Integrating Social Media into a Pan-European Flood Awareness System: A Multilingual Approach

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ISCRAM19

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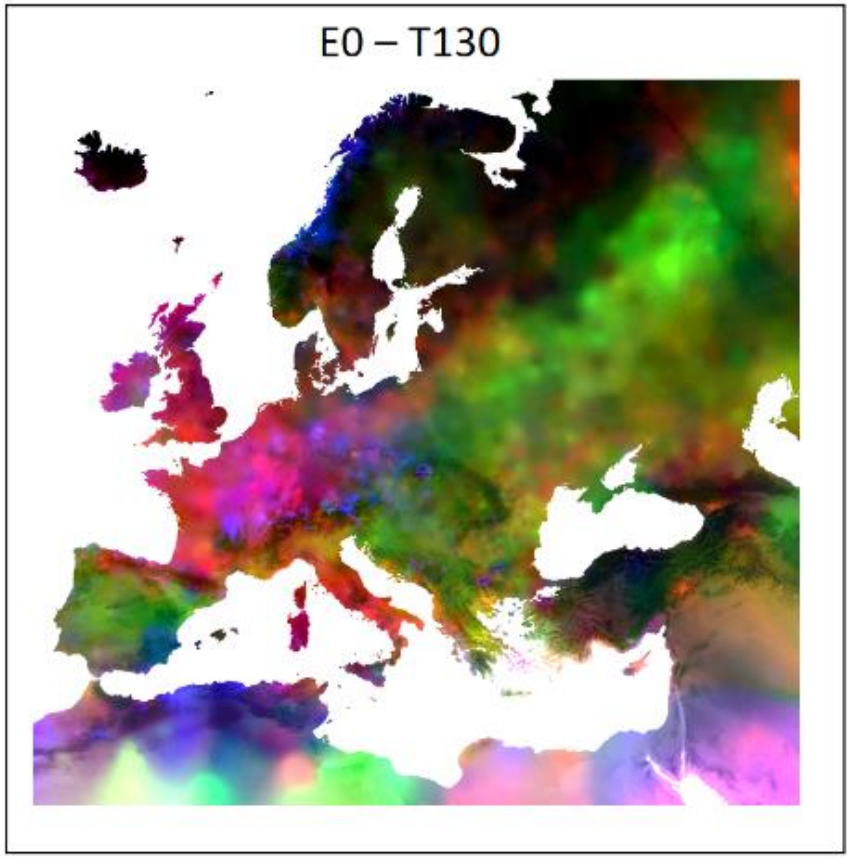

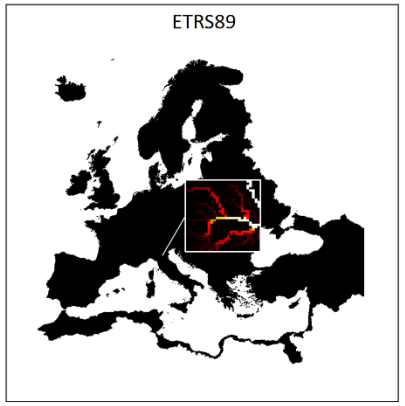

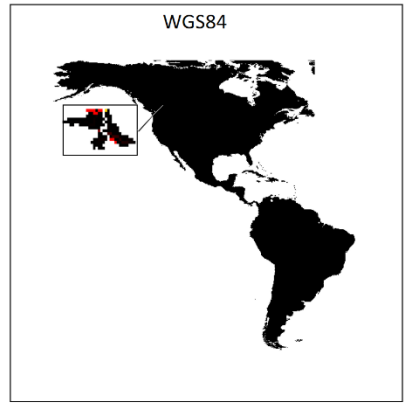

https://ec-jrc.github.io/lisflood/
Open Source Hydrological model

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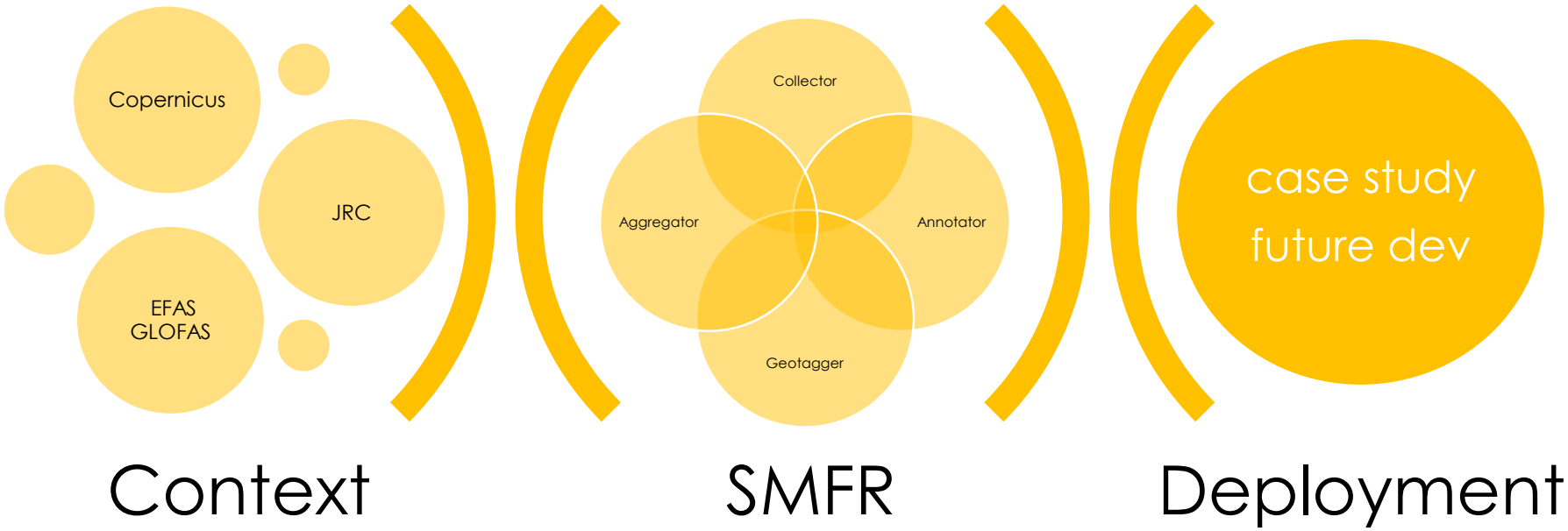
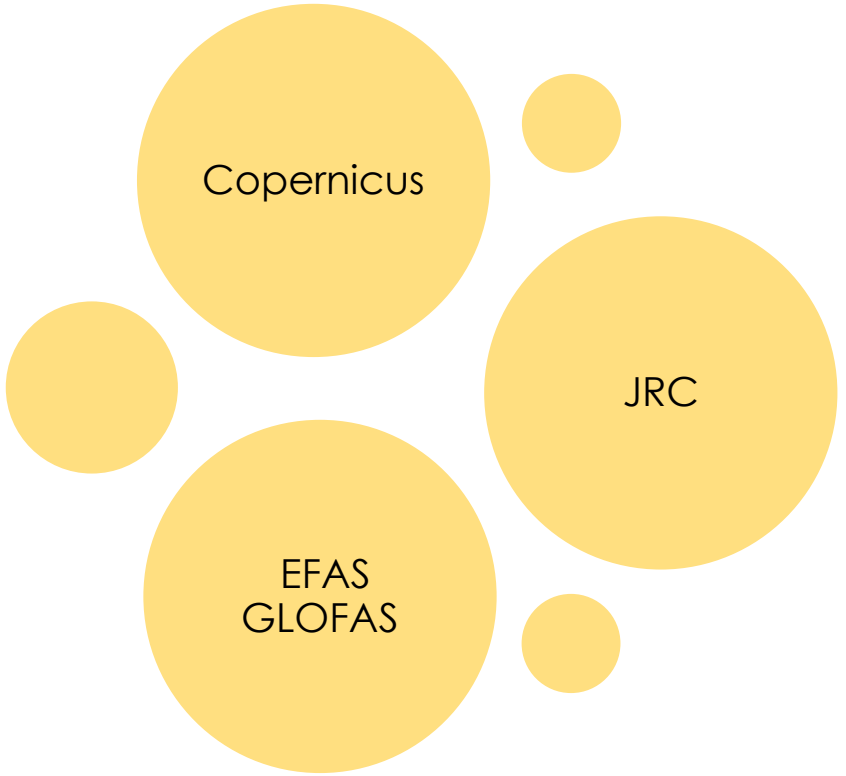
European Commission

Universitat Pompeu Fabra Barcelona

Copernicus

This presentation

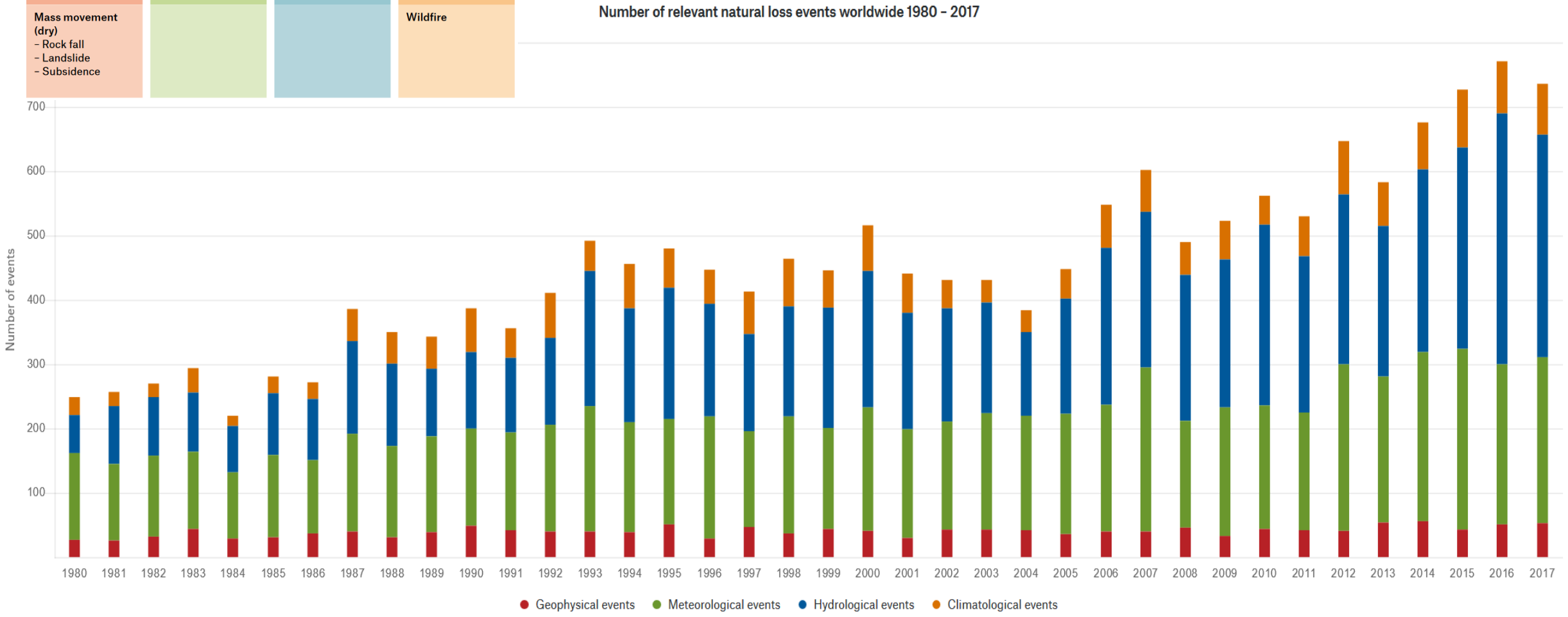




Context

Weather driven disasters are on the rise…

Geophysical events	Meteorological events	Hydrological events	Climatological events
Earthquake	Storms - Tropical storm - Extratropical storm - Local windstorm	Flooding - River flood - Flash flood - Storm surge	Extreme temperatures - Heatwave - Freeze - Extreme winter conditions
Volcanic eruption		Mass movement (wet) - Rock fall - Landslide - Avalanche - Subsidence	Drought
Mass movement (dry) - Rock fall - Landslide - Subsidence			Wildfire



