Clouds Circulation and Climate Sensitivity

Bony, Stevens, Frierson, Jakob, Kageyama, Pincus, Shepherd, Sherwood, Siebesma, Sobel, Watanabe, Webb

We identified Four Questions

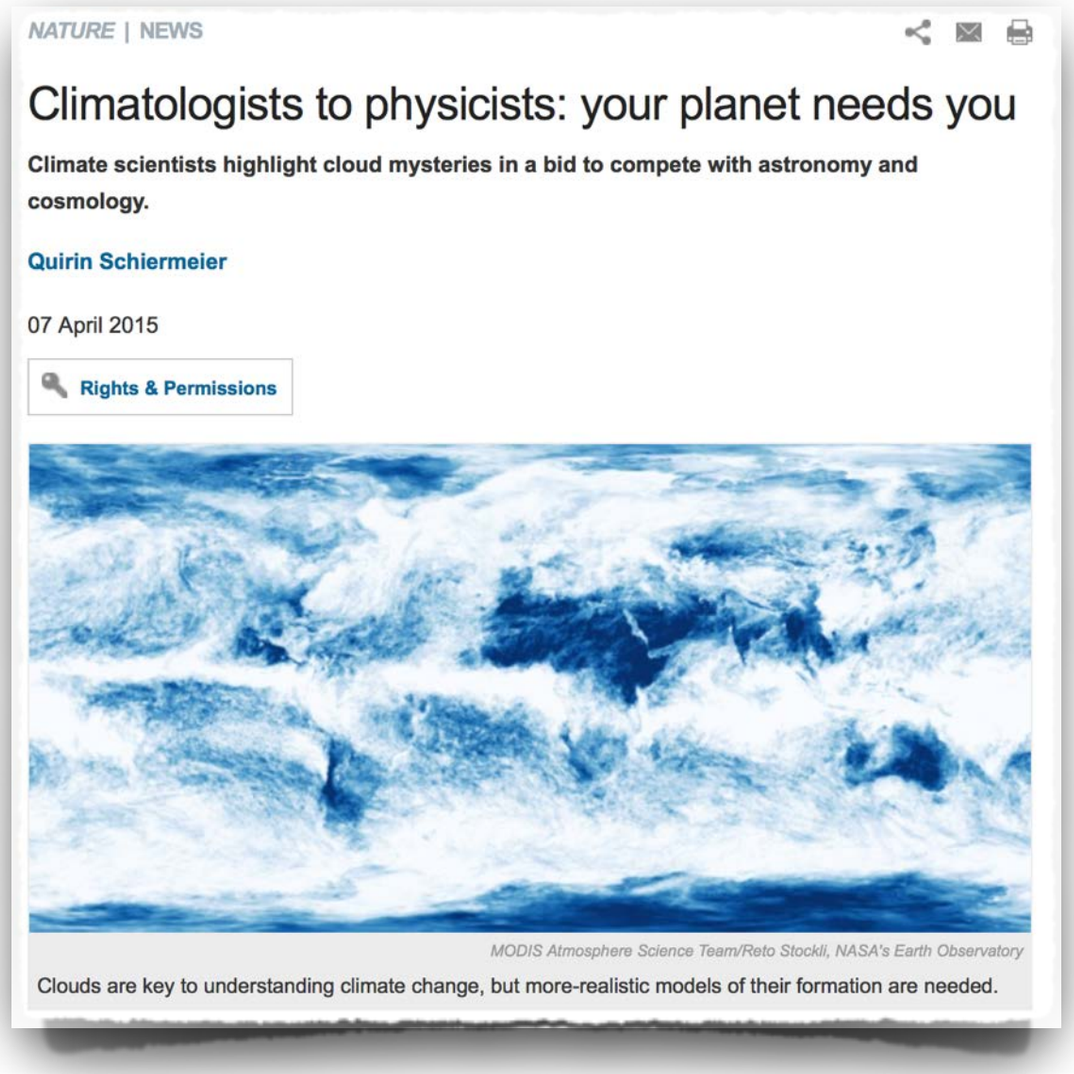
1. **What role does convection play in cloud feedbacks?**
2. **What controls the position, strength and variability of storm tracks?**
3. **What controls the position, strength and variability of the tropical rain belts**
4. **What role does convective aggregation play in climate?**

