Network expansion workshop report and subsequent plans including potential new sites to come into GRUAN and update on certification and assessment progress to date

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The goals of the workshop

- 13-15 June 2012 in Fürstenwalde.
- Define the scientific basis to guide the expansion of GRUAN from its then 15 sites (Ny Ålesund now added), to the expected 35-40 over the next few years.
- The emphasis was on defining the criteria by which network expansion should occur and to consider prospective sites. Little or no consideration given to what they should measure or how they should measure it.
- Bring the workshop white papers (next slide) to a nearly completed state.
- Entrain additional expertise into GRUAN.
- Use quantitative & objective approach to determine how to augment the current GRUAN network with additional sites and to provide recommendations for new sites identified during the workshop & in the resultant White Papers.

The workshop white papers

- Four white papers
  - Climate change detection and attribution
  - Satellite calibration and validation
  - Atmospheric process studies
  - Numerical weather prediction.

were partially developed prior to the workshop.

- Primary means by which we intend to capture input from the community.
- Common format for white papers to allow easy synthesis.
- Highly focussed on addressing key questions specific to each of the 4 primary user communities…

Key questions addressed

Site attributes: What should be the attributes of new sites joining GRUAN to meet the needs of this user community? Attributes might include infrastructure at the site, instrumentation and especially combinations of different instrumentation to meet specific needs, speed of data delivery, on-site expertise, participation in other networks.

Environments: What specific environments need to be considered e.g. stations on remote islands or over snow to meet the needs of this user community?.

Geographical coverage: What are the key considerations for geographical coverage? and What geographical coverage of sites would best serve the needs of this user community?'. Use of web-based tool.

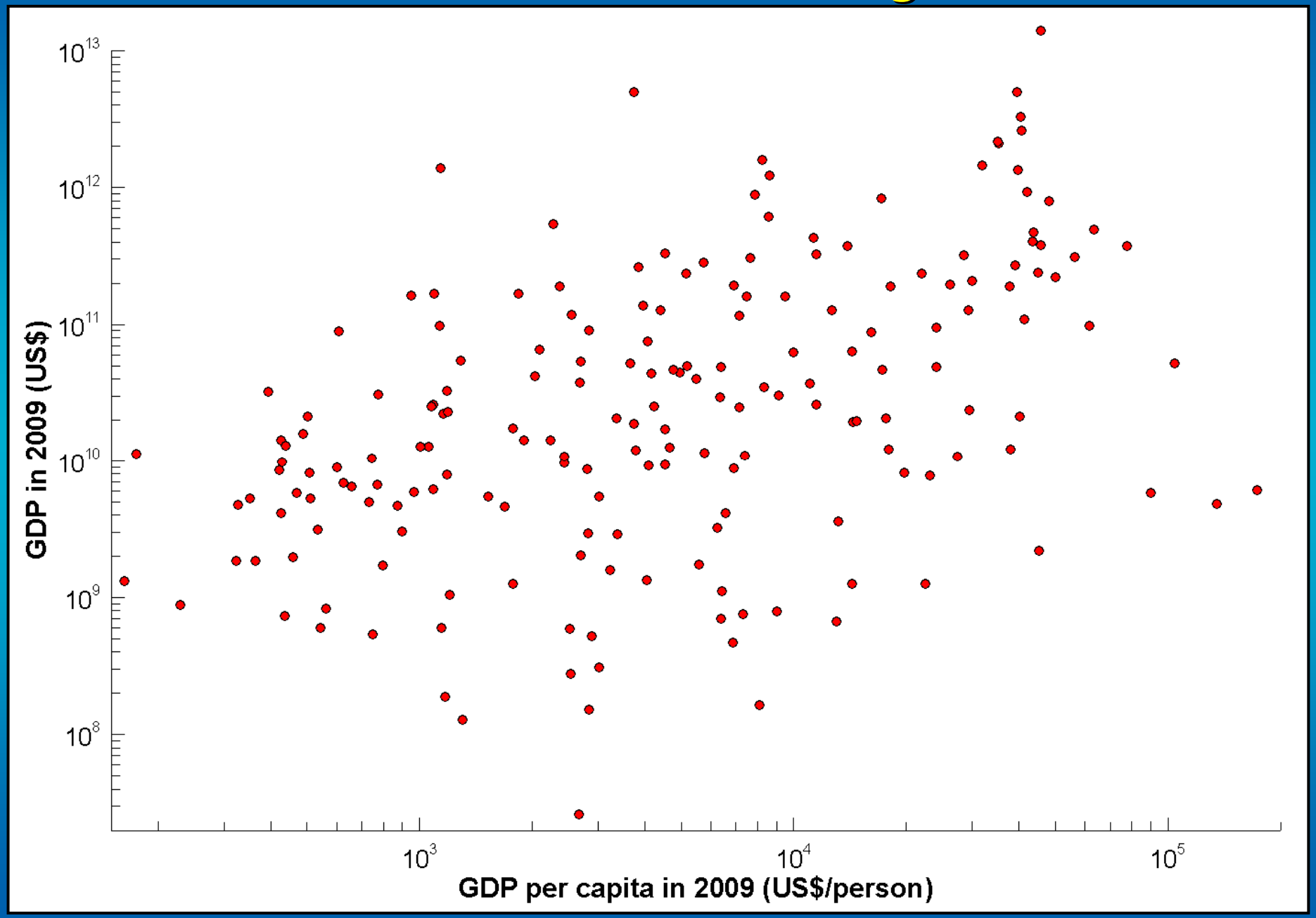
Climate regimes: What large scale climate regimes need to be sampled?

