

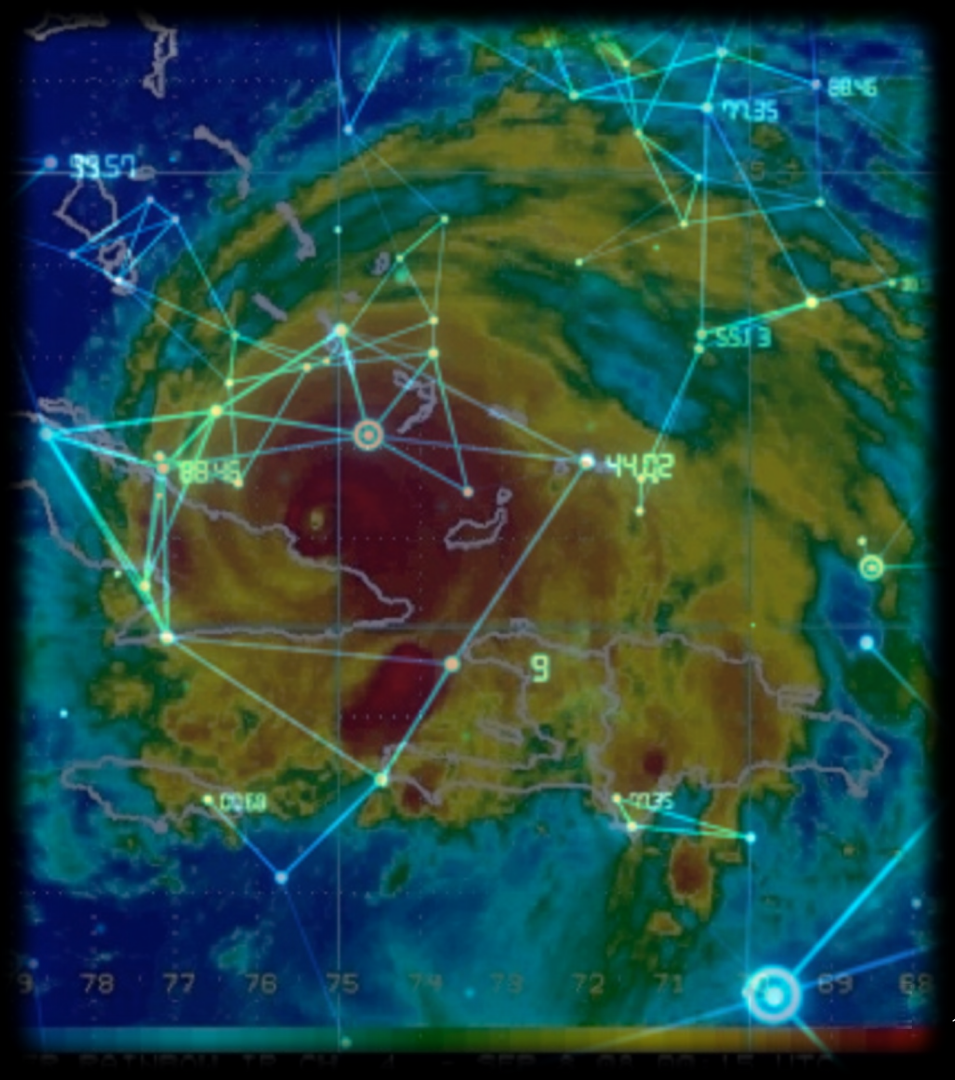
IBM Climate Network for Early Warning Systems

