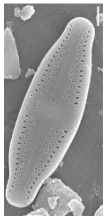
INS 5: Assembling Data for Synthesis: The Good, Bad and In-Between
ESA & USSEE Joint Meeting, Louisville, KY
13 August 2019

Insights from the synthesis of long-term biodiversity data: resources and tools available to community ecologists







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A growing commitment to FAIR Data Principles is facilitating synthesis in ecology

Data and supplementary materials have sufficiently rich metadata and a unique and persistent identifier.

FINDABLE

Metadata and data are understandable to humans and machines. Data is deposited in a trusted repository.

ACCESSIBLE

Metadata use a formal, accessible, shared, and broadly applicable language for knowledge representation.

INTEROPERABLE

Data and collections have a clear usage licenses and provide accurate information on provenance.

REUSABLE

image source: https://libereurope.eu/wp-content/uploads/2017/12/LIBER-FAIR-Data.pdf
also see Wilkenson et al. 2016 (https://www.nature.com/articles/sdata201618)

COPDESS

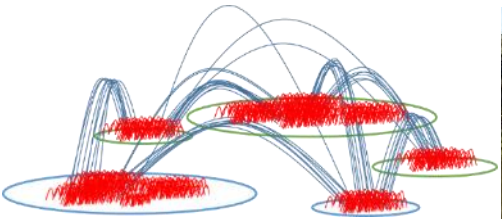
Coalition for Publishing Data in the Earth and Space Sciences

SIGNATORIES

34 Repositories have signed on, including:

- Environmental Data Initiative (host LTER data)
- National Ecological Observatory Network (NEON)
- Arctic Data Center
- UNAVCO
- Dryad
- KNB Data Repository

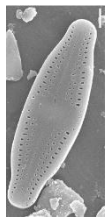
Find commitment statement and signatories here: https://copdess.org/enabling-fair-data-project/commitment-statement-in-the-earth-space-and-environmental-sciences/




Using long term data to understand links between environmental variability and metacommunity stability







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LTER Metacommunities Synthesis Working Group

https://www.nceas.ucsb.edu/projects/12749

https://github.com/sokole/ltermetacommunities

NATIONAL SCIENCE FOUNDATION LTER NETWORK LONG TERM ECOLOGICAL RESEARCH

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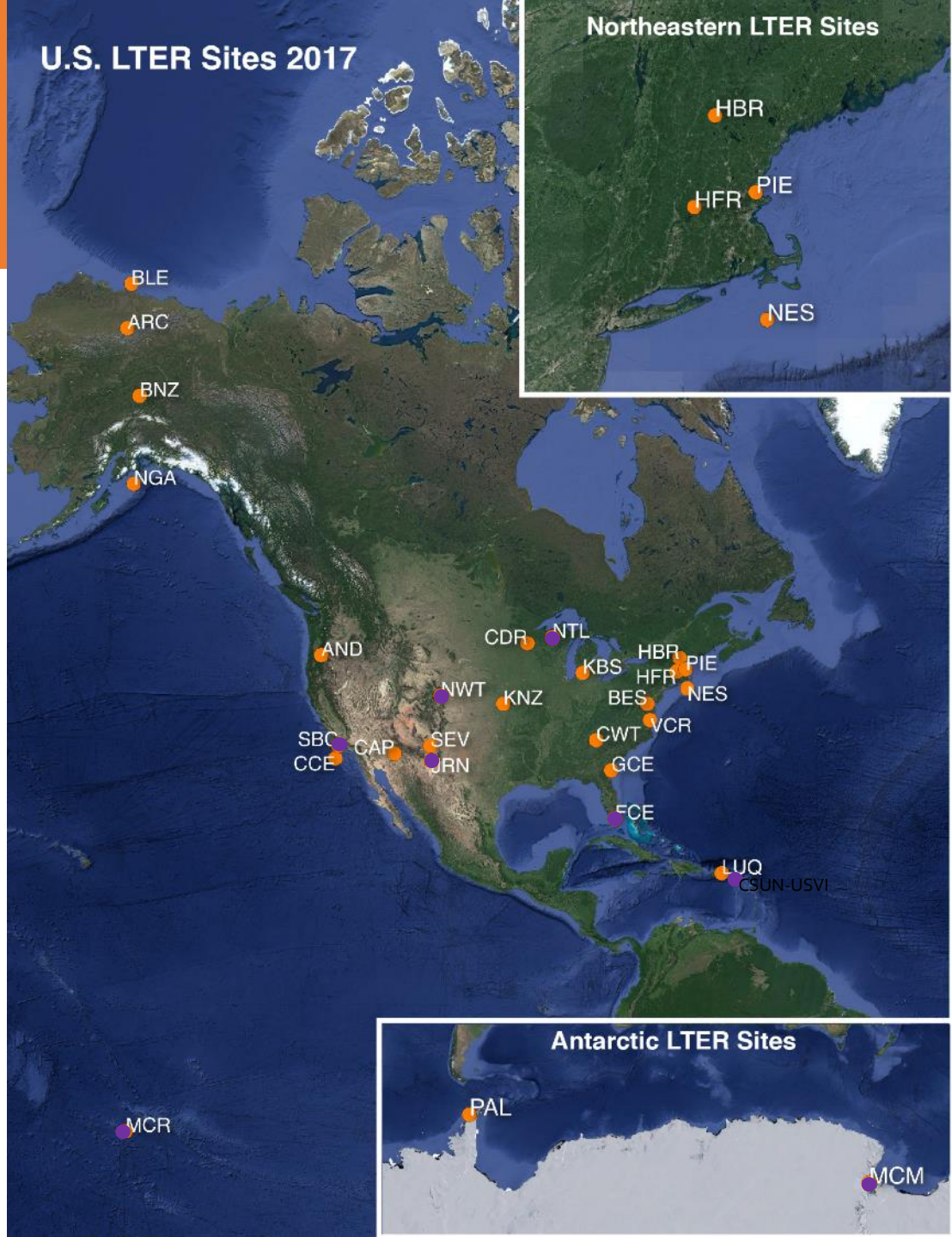
The need for long-term data

