Annual Report by Work Group 2 on Uncertainty Analysis and Parameter Estimation

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2015 ISCMEM Annual Public Meeting
October 28 - 29, 2015
U.S. Army Corps of Engineers, Davis, CA

Outline

- Work Group 2 (WG2) Objective and Goals
- Members and Participants
- Seminars at the WG2 Meetings
- Activities and Technical Projects
- Methodologies, Tools and Applications
- Forward Strategy
- Recommendations for FY2016

Work Group Objectives

- Coordinate ongoing and new research conducted by U.S. Federal agencies on:

  parameter estimation

  uncertainty assessment

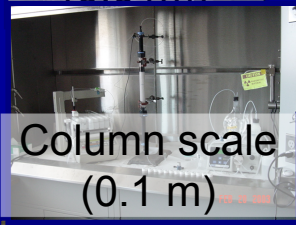
  in support of environmental modeling & applications
- Focus on strategies and techniques
- Includes sensitivity analysis

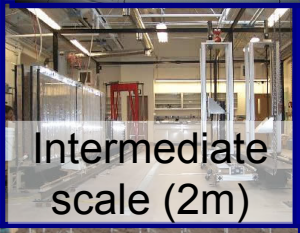
What is needed to achieve this objective?

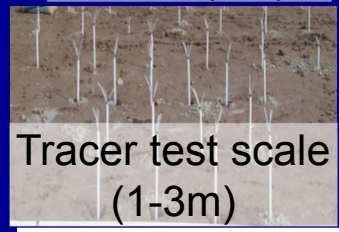
Coordination of research staff and their management thru efficient and targeted use of our limited resources.

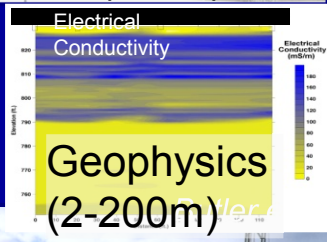
Work Group Goals

- **Basics**:
- ✓ Develop a creative, collaborative environment to advance
  - ➢ parameter estimation in the context of model development .
  - ➢ sources of uncertainty in the context of model predictions.
- ✓ Develop a common terminology.
- ✓ Identify innovative applications.
- **Existing Tools**: Identify, evaluate, and compare available analysis strategies, tools and software.
- **New Tools**: Develop, test, and apply new theories and methodologies.
- **Exchange**: Facilitate exchange of techniques and ideas thru teleconferences, technical workshops, professional meetings, interaction with other WGs and ISCMEM
- **Communicate**: Develop ways to better communicate uncertainty to decision makers (e.g., evaluation measures, visualization).





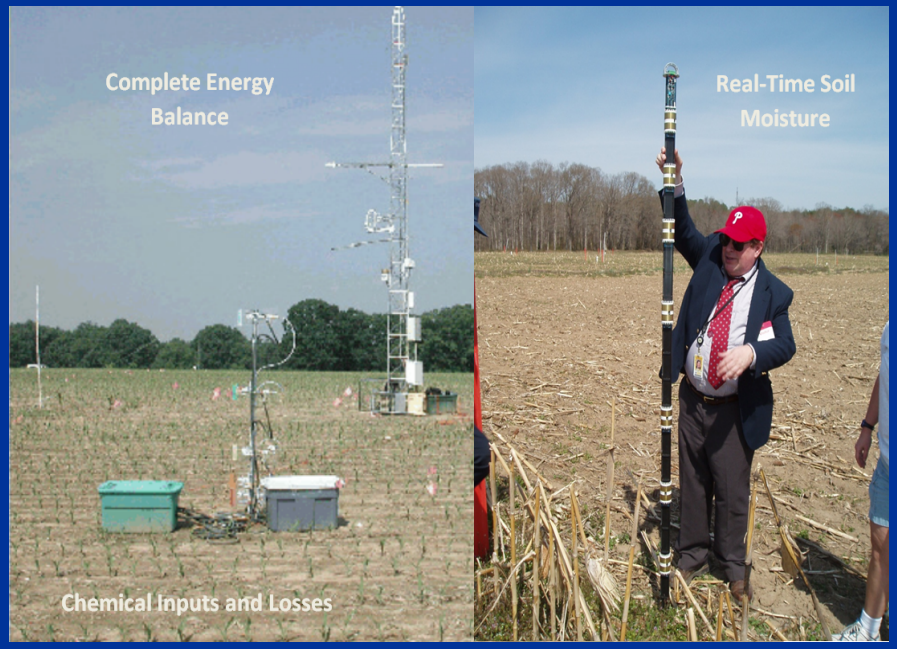




Members and Participants

from U.S. Federal agencies, universities, and industry

- Tom Nicholson, NRC, co-Chair
- Yakov Pachepsky, ARS, co-Chair
- Mary Hill, U. Kansas, co-Chair
- Ming Ye, Florida State U
- Ming Zhu, DOE
- Gary Curtis, USGS



