

## CCI Visualisation Corner 2

Presentations of  
ESA's Climate Change Initiative

*Year 1 Report*

29<sup>th</sup> June 2015  
ref CCI2-YEAR1

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## 0. Introduction

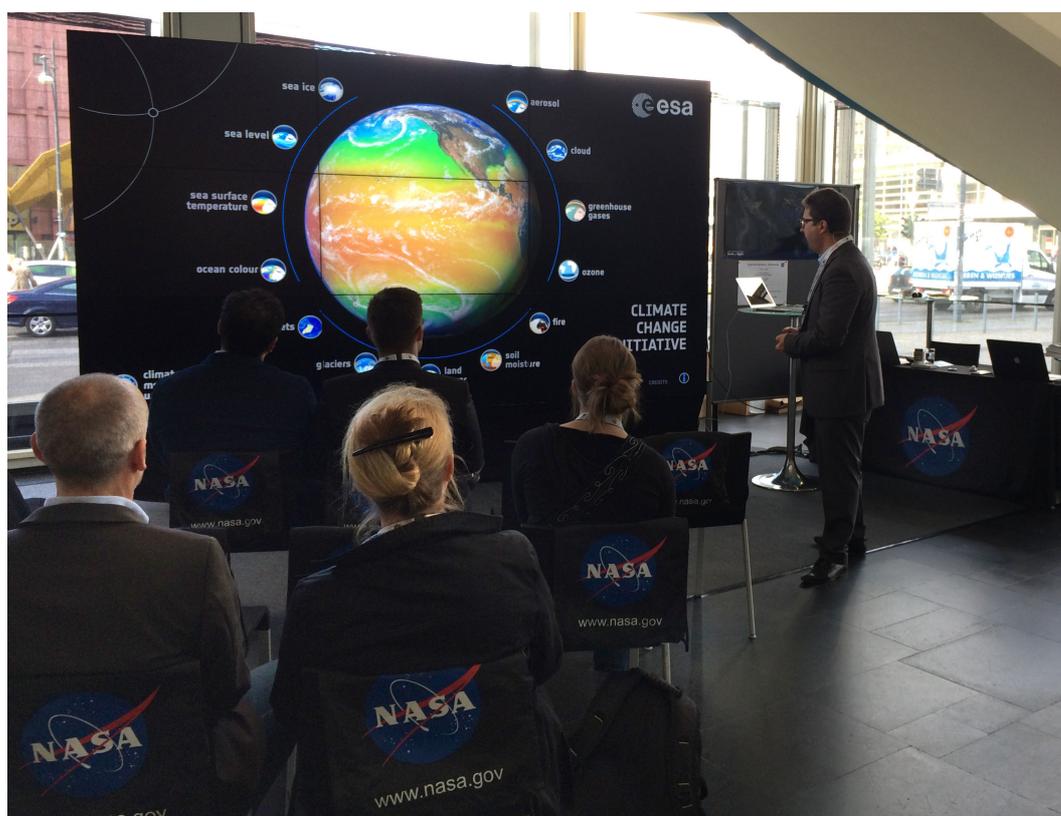
The purpose of this document is to summarise the results of the first year of the *CCI Visualisation Corner 2* project, carried out for ESA by Planetary Visions Limited between May 2014 and June 2015.

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 *Visualisation Corner* has been publicly exhibited at international conferences as detailed at the end of section 1.1. Section 5 sets priorities for future development of the work.



**Fig 1** CCI Visualisation Tool (Exhibition Version) presented on NASA's hyperwall at the 36th International Symposium on Remote Sensing of the Environment, Berlin, 11-15 May 2015.

## 1. Task 1: Exhibition Version

The Exhibition Version was to be developed from phase 1 of the work “to make sure that all appropriate variables from each project are represented”. This developed version is referred to as version 2 of the software. The Exhibition Version was also to be ported from MacOS to iPad and Windows platforms.

