Development Status of Chinese Agrometeorological Service Support System

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1. Significance of service support system for agrometeorological service

- Agrometeorological service for ensuring: high yield, high quality, high efficiency, environmental protection and security of agricultural productions.

- China is transforming its traditional agriculture into modern agriculture:
  
  ----advanced science and technology, commercialization, intensiveness and industrialization.

  *The development of modern agriculture bring forward many higher requirement on agrometeorological service, so we must adapt the change and requirement as soon as possible.*
Traditional agrometeorology transforming into modern agrometeorology, too. Realizing:
----automatic monitoring, accurate forecasting, quantitative evaluation, systematic services, electric transmission and professional personnel.

The data, materials, technologies, measures, index, modules, equipments and operation procedures of traditional agrometeorology shall be improved and promoted.
We must establish a modern agrometeorological service support system which is more automatic and multi-functional.

- **data** are the important basis,
- **analysis software** is the effective tool,
- **information transmission system** is the main channel of operational services.
2.1 Data used in agrometeorological services

(1) Meteorological data:
The routine meteorological data include daily (hourly, weekly, monthly, seasonal, annual)
— mean/max/min air temperature;
— precipitation, precipitation days ($\geq 0.1$mm);
— sunshine duration;
— solar radiation;
— wind velocity and direction;
— ground mean/max/min temperature, 5cm-320cm depth soil temperature
— atmospheric circulation index, SST, etc.
(2) Crop materials:
— crop growth stages,
— growth quantity (like density, LAI, etc.),
— yield formation elements,
— plant diseases and insect pests,
— agrometeorological disasters, etc.
— data on natural pasture growth period and yield,
— livestock and herding.
(3) Soil data:
— soil features like soil moisture, wilting moisture, field capacity, dry soil thickness, frozen soil depth and precipitation penetrating depth;
— soil fertility, soil salt content, soil pH value, soil organic content, soil nutrient content etc.
(4) Ecological data:
— water area of lakes, water quality, water table, flow flux, soil erosion, forest fire disaster, heavy fog, marsh area, etc.,
— ecological element monitoring data including dustfall, atmospheric particulates, natural pasture yield and nutrition, soil moisture and nutrition, wind erosion, due traveling, etc.
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(5) **Remote-sensing data:** Satellite data including EOS/MODIS, NOAA/AVHRR, FY1D, FY2E, FY3A, TM, ETM+, CBERS, SPOT, QuickBird and IKNOIS. Remote sensing data from polar meteorological satellite are mainly transmitted through DVBS and received freely.

(6) **GIS data:** Fundamental geographic data with the scale of 1:4,000,000, 1:1,000,000, 1:250,000 and 1:50,000.
2.2 Universal data processing tools

1) Data processing software: like Excel, Access, SPSS, SAS, Matlab, Sufer, Grapher and SQL server 2000,

2) Remote sensing image processing software: like ENVI, ERDAS Imagine and PCI etc.

3) GIS software: like ARCGIS, ArcView, Mapinfo, MAPGIS and SUPERMAP.
(4) **Satellite system:**

The polar meteorological satellite and EOS/MODIS data are mainly processed through the satellite data receiving, processing and analyzing software systems developed by Beijing ShineTek Satellite Application System Engineering Co., Ltd (CMA).
EOS/MODIS data receiving and processing system
2.3 Special operation and service system

There are also many special software systems, such as AB agrometeorological data coding program, precipitation and soil moisture statistics software, yield prediction software and data inquiry software, are developed independently.
(1) Agrometeorological information/forecasting system

◆ **PAMOS:** Ten provincial meteorological bureaus organized by CMA developed the new generation of Provincial Agrometeorological Operation and Service System (PAMOS), included the functional modules: database, agrometeor. information, forecasting, agroclimate resource development and application, satellite remote sensing and information service.

The system has been applied in the meteorological departments of 34 provinces. But because it is very comprehensive and complex, its applications have many restrictions.
The new generation of Provincial Agrometeor. Operation and Service System (PAMOS)

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Agrometeorological information system: ten-day/monthly report coding system, ten-day/monthly report analyzing and processing system, agrometeorological information forecasting system, observation information and operation system of automatic meteorological station etc.;
(2) Agrometeorological disaster monitoring and early warning evaluation

Mainly including drought monitoring evaluation and early warning system, drought or extreme rainfall monitoring system, drought disaster damage evaluation model, dry-hot-wind disaster evaluation mode, low temperature and cold injury forecasting model for rice, late frost damage forecasting model and agrometeorological disaster monitoring and alarming system;
(3) Soil moisture monitoring and forecasting system

