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On behalf of:



Federal Ministry for the  
Environment, Nature Conservation,  
Building and Nuclear Safety

of the Federal Republic of Germany



# SolMap - Progress

**Dr.-Ing. Indradip Mitra**

**Senior Technical Advisor**

**GIZ GmbH**

**[indradip.mitra@giz.de](mailto:indradip.mitra@giz.de)**

**IGEF sub group 2 meeting**

**12<sup>th</sup> February 2015, Delhi, India**

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# SRRA station network



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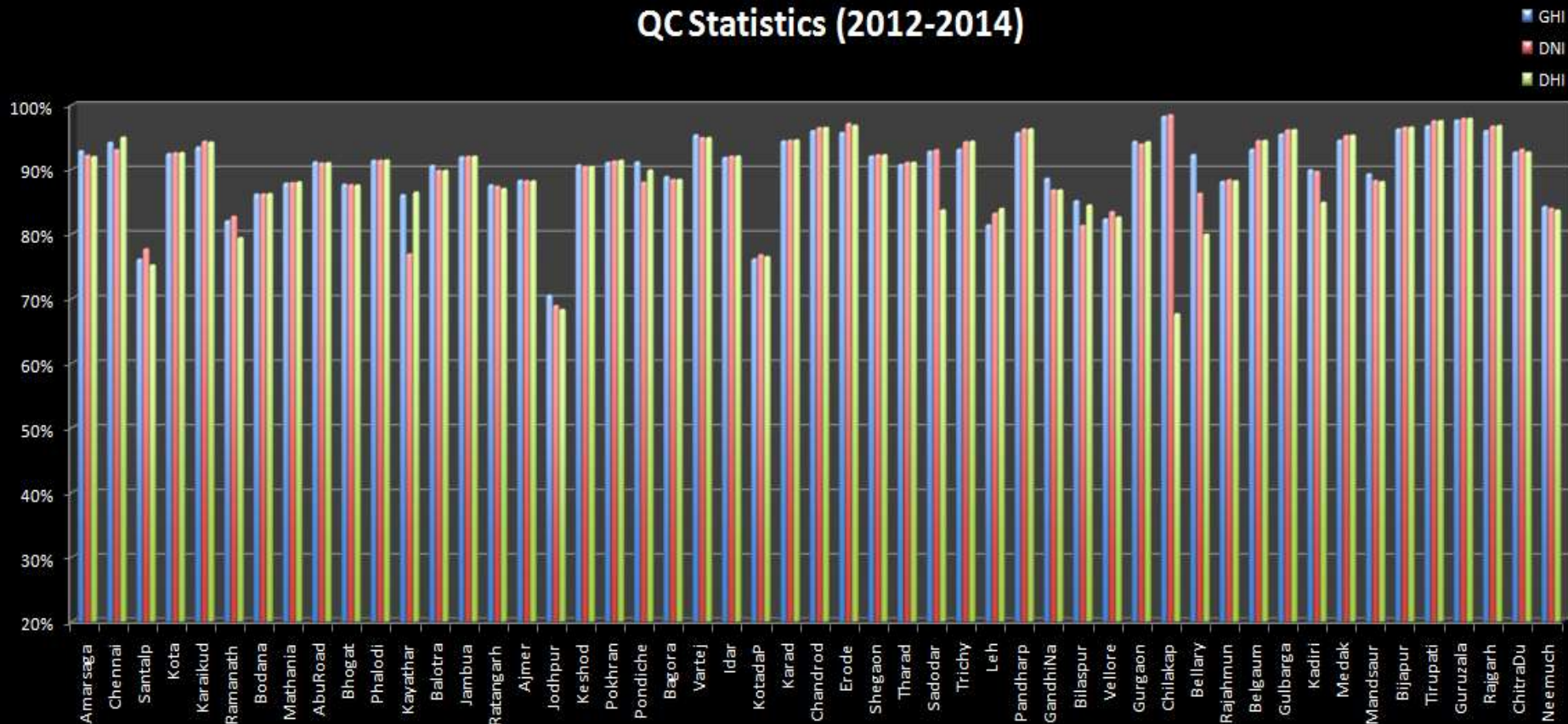


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## QC Statistics (2012-2014)