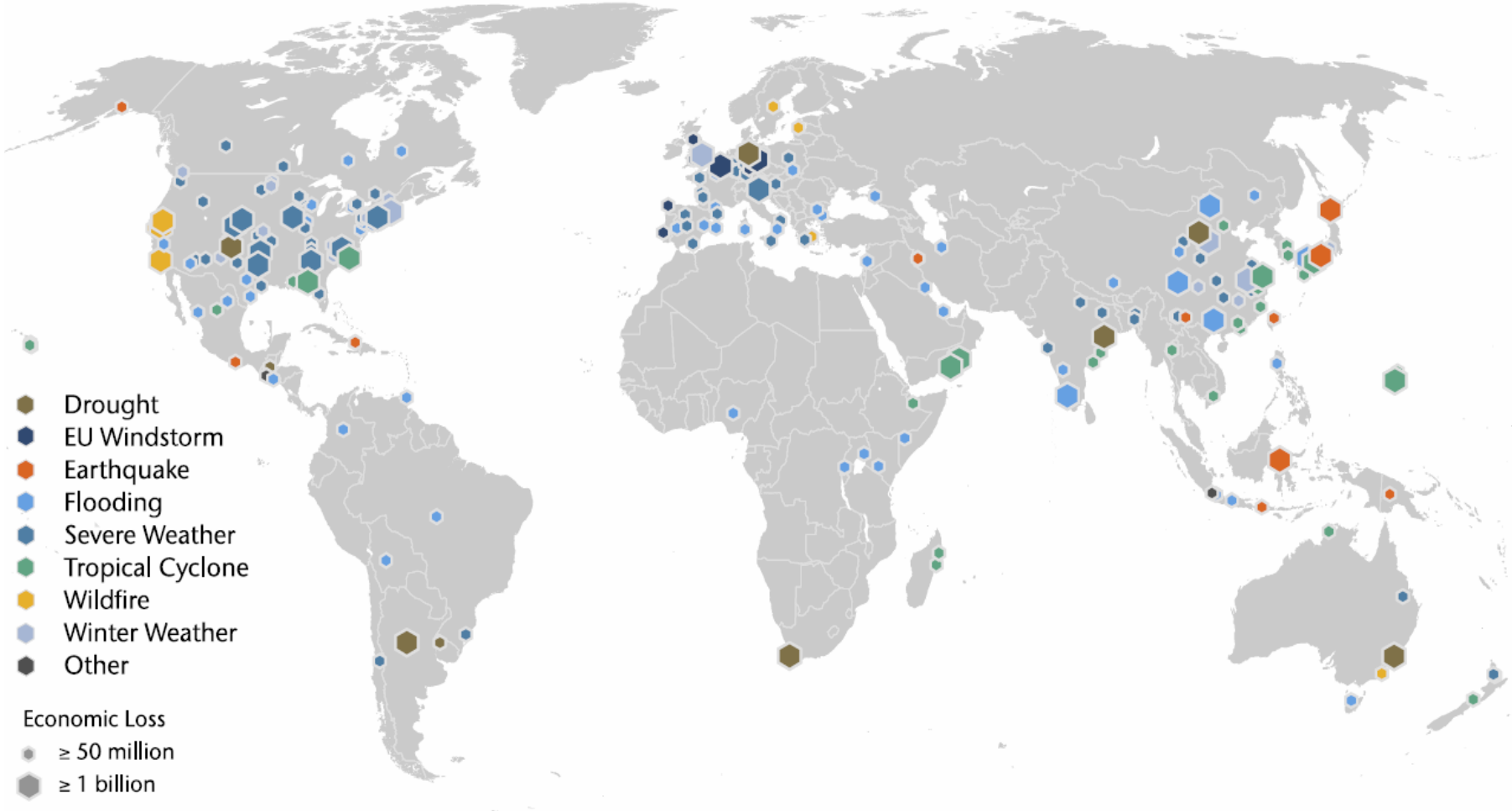
225

Billion USD

Total losses for natural disaster

45%

hydro events



Paris climate agreement: 185 countries have committed to limit the increase of average temperature to 1.5°C

5.700

# of death

>10.000 1.5°C

>12.000 2°C

>20.000 3°C

Dottori et al, Nature Climate Change, 2019

Emergency Management

Copernicus Emergency Management Services

- Complementary to national efforts
- Providing European wide information to the EU's Emergency Response and Coordination Centre (ERCC)
- Knowledge exchange on emergency management for disaster risk at European level
- Focus on Europe but available globally

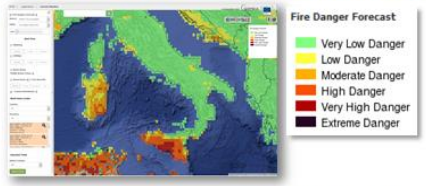
Emergency Management

Copernicus Emergency Management Services

Early Warning & Monitoring Systems

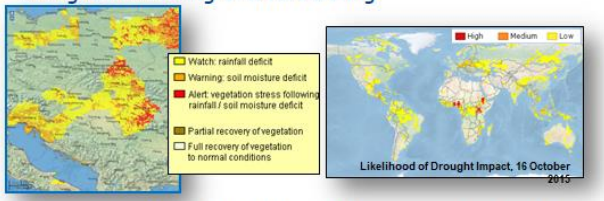
European Forest Fire & Global Wildfire Information Systems (EFFIS & GWIS)

Near real-time & historical information on forest fires & forest fire regimes



European & Global Drought Observatory

Drought monitoring and forecasting



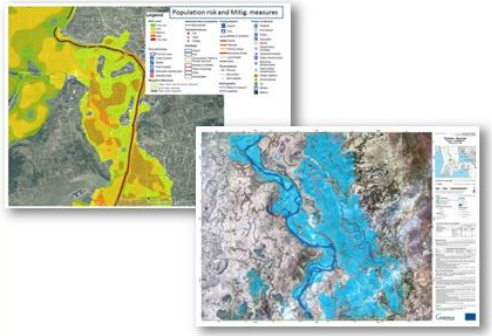
European & Global Flood Awareness Systems (EFAS & GloFAS)

Flood monitoring and forecasting

On-demand Mapping

Rapid Mapping

24/7 on-demand and fast provision of geospatial information

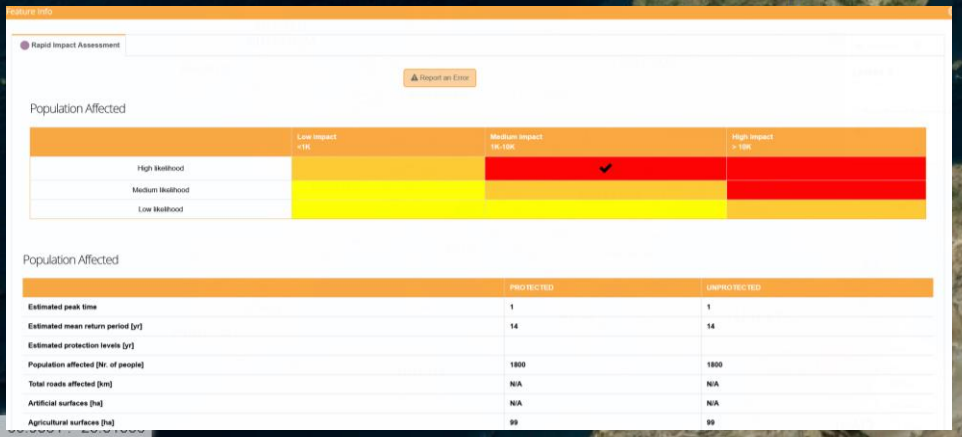


Risk & Recovery Mapping

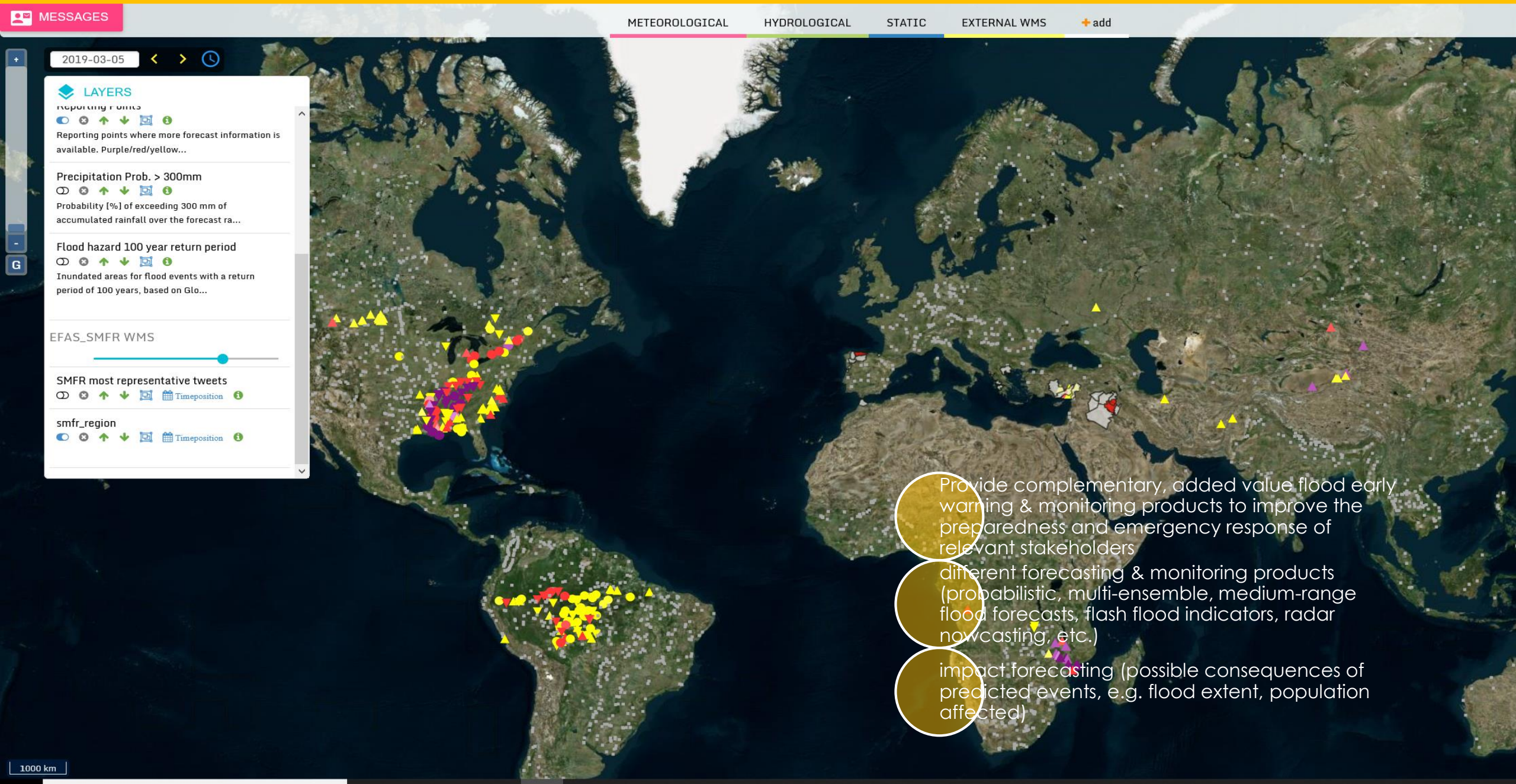
On-demand GI supporting prevention, preparedness, disaster risk reduction, reconstruction, recovery

EFAS – European Flood Awareness System

- Provide complementary, added value flood early warning & monitoring products to improve the preparedness and emergency response of relevant stakeholders
- different forecasting & monitoring products (probabilistic, multi-ensemble, medium-range flood forecasts, flash flood indicators, radar nowcasting, etc.)
- impact forecasting (possible consequences of predicted events, e.g. flood extent, population affected)



