MONTHLY FORECAST OF TC ACTIVITY

François BONNARDOT
Météo-France DIROI/EC

WMO RA-I Training course 2023
Outline

➢ What is monthly forecast
  ✓ Time scale issues
  ✓ What for?
  ✓ Main drivers

➢ Modeling systems for monthly forecast

➢ Available tools and products
  ✓ MISVA platform
  ✓ PISSARO project
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Time-scale

➢ Monthly forecast <-> Subseasonal forecast
➢ Covers leadtimes beyond 10 days up to 40 days
➢ Fills the gap between weather forecast (daily values) and seasonal forecast or outlook (seasonal averages)
➢ Monthly forecast brings relevant information on a weekly time-scales

Figure 1. Qualitative estimate of forecast skill based on forecast range. Source: White et al. (2017).
What for?

➢ Better anticipation of extreme events (tropical cyclones, heavy rainfall events, heat waves, dry spells...).

➢ Development of « earling-warning » application/products for better anticipation and decision making from actors of the Disaster Risk Manager sector, Humanitarian sector (red cross...)

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**Subseasonal predictions and Disaster Risk Reduction**

- **Operational decisions**
  - Weather forecasts
    - (Short range 0-3 days)
    - (Medium range 4-10 days)

- **Tactical decisions**
  - S2S predictions
    - (2 weeks to 2 months)

- **Strategic decisions**
  - Seasonal predictions
    - (3-6 months)

- **Long-term decisions**
  - Climate projections
    - (years/decades)

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*Figure 2. Disaster risk management interventions across the continuum of timescales of climate information. Source: UN report (2019), modified from ESCAP (2017).*

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**Figure** Le concept “Ready!, “Set!”, “Go!” pour l’aide à la prise de décision développé par le Centre climatique de la Croix-Rouge et l’UN. Extrait du rapport 2013 des Nations Unies (ST/ESCAP/2013), source : Godard et al., 2014.
Predictability and main drivers

➢ The time-scale of subseasonal forecast has long been considered as a « predictability desert »
➢ Recent progress in terms of predictability comes from:
  ✗ A better understanding and representation of atmospheric conditions especially through the conceptual scheme of atmospheric waves
  ✗ Improved coupling with, and initialization of, the land-ocean-cryosphere and stratosphere
  ✗ Understanding how these subseasonal predictability sources affect the occurrence (in terms of probability) of extreme events

Main sources of predictability for tropical regions:
  ✗ Oceanic « low frequency » oscillations : ENSO, IOD, SIO → defines the background climate conditions, bring information at a monthly to seasonal time-scale
  ✗ Tropical atmospheric waves : Madden Julian Oscillation (MJO), Equatorial Rossby (ER), Kelvin waves (subseasonal) → predictability sources relevant for explaining variations on weekly to monthly time-scale
Atmospheric drivers

**Definition**: An equatorial wave materializes the propagation of an atmospheric disturbance on a planetary scale. It is coupled to convection: strong convective burst give rise to it and the propagation of the wave favors in turn convection. It remains channeled in the near equatorial zone (± 15°) by the equatorial waveguide but also by the seasonal shift of the ITCZ.

Equatorial waves bring predictability on an intra-seasonal (monthly) scale.
Madden-Julian Oscillation (MJO)

Propagation: Eastwards
Period > 30 jours
Consequences: Succession of enhanced / suppressed large scale deep convection over the Indo-Pacific area within slow moving Walker cells. Modulating influence on tropical cyclogenesis at intra-seasonal time-scale for this region.

Src: NOAA Climate
Equatorial Rossby (ER)

Propagation: Westwards
Period ≈ 10/20 days
Consequences: Symmetrical cyclonic vortexes on both sides of the meteorological equator (varies with the season)
Kelvin waves

Propagation: Eastwards
Period ≈ 3/7 days
Consequences: enhanced convection ahead of a westerly wind surge
Visualisation of atmospheric waves objects

- Hovmollers diagrams
- 7 days averaged maps
- Eq. Waves filtering
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Modeling systems for monthly forecast

- **Ensemble Prediction Systems**

  - **S2S project**: intercomparaison of systems for subseasonal to seasonal forecast (12 modeling group participating)
    - 12 modeling group participating: [https://confluence.ecmwf.int/display/S2S/Models](https://confluence.ecmwf.int/display/S2S/Models)
    - Lead-time: 30 to 60 days depending on systems
    - From 4 to 100 members depending on systems
    - From 30 km to 100 km horizontal resolution depending on systems
    - Most of them are ocean-coupled, some are coupled with sea-ice, wave modules
    - Run daily to weekly

