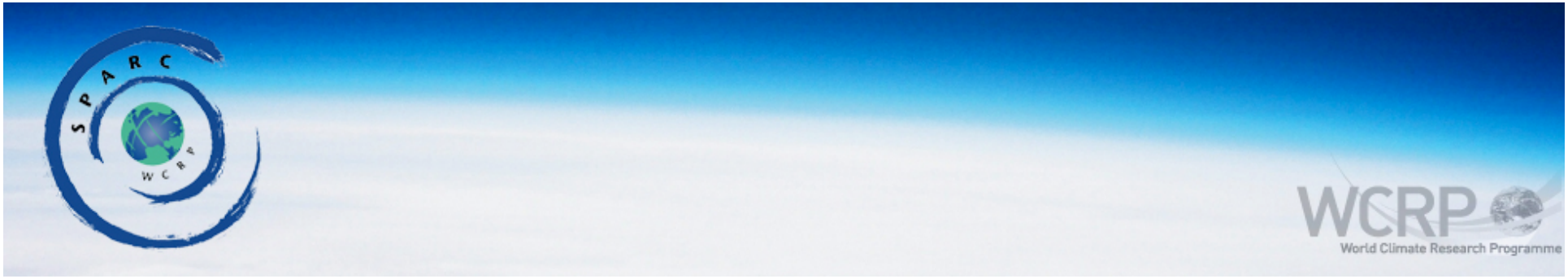


Stratospheric Processes And their Role in Climate (SPARC)

Co-chairs: Joan Alexander (NWRA)
Greg Bodeker (Bodeker Scientific)

SPARC Office Director: Johannes Staehelin (ETH Zürich)

Other SPARC Office staff: Fiona Tummon, Anke Witten and Carolin Arndt Foppa (ETH Zürich), Diane Pendlebury (Univ. of Toronto)

WCRP Liaison: Vladimir Ryabinin

SPARC Modeling Activities

SPARC facilitates stratospheric research on significant issues related to climate, and highlights the importance of stratospheric-tropospheric processes to climate modeling and NWP.

Modeling activities are focused in three of the project's activities:

- CCMI – Chemistry Climate Model Initiative
- DynVar – Dynamical Variability of the stratosphere-troposphere coupled system (climate models)
- SNAP – Stratospheric Network on the Assessment of Predictability (global forecasting models)

Also relevant developments within SOLARIS/HEPPA, Gravity Waves, DA, and SSiRC

Chemistry-Climate Model Initiative (CCMI)

Co-leads: Veronika Eyring (SPARC), Jean-Francois Lamarque (IGAC)

- Collaborative project between SPARC and IGAC.
- Response to the mandate for SPARC to extend its interests/reach into the troposphere.
- Focus is on process-oriented model evaluation, spawning future model development.
- CCMI will be providing the simulations required by the 2014 WMO/UNEP ozone assessment.

