Memorandum of Agreement

for the

Operation and Continued Development of

MEDSLIK-II

(OCD-MEDSLIK-II)

BY AND AMONG:

The Istituto Nazionale di Geofisica e Vulcanologia, hereinafter referred to as "INGV", with its registered office at Via Di Vigna Murata 605, 00143 Roma - Italy - represented by its President Prof. Domenico Giardini, **AND**

The Centro Euro-Mediterraneo per i Cambiamenti Climatici, hereinafter referred to as "CMCC", with its registered office at Via Augusto Imperatore 16, 73100 Lecce - Italy - represented by its President Dr. Antonio Navarra, **AND**

The Consiglio Nazionale delle Ricerche-Istituto per lo Studio dell'Ambiente Marino Costiero, hereinafter referred to as "CNR/IAMC", with its registered office at via Calata Porta di Massa, porto di Napoli, 80133 Napoli - Italy - represented by its Director Dr. Salvatore Mazzola, **AND**

The Oceanography Center at the University of Cyprus, hereinafter referred to as "OC-UCY", with its registered office at P.O. Box 20537, 1678 Nicosia, Cyprus ,- represented by its Director Prof. Georgios Georgiou,

each of the foregoing a "Partner", collectively "Partners".

Preamble

Having recently developed a new version of an oil spill model system named MEDSLIK-II (De Dominicis et. al 2011) or the "System", based on its precursor oil spill model MEDSLIK (Lardner and Zodiatis 1998; Lardner et al. 2006; Zodiatis et al. 2005, 2008);

Endeavoring to bring the System into operation and ensure its continued, sustainable development as a well-organized, state-of-the-art oil-spill model code suitable for both research and operational work;

Wishing to make the MEDSLIK-II reference code ("Reference Code") freely available under an appropriate free public license, with the aim of attracting a critical mass of scientists to use and contribute to the continued development of the Reference Code;

The Partners hereby agree as follows:

Chapter 1. Purpose

The purpose of this agreement ("Agreement") is to define key aspects of the collaboration, including:

      i)   each Partner's annual commitment of resources and activities;

      ii)   the management and coordination of the MEDSLIK-II System Team provided in Chapter 4.2; and

      iii)   intellectual property rights.

Chapter 2. Definitions

For the purpose of this Agreement, the terms defined herein shall have the respective meanings ascribed to them, and the terms below shall have following meanings:

Access Rights means license and user rights to Background Information or Foreground Information.

Agreement means this Agreement and its annexes, as may be amended from time to time.

Background Information means the Reference Code (version MEDSLIK-II.1.0), owned by CMCC and INGV, and other information owned by any Partner prior to signing this Agreement that is necessary to its implementation. The Background Information is identified in Annex 4.

Contribution means any addition, modification, correction, translation or adaptation provided by any person and integrated into the Reference Code.

Documentation means manuals, papers and other written documents approved by the MEDSLIK-II System Team to describe the MEDSLIK-II system.

External Module means any Module that does not belong at any time to MEDSLIK-II Reference Code.

Foreground Information means the Intellectual Property created as a direct result from the work undertaken by one or several Partners in the development of the Software under this Agreement,

Intellectual Property Rights or IPR means the proprietary rights to exploit a creation, and includes trademarks, patents, copyrights (including copyright in software), industrial designs, and other legal protection, whether or not eligible for registration in a given country.

MEDSLIK-II System means MEDSLIK-II.1.0 Reference Code and subsequent releases, the components of which are specified in Annex 1.

MEDSLIK-II Scientific Leader means the person described in Chapter 4.3 and identified in Annex 3.

MEDSLIK-II System Team or System Team means the team described in Chapter 4.2 and identified in Annex 3.

Module means any component of the Reference Code that has an independent logical or functional consistency.

Partner means a signatory to this Agreement.

Reference Code means the MEDSLIK-II System Software system comprehensive of a source code, scripts, input files, output visualization software and test case input files maintained updated and distributed by the MEDSLIK-II System Team through the MEDSLIK-II server and web pages specified in Annex 1.

Software means all or any part of the MEDSLIK-II Reference code.

Source Code means the set of instructions, in commonly legible form, intended to be executed by a computer to achieve a stated purpose, together with its scripts and input files.

Steering Committee means the committee described in Chapter 4.1.

System means MEDSLIK-II.

System Team Coordinator means the person described in Chapter 4.3 and identified in Annex 3.

Test Cases means input files, scripts and model results that configure MEDSLIK-II reference code in a preset manner and that could be used to check if the Reference Code works properly.

Work-Plan means the annual plan of work defined under Chapter 3.1 below.

Chapter 3. Implementation

3.1 Work Plan

The Work Plan describing each Partner's role in the Agreement is set forth in Annex 2 to this Agreement.

Each Partner agrees to devote sufficient resources and expertise to enable the Work Plan to be implemented in a competent and timely manner in line with recognized best practices for such work.

The Steering Committee shall update the Work Plan annually and amend Annex 2 accordingly.

3.2 Partner Undertakings

To ensure mutual benefits from the collaboration, each Partner agrees to:

i)   make consensus-based decisions on the Agreement priorities, strategic and technical choices;

ii)   promote an open and transparent relationship among the Partners;

iii)   recognize and understand the objectives, needs, capabilities responsibilities and constraints of the other Partners in implementing the Agreement;

iv)   ensure disputes are identified and resolved as soon as practicable;

v)   work collaboratively on MEDSLIK-II Reference Code development;

vi)   make the latest developments readily available to the System Team for implementation in the MEDSLIK-II Source Code; and

vii)   work toward improving the collaboration on oil spill modeling research within Europe and internationally.

