"Two Decades of Down Under Collaboration - Where to Next ?"

by

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Acknowledge Interactions with CIMSS

- CIMSS-Curtin MOU since 1988 - 17 years
- MOU covers graduate students, staff and cooperative research
- Curtin people who have been beneficiaries:-

  Liam Gumley, Paul van Delst, Jason Li, Mark Gray, Brian Osborne, Jim Davies, Peter Fearns, Helen Chedzey, Leon Majewski, Brendon McAtee, Mark Broomhall, Brendan McGann, Brian White, Merv Lynch
- WASTAC – Western Australian Satellite Technology and Applications Consortium (1987)

CIMSS / SSEC – Curtin Interactions

- 1978 Bill and Marcia Smith and (small) family visit Perth
- 1981 first “experiment”: NOAA ERL (Ed Westwater), Bill Smith /Tony Schreiner (SSEC), Merv Lynch (Curtin)
- 1981 met Paul Menzel and Nancy Jesse
- Paul and Nancy visit Perth 1983 on a Curtin Haydn Williams Fellowship
- Multiple visits to Australia by Paul and Nancy
- Visits to Curtin also by Ralph and Paulette Dedecker, Bob Fox, Verner Soumi, Liam Gumley, Bill Hibbard

CIMSS / SSEC – Curtin Interactions

- Remote sensing research with Paul Menzel and Don Wylie (Liam Gumley, Jason Li, Mark Gray, Helen Chedzey)
- Advanced sensors with Bill Smith, Hank Revercomb and Bob Knuteson – HIS, AERI, MAERI field experiments, cruises (Nick Bower, Paul van Delst, Brian Osborne)
- CIMSS Outreach - ITSC series editor (with Paul Menzel)
- MODIS science with Paul Menzel and his team - Liam Gumley, Kathy Strabala, Chris Moeller… (Leon Majewski, Brendon McAtee, Mark Broomhall)