CCMI Activities in 2012

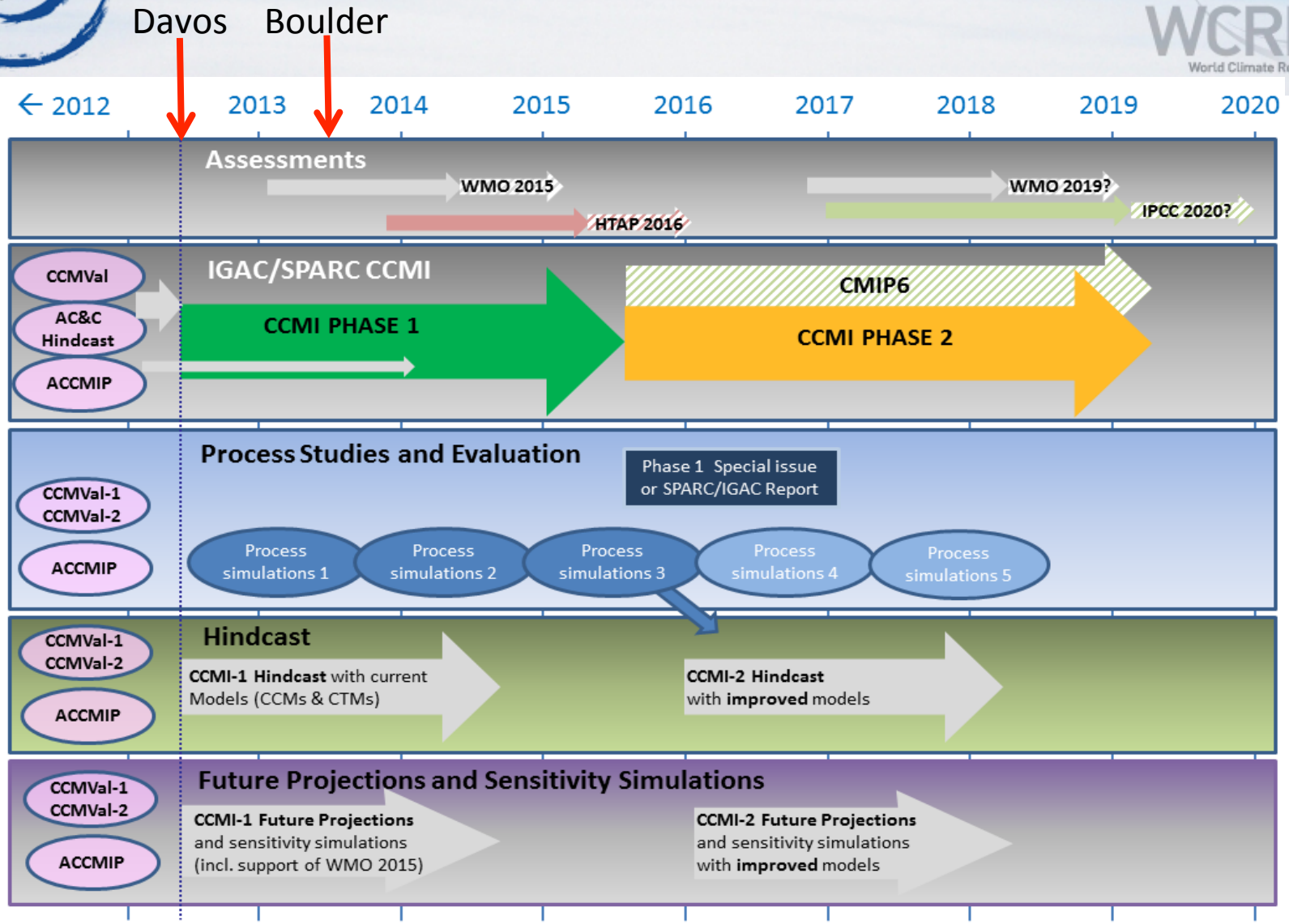
At Davos Workshop May 2012

- Defined a limited set of simulations relevant to tropospheric and stratospheric chemistry-climate
- Defined additional diagnostics for improved comparison to observations
- Identified science questions
- Clear support from the CCM community to create a joint **IGAC/SPARC Chemistry-Climate Model Initiative (CCMI)** to coordinate future (and to some extent existing) IGAC and SPARC chemistry-climate activities.

June-December 2012

- IGAC/SPARC CCMI has been approved by the IGAC/SPARC SSCs, **superseding CCMVal and AC&C which have been terminated**.
  - Co-Chairs CCMI: Veronika Eyring (DLR) and Jean-François Lamarque (NCAR)
  - CCMI Scientific Steering Committee (SSC) has been formed
- CCMI website available http://www.pa.op.dlr.de/CCMI/
- Forcings for the CCMI-1 simulations have been provided on this central website
- Document summarizing the new community-wide CCMI simulations published (Eyring et al., SPARC newsletter, 2013)

CCMI Timeline



IGAC/SPARC CCMI 2013 Workshop

NCAR, Boulder, CO, 14-16 May 2013

Co-Chairs: Veronika Eyring & Jean-Francois Lamarque

Approximately 130 participants

Goals of the Workshop:

- Improve process-oriented model evaluation
- Improve comparability between models and observations (CCMI Expert groups on insitu and satellite data)
- Simulations & analysis in support of upcoming assessments and process studies

