CM4SH
Conceptual Models for Southern Hemisphere - II

End Report

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Summary

This end report describes the project process and results of the WMO & EUMETSAT funded project "Conceptual Models for Southern Hemisphere-II (CM4SH)". This project was an extension for the project first phase, and it ran between January 2015 and March 2016.

The final end report will be delivered to WMO and EUMETSAT by June 2016, after closing the financial accounts and publishing the results on web.

The project team consists of Virtual Laboratory (VLab) Centre of Excellence (CoE) expert teams from Brazil, Argentina, South Africa and Australia. On this project phase the team was reinforced by an expert group from BMKG, Indonesia. Conceptual Model (CM) experts from SATMANU group provided technical and scientific support for the team. External reviewers from CIRA and NOAA provided feedback for each contribution.

The project deliverables consist of seven new southern hemispheric CMs. Altogether after these inclusions and two project phases the library of CM4SH Conceptual Models will contain 15 CMs from tropical and extra-tropical southern hemisphere.

Introduction

Satellite imagery and products are one of the key tools weather forecasters use in monitoring and forecasting the weather. Combining satellite information with other meteorological data sources is the background philosophy in developing Conceptual Models. Conceptual Models are descriptions widely used in communicating the weather information in weather forecasts as well as in training at universities and other meteorological training centers.

Conceptual Models for Southern Hemisphere project supports the development of a collection of CMs for the Southern Hemisphere. In 2014 – 2015 the first project of CM4SH was run with a big success and with a lot of consecutive applications in training and forecasting.

Consequently a second project, CM4SH-2, was initiated (see Memorandum in Appendix 1) and started with a Kick off meeting in February 2015.

The impressions of the team of newly involved team from Indonesia are worth mentioning already here in the beginning of the end report to demonstrate the effects of this work within the team:

"Previously, it was so hard to understand the meteorological information, especially for visual people like me. I didn't have any people to discuss with. Now, when I start to use ITACs, GraDS, process NWP, Vertical Cross Sections, analyze the satellite image, and process the schematics...everything is like eye-opener for me. I will have colleagues to discuss everything with. I expand my options and confidence. "

Project Team

Four VLab Centres of Excellence from Argentina, Brazil, Indonesia and South Africa took part in the project. All of them built a project team consisting of representatives from weather services and universities. The names of the team members involved in the final production of CMs can be seen here:

https://sites.google.com/site/cmsforsh/contributors

Project partner institutes represent very well the variable meteorological and climatological regions of Southern Hemisphere.

A European CM group, who had previous CM experience from "SatManu" project (Manual of the Synoptic Satellite Meteorology), the EUMeTrain program and the first phase of CM4SH, supported the project partners, and offered training, advice and reviewing during the whole project.

External reviewers from NOAA and CIRA assisted in reviewing and giving feedback about the deliverables.

Funding

The project was co-funded by WMO and EUMETSAT; WMO contributed through its the Education and Training Office EUR 20,000 towards the project and EUMETSAT EUR 12,500 plus the in-kind efforts for project oversight and management, as well as a Project meeting at EUMETSAT.

Project milestones

Milestone	Time
Project Kickoff, Nomination of teams	February 2015
Orientation, selection of CMs for each team, bids	March 2015

Preparatory work for Scientific Research	March – April 2015
Scientific research	May- October 2015
CM Content development	July – October 2015
Scientific Review	October-December 2015
Technical Review, English proof-reading	January – February 2016
Publishing, reporting and evaluation	March 2016

See also Appendix 2 for the Project flowchart.

Project phases in brief

- **Project Kick off, nomination of teams**

  There was a change in the teams, Indonesia joined as a new partner while Australia wanted to suspend for this phase because of constraints in personal and time resources. Australia offered advice to the Indonesian team based on the experience they gained during the first phase.

- **Orientation, selection of CMs for each team, bids**
  - In this phase we could already rely on the agreements made during the first phase of CM4SH especially on the definition of CMs, the description of CMs in form of 5 chapters and the way of collecting material.
  - Training could also be reduced compared to the first CM4SH phase. Instead of having online sessions with all partners, training for main topics of CMs and for CM thinking was produced in a form of narrated PowerPoint presentations. The whole material was stored in team Google Drive accessible for all partners.

https://drive.google.com/folderview?id=0B-nzEhTv9auPWVpCSUlPVGM3MlE&usp=sharing

  - The following important CMs were selected by the teams for a development and presentation:
    - Argentina:
      - The Bolivian High and its relationship to deep convection
      - Cold Fronts in Central Argentina
    - Brazil
      - Cyclogenesis and Extra-tropical Cyclones over south-eastern S-America (CPTEC)
      - Upper Tropospheric Cyclonic Vortices (CPTEC)
      - Tropical Cyclones over Northern Atlantic (LAPIS)

- Indonesia
  - Northerly Cold Surge

- South Africa
  - South African Cold Fronts

- **Preparation and Scientific Research work and CM Content Development**

  - The European CM support group accompanied both phases with help of monthly status reports of every team in which the teams were asked specific questions about their progress and eventually typical obstacles.

