

## **VERIFY General Assembly**

WP1 – Christian Mielke, Dirk Günther, Tobias Vossen May 9<sup>th</sup> -11<sup>th</sup> , 2022





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810



What Constitutes Good Verification Data, VERIFY delivers.

- **C**FFCO2 Energy Mix
- FFCO2 Sector Trends
- **SFFCO2** Temporal Trends
- FFCO2 Quick Resume
- Verifys CH4 Data
- Conclusions



### WHAT CONSTITUTES GOOD VERIFICATION DATA

#### VERIFY

- 1. A variety of well documented, updated and maintained data products.
- 2. Easy as well as advanced data for all user levels.
- 3. Spatial distributed data
- 4. Data products that offer a certain level of sectoral attribution. (Agriculture, Energy, LULUCF, ...).
- 5. In addition to the NUTS-0 data, Netcdf data of the final model run outputs for the gases (CH4, N2O, CO2)
- 6. Inventory compilers need to understand the detailes of the data products in full detail (data product training WS including guided hands on training with Jupyter notebooks)

Contains modified Copernicus Sentinel 5P data 08/2020; OSM Data: © OpenStreetMap contributors



#### BRIDGING THE GAP BETWEEN SCIENCE AND INVENTORY COMMUNITIES





#### FFCO2 MIX EUROPEAN WIDE





#### FFCO2 MIX EUROPEAN WIDE



Comparison of fossil CO<sub>2</sub> emissions: Central Europe 2017





Comparison of fossil CO<sub>2</sub> emissions: Western Europe 2017

- Western Europe largely dependant on oil and gas
- Keep in mind nuclear option in WEEU! (France+UK)
- Eastern Europe much more "coal driven"
- Southern Europe also not much "solid driven".
- Whole EU more dependent on oil and gas instead of solid fuels.
- Distribution of fuels always closely matched to IEA when compared to the NGHG Inventory.
- Suggestion for the plots:

Please use -> savefig(myplot.svg, format=,,svg")

/lay 9th -11th , 2022 | Teleconference



#### FFCO2 SECTOR TRENDS EUROPEAN WIDE





#### FFCO2 SECTOR TRENDS EUROPEAN WIDE







- Western Europe largely dependant energy sector decarbonization in the last 10 years, whilst eastern eurpoan countries contribution within the 90s.
- Germany steady decrease over two time periods.
- Overall energy sector largest contributor of emission cuts so far -> EU-ETS really works great!
- Transport, IPPU so far sideways or even more emissions (transport)!
- Great overview analysis plots -> This sectoral dissagregation would be on a "wishlist" for inv. model output data most of the time
- Strong decline in SOZ in emissions of IPPU and manufacturing -> Economic Decline
- Transport sector \_not\_ contributing much to ESD

9th -11th , 2022 | Teleconference

(cc)(i)

#### FFCO2 TEMPORAL TRENDS EUROPEAN WIDE



VERIFY



#### FFCO2 TEMPORAL TRENDS EUROPEAN WIDE







- Gradual decrease in FFCO2 emission visible throughout the datasets
- Trends in data FF CO2 are almost identical throughout the datasets
- Sharp dips in FFCO2 Financial EU Crisis to be seen 2008-2012 esp. In Western Europe whilst Eastern Europe no Euro crisis 2012 (no dip in FFCO2)
- Sharp dip after steady decline or even increase in CO2 (Eastern Europe) due to corona year 2020

#### FFCO2 FOR SINGLE COUNTRIES





- Interesting trend in GR,ES,It&IR Directly related to the EU-Finance Crisis
- Sweden and Germany much more gradual

•

Germany/Poland still high CO2 emissions per capita



1990

1995

2000

2005

[Year]

2010

2015

2020

VERIFY GA meeting | May 9th -11th ,



- FFCO2 trend rather largely driven by economic impacts than by increased decarbonization effects.
- Longer trend shows the road to net zero, but it is more sluggish. So there still is a way to go...
- Sector Strain Strain
- Future Outlook -> War in Ukraine, oil and gas? Embargo -> Catalyst towards Net Zero?



- Can be directly integrated for your NIR/NID document with reference to VERIFY. -> No need to scout and integrate all of the data (EDGAR, PRIMAP, BP etc.) for the long time series data comparison.
- **C** Data directly accessible as figures in neat form or tables for own analysis.
- C Really answers to the 2019 IPCCC refinements on QA/QC and verification.
- **C** Trends consistent with NGHGIs as seen in the temporal trend plots.
- Why does CIF does such a good job but has some disparities in EE and for whole EU?
- Sector plots/disaggregation extremely useful for decision makers to benchmark decarbonization of sectors.
- Maybe Produce some maps of results using Geopandas and shapefiles from the "Natural Earth" Project for Europe. ->(I could give it a try if somebody points me to the backend of the web interface of the fact sheets)
- C This way maybe some nice figures for the next IPCCC AR, from VERIFY?
- Minor thing: Maybe plots would be even nicer with Seaborne/Bokeh?



#### VERIFYS CH4 DATA



	Kyoto Protocol (entering into force)	GOSAT satellite min-max	Wetland: GCP min-max
	Paris Agreement	 GOSAT satellite median	 Wetland: GCP median
_	UNFCCC	SURF min-max	Biomass burning: GCP min-max
	UNFCCC uncertainty	 SURF median	 Biomass burning: GCP median

COI VERIFY Project





CC VERIFY Project



······ Kyoto Protocol (entering into force)	GOSAT satellite min-max	Wetland: GCP min-max
······ Paris Agreement	<ul> <li>GOSAT satellite median</li> </ul>	Wetland: GCP median
- UNFCCC	SURF min-max	Biomass burning: GCP min-max
UNFCCC uncertainty	– SURF median	Biomass burning: GCP median

CC VERIFY Project





CO VERIFY Project



#### VERIFYS CH4 DATA



GOSAT satellite min-max

-- GOSAT satellite median





- Inversions using spaceborne CH4 emission particularly intersting for Southern Europe
- Larger disparaties and error margins in other European domains to be expected considering demand for optical data.
- Spaceborne emissions important future field for verification work in conjunction with inverse modelling.
- More data quantity and quality from larger S5 fleet and longer data continuity to be expected to improove results.

VERIFY Pro

— UNFCCC

Paris Agreement

-- SURF median



- Extreme wealth of data and possibilities offered to inventory agencies
- Premade data (fact sheets by country)
- Python scripts and workbooks for retrieving results
- Possibility of CIF usage put forward to users and developers
- Caters for all skill levels Data- (Consumer->User >Developer)
- Well made web presence that provides an excellent overview over all the results



OVERALL IMPRESSION: ROOM FOR FUTURE EVOLUTION OF PROJECTS

- Missing Workshops on data and tools specifically for inventory agencies leads to "spoon feeding" only with data, which hampers Verify data usage in NIR/NID as inventory compilers need to describe the data products in greater detail in order to use them correctly.
- Maybe future projects need a small demonstrator system for inversions to be run on a powerfull workstation in order to truly appreciate the efforts that go into systems such as CIF, otherwise the buildup: Data-Consumer->User->Developer will not happen in the inventory community.



#### **OVERALL CONCLUSION**

- Great of the shelve data products by VERIFY that can be used by any inventory agency
- Continuity needs to be fulfilled to answer the needs of future reporting:
- Suggestion: GITHUB Data Analysis Repo for inventory agencies to use CAMS-Global, EDGAR, ETS etc. in their NIR/NID? -> Maintainer?
- Future projects should assist inventory agencies in understanding of inverse modelling and to ramp up the data science and analysis for improved NIR/NID



# Thank you for your attention.





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810