CCI Visualisation Corner 2
Presentations of
ESA’s Climate Change Initiative

Year 3 Report
Draft 0.2

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ref CCI2-YEAR3

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0. Introduction

The purpose of this document is to summarise the results of the third year of the CCI Visualisation Corner 2 project, carried out for ESA by Planetary Visions Limited between July 2016 and October 2017.

According to the project’s Statement of Work, the activity would “build on the visualisations developed in the previous contract in order to expand the CCI Visualisation Corner to include the full set of Essential Climate Variables being produced by the CCI, and for public relations and educational purposes.”

The project was broken down into three main tasks (with an additional task for management and reporting):

1. An Exhibition Version for conferences and meetings.
2. A Tablet Version for the public, less data rich with more text and explanations.
3. Video animations of CCI data that help show the inter-linkages between variables, to be incorporated into both of the above.

Progress on each task is described in sections 1-4 below. The Exhibition Version is now available on Windows as well as Mac, and has been publicly exhibited at international conferences as detailed at the end of section 1.1. The Tablet version is now available on Android as well as iPad, with download statistics summarised in section 2.3 and detailed in Appendix 1.

Most work in Year 3 concerned the production of the video animations, some of which was rescheduled from years 1 and 2. Section 4 lists project deliverable items. Section 5 sets priorities for future development of the work.

![Fig 1 All three components of the CCI Visualisation Corner are now complete: Exhibition software on desktop computers (left), animations (centre), and software for the public on tablet devices (right).](image-url)
1. Task 1: Exhibition Version

The Exhibition version allows the user to update content separate to the software, so that the latest versions of the data products can be shown at meetings and conferences. This version is available on desktop (Mac and Windows) and mobile (iPad) platforms.

The Mac and Windows versions have an open file structure, enabling user update of individual projects, and the tailoring of content, including a programmable “self-drive” playback option. The iPad version can be similarly updated and tailored, but due to the iPad’s closed file system, it requires the whole data package to be updated through iTunes.

Year 3 tasks consisted of updating the content, updating the Exhibition for iPad version, and completion of the porting of the software from MacOS to Windows (rescheduled from Year 1).

Fig 2. Exhibition Master version running on iMac.

1.1 WP1100 Exhibition Master

Updates to the Exhibition version content were performed throughout Year 3, and delivered in four batches: in September 2016, ahead of the project Colocation and UN COP22 meetings, in April 2017, for the scheduled end of the project year in July 2017, and final updates in October 2017.

Two secondary datasets were added, and nine datasets were updated to provide longer data spans and the most recent coverage possible. An additional 500GB of data was ingested this year, bringing the total volume of data ingested and processed for the project to over 1TB.

WP1107 Exhibition Master Update 3

The software was updated in September 2016 to:
• correct title font on opening screen and project titles (to conform with ESA style guide).
• remove “Learn More” link on project screens.
• restore the glow around image thumbnails to original appearance (changed with updated Qt version).
Content was updated to include:
- Fire burned area version 2 product, extending the time sequence 2005-2011.
- updated phase 2 team lists for Fire and Sea Level projects.

**WP1108 Exhibition Master Update 4**
The software was updated in April 2017 to restore the playlist mode (lost during Windows version development) and content was updated to include:
- new data (CMUG Mediterranean Sea Level)
- updated data (Ocean Colour, Sea Level Anomaly and Trend, Greenland Ice Sheet ice velocity).

The Ocean Colour colour scheme was also changed to the more natural scheme used in the Tablet Version. These data updates fed into Exhibition for Windows update 1, Tablet for Android update 1, and Tablet for iPad update 2.

A further content update in July included:
- the first batch of animations from Task 3 (Sea Level, Ozone, CMUG, Ocean-Atmosphere Interactions)
- new data (Ozone profile, Antarctic Ice Sheet velocity, Land Cover annual closeups x4)
- updated data (Greenland Ice Sheet velocity, GHG v2 CO2, methane)

GHG v2 now includes coverage over the ocean, requiring a different colouring scheme. We now use a varying degree of transparency to accommodate the year-on-year increase in GHG values across the time period, with transparency scaled to the range of data values within each year.