The task was split into three workpackages in the first year, with the iPad version of the software based on the phase 1 prototype to meet an urgent CCI press deadline, and the Windows version based on the completed version 2 of the software.

### 1.1 WP1100 Exhibition Master

#### Version 1

Development of the Exhibition Master followed the urgent development of the iPad version. Once the iPad version was completed it became clear that it was more efficient for further development to proceed in parallel on both platforms. It was also considered desirable to have refinements developed for iPad to be included in the Exhibition Master version.

For these reasons, and also to offer the CCI science teams the opportunity to use the software themselves, the Exhibition version prototype was developed to a definitive version 1, including a user guide, before embarking on the upgrade to version 2. This effectively brought forward some of the update work planned for year 2. Version 1 was made available to the teams by ESA in March 2015.

#### Design

The design of the Exhibition Master version 2 was developed as described in the *Exhibition Master Version Design Specification v2.1*, dated 24<sup>th</sup> September 2014, and updated to v2.3 17<sup>th</sup> December 2014. ESA design guidelines were followed, as set out in ESA's *Corporate Visual Identity Manual*.

The inclusion of the new project screen (screen type 0.5) required adjustment to the design and content of some of the other information screens. Examples of the new screen designs are shown below.

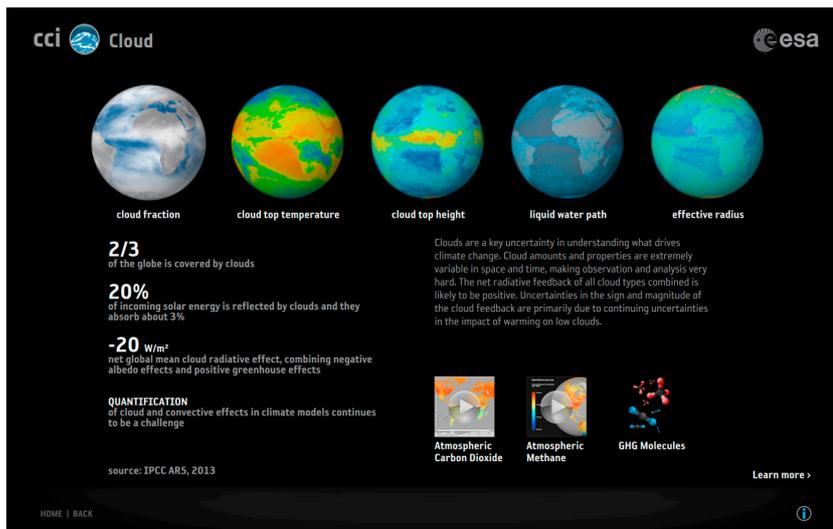


Fig 2. Project screen (type 0.5) with five datasets (top), three illustrations (bottom), and headlines (left).

#### Content

A total of 170GB of science data has been ingested and processed for the project, some of it processed more than once (eg, to apply different stretches or colour schemes to the data).

The following main datasets were updated over the course of the year:

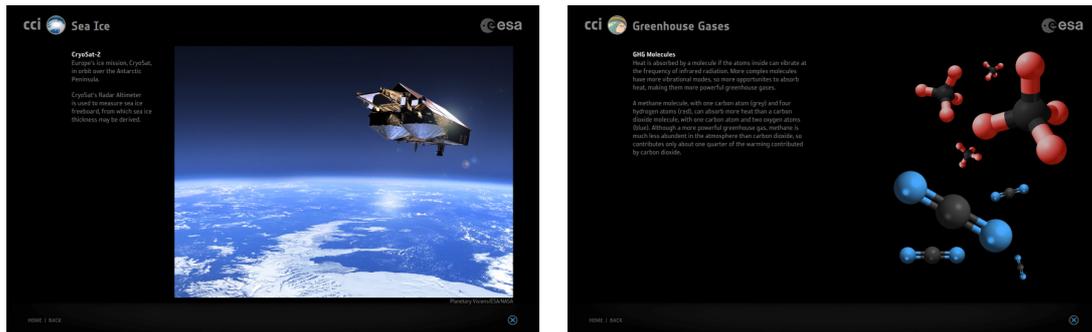
- new Ocean Colour data, 8-day, large size
- new Aerosols data (1995-2012, monthly, 2 versions, gap-filled, explicit time gaps)
- new Fire data (2006-2008, monthly, 2 versions – dark background chosen)
- new Sea Ice data (1992-2008, daily, 1.5GB)
- recoloured Ozone data
- updated home screen movie with CCI Clouds (2 versions).
- Greenland Ice Sheet elevation change extended sequence (1994-2009)
- SST with ice mask
- Sea Ice with ice mask