Soil moisture analyzing and processing system, soil moisture drawing system, soil moisture forecasting system, soil moisture monitoring and predication operation system, meteorological service and operation system for optimal water-saving irrigation;
Soil moisture forecasting system of Henan Province

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(4) Crop yield and growth stages forecasting

Crop yield forecasting system, growth period forecasting system based on dynamic—Stat. model (such as WOFST or DSSAT for wheat, DYCIFOS for Maize), simulation system on meteorological influence on rice growth and yield (such as ORYZA2000), rice simulation and optimizing decision system in Jiangxi (Rcsodsvb), the forecasting model of picking period for medlar (Ningxia), etc.;
Crop yield prediction software
(5) Plant diseases and insect pests forecasting

----National meteorological grades prediction system on plant diseases and insect pests occurrence

----provincial meteorological prediction system on locust disaster, pine caterpillars disaster, rice insect prevention, rice blast in Chongqing, medlar black fruit disease forecasting etc.
Meteorological prediction platform for serious insect pests of agriculture and animal husbandry in Inner Mongolia

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Diseases & insects meteorological grades forecasting system in Henan Province

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(6) Satellite remote sensing monitoring operation

National and regional:

---remote sending monitoring and evaluation system on fire disaster, plant growth, soil moisture and ecological environment monitoring system,

---remote sensing monitoring model on natural pasture yield and remote sensing evaluation model on grazing capacity;
Comprehensive operation system of meteorological satellite remote sensing of Anhui Province
Wheat (Left) and Soil moisture (Right) Monitoring image by NOAA/AVHRR

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(7) Others

NMC of CMA has entrusted SuperMap Company to develop the System of Elaborate Agricultural Climate Zoning Product Making;

Some provincial meteorological bureaus have developed some agricultural climate zoning systems and other systems by themselves, including meteorological evaluation system on ecological quality, simulation mode on banana planting benefit, calculation software for reference evapotranspiration and crop water demand in farmland, decision-making accessory system for agricultural communication system etc.
The application of the analysis tools and operation systems above

------provides better meteorological services for the promotion of agricultural productivity,

------enhances the efficiency of agricultural productivity and promotes the ability of operation application.

However, there are still problems waiting to be solved, such lower automatic level etc.
2.4 Information delivery system

2.4.1 Reception ways for fundamental information of agrometeorology

(1) Surface weather coding report
(2) Agrometeorological coding report
(3) Satellite remote sensing data
(4) Other data

Such as crop planting area, insect pest area, etc. which shall be gained from agricultural departments in the form of E-mail, fax and letter without fixed periods.
2.4.2 Media for the releasing of service products information

(1) TV

CMA has a special meteorological channel which consistently broadcasts meteorological for 24h a day.

Some areas like Shandong Province also set special meteorological channels which can be received by CATV users within the areas.
TV service of agrometeorological information by China Meteorological TV Channel

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(2) **Newspaper**

China Meteorological News, as the only special meteorological newspaper in China, is dedicated to publicizing best meteorological services.

The key provincial or regional meteorological news or agrometeorological service column shall be publicized in the local newspaper.
Newspaper service of agrometeorological information

China Meteorological News

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(3) Network (Website, ftp, E-mail)

Network has been the most popular mode for agrometeorological information releasing at present.
(4) Others

The other meteorological information releasing media include cell phone text, radio, public screen, loudspeaker in countryside, news conference, fax and governmental information exchange. Some provinces even establish the information releasing systems of their own (such as Qinghai meteorological information operation system and Chongqing meteorological information sharing platform).
3. Problems of the agrometeorological service support system

3.1 agrometeorological Data

(1) Poor agrometeorological observation measures and low automatization of material acquisition;
(2) Unrepresentative agrometeorological observation data;
(3) Poor effectiveness of agrometeorological observation data.
Poor agrometeorological observation measures and low automatization of material acquisition
3.2 Analysis tools

(1) There are more general software and programs than special data analysis tools for agrometeorological field;

(2) Due to the lacking of promotion trainings on the data analysis tools (including INSTAT, AgroShell, etc.) recommended by WMO, the tools are seldom used in the China daily agrometeorological operation services;

(3) Chinese agrometeorological operations are short of the data analysis tools and pre-evaluation systems for the evaluation of the effect of climate changes on agriculture;
(4) The operation system and software mainly are universal in the country, they are unable to meet the demands of different climate areas and different provinces;

(5) The agrometeorological operations are in short of mechanical mode; the quantitative remote sensing application is in low level without further development;

(6) The quantitative, dynamic and mechanical numerical simulation method for crop growth is mainly applied to field experiment instead of in the operation;
(7) The agrometeorological information service products are not that normative and quantitative. There are no necessary agrometeorological index and quantitative evaluation models. Meanwhile, the evaluation of the effect of climate conditions on agricultural production is still mainly described in common words with low quantification which is unable to better meet the demands of users.
3.3 Information transmission system

(1) Low informationization of agrometeorological data.