WMO Meeting – Nov. 2/3/4, 22, Geneva

Jonas Weiss

Physics and AI for Climate Impact Group

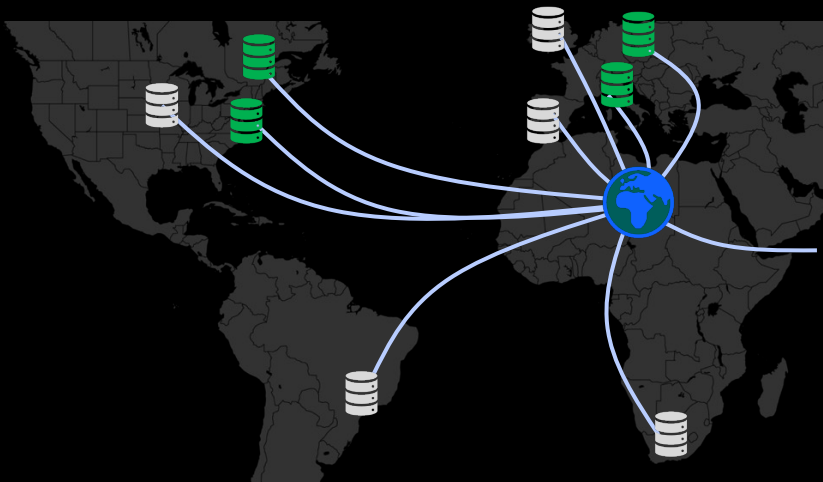
jwe@zurich.ibm.com



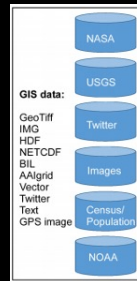
The Climate Network

- Volume of geospatial data exceeds capabilities of single stakeholder/data center (storing, indexing, exploiting)
- Complex insights require many modalities, i.e. access to distributed data
- Data transport is expensive and time consuming
- Collaborating partners may have security, privacy and governance constraints -> maintain partial control

⇒ Need to run complex & distributed workflows with data and model federation across *instances* on a global scale!

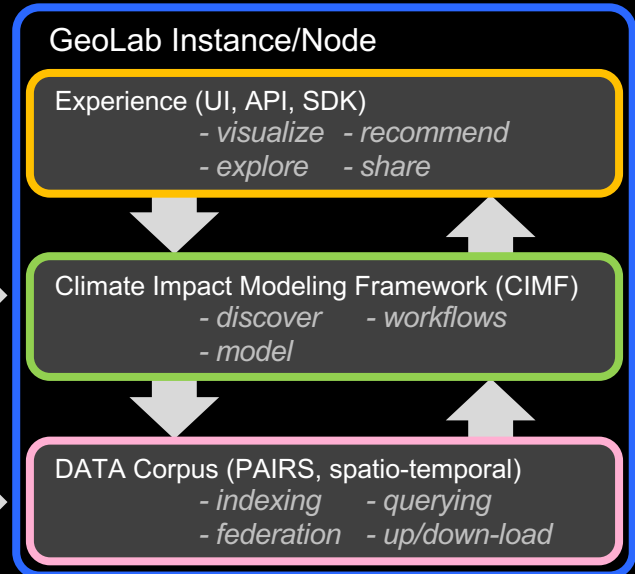


Public & Private
Data Sources
incl. TWC



Ingest

Curate




Planner
Coord.

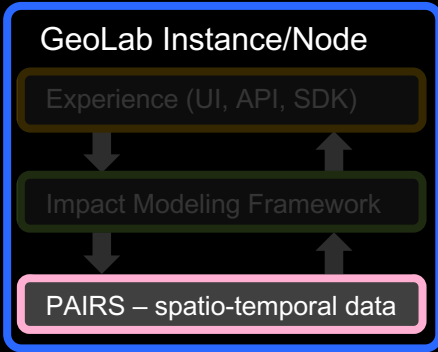
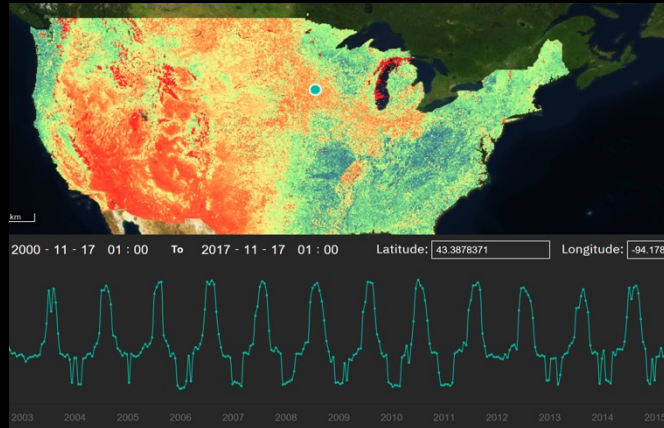
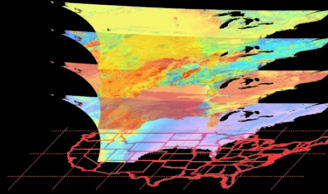

