

The SPARC DynVar Project: A SPARC Project on the Dynamics and Variability of the Coupled Stratosphere-Troposphere System

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Introduction

In light of the growing need to understand the global climate system and its future evolution, stratospheric science requires a renewed and sustained research focus. Although we have known for some time that the tropospheric circulation influences the stratosphere, we have more recently learned that the stratosphere can in turn influence the tropospheric circulation all the way to the surface. This two-way stratosphere-troposphere coupling implies that the stratosphere can significantly influence the global climate system and the pattern and magnitude of global climate change. The problem of stratospheric ozone depletion has already demonstrated how human activity can affect a critical component of the global climate system, how a systematic international research effort is required to understand and solve a global environmental problem, how this research needs to be communicated to society, and how ongoing scientific assessment is essential to evaluate the effectiveness of solutions to the problem. All this makes clear that the

1 stratosphere is an integral part of the climate-change problem and will continue to be a crucial
2 component of research on climate change science, impacts, and mitigation.

3
4 The two-way coupling we have referred to involves dynamical links between the stratospheric
5 circulation and the tropospheric circulation. The troposphere affects the stratosphere principally
6 through upward propagating atmospheric waves that originate in the troposphere. Until recently
7 it was widely thought that the story ended there, *i.e.* that the stratosphere had little influence on
8 the troposphere. One consequence of this line of thought is that the current generation of global
9 general circulation models (GCMs) typically represent the stratosphere relatively poorly. But
10 several recent lines of research suggest that the stratosphere can in fact significantly influence the
11 tropospheric circulation. The seminal modelling studies of Boville (1984) and Boville and Cheng
12 (1988) demonstrated that degrading stratospheric representation can degrade the simulation of
13 tropospheric stationary waves and transient eddies. Further observational work has developed the
14 view that stratospheric influence involves eddy mean-flow interactions that act on intra-seasonal
15 time scales (Kuroda and Kodera, 1999; Baldwin and Dunkerton 2001). The cumulative effect of
16 the intra-seasonal time scale coupling leads to a sensitivity of the tropospheric circulation
17 response to stratospheric processes in both the greenhouse-warming and the ozone-depletion
18 problems (Shindell *et al.*, 1999; Thompson and Solomon, 2002; Gillett and Thompson, 2003).
19 From the cited studies, and many others, we conclude that improvements to stratospheric
20 representation in models might lead to improvements in seasonal and climate-timescale
21 prediction, and ultimately to improvements in the scientific understanding of climate.
22 Characterising and quantifying this kind of stratospheric influence on the troposphere, and
23 ultimately on the global climate system, is a key part of the WCRP SPARC program.

24
25 The goal of this Dynamics and Variability Project for SPARC (which we will refer to by the
26 abbreviation “DynVar”) is to approach the question of the dynamical influence of the
27 stratosphere on the troposphere in a systematic way. The principal tools for this effort will be
28 atmospheric general circulation models (AGCMs) with good stratospheric representation. A
29 novel aspect of DynVar is that we will include ocean models coupled to these AGCMs to
30 investigate in a more realistic setting the two-way troposphere-stratosphere coupling. In addition,

1 DynVar will include a significant component devoted to the use of simplified models and more
2 theoretical approaches to build our understanding of stratosphere-troposphere coupling. Here, we
3 outline a modelling and analysis project intended to take place over a period of five years or
4 longer. Previous successful SPARC projects have built collaborative groups around pragmatic
5 and focused plans. With this history in mind, we will propose activities (GCM simulations and
6 diagnostic analyses) that will mesh well with ongoing international projects and with current
7 activities at the modelling centres that are participating in DynVar.