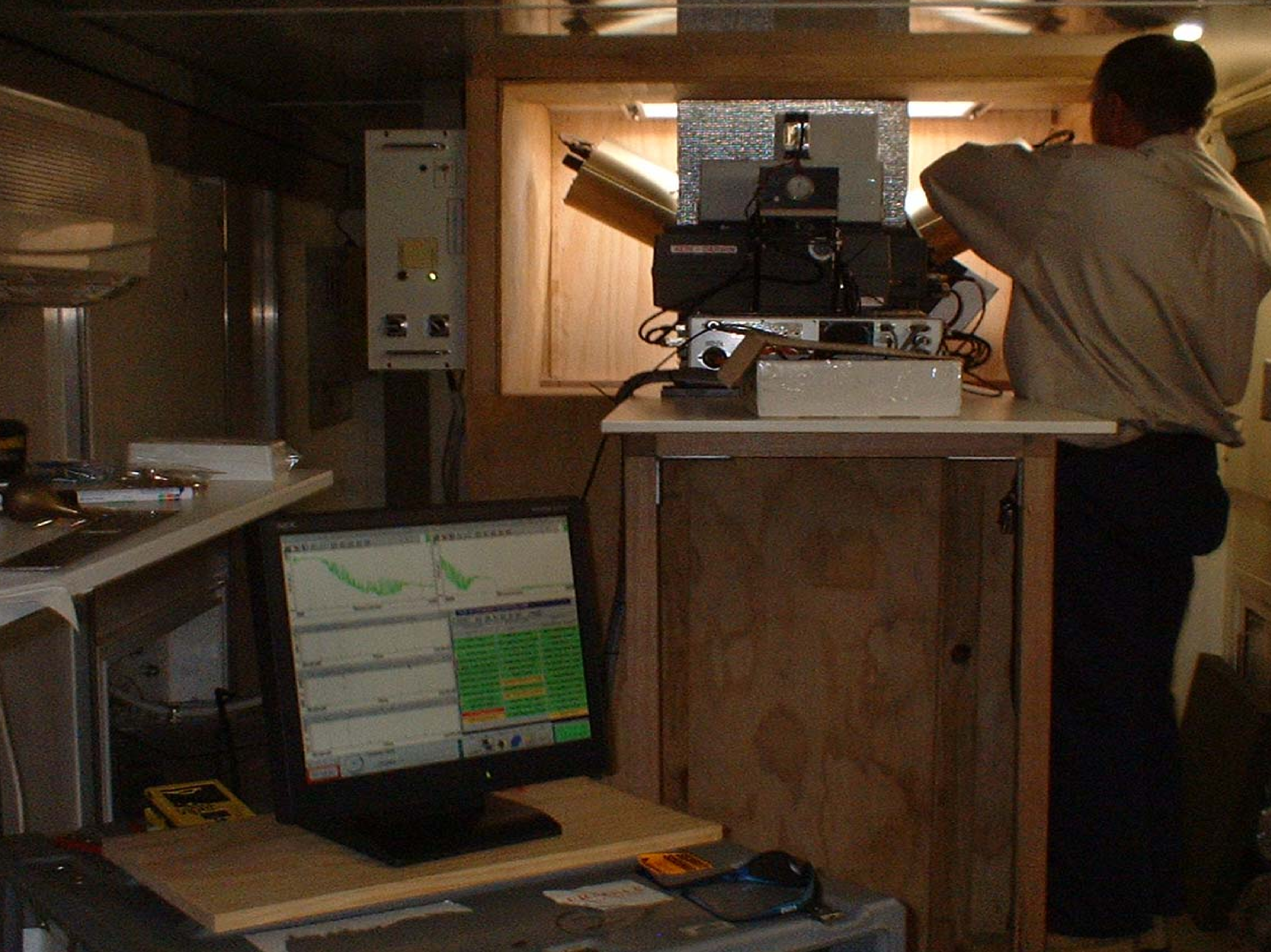
CIMSS / SSEC – Curtin Interactions

- MODIS - direct broadcast facilities
- MODIS Workshops and in Perth (Liam Gumley)
- Remote Sensing course teaching and software developments - Hydra (Paul Menzel,..)
- Bob Fox – MCIDAS (Frank Yu)
- Sanjay Limaya GIFTS Outreach project
- Alan Huang – radiative transfer (Jim Davies)

Centre Support

- Bob Fox, John Roberts, Sally Loy, Mike Dean, Terri Gregory, Jean Phillips, Rose Pertzborn, Dee Wade


HBB
BOMEM
Hartmann&Braun
MB SPECTRAL RADIOMETER
BOMEM
MR-Series



CIMSS - Reflections

- Much in the way of advances in instrumentation and science has been achieved

- Many challenges remain for the future – new products; high spatial; high spectral; atmospheric chemistry; aerosol physical properties; observations, models and data assimilation

- Service the users' needs

What do coupled ocean – atmosphere models require?

Neville Smith states GODAE requires:

- validated infrared SSTs for clear sky regions
- validated microwave derived SSTs for cloudy regions
- diurnal heating corrected SSTs
- a diurnally corrected merged IR / MW product

This product doesn’t exist for the Indian Ocean!

Ceased production it for the Asian region (Kawamura)!