GloFAS – Global Flood Awareness System



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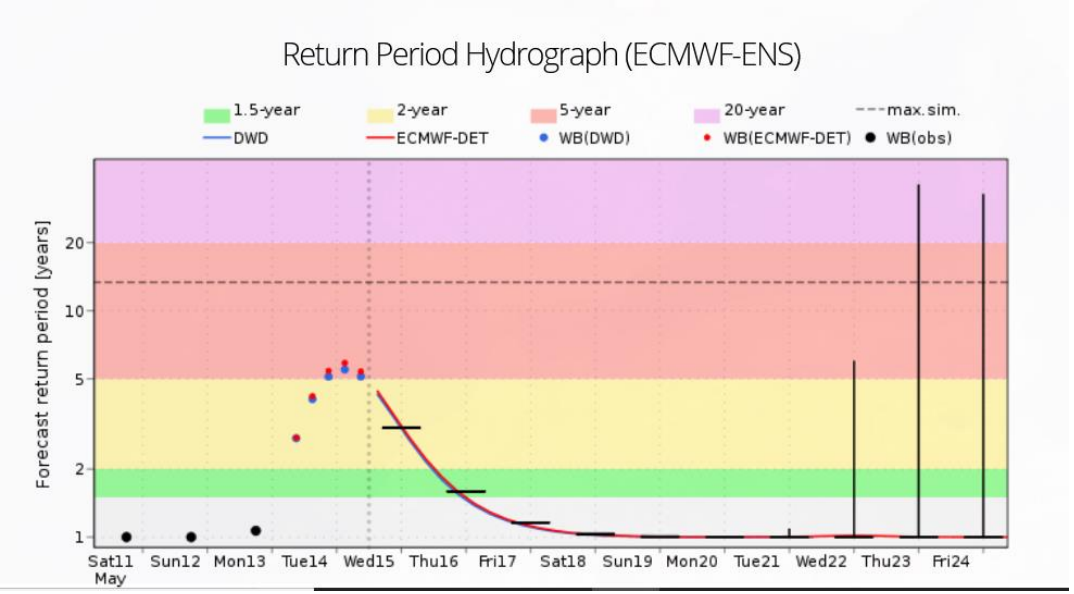
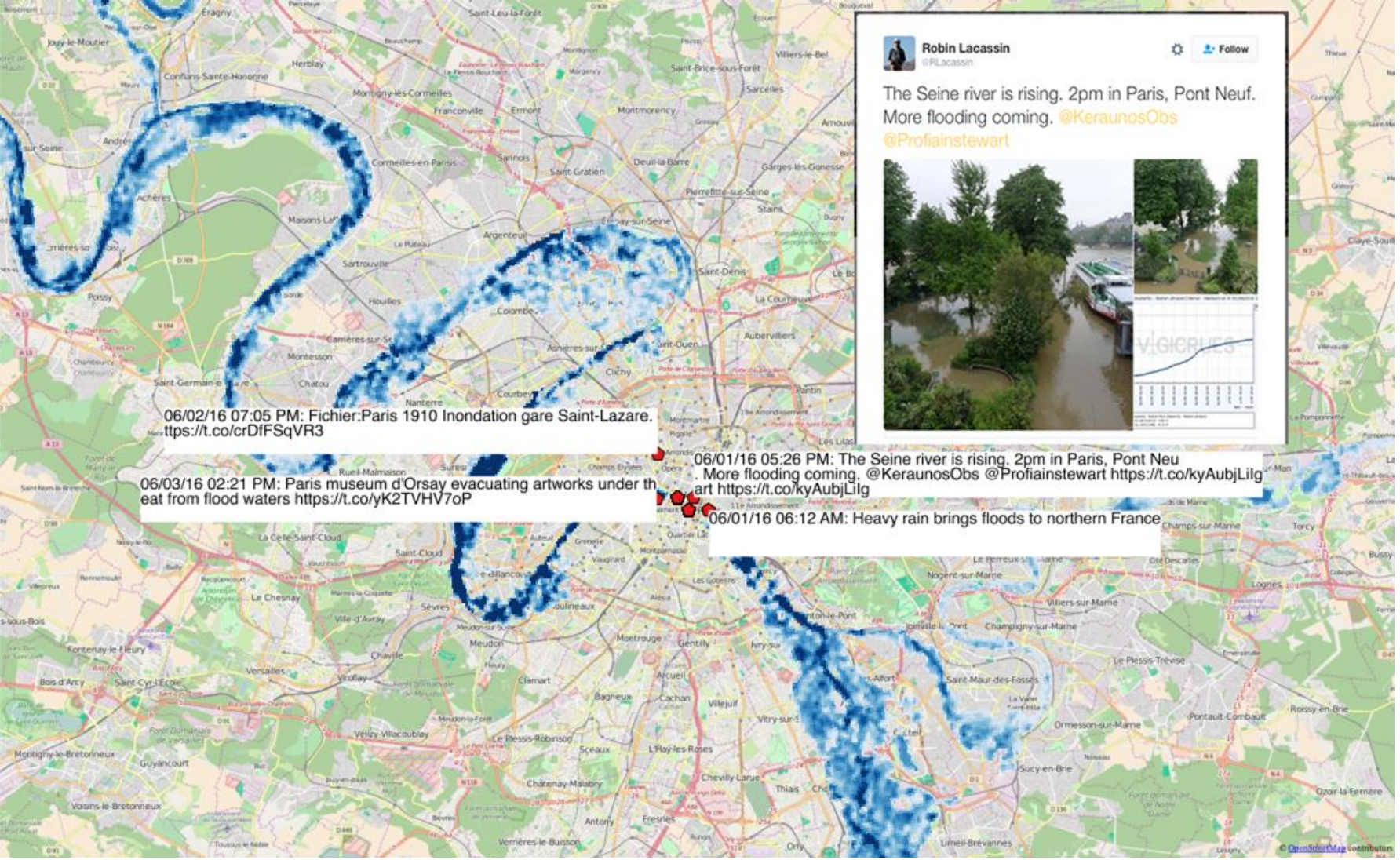
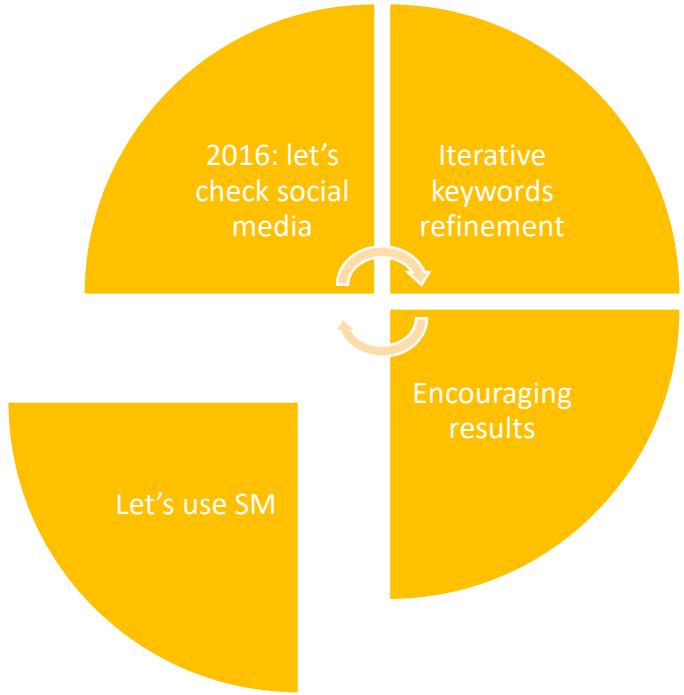


Preparedness → Response → Recovery

Isn't it perfect???

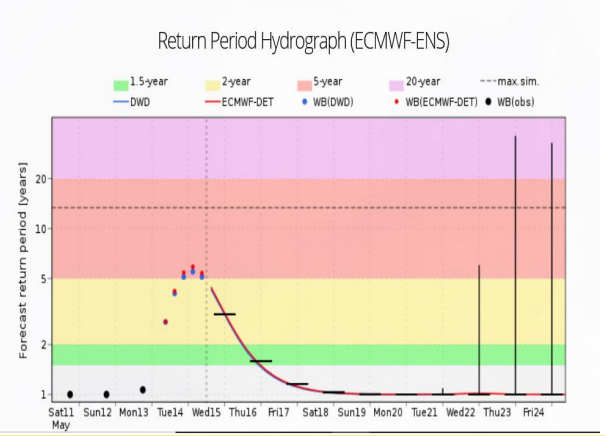
What can go wrong???

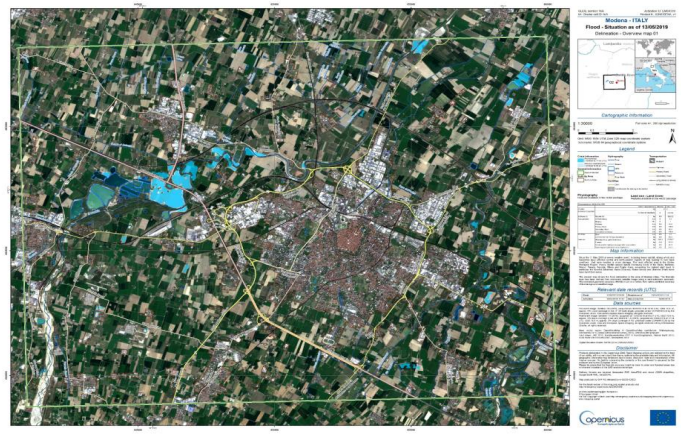




"The Seine river is rising. 2pm in Paris, Pont Neuf. More flooding coming!"
[{**'country_conf': 0.96474487**, 'country_predicted': 'FRA', 'geo': {'admin1': 'Île-de-France', 'country_code3': 'FRA', 'feature_class': 'A', 'feature_code': 'ADM2', 'geonameid': '2968815', 'lat': '48.8534', 'lon': '2.3486', **'place_name': 'Paris'},** 'spans': [{'end': 5, 'start': 0}], 'word': 'Paris'}]

On a side note…among us…by the way… If only ALL the tweets were like these…





Preparedness → Response → Recovery

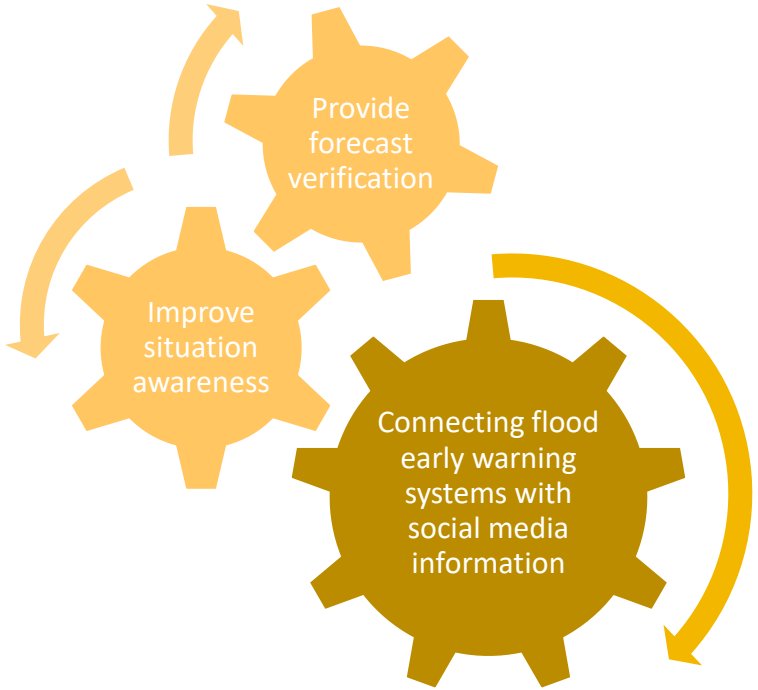


Photo by Bhavesh Jain from Pexels

Social and mainstream media monitoring can provide early information and data on hazardous events at large scale