Long-Term Ecological Research (LTER) *Metacommunities Synthesis working group*

1. Compare metacommunities from different LTER sites
2. Do species' dispersal characteristics predict biodiversity stability?
3. Does environmental variability predict biodiversity stability?



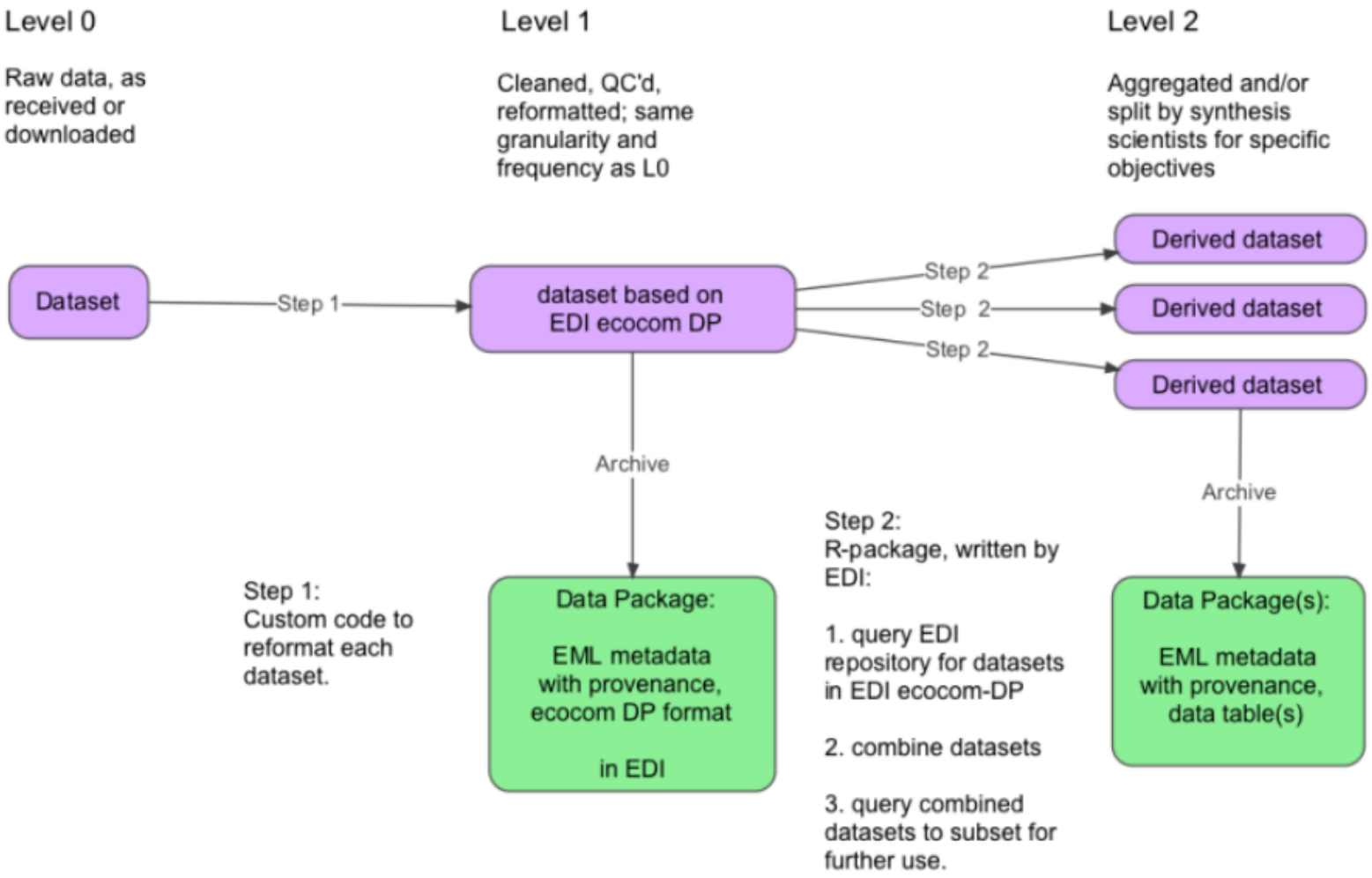


Figure: Abstract view of dataset levels. A flexible intermediate (L1, middle) lies between datasets of primary observations (L0, left) and the aggregated views used by synthesis projects. If