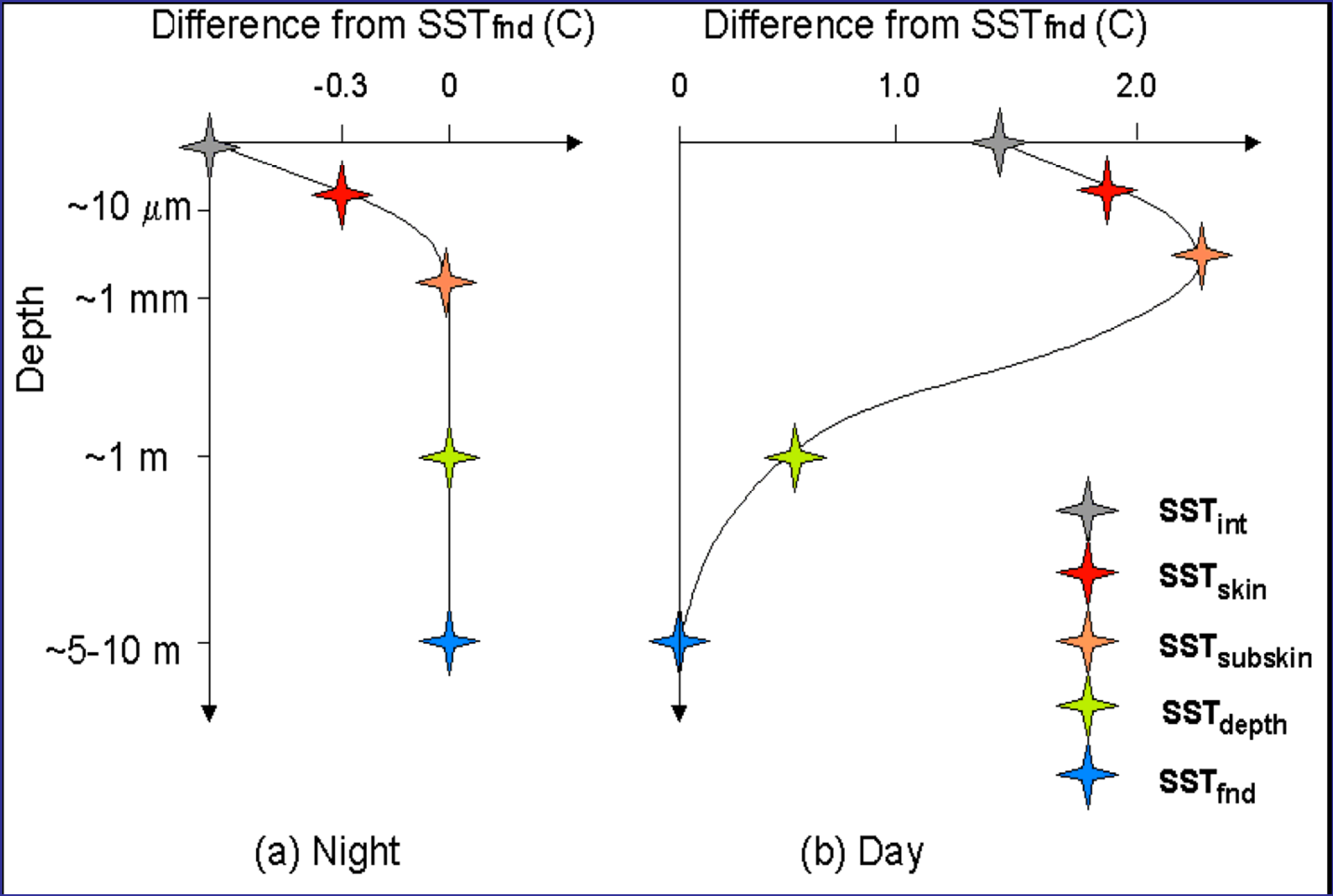
Characterizing Sea Surface Temperature

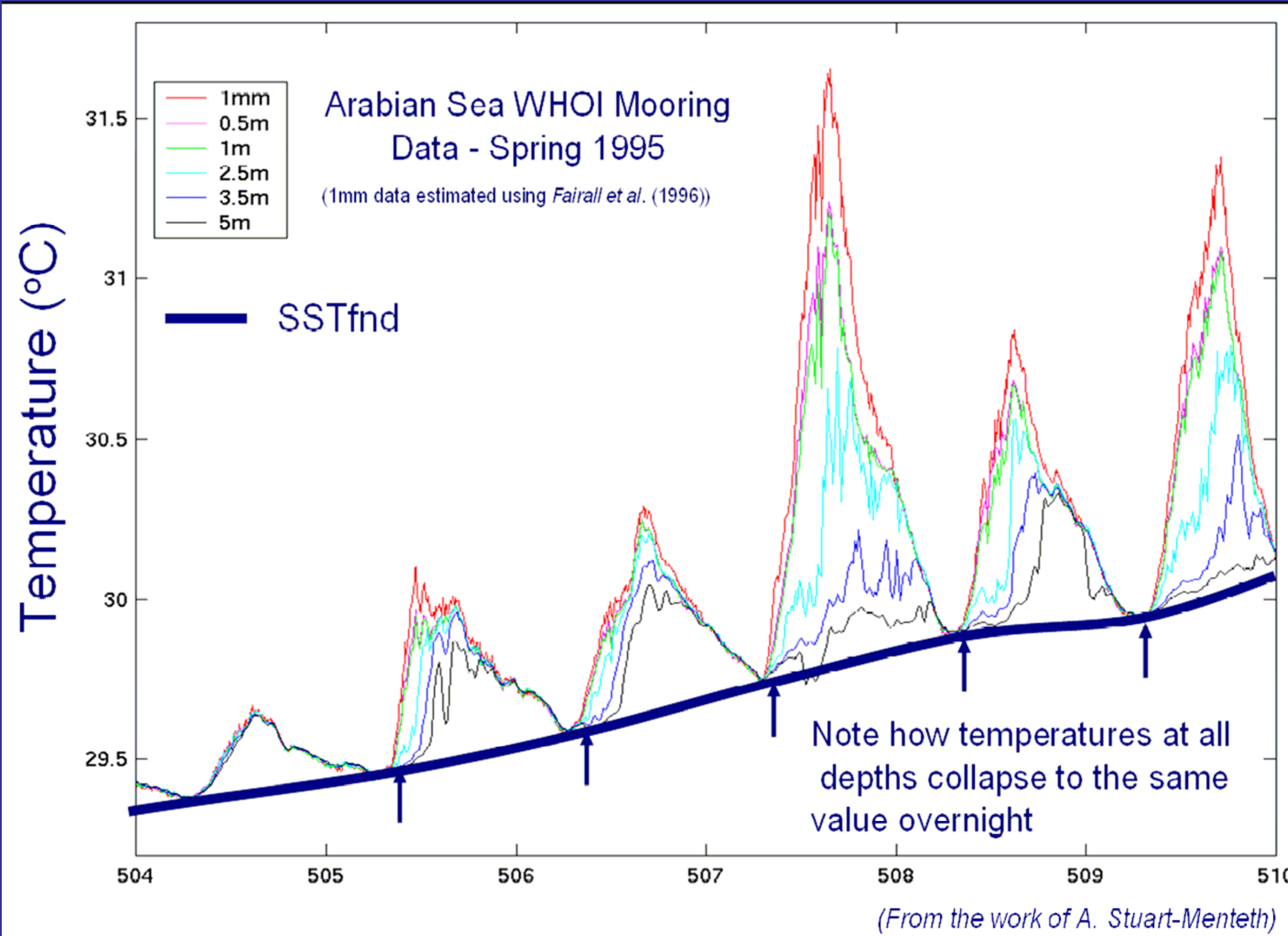
SST is a difficult parameter to define exactly because the upper ocean (~10 m) has a complex and variable vertical temperature structure that is related to ocean turbulence and the air-sea fluxes of heat, moisture and momentum.

- heat transport processes
- time scale of variability

Craig Donlon – GHRSST

http://ghrsst-pp.metoffice.com/documents/GHRSST-PP-Product-User-Guide-v1.1.pdf


Difference from SSTfnd (C)
-0.3
0
Difference from SSTfnd (C)
0
1.0
2.0
Depth
~10 μm
~1 mm
~1 m
~5-10 m
SST int
SST skin
SST subskin
SST depth
SST fnd
(a) Night
(b) Day



Arabian Sea WHOI Mooring
Data - Spring 1995
(1mm data estimated using Fairall et al. (1996))
1mm
0.5m
1m
2.5m
3.5m
5m
SSTfnd
Temperature (°C)
31.5
31
30.5
30
29.5
504
505
506
507
508
509
510
Note how temperatures at all depths collapse to the same value overnight
(From the work of A. Stuart-Menteth)

Tropical Cyclones - Don Gray

- Large values of low level vorticity
- Near equatorial location
- Weak vertical shear in the horizontal wind
- SST ≥ 26 ^{o}C & deep thermocline
- Conditional instability through a deep layer of the atmosphere
- High humidity in the lower and middle atmosphere

