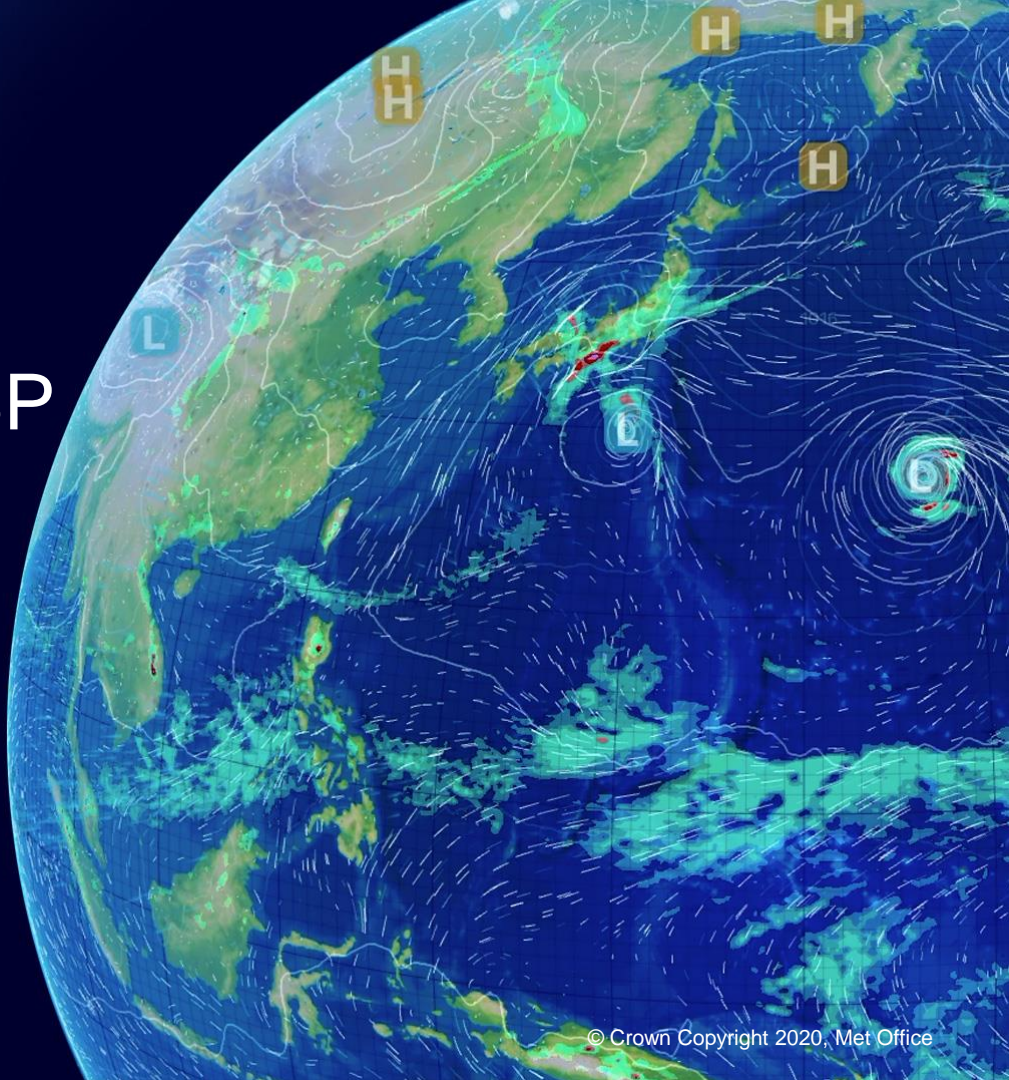


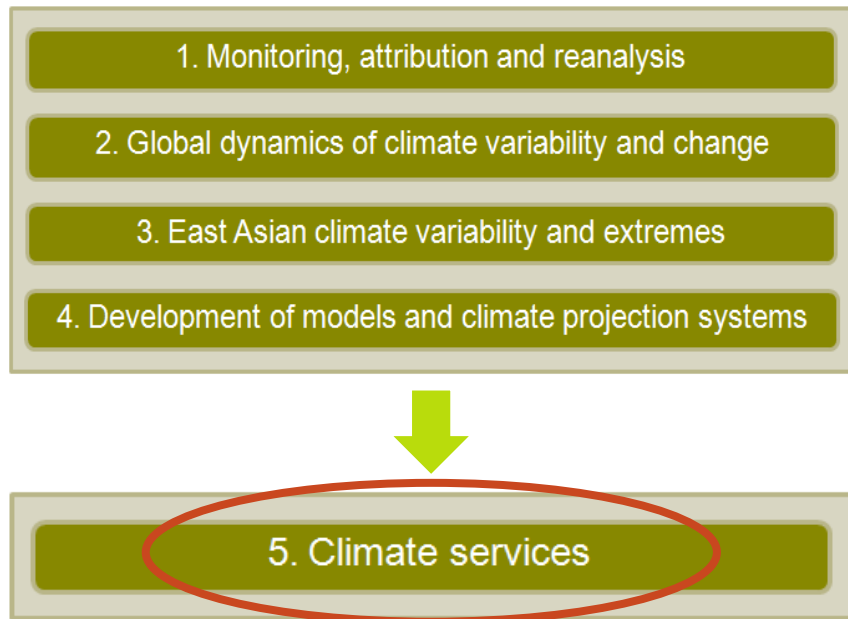
Developing Prototype Climate Services in CSSP China

