

# FROM DATA TO VISUALIZATION

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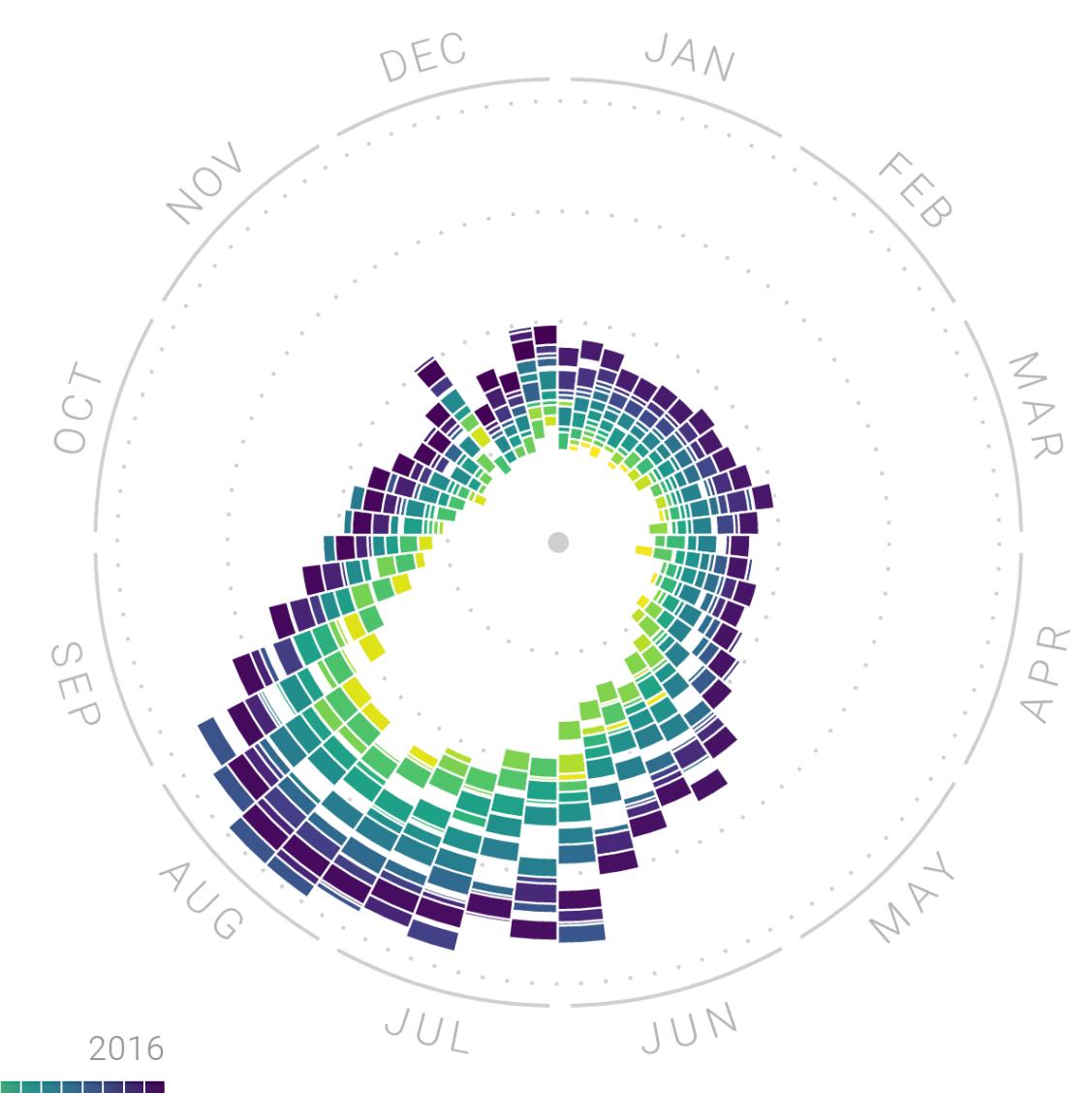
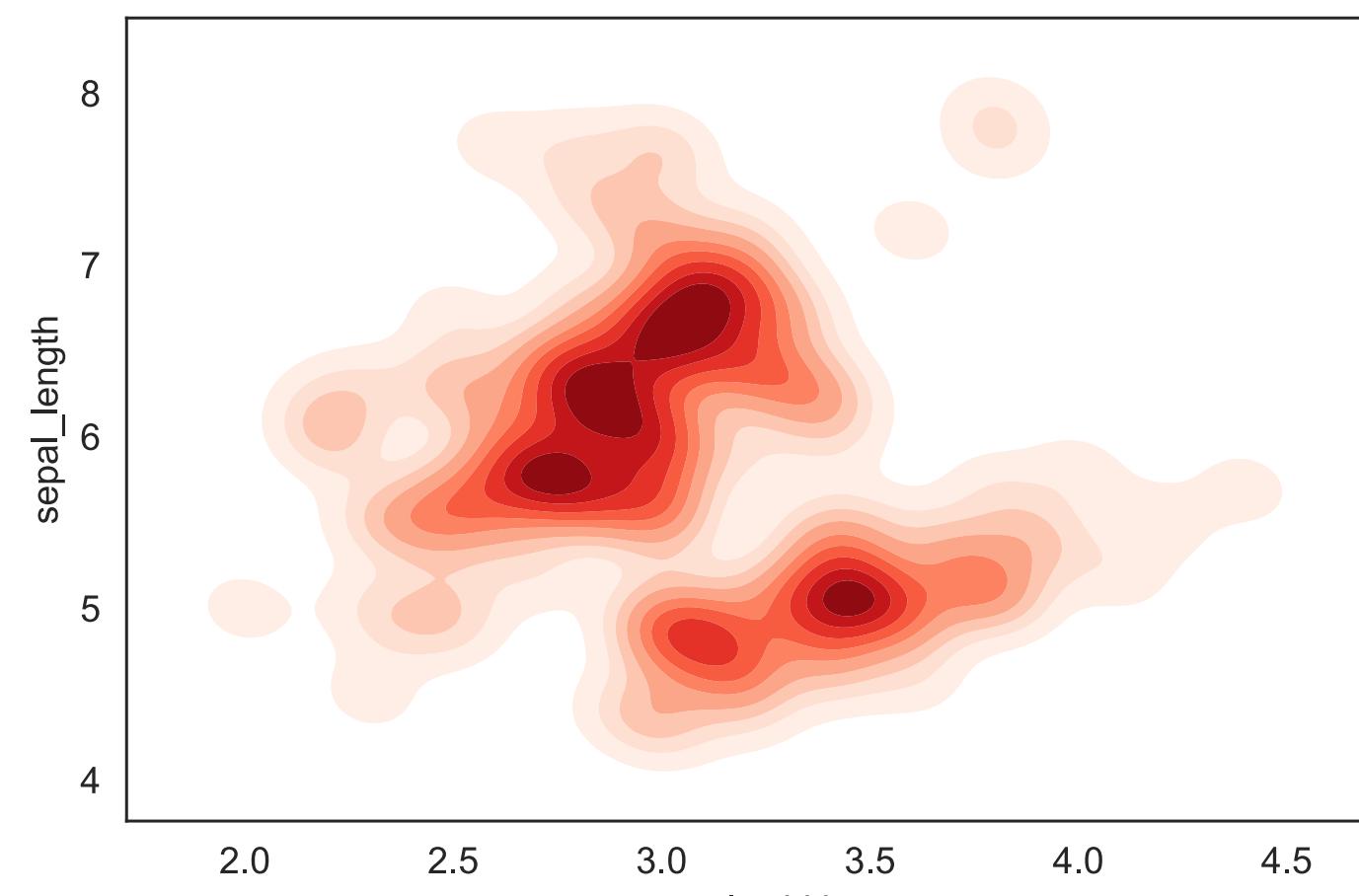
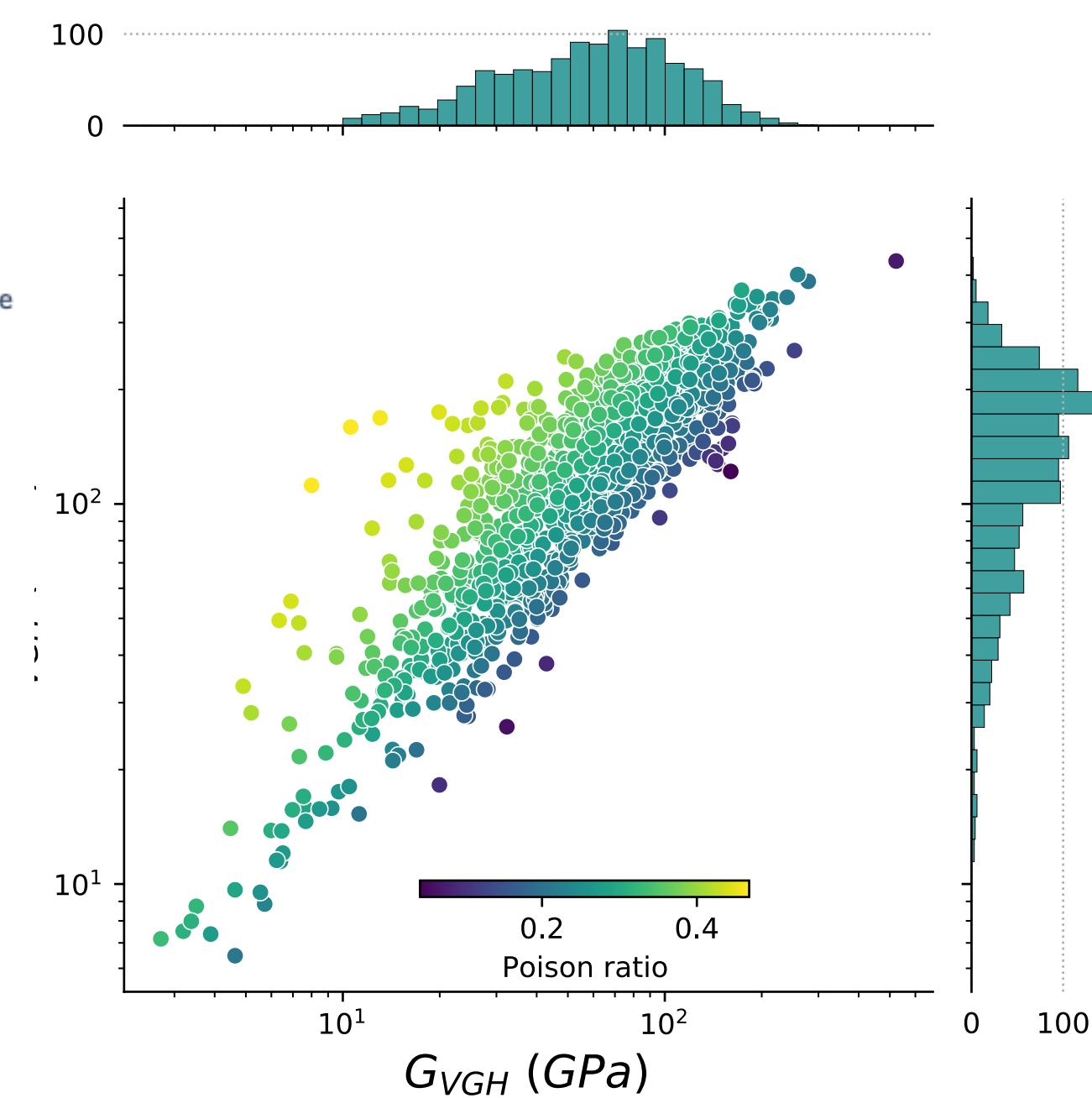
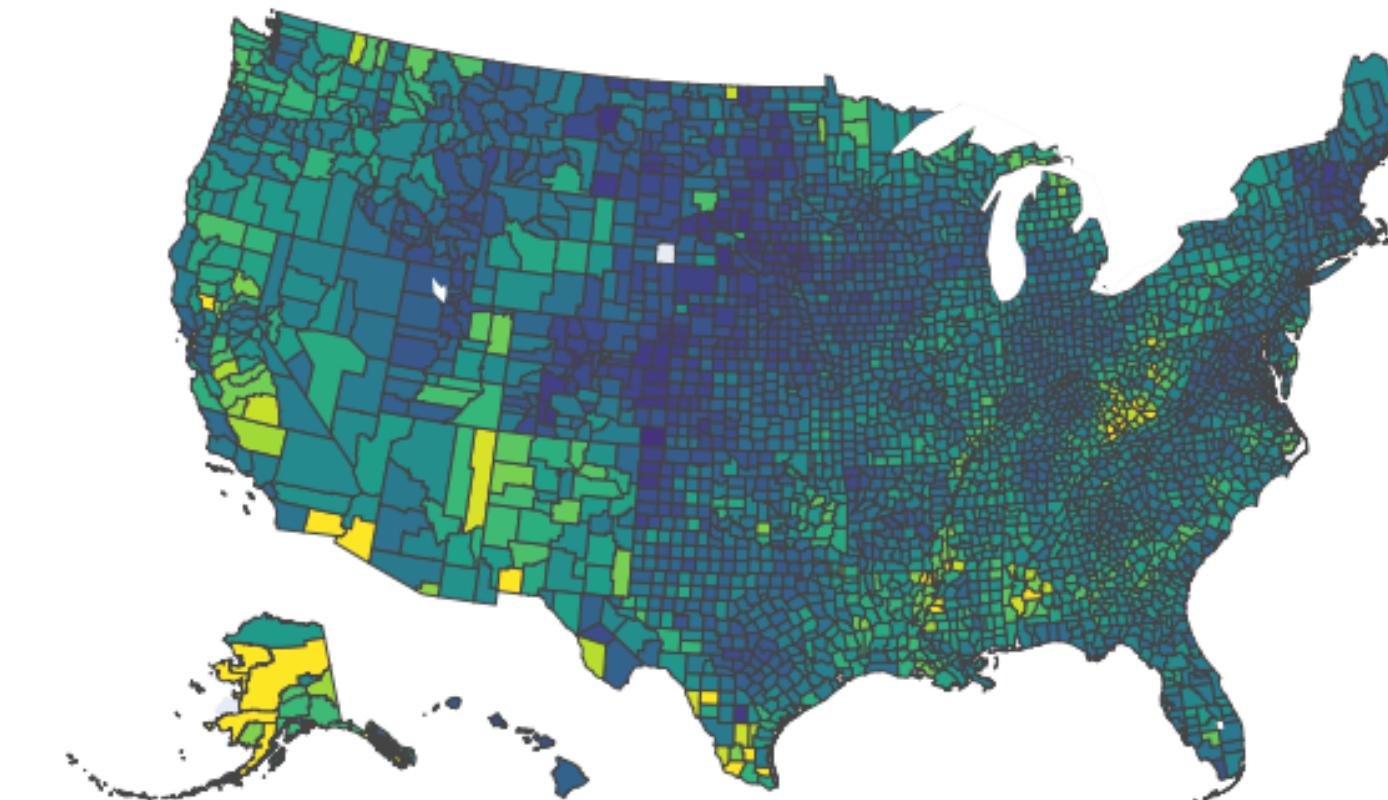
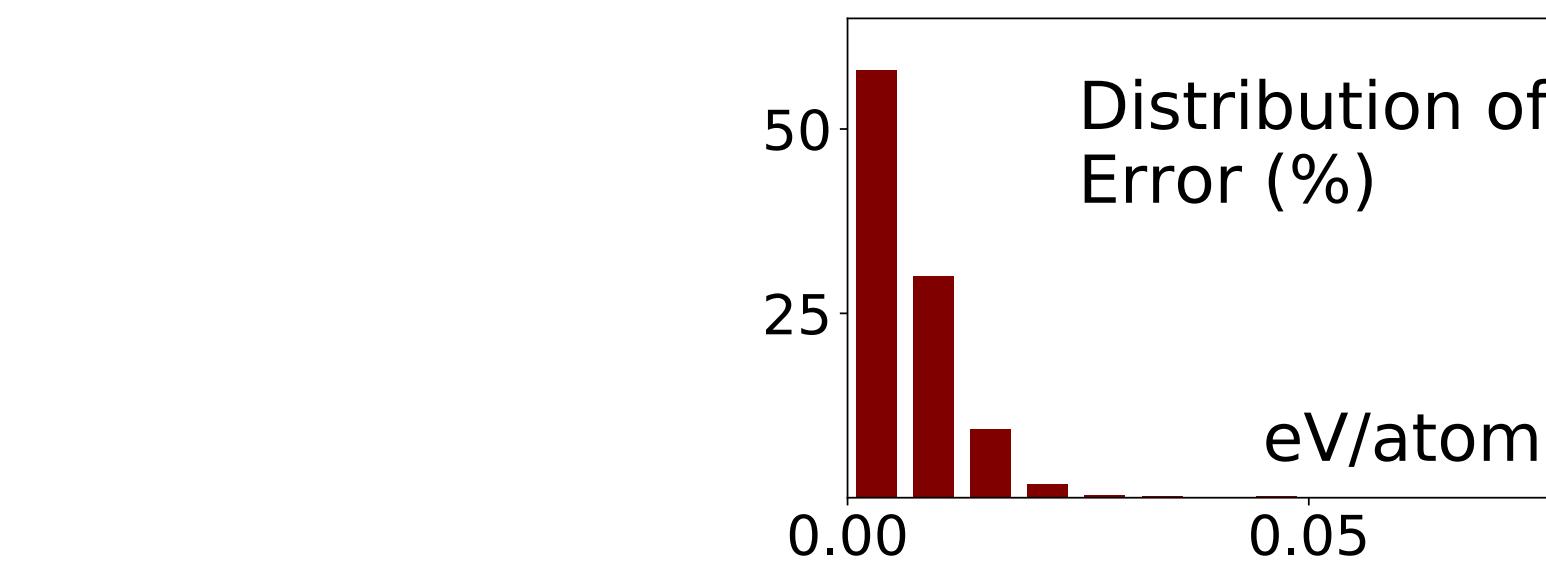
## CONTENT

