# MARITIME WARNINGS and GUIDELINES: STORM SURGE EARLY WARNING SYSTEM FOR SOUTH AFRICA


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- Marine Heritage
- What if?
- RMS Titanic and birth of International Convention of SOLAS
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- Alerts and evaluation
- Way forward
- Acknowledgements

# Marine and Climate Change

Reduction of ice shelf‘s

Antarctica is losing about 36 cubic miles (150 cubic km) of ice/y

Comparison - Los Angeles consumes roughly 1 cubic mile of fresh water/y

The south polar region holds 90 percent of Earth’s ice and 70 percent of the total fresh water on the planet, so any significant pace of melting there is important and could contribute to an already rising sea.

"This is the first study to indicate the total mass balance of the Antarctic ice sheet is in significant decline,“

33 Cities below sea level

Beaches along West Africa retreat 1-2m per annum but sporadic 20-30 meters

Interaction between Oceans and Atmosphere

# South African Maritime Heritage

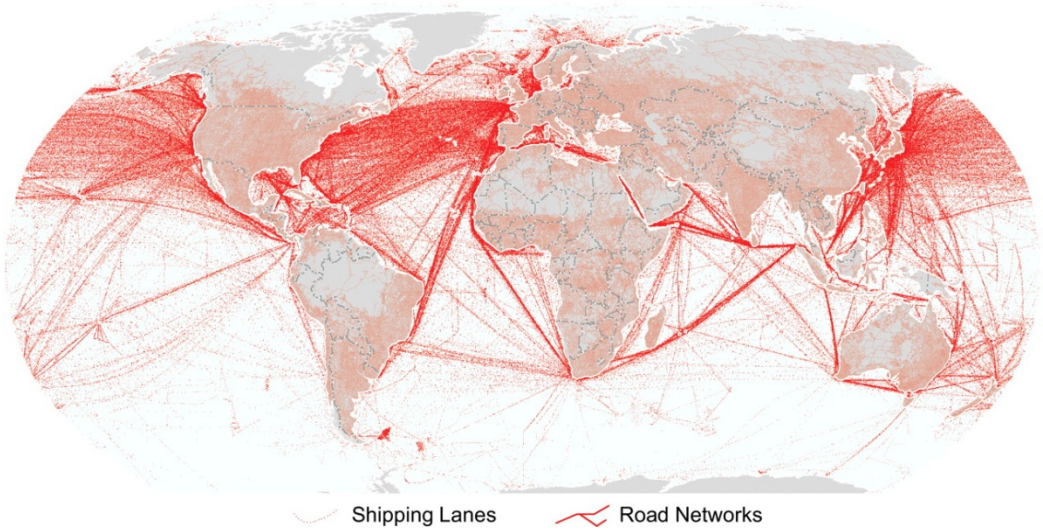
- The modern history of South Africa is closely bound up with the economic and colonial expansion of Europe into the rest of the world after the 15th century. Straddling what was, until the opening of the Suez Canal in 1869, the most viable sea route between Europe and the markets, the southern tip of Africa was pivotal to global politics, trade and economy.

- Since Portuguese explorers rounded the southern tip of Africa more than 500 years ago in their quest for a sea-route to the East, thousands of ships of many nationalities have circumnavigated our rugged and extensive coastline. For a variety of reasons - both human and natural - shipping casualties on the South African coast were frequent. Archival research has already identified more than 2700 vessels known to have been lost around our coast since 1500, and indications are that further research will increase the number of known maritime casualties in our waters to nearer 3000.

- These wrecks include vessels from 37 different nations, and can provide a wealth of information about the Portuguese explorers, the Dutch, English and French East India Companies, the British Royal Navy, 19th century passenger and mail shipping services and World War I and II shipping. **Of local interest are the coasting vessels associated with fishing, whaling, mining, agriculture and other growing needs in South Africa, particularly during the last century**.

# What if?

- 97% of trade
- 56% of GDP
- 24/7
- Second Largest Marine area
- Limited Marine Infrastructure
- Accuracy 90%
- Availability 99%
- WMO and IMO criteria's
- Currently 35 qualified employees
- **You join the SAWS**




South African Weather Service

World Meteorological Organization
Working together in weather, climate and water

# RMS Titanic

**Wednesday**
**10 April 1912**

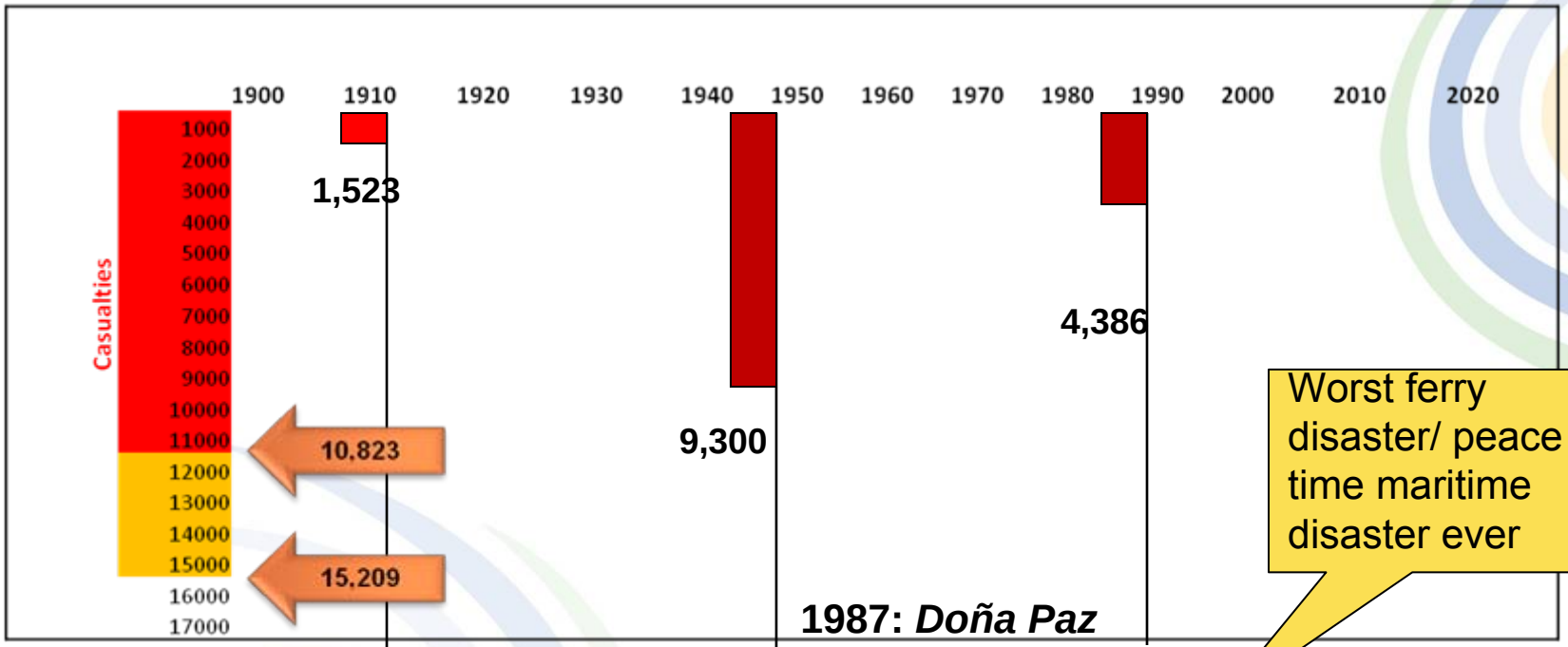
The RMS *Titanic,* the largest ship afloat (*at the time*), left Southampton, England on her maiden voyage to New York City via the Atlantic Ocean. Passenger load of 2,240.

