Value Chain Glossary

A glossary of value chain and warning chain terminology
in a hydrometeorological context

v1.0

Accuracy: An attribute of forecast quality; specifically, the magnitude of the error(s) in a single or a set of forecasts. An "accurate" forecast is one with a small error; it addresses the question "Was the forecast close to what happened?" Accuracy is usually taken as an attribute of deterministic forecasts and is measured in the units of the predictand, but here it is applied to probabilistic forecasts to refer to high probabilities on the verifying outcome, without specific regard to the reliability or resolution of the probabilities. For example, suppose that rainfall is observed to be above-normal, a forecast that indicated 60% probability of above-normal would be considered more accurate than one that indicated 40%. Accuracy is considered a desirable property of probabilistic forecasts for a specific target period (e.g., the seasonal forecast for January – March 2000) (Mason 2013).

Anomaly: The difference between an observed value of a meteorological variable (e.g., seasonally averaged temperature) for a single period [e.g., January – March (JFM) 2000] and its long- term average (e.g., JFM 1961–1990). In the case of seasonally averaged temperature, for example, a positive anomaly occurs when the temperature for the season in question is higher than average, and a negative anomaly occurs when the season is colder than average (Mason 2013).

Attribute: A specific aspect of the quality of forecasts. Forecast quality is multi-faceted, and so forecasts can be described as good or bad in a number of different ways. The attributes of good probabilistic forecasts are discrimination, reliability, resolution, sharpness, and skill (Mason 2013).

Avoided cost method: A valuation method that assesses actual or imputed costs for preventing environmental deterioration by alternative production and consumption processes, or by the reduction of or abstention from economic activities (OECD, 2008); for example, measuring the benefits of reduced air pollution by assessing the cost of installing indoor air purifiers.

Benchmarking: A process in which a business evaluates its own operations (often specific procedures) by detailed comparison with those of another business (especially a competitor), in order to establish best practices and improve performance; the examination and emulation of other organizations' strengths (Oxford English Dictionary).

Benefit–cost analysis: The quantification of the total social costs and social benefits of a policy or a project, usually in monetized terms. The costs and benefits concerned include not only direct pecuniary costs and benefits, but also public goods, as well as externalities, meaning external effects not traded in markets. These include external costs, for example, pollution, noise and disturbance to wildlife, and external benefits such as reductions in travelling time or traffic accidents. Benefits and costs can also be weighted in order to account for different levels of wealth within and across communities involved (Nurmi and Ahtiainen 2018). Benefit–cost analysis is often used to compare alternative proposals. If the total social

benefits of an activity exceed total social costs, this can justify subsidizing projects that are not privately profitable. If the total social costs exceed total social benefits, this can justify preventing projects even when these would be privately profitable. There are several types of criteria for judging the balance of costs and benefits, such as benefit-cost ratio, net present value, and internal rate of return. Yet, in modern social cost-benefit analysis the evaluation of the outcomes is often not narrowed down to one ratio, but various indicators and effects of uncertainty are considered.

Bias: A systematic difference between the forecasts and the outcomes. Biases can be conditional or unconditional (Mason 2013).

Capacity: The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience. Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management (UNDRR, 2021).

Climate information: Climate data, climate products and/or climate knowledge (WMO, 2014a).

Climate product: A derived synthesis of climate data. A product combines climate data with climate knowledge to add value (WMO, 2014a).

Climate services: The provision of climate information in a way that assists decision making by individuals or organizations. A service requires appropriate engagement along with an effective access mechanism and must respond to user needs (WMO, 2014a).

Co-design, co-creation and co-production with users: Interaction with users so that users' expertise is included in the generation of climate information (see Carter et al., 2019: Co-production in African weather and climate services, WiSER, Future Climate for Africa).

Conditional bias: A systematic difference between the forecasts and the outcomes that is dependent upon the forecast. Over- and under-confidence are examples of conditional bias (Mason 2013).