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- Data Visualization
- Why Data Visualization
- Syllabus
- Examples

# DATA VISUALIZATION

- Natural way to communicate using data



# DATA VISUALIZATION



Data?

ourworldindata.org

**Data Explorer: Air Pollution**  
Explore historical emissions of air pollutants from fuel use globally.

POLLUTANT: All pollutants

FUEL: From all fuels (Total)

Per capita

Q Type to add a country...

Sort by: Select... ▾

Country	Nitrogen oxide (NOx) tonnes				Sulphur dioxide tonnes		
	1750	2019	Absolute Change	Relative Change	1750	2019	Absolute Change
China	555 t	480,670 t	+480,114 t	+86,441%	139 t	327,819 t	+327,680 t
Germany	17,526 t	6,782,873 t	+6,765,347 t	+38,602%	7,694 t	6,441,732 t	+6,424,036 t
India	152 t	23,372 t	+23,219 t	+15,238%	85 t	11,539 t	+11,539 t
United Kingdom	242 t	487,161 t	+486,919 t	+201,177%	165 t	66,458 t	+66,293 t
United States	0 t	246 t	+246 t	+218,984%	0 t	390 t	+390 t
Afghanistan	549 t	133,085 t	+132,536 t	+24,147%	367 t	77,387 t	+77,020 t
Antigua and Barbuda	2 t	3,992 t	+3,990 t	+206,334%	2 t	554 t	+552 t
Argentina	237 t	1,031,849 t	+1,031,612 t	+435,049%	22 t	108,724 t	+108,502 t
Armenia	67 t	20,617 t	+20,551 t	+30,892%	28 t	53,291 t	+53,263 t
Aruba	0 t	3,114 t	+3,114 t	+2,368,015%	0 t	24,001 t	+24,001 t
Asia	82,748 t	59,024,664 t	+58,941,916 t	+71,231%	99,522 t	45,640,196 t	+46,118 t
Australia	0 t	1,097,491 t	+1,097,491 t		0 t	1,070,817 t	+1,060,726 t
Austria	461 t	126,546 t	+126,084 t	+27,325%	1,997 t	12,433 t	+12,366 t
Azerbaijan	186 t	85,026 t	+84,840 t	+45,551%	67 t	29,275 t	+29,088 t
Bahamas	1 t	17,823 t	+17,822 t	+1,950,019%	1 t	2,170 t	+2,170 t
Bahrain	2 t	53,379 t	+53,377 t	+2,992,754%	2 t	41,478 t	+41,476 t

