README for ICON MJO Analysis Suite

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This package contains a series of shell and ncl-scripts that allow for the evaluation of the Madden-Julian Oscillation in observational or model data.

Acknowledgement:
The scripts are based on the NCL MJO-Clivar analysis suite (https://www.ncl.ucar.edu/Applications/mjoclivar.shtml), special thanks to the developers of the NCL MJO CLIVAR Analysis Tools!

Our analysis suite combines the 16 NCL MJO CLIVAR scripts into 7 scripts (depending on their analysis procedure), to reduce duplicated data processing and computations.

It requires data on lat-lon grid, with daily or more frequent (6h/12h) output (samples per day >=1). Parts were also tested and run for 48h output (samples per day = 0.5) but this should be handled/checked carefully.

The several aspects to be analysed are as follows:
- Mean State: Determine mean state for summer and winter
- Daily Anomalies: Compute and plot daily anomalies
- Filtering: Apply bandpass filter to daily anomalies, plot filtered variables
- Correlations: Compute correlations, uni- and multivariate EOFs between several anomalies
- Space-Time-Spectra: Create Wheeler-Kiladis Spectra
- RMM-Index: Calculates and plots RMM-Index
- EOFs: Compute and plot EOF fields

- Capsule Script: mjo_analysis_procedure.sh

This script is the starting point for the entire procedure and calls the shell scripts for the seven analysis steps listed above. Variables that will be used by several of the sub-programs are defined here. The seven sub-programs are sourced in this capsule script and run in the same shell, sharing these variables.

Information on data frequency, length of run and its grid has to be provided here. Same applies to information on paths for input and output data, as well as the components which build up into the file name.

- Shell Scripts that call the NCL analysis procedures.
Most of them require adaptation of information (indicated)

mjo_analysis_pt1_mean_state.sh - compute mean state for summer and winter
calls mjo_analysis_clivar_mean_state.ncl
To adapt: File Names for Input Data

mjo_analysis_pt2_anomalies.sh - compute daily anomalies
calls mjo_analysis_clivar_anomalies.ncl
To adapt: File Names for Input Data as well as for Output Data

mjo_analysis_pt3_filtering.sh - apply bandpass filtering and create plots
calls mjo_analysis_clivar_filtering.ncl
To adapt: File Names for Input Data

mjo_analysis_pt4_correlations.sh - compute various correlations and multivariate EOFs
calls mjo_analysis_clivar_correlations.ncl
To adapt: File Names for Input Data, Names of Variables to be processed

mjo_analysis_pt5_wk_spacetime.sh - create Wheeler-Kiladis Space Time plots
calls mjo_analysis_clivar_wk_spacetime.ncl
To adapt: File Names for Input Data, Names of Variables to be processed

mjo_analysis_pt6_rmm-index.sh - compute RMM-Index for various phases
calls mjo_analysis_clivar_rmm-index.ncl
To adapt: If required, additonal seasons and associated number of months could be introduced

mjo_analysis_pt7_eofs.sh - compute and plot EOF fields
calls mjo_analysis_clivar_eofs.ncl
To adapt: File Names for Input Data

This setup of scripts was tested for a 10yr AMIP-like ICON-NWP Experiment at 1deg lat/lon resolution. The input data was structured and named as follows:

ICON_80km_10yr_TOT_PREC_daily.grb2
ICON_80km_10yr_OLR_daymean.grb2
ICON_80km_10yr_U200_daymean.grb2
ICON_80km_10yr_U850_daymean.grb2
ICON_80km_10yr_V850_daymean.grb2

The "`ICON_80km_10yr"'-Part of the file name is referred to as datased and defined as $dataset in the Capsule Script
The "`day"' in daymean data is the part referred to as dataextension and defined as $dataext, the "`daily"' in TOT_PREC is captured as special case in the shell-scripts that use this as input data (mjo_clivar_pt2_anomalies; mjo_clivar_pt5_wk_spacetime)
Output file names for anomalies will then read as ICON_80km_10yr_V850_dayanom.grb2