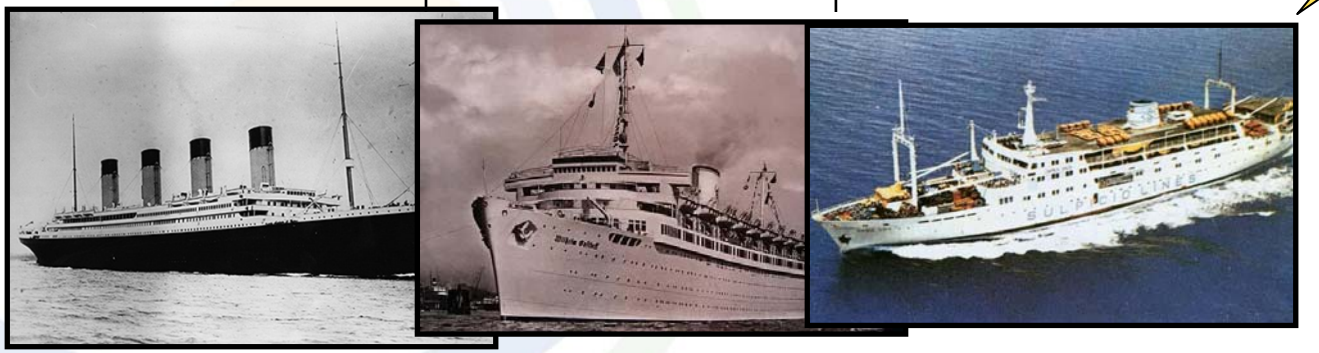
**02:30 Titanic Sinks with 1,523 lives lost**

**Sunday**
**14 April 1912**

**23:45**
**voya**

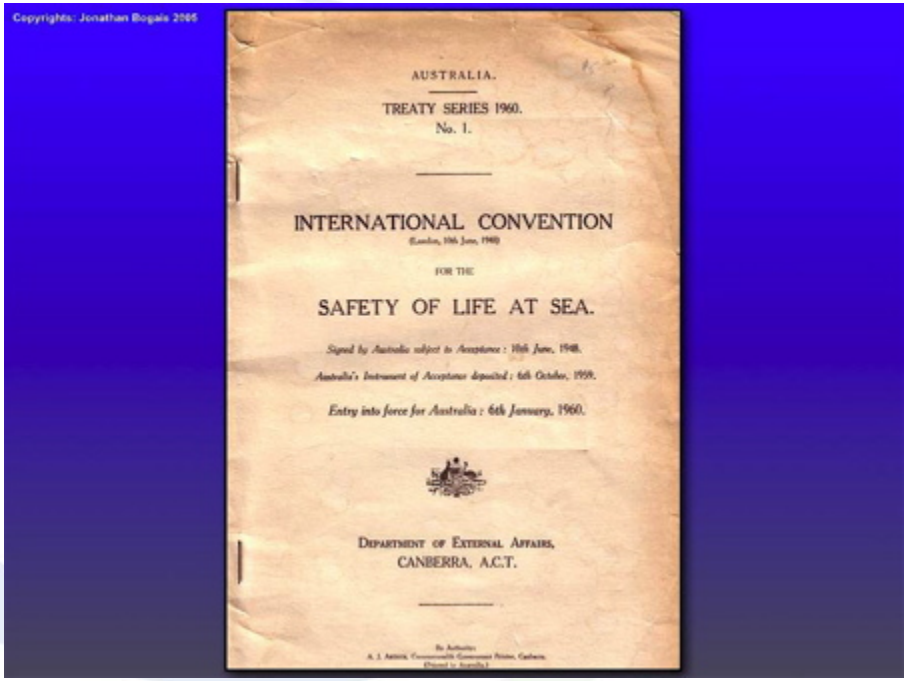
# Notable Maritime Disasters of the 20th Century

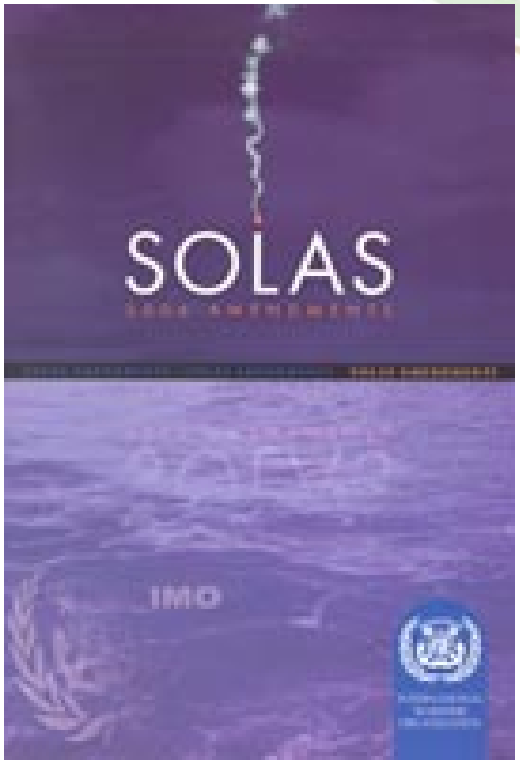


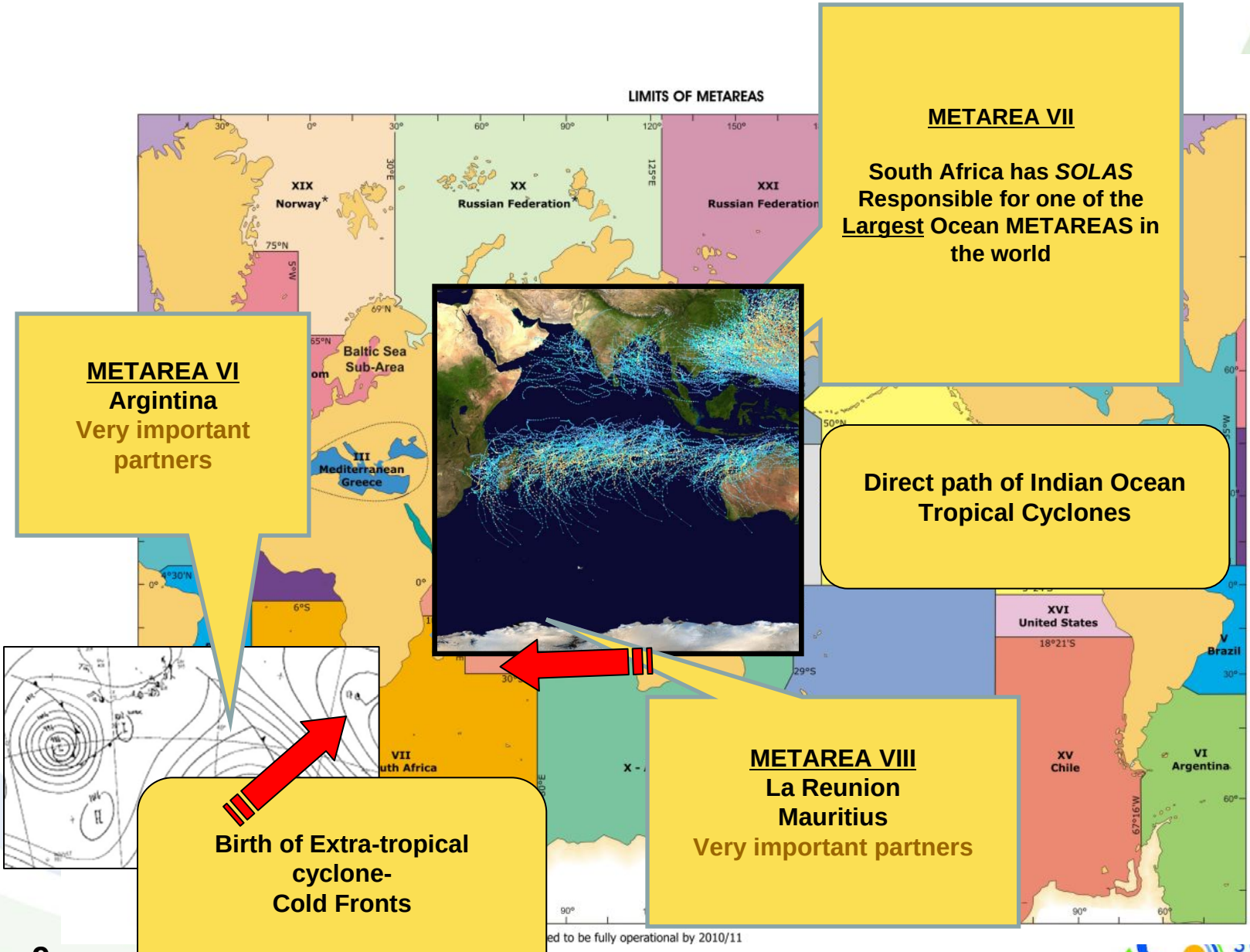
# History

- The International Convention for the Safety of life at sea, (SOLAS).
- SOLAS = The most important international Treaty dealing with Maritime Safety; and one of the oldest of its kind.
- 1st Treaty 1914 after RMs Titanic sank
- Various versions 1929, 1948, 1960, and **1974**