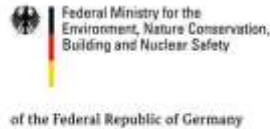
**Average correct values : GHI-> 91%**

**Average correct values : DNI-> 90%**

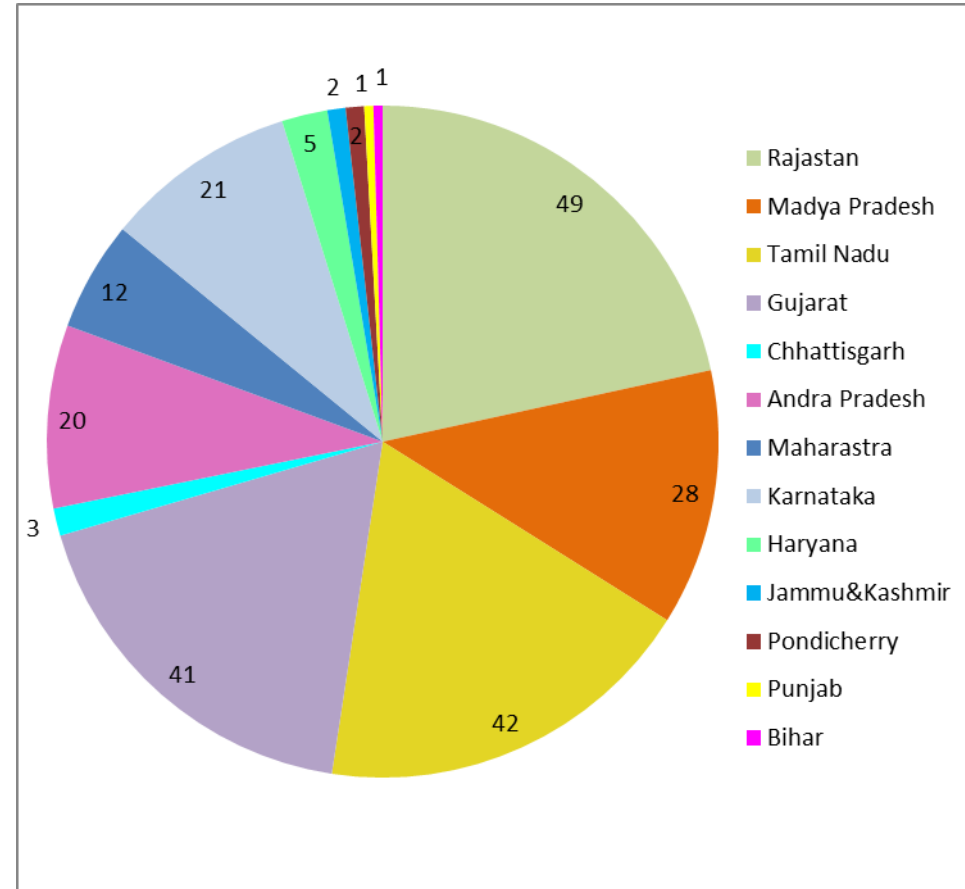
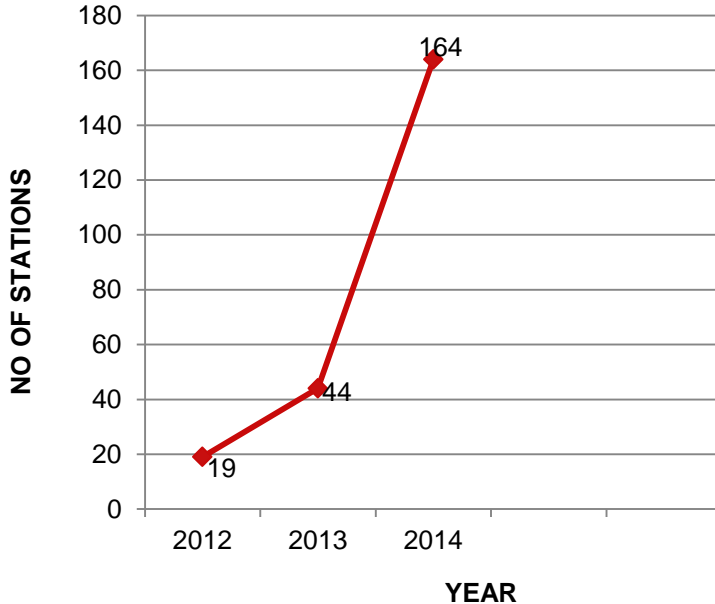
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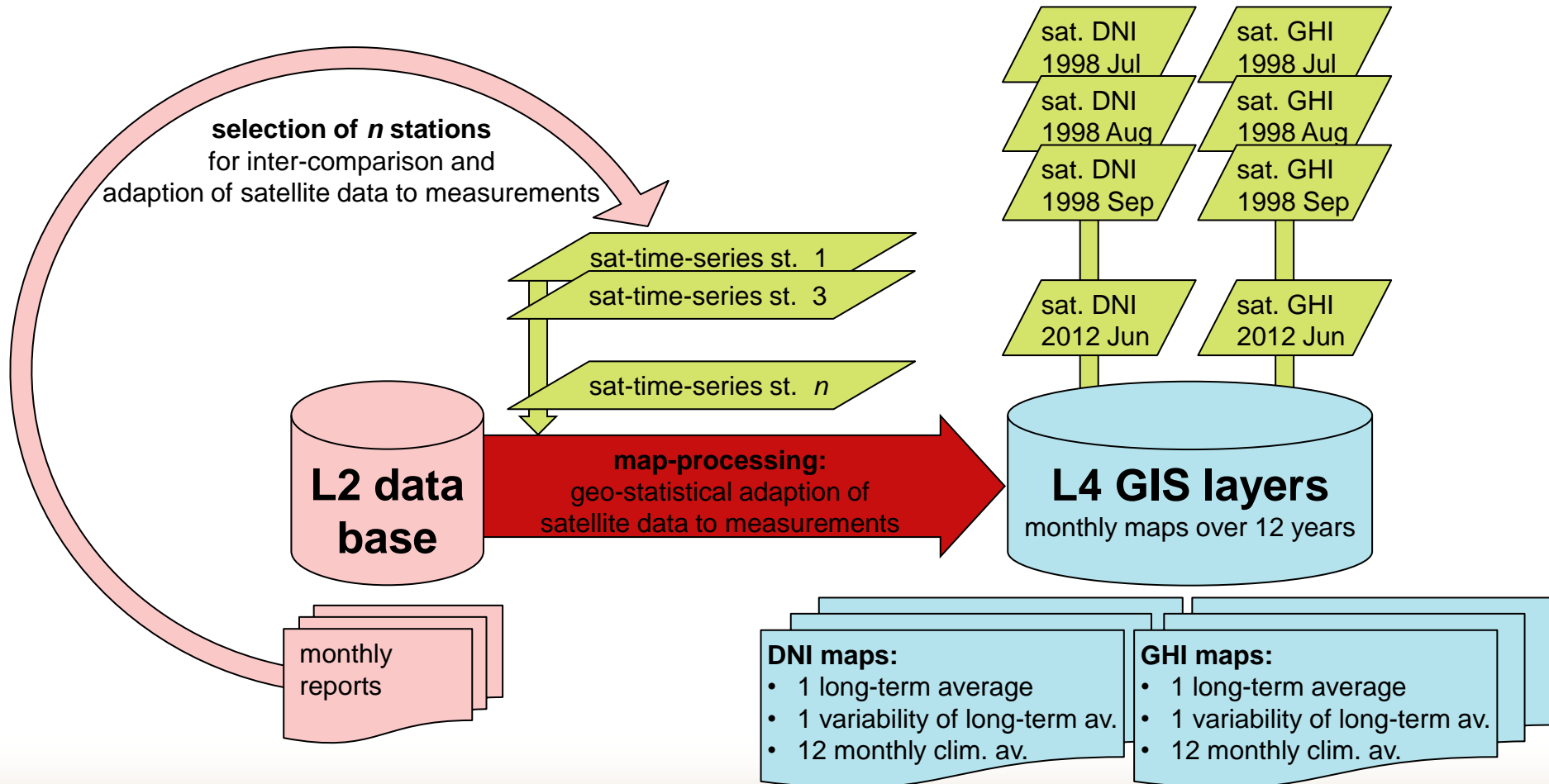
## Procurement of SRRA data