Goals of the CCMI workshop

- Update on status of CCMI-1 model simulations and CCMI expert groups
- Identify/discuss issues/problems with simulation setup
- Finalize output requirements (CMOR tables)
- Further develop approaches for process-oriented evaluation of CCMs
- Identify potential research areas for analysis of simulations
- Bring forward new science
- Discuss CCMI analysis in support of upcoming ozone and climate assessments:
  - Coordinate analysis of relevance for the WMO/UNEP Ozone Assessment 2015 (tight timeline!)
  - Input for Coupled Model Intercomparison Project Phase 6 (CMIP6)
    - First planning meeting early August in Aspen

CCMI Phase 1 Simulations

	Simulation	Period	Comment	
Reference	REF-C1	1960-2010		Comparison with obs.
	REF-C1SD	1980-2010		
	REF-C2 (RCP 6.0)	1960-2100	link to CMIP5	
Sensitivity	SEN-C1-Emis			
	SEN-C1SD-Emis			
	SEN-C1-fEmis			
	SEN-C1SD-fEmis			
	SEN-C1-SSI			
	SEN-C2-RCP2.6		link to CMIP5	
	SEN-C2-RCP4.5		link to CMIP5	
	SEN-C2-RCP8.5		link to CMIP5	
	SEN-C2-fODS 1960		link to CCMVal-2	
	SEN-C2-fODS 2000			
	SEN-C2-fGHG		link to CCMVal-2	
	SEN-C2-fEmis			
	SEN-C2-GeoMIP	2020-		
	SEN-C2-Solartrend			

