SPARC Data Requirements and ESA SPARC Initiative

Susann Tegtmeier
GEOMAR, Kiel, Germany

Kaoru Sato
University of Tokyo, Tokyo, Japan

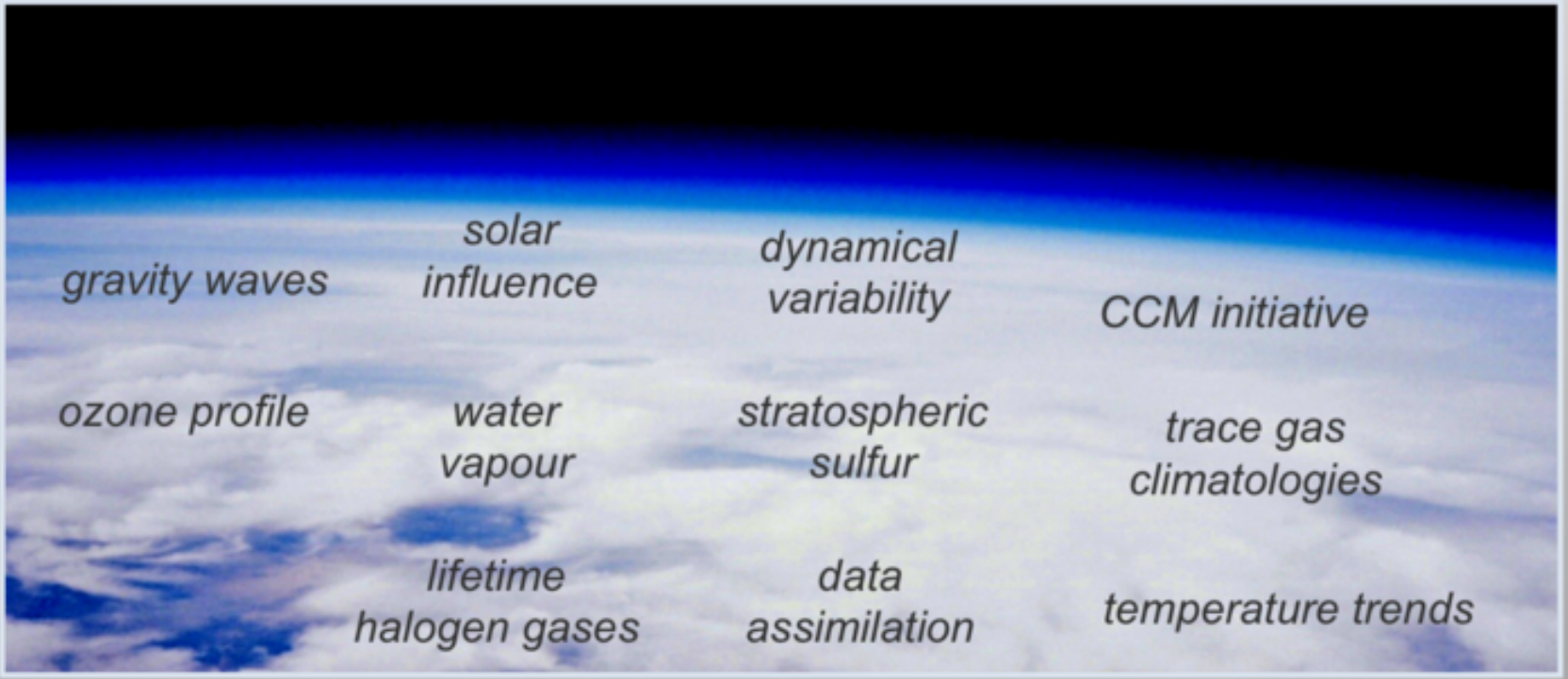
Greg Bodeker
Bodeker Scientific, New Zealand

WCRP Data Advisory Council 2nd Session

SPARC

Themes	Climate-chemistry interactions	Detection, attribution, and prediction of stratospheric change	Stratosphere-troposphere dynamical coupling