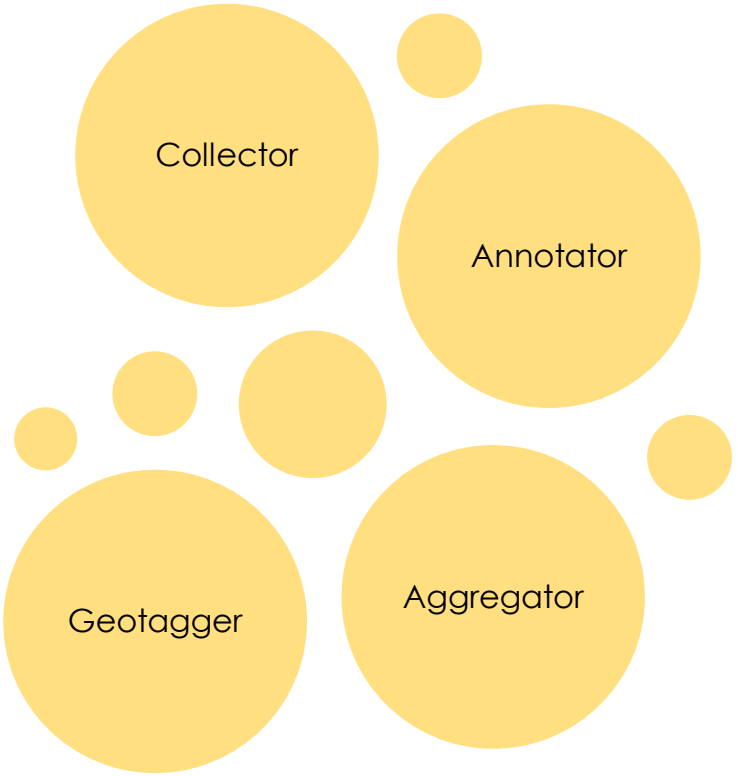
social media analysis (passive, general-purpose user contributions)

crowdsourcing (active, targeted contributions requested by emergency responders)

There were not yet approaches able to provide seamless and reliable integration of this information with existing forecasting, monitoring and mapping tools

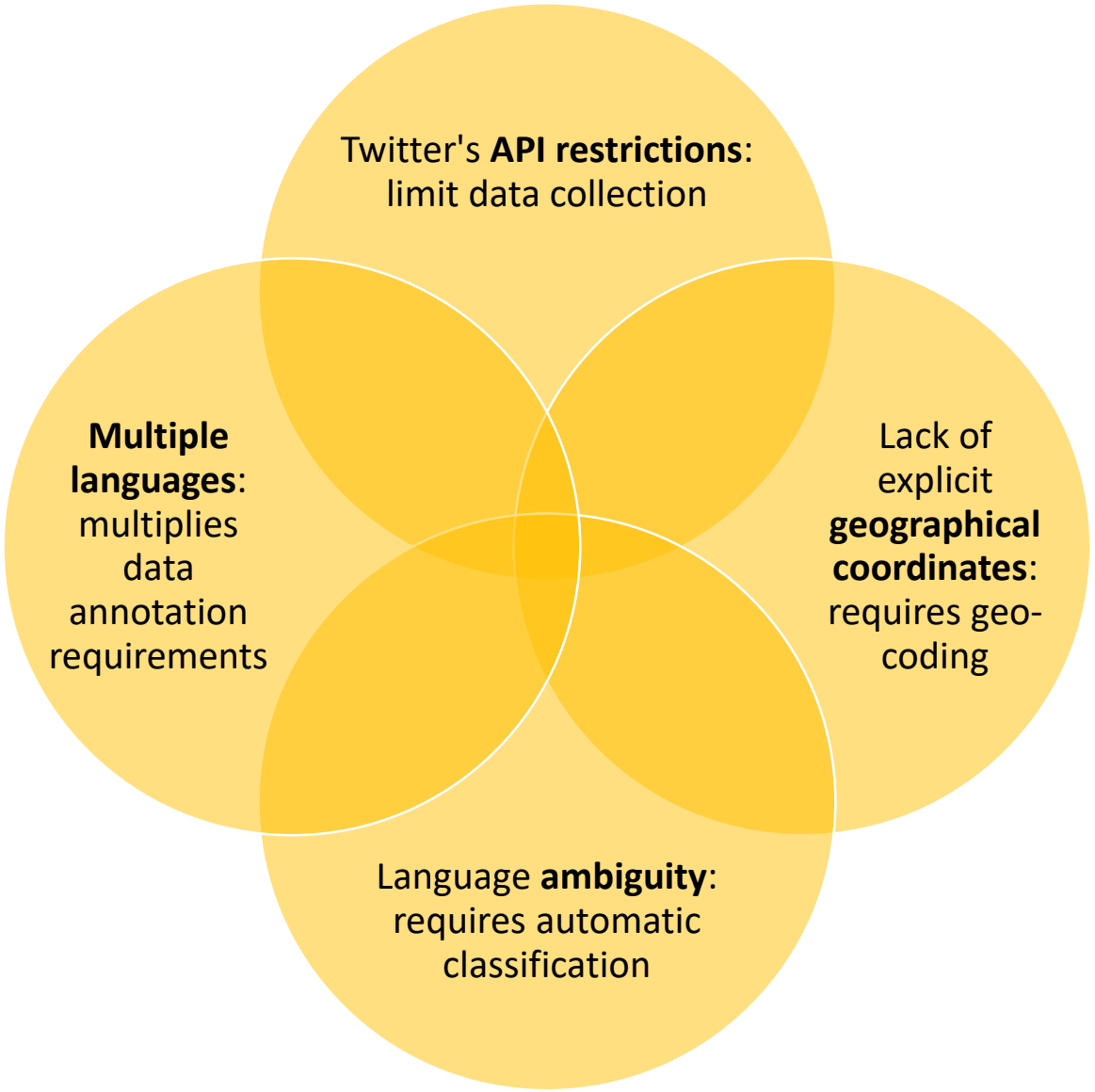
It is difficult to provide multilingual coverage coherent with CEMS domains

It is difficult to process data in a time frame appropriate for emergency management.

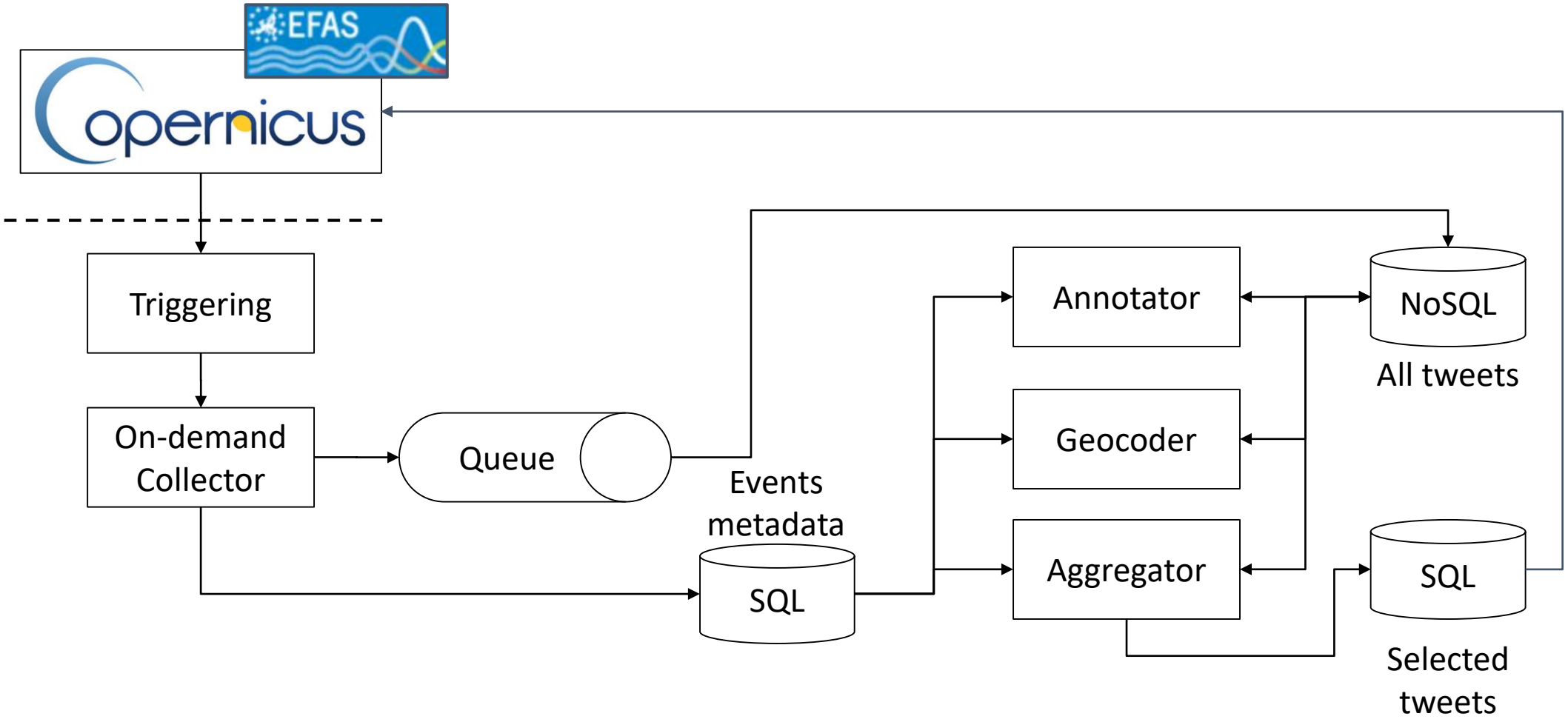


SMFR

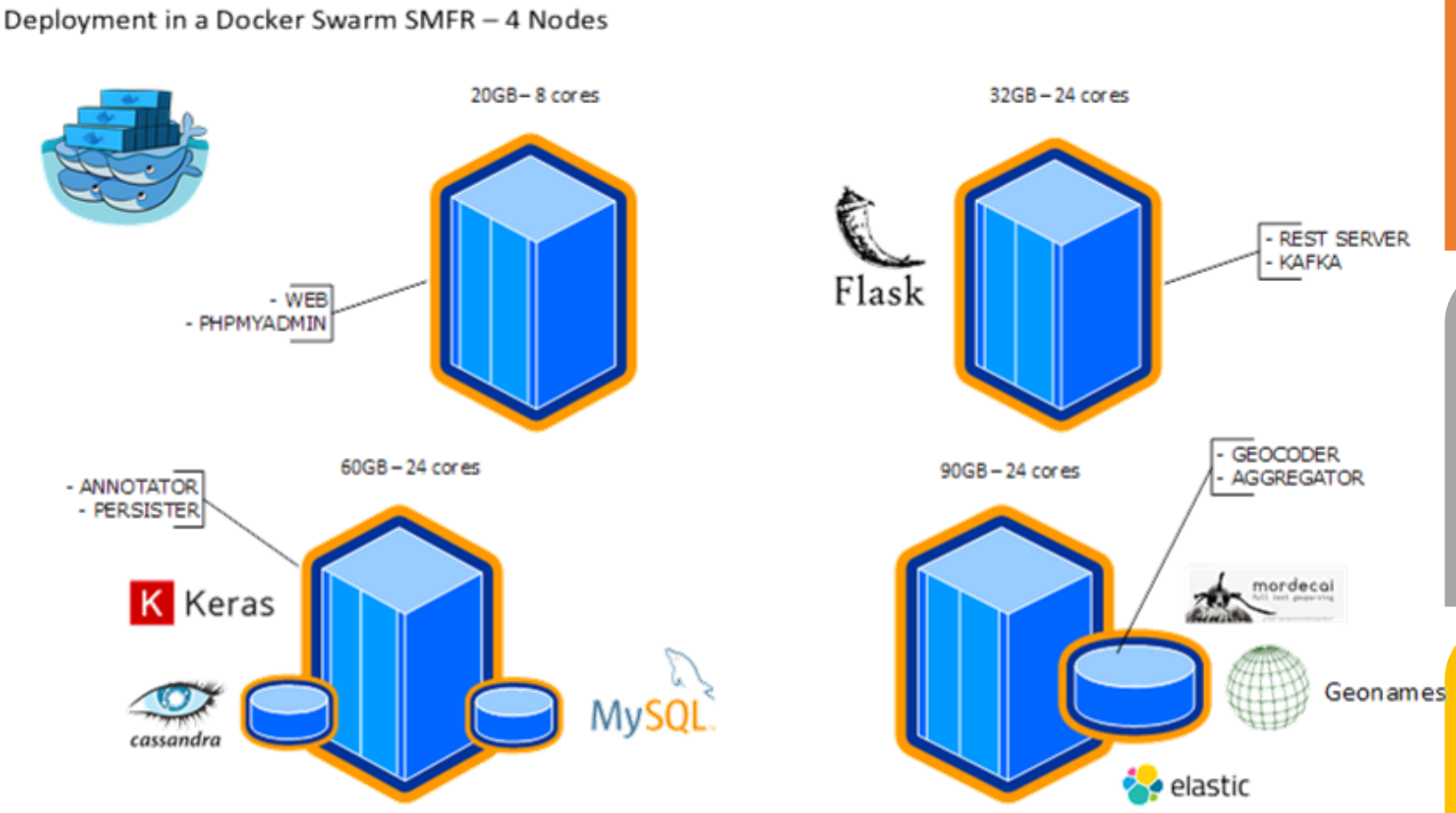
Main technical challenges



SMFR architecture



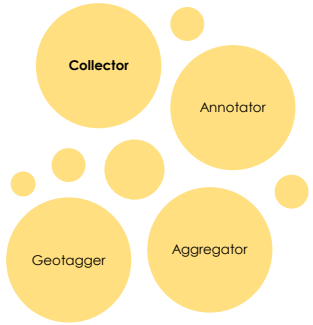
System infrastructure



Architecture based on a "facade" REST SERVER and micro services which expose start/stop operations.

