

Data Management and the GWFNet Catalogue for INARCH/COPE



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Today's Presentation

Endurance of Data

GWFNet

COPE information currently in GWFNet

Additional information and detail requested

Endurance of Data

Four Desirable Concepts Towards Endurance of Data

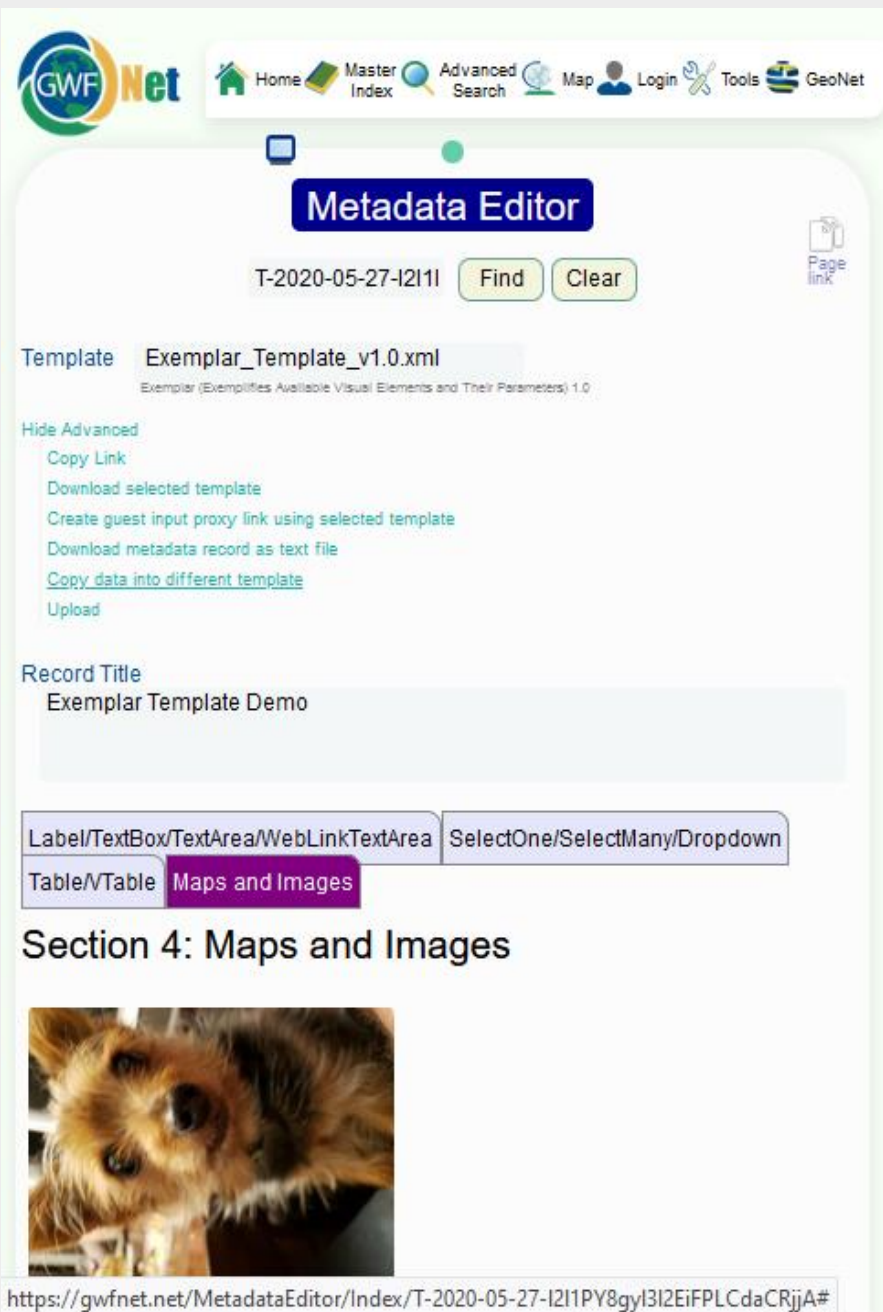
1. Iterative Improvement – We prefer a flexible data system that can accommodate to-be-perfected and partial data so baseline information can be obtained without delay and enhanced later as time and improved knowledge become available.
2. Legacy – This refinement process results in future (meta)data which will improve with time and become tomorrow’s important legacy. Thus we establish a desirable recurring “today’s legacy is tomorrow’s future” pattern.
3. Continuity – Our collection of Water Research data is a “critical mass” constant which spans and survives intact across often overlapping funding events:
 - MAGS, DRI, IP3, CCRN, INARCH-1 (past)
 - GWF, INARCH-2/COPE (present), GIWS
 - GWFO (future),and decades--continuing to be relevant, referenced, and improved. “We are our data.”
4. Decentralized Data – For practical reasons it is best to keep our data decentralized into databases and repositories best suited for the research in question, and track this information through a central catalogue of data.

Information Tracked in Central Data Catalogue

- What is out there:
 - Observatories, Sites per observatory, Stations per site
 - Detailed inventories on instrumentation and equipment per site
 - Projects (of large programs)
 - Publications – Datasets and Papers
- Where it is:
 - Maps (location(s), contours, and bounding boxes)
 - Repositories (Relational Databases, WISKI, FRDR, GitHub, Zenodo, DataStream, Compute Canada, Web Services)
 - Under Embargo or Private (Instructions, “Go talk to Sam and arrange to obtain a copy”)
- Who is responsible for it/Who has it:
 - Authorship, Technicians, Principal Investigators, Model users and creators
- Other information:
 - Videos, interactive charts,
 - Context through cross-referencing and indexing

GWFNet

GWFNet Catalogue



Home Master Index Advanced Search Map Login Tools GeoNet

Metadata Editor

T-2020-05-27-I2I1I Find Clear


Template Exemplar_Template_v1.0.xml
Exemplar (Exemplifies Available Visual Elements and Their Parameters) 1.0

Hide Advanced
Copy Link
Download selected template
Create guest input proxy link using selected template
Download metadata record as text file
Copy data into different template
Upload

Record Title
Exemplar Template Demo

Label/TextBox/TextArea/WebLinkTextArea SelectOne/SelectMany/Dropdown
Table/Table Maps and Images

Section 4: Maps and Images



<https://gwfnet.net/MetadataEditor/Index/T-2020-05-27-I2I1PY8gyI3I2EiFPLCdaCRjjA#>

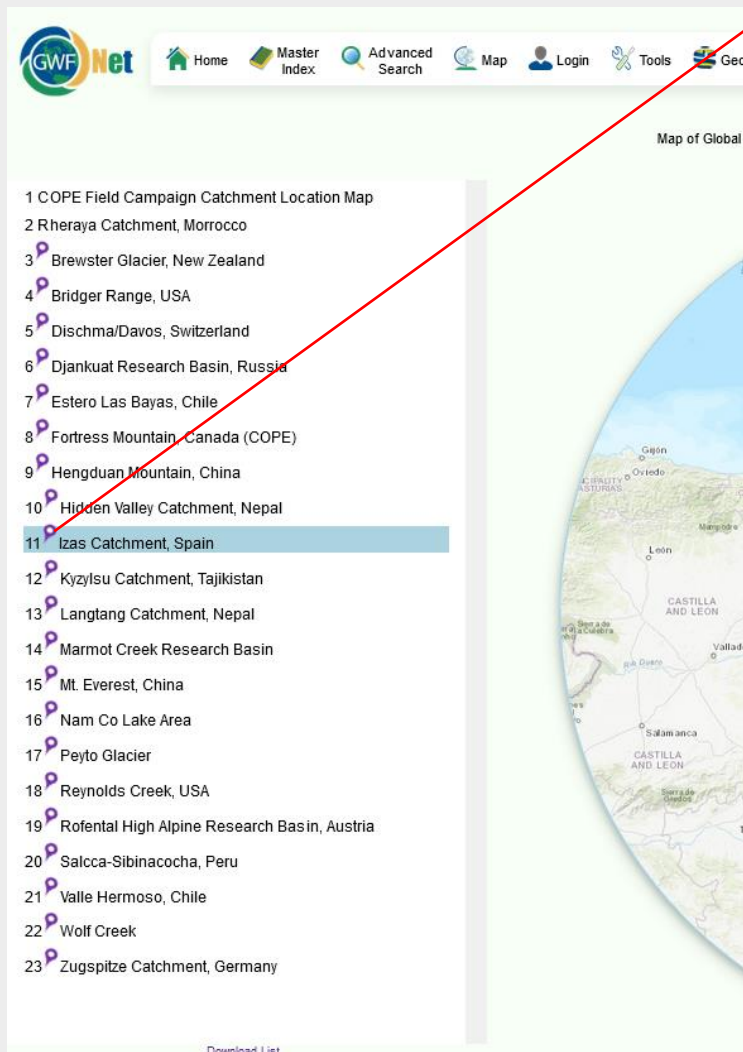
GWFNet is a data catalogue originally created for Global Water Futures (GWF) but will prevail well into the future to include and interrelate information from:

