Grand Science Challenge on Clouds, Circulation and Climate Sensitivity

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The backdrop: For many years now we have talked about our Grand Challenge as being comprised of three phases:

I. Definitional (2012-2015)

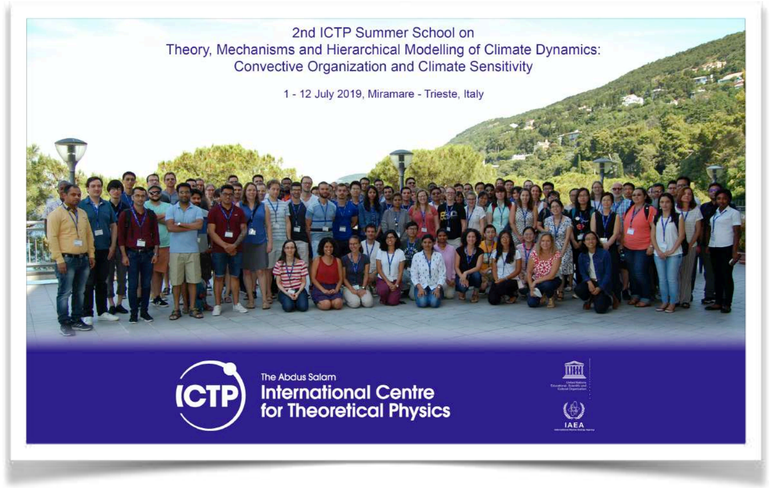
II. Mature (2016-2020)

III. Wrap-up (2021-2022)

Nothing has changed, we are entering the end of the mature phase, and beginning to think about how to bring this to a conclusion.

Some highlights form 2019 and early 2020

Two major assessments, on aerosol forcing (published) and climate sensitivity (revised version submitted) involving 32 and 25 authors respectively. Both in Reviews of Geophysics.



Four workshop/conferences, including this two week workshop/summer school on convective aggregation and climate sensitivity held at ICTP in Trieste, others in

A capstone field study.

WCRP
World Climate Research Programme

A few words about EUREC⁴A

EUREC⁴A *has been in the planning since the very early stages of the Grand Challenge, and has been strongly endorsed by the WCRP. This was particularly helpful in encouraging international participation, also in the Caribbean.*

- WCRP support, and the structure of the core study encouraged the expansion of the scope of the campaign. Starting as a cloud feedback study it grew to incorporate studies of cloud-physics and aerosols, air-sea interaction, as well as ocean miso and sub-mesoscale processes and their influence on the atmosphere.
- Involved 250 scientific participants from about 20 nations, including many in the Caribbean from Belize, to Jamaica, Trinidad and Tobago, Barbados, with strong national support (including ship and aircraft) from Barbados, with major funding coming from the EU, France, Germany, the UK, and the USA.
- Eight major research platforms, aircraft from Barbados, France, Germany, UK and USA, and four global class research vessels (Meteor & Maria S Merian from Germany, L'Atalante from France, and the Ronald H. Brown from the USA) complemented by an array of autonomous vehicles (5 saildrones, 2 wave gliders, 7 sea gliders, 20 drifters including advanced SWIFTs, and 4 UAS, and two kite stabilized helium balloons all in coordinated activities in Jan-Feb 2020., ca 3000 balloon or parachute borne sondes, and nearly four hundred CTDs.
- Seven highly sensitive cloud and precipitation radars mounted on ships, planes and at ground stations. Three water vapor Raman lidars, five wind-lidars, coordinated in-situ sampling with downward airborne remote sensing.
- A novel layout, and unprecedented coverage of water stable isotoplogue measurements from five platforms in the air, on the sea and on land through the downstream trades.
- A very strong modeling component supported by many forecast centers (DWD, ECMWF, Météo-France, NCEP, and local forecasters (through the CMO and CIMH) as well as coordination with the first ever intercomparison of coupled global storm and ocean-eddy resolving (ca 3 km) models (through DYAMOND winter)