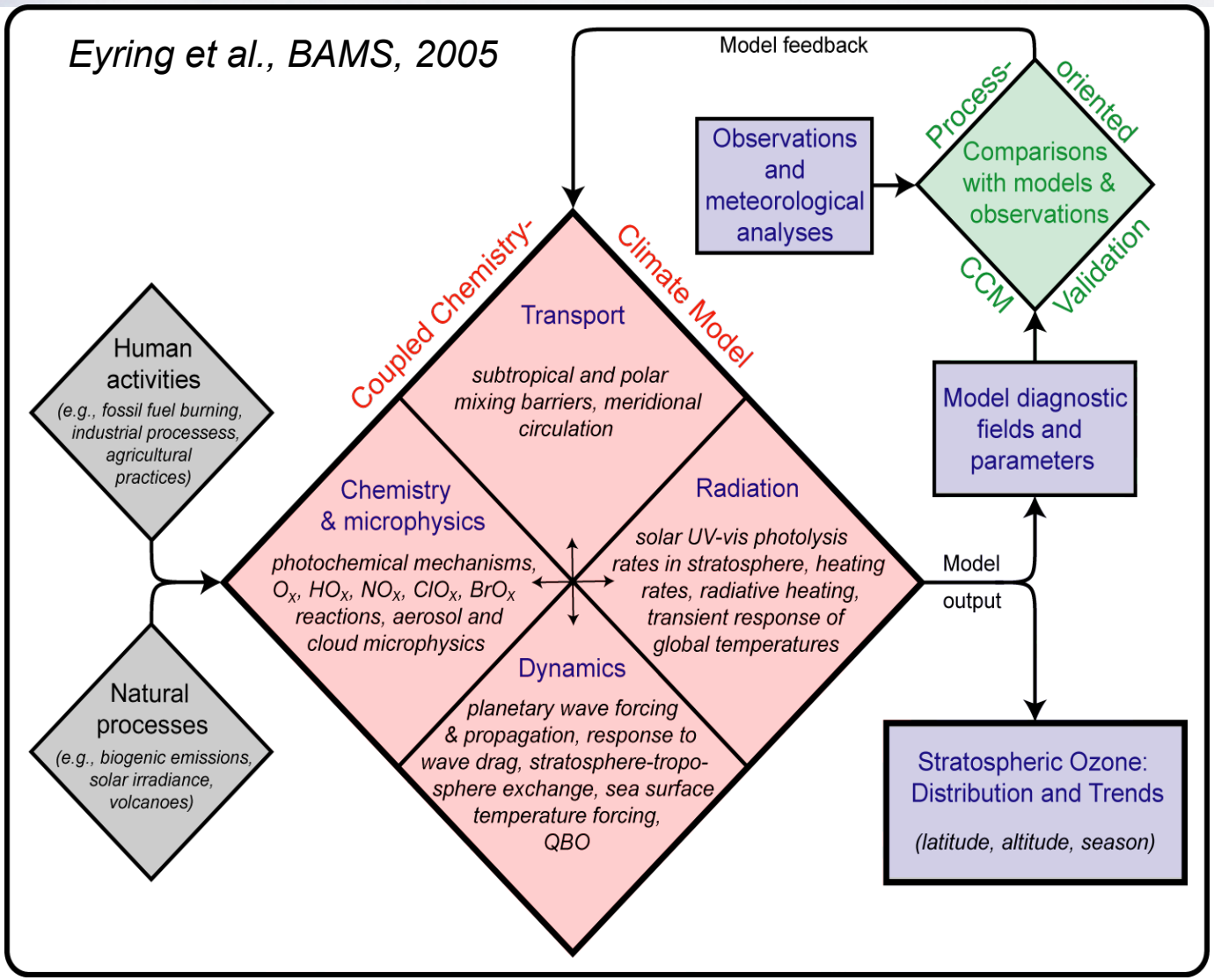
Eyring et al., SPARC Newsletter, 2013

CCMI-1 Participating Model Groups

	Model Name	Modeling Center
1	**ACCESS**	University of Melbourne, CAWCR, AAD, Australia, NIWA, NZ
2	**CCSM4**	NCAR, ESL, USA
3	**CCSRNIES-MIROC3.2**	NIES, Tsukuba, Japan
4	**CESM-Superfast**	LLNL, USA
5	**CICERO-OsloCTM2**	CICERO, Norway
6	**CMAM**	EC (Environment Canada), University of Toronto, York Univ., Canada
7	**CNRM-CCM**	Meteo-France; France
8	**EMAC**	ESCiMo-Consortium (DLR, KIT, FZJ, FUB, UMZ, MPIC), Germany
9	**GEOS CCM**	NASA/GSFC, USA
10	**GFDL-AM3**	UCAR/NOAA, GFDL, USA
11	**GISS-E2-R**	NASA-GISS,USA
12	**HadGEM3-ES**	Hadley Centre, Met Office, United Kingdom
13	**LMDZrepro**	IPSL, France
14	**MIROC-ESM-CHEM**	NIES, Nagoya Univ., JAMSTEC, Japan
15	**MOCAGE**	GAME/CNRM, MéteoFrance, France
16	**MRI**	MRI, Japan
17	**NIWA-UKCA**	NIWA, NZ
18	**SOCOL**	PMOD/WRC and IAC ETHZ, Switzerland
19	**ULAQ**	University of L'Aquila, Italy
20	**UMSLIMCAT**	University of Leeds, UK
21	**UMUKCA**	University of Cambridge, UK
22	**WACCM4**	NCAR, USA

CCMI

GOAL 1: Improved process-oriented model evaluation



Workshop outcome

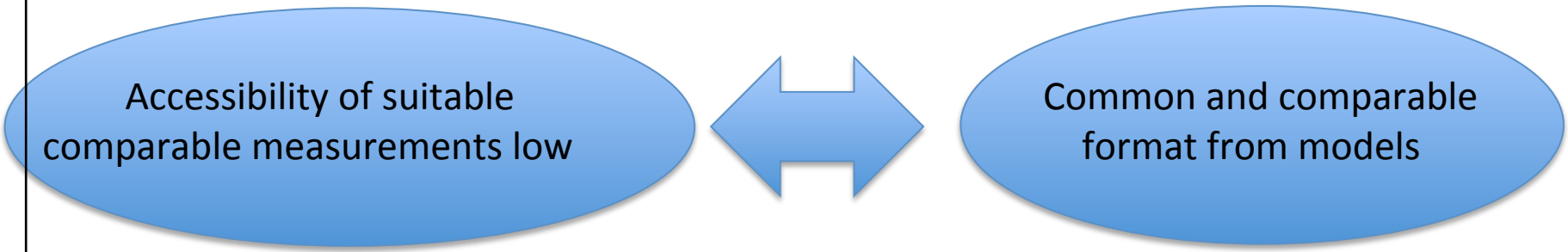
- Has been further refined for the stratosphere
- Has been extended with a particular focus on stratosphere-tropospheric coupling
- The development of a similar standard for tropospheric chemistry climate modeling has been started