Key questions addressed

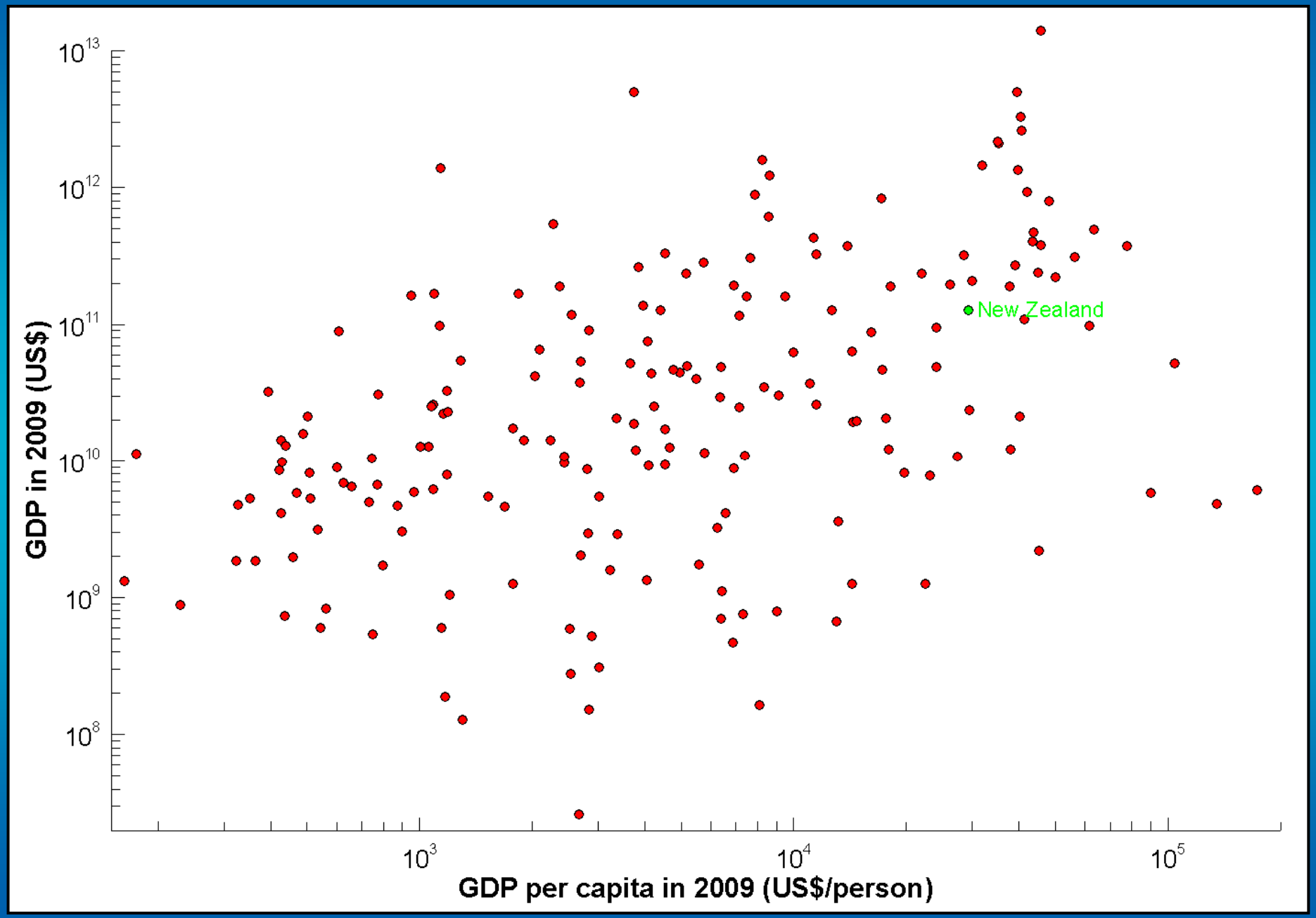
Scientific basis: What is the scientific justification/basis for the design of a network to meet the needs of this user community? Outline where research is lacking to guide network design and what specific targeted research is required to fill those knowledge gaps. This then acts as a research road-map for GRUAN. We see this as a key outcome of this network design activity.

