Implementation of Probabilistic Impact-based Decision Support Services (IDSS) in the Central Weather Administration (CWA)

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Background & Challenges

The increasing frequency and intensity of extreme weather events necessitate the development of more advanced and reliable weather forecasting and early-warning systems. To achieve the goal of becoming a prepared national weather institution, the CWA has adopted the strategy of probabilistic IDSS, as formalized by the National Weather Service (NWS), collaborating with public sectors to aid users in making optimal decisions under forecast uncertainty, aiming to reduce societal, safety, and economic risks under climate change.

The challenges of meteorological data/application across sector:
1. insufficient depth in cross-domain application of meteorological data/information
   - enhancement of translation and customization for meteorological information
   - development of efficient communication mechanisms
2. high complexity in cross-domain collaboration within the agricultural sector
   - lack of a unified communication channel
   - difficulty in developing comprehensive solutions
3. policy guidance : revitalizing industries

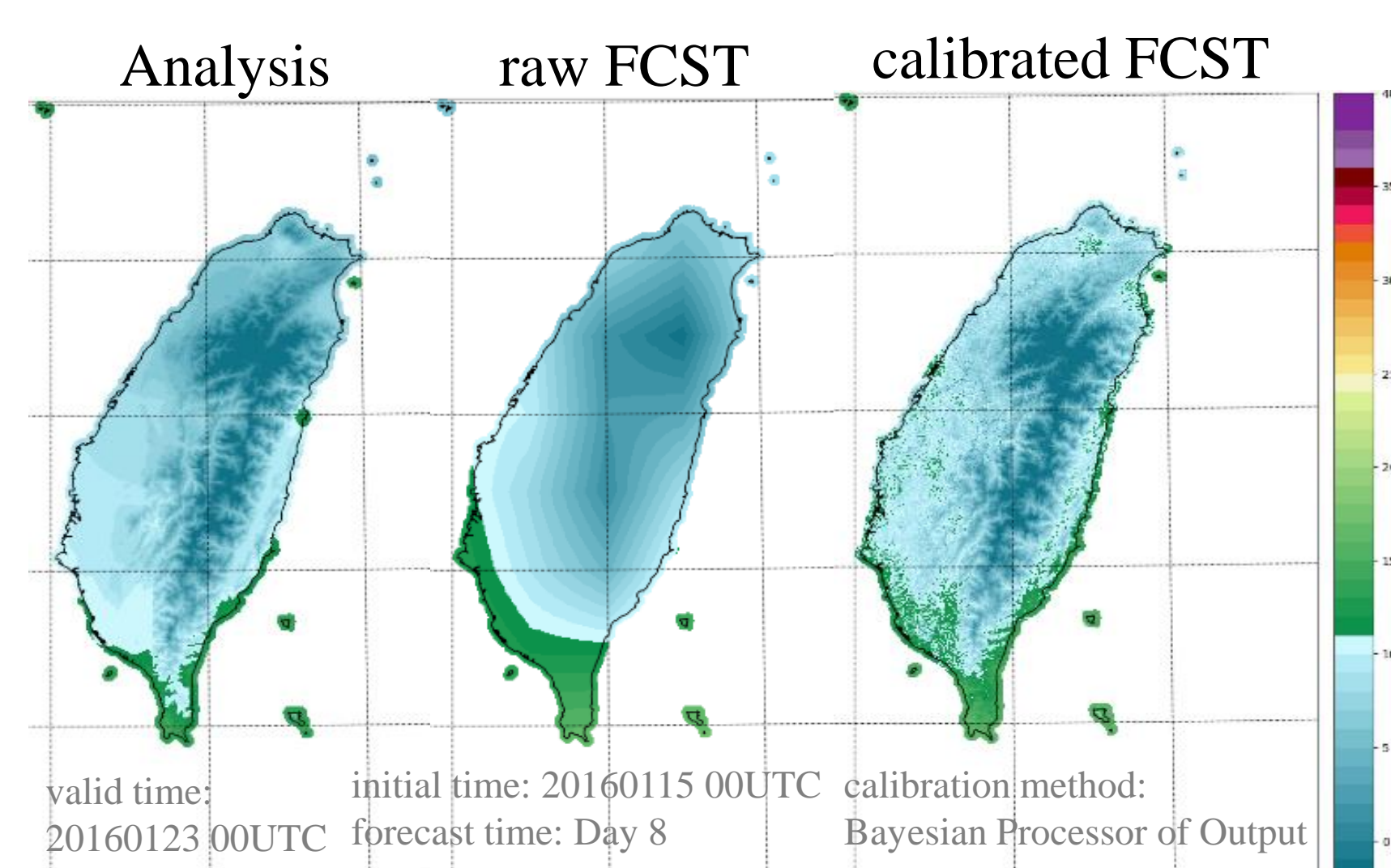Extreme temperature events influence crop growth, including susceptibility to pests and diseases.