# `Where is METAREA VII



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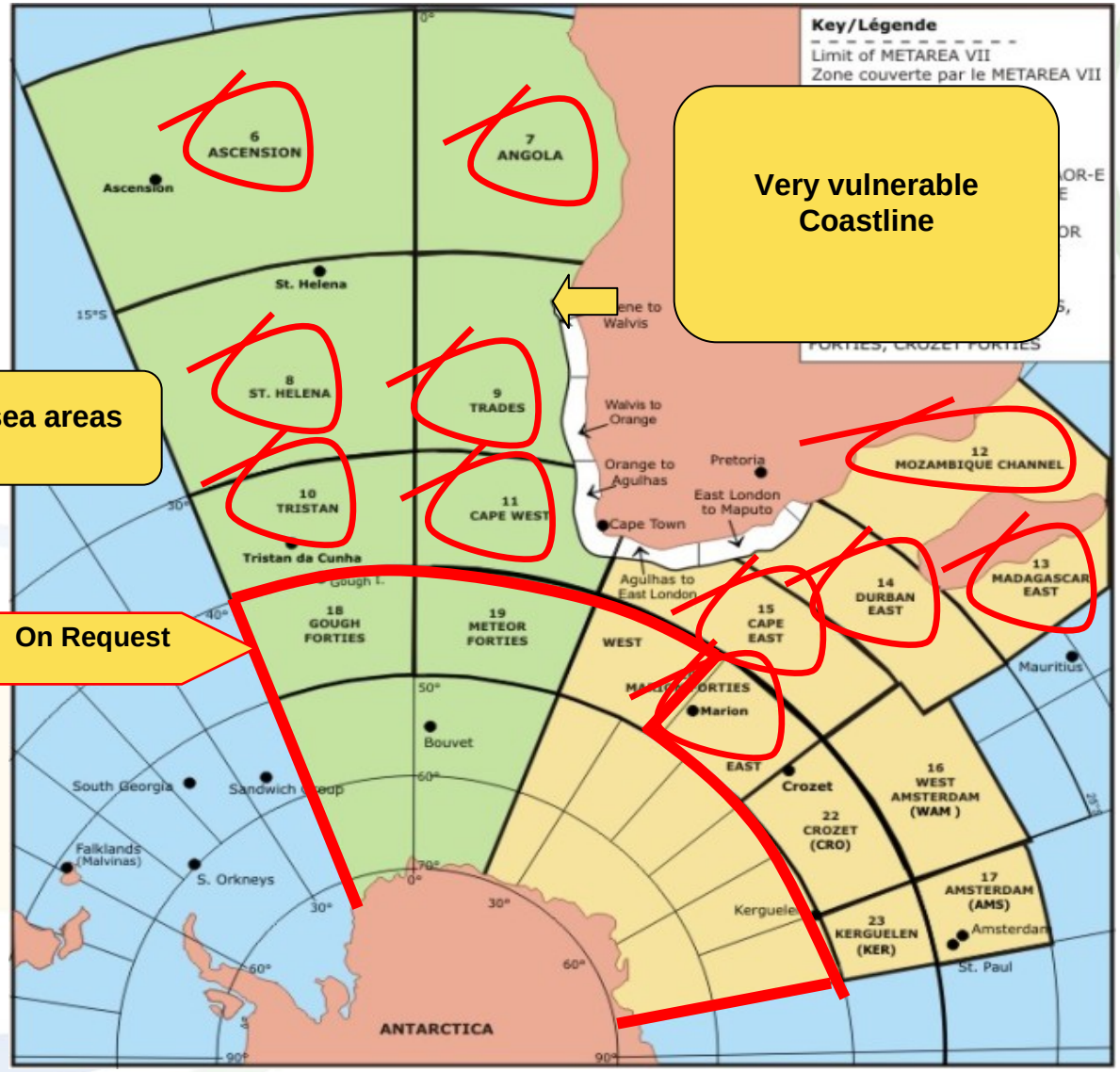
South African Weather Service

# Why are we looking at the Southern Oceans and Antarctica


African Weather Service

# SAWS Responsibility





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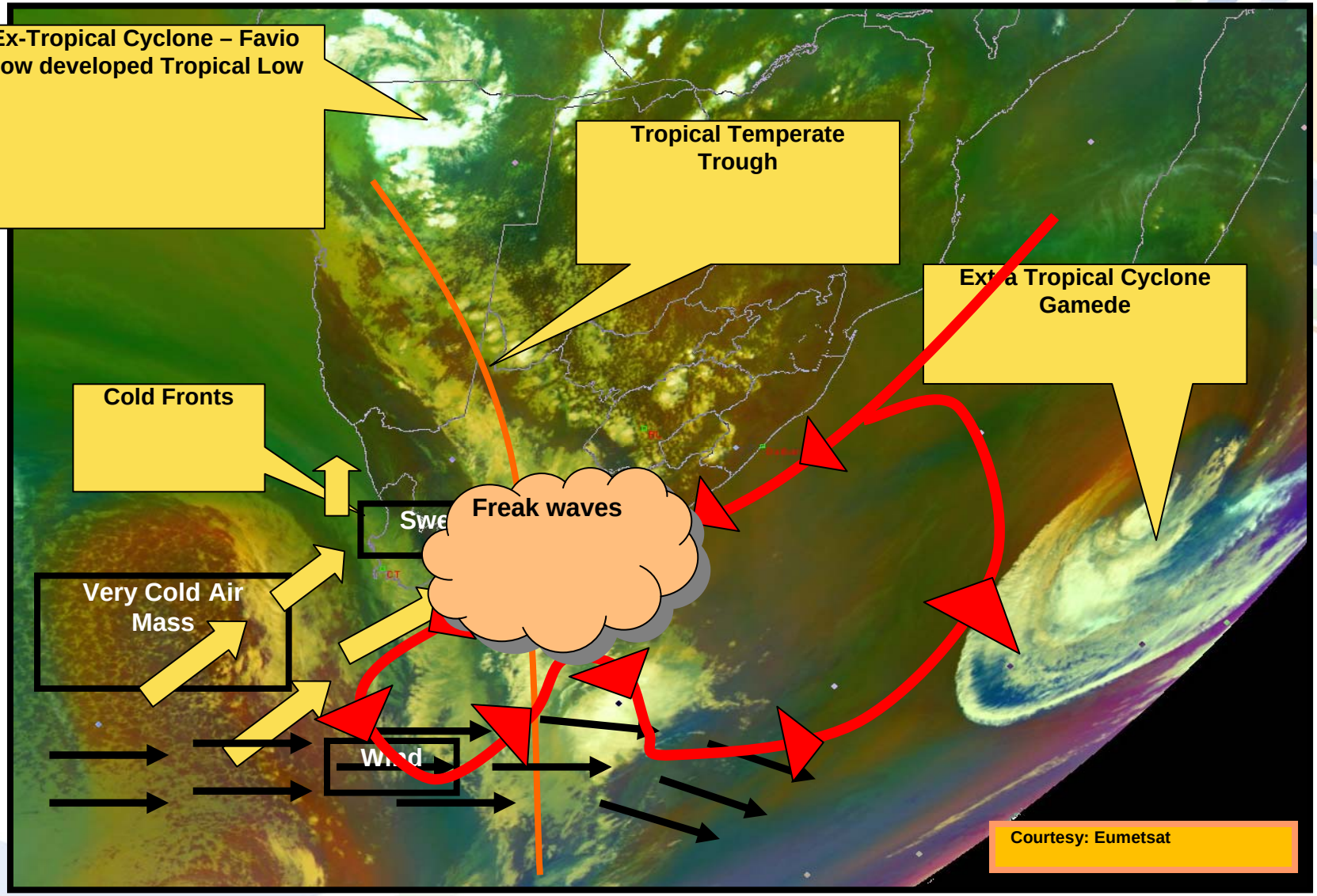
South African Weather Service

# What makes our area so Special



# Types of warnings

Heavy swell over 4m

Definition

Heavy swell greater than 4m with a period of at least 10s.