Risk
Analyst,
Data
Scientist

The Climate Network – Geo Time-Series & Weather Data

PAIRS – Spatio-Temporal Data Storage

Distributed Cluster

- > 750 layers
- + 10 Tbytes/day
- > 6 Petabyte total
- > 100 supported file formats
- Exposed through UI & API
- Technology to be open-sourced
- Blocks of time-series instead of raster-data (linked in space & time)



Every 60 *seconds*
Condition Updates



Every 15 *minutes*
a new Forecast

Data Sources

The Weather Company
Proprietary and Sourced Data

The Weather Company
Weather Models

156K Global Stations

40M+ Mobile Phones

50K Flights a Day

Global Lightning

Air Quality and Pollen

Traffic / Incident Data

National Weather Service
Weather Stations

High Resolution Radar

Oceanographic Data

Open &
Govt Data

Types

Weather

Atmosphere

Historical

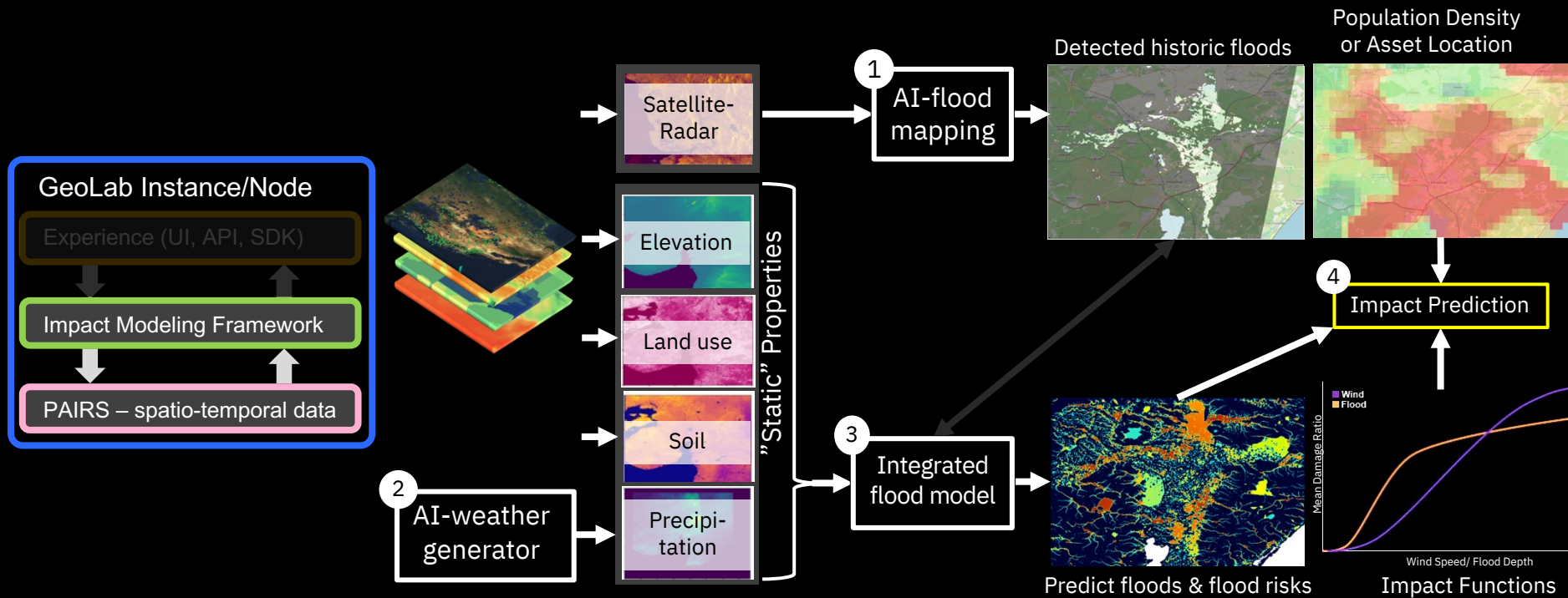
Current

Predictive

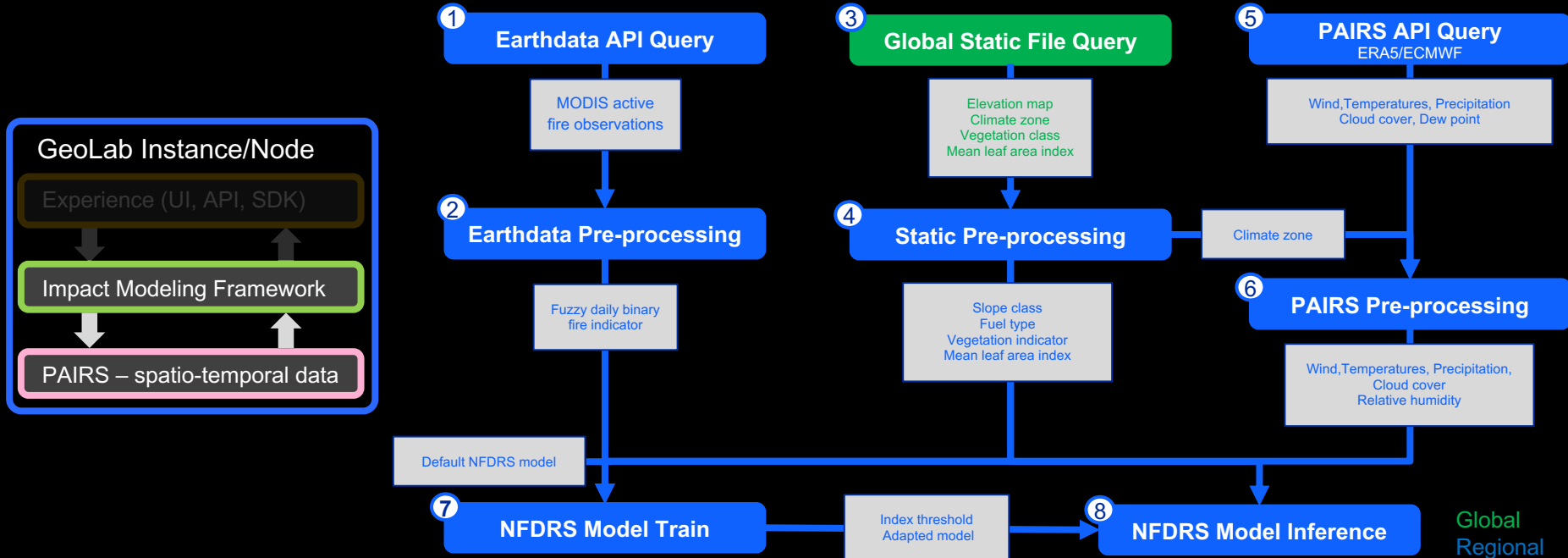
Global

Ultra-local

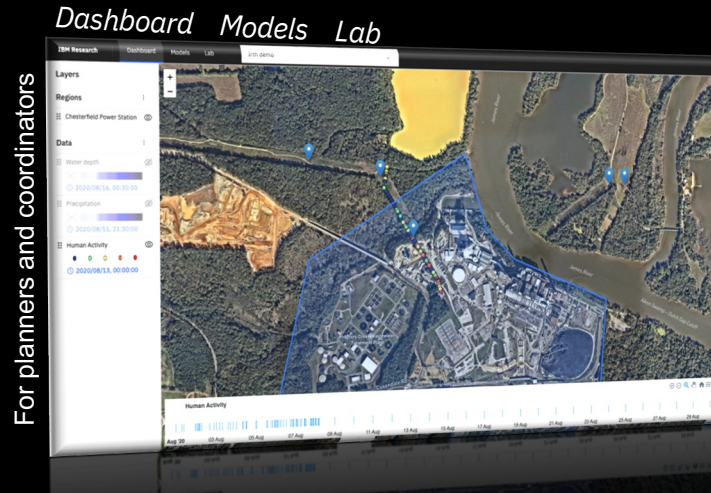
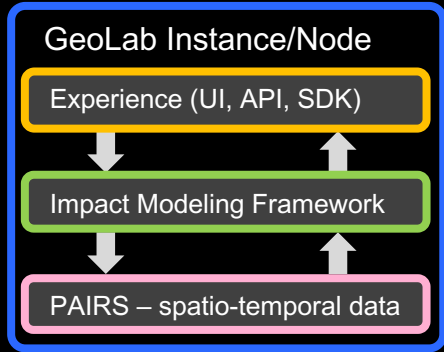
The Climate Network – Impact Modeling Framework