A final update in October 2017, feeding into Exhibition for Windows Update 2 and Exhibition for iPad Update 2, included:
- software compatibility with latest version of development environments Qt5.7 and XCode8.
- all completed animations from Task 3 (adding Atmosphere, Land Cover), with relevant animations accessible from each contributing project.
- info text updates for updated or new data, and headline bullets now limited to three for all projects.

*Fig 3. New ozone profile data, with custom oblique background map and vertical scale.*
**Fig 4.** Animation from Task 3 (CMUG Carbon Dioxide Flux) playing in the Exhibition version.

**Documentation**

Each software release is accompanied by a “read me” file, including basic instructions, and a software delivery note, describing changes since the previous version. The illustrated user guide for the software has been updated to cover the Windows version.

The following major versions of the Exhibition Master software were presented or delivered to ESA:

- **22 Sept 2016** D.1107 Exhibition Master update 3 release (v8.1.9)
- **6 April 2017** Exhibition Master update 4 (part 1) playlist bugfix (v8.2.9)
- **6 Oct 2017** D.1108 Exhibition Master update 4 (part 2) (v8.2.11)

**Conferences**

The Exhibition Version has been presented at the following conferences and science meetings over the course of the year:

- **7-18 Nov 2016** UN Climate Change Conference COP22, Marrakech
- **30 Mar - 1 Apr 2017** Climate Change & Meteorology Communication, Turin
- **13-14 June 2017** ESA Council Meeting, Paris
- **6 July 2017** CCI+ Info Day, ESA-ESRIN, Frascati
- **11-14 Sept 2017** iLEAPS Open Science Conference, Oxford
- **29 Sept 2017** European Researchers’ Night, Oxford
Fig 5. CCI Data Time Spans Update
Grey lines represent full CCI data timespan. Black lines represent data processed and presented in the Exhibition Version. Red lines represent data added in Year 3. The number of ECV parameters is shown for each project. Data for all projects overlaps for the ‘golden year’ of 2008.

Table 1. Software Data Budget

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</tr>
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<td>Software</td>
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<table>
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<td>UK average*</td>
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<td>Typical ADSL2</td>
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download time at
Fibre broadband 50 Mbps 3 min
UK average* 22 Mbps 7 min
Typical ADSL2 8 Mbps 19 min
Basic ADSL 3 Mbps 51 min
(*source: Ofcom, Feb 2015)

Table 1. Software Data Budget
The current data budget for Exhibition (desktop and iPad v2.2) and Tablet versions: 11GB for Exhibition on desktop; 3.5GB for Exhibition on iPad; 1.1GB for the Tablet version. Data volumes for iPad are reduced to maintain performance on the less capable platform. Data volumes for the Tablet version are further reduced in order to limit the download time for the app.
1.2 WP1200 Exhibition for iPad
This version is a development project, which avoids the App Store, allowing for rapid deployment to iPad and separate distribution of content updates. However, it is deployed on “ad hoc” distribution certificates, restricted by Apple policy to a maximum of one year. Two updates have been produced in Year 3 to keep this version running on deployed devices: one in September 2016 with the same content as Exhibition Master update 3, and one at the end of the year to match Exhibition Master update 4.

A separate content bundle is maintained for iPad due to the platform’s more restricted graphics and storage capabilities compared with the Exhibitions Version’s desktop computers.

Tasks for the iPad updates include:
• Preparation of a smaller data bundle, with only standard-size data maps (840x1680 pixels) and limited temporal resolution of no fewer than 8 days.
• Some adjustment to the text layout is required for the 4:3 aspect ratio of the iPad screen and larger font size of the iPad version.
• Recompiling the software and re-issue with ad-hoc distribution certificate.

The following major versions of the Exhibition for iPad software were delivered:

- 22 Sept 2016 D.1204 Exhibition for iPad update 2 (part 1)
- 18 Oct 2017 D.1204 Exhibition for iPad update 2 (part 2) (v8.2.16)

1.3 WP1300 Exhibition for Windows
The deployment of the app to the Windows platform proceeded without major problems. As the Windows version of the app is not distributed through app stores, but instead is distributed privately, all hardware testing for compatibility was performed in-house. The app currently runs successfully under both Windows 7 and Windows 10 environments.