Very rough seas

Definition

Total sea in excess of 4m – 6m

High seas

Definition

Total sea in excess of 6m - 9m

Very high seas

Definition

Total sea in excess of 9 to 14m

# Types of warnings

Phenomenal seas

Definition

Total sea in excess 14m


Abnormal waves in the Agulhas Current:

Definition

Total sea greater than 5m with long period south westerly swell dominating.

Tz > 10s (Zero crossing period)

Tp > 15s (Peak energy period)

# Types of warnings

Gale force winds

Definition

Ave. wind speed of Gale Force of 35 – 40 knots (i.e. “exceeding 34 Knots”)


Strong Gale winds

Definition

Ave. wind speed of Strong Gale Force of 41 – 47 knots

Storm strength winds

Definition

Average wind speed of Storm strength of 48 – 55 knots

Violent storm strength winds

Definition

Average wind speed of Violent Storm strength of 56 – 63 knots

# Types of warnings

Hurricane strength winds

Definition

Average wind speed of Hurricane strength of 64 knots and more

Tropical cyclone

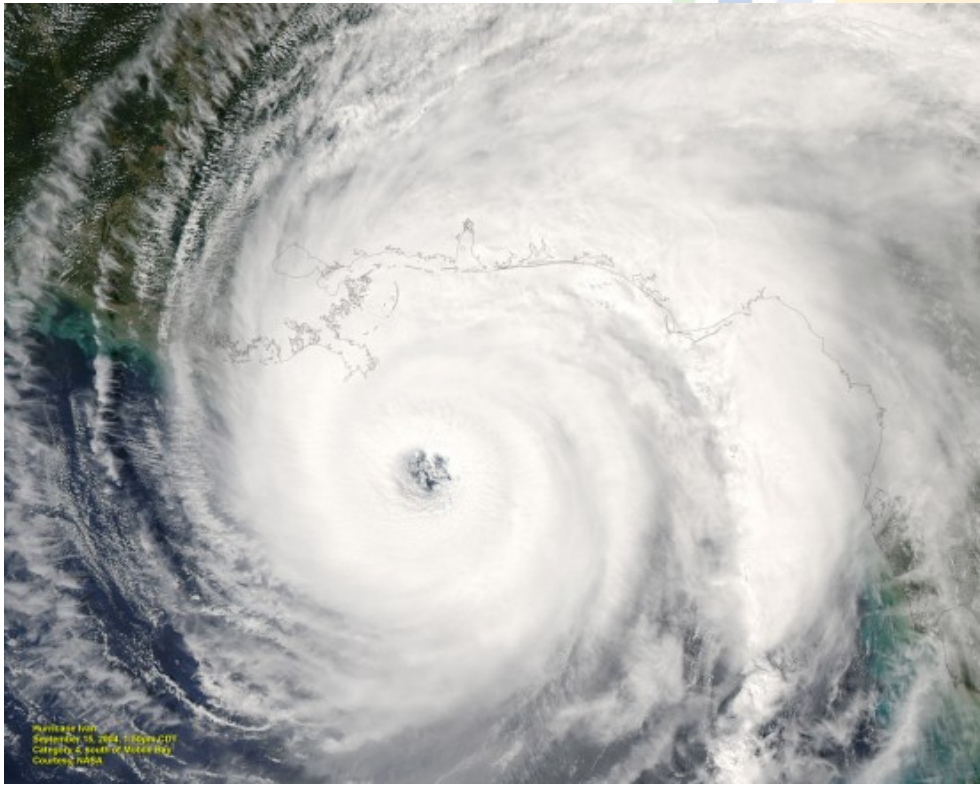
Definition

A Tropical cyclone as defined by RSMC La Reunion

Tropical storm

Definition

A Tropical storm with wind speeds in excess of 47knots



Ice accretion

Definition : Accumulation of ice on ships as a result of freezing sea spray/precipitation in sub zero conditions

# Types of warnings

Reduced visibility

Definition

When the visibility is expected to be less than 5 nm (10 km)

(1nm = 1.852km)

***STORM SURGES?***

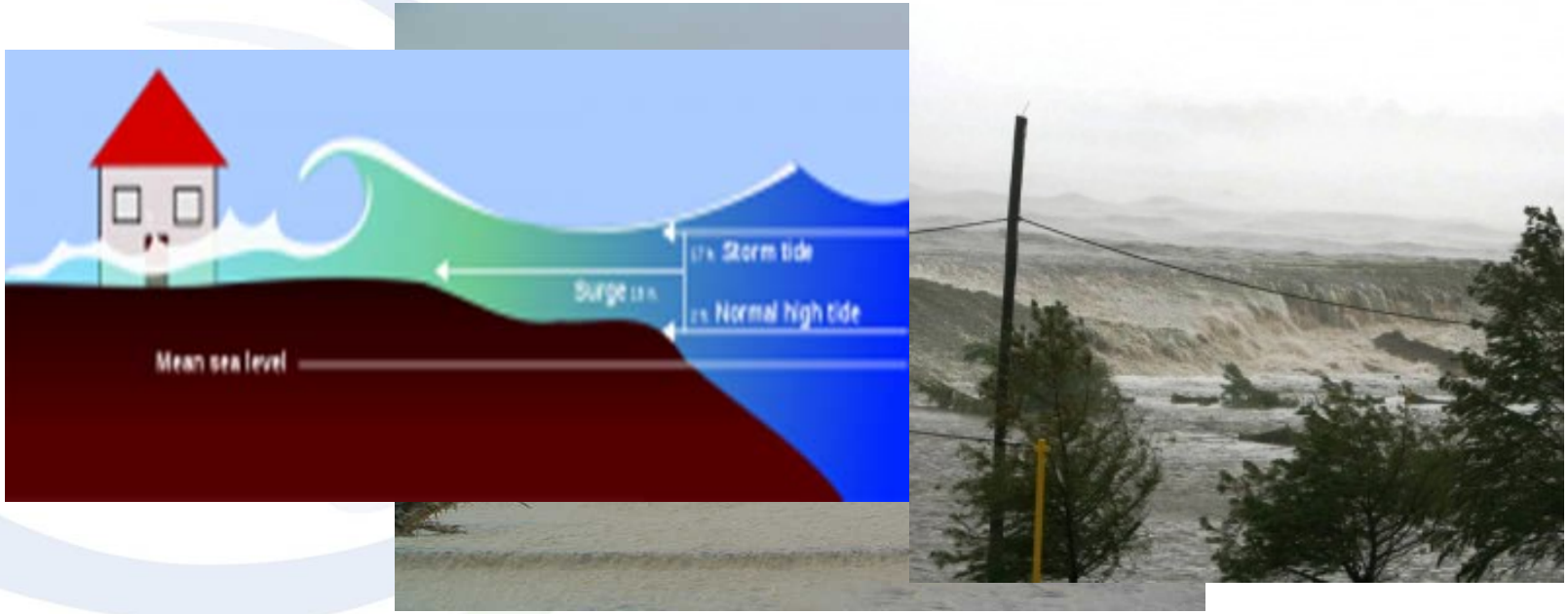
| | Type | |
|---|---|---|
| Moderate | 2nm – 5nm | ( 4km – 10km) |
| Poor | 0.5nm – 2nm | ( 1km – 3.9km) |
| Very poor | Less than 0.5nm | ( 1 km ) |