Confidence A degree of belief placed by the forecaster in a forecast. A confident forecaster believes that there is less uncertainty in the outcome than an unconfident forecaster, and so the confident forecaster will issue a *probabilistic forecast* with greater *sharpness*. For example, in the three- category situation, a forecaster that says there is a 60% chance of above-normal rainfall is more confident than a forecaster who says there is a 50% chance of above-normal rainfall because 60% is a larger shift from the climatological value than is 50%. Consider another example: a forecaster who says there is a 10% chance of above-normal rainfall is more confident than one who says there is a 50% chance. The first forecaster is very confident that above-normal rainfall will not occur, and a probability of 10% is a bigger shift from 33% than is a probability of 50% (Mason 2013).

Confidence interval A range defining upper and lower limits between which the value of a parameter being estimated (e.g., a verification score) is likely to lie. The confidence level defines how likely it is that the interval contains the parameter value (Mason 2013).

Consequences: The outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. In the emergency risk management context, consequences are generally described as the effects on persons, society, the environment and the economy (AIDR, 2019).

Consistency: A correspondence between a forecast and the forecasters' beliefs. If a forecast is consistent, it communicates what the forecaster thinks will happen, and will correctly indicate their level of uncertainty. A forecaster may want to issue a forecast that is inconsistent with their belief to avoid causing an over-reaction, for example, if there are strong indications of dry conditions.

Contingent valuation: A survey method used to ascertain WTP for services or environmental amenities (Tietenberg and Lewis, 2009).

Costs: In a loss assessment context, the resources or alternative consumption which must be sacrificed to achieve the desired end result, such as implementing mitigation (Thompson & Handmer, 1996). (AIDR 2002, Manual 27)

Cost-effectiveness: The achievement of results in the most economical way. This approach assesses efficiency by checking whether resources are being used to produce any given results at the lowest possible cost. Cost-effectiveness is most relevant as a concept of efficiency in cases such as the provision of defence, education, health care, policing or environmental protection, where it is sometimes difficult to measure the monetary value of the results achieved (Black et al., 2012).

Customer (of meteorological or hydrological services): The person or organization which pays for products and services and agrees on the specifications for delivery through a customer–supplier agreement or service-level agreement. The customer may or may not be the user (WMO, 2014b).

Deterministic forecast: A forecast expressed as a specific value (e.g., total rainfall in mm) or a specific category (e.g., temperature in the below-normal, normal, or above-normal category) without any indication of uncertainty (Mason 2013).

Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. The effect of the disaster can be immediate and localized but is often widespread and could last for a long period of time. The effect may test or exceed the capacity of a community or society to cope using its own resources, and therefore may require assistance from external sources, which could include neighbouring jurisdictions, or those at the national or international levels (UNDRR, 2021).

Early warning system (EWS): An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events. Effective "end-to-end" and "people-centred" early warning systems may include four interrelated key elements: (1) disaster risk knowledge based on the systematic collection of data and disaster risk

assessments; (2) detection, monitoring, analysis and forecasting of the hazards and possible consequences; (3) dissemination and communication, by an official source, of authoritative, timely, accurate and actionable warnings and associated information on likelihood and impact; and (4) preparedness at all levels to respond to the warnings received. These four interrelated components need to be coordinated within and across sectors and multiple levels for the system to work effectively and to include a feedback mechanism for continuous improvement. Failure in one component or a lack of coordination across them could lead to the failure of the whole system (UNDRR,2021).

Economic efficiency: A general term that expresses the notion that all available resources are allocated optimally. Economic efficiency in this sense is purely descriptive and does not provide a precise definition or test. Pareto efficiency is a formalization of the concept of economic efficiency that provides a method of testing for efficiency (Black et al., 2012).

