



2014 Understanding Risk Forum

A world map is shown with numerous blue and orange lines representing tropical cyclone tracks. The tracks are most dense in the tropical regions, particularly in the Atlantic, Indian, and Pacific Oceans. The text 'Tropical Cyclones: Innovation in Analysis and Forecasting' is overlaid on the map in a large, white, bold font.

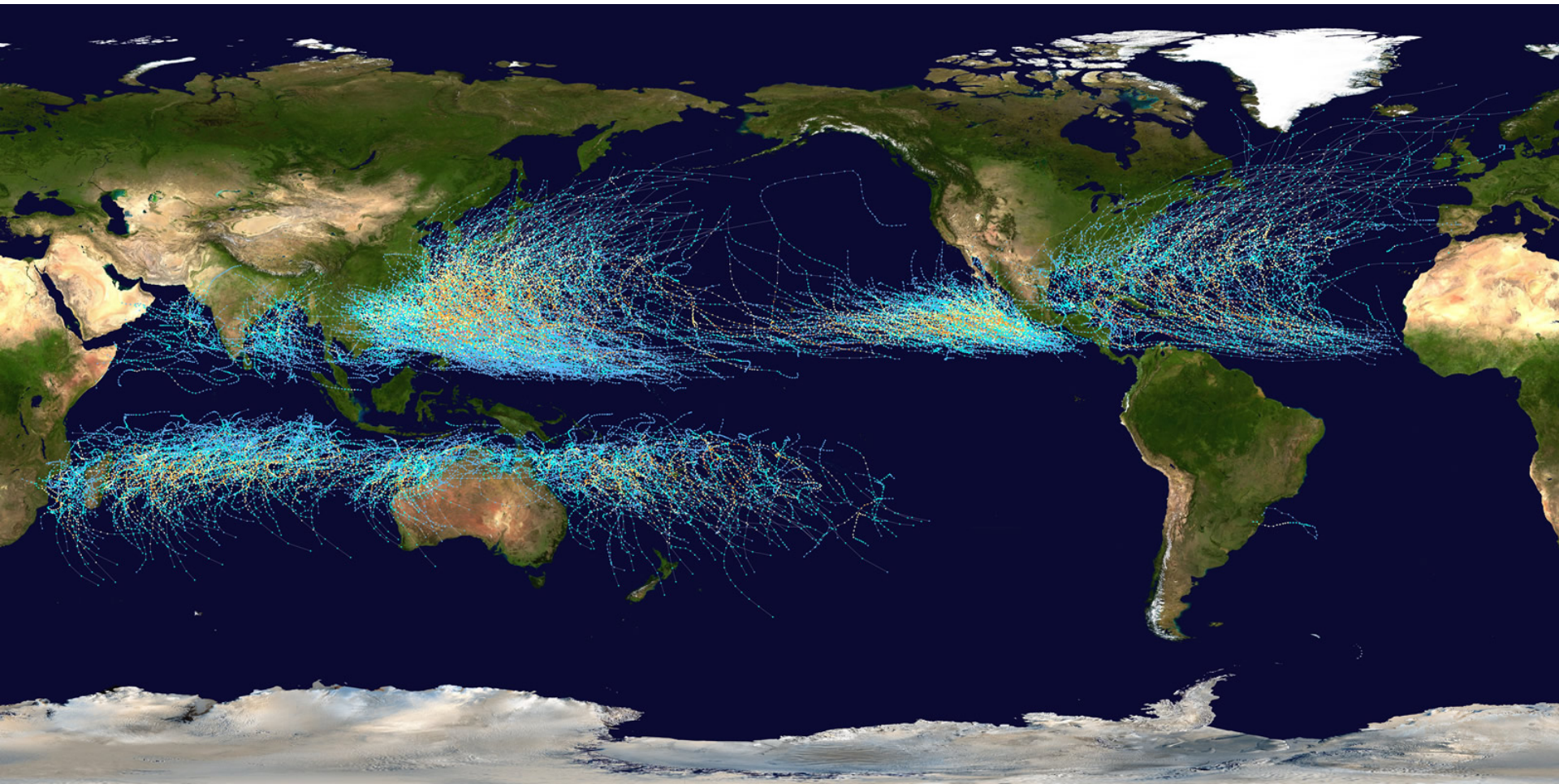
Tropical Cyclones: Innovation in Analysis and Forecasting