Asynchronous persistence to Cassandra leveraging on Kafka queues.

Development phases and deployment are based on containers. We use an internal Docker SWARM of 4 nodes.



Collector

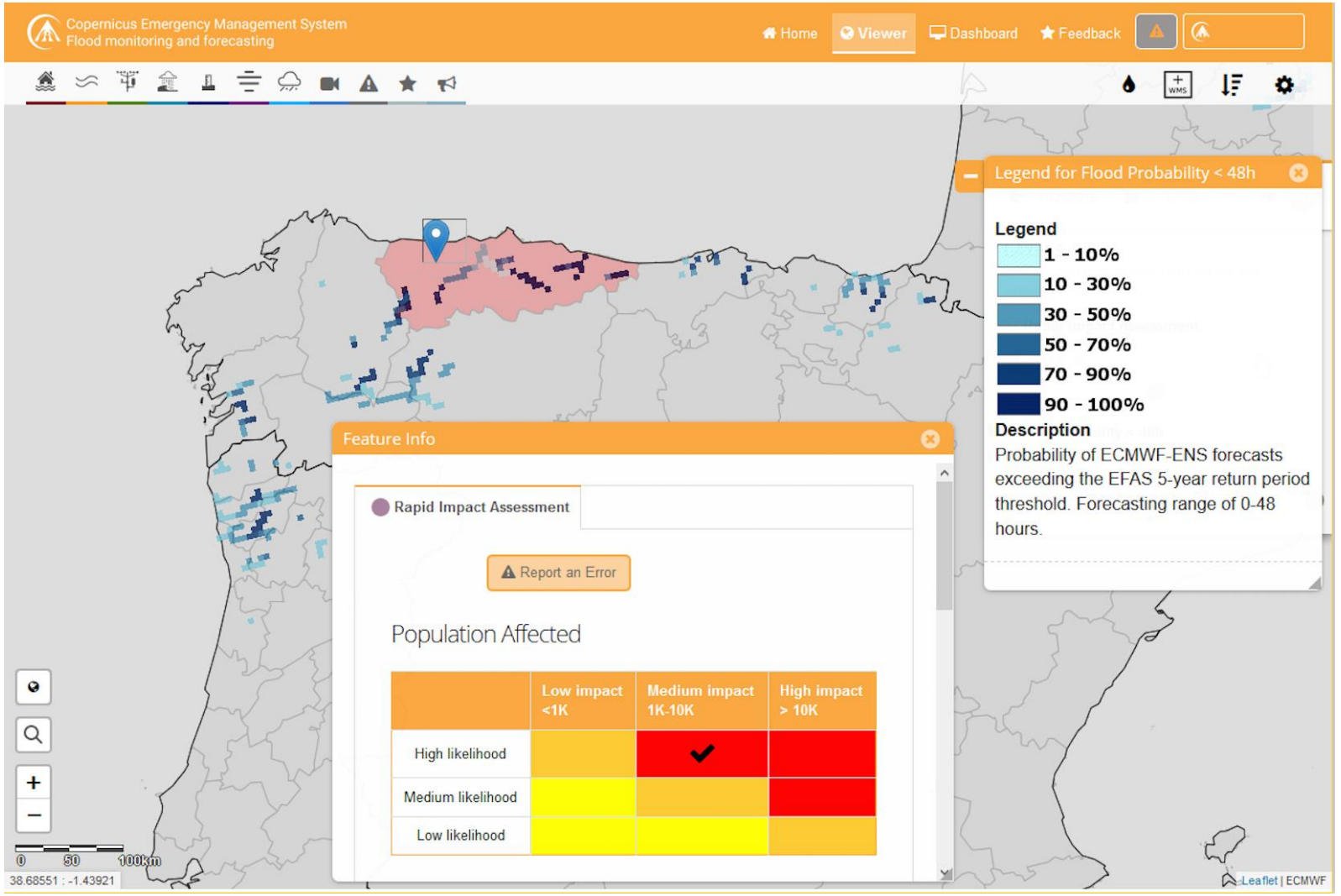
NUTS-lev2 Rapid Risk Assessment

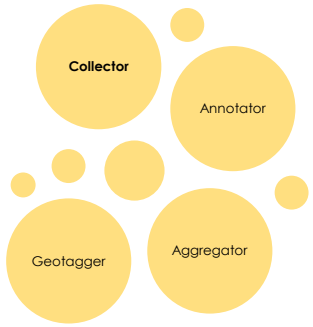
+

Flood probability <48 hrs in advance

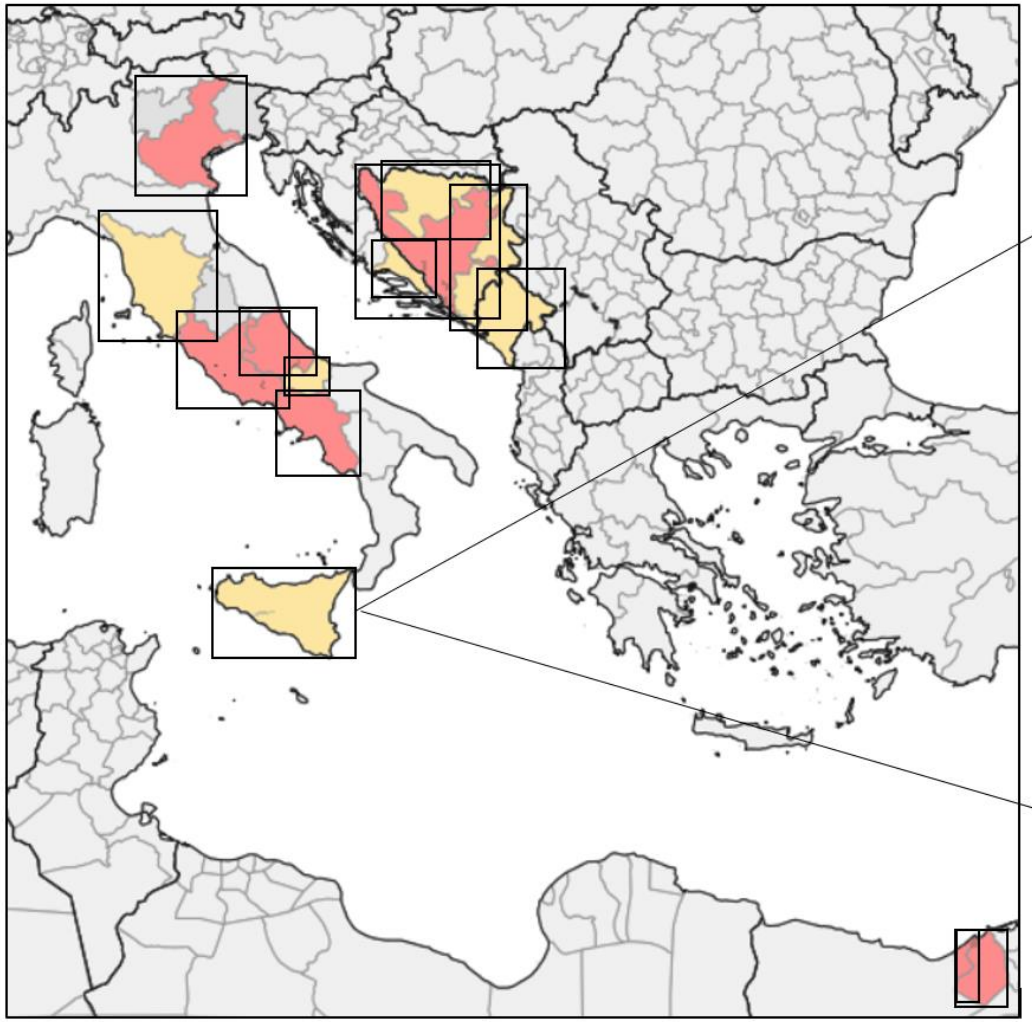
→

NUTS-name
Cities
bounding_box





Collector



Keywords:

Agrigento, Alexandria, Arezzo, Avellino, Banja Luka, Belluno, Benevento, **Caltanissetta**, Campobasso, Caserta, **Catania**, Chieti, Civitavecchia, Damanhur, **Enna**, Firenze, Florence, Frosinone, Gorizia, Grosseto, Isernia, L'Aquila, Latina, Lucca, **Marsala**, Massa-Carrara, **Messina**, Mostar, Naples, Napoli, Padova, **Palermo**, Perugia, Pescara, Pisa, Pistoia, Podgorica, Pordenone, Prato, Prijedor, **Ragusa**, Rieti, Roma, Rome, Rovigo, Salerno, Sarajevo, Siena, **Siracusa**, Split, Splitsko-dalmatinska zupanija, Teramo, Terni, **Trapani**, Trento, Treviso, Trieste, Tuzla, Udine, Venezia, Venice, Verona, Vicenza, Viterbo, Zenica

Locations:

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bbox_Al Jawf=[29.2072,34.9073,29.2087,34.9101]
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bbox_Buskerud=[59.6875,10.5188,59.7448,10.5485]
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bbox_Liepajas Aprinkis=[56.0702,20.9712,56.9715,21.3264]
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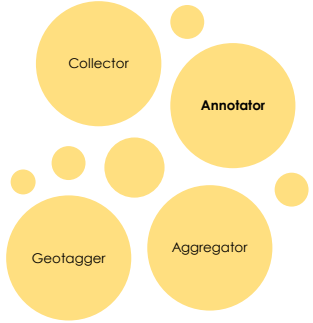
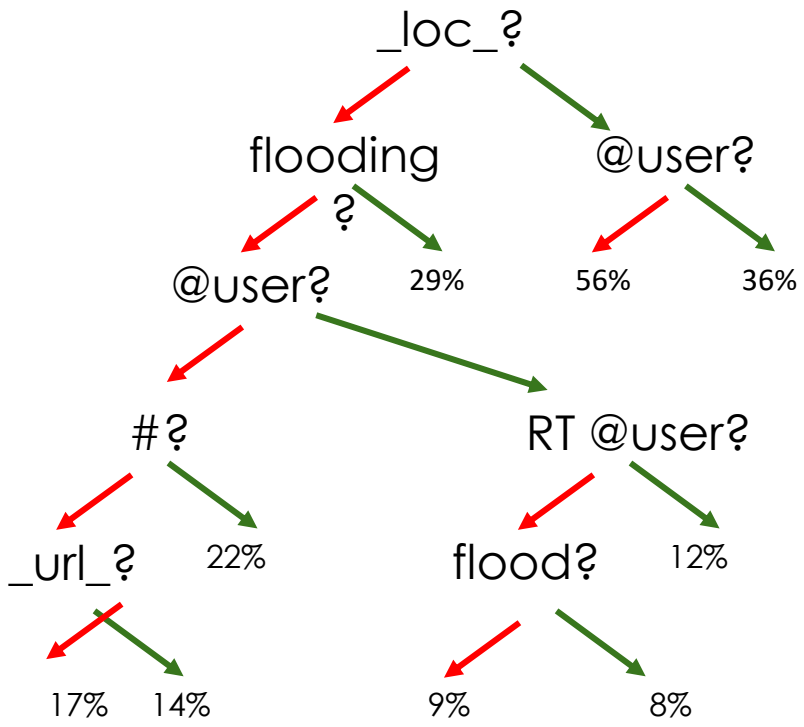
...