Effectiveness: The degree to which something is successful in producing a desired result; success. Examples of improving the effectiveness of the weather enterprise: Better data coverage; Wider information dissemination; More realistic and scalable models; Increased infusion of cutting-edge technology; Greater number of specialized products. (Fair Weather: Effective Partnership in Weather and Climate Services, 2003)

Efficiency: Obtaining the maximum output for given inputs. Efficiency in consumption means allocating goods or services between consumers so that it would not be possible by any reallocation to make some people better off without making anybody else worse off. Efficiency in production means allocating the available resources between industries so that it would not be possible to produce more of some goods or services without producing less of any other (Black et al., 2012).

Event: An observation during the *target period* of a specific outcome of interest. The outcome is explicitly binary: either an event occurs during the *target period*, or it does not occur. For seasonal forecasts, an event is usually defined as the occurrence of the verifying observation in a specific category of interest. For example, if above-normal rainfall is defined as an event, an event occurs if rainfall is above-normal (Mason 2013).

Ex ante: Literally translated from Latin: from before. The term describes activities (for example, actions, decisions, formation of expectations) that are undertaken before the state of nature is revealed. For instance, an ex-ante SEB study involves the analysis of potential benefits of a new or improved met/hydro service before it is actually available to user communities. Ex ante is contrasted with ex post, meaning as viewed after the event (Black et al., 2012).

Ex post: Literally translated from Latin: from after. The value of a variable, or of a decision made, as it appears after the outcome of randomness has been realized, that is, what actually occurred. Ex post is contrasted with ex ante, which means looking at things before the event (Black et al., 2012).

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest (UNDRR, 2021).

Economic loss: Total economic impact that consists of direct economic loss and indirect economic loss. *Direct economic loss*: the monetary value of total or partial destruction of physical assets existing in the affected area. Direct economic loss is nearly equivalent to physical damage. *Indirect economic loss*: a decline in economic value added as a consequence of direct economic loss and/or human and environmental impacts.
Examples of physical assets that are the basis for calculating direct economic loss include homes, schools, hospitals, commercial and governmental buildings, transport, energy, telecommunications infrastructures and other infrastructure; business assets and industrial plants; and production such as crops, livestock and production infrastructure. They may also encompass environmental assets and cultural heritage (UNDRR, 2021).

False-alarm rate (FAR): A measure of the *quality* of *deterministic forecasts*; specifically, the number of *false alarms* divided by the number of non-events. The false-alarm rate measures the proportion of non-events that were incorrectly fore-warned, and should be distinguished from the *false-alarm ratio*, which measures the proportion of incorrect warnings (Mason 2013).

Forecast: A statement of expected meteorological (or hydrological) conditions for a specific period and for a specific area or portion of air space (WMO, 1992).

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation (UNDRR/ISC 2020).

Hit rate (HR): A measure of the *quality* of *deterministic forecasts*; specifically, the number of *hits* divided by the number of *events*. The hit rate measures the proportion of *events* that were fore-warned, and should be distinguished from the *hit score*, which measures the proportion of correct warnings (Mason 2013).

Hydrometeorological hazards: They are of atmospheric, hydrological or oceanographic origin. Examples are tropical cyclones (also known as typhoons and hurricanes); floods, including flash floods; drought; heatwaves and cold spells; and coastal storm surges. Hydrometeorological conditions may also be a factor in other hazards such as landslides, wildland fires, locust plagues, epidemics and in the transport and dispersal of toxic substances and volcanic eruption material (UNDRR. 2021).

Intangible: Items which are not normally bought or sold (such as memorabilia, lives, health and the environment) and for which, therefore, no agreement on their monetary value exists. (AIDR 2002, Manual 27)

Knowledge: Two types of knowledge: Know-how (skill) and know-that of propositional knowledge (justified beliefs). Knowledge is gained through, for example scientific methodology and peer-review, experience and testing (Aven et al, 2018).