The Climate Network – Containers & Workflows → Portability



The Climate Network – GeoLab User Experience



Application Programming Interface

default Default namespace	
GET	/
GET	/data-options
GET	/modules
POST	/workflow/benchmark
POST	/workflow/calibrate
GET	/workflow/pwc/modelRunID/{modelRunID}
GET	/workflow/pwc/{wftype}
POST	/workflow/request
POST	/workflow/status
POST	/workflow/validate

Models

For analysts

Software Development Kit

```
In [ ]: #!pip install ibm-geolab

geolab.explore("2m temperature")
Node = 1, LayerID = 94, LayerName = ERA5 2m Temperature
Node = 1, LayerID = 106, LayerName = CPC 2m Temperature
Node = 1, LayerID = 107, LayerName = CPC 2m Dew Point Temperature

data1 = geolab.load_collection("1, 94")
data1 = data1.filter_temporal(
    start="2010-01-01T00:00:01Z",
    end="2020-01-02T00:00:01Z")

geolab.explore("Precipitation")
Node = 2, LayerID = 56, LayerName = ERA5 Precipitation
Node = 2, LayerID = 67, LayerName = CHIRPS Precipitation

data2 = geolab.load_collection("2, 67")
data2 = data2.filter_temporal(
    start="2010-01-01T00:00:01Z",
    end="2020-01-01T00:00:01Z")

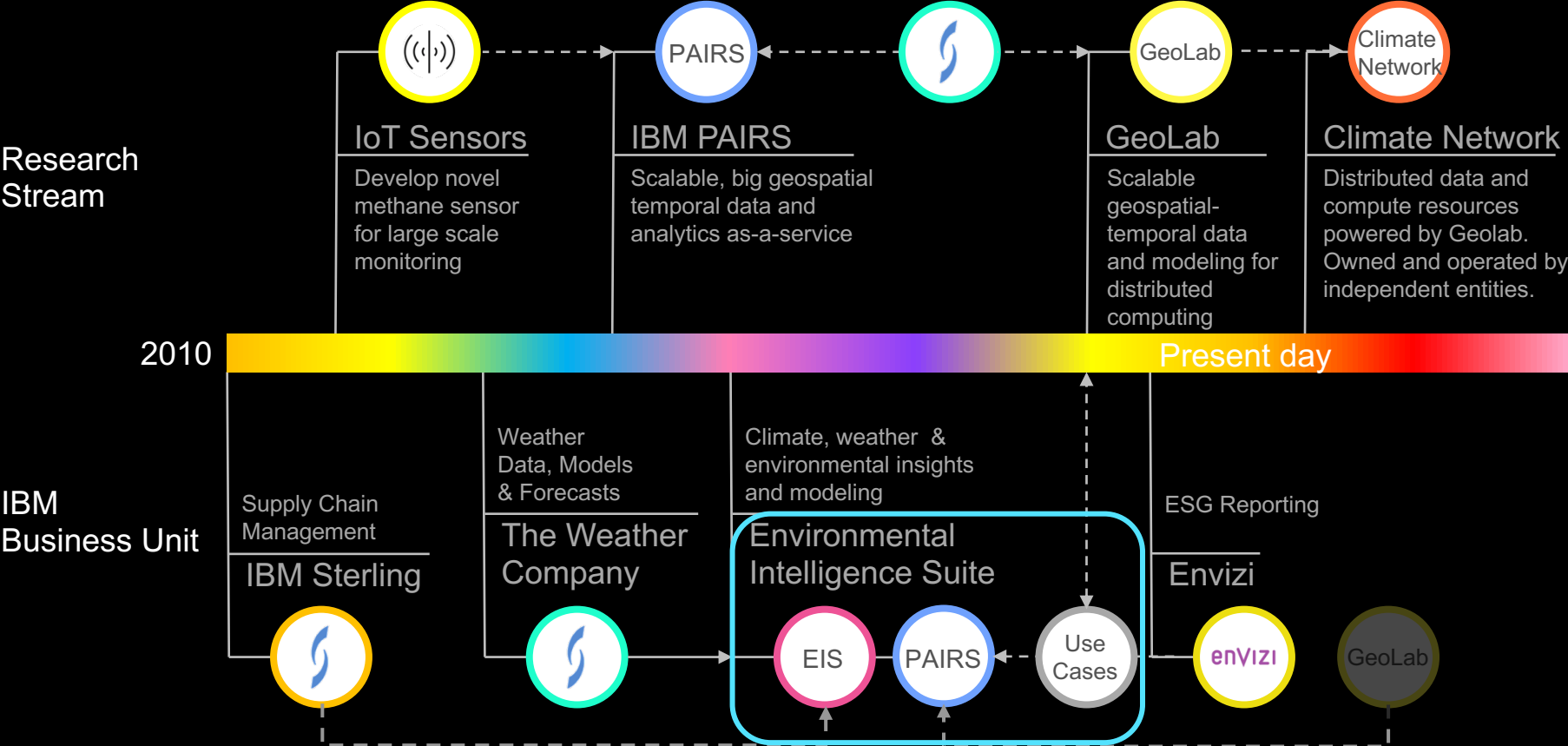
pearsonr = scipy.stats.pearsonr(data1, data2)

#!import torchgeo
```

