Supplementary Material 1 – Detailed explanation on common limitations of current ES modelling tools

i) highly time-consuming data collection requirements

Collection of input data for ES assessments of NBS is very time consuming because it is necessary to take into account the multiple abiotic, biotic and management attributes of these solutions (e.g. vegetation species, size of trees, soil characteristics). For existing NBS interventions, reviews in existing research projects showed that detailed data is in many cases not available (Petucco et al., 2018). Moreover, data on future NBS interventions is unknown at early stages of its planning/design because site surveys have not been done yet (e.g. soil characteristics) or some aspects of the NBS (e.g. vegetation species) are still not defined.

ii) lack of monetisation of ES values

Regarding ES monetary valuation, most ES modelling tools provide outputs only in biophysical or social values because the tools are designed for technical experts. Consequently, the outputs might be hard to understand by stakeholders without technical expertise on ES. For example, ENVI-met only uses biophysical values to inform experts about changes in microclimate conditions (e.g. temperature and humidity regulation, air pollution removal) result of new urban interventions. However, complementing biophysical and/or social values with monetary estimations can facilitate integrating of ES results as part of cost-benefit analysis (Babí Almenar et al., 2018; Busch et al., 2012). It can also facilitate the understanding of models' outcomes by non-technical experts such as decision makers.

iii) lack of consideration of ES demand and other flows; iv) and lack of simultaneous modelling of multiple ES over time.

Despite emergent ad-hoc ES assessment methods are already including other flows different than ES, generalizable ES modelling tools still do not consider them (see Outputs in Table S1). In this sense, flows that represent negative environmental impacts (e.g. eutrophication, acidification) and/or externalities (i.e. enhancement or damage to goods and services for which a market does not exist, such as expenditures result of air pollution damage to human health) or financial values (i.e. goods and services traded in markets, such as human labour or planting material) are still not accounted in generalizable ES modelling tools. These tools do not always consider ES demand either, and they tend to calculate ES supply for a specific ES class and point in time or for a short period not taking into account a life cycle thinking perspective. This might give a partial picture about NBS. In this sense, current ES modelling tools still prevent to integrate in their evaluations ES synergies and trade-offs and the evolution in environmental impacts and positive and negative externalities over the entire life cycle of NBS. Therefore, end users of these tools (researchers or practitioners) need to do these later analysis without the support of tools specific for NBS and in most cases following ad-hoc methodological procedures.

Table S1. Synthetic comparison of well-known ES modelling tools used as Decision Support Tools.

Tool	Urban /Rural	Spatial level	Dynamic simulation	Outputs	Uncertainty Represented	Type of value	Online Offline	User	Source
LUCI	Rural	Watershed/ metropolitan	No	ES	No	Biophysical	Offline	Technical user & Decision maker	https://www.lucitools.org
InVEST	Rural	Watershed/ metropolitan	No	ES	Yes	Biophysical	Offline	Technical user & Decision Maker	https://naturalcapitalproject.stanford.edu/invest/
ARIES	Rural	Watershed/ metropolitan	No	ES	No	Biophysical	Offline	Technical User	http://aries.integratedmodelling.org/
Co$ting Nature	Rural	Watershed/ metropolitan	No	ES	No	Monetary	Online	Technical User	http://www.policysupport.org/costingnature
i-Tree	Urban	Metropolitan to site level	Yes	ES	No	Biophysical and monetary	Offline	Technical User & Decision Maker	https://www.itreetools.org
ENVI-met	Urban	Metropolitan to Site level	Yes	Like ES	No	Biophysical	Offline	Technical User	https://www.envi-met.com/
SWMM	Urban	Metropolitan to site level	Yes	Like ES	No	Biophysical	Offline	Technical User	https://www.epa.gov/water-research/storm-water-management-model-swmm
GreenPass	Urban	Site level	Yes	Like ES	Unknown	Biophysical	Offline	Built environment Professional. (Non-technical expertise required)	https://greenpass.at/

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