► 1750 2019

CHART TABLE SOURCES DOWNLOAD

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# DATA VISUALIZATION



Data



Message



Communication Fail

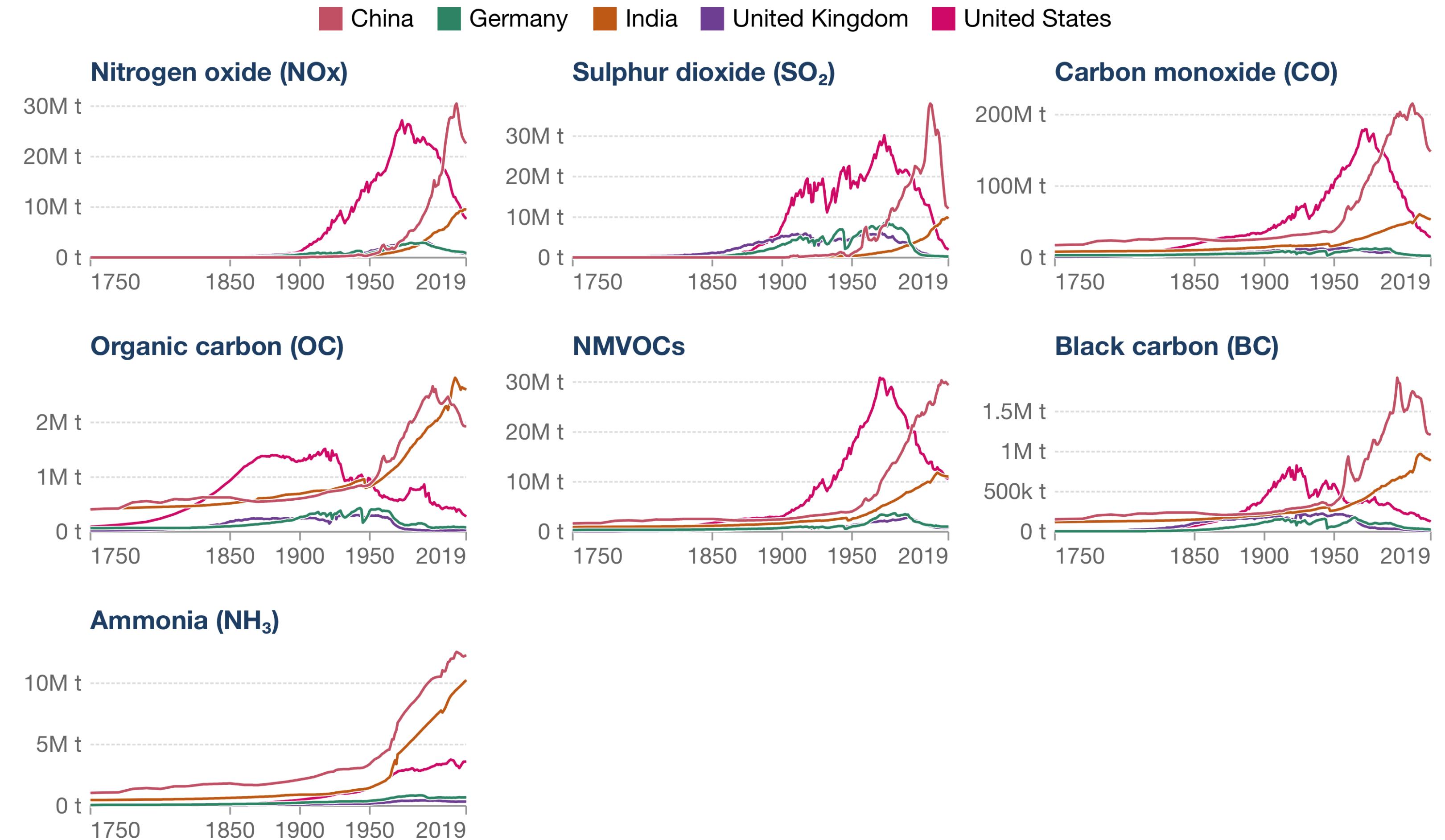
air-pollution

		Black carbon (BC)	Ammonia (NH <sub>3</sub> )	Nitrogen oxide (NOx)	Sulphur dioxide (SO <sub>2</sub> )	Carbon monoxide (CO)	Organic carbon (OC)	NMVOCs	Black carbon (BC)	Ammonia (NH <sub>3</sub> )	Entity	Year
1	s											
2	.2902339285	1633.03077838778	7628.357285386160	0.19818329940785400	0.049746191015188200	50.6939727260384	1.9471017189058100	4.749676094898860	0.5826908672288340	2.7219169295396800	Afghanistan	1750
3	.38453285500	1699.5359485450400	7946.022531769270	0.2018133164010940	0.0506217143336243	51.5861768188554	1.9813703317077200	4.833355296920510	0.5929461135358900	2.772264500974360	Afghanistan	1760
4	.53344412600	1768.59553590151	8276.89805400812	0.20550542432817600	0.051508044573197100	52.48939373002460	2.016061935180700	4.91807782779989	0.6033279442933450	2.823530754591020	Afghanistan	1770
5	.50476728900	1840.28545696635	8621.530649109730	0.20926128749628000	0.052405034898307700	53.40347382638380	2.0511707820737500	5.003831027105900	0.6138346395753020	2.8757463351950300	Afghanistan	1780
6	.3771296059	1914.68049233857	8980.4893857581	0.2130800512799540	0.053311841875310700	54.327557604897500	2.0866638597869600	5.090535879324440	0.6244563200106490	2.9289081787613200	Afghanistan	1790
7	.07107193800	1991.85363375057	9354.36646023989	0.20742763200239300	0.05184479963709730	52.83256476837590	2.0292427707459800	4.9505814351200600	0.6072724493141980	2.851940993975580	Afghanistan	1800
8	.2753689079	1999.86650221402	9410.816293850180	0.20886312416933100	0.05205336192951010	53.04510066202930	2.0374060489743000	4.970510783203630	0.6097153970164700	2.869151309100670	Afghanistan	1801
9	.24629090300	2007.8769929042300	9467.411134154990	0.2103035667126400	0.05226186233224630	53.2575734868622	2.045566904796130	4.990434338137290	0.612157619787875	2.8864058335838400	Afghanistan	1802
10	.54887741000	2015.8851058211700	9524.15098115438	0.211748329508193	0.05247030084530550	53.46998324287440	2.053725338211460	5.010352099921040	0.6145991176284060	2.903704567425120	Afghanistan	1803
11	.2661448602	2023.8908409648600	9581.035834848280	0.21319804268011700	0.0526786774686875	53.682329930065900	2.0618813492202800	5.030264068554940	0.617039805380670	2.9210475106244800	Afghanistan	1804
12	.5584004475	2031.8941983352900	9638.065695236760	0.21465249618703500	0.052886992202392400	53.89461354843690	2.0700349378226000	5.050170244038870	0.6194799385168570	2.9384346631819400	Afghanistan	1805
13	.31654503300	2039.89517793247	9695.24056231975	0.2161116900289500	0.05309524504642070	54.106834097987200	2.0781861040184400	5.0700706263729600	0.6219192615647770	2.955866025097490	Afghanistan	1806
14	.0859070273	2047.8937797564000	9752.26138163816	0.21756575452355800	0.05330343600077200	54.318991578717100	2.086334847807760	5.089965215557100	0.6243578596818290	2.9732504212311500	Afghanistan	1807
15	.3211580197	2055.89000380707	9809.72505136348	0.21903438907723500	0.05351156506544600	54.53108599062620	2.0944811691905900	5.109854011591370	0.6267957328680090	2.9907698327327700	Afghanistan	1808
16	.5374074804	2063.88385008449	9867.3337277833	0.2205077639659080	0.0537196322404433	54.74311733371490	2.102625068166930	5.129737014475730	0.6292328811233200	3.0083334535924700	Afghanistan	1809
17	.7346554096	2071.87531858865	9925.08741089771	0.2219858791895750	0.05392763752576370	54.95508560798290	2.1107665447367600	5.149614224210250	0.631669304447759	3.025941283810280	Afghanistan	1810
18	.5004771376	2080.18124756615	9984.63992077093	0.223505177817514	0.05414382771983290	55.1753947327247	2.119228384525750	5.170274535712680	0.6342015998677290	3.0440975368204100	Afghanistan	1811
19	.6244620531	2088.48446380631	10044.3434512168	0.22502940887254600	0.05435994730563990	55.395631903950900	2.1276874606565400	5.1909282379667700	0.6367330682336310	3.0622998326880500	Afghanistan	1812
20	.37085589500	2096.78496730912	10104.1980022351	0.22655857235466900	0.05457599628318450	55.615797121661600	2.1361437731291100	5.211575330972410	0.6392637095454630	3.0805481714131400	Afghanistan	1813
21	.37872313400	2105.08275807459	10164.2035738261	0.22809266826388500	0.05479197465246680	55.83589038585670	2.144597321943490	5.232215814729700	0.6417935238032290	3.098842552995760	Afghanistan	1814
22	.3469807026	2113.37783610271	10224.3601659896	0.22963169660019500	0.05500788241348660	56.05591169653630	2.1530481070996400	5.252849689238600	0.644322511069240	3.1171829774358500	Afghanistan	1815
23	.04410757000	2121.6702013935	10284.3575248587	0.2311654180676870	0.0552237195662439	56.27586105370030	2.1614961285976000	5.2734769544990900	0.6468506711565550	3.1354748551398500	Afghanistan	1816
24	.6401624767	2129.9598539469400	10344.8148969727	0.23271426963502700	0.05543948611073900	56.49573845734880	2.1699413864373500	5.294097610511190	0.649378004252116	3.15390698078436	Afghanistan	1817
25	.54235861600	2138.24679376303	10405.4232896594	0.23426805362945900	0.05565518204697160	56.71554390748170	2.1783838806188900	5.314711657274880	0.6519045102936070	3.1723851492864000	Afghanistan	1818
26	.8466309118	2146.53102084178	10466.182702918600	0.235615936887946	0.055820857918237500	56.88437629299550	2.184868553457950	5.330549228331300	0.6538451175066760	3.188056633140350	Afghanistan	1819
27	.17347627200	2154.81253518318	10527.0931367503	0.2367539981673330	0.0559359998736630	57.00171208882040	2.1893752969119500	5.341561220228190	0.6551938083460340	3.2008753107121200	Afghanistan	1820
28	.22.72119628	2161.58871000446	10580.9541043549	0.23751693972261600	0.055961413705323000	57.02760999775930	2.1903700081231500	5.344006311224840	0.6554914862396290	3.208623962364510	Afghanistan	1821
29	.0053525743	2168.36242060525	10634.9403027075	0.23806572759310800	0.05593631653591090	57.00203466835810	2.18938					