3.3 Financial Arrangements

3.3.1 Each Partner shall contribute to the Work Plan at least the equivalent of 0,5 year of staff time (as defined by the rules of the Partner concerned) annually.

3.3.2 Each Partner shall bear the cost of carrying out its own activities under the Work Plan.

Chapter 4. Management and Coordination

4.1 Steering Committee

4.1.1 Role. The Steering Committee is the Agreement's decision-making and arbitration body. It shall determine:

i)   the strategic direction of the Agreement;

ii)   the MEDSLIK-II Scientific Leader and MEDSLIK-II System Team Coordinator chosen from the System Team;

iii)   the Work-Plan for each year and the subsequent amendment of Annex 2;

iv)   the contributions of each Partner to the Work-Plan;

v)   any modifications needed to this Agreement;

vi)   whether to include any new Partners;

vii)   whether to remove any Partner in accordance with Chapter 7.2; and

viii)   the settlement of disputes.

4.1.2 Composition

The Steering Committee shall be composed of one representative nominated by each Partner, as identified in Annex 3. The MEDSLIK-II Scientific Leader and the MEDSLIK-II System Team Coordinator shall also attend Steering Committee meetings and have voting rights.

4.1.3 Chairperson

The Chairperson of the Steering Committee (Chairperson) shall be elected by the Steering Committee at its first meeting. Each Partner may serve as Chairperson for a three-year term on a rotating basis. The

Chairperson may give one year's advance notice of his/her intention to step down, in which case the Steering Committee shall elect a new Chairperson at its next meeting. The Chairperson shall set the agenda for and lead Steering Committee meetings, and shall ensure that the decisions taken therein are implemented.

4.1.4 Meetings

The Steering Committee shall meet at least once each year, and shall hold extraordinary meetings at the request of any Partner or of the MEDSLIK-II System Team Coordinator. The Chairperson shall give each of the Partners at least thirty (30) calendar days written advance notice of annual meetings and fifteen (15) calendar days notice of extraordinary meetings. Should a Partner wish to propose any item for the agenda, it shall provide the other Partners written notice thereof at least seven (7) calendar days prior to the meeting date. The Chairperson shall draft the minutes of each meeting to formalize in writing all decisions taken and shall dispatch them to all Partners within fifteen (15) calendar days of the meeting's conclusion. If no Partner objects to the minutes within 15 days of receipt, the minutes shall be considered accepted. Any such objection shall be made in writing to the Chairperson.

4.1.5 Voting

All members of the Steering Committee shall be eligible to vote on the matters listed in Chapter 4.1.1 above. All decisions of the Steering Committee shall be taken by unanimous vote.

4.2 MEDSLIK-II System Team

4.2.1 Responsibilities

The MEDSLIK-II System Team is responsible for developing and maintaining the MEDSLIK-II Reference Code, its documentation and its distribution through the MEDSLIK-II web server specified in Annex 1 and Annex 2 for its subsequent releases.

The MEDSLIK-II System Team shall carry out the Work Plan, which may include:

    i)   incorporating all new scientific and technical developments into MEDSLIK-II System;

    ii)   reorganizing code to improve its readability, orthogonality or structure;

    iii)   maintaining the on-line documentation;

    iv)   overseeing the configuration of the available versions of MEDSLIK-II;

    v)   testing and releasing new versions;

vi)   releasing Test Cases to work with the reference code released at any given time;

vii)   making MEDSLIK-II readily available to Partners and the scientific community;

viii)   providing assistance to new users;

ix)   providing logistical support for user meetings;

x)   assisting scientific development in areas of high priority.

4.2.2 Neither the MEDSLIK-II System Team nor any Partner will be required to provide any of the following types of support unless otherwise agreed among the Partners:

i)   application of the System to specific cases for service purposes;

ii)   tuning the parameters of models for specific cases;

iii)   on-demand responses following operational System failures;

iv)   operational support to oil spill emergencies;

v)   configuration of MEDSLIK-II System for specific areas, such as defining specific grid locations or bathymetry, hydrodynamic ocean model integration; or

vi)   other forms of support not expressly contemplated in this Agreement.

4.2.3 Composition

The MEDSLIK-II System Team shall comprise Partner scientists and technicians, with at least one representative per Partner. The composition is set forth in Annex 3, as may be modified in accordance with Chapter 8.2.

4.2.4 Coordination

The MEDSLIK-II System Team shall be coordinated by a MEDSLIK-II System Team Coordinator.

4.3 MEDSLIK-II Scientific Leader and System Team Coordinator

4.3.1 Selection

At its first meeting, the Steering Committee shall elect a MEDSLIK-II Scientific Leader and a MEDSLIK-II System Team Coordinator to three-year terms, renewable once. Either may step down with one year's advance notice to the Chairperson, in which case the Steering Committee shall select the successor at its next meeting. The members of the Steering Committee are set forth in Annex 3, as may be modified in accordance with Chapter 8.2.

4.3.2   Responsibilities

The MEDSLIK-II Scientific Leader and the MEDSLIK-II System Team Coordinator shall jointly:

i)   develop the scientific and technological knowledge within the MEDSLIK-II System Team;

ii)   establish scientific and technical priorities for development of the MEDSLIK-II code;

iii)   ensure the timely and appropriate reviews of proposed contributions to the MEDSLIK-II code;

iv)   promote the Agreement and seek opportunities for funding.

4.4 User Meetings

A meeting of MEDSLIK-II System users shall be held annually to discuss relevant issues and collect feedback jointly with the Steering Committee meeting.

Chapter 5. Intellectual Property Rights

5.1 Background Information

5.1.1   The Partners have identified and listed in Annex 4 the Background Information that is relevant to this Agreement.