Activities



Methods	Process studies	Data/observations	Modelling

Aerosols **Ozone** **Water vapour**

Stratospheric winds **Temperature** **Other chemical constituents**

SPARC - scientific user of observational data

Growing emphasis on:

- Ensuring that **observational data sets meet specific scientific needs**

Strategy within SPARC

- Determine **kind and quality of measurements** that are needed to support SPARC activities in a concrete manner (document, **workshop**)
  - Provide coordinated input to international bodies (GCOS, CEOS)
  - Stimulate greater use and improvement of observational products by SPARC activities
  - Respond to requests from funding entities, including space agencies, concerning SPARC measurement needs and priorities.

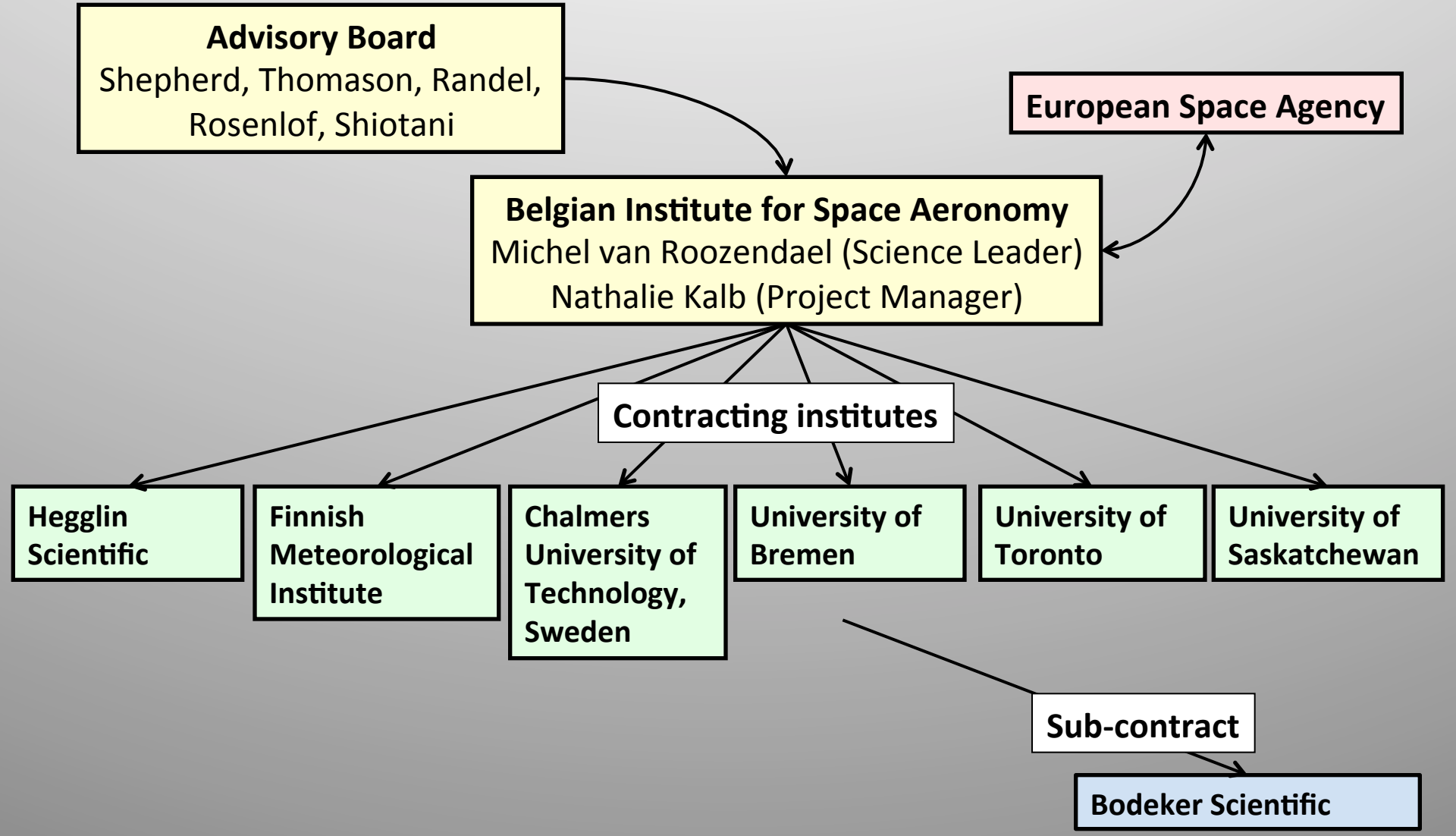
- ESA-funded project to develop long-term climate data records of stratospheric temperature, water vapour, ozone and aerosols as well as climatologies of short-lived species – **the ESA SPARC Initiative (SPIN)**

