



the cci toolbox newsletter

ISSUE 01 | DECEMBER 2017



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The CCI Toolbox project partners comprise Brockmann Consult GmbH, Telespazio VEGA UK, S[&]T, Deutscher Wetterdienst, University of Reading, University of Zurich, and is supported by the European Space Agency (ESA) as part of the Climate Change Initiative (CCI). The CCI Toolbox has been produced by Carsten Brockmann (Science Lead), Norman Fomferra (Technical Lead), Anna Corlyon (Project Manager), Tom Block, Marco Zühlke, Susan Smollich, Janis Gailis, Dag Evensberget, Krzysztof Bernat, Rainer Hollmann, Stephan Herzog, Petra Fuchs, Luzia Keupp, Chris Merchant, Kevin Pearson, Frank Paul, Fay Done, Helen Clifton, Ed Pechorro (ESA Technical Manager), Simon Pinnock (ESA Technical Officer).



contents

welcome

news

who is the toolbox for
champion users' feedback

operations of the toolbox

behind the toolbox

development roadmap

join the toolbox

terms & conditions

welcome

Climate Change is impacting our lives, tomorrow as well as today. Understanding Climate Change requires data, people, and enabling technologies. The European Space Agency is running the Climate Change Initiative, briefly called CCI, a 140M€ programme, to provide an adequate, comprehensive, and timely response to the extremely challenging set of requirements for long-term satellite-based products for climate. The CCI Toolbox, Cate, is an enabling technology which connects scientists, decision makers and knowable public to CCI, and other climate data. Cate version 1 has been released in autumn this year and is now used by scientists for their daily work. In this winter edition of the newsletter we highlight the key innovations brought by Cate v1. CCI is a long term programme, and in the roadmap section we tell you our plans for future releases. However, Cate is an open source project, driven by user's requirements and implemented in an agile software development process. Your feedback, requirements and priorities will help us shaping Cate to optimally support your work for understanding Climate Change.

Enjoy reading!



3

Number of CCI Toolbox user interfaces.

news

The CCI Toolbox software version 1.0 has arrived! This major milestone was the culmination of a many months of work by the whole of the team. The CCI Toolbox software, called Cate, was released at version 1.0 in November 2017 enables easy access and processing of ESA's growing Climate Dataset. You can find this at climatetoolbox.io.

What is the CCI Toolbox?

ESA Climate Change Initiative (CCI) has produced 14 Essential Climate Variables and will start the development and production of 9 additional ECVs in 2018. All ECVs are stored in and available from the Open Data Portal (cci.esa.int/data). The CCI Toolbox software, Cate, is making these data directly accessible for visualisation, analysis and processing, and allows combining ESA ECVs with other climate data.

How do we decide what goes in releases?

We use climate change Use Cases that are defined by our Champion Users: Twenty two Use Cases have been compiled. They cover a wide range of applications, from high level examples, through scientific questions, e.g. "Renewable Energy Resource Assessment with regard to Topography", to education in "School Seminar Climate and Weather". All the Use Cases can be found here (cate.readthedocs.io/en/latest/use_cases.html#).

Will be actually be useful to the Climate Community?

The CCI Toolbox comprises a rather special team, and an interactive method of working. Cate is developed by team composed of both professional software scientists and climate users, or "Champion Users", as we call them. This means that the climate users are driving the software development. An agile development process has been agreed by users and developers, with 3-monthly releases, which allow users to define features to be implemented and to try out, and test, the successful implementation. This incremental approach with short iteration cycles assures the Toolbox is fit-for-purpose, there are no misunderstandings and we can react to new emerging needs.

How does it CCI Toolbox work?

The CCI Toolbox software, Cate, is a Python package, which provides a command-line interface (CLI), application programming interface (API), and a web API interface. Cate also implements all required climate data visualisation, processing, and analysis functions. It defines a common climate data model and provides a common framework to register, lookup and invoke operations and workflows on data represented in the common data model.



Have a look at our Teaser on YouTube:
www.youtube.com/watch?v=dNEJk0ViZXM

**We hope
you enjoy it!**

who is the toolbox for

Toothbrushes. Cars. Vacuum cleaners. Vegan ice cream. Helicopter rotor blades. What do they all have in common? Users. All have users who rightfully demand that the product suits their needs. In the modern era of mass production, mass information, and mass choice, those products that do not delight, do not inspire or do not meet the basic needs of their target users are soon discarded for fitter products. And so is the same with software, including scientific software.