# Background

- DEA workshop February 2011 on Storm Surges
- Climate Change impacts on African Coastal Communities

Storm Surge Definition:

***An abnormal rise of the sea level generated by a storm, over and above the astronomical spring high tides***



# Extreme events are predicted to increase in both frequency and intensity

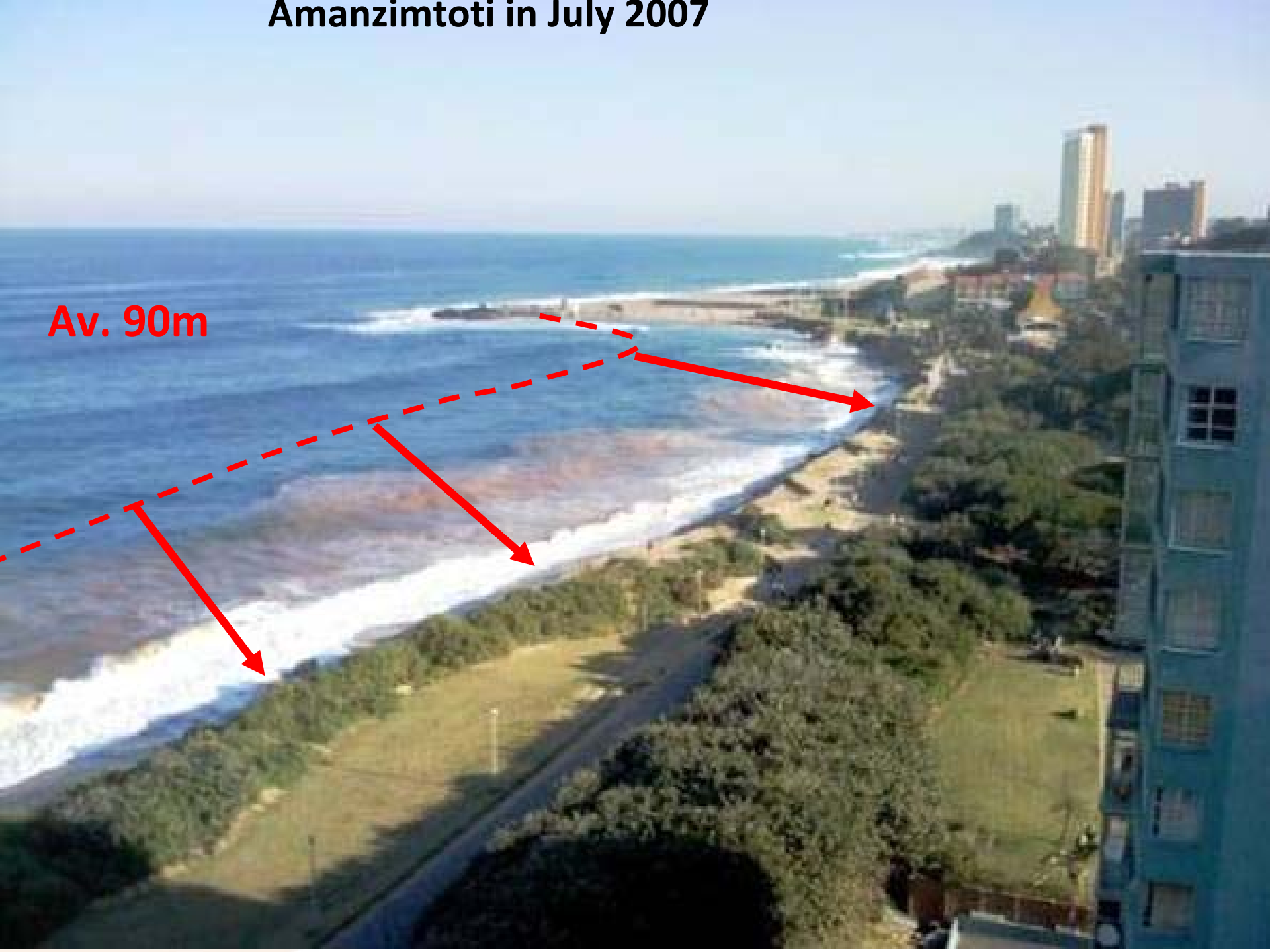


MAERSK
SEALAND


1970
2007

Amanzimtoti in Jan 2007

Amanzimtoti in July 2007

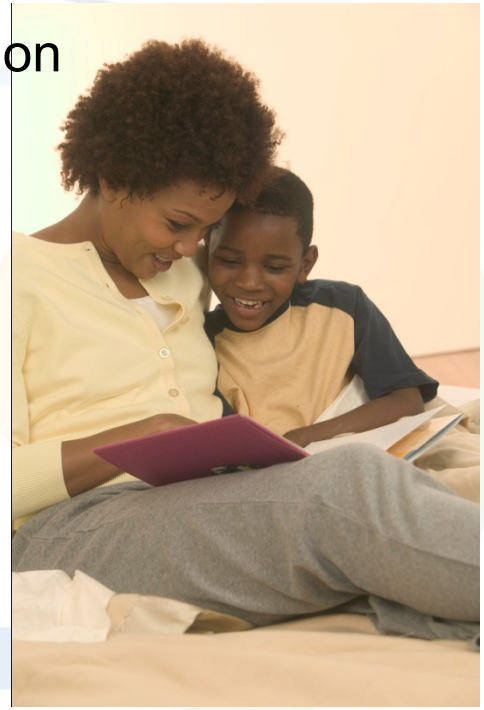


# SCOPE

Reference document on the guidelines for the issuing of storm surge alerts

# Objective

- Standardise the procedures and processes for the issuing of storm surge alerts in line with standard processes of the multi-hazard early warning system as applied in South Africa.
- Act as a guideline for the dissemination and communication of such information



# Mandates and Roles relevant to Storm Surge Alerts

## South African Weather Service (SAWS)

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- Di e (but no
- The National, Provincial, Local Government and NGO's

# Mandates and Roles relevant to Storm Surge Alerts

## Disaster Management (DM)

- Dissemination of the alert to

  The National, Provincial, Local Government and NGO's

  All potentially affected members of the public

  Councillors and Traditional leaders

- Risk and vulnerability identification and implementation of mitigation measures
- Development of awareness and educational programs in conjunction with other relevant organisations
- Development and ongoing assessment of management plans

# Mandates and Roles relevant to Storm Surge Alerts

## Council for Scientific and Industrial Research (CSIR),

- Monitoring and exchanging of relevant met-ocean in situ data and information
- Storm surge research
- Collaborate with SAWS and other institutions regarding the development of a storm surge model

CSIR
our future through science

# Mandates and Roles relevant to Storm Surge Alerts

## South African navy Hydrographic Office (SANHO)

- Updated astronomical tide information

# Criterea for issuing Storm Surge Alerts

- Definition: ***"An abnormal rise of the sea level generated by a storm, over and above the astronomical spring high tides."***
- Astronomical spring high tide conditions, when the water level is expected to be between 0.8 and 1.0 metres above the mean level of tides along the coast
- A deep-sea significant wave height of at least 3 metres
- This would typically be associated with:
  - The passage of a well-established or deep cold front (mid latitude cyclone).
  - The presence of a slow moving tropical or extra tropical surface low pressure system below 1004 hPa in close proximity to the coast.
  - Rapid cyclogenesis of a deep low pressure system.

