

# Virtual Institute – ‘Polar to Tropical Connections (PTC)’

## Castine Meeting – 14 to 15th of June 2010

**Attendees:** Paul Mayewski (Host US), Andrei Kurbatov (US), Sharon Sneed (US), Jefferson Simones (Brazil), Ricardo Jana (Chile), J. Curt Stager (US), Kirk Maasch (US), Stefan Kraus (Chile), Ian Goodwin (Australia), Nancy Bertler (NZ), Dan Dixon (US), Nicky Spaulding (US), Bjorn Grigholm (US), Elena Korotkikh (US), Mariusz Potocki (US), Isaias Ullmann Tholn (Brazil), Magdalena de Mello Monques (Brazil)

### 1. Virtual Institute: ‘Polar to Tropical Connections’

The CCI, University of Maine, secured the following URL addresses:

- <http://www.polartropical.org>
- <http://www.polartropical.com>
- <http://www.polartropical.net>

The group agreed on the name ‘Polar to Tropical Connections’ (or PTC) and updated the Mission Statement to:

*To identify past and present climate signals and quantify the transfer of heat, moisture, salt and tracers (aerosols, pollutants) between Antarctica and the Tropics. This investigation is crucial in assessing the current and projected impact of the recent disruptive shift of Southern Hemisphere climate patterns.*

The PTC webpage now includes new links to:

### 2. Executive Committee for PTC

A PTC Executive Committee was established to represent national members:

- Ian Goodwin (Australia)
- Jefferson Simones (Brazil)
- Ricardo Jana, Stephen Kraus (Chile)
- Nancy Bertler (New Zealand)
- Paul Mayewski, Andrei Kurbatov (USA)

### 3. Organisations contributing to PTC

PTC comprises researchers from:

- Centro de Estudios Científicos, Chile (CECS)
- Centro Polar e Climático, Universidade Federal do Rio Grande do Sul, Brazil (UFRGS)
- Climate Change Institute, USA (CCI)
- Climate Futures at Macquarie, Australia
- Department of Antarctic Biology, Polish Academy of Sciences
- Fundacion CEQUA, Chile

- GNS Science, New Zealand
- Institute of Tibetan Plateau Research, China
- Instituto Antártico Chileno, Chile (INACH)
- Instituto Nacional de Pesquisas Espaciais, São José dos Campos, Brazil (INPE)
- Joint Antarctic Research Institute, New Zealand
- Observatório Nacional, Rio de Janeiro Brazil (ON)
- Paul Smith's College, NY, USA
- Victoria University of Wellington, New Zealand
- Universidade Estadual do Rio de Janeiro, Rio de Janeiro, Brazil (UERJ)
- Universidad de Magallanes, Chile (UMAG)

#### **4. PTC Integrated Programmes:**

**PTC supports an integrated programme that aims to:**

1. Organize and conduct joint scientific efforts
2. Exchange students and scholars
3. Exchange technology
4. Share data through IceREADER, NSDS, AGDS, and WDCA, p301
5. Organize workshops and dedicated journals
6. With emphasis on socially relevant and accessible results

#### **5. Initial PTC Flagship Products**

- CASA (Climate of Antarctica and South America)
  - Detroit Plateau shallow ice coring (2007)
  - Detroit Plateau deep ice coring (2012-13)
- Roosevelt Island Climate Evolution (RICE) (web page en route)
- Mill Island Ice Core (Ian en route)
- ESCCI (Eastern Seaboard Climate Change Initiative (website Ian)
- South African Cape Lake Sediment programme (winter rainfall reconstructions) (Curt in progress)
- Polar to Tropics Climate Connections and Implications (paper in progress)
- PTC Workshop Castine, June 14-15, 2010 (this report)
- PTC visualization (figure from paper) – make into poster?
- CASA SCAR BA poster Stefan et al. to deliver
- South American ice coring activities (Tupungatito ice core plus?)
- New Zealand ice coring activities (Morgenstern et al.)
- Subtropical Coral Coring (Ian)
- Asian Ice Coring Programme (AICA) and CADIP (Vladimir)
- LaClavere (Stefan will check)

#### **6. PTC Linkages**

- SCAR / AGCS (accomplished)
- Pages ARTS (Ian)
- CLIVAR (accomplished through AGCS)
- IPCC (Ricardo)

- ITASE/AGCS (accomplished)

## 7. The next PTC meeting/workshop

It has been proposed that the next meeting will be held in Australia in 2012, perhaps at Heron Island (Ian Goodwin to investigate)

## 8. PTC Synthesis Manuscript

It was decided that a synthesis paper should be a flagship product of the PTC group. A draft should be submitted by the chapter authors (as outlined below) to Paul Mayewski (paul.mayewski@maine.edu) by **01 August 2010**. A compiled draft will be compiled by 30 September and sent out to all authors for further input.