Future contribution to pytorch-geospatial comm.

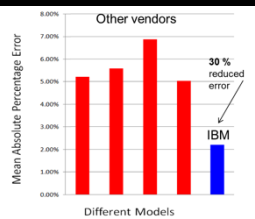
For data scientists

How everything fits together

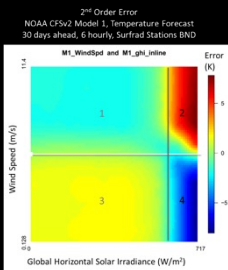


IBM Environmental Intelligence Suite – (Climate) Use Cases

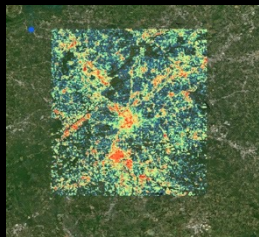
Renewable energy



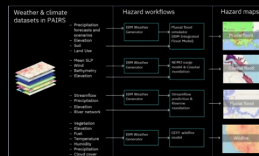
Long-term forecasting



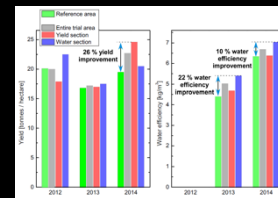
AQ modeling



Disaster management: Wildfire, Floods etc.



