CLIDDSS: A Decision Support Tool for Climate Services

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Outline of Talk

I. Our Philosophy in Considering Tools for Climate Services
II. Stakeholder Needs for Hydroclimatic Information
III. CLIDDSS
IV. Conclusions, Recommendations
Many Space & Time Scales

Weather Forecasts

Extended/Seasonal Weather Predictions

Climate Outlooks

Decadal Variability

Climate Change

Spatial Scale (km$^2$)

General Flood

Flash Flood

Drought and Conjunctive Management

Reservoir Operation, Well-Field, Watershed Resources, and Ecosystem Management

Safe Yield and Reliability

Structural Integrity

Temporal Scale
Timescales of Climate Information

- **Past**
  - Instrumental record: decades to over one century
  - Paleoclimatological indicators: centuries to millenia

- **Future**
  - Forecasts: months to over one year
  - Climate change: decades to century
Needs of Federal and State Governments

**Concerns for Climate Science Enterprise**

- Transferability
- Scalability
- Change decisions and decision processes
- Public support for climate research

Enabling system-wide change
Sustainability
General Needs of Users

**Products**: link variability, impacts, response options

**On-going Process**: mutual capacity building

**Equitable**: outcomes benefit participants

**Equity**: Affected stakeholders; tools for knowledge development and diverse decision processes, on-going support of research products and tools
Needs for Climate Information and Forecasts

Common across all groups
Tendency to interchange climate and weather
Uninformed, mistaken about information interpretation, e.g., forecasts
Use of forecasts limited by lack of demonstrated forecast skill

Common across many, but not all, stakeholders
Have difficulty distinguishing between “good” & “bad” products
Have trouble linking information about the past, present, and future

Unique among stakeholders
Relevant information variables, regions (location & scale), seasons, lead times, performance characteristics
Technical sophistication: base probabilities, distributions, statistics
Role of information in decision making process: policy, operations
Realization of socio-economic benefits from public investment in hydroclimatic science remains incomplete because decision makers have difficulty: 1) interpreting individual products, 2) appropriately judging information credibility, and 3) linking different types of information, both conceptually and practically.

The challenge: Creating flexible information products and tools that can accommodate unique user needs.

The goal: Systemic change in the nature of information delivery and use.

**Three Tools**
- Forecast Evaluation Tool
- Automated Hydrologic Threshold Alert System
- Climate Information Delivery and Decision Support System
Currently for NWS CPC climate forecasts, 3MLO, Alaska

Six elements in our webtool:

- Exploring Forecast Progression
- Forecast Interpretation - Tutorials
- Historical Context
- Forecast Performance
- Use in Decision Making
- Details: Forecast Techniques, Research
Automated Threshold Alert System

Addresses Difficulties in Continuous Near-real Time Monitoring and Response

Automatically accesses USGS real-time gauge network, tests for compliance with hydropower license settlement limits, and notifies key individuals when settlement limits have been exceeded. **Email notices link to data displays**

Web-forms enable standardized reporting by responders, including agency personnel, volunteers, and power companies, on the causes and consequences of flow excursions invoking notification. **User groups manage their own threshold database: equations, email lists & messages, station lists, etc.**
Information Management: Collections of products from different sources stored in customer-based portfolios.

Save a history of work on each product, so you can return to your work any time, easily repeat past analyses using updated data.

Report Generation

• create PDF reports of your product collections and analysis results for non-Internet users

• automatically includes provider-mandated legends, data sourcing, logos, contact information, caveats, explanations

• sections for intermediary’s value-added comments
**CLIDDSS: Climate Information Delivery and Decision Support Tool**

### What Providers Get
- Control over ancillary content of products
- Maintain their ‘brand’ and image
- Track contextual use of products

### What Intermediaries Get
- Can focus on adding value rather than accessing data
- Efficiency allows serving many more clients while hitting their individual needs
- Can maintain their ‘brand’ and image
- Interdisciplinary networking through group involvement in portfolio and report development

