

CM4SH: A CROSS HEMISPHERIC PROJECT ABOUT CONCEPTUAL MODELS

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Abstract

Since begin 2013 a project for the evaluation and presentation of Conceptual Models for the Southern Hemisphere is supported by WMO and EUMETSAT. Four countries/regions in the Southern Hemisphere: Argentina, Australia, Brazil and South Africa are working together and are supported by a European CM team.

The paper shows the goal of the project, the target user groups, the status and an outlook.

CONCEPTUAL MODELS (CM)

The definition of CMs agreed many years ago in a COST Project in Europe is:

A CM describes essential features of a meteorological phenomenon and identifies the principal processes taking place.

There are two fundamental statements contained in this definition: 1) CMs look into **features** seen in images, observation data or parameter charts and 2) the physical-meteorological processes that take place in the troposphere and are the cause for the cloud and weather features of a CM are investigated.

CMs are important tools in meteorological training for a better understanding of weather systems but also tools in weather forecast to combine the different meteorological data in a useful and efficient way. This leads to an application of CMs especially in weather analysis, nowcasting and for detecting numerical model deviations.

On the Northern Hemisphere in the region of N-Atlantic + Europe a thorough collection of CMs has been developed by European experts and can be found in SatManu (<http://www.eumetrain.org/satmanu/SatManu/main.htm>). About 60 CMs are described according to a) their appearance in satellite images, b) the responsible meteorological-physical background, c) those numerical key-parameters which are typical for the CM and their typical features, d) information about these key parameters in the vertical cross sections and e) last but not least the typical weather events, with special respect to possible hazards; a comprehensive list of literature as well as a "short version" for a quick overview completes the presentation

On the Southern Hemisphere the "tool CM" is known but only elements of some CMs are yet described. This was one of the starting points of the CM4SH project.

BASIS AND GOALS OF CM4SH – A VIRTUAL PROJECT

The user groups of CMs on the Southern Hemisphere indicated the necessity and willingness to develop and present CMs in a comparable way among the different regions of the SH and the already existing material on the NH. It was decided to involve the network of Virtual Laboratories of WMO which are producers but also users of the outcome. As there are two entry points from training and

from weather forecast it is a speciality of this project that training institutions and weather services work together.

Teams from Argentina, Australia, Brazil and South Africa are partners of CM4SH and are supported by a European CM team which was the protagonist within the production of SatManu and can support with all the experience made during this work.

As financial funds are very limited, it was clear from the beginning that project meetings will not be possible and that consequently the project has to be managed as a “virtual project” with online meetings using all possible communication tools available.

The main goals of the CM4SH are:

- **To collect, create and share training resources about CMs for Southern Hemisphere.**
- **To increase the operational forecasters’ understanding of the weather systems with the help of CMs and also increase their forecasting skills.**
- **To establish a virtual team that can work together and support each other despite the distance.**

STEPS AND MILESTONES

To be able to deliver results which are understandable and comparable for all meteorological students and post graduate meteorologist across different regions and hemispheres, it was necessary to prepare in the first phases of the project a common understanding and working ground.

In an **orientation phase** all partners decided to use the definition of CMs as well as the different input and subchapters as described in the first chapter.

As for some of the partners the work with and on CMs was quite new, also a project **training phase** was introduced which had to be adapted to the needs of a virtual project. Instead of meetings or long online presentations a set of necessary CM-literature for groups of weather systems was put together and provided to the project partners. The teams met in live meeting to discuss the material provided and how it is applicable to each region. This was an interesting experiment for comparison among the 4 regions.

As a **first deliverable** all partners collected those CMs being already known or supposed to exist in their area and all existing literature about them. From these collections a literature survey as well as an inventory of CMs in the different areas of the SH could be made. This inventory shows similar chapters and CMs as in SatManu but also new ones which do not appear on the NH like for instant tropical CMs. On the other hand many CMs are mentioned by more than one of the partners which is of course a source of mutual comparison (<http://www.wmo-sat.info/vlab/conceptual-models-southern-hemisphere/>)

From this big amount of collected CMs every partner selected two CMs of special importance which will be developed in full content as **third deliverable** of the project. For all other CMs only a so-called **quick-look archive** is to be produced as a **second deliverable**. This archive will be a source of interesting cases for potential next phases of the project CM4SH.

