SWIOCOF – 12

Moving from Climate Forecasts to Impact based forecasts and Climate Services

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SWIOCOF-12 : Which Climate Services ?

Definition of Climate Services (WMO)

- **Generating and providing information on past, present and future climate, and on its impacts on natural and human systems**
  - Climate monitoring
  - Climate watches
  - Monthly/Seasonal/Decadal climate predictions
  - Climate Change projections
  - **Need for more information than climate**
- **...**

SWIOCOF-12 : Which Climate Services ?

Definition of Climate Services (WMO)

- **Helping the user to choose the right product for decision making, and use it appropriately including aspects of uncertainty**
  - **Tailored information for Decision Making Processes (DMPs)**,
  - **Impact of the use of the information onto the DMPs** and associated evaluation,
  - Uncertainty and Decision Making,
  - Necessary shared knowledge,

SWIOCOF-12 : Which Climate Services ?

Impact based information

- **Impact based information**
  - More relevant to the user's Decision Making Process
  - Make the information more actionable
  - Facilitate the risk assessment
  - Better understanding on the user side
- **Impact variables**
  - Directly related to Stakeholder activity
  - Relevant to describe Climate impact onto the user activity
  - Possibly mixing climate and non climate data,
  - Ideally available over the past (see hindcast)
- **...**

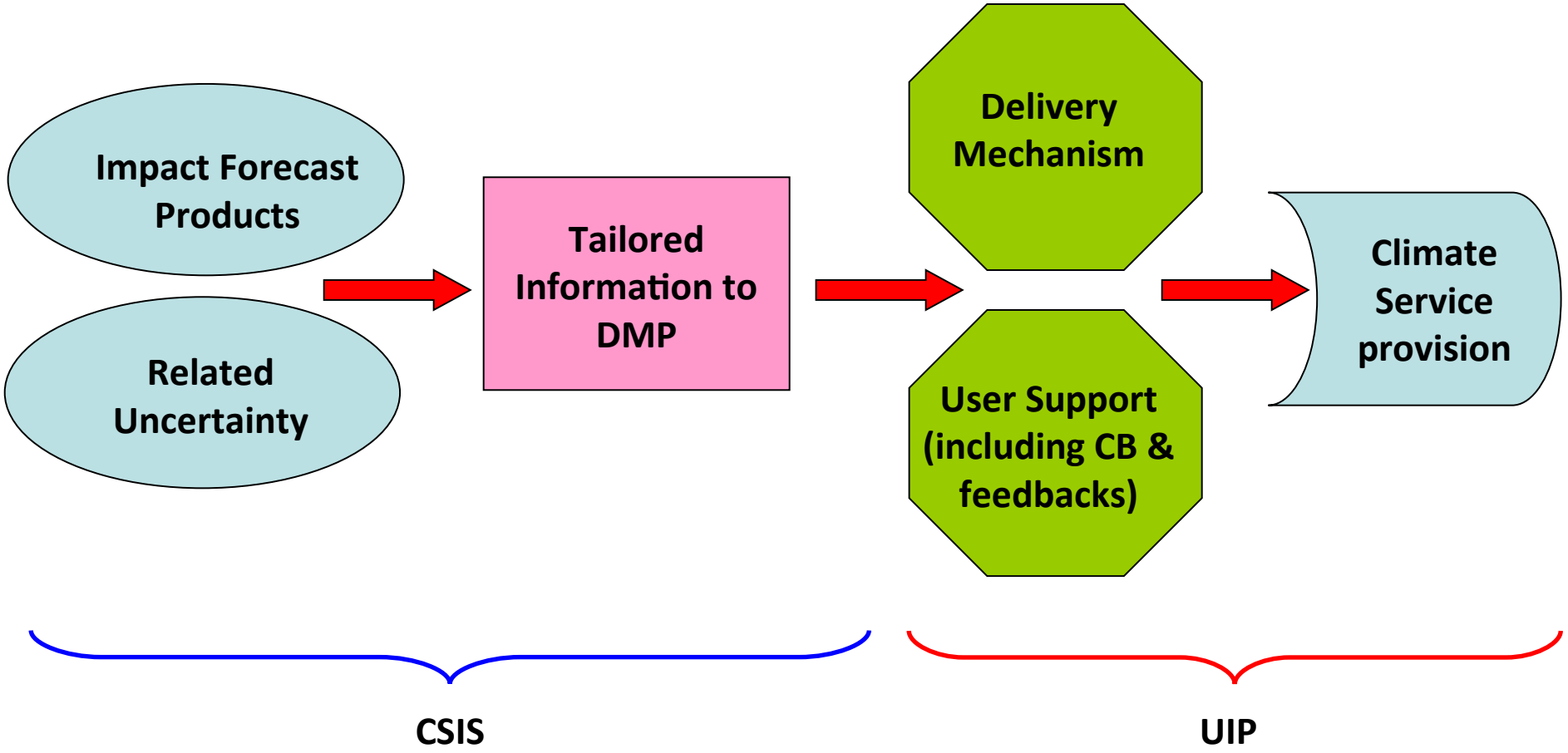
SWIOCOF-12 : Which Climate Services ?