The following additional ECV parameters were included (see status summary in Appendix 1):

- CMUG Air-Sea CO2 Flux (Met Office, 1997-2012, daily, derived from CCI Ocean Colour chlorophyll products)
- Sea Ice thickness (Oct-April only, northern hemisphere)
- Cloud height, temperature, optical depth, effective radius, ice and liquid water path
- Antarctic ice sheet elevation change (still 1992-2012)
- additional Glacier time sequences (Karakoram)
- sea level regional trend

The following new illustrations were included:

- sea ice: Sea Ice Thickness from CryoSat video; CryoSat photo
- ice sheets: Store Glacier photo; ice velocity map
- glaciers: Baltoro Glacier movie; Caresa Glacier front variation graph
- ghg: GHG Molecules graphic



**Fig 3.** Illustrations may be large pictures with short captions (left), or smaller pictures with more detailed text (right).

Additional text for individual ECV parameters is under development (awaiting input from science teams).

As well as ingesting content into the software according to the project's workplan, large-format graphics based on the content have been produced for print use on several occasions in response to requests from ESA.

### Software

Software development was undertaken using C++ and OpenGL under the Qt 5.4 cross-platform development environment. Version 2 software requires additional folders in the contents area, but version 1 structure remains intact so that version 1 and 2 software can both use the same data area. This allows version 1 to be used for public presentation while version 2 is in development or testing on the same machine.

A prioritised list of software functionality was set out in the Design Specification. *Essential* items were to be implemented for the alpha version of the software. *Preferred* items would be implemented by the beta version if possible. *Possible* items were enhancements not regarded as essential to the success of the project, but would be candidates for work in following years. Development was undertaken in such a way as to allow easy implementation of the *Possible* items in future. The functionality priorities are shown here with their status:

### *Essential*

- Project Screen (Type 0.5) to accommodate projects with multiple ECV parameters. – *achieved by alpha*
- CMUG project to show sample climate model data sequence. – *achieved by alpha*
- Graphic links on Project Screen – *achieved by alpha*

### *Preferred*

- Accommodate new project (Antarctic Ice Shelves), either within the current Ice Shelves or as a separate project. – *achieved by beta*
- Data Tables – *no data requiring this has been received – not a priority*

### *Possible*

- Graphs drawn live from data files (if required). – *fewer graphs will be shown, prepared by hand*
- Video playing with other content on Type 1 screen. – *not a priority*
- Dynamic transitions: animated overlay graphics such as logos and data moving/shrinking on/off/around the screen. – *developed under WP2100 instead*

All *essential* software functionality from the Design Spec is now achieved. Of the *preferred* functionality, data tables is not achieved, no tabular data having been received. Of the *possible* functionality, dynamic transitions are instead being developed for the Tablet Version under WP2100, and may become available to the Exhibition Version at a later date. None of the other possible functions are considered a priority.

In addition to the requirement to show multiple ECV parameters specified in the Statement of Work, some additional functionality was included in response to requests from the CCI science teams and ESA, and to improve the interface and performance:

- automatic playback of the data sequences.
- self-drive or playlist mode, to display the content unattended from a script file.
- optional science team branding on the opening screen.
- on-screen navigation buttons for functions that were keyboard-only in the prototype.
- improvements to data synchronisation in Comparison mode
- CMUG included as full project with data, etc.