# DATA VISUALIZATION

## Emissions of air pollutants

Our World  
in Data



Source: Community Emissions Data System (CEDS)

[HTTPS://OURWORLDINDATA.ORG](https://ourworldindata.org)

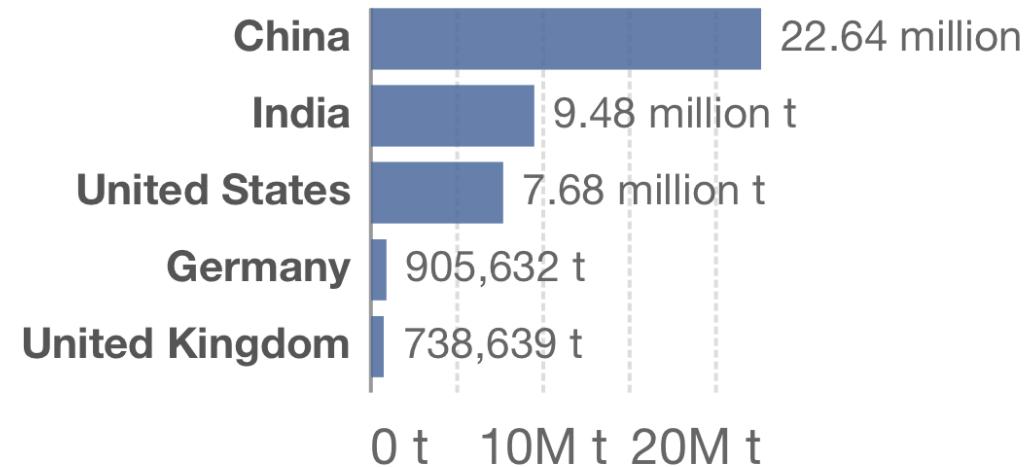
CC BY

# DATA VISUALIZATION

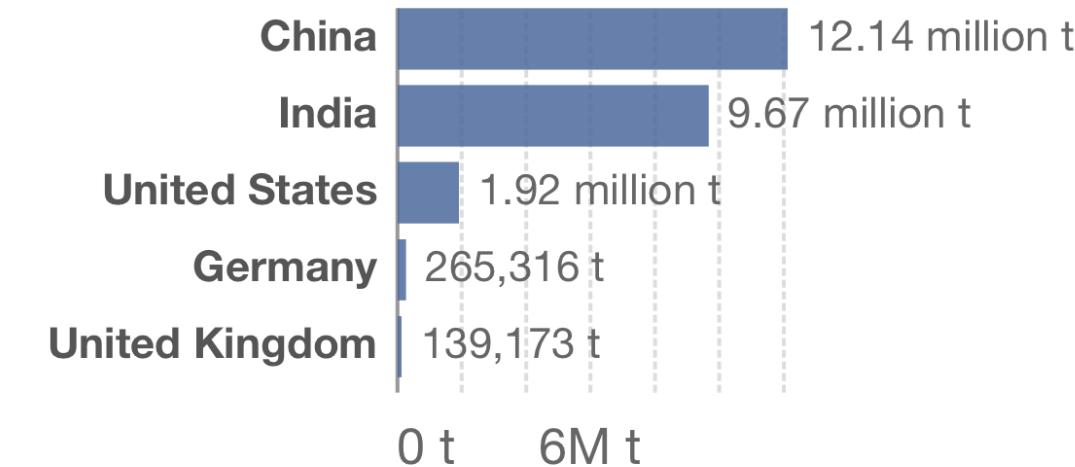
## Emissions of air pollutants, 2019

Our World  
in Data

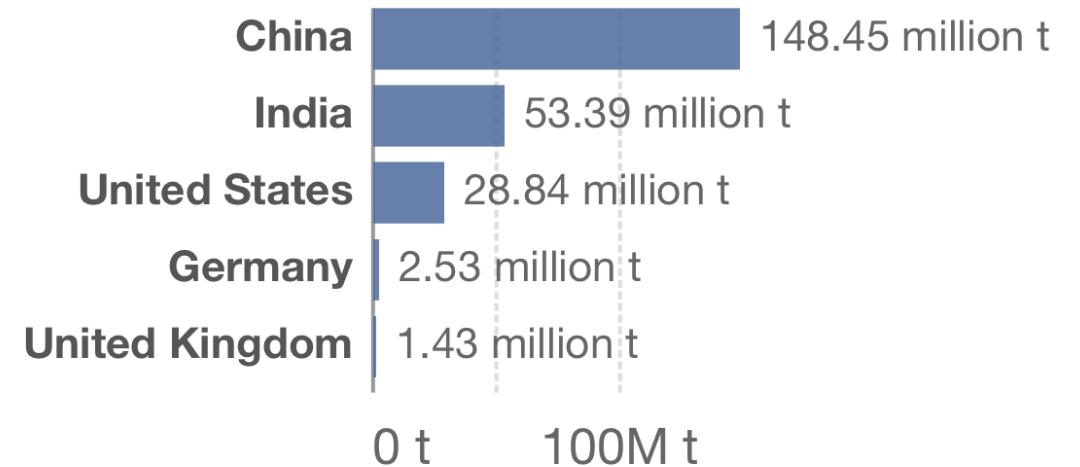
**Nitrogen oxide (NOx)**



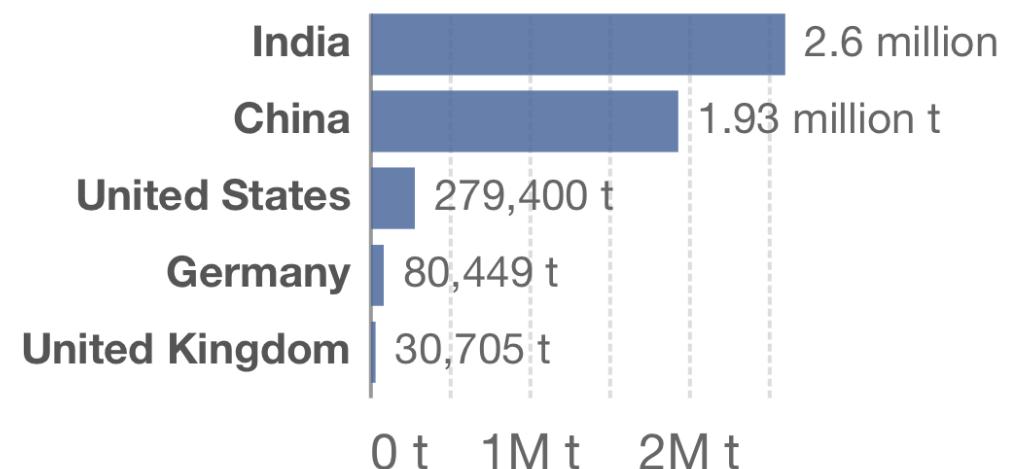
**Sulphur dioxide (SO<sub>2</sub>)**



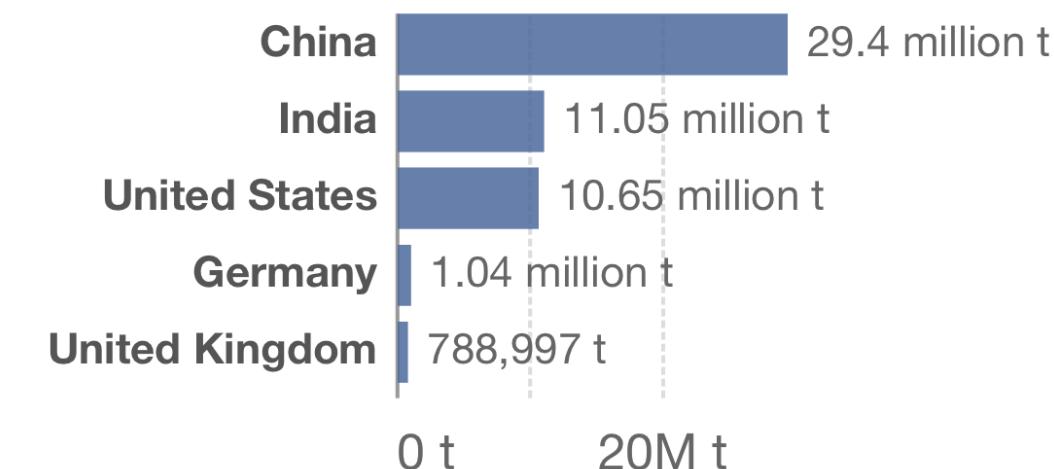
**Carbon monoxide (CO)**



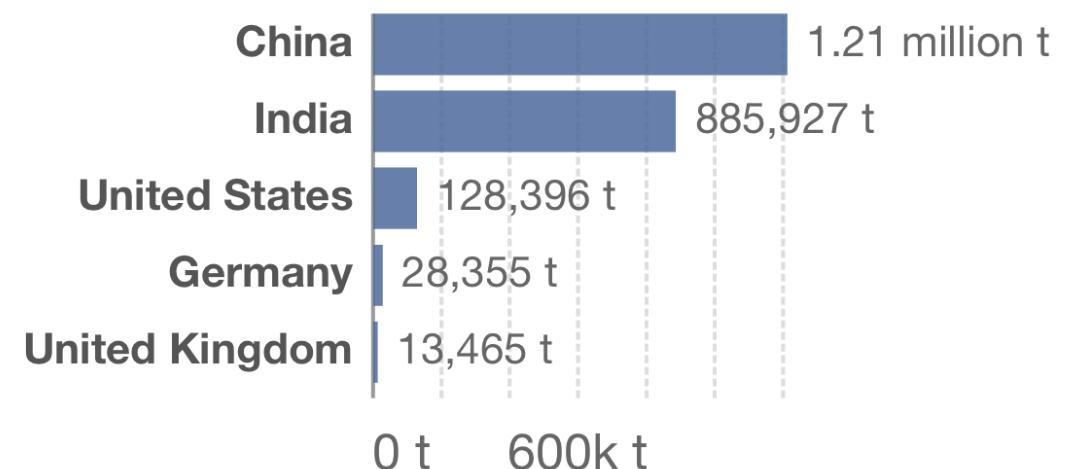
**Organic carbon (OC)**



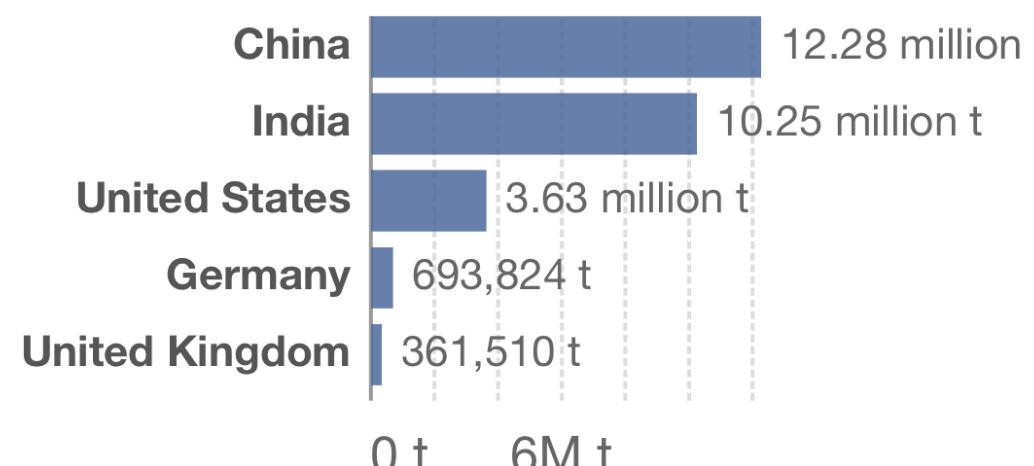
**NMVOCs**



**Black carbon (BC)**



**Ammonia (NH<sub>3</sub>)**

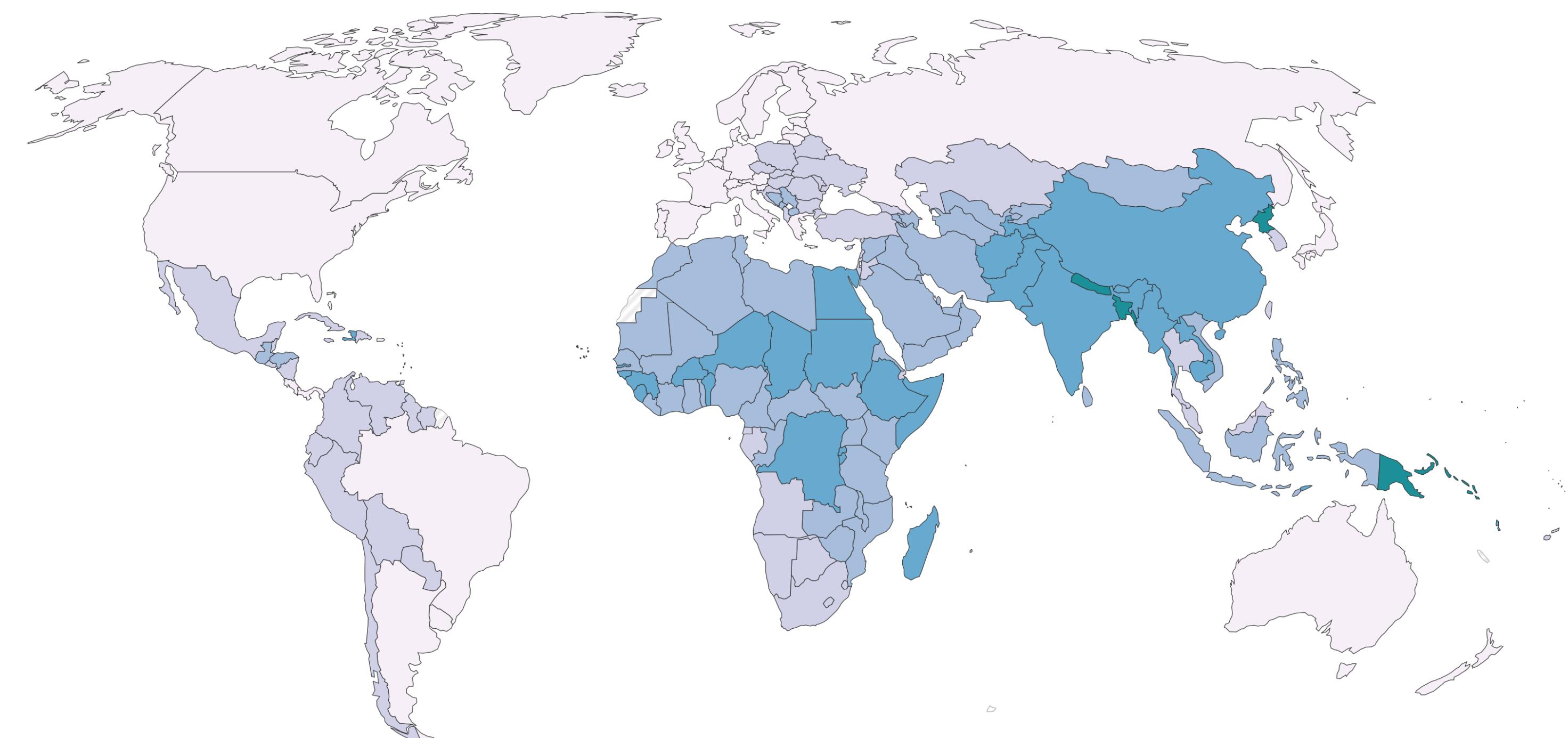