8 9 **Project Goals**

10
11 Our long-term goal is to determine the dependence of the mean climate, climate variability, and
12 climate sensitivity on the stratospheric general circulation as represented in AGCMs. We present
13 a representative list of thematic and more specific research questions of interest to us:

14
15 *1. How does the stratosphere (more specifically, the stratospheric general circulation as*
16 *represented in climate models) affect the tropospheric general circulation?*

- 17 • To what extent, and in what way, does a poor representation of the stratosphere degrade the
18 simulation of tropospheric circulation in GCMs?
- 19 • What are the consequences of the “fixes” tropospheric modellers need to make, *e.g.*
20 roof/Rayleigh drag, to obtain a reasonable tropospheric climate in their atmospheric GCMs
21 (AGCMs)? To what extent are the model stratospheres sensitive to their treatment of
22 unresolved (*e.g.* gravity) waves and other dissipative processes, and how does this affect the
23 tropospheric simulation?
- 24 • How would stratospheric influences on the troposphere affect the simulation of the coupled
25 ocean-atmosphere system?

26
27 *2. How does the stratosphere influence climate variability on all time scales?*

- 28 • How well do models capture the intra-seasonal vertical coupling between stratosphere and
29 troposphere in the extra-tropics? Does this coupling influence lower tropospheric variability
30 and the variability of the ocean/sea-ice system?

- 1 • Does the stratosphere influence the tropospheric tropical and extra-tropical response to
- 2 ENSO?
- 3 • What are the implications of stratosphere-troposphere coupling for long-range predictions of
- 4 weather and for forecasts of circulation anomalies on seasonal time scales?
- 5 • How does the quasi-biennial oscillation (QBO) affect tropospheric climate?
- 6 • How do 11-year solar cycle variations affect tropospheric climate? (In collaboration with
- 7 SPARC SOLARIS.)
- 8

9 *3. How does the stratosphere influence climate change?*

- 10 • Do models predict in a consistent manner how stratospheric climate change will affect the
- 11 tropospheric circulation and the coupled ocean-atmosphere system?
- 12 • How is the circulation response to climate forcing related to the stratosphere-controlled
- 13 aspects of climate variability raised in the previous set of questions? For example, do
- 14 stratosphere-troposphere interactions help explain dynamically the downward influence of
- 15 Southern-Hemisphere ozone depletion on the tropospheric circulation? And are stratospheric
- 16 dynamical processes required to explain tropospheric circulation trends over the 20th century?
- 17

18 To address these and related questions, we propose to focus this group's efforts on the analysis
19 of AGCMs with a good representation of the stratosphere. A high-quality stratospheric
20 component includes enhanced vertical resolution and a higher model lid than found in standard
21 climate model simulations, and appropriately configured radiative transfer modules and subgrid
22 scale parameterizations, etc. We call these models "high-top", as opposed to standard "low-top"
23 (Boville and Cheng 1988) climate models with a relatively poor representation of the
24 stratosphere. We describe a set of requirements for the high-top models later in the section
25 entitled "AGCM Requirements" below.

26
27 Within the set of stratosphere-resolving AGCMs, we also propose to focus on high-top AGCMs
28 with prescribed radiatively active gases, as opposed to stratosphere-resolving coupled chemistry
29 models (CCMs). The interactive chemistry modules in CCMs increase the computational cost of
30 the models, which constrains the length, resolution, and number of ensemble realizations of the
31 simulations that some groups might commit to. But we will of course not exclude those groups

1 who wish to only run their models with interactive chemistry, provided their models satisfy the
2 minimum requirements as outlined in the section entitled “AGCM Requirements” below.

3
4 As well as addressing our research questions, DynVar is meant to help inform and guide the
5 introduction of stratospheric components into comprehensive Earth System Models as these are
6 developed. The high-top/low-top comparison should help us determine to what extent a resolved
7 stratosphere is important for climate-change simulations for future international climate
8 assessments such as the IPCC assessments.