… which were cast in the form of an article for Nature Geosciences …

It is featured on this months cover

Bony, Stevens, Frierson, Jakob, Kageyama, Pincus, Shepherd, Sherwood, Siebesma, Sobel, Watanabe and Webb, 2015: Clouds Circulation and Climate Sensitivity, *Nature Geoscience*, 4, 261-268

It seems to be generating some interest



NATURE | NEWS

Climatologists to physicists: your planet needs you

Climate scientists highlight cloud mysteries in a bid to compete with astronomy and cosmology.

Quirin Schiermeier

07 April 2015

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MODIS Atmosphere Science Team/Reto Stockli, NASA's Earth Observatory

Clouds are key to understanding climate change, but more-realistic models of their formation are needed.

- **Heike Langenberg: "the article has already proved very popular".**
- **Featured prominently in the social media.**
- **Covered by many of the authors's own countries and institutes.**
- **Will hopefully attract bright minds to important problems in the field.**

… but most importantly it is serving to organize and focus activities within the grand challenge.

Workshops are being organized around the Four Questions

1. **What role does convection play in cloud feedbacks?**
   - *Ringberg, March 2015*
2. **What controls the position, strength and variability of storm tracks?**
   - *Grindelwald, August 2015 (joint with SPARC, WWRP?)*
3. **What controls the position, strength and variability of the tropical rain belts**
   - *Columbia/LDEO, September 2015*
4. **What role does convective aggregation play in climate?**
   - *Special Session at EGU, ISSI Feb 2016*

The GC has spawned some high-profile papers in the literature

1. C. Jakob, 2014: Going back to basics, *Nature Climate Change*, 4, 1042-1045
2. T. Shepherd, 2014: Atmospheric circulation as a source of uncertainty in climate change projections, *Nature Geoscience*, **7**, 703-708.
3. Voigt and Shaw, 2015: Circulation response to warming shaped by radiative changes of clouds and water vapor, *Nature Geoscience*, **8**, 102-106.
4. Tan et al., 2015: Increases in tropical rainfall driven by changes in frequency of organized deep convection, *Nature*, **519**, 451-454.
5. S. Sherwood et al., 2015: Adjustments in the forcing-feedback framework for understanding climate change, *BAMS*, in press.
6. T. Mauritsen and B. Stevens, 2015: Missing iris effect as a possible cause of muted hydrological change and high climate sensitivity, *Nature Geoscience*, **8**, in press
7. B. Stevens, 2015: Rethinking the lower bound on aerosol radiative forcing, *J. Climate*, in press.

And is giving impulse to other high-profile meetings

1. GEWEX Open Science Conference, the Hague, July 2015
2. The Climate Symposium, Darmstadt, October 2014
3. WCRP/IPCC workshop Bern, September, 2014.
4. EGU Vienna (next week)
5. CliVar ENSO working group (July, 2015) & CliVar OSC (next year, hopefully)
6. Gordon Research Conference (August 2015, Maine).
7. SPARC Workshop on Blocking and Extremes (Spring 2016, Reading).
8. Tropical Cyclone Workshop (joint with Extremes, Fall 2016, NY).
9. HD(CP)^2 High Resolution Climate Modelling (Feb 2016, Berlin)
10. IC***ESM-5***, Hamburg and Royal Society Meeting (on the drawing board for 2017)

… very strong links to extremes, especially through Bony, Sherwood, Shepherd, Sobel.