Impact based information

- **Impact models**
  - Similar (in term of processes) to any climate model,
  - Needs of hindcast experience (skill, bias correction, …)
  - Input related to climate and possibly non climate data,
  - Needs of initial conditions and forcing terms along the simulation,
  - Relative weight of climate variables onto the output
- **Impact forecasting suites**
  - Downstream of the Climate forecasts,
  - Needs for downscaled climate information,
  - Process similar to Climate Forecasts (ensemble forecasts, MME issues, uncertainty assessment, …),
  - Output relevant for Decision Making (possibly after some post-processing),

SWIOCOF-12 : Which Climate Services ?

Schematic vision for a Climate Service



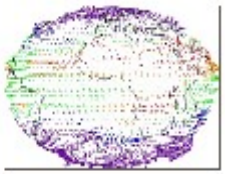
SWIOCOF-12 : Impact based forecast and CS

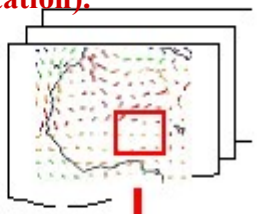
An example : from forecasting information to DMP

The Manantali dam management

Atmospheric Forecast: beginning of August rain for SON

Post-processing/Dissemination : downscaling and tailoring the climate information in impact variable (river flow at a specific station).



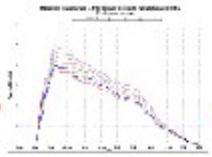


Impact assessment : merging the impact information with management rules and dam data to provide information relevant to the DMP

Schematic representation of the Water Management System of the dam

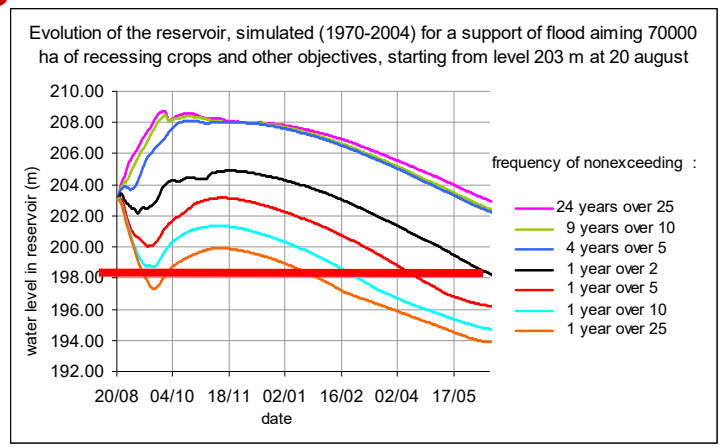
POGR

Water Permament Commission 20 August



Real time management of the water release over the september and october period using the observed flows of the Bakoye and Famélé rivers

Decision Making Process : Choice of the best strategy with respect of concurrent use of water and the characteristics of the climate (dry season occuring end of October and forecast of the end of the rainy season)



