groundwater monitoring programs in context. It is described in the FOCUS groundwater report and foreseen to be used as higher tier leaching risk assessment as well as supporting monitoring studies. SDLM is already used as a higher tier assessment in the national authorization procedure in some EU countries and will probably become more important in future.

At the SETAC Europe 2020 online meeting, the initiative was officially formalised as a SETAC working group, consisting of a triad of members from regulatory agencies, academia, and industries. A steering committee manages the effort to develop harmonized guidelines for spatial distributed leaching modelling across Europe and published a problem definition document describing the aim and scope of the work. In 2021 subgroups for Geodata and Modelling were established with each a specific focus.

The Geodata subgroup is evaluating datasets that can be used to generate a spatial modelling scheme and associated scenarios. Data reviewed fall in several established INSPIRE metadata categories such as Agricultural, Meteorological, Land Cover, Hydrography, Soil, and many other categories. All data are evaluated for spatial coverage, resolution, temporal aspects, period covered, version control, accuracy, and frequency of updates. Data availability is assessed as well to ensure that all SDLM stakeholders can use the same datasets when developing their SDLM framework. The Geodata group primarily focusses on pan-European datasets that cover the EU27 and the UK.

The Modelling subgroup is evaluating the models to be used in the SDLM context. Specific attention is paid to lateral flow processes such as runoff and drainage and the impact on substance transport to groundwater. As worst-case assumption these processes are not considered in lower tier leaching calculations. However, in a spatial context, ignorance of lateral flow may lead to unrealistic leaching patterns, so options were evaluated how to include runoff in a harmonised way into the models (e.g., using the runoff curve number approach as used in FOCUSsw). As the SDLM teams continue to work, this presentation provides an update to interested parties.

Geodata Group Status

1. Completed the definition of the metadata which allows us to better document and compare available datasets at the pan-European level. Metadata elements include:

- **Name -** Name of dataset (short, acronym)
- **Description -** Description of the dataset, a few lines
- **Publisher -** Name of institute that produced and serves the data
- **Literature reference(s) -** Reference to scientific publication
- **Documentation** - Reference to user manual
- **Source link -** Where the data are available
- **Type -** Type of data
- **Format -** Format of data
- **Variables -** Which variables are in the dataset
- **Spatial extent -** Extent of area covered
- **Temporal extent -** Period covered (for dynamic data)
- **Scale -** Cartographic scale for polygon data
- **Temporal resolution -** Frequency of values over time
- **Category -** Grouping in main categories
- **Cost of data access** (related to License) - Free data or open access data is preferred
- **Quality -** Information about the accuracy/quality of the data
- **Version -** Version number (and is the data under version control)
- **Release date -** Date of release
- **Update frequency -** Information about how often a new version is published