9
10 We plan to set up DynVar as an intercomparison activity, with a balanced effort on simulation
11 design and analysis tasks. Fortunately, several members of our group have extensive experience
12 in this kind of effort through the SPARC GRIPS, SPARC CCMVal, and CLIVAR “Climate of
13 the 20th Century” (C20C) projects, as well as through the WMO ozone assessments and the IPCC
14 climate assessments. We will take advantage of existing CCM simulations and AGCM
15 simulations from the ongoing CCMVal and C20C projects (see the section entitled “Connections
16 to Other Projects”).

17
18 Beyond performing simulations with and analysing comprehensive GCMs, DynVar will also
19 have an important component that focuses on developing a dynamical understanding of
20 stratospheric influence. This component will use simplified AGCMs and theoretical approaches
21 to provide a dynamical perspective on the results of the comprehensive models. It is hoped that
22 this component will strengthen the interactions between the modelling and theoretical
23 approaches.

24 25 **Project Organization**

26
27 Paul Kushner is the SPARC DynVar project coordinator, and the co-authors of this newsletter
28 form the project’s organizing group. DynVar is divided into four general themes, or “Analysis
29 Areas”, under which specific research studies (“subprojects”) will be placed. Each analysis area
30 has a coordinator who will act as a contact point for participants, help organize model output

1 release requests, organize workshop sessions, take the lead on summary reports, etc.. The four
2 analysis areas, which will be described more fully in the next section, are

3

4 A. “DynVar Top” (Coordinators: F. Sassi and M. Giorgetta)

5 B. “DynVar Intraseasonal” (Coordinator: J. Perlwitz)

6 C. “DynVar Climate Change” (Coordinator: E. Manzini)

7 D. “DynVar Ideal” (Coordinator: L. Polvani)

8

9 Table 1 lists researchers who, in addition to the organizing group, have expressed interest in
10 participating in DynVar. The project’s membership is open; if you are interested in participating,
11 please contact SPARC DynVar *via* the project website: www.sparcdynvar.org (click on the email
12 link to contact DynVar).

13

14

15

16

18

Table 1: Additional Participants

19

Thomas Birner	<i>U. of Toronto</i>	20
Andrew Charlton	<i>Reading U.</i>	21
Bo Christiansen	<i>DMI</i>	
Judah Cohen	<i>AER</i>	
Eugene Cordero	<i>San Jose State U.</i>	
Veronika Eyring (SPARC CCMVal liason)	<i>DLR Oberpfaffenhofen</i>	
John Fyfe	<i>CCCma/U. of Victoria</i>	
Nathan Gillett	<i>CRU/U. of East Anglia</i>	
Lesley Gray (SPARC SOLARIS liason)	<i>Reading U.</i>	
Nili Harnik	<i>Tel Aviv U.</i>	
Daniel Kirk-Davidoff	<i>U. of Maryland</i>	
Kuni Kodera (SPARC SOLARIS liason)	<i>Nagoya U.</i>	
Ulrike Langematz	<i>FUB</i>	
Craig Long	<i>NOAA/CPC</i>	
Steven Pawson	<i>NASA/GSFC</i>	
Thomas Reichler	<i>U. of Utah</i>	
David Rind	<i>NASA/GISS</i>	
Adam Scaife (CLIVAR C20C liason)	<i>UKMO</i>	
Kiyotaka Shibata	<i>MRI Japan</i>	
Michael Sigmond	<i>CCCma/U. of Victoria</i>	
Seok-woo Son	<i>Columbia U.</i>	
David Thompson	<i>Colorado State U.</i>	
Darryn Waugh	<i>Johns Hopkins U.</i>	
Shigeo Yoden	<i>Kyoto U.</i>	

22

1 It is understood that some participants will wish to use the DynVar Project simulations to support
2 their work in other international projects (e.g. SPARC CCMVal, SPARC SOLARIS, CLIVAR
3 C20C, or one of the IPCC AR4 assessment subprojects); in this case it will not be necessary for
4 participants to define a new subproject specific to DynVar, but merely to make a clear link to the
5 other project. It is also understood that DynVar participants who wish to study similar topics
6 independently will not be expected to collaborate with each other, but will be expected to
7 communicate with each other through the Analysis Area coordinators.