SPIN (ESA SPARC Initiative) Background

- ESA offered support for the use of their data (and 3rd party mission data) by SPARC through the Support To Science Element (STSE)
- 'SPARC Scientific Requirements Document for ESA STSE' developed in October 2010
- 4 lines of satellite-based data sets that would aim to serve as climate data records: temperature, ozone, aerosols and water vapour
- ESA invitation to tender (ITT) in June 2011
- SPARC consortium submitted SPIN proposal in September 2011
- Kick-off meeting in Cambridge in February 2012

The Consortium

(based on SPARC key activities relevant to the data requirements document)



WP11: Phase 1 management

Phase 1

Task 1: Exploration and Detailed analysis of Satellite data

WP14: Temp & H_2O ECV review

WP15: SPARC DI climatologies evaluation

Task 1: Exploration and detailed analysis of satellite data

- **WP14: Temperature and water vapour ECV review**
  - Review GCOS-107 requirements and assess user needs
  - Derive expected future trends from CCM simulations
  - Write a new URD for temperature and water vapour

- **WP15: Evaluation of SPARC Data Initiative climatologies**
  - Systematic comparison of trace gas and aerosol climatologies
  - Investigation of how spatial and temporal sampling characteristics of the instruments may influence the accuracy of the climatologies
  - Coordination and writing of a detailed data analysis report

WP11: Phase 1 management

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Task 1: Exploration and Detailed analysis of Satellite data

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Task 2: Maturation of ESA (including TPM) Data