5.1.2 Each Partner shall retain ownership of its Background Information and related IPR while implementing the Work Plan, including any modified or adapted versions thereto. No provision of this Agreement shall be construed as transferring IPR from one Partner to another.

5.1.3 The Partners shall grant to each other a worldwide, royalty-free license, free of charge, to install, use, further develop and copy the Background Information for the exclusive purpose of executing the Work Plan.

5.1.4 The IPR to any modified or adapted Background Information owned by any Partner shall remain the exclusive property of such Partner.

5.2 Foreground Information

5.2.1 The IPR to all Foreground Information shall be co-owned by the Partners.

5.2.2 The Steering Committee Chairperson shall be responsible for applying for, obtaining and maintaining the IPR protection related to the Foreground Information. Any associated costs shall be shared equitably among the Partners.

5.2.3 Partners distributing code relating to MEDSLIK-II System shall only distribute recent versions that can be interfaced with the most updated version of the Reference Code that is exclusively made available through the MEDSLIK-II web site.

5.3 Third Party Contributions

5.3.1 The Partners shall ensure that any third party that makes a contribution to MEDSLIK-II for use in the further development of the System has granted the Partners a world-wide, irrevocable license, free of charge, to install, use, further develop, sub-license, copy, distribute and store the contribution.

5.3.2 The Partners shall ensure that any such software is subjected to an agreed quality control process and work standards prior to integration into the MEDSLIK-II System.

5.4 Public Licenses

The Partners agree to make the Reference Code available under an appropriate public license that allows users to install, use, further develop, sub-license, copy and distribute the Reference Code. Among other things, the license shall:

    i)   require any user who wishes to further distribute the MEDSLIK-II Reference Code, including the source code, to include the same public license as part of the distribution package; and

   ii) expressly exclude:

       a) any warranty as to the accuracy, soundness or fitness of the Software for any purpose;

       b) liability of the licensors or authors for any use or misuse of the Software; and

       c) patentability of the Software.

5.5. Acknowledgements and Publications

5.5.1 Partners shall acknowledge use of the System in all publications and communications, using the name "MEDSLIK-II System," together with the website specified in Annex 1.

5.5.2 Any proposed publication or communication by one of the Partners, in connection with all or part of the Agreement is required to be submitted to the other Partners at least one month in advance. To this end, a brief description and the subject of the proposed publication or communication shall be submitted to the other Partners together with a copy of the proposed text or visual representation. Any Partner may express an objection to the communication's publication if, in its opinion, the communication carries a reasonable risk of harm, in particular regarding industrial property protection. In case of objection, the publication in question shall be delayed while an agreement is reached. If no Partner objects to the proposed communication within one month of receipt of notice, the consent of all shall be presumed. However, no Partner may withhold its consent to publication or communication for longer than six (6) calendar months from the date the notice was received.

Chapter 6. Confidentiality

6.1 For the duration of the Agreement and for a period of six (6) years thereafter, the Partners shall treat as confidential any information which is so designated by the disclosing Partner, as evidenced by an appropriate stamp, legend or any other notice in writing, or when communicated as confidential at the time of disclosure, as confirmed in writing by the disclosing Partner within thirty (30) days of disclosure.

6.2 Any Partner receiving confidential information shall not:

 i) use it for any purpose other than implementing this Agreement, and then only to the extent necessary;

 ii) disclose it to a third party; or

 iii) copy, duplicate or otherwise reproduce it, in whole or in part;

 unless expressly authorized in writing by the disclosing Partner.

6.3 The obligation of non-disclosure shall not apply to information that is:

 i) published or otherwise made available to the public other than by breach of this Agreement by the receiving Partner;

ii)   already in its possession of the receiving Partner at the time of its signature of this Agreement;

iii)   received from a third party that is under no obligation of non-disclosure;

iv)   communicated by the disclosing party to a third party without restriction on disclosure;

v)   independently developed by or for the receiving Partner; or

vi)   required to be communicated by law, provided that, insofar as reasonably possible, the receiving Partner shall provide the disclosing Partner advance notice of such communication and shall comply with the disclosing Partner's reasonable instructions designed to protect the confidentiality of such information.

6.4 The Partners shall contractually impose the same obligations provided in Chapter 6.1 above on all of their employees, or on any other person working for them who may have access to confidential information, which obligations shall survive termination of employment.

6.5 Nothing contained in this Chapter shall be construed as prohibiting:

i)   the submission of academic theses to examiners in the public institution to which the Partner is related *provided, however,* that the concerned Partner shall obtain the consent of the examiners to abide by the confidentiality provisions herein; or

ii)   the issuance of scientific activity reports or similar to the institute or administrative entity to which it belongs.

Chapter 7. Partners

7.1 Additional Partners

7.2.1 A new Partner may be brought into the Agreement by unanimous vote of the Steering Committee, effective as from the date of its signature of the Agreement.

7.1.2 All new Partners shall commit to contributing resources and activities to carry out the Work Plan, as agreed among all Partners

7.1.3 Any new Partner may take part in discussions of the Work Plan up to six months before it commits resources to the MEDSLIK-II System Team.

7.1.4 Any new Partner shall be granted Access rights to the Background and Foreground Information on the same conditions as the other Partners (Chapters 5.1 and 5.2). The new Partner will have co-ownership of the code developed from MEDSLIK-II from the date of signature of the amendment mentioned in Chapter 9.1.2.