8
9 Keys to success of DynVar include ensuring that the effort be open, transparent and not too
10 burdensome for participating modelling groups; that the simulations be carefully planned and the
11 right model output saved; and that the analyses be straightforward and reproducible so that they
12 can be repeated as new simulations become available. Fortunately, our efforts will be made
13 simpler by following the lead of two other successful WCRP projects: SPARC CCMVal and
14 CLIVAR C20C.

15 16 **DynVar Analysis Areas**

17
18 We will now describe in more detail the Analysis Areas, which are mainly meant to break
19 DynVar into manageable pieces. We will work with DynVar participants to identify the
20 appropriate Analysis Area for their specific subprojects, but we recognize that typical
21 subprojects will have elements that belong to more than one area.

22
23 *Analysis Area A: “DynVar Top” (Coordinators: F. Sassi and M. Giorgetta)*

24 Analysis Area A addresses the influence of the stratosphere on the tropospheric circulation, on
25 the ocean circulation *via* air-sea interactions, and on the cryosphere (in particular the sea ice
26 field). Subprojects in this theme will compare high-top and low-top climate models run with a
27 variety of degrees of interaction with the ocean, from prescribed sea-surface temperature (SST)
28 models to models with a dynamical ocean component.

29
30 Analysis Area A subprojects that have been proposed to date include: an analysis of the

1 influence of enhanced stratospheric representation on the mean circulation, ENSO
2 teleconnections, and low-frequency variability in the troposphere; a study of stratospheric
3 influences on the stationary wave field; a study on the role of planetary wave reflection in
4 determining tropospheric wave structure; and a study on the importance of momentum-
5 conservation constraints in gravity wave drag parameterizations on the coupled stratosphere-
6 troposphere system.

7

8 *Analysis Area B: “DynVar Intraseasonal” (Coordinator: J. Perlwitz)*

9 Analysis Area B addresses issues of stratosphere-troposphere coupling on intra-seasonal time
10 scales (time scales of 10–100 days). This theme will focus on high-top simulations of
11 stratospheric sudden warmings, annular mode propagation signals, stratosphere-troposphere
12 interactions forced from the surface, and so on. The emphasis will be on dynamical analysis of
13 the stratosphere-troposphere interactions present in these models and on the implications for the
14 practical problem of seasonal prediction.

15

16 Analysis Area B subprojects that have been proposed to date include diagnosis of stratospheric
17 sudden warmings and their tropospheric signatures, analysis of the transient response to snow
18 forcing, and a study of the coupling between the North Atlantic Oscillation and the lower
19 stratospheric circulation.

20

21 *Analysis Area C: “DynVar Climate Change” (Coordinator: E. Manzini)*

22 Analysis Area C addresses the role of the stratosphere in controlling the tropospheric circulation
23 response to climate change, and the implications of this for oceanic and cryospheric climate
24 change responses. Our experience to date has shown that the stratosphere will have a relatively
25 small direct influence on global climate sensitivity (measured formally in terms of the
26 equilibrated response to doubled CO₂); instead, the stratospheric influences here will involve
27 links between radiative forcing and the stratosphere-troposphere circulation.

28

29 Analysis Area C subprojects that have been proposed to date include studies of the stratospheric
30 influence on Southern Hemisphere annular mode responses to climate forcing and on sea-ice

1 responses to climate change.

2

3 *Analysis Area D: “DynVar Ideal” (Coordinator: L. Polvani)*

4 Analysis Area D is the component of SPARC DynVar mentioned above that uses simplified
5 models and more theoretical approaches to improve the dynamical understanding of stratospheric
6 influences. Analysis Areas A–C focus on specific physical phenomena such as the mean
7 stratosphere-troposphere climate, intra-seasonal variability, and climate change responses in the
8 comprehensive AGCM simulations that are the main focus of SPARC DynVar. Analysis Area D,
9 on the other hand, will focus on using complimentary methodologies to elucidate the results of
10 the comprehensive AGCMs. We will encourage Analysis Area D participants to develop
11 research subprojects that aim to explain and characterise the robustness of the comprehensive
12 model results from Analysis Areas A–C.