Jennifer Weeks, Stacey New,
Tyrone Dunbar, Nicola Golding and
Chris Hewitt



Developing the science needed to build climate services that support climate-resilient economic development and social welfare

- Strategic partnership between Met Office, China Meteorological Administration (CMA) and Institute of Atmospheric Physics (IAP). Now in its 7th year
- Accelerated and enhanced collaborative scientific research
- Climate Services developed in collaboration
- Five Work Packages - underpinning science that is pulled through and supports climate service development



Developing the science needed to build climate services that support climate-resilient economic development and social welfare

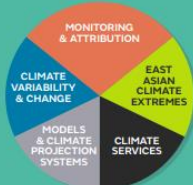
18

UK research partners



5

Core themes



>30

Chinese research partners



>200

Science papers published to-date



>35

Work streams

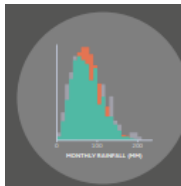


>100

UK scientists



Science highlights



Developing a new way to evaluate the risk of current unprecedented extreme weather and climate events in China.



Skilful forecasts of rainfall, temperature and wind speed on monthly and seasonal timescales over several regions in China.



Investigating the likelihood of crop failures from extreme weather and climate events to evaluate risk to food security in China.

CSSP China – Climate Services

Aims to support CMA in enhancing the China Framework for Climate Services to better meet user needs in priority sectors, which are energy, urban, water, air quality, and food security.

Focused development through a full cycle of prototyping:

- 1) **Understanding** detailed decision-making processes and the climate information needs of a specific user (or user group);
- 2) **Developing** bespoke products and applied science to meet these requirements;
- 3) **Delivering** information through appropriate user engagement, preferably with some element of interactivity and co-production;
- 4) **Evaluating** the service and understanding how decisions were influenced;
- 5) **Feedback** further requirements into underpinning/applied science, and product/service design.

Seasonal forecast for the Yangtze River Basin

Prototype climate
service



WHY IS THE YANGTZE RIVER BASIN IMPORTANT?

Population



Home to 1/3 of China's population

Urban centres



Major cities and economic centres located along the river

Agriculture



Key agricultural region producing about 70% and 50% of China's rice and grain respectively

HOW DOES THE SEASONAL FORECAST HELP SUPPORT ROBUST DECISION-MAKING?

Skilful prediction of summer rainfall



Computer models can predict summer rainfall over the Yangtze River Basin in advance, especially during active El Niño events such as in 2016

Advance warning of high-impact events



The prototype forecast service began in summer 2016 and has run each year since, supporting effective management of hydroelectric dams to alleviate flood and drought impacts

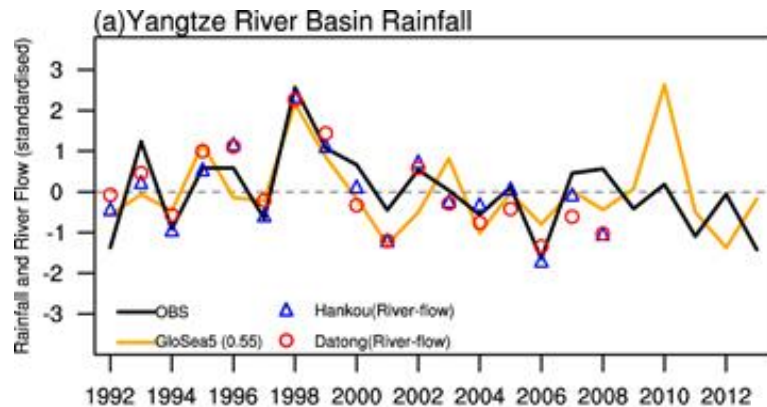
Continual improvement of forecast



The project is working with users to tailor the forecast further to ensure it meets their evolving needs and makes use of the latest forecast capability

Met Office Seasonal forecast for the Yangtze River Basin Prototype climate service

1. GloSea5 showed good seasonal forecast skill for East Asian summer rainfall and Yangtze river flow



2. Developed real-time seasonal forecast with IAP, for use by CMA as forecast guidance. Produced as a pdf briefing, released Feb/March for the summer



**2019 Yangtze River
Seasonal Forecasts**
05 May 2019
© Crown Copyright 2019 Met Office



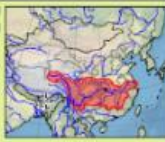
This document provides forecasts for the Yangtze river region in 2019, based on the Met Office's seasonal forecast system. Forecasts are for area-averaged seasonal mean precipitation rate.

