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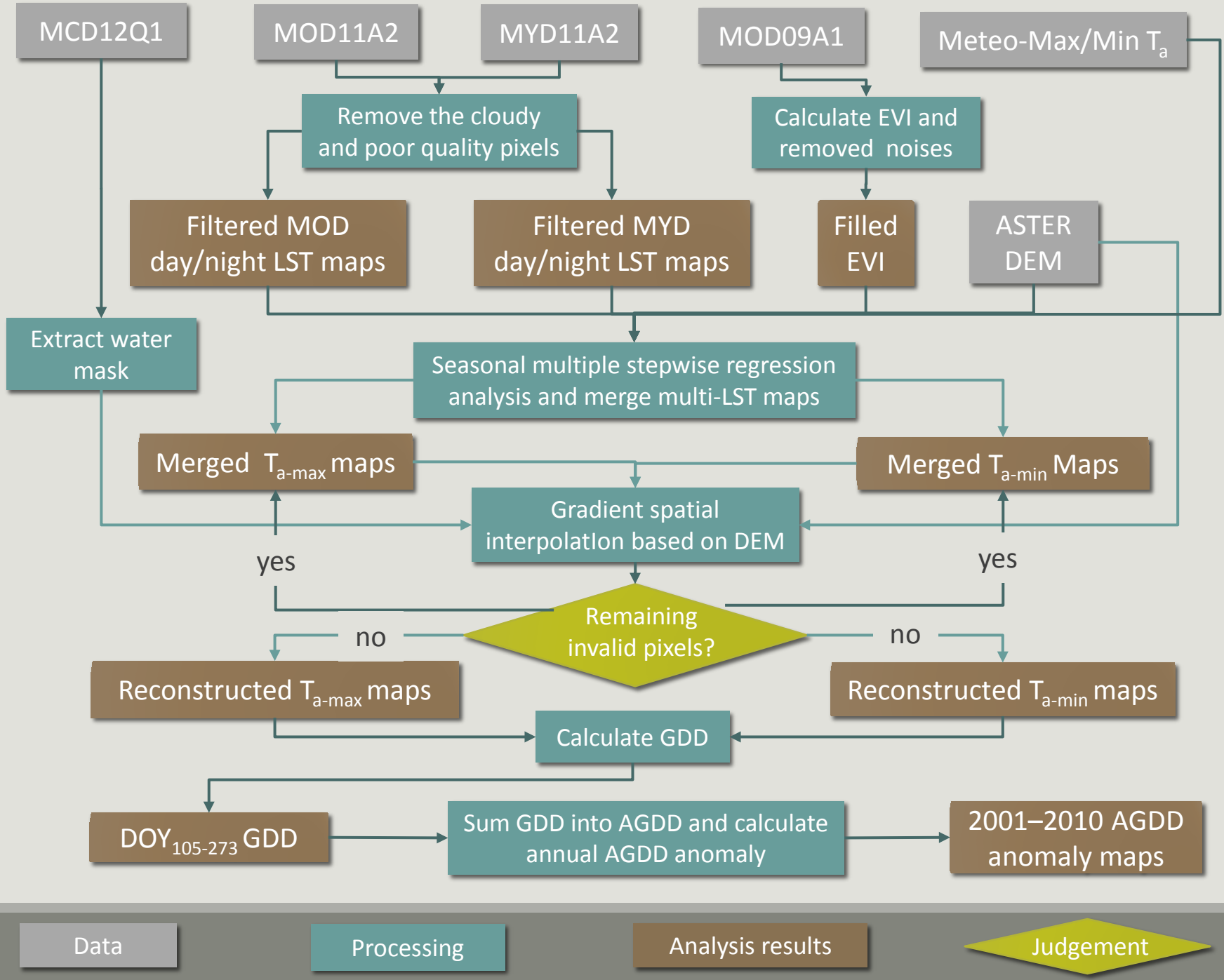
Spatio-temporal reconstruction of air temperature maps and their application to estimate rice growing season heat accumulation using multi-temporal MODIS data

基于多时相MODIS 数据的气温分布时空重建及其在水稻生长季热量条件估算中的应用

Key words: MODIS land surface temperature, Air temperature estimation, Reconstruction, Heat accumulation, Rice growing season, Growing degree day (GDD)

关键词： MODIS 地表温度；气温估算；重建；热量条件；水稻生长季；生长度日


MCD12Q1
MOD11A2
MYD11A2
MOD09A1
Meteo-Max/Min T_a
Remove the cloudy and poor quality pixels
Calculate EVI and removed noises
Filtered MOD day/night LST maps
Filtered MYD day/night LST maps
Filled EVI
ASTER DEM
Extract water mask
Seasonal multiple stepwise regression analysis and merge multi-LST maps
Merged $T_{a\text{-}max}$ maps
Merged $T_{a\text{-}min}$ Maps
Gradient spatial interpolatIon based on DEM
yes
yes
Remaining invalid pixels?
no
no
Reconstructed $T_{a\text{-}max}$ maps
Reconstructed $T_{a\text{-}min}$ maps
Calculate GDD
$DOY_{105\text{-}273}$ GDD
Sum GDD into AGDD and calculate annual AGDD anomaly
2001–2010 AGDD anomaly maps
Data
Processing
Analysis results
Judgement

- The thermal images from remotely sensed satellites can provide better spatial results of temperature-based agro-meteorological indices.

- To solve the critical problems of estimating air temperature (Ta) and filling in missing pixels due to cloudy and low-quality images in growing degree days (GDDs) calculation from remotely sensed data, a novel spatio-temporal algorithm for Ta estimation at all sky condition from Terra and Aqua moderate resolution imaging spectroradiometer (MODIS) data was proposed.

- The verification results of maximum Ta, minimum Ta, GDD, and AGDD from MODIS-derived data to meteorological calculation were all satisfied with high correlations over 0.01 significant levels. Overall, MODIS-derived AGDD was slightly underestimated with almost 10% relative error. It's feasible to employ AGDD anomaly maps to characterize the 2001–2010 spatio-temporal variability of heat accumulation.

- Our study may supply a novel way to calculate AGDD in heat-related study concerning crop growth monitoring, agricultural climatic regionalization, and agro-meteorological disaster detection at the regional scale.