- Brian Skahill, USACOE
- Matt Tonkin, SSPA
- Gene Whelan, EPA-Athens
- Steve Yabusaki, PNNL
- Sanja Perica, NOAA/NWS
- Larry Deschaine, HydroGeologic, Inc.
- Boris Faybishenko, LBNL
- Pierre Glynn, USGS
- Philip Meyer, PNNL
- Bill Cooper, NSF
- Debra Reinhart, NSF
- Bruce Hamilton, NSF

- You?

Activities: Seminars

We conduct seminars to:

- review and discuss ongoing research studies and software development
- formulate proposals for field applications

Uncertainty Analysis for Probable Maximum Precipitation Estimates

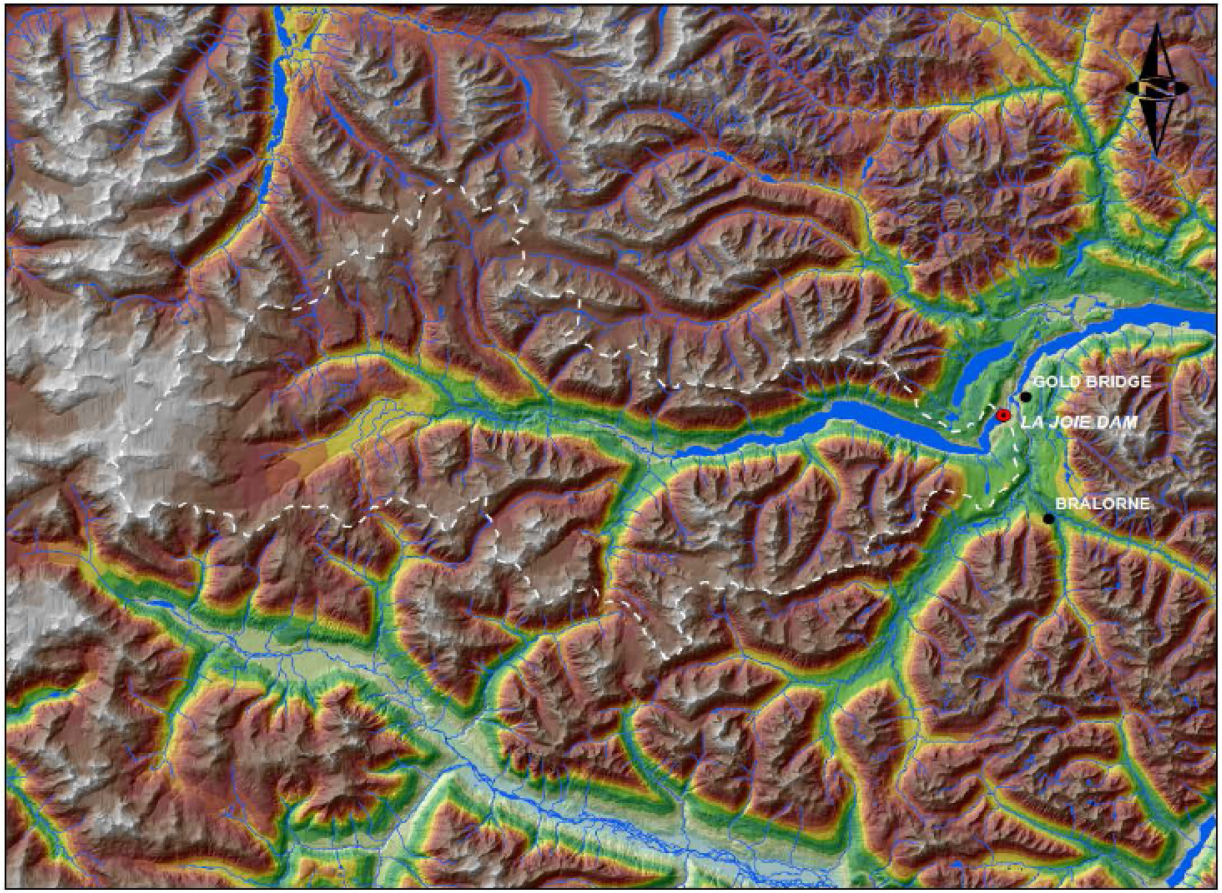
Zoran Micovic, Ph.D., P.Eng., BC Hydro, Canada
Mel Schaefer, Ph.D., P.E., MGS Engineering Consultants, USA
George Taylor, M.S., CCM, Applied Climate Services, USA
NOAA/National Weather Service
Silver Spring, MD
May 18, 2015