The examples presented in the following subchapters are not yet the final description of CMs but should act 1) as a view into the collection of already existing pieces of a CM; 2) as an appetizer for what will be available in the end of the project and 3) as examples for sharing knowledge between the hemispheres as well as among the different regions.

The selected CMs for Argentina

Argentina is interested in a CM called SALLJ (South American Low Level Jet) which is connected with intensive convective cloudiness in form of big MCCs and MCSs as a consequence of warm and moist air transported within a Low Level Jet from northern areas of the Amazonian basin.

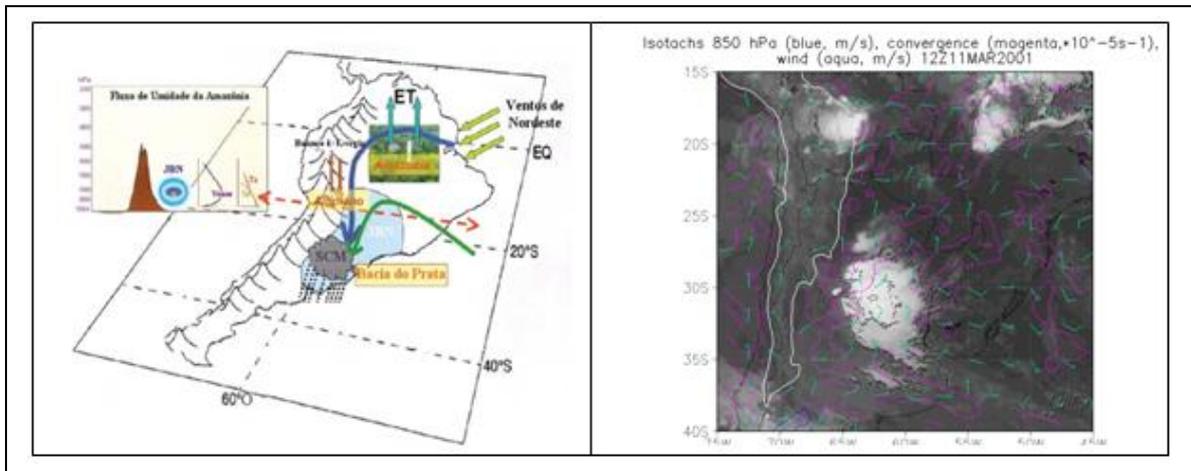


Figure 1: Schematics and a corresponding example of GOES with isotachs, convergence and wind at 850 hPa superimposed

As far as already known, the driving feature of this CM is a low level jet from northern directions leading to low level convergence. But there are also other enhancing features like frontal zones and their connected circulations. This connection will be investigated.

The second CM of interest is related to the mountain range of the Andes and represents the Föhn effect there, called ZONDA and PUELCHÉ. There are a lot of similarities especially in the orographical and physical-meteorological processes of this CM but also locally specific differences especially in the weather events.

