



**LINC**

**Learning about Interacting Networks in Climate**

**Marie Curie Initial Training Networks (ITN)**

FP7- PEOPLE - 2011- ITN

**Grant Agreement No. 289447**

WorkPackages WP1, 2 & 4:

**Deliverables D1.1, D2.1, D4.1, D1.2, D1.3**

**D1.1, D2.1, D4.1 A database created, with united standard including all relevant available climate data**

+

**D1.2 Toolbox developed for estimating multivariate causality and its statistical evaluation**

+

**D1.3 Toolbox developed for efficient eigenvalue determination**

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Status: Public



## **EXECUTIVE SUMMARY**

This document summarizes five separate but related deliverables – D1.1, D2.1, D4.1, D1.2 & D1.3 - which together define the central LINC climate resources database (ver. 1.2).

The aim of the deliverables is to provide a unified database of all relevant available climate data that can be accessed and used by LINC fellows (ERs and ESRs) in their research. In addition the software tools provided in D1.2, D1.3 help in the analysis of climate data using complex network approach.

The database components – climate model data, test data and software - are accessible via the LINC web pages: <http://www.climatelinc.eu/results/database/> and <http://www.climatelinc.eu/results/software/>.

The above resources (software, databases) form the basis of the research undertaken by the ERs and ESRs of LINC in Work Packages WP3-5.

It is planned that these resources will be updated and added to throughout the course of the project. The web pages will be maintained so as the latest data is publicly accessible at all times.

## Deliverable Identification Sheet

<b>Grant Agreement No.</b>	<b>PITN-GA-2011-289447</b>
<b>Acronym</b>	<b>LINC</b>
<b>Full title</b>	<b>Learning about Interacting Networks in Climate</b>
<b>Project URL</b>	<a href="http://climatelinc.eu/">http://climatelinc.eu/</a>
<b>EU Project Officer</b>	Lucia PACILLO

<b>Deliverable</b>	<b>D1.1, D2.1, D4.1 + D1.2, D1.3 - LINC Database of climate data created with united standard plus tools for analysis</b>
<b>Work package</b>	<b>WP1, WP2 &amp; WP4</b>

<b>Date of delivery</b>	<b>Contractual</b>	M 12 / M24	<b>Actual</b>	05-Nov-2013
<b>Status</b>	version. 1.2		final <input checked="" type="checkbox"/>	draft <input type="checkbox"/>
<b>Nature</b>	Prototype <input type="checkbox"/> Report <input type="checkbox"/> Database <input checked="" type="checkbox"/>			
<b>Dissemination Level</b>	Public <input checked="" type="checkbox"/> Consortium <input type="checkbox"/>			

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<b>Abstract (for dissemination)</b>	This deliverable is a cover note for four separate but related software + database deliverables – D1.1, D1.2, D2.1 and D4.1 – all rolled into one. The four deliverable components make up the central LINC database (v 1.1)
<b>Keywords</b>	Database, united standards, climate data, LINC

Version Log			
Issue Date	Rev No.	Author	Change(s)
30-04-2012	001	H. Dijkstra	Creation of database on LINC web and structure
10-05-2013	002	V. Goetcherian	Added Deliverable ID sheet
31-05-2013	003	J. Kurths	Added links to the database on the LINC website and software for estimating multivariate causality and its statistical evaluation.
5-11-2013	004	J. Kurths	Added extension of software for network analysis for efficient eigenvalue determination.

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## 1 INTRODUCTION

This document is a cover note for four separate but related deliverables – D1.1, D1.2, D2.1 and D4.1 - rolled into one. The four deliverable components make up the central LINC database (v 1.1) of climate data which can be found here:

<http://www.climatelinc.eu/results/database/>

and

<http://www.climatelinc.eu/results/software/>

## 2 CENTRAL LINC CLIMATE DATABASE (VERSION 1.2, 05/11/2013)

The LINC database comprises three elements: 1- Climate model data; 2- Test data; and 3-Software. Access to all three is available via the LINC web pages.