1. **54 organizations procured SRRA data: 227 times stations' data got procured**
2. **Customer satisfaction survey is being conducted**



# Processing of solar maps under SolMap project





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# Achievements on PV performance benchmarking until 2014 :

## Comprehensive PV benchmarking database:

- 119 grid connected PV power plants
- Total capacity: 518 MW<sub>p</sub>
- Range of installed capacity: 0.75 – 20 MW<sub>p</sub>
- Monitoring period: Jul'11 – Dec'13

## Inspection of PV power plants in Rajasthan

## Performance analysis carried out by SolMap team (1688 monthly datasets)

## PV-benchmarking tool / automatic report generator

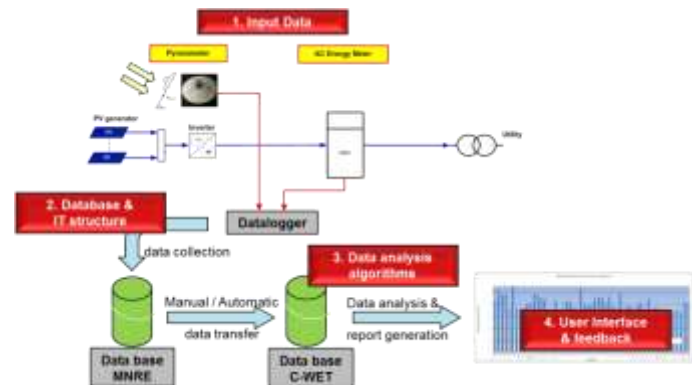
➔ Performance feedback to plant operators on a monthly basis possible