13

14 Analysis Area D subprojects that have been proposed to date include studies of stratospheric
15 control on the time scales of tropospheric variability, of surface-forced stratosphere-troposphere
16 interactions, and of principal modes of variability of the potential vorticity distribution in the
17 stratosphere and troposphere.

18

19 Having identified general research themes, we now describe the primary model data sets that,
20 contingent on broad participation from the modelling community, will form the core resource for
21 this activity. We first describe a set of minimum requirements that models should satisfy to
22 represent the stratosphere-troposphere circulation accurately and in a statistically robust way.
23 We then outline our current proposal for a sequence of simulations designed to address our
24 research questions and themes.

25

26

AGCM Requirements

27

28 ***Model resolution and configuration:*** It is important that the high-top models involved in this
29 effort be of sufficient resolution to capture the important dynamics of the large-scale
30 stratosphere-troposphere circulation, particularly in the extra-tropics. At a minimum, these

1 models should be able to resolve baroclinic eddies in the troposphere, Rossby-wave breaking in
2 the stratospheric surf zone, and the vertical structure of extra-tropical planetary-scale waves
3 propagating from the troposphere to the stratosphere, and stratospheric sudden warming events.
4 *Thus the “high-top” models in the DynVar Project should be AGCMs that solve the primitive*
5 *equations or the non-hydrostatic equations on the sphere, with a horizontal resolution that*
6 *corresponds to at least T42 (3 to 4 degree resolution), and a vertical resolution of at least 35*
7 *levels, with the model lid and the model sponge layer located above the stratopause, which is*
8 *located at approximately 1 hPa.* Given the relatively low horizontal resolutions considered, the
9 high-top models should also include parameterizations of the gravity wave influence on the large
10 scale atmospheric circulation.

11
12 In setting these requirements, we have attempted to weigh the need to realistically represent
13 some of the most important stratosphere-troposphere interactions against the need to encourage
14 broad participation from modelling groups in DynVar. We recognize that if only these minimum
15 requirements are met, some aspects of stratospheric dynamics and stratospheric influence on the
16 troposphere, for example those that need a realistic simulation of the response to solar forcing or
17 of the vertical structure of planetary-scale tropical waves, might not be well represented.

18
19 Some DynVar participants plan to develop methods to systematically transition from low- to
20 high-top AGCMs as a means of introducing stratospheric processes in a controlled manner. This
21 is a potentially valuable approach but will not be required for interested groups to participate in
22 the low-top/high-top comparison. For the low-top models, the main requirement will be that the
23 models have at least T42 horizontal resolution.

24
25 Finally, we note that some DynVar participants are planning to investigate the role of the QBO
26 in tropospheric climate but for the time being QBO representation has not entered into our
27 minimum requirements.

28
29 ***Length of simulations (statistical sampling):*** In some important regions of the stratosphere,
30 particularly in the Northern Hemisphere polar stratosphere, the signal-to-noise ratio of the

1 stratospheric response to climate change is expected to be small (*e.g.* Butchart *et al.* 2000,
2 Fomichev *et al.* 2007). The signals of stratospheric influence on the tropospheric response to
3 climate might consequently be expected to be even more subtle. Thus, we will need to aim for
4 multiple realizations of multi-decadal simulations to ensure meaningful statistical sampling. This
5 requirement will need to be balanced against those of spatial resolution. Factoring in the need for
6 multi-decadal simulations and multiple realizations, the simulations listed below will require at a
7 minimum 50 years of simulation time and often 100 or more years of simulation time.

8
9 ***Boundary and radiative forcings:*** We will try to implement the boundary and radiative forcings
10 used in the models in as consistent a manner as possible. In this effort we will follow the lead of
11 the CCMVal and C20C projects, which have striven for consistency without placing undue
12 burdens on participating modelling centres.