### 2.1 Climate (model) data

- a) Nearly all climate datasets from the instrumental record and many of the (IPCC - AR4) GCM data sets can be downloaded using the [KNMI Climate Explorer](http://climexp.knmi.nl) from: <http://climexp.knmi.nl>
- b) Nearly all proxy data records can be downloaded from the NOAA, the U.S. National Climatic Data Center: <http://www.ncdc.noaa.gov/paleo/data.html>
- c) The CMIP5 data base of IPCC - AR5 models can be found on: [http://cmip-pcmdi.llnl.gov/cmip5/data\\_getting\\_started.html](http://cmip-pcmdi.llnl.gov/cmip5/data_getting_started.html)
- d) The DDC contains data produced from Integrated Assessment Models (IAMs), Carbon-cycle Models, General Circulation Models, and Earth System Models: <http://www.ipcc-data.org/sim/index.html>
- e) The Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data (HOAPS) set is a completely satellite based climatology of precipitation, evaporation and freshwater budget (evaporation minus precipitation) as well as related turbulent heat fluxes and atmospheric state variables over the global ice free oceans. All variables are derived from SSM/I passive microwave radiometers, except for the SST, which is taken from AVHRR measurements. The latest release, HOAPS-3.2, includes the entire SSM/I record from 1987-2008. The products are available as monthly averages and 6-hourly composites on a regular latitude/longitude grid with a spatial resolution of  $0.5^\circ \times 0.5^\circ$  degrees. [http://www.hoaps.zmaw.de/index.php?id=data\\_access](http://www.hoaps.zmaw.de/index.php?id=data_access)
- f) Asian Precipitation - Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE's Water Resources). The APHRODITE project develops state-of-the-art daily precipitation datasets with high-resolution grids for Asia. [http://www.chikyu.ac.jp/precip/cgi-bin/aphrodite/script/aphrodite\\_cgi.cgi/register](http://www.chikyu.ac.jp/precip/cgi-bin/aphrodite/script/aphrodite_cgi.cgi/register)

g) The Tropical Rainfall Measuring Mission (TRMM) is a joint U.S. - Japan satellite mission to monitor tropical and subtropical precipitation and to estimate its associated latent heating. Daily precipitation data can be found on

[ftp://disc3.nascom.nasa.gov/.../data/s4pa/TRMM\\_L3/TRMM\\_3B42\\_daily/](ftp://disc3.nascom.nasa.gov/.../data/s4pa/TRMM_L3/TRMM_3B42_daily/)

## 2.2 Test data

a) In many of the papers where network analysis has been used the NCEP re-analysis data have been used, in particular the atmospheric surface temperature field. This dataset can be downloaded from:

<http://www.staff.science.uu.nl/~dijks101/LINC/>

b) Monthly average global SURFACE air temperature (SAT) fields were used for climate Network construction in the paper J.F. Donges, Y. Zou, N. Marwan and J. Kurths [1].

c) Global monthly averaged and *vertically resolved* atmospheric geopotential height field covering the troposphere and the lower stratosphere. R. Kistler, et. al. [2].

d) Climate records from the North Atlantic region to a period of about 1470 years during the last glacial period were discussed in paper H. Braun, P. Ditlevsen, J. Kurths and M. Mudelsee [3].

## 2.3 Software

a) Over the past years partner CRA has been developing time-series analysis software on regression, correlation, spectrum estimation, extremes etc. Those methods are adapted to take into account typical properties of (paleo-) climate data: non-normal distributions, persistence, uneven temporal spacing. The link to this software is: <http://www.manfredmudelsee.com/soft/index.htm>

b) Partner PIK: TOSCY (Toolboxes for Complex Systems) - toolboxes for time-series analysis.

(i) Cross Recurrence Plot Toolbox

This toolbox contains MATLAB® routines for computing recurrence plots, cross recurrence plots and their quantifications. The most programs contain a user-friendly graphical user interface: a pure command-line application of the programs is also possible.

To download the cross-recurrence plot toolbox is: <http://tocsy.pik-potsdam.de/CRPtoolbox/>

(ii) pyunicorn (UNified Complex network and Recurrence analysis toolbox) is a software that allow to easily construct networks from uni- and multivariate time series data (functional (climate) networks and recurrence networks). This involves linear and nonlinear measures of time series analysis for construction functional networks from uni- and multivariate data as well as modern techniques of nonlinear analysis of single time series like recurrence

quantification analysis and recurrence network analysis (as part of D1.2 - toolbox for estimating multivariate causality and its statistical evaluation). It also can be used to analyze visibility graphs and perform visibility graph-based time reversibility tests. This toolbox was extended with code for efficient eigenvalue determination (as part of D1.3 - toolbox developed for efficient eigenvalue determination).

To download: <http://tocsy.pik-potsdam.de/pyunicorn.php>

(iii) COPRA – Constructing Proxy Records from Age Models  
(MATLAB® and Octave Toolbox)

To download: <http://tocsy.pik-potsdam.de/copra.php>

To download the most recent version of the network software and documentation of PIK is via the link: <http://www.pik-potsdam.de/members/donges/software-1>

### **3 SUMMARY**

A central database of public resources – model data, test data and software - has been set up by the project for use by the LINC Fellows, principal investigators and any other interested researchers. These resources will be updated, and added to, throughout the course of the project. The relevant web pages will be maintained so as the data is always up to date and accessible online..

#### 4 REFERENCES

- [1] J.F. Donges, Y. Zou, N. Marwan and J. Kurths, Complex networks in climate dynamics, *European Physical Journal Special Topics* 174, 157-179 (2009). DOI: [10.1140/epjst/e2009-01098-2](https://doi.org/10.1140/epjst/e2009-01098-2)
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- [3]: H. Braun, P. Ditlevsen, J. Kurths and M. Mudelsee, *Limitation of red noise in analysing DO events*, *Clim. Past*, 6, 85-92, (2010) DOI:[10.5194/cp-6-85-2010](https://doi.org/10.5194/cp-6-85-2010)