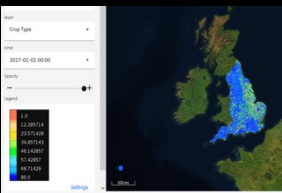
Irrigation management



GHG monitoring



Optimal land identification



Vegetation management



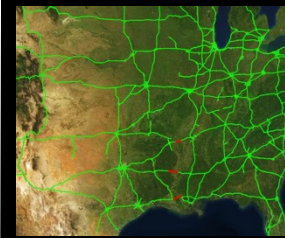
Crop protection



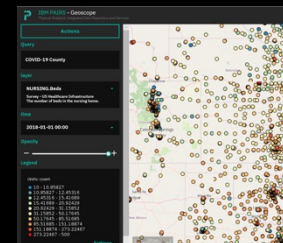
Crop forecasting



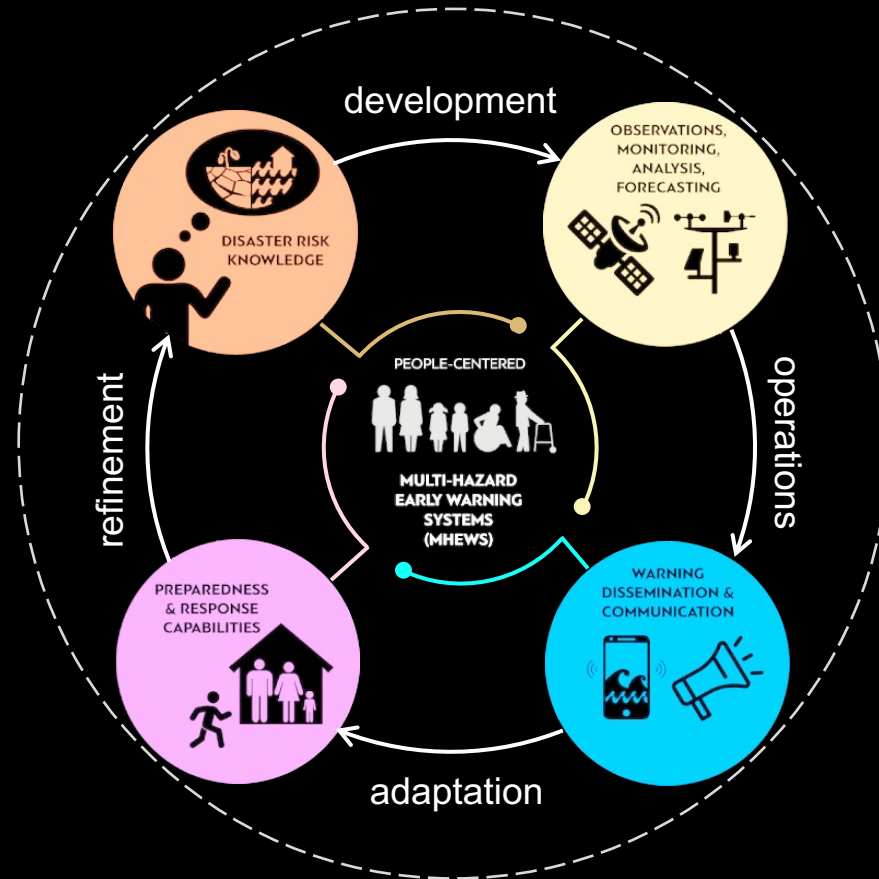
Logistics planning



Geospatial Asset management



Multi Hazard Early Warning Systems



Multi Hazard Early Warning Systems – IBM Ecosystem



IBM PAIRS – Part of IBM EIS

Distributed Cluster

- > 750 layers
- + 10 Tbytes/day
- > 6 Petabyte total

IBM GeoLab & Climate Network

- Experience**
UI & SDK
- Modeling**
CIMF
- Data**
PAIRS

The Weather Company

Global forecasts, every 5 mins., reaching Millions today

Operational Risk Insights

Multiple risk factors, configurable alerst Operational (in use)

IBM Deep Search – NLP

Identify Impact function Search all kind of scientific and other (NLP) data

TWC: Decision Support for Billions to Prepare for Weather



DISASTER RISK KNOWLEDGE

OBSERVATIONS, MONITORING, ANALYSIS, FORECASTING

WARNING DISSEMINATION & COMMUNICATION

PREPAREDNESS & RESPONSE CAPABILITIES



Existing Channels

Trusted by many Industries

<p>2.2 Billion weather forecast locations</p>	<p>Data from 40 Million mobile devices</p>	<p>Atmospheric Data from 50'000 flights per day</p>	<p>200'000+ worldwide weather stations</p>
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Global Scale Operational Solution

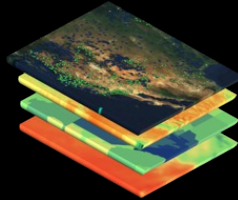
Decision Support for Billions to Prepare for Incoming Weather

26 billion forecasts a day at your fingertip

Multi Hazard Early Warning Systems – IBM Ecosystem



IBM PAIRS – Part of IBM EIS



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IBM GeoLab & Climate Network