But software is a little different than all these products, or any other products. Nothing man-made has ever had as many logical 'moving parts' as software.

A contemporary way of managing this complexity is software development is "Agile". Like playing jazz, the Agile methodologies in software development are a specialised framework of rules within which flexibility, innovation and improvisation can then be cultivated and practiced. This (managed) flexibility and free-thinking allows software makers to listen, learn and work alongside the users they are building for.

This is the approach applied in the CCI Toolbox project. Embedded within our team are climate experts who use climate data and climate tools every day. Since software has more parts than toothbrushes (or more ingredients than vegan ice cream), they have been working alongside the CCI Toolbox developers since the start of the project, and will continue to do so.

The embedded users represent our target users for the CCI Toolbox, and these are as follows...

International climate research community

Contributing to Intergovernmental Panel on Climate Change (IPCC) scientific assessments. This includes climate model development, verification and data-assimilation, and scientists performing research on climate change monitoring, detection, attribution and mitigation.

Earth system science community

Working at a higher level than individual climate indicators, interested in Earth processes, interactions and feedbacks involving a fusion of theory, observations and models to which climate indicators can play a role.

Climate service developers and providers

for use in the development and provision of climate services.

International climate research community

Contributing to Intergovernmental Panel on Climate Change (IPCC) scientific assessments. This includes climate model development, verification and data-assimilation, and scientists performing research on climate change monitoring, detection, attribution and mitigation.

International bodies

responsible for climate change policy making and coordination of climate change measurement, mitigation and adaptation efforts.

Undergraduate and postgraduate students

with an academic interest in climate change.

Journalists

writers and other communicators who wish to access and interact with the latest scientific data on climate change.

"CCI
Toolbox –
My first
choice
for a
quick
start with
the CCI
data sets"



Rainer Hollmann
Champion Users Lead

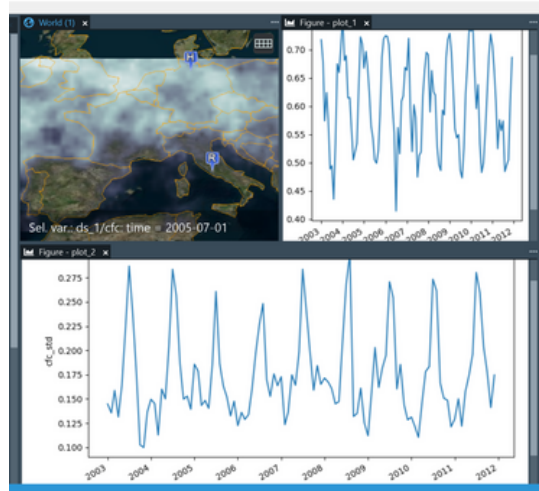
49

Number of operations in the toolbox.

champion users' feedback

As Champion user of the CCI Toolbox (Cate) we have the privilege to drive the scientific development targeted towards our scientific applications and to support the development team to make good choices. In this exercise a lot of scientific based Use Cases have been defined and already realized in Cate. However, here I present a simple use case, recently being confronted with:

Recently during a lesson with students, I was asked to provide a statement about cloud cover for Rome (Italy) and Hamburg (Germany) and how the fractional cloud cover is different. To get a quick idea for an answer on this, I used Cate. I selected quickly the ECV clouds data set from AATSR for the period 2003 to 2012, restricted it to Europe already before performing the download and finally displayed it to the globe. It was then easy to extract the chosen locations from the data sets and to display time series of cloud cover for both cities (see Figure).



The Figure shows the daily mean of fractional cloud fraction for 1st of July 2005 (top left), the time series of fractional cloud cover for Hamburg (top right) and for Rome (bottom), respectively.

From this, I was able to show to the students the main differences in fractional cloud fraction for both cities. Indeed, on average it is a lot more cloudy in Hamburg than in Rome. That's, why it might be nicer to go holiday vacations to Rome. From this simple example, it obvious that Cate is my first choice for a quick start with a CCI data set to support my work.

