Review of the meteorological data treatment into RES-E integration studies

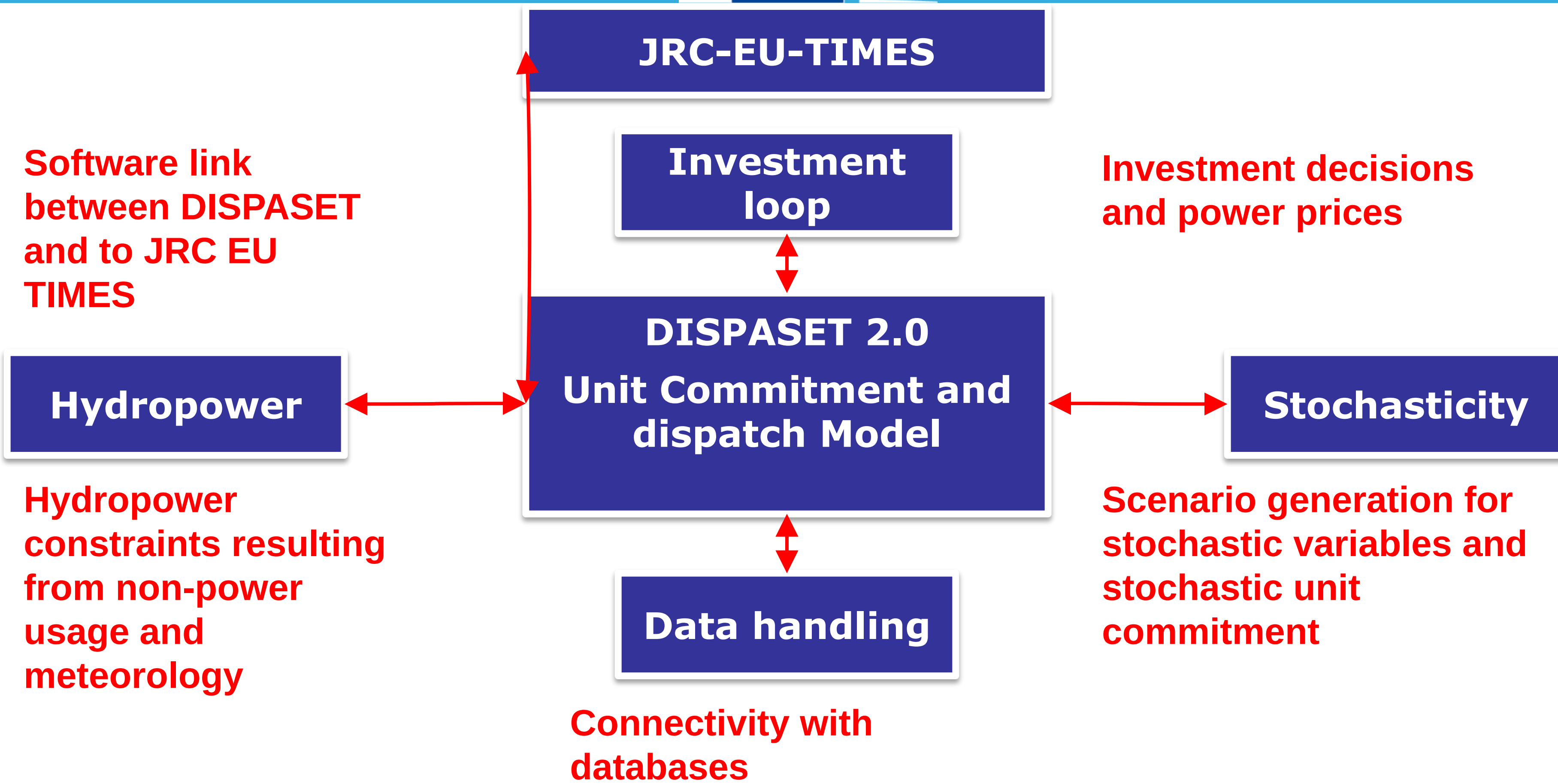
Dr. Iratxe González-Aparicio
Dr. Andreas Zucker

2nd Open Energy Modelling Workshop, 13th - 14th Berlin

Outline

- Dispa-SET 2.1: European Unit Commitment and Dispatch Power Model
- Critical review of studies using meteorological data for RES-S studies
- Considerations when using meteorological data
- Datasets used for the Dispa-SET 2.1 and other related-studies