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Tropical Cyclone Frequency Map





Tropical Cyclones: Analysis and Forecasting

- Factors that affect the historical records
- Forecasting tools/models and methodologies
- Innovations and challenges



Tropical Cyclone Programme

Defining Tropical Cyclone

“Generic term for a warm-core non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized deep convection and closed cyclonic surface wind circulation.

The term is also used for a storm in the South-West Indian Ocean in which the maximum sustained wind speed is estimated to be in the range of 64 to 89 knots and in the South Pacific and South-East Indian Ocean with the maximum sustained surface wind speed greater than 33 knots.” (WMO 2012a)



Tropical Cyclone Records

High level of dependence on satellites.

Consequence: brevity of useful historical TC record

Changes to observation networks have affected the historical record.

Changes to analysis methods have affected the historical record.



Tropical Cyclone Records

Defining Tropical Cyclone: Variations

Intensity defined by wind – a problematic parameter

Turbulence properties: speed dependent on averaging period.

Mean wind vs gusts

Dependence on exposure and small scale factors.

Wind standards can kill tropical cyclones.



Tropical Cyclone Records

Defining Tropical Cyclone: Variations

Tropical Cyclone Classifications

Wind Speeds (kt)	N Indian Ocean	SW Indian Ocean	SW Pacific & SE Indian Ocean	NW Pacific	N Atlantic & NE Pacific
<28	Depression	Tropical Disturbance	Tropical Depression	Tropical Depression	Tropical Depression
28-33	Deep Depression	Tropical Depression			
34-47	Cyclonic Storm	Moderate Tropical Storm	Tropical Cyclone (1)*	Tropical Storm	Tropical Storm
48-63	Severe Cyclonic Storm	Severe Tropical Storm	Tropical Cyclone (2)*	Severe Tropical Storm	
≥ 64 kt	Very Severe Cyclonic Storm	Tropical Cyclone	Sever Tropical Cyclone (3)*	Typhoon	Hurricane (1)**
		Intense Tropical Cyclone	Severe Tropical Cyclopane (4)*		Hurricane (2)**
		Very Intense Tropical Cyclone	Severe Tropical Cyclone (5)*		Hurricane (3)**
	Super Cyclonic Storm		Hurricane (4)**		

*TC Category System in Australia

**Saffir-Simpson Hurricane Wind Scale (US)



Tropical Cyclone Programme

Tropical Cyclone: Associated Hazards

TC databases typically do not address the associated “sub-hazards”

Storm surge is (most?) often not measured.

Flood from tropical low vs flood from TC. Does it matter?

Complex causality of floods.