"I am used to working with many different users; scientists, managers and students. My ambition is to make Cate the tool of choice when a scientifically sound, and technical reliable analysis software is needed by these users.

We have chosen the most popular scientific programming language Python.

We have also allowed all the operations to be critically reviewed by champion users as peers. As a result Cate offers a modern, intuitive graphical user interface to achieve this goal."



Carsten Brockmann
Science Lead



operations of the toolbox

inter-
polation

filtering

temporal
subsetting

oni index

pearson
correlation

histogram
plotting

normalization

internal
anomaly

outlier
detection

long term
average

temporal
aggregation

enso index

46

Number of CCI datasets available through the toolbox.

behind the toolbox



A part of the CCI Toolbox team at DWD Hamburg, from left to right: Chris Bernat, Stephan Herzog, Anna Corlyon, Rainer Hollmann, Marco Zühlke, Janis Gailis, Ed Pechorro, Norman Fomferra

International cooperation. Across science and industry.

Made in Germany (And Norway) [And Switzerland] {And The United Kingdom}.

The CCI Toolbox is built through international cooperation, across science and industry. The project partners comprise *Brockmann Consult GmbH* (Science & technical project lead, Software engineering), *Telespazio VEGA UK Ltd.* (Project management & software engineering), *S[&]T* (Software engineering), *Deutscher Wetterdienst* (Champion user lead, requirements engineering, user operations, feedback provision), *University of Reading* (Champion user), and *University of Zurich* (Champion user).

"I hope
all our
users
will

have as
much fun as the
team has in
developing it."



Norman Fomferra
Technical Lead

22

Number of use cases considered for the design
of the toolbox.

development roadmap

Climate Change science is dealing primarily with time series of global coverage data, i.e. gridded datasets. This is supported in Cate Version 1 by relevant dataset and operations. The next releases will enlarge this scope to ECVs which come as vector data, such as points, lines, or polygons, with associated data attributes. Examples for such datasets are Glaciers and Ice Sheets. We also plan to improve Cate Desktop's user experience in various ways. For example, we'd like to ease working with n-dimensional datasets ($n > 3$) of different spatio-temporal resolution. Another example is operation parameterisation: while users currently have to type or paste coordinates they will later simply select a polygon object on a globe for any parameter of type geometry. We also plan to provide a few code examples and templates that will explain how to use the Cate Python API in your own programs and how to extend Cate by new Python and later also R functions. Finally we want to allow for automatic, patch-level software updates, so you don't have to reinstall the software on every version change.

List of new features to be added in the upcoming year:

- Allow efficient reading, displaying, and processing of *Glacier ECV* and *Ice Sheet ECV* features from ESRI Shapefiles datasets.
- Allow for efficient reading, displaying, and processing of *Land Cover ECV* data from very large gridded datasets.
- Ease working with *spatio-temporal datasets* with more than three dimensions.
- Ease *regridding* to common spatio-temporal resolution.
- Make *parameterisation of dataset operations* more convenient, introduce tools for geometry and time range parameters, support quick lists, drag & drop.
- Provide a new *Timeline GUI Component* that displays availability of ECVs along a time axis and allows for selecting a current point in time or time range.
- Provide a few *Cate plugin* examples showing how to add new data source and new operations using Cate's Python API.
- Introduce *software auto-updates*.



join the toolbox



For information about the CCI Toolbox project, please visit our Website (<http://climatetoolbox.io/>).



For any suggestions, problems, support requests (or even praise) you are invited to post into our User Forum (groups.google.com/forum/#!forum/cci-tools).

If you encounter a not-yet-reported bug, you can also submit it directly into our Issue Tracker (github.com/CCI-Tools/cate/issues).



If you are a developer you may fork our Cate repository on GitHub (github.com/CCI-Tools/cate) and provide fixes and enhancements as pull requests (help.github.com/articles/creating-a-pull-request-from-a-fork/).

Thank you for your contribution!



terms & conditions

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USE OF ESA DATA

The CCI Toolbox is designed to access the data held on the CCI Open Data Portal. This data may be used by any user for any purpose, but the terms and conditions of the data use, such as the acknowledgement of the ESA Climate Change Initiative, must be adhered to. These can be found on the CCI Open Data Portal at cci.esa.int/content/terms-and-conditions.