Installing the Poldirad C-band radar on Barbados

From BOMEX to EUREC⁴A Symposium at the CIMH, one of many outreach activities

The French ATR taking off with the NOAA Hurricane Hunter in the foreground

Kite operations on the deck of the Maria S. Merian

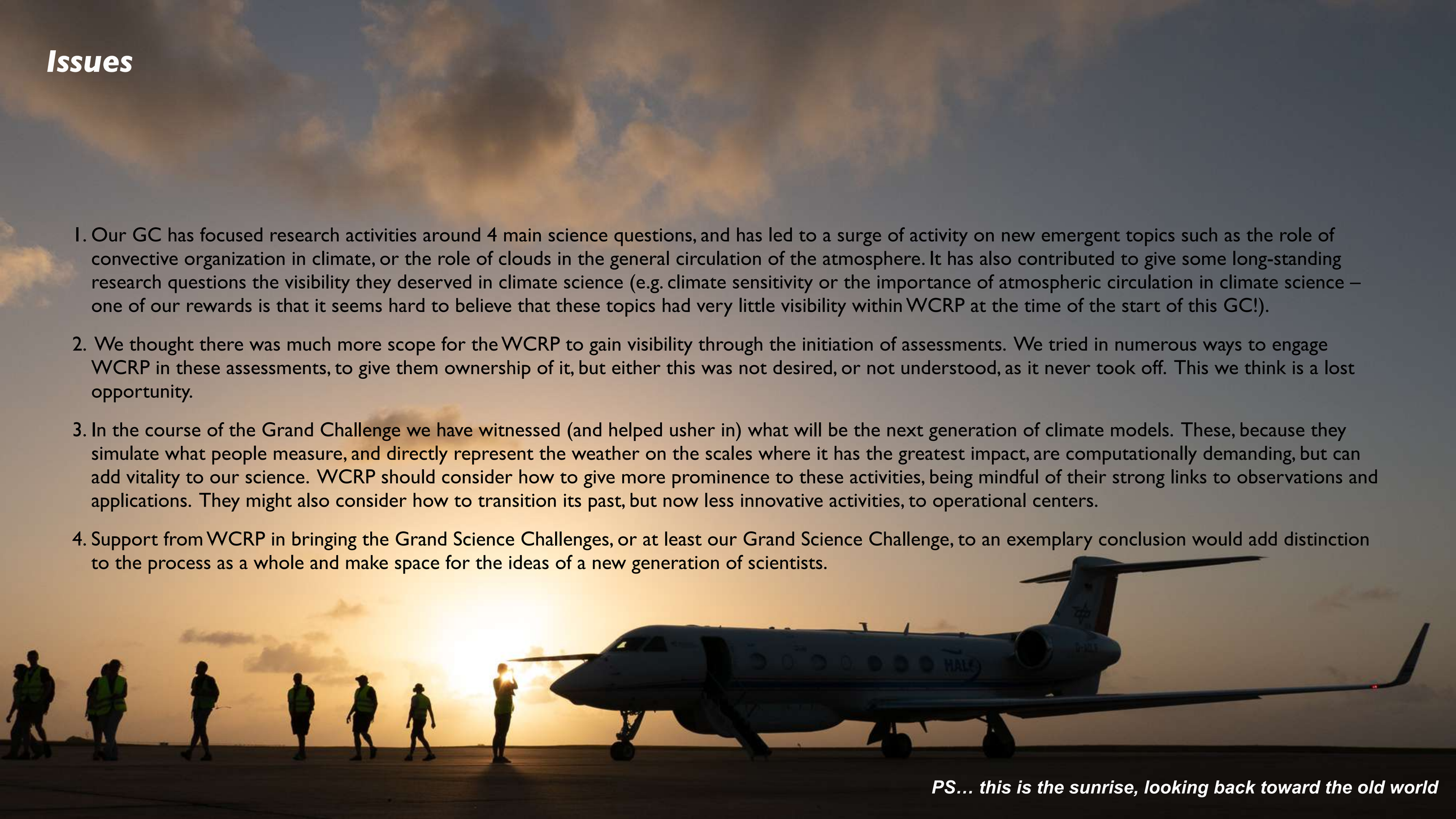
Issues

1. Our GC has focused research activities around 4 main science questions, and has led to a surge of activity on new emergent topics such as the role of convective organization in climate, or the role of clouds in the general circulation of the atmosphere. It has also contributed to give some long-standing research questions the visibility they deserved in climate science (e.g. climate sensitivity or the importance of atmospheric circulation in climate science – one of our rewards is that it seems hard to believe that these topics had very little visibility within WCRP at the time of the start of this GC!).

2. We thought there was much more scope for the WCRP to gain visibility through the initiation of assessments. We tried in numerous ways to engage WCRP in these assessments, to give them ownership of it, but either this was not desired, or not understood, as it never took off. This we think is a lost opportunity.

3. In the course of the Grand Challenge we have witnessed (and helped usher in) what will be the next generation of climate models. These, because they simulate what people measure, and directly represent the weather on the scales where it has the greatest impact, are computationally demanding, but can add vitality to our science. WCRP should consider how to give more prominence to these activities, being mindful of their strong links to observations and applications. They might also consider how to transition its past, but now less innovative activities, to operational centers.

4. Support from WCRP in bringing the Grand Science Challenges, or at least our Grand Science Challenge, to an exemplary conclusion would add distinction to the process as a whole and make space for the ideas of a new generation of scientists.



PS… this is the sunrise, looking back toward the old world