WP13: Matured H_2O dataset

WP12: Matured aerosol dataset

WP16: Short-lived species climatologies

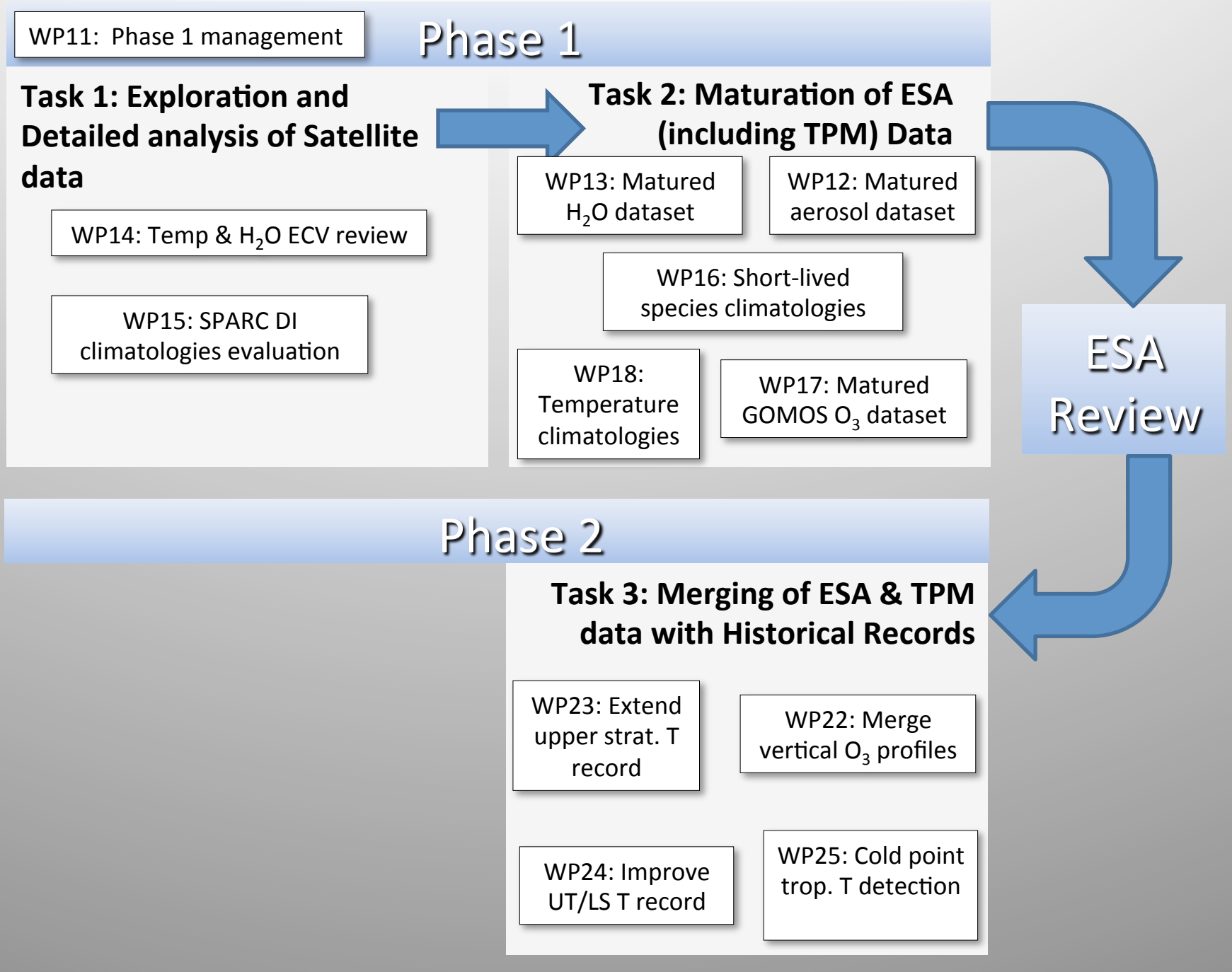
WP18: Temperature climatologies

WP17: Matured GOMOS O_3 dataset

ESA Review

Task 2:
Maturation of ESA data (including third part missions)