- programs prior to GWF (e.g., MAGS, DRI, IP3, CCRN, INARCH ph1),
- current programs (e.g., GWF, INARCH ph2, INARCH/COPE), and
- future programs (e.g., INARCH ph2, GWFO, Other contributors),

GWFNet contains cross-linked, well-**indexed** records (based on easily defined XML templates controlling visual appearance and database variable content) on:

- **observatories, research sites, stations**
- **models** -- descriptions, workflows, inputs, outputs, database requirements, links to source code, and extra information related to setup and operation
- **datasets, paper publications** -- including DOIs, authorship, abstracts, and download locations,
- **persons** associated with projects, data, datasets, models,
- **projects** within programs, (e.g., Mountain Water Futures within GWF),
- other record types, e.g., **videos** (e.g., locations, model usage, etc.), interactive **graphs** (soon to incorporate real-time data from live data sources), and
- any other types of records needed in future (simply add new record templates).
- To facilitate futureproofing (iterative improvement, legacy, and continuity), records based on earlier templates can be transformed into records based on new templates at any time, and all information matching the new template is copied to the new (or in-situ-reformed) record

GWFNet Catalogue – Interactive map links to records and vice versa



The navigation menu includes: Home, Master Index, Advanced Search, Map, Login, Tools, and Geo. Below the menu is a 'Map of Global' section with a list of 23 catchments. Item 11, 'Izas Catchment, Spain', is highlighted in blue. A red arrow points from this item to the main record page.

Izas Experimental Catchment, Spain (COPE)

Related Information
[COPE Field Campaign Catchment Index](#)
[Izas Research Site #1](#)

Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Izas

Country
Spain

Mountain Range
Pyrenees

Primary Contacts

Name	Role	Institution, Country, and Contact Information
Ignacio López-Moreno	Primary Contact	

Catchment Location

Coordinate Format	Latitude	Longitude
Degrees Minutes Seconds	42°44' N	0°25' W
Decimal Degrees	42.7333	-0.4167

Elevation

Minimum	Maximum
2056 m a.s.l.	2311 m a.s.l.

Area
0.33 km²

Glaciarized Area (%)
0 %

Main Land Covers
Subalpine meadows

Lithology
Sandstones, slates

Mean DJFM Temperature
1.2 °C

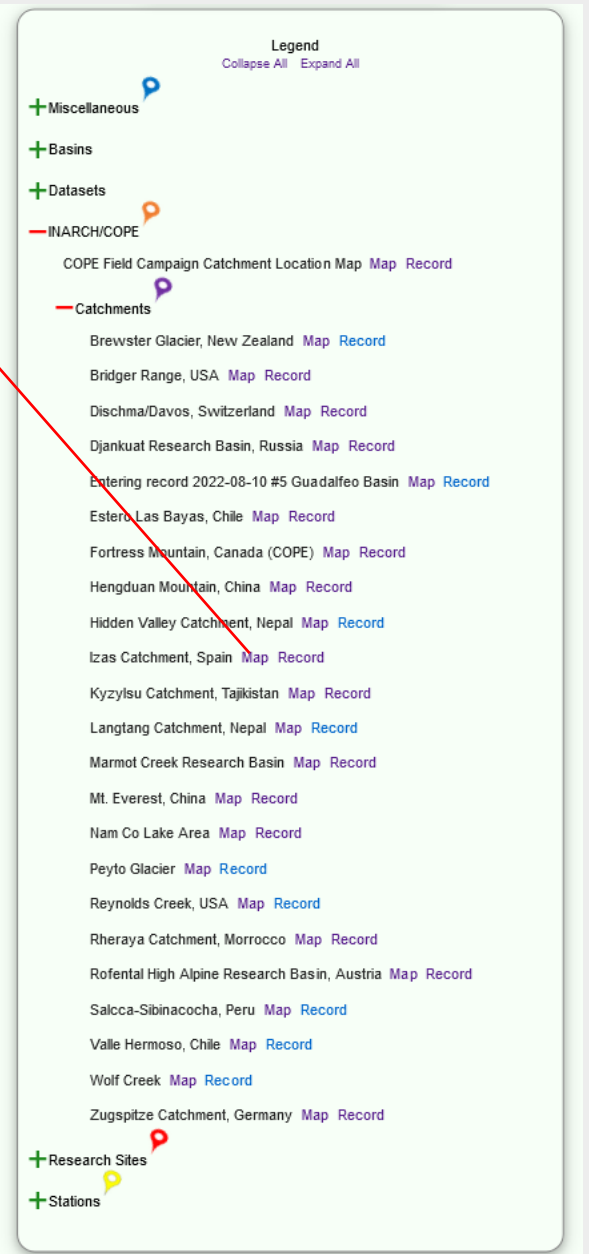
Mean DJFM Precipitation
750 mm

Snow Characteristics
Deep and long lasting isothermal snowpack

Additional Features of this Catchment

Feature	Value
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Additional Information (notes, web addresses, etc.)
The Izas experimental catchment has an area of approximately 55 ha and is located in the central Spanish Pyrenees (42°44' N, 0°25' W) between 2056 and 2311 m above sea level (a.s.l.). This area is close to the main divide of the Pyrenees in the headwaters of the Gállego River, near the border with France. The catchment is exposed to Atlantic climate conditions, and consequently the winters are relatively humid, and the snowpack covers most of the catchment from November to the end of May.




Legend: Collapse All, Expand All

- + Miscellaneous
- + Basins
- + Datasets
- INARCH/COPE
- COPE Field Campaign Catchment Location Map | Map | Record
- Catchments
 - Brewster Glacier, New Zealand | Map | Record
 - Bridger Range, USA | Map | Record
 - Dischma/Davos, Switzerland | Map | Record
 - Djankuat Research Basin, Russia | Map | Record
 - Entering record 2022-08-10 #5 Guadalfeo Basin | Map | Record
 - Estero Las Bayas, Chile | Map | Record
 - Fortress Mountain, Canada (COPE) | Map | Record
 - Hengduan Mountain, China | Map | Record
 - Hidden Valley Catchment, Nepal | Map | Record
 - Izas Catchment, Spain | Map | Record
 - Kyzylsu Catchment, Tajikistan | Map | Record
 - Langtang Catchment, Nepal | Map | Record
 - Marmot Creek Research Basin | Map | Record
 - Mt. Everest, China | Map | Record
 - Nam Co Lake Area | Map | Record
 - Peyto Glacier | Map | Record
 - Reynolds Creek, USA | Map | Record
 - Rheraya Catchment, Morocco | Map | Record
 - Rofental High Alpine Research Basin, Austria | Map | Record
 - Salcca-Sibinacocha, Peru | Map | Record
 - Valle Hermoso, Chile | Map | Record
 - Wolf Creek | Map | Record
 - Zugspitze Catchment, Germany | Map | Record
- + Research Sites
- + Stations

COPE information in GWFNet

COPE Data in GWFNet

- COPE Catchments [[COPE_Catchment_v1.0.xml](#)]
catchment information and map locating catchment and precise site locations
- COPE Research Sites (within Catchments) [[COPE_Research_Site_v1.0.xml](#)]
minimally, there is currently a temporary reference to “Research Site #1”
overview information, map, forcing data, hydrological instrumentation,
hydrometric/cryospheric measurements, hydrological modelling data
- Stations (within Sites) [[Station_v1.0.xml](#)]
lists of instruments, maintenance records, quality control, measurements, maps, etc.
- Models [[Model_v1.0.xml](#)]
snow, hydrological, mass balance, etc. used at each catchment
- Asset records for equipment(especially UAVs [[Asset_v1.0.xml](#)])
- Indexes of the above catchment, site, station, model, asset, person, dataset, publication records related to COPE) [[Index_v1.0.xml](#)]
- Very easy to add new record templates (XML) for COPE if and when needed



[Home](#)
[Master Index](#)
[Advanced Search](#)
[Map](#)
[Login](#)
[Tools](#)
[GeoNet](#)

COPE (Common Observation Period Experiment) Project

Related Information

[Page link](#)

All Projects

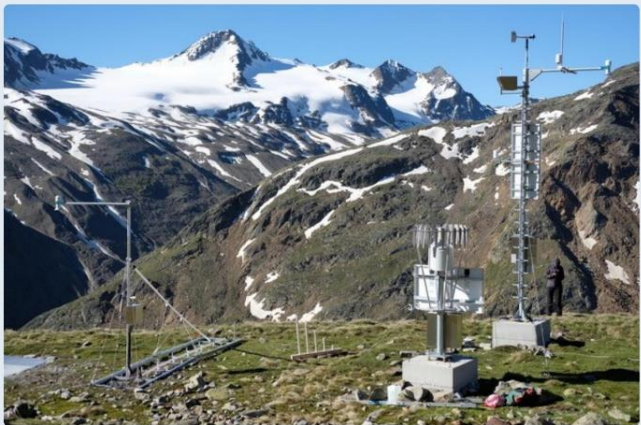
[COPE Field Campaign Catchment Index](#)

[COPE Models](#)

[INARCH: The International Network for Alpine Research Catchment Hydrology Project](#)

Project Information

Section 1: Project Information



Project Name
COPE: Common Observation Period Experiment

Classification (e.g., "GWFF Pillar 3", "CCRN", etc.)