13 14 **Proposed Simulations**

15
16 We propose a sequence of simulations that will help elucidate the effects of stratospheric
17 representation in the absence of coupling to the ocean (AGCM + prescribed SSTs, Simulation
18 Set A), in the presence of thermal coupling to the ocean (AGCM + slab mixed-layer ocean,
19 Simulation Set B), and in the presence of full dynamical coupling to the ocean circulation
20 (AGCM coupled to ocean general circulation model, Simulation Set C).

21 22 ***Set A: “C20C Simulations” -- AGCM simulation with historical SSTs and forcings***

23
24 The ongoing CLIVAR C20C project (<http://www.iges.org/c20c/>) is studying climate variations
25 over the past 130 years using AGCMs forced with prescribed SSTs and observed radiative
26 forcing. Some modelling groups are already running high-top versions of the C20C simulations.
27 We propose that the SPARC DynVar Project should play a prominent role in examining
28 stratospheric influences for the C20C project, and will encourage participating stratospheric
29 modelling groups to run their own C20C simulations. We also propose that the C20C setup
30 should represent the “workhorse” simulation that represents the initial primary focus of the

1 group.

2

3 We propose to compare low-top and high-top versions of the focus period of the C20C
4 simulations that begins in the late 1940's. These simulations will be used to answer many of our
5 research questions related to Analysis Areas A and B. For example, they will help determine the
6 direct influence of representation of the stratosphere on the simulated climate and climate
7 variability. They will also afford us the opportunity to examine the causes of biases in the
8 stratospheric simulation throughout the suite of participating models, which may well affect the
9 character of the stratosphere-troposphere coupling. Trends that are present in the C20C
10 simulations will begin to address the climate change questions of Analysis Area C. It is hoped
11 that at least three realizations of each simulation will be carried out. This will require roughly
12 150 simulation years for each of the high- and low-top models.

13

14 It should be stated that many groups are not prepared to run with the comprehensive list of
15 forcings specified by the C20C. (The forcing prescriptions for the C20C project are available
16 online at http://www.iges.org/c20c/c20c_forcing/home.html and include prescriptions for sea-
17 surface temperatures, sea ice, stratospheric volcanic aerosols, carbon dioxide, and ozone.) This
18 will not be a barrier to participation, as long as whatever forcings are used are implemented
19 consistently and are well documented.

20

21 ***Set B: Coupled AGCM/slab mixed-layer ocean model simulations***

22

23 We have raised a variety of issues related to the influence of the stratosphere on the coupled
24 atmosphere-ocean-cryosphere system. We propose to separately investigate this question using
25 configurations in which an AGCM is coupled to a mixed-layer ocean model (Simulation Set B)
26 and in which an AGCM is coupled to a dynamical ocean model (Simulation Set C). At this point,
27 some groups are focusing their efforts on the mixed layer ocean model approach and others on
28 the dynamical ocean model approach. It is hoped that SPARC DynVar will stimulate groups to
29 pursue both approaches.

30

1 For Simulation Set B, participating groups will be asked to run low-top and high-top versions of
2 their coupled models out to equilibrium, which typically takes 50–100 years. Simulations with
3 radiative forcing components representing present day or preindustrial atmospheric composition
4 will be used to address issues related to Analysis Areas A and B. To investigate Analysis Area C,
5 the response to climate change, we propose to use similar simulations in which CO₂ is doubled.
6

7 **Set C: Coupled AGCM/dynamical ocean model simulations**

8
9 Finally, we propose to examine the influence of coupling to a dynamical ocean model, building
10 on the Set A and Set B simulations. Several groups are now putting together stratosphere-
11 resolving coupled ocean atmosphere models, and it is hoped that this project will allow these
12 models to be analysed in a coordinated way.
13