CCMI

GOAL 2: Improved comparability between models & observations

Observations for model evaluation: Comparability and Accessibility

1. What are the largest impediments to making progress in model evaluation?



Difficulty of measurements to represent climatology (background conditions)

Data quality – strengths and weaknesses - is not sufficiently documented

Steep learning curve to appropriate use of satellite data sets

CCMI

Chemistry-Climate Model Initiative

Moving forward…

- Example "Grand Challenge" for CCMI: Tropospheric OH
  - Relevance to methane and VSLS lifetimes and aerosol chemistry
  - Builds on expertise/interest/observations from a variety of communities
- Initiative: to use such science challenges and community interest as an opportunity to combine tropospheric and stratospheric observational and modeling expertise and efforts

Guiding principles

- Will keep the goals and deliverables of CCMVal, ACCMIP
- Make observational and process communities an integral part of the CCMI
- Emphasize process-oriented evaluation
- Ensure community-based deliverables
- Develop a community wide diagnostic tool for the evaluation of Chemistry-Climate / Earth System Models

DynVar
Dynamical Variability

Lead: Elisa Manzini

- International climate modeling activity with emphasis on the two-way dynamical coupling between the troposphere-stratosphere.
- Promotes the development and use of coupled atmosphere-ocean-sea ice models with extended upper boundaries.
- Also simplified numerical models and theoretical methods.
- Focus: How the stratospheric circulation impacts mean climate, climate variability, and climate change.
- Recent activity called for analysis of SHFP and CMIP5 models: >50% have “high tops”<1hPa. Publications documenting insights into model performance and sensitivity to well-resolved stratospheric processes.

DynVar
Dynamical Variability

Lead: Elisa Manzini

- Workshop April 2013 (joint with SNAP-Stratospheric Predictability)
- High top models better represent stratospheric variability with connections to important climate processes, e.g.
  - Circulation changes associated with ozone loss and recovery.
  - ENSO teleconnections to European winter.
  - Better representation of the seasonal cycle in lower stratosphere water vapor.
  - Planetary wave coupling with representation of downward wave flux events and effects on surface weather patterns.
  - Circulation response to climate change, e.g. stratosphere reduces the predicted shift in the North Atlantic storm track.

DynVar
Dynamical Variability

Lead: Elisa Manzini

Foci for the next phase

- Attention now turned to understanding what is needed (resolution, physics) to properly represent important processes: QBO, reducing circulation biases and improving variability, mechanisms of S-T coupling.

Also …

- Diagnostics for CMIP6
- Grand Challenges on “Regional Climate” and “Clouds, Circulation and Climate Sensitivity” through “changing patterns” due to circulation changes (Sobel and Shepherd leads).
- Links to SHFP, SNAP, and PCPI

SNAP

Stratospheric Network for the Assessment of Predictability

Lead: Andrew Charlton-Perez

- New project: first workshop: 24-26 April 2013, Reading, UK
- 100 participants from 16 countries. Met jointly with DynVar (also close connections with SPARC DA, and WGNE)
- Key results from the meeting were the need for better understanding and quantification of predictability in the coupled stratosphere-troposphere system.
- Review paper on stratospheric predictability planned for completion in 2013.
- Predictability experiments with operational forecast centers are in progress.

SNAP

Stratospheric Network for the Assessment of Predictability

Lead: Andrew Charlton-Perez

- SNAP Predictability Experiment: 7 participating operational centers will collect forecasts of the stratosphere-troposphere at unprecidented levels of stratospheric detail.
- Phase 0 (now) – collecting a limited ~1-year of operational forecast data
- Phase I (now) – collecting hindcast sets of two significant periods of coupled stratosphere-troposphere variability: (a) Jan 2013 NH major warming, (b) Oct 2012 SH final warming.
- Phase II (early 2014) – additional hindcast sets (5-6 more events)
- Will also work with S2S project to analyze stratosphere-troposphere coupled predictability in the S2S archive of forecasts and hindcasts.