2. Data set have been identified and documented

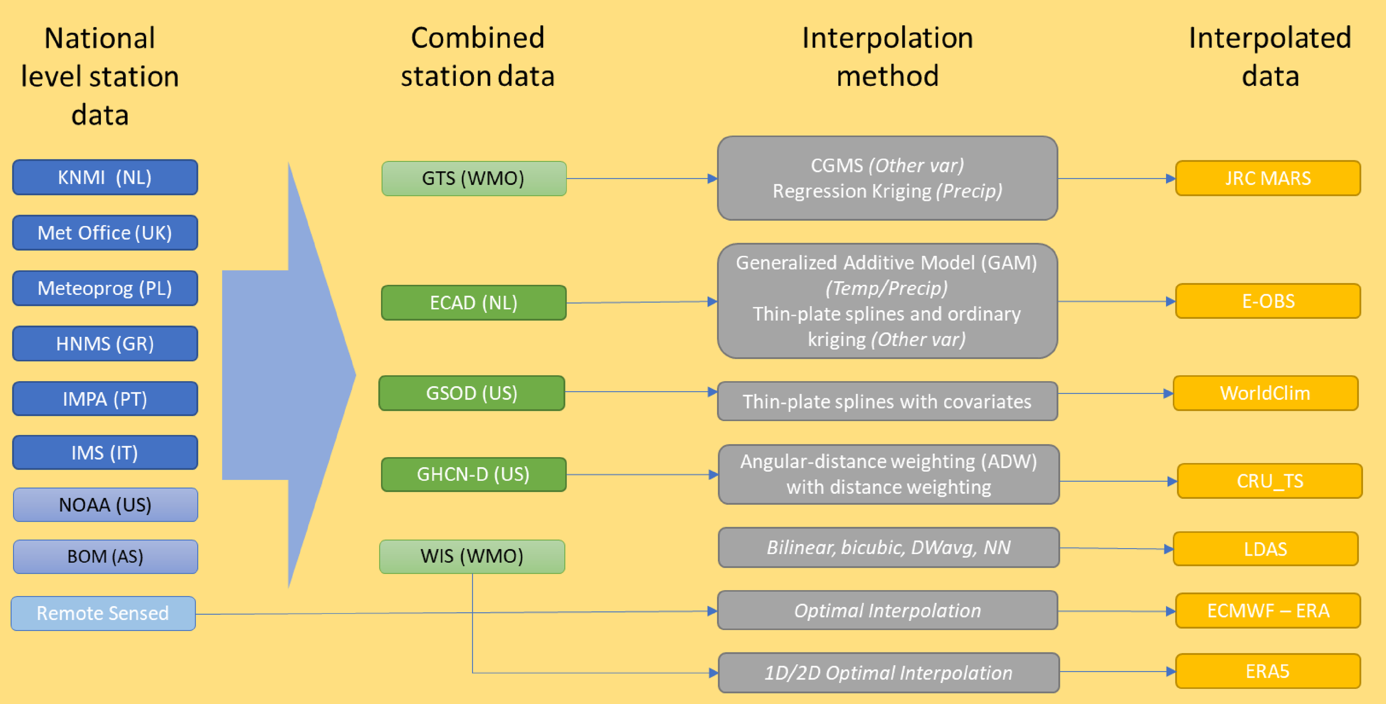
Table 1. Example of metadata being generated to compare the datasets

index	name	description	publisher	category	Lit reference	documentati	source link	type	format	license	variables	spatial extent	temporal extent	spatial
1	Pan European Phenological database (PEP725)		PEP725	crop	Templ, B., Koch,	http://www.p	http://ww	point	*asc		bbch growth stage	EU but not all countries avail	variable	NA
2	Crop Phenology Database of Europe		Crop Life Europe	crop	None yet	TBC	NA	timeseries	*gdb		bbch growth stage	EU27+EEA+CH+UK	2000 - 2020	NA
3	Gridded winter soft wheat phenological database for Europe		JRC - AGRI4CAST	crop	JRC, 2019	https://agri4	https://ag	polygon	ESRI *shp			EU27+EEA+CH+UK	static	25km
4	European Crop Calendar		JRC - AGRI4CAST	crop	JRC, 2015	https://agri4	https://ag	polygon	ESRI *shp			EU27+EEA+CH+UK	static	NUTS0
5	Vegetation Phenology and Productivity Parameters		European Environment	crop	Feng Tian, Zhanz	https://land.c	https://w	grid	?			EU27+EEA+CH+UK	2017 - present	10m
6	AppDate		Fraunhofer Institute for	crop	Klein, M., 2012.	https://softw	https://w	timeseries	*asc		bbch growth stage	EU25+EEA+CH+UK	static	FOCUS
7	Hydrologic regulation of plant rooting depth		Authors	crop	Fan, Ying & Migu	https://www.	Catalog ht	grid	*netcdf		10-y mean maximum depth	global	static	30 arc
8	Global Map of Irrigation Areas		FAO	crop	Siebert, S., Döll,	http://www.f	http://ww	grid	ESRI *ascii grid		irrigation extent	Global	static	5 minu
9	Distribution of irrigated crops in Europe		JRC - AGRI4CAST	crop	JRC, 2021	https://agri4	https://ag	polygon	ESRI *shp		irrigation extent	EU27+EEA+CH+UK	static	10km
10	Historical Irrigation Dataset (HID)		Authors	crop	S. Siebert, M. Ku	https://myge	https://m	grid	ESRI *ascii grid & *netcdf		irrigation extent	Global	static	5 minu
11	Digital global map of artificially drained agricultural areas		Goethe-Universität Fran	soil	Feick, S., Siebert	https://www.	https://w	grid	ESRI *ascii grid & *netcdf		soil drainage extent	Global	static	5 minu