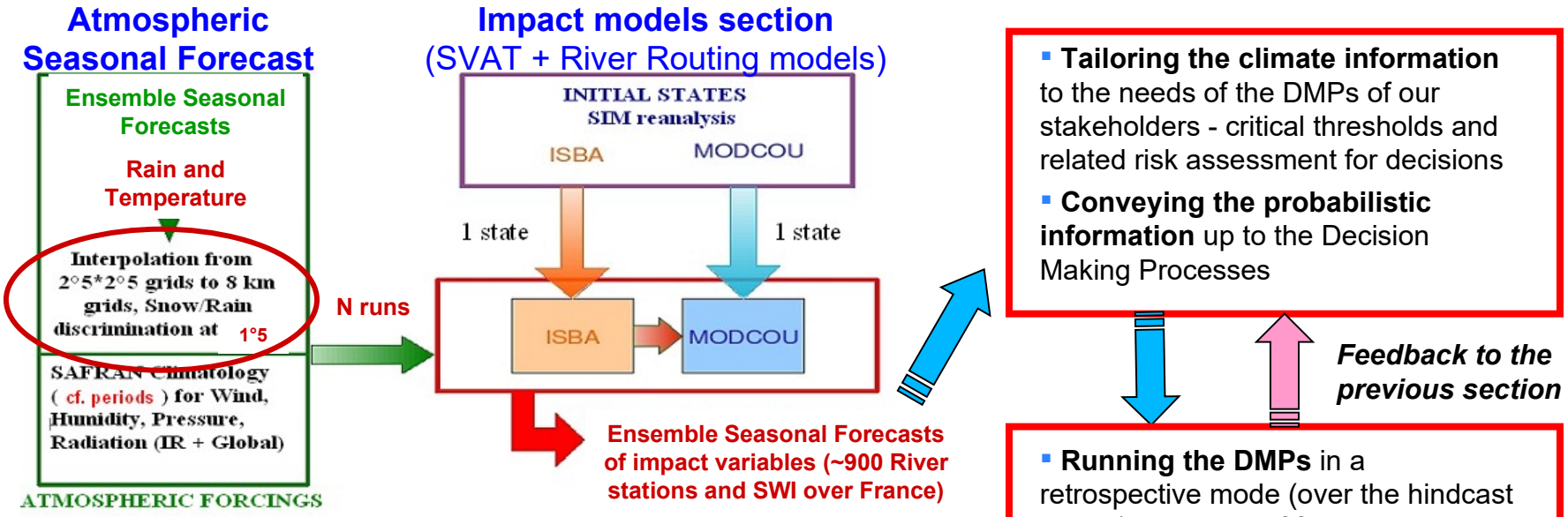
Tailored Information

- Use of the River Flow forecast clearly related to the DMP and management rules
- Transformation of the impact forecast in risk assessment
- Model simulation of water stock evolution into the dam
- Critical threshold into the DMP
- Critical date for Decision (by mid-august)

Schematic representation of the water management system

SWIOCOF-12 : Building a CS (details)

Schematic representation of the MF Water resource prototype



- **Tailoring the climate information** to the needs of the DMPs of our stakeholders - critical thresholds and related risk assessment for decisions
- **Conveying the probabilistic information** up to the Decision Making Processes

Feedback to the previous section

- **Running the DMPs** in a retrospective mode (over the hindcast period) with 2 set of forecasts as proposed in the Placebo protocol
- **Assessing the added value of the seasonal forecast**, the impact of the use of the information onto the DMPs and the relative weight of the Climate Information within the DMPs (thanks to the Placebo protocol)

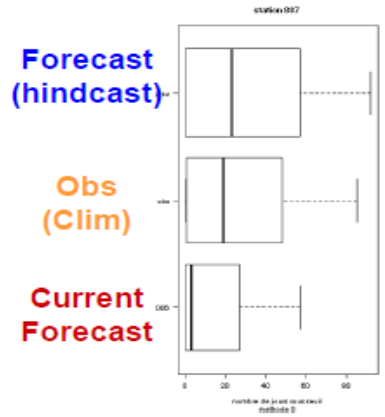
- **Building the Climate Service prototype** first tailored to our specific stakholders and their DMPs
- **Providing the Climate Service in operational mode** using web based services and existing web plateforms (to be likely adpated) at Météo-France
- **Extending the Climate Services** across France, application domains (e.g. Energy, Agriculture) and potentially across Europe

SWIOCOF-12 : Building a CS (details)

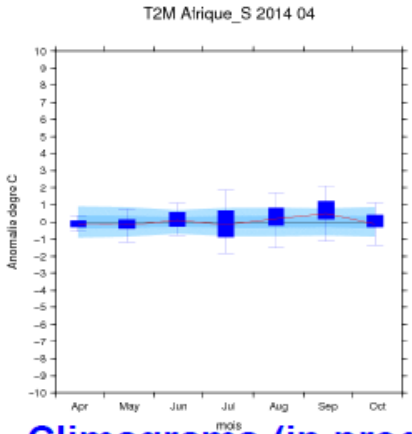
- Tailored Information for the Low Flow period
  - **Provision to EPTB (Seine) and SMEAG (Adour-Garonne)**
    - At key stations used into their DMPs
    - End of Spring (May – beginning of June) with possible insight up to end of November (forecast updated each month useful)
    - River Flow Monthly means : Climagrams
    - River Flow Daily time series :
      - ✓ Ensemble Median, outer Deciles (and Quintile possibly),
      - ✓ For additional simulation (EROS model over the Marne river)
    - River Flow “0” rain scenario (daily values) : for assessing the maximum volume of water to be released (worst scenario).
    - Additional products : Water Volume integrated along the period, Number of days below the relevant thresholds
  - **Communication**
    - Products : Graphics and Digital
    - Risk assessment : Odds or relative Odds instead probabilities