# DATA VISUALIZATION

## Share of deaths attributed to air pollution, 2019

Share of deaths, from any cause, which are attributed to air pollution – from outdoor and indoor sources – as a risk factor.

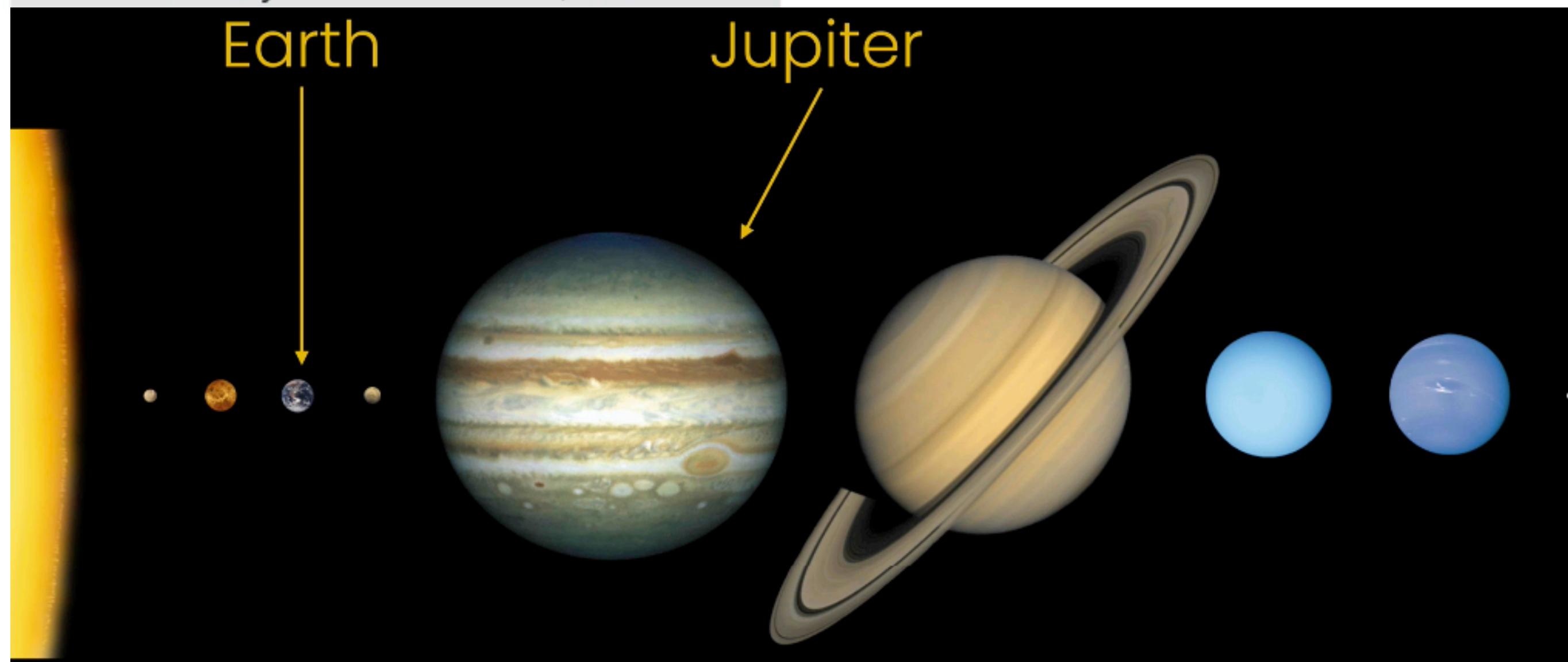
Our World  
in Data



## DATA VISUALIZATION

Planet	Radius (km)
Jupiter	69,911
Saturn	58,232
Uranus	25,362
Neptune	24,622
Earth	6,371
Venus	6,052
Mars	3,390
Mercury	2,440

**“Jupiter’s radius is 10x  
the radius of the Earth”**



## WHY DATA VISUALIZATION

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“

*A picture is worth a thousand words*

“

*A (good) graph is worth a thousand numbers*

## WHY DATA VISUALIZATION

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- Natural and Effective way to communicate with data
- Impactful way to Reveal information
- Effective mean to assist the viewers in thinking about the content

