Follow up Action for the WMO International Workshop on Information Management held at WMO Geneva, 2-4 October 2017

Ad hoc Expert Group
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Proposed Data Catalogue: One of the primary objectives of the workshop was to 'identify key climate-related data sources that should be promoted as reference sources and outline a project to enhance their visibility in the WMO Information System and to simplify user access to them.' This document is a draft catalogue of pre-identified trusted ECV global datasets, climate indices, crowdsourced and hydrology datasets. Guiding principles for datasets are based on workshop group findings and recommendations. Data should include reanalysis, satellite, model and merged datasets. (Documents are available on Meeting Wiki: https://wiswiki.wmo.int/tiki-index.php?page=wwim)

Trusted datasets need to be:

- in digital, open, and interoperable format;
- versioned, archived, and maintained;
- documented with provenance, QC process and references including endorsement by recognized bodies such as IPCC and WMO;
- evaluated by a Maturity Matrix;
- preferably have minted DOI;
- standardized and machine-readable discovery level metadata with documentation of versioned controlled source code and algorithm and available in the WIS Catalogue;
- with information for users about dataset best usage/uncertainty so users can choose what data are most appropriate for their use/application and what the limitations are;
- easily identifiable in search engines;
- easily accessible thru major climate portals/web sites/public clouds such as Amazon;

The datasets selected below meet most of the criteria in the list above. It is by no means an exhaustive list. Please note this first effort focuses on global datasets. Please review the list and provide input, comments and additional possible global datasets. Either send me your comments by email or version your comments and save in originalfilename.version.yourinitials.doc and return them via email attachment. This way I can keep track of input. Please provide me with your input by January 19th. Thank you! Christina Lief (Christina.lief@gmail.com ; phone: +33 769027844)

Temperature (Global Mean Temperature/Daily min-max):

- Latest WMO/GCOS Atmosphere Surface Temperature ECV definition: Surface air temperature has profound and widespread impacts on human lives and activities, affecting health, agriculture, energy demand and much more. It also has impacts on natural systems. It affects the fluxes of heat, momentum, water vapour and trace species between land and atmosphere and between ocean and atmosphere. Its monitoring provides a key indicator of climate change. Observations of it contribute to estimates of what is commonly known as "global-mean surface temperature" and to a number of indices of extreme conditions.

https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-atmosphere-surface-ecv-air-temperature

- Datasets:
    - NOAA/NCEI GHCN-Monthly (GHCN-M) is best for monitoring global and regional trends and variability in mean conditions while the GHCN-Daily (GHCN-D) dataset is good for monitoring daily extremes.
        - GHCN-D: doi:10.7289/V5D21VHZ Full description including source code: https://www.ncdc.noaa.gov/ghcn-daily-description Maturity Matrix: GHCN-D_MM-Stew_v00r09_20170828.docx
        - GHCN-M: doi:10.7289/V5X34VDR Description : https://www.ncdc.noaa.gov/ghcnm/v3.php Maturity Matrix: https://ncics.org/cics-news/dsmm-ghcn-m/

Precipitation (Estimates of liquid and solid precipitation)

- WMO/GCOS Atmosphere Surface Precipitation ECV definition: Precipitation, either liquid or solid, is the most important climate variable directly affecting humans. Through either its duration, intensity and frequency or its lack of occurrence, it influences the supply of water for personal consumption and use in agriculture, manufacturing industries and power generation, causes risks to life and the functioning of society when associated with floods, landslides and droughts, and affects infrastructure planning, leisure activities and more. Precipitation is closely related to cloud properties, a number of terrestrial ECVs and to ocean-surface salinity. It is indicative of the release of latent heat within the energy cycle, as well as being at the heart of the hydrological cycle. https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-atmosphere-surface-ecv-precipitation
- Datasets:
    - GPCC Global Precipitation Climatology Centre monthly precipitation dataset from 1901-present: ftp://ftp-anon.dwd.de/pub/data/gpcc/html/download_gate.html
    - GHCN-D (doi:10.7289/V5D21VHZ) Full description including source code: https://www.ncdc.noaa.gov/ghcn-daily-description
    - GHCN-M maintains the data for precipitation in version 2 https://www.ncdc.noaa.gov/ghcnm/

Sea ice (concentration; extent/edge; thickness; drift)

- WMO/GCOS Ocean Physics Sea Ice ECV definition: Sea ice is a sensitive indicator to changes in the energy absorbed by the ice. It also greatly influences the surface albedo and air–sea exchanges of energy, moisture and carbon. The sea-ice distribution, including polynyas and margins, also has an important influence on marine ecosystems. Changes in the distribution of sea ice affect these ecosystems and a number of activities such as shipping, logistic and tourist operations. https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-ocean-physics-ecv-sea-ice
- Datasets:
    - NSIDC Sea Ice Datasets: http://nsidc.org/data/seaice/pm.html
    - Sea Ice concentration and extent: Sea Ice Index https://nsidc.org/data/G02135/versions/3