### What Users Get
- Beginners benefit from experience of others, through access to pre-developed portfolios
- Capacity-building through group/team-managed portfolios and reports
- Customized translation by specialists of generic products
- Expert screening of ‘good’ information

Synergistic growth in utility as more & more products link to portfolios & report
Initial applications: US-Mexico Border Climate Summary - March 2007

Web services to connect with distributed providers: We are actively seeking providers!
How CLIDDSS Works

User’s computer has:
Browser pointed to FET and
JDO Persistence Layer

Database stores:
• product states (not raw products)
• All data except locally stored images/text

CLIDDSS Application

CLIDDSS
Server

CLIDDSS SOAP Service

Apache Tomcat

JDO Persistence Layer

Database

FET Server

Product Retrieval SOAP Service(s)

Submitting Product State to CLIDDSS

Product Component Retrieval Requests:
(submits a product’s state)

Hard drive stores:
• PDF Report(s)
• Locally saved images/text

Product Components

User Customized Report Template

Report can include:
• Products
• Images
• Text

Persistence Layer allows CLIDDSS to be easily moved from one database to another

Database stores:
• product states
• All data except locally stored images/text
## Steps to Become a Product Provider

<table>
<thead>
<tr>
<th>Product provider’s work</th>
<th>CLIDDSS Developer’s work</th>
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<tbody>
<tr>
<td>• Identify product</td>
<td>• Create a product</td>
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<tr>
<td>• Identify product</td>
<td>submission service for</td>
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<td>components</td>
<td>CLIDDSS based on</td>
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<td>• Supporting text</td>
<td>submitted WSDL file</td>
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<td>• Agency logo</td>
<td>• Send back product</td>
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<td>• Selection criteria</td>
<td>submission WSDL file and</td>
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<td>• Create a SOAP service</td>
<td>service location</td>
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<td>for product</td>
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<td>• Submit SOAP service</td>
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<td>WSDL file to CLIDDSS</td>
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<td>developers</td>
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<td>• Modify product HTML</td>
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<td>page to allow users to</td>
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<td>request product</td>
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Lessons Learned: Knowledge Development Tools

• Transferable, scalable tools are possible!

• Focus on knowledge development, not just data & information.

Prototypes insufficient! Stakeholders need reliable tools, which require solid software foundation, organized development, sustainability for maintenance and expansion.

Interactive webtools require major commitment and resources.

Important for 'Process': Training, other capacity building activities.
Usable Software Tools: Lessons Learned

- If a tool is easy to use on the front end, it was hard and complex on the back end.
- You aren’t programming for today’s technology. You’re programming to accommodate tomorrow’s technology and tomorrow’s markets.
- One super-developer is not enough to complete complex software tools and applications. Sophisticated software tools require programming teams to complete in a time-responsive manner.
- Junior programmers and graduate students, alone, may not be sufficient to complete software tools and applications.

University and climate research programs have not yet come to terms with these issues.
CLIDDSS Design Issues & Plans

• Importance of implementing a well featured report editor
  - To facilitate ease of use, and lessen frustration

• Importance of supporting group development of reports
  - Allow group creation and editing/viewing based on group permissions

• Importance of supporting private business
  - Additional features to allow storage of report data on local computer
  - Some private business may have proprietary data they don’t want stored in the CLIDDSS database.
Past Recommendations
Researchers should adapt: conduct stakeholder-relevant research, develop applications, transition to operations
Decision makers should adapt: use advances in climate information and forecasts, incorporate uncertainty and probabilities, use risk management approaches

New Recommendations
Federal Agencies and Academic Institutions should adapt, too

Serve broad user needs for knowledge development & information management
Exploit evolving technologies
Facilitate rapid deployment of user-customizable webtools
Support ‘products’ over ‘prototypes’
Use Creative Commons to encourage applications by private sector & others
Allow website advertising for efficient financial sustainability
Web Service

“a software system designed to support interoperable machine to machine interaction over a network” \textsuperscript{W3C}

SOAP, a protocol where messages are wrapped in XML and normally sent over HTTP