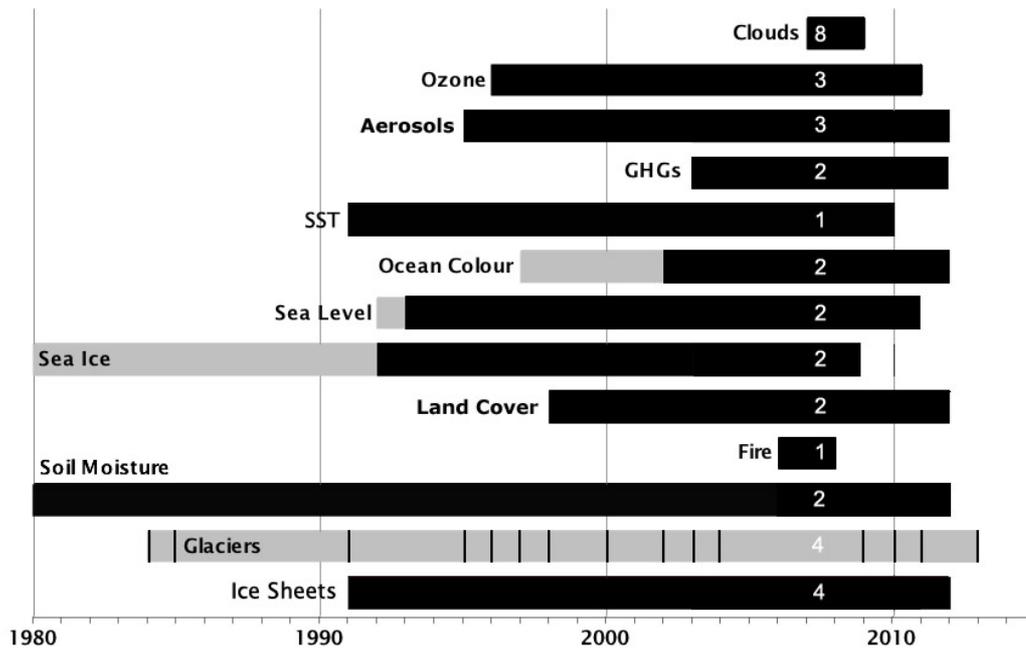
In Playlist mode, URLs are read from a script to present data sequences and info screens. For data sequences, the viewpoint, zoom, date range and playback speed can all be specified. An extract from a playlist is shown below:

```
# <h1>Playlist covering all the projects</h1>
#
5 : index.qml
#
15 : project.qml?project=sst
5 : show.qml?mode=G&project=sst&data=SST/SST&view=-120,-20,1.0&play=1
5 : show.qml?mode=G&project=oceancolour&data=OceanColour/Chlorophyll&view=0.0,0.0,1.0
5 : show.qml?mode=G&project=sealevel&data=SeaLevel/Anomaly&view=0.0,0.0,1.0
5 : datainfo.qml?project=sst&data=SST/SST
10 : projectinfo.qml?project=sst
10 :
compare.qml?project=sst&data=SST/SST&auxproject=sealevel&auxdata=SeaLevel/Anomaly&mode=G&view=-100,0.0,2.0&date=19980126&play=1
```

### **Documentation**

Each software release was accompanied by a “read me” file, including basic instructions, and a software delivery note, describing changes since the previous version. An illustrated user guide was produced for the Version 1 release of the software.

## ESA CCI Data Timespans



**Fig 4. CCI Data Time Spans**

Grey lines represent full CCI data timespan. Black lines represent data processed and presented in the Exhibition Version. The number of ECV parameters is shown for each project.