# Criterea for issuing Storm Surge Alerts

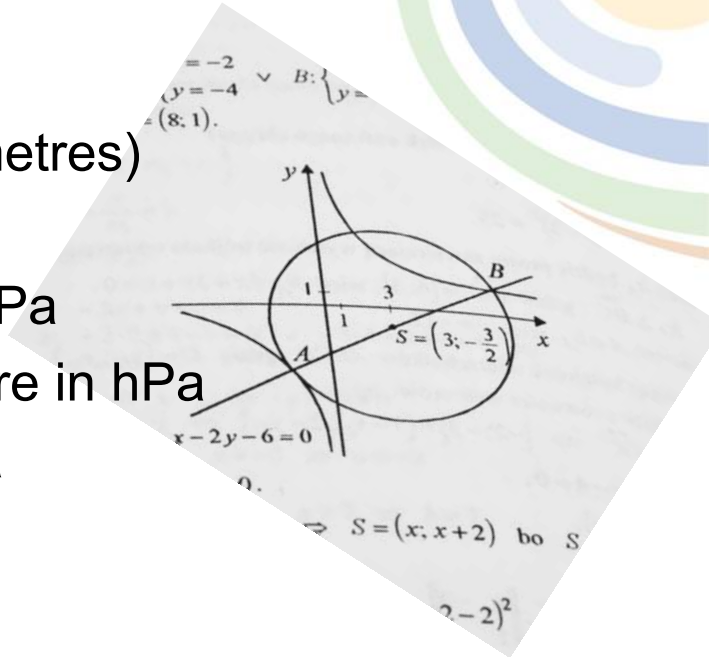
- The effect of the waves approaching the shore:  An approach, described by Goda (2000) is applied to estimate the increase in the water level as a result of wave setup.

- The effect of the local atmospheric conditions:  The atmospheric setup is taken into account by using the inverse barometer approximation which translates to an increase of about 1cm for every 1hPa decrease in atmospheric pressure. This will compensate for wind as well as pressure, (Van Ballegooyen, 1995).

# Criterea for issuing Storm Surge Alerts

- $\triangle S = H'_0 * Ws + (P_1 - P) * C$

- $\triangle S$ = Storm Surge Value in metres
- $H'_0$ = [1]Equivalent significant wave height (metres)
- Ws = [2]Wave setup factor
- P1 = Average sea level pressure of 1013 hPa
- P = Forecast / Observed sea level pressure in hPa
- *C* = Inverse barometer ratio in cm per hPa




- $H'_0$ = Kr * Hs (metres)

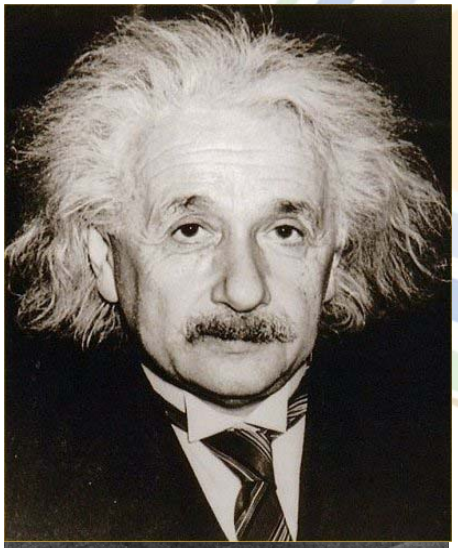
# Criterea for issuing Storm Surge Alerts

*Simplified refraction coefficients (Kr) for regions around South African coast*

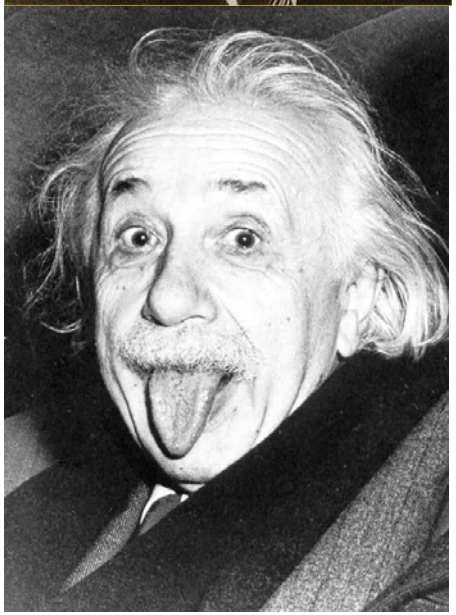
| Wave direction | | Coastal region | | | | |
|---|---|---|---|---|---|---|
| | | West | South-west | South | South-east | East |
| | | Port Nolloth to Cape Town | Cape Town to Cape Agulhas | Cape Agulhas to Cape St Francis | Cape St Francis to East London | East London to Ponta do Ouro |
| NW | (315.0°) | 0.74 | - | - | - | - |
| WNW | (292.5°) | 0.88 | 0.74 | - | - | - |
| W | (270.0°) | 0.95 | 0.78 | 0.50 | - | - |
| WSW | (247.5°) | 0.98 | 0.88 | 0.74 | - | - |
| SW | (225.0°) | 0.95 | 0.96 | 0.88 | 0.74 | - |
| SSW | (202.5°) | 0.83 | 0.96 | 0.95 | 0.83 | 0.74 |
| S | (180.0°) | 0.74 | 0.93 | 0.97 | 0.93 | 0.83 |
| SSE | (157.5°) | - | 0.83 | 0.95 | 0.97 | 0.93 |
| SE | (135.0°) | - | 0.74 | 0.88 | 0.96 | 0.97 |
| ESE | (112.5°) | - | - | 0.74 | 0.88 | 0.95 |
| E | (90.0°) | - | - | 0.50 | 0.78 | 0.88 |
| ENE | (67.5°) | - | - | - | 0.50 | 0.83 |
| NE | (45.0°) | - | - | - | - | 0.50 |

# Criterea for issuing Storm Surge Alerts

- Ws = 0.13 for Tp ≤ 11 s
  = 0.15 for 11 s < Tp ≤ 12 s
  = 0.16 for Tp > 12 s



- $\triangle S = H'_0 * Ws + (P_1 - P) * C$ *(1)*
- $H'_0 = Kr * Hs$ (metres) (2)
- Ws = 0.13 for Tp ≤ 11 s (3)
  = 0.15 for 11 s < Tp ≤ 12 s
  = 0.16 for Tp > 12 s



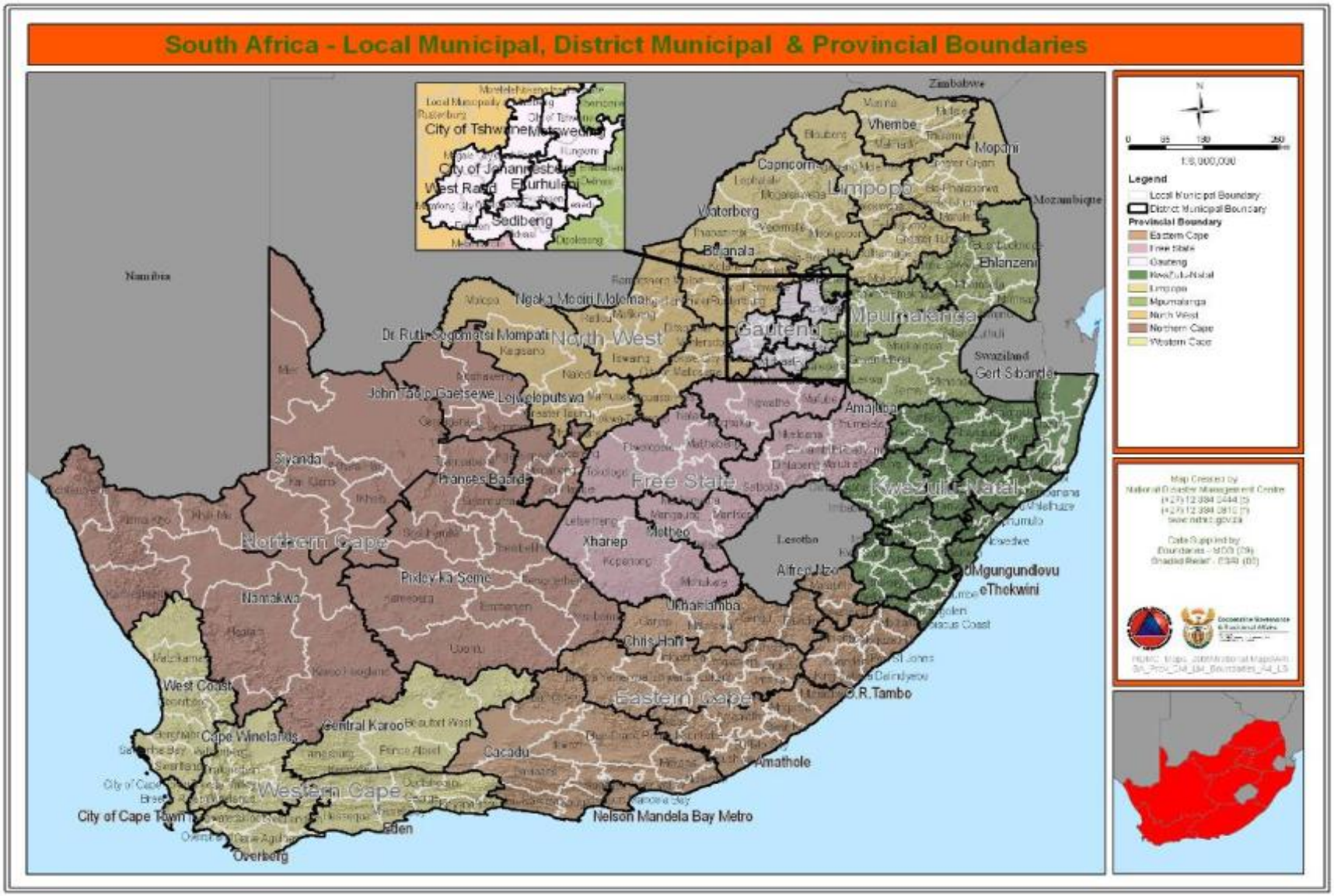
# Conclusion on -Criterea for issuing Storm Surge Alerts