- **WP12: Maturation of OSIRIS and SCIAMACHY aerosol**
  - Retrieval improvements, reprocessing and validation
- **WP13: Maturation of SCIAMACHY water vapour**
  - Algorithm improvements; reprocessing and validation
- **WP16: Short lived species climatologies**
  - Production and evaluation of short-lived species climatologies (ClOx, BrOx, NOx, and HOx)
- **WP17: GOMOS bright limb algorithm**
  - Improvement and production of sample data over the period 2002-2011
- **WP18: Temperature climatologies and compare to RO and SSU**
  - Collect/produce stratospheric temperature climatologies for MIPAS, SMR, GOMOS and ACE-FTS and compare with RO data
  - Calculate differences between the ESA-based simulated SSU channel temperatures and the original SSU temperatures during overlapping periods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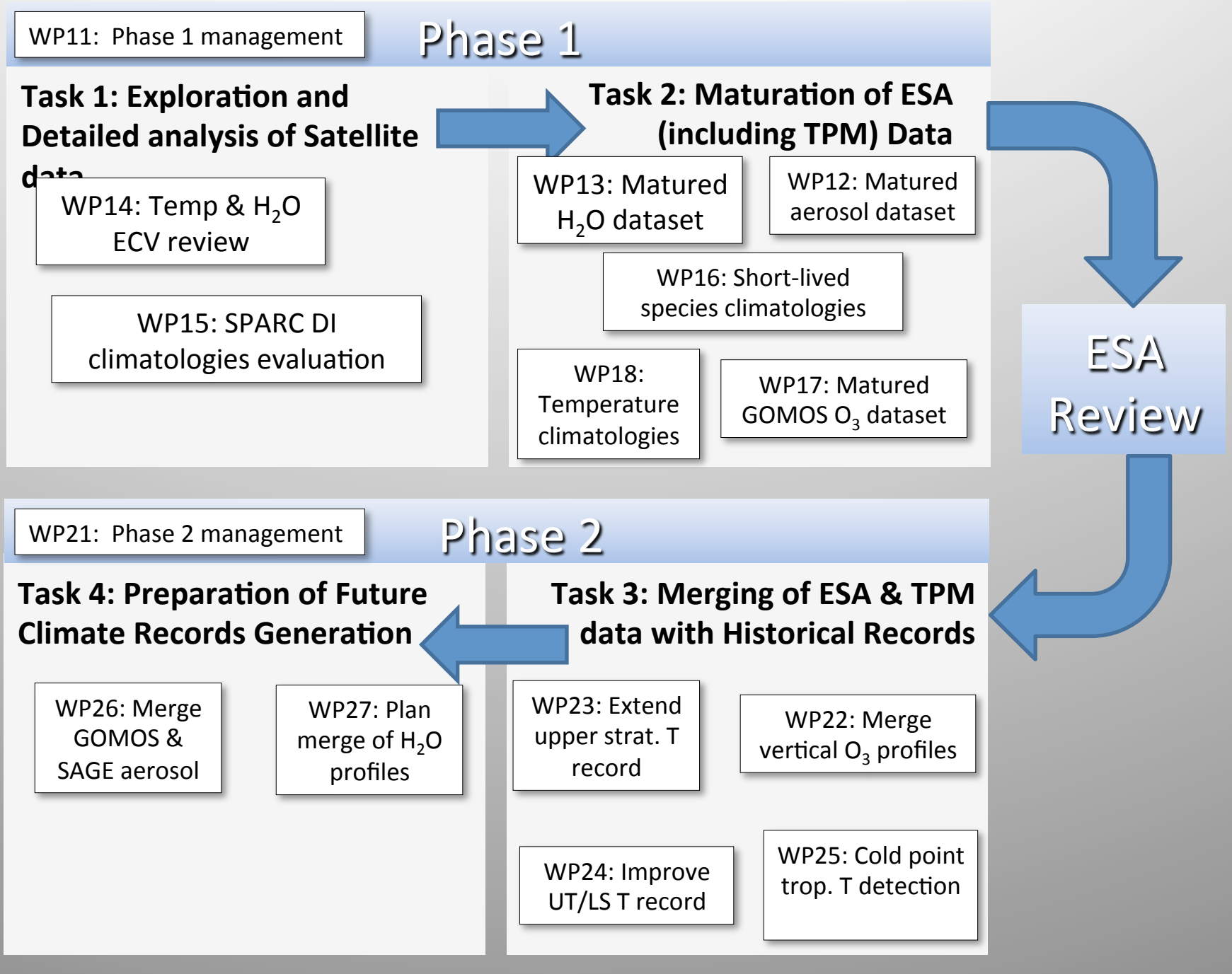
Task 3: Merging of ESA & TPM data with Historical Records
WP23: Extend upper strat. T record
WP22: Merge vertical O_3 profiles
WP24: Improve UT/LS T record
WP25: Cold point trop. T detection