… but also coordinated research activities

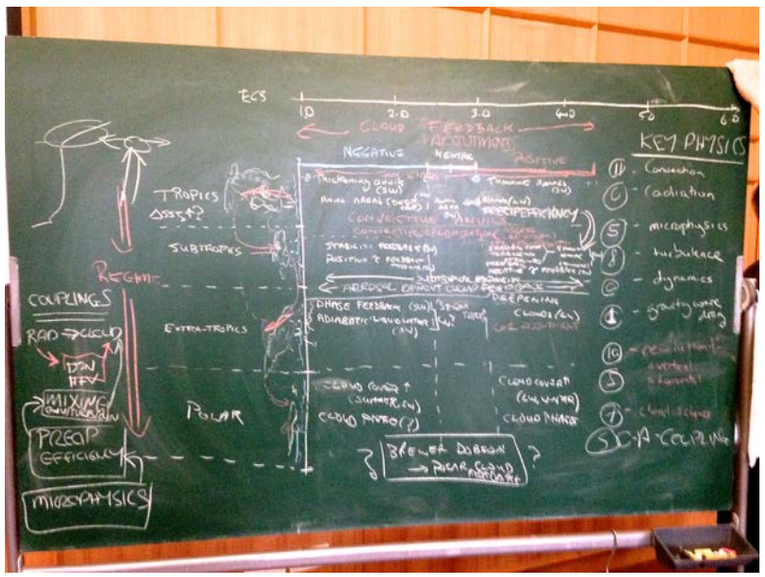
1. **Coordinated Modelling Activities**
   - CFMIP (cloud feedbacks)
   - RFMIP (radiative forcing, espc aerosol forcing)
   - PMIP (paleo climate)
   - Easy Aerosol (independent initiative)
2. **Field Experiments**
   - NARVAL-II (convective organization, Aug 2016, HALO)
   - Downstream/T-NAWDEX (Diabatic processes in storm tracks, Fall 2016, international)
   - UREC^{4}A (French led cloud feedback experiment, on the drawing board)
   - WATER? (WCRP Atlantic Tropical Experiment, Revisited, your job)
3. **Coordinated Proposals**
   - IMPULSE (9 M€, 5 years, not funded)
   - HD(CP)^2 Phase II, in review (15 M€, 3 years)

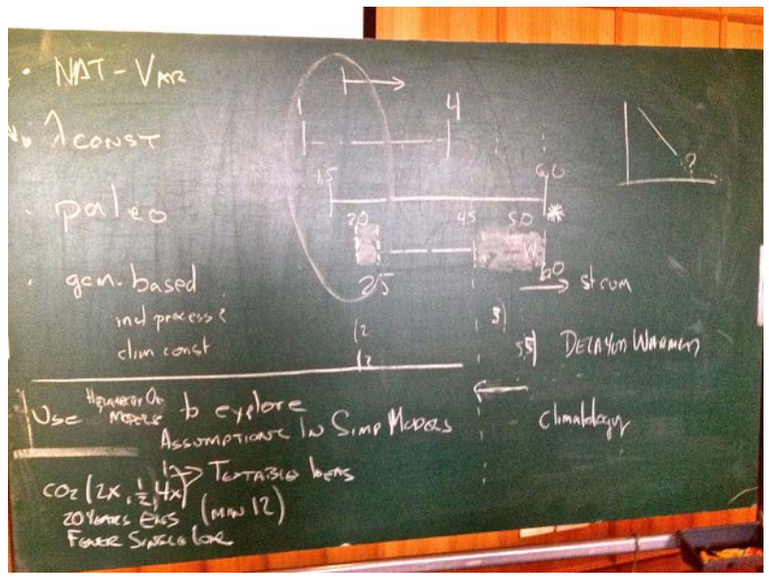
… also the WMAC Summer School to be held at MPI in two months.