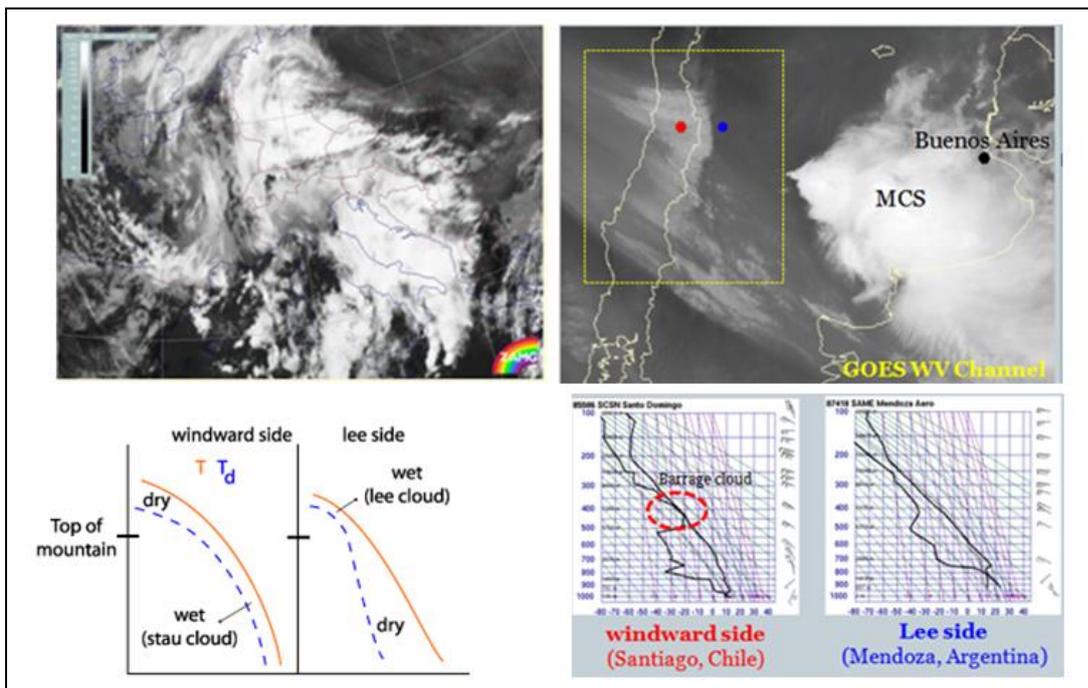


Figure 2: Some comparison of similarities and discrepancies between Föhn at the Alps and Zonda/Puelche at the Andes

The selected CMs for Brazil

Also Brazil – of all partners closest to the equator - is interested in different CMs of convective cloudiness.

One is the detailed description of MCS's which appear frequently in the tropical air mass in the Amazonian basin as well as more to the south.

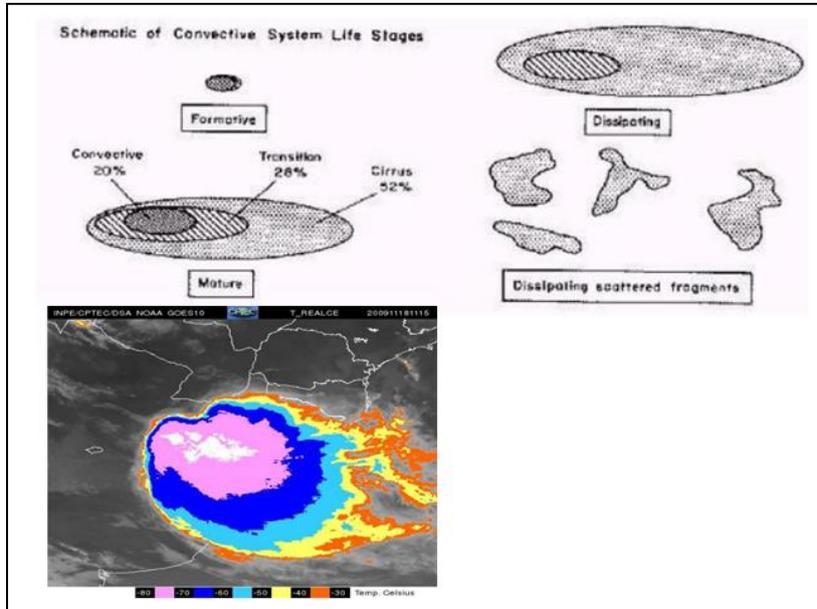


Figure 3: Example for typical life cycle as well as an image of a mature stage of a MCS over Brazil.

The second is the CM SACZ (South American Convergence Zone), a rather stationary line of convective cloud cells stretching from NW to SE Brazil: This convergence zone is a feature of the South American Monsoon system and also connected to some synoptic scale developments like cyclogenesis and stationary fronts.