7.2 Removal and Withdrawal

7.2.1 Without prejudice to any other rights or remedies open to the Partners, the Steering Committee may, by unanimous vote, excluding that of the concerned Partner, and by written notice, remove from the Agreement any Partner that:

    i)   is in material breach of any of the terms of this Agreement and, where the breach is capable of remedy, the Partner fails to remedy such breach within 30 days of receipts of written notice specifying the breach and demanding the remedy;

    ii)   is deemed incompetent, commits repeated acts of misconduct or a single act of gross negligence; or

    iii)   becomes insolvent or ceases to operate.

7.2.2 Any Partner may withdraw from participation in the Agreement by providing the other Partners at least three months' written notice, by registered mail with acknowledgement of receipt, indicating the reasons for withdrawal.

7.2.3 The notice required in 7.2.1 and 7.2.2 shall indicate the effective date of the removal or withdrawal, within the time frames stipulated therein.

7.3 Consequences of Removal or Withdrawal

7.3.1 Any Partner that withdraws or is removed from this Agreement agrees to treat all Confidential Information, in accordance with the requirements set forth in Chapter 6, for a period of five (6) years from the date of withdrawal or removal, and further agrees not to apply for any patent or other proprietary right over any information, subject to its own information, it may have obtained in connection with its participation in the Agreement.

7.3.2 Any Partner that withdraws or is removed from the Agreement shall automatically relinquish the Access Rights granted under Chapter 5 and the co-ownership of any future IPR with respect to the Foreground Information that is developed under this Agreement after the date of withdrawal or exclusion.

7.3.3 The remaining Partners shall retain ownership of their Background and Foreground IPR and their Access Rights to the Background Information of the withdrawing or removed Partner.

7.3.4 Any Partner that withdraws or is removed from the Agreement shall honor its financial commitments up to the effective date of its withdrawal or exclusion.

7.4 No Liability

7.4.1 No Partner shall be liable to any other Partner for damages related to a failure to perform, or to an error in performance, of its obligations under this Agreement.

7.4.2 The Partners shall ensure that all licenses granted under Chapter 5.4 contain an express disclaimer of liability *vis-à-vis* all downstream users.

7.5 No Warranties

The Partners agree that MEDSLIK-II shall be provided free of any warranty as to its performance, accuracy, quality or fitness for a particular purpose, and shall ensure that all licenses granted under Chapter 5.4 contain the same disclaimer.

7.6 No Partnership

7.6.1 The relationship among the Partners is and shall remain exclusively that of a collaboration among independent institutions and nothing contained in this Agreement shall be construed as creating any partnership, joint venture, agency or other legal relationship among the Partners.

7.6.2 No Partner shall make or give any contract, representation, warranty, undertaking or other commitment on behalf of another Partner, unless expressly authorized in writing to do so.

7.7 No Assignment

No Partner shall assign or otherwise transfer, in whole or in part, any of its rights or obligations under this Agreement without the unanimous consent of the other Partners.

7.8. Ability to Perform

Each Partner shall take appropriate measures to ensure that it is able to grant Access Rights and otherwise fulfill its obligations under this Agreement, including *vis-à-vis* its staff, agents or subcontractors.

7.9. Employees

7.9.1 The employees of any Partner may perform work under this Agreement on the premises of another Partner only with the permission of both Partners. Employees working at another Partner's institution must conform to the rules and procedures of that institution.

7.9.2 Each Partner shall be responsible for the remuneration of its staff and non-staff personnel working on the Agreement, including all taxes, contributions and other obligations required by law.

7.9.3 Each Partner is responsible for ensuring that its employees have adequate insurance coverage as required by law.

Chapter 8. Term and Amendments

8.1 Term and Termination

8.1.1 This Agreement shall become effective upon its signature by all Partners, and shall have a duration of five (5) years unless earlier terminated by unanimous agreement of the Partners. Within thirty [30] days of termination, this Agreement may be renewed by written agreement among all or any number of the Partners.

8.1.2 The provisions of this Agreement concerning liability, confidentiality, intellectual property rights and publication shall survive the termination of this Agreement or of any Partner's participation, to the extent needed to enable the Partners to pursue the rights and remedies provided for herein and subject to any applicable time limits provided under this Agreement (see Chapter 6) or prevailing legislation.

8.1.3 For the avoidance of doubt, the termination or withdrawal of any Partner shall not affect its rights or obligations incurred prior to the date of the termination.

8.2. Amendments

Amendments or changes to this Agreement shall be valid only if made in writing and approved by all of the Partners, with the exception of Annex 3 (Members of Agreement Committees and Teams), which may be amended by written notice of the Chairperson to the Partners.

8.3. Severability

Should any provision of this Agreement be deemed or become invalid, whether in whole or in part, the Partners shall agree on a valid substitution that most closely fulfils the original purpose. If no such substitution is practicable, the invalid provision shall be severed from the Agreement. The remaining provisions of the Agreement shall not be affected by any such severance or substitution.

8.4. Entire Agreement

This Agreement, including the annexes hereto, constitutes the entire agreement among the Partners in respect of the Agreement, and supersedes all previous negotiations, commitments and documents related to the collaboration.

Notwithstanding the foregoing, the Partners may conclude ancillary contracts necessary to carry out the provisions of this Agreement.

Chapter 9. Final Provisions

9.1 Language

This Agreement is drawn up in the English language. All documents, communications and meetings related to implementing this Agreement shall be in English.

9.2. Applicable Law

This Agreement shall be construed according to and governed by the laws of the Italian Republic.

9.3 Settlement of Disputes

The Partners agree that all disputes or differences arising from this Agreement will be amicably resolved by the Steering Committee. All disputes that cannot be amicably resolved shall be submitted before the decision of the Court of Rome, Italy.

INTENDING TO BE LEGALLY BOUND, the Partners have executed Agreement in four (4) original copies.

