

SPARC Implementation Plan (2021-2025)

What type of questions might we use?

How can predictability of weather and extreme events on sub-seasonal to decadal timescales be improved?

How will (atmospheric circulation / climate?) change on interannual to centennial timescales?

How and why is atmospheric composition (state) changing over time and what are the impacts?

- **How is stratosphere-troposphere composition changing over time and what are the consequences for climate?**
 - Projections
 - Geoengineering
 - Climate change – air quality interactions
- **How does stratospheric* variability influence the Earth system and its predictability on all time scales?**
 - Tropics; QBO-MJO, atmospheric rivers
 - Polar regions
 - Forecasting
 - ocean
- **What is the evolving role of scale interactions in the stratosphere-troposphere?**
 - GWs in the future
 - Evolution of the tropopause
- **What are the impacts of proposed atmospheric geoengineering approaches?**
- **How do stratosphere-troposphere interactions influence extreme events that impact large populations?**
- **What modelling, observational, analysis and community infrastructures do we need to address the above questions?**

In all of the above questions we contribute to scientific assessments (e.g. WMO ozone, IPCC) and seek to engage with user communities and decision makers.

- **What are the processes that drive (cause) near-term climate extremes?**
- How will the key drivers of climate variability and their regional expressions change?

- **How can predictions of near-term climate extremes be improved?**
- How can initial conditions be improved?
- What are there untapped sources of predictability?
- Do we have the process-level understanding needed for attribution?
- How can we reduce uncertainties in initial conditions for improved prediction?
- What model improvements are most urgently needed?
- Missing processes? resolution? Bias reduction? Better or new observations?
- Will the predictability of extremes change?
- Are there missing processes that are limiting predictive skill?
- What will be the benefit of including interactive ozone and aerosols?
- How can the predictions be made more societally useful?

- **How will future composition changes impact regional weather and climate extremes?**
- Will number and intensity of stratospheric warming events and their coupling to surface climate extremes change in the future?
- Will the QBO change or disappear in the future?
- Will ozone recovery, fire emissions, pollution, ... impact regional weather/climate?
- Interactions between QBO/IOD/ENSO/MJO in a warming climate?