# DATA VISUALIZATION



# DATA VISUALIZATION

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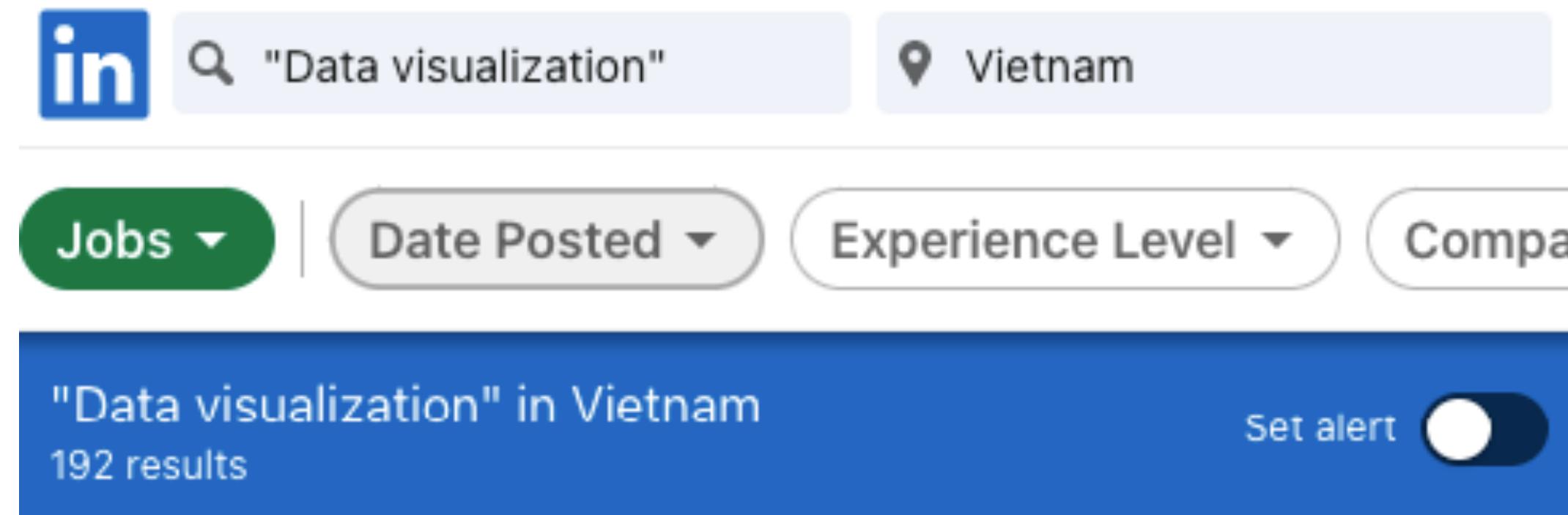
## UNPRECEDENTED VOLUME OF DATA

- The big data analytics market is set to reach \$103 billion by 2023.
- In 2020, every person generated 1.7 megabytes in just a second.
- Internet users generate about 2.5 quintillion bytes of data each day.
- 95% of businesses cite the need to manage unstructured data as a problem for their business.
- 97.2% of organizations are investing in big data and AI.

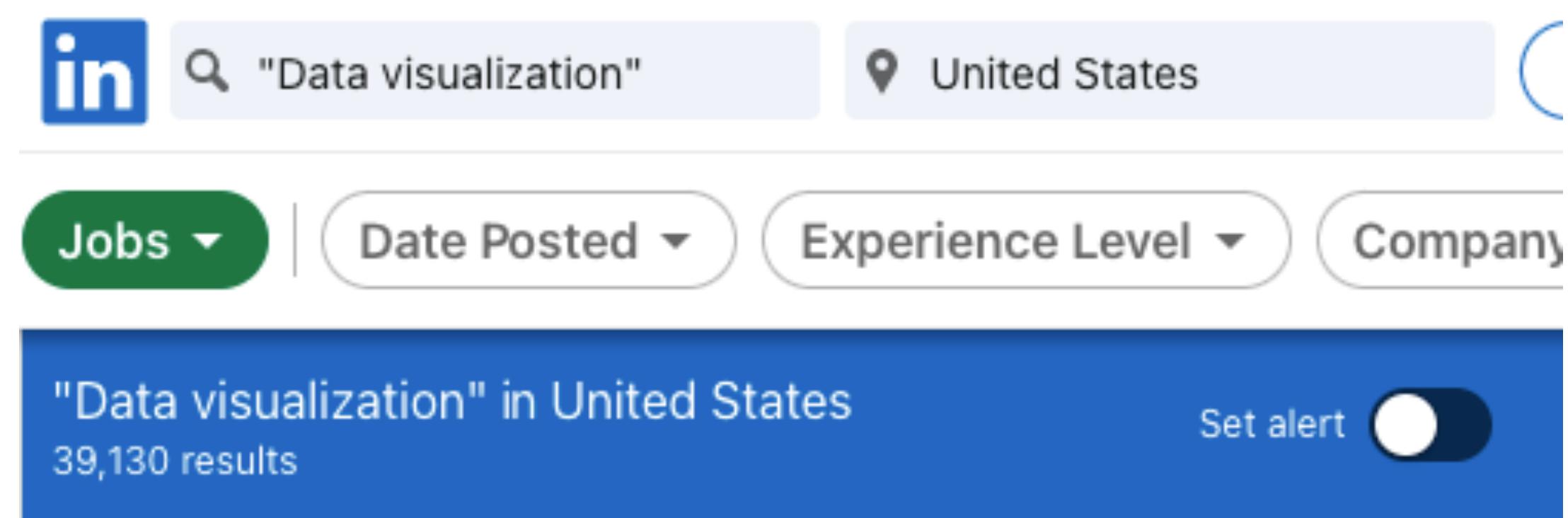
## ALL THIS DATA NEEDS TO BE CLEANED, ANALYZED, AND COMMUNICATED

- And we already know that the most natural way to communicate data is using Data Visualization

# DATA VISUALIZATION

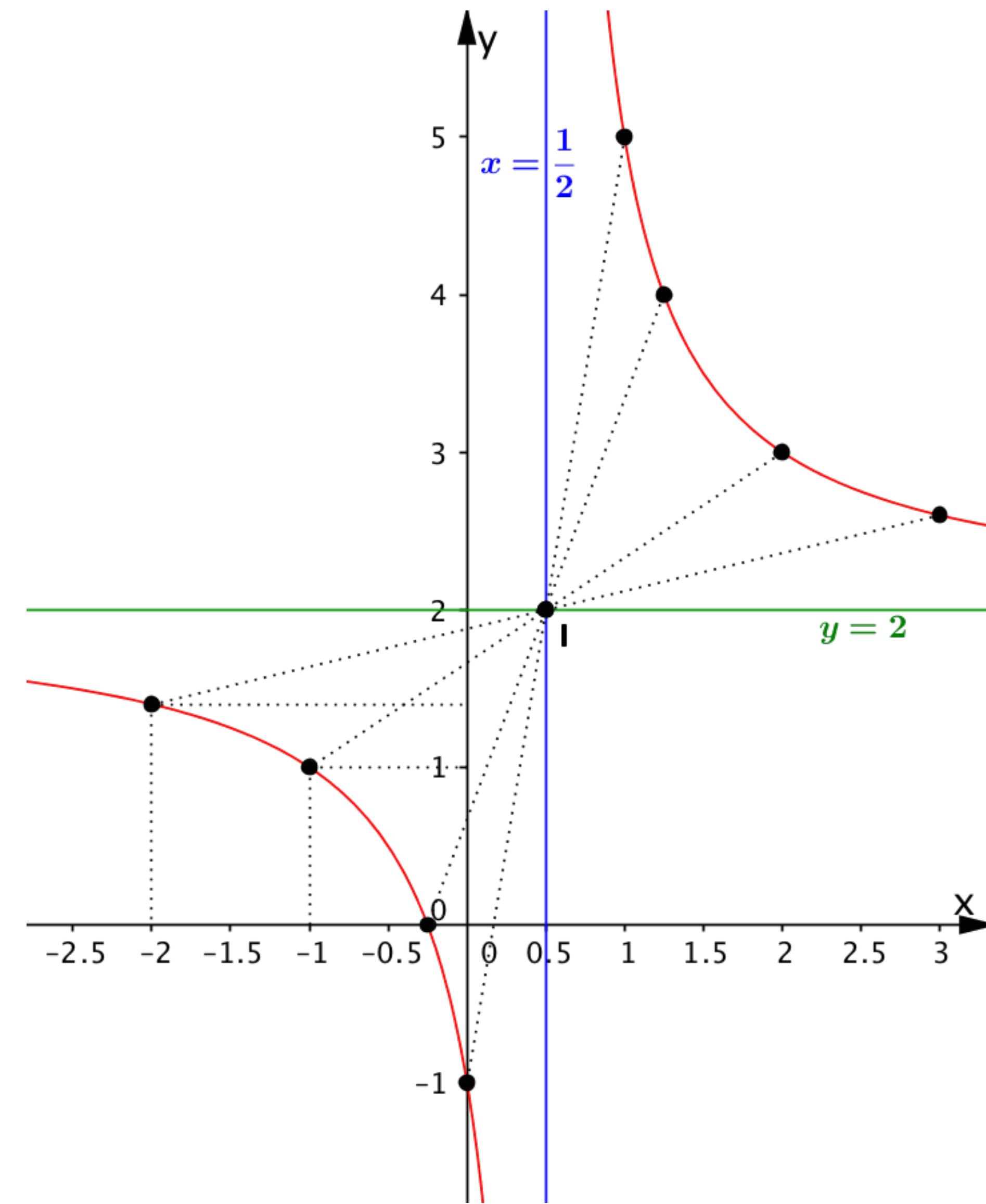
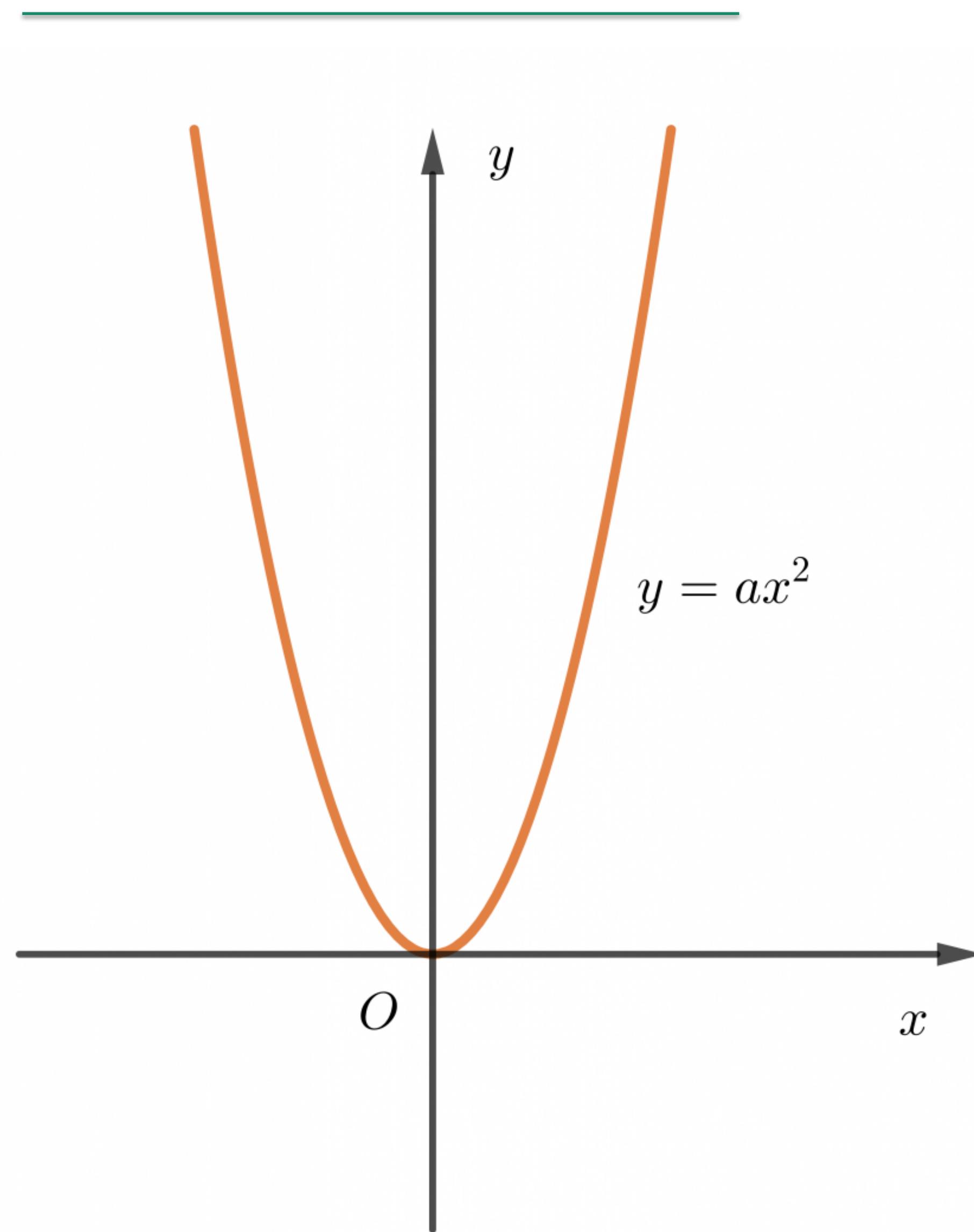