Remote hazards – eg tornadoes, landslides



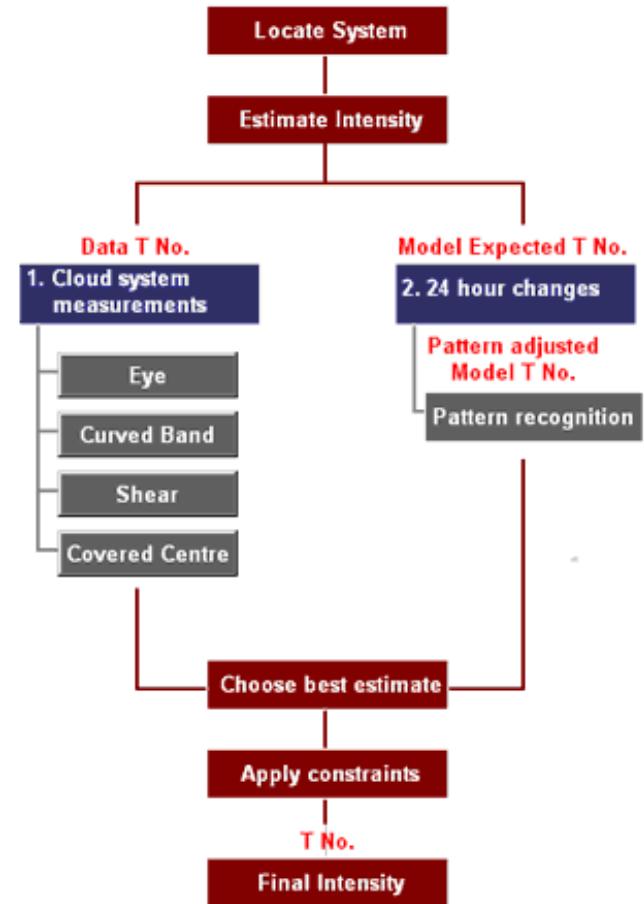
Tropical Cyclone Records

Analysis techniques

Analysis of TC characteristics

Prior to the satellite era – unreliable, incomplete.

Dvorak technique – the foundation of TC databases



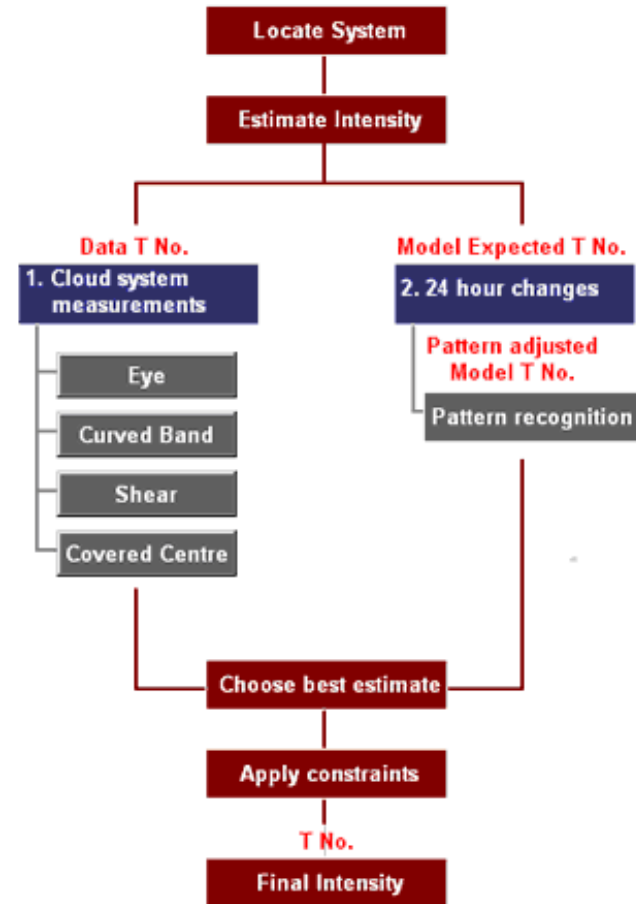


Tropical Cyclone Programme

Analysis techniques

Dvorak Technique

1. Determine CI
2. Map CI to wind
3. Map wind to pressure





Tropical Cyclones: Improving records

Improving the historical record

- Individual agency reanalysis efforts
- International Best Track Archive for Climate Stewardship (IBTrACS)
- International Workshop on the Satellite Analysis of Tropical Cyclones (IWSATC)
- International Workshop on Tropical Cyclones (IWTC)



Tropical Cyclones: Improving records

International Best Track Archive for Climate Stewardship

- Commenced 2009 – “a game changer”
- All agency data provided to IBTrACS
- Global coverage, standardisation.
- IBTrACS team deal with different formats from the agencies.