Task 3:
Merging of ESA (including TPM) data with historical records

- **WP22: Merging vertical ozone profile measurements**
  - Remove offsets between matured GOMOS and SAGE II based on coincident measurement analysis
  - Merge SAGE, SAGE II and GOMOS; characterize errors, validate
- **WP23: Extend upper stratospheric temperature record**
  - Extend the SSU data in time with ESA and ESA-TPM temperature climatologies
  - Generate new merged temperature data sets
- **WP24: Improve UT/LS temperature record**
  - Generate new merged UT/LS temperature data sets, using MSU4/AMSU9 UT/LS data sets and MIPAS, GOMOS, ACE-FTS and SMR
- **WP25: Detection of cold point tropopause temperatures**
  - Evaluate cold point tropopause climatologies derived from ESA-TPM (MIPAS, GOMOS, SMR and ACE-FTS), xSU and meteorological reanalyses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WP21: Phase 2 management
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Task 4: Preparation of Future Climate Records Generation
WP26: Merge GOMOS & SAGE aerosol
WP27: Plan merge of H_2O profiles
Task 3: Merging of ESA & TPM data with Historical Records
WP23: Extend upper strat. T record
WP22: Merge vertical O_3 profiles
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Task 4:
Preparation of future climate records generation

- **WP26: Merge GOMOS and SAGE aerosol records**
  - Obtain aerosol extinction profile datasets from SAGE II, GOMOS, OSIRIS and SCIAMACHY; remove biases and drifts
  - Test merging procedure using limited test data set

- **WP27: Plan merge of water vapour profiles**
  - Use statistical model to remove biases between the ESA & TMP (SCIAMACHY, MIPAS, SMR, GOMOS and ACE-FTS) water vapour datasets and the SAGE II and HALOE to create a single homogenized data set.

Combined SPARC Data Requirements/ SPIN Mid-Term Review Workshop

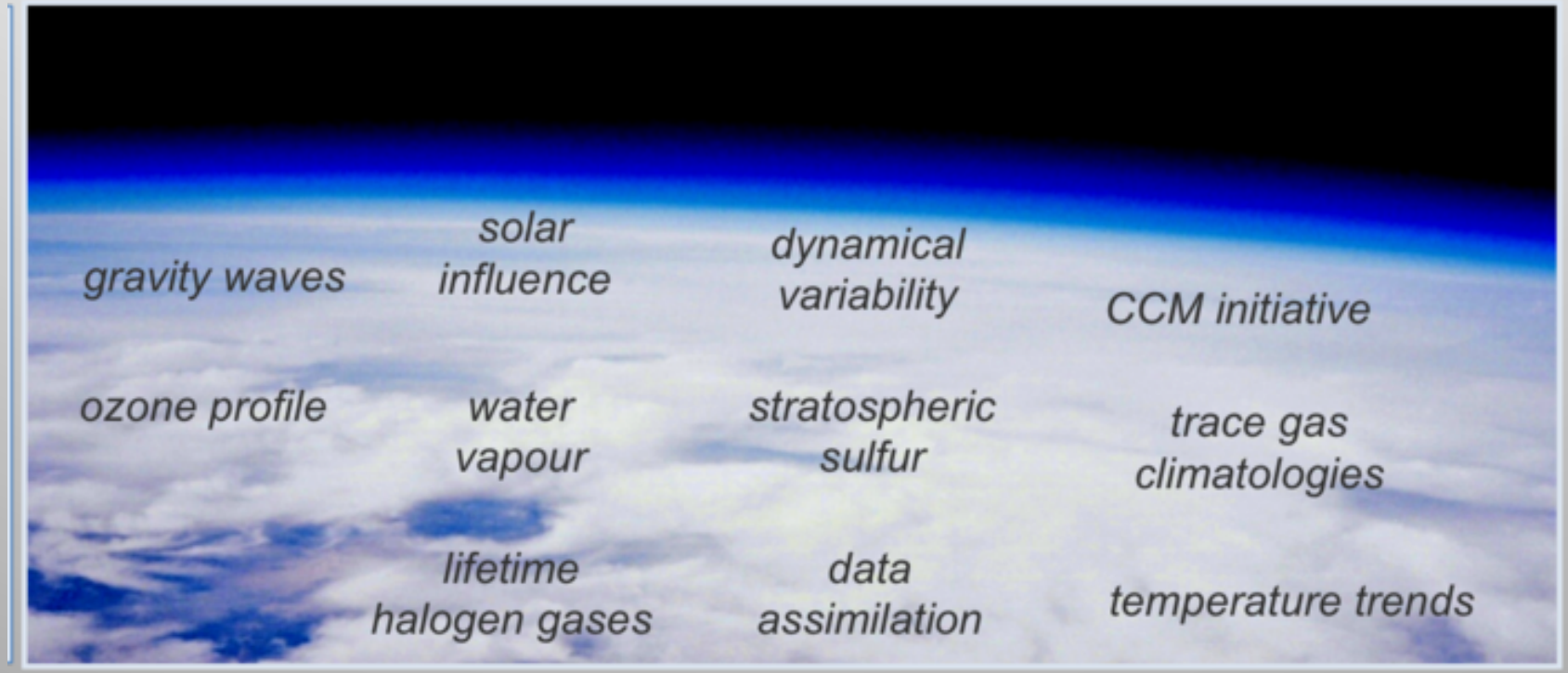
ESA/ESRIN, Frascati, Italy,20-22 February 2013