- NOAA Climate Data Record (CDR) of AVHRR Polar Pathfinder Extended (APP-X) Cryosphere (doi:10.7289/V5MK69W6) Maturity Matrix: https://www1.ncdc.noaa.gov/pub/data/sds/cdr/CDRs/AVHRR_Extended_Polar_Pathfinder/MaturityMatrix_01B-24b.pdf
- Global Cryosphere Watch Data Portal is not operational yet: https://globalcryospherewatch.org/about/

Sea level (Global Mean Sea Level):

- WMO/GCOS Ocean Physics Sea Level ECV definition: The global mean sea level change provides a measure of the net change in ocean mass due to melting of glaciers and ice sheets, changes in terrestrial water resources, as well as net change in ocean volume due to thermal expansion. https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-ocean-physics-ecv-sea-level
- Datasets:
  - PSML: The PSMSL data set is the main source of information on long term changes in global sea level during the last two centuries. The data have been employed intensively in studies such as those of IPCC. http://www.psmsl.org/products/reconstructions/church.php (https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level)
  - CSIRO Church and White sea level reconstruction: http://www.cmar.csiro.au/sealevel/sl_data_cmar.html

Ice-sheet (Surface Elevation Change, Ice Velocity, Ice Mass Chance, Grounding Line Location and Thickness)

- WMO/GCOS Land Ice-Sheet ECV definition: The understanding of the timescale of ice-sheet response to climate change has changed dramatically over the last decade. Rapid changes in ice-sheet mass have surely contributed to abrupt changes in climate and sea level in the past. The total ice loss from the Greenland and Antarctic ice sheets for the 20-year period of 1992–2011 has been 4 260 ± 1 460 Gt, which is equivalent to 11.7 ± 4.0 mm of sea level. However, most of this ice (3 620 Gt) was lost in the second decade of the 20-year period, and the rate of change has increased steadily with time. Over the years 2007–2011, it was equivalent to 1.2 ± 0.4 mm yr–1 of sea level. https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-land-ecv-ice-sheets
- Datasets:
  - NSIDC data: Arctic Regional Climate Assessment (PARCA) began in 1993 with the primary goal of measuring and understanding the mass balance of the Greenland Ice Sheet. http://nsidc.org/data/parca/
  - Global Cryosphere Watch Data Portal http://globalcryospherewatch.org/ data portal is not operational at this time.

- Antarctic Glaciological Data Center (AGDC) at NSIDC archives and distributes Antarctic glaciological and cryospheric data collected by the U.S. Antarctic Program. https://nsidc.org/data/agdc/data-sets

Glaciers (Area, elevation change, mass change data)

- WMO/GCOS Land Glaciers ECV definition: This ECV was termed "Glaciers and ice caps" in IP-10, but here the term "Glacier" is used more generally, to include ice caps. A glacier is defined as a perennial mass of ice, and possibly firn and snow, originating on the land surface from the recrystallization of snow or other forms of solid precipitation and showing evidence of past or present flow. There are several types of glaciers such as glacierets, mountain glaciers, valley glaciers and ice fields, as well as ice caps. Some glacier tongues reach into lakes or the sea, and can develop floating ice tongues or ice shelves. Glacier changes are recognized as independent and natural evidence of climate change, in which high confidence can be placed. Past, current and future glacier changes affect global sea level, the regional water cycle and local hazards.
  https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-land-ecv-glaciers

- Datasets:
  - Global Terrestrial Network for Glaciers (GTN-G) Fluctuations of Glaciers (FoG) Database: http://www.gtn-g.ch/data_catalogue_fog/ WGMS data DOI: http://dx.doi.org/10.5904/wgms-fog-2017-06

Climate indices

- Definition: Extremes such as the annual maximum daily precipitation amount or the annual maximum wind speed have traditionally been modelled with one of three different Extreme Value Distributions in engineering applications. The extremes used as climate change indicators have a much broader context. While some of the indices would fall within the traditional definition, most do not. It is important to make this distinction when analyzing indices since only a very few can be assumed to follow an extreme value distribution. http://etccdi.pacificclimate.org/indices.shtml

- List of 27 Core Indices (out of a total of 40 indices):

1. FD, Number of frost days: Annual count of days when TN (daily minimum temperature) < 0oC.
2. SU, Number of summer days: Annual count of days when TX (daily maximum temperature) > 25oC.
3. ID, Number of icing days: Annual count of days when TX (daily maximum temperature) < 0oC.
4. TR, Number of tropical nights: Annual count of days when TN (daily minimum temperature) > 20oC.
5. GSL, Growing season length: Annual (1st Jan to 31st Dec in Northern Hemisphere (NH), 1st July to 30th June in Southern Hemisphere (SH)) count between first span of at least 6 days with daily mean temperature TG>5oC and first span after July 1st (Jan 1st in SH) of 6 days with TG<5oC.
6. TXx, Monthly maximum value of daily maximum temperature