Unlike iOS and Android versions of the app (which have content burnt into the app), the Windows app internal structure is open and can be updated on an ad hoc basis. Multiple updates to content have therefore been provided by direct download from the Planetary Visions website.

The Windows release version was delivered in September 2016. During use the playlist mode was found to be inoperative, so a fix was provided with the update of July 2017. A content update in October brought the Windows version in line with Exhibition Master update 4 (v2.2).

Fig 6. Exhibition version data comparison screen on Windows.
The following major versions of the Exhibition for Windows software were delivered:

23 Sept 2016  D.1301 Exhibition for Windows version 1 (v8.1.9)
19 July 2017  D.1302 Exhibition for Windows update 1 (v8.2.11)

2. Task 2 Tablet Version

The Tablet Version, Climate from Space, was completed for iPad in Year 2. Work in Year 3 focused on updating the data content as new versions of the CCI products became available, and on porting the software to Android.

![Climate from Space on iPad Pro and Samsung Galaxy Tab S2](image)

2.1 WP2100 Tablet Version for iPad

Core software development for iPad was completed in Year 2. The software was updated to address design style issues raised by ESA Communications and officially launched on 9 August 2016. The changes to conform to ESA’s corporate style guide required re-rendering of the splash movies and replacement of the marketing screenshots for the App Store.

A further update in October 2016 updated some data (Fire, Ice Sheets), and added new CCI Phase 2 team members to the Fire and Sea Level projects, including replacement maps and new logos.

After some issues were reported with older iPads, platform requirement text was added to the App Store: Requires iPad 4th gen (2012), iPad mini 2 (2013), or later.

Development of the Android version required extensive re-engineering of the content structure (see below). To maintain a common content bundle across the platforms, this required a consequent re-engineering of the iPad version. Some iPad-specific changes were also required to stay current with XCode8 and Qt 5.8 and 5.9. This additional work caused a delay in release of the next data update (corresponding to Exhibition Master update 4 part 1) until September 2017.
The following major versions of the Tablet Version iPad software were presented or delivered to ESA:

- 7 July 2016 Tablet for iPad official launch version (v8.1.5)
- 4 Oct 2016 D.2105 Tablet for iPad update 1 (v8.1.9)
- 18 Sept 2017 D.2106 Tablet for iPad update 2 (v8.2.20)

### 2.2 WP2200 Tablet Version for Android

The use of Qt as the development environment allows quick deployment of the app across different platforms. However, the file structure used by the app when built for iOS, is incompatible with that used by Android. The Android version required extensive re-engineering of the content structure into the Android application package (APK) format. The initial internal test version had a small executable with four separate, large content files. An interim version was re-engineered with all app resources in the executable, but content and data still separate, but this was still not practical for distribution.

An internal beta version (v8.2.1) had content re-engineered and bundled with the executable into one file of 1.1GB. This exceeds the 100MB limit on the Google Play store, but is allowed on the Amazon Appstore. A release candidate was made available for download under Live App Testing (up to 500 testers) from our programmer's Amazon Appstore in October 2016, having been tested on the target hardware (Samsung Galaxy Tab S2 32GB). This version was downloaded and installed by ESA in November for use at the COP22 meeting in Marrakech.

The software was moved across to ESA’s Amazon Appstore in December 2016, still under Live Test. Issues with screen layout on non-target widescreen devices were addressed by locking the aspect ratio to 4:3, with the Android version accepted for public release on the Amazon Appstore at the beginning February 2017. ESA announced availability with a web story on 28 March 2017.

![Image](image.png)

**Fig 8. Climate from Space on the Samsung Tab 3 7.0 widescreen tablet.** The Android version has been tested internally on the target device (Samsung Tab S2), and also remotely on a selection of other physical devices through Amazon Web Services Device Farm. The user interface is locked to 4:3 on a widescreen device.