OBJECTIVE OF THE UNCERTAINTY STUDY

- To present a methodology for portraying the uncertain nature of PMP estimation by analyzing individual steps within the PMP derivation procedure whereby for each parameter requiring judgment, a range of possible values and associated likelihoods are specified
- The resulting range of possible PMP values can be compared with the previously derived operational single-value PMP, providing measures of the conservatism and variability of the original estimate
- To the knowledge of the investigators, this is the first time an uncertainty analysis has been conducted for a PMP derived through meteorological analyses

Uncertainty Analysis for Probable Maximum Precipitation Estimates

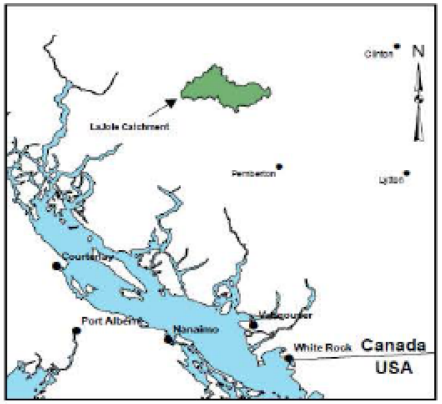
LA JOIE WATERSHED, BC, CANADA



Scale = 1:300,000

Kilometers

0 5 10 20 30



KEY PLAN

0 20 40 80 120

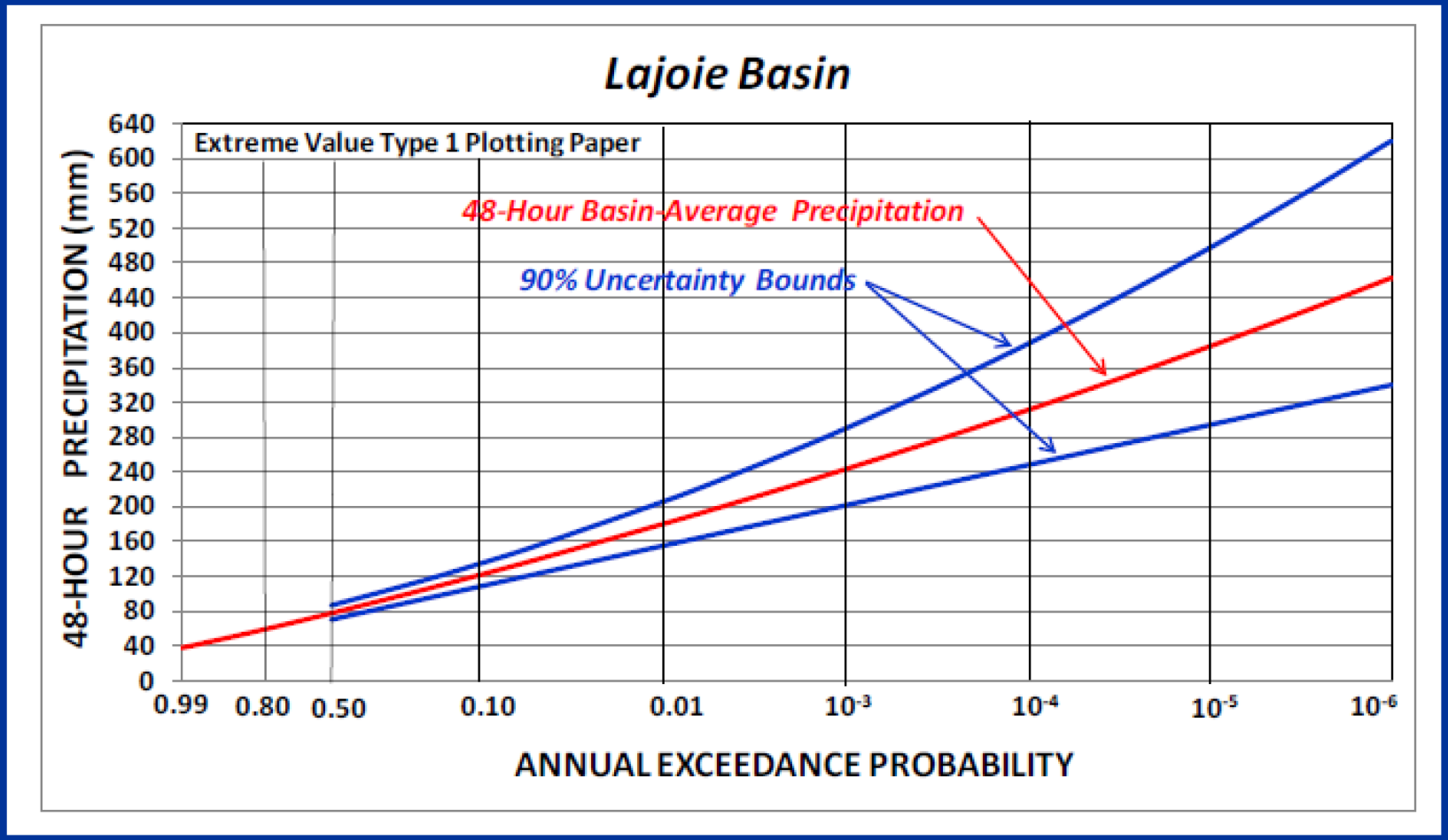
Kilometers

LEGEND

Elevation (m)

280 - 400	1,601 - 1,750
401 - 550	1,751 - 1,900
551 - 700	1,901 - 2,050
701 - 850	2,051 - 2,200
851 - 1,000	2,201 - 2,350
1,001 - 1,150	2,351 - 2,500
1,151 - 1,300	2,501 - 2,650
1,301 - 1,450	2,651 - 2,800
1,451 - 1,600	2,801 - 3,000

- Uncertainty Analysis for PMP was conducted in a manner consistent with assumed existence of an upper limit to precipitation



Assumption: the slope of the precipitation-frequency relationship for extreme precipitation is sufficient that greater precipitation is possible with decreasing likelihood

However there is a physical upper limit for precipitation for a given location, duration and area size

METHODOLOGY FOR ASSESSING UNCERTAINTIES

- Identify sources of uncertainty which are the major contributors to the total uncertainty for a site-specific application
- Formulate procedures under the assumption there is a physical upper limit for precipitation for a given location, duration and area size
- Determine the range of plausible values for each of the parameters used in computation of PMP