3. Data set are being evaluated
4. The data we are evaluating fall in the following categories

   1. Agronomic management practices (crop growth, irrigation)
   2. Climate daily data (rainfall, temperature ETpot, FOCUS zones)
   3. Crops (FOCUS crops, surrogate crops)
   4. Groundwater table depth (lower boundary conditions)
   5. Land use / Land cover (agricultural production areas, crop productions)
   6. Soils
   7. Supporting data (boundaries)

Figure 1. Example of the data evaluation data process for climatic data showing how each data sets is processed



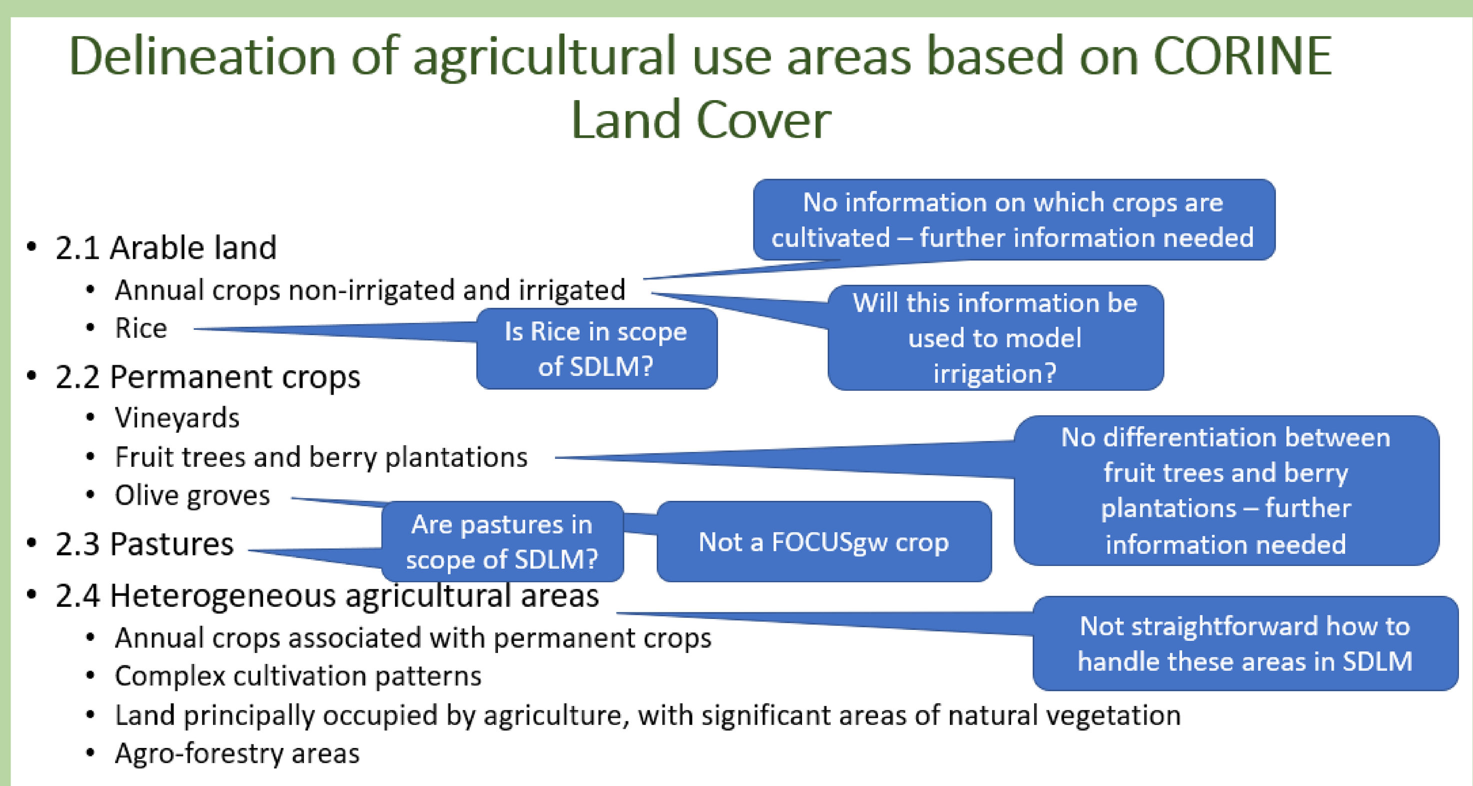
5. As part of the data evaluation process, team members document which variables are present in each dataset as well as determine the ease of use of the data. Table 2 shows an example of a completed data inventory for climate data and the useability. This table shows that few datasets have all required data to run models such as PEARL, PELMO, or PRZM.