- Hs > 3 metres,
- △S can exceed 0.5m
- Astronomical spring high tide
- Actual level of the spring high tide + Storm Surge Value > 1.3m
- = Storm Surge Alert should be issued.

- Offshore wave height > 3 metres
- Spring high tide
- Storm Surge Value > 0.5 m
- = Storm Surge Alert

**4am and 4pm on the day.**

# Process Flow for Storm Surge Alerts



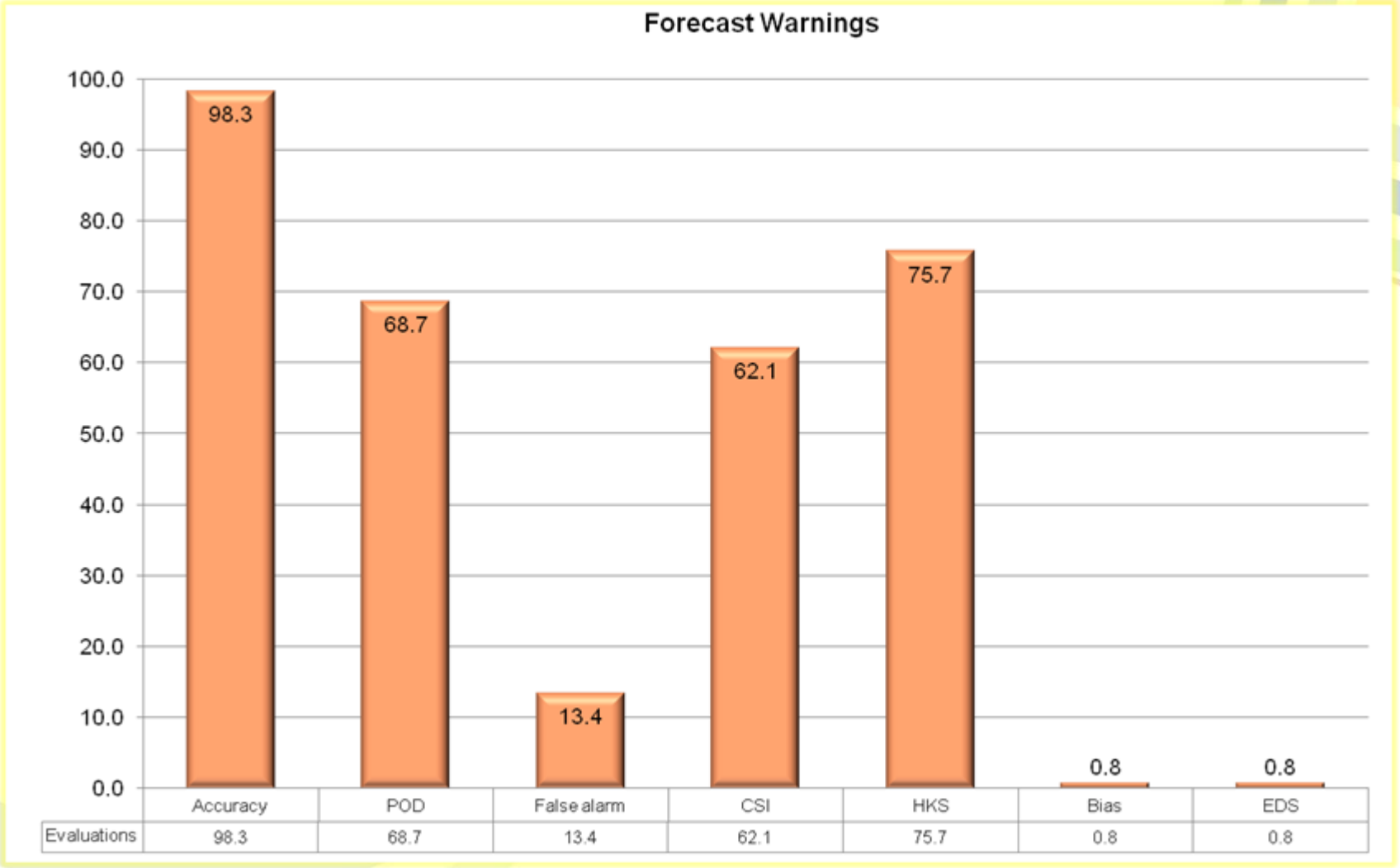
# Types of Alerts

| ***Alert Level*** | ***No Alert*** | ***Advisory*** | ***Watch*** | ***Warning*** |
|---|---|---|---|---|
| | | Be Aware! | Be Prepared! | Take Action! |
| Threat | No hazardous weather expected in next few days | Early warning of *potential* hazardous weather | Weather conditions are *likely to deteriorate* to hazardous levels | Hazard is *already occurring* somewhere or is *about to occur with a very high confidence* |
| Risk | No adverse weather is expected | A risk that adverse weather conditions may occur | Moderate risk that adverse weather conditions will occur | Very high risk, about to happen, or already happening |
| Impact | | A risk of damage to infrastructure and disruption, dangerous to people and communities | Moderate risk of damage to infrastructure and disruption, dangerous to people and communities | High risk of damage to infrastructure and disruption, dangerous to people and communities |
| Advice | | Be alert and follow the latest weather forecasts. | Be vigilant and follow the latest weather forecasts. | Be extra vigilant of dangerous conditions and follow the advice given by authorities. |
| Timescale | | 2 to 6 days period | 1 to 3 day period | Within next 24 hours |

# How to determine Accuracy

| | |
|---|---|
| **Forecasted and Observed/Reported** | **Not Forecasted but Observed/Reported** |
| Forecasted but not Observed/Reported | Not Forecasted and not Observed/Reported |