Work for Android update 1 revealed a fatal problem under the latest Android operating system (Android 7), which seemed to be related to the size of the content bundle files. The solution included breaking the content into smaller components, which required another restructuring of the content files. Amazon then reported that the app was running successfully on all hardware platforms except the Samsung Galaxy Tab - a tablet specifically selected as the target hardware for the app. The problem was resolved by changing the storage methodology of the app's video files - the updated app then passed Amazon's tests and went live to the public on 19 August 2017.
Fixing the Android version to work on the latest OS was deemed more important than updating the (working) iPad version, so the iPad update was delayed until the Android fix was achieved.

The following major versions of the Tablet for Android software were presented or delivered to ESA:

- 25 Oct 2016 D.2201 Tablet for Android version 1.0 (v8.2.5)
- 1 Feb 2017 Tablet for Android public release (v8.2.7)
- 19 Aug 2017 D.2202 Tablet for Android update 1 (v8.2.19)

2.3 App Distribution

*Climate from Space* is available for free download from the Apple and Amazon app stores:

[https://www.amazon.com/European-Space-Agency-Climate-from/dp/B01NBKKHYK](https://www.amazon.com/European-Space-Agency-Climate-from/dp/B01NBKKHYK)

Using the iPad sales figures on the Apple App Store, up to 1 Sept 2017 there have been:

- 2,730 downloads (excluding updates and re-downloads).
- weekly average conversion rate from page views to downloads of 72%
- downloads to 20 of ESA’s 22 member states (and to Canada)

![Fig 9. Climate from Space weekly downloads from publication on 5 May 2016 to Sept 1 2017. Updates and significant promotional events are labelled. (Unlabelled grey lines are iOS version updates. Excludes desktop downloads for clarity.)](image)

There are currently about 25 downloads a week. Download peaks have occurred, including:

- 9–13 May 2016 ESA’s Living Planet Symposium (55 units including the following week)
- 9 Aug 2016 ESA’s official launch (220 units in the following week)
- 28 Mar 2017 Android launch (139 units in the following week)
- 16 Jun 2017 1,500 downloads via desktop in USA
- 11 Sep 2017 100 downloads via desktop in Ireland

Desktop downloads are often associated with bulk download for institutional use such as education. The very large June peak coincided with promotion of the CCI project at the 2017 meeting of the Coordination Group for Meteorological Satellites in South Korea, but it is unclear whether this contributed to the peak.

As well as the iPad and Android launch announcements, there was also promotion of the app by ESA on social media on Earth Day (22 April) and 5 June on the web.
Ignoring desktop downloads, top destinations are the UK (173), followed by the USA (163) and Germany (99), with most copies going to Europe. Further details of downloads, geographical distribution and retention can be found in Appendix 1.

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<thead>
<tr>
<th>Country</th>
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<td>Germany</td>
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<td>Netherlands</td>
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Table 2. Total downloads for the ESA states up to 1 Sept 2017 (app sales figures).

3. Task 3 Animations

The largest part of the Year 3 activities was production of video animations, some of which had been rescheduled from Years 1 and 2 (when the priority was on software development). Two animations started in Year 2 were completed in Year 3 (Sea Level Contributions, Ocean-Atmosphere Interactions). One was storyboarded in Year 2 with production delayed until Year 3 (El Niño). Five new animations were proposed and completed in Year 3: Ozone, CMUG, Atmosphere, Land Cover, Carbon Cycle.

There was some discussion from the science teams about adding narration to the animations, but ESA’s main use is intended at conferences where the audibility of sound cannot be guaranteed and in the various versions of the software. Instead, short explanatory captions were included in the design and production of the animations as a more flexible solution.

The animations have been included in the Exhibition version as they have been completed, published on ESA’s website and social media platforms, and will be included in future updates to the Tablet version.

3.1 Sea Level Contributions

This animation was completed in HD during Year 2, but put on hold after receiving comments from the Ice Sheets science team querying the figures used by the Sea Level team. In
October 2016 all objections were withdrawn with no changes and work resumed, with improved ice motion effect on Antarctica and Greenland, additional captions and a shift of the zero point on the graph. Unfortunately by the time the work was ready for publication, updated versions of the Sea Level and Ice Sheet datasets had been released and it was decided that these ought to be included in the animation so that it did not appear out-of-date. This required the preparation of those data sets and the rendering of those sections to be repeated, further delaying delivery until April 2017.

