Recommendations from the Tenth WMO International Workshop on Tropical Cyclones

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World Meteorological Organization
Organisation météorologique mondiale

"Improved TC science and services for better decision-making"

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IWTC Background

- Started in 1985, led by Dr. William Gray, USA, held every four years in locations impacted by TCs around the world

Workshop	Dates	Location
IWTC-I	25 November–5 December 1985	Bangkok, Thailand
IWTC-II	27 November-8 December 1989	Manila, Philippines
IWTC-III	22 November-1 December 1993	Huatulco, Mexico
IWTC-IV	21-30 April 1998	Haikou, China
IWTC-V	3-12 December 2002	Cairns, Australia
IWTC-VI	21-30 November 2006	San Jose, Costa Rica
IWTC-VII	15-20 November 2010	La Reunion, France
IWTC-VIII	2-7 December 2014	Jeju, Republic of Korea
IWTC-IX	3-7 December 2018	Honolulu, USA

Objectives of IWTC

- To report on current knowledge, forecasting and research trends on tropical cyclones from an integrated global perspective;
- To foster communication within and between the operational and research communities;
- To identify needs and opportunities in TC operations and research and offer recommendations for actions that will improve the global knowledge of and response to TCs.

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IWTC-10

- Held in Bali, Indonesia, 5-9 December 2022
- Theme: "Improved TC science and services for better decision-making"
- Format: Plenary sessions including summary of advances in last four years on several topics, followed by breakout sessions with focused discussions in small groups
  - Special focus session on Communicating Hazards
  - Topic 1: Remote Sensing
  - Topic 2: TC Intensity Change
  - Topic 3: TC Structure Change
  - Topic 4: TC Track and Genesis
  - Topic 5: Forecasting TC Hazards and Impacts
  - Topic 6: TC Variability Beyond the Synoptic Scale
- Reports, presentations, recordings of talks available at https://community.wmo.int/en/meetings/tenth-international-workshop-tropical-cyclones-iwtc-10

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IWTC-10 Recommendations: Summary statistics

- Recommendations committee: Kim WOOD (USA, Chair), Alan BRAMMER (USA), Suzana CAMARGO (USA); Joe COURTNEY (Australia); Anne-Claire FONTAN (WMO); Chris NOBLE (New Zealand); Rob ROGERS (USA); Monica SHARMA (India); Hui YU (China)

- 22 recommendations were agreed upon

- Targeted toward three groups: RESEARCH, OPERATIONS, WMO
    - 17 for RESEARCH
    - 12 for OPERATIONS
    - 8 for WMO
    - 12 for more than one group (e.g., INTEGRATED RESEARCH AND OPERATIONS)
        *Note: Total is more than 22 because of multiple groupings

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Mapping of Recommendations onto IWTC-10 topics
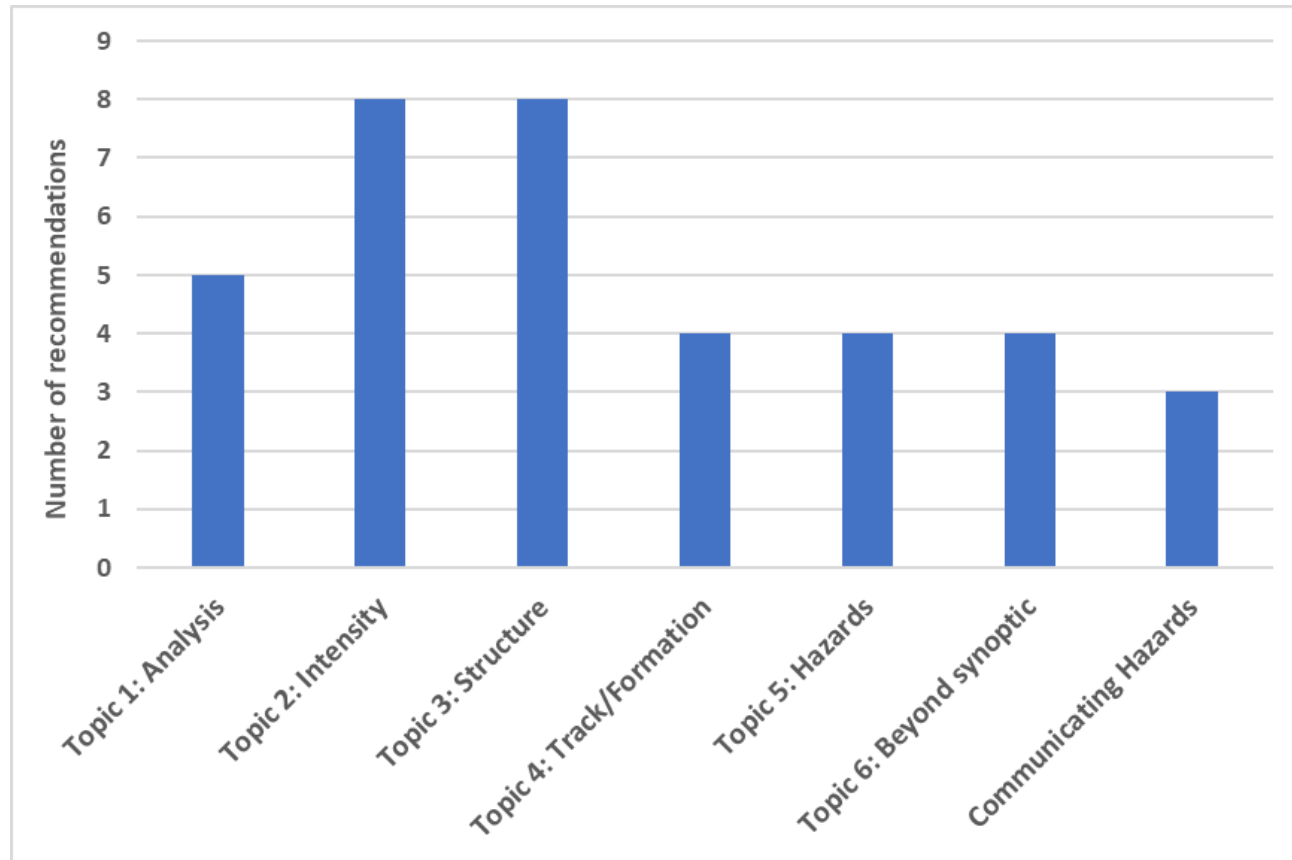
- Topics 2 and 3 have most recommendations – TC intensity and structure. Substantial overlap for those
- Special topic ("Communicating hazards") has the fewest, but they are wide-ranging
- Note totals don't equal 22 because of multiple topics addressed by a recommendation