Project Websites
Please reference this page as:
<https://gwfnet.net/cope>
COPE:
<https://inarch.usask.ca/science-basins/cope.php>

Project Description

INARCH is conducting a Common Observing Period Experiment (COPE) across a network of research basins which started in 2022 to coincide with the start of the snow season in the southern hemisphere, and continuing on until 2024.

During this "COPE", there will be an international, coordinated effort to

- obtain high-quality measurements
- ensure that all sensors remain in working order,
- enhance observations at all participating mountain research basins,
- fly supplementary UAV acquisitions, and to
- run high resolution models and work together to compare processes, share data, and test the robustness of these models in challenging environments around the world.

Why have a COPE? This initiative provides an opportunity for inter-comparisons across the global network of INARCH research sites and basins. While different climates prevail across the network of sites and each are subject to temporally and spatially varying conditions and extreme events, we need to coordinate our own efforts and response to some of the observations and data and also coordinate the modelling. We need to engage the modelling community to ensure we have comparable observations for model testing and evaluation. In some instances there are teleconnections that may occur and can be of interest to examine. Further, by getting these instruments into place and the campaign underway, this would be a start for longer-term observations of higher quality that can be comparable. Tremendous value can accrue from activities such as this and the approach has been used in the past with various GEWEX initiatives (e.g., in western Canada some basins have stayed instrumented over time since the late-1990s). The other aspects are in providing testbeds for instrumentation that some of us may be developing and allowing us to share information about the density of instrumentation and other things that may be useful as people work on basins.

Project Participants

Name	Role	Position Information
John Pomeroy	Steering Committee	Univers Canada Dept. of Canada Resour Director Program Director Director Canmor John.pc
Ignacio López-Moreno	Steering Committee	Pyrenees Spain nlopez@Institute Academ river ba Russia retska@
Ekaterina Rets	Steering Committee	Montan United States Spatial resourc eric.spr
Eric Sproles	Steering Committee	Univers

Ulrich Strasser	Steering Committee	enc.spr Univers Austria ulrich.st
Lindsey Nicholson	Steering Committee	Univers Austria lindsey.
Rainer Prinz	Steering Committee	Univers Austria rainer.p
James McPhee	Steering Committee	Univers Chile jmcph@
Franziska Koch	Steering Committee	Univers Life Sci Austria franzisk
Vincent Vionnet	Steering Committee	Environ Canada Canada vioncent.
Wouter Buytaert	Steering Committee	Imperial United Kingdom w.buyta
Ethan Gutmann	Steering Committee	National Research United States ethan.gutman
Dhiraj Pradhananga	Steering Committee	Univers Canada dhp355
Stephen O'Hearn	Coordination and support (Data)	Global In Canada stepher
Chris DeBeer	Coordination and support	Univers Canada chris.de

Current Status of this Project

Planned

In Progress

Abandoned

Complete

Catalogued INARCH/COPE Data

gwfnet.net/cope



The screenshot shows the GWF Net website interface. At the top, there is a navigation bar with icons for Home, Master Index, Advanced Search, Map, Login, Tools, and GeoNet. The main heading is "COPE (Common Observation Period Experiment) Project". Below this, there is a "Related Information" section with links to "All Projects", "COPE Field Campaign Catchment Index", "COPE Models", and "INARCH: The International Network for Alpine Research Catchment Hydrology Project". A purple button labeled "Project Information" is visible. The section "Section 1: Project Information" is partially visible at the bottom, with a photograph of a snowy mountain range and a weather station.



The screenshot shows the GWF Net website interface for the "COPE Field Campaign Catchment Index". The navigation bar is identical to the previous screenshot. The main heading is "COPE Field Campaign Catchment Index". Below this, there is a list of COPE projects with a "Page link" icon next to the first item. The projects listed are:

- COPE (Common Observation Period Experiment) Project
- COPE Catchment Map
- Brewster Glacier, New Zealand (COPE)
- Bridger Range, USA (COPE)
- Dischma/Davos, Switzerland (COPE)
- Djankuat Research Basin, Russia (COPE)
- Estero Las Bayas, Chile (COPE)
- Fortress Mountain, Canada (COPE)
- Guadafeo Basin, Spain (COPE)
- Hengdian Mountain, China (COPE)
- Hidden Valley Catchment, Nepal (COPE)
- Izaña Experimental Catchment, Spain (COPE)
- Rheraya Catchment, Morocco (COPE)
- Rofental High Alpine Research Basin, Austria (COPE)
- Salcca-Sibinacocha, Peru (COPE)
- Valle Hermoso, Chile (COPE)
- Wolf Creek, Canada (COPE)
- Zugspitze Catchment, Germany (COPE)

Catalogued INARCH/COPE Data

GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

COPE Field Campaign Catchment Index

COPE (Common Observation Period Experiment) Project
COPE Catchment Map

- Brewster Glacier, New Zealand (COPE)
- Bridger Range, USA (Cope)
- Dischma/Davos, Switzerland (COPE)
- Djankuat Research Basin, Russia (COPE)
- Estero Las Bayas, Chile (COPE)
- Fortress Mountain, Canada (COPE)
- Langtang Catchment, Nepal (COPE)
- Marmot Creek, Canada (COPE)
- Rheraya Catchment, Morocco (COPE)
- Rofental High Alpine Research Basin, Austria (COPE)
- Salcca-Sibinacocha, Peru (COPE)
- Valle Hermoso, Chile (COPE)
- Wolf Creek, Canada (COPE)
- Zugspitze Catchment, Germany (COPE)

GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

Marmot Creek, Canada (COPE)

Page link

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

Catchment Information Map of Catchment and Site Location(s)

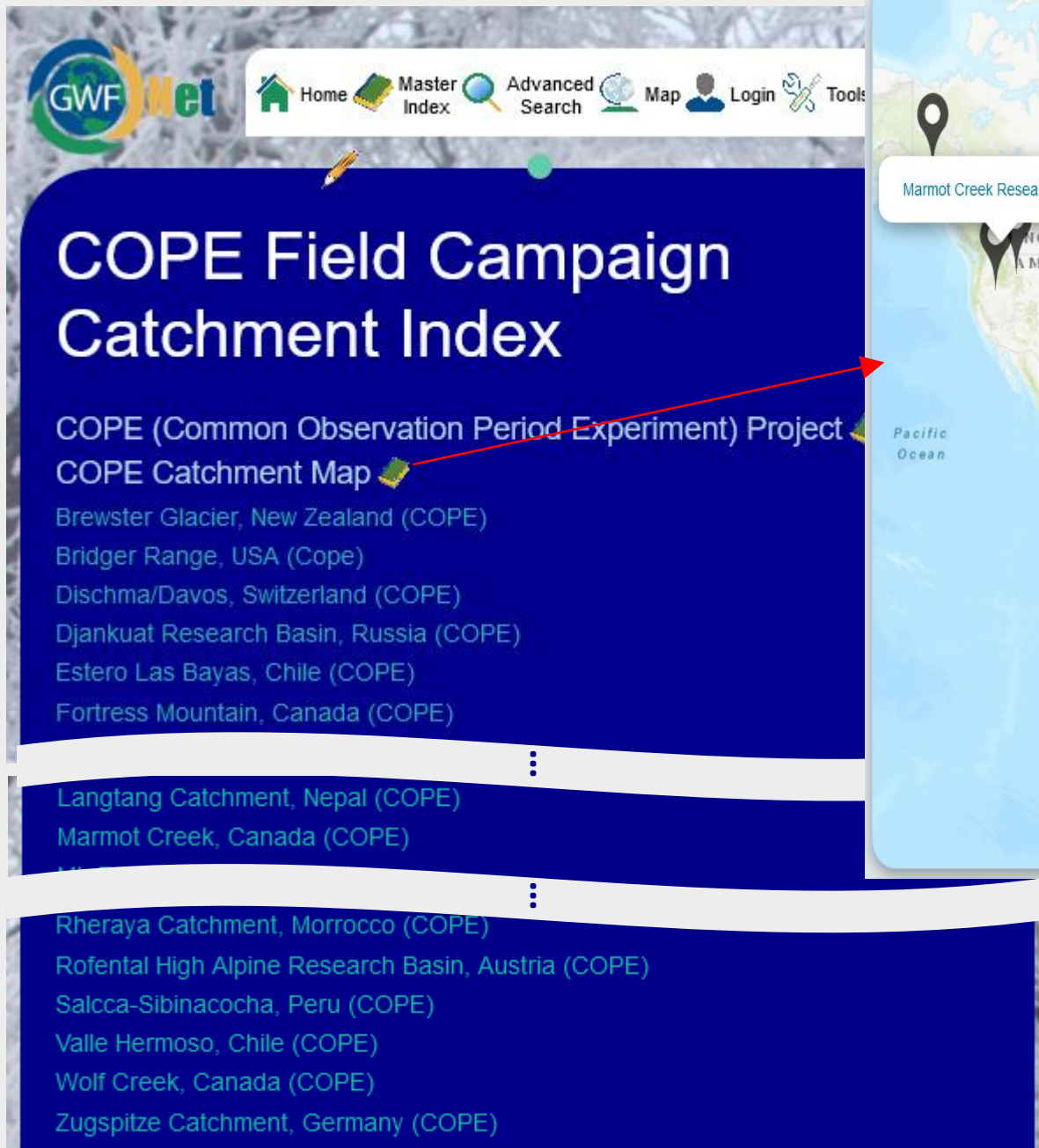
Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies

Catalogued INARCH/COPE Data

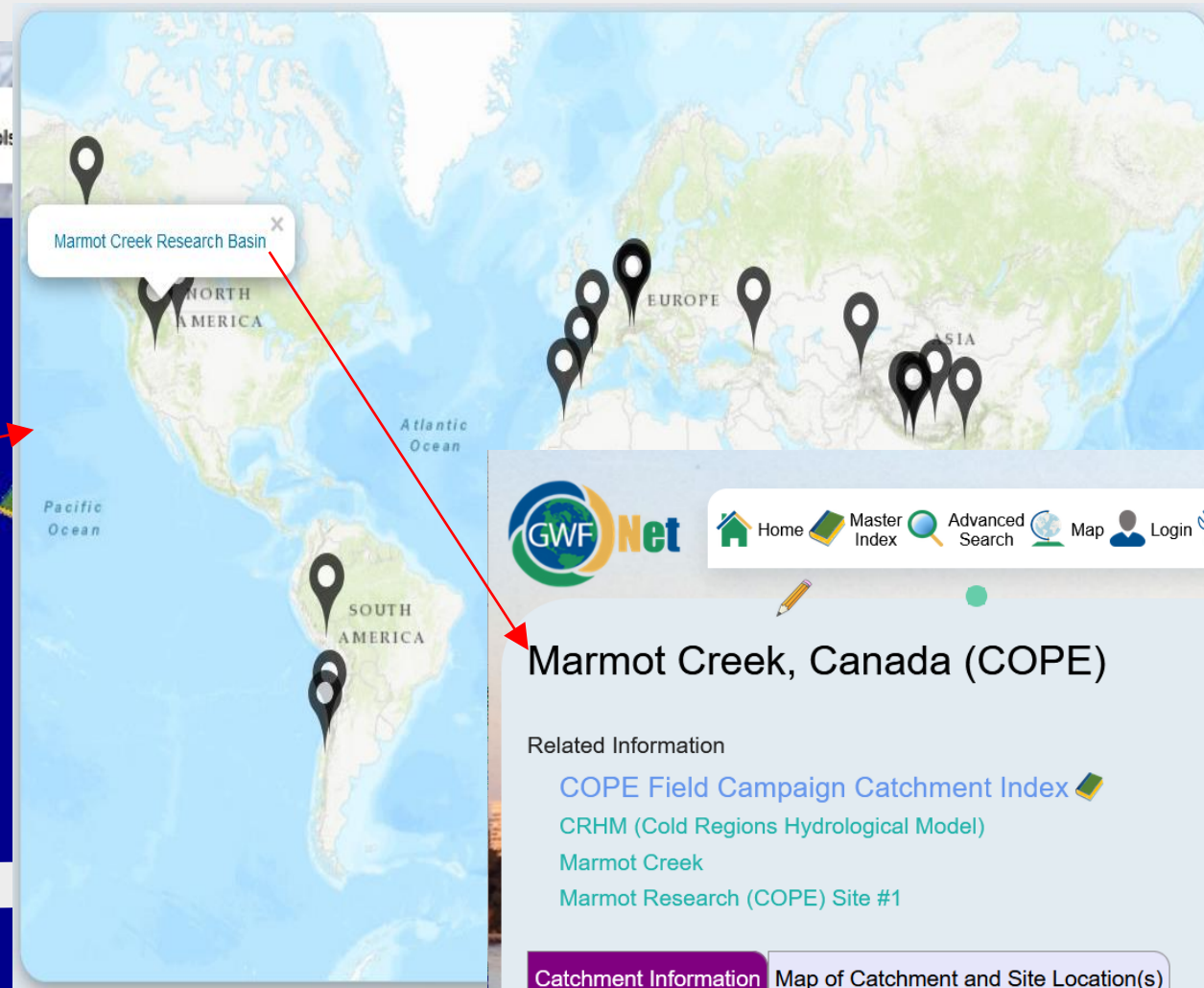


GWF Net Home Master Index Advanced Search Map Login Tools

COPE Field Campaign Catchment Index

COPE (Common Observation Period Experiment) Project
COPE Catchment Map

- Brewster Glacier, New Zealand (COPE)
- Bridger Range, USA (COPE)
- Dischma/Davos, Switzerland (COPE)
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- Wolf Creek, Canada (COPE)
- Zugspitze Catchment, Germany (COPE)



GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

Marmot Creek, Canada (COPE)

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

Catchment Information Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies

Catalogued INARCH/COPE Data

The screenshot shows the GWF Net web application interface. At the top, there is a navigation bar with icons for Home, Master Index, Advanced Search, Map, Login, Tools, and GeoNet. Below the navigation bar, the page title is "Marmot Creek, Canada (COPE)". To the right of the title is a "Page link" icon. Under "Related Information", there are links for "COPE Field Campaign Catchment Index", "CRHM (Cold Regions Hydrological Model)", "Marmot Creek", and "Marmot Research (COPE) Site #1". A "Catchment Information" tab is selected, showing a "Map of Catchment and Site Location(s)". The main section is titled "Section 1: Catchment Information" and contains the following details:

- Catchment Name:** Marmot Creek
- Country:** Canada
- Mountain Range:** Canadian Rockies

Below the text is a large aerial photograph of a mountainous region. A yellow outline highlights the "Marmot Basin". Other geographical features are labeled: "Bow River" in the upper right and "Kaminuska River" in the lower left.

Primary Contacts

Name	Role	Institution, Country, and Contact Information
John Pomeroy	Primary Contact	

Catchment Location

Coordinate Format	Latitude	Longitude
Degrees Minutes Seconds	50° 57' 40.536" N	115° 11' 22.632" W
Decimal Degrees	50.96126	-115.18962

Elevation

Minimum	Maximum
1590 m a.s.l.	2829 m a.s.l.

Area

9.4 km²

Glaciarized Area (%)

0

Main Land Covers

Montane, subalpine, alpine

Lithology

Conglomerate, sandstones, shales, siltstones

Mean DJFM Temperature

-8.3°C (2325 m.a.s.l.), -7.3 °C (1845 m.a.s.l.), -5.6°C (1436 m.a.s.l.)

Mean DJFM Precipitation

279 mm (2325 m.a.s.l.), 147 mm (1845 m.a.s.l.), 107 mm (1436 m.a.s.l.)

Snow Characteristics

cold continental, deep

Additional Features of this Catchment

Feature	Value

Additional Information (notes, web addresses, etc.)

Marmot Creek Stations (links to real-time data):

Centennial Ridge: <http://giws.usask.ca/cfh/Marmot/Nakiskachart.html>

Fisera Ridge: <http://giws.usask.ca/cfh/Marmot/Fiserachart.html>

Hay Meadow: <http://giws.usask.ca/cfh/Marmot/HayMeadowchart.html>

Upper Clearing: <http://giws.usask.ca/cfh/Marmot/UpperClearingchart.html>

Vista View: <http://giws.usask.ca/cfh/Marmot/VistaViewchart.html>

Catalogued INARCH/COPE Data

Marmot Creek, Canada (COPE)

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies

Primary Contacts

Name	Role	Institution, Country, and Contact Information
John Pomeroy	Primary Contact	

Marmot Research (COPE) Site #1



Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
- [Marmot Creek, Fisera Ridge Station](#)
- [Marmot Creek, Hay Meadow Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Upper Clearing Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

- Site Overview
- Map
- Forcing Data**
- Hydrological Instrumentation
- Hydrometric/Cryospheric Measurements
- Hydrological Modelling Data

Section 3: Forcing Data

Standard Forcing Variables

Forcing Variable	Instrumentation Description	Temporal Resolution
T	Vaisala	
RH	Vaisala	
K in	Kipp&Zonen, Apogee CS300-L, Li-cor LI200s	
K out	Kipp&Zonen, Apogee CS300-L, Li-cor LI200s	
L in	Kipp&Zonen	
L out	Kipp&Zonen	
Net Radiometer	Kipp&Zonen	
Wind Speed	RM Young 05305-10, RM Young 05105-10, Met One 50.5, 3-cup anemometer	
Wind Direction	RM Young 05305-10, RM Young 05105-10, Met One 50.5	
Precipitation	Geonor T200B gauge with alter shield, Texas TE525M rain gauge, Hydrological Services TB4 tipping bucket rain gauge	