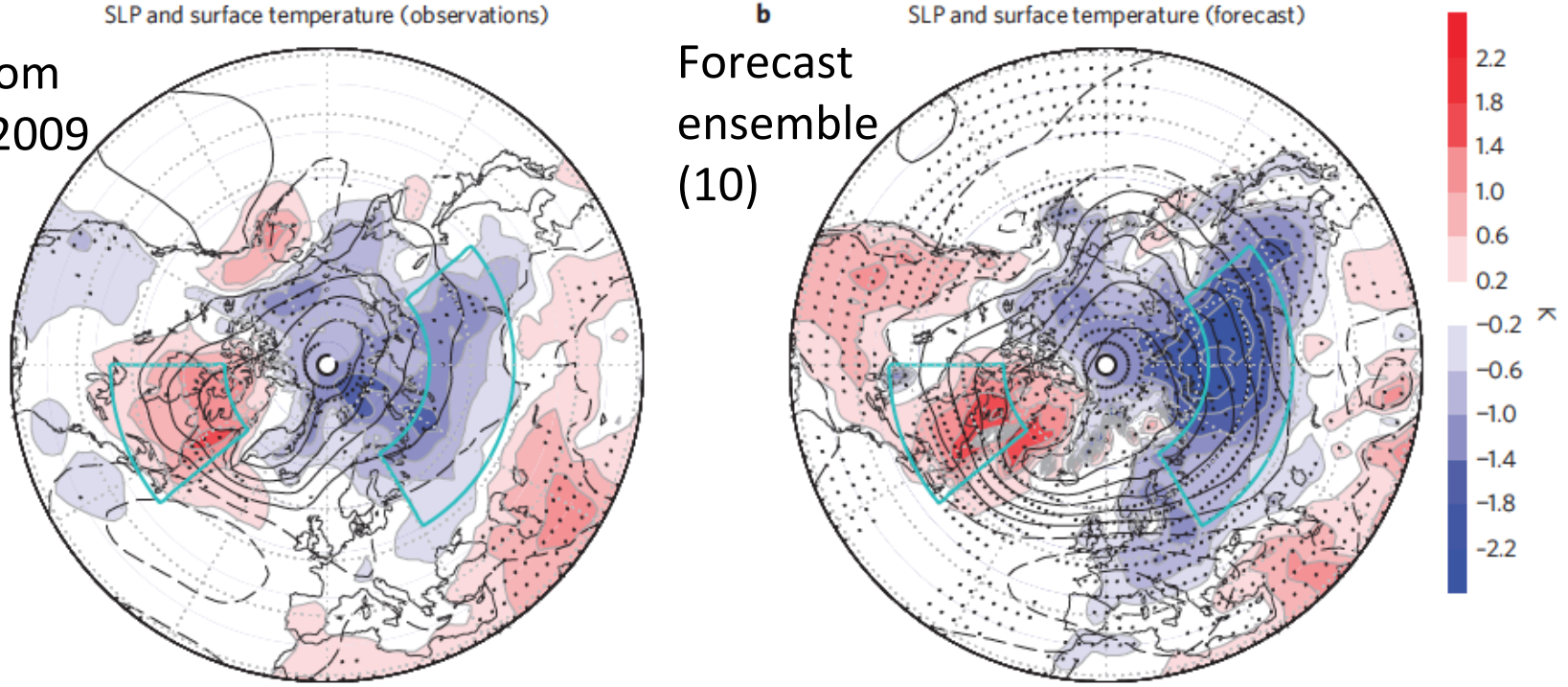
SNAP
Joint Workshop w/DynVar

Actionable information for forecasters:

- Stratosphere-resolving models give significant predictability of the surface response to SSWs when initialized at the onset.
- SLP response averaged 16-60d after SSW. (Sigmond et al. 2013)

Obs from 1979-2009 (20)

Forecast ensemble (10)



Other SPARC Modeling Activities

Gravity Waves, Lead: Joan Alexander

- Momentum Budget Study (led by D. Long at Univ. of Exeter, UK): Climate models and reanalyses, including wave driving, diffusion, surface drag.

Solar Influences, Co-leads: Katja Matthes and Bernd Funke

- New solar spectral irradiance observations, and impacts of variability in climate models (Ermolli et al., 2013).
- Providing SSI datasets to CCMI for sensitivity simulations.

Stratospheric Sulfur Aerosols, Co-leads: Markus Rex, Claudia Timmreck

- New project: Goals include interactive stratospheric aerosol layer in climate models