Istituto Nazionale di Geofisica e Vulcanologia (INGV)

———————————————————

(Full name of Partner)

———————————————————

(Name of authorized signatory)

———————————————————

(Signature)

———————————————————

(Date)

Centro EuroMediterraneo per i Cambiamenti Climatici (CMCC)

_____

(Full name of Partner)

_____

(Name of authorized signatory)

_____

(Signature)

_____

(Date)

Consiglio Nazionale delle Ricerche-Istituto per lo Studio dell'Ambiente Marino Costiero (CNR/IAMC)

_____

(Full name of Partner)

_____

(Name of authorized signatory)

_____

(Signature)

_____

(Date)

Oceanography Center at the University of Cyprus (OC-UCY)

_____

(Full name of Partner)

_____

(Name of authorized signatory)

_____

(Signature)

_____

(Date)

ANNEX 1   TECHNICAL SPECIFICATIONS

A.1.1 Medslik-II Reference Code description

The MEDSLIK-II.V1.0 system is composed of six main parts, i.e.:

1) the source code;

2) the input data files;

3) the output data files;

4) the script files to compile and execute in a Linux operative system;

5) the visualization software;

6) a Test Case set up.

The first version of the MEDSLIK-II reference code will be made available by INGV at ftp site to the Partners of the Agreement after signature of the Agreement.

A.1.1.1 Source Code

The MEDSLIK-II.V1.0 Fortran source codes are located in the folder *source.*

The main codes are (all the codes are listed in Figure 1:

medsliku_II.for: simulation of a single oil spill.

Extract_II.for: extraction of the required forecast data from the text files derived from netCDF forecast output.

A.1.1.2 Input data files

The input data files for MEDSLIK-II.V1.0 are mainly ASCII format files.

The 2 most important files are listed below (all the files are listed in Figure 1):

- *medslik_inputfile.txt*: contains the input spill data needed to perform the simulation (spill date & time, position (lat & lon), spill duration, spill volume, type of oil. The medslik_inputfile.txt is processed and the input data are saved in the medslik5.inp file and in the file *medslik.tmp* (it contains the limits of the area and the list of the currents forecast files needed for the simulation).
- *medslik5.par*: contains the parameters needed for the simulation, such as the drift angle, the drift angle, the current depth, the horizontal and vertical diffusivity. The medslik5.par can be manually edited.

The Input data Archive part of Medslik consists of 2 folders:

- *data*, contains the oil type database files and the bathymetry files for the different region in the Mediterranean sea and other associated data files.

- *fcst_data,* contains the oceanographic and wind data organized in subdirectories indicated in the following table.

Mediterranean Forecasting System (MFS) – hourly output	O1h
Adriatic Forecasting System (AFS) – hourly output	A1h
Mediterranean Forecasting System (MFS) – daily output	OPA
Adriatic Forecasting System (AFS) – daily output	A24
Sicily Channel Regional Model (SCRM) - hourly output	S1h
Sicily Channel Regional Model (SCRM) - daily output	S24
Tyrrhenian Regional Model (TYREMS) - hourly output	T1h
Tyrrhenian Regional Model (TYREMS) - daily output	T24
ECMWF 0.5 ° winds	ECM
ECMWF 0.25°	E25

Table 1. Models output and corresponding folders.

A.1.1.3 Output data files

The output data files are ASCII format files:

The Output data Archive part of MEDSLIK-II consists of 1 folder:

- *output: t*he output files are automatically saved in subfolders whose name has the structure MMM_YYYY_MM_DD_HH_MM_NAME

where

(MMM is the name of the oceanographic model used for simulation, YYYY: year, MM: month, DD: day, HH: hour, MM: minutes, NAME: the simulation name chosen by the user).

The folder contains:

- The input file in text format (medslik5.inp);

- The parameters file in text format (medslik5.par);

- the medslik.fte the file, which contains the trend over time of: the oil volume spilled, the percentage of oil evaporated, the percentage of oil on the surface, the percentage of oil dispersed, the percentage of oil on the coast, the oil-water emulsion viscosity, the oil viscosity, the oil density, the fraction of water contained in the oil-water emulsion, etc.

- outhhhh.srf files: contain the values of the oil concentration on the surface;

- outhhhh.dsp files: contain the values of the dispersed oil concentration;

- outhhhh.cst files: contain the values of the oil concentration on the coast;

- outhhhh.tot files: contain the values of the oil concentration on the surface with a concentration greater than 0.05 m3/km2 and the coordinates of the slick contour;

where hhhh in the file name indicates the number of hours after the start of the spill.