SWIOCOF-12 : Building a CS (details)

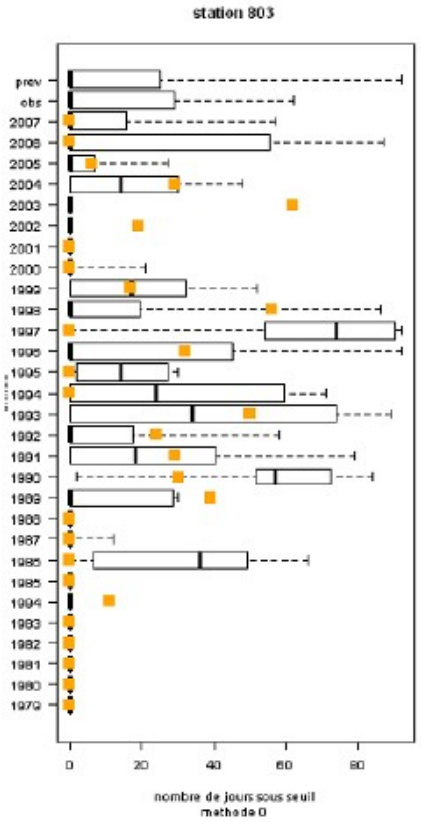
- Tailored Information to DMPs : Some examples

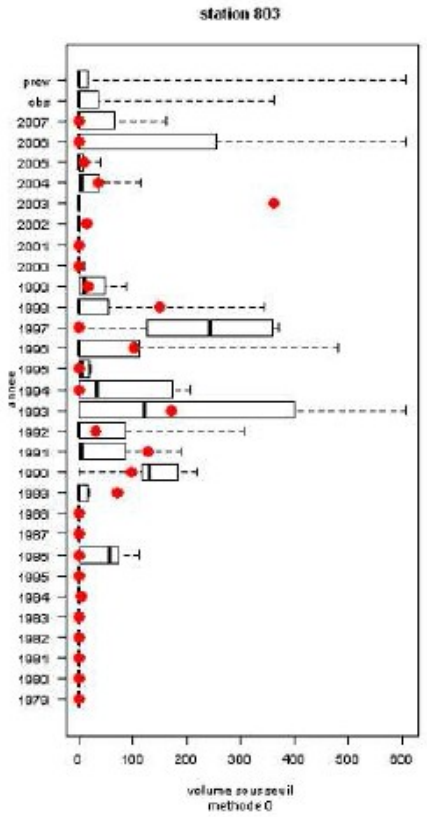


Uncertainty information (pdf)



Climagrams (in progress)

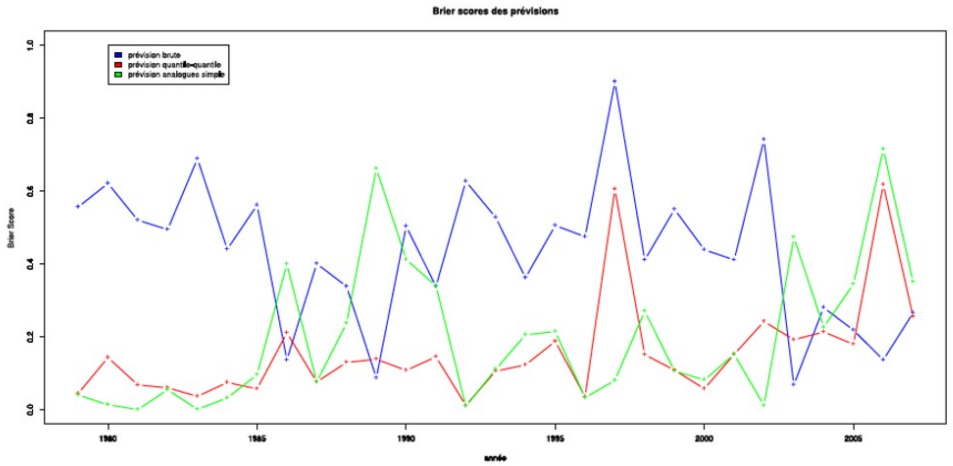




Number of Days (left) and Integrated Volume (right) under the vigilance threshold

SWIOCOF-12 : Building a CS (details)

- **Calibration of the River Flows (with respect of stakeholders data)**
  - **Several methods tested against raw forecasts**
    - Quantile/Quantile correction,
    - Analogues
      - ✓ Ensemble Median or Ensemble mean, number of analogues, Time window considered,
    - PDF adjustement,