References: Any and all relevant references should be included. It is essential that GRUAN expansion has a strong foundation in peer-reviewed literature.

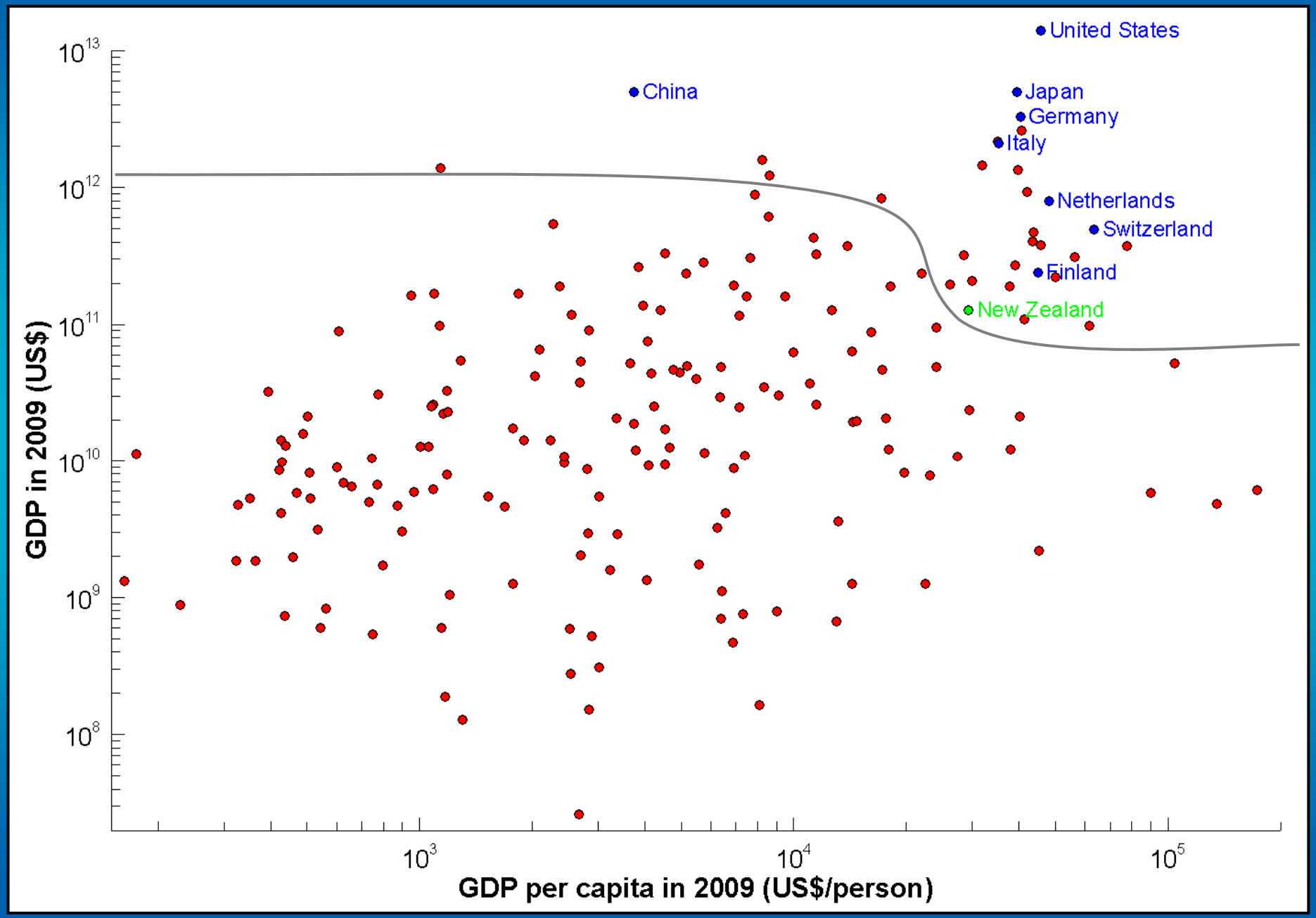
The GRUAN challenge



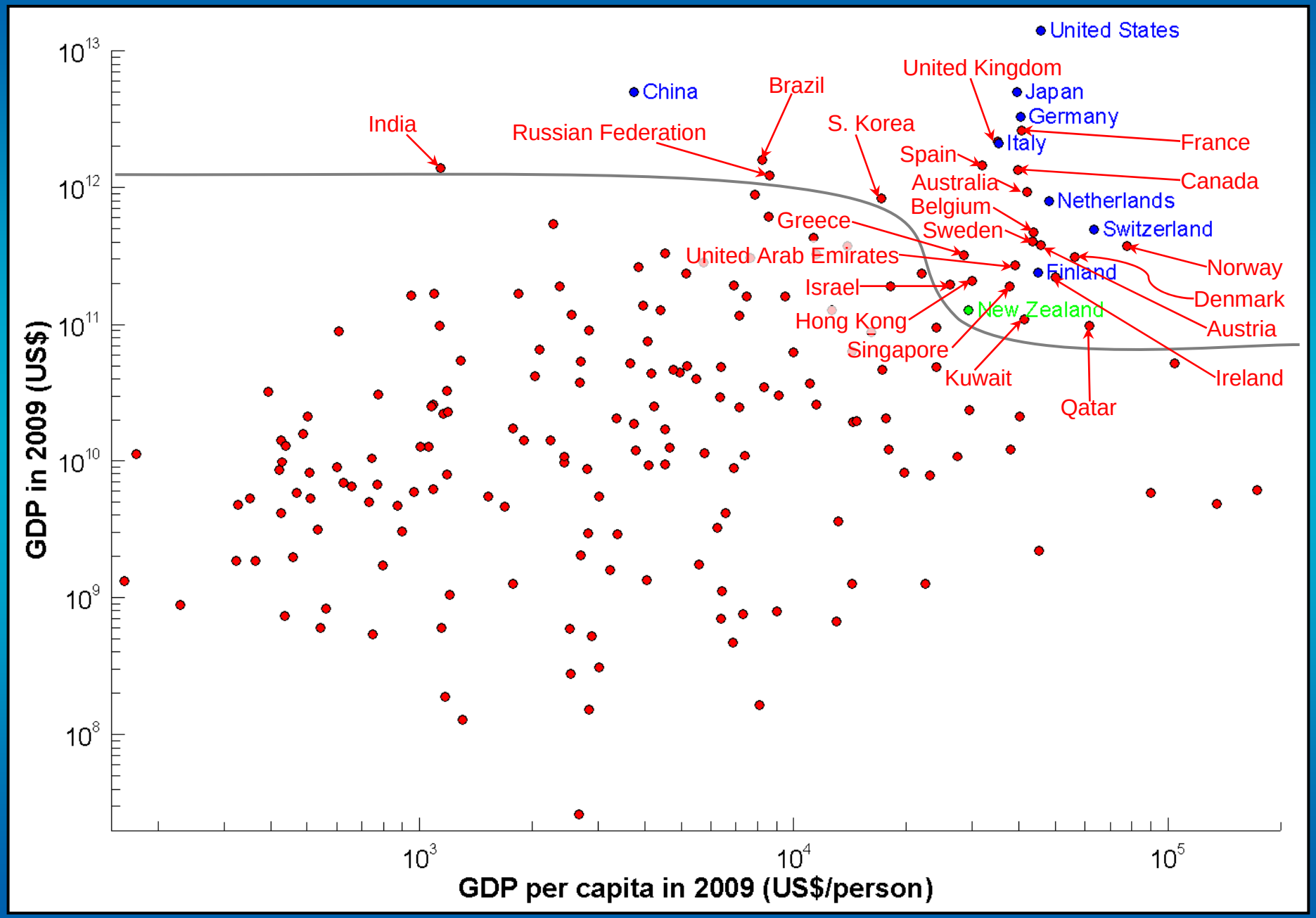
Southern Hemisphere countries supporting a GRUAN site



All countries supporting a GRUAN site



Who is missing?



All very nice but…

- Nothing in Antarctica.
- Nothing in Africa.
- Only Brazil in South America.
- Only three countries in the Southern Hemisphere.

How do we solve this problem?

There will likely be countries with a strong commitment to research in Antarctica that would potentially support a GRUAN site in Antarctica. Can we extend that idea to countries that may have a strong commitment to supporting research in protectorates, in ex-colonies, or in developing countries?