In addition, the folder *output* contains one subfolder (*plot)* containing the two sub-folders containing the data of the wind and currents in the area affected by the spill.
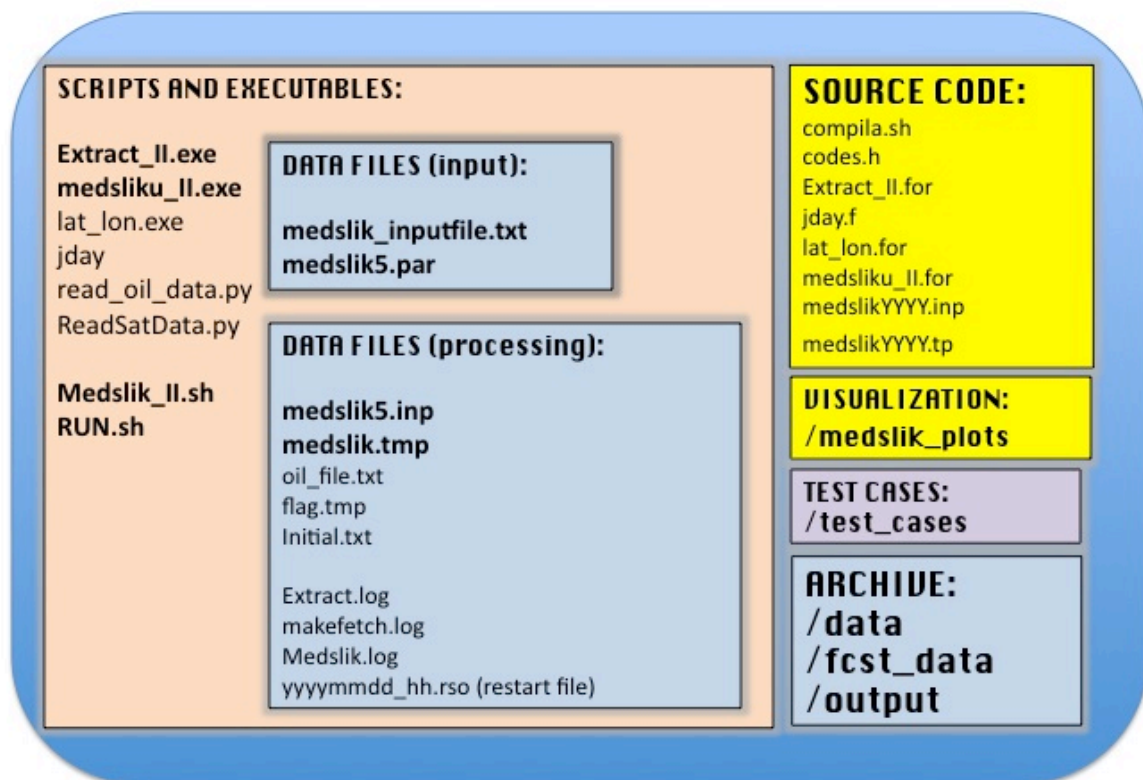

Figure 1. MEDSLIK-II Reference Code Architecture.

A.1.1.4 Script files and executables

The script *RUN.sh* first launches the model run (*medslik_II.sh*) and then the visualization execution (*medslik_plots/medslik_plots.sh*).

The operations performed by the Linux shell script (*medslik_II.sh*) are listed below.

1. Read input data

The *medslik_inputfile.txt* is processed. If the corresponding option has been selected the oil slick input data are read from the satellite data file.

2. Read the oil characteristics (using the routine read_oil_data.py) from the oil type database (*oilbase.txt* and *oil_list.txt*)

3. Save Input data

   This section is for the saving of the input data in the *medslik5.inp* file.

4. Area selection

   This section is for the selection of the area interested by the spill (using the routine *lat_lon*). The limits of the area and the list of the currents forecast files needed for the simulation are saved in the *medslik.tmp* file.

5. Extract currents, wind and SST data

   This section calls the routine *Extract_II.exe* (the executable of *Extract_II.for*), which extract the currents, wind and SST of the area interested by the spill.

6. Run

   This section calls the *medsliku_II.exe* (the executable of *medsliku_II.for*) in order to perform the simulation of the transport and weathering of the oil.

A brief description of the executables, launched by the script shell, is given below:

- *lat_lon*

lat_lon calculates the geographical limits of the area interested by the spill (the area is calculated assuming the slick travels at less than 1.5 nauticalmiles/h from spill site)

- *jday*

jday converts the calendar dates to astronomical julian dates and the elapsed time between instances over periods of time.

- *read_oil_data.py*

read_oil_data.py read the oil characteristics from the oil type database file *oilbase.txt* and *oil_list.txt* (located in the *data* folder).

- *ReadSatData.py*

ReadSaDatat.py reads the satellite data file (if the corresponding option has been selected) and writes two text files (*Initial.txt and medslik_sat.inp*) containing the slick contour and oil spill data. This routine has to be adapted for the specific satellite date file format (usually XML or GML file).

- *Extract_II.exe*

Extraction of the required wind/currents data from the netCDF files. *Extract_II.for* reads from the *medslik.tmp* the limits of the region that has to be extracted from the wind/currents data files.

- *medsliku_II.exe*

medsliku_II.exe is the executable of the *medsliku_II.for* code.

A.1.1.5 Visualization software

The visualization software is located in the folder *medslik_plots*, which contain the NCL codes and the shell script (*medslik_plots.sh*) to run the visualization procedure.

The MEDSLIK-II.V1.0 visualization software reads the oil on surface output (.srf) and plots the oil slick concentration in space and time, together with the wind and currents.

The maps are saved in the subfolder *plots* located in the simulation output directory (MMM_YYYY_MM_DD_HH_MM_NAME, see A.1.1.3).

The MEDSLIK-II.V1.0 visualization software allows plotting available satellite observations together with the oil slick prediction. The software automatically read the observation files that have to be saved in the simulation output directory (examples of observation file format are provided in *test_cases* folder).

The *medslik_plots.ncl*, located in the simulation output directory, is the parameter files, which can be edited by the user to set the lat/lon image limits, to choose the time step between two subsequent images.

