Permissible Level as per [Indian Standards](http://www.arthapedia.in/index.php?title=Ambient_Air_Quality_Standards_in_India#targetText=The%20WHO%20Guidelines%20indicate%20that,as%20compared%20to%20WHO%20guidelines.)

|  |  |  |
| --- | --- | --- |
| Nitrogen Dioxide (NO2), µg/m3 | Annual\* 24 hours\*\* | 40 80 |

|  |  |  |
| --- | --- | --- |
| Sulphur Dioxide (SO2), µg/m3 | Annual\* 24 hours\*\* | 50 80 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Classification** | | **NO2** | | | | **SO2** | | | | **ratio of NO2/SO2** | | |
| **η.10** | **η.50** | **η.90** | **Range** | **η.10** | **η.50** | **η.90** | **Range** |
| **Clsuter-1** | **Very Low Both (VLB)** | 19.56 | 24.69 | 31.54 | 11.99 | 13 | 15.62 | 19.12 | 6.12 | 1.5 | 1.58 | 1.65 |
| **Clsuter-2** | **Low NO2 and Very Low SO2 (LNVLS)** | 34.14 | 41.02 | 49.28 | 15.14 | 17.03 | 20.91 | 26.27 | 9.24 | 2.01 | 1.96 | 1.88 |
| **Clsuter-3** | **Low NO2 and Low SO2 (LNLS)** | 36.87 | 40.02 | 43.91 | 7.041 | 29.13 | 31.34 | 33.98 | 4.85 | 1.27 | 1.28 | 1.29 |
| **Clsuter-4** | **Moderate NO2 and Low SO2 (MNLS)** | 38.31 | 45.51 | 52.26 | 13.95 | 27.17 | 31.68 | 36.3 | 9.14 | 1.41 | 1.44 | 1.44 |

For NO2 and SO2 we calculated the clusters based on its monthly percentile.

Percentile were taken at 10, 50, 90 to ignore outliers and get an overall idea of the range of these pollutants.

Time period is between 1987-2015 for this particular clustering.

During clustering there were cluster found to have concentration way below acceptable level tagged as **Very Low Both (VPL) , even the** η.90 **average values i.e. NO2(31.5) AND SO2(19.1) are way below minimum threshold of 40 and 50 levels. No2/so2 ratios is ard 1.5 for all brackets**

Next two cluster have similar average η.50 which is just at the boundary of acceptable level of 40 ; but lower range 17-26 of SO2 Maps to higher range of NO2 34-49(15) where the higher range 29-33 maps to smaller range of 36-43(7). The no2 to so2 ratio is ard two for the 2nd cluster and 1.2 for the 3rd.

Cluster fours with highest η.90 and η.50 for NO2 and η.90 SO2 , SO2 range is greater than cluster 3 although η.50 is almost similar. NO2 TO SO2 ratios here is 1.44.

Town wise

**STATIONARY**

Small town remain stationed in the VLB bucket mostly for both industrial and residential area’s, for say :-

* AKOLA,
* AMRAVATI,
* LATUR,
* JALNA,
* LOTE,
* TARAPUR

**Few bigger cities follow the same trend :-**

* NASHIK
* NAGPUR
* **Mumbai**

Lote, Tarapur, Nashik, NAGPUR (nov-dec 2015 LNLS) and Mumbai (still 1995) do see some spikes to higher cluster for a set of months but come down to the normal low-level post that period.

**Few others cities are stationed in LNVLS cluster :-**

* SOLAPUR,
* NAVI MUMBAI,
* GREATER MUMBAI,
* MAHAD
* BADLAPUR

**Alternating**

* NAVI MUMBAI Industrial between moderate and low and recently moderate
* KOLHAPUR was VLB from 2009 till 2012, went up to LNVLS 2013 till 2014 and wnet back to VLB IN 2015
* Spike
* NANDED-Industrial – remains low with spikes on regular interval pushing for LNLS and MNLS clusters

**Negative Movements**

* NAVI MUMBAI Industrial alternating between moderate and low and recently moderate.
* **PUNE—Residential** initially was in LNLS and MNLS bracket till 1991 and improved towards LNVLS till 2014 but moved back to MNLS cluster in 2015
* **Another set remained VLB initially and transition into the LNVLS cluster**
  + JALGAON,
  + SANGLI,
  + ROHA - Residential
  + THANE
  + SANGLI
  + AURANGABAD

**Positive Movements**

* **PUNE-- Industrial** mostly stayed in till 2001 and then moved towards LNVLS from LNLS by 2013 and started alternating between LNLS and VLB in 2015
* ROHA-industrial moving from moderate to low
* NANDED-Residential sep 2013 was in MNLS post that has come down to VLB level by 2015
* DOMBIVLI for the year 1994-98 remained in VLB, went through all four cluster till 1999, stationed in MNLS for 2000 and between 2012-14 was in LNVLS cluster and moved back to VLB.
* CHANDRAPUR Alternate betn LNVLS and LNLS till 1999, remained LNVLS till 2009 moved to VLB then onwards.

**SPM 2.5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Values** | | | |
| **ClusterID** | **0** | **1** | **2** | **3** |
| **clusters\_SPM\_P10** | 111.927658 | 125.8115 | 265.210326 | 286.761039 |
| **clusters\_P10\_SPM\_MOM\_diff** | -56.39615 | 0.78226 | 19.958048 | 138.631429 |
| **clusters\_SPM\_Median** | 139.477402 | 164.2362 | 316.73657 | 326.571429 |
| **clusters\_Median\_SPM\_MOM\_diff** | -70.322022 | 1.463821 | 27.703961 | 152.603896 |
| **clusters\_SPM\_P90** | 185.440226 | 216.2231 | 364.085028 | 354.266234 |
| **clusters\_P90\_SPM\_MOM\_diff** | -74.728095 | 3.022857 | 29.109118 | 138.735844 |
| **range** | 73.512568 | 90.41166 | 98.874702 | 67.505195 |
| **Range Name** | High | Very High | Extreme Less Range, SMALLER CHANGE | Extreme More Range, BIGGER CHANGE |
| **count** | 399 | 1827 | 552 | 77 |
| **Percentage Population** | 13.9754816 | 63.99299 | 19.33450088 | 2.697022767 |
| **Particulate Matter (size less than 2.5 µm) or PM2.5 µg/m3** | **Annual\*** | **40 60** | **Approved Range** | |
| **24 hours\*\*** |

Almost all cities are above acceptable level.

Industrial area of LOTE, MUMBAI(sep-feb, 1990-2009), PUNE is fluctuating between high and extremer high range; same is true for residential area of AURANGABAD, LATUR. SANGLI is flutating between high and very high

**JALGAON, KOLHAPUR, BADLAPUR – Industrial, AURANGABAD - Sensitive Area, NAGPUR, NASHIK, NAVI MUMBAi – Residential, PUNE – Residential, ROHA, TARAPUR, THANE are in the very high cluster with median as high as 164 , their monthly level change is minimal.**

CHANDRAPUR has moved into extreme high range negatively

ROHA ,LATUR,lote Industrial is static on high, Mumbai, NAVI MUMBAI- Industrial residential is in the extremely high , and Nagpur , nashik , PUNE- Residential and NAVI MUMBAI- Residential, TARAPUR, THANE on very high

Mahad is moving towards positive direction toward high range, SOLAPUR is moving to wards very high range from extremely

2004-2010

Aurangabad stayed in cluster zero always

Chandarpur-R shuffling between 0 and 1 from 2005 till aug 2007.

Sep 2007 till nov 2008