### 3.2 Ocean-Atmosphere Interactions

This animation was presented in SD in October 2016. Additional captions, timing adjustments, a change to the SST and chlorophyll colour schemes, new ocean colour data, improved gap-filling and an additional sea ice minimum extent were applied before completion of final SD in March 2017, approved for HD rendering in May 2017.

![Image](image1)

*Fig 11. CCI Ocean-Atmosphere Interactions animation.*

### 3.3. CMUG CO2 Ocean Flux

A storyboard for this animation was delivered in November 2016 and forwarded with revisions to the science teams in December. Computer graphics is used to illustrate micro-scale processes – the absorption of carbon dioxide by phytoplankton near the sea surface. Science team comments on captions were incorporated for a final storyboard (v4) in February 2017 and the SD version was presented in March 2017. ESA comments on labelling and geographical coverage were incorporated and completed in HD in June. Ambient sound was used to add realism to the opening computer graphic sequence, with specially-recorded sloshing waves and underwater sound effect.

![Image](image2)

*Fig 12. CCI CMUG Carbon Dioxide Ocean Flux animation.*

### 3.4 Ozone

The Ozone animation was storyboarded in November 2016, showing the vertical as well as global distribution of ozone through the seasons, and ending with a possible link between ozone depletion and Antarctic sea ice coverage. This link was considered too uncertain by ESA, so was dropped from a revised storyboard presented to the science team in February.
2017. A final storyboard (v3) added discussion of low level ozone and its link with tropospheric pollutants, illustrated by aerosols data.

For production of the animation, PVL requested ozone data with a shorter timestep than the standard CCI monthly product, and ozone profile data. Production proceeded with global total ozone and ozone profile data both on a 6-hourly time step. Final version was delivered in June 2017. The ozone profile data processed for the animation was also incorporated into the data viewer for the software products.

Fig 13. CCI Ozone animation

3.5 Atmosphere
This animation was to link all the atmospheric ECVs together in one ascent up through the atmosphere. The main data products for each of these projects are of relatively low spatial and temporal resolution, so computer graphics is used to illustrate the processes involved. ESA suggested motivating the story with the updraft from a bush fire, so linking Fire, Aerosol, Cloud, GHG and Ozone projects, and this was presented as a storyboard in December 2016. Revised storyboards were presented after ESA and science team comments in January and February 2017.

Production proceeded initially with the standard monthly ozone and cloud data, but then, to improve the visual quality, with the daily cloud data from the CCI promo animation and the six-hourly ozone data from the ozone animation. Production was delayed by second thoughts about the opening sequence. ESA requested something more anthropogenic than a bush fire, and PVL proposed a smoke plume, as if from a chimney stack, interacting with sunlight. Production was completed on this (version 5) storyboard with HD delivered in August 2017.

Fig 14. CCI Atmosphere animation

3.6 Land Cover
The Land Cover animation explains the process of creation of the global land cover maps, and shows some examples of change across a range of locations and cover types. Africa,
Asia and South America are shown, including examples of deforestation, urbanisation and water resources.

The science team received the storyboard in December 2016, and it was revised after comments in February 2017 to show the global coverage of the maps. Production started with three of the original 5-year epoch land cover maps, which were replaced by new annual maps for different locations. A fourth map was added to cover the topic of water resources. Final HD was delivered in August 2017.

![Fig 15. CCI Land Cover animation](image)

### 3.7 Carbon Cycle

The Carbon Cycle animation links Land Cover, Fire, GHG, Ocean Colour, GHG and CMUG projects. A storyboard was presented tracing carbon from the biosphere (land and ocean) into the atmosphere and back to the ocean sink. This narrative was broadly accepted by ESA, with an illustration of anthropogenic CO2 sources requested to replace the latitude-averaged CO2 “flying carpets”, and forwarded to the relevant science teams who approved it with some caption changes at the 2017 CMUG meeting.

Before production could start, ESA requested a major change to the narrative to separate land and ocean biosphere components so that land-atmosphere and ocean-atmosphere interaction could be presented separately, and dropped the requirement to show anthropogenic CO2 sources. PVL argued against such major changes after science team approval, and on the grounds that they disrupted the narrative and stylistic flow. After discussion, some of the changes were included by PVL in an updated storyboard (version 5) and approved by ESA at the annual review meeting in July 2017. Production commenced in August, with motion rushes including caption placement presented in October.