The map on the right shows the **basin average** region we are forecasting for. The location of the Three Gorges Dam is marked with a star.

The current headline results for this region are:

For JJA:

- There is a 45% chance of above-average rainfall for the *basin average*.
- There is a 55% chance of below-average rainfall for the *basin average*.



3. Forecast supports decision making of water management organizations in Yangtze river basin, including the Three Gorges Dam

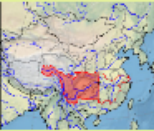


This page shows forecasts for the **Upper Reaches** of the Yangtze River basin, shown in the map on the right.

The current headline results for this region are:

For JJA:

- There is a 60% chance of above-average rainfall for the *Upper Reaches*.
- There is a 50% chance of below-average rainfall for the *Upper Reaches*.

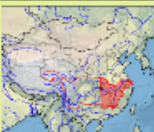



This page shows forecasts for the **Middle & Lower Reaches** of the Yangtze River basin, shown in the map on the right.

The current headline results for this region are:

For JJA:

- There is a 50% chance of above-average rainfall
- There is a 50% chance of below-average rainfall

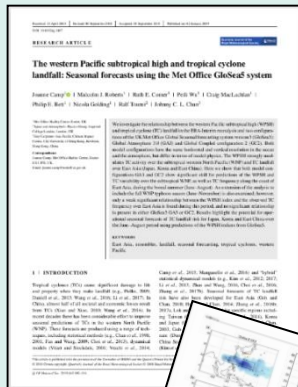


4. From user feedback, improved forecast for 2019 summer by having longer lead time (early Feb) and more regional detail

Seasonal forecast for tropical cyclone landfall risk

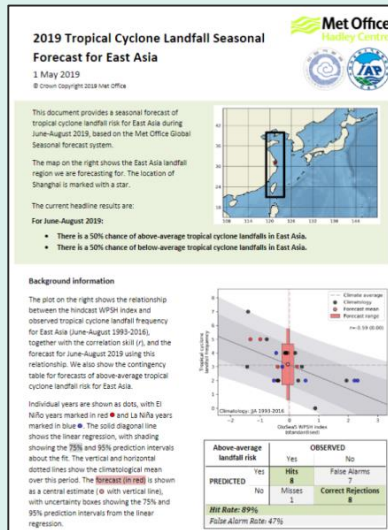
Prototype climate service

Research



Jo Camp et al. February 2019

Prototype Forecast



Issued May 2019

User Engagement Visit



Shenzhen & Beijing, June 2019

What did we learn?



e.g. Users might not make distinctions between different elements of typhoon event

Feedback suggested longer lead time required

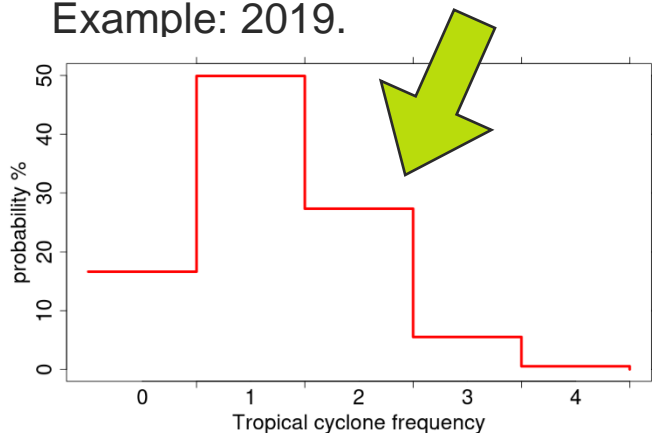
Seasonal forecast for tropical cyclone landfall risk

Prototype climate service

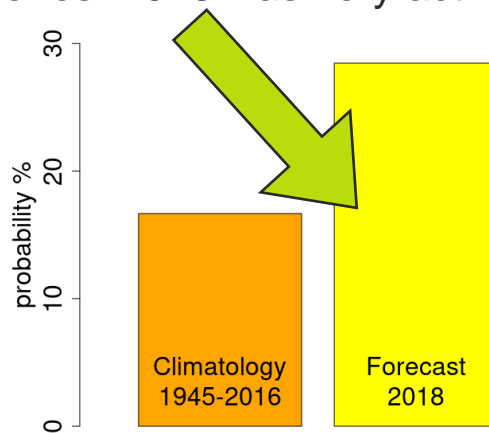
We are engaging with users to develop a tailored service

The basis of the forecast is a probability distribution.