(2) Limited agrometeorological service targets and asynchronous information transmission.

(3) Lacking of highly-effective and automatic information releasing system.

(4) Single agrometeorological service productions are not well integrated with the new technologies like RS and GIS, etc.
(5) Limited information coverage.
(7) Slow renewal of agrometeorological information.

(6) Shortage of effective feedback mechanism. And the information is not publicized consistently and timely.
4. DEVELOPMENT SUGGESTIONS

4.1 Agrometeorological Data

(1) Decreasing automatic instruments prices, strengthening automatic agrometeorological observation

(2) Increasing the temporal and spatial intensity of agrometeorological data

(3) Strengthening the dynamic monitoring on agrometeorological disaster

(4) Strengthening the application of satellite data
- 119 AWS in Henan Province (UP)

- Nearly 1800 rainfall stations in Henan Province (Down)
4.2 Agrometeorological operation analysis tools and operation system development

(1) Since the special agrometeorological operation analysis tools are in shortage at present, concentrated research & development and promotion of the tools shall be strengthened.

(2) Strengthening the focus on the agrometeorological analysis tools recommended by WMO and introducing the tools into agrometeorological operational services timely.

(3) The development and introduction of special data analyzers to evaluate the climate change effect shall be further strengthened.
(4) More **special** operation systems shall be developed on the basis of multiple observation, and more efforts shall be made to further support the intensive development of agrometeorological operation software.

(5) Organizing some **training courses** on remote sensing, GIS and analyzer or skill trainings for agrometeorological service.

(6) More operation systems should be promoted and more convenient analyzers should be provided by WMO.

(7) Promoting the application systems of crop growth simulation mode and dynamic yield forecasting mode. Strengthening the application of agrometeorological simulation mode to larger scales.
4.3 Information delivery system

(1) Establishing modern agrometeorological service platform and automatic information delivery systems as soon as possible.

(2) Strengthening direct services for farmer, promoting the establishment of countryside information service stations and focusing on the problems like the last 1km of information publication.
(3) Establishing the public feedback mechanism, aiming at improving the mode and content of the service.

(4) Improving the status of agrometeorological service products which are single, old and poor in operation, highlighting the local characteristics and increasing the practicability of serving farmers.

(5) WMO shall develop more channels to release various latest agrometeorological operation and development news and data to every country.
4.4 Recommended agrometeorological software, methods and resources

4.4.1 Agrometeorological data

(1) Soil moisture is the most common material in agrometeorological operations, so the application of automatic soil moisture data observation shall be strengthened. At present, Henan and Shaanxi have initially established FDR automatic soil moisture observation networks of their own, which have well applied the soil moisture data to agrometeorological operations and services.
Automatic soil moisture observation network of Henan

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(2) Strengthening the application of satellite remote sensing data. Chinese FY-3A polar meteorological satellite is equipped with 11 remote sensing instruments, it will have a comprehensive (global, 3-D, all-time and multi-spectrum) exploration to global environment and play a key role in agrometeorological operations.

In addition, the application of satellite data like SPOT, TM and CBERS (data free!) with high resolving power shall also be strengthened, for they will play an important role in the evaluation of crop area and yield.
4.4.2 Agrometeorological analysis tool

(1) PAMOS, which is developed by CMA, is able to well meet the daily agrometeorological operation services. The system (Version 2.0) is now under development, which will be provided with better functions and convenient operations.

(2) At present, Chinese Academy of Meteorological Sciences (CAMS), on the basis of WOFST model, observation data of large fields and satellite remote sensing data, has initially established the winter wheat yield forecasting operation system for North China, which is effective and worth being promoted and applied.
CBERS satellite image (19m)
(3) NMS of CMA develop the **GIS-based Elaborate Agricultural Zoning Production Making Platform** to meet the demand of technicians of the industry for making agricultural climate zoning products, aiming at realizing the interactive and fast making of professional and high-qualified zoning products. The system is advanced and convenient, with strong functions. It will greatly promote the operations of agricultural climate zone division works.
high quality wheat elaborate agricultural zoning Map in Zhengzhou city
4.4.3 Agrometeorological information service system

(1) It is convenient and fast to deliver agrometeorological observation information through cell phone signals like GPRS and GSM, communication satellite signal or broadband network, so it is worth being greatly promoted.

(2) Agrometeorological service information shall be delivered to the countryside and farmers timely through multiple modern methods including TV, radio, network, cell phone text, community radio, DAB, agrometeorological disaster alarming information receiver, etc.
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