Insufficient rainfall can negatively affect both the yield and quality of tea leaves.

High temperature and humidity would impact milk production in dairy cows.

Implementation — A Case on the Application of 2-meter Temperature Forecasting for Agricultural Crops

Analysis   raw FCST   calibrated FCST

valid time: 20160123 00UTC
initial time: 20160115 00UTC forecast time: Day 8
calibration method: Bayesian Processor of Output

**Analysis Data**: Taiwan Station-based Analysis
- data period: 1998-now
- grid spacing: 1 km
- time resolution: daily

Forecast: NCEP GEFS v12
- grid spacing: 0.5 deg
- time resolution: 6 hourly
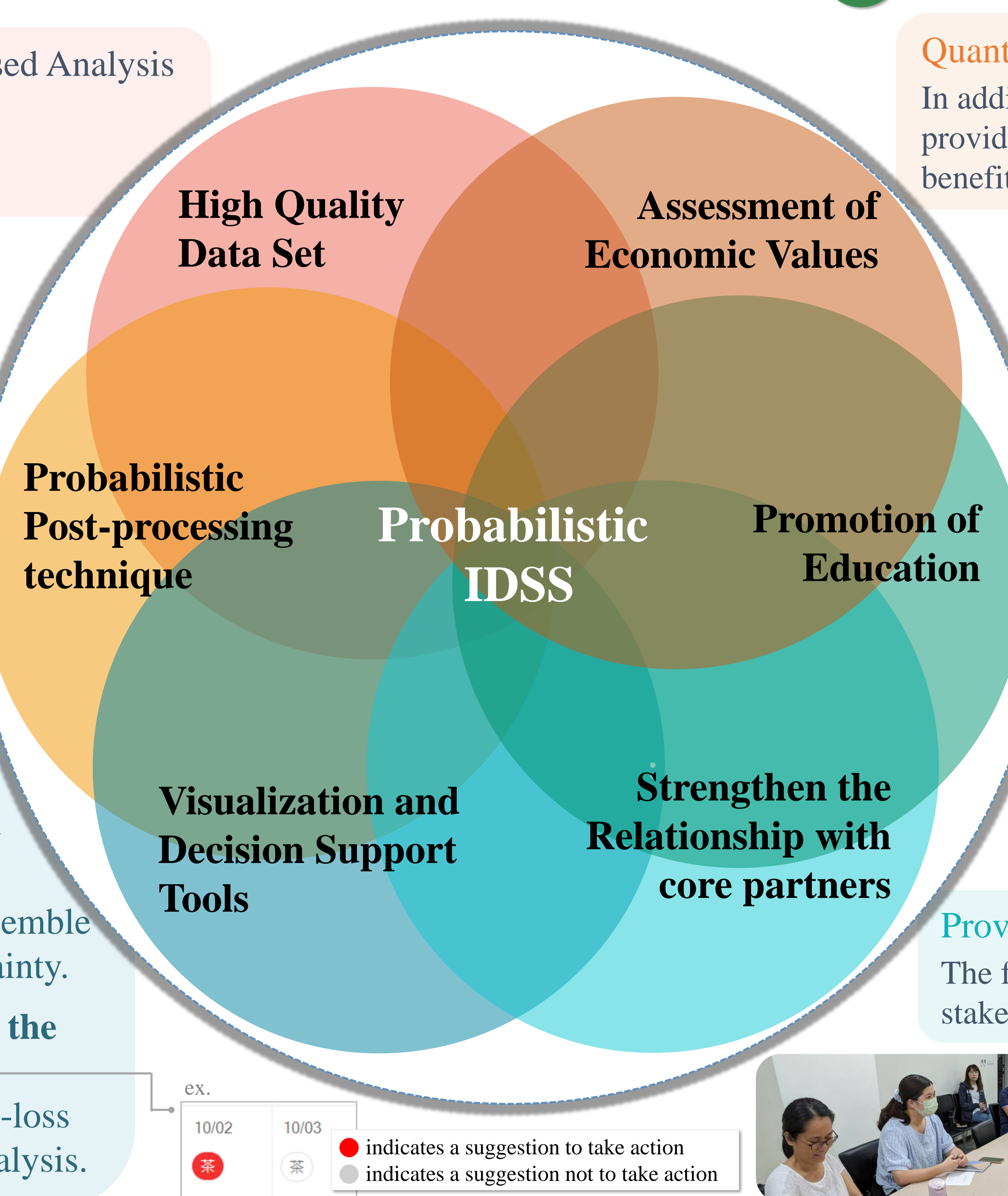
Statistical Post-Processing Technique:
- **bias correction** to improve the reliability of forecasts
- **Downscaling** for the demand of fine spatial scale (e.g. 1km)
- **Probabilistic and customized products**
  Ex. tercile probabilistic forecast, signal-based early-warning.
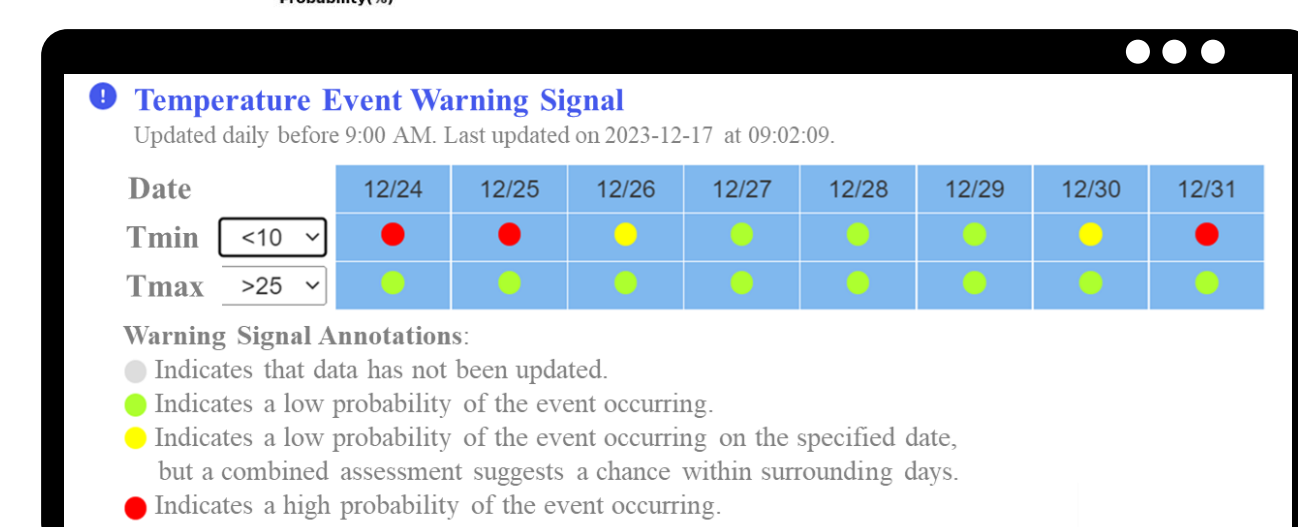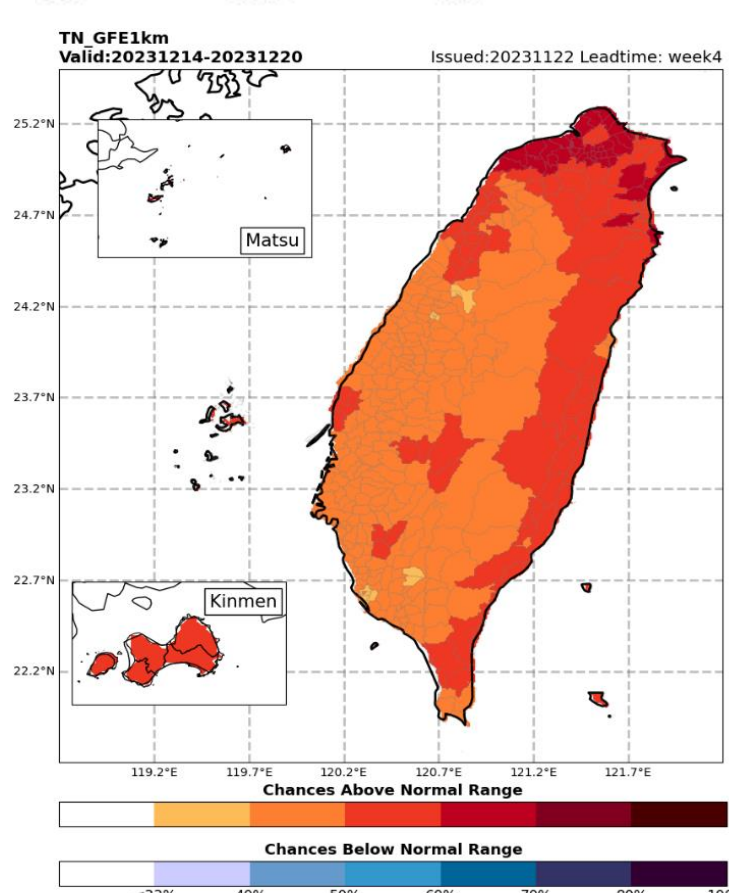
An user-friendly tool to transfer probabilistic/decision-making information

Stage 1: comprehensive forecasting including deterministic forecasts (e.g., ensemble mean) and information on forecast uncertainty.