  - Between July and begin of August 2016 “get together” online meetings between every team and the support group were held.

  - This accompanying support was also directed to have already a solid basis for a meeting with representatives of all teams and the CM support group in the beginning of October in Darmstadt. This face-to-face meeting was held in order to manage better the content development and to have a deeper discussion and agreement on scientific aspects for each CM. The meeting replaced the foreseen online meeting and was not only very positive in respect to the personal atmosphere but could also set important accents for the finalisation of the Content development,
  - For the content development the same Software “Google Sites” was chosen as in the predecessor project before.

- **Scientific review phase**

  This phase extended over December to February and was split in 3 phases:

  - The European CM support team reviewed all CMs in two time steps: first for larger supplements and then for a scientific fine tuning.
  - In February the external reviewers from NOAA and CIRA gave valuable comments during the final review phase.

- **Technical finalisation**
  Technical finalisation was mainly done by the EUMETSAT team. The key technical support person left EUMETSAT in January, which caused some delay in technical finalisation and publishing of the material.

Deliverables

CMs selected from each partner and fully developed in a style comparable to SatManu.

All above can be accessed through the following URL:[1]

http://www.cm4sh.org/

Outside but in parallel to this project the team of EUMeTrain decided to include all CMs of the Southern Hemisphere developed in CM4SH in SatManu. This is a very fruitful widening for both manuals: SatManu and CM4SH and can be seen under: http://www.eumetrain.org/satmanu/index_conc.html.

Also all CMs from CM4SH-II will be added in this way to SatManu.

Short description of the fully developed CMs

Cloud patterns Associated with Cold Fronts in Central Argentina

The meteorological phenomena that occur in the central part of Argentina are mostly related to the passage of baroclinic waves immersed in the westerlies flow. Cold frontal systems or cold fronts are associated with different cloud patterns that can be clearly identified in satellite images.

Bolivian High and its Relationship with Deep Convection

The Bolivian High is a high pressure system visible at 200 hPa, which predominates in the South American atmospheric circulation during summertime. Its diagnosis and forecast is of special interest due to its relationship with the precipitation in South America and, in particular, with the occurrence of deep moist convection over the north western region of Argentina.

Tropical Cyclones on Northern Atlantic

This is the first time that the important CM "Tropical Cyclone" is treated in a manual of CMs. Tropical cyclones are phenomena that can varies greatly in intensity, location and appearance. The Conceptual Model presented here describes some aspects of a tropical cyclone for one particular tropical region. Therefore the CM presented here should be regarded as the first important step towards a comprehensive description of various tropical cyclone developments.

Cyclogenesis and Extra-tropical Cyclones over Southeastern South America

Atmospheric closed circulations rotating clockwise in the Southern Hemisphere typically form close to the east coast of Uruguay and Southern Brazil and propagate south-eastward, reaching the maximum intensity over the South Atlantic Ocean. Typical cloud configurations

[1] To be completed by June 2016.

during the development can be identified and it is an interesting fact that the start of a cyclogenesis is not combined with the usual wave stage but with an old upper tropospheric vortex.

Upper Tropospheric Cyclonic Vortices

During austral summer (Dec–Feb) the upper tropospheric circulation over South America is characterized by the presence of a quasi-stationary high over Bolivia (know as Bolivian high and treated by the Argentinean CM4SH team) and a deep trough to its east over northeast Brazil and adjacent Atlantic Ocean. With a certain frequency the trough at the northeastern coast of Brazil closes forming upper tropospheric cyclonic vortices. Those systems are known as VCAN (from Portuguese acronym for UTCV).

Northerly Cold Surge

The southward movement of cold-air outbreaks from Siberian-Mongolian High (SMH) are an important aspect of intra-seasonal variability of the winter monsoon. This cold and dry intrusion -- often called as "cold surge" – associated with a surface pressure raise, a sharp drop in temperature in China and a strengthening of northerly wind prevailing southward reaching as far as the equator.

As the surge move southward, it interacts often with convection processes over the South China Sea, in the region of north of Borneo, along the Indo-China coast and Java Sea. The severe weather accompanying the intense cold surge often brings about major disruptions of agricultural and economic activities in the affected regions.

South African Cold Fronts

Cold fronts are most common during the winter over South Africa. Cold fronts pass once to twice a week over the southern part of South Africa displacing the surface high pressure systems and their associated stable weather conditions that normally dominate the interior. Most of the frontal depressions are rooted south of 40 degrees south.