Tropical Cyclones: Improving records

International Workshop on the Satellite Analysis of Tropical Cyclones (IWSATC)

Documenting variations in the Dvorak technique:

- over time
- across agencies

Looking for sources of systematic bias:

- due to variations in application of the technique
- due to use of different CI->wind->pressure relationships



Tropical Cyclones: Improving records

WMO International Workshop on Tropical Cyclones (IWTC)

Quadrennial series of workshops designed to bring tropical cyclone research and operational communities together with the overall aim of improving tropical cyclone warning services



Tropical Cyclone Forecasting

Tools and methodologies

Track forecasting

- well defined process, consensus forecasting.
- steady improvement.

Intensity forecasting – on the threshold of a breakthrough?

Structure – not well measured, forecast or verified

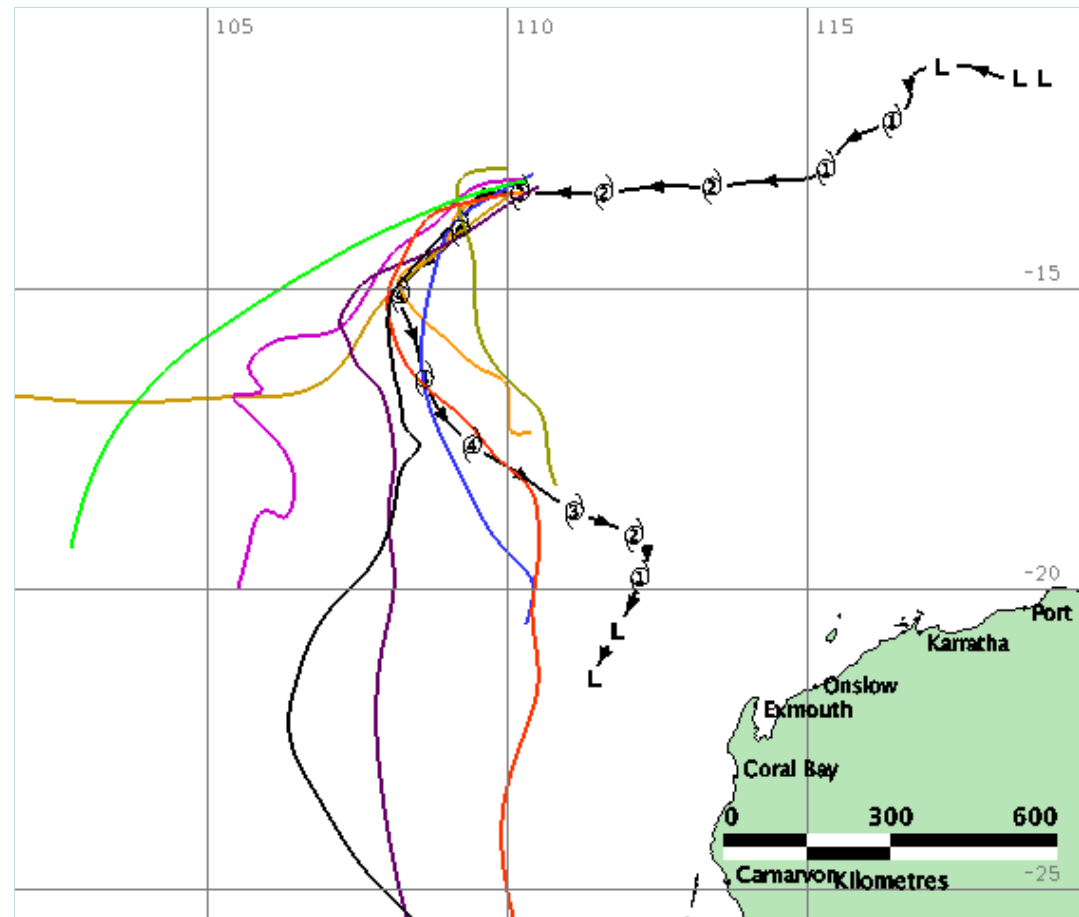


Tropical Cyclone Forecasting

Consensus track forecasting: "Multi-model"

Process:

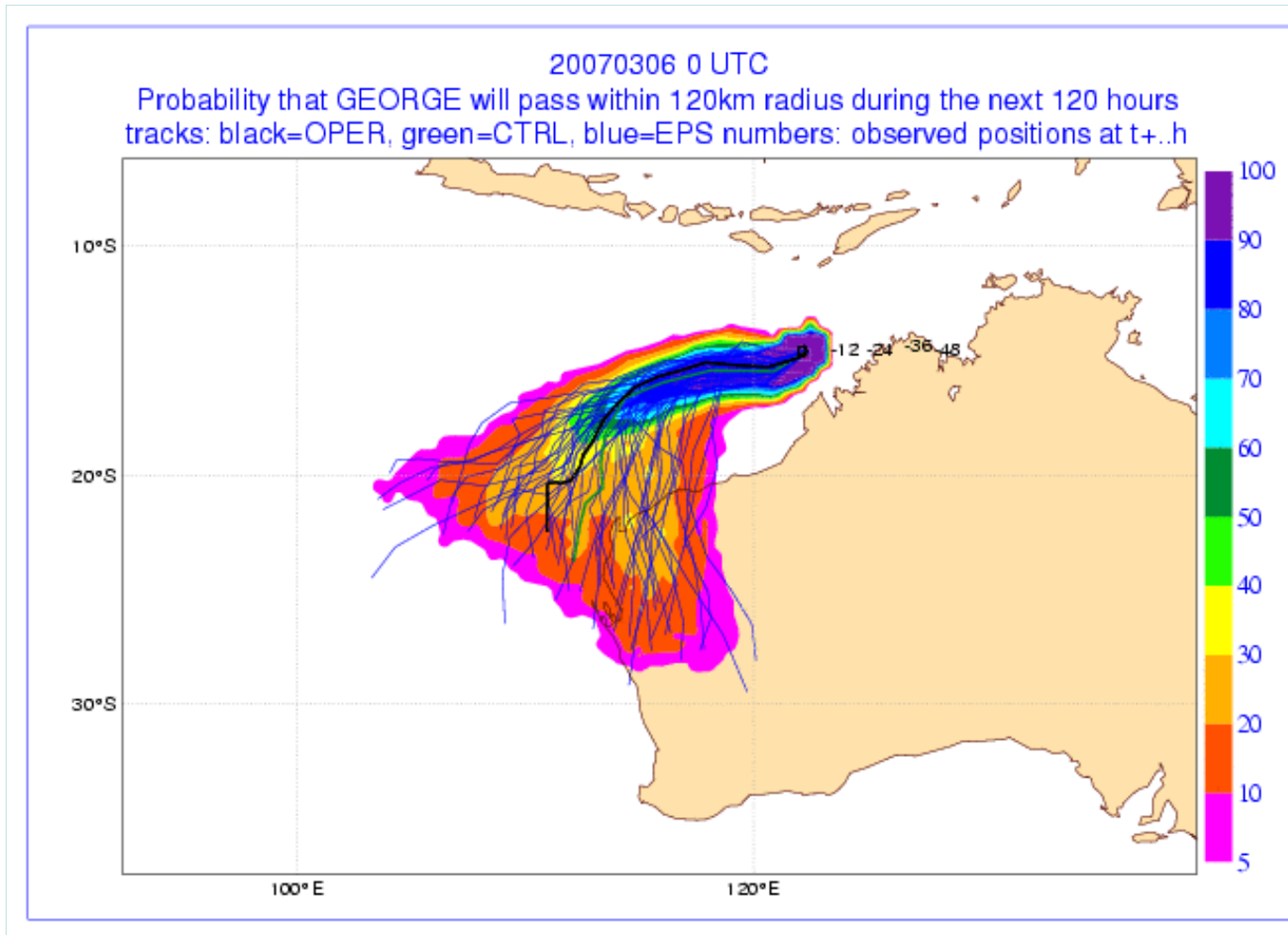
- Acquire tracks
- Perform initial position correction
- Interpolate tracks
- Combine tracks