**Table 1. Software Data budget**

	Mac	iPad	Input
Sea Surface Temperature	4370	365	109.000
Sea Ice	1770	246	18.800
Ocean Colour	611	269	34.740
Greenhouse Gases	199	199	
Sea Level	180	180	0.480
CMUG	159	159	
Aerosol	97	97	4.380
Soil Moisture	98	98	
Land Cover	93	83	0.080
Ozone	70	70	0.790
Cloud	121	121	0.040
Fire	17	17	0.080
Glaciers	36	36	0.370
Ice Sheets	3	3	
<b>Science Data</b>	<b>7824 MB</b>	<b>1943 MB</b>	<b>169 GB</b>
<b>Video</b>	<b>539 MB</b>	<b>539 MB</b>	
<b>Info, Metadata</b>	<b>29 MB</b>	<b>29 MB</b>	
<b>Software</b>	<b>47 MB</b>	<b>14 MB</b>	
<b>TOTAL</b>	<b>8439 MB</b>	<b>2525 MB</b>	<b>169 GB</b>

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

13 Jun 2014	Version 1 beta version (4.15)
7 Nov 2014	Version 1 beta version (5.3.1)
2 Dec 2014	Version 1 beta version (5.3.6)
4 Mar 2015	Version 1 Release (5.3.7)
12 Mar 2015	D.1102 Version 2 Alpha version (6.1.0)
10 Jun 2015	D.1103 Version 2 Beta version (6.2.6)

### Conferences

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

13 Jun 2014	CCI Press Day, Royal Society, London
14-20 Jul 2014	Farnborough International Air Show
13-17 Oct 2014	The Climate Symposium, Darmstadt
15-19 Dec 2014	American Geophysical Union, San Francisco
12-17 Apr 2015	European Geosciences Union, Vienna
11-15 May 2015	International Symposium on Remote Sensing of the Environment, Berlin
25 May -11 Jun 2015	World Meteorological Organisation Congress, Geneva
15-21 Jun 2015	Paris Air & Space Show

### 1.2 WP1200 Exhibition for iPad

The Exhibition for iPad version was developed rapidly from the Phase 1 prototype software for use at the CCI Press Day at the Royal Society, London, on 13 June 2014. Some adjustments to layout were necessary to accommodate the iPad's 4:3 screen shape, and the device's smaller screen size. Some content adjustments were also made: limiting the size of maps to the standard size; showing weekly rather than daily maps for some data with long time spans.

The iPad version was further developed in parallel with the definitive Version 1 of the Exhibition Master, and with Version 2. This development chain is considered more efficient than leaving the iPad updates to Year 2 as originally planned.



Fig 5. Exhibition for iPad version at CCI-CMUG Meeting, SMHI, Norrköping, 28 May 2015

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

13 Jun 2014	D.1201 Beta version (5.0)
12 Aug 2014	Beta version (5.1)
7 Nov 2014	Beta version (5.3.1)
2 Dec 2014	D.1202 Version 1 Release candidate (5.3.6)
19 Mar 2015	D.1202 Version 1 Release (5.3.7)

### 1.3 WP1300 Exhibition for Windows

In preparation for the Windows port of the software, initial testing has shown no problem with running the 3D graphics components - the globe and map viewer - and data playback. Some issues with window control are apparent: the Windows user area is not shown.

Some problems have been identified with taking the existing content to Windows:

- H264 video file format requires QuickTime installed, or the video to be reformatted
- unix line endings in text files (including metadata and menus) need replacing with Windows carriage return, line feed.

The Windows version is dependent on the completion of the Exhibition Master version 2, and is considered less important than the Tablet version.