Catalogued INARCH/COPE Data

GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

Marmot Creek, Canada (COPE)

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)


Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies



Primary Contacts

Name	Role	Institution, Country, and Contact Information
John Pomeroy	Primary Contact	

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
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- [Marmot Creek, Hay Meadow Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Upper Clearing Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

- Site Overview
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- Hydrometric/Cryospheric Measurements
- Hydrological Modelling Data

Section 4: Hydrological Instrumentation

Standard Hydrological Instrumentation (including sensor name and model)

Hydrological Variable	Instrumentation Description	Temporal Resolution
Water Level	Solinst Levellogger	
Discharge Method	Basin discharge -1962 to 19 June 2013 measured by Water Survey of Canada at V-notch gauge (05BF016); -from 26 June 2013 to current, basin discharge	
Water Temperature	Solinst Levellogger	
Isotope Types (e.g., O18, D, T)		
Water Conductivity		
Turbidity		
Sediment Load (Gravels)		
Water Sampling Hydrogeochemistry (Elements)		
Groundwater Level	Yes, Groundwater Observation Well Network from Alberta Environment and Parks	
Soil Moisture	Yes, CS615 and CS616 soil moisture probes	

Catalogued INARCH/COPE Data

GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

Marmot Creek, Canada (COPE)

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Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
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Primary Contacts

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Marmot Research (COPE) Site #1

Related Information

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- [Marmot Creek, Upper Clearing Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)


- Site Overview
- Map
- Forcing Data
- Hydrological Instrumentation
- Hydrometric/Cryospheric Measurements**
- Hydrological Modelling Data

Section 5: Hydrometric/Cryospheric Measurements

Standard Hydrometric/Cryospheric Measurements

Hydrometric/Cryospheric Variable	Measurement Description	Temporal Resolution
Terrestrial Laser Scanner	Yes, at a forest clearing for 2013-2014 field season	N/A
UAV Sensors	2019 operations in past near Upper Clearing (additional permitting challenges limits flexibility)	N/A
Snow Surveys	Yes, several manual snow survey transects located in and above alpine treeline, in subalpine forest, forest clearings, and valley bottom	N/A
Time-lapse Photographs	Yes	
SWE Instruments, Pillows	Sommer Snow Pack Analyzer (SPA)	every 15 minutes
Snow Depth	CS SR50	every 15 minutes
Soil Temperature	CS 107 thermistor, Type K Thermocouple, Stevens HydraProbe	
Surface Temperature	IRTC homemade sensor	
Eddy Covariance	No	
Ice Elevation	N/A	N/A
Debris Covered Ice Elevation	N/A	N/A

Catalogued INARCH/COPE Data

 [Home](#) [Master Index](#) [Advanced Search](#) [Map](#) [Login](#) [Tools](#) [GeoNet](#)

Marmot Creek, Canada (COPE)

[Page link](#)

Related Information

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Catchment Information [Map of Catchment and Site Location\(s\)](#)

Section 1: Catchment Information

Catchment Name
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Marmot Research (COPE) Site #1



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- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

[Site Overview](#) [Map](#) [Forcing Data](#) [Hydrological Instrumentation](#) [Hydrometric/Cryospheric Measurements](#)

Hydrological Modelling Data

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Catalogued INARCH/COPE Data

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
- [Marmot Creek, Fisera Ridge Station](#)
- [Marmot Creek, Hay Meadow Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Upper Clearing Station \(THIS RECORD BEING EDITED\)](#)
- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

- Site Overview
- Map
- Forcing Data
- Hydrological Instrumentation
- Hydrometric/Cryospheric Measurements

Hydrological Modelling Data

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

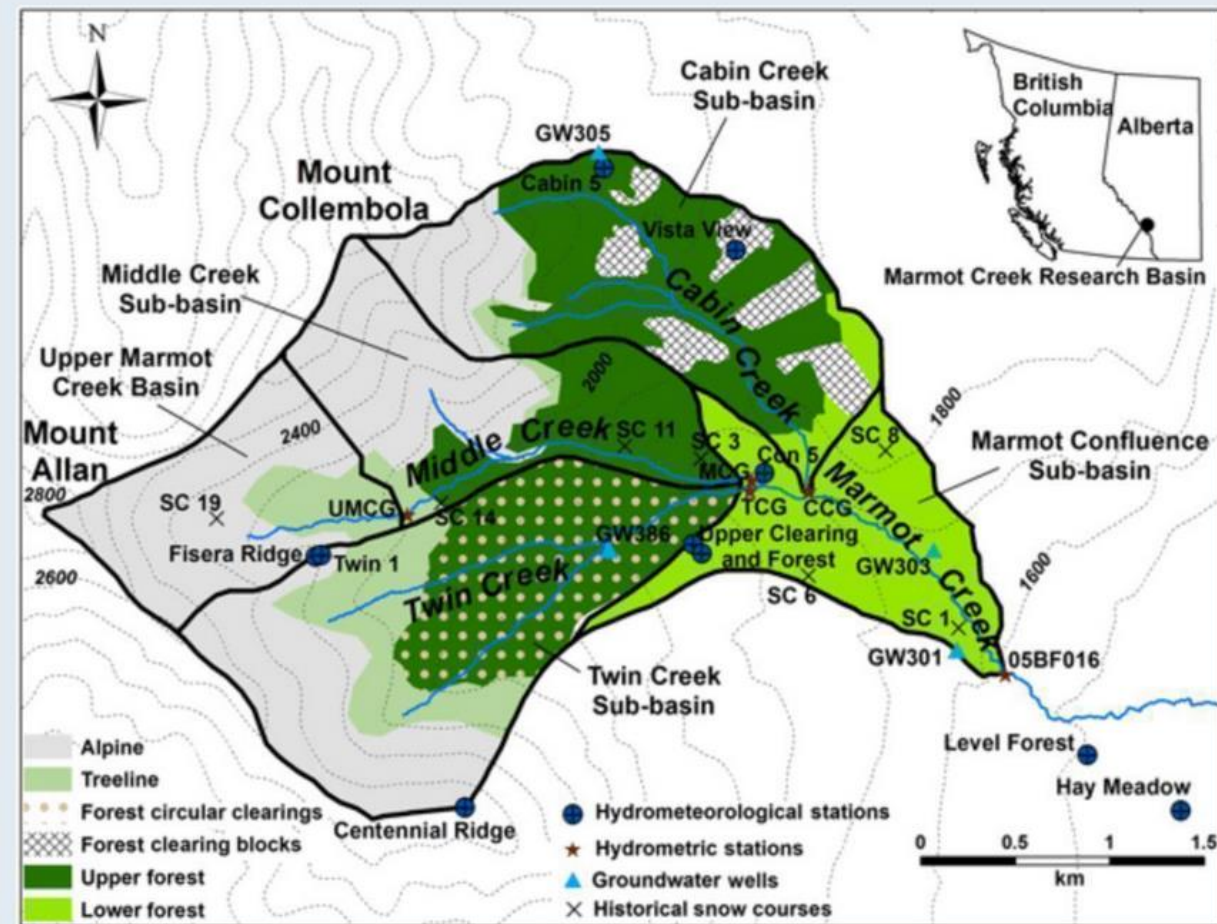
Marmot Creek, Centennial Ridge Station

Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

- Station Metadata
- Quality Control
- Instrument Measurements
- Station Maintenance
- Map
- Additional Information

Section 1: Station Metadata



Catalogued INARCH/COPE Data

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
- [Marmot Creek, Fisera Ridge Station](#)
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- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

- [Site Overview](#)
- [Map](#)
- [Forcing Data](#)
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- [Hydrometric/Cryospheric Measurements](#)
- [Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station



Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

- [Station Metadata](#)
- [Quality Control](#)
- [Instrument Measurements](#)
- [Station Maintenance](#)
- [Map](#)
- [Additional Information](#)

Observatory Station Summary

Station Name	Centennial Ridge
Location	Marmot Creek, Kananaskis, Alberta
GPS Coordinates	UTM 11 626894E; 5645229N long: -115.1937° lat: 50.9447°
Elevation	2470 m
Data Logger	CR1000 (SN:63333)
Program Name	Centennial115G01
Installation Date	July 23rd, 2005
Power	120Ah battery with 30W solar panel
Telemetry	RF401
Miscellany	

Detailed Metadata

Instrument	Manufacturer	Variable	Variable Name
HMP45C212	Vaisala	Air Temperature	HMP45C212T
		RH	HMP45C212RH
		RH	RHcorrected
05105-10 Wind Monitor	RM Young	Wind Speed	WindSpeed
		Wind Direction	WindDir
TE525M	Texas Instruments	Rainfall	Rainfall
SR50A Sonic Ranger	Campbell Scientific	Snow Depth	SnowDepth
		Signal Quality	SignalQuality
107B	Campbell Scientific	Soil Temperature	SoilT5
			SoilT15
L10000	Lisar	Incoming Shortwave Radiation	Sun

Catalogued INARCH/COPE Data

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
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[Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station



Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

[Station Metadata](#) [Quality Control](#) [Instrument Measurements](#) [Station Maintenance](#) [Map](#) [Additional Information](#)

Section 2: Quality Control

Date Updated

2020-04-20

Is QC in Effect?