Tropical Cyclone Forecasting

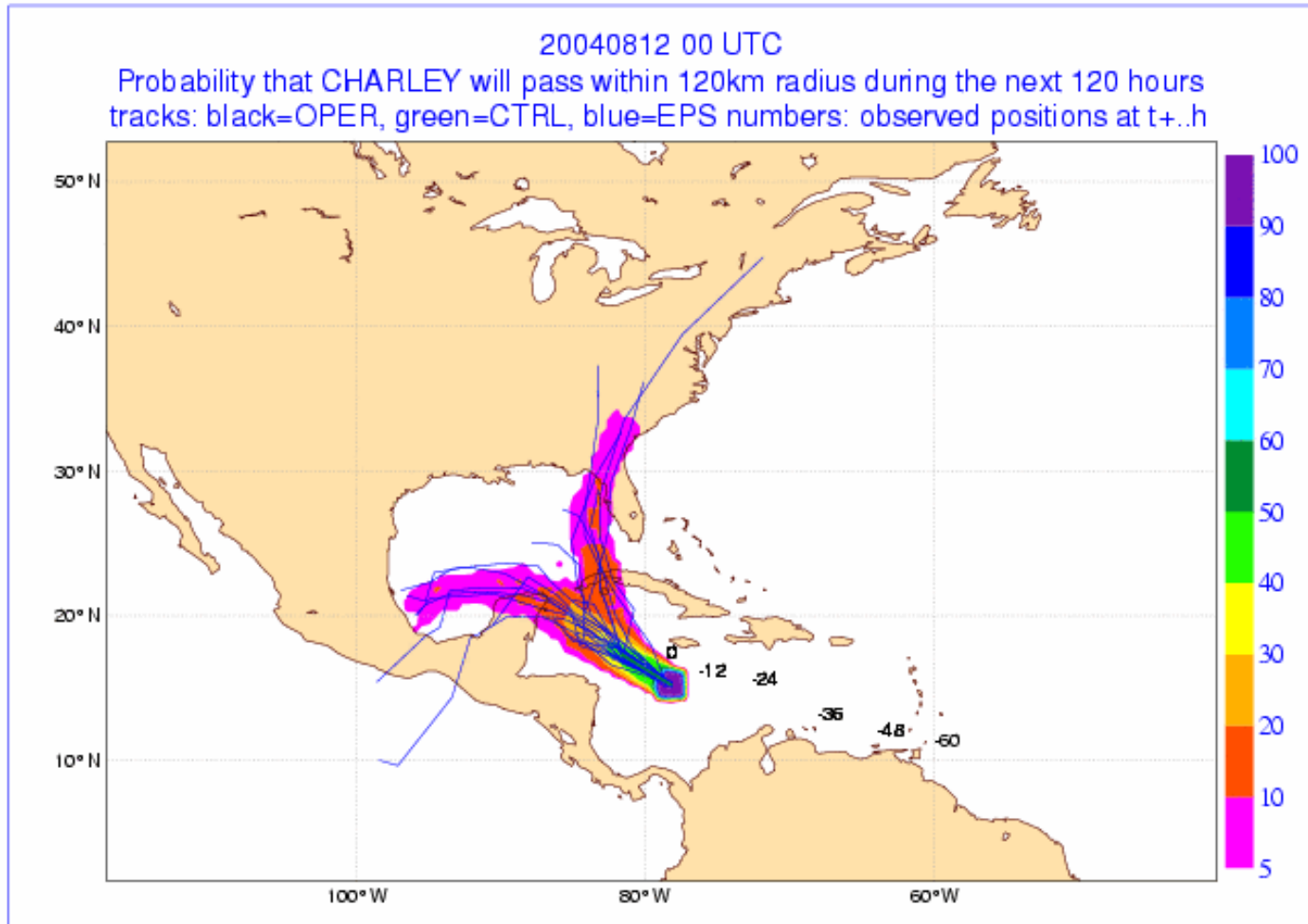
Consensus track forecasting: EPS





Tropical Cyclone Forecasting

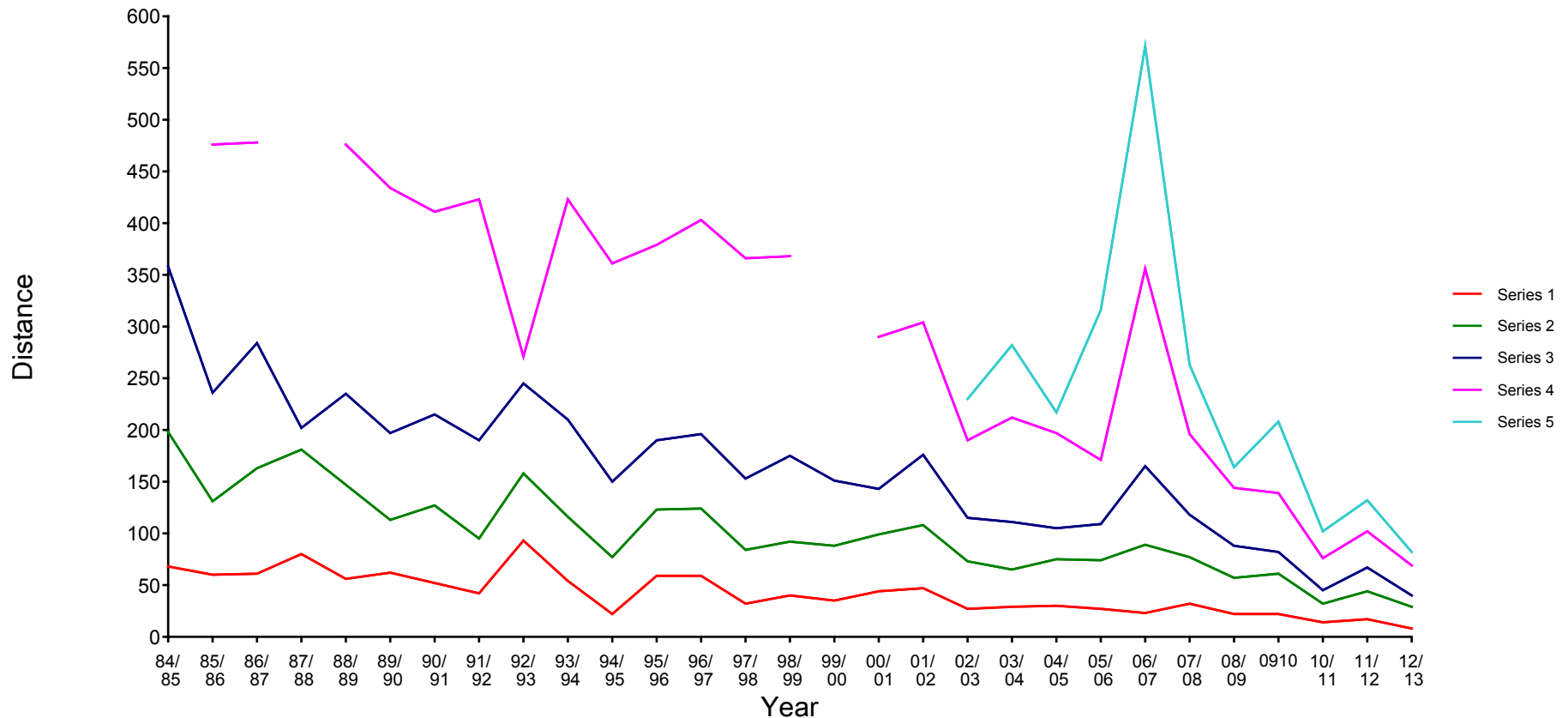
Consensus track forecasting: EPS





Tropical Cyclone Forecasting

Track forecasting improvement





Tropical Cyclone Forecasting

Future improvements

Better satellite observations

Model resolution improvements

Model physics improvements

Improved intensity forecast process

Improved communication of risk



Tropical Cyclone Forecasting

Ongoing challenges

Intensity and structure forecasting

Verification

Improved communication:

- uncertainty in forecasts
- community risk



Thank you



Tropical Cyclone Forecasting

text