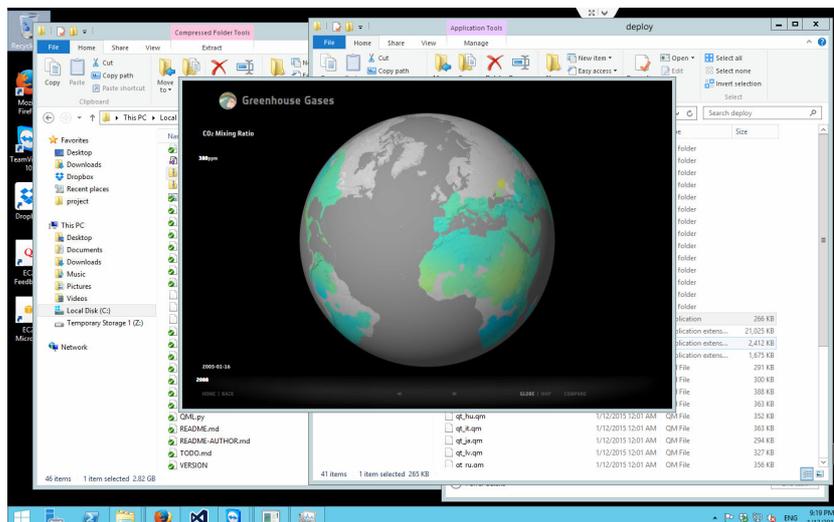


Fig 6. Preliminary testing of the software in a Windows environment.

## 2. Task 2 Tablet Version

The Tablet Version is an e-book “for a more general audience that can be understood by anyone who is not familiar with ESA and does not have a scientific background”. The working title is *Climate from Space*.

### 2.1 Design

Design of the Tablet Version was late starting and took longer than expected. A functional design specification was delivered in December 2014. Final screen designs were presented in an update to the Tablet Version Design Specification, v1.2, dated 19 May 2015. After ESA’s acceptance of the design, run-time graphics were generated from the design files.

### 2.2 Software

Software engineering on the Tablet version was due to follow completion of the Exhibition version 2. To reduce the delay caused by extra work on Exhibition v2, personnel were reassigned to software engineering the Tablet Version, and this work was started before the design phase was complete. Basic functionality was implemented:

- database-driven page construction and page contents

- animated icon/content transitions between pages
- application of multiple styles during transitions

Software is now being developed using the run-time graphics files from the final design. The next major task is construction of an API to allow the general engine to call the existing data viewer.

### 2.3 Content

Content development for the Tablet Version started with an online survey of the science teams set up at the Colocation Meeting in November 2014. This was followed up by editorial conferences involving the writer, the producer and ESA. A writing style guide and content template was added as an appendix 4 to the Tablet Version design spec.

First-draft texts from the writer are underway. These are being edited for English and technical content before sending to science teams for approval. Science team comments and corrections are then included in a final edit. This process has been completed for a prototype chapter (Glaciers), and is underway for the other chapters. So far the following have been completed:

- Editorial outlines for Glaciers, Aerosols, Sea Ice, Ice Sheets, Ocean Colour, SST, Sea Level
- First draft text for Glaciers, Sea Ice, Ice Sheets, Ocean Colour, SST
- Edited text for Glaciers, Sea Ice, SST
- Picture research for Glaciers, Aerosols, Sea Ice.



*Fig 7. Climate from Space app opening screen/contents list.*

Picture research is conducted after each first-draft text is completed. Selected images are laid out in a Word document alongside the text for easy circulation and comment from the science teams and ESA.

To facilitate some user testing of the content before the software is complete, a mockup of the Tablet version has been built using an app prototyping tool (Briefs). Briefs documents may be viewed on iPad using a free viewer ([Briefscase](#)). The tool allows limited interactivity, allowing the content and basic interface to be shared on iPad within the production team, and shown to others.

Currently the prototype chapter has been built in Briefs and two more chapters are underway. The intention is to circulate a Briefs mockup of the app with three complete chapters to get feedback from ESA, the science teams and the intended audience on the length and level of technical detail of the text and the text/image balance.

Video interviews with all the science team leaders have been acquired from ESA Communications, These are to be edited to remove questions and prompts, and post-produced to replace the green screen with the background colour of the app. This has been completed for one interview as part of the design phase

