**Conference Presentation Script (15 minutes, English)**

**1. Title Page**

Good afternoon everyone, and thank you for joining this session.  
Today, I will present my study on:  
**“Estimation of the Structure Efficiency that Caused Different Flood Damages in 1931 and 1954.”**  
This work combines historical archives, hydrological reconstruction, and a System Dynamics model to understand why the 1954 flood, despite being more extreme, resulted in relatively smaller economic losses compared to 1931.

**2. Introduction – 1931 Flood Photographs (1)**

[Slide: historic photos of inundated streets in Wuhan, 1931]  
Let me begin with some historic images of the 1931 Yangtze River flood.  
This event has been remembered as one of the deadliest floods in recorded history, inundating large areas of central China.  
The photos remind us of the human suffering and the sheer scale of destruction, when streets turned into waterways and ordinary life collapsed.

**3. Introduction – 1931 Flood Photographs (2)**

[Slide: rural inundation scenes, 1931]  
Beyond the cities, the countryside was devastated. Vast farmland was submerged, millions were displaced, and famine and disease followed.  
These photographs are a vivid reminder that floods are not only hydrological events, but also deeply social and institutional challenges.  
With this perspective, we can now move to the scientific background of the two great floods: 1931 and 1954.

**4. Environmental Background**

Turning to long-term rainfall statistics:  
Across almost a century of data for the Yangtze River basin, both **1931 and 1954 stand out as extreme years**.  
In fact, both years’ cumulative rainfall exceeded the long-term average, and 1954 went even further—above the 90th percentile of the historical distribution.  
So in terms of rainfall supply, 1954 presented an even stronger environmental pressure than 1931.

**5. Hydrological Background**

Looking at measured streamflow and rainfall from hydrological stations:  
Both 1931 and 1954 are clearly abnormal years, far above the long-term baseline.  
But 1954 was exceptional—the peak discharge and seasonal runoff volumes reached record-breaking levels.  
This means that **objectively, the 1954 flood was the stronger hydrological event**.

**6. Simulated Inundation**

We then reconstructed the inundation process of the two floods using hydrological and topographic data.  
The results show that the **1954 flood covered about 59,000 square kilometers**, compared to only 39,000 in 1931.  
That is, the 1954 inundation area was about **1.5 times larger**.  
So naturally, one might expect 1954 to also bring far greater economic damage.

**7. Simulated Damage**

However, the simulation of agricultural and economic damage tells a more nuanced story.  
While inundated farmland increased by 50% from 1931 to 1954, the **economic loss only grew by about 30%**.  
This means that the growth in damage was **smaller than the growth in hazard exposure**.  
This paradox leads us to the central question of this research: perhaps the relief system itself had become more efficient by 1954.

**8. Transition – From Damage to System Efficiency**

This observation motivates our key research question:  
**Was the relative reduction in damage driven by an improvement in disaster relief efficiency?**

To explore this, we introduce a System Dynamics model.  
Here, we define a key indicator: **Structural Efficiency (SE)**,

This captures how effectively collected resources were actually delivered to affected households.

**9. System Dynamics Model Structure**

The model consists of two coupled layers:

* **Material flows**: resources move top-down from Central (Z) → Province (P) → County (C) → Village (V).
* **Information flows**: needs and appeals move bottom-up from villages, through media reporting, to higher authorities.  
  The coupling mechanism is simple: **more unmet need produces more appeals, which accelerates dispatch and collection.**  
  This way, the model reflects the institutional responsiveness of the relief system.

**10. Sources (Documents)**

To drive the model, we used a wide range of archival sources:

* For **1931**: *Record of the Hankou Flood*, *Archival Documents of the 1931 Flood in Hubei*, and national economic surveys.
* For **1954**: *Archival Documents on Flood Control and Relief in Hubei, 1954*.  
  These first-hand sources provide detailed records of breaches, dispatches, and relief operations.

**11. Sources (Evidence to Data)**

From these documents, we constructed daily time series:

* **Hazard and breaches** → BREACH signals.
* **Shipments and arrivals** → LINK\_SHIP and LINK\_ARR.
* **Media reports and appeals** → MEDIA\_REQ.  
  For example, notes such as “streets navigable only by boat” were encoded as logistics constraints.  
  In total, over 400 archival records were parsed into model-ready sequences.

**12. Fitting Sequence**

The fitting process works as follows:

* **Hazard proxies**: breaches are smoothed ±3 days, or replaced by media intensity when missing.
* **Logistics calibration**: transport delay τ(link) is estimated from the cross-correlation of shipments and arrivals.
* **Media calibration**: parameters μ\_media and k\_news are tuned to fit MEDIA\_REQ against allocation responses.

**13. Parameter Calibration – Resources**

One important observation is the difference in **record density**.  
The 1931 data set is sparse, with many missing local-level entries.  
The 1954 archive is far richer, with detailed records from central to county levels.  
This not only improves calibration robustness, but also reflects the growing institutional maturity of the relief system by 1954.

**14. Parameter Calibration – Results**

The right-hand plot shows transport calibration:

* **Horizontal axis**: best\_lag, the transport delay in days.
* **Vertical axis**: daily shipment and arrival values.  
  The results:
* In **1931**, best\_lag is longer, with weaker correlation. Logistics were slow.
* In **1954**, best\_lag is shorter, with stronger fit. Logistics were faster and more efficient.

**15. Parameter Settings**

The model baseline includes:

* Hazard inflow: 60 households/day.
* Administrative friction: 0.5 units/day.
* Dispatch caps: Central 100, Province 120, County 150 units/day.
* Transport lags baseline: 2–2–1 days.
* Media/appeals responsiveness parameters.

Differences between 1931 and 1954 are captured in calibrated parameters such as **transport delays, media responsiveness, and appeal sensitivity**.

**16. Results**

Now let us compare the model results:

* **Village coverage**: in 1954 relief reached households faster and broader.
* **Remaining need**: persisted much longer in 1931, but declined rapidly in 1954.
* **Dispatch vs arrival**: 1931 showed long gaps between shipment and arrival; 1954 converged more quickly.
* **Information signals**: in 1931, media and appeals decayed quickly; in 1954, they remained strong and sustained pressure on the system.  
  Together, these confirm that **structural efficiency was higher in 1954**.

**17. Summary**

To summarize:

1. **Hydrology**: 1954 was objectively the stronger flood—greater rainfall, flow, and inundation area.
2. **Damages**: but its relative economic loss was smaller than in 1931.
3. **Model evidence**: the System Dynamics model shows 1954 had shorter transport delays, stronger media feedback, and higher structural efficiency (SE ≈ 0.78 vs 0.64 in 1931).

Thus, institutional evolution and a more mature relief system explain why 1954 performed better under harsher conditions.  
This highlights that **disaster outcomes are shaped not only by hazard severity, but also by systemic capacity to respond.**

Thank you.