Comparison of Brier Scores for different calibration methods over the Hindcast period (1979-2007) at Lamagistère (S1 – Garonne)

Stat.	S1 Gar.	S2 Gar.	S3 Tarn	S4 Ave.	S5 Arie.
Met.	**QQ**	**QQ**	**QQ**	**ANA 1**	**QQ**

Best calibration method for different rivers and stations (period 1979-2007)

The QQ correction is the best calibration method most of the time

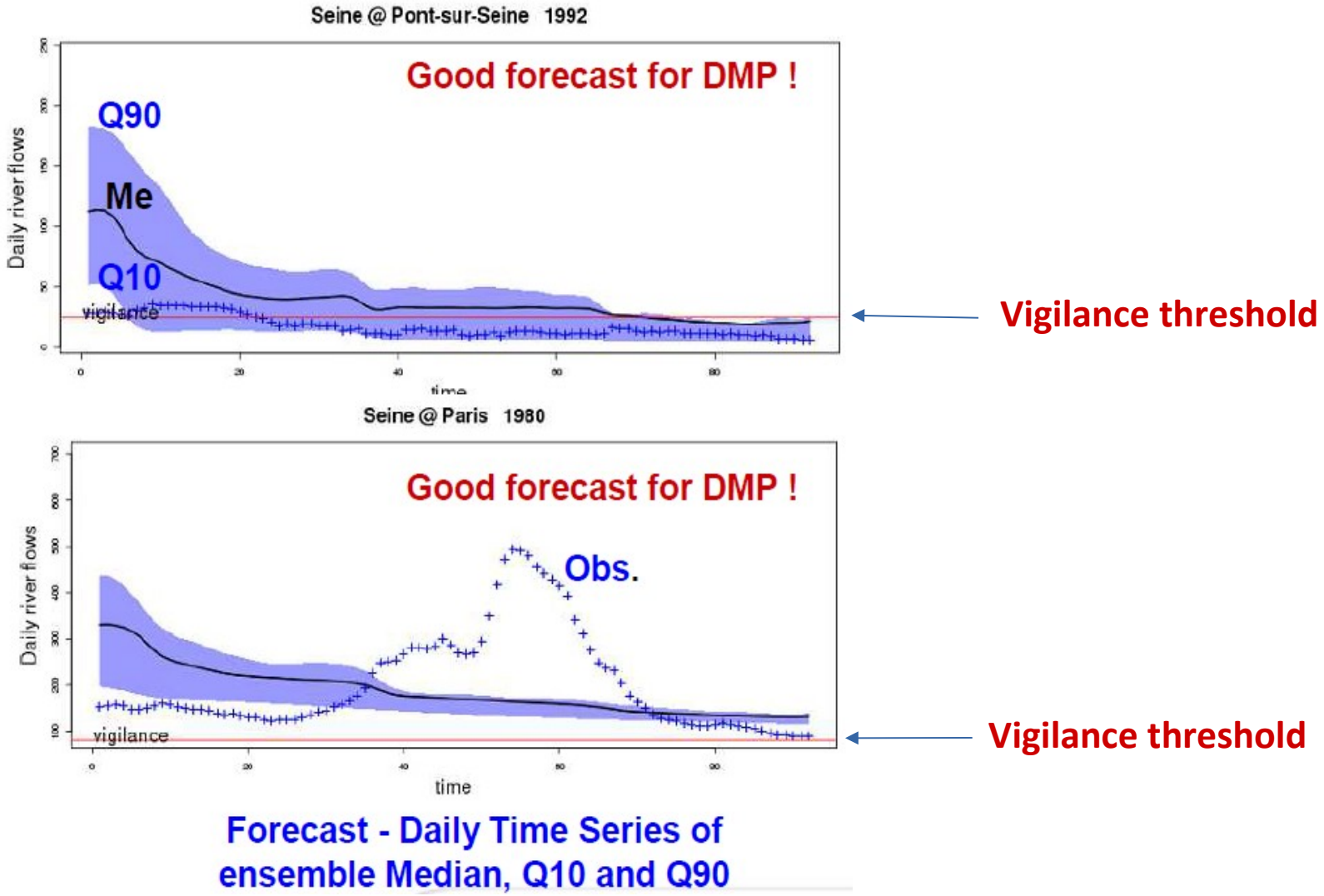
SWIOCOF-12 : Building a CS (details)