NUTS-lev.2 EU = ADM-lev.2 GADM



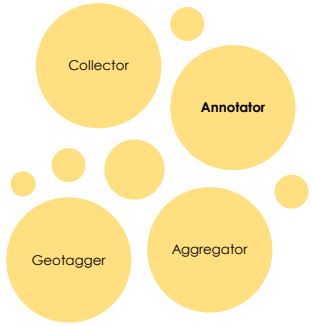
Annotator

Text classification: first attempts



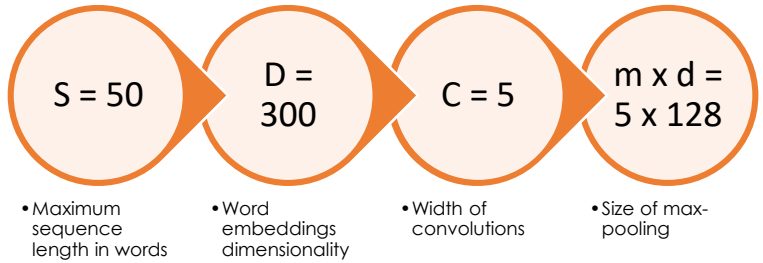
Example Decision Tree

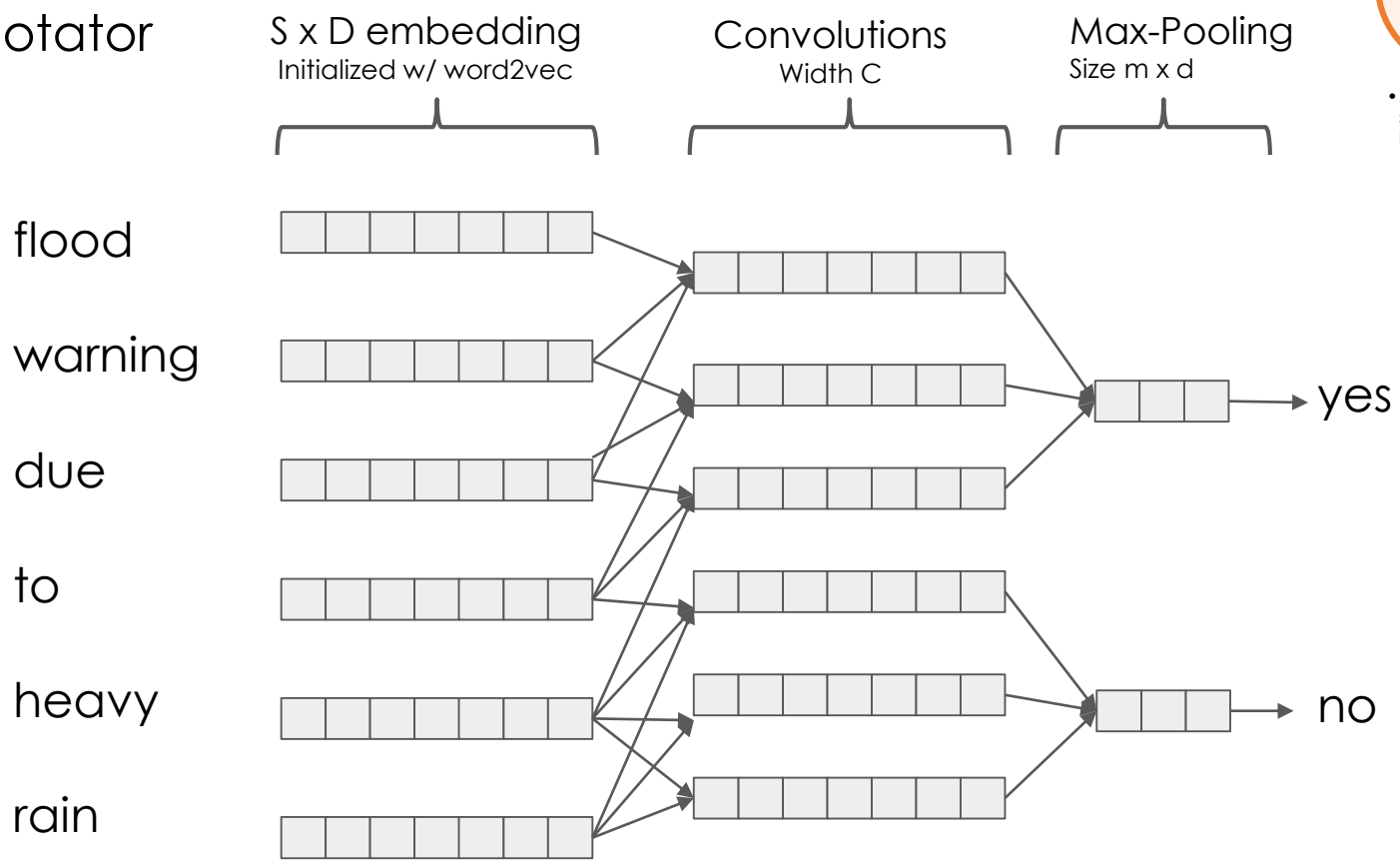
- Diverse training sets
- Crowdsourced annotations
- Multiple annotators/tweet
- Typically 80%-85% accurate
- Other methods (e.g., SVM)

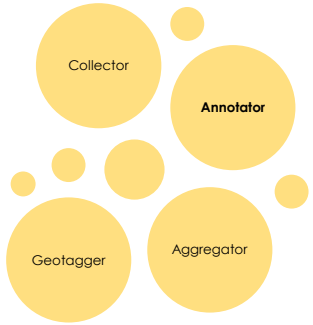


Annotator

CNN for text classification







CNN for text classification

"photos of students helping families clean up their flooded..."	"was having a rough day till i saw tops pics flooding my social media"	"reeds beach restoration aims to improve water flow, reduce flooding"
•99% YES	•39% YES	•2% YES

Annotator

flood

warning

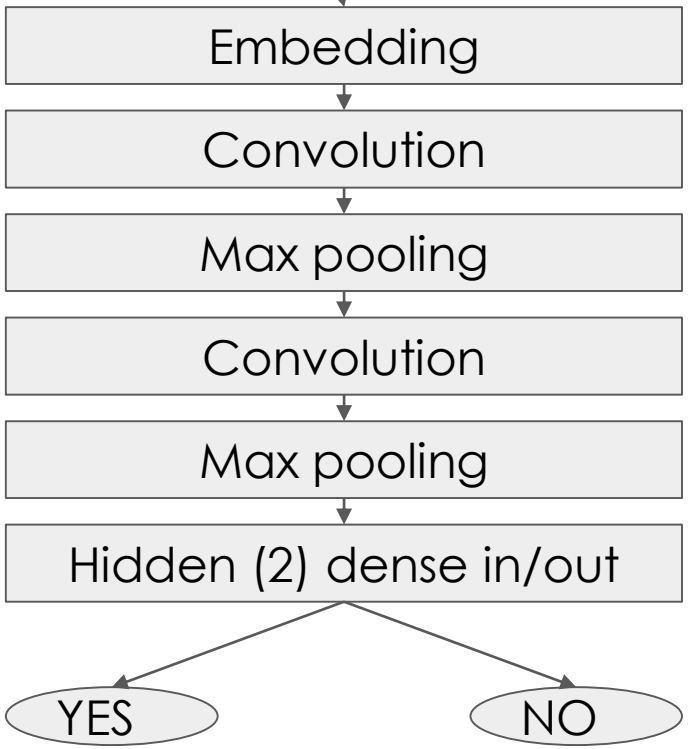
due

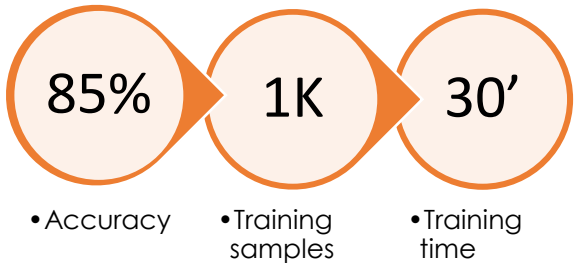
to

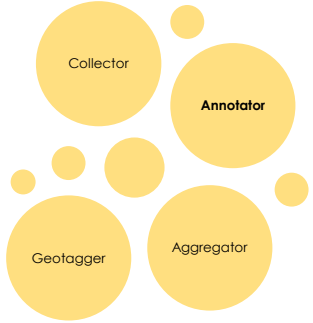
heavy

rain

...