Connecting countries

Key Outcomes

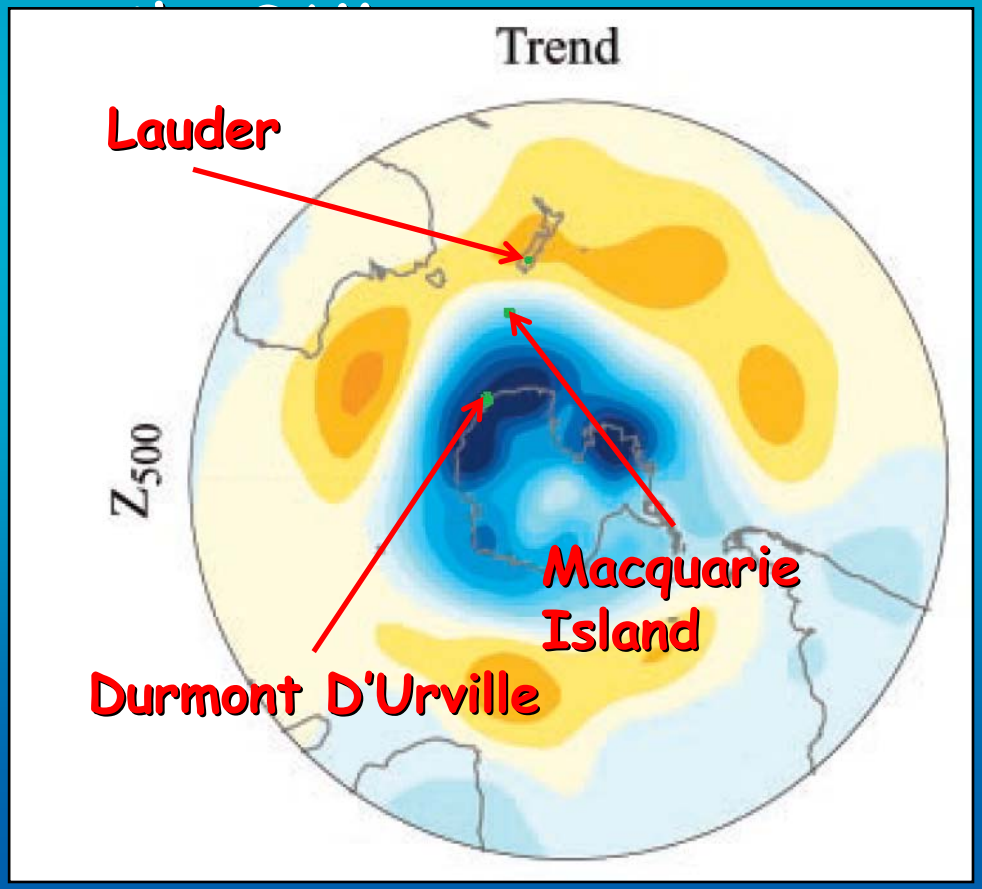
- Global coverage: The complete range of atmospheric variability should be sampled by having sites in each of the major climate regions (polar, mid-latitude, subtropical and tropical) in both hemispheres.

- Modes of variability: Sites should cover a wide variety of different climate regimes and large scale modes of variability such as the SAM, NAM, ENSO, QBO, and should also permit detection of expansion of the tropics, changes in the strength of the Brewer-Dobson circulation, and the monsoon. These phenomena are important because they may change significantly in the future with increases in greenhouse gases and other perturbations to the climate system. In addition, sampling the divergent circulations over the tropical warm pool is vital for our understanding of the climate system because these circulations drive weather patterns around the globe.

What large scale climate regimes need to be sampled?