Evaluation of Impact Forecasts

- **Evaluation of the impact probabilistic forecast**
  - Reference dataset (impact variables, …)
  - Reference strategy (climatology, random atmospheric forcing, …)
- **Evaluation of the impact of the use of the information**
  - Demonstration of the impact of the use of the information onto the DMP : based on Placebo concept
  - Stakeholders “replaying” (if possible) 30 years of decisions (blind method),
  - Issuing a comprehensive analysis of the Decision made,

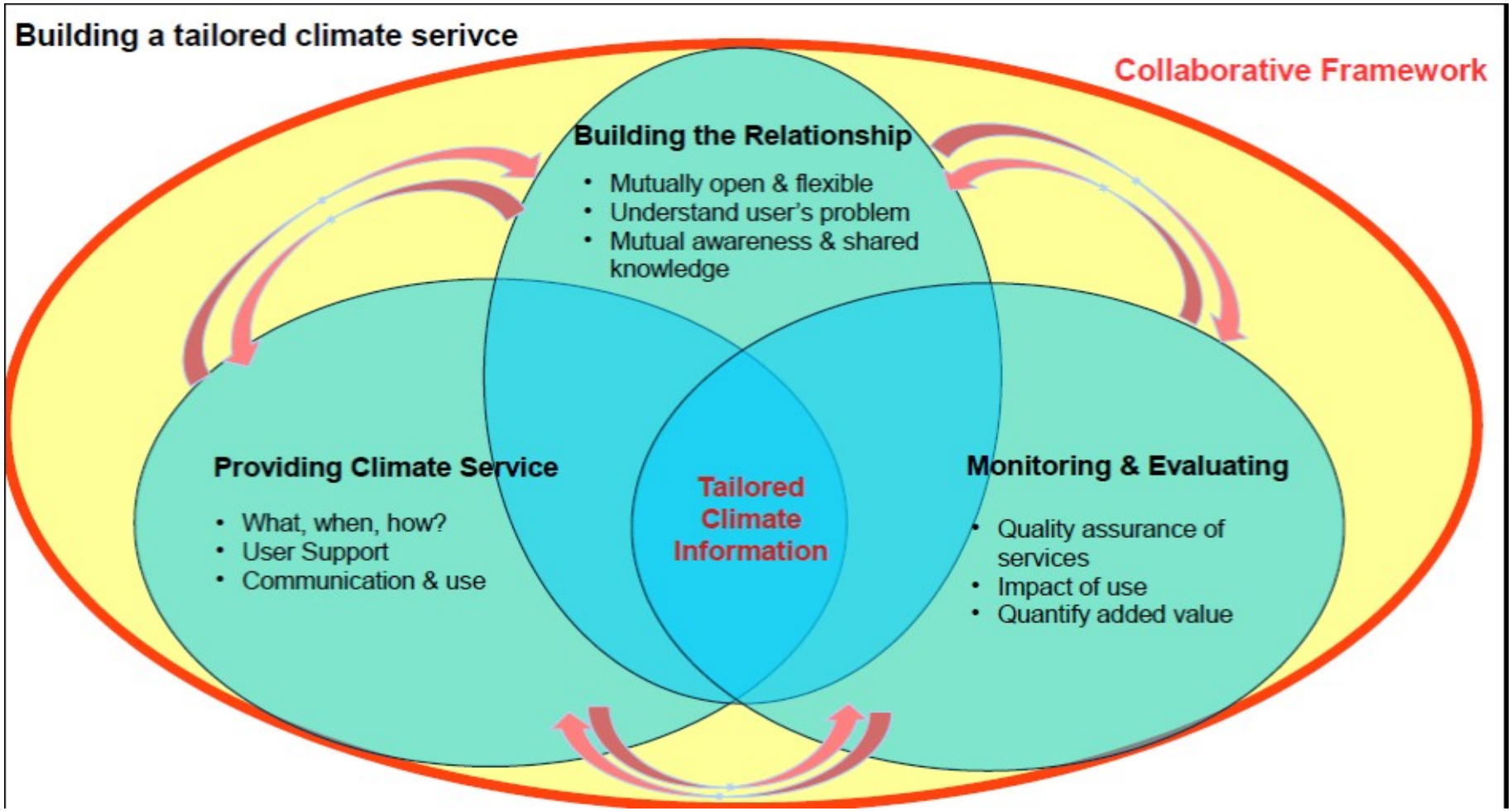
SWIOCOF-12 : Building a CS (details)

- **Tailored Information to DMPS : Importance of a specific evaluation**



SWIOCOF-12 : Which Climate Services ?

- A synthetic framework for Tailored Climate Information



SWIOCOF-12 : Which Climate Services ?