![Fig 16. CCI Carbon Cycle animation: frames from storyboard.](image)

### 3.8 El Niño

The storyboard developed in Year 2 was modified in light of ESA’s comments at the Year 2 annual review meeting in August 2016, and sent for science team comment in February 2017. Just before production was due to start in May 2017, ESA requested further revisions to the storyboard with additional data external to the project (SST with depth, ENSO Index). The source of this data was identified by ESA in October 2017.
Table 3. CCI animations, showing projects involved, total number of datasets visualised (excluding background maps) and running time (duration) for each animation.

3.9 Deliverables
The following animations have been delivered in Year 3:

- 26 Apr 2017 D.3201 Sea Level Contributions (redelivery)
- 29 May 2017 D.3202 Ocean-Atmosphere Interactions
- 14 Jun 2017 D.3303 CMUG Carbon Dioxide Flux
- 13 Jun 2017 D.3304 Ozone
- 25 Aug 2017 D.3302 Atmosphere
- 25 Aug 2017 D.3305 Land Cover

3.10 Discussion
The animations took longer than scheduled to complete, largely due to a growth in their complexity compared to the original expectation. Rather than relating two or three datasets or projects, the animations have often covered quite complex topics using data from many of the ECVs or even from outside the CCI project. Some have also taken on a wider educational aspect beyond simple data visualisation. All but one are longer than the expected 1-2 minutes. The number of projects and datasets involved, and the duration of each animation are shown in Table 3.

As pointed out in the Year 2 report, it has proved difficult to keep animation production to schedule when an animation has multiple “clients” in the form of the science teams. There has also been at times slow feedback from ESA, with late changes to some storyboards and some major decisions left until graphics production was well underway, causing work to be delayed or repeated. To minimise delay in future, it is requested that ESA provide comments, if possible, within one week of receipt of storyboards, rushes or requests for information. To avoid confusion and duplication of effort it is recommended that PVL retain version control on the development of storyboards and that specific problems are clearly identified and discussed before embarking on re-writes.
4. Task 4 Management and Meetings

Progress has been reported to ESA by email on an ad hoc basis throughout the year, and at the scheduled quarterly progress meetings and milestone reviews. The agenda was set for these meetings, and minutes recorded, by PVL.

A second animator was engaged by the contractor in Year 2 to address delays and to cope with the larger workload on Task 3 Animations. The additional effort was covered in part by reassigning labour from other parts of the project: graphic design proved to be unnecessary in Years 2 and 3; there was also some software engineering time reassigned to animation.

A Contract Change Notice was requested in June 2017 to extend the contract for one year (see 5.2 below), with the Final Report delayed until the end of the extended work period. The contract change was received and signed by the contractor on 26 July 2017.

4.1 Meetings

In addition to quarterly progress meetings, and ad hoc production meetings, Planetary Visions staff have attended the following meetings to report progress, demonstrate the software, and collate science team feedback:

11 Aug 2016 Year 2 Review Meeting, ESA-ECSAT (PE, KMT on Skype)
4-6 Oct 2016 CCI Colocation Meeting, ESA-ESTEC Frascati (PE)
13-14 Feb 2017 CMUG Integration Meeting, Paris (PE)
19 Jul 2017 Year 3 Review Meeting, ESA-ECSAT Harwell (PE, KMT)

4.2 Project Documents

Review documents have been prepared after significant milestones, and various documents prepared and circulated within the project team and to the wider CCI science team as required. A list of project documents is provided below (not including quarterly project reports and minutes):

2 Dec 2016 CCI2-PR8 Project Report 8 (Milestone 5)
1 March 2017 userguide-v2 CCI Visualisation Tool v2 User Guide
20 Feb 2017 landcover-storyboard-v2 Land Cover storyboard
21 Feb 2017 cci-elnino-storyboard-v3 El Niño storyboard
23 Feb 2017 cmuig-storyboard-v4 CMUG CO2 Flux storyboard
5 June 2017 cci2-ozone-storyboard-v5 Ozone storyboard
1 June 2017 cci2-carboncycle-storyboard-v5 Carbon Cycle storyboard
16 July 2017 cci2-CO2-Flux-storyboard-v5 CMUG CO2 Flux storyboard
25 Oct 2017 CCI2-YEAR3 Year 3 Report (this document)