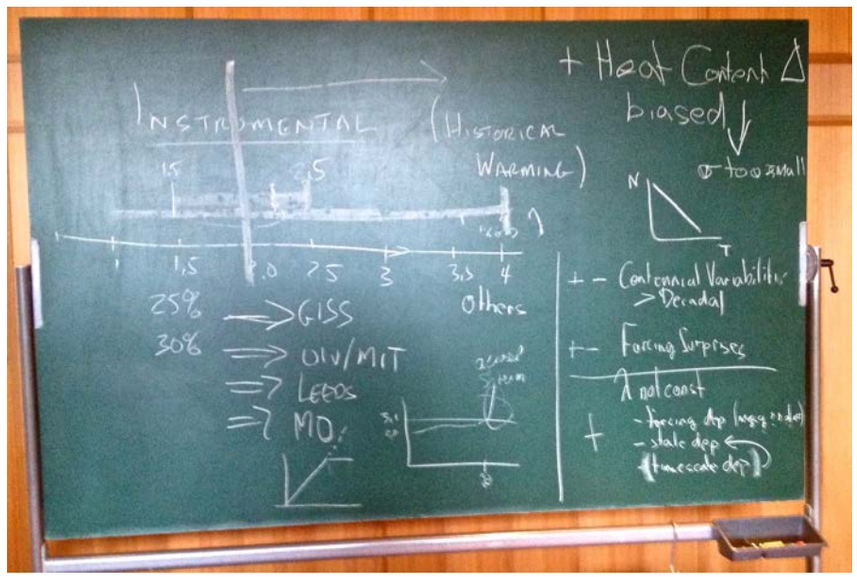
Ringberg 2015: Earth's Climate Sensitivities

a working meeting, over five days, on the question of Earth's Climate Sensitivities.

