Southwest Pacific Ocean Circulation and Climate Experiment: SPICE

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Science plan: www.clivar.org
Southwest Pacific Ocean Circulation and Climate Experiment

Objectives:

1. Understand the southwest Pacific in climate
2. Understand local oceanic environment influences

North Coral Sea: WBC and Straits

Local and regional oceanic impacts

SEC inflow:
Jets and Bifurcation
Heat transports

EAC/EAUC:
Variability and air-sea fluxes

SPCZ

SPICE issues

Thermocline water formation
Outline

1- Southwest Pacific and Climate
2- SPCZ
3- Thermocline waters
4- Ongoing/submitted projects
The Southwest Pacific Atmosphere

- SPCZ
- Trade winds
- Trade winds
- A
- A
South Pacific Convergence Zone

High convective activity, precipitation, wind convergence
- Dominant convective feature in the Southern Hemisphere
- Substantial variability: (intra) seasonal; interannual; Equatorward shift 1976
- Unresolved southward bend, poorly modelled
- Strong local effects (SSS, oceanic heat content)

Lintner & Neelin, GRL, 2008

(a) Climatology and (b)-(e) anomalies of TC genesis density for the four classes of SPCZ position. Climatological GPCP SPCZ (green dashed line) and mean composite SPCZ (green line)

Vincent and Lengaigne Pers. comm.

Composites of daily January SSM/I satellite column water vapor (top) and precipitation (bottom) on NCEP Reanalysis 925 mb zonal wind over 140°W-120°W, 20°S-10°S

COADS cloudiness 1960-1970
20th century climate model
Decadal influences:
Thermocline water connection between the subduction zone of the South East Pacific and the equator

Lines show geostrophic streamlines on the isopycnal (courtesy B. Kessler)
Decadal influences: Thermocline water connection

A temperature anomaly on sigma=25 (EUC core) from the Southeast Pacific preceeds Nino-3 by 7 years

Giese et al. 2002: T on sigma=25

Izumo et al., 2002: Origins of Nino 3 waters
Fate of the incoming warm water

2.6 PW
Southwest Pacific Topography

- Papua New Guinea (PNG)
- Solomon Islands
- Coral Sea
- Vanuatu
- Fiji
- New Caledonia
- Australia
- Tasman Sea
- New Zealand
Jets in numerical models

From Webb 2000

Regional field experiment

- Solomon Strait moorings 2010
- Solomon Sea surveys 2007
- Solomon Glider monitoring 2007
- Coral Sea Argo seeding 2005
- SEC surveys (glider/hydro) 2004
- SFC monitoring (XCTD/VOS) 2008
- EAC surface drifter release 2007
- EAC glider monitoring 2009
- Tasman Box HR XBT running
- Norfolk Gap mooring array TBS
- TAS outflow mooring array TBS
Modelling strategy: regional zooms

1. Help to design observation / monitoring program
2. Sensitivity experiments
3. Regional applications
Ongoing programs-observations

-Coral Sea:
  Cruises Secalis (IRD; 2003-2006)
  Cruise P21 repeat (IORGC/JAMSTEC; 2008)
  Glider transects (CORC/NOAA/IRD; 2005, 2006)
  XTB SEC transport surveys (IRD; 2008-2010)
  Argo deployments (UW/IRD; 2008-2010)

-Solomon Sea
  Cruise Flusec (IRD; 2007)
  Cruise Pandora (IRD; 2010)
  South Solomon heat transport (CORC/NOAA/IRD; 2010-2013)
  SPICEMoor (SIO/CSIRO/IRD; 2010-2013) (S)
  Glider transects (CORC/NOAA/IRD 2007-2011)
Ongoing programs-observations

-Tasman Sea:
  XBT EAC surveys (CSIRO)
  EAC surface drifter programme (BMRC; 2007-?)
  EAC mooring array (IMOS)
  EAC Glider transects off Tasmania (IMOS; 2008-?)
  Argo deployments (CSIRO)

-GBR:
  Great Barrier Reef Ocean Observing System (IMOS)

-Air-sea fluxes
  VOS equipment with AWS/SST (BMRC; 2007-?)

-Sea Surface Salinity
  VOS (1969-ongoing)

-Thermocline structure:
  VOS-XBT (1979-ongoing)
The SEC-ALIS cruises

SECALIS-1: Jul 2003
SECALIS-2: Dec 2004
SECALIS-3: Jul 2005
SECALIS-4: Nov 2006
Oceanic circulation in December 2004

Transport 0-2000m

Ganachaud, Gourdeau, Kessler, JPO, 2008

OCCAM 1/12° 2004 average

1Sv = 10⁶ m³s⁻¹
Glider measurements, 2005
(Gourdeau, Kessler, Davis, Sherman, 2008)

U, T and S
• Prototype, Scripps OI, San Diego
• Dropped July 17th, 2005
• Recovered October 18th, 2005
SECARGO: SEC entrance monitoring

AM SECARGO #1

Participants: Rick Rupan and David Varillon

DEPLOYMENT DONE FOR SECARGO#1 28/06–01/07 200
Mooring plans:
- GBROOS moorings: 2007+
- NSW moorings: 2009
Glider surveys start 2009

Steinberg, C., Bainbridge, S., Thursday
GBROOS

NSW national reference transect
Ridgway, K., Thursday at 12pm
East Australia Circulation surface Drifter Program

- Regular release of Lagrangian drifters with temperature sensors
- From VOS/XBT ship
- Fine EAC observation
- Validation of Bluelink products
- Two releases so far: 2007; 2008. Target is 2/year.

Brassington et al., CAWCR 2008
Solwara Pilot study
(IRD-CNRS-PMEL-SIO-CSIRO)

• Exploratory surveys: 2007, 2010
• Glider monitoring: 2007-2010
• Mooring arrays: 2010-2012
• Modelling/assimilation
Gliders measure transport in the Solomon Sea
(SIO/PMEL/IRD)

Tracks and vectors of 0-700 m average flow from first 4 Spray glider cruises between the Solomon Islands and Rossel Island, the SE corner of the new Guinea continental shelf. (Kessler, PMEL)

Integral of depth averaged flow along glider tracks away from Rossel Island. Color codes are year/month of cruise. Transport at end of 2007 was low or out of Solomon Sea. July 2008 showed strong inflow. Each cruise can contribute up to 3 curves indicated by line type. (Davis, SIO)
A regional field experiment: within existing large scale programs

UW/CSIRO/IRD

BOM/MF

IRD

SIO/CSIRO/IRD

BOM/IRD

IMOS/Bluewater and climate
Ocean and climate impacts on environment in the southwest Pacific

Consequences of ocean and climate fluctuations:
- Biodiversity, Coral reefs
- Freshwater-agriculture and health
- Tropical cyclones
- Sea surface height

Pacific Island Countries:
Fragile ecosystems, low-lying populated areas, isolated places

Australia and New Zealand:
Climate depends on heat content in the Tasman Sea
Freshwater resources critical
Important changes in biodiversity
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