Loss/Damage: A loss is counted if it is an economic loss, unless otherwise specified. An economic loss is a measure of the impact of the disaster on the specified economy. It is taken as being equal to the resources (expressed in time, money or intangible loss) lost by the specified area as a result of the disaster (see also 'net loss'). This is distinct from financial losses due to the disaster which are losses borne by individual enterprises as well as the other sectors. Many individual business losses do not amount to economic losses as their losses are

offset by other businesses gaining the trade, or are made up over time. (AIDR 2002, Manual 27)

Mitigation: Any measure intended to reduce the severity of, or eliminate the risk from, disasters. Mitigation is usually thought of in terms of prevention and community preparedness (AIDR 2002, Manual 27). The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. It should be noted that, in climate change policy, "mitigation" is defined differently, and is the term used for the reduction of greenhouse gas emissions that are the source of climate change (UNDRR,2021).

Multi-hazard: (1) The selection of multiple major hazards that are faced by a community, and (2) the specific contexts where hazardous events may occur simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects (UNDRR/ISC 2020).

Multi-hazard early warning systems: Like EWS above, but address several hazards and/or impacts of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects. A multi-hazard early warning system with the ability to warn of one or more hazards increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated and accurate hazards identification and monitoring for multiple hazards (UNDRR, 2021).

National Hydrological Service: An organization with national responsibility for river, lake and other hydrological observation, data management, research, modelling and streamflow forecasting and warning responsibilities (WMO, 1992, 2000, 2001, 2012b). The functions of the NHS are similar to those of the National Meteorological Service but focused mainly on the surface phase of the hydrological cycle; NHSs are often located with water supply or river management ministries.

National Meteorological and Hydrological Service: Refers to an NMS or NHS, or an organization which combines the functions of both (WMO, 1992, 2000, 2012b). The plural, NMHSs, refers to multiple organizations (NMHS, NMS, and NHS).

National Meteorological Service: An organization established and operated primarily at public expense to carry out those national meteorological and related functions which governments accept as a responsibility of the state in support of the safety, security and general welfare of their citizens and in fulfilment of their international obligations under the Convention of the World Meteorological Organization (WMO, 1992, 2000, 2012b; Zillman, 1999). The primary functions of an NMS are usually identified as observation, data archival, research, service provision and international cooperation.

Non-market valuation: The economic valuation of goods and services not distributed through markets (Black et al., 2012; from "non-marketed economic activities").

Nowcast: A description of current weather and a short-period (one to two hours) forecast (WMO, 1992).

Numerical weather prediction (NWP): The forecasting of the behaviour of atmospheric disturbances by the numerical solution of the governing fundamental equations of hydrodynamics, subject to observed initial conditions. Electronic computers and sophisticated computational models are required (Geer, 1996).

Preparedness: The knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery (UNDRR, 2021).

Present value: The value today of a future payment, or stream of payments, discounted at some appropriate compound interest – or discount – rate (Downes and Goodman, 2010).

Probabilistic forecasts: A forecast that is expressed as a probability or set of probabilities of one or more events occurring. Probabilistic forecasts explicitly indicate the level of uncertainty in the prediction, and communicate the level of *confidence* the forecaster has in the forecast. If a probabilistic forecast is *consistent*, the probability for any specific category can be interpreted as the probability that the forecaster thinks a deterministic forecast of that category will be correct (Mason 2013).

Public weather services: Those basic weather and related services provided, usually by the NMS, for the benefit of the public (WMO, 1999).

Quality: A measure of the association between forecasts and the corresponding observations (Mason 2013).

Recovery: The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk (UNDRR, 2021)**.**

Reliability: An *attribute* of the *quality* of *probabilistic forecasts*; specifically, the correspondence between the forecast probabilities and the conditional observed relative frequencies of events. Forecasts are reliable if, for all forecast probabilities, the observed relative frequency is equal to the forecast probability (i.e., an event must occur on 40% of the occasions that the forecast probability is 40%, 50% of the occasions the probability is 50% etc.) (Mason 2013).

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (UNDRR, 2021).

Response: Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. Effective, efficient and timely response relies on disaster risk-informed preparedness measures, including the development of the response capacities of individuals, communities, organizations, countries and the international community (UNDRR, 2021).

