



## Collaborative Climate Community Data and Processing Grid (C3-Grid)

### Documentation Diagnosis-Tools: „Eady“

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Work packages:	Workflows (AP1,3,4,5,6,7)
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## Introduction - Eady Growth Rate

The calculation of the Maximum Eady Growth Rate "Eady" has been chosen as a new standard workflow. The parameter describes how well deep pressure systems can develop in a weather situation over a specific area. It combines i.e. higher scaled weather situations with the development of extreme cyclones on the basis of theoretical derivations.

For calculation the parameters geopotential, temperature, humidity and wind velocity are necessary. It is typically calculated with daily means for a minimum of three days for single events but can also be used with monthly means.

## Method

The Eady growth rate assesses baroclinic instability through the vertical gradient in horizontal wind speed in the troposphere and a measure of static stability (Hoskins and Valdes 1990 in Paciorek et al. 2002).

Calculate approximate Eady Maximum Growth Rate (cf. Lindzen and Farrel; 1980; JAS 37, p. 1635) including vertical shear contribution of meridional wind.

Formula (cf Hoskins and Valdes; 1990, JAS 47, p. 1644):

$$\sigma_{BI} = 0.31 * \left( \frac{f}{N} \right) * \left| \frac{\delta(v,u)}{\delta z} \right|$$

Version for the layer between the 2 entry levels using Geopotential instead of geometric height, on a regular LAT/LON Grid

Input: - upper and lower pressure levels (i.e. 300, 500 hPa)  
- number of longitudes and latitudes of the used grid (region)  
- geopotential  
- horizontal windfield (zonal (u) & meridional (v) wind)  
- temperature in Kelvin

Output: Eady Maximum Growth rate (sigma(bi)) in [day\*\*-1]

## Components of the workflow „EADY“

eady.pl	calculates EADY parameter
graphic.pl	creates an image from the results of eady.pl
eady.sh	Shell script for the automatic start of the workflow in C3GRID
./src/	fortran sources
eady_grow.f90	module for the calculation of the EADY parameters
eady_do.f90	triggering of the EADY module

-> 'compile.sh' creates the program 'eady' in the base directory

Necessary programs:

cdo ClimateDataOperator

INPUT:

datafile (grib)

parameters for calculation:

level\_up = upper level

level\_down = lower level

lat\_n = northern latitude

lat\_s = southern latitude

lon\_w = western longitude

lon\_e = eastern longitude

OUTPUT

results

gribfile\_alles = Eady result file in GRIB

gribfile\_zeitmittel = time mean for image (temporal file)

grads\_steuerdatei = control file for GrADS (latitudes, longitudes,  
starttime, endtime, title, subtitle, etc.)

triggering of the Graphic module (graphic.pl)

INPUT:

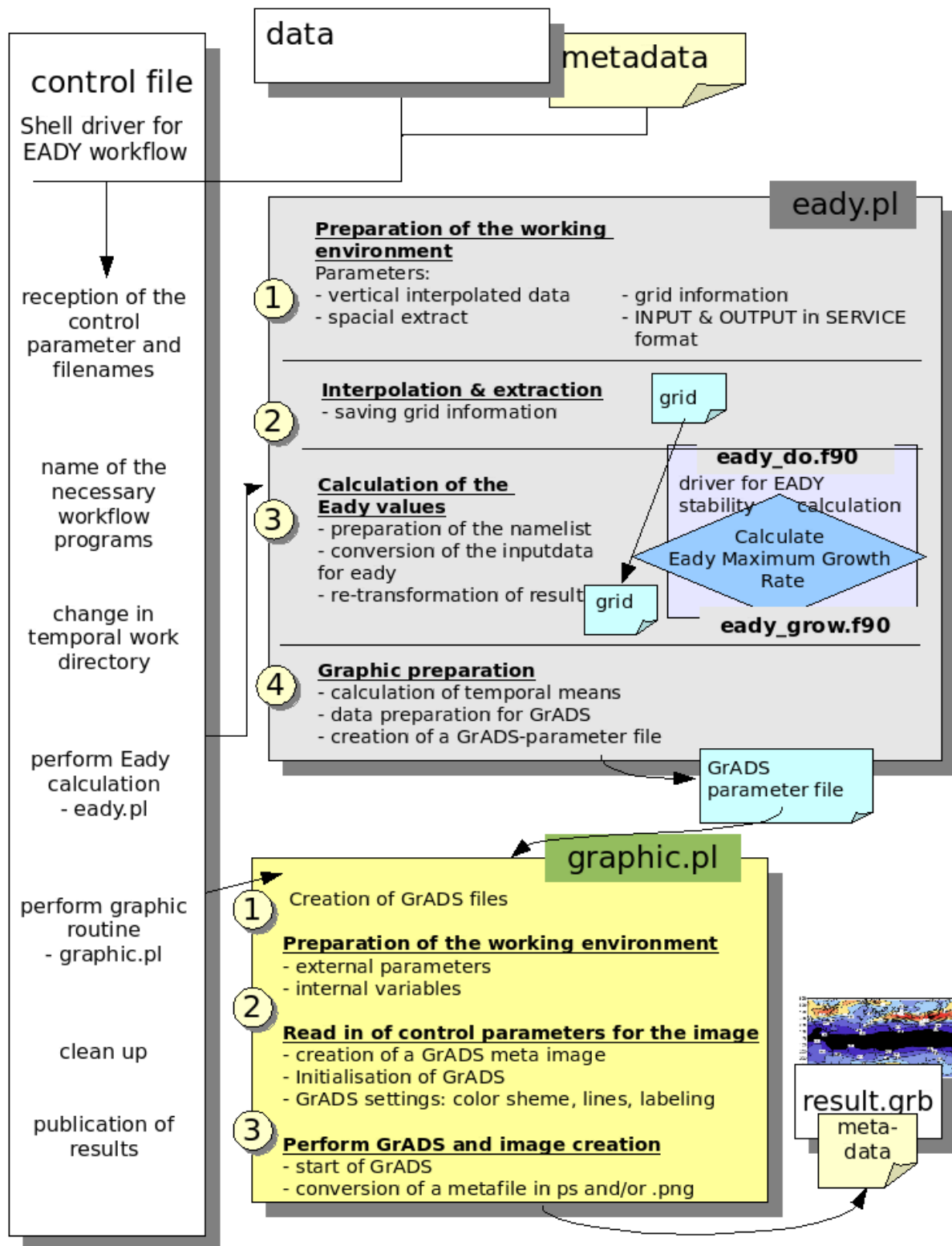
ctrlfile\_zeitmittel = GrADS control file (.ctl) from the time mean  
GRIB file