DISPASET 2.0
and planned extensions



Hidalgo-Gonzalez I, Quoilin S, Zucker A. Dispa-SET 2.0 (2014). **Unit Commitment and power dispatch model**, Publication Office of the European Union JRC93780. ISBN 978-92-79-44690-0 (pdf)

I. Gonzalez-Aparicio & A. Zucker, 2015. **Review of meteorological data treatment into RES-E integration studies (2015)** (under revision, published as JRC-Report)

F. Monforti-Ferrario, M.M. Miglietta, T Huld, R Lacal-Arantegui, I Gonzalez-Aparicio, G. Fulli. **Spatial and time complementarity of future wind energy production patterns over Europe: main features and consequences for transmission grids**. 3rd International Conference Energy & Meteorology, Weather & Climate for the energy industry, 22-26 June 2015, Boulder

Gonzalez-Aparicio, I. & Zucker, A. 2015. **Impact of wind power uncertainty forecasting on the market integration of wind energy in Spain**. Applied Energy Journal, under revision

Review of existing studies

STUDY	Year of publication	Approach	Horiz. & and temp resolution	Time frame of meteorological data used	Final purpose
DENA II	2010	NWP model: EU – COSMO	6x 6 km. 1-hourly → Statistical downscaling to 15-minutely	2004-2007	Integration of RES in the German power supply for 2015-2020
North Sea Grid	2012	Time series ?	?	2006	Assumptions for 2030, wind power scenarios to improve current and future infrastructure development in the North Sea Area
EdF	2015	Reanalysis: ERA-Interim ERA-40	50 x 50 km 3-hourly	31 years:	Meteorological data are used as input for the CONTINENTAL model in order to assess the flexibility into electricity system planning
NREL	2013	NWP model: WRF	2 x 2 km 10-minutely → biased and downscaling to 1-minutely by statistics	2004-2006	Investigate the impact of up to 35% energy penetration of wind, PV and concentration solar power on the power system.
NREL	2013	Reanalysis: GFS	6x6 km 1-hourly	1979- present	Development of wind resource and wind output datasets
Rassmunsen et al. , Heide et al.	2011 & 2010	Private source (WEPROG) & Reanalysis: NCAR/NCEP	50 x 50 km & 47 x 48 km 1-hourly	2000-2007	Optimal combination of storage and balancing in a 100% renewable European Power System. Seasonal optimal mix of wind and solar power in a future, highly renewable Europe
Budischack et al.	2013	Observations: 135 meteorological stations	1-hourly	1999-2002	Cost-minimized combinations of wind power, solar power and electromechanical power, powering the grid up to 99.9% of the time.
Univ. Cologne	2015	Time series ?	?	Clusters of 32 type of days in a year	Modelling flexibility needs in the European power system
Gaetani et al.	2014	Projections: GCM model ECHAM5-HAM	T63 – 180 x 180 km approx.	Difference between 2030-2000	Assess the near future change in productivity of photovoltaic energy in Europe and Africa

Review of existing studies

The GCM, RCM and the NWP are able to simulate the global/regional climate system and the atmospheric processes on different spatial and time scales, respectively