- Yes
- Yes (but see Notes for exceptions)
- No

Quality Control Parameter Table

Parameter	Data Logger Actions	MatLab QC Actions	Further Actions R
Air Temp			
RH Corrected	corrected for air temp < 0. if RH > 100 then RH=0		
Incoming SW			
Outgoing SW			
Snow Depth	corrected for air temp		
Windspeed			
Wind Direction			
Rainfall			
Soil temp 15			
Soil Temp 5			
Pressure	adjusted to sea level		

Notes

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
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- [Marmot Creek, Fisera Ridge Station](#)
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[Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station



Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

[Station Metadata](#) [Quality Control](#) [Instrument Measurements](#) [Station Maintenance](#) [Map](#) [Additional Information](#)

Section 3: Instrument Measurements

Measurement Table

Instrument	Variable	Measurement Type	Frequency
HC2-S3	HMP45C212T	Average	15 min
	HMP45C212RH	Average	15 min
	RHcorrected	Average	15 min
05305-10	WindSpeed	WindVector	15 min
	WindDir	WindVector	15 min
	WindDir_StDev	WindVector	15 min
SR50A	SnowDepth	Average	15 min
	SignalQuality	Average	15 min
LI200S	Swin	Average	15 min
	Swout	Average	15 min
TE525M	Rainfall	Totalize	15 min
107B	SoilT5	Average	15 min
	SoilT15		15 min
CS106 Battery	Pressure	Sample	15 min
		Maximum	Daily
		Minimum	Daily
Logger	Ptemp	Maximum	Daily
		Minimum	Daily
HC2-S3	HMP45C212T	Average	Daily
	HMP45C212T	Maximum	Daily

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
- [Marmot Creek, Fisera Ridge Station](#)
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Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station



Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

[Station Metadata](#) [Quality Control](#) [Instrument Measurements](#) [Station Maintenance](#) [Map](#) [Additional Information](#)

Section 4: Station Maintenance

Install Date

July 23rd, 2005

Installer

Mike Solohub

Original Installation

Instrument	Height	Notes
107 B Soil Temperature	5 cm and 15 cm below surface	
NRG wind direction	223 cm	
NRG wind speed	223 cm	
SR50	127.4 cm	
LI200S (Incoming)	155.7 cm	
LI200S (Outgoing)	144 cm	
TB4	65 cm	
HMP35C	224 cm	
Particle Detector	82.5 cm	

Station Maintenance and Changes

Date	Maintenance Performed	Old Serial Number	New Serial Number
2019-11-18	Coordinates - Updated according to Xing Fang's corrections		
08-Aug-18	Update CR1000 OS and Cell Modem TBD date of completion		
08-Aug-18	Replaced TE525M tipping bucket that was lost by wind with new TB4	13273-394	118-257
01-Feb-17	Replaced broken RM Young with new unit		
04 2014	CR10X out - CR1000 In		
Jul 3rd, 2013	SR45 Out - SR50A In		
Aug 19th, 2010	HMP35C out - HMP45C212 In		
2008/2009	CR21 out - CR10X In		
2008/2009	CR21 out - CR10X In		

Catalogued INARCH/COPE Data

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
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[Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station

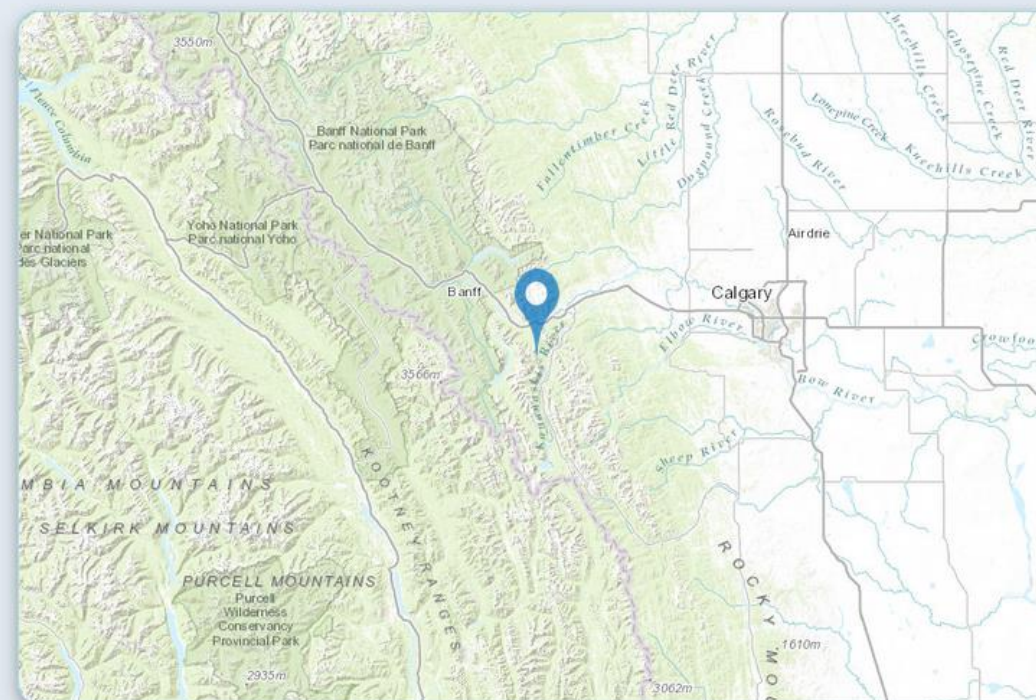
Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

[Station Metadata](#) [Quality Control](#) [Instrument Measurements](#) [Station Maintenance](#) [Map](#) [Additional Information](#)

Section 5: Map

Station Location



[Toggle Interactive](#)

- +

[Center](#) [Reset](#)

Display [Topo \(ArcGIS\)](#)

[View on Global Map](#)

Catalogued INARCH/COPE Data

Marmot Research (COPE) Site #1

Related Information

- [Marmot Creek, Canada \(COPE\)](#)
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[Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Creek, Centennial Ridge Station



Related Information

- [Stations](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

[Station Metadata](#) [Quality Control](#) [Instrument Measurements](#) [Station Maintenance](#) [Map](#) [Additional Information](#)

Section 6: Additional Information

Additional Information (notes, web addresses, etc.)

Real-time data:

<http://giws.usask.ca/cfh/Marmot/Nakiskachart.html>

Marmot Research (COPE) Site #1



Related Information

[Marmot Creek, Canada \(COPE\)](#)

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[Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Research (COPE) Site #1



Related Information

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- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

Site Overview | Map | Forcing Data | Hydrological Instrumentation | Hydrometric/Cryospheric Measurements | **Hydrological Modelling Data**

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Marmot Research (COPE) Site #1



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- [Map](#)
- [Forcing Data](#)
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- [Hydrometric/Cryospheric Measurements](#)
- [Hydrological Modelling Data](#)

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

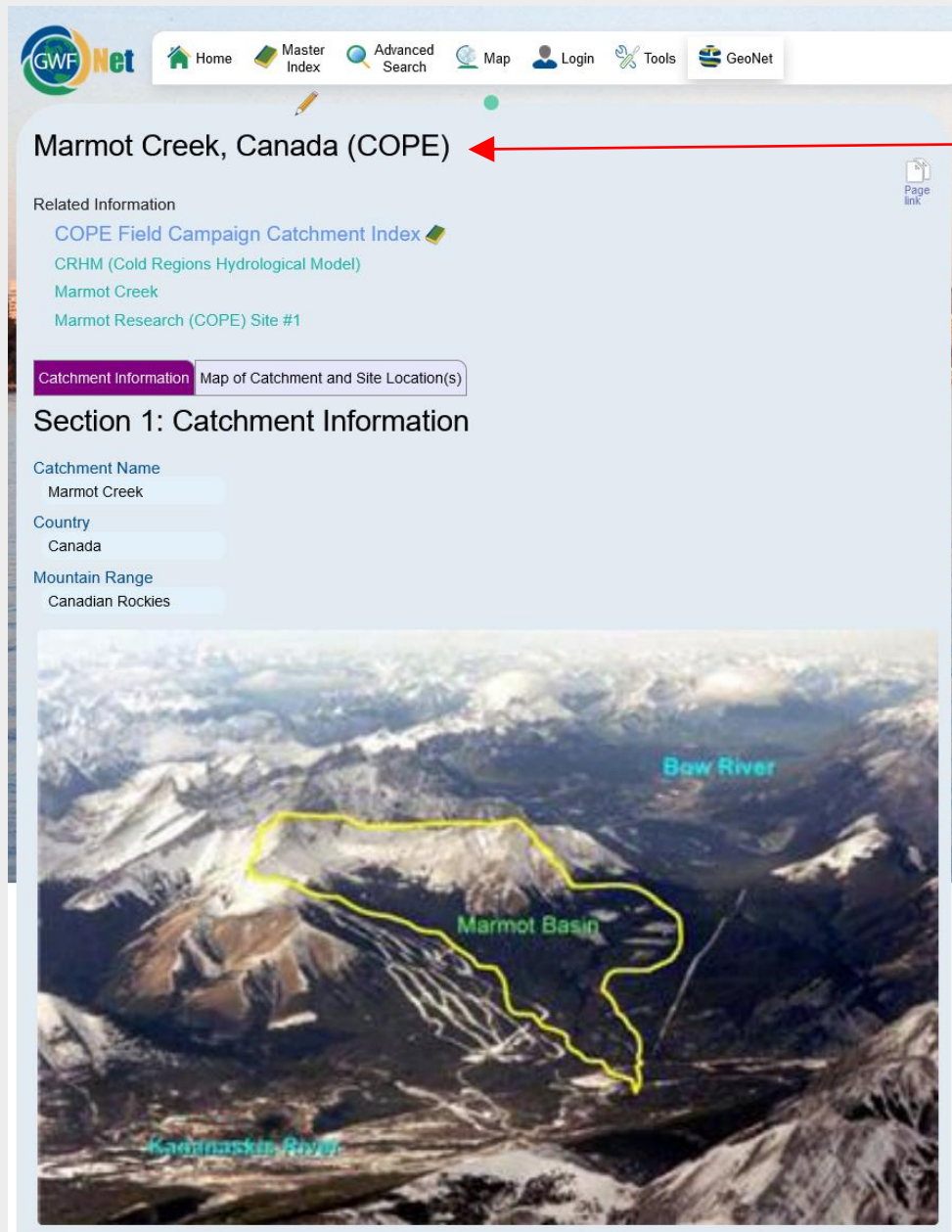
Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Catalogued INARCH/COPE Data



