Remote Sensing for Water Management Optimization


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7) Università di Bologna. Department of Industrial Chemistry “Toso Montanari” (UB)
8) International Water Association (IWA)
9) Confederación Hidrográfica del Júcar [Jucar River Basin Authority] (CHJ)
10) Instituto Valenciano de Investigaciones Agrarias [Valencian Institute for Agronomical Research] (IVIA)
11) Centro de Edafología y Biología Aplicada del Segura [Center for Soil and Applied Biology] (CEBAS-CSIC)
12) Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research (IMK-TRO) (KIT)
14) European Space Agency (ESA)
15) Fundación para la Investigación del Clima [Climate Research Foundation] (FIC)
16) Confederación Hidrográfica del Segura [Segura River Basin Authority] (CHS)
17) GMV Innovating Solutions (GMV)
18) (AEMet) Delegación en Valencia de la Agencia Estatal de Meteorología
19) EIP Water Secretariat
Other Invited:

1) Aquaprofit Co. (Hungary)
2) Centre de Recherche Public Gabriel Lippmann (Luxembourg)
3) Centre de Recherche Public Henri Tudor (Luxembourg)
4) Climate-KIC Central Hungary
5) Organica Water (Hungary)

Other Wishing to Collaborate/Join:

1) Bell Pottinger (UK)
2) Isle Utilities (UK)
RESEWAM-O is an *Innovation Opportunity* service, *par excellence*, envisaging the provision of a versatile methodology - in principle applicable in all sensitive areas in the world - that integrates the knowledge, diagnostic and monitoring capacity of remote sensing with optimum engineering solutions and efficient financial tools.

*This is innovative!*

For the first time, the problem (*water scarcity*) and the solution (*water resources connections, treatment plants, preserving freshwater supplies for urban uses that will be connected through a feasibility plan*) are approached together within the same vision (*RESEWAM-O*).
RESEWAM-O EIP Water Action Group aims to develop agricultural *Adaptation to Climate Change* activities using
- *Earth Observation Remote Sensing* techniques and
- *Water Management* solutions
in order to enhance socio-economical and environmental values in water sensitive areas.

Through a multidisciplinary
- scientific,
- industrial and
- administration composition

RESEWAM-O puts together administration, agricultural farmers/cooperatives and companies suppliers of water services to develop services and products helping various economic sectors adapting to climate change, especially focusing on energy and water utilities.

RESEWAM-O will study negative climate impacts in water-deficit lands to reactivate them and generate income.
RESEWAM-O’s main goal is to create an innovative methodology for water resources re-distribution by combining:

- remote sensing diagnosing tools,
- economic feasibility studies,
- engineer knowledge and
- policy decisions

to correctly manage all water resources, mainly waste water, and recover life in unprofitable areas.

The envisaged end product is a robust integrated toolbox for:

- water scarcity detection,
- diagnosis and assessment,
- optimum solution completion, and
- feasibility plan

for water re-distribution, in principle applicable in any water-scarce area of the world.
RESEWAM-O EIP Water Action Group

wants to close the cycle of the different water resources, especially reclaimed water, in order to compensate scarcity and unpredictable weather conditions with the goal to developing a successful and balanced economical life style.

“win-win” negotiation

• Water treatment plants and end users are usually disconnected.
• Water infrastructures may also be inappropriate.
• There could even be technological deficiencies in the wastewater treatment process emergent contaminants

RESEWAM-O’s role is to identify these risks and propose how to face them.
The final objective is to put together agricultural farmers/cooperatives, companies suppliers of water services and the administration to facilitate their decision whether the necessary expenditure and investment would be worthwhile and rewarding. RESEWAM-O will therefore generate new market opportunities thanks to the information provided that conventional water management agents usually do not know. RESEWAM-O is a “win-win” negotiation:

- **Agricultural farmers/cooperatives**: opening a new more extended green market of more sustainable, saleable agricultural products, developed in arid/semi-arid areas using reclaimed water as primary resource
- **Companies supplying water services**: more freshwater available to cover increasing urban demands
- **Public administration**: revitalisation of areas out of production, new agricultural food products, reactivation of economy, economisation of products and better protection of Environment
RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)

RESEWAM-O EIP Water Action Group Pilot Study

Valencia & Alacant Anchor Stations

(Most?) suitable area in Europe for validation of low spatial resolution remote sensing data and products

HR MERIS, 23 Mar 2002
Experimental Water Cycle Observatory

VALENCIA ANCHOR STATION

ALACANT ANCHOR STATION
Selection of the Valencia Anchor Station Area

Classified LANDSAT image (8th July 2003) (50x50 km²)
GERB Ground Validation Campaign June 2003

GERB Ground Validation Campaign February 2004
Selection of the Alacant Anchor Station Area
NDVI. Valentian Community, FU Berlin MEDOKADS AVHRR Database Period 1989 - 2000

Mean Value
Minimum Value
Variability

Results of wavelet study for the FU Berlin MEDOKADS AVHRR Database
Period 1989-2002