Goals of the workshop

- Discuss material developed to date by the various **SPARC activities** defining their **measurement requirements**
- Discuss **future** SPARC measurement requirements and how these may form the basis for new activities and a possible follow-on to SPIN.
- Synthesize the activity-level measurement requirement reports developed to date and the outcomes of the discussion to **produce an integrated document**

Outline of the workshop

Presentations from all SPARC activities:



Specific focus on:

- Ozone
- Water Vapor
- Temperature
- Aerosols

Questions/issues discussed during the workshop

- **Why do we need a particular measurement? And why continue into the future?** (e.g. ozone)
  - Montreal protocol
  - Climate variability and trends (changing BDC, solar variability …)
  - Radiation (high vertical resolution)
  - Model validation (key reference period) …

- **What kind of measurements do we need?**
  - Identified need for future Limb missions, gap filling
  - High resolution measurements required (e.g. in the UTLS) such as would be possible from PREMIER
  - In situ data

- **What about uncertainty estimates?**
  - Need for systematic characterization of all sources of error for single measurements (‘*bottom up*’)
  - Uncertainties in climatological fields: improved precision but possible impact of sampling bias

General discussion

- Need for clear statement of value of existing data; the "golden age" of measurements will be a key reference period for model and reanalysis validation for a long time
- Need for measurements and models to "meet in the middle"
- Need for expansion of Obs4MIP efforts
- Facilitate data availability and liaison with networks
- Need to acknowledge source of data, and make it traceable (e.g. doi's)
- Stratospheric aerosol needs to be included in ESA CCI_aerosol

Discussion of satellite trace gas observations

- Accuracy of diurnal scaling factors short-lived species
- Value of UTLS constraints on surface source inversion, and convective transport, e.g. methane (useful lessons from TES and MLS)
- Species needed for UTLS chemistry
- Sampling biases, vertical resolution
  - Assessing utility of dynamical coordinates (e.g. PDFs)
  - Sampling issues at high latitudes
  - UTLS, especially ozone and water vapour (need to include in situ)
  - USLM; diurnal cycle big here

Discussion of ground-based observations

- Think about supporting ground-based networks and balloon sampling to continue data record: e.g. NO2
- WAVAS-2 has produced a combined balloon hygrometer data set, which would be invaluable for validation
- Optimal design of ozone network (with NDACC etc)
- Ground-based ozone stations in tropics; can we do studies to help make the case?
- Balloon measurements of stratospheric aerosol (satellite validation, also knowledge of size distribution)

Further data needs …

- Estimates of w bar star (e.g. tape recorder)
- Need more SSU products (transition from SSU to AMSU; can limb measurements extend SSU Ch3?)
- DA: vertically resolved ozone, gravity wave parameters, stratospheric winds
- Long-term validation data sets of solar impact
- EPP: particle fluxes hugely uncertain, need to measure NOx in MLT to detect response
- Gravity waves: momentum flux, phase speed, and direction, best measurements are from super-pressure balloons (also possible high-resolution radiosonde data, radars), useful constraints available from nadir sounders, e.g. IASI