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Overview of IWTC-10 Recommendations

Topic 1. Remote sensing for TC analysis (5)

- Aircraft and satellite-centric
- Encouraging use and sharing of new observing capabilities
- Examples:

  - *Explore the development and deployment of low-cost technologies (e.g., balloons, gliders, uncrewed systems, animal-borne sensors) for collecting in situ measurements of subsurface, air-sea interface, lower boundary layer, and three-dimensional measurements of kinematic and thermodynamic fields in the TC inner core and environment. When possible, make these observations available in real time.*

  - *Encourage continued investment in the planning, launch, and support of low-earth orbit satellite missions to sustain and improve spatial and temporal coverage of observations that capture TC size, structure, and intensity (e.g., microwave imagery, scatterometers, synthetic aperture radar) including low-cost missions such as CubeSats.*

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Overview of IWTC-10 Recommendations

Topic 2. TC intensity changes (8)

- Physical process studies and improving forecasting techniques
- Examples:

  - *Continue research toward improved understanding of the conditions, precursors, and processes leading to TC intensity change throughout the entire TC lifecycle (pre-formation through to decay), taking into account its multiscale nature ranging from the convective to the synoptic scale. Special focus should be given to rapid intensification and near-coast formation, including onset, duration, and potential intensification rate.*

  - *Continue to advance research and operational use of post-processing tools (statistical guidance, model consensus, AI/ML techniques, and multi-model ensemble uncertainty) for intensity change forecasts with a focus on rapid intensity change and cases identified as operationally-challenging forecasts.*

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Overview of IWTC-10 Recommendations

Topic 3. TC Structure change and mid-latitude interactions (8)

- Physical process studies and standardizing datasets and definitions for structure analysis
- Examples:
  - *Pursue the development of a holistic approach to consistent basin-specific definitions of multiple cyclone types (e.g., ETC, STC, TC, medicanes), and transition pathways among these types (ET, TT, etc.), that builds on the cyclone phase space. Develop and share diagnostic techniques.*

  - *Develop a list of current methods to define, analyze, diagnose, and predict cyclone wind structure across all operational centers to identify advantages and shortcomings in these methods. Develop operational tools to overcome those gaps by incorporating new observational data, derived products (e.g., AMVs), and NWP.*

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Overview of IWTC-10 Recommendations

Topic 4. TC Track and formation [incorporating TC-PFP outcomes] (4)

- Overlap with other topics, cross-cutting recommendations
- Examples:

  - *Encourage operations to promote the difficult cases database to the research community, explore improvements to the database based on research needs, and update the database on a regular basis.*

  - *Recommend further research into explainable and validated AI/ML techniques with the cooperation of the operational community to address components in the TC analysis and forecast process.*

  - *Exploit online communication technologies (e.g., Zoom) and leverage in-person meetings to facilitate training sessions and workshops on the expanding range of emerging challenges in TC analysis and forecasting as identified by the AG-TC (Advisory Group on Tropical Cyclones).*

Overview of IWTC-10 Recommendations

Topic 5. Forecasting hazards and Impacts [including landfall] (4)

- Improved prediction of hazards and impacts adequate for different time scales
- Examples:

  - *Expand verification studies of TC prediction from individual models towards multi-model ensembles and expand verification metrics to include precipitation, intensity, life-cycle interactions, and impacts that would be closer to stakeholders' interests, providing consistent metrics and comprehensive measures of skill that are adequate for different time scales (sub-seasonal, seasonal, decadal, and beyond).*

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Overview of IWTC-10 Recommendations

Topic 6. Tropical Cyclone Variability beyond the Synoptic Scale (4)

- Process studies, database expansion for variability on subseasonal, seasonal, decadal, climate time scales
- Examples:

- *Continue to investigate the physical mechanisms behind global TC frequency using both observations and modeling studies to clarify the expected changes of TC frequency in the future.*

- *Encourage the development of skillful seasonal and sub-seasonal forecasts across all ocean basins that would meet stakeholders' needs through dynamical and statistical methods as well as intercomparison and evaluation of the forecasts.*

Overview of IWTC-10 Recommendations

Special Focus session. Communicating Hazards (3)

- Emphasize importance of social science to improve communication specific to local conditions
- Examples:

  - *Encourage the engagement of social scientists with forecasters to enhance communication under a range of TC impact scenarios to support the decision-making process down to the local level. Forecasters should share outcomes and lessons learned with the global operational TC community.*

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Summary

- Concise list of actionable recommendations tailored to a broad spectrum of the TC research and forecasting community
- Key is to track progress toward addressing these recommendations
    - Ongoing task by the community
- Greater involvement from social science community will be helpful for future workshops

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Thank you
Merci

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