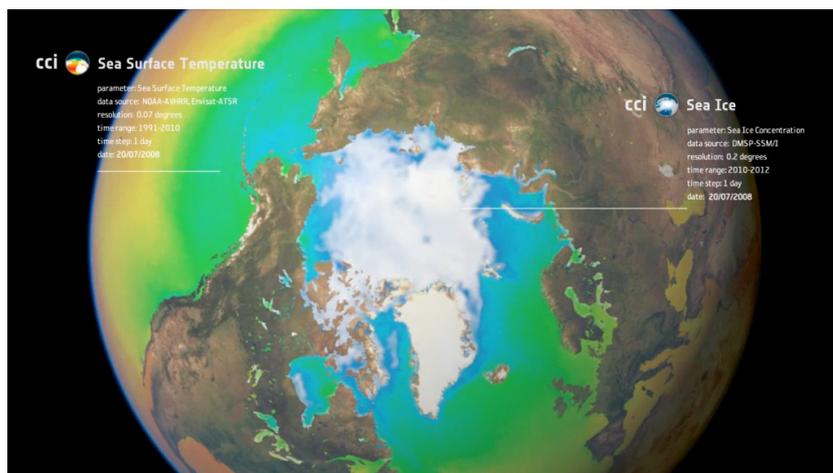
### 3. Task 3 Animations

Storyboards have been completed for 3 animations based on suggestions from the ocean science teams:

- Regional Sea Level Trends
- Sea Level Rise Contributions
- Interactions of Ocean and Atmosphere

A fourth storyboard has been developed for an overall promotional video showing all the projects, and this is in production. Although a simple concept, this has required the reprocessing of some long data sequences to present the data against a realistic, natural-colour background map, with data time spans carefully chosen to show specific events, and to ensure correct seasonal alignment when multiple data overlap. This has proved to be a time-consuming production task.

A first version has been produced with a fixed-camera position to final HD quality and delivered to ESA for interim use. A complete motion design for the final version and approximately one quarter of the sequence rendered at full quality was presented at the annual review meeting.



**Fig 8.** CCI promotional video animation, showing SST and Sea Ice datasets

## 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.

### 4.1 CCI Meetings

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

13 Jun 2014	CCI Press Day, Royal Society, London
20-22 Oct 2014	CCI Colocation Meeting, ESA-ESRIN, Frascati
26-28 May 2015	CMUG Meeting, SMHI, Norrkoping

### 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):

8 Jul 2014	CCI2-1200-beta	Exhibition for iPad beta version Review
24 Sep 2014	CCI2-D1101	Exhibition Master Design Specification v2.1
4 Dec 2014	CCI2-D2101	Tablet Version Design Specification v1.0
17 Dec 2014	CCI2-D1101-v2-3	Exhibition Master Design Specification v2.3
12 Mar 2015	userguide-cci-5-3-7	CCI Visualisation Tool User Guide v5.3.7
31 Mar 2015	CCI2-exhibition-alpha	Exhibition Version 2 alpha version Review
30 Apr 2015	CCI2-D2101-v1-1	Tablet Version Design Specification v1.1
19 May 2015	CCI2-D2101-v1-2	Tablet Version Design Specification v1.2
17 Jun 2015	CCI2-exhibition-beta	Exhibition Version 2 beta version Review
27 June 2015	CCI2-YEAR1	Year 1 Report (this document)

### 4.3 Deliverables

The following Year 1 deliverable items have been completed and delivered:

13 Jun 2014	D.1201	Exhibition for iPad beta version
1 Sep 2014	D.1101	Exhibition Master design specification
1 Dec 2014	D.1202	Exhibition for iPad release version 1.0
	D.2101	Tablet for iPad design specification
1 Mar 2015	D.1102	Exhibition Master alpha version
1 Jun 2015	D.1103	Exhibition Master beta version

The following Year 2 deliverable items have been brought forward and completed in Year 1:

1 Dec 2015	D.1105	Exhibition Master update 1 (definitive Version 1)
1 Mar 2016	D.1203	Exhibition for iPad update 1 (to version 2)

The following Year 1 deliverable items have yet to be completed (revised delivery dates are indicated):