## Presentations at: EuroSun 2014, EU PVSEC 2014, Intersolar India 2014

## PV plants in database (12 states)



Map © mapsindia.com



Structure of PV benchmarking approach



## ■ Outlook until August 2015:

- ❑ Objective: Increase in plant performance by improved feedback to plant operators
- ❑ Extended plant performance analysis:  
Filtering by plant size, geography, time of installation, inverter-technology, ...
- ❑ Quality assurance of irradiation data measured at PV plants;  
use of reference data from SRRRA stations
- ❑ Specific yield comparison in case of unreliable radiation data

Flagging of data gaps and exceeded physical limits			
yes		Variance of daily SRRRA irradiation data < limit?	
yes		no	
POA in correlation with SRRRA data?		Use data measured at PV plant	
yes		no	
Use data measured at PV plant		Replace data measured at plant by SRRRA data	
yes		no	
PR > physical limits?		Final yield < Yf of nearby plants?	
yes		no	
Calculate PR		Message to plant operator: "Check irradiation sensor!"	
PR < limit?		yes	
yes		no	
Message to plant operator: "Yield reduced!"		Plant operation seems to be ok	
Message to plant operator: "Yield reduced!"		Plant operation seems to be ok	

QC algorithms

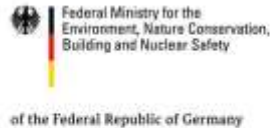
Benchmarking of plant performance

Feedback to plant operators

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## Few international publications from SolMap

- Mitra, I, Chhatbar, K., Kumar, A, Giridhar, G, Vashistha,R., Meyer, R, Schwandt, M. (2014) *Solmap: Project In India's Solar Resource Assessment. Int. Journal of Renewable Energy Development*, 3(3), 207-216.
- Schacht V, Haeberle A, Mitra I, Kumar A, Srivastava A.N, 2014. *PV Performance Benchmarking in India. Results from the Project "Solar Mapping and Monitoring – SolMap*. EU PVSEC
- Schacht V, Haeberle A, Mitra I, Kumar A, Srivastava A.N, 2014. *PV Performance Benchmarking in India. Results from the Project "Solar Mapping and Monitoring - SolMap"*. ISES EuroSun
- Kumar A, Gomathinayagam S, Giridhar G, Mitra I, Vashistha R, Meyer R, Schwandt M, Chhatbar K, 2014. *Field experiences with the operation of solar radiation resource assessment stations in India* . Energy Procedia 49 ( 2014 ) 2351 – 2361, Elsevier
- Marko Schwandt, Kaushal Chhatbar, Richard Meyer, Katharina Fross, Indradip Mitra, Ramadhan Vashistha, Godugunur Giridhar, S. Gomathinayagam, Ashvini Kumar: *Development and test of gap filling procedures for solar radiation data of the Indian SRRA measurement network: 2013 ISES Solar World Congress*
- Marko Schwandt, Kaushal Chhatbar, Richard Meyer, Indradip Mitra, Ramadhan Vashistha, Godugunur Giridhar, S. Gomathinayagam, Ashvini Kumar: *Quality check procedures and statistics for the Indian SRRA solar radiation measurement network: 2013 ISES Solar World Congress*
- Solar Radiation Resource Assessment in India: IRENA Case Study 2013, International Renewable Energy Agency
- Ashvini Kumar, Godugunur Giridhar, Ramdhan Vashistha, Richard Meyer, Indradip Mitra, Marko Schwandt, Kaushal Chhatbar: *ADVANCES IN SOLAR RADIATION RESOURCE ASSESSMENT IN INDIA: European PVSEC 2012*
- Ashvini Kumar, S. Gomathinayagam, Godugunur Giridhar, Indradip Mitra, Ramdhan Vashistha, Richard Meyer, Marko Schwandt, Kaushal Chhatbar: *Solar Resource Assessment and Mapping of India: IEA Solar PACES 2012*
- Indradip Mitra, Kaushal Chhatbar, Ashvini Kumar, Godugunur Giridhar, Ramdhan Vashistha, Richard Meyer, Marko Schwandt: *Solmap: Project In India's Solar Resource Assessment: International Conference "Renewable Energy 2030 – Experts' Visions", University of Oldenburg 2012*