- Develop a probability distribution or otherwise characterize the likelihood of parameter values over the range of values for each parameter
- Use Monte Carlo simulation methods to determine the distribution of possible PMP values, the best-estimate and uncertainty bounds and identify the likelihood of the originally adopted PMP value within the distribution
- Test the method on a watershed for which a single-value PMP has already been developed using conventional deterministic methods

WG2 Forward Strategy

Energize the science and technology thru closer linkage to decision making:

- better understand the methods being used in parameter estimation and uncertainty analyses
- *establish a base set of model sensitivity analysis and uncertainty evaluation measures, in addition to the other performance measures*
- use and compare different methods in practical situations

Recommendations for FY2016

- Expand multimedia scope and WG2 membership
- Assist development and creation of other working groups
  - Take advantage of the relevance of uncertainty and parameter estimation to all environmental modeling and monitoring fields.
  - Develop and conduct joint ISCMEM teleconferences
    - WG1 (Software System Design; design of uncertainty and parameter estimation software and data fusion)
    - WG3 (Reactive Transport Models and Monitoring; support decision making)
  - Act as an incubator to build support for new ideas
    - Proposed WG on monitoring based on the importance of monitoring to uncertainty and parameter estimation, and visa versa
- Sponsor technical workshops on endorsed studies
- ISCMEM Website
  - Develop a new Website to enhance Information Transfer of Technical Reports and Data Sources

References

Micovic, Zoran; Schaefer, M.G.; and Taylor, G.H.; *Uncertainty analysis for Probable Maximum Precipitation estimates*, Journal of Hydrology 521 (2015) 360 – 373, Elsevier B.V., New York, NY

ISCMEM

Interagency Steering Committee on Multimedia Environmental Modeling

Annual Public Meeting on Environmental Modeling