Observational Surrogates

- SST is (almost) OK – deep thermocline? ARGO floats - OK
- low level vorticity – scatterometer & MW winds -OK
- conditional instability – convection / cloud development - OK
- low and middle level moisture – OK
- near equatorial location – OK
- weak vertical wind shear – cloud and moisture drift winds

Tropical Cyclone Tim

20-30 March 1994

Date March 1994	Surface Wind Speed ms^{-1}	Water Vapour mm	Liquid Water mm	Rainfall mm hr^{-1}
20	7.5	48	0.1	0
21	7.5	30	0.01	0
22	11.5	33.9	0.03	0
23	9.3	33.3	0.06	0
24	6.6	53.1	0.03	0
25	4.2	59.4	0.03	0
26	3	54	0.03	0
27	11.3	52.8	0.32	0
28	9.45	57	0.61	7.7
29	13.2	49.5	0.72	25
30	19.8	60.3	0.85	25

Data from DMSP 11 for March 20-30, 1994 for tropical cyclone Tim

GASP MAR 1994	T850 K	T700 K	T500 K	T200 K	RH 850 %	RH 700 %	WIND U 850 ms^{-1}	WIND V 850 ms^{-1}	WIND U 200 ms^{-1}	WIND V 200 ms^{-1}	ZEHR GP
21	290.3	283.0	267.3	220.5	N/A	N/A	-1.7	3.1	-1.6	3.0	0.0
22	290.1	282.4	268.9	219.8			-8.3	1.0	2.4	5.4	0.0
23	290.6	282.6	269.3	221.9			-10.1	1.1	0.2	8.6	0.0
24	290.5	282.1	268.6	220.3			-5.6	-0.3	-4.4	7.4	0.0
25	290.1	283.5	267.5	220.5			-4.8	1.4	-2.7	1.3	0.0
26	290.5	284.0	268.7	221.7			-7.5	-1.0	0.2	-7.8	0.0
27	289.8	283.7	268.6	220.2			-2.3	-3.8	2.0	-0.3	0.0
28	289.8	282.9	267.6	218.7			0.7	-4.6	2.9	1.1	0.0
29	289.6	282.3	267.4	219.9			-2.4	-5.62	5.5	7.0	0.0
30	289.9	282.4	267.4	220.6			-6.0	4.4	1.5	2.1	0.0

Tropical Cyclone Elaine

March 7-17, 1999

Date March 1999	Surface Wind Speed ms^{-1}	Water Vapour mm	Liquid Water mm	Rainfall $mmhr^{-1}$
07	2.9	59.1	0.9	0.0
08	3.0	57.3	1.2	8.8
09	3.3	63.0	1.2	0.3
10	4.5	62.4	0.3	0.3
11	3.2	54.0	0.0	0.0
12	3.5	54.9	0.3	0.0
13	2.6	48.6	0.0	0.0
14	4.1	57.0	0.0	0.0
15	3.8	48.6	0.2	0.0
16	6.1	7.05	0.5	9.6
17	11.7	75.0	1.7	15.4

Data from DMSP 13 for March 07-17, 1999 for tropical cyclone Elaine

GASP MAR 1999	T850 K	T700 K	T500 K	T200 K	RH 850 %	RH 700 %	WIND U 850 ms^{-1}	WIND V 850 ms^{-1}	WIND U 200 ms^{-1}	WIND V 200 ms^{-1}	ZEHR GP
06	291.2	282.8	268.6	220.3	77	58	4.7	2.0	-13.0	4.0	0.0
07	290.5	282.4	268.7	219.7	80	64	1.8	2.9	-10.3	3.4	0.0
08	291.4	283.5	267.5	220.1	73	60	-0.9	2.1	-10.2	4.0	0.0
09	292.5	284.0	267.4	219.9	58	51	-3.2	0.8	-9.0	1.1	0.0
10	292.1	282.8	268.7	219.9	62	62	-3.0	-1.7	-9.3	3.0	0.0
11	290.9	282.5	268.2	220.3	69	67	-1.4	-2.9	-1.7	-0.8	0.0
12	292.4	282.5	268.4	219.8	64	66	-4.8	-0.6	-7.2	-0.1	0.1
13	292.7	282.2	269.0	220.0	67	75	-4.3	0.4	-3.1	-1.1	0.0
14	292.5	282.9	268.1	219.9	65	57	-4.1	-0.4	0.0	2.1	0.0
15	291.3	281.9	268.8	220.8	61	60	-6.9	-2.3	-1.7	7.0	0.0
16	293.1	283.8	268.2	220.5	61	55	-8.3	3.0	-7.1	2.1	1.3