4.3 Deliverables

The following deliverable items have been completed and delivered in Year 3:

22 Sept 2016 D.1107 Exhibition Master update 3 release (v8.1.9)
22 Sept 2016 D.1204 Exhibition for iPad update 2
23 Sept 2016 D.1301 Exhibition for Windows version 1 (v8.1.9)
4 Oct 2016 D.2105 Tablet for iPad update 1 (v8.1.9)
25 Oct 2016 D.2201 Tablet for Android version 1.0 (v8.2.5)
26 Apr 2017 D.3201 Animations Year 2 (Sea Level Contributions - redelivery)
29 May 2017 D.3202 Animations Year 2 (Ocean-Atmosphere Interactions)
14 Jun 2017 D.3303 Animations Year 3 (CMUG Carbon Dioxide Flux)
13 Jun 2017 D.3304 Animations Year 3 (Ozone)
19 July 2017 D.1302 Exhibition for Windows update 1 (v.8.2.11)
19 Aug 2017 D.2202 Tablet for Android update 1 (v8.2.19)
25 Aug 2017 D.3302 Animations Year 3 (Atmosphere)
25 Aug 2017 D.3305 Animations Year 3 (Land Cover)
19 Sept 2017 D.2106 Tablet for iPad update 2 (v8.2.20)
6 Oct 2017 D.1108 Exhibition Master update 4 (v8.2.11)
18 Oct 2017 D.1204 Exhibition for iPad update 2 (part 2) (v8.2.16)
The following Year 3 deliverables are outstanding:

D.2203 Tablet for Android update 2
D.3301 Animations Year 3 (Carbon Cycle)
D.3203 Animations Year 2 (El Nino)

5. Conclusion

All major items under Tasks 1, 2 and 3 have now been completed, with the Exhibition version available on Mac, Windows and iPad, and the Tablet version available on iPad and Android. A collection of computer graphic animations has been produced covering data from all of the CCI projects.

In order to bridge the gap before the start of CCI+, the work is extended for one year on a maintenance and update basis, while ESA completes a strategic communications review for the CCI project, led by the University of Oxford.

5.1 Schedule
An updated outline schedule is shown in Appendix 2. Production of the final two animations has over-run the scheduled end of the project, delaying the final update to the Tablet version. It is expected that both animations will be complete, and included in updated Exhibition and Tablet versions, by the end of December 2017.

5.2 Contract Extension
The contract is extended for one year to cover maintenance of the current software, and content updates with the expectation of annual updates from most projects (ref ESA-CCI-EOPS-KNOW-SW-17).

Software Maintenance
To maintain the Exhibition Version software on Mac and Windows, and the Tablet Version on iPad and Android, including bug fixes and software updates to ensure it continues to run on current versions of each operating system, and is compatible with any operating system changes brought out during the duration of the contract.

Content Update
To ensure latest versions of the project data are included in the Exhibition and Tablet versions, including annual updates expected from most projects, any periodic data releases and new products. It also includes changes to the text to accompany the data updates, and more generally in order to keep the content up to date. Key illustrations and videos should also be updated where improved sources become available.

5.3 Further Work Offered
The following items were offered as part of the contract extension, but declined by ESA:

**Exhibition for iPad maintenance and content update**

**Tablet version software development**
To add functionality and user interface improvements to the Tablet Version:
• hotspots for zoom-down access to local data sets in the data viewer
• labels in the data viewer, including time-sensitivity
• embedded video player (on text page, rather than full-screen)
• rotating globe on main menu screen
• more fluid page-turning transitions (sideways slide)

**Smartphone Version**
A stripped-down app capitalising on the interactivity of the data viewer, with minimal text, optimised for smartphones (iPhone and Android).
Appendix 1 App Distribution

Climate from Space is available for free download from the Apple and Amazon app stores:

https://www.amazon.com/European-Space-Agency-Climate-from/dp/B01NBKJKHYK

A1.1 Downloads

Using the sales figures on the App Store, we can see how the app has done since its launch in May 2016. Up to 1 Sept 2017 there were:

• 2,730 downloads (excluding updates and re-downloads).