GWF Net Home Master Index Advanced Search Map Login Tools GeoNet

Marmot Creek, Canada (COPE)

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)


Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies



Marmot Research (COPE) Site #1



Related Information

- [Marmot Creek, Canada \(COPE\)](#)
- [Marmot Creek, Centennial Ridge Station](#)
- [Marmot Creek, Fisera Ridge Station](#)
- [Marmot Creek, Hay Meadow Station \(THIS RECORD BEING EDITED\)](#)
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- [Marmot Creek, Vista View Station \(THIS RECORD BEING EDITED\)](#)

Site Overview | Map | Forcing Data | Hydrological Instrumentation | Hydrometric/Cryospheric Measurements

Hydrological Modelling Data

Section 6: Hydrological Modelling Data

Vegetation Map

Forest cover type map from Alberta Forest Service (1963), SPOT5 (July 2007)

Soil Map

No

Soil Depth Information

Yes

Digital Elevation Map (and Spatial Resolution)

Yes, 1 m Lidar and 8 m resampled Lidar

Additional Modelling Information

Catalogued INARCH/COPE Data

Marmot Creek, Canada (COPE)

Related Information

- [COPE Field Campaign Catchment Index](#)
- [CRHM \(Cold Regions Hydrological Model\)](#)
- [Marmot Creek](#)
- [Marmot Research \(COPE\) Site #1](#)

Catchment Information | Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name
Marmot Creek

Country
Canada

Mountain Range
Canadian Rockies

CRHM (Cold Regions Hydrological Model)

Related Information

- [All Models](#)
- [COPE Models](#)
- [CRHM model projects outputs](#)
- [Fortress Mountain, Canada \(COPE\)](#)
- [Marmot Creek, Canada \(COPE\)](#)
- [Modelling Research of Kevin Shook \(Next Gen\)](#)
- [Modelling Research of Logan Fang](#)
- [Wolf Creek, Canada \(COPE\)](#)

Model Information | Inputs | Outputs | Workflow

Section 1: Model Information

Name (e.g., CRHM)
CRHM

Full Name (e.g., Cold Regions Hydrological Model)
Cold Regions Hydrological Model

Description

CRHM is a (modular) framework which integrates researcher-selected numerical algorithms to model hydrological processes in small- to medium-sized catchments to enable the investigation of hydrological conditions for a wide variety of landscape/climate combinations.

Section 1: Model Information

Name (e.g., CRHM)

CRHM

Full Name (e.g., Cold Regions Hydrological Model)

Cold Regions Hydrological Model

Description

CRHM is a (modular) framework which integrates researcher-selected numerical algorithms to model hydrological processes in small- to medium-sized catchments to enable the investigation of hydrological conditions for a wide variety of landscape/climate combinations.

Processes modelled may include:

- blowing snow redistribution
- snow and rain interception by forest canopies
- sublimation
- snowmelt in open and forested environments
- infiltration into frozen and unfrozen soils
- soil moisture storage and movement
- water movement along hillslopes (with and without permafrost)
- actual evaporation and evapotranspiration
- radiation exchange on complex surfaces and through vegetation
- wetland dynamics
- variable contributing area
- groundwater flow
- streamflow hydraulics
- gravitational snow transport
- glacier melt

CRHM incorporates information about distinct landscape elements called Hydrological Response Units (HRUs). HRUs can be linked in process-specific sequences such as blowing snow, overland flow, organic layer subsurface flow, mineral interflow, groundwater flow, and streamflow.

More information about the system is included in C.R. Ellis, J.W. Pomeroy, T. Brown, and J. MacDonald 2010: Simulation of snow accumulation and melt in needleleaf forest environments *Hydrology and Earth System Sciences* 14: pp. 925–940.

https://research-groups.usask.ca/hydrology/documents/downloads/Ellis_etal_2010_HESS.pdf

Technical Details:

<https://research-groups.usask.ca/hydrology/modelling/crhm.php#TechnicalDetails>

Other links:

<https://www.doi.org/10.1002/hyp.6787>

https://research-groups.usask.ca/hydrology/modelling/crhm_manual_march_15_2013.pdf (CRHM Manual PDF)

Institution

University of Saskatchewan

Purpose

Models an investigator-selected variety of hydrological processes (see list in Description) in small- to medium-sized catchments.

Contact Persons

Name	Role	Contact Information
John Pomeroy	Main Investigator	john.pomeroy@usask.ca
Logan (Xing) Fang	Model Development	xing.fang@usask.ca

Catalogued INARCH/COPE Data

Model Information **Inputs** Outputs Workflow

Section 2: Inputs

Minimum Input Data

Input Data	Units (if specific or preferred)	Additional Information
Temperature		
Relative Humidity		
Shortwave Radiation In		When unavailable, model can estimate it
Wind Speed		
Precipitation		

Optimal Input Data (additional to above minimal input data)

Additional Input Data	Units (if specific or preferred)	Additional Information

Calibration Data

No formal calibration

Validation Data

SWE, snow depth, albedo, glacier ablation stakes, soil moisture, and streamflow

Section 3: Outputs

Model Outputs

Outputs	Additional Information
Mass and energy fluxes for snowpack and glacier, water balance	

Processes Modelled

Processes	Additional Information
blowing snow redistribution	
snow and rain interception by forest canopies	
sublimation	
snowmelt in open and forested environments	
infiltration into frozen and unfrozen soils	
soil moisture storage and movement	
water movement along hillslopes (with and without permafrost)	
actual evaporation and evapotranspiration	
radiation exchange on complex surfaces and through vegetation	
wetland dynamics	
variable contributing area	
groundwater flow	
streamflow hydraulics	
gravitational snow transport	
glacier melt	

Spatial Resolution

HRU scale

Temporal Resolution

Sub-daily (ideally hourly)

Strengths and Limitations

- Station data are not readily available for all catchments
- Data may contain long gaps

External and Internal Tools

- R package (CRHMr) for filling data through interpolation
- R package (Reanalysis) for creating CRHM .obs files from gridded data

Source Code Availability

Module code and tools are publicly available (with examples)

Data Sources

Station (ECCC, provincial, research site) and Reanalysis data

File Formats

Timeseries stored in flat ASCII (.obs)

Section 4: Workflow

Model Workflow

1. Download station data
2. QA/QC (manual/ using CRHMr package)
3. Filling the gaps in data through interpolation/ imputation using CRHMr
4. Create .obs files of forcing timeseries using CRHMr

See <https://research-groups.usask.ca/hydrology/modelling/crhm.php#TechnicalDetails>

Notes

Empty text area for notes.