datasets are in a recognized format, EDI can create tools for some basic functions

Figure from https://github.com/EDIorg/ecocomDP

Findable Accessible Interoperable Reproducible

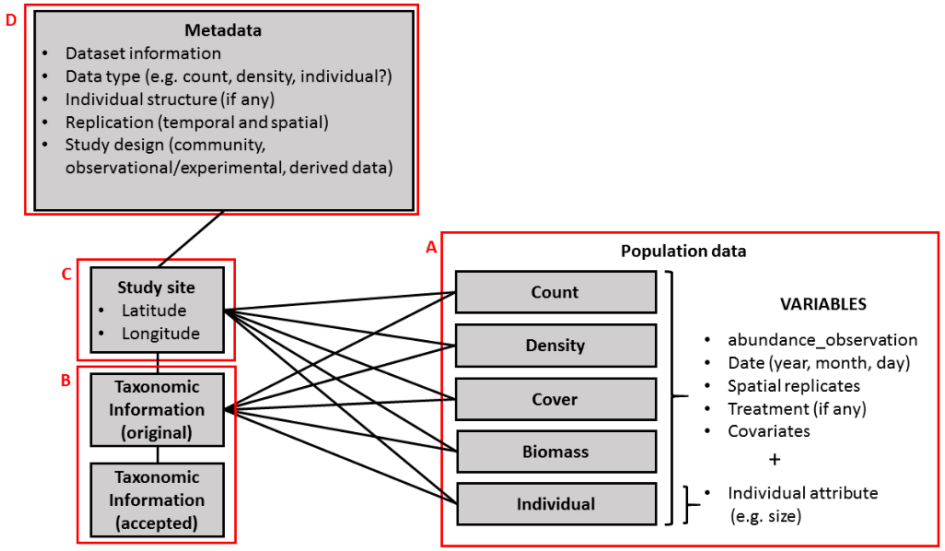
Challenges to finding data

- Where do I start?
- Are relevant data sets actually discoverable?
- How do keywords map to actual data? Do keywords map consistently?
- How do I know if a data actually meet my criteria? (LTER metacommunities looking for spatial and temporal replication)