A screenshot of a LinkedIn search interface. The search bar at the top contains the text "Data visualization" and the location "Vietnam". Below the search bar are several filter buttons: "Jobs" (highlighted in green), "Date Posted", "Experience Level", and "Company". A blue banner below the filters displays the search query and the number of results: "'Data visualization' in Vietnam" and "192 results". To the right of the results count is a "Set alert" button with a toggle switch.



A screenshot of a LinkedIn search interface, identical in layout to the one above, showing search results for "Data visualization" in the "United States". The banner indicates "39,130 results".

## EXAMPLES



## EXAMPLES

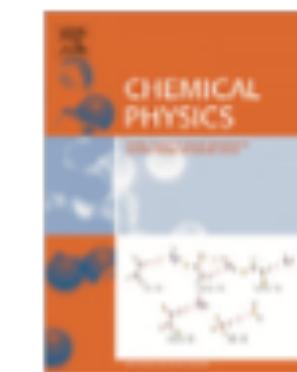
Chemical Physics 400 (2012) 59–64



Contents lists available at SciVerse ScienceDirect

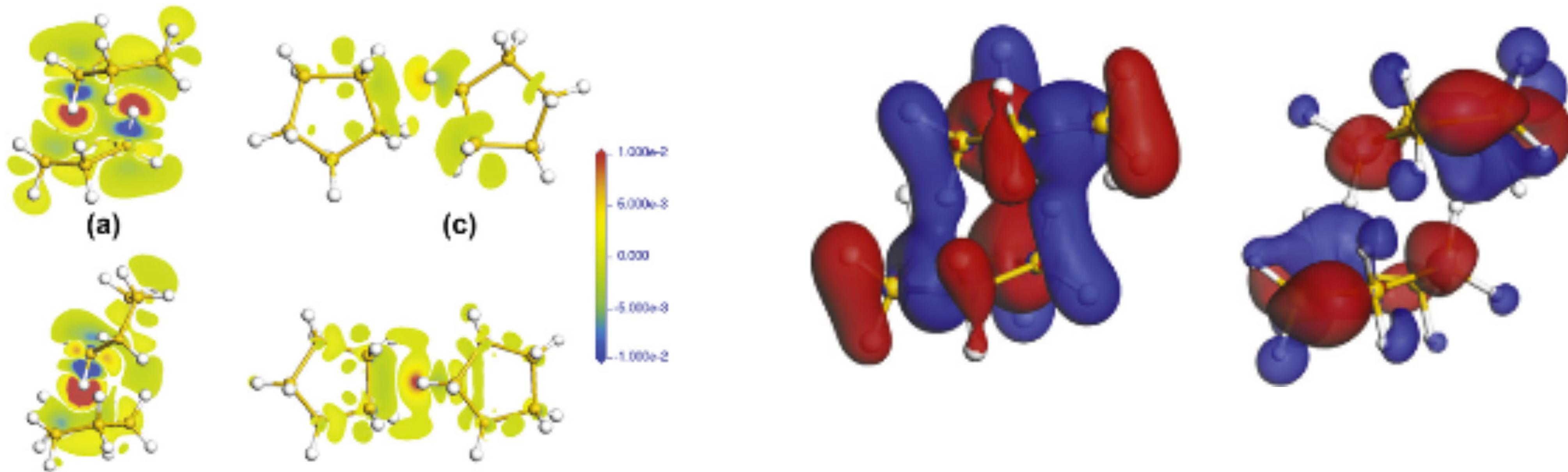
Chemical Physics

journal homepage: [www.elsevier.com/locate/chemphys](http://www.elsevier.com/locate/chemphys)



### Ab-initio study of intermolecular interaction and structure of liquid cyclopentasilane

Pham Tien Lam <sup>a</sup>, Ayumu Sugiyama <sup>a,b</sup>, Takashi Masuda <sup>b</sup>, Tatsuya Shimoda <sup>a,b</sup>, Nobuo Otsuka <sup>a</sup>,  
Dam Hieu Chi <sup>a,b,c,\*</sup>



# EXAMPLES

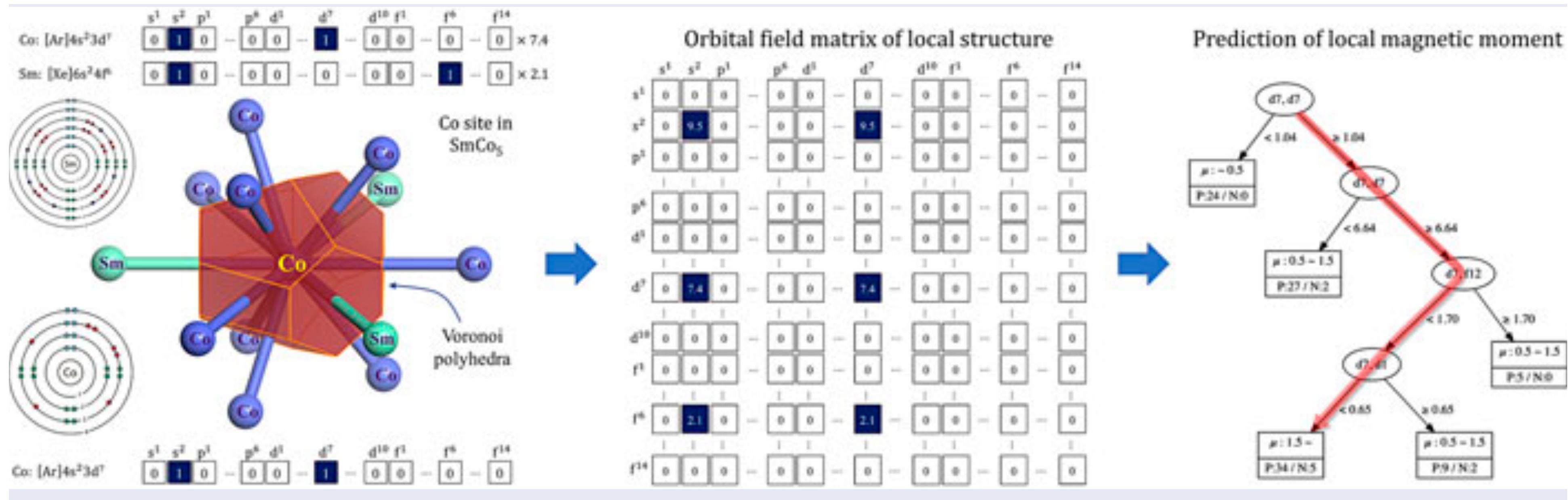
SCIENCE AND TECHNOLOGY OF ADVANCED MATERIALS, 2017  
VOL. 18, NO. 1, 756–765  
<https://doi.org/10.1080/14686996.2017.1378060>