A.1.1.6 Test case set up

In order to the test the correct operation of the system, the meteo-oceanographic data and input file needed to run 1 test case are located in the folder *test_cases*/TEST_ALGERIA.
This folder contains the input file, the observation file, the Mediterranean Forecasting System hourly data archived in the folder O1h and the ECMWF wind data archived in the folder ECM.
To execute the test cases:
- manually copy the files contained in O1h and ECM in the corresponding subfolders located in the *fcst_data* folder;
- manually copy the input file and observation file in the main MEDSLIK-II directory
- run the script shell *RUN.sh* (on the virtual machine provided: source *RUN.sh*)

The folder *output/MFS_2008_08_05_0951_ALGERIA* will contain the output files (*srf, *dsp, *cst and *tot for each hour of simulation and the *medslik.fte* file), the input and parameter text files (*medslik_inputfile.txt, medslik.tmp, medslik5.inp, initial.txt*), the observation file (*observation_0808071050.txt*) and the visualization parameter file (*medslik_plots.ncl*). The subfolders O1h and ECM will contain the meteo-oceanographic data for the area interested by the spill in text format. The subfolder plot will contain the oil concentration maps.
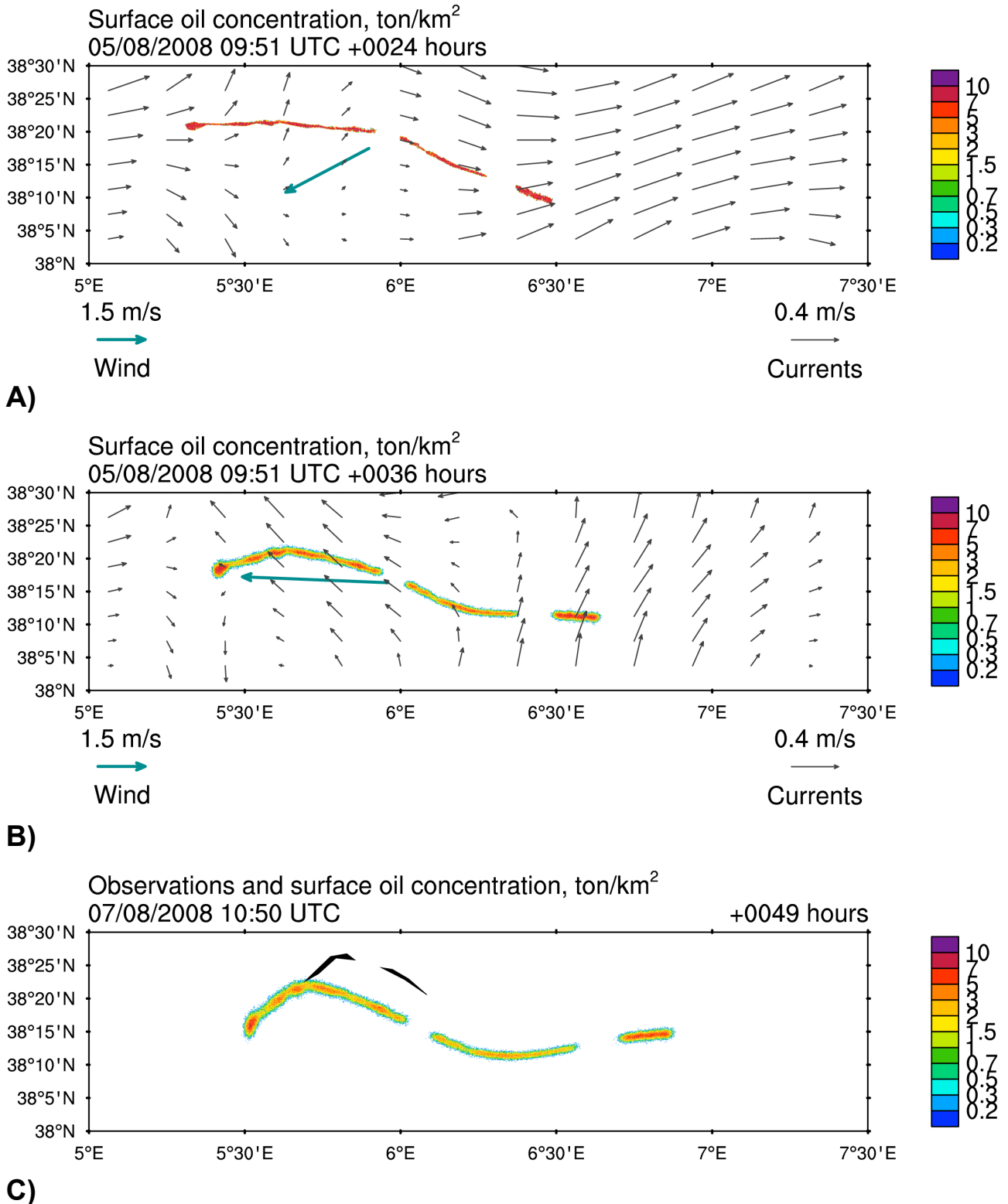In Figure 2 three example maps are shown.

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Figure 2. Test case 'TEST_ALGERIA' output map. In panel A and B are plotted the oil slick concentration, the currents fields (black arrows) and wind in the slick centre (blue arrow) after 24 hours of simulation (A) 36 hours (B). In panel C the superimposition of the observation and the oil slick after 49 hours of simulation is shown.

A.1.2 Medslik-II Server

The Reference code runs on a Linux operating system. The reference code is given within a package that installs a virtual machine server with a Linux software that has been tested to work with the reference code software.

A.1.3 Medslik-II Web pages

The Medslik-II Web pages for the MEDSLIK-II.V1.0 are located at the following web site:

http://gnoo.bo.ingv.it/MEDSLIKII

 and they will be upgraded following the Work Plan presented in Annex 2.

ANNEX 2   INITIAL WORK PLAN

The initial Work Plan is described below for each partner.

A.2.1 INGV contribution

A.2.1.1 Research and development

- *Software Environment*

INGV during 2012 will develop the following software:

- shell script to run the model code in Linux environment;

- *Numerical integration scheme developments*

INGV during 2012 will study and implement higher order numerical integration scheme.