The Manuscript might include the following sections:

- PTC Mission Statement
- Observation of changes relevant to the mission statement in distinct geographical regions – Antarctica, Australia, South America, Africa, New Zealand, Ocean, ITCZ, SPCZ, Polar Front, and also marine ecosystems. (each group to write ~500 word section – submit by 01 Aug 2010)
- Observations to visualise in overview figure (to be drafted and circulated by Kirk)
- Identify mechanisms for the observed changes (based on submitted sections)
- Holocene climate forcings (volcanic forcing, insolation at different sites, greenhouse gas record, solar variability) (background information)
- Graphics – Ocean Tunnelling / Atmospheric Bridge – should emphasis the link between the two (not isolated) – perhaps a cross section

Individual sections might include:

### GENERAL OCEAN / ATMOSPHERE CIRCULATION (Kirk, Ian)

- ITCZ – last 30 years (Seidel & Randel 200, 2008) paleo info too, Indonesian corals
- SPCZ – last 100 years (Lindsey 2008)
- Subtropical High (Wasil Drosdowsky)
- PAGES Hadley circulation book
- Polar front – Kerguelan snow cover, Herd Island
- Westerlies intensify (Thomson and Solomon, 2002)
- Kerguelan snow cover
- Herd Island Warming
- Semi-permanent highs and lows

### OCEAN (All)

- Easter Island record – south pacific high (Rob Dunbar) – last 30 years
- Indonesian throughflow - Mewyers
- Agulas weakening – Biatsch et al. 2008, Nature SST increase last 25-30 ys
- Brazil Current (JGR 1999, Zanirov et al)

## ANTARCTICA (Paul, Ian, Dan, Nancy)

- Schneider and Steig 2008 PNAS 1940 warming due to tropical warming (ice cores)
- Increase in snow accumulation at Gomez – Thomas 2008
- Increase sea ice distribution since 1979 – Cavalerie & Parkinson 2008, JGR
- Marine air masses = sulphate and nss Ca (Dixon et al 2004, and in review)
- Pollution – U, Ba, As
- Ocean warming (Gille 2002, Boning 2008)

### Longer-Term (Holocene)

- Ice Sheet & Ice Shelf retreat
- Global Sea Level
- Solar Changes – South Pole Be<sup>10</sup> (also affecting Zonal Wind Strength) (Raisbeck et al., 1990; Bard et al., 2000; Mayewski et al., 2005)
- Tropical Volcanism – large eruptions influence Antarctic climate (e.g. Pinatubo exacerbated El Nino)

### Recent

#### Atmospheric

- SAM (Southern Annular Mode - Westerlies) – Instrumental records show intensification since 1950s (Randel and Wu, 1999; Thompson et al., 2000; Thompson and Solomon, 2002; Marshall, 2003)
- NAMI (Northerly Air Mass Incursions into West Antarctica) – nssCa records show intensification since 1950s, unprecedented increase since ~1980 (Yan et al., 2005; Dixon et al., in review)
- SLP (Sea Level Pressure) – Marine aerosols (and accumulation) show intensification in recent decades (Kreutz et al., 2000; Souney et al., 2002; Kaspari et al., 2004)
- EAH (East Antarctic High) – Law Dome NO<sub>3</sub> behaves inversely to marine aerosols (Goodwin et al., 2003)
- ENSO – More frequent and intense El Ninos in recent decades (related to South Pole MS, also weakly associated with West Antarctic Accumulation records) (Meyerson et al., 2002; Turner, 2004)

#### Cryospheric

- Sea Ice – MS, nssSO<sub>4</sub> and Na (much variability around continent (increasing in most areas), overall slight increases since late 1970s– also related to plankton, krill & penguin colonies?) (Welch et al., 1993; Meyerson et al., 2002; Curran et al., 2003; Abram et al., 2007, Sneed et al. in review, Dixon et al, 2005)
- Precipitation – increasing on peninsula no change in interior (Turner et al., 2005; Monaghan et al., 2006; Thomas et al., 2008)
- Ice shelf collapse on Antarctic Peninsula (caused by melting and cracking on surface combined with sea ice removal and exposure to wave action) – attached glaciers surge into ocean (Rignot et al., 2004; Scambos et al., 2004; van den Broeke, 2005) Cook et al. 2005 (100 year record)
- Mass balance (Rignot 2008, Valicogna 2009, ACCE Document)

### Temperature Changes

- Warming – Antarctic Surface, Peninsula & Troposphere (Turner et al., 2006; Schneider et al., 2006; Lubin et al., 2008; Monaghan et al., 2008; Steig et al., 2009)
- Cooling – Spring Stratosphere since 1980s (Santer et al., 1996; Thompson and Solomon, 2002; van den Broeke and van Lipzig, 2004)