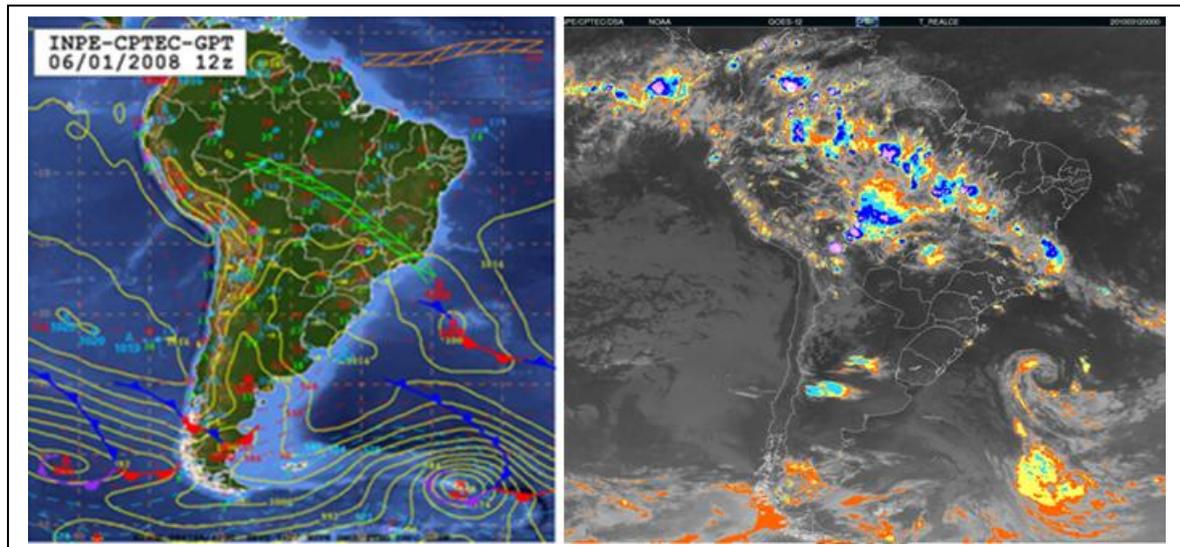


Figure 4: Localisation, synoptic environment and satellite image example for the South American Convergence Zone over Brazil

The selected CMs for South Africa

South Africa has chosen two synoptic scale CMs: the COLs (Cut off Lows) which are CMs in the middle and upper levels of the troposphere and can appear as system alone or can merge with separate low level systems. In the latter situation they appear often over South Africa and are very weather intensive.

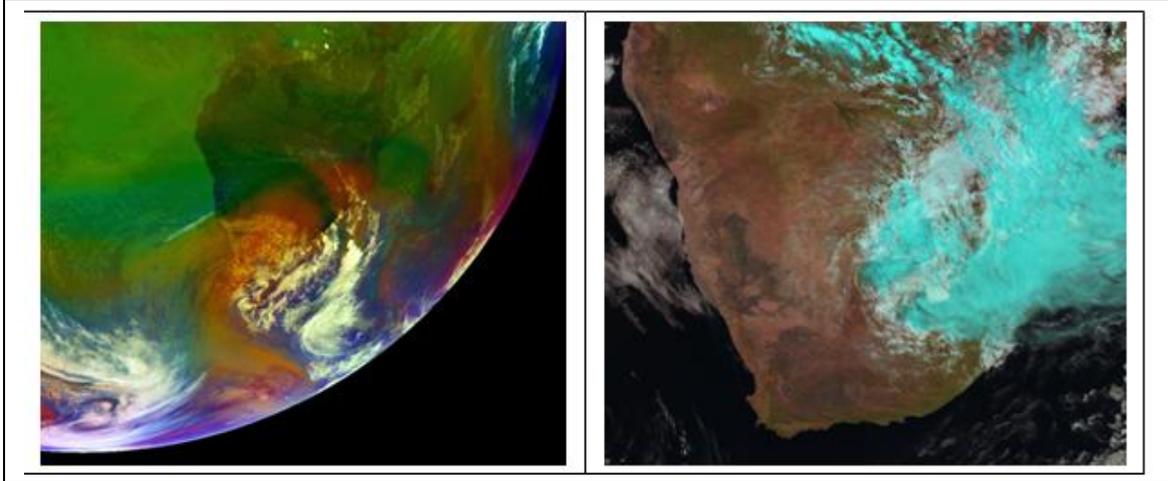


Figure 5: Two examples of COLs . Left: winter case with surface cold front; right: summer case without correspondence in low levels

The second CM is about tropical cyclones over the land. There is already relevant literature from university Pretoria (<http://www.wmo-sat.info/vlab/conceptual-models-southern-hemisphere/1601-2/>) which will be the basis for the development of a corresponding CM.