<table>
<thead>
<tr>
<th>Mean of the Trend</th>
<th>“Minimum” of the Sum (Trend + Variability)</th>
<th>“Range” of Variability</th>
</tr>
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<tbody>
<tr>
<td>G</td>
<td>B</td>
<td>R</td>
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<tr>
<td>indicates the mean state of vegetation along the period analyzed</td>
<td>related to the minimum amount of vegetation present in each pixel during the period analyzed</td>
<td>informs about the amplitude of the annual phenological cycle</td>
</tr>
</tbody>
</table>

J. Gimeno Ferrer, M.A. Gilabert, E. Lopez-Baeza (Sept 2003)
An RGB Image of “Desertification”

Standard Precipitation Index (SPI)

Indicator of the deficit/surplus precipitation intensity wrt normal conditions

Similar Cycles of Drought and Hydrological Surplus

Temporal evolution of SPI-24

Characterisation of Socio-Economical Drought

Well defined periods characterized by drought or hydrological excess


• 1979-1985. Longest drought cycle. Similar in both areas
• 1990-1995. Maximum SPI values in both areas. VAS was more affected
• 1998-2001. Shortest cycle that caused moderated dry events

Cecilia Narbon
Standard Precipitation Index (SPI)

Temporal evolution of SPI-12
Characterisation and monitoring of Hydrological Resources

Temporal evolution of SPI-9
Characterisation of Agricultural Droughts

Cecilia Narbon
\[ TVDI = \frac{TSS - TSS_{\text{min}}}{a + b \cdot NDVI - TSS_{\text{min}}} \]

**TVDI 25th Sep 2009**

**Temperature Vegetation Dryness Index**
$$TVDI = \frac{TSS - TSS_{\text{min}}}{a + b\text{NDVI} - TSS_{\text{min}}}$$
First Map of Global Soil Moisture Retrievals
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Well observed drought by SMOS. Soil moisture in February 2010, 2011 and 2012 (average values), for ascending overpasses (~ 6am, solar local time). Note that February 2010 was still the beginning of the mission and the commissioning phase, which explains some lack in the retrievals.

MIR_SMUDP2 – Soil_Moisture (m3m−3) – February 2010

Cylindrical projection – 682 product(s) – Generated on 20120229T181350
Orbits: Ascending – Fill value: -999.0

SMOS Global Mapping Tool v2.4
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14th Mar 2013

22nd Mar 2013

15th Apr 2013
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Legend

<table>
<thead>
<tr>
<th>Type of treatment</th>
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<tbody>
<tr>
<td>More rigorous (N &amp; P) + Tertiary</td>
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<tr>
<td>More rigorous (N) + Tertiary</td>
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<td>More rigorous (N)</td>
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<td>Primary</td>
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<td>Pretreatment / Emissary</td>
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<td>No Data</td>
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Station Utiel

Precipitation April: 13 mm

Mediterranean Sea
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The RESEWAM-O methodology:

① Use current remote sensing technology to identify sensitive areas and evaluate their potential agricultural productivity by means of conventional indices linked to soil moisture/dryness conditions, evapotranspiration, soil and vegetation conditions -current and climate change projected, etc.

② Propose a global optimisation model for water allocation incorporating the detailed information from remote sensing technology.

③ Validate and strengthen the identification of sensitive areas, as well as relevant periods, dry and wet spells, by the use of the numerical high-resolution regional simulations of our modelling partners of soil conditions and precipitation distributions.

④ Develop feasibility studies for the target areas (pilot area and extended application areas) under conditions of operational methodology. Three situations could be faced: i) renovate and enhance still useful existing infrastructures ii) decide the necessity to create a new infrastructure system, iii) decide the non-profitability of any investment.
The RESEWAM-O methodology:

⑤ Elaborate climate change projections for different scenarios for the target areas to guarantee the return of the investment along a couple of decades.

⑥ Create a guideline on recommendations of best practices studies to improve the water management in a geographical area.

⑦ Support policy makers in their decisions to apply the most convenient answers in the focus areas.

⑧ Thoroughly develop a RESEWAM-O decision support system / service from the first-phase Pilot Study over a well-known and characterised area and define the conditions to be extended to other vulnerable areas.

⑨ Dissemination, scientific marketing and exploitation in parallel with education, outreach and capacity building.
Objectives
- Determine Economic Viability
- Efficient Process Performance

how?
Economic Viability
Best Tool
Cost-Benefit Analysis (ABC)

Net Benefit = Total Benefit – Total Costs

Advantages:
• Recognised tool for the evaluation of the economic viability
• Guarantees economic rationality of inversions
Costs Evaluation

- Total Costs Estimation
- Estimation of Costs Functions associated to the process
  - Projection of Inversion Costs
  - Projection of Operation and Maintenance Costs
- By relating the different process variables

Reinforce re-utilisation
Evaluation of Environmental and Social Benefits

- **Shadow Prices** (*Precios Sombra*)
  Way of estimation of the environmental impact
  By giving monetary values to the unwanted outputs of the purification process

... as an alternative to the more conventional contingent evaluation
Evaluation of Efficiency

- **Stationary Analysis**
  - Efficiency analysis of productive activity

- **Dynamic Analysis**
  - Evolution analysis of efficient performance
  - Changes in technology → Technology Innovation
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http://www.eip-water.eu/working-groups/resewam-o-remote-sensing-water-management-optimization-ag132
thank you for your attention