Cold fronts, which move over the southern and central parts of South Africa, do not only result in a decrease in surface temperatures and the arrival of precipitation, predominantly along the coastal belt, but dry and windy conditions are possible east of the front, as low level wind speeds increase. This increase in wind speed over the eastern interior of South Africa, which is very dry during the winter months, can result in runaway fires (Veld Fires).

Communication

Apart from one meeting of representatives of all teams at EUMETSAT and occasional meetings at international conferences, this project was – as the predecessor project -

designed as an online project. Consequently we could rely on the experiences of the first phase.

Besides the typical electronic communication ways like mails, a project platform within “Active Collab” was used. Information about phases and milestones, announcements of online meetings and recorded sessions as well as some discussions were done via this platform.

For the online meetings we used Saba Centra online meeting Software as well as WebEx software. Despite some common small technical problems these worked very well. There were 9 meetings for all participants:

- Kick off with Indonesia on 13 February 2015.
- Kick off with Argentina and Brazil on 3 March 2015.
- Kick off with South Africa on 9 March 2015.
- All Team meeting with CM presentations 8 April 2015.
- Five “Get Together” meetings between July and August 2015
- Information meeting in the end of the meeting at EUMETSAT on 15 October 2015.
- Closing meeting on 13 April 2016

Feedback from each centre

On 13th April 2016 an online closing meeting took place with the aim to summarise what worked fine, what was learned, what difficulties the teams had experienced, and what are their future plans.

The partners reported similar experiences as an outcome of working on this project. They can be summarised in three categories:

1) They learned a different way of looking into the weather systems through the CM approach and, by this, learning to use the applications and meteorological archives for scientific work.
2) They increased a deeper interest in the CMs within the forecasting and training departments.
3) They learned to organise the group work between different institutes, including new team members and promoting cooperation between different groups.

All partners agreed that there is still need for more CMs and they are consequently in favour for a continuation. There are already clear ideas about the most important CMs; not all but many CMs are local and small scale ones. These include, for example:

Argentina	Local circulations (sea/river breezes) Mountain waves and CAT Mid-level cut-off
Brazil	Continuation of tropical cyclones Subtropical cyclones CMs important for Nowcasting
Indonesia	CMs in connection with the Madden-Julian Oscillation
South Africa	Small CMs within forecast area, initiated and developed by forecasters

Summary and Outlook

As was shown already during the first phase CM4SH does not only produce new material for the training centres, the Centres of Excellence, but fosters the communication among different institutes and research groups. What can also be clearly seen is an increasing interest of the forecast departments in the developed CMs. As a consequence of this the proposed CMs for the next phase are more of a local and small scale important for forecasting and warning services.

Appendix 1. updated

Memorandum

To	:	
From	:	USD/VN
Copy	:	
Ref.	:	EUM/USD/MEM/12/683665, v1 Draft
Date	:	18 December 2012

Subject : **Project outline on Conceptual Models of Southern Hemisphere**

Introduction

The request for this project has come from the Management Group of the WMO / CGMS Virtual Laboratory for Satellite Meteorology and it has been endorsed by the CGMS at its recent meeting in Switzerland (Nov 2012), see below.

CGMS/VLab co-chairs	VI.1	40.9	CGMS to investigate the possibility to provide funding to the VLab CoEs in Argentina, Australia, Brazil and South Africa, to establish a project for generation of conceptual models for the Southern Hemisphere.	CGMS-41	**OPEN**

Satellite imagery and products are one of the key tools weather forecasters use in monitoring and forecasting the weather. Whilst a great deal of literature and training resources exist utilizing Northern Hemisphere examples there is not the same depth and spread of material in the southern hemisphere. This project aims to improve this situation by reviewing the current examples of dynamically and thermodynamically consistent conceptual models for the Southern Hemisphere and creating the missing models based upon templates already developed for the Northern Hemisphere around the widely used SATManu publication.

When completed, the material will be used by the Centres of Excellence in the Southern Hemisphere who will also participate in the development of the material.

PROJECT OUTLINE

The project will consist of several phases:

Phase 1 – Documentation and review of existing Southern Hemisphere conceptual models against typical southern hemisphere weather systems

Phase 2 – Development of missing conceptual models utilizing the SATManu templates and material.

Phase 3 – Testing of new and revised material by the Southern Hemisphere CoEs

Phase 4 – Initial publication of the material

PROJECT ORGANISATION AND DURATION

EUMETSAT has offered to act as overall project coordinator and manager and will contract a lead technical expert to support the work of the Centres of Excellence. Centres of Excellence will be able to bid for small amounts of funds to develop / adapt conceptual models and refine existing ones to the standard and layout of the SATManu examples for the Northern Hemisphere. Opportunities will be taken of conferences and workshops such as the CALMET workshop in August 2013 to showcase the work and bring the relevant experts together for discussions.