grads\_steuerdatei = control file for GrADS

OUTPUT

picture (.ps, .png) = image from the time mean

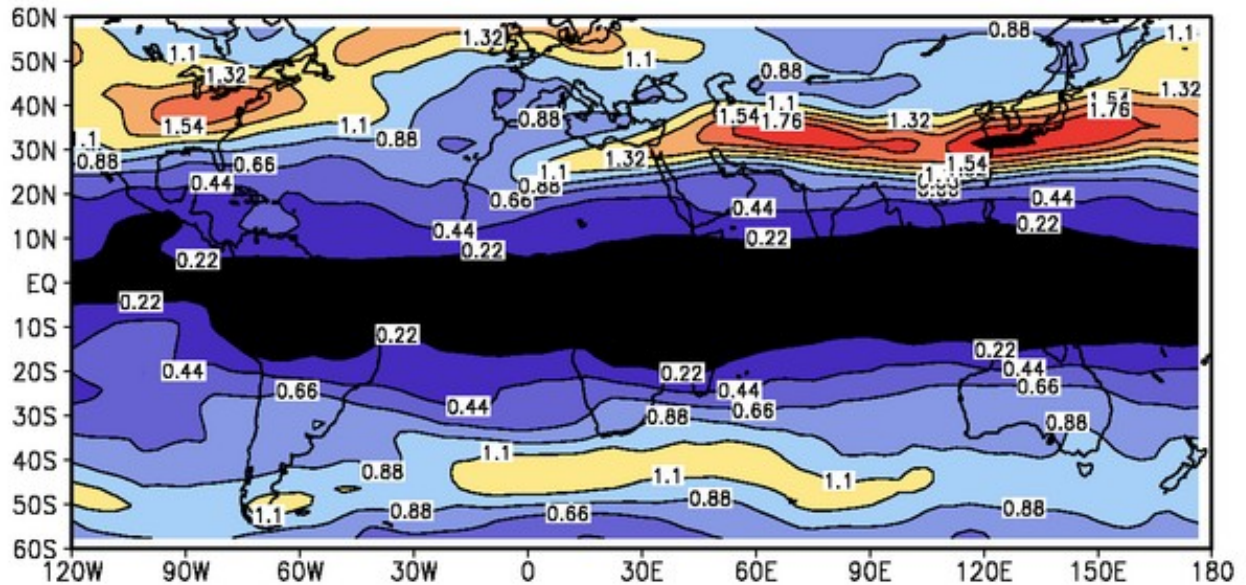
# Eady Workflow



**Pic.1:** Graphic workflow description

## Results

For an easier visualisation the result preview picture shows the temporal mean maximum eady growth rate. That means for the depiction the average of the user defined time was calculated. The result GRIB-file still contains the whole timeseries for the given period.



**Pic. 2:** mean Eady Growth Rate [1/day] in the time 0800-1-2 – 0800-1-31 for the layers 500 - 300

## References

- Hoskins, B.J. and Valdes, P.J.(1990): On the existence of Storm-Tracks. J. of the Atm. Sciences. Vol.47, No.15, p.1854-64.
- Paciorek, C.J. et al. (2002): Multiple Indices of Northern Hemisphere Cyclone Activity, Winters 1949–99. J. of Climate. Vol.15, p. 1573-90.