The selected CMs for Australia

Also Australia has selected synoptic scale CMs: rapid cyclogenesis developments and shallow Cold fronts over the continent in winter time.

Shallow Cold Fronts happen preferably in late summer and one driving factor is the heating of the continent during the summer time and consequently the involvement of dry air.

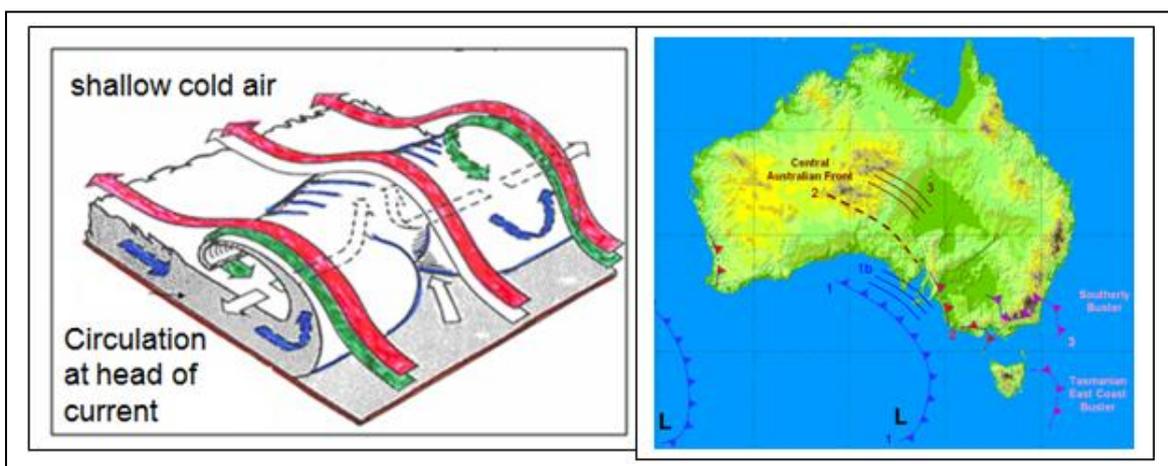


Figure 6: Schematic of background for shallow Cold fronts over the Australian continent and the typical evolution in respect to the location

Rapid cyclogenesis is a very prominent and weather active CM also in the Northern Hemisphere over the North Atlantic. The cases in the region of Australia happen in much more equator-ward latitudes. Therefore not only the detailed discussion of this CM for a usage in weather analysis and forecast will be of high interest but also the similarities and differences to the North Atlantic cases.