Advanced Search

Advanced Search

Show Instructions

Global Search

Search Term or Ref# (all or part)

Find

- Match All Fields
 Match Any Fields

Clear

Set Output Variables

Template-based Search

Choose Template:

Publication_v1.0.xml

Record Title

Publication Abstract Download Computed Information

Section 1: Publication

Authorship

Pomeroy & Clark

Title

Year

2020 || 2021

Publication Outlet

DOI

Search Results

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389 results found

1 Publication 1.0

T-2021-11-12-b10XOum3j0EuNxVtfuyS5TA

RecordTitle

Publication 2018: ESM-SnowMIP: Assessing models and quantifying snow-related climate feedbacks

Authorship

Krinner, G., Derksen, C., Essery, R., Flanner, M., Hagemann, S., Clark, M., Hall, A., Rott, H., Brutel-Vuilment, C., Kim, H., Ménard, C., Mudryk, L., Thackeray, C., Arduini, G., Bartlett, P., Boone, A., Chéruy, F., Colin, J., Cuntz, M., Dai, Y., Decharme, B., Derry, J., Ducharme, A., Dutra, E., Fang, X., Fierz, C., Ghattas, J., Gusev, Y., Haverd, V., Kontu, A., Lafaysse, M., Law, R., Lawrence, D., Li, W., Marke, T., Marks, D., Nasonova, O., Nitta, T., Niwano, M., Pomeroy, J., Raleigh, M.S., Schaedler, G., Semenov, V., Smirnova, T., Stacke, T., Strasser, U., Svenson, S., Turkov, D., Wang, L., Wang, T., Wever, N., Yuan, H. and Zhou, W.

Title

ESM-SnowMIP: Assessing models and quantifying snow-related climate feedbacks

Year

2018

2 Publication 1.0

T-2021-11-14-p1Ly4JVLp2CUK3H0WtZvU2vQ

RecordTitle

Publication 2020: Impacts of predicting the liquid fraction of mixed-phase particles on the simulation of an extreme freezing rain event: the 1998 North American Ice Storm

Authorship

Cholette, M., Thériault, J. M., Milbrandt, J. A., & Morrison, H.

Title

Impacts of predicting the liquid fraction of mixed-phase particles on the simulation of an extreme freezing rain event: the 1998 North American Ice Storm

Year

2020

Advanced Search

Template-based Search

Choose Template:

COPE_Research_Site_v1.0.xml

Record Title

Site Overview Map **Forcing Data** Hydrological Instrumentation Hydrometric/Cryospheric Measurements

Hydrological Modelling Data

Section 3: Forcing Data

Standard Forcing Variables

Forcing Variable	Instrumentation Description	Temporal Resolution
T		Select option
RH		Select option
K in		Select option
K out		Select option
L in	Kipp and Zonen	Select option



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Map

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Tools

GeoNet

Brewster Glacier Research Site #1

Related Information

[Brewster Glacier, New Zealand \(COPE\)](#)

Site Overview Map **Forcing Data** Hydrological Instrumentation Hydrometric/Cryospheric Measurements

Hydrological Modelling Data

Section 3: Forcing Data

Standard Forcing Variables

Forcing Variable	Instrumentation Description	Temporal Resolution
T	Vaisala HMP 45 AC	
RH	Vaisala HMP 45 AC	
K in	Kipp and Zonen CNR1	
K out	Kipp and Zonen CNR1	
L in	Kipp and Zonen CNR1	
L out	Kipp and Zonen CNR1	
Net Radiometer	Kipp and Zonen CNR1	
Wind Speed	RM Young 0 1503	
Wind Direction	RM Young 0 1503	
Precipitation	TB4	
Pressure	Vaisala PTB 110	

Additional Forcing Variables

Variable	Instrumentation Description	Temporal Resolution
		Select option

Additional Forcing Variable Information

Advanced Search

- Select Template (e.g., Catchment) and immediately press Find -- gives list of all Catchment records!

Global Search

Search Term or Ref# (all or part)

Find

Match All Fields
 Match Any Fields

Clear

Set Output Variables

Template-based Search

Choose Template:

COPE_Catchment_v1.0.xml

Record Title

Catchment Information Map of Catchment and Site Location(s)

Section 1: Catchment Information

Catchment Name

Country

Mountain Range

Primary Contacts

Table with columns: Name, Role, and Institution, Country, and Contact Information

Catchment Location

Coordinate Format	Latitude	Longitude
Degrees Minutes Seconds		

GWFF Net

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Search Results

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23 results found

- COPE Catchment 1.0

[T-2022-05-11-C1Y8eNFdy062nK9B0AUFig](#)

RecordTitle
Brewster Glacier, New Zealand (COPE)

COPECatchmentName
Brewster Glacier

COPECatchmentCountry
New Zealand
- COPE Catchment 1.0

[T-2022-08-11-Z12HHaDnKRECZ2VLrmFRQAgg](#)

RecordTitle
Bridger Range, USA (Cope)

COPECatchmentName
Bridger Range

COPECatchmentCountry
USA
- COPE Catchment 1.0

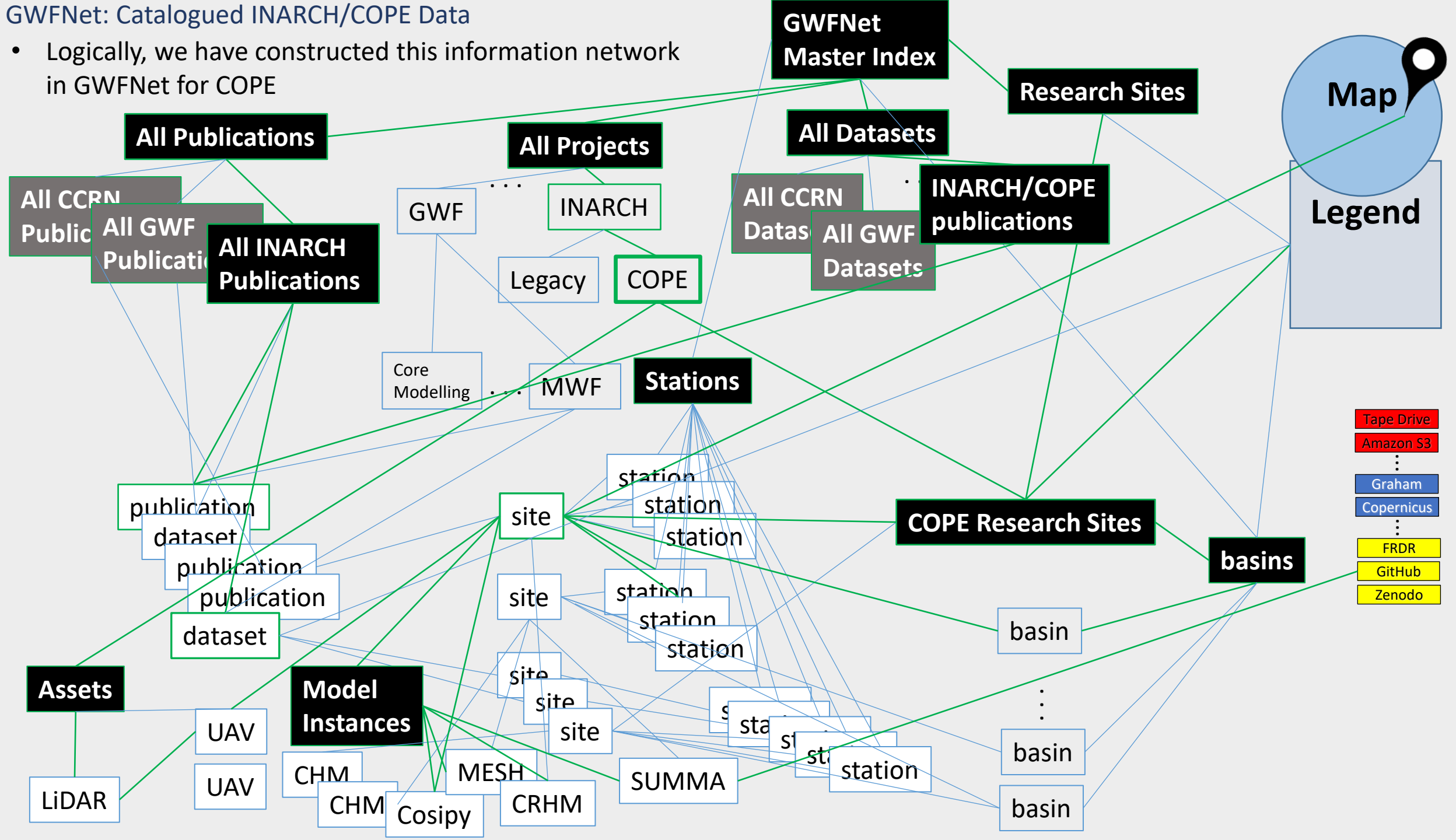
[T-2022-09-22-r104BzN4XuUebMr1r2OyAMaRA](#)

RecordTitle
Dischma/Davos, Switzerland (COPE)

COPECatchmentName
Dischma/Davos

GWFNet: Catalogued INARCH/COPE Data

- Logically, we have constructed this information network in GWFNet for COPE



Additional Information and Detail Requested

Additional Information and Detail Requested

- site names (even for just one site rather than site #1) and exact latitude and longitude locations
- station names and exact latitude and longitude locations
- detailed lists of instrumentation at each site and station
- measurement frequencies at stations
- download locations for:
 - vegetation maps
 - digital elevation maps
 - soil depth
 - snow survey data
 - anything else you find relevant

The End
Thank you!