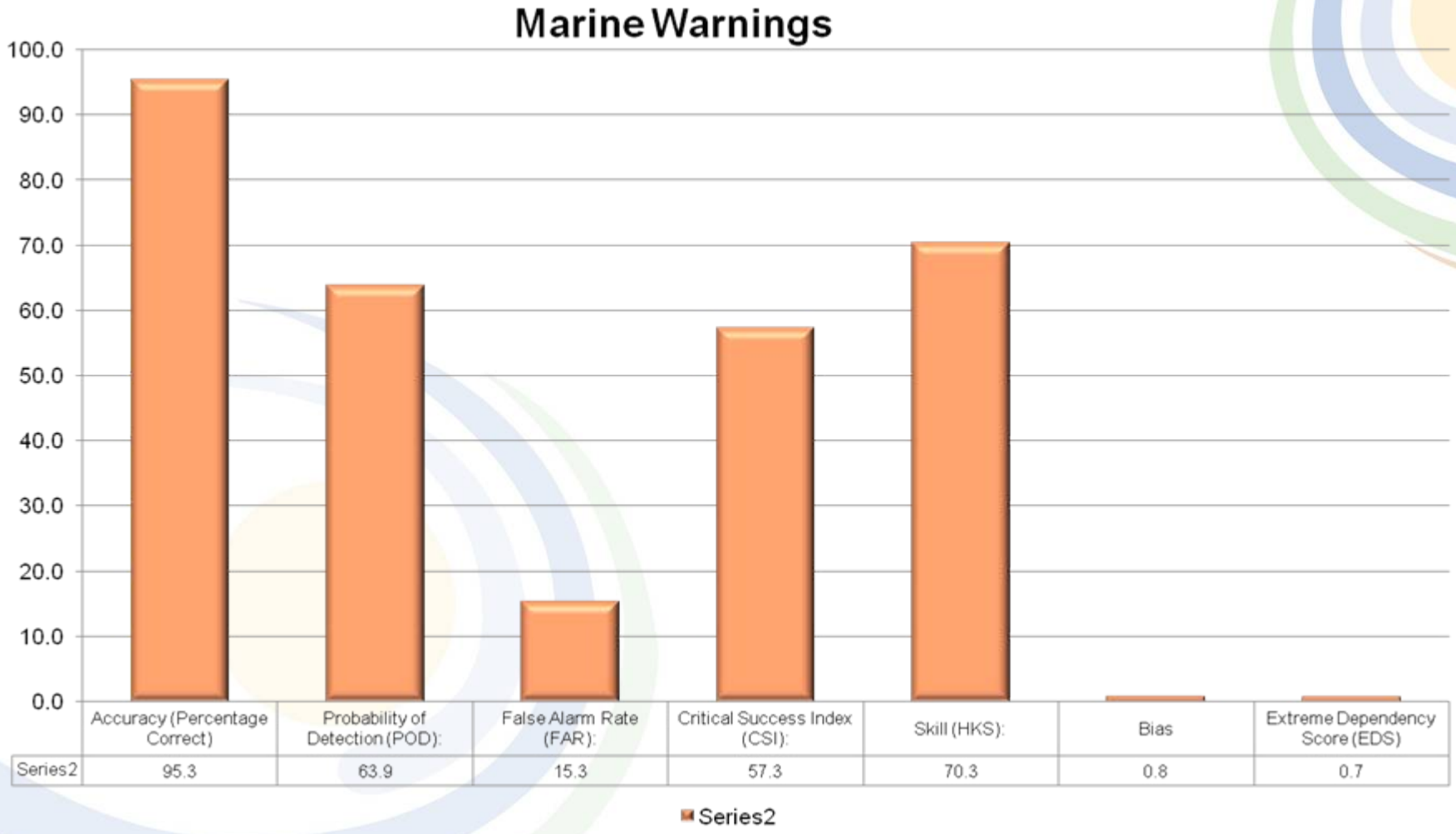
# 2010-11 Weather Warnings Accuracy






South African Weather Service

# 2010-11 Weather Warnings Accuracy



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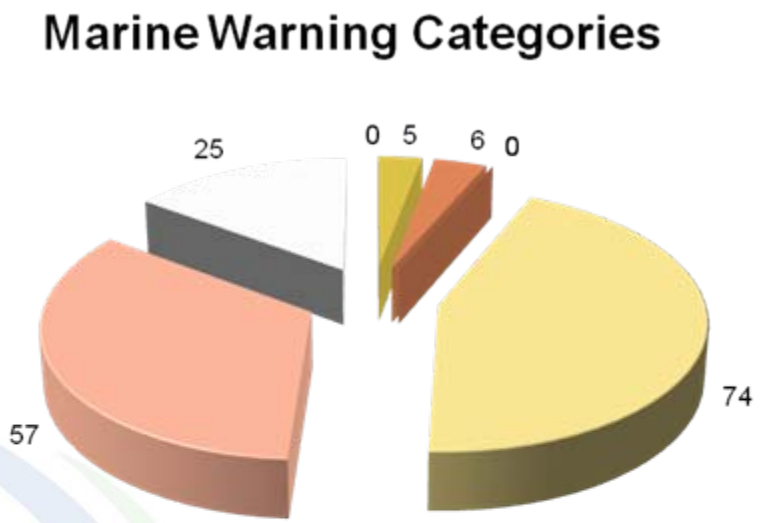
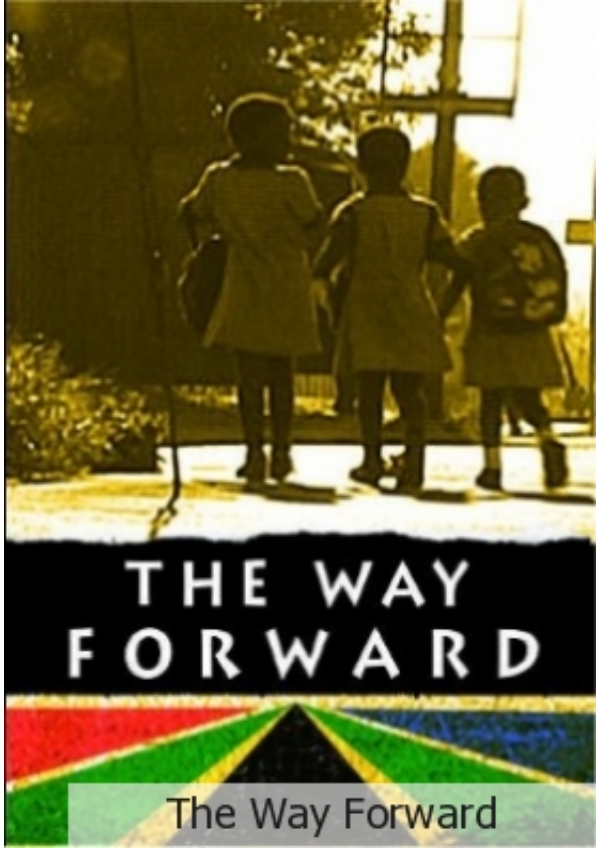


# Way Forward

- Awareness campaign
- WEB portal
- Case study for verification and annual review
- SAWS Work Instructions + Partners
- African Journal of Marine Sciences
- High Risk Areas
- Template for SA and Africa
- COP17, JCOMM and WMO



# Additional Comments

- Establishment of economic and financial mechanism for funding science in Africa (African fund to address climate change water resources coastal and marine issues in Africa similar to the African heritage find)
- Africa already rich - although poor
- There is a gap between science and governance that needs to be bridged, until such time there is a mechanism for interplay between science, policy and governance Africa would be far away from the proposed reality

**INVEST IN MARINE INFRASTRUCTURE**

# 2012? Watch this space

- Workshop to discuss a standard criteria for issuing a specialised estuary alert considering the following phenomena
  1. Amount of terrestrial based rainfall expected over the catchment and estuary itself
  2. The sea state regarding the possibility of rough or high seas
  3. Astronomical tide information regarding tide phases
  4. The likelihood of a storm surge occurring simultaneously with the predicted flood event.
- The result would be clearly defined criteria for the issuance of an Estuary Flood Alert

# Acknowledgements


- Development Team
  - SAWS (Santjie du Toit, Carlton Fillis, Kevin Rae, Hugh van Niekerk, Johan Stander)
  - DM (Shane Brown, Gerhard Otto)
  - CSIR (Marius Rossouw)
- DEA
  - Geoff Brundrit
- eThekwini municipality
  - Andrew Mather



the Facade of Noggmorff
...EVERYBODY IS A MINER

# Thank you

www.weathersa.co.za