  - **ECMWF system for operational applications (but not the only one)**
    - 46 days leadtime
    - 100 members
    - 35 km horizontal resolution, 137 vertical levels
    - Run frequency: daily
    - Ocean model: NEMO 0.25° resolution
    - Sea Ice model: LIM2
    - ECMWF Wave model plugged

  More details on [https://confluence.ecmwf.int/display/S2S/ECMWF+model+description](https://confluence.ecmwf.int/display/S2S/ECMWF+model+description)
Modeling systems for monthly forecast

https://charts.ecmwf.int/
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➢ **MISVA**: Monitoring and forecast of IntraSeasonal Variability over Africa
➢ Collaboration between Météo-France and Western African météorological services
➢ Aims at a better understanding and better forecast of rains, especially extreme rains, in West Africa at synoptic to sub-seasonal scales
➢ Extension to other basins like south-West Indian Ocean basin for some products
➢ Better understanding of the subseasonal variability and identification of relevant drivers for a better anticipation of atmospheric hazards in the Indian Ocean

➢ Provide new products for a better integration of monthly forecast data into decision-making and management processes for disaster risk reduction
For better understanding of the subseasonal variability and identification of relevant drivers for a better anticipation of atmospheric hazards in the Indian Ocean, a methodology was developed to better structure the exploitation of monthly forecast data.

- Semi-automatic production of the technical briefing material on Tuesday
- Preparation session with 2 or 3 experts on Wednesday
- Briefing on Thursday with participation of researchers, developers, operational forecasters
- Provide a comprehensive message on the basin configuration, tropical cyclone activity, weather regimes for W2/W3/W4
PISSARO project: monthly briefing activity

Outlooks on weekly time scale:
- Cyclone activity over SWIO region (early warning of potentially impacting events)
- Dominant Weather regimes for specific locations (La Réunion, Mayotte, Seychelles...)

Analysing the conditions through the atmospheric wave concept scheme helps understanding and interpreting model outputs
PISSARO project: specific products for cyclone hazard anticipation

Cyclone hazard anticipation product for inhabited areas of the southwest Indian Ocean
Produit d’Anticipation de l’aléa Cyclonique pour les Territoires habités du Sud-Ouest de l’Océan Indien (PACT-SOOI)

Colour levels express an increasing degree of reliability of the cyclone signal
Niveaux de couleur expriment un degré de fiabilité croissant du signal cyclonique

Time ranges:
Week 1 (W1) = D+7 to D+13
Week 2 (W2) = D+14 to D+20
Week 3 (W3) = D+21 to D+27

Zoning of SWIO for TC risk assessment conjointly built with PIROI considering access issues
PISSARO project: specific products for cyclone hazard anticipation

Ensemble prediction of tracks within ECMWF EPS system

Tracks for SWIO basin for week 2 base 2023-02-13 valid from 2023-02-20 to 2023-02-27

Ensemble des scénarios de trajectoires possibles de système dépressionnaires pour une semaine donnée (en orange : stade tempête et en rouge stade cyclones)

Strike probabilities

Probabilité d’occurrence de un (ou plusieurs) système (a minima au stade de tempête) dans un rayon de 300 km

Tropical Cyclone Hazard Assessment based on ECMWF strike probability monthly forecast

Week 2 starting 2023-02-20 ending 2023-02-27
Base : 2023-02-13 00UTC

Signaux d’activité cyclonique (présence d’une zone colorée) et degré de fiabilité associée à ces signaux (échelle de couleurs).

A noter : niveaux de fiabilité calibrés en fonction des bonnes détections et des fausses alertes associées à différentes probabilités d’occurrence.
PISSARO project: specific products for cyclone hazard anticipation

TRAJECTOIRES

STRIKE PROBABILITY 0.5

STRIKE PROBABILITY STATS ZONALES

Base: 29 dec 2022

Week 3: 16-23 jan 2023

Cheneso
PISSARO project: specific products for cyclone hazard anticipation
Other products under construction

Heavy Rainfall risk assessment
- ongoing work to calibrate the risks level...

ITCZ forecast for W2 leadtime (2021-12-06 to 2021-12-12)

ITCZ probabilistic product
- predictability of the ITCZ in terms of location and associated rainfall activity
- better anticipation of the onset of the rainy season and/or heavy rainfall systems during the rainy season (partnership with SMA)