Risk: The chance of something happening that will have an adverse impact on community, business or individual objectives. In emergency risk management, risk is used to describe the likelihood of harmful consequences arising from the interaction of hazards, exposure to the hazards, and the vulnerability of what is exposed (EMA, 1998). It is usually considered in terms of communities and the environment. (AIDR 2002, Manual 27)

Risk Management: Activities to handle risk such as prevention, mitigation, adaptation or sharing. It often includes trade-offs between costs and benefits of risk reduction and choice of a level of tolerable risk (Aven et al., 2018).

Seamless: A product, service or series of products and services that spans from historical baselines of hazard risk to recent and real time observations, through to hourly to seasonal forecasts and future year(s) projections (FWF 2020).

Sensitivity analysis: The study of how the uncertainty in the output of a model (such as a BCA) can be apportioned to different sources of uncertainty in the model input (Saltelli, 2002).

Skill: An *attribute* of forecast *quality*; specifically, a comparative measure of forecast *quality*, in which a set of forecasts has positive skill if it scores better on one or more forecast *attributes* than another set, known as the reference set. Forecast skill is usually measured against a naïve forecasting strategy, such as random guessing, perpetual forecasts of one category, or *climatological probabilities* of all categories, but can be calculated using any reference set (Mason 2013).

Social benefit: The total benefit from any activity. This includes benefits accruing directly to the person or firm conducting the activity, as well as external benefits outside the price system accruing to other people or firms (Black et al., 2012).

Social cost: The total cost of any activity. This includes private costs which fall directly on the person or firm conducting the activity, as well as external costs outside the price system which fall on other people or firms (Black et al., 2012).

Tangible: Items which are normally bought or sold and which are therefore easy to assess in monetary terms. (AIDR 2002, Manual 27)

Triple bottom line: Using ecological and social criteria for measuring organizational success, in addition to financial performance (Allen and Lieberman, 2010, p. 82).

Uncertainty: A consciousness of limited knowledge about present facts or future events. There is a formal distinction between risk and uncertainty: risk applies when probabilities can be assigned to the likely occurrence of future outcomes; uncertainty applies when probabilities cannot be assigned (Black et al., 2012).

Unconditional bias: A systematic difference between the forecasts and the outcomes that is independent of the forecast. *Over-* and *under-forecasting* are examples of unconditional bias (Mason 2013).

User (of meteorological or hydrological services): The individual, organization or intermediary who receives the product and services and bases his or her decisions on them. For the delivery of public weather services, members of the public will ideally have their needs considered by an organization or representative body, although in reality this is often done in an ad-hoc manner based on different information-gathering methods such as surveys or focus groups, involving little direct contact with individual members of the public (WMO, 2014b).

Value added: The amount by which the value of information, services or goods is increased at each stage of its production (Oxford English Dictionary).

Value Chain: The process or activities by which value is added to information, services or goods, from production to final use or consumption (Stevenson and Waite, 2011). The value chain provides the framework for characterizing relationships, processes, inputs, contributions, operational contexts of stakeholders, that can be used to describe actual hazardous events.

Value cycle: In the hydrometeorological context, the production (observing, modeling, forecasting) of information, the dissemination to users (ways of provision, communication, and tailor-made products), perception and decision-making, and the outcomes and values, incorporating feedback from users at all steps along the cycle to explore "what works" in terms of relevance, quality, and impact (Ruti et al., 2020).

Value of information: The value of the outcome of action taken with the information less its value without the information (West and Courtney, 1993, p. 230).

Verification: A process for determining the accuracy of a weather or climate forecast (or prediction) by comparing the predicted weather with the actual observed weather or climate for the forecast period (Glickman, 2000).

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. For positive factors which increase the ability of people to cope with hazards, see also the definition of 'Capacity' (UNDRR, 2021).

Warning chain: Specific instances of value chains that are used for warnings.