Ringberg 2015: Earth's Climate Sensitivities

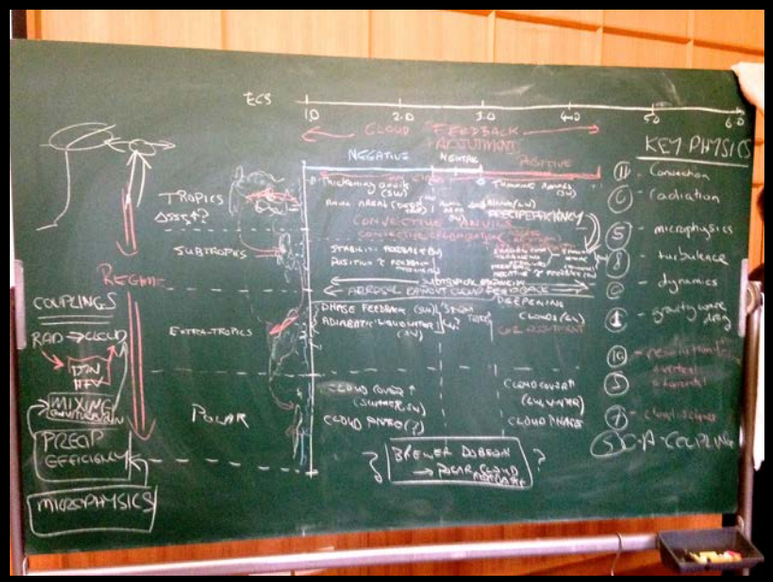


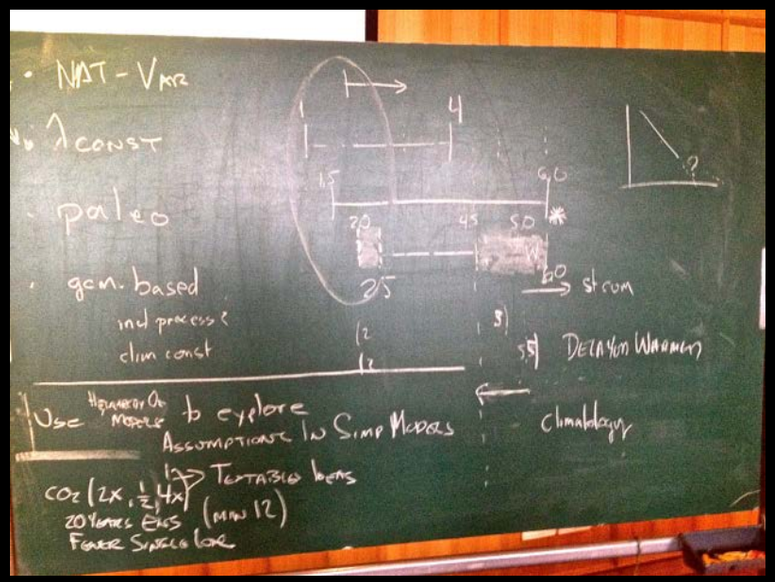


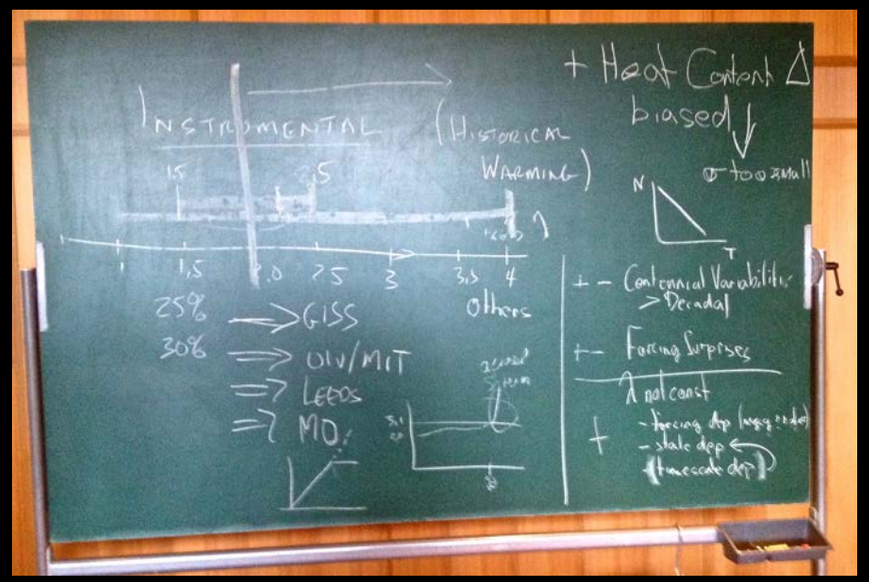


- Thirty-two participants spent five days together discussing climate sensitivity.
- Organized around specific themes: Palaeo record, historical warming, insights from comprehensive modeling, variability and ocean heat uptake, etc.
- A working meeting: half the time spent in plenum discussing specific issues.
- Open and transparent, closely followed by a number of prominent blogs.
- We got somewhere… actually the Ringberg Meetings will change the world.

Ringberg 2015: Recommendations







- Several specific recommendations: e.g., characterising forcing within CMIP is an imperative; more attention to historical period; the importance of a model hierarchy, etc.
- Great promise for narrowing uncertainty by working through specific hypotheses for low (<2) and high (>4) sensitivities.
- Write a *BAMS* article outlining key gaps and ways forward.
- The WCRP should initiate and endorse a formal assessment process lead by the Grand Challenge … we will start now and meet again in 2018.

Your Homework

- Maintain a sharp, yet discriminating, focus on the Grand Science Challenges.
- Nurture links, e.g., to extremes which links closely to circulation; WGNE coordination of AMIP^{T} in cooperation with T-NAWDEX? CLIVAR OSC focus on GC?
- Work with funders to better communicate the importance of basic science and coordination in basic science. *If you don't say this, who will?*
- Work with our GC to initiate and support an assessment process, for climate sensitivity. This can be a model for other grand challenges.

*Organize a measurement initiative (**field programme**) that can responsibly advance the basic science in anticipation of a new willingness (and considerable funding) to **understand** drivers of regional change … e.g., a GATE-II (WATER).*