From Climate data to Climate knowledge:
How to share and integrate climate data & information?

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The Earth is a complex system of systems

Mankind has become a geophysical parameter

- Geophysics has become a Political Issue
- ...Earth Observations are needed to inform decisions
Environmental data

- Physical, chemical, biological, and socio‐economical data & statistics
- Describe a location through a set of attributes
- Can be integrated into GIS

...but finding and accessing data is still difficult

- Many repositories of data of different formats and quality
- Missing documentation (metadata)
- Fragmentation
- Policies

DATA: BY THE NUMBERS

www.phdcomics.com
One dataset for many users...

...Many datasets for one user!
Data is the fuel of scientific analysis and decision-making!

Global Sustainability Challenges
Sept 2015 - 2030 Agenda for Sustainable Development
Global Sustainability Challenges
Dec 2015 - COP21 Paris Declaration

Selected Significant Climate Anomalies and Events in 2015

Global Sustainability Challenges

Informed & evidence-based Decision Making

Turning raw data into understandable information
Data to knowledge


Data to knowledge

Wisdom
Knowledge
Information
Data

Context
Understanding

Why?
How?
Who, what, when, where?
An asset/opportunity

Big data in numbers

BIGGER OPPORTUNITIES

“It is a very sad thing that nowadays there is so little useless information.” – Oscar Wilde

DATA, DATA, EVERYWHERE

1 BILLION GB = 1 EXABYTE
2.5 EXABYTES
THAT NUMBER DOUBLES EVERY MONTH

90% of the world’s data was created in the last two years
How to extract and convey useful information from this enormous amount of data?
How data science works?

The Process

- Ask an interesting question.
- Get the data.
- Explore the data.
- Model the data.
- Communicate and visualize the results.

What are the evidences for warming of the climate system?

Global Warming Predictions

Based on HadCM3

Temperature Increase (°C)
Get the data: Discover and access

- GEO/GEOSS – Data Sharing platform: [http://www.geoportal.org](http://www.geoportal.org)
- Enable Discovery, Visualization, Evaluation and Access to Data.
- Relies on Interoperability & Standards

Interoperability

- US type
- EU type
- UK type
- Euro plug

[Universal adapter]
Interoperability

“the ability of two or more systems or components to exchange information and to use the information that has been exchanged”.

Issues and challenges related to SDGs

Lehmann & al., in prep.
Essential Climate Variables (ECV)

http://www.wmo.int/pages/prog/gcos/index.php?name=EssentialClimateVariables

Climate services

- Climate data are essential to enable multi-disciplinary environmental science
- Lack of interoperability: lots of data formats and access methodologies.
- Climate community can learn from geospatial community
- OGC and ISO standards can leverage the information potential of climate data in a multi-disciplinary framework.

Giuliani & al., in prep.
Standards in climate science

- Data format: OGC NetCDF
- Documentdata:
  - OGC Catalog Service for the Web (CSW),
  - ISO 19115/19119/19139
- Quality & Uncertainty:
  - QualityML,
  - UncertML (e.g., NetCDF Uncertainty Conventions)
- Visualization & Download:
  - Web Map Service (WMS),
  - Web Coverage Service (WFS),
  - Web Coverage Service (WCS),
  - Sensor Observation Service (SOS),
  - Table Joining Service (TJS)
- Processing:
  - Web Processing Service (WPS)

More on: [http://www.opengeospatial.org/docs/is](http://www.opengeospatial.org/docs/is)

Giuliani & al., in prep.

A quick example between climate and biodiversity domains

Nativi & al. (2009) Biodiversity and climate change use scenarios framework for the GEOSS interoperability pilot process.
TJS: linking statistics with territory

Store once – (Re)use many times
Data can be a shared resource

The Value of Open Data Sharing

- Economic Growth
- Social Welfare
- Research & Innovation
- Education
- Capacity Development
- Effective Governance & Policy Making

Explore the data

Explore your Data

• Spend time with your dataset:
  • Understand where it came from - can you live with the assumptions the data collectors made?
  • Look at it
  • Plot it
  • Where are there holes? Inconsistencies? Anomalies?
  • Clean your data, find better datasets, get more data

Terp (2014)

Model the data

Model your data

• You’re persuading people with ‘truths’: do your best to make sure they’re truthful
  • Always cross-check
  • Statistics is your friend

Terp (2014)
Communicate and visualize

A Carefully Selected List of Recommended Tools

When I meet with people and talk about our work, I get asked a lot what technology we use to create interactive and dynamic data visualizations. To help you get started, we have put together a selection of the tools we use the most and that we enjoy working with. Read more

https://www.datavisualization.ch

Story telling

“STORIES ARE JUST DATA WITH A SOUL.”

DR. BRENÉ BROWN – UNIVERSITY OF HOUSTON
Story maps

Retreat of glaciers

Changes in glaciers and ice caps provide some of the clearest evidence of climate change, and as such they constitute key variables for early detection strategies in global climate-related observations. These changes have impacts on global sea level fluctuations, the regional to local natural hazard situation, as well as on societies dependent on glacial meltwater.

http://limes.grid.unep.ch/dev/storymaps/climatechange/

Story graphs

Arctic Sea Ice Extent

The dotted line represents the average ice extent from 1981 to 2010. Each line represents one yearly cycle of sea ice fluctuations.

2016

Arctic sea ice extent usually reaches an annual maximum around March.

2012

Arctic sea ice extent reached the lowest point on record.

http://www.grid.unep.ch/live
Story graphs

Climate Warming Factors
Modelled contributions of natural and human factors to global temperature changes

[Graph showing contributions of different factors to climate warming]

http://www.grid.unep.ch/live

Story graphs

Global Land and Ocean Temperature Anomalies
Change in global surface temperature relative to 1910-2000 average temperatures

The 10 warmest years in the 139-year record all occurred since 2000, with the exception of 1998. The year 2015 ranks as the warmest on record. The inset series below shows the ten-year average version of global surface temperatures from 1880 to 2015.

[Graph showing temperature anomalies from 1880 to 2015]

http://www.grid.unep.ch/live
Story graphs

Global Surface Temperature

Four independent data sources show nearly identical long-term warming trends

- NASA’s Goddard Institute for Space Studies
- Hadley Centre for Climate Change
- Climatic Research Unit
- University of East Anglia

http://www.grid.unep.ch/live

Global Environmental Goals Tracker

Welcome to the Global Environmental Goals (GEGs) Live Tracker

http://ede.grid.unep.ch/gegslive
Environmental Data Explorer

http://ede.grid.unep.ch

EnviroGRIDS: water resources in the Black Sea catchment

http://portal.envirogrids.net
EnviroGRIDS: water resources in the Black Sea catchment

Take Home messages

Climate data and information are essential to understand major environmental changes.

It is crucial to make these data and information available not in the way that it is collected, but in the way that it is being used by the largest audience possible.
Take Home messages

• Make your data discoverable
• Publish your data as interoperable web services
• Document your data (e.g., metadata)
• Promote & Contribute to GEO/GEOSS

Data is like love...
The more you give...
The more you get!
Projects in preparation

- FNS:
  - SWATCH21: ES of Swiss rivers
  - neCHsus: Nexus approach of Swiss rivers

- H2020:
  - ERA‐PLANET: Essential Variables for SDGs
  - BLUES: nature‐based solutions in Geneva
  - BATEMAN: ES interface for decision making

- Other:
  - Map‐X: mapping the extractive industry and its impacts
  - Data4SDGs: …
  - mySDGs: phone application
  - Agent based SDGs: global assessment of SDGs
  - …

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