Production of the information

✓ Assessing the best compromise between users' needs and climate science (possible products, predictability of the climate system vs time and space scales, …),

✓Assessing the uncertainty inherent to the climate information and taking care of uncertainty tolerability on the user side,

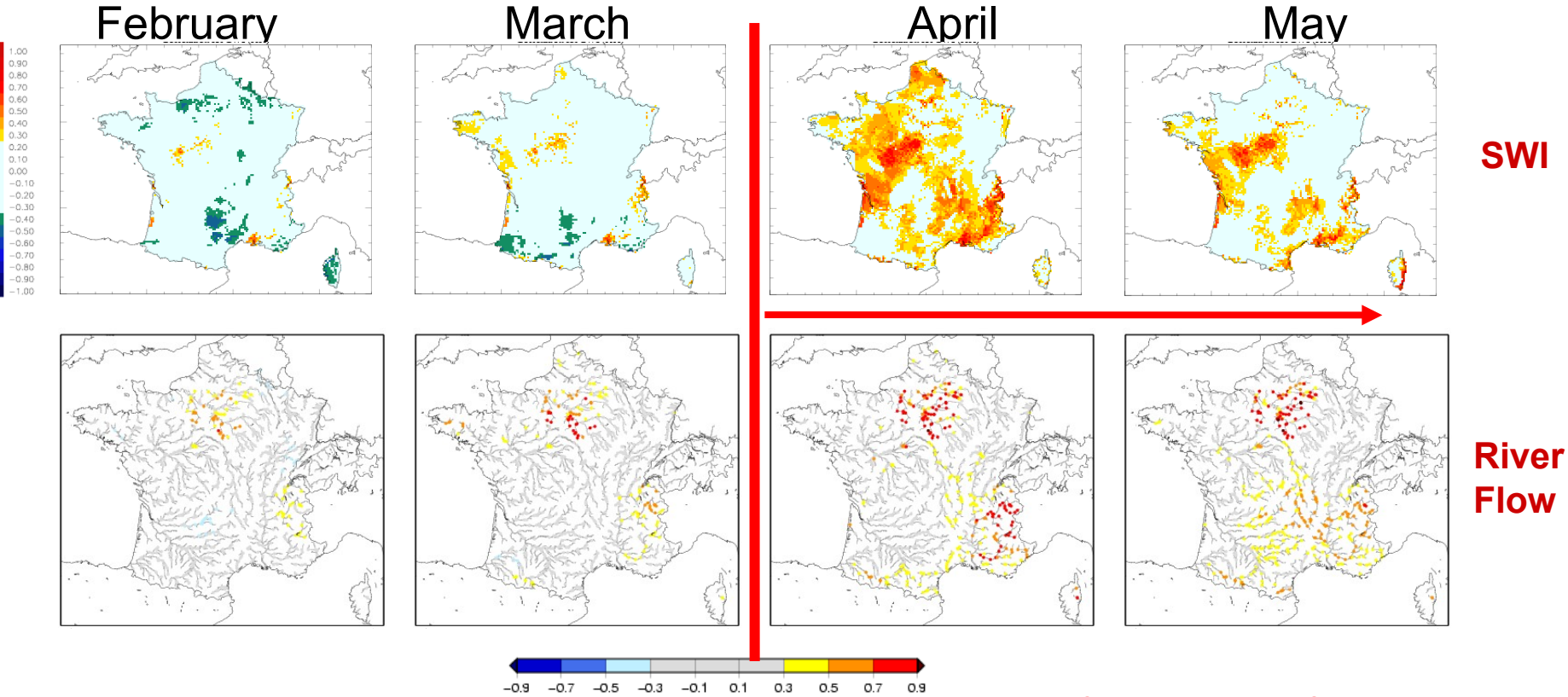
✓ Ensuring the consistency between the provided climate information and the use of the information,

✓ Ensuring a dual liaison between providers and users : from the provider viewpoint needs of information on the use of the climate information (actions/decisions, available options, decisional calendar, critical scales and periods, …)

The production and provision of Climate Information must be driven by possible users' actions

SWIOCOF-12 : Liaison Provider/Stakeholder

- Correlation for SWI and River Flows over the 1979-2007 period (HYDRO-SF / ARPEGE-S3) for different IC for the summer forecast (JJA)



Correlations > 0.3 significant.
Clear improvement between March and April

No useable information before the beginning of April

SWIOCOF-12 : Building a CS (framework)

Some principles : Building relationship

- Overarching principles : credibility, salience, legitimacy, flexibility, transparency
- Who is the target