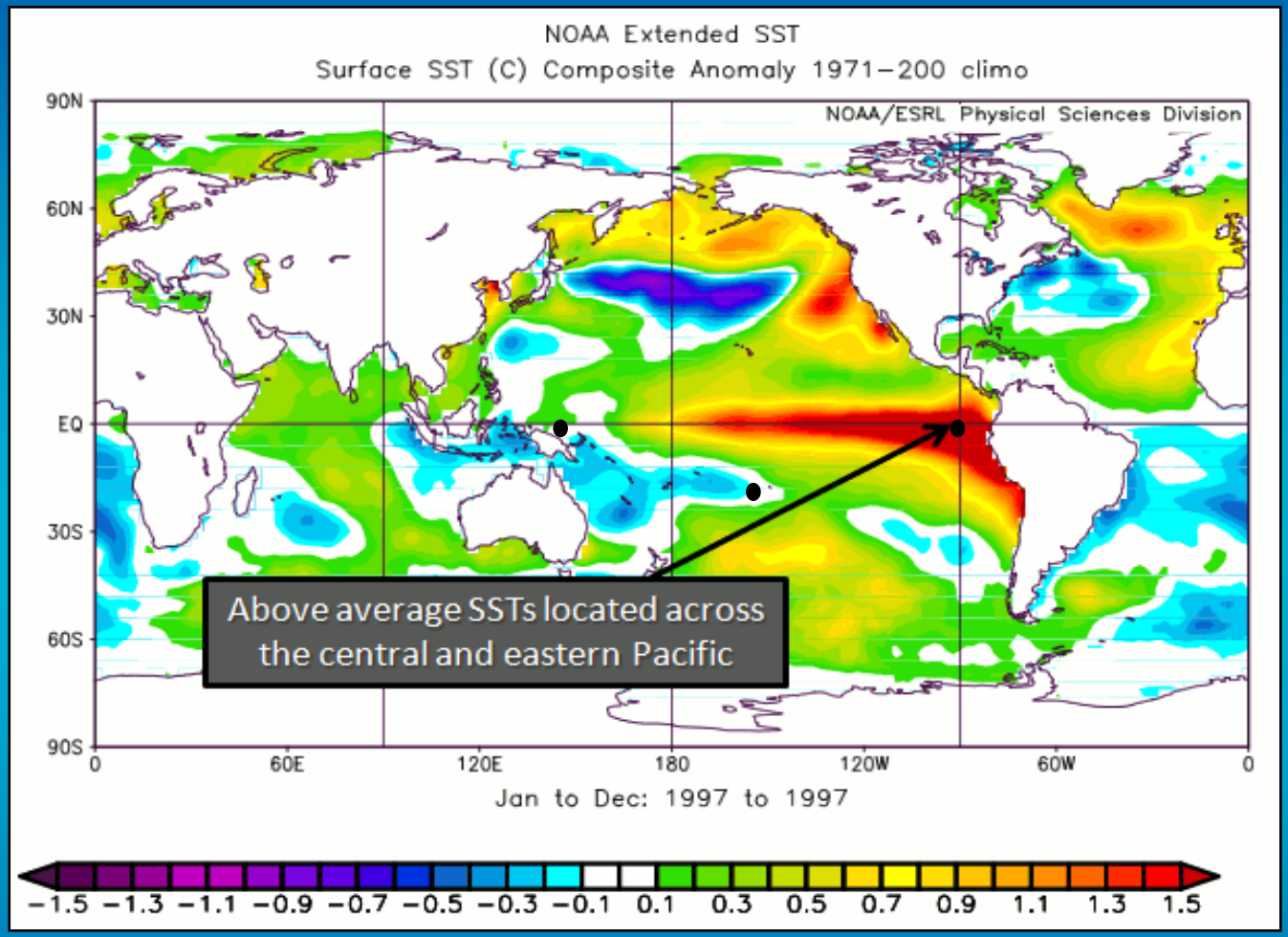
1. Example: The Southern Annular Mode (SAM)

Monitoring the SAM with GRUAN-quality measurements will be important for diagnosing the vertical coupling mechanisms associated with the SAM and for promoting studies that look at the regional implications of changes in



22-year (1979 - 2000) linear trends in 500 hPa geopotential heights (Thompson and Solomon, 2002). As an example for geographic coverage necessary for the detection of a trend in the SAM, the green dots indicate the location of 3 stations spanning the maxima of the pattern and the node.

2. Example: The El Niño Southern Oscillation (ENSO)



ENSO has a strong, direct impact on human life, producing regions of increased precipitation and flooding.

For the geographical coverage for detecting trends in ENSO, the following sites would be advantageous: San Cristobal (0.8°S, 89.4°W), Manus Island (2.1°S, 147.0°E, already a GRUAN station) and Tahiti (17.7°S, 149.5°W) indicated as black dots.

Key Outcomes (2)

- Environment: Sites should cover a variety of surfaces such as forest, deserts, snow and ice as well as stations on small, remote islands to represent surrounding ocean conditions, remote mountain top sites but also regions such as the Mediterranean basin with influences of urban pollution.

- Weather conditions: It would be beneficial if most of the atmospheric measurements were made under clear-sky conditions to minimise the uncertainties introduced by radiative transfer modelling in the presence of clouds, and that relatively simple, climatological vertical profiles of temperature and humidity are observed to avoid complicated features that make trend determination difficult.

Key Outcomes (3)

- Temporal and spatial co-location is absolutely critical in the calibration and validation of satellite observations and it is preferable to have a smaller number of good quality and easily maintained sites in places where satellite overpasses coincide with regular GRUAN sonde launches rather than a high number of sites.

- Historical data: For monitoring changes in climate, long-term, stable, and homogeneous time series of measurements are required. All else being equal, sites with an existing history of such measurements should be selected. Sites with in-house scientific expertise in analysing and understanding long-term climate data records, and long-term commitment to supporting both the observational programmes and the ongoing analysis of observations would be ideal.