14 Similarly to the simulations described above, we will encourage modelling groups to contribute
15 model output from high- and low-top versions of their coupled ocean atmosphere models as
16 these are developed. As they come online, we will take advantage of available control
17 simulations with time-independent forcing to address various issues in Analysis Areas A and B,
18 and climate-change simulations to address Analysis Area C. Proposals being discussed at this
19 point for climate change simulations include using the forcing scenarios from the IPCC AR4, or
20 using the simpler 1%/year CO₂ increase forcing from the Coupled Model Intercomparison
21 Project 2 (CMIP2, see <http://www-pcmdi.llnl.gov/projects/cmip/index.php>).
22
23

24 **Connections to Other Projects**

25
26 *Connections to the SPARC CCMVal Project (Liason: V. Eyring):* A key focus for CCMVal is the
27 evaluation of processes that determine the basic dynamical state of the stratosphere in the
28 underlying GCMs on which the CCMs are based and the response of the stratospheric Brewer
29 Dobson circulation (BDC) to climate change. There is a natural overlap here with DynVar
30 because planetary-scale wave and gravity wave forcing drive much of the BDC overturning.
31 CCMVal is already well established; ongoing diagnostic efforts with existing multi-CCM

1 simulations will certainly help clearly define and begin to answer many of the questions we have
2 raised. In turn, DynVar will support CCMVal with studies to understand statistical uncertainties
3 and to identify robust diagnostics. Thus, the two projects have several points of contact and we
4 can expect mutual benefits for both projects.

5
6 *Connections to the SPARC SOLARIS Project (Liasons: L. Gray and K. Kodera):* The aims of
7 SOLARIS are very specific to understanding the influence of solar variability on both the
8 stratosphere and the troposphere, compared to the aims of DynVar which are much broader.
9 Nevertheless, several of the possible mechanisms for solar influence on the troposphere are
10 identical to those studied in DynVar, so there will be significant potential collaborations, both in
11 terms of simulations and diagnostics.

12
13 *Connections to the CLIVAR C20C Project (Liason: A. Scaife):* C20C has involved the use of
14 both ocean-forced AGCMs and observed data, to study climate variations and changes over the
15 last 130 years, in particular the period since the late 1940's. The analysis subprojects comprising
16 this effort provide an observationally based testing ground for GCMs and Earth-Systems Models
17 as they evolve. The standard Set A C20C historical-forcing simulations are carried out fairly
18 routinely at some centres and can provide data that addresses several of our research questions.
19 Several modelling groups, some of whom are already participating in C20C, are planning to
20 improve stratospheric representation or have done so already. Overall the goals and plans of the
21 C20C project mesh well in several respects with those of DynVar.

22 23 **Conclusion**

24
25 Many aspects of the SPARC DynVar Project are still in the planning stage. We are at this point
26 identifying interested participants and their subprojects, and identifying modelling groups that
27 are prepared to contribute model output to DynVar. We will next proceed to work with the
28 modelling groups on issues of simulation design and will establish a method of data distribution.
29 Discussion and details of DynVar will take place *via* email and the website being built at
30 www.sparcdynvar.org. We will provide updates on the project's progress at the CCMVal

1 meeting in June 2007, at the SPARC SSG meeting in September 2007, and through brief SPARC
2 Newsletter contributions. We plan to report scientific progress on DynVar at the Chapman
3 Conference on stratosphere-troposphere coupling in September 2007 and at the SPARC General
4 Assembly in 2008, and plan to organize focus workshops in the coming year.

5
6 In their 1988 study, Boville and Cheng remarked that the “vertical truncation in current GCMs
7 appears to be based primarily on related justifications which are of purely practical origin.” The
8 situation remains much the same today, as does the onus on stratospheric scientists to
9 demonstrate to the broader climate community that improved stratospheric representation will
10 improve Earth System Models and will modify the simulated response to climate change. Our
11 sense is that improving stratospheric representation is a tractable task and one that might provide
12 valuable benefits to Earth System Models at a reasonable and predictable cost.

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