The Climate Network

Technical Expert Forum 2022 – Nov. 30, 2022

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AI for Climate Impact Group
Needed Data-Platform for Methane Leak Estimation on Fracking Fields → PAIRS

**Sentinel 5P**
- Methane
- Nitrogen Dioxide
- Ozone
- Sulphur Dioxide
- Carbon Monoxide

**Methane concentration in Texas**

From Concentration to Methane Leak Mass Flow:

Inverse of Gaussian plume model

\[ \partial_t C + \nabla \cdot (C \mathbf{u}) - \nabla (K \nabla C) - S = 0 \]

- **Advection**
- **Diffusion**
- **Source**

**Plume of Methane Leak**

Wind velocity
The Climate Network – Collaborating on Data and Models

• 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 control over critical assets

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

Network – Instance/Node

Experience (UI, API, SDK)
- visualize - recommend
- explore - share

Climate Impact Modeling Framework
- discover - workflows
- model

DATA Corpus (PAIRS, spatio-temporal)
- indexing - querying
- federation - up/down-load

Public & Private Data Sources incl. TWC

GIS data
- GeoTIFF
- Imagery
- Metadata

Twitter
- TWC
- Datasets

Text
- Metadata
- Text
- GIS

Images
- Images

PHACT – AI for Climate Impact Group, November 30 2022, © IBM Corporation
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)

Data Sources
- 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

Types
- Weather
- Atmosphere
- Historical
- Current
- Predictive
- Global
- Ultra-local

Network Instance/Node
- Experience (UI, API, SDK)
- Impact Modeling Framework
- PAIRS – spatio-temporal data

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The Climate Network – Impact Modeling Framework

1. AI-flood mapping
   - Detected historic floods
   - Population Density or Asset Location

2. AI-weather generator

3. Integrated flood model
   - Predict floods & flood risks

4. Impact Prediction
   - Impact Functions

Network Instance/Node
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"Static" Properties
- Satellite-Radar
- Elevation
- Land use
- Soil
- Precipitation

Impact Functions
- Wind Speed/Flood Depth
- Mean Damage Ratio

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The Climate Network – Framework User Experience

Dashboard Models Lab

For planners and coordinators

For analysts

Network Instance/Node Experience (UI, API, SDK)
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- PAIRS – spatio-temporal data

Application Programming Interface

Software Development Kit

For data scientists

Future contribution to pytorch-geospatial comm.
Use Case: Accelerated Climate Adaptation Discovery Cycle

Computer Vision and AI to accurately map and detect extreme weather events

Physical and surrogate models – e.g. with statistical sampling of extreme events to create risk maps as function of climate scenarios

Overlay risks with catalogued or automatically detected assets and impact functions to estimate damage (potential)

Suggest adaptation strategies

Sandip Roy – IBM Watson AI for Climate Impact Group, November 30 2022, © IBM Corporation
DeepSearch – Finds Impact-Functions in Scientific Literature and Geo-References them based on NLP

DeepSearch

17.3K abstracts convert to 11 json geo-classes

Geospatial Search & Exploration

Plot of polygons and points retrieved from Open Street Map

Hazard Mapping

Hazard Models & Risk Maps

Asset Impact Estimation

Adaptation

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IBM Geospatial Data and Model Ecosystem

IBM PAIRS – Part of IBM EIS
- Distributed Cluster
  - > 750 layers
  - + 10 Tbytes/day
  - > 6 Petabyte total

IBM Climate Network and Framework
- Experience UI & SDK
- Modeling Framework
- Data PAIRS

The Weather Company
- Global forecasts, every 5 mins., reaching Millions today

IBM Deep Search – NLP
- Identify Impact functions
- Hazard data, damages/losses scientific and other (NLP) data

Operational Risk Insights
- Multiple risk factors, configurable alerts
- Operational (in use)
The Climate Network – Data and Model Collaboration Platform

- 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

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Climate Network Summit on Jan 19th-20th
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