Stage 2: optimal decision suggestion for the maximum economic benefit combining probabilistic forecasts and cost-loss information with economic value (EV) analysis.

Probabilistic IDSS
- High Quality Data Set
- Assessment of Economic Values
- Probabilistic Post-processing technique
- Promotion of Education
- Visualization and Decision Support Tools
- Strengthen the Relationship with core partners

ex.

10/02   10/03

● indicates a suggestion to take action
● indicates a suggestion not to take action

Quantification of benefits with EV analysis

In addition to quantifying the value of forecasts, EV analysis can also provide the probability thresholds that provide the highest economic benefits, significantly aiding users in decision-making.

$$EV = \frac{E_{climate} - E_{forecast}}{E_{climate} - E_{perfect}}$$
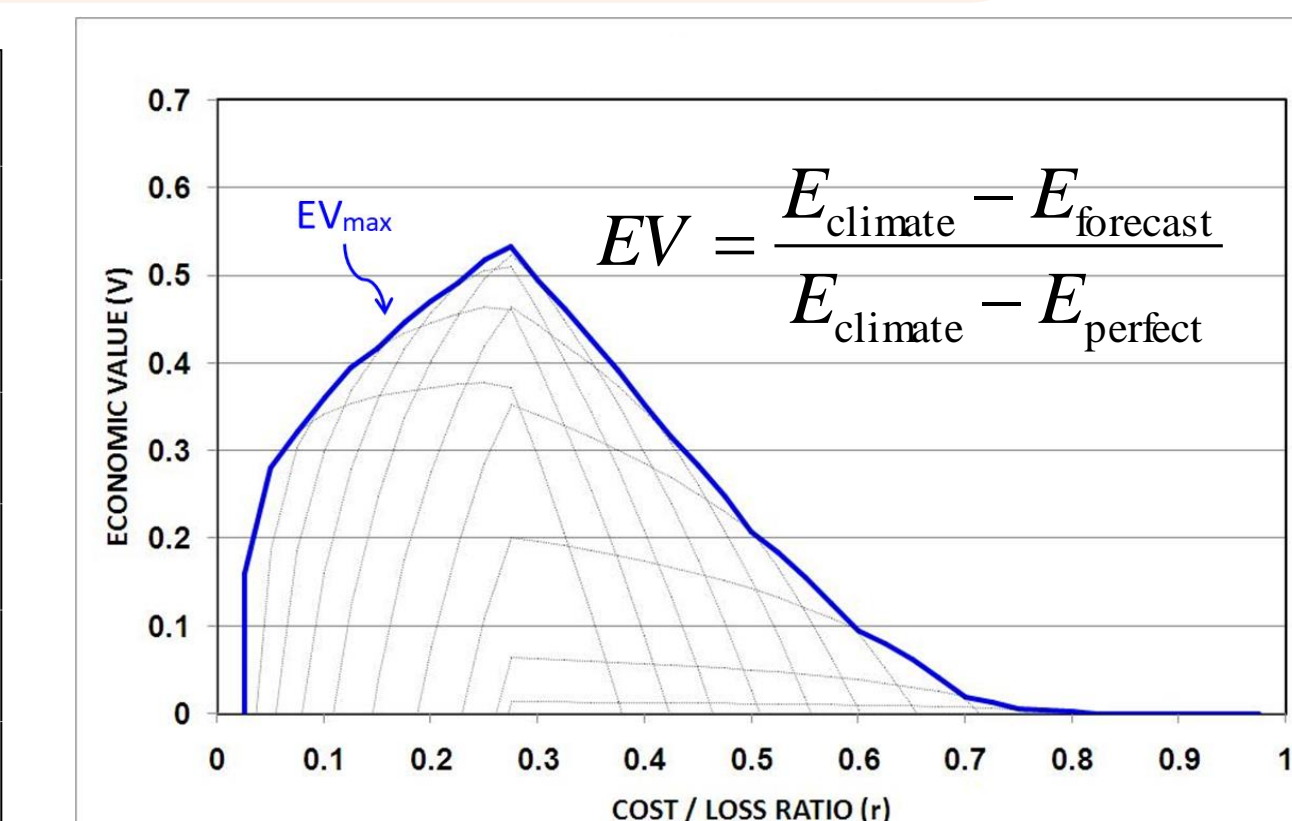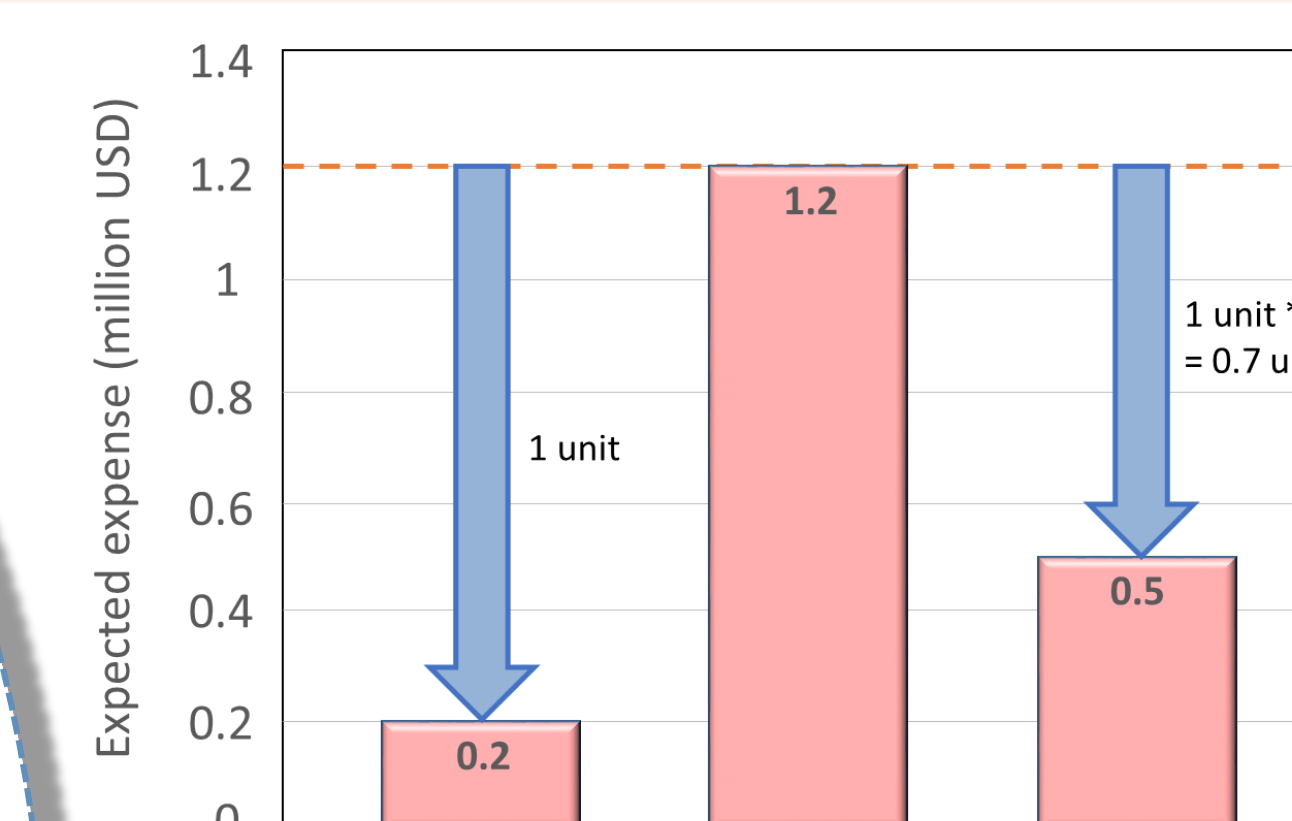
Public science education
- 2 articles in domestic science magazines:
  a. *Cross-Disciplinary Applications of Meteorological Forecasting Information*
  b. *Optimizing Decision-Making Through the Use of Probabilistic Forecasts*
- 1 science education video

Provide appropriate educational training
The focus is to seek solutions, ensuring that all stakeholders are aligned towards common goals.

Conclusion & Future work

The CWA has provided decision-based products, including: 1) signal-based early-warnings for specific locations, and 2) optimal decision suggestion. Future work will be directed towards scenario-based forecast guidance, applications combining AI/ML technology, and the optimization and development of visual decision support service, all aimed at enhancing socioeconomic benefits through disaster mitigation and prevention.

References

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