Findable Accessible Interoperable Reproducible

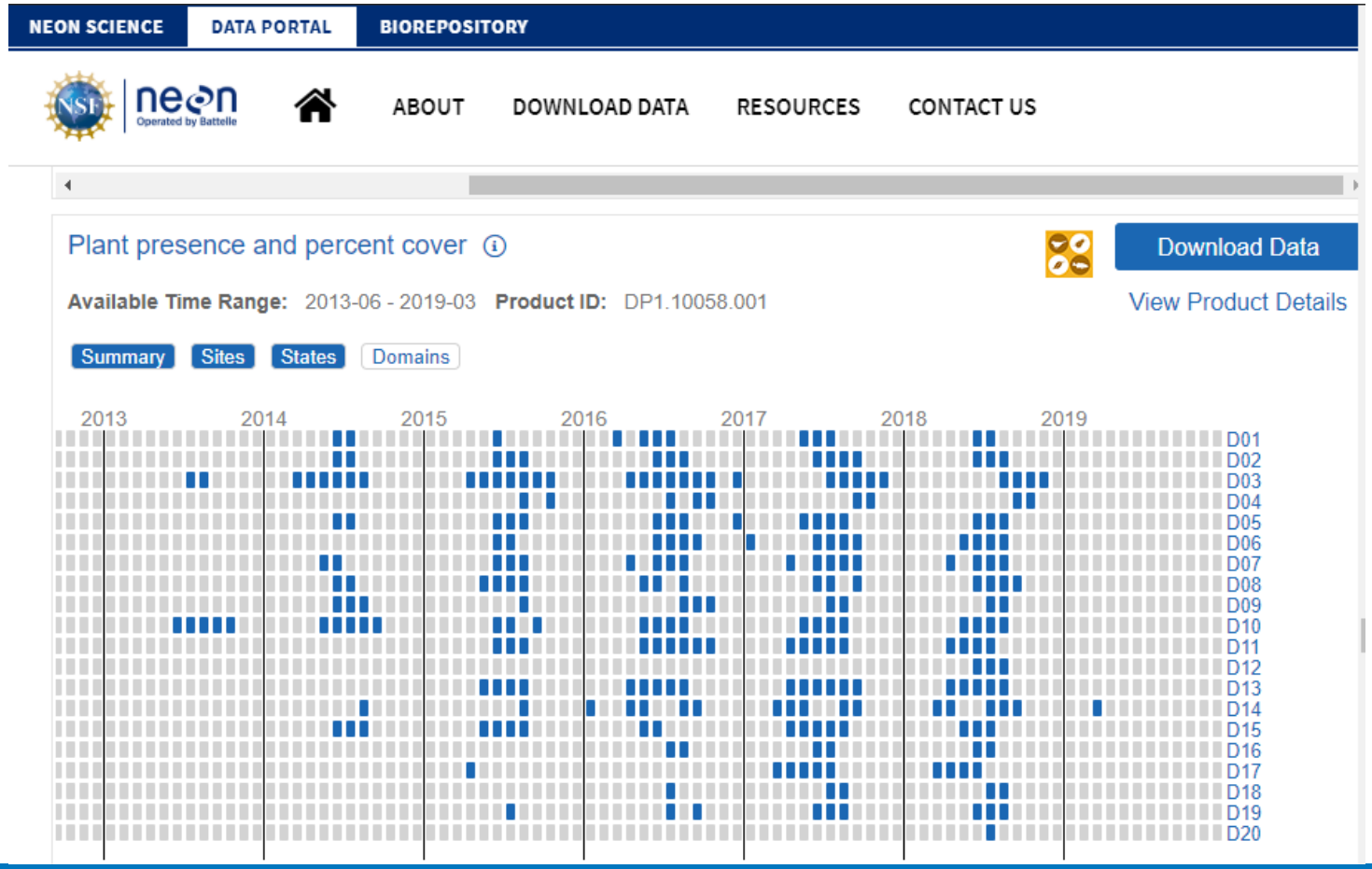
Tools: `popler` R package and database (Compagnoni et al.)
https://github.com/ropensci/popler

An R package to browse and query population-level datasets from the US Long Term Ecological Research (LTER) network



Findable Accessible Interoperable Reproducible

Tools: NEON data browser
https://data.neonscience.org/static/browse.html



Findable Accessible Interoperable Reproducible

Tools: `ecocomDP` R package and data model
https://github.com/EDIorg/ecocomDP

Environmental Data Initiative

Use ecocomDP data

- Find:
  - Use the `view_all_ecocomDP()` function to list all ecocomDP datasets. This function is apart of the `ecocomDP` R package.
  - Environmental Data Initiative (EDI) Enter "ecocomDP' in the 'simple search' box in the EDI data repository.
  - National Ecological Observatory Network (NEON) Use the `view_all_ecocomDP()` function to list all NEON data available in the ecocomDP format. This function is apart of the `ecocomDP` R package.

Findable **Accessible** Interoperable Reproducible

Challenges to accessing data

- How easy is it to import data into my R workspace?