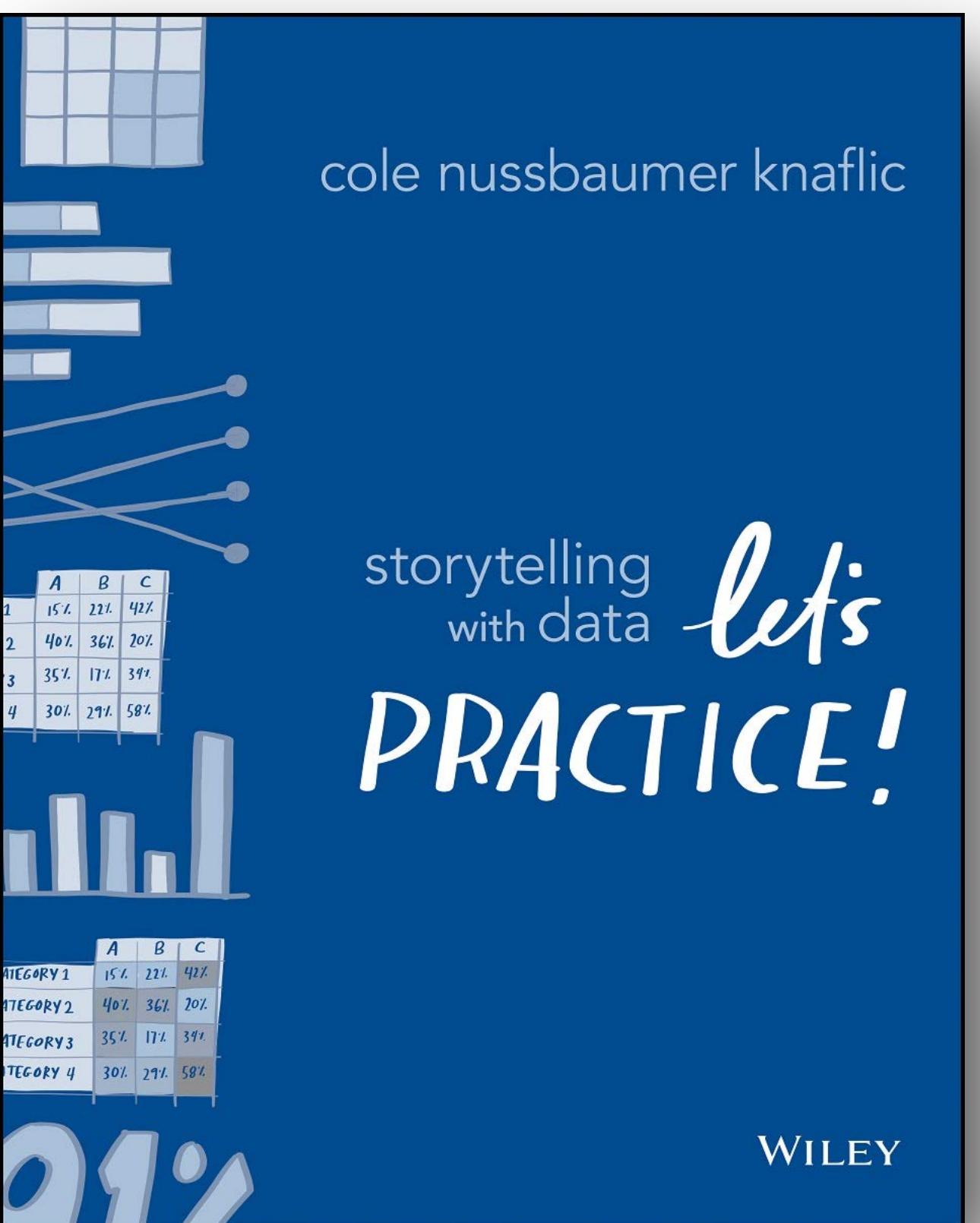
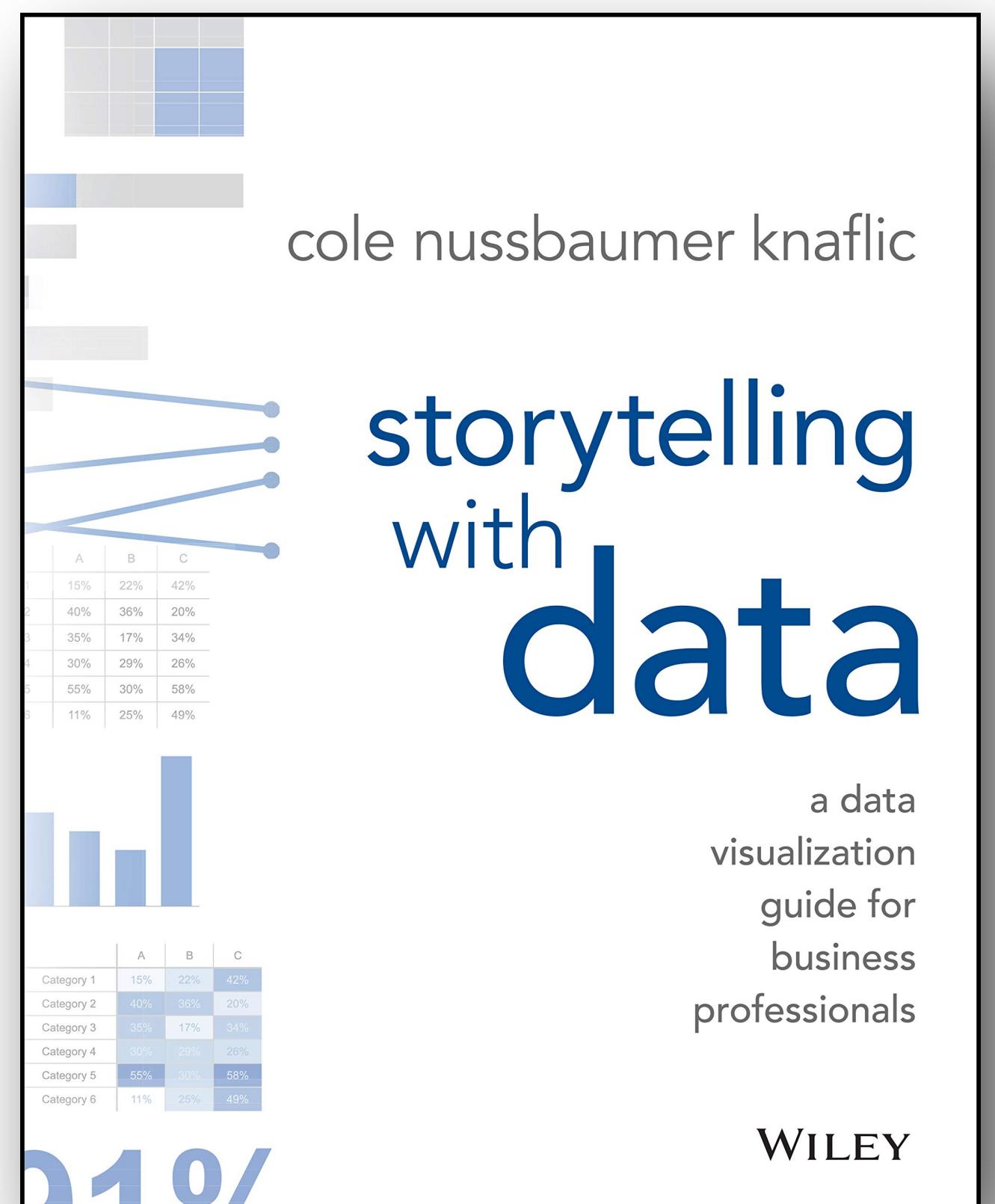
OPEN ACCESS

## Machine learning reveals orbital interaction in materials

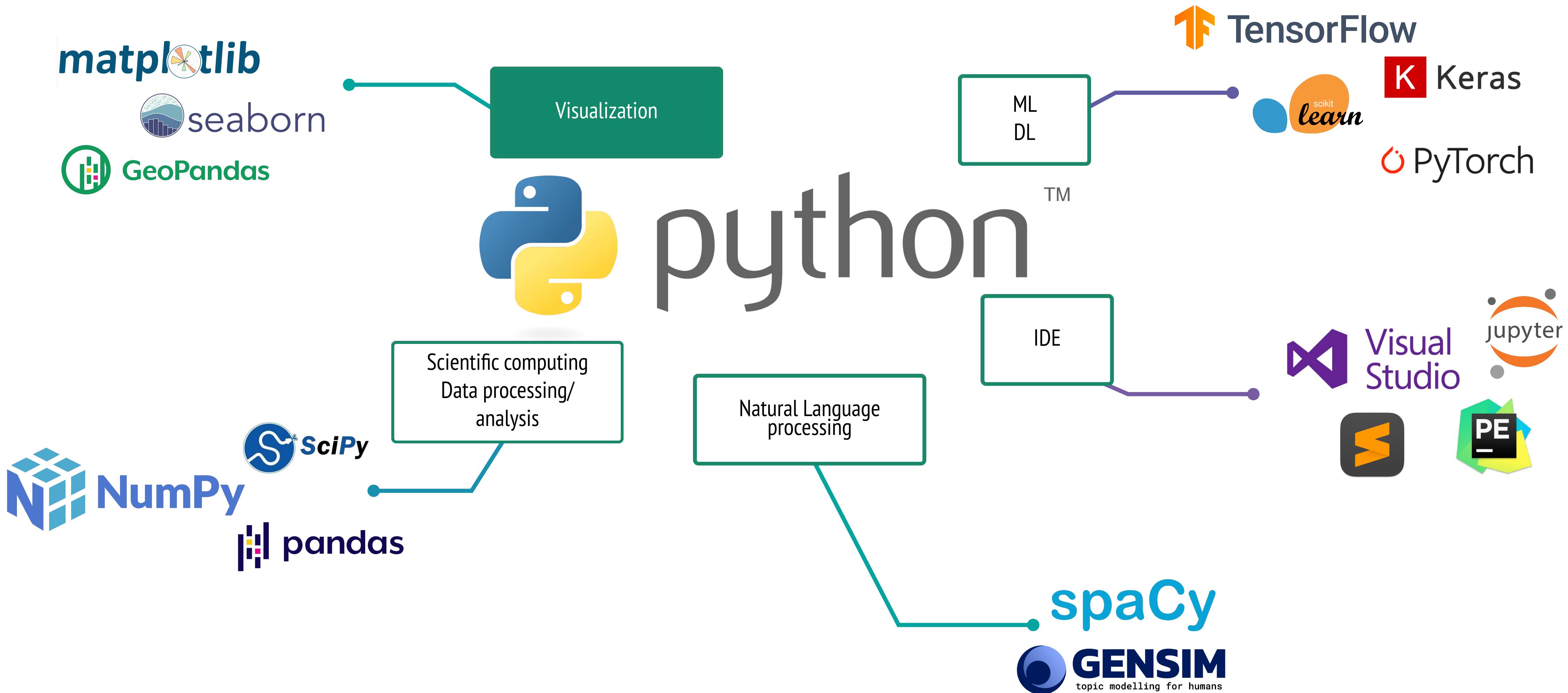
Tien Lam Pham<sup>a,b</sup>, Hiori Kino<sup>b,c</sup>, Kiyoyuki Terakura<sup>a,c</sup>, Takashi Miyake<sup>b,c,d</sup>, Koji Tsuda<sup>c,g,h</sup>, Ichigaku Takigawa<sup>e,f</sup> and Hieu Chi Dam<sup>a,c,e</sup>



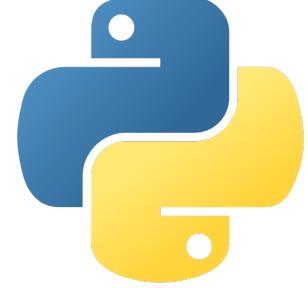
# SUGGESTION



# PROGRAMMING LANGUAGE/ PACKAGE REQUIREMENT



## PROGRAMMING LANGUAGE/ PACKAGE REQUIREMENT

-  python™
-  matplotlib
-  seaborn
-  GeoPandas
- .....