More detailed app analytics are available from users running iOS8 or later who have agreed to share their diagnostics and usage information with app developers. In the last 30 days, 18% of users who installed the app agreed to share their data. The analytics from this smaller group show:

• 12,779 impressions (the app appearing in the App Store)
• 1,829 product page views (the app’s page appearing)
• 1,049 app units (downloaded)

This gives an overall conversion rate of 57% from page views to downloads – a very good rate for an educational app. The rate improves to 69% when counting unique devices for the page views and 72% when averaging weekly rather than daily. No crashes are reported.

![App Store analytics showing app impressions, page views, number and location of downloads.](image)

The app was published in time for ESA’s Living Planet Symposium, 9-13 May, 2016 and there were a modest number of copies installed over the following week. ESA’s official launch for the app, however, was on 9 August 2016, when it was featured on the front page of ESA’s website, resulting in 220 downloads in the following week.
There was a similar spike of 139 downloads in the week following announcement of the Android version on 28 March 2017. The iPad version was also promoted in that announcement. There was also promotion of the app by ESA on social media on Earth Day 22 April, and 5 June on the web.

The largest number of downloads in one day (1,500) was on 16 June 2017. This spike was restricted to the USA, and to desktop downloads, which have no expression in the app analytics data. The spike coincided with, and may be related to, promotion of the CCI project at the 2017 meeting of the Coordination Group for Meteorological Satellites in South Korea. There is a modest peak in the analytics data for that week. Another explanation might be a bulk download for institutional use such as education. There was another bulk download to desktops in Sept 2017 in Ireland.

**Fig A2.** Climate from Space weekly downloads from publication on 5 May 2016 to Sept 1 2017. Updates and significant promotional events are labelled. (Unlabelled grey lines are iOS version updates.)

**Fig A3.** Weekly average conversion rate from unique product page views to downloads.
A1.2 Sources
Since 15 April 2017, analytics have been available for download sources in the following categories:

- App Store browsing: 3% (9 units)
- App Store search: 66% (170 units)

- referred from apps: 14%, including:
  - Facebook: 21 units from 28 impressions
  - Twitter: 11 units from 16 impressions

- referred from websites: 16%, including:
  - esa.int: 138 units from 242 impressions
  - govdelivery.com: 66 units from 129 impressions
  - forskning.no: 7 units from 7 impressions

Fig A4. Climate from Space download sources.

Taking the app analytics data (to remove the North American spike on June 16th), downloads have mainly been to Europe (690 units), followed by North America (213 units). Top destinations are the UK (173), followed by the USA (163) and Germany (99). The app has gone in smaller numbers to all the ESA states except Luxembourg and Estonia. Full figures for all ESA states are shown in Table 1 (figures are slightly higher, from the app sales data, including downloads via desktop).
Fig A5. Downloads by region.

Fig A6. Downloads by territory within Europe (top 10 only).

<table>
<thead>
<tr>
<th>Country</th>
<th>Downloads</th>
</tr>
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<tbody>
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<td>United Kingdom</td>
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<tr>
<td>Germany</td>
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<td>Belgium</td>
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</tr>
<tr>
<td>Austria</td>
<td>21</td>
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</table>

Table A1. Total downloads for the ESA states up to 1 Sept 2017.
A1.3 Retention

The App Store reports insufficient data to provide retention analytics, but it is possible to chart “active devices” ie, those running the app for at least one session during the period (average 5 per week), and “active in the last 30 days” (average 20).

**Fig A7.** Climate from Space weekly active devices.

**Fig A8.** Climate from Space installations active in the last 30 days.
Appendix 2 Project Schedule

Outline Schedule
PE/PVL 24.10.17

<table>
<thead>
<tr>
<th>TASK 1: Exhibition Version</th>
<th>TASK 2: Tablet Version</th>
<th>TASK 3: Animations</th>
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<td>D.3200 Animations x3 (Year 2)</td>
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**milestones**

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