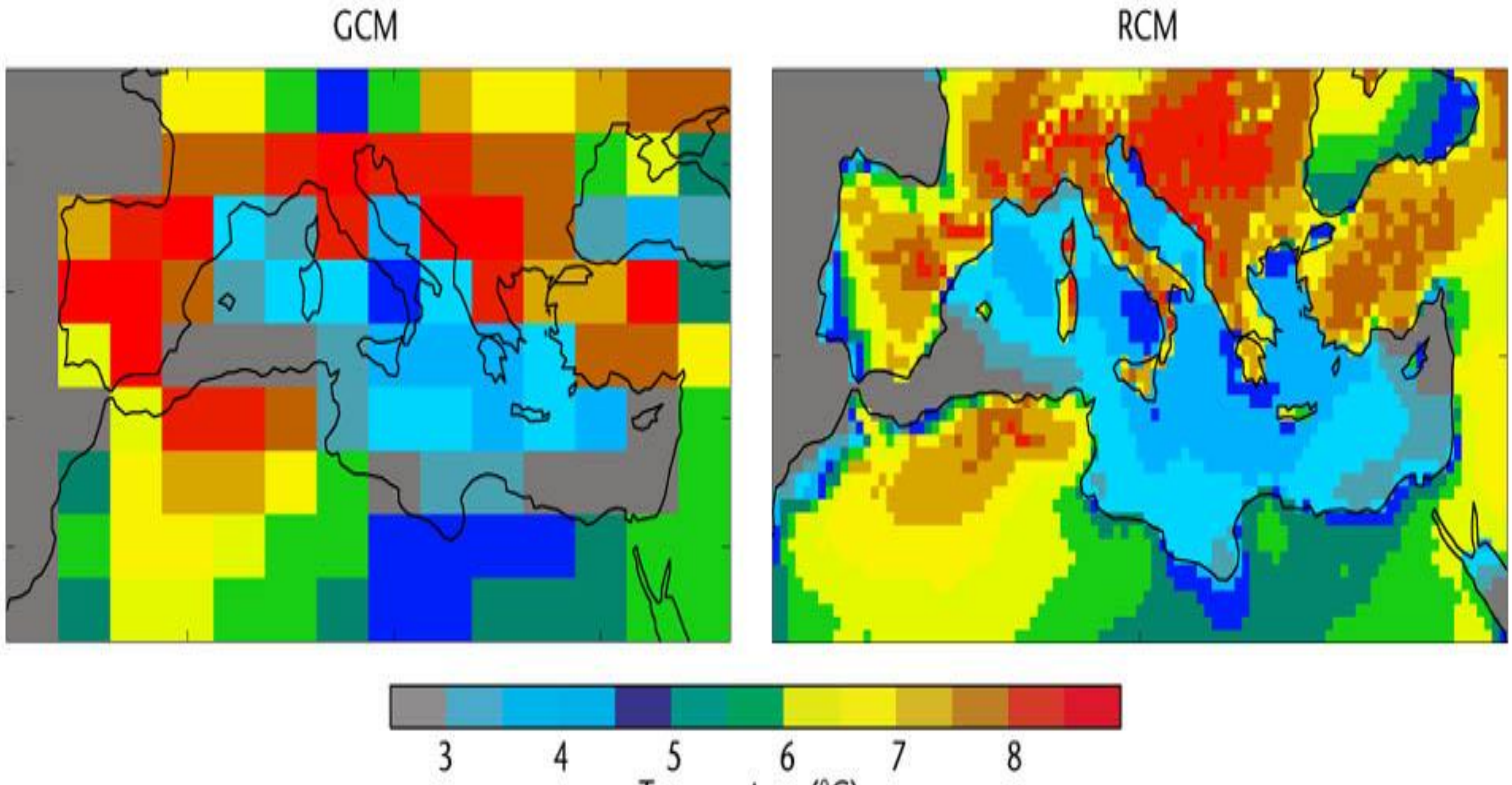
Reanalysis of past weather data presents a clear picture of past weather, independent of the many varieties of instruments used to take measurements over the years. Through a variety of methods, observations from various instruments are added together onto a regularly spaced grid of data.

Considerations

- Horizontal and temporal resolution of NWP or RCM
- Size: Dealing with large datasets: select the domain, and only the necessary data
- Format: NetCDF, GRIB, UGRID, HDF5
- Post-processing tools: IDL/GDL, R-software, CDO-NCO, Ncview/Panoply, "Matlab"