Project will begin 1 January. Phase 2 should be 90% complete by the end of calendar 2013 with the publication of the material during calendar 2014, date depending upon feedback from the CoEs in phase 3.

DELIVERABLES

1. An inventory of existing literature about Conceptual Models s in the whole Southern Hemisphere.

2. Training of the methods in developing and applying Conceptual Models.

3. Descriptions or Examples of selected Southern Hemispheric Conceptual Models, preferably of Conceptual Models connected with hazardous weather.

FUNDING

WMO, through the Education and Training Office, has agreed to provide Euros 20,000 towards the project with EUMETSAT offering a further Euro 10,000 plus the in-kind efforts for project oversight and management.

EUMETSAT's responsibilities

EUMETSAT shall:

a) Coordinate and manage the inventory of existing research and literature about conceptual models in the whole southern hemisphere;
b) In partnership with southern hemisphere VLab Centres of Excellence, develop and describe conceptual models (or create case studies) in the southern hemisphere, using the SATManu templates and material;
c) Assist in the testing of revised and new material by the southern hemisphere VLab Centres of Excellence;

d) Publish the conceptual models via digital media;
e) Provide a technical expert to lead the work and coordinate the input from the VLab Centres of Excellence;
f) Submit six-monthly progress reports to the WMO Education and Training Office and the WMO Space Programme Officer.

WMO's responsibilities

WMO shall make available to EUMETSAT a maximum amount of EUR 20,000.00 (twenty thousand Euros) in 2013 as financial contribution to the implementation of the activities listed under paragraphs 1 (b), (c) and (d) above.

Appendix 2. Project Flowchart

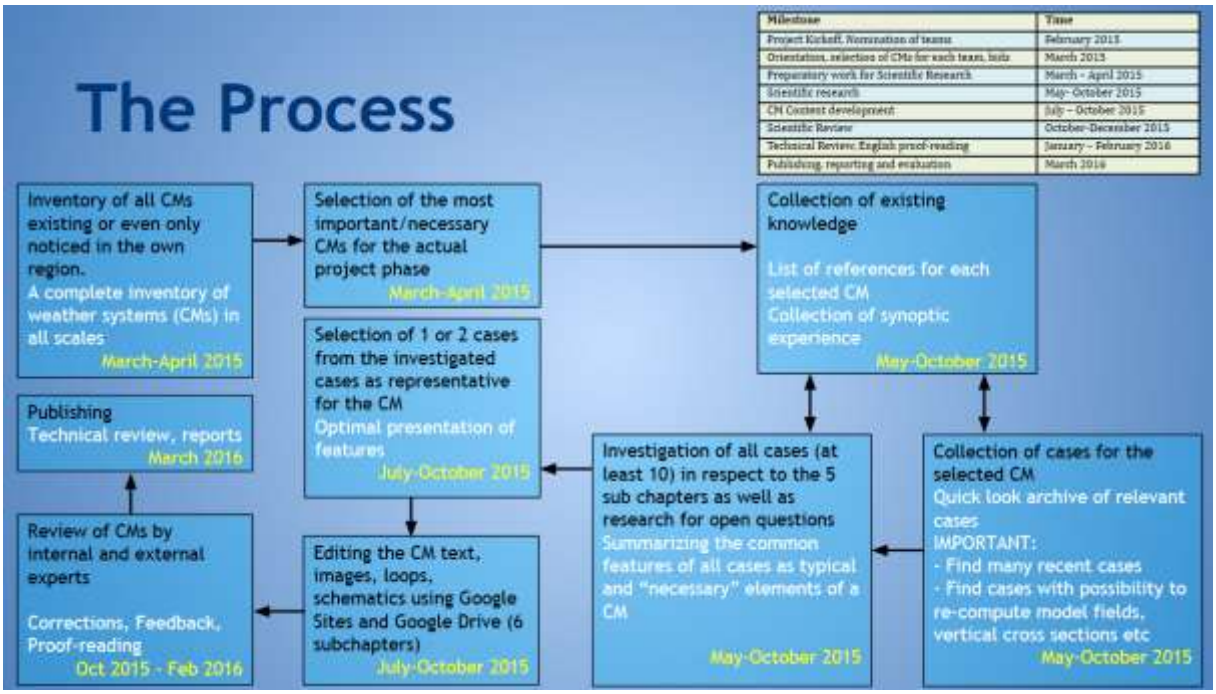

Figure 1. CM4SH Project processes.

Appendix 3. Financial Tables

To Be Added later.