Supplemental Slides
MONSOON

(Very often mentioned, but is it correctly quoted?)
Fig. 1.8. Surface streamlines and sea-level isobars (mb, first two digits omitted). Top: January. Bottom: July. Areas with pressure above 1020 mb are shaded; below 1008 mb, hatched.
C. S. RAMAGE’S DEFINITION OF MONSOON

Regions with January and July surface circulations in which:

- Prevailing wind direction shifts by at least 120 degrees between January and July
- Average frequency of prevailing wind directions in January and July exceeds 40%
- Mean resultant winds in at least one of the months exceed 3 m/s
- Fewer than one cyclone-anticyclone alternation occurs every two years in either month in a 5 degree latitude-longitude rectangle
C. S. RAMAGE’S DEFINITION OF MONSOON

• The seasonal wind shifts should not reflect averaging of a shift in the tracks of moving circulations, but rather the replacement of one persistent circulation system by a reverse and equally persistent circulation system
TUTT
(Tropical Upper Tropospheric Trough)

Even more often quoted, but just what is it?

UNDERSTAND THE NATURE OF WEATHER SYSTEMS
Fig. 1. Schematic of trade wind/jet interaction (dashed lines) with the larger scale upper tropospheric circulation (solid lines). STIR is the subtropical ridge; SFR, the sub-equatorial ridge; TUTT, the tropical upper tropospheric trough.

Fig. 2. The mean 250 mb circulation during the period of 13–24 June 1971. Wind speed (kt) shown by dashed lines.
Dean (1956): Climatological summer-time upper level trough over the Pacific west of the Hawaii Islands. (North Pacific trough)

Ramage (1959): Mean summer upper trough from Alaska to Indonesia (not in eastern North Pacific or the North Atlantic). He named it Mid-Pacific trough (MPT).

Sadler (1963): Showed that the summer upper trough is a dominant feature of the entire North Pacific and North Atlantic Oceans.

Aspliden et al (1966): Found the upper trough (August 1963) to be a climatological feature across the North Atlantic from Spain through the Gulf of Mexico.

- Clearly this is a climatological feature. In real-time analysis, how do you know you are looking at a climatological feature and not a synoptic system, or modified by the presence of synoptic systems?
- If they are tropical, why are they only found over the middle of the oceans?
- Could they be the results of zonal asymmetry, i.e. land-sea contrast and related differential heating?
From Prof. T. N. Krishnamurti’s lecture
EQUATORIAL WAVES

(They have been mentioned more often lately)

UNDERSTAND THE NATURE OF WEATHER SYSTEMS
EQUATORIAL WAVES

- Kelvin waves
- Gravity waves
- Rossby waves
- Mix Rossby-Gravity waves
- Madden Julian Oscillation (MJO)

Analytically derived, then verified with observations
PRESSURE AND WIND OF SOME OF THE LOWEST EQUATORIAL NORMAL MODES

Eastward inertia-gravity wave

Rossby wave

Westward mixed Rossby gravity wave

Kelvin wave

T. Matsuno, JMSJ 1966
Madden Julian Oscillation
(MJO)

40-60 day oscillation,
35 day oscillation, etc
Wave number 1, eastward propagating

(Mentioned quite often these days and maybe linked to TC genesis)
Using outgoing longwave radiation (OLR) to identify various equatorial waves

http://www.cdc.noaa.gov/map/clim/olr_modes/hovEa.html
Characteristics of the equatorial waves

http://www.cdc.noaa.gov/map/clim/olr_modes/

Animation of various modes (OLR)

http://www.cdc.noaa.gov/map/clim/olr_modes/indiv_anim10.html

http://www.cdc.noaa.gov/map/clim/olr_modes/hovEa.html
Eastward propagating zonal wind anomalies and convective activities in the EPAC ITCZ MJO or Kelvin waves?
ECMWF 1000 MB WIND
00Z Aug 25-Sep 22, 2011
GFS 1000 MB WIND ANOMALIES

110901/0000 0000 1000 MB WIND (KTS) ANOMALIES FROM 20-DAY MEAN (110801-110820)
GFS 10m ZONAL WIND ANOMALIES
ITCZ CLOUD LINE BECOMES PERTURBED DURING 110917-110920
Note: Easterly anomalies dominated eastern tropical Pacific. Convection in this region was not active. Westerly anomalies was moving past the dateline from the west.
Note: Westerly anomalies moved fast into eastern tropical Pacific. Convection was active along the northern edge of the westerly anomalies.
Note: Westerly anomalies dominated the whole eastern tropical Pacific. Convection was active along the northern edge of the westerly anomalies, including the eastern portion of the east Pacific where it was subdued just two days earlier. Easterly anomalies started moving across the dateline.
1200UTC Sep 19, 2011

Note: Easterly anomalies from the west continued to extend eastward. Convection in the easterly anomalies was inactive.
East Pacific tropical cyclones formed from easterly waves moving westward across the Caribbean and the central America