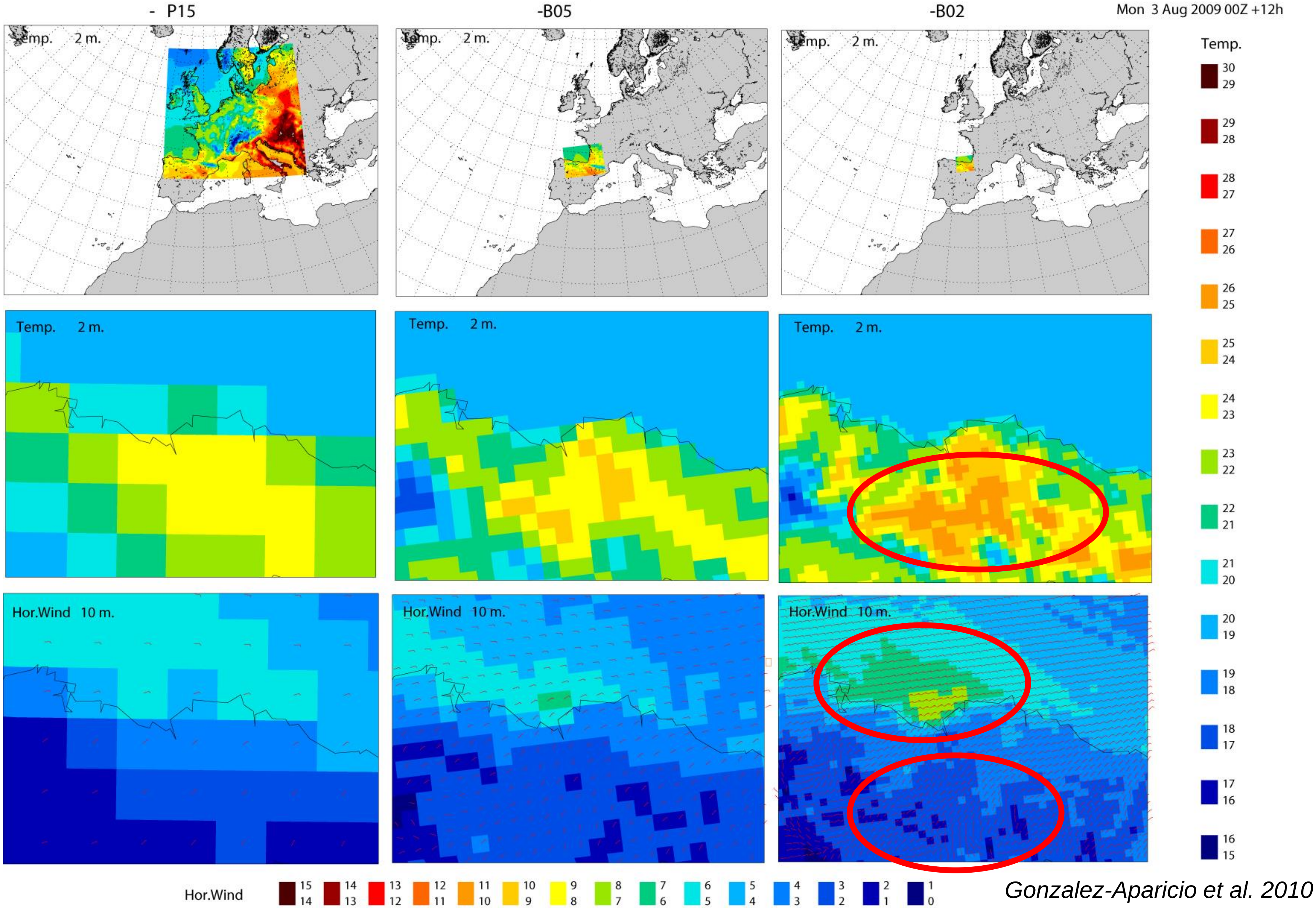
Horizontal Resolution GCM, RCM

100 km x 100 km | 50 km x 50 km



IPCC, 2007

Horizontal Resolution NWP



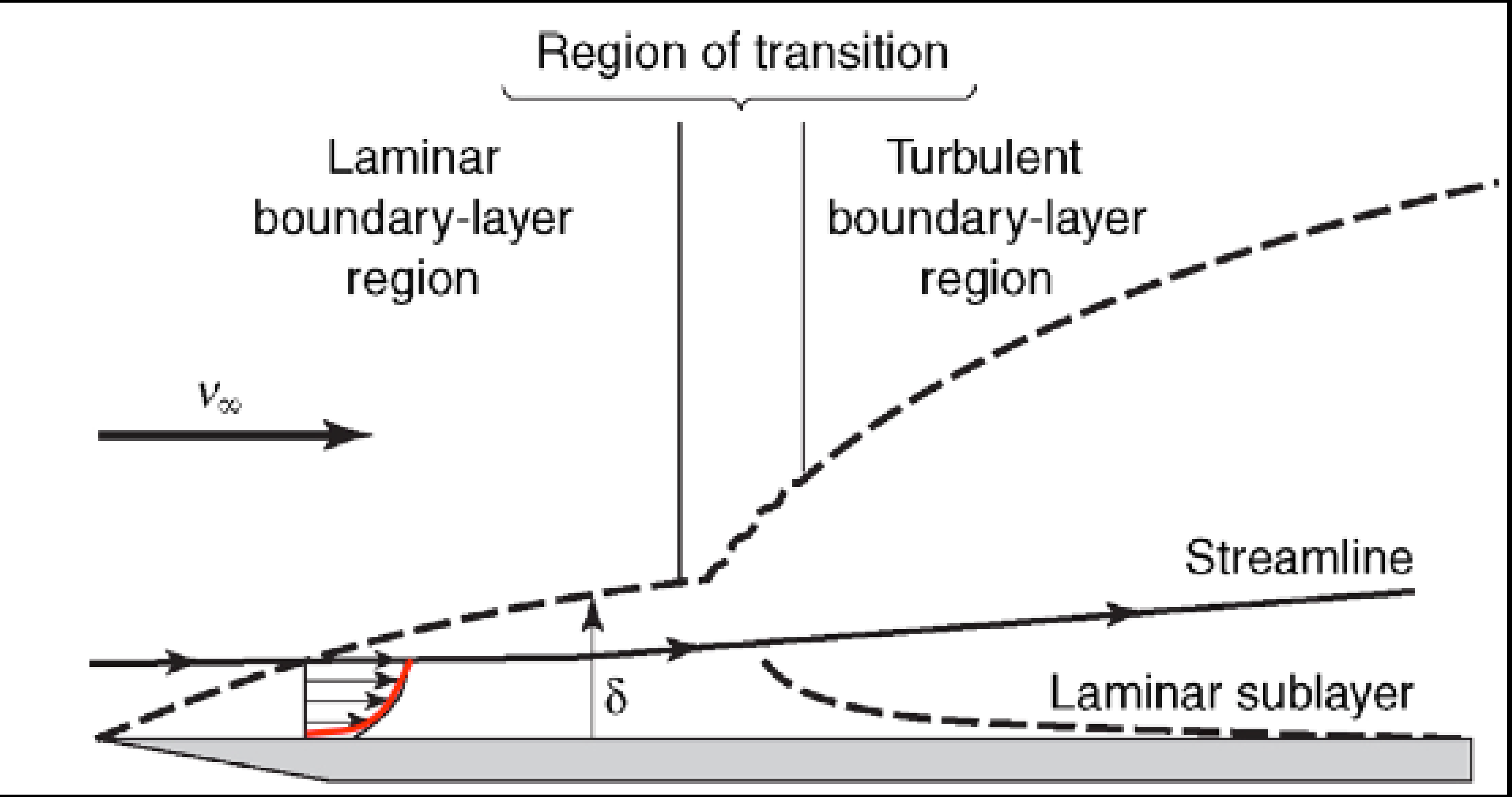
Gonzalez-Aparicio et al. 2010

Model levels, NWP

11/03/2009 – 12:00h

SIMULATIONS: EXAMPLES

Wind Surface level (40) **Wind 1km level (31)** **Wind troposphere (24)**



Datasets for Dispa-SET 2.1

ECMWF

Wind EU-28 energy productions

- Global Domain
- Period: 2012-2014
- Hourly frequency
- 100m w int. two nearest m.l.
- Horizontal resolution 16 x 16 km^2

ERA-Interim

- European Domain
- Period: 1959-present
- 3-Hourly frequency
- 10m w + other meteo var.
- Horizontal resolution 50 x 50 km^2

NASA

MERRA data holdings

- Global Domain
- Period: 1961-present
- Hourly frequency <- int. from 3-h
- 100m w int. two nearest m.l.
- Horizontal resolution 70 x 70 km^2 int. up to 12 km

CORDEX

Ensemble RCM driven by GCMs

- Several domains → EU-28
- Period: 1961-2100
- 3-Hourly frequency
- 10m + other meteo var.
- Horizontal resolution 12 x 12 km^2

Review of climate datasets and sources → Publicly available in:

I. Gonzalez-Aparicio & A. Zucker, 2015 (under review, published as JRC-Report by April)

European Commission

Thank you for your attention

Iratxe González-Aparicio

E-mail: iratxe.gonzalez-aparicio@ec.europa.eu

Tlph: +31 224 56 5251