### **SOUTH AMERICA (Jefferson, Ricardo, Stefan)**

- Penetration of Antarctic air masses to the Anundsen-Bellinghausen (perhaps Weddell) (1997, 1998 Marengo J of Applied Met), past 50 years, more during past 1970s
- Christoph Schneider et al 2003 in spanish,
- Transport of pollution identified from South America to Antarctica (black carbon Perella 2006 , radon flux to South Shetlands)
- Contribution of Patagonian Icecaps to global sea level rise (Rignot et al. 2006 – recent)
- Airmass intrusion into S-Patagonia (Schneider et al. 2003)
- Severe winter 1995 cold front and snowfall (massive loss of sheep) struck S Chile (endlicher and Santana 1997)
- Transport of pollution from South America to Antarctica 2000, Patagonian dust in Antarctica
- Black carbon Perella et al. JGR 2006
- Radon flux to South Shetlands (Evanglista, 2002, J.Env.Radioactivity)
- Moyes 2009 – Longer 1000 years – records from SA – hydrological change in Patagonia
- Brazilian-Mahvians confluence variability (Jefferson)
- More GLOFS in Patagonia (Dussailant, 2009, Nat Hazards increase 2008, 2009)

### **AUSTRALIA (Ian)**

- East Australian current (Deep Sea Research) start ~1850 AD
- Easterly shift east coast waves (Goodwin), Hadley cell starts 1950-60 AD
- Westerly shift in Southern coast waves (Henner, 200?) – last 50 yr
- Increase in Southern Tasman Low pressure systems – last 30 yrs
- Drying shift in Southwest and south east Australian rainfall, – last 40 years
- Increasing rainfall in northern Australia (met data)
- Sea level m

### **AFRICA (Curt)**

- Wetter southwestern Cape – eather data, Reison 2008? – last 30 years
- Widening of tropical belt (Seidel 2007, 2008), 5-8 degree widening 1979-2005
- Intensified flow of Agulas around Cape associated with poleward shift of SAM since 1970, rising SST in S Atlantic, wetter in SW SAfrica (Stager), SEAfrica boundary current through

Mozambique Channel (Zinke coral record, warming since 1960 AD, coral growing more slowly related to southward shift

- Stager lake levels drop since 1960s East Africa

### **ASIA / NORTHERN HEMISPHERE (Bjorn)**

- Fan and Wang 2004, GRL, 1955-2000, Change in dust frequency related to SAM
- East Asian summer monsoon, SAM-connection, Zuh 2009 (Advances in Atmosph. Sciences) – since mid 1980s stronger correlation between SAM and amount of rainfall during monsoon
- Amira Prabhua, 2009, Intern. J. Remote Sensing, 1985-today, strong correlation between Antarctic sea-ice extent and Indian monsoon

### **NEW ZEALAND (Nancy, Ian, Paul)**

- Tree ring record shows temperatures at 3 of 5 sites in NZ are significantly warmer for 20th century in comparison to past ~500 years. However it is difficult to determine whether this is unprecedented [D'Arrigo et al. 1998]
- Jones and Widmann (2003) suggest that the warming in NZ over the past 50 years is not connected to SAM but likely represents an increase in background temperature [Jones and Widmann 2003]
- Upward 1900-2005 trends in Auckland (+1.4C), Wellington, (+0.9C), Lincoln near Christchurch (+1.2C)
- Reduction in frost occurrence
- Sea level increase +10 to +25cm
- Glaciers retreated ~40% shorter, ~25% less area (1880 to 1980 AD)
- Decadal changes are linked to change in Westerlies (both in NZ and Andes). Advance during weaker westerlies, blocking event in the South Pacific, and negative geopotential height anomalies over South Africa [Fitzharris et al. 2007]
- increase in the circulation of the South Pacific Ocean subtropical gyre, extending from the sea surface to middepth, over 12 years (1990s increase in wind-driven circulation resulted from decadal intensification of wind stress curl east of New Zealand-variability associated with an increase in the atmosphere's Southern Hemisphere annular mode) [Roemmich et al. 2007]
- Some hints of more frequent heavy rainfall in the west
- Overview and implications by [Jillian and Ji Young 2008]?

### **POLLUTION (Jefferson, Mariuz, Elena)**

- Transport of pollutants S America to Antarctica, Patagonian dust in Antarctica
- Ozone Hole – Increasing since 1980, stabilized since ~1990 (Thompson et al., 2000; Instrumental Data – Shanklin, 2009)
- U at Detroit Plateau (possibly Australian U mining?)
- Ba at South Pole (sharp rise ~1980)
- As at multiple sites (gradual rise since ~1900, rate of rise increasing ~1970)

**VOLCANISM (Andrei)**

- Robock - Volcanic influence – perhaps Siple Dome, GISP and forcings sequence, including insulation and greenhouse gases, solar variability

**DUST (Dan)**

- (Mahowald paper in press)

**ENSO (All)**

- Turner, 2004 – International Journal of Climatology – last 50 years