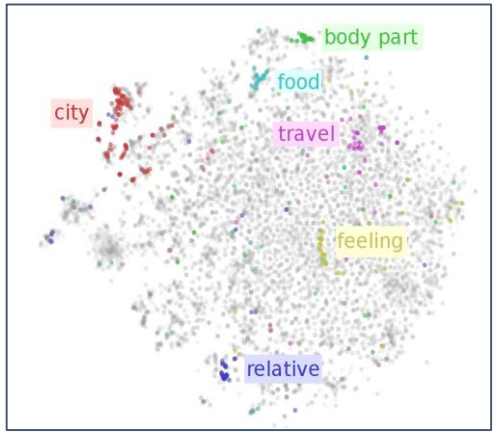


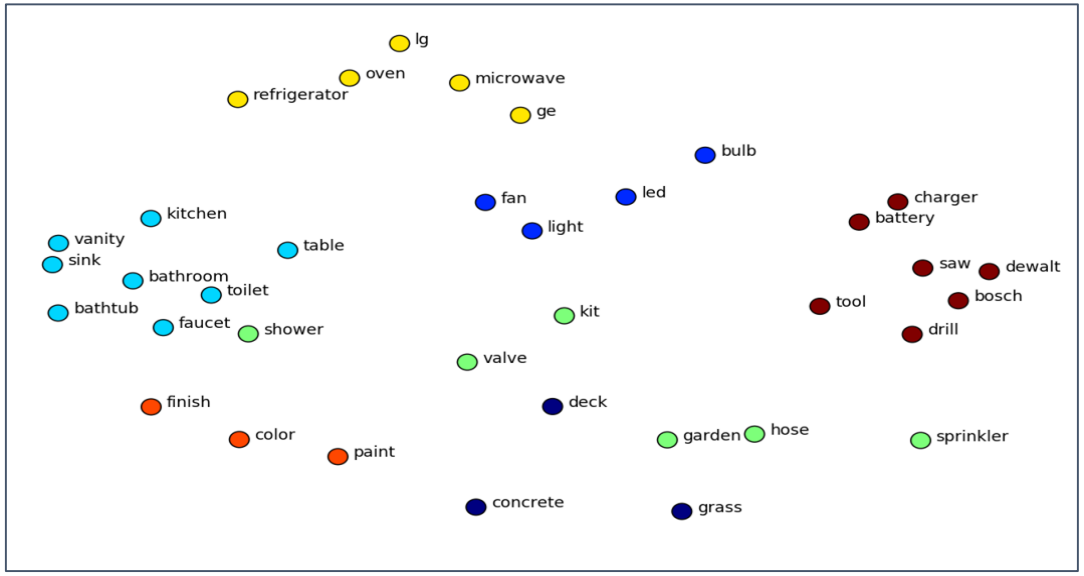




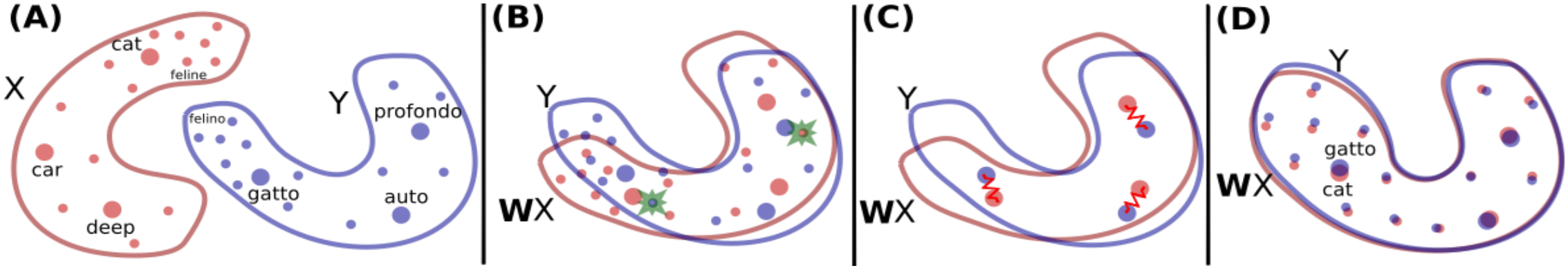
Annotator

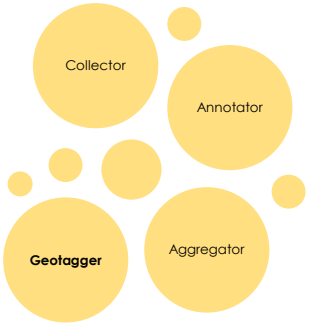
Word embeddings





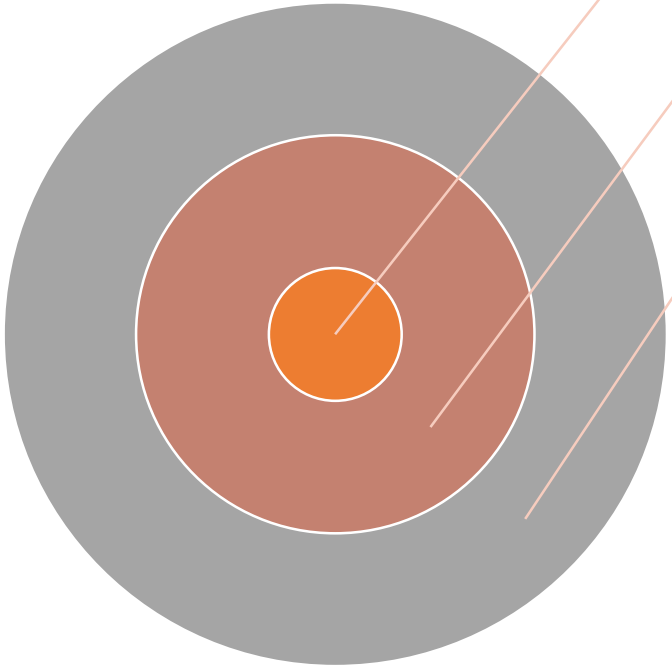
MUSE – Facebook – language agnostic





Geo coding

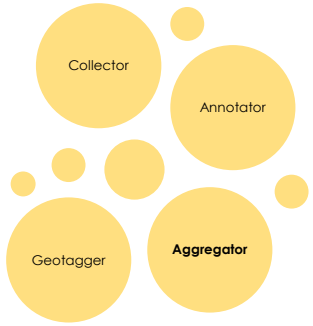
Geocoding implicit geo reference



We try to use mordecai for geolocating the most comprehensive text

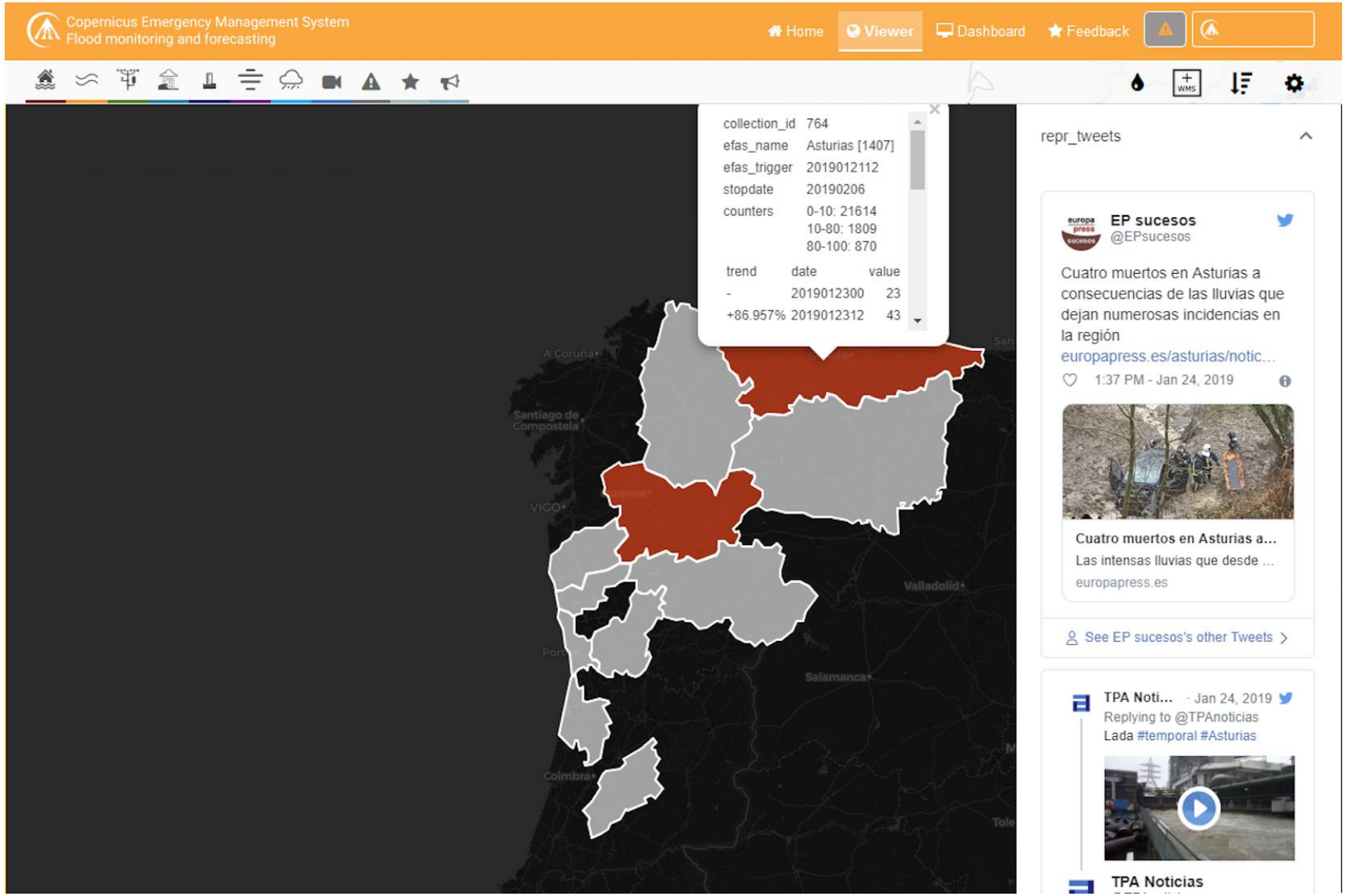
In second instance we take “place” and “coordinates”objects from the tweet

If the geolocator cannot find lat,lon, we do not assign the tweets to the collection

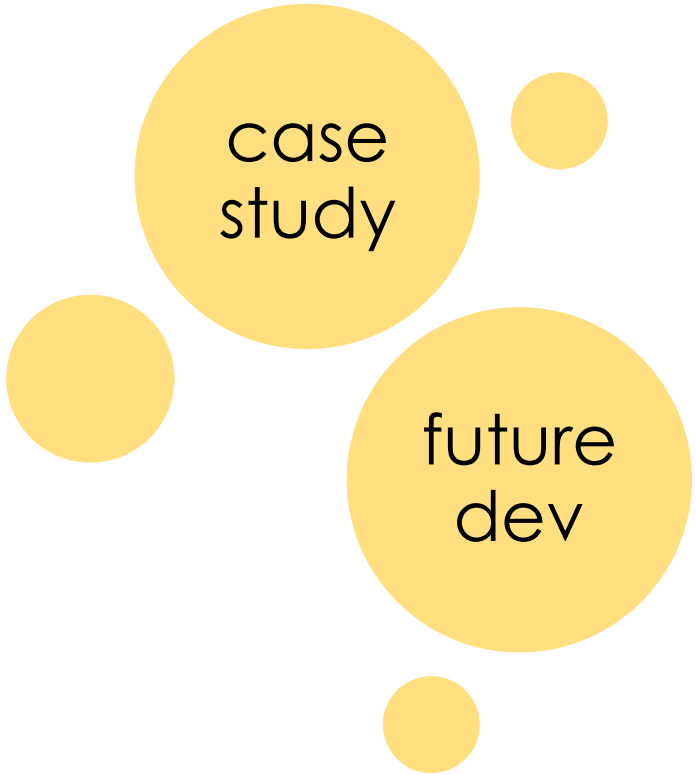


Aggregator

Aggregating tweets per collection



This Talk

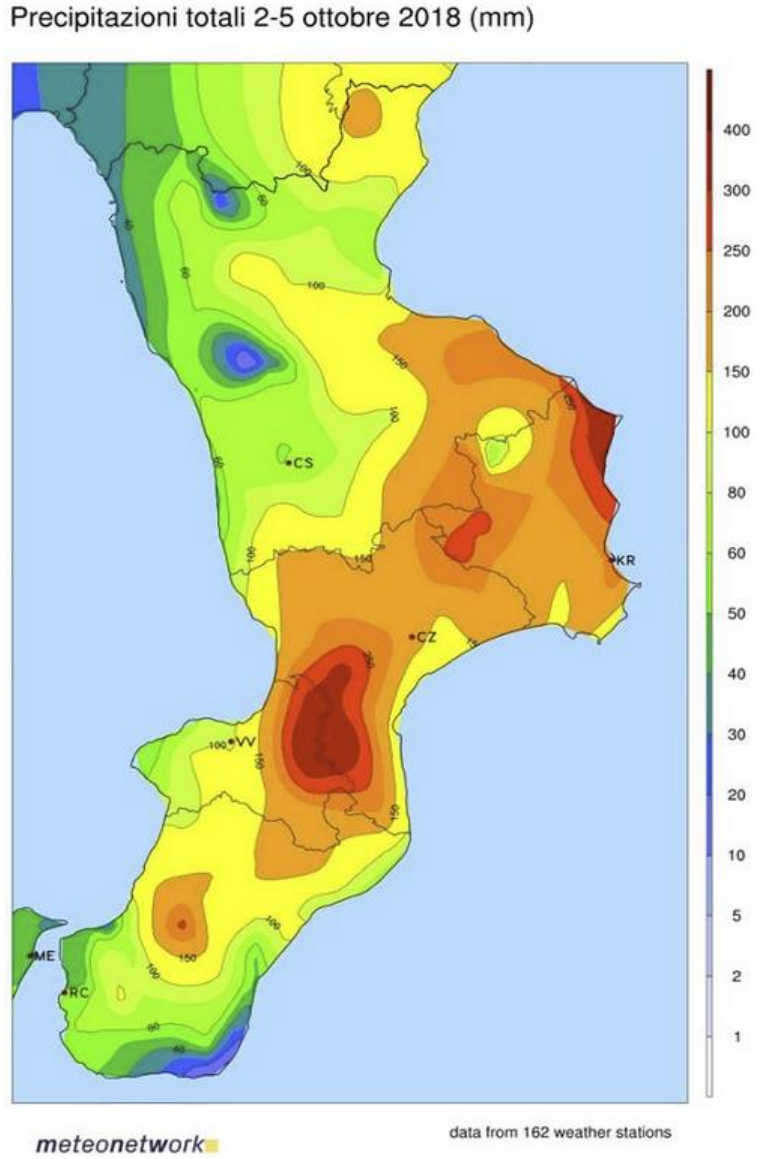


Deployment

Case Study: Calabria Floods in October 2018

- EFAS forecasted a potential flood in the Calabria NUTS-2 area on the 4th of October with a predicted peak time of the event for the following day.