- Being respectful, humble
- Respect their experience in their field
- What do they do?
- What are the stakes?
- What data is available to quantify the impacts?
- What are the externalities?
- What are the decisions you make?
- Which of these decisions may be informed by climate information?
- What information (including climate, traditional knowledge) are you currently using (if any) to inform your decisions?
- Building awareness on range of climate information available
- Which climate information could enhance the quality of decisions (additional or replacement)

SWIOCOF-12 : Building a CS (framework)

- Some principles : Building relationship
  - Building mutual understanding of how this climate information is relevant to the decisions and explain how it works
  - Is further study required to establish the relationship between climate variable and the impact
  - Are there many other non-climatic factors that will also affect impacts that complicate the problem?
  - Can we solve this problem?
  - Do you have options to respond to climate information
  - When are the key decision-making times, and what are the planning time horizons?
  - Given a significant event or updated information do you have options to modify your decision?
  - Building mutual understanding of the tools that will need to be accommodated
  - What are the costs of incorporating this additional climate information into the decision making process? What are the benefits?
  - Building mutual awareness of any standards and regulations

SWIOCOF-12 : Building a CS (framework)

- Some principles : Building a Climate Service
  - Details about what climate information is required
  - Be open about what is possible to produce, scientifically credible, concept that the information may come tied with metadata and related data such as verification statistics, uncertainties to ensure credibility
  - What, how, when to provide?
  - What variables? What resolution (space and time)?
  - Nature of the product (e.g. PDF, index, forecast, average…)
  - Timing of the climate input provided to be relevant, frequency, point in time…
  - Design the form that the climate information will be delivered in graphical, narrative or digital forms
  - What format e.g. ascii, netCDF, GIS layers How must the information should be delivered (Web, Hard copy, USB, FTP, OpenDAP, …)
  - Establish a Help desk or some form of user support
  - Design a process to deliver on the tailored climate service. Timelines, milestones, governance, etc

SWIOCOF-12 : Building a CS (framework)

- Some principles : Monitoring and evaluating
  - Quality Assurance – two-way communication to ensure quality of service
  - Is Helpdesk and support working?
  - Did the tailored climate service deliver the outcomes as expected (timely, quality, verification)?
  - Did the climate service add value to the decision making?
  - Did the climate information change the decision making? If not, why not?
  - Analysis of benefits using operational data to determine value of the intervention

SWIOCOF-12 : A pathway toward CS

- **Provision of Climate Services tailored for Decision Making**
  - **The products and associated uncertainty must be tailored to the targeted DMP**
    - Relevant impact information (without forgetting vulnerability and exposure)
    - Critical decisional thresholds
    - Risk assessment
  - **The nature of the CS should depend on the capabilities of the stakeholder**
    - Advanced vs basic stakeholders
    - Location of the information with respect of the DMPs

SWIOCOF-12 : A pathway toward CS

Provision of Climate Services tailored for Decision Making

- **The provision of a support to stakeholders is crucial for the best possible use of tailored information**
  - Organisation of the user support and associated technical resources
  - Capacity Building (dual/twin CB) and shared knowledge
  - Advanced vs basic stakeholders
  - User feedback organisation

SWIOCOF-12 : A pathway toward CS

A pathway toward Climate Services

- **Mutual Awarness/Education about the CS prototype**
  - Presentation/discussion with the Stakeholders and corresponding Decision Bodies
  - Understanding of the DMPs and their environment for decisions
- **Learning phase**
  - Run of the DMPs over a limited set of years (all the actors)
  - Identification of potential limits and problems and possible corrections
  - Feedback to the tailoring section

SWIOCOF-12 : A pathway toward CS

A pathway toward Climate Services

- **Development of the CS prototypes**
  - Addressing the delivery mechanism
  - Tailoring the information
  - Setting up the user support
  - Designing the interface
  - Preparing/planning the CB activities to build the necessary shared knowledge
- **Evaluation of the Added value in Decision Made (demonstration of the usefulness and value of CS)**
  - Evaluation of the provided information
  - Evaluation of the use of the information
  - Evaluation of the benefice to use of the CS

Thank you for your attention

Any questions ?

SWIOCOF-12 : What to remember

- Downscaling/tailoring necessary for the use of the information
- Best compromise between needs and real possibilities
- Uncertainty part of the information ; must be integrated within the decision making processes and the use of the information
- Dialogue users / providers crucial all along the chain related to the climate information (development of products, dissemination, use, …)
- Knowledge about the use of the information is essential for an efficient liaison and dialogue
- Data from the user domain crucial to tailor relevant products and information to the benefit of the users (sampling size, homogeneity, data quality, …)
- Available actions and decisions should drive the co-design, co-production and the use of the climate information