Willingness to pay: The maximum amount that an economic agent is willing to pay to acquire a specific good or service. The WTP is private information but may be obtained using revealed-preference methods or stated-preference methods (Black et al., 2012).

The entries from AIDR 2002 Manual 27 are consistent with definitions used in EMA (1998).

Version history

Version	Date	Comment/Change
v1.0	17/7/21	First version released

References

AIDR 2002, Australian Disaster Resilience Manual 27: Disaster Loss Assessment Guidelines, Australian Institute for Disaster Resilience CC BY-NC

Australian Institute for Disaster Resilience 2019. Glossary, AIDR Knowledge Hub. Accessible via https://knowledge.aidr.org.au/glossary

Aven, T., Y. Ben-Haim, H. B. Andersen, T. Cox, E. López Doguett, M. Greenberg, S. Guikema, W. Kröger, O. Renn, K. M. Thompson, E. Zio, 2018: Society for Risk Analysis Glossary, Updated August 2018

Black, J., N. Hashimzade and G.D. Myles, 2012: A Dictionary of Economics. Third edition. Oxford, Oxford University Press.

EMA 1998, Australian Emergency Management Glossary, Australian Emergency Manuals Series, Part 1, The Fundamentals, Manual 3, Emergency Management Australia, Canberra.

Geer, I.W, 1996: Glossary of Weather and Climate: With Related Oceanic and Hydrologic Terms. Boston, Massachusetts, American Meteorological Society.

Glickman, T.S., 2000: Glossary of Meteorology. Boston, Massachusetts, American Meteorological Society.

Golnarahi (ed), 2012, Institutional Partnerships in Multi-Hazard EWS. Springer-Verlag Berlin Heidelberg

Mason, S. J. (2013). Guidance on verification of operational seasonal climate forecasts. World Meteorological Organization, Commission for Climatology XIV Technical Report.

Ruti, P.M., Tarasova, O., Keller, J.H., Carmichael, G., Hov, Ø., Jones, S.C., Terblanche, D., Anderson-Lefale, C., Barros, A.P., Bauer, P. and Bouchet, V., 2020. Advancing research for seamless Earth system prediction. Bulletin of the American Meteorological Society, 101(1), pp.E23-E35.

Thompson, P. and Handmer J. 1996, Economic Assessment of Disaster Mitigation: An Australian Guide, Centre for Resource Environmental Studies, ANU and Flood Hazard Research Centre, Middlesex University, for the Australian IDNDR Committee.

United Nations Office for Disaster Risk Reduction (UNDRR)/International Science Council (ISC), 2020: Hazard definition and classification review. Technical Report. United Nations, Geneva.

United Nations Office for Disaster Risk Reduction (UNDRR), 2021: Terminology, https://www.undrr.org/terminology, accessed: 15 June 2021

West, L.A. and J.F. Courtney, 1993: The information problems in organizations: A research model for the value of information and information systems. Decision Sciences, 24(2):229–52.

World Meteorological Organization, 2014a: Implementation Plan for the Global Framework for Climate Services. Geneva, http://www.gfcs-climate.org/sites/default/files/implementation-plan//GFCS-IMPLEMENTATION-PLAN-FINAL-14211_en.pdf.

World Meteorological Organization, 2014b: The WMO Strategy for Service Delivery and Its Implementation Plan (WMO-No. 1129). Geneva.

World Meteorological Organization, 2012b: Convention of the World Meteorological Organization. Basic Documents (WMO-No. 15). 2012 edition. Geneva.

World Meteorological Organization, 2001: The Role and Operation of Hydrological Services (P. Mosley) (WMO/TD-No. 1056). Geneva.

World Meteorological Organization, 2000: Abridged Final Report with Resolutions of the Fifty-second Session of the Executive Council (WMO-No. 915). Geneva.

World Meteorological Organization, 1999: Guide to Public Weather Services Practices (WMO-No. 834). Second edition. Geneva.

World Meteorological Organization, 1992: International Meteorological Vocabulary (WMO-No. 182). Second edition. Geneva.