Several families were forced to evacuate their homes and people were rescued after they climbed onto the rooftops of houses to escape the flooding.
Italian news agency ANSA, stated that the Ponte delle Grazie bridge on provincial highway 19 in the area collapsed during the storms (Redazione ANSA 2018).
Vigili del Fuoco, Italy's National Firefighters Corps, reported major flooding in Ciro Marina, Petilia de Policastro, Strongoli, Cotronei and Isola di
Capo Rizzuto.



Case Study: Calabria Floods in October 2018

			Glove embeddings									MUSE embeddings								
			mono-lingual			cold-start			warm-start			mono-lingual			cold-start			warm-start		
	TL	Pos.	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F
DE	2356	46%	0.95	0.82	0.87	0.59	0.85	0.70	0.93	0.8	0.86	0.88	0.85	0.87	0.54	0.82	0.65	0.89	0.80	0.84
EN	1999	20%	0.79	0.63	0.70	0.59	0.49	0.54	0.67	0.51	0.58	0.64	0.68	0.66	0.33	0.50	0.40	0.58	0.28	0.38
ES	1592	48%	0.80	0.78	0.79	0.61	0.75	0.67	0.71	0.83	0.77	0.70	0.84	0.77	0.62	0.69	0.65	0.68	0.89	0.77
FR	1248	40%	0.74	0.72	0.73	0.50	0.46	0.48	0.62	0.77	0.69	0.69	0.75	0.72	0.44	0.86	0.58	0.59	0.72	0.65

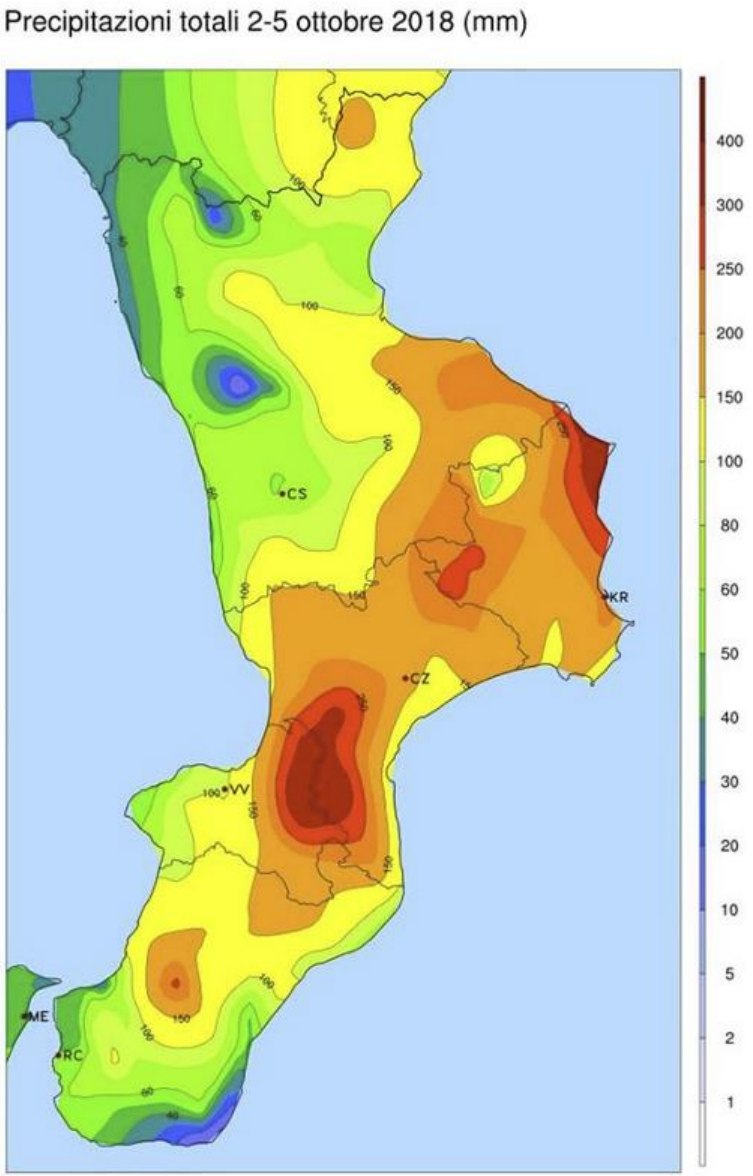
SMFR triggered a collection with a duration of 2 days that was later extended for an additional day due to persistence of the signal from EFAS forecasts.

We analyzed the collection once it was stopped, at midnight on the 7th of October, after collecting 14.347 tweets.

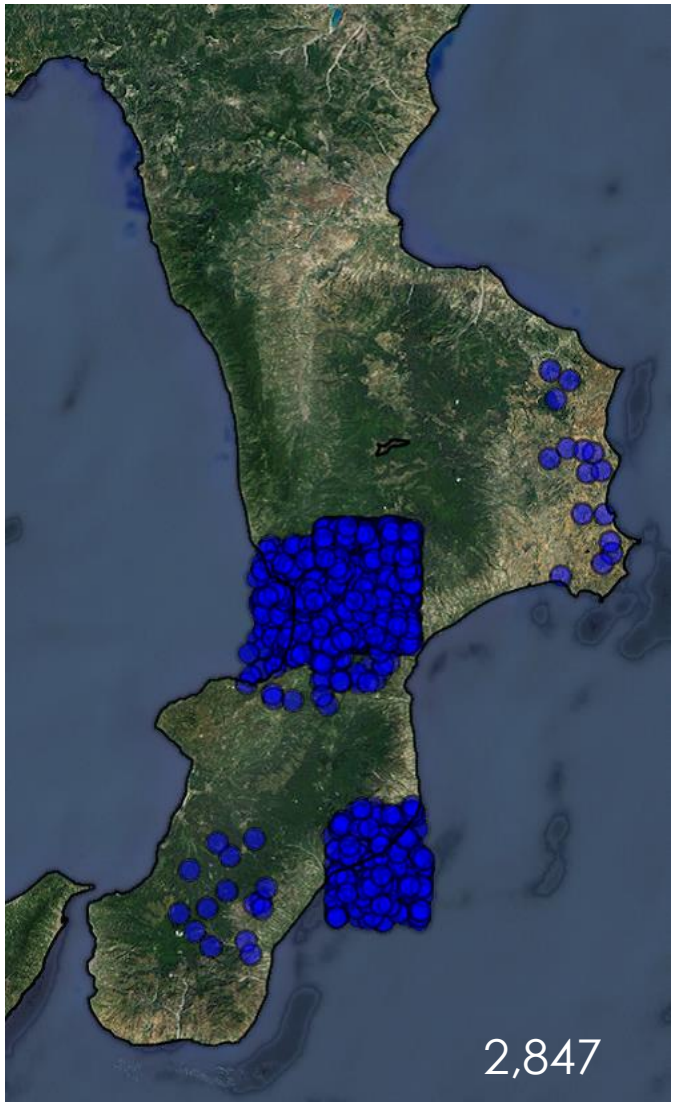
(cold-start) using only labeled data in German, English, Spanish, and French

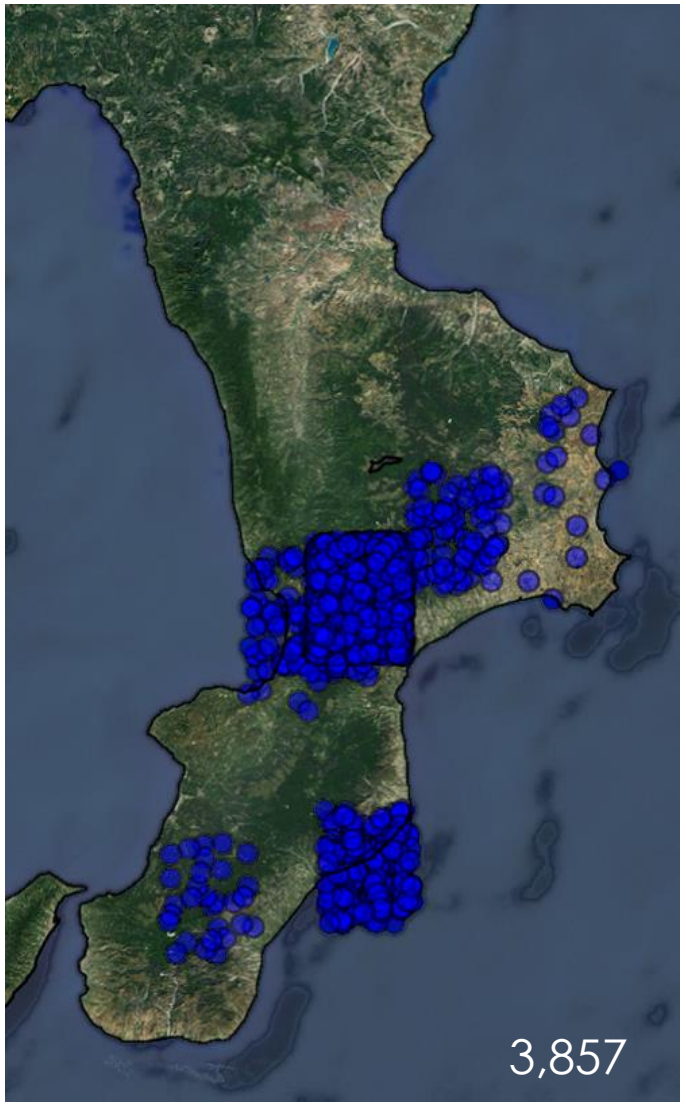
(warm-start) adding 300 manually labeled tweets in Italian from the collected dataset.

Case Study: Calabria Floods in October 2018



P>=0:8.





Case Study: Calabria Floods in October 2018

Cold Start

Conf	Mult	Cent	Text (10 words)
1.0	87	89	Second flood in Calabria in 40 days. Devastation and 2 casualties ... (Seconda inondazione in Calabria in soli 40 giorni. Devastazione e 2 vittime ...)
1.0	11	93	Bad weather in Calabria, the kennel is flooded ... (Maltempo in Calabria, il canile e 'sommerso dall' acqua ...)
1.0	7	97	Bad weather: Red alert in Calabria today and in Puglia tomorrow ... (Maltempo: oggi allerta rossa in Calabria e domani in Puglia ...)
1.0	5	97	Meteo, panic in Calabria: streams flooding roads. Rescuers using rubber boats ... (Meteo, caos in Calabria: torrenti esondati e strade allagate. Soccorsi in gommone ...)
1.0	5	87	Bad weather in Calabria, missing mother and her two sons found dead ... (Maltempo Calabria, trovati morti mamma e due bimbi dispersi ...)

Warm Start (300 manually labeled added)

Conf	Mult	Cent	Text (10 words)
1.0	194	76	I follow with concern the evolution of events in #Calabria ... (Seguo con apprensione l ' evolversi degli eventi in #Calabria ...)
1.0	14	88	Water bomb in Calabria, among the upset in the population ... (Bomba d ' acqua in Calabria, tra la popolazione sconvolta ...)
1.0	14	46	# breakingnews Bad weather Calabria: a woman and one of her son found dead. ... (#ultimora Maltempo Calabria: morta una donna e suo figlio, disperso il fratello ...)
1.0	23	98	Bad weather in Calabria, mom and son found dead, missing 2yrs old brother ... (Maltempo in Calabria, morti mamma e figlio: sic erca il fratellino di 2 anni ...)
1.0	8	94	Bad weather, nigthmarish night in Calabria, Civil Protection: “High risk” ... (Maltempo, notte da incubo in Calabria, Protezione civile: “rischio vittime” ...)

Exploitation SMFR outcomes

NOW
SMFR-EFAS
SMFR-GloFAS
31/93 languages in MUSE/LASER

Potential
SMFR-MULTI
(all or parts of it) could be adapted for other natural disaster / health indicators /

Next
SELF-SMFR
SMFR-URBAN

Photo by rawpixel.com from Pexels

future dev

Deployment

Thank you

Any question?

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