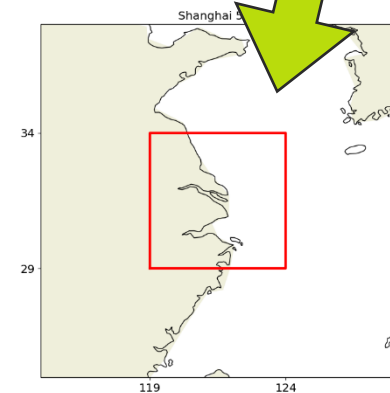
Example: 2019.



However, we can extract elements of the distribution that a particular user seeks. Example: the probability of an 'active' year with 3+ tropical cyclones. 2018 was very active.



We could pick other regions, dependent on the user's requirements



Food Security in CSSP China

Prototype climate service

What are the benefits of this research?

Building resilience to extreme weather



Providing information on the most up-to-date risk of extreme weather events will help communities build climate resilient agriculture and food systems.

Strategies for increasing crop yield



Using adaptation strategies to optimise yield, such as crop rotation.

Developing crop warning systems



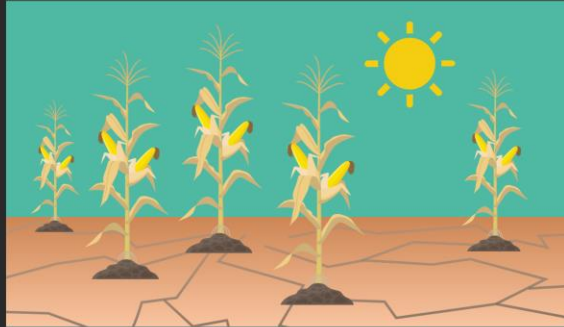
Developing tools to help users better anticipate potential damage to crops.

Food Security in CSSP China

Prototype climate service

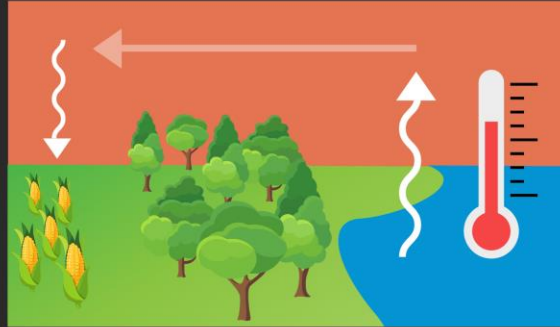
What does our latest research show?

Current risks to crop production



Research has shown there is a 5% chance per year of a larger area drought than any previous event, and roughly a 6% chance per decade of simultaneous maize crop failure in China and the USA.

Predicting unfavourable conditions



Research has identified a link between sea surface temperature patterns in different oceans and yield of maize across North and North-east China. This has potential to provide advance warnings of unfavourable conditions for growing crops.

Where and how crops are affected



Research can help to understand and quantify factors affecting agricultural yield. This is performed through the analysis of water use and crop health indicators.

Food Security in CSSP China

Prototype climate service

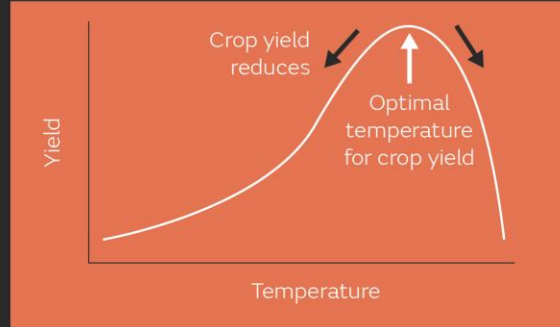
What research is being done?

Modelling extreme weather events



Using the latest climate models to simulate the most extreme weather events that are physically plausible (the UNSEEN* method).

Crop response to extreme weather



Using observations and models to understand how crops are affected by changes in temperature and rainfall.

Satellite mapping of crop risks



Using images from the Copernicus Sentinel satellite database, which can be used to monitor crop stress and impact on yield.

Summary

CSSP China is developing bespoke climate services through the cycle of prototyping:

- A seasonal forecast of summer rainfall in the Yangtze river basin has demonstrated full completion of this cycle
- A seasonal forecast of tropical cyclone landfall risk is being developed and improved in response to feedback and user needs
- A climate change risk assessment for food security will engage with stakeholders to co-develop and communicate policy-relevant material
- Challenges remain in communicating the science and its limitations