Key Outcomes (4)

- Existing networks: GRUAN could benefit appreciably from measurements of water vapor, temperature, ozone, and aerosols conducted by other global networks (NDACC (Network for the Detection of Atmospheric Composition Change), BSRN (Baseline Surface Radiation Network), SHADOZ (Southern Hemisphere ADditional OZonesondes), etc.). Thus, strong consideration should be given to the selection of some sites from these complementary networks for GRUAN expansion. Priority should be given to sites that enable the required vertical coverage of the measurements.

Price versus Preference

Economic cost of augmenting the GRUAN network

A broad range of locations will be identified based on the preferences with consideration for existing infrastructure and in coordination with established networks. Costs are also likely to depend on whether a new site is established in the developed world or in the developing world.

- Most cost-effective option: Approach existing sites in favourable locations that have the flexibility and are willing to add to their operational schedules (e.g. radiosonde launch times) as required.

Acknowedgement

GRUAN network design team

Thomas August, Bill Bell, Stephan Bojinski, Bojan Bojkov, Xavier Calbet, Andrew Charlton-Perez, Domenico Cimini, Belay Demoz, Ruud Dirksen, Tim Hewison, Dale Hurst, Anthony Illingworth, Philippe Keckhut, Rao Kotamarthi, Michael Kurylo, William Lahoz, Thierry Leblanc, Ulrich Löhnert, Craig Long, Fabio Madonna, Gelsomina Pappalardo, Tom Peter, Tony Reale, Karen Rosenlof, Carl Schreck, Marc Schröder, Dian Seidel, Michael Sommer, David Tan, Anne Thompson, Peter Thorne, Holger Vömel, June Wang, Elizabeth Weatherhead, Dave Whiteman

Potential new sites to come into GRUAN

- Sirta and La Reunion Island: Looking forward to hearing from Martial Haeffelin.
- Additional stations in China: In July 2012 June and I (together with Ghassem Asrar, Wenjian Zhang) met with a number of senior staff at CMA.

The outcome of this meeting was that CMA agreed to progress towards hosting 3 additional GRUAN stations in China. Next steps?

Potential new sites to come into GRUAN

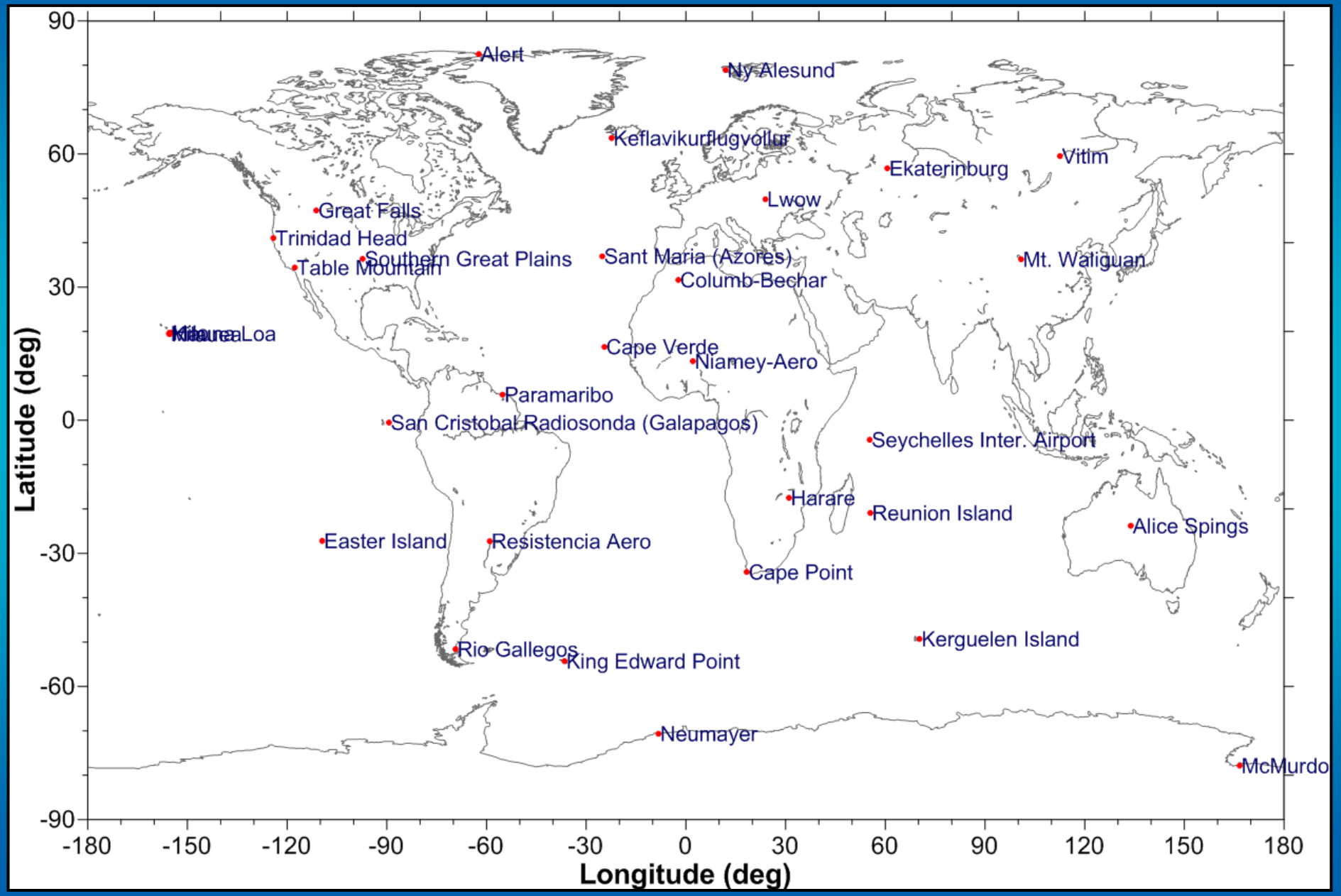
As mentioned by Holger this morning:

- Environment Canada: Eureka and Sandy Lake
- Izaña (Tenerife)
- Chile?

Potential new sites to come into GRUAN

- Bolivia: Marcos Andrade → possibility of a site at Chacaltaya 5240 masl) and/or La Paz (3420 masl). May just need a formal approach. They have experience in launching balloons (Ricardo Forno works with NASA/GSFC every year during the WAVES campaigns). Dave Whiteman has a collaboration with them to develop a lidar system.
- Australia: Russell Stringer and Matt Tully → possibility of sites at Alice Springs, Melbourne, Macquarie Island, Davis. Greg to follow-up with Matt Tully on next steps.
- Africa: Nairobi (Kenya) is a SHADOZ site. Cotonou (Benin), Malindi (Kenya) and Irene (South Africa) are former SHADOZ sites. Niamey was identified during the NEW as a site of interest.
- Other SHADOZ island sites of interest: Hilo (Hawaii), Pago Pago (American Samoa), La Reunion, Suva (Fiji), Papeete (Tahiti), Ascension Island, San Cristobal (Ecuador) – descending cell of Walker circulation.

Other sites mentioned during the workshop



An update on site assessment and certification

In the 3rd quarter of 2012, Lindenberg, Cabauw and Lauder were identified for processing through GRUAN site assessment and certification.

- Site assessment and certification package sent to site by Leader Centre, including application template.
  - Lindenberg → Nov 2012
  - Cabauw → Nov 2012
  - Lauder → Dec 2012
- Response received from site.
  - Lindenberg → 26 Jan 2013
  - Cabauw → Awaiting response
  - Lauder → Awaiting response
- Working Group evaluation of site response, together with the Lead Centre recommendation, and completed questionnaire.
  - Lindenberg → Deadline is ICM-5

An update on site assessment and certification

- Co-chairs write draft response to the site based on the Lead Centre recommendation, questionnaires, and answers to questions posed by members of the WG. The site may be asked to provide additional information.
  - Lindenberg → Deadline is 18 March 2013
- Comments from WG on draft response to the site by WG co-chairs.
  - Lindenberg → Deadline is 1 April 2013
- Formal response to site submitted.
  - Lindenberg → Deadline is 8 April 2013
- Final response from site expected.
  - Lindenberg → Expected response by 6 May 2013
- WG co-chairs make a recommendation to the WG on whether the site should be accepted or rejected. A discussion within the WG finalizes the decision.
  - Lindenberg → 13 May 2013.

A view to the future

- 12 more of the existing sites need to be assessed and certified. We need to do another 4 in the coming year. We need suggestions about which 4 those should be.
- New sites need to be brought into GRUAN and assessed and certified. More on that later.
- Sites currently certified need to be recertified every 4 years. If we have a network of 30 sites (by 2017 as called for in the IP), that means that we need to be recertifying 8 a year i.e. ~1 every 7 weeks. Do we have the resources to do a thorough job on that?
- Someone needs to manage the site assessment and certification process i.e. establish and timetable for the above and ensure that we stick to it. Lead Centre?