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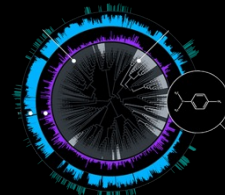


Operational Risk Insights (ORI)



Multiple risk factors,
configurable alerst
Operational (in use)

IBM Deep Search – NLP KGs



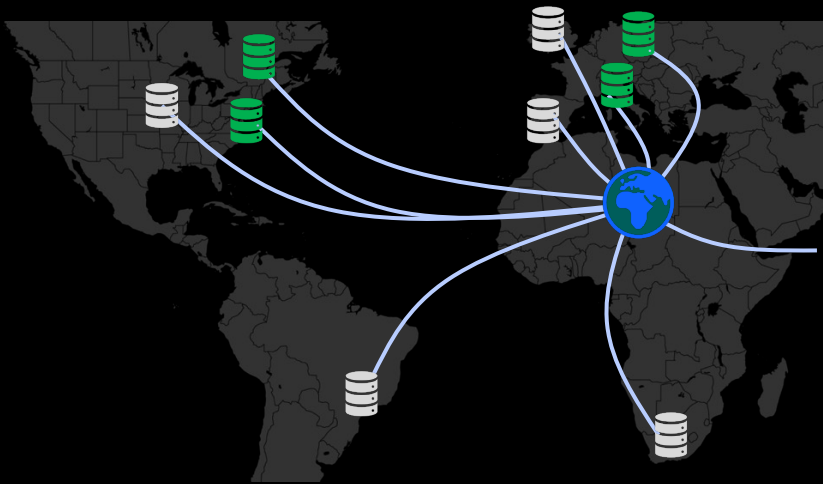
Identify Impact functions
Search & contextualize
all kind of scientific and
other (NLP) data

Collaborations and Partnerships

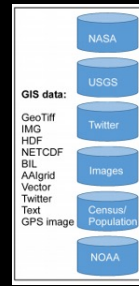


- IBM and IBM Research have a long tradition of collaborating with industry, academia and governments
- With research and development labs/centers on all major continents, cultural and geographic differences and similarities are naturally reflected in our inclusive work
- Our processes and mindset allows for low entry-barrier collaborations

The Climate Network – Data and Model Collaboration Platform

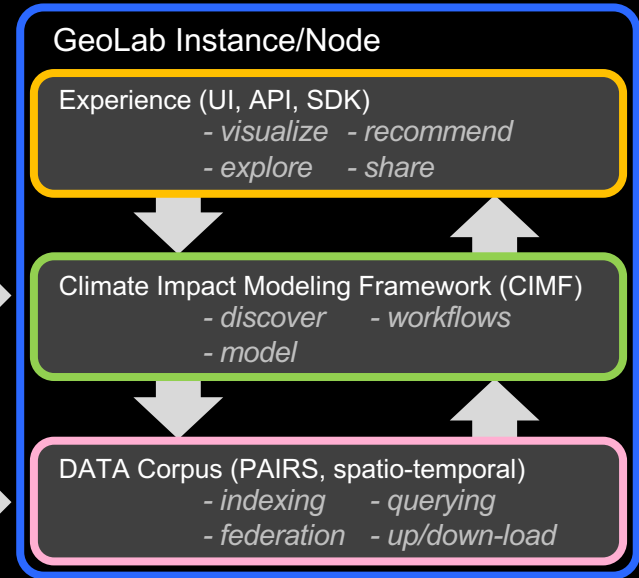


Public & Private
Data Sources
incl. TWC



Ingest

Curate



Planner
Coord.



Risk
Analyst,
Data
Scientist

- Data- and model-federation for global collaboration, data and model sharing across frontiers
- Privacy, security and governance to preserve national and stake-holder interests by “local” ownership
- Public and on-prem cloud enabled
- Kubernetes/Openshift enabled workflows for infrastructure portability and model-sharing flexibility

Climate Network Summit on Jan 19th-20th

→ Marina Rakhlin: mrakhlin@us.ibm.com



Jonas Weiss, jwe@zurich.ibm.com