17 Jul 2015	D.1104	Exhibition Master release version 2.0
	D.2102	Tablet for iPad alpha version
7 Aug 2015	D.2103	Tablet for iPad beta version
10 Jul 2015	D.3100-1	Animations year 1 (Promo)
24 Jul 2015	D.3100-2	Animations year 1 (Sea Level Contributions)
14 Aug 2015	D.3100-3	Animations year 1 (Ocean-Atmosphere Interactions)
1 Dec 2015	D.1301	Exhibition for Windows

#### **4.4 Additional Work**

The following work has been undertaken, additional to the original work plan, at the request of ESA or the science teams:

- User Guide, font bundling (for wider deployment)
- Exhibition Master Playlist mode (in response to science teams and ESA Comms)
- 2015 CMUG Meeting (part of Year 2, but project start delayed and meeting brought forward)
- Exhibition Master version 1 update
- Exhibition for iPad version 1 and 2 updates
- large stills for print (summer 2014, May 2015)
- video recordings for science teams (Fire, SST)
- additional logos and attribution for sea ice
- reprocessing of SST sequence with ice mask
- first animation fixed-camera version completed to final quality HD for interim use

### **5. Conclusion**

The major items under Task 1 – Exhibition for iPad and Exhibition Master v2 - have been largely completed. Task 2 is underway, due for completion in Year 2. Task 3 has been only partially completed.

#### **5.1 Schedule**

Some work on Task 1 Exhibition Version has been brought forward from year 2 to year 1, and some additional work has been performed at the request of ESA and the science teams that was not included in the original workplan. This delayed the start of work on Task 2 Tablet Version, and Task 2 design phase also took longer. Software development for Task 2 is now about one month behind schedule.

In order to focus the software team on the Tablet version, we recommend that the Windows port of the Exhibition version is delayed until completion of the Tablet version, currently scheduled for September 2015. This change is included in the revised schedule shown in Appendix 1.

#### **5.2 Priorities**

Completion of the Tablet version in time for the UN Climate Change Conference COP21 in Paris, 30 Nov – 11 Dec, is now the main priority. Allowing for Apple's 6-week approval stage on the App Store, this means meeting the originally planned date for the first Year 2 deliverable:

1 Sep 2015    D.2104 Tablet for iPad release version 1.0

Priorities expressed by ESA at the Year One Review are:

1. Updated data in the Exhibition version (also to be used in the Tablet version)
2. Tablet version finished on time
3. Graphs of change over time for as many ECVs as possible
4. Animations
5. Other platforms

# Appendix 1 Project Schedule

## ESA CCI Visualisation Corner 2

Outline Schedule  
PE/PVL 19.6.15

- task started early
- task running late

project phase	YEAR 1												YEAR 2												YEAR 3													
project month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
calendar year	2014												2015												2016													
calendar month	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	J	A	S	O	N	D	J	F	M	A	M	J

### TASK 1: Exhibition Version

- D.1101 Exhibition Master design spec
- D.1102 Exhibition Master alpha
- D.1103 Exhibition Master beta
- D.1104 Exhibition Master release v2.0
- D.1105 Exhibition Master update 1
- D.1106 Exhibition Master update 2
- D.1107 Exhibition Master update 3
- D.1108 Exhibition Master update 4

- D.1201 Exhibition for iPad beta
- D.1202 Exhibition for iPad release v1.0
- D.1203 Exhibition for iPad update 1
- D.1204 Exhibition for iPad update 2

- D.1301 Exhibition for Windows
- D.1302 Exhibition for Win update 1
- D.1303 Exhibition for Win update 2

### TASK 2: Tablet Version

- D.2101 Tablet design
- D.2102 Tablet (iPad) alpha
- D.2103 Tablet (iPad) beta
- D.2104 Tablet (iPad) release v1.0
- D.2105 Tablet (iPad) update 1
- D.2106 Tablet (iPad) update 2

- D.2201 Tablet (Android)
- D.2202 Tablet (Android) update 1
- D.2203 Tablet (Android) update 2

### TASK 3: Animations

- D.3100 Animations x3 (Year 1)
- D.3200 Animations x4 (Year 2)
- D.3300 Animations x3 (Year 3)