7. TNx, Monthly maximum value of daily minimum temperature
8. TNxkj=max(TNxkj)
9. TXn, Monthly minimum value of daily maximum temperature
10. TNn, Monthly minimum value of daily minimum temperature
11. TN10p, Percentage of days when TN < 10th percentile: To avoid possible inhomogeneity across the in-base and out-base periods, the calculation for the base period (1961-1990) requires the use of a bootstrap procedure. Details are described in Zhang et al. (2005) .
12. TX10p, Percentage of days when TX < 10th percentile: To avoid possible inhomogeneity across the in-base and out-base periods, the calculation for the base period (1961-1990) requires the use of a bootstrap procedure. Details are described in Zhang et al. (2005) .
13. TN90p, Percentage of days when TN > 90th percentile: To avoid possible inhomogeneity across the in-base and out-base periods, the calculation for the base period (1961-1990) requires the use of a bootstrap procedure. Details are described in Zhang et al. (2005) .
14. TX90p, Percentage of days when TX > 90th percentile: To avoid possible inhomogeneity across the in-base and out-base periods, the calculation for the base period (1961-1990) requires the use of a bootstrap procedure. Details are described in Zhang et al. (2005) .
15. WSDI, Warm spell duration index: Annual count of days with at least 6 consecutive days when TX > 90th percentile
16. CSDI, Cold spell duration index: Annual count of days with at least 6 consecutive days when TN < 10th percentile
17. DTR, Daily temperature range: Monthly mean difference between TX and TN
18. Rx1day, Monthly maximum 1-day precipitation
19. Rx5day, Monthly maximum consecutive 5-day precipitation
20. SDII Simple precipitation intensity index
21. R20mm Annual count of days when PRCP≥ 20mm
22. Rnnmm Annual count of days when PRCP≥ nnmm
23. CDD. Maximum length of dry spell, maximum number of consecutive days with RR < 1mm
24. CWD. Maximum length of wet spell, maximum number of consecutive days with RR ≥ 1mm
25. R95pTOT. Annual total PRCP when RR > 95p
26. R99pTOT. Annual total PRCP when RR > 99p
27. PRCPTOT. Annual total precipitation in wet days

- WMO and ETCCDI produced a technical document enclosing "Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation" WMO-TD No 1500, 2009 by Albert M.G. Klein Tank, Royal Netherlands Meteorological Institute, Francis W. Zwiers and Xuebin Zhang, Environment Canada.
- WMO Climate Indices web page: http://www.wmo.int/pages/prog/wcp/wcdmp/CA_3.php
- KNMI
    - list: http://etccdi.pacificclimate.org/docs/ETCCDMIndicesComparison1.pdf
    - https://climexp.knmi.nl/selectannualindex.cgi?id=someone@somewhere
- Datasets:
    - HADEX2: https://www.metoffice.gov.uk/hadobs/hadex2/download.html
    - The CLIMDEX project aims to produce a suite of in situ and gridded land-based global datasets of indices representing the more extreme aspects of climate. http://www.climdex.org/datasets.html
    - ETCCDI: http://etccdi.pacificclimate.org/data.shtml

- ESRL - Climate Indices - Monthly Atmospheric and Ocean Time Series: https://www.esrl.noaa.gov/psd/data/climateindices/list/

Crowd-sourced datasets

1. Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow) in the US, Canada and the Bahamas. https://www.cocorahs.org/ViewData/
2. The Met Office Weather Observations Website (WOW) project created a crowd sourcing application allowing the general public to submit weather data to the Met Office. http://wow.metoffice.gov.uk/

Hydrology

- Datasets: **NOAA Climate Data Records (CDR) of AMSU-A/B and MHS Hydrological Properties, Version 1**. The NOAA Hydrological Properties for Applications Thematic Climate Data Record (TCDR) consist of Advanced Microwave Sounding Unit-A (AMSU-A), Advanced Microwave Sounding Unit-B (AMSU-B) and Microwave Humidity Sounder (MHS) data to help with the long-term monitoring of the global water cycle. The data cover a time period from 1998 to 2010, at roughly a 48 km (AMSU-A) and a 16-km resolution (AMSU-B/MHS) resolution over the entire globe with 30 (AMSU-A) and 90 (AMSU-B/MHS) observations per scan. The data are ideal for helping with things like validating climate model simulations; identifying climate extremes; validating other observations and more. https://doi.org/10.7289/V5V69GM6 Maturity Matrix: https://www1.ncdc.noaa.gov/pub/data/sds/cdr/CDRs/Hydrological%20Properties/MaturityMatrix_01B-38c.pdf
- The **Global Runoff Data Base (GRDB)** is built on an initial dataset collected in the early 1980s from the responses to a WMO request to its member countries to provide a global hydrological data set to complement a specific set of atmospheric data in the framework of the First Global GARP Experiment (FGGE). The initial dataset of monthly river discharge data over a period of several years around 1980 was supplemented with the UNESCO monthly river discharge data collection 1965-85. Today the database comprises discharge data of nearly 9,500 gauging stations from all over the world. http://www.bafg.de/GRDC/EN/01_GRDC/13_dtbse/database_node.html
- WMO **Hydrohub**: https://public.wmo.int/en/files/wmo-hydro-hub (Presently under development)