Tropical Cyclone Isobel

January 19-30 1996

Date January 1996	Surface Wind Speed ms^{-1}	Water Vapour mm	Liquid Water mm	Rainfall mm hr^{-1}
19	7.8	43.8	0.5	0.0
20	8.5	59.7	0.81	9.6
21	9.3	61.2	0.89	12.0
21	10.8	61.8	1.74	12.0
23	13.7	61.5	0.93	0.0
24	5.4	55.8	0.81	0.0
25	7.7	55.5	0.47	0.0
26	6.6	55.8	0.96	0.0
27	14.1	59.4	0.71	17.7
28	17.7	62.4	1.74	25.0
29	-	-	-	-
30	-	-	-	-

Data from DMSP 13 for January 19-30, 1996 for tropical cyclone Isobel

GASP JAN 1996	T850 K	T700 K	T500 K	T200 K	RH 850 %	RH 700 %	WIND U850 ms^{-1}	WIND V 850 ms^{-1}	WIND U 200 ms^{-1}	WIND V 200 ms^{-1}	ZEHR GP
19	290.9	282.4	267.4	218.9	70	71	-9.9	1.6	-12.2	3.6	0.0
20	290.6	282.9	267.9	219.1	66	64	- 15.0	-0.9	-12.4	3.4	0.0
21	290.2	282.9	267.6	219.1	67	68	- 6.2	-1.2	-16.4	0.7	0.0
22	291.3	282.8	266.6	219.8	64	68	-4.2	-1.2	-17.6	7.4	0.0
23	291.0	282.5	267.0	219.7	70	67	-9.7	-4.2	-16.6	2.2	0.0
24	290.4	282.8	268.8	220.1	76	44	-15.1	-0.1	-16.2	4.3	0.0
25	291.9	281.9	268.6	220.0	51	60	-7.2	1.1	-11.8	3.8	0.0
26	290.6	281.2	268.7	220.6	60	55	-10.5	-1.3	-12.4	3.3	0.0
27	290.5	281.5	268.7	221.4	65	67	-9.3	0.3	-19.0	0.8	0.0
28	290.7	282.0	268.6	219.9	70	52	-12.5	2.8	-15.0	2.9	0.0
29	290.3	282.2	268.5	219.9	57	22	-16.5	-2.1	-14.7	6.2	0.0

Hamilton Index (HI)

$$HI = \{(a_{wv}) \, . \, [(b_{lw}) + (c_{ra}) + (d_{sst})] \, . \, (e_{ws})\}$$

where:

a,b,c, d and *e* are weighing factors that are assigned based on case studies ,

wv = water vapour (mm),

lw = liquid water (mm),

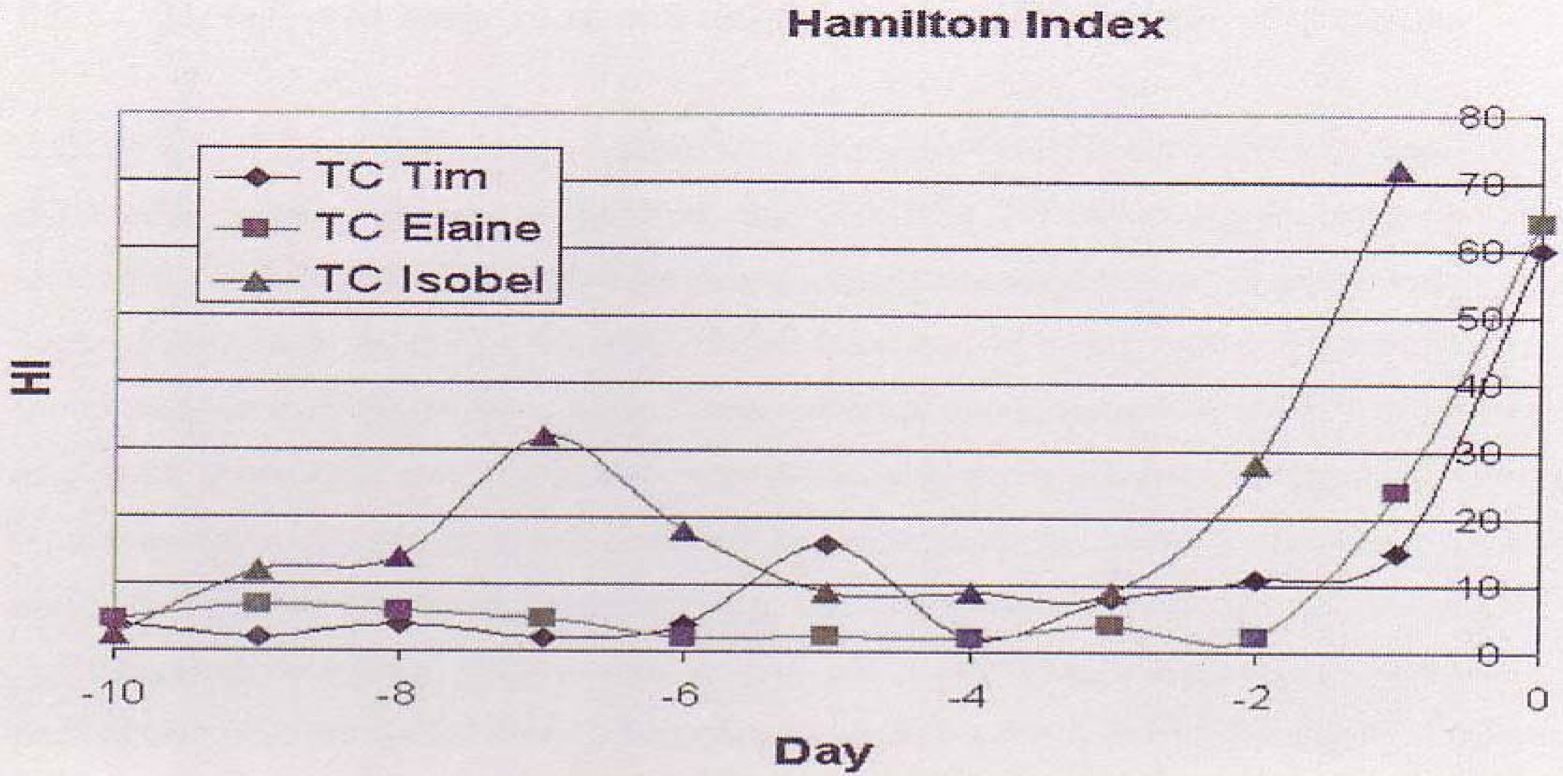
ra = rainfall ($mm.hr^{-1}$),

sst = sea surface temperature (ºC), and

ws = surface wind speed (ms^{-1}).

Score	W V mm	LW mm	RA mm hr^{-1}	WS ms^{-1}	SST °C
0.5	≤45	0	0	≤5	≤27
1.0	≤ 55	≤1.0	≤5	≤10	≤28
2.0	≤65	≤2.0	≤15	≤15	≤29
3.0	≤74	≤3.6	≤24	≤17.4	≤30
4.0	≥ 75	≥ 3.7	≥25	≥17.5	≥31

Lookup table for parameter scores for use in HI



The Hamilton Index applied to daily satellite data for the 3 tropical cyclone case studies investigated.

Hamilton Index

- Index range: 0.38 ≤ HI ≥ 192
- Needs tuning with more case studies
- Need to capture other data sets – Quickscat, wind shear,MODIS,..
- Need grid computing approach with appropriate middleware

Acknowledgements

- CIMSS network - especially Paul Menzel, Bill Smith, Liam Gumley, Hank Revercomb, Bob Knuteson, Ralph Dedecker

- Greg Hamiltion – data sets

The End