A.2.1.2 Documentation and website

- *MEDSLIK II manual*

The manual will be produced by INGV and will explain how to use MEDSLIK II code. INGV will include in the manual the MEDSLIK-II V1.0 code description and documentations related to its own new developments on the code. The manual will present system requirements to install and use the code, how to compile the code, characteristics of needed input files, how to run a simulation, how to read and visualize the outputs.

- *Test case description*

The test case will consists of a set of input data ready to be used to run the code in a certain location of the Mediterranean Sea. The documentation related to the test case will consists of: description of the scenario (location of the spill, time, duration, type of oil...), detailed description of input (hydrodynamic and meteo forcing) and detailed description of results, description of the computer and environment used to run the simulation (computer characteristics, compiler, operative system).

A.2.2 CMCC contribution

A.2.2.1 Research and Development

- **Input/Output visualization software development**

CMCC during 2012 will update the visualization software.

A.2.2.2 Documentation and website

- **Website**

CMCC will implement the MEDSLIK II web site, this will consists of: home page with brief model overview, page with theory description, download area, documentation area, contact page, Agreement description page. The web site will be protected by secure access with user registration.

- ***MEDSLIK II manual***

During 2012 CMCC will provide documentations related to its own developments on the code to be included into the MEDSLIK-II manual.

A.2.3 CNR-IAMC contribution to the work plan.

A.2.3.1 Research and Development

- ***Coupling with Eulerian Current Models***

CNR-IAMC during 2012 will develop the following routine:

Off-line coupling MEDSLIK-II-regional model and MEDSLIK-II-coastal model (SHYFEM), focusing on the internal interpolation and the coastal boundaries.

A.2.3.2 Documentation and website

- ***MEDSLIK II manual***

During 2012 CNR-IAMC will provide documentations related to its own developments on the code to be included into the MEDSLIK-II manual.

A.2.4 OC-UCY contribution to the work plan

A.2.4.1 Research and Development

- Inter-comparison of the relevant developments in MEDSLIK II with those similar developments that already were implemented in MEDSLIK: the Stoke drift using the wave forecasting data, the backtracking, the consideration of the oil spill source at depths below the sea surface.

A.2.4.2 Documentation and website

- ***MEDSLIK II manual***

During 2012 OC-UCY will provide documentations related to its own developments on the code to be included into the MEDSLIK-II manual.

ANNEX 3   MEMBERS OF COMMITTEES and TEAMS

A.3.1 Members of Steering Committees

INGV: Dr. G. Coppini

CMCC: Prof. N. Pinardi

CNR-IAMC: Dr. R. Sorgente

OC-UCY: Dr. G. Zodiatis

A.3.2 MEDSLIK-II System Team

Name of person	Affiliation	Expertise
Dr. M. De Dominicis	INGV	Numerical modelling
Dr. A.Cucco	CNR-IAMC	Numerical modelling
Dr. V.Lyubartsev	CMCC	Visualization software
Eng. M. Drudi	INGV	Linux architecture and scripts
Xenia Panayidou	OC-UCY	Validation inter-comparison
Andria Karaolia	OC-UCY	Visualization software
Stavros Stylianou	OC-UCY	Numerical scripts and visualization software

ANNEX 4   BACKGROUND INFORMATION

A.4.1 INGV

INGV has developed the new version of the reference code, so-called MEDSLIK-II.V1.0 (De Dominicis et al. 2011), based on its pre cursor oil spill model MEDSLIK (Lardner and Zodiatis 1998; Lardner et al. 2006; Zodiatis et al. 2005, 2008).

A.4.2 CMCC

CMCC has the released initial version of the reference MEDSLIK code v. 5.2.3 and in addition has developed the visualization software for the MEDSLIK-II.V1.0 version (Annex 1).

A.4.3 CNR-IAMC

CNR-IAMC implemented the MEDSLIK v. 5.2.3 at the broader sea area of the Sicily Strait, coupled with the Sicily Strait forecasting model.

A.4.4 OC-UCY

OC-UCY has contributed to the development of the MEDSLIK version 5.2.3 of the code that was released to CMCC.

REFERENCES

De Dominicis, M., Pinardi, N., Zodiatis, G., 2011. Advanced marine oil spill modelling for short term forecasting. Part II: Theory. Ocean Modelling xx, xx-xx.

De Dominicis, M., Pinardi, N., Zodiatis, G., Archetti, R., 2011. Advanced marine oil spill modelling for short term forecasting. Part II: Numerical simulations. Ocean Modelling xx, xx-xx.

Lardner, R., Zodiatis, G., Hayes, D., Pinardi, N., 2006. Application of the MEDSLIK oil spill model to the Lebanese Spill of July 2006. European Group of Experts on Satellite Monitoring of Sea Based Oil Pollution. European Communities.

Lardner, R., Zodiatis, G., Loizides, L., Demetropoulos, A., 1998. An operational oil spill model for the Levantine Basin(Eastern Mediterranean Sea), in: International Symposium on Marine Pollution.

Zodiatis G., Lardner R., Hayes D., Georgiou G., Kallos G., Pinardi N., "Oil spill model predictions integrated with operational forecasting and observing systems in the Mediterranean," IMEMS-The 8th International Marine Environmental Modeling Seminar, pp 58, Helsinki, 23-25 August, 2005.

Zodiatis, G., Lardner, R., Hayes, D., Georgiou, G., Pinardi, N., De Dominicis, M., Panayidou, X., 2008. The Mediterranean oil spill and trajectory prediction model in assisting the EU response agencie, in: Congreso Nacional de Salvamento en la Mar, Cadiz, 2-4 October, libro de actas, pp. 535-547.