Table 2. Evaluation of different weather datasets that can be used in an SDLM

Variable - Daily	PEARL	PELMO	PRZM	JRC MARS	ECAD	E-OBS	WorldClim	CRU__TS	GHCN-D	GLDAS	ERA	ERA5	NL-local
maximum air temperature (°C)	x	x		Yes	Yes	Yes	No	No	Yes	No	Derive	Derive	Yes
minimum air temperature (°C)	x	x		Yes	Yes	Yes	No	No	Yes	No	Derive	Derive	Yes
mean air temperature (°C)		x	x	Yes	Yes	Yes	No	No	Derive	Yes	Derive	Derive	Yes
mean daily wind speed at 10m (m/s)	x	x	x	Yes	Yes	Yes	No	No	DOL	Yes	Derive	Derive	Yes
vapour pressure (hPa)	x			Yes	Yes	MSL pressure	No	No	No	Yes	Derive	Derive	Yes
sum of precipitation (mm/day)	x	x	x	Yes	Yes	Yes	No	No	Yes	Derive	Derive	Derive	Yes
potential evapotranspiration from a crop canopy (mm/day)	x		x	Yes	No	No	No	No	DOL	Yes	Derive	Derive	Makkink
total global radiation (KJ/m2/day)	x		x	Yes	Yes	Yes	No	No	No	Derive	Derive	Derive	Yes
humidity (Kpa)	x	x		Yes	Yes	Yes	No	No	NO	Yes	Derive	No	Yes
panET (mm/day)		x	x	No	No	No	No	No	DOL		No	No	
difference between min. and max. temperature per day (°C)		x											
difference between min. and max. temperature per day (°C)		-											
hour		x											
Time step	Daily	Daily	Daily	Daily	Daily	Daily	LTAVG	MNTHAVG	Daily		semi-hourly	Hourly	Daily
Ease of access/use/processing				Very easy	Very easy	Moderate	Very Easy	Moderate	Easy	Moderate	Diff.	Diff.	Very Easy

6. As part of this effort, the definition and delineation of which agricultural areas should be included are addressed and discussed. For example, CORINE land cover may be the basis for all agricultural areas to be included, but which classes and crops should be considered? Those and many other questions are addressed (Figure 2).

Figure 2. Example of discussion points when defining agricultural use areas



7. Many challenges and question remain to be answered including
   1. Which crops are relevant to a SDLM?
   2. What surrogate crops do we need to consider?
   3. Should realistic crop rotations be taken into account?
   4. Can the LUCAS crop data provide insight in current crop distributions?
   5. How can the CAPRI crop dataset be updated to reflect current crop production?
   6. What is the vertical extent of the soils data needed?
   7. Should accuracy of the soils map be considered?

At the "Pesticide Behaviour in air, water, and soil conference in York (UK), an update from the modelling subgroup will be provided.

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