Findable **Accessible** Interoperable Reproducible

Tools: `popler` R package and database (Compagnoni et al.)
https://github.com/ropensci/popler

It only takes 2 lines of code to find and import LTER data into your R working environment!

```
# create a browse object and use it to get data

penguins <- pplr_browse(lterid == 'PAL')

# unpack covariates as well

penguin_raw_data <- pplr_get_data(penguins, cov_unpack = TRUE)
```

Findable **Accessible** Interoperable Reproducible

Tools: `neonUtilities` R package

CRAN: https://cran.r-project.org/web/packages/neonUtilities/index.html
GitHub: https://github.com/NEONScience/NEON-utilities

Load data into your R environment with 1 line of code!

```
# To download plant foliar properties data from all sites, expanded data package:
cfc <- loadByProduct(dpID="DP1.10026.001", site="all", package="expanded")
```

Find tutorials here: https://www.neonscience.org/resources/data-tutorials

Findable **Accessible** Interoperable Reproducible

Tools: `ecocomDP` R package and data model
https://github.com/EDIorg/ecocomDP

Environmental Data Initiative

Browse, query, and download LTER, Macrosystems, LTREB, NEON data sets and more!

Works through API calls to data repositories, so data sets are current

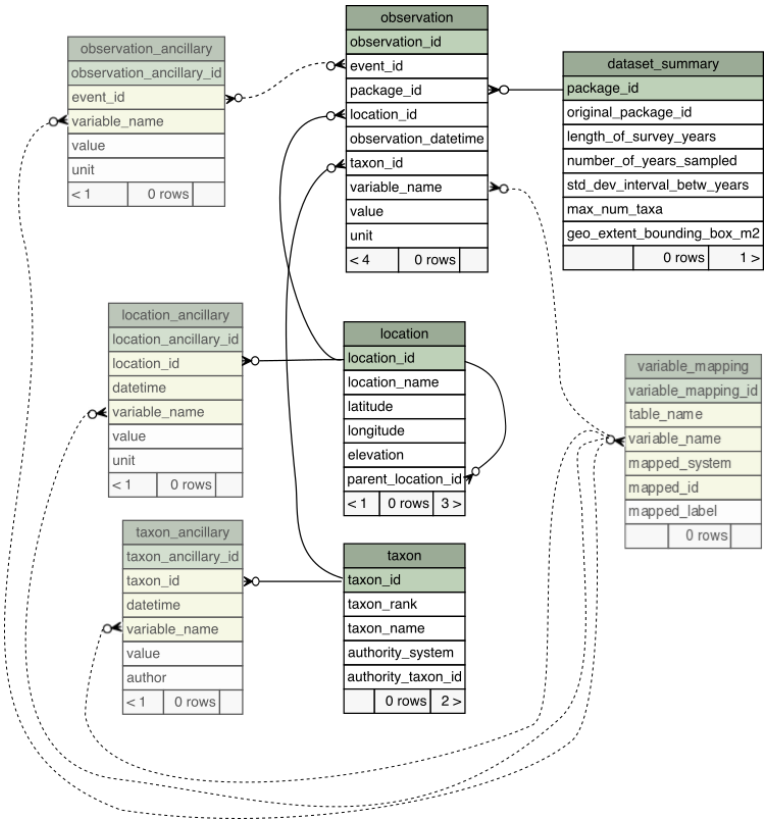
Findable Accessible **Interoperable** Reproducible

Challenges to comparing across datasets

- Data formatting
- Observational scale and grain size
- Taxonomic concepts (biodiversity data)
- Comparable metadata, covariates (environmental and spatial data)

Findable Accessible **Interoperable** Reproducible

Tools: `ecocomDP` Standard data pattern



Use `aggregate_ecocomDP()` to combine datasets.

Findable Accessible Interoperable **Reproducible**

Challenges to maintaining reproducible workflows

- Will data sources always be findable, accessible?
- Can data munging for a particular project be re-created?
- How easy is it for others to make the same calculations?

Findable Accessible Interoperable **Reproducible**

Tools: Version controlled scripted workflow and R packages

- Data munging:
  LTER metacommunities github page
  https://github.com/sokole/ltermetacommunities

- Metacommunity variability metrics
  `ltmc` package for R
  https://github.com/sokole/ltermetacommunities/tree/master/ltmc

Acknowledgements

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NATIONAL SCIENCE FOUNDATION
LTER NETWORK
LONG TERM ECOLOGICAL RESEARCH

NCEAS
National Center for Ecological Analysis and Synthesis

To download these slides:

https://github.com/sokole/ltermetacommunities/ESA_2019/Sokol_INSPIRE