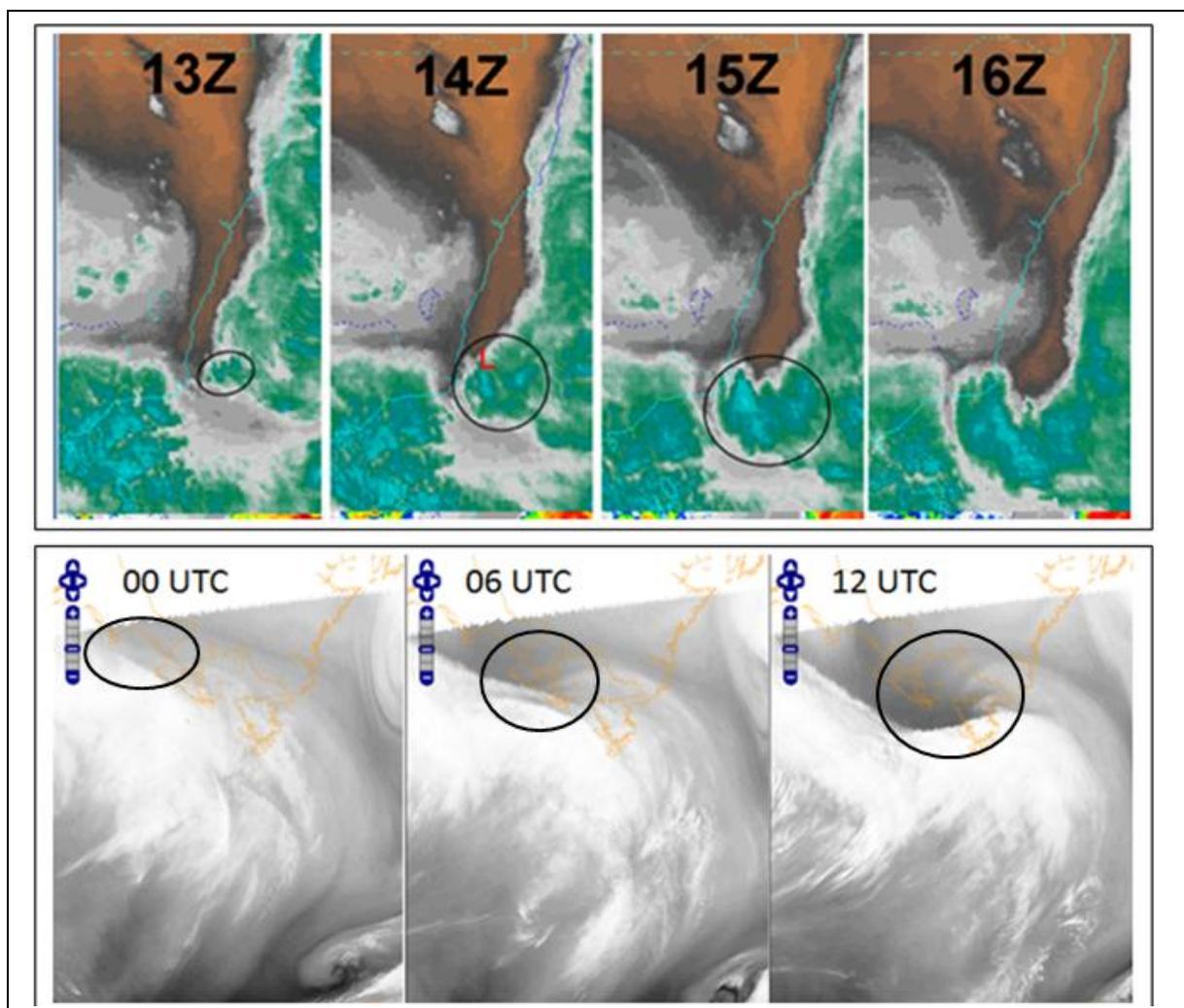


Figure 7: Comparison of a Rapid cyclogenesis development in SE Australia (above) and in North Atlantic area (below)

SUMMARY OF ALREADY REACHED GOALS AND OUTLOOK INTO THE FUTURE

According to the descriptions in the chapters before the time schedule shows that from September 2013 on there are two activities under work: 1) the completion of the quick-look archive for actual good cases in all CMs and 2) the work on the full description of the 8 CMs described above.

It is foreseen to finalise the scientific content of the full description of the selected CMs till end of the year 2013. Three months more will be used to bring the results into the technically appropriate presentation form. This first part of CM descriptions for the SH will also be linked and cross connected among the 4 partners on the SH but also with SatManu for the NH:

In addition to the meteorological scientific work already some very important effects can be seen:

- The work between the different institutes within the partner countries was clearly enhanced, needs of weather services on the one hand and the role and availability of the VLabs on the other hand were made visible;
- A more specified co-operation with neighbour countries was started ;
- Because of the assistance of the European CM group the relevance of new numerical derived parameters was introduced;
- The presentations of CMs in the areas of the 4 partner countries initiated a deeper reflection on the own weather systems.

Looking into the very exhaustive inventory containing at least 100 CMs and the wish not to stop at the description of 8 of them it is planned to proceed this project by a second and probably more. A request will be discussed in the next months and a relevant proposal will be submitted to WMO and EUMETSAT.